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CHAPTER 3

I. PROTECTION OF WATER IN LANCASTER COUNTY

The groundwater and surface water supplies of Lancaster County are recognized to be some of its most valuable natural resources. Lancaster's groundwater resources provide the County with 100% of its potable water supply. Meanwhile, the County's surface water provides a source of employment for the seafood industry, a major attraction for the tourism industry, a source of recreation for citizens, and a potential future water supply for the County. The health of the people, the economy, and the hope for future growth all depend on the quality of these important water resources.

The Lancaster County Potable Water Supply Study and Plan will assess the existing state of these resources, develop goals and objectives concerning the water supply, and present recommendations for protecting and enhancing the water supply in the future. The study will be divided into two sections. The first will examine the existing surface water conditions in Lancaster County. The second will investigate the existing groundwater conditions in the County. The plan will be realistic in that it recognizes that surface and groundwater resources are regionally shared and therefore require regional efforts to ensure their protection. However, the plan also recognizes that much can be done within the county's boundaries to protect our vital water resources. Recommendations proposed in this plan address the regional and local nature of these resources.

A. SURFACE WATER

Lancaster County is bordered by the Chesapeake Bay to the East and the Rappahannock River to the South. Many tidal water bodies meander through the County on the way to the Bay and River including Lancaster Creek, the Eastern and Western branches of the Corrotoman River, Carters Creek, Indian Creek, Dymer Creek, Tabbs Creek, and Antipoison Creek, as well as many smaller creeks. Combined, these water bodies give Lancaster County 330 miles of tidal shoreline.

Lancaster County also has many existing privately owned millponds that are categorized as surface water. These millponds are generally located in the freshwater sections at the headwaters of creeks and were created through the use of impoundment structures. Included in this group are Balls, Blakemore, Kamps, Chinns, Davis, Dunton, and Norris millponds.

1. Surface Water Quality

The quality of surface water is of vital importance to the Lancaster County community. First, many commercial fishermen, seafood industry owners, marina owners, and related employees depend on local waters for their livelihood. Second, citizens of the county enjoy living in a rural, scenic setting that is enhanced by views of, and access, to the water. Lastly, the water is a source of recreation for many in the Lancaster County community, as well as for many visitors to the area.

Agriculture is a major industry within Lancaster County and one whose activities can significantly affect the quality of surface water. Farmers, county officials, and the local Soil and Water Conservation District must work together in the development of nutrient management and other conservation plans that will provide protection to Bay waters while allowing farmers to maximize the productivity of their land. Most pressing is the need to address the application rate for biosolids that under the current standards allow two to five times the amount of phosphorous necessary for crop uptake to be applied.

Conservation plans consider the existing conditions of each individual farm. The plan takes into account soil types, slope, drainage patterns, crop cover and animal populations. Based on the available data and using the Soil Conservation Field Office Technical Guide, a plan is drawn up that recommends the most appropriate conservation practices for each farm. Components of the plan may include grassed waterways for drainage, crop rotation, contour strips, water diversion structures, nutrient management, pesticide management, and herbicide management.

Farmers in Lancaster County generally control the use of fertilizers and pesticides as a matter of complying with law, but also as a matter of economics. With the depressed price of crops and drought conditions of recent years, farmers are extremely careful to prevent runoff and to use only the amount of fertilizer and pesticide that can be absorbed into the soil rapidly. No-till farming is commonplace and has helped considerably to control runoff by limiting disruption to the soil.

The map, Lancaster County Farm Plan Inventory CBLAD and NNSWCD Farm Plan Data, shows cultivated areas in Lancaster County. It draws a distinction between those farms for which a plan is on record and those for which a plan is not on record. While this map indicates a large number of farms for which a plan does not exist, or is not recorded, it is believed that many do have a plan. It will be considered a priority to accurately establish the inventory of existing plans and take the necessary action to ensure plans are developed for the remainder.

While the potential for redevelopment is limited in Lancaster County, opportunity exists primarily on former seafood processing sites. There are several of these sites in Lancaster County, some covering fairly extensive areas of shoreline with impervious cover. There appears to be little demand to reopen these sites for seafood processing, and, as the crab population becomes more depleted, there is indication that some existing sites may go out of business. These sites occupy prime real estate for redevelopment for residential purposes. All site plans submitted for development must show a reduction in impervious cover within the buffer area and must also show at least the required ten percent reduction in the introduction of pollutants and nutrients to protected waters.

