Water Quality Improvement Plan

PEAK CREEK

A plan to reduce bacterial contamination

Technical Document

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Prepared for
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New River Conservancy
Pulaski County

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In Cooperation with
Local Stakeholders

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Table of Contents

List of Figures

List of Tables

INTRODUCTION

1.1 Background

The 1972 Clean Water Act (CWA) requires that streams, rivers, and lakes meet their state's water quality standards. The CWA also requires that states conduct monitoring to identify those waters that do not meet standards. Under the CWA, Virginia has determined that many streams do not meet state water quality standards for the protection of the five designated uses: fishing, swimming, shellfish, aquatic life, and drinking.

When streams fail to meet water quality standards, Section 303(d) of the CWA and the U.S. Environmental Protection Agency's (EPA) Water Quality Management and Planning Regulation both require that states develop a Total Maximum Daily Load (TMDL) for each offending pollutant. A TMDL is a "pollution budget" that sets limits on the amount of pollution that a waterbody can tolerate and still maintain water quality standards. In order to develop a TMDL, background concentrations, point source loadings, and non-point source loadings are considered. A TMDL accounts for seasonal variations and must include a margin of safety. Through the TMDL process, states establish water-quality based controls to reduce pollution and meet water quality standards.

Once a TMDL is developed, Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (WQMIRA) requires development of an 'Implementation Plan' to achieve fully supporting status for impaired waters. An Implementation Plan (IP) describes the pollutant control measures, which can include the use of better treatment technology and the installation of best management practices (BMPs), which need to be implemented in order to meet the water quality goals established in the TMDL.

1.2 Designated Uses and Applicable Water Quality Standards

Water quality standards are designed to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC §1251 et seq.). Virginia Water Quality Standard 9 VAC 25-260-10 (Designation of uses) states:

All state waters, including wetlands, are designated for the following uses: recreational uses, e.g., swimming and boating; the propagation and growth of a balanced, indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them; wildlife; and the production of edible and marketable natural resources, e.g., fish and shellfish.

1.2.1 Bacteria Water Quality Criterion (9 VAC 25-260-170)

In order to protect human health during primary contact recreation (e.g., swimming), the Commonwealth of Virginia has set limits on the amount of specific fecal bacteria in all state waters. The bacteria criterion for freshwater that was in place when the Peak Creek bacteria TMDL was developed in 2004 was based on *Escherichia coli (E. coli)*. At that time, for a non-shellfish supporting water body to be in compliance with the Virginia *E. coli* bacteria standard for contact recreational use, the following criteria (Virginia Water Quality Standard 9 VAC 25-260-170) applied:

The number of *E. coli* bacteria shall not exceed a maximum allowable level of 235-cfu /100 ml. In addition, if data are available, the geometric mean of two or more observations taken in a calendar month should not exceed 126-cfu/100 ml.

Three segments of Peak Creek (VAW-N17R_PKC01A00, VAW-N17R_PKC02A00, and VAW-N17R_PKC03A00) were listed as impaired on Virginia's 2002 303(d) Report on Impaired Waters due to water quality exceedances of the fecal coliform bacteria water quality standard (VDEQ, 2002). During the time between the listing and TMDL development, EPA directed that the state develop a water quality standard for *E. coli* bacteria to replace the fecal coliform standard. The bacteria TMDL for Peak Creek was developed to follow the applicable state standard in place during TMDL development. That is, to not exceed the *E. coli* monthly geometric mean criterion of 126 cfu/100mL, and the *E. coli* single sample maximum assessment criterion of 235 cfu/100mL. Meeting this target provided consistency with Virginia Department of Environmental Quality (DEQ) assessment guidance at the time (VDEQ, 2003).

Since development of the bacteria TMDL, three additional segments within the Peak Creek watershed have been listed as impaired on Virginia's 2020 305(b)/303(d) Water Quality Assessment Integrated Report due to exceedances of the *E. coli* standard; Tract Fork (VAW-N17R_TCK01A00) and Peak Creek (VAW-N17R_PKC03A06 and VAW-N17R_PKC04A00).

In 2019, the Virginia State Water Control Board adopted EPA's nationally recommended bacteria criteria. For *E. coli*, the criteria include a geometric mean value never to exceed 126 bacteria colony counts per 100 milliliters (counts/100mL) and no more than 10% of samples allowed to exceed a statistical threshold value of 410 counts/100mL within a 90-day period. Reductions needed to meet the TMDL will also meet the new standard.

1.3 Attainability of Designated Uses

All waters in the Commonwealth have been designated as "primary contact" for the swimming use regardless of size, depth, location, water quality or actual use. The bacteria standard described in Section 1.2.1 of this report is to be met during all stream flow levels and was established to protect bathers from ingestion of potentially harmful bacteria. However, many headwater streams are small and shallow during base flow conditions when surface runoff has minimal influence on stream flow. Even in pools, these shallow streams do not allow full body immersion during periods of base flow. In larger streams, lack of public access often precludes the swimming use.

Recognizing that all waters in the Commonwealth are not used for swimming, Virginia has approved a process for re-designation of the swimming use for secondary contact in cases of: 1) natural contamination by wildlife, 2) small stream size, and 3) lack of accessibility to children, as well as due to widespread socio-economic impacts resulting from the cost of improving a stream to a “swimmable” status.

The re-designation of the current swimming use in a stream requires the completion of a Use Attainability Analysis (UAA) study. A UAA is a structured scientific assessment of the factors affecting the attainment of the use, which may include physical, chemical, biological, and economic factors as described in the Federal Regulations. The stakeholders in the watershed, relevant Virginia state agencies, and EPA all have the opportunity to comment on UAA studies.

In some streams for which TMDLs have been developed, water quality modeling indicates that even after removal of all of the sources of *E. coli* (other than wildlife), the stream will not attain the applicable water quality standards. In such cases, after demonstrating that the source of *E. coli* contamination is natural and uncontrollable by reasonable control measures, Virginia may decide to re-designate the stream’s use for secondary contact recreation or to adopt site specific criteria based on natural background levels of *E. coli*. All site-specific criteria or designated use changes must be adopted as amendments to the water quality standards regulations. Watershed stakeholders and EPA will be able to provide comment during this process.

2. REQUIREMENTS FOR IMPLEMENTATION PLANS

There are a number of requirements and recommendations for TMDL IPs. The goal of this chapter is to clearly define what they are and explicitly state if the "elements" are a required component of an approvable IP or are merely a recommended topic that should be covered in a thorough IP. This chapter discusses a) the requirements outlined by WQMIRA that must be met in order to produce an IP that is approvable by the Commonwealth, b) IP elements recommended by the EPA, and c) components of an IP required in Section 319 of the CWA.

2.1 State Requirements

The TMDL IP is a requirement under WQMIRA which directs the State Water Control Board (SWCB) 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 outlined in WQMIRA (VDEQ, 2017), including:

- date of expected achievement of water quality objectives,
- measurable goals,
- necessary corrective actions, and
- associated costs, benefits, and environmental impact of addressing the impairment.

2.2 Federal Recommendations

Section 303(d) of the CWA and current EPA regulations do not require the development of TMDL IPs. The EPA does, however, outline the minimum elements of an approvable IP in its 1999 *Guidance for Water Quality-Based Decisions: The TMDL* Process (USEPA, 1999):

- 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.

It is strongly suggested that the EPA recommendations be addressed in the IP, in addition to the components required by WQMIRA.

2.3 Requirements for Section 319 Fund Eligibility

The EPA develops guidelines that describe the process and criteria used to award CWA Section 319 nonpoint source grants to States. The guidance is subject to revision and the most recent version should be considered for IP development. The “Nonpoint Source Program and Grant Guidelines for States and Territories” (USEPA, 2013) identifies the following nine elements that must be included in the IP to meet the 319 requirements:

1. Identify the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan;
2. Estimate the load reductions expected to achieve water quality standards;
3. Describe the NPS management measures that will need to be implemented to achieve the identified load reductions;
4. Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed-based plan.
5. Provide an information/education component that will be used to enhance public understanding of the project and encourage the public's participation in selecting, designing, and implementing NPS management measures;
6. Provide a schedule for implementing the NPS management measures identified in the watershed-based plan;
7. Describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented;
8. Identify a set of criteria for determining if loading reductions are being achieved and if progress is being made towards attaining water quality standards; if not, identify the criteria for determining if the watershed-based plan needs to be revised; and
9. Establish a monitoring component to evaluate the effectiveness of the implementation effort.

3. REVIEW OF TMDL DEVELOPMENT

3.1 Background

In 2003, DEQ started development of TMDLs to address the fecal coliform and benthic impairments in Peak Creek. The final TMDL report was completed in the summer of 2004 (VDEQ, 2004). The TMDL report is available by contacting the DEQ Blue Ridge Regional Office TMDL Coordinator.

The focus of this TMDL IP is on the bacteria impairments in the Peak Creek watershed (Cause Group Code N17R-01-BAC). Three segments of Peak Creek (VAW-N17R_PKC01A00, VAW-N17R_PKC02A00, and VAW-N17R_PKC03A00) were first listed as impaired on Virginia's 2002 Section 303(d) Report on Impaired Waters due to water quality exceedances of the fecal coliform standard (VDEQ, 2002). The Peak Creek fecal bacteria TMDL was developed to address these three impaired segments. Since TMDL development, three additional segments have been listed as impaired due to exceedances of the *E. coli* standard. Two segments of Peak Creek (VAW-N17R_PKC03A06 and VAW-N17R_PKC04A00) were first listed as impaired on the 2006 Virginia Water Quality Assessment 305(b)/303(d) Integrated Report (VDEQ, 2006) and one segment of Tract Fork (VAW-N17R_TCK01A00) was first listed as impaired on Virginia's 2012 Water Quality Assessment 305(b)/303(d) Integrated Report (VDEQ, 2012). DEQ has described the impaired segments as presented in Table 3-1 and Figure 3-1.

The majority of the Peak Creek watershed is located in Pulaski County with a small portion in Wythe County. The watershed is part of the New River Basin [USGS Hydrologic Unit Code (HUC) 05050001] and includes National Watershed Boundary Datasets NE44 (HUC 050500011503), NE45 (HUC 050500011504), and NE46 (HUC 050500011505. The Peak Creek watershed is approximately 53,976 acres in size. Table 3-2 and Figure 3-2 describe the land use acreage at the time of TMDL development.

Table 3-1. Impaired stream segments addressed in the Peak Creek Implementation Plan.

Impaired Segment DEQ AU/ATTAINS ID	Impairment Type	Initial Listing Year	Size	Description	HUC12	VAHU6
Peak Creek VAW-N17R_PKC01A00	Fecal Coliform *E. coli*	2002 2006	1.83 miles	begins just downstream of the Rt. 99/Norfolk Southern crossing extending downstream to the inundation of Peak Creek in Claytor Lake	050500011505	NE46
Peak Creek VAW-N17R_PLC02A00	Fecal Coliform *E. coli*	2002 2006	1.66 miles	begins downstream of the Washington Ave. Bridge (~0.20 miles) and extends on downstream to just below the Rt. 99 Bridge/Norfolk Southern Railway crossing of Peak Creek		
Peak Creek VAW-N17R_PKC03A00	Fecal Coliform *E. coli*	2002 2006	0.51 miles	extends from the mouth of Tract Fork to downstream of the Washington Ave. Bridge (~0.20 miles)		
Peak Creek VAW-N17R_PKC03A06	*E. coli*	2006	0.39 miles	extends from the Magnox, Inc. outfall on downstream to the mouth of Tract Fork	050500011503	NE44
Peak Creek VAW-N17R_PKC04A00	*E. coli*	2006	2.10 miles	extends from the mouth of Hogan Creek downstream to just above the Magnox, Inc. outfall on Peak Creek		
Tract Fork VAW-N17R_TCK01A00	*E. coli*	2012	1.24 miles	from its confluence with Peak Creek upstream to the mouth of Pondlick Branch	050500011504	NE45

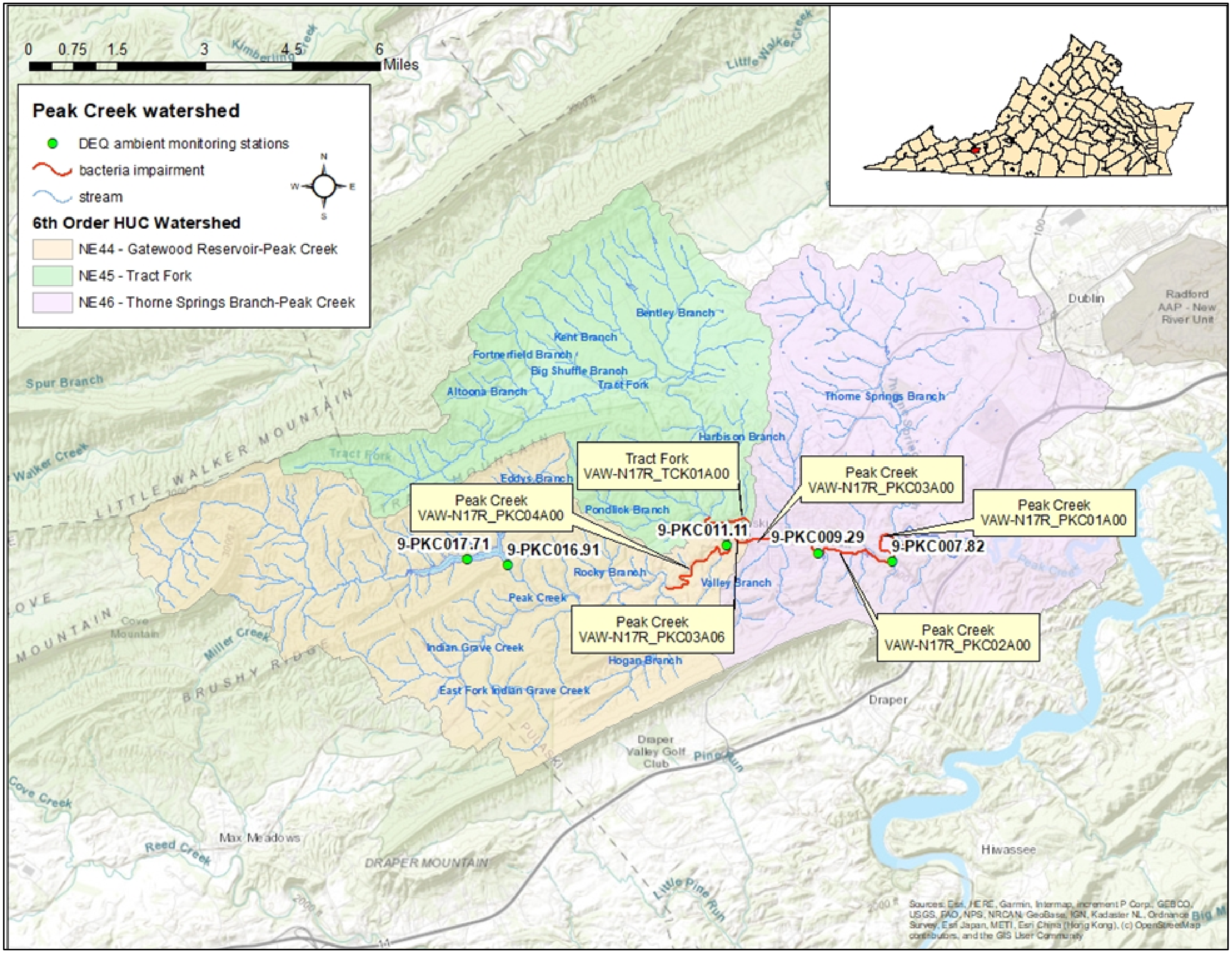

Figure 3-1. Bacteria impaired segments and DEQ water quality monitoring stations used for TMDL assessment in the Peak Creek watershed.

