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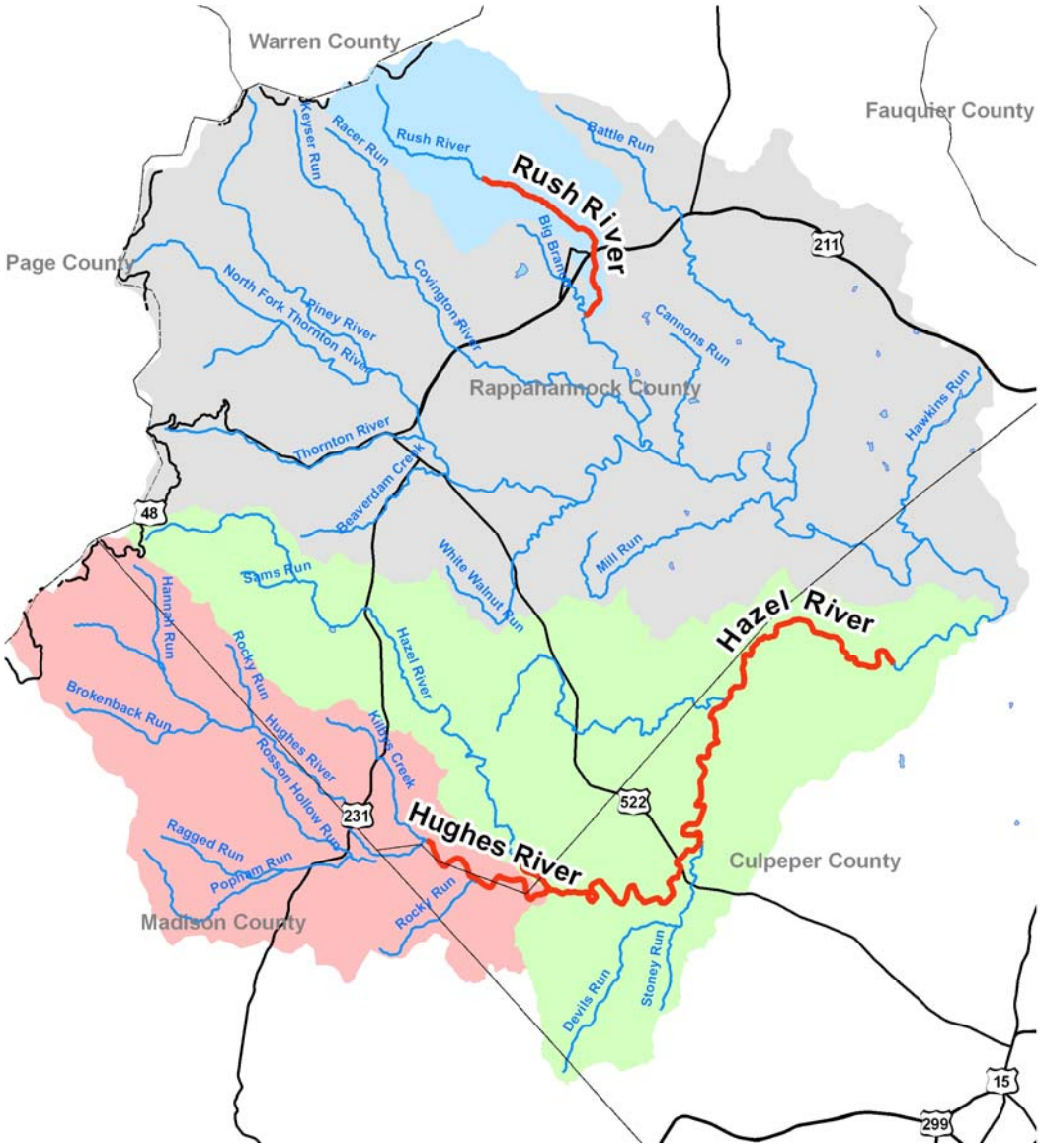
Upper Hazel River
Bacteria Total Maximum Daily Load
Implementation Plan



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1. EXECUTIVE SUMMARY

Introduction

The Total Maximum Daily Load program is a process to restore impaired waters in Virginia. Specifically, TMDL is the maximum amount of pollutant that a waterbody can assimilate without surpassing the state water quality standards for protection of the five beneficial uses: drinking water, recreational (*i.e.*, primary contact/swimming), fishing, shellfishing, and aquatic life. If the water body surpasses the water quality standard during an assessment period, Section 303(d) of the Clean Water Act and the United States Environmental Protection Agency's Water Quality Management and Planning Regulation (40 CFR Part 130) both require that states develop a total maximum daily load for each pollutant. Rush River and Hazel River were initially placed on the Commonwealth of Virginia's Section 303(d) List of Impaired Waters in 2002 for exceedances of the bacteria standard and remained on the 2004 Section 303(d) Total Maximum Daily Load Priority List and Report (VADEQ, 2004) and the 2006 Section 303(d) List (VADEQ, 2006) due to water quality exceedances of the bacteria standard. Hughes River was initially listed as impaired stream on Virginia's 2004 Section 303(d) List (VADEQ, 2004) and remained on the 2006 Section 303(d) List (VADEQ, 2006) due to water quality exceedances of the bacteria standard.

The Total Maximum Daily Load set limits on the amount of bacteria these rivers can tolerate and still maintain support of the Recreational Use. After the Total Maximum Daily Load study is complete and approved by USEPA, Virginia's 1997 Water Quality Monitoring, Information and Restoration Act states in section 62.1-44.19:7 that the "Board shall develop and implement a plan to achieve fully supporting status for impaired waters". To comply with this state requirement, a Total Maximum Daily Load implementation plan was formulated to reduce bacteria levels to attain water quality standards enabling delisting of stream from the Section 303(d) List of Impaired Waters. The Total Maximum Daily Load implementation plan describes control measures, which can include the use of better treatment technology and the installation of best management practices, to be implemented in a staged process. Successful completion and local support of the implementation plan will enable restoration of the impaired waters while enhancing the value of this important resource for the Commonwealth. Opportunities for Madison, Rappahannock, and Culpeper Counties; local agencies; and watershed residents to obtain funding will improve with an approved implementation plan.

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

- Review of TMDL Development Study,
- Public Participation,
- Implementation Actions,
- Measurable Goals and Milestones for Attaining Water Quality Standards,
- Stakeholder's Roles and Responsibilities,
- Integration with Other Watershed Plans, and
- Potential Funding Sources.

Review of TMDL Study

Impairment description, water quality monitoring, watershed description, source assessment, water quality modeling, and allocated reductions were reviewed to determine implications of Total Maximum Daily Load and modeling procedures on implementation plan development. Conditions outlined in the TMDL development study to address bacteria impairments in the Upper Hazel River watershed include:

- Exclusion of most/all livestock from streams is necessary;
- Substantial land-based NPS load reductions are called for on pasture and cropland;
- All straight pipes and failing septic systems need to be identified and corrected;
- Implicit in the requisite to correct straight pipes and failing septic systems is the requirement to maintain all properly functioning septic systems;
- Reductions of pet bacteria loads on residential land use are necessitated; and
- Implicit in the requisite for no point source bacteria load adjustment is the requirement for point sources to maintain permit compliance.

Public Participation

The actions and commitments compiled in this document are formulated through input from citizens of the watershed; Culpeper, Madison, and Rappahannock County governments; Culpeper Soil and Water Conservation District; Virginia Department of Conservation and Recreation; Virginia Department of Environmental Quality; Virginia Department of Health; Virginia Department of Forestry; Virginia Cooperative Extension; National Park Service; Rappahannock-Rapidan Regional Commission; RappFLOW; Piedmont Environmental Council; Friends of the Rappahannock; and Engineering Concepts, Inc. Every citizen and interested party in the watershed is encouraged to put the IP into action and contribute what he or she is able to help restore the health of the streams.

Public participation took place during implementation plan development on three levels. First, public meetings were held to provide an opportunity for informing the public as to the end goals and status of the project, as well as, a forum for soliciting participation in the smaller, more-targeted meetings (*i.e.*, working groups and Steering Committee). Second, working groups were assembled from communities of people with common concerns regarding the implementation process and were the primary arena for seeking public input. Three working groups were formed: Agricultural, Residential, and Governmental. A representative from Virginia Department of Conservation and Recreation, Rappahannock-Rapidan Regional Commission, or Engineering Concepts, Inc. coordinated each working group in order to facilitate the process and integrate information collected from the various communities. Third, a steering committee was formed with representation from the Agricultural, Residential, and Governmental Working Groups; Culpeper, Madison, and Rappahannock County governments; Culpeper Soil and Water Conservation District; Virginia Department of Conservation and Recreation; Virginia Department of Environmental Quality; Virginia Department of Health; Virginia Cooperative Extension; Rappahannock-Rapidan Regional Commission; National Park Service; RappFLOW; Friends of the Rappahannock; and Engineering Concepts, Inc. to guide the development of the implementation plan. Over 500 man-hours were devoted to attending these meetings by individuals representing agricultural, residential, commercial, environmental, and government interests on a local, state, and federal level. Throughout the public participation process, major

emphasis was placed on discussing best management practices (BMPs), locations of control measures, education, technical assistance, monitoring, and funding.

Implementation Actions

The actions and cost needed in both implementation stages were identified and quantified. The overall numbers presented in Table 2 represent the Stage II goal of TMDL source allocation attainment (*i.e.*, no water quality standard exceedance), which is required under WQMIRA and by USEPA for eligibility to receive Section 319 grant funds to apply during implementation. An assessment was also conducted to quantify actions and cost to meet source allocations that translate to an instantaneous standard violation rate of 10% or less resulting in removal of the Hughes River, Hazel River, and Rush River from the Commonwealth of Virginia's Section 303(d) List of Impaired Waters. This is referred to as the Stage I implementation goal.

The quantity of control measures, or BMPs, required during implementation was determined through spatial analyses of land use, stream-network, and the Commonwealth of Virginia aerial maps along with regionally appropriate data archived in the VADCR Agricultural BMP Database and TMDL Development documents. The map layers and archived data were combined to establish average estimates of control measures required overall and in each watershed. Additionally, input from local agency representatives, citizens, and contractors were used to verify the analyses. Estimates of control practices needed for full implementation in the Upper Hazel River watershed are listed in Table 2.

The primary benefit of implementation is cleaner waters in Virginia, where bacteria levels in the Upper Hazel River watershed will be reduced to meet water quality standards, benefiting human health, livestock herd health, stakeholder economy, and aquatic community. It is hard to gage the impact that reducing fecal contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, the incidence of infection from fecal sources, through contact with surface waters, should be reduced considerably. An important objective of the IP will be to foster 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 agricultural and residential practices recommended in this document will provide economic benefits to the landowner, along with the expected environmental benefits on-site and downstream. Improved aesthetics in public areas (*e.g.*, parks) and surrounding businesses provided by control measures (*e.g.*, pet waste kiosks and bioretention) has the potential to draw local citizens and visitors to these areas and a healthy waterway has the potential to attract local citizens and visitors for recreation. Additionally, money spent on materials and technical assistance resources by landowners, government agencies, and non-profit organizations in the process of implementing the implementation plan will stimulate the local economy.

Measurable Goals and Milestones for Attaining Water Quality Standards

The end goals of implementation are restored water quality in the impaired waters and subsequent de-listing of streams from the Commonwealth of Virginia's Section 303(d) List of Impaired Waters. Progress toward end goals will be assessed during implementation through tracking of control measure installations by Culpeper Soil and Water Conservation District;

Natural Resources Conservation Service; Virginia Department of Health, Virginia Department of Conservation and Recreation; Culpeper, Madison, and Rappahannock Counties; Town of Washington; and Rappahannock-Rapidan Regional Commission. The Virginia Department of Environmental Quality will continue to assess water quality through its monitoring program. Other monitoring project activities in the watershed (*e.g.*, RappFLOW) will be coordinated to augment the Virginia Department of Environmental Quality monitoring program. Implementation will be assessed based on reducing exceedances of the bacteria water quality standard to improve water quality resulting in removal of Hughes River, Hazel River, and Rush River from the Commonwealth of Virginia's Section 303(d) List of Impaired Waters.

Implementation of control measures is scheduled for 10 years and will be assessed in two stages. Stage I is based on meeting source allocations that translate to an instantaneous standard violation rate of 10% or less meeting the newly proposed bacteria water quality standard resulting in removal of Hughes River, Hazel River, and Rush River from the Commonwealth of Virginia's Section 303(d) List of Impaired Waters. The Stage II goal is based on implementing source allocations to meet the specified TMDL goal, 0% exceedance of water quality standards. Implementation of control measures is scheduled to begin in July 2009 lasting to June 2019. After implementation inception, three milestones will be met in Stage I and two milestones in Stage II.

