

**IMPLEMENTATION PLAN FOR
THE FECAL COLIFORM TMDL
(TOTAL MAXIMUM DAILY LOAD)
FOR THE
GREENVALE CREEK WATERSHED**

December 2008

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1.0 EXECUTIVE SUMMARY

The report “Rappahannock River: Towles Point to Deep Creek Total Maximum Daily Load (TMDL) Report for Shellfish Condemnation Areas Listed Due to Bacteria Contamination” issued by DEQ in February, 2006 ¹ (hereafter cited as “G-TMDL”) is the first step in the TMDL program for Greenvale Creek, Lancaster County, Virginia. That report develops a TMDL “...that will result in meeting water quality standards.” (p. 21). This implementation plan, drafted by citizens, most of whom live in the Greenvale Creek watershed (figure 1-1), constitutes the second step in the process, namely the development of a simple but realistic implementation plan. This implementation plan uses the Implementation Plan for the “Lynnhaven Bay, Broad Bay and Linkhorn Bay Watersheds Total Maximum Daily Load (TMDL) Report for Shellfish Areas Listed Due to Bacteria Contamination,” (DEQ 2004) for much of its structure and content as appropriate.

Figure 1-1 Greenvale Creek Watershed (insert map)

It is not possible to meet the goals stated in G-TMDL (Table 1-1 below), namely reducing bacterial contamination from wildlife by 16% and all other sources (livestock, pets and humans) by 100% to achieve a total bacterial load reduction of 81%. Few actions can be taken in the watershed that will significantly reduce contamination from wildlife or dogs. Two actions may reduce human contamination within the Greenvale Creek watershed, namely:

- 1) Inspect, pump-out and fix identified failed or failing septic systems, and
- 2) designate Greenvale Creek as a “No Discharge” zone.

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

Growing Area 22	Wildlife	Human	Pets	Livestock	Total
Greenvale Creek	16%	100%	100%	100%	81%

Both actions must be taken within this watershed because “The TMDL seeks to eliminate 100% of the human derived fecal component regardless of the allowable load determined through the load allocation process.” (p. 18). Most actions that would significantly reduce bacterial contamination in other impaired watersheds require additional regulatory changes. These include fencing livestock out of the RPA, elimination of feral dogs, regulating waste disposal from kennels, modifying

“greywater” laws and banning the land application of municipal sewage sludge and poultry litter in the watershed. Continued monitoring will document whether or not these actions, if they are instituted by the State, will result in significant reductions in fecal coliform bacterial levels.

1.1 Introduction

It is desirable, as well as required, to reduce fecal coliform bacterial concentrations in estuarine creeks and rivers from which shellfish (clams, mussels, oysters and scallops) are harvested. G-TMDL identifies the level of bacterial contamination in condemnation number 94, Greenvale Creek, based on long-term monitoring by the Virginia Department of Health, Shellfish Sanitation Division (section 4.0, p. 7-11). In order to implement reductions in bacterial load, the source of the bacteria must be known with certainty. Unfortunately, the sources of bacteria have not been determined with sufficient certainty to withstand legal challenge, in our estimation. BST (Bacterial Source Tracking) data (p. 12-14) are suggestive only, and cannot be used to accurately quantify the degree of reduction necessary from each source^{2, 3, 4}. Except for the proposed reduction of bacteria from wildlife by 16% (Table 5.3), the fraction of bacteria contributed from livestock, pets and humans is irrelevant, because proposed reductions by 100% are required (Table 5.3). Recognizing that “...the reduction of wildlife or changing a natural background condition is not the intended goal of a TMDL.” (p. 23), no action is proposed to reduce bacterial contamination from wildlife. The fact that 59% of land use in this watershed is natural (forest, wetland, water and barren land) and 38% is agricultural (crop and pasture) suggests that the role of wildlife in causing bacterial contamination has been grossly underestimated. Very few livestock are located in the Greenvale Creek watershed any longer. It is unlikely that the remaining 3% of the land (urban and commercial) causes 68% of the bacterial contamination (pets and humans), even allowing for scattered homes on agricultural land⁵. Additionally, fecal coliform bacteria are known to be resident in the anoxic bottom sediment of creeks like Greenvale, and those bacteria cannot be eliminated and are ignored in G-TMDL.⁶

This implementation plan focuses on practical actions that can be taken to reduce further bacterial contamination from livestock, pets and humans, irrespective of the purported importance of those bacterial sources as listed in G-TMDL. The actions suggested are applicable to other water bodies in Virginia’s Northern Neck. Additional action may be required at locations where formal discharge permits exist, and where bacterial contributions may take place from point sources.

This Implementation Plan (IP) is a companion document to the report, “Rappahannock River: Towles Point to Deep Creek Total Maximum Daily Load (TMDL) Report for Shellfish Condemnation Areas Listed Due to Bacteria Contamination,” (DEQ February 2006). Only the Greenvale Creek Watershed section of this report is addressed by this IP. The Greenvale Creek TMDL Study set allocations to limit bacteria pollutant loads discharged to the Greenvale Creek watershed to levels that were modeled to achieve compliance with the state water quality criteria for bacteria for shellfishing waters. This IP bridges the gap between those specified pollutant load allocations and actual reductions in bacteria counts in Greenvale Creek by recommending a set of actions to be taken in the watershed during a fifteen year project timeframe.

State and Federal Requirements

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

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

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

1.2 Review of Greenvale Creek TMDL

A review of TMDL development is provided in section 5.0 (p. 14-21) of G-TMDL. TMDL development is based on watershed characterization that is presented in section 3.0 (p. 4-6) and on water quality data documented in section 4.0 (p. 7-14).

As a result of monthly monitoring conducted by the Virginia Department of Health’s Division of Shellfish Sanitation (DSS), the Virginia Department of Environmental Quality (DEQ) listed the entire Greenvale Creek (VDH/DSS Notice and Description of Shellfish Area Condemnation, Number 022-094, Greenvale and Paynes Creeks, Effective 23 September 2008) as impaired on Virginia’s 1998 Section 303(d) list for being unable to attain the criteria for the production of

edible and marketable natural resources due to elevated levels of fecal coliform bacteria. Despite the condemnation, criteria are in place to protect the public from health effects associated with the direct consumption of bacteriologically contaminated shellfish. Chapter 310 of the Virginia Administrative Code describes how shellfish grown in restricted (condemned) water can enter the commercial market. As stated in **4VAC20-310-20. General provisions.** “A. Nothing in this chapter shall prohibit the harvesting, transporting, or handling of wild and cultured seed-stock shellfish from condemned areas.”

A TMDL study for the Greenvale Creek, completed by DEQ in February, 2006, examined the watershed characteristics and the sources of fecal coliform. Using monthly monitoring data, bacterial source tracking (BST), and a tidal volumetric model, DEQ assigned maximum allowable loads to each source in the watershed in order to bring Greenvale Creek into compliance with the water quality standard for shellfish propagation.

The core of this IP is a set of actions found in Section 7 aimed to reduce the levels of fecal coliform bacteria in Greenvale Creek by the percentages shown in table 1-1. The actions chiefly target bacteria from human and pet (“anthropogenic”) sources. This reflects the staged implementation recommended by the Virginia Department of Environmental Quality and referenced in the TMDL Study.

1.3 Public Participation

Public participation in the TMDL process is summarized on p. viii of the TMDL Executive summary and in section 7.0 (p. 24) of G-TMDL. Two public meetings were held in the watershed to engage the public in the development of the TMDL Implementation Plan for the Greenvale Creek Watershed. Citizens wrote this IP.

1.4 Implementation Actions

For each of the four proposed sources of fecal coliform bacteria, we first propose actions appropriate for all watersheds, and then, in a subsequent paragraph, apply the proposed “universal” actions specifically to the Greenvale Creek watershed.

Wildlife - no action is proposed as addressed in section 6.3.4 of G-TMDL.

Livestock – G-TMDL states (p. 21) “...in agricultural areas of the watershed, the most promising management practice is livestock exclusion from waterbodies. This has been shown to be very effective in lowering fecal coliform concentrations in waterbodies, both by reducing the cattle deposits themselves and by providing additional riparian buffers.” All livestock must be fenced out of the RPA (the RPA is defined in the “Chesapeake Bay

Preservation Act”). In addition, because poultry are a source of fecal coliform bacteria, the land application of poultry litter must be banned from the watershed. Like municipal sewage sludge, poultry litter is imported into the watershed, in cases from out-of-state. Concentrations of fecal coliform bacteria in poultry litter typically exceed concentrations in municipal sewage sludge because the waste is not regulated, and bacteria can persist in soils for at least eight weeks.⁷

G-TMDL estimated four cattle and one chicken in the Greenvale Creek watershed (Table 3-1, p. 4) whereas 10 goats, 1 sheep, 34 fowl and 9 cows are listed on p. 36 (section D) of the Shoreline Sanitary Survey. We know of no cattle or poultry currently within the watershed. Because the land application of poultry litter is largely unregulated in Virginia, there is no information available on its use in the watershed.

Currently there are no Livestock within the Greenvale Creek Watershed, hence no action is required to fence them out of the RPA. The land-application of poultry litter must be banned within the watershed.

Pets –Kennels and other congregations of dogs must be identified and either local or state ordinances enacted to ensure that the fecal material is safely disposed. People can be encouraged to collect the feces from "fenced in" or "house" dogs, and dispose of it in household septic systems. The feces from registered free-roaming dogs cannot be reduced and it is unlikely that citizens will support ordinances that will restrict these kinds of pets because of their importance in security and vermin control. Feral dogs should be eliminated.

G-TMDL estimated there are 35 dogs in the Greenvale Creek watershed (Table 3-1, p. 4). We find six dogs plus a hunt club with resident dogs during hunting season.

Humans -_“The TMDL seeks to eliminate 100% of the human derived fecal component regardless of the allowable load determined through the load allocation process.” (p. 18). Three actions are necessary to achieve this stated goal:

- a - Fix all identified failed/failing septic systems. G-TMDL states (p. 22) “... in both urban and rural areas, reducing the human fecal loading from failing septic systems should be a primary implementation focus because of its health implications.” The “Shoreline Sanitary Survey” conducted by

VDH and the mandated inspection/pumpout that is currently being enforced by Lancaster County should continue and problems that are identified should be eliminated immediately.

Appendix A of G-TMDL (p. 31-37) identifies known problems in the Greenvale Creek watershed. Five cases of effluent discharge were noted in 2001, which should be resolved immediately if they still exist. Four entries may or may not contribute fecal coliform bacteria, three cases where no facilities exist, and one case of an uncapped pipe. Five cases of kitchen or laundry waste (greywater) discharge are noted. "Greywater" or water from sinks, showers, laundries, etc. does not contain significant numbers of fecal coliform bacteria. Septic system operation can be improved by directing "greywater" directly into cisterns or infiltration trenches, or even directly to the drainfield. Virginia's antiquated greywater laws must be changed.

