TMDL Report for Chesapeake Bay Shellfish Waters: Ware Creek, Taskinas Creek, and Skimino Creek Bacterial Impairments in York, James City, and New Kent Counties, VA

Growing Area 50 – Condemnations 073 and 087

Virginia Department of Environmental Quality
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Total Maximum Daily Load Process

Management of water quality is a process intended to protect waters for a variety of uses. The first step in the process is the identification of desired uses for each waterbody. There are typically a number of physical, chemical, and/or biological conditions that must exist in a waterbody to allow for a desired use to exist. In Virginia, most in-shore tidal waters are identified as potential shellfish growing waters. In order to support shellfish propagation without risk to human consumers, shellfish waters must have very low levels of pathogenic organisms. Virginia, as most other states, uses fecal coliforms (FC) as an indicator of the potential presence of pathogenic organisms. To maintain the use of a waterbody for direct shellfish harvesting, the goal is to ensure the concentration of fecal coliforms entering the waterbody does not exceed a "safe" level. The safe level is set as the standard against which water quality monitoring samples are checked.

When water quality monitoring detects levels of fecal coliforms above allowable, "safe" levels, managers must identify the potential sources and plan to control them. The prescribed method for figuring out what must be controlled to attain the water quality standard is the calculation of a Total Maximum Daily Load (TMDL). The TMDL is the amount of fecal coliforms that may be introduced by each potential source without exceeding the water quality standard in shellfish growing waters.

The process of developing a shellfish water TMDL may be generalized in the following manner:

1. Water quality monitoring data are used to determine if the bacterial standard for shellfish have been violated;
2. Potential sources of fecal bacteria loading within the contributing watershed are identified;
3. The necessary reductions in fecal bacteria pollutant load to achieve the water quality standard are determined;
4. The TMDL study is presented to the public to garner comment;
5. An implementation strategy to reduce fecal bacteria loads is written into a plan and subsequently implemented;
6. Water quality monitoring data are used to determine if the bacterial standard is being met for shellfish waters.

Different approaches can be used to determine the sources of fecal pollution in a waterbody. Two distinctly different approaches are watershed modeling and Bacterial Source Tracking (BST). Watershed modeling begins on the land, identifying potential sources which are based on information about conditions in the watershed (e.g. numbers of residents, estimated wildlife populations, estimated number of livestock, etc.). BST begins in the water identifying sources of fecal coliforms, specifically the dominant fecal coliform *Escherichia coli*. The sources are based on either genetic or phenotypic characteristics of the coliform. Virginia's Department of Environmental Quality (VADEQ) has decided to utilize BST, and use a simple volumetric calculation method that uses the Antibiotic Resistance Analysis (ARA) contributions for each of the four general source classes to calculate the reductions needed. This method assumes that fecal bacteria are found in sources of humans, wildlife, livestock, and pets will all differ in their reactions to antibiotics. Thus, when samples of fecal bacteria collected in the water quality monitoring program are exposed to specific antibiotics, the pattern of responses allows matching similarities to the response patterns of bacteria from known sources which have been accumulated in a "source library". Through this analysis, investigators also estimate the relative proportion of the fecal bacteria derived from each of the four general source classes and assumes this proportion reflects the relative contribution from the watershed.

The resulting estimates of the amount of fecal coliform pollution coming from each type of source can then be used to allocate reductions necessary to meet the water quality standard for shellfish growing waters. Identifying and agreeing on the means to achieve these reductions represent the TMDL implementation plan. Continued water quality monitoring will indicate whether the efforts to control sources of fecal coliforms in the watershed have been successful.

Fecal Coliform Impairment

This document details the development of bacterial TMDLs for impaired segments in the Ware Creek, Taskinas Creek, and Skimino Creek watersheds and shellfish growing areas in York, James City and New Kent Counties, Virginia. These TMDLs address the bacteria impairments in Growing Area 50, which includes the condemnation areas for Ware Creek (50-073), Taskinas Creeks (50-073), and Skimino Creek (50-087). The corresponding waterbody TMDL IDs are VAT-F26E-19, VAT-F26E-18, and VAT-F26E-17. The impairments were included in the 1998 303(d) TMDL Priority List and Report, as well as subsequent 303(d) Reports on Impaired Waters and 305(b)/303(d) Water Quality Assessment Integrated Reports.

The applicable state standard specifies that the number of fecal coliform bacteria shall not exceed a maximum allowable level of a Geometric Mean of 14 MPN/100mL (Most Probable Number per 100 milliliters water) and a 90^{th} Percentile value of 43 MPN/100mL for a 5-tube, 3-dilution test or 49 MPN/100mL for a 3-tube, 3-dilution test (Virginia Water Quality Standards 9-VAC 25-260-160). In development of this TMDL, the 90^{th} Percentile 49 MPN/100mL was used, since it represented the more stringent standard.

Sources of Fecal Coliform

Potential sources of fecal coliform consist primarily of non-point source contributions, as there are no permitted point source discharges that directly impact the identified impairment in the watershed. Non-point sources include wildlife; livestock; land application of bio-solids; recreational vessel discharges; failed, malfunctioning, or non-operational septic systems, and uncontrolled discharges (straight pipes conveying gray water from kitchen and laundry areas of private homes, etc.).

Simplified Modeling Approach (Volumetric Model):

A simple volumetric model was used for this TMDL study because the character of the waterbody to be modeled is relatively simple from a hydrologic perspective. The waterbody is small in both area and volume with a single, unrestricted connection to the receiving waters. This model approach uses the volume of the waterbody and the concentration of bacteria in order to establish the existing and final allocation scenarios.

Determination of Existing Loadings

To assist in partitioning the loads from the diverse sources within the Ware, Taskinas and Skimino Creeks watersheds, water quality samples of fecal coliform bacteria were collected for one year and evaluated using an Antibiotic Resistance Analysis (ARA) in a process called Bacterial Source Tracking (BST). These samples were compared to a reference library of fecal samples from known sources. The resulting data were used to assign portions of the load within the watershed to wildlife, humans, pets, or livestock.

The results of this analysis indicated that the primary sources of fecal coliforms for the Ware Creek watershed are livestock (28.4%), wildlife (28.2%), and human (26.0%). The BST study indicates that pets (17.4%) are also a significant source of bacteria in this watershed. The primary sources of fecal coliforms in the Taskinas Creek watershed are wildlife (37.1%), livestock (31.8%), and pets (15.8%). The BST study indicates that human (15.3%) are also a significant source of bacteria in this watershed. The primary sources of fecal coliforms in the Skimino Creek watershed are pets (30.7%), human (26.5%), wildlife (22.9%), and livestock (19.8%). The presence of a large signature attributable to one component is sufficient to establish potential directions for remediation under a future implementation plan.

In order to meet the 90th percentile water quality standard in the watersheds, the BST load allocations show that in general 100% reductions of the human, pet and livestock load components are required. Even with complete removal of the controllable sources, a reduction of the wildlife load is needed to achieve the water quality standard for the estuaries. Based on the calculations, overall reductions of 91% (Ware Creek), 93% (Taskinas Creek), and 90% (Skimino Creek) of the fecal coliform loads in the watersheds will meet the 90th percentile water quality standard.

Load Allocation Scenarios

The next step in the TMDL process was to determine the appropriate water quality standard to be applied. This was set as the 90th percentile standard because the data established that the 90th percentile required the greater reduction. Calculated results of the model for each segment were used to establish the existing load in the system. The load necessary to meet water quality standards was calculated in a similar fashion using the water quality standard criterion in place of the ambient water quality value. The difference between these two numbers represents the necessary level of reduction in each segment.

The results of the BST developed for each segment were used to partition the load allocation that would meet water quality standards according to source. Waste load allocations in watersheds where there are no individual VPDES permitted facilities with bacteria effluent limitations are usually represented in the TMDL as 5% of the calculated Total Maximum Daily Load. This 5% is then subtracted from the load allocation. The results of the model, the BST source partitioning, and the reductions necessary based on the Geometric Mean are shown in **Table E.1** and **Table E.2.** The results of the model, the BST source partitioning, and the reductions necessary based on the 90th Percentile are shown in **Table E.3** and **Table E.4**.

Table E.1: TMDL Summary for Bacteria Impairments of Growing Area 50 Based on the Geometric Mean Standard

Condemnation Area	WLA (Point Sources)	LA (Non-point Sources)	MOS (Margin of Safety)	TMDL
Ware Creek 50-073A (VAT-F26E-19)	3.89E+08	7.39E+09	Implicit	7.78E+09

Condemnation Area	WLA (Point Sources)	LA (Non-point Sources)	MOS (Margin of Safety)	TMDL
Taskinas Creek 50-073B (VAT-F26E-18)	1.42E+08	2.69E+09	Implicit	2.84E+09

Condemnation Area	WLA (Point Sources)	LA (Non-point Sources)	MOS (Margin of Safety)	TMDL
Skimino Creek 50-087A (VAT-F26E-17)	3.84E+08	7.28E+09	Implicit	7.67E+09

Table E.2: TMDL Summary for Bacteria Impairments of Growing Area 50: Current Loads and Estimated Load Reductions Based Upon the Geometric Mean Standard

Ware Creek				
Source	**BST Allocation (% of Total Load)**	**Current Load (MPN/day)**	**Allowable Load (MPN/day)**	**Required Reduction (%)**
Livestock	28	1.03E+10	0.00E+00	100
Wildlife	29	1.06E+10	7.39E+09	27.4
Human	26	9.54E+09	0.00E+00	100
Pets	17	6.24E+09	0.00E+00	100
Point Source	-	-	3.89E+08	0
Total	**100.0**	**3.67E+10**	**7.78E+09**	**78.8**

Taskinas Creek				
Source	**BST Allocation (% of Total Load)**	**Current Load (MPN/day)**	**Allowable Load (MPN/day)**	**Required Reduction (%)**
Livestock	32	6.72E+09	0.00E+00	100
Wildlife	37	7.77E+09	2.69E+09	63.8
Human	15	3.15E+09	0.00E+00	100
Pets	16	3.36E+09	0.00E+00	100
Point Source	-	-	1.42E+08	0
Total	**100.0**	**2.10E+10**	**2.84E+09**	**86.5**

Skimino Creek				
Source	**BST Allocation (% of Total Load)**	**Current Load (MPN/day)**	**Allowable Load (MPN/day)**	**Required Reduction (%)**
Livestock	20	9.40E+09	0.00E+00	100
Wildlife	23	1.08E+10	7.28E+09	29.6
Human	27	1.27E+10	0.00E+00	100
Pets	30	1.41E+10	0.00E+00	100
Point Source	-	-	3.84E+08	0
Total	**100.0**	**4.70E+10**	**7.67E+09**	**83.7**

Table E.3: TMDL Summary for Bacteria Impairments of Growing Area 50 Based on the 90th Percentile Standard

Condemnation Area	WLA (Point Sources)	LA (Non-point Sources)	MOS (Margin of Safety)	TMDL
Ware Creek 50-073A (VAT-F26E-19)	1.36E+09	2.58E+10	Implicit	2.72E+10

Condemnation Area	WLA (Point Sources)	LA (Non-point Sources)	MOS (Margin of Safety)	TMDL
Taskinas Creek 50-073B (VAT-F26E-18)	4.97E+08	9.44E+09	Implicit	9.94E+09

Condemnation Area	WLA (Point Sources)	LA (Non-point Sources)	MOS (Margin of Safety)	TMDL
Skimino Creek 50-087A (VAT-F26E-17)	1.34E+09	2.56E+10	Implicit	2.69E+10

Table E.4: TMDL Summary for Bacteria Impairments of Growing Area 50: Current Loads and Estimated Load Reductions Based Upon the 90th Percentile Standard

Ware Creek				
Source	**BST Allocation (% of Total Load)**	**Current Load (MPN/day)**	**Allowable Load (MPN/day)**	**Required Reduction (%)**
Livestock	28	8.93E+10	0.00E+00	100
Wildlife	29	9.25E+10	2.58E+10	70.9
Human	26	8.29E+10	0.00E+00	100
Pets	17	5.42E+10	0.00E+00	100
Point Source	-	-	1.36E+09	0
Total	**100.0**	**3.19E+11**	**2.72E+10**	**91.5**

Taskinas Creek				
Source	**BST Allocation (% of Total Load)**	**Current Load (MPN/day)**	**Allowable Load (MPN/day)**	**Required Reduction (%)**
Livestock	32	4.48E+10	0.00E+00	100
Wildlife	37	5.18E+10	9.44E+09	81.0
Human	15	2.10E+10	0.00E+00	100
Pets	16	2.24E+10	0.00E+00	100
Point Source	-	-	4.97E+08	0
Total	**100.0**	**1.40E+11**	**9.94E+09**	**92.9**

Skimino Creek				
Source	**BST Allocation (% of Total Load)**	**Current Load (MPN/day)**	**Allowable Load (MPN/day)**	**Required Reduction (%)**
Livestock	20	5.24E+10	0.00E+00	100
Wildlife	23	6.03E+10	2.56E+10	57.5
Human	27	7.07E+10	0.00E+00	100
Pets	30	7.86E+10	0.00E+00	100
Point Source	-	-	1.34E+09	0
Total	**100.0**	**2.62E+11**	**2.69E+10**	**89.7**

Margin of Safety

In order to account for uncertainty in modeled output, a Margin of Safety (MOS) was incorporated into the TMDL development process by making very conservative choices. A margin of safety can be incorporated implicitly in the model through the use of conservative estimates of model parameters, or explicitly as an additional load reduction requirement. Individual errors in model inputs, such as data used for developing model parameters or data used for calibration, may affect the load allocations in a positive or a negative way. The purpose of the MOS is to avoid an overall bias toward load allocations that are too large for meeting the water quality target. An implicit MOS was used in the development of this TMDL through selection of a water quality standard providing a high level of protection, utilization of entire segment volumes for model calculations, averaging extreme high and low values to ensure that the more protective condition with the largest available data set was addressed, and emphasizing watershed-based implementation measures.

Recommendations for TMDL Implementation

The goal of this TMDL was to develop an allocation plan that achieves water quality standards during the implementation phase. Virginia's 1997 Water Quality Monitoring, Information and Restoration Act states in section 62.1-44.19.7 that the "Board shall develop and implement a plan to achieve fully supporting status for impaired waters".

The TMDLs developed for the Ware Creek, Taskinas Creek and Skimino Creek watersheds impairments, provide allocation scenarios that will be a starting point for developing restoration strategies in the implementation plan. Additional monitoring aimed at targeting the necessary reductions is critical to implementation development. Once established, continued monitoring will aid in tracking success toward meeting water quality milestones.

Public participation is critical to the implementation process. Reduction in non-point source loading is the crucial factor in addressing the problem. These sources cannot be addressed without public understanding of and support for the implementation process and the best management practices that address various land use practices. Stakeholder input will be critical from the onset of the implementation process in order to develop an implementation plan that will be truly effective.

Public Participation

During development of the TMDL for the Ware Creek, Taskinas Creek, and Skimino Creek watersheds in Growing Area 50, public involvement was encouraged through a public participation process that included public meetings and stakeholder meetings.

The first public meeting was held on September 1, 2009 at the James City County Library and nine people attended. The purpose of this meeting was to provide a basic description of the TMDL process and the agencies involved and to gain general information about the watershed. Also presented were the initial source assessment inputs, bacterial source tracking, and model results. This meeting was followed by development of the draft TMDL and a review by the stakeholders.

The second public meeting was held on December 7, 2009 at the James City County Library and eight people attended. At this meeting, the TMDL load allocations were presented as well as the final draft report.

Input from these meetings was utilized in the development of the TMDL and improved confidence in the allocation scenarios and TMDL process. Public involvement in the TMDL implementation planning process was encouraged.

1.0 Introduction

This document details the development of bacterial Total Maximum Daily Loads (TMDLs) for segments in Growing Area 50 in York, James City, and New Kent Counties, Virginia. Ware Creek, Taskinas Creek, and Skimino Creek were listed as impaired on Virginia's 303(d) Total Maximum Daily Load Priority List for not meeting the Shellfish Designated Use. The TMDL is one step in a multi-step process that includes a high level of public participation in order to address water quality issues that can affect public health and the health of aquatic life.

1.1 Listing of Water Bodies Under the Clean Water Act

Water quality standards are regulations based on federal or state law that set numeric or narrative limits on pollutants. Water quality monitoring is performed to measure these pollutants and determine if the measured levels are within the bounds of the limits set for the uses designated for the waterbody. The waterbodies which have pollutant levels above the designated standards are considered impaired for the corresponding designated use (e.g. swimming, drinking, shellfish harvest, etc.). The impaired waterways are then listed on the Clean Water Act §303(d) List reported to the Environmental Protection Agency (EPA). Those waters placed on the list require the development of a TMDL intended to eliminate the impairment, and bring the waterbody into compliance with the designated water quality standards.

TMDLs represent the total pollutant loading that a water body can receive without violating water quality standards. 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 in order to restore and maintain the quality of their water resources (EPA, 1999).

Fecal coliform bacteria are the most common causes for the impairments in Virginia shellfish growing waters. This group of bacteria is considered an indicator for the presence of fecal contamination. The most common member of the fecal coliform groups is *Escherichia coli (E. coli)*. Fecal coliforms are associated with the fecal material derived from humans and warm-blooded animals. The presence of fecal coliform bacteria in aquatic environments is an indication that the water may have been contaminated by pathogens or disease-producing bacteria or viruses. Waterborne pathogenic diseases include typhoid fever, viral and bacterial gastroenteritis, and hepatitis A. Filter-feeding shellfish can concentrate these pathogens, which can be transmitted and cause disease when eaten uncooked. Therefore, the presence of elevated numbers of fecal coliform bacteria is an indicator that a potential health risk exists for individuals consuming raw shellfish. Fecal contamination can occur from point source inputs of domestic sewage or from non-point sources of human, (e.g., malfunctioning septic systems) or animal wastes.

Because the fecal coliform indicator does not provide information on the source or origin of fecal contamination, agencies of the Commonwealth, including the Department of Environmental Quality (VADEQ), the Virginia Department of Health – Division of Shellfish Sanitation (VDH-DSS) and the Department of Conservation and Recreation (DCR) have worked together with state universities, the U.S. Geological Survey, and the U.S. Environmental Protection Agency to develop methods to assess sources of fecal coliforms to assist in development of TMDLs for impaired shellfish waters.

1.2 Overview of the TMDL Development Process

A TMDL study for shellfish waters is the first part of a phased process aimed at restoring water quality. This study is designed to determine how much of the pollutant input needs to be reduced in order to achieve water quality standards. The second step in the process is the development of an implementation plan that identifies which specific control measures are necessary to achieve those reductions, their timing for implementation, and cost. The implementation plan will also outline potential funding sources. The third step will be the actual implementation process. Implementation will typically occur in stages that allow for a review of progress in reducing pollutant inputs, refinement of bacteria loading estimates based upon additional data, and identification of changes to pollutant control measures.

The TMDL development process also must account for seasonal and annual variations in precipitation, flow, land use, and pollutant contributions. Such an approach ensures that TMDLs, when implemented, do not result in violations under a wide variety of scenarios that affect bacterial loading.

2.0 Applicable Water Quality Standards

Appropriate water quality standards are based on state and federal laws. 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.)."*

2.1 Designated Uses and Criteria

Generally, most in-shore tidal waters in Virginia are designated as shellfish waters. The identification of the applicable river reaches can be found in the river basin tables at 9 VAC 25-260-390 et seq. For a shellfish supporting water body to be in compliance with Virginia bacterial standards, VADEQ specifies the following criteria (9 VAC 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."*

2.2 Classification of Virginia's Shellfish Growing Areas

The Virginia Department of Health, Division of Shellfish Sanitation (VDH-DSS) is responsible for classifying shellfish waters and protecting the health of bivalve shellfish consumers. The VDH- DSS follows the requirements of the National Shellfish Sanitation Program (NSSP), which is regulated by the U.S. Food and Drug Administration. The NSSP specifies the use of a shoreline survey as its primary tool for classifying shellfish growing waters. Fecal coliform concentrations in water samples collected in the immediate vicinity of the shellfish beds function to verify the findings of the shoreline survey and to define the border between approved and condemned (unapproved) waters. Much of the effort is focused on locating fecal contamination, and in this manner minimizing the introduction of human pathogens to shellfish waters.

VDH-DSS designs and performs the shoreline survey to locate sources of pollution within the watersheds of shellfish growing areas. This is accomplished through a property-by-property inspection of the onsite sanitary waste disposal facilities of most properties on non-sewered sections of watersheds, and investigations of other sources of pollution, such as wastewater treatment plants (WWTP), marinas, livestock operations, landfills, failing septic systems, etc. The information is compiled into a written report with a map showing the location of the sources of real or potential pollution sources and sent to the various city or county agencies that are responsible for regulating these concerns. Once an onsite problem is identified, local health departments (LHDs), and/or other state and local agencies may play a role in the process of correcting the deficiencies.

The VDH-DSS collects monthly seawater samples at over 2,000 stations in the shellfish growing areas of Virginia. Though they continuously monitor sample data for unusual events, they formally evaluate shellfish growing areas on an annual basis. The annual review uses data from the most recent 30 samples (typically 30 months), collected randomly with respect to weather. The data are assessed to determine whether the water quality standards are met. If the water quality standards are exceeded, the shellfish area is closed for the harvest of shellfish that go directly to market. Those areas that marginally exceed the water quality standard and are closed for the direct marketing of shellfish are eligible for harvest of shellfish under a permit from the Virginia Marine Resources Commission and VDH-DSS. The permit establishes controls that in part require shellfish be allowed to depurate for 15 days in clean growing areas or specially designed, licensed, on-shore facilities. Shellfish in growing areas that may be highly polluted, such as those in the immediate vicinity of a wastewater treatment facility (prohibited waters), are not allowed to be moved to clean waters for depuration.

A copy of the most current VDH-DSS Condemnation Notice is in Appendix A. The notice may also be located at http://www.vdh.virginia.gov/EnvironmentalHealth/Shellfish/closureSurvey/index.htm.

3.0 Watershed Characterization

The Ware Creek watershed, VAT-F26E-19, is located along the York River, just south of the Hog Island Wildlife Refuge area. The New Kent County and James City County border intersects the entire length of the stream. The impaired segment encompasses 0.1 square miles of stream length upstream form the outlet to the York River. The location of the watershed is shown in **Figure 3.1**. The drainage area of the watershed is approximately 23.7 square miles. Land use distribution is based on data from the 2000 National Land Cover Data Set (NLCD 2000). A distribution of the land use in the watershed is shown in **Figure 3.2**. Approximately 66% of the land use in the watershed is undeveloped forest. As the land use area within the watershed is based upon surface area, the 1.9 % water and 8.6% wetlands reflect that portion of the watershed area occupied by Ware Creek. Agriculture occupies 8.9% pasture and 11.9% crop land. Agriculture is based on dairy, beef, cotton, and peanut farms. Developed lands, termed urban and commercial, occupy only 1.7% of the landscape. This watershed contains the Stonehouse Commerce Park and Hankins Industrial Park. **Table 3.1** presents the land distribution.

The Taskinas Creek watershed, VAT-F26E-18, is located along the southern side of the York River, near the town of Croaker, VA in James City County. Taskinas Creek is located in a Chesapeake Bay National Estuarine Research Reserve and is within the York River State Park. The impaired Growing Area encompasses the whole estuarine portion of the stream. The location of the watershed is shown in **Figure 3.1**. The drainage area of the watershed is approximately 6.5 square miles. Land use distribution is based on data from the 2000 National Land Cover Data Set (NLCD 2000). A distribution of the land use in the watershed is shown in **Figure 3.2**. Approximately 77.3% of the land use in the watershed is undeveloped forest. As the land use area within the watershed is based upon surface area, the 2.1 % water and 9.1% wetlands reflect that portion of the watershed area occupied by Taskinas Creek. Agriculture occupies 5.1% pasture and 6.3% crop land. Agriculture is based on dairy, beef, cotton, and peanut farms. Developed lands, termed urban and commercial, occupy only 0.1% of the landscape. **Table 3.1** presents the land distribution.