Implementation in years one through six for agricultural source reductions focuses on livestock exclusion and pasture management systems. BMPs installed in years seven through ten are based on additional livestock exclusion, additional treatment of runoff from pasture land using retention ponds to remove remaining bacteria load not treated with the pasture management systems installed during Stage I, cropland conversion, and manure / biosolids incorporation into soil. Retention ponds are more costly and are logistically more difficult to design and locate on individual farms. Implementation in years one through six for residential bacteria loads focuses on identification and removal of straight pipes, repairing or replacing failed septic systems, installation of pet waste enzyme digesting composters, a pet waste control program, and installation of storage and treatment systems for waste from confined canine units (CCU). Implementation of these control measures will continue in years seven through ten if needed.

Water quality improvement is expected to increase each year. A 0% overall bacteria load reduction is expected at the second year, 0% in the fourth year, and 0% in the sixth year. Based on water quality modeling projections for the sixth year (Milestone 3), the Hughes River, Hazel River, and Rush River would be in a probable position to be de-listed from the Commonwealth of Virginia's Section 303(d) List of Impaired Waters. Considering the dynamics of a stream ecosystem and the inherent difficulties that may arise preventing BMP implementation, the final milestone of TMDL Allocation attainment was set at 10 years following implementation commencement.

The process of a staged implementation implies targeting of control measures, ensuring optimum utilization of resources. In quantifying agricultural BMPs through the use of aerial, land use, and stream network GIS layers, maps were formulated showing potential livestock access, pastureland, and crop fields. These maps identify farm tracts that CSWCD should concentrate efforts in. Owners will be contacted and progression through control measure installation will be

tracked. Known problem areas, clusters of older homes, or houses in close proximity to streams known by the Virginia Department of Health will be targeted for onsite treatment system control measures. Steps outlined in pet waste BMP stages results in targeting of source type and resources.

Stakeholder's 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. Successful implementation depends on stakeholders taking responsibility for their role in the process, the primary role falls on the local groups that are most affected; that is, businesses, community watershed groups, and citizens. However, local, state, and federal agencies also have a stake in seeing that Virginia's waters are clean and provide a healthy environment for its citizens. Stakeholder participation and support is essential for achieving the goals of this Total Maximum Daily Load effort (*i.e.*, improving water quality and removing streams from the impaired waters list). It must first be acknowledged that there is a water quality problem, and changes must be made as needed in operations, programs, and legislation to address these pollutants. In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions.

The agencies regulating activities that impact water quality in Virginia include: Virginia Department of Environmental Quality, Virginia Department of Conservation and Recreation, Virginia Department of Agriculture and Consumer Services, Virginia Department of Game and Inland Fisheries, Virginia Department of Health, Virginia Department of Forestry, and Virginia Cooperative Extension. The Culpeper Soil and Water Conservation District is a local unit of government responsible for the soil and water conservation work within Greene, Culpeper, Madison, Orange, and Rappahannock Counties. The district's overall role is to increase voluntary conservation practices among farmers, ranchers, and other land users. Specific to the Total Maximum Daily Load implementation, the district will lead education and technical assistance efforts and track best management practice implementation for the agricultural and onsite sewage disposal systems. The Rappahannock-Rapidan Regional Commission promotes efficient development of the environment by assisting and encouraging local governmental agencies to plan for the future. Rappahannock-Rapidan Regional Commission will lead the pet waste management implementation with assistance from localities and Culpeper Soil and Water Conservation District. Additionally, Rappahannock-Rapidan Regional Commission will continue to work with Virginia Department of Conservation and Recreation and the Steering Committee to periodically revisit implementation progress and suggest plan revisions as needed.

Integration with Other Watershed Plans

Each watershed within the state is under the jurisdiction of a multitude of individual yet related water quality programs and activities, many of which have specific geographical boundaries and goals. These include but are not limited to, the Chesapeake Bay 2000 agreement, Tributary Nutrient Reduction Plans, TMDLs, Roundtables, Water Quality Management Plans, Erosion and Sediment Control regulations, Stormwater Management Program, Source Water Assessment Program, and local comprehensive plans. In some cases, an implementation plan may even address multiple TMDLs (*e.g.*, bacteria and benthic) for the same impaired water body. The progress of these projects or programs needs continuous evaluation to determine possible effects

on implementation goals. For example, financial and technical resources may be maximized for implementation by coordinating and expanding the planning and implementation activities of these on-going watershed projects or programs. Current initiatives within Town of Washington and Culpeper, Madison, and Rappahannock Counties to be integrated with the Upper Hazel River Total Maximum Daily Load Implementation Plan include:

- Culpeper, Madison, and Rappahannock Counties Comprehensive Plans
- Town of Washington Comprehensive Plan
- Culpeper Soil and Water Conservation District Septic System Program
- Town of Washington Waste Water Treatment Plant Construction
- Rappahannock County and Madison County Easement Programs
- Madison County Asset Mapping Project
- RappFLOW Strategic Plan
- Friends of the Rappahannock Strategic Plan
- The Hughes River Partnership Strategic Plan
- Rappahannock League for Environmental Protection Strategic Plan
- Piedmont Environmental Council Strategic Plan

Potential Funding Sources

Potential funding sources available during implementation were identified in the course of plan development. Detailed description of each source (*i.e.*, eligibility requirements, specifications, incentive payments) can be obtained from the Culpeper Soil and Water Conservation District, Virginia Department of Conservation and Recreation, Virginia Department of Environmental Quality, Virginia Department of Game and Inland Fisheries, Virginia Cooperative Extension, Virginia Department of Health, and Natural Resources Conservation Service. Potential funding sources include:

- Federal Clean Water Act Section 319 Increment Funds
- U.S. Department of Agriculture Conservation Reserve Enhancement Program, Conservation Reserve Program, Environmental Quality Incentives Program, Wetland Reserve Program, and Wildlife Habitat Incentive Program
- U.S. Fish and Wildlife Service Conservation Grants and Private Stewardship Programs
- National Fish and Wildlife Foundation
- Chesapeake Bay Small Watershed Grants Program
- Virginia Agricultural Best Management Practices Cost-Share and Tax Credit Programs
- Virginia Water Quality Improvement Fund
- Virginia Small Business Environmental Compliance Assistance Fund
- Virginia Landowner Incentive Program
- Community Development Block Grant Program
- Rural Community Assistance Program
- Southeast Rural Community Assistance Project
- Chesapeake Bay Foundation
- Krebser Foundation
- Piedmont Environmental Council
- Friends of the Rappahannock

2. INTRODUCTION

The Total Maximum Daily Load (TMDL) program is a process to restore impaired waters in Virginia. Specifically, TMDL is the maximum amount of pollutant that a water body can assimilate without surpassing the state water quality standards for protection of the five beneficial uses: drinking water, recreational (i.e., primary contact/swimming), fishing, shellfishing, and aquatic life. If the water body surpasses the water quality criteria during an assessment period, Section 303(d) of the Clean Water Act (CWA) and the United States Environmental Protection Agency's (USEPA) Water Quality Management and Planning Regulation (40 CFR Part 130) both require that states develop a TMDL for each pollutant.

Rush River and Hazel River were initially placed on the Commonwealth of Virginia's Section 303(d) List of Impaired Waters in 2002 for exceedances of the bacteria standard and remained on the 2004 Section 303(d) TMDL Priority List and Report (VADEQ, 2004) and the 2006 Section 303(d) List (VADEQ, 2006) due to water quality exceedances of the bacteria standard. Hughes River was initially listed as impaired stream on Virginia's 2004 Section 303(d) List (VADEQ, 2004) and remained on the 2006 Section 303(d) List (VADEQ, 2006) due to water quality exceedances of the bacteria standard.

Hughes River at Route 644, location of VADEQ station 3-HUE000.20

The TMDL set limits on the amount of bacteria these rivers can tolerate and still maintain support of the Recreational Use. After the TMDL study is complete and approved by USEPA, Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (WQMIRA) states in section 62.1-44.19:7 that the "Board shall develop and implement a plan to achieve fully supporting status for impaired waters".

To comply with this state requirement, a TMDL implementation plan (IP) was formulated to reduce bacteria levels to attain water quality standards enabling delisting of stream from the Section 303(d) List of Impaired Waters. The TMDL IP describes control measures, which can include the use of better treatment technology and the installation of best management practices (BMPs), to be implemented in a staged process. Successful completion and local support of the implementation plan will enable restoration of the impaired waters while enhancing the value of this important resource for the Commonwealth. Opportunities for Madison, Rappahannock, and Culpeper Counties, local agencies, and watershed residents to obtain funding will improve with an approved IP.

Hazel River at Route 729, location of VADEQ station 3-HAZ018.29

This public document is an abbreviated version of the technical document, which can be obtained by contacting the Virginia Department of Conservation and Recreation (VADCR) office.

3. STATE AND FEDERAL REQUIREMENTS FOR IMPLEMENTATION PLANS

In developing this implementation plan, both state and federal requirements and recommendations were followed. Virginia's 1997 WQMIRA directs the State Water Control Board (SWCB) to "develop and implement a plan to achieve fully supporting status for impaired waters" (§62.1-44.19:4 through 19:8 of the Code of Virginia). WQMIRA establishes that the implementation plan shall include the date of expected achievement of water quality objectives, measurable goals, corrective actions necessary and the associated costs, benefits, and environmental impacts of addressing the impairments.

Section 303(d) of the CWA and current USEPA regulations do not require the development of implementation strategies. USEPA 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 description of the implementation actions and management measures, timeline for implementing these measures, legal or regulatory controls, time required to attain water quality standards, monitoring plan, and milestones for attaining water quality standards.

Rush River at Route 683, location of VADEQ station 3-RUS005.66

USEPA develops guidelines that describe the process and criteria to be used to award CWA Section 319 nonpoint source grants to States. The guidance is subject to revision and the most recent version should be considered during implementation. The "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003" identifies the nine elements that must be included in the IP to meet the Section 319 requirements.

The process of incorporating these state and federal guidelines into an IP consisted of three major components: 1) public participation, 2) implementation actions, and 3) measurable goals and milestones.

Thornton River at Route 729, location of VADEQ station 3-THO006.50

Once developed, VADEQ will present the IP to the SWCB for approval as the plan for implementing pollutant allocations and reductions contained in the TMDLs. In addition, VADEQ will request the plan be included in the appropriate Water Quality Management Plan (WQMP), in accordance with the CWA's Section 303(e) and Virginia's Public Participation Guidelines for Water Quality Management Planning. In response to a Memorandum of Understanding (MOU) between USEPA and VADEQ, VADEQ also submitted a draft Continuous Planning Process to USEPA in which VADEQ commits to regularly updating the WQMPs. Thus, the WQMPs will be, among other things, the repository for all TMDLs and TMDL IPs developed within a river basin.

4. REVIEW OF TMDL DEVELOPMENT STUDY

Rappahannock Rapidan Regional Commission (RRRC) and Engineering Concepts, Inc. (ECI) were contracted by VADEQ to develop an approvable bacteria TMDL for the Upper Hazel River. The final TMDL was completed in April 2007 with subsequent approval by USEPA in January 2008. The TMDL development document can be obtained at the VADEQ office in Woodbridge, VA or via the Internet at www.deq.virginia.gov. Impairment description, water quality monitoring, watershed description, source assessment, water quality modeling, and allocated reductions were reviewed to determine implications of TMDL and modeling procedures on IP development.

Hazel River (VAN-E04R-01) and Rush River (VAN-E05R-01) were initially listed as impaired stream on Virginia's 2002 Section 303(d) Total Maximum Daily Load Priority List and Report (VADEQ, 2003b) and remained on the 2004 Section 303(d) List (VADEQ, 2004) and 2006 Section 303(d) List (VADEQ, 2006) due to water quality exceedances of the bacteria standard. Hughes River (VAN-E03R-01) was initially listed as impaired stream on Virginia's 2004 Section 303(d) Total Maximum Daily Load Priority List and Report (VADEQ, 2004) due to water quality exceedances of the bacteria standard. The segment remained on the 2006 Section 303(d) List (VADEQ, 2006) due to water quality exceedances of the bacteria standard.

Straight Pipe

The impaired portion of Hughes River (VAN-E03R-01) delineated by VADEQ, beginning at the confluence with Kilbys Run and continuing downstream approximately 3.68 miles to the confluence with Hazel River, is listed as impaired by fecal coliform and *E. coli* bacteria on Virginia's 2006 Section 303(d) List (VADEQ, 2006) due to water quality exceedances of the bacteria standard at station 3-HUE000.20 at Route 644.

