Water Quality Implementation Plan for the Yeocomico River, and Mill, Gardner, Jackson and Bonum Creeks, Northumberland and Westmoreland Counties

Technical Report

(Shellfish Areas Listed Due to Bacterial Contamination)

Prepared by:
The Virginia Department of Environmental Quality in cooperation with the stakeholders of Northumberland and Westmoreland Counties

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TABLE OF CONTENTS

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EXECUTIVE SUMMARY

This document includes restoration activities for the following TMDL watersheds: The Yeocomico River Watershed, Gardner, Jackson, and Bonum Creeks, and Mill Creek, all of which are located in both Westmoreland and Northumberland Counties, Virginia. Restoration activities for an additional nine waterbodies which were not included in a TMDL but were identified as impaired for recreational use and shellfish impairments. This Implementation Plan addresses the following waterbodies: Gardner, Jackson, Bonum, Lodge, and Mill creeks, Hampton Hall, Kinsale, and Shannon branches, an unnamed tributary to Lodge Creek, an unnamed tributary to Hampton Hall, as well as a portion of the West Yeocomico River.

The above mentioned creeks do not support Virginia's bacteria standards for the production of edible and marketable seafood, or recreational use. The applicable fecal coliform bacteria standard specifies that the 90th percentile fecal coliform value for a sampling station not exceed an MPN (most probable number) of 49 per 100 milliliters. For every impaired water body on the 303(d) list, the Clean Water Act and the U.S. Environmental Protection Agency (EPA) both require that states develop a Total Maximum Daily Load (TMDL) for each pollutant (40 CFR Part 130). TMDLs establish the reduction in loads needed to restore these waters. The Virginia Water Quality Monitoring, Information and Restoration Act (WQMIRA) directs the State Water Control Board (SWCB) to "develop and implement a plan to achieve fully supporting status for impaired waters."

Through the Clean Water Act (CWA) of 1972, the state of Virginia identifies streams that do not meet water quality standards for specific uses through water quality monitoring and assessment. When streams fail to meet 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 pollutant. A TMDL establishes limits on the amount of pollution a stream can tolerate while maintaining water quality standards. Once a TMDL is developed, measures are taken to reduce pollution levels in the stream. Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (WQMIRA) states in section 62.1-44.19:7 that the "*Board shall develop and implement a plan to achieve fully supporting status for impaired waters".* Such a plan is known as a Total Maximum Daily Load (TMDL) Implementation Plan (IP) as defined and described by the *Guidance Manual for Total Maximum Daily Load Implementation Plans*.

Review of TMDL Development

The impaired waters encompassed in this IP include those from three completed TMDL studies, as well as nested segments not included in TMDLs. The Yeocomico River TMDL study was completed in 2006, and the Gardner, Jackson, and Bonum Creeks TMDL study was completed in 2009. The Mill Creek bacterial TMDL for recreation use was completed in 2010. Mill Creek is a tributary to the South Yeocomico River located within the Yeocomico River watershed. The proposed implementation plan would also include several other shellfish use impairments as well as riverine and saltwater recreation use impairments for which TMDLs were not developed (i.e. nested).

DEQ used a simplified tidal volumetric model along with bacterial source tracking to aid in identifying sources (i.e. human, livestock, pet, and wildlife) of fecal contamination in the development of the TMDLs. The TMDLs of all watersheds are based on the 30-sample 90th percentile concentration,

which was determined to represent the critical condition and require greater reductions. As part of this plan, DEQ re-assessed sources in the watersheds and worked in concert with VIMS to re-assign bacteria load reductions in each of the watersheds (Table ES-1).

Table ES-1. Bacteria loads and reductions required in each watershed.

Watershed	Current Load (MPN/day)	Load Allocation (MPN/day)	Reduction Needed (%)
Gardner Creek	5.33E+11	1.96E+11	63%
Jackson Creek	4.71E+11	1.44E+11	69%
Bonum Creek	6.54E+11	2.96E+11	55%
West Yeocomico River, Hampton Hall	1.71E+12	8.25E+11	52%
Mill Creek (tidal and non-tidal)	4.57E+11	3.94E+10	91%
Lodge Creek (including XMA Lodge Creek, UT)	1.06E+12	4.14E+11	61%

Public Participation

Public meetings were held to inform the public about the end goals and status of the IP process as well as to provide a means for soliciting participation in the smaller, more targeted meetings (i.e., working groups). Two working groups were developed through the course of the planning process: an agricultural working group and residential work group, and a government working group (composed of local government representatives from both Westmoreland and Northumberland Counties). The working groups focused primarily on supplementing and verifying information to incorporate into the Bacteria Source Assessment (BSA). They also provided input in regards to the Best Management Practices (BMPs) that would work best within the watershed.

During the public participation process, a major emphasis was placed on addressing bacteria sources, especially septic system problems, increasing education/outreach, importance on partnerships, and the implementation funding sources.

Assessment of Implementation Action Needs

The workgroup process, TMDL studies and multiple sources were used to reassess bacterial sources assessment for the implementation areas and to evaluate alternative BMPs and strategies to reduce the bacteria loads. The various practices were discussed by the workgroup regarding costs, effectiveness, and appropriateness for the specific circumstances in the watersheds. Overall, the implementation needs for the five year phase 1 implementation period were identified and are shown in Tables ES-2 and ES-3, while education needs for both phase 1 and 2 during the implementation period are identified in Table ES-4.

Table ES-2. Agricultural BMPs estimated to be included during phase 1 (Years 1-5) in each watershed.

Control Measure	Unit	Unit Cost ($)	Bonum Creek	Gardner Creek	Jackson Creek	Mill Creek	Lodge Creek (Tidal, including XMA Lodge UT)	West Yeocomico River and Hampton Hall
Woodland Buffer Filter Area (FR-3)	Acres	700				10	5	20
Livestock Exclusion with Riparian Buffers (LE-1T, SL- 6T)	System	15,00	2	1	2	1	2	1
Livestock Exclusion with Reduced Setback (LE-2T)	System	10,00			2	2	2	
Vegetative Cover on Cropland (SL-1)	Acres			25		10	5	20
Grazing Land Protection (SL-6)	Acres					1	1	20
Small Acreage Grazing System (SL-6AT)	System	1,500		1			10	1
Small Grain Cover Crop for Nutrient Management (SL-8B), VACS Funding	Acres		10	10		10	12	50
Pasture Management (Livestock/horse) (SL-10T)	Acres	75		15			1	
Pasture Management (Sheep/Goats) (SL-10T)	Acres	75		1			1	
Grass Filter Strip (WQ-1)	Acres					5	5	30
Sediment Retention, Erosion, or Water Control Structures (WP-1)	Drainage Acres	4,300				10		50
Animal Waste Control Facility (WP-4)	System					1	1	
Stream Protection (WP-2T)	Acres					2	1	20

Table ES-3. Residential BMPs estimated to be included during phase 1 (Years 1-5) in each watershed.

Control Measure	Unit	Unit Cost ($)	Bonum Creek	Gardner Creek	Jackson Creek	Mill Creek	Lodge Creek	West Yeocomico River and Hampton Hall Branch
Phase 1 (Years 1-5) Septic Tank Pumpout (RB-1)	System	300	199	101	114	184	369	525
Septic Connection to Public Sewer System (RB-2)	System					30	20	30
Septic System Repair (RB-3)	System	3,000	10	6	6	6	12	
Septic System Replacement/Installation (RB-4)	System	6,000	5	4	3	3		
Septic System Replacement/Installation with Pump (RB-4P)	System	6,500			1	1		16
Alternative On-Site System (RB-5)	System	25000			2	2		5
Residential Pet Waste Composters	System	50	63	25	34	34	75	
Public Pet Waste Collection Facility Can Signage/Supplies)		600	3	5	5	5	10	15
Vegetated Buffer on Residential Land	Acres	400		5				
Rain Garden	Acres	5,000		5			5	10
Recreational/Aquaculture Boater Education Program				1				1
Residential Education Program			1	1	1	1	1	1
Vegetative Buffer on Residential Land	Acres		5	5		5	5	20
Wildlife Education Program				1	1	1		

Table ES-4. Education programs estimated to be needed for all watersheds (cost split among all watersheds).

		Education programs	
Phase 1 (Years 1-5)	**Phase 2 (Years 6-10)**	**Total cost per program ($)**	**Practice**
1	1	3,600	Recreational Boater Education Program
1	1	3,000	Residential Education Program (pet, septic)
1	1	3,000	Aquaculture (Oyster Gardening) Education Program
1	1	12,000	Wildlife Education/Management Program

Cost estimates for agricultural, residential, and educational programs in this plan were calculated by multiplying the unit cost by the number of BMP units in each watershed. Average costs for BMP installations in Virginia were used once the workgroup confirmed that they were reliable estimates. The unit cost estimates for the agricultural BMPs were derived from the Department of Conservation and Recreation's Agricultural Cost-Share Database. The unit costs for residential practices were developed through discussions with local health departments, the TMDL IP working groups and estimates from previous TMDL implementation plans. Estimates for education programs were based on target audience size and experience in other plans. The total implementation cost estimates for all the watersheds are listed as follows:

Table ES-5. Implementation Costs of All Watersheds

Watershed	Phase 1 (years 1-5)	Phase 2 (years 6-10)	Total
Bonum Creek	$159,350	$156,300	$315,650
Gardner Creek	$135,750,	$54,900	$190,650
Jackson Creek	$188,650	$79,800	$268,450
West Yeocomico River, Hampton Hall	$843,000	$892,600	$1,735,600
Mill Creek (tidal and non-tidal)	$461,000	$94,800	$555,800
Lodge Creek Tidal, including XMA Lodge Creek UT	$393,000	$232,300	$625,300

The primary benefit of this implementation is cleaner water in the Bonum, Gardener, Jackson, Mill, Lodge Creeks and the West Yeocomico River/Hampton Hall Branch. The goal is to implement the IP so that fecal contamination may be reduced and allow for the removal of the condemnation of the shellfish growing areas. The benefit to the oyster growers in these creeks would be that once the water quality is restored, they would no longer need to transport their floats to clean water to depurate oysters prior to consumption. Reducing fecal contamination levels in these creeks, from all anthropogenic sources will improve public health by reducing the risk of infection from fecal sources through contact with surface waters.

The residential programs will play an important role in improving water quality, but there may also be additional return on the investment in terms of economic benefits to homeowners. An improved understanding of private on-site sewage systems (including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance) will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The replacement of failing on-site sewage disposal systems with new septic or alternative treatment systems will have a direct and substantial impact by improving property values and improving the local economy.

An important objective of the implementation plan is to improve water quality and foster continued economic vitality and strength. This objective is based on the recognition that healthy waters improve economic opportunities for Virginians, and a healthy economic base enhances the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document are expected to provide economic benefits, as well as environmental benefits, to the property owners in these watersheds

INTRODUCTION

Background

Land Use

The GIS land use data, Virginia Land Cover 2016 by Virginia Geographic Information Network (VGIN), was obtained from http://vgin.maps.arcgis.com/home/item.html?id=d3d51bb5431a4d26a313f586c7c2c848

Figure 1 is the land use map of the watershed. Table 1 and Figures 2-4 display the landuse percentages.

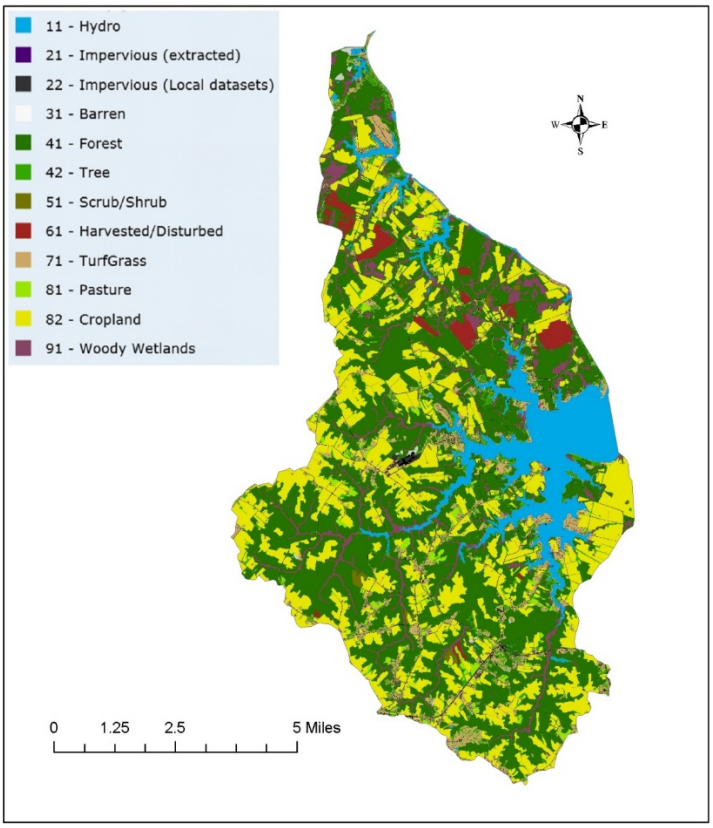


Figure 1. Land use of the Yeocomico River, Gardner Creek, Jackson Creek, Bonum Creek and Lodge Creek including XMA Lodge UT Watersheds.

Table 1. Areas and Percentages of the Impaired Segments

Landuse Category	Entire Area		Gardner, Jackson, and Bonum Creeks		Yeocomico River	
	Area (acres)	Percentage	Area (acres)	Percentage	Area (acres)	Percentage
Hydro	1.7	1.1%	0.5	1.7%	1.2	1.0%
Impervious (Extracted)	1.4	0.9%	0.1	0.4%	1.3	1.1%
Impervious (Local Datasets)	2.4	1.5%	0.5	1.6%	1.9	1.5%
Barren	0.3	0.2%	0.1	0.5%	0.2	0.1%
Forest	69.6	45.3%	13.1	42.2%	56.5	46.1%
Tree	9.4	6.1%	2.0	6.5%	7.4	6.0%
Scrub/Shrub	0.6	0.4%	0.1	0.1%	0.5	0.4%
Harvested/Disturbed	3.1	2.0%	1.4	4.6%	1.7	1.4%
Turfgrass	11.3	7.3%	2.1	6.6%	9.2	7.5%
Pasture	1.8	1.2%	0.2	0.6%	1.6	1.3%
Cropland	42.5	27.7%	8.2	26.3%	34.3	28.0%
Woody Wetlands	9.5	6.2%	2.7	8.9%	6.8	5.5%

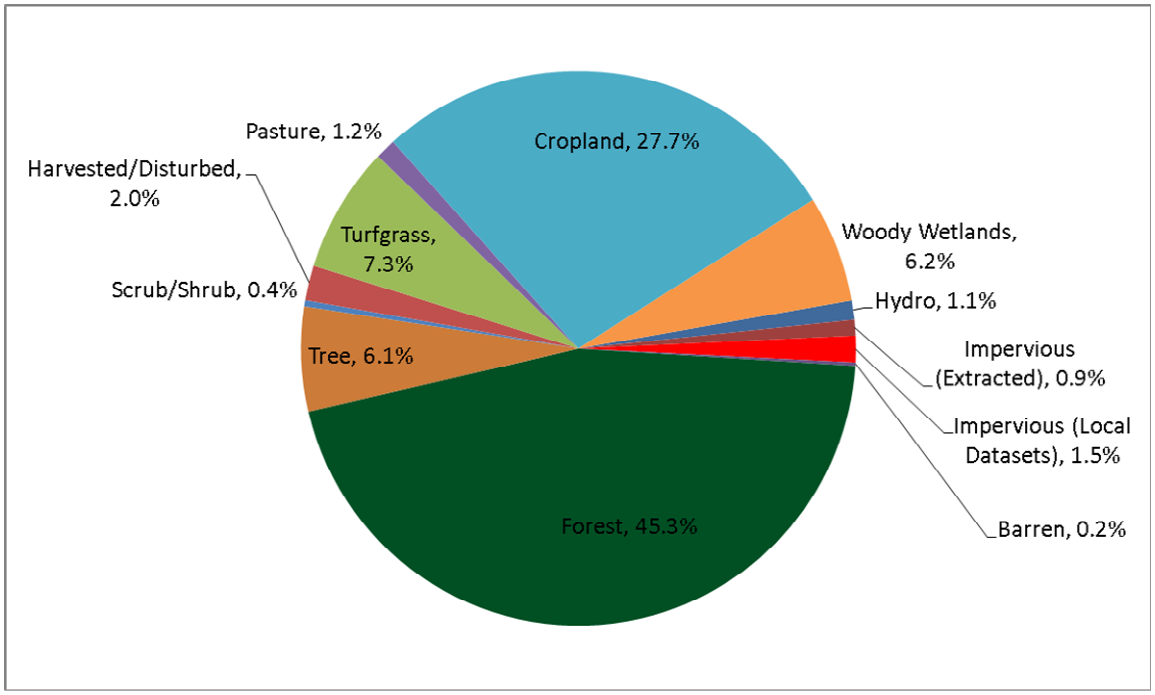


Figure 2. Land use of the Entire Area.

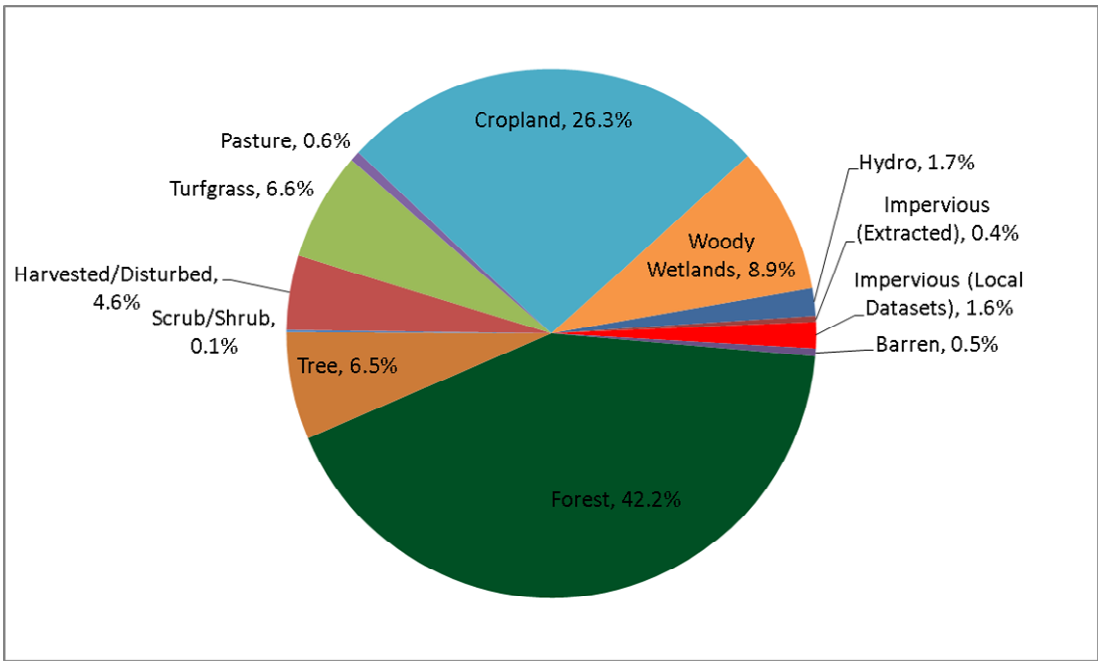


Figure 3. Land use of the Gardner, Bonum, and Jackson Creeks.

