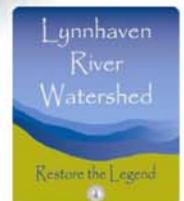


# Implementation Plan for the Fecal Coliform Total Maximum Daily Load (TMDL) for Shellfish Areas of Lynnhaven Bay, Broad Bay and Linkhorn Bay Watersheds



PEP06-01

June 2006

**IMPLEMENTATION PLAN FOR  
THE FECAL COLIFORM TMDL  
(TOTAL MAXIMUM DAILY LOAD)  
FOR SHELLFISH AREAS OF  
LYNNHAVEN BAY, BROAD BAY  
AND LINKHORN BAY WATERSHEDS**



**June 2006**

**PEP06-01**

---

## TABLE OF CONTENTS

1.0	EXECUTIVE SUMMARY .....	1
1.1	Introduction .....	1
1.2	Review of Lynnhaven, Broad, and Linkhorn Bays TMDL.....	1
1.3	Public Participation .....	2
1.4	Implementation Actions.....	2
1.5	Associated Costs and Benefits .....	3
1.6	Measurable Goals and Milestones.....	3
1.7	Stakeholders Roles and Responsibilities .....	3
1.8	Watershed Planning Efforts .....	3
1.9	Potential Funding Sources.....	4
2.0	INTRODUCTION .....	5
2.1	Purpose, Scope, and Timeframe .....	5
2.2	Regulatory Background .....	8
2.3	Designated Use and Water Quality Standard .....	8
2.4	Lynnhaven, Broad, and Linkhorn Bays TMDL Efforts .....	9
2.5	Lynnhaven, Broad, and Linkhorn Bays Watersheds .....	10
3.0	STATE AND FEDERAL REQUIREMENTS .....	12
3.1	Background.....	12
3.2	State Requirements .....	12
3.3	Federal Requirements .....	12
3.4	Federal Consent Decree.....	13
4.0	REVIEW OF TMDL DEVELOPMENT.....	14
4.1	Description of Watershed Characteristics .....	14
4.2	Description of Impairment.....	17
4.3	Description of Water Quality Monitoring.....	19
4.4	Description of Water Quality Modeling.....	23
4.5	Description of Sources Considered .....	24
4.5.1	Point Source Contributions .....	24
4.5.2	Non-Point Source Contributions.....	25
4.6	TMDL Load Reductions and Allocation Results.....	27

5.0	ADDITIONAL INFORMATION SINCE TMDL DEVELOPMENT .....	29
5.1	Land use Changes.....	29
5.2	Additional Shellfish Condemnation Areas.....	29
5.3	Additional Water Quality Monitoring Sites.....	29
5.4	Updated Shoreline Survey.....	29
5.5	Updated Water Quality Modeling.....	29
6.0	PUBLIC PARTICIPATION .....	35
7.0	IMPLEMENTATION OPTIONS.....	36
7.1	Linking the TMDL to Implementation .....	36
7.2	Identifying Implementation Actions .....	39
7.2.1	Agricultural BMPs .....	42
7.2.2	Sanitary Sewer System Improvements.....	42
7.2.3	Stormwater Programs .....	44
7.2.4	Boating Programs .....	46
7.2.5	Pet Waste Programs.....	46
7.2.6	Erosion and Sedimentation BMPs .....	47
7.2.7	Aquatic Resource Restoration .....	47
7.2.8	Education Programs .....	48
7.2.9	Land Use Management.....	49
7.2.10	Wildlife Contribution Controls.....	50
7.3	Implementation Costs and Benefits .....	51
8.0	MEASURABLE GOALS AND MILESTONES .....	54
8.1	Establishing Goals .....	54
8.1.1	TMDL Goals.....	54
8.1.2	Related Watershed Management Goals.....	54
8.2	Establishing a Timeline and Milestones for Implementation .....	54
8.3	Developing Tracking and Monitoring Plans.....	56
9.0	STAKEHOLDERS ROLES AND RESPONSIBILITIES .....	58
9.1	Federal.....	58
9.1.1	United States Environmental Protection Agency.....	58
9.1.2	United States Navy .....	58
9.2	State .....	59
9.2.1	Department of Environmental Quality (DEQ) .....	59

9.2.2	Department of Conservation and Recreation (DCR).....	59
9.2.3	Virginia Department of Health (VDH) .....	60
9.2.4	Soil and Water Conservation District .....	60
9.2.5	Department of Game of Inland Fisheries .....	60
9.2.6	Virginia Marine Resource Commission .....	60
9.3	Regional.....	61
9.3.1	Hampton Roads Planning District Commission.....	61
9.3.2	Hampton Roads Sanitation District .....	62
9.4	City of Virginia Beach.....	62
9.5	Private Sector, Non-governmental, and Citizen Groups .....	62
9.5.1	Lynnhaven River 2007 .....	62
9.5.2	Chesapeake Bay Foundation.....	63
9.5.3	Alliance for the Chesapeake Bay .....	64
10.0	RELATED WATERSHED PLANNING EFFORTS .....	67
10.1	Adjacent Impaired Waterbodies.....	67
11.0	POTENTIAL FUNDING SOURCES.....	69
11.1	Requirements for Section 319 Fund Eligibility .....	70
	REFERENCES.....	71

## **1.0 EXECUTIVE SUMMARY**

### **1.1 Introduction**

This Implementation Plan (IP) is a companion document to the report, "Lynnhaven Bay, Broad Bay and Linkhorn Bay Watersheds Total Maximum Daily Load (TMDL) Report for Shellfish Areas Listed Due to Bacteria Contamination,"(DEQ 2004). The Lynnhaven Bay TMDL Study set allocations to limit bacteria pollutant loads discharged to the Lynnhaven River watershed to levels that were modeled to achieve compliance with the state water quality criteria for bacteria for shellfishing waters. This IP bridges the gap between those specified pollutant load allocations and actual reductions in bacteria counts in Lynnhaven, Broad, and Linkhorn Bays by recommending a set of actions to be taken in the watershed during a fifteen year project timeframe.

#### State and Federal Requirements

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

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

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

### **1.2 Review of Lynnhaven, Broad, and Linkhorn Bays TMDL**

As a result of monthly monitoring conducted by the Virginia Department of Health's Division of Shellfish Sanitation (DSS), the Virginia Department of Environmental Quality (DEQ) listed the entire Lynnhaven, Broad and Linkhorn Bays (encompassed by watershed ID VAT-C08E) as impaired on Virginia's 1998 Section 303(d) list for being unable to attain the criteria for the production of edible and marketable natural resources due to elevated levels of fecal coliform bacteria. The criteria are in place to protect the public from health effects associated with the consumption of bacteriologically contaminated shellfish.

A TMDL study for the Lynnhaven, Broad, and Linkhorn Bays, completed by DEQ in March 2004, examined the watershed characteristics and the sources of fecal coliform to the bays. Using monthly monitoring data, bacterial source tracking (BST), and a tidal

volumetric model, DEQ assigned maximum allowable loads to each source in the watersheds in order to bring Lynnhaven Bay, Broad Bay, and Linkhorn Bay into compliance with the water quality standard for shellfish propagation.

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

Growing Area	Bird	Wildlife	Human	Pets	Livestock	Total
Lynnhaven Bay (70)	93.8	0	100	100	100	81.5
Broad and Linkhorn Bays (71)	0	0	50	0	0	16.2

The core of this IP is a set of actions found in Section 7 aimed to reduce the levels of fecal coliform bacteria in Lynnhaven, Broad and Linkhorn Bays. The actions chiefly target bacteria from human and pet (“anthropogenic”) sources. This reflects the staged implementation recommended by the Virginia Department of Environmental Quality and referenced in the TMDL Study.

### 1.3 Public Participation

Two public meetings were held in the watershed to engage the public in the development of the TMDL Implementation Plan for the Lynnhaven Bay Watershed. A work group composed of representatives from city departments, the Hampton Roads Planning District Commission (HRPDC), and state and federal agencies was formed to guide development of the TMDL IP.

### 1.4 Implementation Actions

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

- Agricultural BMPs
- Sanitary Sewer System Improvements
- Stormwater Programs
- Boating Programs
- Pet Waste Programs
- Erosion and Sediment Control
- Aquatic Resources Restoration

- Education Programs
- Land Use Management
- Wildlife Contribution Controls

### **1.5 Associated Costs and Benefits**

The primary benefit of the implementation of the management actions described in this IP is the reduction of bacteria levels in the Lynnhaven, Broad, and Linkhorn Bays. The programs and actions contained within this IP will serve to reduce the anthropogenic sources of bacteria within the Lynnhaven Watershed. Because many of the programs mentioned in this report also serve purposes other than to just reduce bacteria and because they cover areas larger than the Lynnhaven Watershed, the costs of reducing bacteria levels in the Lynnhaven Watershed can be difficult to estimate. City of Virginia Beach staff estimated costs for management categories using knowledge of current program costs and best professional judgment.

### **1.6 Measurable Goals and Milestones**

The goal of the TMDL developed for Lynnhaven, Broad and Linkhorn Bays is to bring the impaired water segments within the Lynnhaven watershed into compliance with the water quality standard for bacteria in shellfishing waters. Once the water segment achieves compliance with the bacteria criteria, then the segment can be removed from the 303(d) Impaired Waters List. Throughout the fifteen year project timeframe, DSS will continue its monthly monitoring of stations throughout the Lynnhaven watershed. Currently, this monitoring program includes 21 monitoring stations within the Lynnhaven Bay and 33 stations within Broad and Linkhorn Bays. Project progress will be tracked throughout the timeframe of the implementation plan, and the effectiveness of the management actions proposed in this IP will be evaluated at the end of five, ten, and fifteen years.

### **1.7 Stakeholders Roles and Responsibilities**

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

### **1.8 Watershed Planning Efforts**

The City of Virginia Beach is in the process of developing a watershed management plan for the Lynnhaven River Watershed that includes the sections not meeting the water quality standards for bacteria in shellfishing waters. The management actions and

programs described in this report are consistent with the goals and objectives of the developing watershed management plan.

The City of Virginia Beach is also working with the US Army Corps of Engineers (USACE) on the Lynnhaven River Environmental Restoration Project. Components of this project include the development of hydrodynamic and watershed loading models for the Lynnhaven Watershed. These models will aid the understanding of the sources and dynamics of bacteria loading within the watershed. While the primary purpose of this Environmental Restoration Project is to reestablish natural aquatic habitats within the Lynnhaven River, some actions such as the restoration of tidal wetlands and preservation of stream buffers will also serve to reduce bacteria loading to the Lynnhaven, Broad, and Linkhorn Bays.

### **1.9 Potential Funding Sources**

One of the objectives of this TMDL Implementation Plan was to maximize utilization of existing programs and resources to achieve the goal of reducing bacteria levels within the Lynnhaven Watershed. In general funding for these programs and the management actions described in this IP will come from four sources:

- Locality funds
- Private / nonprofit funds
- Virginia State funds
- Federal funds

## 2.0 INTRODUCTION

### 2.1 Purpose, Scope, and Timeframe

This Implementation Plan (IP) is a companion document to the report, "Lynnhaven Bay, Broad Bay and Linkhorn Bay Watersheds Total Maximum Daily Load (TMDL) Report for Shellfish Areas Listed Due to Bacteria Contamination," completed by the Virginia Department of Environmental Quality (DEQ) in March 2004, which will henceforth be referred to as the TMDL Study. The IP creates a framework to achieve the reductions in bacteria counts recommended in the TMDL Study. The core of this IP is the set of actions presented in Section 7 intended to reduce the levels of fecal coliform bacteria in Lynnhaven Bay, Broad Bay, and Linkhorn Bay from controllable sources. The goal of the IP is compliance with the State of Virginia water quality standard for bacteria for shellfishing waters. This IP follows the State guidance for TMDL implementation plans published by DEQ. This TMDL and Implementation Plan are the first of many to be completed within the jurisdiction of the City of Virginia Beach. It is the intention that this document will serve as a framework for TMDL Implementation Plans that will be completed in the future.

The TMDL study that was approved by the US Environmental Protection Agency (USEPA) in August 2004 and the Virginia State Water Control Board in December 2004 examined the watersheds, their characteristics, and the sources of fecal coliform throughout the watersheds. Using monthly monitoring data, bacterial source tracking (BST), and a tidal volumetric model, DEQ was able to assign maximum allowable loads to each source in the watersheds in order to bring Lynnhaven Bay, Broad Bay and Linkhorn Bay into compliance with the water quality standard. This IP outlines a strategy and the proposed actions to reduce anthropogenic loading of bacteria to the level set forth in the TMDL study in order to comply with the water quality standard for fecal coliform for shellfishing waters. The proposed actions included in this IP will be performed by the City of Virginia Beach in cooperation with state, federal, and non-governmental entities. These actions are expected to be completed within a ten to fifteen year timeframe.

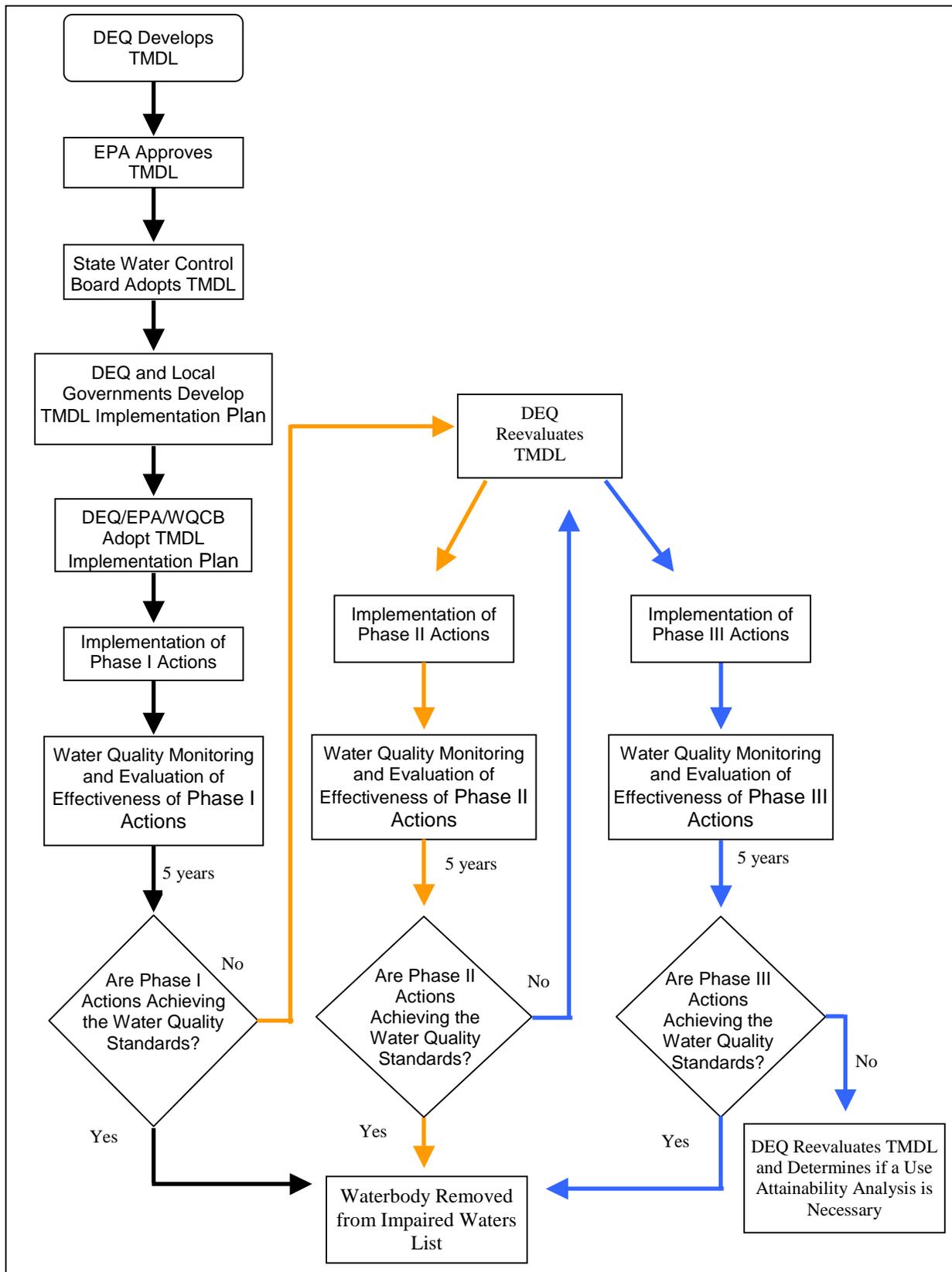
The pollutant reductions in Lynnhaven Bay, Broad Bay and Linkhorn Bay Watersheds will be implemented in a staged fashion. Staged implementation is an iterative process that first addresses those sources with the largest impact on water quality. Stage 1 management actions will target the controllable, anthropogenic bacteria sources identified in the TMDL, setting aside control strategies for wildlife except for cases of over population. During the implementation of the stage 1 scenario, all controllable sources will be reduced to the maximum extent practicable using an iterative approach. DEQ will re-assess water quality data collected by the Virginia Department of Health, Division of Shellfish Sanitation (VDH-DSS) throughout the Lynnhaven watershed during and subsequent to the implementation of the stage 1 scenario to determine if the water quality standard is attained.