Table 3-2. Land use acreage and percent total watershed acreage by land use category during TMDL development.

Land use*	Area	
	Acres	%
Water	247	<1
Residential/Recreational	1,687	3
Commercial & Services	653	1
Barren	200	<1
Woodland/Wetland	35,471	66
Pasture/Hay	13,446	25
Livestock Access	695	1
Cropland	1,577	3
Total	**53,976**	

* From the Peak Creek TMDL study (VDEQ, 2004). Source: 1996 National Land Cover Dataset.

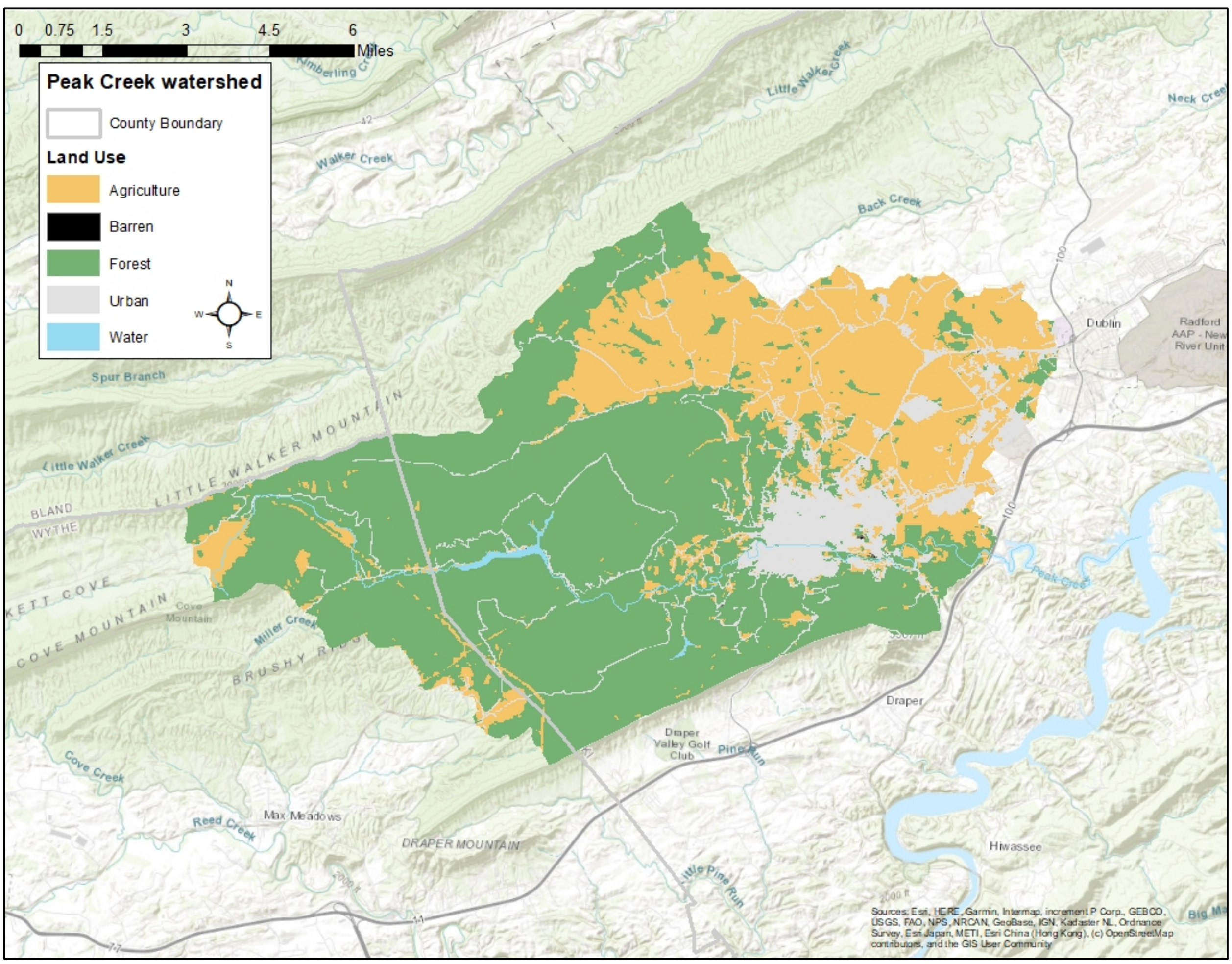

Figure 3-2. Land use in the Peak Creek watershed.

3.2 Water Quality Monitoring Data

Data collected from five DEQ ambient water quality monitoring stations were used to list Peak Creek as impaired for exceedances of the fecal bacteria standard. Table 3-3 provides a summary of the data collected from these stations and Figure 3-1 shows the locations of the stations.

Table 3-3. Ambient water quality monitoring stations in the Peak Creek watershed used for TMDL assessment from January 1990 through October 2002.

Station ID	Stream Name	Number of Samples	Exceedance Rate[1]	Exceedance Rate[2]
9-PKC007.82	Peak Creek	14	3	5
9-PKC009.29	Peak Creek	47	9	16
9-PKC011.11	Peak Creek	45	1	4
9-PKC016.91	Peak Creek	12	0	0
9-PKC017.71	Peak Creek	11	0	0

1 exceedances are based on the pre-2003 fecal coliform single sample standard (i.e.., 1,000 cfu/100ml)
2 exceedances are based on the interim fecal coliform single sample standard (i.e.., 400 cfu/100ml) at the time of TMDL development

3.3 Water Quality Modeling

The Hydrologic Simulation Program – FORTRAN (HSPF) water quality model was used to model fecal coliform transport and fate in the watersheds. The HSPF watershed model simulates pollutant accumulation, die-off, and wash off according to the distribution of land uses, soils, and geographic features in a watershed. HSPF then simulates the routing of water and pollutants through the stream channel network, considering instream processes such as die-off. For the Peak Creek bacteria TMDL, a source assessment of fecal coliform bacteria was performed for the watershed. Fecal coliform was then simulated as a dissolved pollutant using the HSPF model, and concentrations were translated to *E. coli* concentrations using DEQ's translator equation.

3.4 Bacteria Source Assessment

Potential sources of bacteria considered in the development of the bacteria TMDL included point source and nonpoint source contributions.

3.4.1 Point Sources

A TMDL's waste load allocation accounts for the portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Point sources of *E. coli* bacteria in the watersheds include all municipal and industrial plants that treat human waste, as well as private residences that have general permits. These point sources are required to maintain an *E. coli* discharge concentration no greater than 126 cfu/100mL. Virginia issues Virginia Pollutant Discharge Elimination System (VPDES) permits for point sources. At the time of TMDL development, there was one permitted point source discharging bacteria in the Peak Creek watershed, a domestic sewage general permit. Table 3-4 lists the permitted source, along with the permitted discharge and waste load allocation in the TMDL.

Table 3-4. Permitted bacteria point source discharging in the Peak Creek watershed.

Permit Number	Facility Name	Permit Type	Receiving Stream	*E. coli* Load (cfu/year)
VAG402040	Single Family Residence	General	Peak Creek	8.70×10^{8}

3.4.2 Nonpoint Sources

Nonpoint source pollution originates from sources across the landscape (e.g., agriculture and residential land uses) and is delivered to waterbodies by rainfall and snowmelt. In some cases, a precipitation event is not required to deliver nonpoint source pollution to a stream (e.g., pollution from straight pipes or livestock directly defecating in a stream). Nonpoint sources of bacteria in the watershed include failing septic systems, straight pipes, sewer overflows, land application of manures, livestock, wildlife, and domestic pets. During TMDL development, bacteria loads were represented either as land-based loads (where they were deposited on land and available for wash off during a rainfall event) or as direct loads (where they were directly deposited into the stream). Land-based nonpoint sources are represented as an accumulation of bacteria on the land, where some portion is available for transport in runoff. The amount of accumulation and availability for transport vary with land use type and season. The maximum accumulation was adjusted seasonally to account for changes in die-off rates, which are dependent on temperature and moisture conditions. Direct loads are modeled similarly to point sources since they do not require a runoff event for delivery to the stream. Nonpoint sources of bacteria in the watershed are summarized in Table 3-5.

Table 3-5. Estimated annual nonpoint fecal coliform loadings to the land surfaces and stream by source and land use categories in the Peak Creek watershed for 2003 conditions.

Source	Fecal coliform loading ($x10^{13}$ cfu/yr)	Percent of total loading
Direct loads to streams		
Livestock in stream	336.0	25
Straight pipe and Sewer overflow	3.0	<1
Wildlife in stream	1.5	<1
Loads to land surfaces		
Pasture	343.6	26
Livestock	*293.1*	*22*
Pet	*0.4*	*<1*
Wildlife	*50.1*	*4*
Cropland	502.0	38
Manure Application	*497.0*	*37*
Wildlife	*5.0*	*<1*
Residential/Commercial	47.8	4
Human (Septic)	*12.9*	*1*
Pet	*29.2*	*2*
Wildlife	*5.7*	*<1*
Forest	92.1	7
Total	**1,326.0**	

3.5 TMDL Allocation Scenarios

The bacteria TMDL includes the reduction scenario needed to meet the *E. coli* water quality standard. Different scenarios were evaluated to identify scenarios for implementation that meet both the calendar-month geometric mean bacteria standard (126 cfu/100 mL for *E. coli*) and the maximum single sample criterion (235 cfu/100 mL for *E. coli*) with zero exceedances. The margin of safety (MOS) was implicitly incorporated into the TMDL by conservatively estimating several factors affecting bacteria loadings, such as animal numbers, production rates, and contributions to streams. Allocation scenarios were made by first exhausting options related to anthropogenic sources, then iteratively reducing wildlife sources until there were no exceedances of the bacteria standards (Table 3-6). Table 3-7 lists the bacteria TMDL equation. It includes the waste load allocation (WLA) from the permitted source (Table 3-4) and the load allocation (LA) which represents the allowable non-point sources. An implicit margin of safety (MOS) is included in the TMDL equation.

Table 3-6. Bacteria reduction scenario needed to meet the *E. coli* water quality standard for the Peak Creek watershed.

E. coli Loading Reductions (%)					% Exceedance of *E. coli* standard	
Livestock Direct Deposit	Pasture and Cropland	Residential and Urban	Straight Pipes and Sewer Overflows	Wildlife	Geometric Mean Criterion	Single Sample Maximum Assessment Criterion
100%	99.5%	99.5%	100%	68%	0	0

Table 3-7. Bacteria TMDL equation for Peak Creek expressed as an average annual load.

Wasteload Allocation (WLA) (cfu/yr)	Load Allocation (LA) (cfu/yr)	Margin of Safety (MOS)	TMDL (cfu/yr)
8.70×10^{08}	4.26×10^{12}	Implicit	4.261×10^{12}

Note that the TMDL goal cannot be met without bacteria reductions from wildlife sources. This IP focuses on reducing the anthropogenic bacteria sources to meet the delisting goal. At the time of TMDL development, the delisting goal was less than 10% exceedance of the single sample criterion (235 cfu/100 mL). The reductions needed to meet the delisting goal were modeled during TMDL development (Table 3-8).

Table 3-8. Bacteria reduction scenario needed to meet the *E. coli* delisting goal for the Peak Creek watershed.

E. coli Loading Reductions (%)					% Exceedance of *E. coli* standard	
Livestock Direct Deposit	Pasture and Cropland	Residential and Urban	Straight Pipes and Sewer Overflows	Wildlife	Geometric Mean Criterion	Single Sample Maximum Assessment Criterion
90%	50%	50%	100%	0%	1.67	9.53

3.6 Implications of the TMDL on the Implementation Plan

Based on the bacteria reductions developed for the TMDL, it is clear that significant reductions will be needed to meet the water quality standard for bacteria, particularly with respect to direct deposition from livestock. In addition, all uncontrolled discharges, failing septic systems, leaking sewer lines, and overflows must be identified and corrected.

However, there are subtler implications as well. Implicit in the requirement for 100% correction of uncontrolled discharges is the need to maintain all functional septic systems. Wildlife bacteria loads will not be explicitly addressed by this Implementation Plan. All efforts will be directed at controlling anthropogenic sources.

3.7 Changes since TMDL Study

3.7.1 Alternate Allocation Scenario

During implementation planning, the recommended percent reductions from bacteria sources in the allocation scenario changed slightly from the TMDL study. The agricultural and residential working group selected a reduction scenario (Table 3-9) that meets the current delisting goal of less than 10.5% exceedance of the single sample criterion (235 cfu/100 mL). The working group recommended that half of the reductions be applied during the first five years of implementation (Stage 1) and the remainder during the next five years (Stage 2). These stages, the associated timeline, and the adaptive approach used are explained in greater detail in Chapter 7.

Table 3-9. Peak Creek bacteria TMDL load allocation (LA) scenario used for implementation.

Source	Existing Load (cfu/yr)	Allocated Load (cfu/yr)	IP Reduction	
			Load Reduction (cfu/yr)	% Reduction
Forest	1.23×10^{15}	1.23×10^{15}	0	0%
Residential and Urban Land*	3.38×10^{14}	3.19×10^{14}	3.38×10^{13}	10%
Pasture and Cropland	9.35×10^{15}	5.35×10^{15}	3.98×10^{15}	43%
Livestock Direct Deposition	1.42×10^{15}	4.36×10^{14}	9.30×10^{14}	66%
Wildlife Direct Deposition	2.53×10^{13}	2.53×10^{13}	0	0%
Failing Septic Systems and Straight Pipes	1.09×10^{14}	0	1.09×10^{14}	100%
Total Load Allocation	$\mathbf{1.24 \times 10^{16}}$	$\mathbf{7.37 \times 10^{15}}$	$\mathbf{5.04 \times 10^{15}}$	**41%**
% Exceedance of Single Sample>235 cfu/100ml				**10.49%**

* not including loads from failing septic systems

3.7.2 Additional Impairments

Since completion of the TMDL study, three additional segments in the Peak Creek watershed have been identified as impaired due to exceedances of the *E. coli* criteria. These are two segments of Peak Creek (VAW-N17R_PKC03A06 and VAW-N17R_PKC04A00) and one segment of Tract Fork (VAW-N17R_TCK01A00) (Table 3-1, Figure 3-1). These additional impairments are “nested” within the existing Peak Creek TMDL.

