ADAPTIVE MANAGEMENT IN THE CHESAPEAKE BAY TOTAL MAXIMUM DAILY LOAD (TMDL) PROGRAM: HOW DO LOCAL WATERSHED MANAGERS ADDRESS UNCERTAINTY AND USE ADAPTIVE MANAGEMENT?

by

Richard Kenneth Friesner
A Dissertation
Submitted to the
Graduate Faculty
of
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in Partial Fulfillment of
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of
Doctor of Philosophy
Environmental Science and Public Policy

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Date: Fall Semester 2015
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Adaptive Management in the Chesapeake Bay Total Maximum Daily Load (TMDL) Program: How Do Local Watershed Managers Address Uncertainty and Use Adaptive Management?

A Dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at George Mason University

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DEDICATION

Over thirty years ago, a group gathered on the campus of George Mason University in Fairfax, Virginia, to sign the first of what would become several Chesapeake Bay agreements. A few years later a dad took his boy (me) fishing for the first time. When the pair got to the lake the water level was well below normal and there were many dead fish along the shore. From that moment, I knew that understanding and protecting water and the environment was worth doing. This dissertation is dedicated to all those that have dedicated their lives to improving our earth and all those parents that teach their children to care for the environment and leave the world a little better than they found it. Together we can change the world. Our future begins now. Let’s #savethebay.
ACKNOWLEDGEMENTS

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LIST OF ABBREVIATIONS

AFBF...............................................American Farm Bureau Federation
AFO...................................................Animal Feeding Operation
AM....................................................Adaptive Management
BAT....................................................Best Available Technology
BMP...................................................Best Management Practice
BZA...................................................Board of Zoning Appeals
CAFO................................................Confined Animal Feeding Operation
CALFED.................................................California Bay-Delta Program
CAST................................................Chesapeake Assessment Scenario Tool
CBF...................................................Chesapeake Bay Federation
CBP...................................................Chesapeake Bay Program
CFR....................................................Code of Federal Regulations
CIP....................................................Capital Improvement Plan
CWA...................................................Clean Water Act
DCR...................................................Virginia Department of Conservation and Recreation
DEQ...................................................Virginia Department of Environmental Quality
DO......................................................Dissolved Oxygen
E&S....................................................Erosion and Sediment Control
EIEN..................................................Environmental Information Exchange Network
EPA...................................................US Environmental Protection Agency
FOR...................................................Friends of the Rappahannock
GWRC................................................George Washington Regional Commission
IRB....................................................Institutional Review board
LA......................................................Load Allocation
LID....................................................Low Impact Development
MAST................................................Maryland Assessment Scenario Tool
MDE...................................................Maryland Department of the Environment
MOS...................................................Margin of Safety
MS4...................................................Municipal Separate Storm Sewer System
NAS...................................................National Academy of Science
NGO...................................................Non-Governmental Organization
NPDES.................................................National Pollution Discharge Elimination System
PDC...................................................Planning Development Commission
PFB...................................................Pennsylvania Farm Bureau
RMP...................................................Resource Management Plans
RPA...................................................Riparian Protection Agency
SAG...................................................Stakeholder Advisory Group
SAV...................................................Submerged Aquatic Vegetation
TMDL................................................Total Maximum Daily Load
TN.....................................................Total Nitrogen
ABSTRACT

ADAPTIVE MANAGEMENT IN THE CHESAPEAKE BAY TOTAL MAXIMUM DAILY LOAD (TMDL) PROGRAM: HOW DO LOCAL WATERSHED MANAGERS ADDRESS UNCERTAINTY AND USE ADAPTIVE MANAGEMENT?

Richard Kenneth Friesner, Ph.D.
George Mason University, 2015
Dissertation Director: Dr. R. Christian Jones

The Chesapeake Bay Total Maximum Daily Load (TMDL) is a federal action the Environmental Protection Agency (EPA) established to create a nutrient and sediment reduction strategy for the Chesapeake Bay based on contributions by six states (Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia) and Washington, DC. The TMDL implementation process was developed by incorporating adaptive management as a major component. Ultimately, each state is responsible for significantly reducing the loads of nitrogen, phosphorus, and sediment that enter the main stem of the Chesapeake Bay, between 20% and 25% overall, based on loading rates calculated using data from 2009. In turn, the state governments asked local governments and stakeholders to identify how these reductions could be achieved at the local level through the development of Watershed Implementation Plans. Many people associated with the Chesapeake Bay TMDL have referred to the implementation process as an
adaptive management process. Adaptive management is a structured and iterative process of decision making under uncertain conditions that requires monitoring activities to incorporate new knowledge into the management process. Because the Chesapeake Bay TMDL required a three-tiered watershed implementation process and two-year milestone reviews, it does seem to follow an adaptive management protocol at the state and Federal level, but it was unclear if local, county and city, level municipal watershed managers were able to use adaptive management in their implementation of the Chesapeake Bay TMDL. If the EPA, state, and local governments want the Chesapeake Bay TMDL to be effective, it is important to gauge the understanding that municipal watershed managers have of adaptive management and the available time, resources, staff, and knowledge to dedicate to the implementation process. There have been very few opinion or capacity surveys of this population or about the general public’s perception of the Chesapeake Bay. This dissertation was planned to fill that gap. Results from this research project indicated that all of the Maryland and Virginia portions of three watersheds studied here (Patuxent, Potomac, and Rappahannock River watersheds) had room to improve local understanding of adaptive management and other implementation strategies for the Chesapeake Bay TMDL through adaptive management. Specifically, in watersheds with fewer Municipal Separate Storm Sewer System (MS4) permits, such as the Rappahannock River watershed, there remains information to be gathered and capacity building needed to successfully implement the Chesapeake Bay TMDL. Further, it appeared clear that without a state level or local legal requirement for localities
to implement the TMDL and use adaptive management, several localities throughout the watershed will be unsuccessful in their implementation strategies.
CHAPTER ONE: INTRODUCTION

The Chesapeake Bay is one of the most studied bodies of water in the world. There are thousands of scientific journal articles written about the Chesapeake Bay, more than 2,500 in the Environment Complete database alone as of July 2015. More than 17 million people call this watershed home, and it hosts our nation’s capital and parts of Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia. This area, which stretches for more than 64,000 square miles, has seen a huge increase in population and development from the mid-17th century when it was explored by Europeans (Capper, Power, & Shivers, Jr., 1983).

Figure 1 The Chesapeake Bay Watershed
Changes in how the land is “used” by those that live in the Chesapeake Bay watershed has negatively impacted the health of the water flowing into the Bay and its ability to act as habitat to a variety of plants and animals (Cooper, 1995). Today the three principle constituents that degrade the water quality in the Chesapeake Bay and its subestuaries are nitrogen, phosphorus, and sediment (Boynton, 1998).

The University of Maryland Environmental Center for Environmental Science (UMCES) issued a Chesapeake Bay Report Card in August 2015. The UMCES gave the Bay an overall health score of a “C” with the Patuxent, Potomac, and Rappahannock River watersheds earning grades of D, D+, and C-, respectively. UMCES acknowledges that the Chesapeake Bay is complex heterogeneous ecosystem with its reporting system. The report card uses a number of indicators, including: Chlorophyll a, water clarity, submerged aquatic vegetation (SAV), dissolved oxygen (DO), benthic community, fisheries health, total nitrogen, and total phosphorus (UMCES, 2015).

Regional efforts to improve the health of the Chesapeake Bay have been going on for more than 35 years. The Chesapeake Bay Program which was formed as a partnership between a variety of government and nonprofit organizations in 1983 signifies a major push to improve the health of this watershed (Chesapeake Bay Program, 2015a). In fact, the original Chesapeake Bay Agreement, which created the Chesapeake Bay Program (CBP), was signed on the Campus of George Mason University’s Fairfax, VA campus in 1983 (Walsh, 2003).

The original efforts of the CBP were largely voluntary and have been viewed as marginally successful. In the early 2000s a variety of legal challenges resulted in several
consent decrees that required the US Environmental Protection Agency (EPA) to put in place mandatory restoration efforts. This resulted in the use of a watershed-wide nutrient and sediment reduction strategy called the Chesapeake Bay Total Maximum Daily Load (TMDL). A TMDL is a calculation that assigns pollution loads (a mass) that can enter a given waterbody and still meet strict water quality standards that are dependent on the use of the receiving waterbody. The TMDL calculation is triggered by the Federal Clean Water Act (CWA), and there are more than 42,000 waterbodies in the US listed as impaired and require a TMDL. Over 68,000 TMDLs have been calculated and approved by the EPA (US Environmental Protection Agency, 2015). A separate TMDL is typically calculated for each pollutant that has been identified as exceeding its criteria.

The CWA, interestingly, does not specifically require that the calculated TMDL, as required by the act, be implemented (Benham & Zeckoski, 2007). However, in the Chesapeake Bay TMDL, the six states and District of Columbia, in consultation with the EPA (this is commonly called “cooperative federalism” in the legal community), have set an aggressive timeline and implementation strategy for each jurisdiction (Malloy, 2011). This dissertation focused its study area on the Maryland and Virginia portions of the Patuxent, Potomac, and Rappahannock River watersheds. These two states serve as the focus area because these are representative of the other four states and Washington, DC in the Chesapeake Bay watershed. Maryland and Virginia are the two closest jurisdictions to the main stem of the Chesapeake Bay and both states approached the implementation of the Chesapeake Bay TMDL differently. Further, both states differ historically in their relationship with the Chesapeake Bay based on the number of
counties/cities that are bounded by the main stem of the Bay. Finally, including Maryland and Virginia in the study area allows for a robust analysis of the data collected and for comparisons and conclusions to be drawn based on the results of this dissertation. The allowable pollution under the Chesapeake Bay TMDL for the entire watershed are 189.9 million pounds of nitrogen (a 25% reduction), 12.5 million pounds of phosphorus (a 24% reduction), and 6.45 billion pounds of sediment (a 20% reduction). In the study area for this dissertation, Virginia’s reduction goals are 53.67 million pounds of nitrogen, 5.36 million pounds of phosphorus, and 3,252 million pounds of sediment (Commonwealth of Virginia, 2010, 2012). In Maryland, based on the 2010 data, by 2025 nitrogen must be reduced by 22% or 11.59 million pounds, phosphorus must be reduced by 14.9% or 0.49 million pounds, and sediment must be reduced by 1.9% or 26 million pounds (State of Maryland, 2012). The EPA through the CBP has made adaptive management a key component of the Chesapeake Bay TMDL implementation strategy.

Adaptive management is defined by Williams et al. (2009) most simply as a systematic approach for improving resource management by learning from management outcomes. However, adaptive management is a complex and abstract concept that does not have a consistent definition in the literature or field of practice (Rist, Felton, Samuelsson, Sandström, & Rosvall, 2013; Westgate, Likens, & Lindenmayer, 2013). Similarly to the CBP, adaptive management was born from the work of C.S. Holling (1978) in his book titled *Adaptive Environmental Assessment and Management*. It is from this that this dissertation research begins.
The response from the six states and Washington, DC, to the Chesapeake Bay TMDL came in a series of Watershed Implementation Plans (WIPs). The WIPs detail what actions each state and the District of Columbia will implement to meet the nutrient and sediment reductions to improve the water quality in the Chesapeake Bay and meet the TMDL requirements. As would be expected the WIPs positioned local governments with an important role. These local officials often have multiple responsibilities, especially in small jurisdictions, and without specific and extensive guidance from state or Federal officials, such local municipal watershed managers, may not be in a position to effectively or efficiently implement the TMDL requirements.

Early on in the literature review for this dissertation project it became clear that the local implementers of restoration efforts, including the Chesapeake Bay TMDL, were not regularly surveyed. The literature yielded three surveys; two focused on the general public’s involvement and interest in restoration efforts in the Chesapeake Bay watershed (Center for Watershed Protection, 1999; Julie A. McClafferty, 2002), while the third focused on US Environmental Protection Agency staff knowledge and perceptions of the TMDL process as a whole (Cabrera-Stagno, 2007). This document adds to the existing bases of understanding by examining the perceptions and demographics of local watershed managers. Here a local watershed manager was defined as a county or city employee charged with implementing the Chesapeake Bay TMDL for the local government in which he or she worked. The focus areas for this research were the Maryland and Virginia portions of the Patuxent, Potomac, and Rappahannock River watersheds. This dissertation examines the education and experience of the Chesapeake
Bay TMDL responsible party in each local county in Virginia and Maryland, and independent Cities in Virginia which are in the three watersheds noted above. These individuals play an important role in the successful implementation of the Bay TMDL.

All of this research has been vetted through the George Mason University Office of Research Integrity and Assurance’s Institution Review Board (IRB). Interviewees and respondents answered a series of questions that could impact their employment status. For this reason, location or name identifiers were removed from interview transcripts and survey responses where necessary. Through initial interviews, a survey tool, and further interviews to fill data gaps this dissertation examined both these local officials’ individual perceptions, and each local government body’s ability to implement and meet the requirements of the Bay TMDL.

This research studied some of the cumulative restoration efforts in the Chesapeake Bay. No previous surveys of these local government officials exist in the literature. Further, no one at the various state agencies involved in the Chesapeake Bay TMDL implementation was able to produce a complete list of their main point-of-contact in each local government. Additionally, no comprehensive list of these individuals existed on a state or Federal webpage.

The data and analysis from this dissertation will be useful as state and Federal agencies continue to implement the Chesapeake Bay TMDL and serve as a basis for where to focus additional training and what new training should consist of. State and Federal agencies could use this research to identify how their actions are perceived at the local level. Based on comments during the interview portion of this dissertation, there is
also an interest from local officials to see the results of this research and identify how other jurisdictions responded to the questions.

Major findings included that local watershed managers have educated their governing bodies on the Chesapeake Bay TMDL, including the cost of implementation. However, most local governments are not planning to pay the full cost of implementation. These local governments expect the state or Federal government to provide funding assistance. Related to the dissertation’s inquiry about the use of adaptive management in the Chesapeake Bay TMDL, many local watershed managers could not define the phrase “adaptive management.” A majority of local watershed managers did not feel supported by their state or EPA to use an adaptive management approach to meet the Chesapeake Bay TMDL requirements. These local officials identified a lack of resources and permit requirements as reasons for not using adaptive management or as an impediment to implementing water quality monitoring activities. Finally, non-tidal localities were more likely to support the models used by the EPA to develop the Chesapeake Bay TMDL. This was counter to the hypothesis that localities farther from the main stem of the Chesapeake Bay would be less engaged and interested in the Chesapeake Bay TMDL.

Based on the data collected for this dissertation, the most qualified respondents: 1) were educated as an engineer or policy/law, 2) had experience with maintaining an MS4 permit, 3) have experience being involved in a local TMDL taskforce, and 4) have experience with a locality that was part of an MSA. These were found to all be predictors
of a higher than average understanding and potential for success in the Chesapeake Bay TMDL implementation process and the use of adaptive management.
CHAPTER TWO: ABOUT THE CHESAPEAKE BAY AND TMDLS

The Chesapeake Bay is one of the largest estuaries in the world and the largest in the United States. The size of the Chesapeake Bay creates some very interesting physical, chemical, and biological characteristics. Humans have historically used the Chesapeake Bay as a resource for food, transportation, and waste disposal. More recently the estuary has been used for tourism and recreational activities. All of these uses produce substantial economic benefits to the region. As a result of these uses, humans have tried to manage the estuary, but it wasn’t until circa 1980 that this effort became a federal focus with the development of the US Environmental Protection Agency’s (EPA) CBP. After several failed and largely voluntary programs, the CBP, in consultation with the six states (Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia) and the District of Columbia that makeup the Chesapeake Bay Watershed, developed a Total Maximum Daily Load (TMDL) – also referred to as a “pollution diet” for the estuary. This Chesapeake Bay TMDL specifically required that adaptive management be used to meet the nutrient and sediment reductions required as part of the Chesapeake Bay TMDL.

The primary research question of this dissertation asked how local watershed managers addressed uncertainty and used adaptive management. Here uncertainty refers to the unknown outcomes of management actions. That is, responses to management action(s) can differ and may not always be linear or a significant lag time can exist. To answer this question the general chemical, physical, and biological aspects of the estuary
must be understood. Additionally, the historical context of adaptive management must be reviewed. This literature review will review these components to allow for a fuller discussion of the research question.

**History of the Chesapeake Bay**

The Chesapeake Bay’s hydrology is characteristic of a tidally influenced shallow estuary. Understanding the formation of the Chesapeake Bay on a geologic timescale along with many of the features that describe the approximately 64,000 square miles that make up the Chesapeake Bay watershed is helpful in understanding the management of this large area. The circulation of water and impacts of density, from both salt content and temperature, play an important role in the effects of biological and chemical degrees of stratification. This section explores these important physical aspects of the Chesapeake Bay and its watershed.

It was in 1607 that the first English colonists in the Chesapeake Bay region established Jamestown. The settlement along the banks of the brackish portion of the James River was not an ideal location and those who lived there were left vulnerable to salt poisoning and other foul diseases (Carpenter, 1983).

The first European to record his explorations of the Chesapeake Bay was Brother Carrera, a Spanish priest in 1592. He described the Chesapeake Bay as “…the Bay of the Mother God, and in it there are many deep-water ports, each better than the next” (Capper et al., 1983). From this description of the Chesapeake Bay we get an insight into the European mind. The explorers and settlers identified the natural resources of the new world as a source of prosperity. The Chesapeake Bay was a source of food,
transportation, drinking water, waste disposal, and in the late 16th and early 17th century, tobacco.

The initial European settlers’ mindset to “use” the estuary as a means of prosperity carries through to today. This is seen in property law where certain properties have legal access to the Chesapeake Bay. Also, the recognition of the vast ecosystem services that the Chesapeake Bay provides to the region and the many jobs that are associated with tourism, aquatic species harvests, and from transportation ports.

Unfortunately, over the years, such usage has led to degradation. For example, nutrient inputs to the Chesapeake Bay, specifically nitrogen (N) and phosphorous (P), have been identified as the main sources of degradation. By the 1960s it was commonly believed by the estuarine scientific community that P was the limiting nutrient in all aquatic systems (Redfield 1958). However, by the early 1970s this premise was challenged by Ryther and Dunstan (1971) when they identified that a reduction in P produced very small restorative benefits. Howarth and Marino (2006) showed that in the last decade scientific consensus has identified that both N and P play an important role in the eutrophication of aquatic systems, including estuaries.

Between 1607 and present day many changes in land use occurred in the Chesapeake Bay watershed which amplified the stressors on the ecosystem. In their book Discovering the Chesapeake: the history of an ecosystem Curtin et al.(2001) laid out a historical view of humans’ relationship with the Chesapeake Bay from indigenous groups, European explorers, and settlers, to present day Americans. Using the Curtin et
Fisher et al. (2006) identified the historical change in population, agricultural output, and laborer output in the Choptank River watershed within the western shore (of Maryland) portion of the Chesapeake Bay watershed. Using this information, the land area necessary to produce the agricultural outputs was calculated from 1665 to 1820. Fisher et al. (2006) identified that by 1800 more than 80% of the land in the Choptank watershed was devoted to agriculture, with more than 60% of this area as croplands. Pollen analysis of sediment cores taken near the mouth of the Choptank River identified a significant decrease in oak pollen compared to ragweed pollen, coupled with increases in the sedimentation rate and sulfur preservation rate between 1770 and 1800 (Brush, 1984, 1997; Cooper & Brush, 1993). Interestingly, between 1800 and 1820 new rotation techniques and soil amendments helped to reduce the area needed to produce the same quantity of crops by 30%.

It has been shown by Cooper (1995) that sedimentation rates increased by 0.46 cm/y between approximately 1740 and 1840. Others have also identified significant increases in sedimentation rates from circa 1750 (Curtin et al., 2001). These identifications were made using stratigraphic records, while the other conclusions (Brush, 1984, 1997; Cooper, 1995; Cooper & Brush, 1993; Fisher et al., 2006) were made using written records. Important here was that each of these sources identified a decrease in forested land after colonization, and stratigraphic history showed an increase of sedimentation rates during the same period.
The human induced land use changes in the Chesapeake Bay watershed from forest land to agricultural land impacted the benthic topography of the Chesapeake Bay. All of the tributaries discharge sediment into the Chesapeake Bay, and this sediment then enters the circulation patterns of the tributary estuaries. The actions of tides, flow, wind, and the physical characteristics of the Chesapeake Bay all have important effects on sediment transport and deposition within all estuaries including the Chesapeake Bay.

Estuaries are complex systems in which freshwater from land-based runoff and salt water from the ocean mix. A very well established and accepted definition of an estuary is “…a semi-enclosed coastal body of water which has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage” (Pritchard & Cameron, 1963). These aquatic systems provide habitat and food for countless species. The physical and chemical forces that influence water circulation in estuaries help to define the species that can exist in it, and it is important that aquatic ecologists and managers understand these processes. There are a number of physical and chemical factors that affect the water circulation in estuaries, including: freshwater input, residence time, mixing caused by salt concentrations, temperature, earth’s rotation, wind, and tides.

Changes in land use impact three main characteristics of freshwater input: changes in runoff hydrology, and the chemical and suspended materials contained in the runoff water. “The implication is that forests, with their relatively greater foliage have more potential for catchment loss (evaporation plus transpiration) than cropland” (Steiner, 1987). Steiner (1987) tried to detect any trends in the runoff hydrograph as land
use changed from rural to suburban in two Maryland catchments in the Potomac River basin. Steiner (1987) found that overall mean flows and runoff event flows increased as land use changes from rural to suburban. Included in this analysis was a trend to faster higher volume runoff events. For example, during a storm event more runoff reaches the stream because of an increase in impervious surface area as land use changes from rural to suburban.

Population growth is the main driver of land use and other environmental changes over time in the Chesapeake Bay watershed. Although not completely reliable, population estimates for people living along the Chesapeake Bay and its major tributaries around turn of the 17th century was between 30,000 and 45,000 people. Today there are more than 17,000,000 people living in the Chesapeake Bay watershed. Predictors expect the population to grow to 20,000,000 by the year 2030 (Chesapeake Bay Program, 2015b).

**Nutrient Characteristics**

In the early 1970’s aquatic ecologists focused concerns of eutrophication causes on phosphorous and carbon in all aquatic systems. While scientific data showed the influences of nitrogen in estuarine systems, it was not until the 1980’s and 1990’s that nitrogen was identified as a primary cause of eutrophication. Now managers of estuaries all over the world, including the Chesapeake Bay, focus on nitrogen and phosphorous because of increasing knowledge about how ecosystems respond to increasing inputs of nutrients (Boynton, 1998; D’Elia, 1987; Fisher et al., 2006; Howarth & Marino, 2006). During this same time period, better monitoring and understanding of general water
quality parameters has greatly improved the information that watershed managers can use, including local monitoring programs (R. C. Jones, Kelso, & Schaeffer, 2008). In keeping up with new science and a better understanding of the Chesapeake Bay, lawmakers have introduced regulations and policies (Boynton, 1998) to safeguard natural resources such as the Chesapeake Bay. There is now more estuarine water quality data than ever before available to managers and academics (Boynton & Kemp, 2008; Bricker et al., 2008). This large volume of available water quality data suggests that an adaptive management approach to meeting the Chesapeake Bay TMDL is possible.

Management actions in the Chesapeake Bay watershed and many aquatic systems around the world have focused on limiting eutrophication within the system by limiting nutrient inputs. Water quality data collected to date has shown an increase in phytoplankton, chlorophyll-a (chl-a), a measure of primary producers in most regions of the Chesapeake Bay. There are instances where turbidity has caused reduced light conditions and lower chl-a levels. Shifts in chl-a certainly are correlated to total nitrogen (TN) and total phosphorus (TP) concentrations present in the water column (Kemp et al., 2005).

**The Clean Water Act and Total Maximum Daily Load (TMDL) Requirements**

Between 1962 and 1972 a number of significant and historic events took place to make the passage of the Clean Water Act (CWA) possible on October 18, 1972. Earlier Federal legislation, such as the Rivers and Harbors Act of 1899, focused on the use of waterways for transportation and human health protections. Rachel Carson’s Silent Spring (1962), followed by the fire on the Cuyahoga River in 1969, and the establishment
of the EPA on December 2, 1970, all played an important role in the law’s creation. The Clean Water Act of 1972 extensively overhauled the existing Federal Water Pollution Control Act, which was authorized in 1948, providing the necessary tools to effectively manage the emerging water pollution issues.

Central to the CWA is the concept of cooperative federalism. The CWA was set up to allow for collaboration at the Federal, state, tribal, and local government levels. For example, the Federal government created effluent standards for point sources across the states which are performance criteria industrial dischargers must meet. Under agreements with EPA, the National Pollution Discharge Elimination System (NPDES) permitting process is administered by the states, thereby splitting the job of reducing pollution from point sources between the Federal and state governments. This is an example of cooperative federalism within the CWA as is the TMDL development and implementation process (S. C. Jones, 2013).

**The TMDL Requirement**

The CWA provides the legal basis for the TMDL. This section discusses the TMDL process in general, specifically within the Chesapeake Bay, and the call and need for adaptive management as part of the Chesapeake Bay TMDL process.

The CWA requires that states identify any waterbody that does not meet strict water quality standards every two years. This list of impaired water bodies is referred to as the 303(d) list. This monitoring requirement comes from section 303(d) of the Clean Water Act, and it is these water bodies that must have a TMDL calculated to help the waterbody meet specific water quality standards to be “delisted.” A TMDL is a
calculation of the maximum amount of a pollutant that a waterbody can receive per day and still meet strict water quality standards to ensure that it is swimmable and fishable. The TMDL is required so that the waterbody is safe for its intended use such as boating, fishing, or as habitat for aquatic species. A TMDL is calculated as:

Equation 1 TMDL
TMDL = ΣWLA_i + ΣLA_i + MOS

- **Waste Load Allocation (WLA):** The total amount of pollution contributed from point sources.
- **Load Allocation (LA):** The total amount of pollution contributed from non-point sources.
- **Margin of Safety (MOS):** The margin necessary to ensure that the TMDL is not exceeded given the uncertainty of pollution sources. It is unlikely that every point and non-point source can be identified in a given watershed; therefore this is where the calculation accounts for uncertainty.

Once the load (actual amount of the pollutant in pounds or tons) is calculated it can be “assigned” to the various pollution sources. For all intents and purposes, this allows for pollution limits for each type of source to be set.

The TMDL approach focusses on waterbody outcomes instead of limiting pollution from an individual source. This shift represents a large difference from traditional single permit management, such as NPDES permits. In the TMDL
implementation each permit is issued to a potential polluter while considering the entire ecosystem. The Clean Water Act (CWA) contains the legislative requirements of the TMDL (*United States Code, 2006 Edition, Supplement 5, Title 33 - NAVIGATION AND NAVIGABLE WATERS, 2012*).

The Code of Federal Regulations (CFR) defines the process as one “…for identifying water quality limited segments still requiring wasteload allocations (WLAs), load allocations (LAs), and total maximum daily loads (TMDLs), setting priorities for developing these loads; establishing these loads for segments identified, including water quality monitoring, modeling, data analysis, calculation methods, and list of pollutants to be regulated…and involving the public, affected dischargers, designated area wide agencies, and local governments in this process…” (40 C.F.R. 130.7, n.d.). The TMDL is based on the desired use of the waterbody – whether it is for boating, fishing, or swimming – each one of these uses will require a different level of water quality. The TMDL can accommodate these differences in any waterbody, including the Chesapeake Bay.

**Pollutants Regulated by TMDLs**

Any constituent in the water column (chemical, biological, or physical) can be regulated by a TMDL. Of the 75,205 impaired waters listed by the CWA 303(d) across the country, the table below shows the causes, as recorded by the USEPA (2015).
<table>
<thead>
<tr>
<th>Cause of Impairment Group Name</th>
<th>Number of Impairment Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pathogens</td>
<td>10883</td>
</tr>
<tr>
<td>Nutrients</td>
<td>7917</td>
</tr>
<tr>
<td>Metals (other than Mercury)</td>
<td>7055</td>
</tr>
<tr>
<td>Organic Enrichment/Oxygen Depletion</td>
<td>6700</td>
</tr>
<tr>
<td>Sediment</td>
<td>6477</td>
</tr>
<tr>
<td>Polychlorinated Biphenyls (PCBs)</td>
<td>6194</td>
</tr>
<tr>
<td>Mercury</td>
<td>4557</td>
</tr>
<tr>
<td>pH/Acidity/Caustic Conditions</td>
<td>4322</td>
</tr>
<tr>
<td>Cause Unknown - Impaired Biota</td>
<td>4075</td>
</tr>
<tr>
<td>Temperature</td>
<td>3128</td>
</tr>
<tr>
<td>Turbidity</td>
<td>2892</td>
</tr>
<tr>
<td>Salinity/Total Dissolved Solids/Chlorides/Sulfates</td>
<td>1898</td>
</tr>
<tr>
<td>Pesticides</td>
<td>1840</td>
</tr>
<tr>
<td>Algal Growth</td>
<td>1289</td>
</tr>
<tr>
<td>Cause Unknown</td>
<td>1160</td>
</tr>
<tr>
<td>Habitat Alterations</td>
<td>869</td>
</tr>
<tr>
<td>Dioxins</td>
<td>561</td>
</tr>
<tr>
<td>Total Toxics</td>
<td>517</td>
</tr>
<tr>
<td>Toxic Organics</td>
<td>480</td>
</tr>
<tr>
<td>Other Cause</td>
<td>454</td>
</tr>
<tr>
<td>Ammonia</td>
<td>420</td>
</tr>
<tr>
<td>Toxic Inorganics</td>
<td>371</td>
</tr>
<tr>
<td>Flow Alteration(s)</td>
<td>219</td>
</tr>
<tr>
<td>Oil and Grease</td>
<td>191</td>
</tr>
<tr>
<td>Nuisance Exotic Species</td>
<td>119</td>
</tr>
<tr>
<td>Taste, Color and Odor</td>
<td>102</td>
</tr>
<tr>
<td>Fish Consumption Advisory</td>
<td>98</td>
</tr>
<tr>
<td>Biotoxins</td>
<td>87</td>
</tr>
<tr>
<td>Trash</td>
<td>83</td>
</tr>
<tr>
<td>Noxious Aquatic Plants</td>
<td>68</td>
</tr>
<tr>
<td>Cause Unknown - Fish Kills</td>
<td>64</td>
</tr>
<tr>
<td>Chlorine</td>
<td>59</td>
</tr>
<tr>
<td>Radiation</td>
<td>52</td>
</tr>
<tr>
<td>Nuisance Native Species</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>75,205</td>
</tr>
</tbody>
</table>
Of interest to this dissertation, the two states included in the study area, Maryland and Virginia, have 337 and 1,490 overall CWA 303(d) listings of impaired waters. Maryland has 337 and Virginia has 1,490.

**Implementation Requirements of the TMDL**

One of the most interesting components of the TMDL in the CWA is that the act does not require that the TMDL be implemented, only that the calculation be made and information about implementation be developed. “In order to allocate loads among both nonpoint and point sources, there must be reasonable assurances that nonpoint source reduction will in fact be achieved…In the case of nonpoint sources, both state and local laws may authorize the implementation of nonpoint source controls such as the installation of Best Management Practices (BMPs)” (US Environmental Protection Agency, 1991). In Virginia, however, TMDL implementation is required based on the 1997 Water Quality Monitoring, Information, and Restoration Act (Commonwealth of Virginia, 1997). Guidance on the implementation of TMDLs has also been provided by Virginia and detailed the necessary components of a TMDL implementation plan (Commonwealth of Virginia, 2003). In Maryland there is no direct TMDL implementation requirement outside of the Chesapeake Bay TMDL, but an implementation plan was expected to be created as part of the Chesapeake Bay TMDL creation process (State of Maryland, 2010a). This differentiates a standard TMDL from the Chesapeake Bay TMDL.
The TMDL Implementation Process

Implementation of the Chesapeake Bay TMDL is a complicated process due to a number of factors including legislative, legal, agency jurisdiction, and management techniques. The Clean Water Act stipulated that a TMDL must be developed (i.e. calculated) for each watershed on the 303(d) list, but not that a TMDL be implemented. However, because the Chesapeake Bay TMDL is part of a larger EPA led initiative the WIPs are fully incorporated and are required to be carried out by the states and local jurisdictions. This historical lack of a required implementation process leaves local watershed managers in a difficult position; charged to improve the water quality of 303(d) listed waters while not possessing the Federal, and sometimes state, legislative or legal tools to implement a TMDL. This predicament has prevented or slowed the implementation of some TMDLs.

The implementation mechanics differ substantially depending on the pollutant of concern and the nature of the watershed. Federal, state, and local requirements or guidance also play an important role in TMDL implementation. Both Maryland and Virginia have created TMDL implementation guidance documents. In Maryland the Maryland Department of Environment’s (MDE) Science Services Administration is the lead agency for TMDL development and implementation, and a number of stakeholders are involved in the TMDL development and implementation processes. MDE also has a draft version of the state’s TMDL implementation framework document available on the Internet. The Virginia Water Quality Monitoring, Information, and Restoration Act (WQMIRA) requires that implementation plans be completed and include: (1) expected date for achievement of water quality goals, (2) that goals be measureable, and (3) that...
necessary corrective actions be included along with (3) costs, (4) benefits, and (5) potential environmental impacts.

**The Role of Politics in the Chesapeake Bay TMDL**

Politics and policy development play an important role in the Chesapeake Bay TMDL, and it is inappropriate to assume that the process can occur without political pressures. In particular, agricultural interests have been resistant to efforts to introduce innovative farming practices to improve water quality (Reganold et al., 2011). The Center for Responsive Politics (2015) identified the agribusiness industry as one of the top 10 lobbying industries, consistently spending over $125 million annually since 2008. Politicians at the federal, state, and local level certainly feel pressure from agricultural interests to protect their business interests. These efforts certainly led, at least in part, to the CWA requiring that an implementation plan be developed, but not requiring that it be implemented.

The political dilemma here sets at odds a desire to develop undeveloped woodlands in a lower intensity manner with those who desire the status quo and ensuring current farming practices with no additional regulation. Politicians feel pressure to develop and grow their populations, especially those near major population centers such as Baltimore, Richmond, and Washington, DC. At the same time, these political leaders feel pressure from agricultural interests to keep the status quo and ensure farming practices can continue unabated by new regulations. For this reason, Howard Ernst (2010) argued for a “dark green” environmental awakening to save the Chesapeake Bay. He argued that a new group of political leaders and advocates need to step forward, stop
posturing, and start confronting the problems caused by low density development and agricultural interests in the Chesapeake Bay watershed.

**Measuring Success or Failure in TMDL Implementation**

TMDL implementation begins when the LAs and WLAs are distributed and actions are taken to achieve specified limits. Next, managers have to allow the ecosystem time to respond to the actions in order to determine if the TMDL was set in such a way that water quality is improving as predicted. An important component of environmental management strategies is that ecosystems may not respond instantaneously.

For example, the Lynnhaven River watershed, located entirely in Virginia Beach, Virginia, was added to the Commonwealth’s 303(d) list for fecal coliform in 2004, and in conjunction with a variety of stakeholders a TMDL was calculated and an implementation plan prepared by 2006. The partnerships formed in this example exemplify the importance of a constructive and engaging process. The City of Virginia Beach didn’t have the resources or staff to focus on the TMDL implementation. The Lynnhaven River NOW, a nonprofit organization dedicated to restoring the river, stepped in and provided the support the city needed in a true partnership. By 2012 the portion of the Lynnhaven River identified as producing shellfish safe to consume nearly doubled, from 29% in 2007 to 42% in 2012 (S. C. Jones, 2013). But, even when a TMDL has been fully implemented, monitoring activities continue and there is still the potential that the river ecosystem could return to the 303(d) impaired waters list.
The Chesapeake Bay TMDL

The Chesapeake Bay TMDL has been described as a “pollution diet” (USEPA, 2010). It limits the amount of nitrogen, phosphorous, and sediment that can enter the Chesapeake Bay and its subestuaries. A 1999 consent decree which resolved a law suit, American Canoe Association et al. v. the United States EPA, 54 F.Supp. 2d 621 (E.D. Va. 1999), required a TMDL be developed for all of Virginia’s impaired waterways that feed the Chesapeake Bay by May 1, 2011 (Commonwealth of Virginia, 2010). EPA took the lead in developing the Chesapeake Bay TMDL, with direction and support from the White House, largely because of the Chesapeake Bay’s multi-state watershed. This issue is multijurisdictional because watersheds do not follow state, congressional, or international boundaries, and these transboundary waters create complex situations for stakeholders and government officials (Suarez & Sklarew, 2002). In order for Virginia’s impaired waterways to meet water quality standards, adjoining political jurisdictions must cooperate with Virginia.

Work on the TMDL was not immediately started when the EPA signed the Chesapeake 2000 Agreement, because that agreement was projected to adequately reduce nutrient loading to the Chesapeake Bay by the year 2010, and would have made the Chesapeake Bay TMDL unnecessary. However, anticipating that the 2000 agreement was not going to meet the goals set by 2010, the EPA started the TMDL process several years earlier (Blankenship, 2010).

The similarities between the TMDL processes set forth in the Code of Federal Regulations, title 40, sec. 130 and the Chesapeake Bay TMDL are currently controversial (see American Farm Bureau Federation v. EPA). “On January 10, 2011, American Farm
Bureau Federation (AFBF) and Pennsylvania Farm Bureau (PFB) filed suit against EPA challenging the promulgation of the Final Chesapeake Bay TMDL. In this litigation, AFBF and PFB sought to prevent EPA from engaging in any further activities related to the enforcement or implementation of this Final TMDL” (Pifer, 2013). In its filing the plaintiffs, noted above, argued four key points:

1. The final TMDL is not in accordance with the Clean Water Act, because the EPA does not have implementation authority.

2. The EPA violated the Administrative Procedures Act by not allowing for a sufficient public comment period before the final TMDL was issued.

3. The data used by the EPA to develop the models that were created to determine the load allocations for each state were not made available for public review.

4. The Chesapeake Bay TMDL was arbitrary and capricious.

In its argument the EPA questioned if the AFBF and the other plaintiffs had standing. Further, EPA argued that the final TMDL was developed in accordance with all applicable laws and that the final TMDL did not create implementation requirements. Instead the EPA pointed to the final TMDL as an example of cooperative federalism and argued that the states developed their own implementation plans in conjunction with the EPA (American Farm Bureau Federation v. EPA, 2015).

The main argument here was that the EPA did not have the authority to implement the Chesapeake Bay TMDL. In a thorough review of Code of Federal Regulations, title 40, sec. 130, there was no mention of implementation of a finalized and approved TMDL. In fact, this has become a major shortcoming of the law; the TMDL
must be calculated, but its implementation is not required. The EPA has identified the President’s Executive Order as a driver and cooperated with the states to develop their own Watershed Implementation Plans (WIPs) thereby not directly forcing the states to implement nitrogen, phosphorous, and sediment reductions in the watershed. In short, the EPA was acting as though the Chesapeake Bay TMDL was a direct continuation of Code of Federal Regulations, title 40, sec. 130. Dissenters from the Farm Bureau argued that the EPA has over-stepped its bounds by requiring implementation of the Chesapeake Bay TMDL where the legislation did not give the agency authority to do so. At this date the Third Circuit Court of Appeals upheld a previous ruling that the EPA has the legal authority to enforce the Chesapeake Bay TMDL implementation plans. As of November 6, 2015 the AFBF and other plaintiffs requested that the US Supreme Court review the decision of the Third Circuit Court of Appeals (Blankenship, 2015). It is unclear if the Supreme Court will accept the AFBF petition. The only thing clear in this argument is that it still continues with no final outcome.

