# 1.0 INTRODUCTION

The Eastern Shore of Virginia depends entirely on ground water for potable water supplies, as well as most non-potable supplies such as irrigation water. Because the peninsula is surrounded by large bodies of saltwater, ground water becomes brackish at relatively shallow depths (< 350 feet) in most areas, and the total available ground water supply is more limited than on the mainland. Local ground water protection ordinances are one way to ensure protection and wise management of this supply for both existing uses and future growth in Accomack and Northampton Counties. This report documents the results of a modeling investigation into the potential effects of residential development on ground water availability and quality. The modeling results are intended to assist local governments in developing water resource protection ordinances for the Eastern Shore.

## 1.1 BACKGROUND

Threats to ground water on the Eastern Shore may be placed into three general categories: (1) saltwater intrusion; (2) hydraulic head depression; and (3) contamination from surface sources. Intrusion of saltwater into fresh ground water aquifers can be caused by wells that are screened too close to the freshwater-saltwater interface, are too close to the shore, and/or pump at an excessive rate (Figure 1-1). Depression of the hydraulic head occurs around every pumping well, but if pumping rates are too high or if wells are to close to each other, water levels in some wells can drop so low that well yields are reduced. In extreme cases, the head can fall so low that the aquifer is partially dewatered, which in turn can cause consolidation and a permanent loss of transmissivity (which will also reduce well yield).

The ground water table is generally found within 20 feet of the surface near the central spine of the Eastern Shore, and is less than 6 feet from the surface near most coastal areas. The material comprising the water table aquifer is typically sandy, and infiltration of water into this aquifer is relatively rapid. Because the water table aquifer is productive, it is used by a significant number of private residences as a source of drinking water. However, its shallow depth and lack of overlying confining unit make this aquifer highly vulnerable to contamination from a variety of sources. Major potential sources of ground water contamination on the Eastern Shore include fertilizer, pesticides, and septic system effluent (Figure 1-2).

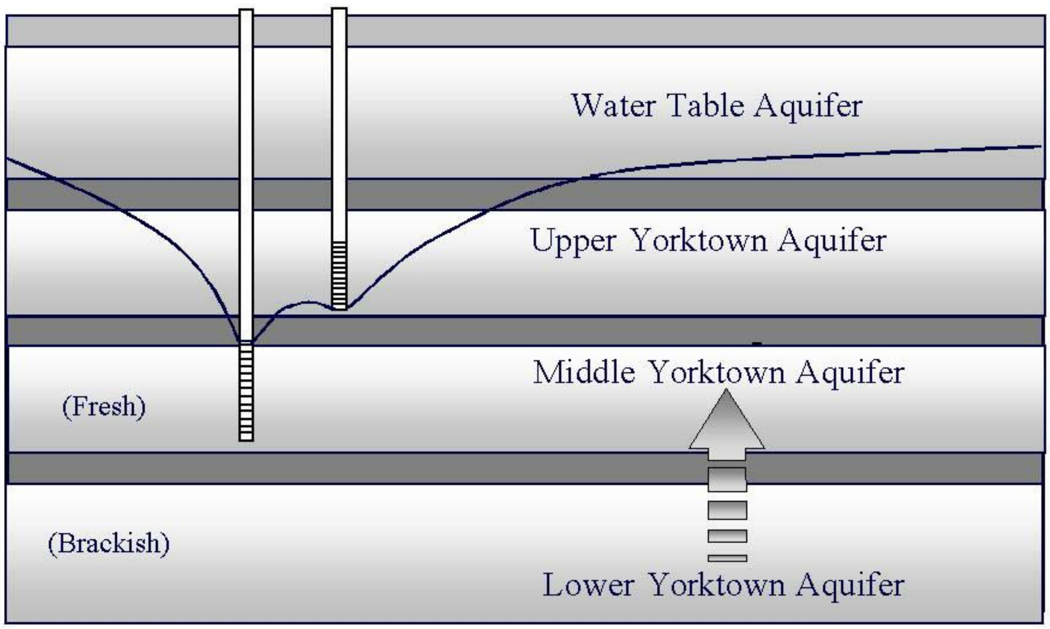


Figure 1-1: Schematic of saltwater intrusion and drawdown in response to pumping.