The impaired portion of Hazel River (VAN-E04R-01) delineated by VADEQ, beginning at Route 707 bridge and continuing downstream approximately 16.67 miles to the confluence of an Unnamed Tributary to Hazel River at rivermile 16.03, is listed as impaired by fecal coliform and *E. coli* bacteria on Virginia's 2006 Section 303(d) List (VADEQ, 2006) due to water quality exceedances of the bacteria standard at station 3-HAZ018.29 at Route 729, station 3-HAZ026.16 at Route 522, and station 3-HAZ032.54 at Route 644. A portion of the impaired section of Hazel River was listed in Attachment C (Plaintiff's list of waters that were added to the 303(d) list in 2002) of the 1999 Consent Decree for fecal coliform.

Failed Septic System

The impaired portion of Rush River (VAN-E05R-01) delineated by VADEQ, beginning at the confluence of an Unnamed Tributary to Rush River, at river mile 8.78, and continuing downstream approximately 4.55 miles to the confluence of Big Branch, is listed as impaired by fecal coliform and *E. coli* bacteria on Virginia's 2006 Section 303(d) List (VADEQ, 2006) due to water quality exceedances of the bacteria standard at station 3-RUS005.66 at Route 683 bridge, upstream of Route 211/522.

The Hughes River (VAN-E03R-01) watershed area is approximately 45,790 acres consisting mainly of forest (74%) and pasture/cropland (25%). The remaining area is split between residential and water/wetland. The Hazel River (VAN-E04R-01) watershed is approximately 79,980 acres in size. Hazel River (VAN-E04R-01) is mainly a forested watershed (about 71%) with pasture/cropland, residential, and water/wetland comprising 28%, 1%, and <1% of the area, respectively. The Rush River (VAN-E05R-01) watershed area of approximately 9,840 acres is comprised of forest (79%), pasture/cropland (20%), residential (1%), and water/wetland (<1%). The Thornton River watershed area is approximately 90,380 acres consisting mainly of forest (65%) followed by pasture/cropland (33%), residential (1%) and water/wetland (1%) land uses.

Conditions outlined in the TMDL development study to address bacteria impairments in the Upper Hazel River watershed include:

- Exclusion of most/all livestock from streams is necessary;
- Substantial land-based NPS load reductions are called for on pasture and cropland;
- All straight pipes and failing septic systems need to be identified and corrected;
- Implicit in the requisite to correct straight pipes and failing septic systems is the requirement to maintain all properly functioning septic systems;
- Reductions of pet bacteria loads on residential land use are necessitated; and
- Implicit in the requisite for no point source bacteria load adjustment is the requirement for point sources to maintain permit compliance.

Livestock Stream Access

Pastured Livestock

Land Application

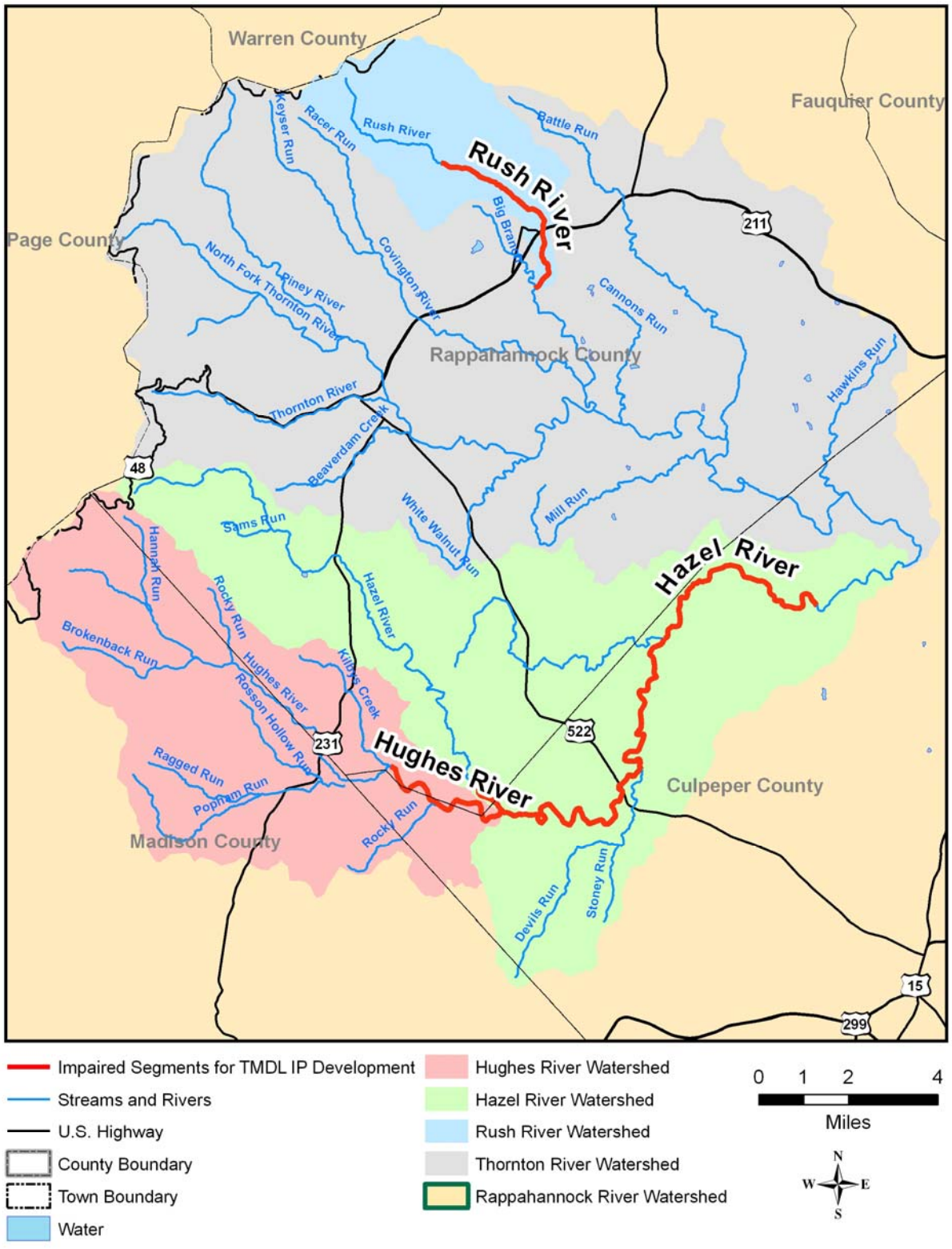

Figure 1. Upper Hazel River watershed location.

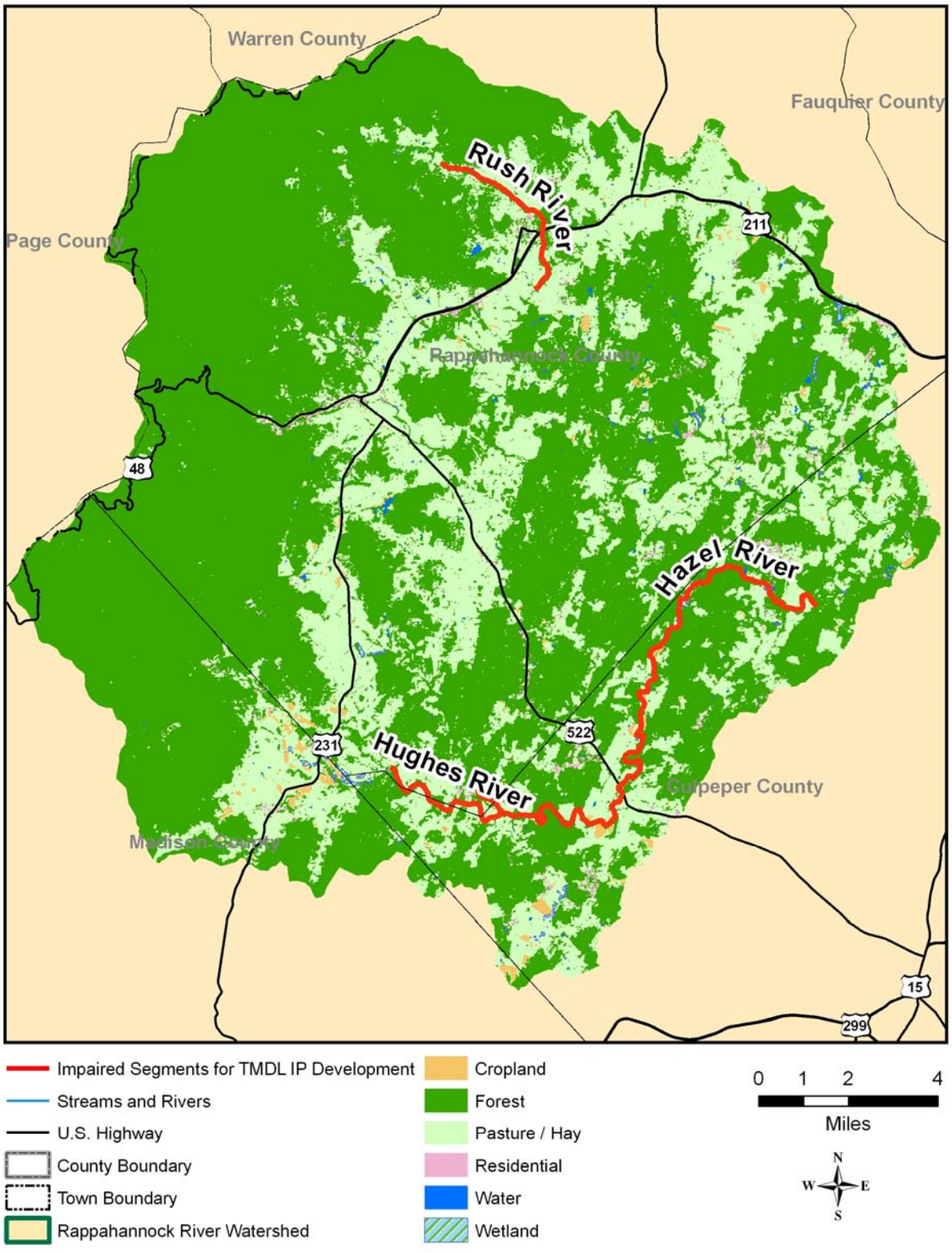

Figure 2. Land uses in the Upper Hazel River watershed.

5. PUBLIC PARTICIPATION

5.1 Process

The actions and commitments compiled in this document are formulated through input from citizens of the watershed; Culpeper, Madison, and Rappahannock County governments; Culpeper Soil and Water Conservation District (CSWCD); Virginia Department of Conservation and Recreation (VADCR); Virginia Department of Environmental Quality (VADEQ); Virginia Department of Health (VDH); Virginia Department of Forestry (VADOF); Virginia Cooperative Extension (VCE); National Park Service (NPS); Rappahannock-Rapidan Regional Commission (RRRC), RappFLOW, Piedmont Environmental Council (PEC), Friends of the Rappahannock (FOR), and Engineering Concepts, Inc. (ECI). Every citizen and interested party in the watershed is encouraged to put the IP into action and contribute what he or she is able to help restore the health of the streams.

Bioretention (LID Practice)

Public participation took place during IP development on three levels. First, public meetings were held to provide an opportunity for informing the public as to the end goals and status of the project, as well as, a forum for soliciting participation in the smaller, more-targeted meetings (*i.e.*, working groups and Steering Committee). Second, working groups were assembled from communities of people with common concerns regarding the implementation process and were the primary arena for seeking public input. Three working groups were formed: Agricultural, Residential, and Governmental. A representative from VADCR, RRRC, or ECI coordinated each working group in order to facilitate the process and integrate information collected from the various communities. Third, a steering committee was formed with representation from the Agricultural, Residential, and Governmental Working Groups; Culpeper, Madison, and Rappahannock County governments; CSWCD; VADCR; VADEQ; VDH; RRRC; NPS; RappFLOW; FOR; and ECI to guide the development of the IP. Over 500 man-hours were devoted to attending these meetings by individuals representing agricultural, residential, commercial, environmental, and government interests on a local, state, and federal level (Table 1).

Throughout the public participation process, major emphasis was placed on discussing best management practices (BMPs), locations of control measures, education, technical assistance, monitoring, and funding.

Table 1. Meetings held during the Upper Hazel River TMDL IP development process.

