Upper York River Basin
Watershed Implementation Plan

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EXECUTIVE SUMMARY

Introduction

The Virginia Total Maximum Daily Load (TMDL) program is a process to improve water quality and 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 six beneficial uses: drinking water, recreational (i.e., primary contact/swimming), fishing, shellfishing, aquatic life, and wildlife.

Beaver Creek, Mountain Run, Pamunkey Creek, Plentiful Creek, and Terrys Run were initially placed on the Commonwealth of Virginia's Section 303(d) List of Impaired Waters in 1998 for exceedances of the bacteria standard. Goldmine Creek was initially placed on the list in 2004 for exceedances of the bacteria standard. After these listings, a TMDL study was conducted to identify bacteria sources in the watersheds. After a TMDL study is complete and approved by the United States Environmental Protection Agency, 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 TMDL implementation plan was developed to reduce bacteria levels to attain water quality standards allowing delisting of streams from the Section 303(d) List of Impaired Waters. The TMDL 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.

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**
- **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 TMDL and modeling procedures on implementation plan development. Conditions outlined in the TMDL development study to address the bacteria impairments in these watersheds include:

- Exclusion of most/all livestock including horses 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 requirement to correct straight pipes and failing septic systems is the requirement to maintain all properly functioning septic systems;
- Reductions to pet bacteria loads on residential land use are necessary; and
- Implicit in the requirement 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; Louisa, Orange, and Spotsylvania Counties government; Town of Orange government ; Culpeper Soil and Water Conservation District; Thomas Jefferson Soil and Water Conservation District; Tri-County/City Soil and Water Conservation District; Virginia Department of Conservation and Recreation; Virginia Department of Environmental Quality; Virginia Department of Health; Virginia Cooperative Extension; Natural Resources Conservation Service; Farm Bureau; Piedmont Environmental Council; Southeast Regional Community Assistance Project; Rappahannock-Rapidan Regional Commission; Thomas Jefferson Planning District Commission, and Blue Ridge Environmental Solutions, Inc.

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, three working groups were formed: Agricultural, Residential, and Governmental. Third, a Steering Committee was formed with representation from the Agricultural, Residential, and Governmental Working Groups; Louisa, Orange, and Spotsylvania Counties government; Town of Orange government ; Culpeper Soil and Water Conservation District; Thomas Jefferson Soil and Water Conservation District; Tri-County/City Soil and Water Conservation District; Virginia Department of Conservation and Recreation; Virginia Department of Environmental Quality; Virginia Department of Health; Virginia Cooperative Extension; Natural Resources Conservation Service; Rappahannock-Rapidan Regional Commission; Thomas Jefferson Planning District Commission; and Blue Ridge Environmental Solutions, 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.

Implementation Actions

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 Virginia Department of Conservation and Recreation Agricultural BMP Database and TMDL document. Bacteria load reductions on land uses were determined through modeling alternative implementation scenarios, defining percentage of land use area or unit amount treated by control measure, then applying related reduction efficiency to the associated load. Additionally, input from local agency representatives, citizens, and contractors were used to verify the analyses.

Associated cost estimations for each implementation action were calculated by multiplying the average unit cost per the number of units. Focusing on Stage I (*i.e.*, removal of impairments from impaired waters list) costs, the total agricultural corrective action costs equal $9.38 million. Estimated corrective action costs needed to replace straight pipes and fix failing septic systems during Stage I totals $4.22 million. The cost to implement the pet waste reduction process totals an estimated $0.16 million. Cost to install vegetated buffers, rain gardens, and infiltration trenches during Stage I equal $0.54 million. The total costs to provide assistance in the agricultural and residential programs during Stage I implementation are expected to both equal $1.04 million. The total Stage I implementation cost including technical assistance is $16.38 million with the agricultural cost being $10.42 million and residential cost $5.96 million.

The primary benefit of implementation is cleaner waters in Virginia, where bacteria levels in the Beaver Creek, Goldmine Creek, Mountain Run, Pamunkey Creek, Plentiful Creek, and Terrys Run impairments will be reduced to meet water quality standards, benefiting human and livestock herd health, local economies, and aquatic ecosystems. An important objective of the implementation plan is to foster continued economic vitality and strength.

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 List of Impaired Waters. Progress toward end goals will be assessed during implementation through tracking of control measure installations. The Virginia Department of Environmental Quality will continue to assess water quality through its monitoring program. Implementation will be assessed based on reducing exceedances of the bacteria water quality standard, thereby improving water quality. 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 exceedance rate of 10.5% or less resulting in de-listing of streams. The Stage II goal is based on implementing source allocations to meet the specified TMDL goal, 0% exceedance of water quality standards.

Implementation in years one through eight for agricultural source reductions focuses on installing livestock stream exclusion systems, improving pasture management, and cropland conversion. BMPs installed in years nine and ten are based on additional treatment of bacteria load not treated during Stage I from pasture and cropland using improved pasture management, manure / biosolids incorporation into soil, and retention ponds. Implementation in years one through eight for residential bacteria loads focuses on performing septic tank pump-outs, identification and removal of straight pipes, repairing or replacing failed septic systems, instituting pet waste control education programs, installation of pet waste enzyme digesting composters, installation of confined canine unit waste treatment systems, and vegetated buffer installation. Rain garden and infiltration trench installations will be concentrated in years nine and ten if needed.

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, and 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.

The Culpeper, Thomas Jefferson, and Tri-County/City Soil and Water Conservation Districts will provide cost-share funds, lead education and technical assistance efforts, and track best management practice implementation for the agricultural and residential programs. State agencies conducting regulatory, education, or funding procedures related to water quality in Virginia include: Virginia Department of Environmental Quality; Virginia Department of Conservation and Recreation; Virginia Department of Health; Virginia Department of Agriculture and Consumer Services; Virginia Department of Game and Inland Fisheries; Virginia Department of Forestry; Virginia Cooperative Extension; and Virginia Outdoors Foundation. The Natural Resources Conservation Service will provide cost-share funds and technical assistance.

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 Watershed Implementation Plan, TMDLs, Roundtables, Water Quality Management Plans, Erosion and Sediment Control Regulations, Stormwater Management Program, Source Water Assessment Program, and local comprehensive plans. The progress of these planning efforts 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 activities. Current initiatives within Louisa, Orange, and Spotsylvania Counties to be integrated with the Upper York River Basin TMDL IP include:

- Louisa, Orange, and Spotsylvania Counties Comprehensive Plans
- Town of Orange Comprehensive Plan
- Chesapeake Bay Watershed Implementation Plan
- Lake Anna Watershed Management Plan / Special Area Management Plan
- Louisa Shoreline Protection Plan
- Piedmont Environmental Council Strategic Plan
- Lake Anna Civic Association Strategic Plan
- Lake Anna Ecosystem Restoration Project
- York River and Small Coastal Basin Roundtable

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; Thomas Jefferson Soil and Water Conservation District; Tri-County/City Soil and Water Conservation District; Virginia Department of Conservation and Recreation; Virginia Department of Health; Virginia Department of Environmental Quality; Virginia Department of Game and Inland Fisheries; Virginia Cooperative Extension; Virginia Outdoors Foundation; Natural Resources Conservation Service; Rapidan Better Housing; and Fluvanna-Louisa Better Housing Foundation.

INTRODUCTION

The Virginia Total Maximum Daily Load (TMDL) program is a process to improve water quality and 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 six beneficial uses: drinking water, recreational (i.e., primary contact/swimming), fishing, shellfishing, aquatic life, and wildlife. 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 states to develop a TMDL for each pollutant.

Beaver Creek, Mountain Run, Pamunkey Creek, Plentiful Creek, and Terrys Run were initially placed on the Commonwealth of Virginia's Section 303(d) List of Impaired Waters in 1998 for exceedances of the bacteria standard. Goldmine Creek was initially placed on the list in 2004 for exceedances of the bacteria standard. After these listings, a TMDL study was conducted in 2005 to identify bacteria sources in the watersheds and set limits on the amount of bacteria these rivers can tolerate and still maintain support of the Recreational Use.

Terrys Run

A TMDL IP was developed to reduce bacteria levels to attain water quality standards allowing delisting of the impaired waters from the Section 303(d) List. 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. Local support and successful completion of the implementation plan will enable restoration of the impaired water while enhancing the value of this important resource for the Commonwealth. Opportunities for Louisa, Orange, and Spotsylvania Counties, local agencies, and watershed residents to obtain funding will improve with an approved IP.

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.

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.

Goldmine Creek

USEPA develops guidelines that describe the process and criteria to be used to award CWA Section 319 nonpoint source grants to States. 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.

Once developed, Virginia Department of Environmental Quality (VADEQ) will present the IP to the SWCB for approval as the plan for implementing pollutant allocations and reductions contained in the TMDL. 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.

REVIEW OF TMDL DEVELOPMENT STUDY

Bacteria TMDLs for the Beaver Creek, Goldmine Creek, Mountain Run, Pamunkey Creek, Plentiful Creek, and Terrys Run watersheds were completed in August 2005 with subsequent approval by USEPA in November 2005. 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.

