Cod, Presley, Bridgeman, Hull, Rogers, Cubitt, and Hack Creeks

Total Maximum Daily Load (TMDL) Report for Shellfish Condemnation Areas Listed Due to Bacteria Pollution

Virginia Department of Environmental Quality

October 6, 2009

Table of Contents

List of Figures

List of Tables

Executive Summary

This document details the development of a bacterial Total Maximum Daily Load (TMDL) for segments of the Cod, Presley, Hull, Rodgers, Bridgeman, Cubitt, and Hack Creek watersheds in Northumberland County, Virginia.

The process of developing shellfish water TMDLs 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 for comment, after which the final report is approved by the U. S. Environmental Protection Agency (USEPA) and the Virginia Water Control Board;
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.

Two distinctly different approaches to determine the sources of fecal pollution in a water body are watershed modeling and bacterial source tracking (BST). Watershed modeling identifies potential sources based on information about conditions in the watershed (e.g. numbers of residents, estimated wildlife populations, estimated number of livestock, etc.). BST identifies sources of fecal coliform, specifically the dominant fecal coliform Escherichia coli, based on either genetic or phenotypic characteristics of the coliforms. Virginia's Department of Environmental Quality (VDEQ) uses BST, and specifically a method called antibiotic resistance analysis (ARA). This method assumes that fecal bacteria found in four sources: humans, wildlife, livestock, and pets will all differ in their reactions to antibiotics.

Shellfish impairments that appear on Virginia's 303(d) list of impaired waters are based on condemnation notices issued by the Virginia Department of Health - Division of Shellfish Sanitation (VDH-DSS). VDH-DSS groups creeks geographically for evaluation of water quality and shoreline sanitary conditions; these groups are referred to as "growing areas". This document addresses impairments in growing area 009 (GA009). Based on VDH-DSS condemnations that were in effect at the time the list was prepared, a total of seven segments from this growing area were listed as impaired for shellfish use on Virginia's 1998 303(d) Total Maximum Daily Load Priority List. These segments, along with the date of the applicable VDH-DSS condemnation notice, are as follows: two segments on Cod Creek (31 January, 1997), one on Presley Creek (27 April, 1989), one each on Bridgeman, Hull, and Rogers Creeks (all 31 January, 1997) and one on Cubitt Creek (30 May, 1986). Copies of these condemnation notices are included in Appendix A.

VDEQ expanded the impaired segments in the TMDL because annual shellfish condemnation assessments indicated that some additional tidal tributaries became impaired since the original 1998 listing. To reduce unnecessary resources spent on repeated TMDL developments for additional segments in the same watershed, VDEQ combined the most downstream main stem condemnation with the largest number of tributary cove condemnations from previous VDH-DSS condemnations in

the watersheds, using the combined surface area and volume of these areas in the TMDL development calculations. This is the concept of maximum extent for shellfish use TMDLs.

Applying this concept in GA009, VDEQ added an additional impaired segment to this TMDL for development, and increased the extent of four existing segments. The entire tidal portion of Hack Creek was added as a part of the VDH-DSS condemnation notice dated 14 March, 2007. The condemnation on Presley Creek expanded to include the entire creek up to its current mouth at the Potomac River on 30 March, 2009. The impaired section of the main stem of Hull Creek is shown at its maximum downstream extent on the VDH-DSS condemnation notice dated 21 August, 2000. The VDH-DSS condemnation notice dated 17 March, 2008 indicates the maximum downstream extent of the impaired segments of Bridgeman and Rogers Creeks. The impairment on Bridgeman Creek expanded slightly downstream relative to its extent in the original listing, while the impairment on Rogers Creek expanded to include all of Rogers Creek up to its mouth at the Potomac River. The two impairments on Cod Creek and the impairment on Cubitt Creek were at their maximum extents in the condemnation notices that resulted in their original 1998 303(d) listing; thus they were not expanded further. Copies of the condemnation notices showing the maximum extent of each of the impairments are included in Appendix A.

The maximum extent condemnation for the Cod Creek west and east impaired segments (VAP-A34E-07-SF and VAP-A34E-08-SF, respectively) is identified as the tidal portion of the west and east branches of Cod Creek downstream to the boundaries indicated on the VDH-DSS condemnation notice dated 31 January, 1997. The maximum extent condemnation for the Presley creek impairment (VAP-A34E-09-SF) is identified as the entire tidal portion of Presley Creek to its mouth at the Potomac River, as shown on the VDH-DSS condemnation notice dated 30 March, 2009. The maximum extent condemnation for the Hull Creek main stem impairment (VAP-A34E-12-SF) is identified as the tidal portion of Hull Creek to the downstream boundary indicated on the VDH-DSS condemnation notice dated 21 August, 2000. The maximum extent for the condemnations on Rogers and Bridgeman Creeks (VAP-A34E-10-SF and VAP-A34E-13-SF, respectively) is identified as the tidal portions of those creeks, extending to the downstream boundary indicated on the VDH-DSS condemnation notice dated 17 March, 2008. The maximum extent condemnations for the Cubitt Creek (VAP-A34E-14-SF) and Hack Creek (A34E-36-SF) impairments are identified as the entire tidal portions of those creeks to their mouths at the Potomac River, as indicated on VDH-DSS condemnation notices dated 30 May, 1986 and 14 March, 2007, respectively.

The applicable state standard specifies that the number of fecal coliform bacteria shall not exceed a maximum allowable level of geometric mean of 14 most probable number (3-tube MPN) per 100 milliliters (ml) and a 90th percentile geometric mean value of 49 MPN/100ml (Virginia Water Quality Standard 9-VAC 25-260-5). In development of this TMDL, the 90th percentile, 49 MPN/100 ml, will be the standard utilized for Implementation Planning because it represents the more conservative standard.

Potential sources of fecal coliform consist primarily of non-point source contributions, and include permitted point source discharges 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.).

Virginia DEQ and the Virginia Department of Health collaborated to use a simplified volumetric approach to develop the TMDL. The goal of the procedure is to use bacteriological source tracking

(BST) data and bathymetric data to determine the sources of fecal coliform violations, the estuarine volumes and the load reductions needed to attain the applicable criteria.

To assist in partitioning the loads from the diverse sources within the watershed, BST samples of fecal coliform bacteria were collected monthly for one year. 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 in all creeks covered herein, the primary sources of fecal coliforms were the anthropogenic sources of human, pet and livestock (combined), followed by wildlife as a background contributor. The presence of large signatures attributable to different components is sufficient to establish potential directions for remediation under a future implementation plan.

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 had higher violation rates, and required greater reductions compared to the geometric mean. Calculated results 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 load calculations and the reductions necessary for each watershed and segment are shown below.

Table ES.1 TMDL summary for impairments in GA009, based on 90th percentile water quality data.

Condemnation Area	Volume (m^3)	90th Percentile Fecal Coliform (MPN/100ml)	90th Percentile W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Cod Creek (West)	312614	202.5	49.0	Implicit	6.33E+11	1.53E+11	76%
Cod Creek (East)	184834	288.3	49.0		5.33E+11	9.06E+10	83%
Presley Creek	741082	202.8	49.0		1.50E+12	3.63E+11	76%
Bridgeman Creek	157203	198.1	49.0		3.11E+11	7.70E+10	75%
Hull Creek	2587869	381.4	49.0		9.87E+12	1.27E+12	87%
Rogers Creek	200584	163.6	49.0		3.28E+11	9.83E+10	70%
Cubitt Creek	868036	311.5	49.0		2.70E+12	4.25E+11	84%
Hack Creek	611694	92.8	49.0		5.68E+11	3.00E+11	47%

Cubitt Creek was also listed in 1998, and subsequently re-listed in 2004, as not supporting the primary contact recreational criterion for fecal coliform. The TMDL for this impairment would ordinarily be due in 2016. However, the shellfishing standard for fecal coliform targeted by this TMDL (90^{th} percentile less than 49 MPN / 100 mL) is much more stringent than the recreational use standard for fecal coliform in effect at the time of the recreational impairment listing (no more than 10% of the total samples taken during any calendar month exceeding 400 MPN / 100 mL). As indicated in the table

above, to meet the 90th percentile shellfish standard in Cubitt Creek, it is estimated that loading reductions of 84 percent are required, including a 100 percent reduction of anthropogenic sources. This course of action is consistent with definition number two *("Nested Recreation and Shellfish Impairments")* of a nested impairment as petitioned by DEQ to EPA on March 3, 2009, and approved by EPA on March 25, 2009. Per that agreement, this impairment will be listed in DEQ's 2010 Integrated Report as "Category 4A (nested)", and no recreational TMDL will be developed.

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. A MOS is either numeric or implicit in the design of the TMDL. In this TMDL the MOS is implicit in the conservative assumptions used in the load calculations, such as using the worst case bacterial concentrations in current load calculations, resulting in the highest and most protective percent reductions.

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."

Once a TMDL has been approved by EPA, measures must be taken to reduce pollution levels in the water body. These measures, which can include the use of better treatment technologies, the installation of best management practices (BMPs) and designation of a No Discharge Zone (NDZ), are implemented in an iterative process that is described along with specific BMPs in the implementation plan. The TMDL developed for the Cod, Presley, Bridgeman, Hull, Rogers, Cubitt, and Hack Creeks watershed impairments provides allocation scenarios that will be a starting point for developing implementation strategies. 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. Reductions in non-point source loading are the crucial factor in addressing the problem. These sources cannot be addressed without public understanding of and support for the implementation process. 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 Cod, Presley, Bridgeman, Hull, Rodgers, Cubitt, and Hack Creek watersheds, public involvement was encouraged through a public participation process that included public and stakeholder meetings and public comment periods.

The first technical advisory committee and public meetings were held on June 24th, 2009. A basic description of the TMDL process and the agencies involved was presented and a discussion was held regarding the source assessment input, bacterial source tracking, and load calculations. Public

understanding of and involvement in the TMDL process was encouraged. Input from these meetings was utilized in the development of the TMDL and improved confidence in the allocation scenarios and TMDL process. The TMDL load allocations were presented during the second public meeting held on September 1, 2009. The public meetings were advertised in the local media, signs advertising the meeting were placed at high access road intersections in the watershed for two weeks before the meetings, and email invitations were sent to local government and stakeholders. There were four public comments received during the first public comment period and 2 public comments received during the final public comment period.

1. Introduction

This document details the development of bacterial Total Maximum Daily Loads (TMDL) for segments of the Cod, Presley, Bridgeman, Hull, Rogers, Cubitt, and Hack Creek watersheds in Northumberland County, Virginia.

Shellfish impairments that appear on Virginia's 303(d) list of impaired waters are based on condemnation notices issued by the Virginia Department of Health - Division of Shellfish Sanitation (VDH-DSS). VDH-DSS groups creeks geographically for evaluation of water quality and shoreline sanitary conditions; these groups are referred to as "growing areas". The creeks named above all lie within growing area 009 (GA009). Based on VDH-DSS condemnations that were in effect at the time the list was prepared, a total of seven segments from this growing area were listed as impaired for shellfish use on Virginia's 1998 303(d) Total Maximum Daily Load Priority List. These segments, along with the date of the applicable VDH-DSS condemnation notice, are as follows: two segments on Cod Creek (31 January, 1997.), one on Presley Creek (27 April, 1989), one each on Bridgeman, Hull, and Rogers Creeks (all 31 January, 1997) and one on Cubitt Creek (30 May, 1986). Copies of these condemnation notices are included in Appendix A.

Due to annual VDH-DSS shellfish condemnation assessments, impaired shellfish waters often fluctuate in area and volume, as well as presence or absence of condemnations from year to year. An impaired area may be added to the 303(d) impaired waters list during one assessment cycle, and undergo several evolutions in size during the VDH-DSS cycles prior to TMDL development. Under this dynamic condition, and to reduce unnecessary resources spent on repeated TMDL developments in the same watersheds, VDEQ determined the maximum extent of condemned areas in GA009 from all past VDH-DSS condemnations for development of this TMDL. Specifically, VDEQ combined the most downstream main stem condemnation with the largest number of tributary and cove condemnations in previous VDH-DSS condemnations in GA009, using the combined surface area and volume of these areas in the TMDL development calculations. This is the concept of maximum extent in shellfish use TMDLs.

As a result of applying this concept, VDEQ added an additional impaired segment to this TMDL for development, and increased the extent of four existing segments. The entire tidal portion of Hack Creek was added, based on VDH-DSS condemnation notice dated 14 March, 2007. The condemnation on Presley Creek expanded to include the entire creek up to its current mouth at the Potomac River on 30 March, 2009. The impaired section of the main stem of Hull Creek is shown at its maximum downstream extent on the VDH-DSS condemnation notice dated 21 August, 2000. The VDH-DSS condemnation notice dated 17 March, 2008 indicates the maximum downstream extent of the impaired segments of Bridgeman and Rogers Creeks: the impairment on Bridgeman Creek expanded slightly downstream relative to its extent in the original listing, while the impairment on Rogers Creek expanded to include all of Rogers Creek up to its mouth at the Potomac River. The two impairments on Cod Creek and the impairment on Cubitt Creek were at their maximum extents in the condemnation notices that resulted in their original 1998 303(d) listing; thus they were not expanded further. Copies of the condemnation notices showing the maximum extent of each of the impairments are included in Appendix A.

A TMDL is just 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. 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 standards set for the uses designated for the water body. The water bodies 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 listed on the §303 (d) list reported to the Environmental Protection Agency. Those waters placed on the list require the development of a TMDL intended to eliminate the impairment and bring the water into compliance with the designated standards.

TMDLs represent the total pollutant loading that a water body can contain 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.

Fecal coliform bacteria are the most common cause for the impairments in Virginia shellfish growing waters. 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.

The Virginia Department of Environmental Quality and VDH-DSS use a source identification method called bacterial or microbial source tracking (BST or MST) to assist with assigning load allocations for non-point sources. This method is discussed in section 4.3.

1.1. Overview of the TMDL 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 at what 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 a review of progress in reducing pollutant input, refine bacteria loading estimates based upon additional data and make any identified 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.

2. Designated Uses and Applicable Water Quality Standard

Water quality standards are provisions of state or federal law which consist of a designated use or set of uses for the waters and water quality criteria based upon such uses. The purpose of water quality standards is to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC §1251 et seq.). According to Virginia Water Quality Standards (9 VAC 25-260-5), 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, all tidal waters with salinity in Virginia are designated as shellfish waters. The identification of the applicable river reaches can be found in the river basin tables at 9VAC25-260-390 et seq. For a shellfish supporting water body to be in compliance with Virginia bacterial standards, VDEQ 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, or MF test of 31 CFU (colony forming units) per 100 milliliters."*

2.2. Classification of Virginia's Shellfish Growing Areas

The Virginia Department of Health, Division of Shellfish Sanitation is responsible for classifying shellfish waters. 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.

The VDH-DSS designs and operates the shoreline survey to locate sources of pollution within the watersheds of shellfish growing areas. This is a property-by-property inspection of the onsite sanitary waste disposal facilities on un-sewered sections of watersheds, of other sources of pollution such as wastewater treatment plants (WTP), marinas, livestock operations, landfills, etc. The information is compiled into a written report with a map showing the location of the sources of real or potential pollution found. 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. Shoreline surveys are repeated in watersheds approximately every eight years.

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 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 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 are assumed to 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 self purification.

Some portions of shellfish growing areas are either permanently or seasonally closed to direct shellfish harvesting due to the presence of either marinas or wastewater treatment facility discharges. In these cases, DSS uses a computer model to determine the size and shape of the closure area based on the potential fecal input, *e.g.*, number of boats in a marina or the number of gallons of sewage permitted for the treatment facility. DSS is careful to ensure that a sufficient area is closed to protect public health under even high pollution events without condemning excessive waters.

3. Watershed Characterization

3.1. Geography

A. Collective Watershed

The boundaries of GA009 serve to define the collective watershed of the creeks considered in this TMDL. The growing area occupies 29.4 square miles in northern Northumberland County, on Virginia's Northern Neck (the peninsula of land separating the tidal Potomac and Rappahannock Rivers). All the creeks drain northward into the tidal Potomac River, just upstream of its mouth at the Chesapeake Bay (Figure 3.1). Roughly, the collective watershed is bound on the north by the Potomac River, the south by U.S. 360, the east by State Road 630, and the west by State Roads 646 and 644. Elevation ranges from 5 feet along the tidal shoreline to a maximum of 108 feet along the watershed divide (VDH-DSS, 2006). The tidal creeks are fed by numerous first- and second-order tributaries.

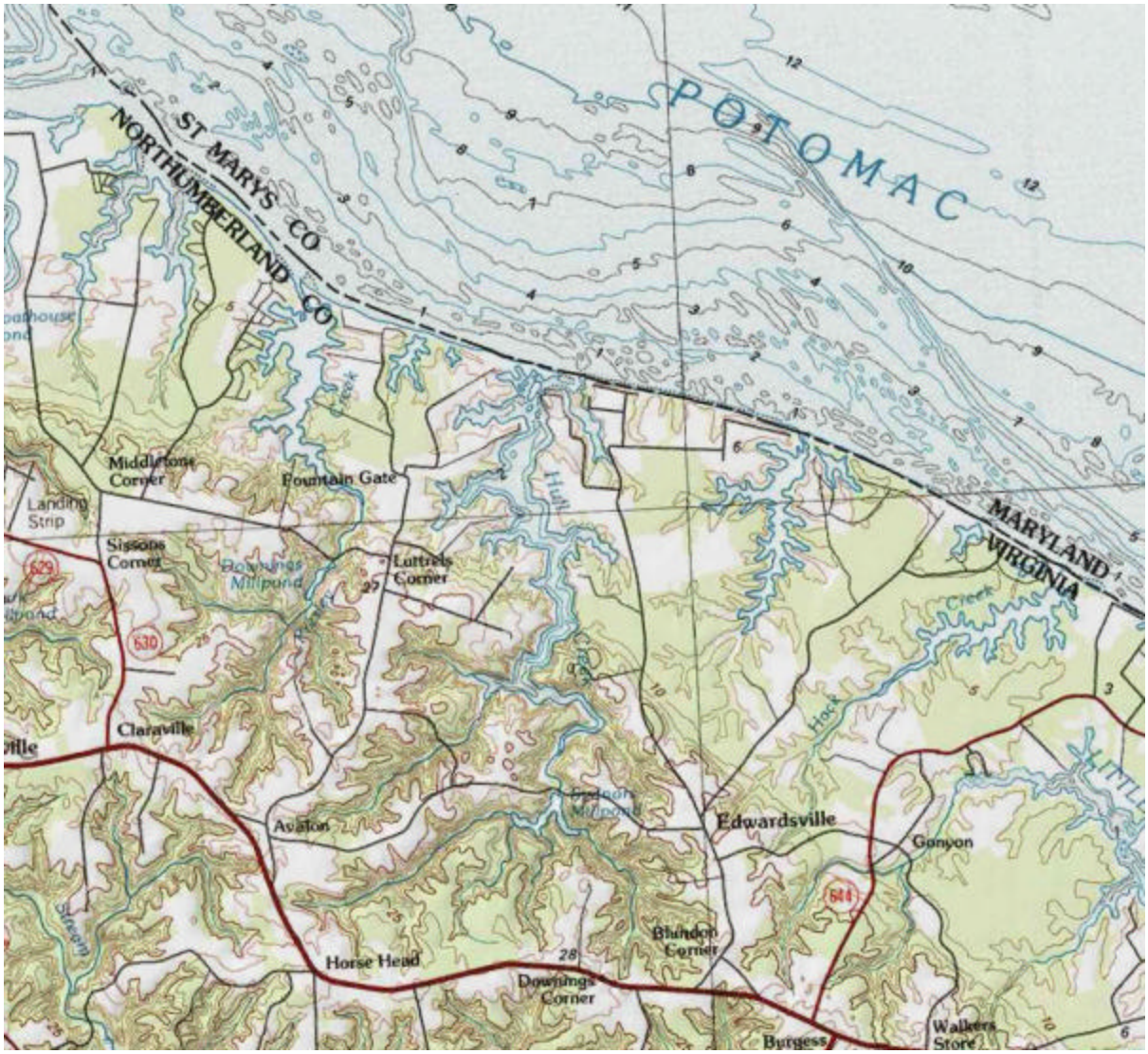


Figure 3.1 Watershed map, showing the tidal creeks addressed in this TMDL.

The area is sparsely populated; the nearest population center is Heathsville, an unincorporated community straddling U.S. 360 roughly 1.5 miles outside the western watershed divide. Residential developments inside the watershed are concentrated along the tidal creeks near their mouths, as well as along the Potomac shoreline itself. Major communities include Pine Point Estates, Bay Quarter Shores, Potomac Bay Estates, Sands on the Potomac, Pleasant Point, Hull Harbor, Oyster Cove, Chesapeake Cove, White Sand Harbour, Lower Bayview, Upper Bayview, Harbour Pointe, Lighthouse Harbour, and Northumberland Plantation. Conversations with local residents suggest a substantial transient population, with many residences occupied only seasonally and/or on weekends. While the area is still largely rural, it is growing steadily; the collective watershed added 300 properties since the previous survey in 1998 (VDH-DSS, 2006).

The total area of the watersheds for the water bodies considered in this TMDL is 26.4 square miles; the difference between this figure and the total for GA009 (29.4 square miles) is accounted for by the watersheds of small water bodies not considered as a part of this TMDL (Corbin Pond and Flag Pond), as well as land draining directly to the Potomac River.

B. Cod and Presley Creeks

Cod and Presley Creeks are the westernmost creeks in the collective watershed (Figure 3-1). Cod Creek has a wide mouth and is easily navigable; in contrast, citizen comments indicate that the mouth of Presley Creek is non-navigable to all but small personal watercraft. The areas of the Cod Creek and Presley Creek watersheds are approximately 3.19 and 6.25 square miles, respectively. Condemnations in these two creeks are addressed in VDH-DSS condemnation 009-141; notices showing the initial and maximum extent listings are included in Appendix A.

C. Bridgeman, Hull, and Rogers Creeks

Bridgeman, Hull, and Rogers Creeks drain the central region of the collective watershed (Figure 3-1). The creeks mouths at the Potomac River exhibit complex morphology, with Bridgeman Creek draining to Hull Creek immediately upstream of Hull Creek's mouth. Rogers Creek essentially drains directly to the Potomac River, although its mouth is immediately adjacent to that of Hull Creek. Navigation into the Potomac River from Hull/Bridgeman Creeks and Rogers Creek is possible with experience and caution. The combined watershed area for these closely grouped creeks is 10.60 square miles. Condemnations in these three creeks are addressed in VDH-DSS condemnation 009-142; notices showing the initial and maximum extent listings are included in Appendix A.

D. Cubitt and Hack Creeks

Cubitt and Hack Creeks drain the eastern third of the collective watershed. Citizen comments indicate that the mouths of these creeks are non-navigable to all but the smallest personal watercraft. The watershed areas of Cubitt and Hack Creeks are 3.29 and 3.08 square miles, respectively. VDH-DSS condemnations in these two creeks are addressed in VDH-DSS condemnation 009-161; notices showing the initial and maximum extent listings are included in Appendix A.

3.2. Geology and Soils

Northumberland County lies in the Atlantic Coastal Plain, the easternmost of Virginia's physiographic provinces. The Atlantic Coastal Plain extends from New Jersey to Florida, and includes all of Virginia east of the Fall Line. The Fall Line is the easternmost extent of rocky-river rapids, the point at which east-flowing rivers cross from the hard, igneous and metamorphic rocks of the Piedmont to the relatively soft, unconsolidated strata of the Coastal Plain. The Coastal Plain is underlain by layers of Cretaceous and younger clay, sand, and gravel that dip gently eastward. These layers were deposited

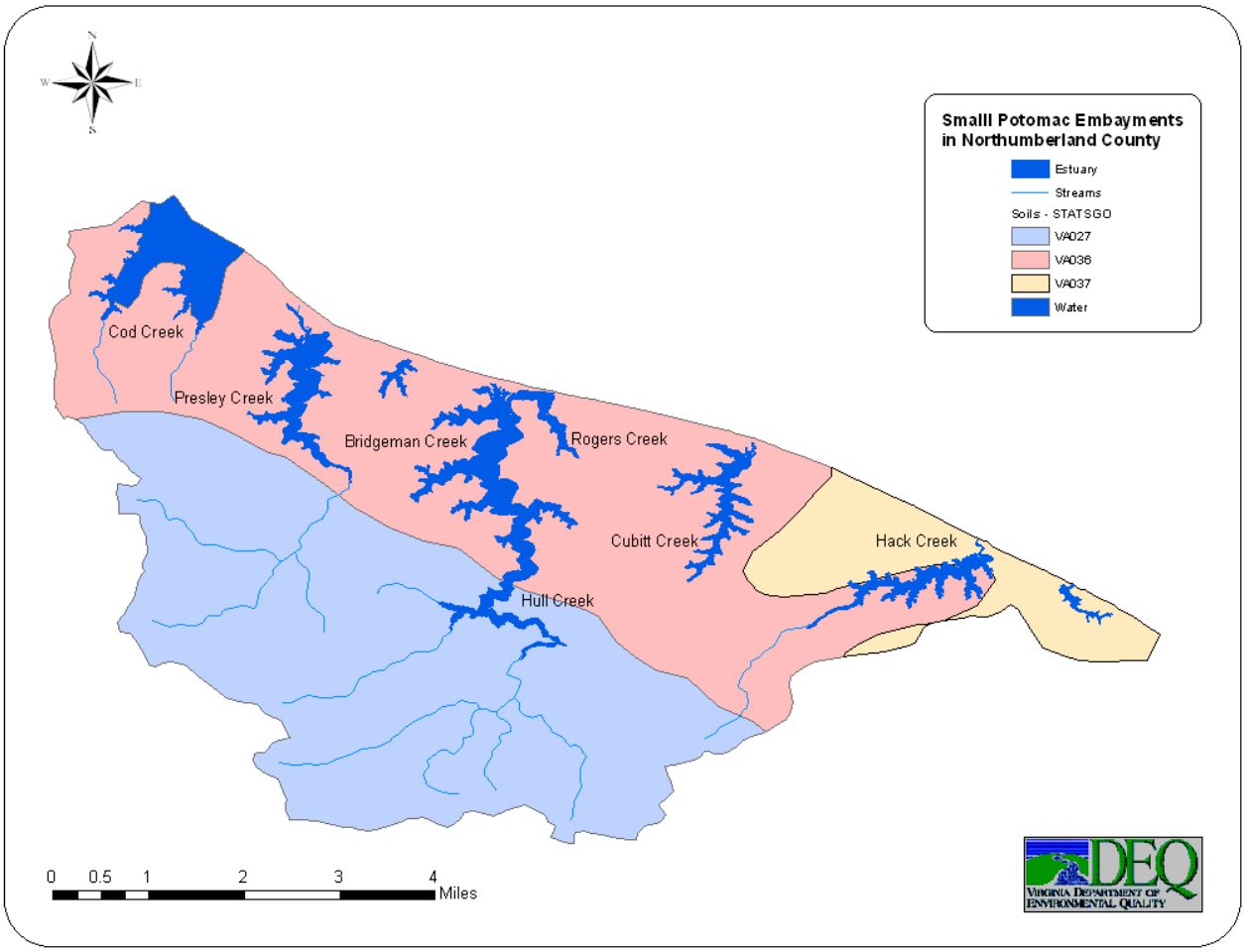


Figure 3.2 Watershed map, showing extent of general STATSGO soil series.

by rivers carrying sediment from the eroding Appalachian Mountains to the west. As the sea level rose and fell, fossiliferous marine deposits were inter-layered with fluvial, estuarine, and beach strata. The youngest deposits of the Coastal Plain are sand, silt and mud presently being deposited in our bays and along our beaches (College of William and Mary, 2006)

Soils for the collective watershed were documented utilizing the VA State Soil Geographic Database (STATSGO). Three general soil types were identified in this database (Figure 3.2). Descriptions of these soil series which follow were derived from queries to the USDA Natural Resources Conservation Service (NRCS) Official Soil Series Description web site (NRCS, 2009).

Soils of the Emporia-Johnston-Kenansville-Remlik-Rumford-Slagle-Suffolk-Tomotley (VA027) series are very deep to deep, and vary between well drained to poorly drained with moderately slow or slow permeability. They formed in moderately fine-textured stratified fluvial and marine sediments on the upper Coastal Plain and stream terraces.

Soils of the Tetotum-Nansemond-State-Emporia-Dragston-Nimmo-Bladen Series (VA036) are very deep and range from well drained to poorly drained. Permeability ranges from moderately rapid and/or rapid to moderately slow or slow. This soil series was formed in sandy or loamy fluvial and marine sediments on Coastal Plain uplands and stream terraces.

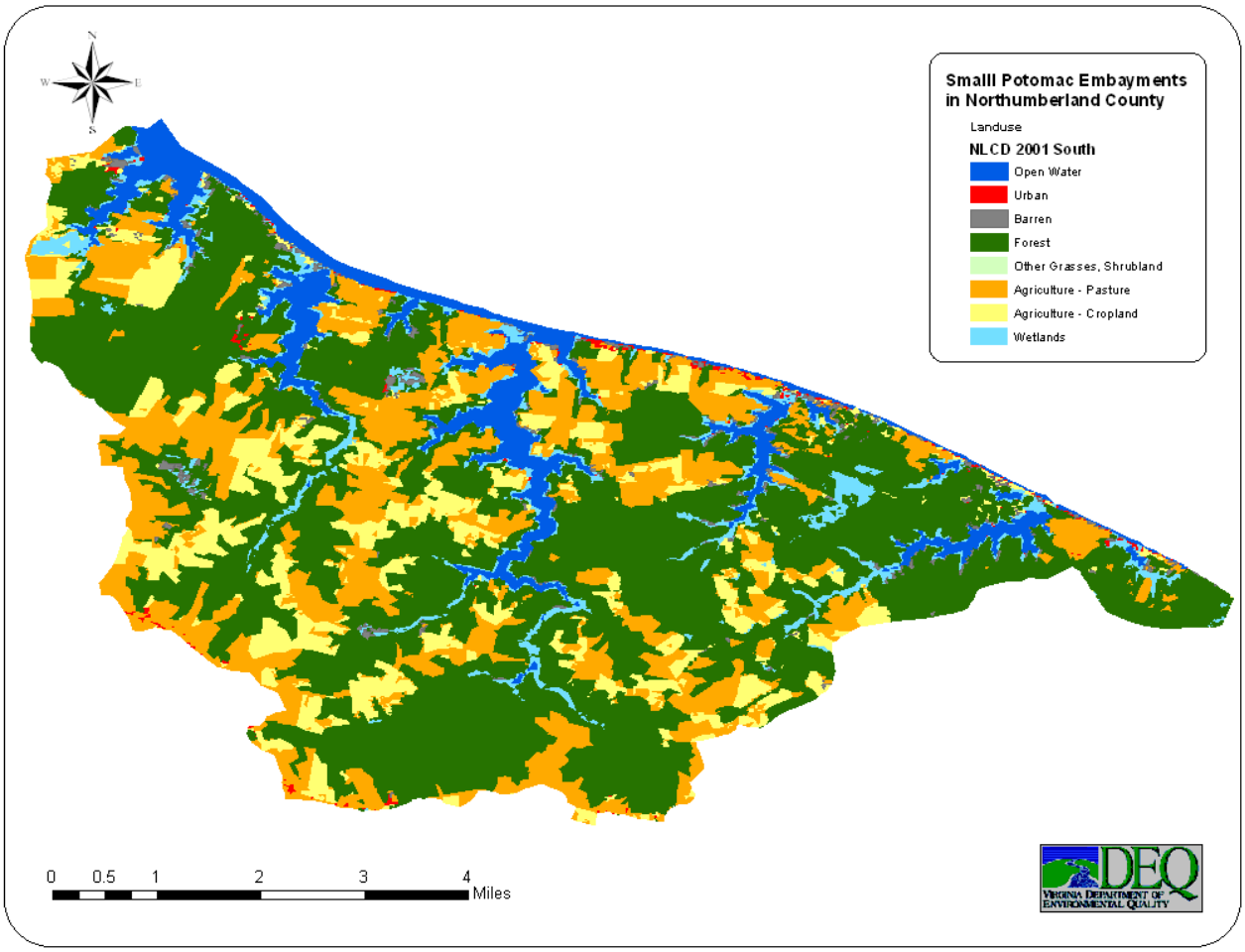


Figure 3.3 Watershed map, showing land use type and distribution.

Soils of the Bibb and Levy-Bohicket-Lumbee-Nansemond-Rumford-Tetotum-State-Suffolk (VA037) are very deep to deep, and vary from well drained to very poorly drained. They range in slope from 0 - 15 percent. Their water capacity varies from low to high. This soils series was formed in sandy to loamy to mucky clay alluvial and marine sediments on the upper Coastal Plain and stream terraces.

3.3. Land Use

A. Collective Watershed

Land use information was gathered from the 2001 National Land Cover Database (MRLC, 2008). About 64 percent of land in GA009 is undeveloped, consisting of forest (51 percent), wetland (6 percent), or open water (7 percent; Figures 3.3, 3.4 Table 3.1). About 34 percent of the land is classified as either cropland (12 percent) or pasture (22 percent). However, local reports and watershed reconnaissance indicate little or no pasture land in GA009; NLCD cropland and pasture are considered lumped as "agriculture" for the remainder of this report. The remaining two percent of land is classified as a combination of urban, barren, or other grasses/shrubs. A tally of E-911 emergency response address points prepared in 2006 indicates a total of 1389 locations within the watersheds considered in this TMDL (S. McKenzie, Northern Neck Planning District Commission, written communication, 2009). Assuming these correspond one-to-one with residences, this yields an average

density of 0.082 residences per acre of combined watershed area (Table 3.2). As stated above, these residences are generally concentrated near the mouths of the creeks.

B. Cod and Presley Creeks

About 69 percent of the Cod Creek watershed is forest, wetland, or open water, and 29 percent is agricultural (Figure 3.5, Table 3.3). The watershed is unique in that it has a considerably higher percentage of open water than the others: 10 percent, compared to 4 to 6 percent for all the others. Cod Creek is also unique in that it has the highest population density: there are a total of 219 E-911 address points in the watershed, yielding a density of 0.11 residences per acre. The Presley Creek watershed has by far the highest percentage of agricultural land of all the watersheds considered: 47 percent, compared to 35 percent for Bridgeman/Hull/Rogers Creeks, the next highest percentage. Correspondingly, Presley Creek has the lowest percentage of undeveloped land (52 percent; Figure 3.5, Table 3.6). The density of residences in the Presley Creek watershed is moderate, at 0.08 residences per acre.

C. Bridgeman, Hull and Rogers Creeks

Collectively, land use in the watersheds of Bridgeman, Hull, and Rogers Creeks is 63 percent undeveloped (forest, wetland, or open water), 35 percent agriculture, and 1.3 percent other uses (Figure 3.7, Table 3.5). Residential density derived from E-911 address points is moderate at 0.08 residences per acre.

D. Cubitt and Hack Creeks

Considered individually, Cubitt and Hack Creeks share the lowest figures for agricultural land use, 29 and 28 percent, respectively (Figures 3.8 and 3.9, Tables 3.6 and 3.7, respectively) and, along with Cod Creek, the highest figures for undeveloped land, 68 and 70 percent. With only 126 E-911 address points, Hack Creek has the lowest residential density of all the watersheds considered, 0.06 residences per acre; residential density in Cubitt Creek is moderate at 0.08 residences per acre (Table 3.2).