Date	Meeting Type	Location	Attendance	Time (hr)
09/16/08	Public Meeting	Washington, VA	27	1.5
09/16/08	Agricultural Working Group	Washington, VA	19	1.5
09/16/08	Residential Working Group	Washington, VA	7	1.5
11/18/08	Agricultural Working Group	Washington, VA	21	2.0
11/18/08	Residential Working Group	Washington, VA	9	2.0
01/12/09	Government Working Group	Culpeper, VA	21	2.0
01/12/09	Agricultural Working Group	Culpeper, VA	15	2.0
02/23/09	Steering Committee	Culpeper, VA	14	2.5
03/30/09	Steering Committee	Culpeper, VA	15	2.5
04/23/09	Public Meeting	Washington, VA	?	2.5

5.2 Working Groups Summary

5.2.1 Agricultural Working Group

The Agricultural Working Group (AWG) consisted predominantly of beef producers and horse owners throughout the watershed. Representatives from organizations that serve this community and will have a role in implementation were also included (*e.g.*, CSWCD, NRCS, and VADCR). The AWG is confident that current BMPs eligible for cost-share in TMDL areas and proposed recommendations will provide the necessary incentive for producers and horse owners to implement required BMPs to meet specified reductions to direct stream, pasture, and cropland loads. Challenges, recommendations, and keys for success discussed in the meetings included:

- CREP program or equivalent incentives need to continue to ensure participation in BMP programs.
- Incentive payment for proposed pasture management system needs to reflect energy costs, since fuel would constitute majority of farmer's cost to implement.
- Potential private funding sources and/or partnerships need to be pursued during implementation. (e.g., Chesapeake Bay Funders and Friends of the Rappahannock River).
- Implementation options afforded by non-government funding should be covered with producers.
- Due to amount of exclusion fencing required, implementation timeline should be at least 10 years.
- Livestock exclusion and pasture load reductions should be a priority over cropland load reductions. Cropland acreage listed in TMDL report over-estimates actual area in watersheds and substantial manure collection and land application from confined beef cows is not

prevalent in these areas. An incentive payment is needed to entice farmers to convert cropland to vegetated buffers to help meet specified cropland load reductions.

- Future implementation actions and/or requirements should consider the viability of an individual producer or agricultural as a whole. Overall, Rappahannock County residents appreciate the farming community and rural aspects of the county and do not want it impacted.
- Two new stream exclusion fencing practices offered through the state cost-share program, effective January 15, 2009, address buffer-width, fencing specifications, and increased level of incentives concerns that were discussed by the AWG.
- Individual contact with farmer to define TMDL, explain what it means to the farmer, and outline options for funding sources will be needed. Additional outreach includes field days, small workshops, field visits, and talks at association meetings.

5.2.2 Residential Working Group

The Residential Working Group (RWG), consisting predominantly of watershed residents, agency representatives, VADCR, and RRRC personnel, focused on means to educate and involve public with regard to implementing corrective actions to replace straight pipes, correct failing septic systems, and manage pet waste. Challenges, recommendations, and keys for success discussed in the two meetings included:

- Concerns associated with on-site sewage disposal systems included a lack of state-wide pump-out requirements; unqualified individuals are inspecting and certifying drainfields for home sales; there are no 319 funds available for mandatory hook-ups (Town of Washington); some assistance possible from state revolving loan fund; soils in TMDL-IP area may limit use of traditional septic systems; alternative systems are costly to install and maintain; identification of problem source may be difficult – may include neighbor observation, stream walks, conversations with landowners; some owners with failing systems will not accept any cost share assistance.

Septic System Pump-out

- Recommendations associated with on-site sewage disposal systems included pump-out should be required at time of property sale and/or require periodic pump-outs; uniformity in pumping/maintenance requirements is needed; develop and implement a system for tracking septic system pump-outs and maintenance; require that information regarding residential septic system management and drain-field location be part of closing documentation at transfer of property; and expand the scope of Rappahannock's Clean Streams Initiative to include the TMDL IP area.
- Several education/outreach techniques need to be utilized during implementation of corrective actions for straight pipes and failing septic systems. The focus must be on obstacles (*e.g.*, money, information, and understanding of issues) that property owners face in correcting problems and proper operation and maintenance of systems. Examples included: school curricula (particularly Earth Science and Health), educational programs presented by CSWCD, newspaper articles, small community meetings, workshops, model

septic system and video displayed in public buildings, demonstration at county fair, information packet provided through realtors on proper operation and maintenance of on-site sewage disposal systems, door hangers, and direct mailings.

- Concerns associated with pet waste management included lack of pet waste management ordinances/requirements within the region; no standardization of waste management for confined canine operations including commercial kennels, hunt clubs, veterinary operations, animal shelters, etc.; and hunt kennels often compost waste and/or spread it on fields.
- Recommendations associated with pet waste management included compile a database of all confined canine operations, identifying their locations and waste management practices; develop an informational brochure detailing proper pet waste management to be distributed by veterinary offices, local SPCAs, hunt clubs, dog licensing offices, etc.; develop and implement educational/outreach programs to inform the public of appropriate pet waste management practices; install pet waste management stations at The Link in Sperryville, the public park in Washington and other identified public dog-walking locations; provide information on, and encourage the use of, private dog waste enzyme digesting composters; determine how existing confined canine operations are currently handling waste and promote those with appropriate management systems while working to improve those with problematic techniques; and develop a model pet/kennel waste management ordinance for consideration and adoption by all localities.

Pet Waste Management Sign

- BMPs listed under the cost-share program (*i.e.*, RB-1 through RB-5), pet waste control program (*i.e.*, signage, pet waste disposal stations, composters, and distribution of educational information), vegetative buffers, and structural BMPs (*e.g.*, retention pond) were recommended control measures.

5.2.3 Governmental Working Group

The Governmental Working Group (GWG) consisting predominantly of agency representatives, VADCR, PEC, RappFLOW, RRRC, and ECI personnel, focused on funding sources, technical assistance needs, regulatory controls, and lead agencies responsible for implementation. Key topics and recommendations included:

- Section 319 funds are not utilized for mandatory hook-ups as is the case for Town of Washington, some assistance may be available form the State Revolving Loan Fund
- Requirements regarding onsite sewage disposal systems recommended by the RWG are agreeable; however, resources to implement or enforce are a concern.
- The CSWCD Septic System Program currently offered throughout Rappahannock County will receive additional funding next fiscal year and change focus to strictly the Upper Hazel River watershed.
- Although some localities' ordinances support maintaining pets in clean conditions, none appear to require specific pet waste management protocols; and most localities consider hunt club kennels as agricultural with no business licensing requirements.

- GWG believes that CSWCD is better suited to take on the responsibility of implementing the pet waste component of the IP with technical assistance from VADCR, county and town personnel; and VDH.
- Based on the recommendations to consider developing programs with greater flexibility in fencing, buffer, and setback requirements; the Livestock Exclusion with Riparian Buffers for TMDL Implementation (LE-1T) and Livestock Exclusion with Reduced Setback for TMDL Implementation (LE-2T) cost-share practices became effective January 15, 2009. The LE-1T practice offers an 85% cost-share and 25% tax credit for traditional requirements of an SL-6 Grazing Land Protection System. The LE-2T practices provide 50% cost-share and 25% tax credit for a 10-feet fence setback requirement from the top of the streambank and the minimum of two-strand electrified polywire/polytape. The practices have a 10-year life span requirement and have to be inspected ever two years by CSWCD.
- Horse operations, and other non-bovine livestock facilities, should be included in the BMP program.
- Assure that landowners understand that although implementation of BMPs may reduce available grazing acreage, it will not affect their land-use classification.
- Many waterfowl, Canada geese in particular, no longer migrate seasonally, so their impacts to water quality are year-round and cumulative, which has been documented by local water quality testing groups in local ponds. A program needs to be developed and implemented to inform citizens of the benefits of pond bank and streamside buffers. Educational funds made available during implementation phase should be directed at wildlife sources and management options, utilizing VDGIF to develop educational materials.
- Review local ordinances and comprehensive plans to identify opportunities to promote water quality improvement; such as, implementation and/or preservation of riparian buffers.
- Up to $50,000 may be available from the Krebser Foundation in 2009 to close the gap between cost share amounts and full cost needed to implement BMPs. If available, funding will be limited to Rappahannock County.
- Federal funding in the amount of $162,000 for BMPs in the Upper Hazel River watershed will be available in 2009. VADCR has $32,709 of Section 319 funds available for CSSWCD technical assistance in the Upper Hazel River watershed in 2009. In addition, $162,500 cost-share funding will be available in 2009 through Virginia Water Quality Improvement Fund for targeted agricultural BMP implementation in the Upper Hazel River watershed.
- Funding sources and programs need to be identified for landowner's needs and income levels for the construction or repair of septic systems in rural areas and for landowners in Washington, VA requesting assistance with hook-up fee requirements for the currently proposed wastewater treatment plant.
- The GWG members expressed to VADEQ staff the desire to have at least one continual monitoring station in each of the three impairment watersheds to measure implementation progress.
- Local interest and activities to be integrated with implementation include: RappFlow, Hughes River Partnership, and Rappahannock League for Environmental Protection.

5.3 Steering Committee Summary

The Steering Committee consisted of representatives from the AWG, GWG, RWG, watershed residents, county and town personnel, government agencies, and ECI. The Steering Committee evaluated recommendations from working groups, reviewed BMP quantification and cost estimates, created implementation goals and milestones, reviewed monitoring plan, discussed potential funding resources available, revised implementation plan document, and evaluated materials for final public meeting. The steering committee will periodically revisit implementation progress and suggest plan revisions as needed. Key topics and recommendations included:

- The Thornton River watershed should be included in the Upper Hazel River TMDL IP and residents should be eligible for similar cost-share as residents in Hughes River, Hazel River, and Rush River watersheds;
- Stakeholders need a sense of ownership for the TMDL IP to trigger desire to be involved and implement control measures;
- Overall, Rappahannock County residents appreciate the farming community and rural aspects of the county and do not want it impacted;
- Water quality monitoring needs to continue at station 3-RUS005.66 on Rush River to enable evaluation of control measure implementation; and
- The NPS does not monitor for bacteria, but welcome groups in the park to conduct coliscan monitoring.

Stream Exclusion Fencing with Vegetated Buffer

Septic System Repair

6. IMPLEMENTATION ACTIONS

6.1 Assessment of Implementation Action Needs

The actions and cost needed in the implementation stages were identified and quantified. The estimated units presented in Table 2 represent the Stage II implementation goal of TMDL source allocation attainment, which is required under WQMIRA and by USEPA for eligibility to receive Section 319 grant funds to apply during implementation. An assessment was also conducted to quantify actions and cost that translate to an instantaneous standard violation rate of 10% or less, meeting the new proposed bacteria water quality standard and resulting in removal of Hughes River, Hazel, River, and Rush River from the Commonwealth of Virginia's Section 303(d) List of Impaired Waters. This is referred to as the Stage I implementation goal. Potential control measures, their associated costs and efficiencies, and potential funding sources were identified through review of the TMDL, input from working groups, and literature review. Control measures were assessed based on cost, availability of existing funds, reasonable assurance of implementation, and water quality impacts. Measures that can be promoted through existing programs were identified, as well as those not currently supported by existing programs and their potential funding sources. The assurance of implementation of specific control measures was assessed through discussion with the working groups and Steering Committee.

Permanent Vegetative Cover on Cropland

The quantity of control measures, or BMPs, recommended during implementation was determined through spatial analyses and modeling alternative implementation scenarios. Spatial analyses of land use, stream-network, and the Commonwealth of Virginia aerial maps along with regionally appropriate data archived in the VADCR Agricultural BMP Database and TMDL document were utilized to establish average estimates of control measures to reduce bacteria loads in the watershed. Additionally, input from local agency representatives, citizens, and contractors were used to verify the analyses.

Removing livestock from the stream corridor was identified as the primary control measure to reduce the livestock direct deposition bacteria load. There are approximately 711 miles of perennial streams in the Upper Hazel River watershed. Exclusion fencing necessary to prevent access to perennial streams and meet the stated TMDL reductions was estimated at approximately 437 miles of fence. Figure 3 displays analysis results for a portion of the watershed. This exclusion fencing is translated into a total of 1,072 Grazing Land Protection Systems (SL-6) to be installed to insure full exclusion of livestock from the streams (Table 2). A typical SL-6 system includes streamside fencing for perennial and intermittent streams, cross-fencing for pasture management, hardened crossing, alternative watering system, watering trough, and a 35-ft buffer from the stream.

A proposed pasture management system BMP to provide incentive for control of upland pasture loads is recommended with the following anticipated criteria:

- Must have NRCS specified livestock exclusion system installed;
- Must have soil testing performed applying lime and fertilizer based on testing results allowing nutrients to be more readily available resulting in an improved stand.;
- Must maintain a 3-inch minimum grass height through the growing season per NRCS recommended specifications;
- Must mow pastures to control woody vegetation;
- Must chain harrow pasture to break-up manure piles after livestock are removed from field;
- Tax credit provided for chain harrow purchase; and
- Incentive payment of $100/ac provided.