Straight Pipe

Mountain Run, Beaver Creek, Pamunkey Creek, and Terrys Run impairment watersheds are located in Orange County, Virginia (Figure 1). Goldmine Creek and Plentiful Creek impairment watersheds are located in Louisa County, Virginia and Spotsylvania County, Virginia, respectively (Figure 1). Mountain Run watershed area is 9,464 acres consisting of forest (50%), pasture/hayland (43%), residential (3%), water/wetland (2%), and cropland (2%) landuses. Beaver Creek watershed is 6,315 acres in size. Beaver Creek is mainly a forested watershed (about 88%) with pasture/hayland and water/wetland comprising 9% and 3% of the area, respectively. Mountain Run and Beaver Creek flow south and drain into the North Anna River. Pamunkey Creek watershed area of 34,382 acres is comprised of forest (54%), pasture/hayland (36%), cropland (7%), residential (2%), and water/wetland (1%). The 18,614 acres in the Terrys Run watershed consists of approximately 58% forest, 29%, pasture/hayland, 12% cropland, and the remaining 1% split between residential and water/wetland land uses. Goldmine Creek watershed is 15,151 acres in size, mainly forested (about 69%), approximately 31% in agriculture production (i.e., pasture/hayland and cropland equal 24% and 4%, respectively) with residential (2%) and water/wetland (1%) landuses contributing the difference. The 7,620 acres of Plentiful Creek watershed are mostly forested (about 70%) with 19%, 10%, 1% of the remaining acreage consisting of pasture/hayland, cropland, and water/wetland land uses, respectively. Pamunkey Creek, Terrys Run, Goldmine Run, and Plentiful Creek watersheds drain directly into Lake Anna.

Potential sources of fecal coliform bacteria include both point source and nonpoint source (NPS) contributions. Nonpoint sources include: wildlife, grazing livestock, land application of manure and biosolids, urban/residential runoff, failed and malfunctioning septic systems, and uncontrolled discharges (straight pipes). Conditions outlined in the TMDL development study to address the bacteria impairments in the Beaver Creek, Goldmine Creek, Mountain Run, Pamunkey Creek, Plentiful Creek, and Terrys Run watersheds include:

- ★ Exclusion of most/all livestock including horses 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 requirement to correct straight pipes and failing septic systems is the requirement to maintain all properly functioning septic systems;
- ★ Reductions to pet bacteria loads on residential land use are necessary; and
- ★ Implicit in the requirement for no point source bacteria load adjustment is the requirement for point sources to maintain permit compliance.

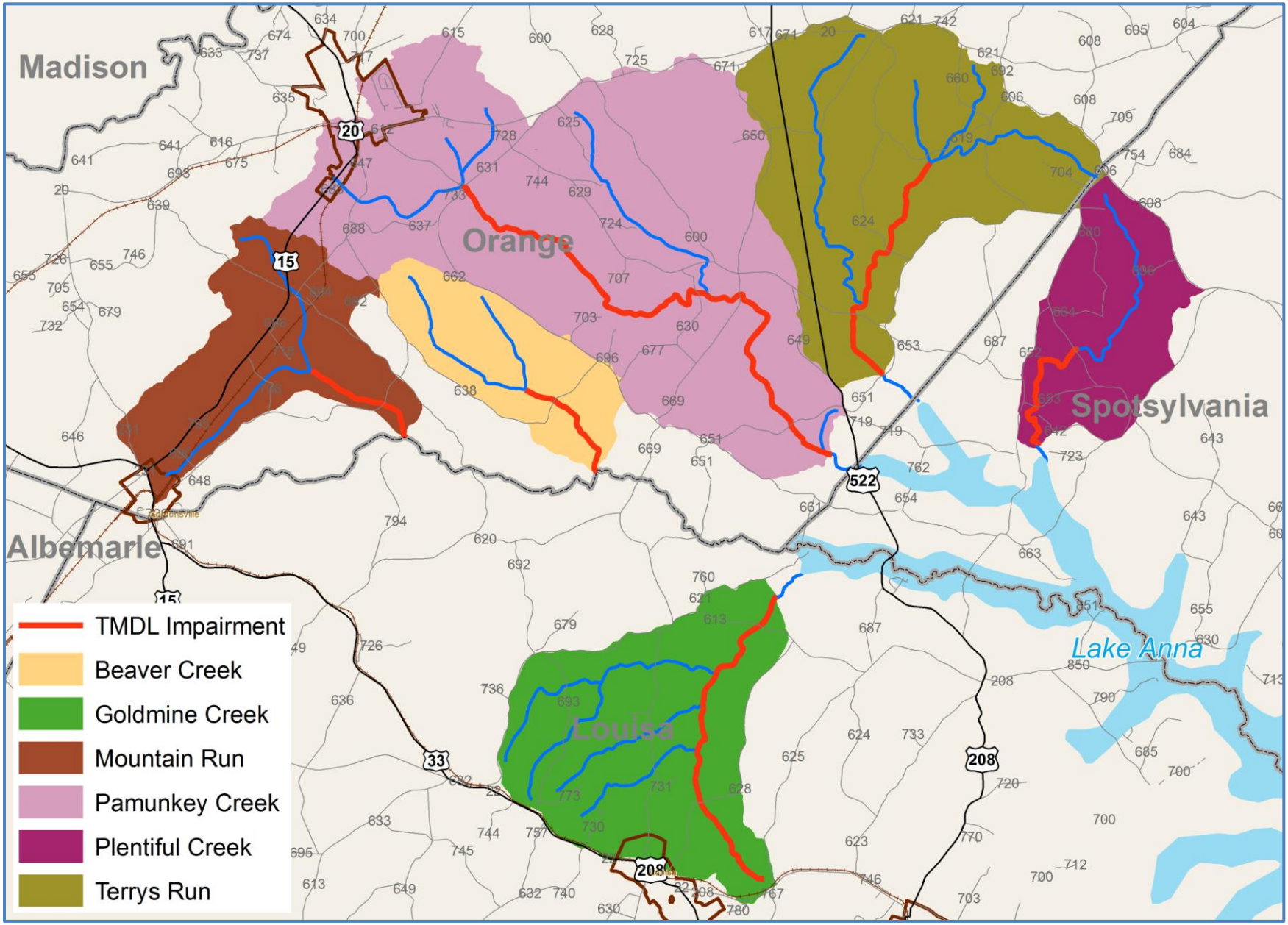


Figure 1. Watersheds location.

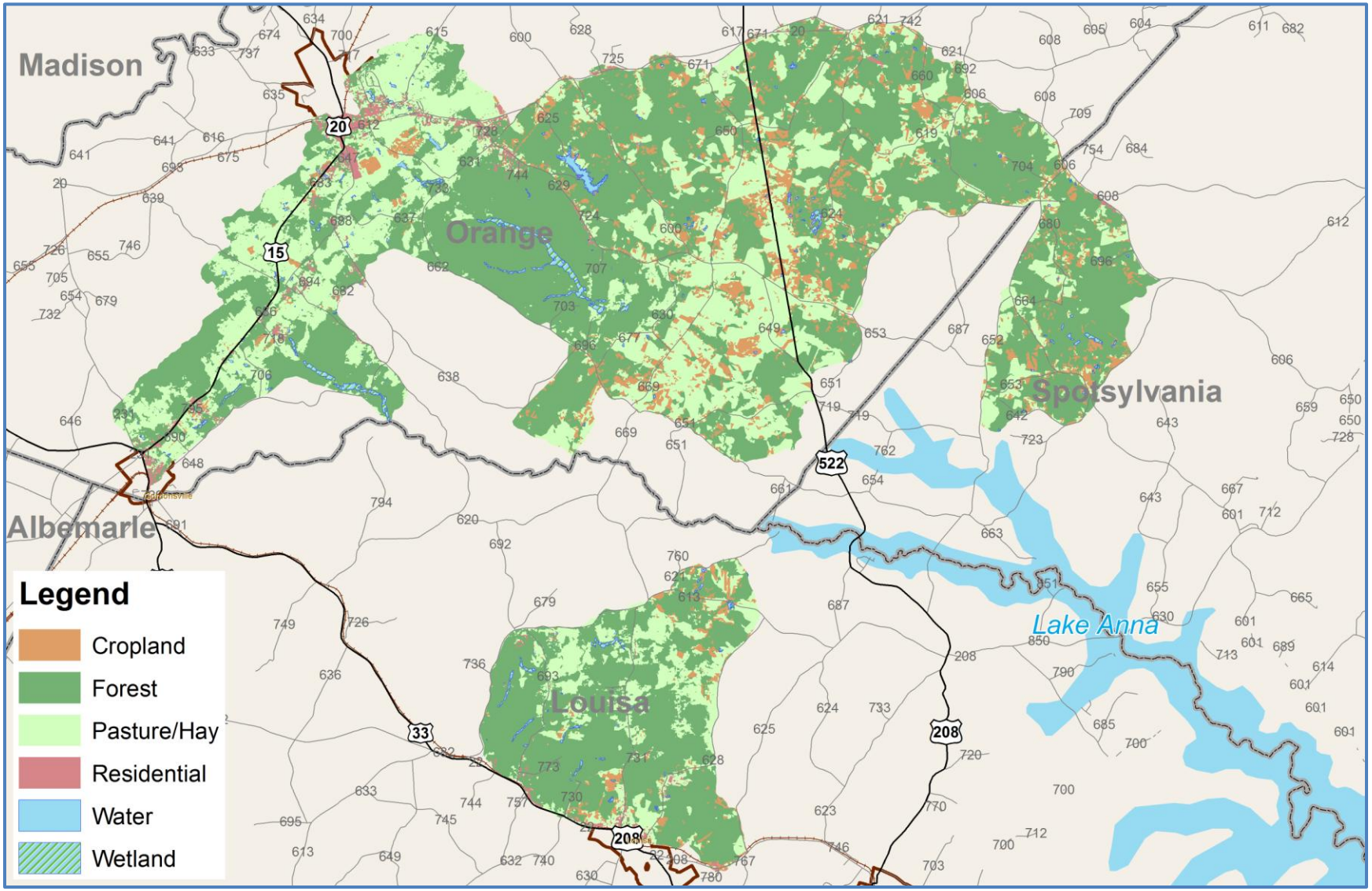


Figure 2. Land uses in the watersheds.