Table 3.1 Collective watershed area by land use type.

Land Use Type	Acres	Square Miles	Percent Total
Open Water	1302	2.03	7%
Urban	109	0.17	1%
Barren	295	0.46	2%
Forest	9583	14.97	51%
Other Grasses, Shrubland	0	0.00	0%
Agriculture - Pasture	4173	6.52	22%
Agriculture-Cropland	2239	3.50	12%
Wetlands	1090	1.70	6%
Total	**18792**	**29.36**	**100%**

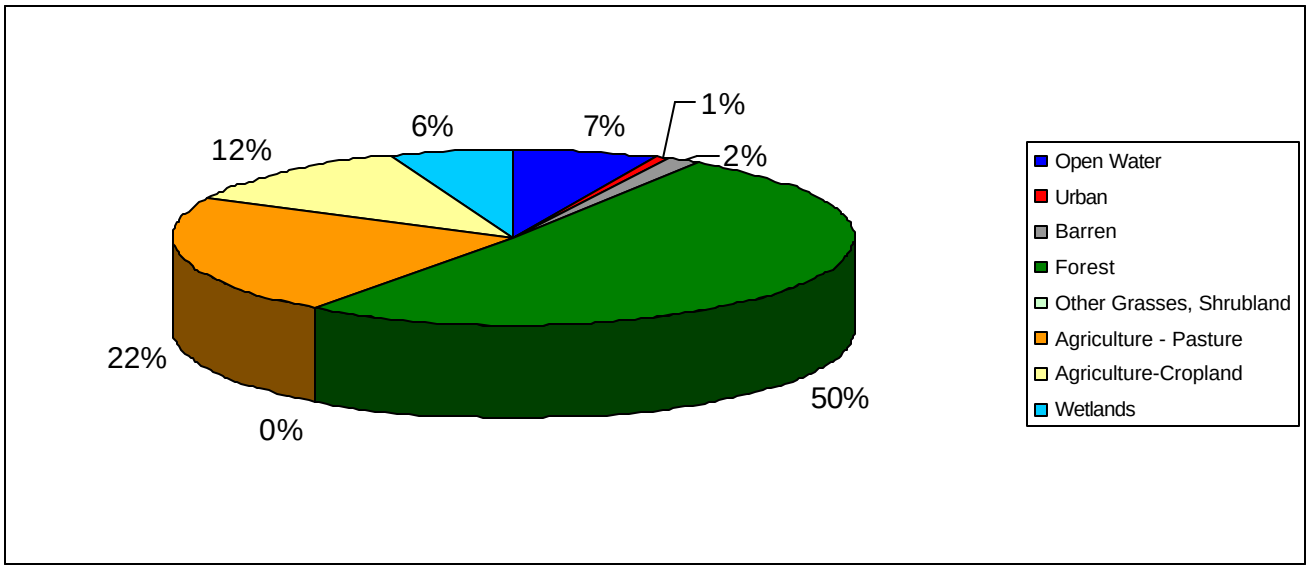


Figure 3.4 Collective watershed area by land use type.

Table 3.2 Watershed area and residential density based on E-911 points.

Watershed	Area		Number of E-911 Points	Residential Density	
	Square Miles	Acres		Per Square Mile	Per Acre
Cod Creek	3.19	2042	219	68.7	0.11
Presley Creek	6.25	4000	338	54.1	0.08
Bridgeman, Hull, Rogers Creeks	10.60	6784	511	48.2	0.08
Cubitt Creek	3.29	2104	195	59.3	0.09
Hack Creek	3.08	1973	126	40.9	0.06
Total (Average)	**26.41**	**16902**	**1389**	**(52.6)**	**(0.08)**

Table 3.3 Cod Creek watershed area by land use type.

Land Use Type	Acres	Square Miles	Percent Total
Open Water	214	0.33	10%
Urban	8	0.01	0.4%
Barren	37	0.06	2%
Forest	1037	1.62	51%
Other Grasses, Shrubland	0	0.00	0%
Agriculture - Pasture	325	0.51	16%
Agriculture-Cropland	267	0.42	13%
Wetlands	154	0.24	8%
Total	**2042**	**3.19**	**100%**

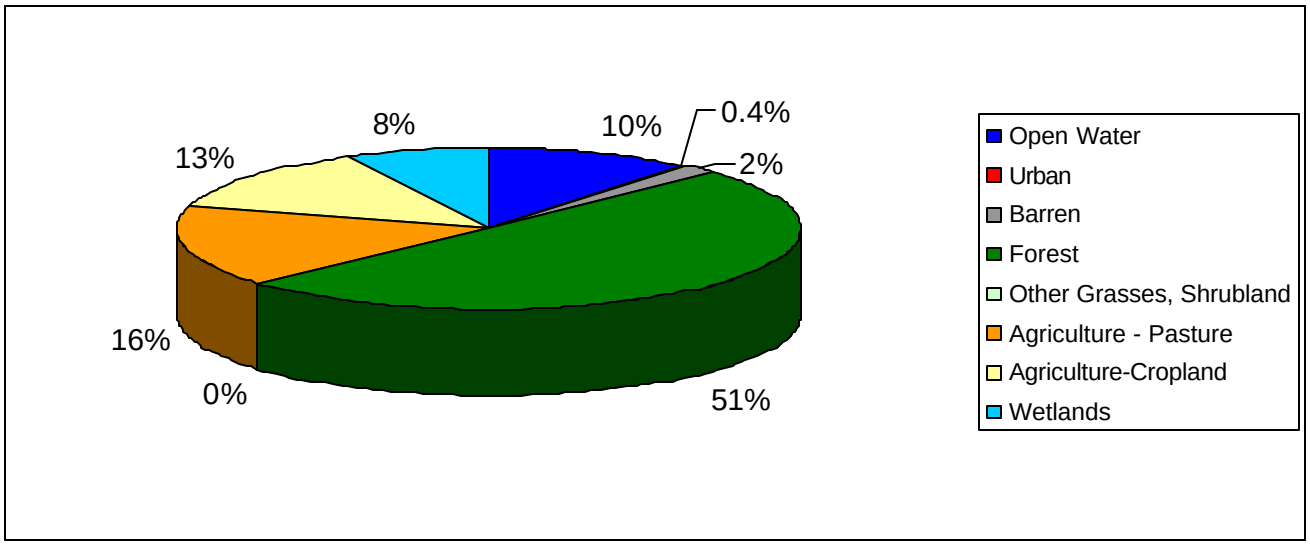


Figure 3.5 Cod Creek watershed area by land use type.

Table 3.4 Presley Creek watershed area by land use type.

Land Use Type	Acres	Square Miles	Percent Total
Open Water	175	0.27	4%
Urban	17	0.03	0.4%
Barren	46	0.07	1%
Forest	1732	2.71	43%
Other Grasses, Shrubland	0	0.00	0%
Agriculture - Pasture	1194	1.87	30%
Agriculture-Cropland	672	1.05	17%
Wetlands	163	0.25	4%
Total	**4000**	**6.25**	**100%**

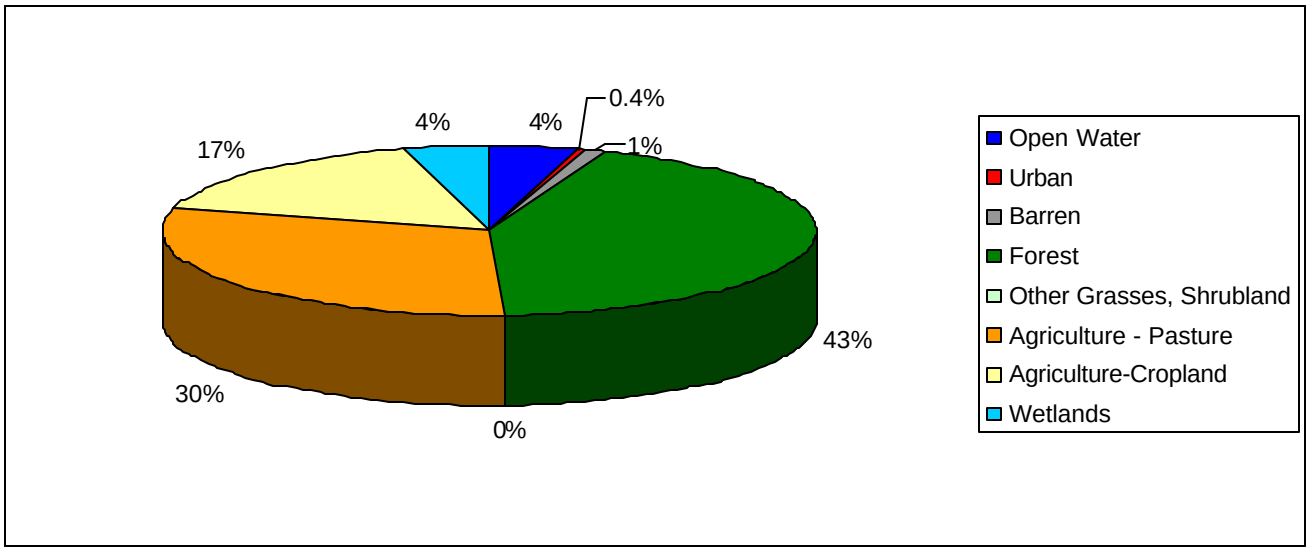


Figure 3.6 Presley Creek watershed area by land use type.

Table 3.5 Bridgeman, Hull, and Rogers Creeks watershed area by land use type.

Land Use Type	Acres	Square Miles	Percent Total
Open Water	438	0.68	6%
Urban	25	0.04	0.4%
Barren	65	0.10	1%
Forest	3541	5.53	52%
Other Grasses, Shrubland	0	0.00	0%
Agriculture - Pasture	1586	2.48	23%
Agriculture-Cropland	812	1.27	12%
Wetlands	317	0.50	5%
Total	**6784**	**10.60**	**100%**

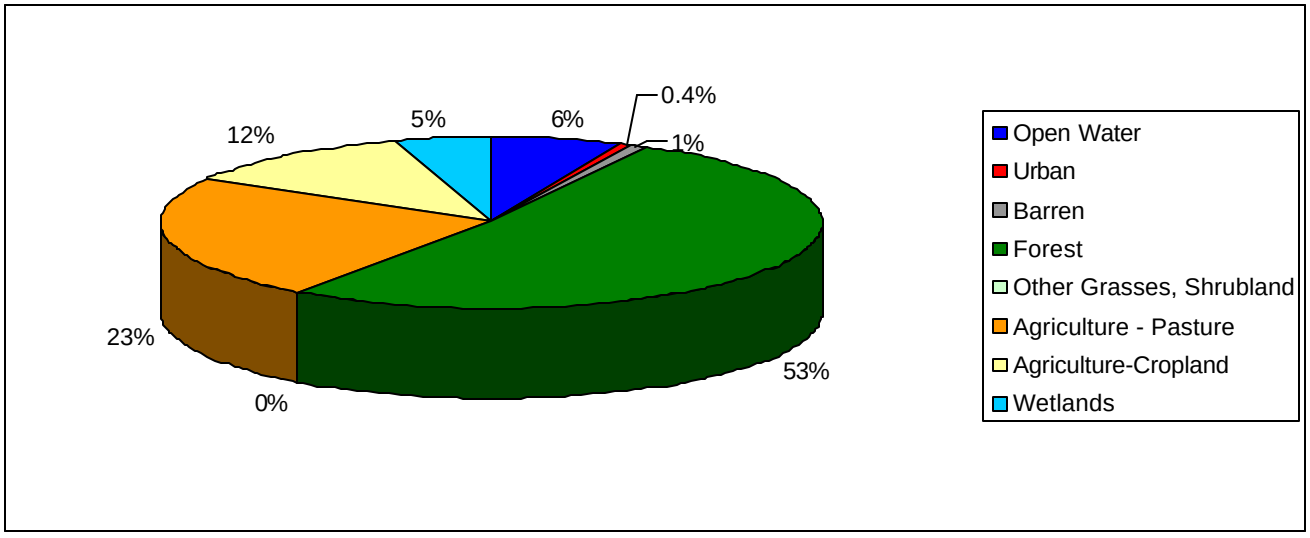


Figure 3.7 Bridgeman, Hull, and Rogers Creeks watershed area by land use type.

Table 3.6 Cubitt Creek watershed area by land use type.

Land Use Type	Acres	Square Miles	Percent Total
Open Water	110	0.17	5%
Urban	11	0.02	1%
Barren	49	0.08	2%
Forest	1183	1.85	56%
Other Grasses, Shrubland	0	0.00	0%
Agriculture - Pasture	415	0.65	20%
Agriculture-Cropland	181	0.28	9%
Wetlands	155	0.24	7%
Total	**2104**	**3.29**	**100%**

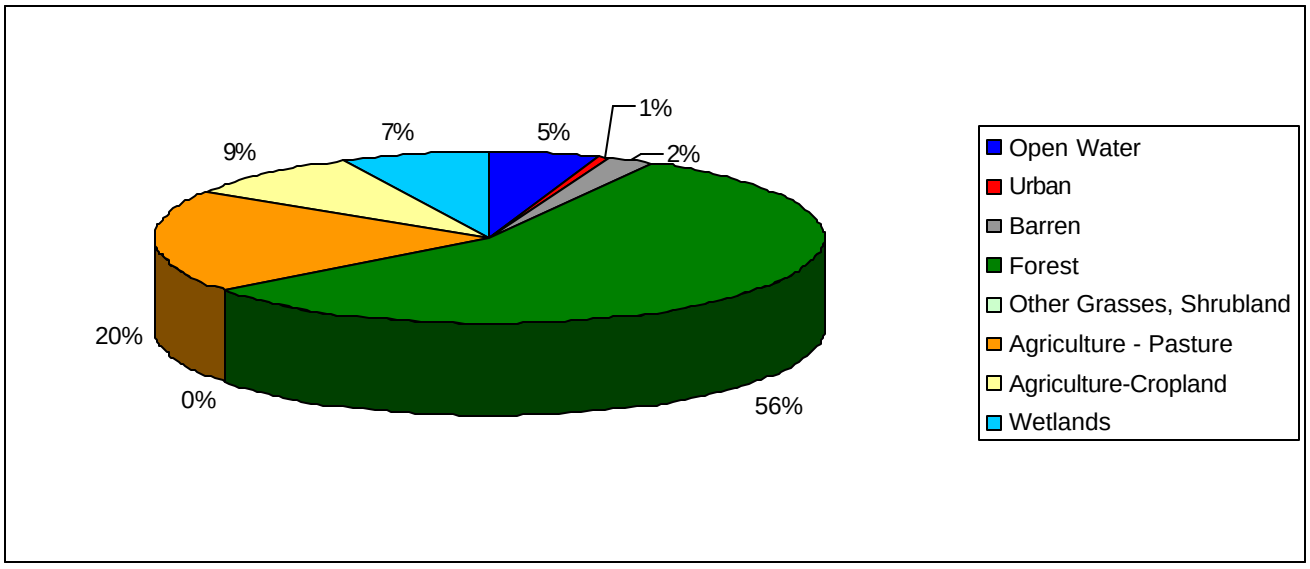


Figure 3.8 Cubitt Creek watershed area by land use type.

Table 3.7 Hack Creek watershed area by land use type.

Land Use Type	Acres	Square Miles	Percent Total
Open Water	104	0.16	5%
Urban	5	0.01	0.2%
Barren	37	0.06	2%
Forest	1148	1.79	58%
Other Grasses, Shrubland	0	0.00	0%
Agriculture - Pasture	328	0.51	17%
Agriculture-Cropland	219	0.34	11%
Wetlands	132	0.21	7%
Total	**1973**	**3.08**	**100%**

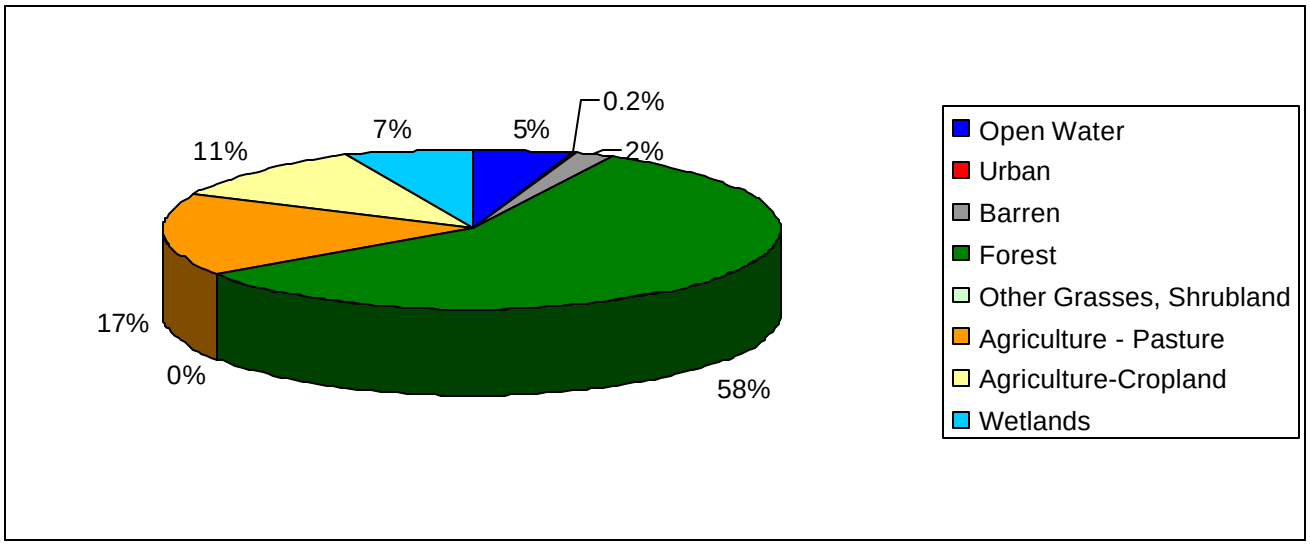


Figure 3.9 Hack Creek watershed area by land use type.

4. Water Quality Impairment and Bacterial Source Assessment

4.1. Water Quality Monitoring

The VDH-DSS water quality monitoring network for GA009 consists of 25 monitoring stations: seven on Cod Creek, two on Presley Creek, one each on Bridgeman and Rogers Creeks, eight on Hull Creek, four on Cubitt Creek and two on Hack Creek (Figure 4.1). The period of record considered in this report is from December 1984 to July 2008. Observations span this entire period for sixteen stations; all stations except two have a minimum of 30 observations and thus an adequate number to assess compliance with shellfish water quality standards. Two stations on Cod Creek, stations 9-2.5 and 9-4.5, were established in December, 2005. At the time this report was prepared, neither had sufficient record to assess compliance; thus, these two stations are not considered in this report. All of these stations are monitored by the VDH-DSS for fecal bacteria. A summary of water quality data from the stations in or bordering condemned areas of maximum extent for the period of record is shown in Table 4.1. Graphs showing the 30-sample running geometric means and 90^{th} percentile for all 23 stations considered in this report are shown in Figures 4.2 through 4.13. The closures in the growing areas are characterized based on all monitoring stations in the condemnation areas (Figure 4.1).

In addition to impairments resulting from VDH-DSS shellfish condemnations, Cubitt Creek near the end of state road 777 (station 1ACUT000.58) was assessed by VDEQ as not supporting the primary contact recreational use in 1998. It has been re-listed as not supporting the recreational use in 2004 with a violation rate of 3/20 for fecal coliform (15% violations). The fecal coliform standard was superseded by an enterococci standard in June 2008. A discussion of the treatment of this impairment is presented in Section 5.

4.2. Condemnation Areas

There were a total of seven VDH-DSS condemned segments active at the time Virginia's 1998 303(d) list was complied; these segments appeared on that list as impaired for fecal coliform bacteria in shellfish supporting waters. As discussed in Section 1, an eighth segment (Hack Creek) was subsequently added as a result of DEQ's assessment of maximum extent. As shown in Figure 4.1, there were two condemned segments in Cod Creek (west and east branches) and one each in Presley, Bridgeman, Hull, Rogers, Cubitt, and Hack Creeks. Also shown on Figure 4.1 are two segments, Corbin Pond and Flag Pond, which are condemned by VDH-DSS for reasons other than water quality sampling; these "administrative condemnations" are not considered in this TMDL. For the eight segments considered, this TMDL addresses the maximum areal extent for all condemnations issued or updated since 1998, as described in Section 1.0 above. The use of maximum extent in regards to shellfish condemnations results in the most protective load allocations. Detailed maps of the shellfish condemnation areas and their associated water quality stations are available from the Virginia Department of Health, Division of Shellfish Sanitation. Copies of the condemnation notices showing the original and maximum extent of all closures are in Appendix A.

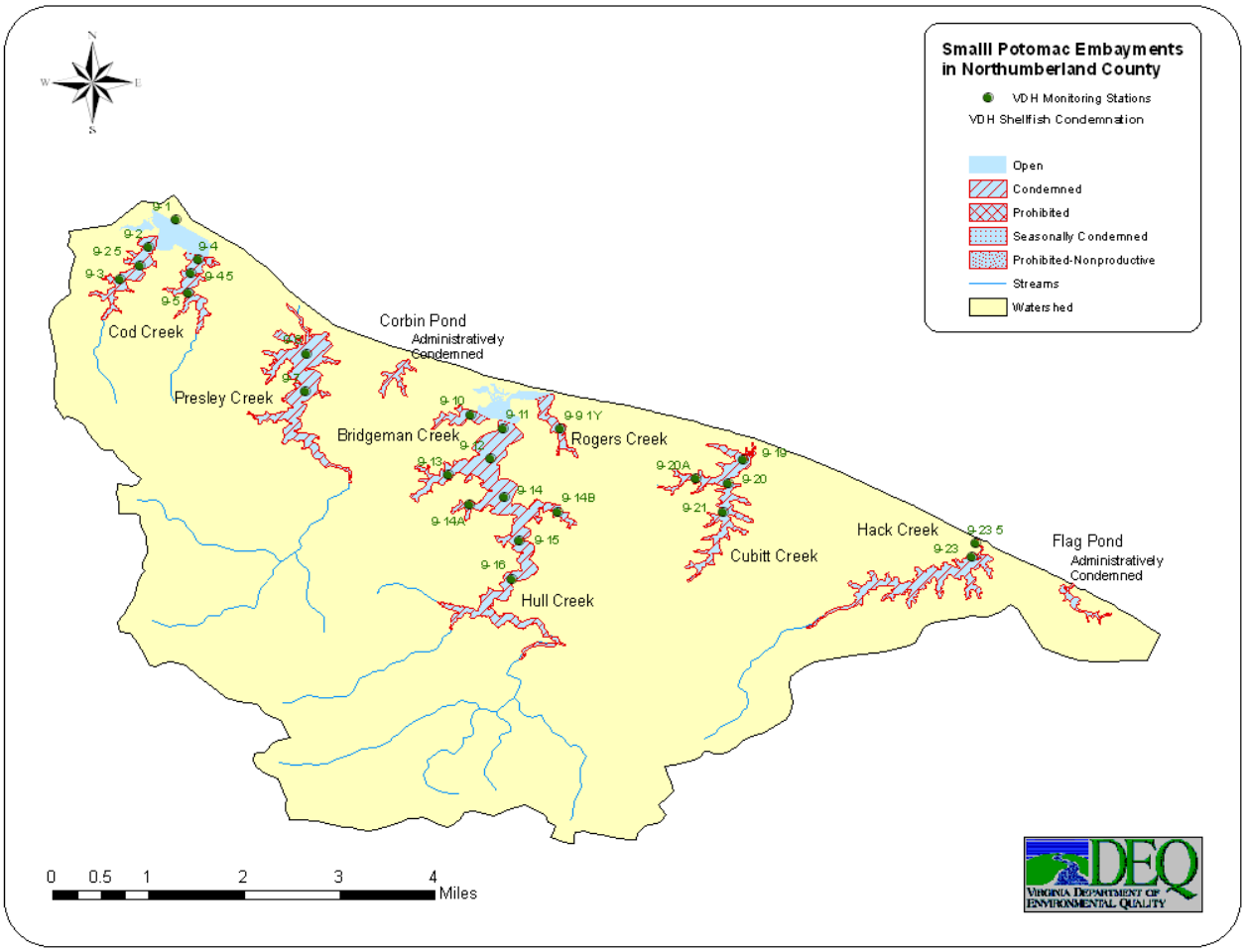


Figure 4.1 Watershed map, showing maximum extent of condemned segments and location of water quality monitoring stations.

4.3. Fecal Coliform Bacteria Source Assessment

A. Point Sources

Based on a DEQ internal query conducted July 13, 2009, there are currently no permitted point sources within GA009.

B. Non-Point Sources

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 to waterways. 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. 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. Contributions from wildlife, both mammalian and avian, are natural conditions and may represent a background level of bacterial loading. It is therefore likely that human loading is due

Table 4.1 Summary of water quality data for monitoring stations in GA009.

Creek Name	Station	Total Monthly Observations	Maximum 30-sample Geometric Mean* MPN/100mL	Maximum 30-sample 90th Percentile** MPN/100mL
Cod Creek	9-1	243	8.5	**57.1**
Cod Creek - West	9-2	253	**14.1**	**86.3**
	9-2.5	28	N/A	N/A
	9-3	244	**34.7**	**202.5**
Cod Creek - East	9-4	249	**15.8**	**101.5**
	9-4.5	28	N/A	N/A
	9-5	244	**32.6**	**288.3**
Presley Creek	9-6	85	**24.4**	**173.8**
	9-7	75	**34.0**	**202.8**
Bridgeman Creek	9-10	239	**29.0**	**198.1**
Hull Creek	9-11	249	**15.0**	**81.3**
	9-12	250	**16.9**	**129.0**
	9-13	247	**27.8**	**152.4**
	9-14	249	**18.8**	**169.9**
	9-14A	43	**33.0**	**216.5**
	9-14B	41	**48.7**	**291.7**
	9-15	249	**27.1**	**205.8**
	9-16	249	**50.1**	**381.4**
Rogers Creek	9-9-1Y	141	**26.5**	**163.6**
Cubitt Creek	9-19	250	**28.4**	**251.9**
	9-20	247	**28.5**	**247.2**
	9-20A	242	**44.4**	**311.5**
	9-21	245	**27.5**	**212.0**
Hack Creek	9-23	64	**17.8**	**92.8**
	9-23.5	34	9.8	**54.5**

N/A = insufficient samples to assess compliance

* values in **bold** exceed the geometric mean criterion of 14 MPN / 100 ml.

** values in **bold** exceed the 90th percentile standard of 49 MPN / 100 ml.

to failures in septic waste treatment systems and/or potential pollution from recreational vessel discharges.

Shoreline Sanitary Survey

The shoreline survey is used as a tool to identify non-point source contribution problems and locations. Figure 4.14 shows the results of the DSS sanitary shoreline survey for GA009 conducted January through April, 2006. The survey identified fifteen onsite sewerage deficiencies, nine of which were assessed as having potential to contribute pollution directly to a nearby water body. Of those nine, five remained uncorrected as of June, 2009. The survey also identified four animal sources, one with potential for direct contribution; all have been corrected as of June 2009. Finally, the survey found six non-marina boating sources, one of which remained uncorrected as of June, 2009. (There are no marinas in GA009). A copy of the full survey is included in Appendix A.

VDH-DSS conducts new Sanitary Surveys every 8 years for each of the growing areas. Corrected violations are updated on a regular basis; however, new deficiencies are only reported when a new survey has been completed.

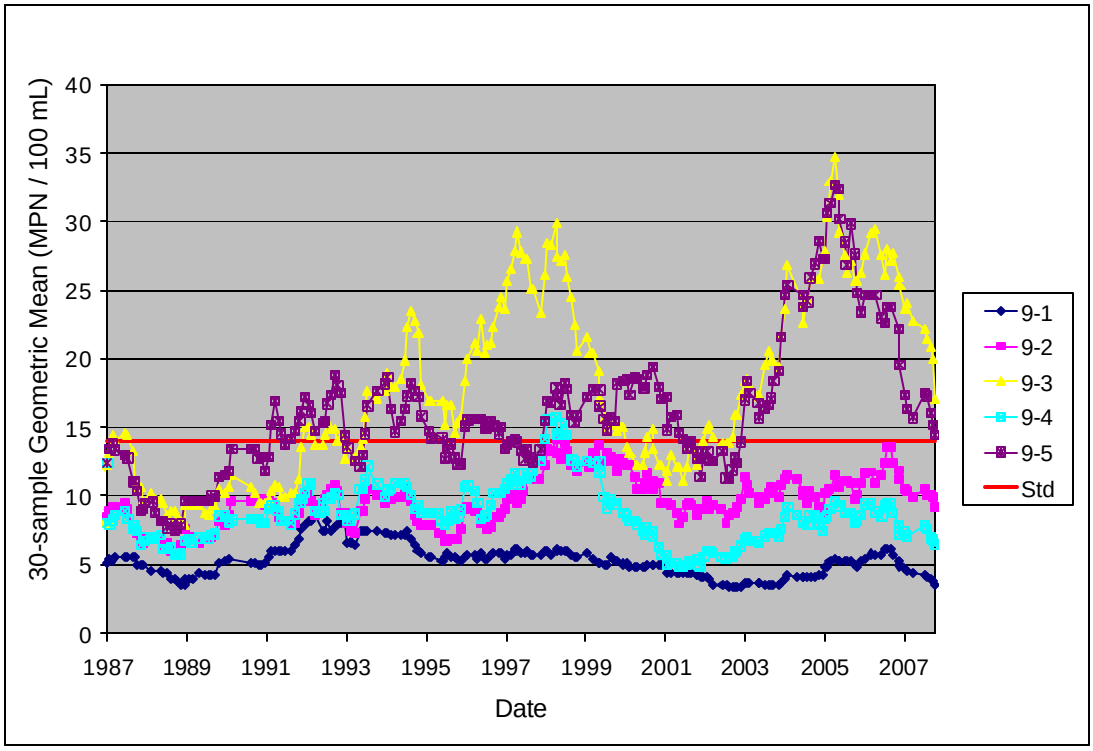


Figure 4.2 30-sample geometric mean fecal coliform for stations in Cod Creek.

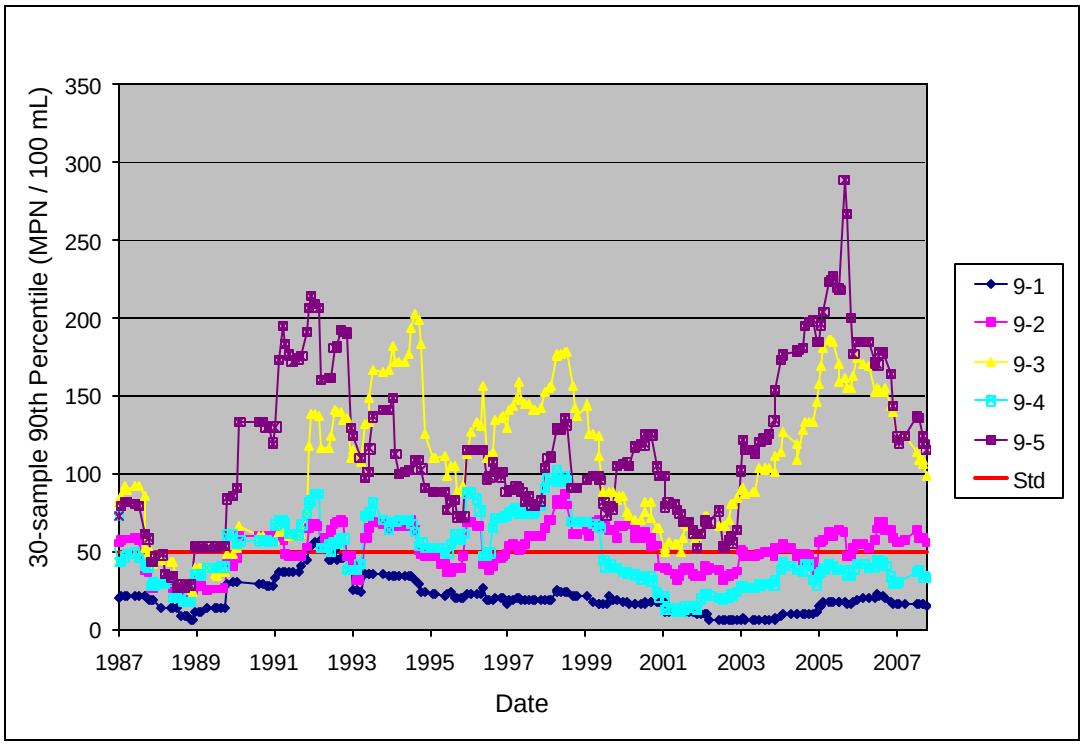


Figure 4.3 30-sample 90th percentile fecal coliform for stations in Cod Creek.

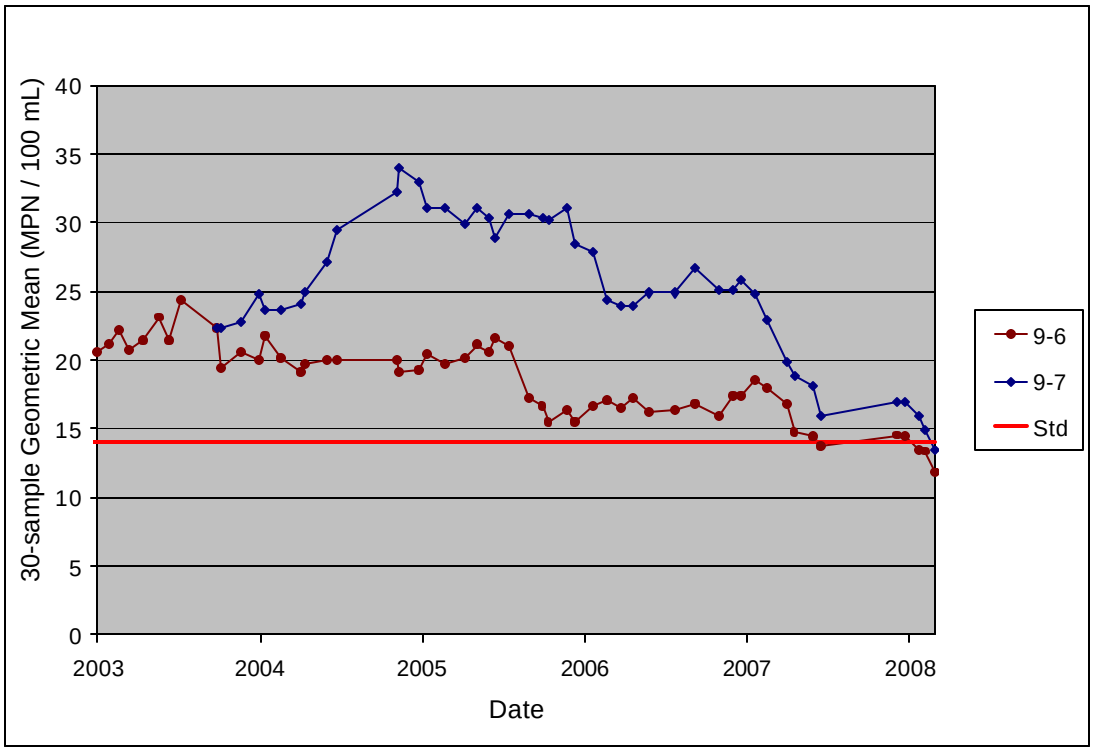


Figure 4.4 30-sample geometric mean fecal coliform for stations in Presley Creek.