In order to address pasture land reductions, the benefit of installing the SL-6 exclusion systems and pasture acreage incorporated in the proposed pasture management system BMP were calculated. Total of 53,621 acres in the Upper Hazel River watershed will be included in the pasture management system BMPs. Given reductions were not sufficient to meet TMDL reduction goals, installation of retention ponds may be necessary to treat runoff from this acreage during Stage II of implementation.

During IP development, the AWG and GWG noted a decreasing trend in cropland acres and minimal land application of collected beef manure in the Upper Hazel River watershed. The conversion of cropland to pasture or forest land uses results in a bacteria load reduction. Therefore, it was decided that the primary control measure for cropland bacteria load reduction will be permanent conversion of cropland to pasture and forest land uses. The conversion was divided evenly between SL-1 Permanent Vegetative Cover and FR-1 Reforestation of Erodible Crop and Pastureland BMPs. Additionally, manure / biosolids incorporation into soil was need in part of the watershed. Converting 283 acres to pasture and 283 acres to forest land uses and incorporating manure / biosolids into soil on approximately 569 cropland acres during Stage II was estimated to address required cropland reductions.

Re-forestation

Table 2. Estimation of control measures with unit cost (average) needed to meet implementation goals during 10-year timeline for agricultural and residential bacteria reductions in Upper Hazel River watershed.

Control Measure	Unit	Estimated Units Needed (#)	Unit Cost[1] ($)
Agricultural			
Livestock Exclusion System (e.g., SL-6 system)	System	1,072	21,600
Pasture Management System	Acres - Treated	53,621	100
Permanent Vegetative Cover on Cropland (SL-1)	Acres - Installed	283	300
Reforestation of Erodible Crop and Pastureland (FR-1)	Acres - Installed	283	400
Manure / Biosolids Incorporation on Cropland	Acres - Treated	569	20[a]
Retention Pond	Acres - Treated	5,419	2,000[a]
Technical Assistance	Full Time Equivalent	60[b]	84,000
Residential			
Alternative Sewage Disposal System	System	130	25,000
New Septic System	System	777	9,000
Repaired Septic System	System	439	3,500
Pet Waste Enzyme Digesting Composters	System	1,908	50
Pet waste Management Program	System	4	5,000
Confined Canine Unit Treatment System	System	12	15,000
Vegetated Buffers	Acres - Treated	510	400
Technical Assistance	Full Time Equivalent	20[b]	84,000

[1] Unit cost = installation or one-time incentive payment; [a] Cost per acre treated, [b] Total for 10-year timeline

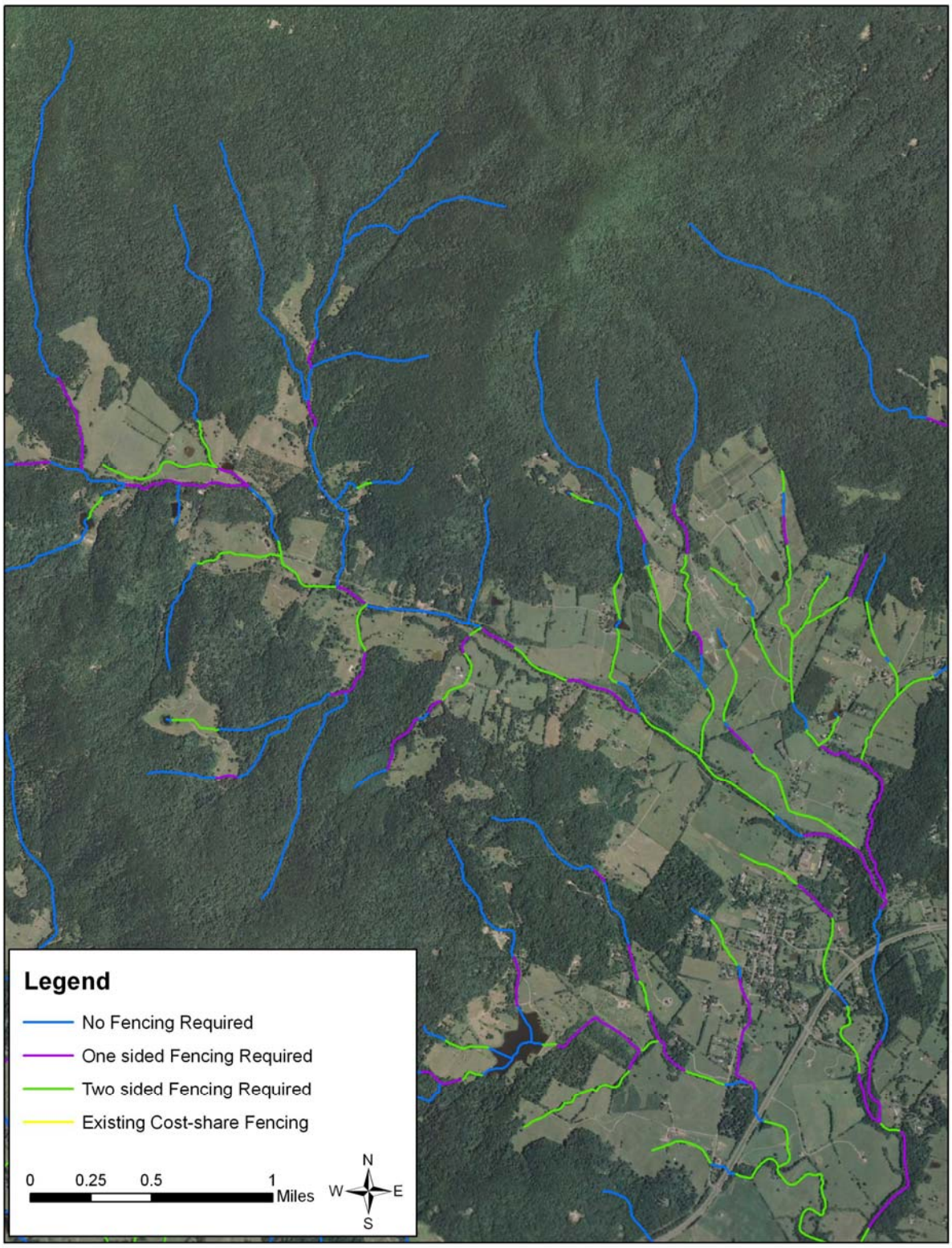

Figure 3. Example of potential livestock exclusion fencing analysis results for portion of Upper Hazel River watershed.

The number of straight pipes and failing septic systems were based on numbers reported in the TMDL documents. It was decided that budgeting should be based on correcting all systems identified. Based on discussion with Rappahannock County Health Department and Steering Committee, it was assumed that 90% of the straight pipes would be replaced with a conventional septic system and 10% replaced with an alternative on-site sewage disposal system. Failing septic systems were assumed to be corrected by repairing the existing septic system (40%), installing a new conventional septic system (50%), or installing a new alternative sewage disposal system (10%). It is estimated that 439 septic system repairs, 777 conventional septic systems, and 130 alternative on-site sewage disposal systems are considered necessary to correct straight pipes and failing septic systems in the four watersheds during Stage I (Table 2). A four-step program was proposed to address pet waste reductions. In the first step, a pet waste control program consisting of educational packets, signage, and disposal stations in public areas will be instituted in each watershed. The second step will be installing pet waste enzyme digesting composters at 1,908 residences. The third step will be identification of confined canine units (CCU) and installing approximately 12 CCU waste treatment systems throughout the Upper Hazel River watershed. The installation of vegetated buffers on residential land use is the fourth step. Components of the four-step program are outlined in Table 2.

Pet Waste Composter

Implicit in the TMDL is the need to avoid increased delivery of pollutants from sources that have not been identified as needing a reduction, and from sources that may develop over time, as implementation proceeds. One potential for additional bacteria source identified is the resident Canada geese population. Care should be taken to monitor the geese population impact on water quality.

6.2 Assessment of Technical Assistance Needs

To determine the number of full time equivalents (FTE) considered necessary for agricultural technical assistance during implementation, the average cost-share amount of practices needed to be installed per year during implementation was divided by an average cost-share amount that one FTE can process in a year. It was assumed that all BMPs would need some level of technical assistance and the FTE would be responsible for educational outreach. Six FTEs per year, five for livestock exclusion systems and one for pasture and cropland load reductions, providing technical assistance for the agricultural program are needed throughout the ten-year implementation timeline (*i.e.*, 60 total). Members of the RWG, GWG, and Steering Committee estimated that two technical FTE per year, one for on-site sewage disposal system corrections and one for pet waste management, would be required throughout the ten-year implementation timeline (*i.e.*, 20 total) to provide technical assistance and educational outreach tasks to reduce bacteria loads on residential land uses.

6.3 Cost Analysis

Associated cost estimations for each implementation action during Stages I and II were calculated by multiplying the average unit cost per the number of units shown in Table 2. Table 3 lists installation and technical assistance costs to implement agricultural and residential programs

for implementation Stages I and II. Focusing on Stage I (*i.e.*, removal of impairments from impaired waters list) costs, the average installation cost for full livestock exclusion systems and pasture management system BMPs in the Upper Hazel River watershed is $13.87 million and $3.32 million, respectively. There is no cost in Stage I associated with control measures to obtain the cropland land-applied reductions in the Upper Hazel River as these reductions will be a focus in Stage II. Estimated corrective action costs needed to replace straight pipes and fix failing septic systems during Stage I totals $7.10 million excluding technical assistance. The cost to implement the three-step pet waste reduction process totals an estimated $0.26 million excluding technical assistance.

It was determined by the JMSWCD, VADCR, VDH, GWG, and steering committee members that it would require $60,000 and $48,000 to support the salary, benefits, travel, and training of one technical FTE and administrative FTE, respectively. The total cost to provide assistance in the agricultural and residential programs during Stage I implementation is expected to be $3.02 million and $1.01 million, respectively. The total Stage I implementation cost including technical assistance is $28.58 million with the agricultural cost being $20.21 million and the residential cost $8.37 million (Table 3).

Rotational Grazing System

Table 3. Implementation cost associated with percentage of practices installed addressing agricultural and residential practices along with technical assistance needed in Upper Hazel River watershed.

YEAR	AGRICULTURAL					RESIDENTIAL				TOTAL COST
	Livestock Direct Deposition ($)	Pasture Load Reduction ($)	Cropland Load Reduction ($)	Technical Assistance ($)	Total ($)	On-site Sewage Disposal Systems ($)	Pet Waste Management ($)	Technical Assistance ($)	Total ($)	($)
1	2,311,000	536,000	0	504,000	3,351,000	1,184,000	30,000	168,000	1,382,000	4,733,000
2	2,311,000	536,000	0	504,000	3,351,000	1,184,000	30,000	168,000	1,382,000	4,733,000
3	2,311,000	536,000	0	504,000	3,351,000	1,184,000	45,000	168,000	1,397,000	4,748,000
4	2,311,000	536,000	0	504,000	3,351,000	1,184,000	45,000	168,000	1,397,000	4,748,000
5	2,311,000	590,000	0	504,000	3,405,000	1,184,000	55,000	168,000	1,407,000	4,812,000
6	2,311,000	590,000	0	504,000	3,405,000	1,184,000	55,000	168,000	1,407,000	4,812,000
7	2,311,000	3,246,000	49,000	504,000	6,110,000	1,184,000	61,000	168,000	1,413,000	7,523,000
8	2,311,000	3,246,000	49,000	504,000	6,110,000	1,184,000	61,000	168,000	1,413,000	7,523,000
9	2,333,000	3,193,000	49,000	504,000	6,079,000	1,184,000	61,000	168,000	1,413,000	7,492,000
10	2,333,000	3,191,000	49,000	504,000	6,077,000	1,184,000	61,000	168,000	1,413,000	7,490,000
Stage I Total (1-6)	**13,866,000**	**3,324,000**	**0**	**3,024,000**	**20,214,000**	**7,104,000**	**260,000**	**1,008,000**	**8,372,000**	**28,586,000**
Stage II Total (1-10)	**23,154,000**	**16,200,000**	**196,000**	**5,040,000**	**44,590,000**	**11,840,000**	**504,000**	**1,680,000**	**14,024,000**	**58,614,000**

6.4 Benefit Analysis

The primary benefit of implementation is cleaner waters in Virginia, where bacteria levels in Upper Hazel River will be reduced to meet water quality standards. Cleaner waters can benefit human health, stakeholder economy, livestock herd health, and aquatic community.