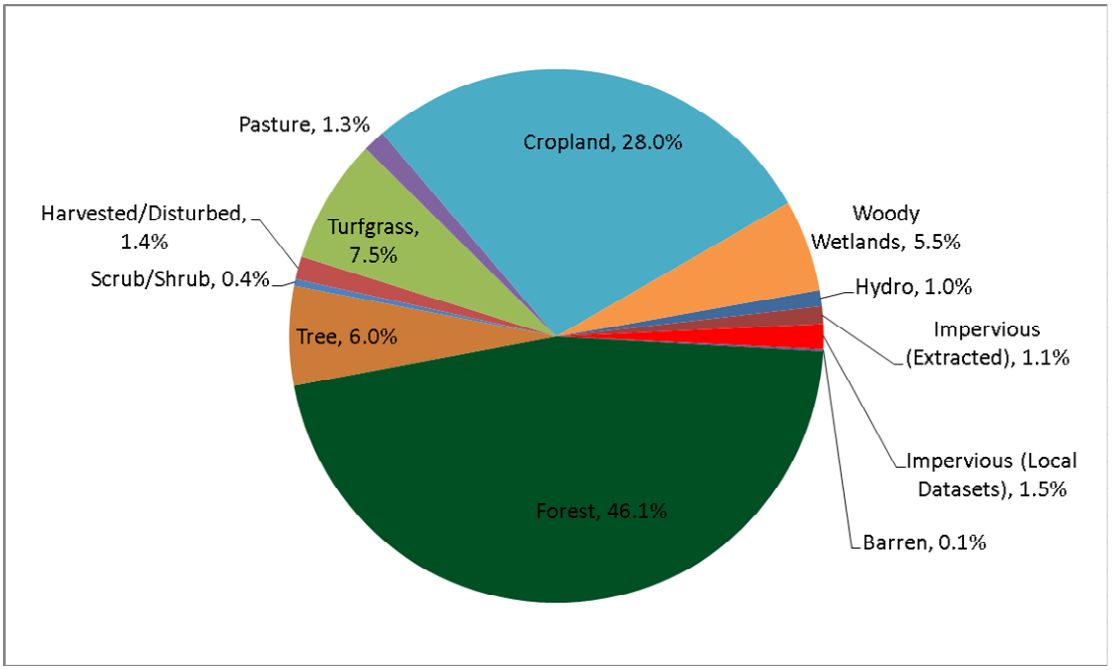


Figure 4. Land use of the Mill, Lodge Creeks and Yeocomico River Gardner.

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

drinking. Virginia submits a list on the health of all its waters to Congress every two years. No waterbody can be removed from the list until:

- Its problems are solved and standards are achieved or
- The designated uses not being achieved are removed after a detailed analysis clearly shows that they cannot be obtained.

When water bodies fail to meet standards, Section 303(d) of the CWA and the US Environmental Protection Agency's (EPA) Water Quality Management and Planning Regulation (40 CFR Part 130) require states to develop TMDLs for each pollutant. A TMDL is a "pollution budget" for a waterbody. That is, it sets limits on the amount of pollution that a stream can tolerate and still maintain water quality standards. In order to develop a TMDL, background concentrations, point source loadings, and non-point source loadings are considered. 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 and approved by EPA, measures must be taken to reduce pollution levels in streams. These measures, which can include the use of better treatment technology and the installation of best management practices (BMPs), are implemented in a staged process that will be described, along with specific BMPs in this IP. CWA regulations prohibit new discharges that "will cause or contribute to the violation of water quality standards."

Applicable Water Quality Standards

Water quality standards are designed to protect 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:

> *A. 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.*
>
> *E. At a minimum, uses are deemed attainable if they can be achieved by the imposition of effluent limits required under 55301(b) and 306 of the Clean Water Act and cost-effective and reasonable best management practices for nonpoint source control.*
>
> *G. The [State Water Control Board] board may remove a designated use which is not an existing use, or establish subcategories of a use, if the board can demonstrate that attaining the designated use is not feasible because:*
>
> *1. Naturally occurring pollutant concentrations prevent the attainment of the use;*
>
> *6. Controls more stringent than those required by 55301(b) and 306 of the Clean Water Act would result in substantial and widespread economic and social impact.*

(For a complete listing of this legislative reference regarding the Designation of Uses in Virginia waters, please go to: http://leg1.state.va.us/cgi-bin/legp504.exe?000+reg+9VAC25-260-10)

Effective February 1, 2010, VADEQ specified new bacteria standards in 9 VAC 25-260-170.A. These standards replaced the existing fecal coliform standard of 9 VAC 25-260-170. For a non-shellfish supporting waterbody to be in compliance with Virginia bacteria standards for primary contact recreation in a saltwater or transition zone, the current criteria are as follows:

> *"Enterococci bacteria shall not exceed a monthly geometric mean of 35 CFU/100 ml in transition and saltwater. If there are insufficient data to calculate monthly geometric means in transition and saltwater, no more than 10% of the total samples in the assessment period shall exceed enterococci 104 CFU/100 ml."*

For a shellfish supporting waterbody to be in compliance with Virginia's bacteria standards for the production of edible and marketable natural resource use, the Virginia Department of Environmental Quality (DEQ) specifies the following criteria (9VAC 25-260-160):

> *"In all open or estuarine waters capable of propagating shellfish or in specific areas where public or leased private shellfish beds are present, and including those waters on which condemnation or restriction classifications are established by the State Department of Health, the following criteria for fecal coliform bacteria shall apply:*

The geometric mean fecal coliform value for a sampling station shall not exceed an MPN (most probable number) or MF (membrane filtration using mTEC culture media) of 14 per 100 milliliters (ml). The estimated 90th percentile shall not exceed an MPN of 43 per 100 ml for a 5-tube decimal dilution test or an MPN of 49 per 100 ml for a 3-tube decimal dilution test or MF test of 31 CFU (colony forming units) per 100 ml."

These standards are calculated using a 30-month window, which means that every consecutive 30-month data group must have a *geometric mean* of 14 CFU/100mL or less and a *90th percentile* of 31 CFU/100ml or less for mTEC data to meet both standards.

For those waters that do not meet the criteria, Chapter 310 of the Administrative Code describes the process by which shellfish grown in restricted (condemned) waters can enter the commercial market, a process referred to as depuration or relaying.

Fecal Bacteria Impairments

Fecal coliform bacteria detection in exceedance of the shellfish use standard constitutes an impairment in Virginia shellfish growing waters. This group of bacteria is used as an indicator of the presence of fecal contamination; a common member of the fecal coliform group is *Escherichia coli*. Fecal coliform bacteria are associated with fecal material derived from humans and warm-blooded animals, and their presence in aquatic environments is an indication that the water may have been contaminated by pathogens or disease-producing bacteria or viruses. Waterborne pathogenic diseases include typhoid fever, viral and bacterial gastroenteritis, and hepatitis A. Pathogens are concentrated in filter-feeding shellfish and can cause disease when eaten uncooked. Therefore, the presence of elevated numbers of fecal coliform bacteria is an indicator that a potential health risk exists for individuals consuming raw or undercooked shellfish. Fecal contamination can occur from point source inputs of treated sewage or from nonpoint sources of human waste (e.g., malfunctioning septic systems), and waste from livestock, pets, and wildlife.

The shellfish impairments of the Bonum, Gardener, Jackson, Mill, Lodge Creeks and the West Yeocomico River/Hampton Hall Branch. are based on restrictions placed on commercial shellfish harvest to protect public health. Condemnations in Growing Area 86-136 and Growing Area 187-174 were issued by the Virginia Department of Health, Division of Shellfish Sanitation (VDH-DSS) based on monthly monitoring data. VDH-DSS collects monthly fecal coliform bacteria samples from each of its sampling stations in Virginia's tidal estuaries. They then calculate geometric means based on the most recent 30 months of sampling data to determine condemnation areas.

This IP outlines a strategy for reducing anthropogenic loadings of bacteria to a level that complies with each TMDL. With completion of the IP, Virginia has identified a plan for meeting the water quality goals within the 5 creeks and a means to enhance local natural resources. Additionally, approval of the IP will enhance opportunities for funding during implementation.

STATE AND FEDERAL REQUIREMENTS FOR IMPLEMENTATION PLANS

There are a number of state and federal requirements and recommendations for TMDL IPs. The goal of this chapter is to clearly define these 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 has three sections that discuss the a) requirements outlined by the Water Quality Monitoring, Information, and Restoration Act (WQMIRA) that must be met in order to produce an IP that is acceptable and approvable by the Commonwealth, b) EPA recommended elements of IPs, and c) required components of an IP in accordance to Section 319 guidance.

State Requirements

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

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

Federal Requirements

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

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

Requirements for Section 319 Fund Eligibility

EPA develops guidelines that describe the process and criteria to be used to award CWA Section 319 nonpoint source grants to States. Congress amended the CWA in 1987 to establish the Section 319 Nonpoint Source Management Program. Under Section 319, States, Territories, and Indian Tribes receive grant money, which supports a wide variety of activities, including the restoration of

impaired waters. The guidance is subject to revision and the most recent version should be considered for IP development. The "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003" identifies the following nine elements that must be included in the IP to meet the 319 requirements:

1. Identify the causes and sources of 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 procedures 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, measureable 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 progress is being made towards attaining water quality standards, and if not, 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 efforts.

The process of incorporating these state and federal guidelines into an IP consists of three major components:

1. Public participation
2. Implementation actions
3. Measurable goals and milestones.

Once developed, DEQ will present the IP to the SWCB for approval as the plan for implementing pollutant allocations and reductions contained in the TMDLs. DEQ will also request that the plan be included in the appropriate Water Quality Management Plan (WQMP), in accordance with the CWA's Section 303(e) and Virginia's Public Participation Guidelines for Water Quality Management Planning. As stated in the Memorandum of Understanding (MOU) between EPA and DEQ, DEQ will also submit a draft Continuous Planning Process to EPA where DEQ commits to regular updates of the WQMPs. Therefore, the WQMPs will be the repository for all TMDLs and the TMDL IPs developed within a river basin. The IP will also be presented to the EPA Nonpoint Source Program for approval.

REVIEW OF TMDL DEVELOPMENT

Water quality monitoring data, bacteria source assessments and the allocated reductions in the TMDL studies for each of the creeks were reviewed to determine the implications of the TMDLs on IP development.

As a part of TMDL development to assist in partitioning the bacteria loads from the diverse sources within the watersheds, bacterial source tracking (BST) sampling was conducted by DEQ. Bacterial source tracking is intended to aid in identifying sources (i.e. human, livestock, pet, and wildlife) of fecal contamination in water bodies. The studies used the antibiotic resistance approach (ARA) for the analysis, which is based on the premise that bacteria from different sources have different patterns of resistance to a variety of antibiotics. Samples were collected and analyzed on a monthly basis from October 2003 to September 2004. The BST results were used to estimate the percentage of the bacteria load coming from each of the source sectors: wildlife, human, livestock, and pet. It should be noted that BST and ARA have advantages and disadvantage and the results from studies using these methodologies should be used in conjunction with other knowledge of the watershed. BST is not a quantitative tool and was only intended to be used to identify and estimate potential source loads to the study area.

A simplified tidal volumetric model was used in the development of the TMDLs. This method uses the volumes of the creeks being studied and the monitored fecal coliform concentrations to calculate the current load conditions. The creek volume and the state water quality standard were used to calculate the allowable load. The difference between the current load and the allowable load was then used to calculate the required reduction for each creek. The TMDLs for the impaired water bodies are based on the 30-sample 90^{th} percentile concentration, which was determined to represent the critical condition. The resulting loads and reductions from the analysis are shown in Table 2. Please note that for this implementation plan bacterial concentrations were based on the more recent mTEC methodology that VDH-DSS began using in 2008. See the Current Load Changes section that follows for details.

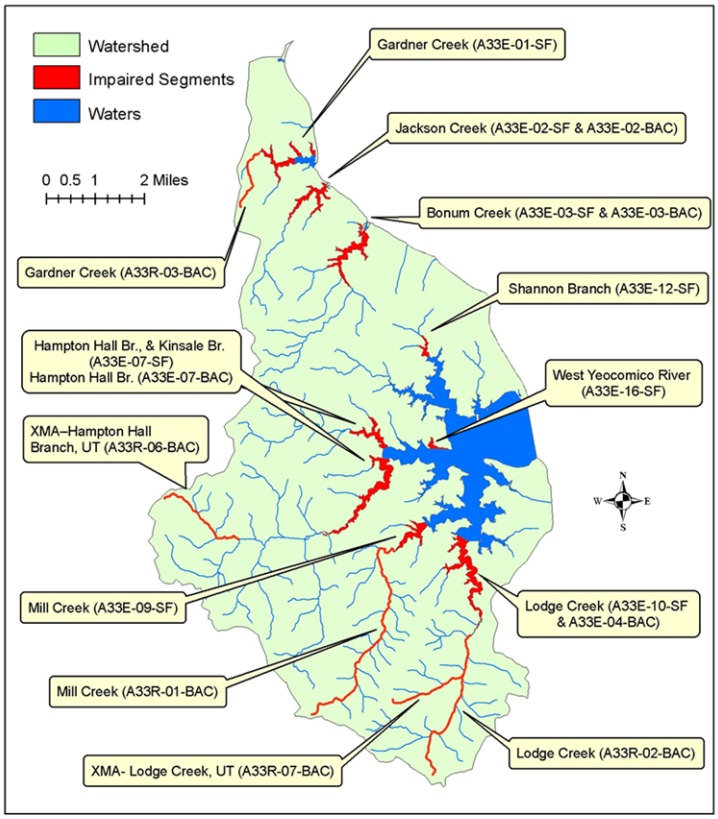
Table 2. Bacteria load and required reductions for the Gardner, Jackson, Bonum, West Yeocomico River/Hampton Hall Branch, Mill Creeks, Lodge Creek including XMA-Lodge UT.

Watershed	Current Load (MPN/day)	Load Allocation (MPN/day)	Reduction Needed (%)
Gardner Creek	1.42E+12	1.96E+11	86.2%
Jackson Creek	1.38E+12	1.44E+11	89.6%
Bonum Creek	2.74E+12	2.96E+11	89.2%
West Yeocomico River/ Hampton Hall Branch	2.32E+12	8.25E+11	64%
Mill Creek–Tidal and non-Tidal Creeks	1.38E+12	3.94E+10	97%
Lodge Creek including XMA-Lodge UT	1.51E+12	4.14E+11	72.6%

The fecal bacteria TMDLs for these creeks were developed by DEQ. The TMDL studies titled *Total* Maximum Daily Load (TMDL) Report for Shellfish Areas Listed Due to Bacterial Contamination for Yeocomico River (including Hampton Hall Branch, Lodge XMA Lodge Creek UT) and Mill Creek was developed in 2006. TMDL Report for Gardner, Jackson and Bonum Creeks was developed in 2009. The reports are available on the internet via the DEQ website, http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLDevelopment/ApprovedTMDLReports.aspx. These TMDLs used the 90th percentile standard of 49 MPN/100 ml because it was the more stringent condition for assessing water quality in each creek.

Although Hampton Hall and West Yeocomico were removed from the Impaired Waters List in 2016, these were included in this IP to address corrective actions that can be used to prevent future unacceptable fecal coliform loadings in the watershed. Also, additional areas within Gardner Creek, Jackson Creek, Bonum Creek, Hampton Hall Branch, West Yeocomico River and Lodge Creek have become impaired since the approval of the TMDLs; these sections will be addressed by BMP implementation in their respective subwatersheds. Figure 5 shows the water bodies that were covered in each of the watershed and VDH impairments.

Figure 5. Bacteria impaired water bodies covered in completed TMDLs and additional VDH impairments.



CURRENT LOAD CHANGES

Bacterial concentrations in coastal embayments have high seasonal and interannual variation and depend strongly on hydrological conditions. The TMDLs that were developed for the creeks addressed in this IP, used data prior to 2008. The current load is expected to change. Since 2008, VDH-DSS has used a membrane filtration technique (mTEC) that uses direct plate counts to measure fecal coliform concentrations instead of the multiple tube fermentation method. The new method reduces statistical uncertainty and provides a more accurate measurement of bacterial concentrations. In addition, this new method is associated with a new water quality standard (31 CFU per 100 mL). Table 4 shows the average geomean and 90th percentile concentrations measured using the new membrane filtration method (mTEC) after 2008 as well as the geomean and 90th percentile values that were used to calculate loads in the EPA approved TMDL reports.

Table 3. Bacteria current loads and reductions required in each watershed. Note that Virginia Water Quality Standards require that the geometric mean not exceed 14 MPN/100mL and the 90th % not exceed 49 MPN/100mL for a 3-tube dilution test and 31 CFU/100mL for a mTEC membrane filtration test.

Watershed	Current Load (MPN/day)	Load Allocation (MPN/day)	Reduction Needed (%)
Gardner Creek	5.33E+11	1.96E+11	63%
Jackson Creek	4.71E+11	1.44E+11	69%
Bonum Creek	6.54E+11	2.96E+11	55%
West Yeocomico River, Hampton Hall	1.71E+12	8.25E+11	52%
Mill Creek (tidal and non-tidal)	4.57E+11	3.94E+10	91%
Lodge Creek (including XMA Lodge Creek, UT)	1.06E+12	4.14E+11	61%

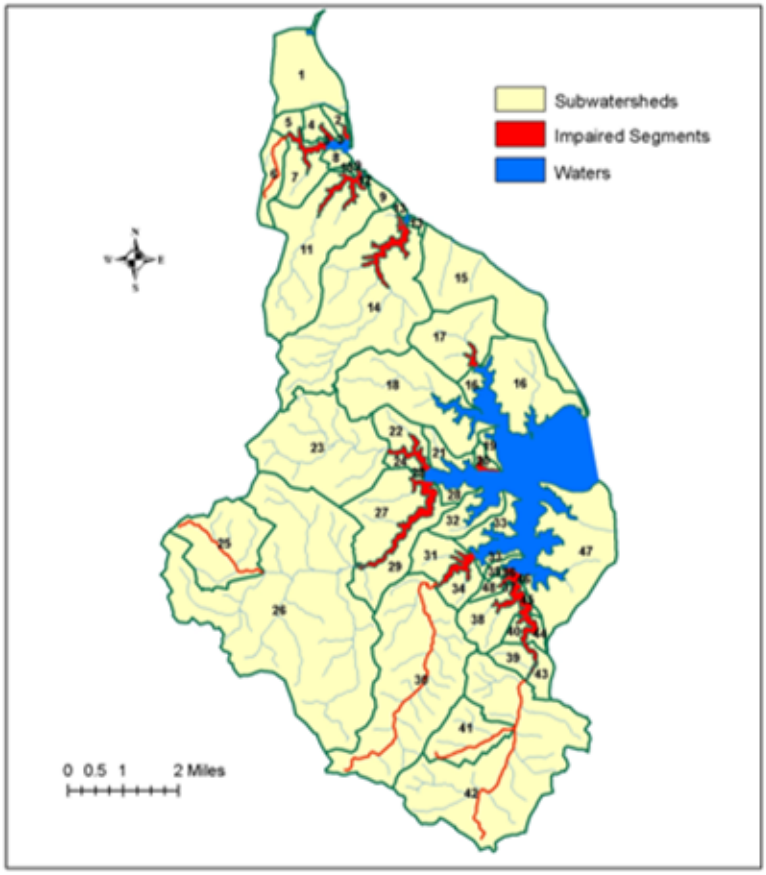
BACTERIA SOURCE REASSESSMENT

This section explains the source reassessment that was conducted for all watersheds. This reassessment was conducted to quantify bacteria loadings contributed by human, livestock, pets, and wildlife on various land uses and to develop BMP implementation strategies to address direct and indirect bacteria inputs to shellfish waters. In order to address bacterial impairments and land use variations within each of the watersheds, the watersheds were split up into 48subwatersheds (Figure 6). Although few sub watersheds were not initially included in the TMDLs developments, calculations for each of these sub watersheds were included in this implementation plan in order to assess corrective actions that can be used to reduce fecal coliform loadings in these areas. After TMDL developments, VDH announced more condemnation of the growing areas within all TMDL developed watersheds. Details are listed in Appendix D.

Table 4. Sub watershed IDs of Each Impaired Segment.

Water Name	Subwatershed ID
Gardner Creek-Tidal	2, 4-7
Gardner Creek-Nontidal	6
Jackson Creek	10-12
Bonum Creek	14
Shannon Branch	17
West Yeocomico River	20
Kinsale Branch	22-24
Hampton Hall Branch	25-27, 29
XMA – Hampton Hall Creek UT	25
Mill Creek-Tidal	30, 31, 34
Mill Creek-Nontidal	30
Lodge Creek-Tidal	36-46, 48
Lodge Creek-Nontidal	41, 42
XMA - Lodge Creek, UT	41

Figure 6. Subwatersheds locations in Westermoreland and Northumberland Counties, VA.