4. PUBLIC PARTICIPATION

Collecting input from the public on implementation and outreach strategies to include in the Implementation Plan was a critical step in this planning process. Since the plan will be implemented voluntarily by watershed stakeholders, local input and support are the primary factors that will determine the success of this plan.

4.1 Public Meetings

The first public meeting was held on May 11, 2021 to kick off the development of the Implementation Plan. Due to the Governor's declaration of a State of Emergency in response to the COVID-19 pandemic, the first public meeting was held virtually as it was not safe to meet in person. This meeting served as an opportunity for local residents to learn more about the problems facing Peak Creek and work together to come up with new ideas to protect and restore water quality in their community. This meeting was publicized through a public notice, community websites, and direct e-mail communications with the New River Conservancy, Town of Pulaski, New River Valley Regional Commission, Skyline Soil and Water Conservation District (SWCD), Big Walker SWCD, New River Health District, and Pulaski County. Approximately 14 people attended.

The meeting included a presentation by DEQ on the process to be used to complete a bacteria TMDL IP for Peak Creek. The presentation also included a discussion on existing water quality conditions in the creek and what types of actions and information could be included in the Implementation Plan to improve water quality.

The final public meeting was held on January 11, 2022 at the Train Station in Pulaski, VA to present the draft Peak Creek Implementation Plan and the implementation strategy to address the bacteria impairment. After the meeting, a 30- day public comment period extended to February 10, 2022. No comments were received during this period.

4.2 Working Groups

The role of the IP working group was to discuss methods needed to reduce bacteria sources from entering the Peak Creek watershed. For residential bacteria sources, the working group's goal was to recommend methods to identify and correct or replace failing septic systems and straight pipes, in addition to addressing pet waste and urban stormwater management. For livestock sources, the working group's aim was to review BMPs and outreach strategies from an agricultural perspective. Overall, the working group's objectives were to provide input about the type, number, and costs of BMPs and to identify any barriers (and possible solutions) that could impede BMP implementation.

During their first meetings on July 21, 2021 at the Pulaski County Administration Building, the working groups discussed the general state of agriculture and septic system maintenance in the watershed. Each of the groups also discussed education and outreach opportunities in the watershed. Attendees of the government working group meeting consisted of staff from the New River Conservancy, Town of Pulaski, Friends of Peak Creek, New River Valley Regional Commission, Pulaski County, Virginia Department of Health, Skyline SWCD, Pepper's Ferry Regional Wastewater Treatment Authority, and DEQ, among others. They discussed residential sewage handling and disposal, including percentages of failing septic systems needing repairs or replacements. They also discussed available agricultural programs for implementation, current level of participation, and funding opportunities. The agricultural and residential working group consisted of various members of the community. They discussed agricultural and residential practices of interest to local stakeholders. The group also discussed methods to locate potential failing septic systems and straight pipes in the watershed.

A second agricultural and residential working group meeting was held on September 3, 2021 at the Pulaski County Administration Building to review preliminary best management practices and associated estimated costs. Participants suggested a number of changes to the cost and extent of potential BMPs based on their knowledge of the watershed. The group discussed timeframes needed to meet implementation goals. The group agreed that implementation should occur in two 5-year stages. Defining implementation in stages allows for progress towards water quality goals to be assessed at regular intervals. Adaptive management may be necessary as implementation occurs, which is explained in greater detail in Chapter 7. The working group met on October 21, 2021 at the Pulaski County Administration Building to review the draft Implementation Plan and to discuss plans for the final public meeting. The group provided comments on the draft plan and discussed an agenda for the final public meeting.

5. IMPLEMENTATION ACTIONS

An important part of the Implementation Plan is the identification of specific BMPs and the associated technical assistance needed to improve water quality. Since this IP is designed to be implemented by landowners on a voluntary basis, it is necessary to identify BMPs that are both financially and technically realistic and suitable for the community. As part of this process, the costs and benefits of the proposed BMPs must be evaluated. Once the suitable BMPs have been identified, the number of each BMP needed to meet the TMDLs and interim implementation goals is estimated.

5.1 Identification of Best Management Practices

Potential pollutant control measures or BMPs, their associated costs and efficiencies, and potential funding sources were identified through review of the TMDL, input from the working group, and literature reviews. BMPs that can be promoted through existing state and federal cost-share programs were identified, as well as those that are not currently supported by existing programs.

Some BMPs had to be included in order to meet the water quality goals (e.g. repair or replacement of failing septic systems and straight pipes) established in the TMDL, while others were selected through a process of stakeholder review and analysis of their effectiveness in these watersheds.

5.1.1 Control Measures Implied by the TMDL

The reductions in bacteria identified by the bacteria TMDL study dictated that some BMPs must be employed during implementation in order to meet the pollutant reductions specified in the bacteria TMDL.

Livestock Exclusion

In order to meet the bacteria reductions in direct deposition from livestock, some form of stream exclusion is necessary. Fencing is the most obvious choice; however, the type of fencing, distance from the stream bank, and most appropriate management strategy for the fenced pasture are less obvious. While it is recognized that farmers will want to minimize the cost of fencing and the amount of pasture lost, the inclusion of a streamside buffer strip helps to reduce bacteria, sediment and nutrient loads in runoff. The incorporation of effective buffers (35-foot minimum width) could reduce the need for more costly control measures. From an environmental perspective, the best management scenario would be to exclude livestock from the stream bank 100% of the time and establish permanent vegetation in the buffer area. This prevents livestock from eroding the stream bank, provides a buffer for capturing pollutants in runoff from the pasture, and establishes (with the growth of streamside vegetation) one of the foundations for healthy aquatic life. From a livestock-production perspective, the best management scenario is one that provides the greatest profit to the farmer. Taking even a small amount of land out of production may seem contrary to that goal. However, a clean water source has been shown to improve milk production and weight gain. Clean water will also improve the health of animals (*e.g.,* cattle and horses) by decreasing the incidence of waterborne illnesses and exposure to swampy areas near streams. State and federal conservation agencies including Virginia Department of Conservation and Recreation (VADCR) and the Natural Resources Conservation Service (NRCS) have incorporated livestock exclusion practices into their agricultural cost-share programs that offer farmers greater flexibility in fencing options and greater financial incentives. This flexibility allows farmers with limited pasture acreage to exclude livestock from the stream while reducing the amount of grazing land that is taken out of production.

Septic Systems and Straight Pipes

The 100% reduction in loads from failing septic systems and straight pipes is required by law. The options identified for addressing straight pipes and failing septic systems included: maintenance or repair of an existing septic system, installation/replacement of a conventional septic system, installation of an alternative waste treatment system, and connection to an existing permitted waste treatment system. It is anticipated that a significant portion of straight pipes will be located in areas where adequate space for a conventional septic drain field is not available. In these cases, the landowner will have to consider an alternative septic system.

5.1.2 Control Measures Selected through Stakeholder Review

In addition to the BMPs that were required by the bacteria TMDL, a number of others were needed to control fecal bacteria from land-based (nonpoint) sources. Various alternative BMP implementation scenarios (number and type) were developed and presented to the working group. All scenarios began with the BMPs that were prescribed by the bacteria TMDL, such as eliminating all straight pipes. Next, a series of established BMPs were examined by the working group, who considered both their economic costs and the water quality benefits that they produced. The majority of these practices are included in state and federal cost-share programs that promote conservation. In addition, innovative and site-specific practices suggested by local stakeholders and technical conservation staff were considered.

The initial set of BMPs and their efficiencies considered to estimate needs for this plan are listed in Table 5-1.

5.2 Quantification of Control Measures

The quantity of control measures recommended during IP development was determined through spatial analyses, modeling alternative implementation scenarios, and using input from the working group. Data on land use, stream networks, and elevation were used in spatial analyses to develop estimates of the number of control measures recommended overall in the watershed, and within smaller sub-watersheds.

Data from the Virginia Department of Conservation and Recreation (DCR) Agricultural BMP Database and the Skyline SWCD showing where BMPs are already installed were considered when developing the agricultural BMP estimates (Table 5-2). In addition, census data were used to quantify septic system repairs and replacements needed to meet the reductions specified in the bacteria TMDLs. Estimates of the number of residential on-site waste treatment systems, streamside fencing and number of full livestock exclusion systems were made through these analyses. The number of additional BMPs were determined through modeling alternative scenarios and applying the related pollutant reduction efficiencies to the associated bacteria loads.

Table 5-1. Best management practices and associated treatment effectiveness.

Control Measures	% Effectiveness	Reference	Units
Residential Wastewater Practices			
Septic Tank Pump-out (RB-1)	5%	1	system
Connection to Public Sewer (RB-2)	100%	2	system
Septic Tank System Repair (RB-3, RB3R)	100%	2	system
Septic Tank System Installation/Replacement (RB-4, RB-4P)	100%	2	system
Alternative On-site Waste Treatment System (RB-5)	100%	2	system
Pet Waste Removal Practices			
Pet Waste Disposal Station (PW-1)	75%	1	number
Pet Waste Digester (PW-2)	100%	2	number
Pet Waste Education	50%	1	program
Stormwater Reduction Practices			
Urban Tree Planting (CL-2)	50%	3	acres treated
Filter Strips (CL-4)	22%	3	acres treated
Riparian Buffer – Forest/Grass/Shrub (CL-5)	56%	3	acres treated
Bioretention/Raingarden (RG)	90%	3	acres treated
Cropland Practices			
Continuous No-Till (SL-15B)	70%	1	acres
Cover Crop (SL-8B, SL-8H)	20%	1	acres
Livestock Waste Reduction Practices			
Alternative Water System (SL-6B)	10%	3	acres
Stream Exclusion with Grazing Land Management (SL-6N, SL-6W)	100%	2	system
Pasture Management – Cattle (SL-9, SL-10T)	50%	1	acres
Stream Protection (WP-2N, WP-2W)	100%	2	system

1 - VADEQ. 2017. Guidance Manual for Total Maximum Daily Load Implementation Plans

2 - Removal efficiency is defined by the practice

3 – Chesapeake Assessment Scenario Tool – Bacteria effectiveness assumed equal to sediment effectiveness

Table 5-2. Agricultural best management practices (BMPs) installed in the Peak Creek watershed since 2004.

BMP Name	BMP Code	Extent Installed		
		Number	Units	Amount
CREP riparian forest buffer	CP-22	2	acres	2
CREP stream exclusion with grazing land management	CRSL-6	2	linear feet	1,682
Stream exclusion with grazing land management	SL-6	6	linear feet	15,093
Alternative water system	SL-6B	3	acres	437
Stream exclusion with wide width buffer & grazing land management	SL-6W	1	linear feet	125
Small grain and mixed cover crop	SL-8B	1	acres	24
Idle land / wildlife option and idle tobacco land	WL-2	1	acres	19
Animal waste control facilities	WP-4	2		
Loafing lot management	WP-4B	1		
Legume based cover crop	WQ-4	1	acres	18

5.2.1 Agricultural Control Measures

Livestock Exclusion BMPs

In order to reduce bacteria in Peak Creek and its tributaries, livestock must be excluded from the stream. To estimate fencing needs, the stream network was overlaid with land use using GIS mapping software. Stream segments that flowed through or were adjacent to land use areas that had a potential for supporting cattle (e.g., pasture) were identified using 2016 Virginia Land Cover Dataset (VLCD), which is derived from aerial imagery, and the 2017 National Hydrography Dataset (NHD) streams layer. If the stream segment flowed through the land-use area, it was assumed that fencing was needed on both sides of the stream. If a stream segment flowed adjacent to the land-use area, it was assumed that fencing was required on only one side of the stream. Not every land-use area identified as pasture has livestock on it. However, it was assumed that all pasture areas have the potential for livestock access. Following GIS analyses of fencing needs, the DCR Agricultural BMP Database was queried to identify the number of livestock exclusion systems already in place in the watershed. Over 24,000 linear feet of livestock exclusion fencing has been installed in the Peak Creek watershed, approximately 8,000 linear feet before the TMDL study, and over 16,000 since the TMDL study. Since the livestock exclusion fencing installed before the TMDL study was not accounted for in the TMDL model, this fencing and the fencing installed since the TMDL study were subtracted from the length of fencing needed to accomplish the reduction of bacteria loads from livestock stream access needed to meet the delisting goal.

When presented with initial fencing estimates at the second working group meeting, stakeholders noted that the estimates were too high for the Peak Creek watershed. Using the 2020 National Agricultural Statistics Service cropland data layer (USDA-NASS, 2020) and a visual assessment of aerial imagery of areas identified as pasture, the fencing estimates were recalculated. It is estimated that approximately 30% of area identified as "pasture" in the VLCD is misidentified (e.g., large grassy spaces in residential areas, recreational fields) or not suitable for livestock access (e.g., no fencing). Table 5-3 shows the recalculated estimate of approximately 15.2 miles of exclusion fencing still needed.

Table 5-3. Stream fencing needs summary.
Note: % of total shown in parenthesis.

6th Order HUC Watershed	Estimated total length of streambank in pasture (feet)	% reduction of livestock direct deposition in stream	Approximate fencing installed to date (feet)	Fencing still needed (feet)
NE45 - Tract Fork	49,552	70	5,605	29,082
NE 46 - Thorne Springs Branch–Peak Creek	78,633		16,983	38,060
NE44 - Gatewood Reservoir-Peak Creek	18,153		1,772	10,935
Total	**146,338**		**24,360 (17%)**	**78,077 (53%)**

It is expected that the majority of livestock exclusion fencing will be accomplished through Virginia Agricultural BMP Cost-Share Program (VACS) and the DEQ Non-Point Source BMP Implementation Program. Landowners have a number of options when it comes to installing livestock exclusion fencing through these programs. Some applicable cost-shared BMPs for livestock exclusion in the programs are the SL-6N (Stream Exclusion with Narrow Width Buffer and Grazing Land Management) and the SL-6W (Stream Exclusion with Wide Width Buffer and Grazing Land Management). Federal Natural Resource Conservation Service (NRCS) cost-share programs are also available, including the CREP (Conservation Reserve Enhancement Program) practice CRSL-6 (CREP Stream Exclusion with Grazing Land Management).

In order to develop an estimate of the number of fencing systems needed in the watershed, aerial imagery was utilized in conjunction with local data from the DCR Agricultural BMP Database to determine typical characteristics (e.g., streamside fencing length per practice) of livestock exclusion systems in the region. In addition, input was collected from the working group and the Skyline SWCD regarding typical components of each system, associated costs, and preferred fencing setbacks. These characteristics were then utilized to identify the mix of fencing practices available through state cost-share programs to include in the Implementation Plan (Table 5-4).

