Implementation Plan for Fecal Coliform TMDL (Total Maximum Daily Load) for Mill Creek and Powhatan Creek

Virginia Department of Environmental Quality

Hampton Roads PDC Planning District Commission

James City County Jamestown 1607

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ABSTRACT

The Mill and Powhatan Creek Watersheds are located within James City County in Southeastern Virginia. In response to Section 303(d) of the Clean Water Act, the Virginia Department of Environmental Quality (VADEQ) listed portions of Mill Creek and Powhatan Creek beginning with Virginia's 1998 Section 303(d) list for being unable to attain the water quality standard for primary contact recreational waters due to elevated levels of fecal coliform bacteria.

The Virginia Department of Environmental Quality completed the "Bacteria Total Maximum Daily Load for Mill Creek and Powhatan Creek," in March 2008. The Mill and Powhatan Study set allocations to limit bacteria pollutant loads discharged to the watersheds to levels that were modeled to achieve compliance with the state water quality criteria for bacteria for primary contact recreational waters. This Implementation Plan bridges the gap between those specified pollutant load allocations and actual reductions in bacteria counts in Mill and Powhatan creeks by recommending a set of actions to be taken in the watersheds during a fifteen year project timeframe.

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IMPLEMENTATION PLAN FOR THE FECAL COLIFORM TMDL (TOTAL MAXIMUM DAILY LOAD) FOR MILL CREEK AND POWHATAN CREEK

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Prepared by the staff of the Hampton Roads Planning District Commission

April 2011

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1.0 EXECUTIVE SUMMARY

1.1 Introduction

This Implementation Plan (IP) is a companion document to the report, "Bacteria Total Maximum Daily Load for Mill Creek and Powhatan Creek" (DEQ 2008). The Mill and Powhatan Creeks TMDL Study set allocations to limit bacteria pollutant loads discharged to the Mill Creek and Powhatan Creek watersheds to levels that were modeled to achieve compliance with the state water quality criteria for bacteria for primary contact recreation. This IP bridges the gap between those specified pollutant load allocations and actual reductions in bacteria counts in Mill and Powhatan Creek by recommending a set of actions to be taken in the watersheds during a fifteen year project timeframe.

Two sets of regulatory requirements for the development of TMDL IPs are applicable in the state of Virginia.

- §303(d) of the Federal Water Pollution Control Act of 1972 commonly known as the Clean Water Act (CWA)
- Virginia Water Quality Monitoring, Information and Restoration Act of 1997 (WQMIRA)

CWA strives "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The inception of the federal TMDL program is found in section 303(d) of that legislation. WQMIRA requires the State to develop reports assessing water quality of state waters, to provide data to develop programs addressing water quality impairments, to develop TMDLs and to develop IPs.

1.2 Review of Mill Creek and Powhatan Creek Bacteria TMDL

Mill Creek (VAT-G10E-03) was initially listed as impaired on Virginia's 2002 303(d) Report on Impaired Waters due to exceedances of Virginia's water quality standard for fecal coliform. In January 2003, Virginia adopted a water quality standard for enterococci bacteria for saltwater and transition zones. Mill Creek was listed as not supporting the Recreation Use on Virginia's 2006 305(b)/303(d) Water Quality Assessment Integrated Report (VADEQ, 2006) due to water quality violations of the enterococci bacteria standard.

Powhatan Creek has two segments that have been identified as impaired and do not support the Recreation Use. Segment VAT-G10E-01, the tidal segment of Powhatan Creek, was listed in Virginia's 1998 303(d) TMDL Priority List and Report because of violations of the fecal coliform water quality standard. The tidal segment of Powhatan Creek is currently listed as impaired on Virginia's 2006 305(b)/303(d) Water Quality Assessment Integrated Report due to violations of the enterococci bacteria standard.

Sufficient exceedances of the fecal coliform bacteria standard in the nontidal segment (VAT-G10R-02) led to a listing in the 2002 305(b)/303(d) Water Quality Assessment Integrated Report. The non-tidal segment of Powhatan Creek is listed as impaired on Virginia's 2006 305(b)/303(d) Water Quality Assessment Integrated Report due to violations of the *E. coli* bacteria standard.

A TMDL study for the Mill Creek and Powhatan Creek watersheds, completed by DEQ in March 2008, examined the watershed characteristics and the sources of fecal coliform to the creeks. Using monitoring data, bacterial source tracking (BST), and watershed models, DEQ assigned maximum allowable loads to each source in the watersheds in order to bring Mill and Powhatan Creeks into compliance with the water quality standard for primary contact recreation. Table 1-1 outlines the source reductions necessary (as estimated by the model) in order for Mill and Powhatan Creeks to achieve water quality standards.

Table 1-1: TMDL Reduction in Fecal Coliform Loadings from Existing Conditions

Impaired Waterbody	Agriculture	Wildlife Direct Deposit	Residential	Forest	Marinas and Canal
Mill Creek	92%	92%	92%	0%	0%
Powhatan Creek	92%	92%	92%	0%	100%

The core of this IP is a set of actions found in Section 7 aimed to reduce the levels of fecal coliform bacteria in Mill and Powhatan Watersheds. The actions chiefly target bacteria from human and pet ("anthropogenic") sources. This reflects the staged implementation recommended by the Virginia Department of Environmental Quality and referenced in the TMDL Study.

1.3 Public Participation

Two public meetings were held in the watershed to engage the public in the development of the TMDL Implementation Plan for the Mill and Powhatan Creek Watersheds. A work group composed of representatives from County departments, the Hampton Roads Planning District Commission (HRPDC), and state and federal agencies was formed to guide development of the TMDL IP.

1.4 Implementation Actions

The management actions outlined in this IP capitalize on existing and planned programs and efforts within the Mill and Powhatan Creek watersheds and will be implemented in four phases. Ongoing actions have already been initiated in response to other regulatory programs, but are expected to reduce bacteria loads to the waterbodies. Phase I actions are those that have been recently initiated or will be initiated in the near future in response to the TMDL and are scheduled for completion within five years. Phase II activities are those that are planned for implementation within the next five to ten years and may not have approved funding sources yet. Phase III actions may require regulatory changes, so they may be implemented as necessary if actions undertaken in the previous phases do not significantly improve water quality within the study area. All management actions were divided into the following eight management categories:

- Sanitary Sewer System Improvements
- Septic System Programs

- Stormwater Quality Programs
- Boating Programs
- Pet Waste Programs
- Aquatic Resources Restoration
- Land Use Management
- Wildlife Contribution Controls

1.5 Associated Costs and Benefits

The primary benefit of the implementation of the management actions described in this IP is the reduction of bacteria levels in the Mill Creek and Powhatan Creek watersheds. The programs and actions contained within this IP will serve to reduce the anthropogenic sources of bacteria within the watersheds. Because many of the programs mentioned in this report also serve purposes beyond reducing bacteria and cover areas larger than the Mill and Powhatan Creek watersheds, the costs of reducing bacteria levels can be difficult to estimate. James City County staff estimated costs for management categories using knowledge of current program costs and best professional judgment.

1.6 Measurable Goals and Milestones

The goal of the TMDL developed for Mill and Powhatan Creeks is to bring the impaired water segments within the watersheds into compliance with the water quality standard for bacteria for primary contact recreation. Once the water segment achieves compliance with the bacteria criteria, then the segment can be removed from the 303(d) Impaired Waters List. Throughout the fifteen year project timeframe, DEQ will continue its monitoring of stations in the Mill and Powhatan watersheds. Currently, this monitoring program includes 1 monitoring station at the mouth of Mill Creek and 3 stations on Powhatan Creek. Project progress will be tracked throughout the timeframe of the implementation plan, and the effectiveness of the management actions proposed in this IP will be evaluated at the end of five, ten, and fifteen years.

1.7 Stakeholders Roles and Responsibilities

Stakeholders are individuals who live or have land management responsibilities in the watershed, including government agencies, businesses, private individuals and special interest groups. Stakeholder participation and support is essential for achieving the goals of this TMDL effort. Stakeholders for this project were identified at the beginning of IP development and invited to sit on the Technical Advisory Committee along with agency representatives and County staff.

1.8 Watershed Planning Efforts

In 2001, James City County hired the Center for Watershed Protection to develop the Powhatan Creek Watershed Management Plan. In 2009, the County hired Vanasse Hangen Brustlin, Inc (VHB) and began the process of developing a watershed management plan for Mill Creek. The

Mill Creek Watershed Management Plan will follow the outline and approach established during the development of the Powhatan Creek plan and is expected to be complete summer 2011.

As part of the James City County watershed planning process, three special studies were performed to gain a better scientific understanding of the Powhatan stream system; these included the stream and floodplain assessment, the conservation area study, and the Stormwater Management Master Plan. The stream and floodplain assessment consisted of an instream habitat survey for the majority of the non-tidal watershed and reported on stream channel stability and habitat conditions in each of the subwatersheds. The conservation area study identified the presence of rare, threatened or endangered (RTE) species, contiguous forest and high quality wetlands and identified potential threats and impacts to their existence. The stormwater master plan developed specific stormwater criteria for subwatersheds, identified existing stormwater practices for retrofit possibilities, and located potential regional stormwater facilities.

The watershed management plan provides a summary of the findings from the Powhatan Creek baseline report, the three special studies, and the stakeholder process conducted by the Center for Watershed Protection, the James River Association and James City County. A specific watershed management plan and accompanying maps were drafted for the twelve subwatersheds based on the eight tools of watershed protection.

The goals of the study were to prevent further degradation of the water quality of Powhatan Creek, maintain the quality of the creek's wetlands, maintain biological and habitat diversity, and promote habitat connectivity. The sub-watershed boundaries of the Powhatan Watershed Plan were compared to the boundaries for the TMDL. The Powhatan TMDL study subwatersheds were delineated to match, to the extent possible, those created for the Powhatan Watershed Plan. This was done to ensure that information developed as a part of the Powhatan TMDL could also be used for implementation of the Powhatan Watershed Plan.

1.9 Potential Funding Sources

One of the objectives of this TMDL Implementation Plan is to maximize utilization of existing programs and resources to achieve the goal of reducing bacteria levels within the Mill and Powhatan Watersheds. In general, funding for these programs and the management actions described in this IP will come from four sources as they are available:

- Locality funds
- Private / nonprofit funds
- Virginia State funds
- Federal funds

2.0 INTRODUCTION

2.1 Purpose, Scope, and Timeframe

This Implementation Plan (IP) is a companion document to the report "Bacteria Total Maximum Daily Load for Mill Creek and Powhatan Creek" completed by the Virginia Department of Environmental Quality (DEQ) in March 2008, which will henceforth be referred to as the TMDL Study. The IP creates a framework to achieve the reductions in bacteria counts recommended in the TMDL Study. The core of this IP is the set of actions presented in Section 7 intended to reduce the levels of bacteria in Mill and Powhatan Creek watersheds from anthropogenic sources. The goal of the IP is compliance with the State of Virginia water quality standard for bacteria for primary contact recreation. This IP follows the State guidance for TMDL implementation plans published by DEQ and DCR.

The TMDL study that was approved by the US Environmental Protection Agency (USEPA) in April 2009 and the Virginia State Water Control Board in July 2009 examined the watersheds, their characteristics, and the sources of bacteria throughout the watersheds. Using monthly monitoring data, bacterial source tracking (BST), Hydrological Simulation Program-FORTRAN (HSPF) and a tidal volumetric model, DEQ was able to assign maximum allowable loads to each source in the watersheds in order to bring Mill Creek and Powhatan Creek into compliance with the water quality standard.

This IP outlines a strategy and the proposed actions to reduce anthropogenic loading of bacteria to the level set forth in the TMDL study in order to comply with the water quality standard for bacteria in primary contact recreational waters. The proposed actions included in this IP will be performed by James City County and state, federal, and non-governmental partners. These actions are expected to be completed within a ten to fifteen year timeframe.

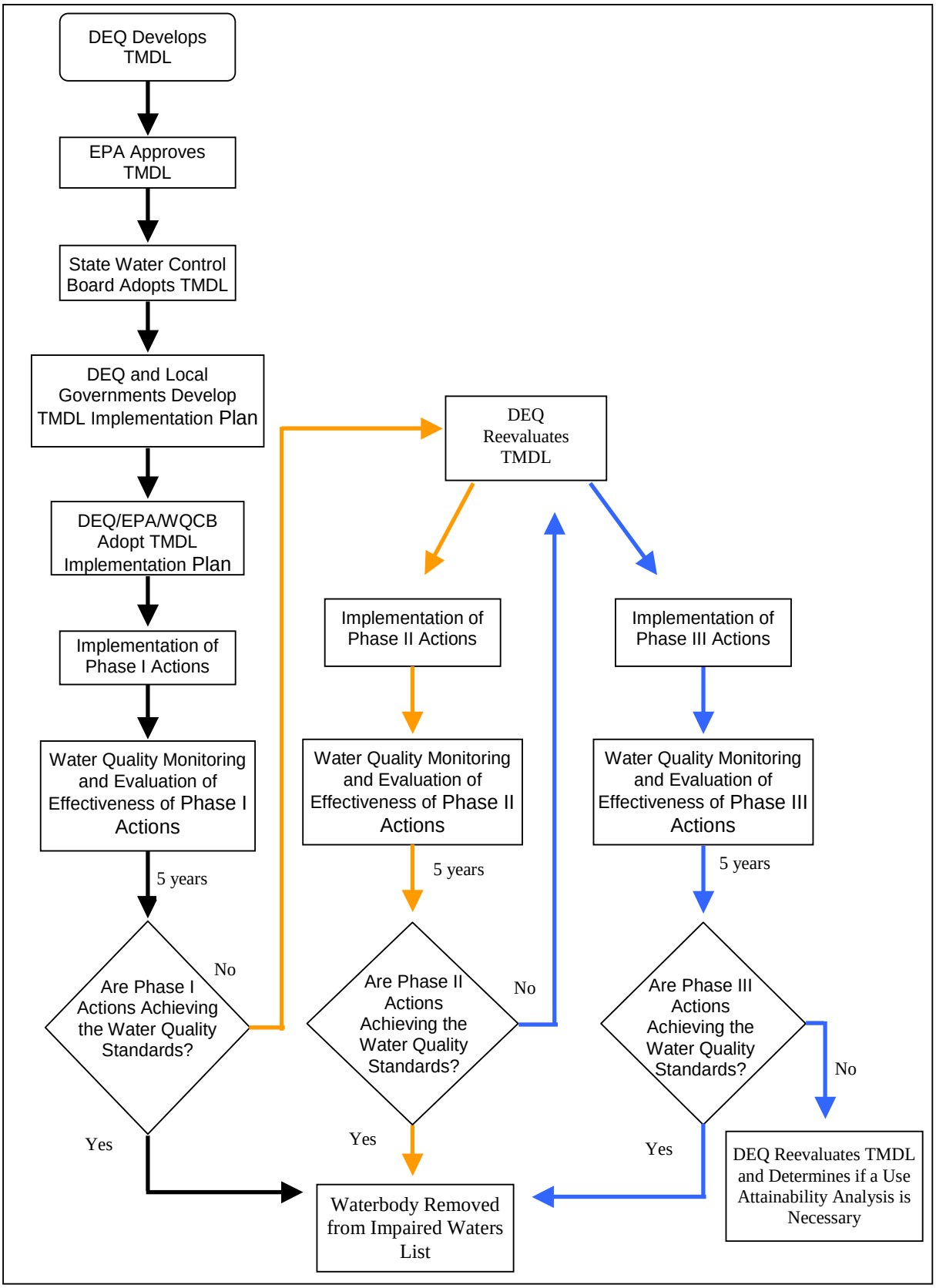
The pollutant reductions in Mill and Powhatan Watersheds will be implemented in a staged fashion. Staged implementation is an iterative process that first addresses those sources with the largest impact on water quality. Stage 1 management actions will target the controllable, anthropogenic bacteria sources identified in the TMDL, setting aside control strategies for wildlife except for cases of over population. During the implementation of the stage 1 scenario, all controllable sources will be reduced to the maximum extent practicable using an iterative approach. DEQ will re-assess water quality data during and subsequent to the implementation of the stage 1 scenario to determine if the water quality standard is attained.