Practice details and bacteria production rates are listed in Appendix E. These were the same for each waterbody. Reassessment of nonpoint fecal sources from residential septic systems, livestock, wildlife and pets were estimated using census data, local input, and habitat availability.

Livestock Estimation:

Livestock numbers were obtained initially from the most recent USDA Ag. Census. Considering the IP area only covers a small portion of both Westmoreland and Northumberland Counties, these initial numbers were further reduced by using a ratio of the percent of IP area from each county by the livestock estimates listed for each county. Further, the livestock estimations were reviewed by the agricultural working group, and verified by county extension agents (VCE).

Household Estimation:

Household Estimates were derived from counting the number of address sites within the IP area. Address sites were derived from the VGIN GIS Database. Westmoreland County provided a GIS map of the sewer areas in their county. For the remainder of Westmoreland County, and for the household estimates in Northumberland County, it was assumed that homes utilized residential septic systems. A 7% failure rate was used to develop the estimated number of residential septic systems that were failing or not functioning properly.

Pet Estimation:

Dog and cat estimates in the watersheds were determined using updated American Veterinary Medical Association calculations that were based on the number of houses within each watershed. Dog estimates assumed that 36.5% of households had 1.6 dogs (0.365 * 1.6 * Number of houses) and cat estimates assumed that 30.4% of households had 2.1 cats (0.304 * 2.1 * Number of houses). Based on internet searches, observations in the watershed, and stakeholder knowledge, no kennels or hunt clubs were included in the dog estimates.

Wildlife Estimation:

Wildlife estimates were developed using information from various sources. A 308 foot buffer around each impairment was used to calculate the number of X. Wildlife estimates were based on previously reported TMDL data, habitat availability, and stakeholder input.

Deer, muskrat, and raccoon populations were estimated based on the acreage of available habitat and the animal densities found in those habitats. Deer habitat included forest, harvested forest land, orchards, grazed woodland, urban grassland, cropland, pasture, wetlands, transitional land, low density residential, and medium density residential land uses. Deer density indices (animals/acre) were multiplied by the total watershed acreage in each watershed. Densities of muskrat were multiplied by the acreage of the watershed that fell within 308 ft. of water bodies. This is because muskrat are most prevalent in this 308 ft. buffer region.

For specific source assessment numbers that were used in each watershed, see Appendix X. The revised source assessment numbers were used to calculate daily fecal coliform loading to each of the impairments.

Because each land use has different properties in terms of hydrology, a portion of the flow and bacteria will be lost due to infiltration and decay. The delivery transport rates of bacteria from different land uses to the receiving waters do, in fact, differ. The portion of flow and bacteria discharged to receiving waters can be quantified using runoff coefficients and bacterial delivery rates.

The runoff coefficient is a dimensionless coefficient that relates the amount of runoff to the amount of precipitation in a drainage area. This coefficient is larger for land uses that have low infiltration and high runoff (pavement, steep gradient), and is lower for permeable, well vegetated land uses (forest, flatland). The runoff coefficient is a function of the land use, soil type, and drainage basin slope. The amount of runoff in a watershed can be estimated using runoff coefficients for different land uses.

The bacterial delivery rate is the ratio of the amount of discharge of bacteria to the amount of bacteria received for a drainage area. This differs for each type of land use and varies significantly for different soil permeabilities. Using the delivery rate of a specific land use type, the bacterial loading for the land use can be correctly estimated by multiplying the delivery rate and the total amount of loading to the drainage area.

In order to estimate both the runoff coefficient and bacteria delivery rate for each land use, VIMS collaborators used a watershed model previously developed for Onancock Creek and other Eastern Shore watersheds (Shen et al., 2008; Wang, 2005). The modeling approach was based on the premise that pollutants from various sources (livestock, wildlife, septic systems, etc.) accumulate on the land surface and are subject to runoff during rain events, whereas they will die off gradually during dry periods. In addition, different land uses are associated with various hydrological processes that determine the potential bacteria load from each land use type. The watershed model is driven by hourly precipitation; therefore, the bacterial loading variations due to variations in hydrological processes can be accurately simulated. Using previously calibrated hydrological and bacterial decay parameters for watersheds on the Eastern Shore, VIMS conducted 7-year model simulations for each land use type and determined mean delivery rates of bacteria for each land use category in the region.

Because each bacterial source (e.g., livestock, pet, wildlife) can accumulate differently on alternate land uses (e.g., wetland, urban land, cropland, etc), the total loading for a particular bacterial source was determined using areally weighted land use delivery rates based on the source distribution. By computing the load for each bacterial source, the total loading from the drainage basin was estimated.

A detailed description of this modeling approach, runoff coefficients and delivery rates are provided in Appendix C.

Using these results, new TMDL load reductions were calculated. The BMP needs in the watersheds were based on these revised loads.

Table 5. Revised current loading and required reductions for the Bonum, Gardener, Jackson, Mill, Lodge Creeks and the West Yeocomico River/Hampton Hall Branch based on the source reassessment, runoff coefficients, and bacteria delivery rate.

Watershed	Current Load (MPN/day)	Load Allocation (MPN/day)	Reduction Needed (%)
Gardner Creek	5.33E+11	1.96E+11	63%
Jackson Creek	4.71E+11	1.44E+11	69%
Bonum Creek	6.54E+11	2.96E+11	55%
West Yeocomico River, Hampton Hall	1.71E+12	8.25E+11	52%
Mill Creek	4.57E+11	3.94E+10	91%
Lodge Creek (including XMA Lodge Creek, UT)	1.06E+12	4.14E+11	61%

PUBLIC PARTICIPATION

Public input on restoration and outreach strategies for this IP was an important part of this planning process. Since the plan will be implemented primarily by watershed stakeholders on a voluntary basis with some financial incentives, local input and support are the primary factors that will determine the success of this plan.

Public Meetings

Public meetings were held to inform the public regarding the goals and status of the IP project as well as to provide a means for soliciting participation in the smaller, more targeted meetings (i.e., working groups).

The first public meeting was held on February 2, 2017at the Northumberland Library, located at Heathsville, VA. This initial meeting was attended by a total of 16 people, including local landowners, farmers, stakeholders, Northern Neck Soil Water Conservation District (NNSWCD). During the meeting DEQ and VIMS representatives explained the impaired water bodies, TMDL and IP development processes, and bacterial loading models. Attendees discussed livestock exclusion stream fencing, new sewer connections and possibility of no-discharge zone to improved water quality. Need of funding availability and public cooperation was also discussed. The group decided that two working groups would be formed – agricultural and residential working groups, to discuss bacteria sources, control measures and plan details.

The final public meeting was held on August 30th, 2022 at the Northumberland Public Library, located in Heathsville, VA. The intended purpose of this meeting was to obtain feedback from watershed stakeholders on the proposed plan to restore water quality in the Yeocomico River Watershed. No attendees showed.

Working Groups

The first working group meeting was held at the end of the first public meeting. Representatives of DEQ attended each working group in order to facilitate the process and integrate information collected from the various attendees. The discussion during this meeting covered current data gaps, the potential for agricultural and residential BMP installation, and education opportunities in the watersheds. In agricultural working group, there was tremendous interest in cost-share program and indicated presence of livestock, sheep, and wildlife presence. During this workgroup, source assessment numbers for livestock, wildlife, and pets were discussed. Workgroup members pointed out livestock locations on watershed maps and noted that the wildlife numbers reported in the TMDL documents were too low.

In residential group, it was indicated that in the next ten years, most likely to see increased number of houses than farmland. Northumberland County sends out pump-out letters. Westmoreland County – residents have to show proof of pump out to get a building permit. Proper pet waste disposal was emphasized. Shoreline areas are predominantly owned by weekend residents. The interior areas primarily are of lower-income residents who cannot afford pump-outs. There is recreational use of these waters in the area. Boat ramps in Lodge Creek and recreational fishing, canoes/kayaks and aquaculture are also present in these watersheds.

The second work group meeting was scheduled in March of 2018. No attendees showed.

ASSESSMENT OF IMPLEMENTATION ACTION NEEDS

The BMP and corrective action needs in the watershed are divided into major categories below: agricultural, residential, education programs, and pet waste management BMPs.

Agricultural BMPs

Agricultural lands in the watersheds are predominantly row crops. The fields are generally well buffered according to the Eastern Shore Soil and Water Conservation District.

Field surveys and stakeholder workgroups revealed very few livestock or horses in the watersheds. BMPs to address these small pastures and cropland include buffers, livestock exclusion, pasture management, and cover crops. The livestock exclusion with riparian buffers and reduced setback BMP (LE-1T, SL-6T, LE-2T), the small acreage grazing system BMP (SL-6AT), the woodland buffer filter area BMP (FR-3), the small grain cover crop BMP (SL-8B), the Sediment Retention, Erosion, or Water Control Structures BMP (WP-1), and the pasture management BMP (SL-10T) are cost-shared practices in the Virginia Agricultural Cost-Share Programs for TMDL implementation areas.

Table 6. Agricultural BMPs needs to be included during phase 1 (Years 1-5) in each watershed.

Control Measure	Unit	Bonum Creek	Gardner Creek	Jackson Creek	Mill Creek	Lodge Creek	West Yeocomico River and Hampton Hall Branch
Woodland Buffer Filter Area (FR-3)	Acres				10	5	20
Livestock Exclusion with Riparian Buffers (LE-1T, SL- 6T)	System	2	1	2	1	2	1
Livestock Exclusion with Reduced Setback (LE-2T)	System			2	2	2	
Vegetative Cover on Cropland (SL-1)	Acres		25		10	5	50
Grazing Land Protection (SL-6)	Acres				1	1	20
Small Acreage Grazing System (SL-6AT)	System		1			10	1
Small Grain Cover Crop for Nutrient Management (SL-8B), VACS Funding	Acres	10	10	10	10	12	50
Pasture Management (Livestock/horse) (SL-10T)	Acres		15	10		1	
Pasture Management (Sheep/Goats) (SL-10T)	Acres		1			1	
Grass Filter Strip (WQ-1)	Acres				5	5	30
Sediment Retention, Erosion, or Water Control Structures (WP-1)	Drainage Acres				10		50
Animal Waste Control Facility (WP-4)	System				1	1	
Stream Protection (WP-2T)	Acres				2	1	20

Table 7. Agricultural BMPs needed for the Bonum Creek.

	Agricultural BMPs	
Phase 1 (Years 1-5)	**Units**	**Practice**
2	System	Livestock Exclusion with Riparian Buffers (LE-1T, SL-6T)
10	Acres	Small Grain Cover Crop (SL-8B) (VACS Funding)

Table 8. Agricultural BMPs needed for Gardner Creek.

	Agricultural BMPs	
Phase 1 (Years 1-5)	**Units**	**Practice**
1	System	Livestock Exclusion with Riparian Buffers (LE-1T, SL-6T)
25	Acres	Vegetative Cover on Cropland (SL-1)
1	Acres	Small Acreage Grazing System (SL-6AT)
10	Acres	Small Grain Cover Crop (SL-8B) (VACS Funding)
15	Acres	Pasture Management (Livestock/horse) (SL-10T)
1	Acres	Pasture Management (Sheep/Goat) (SL-10T)

Table 9. Agricultural BMPs needed for Jackson Creek.

	Agricultural BMPs	
Phase 1 (Years 1-5)	**Units**	**Practice**
2	System	Livestock Exclusion with Riparian Buffers (LE-1T, SL-6T)
2	System	Livestock Exclusion with Reduced Setback (LE-2T)
10	Acres	Small Grain Cover Crop for NM
10	Acres	Pasture Management (Livestock/horse(

Table 10. Agricultural BMPs needed for Mill Creek.

	Agricultural BMPs	
Phase 1 (Years 1-5)	**Units**	**Practice**
10	Acres	Woodland Buffer Filter Area (FR-3)
1	System	Livestock Exclusion with Riparian Buffers (LE-1T, SL-6T)
2	System	Livestock Exclusion with Reduced Setback (LE-2T)
10	Acres	Vegetative Cover on Cropland (SL-1)
10	Acres	Small Grain Cover Crop (SL-8B) (VACS Funding)
1	Acres	Grazing Land Protection (SL-1)
5	Acres	Grass Filter Strip (WQ-1)
10	Acres	Sediment Retention, Erosion, or Water Control Structures (WP-1)
1	System	Animal Control Facility (WP-4)
2	Acres	Stream Protection (WP-2T)

Table 11. Agricultural BMPs needed for Lodge s Creek (including XMA Lodge Creek UT).

	Agricultural BMPs	
Phase 1 (Years 1-5)	**Units**	**Practice**
5	Acres	Woodland Buffer Filter Area (FR-3)
2	System	Livestock Exclusion with Riparian Buffers (LE-1T, SL-6T)
2	System	Livestock Exclusion with Reduced Setback (LE-2T)
5	Acres	Vegetative Cover on Cropland (SL-1)
10	System	Small Acreage Grazing System (SL-6AT)
1	Acres	Grazing Land Protection (SL-6)
12	Acres	Small Grain Cover Crop (SL-8B) (VACS Funding)
1	Acres	Pasture Management (Livestock/horse) (SL-10T)
1	Acres	Pasture Management (Sheep) (SL-10T)
5	Acres	Grass Filter Strip (WQ-1)
1	System	Animal Waster Control Facility (WP-4)
1	Acres	Stream Protection (WP-2T)

Table 12. Agricultural BMPs needed for West Yeocomico River and Hampton Hall Branch.

	Agricultural BMPs	
Phase 1 (Years 1-5)	**Units**	**Practice**
20	Acres	Woodland Buffer Filter Area (FR-3)
1	System	Livestock Exclusion with Riparian Buffers (LE-1T, SL-6T)
1	System	Small Acreage Grazing System (SL-6AT)
50	Acres	Vegetative Cover on Cropland (SL-1)
50	Acres	Small Grain Cover Crop (SL-8B) (VACS Funding)
20	Acres	Grazing Land Protection (SL-6)
50	Acres	Sediment Retention, Erosion, or Water Control Structures (WP-1)
30	Acres	Grass Filter Strip (WQ-1)
20	Acres	Stream Protection (WP-2T)

The needed agricultural BMPs for phase 2 (years 6-10) of staged implementation are provided in tables with the cost estimations for each watershed.

Residential and Pet Management BMPs

Residential BMPs will focus on maintenance and repair of septic systems, identification and elimination of illegal "straight pipe" sewage discharges, the replacement of failed septic systems, and the installation of alternative waste treatment systems. In addition, minimization of pet waste runoff from homeowner's yards through education, pet waste composters, and installing vegetated buffers, rain gardens and pet waste collection facilities in public areas with high usage are included in the plan.

A 5% five-year septic system failure rate was estimated with the help of VDH. In addition, it was estimated that 3% of the houses in the watersheds lacked septic systems.

During workgroup meetings, local stakeholders stated that septic system inspections to detect impending failures should be included in the plan. Note that the RB-1 Septic Tank Pumpout Practice proposed in this plan is described in the TMDL cost-share manual as a practice aimed at "maintenance of septic tank system by having septic tank pumped to remove solids and inspection of the septic tank." In addition, cost-share is authorized in the RB-3 Septic Tank System Repair Practice included in this plan for inspection of the distribution box in failing septic systems.

Based on workgroup knowledge and observations in the watersheds, no kennels or hunt clubs were identified in the area and therefore no confined canine waste control has been proposed in this plan. However, public pet waste disposal stations could be useful in the selected area, like fast food parking lots, parks, and other potential areas. These waste stations could be maintained by property

owners and/or maintenance employees where they are installed or by volunteer groups in the community. Increased availability of public pet waste stations coupled with residential education programs should result in reduced pollution transport in the watersheds. A summary of residential and the pet waste management BMPs, including pet waste disposal stations (facility/signage/supplies) needed in each watershed is summarized in following tables.

Table 13. Residential and Pet Waste BMPs needed for the Bonum Creek.

		Residential BMPs	
Phase 1 (Years 1-5)	**Phase 2 (Years 6-10)**	**Units**	**Practice**
199	199	System	Septic Tank Pumpout (RB-1)
10	10	System	Septic System Repair (RB-3)
5	5	System	Septic System Replacement/Installation (RB-4)
5		Acre	Vegetated Buffer on Residential Land
		Pet Waste BMPs	
63		System	Pet Waste Composter
3		System	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies

Table 14. Residential and Pet Waste BMPs needed for Gardner Creek.

		Residential BMPs	
Phase 1 (Years 1-5)	**Phase 2 (Years 6-10)**	**Units**	**Practice**
101	101	System	Septic Tank Pumpout (RB-1)
6	6	System	Septic System Repair (RB-3)
4		System	Septic System Replacement/Installation (RB-4)
25		System	Pet Waste Composter
5		Acres	Vegetated Buffer on Residential Land
5		Acres	Rain Garden
		Pet Waste BMPs	
5		System	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies

Table 15. Residential and Pet Waste BMPs needed for Jackson Creek.

		Residential BMPs	
Phase 1 (Years 1-5)	**Phase 2 (Years 6-10)**	**Units**	**Practice**
114	114	System	Septic Tank Pumpout (RB-1)
6		System	Septic System Repair (RB-3)
3		System	Septic System Replacement/Installation (RB-4)
1		System	Septic System Replacement/Installation with Pump (RB-4P)
2		System	Alternative On-Site System (RB-5)
		Pet Waste BMPs	
34		System	Pet Waste Composter
5		System	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies

Table 16. Residential and Pet Waste BMPs needed for Mill Creek.

		Residential BMPs	
Phase 1 (Years 1-5)	**Phase 2 (Years 6-10)**	**Units**	**Practice**
184	184	System	Septic Tank Pumpout (RB-1)
30		System	Septic Connection to Public Sewer System (RB-2)
6	6	System	Septic System Repair (RB-3)
3		System	Septic System Replacement/Installation (RB-4)
1		System	Septic System Replacement/Installation with Pump (RB-4P)
2		System	Alternative On-Site System (RB-5)
5		Acre	Vegetated Buffer on Residential Land
		Pet Waste BMPs	
34		System	Pet Waste Composter
5		System	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies

Table 17. Residential and Pet Waste BMPs needed for Lodge Creek (including XMA Lodge Creek UT).

		Residential BMPs	
Phase 1 (Years 1-5)	**Phase 2 (Years 6-10)**	**Units**	**Practice**
369	369	System	Septic Tank Pumpout (RB-1)
20		System	Septic System Repair (RB-3)
12		System	Septic System Replacement/Installation (RB-4)
75		System	Pet Waste Composter
5		Acres	Vegetated Buffer on Residential Land
5	3	Acres	Rain Garden
		Pet Waste BMPs	
10		System	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies

Table 18. Residential and Pet Waste BMPs needed for West **Yeocomico River and Hampton Hall Branch**

		Residential BMPs	
Phase 1 (Years 1-5)	**Phase 2 (Years 6-10)**	**Units**	**Practice**
525	525	System	Septic Tank Pumpout (RB-1)
30	20	System	Septic System Repair (RB-3)
16	10	System	Septic System Replacement/Installation with Pump (RB-4P)
5	2	System	Alternative On-Site System (RB-5)
	10	Drainage Acres	Retention Ponds
20		Acres	Vegetated Buffer on Residential Land
10	10	Acres	Rain Garden
		Pet Waste BMPs	
15	10	System	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies

Education Programs

In addition to standard BMPs, target audiences were identified for educational outreach programs. The first group was recreational boaters that use the public boat ramps and marinas in the watersheds along with other boaters that may enter the creek for recreational purposes. The focus of this educational effort will be to inform boaters about the availability of sanitary pump out facilities in the area and the detrimental impact overboard discharge of human waste can have on water quality.

Another educational program will focus on aquaculture education, or "oyster gardening." Funds may be used to support educational efforts aimed at helping homeowners set up their own dockside oyster floats and offering a lecture series on the latest research in oyster culture. Oyster gardening can build stronger connections to local water quality. The Anheuser-Busch Coastal Research Center (ABCRC), which is located near Oyster, Virginia, regularly offers oyster gardening workshops (http://www.abcrc.virginia.edu/siteman1/?q=Teachers). More information about oyster gardening can be found on the DEQ website (http://www.deq.virginia.gov/programs/coastalzonemanagement/czmissuesinitiatives/oysters/gardening.aspx).