Table 5-4. Livestock exclusion needed to achieve reduction of bacteria load from livestock direct deposition. Assumes one exclusion system averages 1,750 linear feet of stream fencing.

6th Order HUC Watershed	Fencing needed	SL-6N (10 – 25 ft buffer): 10%		SL-6W (35 – 50 ft buffer): 90%	
	feet	feet	systems	feet	systems
NE45 - Tract Fork	29,082	2,908	2	26,174	15
NE 46 - Thorne Springs Branch–Peak Creek	38,060	3,806	2	34,254	20
NE44 - Gatewood Reservoir-Peak Creek	10,935	1,094	1	9,841	6
Total	**78,077**	**7,808**	**5**	**70,269**	**41**

The VACS Program includes a series of livestock exclusion practices that may be used to meet exclusion goals in priority implementation watersheds. Stream Exclusion with Narrow Width Buffer and Grazing Land Management (SL-6N) offers between 60% to 75% cost-share rate for off stream watering, establishment of a rotational grazing system, stream crossings, and stream exclusion fencing with a 10 to 25-foot setback and a lifespan of 10 to 15 years. Based on discussions with the working group, it was determined that the practices with narrow buffer width would be the most appealing to producers in the watershed due to the minimal buffer setback requirement. Greater buffer setbacks were discussed, but working group members felt that even with additional financial incentives, a setback greater than 25 feet would be less achievable. It was estimated that approximately 10% of fencing in the watershed would be installed using the SL-6N practice.

For areas where greater setbacks would be possible, the Stream Exclusion with Wide Width Buffer and Grazing Land Management (SL-6W) offers between 85% to 100% cost-share rate for off stream watering, establishment of a rotational grazing system, stream crossings, and stream exclusion fencing with a 35 to 50-foot setback and a lifespan of 10 to 15 years. It was estimated that approximately 90% of fencing in the watershed would be installed using the SL-6W practice.

While the suite of BMPs outlined in this plan will satisfy the bacteria reductions needed to meet water quality goals, the quantity and details of these BMPs are subject to change in the future to reflect updates to related policies and programs, including cost share programs.

Land Based Agricultural BMPs

In order to meet the bacteria reductions outlined in the TMDL, BMPs to treat land-based sources of bacteria must also be included in implementation efforts. Table 5-5 provides a summary of percent and acreage of applicable land use (pasture or cropland) of the land based agricultural

BMPs by sub-watershed needed to achieve water quality goals. For example, applying Improved Pasture Management to 27.62% (1,011 acres) of the existing pasture acreage (3,661 acres) in NE45 - Tract Fork will provide the reductions needed from pasture in that sub-watershed. It is expected that funding assistance for the majority of agricultural practices will be provided by the Virginia Agricultural BMP Cost-Share Program (VACS), DEQ Non-Point Source Program, and federal Natural Resource Conservation Service (NRCS) cost-share programs.

Table 5-5. Estimated agricultural land and potential agricultural BMPs to accomplish bacteria reduction goals in the Peak Creek watershed.

BMP (Cost-share codes in parentheses)	Sub-watershed	Existing (acres)	Extent needed (% total land use acres)	Extent needed (acres)
Pasture				
Improved Pasture Management (SL-10)	NE45 - Tract Fork	3,661	27.62%	1,011
	NE 46 - Thorne Springs Branch–Peak Creek	5,411	28.48%	1,541
	NE44 - Gatewood Reservoir-Peak Creek	566	26.68%	151
Cropland				
Continuous No-Till (SL-15B)	NE45 - Tract Fork	632	5.00%	32
	NE 46 - Thorne Springs Branch–Peak Creek	674	5.00%	34
	NE44 - Gatewood Reservoir-Peak Creek	197	5.00%	10
Cover Crop (SL-8B, SL-8H)	NE45 - Tract Fork	632	5.00%	32
	NE 46 - Thorne Springs Branch–Peak Creek	674	5.00%	34
	NE44 - Gatewood Reservoir-Peak Creek	197	5.00%	10

Grazing Systems and Improved Pasture Management (SL-7, SL-10)

Establishment of rotational grazing systems for cattle is recommended in conjunction with livestock exclusion projects. The majority of fencing programs will provide cost-share for the establishment of cross fencing and alternative watering sources in order to establish these systems. In cases where livestock exclusion is not necessary, improved pasture management was prescribed. Like a grazing system, improved pasture management allows a farmer to better utilize grazing land and associated forage production. Improved pasture management includes:

- Implementing a current nutrient management plan
- Maintaining adequate soil nutrient and pH levels
- Managing livestock rotation to paddock subdivisions to maintain minimum grazing height recommendations and sufficient rest periods for plant recovery
- Maintaining adequate and uniform plant cover (≥ 60%) and pasture stand density

- Locating feeding and watering facilities away from sensitive areas
- Managing distribution of nutrients and minimizing soil disturbance at hay feeding sites by unrolling hay across the upland landscape in varied locations
- Designating a sacrifice lot/paddock to locate cattle for feeding when adequate forage is not available in the pasture system. Sacrifice lot/paddock should not drain directly into ponds, creeks or other sensitive areas and should not be more than 10% of the total pasture acreage.
- Chain harrowing pastures to break-up manure piles after livestock are removed from a field at least twice a year to uniformly spread the manure load, or manage manure distribution through rotational grazing

Continuous No-Till (SL-15B)

Farmers till their land to aerate, warm, and shape soil as well as to bury crop residue and remove weeds. Beyond these benefits though, tilling results in many other negative effects like soil compaction, loss of organic matter, disruption of soil organisms, and increased soil erosion and runoff. No-till farming, in contrast, minimizes soil disruption, but requires different management techniques to maintain crop yields. The Continuous No-Till Forage Production System practice (SL-15B) provides a per-acre payment for farmers who stop tilling their soil. According to the Skyline SWCD, the majority of farmers in the Peak Creek watershed are using some form of reduced tillage.

Cover Crop (SL-8B, SL-8H)

Many farmers in the Peak Creek watershed are already implementing the use of cover crops because of the benefits associated with improved soil quality, reduction of nutrient losses, decreased field maintenance, and erosion control. Two types of cover cropping practices were selected for this plan. The small grain cover crop practice (SL-8B) and the harvestable cover crop practice (SL-8h) were selected because they provide cost-share and tax credits to participating farmers for establishing vegetative cover, specifically grains like winter rye and winter wheat, on cropland for protection from erosion and the reduction of nutrient losses to groundwater.

5.2.2 Residential Control Measures

Failing Septic Systems and Straight Pipes

By law, all failing septic systems and straight pipes must be identified and corrected. The number of failing septic systems and straight pipes in the Peak Creek watershed was estimated based on the 2000 Census of Population and Housing for Virginia, as well as input from stakeholders during TMDL development. The 2000 U.S. Census block maps were used to estimate the spatial distribution of the failing septic systems and straight pipes. Based on stakeholder input at the first working group meeting, the number of straight pipes in the watershed is higher than what is estimated in the TMDL report. With consensus from the stakeholders, the number of estimated straight pipes was increased by 10% for implementation. Table 5-6 shows the estimated number of failing septic systems and straight pipes in the Peak Creek watershed and the breakdown of the estimated septic system repairs and replacements. Residential cost share assistance is made available for these septic BMPs through the Virginia Nonpoint Source Implementation Program administered by DEQ. The geographical extent of an eligible area is identified in a grant agreement and in a watershed management plan such as an Implementation Plan. The residential septic BMPs outreach and funding will be most effective in cooperation with the local health department to make property owners with septic system malfunctions or straight pipes aware that funding is available locally.

Table 5-6. Estimated number of failing septic system and straight pipe repairs and replacements needed in the Peak Creek watershed.

Estimated Houses with Standard Septic Systems	Estimated Houses with Failing Septic Systems	Estimated Houses with Straight Pipes	Estimated No. of Systems Needed			
			Septic System Pump-outs	Septic System Repairs	Conventional Septic Systems	Alternative Septic Systems
2,427	675	40	1,820	607	61	47

Based on input from the working group, it was estimated that 90% of failing septic systems could be corrected with a repair or maintenance, and the remaining 10% would need to be replaced. DEQ administers a septic BMP cost-share program for targeted watersheds with approved Implementation Plans. This program provides cost-share for two kinds of septic system repairs, those requiring a permit, and those consisting of an inspection and repair that does not require a permit. It was estimated that half of the failing septic systems repairs would be minor in nature and thus not require a permit, while the remainder would be significant enough that one would be required. Of the systems that need to be replaced, it was estimated that 10% will require alternative waste treatment systems due to the geology present at the site, or a lack of space necessary for a conventional septic drain field.

A septic tank pump-out program was also discussed by the working group as a good way to heighten local awareness of septic system maintenance needs and to locate failing septic systems. The working group believes most residents in the Peak Creek watershed would be very receptive to a septic tank pump-out program. Based on the working group's anticipated popularity of this program, the estimates shown in Table 5-6 are based on pumping out septic tanks for 75% of households in the watershed.

Stormwater and Pet Waste

Based on an analysis of the sources estimated during TMDL development, the primary source of *E. coli* in the Woods Creek watershed is runoff from pasture and livestock in the stream; however, the working group agreed that bacteria from urban and residential areas should be addressed in a similar manner to agricultural sources. This presents a more comprehensive approach to management of the watershed, and assigns some degree of responsibility to all pollutant source sectors within the watershed. Urban/residential pollutant sources are primarily located in the Town of Pulaski. The working group agreed that the Town would be the most suitable location for any stormwater management practices, and for a targeted pet waste education program and associated BMPs (Table 5-7).

Table 5-7. Residential stormwater and pet waste BMPs for the Peak Creek watershed.

BMP (Cost-share codes in parentheses)	Units	Extent
Rain barrel	Barrel	212
Tree planting (CL-2)	Acres treated	0.25
Filter strips (CL-4)	Acres treated	0.25
Riparian buffers – grass/trees (CL-5)	Acres treated	2
Rain garden (RG)	Acres treated	15
Pet waste disposal station (PW-1)	Station	4
Pet waste digester (PW-2)	Digester	45
Pet waste education program	Program	1
Fenced dog park	Park	2

With input from the working group, it was determined that there may be areas throughout the town well-suited for installation of urban stormwater BMPs to reduce the bacteria load to Peak Creek. The Virginia Conservation Assistance Program (VCAP) provides cost-share and technical assistance for certain stormwater BMPs. Some applicable cost-shared BMPs selected by the working group are Conservation Landscaping (CL-1, Meadow; CL-2, Tree Planting, CL-3, Mulched Beds, CL-4, Filter Strips, and CL-5, Riparian Buffers) and Rain Gardens (RG). A possible site for riparian buffers is the Pulaski Community Garden. Possible sites for rain gardens include Calfee Park, the TG Howard Community Center, Critzer Elementary School, and Pulaski Elementary School, among others. The working group also suggested the addition of rain barrels, which divert runoff water from rooftops and reduce stormwater flow to the streams. Rain barrel workshops will provide opportunities to educate watershed residents about the benefits of reducing stormwater runoff from their properties.

Implementation of a targeted pet waste education program would encourage pet owners to pick up after their pets and facilitate proper disposal of pet waste. The working group suggested a pet waste education program be combined with septic waste education. Such a program would include the development and distribution of educational materials, installation of pet waste disposal stations with collection bags, and the promotion of pet waste BMPs including pet waste digesters. This program could include newspaper articles, radio ads, postcard mailings and brochures to be distributed at local events and businesses.

The working group noted that there are currently four pet waste disposal stations in the Peak Creek watershed and proposed four potential sites for additional stations. The additional sites are the trailhead for the New River Trail and other walking trails and local parks. The working group mentioned that the Friends of Peak Creek may be able to help with maintaining these stations. The working group also suggested the addition of two fenced dog parks in the watershed, one in the town and one in the county. Two of the proposed pet waste disposal stations would be installed in these parks. Reductions in bacteria in the dog parks are attributed to the pet waste stations.

A number of pet waste digesters are included in the plan to allow homeowners to collect outdoor pet waste and safely dispose of it. There are several types of digesters, some requiring more maintenance than others. A septic-style digester (e.g. Doggie Dooley® system) is inserted in the ground (2-4 feet below the surface) with a lid on top. Pet waste is added to the digester along with water and a special enzyme to accelerate decomposition. Traditional digesters may also be used to treat pet waste.

5.3 Technical Assistance and Education

In order to get landowners involved in implementation, it will be necessary to initiate education and outreach strategies and provide technical assistance with the design and installation of various best management practices. There must be a proactive approach to contact farmers and residents to articulate exactly what the TMDL means to them and what practices will help meet the goal of improved water quality. The working groups recommended several education/outreach techniques, which will be utilized during implementation.

The following general tasks associated with agricultural and residential programs were identified:

Agricultural Programs

- Contact landowners in the watersheds to make them aware of cost-share assistance, and voluntary options that are available to agricultural producers interested in conservation.
- Provide technical assistance for agricultural programs (e.g., survey, design, layout).
- Give presentations at meetings of local Farm Bureau, Ruritans, and other groups. Provide information for distribution with newsletters and at local events (e.g., New River Valley Fair).
- Organize educational programs for farmers including farm tours in partnership with Skyline SWCD, NRCS, VA Cooperative Extension and Farm Bureau.
- Work with NRCS and Skyline SWCD to conduct door to door outreach regarding agricultural BMPs
- Work with VA Cooperative Extension to hold rotational grazing workshops and "fencing school" programs in the watersheds. These have been offered in other areas in the state and have been well received by the agricultural community.
- Work with county Board of Supervisors representatives to contact agricultural landowners in the watershed to discuss water quality issues and potential management strategies
- Assess and track progress toward BMP implementation goals
- Evaluate use of existing agricultural programs and suggest modifications; i.e. adaptive management

Residential Programs

- Identify failing septic systems (*e.g.*, contact landowners in older homes, septic pump-out program)
- Develop and distribute educational materials (e.g., septic system maintenance guide). Emphasize how the residential septic cost-share assistance can help reduce costs to the homeowner
- Create informational brochures for septic systems contractors and plumbers to distribute to customers
- Encourage a partnership between the Department of Health and local realtors to share the capacity of a home's septic system with potential buyers
- Conduct outreach at public service board meetings
- Launch a newspaper campaign about septic system maintenance. Emphasize the connection between proper maintenance, groundwater science and financial assistance available
- Provide educational materials to residents on proper disposal of pet waste to destroy all *E. coli* bacteria
- Utilize educational programs already established within the local schools
- Assess progress toward implementation goals

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

The staffing level needed to implement the agricultural and residential components of the plan was estimated based on discussions with stakeholders and the staffing levels used in similar projects. Staffing needs were quantified using full time equivalents (FTE), with one FTE being equal to one full-time staff member. Based on the size of the watershed, the extent of implementation needed, and the overall project timeline, an estimate of one FTE was used for technical assistance. This estimate was based on similar implementation projects in other watersheds where one staff member is administering both the septic and agricultural programs. It is expected that staff from the Pulaski County Health Department would be directly involved in any connections to septic system repair or replacement BMPs, serving as the project lead on any of these efforts in their locality with support from the Skyline SWCD.