PUBLIC PARTICIPATION

Process

The actions and commitments compiled in this document are formulated through input from citizens of the watershed; Louisa, Orange, and Spotsylvania Counties government; Town of Orange government ; Culpeper Soil and Water Conservation District (CSWCD); Thomas Jefferson Soil and Water Conservation District (TJSWCD); Tri-County/City Soil and Water Conservation District (TCCSWCD); Virginia Department of Conservation and Recreation (VADCR); Virginia Department of Environmental Quality (VADEQ); Virginia Department of Health (VDH); Virginia Cooperative Extension (VCE); Natural Resources Conservation Service (NRCS); Farm Bureau; Piedmont Environmental Council (PEC); Southeast Regional Community Assistance Project (Southeast RCAP); Rappahannock-Rapidan Regional Commission (RRRC); and Blue Ridge Environmental Solutions, Inc. (BRES). 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 these waterbodies.

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, three working groups were formed: Agricultural, Residential, and Governmental. Third, a Steering Committee was formed with representation from the Agricultural, Residential, and Governmental Working Groups; Louisa, Orange, and Spotsylvania Counties government; Town of Orange government; CSWCD; TCCSWCD; TJSWCD; VADCR; VADEQ; VDH; VCE; NRCS; RRRC; and BRES 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 (Table 1).

Livestock Stream Access

Pastured Livestock

Land Application

Table 1. Meetings held during the TMDL IP development process.

Date	Meeting Type	Location	Attendance	Time (hr)
01/25/11	Public Meeting	Louisa County Administration Building	38	1
01/25/11	Agricultural Working Group	Louisa County Administration Building	16	1
01/25/11	Residential Working Group	Louisa County Administration Building	9	1
02/08/11	Public Meeting	Town of Orange Public Works Building	42	1
02/08/11	Agricultural Working Group	Town of Orange Public Works Building	22	1
02/08/11	Residential Working Group	Town of Orange Public Works Building	12	1
03/30/11	Governmental Working Group	Town of Orange Public Works Building	19	2
05/03/11	Agricultural Working Group	Town of Orange Public Works Building	14	2
05/03/11	Residential Working Group	Town of Orange Public Works Building	14	2
05/10/11	Agricultural Working Group	Louisa County Library	7	2
05/10/11	Residential Working Group	Louisa County Library	7	2
06/07/11	Steering Committee	Town of Orange Public Works Building	19	2
06/21/11	Public Meeting	Town of Orange Public Works Building	20	2

Agricultural Working Group Summary

The Agricultural Working Group (AWG) consisted predominantly of beef and dairy producers throughout the watershed. Representatives from organizations that serve this community and will have a role in implementation were also included (*e.g.*, CSWCD, TCCSWCD, TJSWCD, NRCS, VADCR, and Farm Bureau). 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 landowners to implement required BMPs to meet specified reductions to direct stream, pasture, and cropland bacteria loads. Challenges, recommendations, and keys for success discussed in the meetings included:

- ★ Primarily beef and dairy operations exist in these watersheds. Confined animal feeding operations consist of four dairies and two poultry facilities and it was determined that additional animal waste storage is not needed. Changes in land use since 2005 include cropland changes from corn production to pasture, and limited residential building due to the economy.

- ★ Providing electricity to a groundwater well can be a big issue in these watersheds due to the expense.
- ★ Livestock exclusion fencing is not practical in flood-prone areas and would be destroyed frequently in some areas of the watershed. If a fence is constructed using cost-share funding and is destroyed due to a natural disaster such as a flood, funding will be available to replace fence one time if the disaster did not take place within the same year as the construction of the fence.
- ★ More geese exist near Lake Anna than what is estimated in the 2005 TMDL study and stay year round. Natural buffers should be encouraged to deter residency.
- ★ Continuing Conservation Initiative Stream Exclusion fencing (CCI-SE) program is a new Department of Conservation and Recreation (DCR) cost-share practice that pays $1/ft for five years for one-sided stream exclusion fencing and $2/ft for both sides. Promotion of CCI-SE hopes to capture voluntary practice data. The only requirement is that the fencing must be for stream exclusion, there is no set back requirement.
- ★ While stream-side fencing is not popular with older farmers, they do favor water trough installations and recognize the benefits of cold, clean drinking water for their livestock.
- ★ Lake Anna Civic Association (LACA) is interested in funding a demonstration project in which they would partner with a farmer participating in the exclusion fencing cost-share programs by covering the difference between the cost-share amount and the total amount needed.
- ★ The Soil and Water Conservation Districts can assist farmers individually to find the best cost-share programs that will work for their needs – flexible options exist.

Alternative Water Source

- ★ With regard to cost-share programs, Farm Labor and Contractor Labor cost credit may vary depending on the county. Orange County credits farm and contractor labor equally. In Spotsylvania County, contractor labor receives a higher value than farm labor. It was recommended that farm labor and contractor labor be credited equally within the watershed. Cost estimates should be irrelevant of who does the work.
- ★ Securing and researching funding will be critical for success of the TMDL-IP.
- ★ More focus should be placed on educating and supporting the Equine industry.
- ★ More water testing needs to be done and samples taken in other locations than where previously collected;
- ★ One Full Time Equivalent (FTE) technical assistant was not adequate to complete the proposed workload within a 10 year period.
- ★ Retention ponds should be a last resort/catch-all if needed to reduce the exceedance rate to 0% due to their considerable expense.
- ★ Pasture management, not just exclusion fencing, is an important factor in achieving reduction loads.
- ★ Applicable education/outreach methods should include farmer-to-farmer interaction, SWCD and Farm Bureau newsletters; field tours conducted by SWCDs, educational events conducted by Virginia Cooperative Extension, Cattleman's and Dairymen's Association events, FSA newsletter,

information booth at CVCA Field Day and County Fair (although more residents than farmers may be reached at the fair).

Residential Working Group Summary

The Residential Working Group (RWG); consisting of watershed residents and Town of Orange; Louisa, Orange, and Spotsylvania Counties; CSWCD; TJSWCD, TCCSWCD; VADCR; VADEQ; VDH; VCE; NRCS; RRRC; and BRES 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 meeting included:

- ★ Spotsylvania County has a county-wide stormwater ordinance and falls under the Chesapeake Bay requirements. Most of the Plentiful Creek watershed in Spotsylvania County is wooded and hasn't had a building permit issued since 2003. Louisa County requires permits for repairs to septic systems and requires 100% reserve. There might be opportunities within the Pamunkey Creek and Goldmine Creek watersheds for connecting to public sewer. Regional population growth in Louisa County has resulted in increased demands on the Louisa Sewage Treatment Plant.
- ★ There is not enough voluntary compliance to forgo regulation. Education for homeowners is needed to encourage participation so that regulation is a last resort.
- ★ Grey water containing disinfectants and detergents from maintenance activities contributes to the degradation of surface and groundwater quality.
- ★ Most owners of alternative on-site sewage disposal systems (OSDS), as well as those of conventional septic systems, are not informed of the system's mechanical function, cost, and failure rates.
- ★ Many areas within the watershed are not suited for systems of any kind-conventional or alternative Specific soils determined to be unsuitable (Louisa Comprehensive Plan).

- ★ Information regarding septic system type, function, location and maintenance, including costs, should be included in closing documents at all home sales. To reach all property owners, include septic system information with tax assessments.
- ★ Repairs to failing septic systems will have a greater effect at reducing the bacteria exceedance rate versus pump-outs.
- ★ Older structures along Tomahawk Creek and the Houseworth Street area (Pamunkey Creek Watershed) should be evaluated. Older homes along Route 15 might have failures.
- ★ Pet waste management information must be introduced strategically; there may be resistance to programs perceived as trivial or frivolous.

- ★ Pet waste management education and outreach included develop and implement public information campaigns on pet waste management; devise and implement pet waste composter construction workshops similar to rain barrel workshops offered by SWCDs; reach out to home owners associations to promote pet waste composters, collection kiosks, and other management strategies; and seek funds to install kennel waste management program as pilot project and consider offering a "clean kennel" award.
- ★ It was suggested the bacteria water quality standard be put in terms that the general public can understand. What does this mean to me? Suggestions included: unhealthy water that if swallowed can lead to illness, ear infection, etc.
- ★ Information found in the TJSWCD study examining Goldmine Creek tributaries to identify bacterial hot spots could be used as a template for how counties address all the impaired segments in a county.
- ★ Determine if coordination with the Army Corps of Engineers Lake Anna Ecosystem Restoration Project would be beneficial to the TMDL-IP.
- ★ Efforts should be made to educate high school students and get other stakeholders to assist with public education.

Governmental Working Group Summary

The Governmental Working Group (GWG) consisting of representatives from Louisa, Orange, and Spotsylvania Counties; Town of Orange; CSWCD; TCCSWCD; VADCR; VADEQ; VDH; NRCS; Farm Bureau; RRRC; and BRES personnel, focused on funding sources, technical assistance needs, regulatory controls, and lead agencies responsible for implementation. Key topics and recommendations included:

- ★ Alternative systems require annual maintenance contracts that have increased in cost from $150 - $200 a few years ago up to $400 currently with more than 10% of alternative systems have been installed on smaller, subdivided lots.
- ★ Culpeper Soil and Water Conservation District have funded more repairs than replacement of failing septic systems in their district.
- ★ The Health Department cannot provide an inventory of failing septic tanks or straight pipes; the TMDL study is the best tool to use. A measureable action plan is needed that includes a tracking system for all septic systems, including alternative systems – Albemarle or Gloucester Counties' methods could be used as a model. Information on septic tanks (location, maintenance requirements, etc.) could be included as part of required sale documents by Real Estate agents.
- ★ Homeowners, especially in rural areas, may be reluctant to participate in cost-share programs due to anti-government philosophies and unwillingness to disclose personal financial

Alternative On-site Sewage Disposal System

information.

