CHAPTER 1 [1]
ANALYSIS OF PHYSICAL AND ENVIRONMENTAL CONDITIONS

A. INTRODUCTION

A Comprehensive Plan for Northumberland County should have two broad objectives. First, it should identify long-range and strategic community needs of the County's growing population and second, it should provide a planning framework designed to guide physical change which comes in response to such growth.

The Virginia Code (starting with Title 15.2-2223) authorizes all local governments to prepare and administer comprehensive plans and related regulatory functions. Comprehensive Plans are mandated for all of Virginia's local governments by these statutes; and it is also a requirement that they be reviewed every five years (Title 15.2-2230). Tools for implementing the comprehensive plan include a subdivision ordinance, and a zoning ordinance. The subdivision ordinance is mandated by the general planning statutes. Zoning was first mandated by the Chesapeake Bay Preservation Act (1989) but the County has had a zoning ordinance (authorized by the general planning statutes) since 1974. Regulations adopted pursuant to the Chesapeake Bay Act establish the following planning requirements for comprehensive plans of communities under their jurisdiction.

- **Physical Constraints to Development**: which addresses those natural geographic qualities which seriously limit the potential for development.

- **Protection of Potable Water Supply**: which is concerned about protecting the existing and potential supply of drinkable water within the community.

- **Shoreline Erosion Control**: which focuses on the loss or potential loss of shorelines due to erosion caused by wind, waves and boat wakes.

- **Access to Waterfront Areas**: which deals with access and potential access to areas for private as well as public use.

- **Redevelopment of Intensely Developed Areas and Other Areas Targeted for Redevelopment**: which focuses on opportunities to reduce pollution through conversions of existing development.

This chapter of the Comprehensive Plan focuses on current physical and environmental conditions that may influence or limit the future use of land. The conditions examined include both natural and man-made conditions which for purposes of analysis are grouped into the categories as listed above. They reflect the planning emphasis of the Chesapeake Bay Preservation Act, with the exception of the category "redevelopment of intensely developed areas." No areas in Northumberland County meet the Chesapeake Bay Act criteria of intensely

[1]Filename = Chapter_1_ Final

developed areas.

These analyses will be used in later chapters as follows: In Chapter 2, environmental issues and strategies will be organized around these four topics; in Chapter 3, the structural framework of the Future Land Use Plan and land use policies will flow from the analysis plus the issues of Chapter 2; and in Chapter 5, Water Quality Preservation Plan, a strategy for meeting the requirements of the Chesapeake Bay preservation laws and regulations, will be organized around the same topics. Also included as Appendix A to the Plan Report will be a study of the Economy and Demographics of the County which provides the basis for growth projections upon which the plan is based.

The format used throughout the Comprehensive Plan will follow the same five criteria of the Chesapeake Bay Preservation Act. Another important factor in selecting the format for this Chapter is the requirements of the Virginia Statutes concerning comprehensive plans for local communities. In this regard, the analyses should provide a thoroughly researched basis for determining need and formulating the substance of the comprehensive plan.

The Northern Neck Planning District Commission's (NNPDC) work in revising this Chapter is predicated on prior work performed by the County, which is hereby acknowledged. The NNPDC has provided certain maps of physical conditions that were originally established in the Virginia Geographic Information System (VIRGIS).[2] Through a series of electronic steps, these maps were converted to the form in which they appear in this Chapter. The County also provided the NNPDC with a digital file of a previous draft of the physical analysis section of the Comprehensive Plan.[3] Where applicable, much of that original text is used here.

Maps displayed in this Chapter were produced by the Northern Neck PDC using ESRI's ArcGIS 10.0 desktop GIS software.[4] They include a combination of maps prepared from VIRGIS sources and original maps prepared for this Plan by the NNPDC.

[2]Northumberland County uses data from the Virginia Geographic Information System (VIRGIS) developed by Virginia Tech and maintained by the Northern Neck Planning District Commission.

[3]File name of County's work is: "Chapter_1.doc", and was downloaded from Northumberland County's website, http://www.co.northumberland.va.us.

[4]ArcGIS 10.0 is proprietary desktop mapping software created and marketed by Environmental Systems Research Institute (ESRI). VIRGIS data has previously been converted from its native DLG3- Optional format to ESRI ArcGIS Shapefile format by the NNPDC. VirGIS Raster Layers (elevation, erosion index) were imported using ESRI's Spatial Analyst extension for ArcView 3.2.

B. PHYSICAL FACTORS THAT INFLUENCE OR CONSTRAIN DEVELOPMENT

Many factors can influence the type as well as the timing of development and most of these are related to markets and economic conditions. Early in the life of this Nation, most of the population relied on agriculture of one type or another for both employment and to meet their needs for foods and services. After the beginning of the industrial revolution, towns and urban places became more important as jobs and trade centers. As jobs were generated by industries, markets for housing, trade and services were generated as people moved from rural areas to urban places in order to be close to their work. This pattern resulted in mass migration to towns, cities and metropolitan areas during the last century. As a result, the rural areas lost population for most of the first three-fourths of the 20th century.

But certain areas appear to have a capacity to attract people for recreation or retirement based on the natural resources of the community itself and the quality of life. Some such communities have become magnets for retired persons and great centers of tourism which, in and of themselves, function as job centers. Although still very much a rural community, Northumberland County has attracted a large retirement population as evidenced by the large amount of building that has been taking place along the County shorelines. It went through a long period of declining population, but for a decade or more the County is again experiencing growth, this time from the attraction of the County itself. With more miles of buildable shoreline than any other county in Virginia, Northumberland has an asset that has become a growth generator. Waterfront development accounts for three out of four residential lots in the County and most of the new residential structures built in the past decade. A demographic and economic study (Appendix A) conducted as part of the research for the comprehensive plan suggests that the County will see much more of this type of development during the next decade. However, there is a fixed amount of shoreline in the County, and each year, as more waterfront residences are constructed, that resource is reduced.

Certain parts of the County have already proved to be desirable as building sites, and since "success builds upon success" one might expect these areas to attract more development. The most suitable sites for waterfront development have already been developed, which forces new development into less suitable, more environmentally sensitive areas. The factors below need careful attention whenever new development is proposed, either waterfront or inland. In the following pages some of the most significant conditions that will influence or constrain development are dealt with in detail. They include:

1. Existing development
2. Topography, physiography and hydrography
3. Prime agricultural soils
3. Soil suitability for on-site sewage treatment
4. Shrink-swell soil factors

5. Flood-prone areas
6. Wetlands and natural habitat areas
7. Historic resources
8. Chesapeake Bay protected areas

Each of these topics is discussed briefly below. Where information is available, major physical features that would affect potential development are shown with a map. The narrative provides related descriptive information and significant observations as to how the conditions may influence planning policies.

1. Existing Development

Existing development has a powerful influence on future land use patterns because future development in rural communities almost always comes either as an extension of existing development or on new land but rarely as a replacement of existing buildings. Developers are encouraged to reuse/renovate existing buildings, as this makes good economic sense while at the same time preserving open space in the county. For purposes of planning for one or two decades, one might consider the existing development pattern as a fixed feature. This section reports on existing land use and existing subdivisions with a special analysis of shoreline subdivisions included.

a. Land Use

Figure 1.1 gives a graphic picture of existing development in Northumberland County in 2015. This map was developed from E911 data obtained from the County Office of Building and Zoning in April 2015. The E911 data contains all addressable structures in the County.[5]

- Residential Structures: This category includes all dwellings that are not included in the other two categories below. As mentioned in the footnote, all addressable structures are included. This use is illustrated by round gray dots on the Existing Development Map (Figure 1.1). There are a total of 12,898 structures in this category shown in this illustration.

- Business/Commercial Structures: All commercial-type structures are included such as retail stores, offices, convenience stores, personal and business service shops, as well as industrial and marine structures. They are shown on the map as a round red dot. There are a total of 578 commercial structures indicated on the map. These structures were manually coded from the "Name" field in the E911 rural structures

[5]Addressable buildings include garages, sheds, boathouses and other accessory structures, as well as commercial/industrial buildings, single and multifamily residences. The numbers of structures listed below may seem high; however, all are ground-truthed by the office of Building and Zoning. In addition, abandoned buildings are included in the data.

database.

- Public: This is a mixed category which includes mostly county buildings or facilities, schools, and church structures. There are 100 structures in this category and they are shown on the map by a green dot. These structures were also coded from the E911 rural structures database.

- Semi-Public: This category includes civic organization structures such as hunt clubs, homeowner's associations, historical societies, and others. There are 36 of these structures, and they are shown on the map as a magenta dot. These structures were identified from the E911 rural structures database.

This map illustrates the primary characteristics of development in Northumberland County. It is concentrated along existing roads and along the waterfront. Residential development appears along all roads while most of the commercial development is located along the primary highways. A concentration of commercial development within several villages is especially visible from this map. While it appears there are substantial commercial structures along the waterfront, it is often a home-based business such as sign making or a tree service company. On the other hand, charter boat operations and seafood structures are water-dependent uses and are also shown.

The largest single category of land use is for agriculture and forestry as illustrated by the large amount of white area on the map. Farming and forest uses have remained fairly untouched by development at this stage, except for conversions of land to development along the various waterfronts.

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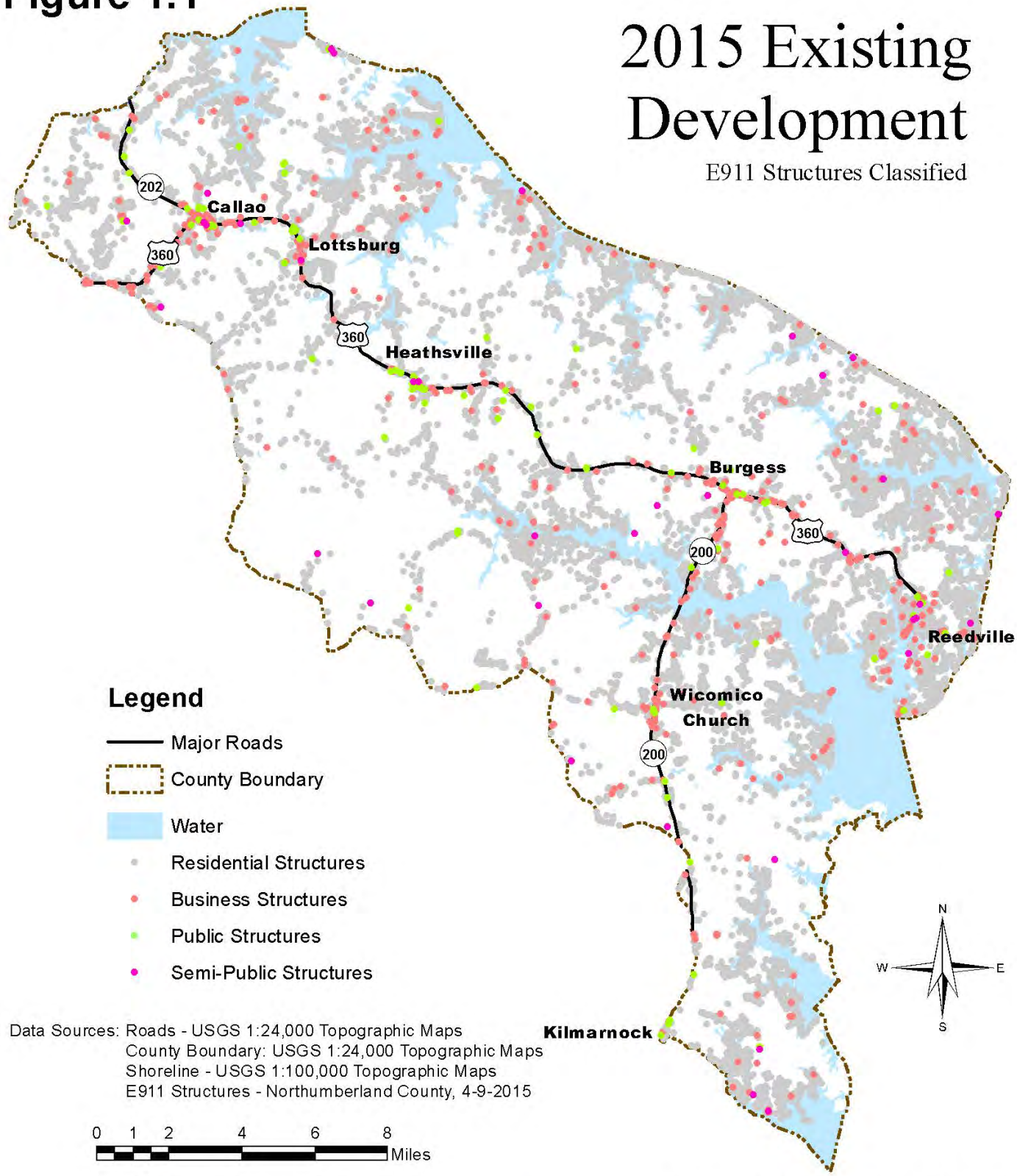
Figure 1.1



This project was funded by the Northern Neck Planning District Commission and the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant #NA14NOS4190141 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended.

b. Subdivisions

New subdivisions are important in evaluating development potential because once subdivision lots are recorded and streets developed to serve them, as a practical matter, the landscape of that land is changed forever. This may account for the fact that subdivision ordinances were one of the first planning tools mandated by state legislation. Subdivisions have played an important part in the development of Northumberland County during the last two decades, particularly development along the waterfront. While data is available on individual subdivisions, there is no inventory of subdivisions and waterfront vs. non-waterfront properties. Anecdotal evidence indicates more than three-fourths of all subdivision lots are occurring in waterfront developments. Figure 1.2 provides a graphic representation of the location of major waterfront subdivisions located within the County. There is no one specific concentration of subdivisions on any of the rivers or creeks; they are dispersed along the shorelines throughout the County.

It appears that in many of the larger subdivisions, only a small share of the lots are actually on the waterfront; the remaining are inland lots. And while the majority of the waterfront lots have been developed with homes, most of the inland lots are still vacant. These vacant lots that are already platted can be developed quickly, and could impact the demand for services in the County if the majority are developed.

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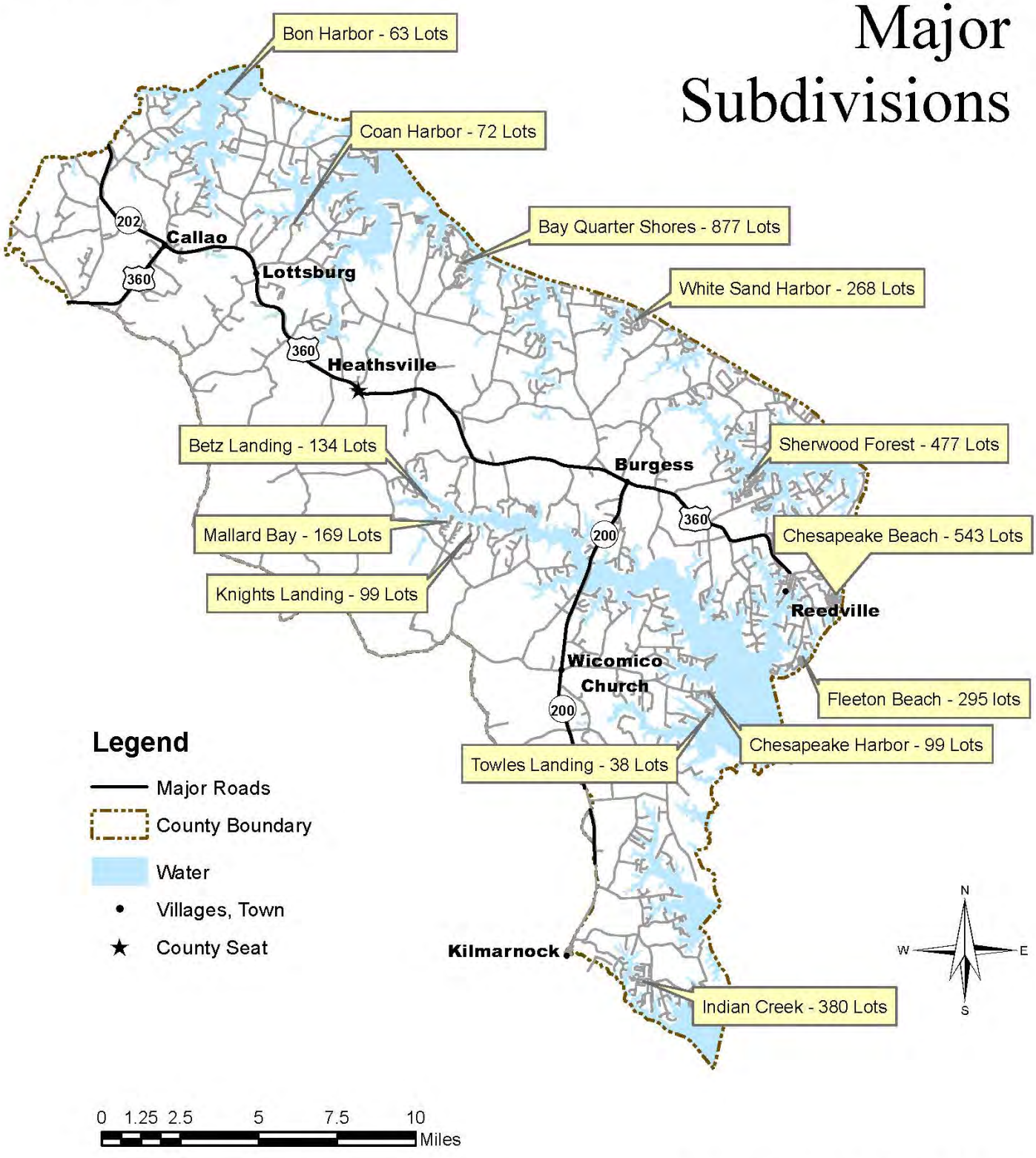
Figure 1.2



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2. Topography, Physiography and Hydrography

a. Topography and Physiography

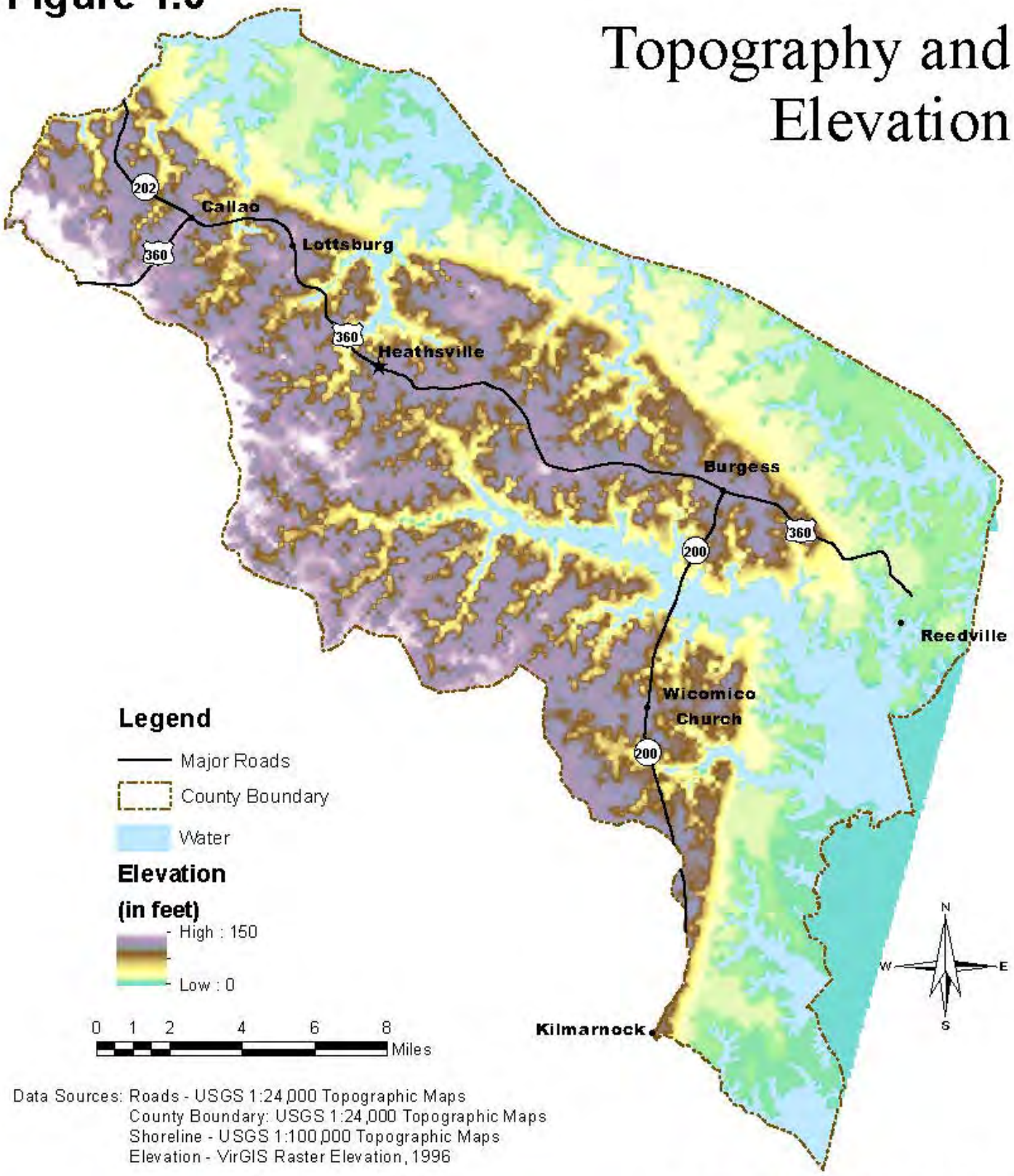
The topography and physiography of lands can greatly influence surrounding natural resources. The amount and rate of runoff and groundwater discharge which ultimately reaches water bodies are influenced by the size, shape, and topographic, physiographic and hydrographic characteristics of a watershed. Typically, runoff rates and the potential for erosion increase as slopes increase.

Elevation levels within Northumberland County range from sea level to approximately 150 feet. Although Northumberland County lies within the Coastal Plain region, the County contains three physiographic sub-regions which vary from flat coastal lands to hillier areas. The fluvial river terrace sub-region includes tidal marsh areas along major rivers and creeks and some adjacent lands which range from 10 to 50 feet above sea level. The low marine terrace sub-region ranges from 10 to 15 feet above sea level and typically lies between the fluvial river terrace and the upland. The fluvial river terrace and low marine terrace physiographic sub-regions comprise a band of level terraces along most of the Chesapeake Bay and the lower portion of the Potomac River. The coastal plain upland sub-region includes the inland plateaus as well as the cliffs along the two major rivers in the County, with elevations ranging from 90 to 150 feet above sea level. Figure 1.3 is a map showing the topography (elevations) of the County.

A conspicuous feature of Northumberland County's topography is an escarpment known as the "Suffolk Scarp". This feature which runs along the entire eastern coast of Virginia is located approximately two to three miles inland and is marked by a sharp drop in elevation at about 50 feet above sea level.

Figure 1.3 illustrates the principal topographic characteristics of the County. In particular, this map delineates clearly the Suffolk Scarp. The area between the "drop-off" and the shoreline of the Potomac River and Chesapeake Bay occupies nearly half of the County's total area and almost all of the area in demand for new development. Other maps and/or data appearing later in this Chapter will show that much of the area that lies seaward from the Suffolk Scarp is disadvantaged by poor percolation. In addition to the difficulty finding soils that are suitable for septic systems, much of the land along the internal rivers and streams have slopes in excess of 15 percent. There is the problem of increased soil erosion in cases where slopes are both "steep" and "highly erodible". Careful attention should be given to ensure that new development is adjusted to these sensitive features of the soil and topography. *(Highly erodible soils will be discussed in more detail in C.3.b.)*

Figure 1.3



Data Sources: Roads - USGS 1:24,000 Topographic Maps
County Boundary: USGS 1:24,000 Topographic Maps
Shoreline - USGS 1:100,000 Topographic Maps
Elevation - VirGIS Raster Elevation, 1996

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b. Hydrography

Figure 1.4 presents the hydrography of the County – the locations of the streams, rivers and ponds. Northumberland County has an abundance of streams that channel water towards the rivers and eventually the Chesapeake Bay. The density of streams in the county is highest in the upland area, where the topography of the land creates headwater streams. As the land descends to the rural low shelf, the streams become less dense, as there is little topography that generates stream confluence.