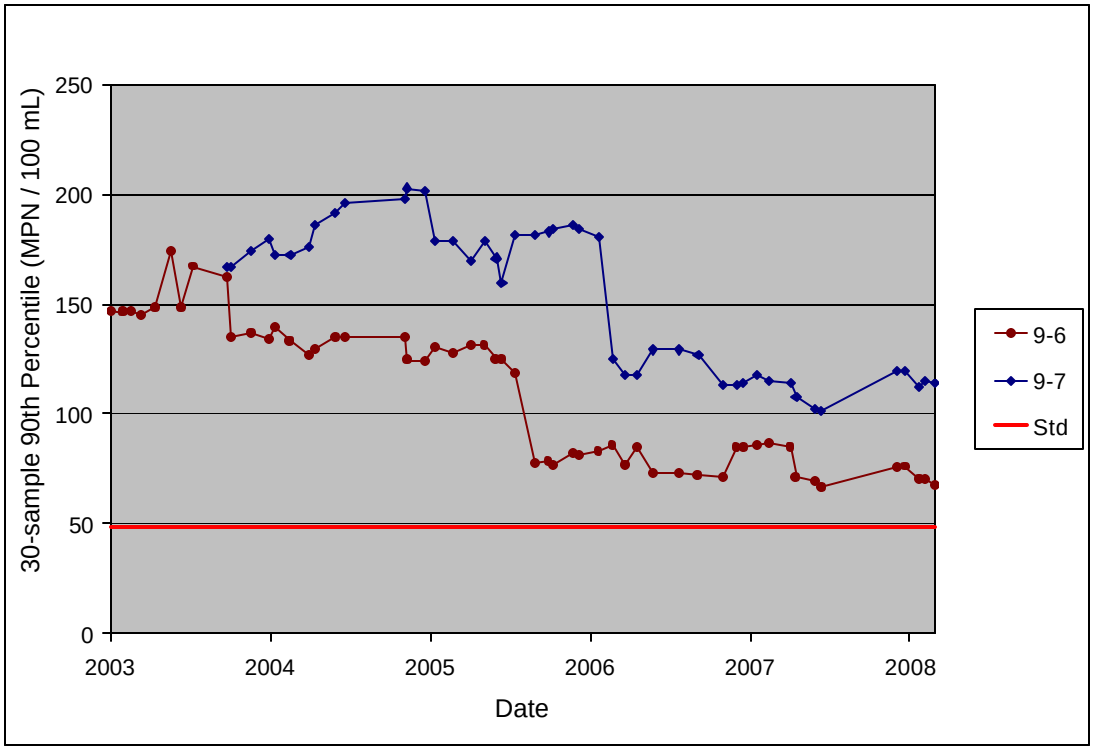


Figure 4.5 30-sample 90th percentile fecal coliform for stations in Presley Creek.

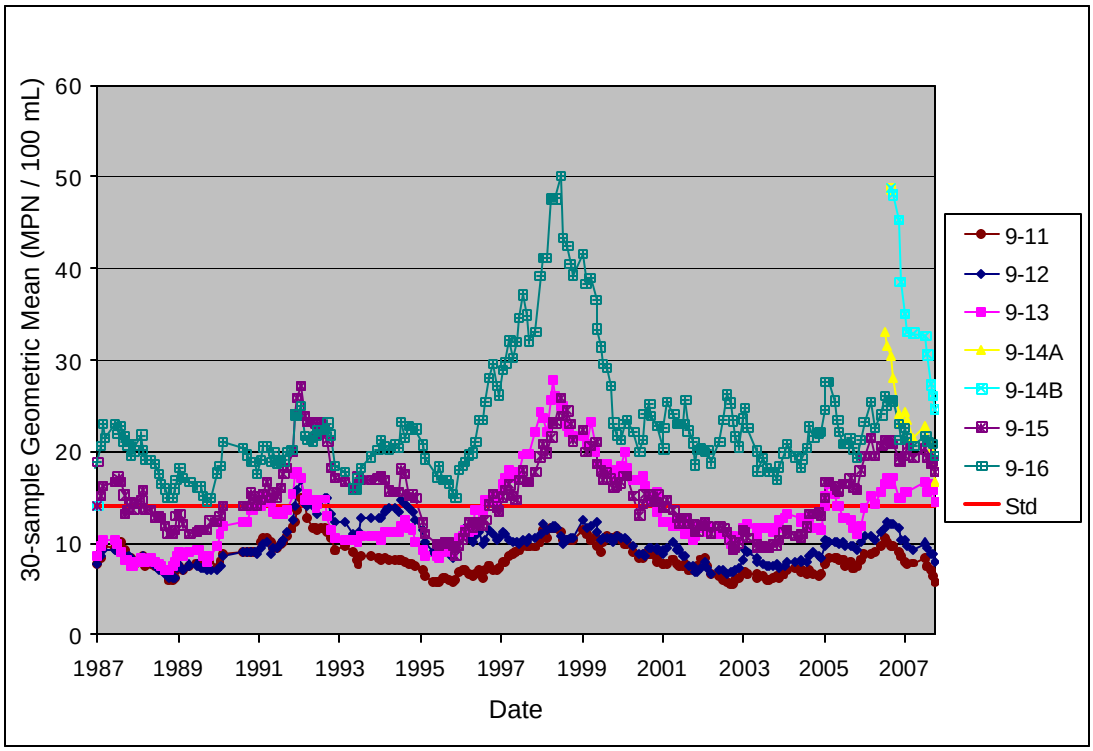


Figure 4.6 30-sample geometric mean fecal coliform for stations in Hull Creek.

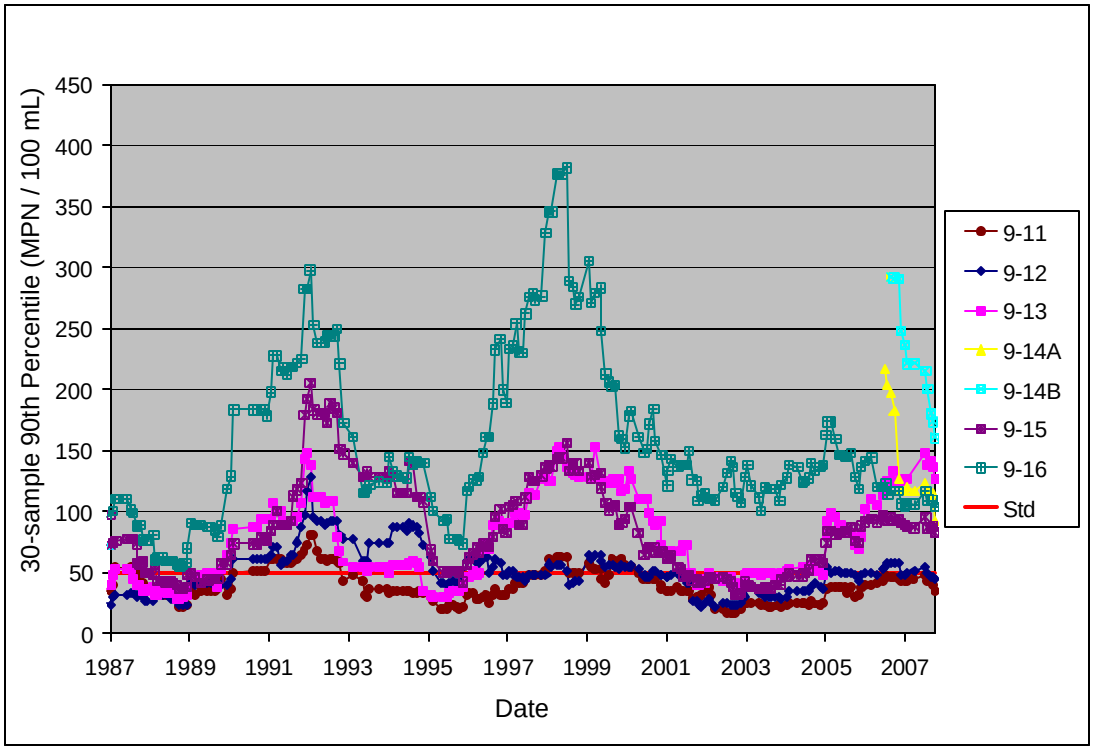


Figure 4.7 30-sample 90th percentile fecal coliform for stations in Hull Creek.

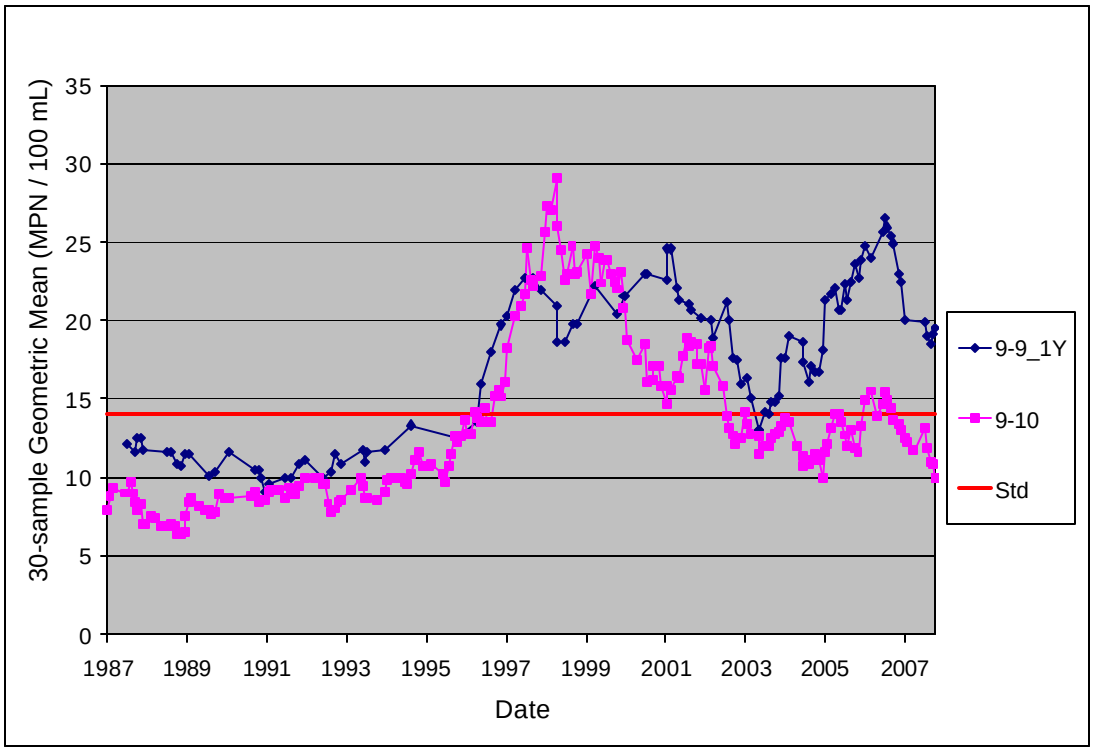


Figure 4.8 30-sample geometric mean fecal coliform for stations in Bridgman and Rogers Creeks.

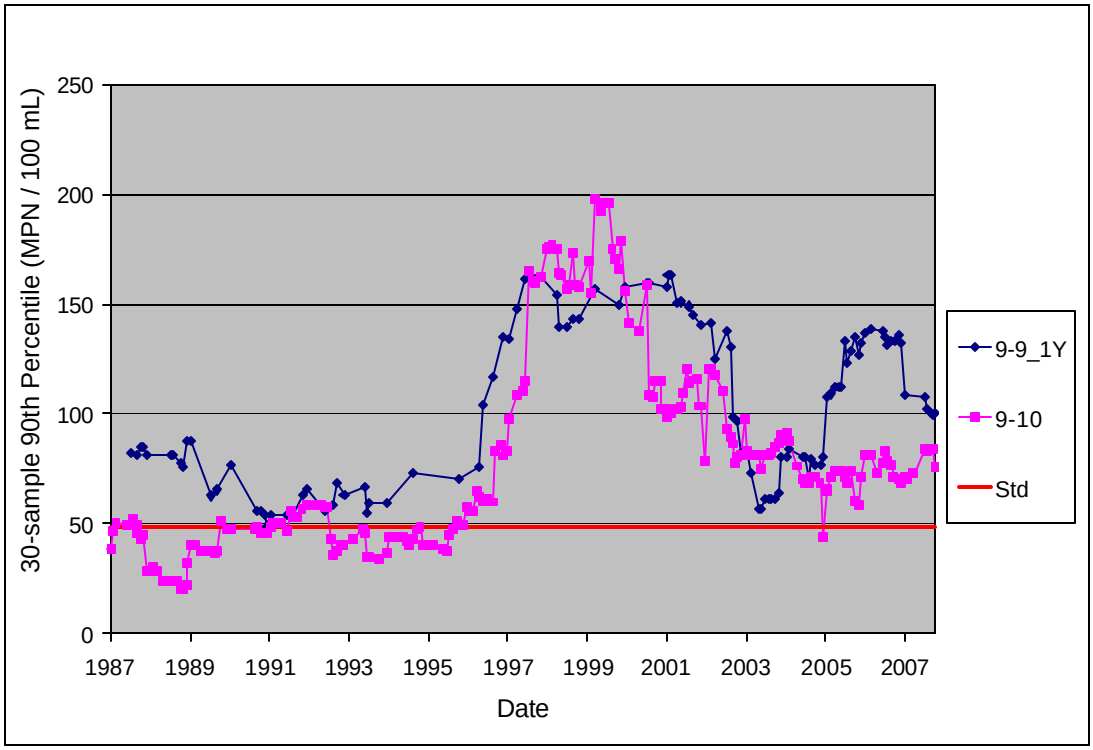


Figure 4.9 30-sample 90th percentile fecal coliform for stations in Bridgeman and Rogers Creeks.

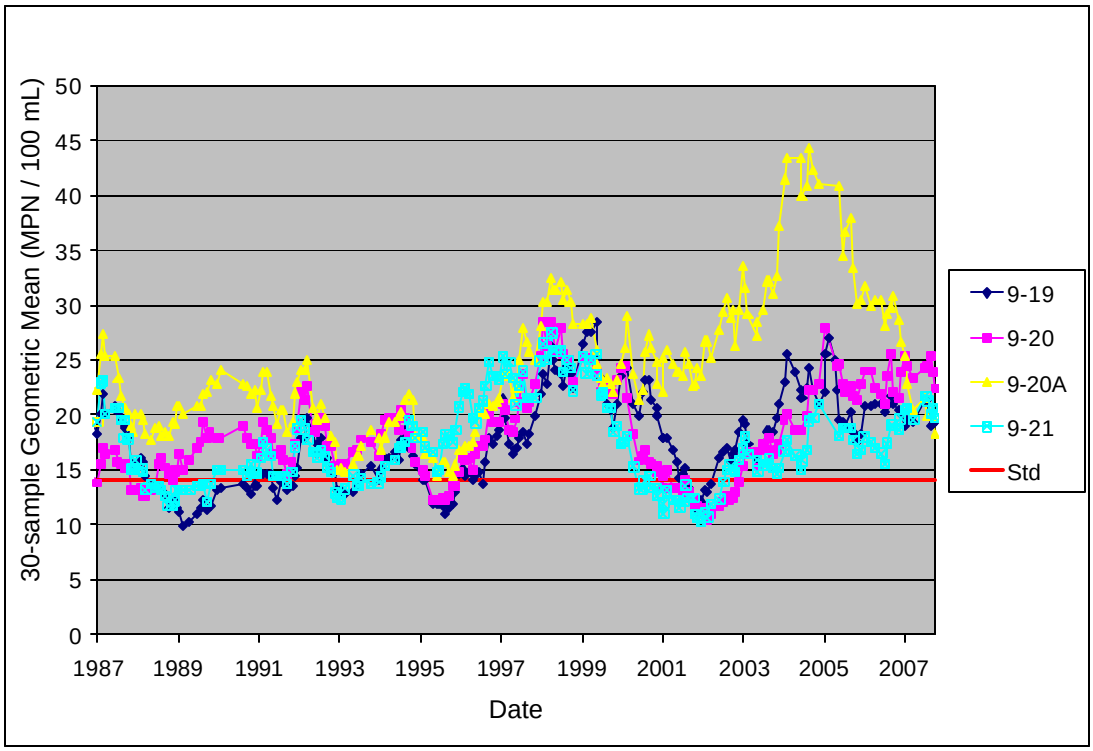


Figure 4.10 30-sample geometric mean fecal coliform for stations in Cubitt Creek.

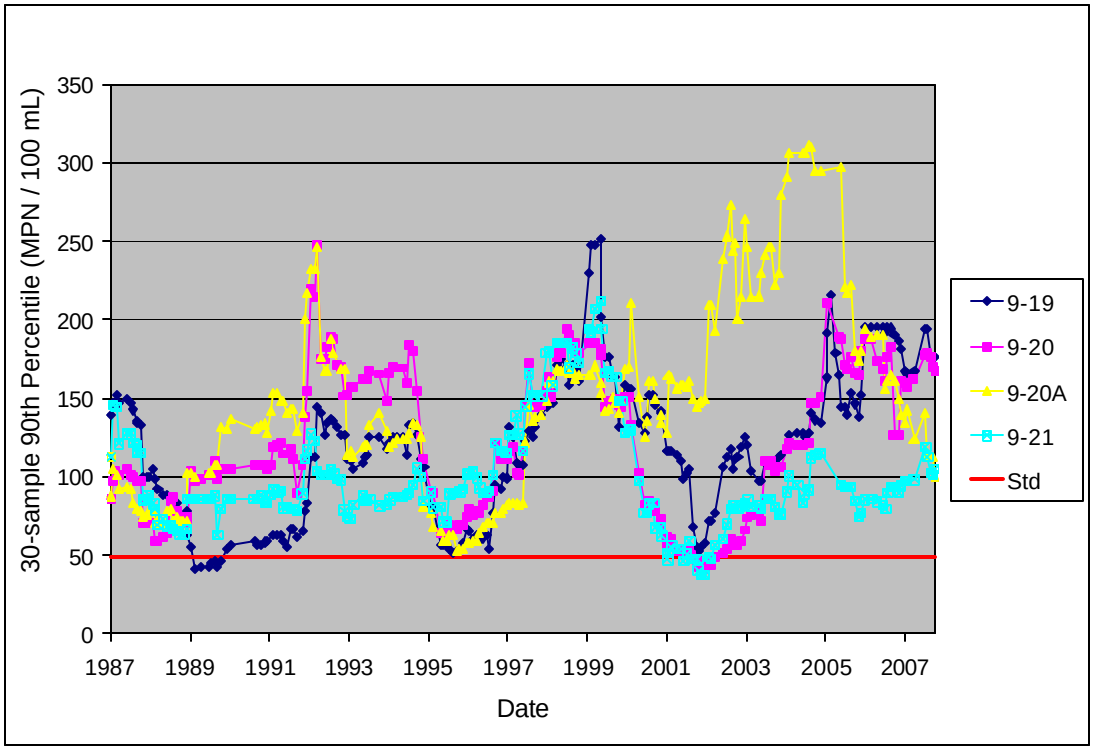


Figure 4.11 30-sample 90th percentile fecal coliform for stations in Cubitt Creek.

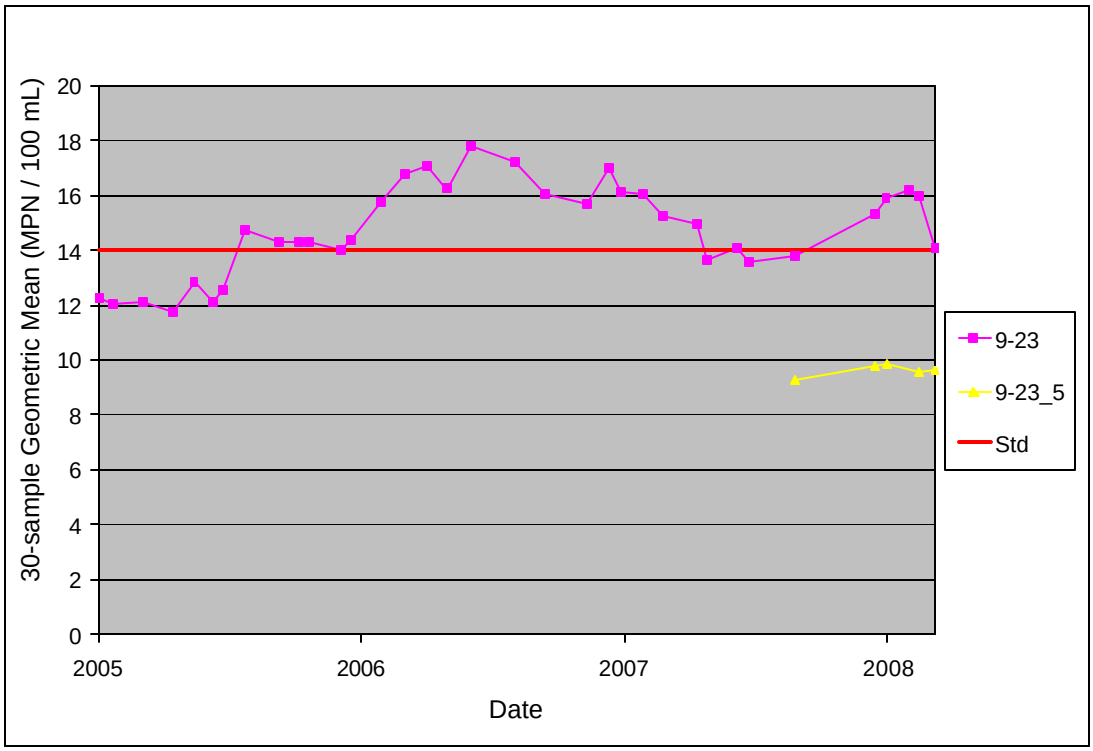


Figure 4.12 30-sample geometric mean fecal coliform for stations in Hack Creek.

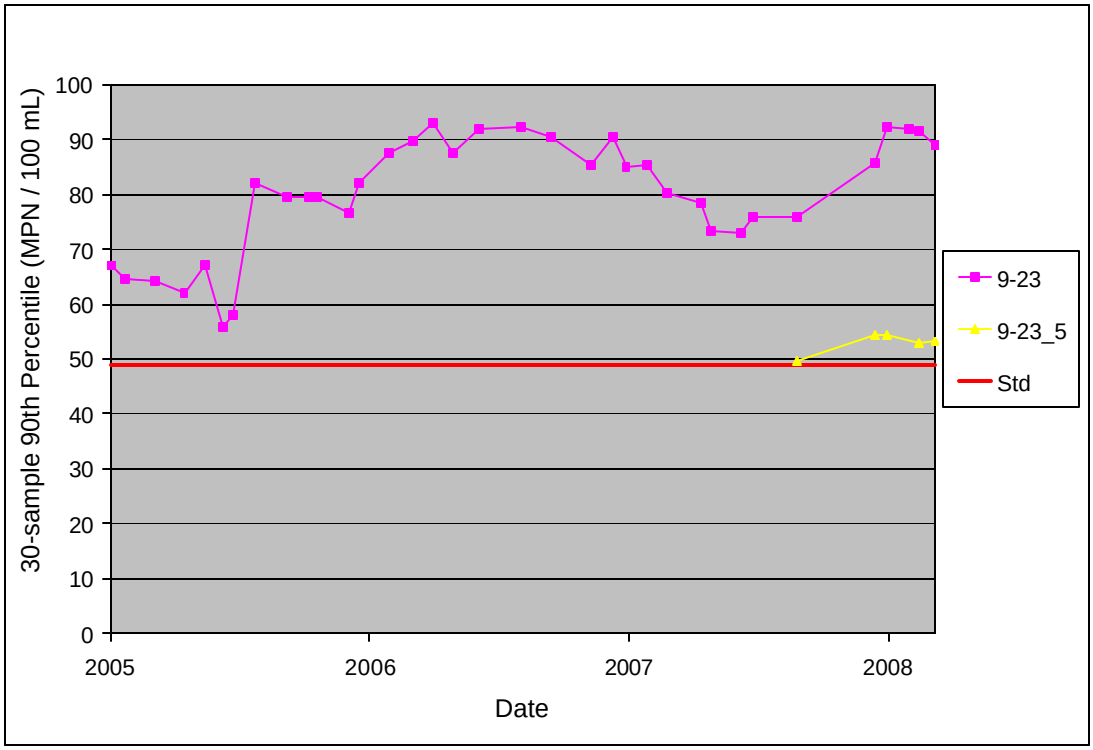


Figure 4.13 30-sample 90th percentile fecal coliform for stations in Hack Creek.

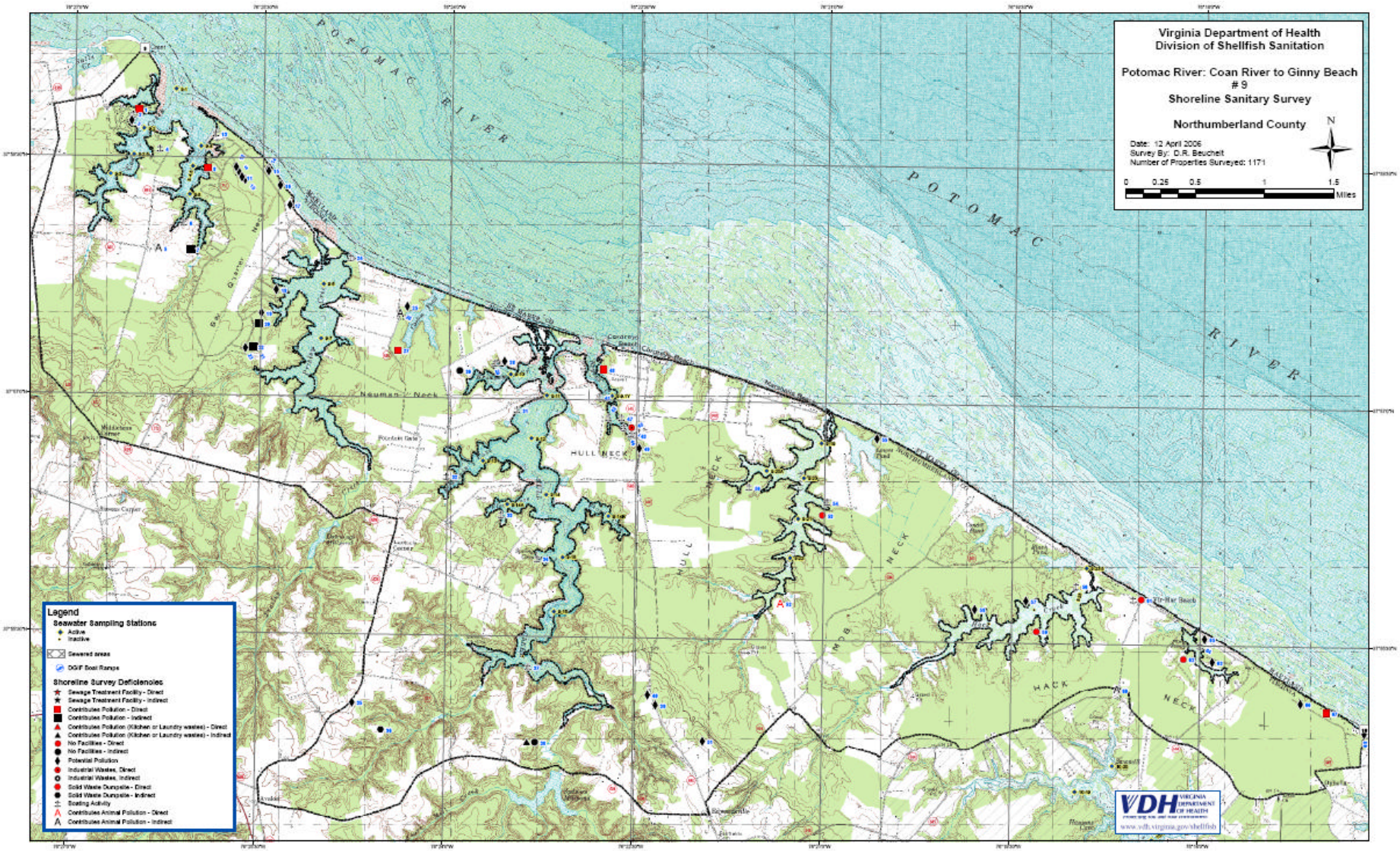


Figure 4.14 VDH-DSS shoreline sanitary survey map.

Human, Wildlife and Livestock

Livestock numbers in Table 4.2 were gathered through observations made by DEQ TMDL staff by traveling through watersheds and making head counts of livestock/pets which were visible from roads. We compared our numbers with those numbers given to us through citizen comments on livestock populations. The "Human" numbers in Table 4.2 indicate direct septic or boating sources identified in the 2006 VDH-DSS Sanitary Survey for GA009, which remained unresolved as of June, 2009. The "Kennel / Pet Boarding" numbers reflect both field observations and deficiencies reported in the sanitary survey. Because of the potential for kenneled animals to roam free (e.g., during hunting season), all of the latter facilities are listed below regardless of "corrected/uncorrected" status with VDH-DSS.

Table 4.2 Domestic animals and septic systems observed contributing pollution by watershed in GA009.

Fecal Coliform Sources	Cod Creek
Chickens	10
Goats	6
Human	2
Kennel / Pet Boarding Operations	1
Fecal Coliform Sources	**Presley Creek**
Kennel / Pet Boarding Operations	1
Fecal Coliform Sources	**Hull/Rogers/Bridgeman Creeks**
Chickens / Guinea Hens	6
Alpaca	7
Horses	4*
Fecal Coliform Sources	**Cubitt Creek**
Human	1
Kennel / Pet Boarding Operations	2
Fecal Coliform Sources	**Hack Creek**
Human	2
Kennel / Pet Boarding Operations	2

* Estimated; only stalls were observed.

Calculations for population estimates of pets and wildlife are shown in Table 4.3. The method used to calculate these population estimates is found in Appendix B and data is supplied by VIMS and DGIF. Records provided by the Northumberland County Treasurer's office cited 2271 individual dog licenses and 79 kennel licenses issued as of July, 2009. These records are available upon request from the Northumberland County Treasurers' Office.

Table 4.3 Pet and wildlife population calculated estimates by watershed in GA009.

Creek	Dogs	Deer	Raccoon	Ducks	Geese
Cod Creek	46	43	66	266	198
Presley Creek	89	84	121	240	179
Hull Creek	136	129	208	342	255
Rogers Creek	6	6	8	54	40
Bridgeman Creek	5	5	6	99	74
Cubitt Creek	53	48	85	244	181
Hack Creek	51	47	91	217	162
Total	385	362	587	1462	1089

Biosolids and Poultry Litter Application

A search of permitted biosolids land-applications by land-applier within GA009 was made. No records of land-applied biosolids permits for farms within the growing area were found (Scott Haley, VA DEQ, written communication March 16, 2009). Biosolids are also referred to as sewage sludge, which are the solid, semisolid, or liquid materials removed during the treatment of domestic sewage in a treatment facility. Biosolids include, but are not limited to, solids removed during primary, secondary, or advanced wastewater treatment, scum, domestic septage, portable toilet pumpings, Type III marine sanitation device pumpings, and sewage sludge products. When properly treated and processed, sewage sludge become "biosolids" which can be recycled and applied as fertilizer to improve and maintain productive soils and stimulate plant growth. Beginning January 1, 2008 the Virginia Department of Environmental Quality (DEQ) assumed regulatory oversight of all land application of biosolids.

A search was conducted for records of poultry litter transport and storage within Northumberland County. Two records from 2005 indicate 100 tons of poultry litter was delivered within the Chesapeake Bay watershed in the vicinity of Kilmarnock, Virginia. No other information is available; however this information suggests that in 2005, 100 tons of poultry litter were destined for farmland applications within the Chesapeake Bay watershed which may have included the watersheds in GA009.

C. Bacterial Source Tracking

Bacterial Source tracking 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 human, domestic animal, and wild animals will have significantly different patterns of resistance to a variety of antibiotics. The Antibiotic Resistance Analysis (ARA) uses fecal streptococcus or E. coli and patterns of antibiotic resistance for separation of sources of the bacterial contribution. The BST analysis used for this TMDL classified the bacteria into one of four source categories: human, pets, livestock, and wildlife. However, BST analysis is an inexact technique that is still under evaluation and error exists in correctly assigning E. coli isolates to the appropriate fecal sources. BST is a general tool for making a broad determination of bacterial source, therefore BST percentages should not be considered precise.

Table 4.4 Summary of bacterial source tracking (BST) samples taken in GA009.

Station ID	DSS Area	HUP	County	Impairment	# Times Plates Received
9-3	9	A34E	Northumberland	Cod Creek (West)	11
9-5	9	A34E	Northumberland	Cod Creek (East)	10
9-6	9	A34E	Northumberland	Presley Creek	11
9-16	9	A34E	Northumberland	Hull Creek	11
9-9.1Y	9	A34E	Northumberland	Rogers Creek	11
9-10	9	A34E	Northumberland	Bridgeman Creek	11
9-19	9	A34E	Northumberland	Cubitt Creek	11

The BST sampling period was October 2005 through September 2006. The target sampling interval was once monthly. The location of BST stations are chosen by VDH. Table 4.4 shows the summary of all BST monitoring stations for GA009 (MapTech, Inc, 2008). Tables 4.5 through 4.11 show the sample-by-sample BST results for Cod Creek east, Cod Creek west, Presley Creek, Bridgeman Creek, Hull Creek, Rogers Creek, and Cubitt Creek, respectively. For each station where BST was collected, BST percentages were weighted by the number of isolates, concentration, and volume. Thus the higher the number of isolates, concentration, and volume; the more weight an individual sample was given in calculating the BST source percentages. Tables 4.12 through 4.17 show the weighted average BST for Cod Creek east, Cod Creek west, Presley Creek, Bridgeman Creek, Hull Creek, Rogers Creek, and Cubitt Creek, respectively. No BST analysis was conducted in Hack Creek. Residential density in Hack Creek is somewhat lower than that in the adjacent Cubitt Creek (0.06 versus 0.09 residences per acre, respectively; Table 3.2); otherwise, the creeks have broadly similar land use (Tables 3.6, 3.7; Figures 3.8, 3.9). Therefore, the BST results for Cubitt Creek (Table 4.17) were also applied when computing load reductions by source in Hack Creek (see section 5.2 below). The respective BST pie charts for these creeks are shown in Figures 4.15 through 4.21.

The BST shows that for Cod Creek west, the largest percentage source was human (33%), followed by livestock at 31%, pet at 25%, and wildlife at 11%. In Cod Creek east, the largest contributor was wildlife at 36%, followed by livestock at 30%, pet at 23%, and human at 11%. The BST analysis for Presley Creek indicates that wildlife is the largest contributor at 34%, followed by pet at 27%, human at 26%, and livestock at 13%. In Bridgeman Creek, the largest contributor was livestock at 46%, followed by pet at 22%, wildlife at 19%, and human at 13%. In Hull Creek, the results suggest the largest contributor was wildlife at 31%, followed by livestock at 27% and pets and human, both at 21%. In Rogers Creek, the largest contributor was wildlife at 39%, followed by pet at 33%, human at 18%, and livestock at 10%. Finally, in Cubitt Creek, the largest contributor was pet waste at 52%, followed by wildlife at 17%, human at 16%, and livestock at 15%. These values were used as a tool to help determine the source allocations in deriving the Total Maximum Daily Loads for GA009.