Finally, there will be several education outreach efforts to residential property owners in the watersheds. Educational materials will address managing nuisance wildlife, pet waste management, and proper care and maintenance of septic systems. Proper septic system maintenance includes: knowing the location of the system components and protecting them (*e.g.,* not driving or parking on top of septic tanks or drain fields, not planting trees where roots could damage the system), keeping hazardous chemicals out of the system, minimizing or eliminating the use of garbage disposals, pumping out the septic tank every five years, and knowing how to identify system problems. Resources from the "Septic Smart" program, which was created by EPA, can be used to education homeowners in the watersheds (www.epa.gov/septicsmart). Education for regional plumbers and septic professionals on how to properly inspect septic system components was identified by stakeholders as an additional area that would be useful in the watershed.

Because of proximity of the watersheds in this implementation plan, one allocation of educational and wildlife management program money has been proposed for the entire area. The per unit costs included in Appendix E and the implementation costs included for these programs within each watershed reflect a proportion of the total cost for the entire area; however these funds may be moved around between watersheds based on funding needs. For example, although recreational boater education was allotted $3,600 as part of this plan, each of the six watersheds was assigned $600 ($3,600/6 watersheds = $600 per watershed). The total amount allotted for residential education was $3,000 ($500 per watershed), the total amount allotted for aquaculture education was $3,000 ($500 per TMDL watershed), and the total amount allotted for wildlife education and management was $12,000 ($2,000 per watershed). A summary of the education programs included in this plan is provided in following table.

Table 19. Education programs needed for all watersheds.

Education programs			
Phase 1 (Years 1-5)	**Phase 2 (Years 6-10)**	**Total cost per program ($)**	**Practice**
1	1	3,600	Recreational Boater Education Program
1	1	3,000	Residential Education Program (pet, septic)
1	1	3,000	Aquaculture (Oyster Gardening) Education Program
1	1	12,000	Wildlife Education/Management Program

Phased Implementation

Initial implementation efforts (Phase 1) will focus on the most cost effective BMPs and educational programs that reduce human, pet, and livestock sources of contamination. Upon completion of Phase 1, water quality will be re-assessed to determine if water quality standards are attained. If water quality standards are not being met, additional actions, including continuation of Phase 1 educational programs and wildlife control education may be implemented in Phase 2. In addition, local citizens may elect to move forward with wildlife management plans to address fecal coliform contributions. These plans typically evaluate wildlife populations and explore control options in order to maintain sustainable wildlife levels based on local citizen objectives.

Information regarding nuisance wildlife laws and conflict resolution can be found on the Virginia Department of Game and Inland Fisheries (VDGIF) website (http://www.dgif.virginia.gov/wildlife/problems/).

The US Fish and Wildlife Service has revised federal regulations to include depredation orders relating to resident Canada geese that can cause injury to people, property, agricultural crops, or other interests. The Nest and Egg Depredation Order allows for the destruction of resident Canada geese nests and eggs by landowners, homeowners associations, public land managers, and local governments once they have registered the land they own on the Resident Canada Goose Nest and Egg Registration Site (https://epermits.fws.gov/eRCGR/geSI.aspx?ReturnUrl=%2feRCGR). The Agricultural Depredation Order allows agricultural producers to control resident Canada geese using certain lethal methods when the geese are damaging crops. For details and permitting information for this practice, see the VDGIF website (http://www.dgif.virginia.gov/wildlife/problems/canada-geese/).

There are several non-lethal deer management options recommended by VDGIF: fencing, keeping dogs in areas where deer are unwanted, loud noises, and chemicals that will taste or smell bad to deer. If these management techniques are unsuccessful, there are five programs available to landowners: the Deer Management Assistance Program (DMAP), Damage Control Assistance Program (DCAP), kill permits, Deer Population Reduction Program (DPOP), and the urban archery season. For details on these five programs, see the VDGIF website (http://www.dgif.virginia.gov/wildlife/problems/deer/).

If water quality standards are still not met, a use attainability analysis (UAA) may be initiated to reflect the presence of naturally high bacteria levels due to uncontrollable sources. The outcome of the UAA may lead to the determination that the designated uses of the waters may need to be changed to reflect the attainable uses.

Table 20. Projected bacterial load reductions during Phase 1 and Phase 2 implementation within each watershed.

Watershed	Proportion of Bacteria Reduction to be Completed by End of Phase 1 (%)[a]	Proportion of Bacteria Reduction to be Completed by End of Phase 2 (%)[b]
Bonum Creek	49.7	100
Gardner Creek	27.0	100
Jackson Creek	54.4	100
Mill Creek	45.7	100
Lodge Creek (including XMA Lodge Creek UT	60.1	100
West Yeocomico River/Hampton Hall Branch	26.3	100

[a] These percentages indicate progress towards the overall bacteria load reductions; and should not be confused with the overall percent reductions reported earlier in Table 5.
[b] A 100% in this column indicates that all required bacteria reductions should be completed by the end of Phase 2.

COST BENEFIT ANALYSIS

Cost estimates of the agricultural, residential, and other BMPs in this plan were calculated by multiplying the unit cost by the number of BMP units in each watershed. The unit cost estimates for the agricultural BMPs were derived from DCR's Agricultural Cost Share Database. Average costs for BMP installations were used. The unit costs for residential practices were developed through estimates from previous implementation plans and discussions with the workgroups. Cost share septic system funding was also useful for determining practice costs. Estimates for education programs were based on previous implementation plans and as suggested in work groups. Following tables summaries implementation actions and the costs in each of the watersheds for phase 1 and phase 2. The total phase 1 (years 1-5) cost estimates for the entire area was $2,180,750 and is broken down by watershed as below:

Bonum Creek: $159,350
Gardner Creek: $135,750
Jackson Creek: $188,650
Mill Creek: $461,000
Lodge Creek, including XMA Lodge Creek UT: $393,000
West Yeocomico River/Hampton Hall Branch: $843,000

Additional, Phase 2 (years 6-10) implementation costs for all of the watersheds combined was estimated to be $1,525,700 and was distributed as follows:

Bonum Creek: $156,300
Gardner Creek: $69,900
Jackson Creek: $79,800
Mill Creek: $94,800
Lodge Creek, including XMA Lodge Creek UT: $232,300
West Yeocomico River/Hampton Hall Branch: $892,600

When looking at the amount of money estimated for education programs on a per unit basis in the following tables, please note that the educational and wildlife management budgets can be shifted between each of the watersheds as long as the total budget for all of the watersheds combined is not exceeded. For example, although recreational boater education was allotted $3,600 as part of this plan, each of the six TMDL watersheds was assigned $600 ($3,600/6 TMDL watersheds = $600 per TMDL watershed). The total amount allotted for residential education was $3,000 ($500 per TMDL watershed), the total amount allotted for aquaculture education was $3,000 ($500 per TMDL watershed), and the total amount allotted for wildlife education and management was $12,000 ($2,000 per TMDL watershed). The potential bacteria reductions associated with these programs were factored into the overall reductions in each watershed.

Table 21. Implementation costs for Bonum Creek.

Bonum Creek Implementation Costs				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
2	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$30,000
10	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$1,000
199	Septic Tank Pump Out - MANDATORY	RB-1	$300	$59,700
10	Septic System Repair	RB-3	$3,000	$30,000
5	Septic System Installation/Replacement	RB-4	$6,000	$30,000
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
5	Vegetated Buffer on Residential Land		$400	$2,000
63	Residential Pet Waste Composters		$50	$3,150
5	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$3,000
Phase 1 Total				$159,350
Phase 2 Implementation Costs				
2	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$30,000
199	Septic Tank Pump Out - MANDATORY	RB-1	$300	$59,700
10	Septic System Repair	RB-3	$3,000	$30,000
5	Septic System Installation/Replacement	RB-4	$6,000	$30,000
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
1	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$5,000	$5,000
Phase 2 Total				$156,300
Bonum Creek Implementation Costs				$315,650

Table 22. Implementation costs for Gardner Creek.

Gardner Creek Implementation Costs				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
1	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$15,000
25	Vegetative Cover on Cropland	SL-1	$300	$7,500
1	Small Acreage Grazing System	SL-6AT	$1,500	$1,500
10	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$1,000
15	Pasture Management (Livestock/horse)	SL-10T	$75	$1,125
1	Pasture Management (Livestock/sheep)	SL-10T	$75	$75
101	Septic Tank Pump Out - MANDATORY	RB-1	$300	$30,300
6	Septic System Repair	RB-3	$3,000	$18,000
4	Septic System Installation/Replacement	RB-4	$6,000	$24,000
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
5	Vegetated Buffer on Residential Land		$400	$2,000
5	Rain Garden		$5,000	$25,000
25	Residential Pet Waste Composters		$50	$1,250
5	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$3,000
1	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$5,000	$5,000
Phase 1 Total				$135,750
Phase 2 Implementation Costs				
101	Septic Tank Pump Out - MANDATORY	RB-1	$300	$30,300
6	Septic System Repair	RB-3	$3,000	$18,000
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
1	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$5,000	$5,000
Phase 2 Total				$54,900
Gardner Creek Implementation Costs				$190,650

Table 23. Implementation costs for Jackson Creek.

Jackson Creek Implementation Costs				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
2	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$30,000
2	Livestock Exclusion with Reduced Riparian Buffers	LE-2T	$10,000	$20,000
10	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$1,000
10	Pasture Management (Livestock/horse)	SL-10T	$75	$750
114	Septic Tank Pump Out - MANDATORY	RB-1	$300	$34,200
6	Septic System Repair	RB-3	$3,000	$18,000
3	Septic System Installation/Replacement	RB-4	$6,000	$18,000
1	Septic System Installation/Replacement with Pump	RB-4P	$6,500	$6,500
2	Alternative on Site Systems	RB-5	$25,000	$50,000
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
34	Residential Pet Waste Composters		$50	$1,700
5	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$3,000
1	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$5,000	$5,000
Phase 1 Total				$188,650
Phase 2 Implementation Costs				
1	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$15,000
114	Septic Tank Pump Out - MANDATORY	RB-1	$300	$34,200
8	Septic System Repair	RB-3	$3,000	$24,000
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
1	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$5,000	$5,000
Phase 2 Total				$79,800
Jackson Creek Implementation Costs				$268,450

Table 24. Implementation costs for Mill Creek (Tidal and Non-Tidal).

Mill Creek (Tidal and Non-Tidal) Implementation Costs				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
10	Woodland Buffer Filter Area	FR-3	$700	$7,000
1	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$15,000
2	Livestock Exclusion with Riparian with Reduced Setback	LE-2T	$10,000	$20,000
10	Vegetative Cover on Cropland	SL-1	$300	$3,000
1	Grazing Land Protection	SL-6	$400	$400
10	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$1,000
5	Vegetative Cover on Cropland or Grass Filter Strip	WQ-1	$400	$2,000
2	Stream Protection	WP-2T	$400	$800
10	Sediment Retention, Erosion, or Water Control Structures	WP-1	$4,300	$43,000
1	Animal Waste Control Facility	WP-4	$38,900	$38,900
184	Septic Tank Pump Out - MANDATORY	RB-1	$300	$55,200
30	Septic Connection to Sewer System	RB-2	$5,600	$168,000
6	Septic System Repair	RB-3	$3,000	$18,000
3	Septic System Installation/Replacement	RB-4	$6,000	$18,000
1	Septic System Installation/Replacement with Pump	RB-4P	$6,500	$6,500
2	Alternative on Site Systems	RB-5	$25,000	$50,000
1	Residential Education Programs (pet, septic, horse/sheep)		$2,500	$2,500
5	Vegetated Buffer on Residential Land		$400	$2,000
34	Residential Pet Waste Composters		$50	$1,700
5	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$3,000
1	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$5,000	$5,000
Phase 1 Total				$461,000
Phase 2 Implementation Costs				
1	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$15,000
184	Septic Tank Pump Out - MANDATORY	RB-1	$300	$55,200
6	Septic System Repair	RB-3	$3,000	$18,000
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
1	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$5,000	$5,000
Phase 2 Total				$94,800
Mill Creek (Tidal and Non-Tidal) Implementation Costs				$555,800

Table 25. Implementation costs for Lodge Creek.

Lodge Creek (Tidal, Non-Tidal and XMA Lodge Creek UT) Implementation Costs -Phase-1				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
5	Woodland Buffer Filter Area	FR-3	$700	$3,500
2	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$30,000
2	Livestock Exclusion with Reduced Setback	LE-2T	$10,000	$20,000
5	Grazing Land Protection	SL-1	$300	$1,500
1	Small Acreage Grazing System	SL-6	$400	$400
10	Small Acreage Grazing System	SL-6AT	$1,500	$15,000
12	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$1,200
1	Pasture Management (Livestock/horse)	SL-10T	$75	$75
1	Pasture Management (sheep)	SL-10T	$75	$75
5	Grass Filter Strip	WQ-1	$400	$2,000
1	Stream Protection	WP-2T	$400	$400
1	Animal Waste Control Facility	WP-4	$38,900	$38,900
369	Septic Tank Pump Out - MANDATORY	RB-1	$300	$110,700
20	Septic System Repair	RB-3	$3,000	$60,000
12	Septic System Installation/Replacement	RB-4	$6,000	$72,000
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
5	Vegetated Buffer on Residential Land		$400	$2,000
5	Rain Garden		$5,000	$25,000
75	Residential Pet Waste Composters		$50	$3,750
10	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$6,000
Phase 1 Total				$393,000
Phase 2 Implementation Costs				
3	Woodland Buffer Filter Area	FR-3	$700	$2,100
1	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$15,000
1	Small Acreage Grazing System	SL-6AT	$1,500	$1,500
10	Permanent Vegetative Cover on Critical Areas	SL-11	$700	$7,000
1	Stream Protection	WP-2T	$400	$400
1	Animal Control Facility	WP-4	$38,900	$38,900
5	Sediment Retention, Erosion, or Water Control Structures	WP-1	$4,300	$21,500
2	Stormwater Retention Pond	WP-5	$4,300	$8,600
369	Septic Tank Pump Out - MANDATORY	RB-1	$300	$110,700
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500

1	Aquaculture Education Workshops (public/restaurant)		$500	$500
3	Rain Garden		$5,000	$15,000
1	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$10,000	$10,000
Phase 2 Total				$232,300
Total (Tidal, Non-Tidal and XMA Lodge Creek UT)				$625,300

Table 26. Implementation costs for West Yeocomico River/Hampton Hall Branch.

West Yeocomico River/Hampton Hall Branch Implementation Costs				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
20	Woodland Buffer Filter Area	FR-3	$700	$14,000
1	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$15,000
50	Vegetative Cover on Cropland	SL-1	$300	$15,000
20	Grazing Land Protection	SL-6	$400	$8,000
1	Small Acreage Grazing System	SL-6AT	$1,500	$1,500
50	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$5,000
30	Vegetative Cover on Cropland or Grass Filter Strip	WQ-1	$400	$12,000
20	Stream Protection	WP-2T	$400	$8,000
50	Sediment Retention, Erosion, or Water Control Structures	WP-1	$4,300	$215,000
525	Septic Tank Pump Out - MANDATORY	RB-1	$300	$157,500
30	Septic System Repair	RB-3	$3,000	$90,000
16	Septic System Installation/Replacement with Pump	RB-4P	$6,500	$104,000
5	Alternative on Site Systems	RB-5	$25,000	$125,000
1	Recreational Boater Education Programs		$5,000	$5,000
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
20	Vegetated Buffer on Residential Land		$400	$8,000
10	Rain Garden		$5,000	$50,000
15	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$9,000
Phase 1 Total				$843,000
Phase 2 Implementation Costs				
20	Woodland Buffer Filter Area	FR-3	$700	$14,000
1	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$15,000
1	Small Acreage Grazing System	SL-6AT	$1,500	$1,500
50	Permanent Vegetative Cover on Critical Areas	SL-11	$700	$35,000

50	Stream Protection	WP-2T	$400	$20,000
50	Sediment Retention, Erosion, or Water Control Structures	WP-1	$4,300	$215,000
30	Stormwater Retention Pond	WP-5	$4,300	$129,000
50	Vegetative Cover on Cropland or Grass Filter Strip	WQ-1	$400	$20,000
525	Septic Tank Pump Out - MANDATORY	RB-1	$300	$157,500
20	Septic System Repair	RB-3	$3,000	$60,000
10	Septic System Installation/Replacement with Pump	RB-4P	$6,500	$65,000
2	Alternative on Site Systems	RB-5	$25,000	$50,000
10	Retention Ponds		$4,300	$43,000
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
10	Rain Garden		$5,000	$50,000
10	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$6,000
1	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$10,000	$10,000
Phase 2 Total				$892,600
Total West Yeocomico River/Hampton Hall Branch Implementation Costs				$1,735,600

The primary benefit of this implementation is cleaner water in the Bonum, Gardner, Jackson, Mill, Lodge, XMA Lodge UT Creeks and Yeocomico River. The goal is to implement the IP so that fecal contamination may be reduced and allow for the removal of the condemnation of the shellfish growing areas. The principal benefit to the oyster growers in these creeks would be that once the water quality is restored, they would no longer need to transport their floats to clean water to depurate oysters prior to consumption. Reducing bacteria contamination levels in these creeks, particularly from anthropogenic sources will improve public health by reducing the risk of infection from fecal sources through contact with surface waters.

The residential programs will play an important role in improving water quality, but there may also be additional return on the investment in terms of economic benefits to homeowners. An improved understanding of private on-site sewage systems (including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance) will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The replacement of failing on-site sewage disposal systems with new septic or alternative treatment systems will have a direct and substantial impact by improving property values and improving the local economy.

An important objective of the implementation plan is to foster continued economic vitality and strength. This objective is based on the recognition that healthy waters improve economic opportunities for Virginians, and a healthy economic base enhances the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document are expected to provide economic benefits, as well as environmental benefits, to the property owners in these watersheds.

TARGETING

The priority order for implementation activities within each of the watersheds is as follows:

High priority: The Bonum, Creek and West Yeocomico River/Hall Branch watersheds have the high implementation priority because they require less bacteria load reductions (total and from wildlife sources) compared to other watersheds.

Medium priority: Gardner, Jackson, and Lodge Creek, XMA Lodge UT Creeks watersheds have a medium implementation priority because they require comparatively higher bacteria load reductions (total and from wildlife sources).

Low priority: Implementation in Mill Creek watershed will have a lowest priority because it require highest bacteria reductions (total and from wildlife sources).

STAKEHOLDER ROLES AND RESPONSIBILITIES

Stakeholders are individuals who live or have land management responsibilities in the watershed, including government agencies, businesses, private citizens, and special interest groups. Achieving the goals of the Bonum, Gardner, Jackson, Mill, Lodge Creek including XMA Lodge Creek UT TMDL IP efforts (i.e. improving water quality and removing these waters from the impaired waters list) is dependent on stakeholder participation. Both the local stakeholders who are charged with the implementation of control measures and the government stakeholders who are responsible for overseeing human health and environmental programs must first acknowledge there is a water quality problem, and then make the needed changes in operations, programs, and legislation to address the pollutants.

The **EPA** has the responsibility for overseeing the various programs necessary for the success of the Clean Water Act. However, administration and enforcement of such programs falls largely to the states. In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. Currently, there are five state agencies responsible for regulating and providing educational outreach for activities that impact water quality with regard to this implementation plan. These agencies include: the Department of Environmental Quality, the Department of Conservation and Recreation, the Department of Health, the Department of Agriculture and Consumer Services (VDACS), and VA Cooperative Extension (VCE).

DEQ is responsible for monitoring the waters to determine compliance with state standards, and for requiring permitted point source dischargers to maintain pollutant loads and concentrations within permit limits. They have the regulatory authority to levy fines and take legal action against those in violation of permits. Additionally, DEQ is responsible for presenting this IP to the SWCB for approval as the plan for implementing pollutant allocations and reductions contained in the TMDLs. DEQ is responsible for addressing nonpoint sources (NPS) of pollution as of July 1, 2013.