Almost anywhere in Northumberland County, you are not far from a stream. Whether it is a small ephemeral stream, a larger perennial stream, or a free flowing tidal creek or river, you seldom have to travel more than a mile in any direction to encounter flowing surface water. Most streams begin in the gullies and ravines in the upland that are forested. The streams then join with other first order streams to create second order streams and so forth, ever growing in size and volume. The larger rivers in the county, progressing from north to south are the Yeocomico, Glebe, Coan, (all draining into the Potomac) the Little Wicomico, Great Wicomico, Indian Creek and Dividing Creek (which drain into the Chesapeake Bay).

Nearby streams can be polluted by careless persons. Citizens need to be aware that some of the actions they routinely do could harm stream health. Over-fertilizing lawns, careless handling of automotive fluids, and other day-to-day activities can pollute nearby streams and groundwater. Care is needed to minimize human impacts to surrounding surface and groundwater.

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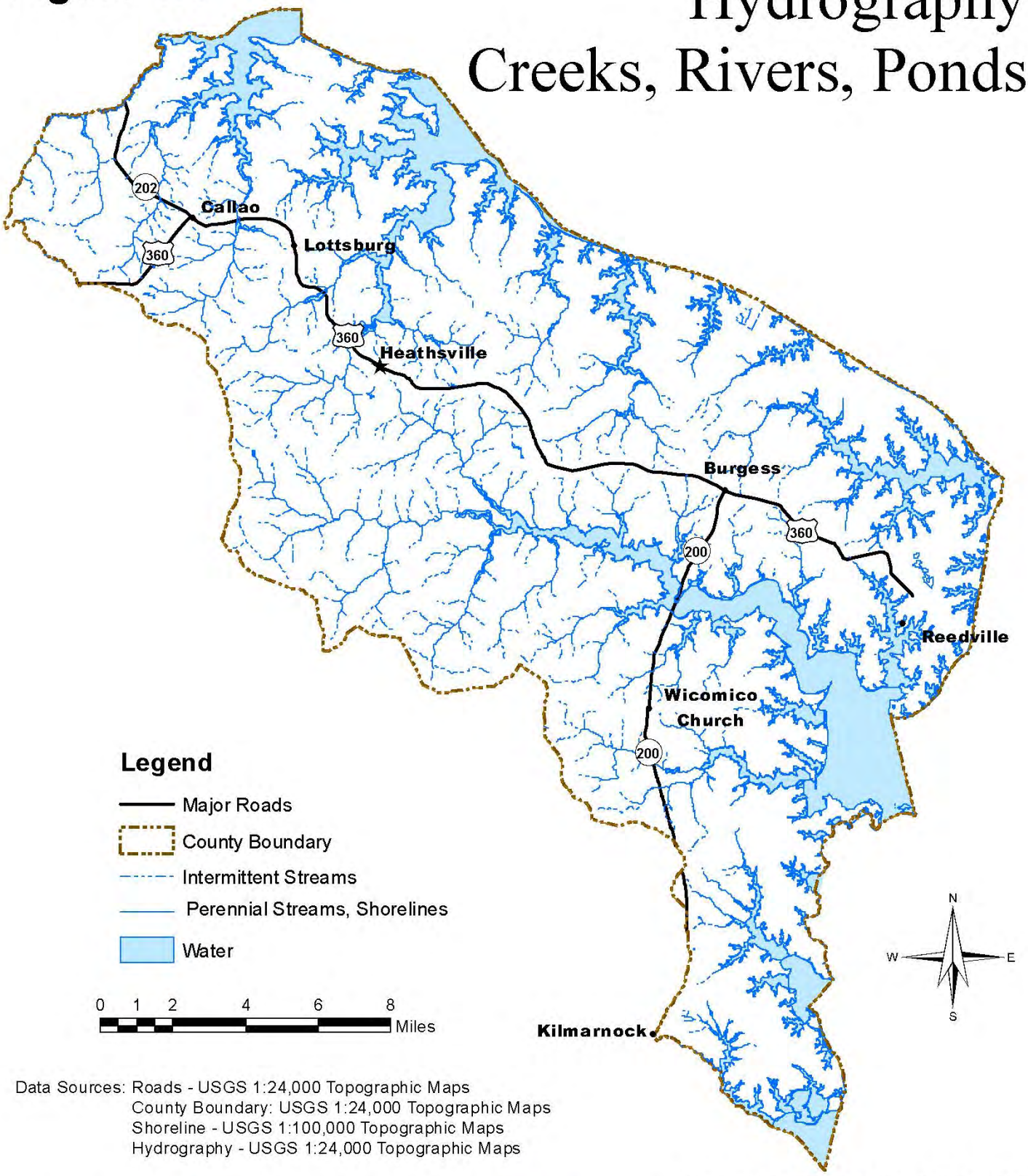
Figure 1.4

Hydrography
Creeks, Rivers, Ponds



Data Sources: Roads - USGS 1:24,000 Topographic Maps
County Boundary: USGS 1:24,000 Topographic Maps
Shoreline - USGS 1:100,000 Topographic Maps
Hydrography - USGS 1:24,000 Topographic Maps

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3. Prime Agricultural Soils (Prime Farmland)

Prime Agricultural Soils have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. They have the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to current farming methods. In general, prime farmland has an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, an acceptable level of acidity or alkalinity, an acceptable content of salt or sodium, and few or no rocks. Its soils are permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods of time, and it either does not flood frequently during the growing season or is protected from flooding. Figure 1.5 presents the prime agricultural soils of Northumberland County.

All of the soil qualities that make for high agricultural production are also desirable characteristics for building sites. Thus, these soils are more likely to be built upon because of their suitability for supporting foundations and conventional septic systems. In addition to the favorable soil characteristics, these lands have been previously cleared of trees, shrubs and vegetation so that the land can be cultivated. Therefore, there are no costs associated with land clearing. A developer or landowner can begin construction as soon as the land changes ownership, putting additional developmental pressure on prime farmland.

Why should we be concerned with the loss of Prime Farmland?

Food is produced on prime farmland more efficiently and with less soil erosion, resulting in less pollution from sediment, nutrients and pesticides. When prime land is lost, it not only takes more non-prime land to produce the same amount of food, but also results in lower returns per unit of production input. This means either higher domestic prices or fewer products to sell. In addition, if these areas are lost to production, more marginal lands may be cultivated, which could pollute nearby streams with sediment and phosphorous.

The United States is a food-exporting country. Loss of prime farmland, as mentioned above, eventually reduces our export potential or forces into production land previously considered marginal. Much of this marginal land should remain in forage or forestry production to prevent the land resource from being damaged. Often this marginal land is adjacent to the prime farmland. When this land is in forage or forestry, it acts to absorb any nutrients that do flow off the cultivated land. When this marginal land is pressed into production, the buffer action is lost, and pollution can be transmitted to nearby water bodies.

Loss of agricultural land to urban development, by and large, is irreversible. When cropland is diverted to forestry, forage production or recreation uses, the land can be easily returned to intensive crop production, if need be. However, when the land is developed (converted to urban or suburban land use or subdivided), it is impractical, if not impossible to bring such land back into production again. Policies may be established to protect desirable agricultural land and at the same time provide the property owner the

ability to take advantage of rising property values using open space concepts as discussed in Chapter 3.

Prime farmland is a component of healthy economy. The County has policies in place that can protect prime farmland so as to keep agricultural production at a high level (and generate taxable income), and reduce pollution at the same time. Deferred land use value taxation allows landowners that have their land in agricultural and forest production to pay less tax, so as to increase their return on investment. If the landowners develop the property, then they have to pay back the difference between the deferred tax amount and the standard tax amount for the prior five tax years. This policy helps keep farmland in production and may slow the conversion of farmland to residential property in the county.

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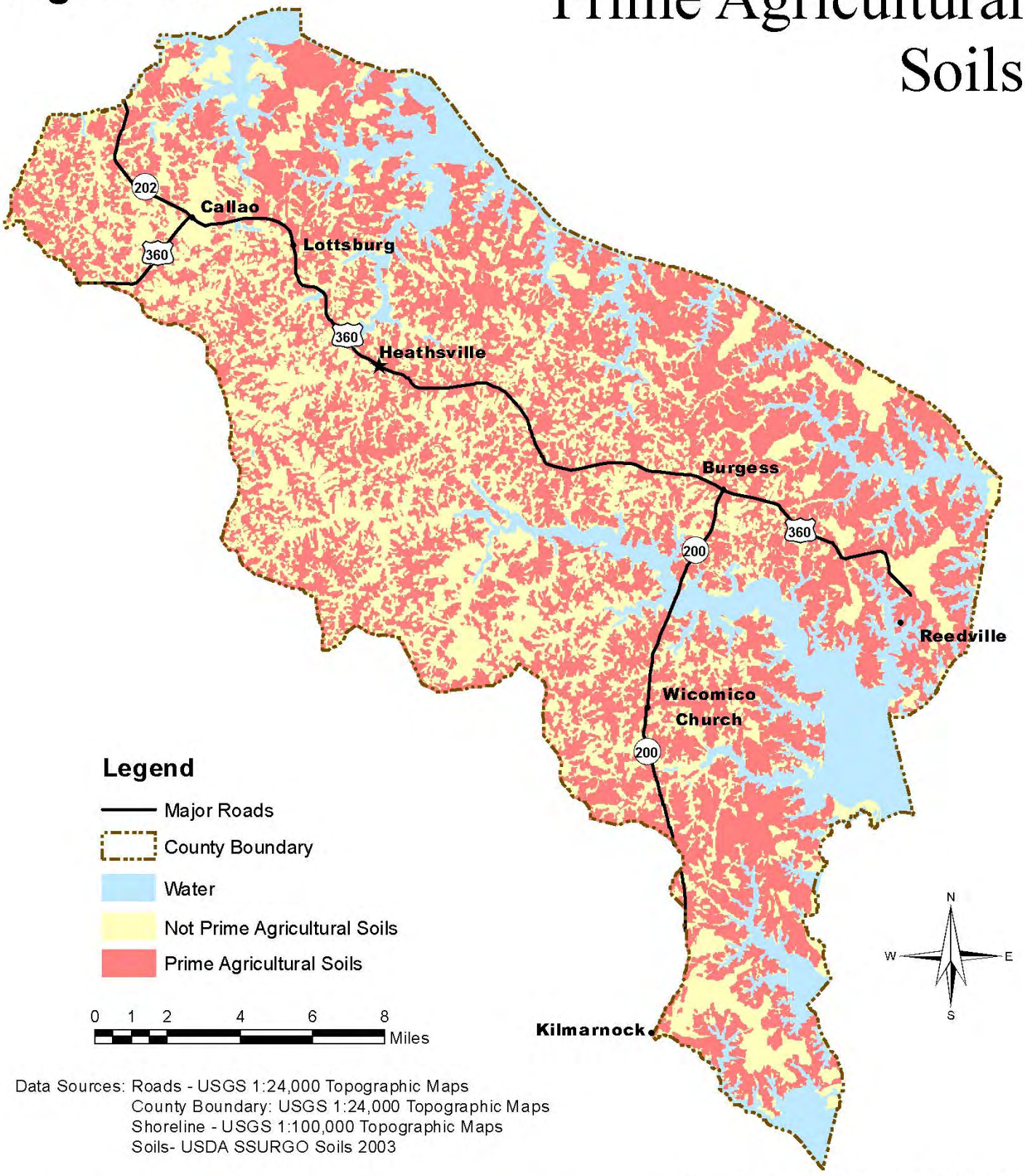
Figure 1.5

Prime Agricultural Soils



Data Sources: Roads - USGS 1:24,000 Topographic Maps
County Boundary: USGS 1:24,000 Topographic Maps
Shoreline - USGS 1:100,000 Topographic Maps
Soils- USDA SSURGO Soils 2003

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4. Soil Suitability for On-Site Sewage Treatment

One of the most important factors to consider in determining soil suitability for development in rural areas is the suitability of the soil for sewage disposal through the use of septic drainfields. Because Northumberland County is not serviced by a public sewage system (except for Reedville, Fleeton, Callao, and North Kilmarnock, see Figure 1.6, Sewered Areas Map), careful consideration must be given to the design, construction, and maintenance of septic tank systems or other on-site sewage disposal systems located on questionable sites such as those in flood prone areas, on steep slopes, or with poorly-drained soils.

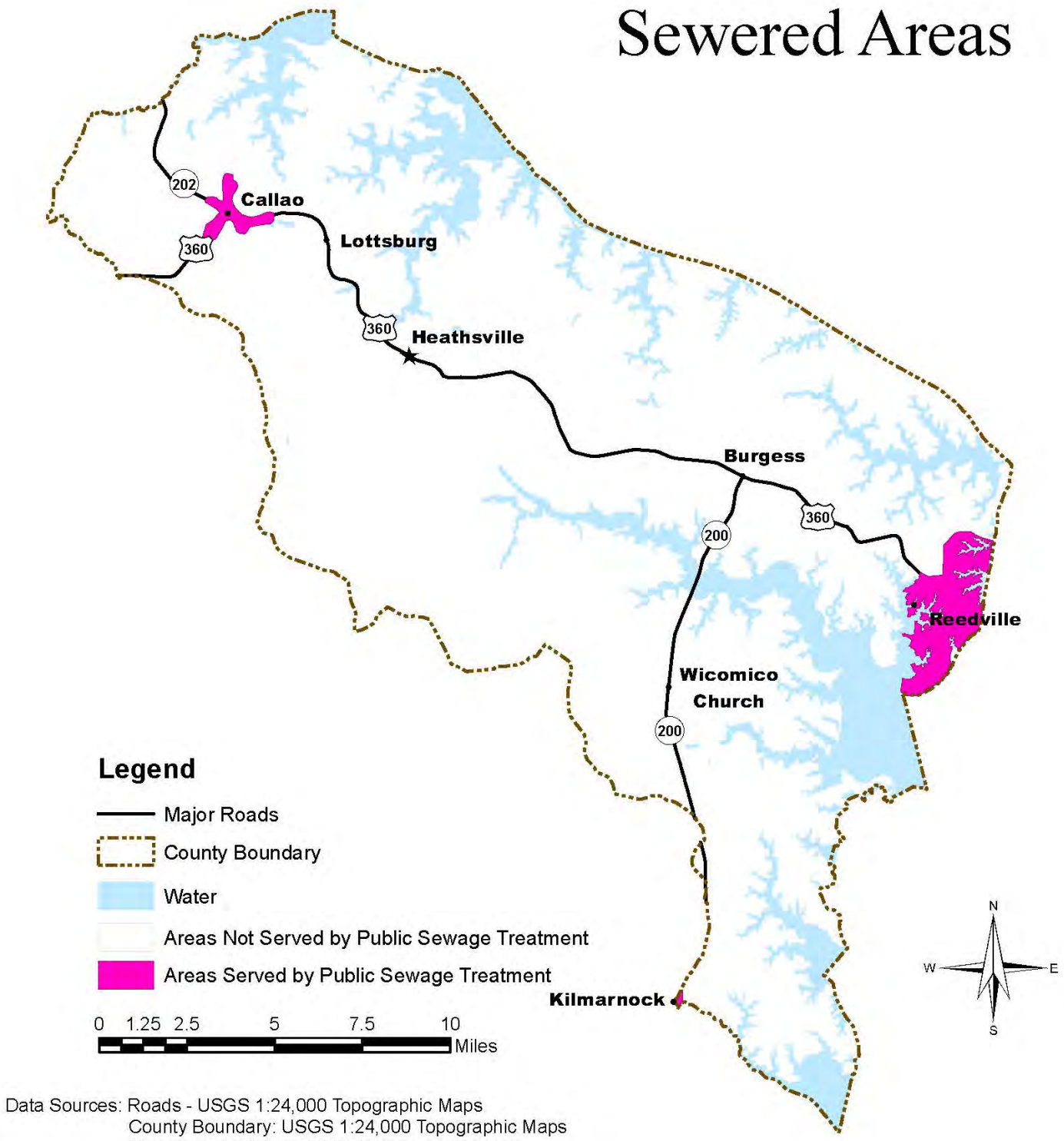
Figure 1.7 Conventional Septic System Suitability, illustrates those areas within the County that have characteristics which are generally unsuited for establishing conventional septic tank drain fields. This map is a composite of factors from the United States Department of Agriculture's (USDA) Soil Survey that limit the soil's capacity to accept septic tanks. Locations of high water tables, steep slopes, flood prone areas, and soils with inappropriate permeability rates were combined to determine areas in the County where soils are suitable to support septic systems. The county soil surveys are to be used as a planning tool, and as such, have limitations. No doubt, areas of suitable soils for septic tanks occur within the areas coded as "poor".

Most of the problem areas are in the low lying area spanning a two-to-three mile band that roughly parallels the Chesapeake Bay and the Potomac River shorelines. This area is characterized by elevations lower than 50 feet above sea level. In addition, there are a large number of smaller problem areas that run throughout the County. These are mostly located along streams and include stream banks and other steep slopes. The latter is a problem not only for septic tanks but also as a source of soil erosion. Erosion can result when unstable soil is disturbed particularly if the slope is steep.

Despite the conditions noted above, it can be observed from Figure 1.7 that most of the land area within the shelf area between the Suffolk Scarp and the shorelines may have acceptable soils for conventional septic tanks. Nevertheless, this is an area where caution should be used in selecting sites where on-site sewage disposal is necessary.

Some clay and silt soils in the County are poorly suited for sewage disposal because their low permeability characteristics limit the rate which water moves down through the soil. An example of this situation occurs in Callao, where Beltsville soils contain fragipan, a dense soil layer beneath the surface which contributes to water quality impacts and presents a risk to human health. Soils with extremely low permeability may cause septage to rise to the surface, and obvious risk to human health. The state standard is that a permeability of less than 0.6 (0.6 inches of percolation per hour) is unacceptable for septic tank fields.

Figure 1.6



Data Sources: Roads - USGS 1:24,000 Topographic Maps
County Boundary: USGS 1:24,000 Topographic Maps
Shoreline - USGS 1:100,000 Topographic Maps
Sewered Areas - VDH, DSS and Northumberland County staff

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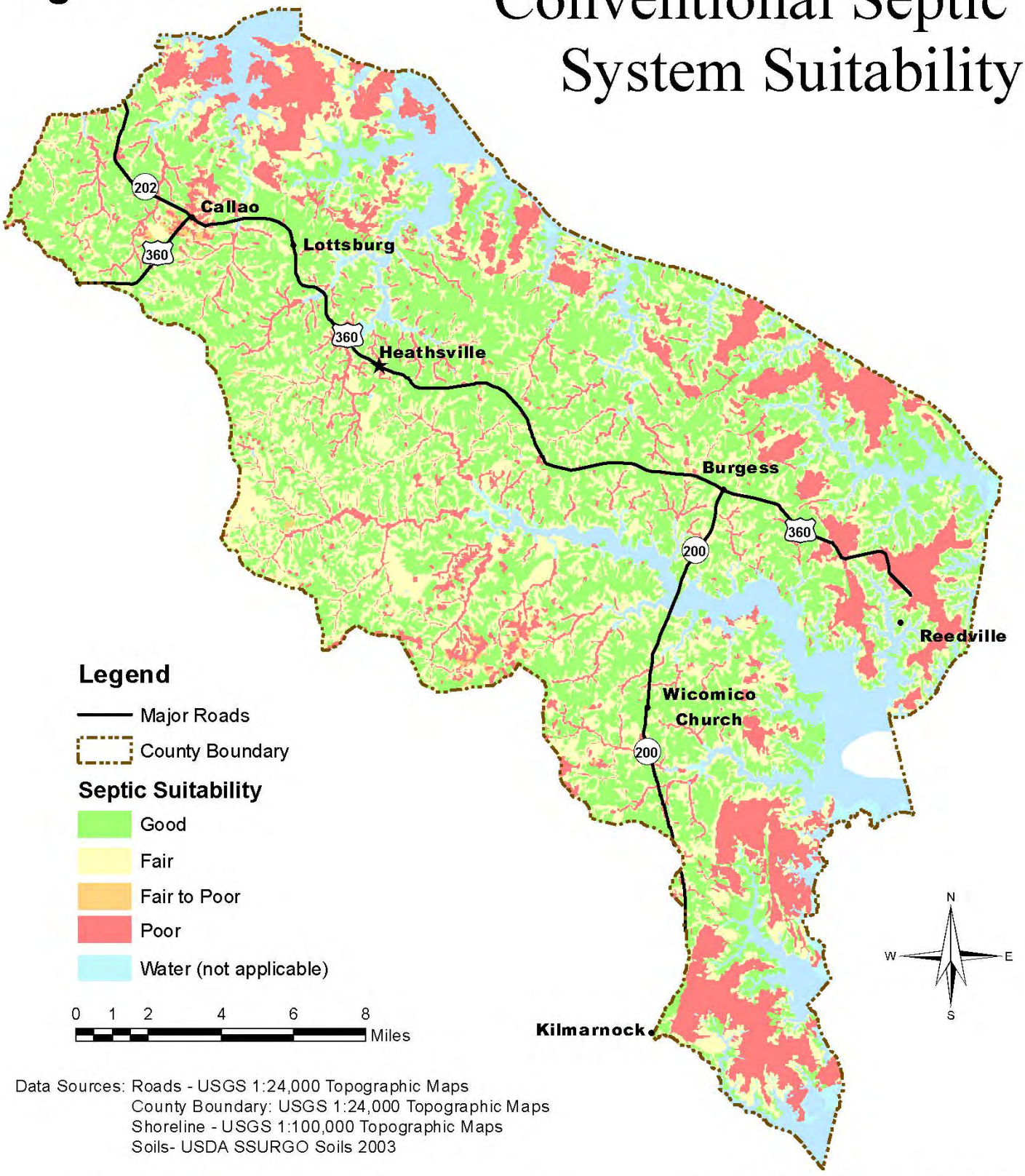
Figure 1.7

Conventional Septic System Suitability



Data Sources: Roads - USGS 1:24,000 Topographic Maps
County Boundary: USGS 1:24,000 Topographic Maps
Shoreline - USGS 1:100,000 Topographic Maps
Soils- USDA SSURGO Soils 2003

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At the other end of the range, highly permeable soils are also unsuitable for installation of conventional septic systems, because the effluent moves through it too fast to provide adequate treatment, having the potential to contaminate groundwater. State standards establish "6.0 inches per hour" as the maximum permeability acceptable for septic tank installation.

In summary, most of the development that is likely to occur within the County in the near future, given the large number of subdivision lots in scattered subdivisions, will require septic tanks - the only viable option for sewage disposal in these areas. The ability to install septic tanks will depend entirely upon the suitability of the soil for drain fields. The determination of whether the soil is acceptable for drain fields is to be made by the Health Department on a case-by-case basis. "Percolation", as the process for the ground accepting the outflow from septic tanks, refers to the rate that the water will pass through the soil while it is saturated. If percolation occurs too fast, then the septic tank fails because the drainage passes through the soil too quickly. If it occurs too slowly then the drainage may pass horizontally through the soil untreated and contaminate the underground water supply.