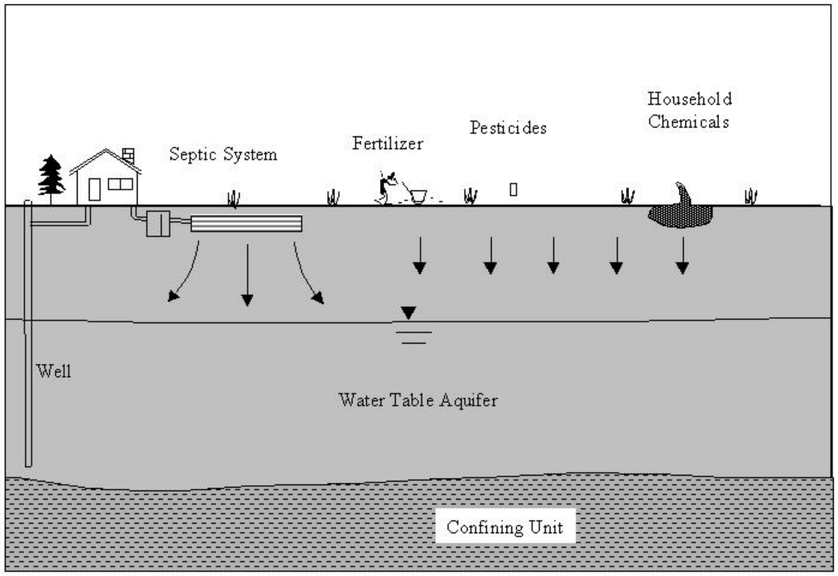


Figure 1-2: Common ground water contaminant sources in residential developments.

Individual ground water users that pump more than 10,000 gallons per day (gpd) are regulated by the Virginia Department of Environmental Quality. However, a large number of smaller demands (such as residential developments served by individual private wells) can also have adverse effects on ground water levels and quality. Many localities in Virginia have enacted ground water protection ordinances to ensure that development does not result in overpumpage or ground water contamination. Such ordinances typically specify minimum lot size, lot number, maximum impermeable areas, and minimum standards for the construction and operation of wells and septic systems. The purpose of this report is to provide technical information that can be used by Accomack and Northampton Counties to design effective ground water protection plans or ordinances relating to residential or commercial development.

Section 1.0 of this report describes the hydrogeologic setting of the Eastern Shore and provides a review of ground water protection laws at the federal, state, and local level. Section 2.0 describes the modeling approach that was used to simulate the potential impacts of various development scenarios on a mid-peninsula site and a near-shore site on the Eastern Shore. Section 3.0 describes the results of the modeling scenarios, including the sensitivity of ground water quality and level to variables that might be regulated by ordinance. Finally, section 4.0 provides a summary of the findings and recommendations relating to the need and form of ground water protection ordinances and plans on the Eastern Shore.

## 1.2 HYDROGEOLOGY OF THE EASTERN SHORE

There have been a substantial number of local and regional studies on the geologic and hydrologic characteristics of the sediments on the Eastern Shore of Virginia and adjacent areas of Maryland. Many of these studies have dealt principally with geologic descriptions of the formational units. The principal regional studies on the hydrogeology of the Eastern Shore and adjacent portions of Maryland are Fennema and Newton (1982), Richardson, D. (1992), Hulme (1955), and Cushing et al (1973). Other sources providing information presented in this section are Bachman and Wilson (1984), Hansen (1969), Weigle (1974), and Werkheiser (1990).

Most of the developable area of the Eastern Shore is underlain by moderately well-drained to excessively well-drained sandy and loamy soils. However, poorly-drained soils are also common along the central spine of the peninsula and in the western portion of Accomack County. The most prevalent soil association is the Bojac-Munden-Molena association, which underlies almost half the total land area of the Eastern Shore and has a permeability of 2-6 inches/hour in most locations. Septic system suitability of this soil type is considered moderate and limited more by drainage than by water table height considerations (HWH 1992). Much of the central part of Northampton County and the western portion of Accomack County are underlain by the Nimmo-Munden-Dragston association, which has a permeability of 1.2-2 inches/hour in most locations. This soil association is not well suited for septic systems due to poor drainage and seasonal high water table conditions.

The uppermost aquifers on the Eastern Shore consist of sediments from the Columbia Group and Chesapeake Group (Figure 1-3). All of the Chesapeake Group sediments and the lower members of the Columbia Group sediments were deposited under marine near shore to shelf conditions. As such, they can be generally characterized as a thickening wedge of sediments dipping seaward, to the east. These sediments range in thickness from approximately 200 feet in the western areas to 500 feet to the east. Slopes at the formational contacts increase with depth, from approximately 2 to 6 feet per mile at the base of the Chesapeake Group to 10 to 11 feet per mile at the base of the Columbia Group.