6.4.1 Human Health

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

6.4.2 Economics

An important objective of the IP is to foster 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 agricultural and residential practices recommended in this document will provide economic benefits to the landowner, along with the expected environmental benefits on-site and downstream. For example, exclusion of cattle from streams leading to the development of alternative (clean) water sources, improved pasture management, private sewage system maintenance, and improved aesthetics around businesses provide economic benefits. Additionally, money spent by landowners, government agencies, and non-profit organizations in the process of implementing the IP will stimulate the local economy.

The benefit of a Grazing Land Protection System BMP is improved profit through more efficient utilization and harvest of forage by grazing animals. Standing forage utilized directly by the grazing animal is always less costly and of higher quality than the same forage harvested with equipment and fed to the animal (VCE, 1996). Several factors contribute to greater profitability: stocking rate can usually be increased by 30% to 50%; high-quality, fresh, and unsoiled vegetative growth available throughout the grazing system increases weight gain per acre; vigor of the pasture sod is improved; and handling and checking grazing animals is easier. More accurate estimates of the amount of forage available, greater uniformity in grazing of pastures, flexibility of harvesting and storing forage not needed for grazing, and extending the length of the grazing season while providing a more uniform quality and quantity of forage throughout the season are important benefits afforded by this system (VCE, 1996).

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. In addition, investment in the home is protected with a properly functioning sewage disposal system. A home's value can be decreased up to 40% with a failed septic system (Shepherd, 2006). The average septic system will last 20-25 years if properly maintained. Proper maintenance includes; knowing the location

of the system components and protecting them by not driving or parking on top of them, not planting trees where roots could damage the system, keeping hazardous chemicals out of the system, and pumping out the septic tank every three to five years. The cost of proper maintenance, as outlined here, is relatively inexpensive in comparison to repairing or replacing an entire system.

Improved aesthetics in public areas (*e.g.*, parks) and surrounding businesses provided by control measures (*e.g.*, pet waste kiosks and bioretention) has the potential to draw local citizens and visitors to these areas. In addition, a healthy waterway has the potential to attract local citizens and visitors for recreation.

Alternative On-site Sewage Disposal System

6.4.3 Livestock Herd Health

A clean water source coupled with exclusionary fencing has been shown to increase weight gains; decrease stress; reduce herd health risks associated with increased exposure to water-transmitted diseases, bacteria, virus and cysts infections; reduce mastitis and foot rot; and decrease herd injuries associated with cattle climbing unstable streambanks or being stuck in mud.

6.4.4 Aquatic Community Improved

Stream bank protection provided through exclusion of livestock from streams will improve the aquatic habitat in these streams. Vegetated buffers that are established will also help reduce sediment and nutrient transport to the stream from upslope locations. The installation of improved pasture management systems should also reduce soil and nutrient losses and increase infiltration of precipitation; thereby, decreasing peak flows downstream. Reductions in nutrient and sediment loadings contribute to attainment of nutrient and sediment reduction goals for the Commonwealth of Virginia Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy for the Rappahannock River and Northern Neck Coastal Basins, April 2004. Local initiatives, such as Rappahannock County Riparian Easement Program, will additionally be complemented by actions performed during TMDL implementation.

7. MEASUREABLE GOALS AND MILESTONES FOR ATTAINING WATER QUALITY STANDARDS

The end goals of implementation are:

1) Restored water quality in the impaired waters, and
2) Subsequent de-listing of streams from the Commonwealth of Virginia's Section 303(d) List of Impaired Waters.

Alternative Water Source

Progress toward end goals will be assessed during implementation through tracking of control measure installations by Culpeper Soil and Water Conservation District; Natural Resources Conservation Service; Virginia Department of Health, Virginia Department of Conservation and Recreation; Culpeper, Madison, and Rappahannock Counties; Town of Washington; and RRRC. The VADEQ will continue to assess water quality through its monitoring program. Other monitoring project activities in the watersheds (*e.g.*, RappFLOW) will be coordinated with VADEQ to augment the VADEQ monitoring program. Implementation will be assessed based on reducing exceedances of the bacteria water quality standard to improve water quality resulting in removal of Hughes River, Hazel River, and Rush River from the Commonwealth of Virginia's Section 303(d) List of Impaired Waters.

Implementation of control measures is scheduled for 10 years and will be assessed in two stages. Stage I is based on meeting source allocations that translate to an instantaneous standard violation rate of 10% or less meeting the newly proposed bacteria water quality standard resulting in removal of Hughes River, Hazel River, and Rush River from the Commonwealth of Virginia's Section 303(d) List of Impaired Waters. The Stage II goal is based on implementing source allocations to meet the specified TMDL goal, 0% exceedance of water quality standards. Implementation of control measures is scheduled to begin in July 2009 lasting to June 2019 (Tables 3 and 4). After implementation inception, three milestones will be met in Stage I and two milestones in Stage II.

Implementation in years one through six for agricultural source reductions focuses on livestock exclusion and pasture management systems. BMPs installed in years seven through ten are based on additional livestock exclusion, additional treatment of runoff from pasture land using retention ponds to remove remaining bacteria load not treated with the pasture management systems installed during Stage I, cropland conversion, and manure / biosolids incorporation into soil. Retention ponds are more costly and are logistically more difficult to design and locate on individual farms. Implementation in years one through six for residential bacteria loads focuses on identification and removal of straight pipes, repairing or replacing failed septic systems, installation of pet waste enzyme digesting composters, instituting pet waste control programs, and installation of storage and treatment systems for waste from confined canine units (CCU). Implementation of these control measures will continue in years seven through ten if needed.

Streambank Buffer Establishment

Table 4 lists the cumulative progress towards the TMDL endpoint as implementation milestones are met. Water quality improvement is expected to increase each year. A 18% overall bacteria load reduction is expected at the second year, 37% in the fourth year, and 57% in the sixth year. Based on water quality modeling projections for the sixth year (Milestone 3), the Hughes River, Hazel River, and Rush River would be in a probable position to be de-listed from the Commonwealth of Virginia's Section 303(d) List of Impaired Waters. Considering the dynamics of a stream ecosystem and the inherent difficulties that may arise preventing BMP implementation, the final milestone of TMDL allocation attainment was set at 10 years following implementation commencement.

The process of a staged implementation implies targeting of control measures, ensuring optimum utilization of resources. In quantifying agricultural BMPs through the use of aerial, land use, and stream network GIS layers, maps were formulated showing potential livestock access, pastureland, and crop fields. Portion of map created of Upper Hazel River watershed is depicted in Figure 3. These maps identify farm tracts that CSWCD should concentrate efforts in. Owners will be contacted and progression through BMP installation will be tracked. Known problem areas, clusters of older homes, or houses in close proximity to streams known by the VDH will be targeted for onsite treatment system control measures. Steps outlined in pet waste BMP stages results in targeting of source type and resources.

Table 4. Cumulative implementation and water quality milestones along with cost for Upper Hazel River watershed.

Control Measure	Unit	Milestone 1 Completed by 2011	Milestone 2 Completed by 2013	Milestone 3 Completed by 2015	Milestone 4 Completed by 2017	Milestone 5 Completed by 2019
Agricultural						
Livestock Exclusion System (e.g., SL-6 system)	System	214	428	642	856	1,072
Pasture Management System	Acres - Treated	10,724	21,448	32,172	42,896	53,621
Permanent Vegetative Cover on Cropland (SL-1)	Acres - Installed	0	0	0	142	283
Reforestation of Erodible Crop and Pastureland (FR-1)	Acres - Installed	0	0	0	142	283
Manure / Biosolids Incorporation on Cropland	Acres - Treated	0	0	0	284	569
Retention Pond	Acres - Treated	0	0	0	2,710	5,419
Technical Assistance	Full Time Equivalent	12	24	36	48	60
Residential						
Alternative Sewage Disposal System	System	26	52	78	104	130
New Septic System	System	156	312	468	624	777
Repaired Septic System	System	88	176	264	352	439
Pet waste Management Program	System	2	4	4	4	4
Pet Waste Enzyme Digesting Composters	System	382	764	1,146	1,528	1,908
Confined Canine Unit Treatment System	System	2	6	12	12	12
Vegetated Buffers	Acres - Treated	0	0	0	256	510
Technical Assistance	Full Time Equivalent	4	8	12	16	20
Cumulative Bacteria Reduction (%)		**18.3**	**36.7**	**56.7**	**76.6**	**94.9**
Cumulative Cost (millions $)		**9.49**	**18.97**	**28.45**	**43.45**	**58.49**

7.1 Monitoring

Virginia's 1997 WQMIRA requires that TMDL IPs include measurable goals and milestones for attaining water quality standards. Implicit in those milestones is the requirement of a method to measure progress. Implementation progress will be evaluated through water quality monitoring conducted by VADEQ through the agency's monitoring program and any additional monitoring support (*i.e.*, citizen monitoring) that may develop as implementation progresses. RappFLOW (www.RappFLOW.org), a citizen interest group, regularly monitors streams in Rappahannock County and has recently completed an extensive water quality study of the county.

VADEQ will monitor at eight stations located in the Upper Hazel River watershed (Table 5 and Figure 4). Stations 3-HUE000.20, 3-HAZ018.29, 3-THO006.50, and 3-THO014.37 are ambient trend stations and will be monitored indefinitely on a bi-monthly basis during implementation. Stations 3-THR000.50, 3-POH000.48, and 3-XHH000.24 are watershed stations and will be monitored on a bi-monthly basis from January 2009 through December 2010, after which monitoring continuation by VADEQ beyond this period will be evaluated. The GWG and Steering Committee requested that monitoring continue at station 3-RUS005.66, the station used to designate Rush River as impaired. A two-year sampling rotation from 2007-2008 was recently completed at station 3-RUS005.66 and VADEQ plans to continue monitoring at least through 2010 to aid in assessing implementation progress. The following parameters will be collected at the ambient trend monitoring stations: *E. coli* bacteria, temperature, dissolved oxygen, pH, specific conductance, total nitrogen, total phosphorus, total solids, and total suspended solids. For the watershed stations, the same parameters are collected at trend stations excluding total suspended solids. Monitoring results are accessible on the VADEQ website (http://www.deq.state.va.us/water/).

Table 5. Monitoring station identification, station location, station type, and monitoring schedule for VADEQ monitoring stations in the Upper Hazel River watershed.

Station ID	Station Location	Station Type	Monitoring Schedule
3-HUE000.20	Hughes River at Route 644	Trend[1]	long term
3-HAZ018.29	Hazel River at Route 729	Trend	long term
3-RUS005.66	Rush River at Route 683	TMDL IP[2]	2009 - 2010
3-THO006.50	Thornton River at Route 729	Trend	long term
3-THO014.37	Thornton River at Route 626	Trend	long term
3-THR000.50	North Fork Thornton River at Route 211 / 522	Watershed[3]	2009 – 2010
3-POH000.48	Popham Run at Route 603	Watershed	2009 – 2010
3-XHH000.24	Unnamed Tributary to Thornton River at Route 626	Watershed	2009 – 2010

[1] Trend Stations – historically located, long-term water quality monitoring stations used to assess changes in water quality over long periods of time; sampled at least six times per year

[2] TMDL IP Stations – located in watersheds with a developed TMDL IP; designed to track implementation progress; sampled six times during the year (sampling occurs every other month)

[3] Watershed Stations – typically located near mouth of a watershed; designed to provide comprehensive statewide coverage of smaller watersheds; sampled 12 times over a consecutive two-year period (sampling occurs every other month); each watershed is monitored for a two-year term within a six-year rotational cycle