The Skimino Creek watershed, VAT-F26E-17, is located along the York River, approximately 10 miles south of West Point. The James City County and York County border intersects the length of the stream. The impaired Growing Area encompasses the whole estuarine portion of the stream. The location of the watershed is shown in **Figure 3.1**. The drainage area of the watershed is approximately 7.8 square miles. Land use distribution is based on data from the 2000 National Land Cover Data Set (NLCD 2000). A distribution of the land use in the watershed is shown in **Figure 3.2**. Approximately 72% of the land use in the watershed is undeveloped forest. As the land use area within the watershed is based upon surface area, the 3.6% water and 13.3% wetlands reflect that portion of the watershed area occupied by Skimino Creek. Agriculture occupies 5.3% pasture and 4.2% crop land. Agriculture is based on dairy, beef, cotton, and peanut farms. Developed lands, termed urban and commercial, occupy only 1.6% of the landscape. **Table 3.1** presents the land distribution.

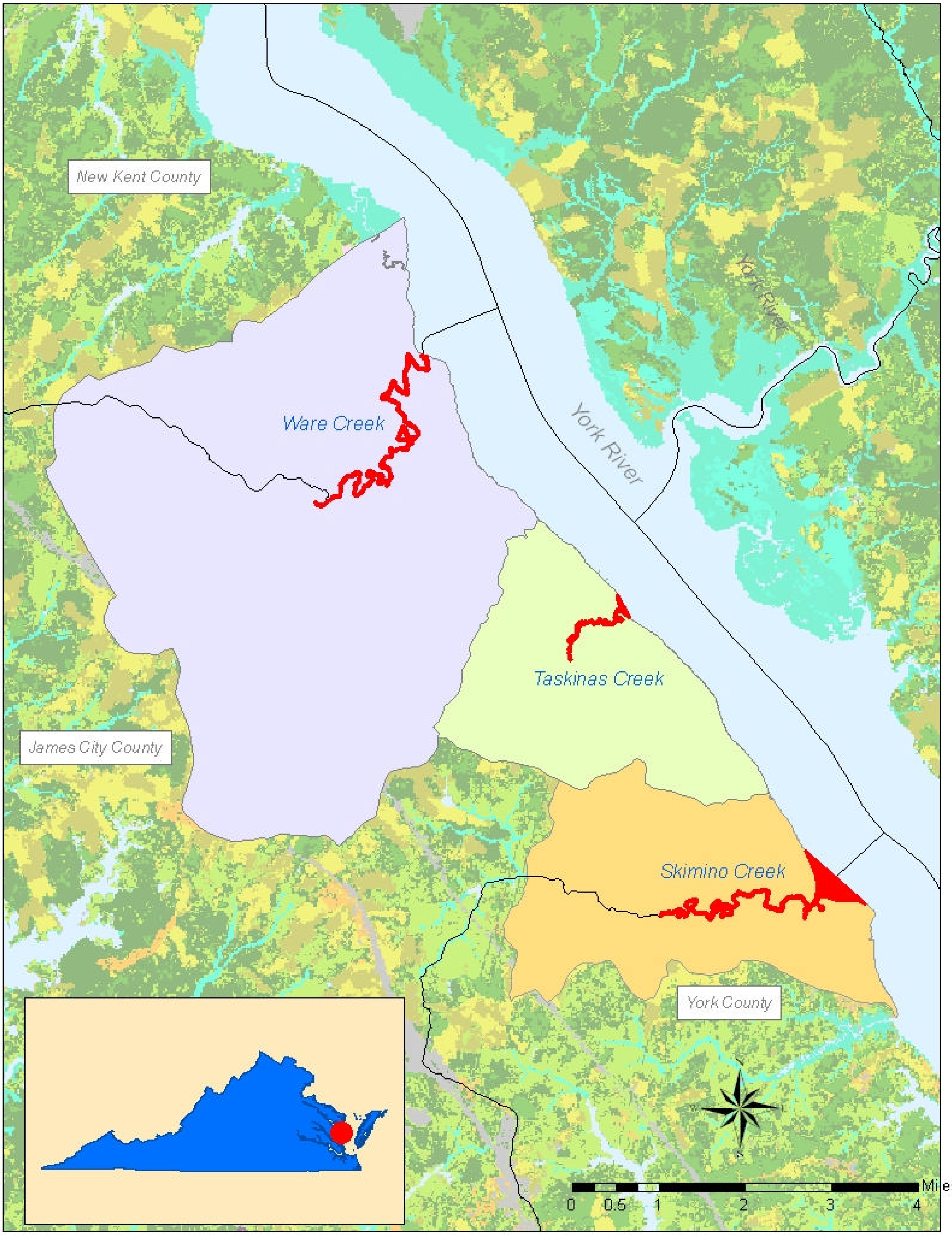


Figure 3.1: Location of the Ware Creek, Taskinas Creek, and Skimino Creek Watersheds

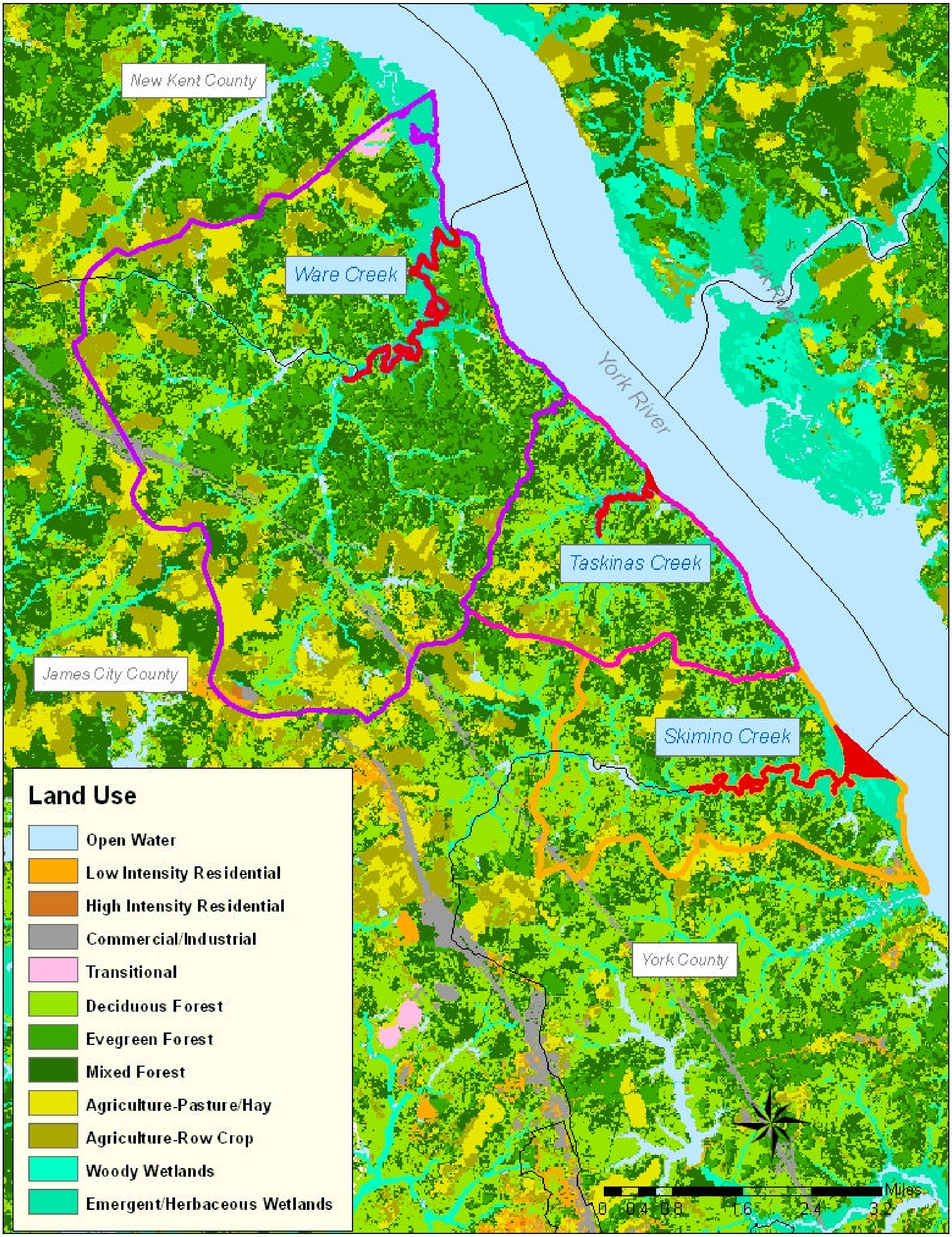


Figure 3.2: Land Use Distribution in the Ware Creek, Taskinas Creek and Skimino Creek Watersheds

Table 3.1A: Land Use Distribution in the Ware Creek Watershed

General Land Use Category	Land Use	Acres	Percent of Watershed
Developed 1.7%	Low-intensity residential	49.59	0.33
	High-intensity residential	11.53	0.08
	Commercial/Industrial	198.63	1.31
Undeveloped 75.1%	Deciduous forest	3202.78	21.06
	Evergreen forest	2720.23	17.89
	Mixed forest	4184.93	27.52
	Woody wetlands	578.62	3.81
	Emergent-herbaceous wetlands	737.34	4.85
	Bare rock/Sand/Clay	0	0
Agriculture 20.8%	Pasture/Hay	1356.43	8.92
	Row crops	1806.83	11.88
Transitional		58.72	0.39
Water		300.29	1.97
Total		**15205.94**	**100.00**

Table 3.1B: Land Use Distribution in the Taskinas Creek Watershed

General Land Use Category	Land Use	Acres	Percent of Watershed
Developed 0.1%	Low-intensity residential	0	0
	High-intensity residential	0	0
	Commercial/Industrial	3.54	0.09
Undeveloped 86.4%	Deciduous forest	1580.05	38.13
	Evergreen forest	202.13	4.88
	Mixed forest	1420.37	34.27
	Woody wetlands	179.88	4.34
	Emergent-herbaceous wetlands	196.79	4.75
	Bare rock/Sand/Clay	0	0
Agriculture 11.4%	Pasture/Hay	212.15	5.12
	Row crops	261.97	6.32
Transitional		0	0
Water		87.24	2.11
Total		**4144.13**	**100.00**

Table 3.1C: Land Use Distribution in the Skimino Creek Watershed

General Land Use Category	Land Use	Acres	Percent of Watershed
Developed 1.6%	Low-intensity residential	34.73	0.70
	High-intensity residential	0.22	0.00
	Commercial/Industrial	46.15	0.93
Undeveloped 85.3%	Deciduous forest	1743.81	35.03
	Evergreen forest	375.90	7.55
	Mixed forest	1461.64	29.36
	Woody wetlands	185.47	3.73
	Emergent-herbaceous wetlands	478.67	9.61
	Bare rock/Sand/Clay	0	0
Agriculture 9.5%	Pasture/Hay	264.07	5.30
	Row crops	207.99	4.18
Transitional		0	0
Water		180.00	3.62
Total		**4978.63**	**100.00**

All sources of fecal coliform contamination must be determined within the watershed. Estimations of the populations of livestock and wildlife, as well as numbers of septic systems within the watershed are shown in **Table 3.2**. These numbers are low estimates as the supporting data are several years old. (**Appendix B**).

Table 3.2: Estimated Fecal Coliform Source Populations in the Impaired Condemnation Zones of Growing Area 50

Fecal Coliform Source		Ware Creek	Taskinas Creek	Skimino Creek
Livestock	Cattle	10	5	8
	Chicken	12	8	10
	Pig	2	0	0
	Horse	40	36	22
Wildlife	Deer	1466	1258	997
	Raccoon	822	651	339
	Geese	778	704	359
	Duck	1045	1188	574
Pet	Dog	452	375	
Human	Septic*	833	691	

* Failing septic systems can be calculated based on the number of houses in the watershed, year houses were built, and the number of deficiencies identified in the VDH-DSS Shoreline Sanitary Survey

4.0 Water Quality Impairment and Bacterial Source Assessment

4.1 Condemnation Area

The impaired segments of Ware Creek, Taskinas Creek and Skimino Creek in Growing Area 50 were listed as impaired on Virginia's 1998 303(d) TMDL Priority List and Report for violation of the water quality standard for fecal coliform bacteria in shellfish supporting waters (TMDL IDs VAT-F26E-19, VAT-F26E-18, VAT-F26E-17 respectively). Detailed maps of the shellfish condemnation areas and the associated water quality stations are available from the Virginia Department of Health - Division of Shellfish Sanitation. A map of the condemnation areas is shown in **Figures 4.1A and 4.1B**. Copies of the condemnation notices may be found in **Appendix A**.

4.2 Water Quality Monitoring

The water quality monitoring network in the Ware Creek and Taskinas Creek watershed study areas consists of 2 stations each in Shellfish Growing Area 50-073A and 50-073B (**Figure 4.1A**). There are 4 monitoring stations in the Skimino Creek watershed in Shellfish Growing Area 50-087A (**Figure 4.1B**). These stations are monitored by VDH-DSS for fecal bacteria. All of the stations in the watersheds are located in the impaired segments. This number may vary as VDH-DSS adds or removes stations in order to provide necessary coverage to determine public health risks. In Ware Creek, stations 50-23 and 50-24 have a long historical data record of 1985-2009. In Taskinas Creek, stations 50-22 and 50-22A have a long historical data record of 1985-2009. Stations 50-1, 50-2, 50-3, and 50-4 in Skimino Creek also have a long historical data record of 1985-2009.

This TMDL study examined bacterial monitoring data at each of the stations for a period of time from November 2004 through July 2007. A summary of water quality data for the monitoring period during the TMDL study is shown in **Table 4.1**. Graphs depicting the geometric mean, and the 90th percentile bacteria data are shown in **Figures 4.2 – 4.7**.

The closure in the growing area is characterized based on the monitoring stations in the closed area. To facilitate an effective assignment of the appropriate level of protection for this system, the highest water quality data was used to assess the existing load from the station in the condemned area. This provides an increased margin of safety while providing a target that can be easily comprehended and uniformly implemented while retaining the necessary protection for the affected water.

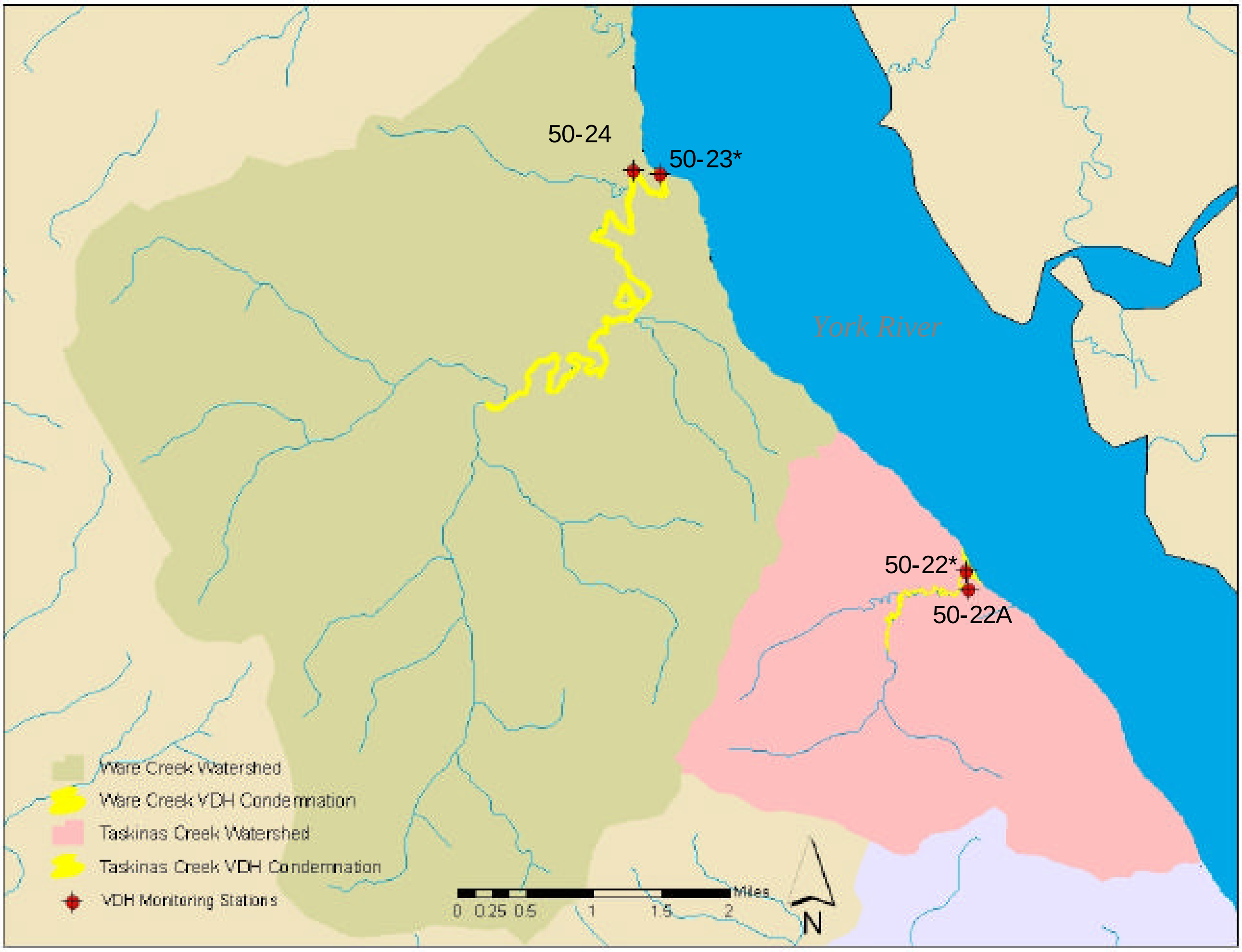


Figure 4.1A: Ware Creek and Taskinas Creek Condemnation Zones in Growing Area 50 with VDH-DSS Water Quality Monitoring Station Locations

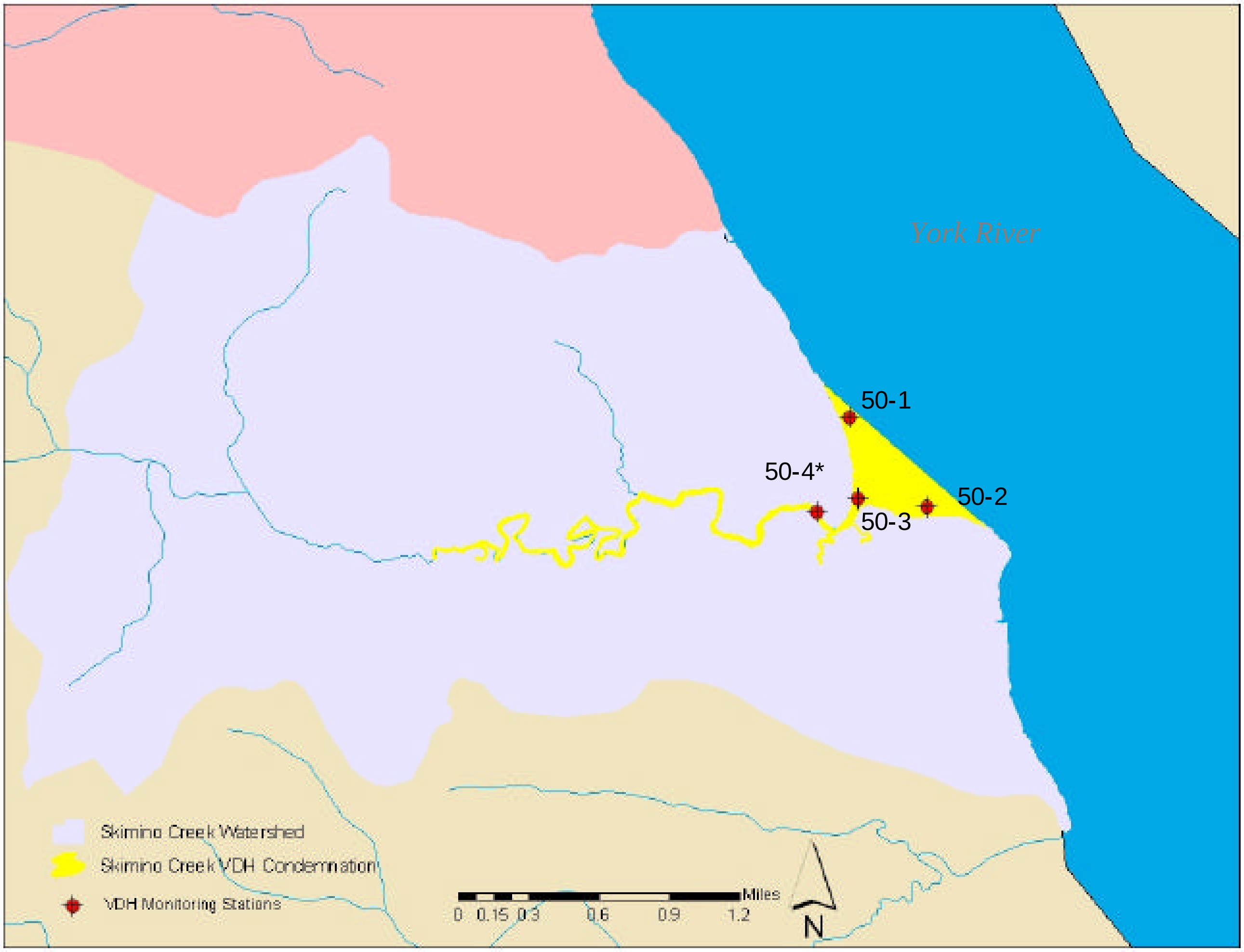


Figure 4.1B: Skimino Creek Condemnation Zone in Growing Area 50 with VDH-DSS Water Quality Monitoring Station Locations

Table 4.1: VDH-DSS Water Quality Data Summary for Growing Area 50

Stream	Station ID	30 Sample Observation Period	Maximum Geometric Mean (MPN/100mL)	# of Violations	Maximum 90th Percentile (MPN/100mL)	# of Violations
Ware Creek	50-23	11/4/04-7/16/07	35.3	30	219.8	30
	50-24	11/4/04-7/16/07	66.0	30	574.0	30
Taskinas Creek	50-22	11/4/04-7/16/07	31.2	30	239.0	30
	50-22A	11/4/04-7/16/07	103.5	30	691.8	30
Skimino Creek	50-1	11/4/04-7/16/07	8.0	0	28.4	0
	50-2	11/4/04-7/16/07	14.0	1	94.6	29
	50-3	11/4/04-7/16/07	51.6	30	478.5	30
	50-4	11/4/04-7/16/07	85.8	30	467.8	30