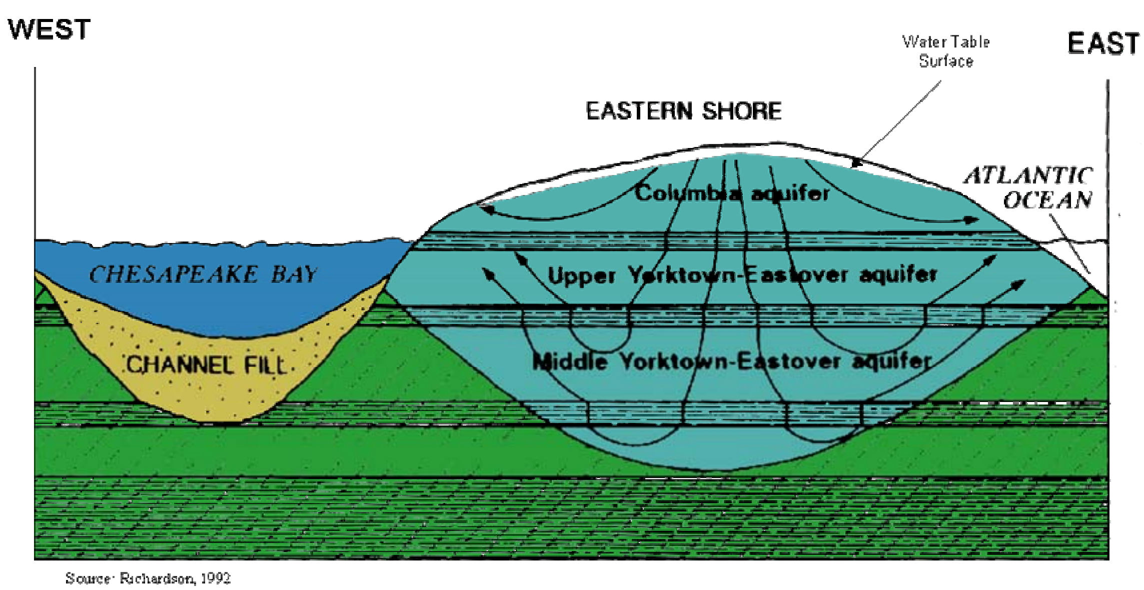


Figure 1-3: Hydrogeologic cross-section of the Eastern Shore.

The uppermost unit is generally designated the Columbia aquifer, and represents the water table aquifer in most areas of the Eastern Shore. The Columbia aquifer overlies the Yorktown aquifer, which has been subdivided into three hydrologic units (upper, middle, and lower). The upper and middle Yorktown aquifers are fresh throughout most of the Eastern Shore, while the lower Yorktown aquifer is typically brackish near the coast and fresh inland. Underlying the Yorktown aquifer is the Choptank aquifer, which is also comprised of sediments belonging the Chesapeake Group. Ground water in the Choptank aquifer is brackish to saline in this area. Because the Choptank and other deeper brackish ground water aquifers cannot provide acceptable water quality, they will not be described in greater detail.

The Columbia and Yorktown aquifers each consist of a sequence of sandy units separated by fine-grained facies, which are predominately fine sandy silts and clayey fine sands. The confining units separating the aquifers are leaky, and there is significant ground water flow through these layers. Flow through the confining units is the dominant source of recharge for the Yorktown aquifer on the Eastern Shore of Virginia. Within the individual aquifers there commonly are discontinuous silty and clayey layers which locally serve to restrict vertical flow.

### 1.2.1 Columbia Aquifer

The Columbia aquifer is the uppermost aquifer and is unconfined over most of the area. Sediments comprising this aquifer unconformably overlie the Yorktown aquifers, and are in turn, unconformably overlain by Holocene sediments. To the northwest, the Columbia aquifer generally does not exceed 20 feet in thickness, and to the south and east, the aquifer thickness typically ranges from 40 to 140 feet. The greatest thickness for the Columbia aquifer occurs near Salisbury, Maryland. On the Eastern Shore of Virginia, thickness generally ranges from 20 feet near the coast to 60 feet inland.