6. COSTS AND BENEFITS

6.1 BMP Cost Analysis

The costs of agricultural best management practices included in the Implementation Plan were estimated based on data for Pulaski County from the VADCR Agricultural BMP Database, the FY-2021 NRCS cost list for BMP components, and considerable input from the Skyline SWCD and working group.

The majority of agricultural practices recommended in the IP are included in state and federal cost-share programs. These programs offer financial assistance in implementing the practices and may also provide landowners with an incentive payment to encourage participation. Consequently, both the potential cost to landowners and the cost to state and federal programs must be considered. Table 6-1 shows total agricultural BMP costs by watershed.

The total cost of livestock exclusion systems includes not only the costs associated with fence installation, repair, and maintenance, but also the cost of developing alternative water sources for SL-6N and SL-6W. The cost of fence maintenance can often be a deterrent to participation. In developing the cost estimates for fence maintenance shown in Table 6-1, a figure of $3.25/linear foot of fence was used. It was estimated that approximately 10% of fencing would need to be replaced over the 10-year timeline of this project.

Residential areas contribute a small percentage (less than ten percent) of overall bacteria to the Peak Creek watershed. However, 100% of failing septic systems and straight pipes have to be repaired or replaced. The estimated costs of recommended residential BMPs were approximated based on input from the working group, other Implementation Plans in the vicinity, and Virginia's NPS Implementation BMP Guidelines for Fiscal Year 2021. Table 6-2 shows total residential BMP costs for the implementation period.

Total estimated costs for implementation practices needed to meet the bacteria delisting goal are summarized in Table 6-3 for two planned stages of implementation. These stages, the associated timeline, prioritization, and the adaptive approach used are explained in greater detail in Chapter 7.

Table 6-1. Agricultural BMP implementation costs for the Peak Creek watershed.
Assumes one exclusion system averages 1750 linear feet of stream fencing.

Practice	Cost-share Code	Unit	Average Unit Cost	Sub-watershed	Number of Units	Cost
Stream Exclusion with Narrow Width Buffer and Grazing Land Management	SL-6N	system	$75,000	NE45 - Tract Fork	2	$150,000
				NE 46 - Thorne Springs Branch–Peak Creek	2	$150,000
				NE44 - Gatewood Reservoir-Peak Creek	1	$75,000
Stream Exclusion with Wide Width Buffer and Grazing Land Management	SL-6W	system	$75,000	NE45 - Tract Fork	15	$1,125,000
				NE 46 - Thorne Springs Branch–Peak Creek	20	$1,500,000
				NE44 - Gatewood Reservoir-Peak Creek	6	$450,000
Exclusion Fence Maintenance 10 years	N/A	feet	$3.25	NE45 - Tract Fork	2,908	$9,451
				NE 46 - Thorne Springs Branch–Peak Creek	3,806	$12,370
				NE44 - Gatewood Reservoir-Peak Creek	1,094	$3,556
Improved Pasture Management	SL-10	acre	$75	NE45 - Tract Fork	1,011	$75,825
				NE 46 - Thorne Springs Branch–Peak Creek	1,541	$115,575
				NE44 - Gatewood Reservoir-Peak Creek	151	$11,325
Continuous No-Till	SL-15B	acre	$35	NE45 - Tract Fork	32	$1,120
				NE 46 - Thorne Springs Branch–Peak Creek	34	$1,190
				NE44 - Gatewood Reservoir-Peak Creek	10	$350
Cover Crop	SL-8B, SL-8H	acre	$40	NE45 - Tract Fork	32	$1,280
				NE 46 - Thorne Springs Branch–Peak Creek	34	$1,360
				NE44 - Gatewood Reservoir-Peak Creek	10	$400
Total Estimated Agricultural Cost						**$3,683,801**

Table 6-2. Residential BMP implementation costs for the Peak Creek watershed.

Practice	Cost-share Code	Unit	Average Unit Cost	Number of Units	Cost
Septic tank pump-out	RB-1	system	$350	1,820	$637,000
Septic tank system repair	RB-3	repair	$5,000	304	$1,520,000
Septic system inspection and non-permitted repairs	RB-3M	repair	$2,000	303	$606,000
Septic tank system installation or replacement	RB-4	system	$15,000	30	$450,000
Septic tank system installation/replacement w/ pump	RB-4P	system	$25,000	31	$775,000
Alternative waste treatment system	RB-5	system	$30,000	47	$1,410,000
Rain barrels	N/A	barrel	$75	212	$15,900
Conservation Landscaping - Tree planting	CL-2	acre	$18,000	0.25	$4,500
Conservation Landscaping - Filter strips	CL-4	acres treated	$6,000	0.25	$1,500
Conservation Landscaping - Riparian buffers – grass/trees	CL-5	acres treated	$500	2	$1,000
Rain gardens	RG	acres treated	$4,000	15	$60,000
Pet waste disposal station	PW-1	station	$250	4	$1,000
Pet waste digester	PW-2	digester	$100	45	$4,500
Pet waste education program	N/A	program	$5,000	1	$5,000
Fenced dog park	N/A	park	$28,000	2	$56,000
Total Estimated Residential Cost					**$5,547,400**

Table 6-3. Total BMP implementation costs by stage for the Peak Creek watershed.

BMP Application	Cost by Stage		Total
	Stage 1 (Years 1 - 5)	Stage 2 (Years 6 - 10)	
Agricultural	$1,841,901	$1,841,900	**$3,683,801**
Residential	$2,804,700	$2,742,700	**$5,547,400**
TOTAL ESTIMATED COST	**$4,646,601**	**$4,584,600**	**$9,231,201**

6.2 Technical Assistance

Technical assistance costs were estimated as one full time position using a cost of $60,000/position per year. This figure is based on the existing staffing costs included in the Virginia Department of Environmental Quality's grant agreements with the Soil and Water Conservation Districts across the state to provide technical assistance to landowners in implementation watersheds. Based on the 10-year timeline of this plan (described in the Implementation Timeline section of this plan), this would make the total cost of technical assistance approximately $600,000. When factored into the cost estimate for BMP implementation shown in Table 6-3, this would make the total cost of implementation approximately $9.83M.

6.3 Benefit Analysis

The primary benefit of implementing this plan will be cleaner water in Peak Creek. Specifically, *E. coli* contamination in the stream will be reduced to meet water quality standards. It is hard to gage the impact that reducing *E. coli* contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, because of the reductions required, the incidence of infection from *E. coli* sources through contact with surface waters should be reduced considerably.

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

6.3.1 Agricultural Practices

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

Restricting livestock access to streams and providing them with a clean water source has been shown to improve weight gain and milk production in cattle (Zeckoski et al., 2007). Studies have shown that increasing livestock consumption of clean water can lead to increased milk and butterfat production and increased weight gain (Landefeld and Bettinger, 2003). Table 6-4 shows an example of how this can translate into economic gains for producers. Fresh clean water is the primary nutrient for livestock, with healthy cattle consuming, on a daily basis, close to 10% of their body weight during winter and 15% of their body weight in summer.

Table 6-4. Example of increased revenue due to installing off-stream waterers (Surber et al., 2003).

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

Many livestock illnesses can be spread through contaminated water supplies. For instance, coccidia can be delivered through feed, water and haircoat contamination with manure (VCE, 2009). Additionally, keeping cattle in clean, dry areas has been shown to reduce the occurrence of mastitis and foot rot. Horses drinking from marshy areas or areas accessed by wildlife or cattle carrying Leptospirosis tend to have an increased incidence of moonblindness associated with Leptospirosis infections (VCE, 1998a; VCE, 1998b). A clean water source can prevent illnesses that reduce production and incur the added expense of avoidable veterinary bills.

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 stocking rates by 30 to 40% and, consequently, improve the profitability of the operation. With feed costs typically responsible for 70 to 80% of the cost of growing or maintaining an animal, and pastures providing feed at a cost of 0.01 to 0.02 cents/lb of total digestible nutrients (TDN) compared to 0.04 to 0.06 cents/lb TDN for hay, increasing the amount of time that cattle are fed on pasture is clearly a financial benefit to producers (VCE, 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. Another benefit is that cattle are closely confined allowing for quicker examination and handling. In general, many of the agricultural BMPs recommended in this document will provide both environmental benefits and economic benefits to the farmer.

6.3.2 Residential Septic Practices

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. In terms of economic benefits to homeowners, an improved understanding of on-site sewage treatment systems, including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The average septic system will last 20 to 25 years if properly maintained. Proper maintenance includes: knowing the location of the system components and protecting them (*e.g.,* not driving or parking on top of them), not planting trees where roots could damage the system, keeping hazardous chemicals out of the system, and pumping out the septic tank every 3 to 5 years.

The cost of proper maintenance, as outlined here, is relatively inexpensive ($350) in comparison to repairing or replacing an entire system ($2,000 to $30,000). Additionally, the repair/replacement and pump-out programs will benefit owners of private sewage (*e.g.,* septic) systems, particularly low-income homeowners, by sharing the cost of required maintenance.

6.3.3 Residential and Urban Stormwater Management Practices

The primary benefits of urban stormwater management practices to private property owners include flood mitigation and improved water quality. A 2004 study assessing the economic benefits of stormwater management showed that these services can be valued at up to 5% of the market value of a home (Braden and Johnston, 2004). In flood prone and waterfront communities these services can be assigned an even greater value by property owners (Thunberg and Shabman, 1991).

In addition, urban BMPs have a number of economic benefits to localities. Increased retention of stormwater on site can lower peak discharges, thereby reducing the drainage infrastructure needed to prevent flooding. This can result in cost savings to local governments through reduced engineering and land acquisition costs, and reduced materials and installation costs for stormwater culverts and streambank armoring to prevent scour. Additional savings may be realized by local governments through reduced pollution treatment costs, particularly in communities with combined sewers. By reducing storm sewer flows through increased infiltration of stormwater, localities can subsequently reduce stormwater treatment costs, overflow damages and storage costs (Braden and Johnston, 2004). Lastly, implementation of urban BMPs greatly reduces soil erosion and sediment transport to our rivers, streams and lakes. A 1993 study of the economic cost of erosion-related pollution showed that national off-site damages from urban sediment sources cost between $192 million to $2.2 billion per year in 1990 dollar values (Paterson et al, 1993). This cost range would be far greater today if adjusted for inflation.

6.3.4 Watershed Health and Associated Benefits

Focusing on reducing bacteria in the watershed will have associated watershed health benefits as well. Reductions in streambank erosion, excessive nutrient runoff, and water temperature are additional watershed health benefits associated with streamside buffer plantings. In turn, reduced nutrient loading and erosion and cooler water temperatures improves habitat for fisheries, which provides associated benefits to anglers and the local economy.

Riparian buffers can also improve habitat for wildlife such as ground-nesting quail and other sensitive species. Data collected from Breeding Bird Surveys in Virginia indicate that the quail population declined 4.2% annually between 1966 and 2007. Habitat loss has been cited as the primary cause of this decline. As a result, Virginia has experienced significant reductions in economic input to rural communities from quail hunting. The direct economic contribution of quail hunters to the Virginia economy was estimated at nearly $26 million in 1991, with the total economic impact approaching $50 million. Between 1991 and 2004, the total loss to the Virginia economy was more than $23 million from declining quail hunter expenditures (VDGIF, 2009). Funding is available to assist landowners in quail habitat restoration (see Chapter 9).

In addition to the benefits to individual landowners, the economy of the local community will be stimulated through expenditures made during implementation, and the infusion of dollars from funding sources outside the impaired areas. Building contractors and material suppliers who deal with septic system pump-outs, private sewage system repair and installation, fencing, and other BMP components can expect to see an increase in business during implementation. Additionally, income from maintenance of these systems should continue long after implementation is complete. As will be discussed in greater detail in Chapter 9, a portion of the funding for implementation can be expected to come from state and federal sources. This portion of funding represents money that is new to the area and will stimulate the local economy. In general, implementation will provide not only environmental benefits to the community, but economic benefits as well, which in turn will allow for individual landowners to participate in implementation.

7. MEASUREABLE GOALS AND MILESTONES

Based upon the scope of work involved with implementing this TMDL, full implementation could be expected within 10 years provided that full funding for technical assistance and BMP cost-share are available. Delisting from the Virginia Section 305(b)/303(d) list can be expected after full implementation, when BMPs attain their maximum reduction efficiencies. A timeline for implementation, water quality and implementation goals and milestones, and strategies for targeting of best management practices are described in this section.

7.1 Milestone Identification

The end goals of implementation are restored water quality of the impaired water and subsequent delisting of the water from the Commonwealth of Virginia's Section 305(b)/303(d) list following implementation. Progress toward end goals will be assessed during implementation through tracking of best management practices through the Virginia Agricultural BMP Cost-Share Program 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 control measures installed within certain timeframes, while water quality milestones establish the corresponding improvements in water quality that can be expected as the implementation milestones are met. The milestones described here are intended to achieve full implementation within 10 years.

Normally, following the idea of a staged implementation approach, resources and finances will be concentrated on the most cost-efficient control measures and areas of highest interest first. For instance, concentrating on implementing livestock exclusion fencing within the first several years may provide the highest return on water quality improvement with less cost to landowners. However, the availability of technical and financial assistance also has to be considered. Implementation has been divided into two stages: Stage 1 includes years 1 through 5 and Stage 2 includes years 6 through 10. The working group recommended that 50% of the agricultural and residential practices be implemented in Stage 1 and the remaining implemented in Stage 2, to provide adequate technical and financial assistance to property owners throughout implementation.

Using the model developed during the TMDL study with spreadsheet analyses of applied BMPs, simulated results show that a 41% bacteria load reduction from existing conditions results in the delisting goal of a 10.49% exceedance of the single sample criterion (235 cfu/100mL). These results were achieved with a 70% reduction from livestock direct, 45% reduction from agricultural lands, 100% reduction from straight pipes and failing septic systems, and 10% reduction from residential and urban lands (excluding failing septic systems) (Table 3-9). Table 7-1 shows the implementation goals for each stage needed to meet the water quality goal of less than 10.5% exceedance of the maximum single sample *E. coli* criterion (235 cfu/100 mL) after full implementation (end of Stage 2). Table 7-2 shows the estimated bacteria reductions from each type of BMP for the Peak Creek watershed in each implementation stage. The total estimated bacteria reductions listed in Table 7-2 correspond to the % reductions needed from each bacteria source (Table 3-9) to meet the delisting goal. Table 7-3 shows the estimated water quality improvement goals since TMDL development and in each implementation stage. Estimated bacteria reductions since TMDL development include reductions in dairy cattle and installed BMPs.