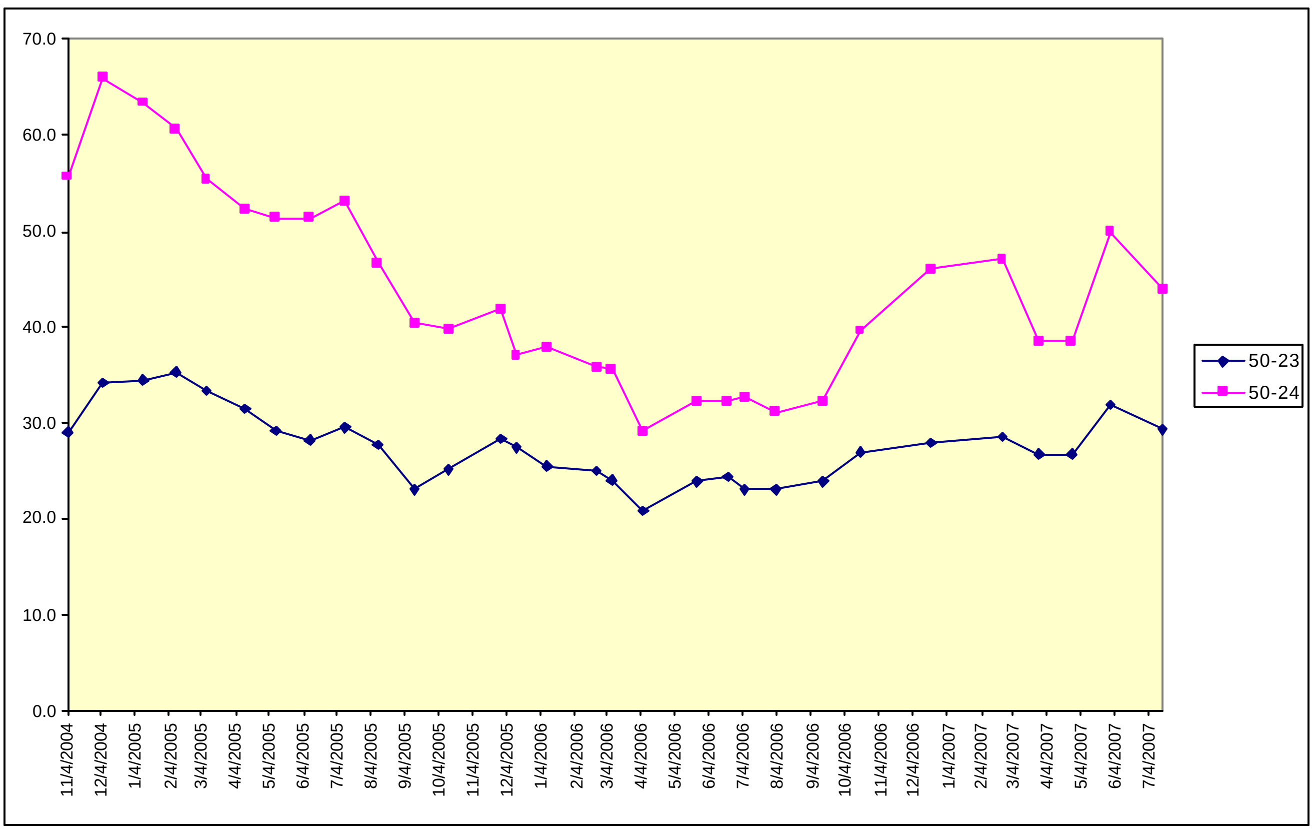


Figure 4.2: VDH-DSS 30-Sample Geometric Mean for Ware Creek 50-073 (WQS 14 MPN/100mL)

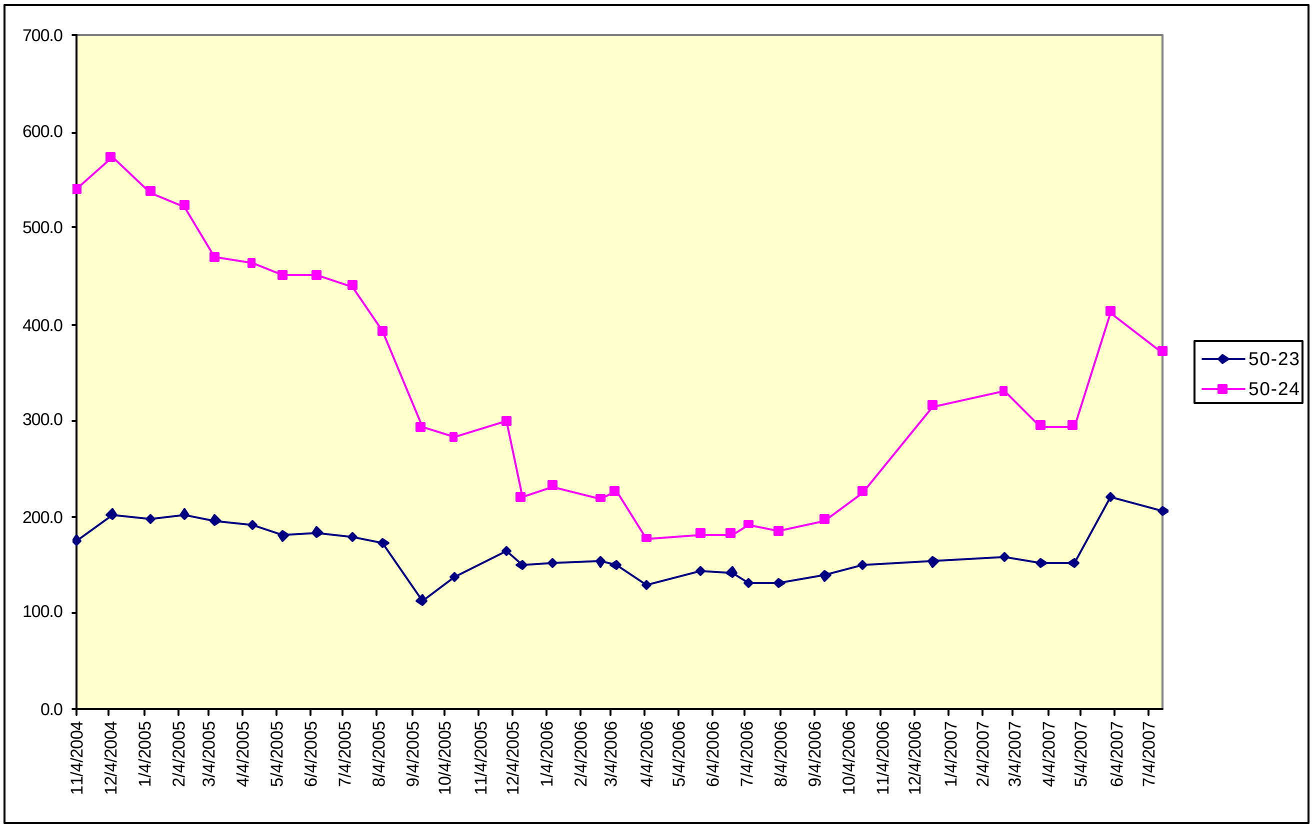


Figure 4.3: VDH-DSS 30-Sample 90th Percentile for Ware Creek 50-073 (WQS 49 MPN/100mL)

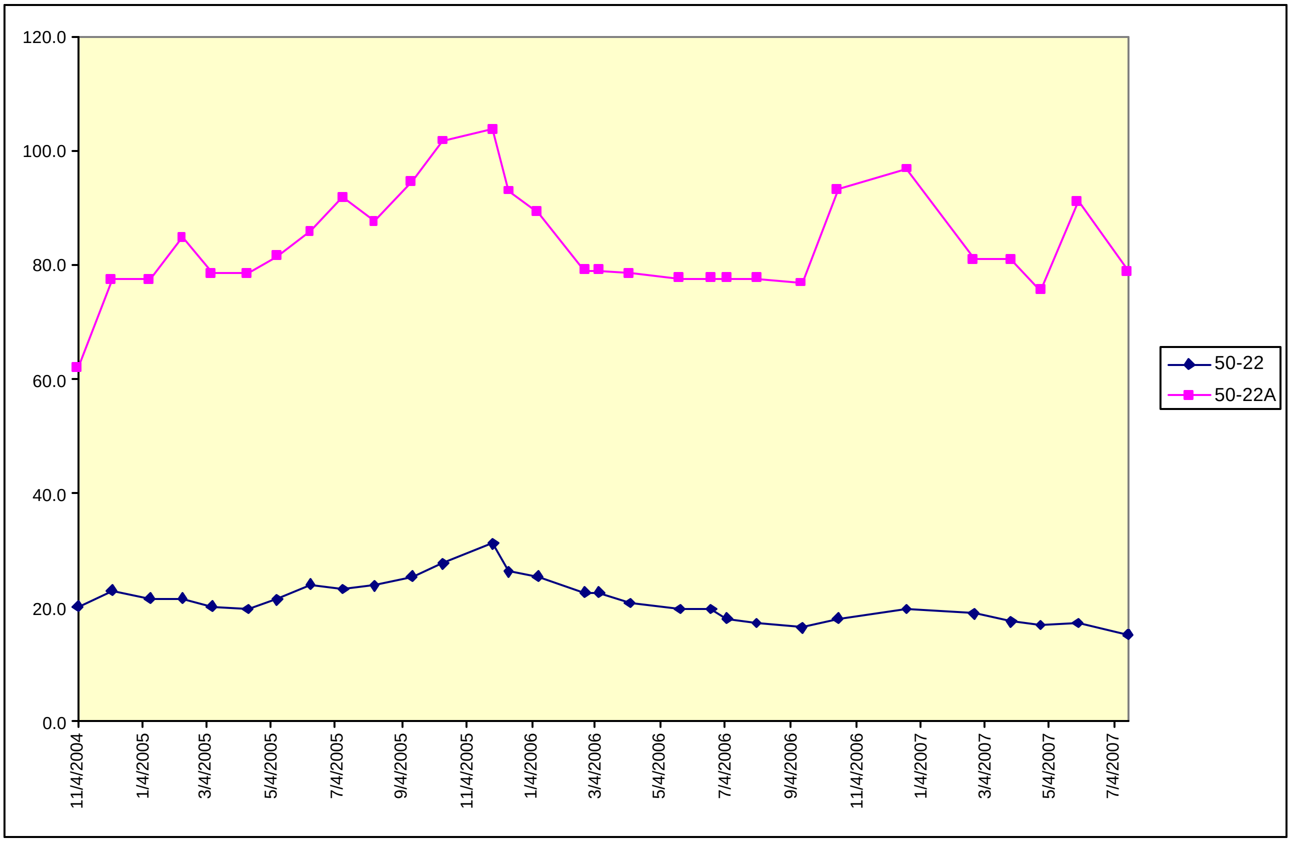


Figure 4.4: VDH-DSS 30-Sample Geometric Mean for Taskinas Creek 50-073 (WQS 14 MPN/100mL)

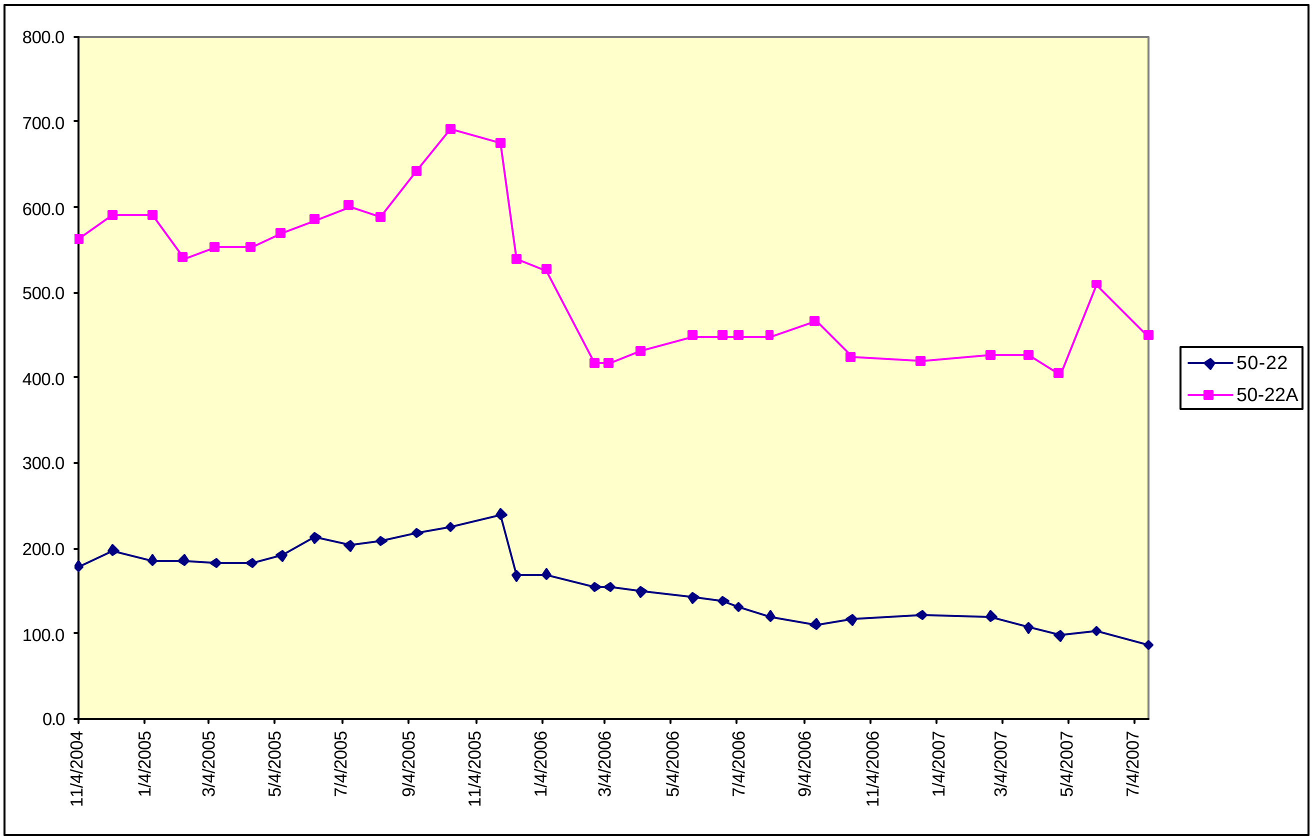


Figure 4.5: VDH-DSS 30-Sample 90th Percentile for Taskinas Creek 50-073 (WQS 49 MPN/100mL)

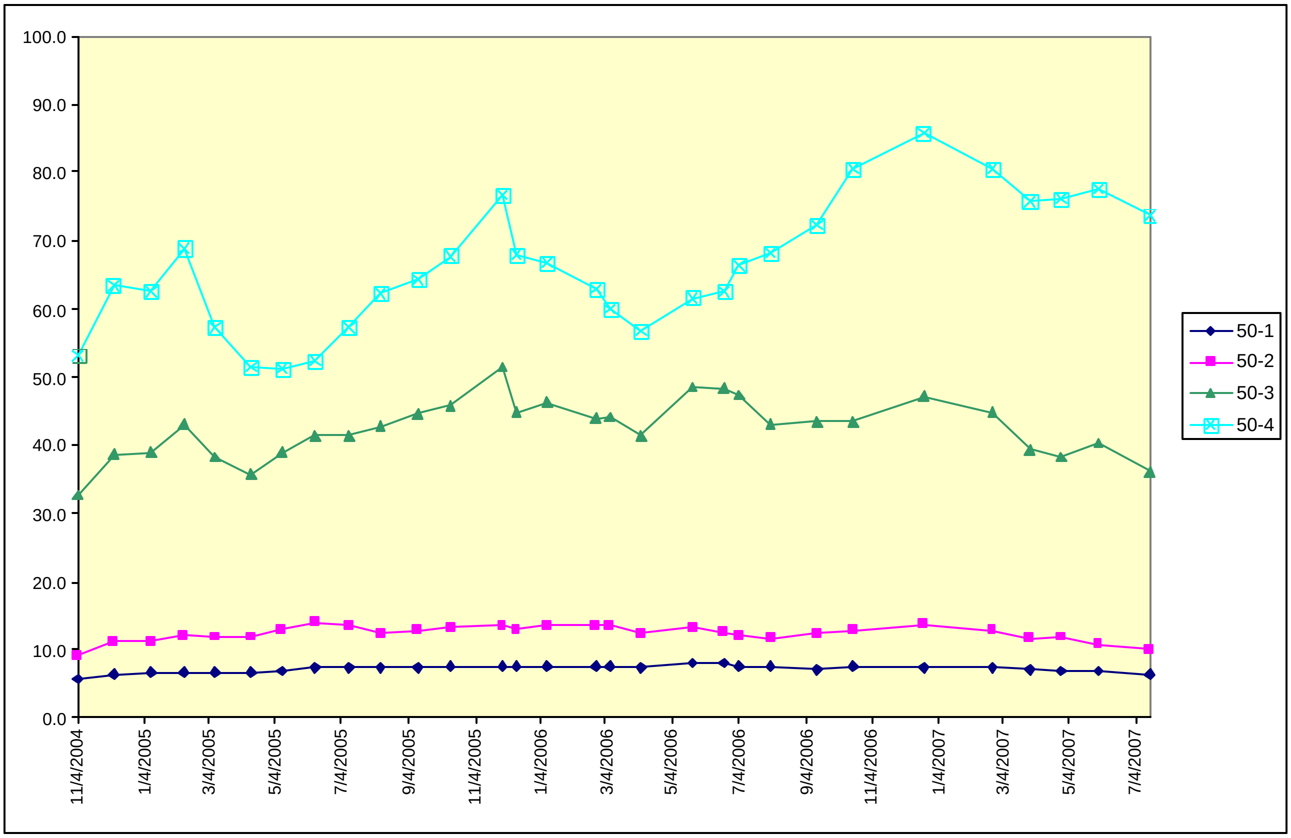


Figure 4.6: VDH-DSS 30-Sample Geometric Mean for Skimino Creek 50-087 (WQS 14 MPN/100mL)

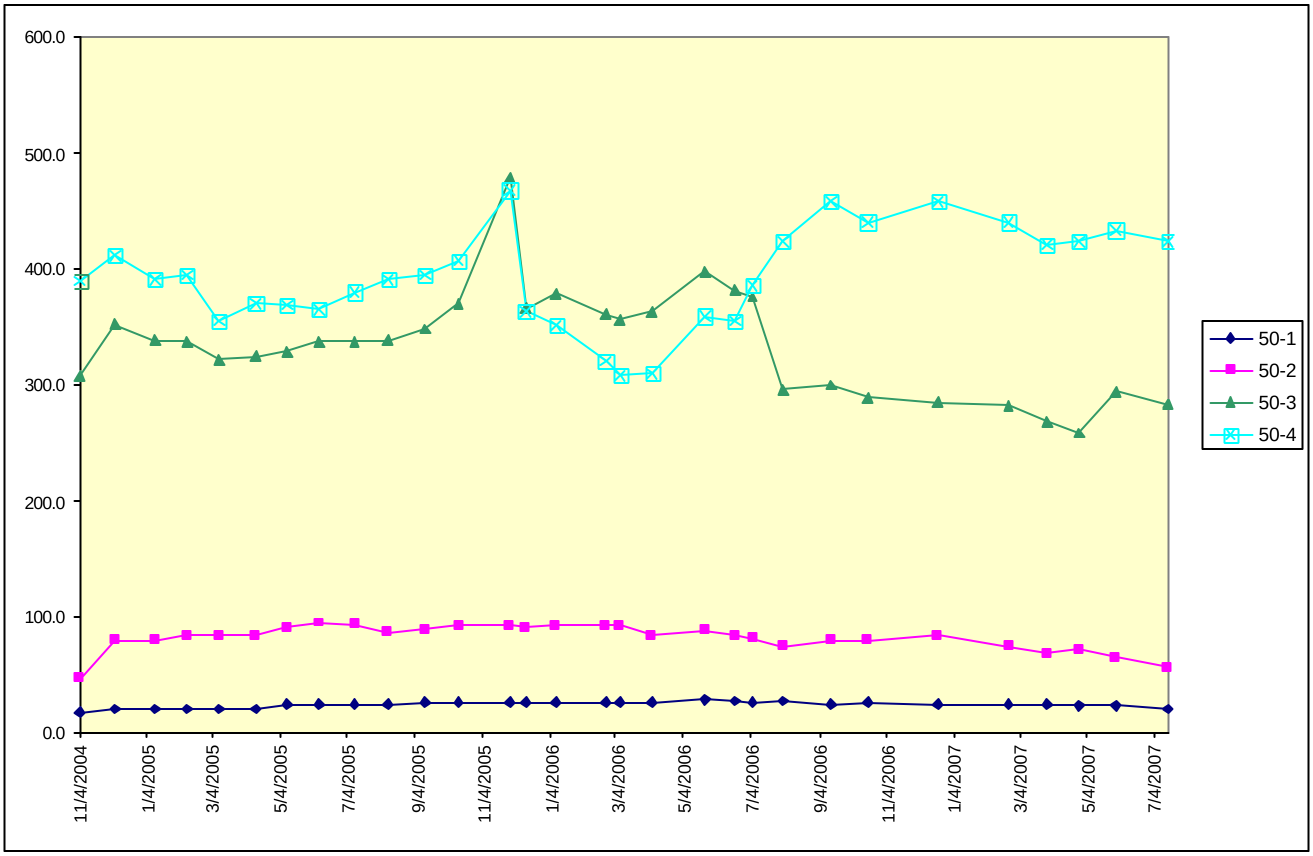


Figure 4.7: VDH-DSS 30-Sample 90th Percentile for Skimino Creek 50-087 (WQS 49 MPN/100mL)

4.3 Fecal Coliform Bacterial Source Assessment

Data from the VDH-DSS shoreline sanitary survey are used as a tool to identify potential fecal coliform sources and locations. **Figure 4.8** shows the results of the survey period of November 18, 2005 to July 28, 2006. These locations were determined to have a possible impact on the condemned shellfish growing area. In the 2006 Sanitary Survey, a total of 2 indirect on-site sewage deficiencies were documented in the watersheds of Growing Area 50. They were identified because of discharging laundry waste to the ground. According to the Survey, there is a public boat ramp which has sanitary facilities provided. However, there were no boat holding tank pump-out or portable toilet dump station facilities present. A private boat ramp was documented and does not have any sanitary facilities, boat holding tank pump-out, or portable toilet dump station facilities present at this location. Eight sites of indirect contributors of animal pollution were identified in the survey, because none have direct access to the water. The number of deficiencies displayed on the map may or may not agree with this total due to overlap of mapped locations displayed and/or multiple deficiencies at one location.

The shoreline sanitary survey "lists only those properties that have a sanitary deficiency or other environmental significance." It was noted in the Survey that there are several large, undeveloped tracts of land in these watersheds which could lead to a significant possibility that considerable amounts of wildlife animal waste are introduced into the watersheds. Further information about listings of pollution contributions by source in the August 24, 2006 VDH-DSS shoreline sanitary survey is in **Appendix A**. Field forms with information on properties and sources listed in this report are on file in the Richmond office of the Division of Shellfish Sanitation.

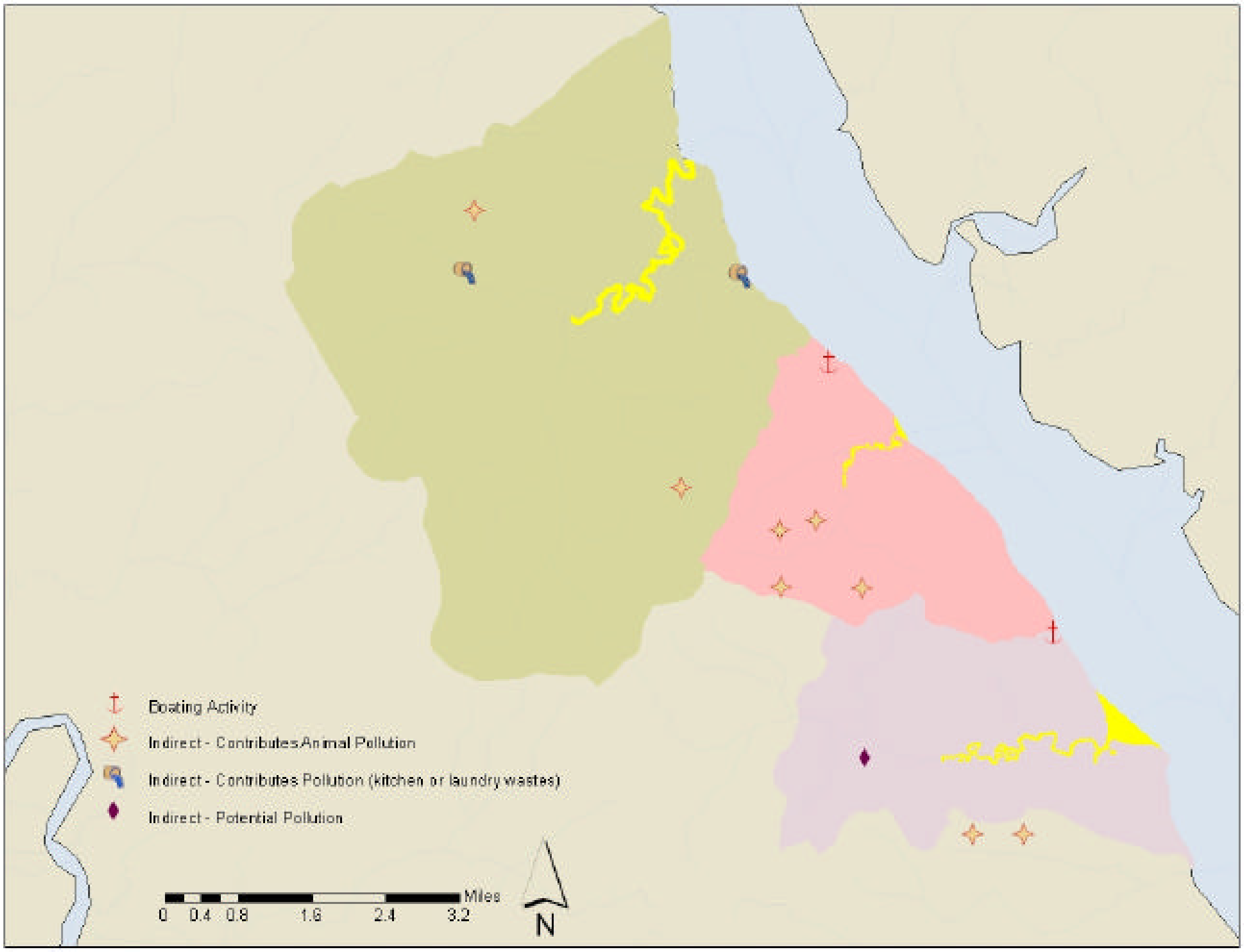


Figure 4.8: VDH-DSS Sanitary Shoreline Survey Deficiencies for Growing Area 50

Point Source Contributions

There are no VPDES permitted wastewater treatment plant discharges that contribute fecal coliform to the impaired waters in the shellfish growing area. Waste load allocations in watersheds where there are no individual VPDES permitted facilities with bacteria effluent limitations are usually represented in the TMDL as 5% of the calculated Total Maximum Daily Load. This 5% is then subtracted from the load allocation.