- b - Ban the land application of municipal sewage sludge in the watershed. Municipal sewage sludge from Blue Plains typically contains about 400 CFU per dry gram, and it is unlikely that sludge from other sources contains fewer bacteria. Bacterial concentrations in sludge are not monitored by either VDH or DEQ. Converting to wet-weight (75% moisture), each 20-ton truck imports roughly two trillion CFU into the watershed, which is spread on approximately one acre. The load allocation for fecal coliform bacteria is zero MPN/day (p. vii of the Executive Summary and p. 19, G-TMDL). Importing fecal coliform bacteria of human origin into a watershed where the stated goal is "... to eliminate 100% of the human derived fecal component ..." (G-TMDL p. 18) must cease.

There have been no known uses of sewage sludge in the Greenvale Creek watershed and no formal permits for land-application exist.

- c - Designate Greenvale Creek as a "no discharge" zone for boats. It is uncertain if overboard discharge is a source of bacteria, but a single event can contribute massive numbers of bacteria.

Three marinas in Greenvale creek are documented in G-TMDL (p. 35.) None of the marinas are identified as being problematical, and no action is required.

The management actions outlined in this IP capitalize on existing and planned programs and efforts within the Greenvale watershed and will be implemented in three phases. Phase I actions are those that have already been initiated or are scheduled for completion within five years. Phase II activities are those that are planned for implementation within the next five years but may not have approved funding sources yet. Phase III actions may require regulatory changes, but they may be implemented as necessary if Phase I and Phase II actions do not significantly improve water quality within the study area. All management actions were divided into the following ten management categories:

- Agricultural BMPs
- Septic System inspections/pumpouts
- Boating Programs
- Pet Waste Programs
- Erosion and Sediment Control
- Aquatic Resources Restoration
- Education Programs
- Land Use Management
- Wildlife Contribution Controls

1.5 Associated Costs and Benefits

The primary benefit of the implementation of the management actions described in this IP is the reduction of bacteria levels in the Greenvale Creek. The programs and actions contained within this IP will serve to reduce the anthropogenic sources of bacteria within the Greenvale Watershed. Because many of the programs mentioned in this report also serve purposes other than to just reduce bacteria, for example, reducing the nutrient (nitrogen and phosphorus) loads, and because they are applicable to areas larger than the Greenvale Watershed, the costs of reducing bacteria levels in the Greenvale Watershed can be difficult to estimate.

1.6 Measurable Goals and Milestones

As stated in G-TMDL (p. 22) “VDH-DSS will continue sampling at the established bacteriological monitoring stations in accordance with its shellfish monitoring program. VADEQ will continue to use data from these monitoring

stations and related ambient monitoring stations to evaluate improvements in the bacterial community and the effectiveness of TMDL implementation in attainment of the general water quality standard.”

The goal of the TMDL developed for Greenvale Creek is to bring the impaired water segments within the Greenvale watershed into compliance with the water quality standard for bacteria in shellfishing waters. Once the water segment achieves compliance with the bacteria criteria, then the segment can be removed from the 303(d) Impaired Waters List. Throughout the five year project timeframe, DSS will continue its monthly monitoring of stations throughout the Greenvale watershed. Currently, this monitoring program includes 4 monitoring stations within Greenvale Creek. Project progress will be tracked throughout the timeframe of the implementation plan, and the effectiveness of the management actions proposed in this IP will be evaluated at the end of five years.

1.7 Stakeholders Roles and Responsibilities

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

Citizens (local stakeholders) can be requested to voluntarily comply with some of the proposed actions outlined above, but mandates almost certainly will be necessary. It is unlikely that voluntary actions intended to reduce the concentrations of fecal coliform bacteria from livestock, pets and humans will significantly reduce bacterial concentrations in formally impaired rivers and creeks, just as voluntary actions by agriculture have not significantly reduced agricultural pollution of Chesapeake Bay.

Livestock - owners can be asked to voluntarily fence livestock out of the RPA. A state-wide mandate will likely be required to achieve this goal. Farmers are unlikely to forgo the use of poultry litter, which is also responsible for massive nitrogen and phosphorous pollution, without mandate.

Dogs - Pet owners can be asked to dispose of feces so that contamination of water does not take place. Mandated controls on kennels and other congregations of dogs, and elimination of feral dogs are likely to be necessary.

Human - Citizens can be asked to monitor their septic systems and report problems to VDH. Because of the expense involved in repair, this request is unlikely to change citizens' behavior. Additional monitoring and inspection beyond VDH's Shoreline Sanitary Survey and the County's mandated inspection/pumpout is not likely to identify additional problems or to be cost-effective. Farmers are unlikely to forgo the use of municipal sewage sludge, which is also responsible for massive nitrogen and phosphorous pollution, without mandate. Boaters can be asked not to discharge waste overboard (already a violation of law – GTMDL p. 52), but a request is not likely to deter violators. Mandated prohibition and enforcement are necessary. Virginia's laws should be identical to the laws in Maryland, resulting in uniformity throughout Chesapeake Bay.

1.8 Watershed Planning Efforts

Bacterial contamination in other watersheds in Virginia's Northern Neck is not significantly different from Greenvale Creek because land-use is similar everywhere. The highest bacterial concentrations in all creeks and rivers are found in the headwaters, where residential development is typically lowest. Roughly half of the land is forested, and agricultural practices occupy about one third of the land. It is not productive to consider watersheds individually, especially because existing BST data are considerably less accurate than the small differences in land use between watersheds. The actions outlined in this Implementation Plan are applicable throughout the Northern Neck. Where formally permitted point source discharges exist, additional action may be necessary, but it is likely that the potential bacterial contamination in those few cases is already satisfactorily contained.

Lancaster County is working with the US Army Corps of Engineers (USACE) on the Greenvale Creek dredging to improve the hydrodynamic action within the creek to mitigate the bacteria loading in Greenvale Creek.

1.9 Potential Funding Sources

G-TMDL addresses potential funding sources in section 6.3.3 (p. 23.) Repair of septic systems is the only action that may require funds. It can be argued that the cost of other actions specified above, including fencing livestock out of the RPA and disposing of feces from kennels, should be the responsibility of the property owner. Repair/replacement of failed/failing septic systems can be expensive. Low-lying land adjacent to waterways is especially problematic because the water table

is near the land surface and there are many areas where the soil is not appropriate for a conventional drainfield. Additionally, many old septic systems exist, for which the location and method of construction do not conform to existing law. And finally, failed/failing stems can belong to disadvantaged property owners who do not have the resources to repair/replace a system that costs many thousands of dollars.

An unfunded mandate to repair/replace problematic septic systems, which might preclude a citizen from using their property, is unacceptable. In cases of "hardship," funds must be derived from private/local/state/federal government sources. For all other cases, property owners should be responsible for compliance.

One of the objectives of this TMDL Implementation Plan is to maximize utilization of existing programs and resources to achieve the goal of reducing bacteria levels within the Greenvale Creek Watershed. Funding for these programs and the management actions described in this IP can come from four sources:

- Locality funds
- Virginia State funds
- Federal funds
- Private funds

Conclusion

Actions to reduce high fecal coliform bacterial levels in formally impaired creeks and rivers in Virginia's Northern Neck will have very limited effects. Forest and agriculture dominate the land-use and only small percentages of the land are residential or urbanized. In the Greenvale Creek watershed, repair of failed/failing septic systems and prohibition of overboard boat discharge should be mandated and feral dogs should be eliminated. In other watersheds, banning the land-application of poultry litter and municipal sewage sludge, and managing the waste from kennels and other concentrations of dogs should be initiated. Citizen education with regard to septic system maintenance and proper disposal of dog wastes, though desirable, is unlikely to result in any significant reduction in the levels of fecal coliform bacteria in the water. The only action that requires funding is the repair/replacement of identified failed/failing septic systems for citizens who can demonstrate "hardship." Maintenance dredging the mouth of Greenvale Creek should also be periodically scheduled. Increased circulation will certainly reduce bacterial concentrations near the mouth of the creek, but is unlikely to affect small arms of the creek or its headwaters.

2.0 _INTRODUCTION

2.1 Purpose, Scope, and Timeframe

This Implementation Plan (IP) is a companion document to the report, “Greenvale Creek, Towles Point Watersheds Total Maximum Daily Load (TMDL) Report for Shellfish Areas Listed Due to Bacteria Contamination,” completed by the Virginia Department of Environmental Quality (DEQ) in 2006, which will henceforth be referred to as G-TMD. The IP creates a framework to achieve the reductions in bacterial concentrations recommended in G-TMDL. The core of this IP is the set of actions presented in Section 7 intended to reduce the levels of fecal coliform bacteria in Greenvale Creek from controllable sources. The goal of the IP is striving toward compliance with the State of Virginia water quality standard for bacteria for shellfishing waters. This IP follows the State guidance for TMDL implementation plans published by DEQ. This TMDL and Implementation Plan are the first of many to be completed within the jurisdiction of the Lancaster County. It is the intention that this document will serve as a framework for TMDL Implementation Plans that will be completed in the future.

The TMDL study that was approved by the US Environmental Protection Agency (USEPA) in 2006 and the Virginia State Water Control Board in examined the watersheds, their characteristics, and the sources of fecal coliform throughout the watersheds. Using monthly monitoring data, bacterial source tracking (BST), and a tidal volumetric model, DEQ was able to assign maximum allowable loads to each source in the watersheds in order to bring Greenvale Creek into compliance with the water quality standard. This IP outlines a strategy and the proposed actions to reduce anthropogenic loading of bacteria to the level set forth in the TMDL study in order to comply with the water quality standard for fecal coliform for shellfishing waters. The proposed actions included in this IP will be performed by Lancaster County in cooperation with state, federal, and non-governmental entities. These actions are expected to be completed within a five-year timeframe.

The pollutant reductions in Greenvale Creek Watersheds will be implemented in a staged fashion. Staged implementation is an iterative process that first addresses those sources with the largest impact on water quality. Stage 1 management actions will target the controllable, anthropogenic bacteria sources identified in the TMDL, setting aside control strategies for wildlife except for cases of over-population. During the implementation of the stage 1 scenario, all controllable sources will be

reduced to the maximum extent practicable using an iterative approach. DEQ will re-assess water quality data collected by the Virginia Department of Health, Division of Shellfish Sanitation (VDH-DSS) throughout the Greenvale Creek Watershed during and subsequent to the implementation of the stage 1 scenario to determine if the water quality standard is attained.