In 2000, the State passed more stringent separation distances between septic absorption fields and the first occurrence of groundwater (the water table aquifer). At the same time, recent developments in technology have given rise to engineered residential septic systems that are allowed by the Health Department in areas previously deemed “undevelopable” due to soil conditions. Most rely on some type of secondary treatment to treat and disinfect the septage before releasing it into the ground. The cost of these systems is approximately three times the cost of a conventional septic system. There are systems that use peat moss to filter, systems that use low pressure to ”dose” the field, and others that use oxygen pumped into a chamber to treat septage. Regardless of the technology, a maintenance agreement between a qualified company and the property owner is required, as these systems must be maintained properly to protect groundwater. Annual reporting to the Health Department of the results of the inspection by a qualified inspection company is also required.

Every effort should be taken to minimize threats to groundwater in the County, particularly because the County relies entirely on groundwater for its potable water. The groundwater of the surficial aquifer can be protected by increased vertical separation between a drainfield and the water table. Such separation provides adequate biological treatment, minimizing contamination of surface and ground water. In 2000, the State passed more stringent separation distances between septic absorption fields and the first occurrence of groundwater (the water table aquifer). This law grandfathers existing septic systems to the old distance, provided they do not fail. However, if the conventional system fails, the new regulations take precedence. The implications of this is that some of the older septic systems, when they fail, may need to be replaced by engineered or alternative septic systems in order to meet Health Department regulations.

Percolation and depth to groundwater testing should be completed prior to subdividing or platting land to ensure that purchased lots have primary and reserve sewage disposal areas on site. Homeowners should be encouraged to use water conservation devices to ease the load on septic systems. In addition, purchasers of land need to be aware that many developers have been creating reserve septic system drainfields to comply with the Chesapeake Bay Preservation Act that will only accept expensive engineered secondary treatment systems. While these small

reserve drainfields may be due to site limitations, those who purchase land for residences need to know the economic consequences if the primary septic system fails. It is also important for homeowners to understand that conventional septic systems have a lifespan of 25 to 30 years and that all, given enough time, will eventually fail. The best way to extend the life of a conventional septic system is to reduce the hydraulic load on the system and have it inspected or pumped every five years. Low flow water fixtures are the easiest way to reduce the hydraulic load on the system, while at the same time conserving potable groundwater. Garbage disposals should be avoided because they greatly increase the load of solids on the septic system.

5. Shrink-swell Factors

Shrink-swell is the potential for volume change in a soil with a loss or gain in moisture. Volume changes occur mainly because of the interaction of clay minerals with water which varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of change in soil moisture content influence the amount of swelling of soils in place.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special engineering designs must be used to compensate in such conditions.

Figure 1.8 illustrates the general shrink-swell potential of Northumberland County's soils using a four-step classification.

- High shrink-swell soils (the lowest quality) are present within the area between the shoreline and the Suffolk Scarf, but this type of soil is not the dominant class even in this area which otherwise has some soil qualities that are averse to development.

- Low shrink-swell soils are present throughout the County but more dominant in the lower-lying areas of the high lands south and west of Routes 360 and 200. Low shrink-swell soils are more common in the drainage and stream basins of this portion of the County.

- Moderate shrink-swell is also found throughout the County and most commonly along the ridges between creeks and swales. Several points should be observed: (i) that most of the roads built by the Virginia Department of Transportation are located along the ridges where the better classes of soil are found; (ii) that almost all existing development occurs adjacent to existing roads which also have the advantages of the good soils; (iii) because of the distance between the tops of the ridges and the creeks and drainage ways that follow the valleys, development of this type has the least detrimental impact on water quality; and (iv) despite these advantages, the areas most in demand are in the lowlands where few of these conditions are present.

- The last category, none, is not significant because very little of the land area of the County is classified in this manner.

Overall, the county soils are within an acceptable range as to shrink-swell qualities, and this

condition should not present any barrier to development that cannot be compensated for by engineering design.

6. Flood-prone Areas

Floodplains are low-lying land areas adjacent to rivers, streams, creeks, and other water bodies that are subject to periodic flooding when precipitation causes the volume of water to exceed the capacity of the waterway. Left in an unaltered, undeveloped state, floodplains can serve important natural, recreational, and historical functions.

There are a multitude of factors, such as topography, geographic orientation of the shoreline, depth and duration of flooding, and rate of water rise, which affect damages caused by a flood. The amount of flood damage is also affected by the extent of development within a floodplain since development can interfere with many of the natural functions floodplains serve.

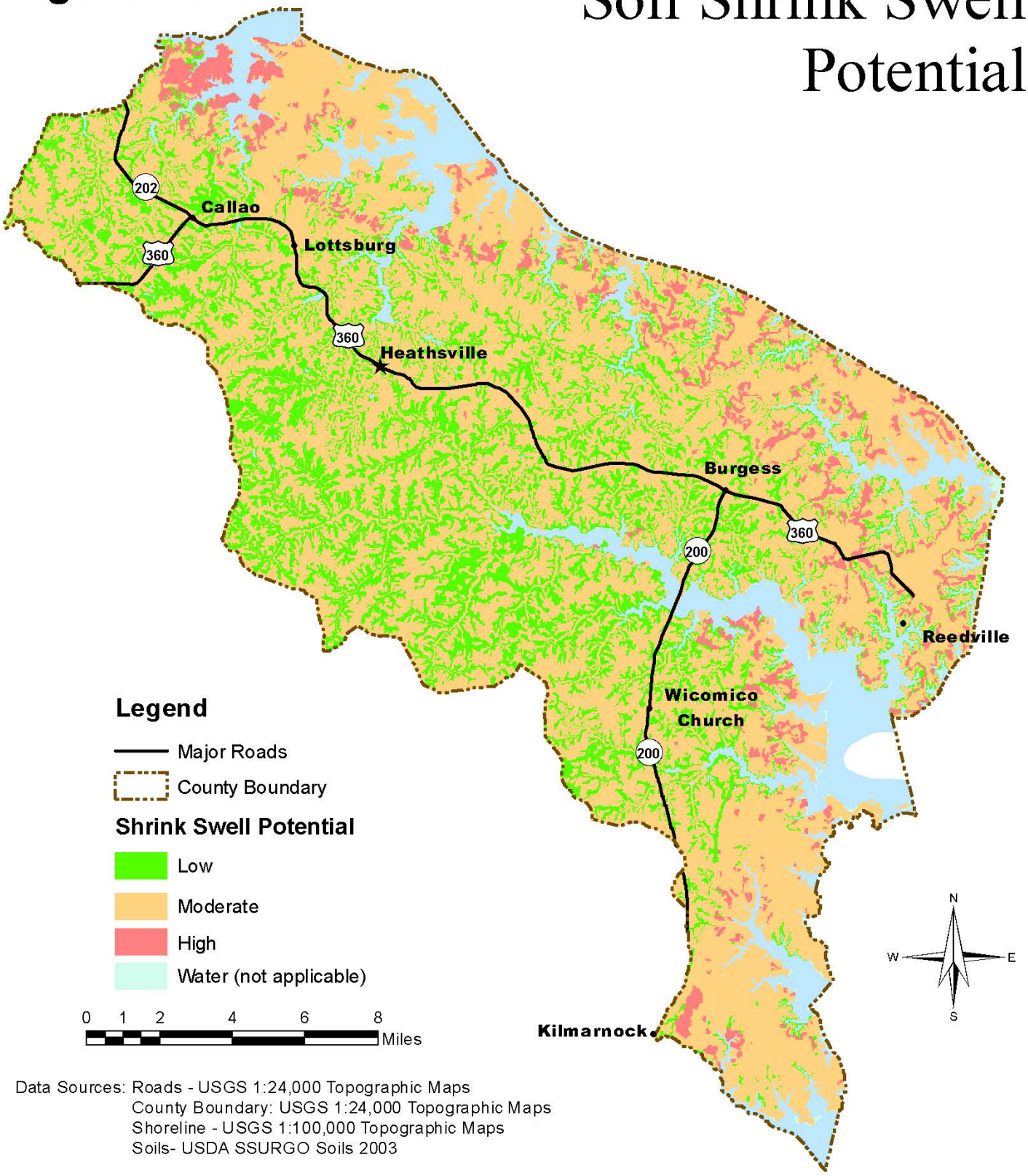
According to Northumberland County's Flood Insurance Study, the coastal areas of the County are vulnerable to tidal flooding from major storms such as hurricanes and northeasters. These types of storms produce large amounts of precipitation, high winds and low atmospheric pressure that cause large volumes of water to impinge against the shore. The topography of the area flooded, rate of rise of floodwaters, depth and duration of flooding, exposure to wave action, and extent to which structures have been placed in the floodplain determine the amount and extent of damage caused by any tidal flood.

Northumberland County has experienced major storms and flooding since early settlement of the area. The most recent severe storm occurred in September of 2004 when winds from tropical storm Isabel in excess of 65 miles per hour pushed tides eight feet above normal levels and destroyed bulkheads, boathouses, and other waterfront structures in the Northern Neck and other areas along the Chesapeake Bay and Potomac River.

Congress established the National Flood Insurance Program in 1968. This program enables property owners to purchase federally backed flood insurance within communities which implement floodplain management measures to reduce flood risks to new development. Regulations of the National Flood Insurance Program specify requirements that must be included in local ordinances if a community wishes to participate in the program. Requirements of the program include regulation of buildings and other development in floodplain areas. The Federal Emergency Management Agency (FEMA) establishes flood risk data for insurance rating and floodplain management in addition to conducting Flood Insurance Studies and Maps for localities. The Flood Insurance Rate maps define flood hazard areas, or areas subject to inundation at 100-year and 500-year intervals. A 100-year flood zone has a one percent (1.0%) chance of being inundated in any given one-year period, whereas the 500-year flood zone has a two-tenths of one percent (0.2%) chance of being flooded in the same one-year period.

Figure 1.8

Soil Shrink Swell Potential



Data Sources: Roads - USGS 1:24,000 Topographic Maps
County Boundary: USGS 1:24,000 Topographic Maps
Shoreline - USGS 1:100,000 Topographic Maps
Soils- USDA SSURGO Soils 2003

This project was funded by the Northern Neck Planning District Commission and the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant #NA14NOS4190141 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended.

FEMA has completed new Flood Insurance Rate Maps (FIRMs) for Northumberland County, which were adopted on February, 18, 2015, and these maps are on file in the Office of Building and Zoning in the County Administration Building (old courthouse). The FIRMS are also in digital form in the County Geographic Information System (GIS). Figure 1.9 depicts FEMA FIRM 100 year (1.0% chance) and 500-year (0.2% chance) floodplains within the County.

FEMA's Flood Insurance Study determined that all development in the County's floodplains is subject to water damage. Some flood-prone areas are subject to high velocity wave action which may cause structural damage and severe erosion along the shoreline. Due to the exposure afforded by the expanses of open water (fetch) on the Chesapeake Bay and the Potomac River, the northern and eastern sections of the County are most vulnerable to wave damage.

There is considerable development in Northumberland County that is located within the 100-year floodplain shown on the Floodplain Map. It includes full-time dwellings, seasonal cottages, businesses and industries. This is understandable, given that most of the existing development within the County occurred before the flood zone maps were first prepared pursuant to a 1968 federal law. Even today an owner still has the option of building within a floodplain; however, most dwellings that are financed with insured loans are required by the mortgage insuring agency to purchase flood insurance, and/or raise the lowest habitable floor above the 100-year flood elevation.

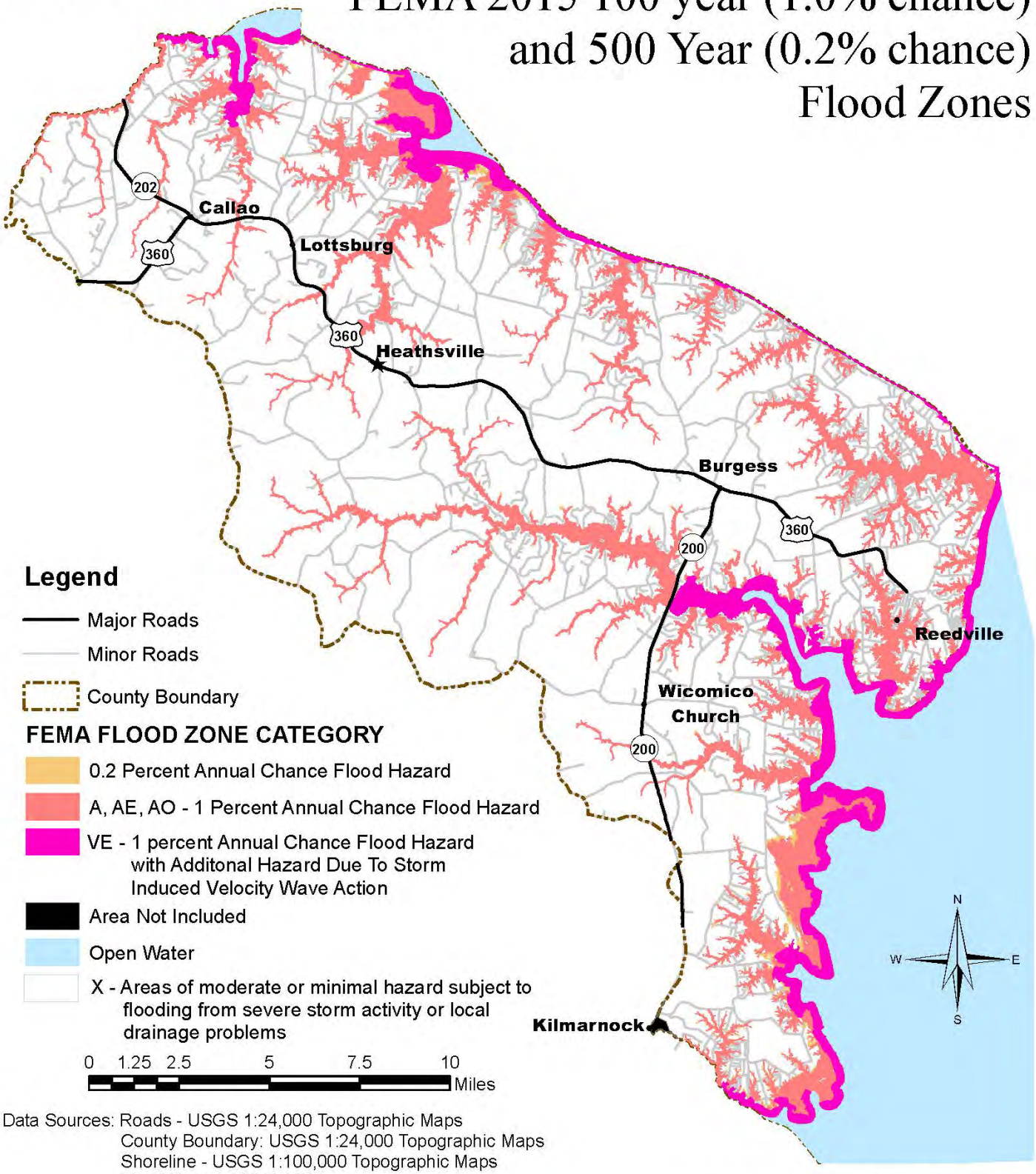
Structural and natural elements that afford some protection against flooding include bulkheads, seawalls, jetties, and sand dunes. The regulatory flood protection measures are included in various codes and ordinances which regulate some aspect of development within floodplains, including: State Uniform Building Code, County's Floodplain Management Ordinance, Subdivision Ordinance, and Chesapeake Bay Preservation Ordinance.

The County's Floodplain Management Ordinance was enacted in May 1989, and subsequently revised and adopted on October 9, 2014, with an effective date of February 18, 2015. The general provisions of the ordinance include regulation of uses, activities, and development which will cause unacceptable increases in flood heights, velocities, and frequencies; restriction or prohibition of certain uses, activities and development within areas subject to flooding; requirement of protection or flood proofing for all uses, activities, and development in flood prone areas; and protection for individuals buying lands and structures unsuited for intended purposes because of flood hazards.

The County's Subdivision Ordinance requires those who subdivide land to provide information needed to determine if improvements such as drainage plans and flood control devices are necessary to develop the property. If improvements are necessary, the subdivider must provide plans with a surveyor's or engineer's statement that such improvements will be adequate for property development when properly installed.

Figure 1.9

FEMA 2015 100 year (1.0% chance) and 500 Year (0.2% chance) Flood Zones



Data Sources: Roads - USGS 1:24,000 Topographic Maps
County Boundary: USGS 1:24,000 Topographic Maps
Shoreline - USGS 1:100,000 Topographic Maps
Flood Zones- FEMA 2015

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The County's Chesapeake Bay Preservation Act Ordinance limits development to within 100 feet of tidal waters connected with continuous flow. The 100-foot setback is created as a pollutant filter buffer strip, but can serve as a flood hazard buffer also. In addition, the 100-foot setback also protects homeowners from the effects of shoreline erosion. All in all, the Bay Act requirements help protect both the Bay from pollution and the homeowner from natural forces.

7. Wetlands and Natural Habitat Areas

a. Wetlands

Wetlands are transitional areas between dry uplands and wet bottomland areas such as streams, rivers, bays, and other bodies of water. Often referred to as swamps, bogs, pocosins, and marshes, wetlands serve as a natural water filter for wastes and sediments, a barrier and an absorber of floodwaters, a buffer and stabilizer of the shoreline from coastal erosion, a recharge area for groundwater, and an important breeding and nesting ground for many important species of fish, bird, and plant life. Wetlands are often referred to as the "nurseries of the Bay". Wetlands also serve as valuable sites for recreation, open space, and education.

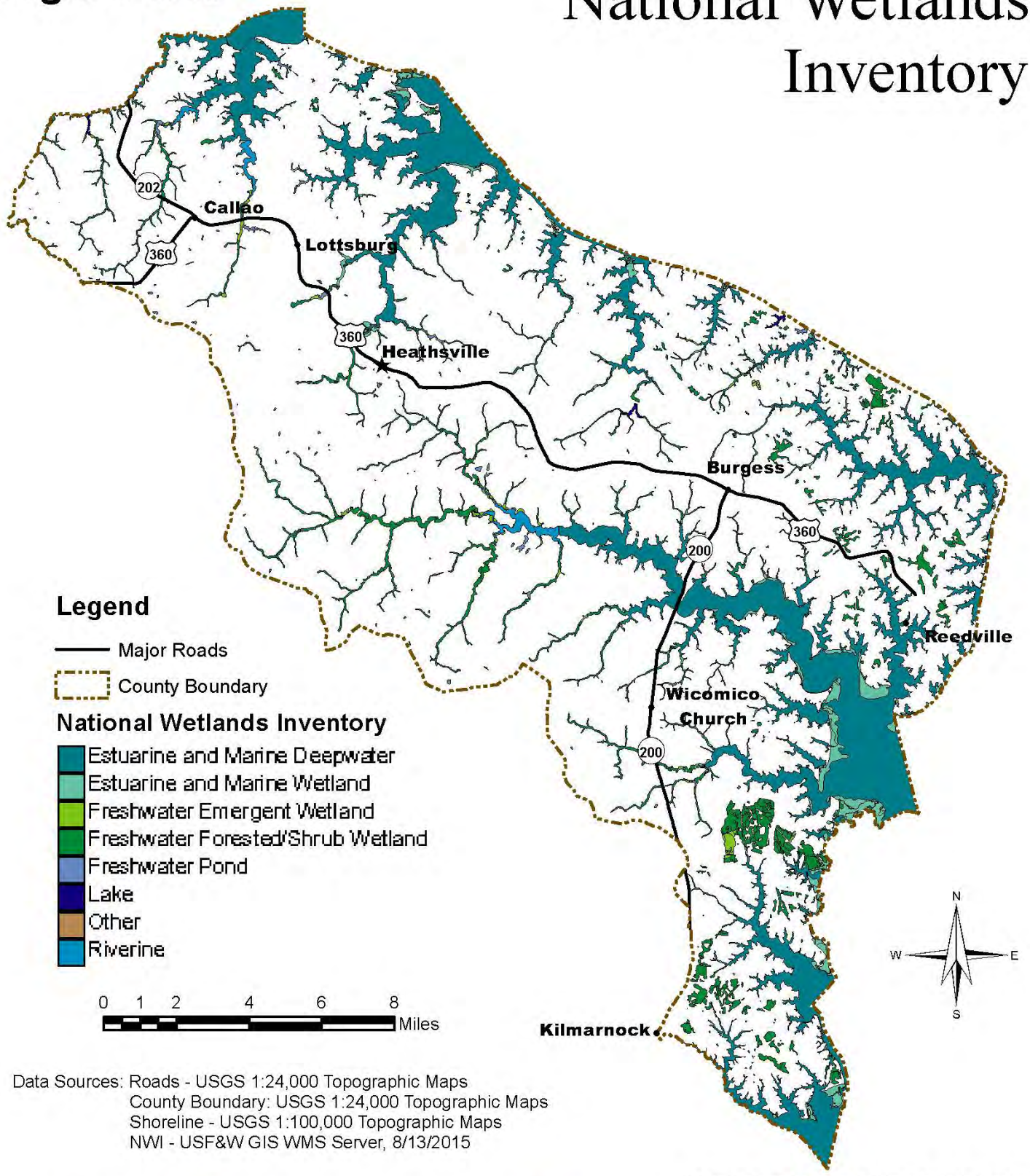
Wetlands are classified as either tidal or nontidal. Tidal wetlands are vegetated marshes, nonvegetated beaches, sandflats, and mudflats which receive regular tidal flooding by salt or brackish water. Tidal wetlands in the County are generally located along the bottomlands of major drainage streams subject to tidal action. Saltwater and freshwater marshes are typified by anaerobic mineral soils vegetated primarily by grasses, while mudflats and beaches do not support aquatic or terrestrial vegetation, but nonetheless are valuable to many species of benthic organisms and wildfowl.

Nontidal wetlands, which may be adjacent to tidal marshes as well as farther inland, are beyond tidal influences, and are either continually or seasonally saturated by fresh water from either surface runoff or groundwater saturation. Due to seasonal and yearly variations, these types of wetlands are not as easily recognized, since there may not be any surface evidence of the presence of water during certain times of the year. To delineate the extents of these wetlands, experts use plant species, soil characteristics and other factors to separate wetland areas from upland areas.

According to the National Wetland Inventory, there are 1,560 acres of tidal wetlands in Northumberland County. Some of the larger marsh areas include approximately 157 acres in Dameron Marsh, 125 acres in Barnes Creek, and 85 acres on Hughlett Point. See Figure 1.10 for additional wetland locations in the County.

Figure 1.10

National Wetlands Inventory



Data Sources: Roads - USGS 1:24,000 Topographic Maps
County Boundary: USGS 1:24,000 Topographic Maps
Shoreline - USGS 1:100,000 Topographic Maps
NWI - USF&W GIS WMS Server, 8/13/2015

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For years, wetlands were considered undesirable wastelands and breeding grounds for mosquitoes which should be filled, drained, or altered. Consequently, millions of acres of wetlands were lost to a number of drainage and land-filling projects in order to convert them to agricultural lands or development sites. Wetlands are extremely vulnerable to physical and hydrologic changes such as dredging, filling, and water pollution, and lose their ability to perform natural functions when they are filled or drained. It has been estimated that between the mid 1950s and late 1970s, 11 million acres of wetlands were lost nationwide. During this period, Virginia lost approximately 57,000 acres of freshwater vegetated wetlands to agricultural conversion, channelization, forestry, pond, lake, and reservoir construction and other development. During the early 1970s, the science community began to realize the significant functions and importance of wetlands and as a result, a number of federal, state, and local regulations evolved to manage and protect both tidal and nontidal wetlands.

- Federal Regulations: Sections 401 and 404 of the Clean Water Act are the primary federal regulations which affect development on wetlands. Before a wetland can be filled or disturbed, a 404 permit must be obtained from the U.S. Army Corps of Engineers.