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

The City of Virginia Beach is currently working with the U.S. Army Corps of Engineers and the Virginia Institute of Marine Science (VIMS) on a restoration study for the Lynnhaven River that includes hydrodynamic and water quality modeling that will serve to better define the sources and quantity of bacteria loading within the Lynnhaven, Broad and Linkhorn Bay watersheds. The load allocations set forth in the TMDL study may be modified based on new information collected through ongoing monitoring data following the implementation of actions set forth in this document.

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

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



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

## **2.2 Regulatory Background**

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

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

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

## **2.3 Designated Use and Water Quality Standard**

According to Virginia Water Quality Standards (9 VAC 25-260-5), the term "water quality standards means provisions of state or federal law which consist of a designated use or uses for the waters of the Commonwealth and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC §1251 et seq.)."

According to Virginia Water Quality Standards (9 VAC 25-260-10A), "all state waters are designated for the following uses: recreational uses (e.g., swimming and boating); the propagation and growth of a balanced indigenous population of aquatic life, including

game fish, which might be reasonably expected to inhabit them; wildlife; and the production of edible and marketable natural resources (e.g., fish and shellfish).”

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

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

## **2.4 Lynnhaven, Broad, and Linkhorn Bays TMDL Efforts**

Two segments within the Lynnhaven, Broad and Linkhorn Bays have been restricted pursuant to Title 28.2 Chapter 8, sections 228.2-803, 228.2-808, 32.1-20 and 9-6.14:4.1 B16 of the Code of Virginia by the Virginia Department of Health, Division of Shellfish Sanitation (VDH-DSS). Notice and Description of Shellfish Condemnation Area 25, Lynnhaven River, Broad Creek and Linkhorn Bay describes and delineates harvest areas that are restricted because water quality monitoring data show excessive levels of bacteria in these waters. The waters also were classified as impaired on the state’s 303(d) list of impaired waters and require a TMDL.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (DEQ) listed the entire Lynnhaven, Broad and Linkhorn Bays (encompassed by watershed ID VAT-C08E) as impaired on Virginia’s 1998 Section 303(d) list for being unable to attain the criteria for the production of edible and marketable natural resources due to elevated levels of fecal coliform bacteria. The criteria are in place to protect the public from health affects associated with the consumption of bacteriologically contaminated shellfish.

A TMDL study for the Lynnhaven, Broad, and Linkhorn Bays was completed by DEQ in March 2004 and approved by the US Environmental Protection Agency (USEPA) in August 2004 and the Virginia State Water Control Board in December 2004. The TMDL study examined the watersheds, their characteristics, and the sources of fecal coliform throughout the watersheds. Using monthly monitoring data, bacterial source tracking

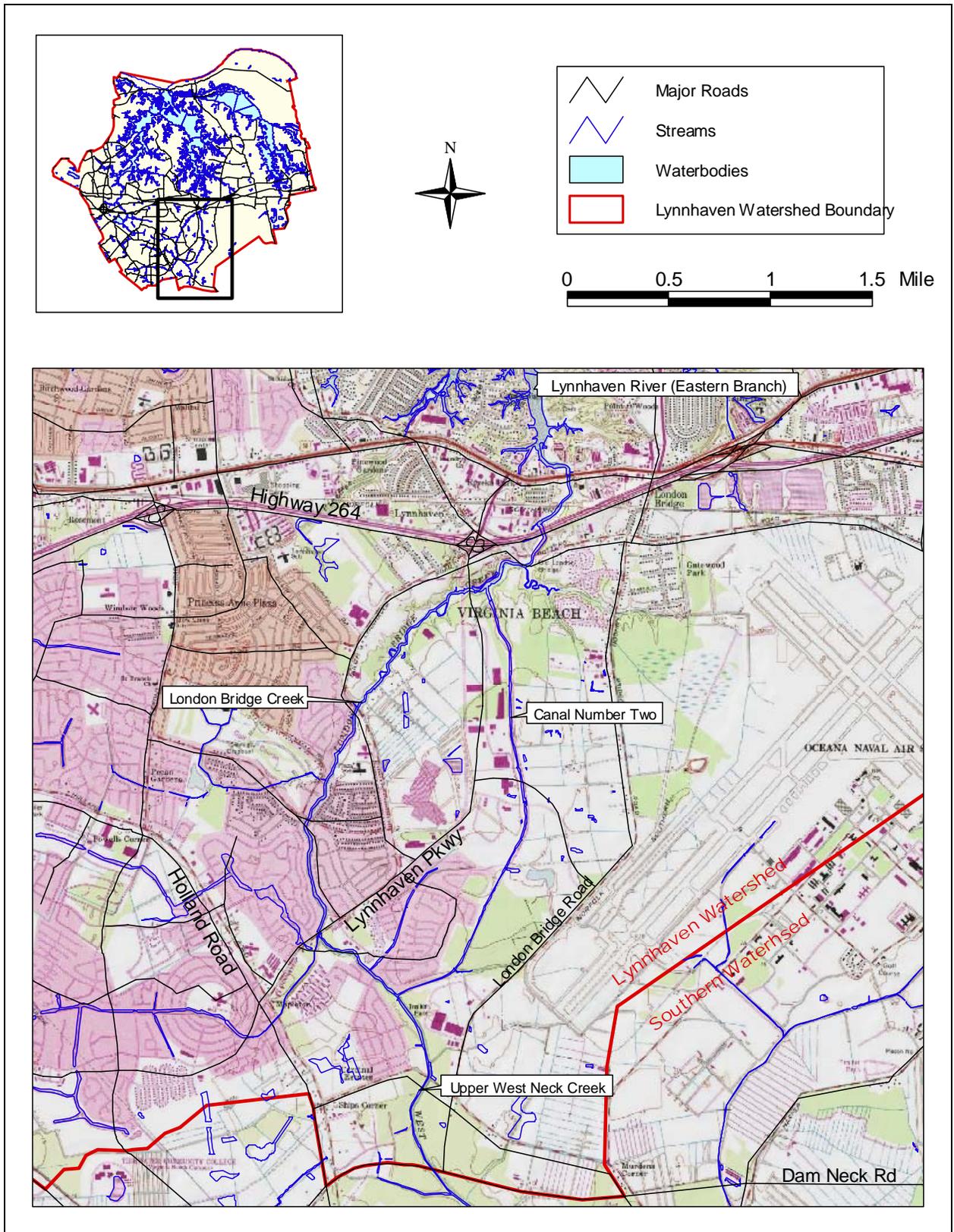
(BST), and a tidal volumetric model, DEQ assigned maximum allowable loads to each source in the watersheds in order to bring Lynnhaven Bay, Broad Bay, and Linkhorn Bay into compliance with the water quality standard for shellfish propagation.

## **2.5 Lynnhaven, Broad, and Linkhorn Bays Watersheds**

Lynnhaven, Broad and Linkhorn Bays are located entirely within the City of Virginia Beach in southeastern Virginia at the southern shore of the mouth of the Chesapeake Bay, near Cape Henry. The watershed occupies a landscape position along the southern shore of the mouth of the Chesapeake Bay between Cape Henry and the Chesapeake Bay Bridge Tunnel in Virginia's Coastal Plain Physiographic Province and the Coastal Lowland sub province. The Coastal Lowland sub-province is characterized by flat, low relief regions along the major rivers and Chesapeake Bay. Elevations range from 0' to 60' above mean sea level.

The Lynnhaven, Broad and Linkhorn Bay watershed drains north to the Chesapeake Bay and is subject to the ebb and flow of the tide. The Lynnhaven Bay flows north from its headwaters bordering Dam Neck Road to the south, Great Neck Road to the east and Independence Boulevard and Pembroke Boulevard to the west. Broad Bay and Linkhorn Bays lie directly east of Great Neck Road. Broad Bay is bordered on the northeast by First Landing State Park, and to the east by US 60. This tributary enters Lynnhaven Bay at its confluence with the Chesapeake Bay. The drainage area of the Lynnhaven, Broad and Linkhorn Bay watershed is approximately 40,683 acres, or 64 square miles. The nearest climate station is located at Cape Henry in Virginia Beach, Virginia approximately 2 miles east of the study area. The average annual rainfall as recorded at Cape Henry is 41.32 inches.

The Lynnhaven Watershed is hydraulically connected to the Southern Watershed via West Neck Creek, London Bridge Creek and Canal Number Two. A detailed map of this section of the watershed is shown in Figure 2-2. The nature of this connection will be discussed in further detail in Section 4.1. These waterbodies are listed as impaired for fecal coliform (DEQ 2004). A bacteria TMDL report that includes these waterbodies was developed by Map Tech, Inc for DEQ, and approved by EPA in September 2005. The results of the tidal water quality model indicate that the water quality in West Neck Creek, London Bridge Creek, and Canal Number Two is greatly influenced by water quality in Lynnhaven Bay (Map Tech Inc. 2005). Therefore, the implementation activities addressed in this report should also serve to reduce bacteria loads to West Neck, London Bridge Creek, and Canal Number Two.



**Figure 2-2: Connection Between Lynnhaven and Southern Watersheds**

## **3.0 STATE AND FEDERAL REQUIREMENTS**

### **3.1 Background**

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

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

### **3.2 State Requirements**

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

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

### **3.3 Federal Requirements**

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

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

### **3.4 Federal Consent Decree**

The Commonwealth of Virginia was a signatory to the June 11, 1999 consent decree settling federal case no. 98-979-A “American Canoe Association, Inc. and the American Littoral Society v. USEPA and USEPA – Region III.” By signing the consent decree, Virginia committed to develop TMDL studies by 2010 for all Virginia water segments listed on the 1998 303(d) Impaired Waters list.

## **4.0 REVIEW OF TMDL DEVELOPMENT**

### **4.1 Description of Watershed Characteristics**

The 64 square mile drainage area of the Lynnhaven, Broad and Linkhorn Bay watershed is located entirely within the City of Virginia Beach in southeastern Virginia at the southern shore of the mouth of the Chesapeake Bay. It occupies a landscape position between Cape Henry and the Chesapeake Bay Bridge Tunnel in Virginia's Coastal Plain Physiographic Province and the Coastal Lowland sub province. The Lynnhaven Bay flows north from its headwaters bordering Dam Neck Road to the south, Great Neck Road to the east and Independence Boulevard and Pembroke Boulevard to the west. Broad Bay and Linkhorn Bay lie directly east of Great Neck Road. Broad Bay is bordered on the northeast by First Landing State Park, and to the east by US 60. The Lynnhaven, Broad and Linkhorn Bay watershed drains north to the Chesapeake Bay and is subject to the ebb and flow of the tide.

As discussed in Section 2.5, the Lynnhaven Bay is hydraulically connected to the southern watershed via West Neck Creek, London Bridge Creek and Canal Number 2. Maximum movement of pollutant into London Bridge Creek, West Neck Creek and Canal Number 2 from Lynnhaven Bay will take place during a positive flow event (flow is going from north to south), similarly, the maximum movement of pollutants from the North Landing River will occur during a negative flow event (flow from south to north). A USGS study conducted in 1992 concluded that positive flows occur 64% of the time, while negative flows occur only 36% of the time (Bales and Skrobialowski 1994). Due to this hydraulic connection, the management actions in this implementation plan should positively affect the water quality in the southern watershed. A TMDL for bacteria has also been developed by DEQ for the coastal waters of the southern watershed, including Canal Number 2, West Neck Creek and London Bridge Creek. Subsequently, the implementation of that TMDL should positively affect water quality in West Neck Creek, London Bridge Creek, and the upper Eastern Branch of the Lynnhaven River.

Lynnhaven Bay is a trap estuary that receives freshwater input from coastal streams and urban runoff. The system receives little freshwater inflow from its small coastal tributaries, and its circulation is dominated by tidal flushing with waters from the Chesapeake Bay through the narrow Lynnhaven Inlet constricted by the Lesner Bridge. The Lynnhaven is a shallow system with a maximum depth of 9 meters outside the inlet. The Lynnhaven system has a history of shellfishing closures. Linkhorn Bay, the most eastward extension of the system, has been closed to shellfishing since 1930. Since 1971, the system has ranged from complete closure to conditionally opened and back again. Lynnhaven Bay and the Eastern and Western Branches have remained closed since the June 1986 condemnation. Broad Bay has been reopened and closed again periodically from 1987 to the present (Neilson et al. 1992).

The degradation of water quality throughout the Lynnhaven system reflects the change in surrounding land area from predominantly agricultural to urban starting from the 1950's through 1970. This trend of developing agricultural land for urban uses (predominantly residential) has continued at a slower rate until the present. The increase in impervious area and pollutant discharge that accompanied this development corresponds to a decrease in water quality (Neilson et al. 1992). The area comprising the Lynnhaven, Broad and Linkhorn Bays can be characterized as highly urbanized and densely populated. Undeveloped land comprises less than 25% of the total watershed as forest, wetland, urban grassland, or water. Land use area by category is shown in Table 4-1 and Figure 4-1.

**Table 4-1: 2000 Land Use for Lynnhaven, Broad and Linkhorn Watersheds (DEQ 2004)**

Land Use Category	Area (acres)	Area (%)
Single Family/Duplex	15078	37%
Town House	768	2%
Multi-family	1551	4%
Commercial	1806	4%
Office	652	2%
Industrial	457	1%
Military	2393	6%
Streets	5178	13%
Public/Semi-public	2662	7%
Agriculture-cropland	1717	4%
Agriculture-pasture	248	1%
Park	2876	7%
Marsh/wetland	1711	4%
Undeveloped	3580	9%

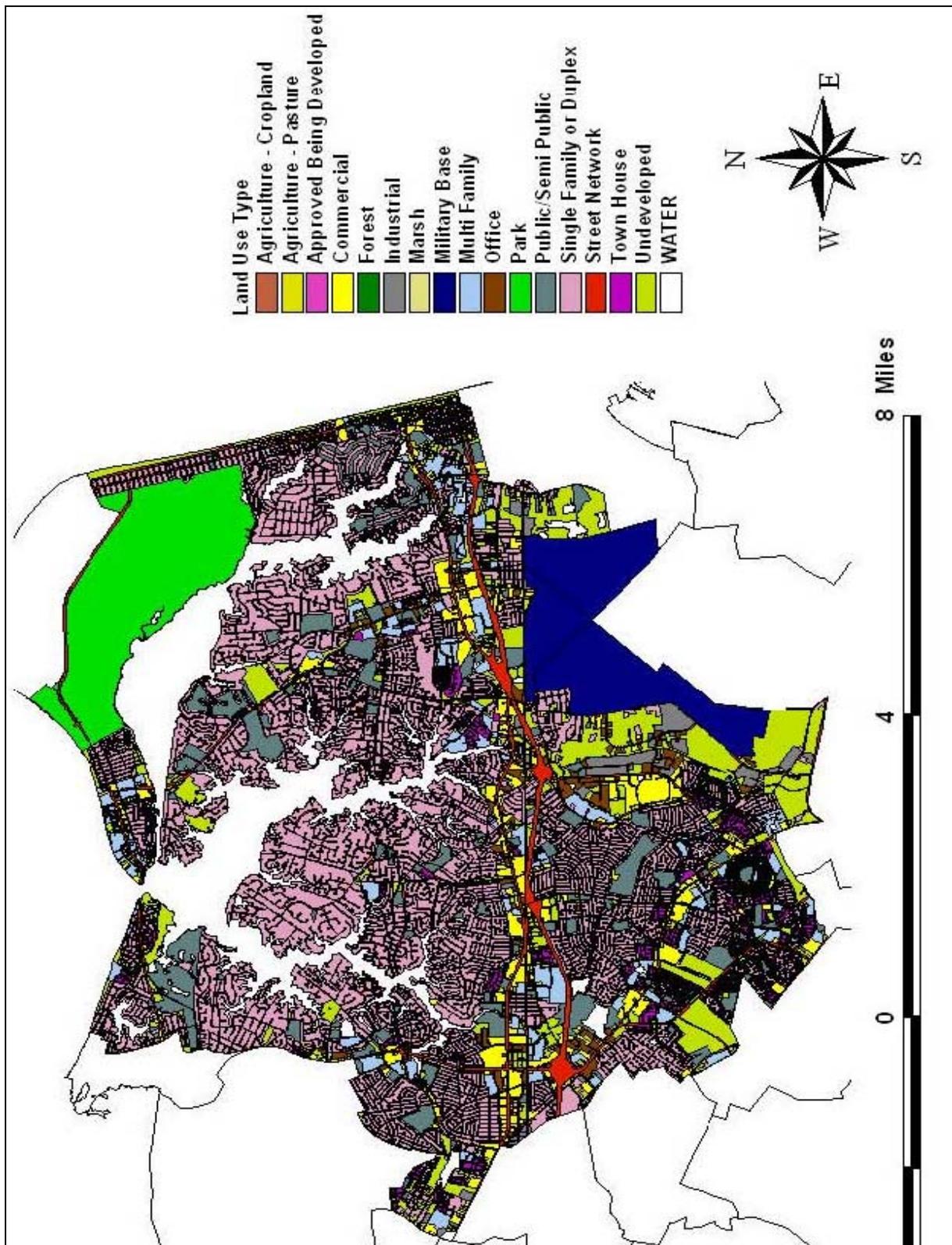


Figure 4-1: 2000 Land Use in Lynnhaven, Broad, and Linkhorn Bay Watersheds (DEQ 2004)

## 4.2 Description of Impairment

One segment in each of Lynnhaven Bay, Broad Bay and Linkhorn Bay as well as Long Creek was listed as impaired on Virginia's 1998 303(d) Total Maximum Daily Load Priority List and Report (DEQ 1998) due to violations of the State's water quality standard for fecal coliform bacteria in shellfish supporting waters. VDH-DSS, Notice and Description of Shellfish Condemnation Number 25, Lynnhaven River, Broad and Linkhorn Bays, lists and describes the condemnation areas in these watersheds and their tributaries effective as of April 10, 1998. Table 4-2 shows that these segments continued to be reported as impaired in the Commonwealth of Virginia's 2004 305(b)/303(d) Water Quality Assessment Integrated Report. A generalized map of the areas affected by the condemnation notice is shown in Figure 4-2.