Stage 1 implementation management actions will be divided into three phases. Phase I actions are those that have already been initiated or are scheduled for completion within five years. Phase II activities are those that are planned for implementation within the next five years but may not have approved funding sources yet. Phase III actions may require regulatory changes, but they may be implemented as necessary if Phase I and Phase II actions do not significantly improve water quality within the study area. Stage 1 implementation actions are discussed in greater detail in Section 7.

Lancaster County is currently working with the U.S. Army Corps of Engineers on dredging Greenvale Creek to improve hydrodynamic action within the creek. The load allocations set forth in G-TMDL may be modified based on new information collected through ongoing monitoring data following the implementation of actions set forth in this document.

The TMDL may be reevaluated by DEQ after implementation of stage 1 management actions or if new information on water quality or hydrodynamics in the Greenvale system becomes available. Only DEQ can revise a TMDL; the decision tree for approval and revision of the TMDL and Implementation Plan are outlined in Figure 2-1.

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

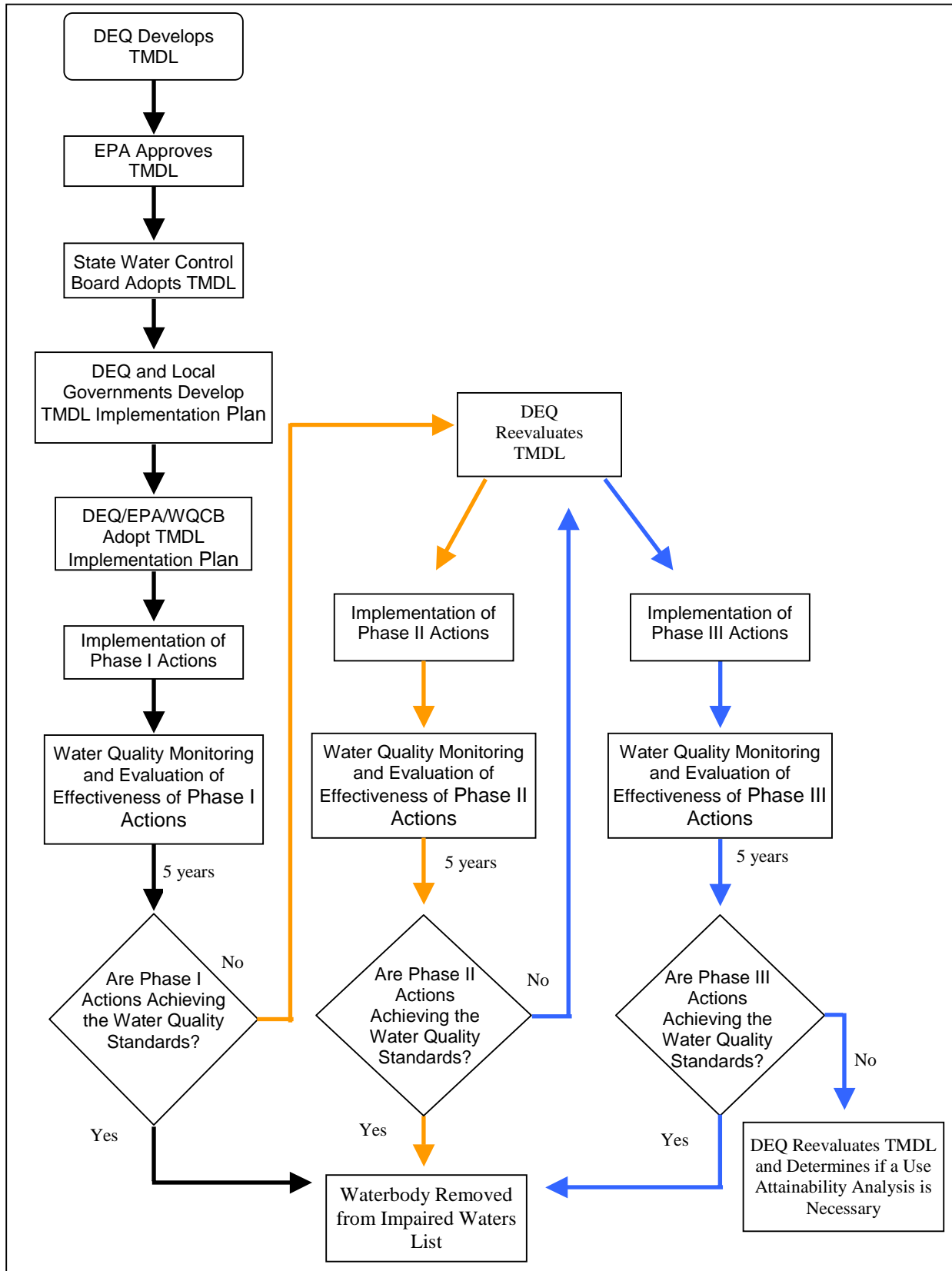


Figure 2-1: Decision Tree for Approval and Revision of TMDL

2.2 Regulatory Background

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

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

Once a TMDL is developed and approved by EPA, measures must be taken to reduce pollution levels in the stream. These measures, which can include the use of better treatment technology and the installation of best management practices (BMPs), are implemented in a staged process that is described along with specific BMPs in the IP. In general, the Commonwealth intends for the pollutant reductions to be implemented in a staged fashion. Staged implementation is an iterative process that first addresses those sources with the largest impact on water quality.

2.3 Designated Use and Water Quality Standard

According to Virginia Water Quality Standards (9 VAC 25-260-5), the term "water quality standards means provisions of state or federal law which consist of a designated use or uses for the waters of the Commonwealth and water quality criteria for such waters based upon such uses. Water quality standards are to

protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC §1251 et seq.).”

According to Virginia Water Quality Standards (9 VAC 25-260-10A), “all state waters are designated for the following uses: recreational uses (e.g., swimming and boating); the propagation and growth of a balanced indigenous population of aquatic life, including game fish, which might be reasonably expected to inhabit them; wildlife; and the production of edible and marketable natural resources (e.g., fish and shellfish).”

For a shellfish supporting water body to be in compliance with Virginia's bacteria standards for the production of edible and marketable natural resources use, DEQ specifies the following criteria (9VAC 25-260-160): “In all open ocean or estuarine waters capable of propagating shellfish or in specific areas where public or leased private shellfish beds are present, and including those waters on which condemnation or restriction classifications are established by the State Department of Health the following criteria for fecal coliform bacteria shall apply; The geometric mean fecal coliform value for a sampling station shall not exceed an MPN (most probable number) of 14 per 100 milliliters. The 90th percentile shall not exceed an MPN of 43 for a 5 tube, 3 dilution test or 49 for a 3 tube, 3 dilution test” For those waters that do not meet these criteria, Chapter 310 of the Virginia Administrative Code describes the process by which shellfish grown in restricted (condemned) waters can enter the commercial market.

The impairment for Greenvale is based on restrictions placed upon the harvesting of shellfish from these waters. The restrictions which are issued by the Virginia Department of Health’s Division of Shellfish Sanitation (DSS) are based on monthly monitoring data. DSS collects monthly fecal coliform bacteria samples from each of its sampling stations in the Bays. DSS calculates geometric mean and 90th percentile concentration values based on the most recent 30-months of sampling data. Most of the stations were listed for failing to attain the 90th percentile criteria.

2.4 Greenvale Watershed TMDL Efforts

Greenvale Creek have been restricted pursuant to Title 28.2 Chapter 8, sections 228.2-803, 228.2-808, 32.1-20 and 9-6.14:4.1 B16 of the Code of Virginia by the Virginia Department of Health, Division of Shellfish Sanitation (VDH-DSS). Notice and Description of Shellfish Condemnation Area 94, Greenvale Creek,

describes and delineates harvest areas that are restricted because water quality monitoring data show excessive levels of bacteria in these waters. The waters also were classified as impaired on the state's 303(d) list of impaired waters and require a TMDL.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (DEQ) listed the entire Greenvale Creek as impaired on Virginia's 19xx Section 303(d) list for being unable to attain the criteria for the production of edible and marketable natural resources due to elevated levels of fecal coliform bacteria. The criteria are in place to protect the public from health affects associated with the consumption of bacteriologically contaminated shellfish.

A TMDL study for the Greenvale Creek watershed was completed by DEQ in February 2006 and approved by the US Environmental Protection Agency (USEPA) in August 2008. The TMDL study examined the watersheds, their characteristics, and the sources of fecal coliform throughout the watersheds. Using monthly monitoring data, bacterial source tracking (BST), and a tidal volumetric model, DEQ assigned maximum allowable loads to each source in the watersheds in order to bring Greenvale Creek into compliance with the water quality standard for shellfish propagation.

2.5 Greenvale Creek Watershed

Greenvale Creek is located entirely within the Lancaster County on Virginia's Northern Neck. The watershed occupies a landscape position along the western shore of Chesapeake Bay in Virginia's Coastal Plain Physiographic Province and the Coastal Lowland sub-province. The Coastal Lowland sub-province is characterized by flat, low relief regions along the major rivers and Chesapeake Bay. Elevations range from 0' to 110' above mean sea level.

The Greenvale watershed drains south to the Rappahannock River and is subject to the ebb and flow of the tide. Greenvale Creek flows south. The drainage area of the Greenvale, watershed is approximately 4.05 [from Table 4-2] square miles. A detailed map of this section of the watershed is shown in Figure 2-2.

QuickTime™ and a
PDF viewer plugin are required to see this picture.

Figure 2-2: Land Use Within the Greenvale Creek Watershed (Lancaster County)

3.0 STATE AND FEDERAL REQUIREMENTS

3.1 Background

There are two sets of regulatory requirements for the development of TMDL Implementation Plans (IPs) in the state of Virginia.

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

3.2 State Requirements

The TMDL Implementation Plan is a requirement of Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act (§62.1-44.19:4 through 19:8 of the Code of Virginia), or WQMIRA. WQMIRA directs the Virginia Department of Environmental Quality (DEQ) to “develop and implement a plan to achieve fully supporting status for impaired waters.” In order for Implementation Plans to be approved by the Commonwealth, they must include the following:

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

3.3 Federal Requirements

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

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

3.4 Federal Consent Decree

The Commonwealth of Virginia was a signatory to the June 11, 1999 consent decree settling federal case no. 98-979-A “American Canoe Association, Inc. and the American Littoral Society v. USEPA and USEPA – Region III.” By signing the consent decree, Virginia committed to develop TMDL studies by 2010 for all Virginia water segments listed on the 19?? 303(d) Impaired Waters list.