- State Regulations: The Commonwealth of Virginia began to regulate wetlands in the early 1970s, with the passage of the Virginia Wetlands Act of 1972. The purpose of this act was to ensure that wetlands of primary ecological significance shall not be altered or unreasonably disturbed. The following areas were exempted from this Act: agricultural, silvicultural, and horticultural activities; cultivation and harvest of shellfish and worms for bait; maintenance and repair of roads and railways; outdoor recreational activities that do not disturb wetlands; construction and maintenance of noncommercial piers, boat houses, and fences constructed so as to preserve tidal flow, construction of navigational aids; maintenance of man-made drainage ditches; governmental activities; and activities undertaken pursuant to emergency decrees.

  In June 1998, the US Supreme Court ruled that the Army Corps of Engineers did not have the authority to regulate draining of non-tidal wetlands not connected by surface flow. This precedent called the “Tulloch Ruling” opened the door to destruction of thousands of acres of non-tidal wetlands. To close this loophole and to protect the State Water Control Board’s mandate of “no net loss” of wetlands, legislation was introduced and passed in 2000 that requires landowners to get a state permit to drain any non-tidal wetland. The Virginia State Water Protection Permit now states that it is unlawful to “new activities to cause draining that significantly alters or degrades existing wetland acreage or functions”. This important State law effectively ended the practice known as “Tulloch Ditching”, and affords a level of protection to non-tidal wetlands.

- Local Regulations: The Virginia Wetlands Act gave local governments authorization to establish local wetlands boards to exercise jurisdiction and review and issue permits for development on wetlands. In addition to establishing wetland regulations and wetlands boards pursuant to the Virginia Act, Northumberland County adopted a Chesapeake Bay Preservation Area Ordinance that establishes a Resource Protection Area consisting of any wetlands plus a 100-foot vegetated buffer strip located landward from wetlands. Other regulations in Northumberland County that protect wetlands include the Floodplain

Ordinance, Erosion and Sediment Control Ordinance, and Subdivision Ordinance.

Figure 1.10 above illustrates United States Fish and Wildlife Service National Wetland Inventory wetland locations within the County; although this map only shows polygon wetlands (most streams also have linear (line) wetlands associated along their entire length). The County has on file a hard copy of the National Wetland Inventory, as well as a digital copy on the County's GIS System. That source should be used for specific wetland locations and configurations, although field conditions and delineations take precedence over any map product.

The predominant locations for wetlands are along the many streams which flow into the rivers that comprise its more than 509 miles of shoreline, according to data in Virginia Institute of Marine Science, Comprehensive Coastal Inventory, Center for Coastal Resource Management's report Northumberland County Shoreline Situation Report. In that report, compiled in June 2003, 45 miles of eroding marshes and 246 miles of stable marsh buffers were observed and recorded. In 2014, the Virginia Institute of Marine Science's Comprehensive Coastal Inventory updated the 2003 report using onscreen digitizing over 2012 and 2013 aerial photos to create a new 2014 Digital Shoreline Situation Report. The 2014 Report does not differentiate the shoreline stability of marshes as a category as the 2003 Report does, however it does report there are 1,640 acres of marshes in the county. The 2014 Report identified 427 miles of stable shoreline, 68 miles of unstable shoreline and 15 miles of shoreline where the erosion condition was unknown which equals 509 miles of total shoreline. The new 2014 Digital Shoreline Situation Report can be viewed here, using the Map Viewer:

http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/virginia/northumberland/northumberland_disclaimer.htm

b. Natural Habitat Areas

There are many sites within the County which are known to be a natural habitat resource for rare, threatened or endangered species which have been inventoried as part of a state or federal natural heritage program. Information for locating these sites can be found on an annual map created by the Department of Conservation and Recreation's Division of Natural Heritage Program entitled Natural Heritage Resources - Northumberland County. Due to the sensitive nature of natural heritage resources, that map is not shown in this plan. A hard copy of that map is on file at the Office of Building and Zoning, and is used to screen site plans to see if they impact rare, threatened or endangered species. If development should occur within the vicinity of these areas, the County should examine each project so that development does no harm to the protected natural habitat site. Persons proposing development should be required to identify the protected areas in detail on the site plans submitted for review by the County.

8. Historic Resources

The Virginia Department of Historic Resources is responsible for identifying and mapping known resources of historical and archaeological significance. In many communities throughout Virginia, this agency has sponsored the performance of in-depth surveys to identify both the location and historical context of buildings and sites of historic importance. VDHR has not completed an in-depth study of sites for Northumberland County, although it maintains an incomplete record of about 120 possible historic sites and buildings that have been identified over a period of time. New projects, such as highway widenings, now require a survey of possible historic sites that are likely to be affected by the project. Should a countywide survey of possible historic sites be undertaken by VDHR, it is likely that 500 or more sites would be identified. In these surveys VDHR locates every building or site that is more than 50 years old.

Figure 1.11 depicts the general locations of sites that have been placed on the National Register of Historic Places (http://www.nationalregisterofhistoricplaces.com/VA/Northumberland/state.html). The list includes the following sites:

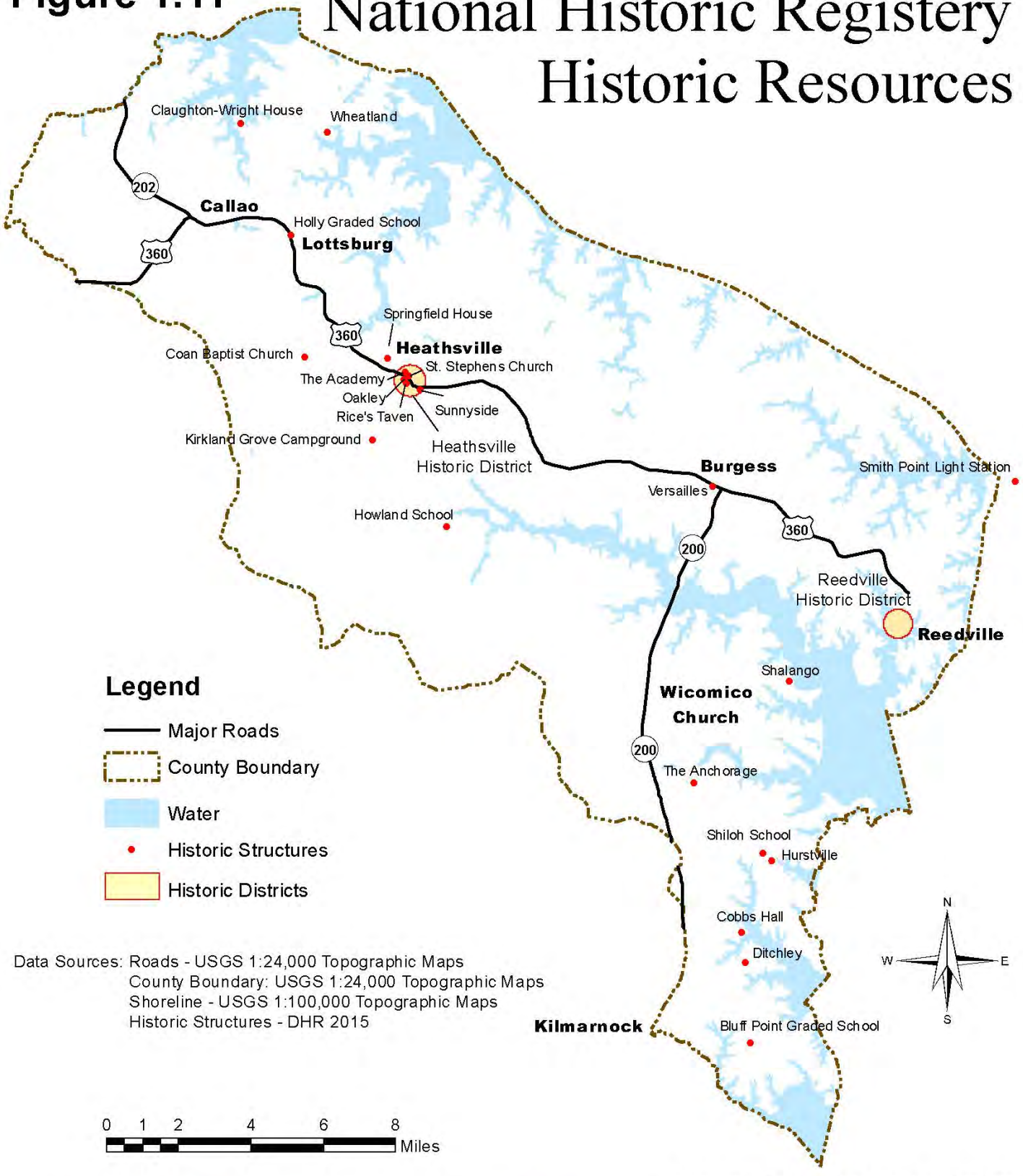
The Academy	The Anchorage	Claughton-Wright House
Coan Baptist Church	Cobbs Hall	Ditchley
Heathsville Historic District	Holly Graded School	Howland School
Hurstville	Kirkland Campground	Oakley
Reedville Historic District	Rice's Hotel	Shalango
Shiloh School	Smith Point Light Station	Springfield
St. Stephens Church	Sunnyside	Versailles
Wheatland		

Additional sites are listed in Appendix A. Historic landmarks and districts may be protected by the County through zoning regulations authorized in Section 15.2-2306 of the Code of Virginia. This legislation authorizes the local governing body to adopt an ordinance setting forth the historic landmarks within the County as established by the Virginia Landmarks Commission, and any other buildings or structures within the County having an important historic, architectural or cultural interest. The Code also enables the County to establish *"Historic Areas"*, which are defined as follows:

> *"An historic area (district) is an area containing buildings or places in which historic events occurred or having special public value because of notable architectural or other features relating to the cultural or artistic heritage of the community, of such significance as to warrant conservation and preservation."*

An historic district has been established in the Reedville community and one in Heathsville. Designation as an "historic district" may include an entire community or in such a district may be as small as a single building or site. When areas or sites are placed on the National Register of Historic Places, that status signifies that the sites contain historically and architecturally important collections of resources. Rehabilitation work performed on income-producing properties in historic districts may be eligible for Federal tax credits.

Figure 1.11 National Historic Registery Historic Resources



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The County may wish to continue the development of its historic resources through a comprehensive survey available through VDHR although the local government is usually required to provide matching funds for the survey. With a complete survey of historic sites, Northumberland would be in a position to prepare a Historic Preservation Plan as a future addendum to the Comprehensive Plan.

9. Chesapeake Bay Protected Areas

The Chesapeake Bay Preservation Act was adopted by the Commonwealth of Virginia to improve the quality of the water that enters the Chesapeake Bay. The Act established a cooperative state and local government program to protect water quality of the Bay and its tributaries and requires localities in Tidewater Virginia to incorporate general water quality protection measures into their comprehensive plan, zoning ordinance, subdivision ordinance, and erosion and sediment control ordinance. The Act also established the Chesapeake Bay Local Assistance Board and Chesapeake Bay Local Assistance Department. The Chesapeake Bay Preservation Area Designation and Management Regulations were originally adopted in 1989 and were amended in 1991, 2001 and in 2012 as part of the Integration Bill. The Integration Bill moved the technical assistance portion of the Chesapeake Bay Preservation Act from the Department of Conservation to the Department of Environmental Quality, Division of Water Programs, abolished the Chesapeake Local Assistance Board and transferred the oversight of the Chesapeake Bay Preservation Act to the State Water Control Board.

The Regulations require Tidewater localities to define and protect Chesapeake Bay Preservation Areas; lands which if improperly developed may result in substantial damage to the Bay and its tributaries. These localities were required to adopt zoning regulations and establish a zoning district map delineating Chesapeake Bay Preservation Areas. Northumberland County's Chesapeake Bay Preservation Area Ordinance, patterned after a model ordinance provided by CBLAD, and became effective September 20, 1990. Chesapeake Bay Preservation Areas are classified into two categories: Resource Protection Areas (RPA's) and Resource Management Areas (RMA's). The RPA is more restrictive of allowable uses than the RMA.

- RPA's consist of lands at or near the shoreline which possess intrinsic water quality. The regulations define RPA's as tidal wetlands, nontidal wetlands connected by surface flow and contiguous to tidal wetlands, tributary streams, tidal shores, and other lands which provide for the removal, reduction, or assimilation of sediments, nutrients, and potentially-harmful or toxic substances in runoff or groundwater discharge entering the Bay and its tributaries. A buffer area not less than 100 feet in width must be located adjacent to and landward of RPA's and along both sides of any tributary stream. The only permitted uses in RPA's are redevelopment of existing uses, water dependent uses such as piers, public utilities, railways and roadways, water wells, passive recreation uses, and historic preservation or archaeological activities.

- RMA's, as established by Northumberland County, contain all areas of the County that are not classified as Resource Protection Areas. The RMA includes lands that have the potential to cause significant water quality degradation if improperly used or developed.

Any use permitted under the County's zoning ordinance is permitted in the RMA, provided, all development meets performance criteria set forth in the Bay Act Regulations. Thus, all lands within the County are either in the RPA or the RMA.

- Intensely Developed Areas (IDA's) are areas of concentrated development within the RPA where development has severely altered the natural state of the area such that it has more than 50 percent impervious surfaces, public sewer and water is constructed and currently serves the area, and housing density is equal to or greater than four dwelling units per acre. Although some of the designation criteria may exist in certain areas of the County, there are no areas of concentrated development which meet all IDA criteria; therefore, Northumberland County has not designated any areas as IDA's.[6] IDA designation is optional on the part of the County.

In addition to defining Chesapeake Bay Preservation Areas, the Chesapeake Bay Preservation Area Designation and Management Regulations established Land Use and Development Performance Criteria to minimize non-point source pollution from stormwater runoff, minimize erosion and sedimentation, and maximize rainwater infiltration to reduce the introduction of nutrients and toxics and groundwater discharge of pollutants entering state waters affecting the Chesapeake Bay. Any use, development, or redevelopment of land in Chesapeake Bay Preservation Areas must meet several performance criteria to the satisfaction of the reviewing local government. The criteria include the following:

- preservation of indigenous vegetation
- minimization of land disturbance
- use and maintenance of best management practices (BMP's)
- minimization of impervious cover
- a plan of development review process and erosion and sediment control measures for development exceeding 2,500 square feet
- control of stormwater runoff and its quality
- requirement of a soil and water quality conservation and nutrient management plan for lands upon which agricultural activities are being conducted within the RPA
- requirement of all wetland permits prior to any land disturbance
- the inspection and pump-out (if necessary) of on site sewage treatment systems at least once every five years

[6]Reedville is the only area that was considered, but it fails to meet the density requirement of four dwellings per acre which is part of the criteria for an IDA. See also Chapter 5 under "Policies relative to Intensely-Developed Areas.

- requirement of a reserve sewage disposal site equivalent to the waste treatment capacity of the primary drainfield for new development

Figure 1.12 shows the Chesapeake Bay 100-foot Resource Protection Areas delineated for the County.

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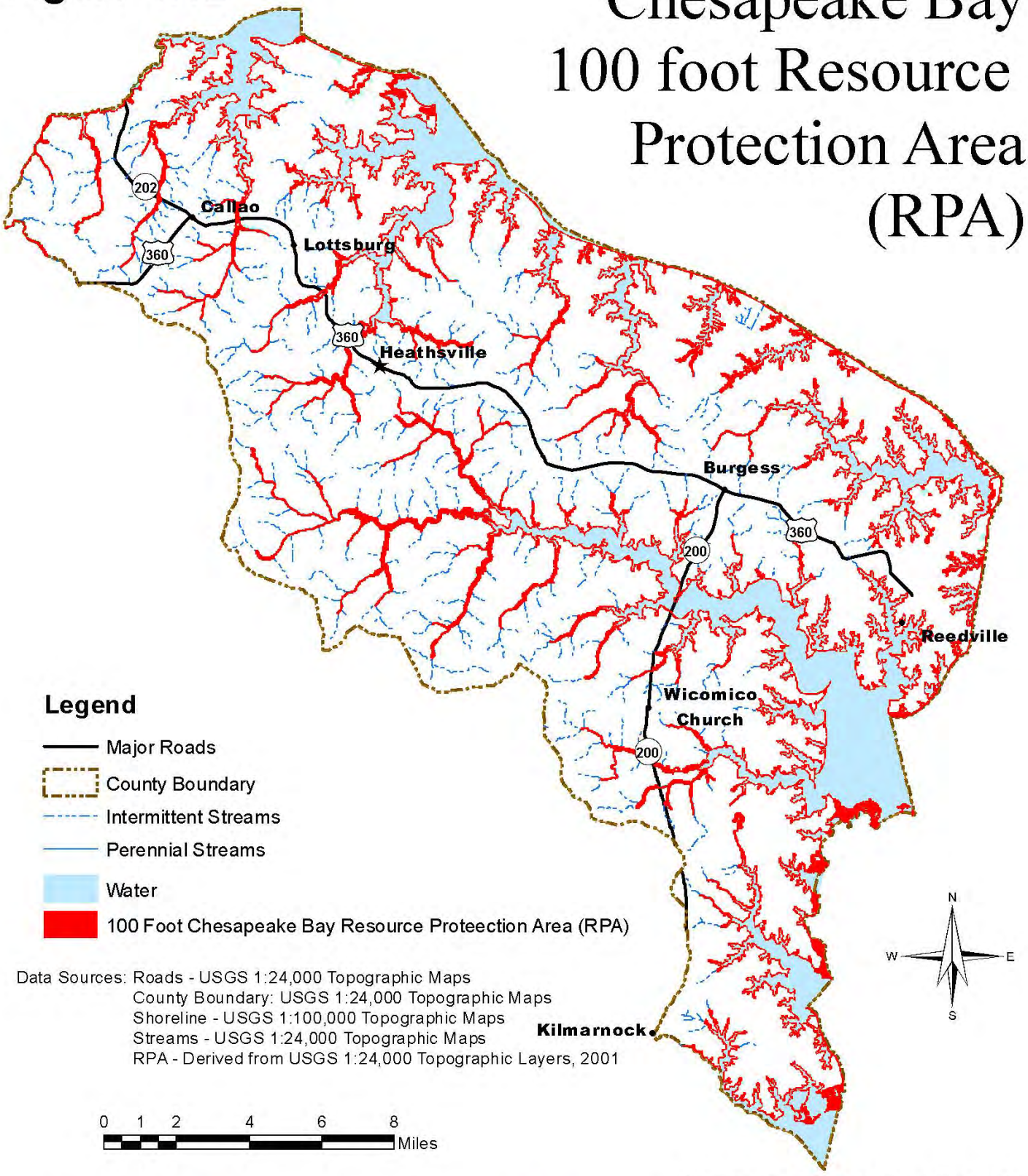
Figure 1.12

Chesapeake Bay 100 foot Resource Protection Area (RPA)



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C. ANALYSIS OF CONDITIONS RELATED TO POTABLE WATER SUPPLY

1. Groundwater

a. The Hydrologic Cycle

Water resources are often described in the context of a hydrologic cycle, which is the cyclical movement of water within the environment from atmosphere to land to sea to atmosphere again. Precipitation, infiltration, evaporation, and transpiration are the main mechanisms which move water from one location to another. Precipitation in the form of rain, snow, or hail can be intercepted by vegetation, infiltrate into the ground, or runoff into surface waters. Plants that intercept precipitation absorb moisture and transpire water molecules back into the air. Infiltrated water moves underground in storage areas between underground layers of rock or sediment, known as aquifers. Water not infiltrated eventually runs into depression areas, such as puddles, streams, lakes, rivers, and oceans. As exposed surface waters evaporate into the atmosphere, the hydrologic cycle continues.

b. Groundwater Aquifers[7]

Groundwater occurs during the hydrologic cycle when water moves into and through the earth's surface. In Northumberland County groundwater is stored in layers of permeable sand and gravel called aquifers. Three aquifers comprise the underground water supply for Northumberland County: the surficial (water table) aquifer; the Brightseat-Upper Potomac aquifer; and the Chickahominy-Piney Point aquifer. All of the aquifers slope downward from the Fall Line in the west to the Chesapeake Bay in the east.

- The water table aquifer: the uppermost aquifer system is close to the surface and is accessed by shallow wells. These shallow wells are the least expensive to construct. The water table aquifer is the most vulnerable of all the aquifers to contamination. The water table (unconfined) aquifer consists generally of fine sand and shells to depths reaching 80 feet or more and yields approximately 5 to 20 gallons per minute of moderately soft water that is generally satisfactory for domestic use. This aquifer is a historically significant and sustainable source for minor supplies of domestic groundwater in Northumberland County, supplying groundwater to farms, institutions, residences and other small users in the region.

- The Chickahominy-Piney Point aquifer is the shallowest artesian aquifer. The top of the aquifer is situated at approximately 350 feet below sea level in the vicinity of Reedville where the aquifer is approximately 140 feet thick. In the Callao region this aquifer is less than 100 feet thick, and its top occurs at a depth of approximately 200 feet below sea level. The Chickahominy-Piney Point aquifer yields 5 to 20 gallons per minute of moderately soft water with acceptable

7 Reference USGS Professional Paper 1404-C

fluoride and sodium concentrations. It is a good source of potable water for moderate suppliers. This aquifer once served as a reasonable source of water for residents of the Northern Neck, but it has been superseded in importance by the deeper Brightseat-Upper Potomac aquifer system. Because of both quantity and quality problems, it is highly unlikely that this aquifer will ever be counted again to serve as a major source of groundwater for the Northern Neck.

- The principal artesian aquifer underlying the County is the Brightseat-Upper Potomac aquifer. At Reedville the top of this aquifer is situated at a depth of 658 feet below sea level. The total thickness of the water-bearing sands of this aquifer at this locality exceeds 220 feet. The aquifer thins gradually westward, and its top rises to a depth of approximately 530 feet below sea level in the vicinity of the Westmoreland County line. The Brightseat-Upper Potomac aquifer yields from 40 to 840 gallons per minute of soft, sodium-bicarbonated water, with slightly higher than normal chloride values in the southeastern most tip of the County. High sodium contents of greater than 200 parts per million are typical south of Wicomico Church.

In a report prepared in the late 1970s by the then Water Control Board (now the Department of Environmental Quality [DEQ]), it was concluded that under (then) current and projected rates of utilization, that groundwater should adequately meet the needs of Northumberland County through the year 2020.[8] However, that was 1978. The water levels in the major aquifers have been dropping 1.1 feet a year over the past few decades and the rate of decline in the vicinity of West Point, VA and in southern Maryland is approximately 3.5 ft/yr – in the same aquifers that supply Northumberland County. At the current rate of population growth and urban development, the critical Brightseat-Upper Potomac aquifer will be severely impaired by mid century. For up to date information regarding groundwater studies, water supply planning and expansion of groundwater management areas, refer to Chapter 5, pages 7-9.

c. Potable Water Supply (Wells)

Almost all developed sources of potable water in Northumberland County are supplied by wells. According to the 1990 Census, individual wells supplied potable water to 5037 households in the County and public or private systems supplied an additional 1754 households. Generally, three types of wells are found in the County: dug wells, drilled wells, and driven wells.

- Dug wells: range in depth from 8 to more than 80 feet, tap into the water table aquifer, and the yield and quality of water from them varies considerably. At low elevations, some dug wells yield brackish water when pumped heavily. Dug wells tap into the upper water table aquifer which is vulnerable to contamination from surface and sub-surface contamination sources. Health officials suggest that these wells be monitored carefully, especially the grout on the well casing, and when necessary replaced with wells meeting

8 [8]State Water Control Board, Groundwater of the Northern Neck, Planning Bulletin 307, circa 1978

current standards. In 1990, Northumberland County was one of the top ten localities in the Commonwealth having the most dug wells (2,211).

- Drilled wells: tap artesian (pressurized) water and range in depth from 300 to 900 feet. Deep drilled wells supply almost all of the water used by moderately heavy users including residential communities and industries. Homeowners, industries, and farmers favor them since they provide a substantial supply of good quality water. Oftentimes homeowners will replace a failing dug well with a drilled well for a more reliable potable water source.

- Driven wells: range in depth from 10 to 20 feet and are located primarily at lower elevations. Driven wells are not considered important water sources, since they generally yield low quality or brackish water, and are not very common.