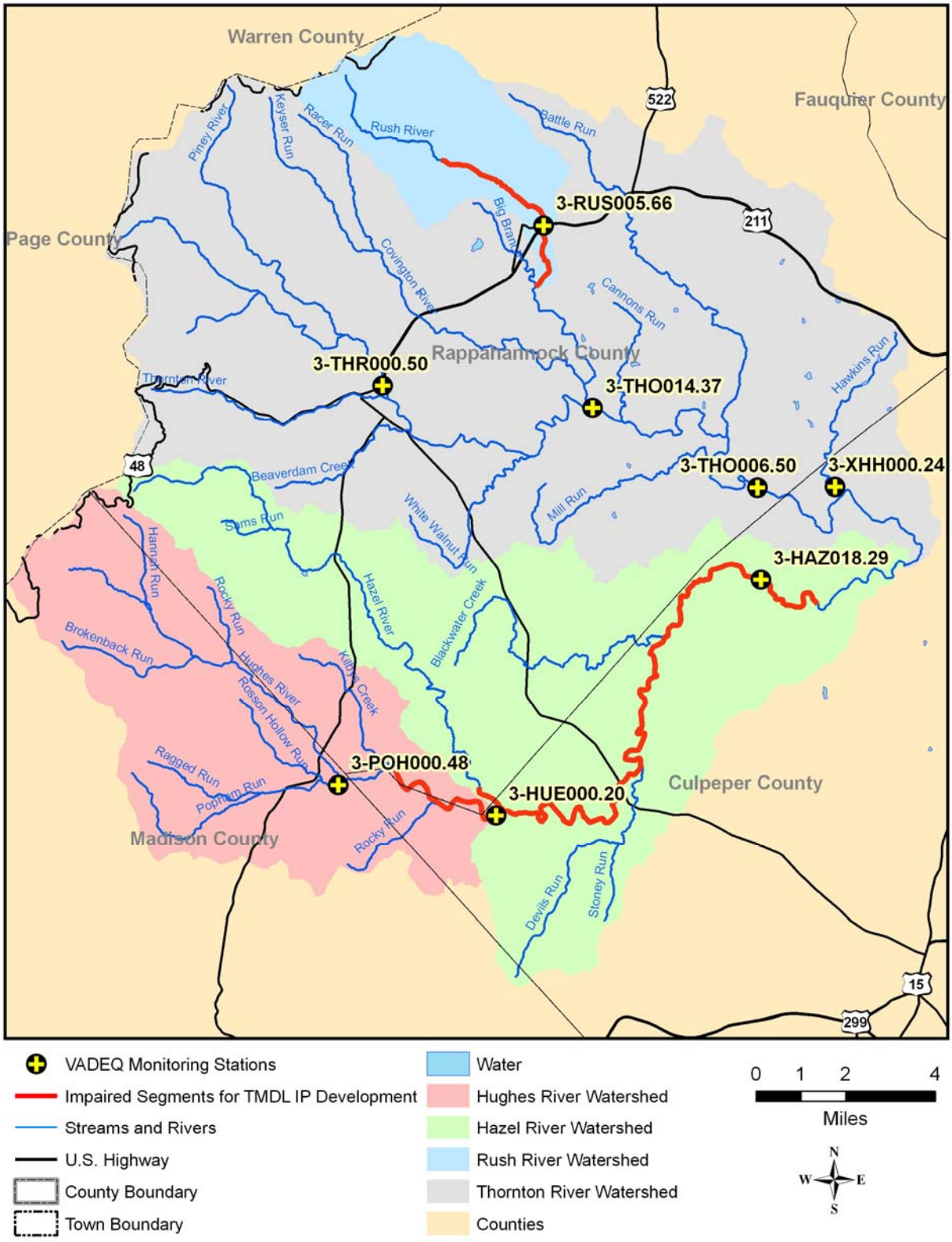

Figure 4. Location of VADEQ monitoring stations in the Upper Hazel River watershed.

8. STAKEHOLDER'S 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. Successful implementation depends on stakeholders taking responsibility for their role in the process. The primary role falls on the local groups that are most affected; that is, businesses, community watershed groups, and citizens. However, local, state, and federal agencies also have a stake in seeing that Virginia's waters are clean and provide a healthy environment for its citizens. Stakeholder participation and support is essential for achieving the goals of this TMDL effort (*i.e.*, improving water quality and removing streams from the impaired waters list). Virginia's approach to correcting non-point source pollution problems continues to be encouragement of participation through education and financial incentives; that is, outside of the regulatory framework. If, however, voluntary approaches prove to be ineffective, it is likely that implementation will become less voluntary and more regulatory.

The roles and responsibilities of some of the major stakeholders on a federal, state, and local level are as follows:

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

NRCS: The Natural Resources Conservation Service is the federal agency that works hand-in-hand with the American people to conserve natural resources on private lands. NRCS assists private landowners with conserving their soil, water, and other natural resources. Local, state and federal agencies and policymakers also rely on the expertise of NRCS staff. NRCS is also a major funding stakeholder for impaired water bodies through the Conservation Reserve Enhancement Program (CREP) and the Environmental Quality Incentive Program (EQIP).

Pet Waste Kiosk

In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. State government has the authority to establish state laws that control delivery of pollutants to local waters. Local governments in conjunction with the state can develop ordinances involving pollution prevention measures. In addition, citizens have the right to bring litigation against persons or groups of people who can be shown to be causing some harm to the claimant. Through hearing the claims of citizens in civil court, and the claims of government representatives in criminal court, the judicial branch of government also plays a significant role in the regulation of activities that impact water quality. Currently, there are seven state agencies responsible for regulating and/or overseeing statewide activities that impact water quality in Virginia. These agencies include: VADEQ, VADCR, Virginia Department of Agriculture and Consumer Services (VDACS), VDGIF, Virginia Department of Health (VDH), Virginia Department of Forestry (VADOF), and VCE.

VADEQ: The State Water Control Law authorizes the SWCB 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 recreation, fishing, shellfishing, aquatic life, and drinking

water uses. For many years the focus of VADEQ'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 VADEQ'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. VADEQ is the lead agency in the TMDL process. The Code of Virginia directs VADEQ to develop a list of impaired waters, develop TMDLs for these waters, and develop IPs for the TMDLs. VADEQ administers the TMDL process, including the public participation component, and formally submits the TMDLs to USEPA and the SWCB for approval. VADEQ is also responsible for implementing point source WLAs, regulation of biosolids applications, assessing water quality across the state, and conducting water quality standard related actions.

VADCR: The Virginia Department of Conservation and Recreation is authorized to administer Virginia's NPS pollution reduction programs in accordance with §10.1-104.1 of the Code of Virginia and §319 of the Clean Water Act. USEPA is requiring that much of the §319 grant monies be used for the development of TMDLs. Because of the magnitude of the NPS component in the TMDL process, VADCR is a major participant in the TMDL process. VADCR has a lead role in the development of IPs to address correction of NPS pollution contributing to water quality impairments. VADCR also provides available funding and technical support for the implementation of NPS components of IPs. The staff resources in VADCR's TMDL program focus primarily on providing technical assistance and funding to stakeholders to develop and carry out IPs, and support to VADEQ in TMDL development related to NPS impacts. Under the Virginia Stormwater Management Program, VADCR is responsible for the issuance, denial, revocation, termination, and enforcement of National Pollutant Discharge Elimination System (NPDES) permits for the control of stormwater discharges from municipal separate storm sewer systems (MS4) and land disturbing activities. VADCR staff will be working with other state agencies, local governments, soil and water conservation districts, watershed groups, and citizens to gather support and to improve the implementation of TMDL plans through utilization of existing authorities and resources.

Stream Exclusion Fencing

VDACS: The Virginia Department of Agriculture and Consumer Services Commissioner of Agriculture has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis (Pugh, 2001). If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken, which may include civil penalties. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, *etc*. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures.

VDGIF: The Virginia Department of Game and Inland Fisheries manages Virginia's wildlife and inland fish to maintain optimum populations of all species to serve the needs of the

Commonwealth; provides opportunity for all to enjoy wildlife, inland fish, boating and related outdoor recreation; and promotes safety for persons and property in connection with boating, hunting, and fishing. The VDGIF has responsibility for administering certain U.S. Fish and Wildlife Service funding programs. Personnel participate, review, and comment on projects processed through state and federal project and permitting review processes to insure the consideration for fish and wildlife populations and associated habitats.

VDH: The Virginia Department of Health is responsible for maintaining safe drinking water measured by standards set by the USEPA. Their duties also include septic system regulation. Like VDACS, VDH is complaint driven. Complaints can range from a vent pipe odor that is not an actual sewage violation and takes very little time to investigate, to a large discharge violation that may take many weeks or longer to effect compliance. For TMDLs, VDH has the responsibility of enforcing actions to correct failed septic systems and/or eliminate straight pipes (Sewage Handling and Disposal Regulations, 12 VAC 5-610-10 *et seq*.).

Virginia Department of Forestry (VADOF): The VADOF has prepared a manual to inform and educate forest landowners and the professional forest community on proper BMPs and technical specifications for installation of these practices in forested areas (www.dof.state.va.us/wq/wq-bmp-guide.htm). Forestry BMPs are intended to primarily control erosion. For example, streamside forest buffers provide nutrient uptake and soil stabilization, which can benefit water quality by reducing the amount of nutrients and sediments that enter local streams.

Riparian Forest Buffer

VCE: Virginia Cooperative Extension is an educational outreach program of Virginia's land grant universities (Virginia Tech and Virginia State University), and a part of the national Cooperative State Research, Education, and Extension Service, an agency of the United States Department of Agriculture (USDA). VCE is a product of cooperation among local, state, and federal governments in partnership with citizens. VCE offers educational programs and technical resources for topics such as crops, grains, livestock, poultry, dairy, natural resources, and environmental management. VCE has published several publications that deal specifically with TMDLs. For more information on these publications and to find the location of county extension offices, visit www.ext.vt.edu.

Regional and local government groups work closely with state and federal agencies throughout the TMDL process; these groups possess insights about their community that may help to ensure the success of TMDL implementation. These stakeholders have knowledge about a community's priorities, how decisions are made locally, and how the watershed's residents interact. Some local government groups and their roles in the TMDL process are listed here:

CSWCD: The Culpeper Soil and Water Conservation District is a local unit of government responsible for the soil and water conservation work within Culpeper, Greene, Madison, Orange, and Rappahannock Counties. The district's overall role is to increase voluntary conservation

practices among farmers, ranchers, and other land users. District staff work closely with watershed residents and have valuable knowledge of local watershed practices. Specific to the TMDL implementation, the district will lead education and technical assistance efforts and track BMP implementation for the agricultural and residential programs.

Culpeper, Madison, and Rappahannock Counties and Town of Washington Government Departments: Government staff work closely with local and state agencies to develop and implement the TMDL. The staff may also help to promote education and outreach to citizens, businesses, and developers to introduce the importance of the TMDL process.

Alternative On-site Sewage Disposal System

RRRC: Environmental planning is a long-standing area of emphasis of the RRRC, which is complementary to the TMDL process. RRRC continues to promote efficient development of the environment by assisting and encouraging local governmental agencies to plan for the future. TMDL development and implementation plan development have been contracted through the RRRC. RRRC will lead the pet waste management implementation with assistance from localities and CSWCD. Additionally, RRRC will continue to work with VADCR and the Steering Committee to periodically revisit implementation progress and suggest plan revisions as needed.

Citizens & Businesses: The primary role of citizens and businesses is simply to get involved in the TMDL process. This may include participating in public meetings, assisting with public outreach, providing input about the local watershed history, and/or implementing BMPs to help restore water quality.

RappFLOW: RappFLOW is a grassroots group of citizen volunteers founded in the summer of 2002, representing the varied interests of people who live in and around Rappahannock County, VA. The goal of RappFLOW is to build a shared base of knowledge among all stakeholders. From this knowledge, RappFLOW distills and prioritizes issues that are important to the citizens and to the protection of the watershed. This knowledge-building activity is viewed as foundational for future watershed management planning activities.

FOR: Friends of the Rappahannock was formed in 1985 as a non-profit, grassroots conservation organization, whose common goal is to maintain the water quality and scenic beauty of the Rappahannock River and its tributaries. FOR works with a wide variety of stakeholders, from local governments to elementary students, to educate about the river and to advocate for actions and policies that will protect and restore the values that make the Rappahannock River so special. FOR promotes environmentally responsible planning through active participation in the civic process. FOR professional staff provide technical support to local governments, developers, and teachers in areas of special expertise, including low impact development codes and ordinances, watershed planning, water quality monitoring, invasive species control, and streambank restoration.

Hughes River Partnership: Founded in 2008, Hughes River Partnership works with landowners in the Hughes River watershed to promote the development of conservation easements and encourage land use practices that support agricultural sustainability in the area.

RLEP: Rappahannock League for Environmental Protection hosts educational events and informative website on local environmental issues.

PEC: Piedmont Environmental Council safeguards the landscapes, communities and heritage of the Piedmont by involving citizens in related public policy and land conservation.

Community Civic Groups: Community civic groups take on a wide range of community service including environmental projects. Such groups include the Ruritan, Farm Clubs, Homeowner Associations and youth organizations such as 4-H and Future Farmers of America. These groups offer a resource to assist in the public participation process, educational outreach, and assisting with implementation activities in local watersheds.

Animal Clubs/Associations: Clubs and associations for various animal groups (*e.g.*, beef, equine, poultry, swine, and canine) provide a resource to assist and promote conservation practices among farmers and other landowners, not only in rural areas, but in residential areas as well.