- ★ Cost for public sewer service, including connection to the service and on-site improvements is estimated to run from $15,000 to $20,000 per dwelling in all three counties.
- ★ Of the localities represented, only the Town of Orange has current opportunities for public sewer connections as the Town of Orange has a new waste water treatment plant. Future connections could be available in Louisa County.
- ★ As part of the State law requiring any homeowner residing east of Interstate 95 to have their septic system pumped every 5 years, Spotsylvania County sends homeowners letters reminding them of that requirement. Homeowners in all the counties should be informed of pump-out recommendations/requirements and cost-share programs available for pump-outs and repairs.
- ★ Based on soil types and Health Department experience within the region, all three counties estimate funds addressing OSDS for the IP be allocated as follows:
  - 60% towards repairs
  - 30% for replacement, and
  - 10% for alternative waste treatment systems;
- ★ Louisa, Orange, and Spotsylvania Counties require a kennel license for owners with a certain number of dogs. More precise dog counts might be derived by determining the number of dog licenses that have been issued.
- ★ The Town of Orange has installed pet waste stations obtained from the Culpeper Soil and Water Conservation District through grant funds from York River and Small Coastal Basin Roundtable; a reduction in the amount of pet waste left on sidewalks has been observed. A program similar to Fauquier County's "It's Your Doodie" Pet Waste Management project could be replicated in each of the three counties.
- ★ The Fauquier County SPCA has implemented several strategies to properly manage animal waste and may be used as a model for commercial and private kennels such as hunt clubs and veterinary clinics. Grant funding should be sought to assist kennel owners in improving their facilities.
- ★ Success will be determined by the delivery of the outreach efforts and positive experiences of program participants will be helpful in gaining additional participation. It has been demonstrated that educational outreach to children and youth is very effective in conveying information and influencing responsible behavior in parents.
- ★ Funding must be secured and available before outreach is implemented. Efforts should be made to eliminate waiting lists – funds must be available and adjusted accordingly along the way. Farmers may also consider combining cost-share programs with conservation easements to receive additional tax incentives as offered through the Virginia Outdoors Foundation.
- ★ Recommended that funding be available on a bid basis to contractors (septic pump-out and repair, fencing installation, etc.) who can provide services to homeowners and farmers at discounted rates. This will circumvent concerns regarding dealing with government offices and may result in increased success.

- ★ Additional monitoring, including citizen monitoring, of the impaired streams is recommended.
- ★ Proposed roles and responsibilities for agencies included:
  - **Louisa, Orange, Spotsylvania Counties and Town of Orange:** administer the counties erosion and sediment control program, provide mapping assistance, and update ordinances to promote conservation efforts.
  - **CSWCD, TCCSWCD, and TJSWCD:** provide agricultural cost-share funds, administer and provide technical assistance for agricultural and residential programs.
  - **VDH:** help develop education material and track installation, location and maintenance of all septic systems, including alternative systems
  - **RRRC:** develop and distribute pet waste management educational materials
  - **VADEQ:** provide ambient monitoring and assist with citizen monitoring
  - **NRCS, VCE,** and **VADOF**: provide education/technical assistance and funding

Steering Committee Summary

The Steering Committee consisted of representatives from the AWG, RWG, and GWG; Louisa, Orange, and Spotsylvania Counties; Town of Orange; CSWCD; TCCSWCD; TJSWCD; VADCR; VADEQ; VDH; VCE; NRCS; RRRC; Farm Bureau ; PEC; and BRES. 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.

IMPLEMENTATION ACTIONS

An assessment was conducted to quantify actions and costs for two implementation stages. Actions and costs that translate to an instantaneous standard exceedance rate of 10.5% or less, resulting in removal of these streams from the List of Impaired Waters, were quantified. This is referred to as the Stage I implementation goal. The Stage II implementation goal is TMDL source allocation attainment. Estimated units presented in Tables 2 and 3 depict the Stage I and Stage II goals. 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.

Agricultural Implementation Needs

Removing livestock from the stream corridor was identified as the primary control measure to reduce the livestock direct deposition bacteria load. There are approximately 356 miles of perennial streams in these six watersheds. Currently in these watersheds, approximately 11 miles of exclusion fencing have been installed. Exclusion fencing necessary to prevent access to perennial streams and meet the stated TMDL reductions was estimated at approximately 141 miles of fence. Figure 3 displays analysis results for a portion of Plentiful Creek watershed. The exclusion fencing is translated into a total of 320 exclusion systems to be installed to insure full exclusion of livestock from the streams. In order to provide implementation options to producers, several cost-share programs with varying goals and requirements were included. Based on historical cost-share program participation and working group feedback, total exclusion systems were divided between **Conservation Reserve and Enhancement Program (CREP)**, **Environmental Quality Incentives Program (EQIP)**, **Livestock Exclusion with Riparian Buffers (LE-1T)**, **Livestock Exclusion with Reduced Setback (LE-2T)**, **Small Acreage Grazing System (SL-6AT)**, **and Stream Protection (WP-2T)** (Table 2). In order to address pasture land reductions, the benefit of installing the livestock exclusion systems was coupled with improved pasture management BMPs. Total of 26,966 acres in the watershed would require **Pasture Management** with portions of this acreage improved by the **Pasture and Hayland Planting (NRCS Code 512) and Prescribed Grazing (NRCS Code 528)** BMPs. Given reductions were not

Stream Exclusion Fencing

sufficient to meet TMDL reduction goals, installation of retention ponds may be necessary to treat runoff from this acreage during Stage II of implementation.

Bacteria reduction provided by the dairy liquid manure storage tanks installed in the watersheds was accounted for in the land-applied loads. The AWG decided 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 between **SL-1 Permanent Vegetative Cover and FR-1 Reforestation of Erodible Crop and Pastureland BMPs** based on input from AWG and landuse difference. Additionally, **manure incorporation** into soil was needed in the watersheds. Currently in these watersheds, approximately 376 cropland acres have been converted utilizing the SL-1 (343 ac) and FR-1 (33 ac) practices. Converting 346 acres to pasture and 336 acres to forest land uses and incorporating manure into soil on approximately 2,320 cropland acres during Stage II satisfied the TMDL goal (Table 2).

GIS analysis of the watersheds indicates a significant opportunity for conservation easements through the Virginia Outdoors Foundation (VOF). Conservation incentives in Louisa, Orange, and Spotsylvania Counties include the Purchase of Development Rights program, tax credits that can be sold to any Virginia tax payer, and 100% reimbursement for legal, accounting, appraisal fees, etc.

Permanent Vegetative Cover on Cropland

Re-forestation

Table 2. Estimation of control measures with unit cost (average) needed to meet pasture and cropland bacteria load reduction implementation goals during 10-year timeline.

Control Measure	Unit	Average Unit Cost[5] ($)	Estimated Units Needed (#)						Total
			Beaver Creek	Mountain Run	Pamunkey Creek	Terrys Run	Plentiful Creek	Goldmine Creek	
Pasture and Livestock Exclusion									
Livestock Exclusion System (CREP)	System	25,000	1	8	16	9	1	7	**42**
Livestock Exclusion System (EQIP/CBWI)	System	19,500	3	17	31	19	3	14	**87**
Livestock Exclusion System (LE-1T)	System	19,500	3	17	32	19	2	14	**87**
Livestock Exclusion System (SL-6AT)	System	13,500	0	0	2	2	0	1	**5**
Livestock Exclusion System (LE-2T)	System	15,750	3	16	32	18	2	14	**85**
Livestock Exclusion System (WP-2T)	System	5,000	0	3	6	3	0	2	**14**
Improved Pasture Management[1]	Acres[3]	150	562	3,999	12,091	5,280	1,443	3,621	**26,966**
Retention Ponds	Acre[4]	2,000	269	2,123	7,025	2,904	872	1,948	**15,141**
Cropland[2]									
Permanent Vegetative Cover on Cropland (SL-1)	Acres[3]	370	1	5	200	55	30	55	**346**
Reforestation of Erodible Crop and Pastureland (FR-1)	Acres[3]	450	1	5	200	50	30	50	**336**
Manure Incorporation Into Soil	Acres[3]	25	4	14	1,050	420	272	560	**2,320**
Technical Assistance									
Agricultural – Pasture and Cropland	Full Time Equivalent	65,000							**2/yr**

[1] Improved pasture management comprised of: Pasture and Hayland Replanting (512), Pasture Management, and Prescribed Grazing (528) BMPs

[2] Cropland reductions incorporate reduction afforded by four existing liquid manure storage facilities and poultry litter sheds