**The Chesapeake Bay Agreements**

In 1983 the EPA, Maryland, Pennsylvania, Virginia, and Washington, D.C. signed the first Chesapeake Bay agreement. This agreement created the Chesapeake Executive Council and the Chesapeake Bay Program office in Annapolis, Maryland. The 1983 agreement signified a major regional effort to restore and improve water quality in the Chesapeake Bay watershed (Chesapeake Bay Program, 1983). A second agreement was signed in 1987. The 1987 agreement set a goal of 40% reductions in nutrient pollution by the year 2000 (Chesapeake Bay Program, 1987). The 1987 agreement was
amended in 1992, more clearly and directly identified the 40% reduction goal for nitrogen and phosphorus by the year 2000, and allowed for the goal to be changed based on scientific data, monitoring, and updated models (Chesapeake Bay Program, 1992). Most recently in 2014 and for the first time, all six states and Washington, D.C. signed an agreement on the Chesapeake Bay. The 2014 agreement contains ten goals that range from abundant life to clean water to engaged communities. The 2014 agreement reiterates the states’ goals set in the Chesapeake Bay TMDL, sets the goal of completing the implementation of the Chesapeake Bay TMDL with 100% of the reduction strategies for nutrients and sediment pollution loading implemented by 2025, and calls for stakeholder input through a series of management strategies (Chesapeake Bay Program, 2014).

The Three Phases of the Chesapeake Bay TMDL

The Chesapeake Bay TMDL utilizes three phases in the implementation process. The first Phase set interim reduction goals for nitrogen, phosphorus, and sediment entering the Chesapeake Bay from each state and Washington, DC in the watershed. The second phase refined the spatial scale of the first phase and provided more detail about the pollution controls to be implemented in each jurisdiction. The third phase document is due in 2017 and will refine the implementation strategy based on updated modeling and scientific data.

Perhaps the most concise and best explanation of the Chesapeake Bay TMDL WIP process can be found in the executive summary of the Maryland Phase I WIP. That document laid out the time and process for the WIPs as follows:
“EPA has laid out a three-phased planning process designed to ensure the involvement of interested parties and offer multiple opportunities to refine the Plan over time.

EPA’s primary guidance to the states came in the form of two letters to the Chair of the Chesapeake Bay Principal’s Staff Committee, comprised of the state agencies responsible for Bay related restoration programs. The first, ‘Expectations Letter,’ signed November 4, 2009, laid out EPA’s expectations for the three-phased planning process, including the eight elements of the Phase I Plan. The second, ‘Consequences Letter,’ signed December 29, 2009, laid out the key actions and deadlines for the states to meet and the regulatory and other consequences that could be triggered if they are not met.

The Phase I Plan is to be developed at the same time as the Bay TMDLs, which are to be completed by December 31, 2010. In addition to setting final target loads that provide EPA the necessary information to establish TMDL allocations, the Plan also sets ‘interim target loads.’ EPA has set the year 2017 to achieve 60% of the needed implementation and 2025 as the deadline for achieving final target loads...A Phase II Plan, to be developed in 2011, will refine the details of the Phase I Plan by providing more geographic specificity regarding target loads. The Phase II Plan will also include greater detail about pollution controls that the State and partners will implement by the end of 2017. The time allotted for the Phase II planning process will allow significantly more interaction between the State and interested partners to refine the Phase I Plan. As part of the Phase II planning process, EPA will allow states to revise the TMDL allocations established in the Phase I Plan, subject to public review.

A Phase III Plan will be developed in 2017...The TMDL allocations may again be revised to reflect better data, a greater understanding of the natural systems and to make use of enhanced analytical tools, such as updated watershed and water quality models” (State of Maryland, 2010b, p. ES-2-3).

**Virginia’s Phase I WIP**

In Virginia the initial tone of the Phase I WIP was that of discontent with the WIP development process and timeline set by the EPA, but in the cover letter to the document the Virginia Secretary of Natural Resources, Douglas Domenech, pledged that the Commonwealth will “continue to work with EPA, stakeholders, and the public to ensure that our implementation improves water quality in a manner that is sensible, fair and cost effective as this process unfolds over the next 15 years. The Governor is fully supportive of all reasonable efforts to improve this great natural resource....” To implement the
Chesapeake Bay TMDL, Virginia created a Stakeholder Advisory Group (SAG). This group’s goal was to “…engag[e] a wide variety of interested parties…result[ing] in critical feedback on the model inputs, outputs, and the abilities to implement a host of practices across Virginia’s bay watershed” (Commonwealth of Virginia, 2010, p. 4). The SAG met five times between December 2009 and November 2010. The EPA provided funding so that the Commonwealth could use an outside facilitator, E. Frank Dukes, a member of this dissertation committee, to keep the SAG group on track and maintain a fair process for discussion and comment. The member organizations of the SAG is included in the table below.
<table>
<thead>
<tr>
<th>Virginia Stakeholder Advisory Group Membership List by Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Virginia Stakeholder Advisory Group Members</strong></td>
</tr>
<tr>
<td>CBP Citizen’s Advisory Committee – Virginia Member</td>
</tr>
<tr>
<td>CBP Local Government Advisory Committee – Virginia Member</td>
</tr>
<tr>
<td>CBP Scientific and Technical Advisory Committee – Virginia Member</td>
</tr>
<tr>
<td>CDM</td>
</tr>
<tr>
<td>Chesapeake Bay Commission</td>
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<tr>
<td>Chesapeake Bay Foundation</td>
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<tr>
<td>Fountainhead Alliance</td>
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<tr>
<td>Friends of the Rappahannock</td>
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<tr>
<td>Homebuilders of Virginia</td>
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<tr>
<td>James River Association</td>
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<tr>
<td>James River Green Builders Council</td>
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<tr>
<td>Navy – Department of Defense</td>
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<tr>
<td>NRCS</td>
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<tr>
<td>PBS&amp;J</td>
</tr>
<tr>
<td>Rappahannock River Basin Commission</td>
</tr>
<tr>
<td>Rivanna River Basin Commission</td>
</tr>
<tr>
<td>Shenandoah Riverkeeper</td>
</tr>
<tr>
<td>Southern Environmental Law Center</td>
</tr>
</tbody>
</table>

In developing the Phase I WIP, Virginia held an initial webinar with more than 400 participants in October 2009. Seven additional webinars were held before the final document was submitted to the EPA in November 2010. In December 2010, more than 600 people attended five public meeting held to discuss the Chesapeake Bay TMDL process in the Commonwealth.
A major component of Virginia Phase I WIP was the expansion of the Chesapeake Bay Watershed Nutrient Credit Exchange Program (Code of Virginia at §62.1-44.19:12) that was first established in 2005 (Commonwealth of Virginia, 2010). This program encompassed point sources and offsets used to meet stormwater control requirements for development projects. The program does not allow all “trading;” for example, agriculture and forest land owners can only sell credits to the wastewater sector. Virginia recognized that the nutrient exchange program will not fully meet the reduction requirements of the TMDL, and the program was viewed as a cost effective way to reduce nitrogen and phosphorus loads into the Chesapeake Bay.

Virginia’s Phase I WIP discussed in detail how the WLAs and LAs were determined for the various MS4, industrial NPDES, construction activities, confined animal feeding operations, wastewater facilities, and smaller industrial facilities. “Polluted stormwater runoff is commonly transported through MS4s, from which it is often discharged untreated into local waterbodies. To prevent harmful pollutants from being washed or dumped into an MS4, operators must obtain a NPDES permit and develop a stormwater management program” (US EPA, 2015). The document divided the loads between watersheds and source sectors, then reviewed existing and proposed reduction methods. The document contains extensive information about the agriculture sector and noted that many of the previously employed reduction activities in the agriculture sector had been voluntary. A significant approach to this sector was a proposed database that would account for all Best Management Practices (BMPs) implemented in the agriculture and silviculture sectors that should be accounted for; that
is, Virginia wanted to be sure that any existing or newly implemented BMPs were recorded in a database to meet the reduction goals of the Chesapeake Bay TMDL. This type of database could be incorporated into the Environmental Information Exchange Network (EIEN). EIEN is a secured internet based environmental data sharing platform (Mahler & Regan, 2012). Data that is added to the EIEN can potentially be used by the EPA and states in the Chesapeake Bay watershed.

The Commonwealth of Virginia also proposed resource management plans (RMPs) that were to be completed for different agricultural lands, but all of these sector programs were to be voluntary until the agricultural sector failed to meet one of the Chesapeake Bay TMDL milestone goals, at which time the Virginia Department of Conservation and Recreation (DCR) will consult with the governor’s office to propose legislation that would make reduction activities binding for the agriculture sector. Further, the Phase I WIP called for one additional staff member in each of the 28 soil and water conservation districts that were in the Virginia portion of the Chesapeake Bay watershed (Commonwealth of Virginia, 2010). Much of these proposed new staff members were to work on improving stormwater control measures throughout the state.

Stormwater in Virginia is regulated by land disturbance regulations that require an erosion and sediment control plan for development activities of 10,000 square feet or greater, and local plans may be required for disturbances of less than 10,000 square feet, depending on the locality (Erosion and Sediment Control Law §10.1-560 et seq; Code of Virginia). Additionally the trigger for an erosion and sediment control plan requirements is 2,500 square feet in areas covered by the Virginia Chesapeake Bay Act. Virginia
operates its own MS4 program under the Virginia Stormwater Management Act, Clean Water Act, and Chesapeake Bay TMDL and titles its land use permits Virginia Stormwater Management Program Permits. Virginia has eleven Phase 1 MS4 localities (population greater than 100,000), three of which are in this dissertation’s study area: Arlington County, Fairfax County, and Prince William County. The Phase I WIP identified approximately 89 Phase II MS4 permits held by localities in Virginia, but did not list them (Commonwealth of Virginia, 2010). The Commonwealth utilized the MS4 permit program to implement the TMDL. The MS4 permit program allows permit holders three five-year cycles to reach the reduction goals, or a total of 15 years, which extend through 2025. In the first permit cycle MS4 localities were expected to reduce nutrient and sediment inputs by 5%, create a nutrient management plan, and a stormwater management plan, and a Chesapeake Bay TMDL Action Plan. The action plans were required to show, in detail, how the locality will meet the second permit cycle reduction of 35% and the third permit cycle reduction of 60%.

The Virginia Phase I WIP also stated “additional actions to better manage growth (comprehensive planning that provides greater water quality protection, subdivision, zoning and other land use and development ordinances) are necessary to minimize the impacts of growth on local waters. These actions will be identified with additional clarity in the Phase 2 WIPs” (Commonwealth of Virginia, 2010. p. 86).

**Virginia’s Phase II WIP**

In the cover letter for Virginia’s submittal of its Chesapeake Bay Phase II Watershed Implementation Plan, Secretary of Natural Resources Douglas W. Domenech
said “…the time frame provided by EPA to complete the Phase II planning process was far too short for localities, individually or collectively, to finalize and gain approval from governing bodies on potentially expensive strategies and commitments. Despite these constraints, our efforts resulted in 95% of Bay watershed localities actively participating in the Phase II planning process and submitting some level of strategies, information or data in support of this Final Phase II document. There is no doubt that our outreach efforts resulted in local decision makers gaining a greater understanding of pollutant loading from the land uses within their jurisdictions and an appreciation for their contribution to meeting the reduction goals including the WIP” (Commonwealth of Virginia, 2012, p. 1). Interestingly, the response rate of localities in the survey component of this dissertation was only slightly below the local government participation in the Phase II WIP at 92%, or 48 out of 52 localities responding in this dissertation’s survey.

The overall goal of the Phase II WIP was to divide the TMDL allocations into local area targets, at the subwatershed level, and to work with localities to ensure they understand what is expected of them in meeting the TMDL. To meet these overall goals the state government engaged the 16 Planning District Commissions (PDCs) located within the Chesapeake Bay watershed as a vehicle to communicate information about the Chesapeake Bay TMDL, loading rates, and the models. PDCs were established by the Virginia legislature in 1968 and were formed in part “[t]o improve public health, safety, convenience and welfare, and to provide for the social, economic and physical development of communities and metropolitan areas of the Commonwealth on a sound
and orderly basis….” (Commonwealth of Virginia, 1968). The PDCs are made up of representatives from the localities in the planning district, and the state identified that this dissemination method allowed for communication with local governments, Soil and Water Conservation Districts, and representatives of federal facilities. The state asked the PDCs to review and update the modeled land uses, report on BMP implementation progress, and identify resources needed to implement new BMPs. While the PDCs act as a coordinating agency, they lack any real regulatory authority of stormwater, wastewater, or agriculture. A modified approach that engaged county and city governments directly with the state might have been more effective because it would have allowed for a greater free flow of information directly between state and local government officials.

The local government engagement process was described in three steps in Virginia’s Phase II WIP. The first step involved meetings between the Secretary of Natural Resources and the PDCs to provide context to the Chesapeake Bay TMDL Phase II WIP process and goals. This first step was completed between March 2011 and May 2011 and meetings were also attended by several local elected and appointed officials.

In this first step localities were asked if they were willing to participate in the Phase II WIP planning process. The second step consisted of state officials from DCR’s local engagement teams holding follow-up meetings with the PDCs to go over more details of the Phase II WIP planning and development process and determining how involved each of the 16 PDCs wanted to be in the process. The second step occurred between April 2011 and June 2011.
In the third step, data from the EPA model was shared and refined by the PDCs and local governments. Additionally, the PDCs and local officials were asked to review currently implemented BMPs to ensure they were recorded in the WIP, create strategies to implement the necessary BMPs to meet the 2017 and 2025 deadlines, and identify resources necessary to implement these BMPs. The third step occurred between May 2011 and June 2011. Additional workshops were held to help local governments interpret the model data and update the data; these workshops ran through October 2011.

The state used a variety of outreach efforts to educate local officials during the development of the Phase II WIP. These efforts included a dedicated webpage, email listserv, and eleven presentations to interest groups around the state including the Virginia Association of Planning District Commissions. The Virginia Phase II WIP concluded its section on local government involvement with the following statement: “As a result of this engagement effort, PDCs, along with their partner local governments, now better understand the pollutant loadings from the various source sectors, the pollutant reductions needed in order to meet the Bay TMDL, and the level of BMP implementation needed within their areas as identified by the Bay model” (Commonwealth of Virginia, 2012, p. 9). However, the research presented in this dissertation shows that there are still localities that do not understand the Chesapeake Bay TMDL, or who do not support it.

Section 2.4 of the Virginia Phase II WIP made note of both financial and technical assistance being made available to PDCs and local governments. However, none of the officials interviewed or surveyed as part of this dissertation identified that
these resources were available, indicating that they could have been underutilized, or that they were not informed that resources were ready for them.

Due to variability identified in the Chesapeake Bay TMDL model version 5.3.2 and after consultation with the EPA, Virginia altered its Phase II WIP planning for local nonpoint source targets. Initially, the state was going to ask localities to develop implementation strategies to meet the target loads for the jurisdiction. Instead, the state shifted to an “implementation based target.” The state used target data from the Virginia Phase I WIP to assign BMP levels that each locality would be required to implement. However, it should be noted that the Commonwealth called out the limitations of the model as a reason why the loads cannot be distributed between localities and are only provided at the watershed level. These Phase II WIP targets are provided in the table below (Commonwealth of Virginia, 2012).

<table>
<thead>
<tr>
<th></th>
<th>Nitrogen</th>
<th>Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2009 Progress</td>
<td>Draft Allocation</td>
</tr>
<tr>
<td>Eastern Shore</td>
<td>2.00</td>
<td>1.31</td>
</tr>
<tr>
<td>James River</td>
<td>31.52</td>
<td>23.09</td>
</tr>
<tr>
<td>Potomac River</td>
<td>20.31</td>
<td>17.77</td>
</tr>
<tr>
<td>Rappahannock River</td>
<td>6.94</td>
<td>5.84</td>
</tr>
<tr>
<td>York River</td>
<td>6.44</td>
<td>5.41</td>
</tr>
</tbody>
</table>

The values above are provided as million pounds per year. Results are rounded.
These targets provide some context to the reductions needed to meet the TMDL goals. However, it was difficult to find current loads to compare the reductions needed among the watersheds listed in Table 3 in the Virginia Phase I and Phase II WIPs.

The Virginia Phase II WIP also identified an additional $15.5 million in funding during 2012 for agricultural practices such as livestock exclusion from waterbodies, improved animal waste practices, and other activities. One of the very difficult realities of a multijurisdictional watershed such as the Chesapeake Bay is that while some states invest substantially in reduction measures, other states do not. Further, because state budgets are at most determined in year increments, it can be challenging to have a stabilized and increased funding for restoration activities related to the Chesapeake Bay. Virginia proposed RMPs as a requirement on agricultural lands but was still determining the components of these plans and the triggers at the time the Phase II WIP was submitted. The Phase II WIP also identified proposed reductions in stormwater including new regulations that include post construction standards and further regulations on new development (Commonwealth of Virginia, 2012). These proposed actions will be helpful for the state in meeting the reduction goals of the TMDL.

The MS4 permit requirements are clearly stated and will use three permit cycles totaling 15 years to reach the reductions ranging from 6% to 20% depending on the pollutant and the surface type, impervious or pervious. The Phase II WIP includes a list of potential strategies that localities identified they could implement, a list of capacity-building activities, and a list of strategies to develop new BMPs or technologies. The main categories of these strategies are identified as: bioretention technologies, erosion
and sediment control, reducing impervious surfaces, low impact development, nutrient management schemes, managing pet waste, redevelopment, retrofitting existing BMPs, stream/shoreline/floodplain restoration, street sweeping, urban tree planting, and a general category. There were more than 100 strategies proposed along with the resources needed to implement the strategies (Commonwealth of Virginia, 2012). However, because the Phase II WIP was not narrowed down to specific county or city actions it is unclear which localities proposed which strategies, and, therefore, there is no accountability framework, specifically for non-MS4 localities. WLAs from wastewater treatment facilities are permitted and reduction requirements are well documented.

In Secretary Domenech’s cover letter, he wrote, “Virginia will also rely on principles of adaptive management, taking advantage of new technology and cost effective methods that may become available in the future in order to achieve our goals” (Commonwealth of Virginia, 2012, p. 2). This would certainly lead a reader to believe that local managers understood the meaning of adaptive management and how it would be used in the Chesapeake Bay TMDL.

**Maryland’s Phase I WIP**

The initial tone of Maryland Phase I WIP was less argumentative or challenging than the Virginia Phase I WIP in terms of the Chesapeake Bay TMDL implementation process. Further, in the Phase I WIP Maryland indicated its plan was to reach 70% of the final target by 2017. This is more than the 60% required by the EPA and showed the state’s commitment to the TMDL implementation process. According to the document, Maryland was projected to achieve more than 50% of the interim 70% target without
adding any reduction actions for nitrogen that were not already planned for by the state. For phosphorus, 80% of the interim 70% goal was to be achieved without adding any reduction actions that were not already planned for. This was described as possible because of already planned upgrades to wastewater treatments plants throughout the state.

The Maryland Phase I WIP identified that upgrades to major municipal wastewater plants would substantially close these gaps to meet the reduction goals for 2017. The report directly noted in the executive summary that while upgrades to wastewater point sources would get the state to the 2017 goal, nearly all of the remaining reductions would have to come from nonpoint sources. Additionally, the agriculture source sector was identified as the largest source of nitrogen in the state. The capacity analysis performed as part of the Phase I WIP using the resources required at current capacities to meet the 2020 nitrogen target showed how much work the state had to do in the agriculture, urban stormwater, and septic system sectors to meet the timeline. The increases in capacity are two to six times the current rates in the agriculture, stormwater, and septic source sectors. The document listed 58 different strategies to meet the implementation requirements along with a description of each; potential reductions by 2011, 2017, and total; and the estimated cost for the strategy.

The “reasonable assurances” proposed as part of Maryland’s Phase I WIP were detailed. For example in the agriculture sector the plan states “…if the goals for best management practices are not met, Maryland has added a commitment to put in place a regulatory requirement for the use of cover crops in 2014 on agricultural acres for which manure or bio-solids (sewage sludge) are applied” (State of Maryland, 2010b, p. ES-27).
Further, the Phase I WIP incorporates accounting for and monitoring the progress using adaptive management. Also like Virginia, Maryland’s Phase I WIP describes how the state would use nutrient trading schemes to cost effectively reduce nutrient inputs to the Chesapeake Bay. This is one way Maryland is using an adaptive management approach to meet the requirements of the Chesapeake Bay TMDL. That is, Maryland is trying different management actions to identify if they result in the appropriate changes to water quality in the Chesapeake Bay.

The table below is taken from the Maryland Phase I WIP’s section 2.1 and outlines the loading rates as of 2009 and the draft Phase I allocations by watershed, along with the percent reduction needed.

<table>
<thead>
<tr>
<th></th>
<th>Nitrogen</th>
<th>Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2009 Progress</td>
<td>2009 Progress</td>
</tr>
<tr>
<td>Eastern Shore</td>
<td>12.38</td>
<td>1.17</td>
</tr>
<tr>
<td></td>
<td>9.71</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td>22%</td>
<td>7%</td>
</tr>
<tr>
<td>Potomac</td>
<td>18.51</td>
<td>1.01</td>
</tr>
<tr>
<td></td>
<td>15.7</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>15%</td>
<td>11%</td>
</tr>
<tr>
<td>Susquehanna</td>
<td>1.52</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>1.08</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>29%</td>
<td>22%</td>
</tr>
<tr>
<td>Western Shore</td>
<td>13.94</td>
<td>0.77</td>
</tr>
<tr>
<td></td>
<td>9.74</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td>30%</td>
<td>40%</td>
</tr>
<tr>
<td>Patuxent</td>
<td>3.05</td>
<td>0.29</td>
</tr>
<tr>
<td></td>
<td>2.85</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>7%</td>
<td>27%</td>
</tr>
<tr>
<td>MD Total</td>
<td>49.42</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>39.09</td>
<td>2.72</td>
</tr>
<tr>
<td></td>
<td>21%</td>
<td>18%</td>
</tr>
</tbody>
</table>

The values above are provided as million pounds per year. Results are rounded.

From table 4 above, it is clear that the reductions necessary in the Maryland portions of the Chesapeake Bay are significant but were presented in a way that made the total reductions clear.
Maryland’s Phase I WIP discussed in detail how the WLAs and LAs were determined for the various MS4, industrial NPDES, construction land disturbance, confined animal feeding operations, wastewater facilities, and industrial facilities. Maryland’s review of the model data used by the EPA also found incorrect information about loading rates for non-significant industrial facilities. Instead of providing for a specific local review of the data, the Maryland Department of Environment (MDE) provided an estimate of the actual loading rate for this source sector to serve as a starting point for the Phase I WIP (State of Maryland, 2010b).

In Maryland 418,500 onsite sewage disposal systems were identified in the Chesapeake Bay watershed, 46,300 of which are located 1,000 feet from tidal waters of the Chesapeake Bay (State of Maryland, 2010b). Based on the US Census data shown in the Phase I WIP, onsite sewage disposal systems in Maryland served approximately 1,088,100 people in the Chesapeake Bay watershed. The ratio of population per equivalent dwelling unit (EDU) that utilize septic systems was higher in Maryland than the other states in the Chesapeake Bay watershed. As a result, this source sector appeared to be an area in need of improvement and is one reason that Maryland requires all septic systems that service new construction, and all replacement septic systems within 1,000 feet of a tidal portion of the Chesapeake Bay, to include nitrogen removal upgrades. Also, Maryland offers funding in a variety of circumstances to replace or upgrade septic systems. As a result the Phase I WIP calls for additional state staff to manage the septic system programs. This might be a problem if the resources are not allocated to fund these positions.
Another proposed action in the Maryland Phase I WIP was to implement a new Phase II MS4 permit that required a 20% impervious area retrofit or the equivalent. Maryland dedicated a section in the Phase I WIP to “Stormwater and Financial Capacity” (State of Maryland, 2010b). This section identified the different funding sources and mechanisms available to localities to pay for stormwater BMPs and retrofit programs. While direct budget funding is a possibility, Maryland localities also have enabling legislation allowing for a “system of charges” that can be instituted to finance stormwater programs. This funding source is not influenced by the economy or other budget factors and could be a source of funding to provide some of the outlay necessary to implement the Chesapeake Bay TMDL at the local level. This is helpful because it is not dependent on the economy, but finding the political will to implement a stormwater program fee can be challenging, especially at the local level.

In the agriculture sector in Maryland, farms at certain income levels, or based on the total weight of all animals on the farm, must prepare and follow a nutrient management plan that regulates the type, timing, and application of nutrients used in the operation of the farm. The state extension offices assist farmers in developing these plans or can train farmers to develop their own nutrient management plans. There are a variety of other cost sharing or incentive programs aimed at environmental protection and nutrient reduction strategies. Animal Feeding Operations (AFOs) that do not have a pipe, ditch, or other conveyance to remove stormwater runoff containing manure may not be regulated in Maryland. It is up to the owner to determine if the AFO discharges runoff containing manure. This is a pitfall to the AFO program, but it is recognized that the
staff needed to survey and inspect AFOs for potential permitting is extensive and expensive; there are currently approximately 250 total inspections conducted each year.

The Maryland Phase I WIP was developed with a public comment period with 113 sets of comments received, in addition to more than 100 emails, 100 letters, and two petitions with over 1,000 signatures (State of Maryland, 2010b). The comments were used to develop the final Phase I WIP developed by the state and responses to the comments were provided under separate cover (State of Maryland, 2011). These actions showed that public comment was valued and provided important feedback that the authors used in finalizing the Phase I WIP.

**Maryland's Phase II WIP**

In developing the Phase II WIP, Maryland worked with local partners who provided the state with implementation plans at the county level that informed the Phase II WIP development process. Additionally, agricultural working groups at the soil conservation district land scale also developed implementation strategies. In some cases the local plans fell short of the reduction targets or were not submitted, but the state amended the local plans to make them comply (State of Maryland, 2012). The overall thesis of Maryland’s involvement of local county government is summarized in section 2.1 of the document where it stated:

> “Maryland has a very strong county government system. Counties make many decisions regarding land use, zoning and development, implementation of stormwater permits, and construction and operation of wastewater treatment plants that are critical to water quality in general and to the Bay Restoration. Farm planning also occurs through Soil Conservation Districts that are county-based. Even though the WIP is documented at the scale of Maryland’s five major basins, the WIP development process included quantitative goals at a local scale so that the
shared responsibility for implementing the Bay TMDL in Maryland is clear to everyone. The local area reduction targets included information about the relative levels of effort that will be needed from each source sector, such as agriculture, urban and suburban stormwater, septic systems and municipal and industrial waste water. Although the Phase II WIP is a State document, required by EPA, Maryland strongly encouraged local partners to participate in a collaborative effort. Initial local contributions to the WIP were accepted by the State in November 2011. The State also offered the opportunity for local partners to provide refinements in July 2012 and will continue to work with local jurisdictions in the future on implementing and refining the WIP in an adaptive management process” (State of Maryland, 2012, p. 59).

Maryland also setup a WIP Stakeholder Advisory Group in August 2010 and this group was organized “to provide a venue for communication between its member organizations and the State regarding the development of the WIP Phase I and Phase II” (State of Maryland, 2012, p. 64). The membership in the group included those listed in the following table (Maryland Department of the Environment, 2010).

<table>
<thead>
<tr>
<th>Maryland WIP Stakeholder Advisory Group Representative Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chesapeake Bay Foundation</td>
</tr>
<tr>
<td>Chesapeake Bay Local Government Advisory Committee</td>
</tr>
<tr>
<td>Coastal &amp; Watershed Resources Advisory Committee</td>
</tr>
<tr>
<td>Delmarva Poultry Industry Inc.</td>
</tr>
<tr>
<td>Maryland Association of Counties</td>
</tr>
<tr>
<td>Maryland Association of Municipal Wastewater Agencies, Inc.</td>
</tr>
<tr>
<td>Maryland Association of Soil Conservation Districts</td>
</tr>
<tr>
<td>Maryland Board of Realtors</td>
</tr>
<tr>
<td>Maryland Farm Bureau</td>
</tr>
<tr>
<td>Maryland Municipal League</td>
</tr>
<tr>
<td>Maryland State Homebuilders Association</td>
</tr>
<tr>
<td>Sassafras River Association/Upper Eastern Shore Tributary Team</td>
</tr>
<tr>
<td>Sport Fisheries Advisory Commission</td>
</tr>
<tr>
<td>State Water Quality Advisory Committee</td>
</tr>
<tr>
<td>Tidal Fisheries Advisory Commission</td>
</tr>
</tbody>
</table>
The number of stakeholders in this process helped in the production and exchange of ideas.

In the Phase II WIP development process the state also held workshops directed at the agriculture sector in all 23 counties in Maryland, and these workshops attracted more than 1,000 people. The workshops were held in June and July 2011. Because the final load allocations distributed by the EPA in September 2011 changed from the draft goals, additional meetings were held in each county.

The document states that the intended outcome of the Phase II WIP is to provide final target loads at the county level. The EPA scaled back its expectation because of current available data and model restrictions. Local government participation was still a key component in the development of Maryland’s Phase II WIP. One hundred and ten outreach events were conducted by state staff during the development of the Phase II WIP. Here it is important to note that in Maryland state officials engaged directly with county governments to develop the Phase II WIP, while in Virginia local engagement was conducted through regional Planning District Commissions.

The report indicated that Maryland was expected to exceed its reduction goal of 70% of the final targets by 2017. This goal is self-imposed as the EPA set the 2017 goal requirement as 60% of the final targets. Maryland in the Phase II WIP is projected to reach 89% of the final target for nitrogen, 119% of the final target for phosphorous, and 409% of the final target for sediment by the interim deadline (State of Maryland, 2012). The reason for this may be the state wanted to add an additional safety factor to ensure
compliance with the TMDL or that environmental advocates were able to focused state officials to do more than the minimum to protect water quality in the Chesapeake Bay. These projections greatly exceed the projections committed to by Virginia in its Phase II WIP.

The table below is taken from data presented in the Maryland Phase II WIP executive summary and outlines the loading rates as of 2010 and the final Phase II allocations by source sector, along with the percent reduction needed (State of Maryland, 2012).

47
Table 6 Maryland Phase II WIP Load Allocations by Source Sector

<table>
<thead>
<tr>
<th>Source Sector</th>
<th>2010 Progress Million Lbs/Yr</th>
<th>Final Target Million Lbs/Yr</th>
<th>% Reduction from 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Nitrogen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>19.95</td>
<td>15.22</td>
<td>23.70%</td>
</tr>
<tr>
<td>Forest</td>
<td>5.29</td>
<td>5.31</td>
<td>-0.20%</td>
</tr>
<tr>
<td>Non-Tidal Atmospheric Deposition</td>
<td>0.66</td>
<td>0.66</td>
<td>NA</td>
</tr>
<tr>
<td>Septic</td>
<td>3</td>
<td>1.85</td>
<td>38.20%</td>
</tr>
<tr>
<td>Stormwater</td>
<td>9.48</td>
<td>7.55</td>
<td>20.30%</td>
</tr>
<tr>
<td>Wastewater</td>
<td>14.37</td>
<td>10.58</td>
<td>26.40%</td>
</tr>
<tr>
<td>Total</td>
<td>52.76</td>
<td>41.17</td>
<td>22.00%</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>1.64</td>
<td>1.45</td>
<td>11.50%</td>
</tr>
<tr>
<td>Forest</td>
<td>0.15</td>
<td>0.15</td>
<td>NA</td>
</tr>
<tr>
<td>Non-Tidal Atmospheric Deposition</td>
<td>0.04</td>
<td>0.04</td>
<td>NA</td>
</tr>
<tr>
<td>Septic</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Stormwater</td>
<td>0.72</td>
<td>0.5</td>
<td>30.30%</td>
</tr>
<tr>
<td>Wastewater</td>
<td>0.75</td>
<td>0.67</td>
<td>11.20%</td>
</tr>
<tr>
<td>Total</td>
<td>3.3</td>
<td>2.81</td>
<td>14.90%</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>696</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Forest</td>
<td>126</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Non-Tidal Atmospheric Deposition</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Septic</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Stormwater</td>
<td>543</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wastewater</td>
<td>11</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>1,376</td>
<td>1,350</td>
<td>1.90%</td>
</tr>
</tbody>
</table>

Final target values shown above are to be achieved by 2025 in Maryland.
To meet the reduction goals Maryland identified a series of strategies for point sources, nonpoint sources, and the agriculture sector. These strategies included upgrades at large municipal wastewater treatment plants to include enhanced nutrient removal. There was also a planned upgrade of 60% of septic systems within 1,000 feet of tidal waters in the Chesapeake Bay watershed. In Phase I MS4 permit holders will be required to remove 30% of impervious surfaces and Phase II MS4 permit holders will be required to remove 20% of impervious surfaces or implement nutrient management practices on these areas. Agricultural BMPs included in the plan are cover crops, nutrient management plans, and soil conservation planning. Also, the Phase II WIP calls for the implementation of approximately 407,000 acres per year of urban nutrient management practices such as lawn care activities.

The Phase II WIP provides detailed interim (target date of 2017) goals for the strategies to be implemented in the state. An example is the increase of over 16,000 acres of wetlands and wet ponds to manage stormwater throughout the state. These detailed strategies allow the implementation process to be measured and any missed targets can be identified and corrected. The plan also spends considerable time identifying the costs and funding sources available to implement the plan. These plans are effective because the analysis holistically examined the potential sinks for nutrients and sediment, while also providing detailed analysis of the resources required for implementing the plans.

The Maryland Phase II WIP also contains a directive that “an adaptive process with accountability” would be used which discussed the use of adaptive management as a positive component of the planning process as “[t]his opportunity for refinement is
particularly meaningful in view of the State’s recent decision to adopt the 2025 deadline for meeting the Final Target load, which was made after local WIP plans were submitted…” (State of Maryland, 2012, p. 6-7). This is especially important because it shows a direct commitment from the state to implement the TMDL using an adaptive management approach.

**Reasonable Assure “Backstop” Measures for the Chesapeake Bay TMDL**

In developing the draft TMDL, the EPA created allocations using each of the seven jurisdictions’ draft WIP allocations, while also incorporating differing levels of backstop, or safety, allocations. These backstop allocations focused on areas where the EPA had the authority to limit pollution through permit programs (USEPA, 2010). In the final WIP version the EPA reduced or removed the majority of the previously implemented backstop measures but did keep a few to provide added review and contingency plans to ensure the goals of the Chesapeake Bay TMDL were achieved.

In Virginia specifically, the EPA noted concerns about the urban stormwater assurances – specifically for local jurisdictions without an MS4 permit. The EPA noted that it may “shift a greater portion of Virginia’s urban stormwater load from the load allocation to the wasteload allocation. This shift would signal that substantially more stormwater could potentially be subject to NPDES permits issued by the Commonwealth as necessary to protect water quality” (US Environmental Protection Agency, 2010, p. ES-12). It should be noted here that Maryland had no identified backstop actions taken, this signifies that the EPA found the Maryland Phase I WIP to provide “reasonable assurances” that the state would meet the goals of the Chesapeake Bay TMDL. This
identifies that the Maryland implement planning process was superior to the same process in Virginia based upon the review completed by the EPA.

In the final TMDL the EPA made it clear that the agency’s objective is to fully implement the nutrient and sediment reductions called for in the Chesapeake Bay TMDL and that it would use any federal authority available to do so. These potential actions account for a lowering of pollution limits from federally permitted sources and the potential oversight of any authority delegated to the state(s) from the EPA, such as the NPDES permitting program. As a result the agency included the following in the document:

“EPA will carefully review programs and permits in all jurisdictions. EPA’s goal is for jurisdictions to successfully implement their WIPs, but EPA is prepared to take necessary actions in all jurisdictions for insufficient WIP implementation or pollution reductions. Federal actions can be taken at any time, although EPA will engage particularly during two-year milestones and refining the TMDL in 2012 and 2017. Actions include:

- Expanding coverage of NPDES permits to sources that are currently unregulated
- Increasing oversight of state-issued NPDES permits
- Requiring additional pollution reductions from federally regulated sources
- Increasing federal enforcement and compliance
- Prohibiting new or expanded pollution discharges
- Conditioning or redirecting EPA grants
- Revising water quality standards to better protect local and downstream waters
CHAPTER THREE: ABOUT ADAPTIVE MANAGEMENT

This chapter examines the theoretical approach and creation of adaptive management along with the working definitions and process. The differences of passive and active adaptive management are discussed along with criticisms of the method. Finally adaptive management within the context of the Chesapeake Bay TMDL is examined in detail including stakeholder involvement.

Adaptive Management
Adaptive Management from a historical perspective is young, beginning in 1978. However, in a short period of time, it has become a significant component of ecological management. It also seems to be difficult to understand. This section takes a deeper look at the history, definitions, and implementation at the local level of adaptive management.

In this study, participants were asked what they knew about adaptive management. The results were mostly positive, and it was evident that many agencies at different government levels use adaptive management in their processes, though how thoroughly is not clear. The state of Maryland, which has very definitive plans to meet the TMDL goals, clearly cites adaptive management as a leading tool in its plans.

Theoretical Approach and Creation
Many volumes and articles have been published on the topic of adaptive management. The term is cited in hundreds of science based and business management plans. However, the idea is a relatively new one. This concept began with C.S. Holling
in the book *Adaptive Environmental Assessment and Management* (Holling 1978). Holling’s idea incorporates economic, social, and environmental understanding at the very beginning of the management design process as a way to deal with uncertainty.

Holling was searching for a way to deal with the deficiencies inherent in environmental problems: namely, the inability of humans to fully understand the complex ecological relationships that exist in environmental systems. A change in any given chemical, physical, or biological component of an ecosystem can have far-reaching effects in space and time. As managers and scientists we may never fully comprehend the complexity of species to species and species to environment interactions (i.e. ecological complexity). Developing a management strategy that implicitly or explicitly assumes that we have all of the needed knowledge is more than likely to fail or at the very least fall short of any significant goals and objectives. For example, the Chesapeake Bay Program itself has struggled to deal with uncertainties in the Chesapeake Bay watershed as noted by Reckhow et al. (2011) the Committee on the Evaluation of Chesapeake Bay Program Implementation for Nutrient Reduction to Improve Water Quality; National Research Council. Management strategies, once implemented, must be robust enough to deal with future challenges, new understanding and changes in the ecosystem. Holling asked that “[e]nvironmental dimensions [sic] be introduced at the very beginning of the development for policy design process and should be integrated as equal partners with the economic and social dimensions” (Holling, 1978, p. 37). Indeed, adaptive management provides this possibility.
Typically diagrams that depict the adaptive management process are similar to those shown in Figure 1 (Salafsky, Margoluis, & Redford, 2001). This diagram is particularly useful because at the start the authors identify the importance of “clarify[ing] the group’s mission.” The first step in the process is that the group defines its mission. Next, a model of the system is created, followed by a management plan that is intentionally designed to maximize results and learning from the process. After a management plan is developed, a dovetailed monitoring plan is designed. The two plans
are implemented and the data are analyzed. Next, this new information is used to repeat the process iteratively.