Stage 1 implementation management actions will be divided into four phases. Ongoing actions have already been initiated in response to other regulatory programs, but are expected to reduce bacteria loads to the waterbodies. Phase I actions are those that have been recently initiated or will be initiated in the near future in response to the TMDL and are scheduled for completion within five years. Phase II activities are those that are planned for implementation within the next five to ten years and may not have approved funding sources yet. Phase III actions may require regulatory changes, and they may be implemented as necessary if Phase I

and Phase II actions do not significantly improve water quality within the study area. Stage 1 implementation actions are discussed in greater detail in Section 7.

In some water bodies for which TMDLs have been developed, water quality modeling indicates that even after removal of all bacteria sources (other than wildlife), the water body may not attain standards under all flow regimes at all times. Such is the case for Mill Creek, this water body may not be able to attain standards without some reduction in wildlife load. Virginia and EPA are not proposing the elimination of wildlife to allow for the attainment of water quality standards. While managing over populations of wildlife remains as a limited option to local stakeholders, the reduction of wildlife or changing of a natural background condition is not the intended goal of a TMDL. If water quality standards are not being met after implementation of stage 1 management actions, then it may be determined through a Use Attainability Analysis (UAA) (Stage II) that primary contact recreation is not a viable use for Mill Creek. The UAA process is discussed in greater detail in Section 7.2.

Figure 2-1: Decision Tree for Approval and Revision of TMDL



2.2 Regulatory Background

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies which are exceeding water quality standards. TMDLs represent the total pollutant loading that a water body can receive without violating water quality standards. Water quality standards are numeric or narrative limits on pollutants that are developed to ensure the protection of human health and aquatic life. The TMDL process establishes the allowable loading of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. By following the TMDL process, states can establish water quality based controls to reduce pollution from both point and non-point sources to restore and maintain the quality of their water resources (EPA 1991).

In accordance with Federal regulations at 40 CFR § 130.7, a TMDL must comply with the following requirements: (1) designed to attain and maintain the applicable water quality standards, (2) include a total allowable loading and as appropriate, wasteload allocations (WLAs) for point sources and load allocations for nonpoint sources, (3) consider the impacts of background pollutant contributions, (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated), (5) consider seasonal variations, (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and in-stream water quality), (7) consider reasonable assurance that the TMDL can be met, (8) be subject to public participation.

Once a TMDL is developed and approved by EPA, measures must be taken to reduce pollution levels in the stream. 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 is described along with specific BMPs in the IP. In general, the Commonwealth intends for the pollutant reductions to be implemented in a staged fashion. Staged implementation is an iterative process that first addresses those sources with the largest impact on water quality.

2.3 Designated Use and Water Quality Standard

According to Virginia Water Quality Standards (9 VAC 25-260-5), the term "water quality standards means provisions of state or federal law which consist of a designated use or uses for the waters of the Commonwealth and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC §1251 et seq.)."

According to Virginia Water Quality Standards (9 VAC 25-260-10A), "all state waters 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 be reasonably expected to inhabit them; wildlife; and the production of edible and marketable natural resources (e.g., fish and shellfish)."

Section 9 VAC 25-260-170 is the applicable water quality criteria for fecal coliform impairments. Prior to 2002, Virginia Water Quality Standards specified the following criteria for a nonshellfish supporting waterbody to be in compliance with Virginia's fecal standard for contact recreational use:

> *A. General requirements. In all surface waters, except shellfish waters and certain waters addressed in subsection B of this section, the fecal coliform bacteria shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water for two or more samples over a 30-day period, or a fecal coliform bacteria level of 1,000 per 100 ml at any time.*

If the waterbody had an exceedance rate > 10.5% and had at least two exceedances, the waterbody was classified as impaired and the development and implementation of a TMDL was indicated in order to bring the waterbody into compliance with the water quality criterion. Based on the sampling frequency, only one criterion was applied to a particular datum or data set. If the sampling frequency was one sample or less per 30 days, the instantaneous criterion was applied; for a higher sampling frequency, the geometric criterion was applied. This was the criterion used for listing the impairments included in this study. Sufficient fecal coliform bacteria standard violations were recorded at VADEQ water quality monitoring stations to indicate that the recreational use designations are not being supported.

The EPA has since recommended that all states adopt an *E coli* or *enterococci* standard for fresh water and *enterococci* criteria for marine waters. The adoption of the *E. coli* and *enterococci* standard went into effect January 15, 2003 in Virginia. The new criteria, used in developing the bacteria TMDL in this study, are outlined in 9 VAC 25-260-170 and reads as follows:

> *A. In surface waters, except shellfish waters and certain waters identified in subsection B of this section, the following criteria shall apply to protect primary contact recreational uses:*
>
> *1. Fecal coliform bacteria shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water for two or more samples over a calendar month nor shall more than 10% of the total samples taken during any calendar month exceed 400 fecal coliform bacteria per 100 ml of water. This criterion shall not apply for a sampling station after the bacterial indicators described in subdivision 2 of this subsection have a minimum of 12 data points or after June 30, 2008, whichever comes first.*
>
> *2. E. coli and enterococci bacteria per 100 ml of water shall not exceed the following:*

Standard	***Geometric Mean[1]***	***Single Sample Maximum[2]***
Freshwater[3] *E. coli*	*126*	*235*
Saltwater and Transition Zone[3] *Enterococci*	*35*	*104*

[1] For two or more samples taken during any calendar month.
[2] No single sample maximum for *enterococci* and *E. coli* shall exceed a 75% upper one-sided confidence limit based on a site-specific log standard deviation. If site data are insufficient to establish a site-specific log standard deviation, then 0.4 shall be used as the log standard deviation in freshwater and 0.7 shall be as the log standard deviation in saltwater and transition zone. Values shown are based on a log standard deviation of 0.4 in freshwater and 0.7 in saltwater.
[3] See 9 VAC 25-260-140 C for freshwater and transition zone delineation.

2.4 Mill and Powhatan Creek TMDL Development Efforts

Mill Creek (VAT-G10E-03) was initially listed as impaired on Virginia's 2002 303(d) Report on Impaired Waters due to exceedances of Virginia's water quality standard for fecal coliform. In January 2003, Virginia adopted a water quality standard for enterococci bacteria for saltwater and transition zones and the previous fecal coliform bacteria criteria no longer apply. Mill Creek was listed as not supporting the Recreation Use on Virginia's 2006 305(b)/303(d) Water Quality Assessment Integrated Report (VADEQ, 2006) due to water quality violations of the enterococci bacteria standard.

Powhatan Creek has two segments that have been identified as impaired and do not support the Recreation Use. Segment VAT-G10E-01, the tidal segment of Powhatan Creek, was listed in Virginia's 1998 303(d) TMDL Priority List and Report because of violations of the fecal coliform water quality standard. The tidal segment of Powhatan Creek is currently listed as impaired on Virginia's 2006 305(b)/303(d) Water Quality Assessment Integrated Report due to violations of the enterococci bacteria standard.

Sufficient exceedances of the fecal coliform bacteria standard in the non-tidal segment (VAT-G10R-02) led to a listing in the 2002 305(b)/303(d) Water Quality Assessment Integrated Report. The non-tidal segment of Powhatan Creek is currently listed as impaired on Virginia's 2006 305(b)/303(d) Water Quality Assessment Integrated Report due to violations of the *E. coli* bacteria standard. The non-tidal segment was determined to be meeting water quality standards during the 2008 Water Quality Assessment.

A TMDL study for the Mill and Powhatan Creek watersheds, completed by DEQ in March 2008, examined the watershed characteristics and the sources of fecal coliform to the creeks. Using monitoring data, bacterial source tracking (BST), and watershed models, DEQ assigned maximum allowable loads to each source in the watersheds in order to bring Mill and Powhatan Creeks into compliance with the water quality standard for primary contact recreation.

2.5 Mill and Powhatan Watersheds

Mill Creek and Powhatan Creek are part of the James River basin. The watersheds are mainly within James City County with a small portion in the City of Williamsburg. The land use distributions in the Mill Creek and Powhatan Creek watersheds are very similar and are mainly composed of forest, but with significant residential areas. Agricultural areas are very small and are composed of cropland with small amounts of pasture. Both Mill Creek and Powhatan Creek flow into the James River (USGS Hydrologic Unit Code11010002), which discharges into the Chesapeake Bay at Hampton Roads harbor in southeast Virginia.

The vast majority of the Mill and Powhatan watersheds are located in the Chesapeake Rolling Coastal Plain level IV ecoregion which is a subset of the Southeastern Plains ecoregion (Figure 2.1). The Chesapeake Rolling Coastal Plain ecoregion is composed of "hilly upland with narrow stream divides, incised streams, and well-drained loamy soils" (Woods et al., 1999). Natural vegetation is "mostly Oak-Hickory-Pine Forest (dominants: hickory, longleaf pine, shortleaf pine, loblolly pine, white oak and post oak)" (Woods et al., 1999). Currently, "urbanization and

residential development are extensive" and "less intensive agriculture, general farming, or part time agriculture occurs; the landuse mosaic is distinct from the more forested rolling, Inner Coastal Plain" (Woods et al.1999).

Figure 2-2-1 Location of Mill and Powhatan Watersheds

3.0 STATE AND FEDERAL REQUIREMENTS

3.1 State Requirements

The TMDL Implementation Plan 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 Implementation Plans to be approved by the Commonwealth, they must include the following:

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

3.2 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.

4.0 REVIEW OF TMDL DEVELOPMENT

4.1 Description of Watershed Characteristics

Mill Creek and Powhatan Creek are part of the James River basin. The watersheds are mainly within James City County with a small portion in the city of Williamsburg. Both Mill Creek and Powhatan Creek flow into the James River (USGS Hydrologic Unit Code11010002), which discharges into the Chesapeake Bay at Hampton Roads harbor in southeast Virginia (DEQ 2008).

Using data from the Mid-Atlantic Regional Earth Science Application Center (RESAC) (RESAC, 2000), land uses were grouped into four major categories based on similarities in hydrologic features and bacteria source characteristics. The land use distribution in the Mill Creek and Powhatan Creek watersheds are very similar and are mainly composed of forest, but with significant residential areas. Agricultural areas are very small and are composed of cropland with small amounts of pasture. Land use distribution is displayed graphically in Figure 4.1 and listed in Table 4.1 (DEQ 2008).

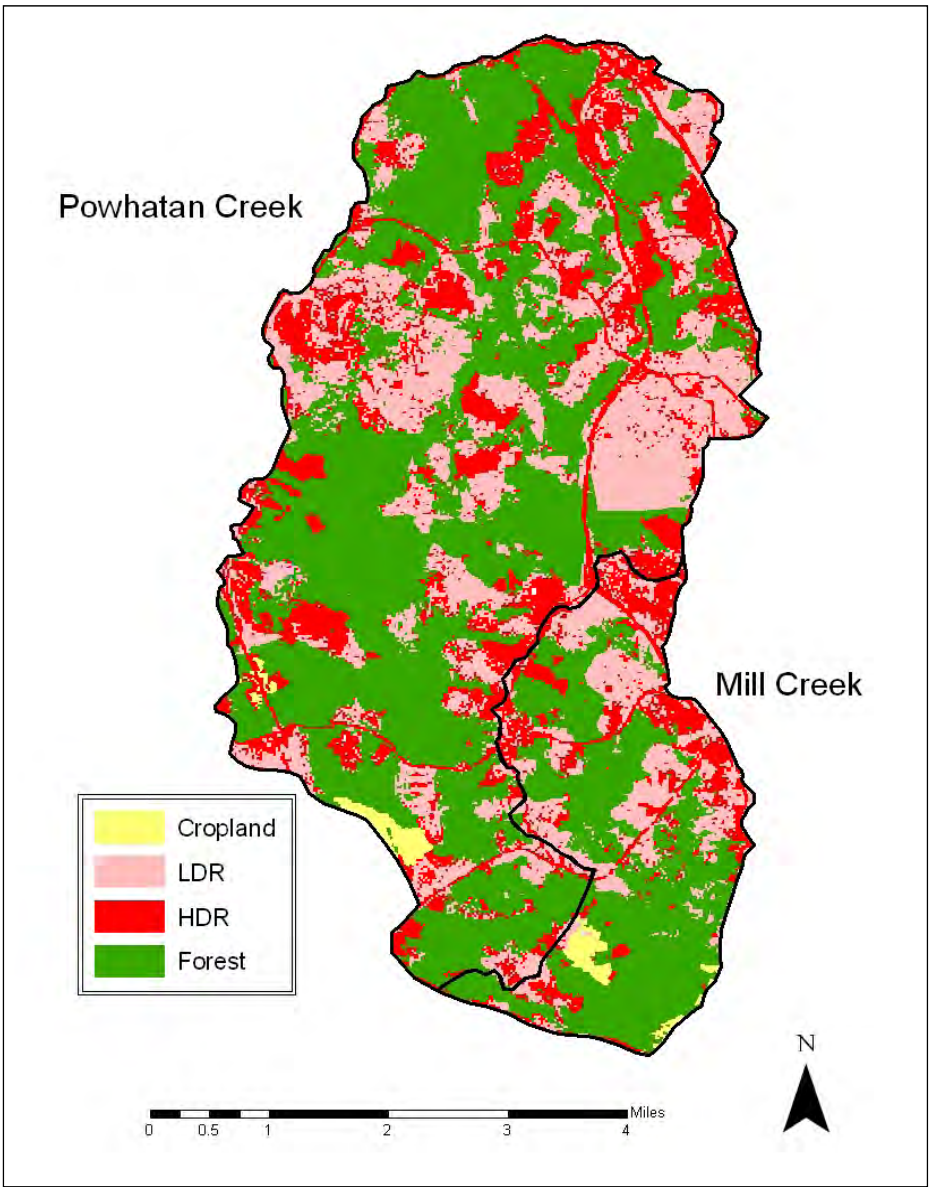
The vast majority of the Mill and Powhatan watersheds are located in the Chesapeake Rolling Coastal Plain level IV ecoregion which is a subset of the Southeastern Plains ecoregion (Figure 2.1). The Chesapeake Rolling Coastal Plain ecoregion is composed of “hilly upland with narrow stream divides, incised streams, and well-drained loamy soils” (Woods et al., 1999). Natural vegetation is “mostly Oak-Hickory-Pine Forest (dominants: hickory, longleaf pine, shortleaf pine, loblolly pine, white oak and post oak)” (Woods et al., 1999). Currently, “urbanization and residential development are extensive” and “less intensive agriculture, general farming, or part time agriculture occurs; the landuse mosaic is distinct from the more forested rolling, Inner Coastal Plain” (Woods et al.1999).