Historically, most **DCR** programs dealt with agricultural NPS pollution through education and voluntary incentive programs. These cost-share programs were originally developed to meet the needs of voluntary partial participation and not the TMDL-required 100% participation of stakeholders. To meet the needs of the TMDL program and achieve the goals set forth in the CWA, the incentives under this program have been adjusted to account for 100% participation. It should be noted that DCR does not have regulatory authority over the majority of NPS issues addressed in this document. Their Division of Chesapeake Bay Local Assistance enforces compliance with the Chesapeake Bay Preservation Act, including septic pump out requirements and the protection of Resource Protection Areas (RPAs) and Resource Management Areas (RMAs).

Through Virginia's Agricultural Stewardship Act, the **VDACS Commissioner of Agriculture** has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis. If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken, which can include a civil penalty up to $5,000 per day. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, etc. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures. The enforcement of the Agriculture Stewardship Act is entirely complaint driven.

VDH is responsible for maintaining safe drinking water measured by standards set by EPA. Their duties also include On-Site Sewage Disposal regulation. Like VDACS, VDH's program is complaint-driven. Complaints can range from a vent pipe odor that is not an actual sewage violation and takes very little time to investigate, to a large discharge violation from a failed septic system that may take many weeks or longer to achieve compliance. VDH has the responsibility of enforcing actions to correct or eliminate failed systems and straight pipes (Swage Handling and Disposal Regulations, 12 VAC 5-610-10 *et seq.*). Their Division of Shellfish Sanitation (DSS) is responsible for protecting the health of shellfish consumers by ensuring that growing waters are properly classified for harvesting. DSS monitors water quality in shellfish growing areas and provides shellfish closings and sanitary surveys to identify deficiencies along the shoreline. They also administer the Clean Marina Program to address the proper operation of pump out facilities and boater education.

VCE is an educational outreach program of Virginia's land grant universities (Virginia Tech and Virginia State University), and is a part of the national Cooperative State Research, Education and Extension Service, an agency of the United States Department of Agriculture. VCE is a product of cooperation among local, state and federal governments in partnership with local citizens. VCE offers

educational outreach and technical resources on topics such as crops, grains, livestock, dairy, horse pasture management, natural resources and environmental management. VCE has several publications related to TMDLs and promotes water quality education and outreach methods to citizens, businesses, and developers regarding necessary pet waste reductions. For more information on publications and county extension offices, visit www.ext.vt.edu.

VDOF (Virginia Department of Forestry) has prepared a manual to inform and educate forest landowners and the professional forest community on proper BMPs and technical specifications for installation of these practices in forested areas. Forestry BMPs are intended to primarily control erosion. For example, streamside buffers provide nutrient uptake and soil stabilization, which can benefit water quality by reducing the amount of nutrients and sediment that enter local streams.

The **NRCS** (Natural Resources Conservation Service) is the federal agency that works hand-in-hand with the American people 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 along with policymakers rely on the expertise of the NRCS staff. NRCS is a major funding stakeholder for impaired water bodies through the CREP and EQIP programs.

The **Northern Neck Soil and Water Conservation District (NNSWCD)** works with many agricultural producers in the region to improve agricultural practices and minimize impacts to the area waterways. In addition to the farming community, they work with citizens on erosion and sediment related compliance concerns and encourage innovative techniques for dealing with stormwater.

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, they can take a leading role in water quality and pet owner education through mailings to landowners, but would need assistance from the Steering Committee and other area groups for the content of these mailed materials. The county will be a key partner in seeking grant funds to repair/replace failing on-site sewage disposal systems and to fund the various education programs proposed in the IP.

Successful implementation depends on stakeholders taking responsibility for their role in the process. While the primary role falls on the landowner, local, state, and federal agencies also have a stake in seeing that Virginia's waters are clean and provide a healthy environment for citizens. While it is unreasonable to expect that the natural environment (*e.g.,* streams and rivers) can be made 100% free of risk to human health, it is possible and desirable to minimize pollution related to humans. Virginia's approach to correcting NPS pollution problems has been, and continues to be, primarily encouragement of participation through education and financial incentives. It is noted that while this IP has been prepared for bacteria impairments in the watersheds, many of the BMPs will also result in reductions in nutrients and sediment reaching the Chesapeake Bay and therefore contribute also to improvements called for in the Chesapeake Bay Watershed Implementation Plan.

Table 26. Implementation responsibilities for the Bonum, Gardner, Jackson, Mill, Lodge, including XMA Lodge UT Creeks and West Yeocomico River/Hampton Hall Brach plans.

Practice	Implementation Responsibility	Oversight Responsibility	Potential Funding
Livestock Exclusion/Buffers	Landowners, SWCD, NRCS	SWCD	Cost-Share
Small Acreage Grazing	Landowners, SWCD, NRCS	SWCD	Cost-Share
Vegetated Buffer on Cropland	Landowners, SWCD, NRCS	SWCD	Cost-Share
Cover Crops on Agricultural Lands	Landowners, SWCD, NRCS	SWCD	Cost-Share
Pasture Management	Landowners, SWCD, NRCS	SWCD	Cost-Share
Other Agricultural Practices	Landowners, SWCD, NRCS	SWCD	Cost-Share
Residential/Septic BMPs	Landowners, SWCD PDC	County, VDH	Private, Grant
Educational Programs	Local Citizen Groups, VCE, nearby University	None	Grant
Vegetated Buffers on Residential Land	Landowners, VDOF	County	Grant
Residential Pet Waste Composters	Landowners, SWCD	None	Grant
Public Pet Waste Collection	Local Citizen Groups, SWCD, State Parks,	None	Grant

MEASURABLE GOALS AND MILESTONES FOR ATAINING WATER QUALITY STANDARDS

Timeline and Milestones

The goals of implementation are restored water quality in the **Bonum, Gardner, Jackson, Mill, Lodge, including XMA Lodge UT Creeks and West Yeocomico River/Hampton Hall Brach**, the removal of the shellfish growing areas from Virginia's Section 303(d) impaired waters list, and the lifting of the shellfish condemnations on the creeks. Progress toward the end goals will be assessed during implementation through tracking of BMP installations and continued water quality monitoring programs. Phase 1 implementation is estimated to take five years. The septic BMPs identified in the implementation plan, including repairs, replacements, and pump outs, will be continuous over a five year maintenance cycle.

Year 1 will include implementation of septic system BMPs, including pump outs, repairs, replacement, and installation of alternative septic systems. Septic tank pump outs will be prioritized for residents identified as reaching the five year point since their last documented service. In addition, residential education programs focused on septic system maintenance, pet waste management, and nuisance wildlife management will occur in year 1.

Year 2 of implementation will continue septic repairs, replacements, and pump outs (especially for households that have not been serviced in five years or more). Residential education programs focused on pet waste management, vegetated buffers, and rain gardens will occur in year 2. Pet waste composters will be distributed as part of this education effort. Livestock exclusion and grazing system BMP opportunities will be included in this year activities.

Year 3 will include residential boater education and aquaculture education programs. In addition, septic repairs, replacements, and pump outs (especially for households that have not been serviced in five years or more) will continue in year 3. Pet waste stations will be installed in high traffic locations and areas frequented by dog walkers. In addition, agricultural BMP practices will be implemented.

Year 4 of implementation will include increased establishment of residential and woodland buffers and rain gardens. Continued septic repairs, replacements, and pump outs (especially for households that have not been serviced in five years or more) will occur. In addition, agricultural BMP practices will be continued to be implemented.

Year 5 of implementation will provide an opportunity to complete any BMPs or education programs that were not completed in previous years as scheduled. In addition, septic repairs, replacements, and pump outs (especially for households that have not been serviced in five years or more) will continue. Residential and woodland buffer establishment and rain garden construction will be continued in year 5. In addition, agricultural BMP practices will be continued to be implemented.

Upon completion of the five year Phase 1 implementation period, all of the BMPs and education programs identified in this plan should have been implemented, thereby addressing all controllable sources of bacteria. Assuming that these reduced loads are maintained and no new bacteria sources are added, the creeks should be on track to water quality improvement. However, it is possible that wildlife loads may still need to be addressed to meet TMDL reductions.

Upon completion of Phase 1 implementation, water quality will be reassessed to determine the progress or status of water quality standard. If water quality improvements are not determined, the local citizens may elect to move forward with Phase 2 (years 6-10) implementation program to address the bacteria contribution from wildlife through a wildlife management plan and additional education. A UAA may be initiated to reflect the presence of naturally high bacteria levels due to uncontrolled sources. The outcomes of the UAA may lead to the determination that the designated use(s) of the waters may need to be changed to reflect the attainable use(s).

Tracking Implementation

Tracking of BMP implementation will serve as an interim measure of progress toward improving water quality in these creeks. Agricultural and residential BMPs installed through the Virginia Agricultural Cost-Share Program will be tracked in the Agricultural Cost-Share Database. Repairs or replacements of onsite septic systems and straight pipes identified in the shoreline sanitary survey can be tracked through the VDH and can be monitored on their website at http://www.vdh.state.va.us/EnvironmentalHealth/Shellfish/documents/shorelinesurvey.pdf. Northumberland and Westmoreland Counties may track pump out notices and associated compliance rates as part of their CBPA strategy.

Monitoring

Improvements in water quality and implementation progress will ultimately be determined through monitoring conducted by DEQ's monitoring programs and the VDH-DSS at bacteriological monitoring stations in accordance with its shellfish monitoring program. DEQ will continue to use data from these monitoring stations and related ambient monitoring stations to evaluate improvements in the water quality and the effectiveness of TMDL implementation in attainment of the water quality standards. VDH-DSS water quality monitoring can be accessed using the agency's GIS Data Viewing tool which uses Google Earth at: http://www.vdh.state.va.us/EnvironmentalHealth/Shellfish/documents/ShellfishSanitation.kml. In addition, see Figure 5 for the locations of VDH-DSS monitoring stations within the watersheds.

Table 27. DEQ bacteria monitoring stations for different watersheds.

Water Body	Monitoring Station
Bonum Creek	**1ABOM000.46**
Gardner Creek	**1AGAD001.73**
Jackson Creek	**1AXDW000.08**
Mill Creek	**1AMIA004.12** **1AMIA002.34**
Lodge, XMA Lodge Creek UT	**1AXMC000.92** **1ALOG003.45**
Hampton Hall Branch	**1AHAM000.92**

Additional monitoring may be conducted by citizen monitors to better identify bacterial sources and the effectiveness of implementation actions. Funding through DEQ for a Citizen Monitoring Program to track implementation progress and refine targeting of bacterial sources that need corrective actions can be pursued.

INTEGRATION WITH OTHER WATERSHED PLANS AND PROJECTS

Virginia's watersheds are managed under a variety of individual, though related, water quality programs and activities, many of which have specific geographical boundaries and goals. These include, but are not limited to the Chesapeake Bay TMDL and Watershed Implementation Plan, TMDLs, Water Quality Management Plans, Watershed Management Plans, Erosion and Sediment Control regulations, Stormwater Management Program, Source Water Assessment Program, Green Infrastructure Plans, and local comprehensive plans.

The watershed projects or programs within Northumberland County and the Westmoreland County to be integrated with this IP include:

- County Comprehensive Plan
- Septic Tank Pump-Out and Inspection
- Chesapeake Bay Preservation Ordinance
- Northern Neck Planning District Commission Septic System Pump-Out Assistance Program
- Northern Neck Soil and Water Conservation District Agricultural Cost Share Program

POTENTIAL FUNDING SOURCES

Potential funding sources available during implementation were identified during IP development. A brief description of the programs and their requirements are provided in this chapter. Detailed descriptions can be obtained from the Eastern Shore Soil and Water Conservation District (ESSWCD), Virginia Department of Conservation and Recreation (DCR), Virginia Department of Environmental Quality (DEQ), Natural Resources Conservation Service (NRCS), Virginia Cooperative Extension (VCE) and others listed below. It is recommended that participants discuss funding options with experienced personnel at these agencies in order to choose the best option.

Virginia Water Quality Improvement Fund

This is a permanent, non-reverting fund established by the Commonwealth of Virginia in order to assist local stakeholders in reducing point and nonpoint nutrient and sediment loads to surface waters. Eligible recipients include local governments, SWCDs, and non-profit organizations. Grants for nonpoint sources are administered through VADEQ. Most WQIF grants provide matching funds on a cost-share basis.

Virginia Agricultural Best Management Practices Cost-Share Program

The cost-share program is funded with state funding administered through local SWCDs. Locally, the ESSWCD administers the program to encourage farmers to use BMPs on their land to better control sediment, nutrient loss, and transportation of pollutants into surface water and groundwater due to excessive surface flow, erosion, leaching, and inadequate animal waste management. Cost-

share is typically 75% of the actual cost, not to exceed the various cost share caps, but there are also some that offer 50% or offer an incentive payment per acre.

Virginia Agricultural Best Management Practices Tax Credit Program

For all taxable years, any individual or corporation engaged in agricultural production for market that has a soil conservation plan in place and approved by the local SWCD, shall be 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 shall be completed within the taxable year in which the credit is claimed. If the amount of the credit exceeds the taxpayer's liability for such a taxable year, the excess may be carried over for credit against income taxes in the next five taxable years. The credit shall be allowed only for expenditures made by the taxpayer from funds of his/her own sources. This program can be used independently or in conjunction with other cost-share programs in the stakeholder's portion of BMP costs.

Virginia Small Business Environmental Assistance Fund Loan Program

The Fund, administered through VADEQ, is used to make loans or to guarantee loans to small businesses for the purchase and installation of environmental pollution control equipment, equipment to implement voluntary pollution prevention measures, or equipment and structures to implement agricultural BMPs. The equipment must be needed by the small business to comply with the federal Clean Air Act, or it will allow the small business to implement voluntary pollution prevention measures. The loans are available in amounts up to $50,000 and will carry an interest rate of 3%, with favorable repayment terms based on the borrower's ability to repay and the useful life of the equipment being purchased or the life of the BMP being implemented. There is a $30 nonrefundable application processing fee. The Fund will not be used to make loans to small businesses for the purchase and installation of equipment needed to comply with an enforcement action. To be eligible for assistance, a business must employ 100 or fewer people and be classified as a small business under the federal Small Business Act.

Federal Clean Water Act Section 319 Incremental Funds

USEPA develops guidelines that describe the process and criteria to be used to award CWA Section 319 NPS grants to states. States may use up to 20% of the Section 319 incremental funds to develop NPS TMDLs as well as develop watershed based plans for Section 303(d) listed waters. The balance of funding can be used to implement watershed based plans that have TMDLs. Funds can be used for residential and agricultural BMPs, and for technical and program staff to administer the BMP programs.

Community Development Block Grant Program

The Department of Housing and Urban Development sponsors this program, which is intended to develop viable communities by providing decent housing, a suitable living environment, and expanded economic opportunities primarily for persons of low and moderate income. Recipients may initiate activities directed toward neighborhood revitalization, economic development, and provision of improved community facilities and services. Specific activities may include public services, acquisition of real property, relocation and demolition, rehabilitation of structures, and provision of public facilities and improvements, such as new or improved water and sewer facilities.

Conservation Reserve Program (CRP)

Offers are accepted and processed during fixed signup periods that are announced by the Farm Services Agency (FSA). All eligible (cropland) offers are ranked using a national ranking process. If accepted, contracts are developed for a minimum of 10 and not more than 15 years. Payments are based on a per-acre soil rental rate. Cost-share assistance is available to establish the conservation cover of tree or herbaceous vegetation. The per-acre rental rate may not exceed the Commodity Credit Corporation's maximum payment amount, but producers may elect to receive an amount less than the maximum payment rate, which can increase the ranking score. Application evaluation points can be increased if certain tree species, spacing, and seeding mixtures that maximize wildlife habitats are selected. Land must have been owned or operated by the applicant for at least 12 months prior to the close of the signup period. The payment to the participant is up to 50% of the cost for establishing ground cover. Incentive payments for wetlands hydrology restoration equal 25% of the cost of restoration.

Environmental Quality Incentives Program (EQIP)

This program is administered by the NRCS and includes cropland erosion control, nutrient management, forest management, animal waste management, grazing land practices, and wildlife habitat on eligible lands. Contracts up to 10 years are written with eligible producers in order to achieve an EQIP plan of operation that includes structural and land management practices. Cost-share is made available to implement one or more eligible conservation practices and incentive payments can be made to implement one or more management practices.

Wildlife Habitat Incentives Program (WHIP)

WHIP is a voluntary program for landowners and land users who want to develop or improve wildlife habitat on private agriculture-related lands. Participants work with NRCS to prepare a wildlife habitat development plan. This plan describes the landowner's goals for improving wildlife habitat and includes a list of practices and a schedule for installation. A 10-year contract provides cost-share and technical assistance to carry out the plan. In Virginia, these plans will be prepared to address one or more of the following high priority habitat needs: early grassland habitats that are home to game species such as quail and rabbit as well as other non-game species like meadowlark and sparrows; riparian zones along streams and rivers that provide nesting and cover habitats for migrating songbirds, waterfowl, and shorebird species; and decreasing natural habitat systems that are

environmentally sensitive and have been impacted and reduced through human activities. Cost-share assistance of up to 75% of the total cost of installation (not to exceed $10,000 per applicant) is available for establishing habitat. Applicants will be competitively ranked within the state and certain areas and practices will receive higher ranking based on their value to wildlife. Types of practices include: disking, prescribed burning, mowing, planting habitat, converting fescue to warm season grasses, establishing riparian buffers, creating habitat for waterfowl, and installing filter strips, field borders, and hedgerows. For cost-share assistance, USDA pays up to 75% of the cost of installing wildlife practices.

Wetland Reserve Program (WRP)

This program is a voluntary program to restore and protect wetlands on private property. The program benefits include providing fish and wildlife habitat, improving water quality, reducing flooding, recharging groundwater, protecting and improving biological diversity, and furnishing recreational and esthetic benefits. Sign-up is on a continuous basis. Landowners who choose to participate in WRP may receive payments for a conservation easement or cost-share assistance for a wetland restoration agreement. The landowner will retain ownership but voluntarily limits future use of the land. The program offers landowners three options: permanent easements, 30-year easements, and restoration cost-share agreements for a minimum of 10 years. Under the permanent easement option, the landowner may receive the agricultural value of the land up to a maximum cap and 100% of the cost of restoring the land. For the 30-year option, a landowner will receive 75% of the easement value and 75% cost-share on the restoration. A ten-year agreement is also available and pays 75% of the restoration cost. To be eligible for WRP, land must be suitable for restoration (formerly wetland and drained) or connect to adjacent wetlands. A landowner continues to control access to the land and may lease the land for hunting, fishing, or other undeveloped recreational activities. At any time, a landowner may request that additional activities be added as compatible uses. Land eligibility is dependent on length of ownership, whether the site has been degraded as a result of agriculture, and the land's ability to be restored. Restoration agreement participants must show proof of ownership. Easement participants must have owned the land for at least one year and be able to provide clear title.

National Fish and Wildlife Foundation

Offers are accepted throughout the year and processed during fixed signup periods. The signup periods are in a year-round, revolving basis, and 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. An approved pre-proposal is a pre-requisite to the submittal of the full proposal. Grants generally range between $10,000 and $150,000. Projects are funded in the US and any international areas that host migratory wildlife from the U.S. 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 (www.nfwf.org). If the project does not fall into the criteria of any special grant programs, the 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.

Norther Neck Planning District Commission

The Northern Neck Planning District Commission provides financial assistance to low-to-moderate income households in order for them to comply with septic pump-out requirements of the Chesapeake Bay Act.

Virginia Department of Forestry

Through the US Forest Service Watershed Forestry Program, VDOF has developed a **Virginia Trees for Clean Water** program designed to improve water quality by planting buffers and trees in neighborhoods and communities. A request for proposal was issued on October 30, 2014 for projects in spring/early fall 2015.

Southeast Rural Community Assistance Project, SERCAP

Southeast RCAP is a non-profit organization that offers grants and loans to low income households in rural regions to help upgrade their water and wastewater facilities. Funding is also used to assist with projects run my small, rural governments, develop small businesses, and assist with hook-up costs

REFERENCES

2017. Virginia Institute of Marine Science, Report on TMDL Implementation Plan of Yeocomico River.

2016, Total Maximum Daily Load Report for Shellfish Areas Listed Due to Bacteria Contamination in Yeocomico River.