[3] Acres installed; [4] Acres treated

[5] Unit cost = installation or one-time incentive payment

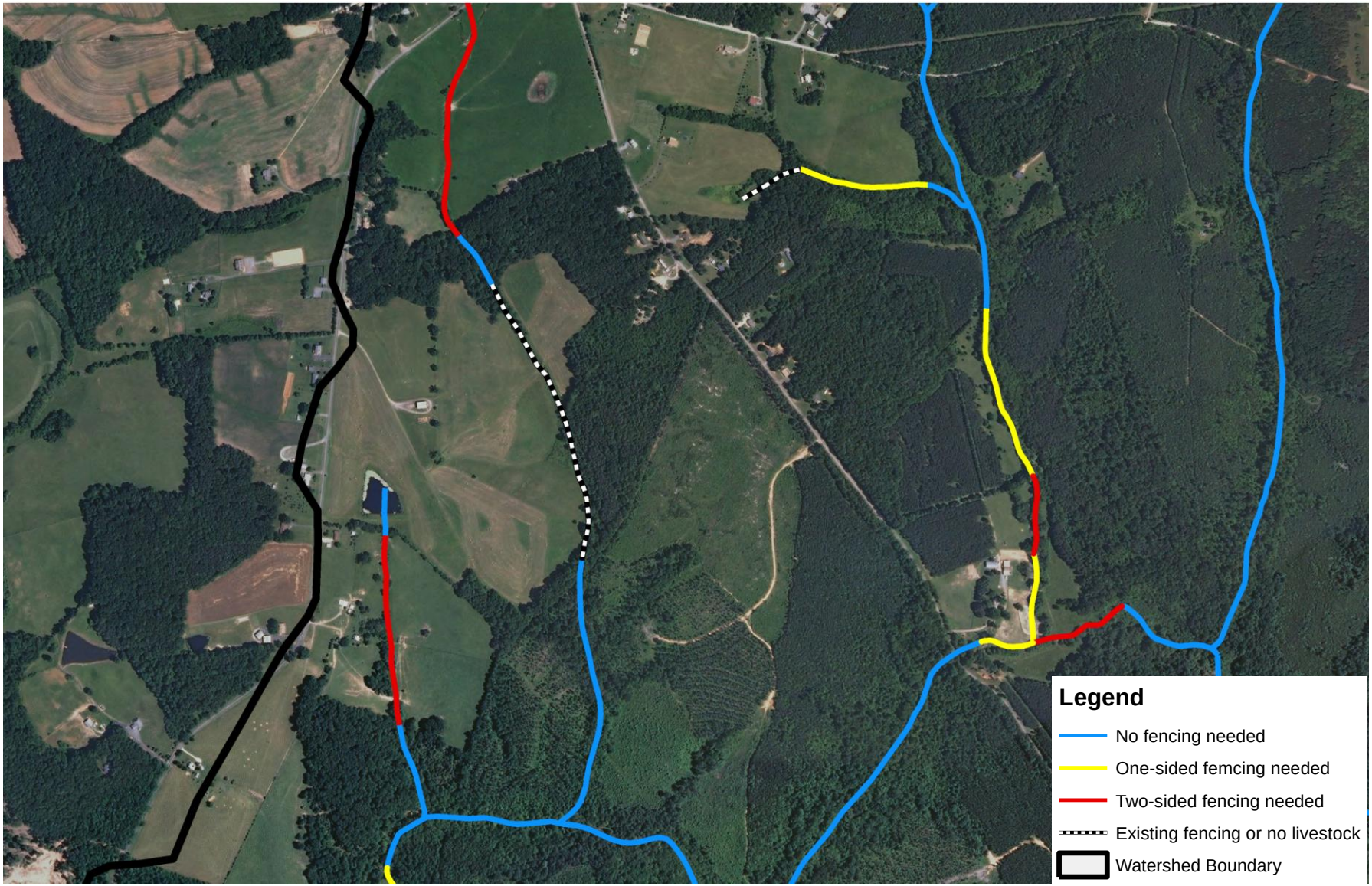


Figure 3. Potential livestock exclusion fencing analysis results for portion of Plentiful Creek.

Residential Implementation Needs

Number of straight pipes and failing septic systems to correct during implementation was established during TMDL development. Based on discussion with Virginia Department of Health and RWG, 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 (OSDS). Failing septic systems were assumed to be corrected by repairing the existing septic system (60%), installing a new conventional septic system (30%), or installing a new alternative OSDS (10%). It is estimated that 514 **septic tank pump-outs**, 302 **septic system repairs**, 201 **conventional septic systems**, and 55 **alternative OSDS** are considered necessary to correct straight pipes and failing septic systems during implementation (Table 3).

Septic System Repair

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 120 residences. The third step will be identification of confined canine units (CCU) and installing approximately seven **CCU waste treatment systems** throughout the watersheds. The installation of **vegetated buffers**, **bioretention**, and **infiltration trenches** on residential land use is the fourth step. Components of the four-step program are outlined in Table 3.

Pet Waste Composter

Pet Waste Kiosk

Table 3. Estimation of control measures with unit cost (average) needed to meet residential and straight pipe bacteria load reduction implementation goals during 10-year timeline.

Control Measure	Unit	Unit Cost[1] ($)	Estimated Units Needed (#)						Total
			Beaver Creek	Mountain Run	Pamunkey Creek	Terrys Run	Plentiful Creek	Goldmine Creek	
Failing Septic Systems									
Septic Tank Pump-out	System	300	27	134	179	92	45	37	**514**
Connection to public sewer	System	15,000	0	0	10	0	0	0	**10**
Septic System Repair	System	4,000	16	81	101	55	27	22	**302**
New Conventional Septic System	System	8,000	8	40	51	28	14	11	**152**
Alternative On-site Sewage Disposal System	System	20,000	3	13	17	9	4	4	**50**
Straight Pipes									
New Conventional Septic System	System	8,000	0	11	19	8	2	9	**49**
Alternative On-site Sewage Disposal System	System	20,000	0	1	2	1	0	1	**5**
Pet Waste Management									
Pet waste education program	Program	5,000	1				1	1	**3**
Pet waste digesters	System	50	20	20	20	20	20	20	**120**
Confined Canine Unit Waste Treatment System	System	20,000	1	1	2	1	1	1	**7**
Stormwater Runoff Best Management Practices									
Vegetated Buffers	Acres[2]	400	1	16	16	9	2	16	**60**
Bioretention	Acres[3]	15,000	0	5	120	1	1	20	**147**
Infiltration Trench	Acres[3]	11,300	0	2	20	0	0	13	**35**
Technical Assistance									
On-site Sewage Disposal Systems	FTE[4]	65,000							**1.8 /yr**
Pet Waste Management	FTE[4]	65,000							**0.2 /yr**

[1] Unit cost = installation or one-time incentive payment; [2] Acres installed; [3] Acres treated; [4] Full time equivalent

Other Potential Implementation Needs

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. Future residential development was identified as a potential source to deliver bacteria to streams through additional septic systems and pets. Care should be taken to monitor these activities and the impact on water quality. This needs to be carefully considered during permit issuance, site plans, and development.

Retention Pond

Assessment of Technical Assistance Needs

To determine the number of full time equivalents (FTE) considered necessary for agricultural and residential 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. Coupling the number of BMPs processed historically and estimates provided by the SWCDs and Steering Committee, two agricultural FTE per year and two residential FTE per year are needed during Stage I of implementation. The residential FTE was divided between OSDS (90%) and pet waste management program (10%) resulting in 1.8 and 0.2 FTE per year for OSDS and pet waste management program technical assistance, respectively (Tables 2 and 3).

Rotational Grazing System

Cost Analysis

Bioretention (Rain Garden)

Associated unit cost estimations for each implementation action during Stages I and II are shown in Tables 2 and 3. Table 4 focuses on installation and technical assistance costs to implement agricultural and residential programs for implementation Stage I (*i.e.*, removal of impairments from impaired waters list). The total average installation cost for livestock exclusion systems and improved pasture management is $9.16 million. The total installation cost for converting cropland to permanent vegetative cover and forest is estimated at $0.22 million. Accordingly, total agricultural corrective action costs equal $9.38 million. Estimated corrective action costs needed to replace straight pipes and fix failing septic systems totals $4.22 million. The cost to implement the pet waste reduction process totals an estimated $0.16 million. Cost to install vegetated buffers, rain gardens, and infiltration trenches during Stage I equal $0.54 million.

It was determined by the CSWCD, TCCSWCD, TJSWCD, VADCR, VDH, GWG, and Steering Committee members that it would require $65,000 to support one technical FTE per year. The total costs to provide assistance in the agricultural and residential programs during Stage I implementation are expected to be both equal $1.04 million (Table 4). The total Stage I implementation cost including technical assistance is $16.38 million with the agricultural cost being $10.42 million and residential cost $5.96 million (Table 4). Stage II and total implementation costs can be found in the Cost Analysis and Measureable Goals and Milestones sections of the technical report.

Table 4. Implementation cost associated with percentage of practices to be installed along with technical assistance addressing agricultural and residential needs in the Beaver Creek, Goldmine Creek, Mountain Run, Pamunkey Creek, Plentiful Creek, and Terrys Run watersheds during Stage I of implementation.

Year	Agricultural				Residential				Total Cost
	Pasture & Livestock Access	Cropland	Technical Assistance	Total	On-site Sewage Disposal System	Pet Waste	Technical Assistance	Total	
	($)	($)	($)	($)	($)	($)	($)	($)	**($)**
1	943,000	27,900	130,000	**1,100,900**	394,300	36,700	130,000	**561,000**	**1,661,900**
2	1,007,000	27,900	130,000	**1,164,900**	554,100	22,500	130,000	**706,600**	**1,871,500**
3	1,011,500	27,900	130,000	**1,169,400**	402,300	22,900	130,000	**555,200**	**1,724,600**
4	1,042,000	27,900	130,000	**1,199,900**	634,100	23,300	130,000	**787,400**	**1,987,300**
5	1,078,700	28,300	130,000	**1,237,000**	426,300	3,300	130,000	**559,600**	**1,796,600**
6	1,154,700	27,900	130,000	**1,312,600**	657,100	258,900	130,000	**1,046,000**	**2,358,600**
7	1,401,600	27,900	130,000	**1,559,500**	430,300	43,300	130,000	**603,600**	**2,163,100**
8	1,520,800	27,900	130,000	**1,678,700**	721,700	290,400	130,000	**1,142,100**	**2,820,800**
TOTAL	**9,159,300**	**223,600**	**1,040,000**	**10,422,900**	**4,220,200**	**701,300**	**1,040,000**	**5,961,500**	**16,384,400**

Benefit Analysis

The primary benefit of implementation is cleaner waters in Virginia, where bacteria levels in the Beaver Creek, Goldmine Creek, Mountain Run, Pamunkey Creek, Plentiful Creek, and Terrys Run impairments will be reduced to meet water quality standards. Actions during implementation can improve human and livestock herd health, local economies, and aquatic ecosystem health.

Human Health

It is hard to gauge the impact that reducing fecal contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, 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 potentially found in all fecal matter.

Livestock Herd Health

A clean water source coupled with exclusionary fencing has been shown to improve weight gain; 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.

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, installing a livestock stream exclusion system with an alternative (clean) water source, improving pasture condition, performing sewage system maintenance, and improving aesthetics throughout the watershed can have an economic benefit on the local economy. Additionally, money spent by landowners, government agencies, and non-profit organizations in the process of implementing the IP will stimulate the local economy.