Transmissivities reported for the Columbia aquifer range from 100 to 50,000 $ft^2$/day. In Maryland, transmissivities are between 2,000 and 10,000 $ft^2$/day with a median of approximately 3,500 $ft^2$/day. The highest transmissivities for the Columbia aquifer are found near Salisbury, Maryland, where values has as high as 50,000 $ft^2$/day have been reported. On the Eastern Shore of Virginia, transmissivities are somewhat lower, typically ranging between 1,000 and 4,000 $ft^2$/day. The general increase in transmissivity to the north appears to be a function of both increasing thickness and increasing hydraulic conductivity.

Ground water levels in the Columbia aquifer on the Eastern Shore and adjacent portion of Maryland mimic surface topography. The highest elevations on the Eastern Shore are along the ridge deposits, with maximum elevations of +30 to +45 feet MSL in the central portion of the peninsula decreasing toward the coastline to approximately +10 feet MSL near the tidal marshes. Overall, it appears that depth to ground water is between

10 and 20 feet below ground surface for the upland areas and 5 to 10 feet below ground surface beneath the terrace deposits. Ground water from the Columbia aquifer is not used for any single large withdrawals on the Eastern Shore, therefore there are not any mappable cones of depression in this aquifer.

### 1.2.2 Upper Yorktown Confining Unit

The upper Yorktown confining unit consists of marine fine sandy silt with some clay and averages 15 to 30 feet thick. Maximum thickness of this confining unit exceeds 100 feet beneath Assateague Island and Chincoteague Island. These sediments are, for the most part, reworked sediments from the upper Yorktown Formation and may locally include fluvial silts and clays. The upper Yorktown confining unit typically consists of a sequence of lenticular interbedded silts, clays, and fine sands and is not massive. It is not uncommon for sandy channel deposits to incise through the confining unit into the underlying upper Yorktown aquifer. Channels penetrating through the confining unit into the Yorktown sediments are located near Salisbury and Pocomoke City (Maryland) and Exmore and Eastville (Virginia). While this unit is areally extensive, and only locally absent, it merely serves to restrict, not preclude, vertical movement of ground water. As evidence of this, the principal source of freshwater recharge and discharge for the Yorktown aquifers on the Eastern Shore is through the confining units.

The top of the upper Yorktown confining unit on the Eastern Shore is approximately -20 feet MSL along the western margin (Chesapeake Bay) to -60 feet MSL along the eastern margin (ocean side). Dip of this unit is 2 to 3 feet per mile and strike is northeast, parallel with the orientation of the peninsula. The Columbia aquifer on the Eastern Shore subcrops into the Chesapeake Bay to the west and the Atlantic Ocean to the east. Where it subcrops, freshwater flows directly from the aquifer into the ocean and estuarine water.

### 1.2.3 Upper Yorktown Aquifer

The upper Yorktown aquifer is the uppermost unit of the Yorktown-Eastover aquifer system, and is generally defined as the first significant sand unit occurring below the unconformity separating the basal Columbia Group sediments from the Chesapeake Group sediments. Sediments deposited in channels incised into the Yorktown Formation have also been identified as the upper Yorktown aquifer, even though it is not clear whether there is a good hydraulic connection between the channel fill sediments and the Yorktown Formation sediments. These channel fill deposits have been identified on the Virginia portion of the Eastern Shore near Exmore and Eastville. In Maryland, the upper Yorktown aquifer is generally referred to as the Pocomoke aquifer. Over most of its extent, the Upper Yorktown aquifer consists of gray fine to medium sand with shell fragments commonly present. Locally, discontinuous coarse sand and gravel layers and thin lenses of blue clayey silt are often present.

Surficial recharge to the upper Yorktown aquifer occurs along a northeast striking belt approximately 1.5 to 4 miles wide. This recharge area is present near Chrisfield, Maryland and extends to the northeast, just east of Salisbury, Maryland. Recharge for the Eastern Shore of Virginia occurs through the overlying confining unit.

The top of the Yorktown aquifer on the Eastern Shore is approximately -75 feet MSL along the western edge to -125 feet MSL to the east. Dip of the upper Yorktown is approximately 3 feet per mile and strike is northeast, parallel to the peninsula. In Maryland, the top of the aquifer in the recharge area is near sea level, increasing to a depth of approximately -150 feet MSL to the east. The upper Yorktown aquifer is typically thinner to the west, where more of the sediments were eroded, and thickens to the east. In Maryland, the upper Yorktown aquifer (Pocomoke aquifer) pinches out in the recharge area and increases in thickness to the southeast, toward Snow Hill. On the Eastern Shore, the thickness of the upper Yorktown aquifer ranges from 15 feet, in southwest Northampton County, to greater than 100 feet near Assateague Island and is typically between 30 and 60 feet thick.