Non-Point Source (NPS) Contributions

Non-point sources of fecal coliform do not have one discharge point but may occur over the entire length of the receiving water. Fecal coliform bacteria deposited on the land surface can build up over time. During rain events, surface runoff transports water and sediment and discharges to the waterway. Sources of fecal coliform bacteria include grazing livestock, concentrated animal feeding operations, manure application and wildlife and pet excretion. Direct contribution to the waterway occurs when livestock or wildlife defecate into or immediately adjacent to receiving waters. Contributions from wildlife, both mammalian and avian, are natural conditions which may represent a background level of bacterial loading.

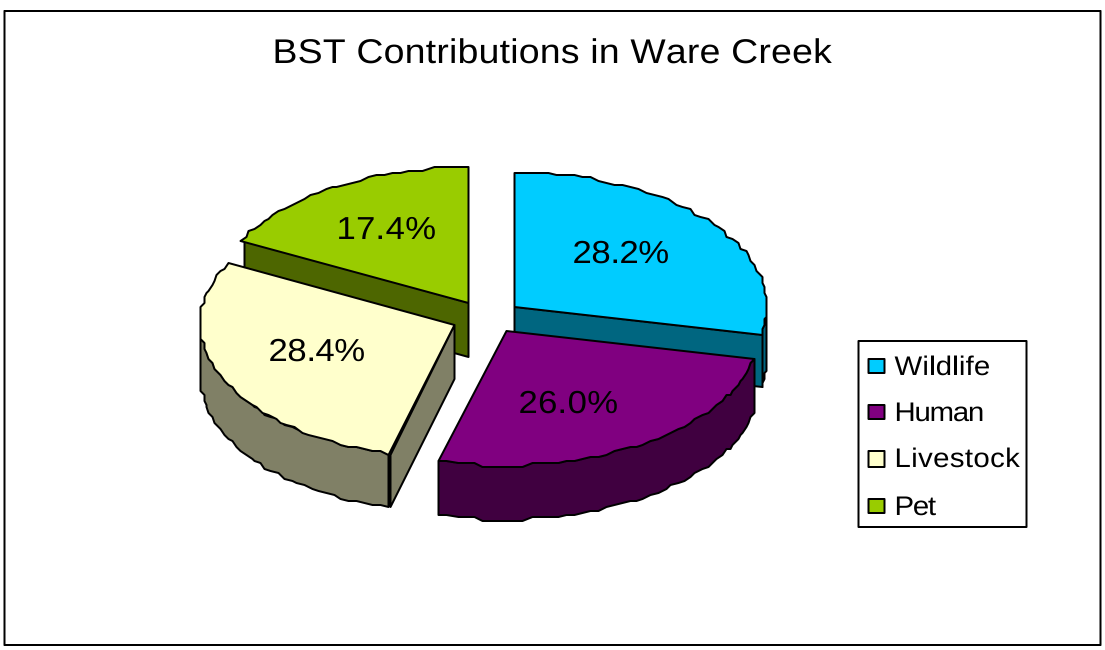
Non-point source contributions from humans generally arise from failing septic systems and associated drain fields, moored or marina vessel discharges, storm water management facilities, pump station failures and ex-filtration from sewer systems. No sewage treatment facilities were listed in the VDH-DSS August 2006 shoreline survey. It is therefore likely that the human loading is due to failures in septic waste treatment systems and/or potential pollution from recreational vessel discharges.

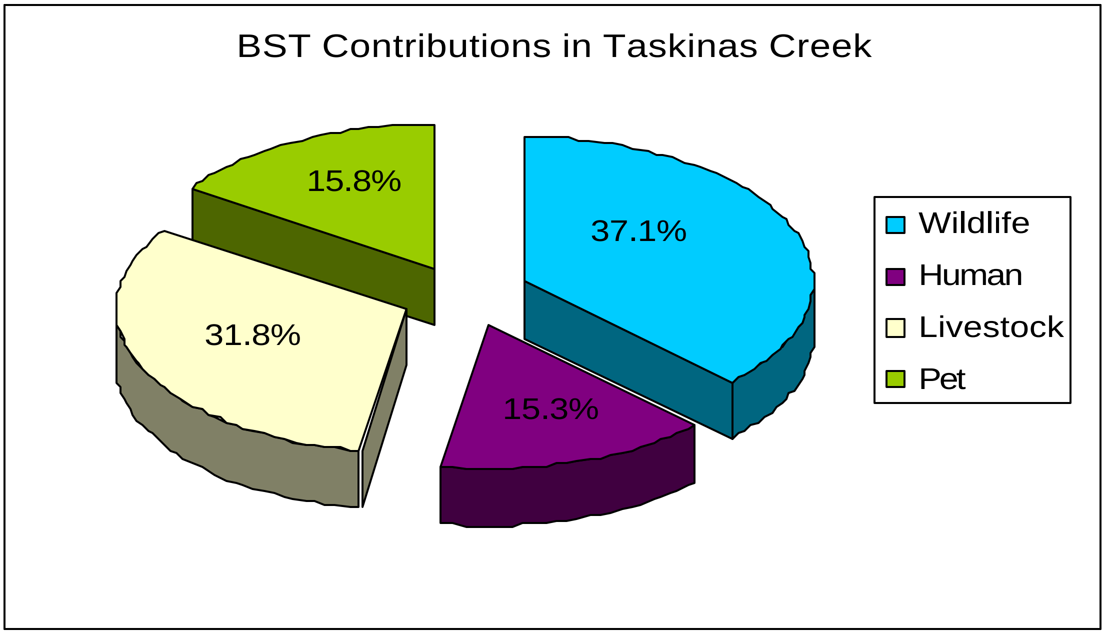
4.4 Bacterial Source Tracking

Bacterial Source Tracking (BST), also referred to as Microbial Source Tracking (MapTech Inc., 2005), is used to identify sources of fecal contamination from human, as well as domestic and wild animals. The BST method used in Virginia is based on the premise that *Escherichia coli (E. Coli)* found in humans, domestic animals, and wild animals will have significantly different patterns of resistance to a variety of antibiotics. The Antibiotic Resistance Approach (ARA) uses fecal streptococcus or *E. coli* and patterns of antibiotic resistance for separation of sources of the bacterial contribution.

The BST analyses for these TMDL studies classified the bacteria into one of four source categories: human, pet, livestock and wildlife. **Figures 4.1A** and **4.1B** show the VDH-DSS monitoring stations in the impaired shellfish growing waters. One station in each of the watersheds was also the BST monitoring station for the impaired Growing Area 50 (Stations 50-22, 50-23, and 50-4). The data developed for the watersheds show the possible dominant bacteria contributions have a fairly even distribution of the sources except for Taskinas Creek where livestock and wildlife are predominant. (**Figure 4.9)**

The mean distribution by month is shown in **Figure 4.10**. The BST sampling period was October 2004 through September 2005. The target sampling interval was once monthly. However, if the graph does not show 12 months, then there were months for which data was not available due to sampling error or no sample taken. Also included in these graphs is the number of bacteria isolates per sample date located along the top of the bars. This data is also shown in **Table 4.2**.





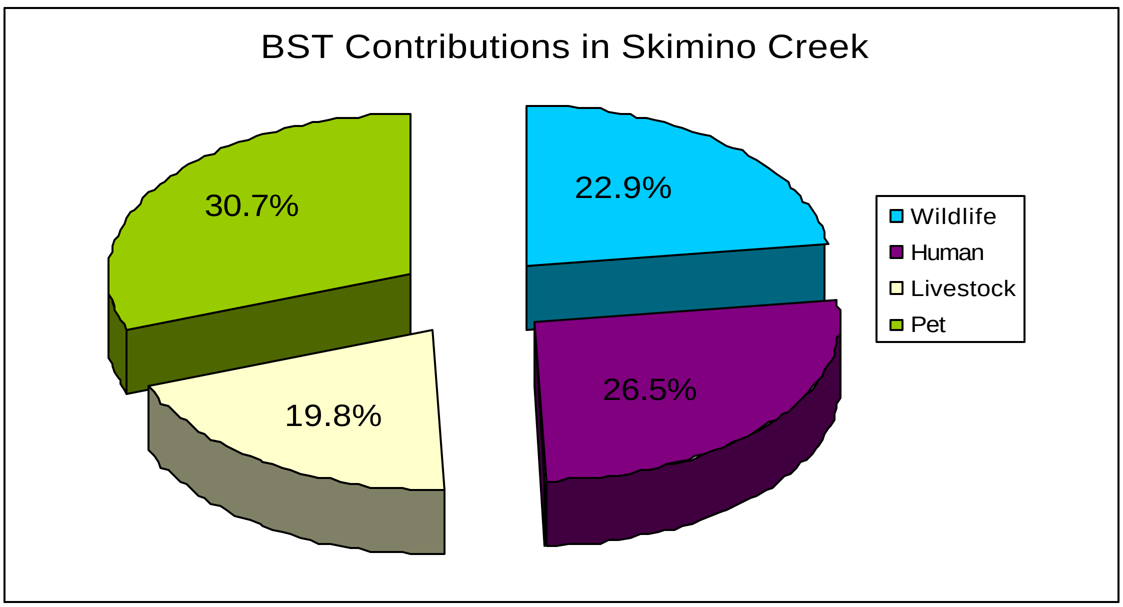
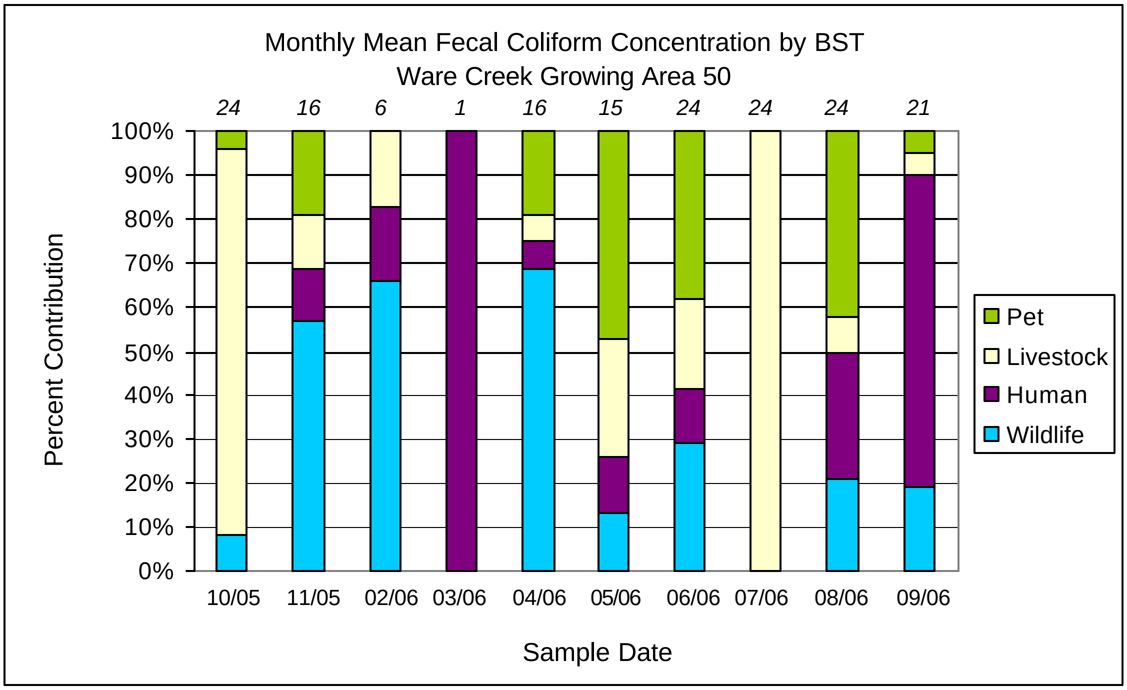
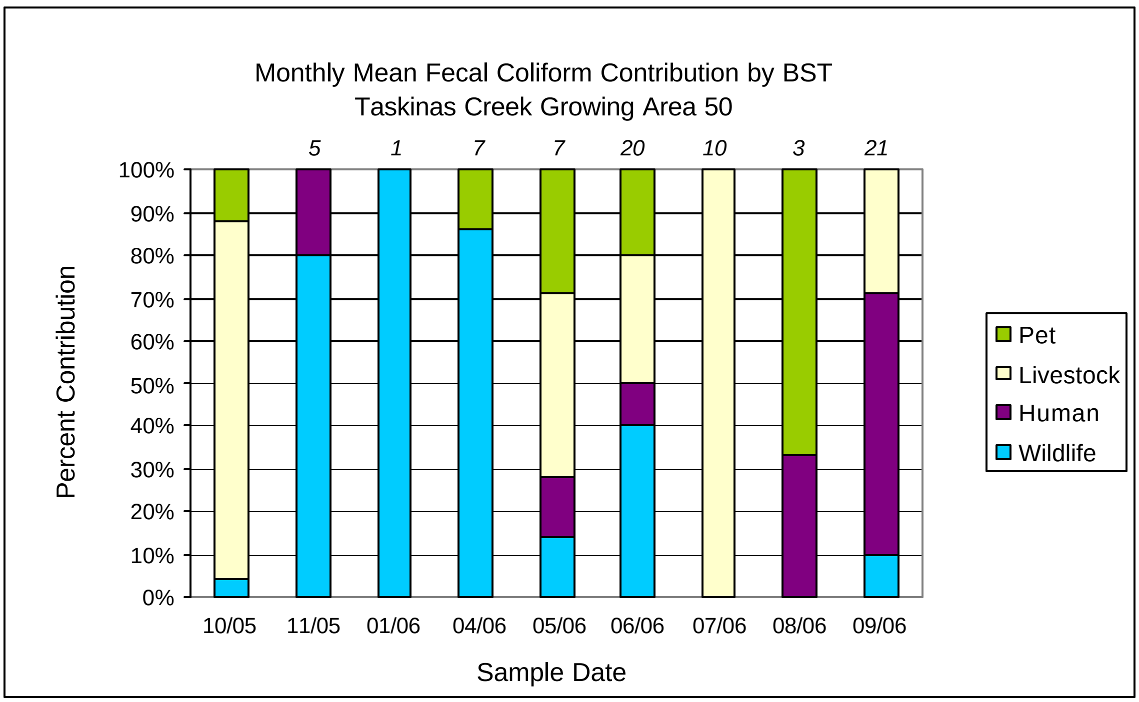


Figure 4.9: Annual BST Results of Fecal Coliform Bacteria for Ware Creek (Station 50-23), Taskinas Creek (Station 50-22), and Skimino Creek (Station 50-4)



Monthly Mean Fecal Coliform Concentration by BST
Ware Creek Growing Area 50
24
16
6
1
16
15
24
24
24
21
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percent Contribution
10/05
11/05
02/06
03/06
04/06
05/06
06/06
07/06
08/06
09/06
Sample Date
Pet
Livestock
Human
Wildlife



Monthly Mean Fecal Coliform Contribution by BST
Taskinas Creek Growing Area 50
5
1
7
7
20
10
3
21
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percent Contribution
10/05
11/05
01/06
04/06
05/06
06/06
07/06
08/06
09/06
Sample Date
Pet
Livestock
Human
Wildlife

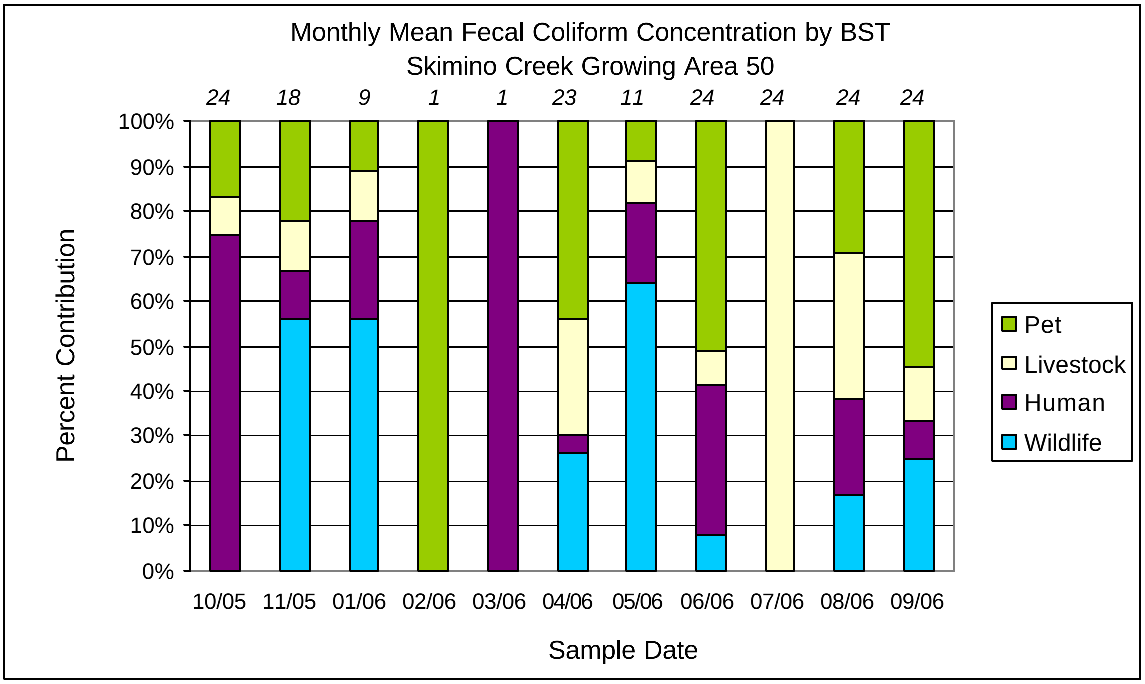


Figure 4.10: Monthly BST Results for Ware Creek (Station 50-23), Taskinas Creek (Station 50-22), and Skimino Creek (Station 50-4)

Table 4.2: Monthly Mean Fecal Coliform Contribution by BST Source

Ware Creek Shellfish Impairment (Station 50-23)					
Sample Date	**Number of Isolates**	**Wildlife (%)**	**Human (%)**	**Livestock (%)**	**Pet (%)**
10/12/2005	24	8	0	88	4
11/28/2005	16	57	12	12	19
2/22/2006	6	66	17	17	0
3/8/2006	1	0	100	0	0
4/5/2006	16	69	6	6	19
5/23/2006	15	13	13	27	47
6/20/2006	24	29	12	21	38
7/5/2006	24	0	0	100	0
8/2/2006	24	21	29	8	42
9/14/2006	21	19	71	5	5
Annual Average		28.2	26.0	28.4	17.4

Taskinas Creek Shellfish Impairment (Station 50-22)					
Sample Date	**Number of Isolates**	**Wildlife (%)**	**Human (%)**	**Livestock (%)**	**Pet (%)**
10/12/2005		4	0	84	12
11/28/2005	5	80	20	0	0
1/9/2006	1	100	0	0	0
4/5/2006	7	86	0	0	14
5/23/2006	7	14	14	43	29
6/20/2006	20	40	10	30	20
7/5/2006	10	0	0	100	0
8/2/2006	3	0	33	0	67
9/14/2006	21	10	61	29	0
Annual Average		37.1	15.3	31.8	15.8

Skimino Creek Shellfish Impairment (Station 50-4)					
Sample Date	**Number of Isolates**	**Wildlife (%)**	**Human (%)**	**Livestock (%)**	**Pet (%)**
10/12/2005	24	0	75	8	17
11/28/2005	18	56	11	11	22
1/9/2006	9	56	22	11	11
2/22/2006	1	0	0	0	100
3/8/2006	1	0	100	0	0
4/5/2006	23	26	4	26	44
5/23/2006	11	64	18	9	9
6/20/2006	24	8	33	8	51
7/5/2006	24	0	0	100	0
8/2/2006	24	17	21	33	29
9/14/2006	24	25	8	12	55
Annual Average		22.9	26.5	19.8	30.7

5.0 TMDL Development

5.1 Simplified Modeling Approach (Volumetric Model):

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 University, James Madison University, and Tetra Tech composed the shellfish TMDL workgroup which developed a procedure using a simplified approach for the development of the TMDL. In this procedure, ambient bacteria data, water body volume, and calculated fecal coliform loads are used. Bacteria source tracking (BST) data was used to determine the sources of fecal coliform violations and the load reductions needed to attain the applicable criteria.

5.2 The TMDL Calculation

To meet the water quality standards for both geometric mean and 90th percentile criteria, the TMDL for the impaired segment in the watershed is defined for the geometric mean load and the 90th percentile load. The TMDL for the geometric mean essentially represents the allowable average limit and the TMDL for the 90th percentile is the allowable upper limit.

Current Fecal Coliform Condition

The fecal coliform concentration in an embayment varies due to the changes in biological, hydrological, and meteorological conditions. The current condition was determined based on the 30-sample geometric mean and 90th percentile of fecal coliform values of each condemned area. The period of record for the monitoring data used to determine the current condition is 2004 to 2006, which also includes the BST monitoring period. The maximum values for geometric mean and 90th percentile were used to represent the current loads. Therefore, the current loads represent the worst case scenario.

Geometric Mean Analysis:

The current 30-sample geometric mean was used for the load estimation. The current load was estimated using simple volumetric calculation model. The allowable load was calculated using the water quality standard of 14 MPN/100mL. The calculated results are listed in **Table 5.1**. The load reduction needed for the attainment of the water quality standard was determined by subtracting the allowable load from the current load. The process may be described by the word equation as follows.

The load reduction is estimated as follows:

1) **Current Load** = Geometric Mean Value (X MPN/100mL) x (volume)

2) **Allowable Load** = Criteria Value (14 MPN/100mL) x (volume)

3) $$\textbf{Load Reduction} = \frac{\textbf{Current Load} - \textbf{Allowable Load}}{\textbf{Current Load}} \times 100\ \%$$

Table 5.1: Geometric Mean Analysis of Current Loads and Estimated Load Reductions in Growing Area 50

Condemnation Area	Volume (m^3)	Max. Fecal Coliform (MPN/100mL)	Water Quality Standard (MPN/100 mL)	Current Load (MPN/day)	Allowable Load (MPN/day)	Required Reduction (%)
Ware Creek 50-073A (VAT-F26E-19)	55,580	66.0	14	3.67E+10	7.78E+09	**78.8**
Taskinas Creek 50-073B (VAT-F26E-18)	54,810	85.8	14	2.10E+10	2.84E+09	**86.5**
Skimino Creek 50-087A (VAT-F26E-17)	20,290	103.5	14	4.70E+10	7.67E+09	**83.7**

90^{th} Percentile Analysis

The current 30-sample 90^{th} percentile concentration was used for load estimation. The current load was estimated using a simple volumetric model. The allowable load was calculated based on the water quality standard of 49 MPN/100mL. This value was also used as boundary condition for the calculation. The calculated results are listed in **Table 5.2**.