Vegetated Buffer (No Mow Zone)

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. 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.

In terms of economic benefits to homeowners, an improved understanding of private OSDS, 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. 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.

On-site Sewage Disposal 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. With a major recreation area just downstream, Lake Anna, this is a vital enhancement to the public's enjoyment of the area.

Aquatic Community Improved

Stream bank protection provided through exclusion of livestock including horses 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 Chesapeake Bay TMDL. Local initiatives, such as riparian easements, will additionally be complemented by actions performed during TMDL implementation.

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.

Progress toward end goals will be assessed during implementation through tracking of control measure installations by CSWCD; TCCSWCD; TJSWCD; NRCS; VADCR; VDH; Louisa, Orange, and Spotsylvania Counties, and RRRC. The VADEQ will continue to assess water quality through its monitoring program. Other monitoring project activities in the watershed (*e.g.* citizen monitoring) will be coordinated to augment the VADEQ monitoring program. Implementation will be assessed based on reducing exceedances of the bacteria water quality standard, thereby improving water quality.

Implementation of control measures is scheduled for 10 years and will be assessed in two stages beginning in January 2012 and lasting to December 2021. Stage I is based on meeting source allocations that translate to an instantaneous standard exceedance rate of 10.5% or less resulting in removal of streams 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. After implementation inception, five milestones will be met in two-year increments until streams are removed from the List of Impaired Waters.

Streambank Buffer Establishment

Implementation in years one through eight for agricultural source reductions focuses on installing livestock stream exclusion systems, improving pasture management, and cropland conversion (Table 5). BMPs installed in years nine and ten are based on additional treatment of bacteria load not treated during Stage I from pasture and cropland using improved pasture management, manure incorporation into soil, and retention ponds (Table 5). Retention ponds are more costly and are logistically more difficult to design and locate on individual farms. Implementation of residential control measure in years one through eight focuses on identification and removal of straight pipes, repairing or replacing failed septic systems, instituting pet waste control program, installation of pet waste enzyme digesting composters, installation of confined canine unit (CCU) waste treatment systems, and installation of vegetated buffers (Table 5). Vegetated buffer, bioretention, and infiltration trench installations are expected to escalate over the last two years (Table 5).

Table 6 lists the cumulative progress towards the TMDL endpoint as implementation milestones are met. Water quality improvement is expected to increase each year. Based on water quality modeling projections, the impairments would be in a probable position to be de-listed from the List of Impaired Waters at the fourth milestone. Considering the dynamics of a stream ecosystem and the inherent difficulties that may arise preventing implementation, the final milestone of TMDL allocation attainment was set at 10 years following implementation commencement.

Riparian Forest Buffer

The process of staged implementation implies targeting of control measures, ensuring optimum utilization of resources. In quantifying agricultural BMPs through the use of aerial photography, land use, and stream network GIS layers, maps were formulated showing potential livestock stream access, pastures, and crop fields. Known problem areas, clusters of older homes, or houses in close proximity to streams known by the VDH will be targeted for on-site sewage disposal system control measures. Steps outlined in pet waste BMP stages results in targeting of source type and resources. Significant exposure to a rain garden and/or infiltration trench project would be attained if installed at schools, county administration buildings, or shopping centers in watershed.

Table 5. Targeted implementation stages for control measures installation.

Control Measure	Beaver Creek	Mountain Run	Pamunkey Creek	Terrys Run	Plentiful Creek	Goldmine Creek
Pasture and Livestock Exclusion						
Livestock Exclusion System (CREP)	I	I	I	I	I	I
Livestock Exclusion System (EQIP/CBWI)	I	I	I	I	I	I
Livestock Exclusion System (LE-1T)	I	I	I	I	I	I
Livestock Exclusion System (SL-6AT)	I	I	I	I	I	I
Livestock Exclusion System (LE-2T)	I	I	I	I	I	I
Livestock Exclusion System (WP-2T)	I	I	I	I	I	I
Improved Pasture Management	I & II	I & II	I & II	I & II	I & II	I & II
Retention Ponds	II	II	II	II	II	II
Cropland						
Permanent Vegetative Cover on Cropland (SL-1)	I & II	I & II	I & II	I & II	I & II	I & II
Reforestation of Erodible Crop and Pastureland (FR-1)	I & II	I & II	I & II	I & II	I & II	I & II
Manure Incorporation into Soil	II	II	II	II	II	II
Failing Septic Systems						
Septic Tank Pump-out	I	I	I	I	I	I
Septic System Repair	I	I	I	I	I	I
Connection to Public Sewer	I	I	I	I	I	I
New Conventional Septic System	I	I	I	I	I	I
Alternative On-site Sewage Disposal System	I	I	I	I	I	I
Straight Pipes						
New Conventional Septic System	I	I	I	I	I	I
Alternative On-site Sewage Disposal System	I	I	I	I	I	I
Pet Waste Management						
Pet waste education program	I	I	I	I	I	I
Pet waste digesters	I	I	I	I	I	I
Confined Canine Unit Waste Treatment System	I	I	I	I	I	I
Stormwater Runoff Best Management Practices						
Vegetated Buffers	I & II	I & II	I & II	I & II	I & II	I & II
Bioretention	I & II	I & II	I & II	I & II	I & II	I & II
Infiltration Trench	I & II	I & II	I & II	I & II	I & II	I & II

Stage I = first eight years of implementation for a 10-year timeline

Stage II = last two years of implementation for a 10-year timeline

Table 6. Cumulative implementation of control measures and water quality milestones.

Control Measure	Unit	Progress Since TMDL Study	Milestone 1 Completed by Jan. 2014	Milestone 2 Completed by Jan. 2016	Milestone 3 Completed by Jan. 2018	Milestone 4 Completed by Jan. 2020	Milestone 5 Completed by Jan. 2022
Pasture							
Livestock Exclusion System (CREP)	System	6	9	21	31	42	42
Livestock Exclusion System (EQIP)	System	6	16	33	53	87	87
Livestock Exclusion System (LE-1T)	System	N/A	18	35	55	87	87
Livestock Exclusion System (SL-6AT)	System	N/A	0	1	3	5	5
Livestock Exclusion System (LE-2T)	System	N/A	16	32	54	85	85
Livestock Exclusion System (WP-2T)	System	N/A	0	3	7	14	14
Improved Pasture Management	Acres - Installed	N/A	5,398	10,796	16,194	21,592	26,996
Retention Pond	Acres - Treated	N/A	0	0	0	0	15,141
Cropland							
Permanent Vegetative Cover on Cropland (SL-1)	Acres - Installed	343	69	138	208	277	346
Reforestation of Erodible Crop and Pastureland (FR-1)	Acres - Installed	33	67	134	202	269	336
Manure Incorporation into Soil	Acres - Treated	N/A	0	0	0	0	2,320
On-site Sewage Disposal Systems							
Septic Tank Pump-out	System	N/A	124	252	382	514	514
Connection to Public Sewer	System	N/A	2	4	7	10	10
Septic System Repair	System	N/A	73	148	224	302	302
New Conventional Septic System	System	N/A	46	97	149	201	201
Alternative Sewage Disposal System	System	N/A	11	24	38	55	55
Pet Waste Management							
Pet waste education program	System	N/A	3	3	3	3	3
Pet waste digesters	System	N/A	30	60	90	120	120
Confined Canine Unit Waste Treatment System	System	N/A	2	4	7	10	10
Stormwater Runoff Best Management Practices							
Vegetated Buffers	Acres - Installed	N/A	7	19	32	46	60
Bioretention	Acres - Treated	N/A	0	0	15	29	147
Infiltration Trench	Acres - Treated	N/A	0	0	3	7	35

Impairment	Instantaneous Bacteria Standard Exceedance Rate (%)					
	Existing	Milestone 1	Milestone 2	Milestone 3	Milestone 4	Milestone 5
Beaver Creek	23	20	16	14	10	4
Mountain Run	24	20	17	13	8	3
Pamunkey Creek	36	27	22	16	10	1
Terrys Run	37	28	23	17	9	4
Plentiful Creek	34	29	22	13	8	6
Goldmine Creek	48	38	30	17	9	1

Monitoring

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. Twelve ambient VADEQ monitoring stations were utilized to assess water quality in the Beaver Creek, Mountain Run, Pamunkey Creek, Terrys Run, Plentiful Creek, and Goldmine Creek watersheds (Table 7 and Figure 4). Station 8-PMC009.85 on Pamunkey Creek is classified as a "trend station". Trend stations are historically located, long-term water quality monitoring stations used to assess changes in water quality over long periods of time and are sampled at least six times per year. The remaining stations are classified as "watershed stations". Watershed stations are typically located near mouth of a watershed, designed to provide comprehensive statewide coverage of smaller watersheds, and sampled 12 times over a consecutive two-year period (sampling occurs every other month) within a six-year rotational cycle.

"Biological stations" 8-BRC001.88 and 8-PMC014.75 were utilized to assess benthic macroinvertebrates in Beaver Creek and Pamunkey Creek, respectively. Biological stations are sampled on a yearly basis in the spring and fall for benthic macroinvertebrates and observational habitat data is collected. Incorporating bacteria monitoring into existing citizen monitoring should be explored.

The citizen monitoring program can be utilized to supplement samples collected through VADEQ's ambient monitoring program. The Coliscan Easygel method is a simple to use and relatively inexpensive method that measures total coliform and *E. coli*. The Coliscan Easygel method was compared to laboratory analysis and found to be an acceptable tool for screening purposes although the data cannot be used directly by VADEQ for water quality assessments. This method is important because it can assist in locating "hot spots" for fecal contamination, assess implementation progress, and target areas for more extensive monitoring. The Coliscan Easygel method was utilized by TJSWCD to test samples collected at 12 stations in the Goldmine Creek watershed in November 2007. Monitoring results were used to target outreach efforts within the watershed. The Lake Anna Civic Association water quality monitors are trained to conduct testing at stations around the lake, but may be interested in expanding the monitoring program to the feeder streams.