Although many residents and businesses in Northumberland County have their own wells, a number of denser developed areas are served by privately owned central water systems, which generally obtain water from the deepest aquifers. Blundon and Hinton Water Company operates a community water system in Reedville, serving more than 400 residents with current withdrawals of about 30,000 gallons per day. The Virginia Department of Health rates the system's capacity at 200,000 gallons per day. The system consists of three deep wells and two elevated storage tanks; however, only two wells are presently in service. Only about five percent of the water from the Blundon and Hinton system is used for residential purposes, the rest of the water is used for industrial purposes.

There are other industrial and residential users which pump relatively large quantities of water; however, records are not available for systems that: do not pump at least 10,000 gallons per day; are not metered; or the Department of Environmental Quality does not keep records on them. The Virginia Department of Health, Office of Water Programs, regulates public water supply systems that serve 25 or more people, or which have more than 15 connections for 60 days or more a year. Public water supply systems consist of:

35	Community systems, which serve towns, and subdivisions
3	Non-transient non-community systems which serve schools, municipal buildings, factories, and offices
19	Transient non-community systems which serve hotels, restaurants, and recreational areas

(Data gathered from the Virginia Department of Health, Office of Drinking Water: https://www.vdh.virginia.gov/ODW/ListingofWaterworksandOwners.htm, 04/05/16.)

According to year 2000 figures from the USGS, total groundwater withdrawals from the Northern Neck region approximate 4.6 million gallons per day. Withdrawals are divided fairly evenly between domestic and industrial use, with most industrial uses devoted to

washing seafood at processing plants. Presently, Reedville and the Town of Kilmarnock in Lancaster County are the major local water-demand centers affecting Northumberland County's water supply although most of Kilmarnock's demand is in Lancaster County.

Large users located outside the County affect the County's available water supply. The primary deep aquifer serving Northumberland County, the Brightseat-Upper Potomac has no surface recharge area; consequently, any major water consumer that accesses this supply may alter the pressure within the aquifer and therefore the quantity and possibly the quality of water. With the County situated between two major "cones of depression" one to the southwest, the West Point paper mill, and one to the north, southern Maryland, the future of the groundwater supply of the County will be determined chiefly by the amount of pumpage in those two regions and not by water use by Northumberland County residents. Currently, groundwater is being pumped from the artesian aquifers in these two pumping centers faster than it can be recharged (as evidenced by the continual decline of water levels in artesian wells). Because of the unique hydrogeologic environment of the Northern Neck, in which the natural groundwater circulation is measured in thousands, even tens of thousands, of years, the artesian aquifers are for all intents and purposes being "mined" of their groundwater. A continuation of this water mining will lead eventually to a water supply crisis in much of Coastal Virginia.

d. Potential Contamination Sources

Potential groundwater contamination sources include landfills, lagoons, and other waste facilities. The Northern Neck Groundwater Quality Management Plan (NNGQMP), created in 2003 by the Northern Neck Planning District Commission outlines these potential contamination sources in detail, with map products that support text. The plan is available on the NNPDC website for download at: http://www.nnpdc.org/PAGES/document-archive.htm . When their locations are known these sources are generally permitted and monitored (point sources) but some groundwater pollutants such as pesticides, fertilizers, and road de-icing chemicals (non-point source pollution) are more difficult to monitor. The State's Groundwater Protection Steering Committee has assigned top priority to the following sources of groundwater contamination. Northumberland County is susceptible to contamination of its groundwater from most of these sources.

Underground Storage Tanks: Contamination of groundwater from underground storage tanks has increased steadily in recent years. Reports indicate that there are thousands of such tanks in use in the State, as well as a substantial amount of unused and abandoned tanks. All underground storage tanks eventually leak. Many contain petroleum products or other substances which have the potential to contaminate groundwater if leakage should occur. Groundwater pollution by petroleum products stored in underground tanks is a very serious problem that is relatively common and often occurs in the vicinity of gasoline service stations. In Northumberland County, the prevalence of underground heating oil tanks installed in the past is particularly troublesome. When homeowners upgrade their

heating systems, they often switch from oil-fired furnaces to electric heat pumps. Due to cost concerns, many homeowners choose not to remove or properly decommission their underground storage tanks. Since residential heating oil tanks fall below the capacity threshold, and thus are not required to be registered with DEQ, there is no way to inventory or catalog the extent of this problem. The NNGQMP has a map of known leaking underground storage tanks in Northumberland County.

In Virginia, the Underground Storage Tank Program requires newly installed underground storage tanks to meet design, construction, and monitoring standards to prevent leaks and overflows and have corrective action plans with a detailed mitigation strategy in the event of a spill. The Department of Environmental Quality operates a Pollution Response Program (PREP), which investigates reported cases of groundwater contamination resulting from petroleum leaking from underground tanks. The Department of Environmental Quality has an interactive GIS web-mapping site that allows users to zoom into their area of interest and examine up to date sites of petroleum releases. The website address is: http://www.deq.virginia.gov/programs/landprotectionrevitalization/petroleumprogram/interactivemapping.aspx. Once there, zoom in to a small area you are interested in, and on the right side of the screen the option for turning on "Petroleum Releases" appears. If you are not zoomed in close enough, the Petroleum Releases option is grayed out and you cannot turn it on, zoom in closer and the option should appear.

The Northern Neck Groundwater Quality Management Plan also has maps from the Northern Neck Emergency Operations Plan, Annex A1: Hazardous Material Response Plan that shows major gasoline and diesel fuel storage tanks sites in Northumberland County and their relative capacities.

Landfills: Various types of substances found in landfills have the potential to contaminate groundwater. Contaminants such as chemicals and fertilizers, hazardous waste, paint, varnish, and other materials may move through the ground and pollute the water table and deeper aquifers. The Virginia Department of Waste Management's regulations contain specific landfill design requirements and standards to prevent groundwater contamination. The NNGQMP has a map of historical landfills in Northumberland County. The Tri-County Landfill (which is located off Rt. 600 near Lara and is non-operational) is the only known historical landfill in the County and monitoring wells are in place to check for possible contamination (by the VDEQ). Monitoring should continue into the foreseeable future to protect the groundwater of surrounding areas.

Lagoons and Holding Ponds: Lagoons and holding ponds often contain liquid waste produced by coal-fired power plants, rendering plants, fertilizer production operations, sewage treatment facilities, and other commercial activities which produce wastes that can infiltrate into the ground and contaminate groundwater.

The NNGQMP includes a map of the two known sewage lagoons in Northumberland County. One is currently in use for sewage at the Northumberland YMCA in Heathsville and the second is closed and near the end of Dungan Road off Coan Stage Road near Heathsville

Septic Systems: Septic systems are considered a major threat to groundwater resources and are the leading contributor to the total volume of waste discharged directly into the ground. Nitrate contamination, household chemicals, septic cleaners, and wastes disposed of in underground absorption systems may pollute groundwater. Although many large mass drainfield systems serve clusters of houses, schools, and commercial facilities in Northumberland County, the most common problem associated with on site septic systems is contamination of individual wells. The NNGQMP has a map of properties in Northumberland County from the NNNPDC Septic System Inventory that are served by septic systems, along with the type of septic system.

Groundwater contamination of the surficial aquifer can occur when septic systems are installed at sites where the soil or sediment is permeable that wastewater percolates too rapidly or where the soil or sediment is saturated. The extent of potential contamination is determined by construction and maintenance procedures as well as the density of septic systems in an area. Consequences of failing septic systems in highly concentrated areas can be far more serious than individual failures.

The Virginia Department of Health is the agency responsible for regulating household septic systems and mass drainfields in the Commonwealth. The Department's primary concern has been protection of public health from surface ponding of sewage caused by soils which do not percolate and contamination of private wells from adjacent septic systems. The Virginia Department of Environmental Quality is responsible for the approval of commercial and industrial septic systems. While these systems are governed by the general requirements of a No-Discharge Program, no separate criteria or program exists for permitting these facilities.

Pesticides and Fertilizers: The most common chemical pollutant in the groundwater of the surficial aquifer is contamination from pesticides and fertilizers and is a complex problem. Although these chemicals are widely used and offer numerous benefits in farming, forestry, and lawn maintenance, their use is difficult to monitor and regulate. Contamination from pesticides and fertilizers in groundwater is dependent upon the rate of application, decomposition rate, water solubility of the substance, nature of the soil, and depth to groundwater. Although contamination from pesticides and fertilizers generally extends over a wide area at very low concentrations, increases may build up over years of use. The most common pollutant in the shallow groundwater aquifer in the Northern Neck is dissolved nitrates, and in many cases the level approaches the EPA’s Maximum Contaminant Level (mcl) of 10 mg/liter. No doubt, septic systems

contribute a substantial part of this load, in addition to chemical fertilizer application (both agricultural and residential).

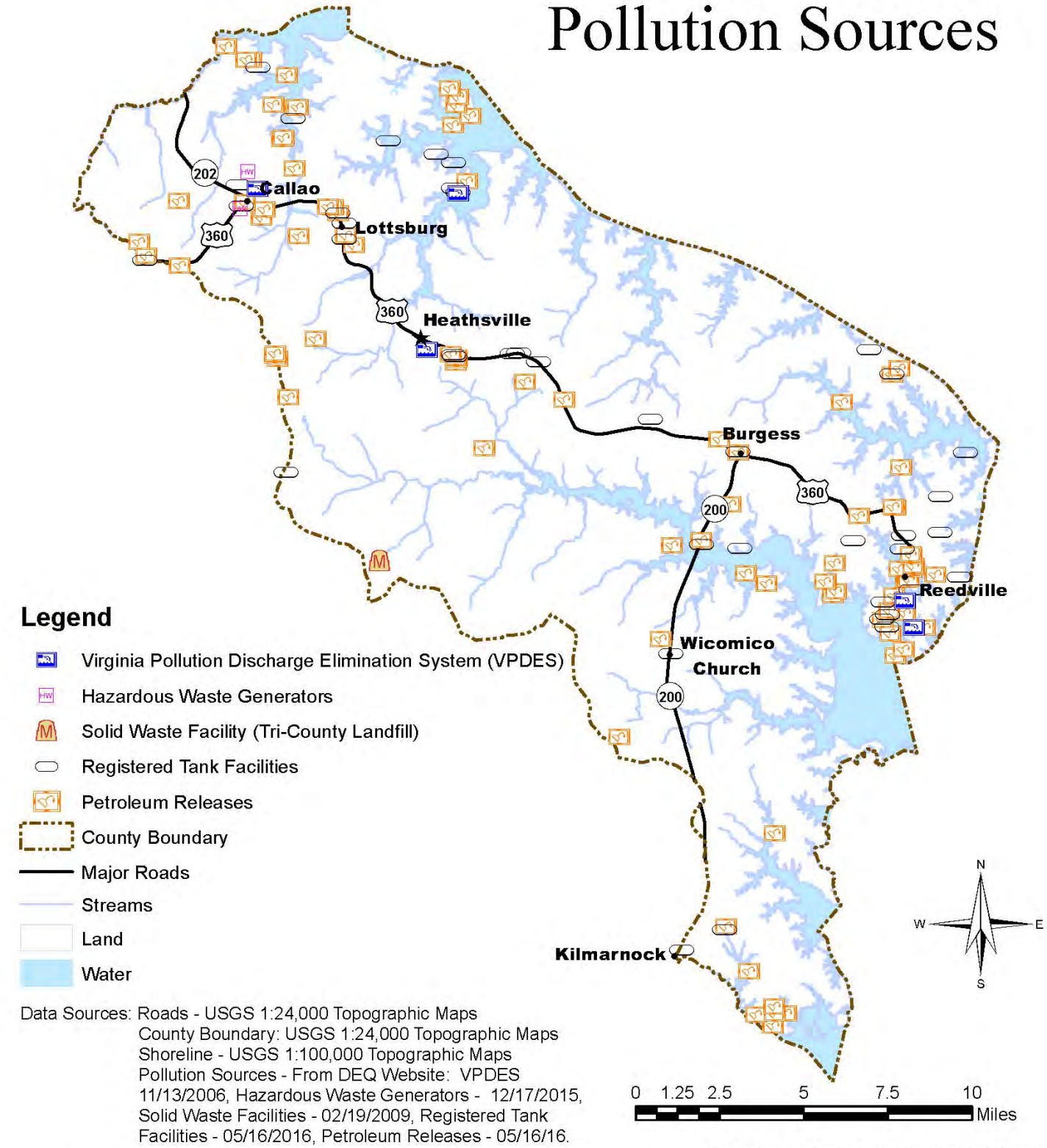
The problem of groundwater contamination by pesticides and fertilizers has been addressed by a number of federal and state regulations. Maximum contaminant levels for approximately a dozen pesticides were adopted by the Environmental Protection Agency under the Safe Drinking Water Act. The Federal Insecticide, Fungicide, and Rodenticide Act and the Toxic Substances Act contain provisions which authorize the EPA and the Commonwealth to protect groundwater from pesticide contamination.

In 1989, Virginia passed the Pesticide Control Act which established a Pesticide Control Board with broad regulatory powers and authorized the Virginia Department of Agriculture and Consumer Services to regulate the registration, labeling, handling, and use of pesticides for certification of private and commercial applicators classified for restricted use. Although there are no specifications for application rates of fertilizer and lime sold in Virginia, these materials are required to be registered. Farmers within the 100 foot Chesapeake Bay Resource Protection Area are required to have a nutrient management plan that gauges the amount of fertilizer the soil needs in each field needs by soil testing. These plans, if followed properly, will minimize agricultural fertilizer over-application. The NNGQMP has a map of showing the pesticide and nitrate leachability of soils in Northumberland County.

Hazardous Waste: The disposal or spilling of toxic and hazardous materials is another potential source of groundwater contamination. The federal legislation which regulates the identification and clean up of sites containing hazardous wastes is the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Presently, no sites have been identified in Northumberland County. Virginia's Department of Waste Management is the agency responsible for maintaining the State's Comprehensive Response Compensation and Liability Information System list. However, there are hazardous waste sites in neighboring counties. The NNGQMP has a map showing those sites on the Northern Neck peninsula.

Figure 1.12A shows pollution source locations for Virginia Pollution Discharge Elimination System (VPDES) Permits, Hazardous Waste Generators, Solid Waste Facilities, Registered Tank Facilities, as well as Petroleum Releases.

Figure 1.12a



Data Sources: Roads - USGS 1:24,000 Topographic Maps
County Boundary: USGS 1:24,000 Topographic Maps
Shoreline - USGS 1:100,000 Topographic Maps
Pollution Sources - From DEQ Website: VPDES 11/13/2006, Hazardous Waste Generators - 12/17/2015, Solid Waste Facilities - 02/19/2009, Registered Tank Facilities - 05/16/2016, Petroleum Releases - 05/16/16.

This project was funded by the Northern Neck Planning District Commission and the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant #NA14NOS4190141 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended.

e. Programs Addressing Point and Non-point Pollution Sources

(1) Pollution Discharge Elimination System Permits

Any "point source" of pollution discharging into waters of the United States requires a National Pollution Discharge Elimination System (NPDES) permit. Industries and waste water treatment plants which discharge pollutants into State waters are required to hold a Virginia Pollution Discharge Elimination System (VPDES) permit. Point sources of pollution are pollution sources which are traceable to a single point, such as an industrial waste or municipal sewage discharge pipe. The Virginia Department of Environmental Quality (DEQ) regulates point source pollution dischargers by regularly monitoring the effluent of permit holders. A list of current point source dischargers in Northumberland County includes the following:

POINT SOURCE DISCHARGERS, 2015- NORTHUMBERLAND COUNTY

VPDES Discharger	Receiving Stream
Public	
Reedville Sanitary District - Callao	Lodge Creek
Northumberland High School	Crabbe Mill Stream
Reedville Sanitary District	Cockrell Creek
Town of Kilmarnock	Indian Creek
Industrial	
Omega Protein, Inc.	Cockrell Creek/Ches. Bay
Lake Packing Co., Inc.	Coan River

(2) Pollution Abatement Permit Program

Many other land uses activities that do not discharge directly into State waters have the potential to contaminate both surface water and groundwater through indirect discharges. Among such activities are the following types of uses:

- Storage of materials in pits
- Ponds and lagoons
- Sewage treatment plants
- Large commercial animal raising activities
- Application or disposal of sludge (animal or industrial waste)
- Recycling of wastewater

- Confined Animal Feeding Operations (CAFO's)

Virginia's Pollution Abatement (VPA) Permit Program regulates and monitors activities in this class to ensure that groundwater sources are protected. Active Pollution Abatement Permits (June, 2015) within Northumberland County included the following activities: Lake Packing Co., Inc. (Permit Number VPA01406), for land application of process water which expires on May 6, 2024, Recyc Systems, Inc (Permit Number VPA00816) for land application of biosolids which expires on March 30, 2020, and Milton F. Wright Trucking, Inc. (Permit Number VPA00838) for land application of biosolids which expires on March 19, 2023.

(3) Mining Permits

Activities associated with industrial, manufacturing, and mining can contaminate groundwater and surface water, however, these are mostly associated with the use of water for coal mining. Declining groundwater levels, reduced surface water recharge, diminished water quality and instream flow, extensive cones of depression, and saltwater intrusion may result from heavy groundwater and surface water usage and pumpage. Mining practices have the potential to affect the movement and recharge of groundwater, lower the water table, and disrupt aquifers. Again, most of these negative externalities are related to coal mining, not surface pit sand and gravel mining, which is the only type of mining occurring in Northumberland County today. As of 2014, there were nine sites in Northumberland County with mining permits. Of those nine sites, six sites mine sand, one site mines gravel, and the final two sites mine sand and gravel. A total of 31 acres in the County are permitted for mining activities, while 24 acres are presently disturbed due to current or previous mining activity. Fourteen and four tenths acres in the County have been reclaimed after mining activities cease. The above data was gathered from the Department of Mines, Minerals and Energy's report and online data found at: https://www.dmme.virginia.gov/dmm/PDF/DATA/ActivePermits.xls

(4) Non-point Sources of Pollution

Non-point sources of pollution exist in every community. This category includes any pollutant whose point of generation cannot be traced to any identifiable facility and whose exact point of entry into the water course cannot be defined. Origins of non-point sources as classified by the Department of Environmental Quality identifies the following classes: agriculture, forestry, construction, urban development, resource extraction, land treatment, disposal and hydrologic modifications.

With the passage of the Clean Water Act in the 1970's point sources of pollution came under permitting and regulations. Today, point sources are mostly in compliance with permits, and the majority of uncontrolled pollution that is entering the nation's waterways is of a non-point source type. This type of pollution is most difficult to assess and control. The Clean Water Act set in place a mechanism to clean up waterways that are impaired. Every two-year's states report to the EPA those waters that do not meet federal clean

water standards, and this report is called the 303(d) list. This list is often referred to as a "dirty waters" list. States must study the impairments, and formulate a clean up plan. The study of what is causing the pollutant specific impairment is called a Total Maximum Daily Load (TMDL) Report. The study seeks to determine the Total Maximum Daily Load of a specific pollutant that can be assimilated by the waterbody before clean water standards are violated.

TMDL's in Northumberland County are all a result of non-point source pollution. The County has fifteen TMDL Studies for impaired water body segments that will be completed by DEQ. All fifteen segments are shellfish impaired waters, that is, the federal standard for fecal coliform bacteria concentration in waters used for harvesting of shellfish had been violated (exceeded). One TMDL study has been completed in Northumberland County, which covers the Coan and Little Wicomico Rivers. Nine of the fifteen segments are contained in this study. The Coan River Final Shellfish TMDL report can be downloaded at:
http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/shellfish/coanfc.pdf.
The Little Wicomico Final Shellfish TMDL Report can be found at:
http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/shellfish/wicomico.pdf
Additional Fecal Coliform Shellfish TMDL reports that have been completed are:
Cockrell Creek Final Shellfish TMDL Report can be found at:
http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/baycoast/cockrell.pdf
Dividing Creek and Prentice Cove Final Shellfish TMDL Report can be found at:
http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/shellfish/dividing.pdf
Indian, Tabbs, Dymer, Antipoison Creeks Final Shellfish TMDL Report (modified) can be found at:
http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/mod/indianmod.pdf
Mill Creek, Ball Creek and Cloverdale Creek Final Shellfish TMDL Report can be found at:
http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/shellfish/millclvr.pdf
Owens Pond and Little Taskmakers Creek Final Shellfish TMDL Report can be found at:
http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/shellfish/owenslittletask.pdf
Cod, Presley, Hull, Rogers, Bridgeman, Cubitt and Hack Creeks Final Shellfish TMDL Report can be found at:
http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/shellfish/presleysf.pdf
Mill Creek, UT, to Kissinger Millpond, Kissinger Millpond Final Shellfish TMDL Report can be found at:
http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/potrvr/millcourt.pdf
Yeocomico River Watershed Final Shellfish TMDL Report can be found at:
http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/shellfish/yeocom.pdf

All warm-blooded creatures generate fecal coliform bacteria, so some of the bacteria levels could be from wildlife populations. The TMDL took samples of the bacteria, and used bacterial source tracking to determine the type of animal that deposited the bacteria.

At almost all stations in both watersheds, humans accounted for the majority of the fecal coliform bacteria. All human fecal bacteria are considered "controllable" by the EPA, so the reduction in the total fecal coliform load must come by reducing the human portion of the fecal coliform load. Probable sources of the human fecal bacteria are failing septic systems, straight pipes, and pollution from boaters. There are currently no State funds available for TMDL implementation (i.e. finding the sources and fixing the problem), so the impairments will likely continue.

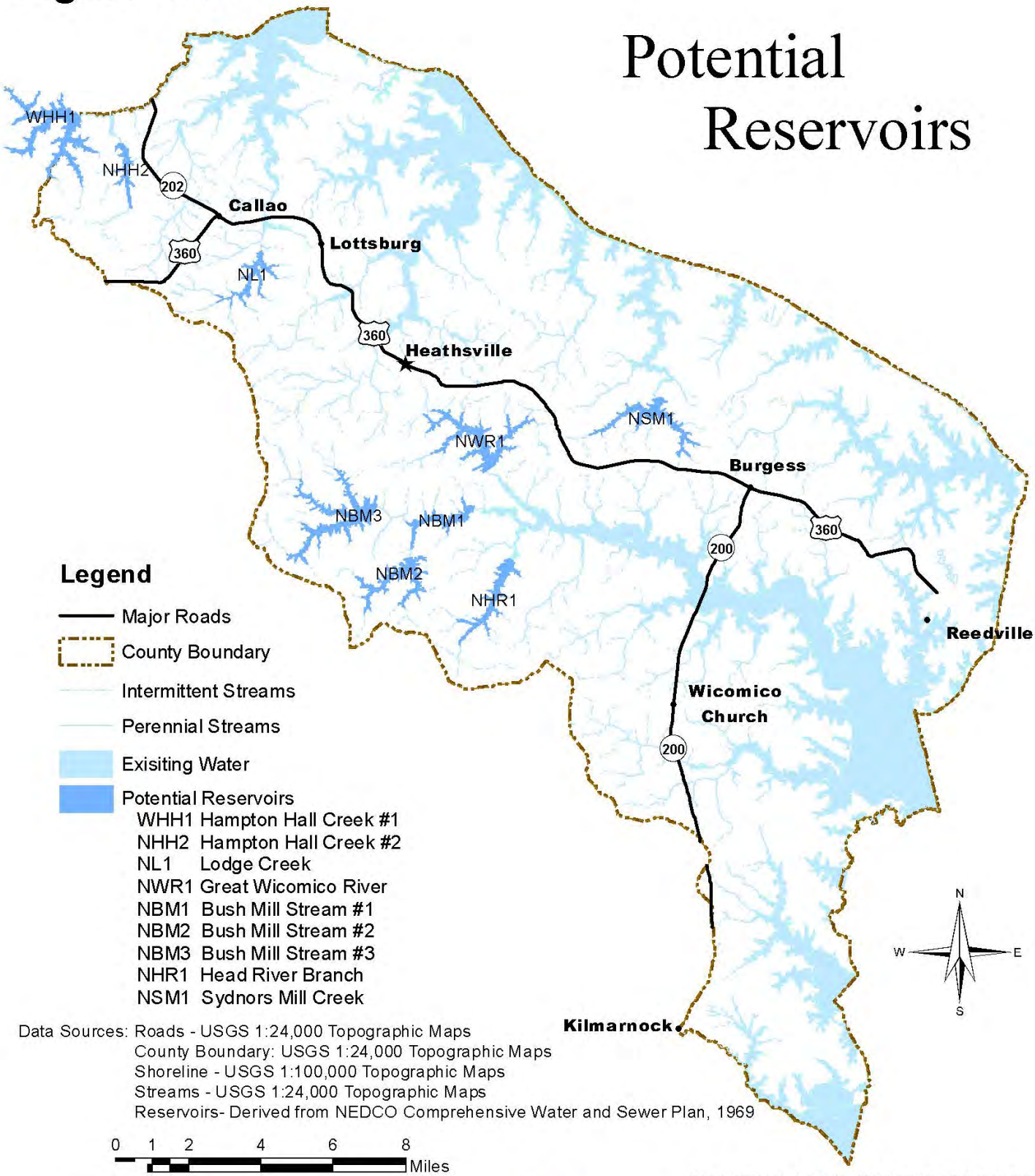
f. Major Planning Issue Concerning Water Supply

The major planning issue regarding potable water supply are to provide for sustainable supplies of water and to protect the groundwater sources from contamination. Expansion of the Virginia Groundwater Management Area to include the County will help with future management of groundwater resources within the region.