Within its methods, adaptive management sets a process that should be followed rather than setting a specific improvement goal or objective. Other management strategies have an end goal or plateau that signifies success. Within the adaptive management strategy there is really no end, because adaptive management is an iterative process. This also means it can be difficult to identify success or failure. Holling adds the ‘assessment’ component because of the importance that monitoring plays within the adaptive management process. This more proactive approach to environmental management is evidence of a shift in thinking that the environment is not ‘cleaned up,’ but rather managed for optimal ecosystem services and human well-being. Thus, participants in adaptive management processes need to understand that adaptive management is a process and not an end goal to be achieved.

In recent years the term “ecosystem services” has been used to describe “…services [that] are indispensable to the well-being and health of people everywhere” (Millennium Ecosystem Assessment, 2005, p. 2). The term was not commonly used in the late 1970’s when Holling completed his work. Many adaptive managers and their goals can be viewed as a means to increase or improve services provided by the ecosystem(s) where management actions focus.

Even at this early stage Holling was quick to point out several myths of adaptive management. Holling’s list included:

• “The central goal for design is to produce policies and developments that result in stable social, economic, and environmental behavior.
• Development programs are fixed sets of actions that will not involve extensive modification, revision, or additional investment after the development occurs.
• Policies should be designed on the basis of economic and social goals with environmental concerns added subsequently as constraints during a review process.
• Each new assessment is unique. There are few relevant background principles, information, or even comparable past cases.
• Any good scientific study contributes to better decision making.
• Ecological evaluation and impact assessment aim to eliminate uncertainty regarding the consequences of proposed developments” (Holling 1978).

Rather than important points to consider, Holling lists common misconceptions that in his view can cause the downfall of an adaptive management strategy. Further, discussions of potential pitfalls regarding adaptive management have been identified and will be examined in detail (Allen & Gunderson, 2011).

Adaptive management is simply defined as a systematic approach for improving resource management by learning from management outcomes (Williams et al., 2009). However, adaptive management is a complex and abstract concept that does not have a consistent definition in the literature or in the field of practice (Rist et al., 2013; Westgate et al., 2013). This is largely due to the abstract way the concept was presented originally (Holling, 1978).

Because the Chesapeake Bay TMDL is an initiative being driven by the EPA, this author used an available EPA definition of adaptive management in the survey tool component of the research. That definition is: “Adaptive management is the process by which new information about the health of the watershed is incorporated into the watershed management plan. Adaptive management is a challenging blend of scientific research, monitoring, and practical management that allows for experimentation and
provides the opportunity to “learn by doing.” It is a necessary and useful tool because of the uncertainty about how ecosystems function and how management affects ecosystems. Adaptive management requires explicit consideration of hypotheses about ecosystem structure and function, defined management goals and actions, and anticipated ecosystem response” (US Environmental Protection Agency, 2000, p. 1).

The National Academy of Sciences (NAS) identified adaptive management as “the effective management of experiments, a carefully planned monitoring program, assessment of results, and a process by which management decisions are modified based on new knowledge. Learning is identified as an explicit benefit of adaptive management and is used to improve future decision making” (Reckhow et al. 2011, p. 7). The NAS definition is in lockstep with the original definition from Holling. The NAS definition is written from the point of view of a scientist manager. In contrast the definition used by Salafsky et al. (2001) identified that “adaptive management incorporates research into conservation action. Specifically, it is the integration of design, management, and monitoring to systematically test assumptions in order to adapt and learn” (p. 12). Both definitions mention management, monitoring, and learning. Additionally, both incorporate planning and/or design.

Despite the apparent appeal of the term, there are several important points for the prospective coastal manager. First, despite its charm, it is hardly clear just what adaptive management actually means. From one perspective, adaptive management is a directive to look at resources holistically. From another perspective, adaptive management is a process whose basic premise is to learn by doing. Still another perspective can
incorporate both previous views. Indeed, there are extensive prescriptions on the use of mathematical models as a basis for adaptive management, detailed guidance on how to expand and manage participation through workshops, and a set of principles for adaptive management (Walters 1986; Holling 1978; Hennessey 1994). “Thus, [adaptive management] appears to be a point of view, a process, and normative objective” (L. King & Blizzard, 2001, p. 2).

The CBP, which dates back to 1983 and is comprised of Maryland, Pennsylvania, Virginia, the District of Columbia (the other Bay states did not participate in the 1983 agreement, but are members now and include Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia, and the District of Columbia), and a number of other federal agencies and nonprofit organizations, is charged to lead the restoration and protection of the Chesapeake Bay. The CBP has created a webpage (Chesapeake Bay Program 2012) which defines adaptive management as “an ongoing, science-based process through which the Chesapeake Bay Program plans, implements and evaluates its restoration efforts. In simple terms, adaptive management is ‘learning by doing’: taking action with acknowledged uncertainties, carefully monitoring outcomes, transparently assessing progress and redirecting efforts when necessary” (Chesapeake Bay Program, 2012, p. 1). This contextual understanding of the CBP’s role in adaptive management is an important one. Perhaps most striking is that the definition does not mention other stakeholders, but rather uses the phrase “evaluates its restoration efforts.” The CBP’s definition of adaptive management is wholly introspective and does not reference the importance of working with varied stakeholders. This is interesting given that the CBP is
itself a partnership of state, federal, academic, and non-governmental organizations. This may be telling about the organization’s overall approach to adaptive management.

Specifically within the Chesapeake Bay watershed, adaptive management has been used, discussed, and studied before (Boesch, 2006) and recently (Chesapeake Bay Program, 2011). Past efforts to restore the Chesapeake Bay are now viewed as ineffective, given that the restoration efforts have been going on for over 30 years with only moderate success, largely because these efforts relied on voluntary participation where adaptive management may not have been consistently applied. The framework of the Chesapeake Bay Executive Order (*Executive Order No. 13508*, 2009) and the Chesapeake Bay TMDL process have made implementation of the TMDL a mandatory and regulated activity for the various political jurisdictions that makeup the Chesapeake Bay watershed. Thus a clear, usable definition of adaptive management is needed, since many participants in this study said they used adaptive management.

**The Dissertation’s Definition of Adaptive Management**

Based on the literature review completed as part of this dissertation, this document concurs with Williams et al. and defines adaptive management as “a systematic approach for improving resource management by learning from management actions” (Williams et al., 2009). This differs from the definition used by the EPA above. The EPA definition was used in the survey tool associated with this dissertation research because EPA is the lead agency for the Chesapeake Bay TMDL.
The Adaptive Management Process in Detail

Adaptive management is clearly a process and not a means to an end. This is clear in the definitions provided above and in the “steps to implementing adaptive management” that are summarized below (Salafsky et al., 2001). Salafsky, Margoluis, and Redford (2001) identified the starting point of the adaptive management process as clearly defining the purpose, by asking the question: what do you want to achieve? Next, a model is constructed and it is noted that a model is “…crucial if learning is to be possible: without an understanding of how one’s model of reality works, it is impossible to go back and improve that understanding when reality fails to agree with prediction” (Salafsky et al., 2001). After the model is developed a management plan is created that should focus on outcome results and learning.

Managers that identify a deficiency in the plan and instantly change the plan are not conducting adaptive management. After creating the management plan, a monitoring plan should be created that will appropriately test the managers assumptions. With the management and monitoring plans in hand, they should then be implemented. That is, adaptive management requires both a management action plan and a complementary monitoring plan. The data collected should be analyzed and results shared with the appropriate stakeholders. Finally, in an adaptive management process the steps above should be run again and again in an iterative process of adaptation and learning. In their guide Salafsky et al. (2001) provide a good road map to completing an adaptive management process.

Perfecting the adaptive management process is important as managers must deal with uncertainty in the ecological system. While there may appear to be a simple
management solution, the adaptive management process accounts for new knowledge and the chance that the ecosystem may not respond as expected. Here, the importance of the process is stressed as a roadmap to find a management solution, but not as a means to an end.

**Adaptive Management Models**

Models are an integral part of the adaptive management process. While it is not possible to fully understand an ecological system and how it will respond to management actions, it is possible to model a range of results based on the information available about the system. Models were discussed at the very beginning of adaptive management, and Holling (1978) noted in his original work that "clearly, any management problem has some parts for which there are sufficient data and others for which there are not; some parts whose processes we know from other sources and some not; and some parts that can adequately be described by a simple function and others that require more elaborate mathematics. It is precisely this that has led us to utilize simulation models as a technique for assessment and analysis. With simulation models we have the flexibility to program a wide variety of functions and relationships and thus made full use of the knowledge we do have. Simulation model construction also helps us identify those areas where information is scarce and needed" (Holling, 1978, p. 66).

Further, there is a clear understanding in adaptive management that uncertainty is to be embraced. The knowledge about the ecosystem that is available can be used to assess and analyze the system and explore a large number of management actions quickly.
Another prolific writer on adaptive management noted that models could even be the first step in an adaptive management process. "...[A]daptive management should begin with a concerted effort to integrate existing interdisciplinary experience and scientific information into dynamic models that attempt to make predictions about the impacts of alternative policies" (C. Walters, 1997, p. 3). This is because these models allow for many management actions to be explored without the time, financial commitment, and effort required for real world implementation actions. Additionally, the model can provide a prediction of the possible management outcomes based on the data available.

Finally, C.S. Holling warned about the use of models to describe regional level ecosystems and extended periods of time. In his text, Holling (1978) notes "...the model described here is aimed at strategic-level regional planning with projections produced over large spatial areas and long periods of time. Detailed quantitative validation of such a model is not only inappropriate, it is, in one sense, quite insufficient" (p. 156). This comment related directly to the Chesapeake Bay TMDL. There has been a great amount of debate over the models used in developing TMDLs and adaptive management (Birkeland, 2001; Copeland, 2012). Models are approximations; however, these models are an important tool in the adaptive management process coupled with a robust monitoring regime to increase scientific knowledge to assist in the implementation of management actions (C. Walters, 1997).
**Monitoring in Adaptive Management**

As managers go through the adaptive management approach, after implementing the preferred management action(s), monitoring must be conducted to evaluate the success of the action and increase the scientific knowledge of the ecosystem for future management. An important point to make regarding adaptive management is that those carrying out the experiments and monitoring outcomes need to be able to analyze the monitoring output. For example, the California Delta, near Sacramento, has approximately 52% of its historical flows diverted or exported (Norgaard, Kallis, & Kiparsky, 2009). The government initiative called CALFED was created to improve the management of the California Delta, especially related to endangered species of birds. This ecosystem provides some important lessons on monitoring in an adaptive management program.

The CALFED program used adaptive management on a small scale, but there was a problem. In the context of the full delta, small adaptive management projects were of little significance because of largescale changes in the ecosystem. “Ecological restoration directed to particular parts of the Delta does not necessarily improve fish populations when conditions elsewhere are becoming worse” (Norgaard et al., 2009, p. 650). Further, without an overall evaluation of the health of the California Delta, small projects were often monitored and evaluated based on non-scientific markers such as the total area such restoration activities were completed for, but this was not the intention of the monitoring that is expected to be part of an adaptive management approach.

"CALFED adaptive management focused at the smaller scale of specific interventions
and projects. But here a different problem emerges: local success means little when the system is changing at larger spatial and temporal scales" (Norgaard et al., 2009, p. 650).

The uncertainty associated with an adaptive management approach to a problem, specifically the modeling and monitoring components, has the potential to become very expensive. As managers and stakeholders discuss, debate, and argue over the data used to create load allocations and waste load allocations – and reallocations – significant financial and other resources can be used (Birkeland, 2001). There is a tendency to use all available resources to implement the adaptive management actions, but resources must be dedicated to monitoring activities to accurately plan for uncertainty and use adaptive management. Further, the monitoring efforts have to be focused on the correct variable(s), as monitoring the wrong variable can provide a false sense of reality (Holling, 1978).

The CBP began long-term monitoring using fixed stations in 1984 throughout the Chesapeake Bay (Olson, 2012). The CBP Monitoring program is a partnership between the CBP, Maryland, and Virginia in the main stem of the Chesapeake Bay and the tidal portions of its subwatersheds. The CBP services a data hub, which allows access to a dataset from an array of sources. This data has been used along with other data types to develop the models used to calculate the Chesapeake Bay TMDL.

**Passive and Active Adaptive Management**

The concepts of active and passive adaptive management appear to stem from the original writings on the concept. The originator of the adaptive management concept and early experts wrote an extensive paper on this topic and described three principle ways to
create management structures. The first was trial and error. The second was passive adaptive management “where historical data available at each time are used to construct a single best estimate or model for response, and the decision choice is based on assuming this model is correct.” (C. J. Walters & Holling, 1990, p. 2060). The third was active adaptive management “where data available at each time are used to structure a range of alternative response models, and a policy choice is made that reflects some computed balance between expected short-term performance and long-term value of knowing which alternative model (if any) is correct” (C. J. Walters & Holling, 1990, p. 2060).

The authors went further to recommend active adaptive management in their conclusion: “When policies are defined, management begins and the same process of design and analysis occurs, but now in an environment where action has to be taken, however uncertain the outcome. That is where active adaptive management can play a central role, because its premise is that knowledge of the system we deal with is always incomplete. Not only is the science incomplete, the system itself is a moving target, evolving because of the impacts of management, the progressive expansion of the scale of human influences on the planet and natural, non-manmade changes. Hence, the actions needed by management must be ones that achieve ever-changing understanding as well as the social goals desired. That is the heart of active experimentation at the scales appropriate to the question” (C. J. Walters & Holling, 1990). However, there were several articles in the literature that pointed to shortcomings with adaptive management. “The entrenched nature of institutional constraints suggest that much information and learning about adaptive management is required before attempts are made to apply the
approach, but to date little support has been provided to the managers who are expected to manage adaptively" (Allan & Curtis, 2005). This is certainly true in the Chesapeake Bay TMDL. Thus, with respect to TMDLs, active adaptive management is necessary to deal with an ever changing ecosystem and uncertainties within that system.

**Criticisms of Adaptive Management**

While adaptive management provides an excellent framework to deal with uncertainty and learn by doing, there are several criticisms to the approach. Without a doubt one of the biggest criticisms of adaptive management is that it is not a standard top down or command and control approach. “Management responds to problems and opportunities, and that is different from an experimental scientist’s desire to explore a phenomenon systematically. Accordingly, there is no reason to think that adaptive management will work smoothly, that it will be easy to coordinate” (Lee, 1999, p. 4). While adaptive management is not always a smooth process, it does provide real opportunity for learning, both about the ecosystem, and the social and political structure around the ecosystem. "Thus, AM appears as an approach that conceptually blocks out the nasty and dark sides of the political process that may disturb rational problem solving. Neither are theoretical arguments provided to support the idea that AM arrangements do in fact work detached from politics; nor does AM put forward convincing design elements that can be assumed to actually safeguard the exclusion of politics in practice. The very effort of blocking out politics, however, renders AM itself a highly political concept as it tends to tacitly build on and reproduce given power relations" (Voss & Bornemann, 2011, p. 8). Adaptive management, or any other management process, does not exist in a vacuum.
Practitioners or academics that believe adaptive management can occur outside of any political reality act to hinder the adaptive management process. It is irresponsible to assume that adaptive management can occur in a vacuum, by incorporating the political process into restoration efforts that use adaptive management help to ensure success, especially as new political leaders are elected or as budgets are constrained.

Adaptive management also requires much coordination and support, both for stakeholder involvement and financing. Also important are the need for time and the political and social will to continue an adaptive management approach in ecosystems that may respond slowly to management actions. “The issue is the cost-effective testing of hypotheses. Adaptive management is not laboratory science, where the burden of proof is tilted toward highly reliable findings by rules such as $p<0.05$, the notion that one’s inferences should be reliable 95 percent of the time. In public policy and the world of action, the usual test is "more likely than not" -- that is, $p<0.5$” (Lee, 1999, p. 6). It is this meshing of management and science that can be a good criticism of adaptive management, but also the greatest opportunity for synergy in management strategies and ecosystem responses. “Adaptive management is difficult to initiate and to sustain. However valuable the surprises it produces may turn out to be, adaptive management is unlikely to be considered affordable in many instances. But there is reason to think that this mode of learning is important, possibly essential, in the search for a durable and sustainable relationship between humans and the natural world” (Lee, 1999). For example, in this dissertation’s research respondents commonly discussed the cost of monitoring associated with adaptive management is a deterrent.
Adaptive Management in the Chesapeake Bay TMDL

In the Chesapeake Bay TMDL, the EPA required the six states that make up the Chesapeake Bay watershed and the District of Columbia to each prepare a Watershed Implementation Plan (WIP), requiring that the states actually carry out these implementation plans. This requirement is specific to the Chesapeake Bay TMDL and beyond the standard TMDL development protocol in the CWA, which does not require that the implementation plan be carried out – only that it be prepared. The use of adaptive management was not explicitly required as part of the WIP development process by the EPA. However, Section 202(f) of Executive Order 1358 required a report to provide a “new emphasis on a sustainable Chesapeake Bay and watershed” (Phillips et al., 2009, p. 5). This report goes on to highlight as its first “major recommendation to strengthen science and increase technical assistance” as to “focus the Chesapeake partnership on sustainability and adopt an adaptive, ecosystem-based management approach” (Phillips et al. 2009, p. 5). This document directly tied the Chesapeake Bay TMDL and Executive Order 1358 to adaptive management and its importance on the WIP process in each state. Of the seven jurisdictions only Delaware and the District of Columbia failed to mention adaptive management in their respective Phase I WIP or Phase II WIP documents. Also, the Maryland Phase I WIP and Pennsylvania Phase II WIP documents mentioned adaptive management more heavily than any of the other jurisdictions, respectively.

These WIPs were required to detail how the various states would meet the TMDL waste load allocations and load allocations as outlined in the Chesapeake Bay TMDL. In the documents the states and District of Columbia detailed how they would meet the
Chesapeake Bay TMDL reductions by providing their rational, strategies, and timeline. From the Virginia Phase I WIP, “As such, we will continue to work with EPA to improve the model and use an adaptive management approach to adjust strategies as necessary based on those improvements.” (Commonwealth of Virginia, 2010, p. 4). Also, from the Maryland WIP, “EPA has recognized the need for ‘adaptive management’ in WIP development and implementation, which is reflected in the three-phase process” (State of Maryland, 2012, p. 5). The Chesapeake Bay TMDL went deeper than just the state level and actually defines the pollutant reductions needed at each watershed segment. There are 92 segments throughout the watershed that make up the states’ 303(d) listings for waterbodies that do not meet water quality criteria. A predominance of these 92 segments lie in or between Virginia and Maryland, which is where this dissertation focused. The EPA must value adaptive management because it was referenced in the guidance documents identified above, and the states were asked to include adaptive management in their WIPs. The table below records how many times adaptive management is mentioned in the states’ WIPs.

<table>
<thead>
<tr>
<th>WIP/State</th>
<th>Delaware</th>
<th>District of Columbia</th>
<th>Maryland</th>
<th>New York</th>
<th>Pennsylvania</th>
<th>Virginia</th>
<th>West Virginia</th>
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<tr>
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<td>0</td>
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<td>2^</td>
<td>4+^</td>
<td>4*^</td>
<td>2*^</td>
</tr>
<tr>
<td>Phase II WIP</td>
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<td>0</td>
<td>2+^</td>
<td>2^</td>
<td>8+^</td>
<td>4^</td>
<td>1*^</td>
</tr>
</tbody>
</table>

* = ‘adaptive management’ mention was related to funding
^ = ‘adaptive management’ mention had no specifics associated with it
+ = ‘adaptive management’ mention was accompanied by a detailed explanation and understanding of the term and its process.
The table below records the number of pages in each state’s WIPs. Further evidence of the seriousness with which each state approached the Chesapeake Bay TMDL implementation planning process,

<table>
<thead>
<tr>
<th>WIP/State</th>
<th>Delaware</th>
<th>District of Columbia</th>
<th>Maryland</th>
<th>New York</th>
<th>Pennsylvania</th>
<th>Virginia</th>
<th>West Virginia</th>
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<tr>
<td>Phase I WIP</td>
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<td>103</td>
<td>234</td>
<td>150</td>
<td>280</td>
<td>141</td>
<td>116</td>
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<td>Phase II WIP</td>
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<td>63</td>
<td>92*</td>
<td>202</td>
<td>86</td>
<td>93</td>
<td>124</td>
</tr>
</tbody>
</table>

numbers above are pages in each document
* = report contained over 400 pages of appendices

To get appropriate input from a variety of stakeholders in Virginia, the EPA and the Virginia Department of Environmental Quality (DEQ) created the Stakeholder Advisory Group (SAG). The SAG was convened to give input to Virginia’s preparation of a Watershed Implementation Plan (WIP). In Maryland, over one year was spent developing the WIP and involved input from MDE, the Maryland Department of Natural Resources, Maryland Department of Agriculture, and the Maryland Department of Planning. The plan received hundreds of public comments after its release in October 2010, with the final document being submitted to the EPA in December 2010. The WIP was required to outline a method for reductions of nutrients and sediments as part of the TMDL process required by the EPA.

The EPA’s TMDL goals are to be evaluated in two-year milestones with the practices necessary to produce a 60% reduction of nutrients and sediment in place by
2017 and 100% of these practices in place by 2025. If Virginia cannot meet these load limits, then the EPA could require any permitted source (basically every contributing source sector except agriculture) to reduce their respective loading enough to meet the TMDL (Commonwealth of Virginia 2010). The EPA has established these “backstop” measures to ensure that each state and DC will meet their required reductions by 2025.

In the Chesapeake Bay TMDL context, adaptive management is an appropriate term to describe the WIP process:

- The Chesapeake Bay Program has a clear mission and goals.
- The reduction goals contained within the WIPs are based on modeled data from the Chesapeake Bay Program, which uses historical and monitoring data to build and verify the model’s accuracy.
- The WIPs serve as the plan that each jurisdiction must use to meet the reduction goals set using the model.
- The WIPs have been set with constant monitoring and review in mind. Every two years the results will be reported and management actions can then be altered based on the new data. This allows for an iterative process. In addition, there is a substantial network of water quality monitoring currently in existence throughout the Chesapeake Bay and its watershed.
- The WIPs cannot operate without stakeholder involvement and input to be successful and they are completed, ultimately at the local level.
- There is some uncertainty in the Chesapeake Bay TMDL and the WIPs. The process embraces this uncertainty.
Adaptive Management is appropriate because of the points identified above. Further, it is necessary that the local watershed managers understand their role in the Chesapeake Bay TMDL and WIP process (inherently this requires that these managers understand adaptive management). Adaptive management and the Chesapeake Bay TMDL require significant understanding by local watershed managers of the overall goals and methods to be effective. It is not enough to know an individual task; rather it is important for local managers to understand how their progress fits into the larger TMDL and adaptive management. Having the larger context of the full restoration efforts allows local watershed managers to better explain the process, goals, and progress to members of their community. Further, by understanding the larger effort local managers can see how their efforts will have a real impact on the local environment.

**Stakeholder Involvement in Adaptive Management**

In both Maryland and Virginia, stakeholder advisory groups were established in 2009 or 2010 to “…engag[e] a wide variety of interested parties…result[ing] in critical feedback on the model inputs, outputs, and the abilities to implement a host of practices across Virginia’s bay watershed” (Commonwealth of Virginia, 2010, p. 5) and “to provide a venue for communication between its member organizations and the State regarding the development of the WIP Phase I and Phase II” (State of Maryland, 2012, p. 64).

In both of these instances stakeholders were invited to participate and while the meetings were afforded standard procedures like appropriate public notice, the membership was not open. At the same time the groups in each state were large in both
the number of participants and the diversity of organizations they represented. A good mix of individuals or organizations were invited and the diversity of participants seems to show that the process was viewed as legitimate.

Dukes and Firehock (2001) identify nine components necessary for an adaptive management approach to be effective. Of these the Chesapeake Bay TMDL meets all. The components include:

1. Clear goals, objectives, and monitoring plans.
2. Afford for an external scientific review of the plan.
3. Good understanding of the Chesapeake Bay ecosystem and problem.
4. Measurable indices that can be used to evaluate progress.
5. Because the plan was developed due to regulatory drivers, then the regulatory entities need to be part of the process.
6. Specific actions and mitigation measures for areas that do not meet the goals.
7. A schedule for evaluation of the success and progress of the plan from an independent review panel or some other third party.
8. The inclusion of groups that can be responsible and have the ability to implement, fund, and carry out monitoring and reporting for the project.
9. The implementation of research to find new technology or other ways to achieve nutrient and sediment reductions (Dukes & Firehock, 2001).

While all nine components identified above are necessary it is paramount that the goals and objectives of an adaptive management process are clear to all of the stakeholders involved and are mutually agreed to. Further, there should be an inclusion
of stakeholders that can carry out management actions and monitoring activities. These organizations must have the legal and financial ability to do this work.

Conducting adaptive management processes using established environmental conflict resolution procedures should allow for a more robust implementation process and a better chance for success. There have been criticisms toward the field of environmental conflict resolution (Amy, 1983). However, the use of a collaborative process has played an important role in remediation of a number of environmental circumstances (Norgaard et al., 2009). Further, a number of case studies have identified a participatory stakeholder process in adaptive management approaches to environmental problems have been successful and allowed for both scientific and social learning to take place (Stringer et al., 2006). The role of environmental resolution practitioners in developing a collaborative processes is evolving, but there certainly seem to be a set of normative approaches (Dukes, 2001).

To summarize this chapter, it is clear that restoration of the Chesapeake Bay watershed is challenging. The EPA established the Chesapeake Bay TMDL was introduced to meet this challenge. The Chesapeake Bay TMDL relies heavily on local implementation and the concept of adaptive management. However, adaptive management is a complex and abstract concept that does not have a consistent definition in the literature.
CHAPTER FOUR: METHODOLOGY

The hypothesis and methods described here are intended to examine the perceptions of the local watershed managers, also known as the locality’s identified point person for the Chesapeake Bay TMDL, and evaluate the Chesapeake Bay TMDL implementation process at the local level. The participants are geographically limited to the Maryland and Virginia portions of the Patuxent, Potomac, and Rappahannock River watersheds. This dissertation focused its study area on the Maryland and Virginia portions of the Patuxent, Potomac, and Rappahannock River watersheds. These two states serve as the focus area because these are representative of the other four states and Washington, DC in the Chesapeake Bay watershed. Maryland and Virginia are the two closest jurisdictions to the main stem of the Chesapeake Bay and both states approached the implementation of the Chesapeake Bay TMDL differently. Further, both states differ historically in their relationship with the Chesapeake Bay based on the number of counties/cities that are bounded by the main stem of the Bay. Finally, including Maryland and Virginia in the study area allows for a robust analysis of the data collected and for comparisons and conclusions to be drawn based on the results of this dissertation.

The ultimate and overarching research questions to be answered are:

1. What are municipal watershed managers in the Patuxent, Potomac, and Rappahannock watersheds currently doing to implement the Chesapeake Bay TMDL in their jurisdiction?
2. Do these managers recognize the role of adaptive management in the Chesapeake Bay TMDL, and how are they using an adaptive approach to meet the TMDL requirements, if at all?

Hypotheses for this research are:

1. There is an inverse relationship between a locality’s distance to the main tributary of study and the municipal watershed manager’s knowledge of and implementation efforts to meet the Chesapeake Bay TMDL. That is, counties and cities adjacent to the Chesapeake Bay, or in a tidal portion of the river systems under study will have a heightened sense of understanding and exert more effort to implement the TMDL than those municipalities that are in non-tidal portions the river watersheds. This is due to the expected perspective that people farther from the main stem of the Chesapeake Bay feel less connected to the estuary and therefore are less concerned about its health.

2. Localities in Maryland will have a more advanced understanding of the role adaptive management plays within the TMDL WIP process compared to those in Virginia. This is largely due to the historical nature of Maryland’s interest in Bay restoration and protection, which has carried through to the present day. Twelve of Maryland’s 24 counties and the City of Baltimore are adjacent to the main stem of the Chesapeake Bay. In Virginia only ten counties and the City of Norfolk are adjacent to the main stem of the Chesapeake Bay. There are 95 counties and 38 Cities in the Commonwealth.
3. Among the three watersheds, the Patuxent River watershed will be the best positioned to successfully implement the TMDL, followed by the Rappahannock and then the Potomac. This is due to the Patuxent’s small number of localities; there are only six localities in the Maryland portion of the Patuxent River watershed. The Rappahannock, existing entirely in Virginia, will be well positioned because of local advocacy groups and a strong PDC. The Potomac will be the most challenging because of the multi-state nature of its watershed and its large population.

4. Overall, municipal watershed managers will identify a lack of staff time and resources as an impediment to full implementation the Chesapeake TMDL WIPs using an adaptive management approach. This is due to the perceived lack of expertise and knowledge in some small local governments where Chesapeake Bay restoration projects must compete with other local priorities for funding and staff time.

Objectives for this dissertation are:

- Provide greater understanding of what municipal watershed managers think/feel about the Chesapeake Bay TMDL.
- Gather information of the effectiveness of the TMDL from the municipal watershed manager’s perspective.
- Gauge local managers understanding of adaptive management.
- Evaluate if local managers see the TMDL as an adaptive management process.
• Determine if the appropriate resources and staff time are available at the local level to effectively implement the TMDL using an adaptive management approach.

• Provide this information to better implement the Chesapeake Bay TMDL.

The EPA, state, and local governments want the Chesapeake Bay TMDL to be effective. In order to ensure this outcome it was important to gauge the understanding that municipal watershed managers have of the Chesapeake Bay TMDL implementation process, the concept of adaptive management, and the available time, resources, staff and knowledge to dedicate to the solution(s). It is these people, municipal watershed managers, who are at the front line of the TMDL’s implementation and success. Early on in the literature review for this dissertation project, it became clear that the local implementers of restoration efforts, including the Chesapeake Bay TMDL, were not regularly surveyed (Cabrera-Stagno, 2007; Center for Watershed Protection, 1999; Julie A. McClafferty, 2002). In several instances, state and Federal officials could not share or point to a list of the individuals at the city, town, or county level that were possible for implementing the Chesapeake Bay TMDL (Davis-Martin, 2013; Dubow, 2014). There have been very few surveys of this population or about Chesapeake Bay in general; only two surveys in the last 10 years have been completed, and they focused on general public perceptions (Center for Watershed Protection, 1999; Julie A. McClafferty, 2002). Adding this key information will help state and federal agencies ensure that the Chesapeake Bay TMDL is carried out effectively at the local level.
Methodological Components

The three defined study areas used to conduct this analysis were the Virginia and Maryland portions of the Patuxent, Potomac, and Rappahannock River watersheds. These three watersheds allow for several interesting comparisons including differences in the implementation of the Chesapeake Bay TMDL and the understanding of adaptive management by local watershed managers. These comparisons include jurisdictional implementation programs, population size, MS4 permit status, the training and experience of the individual manager.

To complete the data collection for this dissertation three steps were carried out. First, for this project, ten (10) initial semi-structured interviews were conducted in the three watersheds of focus: three in the Patuxent, four in the Potomac, and three in the Rappahannock. The initial semi-structured interviews with ten municipal watershed managers distributed throughout the three watersheds were followed by a multi-modal survey delivered to the full population of municipal watershed managers in the Virginia and Maryland portions of the Patuxent, Potomac, and Rappahannock watersheds. The total number of the local jurisdictions identified was 52. A multi-modal survey used multiple methods to collect the survey data. This included phone calls, an on-line survey tool via Survey Monkey, Inc., an emailed version of the survey, and a fax version of the survey.

All versions of the survey used the same questions. The collected responses were combined as part of the data analysis process. Using a multi-modal survey delivery method ensures a high response rate (Dillman, Smyth, & Christian, 2000). It was anticipated that follow-up efforts would be required to get an adequate response to the
survey and using a multimodal format made that task possible. Due to the small population size all members of the population were sampled to provide the largest possible power to any statistical analysis. Following the analysis of the survey results, three additional interviews were conducted to fill data gaps and provide additional information to support the survey data. These follow-up interviews were conducted with one advocacy representative in each of the three watersheds in the study area. An advocacy representative was selected because these individuals have a unique perspective of the entire watershed and can provide a critical analysis of local governments and local watershed managers. This three-tiered research scheme allows for a triangulation of the data. Triangulation is a social science construct whereby the data was characterized using multiple data collection technologies and methods as a means of validation between the different methods (Berg & Lune, 2012).
Following the completion and analysis of the multi-modal survey several gaps were identified in the data. To fill these gaps three semi-structured additional interviews were conducted, one in each of the three watersheds. These gaps refer to the meaning behind the aggregated survey data. That is, why respondents answered questions the way they did. The person selected for this interview was someone involved in the Chesapeake Bay restoration efforts as an advocate and work for a non-governmental organization within the subwatershed. This individual was familiar with the Chesapeake Bay TMDL implementation progress and strategies at the local level, but not a local watershed manager.

The Study Area
For the purposes of this dissertation a locality was defined as a political jurisdiction that was principally responsible for the reduction of nutrients and sediment
loads required as part of the Chesapeake Bay TMDL implementation process. For example, in Virginia counties and independent cities were defined as localities, but towns were associated with the counties that they are located in. In Maryland, only counties were identified as localities for the purposes of this dissertation.

The dissertation research focused on the Virginia and Maryland portions of the Patuxent, Potomac, and Rappahannock watersheds because for each of these there are a manageable and finite number of municipal counties and cities. These two states serve as the focus area because these are representative of the other four states and Washington, DC in the Chesapeake Bay watershed. Both states differ historically in their relationship with the Chesapeake Bay based on the number of counties/cities that are bounded by the main stem of the Bay. The inclusion of Maryland and Virginia in the study area allows for a robust analysis of the data collected and for comparisons and conclusions to be drawn based on the results of this dissertation. Further, these three watersheds provide an excellent opportunity for comparison between a diverse group of municipalities based on population, MS4 permit status and membership in a MSA.
The Patuxent watershed is exclusively in Maryland and contains portions of Anne Arundel County, Calvert County, Charles County, Howard County, Montgomery County, Prince George’s County, and St. Mary’s County.
In the Potomac watershed there are 17 counties: Arlington, Augusta, Clarke, Fairfax, Fauquier, Frederick, Highland, King George, Loudoun, Northumberland, Page, Prince William, Rockingham, Shenandoah, Stafford, Warren, and Westmoreland; and 9 cities: Fairfax City, Front Royal, Harrisonburg, Manassas City, Manassas Park City, Strasburg, Stanton, Waynesboro, Winchester) in Virginia; 9 counties in Maryland: Allegany, Carroll, Charles, Frederick, Garrett, Montgomery, Prince George’s, St. Mary's,
Washington. The watershed contains portions of West Virginia, and Pennsylvania, but for the purposes of this study they were not included.

The Rappahannock watershed is exclusively in Virginia and contains portions of Caroline County, Culpeper County, Essex County, Fauquier County, City of Fredericksburg, King George County, Lancaster County, Madison County, Middlesex
County, Orange County, Rappahannock County, Richmond County, Spotsylvania County, Stafford County, and Westmoreland County.

![Map of the Rappahannock River Watershed](image)

**Figure 7 The Rappahannock River Watershed**

The counties and cities above make the basis for the 52 localities within the research area and act as the population for interview and survey respondents. This dissertation assumed that each locality listed above had at least one person responsible
for carrying out the municipality’s Chesapeake Bay TMDL response and implementation efforts. After the ten strategically selected member of the population were administered the initial semi-structured interviews and the data was analyzed, this information was used to create a survey tool for the full population. The survey respondents were asked questions to verify the information gleaned from the initial interview portion of the research and gain insight on the perceptions of the full population. All initial ten interviews, except for one conducted in person, were conducted via phone and all were recorded using a standard recording device. Respondents were asked to complete the survey by e-mail, phone, or fax as necessary. Some localities were contacted as many as 10+ times in order to solicit a full response to the survey. All 52 localities were asked to complete the survey.

<table>
<thead>
<tr>
<th>State</th>
<th>Locality Name</th>
<th>Locality Name</th>
<th>Locality Name</th>
<th>Locality Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD</td>
<td>Allegany</td>
<td>Anne Arundel</td>
<td>Calvert</td>
<td>Carroll</td>
</tr>
<tr>
<td>MD</td>
<td>Charles</td>
<td>Frederick</td>
<td>Garrett</td>
<td>Howard</td>
</tr>
<tr>
<td>MD</td>
<td>Montgomery</td>
<td>Prince George's</td>
<td>St. Mary's</td>
<td>Washington</td>
</tr>
<tr>
<td>VA</td>
<td>Albemarle</td>
<td>Alexandria</td>
<td>Arlington</td>
<td>Augusta</td>
</tr>
<tr>
<td>VA</td>
<td>Caroline</td>
<td>Clark</td>
<td>Culpeper</td>
<td>Essex</td>
</tr>
<tr>
<td>VA</td>
<td>Fairfax</td>
<td>Fairfax City</td>
<td>Fauquier</td>
<td>Frederick</td>
</tr>
<tr>
<td>VA</td>
<td>Fredericksburg</td>
<td>Gloucester</td>
<td>Greene</td>
<td>Harrisonburg</td>
</tr>
<tr>
<td>VA</td>
<td>Highland</td>
<td>King and Queen</td>
<td>King George</td>
<td>Lancaster</td>
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<tr>
<td>VA</td>
<td>Loudoun</td>
<td>Madison</td>
<td>Manassas</td>
<td>Manassas Park</td>
</tr>
<tr>
<td>VA</td>
<td>Middlesex</td>
<td>Northumberland</td>
<td>Orange</td>
<td>Page</td>
</tr>
<tr>
<td>VA</td>
<td>Prince William</td>
<td>Rappahannock</td>
<td>Richmond</td>
<td>Rockingham</td>
</tr>
<tr>
<td>VA</td>
<td>Shenandoah</td>
<td>Spotsylvania</td>
<td>Stafford</td>
<td>Staunton</td>
</tr>
<tr>
<td>VA</td>
<td>Warren</td>
<td>Waynesboro</td>
<td>Westmoreland</td>
<td>Winchester</td>
</tr>
</tbody>
</table>
Fieldwork
For this project the fieldwork contained three components, each building on the one before. The three components were initial interviews, the use of a survey tool, and finally additional interviews to fill any data gaps.

Institutional Review Board
The George Mason University Office of Research Integrity & Assurance (ORIA) and Institutional Review Board (IRB) govern research involving human subjects. As a result this research project was submitted to the IRB for review prior to any research activity commencing. Of particular note is that none of the respondents have been identified in this dissertation to protect their anonymity and allow the respondents to answer freely without worry of retribution. The submitted documents and the determination letter from the ORIA are provided in the appendix.