Table 7-1. Staged implementation goals in the Peak Creek watershed for each stage.

BMP Type	Description	BMP code	Units	Extent		
				Stage 1	Stage 2	Total
Livestock stream exclusion	Stream exclusion with narrow width buffer and grazing land management	SL-6N	feet (system)	4,002 (3)	3,806 (2)	7,808 (5)
	Stream exclusion with wide width buffer and grazing land management	SL-6W		36,015 (21)	34,254 (20)	70,269 (41)
	Exclusion fence maintenance	N/A		3,904	3,904	7,808
Pasture	Improved pasture management	SL-10	acres	1,352	1,351	2,703
Cropland	Continuous No-Till	SL-15B	acres	38	38	76
	Cover Crop	SL-8B, SL-8H		38	38	76
Residential septic	Onsite sewage system repair	RB-3, RB-3M	repair	304	303	607
	Onsite sewage system installation/replacement	RB-4, RB-4P	system	31	30	61
	Alternative onsite sewage system	RB-5		24	23	47
	Septic tank pump-out	RB-1	pump-out	910	910	1,820
Residential/ Urban stormwater	Rain barrels	N/A	barrel	106	106	212
	Conservation Landscaping - Tree planting	CL-2	acres	0.125	0.125	0.25
	Conservation Landscaping - Filter strips	CL-4	acres treated	0.125	0.125	0.25
	Conservation Landscaping - Riparian buffers – grass/trees	CL-5		1	1	2
	Rain gardens	RG		7.5	7.5	15
Pet waste	Pet waste disposal station	PW-1	station	4	0	4
	Pet waste digester	PW-2	digester	23	22	45
	Pet waste education program	N/A	program	1	0	1
	Fenced dog park	N/A	park	2	0	2
Estimated average annual bacteria load [Existing (2003) = 1.24×10^{16}; Since TMDL development (2021) = 9.74×10^{15}]				8.53×10^{15}	7.37×10^{15}	7.37×10^{15}
% Exceedance of maximum single sample *E. coli* criterion (235 cfu/100 mL) [Existing (2003) = 17.5%; Since TMDL development (2021) = 15.5%]				13.16%	10.49%	10.49%

Table 7-2. Estimated bacteria reductions for each BMP type.

BMP Type	Description (Cost-share codes in parentheses)	Estimated Bacteria Reduction (cfu/yr)			
		Since TMDL development	Stage 1	Stage 2	Total
Livestock stream exclusion	Livestock exclusion from waterway (SL-6N, SL-6W)	$5.34x10^{14}$	$8.48x10^{14}$	$8.17x10^{14}$	$2.20x10^{15}$
Pasture	Improved pasture management (SL-10)	-	$2.06x10^{14}$	$2.06x10^{14}$	$4.12x10^{14}$
Cropland	Continuous No-Till (SL-15B)	$1.71x10^{15}$	$4.76x10^{13}$	$4.76x10^{13}$	$1.81x10^{15}$
	Cover Crop (SL-8B, SL-8H)	$4.18x10^{14}$	$1.16x10^{13}$	$1.16x10^{13}$	$4.42x10^{14}$
Residential septic	Onsite sewage system repair (RB-3, RB-3M)	-	$5.42x10^{13}$	$5.42x10^{13}$	$1.08x10^{14}$
	Onsite sewage system installation/replacement (RB-4, RB-4P)	-	$5.45x10^{12}$	$5.45x10^{12}$	$1.09x10^{13}$
	Alternative onsite sewage system (RB-5)	-	$1.43x10^{13}$	$1.43x10^{13}$	$2.86x10^{13}$
Residential/ Urban stormwater	Conservation Landscaping - Tree planting (CL-2)	-	$1.12x10^{10}$	$1.12x10^{10}$	$2.24x10^{10}$
	Conservation Landscaping - Filter strips (CL-4)	-	$4.93x10^{09}$	$4.93x10^{09}$	$9.86x10^{09}$
	Conservation Landscaping - Riparian buffers – grass/trees (CL-5)	-	$1.00x10^{11}$	$1.00x10^{11}$	$2.00x10^{11}$
	Rain gardens (RG)	-	$1.21x10^{12}$	$1.21x10^{12}$	$2.42x10^{12}$
Pet waste	Pet waste disposal station (PW-1)	-	$8.64x10^{09}$	-	$8.64x10^{09}$
	Pet waste digester (PW-2)	-	$4.97x10^{09}$	$4.75x10^{09}$	$9.72x10^{09}$
	Pet waste education program	-	$2.86x10^{13}$	-	$2.86x10^{13}$
Estimated Total Reduction in bacteria load from existing conditions (2003)		$2.66x10^{15}$	$1.22x10^{15}$	$1.16x10^{15}$	$5.04x10^{15}$
Estimated % Reduction in bacteria load from existing conditions (2003)		21%	10%	9%	41%

Table 7-3. Estimated average annual bacteria load and reductions since TMDL development and for each implementation stage.

	Existing (2003)	Since TMDL development	Stage 1	Stage 2	Total
Estimated average annual bacteria load (cfu/yr)	1.24×10^{16}	9.74×10^{15}	8.53×10^{15}	7.37×10^{15}	**7.37×10^{15}**
Estimated % Reduction in bacteria load from existing	0%	22%	32%	41%	**41%**
% Exceedance of maximum single sample *E. coli* criterion (235 cfu/100 mL)	17.50%	15.49%	13.16%	10.49%	10.49%

7.2 Water Quality Monitoring

7.2.1 DEQ Monitoring

Improvements in water quality will be evaluated through water quality monitoring conducted at DEQ monitoring stations located in the watersheds as shown in Table 7-4 and Figure 7-1. Monitoring will begin no sooner than the second odd numbered calendar year following the initiation of implementation. Beginning implementation monitoring after 2 to 3 years of implementation will help ensure that time has passed for remedial measures to have stabilized and BMPs to have become fully functional.

Table 7-4. Water quality monitoring stations used to evaluate implementation in the Peak Creek watershed.

Assessment Unit	Station ID	Stream Name	Station Description
VAW-N17R_PKC01A00	9-PKC007.80	Peak Creek	Route 99 bridge
VAW-N17R_PKC02A00	9-PKC009.29	Peak Creek	Near Radio Tower – Pulaski County
VAW-N17R_PKC04A00	9-PKC011.11	Peak Creek	Commerce St. bridge, Route 610
VAW-N17R_TCK01A00	9-TCK000.50	Tract Fork	Route 674 bridge

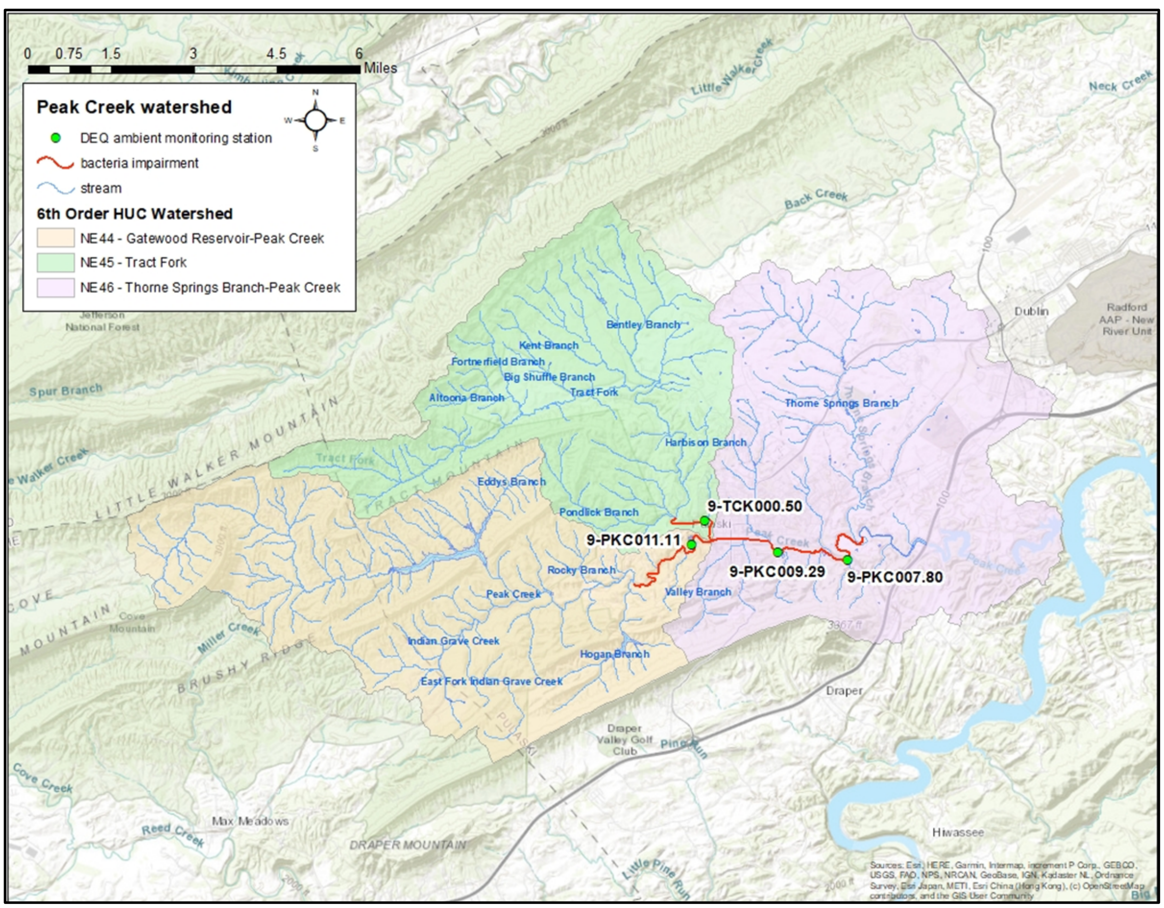

Figure 7-1. Water quality monitoring stations used to evaluate implementation in the Peak Creek watershed.

Most of the stations are part of DEQ's Ambient Monitoring Program, wherein bi-monthly watershed monitoring takes place on a rotating basis for two consecutive years of a six-year assessment cycle. At a minimum, the frequency of sample collections will be every other month for two years. After two years of bi-monthly monitoring an evaluation will be made to determine if the segments have been restored. If so, high frequency monitoring will then be conducted to assess the segments potential for delisting. If full restoration, as defined in the current or most recent version of the DEQ Final Water Quality Assessment Guidance Manual, has been achieved, monitoring will be suspended. If the listing stations shown in Table 7-4, or any other stations associated with this Implementation Plan have three or more exceedances of the bacteria standard within this two-year period, monitoring will be discontinued for two years. Bi-monthly monitoring will be resumed for another two years on the odd numbered calendar year in the third two-year period of the six-year assessment window. After this, the most recent two years of data will be evaluated, and the same criteria as was used for the first two-year monitoring cycle will apply.

7.2.2 Citizen Monitoring

Citizen monitoring is another valuable tool for assessing water quality. Citizen monitoring can supplement DEQ monitoring, identify priority areas for implementation, and detect improvements in water quality following implementation. DEQ offers information on Citizen Water Quality Monitoring at Citizen Monitoring | Virginia DEQ.

There are currently three sites within the Peak Creek watershed that are monitored by citizen scientists (Figure 7-2). Friends of Peak Creek (FOPC) facilitates and provides funding for this effort. The monitors are certified through the New River Conservancy's (NRC) New River Water Watcher Monitoring Program and retrained annually. Samples are collected on a monthly basis and measured for turbidity, conductivity, *E. coli*, pH and dissolved oxygen. The results are available on the NRC's website.

Friends of Claytor Lake (FOCL) also conducts citizen monitoring. There are two bacterial sites that can be used to evaluate water quality conditions in Peak Creek (Figure 7-2). FOCL collects monthly samples from these sites from May through August.

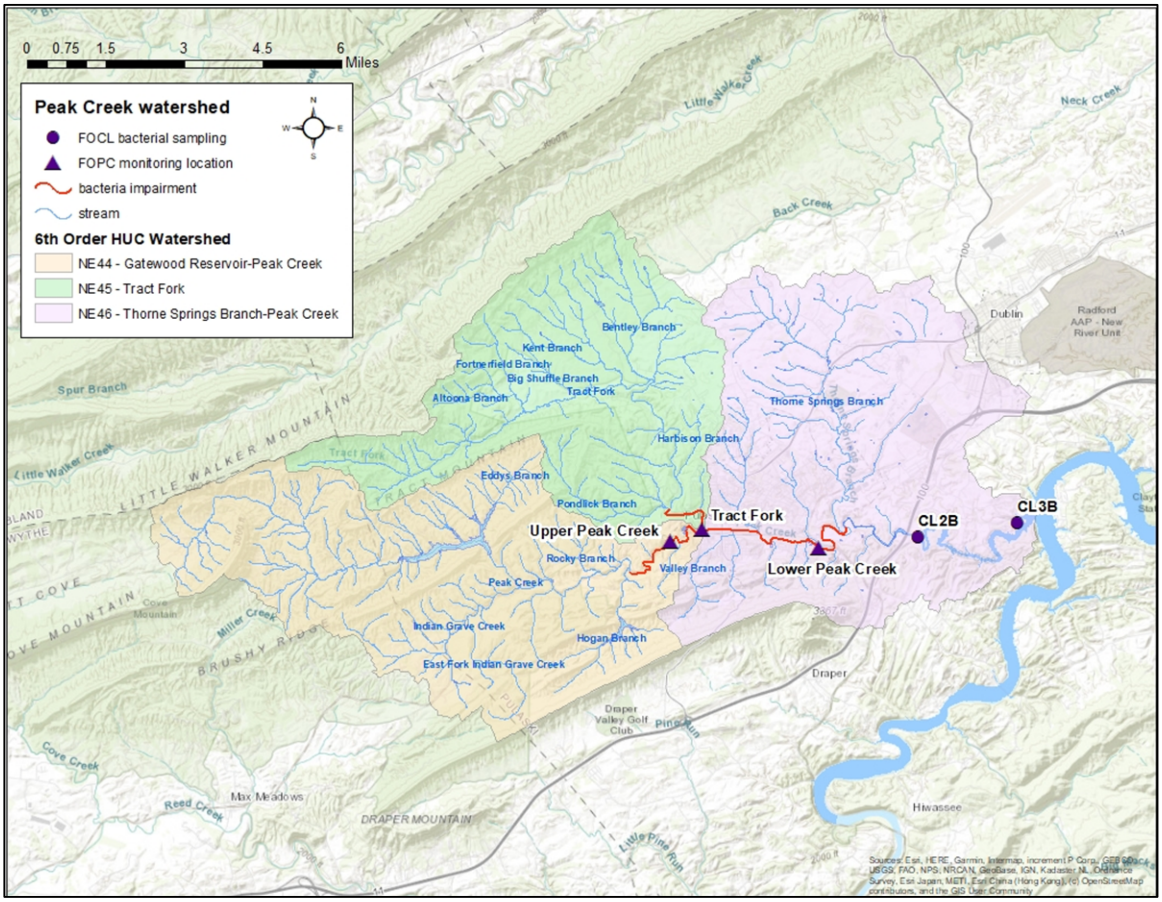

Figure 7-2. Citizen monitoring sites in the Peak Creek watershed.