Table 4.5 Bacterial source tracking results for Cod Creek (west) at station 9-3*.

Station ID	Date of Sample	Lab ID	HUP ID	Number of Isolates	Wildlife	Human	Livestock	Pet
9-3	10/25/2005	D4922	A34E	24	0%	**46%**	**33%**	**21%**
9-3	11/8/2005	D4946	A34E	24	0%	0%	**38%**	**62%**
9-3	12/7/2005	D5046	A34E	24	**50%**	0%	**17%**	**33%**
9-3	1/23/2006	D5251	A34E	24	**54%**	4%	0%	**42%**
9-3	2/21/2006	D5401	A34E	16	0%	**19%**	6%	75%
9-3	3/6/2006	D5453	A34E	2	100%	0%	0%	0%
9-3	4/19/2006	D5719	A34E	23	**79%**	0%	4%	**17%**
9-3	6/15/2006	D5992	A34E	24	4%	4%	**63%**	**29%**
9-3	7/17/2006	D6117	A34E	5	0%	0%	0%	100%
9-3	8/16/2006	D6290	A34E	24	0%	4%	**96%**	0%
9-3	9/13/2006	D6369	A34E	24	**17%**	**71%**	8%	4%

***Bold** type indicates a statistically significant value.

Table 4.6 Bacterial source tracking results for Cod Creek (east) at station 9-5*.

Station ID	Date of Sample	Lab ID	HUP ID	Number of Isolates	Wildlife	Human	Livestock	Pet
9-5	10/25/2005	D4923	A34E	24	0%	4%	**71%**	**25%**
9-5	11/8/2005	D4947	A34E	24	4%	8%	**33%**	**55%**
9-5	12/7/2005	D5047	A34E	23	**74%**	0%	0%	**26%**
9-5	1/23/2006	D5252	A34E	19	**58%**	0%	0%	**42%**
9-5	2/21/2006	D5402	A34E	1	0%	0%	0%	100%
9-5	4/19/2006	D5720	A34E	24	**54%**	0%	**17%**	29%
9-5	6/15/2006	D5993	A34E	24	**38%**	**12%**	**33%**	**17%**
9-5	7/17/2006	D6118	A34E	8	12%	0%	0%	88%
9-5	8/16/2006	D6291	A34E	24	0%	**71%**	**17%**	**12%**
9-5	9/13/2006	D6370	A34E	23	**35%**	**39%**	13%	**13%**

***Bold** type indicates a statistically significant value.

Table 4.7 Bacterial source tracking results for Presley Creek at station 9-6*.

Station ID	Date of Sample	Lab ID	HUP ID	Number of Isolates	Wildlife	Human	Livestock	Pet
9-6	10/25/2005	D4924	A34E	24	4%	**33%**	**25%**	**38%**
9-6	11/8/2005	D4948	A34E	24	0%	0%	**62%**	**38%**
9-6	12/7/2005	D5048	A34E	24	**21%**	0%	**33%**	**46%**
9-6	1/23/2006	D5253	A34E	19	0%	0%	**26%**	**74%**
9-6	2/21/2006	D5403	A34E	3	0%	67%	0%	33%
9-6	3/6/2006	D5454	A34E	4	75%	0%	0%	25%
9-6	4/19/2006	D5721	A34E	24	**79%**	4%	0%	**17%**
9-6	6/15/2006	D5994	A34E	24	**42%**	4%	**33%**	**21%**
9-6	7/17/2006	D6119	A34E	24	**29%**	0%	**21%**	**50%**
9-6	8/16/2006	D6292	A34E	24	0%	**75%**	0%	25%
9-6	9/13/2006	D6371	A34E	24	**75%**	**17%**	0%	8%

***Bold** type indicates a statistically significant value.

Table 4.8 Bacterial source tracking results for Bridgeman Creek at station 9-10*.

Station ID	Date of Sample	Lab ID	HUP ID	Number of Isolates	Wildlife	Human	Livestock	Pet
9-10	10/25/2005	D4926	A34E	24	0%	**12%**	**67%**	**21%**
9-10	11/8/2005	D4950	A34E	24	0%	0%	4%	**96%**
9-10	12/7/2005	D5050	A34E	24	**29%**	0%	**42%**	**29%**
9-10	1/23/2006	D5255	A34E	24	0%	0%	4%	96%
9-10	2/21/2006	D5405	A34E	2	0%	0%	100%	0%
9-10	3/6/2006	D5455	A34E	6	33%	0%	0%	67%
9-10	4/19/2006	D5723	A34E	24	**79%**	0%	0%	**21%**
9-10	6/15/2006	D5996	A34E	24	**63%**	8%	**21%**	8%
9-10	7/17/2006	D6121	A34E	5	0%	20%	80%	0%
9-10	8/16/2006	D6294	A34E	11	**27%**	**46%**	0%	**27%**
9-10	9/13/2006	D6373	A34E	24	**63%**	**21%**	4%	**12%**

***Bold** type indicates a statistically significant value.

Table 4.9 Bacterial source tracking results for Hull Creek at station 9-16*.

Station ID	Date of Sample	Lab ID	HUP ID	Number of Isolates	Wildlife	Human	Livestock	Pet
9-16	10/25/2005	D4927	A34E	24	0%	**41%**	**38%**	**21%**
9-16	11/8/2005	D4951	A34E	24	0%	0%	**54%**	**46%**
9-16	12/7/2005	D5051	A34E	24	**67%**	0%	12%	**21%**
9-16	1/23/2006	D5256	A34E	24	0%	0%	4%	**96%**
9-16	2/21/2006	D5406	A34E	3	0%	0%	0%	100%
9-16	3/6/2006	D5456	A34E	2	0%	0%	50%	50%
9-16	4/19/2006	D5724	A34E	18	**89%**	0%	0%	11%
9-16	6/15/2006	D5997	A34E	24	**59%**	8%	8%	**25%**
9-16	7/17/2006	D6122	A34E	24	8%	4%	**71%**	**17%**
9-16	8/16/2006	D6295	A34E	24	**17%**	**45%**	0%	**38%**
9-16	9/13/2006	D6374	A34E	24	**75%**	**25%**	0%	0%

***Bold** type indicates a statistically significant value.

Table 4.10 Bacterial source tracking results for Rogers Creek at station 9-9.1Y*.

Station ID	Date of Sample	Lab ID	HUP ID	Number of Isolates	Wildlife	Human	Livestock	Pet
9-9.1Y	10/25/2005	D4925	A34E	24	**17%**	**29%**	12%	**42%**
9-9.1Y	11/8/2005	D4949	A34E	24	0%	0%	**75%**	**25%**
9-9.1Y	12/7/2005	D5049	A34E	24	75%	0%	8%	**17%**
9-9.1Y	1/23/2006	D5254	A34E	24	8%	0%	12%	**80%**
9-9.1Y	2/21/2006	D5404	A34E	16	6%	0%	**88%**	6%
9-9.1Y	4/19/2006	D5722	A34E	24	**84%**	0%	4%	**12%**
9-9.1Y	6/15/2006	D5995	A34E	24	**38%**	0%	**21%**	**41%**
9-9.1Y	7/17/2006	D6120	A34E	2	0%	0%	50%	50%
9-9.1Y	8/16/2006	D6293	A34E	8	50%	50%	0%	0%
9-9.1Y	9/13/2006	D6372	A34E	24	**33%**	**46%**	4%	**17%**

Table 4.11 Bacterial source tracking results for Cubitt Creek at station 9-19*.

Station ID	Date of Sample	Lab ID	HUP ID	Number of Isolates	Wildlife	Human	Livestock	Pet
9-19	10/25/2005	D4928	A34E	24	0%	**25%**	**21%**	**54%**
9-19	11/8/2005	D4952	A34E	24	0%	0%	4%	**96%**
9-19	12/7/2005	D5052	A34E	24	**50%**	0%	12%	**38%**
9-19	1/23/2006	D5257	A34E	24	8%	0%	**21%**	**71%**
9-19	2/21/2006	D5407	A34E	1	0%	0%	0%	**100%**
9-19	3/6/2006	D5457	A34E	12	17%	0%	**25%**	**58%**
9-19	4/19/2006	D5725	A34E	10	**90%**	0%	0%	10%
9-19	6/15/2006	D5998	A34E	24	**75%**	4%	0%	**21%**
9-19	7/17/2006	D6123	A34E	6	0%	33%	50%	17%
9-19	8/16/2006	D6296	A34E	6	0%	50%	0%	50%
9-19	9/13/2006	D6375	A34E	23	**87%**	9%	0%	4%

***Bold** type indicates a statistically significant value.

Table 4.12 Isolate, concentration, and volume weighted average BST for Cod Creek by type.

Condemnation Area	Livestock	Wildlife	Human	Pet
141 Cod Creek (West)	**31%**	**11%**	**33%**	**25%**
141 Cod Creek (East)	**30%**	**36%**	**11%**	**23%**

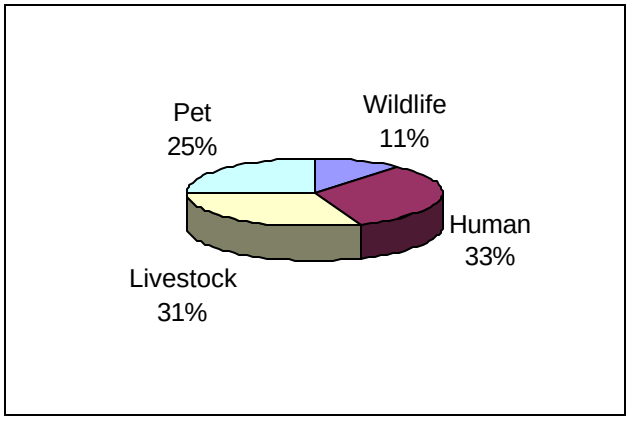


Figure 4.15 Isolate, concentration, and volume weighted average BST for Cod Creek (west) by type

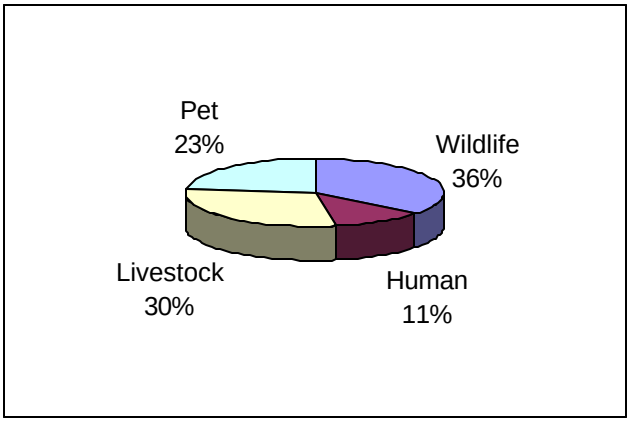


Figure 4.16 Isolate, concentration, and volume weighted average BST for Cod Creek (east) by type.

Table 4.13 Isolate, concentration, and volume weighted average BST for Presley Creek by type.

Condemnation Area	Livestock	Wildlife	Human	Pet
141 Presley Creek	**13%**	**34%**	**26%**	**27%**

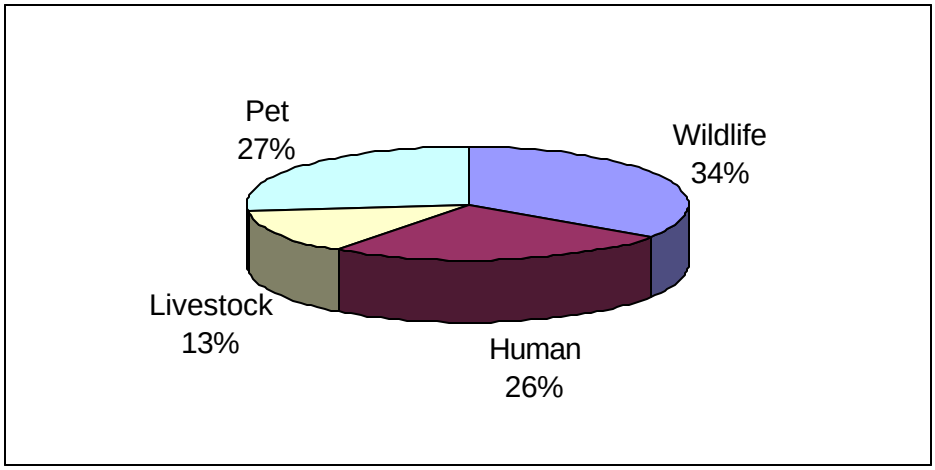


Figure 4.17 Isolate, concentration, and volume weighted average BST for Presley Creek by type.

Table 4.14 Isolate, concentration, and volume weighted average BST for Bridgeman Creek by type.

Condemnation Area	Livestock	Wildlife	Human	Pet
142 Bridgeman Creek	**46%**	**19%**	**13%**	**22%**

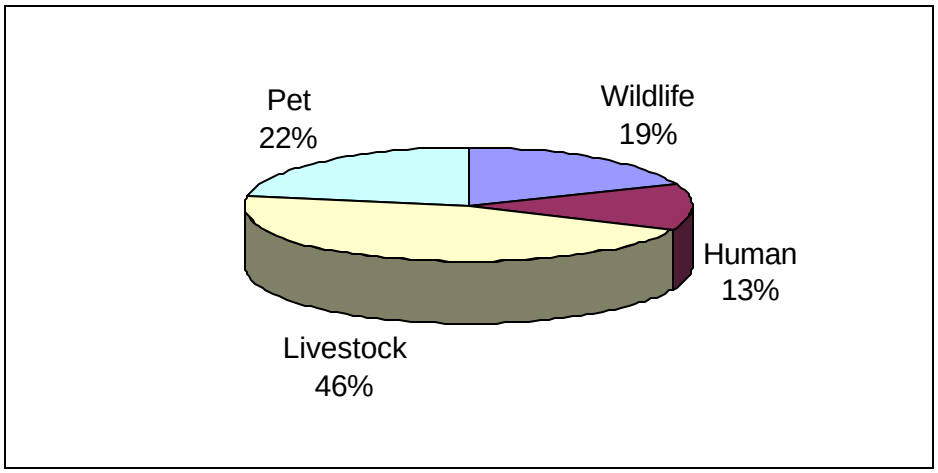


Figure 4.18 Isolate, concentration, and volume weighted average BST for Bridgeman Creek by type.

Table 4.15 Isolate, concentration, and volume weighted average BST for Hull Creek by type.

Condemnation Area	Livestock	Wildlife	Human	Pet
142 Hull Creek	**27%**	**31%**	**21%**	**21%**

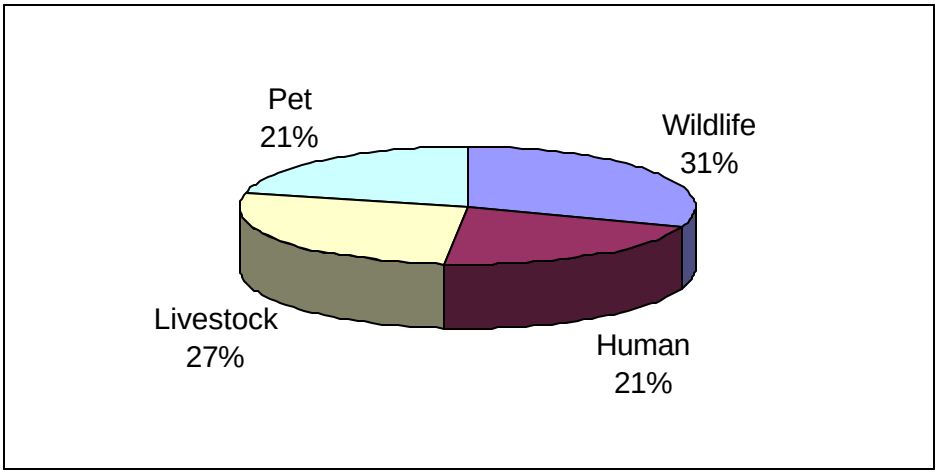


Figure 4.19 Isolate, concentration, and volume weighted average BST for Hull Creek by type.

Table 4.16 Isolate, concentration, and volume weighted average BST for Rogers Creek by type.

Condemnation Area	Livestock	Wildlife	Human	Pet
142 Rogers Creek	**10%**	**39%**	**18%**	**33%**

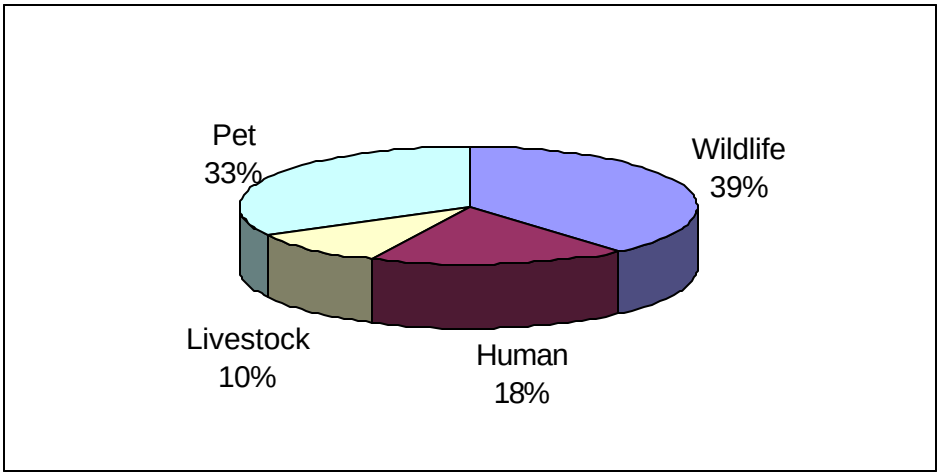


Figure 4.20 Isolate, concentration, and volume weighted average BST for Rogers Creek by type.

Table 4.17 Isolate, concentration, and volume weighted average BST for Cubitt Creek by type.

Condemnation Area	Livestock	Wildlife	Human	Pet
161 Cubitt Creek	**15%**	**17%**	**16%**	**52%**

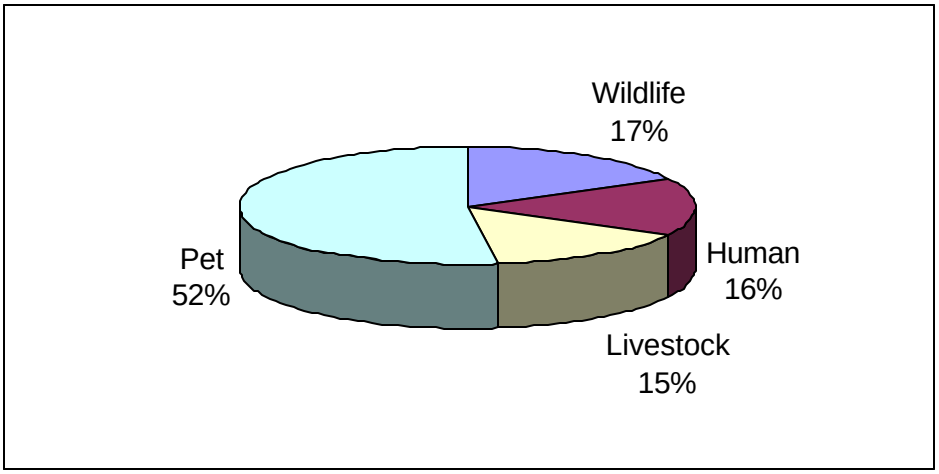


Figure 4.21 Isolate, concentration, and volume weighted average BST for Cubitt Creek by type.

5. TMDL Development

Virginia DEQ and the Virginia Department of Health collaborated to use a simplified volumetric approach to develop the TMDL. The procedure uses bathymetric data to estimate estuarine volumes and BST data and land use to determine the load reductions for each of the four sources of fecal coliform bacteria needed to attain the water quality criteria.

5.1. TMDL Calculation

To meet the water quality standards for both geometric mean and 90th percentile criteria, TMDLs for the impaired segments in the watershed are 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. If observed data were available for more than one monitoring station in a condemned area, the volume-weighted values for each condemned area were used to represent the embayment concentration.

A. 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 worst-case 30-sample geometric mean and 90th percentile of fecal coliform values of each condemned area multiplied by the volume. The monitoring data for the period of record for each station was used to determine the current condition. Data were collected by VDH-DSS from 1984 -2008 for the oldest stations. The maximum values for the period of record for geometric mean and 90th percentile multiplied by the volume were used to represent the current loads. Therefore, the current loads represent the worst case scenario observed.

B. Geometric Mean Analysis

The current geometric mean load was estimated using the worst case 30-sample geometric mean multiplied by the estuarine volume determined by bathymetry. The allowable load was calculated using the water quality standard of 14 MPN/100ml multiplied by the volume. The load reduction needed for the attainment of the water quality standard was determined by subtracting the allowable load from the current load and dividing by the current load. The process may be described by the equation as follows. The geometric mean results are listed in Table 5.1.

The geometric mean load reduction is estimated as follows:

$$(Maximum\ geometric\ mean\ concentration\ observed) \times (volume) = Existing\ Load$$

$$(Geometric\ mean\ criterion: 14\ MPN/100\ ml) \times (volume) = Allowable\ Load$$

$$Load\ \text{Re}duction = \frac{Current\ Load - Allowable\ Load}{Current\ Load} \times 100\%$$

Table 5.1 Geometric mean analysis of current load and estimated load reduction for shellfish impairments in GA009.

Condemnation Area	Volume (m^3)	Geometric Mean Fecal Coliform (MPN/100ml)	Geometric Mean W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Cod Creek (West)	312614	34.7	14.0	Implicit	1.09E+11	4.38E+10	60%
Cod Creek (East)	184834	32.6	14.0		6.03E+10	2.59E+10	57%
Presley Creek	741082	34.0	14.0		2.52E+11	1.04E+11	59%
Bridgeman Creek	157203	29.0	14.0		4.56E+10	2.20E+10	52%
Hull Creek	2587869	50.1	14.0		1.30E+12	3.62E+11	72%
Rogers Creek	200584	26.5	14.0		5.32E+10	2.81E+10	47%
Cubitt Creek	868036	44.4	14.0		3.85E+11	1.22E+11	68%
Hack Creek	611694	17.8	14.0		1.09E+11	8.56E+10	21%

C. 90th Percentile Analysis

The current 90th percentile concentration load was estimated using the worst case 30-sample 90th percentile concentration multiplied by the estuarine volume determined by bathymetry. The allowable load was calculated using the water quality standard of 49 MPN/100ml multiplied by the volume. The load reduction needed for the attainment of the water quality standard was determined by subtracting the allowable load from the current load and dividing by the current load. The process may be described by the equation as follows. The 90th percentile concentration results are listed in Table 5.2

The 90th percentile load reduction is estimated as follows:

$$(Maximum\ 90th\ percentile\ concentration\ observed) \times (volume) = Existing\ Load$$

$$(90th\ percentile\ criterion: 49\ MPN/100\ ml) \times (volume) = Allowable\ Load$$

$$Load\ \text{Re}duction = \frac{Current\ Load - Allowable\ Load}{Current\ Load} \times 100\%$$

D. Recreational Impairment Analysis

As stated in Section 4, Cubitt Creek was also listed in 1998 and subsequently re-listed in 2004, as not supporting the primary contact recreational criterion for fecal coliform. At that time, the criterion required that *"Fecal coliform bacteria shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water for two or more samples over a calendar month nor shall more than 10% of the total samples taken during any calendar month exceed 400 fecal coliform bacteria per 100 ml of water."* (9 VAC 25-260-170 dated June 17, 2002). The TMDL for this impairment would ordinarily be due in 2016. However, the shellfishing standard for fecal coliform targeted by this TMDL (90th percentile less than 49 MPN / 100 mL) is much more stringent than the recreational use standard for fecal coliform stated above. To meet this standard in Cubitt Creek, it is estimated that loading reductions of 84 percent are required, including a 100 percent reduction of anthropogenic sources

Table 5.2 90th percentile analysis of current load and estimated load reduction for shellfish impairments in GA009.

Condemnation Area	Volume (m^3)	90th Percentile Fecal Coliform (MPN/100ml)	90th Percentile W.Q. Standard Fecal Coliform (MPN/100ml)	MOS	Current Load (MPN/day)	TMDL Allowable Load (MPN/day)	Required Reduction
Cod Creek (West)	312614	202.5	49.0	Implicit	6.33E+11	1.53E+11	76%
Cod Creek (East)	184834	288.3	49.0		5.33E+11	9.06E+10	83%
Presley Creek	741082	202.8	49.0		1.50E+12	3.63E+11	76%
Bridgeman Creek	157203	198.1	49.0		3.11E+11	7.70E+10	75%
Hull Creek	2587869	381.4	49.0		9.87E+12	1.27E+12	87%
Rogers Creek	200584	163.6	49.0		3.28E+11	9.83E+10	70%
Cubitt Creek	868036	311.5	49.0		2.70E+12	4.25E+11	84%
Hack Creek	611694	92.8	49.0		5.68E+11	3.00E+11	47%

(Table 5.2). This course of action is consistent with definition number two *("Nested Recreation and Shellfish Impairments")* of a "nested" impairment as petitioned by DEQ to EPA on March 3, 2009, and approved by EPA on March 25, 2009. Per that agreement, this impairment will be listed in DEQ's 2010 Integrated Report as "Category 4A (nested)", and no recreational TMDL will be developed.

5.2. Load Allocation

A comparison of the reductions based on geometric mean load and on the 90th percentile load shows that the 90th percentile load is the critical condition. 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.

The percent loading for each of source category is based on BST source assessment of the watershed and the land use. These percentages are 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. These reductions are summarized in Table 5.3 through 5.10. These tables are created to fulfill the TMDL requirements by ensuring that the criterion is attained.

The TMDL seeks to eliminate 100% of the human derived fecal 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, relatively small (e.g., Hack Creek) to large reductions (e.g., Hull Creek) of the controllable loads (e.g. human, livestock, or pets) are necessary to achieve the water quality standard for the condemnation areas. However, due to the episodic listing and delisting patterns related to this condemnation, and to meet the intent of the Clean Water Act, any human loads present should be eliminated from the system. Through an iterative implementation of actions to reduce the controllable loads, subsequent monitoring may indicate that no further reductions are

necessary or that revisions in implementation strategies may be appropriate. Continued violations may result in the process of Use Attainment Analysis (UAA) for the water body (see Chapter 6 for a discussion of UAA). The allocations presented demonstrate how the TMDLs 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.

Table 5.3 Reductions/allocations based on 90th percentile standard, Cod Creek west.

Condemnation Area	Bacteria Source	BST Allocation % of Total Load	Current Load MPN/day	Load Allocation MPN/day	Reduction Needed
Cod Creek (West) 009-141	Livestock	30%	1.93E+11	8.11E+10	58%
	Wildlife	11%	7.19E+10	7.19E+10	0%
	Human	33%	2.07E+11	0.00E+00	100%
	Pets	25%	1.61E+11	0.00E+00	100%
	Total	**100%**	**6.33E+11**	**1.53E+11**	**76%**

Table 5.4 Reductions/allocations based upon 90th percentile standard, Cod Creek east.

Condemnation Area	Bacteria Source	BST Allocation % of Total Load	Current Load MPN/day	Load Allocation MPN/day	Reduction Needed
Cod Creek (East) 009-141	Livestock	30%	1.60E+11	0.00E+00	100%
	Wildlife	36%	1.91E+11	9.06E+10	53%
	Human	11%	5.96E+10	0.00E+00	100%
	Pets	23%	1.22E+11	0.00E+00	100%
	Total	**100%**	**5.33E+11**	**9.06E+10**	**83%**

Table 5.5 Reductions/allocations based upon 90th percentile standard, Presley Creek.

Condemnation Area	Bacteria Source	BST Allocation % of Total Load	Current Load MPN/day	Load Allocation MPN/day	Reduction Needed
Presley Creek 009-141	Livestock	13%	1.94E+11	0.00E+00	100%
	Wildlife	34%	5.16E+11	3.63E+11	30%
	Human	26%	3.86E+11	0.00E+00	100%
	Pets	27%	4.07E+11	0.00E+00	100%
	Total	**100%**	**1.50E+12**	**3.63E+11**	**76%**

Table 5.6 Reductions/allocations based on 90th percentile standard, Bridgeman Creek.

Condemnation Area	Bacteria Source	BST Allocation % of Total Load	Current Load MPN/day	Load Allocation MPN/day	Reduction Needed
Bridgeman Creek 009-142	Livestock	46%	1.44E+11	1.85E+10	87%
	Wildlife	19%	5.85E+10	5.85E+10	0%
	Human	13%	3.99E+10	0.00E+00	100%
	Pets	22%	6.91E+10	0.00E+00	100%
	Total	**100%**	**3.11E+11**	**7.70E+10**	**75%**

Table 5.7 Reductions/allocations based on the 90th percentile standard, Hull Creek.

Condemnation Area	Bacteria Source	BST Allocation % of Total Load	Current Load MPN/day	Load Allocation MPN/day	Reduction Needed
Hull Creek 009-142	Livestock	27%	2.65E+12	0.00E+00	100%
	Wildlife	31%	3.02E+12	1.27E+12	58%
	Human	21%	2.09E+12	0.00E+00	100%
	Pets	21%	2.11E+12	0.00E+00	100%
	Total	**100%**	**9.87E+12**	**1.27E+12**	**87%**

Table 5.8 Reductions/allocations based on the 90th percentile standard, Rogers Creek

Condemnation Area	Bacteria Source	BST Allocation % of Total Load	Current Load MPN/day	Load Allocation MPN/day	Reduction Needed
Rogers Creek 009-142	Livestock	10%	3.26E+10	0.00E+00	100%
	Wildlife	39%	1.27E+11	9.83E+10	23%
	Human	18%	5.95E+10	0.00E+00	100%
	Pets	33%	1.09E+11	0.00E+00	100%
	Total	**100%**	**3.28E+11**	**9.83E+10**	**70%**

Table 5.9 Reductions/allocations based on the 90th percentile standard, Cubitt Creek.

Condemnation Area	Bacteria Source	BST Allocation % of Total Load	Current Load MPN/day	Load Allocation MPN/day	Reduction Needed
Cubitt Creek 009-161	Livestock	15%	4.04E+11	0.00E+00	100%
	Wildlife	17%	4.65E+11	4.25E+11	9%
	Human	16%	4.24E+11	0.00E+00	100%
	Pets	52%	1.41E+12	0.00E+00	100%
	Total	**100%**	**2.70E+12**	**4.25E+11**	**84%**

Table 5.10 Reductions/allocations based on the 90th percentile standard, Hack Creek.

Condemnation Area	Bacteria Source	BST Allocation % of Total Load	Current Load MPN/day	Load Allocation MPN/day	Reduction Needed
Hack Creek 009-161	Livestock	15%	8.49E+10	8.49E+10	0%
	Wildlife	17%	9.76E+10	9.76E+10	0%
	Human	16%	8.91E+10	0.00E+00	100%
	Pets	52%	2.96E+11	1.18E+11	60%
	Total	**100%**	**5.68E+11**	**3.00E+11**	**47%**

A. Development of Wasteload Allocations

Based on a DEQ internal query conducted July 13, 2009, there are no permitted point source discharges in GA009. Wasteload allocations were set to one percent of the total TMDL to account for future construction of waste treatment facilities.

5.3. Consideration of Critical Conditions and Seasonal Variation

EPA regulation 40 CFR 130.7 (c)(1) requires 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 water body 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 water body was determined using a long-term record of water quality monitoring (observation) data. The period of record for the data was 1984 to 2008. The resulting estimate is quite robust.

A comparison of the geometric mean values and the 90th percentile values against the water quality criteria will determine which 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 represents 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.

5.4. 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. A MOS is either numeric or implicit in the design of the TMDL. In this TMDL the MOS is implicit in the conservative assumptions used in the load calculations, such as using the worst case bacterial concentrations in current load calculations, resulting in the highest and most protective percent reductions.

5.5. TMDL Summary

To meet the water quality standards for both geometric mean and 90th percentile criteria, the TMDL for each creek considered herein must be defined for both the geometric mean load and the 90th percentile load, as required by USEPA. A future growth factor of 1% of the total TMDL was included as a Waste Load Allocation to cover future construction of waste treatment facilities. The TMDLs for each creek are summarized in Tables 5.11 and 5.12.

Table 5.11 TMDL summary for closures in GA009 (geometric mean).

Condemnation Area	Pollutant Identified	TMDL MPN/day	Waste Load Allocation MPN/day (Future Growth)	Load Allocation MPN / day	Margin of Safety
Cod Creek (West)	Fecal Coliform	4.38E+10	4.38E+08	4.33E+10	Implicit
Cod Creek (East)		2.59E+10	2.59E+08	2.56E+10	
Presley Creek		1.04E+11	1.04E+09	1.03E+11	
Bridgeman Creek		2.20E+10	2.20E+08	2.18E+10	
Hull Creek		3.62E+11	3.62E+09	3.59E+11	
Rogers Creek		2.81E+10	2.81E+08	2.78E+10	
Cubitt Creek		1.22E+11	1.22E+09	1.20E+11	
Hack Creek		1.09E+11	1.09E+09	1.07E+11	

Table 5.12 TMDL summary for closures in GA009 (90th percentile).

Condemnation Area	Pollutant Identified	TMDL MPN/day	Waste Load Allocation MPN/day (Future Growth)	Load Allocation MPN / day	Margin of Safety
Cod Creek (West)	Fecal Coliform	1.53E+11	1.53E+09	1.52E+11	Implicit
Cod Creek (East)		9.06E+10	9.06E+08	8.97E+10	
Presley Creek		3.63E+11	3.63E+09	3.59E+11	
Bridgeman Creek		7.70E+10	7.70E+08	7.63E+10	
Hull Creek		1.27E+12	1.27E+10	1.26E+12	
Rogers Creek		9.83E+10	9.83E+08	9.73E+10	
Cubitt Creek		4.25E+11	4.25E+09	4.21E+11	
Hack Creek		3.00E+11	3.00E+09	2.97E+11	

6. 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. This report represents the culmination of that effort for the bacteria impairments in the Cod, Presley, Bridgeman, Hull, Rogers, Cubitt, and Hack Creeks watersheds. 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.

Following approval of a TMDL report by EPA, measures should be taken to reduce pollution levels in the water body. These measures, which can include the use of better treatment technology, the installation of best management practices (BMPs) and designation of No Discharge Zones (NDZ), 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 recent "TMDL Implementation Plan Guidance Manual", published in July 2003 and available upon request from the DEQ 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 or horse exclusion from water bodies. This has been shown to be very effective in lowering fecal coliform concentrations in water bodies, both by reducing the fecal deposits themselves and by providing additional riparian buffer to the stream. Other remedial measures which should be considered in these watersheds are pasture management and manure composting facilities.

Protecting existing riparian zones is an inexpensive way to reduce runoff to the impaired water-bodies and will reduce the input of fecal coliform and enterococci bacteria. The Chesapeake Bay Act requires 100 feet of riparian buffer area around Bay watersheds. Education programs for water-front owners in both urban and rural settings along these streams regarding the importance of maintaining riparian buffers would be beneficial.