The Mill Creek and Powhatan Creek watersheds lie entirely in the North Atlantic Coastal Plain. This physiographic section is characterized by “sedimentary deposits that range in age from Early Cretaceous to Holocene” (USGS, 1997). There are three predominant State Soil Geographic (STATSGO) soil groups found in the Mill Creek and Powhatan Creek watersheds Hydrologic soil groups describe soil texture in terms of potential for surface runoff and infiltration rates. For example, soils in hydrologic group “A” pass a larger proportion of rainfall through to groundwater than soils in hydrologic group “B.” Conversely, soils in hydrologic group “D” inhibit infiltration such that a large proportion of rainfall contributes to surface runoff and therefore a more direct path to stream channels. The fraction of rainfall that either runs off or infiltrates will impact the bacteria loads transported to streams during storm events.

Table 4-1: 2000 Land Use in Mill and Powhatan Watersheds (DEQ 2008)

	Mill Creek		Powhatan Creek	
Landuse	Area (acres)	Percentage of Watershed	Area (acres)	Percentage of Watershed
Cropland	83	2%	111	1%
Pasture	10	<1%	5	<1%
Low Density	962	25%	3748	27%
High Density	742	20%	2986	21%
Forest	1988	53%	7160	51%

Figure 4-1: 2000 Land Use in Mill Creek and Powhatan Creek Watersheds (DEQ 2008)



4.2 Description of Impairment

Pollution from both point and nonpoint sources can lead to fecal coliform bacteria contamination of water bodies. Fecal coliform bacteria are found in the intestinal tract of warm-blooded animals. Although most fecal coliform are not pathogenic, their presence in water indicates contamination by fecal material. For contact recreational activities such as swimming, health risks increase with increasing fecal coliform counts. If the fecal coliform concentration in a water body exceeds state water quality standards, the water body is listed for violation of the contact recreational use. Virginia has recently adopted an *Escherichia coli* (*E. coli*) water quality standard for freshwater and an enterococci standard for saltwater and transition zones for surface waters. The concentrations of these organisms are considered to be better indicators of health risk than the concentration of the broader fecal coliform group.

Mill Creek (VAT-G10E-03) was initially listed as impaired on Virginia's 2002 303(d) Report on Impaired Waters due to exceedances of Virginia's water quality standard for fecal coliform. Mill Creek is currently listed as not supporting the Recreation Use on Virginia's 2006 305(b)/303(d) Water Quality Assessment Integrated Report (VADEQ, 2006) due to water quality violations of the enterococci standard.

Powhatan Creek has two segments that have been identified as impaired and do not support the Recreation Use. Segment VAT-G10E-01, the tidal segment of Powhatan Creek, was listed in Virginia's 1998 303(d) TMDL Priority List and Report because of violations of the fecal coliform water quality standard. The tidal segment of Powhatan Creek is listed as impaired on Virginia's 2006 305(b)/303(d) Water Quality Assessment Integrated Report due to violations of the enterococci standard.

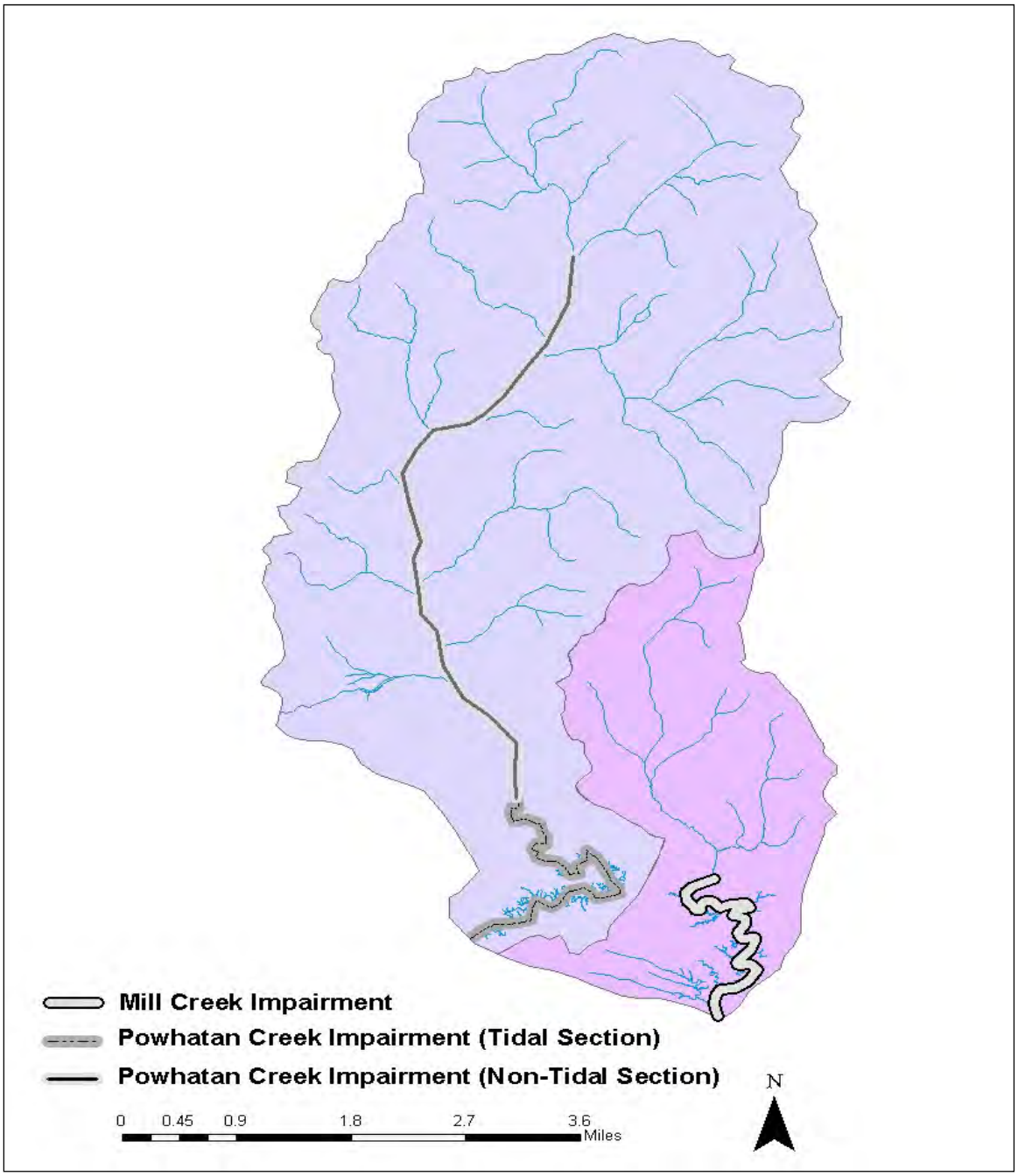
Sufficient exceedances of the fecal coliform bacteria standard in the nontidal segment (VAT-G10R-02) led to a listing in the 2002 305(b)/303(d) Water Quality Assessment Integrated Report. The non-tidal segment of Powhatan Creek is listed as impaired on Virginia's 2006 305(b)/303(d) Water Quality Assessment Integrated Report due to violations of the *E. coli* standard.

A TMDL study for the Mill and Powhatan Creek watersheds, completed in March 2008, examined the watershed characteristics and the sources of bacteria to the creeks. Table 4-2 summarizes the segments for which a TMDL was developed and the associated bacteria indicator and Figure 4-2 illustrates the impaired segments. Using monitoring data, watershed models, and bacterial source tracking (BST), DEQ assigned maximum allowable loads to each source in the watersheds in order to bring Mill and Powhatan Creeks into compliance with the standard for primary contact recreation.

Table 4-2: Mill and Powhatan Creek Impaired Segments

Impaired Segment	Length	Description	Indicator
Powhatan Creek (tidal segment) VAT-G10E-01	0.20 miles	Segment begins at the estuarine/riverine transition and extends to the confluence with James River.	Enterococci
Powhatan Creek (non-tidal segment) VAT-G10R-02	4.85 miles	Segment extends from the confluence with Long Hill Swamp downstream to the estuarine/riverine transition.	E. coli
Mill Creek VAT-G10E-03	1.2 miles	Segment begins at end of tidal influence and extends to the confluence with James River.	Enterococci

Figure 4-2: Impaired Segments in the Mill and Powhatan Watersheds (DEQ 2008)



4.3 Description of Water Quality Monitoring

VADEQ monitors water quality at one station in Mill Creek and two stations in Powhatan Creek. The locations of the monitoring stations used in the TMDL are shown in Figure 4-3 and Table 4-3. Details for fecal coliform data collected at each station are given in Table 4-5. Sufficiently long periods of record are available at each station for use in assessing characteristics of the pollutant loads, such as seasonality, and for calibration of the model.

The bacteria source characterization of the Mill Creek and Powhatan Creek watersheds show a potential for bacteria contributions from agriculture, wildlife, and urban sources. The exceedance rates for the stations causing the impairment listings for these watersheds are given in Table 4-4. As a consequence of these exceedances, Mill Creek and Powhatan Creek were assessed as not supporting the Primary Contact Recreational Use Goal for the 2006 305(b) report and were included on the 2006 303(d) list (VADEQ, 2008).

Table 4-3: Location of DEQ Water Quality Monitoring Stations

Station ID	Station Description	Stream Name
2-MIC000.03 (tidal)	Colonial Parkway Bridge	Mill Creek
2-POW000.60 (tidal)	Colonial Parkway Bridge	Powhatan Creek
2-POW006.77 (non-tidal)	State Route 613 Bridge	Powhatan Creek

Table 4-4: Bacteria Standard Exceedances During the 2004 Assessment Period (2000-2004)

Station ID	Exceedances of Interim Fecal Coliform Standard
2-MIC000.03	11 of 38 (29%)
2-POW000.60	9 of 38 (24%)
2-POW006.77	4 of 38 (11%)

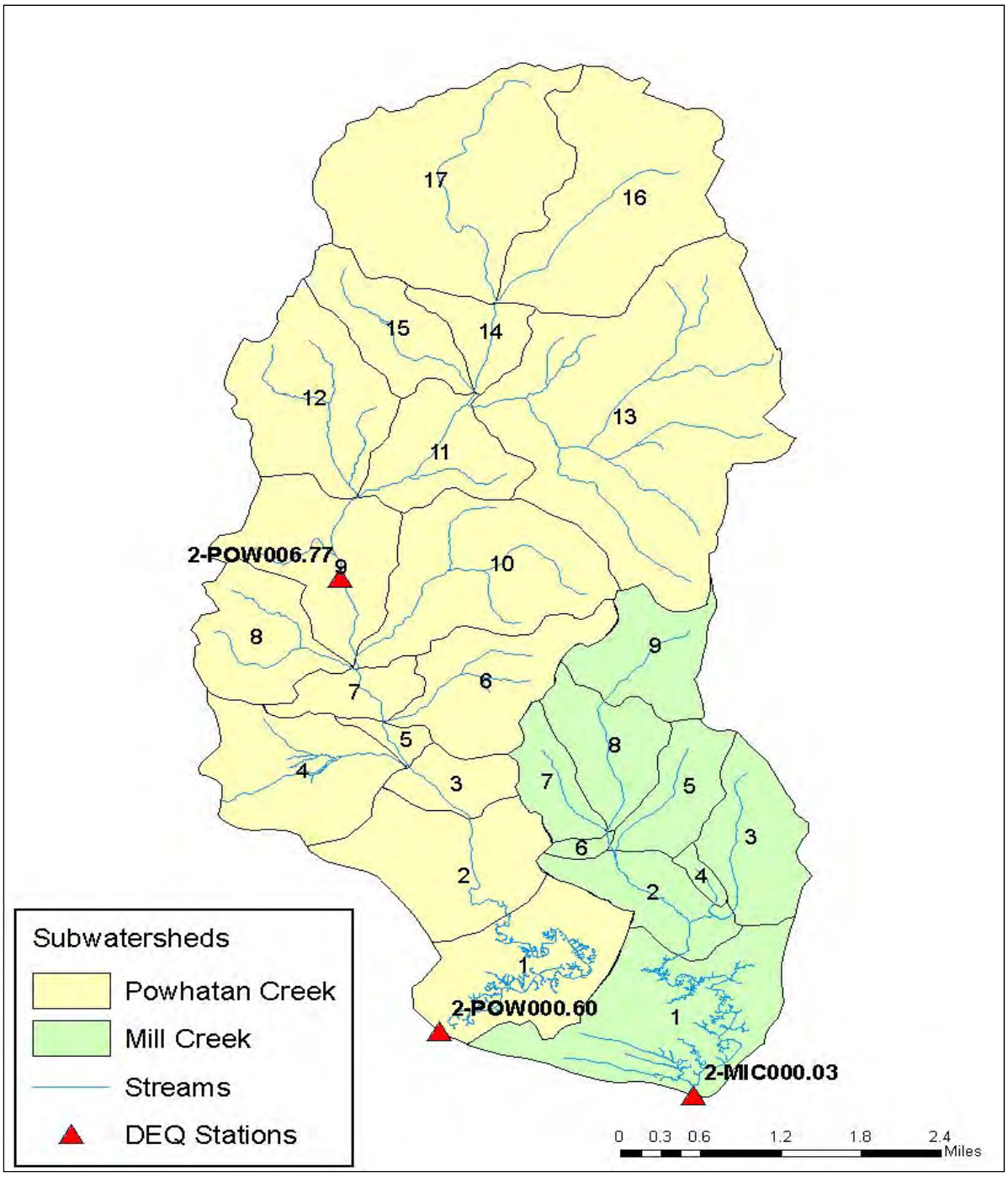
Table 4-5: Summary of Water Quality Data Considered in the TMDL Study