7.3 Prioritizing Implementation Actions

Staged implementation implies the process of prioritizing BMPs to achieve the greatest bacteria reduction benefits early in the process. For example, practices that reduce bacteria from residential septic systems and straight pipes are considered 100% effective. Since malfunctioning septic systems contributing sewage to surface water or groundwater and straight pipes are illegal it will be essential to focus on these human sources. Implementation actions were prioritized spatially based on watershed inventory and optimum utilization of limited technical and financial resources. The Peak Creek watershed was divided into small areas to identify focus areas for prioritization of agricultural and residential BMPs (Figure 7-3 and Figure 7-4). Stage 1 implementation should be concentrated in areas with the “highest” and “high” priority if possible. Factors used to develop BMP priorities were human and livestock health risks, effectiveness of BMPs, stakeholder interest, costs, and ease of installation.

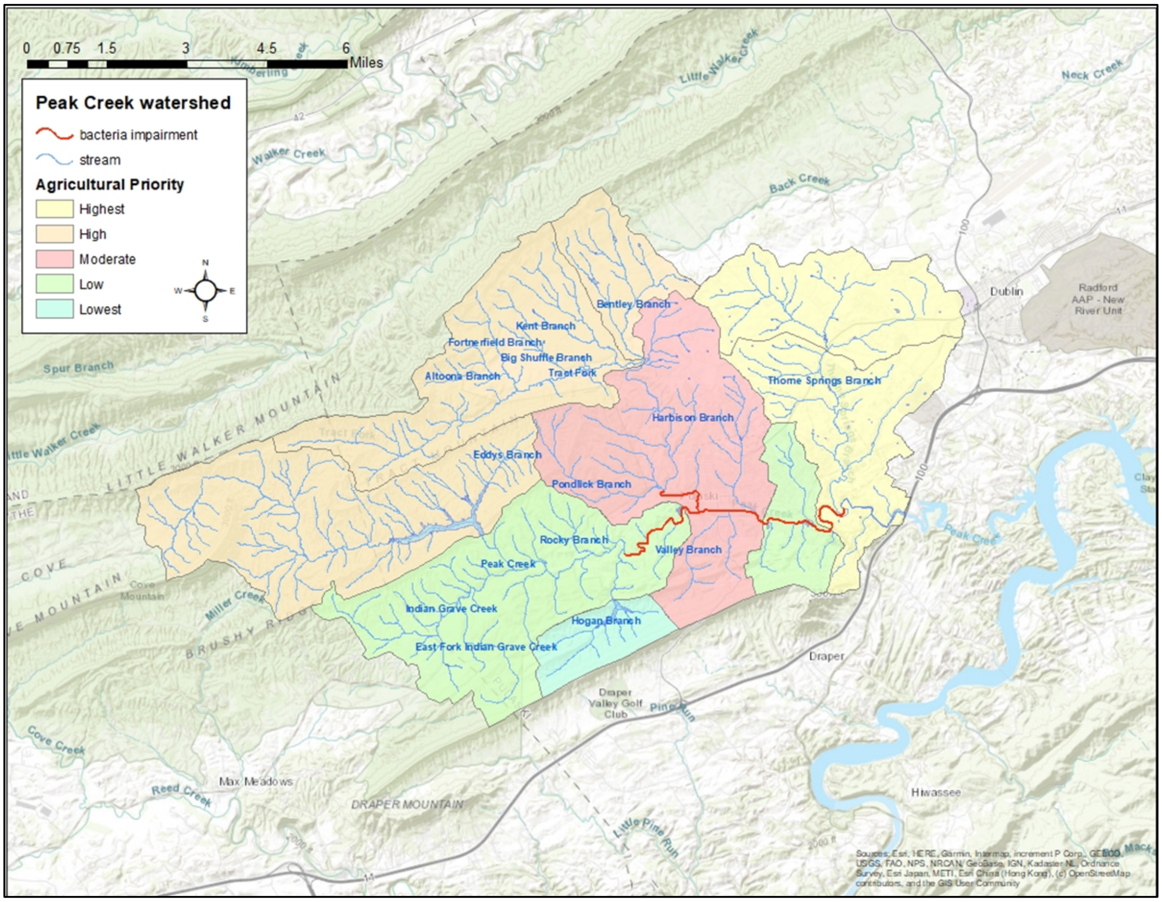

Figure 7-3. Agricultural prioritization by sub-watershed for the Peak Creek watershed.

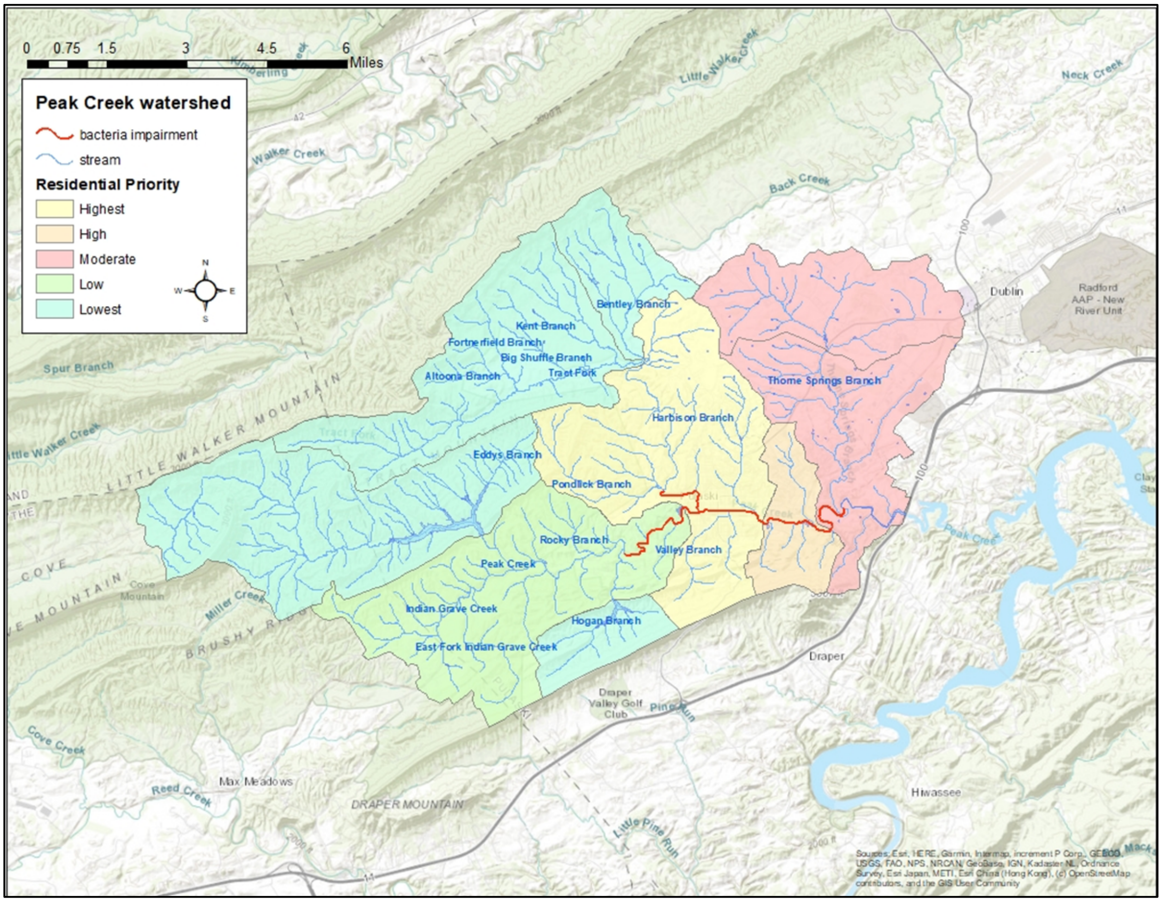

Figure 7-4. Residential prioritization by sub-watershed for the Peak Creek watershed.

7.4 Adaptive Management Strategy

An adaptive management strategy will be utilized in the implementation of this plan in order to achieve the water quality goals. Throughout the course of implementation, the management measures and water quality goals will be assessed and adjustments of actions will be made as appropriate.

The assessment of these measures and goals will be accomplished through monitoring of water quality, as discussed in Section 7.2 of this report, and evaluation of BMP implementation. Both of these mechanisms are documented in DEQ's triennial Progress Reports. The Progress Report is developed at the watershed/IP level and includes a summary of the watershed, implementation highlights, and water quality monitoring results. Information in the Progress Report can be used to determine if adaptive management is necessary. Furthermore, at the end of Stage 1, if assessments of water quality and implementation milestones find that progress toward achieving the bacteria reduction goals is not as expected, the implementation strategy can be adjusted. Stakeholders, such as Skyline SWCD, FOPC, New River Conservancy, and DEQ, will be responsible for making this determination. Stakeholders' roles are described in Chapter 8.

As new technologies and innovative BMPs to address bacteria reduction become available, these practices will be evaluated for implementation in the watershed. Other developments, for example, an extension of the county's sewer lines, could also result in an adaptation of the original implementation schedule. In addition, as new funding opportunities become available, they will be reviewed and pursued if applicable in the Peak Creek watershed.

8. STAKEHOLDERS AND THEIR ROLE IN IMPLEMENTATION

Achieving the goals of this plan is dependent on stakeholder participation and strong leadership on the part of both community members and conservation organizations. The Skyline Soil & Water Conservation District covers most of the project area with respect to administration of the VA Agricultural BMP Cost-Share Program. Additional partners will be necessary in order to address residential implementation needs. The following sections in this chapter describe the responsibilities and expectations for the various components of implementation.

8.1 Partner Roles and Responsibilities

8.1.1 Watershed Landowners

Participation by homeowners and local farmers are equally important in the success of this Implementation Plan. Residential property owners will need to repair or replace any malfunctioning septic system, and ensure that their septic systems continue to work properly by regularly pumping and inspection (every 3 to 5 years). SWCD and NRCS conservation staff will work with farmers to select the most applicable and cost-efficient practices for their farms. To assist with this selection, it is important to consider characteristics of farms and farmers in the watersheds that will affect the decisions farmers make when it comes to implementing conservation practices on their farms. For example, the average size of farms is an important factor to consider, since it affects how much land a farmer can give up for a riparian buffer. The average age of a farmer, which was 58 in Virginia in 2017, may also influence their decision to implement best management practices, particularly if they are close to retirement and will be relying on the sale of their land for income during retirement. In such cases, it may be less likely that a farmer would be willing to invest a portion of their income in best management practices. Table 8-1 provides a summary of relevant characteristics of farmers and producers in Pulaski County from the 2017 Agricultural Census (USDA-NASS, 2017). These characteristics were considered when developing implementation scenarios, and should be utilized to develop suitable education and outreach strategies.

In addition to local farmers and homeowners, participation from elected officials is critical to the success of this plan. Elected officials make important decisions with respect to land use and development that are likely to affect water quality. It is critical that the goals of this plan are considered as these decisions are evaluated.

Table 8-1. Characteristics of farms and farmers in Pulaski County (USDA-NASS, 2017).

Characteristic	Extent
Number of farms	394
Land in farms (acres)	77,504
Full owners of farms	238
Part owners of farms	136
Tenants	20
Operators identifying farming as their primary occupation	206
Operators identifying something other than farming as their primary occupation	434
Average years on present farm	20
Average age of primary operator	58
Average size of farm (acres)	197
Average value of farmland and buildings ($/acre)	$3,518
Average net cash farm income of operation ($)	$17,239
Farms with internet access	305
Farm typology (farms)	
Family or individual	87%
Partnership	6%
Family-held corporation	5%
Corporation other than family held	<1%
Other (cooperative, estate or trust, institutional etc.)	1%

8.1.2 Skyline Soil & Water Conservation District (SWCD)

The SWCD is continually reaching out to farmers in the watersheds and providing them technical assistance with conservation practices. Currently, dedicated staff is not available to work solely in the Peak Creek watershed, meaning that agricultural BMP implementation goals cannot be met without additional resources. SWCD staff responsibilities include promoting available funding for BMPs and aiding in the design and layout of agricultural BMPs. SWCD staff can assist with conducting outreach activities in the watersheds to encourage participation in conservation programs; however, staff time for targeted outreach is limited due to existing workloads. Should funding for additional staff become available for outreach in these watersheds, the Skyline SWCD would be well suited to administer an agricultural BMP program.

Residential septic system practices, outreach and funding could be administered by a number of different entities including the Skyline SWCD or the Pulaski County Health Department.

8.1.3 Friends of Peak Creek, Inc.

Friends of Peak Creek, Inc. (FOPC) is a nonprofit environmental organization based in the Peak Creek watershed. The organization is committed to protecting and preserving Peak Creek and its environs. Since 2013, FOPC has successfully implemented a wide range of community projects enhancing and protecting the watershed including but not limited to riparian buffer plantings, citizen water monitoring, litter clean up, installation of pet waste stations, storm drain markings and educational opportunities to name a few.

Friends of Peak Creek, Inc. was instrumental in the development of a Peak Creek Restoration Plan and Flood Mitigation Plan and are active in achieving subsequent goals. They offer a resource to assist in coordinating public participation, educational outreach and implementation of environmentally beneficial activities and BMPs. FOPC works closely with and serves as a liaison to regulatory agencies, government agencies and like-minded environmental organization to enhance stakeholder understanding and support.

8.1.4 New River Conservancy

New River Conservancy is a 501(c)(3) environmental nonprofit whose mission is to protect the water, woodland, and wildlife of the New River Watershed through dynamic programming, advocacy, and educational outreach. With staff in all three states (NC, VA, WV), New River Conservancy leverages public and private funding to engage communities in water quality improvement and conservation projects throughout the watershed. Specifically, in the Peak Creek watershed, New River Conservancy is proud to support Pulaski and its residents through restoration planning. By leading regular stakeholder meetings and developing strategic water quality improvement goals, New River Conservancy aims to secure funding for water quality improvement projects with financial and in-kind support from partners.