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

The loadings contributed by domestic pets may be reduced through pet waste education programs, "Scoop the Poop" stations in public areas where dogs are often walked which feature trash receptacles and baggies for cleaning up after pets, pet waste composters for pet owners and veterinary clinics, and septic systems for kennels.

In water bodies with significant boat traffic, the designation of a No Discharge Zone may effectively reduce bacterial loads to the impaired segments. A No Discharge Zone in the Lynnhaven River in Virginia Beach, VA., resulted in portions of the estuary being re-opened for shellfish harvesting for the first time in over 70 years.

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 TMDL loading calculations.
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. Link to Ongoing Restoration Efforts

Implementation of this TMDL will contribute to on-going water quality improvement efforts aimed at restoring water quality in the Chesapeake Bay. Tributary strategies have been developed for state-wide water quality improvements and for the Chesapeake Bay. Up-to-date information on tributary strategy development can be found at http://www.snr.state.va.us/Initiatives/WaterQuality/. There are also local organizations such as the Northern Neck Land Conservancy, Northumberland Association of Progressive Stewardship, in addition to the Northern Neck Soil and Water Conservation District (SWCD – a partner of DCR). These groups will be especially helpful during the IP phase in order to form partnerships to facilitate communication regarding on-going water-quality improvement efforts and reductions in bacteria levels.

6.3. Reasonable Assurance for Implementation

A. 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.

B. 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 or the "Act") 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). The Act 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, DEQ 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 DEQ, DEQ also submitted a draft Continuous Planning Process to EPA in which DEQ commits to regularly updating the WQMPs. Thus, the WQMPs will be, among other things, the repository for all TMDLs and TMDL implementation plans developed within a river basin.

C. Implementation Funding Sources

One potential source of funding for TMDL implementation is Section 319 of the Clean Water Act. Other funding sources for implementation include the U.S. Department of Agriculture's Conservation Reserve Enhancement and Environmental Quality Incentive Programs, the Virginia State Revolving Loan Program, the Virginia Agricultural Best Management Practices Cost Share Program, the Chesapeake Bay Restoration Fund, the Virginia Environmental Endowment, the National Fish and Wildlife Foundation, and the Virginia Water Quality Improvement 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.

D. Addressing Wildlife Contributions

In some waters for which TMDLs have been developed, water quality source identification indicates that even after removal of all of the sources of bacteria (other than wildlife), the stream may not attain standards under all flow regimes at all times. However, **neither the Commonwealth of Virginia nor EPA is proposing the elimination of wildlife to allow for the attainment of water quality standards**. This is obviously an impractical and wholly undesirable action. While managing over-populations of wildlife remains as an option to local stakeholders, the reduction of wildlife or changing of a natural background condition is not the intended goal of a TMDL.

Based on the above, EPA and Virginia have developed a TMDL strategy to address the wildlife issue. The first step in this strategy is to develop 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, DEQ 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.

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 lead to the determination 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 will be able to provide comment during this process. Additional information can be obtained at http://www.deq.state.va.us/wqs/WQS03AUG.pdf

7. Public Participation

During development of the TMDL for the Cod, Presley, Bridgeman, Hull, Rogers, Cubitt, and Hack Creek watersheds, public involvement was encouraged through a public participation process that included public meetings and stakeholder meetings.

The first technical advisory committee and public meetings were held on June 24, 2009. A basic description of the TMDL process and the agencies involved was presented and a discussion was held regarding the source assessment input, bacterial source tracking, and load calculations. Public understanding of and involvement in the TMDL process was encouraged. Input from these meetings was utilized in the development of the TMDL and improved confidence in the allocation scenarios and TMDL process. There were four public comments received. The TMDL load allocations were presented during the second public meeting held on September 1, 2009. There were 2 public comments received. The public meetings were advertised in the local media, signs advertising the meeting were placed at high access road intersections in the watershed for two weeks before the meeting, and email invitations were sent to local government and stakeholders.

8. 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.

Biosolids. Also known as Sewage sludge, is the name for the solid, semisolid, or liquid materials removed during the treatment of domestic sewage in a treatment facility. Biosolids include, but are not limited to, solids removed during primary, secondary, or advanced wastewater treatment, scum, domestic septage, portable toilet pumpings, Type III marine sanitation device pumpings, and sewage sludge products. When properly treated and processed, sewage sludge becomes "biosolids" which can be safely recycled and applied as fertilizer to improve and maintain productive soils and stimulate plant growth.

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 water body 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 water body or segment whether or not they are being attained.

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 water body 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 water body.
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 body 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.

Poultry Litter. A material used as bedding in poultry operations. Common litter materials are wood shavings, sawdust, peanut hulls, shredded sugar cane, straw, and other dry, absorbent, low-cost organic materials. After use, the litter consists primarily of poultry manure, but also contains the original litter material, feathers, and spilled feed.

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 water body; 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 (NPDES). 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 water body. It is a measure of a water body'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 water body, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular water body, and an antidegradation 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. Citations

College of William and Mary, 2009, The Geology of Virginia, http://web.wm.edu/geology/virginia/?svr=www, accessed July 28, 2009.

Natural Resources Conservation Service, 2009, Official Soil Series Descriptions, http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi, accessed August 8, 2009.

Multi-Resolution Land Characteristics Consortium, 2008, National Land Cover Database, 2001, http://www.mrlc.gov/nlcd.php, accessed August 8, 2009.

Bacterial Source Tracking Analyses to Support Virginia's TMDLs: Shellfish Stations. December 2006. Map Tech Inc. in cooperation with New River Highlands RC & D. Blacksburg, Virginia

Virginia Department of Health – Division of Shellfish Sanitation, 2006, Potomac River: Coan River to Ginny Beach, Growing Area #009, Northumberland County, Shoreline Sanitary Survey, published April 12, 2006, 11 pp.

US EPA Shellfish Workshop Document (2002).

VA DEQ 1998 303(d) List of Impaired Waters.

10. Appendices

Appendix A. Shoreline Sanitary Survey and Condemnation Notices
Appendix B. Supporting Documentation and Watershed Assessment
1) Fecal Production Literature Review
2) Geographic Information System Sources and Process
3) Population Numbers
4) Watershed Source Assessment
Appendix C. Water Quality Data
Appendix D. Applicable State and Federal Regulations
1) Code of Virginia 62.1-194.1 Obstructing or contaminating state waters.
2) 33 CFR Volume 2, Parts 120 to 199, Revised as of July 1, 2000
Appendix E. Collective Watershed Map
Appendix F. Public Comments

Appendix A. Shoreline Sanitary Survey and Condemnation Notices

9
Growers

COMMONWEALTH of VIRGINIA

Department of Health

RANDOLPH L. GORDON, M.D., M.P.H.
COMMISSIONER

P O BOX 2448
RICHMOND, VA 23218

TDD 1-800-828-1120

JAN 1997

NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 141, POTOMAC RIVER: COD CREEK

EFFECTIVE 31 JANUARY 1997

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 141, Potomac River: Cod Creek," effective 12 February 1996, is cancelled effective 31 January 1997.

2. Condemned Shellfish Area Number 141, Potomac River: Cod Creek, is established, effective 31 January 1997. It shall be unlawful for any person, firm, or corporation to take shellfish from area #141 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 the area are shown on map titled "Potomac River: Cod Creek, Condemned Shellfish Area Number 141, 31 January 1997" 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 141

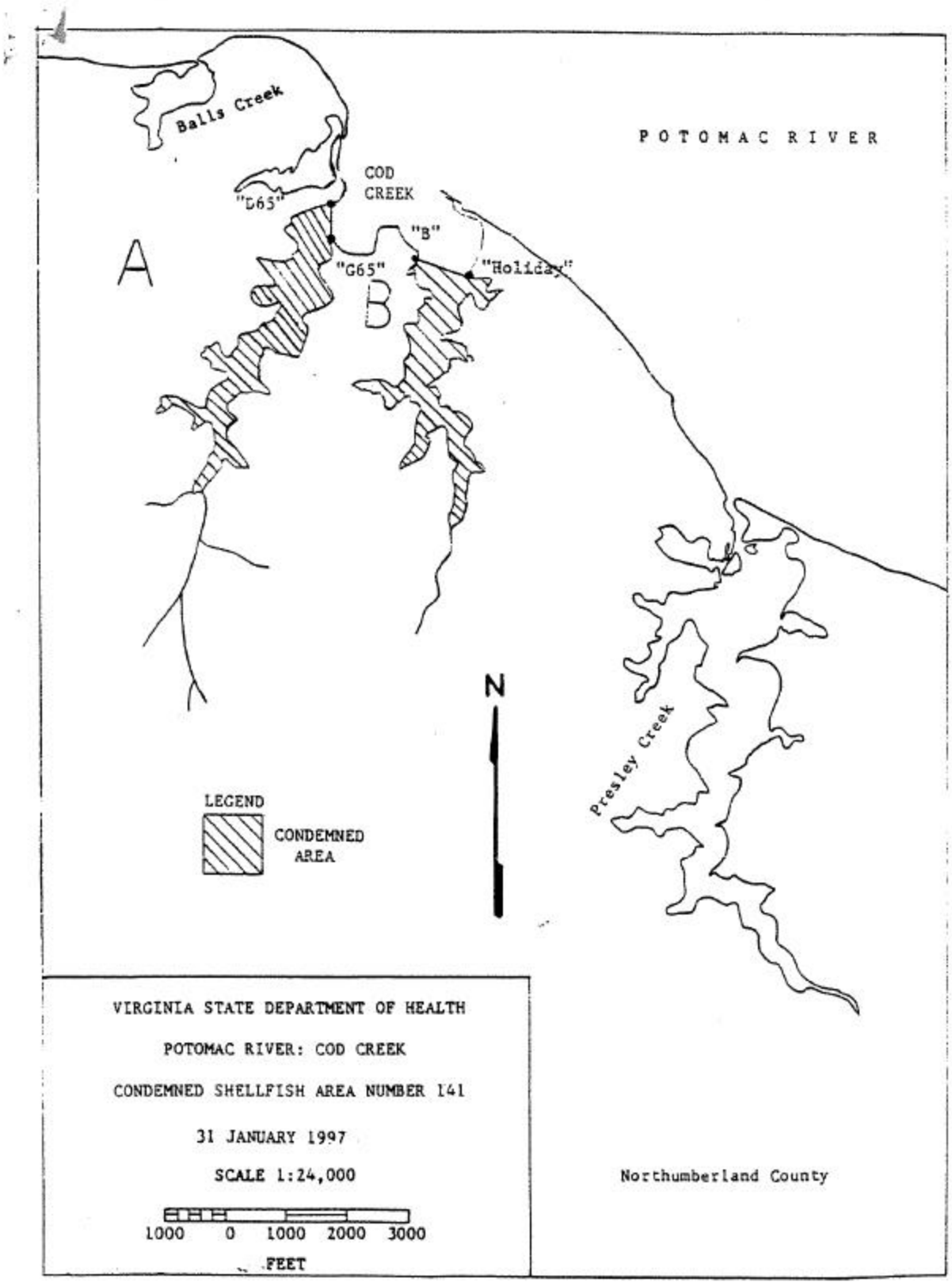
A. The condemned area shall include all of that portion of Cod Creek and its tributaries lying upstream of a line drawn between Marine Resources Commission survey markers "D65" and "G65."

B. The condemned area shall include all of that portion of Cod Creek and its tributaries lying upstream of a line drawn between Marine Resources Commission survey markers "B" and "Holiday."

Recommended by: _____
Director, Division of Shellfish Sanitation

Ordered by: _____
State Health Commissioner Date

VDH VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment


Balls Creek
POTOMAC RIVER
COD
CREEK
"D65"
"B"
"G65"
"Holiday"
A
B
N
Presley Creek
LEGEND
CONDEMNED
AREA
VIRGINIA STATE DEPARTMENT OF HEALTH
POTOMAC RIVER: COD CREEK
CONDEMNED SHELLFISH AREA NUMBER 141
31 JANUARY 1997
SCALE 1:24,000
1000 0 1000 2000 3000
FEET
Northumberland County

2007

REGISTRAR OF REGULATIONS
06 MAR -3 PM 12: 55

COMMONWEALTH of VIRGINIA

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

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

NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 009-141, COD AND PRESLEY CREEKS

EFFECTIVE 16 MARCH 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 009-141, Potomac River: Cod and Presley Creeks," effective 13 October 2005, is cancelled effective 16 March 2006.

2. Condemned Shellfish Area Number 009-141, shown as Sections A, B and C, is established, effective 16 March 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 "Cod and Presley Creeks, Condemned Shellfish Area Number 009-141, 16 March 2006" 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 009-141

A. The condemned area shall include that portion of the western branch of Cod Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°58'46.9",-76°26'21.9") and map coordinate (37°58'39.6",-76°26'23.4").

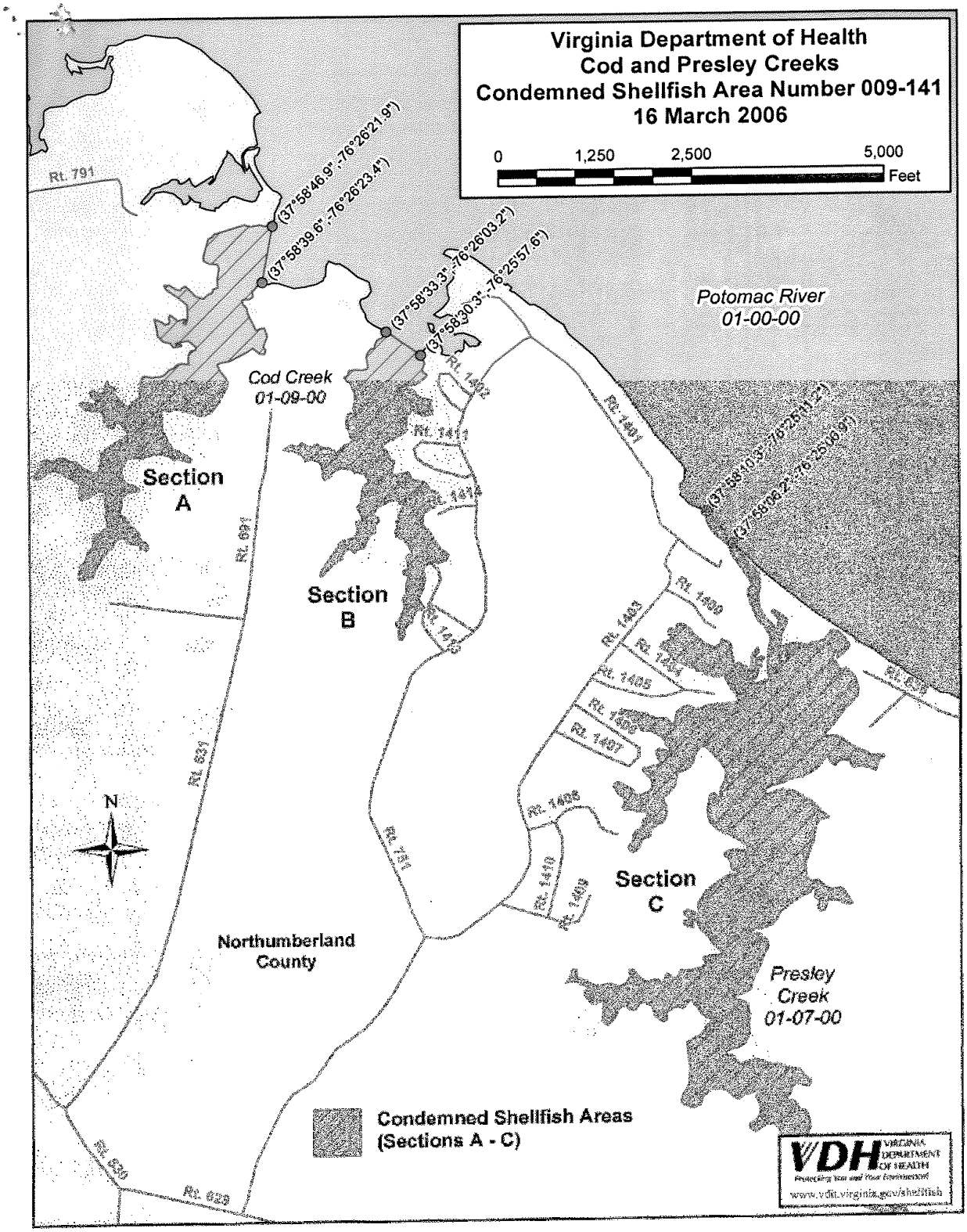
B. The condemned area shall include that portion of the eastern branch of Cod Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°58'33.3",-76°26'03.2") and map coordinate (37°58'30.3",-76°25'57.6").

C. The condemned area shall include all of Presley Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°58'10.3",-76°25'11.2") and map coordinate (37°58'06.2",-76°25'06.9").

Recommended by: _____
Director, Division of Shellfish Sanitation

Ordered by: _____ 03/03/2006
State Health Commissioner — Date

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


Virginia Department of Health
Cod and Presley Creeks
Condemned Shellfish Area Number 009-141
16 March 2006
0
1,250
2,500
5,000
Feet
Potomac River
01-00-00
Cod Creek
01-09-00
Presley
Creek
01-07-00
Section
A
Section
B
Section
C
Northumberland
County
N
Rt. 791
Rt. 691
Rt. 631
Rt. 634
Rt. 629
Rt. 1407
Rt. 1411
Rt. 1414
Rt. 1401
Rt. 1403
Rt. 1404
Rt. 1405
Rt. 1406
Rt. 1407
Rt. 1408
Rt. 1410
Rt. 1409
(37°58'46.9", -76°26'21.9")
(37°58'39.6", -76°26'23.4")
(37°58'33.3", -76°26'03.2")
(37°58'30.3", -76°25'57.6")
(37°58'10.3", -76°25'51.2")
(37°58'08.2", -76°25'46.9")
Condemned Shellfish Areas
(Sections A - C)
VDH
VIRGINIA DEPARTMENT OF HEALTH
www.vdh.virginia.gov/shellfish

140

A34 A01

9

Topo: 145B

COMMONWEALTH of VIRGINIA

C M G BUTTERY, M.D.
COMMISSIONER

Department of Health
Richmond, Virginia 23219

NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION
NUMBER 140, POTOMAC RIVER: PRESLEY CREEK

EFFECTIVE 27 APRIL 1989

Pursuant to Title 28.1, Chapter 7, §§28.1-175 through 28.1-177, §32.1-20, and §9-6.14:4.1 C6 of the Code of Virginia:

1. The "Notice and Description of Shellfish Area Condemnation Number 140, Potomac River: Presley Creek, effective 26 May 1988" (emergency regulation) is cancelled effective 27 April 1989.

2. Condemned Shellfish Area Number 140, Potomac River: Presley Creek, is established effective 27 April 1989. It shall be unlawful for any person, firm, or corporation to take shellfish from area #140 for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.1-179 of the Code of Virginia. The boundaries of the area are shown on map titled "Potomac River: Presley Creek, Condemned Shellfish Area Number 140, 27 April 1989" 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 Revision.

BOUNDARIES OF CONDEMNED AREA NUMBER 140

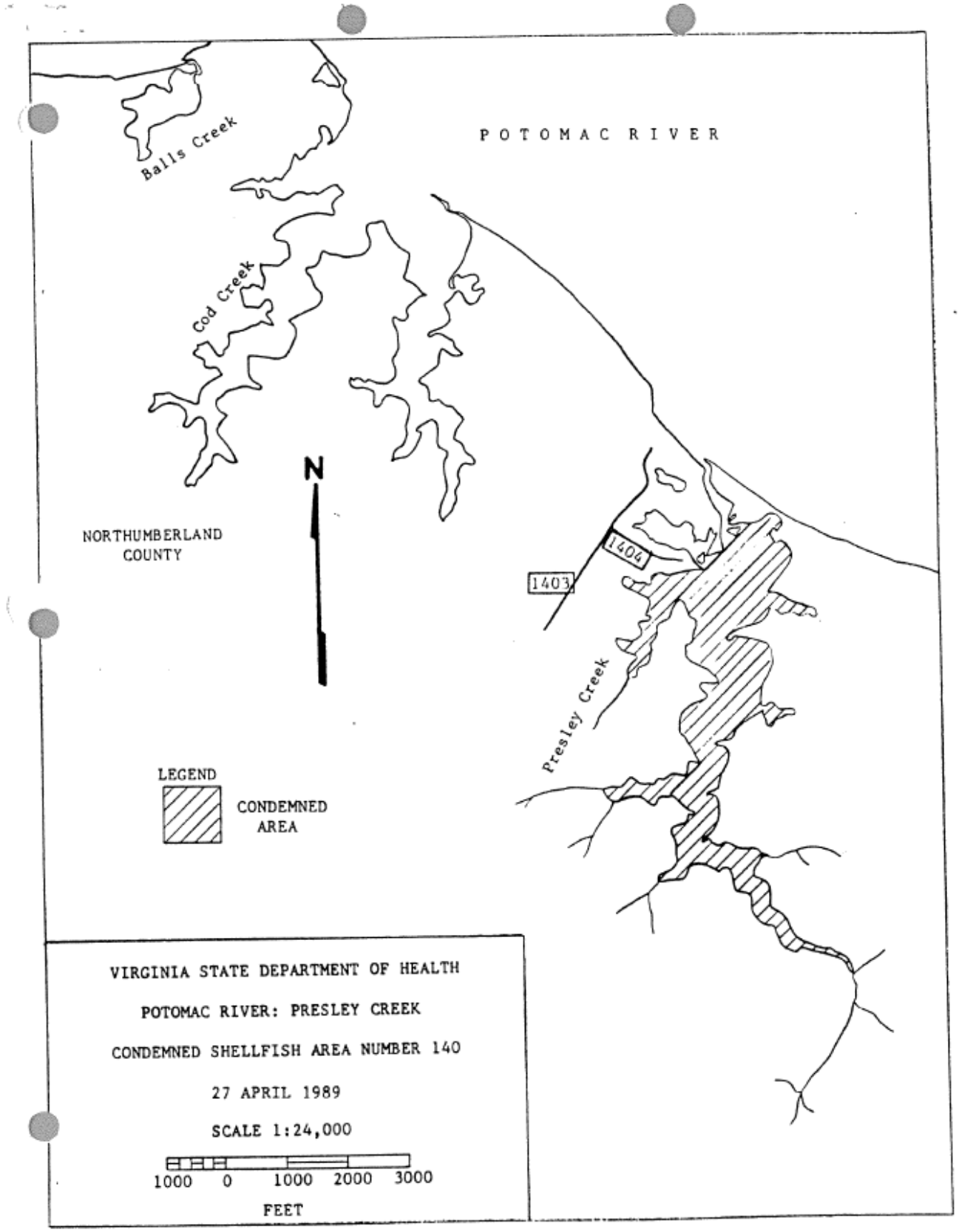
The condemned area shall include all of Presley Creek and its tributaries lying upstream of a line drawn from the prominent projection on the west shoreline at the end of secondary highway 1404 in a northeasterly direction to the opposite shore, a distance of approximately 1100 feet.

Recommended by: Clyde W. Wiley
Director, Division of Shellfish Sanitation

Ordered by:
State Health Commissioner

3.7.89
Date

VDH


POTOMAC RIVER
Balls Creek
Cod Creek
N
NORTHUMBERLAND
COUNTY
1404
1403
Presley Creek
LEGEND
CONDEMNED
AREA
VIRGINIA STATE DEPARTMENT OF HEALTH
POTOMAC RIVER: PRESLEY CREEK
CONDEMNED SHELLFISH AREA NUMBER 140
27 APRIL 1989
SCALE 1:24,000
1000 0 1000 2000 3000
FEET

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

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

NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 009-141, COD AND PRESLEY CREEKS

EFFECTIVE 30 MARCH 2009

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §2.2-4002, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 009-141, Cod and Presley Creeks," effective 16 March 2006, is cancelled effective 30 March 2009.

2. Condemned Shellfish Area Number 009-141, shown as Sections A, B and C, is established effective 30 March 2009. 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 "Cod and Presley Creeks, Condemned Shellfish Area Number 009-141, 30 March 2009" 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 009-141

A. The condemned area shall include that portion of the western branch of Cod Creek and its tributaries lying upstream of a line drawn between latitude / longitude map coordinate (37°58'46.9",-76°26'21.9") and map coordinate (37°58'39.6",-76°26'23.4").

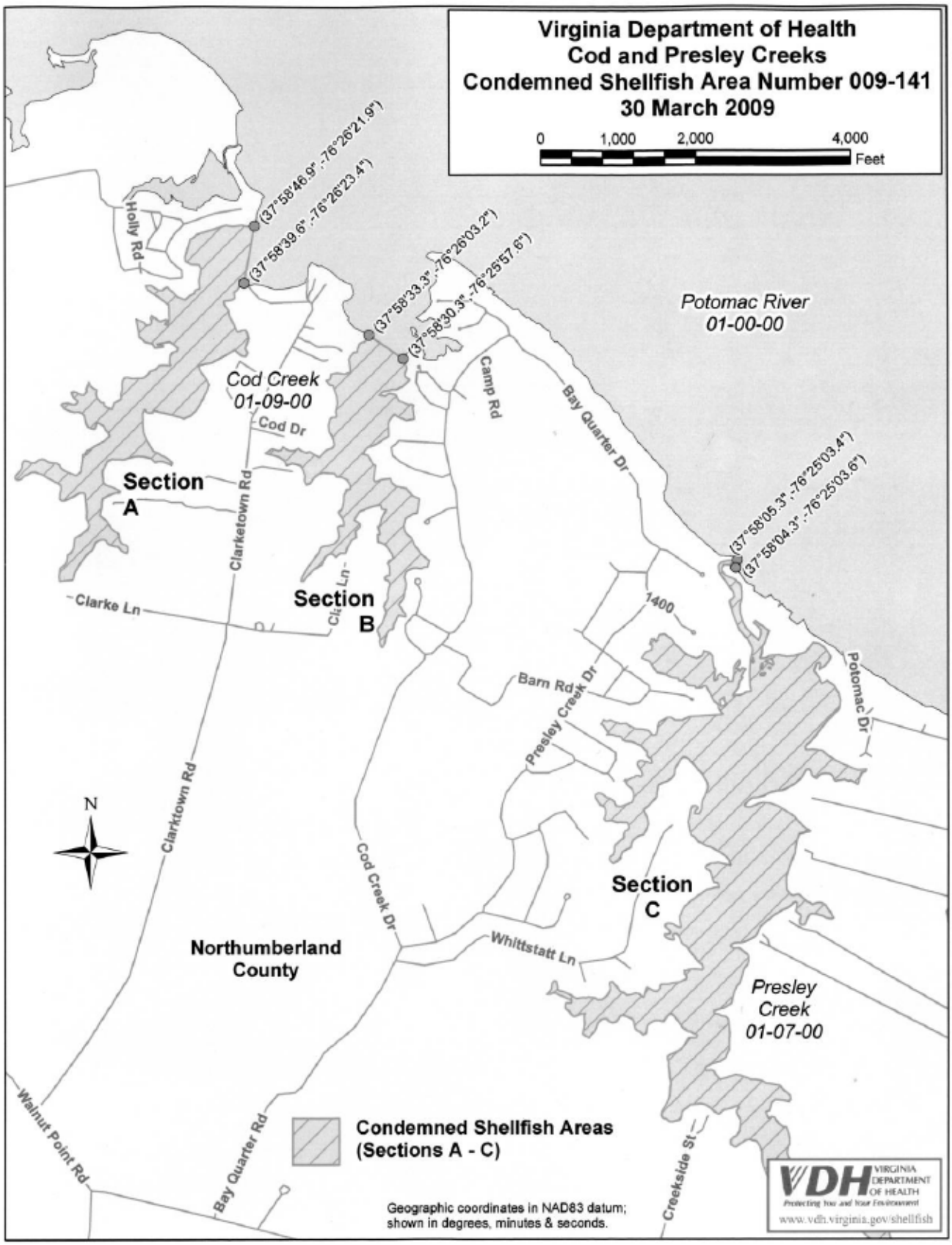
B. The condemned area shall include that portion of the eastern branch of Cod Creek and its tributaries lying upstream of a line drawn between latitude / longitude map coordinate (37°58'33.3",-76°26'03.2") and map coordinate (37°58'30.3",-76°25'57.6").

C. The condemned area shall include all of Presley Creek and its tributaries lying upstream of a line drawn between latitude / longitude map coordinate (37°58'05.3",-76°25'03.4") and map coordinate (37°58'04.3",-76°25'03.6").

Recommended by: _____
Director, Division of Shellfish Sanitation

Ordered by: _____ 3/16/09
State Health Commissioner Date

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


Virginia Department of Health
Cod and Presley Creeks
Condemned Shellfish Area Number 009-141
30 March 2009
0
1,000
2,000
4,000
Feet
(37°58'46.9", -76°26'21.9")
(37°58'39.6", -76°26'23.4")
(37°58'33.3", -76°26'03.2")
(37°58'30.3", -76°25'57.6")
(37°58'05.3", -76°25'03.4")
(37°58'04.3", -76°25'03.6")
Holly Rd
Cod Creek
01-09-00
Cod Dr
Section
A
Clarketown Rd
Clarke Ln
Section
B
Camp Rd
Bay Quarter Dr
Potomac River
01-00-00
1400
Barn Rd
Presley Creek Dr
Potomac Dr
N
Clarktown Rd
Cod Creek Dr
Section
C
Northumberland
County
Whittstatt Ln
Presley
Creek
01-07-00
Walnut Point Rd
Bay Quarter Rd
Creekside St
Condemned Shellfish Areas
(Sections A - C)
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

9
Grow Area

COMMONWEALTH of VIRGINIA

Department of Health
RANDOLPH L. GORDON, M.D., M.P.H.
COMMISSIONER
P O BOX 2448
RICHMOND, VA 23218
TDD 1-800-828-1120

NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 142, POTOMAC RIVER: HULL CREEK

EFFECTIVE 31 JANUARY 1997

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 142, Potomac River: Hull Creek," effective 12 February 1996, is cancelled effective 31 January 1997.

2. Condemned Shellfish Area Number 142, Potomac River: Hull Creek, is established, effective 31 January 1997. It shall be unlawful for any person, firm, or corporation to take shellfish from area #142 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 the area are shown on map titled "Potomac River: Hull Creek, Condemned Shellfish Area Number 142, 31 January 1997" 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 of revision of this order.

BOUNDARIES OF CONDEMNED AREA NUMBER 142

A. The condemned area shall include all of that portion of Hull Creek and its tributaries lying upstream of a line drawn from the projection of the shoreline at the north side of Spring Cove in a northeasterly direction approximately 250 yards to the most prominent point on the opposite shore.

B. The condemned area shall include all of that portion of Rogers Creek and its tributaries lying upstream of a line drawn from a point on the west shore 1600 feet upstream of the point at the mouth of Rogers Creek (designated Point P) in an east by northeasterly direction to the point on the opposing shore.

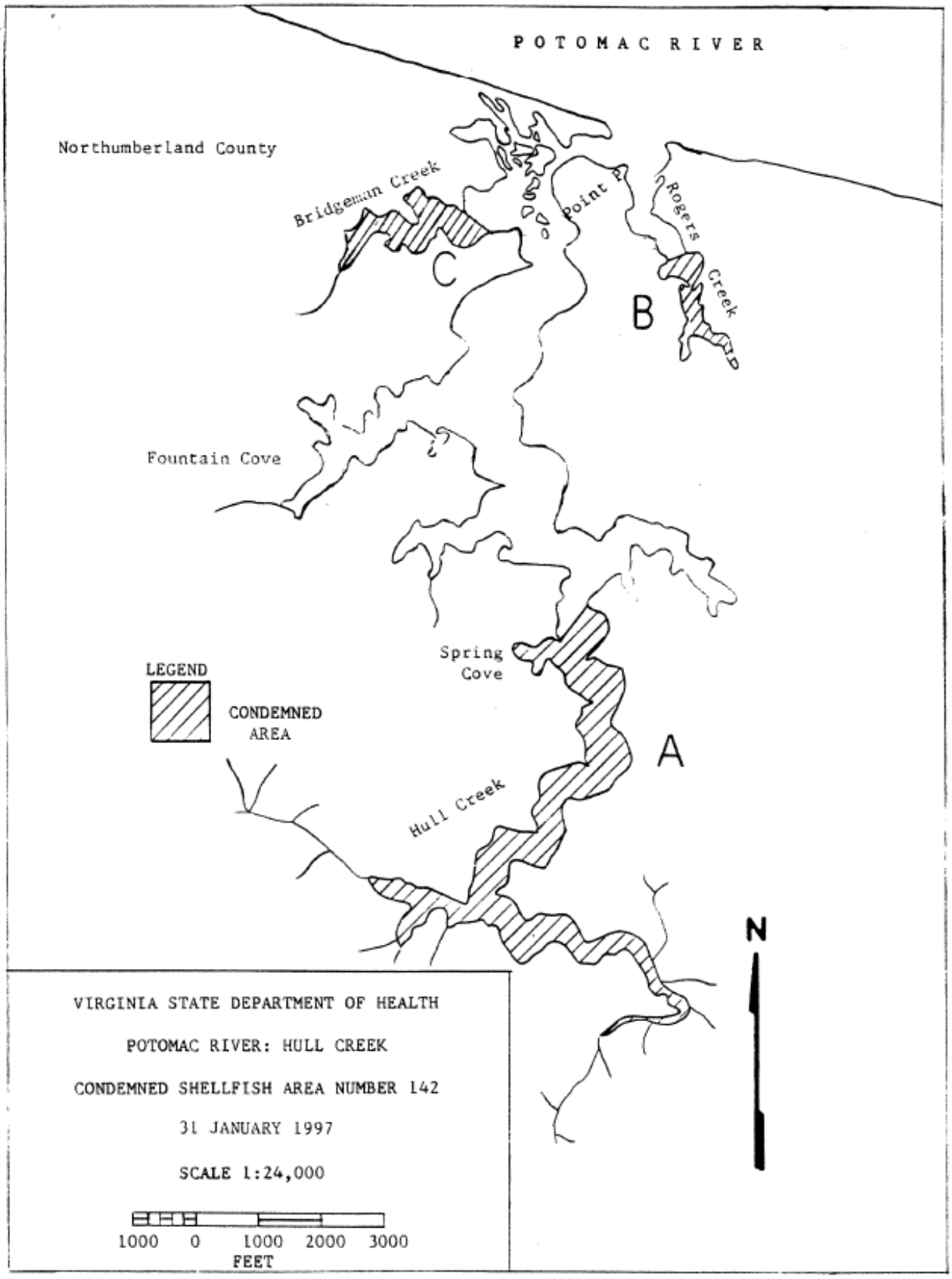
VDH VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment

Shellfish Area Condemnation
Number 142
Page Two

C. The condemned area shall include that portion of Bridgeman Creek and its tributaries lying upstream of a line drawn from the prominent projection on the north shore of the mouth of Bridgeman Creek due southeast to the opposite shore.