Station ID	Sample Date†		No. of Samples	Sample Value (cfu/100 mL)			Exceedances of Single Sample Standard	
	First	Last		Min	Max	Avg	No	. %
2-MIC000.03	7/14/92	1/5/06	134	2	2400*	373	32	24
2-POW000.60	11/5/92	1/5/06	131	8	1600*	359	31	24
2-POW006.77	1/16/95	5/12/05	88	25	3200*	252	13	15

*Capped value

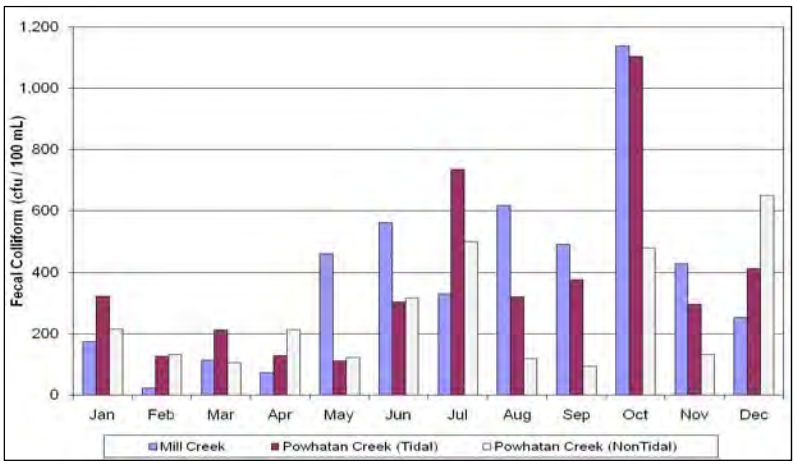
†As of January 2007

Figure 4-3: Water Quality Monitoring Stations Maintained by DEQ



Seasonality of fecal coliform concentrations in the streams was evaluated by plotting the mean monthly fecal coliform concentrations observed at the listing stations (Figure 4-4). Mean monthly fecal coliform concentration was calculated as the mean of all values in any given month for the period of record. The period of record for each station is listed in Table 4-5. A seasonal trend is apparent for both Mill Creek and Powhatan Creek with lower concentrations occurring during the winter and spring and higher concentrations in the summer and fall.

Figure 4-4: Seasonality of Fecal Coliform Concentrations (DEQ 2008)



4.4 Description of Water Quality Modeling

TMDL development requires the use of a watershed-based model that integrates both point and nonpoint sources and simulates in-stream water quality processes. The Hydrologic Simulation Program – FORTRAN (HSPF) version 12 (Bicknell *et al.*, 2001; Duda *et al.*, 2001) was used to model fecal coliform transport and fate in the Mill Creek and Powhatan Creek watersheds. The presence of a tidal zone within the impaired reaches for both Mill and Powhatan Creeks required the addition of a tidal model to accurately model tidal fluxes in the tidal zones. A Tidal PRISM water quality model for small coastal basins and tidal creeks (Kuo and Park, 1994) was used to model fecal coliform transport and fate in the tidal zones.

The HSPF model simulates nonpoint source runoff and pollutant loadings, performs flow routing through streams, and simulates in-stream water quality. HSPF estimates runoff from both pervious and impervious surfaces in the watershed and stream flow in the channel network.

The water quality calibration of both the HSPF and Tidal PRISM models was accomplished using water quality data collected in each watershed. Data from monitoring station 2-POW006.77 was used to calibrate HSPF for the nontidal portion of Powhatan Creek. Because no monitoring data was available for the non-tidal portion of Mill Creek, the calibrated HSPF water quality parameters for the Powhatan Creek were used for simulations of the non-tidal section of Mill Creek. Data from two stations located in the tidal portions of Powhatan (2- 7 POW000.60) and Mill Creek (2-MIC000.03) were used for the Tidal PRISM calibration.

Additional details on the input data used for the modeling and the calibration process can be found in the 2008 TMDL Study.

4.5 Description of Sources Considered

Fecal coliform sources in the Mill Creek and Powhatan Creek watersheds were characterized using data and anecdotal information from the following: Virginia DEQ, Virginia Department of Conservation and Recreation (DCR), Virginia Department of Game and Inland Fisheries (DGIF), Virginia Department of Agricultural and Consumer Services (VDACS), Virginia Department of Health (VDH), public participation, watershed reconnaissance and monitoring, published information, and professional judgment. Point sources and nonpoint sources of fecal coliform are discussed below and described in detail in the TMDL report. In an effort to adequately represent the historic condition of the watershed, changes to some fecal coliform source populations were made for existing conditions and future conditions.

4.5.1 Point Source Contributions

There were four point sources permitted to discharge fecal coliform bacteria in the Mill Creek and Powhatan Creek watersheds. These permitted discharges were for the Municipal Separate Storm Sewer System (MS4) permits for James City County, the City of Williamsburg, Eastern State Hospital, and the College of William and Mary. For this study, the load generated from the College of William and Mary MS4 was aggregated with Williamsburg; Eastern State Hospital MS4 was aggregated with James City County. Although the MS4 conveys runoff from precipitation events, it is considered a point source. The permit allows for the collection and discharge of urban stormwater runoff into a waterbody. Methods to reduce the pollutant load from the MS4s will be included in the next general permit cycle.

4.5.2 Non-Point Source Contributions

Sources of nonpoint source bacteria pollution within the watersheds include livestock, wildlife, pets, and humans. Analysis indicates that significant bacteria loads come from wildlife directly depositing feces in the stream. Wildlife also contribute to loads on land surfaces in accordance with the habitat range for each species. Livestock directly depositing bacteria on the land surface also contribute a significant amount of bacteria to the stream during large storm events. Pets contribute to bacteria loads from the land surface, primarily from residential areas. The amounts of bacteria produced by these nonpoint sources were estimated on a monthly basis to account for seasonal variability in wildlife behavior and livestock production and practices. Table 4-6 summarizes the bacteria produced as a function of where the bacteria are deposited (DEQ 2008).

Table 4-6: Modeled Relative Contribution of Non Point Sources of Bacteria

	Percent of Total	
Source	**Mill**	**Powhatan**
Direct loading to streams		
Wildlife in stream	3	<1
Loading to land surfaces		
Cropland	<1	<1
Pasture	18	3
Residential	73	96
Forest	6	<1

4.6 TMDL Load Reductions and Allocation Results

The Total Maximum Daily Load or total allowable load for a waterbody is composed of a waste load allocation (WLA), load allocation (LA), and margin of safety (MOS).

Total Allowable Load = Waste Load Allocation (WLA) + 5%MOS + Load Allocation (LA)

Total Allowable loads were calculated by multiplying the applicable bacteria criteria by the volume of water. Receiving water volumes were calculated using 1-meter depth profiles from the National Elevation Dataset (NED). The waste load allocation portion of this load refers to the portion of the pollutant load that is delivered to the waterbody from wastewater treatment plants or storm water management systems. In a system like Mill Creek and Powhatan Creek where there are no point source discharges from wastewater treatment plants, the WLA is approximate. It can be, and was, equated to the water that can be expected to be delivered to the waterbody through the stormwater management system. The stormwater management system is designed to collect water from the developed areas of the watershed, so the portion of the total load allocated as the waste load can be equated to the average amount of impervious area within the watershed. Table 4-7 summarizes the total allowable loads for Mill Creek and Powhatan Creek.

Table 4-7: Total Load Allocations and Percent Reductions for Mill and Powhatan Creeks (DEQ 2008)

Waterbody	Source	ΣWLA	ΣLA	MOS*	TMDL
Non-tidal Powhatan Creek	Non point Sources		236×10^{12}		
	Future Load	2.4×10^{12} (1% of LA)			
	James City County (VAR040037 & VAR040076)	15×10^{12}			
	City of Williamsburg (VAR040027 &VAR040039)	0.4×10^{12}			
	Total	17.8×10^{12}	236×10^{12}		253.8×10^{12}
Tidal Powhatan Creek	Source	ΣWLA	ΣLA	MOS*	TMDL
	Non point Sources		14 x 1012		
	Future Load	0.14×10^{12} (1% of LA)			
	James City County (VAR040037 & VAR040076)	6.9×10^{12}			
	City of Williamsburg (VAR040027 &VAR040039)	0.2 x 1012			
	Total	7.24×10^{12}	14×10^{12}		21.24×10^{12}
Mill Creek	Source	ΣWLA	ΣLA	MOS*	TMDL
	Non point Sources		60 x 1012		
	Future Load	6×10^{11} (1% of LA)			
	James City County (VAR040037 & VAR040076)	3×10^{12}			
	City of Williamsburg (VAR040027 &VAR040039)	0.03×10^{12}			
	Total	3.63×10^{12}	60×10^{12}		63.63×10^{12}
*Implicit MOS					

5.0 ADDITIONAL INFORMATION SINCE TMDL DEVELOPMENT

Since the development of the Mill and Powhatan TMDL Study in 2008, additional data has been collected that can aid the understanding of water quality dynamics within the watershed.

5.1 Land use Changes

An assessment of James City County land use data shows that as of 2007, development in the Powhatan Creek watershed had continued to the degree that 14.4% of the watershed is considered impervious. This number is expected to reach 18.8% once the watershed is fully built out. An assessment of 2009 data shows that 21% of the Mill Creek watershed is impervious. Once the few remaining portions of the watershed are fully developed, this number is expected to reach 23.5%

5.2 Sanitary Sewer System Improvements

Several sewer system improvements have been implemented in the Powhatan Creek watershed by the James City Service Authority (JCSA) since the completion of the TMDL.

- Sewer pipe was slip-lined with HDPE pipe from lift station 1-1 to 1-2 at a cost of $1,000,000. This successfully reduced inflow/infiltration to the point that a sanitary sewer evaluation survey (SSES) in this area is not necessary.
- Crushed pipe in the Fords Colony area was repaired removing a partial blockage and restoring normal function to the system in that area.

5.3 2008 Water Quality Assessment

The 2008 Integrated Report summarized water quality conditions in Virginia from January 1, 2001, to December 31, 2006. The non tidal segment of Powhatan Creek (VAT-G10R-02) was not listed as impaired during this assessment cycle. Additional monitoring demonstrated that the segment upstream of station 2-POW006.77 was fully supporting Water Quality Standards.

5.4 JCC Coliscan Easygel Monitoring

In order to gather additional information about the distribution of bacteria sources in the watersheds, the James City County Stormwater Division, with assistance from the VDEQ, began monitoring for indicator bacteria in April 2009 using the Coliscan Easygel method from Micrology Laboratories. The Coliscan Easygel method measures total coliforms and *E. coli.* The process involves adding a water sample to a liquid medium, pouring the combined sample and medium onto a treated petri dish and then incubating for a specified period of time. The results are then “read” by counting the number of bacteria colonies. VDEQ included the Coliscan Easygel method in the *Virginia Citizen Water Quality Monitoring Program Methods Manual*, October 2007, as an acceptable tool for screening purposes. Monitoring is underway at seven sites on Powhatan Creek and five in Mill Creek. Data is collected on a monthly basis, on an ebb tide.

Results from the tests have varied with a few notable areas of concern. There are some locations that show elevated bacteria levels from time to time, with little pattern, and trends are difficult to distinguish with this small amount of data. Generally, the Mill Creek area looks like an overall bigger concern with regard to bacterial loading.

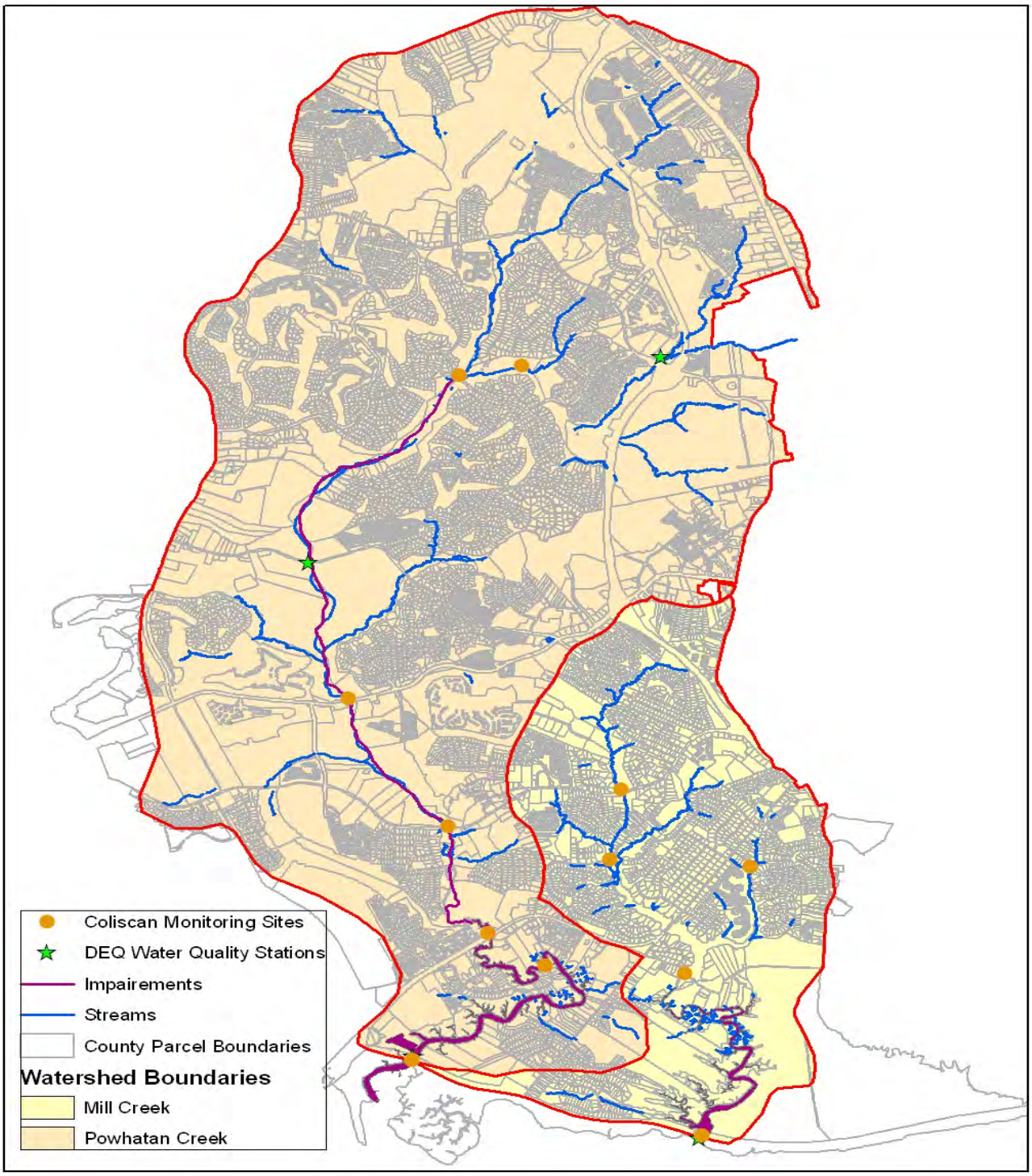
Areas of significance include the eastern branch of Mill Creek, generally east of Jamestown Road and upstream from the Lake Powell wetland. Repeated high counts from that site have fostered further investigation into the area. Other sites are large flood plain areas, likely inhabited by wildlife.