The load reduction is estimated as follows:

$$\textbf{Load Reduction} = \frac{\textbf{Current Load} - \textbf{Allowable Load}}{\textbf{Current Load}} \times 100\ \%$$

Table 5.2: 90^{th} Percentile Analysis of Current Loads and Estimated Load Reductions in Growing Area 50

Condemnation Area	Volume (m^3)	Max. Fecal Coliform (MPN/100mL)	Water Quality Standard (MPN/100 mL)	Current Load (MPN/day)	Allowable Load (MPN/day)	Required Reduction (%)
Ware Creek 50-073A (VAT-F26E-19)	55,580	574.0	49	3.19E+11	2.72E+10	**91.5**
Taskinas Creek 50-073B (VAT-F26E-18)	54,810	478.5	49	1.40E+11	9.94E+09	**92.9**
Skimino Creek 50-087A (VAT-F26E-17)	20,290	691.8	49	2.62E+11	2.69E+10	**89.7**

5.3 Load Allocation

A comparison of the reductions based on the geometric mean load and on the 90th percentile load shows that the 90th percentile load is the critical condition for the impaired waters in Growing Area 50. This is consistent with water quality analysis because the 90th percentile criterion is most frequently exceeded. Therefore, the 90th percentile loading is used to allocate source contributions and establish load reduction targets among the various contributing sources that will yield the necessary water quality improvements to attain the water quality standard in Ware Creek, Taskinas Creek, and Skimino Creek.

Based on source assessment of the watershed, the percent loading for each of the four major source categories is estimated. These percentages are then used to determine where load reductions are needed. The loadings for each source are determined by multiplying the total current and allowable loads by the representative percentage. The percent reduction needed to attain the water quality standard or criterion is allocated to each source category. This is shown in **Tables 5.3 – 5.5** and serves to fulfill the TMDL requirements by ensuring that the criterion is attained.

Table 5.3: Reductions and Allocations Based Upon 90th Percentile Standard

Condemnation Area	Source	BST Allocation (% of Total Load)	Current Load (MPN/ day)	Load Allocation (MPN/ day)	Reduction Required (%)
50-073A Ware Creek	Livestock	28	8.93E+10	0.00E+00	100
	Wildlife	29	9.25E+10	2.58E+10	70.9
	Human	26	8.29E+10	0.00E+00	100
	Pets	17	5.42E+10	0.00E+00	100
	Point Source	-	-	1.36E+09	0
	Total	**100.0**	**3.19E+11**	**2.72E+10**	**91.5**

Condemnation Area	Source	BST Allocation (% of Total Load)	Current Load (MPN/ day)	Load Allocation (MPN/ day)	Reduction Required (%)
50-073B Taskinas Creek	Livestock	32	4.48E+10	0.00E+00	100
	Wildlife	37	5.18E+10	9.44E+09	81.0
	Human	15	2.10E+10	0.00E+00	100
	Pets	16	2.24E+10	0.00E+00	100
	Point Source	-	-	4.97E+08	0
	Total	**100**	**1.40E+11**	**9.94E+09**	**92.9**

Condemnation Area	Source	BST Allocation (% of Total Load)	Current Load (MPN/ day)	Load Allocation (MPN/ day)	Reduction Required (%)
50-087A Skimino Creek	Livestock	20	5.24E+10	0.00E+00	100
	Wildlife	23	6.03E+10	2.56E+10	57.5
	Human	27	7.07E+10	0.00E+00	100
	Pets	30	7.86E+10	0.00E+00	100
	Point Source	-	-	1.34E+09	0
	Total	**100**	**2.62E+11**	**2.69E+10**	**89.7**

TMDLs seek to eliminate 100% of the human-derived fecal bacteria component, regardless of the allowable load determined through the load allocation process. Human-derived fecal coliforms are a serious concern in the estuarine environment and discharge of human waste is precluded by state and federal law. According to the preceding analysis, reduction of the controllable loads; human, livestock and pets, will not result in achievement of the water quality standard for the condemned area. Therefore, a reduction for the wildlife load was applied. Through an iterative implementation of actions to reduce the controllable loads, subsequent monitoring may indicate that further reductions are not necessary, or that revisions in implementation strategies may be appropriate. Continued violations may result in the process of Use Attainment Analysis, UAA, for the waterbody (see Chapter 6 for a discussion of UAA). The allocations presented demonstrate how the TMDL could be implemented to achieve water quality standards; however, the state reserves the right to allocate differently, as long as consistency with the achievement of water quality standards is maintained.

5.4 Development of Wasteload Allocations

There are no permitted point source discharges that affect the harvestable shellfish waters in the watershed. Waste load allocations in watersheds where there are no individual VPDES permitted facilities with bacteria effluent limitations are usually represented in the TMDL as 5% of the calculated Total Maximum Daily Load. This 5% is then subtracted from the load allocation.

5.5 Consideration of Critical Conditions and Seasonal Variation

EPA regulations at 40 CFR 130.7 (c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the waterbody is protected during times when they are most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards. The current loading to the waterbody was determined using a long-term record of water quality monitoring (observation) data.

A comparison of the geometric mean values and the 90th percentile values against the water quality criteria have determined which one represents the more critical condition or higher percent reduction. If the geometric mean values dictate the higher reduction, this suggests that, on average, water sample counts are consistently high with limited variation around the mean. If the 90th percentile criterion requires a higher reduction, this suggests an occurrence of the high fecal coliform due to the variation of hydrological conditions. For this study, the 90th percentile criterion is the most critical condition. Thus, the final load reductions determined using the 90th percentile represent the most stringent conditions and it is the reductions based on these bacterial loadings that will yield attainment of the water quality standard.

Seasonal variations involve changes in surface runoff, stream flow, and water quality as a result of hydrologic and climatologic patterns. Variations due to changes in the hydrologic cycle as well as temporal variability in fecal coliform sources, such as migrating duck and goose populations are accounted for by the use of the long-term data record to estimate the current load.

5.6 Margin of Safety

A Margin of Safety (MOS) is required as part of a TMDL in recognition of uncertainties in the understanding and simulation of water quality in natural systems. For example, knowledge is incomplete regarding the exact nature and magnitude of pollutant loads from various sources and the specific impacts of those pollutants on the chemical and biological quality of complex, natural water bodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection. Due to the very conservative assumptions made in this modeling effort, the margin of safety is considered to be implicit in the load allocations the model establishes.

5.7 TMDL Summary

To meet the water quality standards for both geometric mean and 90th percentile criteria, loads have been defined for the Ware Creek, Taskinas Creek, and Skimino Creek watersheds in Growing Area 50. The TMDL loads are summarized in **Table 5.4** and **Table 5.5**.

Table 5.4: TMDL Summary for Shellfish Growing Area 50 in the Ware Creek, Taskinas Creek and Skimino Creek Watersheds (Geometric Mean)

Condemnation Area	Pollutant Identified	TMDL MPN/day	Waste Load Allocation MPN/day	Load Allocation MPN/day	Margin of Safety
Ware Creek 50-073A (VAT-F26E-19)	Fecal Coliform	7.78E+09	3.89E+08	7.39E+09	Implicit
Taskinas Creek 50-073B (VAT-F26E-18)	Fecal Coliform	2.84E+09	1.42E+08	2.69E+09	Implicit
Skimino Creek 50-087A (VAT-F26E-17)	Fecal Coliform	7.67E+09	3.84E+08	7.28E+09	Implicit

Table 5.5: TMDL Summary for Shellfish Growing Area 50 in the Ware Creek, Taskinas Creek and Skimino Creek Watersheds (90th Percentile)

Condemnation Area	Pollutant Identified	TMDL MPN/day	Waste Load Allocation MPN/day	Load Allocation MPN/day	Margin of Safety
Ware Creek 50-073A (VAT-F26E-19)	Fecal Coliform	2.72E+10	1.36E+09	2.58E+10	Implicit
Taskinas Creek 50-073B (VAT-F26E-18)	Fecal Coliform	9.94E+09	4.97E+08	9.44E+09	Implicit
Skimino Creek 50-087A (VAT-F26E-17)	Fecal Coliform	2.69E+10	1.34E+09	2.56E+10	Implicit

6.0 TMDL Implementation

The goal of the TMDL program is to establish a three-step path that will lead to attainment of water quality standards. The first step in the process is to develop TMDLs that will result in meeting water quality standards. The second step is to develop a TMDL implementation plan. The final step is to implement the TMDL implementation plan, and to monitor water quality to determine if water quality standards are being attained.

Once a TMDL has been approved by EPA, measures must be taken to reduce pollution levels in the waterbody. These measures, which can include the use of better treatment technology and the installation of best management practices (BMPs), are implemented in an iterative process that is described along with specific BMPs in the implementation plan. The process for developing an implementation plan has been described in the "TMDL Implementation Plan Guidance Manual", published in July 2003 and available upon request from the VADEQ and DCR TMDL project staff or at http://www.deq.state.va.us/tmdl/implans/ipguide.pdf. With successful completion of implementation plans, Virginia will be well on the way to restoring impaired waters and enhancing the value of this important resource. Additionally, development of an approved implementation plan will improve a locality's chances for obtaining financial and technical assistance during implementation.

6.1 Staged Implementation

In general, Virginia intends for the required reductions to be implemented in an iterative process that first addresses those sources with the largest impact on water quality. For example, 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. Buffers are needed to reduce bacteria and other pollutants from entering the stream, as well as to control flooding during high flow events. During the development of the implementation plan, stream restoration efforts should be considered.

Additionally, 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. This component could be implemented through education on periodic septic tank pump-outs, as well as a septic system repair/replacement program and the use of alternative waste treatment systems. In urban areas, reducing the loading from leaking sewer lines could be accomplished through a sanitary sewer inspection and management program.

In addition to control measures, educational efforts are vital to the success of an implementation plan. Education should include a pet litter program to educate pet owners on the benefits of cleaning up after their pet, through education material, signs in public area that encourage the proper disposal of waste, and pet waste disposal stations in public areas. Another educational program should focus efforts on septic tank pump-outs and maintenance. This will benefit water quality by preventing failing septic systems. According to the Chesapeake Bay Preservation Act, all septic tanks should be pumped. Also, all failing septic systems must be identified and corrected during implementation.

The iterative implementation of BMPs in the watershed has several benefits:

1. It enables tracking of water quality improvements following BMP implementation through follow-up monitoring;

2. It provides a measure of quality control, given the uncertainties inherent in computer simulation modeling;
3. It provides a mechanism for developing public support through periodic updates on BMP implementation and water quality improvements;
4. It helps ensure that the most cost effective practices are implemented first; and
5. It allows for the evaluation of the adequacy of the TMDL in achieving water quality standards.

Watershed stakeholders will have opportunity to participate in the development of the TMDL implementation plan. Specific goals for BMP implementation will be established as part of the implementation plan development.

6.2 Links to On-going Restoration Efforts

Implementation of this TMDL will contribute to on-going water quality improvement efforts aimed at restoring water quality in the Lower James River basin of Virginia. Other approved TMDLs for shellfish use waters in this area to date include: Upper Nansemond River, Shingle Creek, Pagan River, Jones Creek, Warwick River, Skiffes Creek, and Deep Creek.

6.3 Reasonable Assurance for Implementation

Follow-Up Monitoring

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.

Regulatory Framework

While section 303(d) of the Clean Water Act and current EPA regulations do not require the development of TMDL implementation plans as part of the TMDL process, they do require reasonable assurance that the load and wasteload allocations can and will be implemented. Additionally, Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (WQMIRA) directs the State Water Control Board to "develop and implement a plan to achieve fully supporting status for impaired waters" (Section 62.1-44.19.7). WQMIRA also establishes that the implementation plan shall include the date of expected achievement of water quality objectives, measurable goals, corrective actions necessary, and the associated costs, benefits and environmental impacts of addressing the impairments. EPA outlines the minimum elements of an approvable implementation plan in its 1999 "Guidance for Water Quality-Based Decisions: The TMDL Process." The listed elements include implementation actions/management measures, timelines, legal or regulatory controls, time required to attain water quality standards, monitoring plans and milestones for attaining water quality standards.

Once developed, VADEQ intends to incorporate the TMDL implementation plan into the appropriate Water Quality Management Plan (WQMP), in accordance with the Clean Water Act's Section 303(e). In response to a Memorandum of Understanding (MOU) between EPA and VADEQ, VADEQ submitted a Continuous Planning Process to EPA in which VADEQ commits to regularly update the WQMPs. Thus, the WQMPs will be, among other things, the repository for all TMDLs and TMDL implementation plans developed within a river basin.

Implementation Funding Sources

Cooperating agencies, organizations and stakeholders may identify potential funding sources available for implementation during the development of the implementation plan in accordance with the "Virginia Guidance Manual for Total Maximum Daily Load Implementation Plans". A potential source of funding for TMDL implementation is incremental funding from Section 319 of the Clean Water Act. Other funding sources include the VA Agricultural BMPs Cost-Share Program, Tax Credit Program, and Loan Program. Funding may also be available through the VA Water Quality Improvement Fund, Conservation Reserve Program, Conservation Reserve Enhancement Program, Environmental Quality Incentives Program, Wildlife Habitat Incentive Program, Wetlands Reserve Program, National Fish and Wildlife Foundation, and the Clean Water State Revolving Fund. The TMDL Implementation Plan Guidance Manual contains additional information on funding sources, as well as government agencies that might support implementation efforts and suggestions for integrating TMDL implementation with other watershed planning efforts.

Addressing Wildlife Contributions

In some waters for which TMDLs have been developed, water quality modeling indicates that even after removal of all of the sources of bacteria (other than wildlife), the stream will not attain standards under all flow regimes at all times. **However, neither the Commonwealth of Virginia, nor EPA are proposing the elimination of wildlife to allow for the attainment of water quality standards.** The Department of Game and Inland Fisheries (DGIF) may determine that a population of resident geese, deer or other wildlife is at "nuisance" levels during the implementation plan development in consultation with a local government or a landowner. Measures to reduce such populations may be deemed acceptable if undertaken under the supervision, or issued permit, of the DGIF or the U.S. Fish and Wildlife Service as appropriate**.** While managing over-populations of wildlife will remain as an option to local stakeholders, the reduction of wildlife or changing a natural background condition is not the intended goal of a TMDL.

EPA and Virginia have developed a TMDL strategy to address the wildlife issue. The first step in this strategy is to develop a reduction goal. 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 using the staged approach outlined above. 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 technical assumptions were correct. In some cases, the effort may never have to go to the second phase because the water quality standard excursions attributed to wildlife may be very small and fall within the margin of error.

If water quality standards are not being met, a special study called a Use Attainability Analysis (UAA) may be initiated to reflect the presence of naturally high bacteria levels due to uncontrollable sources. The outcomes of the UAA may determine that the designated use(s) of the waters may need to be changed to reflect the attainable use(s). To remove a designated 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). All site-specific criteria or designated use changes must be adopted as amendments to the water quality standards regulations. Watershed stakeholders and EPA are able to provide comments during this process. Additional information can be obtained at http://www.deq.state.va.us/wqs/WQS03AUG.pdf.

7.0 Public Participation

During development of the TMDL for the Ware Creek, Taskinas Creek, and Skimino Creek watersheds in Growing Area 50, public involvement was encouraged through a public participation process that included public meetings and stakeholder meetings.

The first public meeting was held on September 1, 2009 at the James City County Library and nine people attended. The purpose of this meeting was to provide a basic description of the TMDL process and the agencies involved and to gain general information about the watershed. Also presented were the initial source assessment inputs, bacterial source tracking, and model results. This meeting was followed by development of the draft TMDL and a review by the stakeholders.

The second public meeting was held on December 7, 2009 at the James City County Library and eight people attended. At this meeting, the TMDL load allocations were presented as well as the final draft report.

Input from these meetings was utilized in the development of the TMDL and improved confidence in the allocation scenarios and TMDL process. Public involvement in the TMDL implementation planning process was encouraged.

8.0 Glossary

303(d). A section of the Clean Water Act of 1972 requiring states to identify and list water bodies that do not meet the states' water quality standards.

Allocations. That portion of receiving water's loading capacity attributed to one of its existing or future pollution sources (nonpoint or point) or to natural background sources. (A wasteload allocation [WLA] is that portion of the loading capacity allocated to an existing or future point source, and a load allocation [LA] is that portion allocated to an existing or future nonpoint source or to natural background levels. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading.)

Ambient water quality. Natural concentration of water quality constituents prior to mixing of either point or nonpoint source load of contaminants. Reference ambient concentration is used to indicate the concentration of a chemical that will not cause adverse impact on human health.

Anthropogenic. Pertains to the [environmental] influence of human activities.

Bacteria. Single-celled microorganisms. Bacteria of the coliform group are considered the primary indicators of fecal contamination and are often used to assess water quality.

Bacterial source tracking (BST). A collection of scientific methods used to track sources of fecal contamination.

Best management practices (BMPs). Methods, measures, or practices determined to be reasonable and cost-effective means for a landowner to meet certain, generally nonpoint source, pollution control needs. BMPs include structural and nonstructural controls and operation and maintenance procedures.

Clean Water Act (CWA). The Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972), Public Law 92-500, as amended by Public Law 96-483 and Public Law 97-117, 33 U.S.C. 1251 et seq. The Clean Water Act (CWA) contains a number of provisions to restore and maintain the quality of the nation's water resources. One of these provisions is section 303(d), which establishes the TMDL program.

Concentration. Amount of a substance or material in a given unit volume of solution; usually measured in milligrams per liter (mg/L) or parts per million (ppm).

Contamination. The act of polluting or making impure; any indication of chemical, sediment, or biological impurities.

Cost-share program. A program that allocates project funds to pay a percentage of the cost of constructing or implementing a best management practice. The remainder of the costs is paid by the producer(s).

Critical condition. The critical condition can be thought of as the "worst case" scenario of environmental conditions in the waterbody in which the loading expressed in the TMDL for the pollutant of concern will continue to meet water quality standards. Critical conditions are the combination of environmental factors (e.g., flow, temperature, etc.) that results in attaining and maintaining the water quality criterion and has an acceptably low frequency of occurrence.

Designated uses. Those uses specified in water quality standards for each waterbody or segment whether or not they are being attained.

Direct – Contributes Pollution - (Direct or Indirect) – VDH Division of Shellfish Sanitations terminology for point source or non-point source pollution sources and potential pollution sources used in their Shoreline Sanitary Surveys.

Domestic wastewater. Also called sanitary wastewater, consists of wastewater discharged from residences and from commercial, institutional, and similar facilities.

Drainage basin. A part of a land area enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into a receiving water. Also referred to as a watershed, river basin, or hydrologic unit.

Existing use. Use actually attained in the waterbody on or after November 28, 1975, whether or not it is included in the water quality standards (40 CFR 131.3).
Fecal Coliform. Indicator organisms (organisms indicating presence of pathogens) associated with the digestive tract.
Geometric mean. A measure of the central tendency of a data set that minimizes the effects of extreme values.
GIS. Geographic Information System. A system of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analyzing and disseminating information about areas of the earth. (Dueker and Kjerne, 1989)
Infiltration capacity. The capacity of a soil to allow water to infiltrate into or through it during a storm.
Interflow. Runoff that travels just below the surface of the soil.
Loading, Load, Loading rate. The total amount of material (pollutants) entering the system from one or multiple sources; measured as a rate in weight per unit time.
Load allocation (LA). The portion of a receiving waters loading capacity attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loads should be distinguished (40 CFR 130.2(g)).
Loading capacity (LC). The greatest amount of loading a water body can receive without violating water quality standards.
Margin of safety (MOS). A required component of the TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving water body (CWA section 303(d)(1)©). The MOS is normally incorporated into the conservative assumptions used to develop TMDLs (generally within the calculations or models) and approved by EPA either individually or in state/EPA agreements. If the MOS needs to be larger than that which is allowed through the conservative assumptions, additional MOS can be added as a separate component of the TMDL (in this case, quantitatively, a TMDL = LC = WLA + LA + MOS).
Mean. The sum of the values in a data set divided by the number of values in the data set.
Monitoring. Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.
Narrative criteria. Non-quantitative guidelines that describe the desired water quality goals.
Nonpoint source. Pollution that originates from multiple sources over a relatively large area. Nonpoint sources 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.
Numeric targets. A measurable value determined for the pollutant of concern, which, if achieved, is expected to result in the attainment of water quality standards in the listed waterbody.
Point source. Pollutant loads discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants or industrial waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving water waterbody or river.
Pollutant. Dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. (CWA section 502(6)).
Pollution. Generally, the presence of matter or energy whose nature, location, or quantity produces undesired environmental effects. Under the Clean Water Act, for example, the term is defined as the man-made or man-induced alteration of the physical, biological, chemical, and radiological integrity of water.

Privately owned treatment works. Any device or system that is (a) used to treat wastes from any facility whose operator is not the operator of the treatment works and (b) not a publicly owned treatment works.
Public comment period. The time allowed for the public to express its views and concerns regarding action by EPA or states (e.g., a Federal Register notice of a proposed rule-making, a public notice of a draft permit, or a Notice of Intent to Deny).
Publicly owned treatment works (POTW). Any device or system used in the treatment (including recycling and reclamation) of municipal sewage or industrial wastes of a liquid nature that is owned by a state or municipality. This definition includes sewers, pipes, or other conveyances only if they convey wastewater to a POTW providing treatment.
Raw sewage. Untreated municipal sewage.
Receiving waters. Creeks, streams, rivers, lakes, estuaries, ground-water formations, or other bodies of water into which surface water and/or treated or untreated waste are discharged, either naturally or in man-made systems.
Riparian areas. Areas bordering streams, lakes, rivers, and other watercourses. These areas have high water tables and support plants that require saturated soils during all or part of the year. Riparian areas include both wetland and upland zones.
Riparian zone. The border or banks of a stream. Although this term is sometimes used interchangeably with floodplain, the riparian zone is generally regarded as relatively narrow compared to a floodplain. The duration of flooding is generally much shorter, and the timing less predictable, in a riparian zone than in a river floodplain.
Runoff. That part of precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface water. It can carry pollutants from the air and land into receiving waters.
Septic system. An on-site system designed to treat and dispose of domestic sewage. A typical septic system consists of a tank that receives waste from a residence or business and a drain field or subsurface absorption system consisting of a series of percolation lines for the disposal of the liquid effluent. Solids (sludge) that remain after decomposition by bacteria in the tank must be pumped out periodically.
Sewer. A channel or conduit that carries wastewater and storm water runoff from the source to a treatment plant or receiving stream. Sanitary sewers carry household, industrial, and commercial waste. Storm sewers carry runoff from rain or snow. Combined sewers handle both.
Slope. The degree of inclination to the horizontal. Usually expressed as a ratio, such as 1:25 or 1 on 25, indicating one unit vertical rise in 25 units of horizontal distance, or in a decimal fraction (0.04), degrees (2 degrees 18 minutes), or percent (4 percent).
Stakeholder. Any person with a vested interest in the TMDL development.
Surface area. The area of the surface of a waterbody; best measured by planimetry or the use of a geographic information system.
Surface runoff. Precipitation, snowmelt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants.
Surface water. All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors directly influenced by surface water.
Topography. The physical features of a geographic surface area including relative elevations and the positions of natural and man-made features.
Total Maximum Daily Load (TMDL). The sum of the individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural background, plus a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.
VADEQ. Virginia Department of Environmental Quality.

VDH. Virginia Department of Health.
Virginia Pollutant Discharge Elimination System (VPDES). The national program for issuing, modifying, revoking and re-issuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Clean Water Act.
Wasteload allocation (WLA). The portion of a receiving waters' loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation (40 CFR 130.2(h)).
Wastewater. Usually refers to effluent from a sewage treatment plant. See also **Domestic wastewater**.
Wastewater treatment. Chemical, biological, and mechanical procedures applied to an industrial or municipal discharge or to any other sources of contaminated water to remove, reduce, or neutralize contaminants.
Water quality. The biological, chemical, and physical conditions of a waterbody. It is a measure of a waterbody's ability to support beneficial uses.
Water quality criteria. Levels of water quality expected to render a body of water suitable for its designated use, composed of numeric and narrative criteria. Numeric criteria are scientifically derived ambient concentrations developed by EPA or states for various pollutants of concern to protect human health and aquatic life. Narrative criteria are statements that describe the desired water quality goal. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.
Water quality standard. Law or regulation that consists of the beneficial designated use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular waterbody, and an anti-degradation statement.
Watershed. A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.
WQIA. Water Quality Improvement Act.