9. INTEGRATION WITH OTHER WATERSHED PLANS

Each watershed within the state is under the jurisdiction of a multitude of individual yet related water quality programs and activities, many of which have specific geographical boundaries and goals. These include but are not limited to, the Chesapeake Bay 2000 agreement, Tributary Nutrient Reduction Plans, TMDLs, Roundtables, Water Quality Management Plans, Erosion and Sediment Control regulations, Stormwater Management Program, Source Water Assessment Program, and local comprehensive plans. In some cases, an IP may even address multiple TMDLs (*e.g.*, bacteria and benthic) for the same impaired water body. The progress of these projects or programs needs continuous evaluation to determine possible effects on implementation goals. For example, financial and technical resources may be maximized for implementation by coordinating and expanding the planning and implementation activities of these on-going watershed projects or programs. Current initiatives within Town of Washington and Culpeper, Madison, and Rappahannock Counties to be integrated with the Upper Hazel River TMDL IP include:

Retention Pond

- Culpeper, Madison, and Rappahannock Counties Comprehensive Plans
- Town of Washington Comprehensive Plan
- CSWCD Septic System Program
- Town of Washington Waste Water Treatment Plant Construction
- Rappahannock County Easement Program
- Madison County Easement Program
- Madison County Asset mapping Project
- RappFLOW Strategic Plan
- Friends of the Rappahannock (FOR) Strategic Plan
- The Hughes River Partnership Strategic Plan
- Rappahannock League for Environmental Protection (RLEP) Strategic Plan
- Piedmont Environmental Council (PEC) Strategic Plan

10. POTENTIAL FUNDING SOURCES

Potential funding sources available during implementation were identified in the course of plan development. Detailed description of each source (*i.e.*, eligibility requirements, specifications, incentive payments) can be obtained from the CSWCD, VADCR, VADEQ, VADGIF, VCE, VDH, and NRCS. Sources include:

- Federal Clean Water Act Section 319 Increment Funds
- USDA Conservation Reserve Enhancement Program (CREP)
- USDA Conservation Reserve Program (CRP)
- USDA Environmental Quality Incentives Program (EQIP)
- Wetland Reserve Program (WRP)
- Wildlife Habitat Incentive Program (WHIP)
- U.S. Fish and Wildlife Service Conservation Grants
- U.S. Fish and Wildlife Service Private Stewardship Program
- National Fish and Wildlife Foundation
- Chesapeake Bay Small Watershed Grants Program
- Virginia Agricultural Best Management Practices Cost-Share Program
- Virginia Agricultural Best Management Practices Tax Credit Program
- Virginia Water Quality Improvement Fund
- Virginia Small Business Environmental Compliance Assistance Fund
- Virginia Landowner Incentive Program
- Virginia Revolving Loan Programs
- Community Development Block Grant Program
- Rural Community Assistance Program
- Southeast Rural Community Assistance Project (Southeast RCAP)
- Chesapeake Bay Foundation
- Krebser Foundation
- Piedmont Environmental Council (PEC)
- Friends of the Rappahannock (FOR)

LIST OF ACRONYMS

AWG	Agricultural Working Group
BMP	Best Management Practice
CCU	Confined Canine Unit
CREP	Conservation Reserve and Enhancement Program
CRP	Conservation Reserve Program
CSWCD	Culpeper Soil and Water Conservation District
CWA	Clean Water Act
ECI	Engineering Concepts, Inc.
EQIP	Environmental Quality Incentive Program
FOR	Friends of the Rappahannock
FR-1	Reforestation of Erodible Crop and Pastureland
FTE	Full Time Equivalent
GWG	Government Working Group
IP	Implementation Plan
LID	Low Impact Development
NPS	Nonpoint Source
NRCS	Natural Resources Conservation Service
OSSDS	On-Site Sewage Disposal System
RB-1	Septic System Pump-Out
RB-2	Connection of Malfunctioning OSSDS or Straight Pipe to Public Sewer
RB-3	Septic Tank System Repair
RB-4	Septic Tank Installation / Replacement
RB-5	Alternative On-Site Waste Treatment System
RCAP	Rural Community Assistance Program
RRRC	Rappahannock-Rapidan Regional Commission
RWG	Residential Working Group
SL-1	Permanent Vegetative Cover on Cropland
SL-6	Grazing Land Protection System
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
VADCR	Virginia Department of Conservation and Recreation
VADEQ	Virginia Department of Environmental Quality
VADOF	Virginia Department of Forestry
VCE	Virginia Cooperative Extension
VDACS	Virginia Department of Agriculture and Consumer Services
VDGIF	Virginia Department of Game and Inland Fisheries
VDH	Virginia Department of Health
WP-2T	Stream Protection
WQIF	Water Quality Improvement Fund
WQMIRA	Water Quality Monitoring, Information and Restoration Act
WHIP	Wildlife Habitat Incentive Program
WRP	Wetland Reserve Program

GLOSSARY

Anthropogenic - involving the impact of humans on nature; specifically items or actions induced, caused, or altered by the presence and activities of humans.

Assimilative Capacity - a measure of the ability of a natural body of water to effectively degrade and/or disperse chemical substances. Assimilative capacity is used to define the ability of a waterbody to naturally assimilate a substance without impairing water quality or degrading the aquatic ecosystem. Numerically, it is the amount of pollutant that can be discharged to a specific waterbody without exceeding water quality standards. (see Loading Capacity)

Bacterial Source Tracking (BST) - A collection of scientific methods used to track sources of fecal coliform.

Best Management Practices (BMPs) - reasonable and cost-effective means to reduce the likelihood of pollutants entering a water body. BMPs include riparian buffer strips, filter strips, nutrient management plans, conservation tillage, etc.

Die-off (of fecal coliform) - Reduction in the fecal coliform population due to predation by other bacteria as well as by adverse environmental conditions (e.g., UV radiation, pH).

Cost-share Program - a program that allocates project funds to pay a percentage of the cost of constructing or implementing a BMP. The remaining costs are paid by the producer(s).

Delisting - the process by which an impaired waterbody is removed from the Section 303(d) Impaired Waters List. To remove a waterbody from the Section 303(d) list, the state must demonstrate to USEPA, using monitoring or other data, that the waterbody is no longer impaired.

Discharge - flow of surface water in a stream or canal or the outflow of groundwater from a flowing artesian well, ditch or spring; can also apply to discharge of liquid effluent from a facility or to chemical emissions into the air through designated venting systems.

Erosion - detachment and transport of soil particles by water and wind. Sediment resulting from soil erosion represents the single largest source of nonpoint source pollution in the United States.

Failing septic system - Septic systems in which drain fields have failed such that effluent (wastewater) that is supposed to percolate into the soil, now rises to the surface and ponds on the surface where it can flow over the soil surface to streams or contribute pollutants to the surface where they can be lost during storm runoff events.

Fecal coliform - A type of bacteria found in the feces of various warm-blooded animals that is used as indicator of the possible presence of pathogenic (disease causing) organisms.

Full Time Equivalent (FTE) - is calculated by dividing the total number of paid hours by the number of hours in a time period.

Geographic Information System (GIS) - a system of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analyzing and disseminating information about areas of the earth. An example of a GIS is the use of spatial data for

Emergency Services response (E-911). Dispatchers use GIS to locate the caller's house, identify the closest responder, and even determine the shortest route. All these activities are automated using the electronic spatial data in the GIS.

Geometric mean - The geometric mean is simply the nth root of the product of n values. Using the geometric mean lessens the significance of a few extreme values (extremely high or low values). In practical terms, this means that if you have just a few bad samples, their weight is lessened. Mathematically the geometric mean, $\bar{x}_g$, is expressed as: $\bar{x}_g = \sqrt[n]{x_1 \cdot x_2 \cdot x_3 \ldots \cdot x_n}$ where n is the number of samples, and x_i is the value of sample i.

HSPF (Hydrological Simulation Program-Fortran) - A computer-based model that calculates runoff, sediment yield, and fate and transport of various pollutants to the stream. The model was developed under the direction of the U.S. Environmental Protection Agency (EPA).

Impaired waters - those waters with chronic or recurring monitored violations of the applicable numeric and/or narrative water quality standards.

Instantaneous criterion - The instantaneous criterion or instantaneous water quality standard is the value of the water quality standard that should not be exceeded at any time. For example, the Virginia instantaneous water quality standard for fecal coliform is 1,000 cfu/100 mL. If this value is exceeded at any time, the water body is in exceedance of the state water quality standard.

Load allocation (LA) - portion of the loading capacity attributed to 1) the existing or future nonpoint sources of pollution, and 2) natural background sources. Wherever possible, nonpoint source loads and natural loads should be distinguished.

Loading capacity (LC) - greatest amount of pollutant loading a waterbody can receive without violating water quality standards. (see assimilative capacity)

Margin of safety (MOS) - a required component of the TMDL that accounts for the uncertainty in calculations of pollutant loading from point, nonpoint, and background sources.

Modeling - a system of mathematical expressions that describe both hydrologic and water quality processes. When used for the development of TMDLs, models can estimate the load of a specific pollutant to a waterbody and make predictions about how the load would change as remediation steps are implemented.

Monitoring - periodic or continuous sampling and measurement to determine the physical, chemical, and biological status of a particular media like air, soil, or water.

Nonpoint source pollution - pollution originating from multiple sources on and above the land. Examples include runoff from fields, stormwater runoff from urban landscapes, roadbed erosion in forestry, and atmospheric deposition.

Nutrient - any substance assimilated by living things that promotes growth. The term is generally applied to nitrogen and phosphorus in wastewater, but is also applied to other essential and trace elements.

Pathogen - Disease-causing agent, especially microorganisms such as certain bacteria, protozoa, and viruses.

Point source pollution - pollutant loads discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants or industrial treatment facilities or any conveyance such as a ditch, tunnel, conduit or pipe from which pollutants are discharged. Point sources have a single point of entry with a direct path to a water body. Point sources can also include pollutant loads contributed by tributaries to the main receiving stream or river.

Riparian - pertaining to the banks of a river, stream, pond, lake, etc., as well as to the plant and animal communities along such bodies of water

Runoff - that part of precipitation, snowmelt, or irrigation water that does not infiltrate but flows over the land surface, eventually making its way to a stream, river, lake or an ocean. It can carry pollutants from the land and air into receiving waters.

Sediment - in the context of water quality, soil particles, sand, and minerals dislodged from the land and deposited into aquatic systems as a result of erosion.

Septic system - An on-site system designed to treat and dispose of domestic sewage. A typical septic system consists of a tank that receives liquid and solid wastes from a residence or business and a drainfield or subsurface absorption system consisting of a series of tile or percolation lines for disposal of the liquid effluent. Solids (sludge) that remain after decomposition by bacteria in the tank must be pumped out periodically.

Simulation - The use of mathematical models to approximate the observed behavior of a natural water system in response to a specific known set of input and forcing conditions. Models that have been validated, or verified, are then used to predict the response of a natural water system to changes in the input or forcing conditions.

Stakeholder - any person or organization with a vested interest in TMDL development and implementation in a specific watershed (e.g., farmer, landowner, resident, or business owner)

Straight pipe - Delivers wastewater directly from a building, e.g., house or milking parlor, to a stream, pond, lake, or river.

Total Maximum Daily Load (TMDL) - a pollution "budget" that is used to determine the maximum amount of pollution a waterbody can assimilate without violating water quality standards. The TMDL includes waste load allocations (WLAs) for permitted point sources, load allocations (LAs) for nonpoint and natural background sources, plus a Margin of Safety (MOS). A TMDL is developed for a specific pollutant and can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.

Transitional land use - areas of sparse vegetative cover (less than 25 percent of cover) that are dynamically changing from one land cover to another, often because of land use activities. Examples include forest clearcuts, a transition phase between forest and agricultural land, the temporary clearing of vegetation, and changes due to natural causes (e.g. fire, flood, etc.).

Wasteload allocation (WLA) - the portion of a receiving water's loading capacity that is allocated to one of its existing or future permitted point sources of pollution. WLAs constitute a type of water quality-based effluent limitation.

Water quality - the biological, chemical, and physical conditions of a waterbody. It is a measure of a waterbody's ability to support beneficial uses.

Water quality standards - a group of statements that constitute a regulation describing specific water quality requirements. Virginia's water quality standards have the following three components: designated uses, water quality criteria to protect designated uses, and an anti-degradation policy.

Watershed - area that drains to, or contributes water to, a particular point, stream, river, lake or ocean. Larger watersheds are also referred to as basins. Watersheds range in size from a few acres for a small stream, to large areas of the country like the Chesapeake Bay Basin that includes parts of six states (see, drainage basin).

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