Recommended by: _____
Director, Division of Shellfish Sanitation

Ordered by: _____
State Health Commissioner Date


POTOMAC RIVER
Northumberland County
Bridgeman Creek
Point
Rogers
Creek
C
B
Fountain Cove
Spring
Cove
LEGEND
CONDEMNED
AREA
A
Hull Creek
N
VIRGINIA STATE DEPARTMENT OF HEALTH
POTOMAC RIVER: HULL CREEK
CONDEMNED SHELLFISH AREA NUMBER 142
31 JANUARY 1997
SCALE 1:24,000
1000 0 1000 2000 3000
FEET

COMMONWEALTH of VIRGINIA

Department of Health

E. ANNE PETERSON, M.D., M.P.H.
STATE HEALTH COMMISSIONER

P O BOX 2448
RICHMOND, VA 23218

TDD 1-800-828-1120

NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 142, POTOMAC RIVER: HULL CREEK

EFFECTIVE 21 AUGUST 2000

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 142, Potomac River: Hull Creek," effective 9 September 1998, is cancelled effective 21 August 2000.

2. Condemned Shellfish Area Number 142, Potomac River: Hull Creek, is established, effective 21 August 2000. It shall be unlawful for any person, firm, or corporation to take shellfish from area #142 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 the area are shown on map titled "Potomac River: Hull Creek, Condemned Shellfish Area Number 142, 21 August 2000" 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 of revision of this order.

BOUNDARIES OF CONDEMNED AREA NUMBER 142

A. The condemned area shall include that portion of Bridgeman Creek and its tributaries lying upstream of a line drawn between Marine Resources Commission survey markers "Hurley" and "F1650."

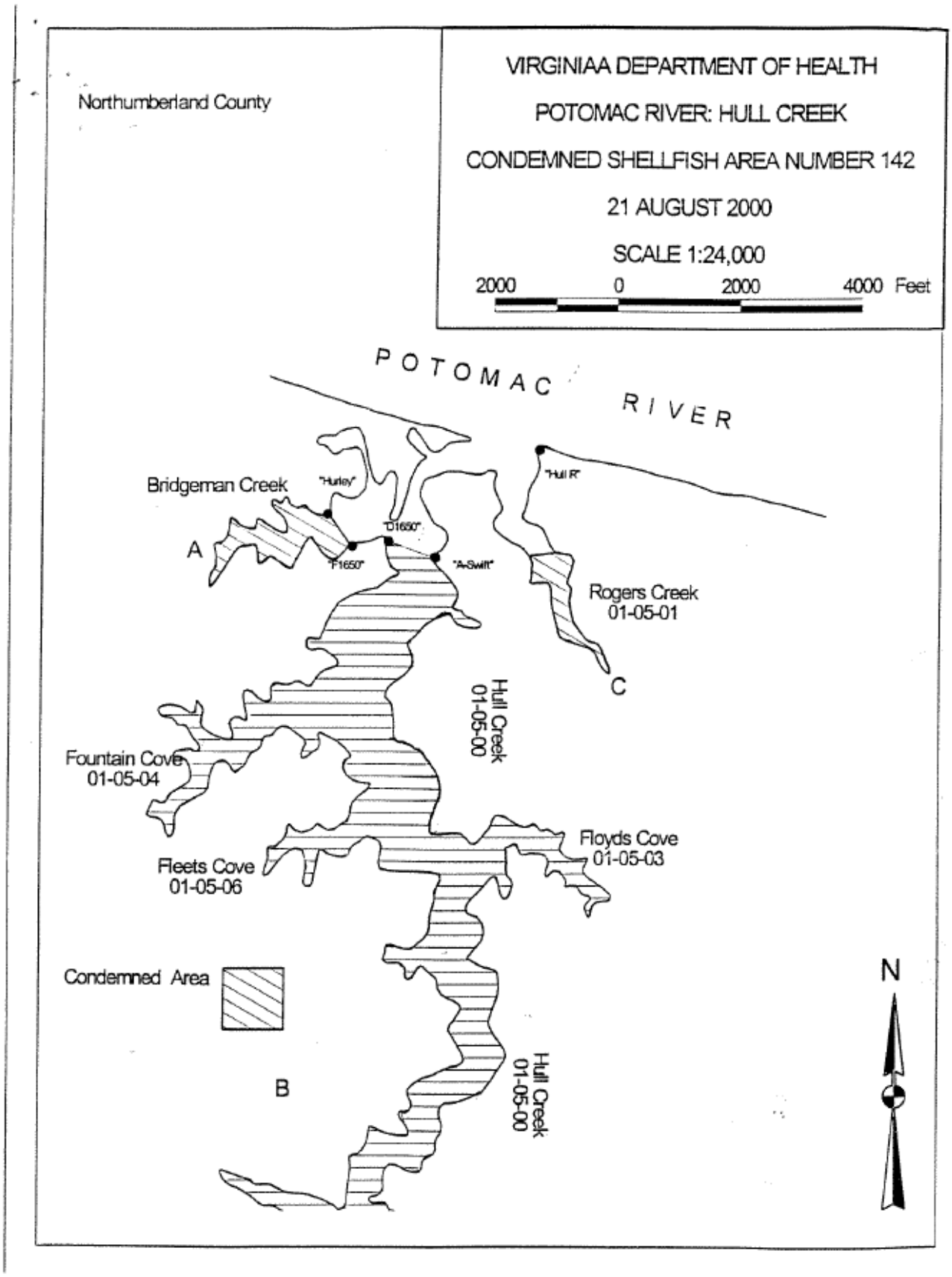
B. The condemned area shall include all of that portion of Hull Creek and its tributaries lying upstream of a line drawn between Marine Resources Commission survey markers "D1650" and "A-Swift."

C. The condemned area shall include all of that portion of Rogers Creek and its tributaries lying upstream of a line drawn due west from a point on the east shore 1370 feet upstream from Marine Resources Commission survey marker "Hull R."

Recommended by: _____
Director, Division of Shellfish Sanitation

Ordered by: _____ 8/8/2000
State Health Commissioner — Date

VDH VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment
www.vdh.state.va.us


VIRGINIAA DEPARTMENT OF HEALTH
POTOMAC RIVER: HULL CREEK
CONDEMNED SHELLFISH AREA NUMBER 142
21 AUGUST 2000
SCALE 1:24,000
2000 0 2000 4000 Feet
Northumberland County
POTOMAC RIVER
Bridgeman Creek
"Hurley"
"D1650"
"F1650"
"A-Swift"
"Hull R"
A
Rogers Creek
01-05-01
C
Hull Creek
01-05-00
Fountain Cove
01-05-04
Floyds Cove
01-05-03
Fleets Cove
01-05-06
Condemned Area
B
Hull Creek
01-05-00
N

REGISTRAR OF REGULATIONS
08 MAR -5 PM 3:23

COMMONWEALTH of VIRGINIA
Department of Health
DIVISION OF SHELLFISH SANITATION
109 Governor Street, Room 614-B
Richmond, VA 23219
Ph: 804-864-7487
Fax: 804-864-7481

NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 009-142, HULL CREEK

EFFECTIVE 17 MARCH 2008

Pursuant to Title 28.2, Chapter 8, §28.2-803 through 28.2-808, §32.1-20, and §2.2-4002, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 009-142, Hull Creek," effective 14 March 2007, is cancelled effective 17 March 2008.

2. Condemned Shellfish Area Number 009-142, shown as Sections A, B, C and D, is established, effective 17 March 2008. 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 "Hull Creek, Condemned Shellfish Area Number 009-142, 17 March 2008" 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 of revision of this order.

BOUNDARIES OF CONDEMNED AREA NUMBER 009-142

A. The condemned area shall include that portion of Bridgeman Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°57'10.3", -76°23'26.7") and map coordinate (37°57'06.8",-76°23'20.0").

B. The condemned area shall include that portion of Hull Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°57'01.3", -76°23'13.5") and map coordinate (37°56'53.9",-76°23'08.6").

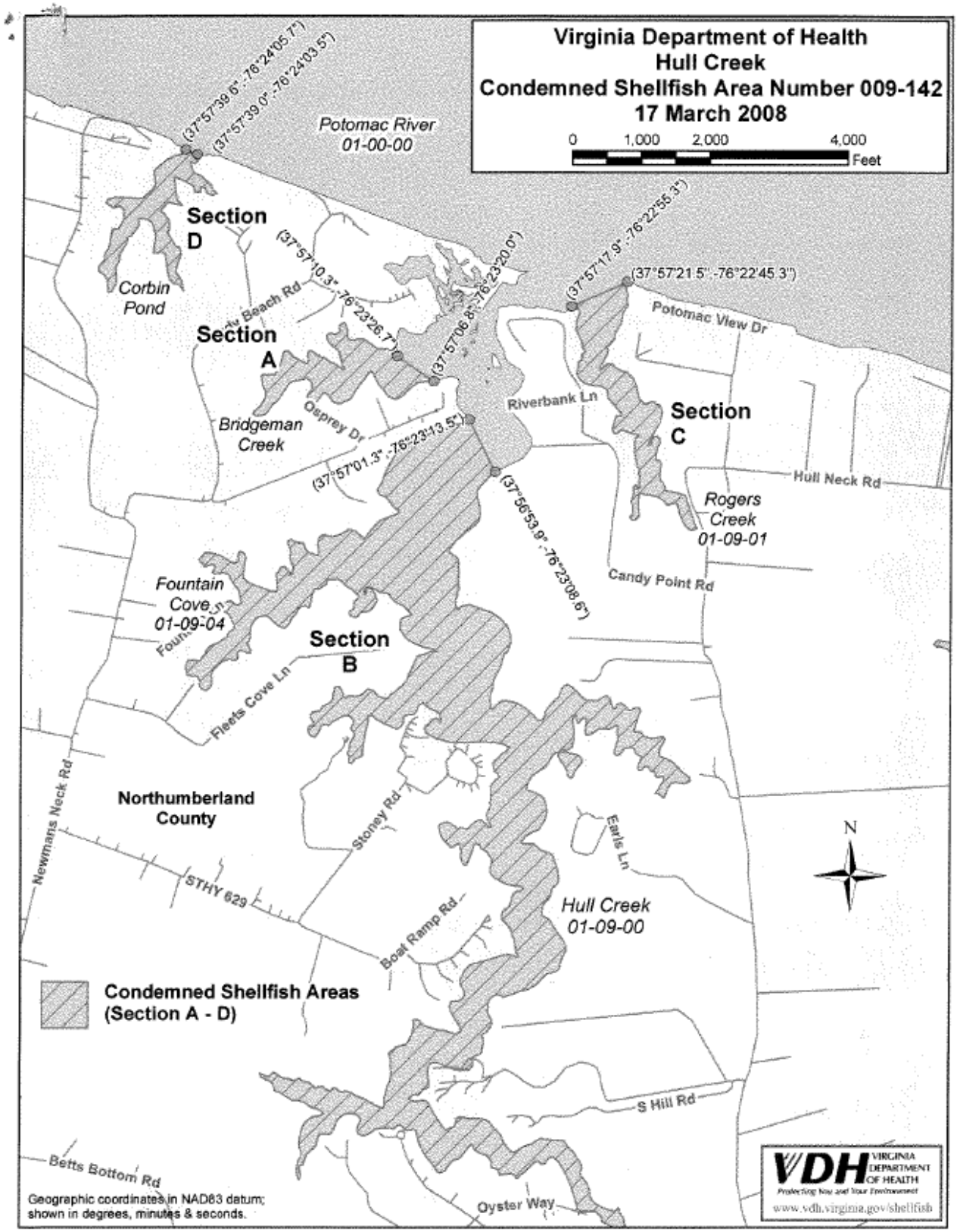
C. The condemned area shall include all of Rogers Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°57'17.9",-76°22'55.3") and map coordinate (37°57'21.5",-76°22'45.3").

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

D. The condemned area shall include all of Corbin Pond and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°57'39.6",-76°24'05.7") and map coordinate (37°57'39.0",-76°24'03.5").

Recommended by: _____
Director, Division of Shellfish Sanitation

Ordered by: _____
State Health Commissioner Date


Virginia Department of Health
Hull Creek
Condemned Shellfish Area Number 009-142
17 March 2008
0 1,000 2,000 4,000
Feet
Potomac River
01-00-00
(37°57'39.6" -76°24'05.7")
(37°57'39.0" -76°24'03.5")
Section D
Corbin Pond
(37°57'10.3" -76°23'26.7")
Section A
(37°57'06.8" -76°23'20.0")
(37°57'17.9" -76°22'55.3")
(37°57'21.5" -76°22'45.3")
Potomac View Dr
Riverbank Ln
Section C
Bridgeman Creek
Osprey Dr
(37°57'01.3" -76°23'13.5")
(37°56'53.9" -76°23'08.6")
Hull Neck Rd
Rogers Creek 01-09-01
Candy Point Rd
Fountain Cove 01-09-04
Section B
Fleets Cove Ln
Northumberland County
Newmans Neck Rd
Stoney Rd
Earls Ln
STHY 629
Boat Ramp Rd
Hull Creek 01-09-00
N
Condemned Shellfish Areas (Section A - D)
S Hill Rd
Betts Bottom Rd
Oyster Way
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

COMMONWEALTH of VIRGINIA
Department of Health
DIVISION OF SHELLFISH SANITATION
109 Governor Street, Room 614-B
Richmond, VA 23219
Ph: 804-864-7487
Fax: 804-864-7481

NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 009-142, HULL CREEK

EFFECTIVE 30 MARCH 2009

Pursuant to Title 28.2, Chapter 8, §28.2-803 through 28.2-808, §32.1-20, and §2.2-4002, B.16 of the *Code of Virginia*:

1. The "Notice and Description of Shellfish Area Condemnation Number 009-142, Hull Creek," effective 17 March 2008, is cancelled effective 30 March 2009.

2. Condemned Shellfish Area Number 009-142, shown as Sections A, B, C, D, E and F, is established effective 30 March 2009. 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 "Hull Creek, Condemned Shellfish Area Number 009-142, 30 March 2009" 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 of revision of this order.

BOUNDARIES OF CONDEMNED AREA NUMBER 009-142

A. The condemned area shall include that portion of Bridgeman Creek and its tributaries lying upstream of a line drawn between latitude / longitude map coordinate (37°57'10.3", -76°23'26.7") and map coordinate (37°57'06.8",-76°23'20.0").

B. The condemned area shall include that portion of Hull Creek and its tributaries lying upstream of a line drawn between latitude / longitude map coordinate (37°56'18.4", -76°23'16.9") and map coordinate (37°56'20.2",-76°23'08.4").

C. The condemned area shall include all of Rogers Creek and its tributaries lying upstream of a line drawn between latitude / longitude map coordinate (37°57'17.9",-76°22'55.3") and map coordinate (37°57'21.5",-76°22'45.3").

D. The condemned area shall include all of Corbin Pond and its tributaries lying upstream of a line drawn between latitude / longitude map coordinate (37°57'39.6",-76°24'05.7") and map coordinate (37°57'39.0",-76°24'03.5").

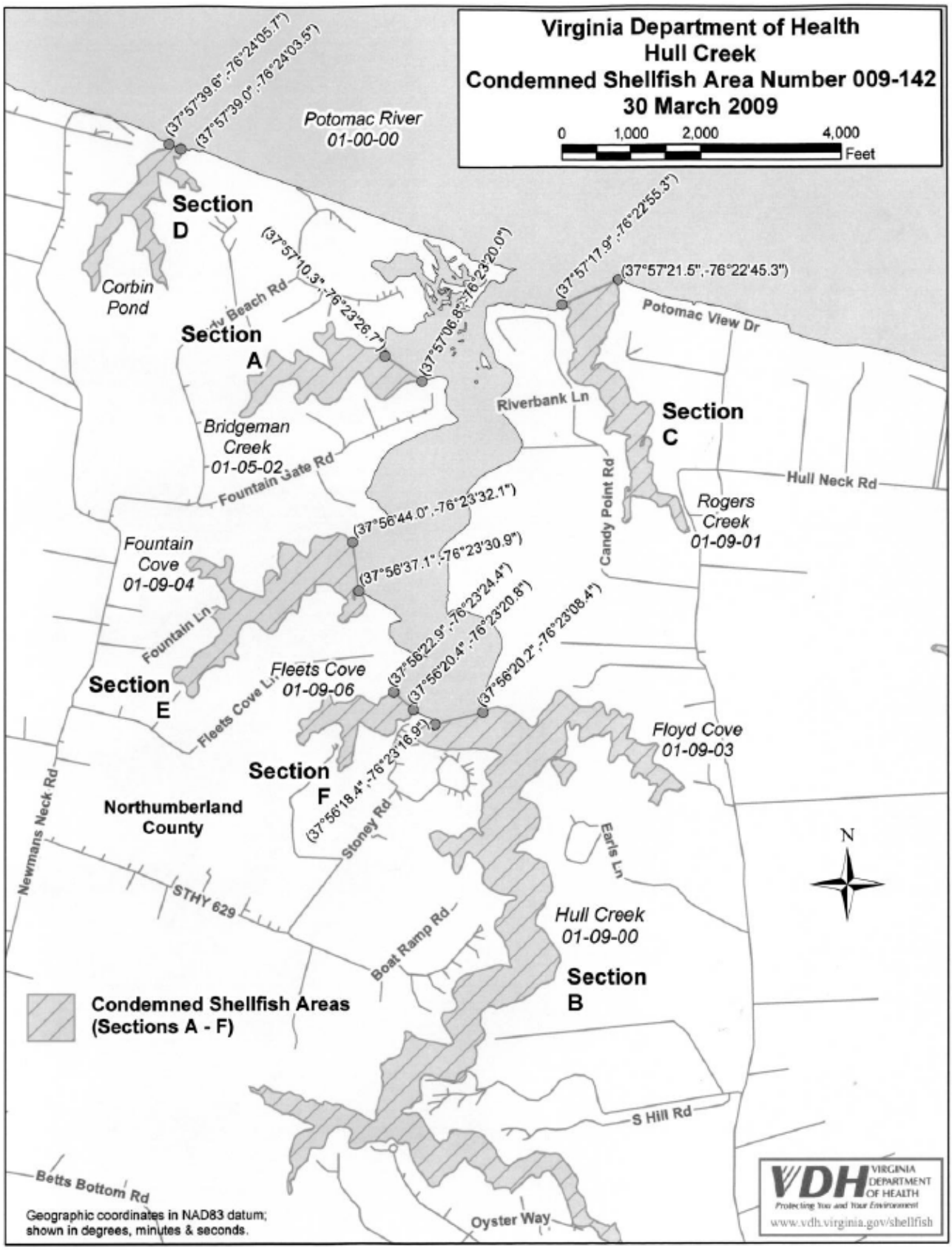
VDH VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment
www.vdh.virginia.gov/shellfish

E. The condemned area shall include all of Fountain Cove and its tributaries lying upstream of a line drawn between latitude / longitude map coordinate (37°56'44.0",-76°23'32.1") and map coordinate (37°56'37.1",-76°23'30.9").

F. The condemned area shall include all of Fleets Cove and its tributaries lying upstream of a line drawn between latitude / longitude map coordinate (37°56'22.9",-76°23'24.4") and map coordinate (37°56'20.4",-76°23'20.8").

Recommended by: _____
Director, Division of Shellfish Sanitation

Ordered by: _____ 3/16/09
State Health Commissioner Date


Virginia Department of Health
Hull Creek
Condemned Shellfish Area Number 009-142
30 March 2009
0 1,000 2,000 4,000
Feet
Potomac River
01-00-00
(37°57'39.6", -76°24'05.7")
(37°57'39.0", -76°24'03.5")
(37°57'17.9", -76°22'55.3")
(37°57'21.5", -76°22'45.3")
(37°57'06.8", -76°23'20.0")
(37°57'10.3", -76°23'26.7")
Section D
Corbin Pond
Ay Beach Rd
Section A
Potomac View Dr
Riverbank Ln
Section C
Bridgeman Creek
01-05-02
Fountain Gate Rd
Hull Neck Rd
Candy Point Rd
Rogers Creek
01-09-01
(37°56'44.0", -76°23'32.1")
(37°56'37.1", -76°23'30.9")
Fountain Cove
01-09-04
Fountain Ln
(37°56'22.9", -76°23'24.4")
(37°56'20.4", -76°23'20.8")
(37°56'20.2", -76°23'08.4")
Fleets Cove
01-09-06
Fleets Cove Ln
Section E
Floyd Cove
01-09-03
Section F
(37°56'18.4", -76°23'16.9")
Northumberland County
Newmans Neck Rd
Stoney Rd
Earls Ln
STHY 629
Boat Ramp Rd
Hull Creek
01-09-00
Section B
N
Condemned Shellfish Areas
(Sections A - F)
S Hill Rd
Betts Bottom Rd
Oyster Way
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

168

GTY

COMMONWEALTH of VIRGINIA

JAMES B. KENLEY, M.D.
COMMISSIONER

Department of Health
Richmond, Virginia 23219

NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION
NUMBER 168, POTOMAC RIVER: CUBITT CREEK

EFFECTIVE 30 MAY 1986

Pursuant to Title 28.1, Chapter 7, Section 28.1-175 through 28.1-177, Code of Virginia, notice is hereby given that Condemned Shellfish Area Number 168, Potomac River: Cubitt Creek, effective 30 May 1986, is established. 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 Title 28.1. Chapter 7, Section 28.1-179, Code of Virginia. The boundaries of the area are shown on map titled "Potomac River: Cubitt Creek, Condemned Shellfish Area Number 168, 30 May 1986" which is a part of this notice.

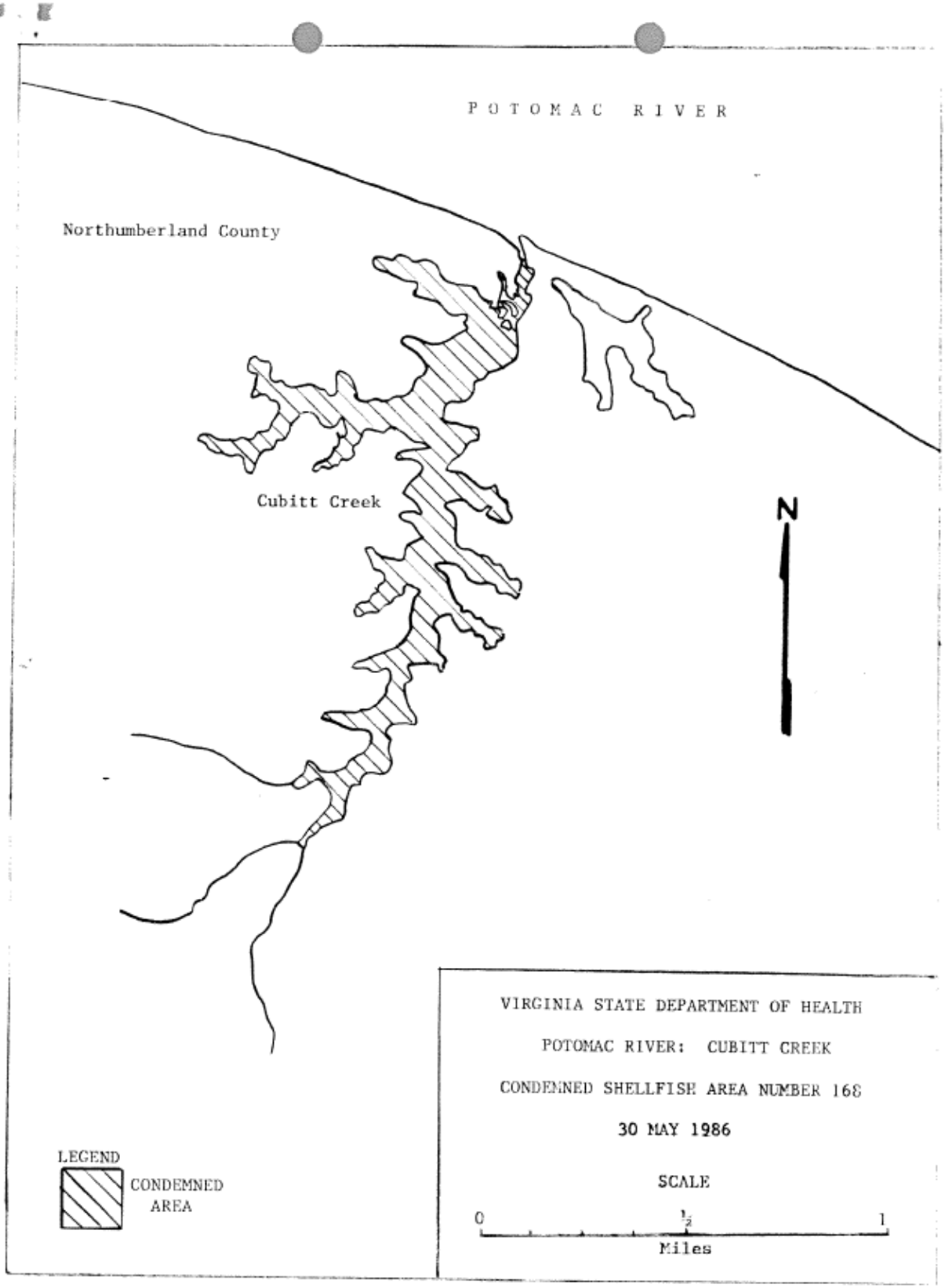
BOUNDARIES OF CONDEMNED AREA

The condemned area includes all of Cubitt Creek and its tributaries lying upstream of a line drawn across the narrowest part of the entrance to Cubitt Creek.

Recommended by: Clyde W. Wiley
Director, Bureau of Shellfish Sanitation

TO	26	REC'D
	GTY	6-2
	RJK	
	MBM	
	BKF	
	DGM	
	BLJ	

Approved by: Edwin M. Brown MD
Acting Health Commissioner


POTOMAC RIVER
Northumberland County
Cubitt Creek
N
LEGEND
CONDEMNED AREA
VIRGINIA STATE DEPARTMENT OF HEALTH
POTOMAC RIVER: CUBITT CREEK
CONDEMNED SHELLFISH AREA NUMBER 168
30 MAY 1986
SCALE
0
½
1
Miles

REGISTRAR OF REGULATIONS
07 MAR -6 PM 2:09

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

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

NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 009-161, CUBITT AND HACK CREEKS

EFFECTIVE 14 MARCH 2007

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 161, Potomac River: Hack Creek," effective 27 April 1989, is cancelled effective 14 March 2007.

2. The "Notice and Description of Shellfish Area Condemnation Number 168, Potomac River: Cubitt Creek," effective 27 April 1989, is cancelled effective 14 March 2007

3. Condemned Shellfish Area Number 009-161, shown as Sections A, B and C, is established, effective 14 March 2007. 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 "Hack and Cubitt Creeks, Condemned Shellfish Area Number 009-161, 14 March 2007" 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 009-161

A. The condemned area shall include all of Cubitt Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°56'53.9",-76°20'56.4") and map coordinate (37°56'53.8",-76°20'55.9").

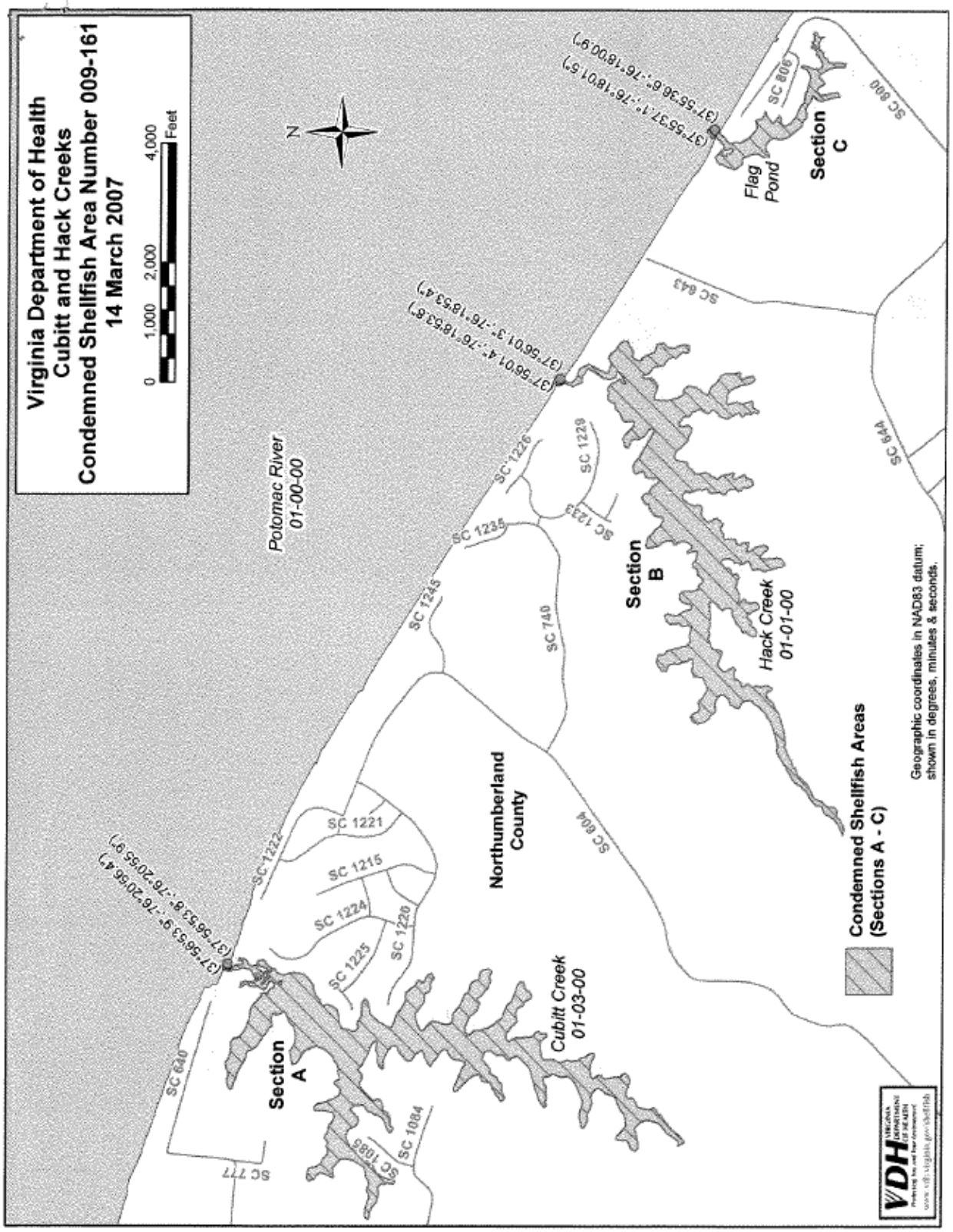
B. The condemned area shall include all of Hack Creek and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°56'01.4",-76°18'53.8") and map coordinate (37°56'01.3",-76°18'53.4").

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

C. The condemned area shall include all of Flag Pond and its tributaries lying upstream of a line drawn between latitude/longitude map coordinate (37°55'37.1",-76°18'01.5") and map coordinate (37°55'36.6",-76°18'00.9").

Recommended by: _____
Director, Division of Shellfish Sanitation

Ordered by: _____ 03/05/2007
State Health Commissioner Date


Virginia Department of Health
Cubitt and Hack Creeks
Condemned Shellfish Area Number 009-161
14 March 2007
0
1,000
2,000
4,000
Feet
N
Potomac River
01-00-00
Section A
Section B
Section C
Cubitt Creek
01-03-00
Hack Creek
01-01-00
Flag Pond
Northumberland County
Condemned Shellfish Areas
(Sections A - C)
Geographic coordinates in NAD83 datum;
shown in degrees, minutes & seconds.
(37°56'53.9", -76°20'56.4")
(37°56'53.8", -76°20'55.9")
(37°56'01.4", -76°18'53.6")
(37°56'01.3", -76°18'53.4")
(37°55'37.1", -76°18'01.5")
(37°55'36.6", -76°18'00.9")
SC 640
SC 777
SC 1222
SC 1221
SC 1215
SC 1224
SC 1220
SC 1225
SC 1084
SC 1085
SC 1245
SC 1235
SC 1226
SC 1229
SC 1233
SC 740
SC 643
SC 644
SC 604
SC 806
SC 800

COMMONWEALTH of VIRGINIA
Department of Health
DIVISION OF SHELLFISH SANITATION
109 Governor Street, Room 614-B
Richmond, VA 23219
Ph: 804-864-7487
Fax: 804-864-7481

POTOMAC RIVER: COAN RIVER TO GINNY BEACH
Growing Area #009
Northumberland County
Shoreline Sanitary Survey

Date: 12 April 2006
Survey Period: January 23, 2006 – April 5, 2006
Total Number of Properties Surveyed: 1171
Surveyed By: D.R. Beuchelt

SECTION A: GENERAL

This survey area extends from Reference Point 9 at Great Point to Reference Point 10 at the end of State Route 739 (extended at a right angle from Route 649), including the Potomac River shoreline between these two points, Cod Creek, Presley Creek, Corbin Pond, Hull Creek (Spring Cove, Fleets Cove, Fountain Cove, Floyds Cove, Bridgeman Creek, and Rogers Creek), Cubitt Creek, Lowes Pond, Condit Pond, Black Pond, Hack Creek, Flag Pond, and all of their tributaries. The survey boundary has been revised. See map for current survey boundary.

The topography of the area surveyed begins with an elevation of 5` along the shoreline and increases to 100` with a maximum of 108` in places at the outer edge of the survey boundary. The area within the boundary drawn by the Division of Shellfish Sanitation is supplied with numerous first and second order streams (rivulets) that feed into the small tributaries of the Potomac River.

Development on the Coan River to Ginny Beach area is progressing at a steady rate. There are several areas of heavy concentration and new subdivisions under development. Developments include: Pine Point Estates, Bay Quarter Shores, Potomac Bay Estates, Sands on the Potomac, Pleasant Point, Hull Harbor, Oyster Cove, Chesapeake Cove, White Sand Harbour, Lower Bayview, Upper Bayview, Harbour Pointe, Lighthouse Harbour, and Northumberland Plantation. At the time of the survey it was found that new areas have been surveyed into building lots and will be under development in the near future. Some homeowners in these developments have purchased secondary sewage systems and small lots to accommodate remote absorption fields for their residential property. When possible, copies are obtained of the remote absorption fields and are filed with the Shoreline survey report in the Richmond office.

According to the Virginia Employment Commission (via VELMA) during 2005 there were 3237 employees located in Northumberland County showing the largest major industry sector as manufacturing with 23 percent of the employment, followed by construction with 13 percent and retail trade, also at 13 percent. The total civilian labor force in

Northumberland County for February 2006 was 6,031 of which 5,681 were employed and 350 were unemployed giving the county an unemployment rate of 5.8 percent.

The 2004 population of Northumberland County was estimated at 12,893. This represents a 14.1 percent increase from 1994.

Meteorological data indicated that 2.65"of precipitation fell during the survey period, with March setting the lowest record in 109 years. A monthly breakdown follows:

January 23-31, 2006	0.68"
February	1.15"
March	0.45"
April 1-5	0.37"
Total	2.65"

There were no Sewage Treatment Facilities found in the survey. Found were 14 on-site deficiencies, 27 properties marked as potential deficiencies, 1 industrial site, 1 solid waste site, 23 boating activity sites, and 3 sites marked for animal pollution. Two campgrounds were found, both which accommodated persons visiting the Bay Quarter Shores and the White Sand Harbour sub-divisions.

It is important to note that this area has grown by 300 properties since the 1998 survey. Some properties are vacation/summer properties. Private docks accompany many of the properties.