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

TMDL ID	Waterbody Name	Impairment	Initial List Date	Assessment Category	City/County	Size
VAT-C08E-10	Dey Cove/ Mill Dam Creek	VDH Shellfish Restriction	1998	5B	Virginia Beach	0.07 Sq. Mi.
VAT-C08E-11	Linkhorn Bay	VDH Shellfish Restriction	1998	5B	Virginia Beach	1.24 Sq. Mi.
VAT-C08E-12	Long Creek/Broad Bay	VDH Shellfish Restriction	1998	5B	Virginia Beach	0.41 Sq. Mi.
VAT-C08E-13	Lynnhaven River and Bay	VDH Shellfish Restriction	1998	5B	Virginia Beach	4.05 Sq. Mi.

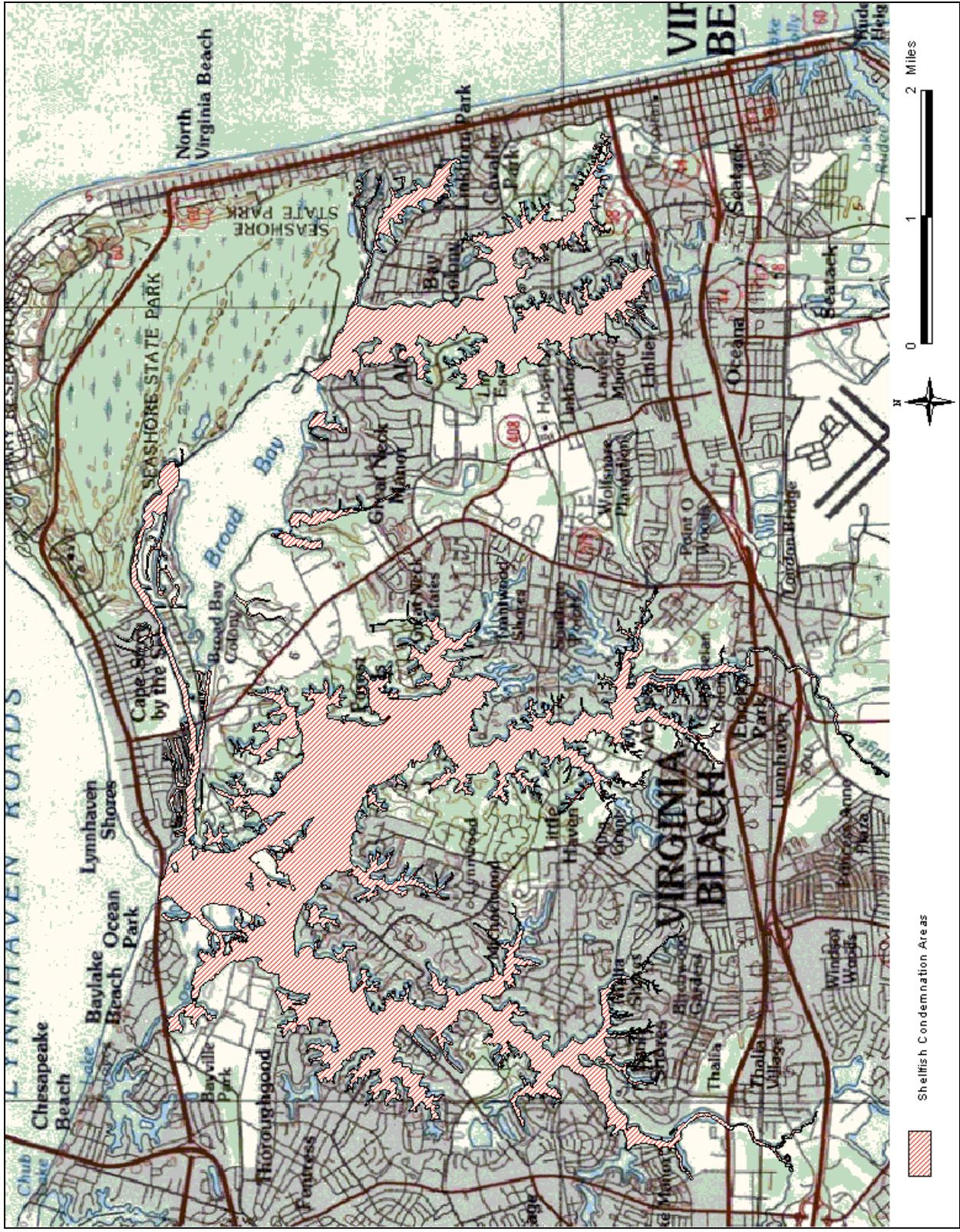


Figure 4-2: Shellfish Condemnation Areas in Lynnhaven Study Areas When TMDL Was Developed

### 4.3 Description of Water Quality Monitoring

The VDH-DSS collects monthly monitoring data for fecal coliform bacteria within the Lynnhaven Bay system. Prior to the development of the TMDL, DSS collected data at 19 monitoring stations within the Lynnhaven Bay and 21 stations within Broad and Linkhorn Bays. Based upon the results of this monitoring the status of the closure areas is reevaluated at a minimum annually, but normally semi-annually. The network of water quality monitoring stations for the Lynnhaven River estuary is shown in Figure 4-3. A summary of water quality for the 30 months preceding the TMDL study and data is shown in Table 4-3.

In order to facilitate the development of the TMDL, a subset of 10 stations was selected for a special study to determine the sources of fecal coliform bacteria at these stations. This TMDL study collected bacterial samples at these stations on a monthly basis from September of 2001 through August of 2002 and used bacterial source tracking (BST) to estimate the source contributions to the Lynnhaven Bay and Broad Bay.

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

The five major source categories that were used in the TMDL study were human, pets, livestock, mammalian wildlife, and birds. A summary of the 12-month averages of source loads for the 10 TMDL study stations is shown in Figure 4-4 and Table 4-4. The data developed for the Lynnhaven Bay watershed indicate that the contribution in most of the closure areas may be comprised of as much as 25% human origin. The average percent contribution estimated for birds exceeded or equaled the estimated human contribution at seven of the ten stations. If the 12-month averages are averaged across all stations, then the sources with the highest estimated percent contribution are 1) Bird, 2) Human, 3) Wildlife, 4) Livestock, 5) Pets. The full BST report for the Lynnhaven Bay is located in Appendix B of the TMDL report.

It should be noted that BST methods are still being developed and there are substantial limitations of this study that should be considered when using the BST results. BST is not a quantitative tool and was only intended to be used to identify and estimate potential source loads to the study area. The accuracy of results using the ARA method is dependent on the size and relevance of a library of potential bacteria sources. Libraries are expensive and time consuming to build, and libraries created for surrounding areas proved inadequate. The small library used in this study could have contributed to unidentified sources for some samples. Another limitation of this study was the number of isolates tested in some samples. The water quality criterion for bacteria in shellfishing waters is very low. Although bacteria concentrations in

Lynnhaven Bay violate this criterion, concentrations are still relatively low especially during dry weather. Numbers may not be precise in samples where less than 10 isolates were used to determine the source loading. Another concern is the use of E. coli as the test organism. Additional research has shown that enterococci is a more effective indicator for BST (DEQ 2004).

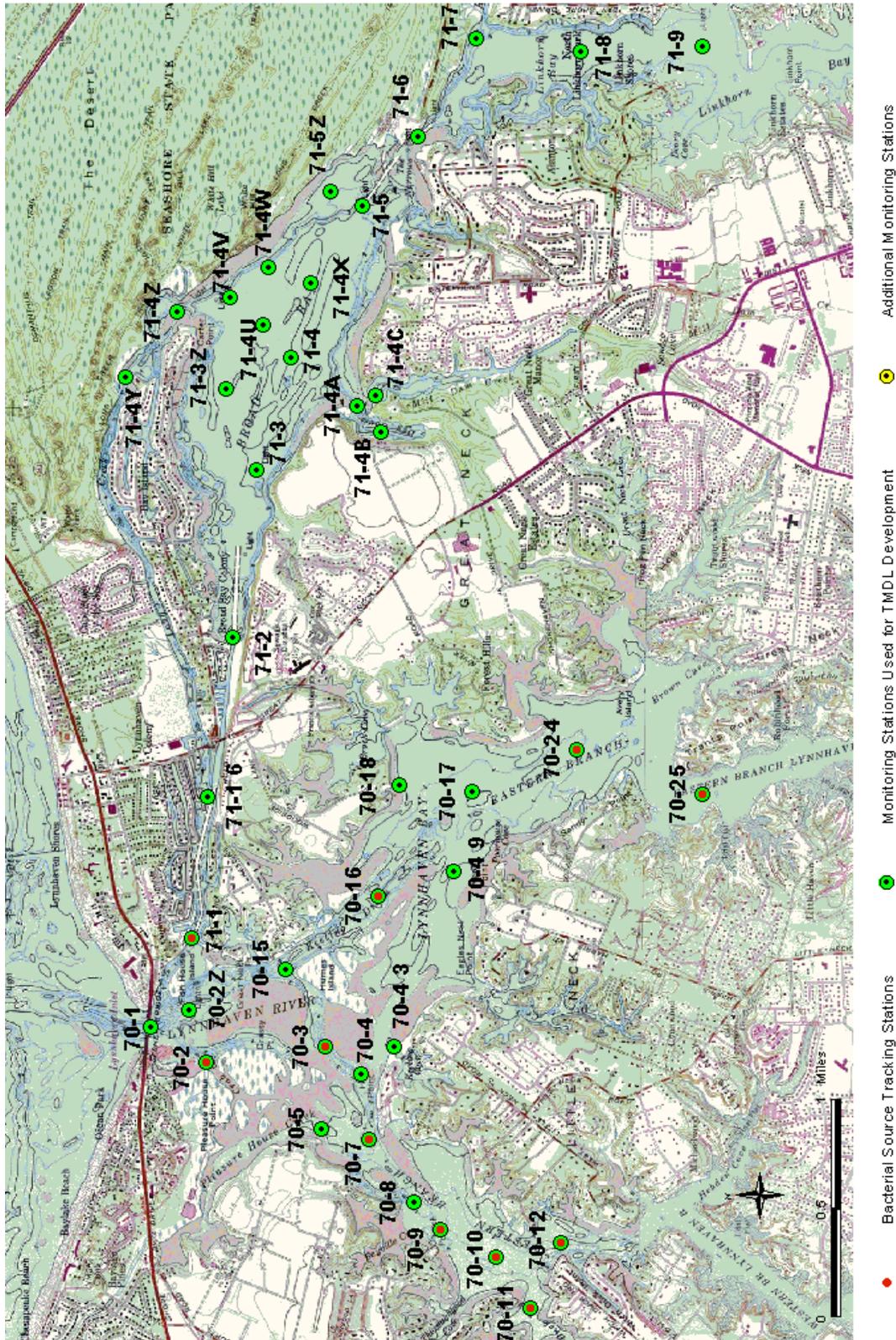


Figure 4-3: Water Quality Monitoring Stations Maintained by VDH-DSS at the Time of TMDL Development

**Table 4-3: Water Quality Data Summary for Lynnhaven, Broad, and Linkhorn Bays from January 2001 to February 2003 (DEQ 2004)**

Station	90th Percentile Preceding 30 Months	Water Quality Standard	Station Meets Standard?	Geometric Mean Preceding 30 months	Geometric Mean Standard	Station Meets Standard ?	Current Condemnation
<b>Lynnhaven</b>		49			14		
70-1	68.4		No	11.4		Yes	Yes
70-2 *	111.7		No	16.8		No	Yes
70-2Z	103.0		No	13.6		Yes	Yes
70-3 *	259.0		No	27.2		No	Yes
70-4	190.1		No	24.7		No	Yes
70-4 3	258.0		No	31.6		No	Yes
70-4 9	164.1		No	14.7		Yes	Yes
70-5	143.3		No	19.2		No	Yes
70-7*	209.7		No	21.0		No	Yes
70-8	332.7		No	27.1		No	Yes
70-9*	306.8		No	30.5		No	Yes
70-10*	368.0		No	30.2		No	Yes
70-11*	182.9		No	27.1		No	Yes
70-12*	569.1		No	41.7		No	Yes
70-15	116.6		No	14.5		Yes	Yes
70-16*	195.1		No	18.7		No	Yes
70-17	230.0		No	20.4		No	Yes
70-18	265.7		No	20.2		No	Yes
70-24*	445.0		No	36.6		No	Yes
70-25*	760.7		No	52.6		No	Yes
<b>Average</b>	<b>264.0</b>			<b>25.0</b>			
<b>Broad Bay and Linkhorn Bay Stations</b>							
71-1*	54.8		No	10.2		Yes	Yes
71-1 6	51.9		No	10.5		Yes	Yes
71-2	52.7		No	9.6		Yes	Yes
71-3	66.1		No	10.2		Yes	Yes
71-3Z	37.2		Yes	7.9		Yes	No
71-4	62.4		No	8.0		Yes	Yes
71-4A	209.4		No	22.0		No	Yes
71-4B	443.9		No	30.9		No	Yes
71-4C	287.0		No	24.3		No	Yes
71-4U	187.2		No	10.2		Yes	Yes
71-4V	23.8		Yes	5.8		Yes	No
71-4W	32.7		Yes	7.4		Yes	No
71-4X	13.4		Yes	4.0		Yes	No
71-4Y	61.1		No	12.3		Yes	Yes
71-4Z	34.4		Yes	8.6		Yes	No
71-5	44.7		Yes	7.8		Yes	No
71-5Z	29.1		Yes	5.7		Yes	No
71-6	46.3		Yes	7.6		Yes	No
71-7	59.9		No	8.6		Yes	Yes
71-8	36.7		Yes	7.5		Yes	No
71-9	72.2		No	9.8		Yes	Yes
<b>Average</b>	<b>90.17</b>			<b>10.9</b>			

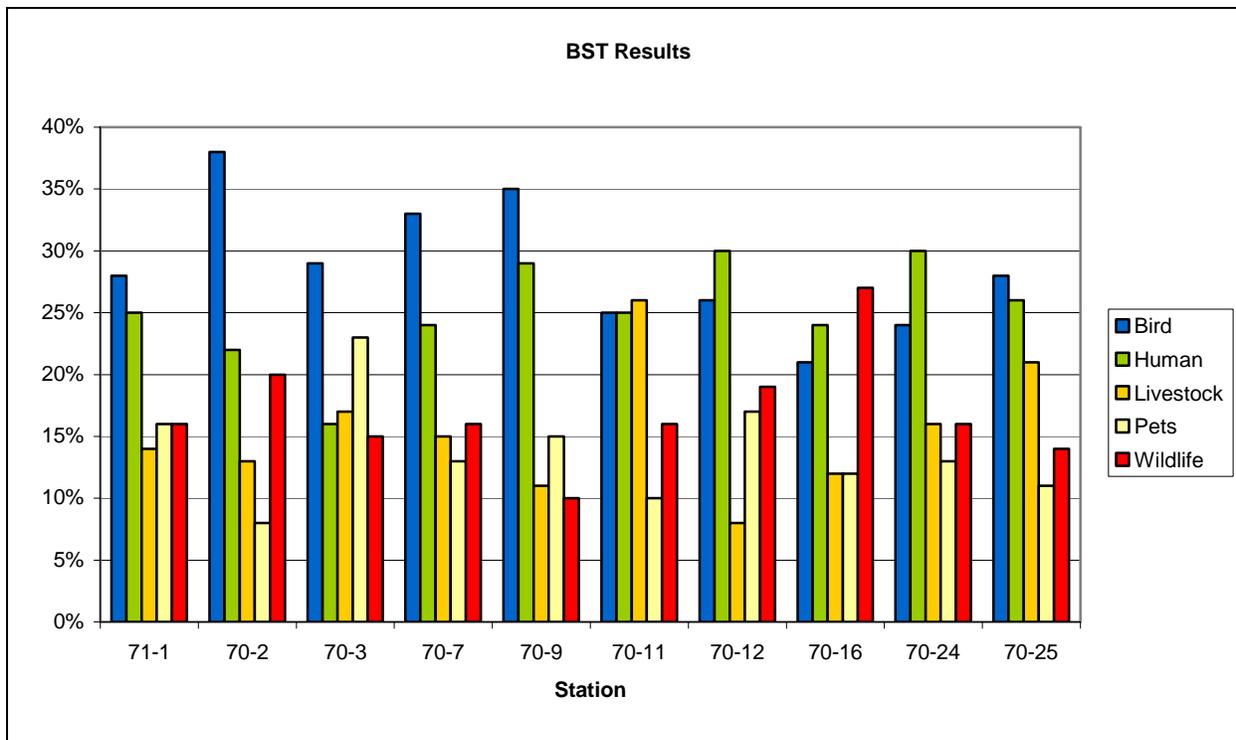


Figure 4-4: Twelve-Month Averages for Source Loads to TMDL Study Stations in Broad and Lynnhaven Bays (DEQ 2004)

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

BST Station ID	% Bird	% Human	% Livestock	% Pets	% Wildlife
70-1	28	25	14	17	16
71-2	37	22	12	8	20
71-3	29	17	17	23	15
71-7	33	24	15	13	16
71-9	35	28	11	15	11
71-11	25	22	26	10	16
71-12	26	30	8	17	18
71-16	21	24	12	16	26
71-24	24	30	16	14	16
71-25	28	26	21	11	14
<b>Cumulative Average</b>	<b>28.6</b>	<b>24.8</b>	<b>15.2</b>	<b>14.4</b>	<b>16.8</b>

#### 4.4 Description of Water Quality Modeling

A simple modeling approach was used to develop the TMDL for the Lynnhaven, Broad and Linkhorn Bays. Personnel from EPA, Virginia DEQ, Virginia Department of Conservation and Recreation (DCR), Maryland Department of the Environment (MDE), Virginia DSS, Virginia Institute of Marine Sciences (VIMS), United States Geological Survey, Virginia Polytechnic Institute and State University, James Madison University, and Tetra Tech composed the shellfish TMDL workgroup to develop a procedure for

developing TMDLs using a simple approach. The goal of the procedure is to use BST data, in conjunction with shoreline surveys and other data, to determine the potential sources of fecal coliform violations and to use ambient water quality data to determine the load reductions needed to attain the applicable criteria. The Lynnhaven, Broad and Linkhorn Bay watershed meets the criteria for using the simple modeling approach because of the following conditions:

- The watershed is hydrologically simple (i.e. limited flushing due to constriction at the mouth of Lynnhaven Bay).
- Land use is homogenous (limited variability in land use patterns due to the dominance of single family homes)
- The area is served by a municipal sewer system that discharges treated effluent outside the basin
- Topography is relatively flat and runoff is collected in a storm water system of pipes, natural and manmade channels, and BMPs.