Table 5-1: James City County Coliscan Monitoring

Waterbody	Site	Description of site	Total *E. coli* *	Total *E. coli* *	Total *E. coli* *	Total *E. coli* *	Total E. coli*	Total *E. coli* *	Total *E. coli* *	Total *E. coli* *	Total E. coli *	Total E. coli *	Total E. coli *
			4/13/09	5/13/09	6/17/09	7/15/09	8/12/09	9/14/09	10/12/09	11/10/09	12/11/09	1/26/10	2/23/10
Mill Creek	MCA	Colonial Parkway	50	50	150	0	100	0	800	50	700	50	0
Mill Creek	MCB	Lake Powell Dam Rd	0	0	50	0	200	150	600	100	450	650	50
Mill Creek	MCC	end of Canham Rd	200	600	600	2650	700	3200	450	1050	400	450	150
Mill Creek	MCD	bridge @ Hickory Signpost Rd	100	50	700	1050	250	450	350	100	0	350	400
Mill Creek	MCE	Rte 5	50	100	1900	950	400	600	100	50	100	300	200
Powhatan Creek	PCA	Chisel Run at Edinburgh	0	0	0	50	150	50	550	0	100	50	100
Powhatan Creek	PCB	Powhatan main stem at Edinburgh	0	50	200	300	350	150	1450	0	150	100	300
Powhatan Creek	PCC	Colonial Parkway	50	50	0	50	0	0	100	50	200	100	0
Powhatan Creek	PCD	main stem at Jamestown Rd	200	150	200	150	450	200	450	100	100	50	50
Powhatan Creek	PCE	Monticello Bridge	0	0	0	50	650	0	100	0	0	100	0
Powhatan Creek	PCF	Rte 5		0	50	50	0	0	100	0	100	100	0
Powhatan Creek	PCG	Landfall at Jamestown		0	50	50	150	100	300	150	100	50	0

*The numbers in the spreadsheet are recorded as the number of E.Coli cells/100 ml.

Figure 5-1: Map of Coliscan Monitoring Stations



6.0 PUBLIC PARTICIPATION

An essential step in implementing a TMDL is the input from a broad range of individuals, agencies, organizations and businesses because of their interest and familiarity with local water quality needs and conditions. Public participation facilitates dialogue between local stakeholders and government agencies to commit resources to TMDL implementation, such as funding and technical support. Community members are best suited to identify and resolve sources of water quality problems. In order to engage the public in the development of the TMDL Implementation Plan for the Mill Creek and Powhatan Creek Watersheds, two public meetings were held on June 18, 2009 and May 13, 2010. James City County, State agencies, and community groups are pursuing a number of activities independently of the TMDL Implementation Plan Process. Where appropriate, these initiatives were incorporated into the TMDL Implementation Plan process.

A work group was established to guide development of the TMDL Implementation Plan. The work group met approximately on a monthly basis to review background materials and draft elements of the implementation plan. A list of meeting dates and the number of attendees can be found in Table 6-1. The work group was composed of representatives of County departments, local advocacy groups, and state agencies.

- Friends of the Powhatan Creek Watershed
- James City County Concerned Citizens
- James City County – Environmental Division, Stormwater Division
- James City County Service Authority
- Hampton Roads Planning District Commission
- Virginia Department of Environmental Quality
- Virginia Department of Conservation and Recreation
- Virginia Department of Health

Because of the well informed citizen groups in these watersheds, this work group was able to function as the technical advisory committee for the development of the Implementation Plan. Given the small size of the Mill and Powhatan Creek watersheds, there was not a need to form additional working groups.

Table 6-1: Technical Advisory Group Meetings

Technical Advisory Meeting Date	Number of Attendees
May 5, 2009	11
June 9, 2009	8
July 28, 2009	5
December 8, 2009	9
February 9, 2010	8
March 23, 2010	7

7.0 IMPLEMENTATION OPTIONS

Implementation of this TMDL will contribute to the ongoing water quality improvement efforts aimed at restoring water quality in the Chesapeake Bay. In general, reduction strategies will be implemented in a staged process that first addresses sources with the largest impact on water quality. In urban areas, the focus will be on reducing pollution due to sanitary sewer overflows, septic system failures, stormwater runoff and recreational boating. Because both the Mill and Powhatan Creek watersheds are highly urbanized, (agricultural land uses account for less than two percent of the land area), there are no agricultural management practices proposed in this Implementation Plan.

7.1 Linking the TMDL to Implementation

The Mill Creek and Powhatan TMDL was approved by EPA in 2008, but relied largely on data collected prior to 2006. Water quality monitoring of the system has been ongoing and several studies have been undertaken since the completion of the TMDL to better understand the sources of bacteria loading. It is important to consider both the TMDL as well as the additional information obtained since its completion when developing the implementation actions that may improve water quality within the Mill and Powhatan watersheds. It should be noted that due to uncertainty, the allocations contained in the TMDL study should, but may not, result in attainment of the bacteria standard for primary contact recreation in Mill Creek and Powhatan Creek. The success of the management actions proposed in this document will be determined by ambient water quality data rather than attainment of load allocations.

James City County and its partners will utilize an adaptive management approach in the implementation of the management actions described within this report. These management actions discussed in detail in subsequent sections were chosen because it is believed they will have the greatest effect on improving water quality within the Mill Creek and Powhatan Creek Watersheds. As actions are implemented, water quality data are collected, and new information and technology become available, James City County, in consultation with the Commonwealth, will discontinue actions that are deemed ineffective and add actions that may not be included in this report.

7.2 Identifying Implementation Actions

The implementation actions discussed below were developed to reduce human, livestock and pet sources of bacteria loading to Mill Creek and Powhatan Creek. These actions will be implemented in three phases as identified in Table 7-1. Ongoing actions have already been initiated in response to other regulatory programs, but are expected to reduce bacteria loads to the waterbodies. Phase I actions are those that have been recently initiated or will be initiated in the near future in response to the TMDL and are scheduled for completion within five years. Phase II activities are those that are planned for implementation within the next five years but may not have approved funding sources yet. Phase III actions may require regulatory changes, but they may be implemented as necessary if Phase I and Phase II actions do not significantly improve water quality within the study area. If all these actions prove to be insufficient to meet

the water quality criterion for primary contact recreation in all or parts of Mill and Powhatan Creeks, then the designation of these waters may need to be further evaluated.

In order to remove a designated use or establish subcategories of a use, the state must demonstrate 1) that the use is not an existing use, 2) that downstream uses are protected, and 3) that the source of bacterial contamination is natural and uncontrollable by effluent limitations and by implementing cost-effective and reasonable best management practices for non-point source control (9 VAC 25-260-10). This and other information is collected through a special study called a Use Attainability Analysis (UAA). All site-specific criteria or designated use changes must be adopted as amendments to the water quality standards regulations. Watershed stakeholders and EPA will be able to provide comment during this process. Follow-up monitoring, described in Section 8.4, will evaluate if the water quality goals are being met. If water quality standards are not being met, a UAA may be initiated to reflect the presence of naturally high bacteria levels due to uncontrollable sources.

Table 7-1 Management Options for Implementation of Mill and Powhatan Creek TMDL

Management Category	Management Option	Development Phase
Sanitary Sewer Improvements	Implementation of SSES Plan	Ongoing
	Implement schedule of Regional SSO Consent Order	Ongoing
	Participation in HRFOG education program	Ongoing
Septic System Programs	CBPA Septic Tank Pump Out and Inspection Information Program	Ongoing
	Update septic system locations through pump out program	Ongoing
	Field survey to estimate septic system failure rates	Phase I
	Implement procedures to address failing septic systems	Phase I
	Develop an onsite wastewater treatment funding program	Phase II
	Increase enforcement actions for failing systems	Phase III
Stormwater Quality Programs	Enforcement of Illicit Discharge provisions within the Stormwater Management Ordinance	Ongoing
	County rain barrel rebate program	Ongoing
	Private BMP Inspection and Maintenance Programs	Ongoing
	IDDE screening in Mill and Powhatan Creek watersheds	Phase I
	Coliscan Monitoring in Mill and Powhatan Creeks	Phase I
	Participation in Regional Bacteria Source Tracking Study	Phase I
	Estimate Stormwater contribution to bacteria loading	Phase II
	Investigate retrofits for wet ponds that would reduce bacteria	Phase I
	Retrofit wet ponds to reduce bacteria concentrations	Phase II
Boating Programs	Sewer improvements and pumpout facility at County Marina	Phase I
	Expanded Boater Education Program	Phase II
	Investigate No Discharge designation for Powhatan Creek	Phase III
	Examine environmental benefits of No Wake Zones	Phase III
Pet Waste Programs	Participation in HRSTORM regional education program	Ongoing
	County "Scoop the Poop" campaign	Ongoing
	Pet waste collectors in County Parks	Phase I
	Free pet waste stations for neighborhoods	Phase I
	Investigate viability of Pet Waste Ordinance	Phase III
Aquatic Resource Restoration	County Stream Restoration Program	Ongoing
	Add wetlands restoration program	Phase III
	Identify areas for sea grass restoration	Phase III
Land Use Management	Chesapeake Bay Preservation Area Ordinance	Ongoing
	Implementation of Special Stormwater Criteria	Ongoing
	Enforcement JCC Erosion and Sediment Control Ordinance	Ongoing
	Implementation of JCC Guidelines for Design and Construction of Stormwater Management BMPs	Ongoing
	PRIDE Program	Ongoing
	Watershed Plan for Powhatan Creek Watershed	Complete
	Watershed Plan for Mill Creek Watershed	Phase I
	Implement bacteria priority areas in Powhatan Watershed	Phase II
	Local Delegation of VSMP	Phase III
Wildlife Contribution Controls	BMP Buffer Management	Ongoing

7.2.1 Sanitary Sewer System Improvements

The TMDL calls for a 92 percent reduction in bacteria loading from residential sources in the Powhatan Creek watershed and 95 percent in the Mill Creek watershed. Sources of human bacteria loading to these waterways include sanitary sewer overflows (SSOs) and failing septic systems. SSOs occur when sewer pipes become blocked due to roots, grease or sediment, or when the system loses electric power at pump stations.

James City County is currently involved in a regional effort to work with HRSD, thirteen other Hampton Roads localitie, Virginia DEQ, and EPA Region 3 to develop and implement a plan to address SSOs. The County entered into a Consent Order with DEQ in September, 2007 that outlined actions necessary to reduce SSOs. The actions include the development and implementation of a Sanitary Sewer System Evaluation Survey (SSES) and the development and implementation of a Condition Assessment and Rehabilitation Plan.

The SSES has three phases, two of which have been completed. The first phase involved the physical inspection of 100% of the sewer manholes in each SSES basin. The second phase involved the smoke testing of the system to identify leaks and interconnections with the stormwater system. The final phase will involve the closed circuit tv inspection of the sewer lines. All aspects of the SSES need to be complete by 2011. After the SSES is complete, the Condition Assessment and Rehabilitation Plan will be developed, which will contain improvements to the system necessary to correct identified deficiencies. This Plan will be implemented over the next 10 to 15 years.

It is too early in the process to develop a list of projects and priorities that will be completed in the Mill and Powhatan Creek watersheds. However, one project has been identified for completion in the Powhatan Creek watershed. A long section of the interceptor gravity sewer line along the main stem of Powhatan Creek will be lined to reduce structural failures of the pipe, and thereby reduce SSOs. The project is estimated to cost $1,800,000.

7.2.2 Septic System Programs

The other source of human bacteria in residential areas is failing septic systems. Both watersheds are located entirely within the County's Primary Service Areas (PSA). Any new development within the PSA must connect to the sewer if it is available. It is considered available for a subdivision development if the parcel is within 1000 feet of a sewer line and for all other construction, if sewer is within 300 feet, that project will have to connect. So, it is unlikely that any new septic systems will be installed in either watershed.

Concerning existing septic systems, there are approximately 360 systems in the Mill and Powhatan Creek watersheds. The County currently requires an inspection or pump-out of septic systems at least once every five years. A survey of 60 systems in the two watersheds was conducted by the County in late 2009. Based on that survey, less than 1% (1) of the systems had visible problems.

There are currently no plans to extend sewer lines in either the Mill or Powhatan Creek watersheds to reduce the number of septic systems. However, given the relatively few systems present in the watersheds and a fairly small failure rate, it is unlikely that failing septic systems are a major source of bacteria. Increased education and enforcement efforts related to the septic system maintenance requirements can help reduce failing septic system bacteria contributions.

The Virginia Department of Health will follow its standard procedures to address failing septic systems within the Mill and Powhatan watersheds. A complaint or report of a failing septic system is reported to the Virginia Department of Health (VDH). The Health Department contacts the owner of the property to ascertain the validity of the claim. If the drainfield is determined to be failing, the system is analyzed for the cause of failure. The owner of the property is then sent a Notice of Violation letter which states that a violation of the state regulations may be occurring and advises them of a time period in which they need to correct the violation.

Property owners who may have difficulty correcting failing septic systems due to lack of funding may be referred to James City County Community Development or be provided with information for the Betterment Loan Program (Created by Title 32.1-164.1:2 of the Code of Virginia). There is currently a waiting list for this program. If an owner refuses to correct the problem, the Health Department may resort to legal action.

In addition to the Betterment Loan Program, James City County offers an emergency home repair program to address immediate needs such as septic tank pumpouts and system replacements. Similar to the loan program, there are income limits and James City County works with Housing Partnerships, Inc. and other providers to assist those who may not meet the emergency program limits. In James City County, system replacements can typically cost between $6,500 and $7,500. Advanced replacement systems for difficult-to-treat sites can cost as much as $23,000. Grinder pumps often cost over $12,000. Information on this program can be found at http://www.jccegov.com/communityservices/housing-com-dev.html.