The County is not able to limit groundwater withdrawals under current Virginia Law, so that is not an option for reducing the demand on groundwater resources. The County can, however, investigate the possibility of surface impoundments (reservoirs) within the jurisdiction. In 1969, the Northern Neck Economic Development Commission (NEDCO) prepared a report for the newly formed NNPDC, entitled Engineer's Comprehensive Plan (for) Water and Sewerage Facilities (in) Lancaster, Northumberland and Richmond Counties. In the report, 43 reservoirs were located; drainage acres, total volume, and daily sustainable yields were calculated throughout the Northern Neck. Nine reservoir sites are identified in Northumberland, with one on the border of Westmoreland and Northumberland Counties (Hampton Hall Creek). At the request of the County Planning Commission in 2003, the NNPDC used Geographic Information Systems (GIS) to digitize the flood elevation of the reservoirs and determine if the reservoirs impacted any existing structures in the County. Using E911 data of building outlines, the two data sets were overlaid. None of the reservoirs impacted any existing buildings, but two houses were within 50 feet of the inundation. Figure1.13 shows the location of the nine potential reservoir sites within the county. The County should consider limiting development in the proposed reservoir footprints so that the option of constructing surface impoundments is still viable, should the demand for groundwater exceed supply.

Another way to reduce the demand on groundwater resources is to reduce the total amount of water used by the average citizen. Low flow plumbing fixtures; as well as judicious use of potable water can reduce the amount of groundwater consumed and lessen the load on septic systems. The County should encourage citizens to use these devices and to think about saving water in their daily routine. For tips on how to reduce the amount of water used in everyday activities go to: http://wateruseitwisely.com/100-ways-to-conserve/

Figure 1.13



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The most vulnerable aquifer is the surficial aquifer, which is closest to the surface and the first to become affected if contaminants pass through the soil. Areas of considerable concern are where the soil is less acceptable for septic tanks and where the elevations are lowest. The areas where most of these conditions are found are the lowlands along the shorelines which are also the area most in demand for development. Future development should be encouraged to make greater use of the lower aquifers, particularly the upper artesian aquifer for water supply. The protection of the artesian aquifers against excessive usage is a matter that should be given high priority in future planning. The county encourages periodic testing of individual wells to ensure that a satisfactory quality of water is maintained. To help in this effort, the County should promote increased awareness of the water testing program that is presently available to county residents from the local Health Department.

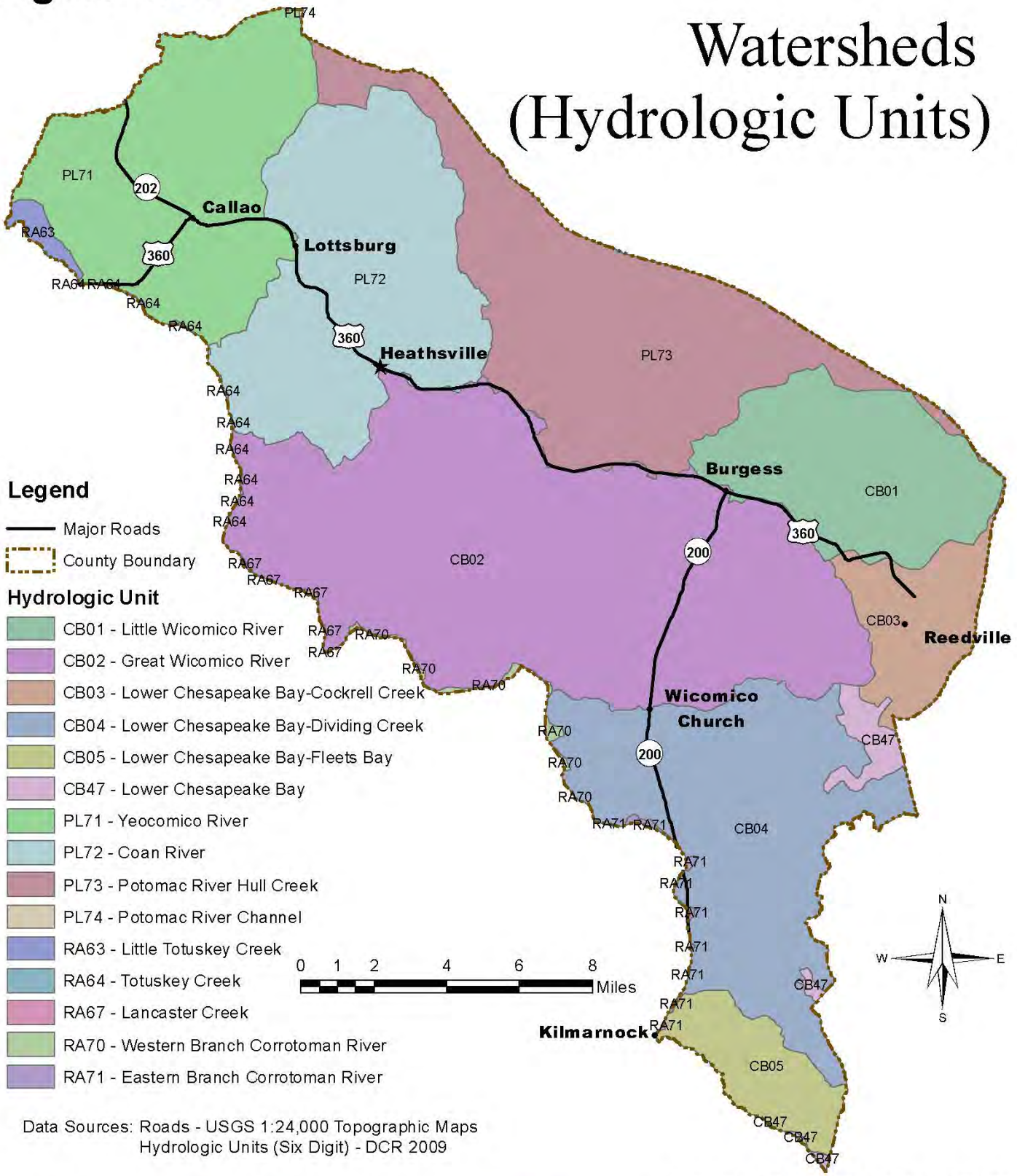
For ways to protect wells from contamination, such as wellhead protection and other measures allowed under Virginia Law, as well as Source Water Protection Program (SWAP) potential pollution data see the Northern Neck Groundwater Quality Management Plan (NNGQMP) created by the Northern Neck Planning District Commission in 2003. The plan is available on the NNPDC website for download at: http://nnpdc.org/PAGES/document-archive.htm

2. Principal Watersheds

The drainage of Northumberland County flows either to Potomac River or directly into the Chesapeake Bay through the many rivers, streams and creeks that penetrate into the County and form its impressive long shoreline. A very small portion (less than 2 acres) of the County drains into the Rappahannock River, and these areas occur along the southern border of the County, adjacent to Richmond and Lancaster Counties. Figure 1.14 Watersheds (Hydrologic Units) shows the principal watershed areas as established by the Virginia Department of Conservation and Recreation, and are referred to as hydrologic units. “Hydrologic Units” are conglomerations of smaller watersheds and are identified by significant rivers or creeks but include the lesser rivers and streams that flow into those named. Hydrologic Units are also coded with an alpha numeric coding system, “PL” is the code for the Potomac, “RA” is the code for the Rappahannock, and “CB” is the code for the Chesapeake Bay. The sequential numbers begin at the headwaters (low numbers) and increase as you go downstream. Thus, “PL72” is downstream of "PL71”.

The table below provides a brief summary of each of the watershed areas, giving the approximate land area occupied by each and highlights of events in each watershed. Some factors are common throughout the County and may not be mentioned in the summaries. For example, septic tank and underground tank failures constitute an on-going threat of pollution.

Figure 1.14



Data Sources: Roads - USGS 1:24,000 Topographic Maps
Hydrologic Units (Six Digit) - DCR 2009

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PRINCIPAL WATERSHEDS NORTHUMBERLAND COUNTY		
WATERSHED IDENTITY	APPROX LAND AREA (SQ MI)	PRINCIPAL FEATURES & ISSUES
A. Yeocomico River (part of Hydrologic Unit PL71)	28	Watershed shared with Westmoreland County; includes West and South Yeocomico Rivers, and their tributaries; significant activities: agriculture, seafood industries, business activities in and near Callao, shoreline residential development. Potential pollution sources: golf courses, sewage treatment facility at Callao[9], several seafood processing plants, recreational areas and marinas, commercial uses handling oil products.
B. Coan River/The Glebe and Kingscote Creek (part of Hydrologic Unit PL72)	31	Watershed includes named bodies of water and tributaries; significant activities: agriculture, seafood industries, shoreline residential development, commercial marinas, and development in and near Lottsburg, Heathsville and Lewisetta. Potential pollution sources: failing septic systems, industrial waste sites, sewage treatment facility, commercial marinas, seafood processing plants. One site has an active VPDES permit[10].
C. Potomac River: Coan River to Ginny Beach (part of Hydrologic Unit PL73)	33	Watershed drains all streams within named area directly into the Potomac River. Significant activities include: agriculture, shoreline residential development, seasonal dwellings and/or campsites, and shoreline residential development. Existing or potential pollution sources: activities around boat ramps and docking areas.
D. Little Wicomico River (part of Hydrologic Unit CB01)	18	Watershed includes Little Wicomico River and all tributaries. Significant activities: seafood industries and sports boating and fishing; part of Burgess commercial area; shoreline residential development; campgrounds; some agriculture. Potential pollution sources: industrial waste, private and commercial boat facilities, seafood processing, failing septic systems.
E. Cockrell Creek and Gaskins Pond (part of Hydrologic Unit CB03)	8	Watershed contains all of Cockrell Creek and tributaries, and several ponds and streams that drain directly into the Chesapeake Bay. Significant activities: Town of Reedville- residential development; a large seafood industrial complex; commercial marine facilities. Chesapeake Beach and Fleeton Beach developments – seasonal dwellings; shoreline residential development. Potential pollution sources: seafood industries, town's sewage treatment plant, public boat landings, boat facilities and usage, failing septic systems, marina pollution.
F. Great Wicomico River (part of Hydrologic Unit CB02)	63	Watershed includes Great Wicomico River basin and all tributaries. Significant activities: business areas at Burgess, Wicomico Church and Heathsville; extensive shoreline residential development; agriculture; campgrounds and agriculture. Potential pollution sources: Tri-county landfill, sewage treatment plants at schools, campgrounds, marine and boat activities.
G. Ches. Bay: Mill Creek and Dividing Creek (part of Hydrologic Unit CB04)	31	Watershed includes several creeks and streams within named area flowing into the Chesapeake Bay, Mill Creek and Dividing Creek. Significant activities: Wicomico Church business area; agriculture; seafood, shoreline residential development (Mill Creek). The least developed of the watershed areas with no major pollution threats.
H. Indian Creek (part of Hydrologic Unit CB05)	7	Watershed includes all tributaries of Indian Creek plus Henrys and Barnes Creeks. Significant activities: Kilmarnock, shoreline residential development, marinas, some agriculture, golf course. Potential pollution from Kilmarnock (Lancaster County), marina pollution

[9] The Callao sewage treatment facility was upgraded in 2005 to serve the Callao region. The Callao sewage treatment plant is an extension of the Reedville Sanitary District, operated by the county.

[10] Pollution Discharge Elimination System (VPDES) permit, issued by the Department of Environmental Quality for wastewater or industrial waste discharges, see page 1:43 for a list of VPDES dischargers in the county and the affected waterbody.

There is an intimate relationship between the land and water resources. Protecting ground water, lakes, rivers, streams, and wetlands requires wise land use. Human population growth and changes in land use increasingly impact aquatic environments. There is an inverse relationship between total impervious cover and habitat quality and species richness (fish and invertebrates). Research has shown that streams in watersheds with greater than 10 percent of their land area in impervious cover begin to show signs of ecological impairment. As the impervious cover in a watershed approaches 25 percent, streams become degraded and the water quality, habitat quality, and biological diversity occurring in watershed streams are all greatly reduced. Virginia Stormwater Regulations have integrated into the calculations incentives to reduce impervious cover, thus reducing the volume of stormwater created by new development. Adhering to the Virginia Stormwater Regulation standards should help minimize impervious cover in county watersheds, thus reducing overall impact of development on fishery resources.

Planning issues related to watersheds should focus on the discharge of water that eventually finds its way into the underground water system or into one of the rivers and eventually into the Chesapeake Bay. The focus of strategy should be on ways of reducing pollutants in surface runoff and groundwater as well as minimizing the amount of such water that actually reaches the Bay. One of the ways to reduce water and pollutants entering the Bay is through three-story vegetated buffers along all streams, ground cover plants, shrubs and trees, in which mature trees are the most important component.

These are the same issues that are addressed by the Chesapeake Bay Preservation Zoning Regulations of the Resource Protection and Resource Management Areas. Drainage issues are also addressed by the Best Management Practices Handbook, Planning Bulletin 522, Va. Water Control Board, 1981. [11]

3. Soil Conditions

This section discusses various qualities of the soil with emphasis on soil conditions that may affect the quality of water in the aquifers, creeks, rivers and eventually the Chesapeake Bay.

a. Water Table

Figure 1.15 maps the seasonal high water table patterns in Northumberland County in terms of its depth below the surface. The seasonal high water table occurs in late Winter, early Spring, usually around late February to early March, before deciduous trees begin to leaf out. The map uses twenty-four inches as the dividing point; therefore, the water table is shown either as being 24 inches or more from the surface or 24 inches or less. The results are not surprising in that the predominant areas of high water table are in the lowest parts of the County near the shorelines.

The seasonal high-water pattern is quite pronounced within the area between the line

[11]Now the Department of Environmental Quality.

previously described as the "Suffolk Scarp" (Refer to Topographic Conditions) and the shorelines of the Potomac River and Chesapeake Bay. That pattern runs from the County line at Kilmarnock then generally parallels Route 200 until it passes Route 360 near Burgess. From there, the escarpment runs approximately parallel to the Potomac River shoreline about two to three miles inland of that river.

One observation that can be made from this pattern is that, even though most of the seasonal high water table may be found in these low areas, some areas nearest the shorelines appear to have a lower water table than the general pattern of the high water table area. This has made it possible for more development to occur immediately adjacent to the shorelines while much of the higher ground nearby is unsuitable for septic tanks (Figure 1.5). Today, however, with the advent of alternative secondary treatment septic systems, the water table is less of a limiting factor than once was true. The potential for pollution from these engineered systems always exists, especially if the systems are not properly maintained by professionals, as required by State law.

The seasonal high water table is also present to a lesser degree in the portion of the County south and west of the "Suffolk Scarp" line, but in the areas south and west of Routes 360 and 200 the high water tables are found mostly along the bottom lands and stream basins that penetrate into these otherwise higher elevations.

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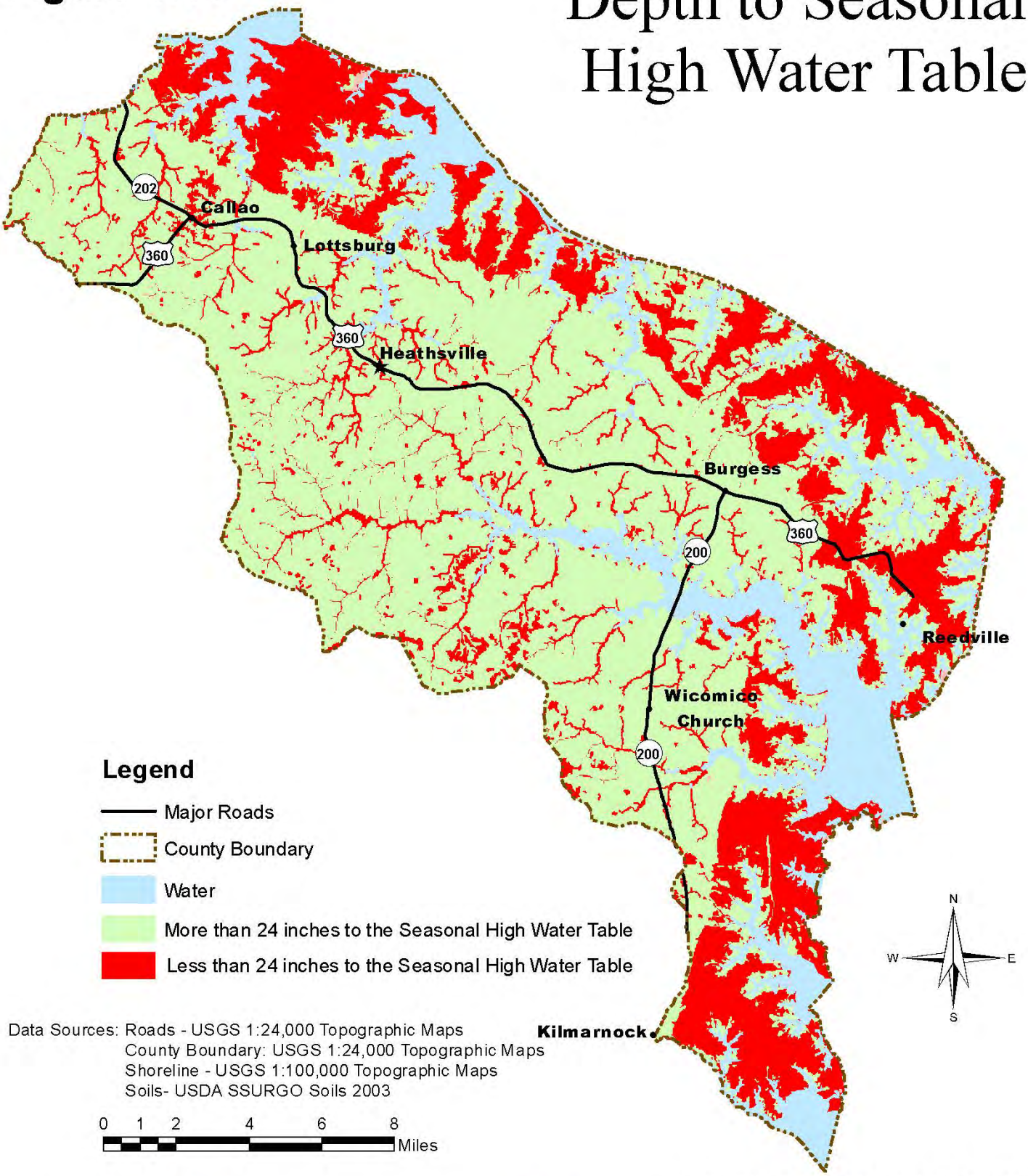
Figure 1.15

Depth to Seasonal High Water Table



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b. Highly Erodible Soils

Soils that are classified as "highly erodible" present a particular concern in the protection of water supply. Erodibility refers to the capacity of soils to be carried from the surface to streams with storm runoff. When this happens, surface impurities are carried into state waters increasing pollution and presenting dangers to marine life, as well as making the creeks less navigable by boats by reducing the depth of the channel.

Areas that are particularly vulnerable to erosion may be found around construction sites, tilled fields and other places where disturbed soil may be exposed to water or wind.

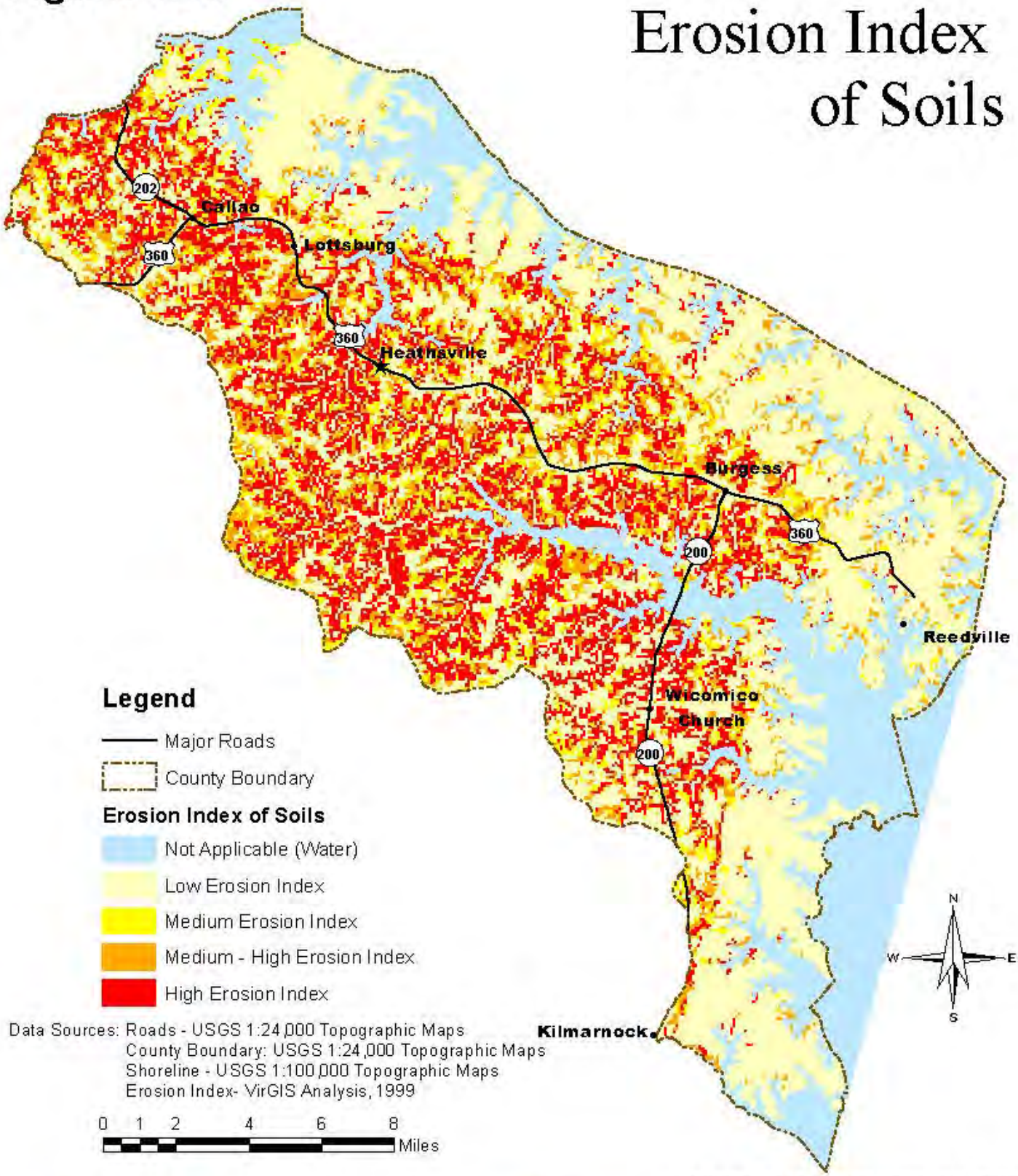
The State has determined that an erosion index of 8.0 or more is high enough to warrant precautions. When such areas are combined with steep slopes, the threat of severe erosion is increased considerably. Since most of the steep slopes in Northumberland County are along streams, there is always a threat of erosion in these areas if the slopes are disturbed. In addition, erosion from cultivated farm areas and intensely developed residential areas can carry large amounts of chemicals into public waters. See Figure 1.16 for an erosion index map.