The AWG, RWG, GWG, and Steering Committee request that monitoring continue at the TMDL impairment listing station for the following parameters: *E. coli* bacteria, temperature, dissolved oxygen, pH, specific conductivity, total nitrogen, total phosphorus, total suspended solids, and stream flow.

Table 7. Monitoring station identification, station location, station type, last monitoring date, and monitoring schedule for VADEQ monitoring stations in the watershed.

Station ID	Station Location	Station Type	Date Last Sampled	Monitoring Schedule
8-BRC001.88	Beaver Creek at Route 638	Watershed, Biological	12/04/08	Program Dependent, Yearly (spring & fall)
8-BRY000.47	Berry Run at Route 629	Watershed	12/28/10	Program Dependent
8-GMC002.19	Goldmine Creek at Route 613	Watershed	12/02/10	Program Dependent
8-MTN000.96	Mountain Run at Route 643	Watershed	05/24/11	Program Dependent
8-PMC009.85	Pamunkey Creek at Route 651	Trend	05/17/11	Long-term(bi-monthly)
8-PMC014.75	Pamunkey Creek at Route 630	Watershed, Biological	12/28/10	Program Dependent, Yearly (spring & fall)
8-PLT002.82	Plentiful Creek at Route 653	Watershed	12/01/08	Program Dependent
8-PLT004.82	Plentiful Creek at Route 601	Watershed	06/29/05	Program Dependent
8-TRY004.98	Terrys Run at Route 629	Watershed	05/24/11	Program Dependent
8-TRY006.72	Terrys Run at Route 624	Watershed	12/04/08	Program Dependent
8-TRY010.80	Terrys Run at Route 692	Watershed	12/04/08	Program Dependent
8-THK000.90	Tomahawk Creek at Route 733	Watershed	06/02/05	Program Dependent

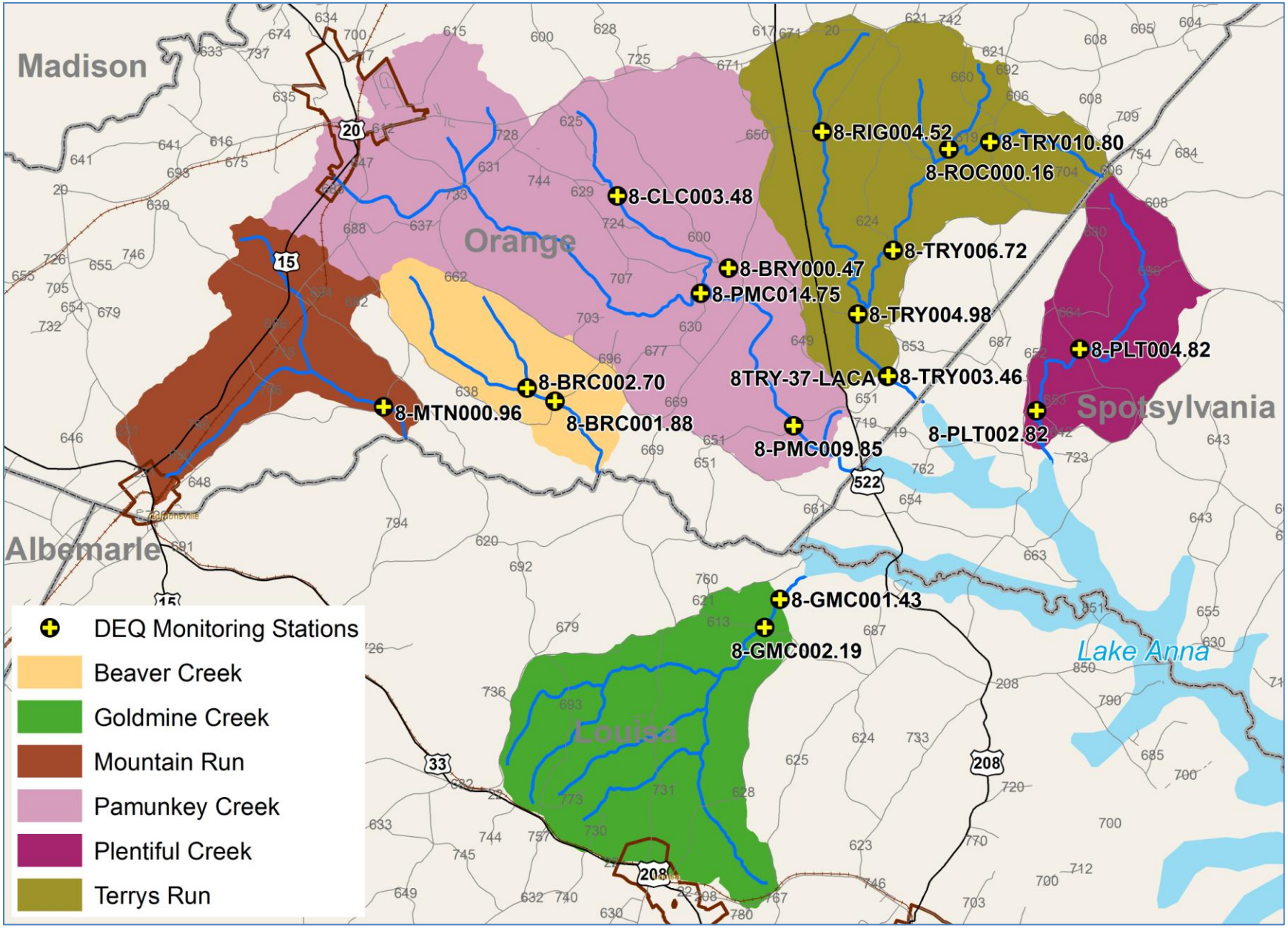


Figure 4. Location of VADEQ monitoring stations in the watersheds.

STAKEHOLDER'S ROLES & 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.

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. CSWCD, TCCSWCD, and TJSWCD will have prominent roles during implementation. CSWCD, TCCSWCD, and TJSWCD will provide cost-share funds, lead education and technical assistance efforts, and track best management practice implementation for the agricultural and residential programs. 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. State agencies conducting regulatory, education, or funding procedures related to water quality in Virginia include: VADEQ, VADCR, VDH, VADACS, VDGIF, VADOF, VCE, and VOF. Governmental, agricultural, residential action items during implementation are included in Tables 8 through 10, respectively.

Table 8. Governmental implementation action items.

Source Issues	Actions & Support	Potential Funding Source	Who will assist?
Continual baseline water quality monitoring	Water quality monitoring: ambient/benthic	VADEQ	VADEQ
Supplemental ambient/benthic monitoring	Water quality monitoring: ambient/benthic; coliscan (bacteria monitoring)	VADEQ, NFWF grant, VA Naturally	SWCD, Citizen Volunteers, LACA
Local government incentives	Ordinance/code options to improve water quality (stream buffer overlay district)	Local Government, Grants	Local Government, RRRC and other PDCs, as appropriate
Inadequate tracking of on-site sewage disposal systems	Develop tracking system; ensure alternative OSDS maintenance agreement in place	VDH, Local Government	VDH

Table 9. Agricultural implementation action items.

Source Issues	Corrective Actions	Potential Funding Source	Who will assist?
Livestock in stream	Livestock exclusion best management practices, Water development upslope	Ag BMP Cost-Share, WQIF, Section 319 Funds, NRCS	SWCD, NRCS
Cropland runoff	Cropland best management practices	Ag BMP Cost-Share, NRCS	SWCD, NRCS
Pasture runoff	Pasture management best management practices	Ag BMP Cost-Share, NRCS	SWCD, NRCS
Streamside runoff	Improved buffers (grass, shrubs, trees)	CREP, EQIP, VDGIF, VADOF, Ag. BMP Cost-Share	VDGIF, VADOF, SWCD, NRCS
Lack of BMP knowledge	Ag BMP education, outreach events	WQIF, VCE, NRCS	SWCD, VCE, NRCS
Livestock access to water	Alternate water source	Ag BMP, VADEQ (low interest loan), NRCS	SWCD, VADEQ, NRCS
Targeting locations for fencing	Ground truthing, stream walks	WQIF, mini grants	SWCD, community interest groups

Table 10. Residential implementation action items.

Source Issues	Corrective Actions	Potential Funding Source	Who will assist?
Lack of septic system maintenance	Regular maintenance	WQIF, NFWF grant, Homeowners, Section 319 Funds	VDH, SWCD
Septic system failure and/or straight pipes	Septic system repairs, replacement, hook-ups, & maintenance	WQIF, NFWF grant, Homeowners, Block Grants	VDH, RRRC, SWCD
No septic system pump out tracking	Computerized tracking system	VDH	VDH, Local Government
Need information on system location at time of home sale	State requirement – initiated by Board of Realtors	Homeowners	VDH
Education needed on septic system function	Septic system education program	WQIF, NFWF grant	Realtors, Teachers, VDH, School Groups, Community Interest Groups
No pet waste management	Education, bag stations, composters, structural practices in concentrated canine areas (kennels)	VCE, SWCD, WQIF, NFWF grant, Roundtables	Interest Groups, Local Governments, Hunt Clubs, Veterinarians, SPCA
Waterfowl impact to ponds	Buffer ponds to discourage waterfowl, especially geese	HOAs, NFWF grant, VDGIF	VADOF, Landowners
Runoff from streamside properties - non-agricultural	Low impact development techniques, install grass/shrub/tree buffers along streams, education on proper land management including erosion control and fertilizer	Homeowners, Developers, NFWF grant, Green Grass Program, PEC, VADOF, NFWF grant, Private Foundations	RRRC, PEC, Local Government, VCE, Interest Groups
Best management practices education for horse owners	Pasture management education; alternative watering sources, livestock exclusion	Ag BMPs, VCE, WQIF	SWCD, VCE, Interest Groups

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

CSWCD, TCCSWCD, and **TJSWCD**: The Culpeper, Tri-County/City, and Thomas Jefferson Soil and Water Conservation Districts are local units of government responsible for the soil and water conservation work within Louisa, Orange, and Spotsylvania 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 IP, the district will provide agricultural cost-share funds, lead education and technical assistance efforts, and track best management practice implementation for the agricultural and residential programs.