In the future, James City County may also consider expansion of the emergency home repair program to provide for the reduction of nitrogen, phosphorus and pathogens being released by continued use of failing septic systems. The program would be designed to assist low-moderate income homeowners with repair/replacement of non-functioning systems with nutrient reducing systems or homeowners whose properties are eligible to install conventional systems but unable to afford repairs without assistance. James City County would work with the Health Department to identify failing septic systems and offer financial assistance to homeowners to assist them in repairing failing systems. It is estimated that grant funding, potentially through the DCR WQIF program, could assist 10-13 homeowners to repair or replace failing systems, with approximately $80,000 over a 2 year period. Additional low interest loans may be available through the Virginia Revolving Loan Program to be blended with grant funds for each project.

7.2.3 Stormwater Quality Programs

The TMDL calls for reductions in bacteria delivered to waterbodies through urban stormwater runoff. Traditional definitions of stormwater have usually characterized it as nonpoint source runoff. However, most urban and industrial stormwater is discharged through conveyances, such as separate storm sewers, ditches, channels or other conveyances, which are considered point sources under the Clean Water Act (CWA), and subject to regulation through the National Pollutant Discharge Elimination System (NPDES) permit program.

Virginia is an authorized state under the federal permitting program. DCR administers the federal program pertaining to the municipal separate storm sewer systems (MS4s) and construction activities as part of the Virginia Stormwater Management Program (VSMP) permit program, which is authorized under the Virginia Stormwater Management Act. As mandated by the Clean Water Act and EPA's Phase 1 (11/16/90) and Phase 2 (12/8/99) stormwater regulations, the federal permitting requirements have been incorporated into the Permit Regulation in sections 4 VAC50-60-380 and 390.

The majority of the Powhatan Creek watershed and the upper half of the Mill Creek watershed are covered by the County's Phase II VSMP permit. The County has implemented or plans to implement the following programs to reduce the bacteria concentrations delivered to the Creeks via stormwater runoff.

7.2.3.1 Coliscan Monitoring

In order to gather additional information about the distribution of bacteria sources in the watersheds, the JCC Stormwater Division, with assistance from the VDEQ, began monitoring for indicator bacteria in April 2009 using the Coliscan Easygel method from Micrology Laboratories. The Coliscan Easygel method measures total coliforms and *E. coli.* The process involves adding a water sample to a liquid medium, pouring the combined sample and medium onto a treated petri dish and then incubating for a specified period of time. The results are then "read" by counting the number of bacteria colonies. VDEQ included the Coliscan Easygel method in Virginia Citizen Water Quality Monitoring Program Methods Manual, October 2007, as an acceptable tool for screening purposes.

Monitoring has been underway since 2009 at seven sites on Powhatan Creek and five in Mill Creek. Data is collected on a monthly basis, on an ebb tide. Going forward JCC Stormwater Division will both continue monitoring existing sites and seek to include additional sites through 2013. Volunteer monitors will be recruited and trained during 2010. Results will be used to identify bacteria management areas for enhanced effort.

7.2.3.2 Wet Pond Retrofits

The Powhatan Creek Stormwater Management Master Plan also identified 24 locations for potential stormwater retrofit sites in the watershed. Some of these potential retrofits include existing or proposed wet ponds. These ponds and others that have been constructed since the study was done need to be investigated for incorporation in the *Bacteria Priority Area*

management option (§7.2.6.3) for possible use in reducing bacteria populations. In addition, the use of aeration systems will be investigated to determine their effectiveness in reducing bacteria populations.

7.2.3.3 Regional Bacteria Source Tracking Study

Many localities within Hampton Roads are faced with the lack of useful bacteria source tracking information provided by Total Maximum Daily Load (TMDL) Studies being developed by DEQ. Stormwater departments throughout the Region experience difficulty in reducing bacteria to impaired waterbodies without sufficient information on the contributing sources, and Utilities departments are being burdened with requests to investigate system deficiencies without reliable evidence. Both departments expressed interest in using reliable methods to determine if bacteria are from a human source. With bacteria TMDLs approved or scheduled for development within all the Hampton Roads localities, locality staff requested additional information on potential bacteria source tracking methodologies.

The Hampton Roads Planning District Commission staff has been leading a regional effort to develop a bacterial identification methodology for the Hampton Roads region. Proven genetic techniques will be used to differentiate bacteria sources at the species level so that TMDL plans can be designed and targeted to address the cause of the bacterial impairment. University researchers will conduct the study, which the Hampton Roads Sanitation District and the following localities have agreed to fund: Isle of Wight, James City County, Norfolk, Portsmouth, Suffolk, Virginia Beach, Williamsburg and York County.

In April 2008 locality staff attended a meeting to hear presentations from leading scientists in the bacteria source tracking field. Dr. Rachel Noble (UNC), Dr. Jody Harwood (USF), and Dr. Charles Hagedorn (VT), provided the attendees with information on the state of the science and the most promising methodologies. Following this meeting, a subcommittee consisting of representatives from the Region's localities and PDC staff was formed to work with the scientists to develop a regional study plan.

The subcommittee considered small watersheds that had completed TMDLs, and selected watersheds that had very high bacteria concentration and/or significant public interest. Three case study sites were selected: Shingle Creek in Suffolk, Moores Creek in York County, and Mill Dam Creek in Virginia Beach. After the Regional Study is complete by the end of 2011, a toolbox of source tracking methodologies will be available to local governments to use in determining if impaired waterbodies are impacted by human sources of bacteria.

7.2.3.4 County Rain barrel Rebate Program

Starting in December 2007, the James City County Service Authority began offering its customers a refund of up to $200 towards the purchase of up to four rain barrels. The purpose of the program was to encourage residents to conserve water used for irrigation and reduce rooftop runoff from residential properties.

7.2.3.5 Phase II General Permit Requirements – Special TMDL Provisions

James City County was issued a new MS4 General Permit for Phase II Stormwater Discharges on July 1, 2008. This permit requires the County to take additional actions to evaluate the stormwater influence on impaired waterbodies with approved TMDLs as of July 1, 2008. The Mill and Powhatan Bacteria TMDL was not approved prior to the effective date of the MS4 permit, so the conditions will not apply in these watersheds until the next permit cycle. However, James City County is already implementing some of the actions ahead of schedule.

7.2.3.5.1 Illicit Discharge Detection and Elimination Program

The operator shall develop and implement outfall reconnaissance procedures to identify potential sources of bacteria from anthropogenic activities. The operator shall perform reconnaissance on all outfalls during the 5-year permit period and shall annually conduct reconnaissance on a minimum of 15% of its known MS4 outfalls discharging to the surface water for which the WLA has been assigned.

7.2.3.5.2 Estimate Stormwater contribution to bacteria loading

The operator shall conduct an annual characterization that estimates the volume of stormwater discharged, in cubic feet and the quantity of pollutant identified in the WLA, in a unit consistent with the WLA, discharged by the regulated small MS4.

7.2.4 Boating Programs

The TMDL called for a 100 percent reduction in bacteria loading from marinas and boats in Powhatan Creek. James City County purchased the Jamestown Yacht Basin in 2006 and began a series of improvements aimed at both user safety and environmental protection. To date the County has:

- eliminated the aging on-site waste disposal system and connected the system to public sewer through a grinder pump and force main
- stabilized the docks to minimize shoreline erosion
- installed new electrical connections for the facility and docks
- upgraded the water supply lines to minimize leaks, conserve water and eliminate on-going erosion along water lines

Installation of a sanitary waste pump-out system was completed in 2010 and the County is considering alternatives to rebuild the fueling docks in order to improve environmental safeguards at the site (Phase I). At this time the facility is leased and operated by a private party. Improvements necessary to meet the Clean Marina Program requirements will be considered during Phase II.

Section 312 of the Clean Water Act requires boats with installed toilets to also have Marine Sanitation Devices (MSDs). Type I and II MSDs are treat and discharge units, while Type III MSDs are holding tanks that must be pumped out at pump out facilities. State law (9 VAC 25-71) prohibits the discharge of raw sewage from boats, holding tanks, or portable toilets. Federal

law prohibits a state from adopting regulations regarding MSDs that are more stringent than federal regulations, but it allows a state to petition EPA for designation of No Discharge Zones (NDZs), where all sewage discharges, treated or untreated, are banned. The state must demonstrate that the particular water body requires special protection and that there are adequate pump out facilities in the area, since boat sewage wastes in NDZs would have to be held until pumped out.

In 2009, Virginia passed HB1774 to amend the § 62.1-44.33 of the Code of Virginia to designate all tidal waters in Virginia as No Discharge Zones. The State is currently developing a prioritization plan for those waterbodies. In the interim, requests for designation must still be made from residents or local governments. James City County will investigate the necessity and feasibility of designating Powhatan Creek as a No Discharge Zone (NDZ).

In order to address shoreline erosion and resuspension of bacteria laden sediment, James City County is studying the feasibility of "No Wake Zones" in Powhatan Creek. The County is also developing an expanded boater education program to provide outreach materials to boaters on ways to reduce their impact on water quality.

7.2.5 Pet Waste Programs

In 2008, recognizing that bacterial impairments were a county-wide problem, James City County initiated a local Scoop-the Poop campaign by placing 15 Dogivalets® in the County park trail system. Of the 15 units, nine are located within the Powhatan Creek watershed. These units dispense pet waste collection bags and provide a safe disposal unit for the bagged waste. Since then, the County has offered similar systems to neighborhoods which agree to undertake the maintenance, prepared a public service announcement (PSA) explaining the use of the Dogivalets® and published information on its webpages. To date, six units have been placed in Powhatan Creek neighborhoods and one unit in a Mill Creek neighborhood. The JCC Stormwater Division has continued to focus on pet owners, participating in the annual Humane Society's Bark-in-the Park fundraiser and developing dog-friendly frisbees with a scoop-the-poop message. HRPDC Scoop-the-Poop campaign materials are extensively utilized. The HRPDC Poop Fairy PSAs air on the County's government and community access channels. In the future, the County may evaluate and consider implementation of a pet waste collection ordinance.

7.2.6 Land Use Management

James City County has several programs that serve to manage development and minimize its environmental impact. Continuation of these programs will serve to protect critical habitats within the Mill and Powhatan watersheds and may be important in reducing the amount of bacteria entering the creek systems.

7.2.6.1 Erosion and Sediment Control

Erosion and sedimentation control measures may indirectly reduce the bacteria loading to waterbodies. Bacteria can cling to small sediments, so erosion prevention measures should

also serve to reduce bacteria loading. The Virginia Department of Conservation and Recreation (DCR) implements the state Erosion and Sediment Control (ESC) Program according to the Virginia Erosion and Sediment Control Law, Regulations, and Certification Regulations (VESCL&R). The law is codified at Title 10.1, Chapter 5, Article 4 of the Code of Virginia, regulations are found at Section 4VAC30-50, and certification regulations are found at Section 4VAC50-50 of the Virginia Administrative Code. The ESC Program's goal is to control soil erosion, sedimentation, and nonagricultural runoff from regulated "land-disturbing activities" to prevent degradation of property and natural resources. The regulations specify "Minimum Standards," which include criteria, techniques and policies that must be followed on all regulated activities. These statutes delineate the rights and responsibilities of governments that administer an ESC program and those of property owners who must comply.

DCR has created the Virginia Erosion and Sediment Control Handbook in order to establish minimum design and implementation standards to control erosion and sedimentation from land-disturbing activities in Virginia. Through the James City County Erosion and Sediment Control Ordinance, all construction in the County must conform to the minimum standards of The Virginia Erosion and Sediment Control Regulations and the Virginia Erosion and Sediment Control Handbook third edition. All construction related activities are to limit land disturbance to the amount necessary to accommodate the desired improvements. Work will be avoided in the tree drip line area and comply with the Virginia Erosion and Sediment Control Handbook with respect to tree preservation and protection. All contractors must have the current edition of the Virginia Erosion and Sediment Control Handbook available on-site.

7.2.6.2 Chesapeake Bay Preservation Ordinance

The Virginia General Assembly adopted the Chesapeake Bay Preservation Act in 1988 and required all localities in Tidewater Virginia to implement local water quality measures by utilizing and developing land in ways that minimize impacts on water quality. James City County responded to this requirement by adopting the state's first Chesapeake Bay Preservation Ordinance (CBPAO) on August 6, 1990. The purpose of the CBPAO is to protect existing high quality waters, prevent an increase in pollution and to restore state waters to a condition that permits all reasonable public uses and supports the growth of healthy aquatic life. This is accomplished by regulating development practices in the watershed. The most highly regulated areas are buffers called Resource Protection Areas (RPAs). RPAs include tidal wetlands, non-tidal wetlands, tidal shores, highly erodible soils, and a vegetated buffer area not less than one hundred feet in width that is adjacent to and landward of these areas. Buffer areas are also located along both sides of any water body with perennial flow. All of the other land in the watershed is labeled as Resource Management Areas, and protects the boundaries of the RPA.

7.2.6.3 Bacteria Priority Areas

The Powhatan Creek Watershed Management Plan dated May, 2002, and its associated Stormwater Management Master Plan identified as a management objective the control of bacteria resulting from development activities in the mainstem areas of the watershed. The

SWM Master Plan recommends that stormwater practices in the tidal portion of the mainstem area be designed to maximize bacteria removal.

For wet ponds and wetland BMPs, these design modifications include: increasing light conditions in the water column, providing a minimum 48 hour detention time for stormwater, designing inlet and outlet structures to prevent re-suspension of bacteria-laden bottom sediments, reducing turf and open areas around ponds to discourage geese and waterfowl populations, and adding shallow benches and wetland areas to enhance the plankton community and increase bacterial predation. For filtering system BMPs, the design modifications include: the use of finer-grained media in the filter bed, extending the detention time for pretreatment chambers, removing sediments from pretreatment areas more frequently, and filters should be oriented to provide maximum solar exposure. For open channel systems, dry swales should be used in place of wet swales, and they should be designed to be self-cleansing or promote maximum sediment retention.

The use of these BMP enhancements needs to be extended to the tidal portion of the Mill Creek watershed as well as the non-tidal portions of both watersheds.

7.2.7 Wildlife Contribution Controls

James City County encourages pond buffers or setbacks to both help filter stormwater and to discourage resident wildlife populations. The County BMP manual provides guidelines on the effective placement and size (width) of buffers. Generally, pond buffers should be at least 25 feet outward from the maximum design high water surface elevation of the pond, usually the 100-year design storm. Forested buffers are particularly desirable adjacent to ponds. Native shrubs and ground covers are recommended in the non-forested areas of the buffer to discourage wildlife. Annual mowing is not required of the pond buffer except in maintenance right-of-ways. In 2011, James City County installed attractive “Do Not Mow Zone” signs along the County-owned BMP pond buffers to lead by example. These signs are evident along walking and biking trails and many sports fields.