4.0 REVIEW OF TMDL DEVELOPMENT

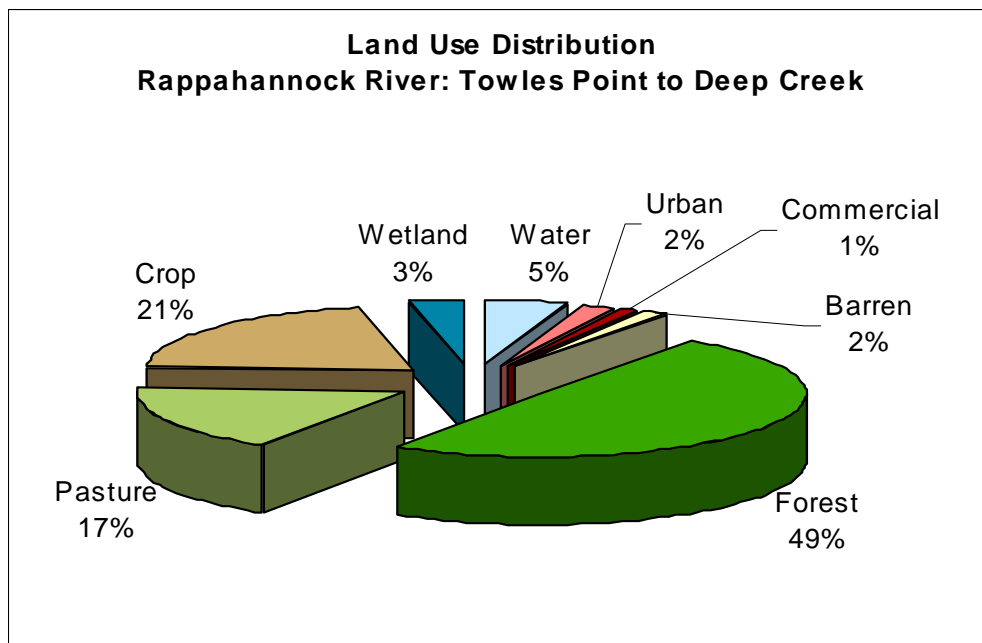
4.1 Description of Watershed Characteristics

The 4.05 [from Table 4.2] square mile drainage area of the Greenvale watershed is located entirely within Lancaster County, Virginia. Greenvale Creek flows south from its headwaters to the Rappahannock River and is subject to the ebb and flow of the tide.

Greenvale Creek is a trapped estuary that receives freshwater input from coastal streams and groundwater discharge. Greenvale is a shallow system with a maximum depth of 3 meters. The Greenvale system has a history of shellfishing closures. Since 1971, the system has ranged from complete closure to portions conditionally opened and back again. The upper reaches of Greenvale Creek have remained closed since 1996.

The area comprising the Greenvale Creek watershed can be characterized as forested with very low-density development. Undeveloped land comprises more than 90% of the total watershed as forest, wetland, pasture or crop, or water. Land use area by category is shown in Figure 4-1.

Figure 4-1: 2000 Land Use Greenvale Watershed



4.2 Description of Impairment

Greenvale Creek was listed as impaired on Virginia’s 1998 303(d) Total Maximum Daily Load Priority List and Report (DEQ 2006) due to violations of the State’s water quality standard for fecal coliform bacteria in shellfish supporting waters. VDH-DSS, Notice and Description of Shellfish Condemnation Number 022-094, Greenvale Creek, effective 23 September 2008, lists and describes the condemnation areas in this watersheds. Table 4-2 shows that Greenvale continued to be reported as impaired in the Commonwealth of Virginia’s 1998 305(b)/303(d) Water Quality Assessment Integrated Report. A generalized map of the areas affected by the condemnation notice is shown in Figure 4-2.

Table 4-2: Greenvale Creek Study Area Fecal Bacteria Impairments For Shellfish Waters Listed In 2004 305(b)/303(d) Water Quality Assessment Integrated Report For which IP’s Will Be Developed (DEQ 2006)

TMDL ID	Waterbody Name	Impairment	Initial List Date	Assessment Category	City/County	Size
94	Greenvale Creek	VDH Shellfish Restriction	1998	5B	Lancaster County	4.05 Sq. Mi

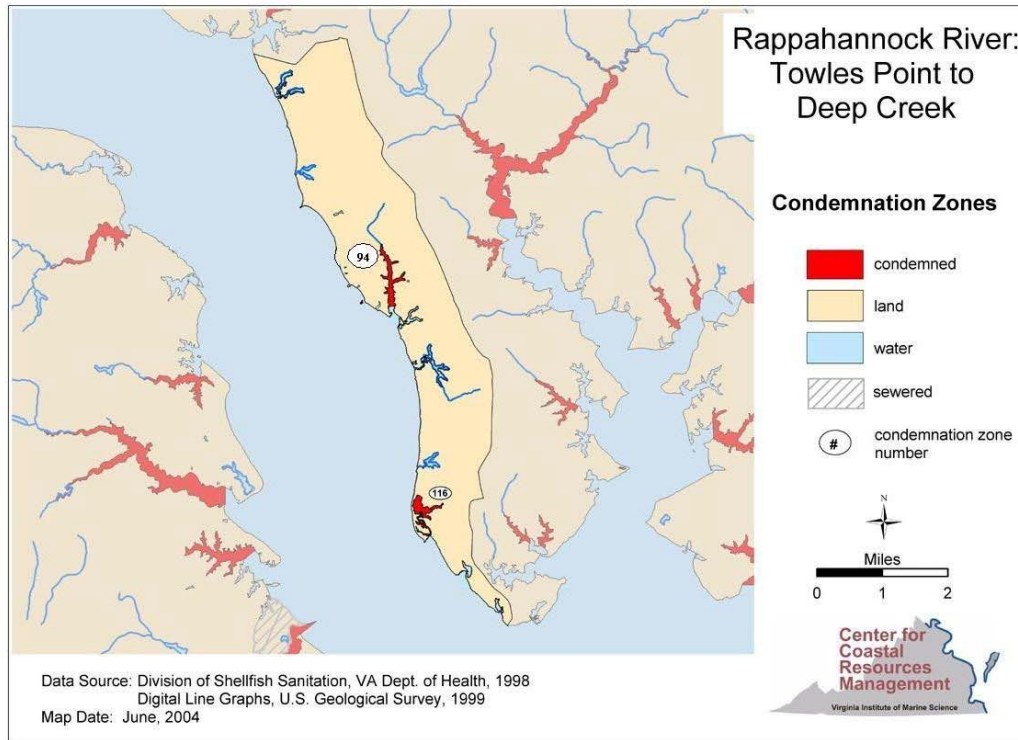


Figure 4.2

Figure 4-2: Shellfish Condemnation Areas in Greenvale Study Areas When TMDL Was Developed

In some streams for which TMDLs have been developed, water quality modeling indicates that, even after removal of all of the sources of fecal coliform (other than wildlife), the stream will not attain standards. TMDL allocation reductions of this magnitude are not realistic and do not meet USEPA’s guidance for reasonable assurance. Based on the water quality modeling, many of these streams will not be able to attain standards without some reduction in wildlife.

This is obviously an impractical action. Therefore, Virginia and EPA are not proposing the elimination of wildlife to allow for the attainment of water quality standards. While managing over-populations of wildlife remains an option to local stakeholders, the reduction of wildlife or changing a natural background condition

is not the intended goal of a TMDL. In such a case, after demonstrating that the source of fecal contamination is natural and uncontrollable by effluent limitations and BMPs, the state may decide to re-designate the stream's use for secondary contact recreation, or adopt site-specific criteria based on natural background levels of fecal bacteria.

The state must demonstrate that the source of fecal contamination is natural and uncontrollable by effluent limitations and BMPs through a Use Attainability Analysis (UAA) as described above. All site-specific criteria or designated use changes must be adopted as amendments to the water quality standards regulations. Watershed stakeholders and EPA will be able to provide comment during this process.

Based on the above, EPA and Virginia have developed a TMDL strategy to address the wildlife issue. The first step in this strategy is to develop an interim reduction goal as discussed in Chapter 5. The pollutant reductions for the interim goal are applied only to controllable, anthropogenic sources identified in the TMDL, setting aside any control strategies for wildlife. During the first implementation phase, all controllable sources would be reduced to the maximum extent practicable. Following completion of the first phase, VADEQ would re-assess water quality in the stream to determine if the water quality standard is attained. This effort will also evaluate if the modeling assumptions were correct. If water quality standards are not being met, a UAA may be initiated to reflect the presence of naturally high bacteria levels due to uncontrollable sources.

4.3 Description of Water Quality Monitoring

The VDH-DSS collects monthly monitoring data for fecal coliform bacteria within the Greenvale Creek system. Prior to the development of the TMDL, DSS collected data at 4 monitoring stations within Greenvale Creek. Based upon the results of this monitoring the status of the closure areas is reevaluated at a minimum annually, but normally semi-annually. The network of water quality monitoring stations for the Greenvale Creek estuary is shown in Figure 4-3. A summary of water quality for the 30 months preceding the TMDL study and data is shown in Table 4-3.

In order to facilitate the development of the TMDL, a subset of stations was selected for a special study to determine the sources of fecal coliform bacteria at these stations. This TMDL study collected bacterial samples at these stations on a monthly basis from (fill in dates) and used bacterial source tracking (BST) to estimate the source contributions to the Greenvale Creek.

BST is used to identify bacterial contributions from anthropogenic and background sources, such as wildlife, for which no precise loading value exists. The TMDL study BST analysis used the Antibiotic Resistance Approach (ARA), to attempt to partition the sources of fecal coliform to the water body. ARA uses fecal streptococcus or *Escherichia coli* (*E. Coli*) and patterns of antibiotic resistance for partitioning sources. The premise is that human, domestic animal, and wild animal fecal bacteria will have significantly different patterns of resistance to the battery of antibiotics used in this test. The ARA was used to estimate the percent loading per source category to the water.

The five major source categories that were used in the TMDL study were human, pets, livestock, wildlife and birds. A summary of the 12-month averages of source loads for the TMDL study stations is shown in Figure 4-4 and Table 4-4. The data developed for the Greenvale Creek watershed indicate that the contribution in most of the closure areas may be could comprised of as much as 25% human origin. The average percent contribution estimated for birds exceeded or equaled the estimated human contribution at seven of the ten stations. If the 12-month averages are averaged across all stations, then the sources with the highest estimated percent contribution are 1) Bird, 2) Human, 3) Wildlife, 4) Livestock, 5) Pets. The full BST report for the Greenvale Creek is located in Appendix B of the TMDL report.