#### **4.5 Description of Sources Considered**

Both point and nonpoint sources of bacteria were considered in the Lynnhaven TMDL Study. Point source pollutant loads are discharged at a specific location from pipes, outfalls, and conveyance channels from municipal wastewater treatment plants, storm water outfalls, or industrial waste facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving water or river. In this study, storm water runoff that flows through the City of Virginia Beach's Municipal Separate Storm Sewer System (MS4) was considered to be a point source because discharges are regulated through a permitting system. Nonpoint source pollutants originate from multiple sources over a relatively large area, and can be divided into source activities related to either land or water use including failing septic tanks, improper animal-keeping practices, forest practices, and urban and rural runoff. In addition to the bacterial source tracking discussed in the previous sections, the DEQ Point Source Inventory and DSS Shoreline Survey were used to determine point sources and principal non-point sources such as failing septic systems and farm based non-point source operations.

##### **4.5.1 Point Source Contributions**

The entire watershed is served by a regional wastewater treatment agency, Hampton Roads Sanitation District. There are no wastewater treatment plants or their permitted discharge locations within the watershed. A large sewage collection system traverses and serves the drainage area. Sewage collection is a joint system in which the City of Virginia Beach operate and maintain the collection system which discharges into HRSD's interceptor system. HRSD conveys the locally collected waste to large centralized and interconnected treatment facilities. According to the TMDL report the

sewer system network had a record of frequent discharges to the adjacent storm water system and to state waters on an annual basis. Any discharge from this system is considered a sanitary sewer overflow (SSO) and considered a point source for this discussion. These SSO discharges are due to gravity sewer line and house clean out leaks and spills, damage to sanitary sewer facilities caused by construction activities, power outages, malfunctions and failures of force mains and pump stations, and similar problems.

Any discharges from both the City of Virginia Beach and HRSD systems are reported to and recorded by the Virginia DEQ using the Hampton Roads Sanitary Sewer Overflow Reporting System (SSORS). This tracking system developed by the Hampton Roads Planning District Commission (HRPDC) became operational in October 2004. The City has reported 40 spills totaling 5,000 gallons from its part of the collection system within the Lynnhaven watershed. However, zero gallons were reported as reaching state waters as a result of those spills.

Storm water outfalls are located throughout the watershed as a part of the City's MS4. Discharges are regulated by the Virginia DCR through a Virginia Pollution Discharge Elimination System (VPDES) permit issued to the City of Virginia Beach. Figure 4-5 shows the locations of the approximately 979 storm water outfalls within the Lynnhaven watershed. Naval Air Station Oceana has a VPDES permit (#VA0005266) to discharge stormwater runoff from the base to London Bridge Creek, Wolfsnare Creek, Great Neck Creek, and West Neck Creek.

#### **4.5.2 Non-Point Source Contributions**

Non-point source contributions to the bacterial levels in the Lynnhaven system result from both anthropogenic and natural sources. Potential human activities which may contribute to the bacterial pollution include failing septic systems and their associated drain fields, sanitary discharges from moored or transiting vessels, improper pet waste disposal practices, exfiltration from existing sewer lines and sheet flow runoff from lawns and urban areas. Natural sources include the abundance of migratory and resident species of birds along with the natural mammalian populations which are expected to occupy the 30% of the watershed area cited as public, agricultural, parks, marshland or undeveloped.

Isolated areas within Lynnhaven watershed still utilize septic systems and have drain fields for sanitary waste treatment. The largest concentration of these homes is located at Little Neck Point in Lynnhaven Bay. Any malfunction within these disposal systems may act as a contributing source of fecal coliform to the Bay. The City has targeted connecting these areas to the regional sewerage collection system. The latest Department of Shellfish Sanitation (DSS) shoreline sanitary survey for Lynnhaven Bay before completion of the TMDL was conducted from May 18, 2000 to June 7, 2000 and identified six potential deficiencies related to septic systems. A shoreline sanitary survey was completed for Broad Bay in 2005, and results of that survey are discussed in Section 5.4.



#### 4.6 TMDL Load Reductions and Allocation Results

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

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

Total Allowable loads were calculated by multiplying the applicable bacteria criteria by the volume of water. Receiving water volumes were calculated using 1-meter depth profiles from the National Elevation Dataset (NED). The waste load allocation portion of this load refers to the portion of the pollutant load that is delivered to the waterbody from wastewater treatment plants or storm water management systems. In an urbanized system like the Lynnhaven Watershed where there are no point source discharges from wastewater treatment plants, the WLA is approximate. It can be, and was, equated to the water that can be expected to be delivered to the waterbody through the storm water management system. The storm water management system is designed to collect water from the impervious areas of the watershed, so the portion of the total load allocated as the waste load can be equated to the average amount of impervious area within the watershed. Averaging the percent impervious area by land use, the Lynnhaven watershed has an average impervious area of 34 percent.

Utilizing this method the waste load allocation is arrived at by assigning 34 percent of the total load allocation calculated under the assumption that this is reflective of the contribution of the impervious area in the watershed. The assumption that this area is 100 percent impervious and has no bacterial decay is a very conservative assumption. This assertion is made with the understanding that there is no meaningful method to determine specific bacterial loading in a storm water system with 979 major and minor outfalls distributed throughout a 64 square mile watershed in the absence of data to calibrate the model. Without the availability of sufficient data from the major outfalls to calculate runoff and transport within known BMP service areas of the MS4 watershed this assumption suffices to provide an initial partitioning of the load into WLA and LA (DEQ 2004).

The load reduction needed to meet water quality standards is the difference between the total allowable load and the current load. The current loadings for the Lynnhaven watershed were determined by reviewing the most recent 30-months of data overlapping the end of the TMDL study in August of 2002. Because all the stations in the Lynnhaven watershed reflect a condition of noncompliance with the water quality standard for bacteria in shellfish waters, the water quality data were averaged across all stations for Lynnhaven Bay and Broad and Linkhorn Bays. This treats high and low values equally and provides a target that can be easily comprehended and uniformly implemented while retaining the necessary protection for the affected waters.

Existing loadings were calculated using the station averages for both the geometric mean and the 90<sup>th</sup> percentile. The geometric mean and 90<sup>th</sup> percentile loads for each shellfish area averaged across all monitoring stations was determined by multiplying the average bacteria count, based on the most recent 30-month period of record, by the

volume of the water. A comparison of the geometric mean data and the 90th percentile data for the last 30 months shows that the 90th percentile data is the more critical condition. The 90th percentile criterion is the criteria most frequently and severely exceeded, and it is reductions in these bacterial loadings that will yield water quality improvements. Therefore the 90<sup>th</sup> percentile loading was combined with the results of the BST to allocate source contributions and establish load reduction targets among the various contributing sources.

The BST data was used to estimate the percent loading for each of the major source categories and is used to determine where load reductions are needed. Because no seasonal differences between sources were identified, the percent loading per source was averaged over the 12-month period. The percent loading by source was multiplied by the 90th percentile load, to determine the load by source. The percent reduction needed to attain the water quality standard was allocated to each source category. This method ensures that all sources and loadings are identified and quantified via the BST and mathematical calculations, seasonal variability is addressed, and critical conditions are identified. The allocations and percent reductions by source for Lynnhaven Bay and Broad and Linkhorn Bays are presented in Tables 4-5 and 4-6. As mentioned in Section 4.3, bacterial source tracking is a relatively new tool with limitations, and results should be used with caution. Additional studies are planned or proposed for smaller areas within the watershed to further define these loadings.

**Table 4-5: Total Load Allocations and Percent Reductions for Lynnhaven Bay (DEQ 2004)**

<b>GROWING AREA 70, CLOSURE 25A</b>	<b>BST Results: Percent of total load</b>	<b>Current Load</b>	<b>Waste Load Allocation</b>	<b>Load Allocation</b>	<b>Total Load Allocation</b>	<b>Percent Reduction</b>
Bird	28.6%	4.09E+12	8.62E+10	1.67E+11	2.54E+11	93.8%
Wildlife	16.8%	2.40E+12	8.16E+11	1.58E+12	2.40E+12	0%
Human	24.8%	3.55E+12	0.00E+00	0.00E+00	0.00E+00	100%
Pets	14.4%	2.06E+12	0.00E+00	0.00E+00	0.00E+00	100%
Livestock	16.8%	2.40E+12	0.00E+00	0.00E+00	0.00E+00	100%
Total	100%	1.43E+13	9.01E+11	1.75E+12	2.65E+12	81.5%

**Table 4-6: Load Allocations and Percent Reductions for Broad and Linkhorn Bays (DEQ 2004)**

<b>GROWING AREA 71, CLOSURE 25B</b>	<b>BST Results: Percent of Total load</b>	<b>Current Load</b>	<b>Waste Load Allocation</b>	<b>Load Allocation</b>	<b>Total Load Allocation</b>	<b>Percent Reduction</b>
Bird	28.6%	9.38E+10	3.19E+10	6.19E+10	9.38E+10	0%
Wildlife	16.8%	5.51E+10	1.87E+10	3.64E+10	5.51E+10	0%
Human	24.8%	8.13E+10	1.38E+10	2.68E+10	4.07E+10	50%
Pets	14.4%	4.72E+10	1.60E+10	3.12E+10	4.72E+10	0%
Livestock	16.8%	5.51E+10	1.87E+10	3.64E+10	5.51E+10	0%
Total	100%	3.28E+11	9.35E+10	1.82E+11	2.75E+11	16.2%

## **5.0 ADDITIONAL INFORMATION SINCE TMDL DEVELOPMENT**

Since the development of the Lynnhaven TMDL Study in 2004, additional data has been collected that can aid the understanding of water quality dynamics within the watershed.

### **5.1 Land use Changes**

The City of Virginia Beach provided tax parcel data from 2005 that was used to estimate current land uses within the Lynnhaven River watershed (Figure 5-1). The Navy has provided land use data from 2001 for Naval Air Station Oceana as seen in Figure 5-2.

### **5.2 Additional Shellfish Condemnation Areas**

Since the development of the TMDL, monitoring data have shown additional violations of the State's water quality standard for fecal coliform bacteria in shellfish supporting waters. Heavy rains over the last sampling period resulted in increased amounts of runoff from urban and agricultural areas resulting in higher fecal coliform loads to tidal waters (VDH 2005). The most recent Notice and Description of Shellfish Condemnation Number 25, Lynnhaven River, Broad and Linkhorn Bays, effective February 10, 2006, includes an additional condemnation area closing all of Broad Bay. These current condemnation areas are depicted in Figure 5-3.

### **5.3 Additional Water Quality Monitoring Sites**

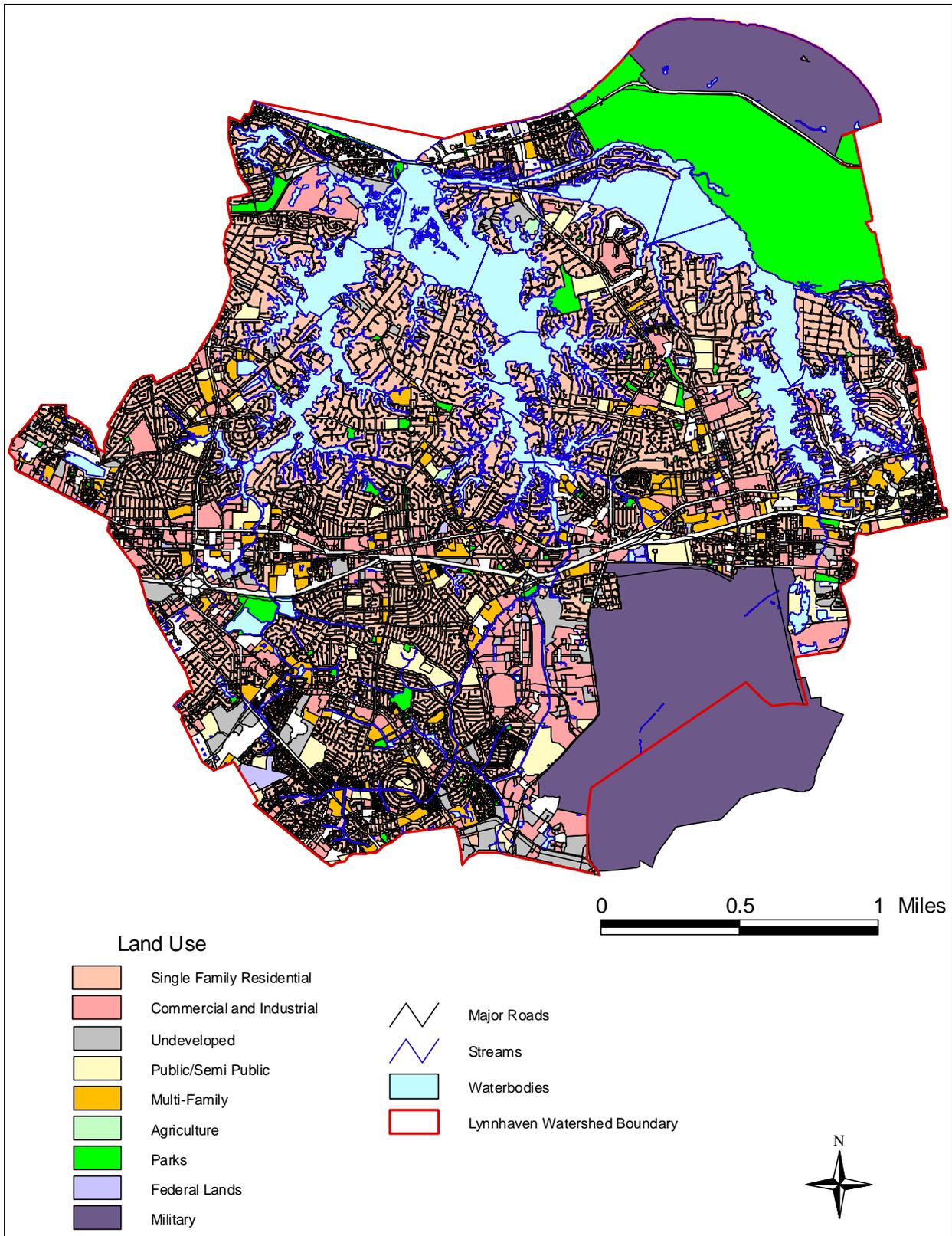
Since the development of the TMDL, VDH-DSS has added 2 fecal coliform monitoring stations in Lynnhaven Bay and 12 stations in Broad and Linkhorn Bays. The locations of these new stations are shown in Figure 5-4.

### **5.4 Updated Shoreline Survey**

VDH-DSS conducted a shoreline survey of growing area #071, Broad and Linkhorn Bays, from August 12, 2005 – September 29, 2005. Within the survey boundary, DSS staff documented sixteen marinas, nine other places where boats are moored, and four potential sites of boating activity to keep under surveillance. No other potential sources of pollution were documented. Figure 5-5 shows the boundary of the survey area and the location of boating activity.

### **5.5 Updated Water Quality Modeling**

In conjunction with the Army Corps of Engineers' restoration study of the Lynnhaven watershed, the Virginia Institute of Marine Sciences (VIMS) is developing a hydrodynamic model for the Lynnhaven River system and URS is developing a watershed-loading model for the Lynnhaven watershed. When completed the hydrodynamic model will provide additional information on the cycling of nutrients, sediment, and bacteria within the Lynnhaven River system, and the watershed loading model will allow the City of Virginia Beach to model the effects of proposed management actions.