7.3 Implementation Costs and Benefits

The primary benefit of the implementation of the management actions described in this IP is the reduction of bacteria levels in Mill Creek and Powhatan Creek. The programs and actions contained within this IP will serve to reduce the anthropogenic sources of bacteria within the Mill Creek and Powhatan Creek Watersheds. However, in addition to and as a result of reducing the amount of bacteria, stakeholders can anticipate benefits within these watersheds that include:

- improved public health
- conservation of natural resources
- improved aquatic life
- improved riparian habitat
- reductions in the amount of flood damage
- improved recreational opportunities
- greater economic opportunities

It is hard to gage the impact that reducing bacterial contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, the incidence of infection from pollutant sources, through contact with surface waters, should be reduced considerably.

The main objective of this IP is improving water quality in Mill and Powhatan Creeks, but additional benefits may include continued economic vitality and strength. Healthy waters can improve economic opportunities for Virginians, and a healthy economic base can provide the resources and funding necessary to pursue restoration and enhancement activities. The residential and urban implementation actions recommended in this IP may provide economic benefits to the landowner, along with the expected environmental benefits. An ancillary benefit may be enhanced real estate values for farms, homes, and businesses located near water bodies with good water quality.

Because the Mill and Powhatan Creek watersheds are located within the Chesapeake Bay watershed, reducing sediment and nutrients loads as a result of BMPs that are installed to reduce bacteria will help obtain implementation goals in the Chesapeake Bay TMDL.

Additionally, money spent by landowners, government agencies, and non-profit organizations in the process of implementing the IP will stimulate the local economy. The residential programs will play an important role in improving water quality, since human waste can carry with it human viruses in addition to the bacterial and protozoan pathogens that all fecal matter can potentially carry. In terms of economic benefits to homeowners, an improved understanding of private sewage systems, including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership (DCR 2003).

Because many of the programs mentioned in this report also serve purposes other than to reduce bacteria, and they may cover areas larger than the Mill and Powhatan Watersheds, the costs of reducing bacteria levels can be difficult to estimate. Estimated costs for proposed management actions and programs are outlined in Table 7-3. The estimated costs for programs such as stormwater management and sanitary sewer system improvements are estimated for the Mill and Powhatan Watersheds from the County-wide annual budgets for these programs.

Table 7-2: Estimated Costs of Management Options

Management Category	Management Option	Estimated Initial Costs[1,2]	Estimated Maintenance Costs[1,2]
Sanitary Sewer Improvements	Implement schedule of Regional SSO Consent Order	$4,095,842	$3 million*
	Participation in HRFOG education program	Ongoing	$7,500
Septic System Programs	CBPA Septic Tank Pump Out and Inspection Information Program	Ongoing	$4,000
	Update septic system locations through pump out program	Ongoing	$20,000
	Field survey to estimate septic system failure rates	$10,000	$20,000
	Implement procedures to address failing septic systems	Ongoing	$20,000
	Develop an onsite wastewater treatment funding program	$20,000	$80,000
	Increase enforcement actions for failing systems	$10,000	$40,000
Stormwater Quality Programs	Enforcement of Illicit Discharge provisions within the Stormwater Management Ordinance	Ongoing	$25,000
	County rain barrel rebate program	Ongoing	$10,500
	Private BMP Inspection and Maintenance Programs	Ongoing	$100,000
	IDDE screening in Mill and Powhatan Creek watersheds	Ongoing	$20,000
	Coliscan Monitoring in Mill and Powhatan Creeks	Ongoing	$12,000
	Participation in Regional Bacteria Source Tracking Study	Ongoing	$25,000
	Estimate Stormwater contribution to bacteria loading	$10,000	$2,000
	Investigate retrofits for wet ponds that would reduce bacteria	$5,000	0
	Retrofit wet ponds to reduce bacteria concentrations	$100,000	$4,160,000
Boating Programs	Sewer improvements and pumpout facility at County Marina	$40,000	$20,000
	Expanded Boater Education Program	$5,000	$5,000
	Investigate No Discharge designation for Powhatan Creek	$5,000	0
	Examine environmental benefits of No Wake Zones	$5,000	0
Pet Waste Programs	Participation in HRSTORM regional education program	$7,500	$7,500
	County "Scoop the Poop" campaign	$5,000	$2000
	Pet waste collectors in County Parks	Ongoing	$2,500
	Free pet waste stations for neighborhoods	$2,500	$250
	Investigate viability of Pet Waste Ordinance	$5,000	0
Aquatic Resource	County Stream Restoration Program	$3,000,000	$300,000
	Add wetlands restoration program	$25,000	$150,000
	Identify areas for sea grass restoration	$25,000	0
Land Use Management	Chesapeake Bay Preservation Area Ordinance	Ongoing	$340,000
	Implementation of Special Stormwater Criteria	Ongoing	
	Enforcement JCC Erosion and Sediment Control Ordinance	Ongoing	
	Implementation of JCC Guidelines for Design and Construction of	Ongoing	
	PRIDE Program	Ongoing	
	Watershed Plan for Powhatan Creek Watershed	Ongoing	
	Watershed Plan for Mill Creek Watershed	$150,000	
	Implement bacteria priority areas in Powhatan Watershed	$10,000	
	Special stormwater criteria for Mill Creek Watershed	10,000	
	Local Delegation of VSMP	TBD	
Wildlife Contribution Controls	BMP Buffer Management	Ongoing	See above

[1] Overall estimates available for broad categories only, based on estimated funding availability, subject to County Board of Supervisors approvals, budget appropriations, grants received, State funding appropriations, and Federal funding appropriations, coupled with known costs for current specific programs and maintenance requirements.

[2] Cost assumptions: 1full time equivalent (FTE) = $100K including fringe, vehicle, office space, equipment, etc.

*Total estimated expenditure over the next 10-15 years.

8.0 MEASURABLE GOALS AND MILESTONES

8.1 Establishing Goals

8.1.1 TMDL Goals

- Reduce fecal bacteria load in order to meet the Total Maximum Daily Load and established water quality standards to the maximum extent economically achievable.

8.1.2 Related Watershed Management Goals

- Restore water quality to the level necessary to support primary contact recreation

8.2 Establishing a Timeline and Milestones for Implementation

As described in previous sections, the actions proposed in this Implementation Plan will be implemented in phases. A schedule of Phase I activities is contained in Table 8-1, and Phase II and III actions will be implemented as actions prove necessary and funding becomes available. The completion of management actions will be tracked in program annual reports. Management actions related to stormwater management will be reported in James City County's MS4 annual report.

Progress towards meeting water quality goals will be tracked through the completion of the 305(b)/303(d) Water Quality Assessment Integrated Report submitted by the Virginia DEQ to EPA every even numbered year. This report is a summary of the water quality conditions for the five year assessment period preceding the report, and serves as the State's list of impaired waters. If the waters within the Mill and Powhatan Creek watersheds remain listed as impaired for bacteria after 2020, then James City County, in cooperation with the stakeholders listed in this report, will reevaluate the causes of impairment to these waters.

Table 8-1 Timeline for Phase I and Ongoing Management Actions

Management Category	Management Option	Projected Start Date	Projected Completion Date
Sanitary Sewer Improvements	Implementation of SSES Plan	ongoing	Nov 2011
	Implement schedule of Regional SSO Consent Order	ongoing	2013
	Participation in HRFOG education program	ongoing	ongoing
Septic System Programs	CBPA Septic Tank Pump Out and Inspection Information	ongoing	Ongoing
	Update septic system locations through pump out program	ongoing	ongoing
	Field survey to estimate septic system failure rates		
	Implement procedures to address failing septic systems		
Stormwater QualityPrograms	Enforcement of Illicit Discharge provisions within the Stormwater Management Ordinance	ongoing	ongoing
	County rain barrel rebate program	ongoing	Dec 2015
	Private BMP Inspection and Maintenance Programs	ongoing	ongoing
	IDDE screening in Mill and Powhatan Creek watersheds	ongoing	June 2013
	Coliscan Monitoring in Mill and Powhatan Creeks	ongoing	ongoing
	Participation in Regional Bacteria Source Tracking Study	ongoing	Jan 2012
Boating Programs	Sewer improvements and pumpout facility at County Marina	ongoing	Dec 2010
Pet Waste Programs	Participation in HRSTORM regional education program	ongoing	ongoing
	County “Scoop the Poop” campaign	ongoing	ongoing
	Pet waste collectors in County Parks	ongoing	ongoing
	Free pet waste stations for neighborhoods	ongoing	June 2013
Aquatic Resource Restoration	County Stream Restoration Program	ongoing	ongoing
Land Use Management	Chesapeake Bay Preservation Area Ordinance	ongoing	ongoing
	Implementation of Special Stormwater Criteria	ongoing	ongoing
	Enforcement JCC Erosion and Sediment Control Ordinance	ongoing	ongoing
	Implementation of JCC Guidelines for Design and Construction of Stormwater Management BMPs	ongoing	ongoing
	PRIDE Program	ongoing	ongoing
	Watershed Plan for Powhatan Creek Watershed	ongoing	complete
	Watershed Plan for Mill Creek Watershed	ongoing	2011
	Implement bacteria priority areas in Powhatan Watershed	ongoing	ongoing
Wildlife Contribution Controls	BMP Buffer Management	ongoing	ongoing

8.3 Developing Tracking and Monitoring Plans

James City County will continue monitoring water quality and measuring the effectiveness of management actions through its coliscan monitoring program. Going forward JCC Stormwater Division will both continue monitoring existing sites and seek to include additional sites through 2013. Volunteer monitors will be recruited and trained during 2010. Results will be used to identify bacteria management areas for enhanced effort. James City County will report on Stormwater related management programs through its MS4 Permit Annual Report. Ultimately, the determination of whether Mill Creek and Powhatan are impaired or meeting water quality standards is determined by water quality monitoring conducted by DEQ at the established stations in Mill Creek and Powhatan Creek (2-POW006.77, 2-POW003.38, 2-POW000.60, and 2-MIC000.03).

9.0 STAKEHOLDERS ROLES AND RESPONSIBILITIES

The management actions described in this report will be implemented by federal, state, regional and local agencies and non-governmental organizations in a collaborative effort to achieve the primary goal of reducing fecal coliform concentrations within the Mill Creek and Powhatan Creek Watersheds. The following section describes the agencies involved in the development of this Implementation Plan. Table 9-1 summarizes the roles and responsibilities of each agency by indicating which management actions each agency is responsible for.

9.1 Federal

9.1.1 United States Environmental Protection Agency

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies which are exceeding water quality standards. The EPA has the regulatory authority to approve TMDLs. Section 303(d) of the CWA and current EPA regulations do not require the development of implementation strategies. The EPA will review the Mill Creek and Powhatan Creek TMDL Implementation Plan for completeness.

9.2 State

9.2.1 Department of Environmental Quality (DEQ)

The State Water Control Law authorizes the State Water Control Board to control and plan for the reduction of pollutants impacting the chemical and biological quality of the State's waters resulting in the degradation of the swimming, fishing, shell fishing, aquatic life, and drinking water uses. For many years the focus of DEQ's pollution reduction efforts was the treated effluent discharged into Virginia's waters via the VPDES permit process. The TMDL process has expanded the focus of DEQ's pollution reduction efforts from the effluent of wastewater treatment plants to the pollutants causing impairments of the streams, lakes, and estuaries. The reduction tools are being expanded beyond the permit process to include a variety of voluntary strategies and BMPs.

The DEQ is the lead agency in the TMDL process. The Code of Virginia directs DEQ to develop a list of impaired waters (303 (d) list), develop TMDLs for these waters, and develop Implementation Plans for the TMDLs. DEQ administers the TMDL process including the public participation component and formally submits the TMDLs to EPA and the State Water Control Board for review and approval.

Additionally, §303(e) of the Clean Water Act and EPA's water quality management regulation 40 CFR 130.5 require the State to develop Water Quality Management Plans (WQMP) for the major watersheds. The purpose of the WQMPs is to present the processes to be used in the watershed for attaining and maintaining water quality standards. Also, the WQMPs serve as the repository for all TMDLs and TMDL Implementation Plans developed within the watershed. DEQ, with the assistance of DCR, the Department of Mines, Minerals and Energy (DMME), and

VDH plans to update the State's 303(e) WQMPs concurrently with the TMDL development effort.

DEQ provided partial funding for the development of this Implementation Plan. DEQ staff attended technical advisory committee meetings, presented information to the TAC on no discharge zones, and assisted in the publication of the public meetings.

9.2.2 Department of Conservation and Recreation (DCR)

DCR is authorized to administer Virginia's nonpoint source pollution reduction programs in accordance with §10.1-104.1 of the Code of Virginia and §319 of the Clean Water Act. EPA is requiring that much of the §319 grant monies be used for the development of TMDLs.

Because of the magnitude of the nonpoint source component in the TMDL process, DCR is a major participant in the TMDL process. DEQ and DCR have signed a Memorandum of Understanding agreeing to a cooperative effort in the TMDL process including Implementation Plan development. Specifically, DCR agreed to assume responsibility for the nonpoint source component of all TMDLs including the final allocations, with the exception of mineral extraction. This includes those TMDLs contracted by DEQ. Also, DCR agreed to present the nonpoint source component of the TMDLs in the public forums. Another major role DCR has in the TMDL process is the awarding and managing of the contractual services for the development of TMDLs related to nonpoint sources.

DCR staff attended technical advisory committee meetings and provided input on management options related to septic systems and pet waste controls.

9.2.3 Virginia Department of Health (VDH)

The Divisions of Onsite Sewage, Water Services, Environmental Engineering, and Marina Programs are responsible for effectively adopting and implementing regulations for marinas, private wells, and onsite wastewater treatment and disposal. The divisions provide guidance, training, technical assistance, grant and administrative support to over 300 field staff. The divisions foster and maintain communication with the onsite community made up of contractors, engineers, soil scientists, pumpers, academics, manufacturers, builders, real estate agents, and most especially, homeowners.

The mission of the Division of Onsite Sewage Services is to protect public health and ground water quality. This is best achieved by implementing an onsite wastewater program based on sound scientific, engineering, and public health principles. The Division strives to maintain effective communication in the onsite community.

On July 1, 2009, the Virginia Department of Health began regulating the operation and maintenance of alternative onsite sewage systems. Interim requirements, such as requiring owners of newly installed alternative systems to record notices in the land records and for owners to operate their alternative systems according to manufacturers' instructions, took

effect on July 1. Other requirements regarding alternative systems are under development and will be phased in as emergency regulations and final regulations go into effect.

VDH staff attended technical advisory committee meetings and played an integral role in determining that failing septic systems are not the primary source of bacteria to Mill and Powhatan Creeks. Staff assisted the County in conducting additional sanitary surveys throughout the watershed.