It should be noted that BST methods are still being developed and there are substantial limitations of this study that should be considered when using the BST results. BST is not a quantitative tool and was only intended to be used to identify and estimate potential source loads to the study area. The accuracy of results using the ARA method is dependent on the size and relevance of a library of potential bacteria sources. Libraries are expensive and time consuming to build, and libraries created for surrounding areas proved inadequate. The small library used in this study could have contributed to unidentified sources for some samples. Another limitation of this study was the number of isolates tested in some samples. The water quality criterion for bacteria in shellfishing waters is very low. Although bacteria concentrations in Greenvale Creek violate this criterion, concentrations are still relatively low especially during dry weather. Numbers may not be precise in samples where less than 10 isolates were used to determine the source loading. Another concern is the use of *E. coli* as the test organism. Additional research has

shown that enterococci is a more effective indicator for BST (DEQ 2004).
References 1 through 3 (p. 11) document some of the problems with the existing
BST data.

Figure 4-3: Water Quality Monitoring Stations Maintained by VDH-DSS at the Time of TMDL Development

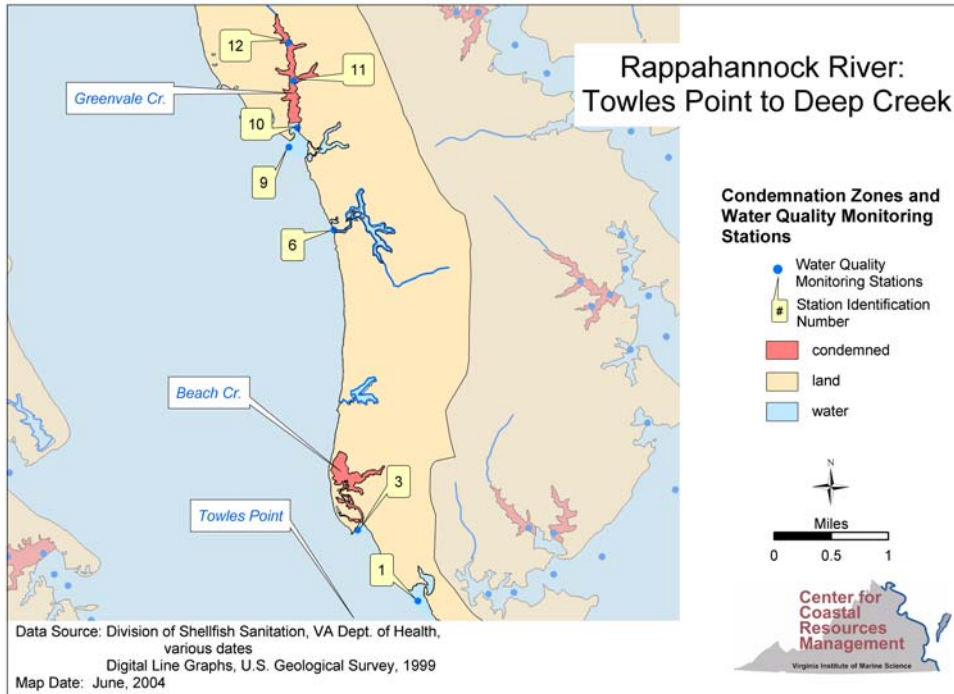


Figure 4.1

(DEQ insert)

Table 4-3: Water Quality Data Summary for Greenvale Creek from January 2001 to February 2003 (DEQ 2004)

Station	90th Percentile Preceding 30 Months	Water Quality Standard	Station Meets Standard?	Geometric Mean Preceding 30 months	Geometric Mean Standard	Station Meets Standard ?	Current Condemnation
Greenvale		49			14		
VDH/DSS							

Figure 4-4: Twelve-Month Averages for Source Loads to TMDL Study Stations in Broad and Greenvale Creeks (DEQ 2004)

Table 4-4: Twelve-Month and Cumulative Averages for Source Loads to BST Stations (DEQ 2004)

BST Station ID	% Bird	% Human	% Livestock	% Pets	% Wildlife
Cumulative Average					

4.4 Description of Water Quality Modeling

A simple modeling approach was used to develop the TMDL for Greenvale Creek. Personnel from EPA, Virginia DEQ, Virginia Department of Conservation and Recreation (DCR), Maryland Department of the Environment (MDE), Virginia DSS, Virginia Institute of Marine Sciences (VIMS), United States Geological Survey, Virginia Polytechnic Institute and State University, James Madison University, and Tetra Tech composed the shellfish TMDL workgroup to develop a procedure for developing TMDLs using a simple approach. The goal of the procedure is to use BST data, in conjunction with shoreline surveys and other data, to determine the potential sources of fecal coliform violations and to use ambient water quality data to determine the load reductions needed to attain the applicable criteria. The Greenvale watershed meets the criteria for using the simple modeling approach because of the following conditions:

- The watershed is hydrologically simple (i.e. limited flushing due to constriction at the mouth of Greenvale Creek).
- Land use is homogenous (mostly forest)
- Topography is relatively flat and runoff must pass through extensive buffers.

4.5 Description of Sources Considered

Both point and nonpoint sources of bacteria were considered in the Greenvale TMDL Study. Point source pollutant loads are discharged at a specific location from pipes, outfalls, and conveyance channels from municipal wastewater treatment plants, storm water outfalls, or industrial waste facilities. Nonpoint source pollutants originate from multiple sources over a relatively large area, and can be divided into source activities related to either land or water use including failing septic tanks, improper animal-keeping practices, forest practices, and urban and rural runoff. In addition to the bacterial source tracking discussed in the previous sections, the DEQ Point Source Inventory and DSS Shoreline Survey were used to determine point sources and principal non-point sources such as failing septic systems and farm based non-point source operations.

4.5.1 Point Source Contributions

There are no point sources within the Greenvale Creek Watershed.

4.5.2 Non-Point Source Contributions

Non-point source contributions to the bacterial levels in the Greenvale system result from both anthropogenic and natural sources. Potential human activities which may contribute to the bacterial pollution include failing septic systems and their associated drain fields, sanitary discharges from moored or transiting vessels, improper pet waste disposal practices and the land-application of municipal sewage sludge. Natural sources include the abundance of migratory and resident species of birds along with the natural mammalian populations which are expected to occupy the 30% of the watershed area cited as public, agricultural, parks, marshland or undeveloped. The land-application of poultry litter also imports fecal coliform bacteria into the watershed.

All homes and businesses within the Greenvale Creek Watershed uses septic systems and have drain fields for sanitary waste treatment. Any malfunction within these disposal systems may act as a contributing source of fecal coliform to the Bay. The latest Department of Shellfish Sanitation (DSS) shoreline sanitary survey for Greenvale Creek before completion of the TMDL was conducted from 2001 and identified five potential deficiencies related to septic systems.

4.6 TMDL Load Reductions and Allocation Results

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

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

Total Allowable loads were calculated by multiplying the applicable bacteria criteria by the volume of water. Receiving water volumes were calculated using 1-meter depth profiles from the National Elevation Dataset (NED). The waste load allocation portion of this load refers to the portion of the pollutant load that is delivered to the waterbody from wastewater treatment plants or storm water management systems. In an urbanized system like the Greenvale Creek Watershed where there are no point source discharges from wastewater treatment plants, the WLA is approximate. It can be, and was, equated to the water that can be expected to be delivered to the waterbody through the storm water management system. The storm water management system is designed to collect water from the impervious areas of the watershed, so the portion of the total load allocated as the waste load can be equated to the average amount of impervious area within the watershed. Averaging the percent impervious area by land use, the Greenvale Creek Watershed has an average impervious area of less than 2 percent.

The load reduction needed to meet water quality standards is the difference between the total allowable load and the current load. The current loadings for the Greenvale Creek Watershed were determined by reviewing the most recent 30-months of data overlapping the end of the TMDL study in August of 200x. Because all the stations in the Greenvale Creek Watershed reflect a condition of noncompliance with the water quality standard for bacteria in shellfish waters, the water quality data were averaged across all stations for Greenvale Creek. This treats high and low values equally and provides a target that can be easily comprehended and uniformly implemented while retaining the necessary protection for the affected waters.

Existing loadings were calculated using the station averages for both the geometric mean and the 90th percentile. The geometric mean and 90th percentile loads for each shellfish area averaged across all monitoring stations was determined by multiplying the average bacteria count, based on the most recent 30-month period of record, by the volume of the water. A comparison of the geometric mean data and the 90th percentile data for the last 30 months shows that the 90th percentile

data is the more critical condition. The 90th percentile criterion is the criteria most frequently and severely exceeded, and it is reductions in these bacterial loadings that will yield water quality improvements. Therefore the 90th percentile loading was combined with the results of the BST to allocate source contributions and establish load reduction targets among the various contributing sources.

The BST data was used to estimate the percent loading for each of the major source categories and is used to determine where load reductions are needed. Because no seasonal differences between sources were identified, the percent loading per source was averaged over the 12-month period. The percent loading by source was multiplied by the 90th percentile load, to determine the load by source. The percent reduction needed to attain the water quality standard was allocated to each source category. This method ensures that all sources and loadings are identified and quantified via the BST and mathematical calculations, seasonal variability is addressed, and critical conditions are identified. The allocations and percent reductions by source for Greenvale Creek. As mentioned in Section 4.3, bacterial source tracking is a relatively new tool with limitations, and results are suggestive only. Additional studies are planned or proposed for smaller areas within the watershed to further define these loadings.

Table 4-5: Total Load Allocations and Percent Reductions for Greenvale Creek (DEQ 2004)

GROWING AREA 22, CLOSURE 94	BST Results: Percent of total load	Current Load	Waste Load Allocation	Load Allocation	Total Load Allocation	Percent Reduction
Bird						
Wildlife						
Human						
Pets						
Livestock						
Total						

5.0 ADDITIONAL INFORMATION

No additional information is available since completion of G-TMDL on any significant land use changes, additional shellfish condemnation areas, additional water quality monitoring sites, or updated shoreline survey or water quality monitoring data.

6.0 PUBLIC PARTICIPATION

An essential step in implementing a TMDL is the input from a broad range of individuals, agencies, organizations and businesses because of their interest and familiarity with local water quality needs and conditions. Public participation facilitates dialogue between local stakeholders and government agencies to commit resources to TMDL implementation, such as funding and technical support. Community members are best suited to identify and resolve sources of water quality problems. In order to engage the public in the development of the TMDL Implementation Plan for the Greenvale Creek Watershed, two public meetings were held in Fall of 2008 and the Winter of 2009. Lancaster County, other agencies, and community groups are pursuing a number of activities independently of the TMDL Implementation Plan Process. Where appropriate, these initiatives were incorporated into the TMDL Implementation Plan process.

A work group was established to guide development of the TMDL Implementation Plan. The work group met approximately on a monthly basis to review background materials and draft elements of the implementation plan. The work group was composed of representatives of city departments and state and federal agencies.