2015. Water Quality Improvement Plan for Gulf, Barlow, Mattawoman, Jacobus and Hungers Creeks.

LIST OF ACRONYMS

ARA	Antibiotic Resistance Approach
BMP	Best Management Practice
BST	Bacterial Source Tracking
CBPA	Chesapeake Bay Preservation Act
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CWA	Clean Water Act
DCAP	Damage Control Assistance Program
DCR	Department of Conservation and Recreation
DEQ	Department of Environmental Quality
DMAP	Deer Management Assistance Program
DPOP	Deer Population Reduction Program
DSS	Division of Shellfish Sanitation
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FR-3	Woodland Buffer Filter Area
FWS	Fish and Wildlife Service
GIS	Geographic Information System
IP	TMDL Implementation Plan
LE-1T	Livestock Exclusion with Riparian Buffers
LE-2T	Livestock Exclusion with Reduced Setback
MOU	Memorandum of Understanding
MPN	Most Probable Number
NLCD	National Land Cover Dataset
NOAA	National Oceanic and Atmospheric Administration
NPS	Nonpoint Source
NRCS	Natural Resource Conservation Service
NNPDC	Northern Neck Planning District Commission
NNSWCD	Northern Neck Soil and Water Conservation District
NWBD	National Watershed Boundary Dataset
RB-1	Septic Tank Pump Out
RB-3	Septic System Repair
RB-4	Septic System Installation/Replacement
RB-4P	Septic System Installation/Replacement with Pump
RB-5	Alternative Waste Treatment System
RPA	Resource Protection Area
RMA	Resource Management Area
SERCAP	Southeast Rural Community Assistance Project
SL-6AT	Small Acreage Grazing System

SL-6T Stream Exclusion with Grazing Land Management for TMDL Implementation

SL-8B Small Grain Cover Crop for Nutrient Management

SL-10T Pasture Management

SWCB State Water Control Board

TMDL Total Maximum Daily Load

UAA Use Attainability Analysis

USDA US Department of Agriculture

VCE Virginia Cooperative Extension

VDACS Virginia Department of Agriculture and Consumer Services

VDGIF Virginia Department of Game and Inland Fisheries

VDH Virginia Department of Health

VDOF Virginia Department of Forestry

VIMS Virginia Institute of Marine Science

WHIP USDA Wildlife Habitat Incentives Program

WP-1 Sediment Retention, Erosion, or Water Control Structures

WQIF Water Quality Improvement Fund

WQMIRA Virginia's 1997 Water Quality Monitoring, Information and Restoration Act

WQMP Water Quality Management Plan

WRP USDA Wetland Reserve Program

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Natural Resources Conservation Service
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Accomac, VA 23301
757-787-3581
www.va.nrcs.usda.gov

Northern Neck Planning District Commission
PO Box 1600
457 Main St.
Warshaw, VA 22572
804-333-1900
www.nnpdc.org

Northern Neck Soil and Water Conservation District
804-313-9102
www.nnswcd.org

VA Department of Agricultural and Consumer Services
102 Governor Street
Richmond, VA 23219
804-786-2373
www.vdacs.virginia.gov

VA Department of Conservation and Recreation
1548-A Holland Road
Suffolk, VA 23434
www.dcr.virginia.gov

Northampton County VA Cooperative Extension
7247 Young Street, Suite A
Machipongo, VA 23405
757-678-7946
http://offices.ext.vt.edu/northampton/

VA Department of Environmental Quality
Piedmont Regional Office
4949 Cox Rd, Ste A
Glen Allen, VA 23060
804-527-5020
www.deq.virginia.gov

VA Department of Forestry
Eastern Region Office
PO Box 759
Tappahannock, VA 22560
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373 Northumberland Hwy Ste B
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(804) 580-3731

Westmoreland County Health Department
18849 Kings Hwy
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APPENDIX A

First and Second Public Meeting Summaries

Workgroup Meeting Summaries:

Residential/Agricultural Working Group Meeting Summary

Government Working Group Meeting Summary

Combined Working Group Meeting Summaries

Steering Committee Meeting Summary

Yeocomico River Watershed Implementation Plan First Public Meeting

Northumberland Public Library, Heathsville, VA

Feb. 2, 2017 6:00-8:00 p.m.

Attendees

Katie Ranger (DEQ)	Jennifer Palmore (DEQ)	Ram Gupta (DEQ)
Anna Reh-Gingerich (DEQ)	Mac Sisson (VIMS)	Kathy Clarke (NNSWCD)
Brandon Dillistin (NNSWCD)	Chip Jones (NNSWCD)	John Sigler
Gail Sigler	Dr. Lynton Land	Kate Daniel
Nancy Demarest	Colston Newton	Stuart McKenzie
Harrison Daniel		

Meeting Summary

Introductions and welcome from Mac and Katie.

Why we are here: waterways are currently impaired due to high bacteria levels, which close shellfish beds for fishing and waterways for recreational use (E. coli, Enterococci, Fecal Coliform). Maps were shown that cover the implementation area. Everything shown in red is currently an impaired segment. Some examples are Gardner Creek, Hampton Hall Branch, Shannon Branch, Yeocomico, etc.

Maps depicting area land-use were also shown, with descriptions of the different types of land uses in the area (pasture, hay, etc.).

Q: Does forest include both clear-cut and established forest?
A: Yes

Comment: pasture, hay, and forest all seem high

To address these impairments, Total Maximum Daily Loads (TMDLs) were generated for watersheds in the area, which is essentially the maximum loading of bacteria that waterways can withstand to reach water quality standards again. Three TMDL reports were generated for this area, and we are combining them into this one Implementation Plan.

Slide was shown with applicable water quality standards. The shellfish criteria is more stringent than the recreational criteria. We are going to aim for the shellfish standard, to also address the recreation.

Map depicting DEQ and VDH monitoring stations was shown.

Q: Do water quality standards still apply in silty areas where shellfish can't grow?
A: Yes

Q: How often are the stations monitored?
A: VDH- monthly, DEQ- varies

A request for maps to be printed/emailed to participants was made. (Maps were printed and distributed during the meeting).

An Implementation Plan serves as a guideline of how to reach the goals of the TMDL. It is a community effort to improve water quality and there are multiple steps we follow to develop the most-effective plan we can. We'll start with a bacteria assessment, then prioritize our sources to find what would be the most effective. Public participation is also a major component, so that we implement projects that will work well in your community.

A bacteria source assessment looks into all possible sources of bacteria. These include point sources under the Virginia Pollution Discharge Elimination System (VPDES) permits and nonpoint sources, including direct inputs and indirect from stormwater runoff. A few slides presented the original TMDL values, percent loadings based on land use, and previously estimated percent reductions.

Wrapped up the presentation with comments about Best Management Practice options, a tentative schedule, and ways that groups and citizens can be involved with the public participation process, including: working groups, steering committees, and public meetings. Working groups are slightly smaller and more specific to certain topics where you can offer input. There will be two meetings for each working group. Towards the end when the IP is finalized, there will be a steering committee review process.

Q&A

Q: Are they all impaired to the shellfish standard?
A: SF stands for shellfish impairment. Those labelled with SF are impaired for shellfish standard.

Q: What is happening with the Hampton Hall map? Why is there a break, but there isn't a break in the areas in the other ones? Was that area not monitored?
A: This is representative of the monitoring stations, so if there are impairments, it was monitored. Some of the areas are also different between tidal or free-flowing which has different water quality standards, so breaks can happen. We also have a map that shows all of the monitoring stations.

Q: The 40% forest percentage also includes clear cut areas? That seems high?
A: Yes, it also includes those areas. Does this still seem representative of the area?
Comment: There was just recently a new land use map that was released by the state.
A: Yes, we will be using those in the IP.

Q: Does the shellfish standard also take into account the habitat, or bottom of the stream? Even if you clean up the water, shellfish won't grow on all habitats.

A: It does not take habitat into account.

Q: What are the symbols on the map?
A: They are all monitoring stations, they just monitor for different things.

Q: What are enterococci?
A: They are also a type of fecal coliform, but they are measured in salt water. E. coli are used to gauge freshwater.

Q: What type of monitoring data is this, professional, citizen..?
A: They are all DEQ monitoring stations.

Q: These data are from 10 decades ago bacteria source tracking, right?
A: Yes.
Citizen response: Then you need to look at them with a great deal of skepticism. The results were from a technique that was not the way an analytical procedure should be done. The results have not been replicated in other methods.
DEQ Response: We will actually be redoing the reductions with a new bacteria source assessment. By contacting the sources themselves through the workgroups, ask for data from citizens if they have any better data, etc…
C: But you still don't have the direct source? BST is the only analytical method. How are you going to estimate wildlife?
DEQ: We will be using data from the VGDIF to estimate wildlife data with best estimations.

Q: Why are some of them at 0% for reductions needed?
A: At the time of the TMDL, those creeks came back as meeting water quality standards, but they were still included.

Q: Go through every one besides Mill Creek, the human is 100% reduction. Why did it happen that way, standard of 0, but not everywhere else?
A: The current load was low enough that it was meeting the standards, so they did not need to do reductions.

Q: Before we move on, you're telling us that we're going to get up-to-date data to get a better picture of how to implement, correct?
A: Yes, we will be collecting more up-to-date information.

Q: Why don't you just do the Yeocomico? Why such a large area?
A: Having a larger area makes it a little bit easier to do implementation, so that we don't have to double up on the efforts.

Q: Are you going to have a meeting in Westmoreland?
A: Possibly.
Citizen Response: You definitely should because these creeks are all in that area, and there's quite a bit talk from shellfish sanitation and organizations about the shellfish beds being closed. Would be good for you to go there.

Comment that near Callao on Lodge Creek, if you go downhill and back up there is a pasture with livestock.

Q: Why is there a difference in the humans for the Mill Creek TMDL?
A: Because this is freshwater, no longer estuarine.

Q: How are you going to get to 0 loading for livestock?
A: Remove the direct input from livestock, by doing exclusion fencing. These are guidelines set by the EPA, so they are the goals that we're trying to reach. May not be able to reach that, but we're going to try to get there. Try to do pump outs.
Citizen Response: In regards to the septic systems, VDH does a shoreline survey, so there may be a problem, but they'll be fixed very quickly…

Q: Chesapeake Bay Act… septic field, do you move to a recovery field if it fails? Bay Act requires reserved drain field for new construction. Do you switch back and forth to clean out the bacteria?
A: It's just meant to be another place to do sewage.

Q: I'm from the SWCD, and you're most likely to see that the livestock numbers have already been met because of a very good cost-share program, that was 100% . Is there a way to get that incorporated into this IP so that the efforts can be focused into other areas so that we don't put money and effort into the livestock work?
A: We will get data from the DCR database from those who have access and incorporate them. Have those been added to DCR?
Citizen: Yes they should have been.

Q: Those percentages are just a part of the whole TMDL right?
A: Yes.

Q: Are there a lot of livestock farms?
A: Yes, they've all had BMPs/Exclusion fencing.
Biosolid testing would come back as human sources. This testing came back as cattle signature. BST analysis tried to determine using different DNA signatures.
Q: But you're no longer using the BST?
A: Right, the numbers could still totally change. The red impairments on the map are current, we're working to try to get the red to be fixed.

Q: Is the Yeocomico currently a no-discharge zone?
A: There is a permit, but it has not been finalized yet.
Comment: I was surprised by the backlash against not having a permit in the area and pumping waste.

Q: How do we get our neighbors involved?
A: Your input will be recorded here, and your input will be given to that section.

Q: Two of us are against the discharge zone, how are we going to get our voices out there?
A: We're trying to include your feelings in with the IPs, because we want to incorporate BMPs that are going to resonate with the community and actually be implemented successfully.

Q: Will the no-discharge zones actually contribute to improving the water quality?
A: I do not have a good answer to that at this time.
Comment: I ask because I have no idea how you would enforce something like that? It's easy to enforce on merchant or bigger ships, but how do you enforce recreational?
Response: Marine police can enforce it by boarding and checking.

Q: What do people give as opposition to no-discharge zone?
A: It would require money from users to install holding tanks in their recreational vessels.

Q: Have we got any figures on Lodge Creek since Callao switched over to sewer system recently?
A: We can check the water quality data after… do you know which year it went into place?
Comment: It went into effect two or three years ago.
Response: We can check the water quality data for the last few years to see if there's a difference.
Comment: You can get those data from the shellfish sanitation for sure.
Comment: I feel like if you switched all cities from septic pump to sewer, it would substantially improve the Chesapeake Bay. There should be no bacteria coming out of a sewage treatment plant.
Response: Sewer is the best option, but it's not always practical/implementable in more rural areas.

Q: Do you have a general timeline?
A: Working group meetings expected to start in March, continue throughout the spring. This is very tentative. Hoping to have a final document close to October, in which case the steering committee will be looking it over in the fall. There are public comment periods.

Comment: climate change could cause a 4-5' rise so would affect the watershed? Scale is 5 years for the first phase and then 10-15 years after that.

Q: Who are the personnel for these working groups?
A: You are if you feel compelled to join one!

Q: What kind of data collection will you be doing for the working groups and committees to help them plan?
A: Bring it from DCR, updated land use… we bring it to the working group to ask if they agree that it is representative… is 40% forest area representative for example?

Q: My concern will be for the non-tidal flush, is the tide going in and just pushing it all into the headwaters and not flushing it all back out? How do we figure that kind of stuff out?
A: In the working groups, we can try to identify some of those things to identify which BMPs will be the most effective.

Q: What are the timelines for implementing the things?
A: Staged implementation, 5 years, 10 years….
Comment: My concern will be factors of sea level rise with climate change, I feel like that will have to be incorporated into the implementation factor.

Q: Is there a place on DEQ's website where we can look at IPs in areas that are comparable to ours so we can get an idea of what to look for in these working groups? And will there be a cost-share program that will help us with these projects?
A: Yes and yes. Those are all listed on our website, Mattaponi will come into play. Once IP is done, we'll start putting BMPs into the ground, that's when the cost-share funding will come into play. BMPs are voluntary from the farmer or homeowner perspective. Addressing those concerns is voluntary.

Q: 319 funding is from EPA?

A: Yes. There are also at least 10 sources of funding that will be listed in the IP, and any if the working group identifies any other.

Q: Will the plan be split into the two counties? Or will it be just one plan?
A: It will be one plan that will cover both counties.

Q: I have a big concern at the Mill Pond Creek… there's a lot of tires, deer carcasses, muck… how are you going to clean up?
A: We can try to address that it in the work group.

Extra Comments:
Comment: I still don't trust these old data… they can tell you how much deer there is, but they won't be able to tell you how much deer waste enters the actual water.
Response: We're going to try to focus on the controllable load, rather than just the wildlife. We cannot control the wildlife, so we're going to focus on septic, pets, and livestock.

Comment: The headwaters have been going on for as long as the population has been growing. It's not going to change.
Response: We're trying to move forward with what we can do. The stakeholder inputs are what we're looking for to find what's realistic, so that we can update this old information.

Comment: DEQ insisted on going through all of these creek by creek a decade ago… all of these creeks were exactly the same. The bacteria increases toward the headwaters, the salinity decreases toward the headwaters. In the headwaters, there are few houses… the water is shallow, it's far from the mouth… There's runoff. There's no flushing in the headwaters. I have a rainfall record of more than a decade and compared them to the shellfish concentrations. Most of the time, heavy rainfall even kicks the bacteria. That tells me that it's wildlife. It's always been this way. Unless you are going to get samples to do microbial source tracking to prove what the source of the bacteria is… The Chesapeake Bay is all about nutrients, this is where the focus should be placed. These creeks are mostly just mud anyway. There's nothing out there but woods and wildlife. I can only think about one creek that has half a dozen cows in it. Almost every single creek that I'm familiar with has a mill pond at the top of them. They were checking the bacteria levels at the dam, which means they would get trapped in that mill pond. There was also a big flock of geese. Did you know that you can take muddy sediment from these creeks and culture fecal bacteria? That means that bacteria are resident in the sediment.

Comment: We will also need to eliminate bio sludge and poultry litter… birds follow the plow. Seagulls are on fields that have bio sludge and poultry litter. The seagulls are brought. It's clean when it's applied… if you're serious about eliminating all human sources of bacteria… you need to ban biosolids. A ¼ of Chesapeake Bay is from the application of biosolids. What happens if we put it into our IP that we want to ban biosolids? Would the state go for it?

Yeocomico River Watershed Implementation Plan – Agriculture Working Group Meeting

Northumberland Public Library, Heathsville, VA

Feb. 2, 2017 6:00-8:00 p.m.

Ag Working Group Members:

- Kathy Clarke, District Operations Manager — **kathy.clarke@nnswcd.org**
- Brandon Dillistin, District Technical Manager — **brandon.dillistin@nnswcd.org**

Kathleen Watson, Education/Outreach Specialist — **kathleen.watson@nnswcd.org**

Q: What is the best source for identifying Ag BMPs?

A: All of the paid ag BMPs should be in the DCR database. No one is entering the voluntary BMPs. SL6, we don't do LE2D or LE1D. All of ours are 35 ft buffers. Entered into the tracking program as SL6s.

Q: What is the best way to let farmers know about conservation programs?

A: We have 99% participation… we have educated the farmers of our annual sign ups, postcards, in the radio, all the papers, put it in the newsletter (4 local newspapers), we have a facebook page, not tv…. word of mouth.

Q: Are there any outreach events that are used to reach the Ag community? Do you have any fairs?

A: Closest thing is the Richmond County fair but it's the last week of sign ups… Cooperative extension.

Q: Are there any other groups related to Ag practices in the area?

Virginia Cooperative extension. NAPS (Northumberland Association Progressive Stewardship), homeowner associations (but don't know where to begin), Master Gardeners, Master Naturalists reached through cooperative extension…

Q: Is the majority of the farmland owned or leased?

A: If they have cows, most of them are owners… not too many areas are leasing. Cropland is a mix of leased and owned. If it's leased, we can do half and half. But owners can say outright no.

Q: Do you expect to see significant changes in farming practices over the next 5-10 years?

A: In the next ten years, most likely to see more houses than farmland… a lot of these small farmers are likely to go out of business. In the future, if the prices are right, they're going to try to develop it. Only way you'd know would be to go through land reports.

Q: Are there many horse owners in the area?

A: There are some horses. A lot of stables for recreation, but no farms.

Q: There are new BMPs for the equine. Any idea how many?

A: We don't know because they're not defined as agriculture so they don't have to participate.

I'd be surprised if we had 30 horses in the entire area.

Loose pigs in the area… they're on national news actually. "Free-range"

We have funding, but not many people are coming forward…

We have a totally different experience with ag BMPs, there was a tremendous interest in the 100% cost-share program, all completely funded. We're still in the later stages of the 80% funded. We had more people come forward than we thought had cows. We still interest after the 100% reduced. We still have some open ones right now.

Everyone that works in our district, lives in these counties.

Q: Could you send a list of how many livestock farms?

No dairy. We have beef. Swine. Horses. Considerable amounts of chickens/goats. We have no permitted chickens. No permitted operations.

Q: What about biosolids?

A: That would have to be through the local health department. They apply and we smell it. We have no records of that. DEQ would have to check with the permits.

Q: Any ideas to how many feet are in one water system of fencing?

A: Varies from farm to farm. You'd have to look at the records individually. Probably $20,000/project would be an average. 2,500 linear ft/system is pretty close to what we do.

Q: How big of a problem is the no-discharge zone?

A: It's a huge problem. They put in a community well and a wwtp, upgraded their facilities to attract boaters that had more discretionary income that had well-equipped boats. But we have a lot of sailboats that do a lot of anchoring.

They don't keep their equipment well-functioning, so they are not actually treating the discharge. The grey water discharge is also bad, with the dish soap in galley kitchens.

Only one marina has a pump out station. There is a huge volume of marinas around Allen Point, Long Point, White Point, Oberston's… have been functioning since the 60's.

There's no enforcement here really… each county has a different policy. The county only sends out a letter to meet their requirement. No follow-up.

APPENDIX B (Impaired Water Bodies/Growing Areas)

APPENDIX C (Bacteria Load Calculations, Land Uses, Transport Coefficients)

Quarterly Report of Yeocomico River TMDL Implementation Plan Project

January-March 2017

1. Bacteria Impairment in Yeocomico River Watershed

There are 17 segments in the Yeocomico River and Gardner, Jackson, and Bonum Creeks watersheds that are impaired by bacteria. Figure 1.1 depicts the location of these impaired segments. Table 1.1 lists the segment names and the associated TMDL IDs.