9.0 Citations

MapTech Inc. December (2005). Bacterial Source Tracking Analysis to Support Virginia's TMDLs: Shellfish Stations.

VADEQ (1998). Virginia Total Maximum Daily Load Priority List and 303(d) List of Impaired Waters.

VADEQ (2003). TMDL Implementation Plan Guidance Manual.

EPA-US (1999). Guidance for Water Quality-Based Decisions: The TMDL Process. EPA 440/4-99-001.

10.0 Appendices

Appendix A

A-1: Growing Area 50 VDH-DSS Shoreline Sanitary Survey August 24, 2006

A-2: Growing Area 50 Condemnation Notice 073A-Ware Creek and 073B-Taskinas Creek

A-3: Growing Area 50 Condemnation Notice 087A-Skimino Creek

Appendix B Supporting Documentation and Watershed Assessment

B-1: Fecal Production Literature Review

B-2: Geographical Information System Data: Sources and Process

B-3: Watershed Source Assessment

B-4: Water Quality Data Summary

Appendix C Code of Virginia §62.1-194.1: Obstructing or contaminating state waters.

Appendix D Guidance Memo No. 04-2022: Procedures for Establishing Boating No Discharge Zones

Appendix E Vessel Sewage Discharge Program

Appendix A

A-1: Growing Area 50 VDH-DSS Shoreline Sanitary Survey August 24, 2006

YORK RIVER: CAMP PEARY TO TERRAPIN POINT
Growing Area # 050
James City, New Kent and York Counties
Shoreline Sanitary Survey

Date: 24 August 2006
Survey Period: November 18, 2005 - July 28, 2006
Total Number of Properties Surveyed: 830
Surveyed By: J.D. Dickerson and J.E. Merritt

SECTION A: GENERAL

This survey area extends from Reference Point 50 at the end of State Route 635 at Terrapin Point to Reference Point 51 at the end of the road approximately 250 yards north of Beaverdam Pond in the Camp Peary Naval Reservation, including the York River Shoreline between these two points; Ware Creek (France Swamp and Cow Swamp), Taskinas Creek, Skimino Creek (Skimino Pond), Powell Lake, Carter Creek, Bigler Mill Pond, and all of there tributaries. The survey boundary has been revised. See map for current survey boundary.

The topography in this area varies in elevation from 10' along the shoreline to a maximum of 110' at the outer southwest edge of the survey boundary. The population is sparse to moderate with heavier concentrations around Christensons Corner, Barlows Corner and Skimino Farms. The economy is based mainly on agriculture, tourism, recreation and commuters to nearby military installations and private industry.

Within this survey area there are several large, relatively undeveloped tracts of land owned in part by private corporations, the state parks department and the U.S. Government. Due to this fact there is the significant possibility of large inputs of wild animal wastes into this watershed. It is notable to mention that in the community of Woodland Estates there are a number of homes that keep horses on site, however only 3 of these properties had enough animals at the time of the survey to be classified as CAP.

Meteorological data indicated that the area received a total rainfall of 30.96" for the survey period. A monthly breakdown is as follows:

November 18-30, 2005 2.29" February 1.41" May 4.16"
December 3.01" March 0.47" June 8.67"
January 2006 4.22" April 3.74" July 1-28, 2006 2.99"

Copies of Bacteriological, Hydrographic, and Shellfish Closure data are available at the area office for review. Copies of the current condemnation notices and maps are available via the Internet at http://www.vdh.virginia.gov/oehs/shellfish/.

This report lists only those properties that have a sanitary deficiency or have other environmental significance. "DIRECT" indicates that the significant activity or deficiency has a direct impact on shellfish waters. Individual field forms with full information on properties listed in this report are on file in the Richmond Office of the Division of Shellfish Sanitation and are available for reference until superseded by a subsequent survey of the area. Data in the report is also made available to local health departments and other agencies to address items that may be out of compliance with their regulatory programs.

SECTION B: SEWAGE POLLUTION SOURCES

SEWAGE TREATMENT FACILITIES
-None-

ON-SITE SEWAGE DEFICIENCIES
2. CONTRIBUTES POLLUTION (Kitchen or Laundry Waste) - 3711 Holly Fork Road, Barhamsville 23011. Dwelling- gray vinyl siding 1 story with white trim. No contact. Laundry waste draining from washing machine located in shed onto ground. Sanitary Notice issued 11-30-05 to field # 23.

4. CONTRIBUTES POLLUTION (Kitchen or Laundry Waste) - 10015 Sycamore Landing Road, Williamsburg 23188. Dwelling- white frame 1 story with black shutters. No contact. Laundry waste draining onto ground through 2" black pvc pipe that is partially buried exiting from house. Sanitary Notice issued 3-3-06 to field # 87.

POTENTIAL POLLUTION
11. 4012 Newman Road, Williamsburg 23188. Dwelling- brick 1 story with white trim. 2 persons. Soil saturated over part of drainfield. Algal mat present but no evidence of effluent eruption observed at time of inspection.

SECTION C: NON-SEWAGE WASTE SITES

INDUSTRIAL WASTES
-None-

SOLID WASTE DUMPSITES
-None-

SECTION D: BOATING ACTIVITY

MARINAS
-None-

OTHER PLACES WHERE BOATS ARE MOORED
5. York River State Park, Croaker Landing, End of Route 805 (Croaker Landing Road), Williamsburg 23188. Owner: Virginia Department of Conservation and Recreation, 203 Governor Street, Suite 213, Richmond 23219. Public boat ramp and piers. 1 person. There were no boats present at time of survey. The only boating service provided are 2 ramps. Containers are available for solid waste collection. Sanitary facilities provided are 2 commodes, 1 urinal and 3 lavatories for men; and for women there are 3 commodes and 3 lavatories. Sewage disposal is by septic tank with drainfield, which appeared to be working satisfactorily at time of inspection. There are no boat holding tank pump-out facilities or portable toilet dump station facilities at this location.

UNDER SURVEILLANCE
10. Riverview Plantation Homeowners Association, End of State Route 606 (Riverview Plantation Road), Williamsburg 23188. Private- boat ramp and dock for subdivision residents. No contact. There were no boats present at time of survey. The only boating service provided is a single ramp. There are no sanitary facilities, no boat holding tank pump-out facilities, no portable toilet dump station facilities and no solid waste containers at this location.

SECTION E: CONTRIBUTES ANIMAL POLLUTION

1. March Morning Farm, 4101 Holly Fork Road, Barhamsville 23011. Dwelling- cream vinyl siding 2 story with black shutters and red tin roof. No contact. Present at time of survey were 8 horses in fenced pastures. Manure appears to be left on ground or composted.

3. Jolin Kennels, 4472 Ware Creek Road, Williamsburg 23188. Dog and cat boarding and grooming. 2 persons. Present at time of survey were 6 dogs in fenced kennels. Facility has the capacity to board 25 animals. Pet waste is disposed of in septic tank. Also observed on site were 25-30 assorted fowl (penned and free roaming). Manure from fowl is left on ground.

6. 4 Meadow Circle, Williamsburg 23188. Dwelling- gray vinyl siding 1½ story with red shutters and white trim. 2 persons. Present at time of survey were 6 horses in fenced pasture. Manure is composted and used as fertilizer.

7. 411 Stonehouse Circle, Williamsburg 23188. Dwelling- yellow vinyl siding 2 story with white trim. No contact. Present at time of survey were 8 horses in fenced pasture. Manure appears to be left on ground surface to decompose.

8. 5194 Riverview Road, Williamsburg 23188. Dwelling- light brown vinyl siding 1 story with white trim. No contact. Present at time of survey were 12 cows in fenced pasture. Manure appears to be left on ground surface to decompose or composted for fertilizer.

9. Stonehenge Kennels, 5550 Riverview Road, Williamsburg 23188. Business- dog kennels and grooming services. 1 person. Present at time of survey were 24 dogs in kennel. Waste from kennels is washed down into gutters that are connected to the septic system.

12. Walnut Acres Farm,143 Skimino Road, Willimasburg 23188. Agricultural- large horse farm with 1 horse stable, 1 barn and 2 residences. 5 persons. Present at time of survey were 23 horses and 3 donkeys in several fenced pastures with no direct access to free flowing streams or tidal waters. Barn is located approximately 100' from Skimino Creek. 1 pasture is located 50' from Skimino Creek. Manure is collected, composted and land applied on construction sites.

13. 106 Deer Path Road, Williamsburg 23188. Dwelling- white vinyl siding with white trim and green shutters. No contact. Present at time of survey were 12 sheep and 3 dogs. Animal shelter located 500' from intermittent stream leading to Carter Creek. Sheep have direct access to dry ravine.

SUMMARY

Area # 050
York River: Camp Peary to Terrapin Point
24 August 2006

SECTION B: SEWAGE POLLUTION SOURCES
1. SEWAGE TREATMENT FACILITIES

0 - DIRECT - None
0 - INDIRECT - None
0 - B.1. TOTAL

2. ON-SITE SEWAGE DEFICIENCIES

Correction of deficiencies in this section is the responsibility of the local health department.
0 - CONTRIBUTES POLLUTION, DIRECT - None
0 - CONTRIBUTES POLLUTION, INDIRECT - None
0 - CP (Kitchen or Laundry Wastes), Direct - None
2 - CP (Kitchen or Laundry Wastes), Indirect - # 2, 4

0 - NO FACILITIES, DIRECT - None
0 - NO FACILITIES, INDIRECT - None
2 - B.2. TOTAL

3. POTENTIAL POLLUTION

Periodic surveillance of these properties will be maintained to determine any status change.
1 - POTENTIAL POLLUTION - # 11

SECTION C: NON-SEWAGE WASTE SITES

1. INDUSTRIAL WASTE SITES

0 - DIRECT - None
0 - INDIRECT - None
0 - C.1. TOTAL

2. SOLID WASTE DUMPSITES

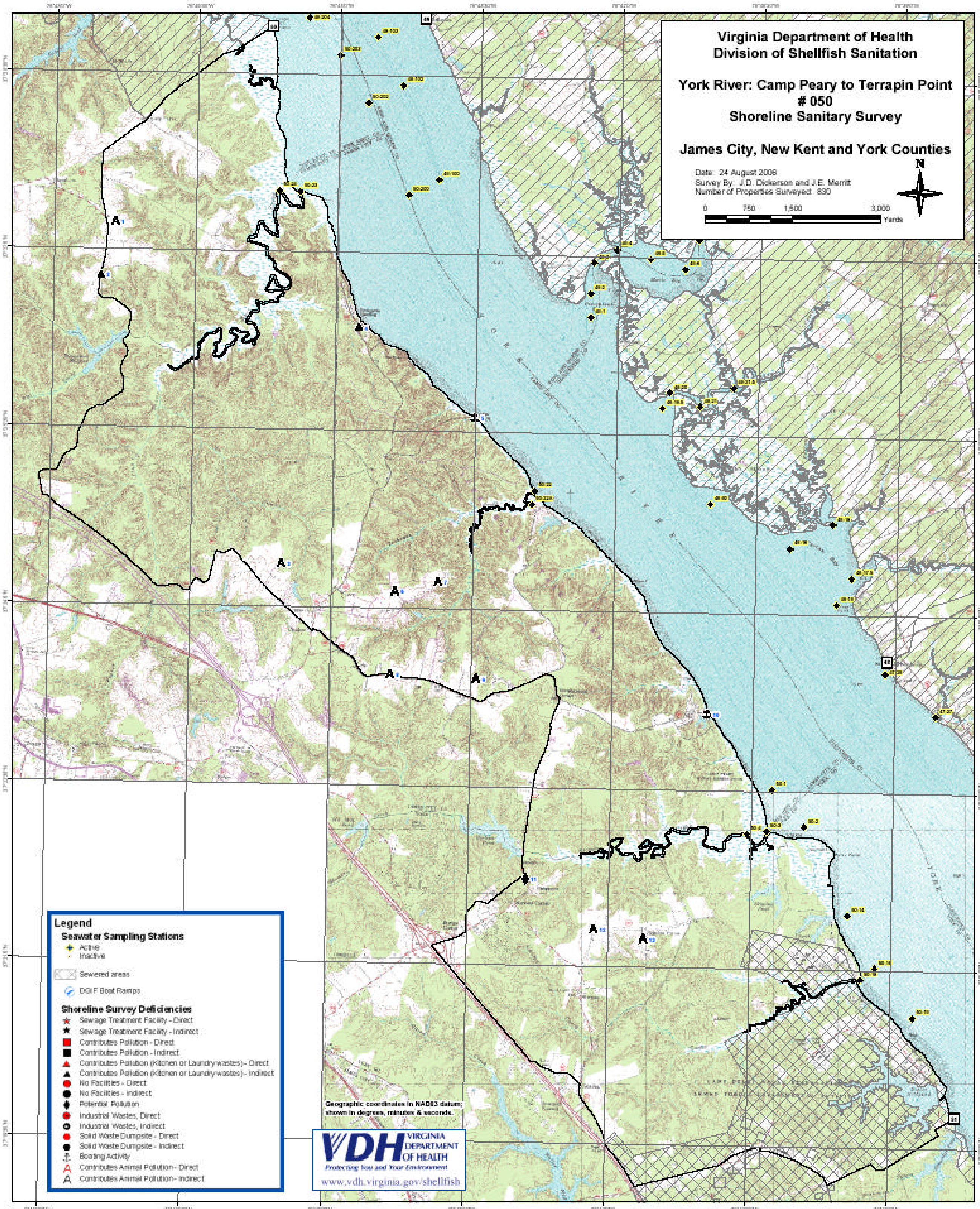
0 - DIRECT - None
0 - INDIRECT - None
0 - C.2. TOTAL

SECTION D: BOATING ACTIVITY

0 - MARINAS - None
1 - OTHER PLACES WHERE BOATS ARE MOORED - # 5
1 - UNDER SURVEILLANCE - # 10
2 - D. TOTAL

SECTION E: CONTRIBUTES ANIMAL POLLUTION

0 - DIRECT - None
8 - INDIRECT - # 1, 3, 6, 7, 8, 9, 12, 13
8 - E. TOTAL



Virginia Department of Health
Division of Shellfish Sanitation
York River: Camp Peary to Terrapin Point
050
Shoreline Sanitary Survey
James City, New Kent and York Counties
Date: 24 August 2006
Survey By: J.D. Dickerson and J.E. Merritt
Number of Properties Surveyed: 830
0
750
1,500
3,000
Yards
N
Legend
Seawater Sampling Stations
Active
Inactive
Sewered areas
DGIF Boat Ramps
Shoreline Survey Deficiencies
Sewage Treatment Facility - Direct
Sewage Treatment Facility - Indirect
Contributes Pollution - Direct
Contributes Pollution - Indirect
Contributes Pollution (Kitchen or Laundry wastes) - Direct
Contributes Pollution (Kitchen or Laundry wastes) - Indirect
No Facilities - Direct
No Facilities - Indirect
Potential Pollution
Industrial Wastes, Direct
Industrial Wastes, Indirect
Solid Waste Dumpsite - Direct
Solid Waste Dumpsite - Indirect
Boating Activity
Contributes Animal Pollution - Direct
Contributes Animal Pollution - Indirect
Geographic coordinates in NAD83 datum; shown in degrees, minutes & seconds.
VDH VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment
www.vdh.virginia.gov/shellfish

Appendix A

A-2: Growing Area 50 Condemnation Notice 073A-Ware Creek and 073B-Taskinas Creek

REGISTRAR OF REGULATIONS

06 JUN -6 PM 2: 11

COMMONWEALTH *of* VIRGINIA

Department of Health

DIVISION OF SHELLFISH SANITATION

109 Govenor Street, Room 614-B

Richmond, VA 23219

Ph: 804-864-7487

Fax: 804-864-7481

NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 050-073, WARE AND TASKINAS CREEKS

EFFECTIVE 20 JUNE 2006

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia.*

1. The "Notice and Description of Shellfish Area Condemnation Number 73, York River: Ware Creek," effective 27 April 1989, is cancelled effective 20 June 2006.

2. The "Notice and Description of Shellfish Area Condemnation Number 166, York River: Taskinas Creek," effective 27 April 1989, is cancelled effective 20 June 2006.

3. Condemned Shellfish Area Number 050-073, shown as Sections A and B, is established effective 20 June 2006. It shall be unlawful for any person, firm, or corporation to take shellfish from these areas for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundaries of these areas are shown on the map titled "Ware and Taskinas Creeks, Condemned Shellfish Area Number 050-073, 20 June 2006" which is part of this notice.

4. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

BOUNDARIES OF CONDEMNED AREA NUMBER 050-073

A. The condemned area shall include all of Ware Creek and its tributaries lying upstream of a line drawn between latitude / longitude map coordinate (37°27'31.5",-76°45'28.3") and map coordinate (37°27'30.4",-76°45'23.3").

B. The condemned area shall include all of Taskinas Creek and its tributaries as well as that portion of the York River lying upstream and inland of a line drawn between latitude / longitude map coordinate (37°25'09.1",-76°42'56.4") and map coordinate (37°24'55.3", -76°42'46.9").

Recommended by: [signature]
Director, Division of Shellfish Sanitation

Ordered by: [signature] 06/05/2006
State Health Commissioner Date

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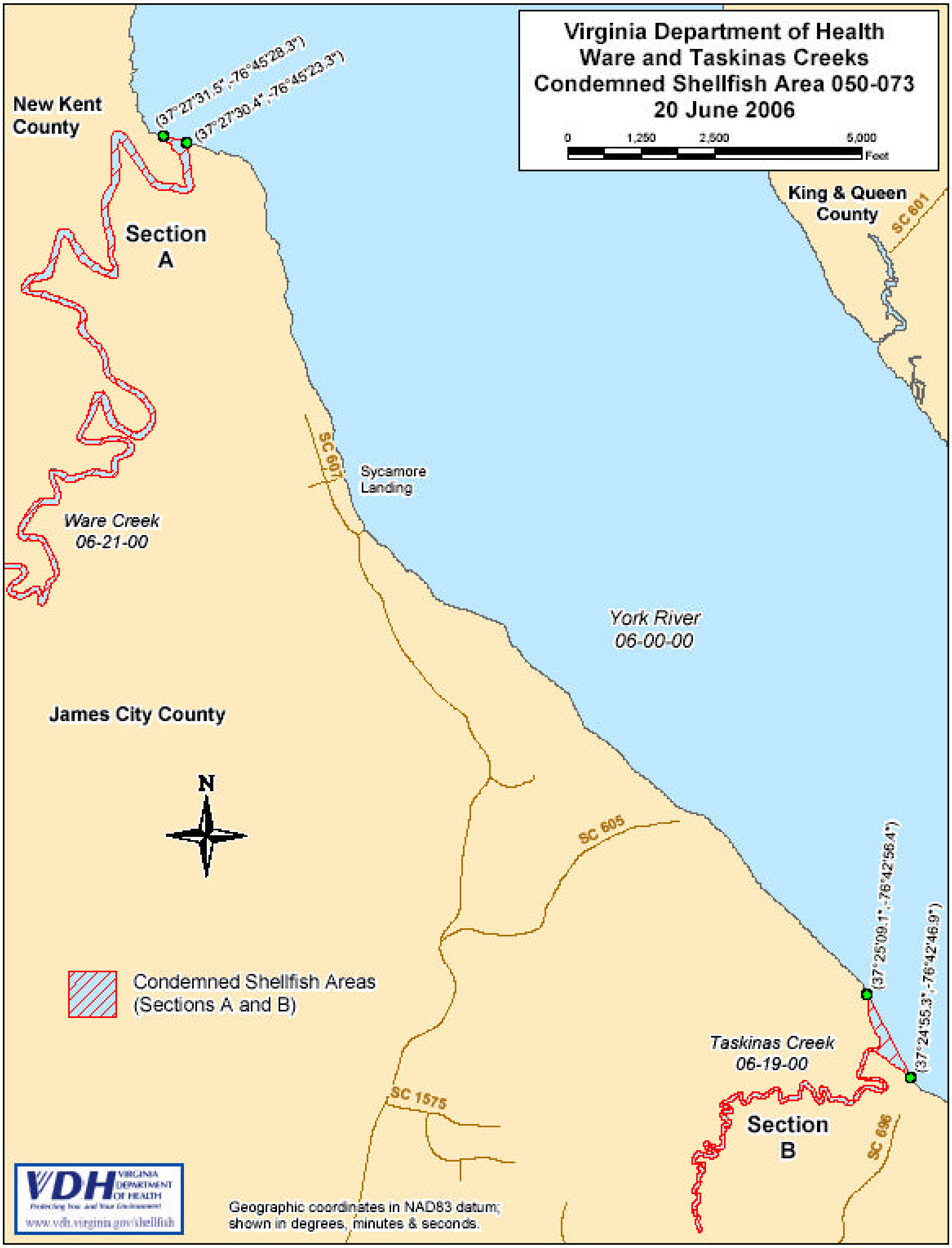
www.vdh.virginia.gov/shellfish



Virginia Department of Health
Ware and Taskinas Creeks
Condemned Shellfish Area 050-073
20 June 2006
0
1,250
2,500
5,000
Feet
New Kent County
(37°27'31.5",-76°45'28.3")
(37°27'30.4",-76°45'23.3")
Section A
King & Queen County
SC 601
SC 607
Sycamore Landing
Ware Creek 06-21-00
York River 06-00-00
James City County
N
SC 605
Condemned Shellfish Areas (Sections A and B)
(37°25'09.1",-76°42'58.4")
(37°24'55.3",-76°42'46.9")
Taskinas Creek 06-19-00
SC 1575
Section B
SC 696
Geographic coordinates in NAD83 datum; shown in degrees, minutes & seconds.
www.vdh.virginia.gov/shellfish

Appendix A

A-3: Growing Area 50 Condemnation Notice 087A-Skimino Creek

REGISTRAR OF REGULATIONS

05 AUG 15 AM 10: 31

COMMONWEALTH *of* VIRGINIA

Department of Health
DIVISION OF SHELLFISH SANITATION
109 Govenor Street, Room 614-B
Richmond, VA 23219

Ph: 804-864-7487
Fax: 804-864-7481

NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 050-087, SKIMINO CREEK

EFFECTIVE 24 AUGUST 2005

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 87, York River: Skimino Creek," effective 25 August 2000, is cancelled effective 24 August 2005.

2. The shellfish condemnation area Number 050-087, shown as Section A, is established, effective 18 August 2005. It shall be unlawful for any person, firm, or corporation to take shellfish from this area for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia*. The boundary of this area is shown on the map titled "Skimino Creek, Condemned Shellfish Area Number 050-087, 24 August 2005" which is part of this notice.