Transmissivity for the upper Yorktown aquifer is generally lower than the Columbia aquifer, and has a lower variability. Transmissivity for this aquifer typically ranges between 1,000 to 5,000 $ft^2$/day and has been reported as high as 8,000 $ft^2$/day near Pocomoke City, Maryland. The high transmissivity near Pocomoke City was reported for a well field lying southeast of the city. A much lower transmissivity (1,200 $ft^2$/day) was reported for a well field lying northwest of the city. This location is near the surficial recharge area for the upper Yorktown aquifer, and the confining layer separating the upper Yorktown aquifer from the Columbia aquifer may have been eroded by a stream channel at or near the well field, and is, thus, receiving recharge directly from the overlying Columbia aquifer or from the adjacent Pocomoke River.

Ground water levels on the Eastern Shore follow the same general pattern as the overlying Columbia aquifer because recharge to this aquifer is from the Columbia aquifer. Because the confining unit separating the two aquifers is consistently present over most of the area, there is significant head loss between the two aquifers. A maximum ground water level of +25 feet MSL occurs in south central Accomack County, decreasing radially from this point. In Northampton County, ground water level is between +5 and +15 feet MSL and in central Accomack County, ground water level is +15 to +20 feet MSL, decreasing to +8 to +12 feet MSL near the state boundary with Maryland. Along the eastern and western coastline, ground water level decreases to approximately +5 feet MSL. A short distance offshore, vertical ground water flow direction is expected to reverse, with fresh ground water flowing from the upper Yorktown aquifer into the overlying Columbia aquifer. There are several prominent cones of depression resulting from ground water withdrawals centered around Crisfield and Pocomoke City (Maryland), and Temperanceville (Tyson Food), Accomack (Perdue), Exmore, and Cape Charles (Virginia).

### 1.2.4 Middle Yorktown Confining Unit

The middle Yorktown confining unit is not as prominent as the upper Yorktown confining unit in this region, and has been described as allowing substantial leakage between the upper and middle Yorktown aquifers. In some areas this confining unit is absent, and over most of the area, it consists of a zone of interbedded silts and clays with numerous fine sand layers. Thickness of the middle Yorktown confining unit ranges between 15 and 100 feet, and tends to be thinner to the west and south.

### 1.2.5 Middle Yorktown Aquifer

The middle Yorktown aquifer is an areally extensive hydrogeologic unit of the Yorktown-Eastover aquifer system. The middle Yorktown aquifer, over most of its extent on the Eastern Shore, is a gray fine sand to silty fine sand with shell fragments prevalent. In some areas, such as near the southern tip of the peninsula, the Middle Yorktown aquifer is coarser, consisting of gray medium to fine sand. This unit fines toward central Northampton County to a silty fine sand. Thickness of the middle Yorktown aquifer typically ranges between 30 and 60 feet, although locally it can be absent or up to 100 feet thick. The top of the aquifer on the Eastern Shore is between -125 feet and 150 feet MSL along the western coast increasing to -225 to -250 feet MSL to the west. Dip of the Middle Yorktown is approximately 6 feet per mile, or roughly twice the dip of the overlying upper Yorktown aquifer beds. As with the other units, strike is northeast, parallel with the peninsula. Transmissivities for the middle Yorktown aquifer on the Eastern Shore range between 1,000 and 3,000 $ft^2$/day where the aquifer is present.

Ground water levels for the middle Yorktown aquifer on the Eastern Shore are only slightly lower in the central portion than level for the upper Yorktown aquifer, with a maximum ground water elevation between +20 and +25 feet MLS near Accomac. At the coast and a short distance offshore, the ground water level in the middle Yorktown aquifer is expected to be slightly higher than the level for the upper Yorktown aquifer, with the vertical ground water flow reversed to an upward direction.

### 1.2.6 Lower Yorktown Confining Unit

The lower Yorktown confining unit has been described on the Eastern Shore of Virginia but has not been identified to the north in Maryland and is assumed to pinch out completely between Chincoteague and Snow Hill. The confining unit is thickest in central and northern Accomack County, thinning to the south and pinching out to the north in Maryland. On the Eastern Shore of Virginia, sediments comprising the lower Yorktown confining unit tend to be finer grained than sediments from the middle Yorktown confining unit. As such, the lower Yorktown confining unit appears to restrict vertical flow more than the middle Yorktown confining unit.