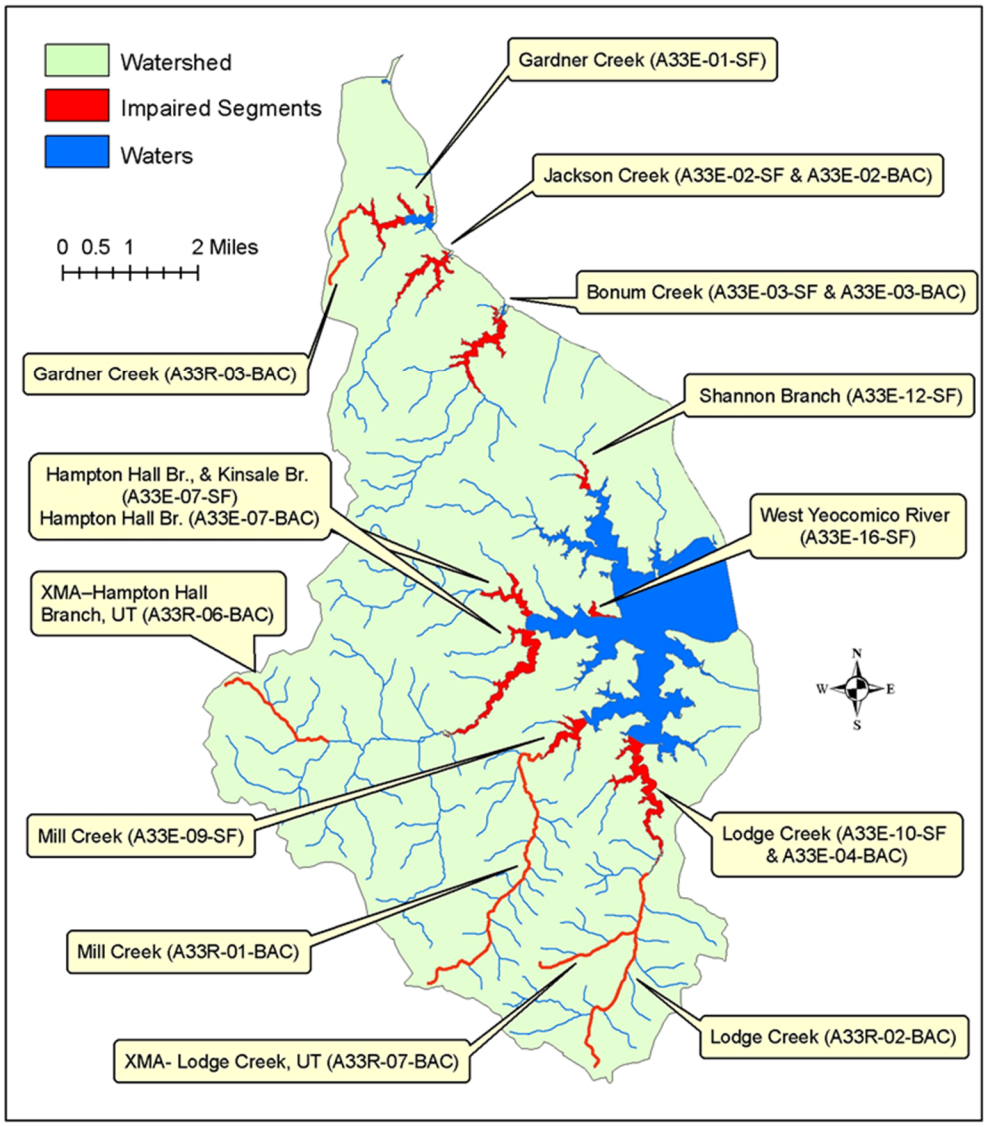

Figure 1.1 Bacteria Impaired Segments.

Table 1.1 List of Impaired Segments.

Location	TMDL ID	Water Name	Impairment
Gardner, Jackson, Bonum Creeks	A33E-01-SF	Gardner Creek	Fecal Coliform
	A33R-03-BAC	Gardner Creek	*E. Coli*
	A33E-02-SF	Jackson Creek	Fecal Coliform
	A33E-02-BAC	Jackson Creek	Enterococcus
	A33E-03-SF	Bonum Creek	Fecal Coliform
	A33E-03-BAC	Bonum Creek	Enterococcus
Yeocomico River	A33E-07-BAC	Hampton Hall Branch	Enterococcus
	A33E-07-SF	Hampton Hall Br., Kinsale Br.	Fecal Coliform
	A33E-09-SF	Mill Creek	Fecal Coliform

	A33E-10-SF	Lodge Creek	Fecal Coliform
	A33E-12-SF	Shannon Branch	Fecal Coliform
	A33E-16-SF	West Yeocomico River	Fecal Coliform
	A33E-04-BAC	Lodge Creek	Enterococcus
	A33R-02-BAC	Lodge Creek	*E. coli*
	A33R-07-BAC	XMA- Lodge Creek, UT	*E. coli*
	A33R-06-BAC	XMA – Hampton Hall Creek UT	*E. coli*
	A33R-01-BAC	Mill Creek	*E.coli*

2. Landuse

The GIS landuse data, Virginia Land Cover 2016 by Virginia Geographic Information Network (VGIN), was obtained from
http://vgin.maps.arcgis.com/home/item.html?id=d3d51bb5431a4d26a313f586c7c2c848

Figure 2.1 is the landuse map of the watershed. Table 2.1 and Figures 2.2-2.4 display the landuse percentages.

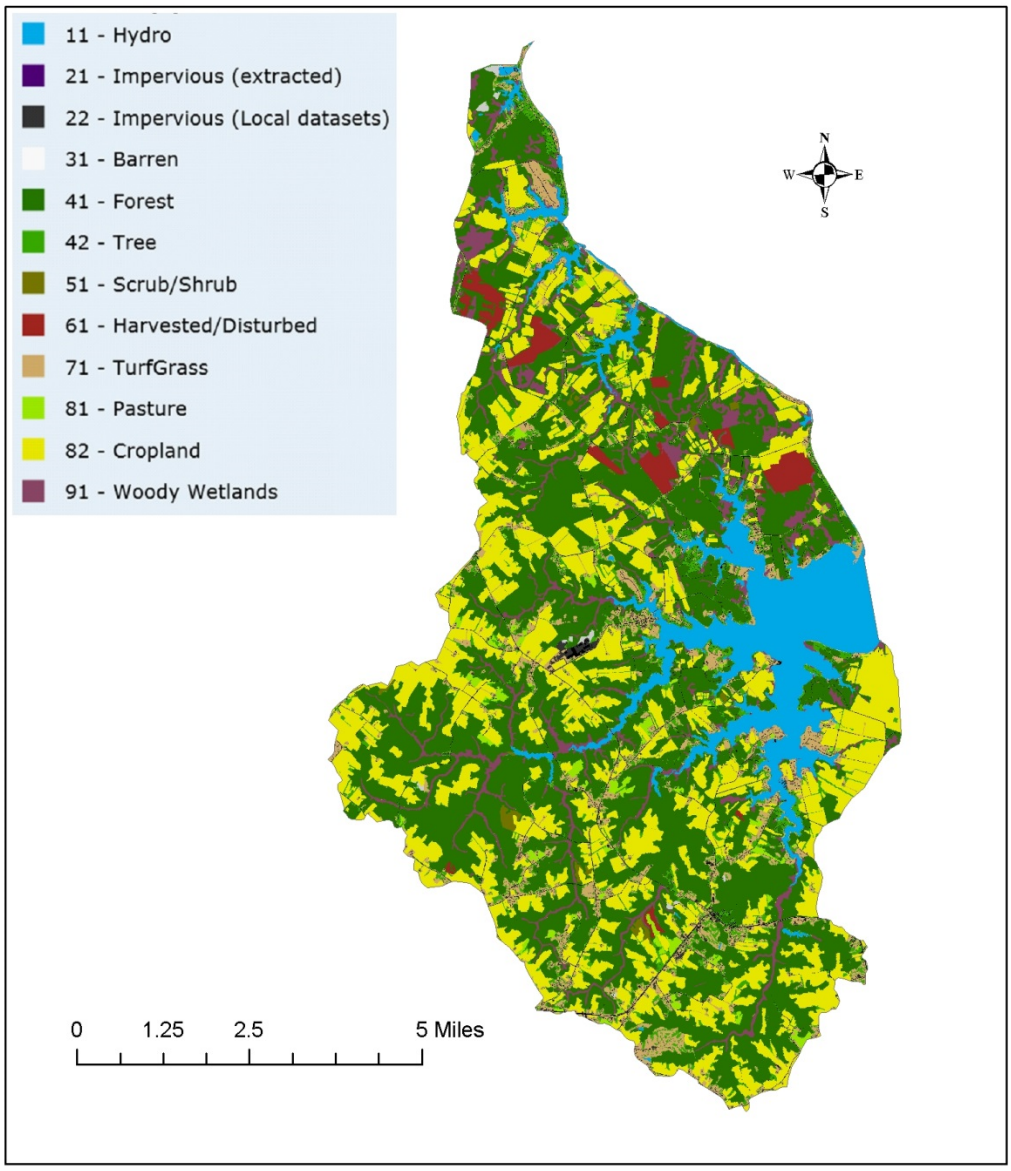

Figure 2.1 Landuse of the Yeocomico River, Gardner Creek, Jackson Creek and Bonum Creek Watersheds.

Table 2.1 Areas and Percentages of the Impaired Segments

Landuse Category	Entire Area		Gardner, Jackson, and Bonum Creeks		Yeocomico River	
	Area (acres)	Percentage	Area (acres)	Percentage	Area (acres)	Percentage
Hydro	1.7	1.1%	0.5	1.7%	1.2	1.0%
Impervious (Extracted)	1.4	0.9%	0.1	0.4%	1.3	1.1%
Impervious (Local Datasets)	2.4	1.5%	0.5	1.6%	1.9	1.5%
Barren	0.3	0.2%	0.1	0.5%	0.2	0.1%
Forest	69.6	45.3%	13.1	42.2%	56.5	46.1%

Tree	9.4	6.1%	2.0	6.5%	7.4	6.0%
Scrub/Shrub	0.6	0.4%	0.1	0.1%	0.5	0.4%
Harvested/Disturbed	3.1	2.0%	1.4	4.6%	1.7	1.4%
Turfgrass	11.3	7.3%	2.1	6.6%	9.2	7.5%
Pasture	1.8	1.2%	0.2	0.6%	1.6	1.3%
Cropland	42.5	27.7%	8.2	26.3%	34.3	28.0%
Woody Wetlands	9.5	6.2%	2.7	8.9%	6.8	5.5%

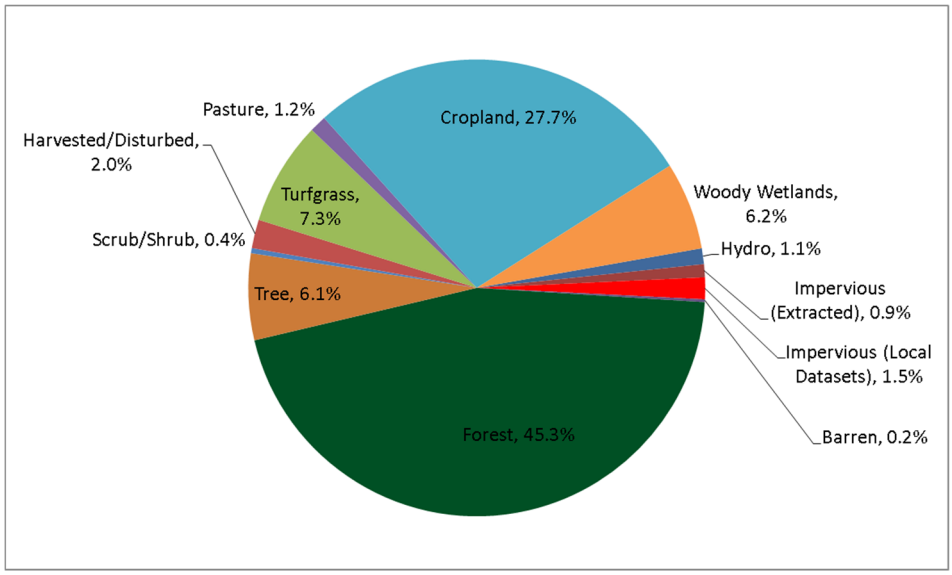

Figure 2.2 Landuse of the Entire Area.

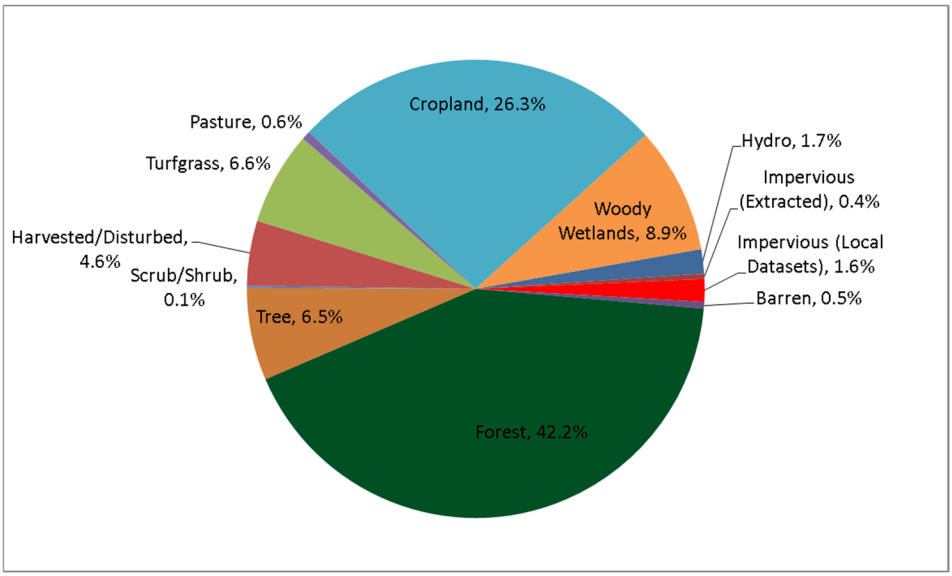

Figure 2.3 Landuse of the Gardner, Bonum, and Jackson Creeks.

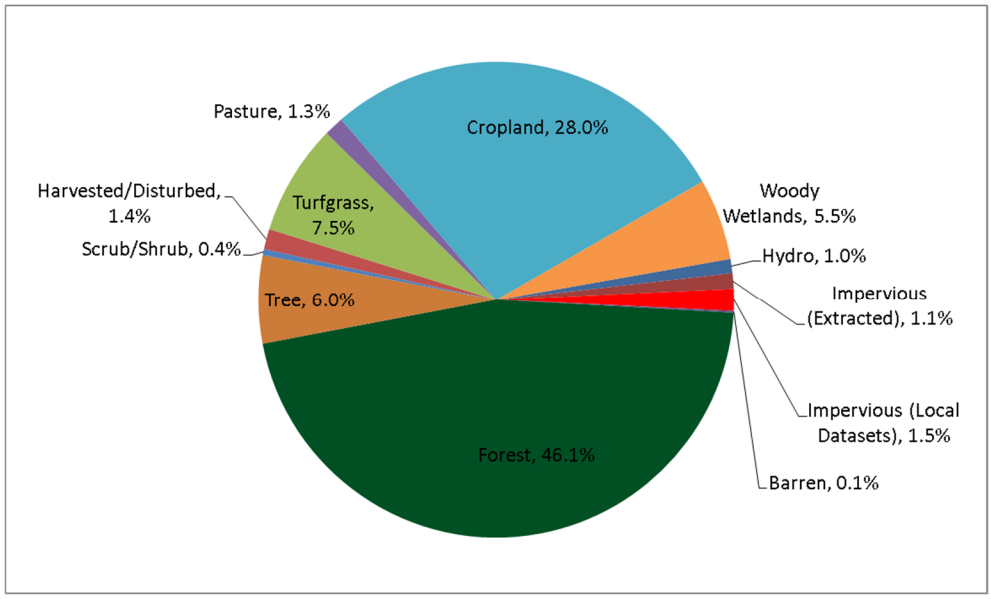

Figure 2.4 Landuse of the Yeocomico River.

3. Monitoring Stations

Figure 3.1 shows the locations of monitoring stations of the VA DEQ (for *E.Coli* and enterococci) and VDH (for fecal coliform). The summary statistics of the monitoring data are listed in Tables 3.1-3.3, for which all bacterial units are in cfu/100 ml.

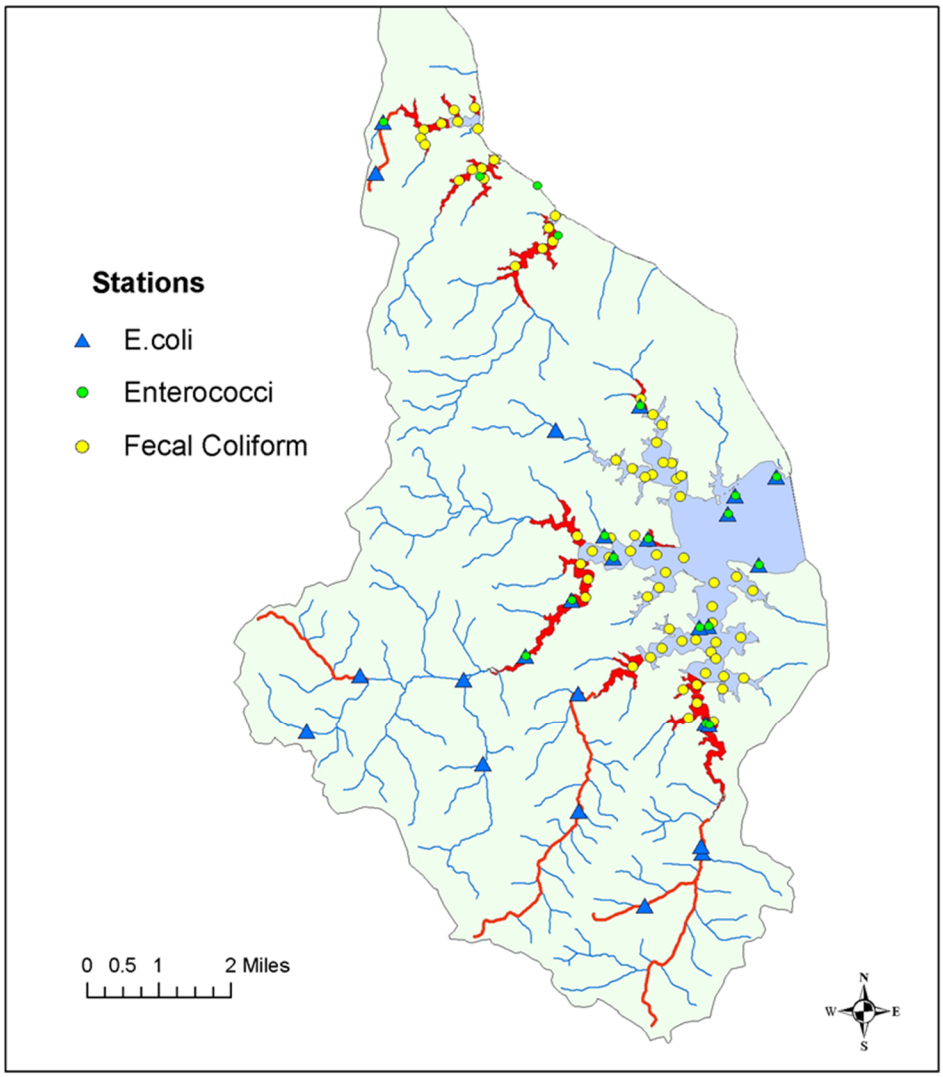

Figure 3.1 Locations of the Bacteria Monitoring Stations.

Table 3.1 Data Statistics for Segments Impaired by E. coli.