- Lancaster County – Departments of Planning, Public Works, Public Utilities, Parks and Recreation, Agriculture
- Virginia Department of Environmental Quality – Water Division and Virginia Coastal Program
- Virginia Department of Conservation and Recreation – Divisions of State Parks, Chesapeake Bay Local Assistance and Soil and Water Conservation
- Virginia Marine Resources Commission
- Virginia Department of Health
- Virginia Institute of Marine Science
- Virginia Department of Game and Inland Fisheries
- Friends of Lancaster County
- Soil and Water Conservation District
- U.S. Army (USACE)

7.0 IMPLEMENTATION OPTIONS

Implementation of this TMDL will contribute to the on-going water quality improvement efforts aimed at restoring water quality in Chesapeake Bay. In general, reduction strategies will be implemented in a staged process that first addresses sources with the largest impact on water quality. In Greenvale Creek the focus of implementation will be on reducing bacterial contamination due to humans. In all areas, the focus will be on reducing pollution due to septic system failures and recreational boating. Lancaster County's septic system inspection/pump-out enforcement will improve the Greenvale Creek Watershed.

7.1 Linking the TMDL to Implementation

The Greenvale Shellfishing TMDL was approved by EPA in 2008, but relied largely on data collected prior to 2006. Water quality monitoring of the system has been ongoing and several studies have been undertaken since the completion of the TMDL to better understand the hydrodynamics of the System as well as the sources of fecal coliform loading. Because the BST data were used to develop the waste load and load allocations for the study area, they were also used as guidance for developing management actions. It is important to consider both the TMDL as well as the additional information obtained since its completion when developing the implementation actions that may improve water quality within the Greenvale System. It should be noted that due to uncertainty, the allocations contained in the TMDL study should, but may not, result in attainment of the fecal coliform standard for shellfishing waters in Greenvale Creek. The success of the management actions proposed in this document will be determined by ambient water quality data rather than attainment of load allocations.

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

The feasibility of attaining the water quality criterion for shellfishing must also be considered. Given the anthropogenic changes throughout the watershed, the history of shellfish closures in the Greenvale Creek and the amount of fecal coliform

attributed to wildlife in the TMDL, the management actions proposed in this implementation plan may prove to be insufficient to open the headwaters of the Greenvale Creek to shellfishing. Therefore, resources will first be focused on implementing management options in areas where they will have the greatest impact on water quality improvements. Because water quality data collected by VDH-DSS indicates the mouth of Greenvale Creek has the greatest potential to achieve the bacteria criterion, Lancaster County is currently focusing its efforts to improve the hydrodynamics by asking USACE to dredge the mouth of the creek.

7.2 Identifying Implementation Actions

The implementation actions discussed below were developed to reduce human, pet and livestock sources of bacteria loading to Greenvale Creek. These actions will be implemented in two phases as identified in Table 7-1. Phase I actions are those that have already been initiated or are scheduled for completion within five years. Phase II activities are those that are planned for implementation within the next five years but may not have approved funding sources yet. Phase III actions may require regulatory changes, but they may be implemented as necessary if Phase I and Phase II actions do not significantly improve water quality within the study area. Activities identified as ongoing are those that have already been implemented and are expected to continue regardless of the level of bacteria within the Greenvale System. If all these actions prove to be insufficient to meet the water quality criterion for shellfishing in all or parts of the Greenvale system, then the designation of these waters for unrestricted shellfishing use may need to be further evaluated.

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

Table 7-1 Management Options for Implementation of Greenvale TMDL

Management Category	Management Option	Development Phase
Agricultural BMPs	Rooftop Runoff Collection	Phase I
	Animal Waste Management Plan	Phase I
	Removal of farm animals	complete
Septic system Improvements		
	Enforcement of Lancaster County Septic Tank Pump Out and Inspection Regulatory Requirements	Ongoing
Stormwater Programs	Rain Barrel use	Phase I
Boating Programs	Establishment of No Discharge Zone	Phase I
	Development of Clean Marina Certification Program	Phase I
	creation of "No Wake Zone" for all of Greenvale Creek	Phase II
Pet Waste Programs	Pet Waste disposal	Ongoing
Erosion and Sediment Control	Enforcement of Lancaster County Erosion and Sediment Control Ordinance	Ongoing
Aquatic Resource Restoration	Riparian Buffer Enhancement Plan	Ongoing
	Oyster Heritage Program	Ongoing
	USACE Greenvale Creek Environmental Restoration Project	Phase I
	USACE Chesapeake Bay Oyster Restoration	Phase I
	Living Shoreline Program	Ongoing
Education Programs	Boater Education Program	Phase I
	Regional Education Programs (HRWET, HRSTORM, HRCLEAN, HRFOG)	Ongoing
	"Scoop the Poop" Program	Ongoing
	Lancaster County contract with Greenvale Creek 2008 for Public Awareness Programs	Phase I
	Greenvale Creek Watershed Markers	Phase I
	Education for Livestock Owners	Phase II
	Lancaster County Septic Tank Pump Out and Inspection Information Program	Ongoing
	Wildlife Feeding Education Program	Phase I
Land Use Management	Lancaster County Preservation Area Ordinance	Ongoing
	Wetlands and Waterfront Operations Program	Ongoing

Management Category	Management Option	Development Phase
Wildlife Contribution Controls	Lancaster County Ordinance to Prevent Feeding of Waterfowl	Phase II
	Evaluate/Inventory Wildlife Populations within the Watershed	Phase III

7.2.1 Agricultural BMPs

Bacterial Source Tracking (BST) suggest that approximately 9 percent of the bacterial load in the Greenvale Creek is attributable to livestock. The TMDL calls for a 100 percent reduction in bacteria inputs from livestock. Currently, there are no identified sources of livestock within the Greenvale Creek Watershed boundaries.

7.2.2 Septic System Inspections/Pumpouts

The TMDL calls for 100 percent reduction in bacteria loading due to human sources to the Greenvale Creek. Sources of human bacteria loading to waterbodies include failing septic systems and discharge from boats.

Lancaster County has enacted a proactive septic system maintenance program. The program will be fully implemented by June 2009. All septic systems in the county will be inspected and/or pumped prior to that time.

The number of failing septic systems can be reduced through education on septic tank pump outs and the septic system repair and replacement programs conducted by Lancaster County. Virginia Department of Health will conduct septic surveys to identify areas where malfunctioning septic systems may be an issue.

7.2.3 Stormwater Programs

Rain Barrel use is encouraged, but short of mandated discharge into infiltration trenches etc. within the RPA is not likely to have any significant effect in reducing bacterial loads to Greenvale Creek.

7.2.4 Boating Programs

The TMDL indicates that recreational boating activity may be a significant source of human waste bacterial loading. In order to reach the 100 percent reduction targets for human waste in Greenvale Creek, actions will be taken to reduce bacteria loadings due to recreational boating.

Section 312 of the Clean Water Act requires boats with installed toilets to also have Marine Sanitation Devices (MSDs). Type I and II MSDs are treat and discharge units, while Type III MSDs are holding tanks that must be pumped out at pump out facilities. State law (9 VAC 25-71) prohibits the discharge of raw sewage from boats, holding tanks, or portable toilets. Federal law prohibits a state from adopting regulations regarding MSDs that are more stringent than federal regulations, but it allows a state to petition EPA for designation of No Discharge Zones (NDZs), where all sewage discharges, treated or untreated, are banned. The state must demonstrate that the particular water body requires special protection and that there are adequate pump out facilities in the area, since boat sewage wastes in NDZs would have to be held until pumped out.

Lancaster County will request that the Greenvale Creek Watershed be designated by the Virginia Department of Environmental Quality and the Environmental Protection Agency as a No Discharge Zone (NDZ). This designation will make it illegal to discharge boat sewage within the Greenvale Creek Watershed. There are adequate pump out facilities and enforcement capabilities to support a NDZ in Greenvale Creek. In order to ensure that discharge from boats is controlled, and is uniform throughout Chesapeake Bay, Virginia law should be changed to conform to existing law in Maryland.

In order to address shoreline erosion and re-suspension of bacteria laden sediment, Lancaster County is planning to request a “No Wake Zone” encompassing all of Greenvale Creek to reduce shoreline erosion in this sensitive area.

7.2.5 Pet Waste Programs

The TMDL calls for a 100 percent reduction in bacteria due to pet waste for Greenvale Creek. This reduction will be achieved primarily through public education campaigns discussed in Section 7.2.8.

7.2.6 Erosion and Sedimentation BMPs

Erosion and sedimentation control measures may indirectly reduce the bacteria loading to waterbodies. Bacteria can cling to small sediments, so erosion prevention measures should also serve to reduce bacteria loading. Historically, Lancaster County’s main generator of sediment pollution was from construction sites and other development and agriculture, but currently shoreline erosion is the leading generator of sediment within the Greenvale Creek Watershed. The creation of Greenvale Creek as a “No Wake Zone” will mitigate this problem.

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

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

7.2.7 Aquatic Resource Restoration

The goal of this implementation plan is to reduce fecal coliform bacteria concentrations to enable the safe consumption of shellfish within designated waters. However, good water quality and a healthy aquatic ecosystem are essential in order to maintain an abundant shellfish population within the Greenvale Creek Watershed. Lancaster County is currently working with the Corps of Engineers and the Virginia Institute of Marine Sciences to develop a restoration plan for the Greenvale Creek. In addition to the development of this plan, there are multiple aquatic resource restoration activities underway within Lancaster County that will help establish a healthy shellfish community in keeping with the goals of the TMDL and implementation plan.

Lancaster County is an active partner in the Oyster Heritage Program that was initiated in 1999 by the Virginia Marine Resources Commission and the Virginia Coastal Program at the Department of Environmental Quality with the goal of restoring oyster reefs and Virginia's native oyster. To date, one oyster reef have been created in Greenvale Creek with plans to establish more reefs. Educational materials to teach the public about the benefits of oysters being brought back into the Greenvale Creek are on display at the Virginia Aquarium and Marine Science Center and the Virginia Institute of Marine Science.

Lancaster County encourages the preservation and restoration of critical shoreline habitats. Living shorelines emphasize the use of natural materials including marsh plantings, shrubs and trees, low profile breakwaters, strategically placed organic material, and other techniques that recreate the natural functions of a shoreline ecosystem. Riparian forest buffers provide canopy shade and stream habitat, filter runoff, and uptake nutrients.

7.2.8 Education Programs

Public education and outreach are important tools for reducing bacterial pollution due to pet waste, stormwater runoff, recreational boating, agricultural practices, and septic system malfunction. Rain Barrel use is encouraged in Lancaster County.