Semi-Structured Initial Interviews
For this project, three or more initial semi-structured interviews (with three or more different municipal officials) were conducted in each of the three watersheds in the study area (Patuxent, Potomac, and Rappahannock) for a total of ten. These interviews were performed with individuals that are municipal watershed managers and represented a variety of interest in the Chesapeake Bay TMDL and various sizes. The semi-structured interview strategy contains several assumptions: 1) the questions must be worded in a way that respondents will understand them 2) researchers must try to approach the questioning from the subject’s point-of-view (Berg & Lune, 2012). The flexibility of the semi-structured interview strategy proved useful; each of the municipal watershed managers interviewed had very different experiences. Here semi-structured
Interviews were selected as the preferred interview questioning method because the researchers had a good understanding of the situation to develop the basic questions, but not enough of an understanding to predict the responses (Richards & Morse, 2007). Interviewees generally work in a fast paced and collegial environment where a formal and structured interview methodology could have been less efficient and effective. Further, the topic of the interview lent itself to a variety of responses that the researcher could not predict. These responses often necessitated follow-up and clarifying questioning that would not be permitted under a structured interview methodology. For the purposes of this dissertation the semi-structured initial interview was the preferred method.

The questions in the semi-structured initial interviews included the following basic questions or similar iterations:

- Is the municipal watershed manager participating in the Chesapeake Bay TMDL? Why?
- How is the manager trying to meet the requirements of the TMDL? What are their experiences so far and how is it going?
- Has the manager heard what other municipalities are doing/trying as part of the implementation process? Has this impacted their actions or what they have tried?
- What would happen if the manager met the TMDL implementation goals and the Chesapeake Bay still did not have an appropriate level of water quality? What would they do?
- Has the manager heard of adaptive management and can they define it?
• What role, if any, does adaptive management play in the TMDL?

Of particular interest was the role that the municipal watershed manager community played in the execution and ultimate success of the TMDL. The semi-structured interviews allowed for the gathering of this information. Interviews were conducted between May 15, 2014 and August 14, 2014.

Multi-Modal Survey
Based on the data collected as part of the semi-structured initial interview process a survey tool was developed in consultation with the dissertation committee. This survey tool was tested with a variety of individuals not in the population to be surveyed as part of this study to evaluate the tool’s performance. The survey tool was used to verify the results of the interviews within the larger watershed communities. “Surveys have an important niche in conservation research. They allow us to quantify critical parameters that describe and explain how things work and the relationship between actor and variables in human and physical environments” (Russell & Harshbarger, 2003, p. 224).

The surveys were executed in a multi-modal method. That is, the survey tool was distributed via e-mail, web-based survey tool called Survey Monkey, fax, and the survey was administered via phone. Using multiple modes for the survey distribution create a greater opportunity for a higher response rate. An initial phone call was placed to all 52 prospective respondents notifying them of the survey. In most instances, the phone call was followed immediately by an email containing a link to the survey tool hosted by Survey Monkey, Inc. In several instances, the survey was administered directly via phone or faxed to the appropriate individual. In some cases it took multiple phone calls
and emails to trigger the respondent to complete the survey tool over the course several months from February 20, 2015 through May 29, 2015. Of the 52 members of the population 48 responded. The four non-responders refused because of a lack of staff time or personnel to complete the survey and were continually contacted until specifically stating they would not complete the survey. The response rate for the survey was 92.3% and is a very high response rate for a survey tool (Kaplowitz, Hadlock, & Lavine, 2004). At the 95% confidence level, a sample size of 48 from a population of 52 yields a confidence interval (also known as a margin of error) of ± 4%.

The survey
Table 10 Independent and Dependent Variables

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS4 permit holder/non-holder</td>
<td>The respondent is involved in the TMDL implementation in the locality</td>
</tr>
<tr>
<td>Population size</td>
<td>Respondent is familiar with the models used to develop the TMDL</td>
</tr>
<tr>
<td>Metropolitan Statistical Area (MSA) member/non-member</td>
<td>Respondent supports the models used to develop the TMDL</td>
</tr>
<tr>
<td>State affiliation (Maryland or Virginia)</td>
<td>EPA and state guidance for the TMDL is appropriate</td>
</tr>
<tr>
<td>Watershed position (adjacent to Bay, tidal, non-tidal)</td>
<td>Municipal governing body understands the requirements of the TMDL</td>
</tr>
<tr>
<td>Watershed membership (Patuxent, Potomac, Rappahannock)</td>
<td>Municipal governing body understands the cost of implementing the TMDL</td>
</tr>
<tr>
<td>Years of experience with water quality issues</td>
<td>Municipal governing body is planning for the cost of implementing the TMDL</td>
</tr>
<tr>
<td>Current employment position (TMDL taskforce, MS4 permit compliance, stormwater/planning/zoning/land disturbance officer)</td>
<td>Municipal governing supports the goals of the TMDL</td>
</tr>
<tr>
<td>Field of study (sciences, engineering, policy/law humanities/social sciences)</td>
<td>Definition of adaptive management</td>
</tr>
<tr>
<td>Highest degree earned (less than high school, high school, associates, bachelors, masters, law, doctorate)</td>
<td>Importance of adaptive management in the TMDL</td>
</tr>
<tr>
<td></td>
<td>State agency supports use of adaptive management in the TMDL</td>
</tr>
<tr>
<td></td>
<td>EPA supports use of adaptive management in the TMDL</td>
</tr>
</tbody>
</table>

The independent and dependent variables listed above were used to segment the responses and analyze the find patterns and differences among the responses.

**Follow-Up Semi-Structured Interviews**

After the analysis of the survey data several gaps were identified that required additional data collection in order to answer the main research questions. To fill these
gaps three follow-up interviews were conducted. These interviews were semi-structured and questions in the follow-up interviews included the following or similar:

- From your experience do local county/city officials in Maryland or Virginia have a better understanding of adaptive management and are better prepared to use it in the Chesapeake Bay TMDL implementation process? Why?
- How prepared do you think local county/city officials in the Patuxent, Potomac, and Rappahannock watersheds are to use adaptive management in the TMDL implementation process? If you had to rank the three watersheds what would be your order and why?
- If local government respondents in either MD and/or VA were to indicate not receiving enough support from their state and federal agencies, what insights could you provide regarding why this might be so?
- Is there anything about one of these three watersheds that makes it distinct with respect to implementing…? If so, which one? And how so?

These questions were posed in a semi-structured format that allowed both the researcher and respondent to have a more natural discussion. These follow-up interviews allowed this author to better understand the survey results and helped to interpret and verify conclusions. In short, these follow-up interviews helped to put meaning behind the survey results in a way that allowed the author to expand on the initial survey.
CHAPTER FIVE: RESULTS AND DISCUSSION

The majority of this dissertation research centered on a series of interviews and the use of a survey tool. Initial semi-structured interviews conducted with 48 of the 52 local watershed managers in the Maryland and Virginia portions of the Patuxent, Potomac, and Rappahannock River watersheds. The initial interviews were used to create a survey tool that was distributed to all of the local watershed managers in the Maryland and Virginia portions of the three watersheds, there were 10 in all. The survey was followed by three strategic semi-structured follow-up interviews to fill the data gaps left by the initial semi-structured interviews and survey. The results of these interviews and surveys are presented and discussed in this chapter.

Semi-Structured Interview Results

Ten semi-structured interviews were conducted for this dissertation. These ten individuals were part of the 54 local watershed managers surveyed in the second phase of the dissertation research. The full dictated interview set is included in the appendix of this dissertation. Any reference to personal or locality identifiers were removed to protect the anonymity of the respondents. The interview transcripts were reviewed for major themes that were present throughout the interviews and frequently repeated. This method of discovering themes in the data is presented by Mayan (2009). A series of fifteen quotes were pulled from the transcripts to illustrate the major themes that were present in the semi-structured interview data along with brief commentary below.
The quotes that follow are divided into four themes. The first five quotes (#1-#5) are all related to the cost of implementing the Chesapeake Bay TMDL, funding sources, monitoring activities, and finding implementation funds locally. The next three quotes (#6-#8) all share a common theme of the local response to the Chesapeake Bay TMDL including the response in non-MS4 localities, local politics, and the capacity to implement in small jurisdictions. The next three quotes (#9-#11) all related to the support that local watershed managers have received from state and federal agencies and officials. The final theme set (#12-#15) is related to the role adaptive management plays in the Chesapeake Bay TMDL and how local watershed managers deal with uncertainty.

**Quote and Discussion #1: Cost and Priorities for Localities**

“So you can see that we would need to be up to about $0.05 on the real estate tax, that would generate about 5% of the total locality’s tax revenue would go to stormwater. So that’s one way to look at it, there are other ways. When communities are struggling with schools and public safety in this economy it has been a very difficult thing to explain that we have to do this by permit. And that I can’t tell you exactly what the measurements are.” – Interview #2

Here a respondent expressed the thought process to pay for the necessary upgrades to the localities’ stormwater system in order to meet the requirements of the Chesapeake Bay TMDL. Adding $0.05 to the real estate tax was needed to meet the requirements, but the governing body of this locality has to include this tax amount with those tax revenues needed to fund school and public safety costs. It can be difficult for an elected official to commit to a tax increase to fund stormwater infrastructure.
requirements in a recession when the same elected official has to cut funding to public safety or schools. Further, the respondent had identified that they don’t know the exact reductions required by the TMDL, and therefore, it is hard to explain to the governing body how many stormwater retrofits are required, or to estimate their cost.

**Quote and Discussion #2: The Cost of Monitoring Programs**

“The thing is we are not doing our own monitoring. At the end of the day, we don’t have the resources to monitor and determine whether these processes are truly improving water quality or not. So, I have no way of knowing unless the state monitors for us and tells us. We just don’t have the resources to do that on our own, I don’t know if other counties are doing that, but we are not.” – Interview #3

Two things are striking about the quote above. First, the respondent does not have the resources to monitor the results of the Chesapeake Bay TMDL implementation actions they take. As a result they cannot use an adaptive management approach, because monitoring is a significant component, without support from a state or Federal agency to carry out the monitoring efforts. Second, the respondent indicated that they do not know if other localities are conducting their own monitoring efforts. So there is some need for better communication between localities and the sharing of information.

**Quote and Discussion #3: The Cost of Implementation**

“Well I have to admit you didn’t ask any questions about funding. I mean that’s part of the adaptive management. Because you can have a goal and predict how much money it’s going to cost, but things being the way they are, you may not be able to get all of that funding within that timeline.” – Interview #4
An excellent point above. Part of the adaptive management approach is a budget. While not explicitly discussed by C.S. Holling (1978), a budget is an important part to the successful implementation of the Chesapeake Bay TMDL using an adaptive management approach.

**Quote and Discussion #4: Funding Sources**

“…there is an expectation on our part that we won’t have to pay 100%, because the Bay TMDL is to protect waters in the main stem of the Bay and the tidal tributaries. So we feel that those other jurisdictions that may be getting the most direct benefit should be paying their fair share to be sure they continue to get that most direct benefit. And so, there should be federal and state cost share money to help offset.” – Interview #4

There were several respondents that identified that the cost of implementing the Chesapeake Bay TMDL was more than their locality could realistically afford. Additionally, there was a sense that state and Federal officials understood this and would provide funding for the implementation, especially in the non-tidal portions of the watersheds where the direct benefit is less than those in the tidal portions or adjacent to the main stem of the Chesapeake Bay.

**Quote and Discussion #5: Funding the TMDL Locally**

“What may happen, and you may hear this from other jurisdictions, there may be a time where because of funding issues and constraints our board of commissioners is forced to reprioritize and the funding part of it may not be as great for water quality protection because it has to be redirected to schools or emergency services, but right now
we are getting a good share and our fair share of money for cleanup of the Bay, implementation of our NPDES permit and ultimately cleanup of the Bay.” – Interview #7

The locality referenced above seems to have found a good mix of tax funding and has committed significant resources to their MS4 and NPDES permits. However, the respondent understood that the funding for the Chesapeake Bay TMDL implementation had to be considered against other potential costs for the locality including schools and emergency services.

**Quote and Discussion #6: Non-MS4 Locality Response**

“So, our approach was, let’s figure out what was done over the past five years that counts and gets us credit and let’s see where that gets us. Like if we established a current pace of implementation based on what we have done over the past 5 years, then you know could we continue that. Could we commit to continuing that? And if we did commit to continuing that current pace of implementation would we meet the goal that the state has set for us. And the answer basically was that we all but would get there. If we just kept doing what we’ve been doing over the past 5 years: the stream restoration projects, the tree planting projects - that’s really a good one for us, the stormwater retrofits that we do voluntarily. You know, if we put all that data together and figured out what kind of credit we got for that and projected it over, until 2025 we were able to say ‘yep, that pretty much closes the gap for us if we continue our current implementation,’ but we needed to beef it up-to do a little bit more.” – Interview #3

The respondent in interview #3 above did not maintain an MS4 permit and as a result most of their previous restoration efforts have been voluntary. However, based on
their calculations continuing on their current trend of implementation projects they might meet the 2025 deadline for sediment, phosphorus, and nitrogen reductions. The respondent did not provide a summary of the water quality monitoring data used to make these calculations. So, it is possible for small municipalities to be effective if they have the will to do so. However, it is unclear if this respondent had complete monitoring data to determine their exact past load.

**Quote and Discussion #7: The Role of Politics**

“I think that under the political climate we have right now, as long as we are meeting the goals of what we are required to meet, there would not be a great level of effort above that at least from a government standpoint. From a citizen standpoint, they might push the government into doing it, but right now the will is to do kind of the absolute minimum they can do.” – Interview #5

Here the respondent is talking about the social and political climate around the Chesapeake Bay TMDL in the locality. In general, the sense is that the local government will continue to do what it has been doing with respect to restoration efforts of the river watershed, but nothing more. The respondent identified that if citizen organizations pushed the government into doing more that it would respond, but at present there is no interest in doing so. This seems to be true of small and often more rural, or non-MS4 localities.

**Quote and Discussion #8: Capacity in Small Localities**

“Well it does, but I don’t know how much you know of how the system works. But that 9 [meaning adaptive management] is something that the state would handle, we
just don’t have the manpower. You are talking to a two man show, we have two people in the zoning office, that try to carry out the environmental program along with all the building, zoning, BZA (Board of Zoning Appeals), we are a small shop. I’m not sure who you are interviewing as far as other counties, but we are probably as bare boned as it gets. As far as adaptive management and the things you are mentioning, I just don’t think that is in our reach as far as actually doing.” – Interview #9

The respondent above painted a picture of a small locality with a small staff. As a result this locality does not have the staff time or resources to focus on adaptive management in the Chesapeake Bay TMDL implementation process, or really the TMDL at all. This office is fully consumed with the review of traditional environmental permits, zoning applications, and other development activities. This locality has few resources to commit to the Chesapeake Bay TMDL implementation or the resources to use an adaptive management approach. State and Federal officials must find a way to support this category of municipality and watershed managers that have a limited amount of staff time to work on the Chesapeake Bay TMDL implementation, or additional regulations need to be put in place to more discretely mandate such actions.

**Quote and Discussion #9: Federal and State Guidance**

“You know, that’s where we need assistance, where the Feds and the state need to come in and say ‘Hey, here’s the practices and this is what these practices will get you, this is what they will cost, and here’s the science you can apply.’ And that just doesn’t exist and so there you are again talking to a community that is cutting back on schools and cutting back on public safety and saying ‘hey you need to spend more,’ and they say
‘what do I get for my buck.’ And you say ‘I can’t really tell you.’ That’s the challenge.” – Interview #2

Here the same respondent is more explicitly explaining that this locality doesn’t have the resources to determine how much of a sediment or nutrient reduction a specific action will have, but the respondent has a sense that the locality will need to spend significantly more on stormwater to meet the requirements of the Chesapeake Bay TMDL. The respondent knows that the governing body will want specifics, which the respondent doesn’t have access to. This respondent is waiting for the state or Federal government to provide him with details on the reduction impact of specific actions and expected costs. In almost every semi-structured interview the cost of implementing the Chesapeake Bay TMDL and monitoring as part of an adaptive management approach came up in the conversation.

**Quote and Discussion #10: Enforcement Mechanisms**

“Then enforcement is a whole other problem. How do you enforce these things? You go out and tell people ‘we’re going to…’ you know it’s not like a septic system where it fails on your property and you want it fixed. You know, this is something not like that. So you are either going to take people to court, which we have done. Or we are going to come up with a ticket system, but the ticket is not going to be enough to make somebody do $5,000 worth of work or replace a rain garden. We can go to kind of follow EPA’s model where we fine them up to $32,000 a day, but can you imagine taking that kind of action against a McDonald’s or some other? It’s going to be tough.” – Interview #2
Here the respondent is talking through the available enforcement actions to get private land owners to comply with the implementation requirements of the Chesapeake Bay TMDL. A ticket or fining structure are two methods to encourage land owners to comply with the requirements of the Chesapeake Bay TMDL. Most localities can implement a ticket or fine structure, but do not have the staff or other resources to inspect private facilities or even follow-up on tickets or fines to ensure compliance.

**Quote and Discussion #11: Understanding the Models**

“Now having said all that, we have been working with the state on the WIP process. The one thing that we have had an issue with them, especially on the WIP Phase II process is that we do not necessarily understand or agree with the state’s “numbers” that they have developed for WIP implementation and that has mainly been through their modeling efforts that we don’t understand nor can we accept them. So, while we have been working on compliance and implementation strategies, we are not in agreement with the Phase II WIP that the state developed for us. Actually, if you look at the Phase II WIP numbers and the documents online, they were generated by the state and not by our county.” – Interview #7

The respondent above has identified that they do not agree with nor understand the models used by the EPA to create the Chesapeake Bay TMDL. Because the respondent does not understand the models, the locality – through the respondent – has taken a stance that the state and Federal government is not acting in the best interest of the locality and has not built the trust needed to successfully implement the Chesapeake Bay TMDL or use an adaptive management approach. Further, the respondent in the last
sentence seems to indicate that the locality was not involved in the development of the Phase II WIP and therefore is having a difficult time buying into the goals of that document and process. It seems that what is needed in this situation is more stakeholder involvement of local officials in the WIP process. Many of these local watershed managers were not included in the initial planning for the TMDL and as a result feel that this initiative is another burden put upon them by state and Federal officials.

**Quote and Discussion #12: Defining Adaptive Management**

“My perception is basically, adaptive management allows you to make a careful plan, have a whole series of projects, and a whole implementation timeline, and you set benchmarks along the way, and you evaluate if you’ve met your implementation timeline and evaluate what is happening in the actual waterbody, and decide if you have to change if you have to add some additional program or if you feel like you need to accelerate implementation of some of the projects that you have in your inventory. Or if you have to stop doing what you’ve been doing and try something else. If you come to the conclusion that you’re not making the progress that you wanted to. And the progress would be water quality improvements.” – Interview #4

Here the respondent defined adaptive management in their own words. Generally, a very good job is done of explaining what the concept is and how it’s done. In this specific instance, there is a reference to the cyclical nature of an adaptive management approach, but it isn’t explicitly stated. The use of words or phrases like “careful plan,” “implementation timeline,” “set benchmarks,” “and evaluate what is
“happening” and are excellently used here to talk about adaptive management. This respondent has a good handle on the adaptive management process.

**Quote and Discussion #13: Defining Adaptive Management Again**

“Well adaptive management is basically what we have been doing for the past few decades. The stormwater program that started in the 1980’s, some assumptions were made at the time that building certain BMPs would affect the water quality. Unfortunately, those assumptions were later disputed by actual water quality monitoring, which showed that those assumptions were incorrect.” – Interview #6

Here the respondent incorrectly defines adaptive management as the efforts this locality has been doing for the past several decades. The respondent has incorrectly identified adaptive management with the Chesapeake Bay restoration efforts as a whole which began in the early 1980’s and began to impact localities by the late 1980’s. This quote showed that the term adaptive management is poorly defined at the local county and city environmental management level. Further, it shows that this respondent may have trouble implementing the Chesapeake Bay TMDL because of this lack of understanding. Holling (1978) would argue that in order for adaptive management to be successfully carried out, all of the stakeholders involved in the process, even those at the local level, must understand the process and their roles in that process.

**Quote and Discussion #14: The TMDL is Not Truly Adaptive Management**

“I don’t know if you’ve read the next generation of Phase I permits in the State of [redacted], but they somewhat mention adaptive management in the general sense and the Bay TMDL. But when you look at what they are asking us to do with water
restoration and watershed implementation plans, they are asking us to come up with specific deadline and specific goals to achieve those TMDLs, and I really think that is contrary to adaptive management because a lot of what we are doing has never been done, certainly not at this large a scale on this most complex waterbody probably in the world. So, I really get cringe when I hear this adaptive management on the regulatory side, which is what the permit is, because I don’t think from a regulatory standpoint that adaptive management is really happening; it’s hard and fast. I think a lot of us are being setup to fail in our permit processes because I don’t think we are being allowed to do adaptive management. We are being asked to come up with quantitative specific plans that will not allow adaptive management to occur. I just think that these new permits are counter to what everyone wants done. I really feel that.” – Interview #7

The respondent above made an excellent point related to the Chesapeake Bay TMDL and the MS4 permit requirements. These processes have timelines with explicit reduction goals for sediment, nitrogen, and phosphorus. As a result, they create a situation in which a true adaptive management approach is not feasible because of the emphasis on experimentation in adaptive management. The respondent noted that the new permit requirements seem to go against the type of restoration efforts state and Federal officials want to occur. However, the respondent could also be using adaptive management as a means to reduce attainment goals and comments here that the rigidity of the permit process doesn’t allow for the manipulation of the attainment goals. Regardless, this is a very poignant comment. It showed that while the Chesapeake Bay
TMDL advocates for an adaptive management approach there is no legal construct within the MS4 permitting process for a true adaptive management approach to be implemented.

**Quote and Discussion #15: Dealing with Uncertainty**

“I would say it is incredibly important or critical to take an adaptive strategy. One of the biggest challenges, well there are two broad challenges. Obviously one is the political environment, but the second is the scientific challenge. We are not just talking about growing a tree. The Chesapeake Bay is a very complex system and just understanding the system is very difficult, similar to climate science. There is no way that someone can strategize what is going to work at the beginning of the process and be right. It is going to have to be a highly adaptive approach to deal with the uncertainty.” – Interview #8

Here the respondent addressed the complexity of the Chesapeake Bay watershed ecosystem. Using an adaptive management approach which allows managers to take into account new scientific knowledge will be key to the long term success of restoration efforts in the Chesapeake Bay watershed or other complex natural resource environments.

Also of note in the comment above is the use of the word uncertainty. An integral component of adaptive management is that it allows managers to embrace and acknowledge uncertainty. In doing so, it is expected that the initial management actions may not be successful and along with new scientific knowledge, new management actions will be implemented and their outcomes monitored in an iterative process. This respondent fully understood that adaptive management, as a concept, is not a means to an end, but a process of learning from management outcomes. The Chesapeake Bay TMDL
is the mechanism that is driving restoration, not the use of adaptive management. Also, it means that stakeholders might not want to keep funding a project that is not always successful in reaching the goals and does not seem to have an end point.

**Semi-Structured Interview Discussion**

The four themes produced by the initial interviews were: 1) cost, 2) the local response and enforcement, 3) support and guidance from state and Federal agencies, and 4) adaptive management and uncertainty. Overall the initial semi-structured interview respondents were concerned how local governments would pay for the improvements required to meet the requirements of the Chesapeake Bay TMDL and that they had no information about financial support from state or Federal agencies. Local watershed managers included in the interview set were concerned about the enforcement tools available to them and specifically that localities with no MS4 permit have no identifiable pressure to meet the implementation requirements. Localities with MS4 permits identified a strong need to meet the Chesapeake Bay TMDL requirements because of the MS4 permit process. While the interview question set did not include a question about cost and funding, it was a major topic of discussion in almost every interview. Overall, local governments see the Chesapeake Bay TMDL as an unfunded mandate, and politicians must consider the cost of implementation along with other priorities such as education and emergency services. Finally, local watershed managers identified a lack of capacity, especially in small jurisdictions, to fully use an adaptive management approach and a lack of financial and technical resources to do so effectively.
Survey Results and Discussion
This section provides a summary of the survey data and discussion section for each dependent variable question associated with the survey tool. This section is provided to accompany the results table that tabulates all of the collected survey data.

The survey generally asked a question and then allowed four responses (strongly agree, somewhat agree, somewhat disagree, strongly disagree). These responses were categorized as binary response (strongly/somewhat agree = yes, strongly/somewhat disagree = no) except for survey question number 9 which was the adaptive management definition score. The binary responses were tabulated and that is provided in table 10.

The binary responses were then used to run logistic regressions for each question as the dependent variable using the available independent variables. A Poisson regression was applied to the adaptive management scores (question number 9) after they were normalized to remove any negative scores.
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Below is a listing of each question from the survey, followed by the results examined by the various grouping or clusters presented in the independent variables. Note that question #10 was an open ended question relating to the definition of adaptive management and is not included in this discussion because very few respondents provided any additional comments.

1. How involved are you in your municipality’s efforts to meet the Chesapeake Bay Total Maximum Daily Load (TMDL)?

Interestingly, of the localities identified representative for the Chesapeake Bay TMDL, eight of the 48 respondents indicated they are not involved with the Chesapeake Bay TMDL at all. Of those eight respondents, all were from Virginia (N=36), all were non-MS4 localities (N=25), and all were in jurisdictions with a population of less than 50,000 people (N=25). The MS4 permit program allows permit holders three five-year cycles to reach the reduction goals, or a total of 15 years, which extend through 2025. In the first permit cycle MS4 localities were expected to reduce nutrient and sediment inputs by 5%, create a nutrient management plan, and a stormwater management plan, and a Chesapeake Bay TMDL Action Plan. The action plans were required to show, in detail, how the locality will meet the second permit cycle reduction of 35% and the third permit cycle reduction of 60%.

Further, six of the eight respondents who indicated they were not involved in the Chesapeake Bay TMDL had 10 or fewer years of experience with water quality and seven of the eight were planning, zoning, or stormwater officers for the jurisdiction. Using a logistic regression analysis there were no significant predictors at the 0.10 confidence level.
The Rappahannock River stood out in this response. Many of the localities in this watershed do not have MS4 permits and have a relatively small population. Therefore, many of these localities have fewer staff to work on the Chesapeake Bay TMDL implementation process.

2. How familiar are you with the models developed by the EPA?
For this question, 41 of the 48 respondents indicated they were familiar with the models used by the EPA to develop the Chesapeake Bay TMDL. Of the seven respondents who indicated they were not familiar with the models, six represent localities from Virginia (N=36). Also, six of the seven respondents who were not familiar with the models were from non-tidal portions of their respective watershed (N=31). Five of those not familiar with the models were the planning, zoning, or stormwater officer for their jurisdiction and five did not have an MS4 permit requirement for their jurisdiction. A logistic regression analysis indicated no significant predictors at the 0.10 level.

The responses to this question point to local government officials who generally do understand the models used to create the TMDL. Of those that are not familiar with the models, these respondents appear to have multiple roles in smaller, overburdened jurisdictions with no permitted requirement to meet TMDL reduction requirements.

3. How likely are you to support the models developed by the EPA?
The majority of respondents, 34 of 48, indicated they did support the models developed by the EPA and used to create the Chesapeake Bay TMDL. Interestingly, all six of the respondents in the Patuxent watershed indicated that they did support the models. Ten of the 36 respondents from Virginia indicated they did not support the EPA
models. Six of the 10 respondents with 26-38 total years of water quality experience indicated they did not support the models. Using the logistic regression analysis it was determined that educational training in engineering is a significant predictor for this question at the 0.05 confidence level. A localities’ watershed position of non-tidal is also significant in the regression model at the 0.10 confidence level.

The responses to this questions indicated that most respondents supported the models used by the EPA to create the Chesapeake Bay TMDL. However, of the 14 respondents that did not support the model, the majority (10) were from Virginia. Further, respondents with an engineering background is a significant predictor that they will support, and therefore understand the EPA models. Additionally, respondents from non-tidal portions of the Chesapeake Bay area also more likely to support the EPA models and this position is a predictor at the 90% confidence level. This is counter to the hypothesis that localities farther from the main stem of the Chesapeake Bay would be less engaged and interested in the Chesapeake Bay TMDL.

4. The EPA and appropriate state agency (MDNR, MDE, VA DEQ, VA DCR) has provided you with the guidance and information you need to successfully implement the Chesapeake Bay TMDL.

The 48 responses to this question were evenly split “yes” to “no.” However, the majority (21 of 36) of respondents from Virginia indicated they had not received appropriate guidance from the state, while in Maryland the majority (9 of 12) indicated they had received appropriate guidance to successfully implement the Chesapeake Bay TMDL. Again, all six respondents in the Patuxent watershed felt they had received appropriate guidance from the various state agencies to successfully implement the
Chesapeake Bay TMDL, while in the Rappahannock watershed the majority (11 of 18) indicated they did not get the guidance and information they need to be successful. Of the respondents without an MS4 permit the majority (15 of 25) indicated they did not get the guidance from the state they needed to be successful in implementing the Chesapeake Bay TMDL, while the majority (14 of 23) of respondents with and MS4 permit said they did have what they needed. Using a logistic regression analysis there are no significant predictors at the 0.10 level.

The responses to this question show that respondents from small localities that are overburdened have difficulty keeping up-to-date on the information being distributed from their state agencies and the EPA. Further, respondents in Virginia and specifically the Rappahannock River watershed need additional resources and/or support to successfully implement the Chesapeake Bay TMDL – especially if they do not have and MS4 permit.

The results here are in line with the EPA’s assessment of the Virginia Phase I WIP. In the final Chesapeake Bay TMDL, EPA noted “minor concerns” with assurances for at least one of the pollution sectors in Pennsylvania, Virginia, and West Virginia. In Virginia the sector was urban stormwater, and the concern was:

“If the statewide rule and/or the Phase II WIP do not provide additional assurance regarding how stormwater discharges outside of MS4 jurisdictions will achieve nitrogen, phosphorus, and sediment reductions proposed in the final Phase I WIP and assumed within the TMDL allocations, EPA may shift a greater portion of Virginia’s urban stormwater load from the load allocation to the wasteload allocation. This shift would
signal that substantially more stormwater could potentially be subject to NPDES permits issued by the Commonwealth as necessary to protect water quality” (US Environmental Protection Agency, 2010, p. ES-12).

5. Governing body understands the requirements of the Chesapeake Bay TMDL

For this question, 32 of the 48 respondents indicated their governing body understands the requirements of the Chesapeake Bay TMDL. In all three of the studied watershed the majority of respondents said their governing body understood the requirements with 5 of 6 in the Patuxent watershed, 15 of 26 in the Potomac watershed, and 13 of 18 in the Rappahannock watershed answering affirmatively. Also, the response ratio was exactly the same at 2:1 between the two states. Using a logistic regression, respondents who were members of the locality’s TMDL Taskforce, or if the respondent was responsible for the localities MS4 permit were both significant predictors at 0.05 level. If the locality was located within a Metropolitan Statistical Area (MSA) or not was a significant predictor to this question at the 0.10 level.

The majority of governing bodies in the study area understand the TMDL, even in the Rappahannock watershed where most of the officials surveyed did not feel supported by their respective state or Federal agencies. Also, there was no difference in this question between Virginia and Maryland – the ratio of responses was the same.

6. Governing body is supportive of the goals the Chesapeake Bay TMDL has set for your municipality.

Of the 48 total respondents, 26 respondents indicated their governing body supported the Chesapeake Bay TMDL. In the three watersheds: five of the six responded
affirmatively in the Patuxent River watershed, 11 of 18 in the Rappahannock River watershed, but in the Potomac River watershed the ratio was reversed with only 11 of 26 identifying their governing body as supportive. In the states: 20 of the 36 respondents from Virginia indicated their governing body was supportive of the Chesapeake Bay TMDL, while only six of 12 in Maryland responded the same way. Based on the population of the jurisdiction the responses were fairly evenly split for localities with less than 50,000 people having 13 of 25 affirmative responses, while localities with between 50,001 and 200,000 people responded evenly with seven affirmative and seven negative responses. But in jurisdictions with over 200,000 people there were six positive responses and only three negative responses. Using a logistic regression, responses to the question of educational training as an engineer were a significant predictor of how supportive the governing body is for the goals of the Chesapeake Bay TMDL at the 0.05 significance level. Additionally, the state that the locality lays in and if the respondent was responsible for their locality’s MS4 permit were significant predictors of the locality’s support for the goals set by the Chesapeake Bay TMDL at the 0.10 significance level.

Here interestingly, 9 respondents that said the governing body understood the requirements of the TMDL (question 5) indicated the governing body does not support the TMDL goals. Three (3) respondents indicated that their governing body doesn’t understand the requirements of the TMDL, but are supportive of the goals. This doesn’t seem to fit as it was expected that the governing body would need to understand the requirements before being supportive of the goals. It is clear that losing nine localities
support for the TMDL while they also understood the requirements is troubling for proponents of the TMDL and state/Federal officials responsible for the successful implementation of the Chesapeake Bay TMDL. Interestingly in the Rappahannock watershed of the 13 governing bodies that understand the TMDL requirements only two (2) did not support the goals of the Chesapeake Bay TMDL.

7. Understands the financial commitment that will be required to meet the requirements of the Chesapeake Bay TMDL.

34 of 48 respondents indicated their governing body understood the financial commitment. The responses by state is of interest here, in Virginia only 24 of 36 respondents identified at their governing body understood the financial commitments, while in Maryland ten of the 12 total responded answered positively. Also of interest the watersheds seem to be fairly consistent, but the majority of respondents in the Patuxent River watershed (6 of 8) responded “yes” while the other two watersheds have a ratio of yes:no of 2:1. This question has the greatest number of significant predictors from all those in the survey. Using a logistic regression, a respondent’s membership in their locality’s TMDL Taskforce or if the respondent is responsible for the locality’s MS4 permit were significant predictors at 0.05 level. The locality’s position in an MSA or Non-MSA, state, and if the locality maintained an MS4 permit were all significant at the 0.10 level.

It is clear that a majority of localities understand the financial commitment associated with the Chesapeake Bay TMDL implementation requirements. However, it seems that Maryland has better positioned itself by educating local elected officials on the costs involved.
8. Governing body is addressing and planning for the financial commitment to meet the requirements of the Chesapeake Bay TMDL.

Of the 48 respondents, 25 indicated that their governing body was planning for the financial commitment associated with the Chesapeake Bay TMDL. In all three watersheds the ratio of “yes” to “no” responses had a majority responding “yes,” but there are some differences: in the Patuxent River watershed four respondents said “yes,” while two said “no.” In the Potomac River watershed 18 of 29 respondents said their governing body was planning for the financial obligations of the TMDL, and in the Rappahannock River watershed the majority (11 of 18) of respondents governing bodies are not planning for the financial commitment. Examining the results based on population size shows a similar trend: 10 of the 25 respondents said “yes” in jurisdictions with <50,000 people, seven of 14 respondents said “yes” in jurisdictions with 50,001-200,000 people, eight of nine respondents said “yes” in jurisdictions with >200,000 people. The results based on population is not surprising because these jurisdictions have larger staffs, more resources, and generally all have an MS4 permit to maintain. Jurisdictions with or without an MS4 permit also showed a shift in the ratio of response: 17 jurisdictions with an MS4 permit responded “yes” while 6 responded “no,” but 8 jurisdictions without an MS4 permit responded “yes” while 17 responded “no.” Interestingly for this question the responses based on years of experience in the respondents current position was equally split. Using a logistic regression analysis there are no significant predictors at the 0.10 level.

In contrast to the previous question (#7) about understanding the financial requirements of the TMDL, the majority of localities are not planning for the financial
commitment of the TMDL, meaning most localities know that TMDL compliance is going to be expensive, but they are not preparing to take on that cost. By watershed the majority of localities in the Rappahannock are not planning for the financial cost of TMDL compliance, while the majority in the Potomac and Patuxent watersheds are. Based on population size, the larger jurisdictions are planning for the cost of TMDL implementation at a much higher rate than those with smaller populations. Also, an MS4 permit made localities more likely to be planning for the cost of the TMDL.

9. Which description(s) below most closely match your understanding/description/definition of the phrase "adaptive management?" Select all that apply (Adaptive Management Definition Score).

Here the respondents were able to select from a list of 10 different potential definition components and were to select all that applied. As a result, the scores had a possible range from -3 to +6, with the highest possible score being +6. However, IBM SPSS Statistics for Windows (2013) could not process a negative number. Because of this the scores were normalized so that no negative scores were present in the data set. The normalized rage was -2 to +7. None of the respondents received the highest score possible, but 12 respondents earned a normalized score of +6. Also, seven respondents indicated that they could not define adaptive management; these respondents were given a score of zero.

The lowest overall mean score came from respondents with a high school diploma as their highest level of education, mean score=2.0 (N=3). Respondent scores followed the trend expected in that with each higher level of education the adaptive management definition score increased. The highest overall mean scores came from respondents from
jurisdictions with a population of over 200,000 people, mean score=5.33 (N=9). By watershed the mean adaptive management definition scores were 5.17, 4.07, and 3.28 in the Patuxent, Potomac, and Rappahannock River watersheds respectively. Maryland bested Virginia with a mean score of 4.58 to 3.53, respectively. Respondents with an MS4 permit performed better producing a mean score of 4.43, while jurisdictions without a MS4 permit had a mean score of 3.20. Generally, respondents with more experience in their current position and or more experience with water quality issues scored higher that those with less experience. Also, respondents indicating they have education or training in policy and/or law, or if the locality had a MS4 permit were all significant predictors in the Poisson regression analysis completed at the 0.05 level. Respondents who currently serve on their locality’s TMDL taskforce, if the locality is located in the Patuxent River watershed, if the locality had a MS4 permit, and the localities population size (population size and adaptive management definition score are directly proportional) are all significant predictors in the Poisson regression at the 0.10 level.