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 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 DEFICIENCIES

1. ***DIRECT*** – CONTRIBUTES POLLUTION – Location: 315 Potomac Shore Drive, Heathsville 22473. Dwelling – 1 story white cinderblock with light green shingles. No Contact. Found was an outside shower, soiled clothes and soap. Located < 50` from the watershed sloped with an elevation of 5`. Sanitary Notice issued 1/23/06 to Field #10. Tax Map # 11-A(1)-17.

7. CONTRIBUTES POLLUTION – Location: 183 Floral Drive, Heathsville 22473. Dwelling – 1 story dome shaped metal building. No Contact. House sewer pipe (PVC) is cracked with part of the sewer pipe missing. Sanitary notice issued 1/27/06 to Field # 114. Tax Map # 11-(1)-29P.

8. ***DIRECT*** – CONTRIBUTES POLLUTION – Location: 101 Circle Dr. Heathsville 22473. Dwelling – 1 story log cabin. No Contact. Found was an outside shower which is located < 30` from, and drains directly into, Cod Creek. Shower is equipped with hot and cold water faucets. Sanitary notice issued 1/30/06 to Field # 155. Tax Map # 11-B(1)-95.

20. CONTRIBUTES POLLUTION – Location: 194 Coral Drive, Heathsville 22473. Dwelling – white mobile home with black shutters and light gray shingles. No Contact. Found on 2/9/06 was a home-made apparatus which was pumping effluent from the absorption field into the woods onto ground surface. A call was placed immediately to Elizabeth Anderson, Environmental Health Specialist for Northumberland County Health Department. Mrs. Anderson visited the property, taking pictures, during the survey. A Sanitary Notice was issued 2/9/06 to Field # 331 by mail to the owner of the property. Later the same day, Mrs. Anderson made contact with the tenant at this property. The homemade apparatus was not found on 2/10/06. Tax Map # 11-B(15)-38.

22. CONTRIBUTES POLLUTION – Location: 147 Elmington Place, Heathsville 22473. Dwelling – Older mobile home, beige with an addition. No Contact. Effluent from septic system/grease trap is pooling onto ground surface from a broken concrete lid. Area is covered with plywood. Sanitary Notice issued 2/9/06 to Field # 339. Tax Map # 11-B(15)-52.

27. ***DIRECT*** – CONTRIBUTES POLLUTION – Location: 31 Fountain Gate Rd., Heathsville 22473. Dwelling – 1 ½ story white with black shingles and black shutters. Property is fenced. No Contact. Found was a white PVC pipe which discharges into a ditch (located on Route 636 and emptying into Hull Creek via a ravine). Discharge appears sudsy. Algae growth present in ditch. (Since the survey visit, while on a seawater collection run in the area, this discharge has also been observed by C. J. Vanlandingham, Field Director of the White Stone office.) Sanitary Notice issued 2/17/06 to Field # 454. Tax Map # 18-(1)-7.

30. NO FACILITIES – Location: On Sandy Beach Road, Heathsville 22473. Dwelling – white Prowler camper. No Contact with owner, but on-site during survey was Mr. Dunn (AOSE) taking soil samples and preparing a site for a septic system. Waste disposal is unknown. Available was an out side, solar-heated shower and other items indicating frequent use of the site. Sanitary Notice issued 2/21/06 to Field # 496. Tax Map # appears as 18-(1)-109-C.

38. CONTRIBUTES POLLUTION (Kitchen or Laundry Wastes) – Location: On Oyster Way (Route 1060), Heathsville 22473. Dwelling – Old Camino travel trailer, beige with orange and brown stripes. No Contact. Wastewater from the gray holding tank has been discharged onto ground surface. (Note: This was also been observed by Rosalie Coultrip, EHS for Northumberland County Health Dept.).

NO FACILITIES – waste disposal of the black tank is unknown. A Sanitary Notice was issued on 3/6/06 to Field # 677. Discovered was the fact that the property had sold two months before. A Notice was then reissued to the new property owner and a letter of apology was sent to the former owner. Tax Map # 26-B(1)-61.

48. ***DIRECT*** – CONTRIBUTES POLLUTION – Location: On Rogers Creek, Heathsville 22473. Dwelling – 2 story, white asbestos shingles with green roof shingles. No Contact. Concrete lids on tanks are cracked. Open area between tanks exposes clay sewer tile pipe. Located within 100` of Rogers Creek at approximately 10` elevation and sloping to 5`. Sanitary Notice issued 3/10/06 to Field # 763. Tax Map # appears as 18-B(1)-9.

53. ***DIRECT*** – NO FACILITIES – Location: On Shadetree Lane, Heathsville 22473. Dwelling - A series of attached sheds made to accommodate living quarters-beige in color. No Contact. Waste disposal unknown. Sheds are located within 100` of Cubitt Creek and are parallel to the property line and ≤ 4` from a drainage ditch which runs to the watershed. Sanitary Notice issued 3/20/06 to Field # 891. Tax Map # 19-A(3)-241.

59. ***DIRECT*** – NO FACILITIES – Location: On Wildlife Drive, Heathsville 22473 – Intruder camper, beige with green stripes. No Contact. Waste disposal unknown. Camper is located at 10 – 20` elevation and is down slope ≤ 60` from the watershed. Sanitary Notice issued 3/29/06 to Field # 1048. Tax Map # 20-(6)-6.

61. ***DIRECT*** – NO FACILITIES – Location: End of Route 643 on Vir Mar Beach Road, Heathsville 22473.. No Dwelling. No Contact. Public Landing for use by citizens of Northumberland County. A sign is posted by the county stating that there are no public facilities for use at this location. This location will be under surveillance. Tax Map # 20-(1)-30.

62. ***DIRECT*** – NO FACILITIES – Location: 316 Flag Pond Lane, Heathsville 22473. Dwelling – older travel trailer, white with blue trim. No Contact. Waste disposal is not known, however, a PVC pipe runs along the ground surface in close proximity to the travel trailer's waster release valve and , 50` from marsh grass of Flag Pond. Sanitary Notice issued 3/30/06 to Field # 1078. Tax Map # 20-B1(1)-23.

67. ***DIRECT*** – CONTRIBUTES POLLUTION – Location: 446 Devils Woodyard Rd., Heathsville 22473. Dwelling – 1 ½ story white asbestos shingles with green roof shingles and green trim. No Contact. Area over septic system and absorption field lines show signs of malfunction. Area is ≤ 100` at approximate 10` elevation from watershed. Sanitary Notice issued 4/4/06 to Field # 1158. Tax Map # 21-A(2)-4.

POTENTIAL POLLUTION

3. Location: 227 Potomac Shore Dr., Heathsville 22473. Dwelling – 1 story green siding. No Contact. A black 1 to 1 ½ inch pipe (hose) is running onto beach. Origin is unknown. Sanitary Notice issued 1/24/06 to Field # 27. Tax Map # 11-A(1)-51.

9. Location: 120 Camp Rd., Heathsville 22473. Dwelling – Prowler travel Trailer, Cream colored with blue, brown and red stripes. No Contact. Sewer hose is disconnected from the waste discharge valve. The valve is uncapped. Sanitary Notice issued 1/31/06 to Field # 171. Located on Lot 20 at Bay Quarters Shores Campground.

10. Location: 120 Camp Rd., Heathsville 22473. Dwelling –Old Travel Trailer, repainted white with black and gold stripes. No Contact. Unapproved waste disposal valve cap. Sanitary Notice issued 1/31/06 to Field # 175. Located on Lot 32 at Bay Quarters Shores Campground.

11. Location: 120 Camp Rd., Heathsville 22473. Dwelling – Wilderness Travel Trailer, cream with orange strip. No Contact. Waste disposal valve cap is missing. Sanitary Notice issued 1/31/06 to Field # 177. Located on Lot 37 at Bay Quarters Shores Campground.

12. Location: 120 Camp Rd., Heathsville 22473. Dwelling – Old Holiday Travel Trailer, white. No Contact. Waste disposal valve cap is missing. Sanitary Notice issued 1/31/06 to Field # 183. Located on Lot 13 at Bay Quarter Shores Campground.

14. Location: 568 Bay Quarter Drive, Heathsville 22473. Dwelling – 1 story gray shingle siding with gray roof shingles and white trim. No Contact. It appears a black hose may be used to drain off storm water. No sign of discharge at time of survey.

15. Location: 544 Bay Quarter Drive, Heathsville 22473. Dwelling – 1 story beige with red shutters and brown shingles. No Contact. It appears the 2-inch pipes are used to drain storm water from under the house. No sign of discharge at time of survey.

16. Location: 416 Bay Quarter Drive, Heathsville 22473. Dwelling – 2 story gray with medium gray shutters and gray shingles. No Contact. A black pipe extends from foundation of house. Part of the pipe is buried underground. No sign of discharge at time of survey.

17. Location: 260 Bay Quarter Drive, Heathsville 22473. Dwelling – 2 car garage (with apartment over head), gray siding, and gray shingles. No Contact. Concrete lid, 24-inch in diameter, cracked. Unsure of origin, but it does no appear to be part of the septic system.

18. Location: 154 Florida Dr. Heathsville 22473. Dwelling – 1 story gray with red shutters and gray shingles. No Contact. Area over absorption field has dark grass. No evidence of effluent pooling or odor.

19. Location: On Route 1408, Hampton Place, Heathsville 22473. Dwelling - small, 1 car garage, (house has been removed). No Contact. 4 inch PVC house sewer pipe is not capped off. Sanitary Notice issued 2/9/06 to Field # 327. Tax Map # 11-B(15)-30.

21. Location: 98 Coral Drive, Heathsville 22473. Dwelling – 1 story light gray siding with blue shutters and black shingles. No Contact. Rainwater is pooling on ground surface over drain field. No sign of malfunction of septic system.

23. Location: 104 Elmington Place, Heathsville 22473. Dwelling – mobile home with dark brown trim and green shutters. No Contact. Waste disposal valve cap is missing. Sanitary Notice issued 2/10/06 to Field # 350. Tax Map # 11-B(15)-77.

25. Location: Lot 1 in Potomac Bay Estates on Newman's Neck Road, Heathsville 22473. Dwelling – 1 ½ gray siding with black shingles and white trim and unattached 3-car garage with apartment overhead. No Contact. Casing on riser for septic system is broken. Sanitary Notice issued 2/16/06 to Field # 446. Tax Map # 12-A(1)-1.

28. Location: 162 Spinmaker Lane, Heathsville 22473. Dwelling – 1 ½ story gray with white trim and black shingles. 2 persons. Area over absorption field has dark grass. No sign of malfunction.

35. Location: 988 Newman Neck, Heathsville 22473. Dwelling – 1 story white asbestos siding/cinder block siding with black trim and light gray shingles. No Contact. Property is overgrown and covered with junk, etc.

39. Location: 2347 Hull Neck Rd., Heathsville 22473. Dwelling – 1 story white vinyl siding and black shingles. No Contact. Property is covered with trash, old cars and other junk.

40. Location: 2423 Hull Neck Rd., Heathsville 22473. Dwelling – 1 story white asbestos shingles with black trim. No Contact. 1-inch PVC pipe to ground surface. No discharge found. Origin unknown.

49. Location: 4228 Hull Neck Rd., Heathsville 22473. Dwelling – 1 story yellow siding with white trim and red shutters. No Contact. Grass is tall and dark over drain field. No signs of malfunction.

51. Location: 1914 Hull Neck Rd., Heathsville 22473. Dwelling – 1 story beige vinyl siding with brown shutters and light brown shingles. 1 person. Property was covered with bags of trash, old junk and debris.

55. Location: 324 Fleet Rd., Heathsville 22473. Dwelling – 2 story, barn-type house with light brown siding, brown shingles and white trim. No Contact. Area over absorption field has tall dark grass. No sign of malfunction.

57. Location: 192 Blue Heron Dr., Heathsville 22473. Dwelling – 1 ½ story green and stone siding with grayish-brown shingles. No Contact. Area over absorption field has tall dark grass. No signs of malfunction.

58. Location: 340 Lighthouse Lane, Heathsville 22473. Dwelling – 1 ½ tan vinyl siding with brown shingles, green shutters with attached garage. 2 persons. Area around septic system has tall grass. No signs of malfunction.

63. Location: 163 Riley Lane, Heathsville 22473. Dwelling – 1 story yellow siding with green shutters and gray shingles. No Contact. Small, green access cover on system is broken and needs to be replaced. Sanitary Notice issued 3/31/06 to Field # 1098. Tax Map # 2-B1(1)1-49.

65. Location: 1148 Brammer Dr, Heathsville 22473. Dwelling – 2 story brick with white shutters and multi-colored shingles. No Contact. Concrete lid is cracked and needs to be replaced. No signs of malfunction. Sanitary Notice issued on 3/31/06 to Field # 1110. Tax Map # 20-B1(1)1-1.

66. Location: 646 Devils Woodyard Rd., Heathsville 22473. Dwelling – 1 story pink with brown shingles and light green shutters. No Contact. Area over absorption field has slightly settled. Grass is darker over the lines. No signs of malfunction.

68. Location: 219 Driftwood Trail, Heathsville 22473. Dwelling – 1 ½ story yellow asbestos siding with gray shingled roof and white trim. No Contact. 2 inch PVC pipe extends from the foundation of the house. No discharge at time of survey. Origin of pipe unknown. Sanitary Notice issued 4/4/06 to Field # 1191. Tax Map # 29-(1)-173.

SECTION C: NON-SEWAGE WASTE SITES

INDUSTRIAL WASTES

46. *DIRECT* - Location: On Hull Neck Rd., Heathsville 22473. Dwelling – boat house, ramp, dock. Facility No. 153. No Contact. One 500-gallon fuel tank < 15` from watershed.

SOLID WASTE DUMPSITES

36. Location: 844 Newmans Neck Rd., Heathsville 22473. Property is posted as No Trespassing/Private Property. No Contact. Unable to access or estimate total acreage. Property is an open dump site used to discard municipal solid waste, bulky waste, organic wastes, yard wastes, construction and demolition debris. This site does not appear to be a controlled dump or secured landfill. The access road is chained and gives the impression to be a private dumping site. Contact was made with the Northumberland County Administrator's Office to obtain additional information. A return call has not been received as of this report.

SECTION D: BOATING ACTIVITY

MARINAS

- None -

OTHER PLACES WHERE BOATS ARE MOORED

2. Location: On Potomac Shore Drive, Heathsville 22473. Owners: Pine Point Civic Association. Community ramp and pier. No Contact. Services available are 16 slips and an in-out ramp. Facility No. 796.

4. Location: 2289 Clarketown Rd., Heathsville 22473. Owner: Francis Haynie. Private ramp and pier. No Contact. Service available is an in-out ramp. Facility No. 765.

13. Location: 1004 Bay Quarter Dr., Heathsville 22473. Owners: Bay Quarter Shores Association. Contact made with Mr. Frank Stewart, Vice President Services available are Clubhouse with restroom facilities, pool, picnic area, beach, in-out ramp, electricity, and solid waste containers. Facility No.1509.

41. Location: On Candy Point Rd. Owners: Robert and Mary O'Neill. Private docking facility. No Contact. Services available are 7 slips, water and electricity. Facility No. 1151.

45. Location: On Hull Neck Rd., Heathsville 22473. Owner: Roxanne Quilter. No Contact. Services available are 4 slips, water and electricity. Facility No. 1154.

46. Location: On Hull Neck Rd., Heathsville 22473. Owner: A. Davis Bugg. Private docking facility. No Contact. Services available are 5 slips, fuel, in-out ramp, water and electricity. Facility No. 1153.

UNDER SURVEILLANCE

6. Location: On Clarke Lane, Heathsville 22473. Owner unknown. No Contact. Private Dock for landowners.

24. Location: On Potomac Dr., Heathsville 22473. Owners: Potomac Bay Estates, Ray Michelini, President. No Contact. Services available are 2 slips, in-out ramp and pier. Facility No. 799.

29. Location: Lot 66 on Spinnaker Lane, Heathsville 22473. Owners: Sands on the Potomac Homeowners Association. No Contact. Services available are dock, in-out ramp, solid waste cans and commons area.

31. Location: On Fountain Gate Rd., Heathsville 22473. Owners: Pleasant Pointe Property Owners. No Contact. Services available are one slip, a dock and in-out ramp. Facility No. 797.

32. Location: On Fountain Lane, Heathsville 22473. Owner: OJN, Corp. No Contact. Services available are 2 slips, dock and an in-out ramp. Facility No. 759.

33. Location: On Curve Way, Heathsville 22473. Community ramp. No Contact. Service available is an in-out ramp.

34. Location: On Boatramp Rd., Heathsville 22473. Owners: Hull Harbour Homeowners Association. No Contact. Services available are 2 slips and an in-out ramp. Facility No. 767.

37. Location: On Greenway Place, Heathsville 22473. Owners: Oyster Cove Property Owners Association. Contact made with David Griffith, President. Services available are a dock and an in-out ramp, and solid waste containers. Facility No. 795.

42. Location: On Candy Point Rd., Heathsville 22473. Owner unknown. No Contact. Private boat landing with dirt in-out ramp.

43. Location: On Hull Neck Rd., Heathsville 22473. Owner unknown. No Contact. Private Dock. County records show property as Tax Map # 18-(1)-13 and owner as Anne Huske. Dock appears unusable. Facility No. 1152.

44. Location: On Hull Neck Rd., Heathsville 22473. Owner: Dave Tambellini. No Contact. Private Dock. Services available are a dock and electricity. Facility No. 1155.

47. Location: 4481 Hull Neck Rd., Heathsville 22473. Owner: Blanton Tate. No Contact. Private Docking Facility. Services available are dock, boathouse, with electric. Water may be supplied by a garden hose.

50. Location: On Potomac Way, Heathsville 22473. Owners: Chesapeake Cove Association Inc. Community Ramp.

54. Location: On Cubitt Creek Rd., Heathsville 22473. Owners: White Sand Harbour Property Owners Association. Contact with Mr. Estell Community Ramp and Dock. Facility No. 827.

56. Location: On Witchduck Lane, Heathsville 22473. Owners: Harbour Pointe Homeowners. No Contact. Community ramp and dock. Facility No. 763.

61. Location: End of Vir Mar Beach Rd., Heathsville 22473. Owner: Northumberland County. No Contact. Public landing / beach.

64. Location: End of Brammer Dr., Heathsville 22473. Owner: Chesapeake Bay Properties, Inc. Contact with Mr. Mitchell Bradley, President. Community dock and ramp.

SECTION E: CONTRIBUTES ANIMAL POLLUTION

4. Location: 61 Clarke Lane, Heathsville 22473. Dwelling – 2 story white siding with black shutters and black metal roof. No Contact. Present at time of survey were 5 goats and 10 15 chickens. Waste disposal is unknown.

26. Location: 4062 Newmans Neck Rd., Heathsville 22473. Dwelling – 1 story gray siding, gray shutters with black shingles. No Contact. Property is fenced. Observed were eight dogs within the fenced area. Waste disposal is unknown.

52. ***DIRECT*** – Location: 177 Mob Neck Rd., Heathsville 22473. Dwelling – green and white mobile home. 2 persons. Four dogs in kennel which is located < 100` at an elevation of 20` dropping to an elevation of 5` on Cubitt Creek. Waste disposal is unknown.

60. Location: 59 Vir Mar Beach Rd., Heathsville 22473. Dwelling – 1 ½ story white siding with metal roof. No Contact. Hack Neck Hunt Club. Present at time of survey were 15 hunting dogs (20 kennels available). Waste disposal is unknown, but kennels and area appears well maintained.

SUMMARY

Area # 009
POTOMAC RIVER: COAN RIVER TO GINNY BEACH
12 April 2006

SECTION B: SEWAGE POLLUTION SOURCES

1. SEWAGE TREATMENT FACILITIES

0 – DIRECT – None
0 – NDIRECT – None
0 – B.1. TOTAL

2. ON-SITE SEWAGE DEFICIENCIES – Correction of deficiencies in this section is the responsibility of the local health department.

5 – CONTRIBUTES POLLUTION DIRECT – # 1, 8, 27, 48, 67
3 – CONTRIBUTES POLLUTION INDIRECT – # 7, 20, 22
0 – CP– (Kitchen or Laundry Wastes), DIRECT – None
1 – CP – (Kitchen or Laundry Wastes), INDIRECT – # 38
4 – NO FACILITIES, DIRECT – # 53, 59, 61, 62
2 – NO FACILITIES, INDIRECT – # 30, 38
15 – B.2. TOTAL

3. POTENTIAL POLLUTION

Periodic surveillance of these properties will be maintained to determine any status change.

27 – POTENTIAL POLLUTION – # 3, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 21, 23, 25, 28, 35, 39, 40, 49, 51, 55, 57, 58, 63, 65, 66, 68

SECTION C: NON-SEWAGE WASTE SITES

1. INDUSTRIAL WASTE SITES

1 – DIRECT – # 46
0 – INDIRECT - None
1 – C.1. TOTAL

2. SOLID WASTE SITES

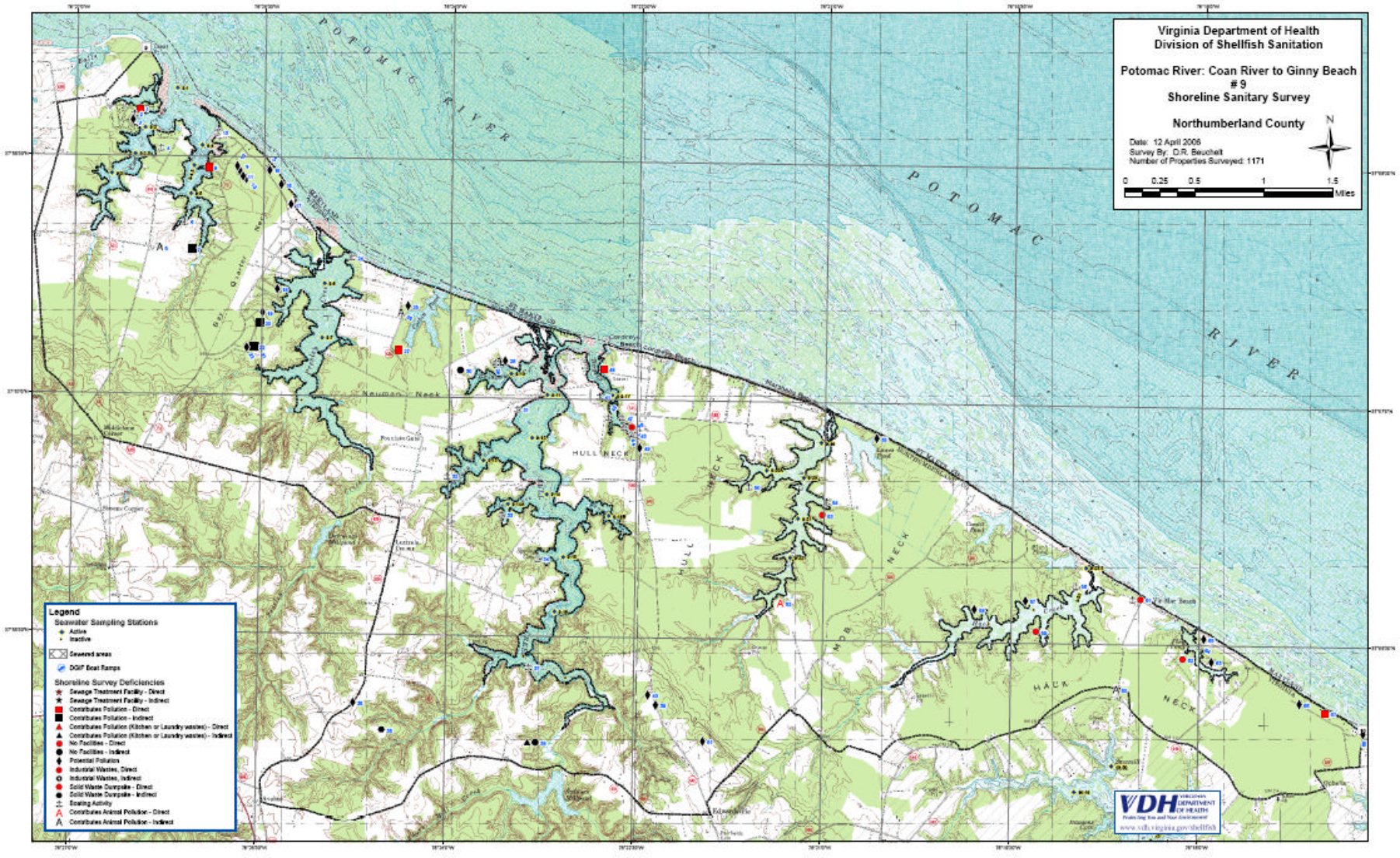
0 – DIRECT – None
1 – NDIRECT – # 36
1 – C.2. TOTAL

SECTION D: BOATING ACTIVITY

0 – MARINAS – None
6 – OTHER PLACES WHERE BOATS ARE MOORED - # 2, 4, 13, 41, 45, 46
17 – UNDER SURVEILLANCE – # 6, 24, 29, 31, 32, 33, 34, 37, 42, 43, 44, 47, 50, 54, 56, 61, 64
23 – D. TOTAL

SECTION E: CONTRIBUTES ANIMAL POLLUTION

1 – DIRECT – # 52
3 – INDIRECT – # 5, 26, 60
4 – E. TOTAL


Virginia Department of Health
Division of Shellfish Sanitation
Potomac River: Coan River to Ginny Beach
9
Shoreline Sanitary Survey
Northumberland County
Date: 12 April 2006
Survey By: D.R. Beuchelt
Number of Properties Surveyed: 1171
0 0.25 0.5 1 1.5
Miles
N
POTOMAC RIVER
Neuman Neck
HULL NECK
HACK NECK
Legend
Seawater Sampling Stations
Active
Inactive
Seaweed areas
DGIF Boat Ramps
Shoreline Survey Deficiencies
Sewage Treatment Facility - Direct
Sewage Treatment Facility - Indirect
Contributes Pollution - Direct
Contributes Pollution - 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
VDH

Appendix B. Supporting Documentation and Watershed Assessment

1) Fecal Production Literature Review

Table B.1 Summary of fecal production literature review.

	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).

2) Geographic Information System Sources and Process

Table B.2 GIS data elements and sources.

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	2001
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	Potomac River 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	2000
	American Veterinary Association	2002
Domestic livestock	National Agricultural Statistics Service, USDA	1997/2001
Wildlife	Virginia Department of Game and Inland Fisheries	2004
	US Fish and Wildlife Service	2004
Septic tanks (from human population)	Division of Shellfish Sanitation, VA Department of Health	Various dates
	US Census Bureau	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

Watershed boundary determined by VDH, DSS. There are 105 watersheds in Virginia.

Subwatershed boundaries were delineated based on elevation, using digital 7.5 minute USGS topographic maps. There are 1836 subwatersheds.

The original land use has 15 categories that were combined into 3 categories:

1. urban (high and low density residential and commercial);
2. undeveloped (forest and wetlands); and
3. 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 DEQ and digital data layer was generated by CCRM. Design flow, measured flow, and fecal coliform discharges were obtained from DEQ.

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

Dog numbers were obtained using the database generated by CCRM. The number of issued dog licenses were supplied by the Treasuries office of Northumberland County. The number of issued licenses was compared to the calculated estimate values based on watershed.

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.

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.

Segment volume was determined from current field bathymetry data.

The 1998 303d 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.

3) Population Numbers

The process used to generate population numbers used for the nonpoint source contribution analysis 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, 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:

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:

Deer—

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

#deer/mi2 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/mi2 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.

Ducks and Geese—

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 south side 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 there is not 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 600ft 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.

4) 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 above.

Table B.3 Nonpoint source load distribution in GA009 by condemned area using watershed model.

Condemnation Area	Livestock	Wildlife	Human	Pet
141 Cod Creek (West)	**30%**	**11%**	**33%**	**25%**
141 Cod Creek (East)	**30%**	**36%**	**11%**	**23%**
141 Presley Creek	**13%**	**34%**	**26%**	**27%**
142 Bridgeman Creek	**46%**	**19%**	**13%**	**22%**
142 Hull Creek	**27%**	**31%**	**21%**	**21%**
142 Rogers Creek	**10%**	**39%**	**18%**	**33%**
161 Cubitt Creek	**15%**	**17%**	**16%**	**52%**

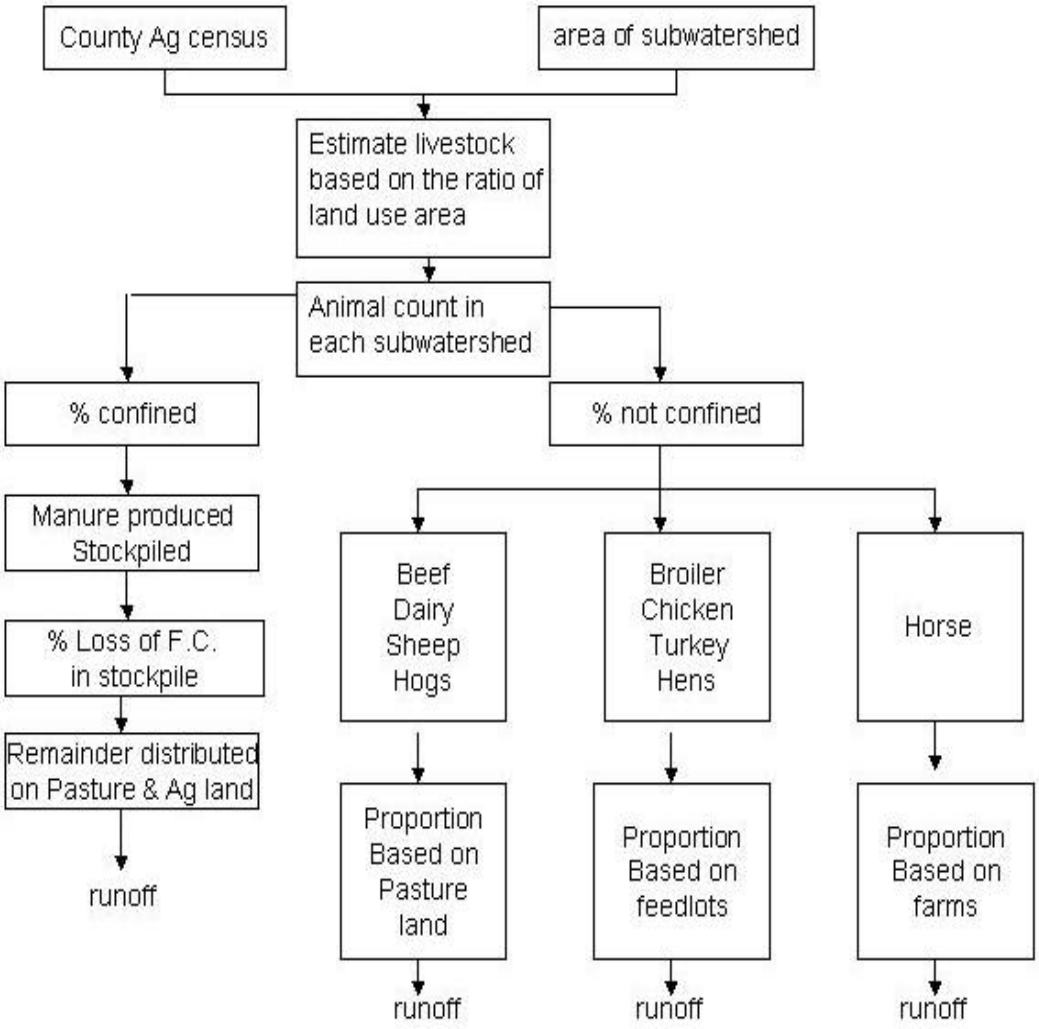


Figure B.1 Diagram to illustrate procedure used to estimate fecal coliform production from estimated livestock production.

Appendix C. Water Quality Data

Table C.1 Observed geometric mean and 90th percentile by condemned area and station for GA009.

Condemned Area	DSS Station Number	Geometric Means		90th Percentiles		Most Recent	
		Mean	Standard Deviation	Mean	Standard Deviation	Geometric Mean	90th Percentile
Cod Creek - West	9-2	9.6	1.8	51.2	13.8	9.2	55.5
	9-2.5	N/A	N/A	N/A	N/A	N/A	N/A
	9-3	17.8	6.4	106.8	45.4	17.0	98.5
Cod Creek - East	9-4	8.6	2.2	47.3	21.2	6.5	32.7
	9-4.5	N/A	N/A	N/A	N/A	N/A	N/A
	9-5	16.1	5.0	114.9	50.6	14.4	115.0
Presley Creek	9-6	18.5	2.8	110.3	32.7	11.8	67.9
	9-7	25.2	5.3	152.6	33.7	13.4	113.7
Bridgeman Creek	9-10	13.4	5.2	79.3	43.9	10.0	76.0
Hull Creek	9-11	8.4	1.8	39.8	13.3	5.8	35.1
	9-12	9.8	2.1	50.4	19.0	8.0	44.2
	9-13	13.4	4.1	77.5	35.2	14.6	126.9
	9-14	11.3	2.5	59.3	31.6	7.9	45.2
	9-14A	24.2	4.8	140.1	40.7	16.6	92.9
	9-14B	35.2	8.3	227.5	46.0	24.6	160.4
	9-15	15.4	4.0	84.8	39.0	17.8	83.2
	9-16	23.0	6.6	156.6	70.0	19.6	104.1
Rogers Creek	9-9-1Y	17.4	4.9	102.8	35.7	19.5	100.2
Cubitt Creek	9-19	17.6	4.1	118.5	45.1	19.4	175.7
	9-20	18.2	4.2	119.7	46.3	22.4	167.9
	9-20A	24.2	6.2	145.9	61.0	18.2	100.4
	9-21	17.3	3.9	99.3	34.7	19.8	104.8
Hack Creek	9-23	14.7	1.7	80.0	10.7	14.1	89.1
	9-23.5	9.6	0.2	52.9	2.0	9.6	53.2

* All figures have units CFU / 100 mL; N/A = insufficient samples to evaluate parameter

Appendix D. Applicable State and Federal Regulations

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

§62.1-194.1. Obstructing or contaminating state waters.

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.)

2) 33 CFR Volume 2, Parts 120 to 199, Revised as of July 1, 2000

NAVIGABLE WATERS

CHAPTER I--COAST GUARD, DEPARTMENT OF TRANSPORTATION (CONTINUED)

PART 159--MARINE SANITATION DEVICES

Subpart A--General

Sec.
159.1 Purpose.
159.3 Definitions.
159.4 Incorporation by reference.
159.5 Requirements for vessel manufacturers.
159.7 Requirements for vessel operators.

Subpart B--Certification Procedures

159.11 Purpose.
159.12 Regulations for certification of existing devices.
159.12a Certification of certain Type III devices.
159.14 Application for certification.
159.15 Certification.
159.16 Authorization to label devices.
159.17 Changes to certified devices.
159.19 Testing equivalency.

Subpart C--Design, Construction, and Testing

Subpart D--Recognition of Facilities

Authority: Sec. 312(b)(1), 86 Stat. 871 (33 U.S.C. 1322(b)(1)); 49 CFR 1.45(b) and 1.46(l) and (m).

Source: CGD 73-83, 40 FR 4624, Jan. 30, 1975, unless otherwise noted.

Subpart A--General

Sec. 159.1 Purpose.