Congress passed the Clean Vessel Act in 1992 (CVA) to help reduce pollution from vessel sewage discharges. The Act established a five-year federal grant program administered by the U.S. Fish and Wildlife Service and authorized \$40 million from the Sport Fish Restoration Account of the Aquatic Resources Trust Fund for use by the States. Federal funds can constitute up to 75% of all approved projects with the remaining funds provided by the States or marinas. Reauthorized in 1998, Congress extended the pumpout grant program through 2003, providing \$50 million to continue to provide alternatives to overboard disposal of recreational boater sewage.

Since 1996, VDH and HRSD have partnered in an annual boater education program funded through the Clean Vessel Act. This program provides boater education concentrating on the proper disposal of on-board sanitary wastes. It also provides free sanitary holding tank pump-outs as a demonstration of ease and effectiveness. Operating with student interns, the activity takes place on weekends during the primary boating season from Memorial Day to Labor Day.

The Northern Neck SWCD has established an Urban Programs Committee to become more actively involved in educational issues and technical assistance to residents of the northern part of Lancaster County, including the Greenvale Creek

Watershed. In the future, the SWCD will work with Lancaster County to implement an education program for equine and livestock facility owners within the County.

Although the first phases of the implementation plan do not directly address bacteria attributed to wildlife, there are a few management actions that can be implemented to reduce human causes of increased wildlife populations. A wildlife feeding education program will be initiated to discourage residents from feeding waterfowl. The feeding of waterfowl can cause local populations to increase and discourage migration in Canada Geese. If the education program is not sufficient, then a County ordinance may be developed to prevent feeding of waterfowl.

Table 7-2: Regional Education Programs available in Lancaster County

Regional Education Program	Description of Program	Program Web Address
???	HR CLEAN educates the region on the techniques of recycling, waste minimization, and the benefits of beautification and litter prevention.	www.Lancova.com
???	HR FOG educates the region on the proper techniques for disposing of oils and grease. The primary audience will be restaurants and homeowners will be a secondary audience.	
???	HR STORM educates the region on the techniques of litter prevention, and the need to keep our storm water clean for the health of area waterways.	
???	The Hampton Roads Water Efficiency Team educates the region on the techniques of water conservation, raising public awareness of the region's water supplies, and promotes efficiency of water use.	

7.2.9 Land Use Management

Lancaster County has several programs that serve to manage development and minimize its environmental impact. Continuation of these programs will serve to protect critical habitats within the Greenvale Creek Watershed and may be important in reducing the amount of bacteria entering the Greenvale Creek system.

The Virginia General Assembly adopted the Chesapeake Bay Preservation Act in 1988 and required all localities in Tidewater Virginia to implement local water quality measures by utilizing and developing land in ways that minimize impacts on water quality. Lancaster County responded to this requirement by adopting the Chesapeake Bay Preservation Area Ordinance (CBPAO) in January of 1991 (???? Exact date?). The CBPAO affects all properties in the County. The purpose of the CBPAO is to protect existing high quality waters, prevent an increase in pollution

and to restore state waters to a condition that permits all reasonable public uses and supports the growth of healthy aquatic life. This is accomplished by regulating development practices in the watershed. The most highly regulated areas are buffers called Resource Protection Areas (RPAs). RPAs include tidal wetlands, non-tidal wetlands, tidal shores, highly erodible soils, and a variable width buffer area not less than one hundred feet in width that is adjacent to and landward of these areas. Buffer areas are also located along both sides of any water body with recurrent flow. All of the other land in Lancaster County is labeled as Resource Management Areas, and protects the boundaries of the RPA.

7.2.10 Wildlife Contribution Controls

The Greenvale Creek TMDL Study suggested that wildlife contributions to Greenvale Creek are significant. As discussed in previous sections, the focus of this implementation plan is to reduce anthropogenic sources of bacteria. However, Lancaster County is considering developing an ordinance that will prohibit the feeding of waterfowl. The County believes this ordinance will discourage undesirable numbers of waterfowl from using habitats throughout the Greenvale Creek Watershed and reduce the amount of waterfowl fecal matter entering the receiving waters of the Greenvale Creek Watershed.

7.3 Implementation Costs and Benefits

The primary benefit of the implementation of the management actions described in this IP is the reduction of bacteria levels in the Greenvale Creek. The programs and actions contained within this IP will serve to reduce the anthropogenic sources of bacteria within the Greenvale Creek Watershed. Because many of the programs mentioned in this report also serve purposes other than to reduce bacteria, and they cover areas larger than the Greenvale Creek Watershed, the costs of reducing bacteria levels in the Greenvale Creek Watershed are difficult to estimate. Estimated costs for proposed management actions and programs are outlined in Table 7-3.

Table 7-3: Estimated Costs of Management Options

Management Category	Management Option	Estimated Initial Costs¹	Estimated Annual Maintenance Costs¹
Agricultural BMPs	Rooftop Runoff Collection for Barns and Horse Stables		
	Equine Facility Inventory for Lancaster County		
	Equine Facility Pasture Management for Lancaster County		
Septic System Improvements*	Find and Fix Program		
	Enforcement of Lancaster County Septic Tank Pump Out and Inspection Regulatory Requirements		
Stormwater Programs	Rain Barrels		
Boating Programs	Establishment of No Discharge Zone		
	Development of Clean Marina Certification Program		
	Request "No Wake Zone"		
Pet Waste Programs	Pet Waste Ordinance		
	Enforcement of Pet Waste Ordinance		
Erosion and Sediment Control	Enforcement of Lancaster County Erosion and Sediment Control Ordinance		
Aquatic Resource Restoration	Riparian Buffer Enhancement Plan		
	Oyster Heritage Program		
	USACE Greenvale Creek Environmental Dredging Project		
	Living Shoreline Program		
Education Programs	Boater Education Program		
	Regional Education Programs		
	"Scoop the Poop" Program		
	County Contract with Greenvale Creek 2009 for Public Awareness Programs		
	Wildlife Feeding Education Program		
	Lancaster County Septic Tank Pump Out and Inspection Information Program		

Management Category	Management Option	Estimated Initial Costs¹	Estimated Annual Maintenance Costs¹
Land Use Management	Lancaster County Preservation Area Ordinance		
	Wetlands and Waterfront Operations Program		
	Habitat Enhancement Committee		
Wildlife Contribution Controls	Evaluate/Inventory Wildlife Populations within the Watershed		
TOTALS			

* Includes new construction, repair, replacement and rehabilitation of septic systems.

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

8.0 MEASURABLE GOALS AND MILESTONES

8.1 Establishing Goals

8.1.1 TMDL Goals

- Reduce fecal bacteria impairment in order to meet the Total Maximum Daily Load and established water quality standards to the maximum extent economically achievable.
- Interim Goal: Reduce fecal bacteria load in order to meet water quality standards for primary contact recreation to the maximum extent economically achievable.

8.1.2 Related Watershed Management Goals

- Restore water quality to the level necessary to support shellfish propagation for water quality benefits.
- Increase the area open for direct marketing of shellfish within Greenvale Creek.
- Restore water quality in the to a level necessary to support direct marketing of shellfish.

8.2 Establishing a Timeline and Milestones for Implementation

As described in previous sections, the actions proposed in this implementation will be implemented in phases. A schedule of Phase I activities is contained in Table 8-1, and phase II and III actions will be implemented as actions prove necessary and funding becomes available. The completion of management actions will be tracked in program annual reports.

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

Management Category	Management Option	Projected Start Date	Projected Completion Date
Agricultural BMPs	Rooftop Runoff Collection		
	Animal Waste Management Plan		
	Equine Facility Inventory for Lancaster County		
	Equine Facility Pasture Management for Lancaster County		
Septic System Improvements	Find and Fix Program		
	Enforcement of Lancaster County Septic Tank Pump Out and Inspection Regulatory Requirements		
Stormwater Programs	Rain Barrels		
Boating Programs	Establishment of No Discharge Zone		
	Creat Geenvale Creek "No Wake Zone"		
Pet Waste Programs	Pet Waste Ordinance		
Erosion and Sediment Control	Enforcement of Lancaster County Erosion and Sediment Control Ordinance		
Aquatic Resource Restoration	USACE Greenvale Creek Environmental Restoration Project		
	USACE Chesapeake Bay Oyster Restoration Study		
	Riparian Buffer Enhancement Plan		
	Oyster Heritage Program		
	Living Shoreline Program		
Education Programs	Boater Education Program		
	Regional Education Programs		
	"Scoop the Poop" Program		
	Wildlife Feeding Education Program		
	Lancaster County Septic Tank Pump Out and Inspection Information Program		
Land Use Management	Chesapeake Bay Preservation Area Ordinance		
	Wetlands and Waterfront Operations Program		

8.3 Developing Tracking and Monitoring Plans

At this time, no additional fecal coliform monitoring plan is being developed for the Greenvale Creek Watershed. Several agencies are currently collecting water quality data throughout the Greenvale system. As long as these efforts continue, Lancaster County does not see a need for additional monitoring. However, if existing monitoring proves to be insufficient in the future or suggests that additional monitoring is necessary, then Lancaster County and DEQ may adapt the current water quality monitoring plan.

Only water quality data collected by the Virginia Department of Health can be used to determine condemnation or opening of a designated shellfishing area. The Virginia Department of Environmental Quality also collects bacteria data within the Greenvale Creek Watershed as part of its surface water quality monitoring, but DEQ is phasing out fecal coliform monitoring in favor of enterococci and *E. coli*. Ambient water quality monitoring of fecal coliform concentrations as outlined in Section 4.3 will also continue to be performed by the VDH-DSS.

Figure 8-1: Water Quality Monitoring Stations in the Greenvale Creek Watershed

See figure 4.3 or get from DEQ.

9.0 STAKEHOLDERS ROLES AND RESPONSIBILITIES

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

9.1 Federal

9.1.1 United States Environmental Protection Agency

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

9.1.2 United States Army

The USACE will dredge Greenvale Creek in order to mitigate circulation problems and enhance the possibility of meeting the goals of the IP in Greenvale Creek.

9.2 State

9.2.1 Department of Environmental Quality (DEQ)

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

lakes, and estuaries. The reduction tools are being expanded beyond the permit process to include a variety of voluntary strategies and BMPs.

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

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

9.2.2 Department of Conservation and Recreation (DCR)

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

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

9.2.3 Virginia Department of Health (VDH)

The VDH is responsible for classifying shellfish growing waters and monitoring the waters for fecal coliform bacteria. Also, the VDH conducts shoreline surveys to

determine potential sources of contamination. This information is evaluated by the VDH to determine areas that are open or restricted for shellfish harvesting for direct marketing. DEQ places the restricted areas on the 303(d) List for TMDL development.