### 1.2.7 Lower Yorktown Aquifer

The lower Yorktown aquifer on the Eastern Shore typically consists of a fining-upward sequence of gray fine sand to silty fine sand with shell fragments. In Maryland, the basal portion is generally coarser, consisting of coarse to medium sand with some gravel. On the Eastern Shore, the lower Yorktown aquifer is usually slightly thicker than the overlying middle Yorktown aquifer, and is generally between 60 and 80 feet thick throughout the area. The top of the lower Yorktown aquifer ranges between -175 and -225 feet MSL along the western coast and -300 to -350 feet MSL along the eastern coast. Dip of the lower Yorktown aquifer is approximately 8 feet per mile, continuing the progressive increase in bed dip with depth exhibited by the overlying units.

The transmissivity of this aquifer on the Eastern Shore is roughly the same or slightly lower than the middle Yorktown, averaging around 1,200 $ft^2$/day in areas where the sediments are productive. There have been only a few pumping tests conducted in the lower Yorktown aquifer of the Eastern Shore and the lower and middle Yorktown aquifer are not differentiated in Maryland. Therefore, there is not a great deal of information on areal variability in the lower Yorktown aquifer's transmissivity.

## 1.3 GROUND WATER PROTECTION REGULATIONS AND PROGRAMS

Numerous federal, state, and local laws and programs with ground water protection components exist. Many are designed to protect ground water from chemical, waste, or petroleum hydrocarbon releases; e.g., the federal Resource Conservation and Recovery Act (RCRA) and Virginia's Undergound Storage Tank Program. This section provides a brief description of the major regulatory and non-regulatory programs aimed at protecting potable ground water supplies from over-pumpage and over-development, rather than from unintentional releases of hazardous substances.

### 1.3.1 Federal

The primary federal regulation for protection of potable ground water supplies is the Safe Drinking Water Act (SDWA), which requires that the U.S. Environmental Protection Agency (USEPA) specify maximum contaminant levels (MCLs) for public water supplies and directs States to develop programs to enforce the standards. Amendments to the SDWA that were passed in 1986 include the Wellhead Protection Program (WHPP) and the Sole Source Aquifer Demonstration Program. Under the 1986 amendments, each state was required to develop a WHPP that delineates wellhead protection areas (WHPAs) around public water supply wells, identifies contaminants within the WHPAs, and specifies ground water protection approaches for state agencies and local governments. Amendments to the SDWA in 1996 required States to develop Source Water Assessment Programs (SWAPs) that extend the WHPP concepts to public waterworks that use surface waters.

The Sole Source Aquifer Demonstration Program allows USEPA to designate aquifers that supply at least 50 percent of the drinking water consumed in an area as 'sole source aquifers.' The designation protects an aquifer by USEPA review of any proposed projects within the area that are receiving federal financial assistance. Such assistance may be denied if USEPA determines that the project does not meet federal, state, or local ground water protection measures. The aquifer system on the Eastern Shore of Virginia was designated a sole source aquifer in 1997.

### 1.3.2 Commonwealth of Virginia

Both the Virginia Department of Environmental Quality (DEQ) and Virginia Department of Health (VDH) enforce regulations relating to ground water protection. However, the Commonwealth's basic approach has been to allow local governments to take the lead in determining the need for and adoption of ground water protection measures. As such, there are no state laws that mandate ground water protection ordinance measures.

*Wellhead Protection Efforts*: In 1986, Virginia formed the interagency Ground Water Protection Steering Committee (GWPSC) to coordinate and promote ground water protection activities. With the aid of a federal grant the GWPSC drafted Virginia's approach to wellhead protection. This report is summarized in the publication *Wellhead Protection: A Handbook for Local Governments in Virginia* (VGWPSC 1991). The heart of Virginia's approach is to educate and encourage local governments to delineate WHPAs and implement protection measures such as comprehensive planning, zoning ordinances, septic tank requirements, acquisition of property development rights, and public education programs.

*Chesapeake Bay Preservation Act*: The Chesapeake Bay Preservation Act was passed in 1988 to create a means for state and local governments to cooperate in protecting water quality in the Chesapeake Bay watershed. The most important provision of the Act is the requirement that local governments designate Chesapeake Bay Preservation Areas. Within these areas, local governments are required to adopt comprehensive plans, zoning ordinances, and subdivision ordinances that include water quality protection measures. The act also created the Chesapeake Bay Local Assistance Department to aid local governments in accomplishing Bay Act goals.