9.3 Regional

9.3.1 Hampton Roads Planning District Commission

Planning District Commissions are voluntary associations that were created in 1969 pursuant to the Virginia Area Development Act and a regionally executed Charter Agreement. The purpose of planning district commissions, as set out in the Code of Virginia, Section 15.2-4207 is "…to encourage and facilitate local government cooperation and state-local cooperation in addressing on a regional basis problems of greater than local significance."

The Hampton Roads Planning District Commission (HRPDC), one of 21 Planning District Commissions in the Commonwealth of Virginia, is a regional organization comprised of this area's sixteen local governments. The HRPDC was formed in 1990 by the merger of the Southeastern Virginia Planning District Commission and the Peninsula Planning District Commission. The HRPDC serves as a resource of technical expertise to its member local governments. It provides assistance on local and regional issues pertaining to Economics, Physical and Environmental Planning, and Transportation. As a Virginia Planning District, the HRPDC is also the Affiliate Data Center for the region, providing economic, environmental, transportation, census, and other relevant information to businesses, organizations and citizens.

The HRPDC was contracted by the Virginia DEQ and James City County to develop this implementation plan for the bacteria TMDL for the Mill Creek and Powhatan Creek watersheds. In addition to facilitating the implementation process and developing this report, the HRPDC will continue to 1) facilitate regional cooperation in stormwater and wastewater management, 2) continue to administer regional education programs, 3) maintain the Sanitary Sewer Overflow Reporting System (SSORS), and 4) develop a protocol for future TMDL Implementation Plan development within Hampton Roads.

9.4 James City County

As discussed throughout this document, James City County has the largest role in improving water quality within the Mill Creek and Powhatan Creek Watersheds. Because the Mill Creek and Powhatan Creek watersheds lie completely within the boundaries of James City County, it has jurisdiction over all local projects within the watershed boundaries. The County will continue public programs to treat stormwater runoff, prevent SSOs, and manage land use development to the maximum extent practicable and as required by law. Specific actions that

James City County will implement in order to reduce bacteria concentrations within the Mill Creek and Powhatan Creek Watersheds are outlined in Tables 7-1 and 9-1.

9.5 Private Sector, Non-governmental, and Citizen Groups

9.5.1 James City County Concerned Citizens Coalition (J4C)

The James City County Concerned Citizens Coalition seeks to "coordinate member groups' activities and interests in protecting the County's valuable resources and promoting an enhanced quality of life for its residents." The group was formed in 2006 and lists as members such organizations as the Historic Route 5 Association and the Williamsburg League of Women Voters. A number of neighborhood and homeowner associations in the Mill Creek and Powhatan Creek watersheds are also listed as members. The organization has focused on presenting Community Education Forums on topics of local interest and presenting their research and findings to the Board of Supervisors.

9.5.2 Friends of the Powhatan Creek

The Friends of the Powhatan Creek Watershed is a group of citizens working together to promote responsible stewardship of the Powhatan Creek Watershed in James City County, Virginia. Since 1999, the "grassroots" organization has been committed to the preservation, conservation, and enhancement of the Powhatan Creek Watershed. Under development pressure, the 23-square-mile watershed still harbors rare, threatened, and endangered species and played an integral part in our nation's humble beginnings at Jamestown.

The all-volunteer group undertakes hands-on activities such as citizen water quality monitoring, stream cleanup and underwater grass restoration. Another main focus is to help to implement the Powhatan Creek Watershed Management Plan adopted by the James City County Board of Supervisors. Recently, they assisted in strengthening the Chesapeake Bay Preservation Ordinance and developing Special Stormwater Criteria for sensitive areas. Recently, Friends of Powhatan Creek, along with the JCC Department of Development Management and the Peninsula Housing and Builders Association developed a consensus document at the Builders for the Bay Roundtable. Other initiatives include the Historic Triangle Corridor Enhancement Committee and pursuit of a no-wake zone for the Powhatan Creek.

Table 9-1: Management Actions and Responsible Stakeholders

Management Category	Management Option	Stakeholders Responsible
Sanitary Sewer Improvements	Implementation of SSES Plan	JCSA
	Implement schedule of Regional SSO Consent Order	JCSA
	Participation in HRFOG education program	JCSA/HRPDC
Septic System Programs	CBPA Septic Tank Pump Out and Inspection Information Program	JCC/DCR
	Update septic system locations through pump out program	JCC/DCR
	Field survey to estimate septic system failure rates	JCC
	Implement procedures to address failing septic systems	JCC/VDH
	Develop an onsite wastewater treatment funding program	JCC/VDH/DCR
	Increase enforcement actions for failing systems	VDH
Stormwater QualityPrograms	Enforcement of Illicit Discharge provisions within the Stormwater Management Ordinance	JCC
	County rain barrel rebate program	JCC
	Private BMP Inspection and Maintenance Programs	JCC
	IDDE screening in Mill and Powhatan Creek watersheds	JCC
	Coliscan Monitoring in Mill and Powhatan Creeks	JCC
	Participation in Regional Bacteria Source Tracking Study	JCC
	Estimate Stormwater contribution to bacteria loading	JCC
	Investigate retrofits for wet ponds that would reduce bacteria	JCC
	Retrofit wet ponds to reduce bacteria concentrations	JCC
Boating Programs	Sewer improvements and pumpout facility at County Marina	JCC/VDH
	Expanded Boater Education Program	JCC
	Investigate No Discharge designation for Powhatan Creek	JCC/VDH
	Examine environmental benefits of No Wake Zones	JCC
Pet Waste Programs	Participation in HRSTORM regional education program	JCC/DCR/HRPDC
	County “Scoop the Poop” campaign	JCC/DCR
	Pet waste collectors in County Parks	JCC
	Free pet waste stations for neighborhoods	JCC
	Investigate viability of Pet Waste Ordinance	JCC
Aquatic Resource Restoration	County Stream Restoration Program	JCC
	Add wetlands restoration program	JCC
	Identify areas for sea grass restoration	JCC
Land Use Management	Chesapeake Bay Preservation Area Ordinance	JCC
	Implementation of Special Stormwater Criteria	JCC
	Enforcement JCC Erosion and Sediment Control Ordinance	JCC
	Implementation of JCC Guidelines for Design and Construction of Stormwater Management BMPs	JCC
	PRIDE Program	JCC
	Watershed Plan for Powhatan Creek Watershed	JCC
	Watershed Plan for Mill Creek Watershed	JCC
	Implement bacteria priority areas in Powhatan Watershed	JCC
	Develop special stormwater criteria for Mill Creek Watershed	JCC
	Local Delegation of VSMP	JCC
Wildlife Contribution Controls	BMP Buffer Management	JCC

10.0 RELATED WATERSHED PLANNING EFFORTS

10.1 Watershed Planning Activities

In 2001, James City County hired the Center for Watershed Protection to develop the Powhatan Creek Watershed Management Plan. In 2009, the County hired Vanasse Hangen Brustlin, Inc (VHB) and began the process of developing a watershed management plan for Mill Creek. The Mill Creek Watershed Management Plan will follow the outline and approach established during the development of the Powhatan Creek plan and is expected to be complete during summer 2010.

As part of the James City County watershed planning process, three special studies were performed to gain a better scientific understanding of the Powhatan stream system; these included the stream and floodplain assessment, the conservation area study, and the Stormwater Management Master Plan. The stream and floodplain assessment consisted of an instream habitat survey for the majority of the non-tidal watershed and reported on stream channel stability and habitat conditions in each of the subwatersheds. The conservation area study identified the presence of rare, threatened or endangered (RTE) species, contiguous forest and high quality wetlands and identified potential threats and impacts to their existence. The stormwater master plan developed specific stormwater criteria for subwatersheds, identified existing stormwater practices for retrofit possibilities, and located potential regional stormwater facilities.

The watershed management plan provides a summary of the findings from the Powhatan Creek baseline report, the three special studies, and the stakeholder process conducted by the Center for Watershed Protection, the James River Association and James City County. A specific watershed management plan and accompanying maps were drafted for the twelve subwatersheds based on the eight tools of watershed protection.

The goals of the study were to prevent further degradation of the water quality of Powhatan Creek, maintain the quality of the creek's wetlands, maintain biological and habitat diversity, and promote habitat connectivity. The sub-watershed boundaries of the Powhatan Watershed Plan were compared to the boundaries for the TMDL. The Powhatan TMDL study subwatersheds were delineated to match, to the extent possible, those created for the Powhatan Watershed Plan. This was done to ensure that information developed as a part of the Powhatan TMDL could also be used for implementation of the Powhatan Watershed Plan.

10.2 Adjacent Impaired Waterbodies

Table 10-1: Waterbodies on the 303(d) List within or adjacent to Mill and Powhatan Creek Watersheds

Name of Waterbody	Impaired Segment with HUC	Cause of Impairment/ Va Category	TMDL Deadline	Suspected or Documented Cause
James River Mainstem	All segments –JL29, 30, 33, 35	Fish Consumption - PCB in Fish Tissue/5A	2018	Contaminated Sediments, Source Unknown
James River Mainstem	2 segments – Chickahominy River to Hog Point, JL29, 30, 33	Chloride/5C	2020	Natural Conditions WQ Standards Use Attainability Analysis Needed
James River Mainstem	At Chickahominy River confluence – JL29, 30	Estuarine Bioassessments/5C	2016	Natural Conditions WQ Standards Use Attainability Analysis Needed
James River Mainstem	From Chickahominy River confluence to Skiffes Cr – JL30, 33, 35	Estuarine Bioassessments/5A	2016	Source Unknown
James River Mainstem	All segments –JL29, 30, 33, 35	Aquatic Plants (macrophytes)/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
James River Mainstem	All segments –JL29, 30, 33, 35	Dissolved Oxygen/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
James River Mainstem	All segments –JL29, 30, 33, 35	Chlorophyll-a/5A	2010	Industrial and Municipal point sources, nonpoint sources (stormwater)
Chickahominy River	Walkers Dam to James River - JL29	Fish Consumption - PCB in Fish Tissue/5A	2018	Contaminated Sediments, Source Unknown

Chickahominy River	Diascund Ck to James River – JL29	Chloride/5C	2016	Natural Conditions WQ Standards Use Attainability Analysis Needed
Chickahominy River	Walkers Dam to James River - JL29	Dissolved Oxygen/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
Chickahominy River	Walkers Dam to James River - JL29	Enterococcus (bacteria)/5A	2020	Source Unknown
College Creek	Tidal Portion – JL34	Enterococcus (bacteria)/5A	2018	Source Unknown
College Creek	Tidal Portion – JL34	Aquatic Plants (macrophytes)/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
College Creek	Tidal Portion – JL34	Dissolved Oxygen/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
Diascund Creek	Diascund Reservoir dam to mouth – JL27	Dissolved Oxygen/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
Gordon Creek	Tidal portion to mouth – JL29	Estuarine Bioassessments/5A	2018	Source Unknown
Gordon Creek	Tidal portion to mouth – JL29	Dissolved Oxygen/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
Little Creek Reservoir	Entire reservoir – JL28	Dissolved Oxygen/5A	2020	Source Unknown
Mill Creek (tributary to Diascund Cr)	Headwaters to tidal limit – JL27	Fecal Coliform/5A	2016	Source Unknown

Mill Creek (tributary to Diascund Cr)	Headwaters to tidal limit – JL27	Dissolved Oxygen/5C	2016	Natural Conditions WQ Standards Use Attainability Analysis Needed
Powhatan Creek	Headwaters to tidal limit – JL31	Benthic – Macroinvertebrates/5A	2014	Source Unknown
Powhatan and Mill Creek	Tidal portion to mouth – JL31, JL33	Enterococcus (bacteria)/5A	2010 – in development	Source Unknown
Powhatan and Mill Creek	Tidal portion to mouth – JL31, JL33	Aquatic Plants (macrophytes)/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
Powhatan and Mill Creek	Tidal portion to mouth – JL31, JL33	Dissolved Oxygen/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
Skiffes Creek	From Skiffes Creek Reservoir dam to mouth – JL35	Fish Consumption - PCB in Fish Tissue/5A	2018	Contaminated Sediments, Source Unknown
Skiffes Creek	From Skiffes Creek Reservoir dam to mouth – JL35	Fecal Coliform/5A	2010	Source Unknown
Skiffes Creek	From Skiffes Creek Reservoir dam to mouth – JL35	Dissolved Oxygen/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
Skimino Creek	Barlows Pond dam to mouth – YO65	Fecal Coliform/5A	2010	Source Unknown
Skimino Creek	Barlows Pond dam to mouth – YO65	Dissolved Oxygen/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
Skimino Creek	Barlows Pond dam to mouth – YO65	Aquatic Plants (macrophytes)/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges

Taskinas and Ware Creek	Tidal portions – YO62	Fecal Coliform/5A	2010	Source Unknown
Taskinas and Ware Creek	Tidal portions – YO62	Dissolved Oxygen/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
Taskinas and Ware Creek	Tidal portions – YO62	Aquatic Plants (macrophytes)/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
Yarmouth Creek	Headwaters to tidal limit – JL28	Dissolved Oxygen/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
York River Mainstem	Both segments – YO63, YO65	Fish Consumption - PCB in Fish Tissue/5A	2018	Source Unknown
York River Mainstem	Both segments – YO63, YO65	Dissolved Oxygen/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges
York River Mainstem	Both segments – YO63, YO65	Aquatic Plants (macrophytes)/5A	2010	Agriculture, Atmospheric Deposition, Clean sediments, Point Sources, Wet weather discharges

11.0 POTENTIAL FUNDING SOURCES

State

Virginia Small Business Environmental Assistance Fund Loan Program
Virginia Resource Authority
Water Quality Improvement Fund
Virginia Clean Water Revolving Loan Fund

Local or Regional

James City County
James City County Capital Improvement Program
Chesapeake Bay Small Watershed Grants Program
Wetlands and Chesapeake Bay Civil Penalties Fund
Hampton Roads Environmental Education Program Mini-Grants

Private Foundations, Non-Profit Organizations, Businesses

National Fish and Wildlife Foundation
Chesapeake Bay Foundation

REFERENCES

U.S. Environmental Protection Agency (EPA). Guidance for Water-Quality-based Decisions: The TMDL Process. 1991, EPA440-4-91-00.

Virginia Department of Conservation and Recreation and Virginia Department of Environmental Quality. Guidance Manual for Total Maximum Daily Load Implementation Plans. Richmond, Virginia. 2003.

Virginia Department of Environmental Quality (DEQ). 303(d) Total Maximum Daily Load Priority List and Report. 1998.

Virginia Tech, Department of Biological Systems Engineering. Bacteria Total Maximum Daily Load Development for Mill Creek and Powhatan Creek. 2008