3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

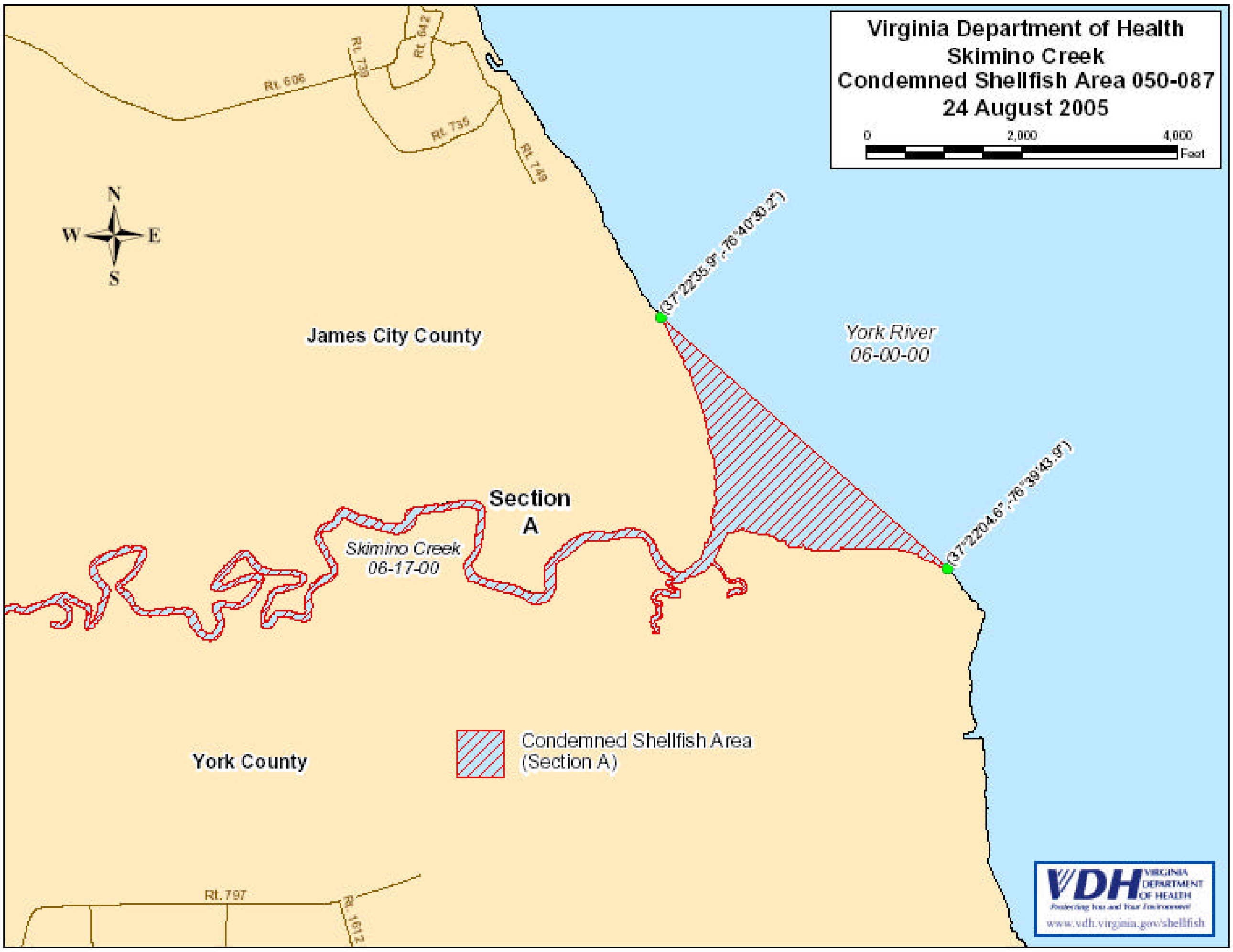
BOUNDARIES OF CONDEMNED AREA NUMBER 050-087

A. The condemned area shall include all of Skimino Creek and its tributaries, as well as a portion of the York River, lying upstream of a line drawn between latitude / longitude map coordinate (37°22'35.9",-76°40'30.2") and map coordinate (37°22'04.6", -76°39'43.9").

Recommended by: ______________________
Director, Division of Shellfish Sanitation

Ordered by: ______________________ 08/11/2005
State Health Commissioner Date

VDH VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment
www.vdh.virginia.gov/shellfish



Virginia Department of Health
Skimino Creek
Condemned Shellfish Area 050-087
24 August 2005
0
2,000
4,000
Feet
Rt. 606
Rt. 739
Rt. 642
Rt. 735
Rt. 749
N
W
E
S
(37°22'35.9", -76°40'30.2")
James City County
York River
06-00-00
(37°22'04.6", -76°39'43.9")
Section
A
Skimino Creek
06-17-00
York County
Condemned Shellfish Area
(Section A)
Rt. 797
Rt. 1612
www.vdh.virginia.gov/shellfish

Appendix B: Supporting Documentation and Watershed Assessment

B-1: Fecal Production Literature Review

Table B.1

	Concentration in feces		Fecal coliform production rate		Comments
	FC/g	Ref.	FC/day (seasonal)	Ref.	
Cat	7.9E+06	1	5.0E+09	4	
Dog	2.3E+07	1	5.0E+09	4	
Chicken	1.3E+06	1	1.9E+08	4	
Chicken			2.4E+08	9	
Cow	2.3E+05	1	1.1E+11	4	average of dairy and beef
Beef cattle			5.4E+09	9	
Deer	1.0E+02	6	2.5E+04	6	assume 250 g/day
Deer	?		5.0E+08	9	best prof. judgment
Duck			4.5E+09	4	average of 3 sources
Duck	3.3E+07	1	1.1E+10	9	
Canada Geese			4.9E+10	4	
Canada Geese	3.6E+04	3	9.0E+06	3	
Canada Geese	1.5E+04	8	3.8E+06	8	assume 250 g/day (3)
Horse			4.2E+08	4	
Pig	3.3E+06	1	5.5E+09	4	
Pig			8.9E+09	9	
Sea Gull	3.7E+08	8	3.7E+09	8	assume 10 g/day
Sea gull			1.9E+09	5	mean of four species
Rabbit	2.0E+01	2	?		
Raccoon	1.0E+09	6	1.0E+11	6	assume 100 g/day
Sheep	1.6E+07	1	1.5E+10	4	
Sheep			1.8E+10	9	
Turkey	2.9E+05	1	1.1E+08	4	
Turkey			1.3E+08	9	
Rodent	1.6E+05	1	?		
Muskrat	3.4E+05	6	3.4E+07	6	
Human	1.3E+07	1	2.0E+09	4	
Septage	4.0E+05	7	1.0E+09	7	assume 70/gal/day/person

1. Geldreich, E. and E. A. Kenner. 1969. Concepts of fecal streptococci in stream pollution. J. Wat. Pollut. Control Fed. 41:R336-R352.
2. Geldreich, E., E. C. Best, B. A. Kenner, and D. J. Van Donsel. 1968. The bacteriological aspects of stormwater pollution. J. Wat. Pollut. Control Fed. 40:1861-1872.
3. Hussong, D., J. M. Damare, R. J. Limpert, W. J. L. Sladen, R. M. Weiner, and R. R. Colwell. 1979. Microbial impact of Canada geese (Branta canadensis) and whistling swans.
4. U.S. Environmental Protection Agency. 2001. Protocol for Developing Pathogen TMDLs. EPA 841-R-00-002. Office of Water (4503F), United States Environmental Protection Agency, Washington, DC. 132 pp.
5. Gould, D. J. and M. R. Fletcher. 1978. Gull droppings and their effects on water quality. Wat. Res. 12:665-672.
6. Kator, H. and M. W. Rhodes. 1996. Identification of pollutant sources contributing to degraded sanitary water quality in Taskinas Creek National Estuarine Research Reserve, Virginia. Special Report in Applied Marine Science and Ocean Engineering No. 336, The College of William and Mary, VIMS/School of Marine Science.
7. Kator, H., and M. W. Rhodes. 1991. Evaluation of Bacteroides fragilis bacteriophage, a candidate human-specific indicator of fecal contamination for shellfish-growing waters. A final report prepared under NOAA Cooperative Agreement NA90AA-H-FD234. Prepared and submitted to NOAA, Southeast Fisheries Science Center, Charleston Laboratory, Charleston, SC. 98 pp.
8. Alderisio, K. A. and N. DeLuca. 1999. Seasonal enumeration of fecal coliform bacteria from the feces of ring-billed gulls (Larus delawarensis) and Canada geese (Branta canadensis). Appl. Environ. Microbiol. 65:5628-5630.
9. TMDL report attributed to Metcalf and Eddy 1991 (Potomac Headwaters of West VA).

Appendix B: Supporting Documentation and Watershed Assessment
B-2: Geographic Information System Data: Sources and Process

A geographic information system is a powerful computer software package that can store large amounts of spatially referenced data and associated tabular information. The data layers produced by a GIS can be used for many different tasks, such as generating maps, analyzing results, and modeling processes. Below is a table that lists the data layers that were developed for the watershed and hydrodynamic models. (**Table B.2**)

Data Element	**Source**	**Date**
Watershed boundary	Division of Shellfish Sanitation, VA Department of Health	Various dates
Subwatershed boundary	Center for Coastal Resources Management	2003
Land use	National Land Cover Data set (NLCD), US Geological Survey	1999
Elevation	Digital Elevation Models and Digital Raster Graphs, US Geological Survey	Various dates
Soils	SSURGO and STATSGO, National Resource Conservation Service	Various dates
Stream network	National Hydrography Dataset	1999
Precipitation, temperature, solar radiation, and evapotranspiration	Chesapeake Bay Program, Phase V	2002
Stream flow data	Gauging stations, US Geological Survey	Various dates
Shoreline Sanitary Survey deficiencies	Division of Shellfish Sanitation, VA Department of Health	Various dates
Wastewater treatment plants	VA Department of Environmental Quality	Various dates
Sewers	Division of Shellfish Sanitation, VA Department of Health	Various dates
Dog population	US Census Bureau American Veterinary Association	2000 2002
Domestic livestock	National Agricultural Statistics Service, USDA	1997/2001
Wildlife	Virginia Department of Game and Inland Fisheries, US Fish and Wildlife Service	2004 2004
Septic tanks (from human population)	Division of Shellfish Sanitation, VA Department of Health US Census Bureau	Various dates 2000
Water quality monitoring stations	Division of Shellfish Sanitation, VA Department of Health	Various dates
Water quality segments	Center for Coastal Resources Management	2003
Tidal prism segments	Department of Physical Sciences, VIMS	2003
Water body volumes	Bathymetry from Hydrographic Surveys, National Ocean Service, NOAA	Various dates
Condemnation zones	Division of Shellfish Sanitation, VA Department of Health	Various dates
Tidal data	NOAA tide tables	2004

Appendix B: Supporting Documentation and Watershed Assessment
B-2A: GIS Data Description and Process

Watershed boundary determined by VDH, DSS. DSS has determined that there are 105 shellfish watersheds or growing areas in Virginia.

Subwatershed boundaries were delineated based on elevation, using digital 7.5 minute USGS topographic maps, generally with 10 foot contour intervals on the eastern shore. Virginia Institute of Marine Science has determined that there are 1836 subwatersheds.

The original land use has 15 categories that were combined into 3 categories:
urban (high and low density residential and commercial);
undeveloped (forest and wetlands); and
agriculture (pasture and crops).

Descriptions of Shoreline Sanitary Survey deficiencies are found in each report. Contact DSS for more information. Digital data layer generated by CCRM from hardcopy reports.

Wastewater treatment plant locations were obtained from VADEQ and digital data layer was generated by CCRM. Design flow, measured flow, and fecal coliform discharges were obtained from VADEQ.

Sewers data layer was digitized from Shoreline Sanitary Surveys by CCRM.

Dog numbers were obtained using the American Vet Associations equation of #households * 0.58.
See website for additional information—
http://www.avma.org/membshp/marketstats/formulas.asp#households1.
Database was generated by CCRM.

Domestic livestock includes cows, pigs, sheep, chickens, turkeys, and horses. Database was generated by CCRM.

Wildlife includes ducks and geese, deer, and raccoons. Animals were chosen based on availability of fecal coliform production rates and population estimates. Database was generated by CCRM.
Ducks and geese–US FWS, DGIF
Deer–DGIF
Raccoons–DGIF

Human input was based on DSS sanitary survey deficiencies and US Census Bureau population data (number of households).

Water quality monitoring data are collected, on average, once per month. Digital data layer of locations was generated by DSS. Water quality data was mathematically processed and input into a database for model use.

Water bodies were divided into segments based on the location of the monitoring stations (midway between stations). If a segment contained >1 station, the FC values were averaged. If a segment contained 0 stations, the value from the closest station(s) was assigned to it. Digital data layer of segments was generated by CCRM. FC loadings in the water were obtained by multiplying FC concentrations by segment volume.

Bathymetry data were used to generate a depth grid that was used to estimate volumes for each water quality segment and tidal prism segment.

The 1998 303(d) report was used to set the list of condemnation zones that require TMDLs. The digital data layer was generated by CCRM from hardcopy closure reports supplied by DSS.

Appendix B: Supporting Documentation and Watershed Assessment

B-2B: Population Numbers

The process used to generate population numbers used for the nonpoint source contribution analysis part of the watershed model for the four source categories: human, livestock, pets and wildlife is described for each below.

Human:

The number of people contributing fecal coliform from failing septic tanks were developed in two ways and then compared to determine a final value.

1) Deficiencies (septic failures) from the DSS shoreline surveys were counted for each watershed and multiplied by 3 (average number of people per household).
2) Numbers of households in each watershed were determined from US Census Bureau data. The numbers of households were multiplied by 3 (average number of people per household) to get the total number of people and then multiplied by a septic failure rate* to get number of people contributing fecal coliform from failing septic tanks.

*The septic failure rate was estimated by dividing the number of deficiencies in the watershed by the total households in the watershed. The average septic failure rate was 12% and this was used as the default unless the DSS data indicated that septic failure was higher.

Livestock:

US Census Bureau data was used to calculate the livestock values. The numbers for each type of livestock (cattle, pigs, sheep, chickens (big and small), and horses) were reported by county. Each type of livestock was assigned to the land use(s) it lives on, or contributes to by the application of manure, as follows:

Cattle	cropland and pastureland
Pigs	cropland
Sheep	pastureland
Chickens	cropland
Horses	pastureland

GIS was used to overlay data layers for several steps:

1) The county boundaries and the land uses to get the area of each land use in each county. The number of animals was divided by the area of each land use for the county to get an animal density for each county.
2) The subwatershed boundaries and the land uses to get the area of each land use in each subwatershed.
3) The county boundaries and the subwatershed boundaries to get the area of each county in each subwatershed. If a subwatershed straddled more than one county, the areal proportion of each county in the subwatershed was used to determine the number of animals in the subwatershed.

Using MS Access, for each type of livestock, the animal density by county was multiplied by the area of each land use by county in each subwatershed to get the number of animals in each subwatershed. If more than one county was present in a subwatershed, the previous step was done for each county in the subwatershed, and then summed for a total number of animals in the subwatershed. The number of animals in each subwatershed was summed to get the total number of animals in each watershed.

Pets:

The dog population was calculated using a formula for estimating the number of pets using national percentages, reported by the American Veterinary Association:

dogs = # of households * 0.58.

US Census Bureau data provided the number of households by county. The number of dogs per county was divided by the area of the county to get a dog density per county. GIS was used to overlay the subwatershed boundaries with the county boundaries to get the area of each county in a subwatershed. If a subwatershed straddled more than one county, the areal proportion of each county in the subwatershed was calculated. Using MS Access, the area of each county in the subwatershed was multiplied by the dog density per county to get the number of dogs per subwatershed. If more than one county was present in a subwatershed, the previous step was done for each county in the subwatershed, then summed for a total number of dogs in the subwatershed. The number of dogs in each subwatershed was summed to get the total number of dogs in each watershed.

Wildlife:

<u>Deer</u> -

The number of deer were calculated using information supplied by DGIF, consisting of an average deer index by county and the formula:

#deer/mi^2 of deer habitat = (-0.64 + (7.74 * average deer index)).

Deer habitat consists of forests, wetlands, and agricultural lands (crop and pasture). GIS was used to overlay data layers for the following steps:

1) The county boundaries and the subwatershed boundaries to get the area of each county in each subwatershed. If a subwatershed straddled more than one county, the areal proportion of each county in the subwatershed was calculated.
2) The subwatershed boundaries and the deer habitat to get the area of deer habitat in each subwatershed.

Using MS Access, number of deer in each subwatershed were calculated by multiplying the #deer/mi^2 of deer habitat times the area of deer habitat. If more than one county was present in a subwatershed, the previous step was done for each county in the subwatershed, then summed for a total number of deer in the subwatershed. The number of deer in each subwatershed was summed to get the total number of deer in each watershed.

<u>Ducks and Geese -</u>

The data for ducks and geese were divided into summer (April through September) and winter (October through March).

Summer

The summer numbers were obtained from the Breeding Bird Population Survey (US Fish and Wildlife Service) and consisted of bird densities (ducks and geese) for 3 regions: the southside of the James River, the rest of the tidal areas, and the salt marshes in both areas. The number of ducks and geese in the salt marshes were distributed into the other 2 regions based on the areal proportion of salt marshes in them using the National Wetland Inventory data and GIS.

Winter

The winter numbers were obtained from the Mid-Winter Waterfowl Survey (US Fish and Wildlife Service) and consisted of population numbers for ducks and geese in several different areas in the tidal region of Virginia. MS Access was used to calculate the total number of ducks and geese in each area and then these numbers were grouped to match the 2 final regions (Southside and the rest of tidal Virginia) for the summer waterfowl populations. Winter populations were an order of magnitude larger than summer populations.

Data from DGIF showed the spatial distribution of ducks and geese for 1993 and 1994. Using this information and GIS a 250m buffer on each side of the shoreline was generated and contained 80% of the birds. Wider buffers did not incorporate significantly more birds, since they were located too far inland. GIS was used to overlay the buffer and the watershed boundaries to calculate the area of buffer in each watershed. To distribute this information into each subwatershed, GIS was used to calculate the length of shoreline in each subwatershed and the total length of shoreline in the watershed. Dividing the length of shoreline in each subwatershed by the total length of shoreline gives a ratio that was multiplied by the area of the watershed to get an estimate of the area of buffer in each subwatershed. MS Excel was used to multiply the area of buffer in each subwatershed times the total numbers of ducks and geese to get the numbers of ducks and geese in each subwatershed. These numbers were summed to get the total number of ducks and geese in each watershed. To get annual populations, the totals then were divided by 2, since they represent only 6 months of habitation (this reduction underestimates the total annual input from ducks and geese, but is the easiest conservative method to use since the model does not have a way to incorporate the seasonal differences).

Raccoons -

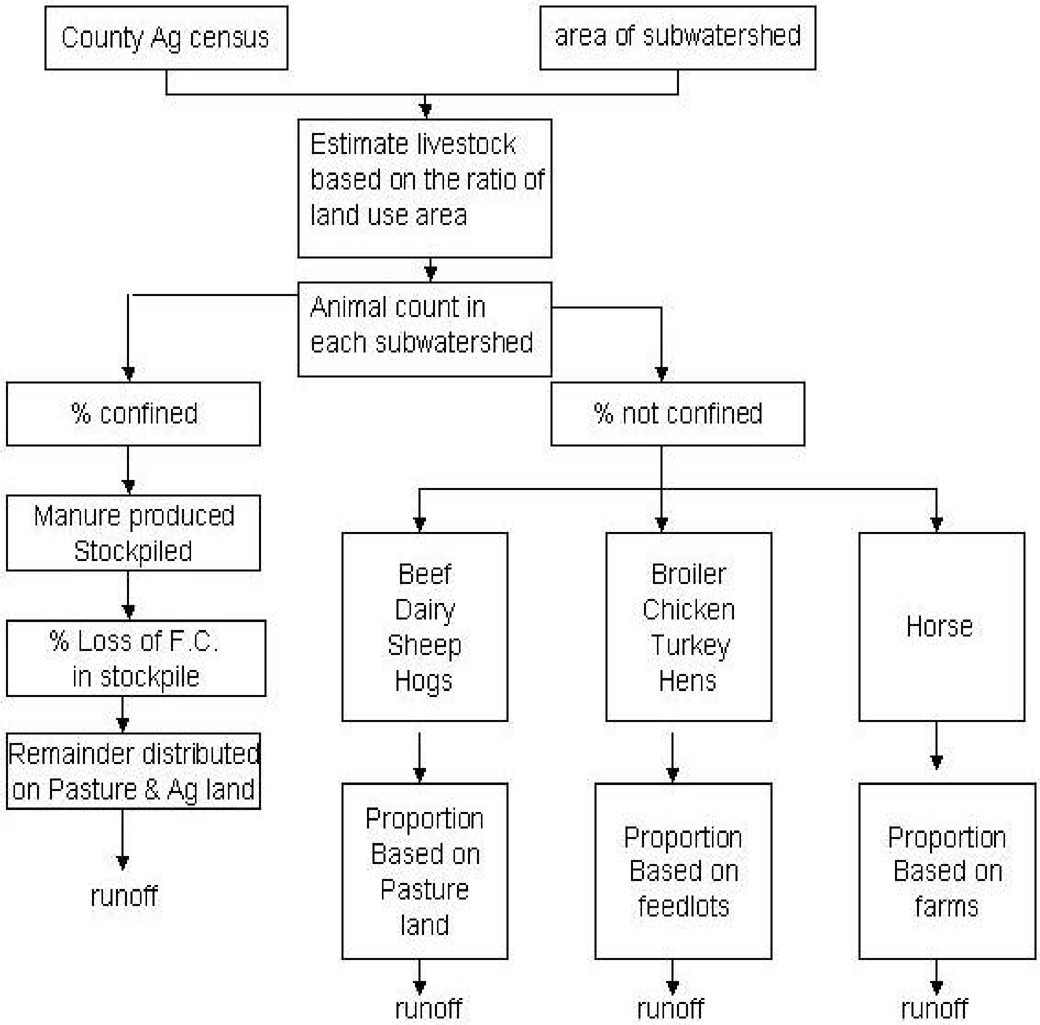
Estimates for raccoon densities were supplied by DGIF for 3 habitats—wetlands (including freshwater and saltwater, forested and herbaceous), along streams, and upland forests. GIS was used to generate a 600 ft buffer around the wetlands and streams, and then to overlay this buffer layer with the subwatershed boundaries to get the area of the buffer in each subwatershed. GIS was used to overlay the forest layer with the subwatershed boundaries to get the area of forest in each subwatershed. MS Access was used to multiply the raccoon densities for each habitat times the area of each habitat in each subwatershed to get the number of raccoons in each habitat in each subwatershed. The number of raccoons in each subwatershed was summed to get the total number of raccoons in each watershed.

Appendix B Supporting Documentation and Watershed Assessment
B-3: Watershed Source Assessment

The watershed assessment calculates fecal coliform loads by source based on geographic information system data. A geographic information system is a powerful computer software package that can store large amounts of spatially referenced data and associated tabular information. The data layers produced by a GIS can be used for many different tasks, such as generating maps, analyzing results, and modeling processes. The watershed model requires a quantitative assessment of human sewage sources (i. e., malfunctioning septic systems) and animal (livestock, pets and wildlife) fecal sources distributed within each watershed.

The fecal coliform contribution from livestock is through the manure spreading processes and direct deposition during grazing. This contribution was initially estimated based on land use data and the livestock census data. In the model, manure was applied to both cropland and pasture land depending on the grazing period. Figure B-1 shows a diagram of the procedure for estimating the total number of livestock in the watershed and fecal coliform production. A description of the process used to determine the source population values for wildlife, pets and human used in the calculation of percent loading is found in Appendix B.