**Figure 5-1: 2005 Land Use Within the Lynnhaven River Watershed (City of Virginia Beach)**





Figure 5-3: Shellfish Condemnation Areas Effective January 21, 2005

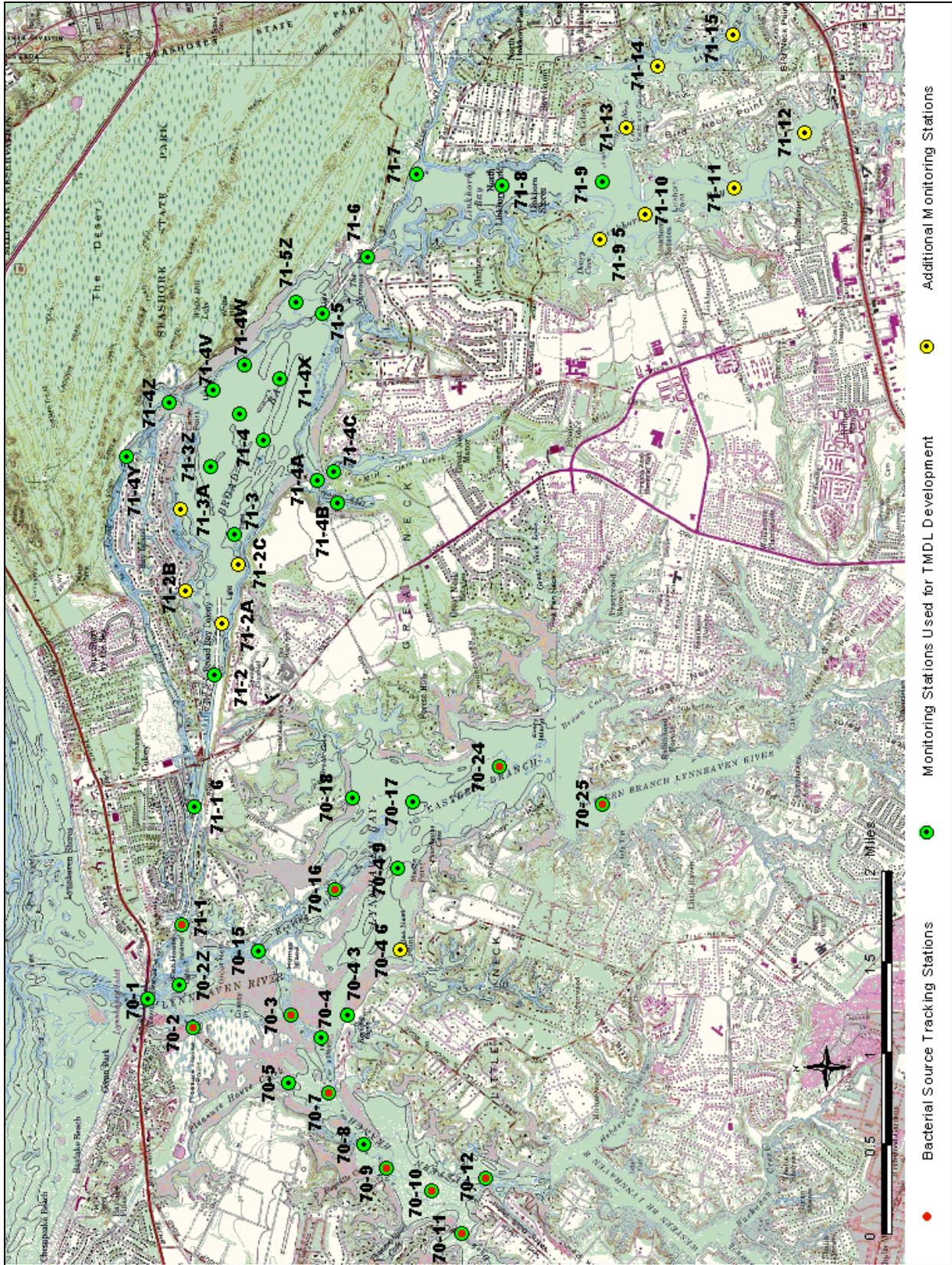


Figure 5-4: VDH-DSS Bacteria monitoring stations active in 2005.

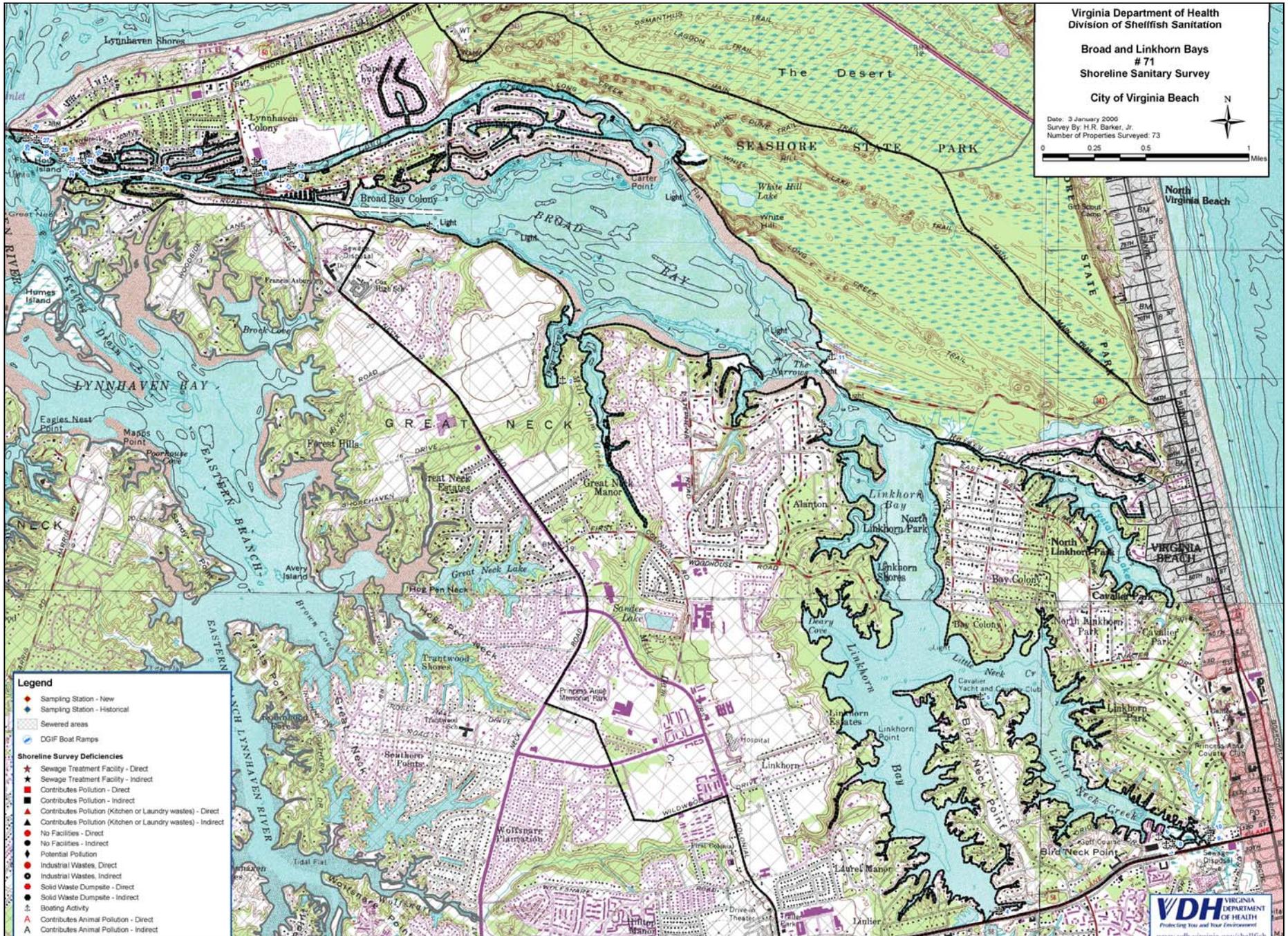


Figure 5-5: Shoreline Survey Boundary

## 6.0 PUBLIC PARTICIPATION

An essential step in implementing a TMDL is the input from a broad range of individuals, agencies, organizations and businesses because of their interest and familiarity with local water quality needs and conditions. Public participation facilitates dialogue between local stakeholders and government agencies to commit resources to TMDL implementation, such as funding and technical support. Community members are best suited to identify and resolve sources of water quality problems. In order to engage the public in the development of the TMDL Implementation Plan for the Lynnhaven Bay Watershed, two public meetings were held in March 2005 and the Spring of 2006. The City of Virginia Beach, other agencies, and community groups are pursuing a number of activities independently of the TMDL Implementation Plan Process. Where appropriate, these initiatives were incorporated into the TMDL Implementation Plan process.

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

- City of Virginia Beach – Departments of Planning, Public Works, Public Utilities, Parks and Recreation, Agriculture
- Hampton Roads Sanitation District
- Hampton Roads Planning District Commission
- Virginia Department of Environmental Quality – Water Division and Virginia Coastal Program
- Virginia Department of Conservation and Recreation – Divisions of State Parks, Chesapeake Bay Local Assistance and Soil and Water Conservation
- Virginia Marine Resources Commission
- Virginia Department of Health
- Virginia Department of Transportation
- Virginia Institute of Marine Science
- Virginia Department of Game and Inland Fisheries
- Virginia Dare Soil and Water Conservation District
- U.S. Navy

## **7.0 IMPLEMENTATION OPTIONS**

Implementation of this TMDL will contribute to the on going water quality improvement efforts aimed at restoring water quality in the Chesapeake Bay. In general, reduction strategies will be implemented in a staged process that first addresses sources with the largest impact on water quality. In Lynnhaven Bay, implementation will focus on reducing bacterial contamination due to humans, pets, and livestock. In Broad and Linkhorn Bays the focus of implementation will be on reducing bacterial contamination due to humans. In urban areas, the focus will be on reducing pollution due to sanitary sewer overflows, septic system failures, stormwater runoff and recreational boating. Many of the implementation actions recommended in this plan are in accordance with the City of Virginia Beach's Watershed Management Plan for the Lynnhaven watershed. Figure 7-1 illustrates the City of Virginia Beach's environmental projects that have been implemented within the Lynnhaven watershed. Many of these projects have been or are being implemented in order to reduce fecal coliform bacteria pollution in Lynnhaven, Broad and Linkhorn Bays. The City of Virginia Beach is constructing and planning extensive rehabilitation of the existing sanitary sewer system and expansion of sewer areas throughout the watershed.

### **7.1 Linking the TMDL to Implementation**

The Lynnhaven Shellfishing TMDL was approved by EPA in 2004, but relied largely on data collected prior to 2003. Water quality monitoring of the system has been ongoing and several studies have been undertaken since the completion of the TMDL to better understand the hydrodynamics of the System as well as the sources of fecal coliform loading. Because the BST data were used to develop the waste load and load allocations for the study area, they were also used as guidance for developing management actions. It is important to consider both the TMDL as well as the additional information obtained since its completion when developing the implementation actions that may improve water quality within the Lynnhaven System. It should be noted that due to uncertainty, the allocations contained in the TMDL study should, but may not, result in attainment of the fecal coliform standard for shellfishing waters in Lynnhaven, Broad and Linkhorn Bays. The success of the management actions proposed in this document will be determined by ambient water quality data rather than attainment of load allocations.

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

The feasibility of attaining the water quality criterion for shellfishing must also be considered. Given the anthropogenic changes throughout the watershed, the history of shellfish closures in the Lynnhaven Bay and the amount of fecal coliform attributed to wildlife in the TMDL, the management actions proposed in this implementation plan may prove to be insufficient to open the headwaters of the Lynnhaven Bay to shellfishing. Therefore, resources will first be focused on implementing management options in areas where they will have the greatest impact on water quality improvements. Because water quality data collected by VDH-DSS indicates that Broad Bay has the greatest potential to achieve the bacteria criterion, the City of Virginia Beach is currently focusing its efforts to identify and reduce sources of bacteria in this area of the watershed.

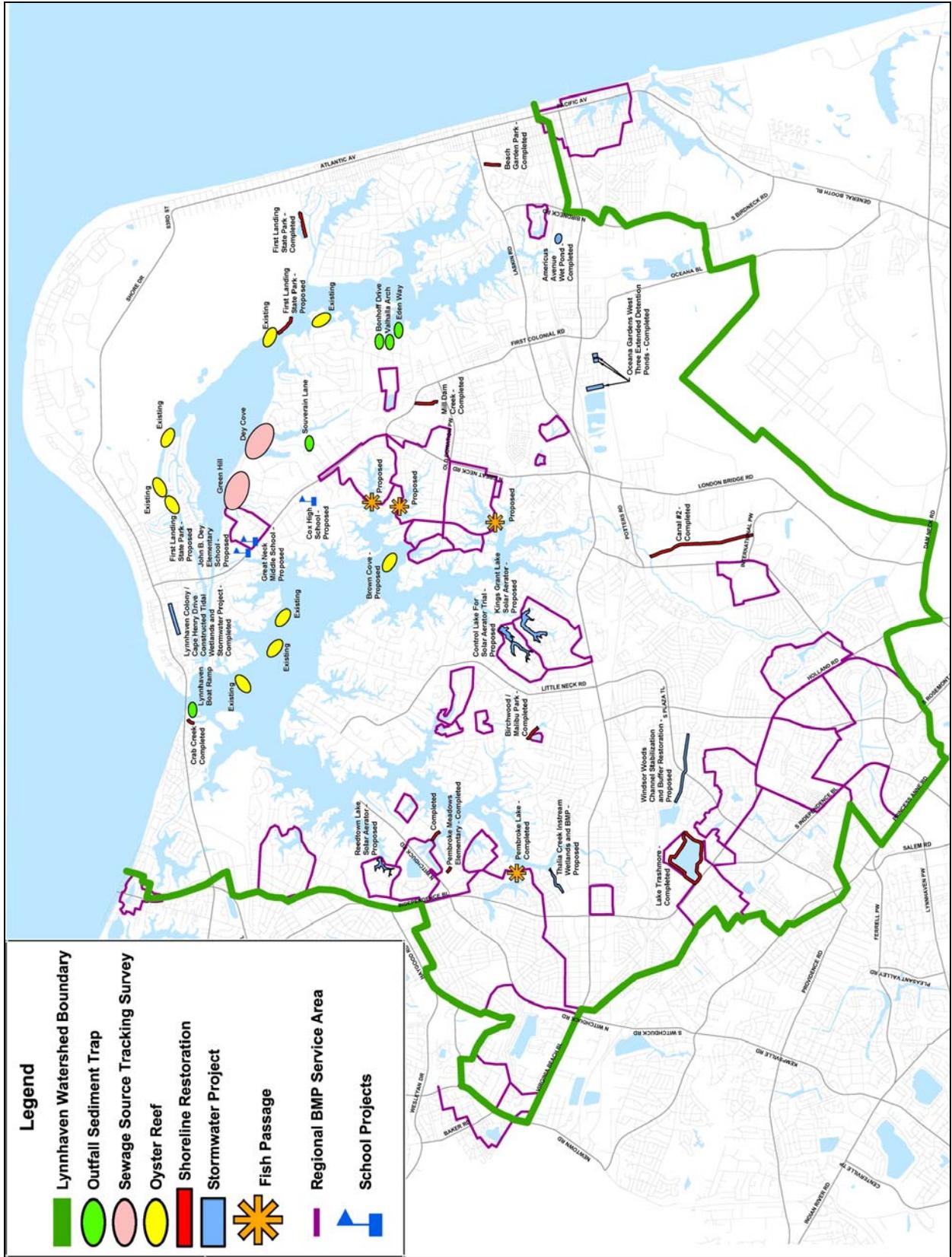


Figure 7-1: City of Virginia Beach Environmental Projects in the Lynnhaven Watershed

## 7.2 Identifying Implementation Actions

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

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

**Table 7-1 Management Options for Implementation of Lynnhaven TMDL**

<b>Management Category</b>	<b>Management Option</b>	<b>Development Phase</b>
Agricultural BMPs	Rooftop Runoff Collection for Horse Stables	Phase I
	Animal Waste Management Plan for Oceana	Phase I
	Equine Facility Inventory for Virginia Beach	Phase I
	Oceana BST Study	Phase I
	Equine Facility Pasture Management for Virginia Beach	Ongoing
Sanitary Sewer Improvements	Development and Implementation of Capacity, Maintenance, Operations, and Management (CMOM) Plan	Ongoing
	Find and Fix Program	Ongoing
	Rehabilitation of Existing Sanitary Sewer Lines	Ongoing
	Little Neck Peninsula Sewer Project	Phase I
	Dey Cove Source Tracking Study	Phase I
	Follow up of Dey Cove Study Results	Phase II
	Policy Change for Mandatory Sewer Connection	Phase III
	Enforcement of CBPA Septic Tank Pump Out and Inspection Regulatory Requirements	Ongoing
Stormwater Programs	Solar Aerators in Stormwater Ponds	Phase I
	Water Quality Monitoring of Ponds with Aerators	Phase I
	Pembroke Area BMP	Phase II
	Investigate Street Sweeping Expansion	Phase I
	Compliance with New MS4 permit	Phase I
Boating Programs	Establishment of No Discharge Zone	Phase I
	Development of Clean Marina Certification Program	Phase I
	Update Inventory of "No Wake Zones"	Phase I
	Expansion of "No Wake Zones" as necessary	Phase II
	Floating Comfort Station	Phase III
Pet Waste Programs	Pet Waste Ordinance	Ongoing
	Enforcement of Pet Waste Ordinance	Phase I
Erosion and Sediment Control	Enforcement of Virginia Beach Erosion and Sediment Control Ordinance	Ongoing
Aquatic Resource Restoration	Riparian Buffer Enhancement Plan	Ongoing
	Oyster Heritage Program	Ongoing
	USACE Lynnhaven River Environmental Restoration Project	Phase I
	USACE Chesapeake Bay Oyster Restoration Study	Phase I
	Living Shoreline Program	Ongoing
Education Programs	Boater Education Program	Phase I
	Regional Education Programs (HRWET, HRSTORM, HRCLEAN, HRFOG)	Ongoing
	"Scoop the Poop" Program	Ongoing
	City contract with Lynnhaven River 2007 for Public Awareness Programs	Phase I
	Lynnhaven Watershed Markers	Completed
	Education for Livestock and Equine Facility Owners	Phase III
	CBPA Septic Tank Pump Out and Inspection Information Program	Ongoing
	Wildlife Feeding Education Program	Phase I

<b>Management Category</b>	<b>Management Option</b>	<b>Development Phase</b>
Land Use Management	Chesapeake Bay Preservation Area Ordinance	Ongoing
	Wetlands and Waterfront Operations Program	Ongoing
	Habitat Enhancement Committee	Ongoing
Wildlife Contribution Controls	City Ordinance to Prevent Feeding of Waterfowl	Phase II
	Evaluate/Inventory Wildlife Populations within the Watershed	Phase III

### **7.2.1 Agricultural BMPs**

Bacterial Source Tracking (BST) indicated that approximately 16 percent of the bacterial load in the Lynnhaven Bay is attributable to livestock. The TMDL calls for a 100 percent reduction in bacteria inputs from livestock. Land use data indicates that less than 1 percent of the land area is classified as pasture. Currently, there are no identified sources of livestock within the Lynnhaven watershed boundaries. The Navy is currently conducting a study to identify all livestock or equine facilities within the Lynnhaven and Southern Watersheds.