Part of the State's strategy for establishing RPA’s and RMA’s in the Chesapeake Bay regulation in the Zoning Ordinance is to reduce the impact of erosion on state waters. The RPA and its associated buffer strip functions as a strainer for water discharging into public waters. The RMA extends protection further by requiring performance standards to be maintained.

c. Steep Slopes

Topographic landforms and corresponding slopes are environmental features that have always required careful consideration in determining appropriate types of land development and use. This was demonstrated earlier in this Chapter by the topographic representation shown on Figure 1.3, which found that nearly all of the state highway roads are located along the tops of ridges. And for reasons of access, all development is likewise located along the roads or very close to them. Other maps illustrated that the level ridge tops also contain the best drained soil. In a cursory examination of the road pattern, one might conclude that they were located randomly, but on closer examination the rationale of their locations relative to topography is obvious. For one thing, excessive slopes seem to have been avoided.

Figure 1.16



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Slopes are also a major consideration in land use planning for several reasons. The first is evident in the pattern of highways. Steep slopes present more engineering problems than moderately sloped or nearly flat land and consequently increase the cost of development. Historically, developers like highway engineers, have sought out land with the fewest construction problems for establishing subdivisions except in cases where amenities offered such significant market advantages that the higher development costs were acceptable. In Northumberland County, both types of development are present but perhaps the more dominant type are those with amenities such as water access. The profit potential of prime waterfront property is taking priority over immediate development costs.

Development on slopes can also present environmental liabilities contributing to excessive soil erosion and resulting in stream pollution. Where certain types of sandy soil which are located on a steep slope is disturbed during construction, the remaining soil can become very unstable, and start to erode. Because many such conditions exist along streams and shorelines, the preferred sites for building homes, these sites are extremely vulnerable to erosion during construction. The erosion problem has been reduced considerably, with the establishment of the Chesapeake Bay RPA which in many cases includes steep slopes when they are adjacent to shorelines and adjacent wetlands. The County's erosion and sedimentation control ordinance also establishes another layer of protection by requiring erosion control mechanisms around construction sites. The establishment of the Department of Conservation's Responsible Land Disturber Program in July 2001, also helps to reduce sedimentation by minimizing excessive land disturbance.

When discussing slope three classes of slopes are included: less than six percent; between six and 15 percent; and greater than 15 percent. The steeper slopes can be seen to form a pattern along the stream beds in the upland parts of the County. Within that area there is very little development in the areas of steep slopes; it is lined along existing roads. The steep sandy land USDA soil category from the County Soil Survey occurs in these areas and is the most vulnerable land in terms of erosion potential. Once vegetation is removed, there is little to hold the soil in place, since the soil lacks organic matter. Retention of native vegetation is recommended to hold this soil type in place in these areas.

In the lowland part of the County, slopes become a secondary issue because in these low lying areas other physical conditions such as poor soils and high water table present a greater constraint to development.

As a planning issue, land with slopes greater than 15 percent (15 feet fall per 100 feet) should be avoided wherever possible and if developed at all, extensive care should be taken to ensure that the site work does not leave unstable banks. Land with slopes greater than 20 percent should be avoided altogether.

d. Soil Permeability

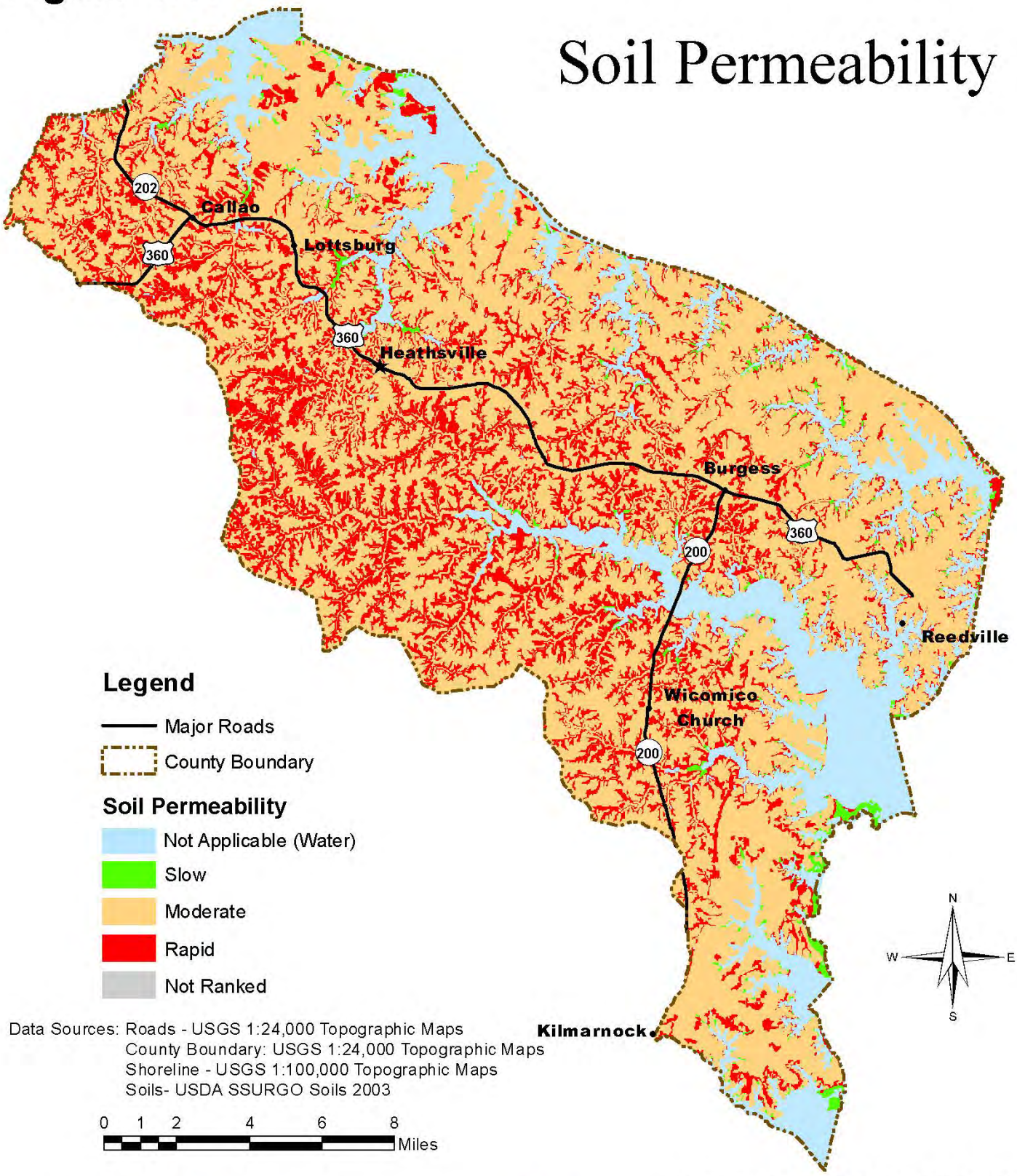
Figure 1.7 (see Section A.4.) displays areas of the County that are unsuitable for conventional septic systems. That map is based on several factors that affect the soil's ability to be used for sewage disposal. Among these are wetness, slope, and texture of soil particles. One of the soil's principal determinants of acceptability is its permeability, an index that describes the rate at which water passes from the surface to lower layers when the soil is thoroughly wet. Soils which have a very high infiltration rate such as sandy or gravely soils are said to have high permeability whereas those with a low infiltration rate are said to have low permeability. Figure 1.17 shows the soil permeability in the County.

The scale established by the State measures infiltration in terms of how many inches per hour will pass through the soil under thoroughly wet conditions. A permeability factor of 0.6 inches per hour or less is regarded as inadequate for conventional septic tank drain fields. In addition, because these soils have a low percolation rate, more of the surface water that falls during precipitation is carried off the site, a condition that also promotes erosion.

High permeability presents another type of problem for septic tanks and the underground water supply. In order for septic tanks to function properly, the effluent must remain in the upper soil long enough for oxidation to destroy anaerobic bacteria and inorganic substances like ammonia and hydrogen sulfide. When the effluent passes through too quickly impurities can enter and pollute the underground water supply. The state standards establish six inches per hour as the maximum acceptable permeability rate for septic tank function.

Therefore, soils with ratings outside the 0.6 through 6.0 range should normally not be used for conventional septic tank fields. Today, with the advent of alternative septic systems, conditions that would previously not support septic systems are now open to development. The expense of the alternative septic systems may deter some from adopting the new technology; however, when compared to the current cost of waterfront property, the expense is negligible.

Figure 1.17



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D. ANALYSIS OF SHORELINE CONDITIONS

1. General Shoreline Conditions

A comprehensive Northumberland County Shoreline Situation Report was published in 2003 by the Center for Coastal Resources Management (CCRM), Virginia Institute of Marine Science (VIMS), College of William and Mary. The report is part of the Comprehensive Coastal Inventory, which was funded in part by the Virginia Coastal Program of the Virginia Department of Environmental Quality. The Coastal Program is funded in part by the National Oceanic and Atmospheric Administration. This inventory contains a wealth of detailed information at an unprecedented level of detail for all of the shorelines within the County. In 2014, the Virginia Institute of Marine Science's Comprehensive Coastal Inventory updated the 2003 report using onscreen digitizing over 2012 and 2013 aerial photos to create a new 2014 Digital Shoreline Situation Report. The new 2014 Digital Shoreline Situation Report can be viewed here, using the Map Viewer: http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/virginia/northumberland/northumberland_disclaimer.htm. In addition, the map and tabular data can be downloaded for query and manipulation in a Geographic Information System.

The 2014 Digital Shoreline Situation Report states that the shorelines of Northumberland County extend for 509 miles.[12] The study identified 10 separate riparian land use conditions that existed at the time of the survey (2014):

- 124 miles (24.4 %) of the area along shorelines overall is still in forests
- 245 miles have a riparian land use of Residential (48.1%)
- 19 miles in scrub-shrub riparian land use (3.7%)
- 81 miles in agricultural land use (15.9%)
- 8 miles in commercial land use (1.6%)
- 21 miles have a riparian land use of grass (4.1%)
- 3 miles were bare (0.6%)
- 7 miles were paved (1.4%)
- 1 mile was detached marsh (0.4%)
- 1 mile was marsh island (0.4%)

[12]Numbers have been rounded. Summing numbers in table may not necessarily equal the exact total whole number shown.

The VIMS Digital Shoreline Situation Report maps shows three categories of data, riparian land use (tabular data shown above), the following map (Figure 1.18) shows the linear shoreline structures present, and the shoreline structures represented by points (docks, boat ramps, and boathouses) can be viewed using the map viewer available on the VIMS website address listed above.

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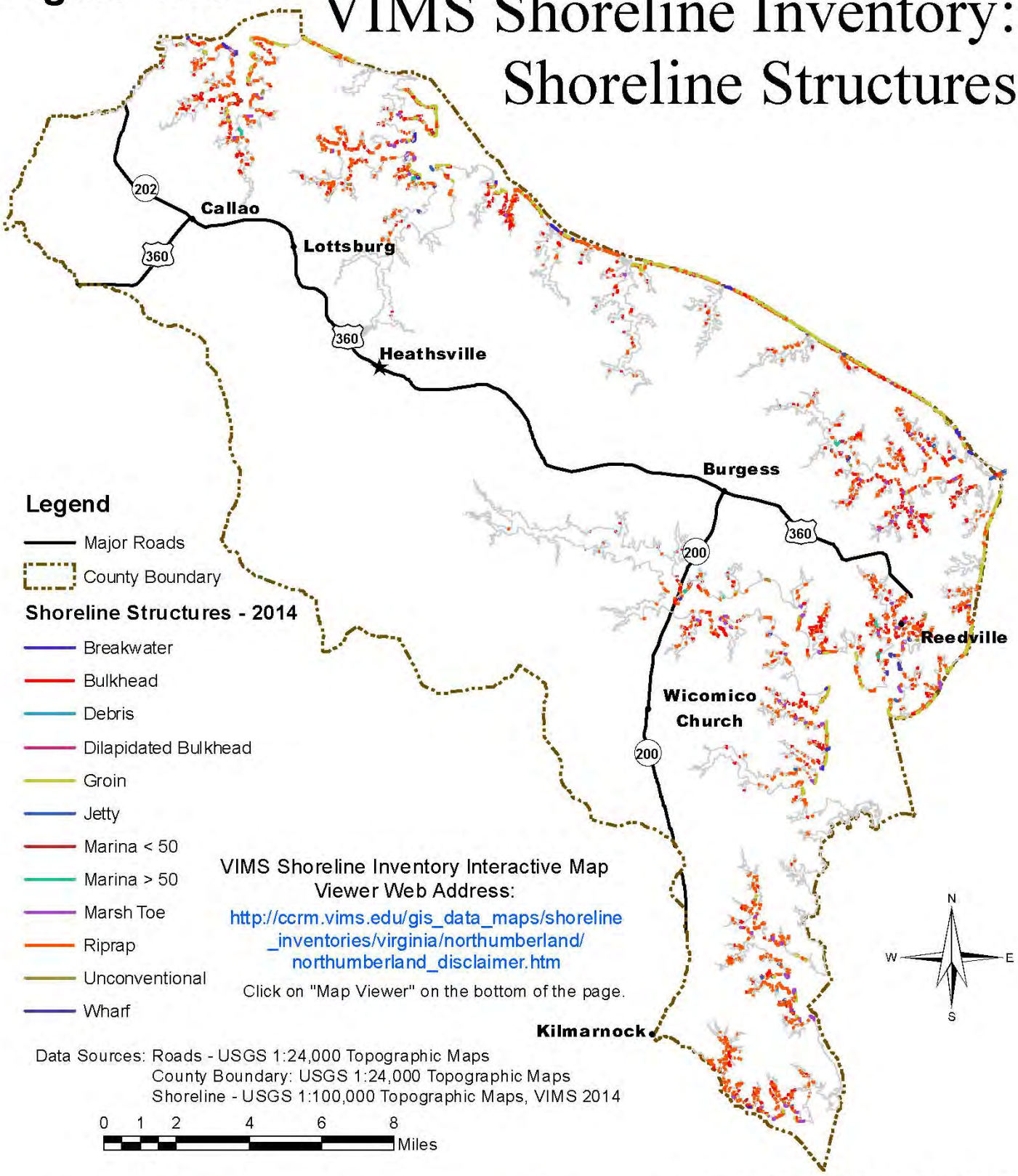
Figure 1.18

VIMS Shoreline Inventory: Shoreline Structures



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It is significant that 48.1 percent of shoreline is in residential land use. One gets an image of much less development by a visual inspection made only from the roads. When one visually inspects the county from the water, it seems much more developed. There is still time to preserve and protect portions of the shoreline. Conservation easements should be encouraged for those landowners who want to preserve their shoreline for future generations. Roughly 28 percent of the shoreline is still in forest or grass. However, everyday more waterfront houses are being built that reduce the available natural shoreline.

The Northumberland County Shoreline Situation Report contains in addition to the riparian land use conditions, bank height and buffer condition, as well as shoreline features which include shoreline structures. Below is a summary of significant shoreline features mentioned in the report.

- There are 3,593 docks that line the shoreline. In addition, there are 400 boathouses, 151 private boat ramps, and 5 public boat ramps. In addition, the report noted 65 "dilapidated docks" along the waterfront.

- Shoreline erosion control structures were also numerous. 135groin fields, 33 jetties, and 21 breakwaters were recorded. Traditional shoreline hardening accounts for 20.4% of the total shoreline, with 31 miles of bulkheads and 73 miles of riprap.

Additional data from the VIMS report are included in Section 3 of Appendix A.

Several issues arise from this analysis. First, less than 30% of the shoreline still remains undeveloped as defined above, there is still opportunity for the County to establish development policies for the shoreline which promote conservation and protection against erosion. Second, more than half of the residential units of the County are on waterfront locations. This suggests an ever-increasing demand for such properties, as both open land and forests are subject to conversion to residential development, along with the accompanying shoreline hardening measures.

In addition to shoreline characteristics, another study (April 2003) by the Center for Coastal Resource Management at VIMS, examined sand dunes in Northumberland County. The study can be found on the Virginia Institute of Marine Science's website online at:

http://www.vims.edu/physical/research/shoreline/docs/locality/Northumberland/northumberland_dune_inventory.pdf

The study identified 59 unique dune sites in the County. The study was done in the few months prior to Hurricane Isabel, so most likely some of the dunes have been modified by that storm event. Most residents of the county are not aware that the County has any dune systems. Examination of the dune systems immediately after Isabel noted that although some dunes were reduced in size, they functioned as energy absorbing features reducing shoreline erosion and inland flooding. Dunes are important habitat and should be protected to the maximum extent

allowed by law.

The most serious shoreline erosion threats come from the actions of strong winds and high surf produced by "northeasters" and hurricanes. The primary targets of these winds and waves are the exposed banks of the Potomac River and the Chesapeake Bay. The next topic addresses this issue in more detail.

2. Shoreline Erosion

Figure 1.19 shows areas that have been identified by the Virginia Institute of Marine Science with erosion problems. Not much of the County's shoreline particularly that exposed directly to the Potomac River and Chesapeake Bay has escaped erosion to some extent. The protected inlets and rivers, not a small amount of the total, are relatively safe from direct erosion from northeaster storms and wave action in the Potomac River and Chesapeake Bay. It is within these protected areas that maximum results can be achieved through planning to reduce potential shoreline erosion. In 1977, Northumberland County ranked second among Tidewater counties in loss of acres of shoreline for the past one hundred years. Net loss was 3,270 acres, or an average erosion rate of 1.1 feet per year. Average shoreline erosion rates can be misleading since erosion occurs sporadically in response to storm events.

Shoreline erosion rates are determined by four principal factors: storm frequency; storm type and direction; resulting wind tides, current, and waves; and storm intensity and duration. Other forces which cause increased levels of stormwater runoff and shoreline erosion are human activity, grading, upland runoff and vegetation removal. Shoreline erosion must be considered recognizing that sea level is rising about 2mm/year and the Northern Neck of Virginia is subsiding about 2mm/year, resulting in an effective rise in sea level of 4-5 mm/year (Lewisetta is at 5.53 mm/yr) or about 1.5-2 inches per decade. Shoreline erosion has a significant impact on water quality and natural resources. Recent studies have indicated that shoreline erosion is responsible for millions of pounds of nitrogen and phosphorus entering the Chesapeake Bay each year and is also responsible for an estimated 15 to 20 percent of sediment entering the Bay.

In 1989, Northumberland County contained approximately 25 miles of artificially stabilized shoreline to combat erosion. As of 2014, that numbers had increased to 104 miles of hardened shoreline. Many shoreline landowners have installed structures such as groins used in conjunction with bulkheads or riprap to reduce or prevent erosion. This technique has met with some success in combating erosion on the shorelines that are exposed to heavy wave and wind action. A shoreline protection program should also contain a variety of techniques controlling erosion in addition to structures. Alternatives that have been used include:

- Living Shorelines - Protection of low energy shorelines by planting grasses, shrubs and vines, along with fiber matting or coconut logs to stabilize beaches, banks, and shorelines while the vegetation establishes itself

- Replacement of sand on recreational beaches although this does not

control shoreline erosion and at best is a temporary solution

- Development of off-shore erosion control structures such as breakwaters and artificial islands to modify wave action, reduce deep water wave energy, and promote beach nourishment. In 2003, there were only 6 breakwaters in the County and in 2014, there are 21 breakwater structures. Breakwaters allow shorelines to rebuild themselves from sediment sources available in the coastal system, thereby creating natural shallow water and beach habitat.

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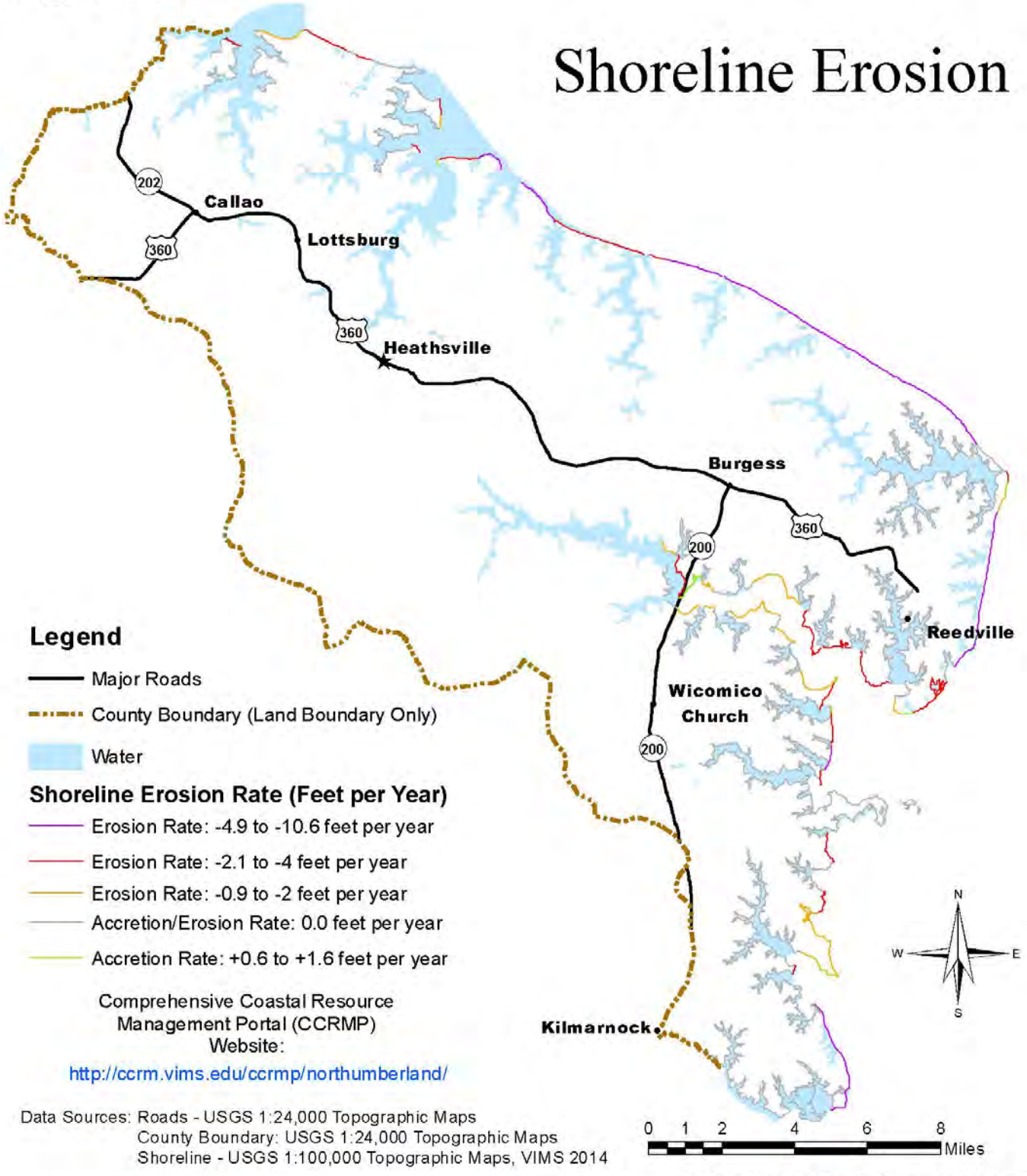
Figure 1.19



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3. Marshlands

Marshlands provide a considerable defense of the shoreline against erosion in addition to their function as a nursery ground for aquatic life. VIMS classifies marshes into three categories: fringe, extensive and embayed.