FIGURE B-1 Diagram to Illustrate Procedure Used to Estimate Fecal Coliform Production from Estimated Livestock Population



Ware Creek: 30-Sample Geometric Mean & 90th Percentile Data Station 50-23 (Geometric Mean: 14 mpn/100mL and 90th Percentile: 49 mpn/100ml)

Date	Fecal Coliform (mpn/100mL)	Geometric Mean	90th Percentile
11/4/2004	240	**29.1**	**175.1**
12/6/2004	43	**34.2**	**203.6**
1/10/2005	43	**34.5**	**198.5**
2/9/2005	9.1	**35.3**	**202.7**
3/9/2005	9.1	**33.3**	**197.3**
4/12/2005	9.1	**31.5**	**191.3**
5/10/2005	3.6	**29.3**	**180.8**
6/9/2005	9.1	**28.3**	**183.9**
7/11/2005	9.1	**29.5**	**179.3**
8/9/2005	7.3	**27.9**	**172.7**
9/12/2005	240	**23.1**	**113.5**
10/12/2005	240	**25.2**	**137.0**
11/28/2005	93	**28.5**	**165.3**
12/12/2005	3	**27.5**	**150.6**
1/9/2006		**25.5**	**152.1**
2/22/2006	9.1	**25.0**	**153.7**
3/8/2006	3.6	**24.1**	**150.9**
4/5/2006	93	**20.9**	**130.2**
5/23/2006	43	**23.9**	**143.1**
6/20/2006	23	**24.4**	**142.1**
7/5/2006	93	**23.2**	**130.5**
8/2/2006	93	**23.2**	**130.5**
9/14/2006	93	**23.9**	**138.8**
10/17/2006	75	**27.0**	**150.6**
12/20/2006	43	**28.0**	**154.0**
2/22/2007	7.3	**28.6**	**157.8**
3/28/2007		**26.9**	**152.4**
4/26/2007	1100	**26.9**	**152.4**
5/30/2007	7.3	**31.9**	**219.8**
7/16/2007	2.9	**29.3**	**206.2**

BOLD = violation of Water Quality Standard

Ware Creek: 30-Sample Geometric Mean & 90th Percentile Data Station 50-24 (Geometric Mean: 14 mpn/100mL and 90th Percentile: 49 mpn/100ml)

Date	Fecal Coliform (mpn/100mL)	Geometric Mean	90th Percentile
11/4/2004	240	**55.7**	**539.9**
12/6/2004	23	**66.0**	**574.0**
1/10/2005	23	**63.4**	**537.8**
2/9/2005	20	**60.7**	**522.0**
3/9/2005	9.1	**55.4**	**469.9**
4/12/2005	93	**52.3**	**464.2**
5/10/2005	23	**51.4**	**450.9**
6/9/2005	9.1	**51.4**	**450.9**
7/11/2005	7.3	**53.2**	**439.3**
8/9/2005	23	**46.7**	**393.1**
9/12/2005	93	**40.5**	**292.0**
10/12/2005	93	**39.8**	**282.2**
11/28/2005	43	**41.9**	**298.9**
12/12/2005		**37.1**	**220.0**
1/9/2006		**37.8**	**231.1**
2/22/2006		**35.8**	**218.8**
3/8/2006	3.6	**35.7**	**226.7**
4/5/2006		**29.1**	**177.2**
5/23/2006		**32.2**	**181.7**
6/20/2006		**32.2**	**181.7**
7/5/2006		**32.7**	**191.7**
8/2/2006	93	**31.1**	**185.7**
9/14/2006	210	**32.3**	**197.3**
10/17/2006	1100	**39.6**	**224.8**
12/20/2006	240	**46.1**	**314.9**
2/22/2007	2.9	**47.1**	**330.3**
3/28/2007		**38.5**	**293.6**
4/26/2007	1100	**38.5**	**293.6**
5/30/2007	9.1	**49.9**	**411.7**
7/16/2007	23	**44.0**	**371.4**

BOLD = violation of Water Quality Standard

Taskinas Creek: 30-Sample Geometric Mean & 90th Percentile Data Station 50-22 (Geometric Mean: 14 mpn/100mL and 90th Percentile: 49 mpn/100ml)

Date	Fecal Coliform (mpn/100mL)	Geometric Mean	90th Percentile
11/4/2004	93	**20.2**	**179.3**
12/6/2004	3.6	**22.9**	**197.7**
1/10/2005	3.6	**21.5**	**186.7**
2/9/2005	3.6	**21.5**	**186.7**
3/9/2005	3.6	**20.2**	**182.5**
4/12/2005	43	**19.7**	**182.6**
5/10/2005	93	**21.4**	**192.5**
6/9/2005	15	**24.0**	**211.4**
7/11/2005	23	**23.1**	**203.4**
8/9/2005	43	**23.9**	**207.5**
9/12/2005	43	**25.4**	**217.1**
10/12/2005	93	**27.6**	**224.5**
11/28/2005	9.1	**31.2**	**239.0**
12/12/2005	3.6	**26.3**	**167.0**
1/9/2006	3.6	**25.5**	**169.0**
2/22/2006	2.9	**22.8**	**155.3**
3/8/2006	3	**22.8**	**155.3**
4/5/2006	7.3	**20.8**	**149.2**
5/23/2006	23	**19.6**	**141.3**
6/20/2006	2.9	**19.7**	**137.4**
7/5/2006	23	**18.0**	**130.7**
8/2/2006	23	**17.2**	**120.0**
9/14/2006	43	**16.4**	**109.9**
10/17/2006	43	**17.9**	**116.1**
12/20/2006	7.2	**19.6**	**121.9**
2/22/2007	9.1	**18.8**	**118.9**
3/28/2007	240	**17.4**	**106.4**
4/26/2007	150	**17.1**	**97.9**
5/30/2007	3.6	**17.3**	**102.5**
7/16/2007	9.1	**15.3**	**86.7**

BOLD = violation of Water Quality Standard

Taskinas Creek: 30-Sample Geometric Mean & 90th Percentile Data Station 50-22A (Geometric Mean: 14 mpn/100mL and 90th Percentile: 49 mpn/100ml)

Date	Fecal Coliform (mpn/100mL)	Geometric Mean	90th Percentile
11/4/2004	240	**62.0**	**562.2**
12/6/2004		**77.3**	**589.5**
1/10/2005	23	**77.3**	**589.5**
2/9/2005	9.1	**84.8**	**540.1**
3/9/2005	23	**78.5**	**552.3**
4/12/2005	93	**78.5**	**552.3**
5/10/2005	240	**81.6**	**569.4**
6/9/2005	93	**85.9**	**584.4**
7/11/2005		**91.8**	**600.5**
8/9/2005	460	**87.5**	**588.0**
9/12/2005	460	**94.7**	**641.9**
10/12/2005	150	**101.7**	**691.8**
11/28/2005	93	**103.5**	**675.2**
12/12/2005		**92.9**	**538.0**
1/9/2006		**89.0**	**526.1**
2/22/2006		**79.0**	**417.4**
3/8/2006		**79.0**	**417.4**
4/5/2006		**78.3**	**432.0**
5/23/2006		**77.6**	**448.2**
6/20/2006		**77.6**	**448.2**
7/5/2006		**77.6**	**448.2**
8/2/2006		**77.6**	**448.2**
9/14/2006		**76.8**	**466.4**
10/17/2006	43	**93.2**	**423.3**
12/20/2006	7.2	**96.7**	**418.8**
2/22/2007		**80.9**	**426.5**
3/28/2007		**80.9**	**426.5**
4/26/2007	460	**75.5**	**404.1**
5/30/2007	23	**91.1**	**507.9**
7/16/2007	460	**78.7**	**447.2**

BOLD = violation of Water Quality Standard

Skimino Creek: 30-Sample Geometric Mean & 90th Percentile Data Station 50-1 (Geometric Mean: 14 mpn/100mL and 90th Percentile: 49 mpn/100ml)

Date	Fecal Coliform (mpn/100mL)	Geometric Mean	90th Percentile
11/4/2004	43	5.8	17.3
12/6/2004	9.1	6.3	20.7
1/10/2005	3.6	6.6	21.2
2/9/2005	2.9	6.6	21.2
3/9/2005	3.6	6.6	21.2
4/12/2005	43	6.6	21.2
5/10/2005	9.1	6.9	24.3
6/9/2005	2.9	7.2	24.8
7/11/2005	3.6	7.2	24.8
8/9/2005	21	7.2	24.8
9/12/2005	3.6	7.4	26.2
10/12/2005	3.6	7.5	26.2
11/28/2005	9.1	7.5	26.2
12/12/2005	3.6	7.5	26.2
1/9/2006	2.9	7.5	26.2
2/22/2006	2.9	7.5	26.2
3/8/2006	3	7.5	26.2
4/5/2006	23	7.4	26.2
5/23/2006	9.1	7.9	28.4
6/20/2006	3.6	8.0	27.9
7/5/2006	43	7.5	25.8
8/2/2006	3.6	7.6	27.5
9/14/2006	9.1	7.2	25.4
10/17/2006	9.1	7.5	25.9
12/20/2006	2.9	7.2	24.4
2/22/2007	2.9	7.2	24.4
3/28/2007	9.1	7.2	24.4
4/26/2007	2.9	7.0	22.9
5/30/2007	2.9	6.9	23.0
7/16/2007	2.9	6.4	21.0

BOLD = violation of Water Quality Standard

Skimino Creek: 30-Sample Geometric Mean & 90th Percentile Data Station 50-2 (Geometric Mean: 14 mpn/100mL and 90th Percentile: 49 mpn/100ml)

Date	Fecal Coliform (mpn/100mL)	Geometric Mean	90th Percentile
11/4/2004	1100	9.1	46.3
12/6/2004	3.6	11.2	**79.3**
1/10/2005	23	11.3	**79.3**
2/9/2005	2.9	12.0	**83.3**
3/9/2005	3.6	11.9	**83.4**
4/12/2005	43	11.9	**83.4**
5/10/2005	23	13.1	**90.7**
6/9/2005	3.6	**14.0**	**94.6**
7/11/2005	2.9	13.5	**93.9**
8/9/2005	23	12.3	**86.6**
9/12/2005	15	12.7	**89.7**
10/12/2005	3.6	13.4	**92.0**
11/28/2005	3.6	13.5	**91.8**
12/12/2005	7.3	13.1	**91.4**
1/9/2006	2.9	13.6	**91.6**
2/22/2006	2.9	13.6	**91.6**
3/8/2006	2.9	13.6	**91.6**
4/5/2006	23	12.4	**84.5**
5/23/2006	2.9	13.2	**88.4**
6/20/2006	9.1	12.5	**84.0**
7/5/2006	23	12.2	**81.1**
8/2/2006	39	11.7	**74.6**
9/14/2006	9.1	12.3	**79.9**
10/17/2006	23	12.7	**80.5**
12/20/2006	9.1	13.7	**83.6**
2/22/2007	2.9	12.7	**74.5**
3/28/2007	39	11.6	**68.6**
4/26/2007	2.9	11.8	**70.9**
5/30/2007	15	10.8	**64.9**
7/16/2007	15	10.2	**56.6**

BOLD = violation of Water Quality Standard

Skimino Creek: 30-Sample Geometric Mean & 90th Percentile Data Station 50-3 (Geometric Mean: 14 mpn/100mL and 90th Percentile: 49 mpn/100ml)

Date	Fecal Coliform (mpn/100mL)	Geometric Mean	90th Percentile
11/4/2004	240	**32.7**	**308.6**
12/6/2004	43	**38.8**	**351.8**
1/10/2005	43	**38.9**	**338.4**
2/9/2005	3.6	43.0	336.8
3/9/2005	3.6	38.1	322.7
4/12/2005	43	**35.6**	**324.8**
5/10/2005	43	**39.0**	**329.0**
6/9/2005	9.1	**41.3**	**337.3**
7/11/2005	23	**41.3**	**337.3**
8/9/2005	150	**42.8**	**338.8**
9/12/2005	460	**44.7**	**348.6**
10/12/2005	1100	**45.8**	**370.6**
11/28/2005	23	**51.6**	**478.5**
12/12/2005	93	**44.9**	**366.0**
1/9/2006	23	**46.2**	**379.0**
2/22/2006	3.6	**43.9**	**360.2**
3/8/2006	3.6	**44.3**	**357.1**
4/5/2006	240	**41.4**	**362.7**
5/23/2006	43	**48.5**	**397.4**
6/20/2006	23	**48.3**	**381.1**
7/5/2006	75	**47.3**	**375.7**
8/2/2006	93	**43.1**	**296.1**
9/14/2006	43	**43.4**	**299.6**
10/17/2006	43	**43.4**	**289.6**
12/20/2006	9.1	**47.1**	**285.3**
2/22/2007	2.9	**44.8**	**282.1**
3/28/2007	43	**39.2**	**268.7**
4/26/2007	460	**38.2**	**258.9**
5/30/2007	3.6	**40.3**	**294.9**
7/16/2007	9.1	36.2	283.0

BOLD = violation of Water Quality Standard

Skimino Creek: 30-Sample Geometric Mean & 90th Percentile Data Station 50-4 (Geometric Mean: 14 mpn/100mL and 90th Percentile: 49 mpn/100ml)

Date	Fecal Coliform (mpn/100mL)	Geometric Mean	90th Percentile
11/4/2004	240	**53.2**	**389.6**
12/6/2004	43	**63.4**	**411.0**
1/10/2005	93	**62.5**	**390.9**
2/9/2005	3.6	**68.9**	**395.6**
3/9/2005	2.9	**57.2**	**354.6**
4/12/2005	39	**51.5**	**370.3**
5/10/2005	93	**51.4**	**369.2**
6/9/2005	93	**52.5**	**365.3**
7/11/2005	93	**57.2**	**379.3**
8/9/2005	150	**62.4**	**390.6**
9/12/2005	93	**64.3**	**394.4**
10/12/2005	460	**67.6**	**407.7**
11/28/2005	43	**76.6**	**467.8**
12/12/2005	150	**68.0**	**363.7**
1/9/2006	43	**66.9**	**351.4**
2/22/2006	15	**62.9**	**321.2**
3/8/2006	9.1	**59.9**	**307.7**
4/5/2006	460	**56.8**	**309.3**
5/23/2006	93	**61.6**	**359.8**
6/20/2006	240	**62.4**	**354.7**
7/5/2006	1100	**66.3**	**386.0**
8/2/2006	240	**68.3**	**423.9**
9/14/2006	93	**72.3**	**457.8**
10/17/2006	150	**80.6**	**439.9**
12/20/2006	23	**85.8**	**458.2**
2/22/2007	23	**80.6**	**439.9**
3/28/2007	93	**75.7**	**420.7**
4/26/2007	150	**76.3**	**424.0**
5/30/2007	20	**77.5**	**433.7**
7/16/2007	3.6	**73.6**	**423.8**

BOLD = violation of Water Quality Standard

Appendix C

Code of Virginia §62.1-194.1 Obstructing or contaminating state waters.

Code of Federal Regulations. Title 33, Volume 2, Parts 120 to 1999 Revised as of July 1, 2000

Except as otherwise permitted by law, it shall be unlawful for any person to dump, place or put, or cause to be dumped, placed or put into, upon the banks of or into the channels of any state waters any object or substance, noxious or otherwise, which may reasonably be expected to endanger, obstruct, impede, contaminate or substantially impair the lawful use or enjoyment of such waters and their environs by others. Any person who violates any provision of this law shall be guilty of a misdemeanor and upon conviction be punished by a fine of not less than $100 nor more than $500 or by confinement in jail not more than twelve months or both such fine and imprisonment. Each day that any of said materials or substances so dumped, placed or put, or caused to be dumped, placed or put into, upon the banks of or into the channels of, said streams shall constitute a separate offense and be punished as such. In addition to the foregoing penalties for violation of this law, the judge of the circuit court of the county or corporation court of the city wherein any such violation occurs, whether there be a criminal conviction therefore or not shall, upon a bill in equity, filed by the attorney for the Commonwealth of such county or by any person whose property is damaged or whose property is threatened with damage from any such violation, award an injunction enjoining any violation of this law by any person found by the court in such suit to have violated this law or causing the same to be violated, when made a party defendant to such suit. (1968, c. 659.)

Appendix D
Guidance Memo No. 04-2022: Procedures for Establishing Boating No Discharge Zones (NDZ)

M E M O R A N D U M
DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF WATER QUALITY PROGRAMS
P.O. Box 10009 Richmond, VA 23240-0009

SUBJECT: Guidance Memo No. 04-2022
Procedures for Establishing Boating No Discharge Zones

TO: Regional Directors
FROM: Ellen Gilinsky, Ph.D., Director
DATE: November 29, 2004
COPIES: Rick Weeks, Jon Van Soestbergen and Cindy Berndt

Summary:

The purpose of this guidance is to provide a procedure for handling public or internal requests for the establishment of boating No Discharge Zones, and for establishing the No Discharge Zones in accordance with federal regulation 40 CFR Part 140 (2004) and state regulation 9 VAC 25-71 (2004).

Electronic Copy:

An electronic copy of this guidance in PDF format is available for staff internally on DEQNET and for the general public on VADEQ's website at: http://www.deq.virginia.gov/water/.

Contact information:

Please contact Mike Gregory, Office of Water Permit Support, (804) 698-4065 or mbgregory@deq.virginia.gov if you have any questions about this guidance.

Disclaimer:

This document is provided as guidance and, as such, sets forth standard operating procedures for the agency. However, it does not mandate any particular method nor does it prohibit any particular method for the analysis of data, establishment of a wasteload allocation, or establishment of a permit limit. If alternative proposals are made, such proposals should be reviewed and accepted or denied based on their technical adequacy and compliance with appropriate laws and regulations.

PROCEDURE FOR VADEQ REVIEW OF SECTION 312 NO DISCHARGE ZONE DESIGNATION REQUESTS

Background

Section 312 of the Clean Water Act and EPA regulations at 40 CFR Part 140 address sewage discharges from boats. The federal regulations control these discharges by requiring boats with installed toilets to have treatment units called Marine Sanitation Devices or "MSDs". Type I and Type II MSDs consist of two levels of treat and discharge units, while Type III MSDs are holding tanks that do not discharge and must be pumped out at pump out facilities. Pump out facilities are usually located at marinas and are regulated by the Virginia Department of Health. Most recreational boats with installed toilets have the holding tanks. Discharging raw sewage from boats, from holding tanks or portable toilets for example, is not directly addressed by federal regulations, but state law prohibits it and this is now clarified in our state regulation 9 VAC 25-71.

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 process is for the state to 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. EPA does not have a specific application but has developed informational documents and a loosely structured process for applying for NDZ designation. Any citizen can initiate the process but the final request must be signed by the governor or chief environmental officer of the state.

Note that since untreated sewage discharges from boats are illegal, the only difference in a NDZ with respect to the law is that boats with treat and discharge units (MSD Type I or II) cannot use them. Since most boats on the water have holding tanks anyway, this is not a significant difference. It might be considered, however, that the public outreach and increased law enforcement efforts in NDZs provide for more protection of the waters with regard to previously undetected illegal discharges. Another consideration is that in areas where there is a considerable amount of commercial boat traffic there are more likely to be boats operating with treat and discharge type units (e.g., tug boats in the Chesapeake Bay).

As of the date of this guidance Smith Mountain Lake is the only designated NDZ in the state. This resulted from a bill that was passed by the General Assembly directing the State Water Control Board to petition EPA for NDZ designation. The designation was received and a new boating regulation, 9 VAC 25-71, was adopted that provides for NDZ identification and enforcement. Since the Smith Mountain Lake NDZ designation inquiries have been received from various groups in the Chesapeake Bay watershed wishing to pursue NDZ designation for other water bodies of concern. In order to handle these requests consistently and in accordance with State Water Control Law at Section 62.1-44.33 the following procedure should be followed.

Procedure

The procedure for designating Section 312 Boating No Discharge Zones will be as follows.

1. When an interested party, local government or state agency proposes No Discharge Zone (NDZ) designation for a waterbody within the state it should submit a proposal including the following information to the Director of the VADEQ Division of Water Quality Programs. The Division of Water Quality Programs will develop this information for VADEQ initiated proposals:

A. Name and contact information for the person or group making the request.
B. Name and location of the waterbody.
C. Exact boundaries of the area to be designated, using latitude and longitude of boundaries, any bordering landmarks or delineating features (e.g., bridges or mean

low water elevations) or other means of identifying the area.
D. A map of the area to be designated.
E. Reason why designation is being sought, i.e., why the water body requires greater environmental protection, including:

(1) Nature of the waterbody (estuary, river, lake, etc.) and a description of its features (e.g., heavily populated area, major port or boating area, pristine bay with little surrounding development, enclosed embayment, deep mountain lake);
(2) any unique features or qualities (including high quality waters) or environmental importance (e.g. shellfish waters) that necessitate stronger resource protection;
(3) information on contact recreational use (e.g., swimming);
(4) any specific water quality problems existing, including 303(d) listing and TMDL status if applicable.

Note that greater environmental protection might be considered necessary to maintain the status of a high quality resource or to improve the status of a low quality one.

F. Indication if the waterbody is:

(1) in an established sanctuary, national or state park, wilderness area, recreation area or if the waterbody is used by endangered or threatened species;
(2) a public water supply.

G. A statement or rough estimate of the availability of boat sewage holding tank pumpouts in the area (more exact information will be developed for the EPA application).
H. A statement or rough estimate of the amount of boat traffic in the waterbody and the type of boat traffic, recreational or commercial (more exact information will be developed for the EPA application).
I. Indication, if available, of any public support or interest for or against the NDZ designation.
J. Information on any local enforcement capability (e.g., police boats).
K. Information on any local public outreach capability (provision of signs, pamphlets or other public awareness efforts).

2. VADEQ will review the proposal and obtain more information if necessary.

3. If VADEQ decides it is not appropriate to proceed, it will indicate why and what options are available to the individual or group if they wish to continue (e.g., approach the State Water Control Board or petition EPA directly).

4. If VADEQ decides to proceed with the proposal it will set up a public meeting and provide public notice by publication in a paper local to the waterbody and by such other means as deemed necessary, notifying the public of the intent to designate the waters and what that means, and providing public meeting information. A 30-day public notice period will follow.

5. After the public meeting and upon completion of the public notice period a review of public comments will be summarized and VADEQ staff will present the proposal for NDZ and the summary of public comments to the State Water Control Board with a recommendation on pursuing the NDZ designation from EPA. Disapproval would mean that the individual or group wishing the designation would have to pursue it directly from EPA, obtaining the governor's signature without VADEQ endorsement.

6. If the State Water Control Board approves pursuing the designation, VADEQ will assist the individual or group in preparing an application to EPA and will coordinate with the Virginia Department of Health, the Department of Game and Inland Fisheries and the Virginia Marine Resources Commission (62.1-44.33 requires consultation with these agencies in formulating boating regulations) as well as with EPA Region III.

7. Once the application is prepared and the draft reviewed by EPA (EPA will indicate if it is sufficient for approval prior to formal submittal), VADEQ will route the application through to the Executive Office for signature by the Secretary of Natural Resources and transmittal to EPA.

8. EPA will publish the proposal in the federal register.

9. Upon final publication in the federal register, the new NDZ will be established at the federal level.

10. VADEQ will amend 9 VAC 25-71 by adding the new NDZ to the list of state designated NDZs, and will present it to the State Water Control Board as final exempt (required to conform to federal law).

11. Publication of the 9 VAC 25-71 amendment will be made in the Virginia Register and the final 30-day notice period will follow, after which the new NDZ is established at the state level.

12. Public awareness and enforcement efforts can begin.

Appendix E Vessel Sewage Discharge Program

Marine Sanitation Device Standard--Establishment of Drinking Water Inake No Discharge Zone(s) Under Section 312(f)(4)(B) of the Clean Water Act; Final Rule.

As of January 30, 1980, if a vessel has an installed toilet (technically referred to as a marine sanitation device (MSD)), it must be equipped with one of three types of MSDs (http://www4.law.cornell.edu/uscode/33/1322.html).

The MSDs (Type I, Type II, Type III) are designed to meet different needs and effluent level requirements. Since portable toilets can be moved on and off a vessel, they are not considered installed toilets; therefore, vessels that have portable toilets are not subject to the MSD regulations.

Types of Marine Sanitation Devices

Sewage Treatment Device	Vessel Length	Standard
Type I- Flow-through device (maceration and disinfection)	equal to or less than 65 feet in length	The effluent produced must not have a fecal coliform bacteria count greater than 1000 per 100 milliliters and have no visible floating solids.
Type II- Flow-through device (maceration and disinfection)	greater than 65 feet in length	The effluent produced must not have a fecal coliform bacteria count greater than 200 per 100 milliliters and suspended solids not greater than 150 milligrams per liter.
Type III- Holding tank	any length	This MSD is designed to prevent the overboard discharge of treated or untreated sewage.

- Type I MSDs rely on maceration and disinfection for treatment of the waste prior to its discharge into the water.

- Type II MSDs are similar to the Type I; however, the Type II devices provide an advanced form of the same type of treatment and discharge wastes with lower fecal coliform counts and reduced suspended solids.

- Type III MSDs are commonly called holding tanks because the sewage flushed from the marine head is deposited into a tank containing deodorizers and other chemicals. The contents of the holding tank are stored until it can be properly disposed of at a shore-side pumpout facility. (Type III MSDs can be equipped with a discharge option, usually called a Y-valve, which allows the boater to direct the sewage from the head either into the holding tank or directly overboard. Discharging the contents directly overboard is legal only outside the U.S. territorial waters which is 3 or more miles from shore.)

Houseboats
In accordance with the FWPCA, a State may adopt and enforce a statute or regulation with respect to the design, manufacture, or installation or use of any MSD on a houseboat, if such statute or regulation is stricter than EPA and USCG requirements. The term "houseboat" refers to a vessel which, for a period of time determined by the State in which the vessel is located, is used primarily as a residence and is not used primarily as a means of transportation. For example, a State may require that houseboats less than 65 feet (19.7 meters) in length with an installed Type I device update to a Type II or III device. **Reference: Section 1322(f)(1)(B) FWPCA**