The Navy used the 2001 Virginia Equine Report and a recent directory of stables from the Tidewater Horse Council Directory to identify potential sources of livestock waste within the Lynnhaven Watershed. The 2001 Virginia Equine Report indicates there are approximately 2,300 equine of all types in Virginia Beach. Using the Tidewater Horse Directory, Oceana staff determined there are 6 equine facilities within the Lynnhaven watershed (5 private and 1 commercial). The majority of agricultural facilities within Virginia Beach are located south of the Lynnhaven watershed boundary in the Southern Waters watershed. Due to the hydraulic connection between the Lynnhaven and Southern Waters watersheds, these facilities may have the potential to impact water quality within the Lynnhaven watershed. The Virginia Beach Department of Agriculture and Virginia Dare Soil and Water Conservation District (SWCD) are planning to work together in the future to educate the operators of these equine facilities about best management practices that will reduce runoff of equine waste to area streams.

There are approximately 140 horses located at Naval Air Station Oceana, but they are just outside the watershed boundary. Horses are fenced out of nearby streams and these pastures are well maintained. Spreading of manure on lands within the Lynnhaven watershed does occur and Oceana has submitted an application to expand the horse facilities to within the watershed boundary. The Navy is currently conducting a bacterial source tracking (BST) study to identify the sources of fecal coliform in streams and drainage ditches in this area of Oceana. The Navy is also working with the Virginia Dare SWCD to develop a nutrient management plan for the manure applications and identify other BMPs that can be implemented to reduce agricultural runoff. A rooftop runoff collection system will be constructed to divert runoff from newly constructed stable roofs away from manure piles. Existing stable roofs will be retrofitted if feasible.

### **7.2.2 Sanitary Sewer System Improvements**

The TMDL calls for 100 percent reduction in bacteria loading due to human sources to the Lynnhaven Bay and Broad and Linkhorn Bays. Sources of human bacteria loading to waterbodies include sanitary sewer overflows (SSOs) and failing septic systems. SSOs occur when pipes become blocked due to roots, grease, or sediment, or when the system loses electric power at the pump station(s).

The City of Virginia Beach is currently involved in a regional effort to work with HRSD, the Virginia DEQ, and EPA Region 3 to develop and implement a plan to address

SSOs. The City has agreed to enter into a Consent Order with DEQ that will outline the actions necessary to reduce sanitary sewer overflows. Recently, the City created an SSO bureau to focus on improving the sanitary sewer system and reducing the occurrences of SSOs. Currently, three full time personnel are devoted to managing the City's fix and find efforts and pump station data analysis.

The City of Virginia Beach has enacted a proactive sanitary sewer maintenance program. The program will be implemented over the next three years. Eleven areas have been scheduled for work in the first year with additional areas to be completed in subsequent years. As part of Virginia Beach's Aging Infrastructure Program and Comprehensive Sanitary Sewer Evaluation Study, contractors working for the Department of Public Utilities will clean and inspect the various sanitary sewers throughout the City.

This program includes cleaning pipes and manholes, smoke testing and CCTVing of sewer lines, and inspection of stream crossings. The City will also continue upgrading pump stations with new generators and bypass pumps. During 2004, thirteen city neighborhood sewer projects were completed, and nine more projects will be completed by October 2005. Through the above actions reported SSOs were reduced by 32 percent from 172 in 2002 to 117 in 2004. A greater reduction of 43 percent was realized in 2005 when the number of SSOs dropped to 82. Additionally, the City of Virginia Beach will develop a full Capacity, Maintenance, Operations, and Management (CMOM) Plan in order to comply with the proposed CMOM requirements found in Section 122.42(e)(2) of the Federal Register.

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

Currently, funds available through the Capital Improvement Program (CIP) are being utilized to construct a public sanitary sewer system for the Little Neck Peninsula. This area has the largest concentration of septic systems still left in Virginia Beach. The first phase of the project was completed in 2003 and replaced 78 septic systems in the Redwood Farm Neighborhood. The remaining work that will replace an additional 320 septic systems is scheduled to be completed in March 2006. Residents will have one year to comply with the mandatory connection policy.

As other neighborhoods show interest in being hooked up to city sewer, they will be put on a priority list. Fifty-one percent of residents living in the area must show interest in becoming part of the City sewer system. Once this occurs the neighborhoods will be prioritized and included in the CIP. If a neighborhood does not show interest in being hooked up to city sewer, but the Health Department determines that the septic systems are a source of violation they will automatically be a priority for the CIP budget without the fifty-one percent consent of residents living there.

The 150-200 structures in the city that are currently hooked up to private septic systems rather than city sewer are being investigated. If a building is near a public sanitary sewer system and the building is capable of connecting by gravity to the public sanitary sewer system, it is mandatory that the building be connected. The only time a structure is not mandated to hook up to a gravity system that is nearby is if the difference in elevation (relief) between the home and the street does not physically allow a gravity connection and a pump system is required to eliminate the septic tank. In this case the homeowner can determine if they want to be hooked to the city sewer or not, unless the septic system has failed and the connection is mandatory.

### **7.2.3 Stormwater Programs**

The TMDL calls for reductions in bacteria delivered to waterbodies through urban stormwater runoff. In 1993, the City implemented a storm water management service fee for the purpose of maintaining and upgrading drainage systems within the City by addressing issues such as floodplain problems, improving drainage, and reducing pollutants in storm water runoff. Projects funded by this fee include the creation and cleaning of roadside ditches, pipe installations, street sweeping, spill clean-ups, and catch basin cleaning.

Traditional definitions of stormwater have usually characterized it as nonpoint source runoff. However, most urban and industrial stormwater is discharged through conveyances, such as separate storm sewers, ditches, channels or other conveyances, which are considered point sources under the Clean Water Act (CWA), and subject to regulation through the National Pollutant Discharge Elimination System (NPDES) permit program.

Virginia is an authorized state under the federal permitting program. DCR administers the federal program pertaining to the municipal separate storm sewer systems (MS4s) and construction activities as part of the Virginia Stormwater Management Program (VSMP) permit program, which is authorized under the Virginia Stormwater Management Act. As mandated by the Clean Water Act and EPA's Phase 1 (11/16/90) and Phase 2 (12/8/99) stormwater regulations, the federal permitting requirements have been incorporated into the Permit Regulation in sections 4 VAC50-60-380 and 390.

The majority of the Lynnhaven, Broad and Linkhorn Bay watershed is covered by a Phase I VPDES permit VA0088676 for the municipal separate storm sewer system (MS-4) owned by the City of Virginia Beach. This permit was issued on January 6, 1996 and reissued in April 2001. The City has submitted an application for renewal of this permit. As of the completion of this report, the renewal process is on going. The existing Phase I VPDES permit for the City of Virginia Beach has been administratively continued. The permit states, under Part II.A., that the "permittee" must develop, implement, and enforce a storm water management program designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable (MEP), to protect water quality, and to satisfy the appropriate water quality requirements of the Clean Water Act and the State Water Control Law." The permit also contains a TMDL

clause that states: “If a TMDL is approved for any water body into which the MS4 discharges, the Board will review the TMDL to determine whether the TMDL includes requirements for control of storm water discharges. If discharges from the MS4 are not meeting the TMDL allocations, the Board will notify the permittee of that finding and may require that the Storm Water Management Program required in Part II be modified to implement the TMDL within a timeframe consistent with the TMDL.” The City of Virginia Beach is currently involved in the reapplication process for its MS4 permit. The implementation actions listed below will be modified in order to comply with the terms of the new permit.

Currently, the City of Virginia Beach is implementing or planning several actions as part of the stormwater program that will serve to reduce fecal coliform levels within the Lynnhaven Watershed. Three solar aerators were installed in each of two stormwater ponds in January 2006. A City report indicated that bacteria levels should drop and dissolved oxygen concentrations should increase through the use of these aerators. The stormwater ponds will be monitored for one year to determine the effectiveness of the aerators at improving water quality and providing additional benefits. If the aerators are effective, the City of Virginia Beach will establish a schedule for expansion of the program. The City of Virginia Beach is exploring the possibility of constructing an instream BMP in the Pembroke area. The project will require environmental permits from DEQ and USACE because it entails retrofitting an existing tidal mud flat into ponds and the establishment of created wetlands.

The City of Virginia Beach is considering a plan to expand its street sweeping efforts. For nearly three years the Department of Public Works has operated a street sweeping program in the Lynnhaven River watershed. There is one sweeper committed to focus on residential areas. Based upon the residential street curb mileage and the one sweeper available for the program the City has projected a multi-year cycle along with the continuation of sweeping the large arterials on a regular cycle. The sweepers that the City owns are broom sweepers and focus on direct collection of organic materials and sediment. The City is currently reviewing the effectiveness of its street sweepers at removing sediment and attached bacteria from the stormwater system. In the future, the City will consider expanding their street sweeping efforts and adding regenerative air sweepers if such actions are deemed cost effective.

The remainder of the watershed area is covered by the Phase II VPDES Permit for U.S. Naval Air Station at Oceana (VAR040043). Storm water runoff from NAS Oceana drains to West Neck Creek, London Bridge Creek, Wolfsnare Creek, Great Neck Creek, and Redwing Lake. The permit outlines the BMPs that will be utilized to meet the six minimum control measures required for compliance with VPDES Phase II regulations, and defines the measurable goals intended to show efforts. U.S. Navy will maintain its Phase II Stormwater Program including data collection efforts and instituting education programs relative to stormwater management.

#### **7.2.4 Boating Programs**

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

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

The City of Virginia Beach has requested that the Lynnhaven Watershed be designated by the Virginia Department of Environmental Quality and the Environmental Protection Agency as a No Discharge Zone (NDZ). This designation will make it illegal to discharge boat sewage within the Lynnhaven Watershed. The City conducted a Marine Sanitation Needs Assessment that determined there are adequate pump out facilities and enforcement capabilities to support a NDZ in the Lynnhaven. DEQ has decided to proceed with the NDZ proposal and a public meeting was held on January 19, 2006. DEQ has presented the NDZ proposal to the State Water Control Board with a recommendation on pursuing the NDZ designation from EPA. A draft NDZ proposal has been sent to the EPA. In conjunction with the NDZ designation, the City is working with Lynnhaven 2007 to develop a Clean Marina Certification Program that will recognize marinas that implement best management practices to reduce pollution.

In order to address shoreline erosion and resuspension of bacteria laden sediment, the City of Virginia Beach is planning to conduct an inventory of existing "No Wake Zones" and determine if additional zones are necessary to reduce shoreline erosion in sensitive areas. In the future, the City may explore the logistics of working with HRSD and marina owners to develop a floating comfort station in Lynnhaven Bay that would provide restroom facilities for boaters. This project is only in the very early stages of development and implementation is contingent upon cost estimates, available funding, and engineering feasibility.

#### **7.2.5 Pet Waste Programs**

The TMDL calls for a 100 percent reduction in bacteria due to pet waste for Lynnhaven Bay. This reduction will be achieved primarily through public education campaigns discussed in Section 7.2.8. The City of Virginia Beach has an ordinance (#1237) that

requires pet owners to clean up after their animals. Violation of this ordinance is a class 4 misdemeanor punishable by a maximum fine of \$250.

### **7.2.6 Erosion and Sedimentation BMPs**

Erosion and sedimentation control measures may indirectly reduce the bacteria loading to waterbodies. Bacteria can cling to small sediments, so erosion prevention measures should also serve to reduce bacteria loading. Historically, Virginia Beach's main generator of sediment pollution was from construction sites and other development, but currently shoreline erosion is the leading generator of sediment within the Lynnhaven watershed.

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

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

### **7.2.7 Aquatic Resource Restoration**

The goal of this implementation plan is to reduce fecal coliform bacteria concentrations to enable the safe consumption of shellfish within designated waters. However, good water quality and a healthy aquatic ecosystem are essential in order to maintain an abundant shellfish population within the Lynnhaven Watershed. Virginia Beach is currently working with the Corps of Engineers and the Virginia Institute of Marine Sciences to develop a restoration plan for the Lynnhaven River. In addition to the development of this plan, there are multiple aquatic resource restoration activities

underway within Virginia Beach that will help establish a healthy shellfish community in keeping with the goals of the TMDL and implementation plan.

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

The City of Virginia Beach also operates a Living Shoreline Program and has developed a Riparian Buffer Enhancement Plan. Both of these initiatives encourage the preservation and restoration of critical shoreline habitats. Living shorelines emphasize the use of natural materials including marsh plantings, shrubs and trees, low profile breakwaters, strategically placed organic material, and other techniques that recreate the natural functions of a shoreline ecosystem. Riparian forest buffers provide canopy shade and stream habitat, filter runoff, and uptake nutrients.

#### **7.2.8 Education Programs**

Public education and outreach are important tools for reducing bacterial pollution due to pet waste, stormwater runoff, recreational boating, agricultural practices, and sanitary sewer overflows. The City of Virginia Beach has contracted with Lynnhaven River 2007 to organize the City's public awareness programs. Virginia Beach Public Works has installed markers throughout the Lynnhaven River watershed to increase awareness of the drainage area to Virginia Beach residents. Virginia Beach will continue to participate in regional education programs coordinated by the Hampton Roads Planning District Commission including HR WET, HR STORM, HR CLEAN, and HR FOG. Brief descriptions of these programs and their web addresses are displayed in Table 6-2.

The Virginia Beach SPCA has partnered with HR STORM to initiate a "Poop Pollutes" campaign to educate dog owners about the water pollution caused by pet waste. The campaign consists of posters, t-shirts, and a website to inform pet owners about the proper disposal of pet waste.

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

Since 1996, VDH and HRSD have partnered in an annual boater education program funded through the Clean Vessel Act. This program provides boater education

concentrating on the proper disposal of on-board sanitary wastes. It also provides free sanitary holding tank pump-outs as a demonstration of ease and effectiveness. Operating with student interns, the activity takes place on weekends during the primary boating season from Memorial Day to Labor Day. In the past, the regional program has included but not targeted marinas on the Lynnhaven estuary. The City of Virginia Beach, beginning in the summer of 2006, will become an active participant in this education effort through funding and public education activities. This will permit weekly emphasis to be placed on those marinas potentially contributing to bacterial pollution in the Lynnhaven.

The Virginia Dare SWCD has established an Urban Programs Committee to become more actively involved in educational issues and technical assistance to residents of the northern part of Virginia Beach, including the Lynnhaven River Watershed. In the future, the SWCD will work with the City of Virginia Beach to implement an education program for equine and livestock facility owners within the City.

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

**Table 7-2: Regional Education Programs in Hampton Roads**

<b>Regional Education Program</b>	<b>Description of Program</b>	<b>Program Web Address</b>
HR CLEAN	HR CLEAN educates the region on the techniques of recycling, waste minimization, and the benefits of beautification and litter prevention.	<a href="http://www.hrclean.org">www.hrclean.org</a>
HR FOG	HR FOG educates the region on the proper techniques for disposing of oils and grease. The primary audience will be restaurants and homeowners will be a secondary audience.	Not yet established
HR STORM	HR STORM educates the region on the techniques of litter prevention, and the need to keep our storm water clean for the health of area waterways.	<a href="http://www.hrstorm.org">www.hrstorm.org</a>
HR WET	The Hampton Roads Water Efficiency Team educates the region on the techniques of water conservation, raising public awareness of the region's water supplies, and promotes efficiency of water use.	<a href="http://www.hrwet.org">www.hrwet.org</a>

### **7.2.9 Land Use Management**

The City of Virginia Beach has several programs that serve to manage development and minimize its environmental impact. Continuation of these programs will serve to

protect critical habitats within the Lynnhaven watershed and may be important in reducing the amount of bacteria entering the Lynnhaven River system.