9.2.4 Soil and Water Conservation District

The Northern Neck Soil and Water Conservation (SWCD) is one of 47 districts in Virginia. Districts are subdivisions of state government which coordinate local natural resource protection programs (section 10.1-50 of the code of VA, 1950, as amended). The Northern Neck SWCD provides local leadership in conservation of soil, water, and related natural resources in the cities of Lancaster County and Chesapeake. Some programs available through the district include: cost-share assistance to agricultural producers who install conservation practices on their farms as well as a wide variety of educational programs that cater to school children and local organizations.

9.2.5 Department of Game of Inland Fisheries

The Virginia Department of Game and Inland Fisheries' mission is to manage Virginia's wildlife and inland fish to maintain optimum populations of all species to serve the needs of the Commonwealth; to provide opportunity for all to enjoy wildlife, inland fish, boating and related outdoor recreation; to promote safety for persons and property in connection with boating, hunting and fishing.

9.2.6 Virginia Marine Resource Commission

The Virginia Marine Resources Commission continues to be a strong force working to protect the Chesapeake Bay and its inhabitants. Two important divisions within the VMCR are the Fisheries and Habitat Management Divisions.

The Fisheries Management Division strives to provide long-term availability of Virginia's finfish and shellfish resources. By developing management plans for both commercial and recreational uses and by tracking fishery stock and its condition, this division provides an important monitoring system that helps with future growth. The fisheries management division also participates in all federal and local government organizations within their areas of responsibility.

The Habitat Management Division conducts a permit program to preserve and protect subaqueous habitat, tidal wetlands and coastal primary sand dunes. These lands are vital in keeping Virginia's water clean and for use as spawning and

nursery areas for marine life. The Habitat Management Division also helps local governments oversee wetland programs.

The Conservation and Replenishment Department also operates under the direction of the VMRC. This department focuses on the management of Virginia's public oyster beds. The Conservation and Replenishment Department's restoration activities include the spreading of cultch as oyster settling substrate, dredging to bring back old oyster beds, oyster reef creation and the movement of oysters from seed to grow-out areas. All of these projects are monitored.

VMRC is also responsible for the Virginia Marine Patrol program. They patrol the waters in the Greenvale Creek Watershed, as well as other waterways in Virginia, providing inspections of harvest methods, the sale of commercial licenses, as well as prosecuting illegal acts from point source pollution to the disregarding of no wake signs.

9.3 Lancaster County

As discussed throughout this document, Lancaster County has an important role in improving water quality within the Greenvale Creek Watershed and throughout Lancaster County. Because the Greenvale Creek watershed lies completely within the boundaries of Lancaster County, the County has jurisdiction over all local projects within the watershed boundaries. The County will continue public programs to treat stormwater runoff, prevent septic system malfunctions, and manage land use development to the maximum extent practicable and as required by law. Specific actions that Lancaster County will implement in order to reduce fecal coliform concentrations within the shellfishing waters of Greenvale Creek's Watershed are outlined in Tables 7-1 and 9-1.

9.4 Private Sector, Non-governmental, and Citizen Groups

In the Greenvale Creek Watershed two non-governmental agencies could play a significant role in improving water quality. These two groups, Greenvale Creek 2009 and the Chesapeake Bay Foundation, will be active in the watershed and are involved in several of the implementation actions that involve public awareness and oyster restoration. In addition to these two groups, the Alliance for the Chesapeake Bay has an interest in the Greenvale Creek Watershed.

9.4.1 Greenvale Creek 2009

Several Lancaster County residents formed Greenvale Creek 2009 in 2008 when they became very concerned about the state of the Greenvale Creek. The organization's primary goal is a clean and healthy Greenvale Creek. Long-term, they want to see water quality improve substantially and to restore a native oyster that can be safely and legally consumed.

They plan on carrying out their goals by identifying and reducing sources of contamination in the Greenvale Creek Watershed, reducing nutrient, sediment and chemical runoff, and restoring lost habitats such as oyster reefs, salt marshes and other buffers that help filter polluted runoff and protect the creek and its marine life. These goals will be implemented by seeding the Creek with xxx,000 water-filtering oysters, promoting a greater public awareness of the Creek's problems, increasing the availability of programs and resources for homeowners on runoff issues, fostering partnerships that apply public and private resources to reduce pollution in the creek and by investing local, state, and federal government in the effort to restore the Greenvale Creek.

9.4.2 Chesapeake Bay Foundation

The Chesapeake Bay Foundation is the largest and oldest conservation organization working to "Save the Bay" in the Chesapeake Bay Watershed. The foundation's focus is to reduce pollution, improve fisheries and protect and restore natural resources. Established in 1967, CBF is a non-profit organization with 95% of its funding privately raised. CBF works in the following three specific areas to protect and restore the Bay: Environmental Education, Environmental Protection (Advocacy), and Restoration.

CBF staff, its members, and volunteers protect the Bay's natural resources from pollution and other harmful activities by fighting for strong and effective laws and regulations, primarily on the state and local level. They work cooperatively with government, business, and citizens in partnerships when possible. When necessary, CBF uses legal means to force compliance with existing laws. Where sustainable, CBF restores the Bay's essential habitats and filtering mechanisms, such as forests, wetlands, underwater grasses, and oysters, through a variety of hands-on projects.

9.4.3 Alliance for the Chesapeake Bay

This group performs monitoring activities on the tributaries to the Bay through the Chesapeake Bay Citizen Monitoring Program. This program has been active in

Maryland, Pennsylvania, and Virginia since 1985. The citizen monitors check dissolved oxygen, pH, salinity, Secchi and water depth, and air and water temperature on a weekly basis. More recently, the program has initiated sampling of nutrients and SAV (submerged aquatic vegetation). The data they collect is utilized by DEQ to evaluate water quality throughout the watershed.

Table 9-1: Management Actions and Responsible Stakeholders

Management Category	Management Option	Stakeholders Responsible
Agricultural BMPs	Rain barrel use	Lancaster County
	Animal Waste Management Plan	Lancaster County
Septic System Improvements		
	Find and Fix Program	Lancaster County/DSS/VDH
	Enforcement of Lancaster County Septic Tank Pump Out and Inspection Regulatory Requirements	Lancaster County
Boating Programs	Establishment of No Discharge Zone	Lancaster County/DEQ
	Creation of Greenvale Creek "No Wake Zone"	Lancaster County
Pet Waste Programs	Pet Waste Ordinance	Lancaster County
	Enforcement of Pet Waste Ordinance	Lancaster County
Erosion and Sediment Control	Enforcement of Lancaster County Erosion and Sediment Control Ordinance	Lancaster County
Aquatic Resource Restoration	Riparian Buffer maintenance	Lancaster County
	Oyster Heritage Program	Lancaster County
	Greenvale Creek dredging	US Army Corps of Engineers
	Chesapeake Bay Oyster Restoration Study	US Army Corps of Engineers
	Living Shoreline Program	Lancaster County
Education Programs	Boater Education Program	DEQ
	"Scoop the Poop" Program	Lancaster County and DEQ
	Education for Livestock Control	Lancaster County in cooperation with State agencies
	Septic Tank Pump Out and Inspection Information Program	Lancaster County
		Lancaster County
Land Use Management	Lancaster County Preservation Area Ordinance	Lancaster County
		Lancaster County
		Lancaster County
Wildlife Contribution Controls	Encourage hunting	Lancaster County
	Evaluate/Inventory Wildlife Populations within the Watershed	Lancaster County and Virginia DGIF

10.0 RELATED WATERSHED PLANNING EFFORTS

Lancaster County may develop a watershed management plan for Lancaster County watersheds that includes the sections not meeting the water quality standards for bacteria in shellfishing waters. The management actions and programs described in this Implementation Plan can form the core of the developing watershed management plan.

Lancaster County is also working with the US Army Corps of Engineers (USACE) to improve the hydrodynamic action within Greenvale Creek. This will be accomplished through the dredging of Greenvale Creek.

Table 10-1: Waterbodies on the 303(d) List within or adjacent to the Greenvale Creek Watershed

TMDL ID	Waterbody Name	Impairment	Initial List Date	TMDL Development Date	County	Size
	All	Fecal Coliform & Enterococci (2004), Dissolved Oxygen	200x		Lancaster County	x.xx Mi ²
	Beech Creek	Fecal Coliform	200?		Lancaster County	??? Mi ²
		Dissolved Oxygen, Fecal Coliform & Enterococci (2004)	1994		Lancaster County	0.11 Mi ²
		Dissolved Oxygen, Chloride, Fecal Coliform	1998		Lancaster County	3.1 Mi.
		Chloride	2004		Lancaster County	3.71 Mi.
		Dissolved Oxygen, Fecal Coliform & Enterococci	1996		Lancaster County	0.03 Mi ²
	Belmont Creek	Fecal Coliform	19??		Lancaster County	??? Mi ²
		Fecal Coliform & Enterococci	2004		Lancaster County	0.002 Mi ²

10.1 Adjacent Impaired Watersheds

As all watersheds on the Northern Neck have similar characteristics and impairments, this Implementation Plan applies universally.

11.0 POTENTIAL FUNDING SOURCES

State

Virginia Agricultural Best Management Practices
Cost-Share Program
Virginia Agricultural Best Management Practices
Tax Credit Program
Virginia Agricultural Best Management Practices
Loan Program
Virginia Forest Stewardship Program
Virginia Small Business Environmental Assistance Fund Loan Program
Virginia Resource Authority
Water Quality Improvement Fund
Clean Water Act Revolving Loan Program

Federal

EPA 319 Funds
USDA Conservation Reserve Program (CRP)
USDA Conservation Reserve Enhancement Program (CREP)
USDA Environmental Quality Incentives Program (EQIP)
USDA Forest Incentive Program (FIP)
USDA Watershed and creek Basin Planning and Installation Public Law 83-566
(PL566)
USDA Wildlife Habitat Incentive Program (WHIP)
USDA Wetland Reserve Program (WRP)
US Fish and Wildlife Service Private Stewardship Program
US Fish and Wildlife Service Conservation Grants

Local or Regional

Lancaster County
Lancaster County Capital Improvement Program
Chesapeake Bay Small Watershed Grants Program
Wetlands and Chesapeake Bay Civil Penalties Fund
Lancaster County Oyster Heritage Trust Fund
Hampton Roads Environmental Education Program Mini-Grants

Landowner Contributions and Matching Funds

The Virginia and federal cost-share assistance programs require a cost-share match, which is generally 25%.

Private Foundations, Non-Profit Organizations, Businesses

National Fish and Wildlife Foundation

Chesapeake Bay Foundation

11.1 Requirements for Section 319 Fund Eligibility

EPA develops guidelines that describe the process and criteria to be used to award CWA Section 319 nonpoint source grants to States. The most recent guidance, “Nonpoint Source Program and Grants Guidelines for States and Territories,” was effective as of October 23, 2003, and identifies the following nine elements that must be included in the IP to meet the 319 requirements:

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

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