8.1.5 Virginia Department of Environmental Quality

The Virginia Department of Environmental Quality (DEQ) has a lead role in the development of TMDL IPs to address non-point source pollutants such as bacteria from straight pipes, failing septic systems, pet waste, agricultural operations, and stormwater that contribute to water quality impairments. DEQ provides available grant funding and technical support for the implementation of NPS (non-point source) components of TMDL IPs. DEQ will work closely with project partners including the Skyline Soil & Water Conservation District to track implementation progress for best management practices. In addition, DEQ will work with interested partners on grant proposals to generate funds for BMPs and projects included in the Implementation Plan. When needed, DEQ will facilitate additional meetings of the working group to discuss implementation progress and make necessary adjustments to the Implementation Plan.

DEQ is also responsible for monitoring state waters to determine compliance with water quality standards. DEQ will continue monitoring water quality in Peak Creek in order to assess water quality and determine when restoration has been achieved and the stream can be removed from Virginia's impaired waters list.

8.1.6 Virginia Department of Conservation and Recreation

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

8.1.7 Virginia Department of Health

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

8.1.8 Natural Resource Conservation Service (NRCS)

The U.S. Department of Agriculture, NRCS, is the federal agency that works hand-in-hand with US citizens to conserve natural resources on private lands. NRCS assists private landowners with conserving their soil, water, and other natural resources. Local, state and federal agencies and policymakers also rely on the expertise of NRCS staff. NRCS is also a major funding stakeholder for impaired water bodies through CREP and the Environmental Quality Incentives Program (EQIP).

8.1.9 U.S. Environmental Protection Agency

EPA has the responsibility of overseeing the various programs necessary for the success of the CWA. However, administration and enforcement of such programs falls largely to the states. Section 303(d) of the CWA and current EPA regulations do not require the development of TMDL IPs. EPA has outlined nine minimum elements of an approvable IP for states to receive Section 319 funding for IP development and implementation.

8.1.10 Other Potential Local Partners

There are numerous opportunities for future partnerships in the implementation of this plan and associated water quality monitoring. A list of additional organizations and entities with which partnership opportunities should be explored is provided below:

- Town of Pulaski
- New River Valley Regional Commission
- Virginia Cooperative Extension
- Virginia Department of Housing and Community Development
- Virginia Department of Agriculture and Consumer Services
- Virginia Department of Forestry
- Virginia Department of Transportation

8.2 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, Water Quality Management Plans, Source Water Protection Programs, and local comprehensive plans. Coordination of the implementation project with these existing programs could result in additional resources and increased participation.

8.2.1 Pulaski County Comprehensive Plan

In the winter of 2018, Pulaski County engaged in a year-long process to update the county Comprehensive Plan. The Draft Pulaski County Comprehensive Plan 2030 is intended to guide development and natural resource management within the jurisdiction. The plan stresses that "it is beneficial for the County to promote the protection of the water resource and to enhance water quality through water quality protection efforts, public education, and through strong partnerships with other localities and organizations that have a common interest in protection of this vital resource." The plan also notes the County's commitment to "guiding new development/redevelopment to include best practices for water quality and by advancing efforts that prevent waste and abuse of water resources."

8.3 Legal Authority

The EPA has the responsibility of overseeing the various programs necessary for the success of the CWA. 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 four state agencies responsible for regulating activities that impact bacteria impaired streams in Virginia. These agencies are DEQ, VADCR, VDH, and Virginia Department of Agriculture and Consumer Services (VDACS).

DEQ has responsibility for monitoring waters to determine compliance with state standards, and for requiring permitted point dischargers to maintain loads within permit limits. It has 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 that hold 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 surface and groundwater contamination. In response to increasing demand from the public to develop new regulations dealing with animal waste, the Virginia General Assembly passed legislation in 1999 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).

VADCR is responsible for administering the Virginia Agricultural BMP Cost-Share and Nutrient Management Programs. Historically, most VADCR programs have dealt with agricultural NPS pollution through education and voluntary incentives. These cost-share programs were originally developed to meet the needs of voluntary partial participation and not the level of participation required by TMDLs (near 100%). To meet the needs of the TMDL program and achieve the goals set forth in the CWA, the incentive programs are continually reevaluated to account for this level of participation.

Through Virginia's Agricultural Stewardship Act (ASA), 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 of 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. VDACS has three staff members dedicated to enforcing the Agricultural Stewardship Act, and a small amount of funding is available to support water quality sampling. The Agricultural Stewardship Act is entirely complaint-driven.

VDH is responsible for maintaining safe drinking water measured by standards set by the EPA. Their duties also include septic system regulation and, historically, regulation of biosolids land application on permitted farmland sites. Like VDACS, VDH’s actions are 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 relation to these TMDLs, VDH has the responsibility of enforcing actions to correct or eliminate failed septic systems and straight pipes.

State government has the authority to establish state laws that control delivery of pollutants to local waters. Local governments, in conjunction with the state, can develop ordinances involving pollution prevention measures. In addition, citizens have the right to bring litigation against persons or groups of people shown to be causing some harm to the claimant. The judicial branch of government also plays a significant role in the regulation of activities that impact water quality through hearing the claims of citizens in civil court and the claims of government representatives in criminal court.

8.4 Legal Action

The Clean Water Act Section 303(d) calls for the identification of impaired waters. It also requires that the streams be ranked by the severity of the impairment and that TMDLs be calculated for streams to meet water quality standards. Implementation Plans are not required in the Federal Code; however, Virginia State Code does include the development of Implementation Plans for impaired streams. EPA largely ignored the nonpoint source section of the Clean Water Act until citizens began to realize that regulating only point sources was no longer maintaining water quality standards. Lawsuits from citizens and environmental groups citing EPA for not carrying out the statutes of the CWA began as far back as the 1970s and have continued until the present. In Virginia in 1998, the American Canoe Association and the American Littoral Society filed a complaint against EPA for failure to comply with provisions of §303(d). The suit was settled by Consent Decree, which contained a TMDL development schedule through 2010. It is becoming more common for concerned citizens and environmental groups to turn to the courts for the enforcement of water quality issues.

Successful implementation depends on stakeholders taking responsibility for their role in the process. The primary role, of course, falls on the landowner. However, local, state and federal agencies also have a stake in ensuring that Virginia's waters are clean and provide a healthy environment for its citizens. An important first step in correcting the existing water quality problem is recognizing that there is a problem and that the health of citizens is at stake. Virginia's approach to correcting NPS pollution problems has been, and continues to be, encouragement of participation through education and financial incentives.

9. POTENTIAL FUNDING SOURCES

A list of potential funding sources available for implementation has been developed. A brief description of the programs and their requirements is provided in this chapter. Detailed descriptions can be obtained from the SWCD, DEQ, VADCR, NRCS, and VCE.

9.1 Virginia Nonpoint Source Implementation Program

Virginia's nonpoint source (NPS) implementation program is administered by DEQ through local Soil and Water Conservation Districts (SWCD), local governments, nonprofits, planning district commissions (PDC), and local health departments to improve water quality in the Commonwealth's streams and rivers and in the Chesapeake Bay. DEQ, through its partners, provides cost-share assistance to landowners, homeowners, and agricultural operators as an incentive to voluntarily install nonpoint source (NPS) best management practices (BMPs) in designated watersheds. The program uses funds from a variety of sources, including EPA 319(h) and the state-funded Water Quality Improvement Fund (WQIF) to install BMPs with the goal of ultimately meeting Virginia's NPS pollution water quality objectives. Although resource-based problems affecting water quality can occur on all land uses, this program addresses cost-share assistance on agricultural, residential, and urban lands. The geographic extent of eligible lands is identified in grant agreements and in watershed-based plans (WBPs), including TMDL IPs approved by DEQ and EPA.

9.2 Virginia Agricultural Best Management Practices Cost-Share Program (VACS)

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

9.3 Virginia Agricultural Best Management Practices Tax Credit Program

For all taxable years, any individual or corporation engaged in agricultural production for market, who has in place a soil conservation plan approved by the local SWCD, is allowed a credit against the tax imposed by Section 58.1-320 of an amount equaling 25% of the first $70,000 expended for agricultural best management practices by the individual. Any practice approved by the local SWCD Board must be completed within the taxable year in which the credit is claimed. The credit is only allowed for expenditures made by the taxpayer from funds of his/her own sources. The amount of the credit cannot exceed $17,500 or the total amount of the tax imposed by this program (whichever is less) in the year the project was completed. If the amount of the credit exceeds the taxpayer's state tax obligation, the excess will be refunded to the taxpayer by the Virginia Department of Taxation. This program can be used independently or in conjunction with other cost-share programs on the stakeholder's portion of BMP costs. It is also approved for use in supplementing the cost of repairs to streamside fencing.

Tax credits are also available for the purchase of precision agricultural equipment and conservation tillage equipment. This includes manure applicators, sprayers, variable rate application equipment, and equipment used to reduce soil compaction. Individuals may claim a state tax credit of 25% of all expenditures made for purchasing and installing the equipment, up to a set maximum amount. A Nutrient Management Plan approved by the local SWCD is required to claim these credits.

9.4 Virginia Conservation Assistance Program (VCAP)

This is a relatively new program that provides financial incentives and technical and educational assistance to residential/urban landowners who install stormwater BMPs in Virginia's Chesapeake Bay watershed. Cost-share is typically 75% and some practices provide a flat incentive payment. SWCDs administer the program to encourage residential and urban property owners to install BMPs on their land to reduce erosion, poor drainage, and poor vegetation that contribute to water quality problems.

9.5 Virginia Water Quality Improvement Fund (WQIF)

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

9.6 Conservation Reserve Program (CRP)

Through this program, cost-share assistance is available to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Applications for the program are ranked, accepted and processed during signup periods that are announced by the Farm Service Agency (FSA). If accepted, contracts are developed for a minimum of 10 and not more than 15 years. To be eligible for consideration, land and applicants must meet certain criteria set by FSA. Payments may include cost share for practice establishment, incentive payments, and rental payments on enrolled acres.

9.7 Conservation Reserve Enhancement Program (CREP)

This program is an "enhancement" of the existing USDA Conservation Reserve Program. It has been enhanced by combining federal funds with state funds in a partnership to address high priority conservation concerns. In exchange for removing environmentally sensitive land from production and establishing permanent resource conserving plant species, farmers are paid an annual rental rate along with state and federal incentives. Contracts are typically established for 10 or 15 years in support of CREP goals, which include reducing sediment, nutrients, nitrogen and other pollutants entering waterbodies, reducing soil erosion, wetland restoration, and enhancement of wildlife habitat.

The landowner can obtain and complete CREP application forms at the FSA center. The forms are forwarded to local NRCS and SWCD offices while FSA determines land eligibility. If the land is deemed eligible, NRCS and the local SWCD determine and design appropriate conservation practices. A conservation plan is written, and fieldwork is begun, which completes the conservation practice design phase.

FSA then measures CREP acreage, conservation practice contracts are written, and practices are installed. The landowner submits bills for cost-share reimbursement to FSA. Once the landowner completes BMP installation and the practice is approved, FSA and the SWCD make the cost-share payments. The SWCD also pays out the state's one-time, lump sum rental payment. FSA conducts random spot checks throughout the life of the contract, and the agency continues to pay annual rent throughout the contract period.

9.8 Environmental Quality Incentives Program (EQIP)

This program was established in the 1996 Farm Bill to provide a single voluntary conservation program for farmers and landowners to address significant natural resource needs and objectives. EQIP is administered by NRCS and offers landowners and farmers cost-share assistance to implement a wide range of conservation practices on agricultural and forest land. Applications are ranked and priority is given to conservation practices that will result in greater environmental benefits.

9.9 EPA Water Infrastructure Finance and Innovation Act (WIFIA) Funds

The WIFIA program was established by the Water Infrastructure Finance and Innovation Act of 2014. WIFIA provides long-term, low-cost supplemental loans for regionally and nationally significant projects. The funds can be used for development and implementation activities for eligible projects including, but not limited to, wastewater conveyance and treatment, drinking water treatment and distribution, enhanced energy efficiency projects at drinking water and wastewater facilities, acquisition of property if it is integral to the project or will mitigate the environmental impact of a project, and combinations of eligible projects. Loans can be combined with other funding sources including state Revolving Fund loans.

9.10 Southeast Rural Community Assistance Project (SERCAP)

The mission of this project is to promote, cultivate, and encourage the development of water and wastewater facilities to serve low-income residents at affordable costs and to support other development activities that will improve the quality of life in rural areas. Staff members of other community organizations complement the SERCAP staff across the region. They can provide (at no cost): on-site technical assistance and consultation, operation and maintenance/management assistance, training, education, facilitation, volunteers, and financial assistance. Financial assistance includes loans and small grants toward repair/replacement/installation of a septic system or an alternative waste treatment system. Funding is available for low-income homeowners.

9.11 National Fish and Wildlife Foundation (NFWF)

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

9.12 Clean Water State Revolving Fund

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

9.13 Wetland and Stream Mitigation Banking

Mitigation banks are sites where aquatic resources such as wetlands, streams and streamside buffers are restored, created, enhanced, or in exceptional circumstances, preserved expressly for the purpose of providing compensatory mitigation in advance of authorized impacts to similar resources. Mitigation banking is a commercial venture that provides compensation for aquatic resources in financially and environmentally preferable ways. Not every site or property is suitable for mitigation banking. Mitigation banks are required to be protected in perpetuity, to provide financial assurances and long term stewardship. The mitigation banking process is overseen by an Inter-Agency Review Team made up of state and federal agencies and chaired by DEQ and the Army Corps of Engineers.

9.14 Indoor Plumbing Rehabilitation (IPR) Program

The Virginia DHCD also offers the IPR loan program to low- and moderate-income homeowners who do not have indoor plumbing or have a failed wastewater disposal system. The IPR program provides zero-interest, subsidized loans with repayments tailored to individual borrower circumstances.

9.15 Other Potential Funding Sources

Additional potential funding sources that have been identified by the working groups or in previous TMDL IPs include:

- Virginia Outdoors Foundation. *For more information:* Virginia Outdoors Foundation | Protecting Virginia's Open Spaces (vof.org), accessed 10/13/2021.
- U. S. Fish and Wildlife Service (FWS) Conservation Grant Program. *For more information:* Financial Assistance | U.S. Fish and Wildlife Service (fws.gov), accessed 10/13/2021.
- USDA Agricultural Conservation Easement Program. *For more information:* Agricultural Conservation Easement Program | NRCS (usda.gov), accessed 10/13/2021.
- Virginia Environmental Endowment. *For more information:* Virginia Environmental Endowment (vee.org), accessed 10/13/2021.
- Trout Unlimited. *For more information:* Trout Unlimited | Home, accessed 10/13/2021.
- Ducks Unlimited. *For more information:* World Leader in Wetlands & Waterfowl Conservation (ducks.org), accessed 10/13/2021.

As part of adaptive management, the state recognizes that other funding opportunities may become available. These opportunities will be utilized if appropriate.

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