Waterbody	Station	Count	Mean	Minimum	Maximum	Period
Garner Creek	1AGAD001.73	11	145	100	300	08/08-06/09
	1AGAD002.54	8	91	25	100	12/08-06/09
XMA – Hampton Hall Creek UT	1AXMA000.12	12	125	25	450	01/11-12/11
Mill Creek	1AMIA004.12	24	238	25	1525	01/08-12/11
	1AMIA002.34	11	155	100	400	07/08-05/09
XMA- Lodge Creek, UT	1AXMC000.92	14	411	25	2000	01/11-12/11
Lodge Creek	1ALOG003.30	35	400	10	9804	01/07-12/15

	1ALOG003.45	3	50	25	75	01/11-03/11

Table 3.2 Data Statistics for Segments Impaired by Enterococcus.

Waterbody	Station	Count	Mean	Minimum	Maximum	Period
Jackson Creek	1AXDW000.08	12	94	25	500	01/09-12/10
Hampton Hall Branch	1AHAM000.96	1	30	25	450	01/11-12/11
	1AHAM000.92	25	489	25	8000	02/09-12/15
Bonum Creek	1ABOM000.46	26	301	25	4200	01/09-12/15
Lodge Creek	1ALOG001.10	1	10	10	10	8/6/2012
	1ALOG001.20	84	99	10	2000	08/03-12/16

Table 3.3 Data Statistics for Segments Impaired by Fecal Coliform (01/08-09/16).

Waterbody	Station	Count	Mean	Minimum	Maximum
Gardner Creek	**1**	96	10	1	75
	1.5	96	25	0	270
	2	96	13	0	81
	2.5	96	30	0	270
	2.8	96	18	0	103
	3	96	27	0	207
	3D	96	21	0	193
	3E	96	23	0	270
Jackson Creek	**5**	96	21	0	240
	5.5	96	18	0	233
	5.7	96	1	0	81
	6	96	43	0	267
Bonum Creek	**7.5**	96	9	0	81
	7.7	96	0	0	21
	8	96	31	0	270
	9	96	55	0	320
Shannon Branch	**11.5**	98	20	0	163
West Yeocomico River	**17.5**	98	15	1	117
Kinsale Branch	**22**	98	32	0	270
Hampton Hall Branch	**24**	98	15	1	81
	25	98	18	0	207
	26	98	23	0	267
Mill Creek	**41**	98	20	0	220
Lodge Creek	**44.5**	98	14	0	270
	45	98	17	1	170
	46	98	24	0	270
	47	98	22	1	237

4. Subwatershed Delineation.

For modeling purposes, the entire area was further delineated to 48 subwatersheds (Figure 4.1), based on landuse data, locations of the impaired segments, and the previous TMDL delineation. The subswatershed IDs included in each impaired segment are listed in Table 4.1.

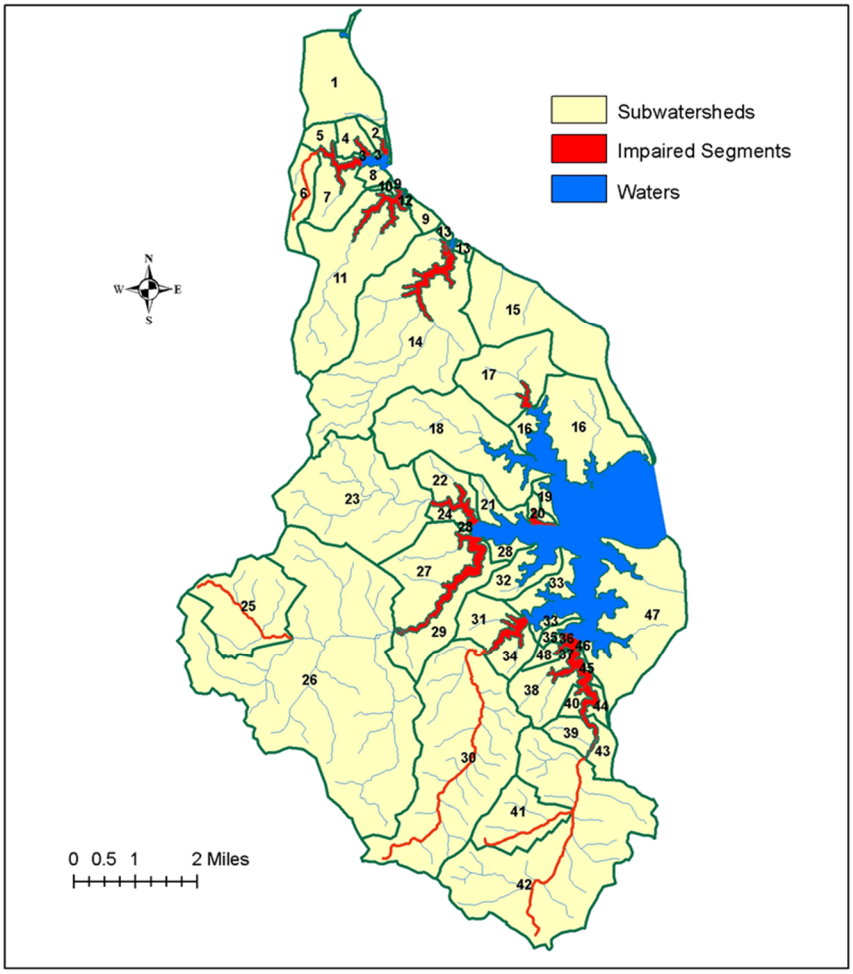

Figure 4.1 Subwatershed Delineation.

Table 4.1 Subwatershed IDs of Each Impaired Segment.

Water Name	Subwatershed ID
Gardner Creek-Tidal	2, 4-7
Gardner Creek-Nontidal	6
Jackson Creek	10-12
Bonum Creek	14
Shannon Branch	17
West Yeocomico River	20
Kinsale Branch	22-24
Hampton Hall Branch	25-27, 29
XMA – Hampton Hall Creek UT	25
Mill Creek-Tidal	30, 31, 34

Mill Creek-Nontidal	30
Lodge Creek-Tidal	36-46, 48
Lodge Creek-Nontidal	41, 42
XMA - Lodge Creek, UT	41

The landuse data included in an xls that was provided earlier includes 2 parts. The first part includes landuse for each subwatershed (SWS1-SWS48). The second part is the sum of the landuse area by impaired segment. For the impaired segment, it also includes its upstream watershed. For example, the tidal impaired segment Mill (tidal) includes land use area for 30, 31, and 34. For its upstream Mill_(Nontidal), it only includes subwatershed 30.

5. End point

Effective February 1, 2010, VADEQ specified new bacteria standards in 9 VAC 25-260-170.A. These standards replaced the existing fecal coliform standard of 9 VAC 25-260-170. For a non-shellfish supporting waterbody to be in compliance with Virginia bacteria standards for primary contact recreation in a saltwater or transition zone, the current criteria are as follows:

"Enterococci bacteria shall not exceed a monthly geometric mean of 35 CFU/100 ml in transition and saltwater. If there are insufficient data to calculate monthly geometric means in transition and saltwater, no more than 10% of the total samples in the assessment period shall exceed enterococci 104 CFU/100 ml."

For shellfish growing areas, the criteria used for developing TMDLs are outlined in 9 VAC 25-260-160 and read as follows:

In all open oceanic or estuarine waters capable of propagating shellfish or in specific areas where public or leased private shellfish beds are present, and including those waters on which condemnation or restriction classifications are established by the State Department of Health, the following criteria for fecal coliform bacteria shall apply:

The geometric mean fecal coliform value for a sampling station shall not exceed an MPN (most probable number) or MF (membrane filtration using mTEC culture media) of 14 per 100 milliliters (ml). The estimated 90th percentile shall not exceed an MPN of 43 per 100 ml for a 5-tube decimal dilution test or an MPN of 49 per 100 ml for a 3-tube decimal dilution test, or MF test of 31 CFU (colony forming units) per 100 ml.

These standards are calculated using a 30-month window, which means that every consecutive 30-month data group must have a *geometric mean* of 14 CFU/100mL or less and a *90th percentile* of 31 CFU/100ml or less for mTEC data to meet both standards.

Table 5.1 Existing Load, TMDL, and Load Reduction for Each Fecal Coliform-Impaired Segment (Load Units in Counts/Year)

Water Name (305b ID)	Existing condition Average		Existing Condition 30-month Mix.		TMDL		Reduction General Average		Reduction 30-month Max.	
	Geomean	90%	Geomean	90%	Geomean	90%	Geomean	90%	Geomean	90%
Gartner Creek 1* (VAP-A33E_GAD01A98)	5.3E+12	2.2E+13	7.1E+12	3.2E+13	6.5E+12	8.0E+12	-22.8%	64.6%	8.5%	74.8%
Gartner Creek 2* (VAP-A33E_GAD01A98)	9.8E+11	6.0E+12	1.6E+12	1.1E+13	1.1E+12	1.0E+12	-11.1%	83.3%	33.2%	91.0%
Gartner Creek 3* (VAP-A33E_GAD01A98)	4.9E+11	3.2E+12	8.0E+11	5.2E+12	8.8E+11	1.2E+12	-80.6%	63.5%	-9.8%	77.7%
Jackson Creek (VAP-A33E_JCK01B14)	7.1E+12	2.9E+13	9.9E+12	4.7E+13	7.1E+12	7.0E+12	0.0%	76.0%	28.8%	85.1%
Bonum Creek (VAP-A33E_BOM01A98)	1.1E+13	3.4E+13	1.3E+13	5.7E+13	1.2E+13	1.2E+13	-10.2%	66.4%	8.5%	79.8%
Shannon Branch (VAP-A33E_SHA01A98)	1.8E+12	1.1E+13	3.1E+12	1.5E+13	3.1E+12	5.3E+12	-74.9%	50.2%	0.0%	65.7%
West Yeocomico River (VAP-A33E_WES01A06)	2.2E+12	1.5E+13	4.2E+12	3.3E+13	6.6E+12	1.4E+13	-196.7%	3.3%	-58.3%	56.5%
Kinsale Branch (VAP-A33E_KIN01A12)	1.4E+13	8.9E+13	2.1E+13	1.4E+14	1.4E+13	2.3E+13	0.0%	73.7%	33.2%	83.0%
Hampton Hall Branch (VAP-A33E_HAM01A02)	1.4E+13	7.7E+13	2.1E+13	1.2E+14	2.9E+13	4.5E+13	-105.4%	41.5%	-34.5%	63.6%
Mill Creek (VAP-A33E_MIA01A98)	6.1E+12	3.6E+13	9.1E+12	6.3E+13	1.2E+13	1.9E+13	-100.5%	47.4%	-33.4%	69.5%
Lodge Creek_Big ** (VAP-A33E_LOG02A98)	2.2E+13	1.1E+14	2.7E+13	1.5E+14	3.2E+13	6.1E+13	-46.1%	43.2%	-18.7%	59.6%
Lodge Creek_Small ** (VAP-A33E_LOG02A98)	2.6E+11	1.1E+12	3.7E+11	2.0E+12	6.2E+11	1.1E+12	-135.1%	4.5%	-69.6%	46.2%

** This part of the Gardner Creek has three separate segments and they were modelled separately. The number order is from upstream to downstream.*

*** This part of the Lodge Creek has two separate segments and their loads were calculated separately. The Lodge Creek_Big is the larger one and Lodge_Small is the smaller one.*

Table 5.2 Existing Load, TMDL, and Load Reduction for Each Enterococci-Impaired Segment (Load Units in Counts/Year)

Water Name (305b ID)	Existing	TMDL	Reduction (Referenced to 104 cfu/100ml)
Jackson Creek (VAP-A33E_JCK01B14)	3.8E+14	6.6E+13	82.6%
Jackson Creek (VAP-A33E_JCK01A98)	7.4E+12	1.3E+12	82.6%
Bonum Creek (VAP-A33E_BOM01A98)	7.4E+14	8.9E+13	87.9%
Hampton Hall Branch (VAP-A33E_HAM01A02)	1.2E+15	2.2E+14	81.4%
Lodge Creek (VAP-A33E_LOG01A98)	1.1E+15	2.8E+14	73.5%
Lodge Creek (VAP-A33E_LOG02B10)	3.8E+13	1.0E+13	73.5%
Lodge Creek_Big* (VAP-A33E_LOG02A98)	1.2E+14	3.2E+13	73.5%
Lodge Creek_Small* (VAP-A33E_LOG02A98)	2.2E+13	5.9E+12	73.5%
Lodge Creek (VAP-A33E_LOG02C12)	6.2E+12	1.6E+12	73.5%

** This part of the Lodge Creek has two separate segments and their loads were calculated separately. The Lodge Creek_Big is the larger one and Lodge_Small is the smaller one.*

Table 5.3 Existing Load, TMDL, and Load Reduction for Each *E.coli*-Impaired Segment (Load Units in Counts/Year)

Water Name (305b ID)	Existing	TMDL	Reduction (Referenced to 235 cfu/100 ml)
Gardner Creek (VAP-A33R_GAD01A10)	1.9E+12	1.5E+12	21.7%
XMA-Hampton Hall Branch, UT (VAP-A33R_XMA01A14)	8.1E+12	4.2E+12	47.8%
Mill Creek (VAP-A33R_MIA01A00)	4.4E+13	1.5E+13	65.2%
Lodge Creek (VAP-A33R_LOG01A04)	1.9E+13	1.0E+13	46.2%
XMC-Lodge Creek, UT (VAP-A33R_XMC01A14)	1.2E+13	2.5E+12	79.3%

6. Bacteria Load Estimation

6.1 Fecal Coliform and Enterococcus

For the estuaries impaired by fecal coliform and/or enterococcus (Table 1.1), a steady state tidal prism model was used to calculate the existing and maximum loads. The model incorporates the influences of tidally induced transport, freshwater input, and removal of fecal coliform via decay (MDE, 2006). It assumes that the embayment is well mixed, and freshwater input, tidal range, and the first order decay of fecal coliform are all constant.

$$L = \left[C \times \left(Q_b + k \times V\right) - Q_0 \times C_0\right] \times C_f \qquad \text{Equation 1}$$

where:
L = bacteria load (counts per day)
C = mean bacteria concentration (counts /100ml) of embayment
Q_b = the quantity of mixed water that leaves the embayment on the ebb tide that did not enter the embayment on the previous flood tide (m^3 per tidal cycle)
k = the bacteria decay rate (per day), which was fixed at 0.6 for both bacteria
V = the mean volume of the embayment (m^3)
Q_0 = the quantity of water that enters the embayment on the flood tide through the ocean boundary that did not flow out of the embayment on the previous ebb tide (m^3 per tidal cycle)
C_0 = the bacteria concentration (counts/100ml) at the ocean boundary
Cf = the unit conversion factor.

Based on the steady state condition:
$Q_b = Q_0 + Q_f$
where Q_f is the watershed flow. The 10-year monthly mean flow from 2007 to 2016 at USGS Station 01669000 (Piscataway Creek Near Tappahannock, VA) was divided by its drainage area, and then multiplied by the drainage area of the impaired embayment to calculate Q_f.
$Q_0 = \beta \times Q_T$
where β is an exchange ratio with a mean value of 0.5. Q_T is the total ocean water entering the bay on the flood tide, which numerically equals to the embayment surface area multiplied by the tidal range.

For fecal coliform existing condition, the monthly observations from January 2008 to September 2016 were used. If there were more than one station within an embayment, the volume-weighted arithmetic mean concentration was calculated for each listed area. To calculate the concentration inside an embayment (C in Equation 1), both average values of geometric mean and 90^{th} percentile, and maximum values of 30-month moving-average of geometric mean and 90^{th} percentile were applied to the model. For ocean boundary condition (C_0 in Equation 1), the average value of both geometric mean and 90^{th} percentile at the station immediately outside the embayment were used.

For fecal coliform maximum allowable loads, the water quality criteria are 14 counts/100ml for geometric mean and 31 counts/100ml for 90th percentile, respectively. To be consistent, the ocean boundary conditions still used the average values of the geometric mean and 90th percentile of the observations for each listed segment.

The calculation of baseline and maximum allowable conditions for enterococcus was similar to that of fecal coliform. However, as there is not enough data to generate the monthly geometric mean and 90th percentile concentrations as required by the criteria, the maximum concentration during the observation period was used. If the maximum value is extremely high compared with the other data and only occur less than 5% of the time, the 95% percentile value was used.

Tables 5.1 and 5.2 list the existing loads, TMDLs, and load reductions for the fecal coliform and enterococcus impaired segments. If a segment is impaired by both bacteria, the higher load reduction will prevail. As all the four upstream tidal segments of Lodge Creek are impaired by enterococcus, and there is only one station in the area, the four segments were modelled as one and the loads were distributed to each segment by its watershed area. The corresponding loads in Table 5.2 are the local watershed loads only (i.e., exclusive of the upstream loads). For the fecal coliform impairment in Lodge Creek, the whole upstream watershed was included in the model, and therefore the loads in Table 5.2 include the upstream loads as well.

6.2 E.coli

For the free-flow streams impaired by *E.coli* (Table 1.1), a steady state distributed-source model was used to calculate the existing and maximum loads (Shen and Zhao, 2010). Since the stream is narrow and the watershed associated with the headwater is very small, the bacteria loads can be assumed to be discharged laterally into the system, and the bacteria is fully mixed laterally and vertically.

$$L = \frac{C \times k}{1 - e^{-\frac{k \times X \times A}{Q}}} \qquad \text{Equation 2}$$

where:
L = distributed source load in counts/day/m^3
C = instream bacteria concentration
k = first-order bacteria decay rate, which is fixed at 0.6/day
X = stream length
A = cross-sectional area
Q = watershed flow. The 10-year monthly mean flow from 2007 to 2016 at USGS Station 01669000 (Piscataway Creek near Tappahannock, VA) was divided by its drainage area, and then multiplied by the drainage area of the impaired stream to calculate Q.

As there is not enough data to generate the monthly geometric mean and 90th percentile concentrations as required by the criteria, the maximum concentration during the observation period was used. If the maximum value is extremely high compared with the other data and only occur less than 5% of time, the 95% percentile value was used. The L in Equation 2 was

multiplied by the stream volume (stream length × cross-sectional area) to get the baseline load and TMDL. Table 5.3 lists the calculated results.

7. Evaluation of bacterial delivery rates from each primary landuse to the receiving waters

Each important landuse was examined for the amount of bacteria that was transported from the watershed to the receiving waters. The amount of transported bacteria predicted by the watershed model was compared to a pre-selected constant of bacteria loading of $1.0e10^8$ counts per day and the resulting ratios, expressed as percentages, could then be used to quantify the delivery rate from a selected landuse over specified periods. The watershed model used for computing the delivery rate is the Poquoson River model. This model is calibrated based on the USGS Gage 01670000 in Beaverdam Swamp near Ark, VA, located approximately 20 miles north of the Back River watershed. The simulation period is from 1/1/1999-12/31/2012. The averaged delivery rate is listed in Table 7.1. For comparison, the delivery rate computed in the Eastern Shore is also listed in the table. Because different locations and weather data used for simulation, estimated rates are not same. The new rates seem more suitable for the watersheds for this study.

Table 7.1 Delivery rates for various land uses in adjacent regions

	land use						
delivery rates	Cropland	Forest	Wetland	Urban Pervious	Urban Impervious	Pasture	Grass Land
Poquoson River (1999-2012)	2.98%	0.78%	4.97%	6.71%	28.27%	2.22%	5.02%
Eastern Shore (1990-1996)	0.6%	0.3%	3.2%	5.3%	38.0%	1.2%	-

References

MDE, 2006. Total Maximum Daily Loads of Fecal Coliform for the Restricted Shellfish Harvesting Area in Wells Cove of the Kent Narrows - Prospect Bay Basin in Queen Anne's County, Maryland.

Shen, J., Y. Zhao, 2010. Combined Bayesian statistics and load duration curve method for bacteria nonpoint source loading estimation. Water Research, (44), 77-84

APPENDIX D

Growing Areas – Old Impaired growing areas not available

APPENDIX E

Source Assessment and Implementation Actions (XLS spreadsheets)

- **Bonum Creek**
- **Gardner Creek**
- **Jackson Creek**
- **Mill Creek**
- **Lodge Creek/XMA Lodge Creek UT**
- **West Yeocomico River**