This question provides some of the most interesting data in the dissertation. The highest score came from respondents that represent localities with 200,000+ people, while the lowest score came from respondents with a high school diploma as their highest degree earned. One of the most striking differences in mean adaptive management definition scores is that of localities with and without an MS4 permit, 4.43 to 3.20, respectively. Evaluating these populations using the Mann-Whitney U test we must reject the null hypothesis and therefore there is a significant difference between the two MS4 permit groups, those with and those without an MS4. There is also a sizeable
difference in mean scores between the two states; however, this difference is not significant. The three watersheds show a sizable difference with the lowest (Rappahannock) mean score of 3.28 and the highest (Patuxent) mean score of 5.17. The comparison between the three watersheds (Patuxent, Potomac, and Rappahannock) was a little bit more difficult because several localities are in more than one of the three watersheds so the samples are not independent. Jurisdictions in the Patuxent and Potomac, and Potomac and Rappahannock River watersheds overlap. In order to determine if the mean scores of the three watersheds are significantly different a permutation test was used. The permutation tested via a Monte Carlo simulation. The hypothesis is:

\[
H_0: \mu_{\text{Rappahannock}} = \mu_{\text{Potomac}} = \mu_{\text{Patuxent}}
\]

Here each \( \mu \) represents the ‘true’ adaptive management definition mean for each watershed. Each permutation, 100,000 total were run, randomly allocated the observed responses to each of the five categories: Patuxent only, Potomac only, Rappahannock only, Patuxent and Potomac, or Potomac and Rappahannock in the same numbers as in the survey. The sample means of each watershed were calculated and stored with each observation in an ‘overlap’ group counts towards two different sample means. The final measure was the sum of squared deviations of the group means from the overall mean. Repeating this process 100,000 times yields an empirical distribution with sample
quantiles to which the observed deviation can be compared. A larger value indicates less
strength of evidence for $H_0$, so that the effective p-value is the proportion of simulated
observations above the observed observation. Since the observed sum of squares falls at
the 0.9461-th quantile, the p-value is $1 - 0.9461 = 0.0539$. Thus there is quite strong
evidence (marginally significant at the alpha = 0.05 level) that the responses differ by
watershed.

10. Please expand on questions 1-9 if you would like to.
This question was not coded because very few respondents provided comments to
this question.

11. From your perspective, how critical is adaptive management to the
Chesapeake Bay TMDL implementation?
Nearly all of the respondents agreed that adaptive management is ‘critical’ to the
Chesapeake Bay TMDL with 46 of the 48 total respondents indicating so. Interestingly
the two negative respondents were both from Virginia; identified themselves as the
stormwater, planning, or zoning official; were from non-tidal jurisdictions; and did not
have an MS4 permit for their jurisdiction. Using a logistic regression analysis there are
no significant predictors at the 0.10 level.

From a social scientist’s perspective it appears that this question was not placed in
the appropriate order given that nearly every respondent indicated that adaptive
management is critical to TMDL implementation. The question’s location within the
survey tool could have influenced the responses. If this is not the case, then this makes it
clear that the majority of respondents believe adaptive management is important to
successful TMDL implementation. However, it is clear that this question was ill placed,
but certainly it can be gleaned that a large number of local watershed managers believe that adaptive management is at least part of the Chesapeake Bay TMDL implementation process.

12. To what degree does the agency leading the Chesapeake Bay TMDL for your state support your use of an adaptive management approach to TMDL implementation?

The majority of respondents (28 of 48) indicated that the agency leading the TMDL implementation in their state does not support the use of an adaptive management approach. By watershed: in the Patuxent River watershed four of six respondents felt supported in using an adaptive management approach to the TMDL implementation, while only nine of 26 respondents in the Potomac River watershed felt the same way, and only eight of 18 in the Rappahannock River watershed felt supported to use an adaptive management approach. Interestingly the respondents by state were fairly similar. In Virginia 13 of 26 respondents felt supported, while in Maryland seven of 12 felt supported. Based on total years of experience in water quality, respondents were approximately 2:1 more likely to respond negatively to this question with 0-25 years of experience, but over 2:1 more likely to respond positively to this question with 26+ years of experience. Using a logistic regression analysis there are no significant predictors at the 0.10 level.

Here the majority of respondents feel that adaptive management is critical to the Chesapeake Bay TMDL, but do not feel supported by their respective state agencies to use an adaptive management approach in the TMDL implementation process. Based on the initial semi-structured interviews, most respondents have said that the lead state
agencies had not provided enough details about the implementation process or the use of adaptive management. There seemed to be a trend, especially with non-MS4 localities respondents that the specific reduction goal for the Chesapeake Bay TMDL as a percentage or mass of current inputs for the locality were not know at the time of the interviews. Further, there is a general sense even in the larger jurisdictions that monitoring (which is a significant component to the iterative process of adaptive management) is not something that local governments can do because of the expertise, cost, and staff time involved. This lack of expertise, resources, and staff time makes for the evaluation of implemented BMPs very challenging.

13. *To what degree does the EPA support your use of an adaptive management approach to the Chesapeake Bay TMDL implementation?*

   Using the binary coding for this question, 19 of the 48 total responses indicated they did feel supported by the EPA to use an adaptive management approach to the Chesapeake Bay TMDL implementation. Responses were fairly standard between watersheds to this question. But the position of the respondent’s jurisdiction in the watershed provided interesting results with only 13 of 31 positive response from jurisdiction in non-tidal portions of the three watersheds, only one (of nine) positive response came from the tidal portions of the watersheds, and five of seven possible positive responses came from those localities adjacent to the main stem of the Chesapeake Bay. Also in this question the responses by state are fairly even. However, responses by MSA are interesting. For localities within an MSA the ratio of positive to negative response to this question is 15:18, but in non-MSA areas the same ratio is 5:10. When categorizing responses by years of experience in water quality, respondents with 0-
25 year of experience were approximately 2:1 more likely to respond negatively to this question of EPA support for using an adaptive management approach to the TMDL implementation, while respondents with 26+ years of experience in water quality were over 2:1 more likely to respond favorably. Using a logistic regression analysis there are no significant predictors at the 0.10 level.

A majority of respondents did not feel supported by the EPA to implement the Chesapeake Bay TMDL using an adaptive management approach. Interestingly the responses were fairly consistent between the three watersheds and two state in the study area. There were some non-significant differences between the localities position within the watershed with the majority of respondents located adjacent to the Bay felt supported by the EPA (5 out of 8), while in the tidal and non-tidal portions the ratios were 1 of 9 and 13 of 31, respectively. Also of interest, respondents within an MSA were more likely to feel supported to use adaptive management by the EPA than non-MSA localities.

Beyond the identified concerns noted above, there was a general sense from the respondents that more communication is needed between state/Federal and local officials. While there were hundreds of public meeting on the Chesapeake Bay TMDL throughout the watershed, it appears that a heightened level of communication is needed among Federal and state agencies and local governments. Though the survey tool did not expressly define support, respondents often identified support to be of a financial nature. Regardless, state and Federal officials need to communicate the resources available to local governments in a more effective way and identify sources of financial support in order to meet the timeline of the Chesapeake Bay TMDL.
Follow-up Semi-Structured Interview Results

Three semi-structured follow-up interviews were conducted for this dissertation. The full dictated interview set is included in the appendix of this dissertation. Any reference to personal or locality identifiers were removed to protect the anonymity of the respondents. The interview transcripts were reviewed for major themes that were present throughout the interviews and repeated by more than one of the three respondents. This method of discovering themes in the data was presented by Mayan (2009). An advocacy representative was selected because these individuals have a unique perspective of the entire watershed and can provide a critical analysis of local governments and local watershed managers. A series of three quotes were pulled from the transcripts to illustrate the major themes that were present in the semi-structured interview data along with brief commentary below.

Follow-up Quote and Discussion #1: Communication

“Again, I think if you watch different listservs and discussion groups for the Chesapeake Bay, there is just a lot more communication, a lot more information that comes out of Maryland and it gives any number of terms, that one possibly included more air time and it becomes part of the dialogue people can use in the discussion.” – Follow-up Interview #1

Here the respondent is making a contrast between local watershed managers’ community communication in Virginia and Maryland. The respondent has identified that Maryland seems to have made the Chesapeake Bay TMDL an adaptive management part of the vernacular and the topics are commonly discussed on listservs and other communications. This could help to identify why survey respondents in Maryland were
better able to define adaptive management, felt better supported by the state, and supported the TMDL at a greater level than the respondents from Virginia.

**Follow-up Quote and Discussion #2: The Need for Regulation**

“"A regulatory permit tends to get people focused, in the voluntary watershed implementation plan where we…well you can pledge that you are going to lose 10-pounds by Christmas time, I’m making this up. I don’t know how much you weight, but if you don’t lose 10-pounds, like whatever, you’re not going to jail. And that’s a watershed implementation plan, it’s voluntary in nature. But an MS4 regulatory permit, if you say-what’s a good analogy-if you say you are going to deliver a contract by, you know complete a scope of work by the 31st of December and you don’t. It’s a signed legally binding contract. I could potentially throw you in jail, because you broke the terms of the contract and it was a legally binding contract, so ‘hey I should lose weight’ vs. ‘I can go to jail if I don’t provide the legally binding deliverables on this contract.’”

You are going to tend to focus on one problem more than the other. So that MS4 permit, at 4.4 vs. 3.2, without an MS4…”you know whatever, I’ve got a lot on my plate, I’m a small jurisdiction” and they don’t all have small “and don’t have much staff and so it’s a voluntary thing and it would be nice and sure, but I’ve got other things that I’m required to do so I’m going to focus on them.”

This respondent makes a fair analogy about the need for additional regulation at the local level to require the Chesapeake Bay TMDL implementation. A common threat throughout the follow-up interviews was that those localities without MS4 permits have no real hard requirement to reduce nitrogen, phosphorus, or sediment inputs. A permit
system or other regulatory framework at the local level could help to ensure that local jurisdictions meet the reduction requirements of the TMDL.

**Follow-up Quote and Discussion #3: The View of Adaptive Management**

“I think they see these as federal mandates that unfunded and/or impossible. At least to the extent that their local economy is dependent upon doing whatever they must in order to balance the books. And so implementing TMDL related strategies where there’s an escape clause, which is exactly what I think adaptive management is, because the benchmarking for whether adaptive management actually reinforces the underlying purpose of a TMDL. Benchmarking is pretty slim. It’s self-interpreted. That’s the wildcard. People can simply certify that they are implementing the TMDL without much scrutiny on how they have done so. And they will cry “adaptive management” where they are noncompliant.” – Follow-up Interview #2

Here the respondent provides an interesting analysis of how some local watershed managers may be thinking of adaptive management and the Chesapeake Bay TMDL. Certainly, all of the follow-up interviewees indicated that there are several localities that are actively disengaged in the Chesapeake Bay TMDL process. The implications of this on the Chesapeake Bay TMDL could be negative. However, there is an argument that the Chesapeake Bay TMDL is not an adaptive process because of the various permit vehicles involved and the lack of opportunity to learn and potentially fail. This quote also confirms statements from the 10 initial interviews that the Chesapeake Bay TMDL is viewed as an unfunded mandate and that the state or federal government will either provide funding or the support needed to meet the TMDL requirements. Further, the lack
of understanding as to the definition of adaptive management by practitioners has created a sense, according to follow-up interviewee #2, that some localities may use adaptive management as a guise for delaying implementation of the Chesapeake Bay TMDL.
CHAPTER SIX: FINDINGS AND RECOMMENDATIONS

This chapter synthesizes the finding of the dissertation and discusses conclusions based on the data collected. Key components of the chapter include summative findings across the three components of the research, and recommendations for further study of this topic in the Chesapeake Bay watershed and beyond.

Findings

This dissertation evaluated the success of the Chesapeake Bay TMDL implementation process and the use of adaptive management at the local level in the Maryland and Virginia portions of the Patuxent, Potomac, and Rappahannock River watersheds. The ultimate and overarching research questions asked were:

1. What are municipal watershed managers in the Patuxent, Potomac, and Rappahannock watersheds currently doing to implement the Chesapeake Bay TMDL in their jurisdiction?

2. Do these managers recognize the role of adaptive management in the Chesapeake Bay TMDL, and how are they using an adaptive approach to meet the TMDL requirements, if at all?

The survey data showed a correlation between a jurisdictions’ status as an MS4 permitted locality and the local watershed manager’s preparation and engagement in the Chesapeake Bay TMDL implementation process. Because MS4 permits are required for urbanized areas as defined by the US Census Bureau, the permits are correlated to population size and membership in a MSA (USEPA, 2012). For example, many of the
localities in the Rappahannock River watershed do not have MS4 permits and have a relatively sparse population. Therefore, many of these localities have fewer staff to work on the Chesapeake Bay TMDL implementation process. The results of this research pointed to the conclusion that local watershed managers in Virginia and specifically the Rappahannock River watershed need additional resources, defined as funding or additional staff time, and/or support from state or Federal agencies to successfully implement the Chesapeake Bay TMDL – especially if they do not have an MS4 permit process. While most of the Rappahannock River watershed respondents do not support the Chesapeake Bay TMDL, their governing bodies do understand the requirements of the TMDL. In the Rappahannock River watershed the majority of the local governing bodies understood the TMDL requirements, and the majority supported its goals as a percentage or mass of current inputs from their locality. However, the majority of localities in the Rappahannock River watershed were not planning for the financial obligations associated with the Chesapeake Bay TMDL, while their counterparts in the Patuxent and Potomac River watersheds were. It appeared that there is still more support needed in the Rappahannock River watershed to get local officials to begin planning for the implementation of nutrient and sediment reductions needed to meet the Chesapeake Bay TMDL two-year milestones, 2017 interim, and 2025 goal periods.

Local watershed managers generally do understand the models used to create the Chesapeake Bay TMDL and that makes them well suited to explain the models and the Chesapeake Bay TMDL process to their respective governing bodies. However, it should be noted that some respondents identified that they do not agree with the models either in
the scale of the data used or the process of model validation. It was unclear to what extent respondents fully understood the models and the complexity involved.

Local watershed managers with an engineering background were statistically more likely to support, and therefore understand the EPA models; this in turn makes these managers better qualified to support the implementation process in their locality. In the three watersheds included in this dissertation the majority of governing bodies understood the TMDL and this is a testament to the hard work of the local watershed managers. In the Rappahannock River watershed, where most of the local watershed managers surveyed did not feel supported by their respective state or Federal agencies, they were still able to provide their governing bodies with an appropriate level of information about the Chesapeake Bay TMDL. However, nine respondents out of 18 in the Rappahannock River watershed said their governing body understood the requirements of the TMDL, but did not support the TMDL goals. This is a real problem, and it appears that a greater focus by state and Federal officials needs to be put on the local benefits of restoring the Chesapeake Bay watershed and implementing the TMDL, especially in the non-tidal portions of the watersheds when communicating with local government officials.

Working in local government can be a very challenging job. In several of the localities with small overall populations included in this research, a very small staff is asked to do many of the same tasks that much larger staffed localities are asked to do. In fact, a non-responder to the survey (one of four) identified a lack of staff time as the driving reason that the survey could not be completed. This strain becomes evident when
the local watershed manager’s role is one of several that a single person must fill. In most instances these small localities do not have an MS4 permit and therefore there is no direct mandate to stay up-to-date on information being distributed by state and Federal agencies about the Chesapeake Bay TMDL. Further, in these small overburdened localities, the local watershed manager and governing bodies do not have the time and resources to fully plan for the TMDL implementation and instead choose to fully fund other important services like schools and emergency personnel. In these smaller jurisdictions there was a real sense that the state and Federal government should provide technical and financial support to ensure the locality meets the TMDL reductions requirements. If not, then the Chesapeake Bay TMDL becomes an unfunded federal mandate that cannot be implemented without burdening local taxpayers with the cost. The respondent in follow-up interview #2 may have said it best “Again, I think they see them as unfunded mandates and therefore they feel perfectly at liberty to ignore them.”

The differences between the two states implementation strategies in the study area was clear: Maryland has positioned itself better by involving and educating local elected officials and local watershed managers on the Chesapeake Bay TMDL implementation process and the costs involved. Throughout the semi-structured interviews and survey response data, local officials in Maryland have a better grasp of the Chesapeake Bay TMDL process, requirements, and the role that adaptive management plays. Maryland seems to be better connected to the Chesapeake Bay, both by the percentage of counties that share a boarder with the main stem and respondents from localities closer to the main stem of the Chesapeake Bay felt better supported by the EPA than those respondents.
farther from the main stem of the Bay. This is also a result of the urgency that these respondents felt in the Chesapeake Bay restoration efforts because the health of the bay directly impacts their local economy. Maryland has had a historical focus on the Chesapeake Bay as early leaders in the state focused the development of towns on its shores. This was especially evident when, as early as 1744 the Maryland Assembly gave access to the town wharf, square, and permission to lease marsh areas to be drained and developed (Capper et al., 1983). Then again later in the 20th Century when critical area legislation was introduced to limit shoreline development (Commonwealth of Virginia, 1988; Maryland Department of Natural Resources, 2015).

Examining the guidance available to localities provided by Maryland and Virginia, it is clear that Maryland has better positioned itself to support local watershed managers in the implementation of the Chesapeake Bay TMDL. In Virginia the main web presence is managed by the Virginia Department of Environmental Quality and contains links to the EPA’s Chesapeake Bay TMDL website, the Phase I WIP, Phase II WIP, and nutrient and sediment reduction milestone documents. However, the webpage contains no guidance to local watershed managers and no links or references to local nutrient or sediment reduction documents (Commonwealth of Virginia, 2015). In Maryland the web presence of the Chesapeake Bay TMDL contains a more robust listing of resources including sections with titles such as “Federal Guidance,” a separate section titled “Guidance,” and a section with links to each local jurisdictions’ WIP Phase II County Plan (State of Maryland, 2015). Also included is a “Key Documents” section that contains a guidance document for local implementation. This guidance document details
exactly what the state is asking to be included in the local governments’ two year milestone reports and action items through early 2016 (State of Maryland, 2013). Accompanying this document is a report template in Microsoft Word format for local governments to use in preparing the Local 2014-2015 two-year milestone reports.

Maryland also took a different approach to the structure of its implementation strategy, relative to Virginia. In Virginia, the state used planning district commissions to disseminate information to the localities, while in Maryland the state communicated directly with the counties. This difference in implementation structure could explain some of the differences between the two states. Based on this review of the information available to local watershed managers in Maryland and Virginia, Maryland is doing a better job of providing information and guidance to its localities. This is true even though Virginia requires that all TMDL implementation plans be fully carried out.

According to the survey responses, local watershed managers overwhelmingly believe that adaptive management is a critical component of the Chesapeake Bay TMDL implementation process. It is clear that this question was ill placed in the survey tool, however the responses were still overwhelmingly positive that adaptive management in the Chesapeake Bay TMDL was necessary. A majority of respondents did not feel supported by their respective state agencies or the EPA to use an adaptive management approach in the TMDL implementation process. Based on the semi-structured interview data, respondents identified that the responsible state agencies had not provided enough details about the implementation process or the use of adaptive management in the implementation process. Based on this dissertation’s definition of adaptive management...
as “…a systematic approach for improving resource management by learning from management outcomes” (Williams et al., 2009, p. 1) the structure and rigidity of the Chesapeake Bay TMDL framework may not be as helpful as the authors of the final Chesapeake Bay TMDL intended. More importantly, from an environmental resolution perspective, it appears that several stakeholders, such as many of the local government officials surveyed in this research, were not included, or not engaged in a way that was constructive to local government officials, in initial discussions by state and regional agencies. This lack of input has left several local watershed managers frustrated with the process. Many public meetings were held throughout Maryland and Virginia, but state and Federal officials must think critically about how local officials are engaged in the Chesapeake Bay TMDL implementation process. These local officials must feel their contributions are an important part of the planning process.

Even in the larger jurisdictions in the study, monitoring the outcomes of management actions in an adaptive management framework does not appear to be feasible because of the expertise, cost, and staff time involved. Unless private, state, or Federal organizations can step in to provide targeted monitoring activities, a true adaptive management approach to implementing the Chesapeake Bay TMDL at the local level cannot be accomplished. While state and Federal organizations do conduct monitoring activities through the Chesapeake Bay watershed, specific monitoring plans are needed to monitor for change in an adaptive process.

From the adaptive management definition scoring matrix respondents confirmed that education level, experience, MS4 permit, and population size were directly
proportional to the mean adaptive management score. Examination of these populations using the Mann-Whitney U test, there was a significant difference between the two MS4 permit groups, those with and those without permits. There was also a sizeable difference in mean scores between Maryland and Virginia. However, this difference was not significant. The three watersheds (Patuxent, Potomac, and Rappahannock) showed a sizable difference with the lowest (Rappahannock) mean score of 3.28 and the highest (Patuxent) mean score of 5.17. The comparison of the mean adaptive management definition scores between the three watersheds was difficult to analyze because several localities are in more than one of the three watersheds making the samples dependent. Using a permutation test via a Monte Carlo simulator there was strong evidence that the mean adaptive management score responses differed by watershed (p=0.0539).

Paramount to this discussion is the fact that there is still much confusion among academics and practitioners on the actual definition of adaptive management (Rist et al., 2013; Westgate et al., 2013). Based upon the literature reviewed, initial semi-structured interviews, and the survey responses, there appeared to be two interesting trends. First, Maryland localities were better prepared to implement the Chesapeake Bay TMDL, while localities in Virginia wanted more guidance and support from state and Federal agencies. Second, among the three watersheds there were significant differences in their understanding of adaptive management and their ability to implement an adaptive management approach to meeting the Chesapeake Bay TMDL. The research design of this dissertation called for a series of follow-up semi-structured interviews to identify the reasons for the two trends described above. These follow-up semi-structured interviews
were conducted with non-governmental subwatershed wide advocacy organizations, of which there are several within each of the three watersheds included in this dissertation. The three interviewees, whose organizations and names have been redacted to protect their anonymity as with all of those involved in this research, identified an overall lack of understanding, particularly in the Rappahannock watershed and weaker communication between localities and state government in Virginia than in Maryland. These follow-up interview respondents also identified that while their organizations focus is on the watershed within which they exist, there are relatively few organizations following the Chesapeake Bay TMDL implementation at the state level.

The hypotheses that there would be an inverse relationship between a locality’s distance to the main tributary of study and the municipal watershed manager’s knowledge of and implementation efforts to meet the Chesapeake Bay TMDL did hold to be true, especially when considering the responses between Virginia and Maryland along with the proportion of counties adjacent to the main stem of the Chesapeake Bay in each state. However, the data made it difficult to show that counties and cities adjacent to the Chesapeake Bay, or in a tidal portion of the river systems under study, will have a heightened sense of understanding and exert more effort to implement the TMDL that those municipalities that are in non-tidal portions the river watersheds.

The hypothesis that localities in Maryland will have a more advanced understanding of the role adaptive management plays within the TMDL WIP process compared to those in Virginia was supported by the data collected as part of this dissertation. However, the reason for this difference seemed to stem from
communication and information sharing that occurred in Maryland, not the historical
classic character of the state’s political boundaries.

Perhaps most astonishing was the hypothesis that among the three watersheds, the
Patuxent River watershed would be the best positioned to successfully implement the
TMDL, followed by the Rappahannock and then the Potomac River watersheds. The
survey and interview results pointed to the Patuxent being best positioned, followed by
the Potomac, then the Rappahannock. Even though the Potomac straddles both Maryland
and Virginia and a very large tract of area the respondents seemed better positioned to
implement the Chesapeake Bay TMDL and had a better grasp of the definition of
adaptive management relative to the respondents in the Rappahannock River watershed.

The final hypothesis was that in general, municipal watershed managers would
identify a lack of staff time and resources as an impediment to full implementation the
Chesapeake TMDL WIPs using an adaptive management approach. This was certainly
true for many of the respondents and even several non-responders to the survey. Even
large jurisdiction representatives who have large staffs and budgets recognized that for
politicians the funding required for nutrient and sediment reductions must also compete
with emergency services and education. Smaller jurisdictions identified the lack of staff
as an impediment to fully understand or implementing the Chesapeake Bay TMDL, using
adaptive management strategies in the implementation, or conducting monitoring
activities required as part of an adaptive management process.
Recommendations for Further Study

The survey results pointed to a lack of understanding and resources of adaptive management and the Chesapeake Bay TMDL implementation process, especially in localities that are not required to maintain an MS4 permit, while there are several local watershed managers that have a good understanding of adaptive management. Further, research should be completed across the full watershed to confirm this along with questions geared to identify what type(s) of support would be most valuable to local watershed managers. Along with this suggested survey, it is necessary to understand the constraints on state and Federal officials responsible for the Chesapeake Bay TMDL. However, it appears that communication from Federal, state, and regional agencies to the local governments needs to be more consistent and effective to ensure the successful implementation of the Chesapeake Bay TMDL.

Policy Recommendations

This section provides several suggested policy changes that can be expected to have a positive impact on implementation of the Chesapeake Bay TMDL at the local level. State and Federal officials should consider these recommendations as the Chesapeake Bay TMDL continues to be implemented and specifically in the study area of this dissertation. By examining these recommendations closely, state and Federal officials can better ensure success as the 2017 Phase III WIPs begin to be developed.

1. A greater focus needs to be put on the local benefits of restoring the Chesapeake Bay watershed and implementing the TMDL, especially in the non-tidal portions of the watersheds. This has been a focus in the past, but as local governments begin to commit financial resources to these efforts
more emphasis must be placed on the local benefits of implementation from state and Federal officials. Certainly one of these benefits is preventing the EPA from using any reasonable assurance “backstop” measures if the local government doesn’t meet its reduction requirements as set in the Chesapeake Bay TMDL.

2. There are many stakeholders engaged in the Chesapeake restoration efforts including the TMDL. A more defined role needs to be developed for planning district commissions and soil and water conservation districts. While, these regional quasi-governmental organizations at times play a small role in the local government response to the Chesapeake Bay TMDL, especially in large jurisdictions, but in smaller jurisdictions they appear to serve as a key resource for TMDL implementation.

3. Many local officials view the Chesapeake Bay TMDL as another unfunded mandate by state and Federal agencies. State and Federal governments should review the expected costs to fully implement the Chesapeake Bay TMDL and work, especially with small jurisdictions, to identify funding sources. These might include expansion or reallocation of cost sharing or other grant programs. Initially nutrient trading schemes are inappropriate, but they may become valuable due to expected population growth in future years and decades. Small, sparsely populated localities with small budgets and tax bases cannot pay the cost of implementing the Chesapeake Bay TMDL without reducing funding to
competing priorities such as schools and emergency services. A funding structure that supports small local governments would be helpful between now and 2025.

4. Adaptive Management is being completed at both a local and regional scale in the implementation of the Chesapeake Bay TMDL. While monitoring of water quality characteristics can be costly, there are other forms of monitoring that local governments can practice. Local and state governments can monitor local policy developments to safeguard water quality, the amount of money spent by the localities on TMDL-related expenses, or other criteria. This type of monitoring is valuable and can be done at any government level without exorbitant cost or time.

5. When local, state, and federal governments hire staff members to work on the Chesapeake Bay TMDL and related projects, the vetting process should include candidates with several years of experience in water quality, experience in policy and science/engineering, and excellent communication skills. This vetting process should include asking each candidate what he or she knows about adaptive management.

6. When local governments hire new watershed managers, the data collected for this dissertation suggest the most successful candidates will possess experience and educational training: 1) as an engineer or in policy/law, 2) have experience with maintaining an MS4 permit, 3) have experience
being involved in a local TMDL taskforce, and 4) have experience with a locality that was part of a MSA.
APPENDIX

Interview 1

RF: Are you a municipal watershed manager that is directly participating in the Chesapeake Bay TMDL?

X: Yes. I would say that I am directly involved in the conservation of the TMDL Chesapeake Bay Watershed. Of course there are many aspects to the implementation of the TMDL. Yes, my particular area is directly involved – knowing that there are many regulatory sectors that are involved.

RF: You’re not doing this alone.

X: Right, my particular focus is on erosion and sediment control within the construction industry. That is where I fall. Of course we have the forestry department here that regulates timber harvesting and then we have the Virginia Department of Agriculture and Consumer Services (VDACS) that regulates the agriculture sector. Obviously there are a wide array of conservation efforts and regulatory involvement.

RF: Do you know why you are involved in this, the political and regulatory reason?

X: My particular, I guess there are several components of the TMDL and sediment would be one and I guess that would be my involvement.

RF: Let me rephrase my question, do you know why your locality is participating?

X: It is mandated by the state that all localities have an erosion and sediment control program.
RF: Right, okay. So how are you implementing the TMDL and trying to reach the requirement, what experiences have you had so far, and how is it going?

X: I’m sorry that was a two part question. How are we implementing?

RF: Right.

X: So okay we are implementing it through the integration of an erosion and sediment control program. Which regulates the construction agency or more specifically the land disturbance of a site of any land disturbance over 10,000 square feet we have regulatory authority over and as far as, I’m sorry the second part of that question – what extent?

RF: What are you experiences so far and how is it going?

X: Okay, I’ve been in this particular job title for 7 or 8 years, so the program has grown. Probably the most important part of it is we have educated the excavators, the contractors that sort of thing on proper control structures and installation and they are being a lot more efficient. Having less failures and in general more aware of what they are doing.

RF: In particular in the time that the TMDL has started have you had to change what you are doing?

X: I think we have probably gotten a little more efficient, a little stricter in how we look at things in a little more detail with as the TMDL implementation has been stepped up since 2006 or 2009.

RF: Okay, so have you heard what other localities are doing or trying as part of the implementation process. And assuming that you have heard is that impacting what you are doing?
X: Yeah I mean I, we don’t have a lot of involvement in other localities and how they implement their programs. No it really hasn’t. I guess we all work independently. No it hasn’t impacted how we implement our program.

RF: Okay. So as a watershed manager for your locality what would happen if the TMDL implementation goals and the quality of the Chesapeake Bay, the level of water quality was not at the goal, what would you do?

X: I guess just to clarify. I’m not really a watershed manager per se. What we do is not a full implementation of the entire concept of the TMDL and that sort of thing. We basically deal with the erosion and sediment control, we have a stormwater program to deal with nitrogen and phosphorus reduction through a stormwater management health. I’m sorry can you repeat the question. I want to clarify that we have many parts and not just one person that is in charge of the TMDL.

RF: I understand. Let me ask this question. Has your locality has been mandated to implement the TMDL by the state?

X: Well when you say implement the TMDL yes we have. TMDL is such a broad term, Total Maximum Daily Load. Nitrogen, phosphorus, sediment and that is done through the agriculture industry. You know that’s what I’m getting at. We don’t have one authority that’s over all of it. I just have one little sliver. I can’t speak on all of it. I can speak on the part on the construction industry. When I’m speaking to this I’m speaking to land disturbance in the construction industry, because there is land disturbance in agriculture and land disturbance within forestry.
RF: Sure. If your locality does not implement the TMDL. If you don’t meet the reduction goals that you’ve been assigned to, who is responsible?

X: The locality.

RF: Okay, and you are an employee of the locality. So which employee is responsible, or is it the locality at large?

X: I would say it’s the locality at large?

RF: Okay.

X: The ultimate liability would fall back to the locality.

RF: From your view point, if the locality did all of these things to meet the reduction goals that the state has set out for you and it did not result in an appropriate level of water quality, what would the locality do?

X: The locality would wait for the state or Federal government to advise us. These are all benchmarks that are set at the federal level. We are going on the guidance of the state and Federal level.

RF: Okay. Some people have called the TMDL implementation an adaptive management process. Have you heard that term before?

X: I can’t say that I have.

RF: Okay. Those are all of the questions that I have. So you are aware I’m interviewing 10 people in the Potomac, Patuxent, and Rappahannock watersheds. I’m going to use these interviews to base a survey on and send it broadly to all local government folks that are involved in this process.

X: I have a little reserve that with only 10 localities.
RF: Let me rephrase that. I’m interviewing 10, but will send the survey to hundreds of people.

X: Right, with such a small survey or data analysis it may not accurately reflect. You know because there may be someone else in our locality that is better to answer these questions.

RF: Who would that be?

X: That’s why I referred you to [redacted] with Soil and Water Conservation District. He would be better to tell you what’s going on in the locality. He deals with me, the agriculture side, and had a better idea of what’s going on.

RF: I understand what you are saying. My question is, that the state has gone through the planning districts to implement the TMDL. You said [redacted], but he’s at the Soil and Water Conservation District right?

X: Right

RF: So he’s not an employee of the locality, correct?

X: That’s correct.

RF: You are relying on him as an expert resource for the implementation.

X: Correct. I guess that’s what we are saying. [redacted] is great, don’t worry about it. I guess that’s where it’s hard for me to comment on specific aspects.

RF: I’m not expecting you to. I’m doing 10 interviews to make sure that the survey I have prepared is appropriate. Beyond these interviews I’ve reviewed thousands of pages of documents.
X: I’m not trying to be too critical or anything. I guess if you’re looking for a point person in the locality government on the TMDL I guess it would be me. I’m involved in one aspect of it and I know there is so much to it, than what I deal with. That’s why I mentioned the Soil and Water Conservation District. [REDACTED] not specifically employed with us. We have a memorandum of agreement that he is in charge of some of what we do as far as TMDL implementation.

RF: Great this has been very educational and I appreciate your time.

X: Take care and I wish you good luck.
Interview 2

RF: A little overview I’m working on my PhD at George Mason University and my research focus is on the implementation of the TMDL at the local level.

X: So who are you talking to?

RF: The project involves this first step of 10 interviews in three watersheds. I will then use these interviews and research that I’ve previously completed to create a survey to go to all local municipal watershed managers in those three watersheds. Then if there are any data gaps I can go back and do additional interviews. That’s the procedure, with the goal that the research will be useful to local, state, and Federal officials.

RF: Read disclaimer.

X: That’s fine I agree.

RF: I have seven questions and we can go off to some tangents if you like. So, you and Fairfax Locality are participating in the TMDL.

X: That’s right.

RF: So why are you participating?

X: So my job, I’m responsible for stormwater, wastewater, and urban forestry. Wastewater permits that we have, we had to reduce the nitrogen and phosphorus discharge rates in compliance with the TMDL. Stormwater we have an MS4 permit, the new one once we get it, requires us to comply with the Chesapeake Bay TMDL.

RF: How are you as a local manager trying to meet the requirements of the TMDL? What are your experiences so far and how is it going?
X: Well, from a wastewater perspective it is just installing new treatment processes at our treatment plant. Now we have agreements with the City of [redacted] or [redacted] [redacted] which is a separate authority, [redacted], and with the [redacted] River Organization. Now all said we are going to spend between $300M and $350M upgrading the wastewater treatment to reduce the nitrogen and phosphorus discharges to meet the TMDL.

RF: Say the amount again.

X: $300M and $350M

RF: Now that is between today and 2025?

X: No that is actually already been spent and already going on. So the wastewater part of it they put in to the earlier permits that started in the mid-2000. I don’t know the exact dates. So we had to be in compliance, our discharge limits had to be in compliance with our permits by 2012 or 2013. So as you look at progress made towards the Bay TMDL, specifically in Virginia, you will see that wastewater has done a whole lot because they got an earlier start.

RF: Right. Logistically it is easier to accomplish something in this sector.

X: Well, it is a point source and the technology is there. So you can measure it more easily and the techniques are there. So in a way yes, but the $350M caused our sewer rates to go up by double digits in a bad economy, so easier isn’t necessary right. It was very hard for a lot of people to understand.

RF: Do you feel like you have the resources to accomplish the implementation goals?
X: Well yes, we have no choice. Now the state did also have water quality improvement grants that they helped with, so there was some state funding that provided some assistance. That’s the wastewater side of it. The stormwater side of it is a whole different mess. So the stormwater side of it, the accounting is not well defined yet. So what we are trying to do is, we started a watershed planning process in 2003/2004 using the tributary strategies as our guide. We’re moving toward meeting those. Then the board increased the funding by about 150% in 2006 towards stormwater and dedicated depending on the real estate tax and we started doing projects. Then the Bay TMDL didn’t come out until 2010 saying what the goals where so that kind of changed it. And then, the accounting for how much credit you get based on different practices you implement is still a moving target. So that is very difficult to comply with. So the estimated costs to comply have been running between $20,000/lbs. for nitrogen to well over $100,000/lbs. for phosphorus. Now some of our projects have been multiple $100,000/lbs for phosphorus we got removed. So complying is very challenging when you don’t know what it is you have to do or you don’t know what technologies exist. Currently, stream restoration appears to be one of the most cost effective practices. It’s also a practice that is easily understood by the community at large. Where they actually see the benefit they get for it, where a lot of the other practices, you know putting a rain garden in someone’s back yard, how that helps the Chesapeake Bay. Or what that actually does for their property or their neighbor’s property. But stream restoration currently is not part of our MS4 permit, because our MS4 permit says we only take credit for what is in our MS4 area. By definition streams are outside our MS4 area. So that’s
one little problem. Then there has been a panel that has been developing the criteria, but the numbers have changed several times and recently there was a 50% change in the nitrogen credit. So when you’re spending and the stream where at $15,000/lbs for phosphorus, which we thought was pretty reasonable compared to the other practices. But when you are talking about spending $100’s of millions of dollars it is very difficult to explain to a community and elected officials that you don’t have a good measuring tool. So that’s been challenging. The estimates that we received from a consultant to just comply with the urban stormwater part of our MS4 permit was $650M over a 15-year period. If we have to meet, come up with an estimate for meeting all urban stormwater in our locality, not just urban stormwater in our MS4 areas but in all of the areas that was at $1.5B. When we just increased our funding, so we have gone from $0.01 on the real estate tax to $0.02 on the real estate tax that generates about $40M. So you can see that we would need to be up to about $0.05 on the real estate tax, that would generate about 5% of the total locality’s tax revenue would go to stormwater. So that’s one way to look at it, there are other ways. When communities are struggling with schools and public safety in this economy it has been a very difficult thing to explain that we have to do this by permit. And that I can’t tell you exactly what the measurements are.

RF: Have you heard what other localities or municipalities are doing as part of the implementation process?

X: Yes, so I work with the state stormwater association, which includes about 30 different local governments. We share information and we are all struggling with the same thing. A lot of communities have put into place a stormwater utility and the
Chesapeake Bay has been a driver behind developing these stormwater utilities to generate the funding. A couple other communities are using the tax method that we did. It kind of depends on the local politics as well as what your locality does. Cities and Counties are different in that cities maintain roads and Counties do not, so our strategies change a little bit. A lot of communities are looking very hard at the stream restoration credits. Again, because the stream based on what type of credits you get for stream restoration. It does appear to be one of the more popular tools, more cost effective tools within the community and appears to be something you get a local benefit out of. Some of our local environmentalists were concerned that the Bay was driving what we were going to spend our money on and what we were going to do verses our local streams. Two or three years ago there was not much credit for stream restoration to meet the Bay TMDL, because it wasn’t in your MS4. It was kind of like you are doing stream restoration on your own.

**RF:** Got it.

**X:** Does that make sense to you?

**RF:** It does. You would say that what you are hearing and seeing from others is impacting your actions?

**X:** Oh yes. There is a lot of exchange of ideas and information between local governments in our stormwater association.

**RF:** So what do you think would happen in your locality and you met the implementation requirements and the Chesapeake Bay still did not have an adequate level of water quality. What would you do?
X: Well I would assume that what would happen then, in our next round of permits there would be requirements that we have to do more stuff. The permit is not something we negotiate, they are issued to us for discharging stormwater. So it is a mandate that the locality has to deal with. I think, there is going to be a lot of pushback at the state and Federal level where a lot of people, rate payers and politicians, are going to say “hey-there is only so much we can do.” If you keep changing the rules how can we plan and program for this. The stormwater is competing with human services, education and public safety. People are doing the stormwater stuff, they are moving in that direction. Even the people at the utilities, like I said, we are at $0.02 on our rate and we need to get to $0.05 and that doesn’t get us there necessarily in time. Those are significant increases, and if at the end of it they said “hey you did all this stuff, but the math or the model wasn’t right” there is going to be a big credibility issue and a lot of problems. So and I think, this is my personal opinion, I don’t think in stormwater we have the technology developed, we don’t know how all of these different techniques that we are putting into place are actually going to function over time, because most of them haven’t been in our tool box for that long. We don’t know what it’s going to take to maintain these facilities so the $660M that I told you about to meet it, that is just capital cost. It doesn’t include any maintenance or operation or reinvestment. So all of these rain gardens and infiltration trenches require different amounts of maintenance, particularly depending where they are located at, and none of that is built into that $660M. So you know, it is, there are a whole lot of unknowns and we set the goal before we knew what the technology was. Things are a little backwards.
RF: I understand what you are saying. Have you heard of adaptive management and can you define it?