The Virginia General Assembly adopted the Chesapeake Bay Preservation Act in 1988 and required all localities in Tidewater Virginia to implement local water quality measures by utilizing and developing land in ways that minimize impacts on water quality. Virginia Beach responded to this requirement by adopting the Chesapeake Bay Preservation Area Ordinance (CBPAO) in January of 1991. The CBPAO affects all properties that drain to the Chesapeake Bay in the City: the majority of which are within the Lynnhaven watershed. The purpose of the CBPAO is to protect existing high quality waters, prevent an increase in pollution and to restore state waters to a condition that permits all reasonable public uses and supports the growth of healthy aquatic life. This is accomplished by regulating development practices in the watershed. The most highly regulated areas are buffers called Resource Protection Areas (RPAs). RPAs include tidal wetlands, non-tidal wetlands, tidal shores, highly erodible soils, and a variable width buffer area not less than one hundred feet in width that is adjacent to and landward of these areas. Buffer areas are also located along both sides of any water body with recurrent flow. All of the other land in the watershed is labeled as Resource Management Areas, and protects the boundaries of the RPA.

The Wetlands and Waterfront Operations Program is operated by the City of Virginia Beach Planning Department, and its main focus is to prevent the despoliation of wetlands, sand dunes, and lowland resources on the coastline of the Chesapeake Bay and Atlantic Ocean. This is done through the regulation of residential and commercial waterfront construction. The preservation of existing wetlands and sand dunes that buffer waterbodies from surrounding development serves to prevent further degradation of water quality from the delivery of pollutants from urban areas.

Established in 1992, the Habitat Enhancement Committee (HEC), comprised of volunteers representing the business community; federal, state and local governments; conservation organizations; as well as the general public, is a partnership committed to enhancing Virginia Beach's natural environment specifically through coastal sand dune stabilization, tidal wetlands restoration, and community tree plantings. Funding for projects is provided from several sources including: civil charges collected from violations to the City's Wetlands and Coastal Primary Sand Dune ordinances, donations by individuals and businesses, and government and private grants. The projects chosen by the Committee have both economic and environmental benefits such as reducing soil erosion, creating wildlife habitat, alleviating flooding, enhancing property values, reducing energy costs, and improving the quality of life for citizens of Virginia Beach.

#### **7.2.10 Wildlife Contribution Controls**

The Lynnhaven River TMDL Study suggested that wildlife contributions to Lynnhaven, Broad and Linkhorn Bays are significant. As discussed in previous sections, the focus of this implementation plan is to reduce anthropogenic sources of bacteria. However, the City of Virginia Beach is considering developing an ordinance that will prohibit the

feeding of waterfowl. The City believes this ordinance will discourage undesirable numbers of waterfowl from using grassy habitats throughout the Lynnhaven watershed and reduce the amount of waterfowl fecal matter entering the receiving waters of the Lynnhaven watershed.

### **7.3 Implementation Costs and Benefits**

The primary benefit of the implementation of the management actions described in this IP is the reduction of bacteria levels in the Lynnhaven, Broad, and Linkhorn Bays. The programs and actions contained within this IP will serve to reduce the anthropogenic sources of bacteria within the Lynnhaven Watershed. Because many of the programs mentioned in this report also serve purposes other than to reduce bacteria, and they cover areas larger than the Lynnhaven Watershed, the costs of reducing bacteria levels in the Lynnhaven Watershed can be difficult to estimate. Estimated costs for proposed management actions and programs are outlined in Table 7-3. The estimated costs for programs such as stormwater management and sanitary sewer system improvements are estimated for the Lynnhaven watershed from the citywide annual budgets for these programs.

**Table 7-3: Estimated Costs of Management Options**

<b>Management Category</b>	<b>Management Option</b>	<b>Estimated Initial Costs<sup>1</sup></b>	<b>Estimated Annual Maintenance Costs<sup>1</sup></b>
Agricultural BMPs	Rooftop Runoff Collection for Horse Stables	\$200,000	\$20,000
	Animal Waste Management Plan for Oceana <sup>2</sup>		
	Equine Facility Inventory for Virginia Beach		
	Oceana BST Study <sup>2</sup>		
	Equine Facility Pasture Management for Virginia Beach		
Sanitary Sewer Improvements*	Development and Implementation of CMOM Plan	\$5,500,000	\$2,550,000
	Find and Fix Program		
	Rehabilitation of Existing Sanitary Sewer Lines		
	Little Neck Peninsula Sewer Project		
	Dey Cove Source Tracking Study		
	Follow up of Dey Cove Study Results		
	Policy Change for Mandatory Sewer Connection		
Enforcement of CBPA Septic Tank Pump Out and Inspection Regulatory Requirements			
Stormwater Programs	Solar Aerators in Stormwater Ponds	\$2,500,000	\$3,000,000
	Water Quality Monitoring of Ponds with Aerators		
	Pembroke Area BMP		
	Investigate Street Sweeping Expansion		
	Compliance with New MS4 permit		
Boating Programs	Establishment of No Discharge Zone	\$200,000	\$20,000
	Development of Clean Marina Certification Program		
	Update Inventory of "No Wake Zones"		
	Expansion of "No Wake Zones" as necessary		
	Floating Comfort Station		
Pet Waste Programs	Pet Waste Ordinance	\$20,000	\$5,000
	Enforcement of Pet Waste Ordinance		
Erosion and Sediment Control	Enforcement of Virginia Beach Erosion and Sediment Control Ordinance	\$50,000	\$500,000
Aquatic Resource Restoration	Riparian Buffer Enhancement Plan	\$2,000,000	\$200,000
	Oyster Heritage Program		
	USACE Lynnhaven River Environmental Restoration Project		
	USACE Chesapeake Bay Oyster Restoration Study		
	Living Shoreline Program		
Education Programs	Boater Education Program	\$100,000	\$25,000
	Regional Education Programs		
	"Scoop the Poop" Program		
	City Contract with Lynnhaven River 2007 for Public Awareness Programs		
	Lynnhaven Watershed Markers		
	Education for Livestock and Equine Facility Owners		
	Wildlife Feeding Education Program		
	CBPA Septic Tank Pump Out and Inspection Information Program		

<b>Management Category</b>	<b>Management Option</b>	<b>Estimated Initial Costs<sup>1</sup></b>	<b>Estimated Annual Maintenance Costs<sup>1</sup></b>
Land Use Management	Chesapeake Bay Preservation Area Ordinance	\$20,000	\$500,000
	Wetlands and Waterfront Operations Program		
	Habitat Enhancement Committee		
Wildlife Contribution Controls	City Ordinance to Prevent Feeding of Waterfowl	\$20,000	\$5,000
	Evaluate/Inventory Wildlife Populations within the Watershed		
<b>TOTALS</b>		<b>\$10,610,000</b>	<b>\$6,825,000</b>

\* Includes new construction, repair, replacement and rehabilitation of sanitary sewer infrastructure.

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

<sup>2</sup> Specific programs funded in their entirety through Federal budget for NAS Oceana.

## **8.0 MEASURABLE GOALS AND MILESTONES**

### **8.1 Establishing Goals**

#### **8.1.1 TMDL Goals**

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

#### **8.1.2 Related Watershed Management Goals**

- Restore water quality to the level necessary to support shellfish propagation for water quality benefits.
- Increase the area open for direct marketing of shellfish within the Lynnhaven River.
- Restore water quality in the Broad and Linkhorn Bays to a level necessary to support direct marketing of shellfish.

### **8.2 Establishing a Timeline and Milestones for Implementation**

As described in previous sections, the actions proposed in this implementation will be implemented in phases. A schedule of Phase I activities is contained in Table 8-1, and phase II and III actions will be implemented as actions prove necessary and funding becomes available. The completion of management actions will be tracked in program annual reports. Management actions related to stormwater management will be reported in the City of Virginia Beach's MS4 annual report.

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

<b>Management Category</b>	<b>Management Option</b>	<b>Projected Start Date</b>	<b>Projected Completion Date</b>
Agricultural BMPs	Rooftop Runoff Collection for Horse Stables	March 2006	March 2007
	Animal Waste Management Plan for Oceana	October 2005	June 2006
	Equine Facility Inventory for Virginia Beach	November 2005	December 2005
	Oceana BST Study	October 2005	June 2007
	Equine Facility Pasture Management for Virginia Beach	Ongoing	
Sanitary Sewer Improvements	Development and Implementation of CMOM Plan	Ongoing	
	Find and Fix Program	Ongoing	
	Rehabilitation of Existing Sanitary Sewer Lines	Ongoing	
	Little Neck Peninsula Sewer Project	Fall 2002	April 2006
	Dey Cove Source Tracking Study	January 2005	January 2007
	Enforcement of CBPA Septic Tank Pump Out and Inspection Regulatory Requirements	Ongoing	
Stormwater Programs	Solar Aerators in Stormwater Ponds	January 2006	January 2007
	Water Quality Monitoring of Ponds with Aerators	January 2006	January 2007
	Investigate Street Sweeping Expansion	Ongoing	
	Compliance with New MS4 Permit	Ongoing	
Boating Programs	Establishment of No Discharge Zone	October 2005	April 2007
	Update Inventory of "No Wake Zones"	October 2005	October 2006
	Development of Clean Marina Certification Program	Completed	
Pet Waste Programs	Pet Waste Ordinance	Completed	
	Enforcement of Pet Waste Ordinance	Ongoing	
Erosion and Sediment Control	Enforcement of Virginia Beach Erosion and Sediment Control Ordinance	Ongoing	
Aquatic Resource Restoration	USACE Lynnhaven River Environmental Restoration Project		
	USACE Chesapeake Bay Oyster Restoration Study		
	Riparian Buffer Enhancement Plan	Ongoing	
	Oyster Heritage Program	Ongoing	
	Living Shoreline Program	Ongoing	
Education Programs	Boater Education Program	Ongoing	
	Regional Education Programs	Ongoing	
	"Scoop the Poop" Program	Ongoing	
	City Contract with Lynnhaven River 2007 for Public Awareness Programs		
	Lynnhaven Watershed Markers	Completed	
	Wildlife Feeding Education Program	Ongoing	
	CBPA Septic Tank Pump Out and Inspection Information Program	Ongoing	
Land Use Management	Chesapeake Bay Preservation Area Ordinance	Ongoing	
	Wetlands and Waterfront Operations Program	Ongoing	
	Habitat Enhancement Committee	Ongoing	

### **8.3 Developing Tracking and Monitoring Plans**

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

Only water quality data collected by the Virginia Department of Health can be used to determine condemnation or opening of a designated shellfishing area. The Virginia Department of Environmental Quality also collects bacteria data within the Lynnhaven Watershed as part of its surface water quality monitoring, but DEQ is phasing out fecal coliform monitoring in favor of enterococci and *E. coli*. These monitoring stations are displayed in Figure 8-1 and will continue to be maintained. The Alliance for the Chesapeake Bay also collects bacteria data at two additional stations for DEQ through its citizen monitoring program. Ambient water quality monitoring of fecal coliform concentrations as outlined in Section 4.3 will also continue to be performed by the VDH-DSS.

Water quality monitoring is also being conducted by the Virginia Institute of Marine Sciences in conjunction with an environmental restoration project being conducted by the US Army Corps of Engineers. This monitoring will include wet weather fecal coliform concentrations in order to determine decay characteristics of fecal coliform within the Lynnhaven system. The City of Virginia Beach will continue to conduct illicit discharge monitoring as specified in its MS4 permit.

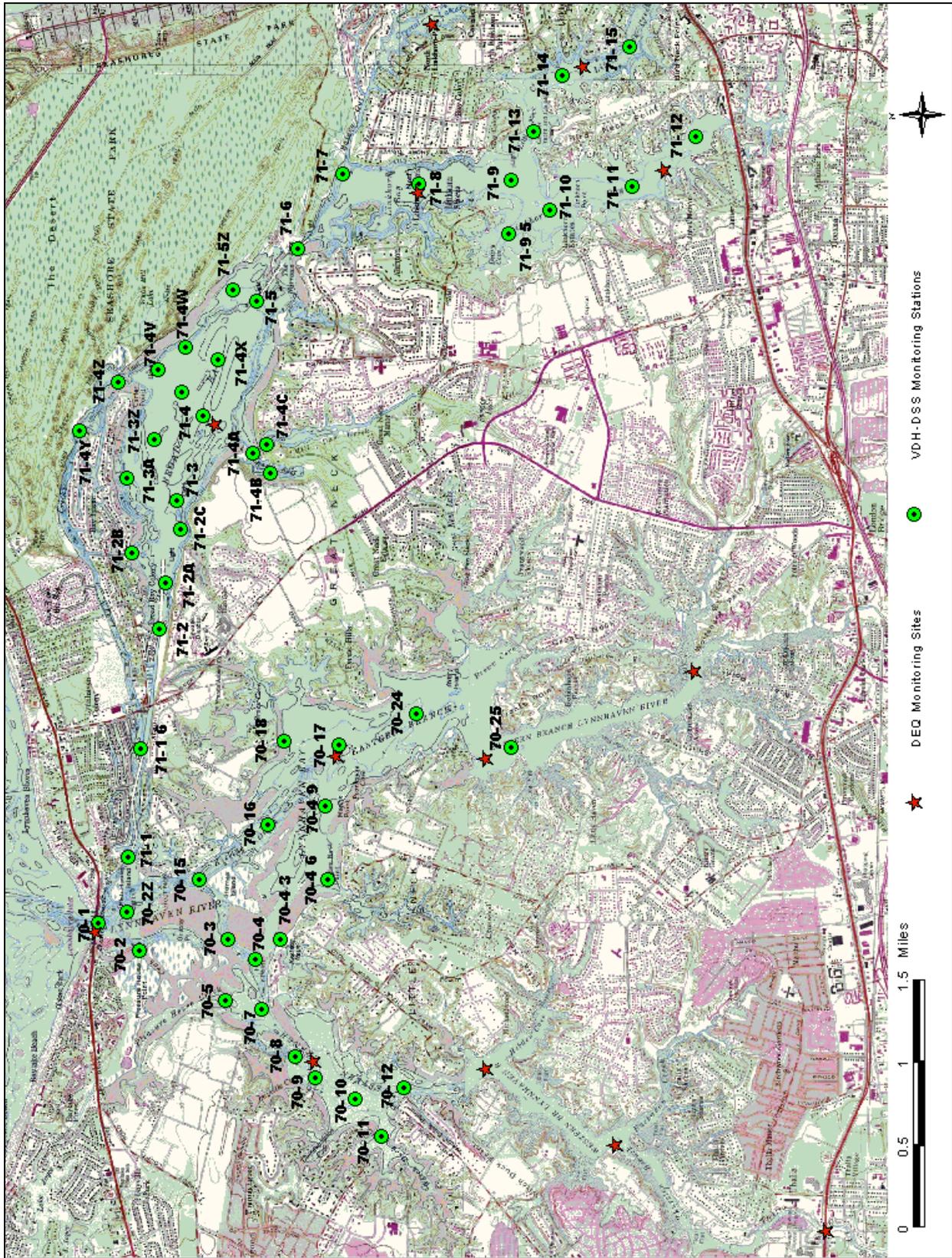


Figure 8-1: Water Quality Monitoring Stations in the Lynnhaven Watershed

## **9.0 STAKEHOLDERS ROLES AND RESPONSIBILITIES**

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

### **9.1 Federal**

#### **9.1.1 United States Environmental Protection Agency**

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

#### **9.1.2 United States Navy**

The federal facilities pollution control law (33USC1323) quoted below regulates the discharge of pollutants from federal properties.

“ (a) Each department, agency, or instrumentality of the executive, legislative, and judicial branches of the Federal Government (1) having jurisdiction over any property or facility, or (2) engaged in any activity resulting, or which may result, in the discharge or runoff of pollutants, and each officer, agent, or employee thereof in the performance of his official duties, shall be subject to, and comply with, all Federal, State, interstate, and local requirements, administrative authority, and process and sanctions respecting the control and abatement of water pollution in the same manner, and to the same extent as any nongovernmental entity including the payment of reasonable service charges. The preceding sentence shall apply (A) to any requirement whether substantive or procedural (including any recordkeeping or reporting requirement, any requirement respecting permits and any other requirement, whatsoever), (B) to the exercise of any Federal, State, or local administrative authority, and (C) to any process and sanction, whether enforced in Federal, State, or local courts or in any other manner. This subsection shall apply notwithstanding any immunity of such agencies, officers, agents, or employees under any law or rule of law.”

## **9.2 State**

### **9.2.1 Department of Environmental Quality (DEQ)**

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

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

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

### **9.2.2 Department of Conservation and Recreation (DCR)**

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

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

### **9.2.3 Virginia Department of Health (VDH)**

The VDH is responsible for classifying shellfish growing waters and monitoring the waters for fecal coliform bacteria. Also, the VDH conducts shoreline surveys to determine potential sources of contamination. This information is evaluated by the VDH to determine areas that are open or restricted for shellfish harvesting for direct marketing. DEQ places the restricted areas on the 303(d) List for TMDL development.

### **9.2.4 Soil and Water Conservation District**

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

### **9.2.5 Department of Game of Inland Fisheries**

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

### **9.2.6 Virginia Marine Resource Commission**

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

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

The Habitat Management Division conducts a permit program to preserve and protect subaqueous habitat, tidal wetlands and coastal primary sand dunes. These lands are vital in keeping Virginia's water clean and for use as spawning and nursery areas for marine life. The Habitat Management Division also helps local governments oversee wetland programs.