This part prescribes regulations governing the design and construction of marine sanitation devices and procedures for certifying that marine sanitation devices meet the regulations and the standards of the Environmental Protection Agency promulgated under section 312 of the Federal Water Pollution Control Act (33 U.S.C. 1322), to eliminate the discharge of untreated sewage from vessels into the waters of the United States,

including the territorial seas. Subpart A of this part contains regulations governing the manufacture and operation of vessels equipped with marine sanitation devices.

Sec. 159.3 Definitions.

In this part:
Coast Guard means the Commandant or his authorized representative.
Discharge includes, but is not limited to, any spilling, leaking, pouring, pumping, emitting, emptying, or dumping.
Existing vessel includes any vessel, the construction of which was initiated before January 30, 1975.
Fecal coliform bacteria are those organisms associated with the intestine of warm-blooded animals that are commonly used to indicate the presence of fecal material and the potential presence of organisms capable of causing human disease.
Inspected vessel means any vessel that is required to be inspected under 46 CFR Ch. I.
Length means a straight line measurement of the overall length from the foremost part of the vessel to the aftermost part of the vessel, measured parallel to the centerline. Bow sprits, bumpkins, rudders, outboard motor brackets, and similar fittings or attachments are not to be included in the measurement.
Manufacturer means any person engaged in manufacturing, assembling, or importing of marine sanitation devices or of vessels subject to the standards and regulations promulgated under section 312 of the Federal Water Pollution Control Act.
Marine sanitation device and device includes any equipment for installation on board a vessel which is designed to receive, retain, treat, or discharge sewage, and any process to treat such sewage.
New vessel includes any vessel, the construction of which is initiated on or after January 30, 1975.
Person means an individual, partnership, firm, corporation, or association, but does not include an individual on board a public vessel.
Public vessel means a vessel owned or bare-boat chartered and operated by the United States, by a State or political subdivision thereof, or by a foreign nation, except when such vessel is engaged in commerce.
Recognized facility means any laboratory or facility listed by the Coast Guard as a recognized facility under this part.
Sewage means human body wastes and the wastes from toilets and other receptacles intended to receive or retain body waste.
Territorial seas means the belt of the seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters, and extending seaward a distance of 3 miles.
Type I marine sanitation device means a device that, under the test conditions described in Secs. 159.123 and 159.125, produces an effluent having a fecal coliform bacteria count not greater than 1,000 per 100 milliliters and no visible floating solids.
Type II marine sanitation device means a device that, under the test conditions described in Secs. 159.126 and 159.126a, produces an effluent having a fecal coliform bacteria count not greater than 200 per 100 milliliters and suspended solids not greater than 150 milligrams per liter.
Type III marine sanitation device means a device that is designed to prevent the overboard discharge of treated or untreated sewage or any waste derived from sewage.
Uninspected vessel means any vessel that is not required to be inspected under 46 CFR Chapter I.
United States includes the States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Canal Zone, and the Trust Territory of the Pacific Islands.
Vessel includes every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on the waters of the United States.

[CGD 96-026, 61 FR 33668, June 28, 1996, as amended by CGD 95-028, 62 FR 51194, Sept. 30, 1997]

Sec. 159.4 Incorporation by reference.

(a) Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in paragraph (b) of this section, the Coast Guard must publish notice of change in the Federal Register; and the material must be available to the public.

All approved material is available for inspection at the Office of the Federal Register, 800 North Capitol Street, NW., suite 700, Washington, DC, and at the U.S. Coast Guard Office of Design and Engineering Standards (G-MSE), 2100 Second Street SW., Washington, DC 20593-0001, and is available from the sources indicated in paragraph (b) of this section.

(b) The material approved for incorporation by reference in this part, and the sections affected, are as follows:

American Society for Testing and Materials (ASTM)
100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 11-95, Standard Specification for Wire Cloth and Sieves for Testing Purposes--159.125

[USCG-1999-5151, 64 FR 67176, Dec. 1, 1999]

Sec. 159.5 Requirements for vessel manufacturers.

No manufacturer may manufacture for sale, sell, offer for sale, or distribute for sale or resale any vessel equipped with installed toilet facilities unless it is equipped with:

(a) An operable Type II or III device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12 or Sec. 159.12a; or

(b) An operable Type I device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12, if the vessel is 19.7 meters (65 feet) or less in length.

[CGD 95-028, 62 FR 51194, Sept. 30, 1997]

Sec. 159.7 Requirements for vessel operators.

(a) No person may operate any vessel equipped with installed toilet facilities unless it is equipped with:

(1) An operable Type II or III device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12 or Sec. 159.12a; or

(2) An operable Type I device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12, if the vessel is 19.7 meters (65 feet) or less in length.

(b) When operating a vessel on a body of water where the discharge of treated or untreated sewage is prohibited by the Environmental Protection Agency under 40 CFR 140.3 or 140.4, the operator must secure each Type I or Type II device in a manner which prevents discharge of treated or untreated sewage. Acceptable methods of securing the device include--

(1) Closing the seacock and removing the handle;

(2) Padlocking the seacock in the closed position;

(3) Using a non-releasable wire-tie to hold the seacock in the closed position; or

(4) Locking the door to the space enclosing the toilets with a padlock or door handle key lock.

(c) When operating a vessel on a body of water where the discharge of untreated sewage is prohibited by the Environmental Protection Agency under 40 CFR 140.3, the operator must secure each Type III device in a manner which prevents discharge of sewage. Acceptable methods of securing the device include--

(1) Closing each valve leading to an overboard discharge and removing the handle;

(2) Padlocking each valve leading to an overboard discharge in the closed position; or

(3) Using a non-releasable wire-tie to hold each valve leading to an overboard discharge in the closed position.

[CGH 95-028, 62 FR 51194, Sept. 30, 1997]

Subpart B--Certification Procedures

Sec. 159.11 Purpose.

This subpart prescribes procedures for certification of marine sanitation devices and authorization for labels on certified devices.

Sec. 159.12 Regulations for certification of existing devices.

(a) The purpose of this section is to provide regulations for certification of existing devices until manufacturers can design and manufacture devices that comply with this part and recognized facilities are prepared to perform the testing required by this part.

(b) Any Type III device that was installed on an existing vessel before January 30, 1975, is considered certified.

(c) Any person may apply to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001 for certification of a marine sanitation device manufactured before January 30, 1976. The Coast Guard will issue a letter certifying the device if the applicant shows that the device meets Sec. 159.53 by:

(1) Evidence that the device meets State standards at least equal to the standards in Sec. 159.53, or

(2) Test conducted under this part by a recognized laboratory, or

(3) Evidence that the device is substantially equivalent to a device certified under this section, or

(4) A Coast Guard field test if considered necessary by the Coast Guard.

(d) The Coast Guard will maintain and make available a list that identifies each device certified under this section.

(e) Devices certified under this section in compliance with Sec. 159.53 need not meet the other regulations in this part and may not be labeled under Sec. 159.16.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976; CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

Sec. 159.12a Certification of certain Type III devices.

(a) The purpose of this section is to provide regulations for certification of certain Type III devices.

(b) Any Type III device is considered certified under this section if:

(1) It is used solely for the storage of sewage and flushwater at ambient air pressure and temperature; and

(2) It is in compliance with Sec. 159.53(c).

(c) Any device certified under this section need not comply with the other regulations in this part except as required in paragraphs (b)(2)and (d) of this section and may not be labeled under Sec. 159.16.

d) Each device certified under this section which is installed aboard an inspected vessel must comply with Sec. 159.97.

[CGD 76-145, 42 FR 11, Jan. 3, 1977]

Sec. 159.14 Application for certification.

(a) Any manufacturer may apply to any recognized facility for certification of a marine sanitation device. The application for certification must indicate whether the device will be used aboard all vessels or only aboard uninspected vessels and to which standard in Sec. 159.53 the manufacturer requests the device to be tested.

(b) An application may be in any format but must be in writing and must be signed by an authorized representative of the manufacturer and include or be accompanied by:

(1) A complete description of the manufacturer's production quality control and inspection methods, record keeping systems pertaining to the manufacture of marine sanitation devices, and testing procedures;

(2) The design for the device, including drawings, specifications and other information that describes the materials, construction and operation of the device;

(3) The installation, operation, and maintenance instructions for the device; and

(4) The name and address of the applicant and the manufacturing facility.

(c) The manufacturer must furnish the recognized facility one device of each model for which certification is requested and samples of each material from which the device is constructed, that must be tested destructively under Sec. 159.117. The device furnished is for the testing required by this part except that, for devices that are not suited for unit testing, the manufacturer may submit the design so that the recognized facility may determine the components of the device and
materials to be submitted for testing and the tests to be performed at a place other than the facility. The Coast Guard must review and accept all such determinations before testing is begun.

(d) At the time of submittal of an application to a recognized facility the manufacturer must notify the Coast Guard of the type and model of the device, the name of the recognized facility to which application is being

made, and the name and address of the manufacturer, and submit a signed statement of the times when the manufacturer will permit designated officers and employees of the Coast Guard to have access to the manufacturer's facilities and all records required by this part.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

Sec. 159.15 Certification.

(a) The recognized facility must evaluate the information that is submitted by the manufacturer in accordance with Sec. 159.14(b) (1), (2), and (3), evaluate the device for compliance with Secs. 159.53 through 159.95, test the device in accordance with Sec. 159.101 and submit to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C.
20593-0001 the following:

(1) The information that is required under Sec. 159.14(b);

(2) A report on compliance evaluation;

(3) A description of each test;

(4) Test results; and

(5) A statement, that is signed by the person in charge of testing, that the test results are accurate and complete.

(b) The Coast Guard certifies a test device, on the design of the device, if it determines, after consideration of the information that is required under paragraph (a) of this section, that the device meets the requirements in Subpart C of this part.

(c) The Coast Guard notifies the manufacturer and recognized facility of its determination under paragraph (b) of this section. If the device is certified, the Coast Guard includes a certification number for the device. If certification is denied, the Coast Guard notifies the manufacturer and recognized facility of the requirements of this part that are not met. The manufacturer may appeal a denial to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001.

(d) If upon re-examination of the test device, the Coast Guard determines that the device does not in fact comply with the requirements of Subpart C of this part, it may terminate the certification.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976; CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

Sec. 159.16 Authorization to label devices.

(a) When a test device is certified under Sec. 159.15(b), the Coast Guard will issue a letter that authorizes the manufacturer to label each device that he manufactures with the manufacturer's certification that the device is in all material
respects substantially the same as a test device certified by the U.S. Coast Guard pursuant to section 312 of the Federal Water Pollution Control Act Amendments of 1972.

(b) Certification placed on a device by its manufacturer under this section is the certification required by section 312(h)(4) of the Federal Water Pollution Control Act Amendments of 1972, which makes it unlawful for a vessel that is subject to the standards and regulations promulgated under the Act to operate on the navigable waters of the United States, if such vessel is not equipped with an operable marine sanitation device certified pursuant to section 312 of the Act.

(c) Letters of authorization issued under this section are valid for 5 years, unless sooner suspended, withdrawn, or terminated and may be reissued upon written request of the manufacturer to whom the letter was issued.

(d) The Coast Guard, in accordance with the procedure in 46 CFR 2.75, may suspend, withdraw, or terminate any letter of authorization issued under this section if the Coast Guard finds that the manufacturer is engaged in the manufacture of devices labeled under this part that are not in all material respects substantially the same as a test device certified pursuant to this part.

Sec. 159.17 Changes to certified devices.

(a) The manufacturer of a device that is certified under this part shall notify the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001 in writing of any change in the design of the device.

(b) A manufacturer shall include with a notice under paragraph (a) of this section a description of the change, its advantages, and the recommendation of the recognized facility as to whether the device remains in all material respects substantially the same as the original test device.

(c) After notice under paragraph (a) of this section, the Coast Guard notifies the manufacturer and the recognized facility in writing of any tests that must be made for certification of the device or for any change in the letter of authorization. The manufacturer may appeal this determination to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

Sec. 159.19 Testing equivalency.

(a) If a test required by this part may not be practicable or necessary, a manufacturer may apply to the Commandant (G-MSE), U.S. Coast Guard, Washington, DC 20593-0001 for deletion or approval of an alternative test as equivalent to the test requirements in this part. The application must include the manufacturer's justification for deletion or the alternative test and any alternative test data.

(b) The Coast Guard notifies the manufacturer of its determination under paragraph (a) of this section and that determination is final.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

Subpart C--Design, Construction, and Testing

Sec. 159.51 Purpose and scope.

(a) This subpart prescribes regulations governing the design and construction of marine sanitation devices.

(b) Unless otherwise authorized by the Coast Guard each device for which certification under this part is requested must meet the requirements of this subpart.

Sec. 159.53 General requirements.

A device must:

(a) Under the test conditions described in Secs. 159.123 and 159.125, produce an effluent having a fecal coliform bacteria count not greater than 1,000 per 100 milliliters and no visible floating solids (Type I),

(b) Under the test conditions described in Secs. 159.126 and 159.126a, produce an effluent having a fecal coliform bacteria count not greater than 200 per 100 milliliters and suspended solids not greater than 150 milligrams per liter (Type II), or

(c) Be designed to prevent the overboard discharge of treated or untreated sewage or any waste derived from sewage (Type III).

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

Sec. 159.55 Identification.

(a) Each production device must be legibly marked in accordance with paragraph (b) of this section with the following information:

(1) The name of the manufacturer.

(2) The name and model number of the device.

(3) The month and year of completion of manufacture.

(4) Serial number.

(5) Whether the device is certified for use on an inspected or an uninspected vessel.

(6) Whether the device is Type I, II, or III.

(b) The information required by paragraph (a) of this section must appear on a nameplate attached to the device or in lettering on the device. The nameplate or lettering stamped on the device must be capable of withstanding without loss of legibility the combined effects of normal wear and tear and exposure to water, salt spray, direct sunlight, heat, cold, and any substance listed in Sec. 159.117(b) and (c). The nameplate and

lettering must be designed to resist efforts to remove them from the device or efforts to alter the information stamped on the nameplate or the device without leaving some obvious evidence of the attempted removal or alteration.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

Sec. 159.57 Installation, operation, and maintenance instructions.

(a) The instructions supplied by the manufacturer must contain directions for each of the following:
(1) Installation of the device in a manner that will permit ready access to all parts of the device requiring routine service and that will provide any flue clearance necessary for fire safety.
(2) Safe operation and servicing of the device so that any discharge meets the applicable requirements of Sec. 159.53.
(3) Cleaning, winter layup, and ash or sludge removal.
(4) Installation of a vent or flue pipe.
(5) The type and quantity of chemicals that are required to operate the device, including instructions on the proper handling, storage and use of these chemicals.
(6) Recommended methods of making required plumbing and electrical connections including fuel connections and supply circuit overcurrent protection.
(b) The instructions supplied by the manufacturer must include the following information:
(1) The name of the manufacturer.
(2) The name and model number of the device.
(3) Whether the device is certified for use on an inspected, or uninspected vessel.
(4) A complete parts list.
(5) A schematic diagram showing the relative location of each part.
(6) A wiring diagram.
(7) A description of the service that may be performed by the user without coming into contact with sewage or chemicals.
(8) Average and peak capacity of the device for the flow rate, volume, or number of persons that the device is capable of serving and the period of time the device is rated to operate at peak capacity.
(9) The power requirements, including voltage and current.
(10) The type and quantity of fuel required.
(11) The duration of the operating cycle for unitized incinerating devices.
(12) The maximum angles of pitch and roll at which the device operates in accordance with the applicable requirements of Sec. 159.53.
(13) Whether the device is designed to operate in salt, fresh, or brackish water.
(14) The maximum hydrostatic pressure at which a pressurized sewage retention tank meets the requirements of Sec. 159.111.
(15) The maximum operating level of liquid retention components.
(16) Whether the device is Type I, II, or III.
(17) A statement as follows:
Note: The EPA standards state that in freshwater lakes, freshwater reservoirs or other freshwater impoundments whose inlets or outlets are such as to prevent the ingress or egress by vessel traffic subject to this regulation, or in rivers not
capable of navigation by interstate vessel traffic subject to this regulation, marine sanitation devices certified by the U.S. Coast Guard installed on all vessels shall be designed and operated to prevent the overboard discharge of sewage,
treated or untreated, or of any waste derived from sewage. The EPA standards further state that this shall not be construed to prohibit the carriage of Coast Guard-certified flow-through treatment devices which have been secured so as to prevent such discharges. They also state that waters where a Coast Guard-certified marine sanitation device permitting discharge is allowed include coastal waters and estuaries, the Great Lakes and interconnected waterways, freshwater lakes and impoundments accessible through locks, and other flowing waters that are navigable interstate by vessels subject to this regulation (40 CFR 140.3).

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

Sec. 159.59 Placard.

Each device must have a placard suitable for posting on which is printed the operating instructions, safety precautions, and warnings pertinent to the device. The size of the letters printed on the placard must be one-eighth of an inch or larger.

Sec. 159.61 Vents.

Vents must be designed and constructed to minimize clogging by either the contents of the tank or climatic conditions such as snow or ice.

Sec. 159.63 Access to parts.

Each part of the device that is required by the manufacturer's instructions to be serviced routinely must be readily accessible in the installed position of the device recommended by the manufacturer.

Sec. 159.65 Chemical level indicator.

The device must be equipped with one of the following:

(a) A means of indicating the amount in the device of any chemical that is necessary for its effective operation.

(b) A means of indicating when chemicals must be added for the proper continued operation of the device.

Sec. 159.67 Electrical component ratings.

Electrical components must have current and voltage ratings equal to or greater than the maximum load they may carry.

Sec. 159.69 Motor ratings.

Motors must be rated to operate at 50 deg.C ambient temperature.

Sec. 159.71 Electrical controls and conductors.

Electrical controls and conductors must be installed in accordance with good marine practice. Wire must be copper and must be stranded. Electrical controls and conductors must be protected from exposure to chemicals and sewage.

Sec. 159.73 Conductors.

Current carrying conductors must be electrically insulated from non-current carrying metal parts.

Sec. 159.75 Overcurrent protection.

Overcurrent protection must be provided within the unit to protect subcomponents of the device if the manufacturer's recommended supply circuit overcurrent protection is not adequate for these subcomponents.

Sec. 159.79 Terminals.

Terminals must be solderless lugs with ring type or captive spade ends, must have provisions for being locked against movement from vibration, and must be marked for identification on the wiring diagram required in Sec. 159.57. Terminal
blocks must be nonabsorbent and securely mounted. Terminal blocks must be provided with barrier insulation that prevents contact between adjacent terminals or metal surfaces.

Sec. 159.81 Baffles.

Baffles in sewage retention tanks, if any, must have openings to allow liquid and vapor to flow freely across the top and bottom of the tank.

Sec. 159.83 Level indicator.

Each sewage retention device must have a means of indicating when the device is more than \3/4\ full by volume.

Sec. 159.85 Sewage removal.

The device must be designed for efficient removal of nearly all of the liquid and solids in the sewage retention tank.

Sec. 159.87 Removal fittings.

If sewage removal fittings or adapters are provided with the device, they must be of either 1\1/2\" or 4" nominal pipe size.

Sec. 159.89 Power interruption: Type I and II devices.

A discharge device must be designed so that a momentary loss of power during operation of the device does not allow a discharge that does not meet the requirements in Sec. 159.53.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.93 Independent supporting.

The device must have provisions for supporting that are independent from connecting pipes.

Sec. 159.95 Safety.

(a) Each device must--
(1) Be free of design defects such as rough or sharp edges that may cause bodily injuries or that would allow toxic substances to escape to the interior of the vessel;
(2) Be vented or provided with a means to prevent an explosion or over pressurization as a result of an accumulation of gases; and
(3) Meet all other safety requirements of the regulations applicable to the type of vessel for which it is certified.
(b) A chemical that is specified or provided by the manufacturer for use in the operation of a device and is defined as a hazardous material in 46 CFR Part 146 must be certified by the procedures in 46 CFR Part 147.
(c) Current carrying components must be protected from accidental contact by personnel operating or routinely servicing the device. All current carrying components must as a minimum be of drip-proof construction or be enclosed within a drip-proof compartment.

Sec. 159.97 Safety: inspected vessels.

The Commandant approves the design and construction of devices to be certified for installation and operation on board inspected vessels on the basis of tests and reports of inspection under the applicable marine engineering requirements in Subchapter F of Title 46, Code of Federal Regulations, and under the applicable electrical engineering
requirements in Subchapter J of Title 46 Code of Federal Regulations.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.101 Testing: general.

Unless otherwise authorized by the Coast Guard, a recognized facility must perform each test described in Secs. 159.103
through 159.131. The same device must be used for each test and tested in the order in which the tests are described. There must be no cracking, softening, deterioration, displacement, breakage, leakage or damage of components or materials that affects the operation or safety of the device after each test described in Secs.

159.103 through 159.117 and Sec. 159.121, and the device must remain operable after the test described in Sec. 159.119. The device must be set up in a manner
simulating installation on a vessel in accordance with the manufacturer's instructions with respect to mounting, water supply, and discharge fittings.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.103 Vibration test.

The device, with liquid retention components, if any, filled with water to one-half of their volume, must be subjected to a sinusoidal vibration for a period of 12 hours, 4 hours in each of the x, y, and z planes, at the resonant frequency of the device (or at 55 cycles per second if there is no resonant frequency between 10 to 60 hertz) and with a peak amplitude of 0.019 to 0.021 inches.

Sec. 159.105 Shock test.

The device, with liquid retention components, if any, filled with water to half of their volume, must be subjected to 1,000 vertical shocks that are ten times the force of gravity (10g) and have a duration of 20-25 milliseconds measured at the base of the half-sine shock envelope.

Sec. 159.107 Rolling test.

(a) The device, with liquid retention components, if any, filled with water to half of their volume, must be subjected to 100 cycles with the axis of rotation 4 feet from the centerline of the device, no more than 6 inches below the plane of the bottom of the device, and parallel to any tank baffles. The device must then be rotated 90 degrees on its vertical axis and subjected to another 100 cycles. This testing must be repeated with the liquid retention components filled to the maximum operating level as specified by the manufacturer in Sec. 159.57.
(b) Eighty percent of the rolling action must be approximately 15 degrees on either side of the vertical and at a cyclic rate of 3 to 4 seconds. Twenty percent motions must be approximately 30 degrees, or the maximum angle specified by the manufacturer under Sec. 159.57, whichever is greater, on either side of the vertical at a cyclic rate of 6 to 8 seconds.

Sec. 159.109 Pressure test.

Any sewage retention tank that is designed to operate under pressure must be pressurized hydrostatically at a pressure head of 7 feet or to 150 percent of the maximum pressure specified by the manufacturer for operation of the tank, whichever is greater. The tank must hold the water at this pressure for 1 hour with no evidence of leaking.

Sec. 159.111 Pressure and vacuum pulse test.

Liquid retention components of the device with manufacturer specified venting installed must be subjected to 50 fillings of water at a pressure head of 7 feet or the maximum pressure specified by the manufacturer for operation of the device, whichever is greater, and then emptied with a 45 gallon per minute or larger positive displacement pump that remains in operation 30 seconds after emptying the tank at the end of each cycle.

Sec. 159.115 Temperature range test.

(a) The device must be held at a temperature of 60 deg.C or higher for a period of 16 hours.
(b) The device must be held at a temperature of -40 deg.C or less for a period of 16 hours following winterization in accordance with manufacturers' instructions.

Sec. 159.117 Chemical resistance test.

(a) In each case where the recognized facility doubts the ability of a material to withstand exposure to the substances listed in paragraphs (b) and (c) of this section a sample of the material must be tested.
(b) A sample referred to in paragraph (a) of this section must be partially submerged in each of the following substances for 100 hours at an ambient temperature of 22 deg.C.

(1) Sewage.
(2) Any disinfectant that is required in the operation of the device.
(3) Any chemical compound in solid, liquid or gaseous form, used, emitted or produced in the operation of the device.
(4) Fresh or salt (3.5 percent Sodium Chloride) flush water.
(5) Toilet bowl cleaners.
(6) Engine Oil (SAE/30).
(7) Ethylene Glycol.
(8) Detergents (household and bilge cleaning type).
(c) A sample of the material must be doused 20 times, with a 1 hour drying period between dousings, in each of the following substances:
(1) Gasoline.
(2) Diesel fuel.
(3) Mineral spirits.
(4) Turpentine.
(5) Methyl alcohol.

Sec. 159.119 Operability test; temperature range.

The device must operate in an ambient temperature of 5 deg.C with inlet operating fluid temperature varying from 2 deg.C to 32 deg.C and in an ambient temperature of 50 deg.C with inlet operating fluid temperature varying from 2 deg.C to 32 deg.C.

Sec. 159.121 Sewage processing test.

(a) The device must process human sewage in the manner for which it is designed when tested in accordance with this section. There must be no sewage or sewage-treating chemicals remaining on surfaces or in crevices that could come in contact with a person using the device or servicing the device in accordance with the instructions supplied under
Sec. 159.57(b)(7).
(b) During the test the device must be operated and maintained in accordance with the manufacturer's instructions. Any initial start-up time specified by the manufacturer must be allowed before test periods begin. For 1 hour of each 8-hour test period, the device must be tilted to the maximum angles specified by the manufacturer under Secs. 159.55 and 159.57.
(c) Except for devices described in paragraph (d) of this section, the devices must process and discharge or store human sewage over at least an 8-consecutive hour period on at least 10 days within a 20-day period. The device must receive human sewage consisting of fecal matter, urine, and toilet paper in a ratio of four urinations to one defecation with at least one defecation per person per day. Devices must be tested at their average rate of capacity as specified in Sec. 159.57. In addition, during three periods of each day the system must process sewage at the peak capacity for the period of time it is rated at peak capacity.

(d) A device that processes and discharges continuously between individual use periods or a large device, as determined by the Coast Guard, must process and discharge sewage over at least 10-consecutive days at the average daily capacity specified by the manufacturer. During three periods of each day the system must process sewage at the peak capacity for the period of time it is rated at peak capacity. The sewage for this test must be fresh, domestic sewage to which primary sludge has been added, as necessary, to create a test sewage with a minimum of 500 milligrams of suspended solids per liter.

Sec. 159.123 Coliform test: Type I devices.

(a) The arithmetic mean of the fecal coliform bacteria in 38 of 40 samples of effluent discharged from a Type I device during the test described in Sec. 159.121 must be less than 1000 per 100 milliliters when tested in accordance with 40 CFR Part 136.
(b) The 40 samples must be taken from the device as follows: During each of the 10-test days, one sample must be taken at the beginning, middle, and end of an 8-consecutive hour period with one additional sample taken immediately following the peak capacity processing period.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.125 Visible floating solids: Type I devices.

During the sewage processing test (Sec. 159.121) 40 effluent samples of approximately 1 liter each shall be taken from a
Type I device at the same time as samples taken in Sec. 159.123 and passed expeditiously through a U.S. Sieve No. 12 as specified in ASTM E 11 (incorporated by reference, see Sec. 159.4). The weight of the material retained on the screen after it has been dried to a constant weight in an oven at 103 deg.C. must be divided by the volume of the sample and expressed as milligrams per liter. This value must be 10 percent or less of the total suspended solids as determined in accordance with 40 CFR Part 136 or at least 38 of the 40 samples.

Note: 33 U.S.C. 1321(b)(3) prohibits discharge of harmful quantities of oil into or upon the navigable waters of the United States or adjoining shorelines or into or upon the waters of the contiguous zone. Under 40 CFR 110.3 and 110.4 such discharges of oil include discharges which:

(a) Violate applicable water quality standards, or

(b) Cause a film or sheen upon or discoloration of the surface of the water or adjoining shorelines or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines. If a sample contains a quantity of oil determined to be harmful, the Coast Guard will not certify the device.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976; USCG-1999-5151, 64 FR 67176, Dec. 1, 1999]

Sec. 159.126 Coliform test: Type II devices.

(a) The arithmetic mean of the fecal coliform bacteria in 38 of 40 samples of effluent from a Type II device during the test described in Sec. 159.121 must be 200 per 100 milliliters or less when tested in accordance with 40 CFR Part 136.

(b) The 40 samples must be taken from the device as follows: During each of the 10 test days, one sample must be taken at the beginning, middle and end of an 8-consecutive hour period with one additional sample taken immediately following the peak capacity processing period.

[CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.126a Suspended solids test: Type II devices.

During the sewage processing test (Sec. 159.121) 40 effluent samples must be taken at the same time as samples are taken for Sec. 159.126 and they must be analyzed for total suspended solids in accordance with 40 CFR Part 136. The arithmetic mean of the total suspended solids in 38 of 40 of these samples must be less than or equal to 150 milligrams per liter.

[CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.127 Safety coliform count: Recirculating devices.

Thirty-eight of forty samples of flush fluid from a re-circulating device must have less than 240 fecal coliform bacteria per 100 milliliters. These samples must be collected in accordance with Sec. 159.123(b) and tested in accordance with 40 CFR Part 136.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.129 Safety: Ignition prevention test.

(a) Components of a device that are a potential ignition source in an explosive atmosphere must pass the test in paragraph (b) or (c) of this section or meet the requirements of paragraph (d) or have a specific warning in the instruction manual required by Sec. 159.57 that the device should not be installed in an explosive atmosphere.

(b) Components protected by vapor exclusion must be placed in a chamber filled with a rich mixture of gasoline or propane in air with the pressure being varied from 0 to 2 psig once an hour for 8 hours. Vapor readings must be taken in the void being protected and must indicate a leakage less than 20 percent of the lower explosive limit of the mixture in the chamber.

(c) Components providing ignition protection by means other than vapor exclusion must be fitted with an ignition source, such as a spark plug, and a means of injecting an explosive mixture of gasoline or propane and air into the void that protects
the component. Connections must be made so as to minimize any additional volume added to the protected void by the apparatus delivering the explosive mixture. The component must be placed in a chamber filled with an explosive mixture
and there must be no ignition of the explosive mixture surrounding the component when the following tests are conducted:

(1) Using any overload protection that is part of the device, the potential ignition source must be operated for one half hour at 110 percent of its rated voltage, one half hour at 50 percent of its rated voltage and one half hour at 100 percent of its rated voltage with the motor or armature locked, if the potential ignition source is a motor or part of a motor's electrical circuit.

(2) With the explosive mixture in the protected void, the test installed ignition source must be activated 50 times.

(3) The tests paragraphs (c) (1) and (2) of this section must be repeated with any plugs removed.

(d) Components that are certified as being intrinsically safe in accordance with the Instrument Society of America (RP 12.2) or explosion proof in accordance with the Underwriters Laboratories STD 698 in Class I, Group D hazardous locations (46 CFR 111.80-5(a)) need not be subjected to this testing.

Sec. 159.131 Safety: Incinerating device.

An incinerating device must not incinerate unless the combustion chamber is closed, must purge the combustion chamber of combustible fuel vapors before and after incineration must secure automatically if the burner does not ignite, must not allow an accumulation of fuel, and must neither produce a temperature on surfaces adjacent to the incineration chamber higher than 67 deg.C nor produce a temperature on surfaces in normal body contact higher than 41 deg.C when operating in an ambient temperature of 25 deg.C. Unitized incineration devices must completely burn to a dry, inert ash, a simultaneous defecation and urination and must not discharge fly ash, malodors, or toxic substances.

Subpart D--Recognition of Facilities

Sec. 159.201 Recognition of facilities.

A recognized facility is an independent laboratory accepted by the Coast Guard under 46 CFR 159.010 to perform the tests and inspections required under this part. A list of accepted laboratories is available from the Commandant (G-MSE-3).

[CGD 95-028, 62 FR 51194, Sept. 30, 1997, as amended by USCG-1999-5832, 64 FR 34715, June 29, 1999]

Appendix E. Collective Watershed Map

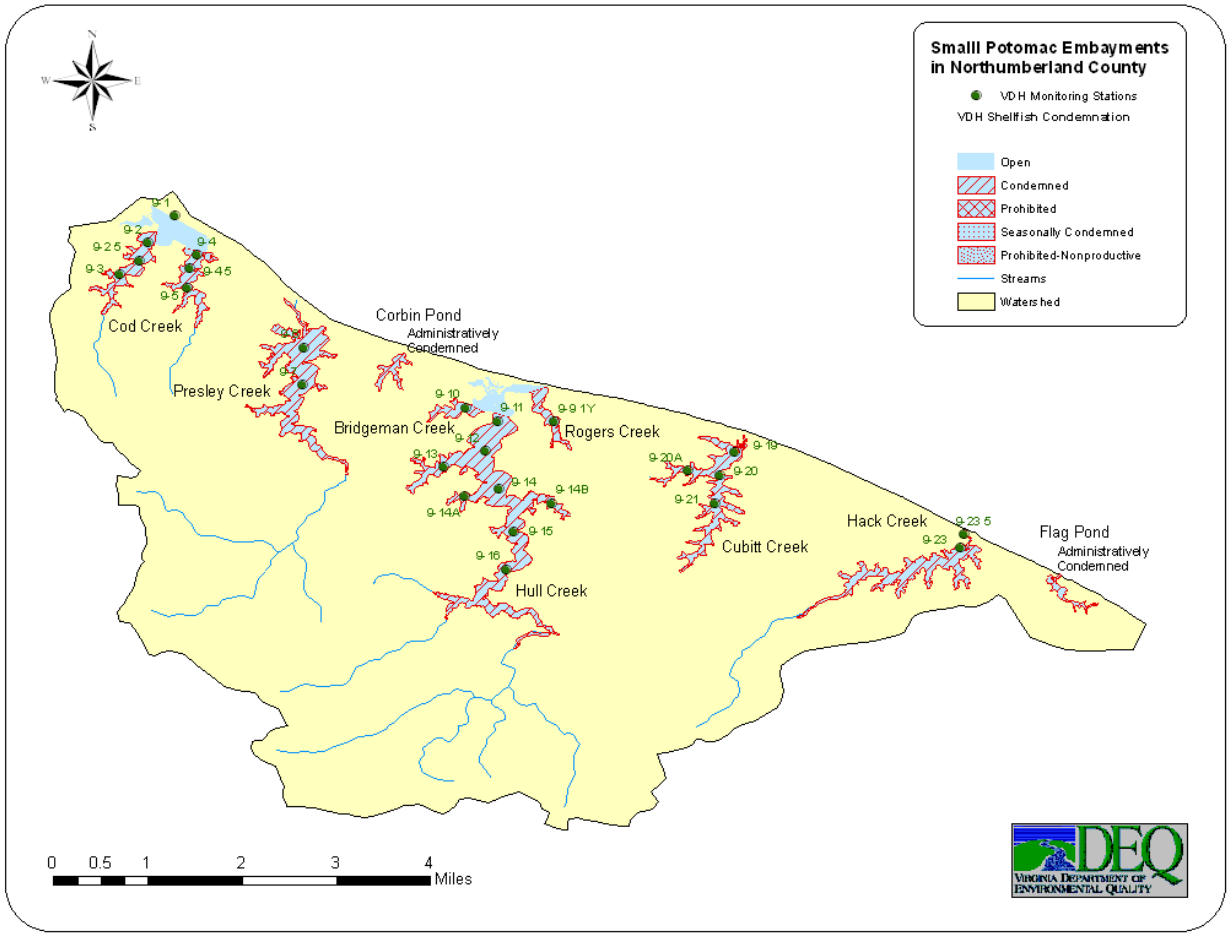


Figure E.1 Cod, Presley, Hull, Rogers, Bridgeman, Cubitt, and Hack Creeks Collective Watershed Map

Appendix F. Public Comments