*Department of Environmental Quality*: The most important ground water protection law enforced by DEQ is the Ground Water Management Act of 1992 (9 VAC 25-610) that specifies the procedure for designation of ground water management areas and the issuance of ground water withdrawal permits. The Eastern Shore of Virginia was designated a Ground Water Management Area in 1992 and any withdrawal of 300,000 gallons per month in this area requires a ground water withdrawal permit from DEQ. Before a permit can be issued, it must be demonstrated that the withdrawal will have no significant unmitigated impact on existing ground water users or the ground water resource. Specifically, it must be demonstrated that:

- The withdrawal will not cause saltwater intrusion into the aquifer.
- No other viable water sources exist.
- The withdrawal utilizes the lowest quality and least amount of water that supports the use.
- Confined aquifers will not be dewatered.
- The area of impact remains on the applicant's property; or adverse impacts beyond the applicant's property will be mitigated.
- The withdrawal will not lower water levels in a confined aquifer below 80% of the distance between the historical pre-pumping levels and the top of the aquifer.
- The applicant will implement a water conservation and management plan.

DEQ also enforces the Ground Water Rules and Standards for Water Wells, a set of standards for well construction, maintenance, and abandonment that ensures that wells will not become conduits of contamination to the subsurface. Virginia's Water Quality Standards (9VAC 25-260) include both enforceable ground water standards and non-enforceable ground water criteria as well as an anti-degradation policy that states that the natural quality of ground water will be maintained even it is below the ground water standards.

*Department of Health*: VDH is the primary state agency that enforces provisions of the SDWA and related state laws such as the Waterworks Regulations (12 VAC 5-590). Other relevant VDH-enforced laws are the Private Well Regulations (12 VAC 5-

630) and the Sewage Handling and Disposal Regulations (12 VAC 5-610). The Private Well Regulations specify minimum construction standards for private wells and minimum distances from potential sources of contamination such as septic systems, pipelines, and petroleum storage tanks. The Sewage Handling and Disposal Regulations specify construction standards, soil percolation rates, and separation distances to the seasonal water table for septic systems.

In response to the 1996 Amendments to the SDWA, VDH has released a draft SWAP document (VDH 1999). Under the proposed SWAP, source water protection areas for public ground water sources (analogous to WHPAs) would be delineated using the fixed radius approach, with two protection zones of 1,000 ft and 1 mile radii. The document also describes Virginia's strategic approach for identifying contamination sources and susceptibility for each water source.

### 1.3.3 Eastern Shore of Virginia Ground Water Committee

Accomack and Northampton Counties formed a Ground Water Committee in 1990 to oversee the development of the *Ground Water Supply Protection and Management Plan for the Eastern Shore of Virginia* (HWH, Inc. 1992). The plan identified five major pumping centers that needed protection and delineated three protection zones. Zone 1 consists of a 200-foot radius around each wellhead and was delineated to protect wells in the case of poorly constructed or faulty wellheads. Zone 2 encompasses the central recharge spine of the Eastern Shore peninsula, a strip about 5,000 feet wide. Zone 2 was delineated to protect the major source of recharge water to the confined aquifers. Zone 3 includes virtually the entire Eastern Shore, and was delineated to emphasize the importance of protecting the entire ground water resource. Ground water protection measures recommended in the plan include:

- Creation of an overlay zoning district in the spine recharge area.
- Restriction on the siting of mass drainfields in the spine recharge area.
- Revision of county and subdivision zoning ordinances to incorporate ground water protection measures.
- Development of a private well ordinance to control the siting and construction of new wells.

The Ground Water Committee is currently implementing the ground water protection program and, as part of this implementation, is supporting the quantitative evaluation of various protection measures such as ordinances.

### 1.3.4 Northampton County

Northampton County revised their comprehensive plan in 1993 to support the findings of the Ground water Plan. Northampton County has designated the entire county as a Chesapeake Bay Preservation Area, forming the Chesapeake/Atlantic Preservation (CAP) District. The intent of the CAP as it relates to the ground water resource includes protecting existing high quality state waters, restoring all other state waters to a condition or quality that will permit all reasonable public uses, safeguarding the clean waters of the Commonwealth from pollution, preventing any increase in pollution, reducing existing pollution, and promoting water resource conservation. With the exception of some parts of incorporated towns, the CAP Overlay District applies to all of Northampton County, and the ground water protection provisions under the CAP are extended to both coastal and inland (spine recharge) areas.