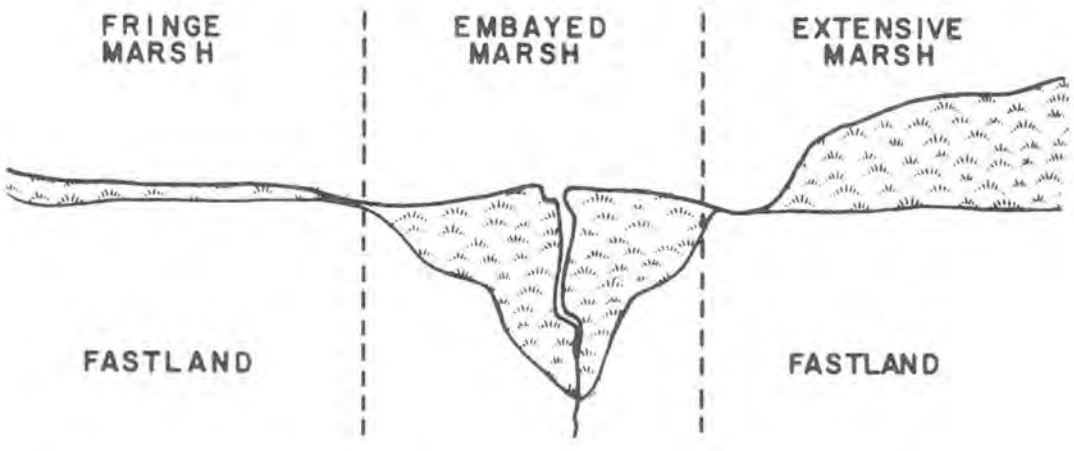
Fringe marsh is defined to be less than 400 feet in width and runs in a band parallel to the shore.

Extensive marsh is that which has extensive acreage projecting into an estuary or river. This type of marsh has the highest value for wildlife.

Embayed marsh is a marsh which occupies a reentrant or drowned creek valley.

The following sketch illustrates these three types of marshlands. The fringe marshes have maximum values as a buffer to wave erosion of the fastland. The seaward margins of most marshes are undergoing erosion as a result of rising sea level. Citizens should be encouraged to manage marshes by clearing them of debris, pruning back overhanging vegetation to provide as much sunlight as possible, and allowing the marsh to move progressively landward in response to rising sea level.

A GENERALIZED ILLUSTRATION OF THREE TYPES OF MARSH



As a component of the 2014 Shoreline Situation Report, VIMS has updated the Tidal Marsh Inventory, and it accessible through the VIMS Digital Shoreline Inventory Map Viewer located here:
http://cmap.vims.edu/ShlInv/Northumberland/Northumberland_ShlInv.html

E. ACCESS TO STATE WATERS

Many objectives of the Chesapeake Bay Program focus on improving the quality of potable water and preserving habitats for marine life within the Bay and its tributaries. In addition, the program also emphasizes a desire to improve public access for recreational and commercial purposes. The concept is that when people enjoy the richness and beauty of the Bay, then they will be more likely to take steps to protect it, or reduce their impact on the Bay. Therefore, it may be stated that there is a dual focus of the Chesapeake Bay Program relative to access: to increase recreational opportunities while protecting the water quality and natural resources of the Bay. This section examines factors that may influence the establishment of new public or private access points to the Bay or its tributary tidal streams.

1. The Chesapeake Bay Area Public Access Plan

In 1990, the Chesapeake Executive Council published its report titled The Chesapeake Bay Area Public Access Plan which included a report for every county within Virginia and in the adjoining states that were covered by the program. That study identified major existing access facilities ranging from state-operated boat ramps to commercial marinas. Figure 1.20 depicts the general locations of existing waterfront access facilities in Northumberland County. They are grouped on this map into four categories:

- Fishing piers, Great Wicomico River Public Fishing Pier
- Boat Ramps, including state as well as private ramps. In addition to the public boat launch ramps, many, if not most, of the marinas also have boat launching ramps in addition to boat slips. However, marinas usually charge for the use of their launch facilities, whereas public ramps are free to use.
- Swimming Beaches: There is one public (free) beach (Vir-Mar Beach) identified in the inventory. Also, many of the member-only community associations have private recreational areas that include beaches.
- Natural Area Preserves, Bush Mill, Dameron Marsh and Hughlett Point.

The natural habitat areas provide limited access for purposes of observation and nature study. The State has three nature preserves, one upstream on the Great Wicomico River, Bush Mill Stream, one at the mouth of Dividing Creek, Hughlett Point, and Dameron Marsh which is located mid-point on the Chesapeake Bay shore in the County. Each of these sites has some potential for public access, and Dameron Marsh has installed a canoe/kayak launch and a small

parking area. More information about how to access the Dameron Marsh hand carry boat launch can be found here: http://www.dcr.virginia.gov/natural_heritage/natural_area_preserves/dameron.shtml. Bird (and wildlife) watching, and hiking are passive recreation activities that are traditionally allowed at these preserves.

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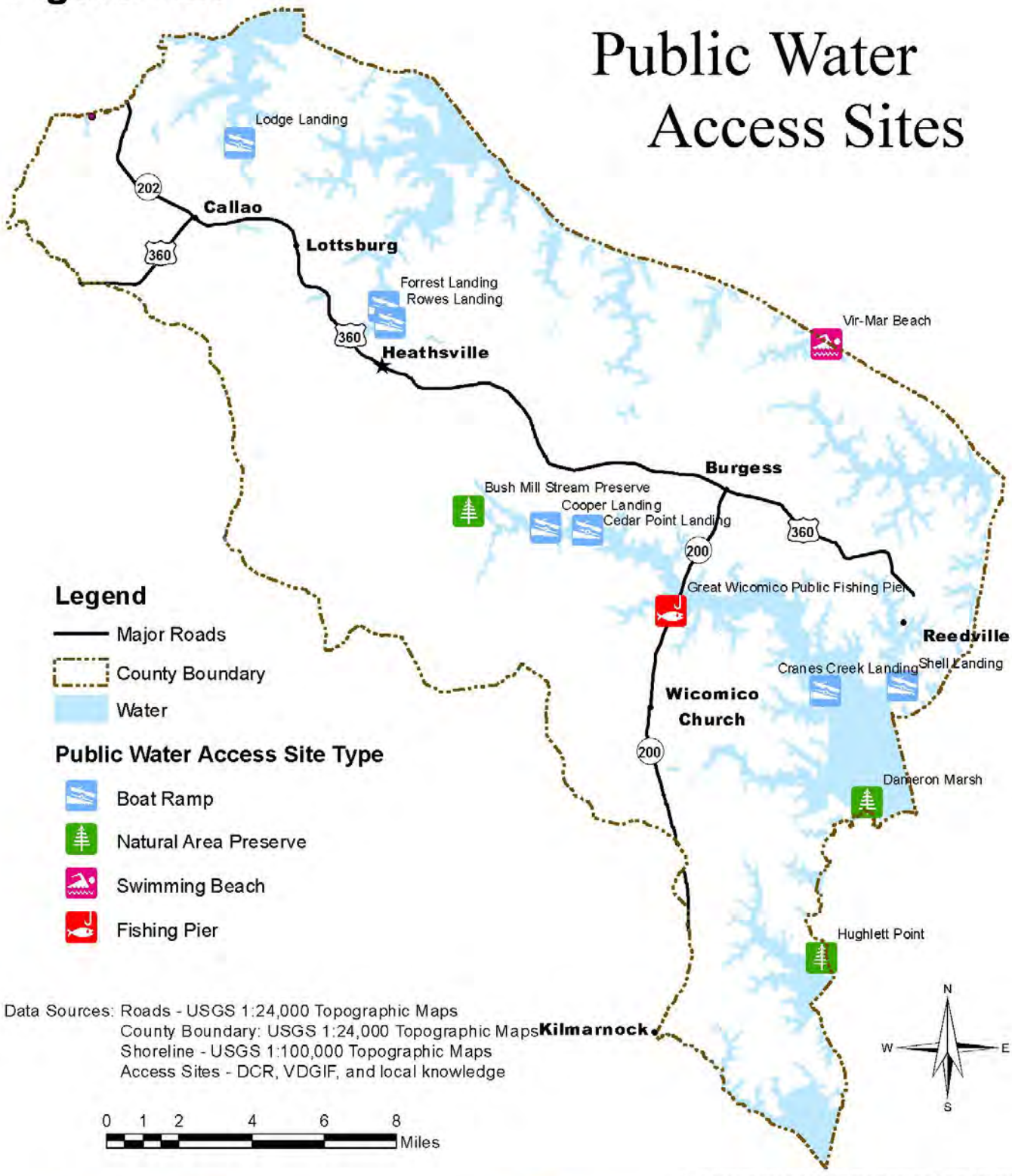
Figure 1.20



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The Public Access Plan cites a need to increase access to public beaches and to upgrade public boat ramps. Marshes and wetlands are also suggested as resources to extend opportunities for the public to enjoy the shoreline and waterfront for both recreational and educational purposes. The concern for more and improved public access to public waters also came from community workshops. It was observed in the workshops that the present level of facilities is inadequate to serve county residents as well as summer visitors.

The previous Comprehensive Plan pointed out the lack of public water access points in the County for citizens. The County is blessed with 14 power boat ramps; however, there are very little opportunities for those citizens who want to bank fish, crab, launch canoes and/or kayaks, and most of the sites suffer from inadequate parking. The County does have VirMar Beach, a small (250 ft) long beach area on the Potomac River for fishing, crabbing, swimming and/or picnicking. The Northumberland County Planning Commission has been working for over five years towards improving public water access for Northumberland County citizens. To that end, Northumberland County, with the assistance from the Northern Neck Planning District Commission, submitted a grant application for a public fishing pier on the Great Wicomico River to The Virginia Department of Environmental Quality's Coastal Program (funded by the National Oceanic and Atmospheric Administration) in 1999. To secure matching funds, the County submitted another grant application to the Virginia Marine Resources Commission's Recreational Saltwater Fishing Development Fund in 2000. Both grants were awarded, and the County now has a public fishing/crabbing pier to serve its citizens.

The enabling legislation to form the Northern Neck Chesapeake Bay Public Access Authority (NNCBPAA) was created by an act of the Virginia General Assembly in 2005. The Virginia State Code reference for the creation of the NNCBPAA is 15.2-6626 through 15.2-6651. Northumberland County officially joined the NNCBPAA, along with three of the other four Northern Neck Counties on September 12, 2006. While no significant on the ground projects have come to fruition for the NNCBPAA in Northumberland County as of yet, it is not for lack of effort.

In 2010, the County joined with the other NNCBPAA counties to participate in a project by the Army Corps of Engineers to create the Northern Neck Regional Shallow Draft Navigation and Sediment Management Plan. The purpose of the plan was to quantify the cost to maintain federal navigation channels in the county, and to analyze possible cost saving approaches to grouping creeks that needed dredging on a similar schedule. Since mobilization is a large portion of the cost of dredging projects, the concept of grouping creeks together to minimize the mobilization costs, thereby reducing overall dredging costs. With overall Federal budget reductions required into the future, there is likely to be less and less Federal funding for maintaining Federal navigation channels, so this study will be valuable into the future. The Northern Neck Regional Shallow Draft Navigation and Sediment Management Plan can be accessed on the Northern Neck PDC website at:
http://www.nnpdc.org/PAGES/PAA/Shallow-Draft-Navigation-and-Sediment-Management-Plan-2011-09-WEB.pdf

NNCBPAA staff, through technical assistance funding through with the Virginia Coastal Zone Management Program has created water trails for Cockrell Creek and the headwaters of the Coan River. Currently, NNPDC staff are working on two additional water trails, one on near Lewisetta on the Coan River and another one near the headwaters of the Great Wicomico River, both trails will be completed in late 2016. Once completed, these water trail guides will join the 12 other existing Northern Neck Water Trails located on the Northern Neck Tourism website. To access the Northern Neck Water Trails, click on "Visit", then click on "Parks and Nature Trails" and scroll down. The Northern Neck Tourism website is found at: http://www.northernneck.org/. With the recent economic downturn, there has been an increase in the number of people who have turned to human powered vessels to enjoy the waterways. Canoes, kayaks, paddleboats, and stand up paddleboards are being seen more and more often in local waters.

2. Shoreline Land Use

If the water-related industries and marinas are added to the residential development discussed above, one may observe that considerable development exists along the shoreline of Northumberland County. Despite this seemingly abundance of access, there is little opportunity for citizens who do not own waterfront property or a trailered boat to access the recreational opportunities offered by the Bay and its tributaries. The County will continue to work to help provide land-locked citizens with areas to access and enjoy State waters.

3. Effects of Underwater Grasses

These grasses were once abundant mostly in the shallow waters of protected coves and creeks and may hold the secret to improving the Chesapeake Bay. They are usually found in "low energy zones" of coves and creeks which are not subject to the severe tidal and wind action more prevalent in areas such as the southern shore of the Potomac River. Areas of submerged vegetation as identified by VIMS are shown on their website at: http://www.vims.edu/bio/sav/index.html. To view SAV coverages, click on the "Interactive Map" link. The most recent SAV survey is shown on the interactive map, and you can turn on an off previous year SAV surveys to see the trends in SAV coverage. Underwater grasses grow prodigiously in shallow protected waters where they become nurseries for fin and shellfish as well as habitats and refuges for waterfowl. Underwater grasses, called submerged aquatic vegetation (SAV), not only filters surface water as it enters the streams but it also acts as a buffer against tidal action. For shorelines in low energy locations, underwater grasses have been found to form a quite adequate defense against shoreline erosion. The SAV beds are truly the “nurseries of the Bay”, a place where larval stages of shellfish and other juvenile species can find protection, and habitat. Grasses now occupy only about 10% of the area they once occupied, and until water clarity can be improved, they are unlikely to expand.

4. Factors Influencing the Establishment of New Access Points.

The Virginia Marine Resources Commission has established criteria for establishing new

Marinas. Some of the more "desirable" of these are summarized below:[13]

- Water depth must be greater than three feet from mean low water.
- Site must not interfere with shellfish production.
- Wave height and current to be very low.
- Channel does not require frequent dredging; when dredging is required, a suitable disposal site is available; marina must be within 50 feet of navigable water depth.
- The tidal exchange shall be adequate to maintain water quality.
- No encroachment upon wetlands; habitat areas (endangered species); submerged aquatic vegetation; or existing recreational use.
- Shoreline stabilization is required without use of artificial structures.

The Virginia Institute of Marine Science (VIMS) created a marina suitability model for Virginia utilizing the above criteria, and created maps showing the suitability for new marinas that are located here: http://ccrm.vims.edu/gis_data_maps/static_maps/marinasiting/marinasiting.html

The Virginia Department of Health, Division of Shellfish Sanitation, is the agency responsible for approving or condemning certain water bodies for the taking of shellfish. Condemnation of oyster grounds due to unsatisfactory pollutant levels continues to render the available oyster grounds in the County off limits. Shellfish may be harvested from most condemned areas; however, they must first be relayed to approved waters for 15 days before marketing. Relaying is only allowed when the water temperature is above 50 degrees.

Rivers and creeks that do not meet shellfish harvesting water quality standards occur in the majority of the rivers in the County and are continuously changing. Creeks that currently have some section closed to shellfish harvesting include the Yeocomico and Coan Rivers, Presley, Cod, Hull, Cubbit, Hack Creeks, Little Wicomico River, Owens and Gaskins Ponds, Taskmakers and Cockrell Creeks, Great Wicomico River, Mill, Ball, Cloverdale, Dividing and Indian Creeks. To examine the current extent of the closure areas, visit:

http://www.vdh.virginia.gov/EnvironmentalHealth/Shellfish/closureSurvey/index.htm

In summary, there is a need to provide more public access to the Chesapeake Bay and its tributaries but there is also an equally important need to do so in a way that does no harm to the quality of the Chesapeake Bay.

[13]See page VI-82, Local Assistance Manual for complete list of criteria.

F. Characterization of Commercial and Recreational Fisheries

Northumberland County is blessed with abundant aquatic resources in its streams, creeks and rivers; from oysters to crabs to finfish. Menhaden is commercially caught and rendered into fish oil and fish meal by Omega Protein, Inc., located on Cockrell's Creek in Reedville. Omega harvests menhaden mainly in the main stem of the Chesapeake Bay, but sometimes ventures into the Atlantic Ocean following the large schools of menhaden. Local watermen also catch menhaden for bait for crab pots and for chumming for gamefish. Local watermen also harvest various species of fish and shellfish, including Bluefish, Blue Crabs, Croaker, Flounder, Oysters, Sea Trout, Spot, Striped Bass as well as other species (see Appendix A, page 14 for the historic annual dollar value of the fish harvested). Methods used by commercial watermen to harvest finfish include using hook and line, gill nets as well as pound nets in the Chesapeake Bay and the Potomac River. Local watermen also crab with crab pots throughout the County creeks and rivers, as well as the Potomac River and Chesapeake Bay. Charter boats are based throughout the rivers of the County and target most of the species listed above.

Recreational fishing in Northumberland County includes Striped Bass fishing in the spring, Bluefish, Flounder, Croaker in early summer and Spanish Mackerel, Spot, Trout, Red Drum and Cobia fishing in late summer, with Striped Bass fishing returning in the fall and early winter. Most of the species above are targeted in the Potomac River and Chesapeake Bay, but some such as Croaker and Spot, including juveniles of other species are found in the interior rivers and creeks at various times of the year. There are also recreational crabbers that run trotlines for crabs as well as traditional chicken necking for crabs, using collapsible traps as well as traditional crab pots. Recreational oyster harvesters occasionally hand tong on the numerous public Baylor grounds as well.

There are five state constructed oyster reef sanctuaries in Northumberland County; two in the Yeocomico River at Barn Point and Indian Bar, one in the Coan River at Island Bar, and two in the Great Wicomico River at Shell Bar and at Cranes Creek. In addition to the oyster sanctuaries, there is an oyster larvae nursery at Cowart Seafood on the Coan River, and oyster aquaculture cages placed on creek bottomland throughout the County's rivers. Local watermen lease creek bottomland in all of the County's creeks and place oyster shells to attract oyster spat as well as use the oyster aquaculture technique of spat-on-shell to place oysters in the creeks for later harvest. Most of the time, the watermen use PVC pipes to mark their oyster reefs. There are numerous citizens who practice oyster gardening along residential waterfront docks and piers that are distributed throughout the county. As one would expect water quality is of paramount importance in keeping healthy stocks of finfish and shellfish in county and adjacent waters.

Figure 1.21, the Aquatic Resources Map, shows the location of various aquatic resources in and around Northumberland County, that include private oyster gardener locations,

commercial oyster aquaculture, state constructed oyster reefs, baylor (public oyster) grounds, private oyster leases as well as anadramous fish use areas.

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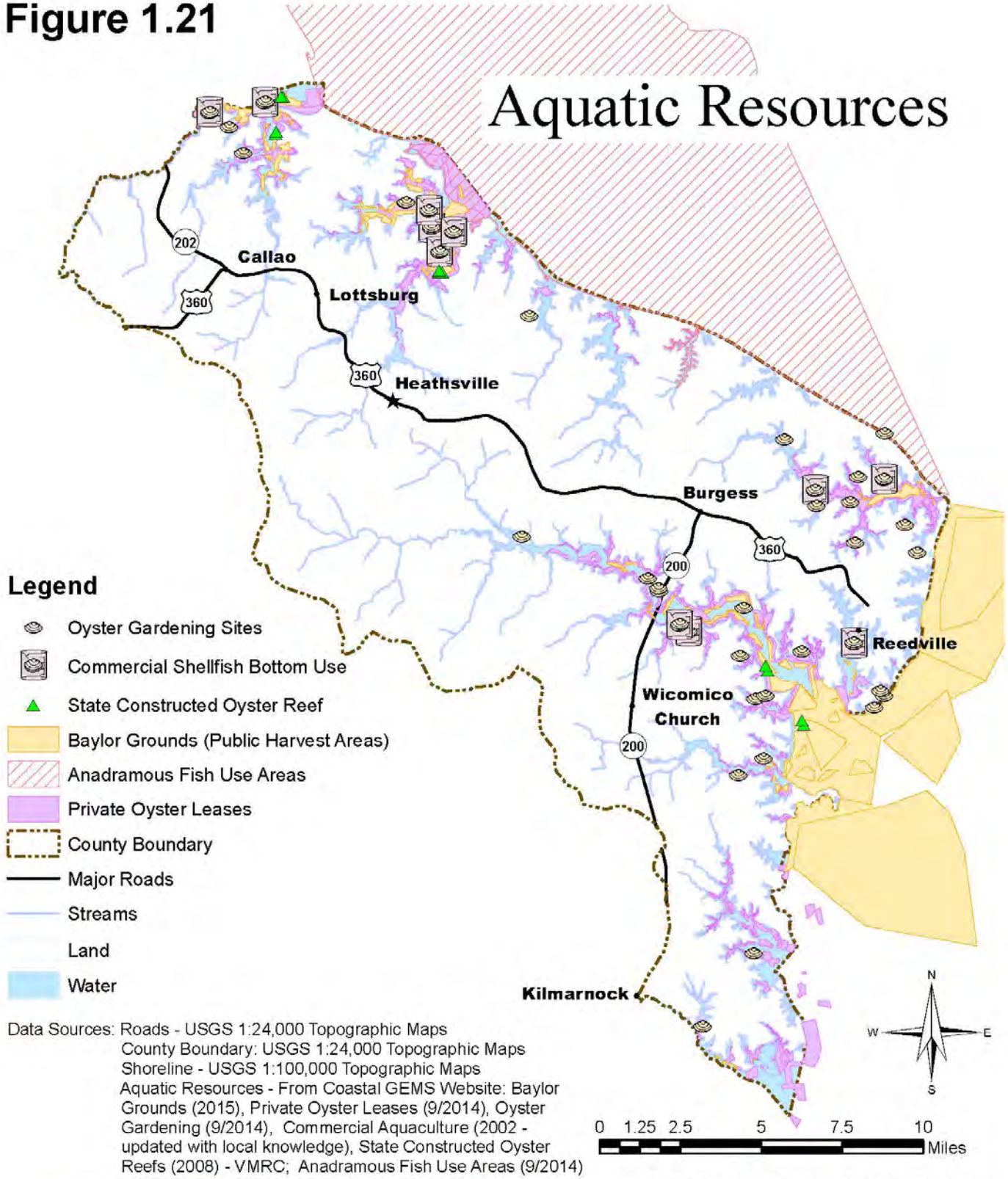
Figure 1.21



Data Sources: Roads - USGS 1:24,000 Topographic Maps
County Boundary: USGS 1:24,000 Topographic Maps
Shoreline - USGS 1:100,000 Topographic Maps
Aquatic Resources - From Coastal GEMS Website: Baylor Grounds (2015), Private Oyster Leases (9/2014), Oyster Gardening (9/2014), Commercial Aquaculture (2002 - updated with local knowledge), State Constructed Oyster Reefs (2008) - VMRC; Anadramous Fish Use Areas (9/2014) - VDGIF

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