X: I’ve heard of adaptive management. I’m not sure I can give you a definition. Why don’t you give me your definition and I will tell you what it means to me.

RF: Sure. Adaptive management is an iterative process of learning by doing. Many people have described the Chesapeake Bay TMDL as an adaptive process.

X: That makes a lot of sense. And I thought adaptive processes went beyond just the TMDL, it involved treating you wastewater and stormwater as a combined until in meeting the Bay TMDL.

RF: It really is an abstract idea.

X: For us, one of the things we have done recently at our wastewater treatment plant is added a reuse component. So we treat the wastewater and then put the water back as a useful product. And we are using the water in the waste to energy plan. A lot of the water is used in their processes and dissipated in other ways. So all of the nutrients associated with that discharge are no longer discharged. So last year 400 and some lbs., no 400M Gallons of water was diverted from being discharged as wastewater effluent. So if I take that 400M Gallons of water and convert that to nitrogen and phosphorus it’s several hundred lbs of phosphorus and I forget how many lbs of nitrogen. So that in itself would get me a long way to the first 5% that I have to do for nitrogen and phosphorus. It doesn’t help with sediment necessarily. The other thing is that our treatment plants were treating our phosphorus much lower that the discharge limits so there are potential credits there. So, when we look at, Virginia has a well-established trading program with nitrogen
and phosphorus for point sources. And they have made it much lower than it’s costing us to do stormwater that it would seem to make sense that you could buy some time if you start to manage the whole. That allows the stormwater technology to develop and for more information. One of the things we are doing with our stormwater approach is we are not putting all our eggs in one basket. So we have done a couple green roofs and we are doing a few pond retrofits both dry ponds, wet pond retrofits, we are doing stream restorations, porous pavers, we are putting in rain gardens we are putting in rain trenches. So we are trying a lot of different practices so we can see what it takes to retain these practices to see how these practices tend to work, but the monitoring and the science is a whole other challenge. So we’ve done some monitoring and we are spending $400,000 a year we are giving USGS to do some continuous monitoring in our streams. We’ve got a contract with a lab, which is part of Virginia Tech, where we are spending another $100,000-$150,000 to monitor some of our facilities. Only the problem is that the improvements, there is a long reaction time when you actually do things and when you actually see changes. And then there are so many other factors with the rate of rainfall and other pieces that it’s not anywhere near as a controlled environment you have with wastewater. So the results are not very quick in coming, they are very expensive and very hard for us to afford. And it’s very hard to explain to a community that you are spending this type of money just to do monitoring. You know, that’s where we need assistance, where the Feds and the state need to come in and say “hey, here’s the practices and this is what these practices will get you, this is what they will cost and here’s the science you can apply.” And that just doesn’t exist and so there you are again
talking to a community that is cutting back on school and cutting back on public safety and saying “hey you need to spend more,” and they say “what do I get for my buck.” And you say “I can’t really tell you.” That’s the challenge.

RF: That information is very helpful.

X: So then, the other piece now is that we have new state standards that require these facilities, or they don’t require, but when we adopt them we require residential development, which infill residential is part of, we are a fairly developed community so most of the development that goes in now is infill. So they are squeezing two or three lots into an area. So, it is encouraging the LID type techniques on individual lots. We are very concerned with, you know, the sustainability of that as to we are going to go out and tell these individual residential homeowner “hey you didn’t maintain your rain garden, or hey you put a swing set over your infiltration trench-you need to take the swing set out, or hey you have porous pavers on your driveway and you sealed them-you need to sandblast that sealer off and vacuum it all out.” We are concerned with the sustainability of that, and we’ve got over 5,000 stormwater management facilities currently in our inventory with 300-400 coming online each year now. So, just the mass of an inspection program, inventory program, and then potential enforcement on single family homes, or small businesses is-I’m concerned that it’s not going to be sustainable over the long term.

RF: It’s a lot of facilities to inspect, I’m sure you don’t have the staff for that.

X: Well we do it by contract. We are required, so we have to do it. We have, we typically use outside contractors-engineering services-to do it. But it is very expensive. I
think it’s about a $2M program right now. Then enforcement is a whole other problem. How do you enforce these things? You go out and tell people “we’re going to…” you know it’s not like a septic system where it fails on your property and you want it fixed. You know, this is something not like that. So you are either going to take people to court, which we have done. Or we are going to come up with a ticket system, but the ticket is not going to be enough to make somebody do $5,000 worth of work or replace a rain garden. We can go to kind of follow EPA’s model where we fine them up to $32,000 a day, but can you imagine taking that kind of action against a McDonald’s or some other? It’s going to be tough.

**RF:** Yes very tough.

**X:** So the community first, the majority of the people in our community do not pay a lot of attention to the Bay TMDL or they bay strategies, the tributary strategies. So when they did a survey in 2007 or so about 92% of the people said “Oh yeah, they want to save the Chesapeake Bay.” 70% of the people thought that all stormwater went to a wastewater treatment plant. So they didn’t know what they were answering. So when we put the numbers to what it would cost a lot of people went “wow, wow, wow!” We need to slow down and think about this. But when they did a survey later after 2010, right around 50% wanted to save the Bay, but less than 45% wanted to pay any additional money towards it. So, the first shock came was the price tag put on it and a lot of people said “hey, that’s not realistic. Your numbers are too high-you are over inflating this local government.” And we were just using some EPA numbers. And what we are finding is actuality it is costing a whole lot more. Um, and then the next piece that is going to hit
people is the maintenance and how it impacts their individual properties. So, and that hasn’t hit yet. We talk about it and try to explain it to people, but until we go out and actually enforce it, that’s when they get it.

**RF**: And your local officials and governing body, do they have a good handle on this do you think?

**X**: I think our local officials have a pretty good handle on it. Our locality board has what they call their environmental committee, it’s a committee of the whole and they meet quarterly. So I would say every three months or so I’m in front of them explaining the process we are going through, the different things we are doing. Right now we have had 3 discussions over the last 9 months over the locality taking the responsibility of maintaining some of the private facilities, so we can be sure they are maintained. To take some of the burden off of homeowner’s associations that don’t really have the skill, the ability, or the resources. So to move it more into the governmental arena vs. the private arena. That’s a big change and a big cost. So I think they do understand it and I think they understand there are many unknowns and I think our board support us and they have approved a Capital Improvement Plan that take our stormwater service district tax and increases it 0.25% over 3 years, which will get us to 3.25% as each quarter sets about another $5-$6M in revenue. But you know, they are aware that that doesn’t get them there.

**RF**: What I’m finding so far is that localities are in varying stages to respond and implement. It is a significant resource allocation and not everyone is your locality in terms of the available money.
X: Correct, smaller communities have a hard time just understanding. They have one person that is doing multiple jobs, you know, stormwater is just one of their jobs. So they have a very difficult time trying to understand it. Weighing the revenues is a very difficult job, you know, we get a lot of push back because it is calling the average residential homeowner, you know $0.01, $50 a year. Now we are up to $0.02, so $100 a year and we are getting a lot push back and this is a community that has a median household income of over $100,000. Newport News and Richmond are raising about the same amount per household or close to it and their median household income is under $40,000. So the City of Portsmouth has similar rates and their median household income is under $40,000. So this is hitting people pretty hard and there is a lot of pushback on it. The understanding depends on, there are a lot of people learning and developing the understanding. And there are a lot of elected officials that, a lot of communities have had a difficult time getting their elected officials to pay attention. They describe it as: you go to a work session and as soon as you start talking their eyes glaze over. When you start talking “oh yeah, we are going to need $660M over the next 15-years” they are going “right.” And they say “well how are we going to measure this” and you say “well that’s a problem” and “what exactly do we need to do?” You know that’s still been evolving. So how do you get someone that has so many issues that they are dealing with to focus on this issue when it’s still evolving.

RF: These are excellent points. I want to thank you very much for your time. The plan is to do this survey and then once I have a final document to summarize that and provide it to the localities, states and the EPA as well.
X: I’m interested in seeing what you come up with and what you find when you talk to other communities. Like it said, we keep in touch and I work with the state stormwater association so anything would be helpful.

RF: You bet, thank you so much.

X: Thank you
Interview 3

RF: You are participating in the Chesapeake Bay TMDL, why are you doing so?

X: The state of Maryland has basically delegated the responsibility to each county to develop a watershed implementation plan. I suppose we could have gone kicking and screaming and protested as some would like us to do, but we decided our approach has been that the state is giving us the opportunity and we feel we can do a better job at this for our own county than the state can do for our county. So, we have chosen to take the challenge and do it ourselves.

RF: To be fair other localities have said we don’t want to participate and we are going to do the bare minimum that you require us to do.

X: We felt, that if it has to be done. If we weren’t going to do it the state was going to do it for us. So, we thought that we could do a better job than the state could because we know our county.

RF: How are you trying to meet the requirements of the TMDL, what experience has you had so far and how is it going?

X: So, when we were developing our plan we kind of had a hunch. Well, let me start with some background of our County. I don’t know how familiar you are with our County.

RF: I know some basic information.

X: Okay, so we are not the farthest county to the west, but we are close. So we are in the furthest reaches of the Bay when it comes to the Potomac River watershed. You know,
we are one of the furthest west counties that there are. And we have very mountainous terrain and we are a very rural county. Our population is only 75,000. We don’t really grow. I mean we haven’t for many, many years-probably since the 1960’s. There was a lot of development here associated with coal mining in the 1960’s and after than when the coal miners kind of pulled out of town we have remained static since then and our population has declined. The last census, the 2010 census, showed the most slightest increase. Like barely an increase in population. Are you still there?

RF: Yes I am.

X: Okay, so I guess the overriding of our elected officials and our community in general is what on earth we could possibly do in our County that is going to make a difference for the Chesapeake Bay. A) we are the furthest you can get away in the state of Maryland, and in the Potomac River watershed and B) we are already so rural and we don’t experience growth in terms of development to speak of. Our population doesn’t see growth, we see random development projects here and there, but if you look at our housing development it’s just it’s sad really. You know, our elected officials are constantly struggling with how can we boost economic development in our County. So we look very very different from most counties in the state and the counties that get all the attention. Um, you know our issues or problems that our elected officials face are sometime polar opposites of what the bigger counties face. So, you know in terms of watershed implementation plan, our hunch or our goals was. You know what, we are already pretty good environmental stewards. We already do we already practice environmental stewardship here. We do stream restoration projects, um we plant trees.
We already have 75% of our county is forested cover. I mean that’s a fact. So we felt like if we could gather all that data and show in the past 5 years. You know when we were developing the plan the baseline I think was 2005 or 2006 I want to say that the land use data that the model used. So they had said any projects that you have done since then um if you submit that data you can get credit for it basically. So, our approach was, let’s figure out what was done over the past five years that counts and gets us credit and let’s see where that gets us. Like if we established a current pace of implementation based on what we have done over the past 5 years, then you know could we continue that. Could we commit to continuing that? And if we did commit to continuing that current pace of implementation would we meet the goal that the state has set for us? And the answer basically was that we all but would get there. If we just kept doing what we’ve been doing over the past 5 years: the steam restoration projects, the tree planting projects (that’s really a good one for us), the stormwater retrofits that we do voluntarily. You know, if we put all that data together and figured out what kind of credit we got for that and projected it over, until 2025 we were able to say “yep, that pretty much closes the gap for us if we continue our current implementation,” but we needed to beef it up-to do a little bit more. Really the tree planting is what we established as the activities that made the most sense for us. So that’s really the only type of BMP that we have really beefed up.

RF: Have you heard what other counties are doing or trying as a part of the implementation process and has that impacted what you’re doing?
X: Not really. Honestly there aren’t too many other counties…Well I will say Garrett County’s watershed implementation plan basically identifies sediment and erosion control on extracted lands as their only practice to close their gap. And, um, we did we really hadn’t thought of that, and because they pursued that only because it is something they were doing anyway and they thought they could get credit for it, which they did. Then we actually pursued that practice as well in terms of collecting the data. Again, it’s just a matter of reporting what we are already doing. Um, so that’s an example of that. Besides that I don’t really pay much attention to what’s going on in Montgomery County or the others. Because they just look so different that us, their issues and problems are just so so different. So it wouldn’t really make sense for us to.

RF: What would you do if you fully implemented your plan and the Chesapeake Bay still did not meet appropriate levels of water quality?

X: What will we do? Um, you know I would say that the projects that we are doing here to improve the quality of the Chesapeake Bay also are improving our own streams so I wouldn’t really change a whole lot. I’d keep doing what we are doing, you know I’d guess it’s up to the state to say that we need to raise the bar on what we are doing. But I wouldn’t stop doing what we’re doing, because really we’re doing it anyway. You know what I mean? Now it’s just a matter of making sure that the data gets recorded. I mean we are doing a little bit more than we would have done, but I mean it benefits us to.

RF: And going on and continuing your plan as you’ve set out, you will meet the requirements by 2025?

X: Yes.
RF: Some people have referred to the Chesapeake Bay TMDL and the Chesapeake Bay clean-up strategies in the past as adaptive management, are you familiar with that term?

X: I can guess what you mean, but you’d better describe it.

RF: Sure a simple definition of adaptive management is learning by doing. Not trial and error, but taking past experience and knowledge and implement it. Monitoring the results of those actions and then adjusting accordingly for future actions.

X: Sure.

RF: So given that. What role if any does an adaptive management process play in the TMDL?

X: Um, do you mean at the local level?

RF: Yes.

X: The thing is we are not doing our own monitoring. At the end of the day we don’t have the resources to monitor and determine whether these processes are truly improving water quality or not. So, I have no way of knowing unless the state monitors for us and tells us. We just don’t have the resources to do that on our own, I don’t know if other counties are doing that, but we are not.

RF: For the program that you do have, do you have the appropriate resources to meet the implementation goals by 2025?

X: Um, our WIP says that we will pursue funding. So, the answer to that is yes and no. It’s not because it’s not our pot of money that we are using for implementation, we are seeking grants. But then at the same point we have had success in getting the grants that we need over the last two years. Um, you know state grants, so, I don’t you know as long
as the state has the funding that we can pursue then we will implement. We don’t do our own whatever, people call it the rain tax, we are not required to do that and we don’t do that.

RF: And as far as you know do your commissioners and executives understand what’s happening and do they understand the costs involved?

X: I think they do, but their staff has basically presented them with a plan that says we will be able to meet our goal by just slightly beefing up our current pace of implementation. And the funding source is state and federal grants. So, it’s not like their staff is saying we need you to come up with $X to implement this. We’re not saying that, we are saying we will come up with grant money to do this. And if the state or the Feds don’t give us grant money to do it, then it can’t get done. And we were very up front with that in our WIP. The commitment is to pursue funding and where funding is available implement. And so far that has worked fine, we have been able to secure the funding that we need. There is not any huge reason for them to be alarmed.

RF: Do you have a sense of the total cost of implementation for your organization.

X: Not really, no.

RF: This is really helpful. That is all the questions I have. Thank you for your time today. I’m completing these interview and the ultimate goal is to share these results with the community.

X: Great. It is notable to say that we are putting the level of effort into this based on the gap we have to close. And the reason that is significant is that the gap we have to close is smaller than the other counties in Maryland. Because we are so far from the Bay, we
didn’t have as much to do to begin with. At one point, somebody did a survey and they compared our WIP to Montgomery County or Anne Arundel County. And of course there are going to be a lot more in detail and have these higher costs and much more detailed plans of what’s involved, because they have a much larger gap to close. And ours, you can compare ours to theirs because we don’t have the problem to begin with. You know the expectation is lower to begin with. So we have the luxury of being able to just kind of you know identify the projects that we think we can tackle amongst ourselves, we seek the grants, and so far we’ve had success. We are happy with the way things are turning out so far.

RF: Excellent. Thank you very much for your time.

X: Take care.
**Interview 4**

**RF:** Are you participating in the Chesapeake Bay TMDL and why?

**X:** In terms of identifying how our programs will help to make progress in the reductions necessary to restore the Bay. Yes we are participating. It is a programmatic requirement of our MS4 Permit.

**RF:** How are you trying to meet the requirements of the TMDL and what are your experiences so far, how is it going?

**X:** Okay well, first our MS4 Permit has been setup in terms of the local TMDL. Our permit required that we develop an implementation strategy that will show how we are going to make pollutant load reductions meet the waste load allocations for any EPA approved TMDL. In the state of Maryland there are no waste load allocations specific to our county. So, our strategy reflects more of a planning level approach to produce the reductions necessary to meet the Bay restoration goals. There is no absolute permit requirement that we have to show how we are going to meet a goal and that’s because we don’t have specific Bay reduction goals. So what we are doing is we are tracking what our cumulative nitrogen and phosphorus reductions are as we implement projects to make reductions to the local waterbody TMDL.

**RF:** Okay. So you don’t have a goal per se of a reduction, but you are tracking the reductions that you are making.

**X:** There are approximate goals. Total nitrogen and total phosphorus for our county. We can track progress toward meeting those reduction goals.
RF: But your focus is on your MS4 permits.

X: That is correct, on the local waterbody TMDL. Which for our county, because we are an upstream jurisdiction the reductions necessary to meet our local water quality goals are much greater than the reductions to meet the reduction goals for our county for the Bay TMDL.

RF: Okay, understood. In implementing the changes that you are making have you heard what other municipalities are doing or trying as part of the implementation process.

X: Absolutely. All the local jurisdictions are trying as many things as possible, because there is no one tool as you can imagine. It’s not going to magically reduce pollutants in our urban sector, so we have a combination of approaches. We are going back and where we have large stormwater management ponds that were built under old criteria, we are identifying the feasibility of implementing retrofits for pollutant load reductions to those old facilities. Then we are also, where it’s possible, where we have the land available, adding additional stormwater management and wherever possible we are trying to use the vegetative treatment practices, environmental site design, LID practices, bioretention, rain gardens permeable pavement, etc. We are also looking at non-structural programs. We have a small street sweeping program, we have a significant stream restoration program we feel is very important to address the sediment that is coming from our eroding stream banks and eroding stream channels.

RF: Those restoration programs are not part of your MS4?

X: No we get credit for stream restoration, we do. We also get credit for street sweeping, and we get credit for tree planting for a certain density.
**RF:** What would happen if you went through the TMDL implementation goals and you met them, and the Chesapeake Bay still did not have an appropriate level of water quality, what would you do?

**X:** In our case we would have met our permit requirements, because of our local TMDLs we will be far above what our goal is for the Bay restoration. So, I think it would be up to how the state and the Federal government would follow up so it is all of the sources for meeting the Bay restoration goals. So, just because we meet our 24% and 19% doesn’t guarantee that everyone else in the watershed is going to be doing everything they can to meet their share of the Bay restoration goals. It’s also the timeline issue. If we had all of the projects that we could get could be done by 2017, we don’t anticipate that the water quality response would be instantaneous.

**RF:** So, would it be right in saying if you met all of your requirements and the water quality was still not at an appropriate level you would wait to get direction from the state or Federal government?

**X:** Yes

**RF:** Have you heard the phrase adaptive management before?

**X:** Yes. Many times.

**RF:** So can you define it?

**X:** My perception is basically, adaptive management allows you to make a careful plan, have a whole series of projects and a whole implementation timeline and you set benchmarks along the way and you evaluate if you’ve met your implementation timeline and evaluate what is happening in the actual waterbody and decide if you have to change
if you have to add some additional program or if you feel like you need to accelerate implementation of some of the projects that you have in your inventory. Or if you have to stop doing what you’ve been doing and try something else. If you come to the conclusion that you’re not making the progress that you wanted to. And the progress would be water quality improvements.

RF: Some have described the entire TMDL process or the entire Chesapeake Bay restoration since the 1980’s as an adaptive process. Do you agree with that? And what role do you think adaptive management plays in the TMDL?

X: I disagree that adaptive management process [has been going] since the 1980’s. We didn’t have good timelines and we didn’t have good traction. We really didn’t know if what we were doing was making that much of a difference. I think it’s only been recently when there’s been a regulatory framework with a specific reduction goal that you could enter into a real adaptive management approach. Previously it was sort of everybody doing everything everywhere and hope that you might see a water quality response. And then of course there the technical issues associated with the model as well.

RF: Right the early model.

X: Yes

RF: So, you would describe the current TMDL as an adaptive management process?

X: I hope so.

RF: That is all the questions that I have. I want to say thank you for talking with me today. Once I have final results from the survey I will share it with the community.
X: Well I have to admit you didn’t ask any questions about funding. I mean that’s part of the adaptive management. Because you can have a goal and predict how much money it’s going to cost, but things being the way they are you may not be able to get all of that funding within that timeline.

RF: Well talk to me about that. Do you have a range of the cost for your county to meet the TMDL requirements?

X: Yes as part of our MS4 permit implementation strategy we estimated that it would cost on the order of $300M to meet what’s called, over a 5-year period to meet the pervious goal. That is not a nitrogen or phosphorus goal that is based on being able to add stormwater management to manage runoff from additional impervious that’s not currently managed. In terms of the Bay restoration goal. We estimated about $1B or $900M. Those are based on estimating cost per acre per certain type of BMP and making some assumptions about how many acres of the type of BMP we might be able to implement.

RF: Do you have a mechanism to encumber that amount of money?

X: Well in theory we might, because we have a water quality protection charge. So, our current CIP funding is about $330M over 6 years, but that’s all through bond with the debt service being paid for the annually collected water protection charge, which right now is about $88 and some change for the average residential until. It’s a lot more for commercial or institutional property that has a lot of impervious. So in theory we could continue to increase that water quality protection charge in order to cover all costs of implementing projects to meet our MS4 permit and other programmatic goals.
RF: But only in theory?

X: Well, I think eventually the taxpayers are not going to be too keen on paying $270 a year for stormwater requirements to protect way down stream. It’s also the timeline. There isn’t a timeline for us to meet our local TMDLs. So we could spread that cost out over a very long period of time. But you know there is a timeline for meeting the Bay TMDL.

RF: Interesting, so I’ll say that I don’t ask a question about funding, but so far in every interview it has been one of the things that we spend the most time talking about.

X: I will say, that there is an expectation on our part that we won’t have to pay 100%, because the Bay TMDL is to protect waters in the main stem of the Bay and the tidal tributaries. So we feel that those other jurisdictions that may be getting the most direct benefit should be paying their fair share to be sure they continue to get that most direct benefit. And so, there should be federal and state cost share money to help offset.

RF: Right. As far as you know, does your governing body understand the cost associated with this and the situation that you are in over the short and long-term?

X: They know it’s going to happen. Right now, I can’t say they are committed and you know we have changes in elected officials all the time. If you are looking at 2020 they can’t predict what the financial situation is going to be in 2020. And they can’t commit the county for what’s going to happen in 2020. They are aware it’s going to cost a lot of money. I mean they are already aware of how much it costs to meet the timeline for MS4 permitting, you know that $300M over 6 years to meet the 20% restoration goal in our current permit.
RF: Okay. So in general the governing body have some experience with this already.

X: Yes.

RF: That’s all the questions. I appreciate your time and will be in touch.

X: Great
Interview 5

**RF:** Is your county participating in the TMDL?

**X:** Yes

**RF:** Why are you participating?

**X:** The participation is mostly I’d say because we recognize the issues with the Chesapeake Bay and the clean-up necessary and are also anticipating that we are going to have to participate in the Clean Water Act NPDES, MS4, Phase 1 if we hit our 100,000 population so getting a jump start on that. We haven’t got a permit yet, but getting a jump start on that can only benefit us, and we have been a longtime participant in the predecessor to the WIP and TMDL process – the Tributary Strategies programs. So it’s been a continuation of that Tributary Strategies that was voluntary and moved into a more regulatory framework.

**RF:** What are the actions you are taking to meet the requirements of the TMDL, what experiences have you had so far, how is it going?

**X:** We have a steering committee that is made up of the agencies or groups of people that are interested or have a stake in the Bay cleanup. Citizens or participants are from the agencies that are responsible for the cleanup. You know, Soil and Water Conservation, wastewater treatment authority, health department, Agriculture Group. So we have all of those people that were participating before on the TMDL working on this. We are essentially taking the 4 different sectors: wastewater treatment, septic systems, urban runoff, and agriculture and came up with a list of things that we are currently working on
and would like to expand and things we are interested in expanding into; we don’t have programs yet, but think they are feasible in our county and a list of sort of pie in the sky-we wish we could do these things. We’ve been working on finding partners for grant funding using our county’s existing capital programs to implement projects. And also working with outside organizations to do work that they want to get done. For example, we have a watershed association that is getting grants outside of any government activity to implement projects. So, we are making progress. I think that we have not yet committed to the really big ticket items both price wise and effort wise. Right now we are still in the same effort with a slight expansion of our budget so we are going to have to step up more at some point.

RF: You are not doing that in this upcoming fiscal year?
X: Not yet. I will give you an example we have a project we have to do stormwater retrofits. We have identified 110 or so stormwater retrofits that are necessary. We had money in the budget to pay for those, or 25 of those projects. We sought grants from the state, or actually the National Fish and Wildlife Foundation, to pay for the cost of doing some of those implementation projects. We got that grant, but the money we already had in the budget was moved out of the budget. So, instead of doubling our efforts with the amount of money we had available we maintained our effort level. We are going to have to move beyond that at some point, but we haven’t done that yet. Frankly, the people that make that decision haven’t gotten to that decision yet.

RF: Those are the commissioners?
X: Yes.
RF: Okay. Do you have a sense of the total cost of meeting the requirements of the TMDL by 2025?

X: I do not. We did a sort of everything by everyone everywhere kind of approach to what could be done. But there has been very little prioritization yet because we need the county commissioners to do that to say these are the projects that we want to move forward with. We don’t need all of the projects that we identified to accomplish the goal, but we don’t know which ones there are going to be willing to move forward with.

RF: Is the goal to maximize the removal of nitrogen, phosphorus and sediment and try to get the most bang for your buck?

X: That is what we want to do. We do have in this capital budget a capital project to hire a consultant to help us do some of that cost benefit analysis. We have not put that on the street yet.

RF: Okay. Have you heard what other jurisdictions are doing to try to meet their part of the implementation process?

X: Maryland is pretty good about publishing what people are doing and we have a website that tells what people are committing to and a lot of their analysis. And they also do a lot of outreach and we have meetings where we have all of the jurisdictions in our area talking about what’s possible and maybe we can collaborate on some things. As well as some state wide meetings so we are pretty familiar with what other people are doing.

RF: Has that impacted your actions and what you have tried or looked into?
X: We added a couple BMPs to our recommended list because based on some of the work that another locality is doing. They had a consultant that gave an analysis that doing septic tank pumping might get as much bang for your buck as doing BATs systems without the extreme cost of doing large amounts of BATs systems so we added that item to our list as a result of that. I’m sure there are other examples, but none of them come to mind. We have gotten some ideas from others and have included those.

RF: And BAT is Best Available Technology?

X: Yes for retrofits of septic systems to reduce nitrogen.

RF: OK. What would happen if you implement these things and meet the requirements set forth in the TMDL by the state and the EPA and the Chesapeake Bay’s water quality was still not at an appropriate level? What would you do?

X: I think that under the political climate we have right now, as long as we are meeting the goals of what we are required to meet, there would not be a great level of effort above that—at least from a government standpoint. From a citizen standpoint, they might push the government into doing it, but right now the will is to do kind of the absolute minimum they can do.

X1: The other thing to remember for us is that we’re at the furthest end of the pollution chain. So if we met all of our requirements and the water quality still wasn’t good I think that the one thing to do would be to start looking upstream and try and see what the major pollutants are. Try and get those people to come into line to reduce what they’re doing. Down here, if we take all ours out there’s still probably a large chance—I don’t know how we could quantify this—that what we are getting is coming from someplace else.
X: Yeah and I agree with that.

RF: Okay. Let me take it a step further. Let’s say that every jurisdiction meets the requirements, but the water quality in the Bay is still poor. What action would you taking in that situation, if any?

X: What I think will happen if that happens is that the uses for the Chesapeake Bay will be changed in order to meet the criteria. Because the amount of pollution reduction is based on the uses for the water that are identified. So I know in Baltimore Harbor they’ve already changed the uses. Fishable and swimmable in Baltimore Harbor is not reasonable. So they may find that it’s not reasonable to try to achieve the goals that are currently set for the Chesapeake Bay. I suspect that not at a county level, but at a state level between Pennsylvania, Virginia, and Maryland there would be a push to look at whether or not that use is ever achievable and if that use needs to be changed.

RF: Some people have called the TMDL and even some of the precursors to it, the Tributary strategies and others, an adaptive process. Do you know what that phrase means and can you define it?

X: I do and I can. It’s a process where we look at what we have done and if that’s not working to change our approach or our level of effort and just keep kind of taking periodic assessment and seeing what needs to change. And that is, I think that is, I mean now that we are in a regulatory framework having been in a voluntary framework I think that is an example of that.

RF: What role do you think adaptive management does play in the TMDL?
X: I think it is the only way we will be able to get even close to what we need to do. We are going to have to keep changing our methods and processes to get there.

RF: That is all of the questions that I have prepared. Are there any questions that you have?

X: I don’t think so.

X1: I have a question. I was interested in joining this conference call in the hopes that some of the work that you are putting out would have something to do with the removal of pollutions in the watershed. Is that something that you are looking at? Or are you just more policy oriented and not looking to see how well the model is working?

RF: My research is really focused on the implementation. Not exactly what you are looking for. I would say that based on my experiences so far that it would be worth you looking into County, they have done some work to quantify the pollutant removal of certain technologies. For example they have a number for how many linear feet would produce a pound of nitrogen reduction.

X: We have that calculation as well. Maryland Department of Environment has worked collaboratively with a number of consultants who have done some quantification tools and that tool was calibrated with the model that EPA uses so that our actions on the ground get credited for the right amount of reduction.

RF: Right. Let me make sure I’m on the right page. My understanding is that this is like a video game. You are to implement so many actions that reduce nitrogen, phosphorus and sediment according to the model. While the actual is very important, what actually
comes out of your county, from a regulatory standpoint what matters is that the model shows you’ve removed the amount required.

**X**: That is correct. In 2017, the midpoint estimate, they are going to look at everything that has been done and they are going to look at actual water quality data and see if the results based on the model are actually happening on the ground. And if they are not happening on the ground then there will be a recalibration of the model to adjust for the difference and then we will get new loads and those new load will be the next piece that we have to do after 2017.

**RF**: Right. So maybe I didn’t understand your question correctly.

**X1**: I think you did. We have our steps that are going to credit us with a reduction. Whether or not those results yield the reduction we want is a mystery.

**RF**: My research is purely policy related. I’m not doing any physical implementation or analysis.

**X1**: You’re researching compliance with the strategy to implement the model.

**RF**: My ultimate question focuses on the idea of adaptive management and its use by localities in the TMDL. But what I’ve heard a lot so far is people discussing what resources they have available. My prepared questions don’t ask about funding, but it has come up in every interview I’ve done.

**X**: Yes and in every future interview you do.

**RF**: Yes I think you are right. So, I’m not looking at those reductions, but am looking at the implementation policy and the resources available from the state and Federal government.
X: I’m kind of the opinion that it has taken 100 years to get the water quality in the state it’s in and demanding that it get fixed in 10 or 15 years is not reasonable, but we will work our darndest to do what they have asked.

RF: And basically you don’t have a choice, correct?

X1: That’s right. We do hope they are on the right track and that it would be checked. Somehow as effective as it is. Like X pointed out, County did some research—I’m not sure what they’ve done—but pumping septic tanks is more effective than the BAT. That would be something in the quantification realm that would be important to note, but in the big scope of things that’s just a very small action. If you multiplied that by all the potential reductions out there you might come up with a better result.

RF: Right. It has got to be the state and the EPA to quantify that themselves and give you credit in the model?

X: Right.

RF: I’m guessing some of those thing don’t have values associated with them at this time.

X: Some things don’t have values and there are some things that we question the value of. So we have known water quality issue and they have assigned runoff calculations for all those things to say this is how we got to that quantity and their base calculation for the pollutant load is wrong. Water quality hasn’t changed, which means not just the one thing they’re looking at needs to be addressed, but they need to go through and adjust all the other sources to account for the change in the water quality. And I don’t know how that’s being done. We’ve mentioned it in our various and sundry meeting with the state
saying you know “we think that the number that you are getting for runoff from larger residential dwellings isn’t right.” So we think our numbers should be lower, but if our numbers should be lower that means that other land use somewhere else has to go up. So, that’s just a big, you know, argument among the different sectors that “I’m not doing what you say I am, so somebody must be doing worse than they think they are.” Anyway, it’s been interesting.

**RF**: I want to thank you for your time today. I will be sure to include you when I provide results.

**X**: Thank you.
Interview 6

RF: Is your locality participating in the TMDL and why?

X: Well, there are various reasons [redacted] County has been… I would say since 1987 very much concerned with the control of stormwater to the point where [redacted] County had developed a stormwater fund dedicated to control stormwater. There has been various management ordinance that have been passed for the control of water not just focusing on development but also focusing on the various watershed needs, which included vast amounts of water quality monitoring over the past few decades. Recently, incorporation of the new clean water act fees which were a requirement from the state from House Bill 997 in the State of Maryland. So, our concerns with respect to clean water has been known for many many years. The TMDL implementation came about 2-3 years ago. The focus was for 9 counties in the state of Maryland to begin accounting for the TMDL allocations of nitrogen, phosphorus and sediment. The TMDL included urban areas and other sectors such as agriculture, wastewater, and septic. To make it short, the reason why [redacted] County is participating in the Chesapeake Bay TMDL is because we have mutual interest in reducing our local loads which in turn will also reduce the Bay loads.

RF: How are you trying to meet the requirements of the TMDL and what are your experiences so far?

X: Well, meeting the requirements is a very elusive process. It’s not a simple thing. It’s not as simple as just simply buying a filter putting it in the stream and making sure the
load reductions are there. The technologies have been developing over the years some of the early approaches that [X] County had tried was to control the quantity of water at the large regional facilities which are you know coal ponds. These locations we used to retain the water for 24-hrs by providing storage on these ponds to further reduce and create a nutrient reduction that way. As the years’ progressed newer technologies such as low impact development emerge, in which the philosophy is to keep the water on site and not let it run out. Past technologies would allow the water to run out and be treated someplace else. In this case, with low impact development a couple of pilot developments were done in the 1990’s and some of them were successful. Some did fail due to the lack of maintenance, but none the less the latest generation of our regulations require handling the stormwater on site and in the state of Maryland that is called environmental sensitive design. So, all development that takes place in the county must address environmental sensitive design and CIP project or any restoration projects to be done by the county or by state and federal will have to consider that construction. The major way that you would use is impervious area, how much of that area is being used. In [X] County, in particular the areas of the Anacostia watershed were built prior to any stormwater management regulation. They were built almost to full capacity up to the 1960’s and 1970’s. The lack of stormwater controls is evident in the Anacostia watershed. So [X] County is accelerating now their stormwater programs in these areas. And we have now a robust CIP program, we have a very large grant program which we receive funds from state and Federal agencies in which we receive funds for the Anacostia. We have partnerships with municipalities in the Anacostia and we are
recently trying to enter into a public-private partnership focused on environmental sensitive design devices on the Anacostia watershed and other areas where they might be useful due to large impervious areas.

RF: So did projects not need to meet the environmental sensitive design requirements before the TMDL or is this something that happened before that?

X: No it happened before that. The TMDLs came out just recently, but typically there is a tipping point before the TMDLs can be fully implemented. These limits come about, the accumulation of nutrients in the bay, the state and the EPA due to the many years of monitoring the nutrient concentrations in the Bay were increasing over many years.

Meanwhile, stormwater management was in the state of Maryland since 1985. So, they didn’t see the nutrient trend slowing down on the Bay so they decided to do the TMDLs for the bay for nitrogen and phosphorus which in a sense is the canary in the coal mine. The trigger for the 9 counties in Maryland that drain into the Chesapeake Bay into action to try and figure out an accelerated rate of restoration. Prior to the TMDL we had no time lines, now we do. So, our first timeline is 2017 the second is 2025. As far as reducing the loads. How are we going to do that is by implementing restoration projects everywhere? The individual homeowner can install rain gardens and rain barrels and retain the rainwater on their properties also in commercial and industrial properties.

RF: So you are starting to implement those sorts of projects now.

X: Right. We are starting to accelerate the rate and the quantities. We have been doing projects for decades already, but not at the fast rate that is called for in the Bay TMDL Plan. Because the Bay TMDL Plan has numerical values for nitrogen, you know not to
exceed the amount for the county and our reductions are called for by 2017 and further reductions by 2025. The numerical values force us to implement our restoration efforts at a very fast rate.

**RF:** With the acceleration of those projects, who is paying for that?

**X:** Well in the county we have three legs of funding. One of the legs has always been the stormwater program that we have, because it pays for the infrastructure that we have built storm drain systems everywhere. As well as the ponds and BMPs that pre-date the latest generation of BMPs. All of that which was built on the public side, which is the county side, we have to maintain. So we have some revenues that come from that fund, we call it the Enterprise Fund, it come from our taxpayers. Just last year we passed a new bill called our Clean Water Act Fees which we collect fees for addressing specifically water quality.

**RF:** So are those the three: tax dollars, the Enterprise Fund, and the Clean Water Act Fees?

**X:** No. Clean Water Act Fees is one, the Enterprise Fund which is a stormwater fund, as well as grants – we also do heavy grants. We get between $5-$10M/year in grants.

**RF:** The three legs that you are looking at is not real estate taxes?

**X:** That is correct. It does have some matching funds that are needed to match the grants.

**RF:** Okay so those matching funds would come from your operating budget?

**X:** Yes. That is correct.

**RF:** Do you have a sense on the total amount you will need to meet the requirements?

**X:** It has been estimated at $1.1B.
RF: Okay wow.

X: Yes and that is just about the same number for all of the jurisdictions here in Maryland.

RF: Speaking of the other jurisdictions. Have you heard what the managers in other jurisdictions are doing or trying as part of the implementation process?

X: Well they are doing the best they can. They are trying to be innovative. Most of the larger counties are really scrambling to set up programs where they can streamline and setup more. One of the biggest difficulties is that there is a lot of land that produces runoff that isn’t owned by the locality. The question is, where you do the restoration if you don’t want to share the property to build the BMP. So the biggest problem is where to put the BMPs.

RF: Has what these other municipalities are doing impacted your actions and what you are trying to do?