Louisa, Orange, and Spotsylvania Counties Government Departments: Government staff work closely with local and state agencies to develop and implement the TMDL. Staff will administer the erosion & sediment control and stormwater programs, provide mapping assistance, and may also help to promote education and outreach to citizens, businesses, and developers to introduce the importance of the TMDL process.

Rappahannock-Rapidan Regional Commission: 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 SWCDs. 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 implementation. This may include participating in public outreach, implementing BMPs to help restore water quality, and partnering with other stakeholders to improve water quality.

Lake Ann Civic Association: The purpose of the Association is to further the preservation and conservation of Lake Anna and its watershed as a clean and beautiful resource, through education, advocacy, and broad-based community involvement. Trained personnel conduct water quality monitoring at stations throughout the lake.

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.

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, wildlife, 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. 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.

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, driven by complaints. 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*.).

VADACS: 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. If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local SWCD. If a producer fails to implement the plan, corrective action

can be taken, which may include civil penalties. An emergency corrective action can be issued 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: 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 to insure consideration for fish and wildlife populations and associated habitats.

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.

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 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.

VOF: The Virginia Outdoors Foundation was established in 1966, "to promote the preservation of open-space lands and to encourage private gifts of money, securities, land or other property to preserve the natural, scenic, historic, scientific, open-space and recreational areas of the Commonwealth." The primary mechanism for accomplishing VOF's mission is through open-space easements. Open-space easements allow land to continue to be privately owned but restricted to serve and protect land for the public good.

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. USEPA provides funding to implement TMDLs through Section 319 Incremental Funds.

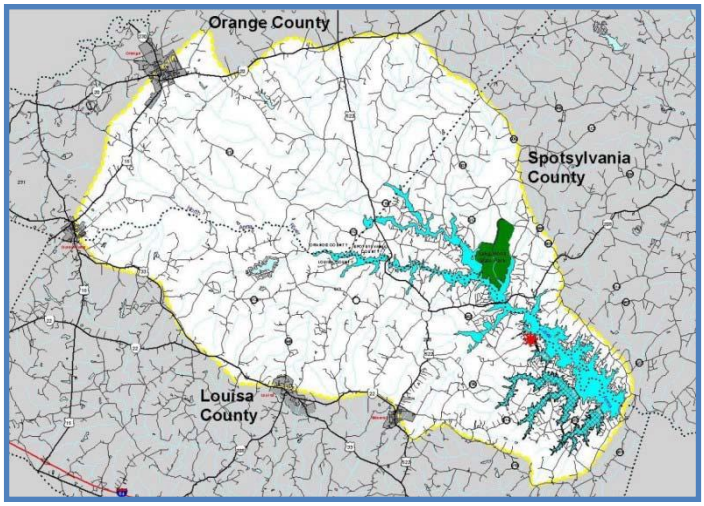
NRCS: The Natural Resources Conservation Service is the federal agency that works hand-in-hand with the American people to conserve natural resources on private lands. NRCS assists private landowners with conserving their soil, water, and other natural resources. Local, state and federal agencies along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

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 Chesapeake Bay Watershed Implementation Plan, TMDLs, Roundtables, Water Quality Management Plans, Erosion and Sediment Control Regulations, Stormwater Management Program, Source Water Assessment Program, and local comprehensive plans. The progress of these planning efforts 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 activities. Current initiatives within Louisa, Orange, and Spotsylvania Counties to be integrated with the Upper York River Basin TMDL IP include:

- Louisa, Orange, and Spotsylvania Counties Comprehensive Plans
- Town of Orange Comprehensive Plan
- Goldmine Creek Clean-up Project (TJSWCD)
- Chesapeake Bay Watershed Implementation Plan
- Lake Anna Watershed Management Plan / Special Area Management Plan
- Louisa Shoreline Protection Plan
- Piedmont Environmental Council Strategic Plan
- Lake Anna Civic Association Strategic Plan
- Lake Anna Ecosystem Restoration Project

Chesapeake Bay Watershed Implementation Plan



Lake Anna Watershed Management Plan / Special Area Management 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 CSWCD, TJSWCD, TCCSWCD, VADCR, VDH, VADEQ, VADGIF, VCE, VOF, and NRCS. Table 11 illustrates various financial opportunities that exist from selected cost-share programs for agricultural and residential implementation needs. Sources include:

Federal Sources

- Federal Clean Water Act Section 319 Incremental Funds
- U.S. Department of Agriculture (USDA) Conservation Reserve Enhancement Program (CREP)
- USDA Conservation Reserve Program (CRP)
- USDA Environmental Quality Incentives Program (EQIP)
- USDA Chesapeake Bay Watershed Initiative (CBWI)
- USDA Wetland Reserve Program (WRP)
- USDA Wildlife Habitat Incentive Program (WHIP)
- U.S. Fish and Wildlife Service Conservation Grants
- U.S. Fish and Wildlife Service Private Stewardship Program

Virginia Sources

- Virginia Agricultural Best Management Practices Cost-Share Program
- Virginia Agricultural Best Management Practices Tax Credit Program
- Virginia Water Quality Improvement Fund
- Virginia Forest Stewardship Program
- Virginia Small Business Environmental Compliance Assistance Fund
- Virginia Clean Water Revolving Loan Fund (VCWRLF)
- Virginia Outdoors Foundation
- York River and Small Coastal Basin Roundtable

Regional and Private Sources

- Community Development Block Grant Program
- Southeast Rural Community Assistance Project (Southeast RCAP)
- National Fish and Wildlife Foundation
- Chesapeake Bay Foundation
- Rapidan Better Housing
- Fluvanna-Louisa Housing Foundation

Table 11. Control measures with estimated cost-share program and landowner costs.

Control Measure	Program Code	Unit	Cost-share	Average Cost/Unit to State or Federal Program ($)	Average Cost/Unit to Landowner ($)[1]
Livestock exclusion with 35 ft buffer	CREP	System	50% + varied incentive	22,500	2,500
	EQIP/CBWI	System	75%	14,625	4,875
	LE-1T	System	85%	16,575	2,925
Small Acreage Grazing System with 35 ft setback	SL-6AT	System	50%	6,750	6,750
Livestock exclusion with 10 ft setback	CBWI	System	75%	14,625	4,875
	LE-2T	System	50%	7,875	7,875
Stream Protection	WP-2T	System	75% + $0.50/ft incentive	4,725	1,250
Pasture and Hayland Re-planting	512	Acres	$165/ac	165	130
Prescribed grazing	528	Acres	$30/ac	30	40
Permanent vegetative cover on cropland	SL-1	Acres	75% + varied incentive	313	57
Reforestation of erodible crop and pastureland	FR-1	Acres	up to $300/ac	300	150
Manure incorporation into soil	N/A	Acres	N/A	0	25
Septic Tank Pump-out	RB-1	System	50%	150	150
Connection to Public Sewer	RB-2	System	50% - 75%	4,500 – 6,750	2,250 - 4,500
Septic Tank System Repair	RB-3	System	50% - 75%	2,000 – 3,000	1,000 - 2,000
Septic Tank System Installation / Replacement	RB-4	System	50% - 75%	4,000 –6,000	2,000 - 4,000
Septic Tank System Installation / Replacement w/ Pump	RB-4P	System	50% - 75%	4,500 – 6,750	2,250 - 4,500
Alternative On-site Waste Treatment System	RB-5	System	50% - 75%	10,000 – 15,000	5,000 - 10,000

[1] Does not include tax credit or in-kind service

LIST OF ACRONYMS

AWG	Agricultural Working Group
BMP	Best Management Practice
CBWI	Chesapeake Bay Watershed Initiative
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
EQIP	Environmental Quality Incentive Program
FR-1	Reforestation of Erodible Crop and Pastureland
FSA	Farm Service Agency
FTE	Full Time Equivalent
GWG	Government Working Group
IP	Implementation Plan
LE-1T	Livestock Exclusion with Riparian Buffers
LE-2T	Livestock Exclusion with Reduced Setback
LID	Low Impact Development
NPS	Nonpoint Source
NRCS	Natural Resources Conservation Service
OSDS	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
RRRC	Rappahannock-Rapidan Regional Commission
RWG	Residential Working Group
SL-1	Permanent Vegetative Cover on Cropland
SWCB	State Water Control Board
TCCSWCD	Tri-County/City Soil and Water Conservation District
TJSWCD	Thomas Jefferson Soil and Water Conservation District
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
VADACS	Virginia Department of Agriculture and Consumer Services
VADCR	Virginia Department of Conservation and Recreation
VADEQ	Virginia Department of Environmental Quality
VADOF	Virginia Department of Forestry
VCE	Virginia Cooperative Extension
VDGIF	Virginia Department of Game and Inland Fisheries
VDH	Virginia Department of Health
VOF	Virginia Outdoors Foundation
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)

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.

Cost-share Program - a program that allocates 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 attaining the water quality standard.

E. coli- 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.

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.

Full Time Equivalent (FTE) - Is a way to estimate staff needed for a project. A FTE of 1.0 means that the position is equivalent to a full-time worker, while a FTE of 0.5 indicates a part-time worker.

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.

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 E.coli is 235 cfu/100 mL. If this value is exceeded at any time, the water body is in exceedance of the state water quality standard.

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.

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.

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.

Stakeholder - any person or organization with a vested interest in development and implementation of a local watershed water quality implementation plan (e.g., farmer, landowner, resident, business owner, or government official)

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.

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).

CONTACT INFORMATION

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