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

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

### **9.3 Regional**

#### **9.3.1 Hampton Roads Planning District Commission**

Planning District Commissions are voluntary associations that were created in 1969 pursuant to the Virginia Area Development Act and a regionally executed Charter Agreement. The purpose of planning district commissions, as set out in the Code of Virginia, Section 15.2-4207 is "...to encourage and facilitate local government cooperation and state-local cooperation in addressing on a regional basis problems of greater than local significance."

The Hampton Roads Planning District Commission (HRPDC), one of 21 Planning District Commissions in the Commonwealth of Virginia, is a regional organization comprised of this area's sixteen local governments. The HRPDC was formed in 1990 by the merger of the Southeastern Virginia Planning District Commission and the Peninsula Planning District Commission. The HRPDC serves as a resource of technical expertise to its member local governments. It provides assistance on local and regional issues pertaining to Economics, Physical and Environmental Planning, and Transportation. As a Virginia Planning District, the HRPDC is also the Affiliate Data Center for the region, providing economic, environmental, transportation, census, and other relevant information to businesses, organizations and citizens.

The HRPDC was contracted by the Virginia DEQ and the City of Virginia Beach to develop this implementation plan for the bacteria TMDL for shellfishing waters of the Lynnhaven, Broad and Linkhorn Bay watersheds. In addition to facilitating the implementation process and developing this report, the HRPDC will continue to 1) facilitate regional cooperation in stormwater and wastewater management, 2) continue to administer regional education programs, 3) maintain the Sanitary Sewer Overflow Reporting System (SSORS), and 4) develop a protocol for future TMDL Implementation Plan development within Hampton Roads.

### **9.3.2 Hampton Roads Sanitation District**

The Hampton Roads Sanitation District (HRSD), a political subdivision of the Commonwealth of Virginia, was created by public referendum in 1940 to eliminate sewage pollution in the tidal waters of the Chesapeake Bay. The mission of HRSD is to prevent pollution, protect public health, and support community development by providing wastewater collection, treatment, and related services. In addition to returning treated effluent water to nature, HRSD is also involved in many educational programs. HRSD also takes a financial role by presenting penalty fund environmental grants. These grants are given to those organizations whose projects benefit the receiving waterways or residents of HRSD and relate to environmental education or water quality improvements. HRSD is a constant partner in making sure the Virginia waters, including the Lynnhaven Watershed, are becoming a safer resource for years to come.

### **9.4 City of Virginia Beach**

As discussed throughout this document, the City of Virginia Beach has the largest role in improving water quality within the Lynnhaven, Broad, and Linkhorn Bays. Because the Lynnhaven, Broad and Linkhorn Bay watersheds lie completely within the boundaries of the City of Virginia Beach, it has jurisdiction over all local projects within the watershed boundaries. The City will continue public programs to treat stormwater runoff, prevent SSOs, and manage land use development to the maximum extent practicable and as required by law. Specific actions that the City of Virginia Beach will implement in order to reduce fecal coliform concentrations within the shellfishing waters of Lynnhaven, Broad, and Linkhorn Bays are outlined in Tables 7-1 and 9-1.

### **9.5 Private Sector, Non-governmental, and Citizen Groups**

In the Lynnhaven River Watershed two non-governmental agencies have played a significant role in improving water quality. These two groups, Lynnhaven River 2007 and the Chesapeake Bay Foundation, will continue to be active in the watershed and are involved in several of the implementation actions that involve public awareness and oyster restoration. In addition to these two groups, the Alliance for the Chesapeake Bay operates six citizen monitoring locations within the Lynnhaven watershed.

#### **9.5.1 Lynnhaven River 2007**

Several Virginia Beach residents founded the non-profit organization Lynnhaven River 2007 in 2003 when they became very concerned about the state of the Lynnhaven River. The organization's number one goal is a clean and healthy Lynnhaven River. Long term they want to see water quality improve substantially and to restore a native oyster that can be safely and legally consumed.

They plan on carrying out their goals by identifying and reducing sources of contamination in the Lynnhaven, reducing nutrient, sediment and chemical runoff, and restoring lost habitats such as oyster reefs, salt marshes and other buffers that help

filter polluted runoff and protect the river and its marine life. These goals will be implemented by seeding the river with 500,000 water-filtering oysters, promoting a greater public awareness of the river's problems, increasing the availability of programs and resources for homeowners on runoff issues, fostering partnerships that apply public and private resources to reduce pollution in the river and by investing local, state, and federal government in the effort to restore the Lynnhaven River.

## **9.5.2 Chesapeake Bay Foundation**

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

For students and their teachers, CBF has two educational programs that service the Hampton Roads area. One program is CBF's 42-foot deadrise vessel, Baywatcher, and the second program is the Virginia Canoe Rig. In addition to studying the effects that this southernmost Bay port has on the watershed, students explore the Lynnhaven River and learn about the relationship between the land and the water aboard either of these vessels. There is also a restoration component (for shad, underwater grasses, and/or oysters) applicable to students and their teachers in certain cases. There are also five residential centers up and down the Bay that Virginia Beach students and teachers can and have visited.

For teachers, CBF has two programs that help instill Bay understanding in the classroom, the W.A.V.E. (Watershed Action for Virginia's Environment) Curriculum and the Chesapeake Classrooms Program. Through Chesapeake Classrooms, CBF provides professional development and materials to interested teachers over one year to implement multi-week units focused on the local watershed environment. Chesapeake Classrooms help increase students' environmental literacy, stewardship, and engagement in the learning process.

For adults, CBF's Hampton Roads office coordinates programs such as the “Green Breakfast”, “Save the Bay Breakfast”, and a Speakers Bureau and Fairs and Festivals outreach program. These types of programs build stewardship and help create a knowledge base for area citizens to help care for local natural resources. CBF believes that in order to improve water quality of the Bay and its tributaries, it is necessary to educate and empower its citizens, teachers and students about Bay health.

CBF staff, its members, and volunteers protect the Bay's natural resources from pollution and other harmful activities by fighting for strong and effective laws and regulations, primarily on the state and local level. They work cooperatively with government, business, and citizens in partnerships when possible. When necessary, CBF uses legal means to force compliance with existing laws. Where sustainable, CBF

restores the Bay's essential habitats and filtering mechanisms, such as forests, wetlands, underwater grasses, and oysters, through a variety of hands-on projects.

### **9.5.3 Alliance for the Chesapeake Bay**

This group performs monitoring activities on the tributaries to the Bay through the Chesapeake Bay Citizen Monitoring Program. This program has been active in Maryland, Pennsylvania, and Virginia since 1985. The citizen monitors check dissolved oxygen, pH, salinity, Secchi and water depth, and air and water temperature on a weekly basis. More recently, the program has initiated sampling of nutrients and SAV (submerged aquatic vegetation). Within the Lynnhaven watershed, the citizen monitors collect data at six sampling locations. The data they collect is utilized by DEQ to evaluate water quality throughout the watershed.

**Table 9-1: Management Actions and Responsible Stakeholders**

<b>Management Category</b>	<b>Management Option</b>	<b>Stakeholders Responsible</b>
Agricultural BMPs	Rooftop Runoff Collection for Horse Stables	Navy/ Virginia Dare SWCD
	Animal Waste Management Plan for Oceana	Navy
	Equine Facility Inventory for Virginia Beach	Navy
	Oceana BST Study	Navy
	Equine Facility Pasture Management for Virginia Beach	City of Virginia Beach/Virginia Dare SWCD
Sanitary Sewer Improvements	Development and Implementation of CMOM Plan	City of Virginia Beach
	Find and Fix Program	City of Virginia Beach
	Rehabilitation of Existing Sanitary Sewer Lines	City of Virginia Beach
	Little Neck Peninsula Sewer Project	City of Virginia Beach
	Dey Cove Source Tracking Study	City of Virginia Beach
	Analysis of Dey Cove Study Results	City of Virginia Beach
	Policy Change for Mandatory Sewer Connection	City of Virginia Beach
	Enforcement of CBPA Septic Tank Pump Out and Inspection Regulatory Requirements	City of Virginia Beach
Stormwater Programs	Solar Aerators in Stormwater Ponds	City of Virginia Beach
	Water Quality Monitoring of Ponds with Aerators	City of Virginia Beach
	Pembroke Area BMP	City of Virginia Beach
	Investigation of Street Sweeping Expansion	City of Virginia Beach
	Compliance with New MS4 Permit	City of Virginia Beach
Boating Programs	Establishment of No Discharge Zone	City of Virginia Beach/DEQ
	Development of Clean Marina Certification Program	City of Virginia Beach with Lynnhaven 2007
	Update Inventory of "No Wake Zones"	City of Virginia Beach
	Expansion of "No Wake Zones" as Necessary	City of Virginia Beach
	Floating Comfort Station	City of Virginia Beach
Pet Waste Programs	Pet Waste Ordinance	City of Virginia Beach
	Enforcement of Pet Waste Ordinance	City of Virginia Beach
Erosion and Sediment Control	Enforcement of Virginia Beach Erosion and Sediment Control Ordinance	City of Virginia Beach
Aquatic Resource Restoration	Riparian Buffer Enhancement Plan	City of Virginia Beach
	Oyster Heritage Program	City of Virginia Beach
	Lynnhaven River Aquatic Restoration Study	US Army Corps of Engineers
	Chesapeake Bay Oyster Restoration Study	US Army Corps of Engineers
	Living Shoreline Program	City of Virginia Beach

<b>Management Category</b>	<b>Management Option</b>	<b>Stakeholders Responsible</b>
Education Programs	Boater Education Program	City of Virginia Beach
	Regional Education Programs (HRWET, HRSTORM, HRCLEAN, HRFOG)	City of Virginia Beach and HRPDC
	"Scoop the Poop" Program	City of Virginia Beach and Lynnhaven River 2007
	City Contract with Lynnhaven River 2007 for Public Awareness Programs	City of Virginia Beach
	Lynnhaven Watershed Markers	City of Virginia Beach
	Education for Livestock and Equine Facility Owners	City of Virginia Beach in cooperation with State agencies
	CBPA Septic Tank Pump Out and Inspection Information Program	City of Virginia Beach
	Wildlife Feeding Education Program	City of Virginia Beach
Land Use Management	Chesapeake Bay Preservation Area Ordinance	City of Virginia Beach
	Wetlands and Waterfront Operations Program	City of Virginia Beach
	Habitat Enhancement Committee	City of Virginia Beach
Wildlife Contribution Controls	City Ordinance to Prevent Feeding of Waterfowl	City of Virginia Beach
	Evaluate/Inventory Wildlife Populations within the Watershed	City of Virginia Beach and Virginia DGIF

## 10.0 RELATED WATERSHED PLANNING EFFORTS

The City of Virginia Beach is in the process of developing a watershed management plan for the Lynnhaven River Watershed that includes the sections not meeting the water quality standards for bacteria in shellfishing waters. The management actions and programs described in this report are consistent with the goals and objectives of the developing watershed management plan.

The City of Virginia Beach is also working with the US Army Corps of Engineers (USACE) on the Lynnhaven River Environmental Restoration Project. Components of this project include the development of hydrodynamic and watershed loading models for the Lynnhaven Watershed. These models will aid the understanding of the sources and dynamics of bacteria loading within the watershed. While the primary purpose of this Environmental Restoration Project is to reestablish natural aquatic habitats within the Lynnhaven River, some actions such as the restoration of tidal wetlands and preservation of stream buffers will also serve to reduce bacteria loading to the Lynnhaven, Broad, and Linkhorn Bays.

### 10.1 Adjacent Impaired Waterbodies

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

TMDL ID	Waterbody Name	Impairment	Initial List Date	TMDL Development Date	City/County	Size
VAT-C08E-03	Thalia Creek	Fecal Coliform & Enterococci (2004), Dissolved Oxygen	2002	2010	Virginia Beach	0.13 Mi <sup>2</sup>
VAT-C08E-04	Western Branch Lynnhaven	Fecal Coliform	2002	2014	Virginia Beach	0.15 Mi <sup>2</sup>
VAT-C08E-05	London Bridge Creek & Canal #2	Dissolved Oxygen, Fecal Coliform & Enterococci (2004)	1994	2010	Virginia Beach	0.11 Mi <sup>2</sup>
VAT-C08E-06	Eastern Branch Lynnhaven River	Fecal Coliform	2004	2016	Virginia Beach	0.46 Mi <sup>2</sup>
VAT-C08E-07	West Neck Creek (Upper) to London Bridge Creek	Fecal Coliform & Enterococci (2004), Dissolved Oxygen	1998	2010	Virginia Beach	0.03 Mi <sup>2</sup>
VAT-C08E-09	Little Creek Channel	Fish Tissue PCBs	2002	2014	Virginia Beach	0.01 Mi <sup>2</sup>
VAT-C08L-02	Lake Smith (Lower)	Dissolved Oxygen	2002	2014	Virginia Beach	74 Ac.
VAT-K41R-04	North Landing River	Chloride	2004	2016	Chesapeake, Virginia Beach	12.01Mi.
VAT-K41R-05	West Neck Creek (Middle)	Dissolved Oxygen, Chloride, Fecal Coliform	1998	2010	Virginia Beach	3.1 Mi.

TMDL ID	Waterbody Name	Impairment	Initial List Date	TMDL Development Date	City/County	Size
VAT-K41R-06	West Neck Creek (Lower)	Chloride	2004	2016	Virginia Beach	3.71 Mi.
VAT-K42E-01	Nawney Creek (Upper)	Dissolved Oxygen, Fecal Coliform & Enterococci	1996	2010	Virginia Beach	0.03 Mi <sup>2</sup>
VAT-K42E-02	Nawney Creek (Lower)	Fecal Coliform	1996	2010	Virginia Beach	0.06 Mi <sup>2</sup>
VAT-K42E-03	Hell Point Creek (Lower) tributary to North Bay	Fecal Coliform & Enterococci	2004	2016	Virginia Beach	0.002 Mi <sup>2</sup>
VAT-K42E-04	Muddy Creek tributary to North Bay	Fecal Coliform	2004	2016	Virginia Beach	0.01 Mi <sup>2</sup>
VAT-K42E-05	Beggars Bridge Creek tributary to Shipp's Bay	Fecal Coliform	2004	2016	Virginia Beach	0.02 Mi <sup>2</sup>
VAT-K41R-01	Pocaty River	Dissolved Oxygen	2002	2014	Chesapeake, Virginia Beach	6.61 Mi.
VAT-K41R-02	Milldam Creek	Dissolved Oxygen, Fecal Coliform	2002	2010	Virginia Beach	3.29 Mi.
VAT-K41R-03	Albemarle Canal (upstream of North Landing River)	Dissolved Oxygen, Chloride	2002	2010	Chesapeake, Virginia Beach	10.66 Mi.
VAT-D07E-01	Lake Wesley	pH	1998	2010	Virginia Beach	0.01 Mi <sup>2</sup>
VAT-D07E-02	Lake Rudee	pH, Fecal Coliform	2002	2014	Virginia Beach	0.13 Mi <sup>2</sup>
VAT-D07E-03	Owl Creek (lower)	pH	2002	2014	Virginia Beach	0.01 Mi <sup>2</sup>

## 11.0 POTENTIAL FUNDING SOURCES

### **State**

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

### **Federal**

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

### **Local or Regional**

City of Virginia Beach  
City of Virginia Beach Capital Improvement Program  
Chesapeake Bay Small Watershed Grants Program  
Wetlands and Chesapeake Bay Civil Penalties Fund  
City of Virginia Beach Oyster Heritage Trust Fund  
Hampton Roads Environmental Education Program Mini-Grants

### **Landowner Contributions and Matching Funds**

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

### **Private Foundations, Non-Profit Organizations, Businesses**

National Fish and Wildlife Foundation  
Chesapeake Bay Foundation

## 11.1 Requirements for Section 319 Fund Eligibility

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

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

## REFERENCES

Bales, Jerad D. and C. Skrobialowski. Flow and Salinity in West Neck Creek, Virginia, 1989-92, and Salinity in North Landing River, North Carolina, 1991-92. U.S. Geological Survey Water Resources Investigations Report 94-4067. 1994.

MapTech, Inc. Development of Bacterial TMDLs for the Virginia Beach Coastal Area (London Bridge Creek & Canal # 2, Milldam Creek, Nawney Creek, West Neck Creek (Middle), and West Neck Creek (Upper)). Blacksburg Virginia, 2005.

Neilson, Bruce J., Nancy Wilson, Hershner, Carl H., Kator. Man Versus Mollusk: Studies of Water Quality Problems, How They Affect Shellfish and Shellfish Harvesting, and How the Commonwealth Should Address These Problems. Virginia Institute of Marine Science, College of William and Mary. 1992.

U.S. Environmental Protection Agency (EPA). Guidance for Water-Quality-based Decisions: The TMDL Process. 1991, EPA440-4-91-00.

Virginia Department of Conservation and Recreation and Virginia Department of Environmental Quality. Guidance Manual for Total Maximum Daily Load Implementation Plans. Richmond, Virginia. 2003.

Virginia Department of Environmental Quality (DEQ). 303(d) Total Maximum Daily Load Priority List and Report. 1998.

Virginia Department of Environmental Quality (DEQ). Lynnhaven Bay, Broad Bay and Linkhorn Bay Watersheds Total Maximum Daily Load (TMDL) Report for Shellfish Areas Listed Due to Bacteria Contamination. Richmond, Virginia. 2004.

Virginia Department of Health (VDH). Increase in Area Shellfish Closures Caused by Heavy Rainfall. Richmond, VA. June, 2005.