X: No. In Maryland we keep our communications open between jurisdictions and we compare notes. One of the places where we do that is the Washington Metropolitan Council of Governments in DC, where jurisdictions meet and discuss policies and regulations. Everyone is doing the best they can, we all have different needs and budgets and different executives and councils. It is an entire apparatus that has to be moved to budget annually the amount of water that needs to go out.

RF: What would happen if you met the TMDL goals for nitrogen, phosphorus and sediment and the water quality in the Chesapeake Bay was still low, what would you do? What would your county do?
X: We will probably never meet the level to be honest with you. The concentrations are very high and Maryland is only one of the states that drains into the Bay. You have many others that are not really playing ball as Maryland is. So jurisdictions are going to pace their production and every jurisdiction knows what weaknesses they have and we are going to address those. We first have to manage our internal house and we are going to have to do it at a very fast pace with the dollars we have been allocated and they are going to get built. Now let’s say in 2025 we are only able to achieve 50% of the goal, okay, for our county. That may not be substantial across the board for the whole Chesapeake Bay. None the less for us we have built enough BMPs and we have a certain level of confidence. So it would have to be negotiated with state officials and the EPA, what would be the next step. So again the rule of thumb, the strategy would be what we do in our own county first because we do also have local TMDLs we have to meet.

RF: Have you heard the phrase adaptive management before and can you define it?

X: Well adaptive management is basically what we have been doing for the past few decades. The storm water program that started in the 1980’s, some assumptions were made at the time that building certain BMPs would affect the water quality. Unfortunately, those assumptions were later disputed by actual water quality monitoring, which showed that those assumptions were incorrect. Adaptive management teaches you to make alterations to your strategy to compensate for your assumptions. Low impact development has been one of those strategies. The State of Maryland has been applying adaptive management for a long time. The biggest challenge in adaptive management that we are going to run into is adapting technology to improve what we have right now –
which is to reduce the footprint form the BMPs, manage more, and reduce the concentration to a greater extent, and for that we are going to need more research from universities and the introduction of different types of media that can clean the water more efficiently. At this point the strategy in Maryland is to reduce the water volume, store it under ground and breakdown the nutrients in a slow way.

RF: Okay. Does adaptive management play a role in the TMDL implementation overall?

X: Yes it does in how quick we can reach the goal with the least amount of money.

RF: That’s all the questions I have. Do you have any other comments?

X: That was simple.
Interview 7

RF: Is your municipality participating in the Chesapeake Bay TMDL and why?

X: Well first of all I’d like to preface any answers that I give are my understanding and my perspective and may or may not be the view of the county as a whole.

RF: I want to be clear that I’m not receiving any funding for this project and it is fulfilling an interest that I have. It is not funded by the Federal or state government and it’s not intended to be for their use or to out anyone, but to give a better understanding to all people involved in the TMDL.

X: I just wanted to preface this because if you asked someone else in the county they might give you a slightly different answer because of their perspective. To answer your question, we are of course indirectly involved because everyone in Virginia is influenced by the Chesapeake Bay Act and is a participant in that effort. However, in this stage we are very indirectly and passively involved.

RF: What do you mean by passively involved?

X: Well, for instance, recently the Rappahannock Regional Basin Commission Technical Committee had two different meetings to discuss the ramifications the new milestones have on localities. Because the word was out that the new milestones would involve localities more than the previous milestones so we wanted to assess the true ramifications. We met and consistently felt that the milestones and the implementation effort had not really transitioned or evolved to the level that we thought it would have at this stage. We were told early on that a previous effort from Virginia’s perspective was
to get most of the programmatic items done so they can start adapting and moving into the more on the ground efforts beyond those programmatic changes. So that is why we convened these meetings because in the past the localities have not been involved or only passively involved in that process because it is programmatic. When DEQ is creating a new protocol or working with the health department, working with other agencies, or putting new guidelines in place, or developing funding sources, or writing grants/contracts. These are all internal things at DEQ or other agencies that they are doing to develop programmatic capacity. Which is all relevant and needed, but doesn’t really involve localities. So when we looked at these milestones and it seemed to be a lot of the same programmatic things, you know – DEQ will be doing this or the Health Department will be doing this. All of these things have potential serious ramifications to localities, but right now there is no clear – “what does our county have to do.” We have certain targets we need to meet. Are we given the latitude to meet the goal our own way that works best for us or is there a consistent way of implementing it on the ground that we need to be consistent with the State on? That is not one of the things in there. If you look at the milestones there is really nothing in there that has any goal or action item for localities to do. There is one item that says coordinate with localities to get their buy in. Okay, but that’s not really an action item, so our county like other counties in the Rappahannock River Basin Commission a lot of these things have the ability to impact what we are doing, but at a later stage. Keeping an eye out and seeing how it progresses, right now it is a wait and see, it is fairly passive involvement from localities.
RF: My understanding is that each locality has a specific target for reductions of nitrogen, phosphorus and sediment to meet by 2017 and 2025.

X: The watersheds do, but not the localities. There is for the Rappahannock River, but not for our county. So are we going to divide that up between the localities in the watershed? Do we tell DEQ how we will partition that goal? If we take these local efforts and DEQ doesn’t accept them that is wasted effort. Or do we wait until the state comes in and divides it? We don’t know and the localities don’t want to do something that may not be accepted in the end. The model says watersheds, but the model doesn’t partition it to the individual counties. The counties don’t have the authority to divide the reduction allocations and the state hasn’t done it yet, so it is a wait and see.

RF: Are you implementing any strategies to try and reduce your nutrient and sediment loads to the river or not?

X: Well we are in some ways doing it more than others in the Rappahannock watershed. And half our county is in the Rappahannock watershed and the other half is in the [redacted] watershed, there has been more discussions on this on the Rappahannock side with those partners. We are a little different now, because we are a new MS4 entity and we now have specific targets associated with the MS4, not generic targets for the Chesapeake Bay purposes, but specifically for the MS4 that the other counties in the Rappahannock watershed have. But we have just been designated as an MS4 a few months ago so we are still in the early stages of that. Outside of that, there are lots of discussions about when we get to the point of action we are prepared, but we are still in the wait and see period. What are the things that we are currently doing that we can get
credit for? What are the different things that are new features that we can modify if we know the quantity of nutrients that we need to reduce by, can we adapt this project to meet those needs? As far as work outside the MS4 it isn’t really happening, because the lack of specificity on what we can do and there is a lack support for counties that try and do it on their own.

RF: Have you heard what other municipalities are doing or trying as part of the implementation process and has that influenced what you are trying to do?

X: We have heard different options that people are doing and trying as data gathering to see how it would work in our county. The partners in the Rappahannock are like us in a wait and see, those on the east side in the [redacted] they are a lot more urban than us and we often feel that things that work for them won’t work for us and we don’t look to them for examples. So then again, we are wait and see.

RF: What would happen if you implement the TMDL as required, whatever the reductions are you meet them, and the Chesapeake Bay water quality was still low, what would you do?

X: I believe the county’s perspective is that the state is the lead in this and we would look for the state to guide us what the next step would be. It isn’t our position to take a leadership role in the direction of this. But that is a consideration, what would we be doing, even the stormwater permit tightening is a strategy for improving the Bay. That in itself is at best maintaining status quo in new development is to bring the water to the same conditions present prior to the development it doesn’t necessarily improve it. So, to improve the conditions of the Bay you have to go beyond the status quo, to above and
beyond. But how the state proposes to do that we are interested to see, but our county is not the one to lead this.

RF: Does the county have a sense of what it will cost the county to comply?

X: (Pause). I would answer that two different ways. Once we get certain targets, to meet those particular standards I feel it will only be modest costs, but that’s one answer. To actually meet the full needs of Bay improvements is excessively costly, but the reason I put it in two statement – there is often an incongruence between the requirements and what you need. There are also really creative ways to meet the regulations without actually making the Bay better. Obviously you need political support, to lessen the controversial aspects and implementation challenges to that people will be more accepting and meet those targets. Now if those compromised targets meet the goals of the program by 2025, if it does not you need to adjust those targets to meet the goal. Does that make sense?

RF: I think I understand. Do you think the politicians in the county understand what is involved and the potential costs?

X: Some do and some do not. The county administrator had spent a lot of time thinking about how to meet the requirements. Some of the board members, it is so far down on their list as an issue, until all of a sudden and we don’t have any hard requirements to meet. When it does come the amount of effort just to meet this requirement would be supported, but then no more. With all the other issues in the county this isn’t high on the radar screen.
RF: Okay. Have you heard the term adaptive management before and if you have can you define it.

X: Of course I’ve heard the term before and yes I can define it. Are you wanting me to? RF: Yes. Please.

X: It’s where you have a desired vision, but the way you approach it isn’t scripted out yet and even if it is it’s only to get started and the intent is once you start to get results, interim results, you reassess it to see if you are meeting your end result, if not you need to readapt and readjust your approach your decisions, that’s the adaptive part as new data comes in you are constantly redefining and taking different tasks to different routes and strategizing in order to meet the end result than just some fix on the process from the start.

RF: You defined it very well. I would say it is learning by doing. Taking your experience from the work that you do and then implementing a strategy to meet an end result, in this case the water quality of the Chesapeake Bay. As you go along implement a strategy, monitor the outcomes, and then adjust your implementation strategy and process constantly refining.

X: That’s right.

RF: So what role if any does adaptive management play in the TMDL?

X: I would say it is incredibly important or critical to take and adaptive strategy. One of the biggest challenges, well there are two broad challenges. Obviously one is the political environment, but the second is the scientific challenge. We are not just talking about growing a tree. The Chesapeake Bay is a very complex system and just
understanding the system is very difficult, similar to climate science. There is no way that someone can strategize what is going to work at the beginning of the process and be right. It is going to have to be a highly adaptive approach to deal with the uncertainty. The other complexity is the political challenge with all of the different jurisdictions there is a lot of inflexibility, but adaptive management is a critical part of this. We have to find a way to get the political entities to allow a greater flexibility of an adaptive process. You would not be able to do this without adaptive management.

RF: Okay. That is all of the prepared questions that I have. Is there anything that you would like to add?

X: Well this is only my opinion and not that of my county, but the improvement of the Chesapeake Bay I see two approaches that could work. 1-a very top down approach, very regulatory where the federal and states tell the localities this is what we are doing, a very regulatory top down approach. Or a very bottom up approach where localities have buy in. Localities have ownership in it, you need to have a sense of ownership in it and be involved, so far the state process has been more of a top down approach and as a consequence localities don’t have any flexibility and don’t take any ownership in the issue. Water quality, it’s hard to get the localities to take ownership beyond the minimum required by law because they view it as a state issue and the counties aren’t involved. So they are not interested, don’t take any initiative in it and it becomes a wait and see till some regulations come. As regulations come they may grumble about it, but they will apply the regulations. So if you want to change the dynamic you either have to be more aggressive with the regulations which may not be possible or you may have to
change the roles and responsibilities and give localities ownership. Whether it be landowners and watershed councils, or whether it be localities so there is incentives and investment for localities to take the initiative and work with landowners and take the initiative and do things from the ground up. Right now, it is kind of like the middle of the road approach so it’s not really accomplishing either one that effectively because it’s not enough ownership in localities so they take the ownership and it’s not enough regulatory support to get us to meet our goals so therefore we are stuck in this middle of the road which really isn’t letting us accomplish either. That’s opinion, but I think it is a solid point.

**RF:** So to summarize, the state and feds should pick one. Take a command and control or grass roots approach, but what they are doing now isn’t really accomplishing anything and is not helpful.

**X:** In essence I realize it is so complicated it will require a range of approaches so everything isn’t in one basket, but in essence yes. The ultimate approach has to be one of those two because otherwise. Yes that summarize was very accurate.
**Interview 9**

**RF:** Is your municipality participating in the Chesapeake Bay TMDL and why, if so?

**X:** Well basically here in our locality we carry out the Chesapeake Bay Act and the regulations that we adopted under the Bay Act. TMDL guidance is coming down through the Department of Environmental Quality and the EPA I guess at this point we are doing business as normal with respect to the implementation of the Chesapeake Bay Act. The TMDL, some research was done several years ago and at the local level we haven’t heard and we don’t deal with it as far as reporting, all of that is done by the DEQ. As far as Total Maximum Daily Load studies, we don’t do them and are not really involved in them.

**RF:** So because of the Chesapeake Bay TMDL are you implementing any strategies…let me start with this question. Do you have specific sediment and nutrient reductions that you have to meet as part of the TMDL?

**X:** No, not as of right now. State stormwater regulations have changed, which has affected some of the nutrient reductions there. The department of health has implemented some new regulations related to onsite septic systems, but as far as anything that we do here locally. Keep in mind that we are the Building and Zoning Office, we issue building permits and plan approval for commercial and residential projects. Most of the environmental permits other than land disturbances are issued by state and federal agencies. I’d be interested to know what kind of feedback you are getting from other localities. We know the regulations that we are having to enforce, such as the new
stormwater regulations, which took effect on July 1 are supposed to improve numbers in the overall TMDL. I don’t deal with it directly, state agencies produce the guidance manual and that sort of thing. Eventually it will all trickle down to the localities I’m sure.

RF: So you are not implementing any new strategies or mechanisms to implement the new TMDL requirements. You are defaulting to or looking for guidance from the state.

X: Well we do require best management practices and stormwater management plans. This is nothing new, this is been going on for many years. BMPs, encroachment into the RPA, and buffers and we are trying to use a lot more bioretention on commercial projects whenever the impervious cover, and residential as well, is more than 16% we address both water quantity and quality. All of the calculations are submitted by a professional engineer and reviewed by this office. So that strategies that are used on the plans that we review leads overall to the numbers on the TMDL stuff. So I think everything that we do contributes.

RF: Right. Since the Chesapeake Bay TMDL has come into being you have not changed any of your practices beyond the recent changes in the State stormwater regulations?

X: No sir.

RF: Have you heard what other municipalities are doing as part of their implementation process?

X: No I haven’t.

RF: Okay.

X: I think that most localities that you will talk to in my area will probably tell you the same thing that I am.
RF: Okay. Do you have a sense that your county may be asked to find reductions in nitrogen, phosphorus and sediment to meet the TMDL in the future?

X: Oh yes I do, I do. I don’t remember what the target date was 2015 maybe, and then 2025.

RF: Yes 2017 and the 2025 I believe.

X: The Soil and Water Conservation District, they are working with the agricultural side as far as increased stream buffers and keeping livestock out of the streams. What we are doing here we are hoping that nitrogen reductions through the health department, which is a state agency, will help reduce the numbers.

RF: Do you think that in line with you having to make some reductions that there will be costs associated with those items?

X: Oh definitely. Nitrogen reduction on septic systems alone, you know that is not cheap.

RF: Do you have any overall sense of what it would cost the county or idea of future planning for what it will cost the county to comply with the TMDL?

X: I do not. I know it would be a lot of money. The TMDL study, I was a little disappointed with DEQ presented the TMDL study here.

RF: For the Chesapeake Bay?

X: Yes. To me it was a big model and there was a lot of inaccurate information for this county: livestock number, contributing sources that type of thing. It was just way off. So it seems to me that it is going to be costly. We are concerned that the model was inaccurate.
RF: When you say “we” who are you referring to?

X: The county at large and my fellow workers.

RF: Do you have a board of supervisors there?

X: Yes.

RF: How much would you say they know about the TMDL and the implementation process and potential costs?

X: I would think other than the meeting that the DEQ had here, which I think two of them were present and what I have explained to them a few years ago when this all came about, I would say they have a fairly good understanding and we also feel that this is something we are going to have to look at closely. I’m afraid that we are not going to have much input next to what we can do once EPA is involved.

RF: In 2017 or 2025 when the TMDL is fully implemented, meaning all of the appropriate implementation strategies have been accomplished, but the Chesapeake Bay still does not have an appropriate level of water quality. What would you and the county do?

X: That’s a very good question. I don’t know. I have always been a firm believer that we have always been very proactive and tried to do everything that we could as a county to do the best we can to improve water quality. I feel that many of the things that are coming down the pike are kind of farfetched. We are hoping that we can bring these numbers down, but I’m afraid that the numbers may not change and I’m afraid of what we might do when we find out that the numbers are not changing for the better. I really
don’t know what we would do. We would probably be forced to work hard and come up with a plan of action to try and improve them.

**RF:** One follow-up question. When you say that you would be forced to work hard, do you mean that you would look for direction from the EPA and the state on what you should do, or would you enact something on your own.

**X:** We would probably look for guidance from the state and Federal agencies. I feel like we are doing enough on our own as it is. I don’t think there is anything else we could do, except to stop building and just shut down. Sometimes I think that is what they want us to do.

**RF:** Okay. Have you heard of adaptive management before and are you able to define it?

**X:** No sir.

**RF:** Okay. Adaptive management is something that is mentioned in the Chesapeake Bay TMDL Phase I and II WIP. It’s generally described as learning by doing. In this case it is implementing a water quality strategy, monitoring, then analyzing the results of that monitoring, and adjusting your actions based on the new knowledge you’ve gained. Does that make sense or ring a bell?

**RF:** Well it does, but I don’t know how much you know of how the system works. But that is something that the state would handle, we just don’t have the manpower. You are talking to a two man show, we have two people in the zoning office, that try to carry out the environmental program along with all the building, zoning, BZA, we are a small shop. I’m not sure who you are interviewing as far as other counties, but we are probably
as bare boned as it gets. As far as adaptive management as the things you are mentioning, I just don’t think that is in our reach as far as actually doing.

**RF:** Okay. I think that is all the questions I have, thank you for the time.

**X:** I don’t feel like I have helped you very much.

**RF:** You have and I thank you for your time.

**X:** The bottom line is that we have had very little involvement with the TMDL other than with the state when the study was done. We are trying to do everything that we can as per their guidance once the results come out.

**RF:** That is helpful, you have had some initial contact with the state government with the Phase I and II WIP, but not much interaction after that. Is that correct?

**X:** That is correct. Again I will say that the data they presented to us at the initial meeting was inaccurate and didn’t really impress us much. It is really hard to get someone on board at an official meeting when you present what they presented. We are trying to do the best we can with what little manpower we have here in our office and we are doing our best to comply and make things better and that is kind of hard to do.

**RF:** Let me ask one other question about money. If you think that it will cost a substantial amount of money to comply with the TMDL, where will your county get that money?

**X:** Well we would hope that there would be some state and federal grants, but I don’t know where that would come from without raising taxes. Hopefully there would be some grant money.

**RF:** Well thank you for your time.
X: I hope I helped you out a little.

RF: You did, have a nice day.
Interview 10

RF: Is your municipality participating in the Chesapeake Bay TMDL and why?

X: Yes we are. Several reasons, we are in the Chesapeake Bay area and fall under the Chesapeake Bay Act regulations and we are a jurisdiction that holds an MS4 permit and that mandates that we have a Chesapeake TMDL action plan.

RF: Are you a Phase 1 or Phase 2?

X: We are a Phase 2 MS4. So to answer your question we are driven by the MS4 permit.

RF: Okay. How are you trying to meet the requirements of the TMDL and what experiences have you had so far?

X: Okay. That’s a big question. Our permit spells out what our requirement is and our permit, let me back up. Under the MS4 program there are 5 year cycles. So we have 15 years, 3 cycles to complete our Bay TMDL which puts us outside the 2025 deadline.

RF: When was your last renewal?

X: Just last year. We will end in 2028. So again that’s how that cycle works. We are driven by our permit and that’s how that works. Your load reductions are based on your watershed nitrogen, phosphorus and sediment loads. And then out of that, you go ahead and define the regulated and unregulated land and that narrows on down to what you have to regulate based on the permit and the impervious covering and that’s what you treat. So what I had to do is break out state property, Federal property and things like that and then narrow that on down to see what is actually regulated land from there. So any private street and so on. You get that number and you plug it into the TMDL action
guidelines and that will spit out your actual reduction number that you have to achieve. Of that end number on the Chesapeake Bay TMDL action plan your first permit cycle, and again there are 3 permit cycles to 2028, of that first cycle we are required to reduce that load by 5%. Second cycle we have to do 30%, oh-I’m sorry 35% and then the 4 cycle would be 60%. So that’s how it works. I’m in the process of crunching all those numbers and plugging that into the Bay TMDL action plan and model my results. I haven’t really defined the final number, I do have a ballpark estimate based on the allocations that the state has given me, and I back calculated that in there based on that. The load is low and doesn’t really compare to some localities, but it is a substantial load. The 5% is going to be easy to achieve, the 35% is going to be harder, and that last 60% is going to be a real challenge-the hardest part of meeting that permit. The thing that really hangs over the head of the permit holder is that permit where your other localities they have a Bay Action Plan for the TMDLs. There is nothing really binding to that, no consequences if you don’t meet that. Whereas on the permit side and MS4s there are regulations and the Clean Water Act that drive that. So to answer your question, a little more specifically – what do I know I’m going to actually do? In the first cycle to meet that 5% I’m going to use existing practices that we are doing, which is street sweeping. There are 5 or 6 minimum control measures that you have to meet: public outreach, education, street sweeping, leaf collection.

**RF:** This is all on the permit side?

**X:** Yeah. So all of that I can get my 5% and then on the next cycle I’m going to be looking at the land the locality owns, enhance those to get reductions that way. And look
at other things, enhanced street sweeping, things of that nature. I don’t have a defined action plan just yet, I’m still working on that. I can say overall my calculations on a cost estimate based on EPA’s guidance as far as cost to remove nitrogen, phosphorus and that – phosphorus alone they are basing that anywhere from $5,000-$10,000/pound so calculate that into our number gives millions of dollars.

RF: And that is just phosphorus.

X: Well yeah, that is the target. A lot of nitrogen removal will result from that. So there are all kind of different practices you can do as far as enhanced street sweeping, stream restoration, enhanced BMPs – you know get those up to higher standards and get better water quality. So overall I don’t have a specific plan of how we are going to meet the reductions yet, but I do know it is going to be costly. I hope that answers the first part of your question.

RF: That is helpful. Have you heard what other municipalities are doing to implement the TMDL and is that effecting what you are doing?

X: Well I have stayed in touch. I’m a member of the Virginia Municipal Stormwater Association (VAMSA) basically your permit holders and some other stakeholders. I’ve listened to them, gone through some of the VAST modeling and the VAST, CAST, MAST – I’m sure you’ve heard of some of those.

RF: Yes.

X: So they give you different scenarios that you can use to implement, whether it be green infrastructure or improvement project to try and reduce those loads. As well as your illicit discharge detection elimination program, which I didn’t go through those 5
MCMs, but that is one of them along with outreach and education, illicitly discharge protection elimination program so as you build those programs and enhance them you can get those reductions assuming you have the monitoring. Same as the outfalls you start monitoring and finding those then eliminating them, so there are ways to get those load reductions, but you have to monitor and log them to get the reductions, the end result.

RF: And that is a challenge to monitor those outcomes. My understanding what that you can get credits, for example if you do a quarter mile of stream restoration you are able to claim credits. Is that correct?

X: Yeah, but these haven’t really defined that process yet. There is some debate among the different committees that are reviewing that. So I don’t think that has really been defined as far as how much credit you get. It was on the table and then they took it off, people were upset because they already started stream restoration and the engineering process. Because you have to have data before, then monitor and have data afterwards. It would be no different than our requirement in the permit to monitor outfalls for illicit discharge. So once we find an illicit discharge, we have to find the source and eliminate it. But there is a whole crediting process in there as well, which I was working with the Center for Watershed Protection and the Stormwater Network Group. Oh, what’s his name? Anyway, we were on a committee to determine how to credit when you do eliminate an illicit discharge that has not been approve yet. It went through to the board a few weeks ago and we have a few things we still need to look at. So there are different
ways, but the bottom line is to get some of those credits you have to track it and monitor it before and after.

**RF:** Right, so has what other people are doing impacted what you are doing?

**X:** Well I’d have to say yes as far as it gives you ideas that you can build on, and learn from their mistakes. I’m staying in tune with everything. You know every locality is different as far as their budgeting and funds available. Again, the difference in some of the counties as far as a Phase 1 or Phase 2 MS4, you know a Phase 1 is more stringent criteria so it might have more demands on what your TMDL is.

**RF:** What would happen if in 2028 you had done everything you needed to do to implement the TMDL and the level of water quality was not high enough. What would you do, what would you do?

**X:** Well I think the driver is that permit. So are you asking me if I met the requirements of the permit or the requirements of the TMDL?

**RF:** I’d assume that they are directly related.

**X:** Well two things. We are driven to be compliant with the TMDL thru the permit, I mean it is a legitimate question, but a very broad question. Because the way the model is based, the way these numbers are generated may not be the right way to go about assigning that. There have been a lot of questions about the model.

**RF:** What are some of those questions?

**X:** The input data that they used. A model like any model is based on the outcomes you are comfortable with. So different models dealing with hydrology and things of that nature. There has been questions about the type of model being used, the data that was
input, and the data that wasn’t input. So to me that effects the outcomes. Now to answer your question, in the regulations we have to try and meet that to the extent practical. So having said that, if we have tried everything we can, well then as a whole the state and everybody has to look at why. Now if it is for our locality and see how the program was carried out and followed through the way it was planned out to meet the requirements of that permit. But then we are trying to look into the future and with anything it is hard to try and predict the future. That’s the focus of the policy. If we don’t sustain the outcomes we have to look at other options to meet those goals.

RF: Let me ask it this way. The localities’ permits are related to the TMDL, assuming everyone met the requirements, but because of the model or data or credits the water quality did not improve – what would the locality do? Would you wait for guidance from the state or EPA or would you do something on your own?

X: Just like we have in the past it is all driven by the regulations. At that time we would have to take a step back and say “we did what you asked us to, to the maximum extent practical, we were in compliance with our permit and the Bay didn’t respond.” Well I’d have to say we need to take a look at the variable that weren’t looked at before, that weren’t put into the model. Or what can some of the other sectors do to step up and fill in for that gap that the stormwater sector couldn’t do. Because there are different sectors: you have your Ag sector, your forest sector, your urban stormwater sector, your wastewater sector. So if they were all in compliance and met the conditions, but yet the Bay didn’t respond everyone as a group needs to regroup and see what went wrong. Look at what was put in and what wasn’t, because we all would have failed as a whole.
**RF**: The locality wouldn’t take action on its own, you would probably wait for guidance from the state or Federal government.

**X**: Right, because you have to know that this costs money. If we go and do something on our own, who is to say that we will get credit for it? So bottom line, it may be a waste of money because it would improve water quality, we all know that, but we wouldn’t get credit for it. It’s not to say that we are not doing additional things now. We are doing things that meet our permit conditions, but as well I’m implementing other things now. For example, I’m implementing different technologies like the trash guards at some of my outfalls trying to treat those areas, even though it’s at the end of the pipe, and treatment is not the best way, given the constraints that I have it is kind of hard to go in and retrofit where you don’t have the space. I have some trash guards out I’m getting data on that. I have some rain gardens and I’m treating some impervious areas right now, I don’t have to, but I’m going to, to do some additional water quality. It’s not like we are doing the minimum we are doing some additional things.

**RF**: So you mentioned then about the cost, were does that money come from?

**X**: We don’t have what’s called a stormwater utility fee, some localities do that. The state just recently passed some legislation about that and it has been on the books for a while. I think more localities are look at that as a way to fund this and it helps a lot of localities. We don’t have that funding source right now, like I said previously those costs are there. Say that question again?

**RF**: Where is the funding going to come from to meet the TMDL and permit requirements?
X: Right now I do have some funding available. I go a fiscal year 2015 budget, some funding. But as I move forward I’m going to look at my next permit cycle I’m going to look at implementing a stormwater utility fee to offset that cost. So as it stands right now we don’t have that funding coming from our general fund.

RF: How would that stormwater utility fee work exactly?

X: It would be based on a couple of different things such as land use. Whether you are a residential, commercial, or industrial. Then it would also be based on the amount of impervious cover that the particular parcel has. Then the fee would be associated with that.

RF: Does the governing body have a handle on the funding requirements and do you think they will give you the resources you need to meet the requirements?

X: Well that is a multi-question. I’m going to have to say no they don’t really have a handle on it. We’ve told them over the last two or three years that it is coming, provided extensive memos explaining it to them. I will say that, that is one of my objectives here over the next year or so is to approach the governing body and tell them what is here and what we need to do will cost money. Overall, no I don’t think they have a really good grasp on the challenges that I face, that the permit drive certain things. But like I said I want to bring the governing body up to speed eventually and then hopefully, like I said, I got some bump in funding for 2015 and I plan on as well as 2016 and on and that is going to keep increasing. I have to justify how to spend that and why we need to do that, but overall no.
RF: The Chesapeake Bay TMDL mentions adaptive management in the WIPs. Can you define that term?

X: Well adaptive management is more or less what we have already been doing as far as your E&S program, compliance with the E&S regulations and the Chesapeake Bay Act, things like that. That’s more to me an adaptive management thing to where you try to manage those regulations with the end result being discharge. Then of course the new regulation changes of runoff reduction and everything. That is what that is kind of geared toward is that discharge. You know there is adaptive management and integrative management practices you know those are terms that have a loose fit to a degree, it kind of depends on how you interpret them. Does that make sense?

RF: Yes. The definition that I have for adaptive management is learning by doing. Basically, it’s…

X: What we’ve been doing, like I said, E&S and the Chesapeake Bay Act, things we’ve been doing.

RF: It’s taking a strategy and implementing it, conducting monitoring of the results, interpreting those results, then adjusting your actions based on the new information in an iterative process.

X: That’s kind of the purpose of what the VAST, CAST, and MAST is trying to do. Is to give you those different strategies so you can build on the capacity to get those end results. And then of course you monitor and go back – what’s not working right. Like you said you go back and answer. Like I said, with street weeping, so I can monitor my street sweeping based on a baseline of my aggregator and do samples of what I get swept
up and things like that. So and I see that we generate X amount of, and X equals some
factious amount let’s say 1,000. Then I say let’s see if we can’t get more so we double
up or expand our street sweeping. So to me that’s that adaptive piece. You do what
you’re doing, but you see if you can adapt it. A good example would be like the, without
the Chesapeake Bay Act we went ahead and did a LID (Low Impact Development)
ordinance. So to me that is kind of an adaptive approach as well because you are
adapting your procedures and policies to get better water quality, less runoff, less
pollution.

RF: I think you would say that adaptive management plays a role in the TMDL.

X: Most definitely. Especially when 2025 comes that’s going to be a big piece adaptive
management. We are going to look back and say this is what we did. How can we go
back and enhance what we are doing?

RF: Does the TMDL milestones allow for that as well and are you involved with the
milestones?

X: Well the state has already put out their targets, I don’t know if you saw them. What’s
his name Davis-Martin?

RF: James.

X: James Davis-Martin. He did a presentation and showed what the state has come up
with for the milestones. On the local level, yeah you are still projected to do your
milestones. So, say your question again.

RF: I was asking about the milestones and if that plays into adaptive management and if
you are affected by the milestones, if at all.
X: Well yes it does play into adaptive management, but from my perspective because I’m a permit holder I’m driven by those cycles of that permit. The first 5-years I have the 5% reeducations and then 35%, that’s what I’m focused on.

RF: Is there anything else you would like to add?

X: No, I’m good.
Survey tool follows on the next pages.
This survey is designed to provide researchers with information about your understanding, involvement, and experience with adaptive management strategies in aquatic settings. This data will be used for a dissertation project and shared with state and federal officials to improve the Chesapeake Bay TMDL process and to improve the water quality within the Bay and its watershed. Your anonymity will be maintained.

INFORMED CONSENT FORM
(The following text is required by the George Mason University Institutional Review Board)

RESEARCH PROCEDURES
This research is being conducted to further our understanding of the capacity for adaptive management in the Chesapeake Bay TMDL. If you agree to participate, you will be asked to complete the survey that follows. IT IS EXPECTED TO TAKE NO MORE THAN 10 MINUTES TO COMPLETE.

RISKS
There are no foreseeable risks for participating in this research.

BENEFITS
There are no direct benefits to you as a participant other than to further research which aims to improve the Chesapeake Bay TMDL process at the local level through heightened understanding of local capacity.

CONFIDENTIALITY
The data in this study will be confidential. The names and other identifiers will not be placed on surveys or other research data. Your name will not be included on the surveys and other collected data through the use of an identification key, the researcher will be able to link your survey to your identity, and only the researcher will have access to the identification key. It will not be shared with state or federal officials.

PARTICIPATION
Your participation is voluntary, and you may withdraw from the study at any time and for any reason. If you decide not to participate or if you withdraw from the study, there is no penalty or loss of benefits to which you are otherwise entitled. There are no costs to you or any other party.

CONTACT
This research is being conducted by Richard K. Friesner and R. Christian Jones, Ph.D. at George Mason University. We may be reached at 540.455-0340 and rfriesner@gmu.edu or rjones@gmu.edu for questions or to report a research-related problem. You may contact the George Mason University Office of Research Integrity & Assurance at 703.983-4121 if you have questions or comments regarding your rights as a participant in the research.

This research has been reviewed according to George Mason University procedures governing your participation in this research.

CONSENT
By clicking the next button I agree that I have read this form and agree to participate in this study.

While it is understood that no computer transmission can be perfectly secure, reasonable efforts will be made to protect the confidentiality of your transmission.
Richard Friesner - Adaptive Management in the Chesapeake Bay

*1. How involved are you in your municipality’s efforts to meet the Chesapeake Bay Total Maximum Daily Load (TMDL)?

- Very involved (working on TMDL related activities at least weekly)
- Somewhat involved (working on TMDL related activities at least monthly)
- Slightly involved (working on TMDL related activities at least once a quarter)
- Not at all involved (rarely working on TMDL related activities, if at all)

The EPA has developed a series of models the agency has used to determine the nutrient and sediment reductions needed to meet the Chesapeake Bay TMDL for each watershed.

*2. How familiar are you with the models developed by the EPA?

- Very familiar
- Somewhat familiar
- Somewhat unfamiliar
- Not at all familiar

*3. How likely are you to support the models developed by the EPA?

- Very likely
- Somewhat likely
- Somewhat unlikely
- Not at all likely

Please state the degree to which you agree with each of the following statements:

*4. The EPA and appropriate state agency (MDNR, MDE, VA DEQ, VA DCR) has provided you with the guidance and information you need to successfully implement the Chesapeake Bay TMDL.

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

With respect to the Chesapeake Bay TMDL, your municipality’s governing body (County Board of Supervisors, City/Town Council):
Richard Friesner - Adaptive Management in the Chesapeake Bay

5. Understands the requirements of the Chesapeake Bay TMDL.
   - Strongly Agree
   - Agree
   - Disagree
   - Strongly Disagree

6. Is supportive of the goals the Chesapeake Bay TMDL has set for your municipality.
   - Strongly Agree
   - Agree
   - Disagree
   - Strongly Disagree

7. Understands the financial commitment that will be required to meet the requirements of the Chesapeake Bay TMDL.
   - Strongly Agree
   - Agree
   - Disagree
   - Strongly Disagree

8. Is addressing and planning for the financial commitment to meet the requirements of the Chesapeake Bay TMDL.
   - Strongly Agree
   - Agree
   - Disagree
   - Strongly Disagree
Richard Friesner - Adaptive Management in the Chesapeake Bay

9. Which description(s) below most closely match your understanding/description/definition of the phrase "adaptive management?" Select all that apply.

☐ A flexible decision making process
☐ Deals with uncertain outcomes
☐ Monitoring of outcomes is a significant component
☐ Takes into account new scientific knowledge
☐ An iterative learning process
☐ Used to achieve a defined goal
☐ Stakeholder process
☐ It’s something the state or federal government is doing, not us
☐ Allows for adjustment to changing political complexities
☐ Not able to define the phrase
☐ Other (please specify)

10. Please expand on questions 1-9 if you would like to in the text box below. (This is not a required response)
Adaptive management is defined by the EPA as:

"Adaptive management is the process by which new information about the health of the watershed is incorporated into the watershed management plan. Adaptive management is a challenging blend of scientific research, monitoring, and practical management that allows for experimentation and provides the opportunity to ‘learn by doing.’ It is a necessary and useful tool because of the uncertainty about how ecosystems function and how management affects ecosystems. Adaptive management requires explicit consideration of hypotheses about ecosystem structure and function, defined management goals and actions, and anticipated ecosystem response."

**11. From your perspective, how critical is adaptive management to the Chesapeake Bay TMDL implementation?**

- Very important
- Somewhat important
- Somewhat not important
- Not important at all

**12. To what degree does the agency leading the Chesapeake Bay TMDL for your state supports your use of an adaptive management approach to TMDL implementation?**

- Very high level of support
- High level of support
- Low level of support
- Very low level of support

**13. To what degree does the EPA support your use of an adaptive management approach to the Chesapeake Bay TMDL implementation?**

- Very high level of support
- High level of support
- Low level of support
- Very low level of support

14. Please expand on your answers to questions 11-13 if you would like to in the text box below. (This is not a required response)
Richard Friesner - Adaptive Management in the Chesapeake Bay

The information below is demographic in nature.

**15. What is the highest level of education you have completed?**
- [ ] Less than High School
- [ ] High School
- [ ] Associates
- [ ] Bachelors
- [ ] Masters
- [ ] Law Degree
- [ ] Doctorate

**16. What best describes your field of study? (Check all that apply)**
- [ ] sciences
- [ ] engineering
- [ ] policy/law
- [ ] humanities/social sciences
- [ ] Other (please specify)

**17. How many years have you served in your current position?**
(round up to the nearest year)

Years

**18. What best describes your current position's function(s)? (Check all that apply)**
- [ ] I am the identified point person (on the municipality’s payroll) for the locality’s Chesapeake Bay TMDL task force, committee, or working group.
- [ ] I am the individual responsible for the municipality’s MS4 permitting.
- [ ] I am the stormwater, planning, zoning, or land disturbance officer for the municipality.
- [ ] Other (please specify)

**19. How many years of experience do you have working on water quality issues?**
(round up to the nearest year)

Years
Richard Friesner - Adaptive Management in the Chesapeake Bay

**20. In which watershed(s) is your municipality located?**
- □ Rappahannock River
- □ Potomac River
- □ Patuxent River
- □ Other (please specify) ____________

**21. What best describes your municipality's position within the watershed(s)?**
(Pick the best single answer)
- □ Non-tidal (far from the main stem of the Chesapeake Bay, where river height is not affected by tides)
- □ Tidal - middle waters (somewhat far from the main stem of the Chesapeake Bay, where there is some tidal variation in river height, but water is not brackish)
- □ Near the mouth of the river (adjacent to the main stem of the Chesapeake Bay, where there is tidal variation in river height and notably brackish water)

**22. In which state does your municipality lie?**
- □ Virginia
- □ Maryland
- □ Other (please specify) ____________

**23. What is your office's zip code?**
- ____________

**24. What is the total population of your municipality?**
- ____________

**25. Does your municipality have a Municipal Separate Storm Sewer System (MS4) permit?**
- □ Yes
- □ No
- □ I don't know

**26. Please expand on your answers to questions 15-25 if you would like to in the text box below. (This is not a required response)**
- ____________

Page 8
Follow-up Interview #1

RF: The interview here, I have four questions prepared, but it is semi-structured so we can have a kind of conversation. Our discussion doesn’t have to be rigid.