There are two areas defined under the CAP: Resource Protection Areas (RPAs) and Resource Management Areas (RMAs). The RPAs include coastal areas such as tidal wetlands, non-tidal wetlands connected by surface flow to and contiguous with tidal wetlands or tributary streams, and shorelines or tidal shores. RMAs include floodplains, highly erodible soils, highly permeable soils, non-tidal wetlands not included in the RPA, and other lands that protect the quality of state waters. Northampton County's zoning ordinances have been revised to include the following ground water protection measures:

- Construction footprints will not exceed 60% of a site;
- Land development will minimize impervious cover;
- All septic systems must be pumped out at least once every five years; and
- A reserve septic system with a capacity at least equal to that of the primary system must be provided on all newly developed parcels.

There are also several common performance standards required over the entire CAP, including both RPAs and RMAs. Some of these performance standards are intended to achieve specific goals such as preventing a net increase in non-point source pollution from new development, achieving a 10-percent reduction in non-point source pollution from redevelopment, and achieving a 40-percent reduction in non-point source pollution from agricultural uses. If these goals are met for the county, there will be significant protection of the water table aquifer, which is most affected by the non-point source pollutants. Goals of the CAP performance standards also provide for increasing recharge of the ground water by minimizing impervious cover, thereby reducing storm water runoff. Maintaining recharge to the water table aquifer is the only way to insure ground water remains a renewable resource.

Northampton County has drafted (but not approved) an ordinance aimed at providing additional protection for groundwater resources. There are few direct measures that act to preserve the ground water supply in the proposed ordinance. The most significant measures include encouraging connections to central water and sewerage systems, limiting the amount and locations where industries can withdraw ground water, and restricting the amount of water used for irrigation in sensitive areas. The proposed ordinance requires that, when central water and/or sewerage systems with adequate capacity either exist or are proposed within a reasonable distance of the development, provisions will be made to connect to the system. Industrial uses are restricted to using less than 50,000 gallons/day (less than 300,000 gallons/month) in all Districts. A special use permit may be issued for industrial withdrawals exceeding these amounts only in Community Development Districts types "CG" and "M1". Irrigation wells using more than 300,000 gallons/month are not allowed in Conservation Districts. In all other districts (except for agricultural districts), such irrigation well require special use permits. There are also significant restrictions on lot sizes within various Zoning Districts, such as Rural Villages and Conservation Districts. These restrictions prevent high density residential developments over much of the county.

The Northampton County zoning ordinance does not address a number of ground water protection issues. Primary among these are construction standards and performance standards for potable water and irrigation wells. Such performance standards, for instance, would require use of the water table aquifer for irrigation and the usage of the confined Yorktown aquifers for potable water supplies, unless a special exception is granted. Performance standards might also include other water quality parameters (the Health Department requires testing only for coliform bacteria), such as nitrates from agricultural activities and chlorides from saltwater intrusion. Addition of some of these requirements to the appropriate Primary or Secondary Zoning Districts (such as Community Development Districts) would provide significant measures to preserve the existing ground water resource.

### 1.3.5 Accomack County

In compliance with the Chesapeake Bay Preservation Act, Accomack County delineated the western portion of the county as a Resource Management Area in 1992. The protection measures provided in the Accomack County ordinance are generally the same for Northampton County, except they do not apply to the eastern (seaside) portion of the county nor does it apply to much of the spine recharge area. The limited area covered by the Chesapeake Bay Preservation Act reduces the impact of the ground water protection in Accomack County.

In November 1998, Accomack County passed an ordinance that requires the development of a Resource Quality Protection Plan (RQPP) for any commercial or industrial development that creates 5 acres or more of impervious surface, or any new proposed subdivision with 50 or more lots. If such a subdivision is expected to use 10,000 gallons (or more) of ground water per day, the RQPP must contain a ground water use analysis that addresses:

- An analysis of daily and average demands;
- Well screen depths;
- Analysis of ground water chloride levels;
- Number, location, and capacity of wells;
- An evaluation of potential ground water quality and quantity effects, including a map showing the area in which 1 foot or more drawdown will occur; and

- Any supplemental information required by the county administrator, such as additional water quality analyses or saltwater intrusion modeling.

Moreover, the ordinance states that "Ground water withdrawal shall cause no reduction in ground water levels or changes in ground water quality that limit the ability of ground water use…" This ordinance provides the most protection of ground water resources from potential threats imposed by non-permitted users on the Eastern Shore. However, the ordinance does not address specific protection measures or provide general guidance on acceptable development plans.