X: Okay

RF: From your experience, do local-county or city officials in Maryland or Virginia have a better understanding of adaptive management and is one better prepared to use it in the Chesapeake Bay TMDL implementation process? If so, why?

X: I would expect Maryland has a better understanding of it, because it’s not a term I hear often used at a staff level, or even at the elected official level. More often there than at the staff level in the meetings that I’m a part of. So, I just don’t think it’s a term that is used.

RF: Why do you think that is?

X: Because it’s a complicated term, unless it has real meaning and people understand the process that is going to be used it’s a term that is used to assess and make those changes and adapt I don’t think it means anything to them. So they think of it as a policy wonk term and not something real.

RF: And by them, you mean the people in Virginia v. Maryland?

X: Yeah. Again, I think if you watch different listservs and discussion groups for the Chesapeake Bay, there is just a lot more communication, a lot more information that comes out of Maryland and it gives any number of terms, that one possibly included more air time and it becomes part of the dialogue people can use in the discussion.
**RF:** Understood. The next question I have is how prepared do you think local county/city official in the Patuxent, Potomac, and Rappahannock River watersheds are to use adaptive management in the TMDL implementation process?

**X:** Again, I don’t think they can define as to what that means. Here in Virginia I wouldn’t think they are prepared to use it. The basic way I would describe the difference between Virginia and Maryland, and I’ve never worked in Maryland so this could be a case of the grass is greener on the other side of the fence with respect to that. In general, the culture, the NGOs, the government seem more proactive in resolving the issue. In Virginia, it seems to be more reactive as in “tell me what to do and I will do it, but you have to specifically tell me what to do.” And so, that doesn’t work very well with the adaptive management piece because there is no culture of anticipating what that next thing, and how to get prepared for it.

**RF:** Okay. If you had to rank the three watersheds: Patuxent, Potomac, and Rappahannock – what would be your order?

**X:** That I can’t say because I don’t know much about the Patuxent, I know a little bit about the Potomac, but not very much. I don’t have any gauge.

**RF:** From your vantage point in working with the Rappahannock, how does the Rappahannock fair compared to the rest of Virginia or the entire Chesapeake Bay?

**X:** In what aspect?

**RF:** In the capacity to implement the Chesapeake Bay TMDL and use…

**X:** Alright I have a way to answer that. In the Rappahannock, because so many of the localities are waiting to be told what they must do in order to meet any TMDL
obligations, they have to know the obligation. And the only ones right now that have a legal obligation are the MS4s. In the Rappahannock watershed there are a few MS4s and they have a legal obligation to load reduction requirements. But no one else has a specific requirement. Or they talk as if they don’t have…they have from my perspective they have things that they are supposed to be doing.

RF: So, if local government respondents in the survey in Maryland and/or Virginia were to indicate they don’t have enough support from there state or federal agencies what insights can you provide regarding why that might be so.

X: Well let’s even just focus on the MS4 permits for a moment, as you may be aware LOCALITY NAME the state agency responsible for the stormwater?MS4 program has shifted from DCR to DEQ and that kind of, there was a tremendous, and the rules have kind of been in flux during this period of time too. So, there’s a lot of management leadership at a state level that has to come up to speed itself rather than being able to again be proactive and having tools and guidance available for folks.

RF: What about the non-MS4 localities?

X: Again, they are struggling with that issue the stormwater management plan rules that changed last July as kind of the closest thing that helps get to some aspect of this. And again that doesn’t direct the TMDL load, but they are focused on dealing with that and there is the “do we opt into the program or not opt into the program.” Are they a Bay municipality? What pieces are we responsible for, they still have an NPDES program, sediment control program and how does that marry with the states doing and there is a lot of confusion there. And it deflects from dealing with the historic load, the sources that
are uncontrolled – the ones that won’t be covered by the stormwater management plans. And that’s only going to deal with new load, that’s holding the line, that’s not dealing with the load that was modeled in the TMDL. I mean, that’s part of it, the growth is part of it, but you have all of this other stuff that’s not being address by the stormwater rules and there’s just a lot on their plates to try and figure out.

RF: In all the work that is on their plate and all of the figuring out that they have to do, is there a breakdown between the state and the localities?

X: There is. There are probably different way that it breaks down, but again the actual what do localities have to do – if I put on that perspective – what do you want a county to actually do? Well there is stuff in the WIP, there are assumptions in the model about septic tanks, about stormwater, about agricultural land, but it’s not conveyed in a permit requirement in any way so the “you must do this” is a little hard for them to implement. You know how that whole funding cycle works, where you go in and ask for capital improvement money or even anything is possible, but where is the push where is the carrot it’s hard for them to focus on that. On the agriculture side the soil and conservation district is certainly out there trying to get people to sign up. So even with, there are some localities, so even with 100% money for cattle exclusion they still have trouble, because it is a reimbursement program. And so the farm still has to come up with the money, where there is the willingness to take government money. And they have to come up with the money so it’s not an automatic battle. There were some folks in [redacted] County, which had a very small piece of the watershed, the [redacted] Soil and
Water Conservation District offered 100% match to cattle exclusion this year and there were three farmers and none of them would take it.

RF: Hum.

X: You know, because there are inherent barriers to the program even at 100%.

RF: Right, right.

X: You know so, it makes things difficult that there are so many pieces to the puzzle. It really does take that kind of: alright, which piece do you have? How are you moving forward on it? What are the barriers? Are there ways we can get rid of the barriers? And there really isn’t that discussion. The only forum that I know of that does that on a large scale is the Rappahannock River Basin Commission and its technical committee, and they focus more on that reactive mode. “We don’t have the data. You want us to report, but we don’t have a form. We don’t know what you want us to report on. I don’t want to invest in creating a report, because then you are going to tell me what you want and I’m going to have to change everything that I’m doing.”

RF: Uh hum.

X: On the local level you have a local TMDL implementation like the upper Rapidan bacterial TMDL. That has formed a local stakeholder group that had public meetings, I want to the last one. The public meeting questions were great, I was so impressed with the questions they asked and the engagement they got, but that exists on only a local TMDL level not on the Bay level TMDL comes on down. Years ago when the river basin plan up there by the Rappahannock river basin plan, before the TMDL, and there were a lot of things, I would attend, and FOR would convene them, and there were a 100
people in the room, but I think that the door is stuck now. It’s not an active program, it’s not an active plan that anybody is implementing.

**RF:** Right.

**X:** Again, I think that all of the comp plan conversations that have gone on, it stays at a 50,000 foot level instead of being able to direct any specific things to how would this be used to implement the TMDL. Because again it’s not code, it’s not ordinance, it’s not any of that stuff. So it’s not the right document, but you know we only discuss it as a with regards to the MS4.

**RF:** Right.

**X:** So has close to 500 pounds of phosphorus that he is obligated to remove and so he has different programs and different mechanisms and different things, but we’ve got a that is largely built out and he still has that load. So where is that load going to come from? And what is happening is that staff has got resources to hire an outside consultant. Some of the other counties don’t even have that ability.

**RF:** Right. You think that those things are all counter to Maryland?

**X:** I think there is a different structure. Again, it’s a case of the grass is greener on the other side of the fence and what I’m seeing is there is a lot more communication of information, a lot more outreach on a general level, a lot more training opportunities there are offering a lot of different training opportunities, but it is hard to have a clear perspective from here.
RF: A follow up to your comments. I know you know this, but so we are clear, in Virginia the state used the planning district commissions to create the Phase II WIPS and start the local process of implementation.

X: Right.

RF: In Maryland the state went directly to the counties, the localities. Do you think that process would have – if Virginia would have gone directly to the counties – would that have worked as well? Would we be in the same position or would it have been different?

X: I’m trying to think. Our planning district commissions are really good, you know the one we work with up in Rappahannock, the Rapidan are engaged, they know what’s going on. The GWRC are the same. So it should have worked, I don’t see any reason that this strategy wouldn’t have worked, but it certainly seems like it could have been more efficient from a state standpoint.

RF: Okay.

X: To do it that way, you know to deal with fewer entities.

RF: Right. So, is there anything about one of the three watersheds that we are talking about here today that makes it distinct with respect to implementing the TMDL?

X: Again, I don’t know the other watersheds. I mean, the Potomac certainly because it is split across jurisdictions certainly has additional complications and because that is such a tremendous land area that it covers. But I don’t know enough about the other two. Yeah, so I don’t know the answer to that.

RF: Okay. Are there any additional comments or questions that you have?
X: No. I would love to read your thesis when it’s done. I am curious about it. The attitudes, I keep trying to compare it to the other experiences I’ve had and Virginia doesn’t fit into that, and so I’m constantly a little curious about it all.

RF: I will be sure to share it with you. Thank you for your time today.
Follow-up Interview #2

X: I will be candid. Stuck in my mind is a conversation I had with

[REDACTED] from the Chesapeake Bay Program who explained they lowered the attainments as a part of the adaptive management process, they lowered the attainments in the Bay agreement because folks weren’t really meeting them. And so they felt if they lowered the attainments folks had a greater likelihood of actually meeting the goal. And then they feel empowered to want to do more, which struck me as either folly or at least not in keeping with what I thought adaptive management is. It’s not driven by people’s expectations, it’s driven by inputs, by information. So I guess that is kind of a sideshow, in how it’s being applied might be a little muddy.

RF: You are exactly right on the process of adaptive management in that it is a means to an end and not an end in itself. I think with any management action, adaptive management doesn’t occur in a vacuum and so there are political, financial, and other social constraints that come upon it and so that is certainly part of the reason that this research is so valuable.

X: Got it. That clears some of the fog for me in terms of, you know understanding what the hell they are really doing and what they are supposed to be doing.

RF: Here I briefly summarize the survey results.

RF: From your experience do local county and city officials in Maryland or Virginia have a better understanding and are better prepared to use it in the Chesapeake Bay TMDL implementation process? And if so why?
X: Well that’s a complex question. I think that adaptive management is a lifeline that is used by jurisdictions to be very flexible in their application of the policy related to the TMDL. I do not accept that the definition of adaptive management simply allows folks to do what is expedient or not do those things that are not funded. Yet, I do see some perception within the jurisdiction that adaptive management is sort of the joker in the deck. That you can simply do what is expedient and use the joker to justify it. “Oh, well this is adaptive management.” I do not see adaptive management supported by good science generally speaking, but part of your question had to do with how well people understand it. I think that people understand that it has flexibility attached to it, that you don’t have to do exactly what is on the page, you can do that which is “adaptive.” I think that is how it is construed and it actually defeats the purpose of the TMDL. To allow folks to simply do that which is readily done and is readily funded and doesn’t not create too much travail. So it is something that is complicated. The core of your question what how well do they understand it? I don’t think they understand it very well, in that the definition of it is a little bit foggy in how it is being presented and how it is being used. I mentioned to you a moment ago that [redacted] of the Chesapeake Bay office argued that adaptive management simply allowed folks to lower attainment so that could more readily achieve goals related to the TMDL. Well that is f***king bazar. That’s just insane. Right, I mean you are just lowering the standards in order to allow people to achieve something, which may or may not be proportional to the existing problem. And certainly is not in any way linked to achieving the limits inherent in the
TMDL. So, it’s pretty fraudulent I think, but it provides enough latitude to the jurisdictions to self-interpret what adaptive management is.

RF: Sure, I understand that. Do you think local officials in Maryland or Virginia do better at understanding where adaptive management fits into the TMDL?

X: No I don’t think they do. I think they see these as federal mandates that unfunded and/or impossible. At least to the extent that their local economy is dependent upon doing whatever they must in order to balance the books. And so implementing TMDL related strategies where there’s an escape clause, which is exactly what I think adaptive management is, because the benchmarking for whether adaptive management actually reinforces the underlying purpose of a TMDL. Benchmarking is pretty slim. It’s self-interpreted. That’s the wildcard. People can simply certify that they are implementing the TMDL without much scrutiny on how they have done so. And they will cry “adaptive management” where they are noncompliant.

RF: Okay. Do you think the people in Virginia or Maryland have the same understanding of the process? Are they in the same boat, or is one better than the other?

X: I think they’re on par. I think it’s a had comparison because they’re different subcultures, very different legal, state legal systems any way, common law legal systems with respect to water law. So it’s hard to say that one understands it more or less than the other, I think they are both equally intellectually bankrupt on the subject.

RF: Okay thank you. How prepared do you think local county and city officials in the Patuxent, Potomac, and Rappahannock watersheds are to use adaptive management and
overall implement the TMDL. If you had to rank the three what would be the order and why?

X: I don’t think that they are very prepared at all to implement the TMDL. Again, I think they see them as unfunded mandates and therefore they feel perfectly at liberty to ignore them. If there is no money in the kitty to do it, then we’re not going to do it. You can’t make us do it unless you give us some money. I think that is the spirit in which the TMDL is seen. In Maryland, I’m less familiar with Virginia law, particularly with respect to land use, but in Maryland because land use is strictly local I think there is a presumption that is part of the fiat of local perks. So this unfunded mandate that flows through the state from the Fed is seen as impractical and something that will probably disappear with the next administration. I think it’s also being contorted in Maryland, in particular maybe just because I’m in Maryland and my river starts and ends in Maryland, but I think it’s been contorted by the Chesapeake Bay Foundation as its workmanship. That it’s somehow related to a lawsuit that they filed, which as an attorney I can tell you didn’t even ask for any relief. It’s a pleading that did ask to actually do anything. I think the Obama administration was inclined to promulgate the TMDL, which was long overdue. And so thus, the notion that the TMDL process is part of the Chesapeake Bay Foundation’s workmanship completely pollutes the notion that it is a binding initiative. That it doesn’t flow from governmental authority. It’s some hazy-fuzzy lawsuit that a nonprofit filed where they are attempting to brand the TMDL to their workmanship. So I think that also contaminates or makes less efficient the overall process, because it’s
perceived that [Chesapeake Bay Foundation] CBF did it as opposed to a lawful mandate from a regulatory authority.

RF: That is interesting. Based on what you know. You are saying here that the three watersheds are basically in the same boat or are on par in terms of their ability to implement the TMDL and use adaptive management.

X: Yeah, I think they are. But more over what I’m also saying is that I do not believe that these are, this is not a popular initiative at the ground level. People don’t want to do this stuff in the first place and they will find contextual reasons not to do them, adaptive management is as good as any reason not to do the express requirements of meeting these requirements. Among them, for example is the escape clause of nutrient trading which people grab handedly almost before they even look at the TMDL the opportunity to create commerce around sliding compliance standards through mitigation and pollution trading is much more attractive than strict enforcement any day of the week. Who would comply when there is an alternative, a handy one that is inherent at least under Maryland doctrines? The notion is if you don’t like or want to do this stuff-trade! Or mitigate. So again, it’s worthless as anything that’s binding to be implemented in good faith.

RF: Now, you know it’s interesting from your perspective. The Maryland WIP actually adds a safety buffer of an additional 10% of reduction. Do you think that is a showmanship sort of a thing, or do you think the intent of that is to safeguard and ensure that Maryland meets the requirements?

X: I think that’s a nod to the smaller segment of the environmental community that has recognized that most of this stuff is dam near impossible to verity. So a margin for error
was the least they could do. I think 10% is a pretty stingy, you know not nearly aggressive enough, but I think that’s all it is. It’s a nod, it’s a gesture that allows people a little wiggle room or allows us a little wiggle room that allows us to implement these standards.

RF: Sure, but from a… I think it’s interesting that Maryland is the only jurisdiction that plans to exceed the TMDL requirements.

X: Well they can raise money around that notion. Whether they will actually succeed remains to be seen.

RF: That’s absolutely true. So, if local government respondents in this survey in either Maryland or Virginia were to indicate not receiving enough support from their state or Federal agencies, what insights do you think you can provide on why that might be so?

X: Well let’s be clear on what they think support means. I think to the jurisdictions support is money. I think this entire thing is about economics for a lot of these places. They either can’t afford to comply or implement, or don’t see why they should have to make room in their budget to deal with this stuff. Hence the claim by both environmentalists and municipal officials that there isn’t enough money in the system.

Alright, that is a refrain that you hear constantly. So, the expectation that there has to be money in it or it’s B.S. shifted the focus away from compliance and onto the money, which is a whole different enterprise. The money people are very different folks from the program people, and very different from the science people. They really are in different camps and are talking about different stuff. You and I might want to talk about complying with the TMDL. The more the other crowd wants to talk about what’s in it for
us economically and are there green jobs attached to it. To me it’s a form of green capitalism. In essence it’s not a movement generally, and when I say movement I mean the Bay preservation movement, of particularly successful actions right. These waters have been degrading for 40-years. With the hollow hope that dissolved oxygen will change or some hotspot will get better, but holistically it’s a failing movement desperately trying to claim some success simply for promulgating a TMDL with no real implementation scheme for achieving this. Left up to the jurisdictions who don’t want to do it in the first place. It was broken from the outset.

**RF:** Right. Do you think Maryland and/or Virginia have done a particularly good job or one has done a better job than the other at communicating clearly and concisely the requirements of the TMDL and providing that support that is not financial in nature?

**X:** No I don’t think they have done a particularly good job at all. I think where the rubber meets the road there are a whole lot of folks that don’t even know what TMDL stands for. I think that is a term of art used by the professional community used to describe what they are attempting to do. It’s a fancy-schmancy way of saying we are trying to put pollution limits on these waterways, but again I don’t think they have done a good job of communicating much of anything, frankly. It’s an orphaned initiative in my view, but it has become a big focus of the funded community. It’s something they can point to that got promulgated that frankly was a legal requirement anyhow. I mean, it really not something that was created from community based activism.

**RF:** Right. Do you think in particular one sector of the polluters, whether it’s urban or agriculture or whatever, that are doing better than the others?
X: No I don’t. I think that again the TMDL is poorly promulgated. There’s a lot of slippy slidy stuff. There is computer modeling inherent. There’s lack of disclosure on the Delmarva Peninsula, for example, on exactly what the contribution is for the CAFOs for the chicken farms. There’s a lot of smoke and mirrors and too much room for error, generally speaking. None of the folks were inclined to actually implement or enforce the TMDL. I think it’s been an enormous distraction from enforcement, because the presumption is that once we promulgate the TMDL we’re saved. We simply just need to have the TMDL. The irony or the paradox is the more stringent the TMDL is on paper, the greater demand for pollution credits from the pollution industry. The value goes up considerably on the basis of a stringent TMDL. So the appearance of being really vigorous and zealous about promulgating this has really created a fresh marketplace to basically put pollution on the stock market. But no emphasis to clean the waterways up, only to broker the greater economic value of liquidating these resources and polluting them and selling the right to pollute. That’s very attractive to some industries in this transaction, selling the right to pollute is huge in terms of that need for new money.

RF: So, is there anything distinct between the Patuxent, Potomac, and Rappahannock watersheds with regard to Bay restoration that sets one or more of the three apart from the others?

X: We the Patuxent, in particular, in Maryland I think is set apart for a couple of reasons. For one, the I guess the basic geo-terrain is actually the longest and deepest river that starts and end in Maryland, it’s an intra-state river, with the deepest water in the Chesapeake Bay 200 feet down in Solomons. The other distinction on the Patuxent side
is that it is a river that was brought back to health through Clean Water Act legislation
back in the 1980’s and it’s the only river in Maryland that has ever been brought back
substantially to health through state regulatory action. I think that the Rappahannock,
like the Patuxent, has a fairly strong willed tradition of citizen activism. Friends of the
Rappahannock in particular has been pretty unflinching in its efforts to use litigation and
whatever tools at hand in order to preserve and protect that river. And so, I think it’s
probably better off than some. People have argued that the Patuxent is a river that you
could really do something on, if you wanted to do something with the TMDL, because
it’s all in one jurisdiction. It doesn’t go to Virginia, it doesn’t go to Washington, and it’s
all within one jurisdiction. All those gains that were made with litigation in the 80’s have
now been consumed frankly by government slope. By poorly regulated growth, by 36
and counting waste water treatment plants, by non-compliant coal generators that are
pumping waste at 40-time their daily standard. I mean forget the TMDL, they’re not
even enforcing these individual permits. The bubble permits that make it dam near
impossible to tell who’s polluting because you are basically permitting a section of the
river as opposed to individual permits. There are a lot of smoke and mirrors surrounding
this, but would be the commonality between the Patuxent and Rappahannock. Was the
Potomac the other watershed you mentioned, I can’t remember what the other one was.

**RF:** Yes the Potomac, that’s right.

**X:** The so called nation’s river. Well I don’t know very much about what’s going on with
the TMDL on the Potomac side. So hard for me to comment on that one.
RF: That’s all questions I have for you is there anything that you want to add or any questions for me?

X: Yeah, I actually believe and if you talk to anyone familiar with the work that does that is heavily weighted towards litigation and enforcement, then we are probably seen as outliers or heretics. We believe that they Bay movement is inherently fraudulent to the extent that it postures a zealous community of folks determined to clean up the Bay, but it also postures that sole reason we have these tributaries and work being done on these tributaries is because they drain to the Bay. So it actually short-circuits any real interest in protecting local water, in so much as it protects the Chesapeake Bay. I believe it’s fraudulent in that it has no capacity, the movement has no capacity, to deliver anything close to what it has promised the general public which is largely very optimistic reports that things are getting better by degrees. Further, postures that it is supported by the very best science, which incidentally is always found in the very best neighborhoods where we are restoring property value and real estate wealth for people in waterfront areas where we are using remediation sites some of the most pristine regions of the state as opposed to working on where the worst problems are. And further fraudulent because the leaders of the movement have to know this, they have to be completely aware and yet would quickly see that these are perfectly good programs even if nothing gets cleaned up. That’s it a really good TMDL, even if no one enforces it, it’s a really good job none the less. So it’s completely a movement that has lost its way in terms of outcomes and has lost any sense of accountability to anyone for any purpose whatsoever other than its own self-interest and so it’s really shocking in
my book that this goes either unchallenged or unnoticed and I think part of that is because of the centralization of the funding regime. Within the areas that you mentioned there are basically three major funders who are conservatively funded, who are moderate Republican, who basically believe that we should be working within administrative processes, not within grassroots areas, but in administrative processes to bring these rivers back. Hence, the Bay movement has gone the way of the war on poverty, the war on drugs, and the war on terror. It’s just as institutionalized and just as broken.

RF: Who are the three funding, the three main drivers that you are speaking about?
X: which argue that it’s the seventh largest river restorer on the planet that is the source of the money, thus its desire to put pollution on the stock market. which is spending down its capital, so at any rate it won’t be around for very long, but it is also a relatively conservative funder that promotes individual responsibility, never corporate responsibility, the problem is you and me are eager to promote behavior change. So in other words we are working to change the behavior of the electorate rather than hold the feet to the fire for the actual discharge and polluters. If there is a third one, I’m not sure this third one reaches into Virginia at all it probably doesn’t, but it is in Maryland and that is the , which is heavily funded by and . Not a hell of a lot is going to happen there and again they do not fund advocacy. If you want to clean up the Bay why the f**k wouldn’t you fund advocacy, think about that for a minute. They come out and say no way can their money be used to advocate for anything. Holly shit.
RF: That’s very helpful and good perspective. Do you have any additional comments or questions?

X: No. I think that’s key. I guess in sum I would say that the work we do is to I think primarily to galvanize the public to the urgency of these problems because the prevailing message from the establishment movement is that everything’s fine. We got this under control, we’ve got a TMDL. Or things are getting better, but there’s really no sensibility that there is urgency surround these problems. And the lack of diversity within the overall movement, it is an all-white non-integrated movement that is sustained by wealthy donors. And thus, it does not work where EPA tells us the worse problems are likely to be, which is in communities of color, communities that don’t have money, disenfranchised places. In fact, people will roundly argue within this movement, that because of the scarcity of money we need to make sure to prioritize those areas where we’ll go the furthest, which I assure you will not be in toxic row. So we are working on where the best areas are, not where the problems are and intuitively, I’m not a scientist, but how many Ph.D.’s do you need to know when something is broken, I must say. But intuitively, I must say, if you really were in good faith trying to clean up the Bay you would start in the worst problems are, not in the best neighborhoods.

RF: Thank you very much for your time today.
Follow-up Interview #3

RF: Sorry about that.

X: No worries.

RF: Does that data make sense to you.

X: Well I guess anytime we are looking at numbers, it looks like you have some good stuff here, it raises a couple of questions, I guess. In terms of different thoughts, the Patuxent is wholly in Maryland, the Rappahannock is wholly in Virginia, and then the Potomac is in-between, a little bit in Virginia and a little bit in Maryland. Much of the work on the Virginia side of the river around the Watershed Implementation Plans were often handled, and this is true of also the James and Shenandoah etc., were handled by these-I don’t have the name, just let me look it up.

RF: Planning District Commissions.

X: Exactly. Like the Northern Virginia Regional Planning Commission. I think it’s made of Louden, Fairfax, Arlington, and Alexandria. And so, although, in that case, I think Louden held back on some of its data and whatnot. Were as on the Maryland side it was told to counties individually. The local governments aren’t the regional planning commissions, they are the local counties and if a few cases the cities. That’s sort of one piece. And supporting the use of the TMDL again not knowing that...you said that 20 out of 48 respondents said the state supports them on the TMDL and (inaudible), that’s what I was sort of curious about how that 9 out of 26...because there is definitely stronger commitment on almost any environmental protection plan on the Maryland side to the idea, than the Virginia side. But often times the Maryland side jurisdictions won’t carry
out the work that they are actually supposed to do. Regional Planning Commissions and then this is interesting. It’s always interesting to look at the data and it generates questions always. Inaudible. Anyway again under the adaptive management out of a possible six, Maryland was a full 15%, a full 1 higher, than in Virginia. The Potomac was a little better than the Patuxent, but that’s because some of it is in Maryland and the Rappahannock being totally in Virginia at 3.3 and Patuxent all in Maryland at 5.2, you get some interesting question about both: how the rollout of information was handled by both Virginia and Maryland? And, then what kind of education, involvement support was provided in the last couple years. I’m just splashing around this with you here. A regulatory permit tends to get people focused, in the voluntary watershed implementation plan where we…well you can pledge that you are going to lose 10-pounds by Christmas time, I’m making this up. I don’t know how much you weight, but if you don’t lose 10-pounds, like whatever, you’re not going to jail. And that’s a watershed implementation plan, it’s voluntary in nature. But an MS4 regulatory permit, if you say-what’s a good analogy-if you say you are going to deliver a contract by, you know complete a scope of work by the 31st of December and you don’t. It’s a signed legally binding contract. I could potentially throw you in jail, because you broke the terms of the contract and it was a legally binding contract, so “hey I should lose weight” vs. “I can go to jail if I don’t provide the legally binding deliverables on this contract.” You are going to tend to focus on one problem more than the other. So that MS4 permit, at 4.4 vs. 3.2, without an MS4…”you know whatever, I’ve got a lot on my plate, I’m a small jurisdiction” and they don’t all have small “and don’t have much staff and so it’s a voluntary thing and it would
be nice and sure, but I’ve got other things that I’m required to do so I’m going to focus on them.”

RF: Right. I’ve hit on many of the questions that I had. So from your experience you would say that it seems local county and city officials have a better understanding of adaptive management and are better prepared to use it in the TMDL than Virginia?

X: Well that’s what your data says. In my other experiences I don’t think I’m qualified to make a statement independent of the data, but you know-in general Maryland is more likely to embrace certain concepts even if they don’t end up actually fully executing on it. Whereas, oh and I left this one out just so I don’t forget it. Virginia is what they call a Dillon Rule state, where all the power is reserved to the state, to Richmond, unless it is delegated to the localities. Which is the inverse, in states like Maryland where most of the power is local with the counties. So that’s another dynamic at play. I’m sure, in terms of how and why the differences, the higher scores for Maryland localities verses Virginia localities.

RF: Okay. Do you think that people in general understand adaptive management and how it works and how to implement it? And if you had to rank the three jurisdictions based on what you think their understanding of adaptive management is, can you rank the three?

X: The three being the three watersheds?

RF: Yes.

X: the Patuxent…Um, it’s interesting. I know a little bid about the Rappahannock and I know a little bit about the Patuxent. The Patuxent is a smaller geography, the smallest
geography in terms of land and the Potomac’s the largest. Do decision makers at the localities understand and/or use or apply the whole idea of sort of integration in a loop of you know you design projects, then monitoring and testing as you go, then adapting based on what you want.

**RF:** Right.

**X:** I’m trying to think, have I seen anything? I don’t know that I’ve seen anything, I mean I understand the concept, but have I seen anything on adaptive management even in Montgomery County v. Howard County or something just to stay on the Maryland side. Or Montgomery County vs. Frederick County to stay in the Potomac. I, you know Montgomery is clearly a much more sophisticated because they have bigger staffs. I mean they have a bigger department of environment, they have more expertise and experience than say a Frederick County. And Frederick has a lot more than, I don’t know if you covered, but an Allegany or a Garrett County. So that’s the other sort of, if you look at the big Fairfax and Montgomery counties of the world. Then there’s the in-between ones like a Louden or a Frederick, then more remote ones like a Frederick County, Virginia or an Allegany County, Maryland. You also have size in terms of, and some of that maps to MS4 permits because that is based on population. You almost can split them into big-urban and more suburban now, or rural and trying to stay rural. You know, I would expect this big established urban are going to be the most sophisticated under the MS4s and they have the budgets and the staffs, and they can go to training so they should know about adaptive management. Whereas, the rural counties are like “hey this is managed by someone who has 18 other responsibilities, and not all of them in the
environment/conservation/water quality space even.” It could be the sewage treatment plant guy that is responsible for this. So he was your respondent for this. But yeah the aquatic restoration director, if there is such a thing in Fairfax County.

**RF:** Right. That makes sense. What you’re saying certainly fits. Your comments at the beginning of your discussion when you talked about how the TMDL was rolled out between Virginia and Maryland, where Maryland communicated directly with the counties, and Virginia communicated through the Planning District Commissions.

**X:** Yeah.

**RF:** So that is certainly one way that two jurisdictions in different states might feel different in terms of being supported in this work. Are there other insights you could provide regarding that, that support whatever support means to you besides the way they communicated.

**X:** It’s a good question and, you know. Louden county at the time the Northern Virginia Regional Commission was trying to gather up plans Louden was very hesitant, resistant whatever to participating. And…

**RF:** You are referring to Loudon County, there isn’t a Louden Planning District, right?

**X:** Yeah correct. I appreciate you clarifying. Louden County was part of the Northern Virginia Planning District. The county was very reluctant/resistant, hostile is a little strong, but definitely didn’t want to participate. Some of that flow from the elected leadership. Staff often will take their ques, their leads, there whatever, directions in some cases I’m sure, from the local government. Whether it’s the county council or board of supervisors or whatever they’re called, but the elected local government. Louden County
has a very conservative nine member board of supervisors, well now it’s only eight because one had to resign, but nine member board of supervisors. Whereas, Montgomery has a very progressive nine member county council. So even in terms of feeling supported, wanting to participate, but in terms of other ways the state could support them. I know that in Virginia, Richmond, the state had a very small grant pool for sort of local assistance, local financial help. There were a bunch of grants awarded to localities a couple years ago. But if you got a grant does that mean anything, you’d have to poke around, I don’t, yeah let me think, and yeah I don’t have that list anywhere. Did the ones who got a grant feel supported and the ones who didn’t feel like they weren’t. I don’t know, but that would be an interesting sort of slice.

RF: Okay. So certainly funding structures play a role.

X: Yes. And when did you go out with this survey, this summer? I’m also thinking timing wise.

RF: Yes. It was at the beginning of this year.

X: this calendar year.

RF: Yes, and into the spring time.

X: Yep. I mean, what other variables. There is a new administration and a republican administration in Annapolis which is unusual. It’s not that it has never happened, but usually there is always going to be a new administration, but the fact that it was a republican not a democratic administration. I’m feeling all this pressure being the one person from the Potomac filling all these gaps, I’m just kidding. But I do think you know people follow the lead. The career executive branch staff at the local cities and counties,
they’re not going to stick their necks out if they think there head is going to get shot off. Depending on, if they are good enough to read the tea leaves to see how much latitude they have to run with something or not based on the political environment. So you know. But the adaptive management question that it sounds like you are really trying to drill down, yeah that’s one where I don’t have a good feel for you know “oh yeah, I’ve heard that these counties are really on the adaptive management and this one is hostile because they don’t, you know, think dinosaurs never existed.”

RF: Is there anything about one of these three watersheds: Patuxent, Potomac, or Rappahannock that makes them really distinct with respect to implementing the TMDL? There might be things about all three, and we could run down each of them. Or if there are a few specific things you want to point out, it’s up to you.

X: I think. The Rappahannock and the Potomac both have some pretty urbanized areas and then a lot more rural, but the Potomac’s clearly got the greatest population. You know, we’ve got 17 million people in the Chesapeake Bay watershed. Depending how you draw the circle in the DC Metro area to include Louden and Frederick is north of 5 million. It’s not to say that there isn’t population development pressure on the Rappahannock or polluted runoff, but development pace in the DC Metro a little bit spills over, but not to the same degree as the Patuxent. The development, the growth and increase of impervious surfaces. I talked earlier about different jurisdiction, but I don’t know if I know the Patuxent as well. I want to look at a map for a second [looks up map on computer]. Again, the Patuxent skirts, but doesn’t go through DC and it’s not in
Baltimore. It doesn’t have the population center in the middle of it the way the District is or the way Fredericksburg is on the Rappahannock.

**RF**: Kind of like what you’re saying. The Potomac’s multi-jurisdictional status makes it a challenge, or makes it different.

**X**: Right. And the good news talking about Maryland and Virginia, not that it’s huge because it’s not a huge land mass, but it’s huge in other ways. There’s this District of Columbia thing. There are going to be some dramatic changes there to water quality to eliminate combines sewer overflows in the next 10-years. And is the District a city, county, or state.

**RF**: Right.

**X**: The other differences, and again the Rappahannock and the Potomac are more similar, are the closest common pair that you could come up with. You know reach size, major cities, things like that.

**RF**: That’s the prepared questions I have. Are there other things that you want to say or are valuable to put in?

**X**: You know it’s a good question. And as appropriate down the road I’d love to – whatever your final product is – I’d love to see it. We are always trying to, because at the end of the day to clean up the Chesapeake Bay. To fully implement the Chesapeake Bay TMDL which is for the entire bay. Almost all of the implementation has to happen at the local level. In the case of Virginia and Maryland, unlike Pennsylvania, the local level is primarily the counties. There are few cities, the Alexandrias and the Districts, but primarily of the 52 that you looked at most of them are counties. And that is where all
the action is going to be and the success is going to hinge, because the Bay is a multi-
state – as is the Potomac, you need a federal framework because of the interstate issues.
But the implementation is totally at the local level and that’s why I think the expertise,
support, and understanding at the local level of what their options are and the plusses and
minuses, and what are the most cost effective options to reduce pollution is going to be
challenging. So, I just think in lean budget time, from a financial perspective I’m not
sure how much support any counties should be counting on from Annapolis or
Richmond. There’s not, and that’s why Maryland has tried to…well they haven’t.
They’ve tried to put in place and then revised a requirement for a local dedicated fund in
the 10 counties in Maryland that have MS4 permits, their Phase 1. So local dedicated
revenue streams to pay for all the work that will need to be done to eliminate all the
pollution flowing into creeks, runs, and streams. So, the state is saying we don’t have the
money, but we’re not going to have enough money so it has to come from the localities.
It’s sort of like saying “hey, we’re not getting enough support from the state.” The only
two ways I can see the state supporting in through technical assistance or money. And
money is more important than technical assistance to a lot of these. And “hey no, they
told us we have to clean it up, and I’m not getting a lot of support.” I’m not surprised that
only 20 out of 48, so 40% feel like they are getting state support. Isn’t that what you said
20 out of 48 total respondents?

RF: That’s right.
X: So 40-44% feel like they are getting support, it’s a clear minority and it’s all around the money. I suspect that’s how they find support as opposed to “Rah Rah here’s a sticker, clean water Maryland, clean water Virginia.” You know?

RF: Right. Great, I want to thank you very much for you time.

X: You bet. Interesting project.

RF: I will do my best to get you a summary of the thesis. I’m sure you won’t want to read the whole thing

X: Okay. Thanks a lot.
DATE: February 26, 2014

TO: R. Chris Jones, PhD
FROM: George Mason University IRB

Project Title: [541083-1] Chesapeake Bay TMDL - Adaptive Management

SUBMISSION TYPE: New Project

ACTION: DETERMINATION OF NOT HUMAN SUBJECT

RESEARCH DECISION DATE: February 26, 2014

Thank you for your submission of New Project materials for this project. The Office of Research Integrity & Assurance (ORIA) has determined this project does not meet the definition of human subject research under the purview of the IRB according to federal regulations.

Please remember that if you modify this project to include human subjects research activities, you are required to submit revisions to the ORIA prior to initiation.

If you have any questions, please contact Karen Motsinger at 703-993-4208 or kmotsing@gmu.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within George Mason University IRB's records.
**Review Details**

**[541083.2] Chesapeake Bay TMDL - Adaptive Management**

**George Mason University IRB, Fairfax, VA**

### Submission Details

- Submitted To: George Mason University IRB, Fairfax, VA
- Submitted by: Richard Friesner
- Submission Date: 02/04/2015
- Submission Type: Amendment/Modification
- Local Board Reference Number

### Board Documents:

There are currently no documents from George Mason University IRB.
DATE: September 3, 2015

TO: R. Chris Jones, PhD
FROM: George Mason University IRB

Project Title: [541083-3] Chesapeake Bay TMDL- Adaptive Management

SUBMISSION TYPE: Amendment/Modification

ACTION: DETERMINATION OF NOT HUMAN SUBJECT

RESEARCH DECISION DATE: September 3, 2015

Thank you for your submission of Amendment/Modification materials for this project. The Office of Research Integrity & Assurance (ORIA) has determined this project does not meet the definition of human subject research under the purview of the IRB according to federal regulations.

Please remember that if you modify this project to include human subjects research activities, you are required to submit revisions to the ORIA prior to initiation.

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Title 40: Protection of Environment PART 130—WATER QUALITY PLANNING AND MANAGEMENT, Title 40: Protection of Environment PART 130—WATER
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BIOGRAPHY

Richard Kenneth Friesner graduated from Valley High School, Albuquerque, New Mexico, in 2000. He received his Bachelor of Science from the University of Kansas in 2004 and Master of Science in Environmental Science from the University of Kansas in 2006. Richard was employed as an Environmental Scientist and promoted to Department Manager for Environmental Services at Professional Service Industries, Inc. between 2006 and 2010. He began working as the Program Director for the Washington Youth Summit on the Environment (WYSE) at George Mason University in 2010 and was promoted to Director of the Washington Scholars Program and Special Partnership within the Office of Admissions in 2013 while still coordinating the WYSE program. Richard is married to Bethany, has two children Benjamin and Samuel, and lives in Fredericksburg, Virginia.