2. Measures of Surface Water Quality

a. Condemned Shellfish Grounds

One indicator of surface water quality is the location of condemned and seasonally condemned shellfish grounds. Every two years the Commonwealth of

Virginia prepares a report on the quality of the State's Waters and presents it to the U.S. Environmental Protection Agency and the United States Congress. The document is called the 305 (b) Report to EPA and Congress and addresses how well the State is meeting the Federal Clean Water Act's goals of providing waters suitable for swimming and fishing. In this report, state waters are evaluated as to whether they are "Fully Supporting," "Fully Supporting But Threatened," "Partially Supporting," or "Not Supporting" concerning the goal of fishable waters. Local waters that have been condemned for shell fishing by the Virginia Department of Health fall under the category of Partially Supporting in regard to fishing.

Lancaster County has approximately 1,370 acres of condemned shellfish grounds. Typically shellfish condemnation areas in Lancaster County are found only in portions of creeks, not throughout the entire creek. Exceptions are Carter Creek, Greenvale Creek, Paynes Creek, Beach Creek, Lancaster Creek, and Mulberry Creek, which are all mostly, or totally, designated as condemned or seasonally condemned.

Locations of shellfish condemnations are important water quality indicators because the waters have been condemned due to elevated levels of fecal coliform bacteria. High levels of fecal coliform bacteria can be due to animal (domestic and wild) waste, failing septic systems, marinas, or the flushing characteristics of the particular water body.

b. Ambient Water Quality Monitoring

Another measurement of water quality that is addressed in the 305 (b) Report is ambient water quality monitoring results. The Virginia Department of Environmental Quality has designated monitoring stations at various locations in the different surface water bodies throughout the state. The stations are used to monitor four conventional pollutant levels including dissolved oxygen, pH, temperature, and fecal coliform bacteria. Data collected from each station is then assessed to see if it meets the Virginia Water Quality Standards for Dissolved Oxygen, pH, and Maximum Temperature. There are seven ambient water quality stations located in, or very close to, Lancaster County's boundaries further identified as follows:

W 22 (Station ID: 3-CRR003.38) - Corrotoman River near Red Buoy #6 in Lancaster County.

W 23 (Station ID: 3-RPP010.60) - Rappahannock River off Orchard Point near the Lancaster County and Middlesex County boundary in the Rappahannock River Basin.

W 24 (Station ID: 3-RPP017.72) - Near buoy #8 southwest of the mouth of Greenvale Creek near the Lancaster County and Middlesex County boundary in the Rappahannock River Basin.

W 25 (Station ID: 3-RPP025.52) - Near buoy #11 off Goose Point on the

Middlesex County side in the Rappahannock River Basin.

W 26 (Station ID: 3-RPP031.57) - Opposite Morattico on the Middlesex County side in the Rappahannock River Basin.

W 9 (Station ID: 7-IND002.26) - Indian Creek opposite Kilmarnock Wharf on the Northumberland County side of the creek in the Chesapeake Bay Basin.

LE 3.6 (Station ID: LE3.6) - Mouth of the Rappahannock River between Windmill and Stingray Points in the Chesapeake Bay Basin—also designated as a Chesapeake Bay Water Quality Monitoring Station.

c. Nonpoint Source Pollution Monitoring (will be addressed below under "Threats to Surface Water Quality" section.)

3. Sensitive Surface Water Features

Lancaster County is fortunate to benefit from an abundance of marine resources that are directly related to the quality of its surface water bodies. These natural resources include Submerged Aquatic Vegetation, Wetlands, and Shellfish Grounds. Descriptions of these features, their functions in the man-made and natural environments, and the extent of their presence in Lancaster County are given below.

a. Submerged Aquatic Vegetation

Submerged Aquatic Vegetation (SAV), or sea grass, is a valuable natural marine resource that is found adjacent to the shoreline in many parts of Lancaster County. SAV is important because it provides ideal habitat for blue crabs and juvenile finfish. SAV also acts to provide protection for molting crabs and is a source of food for waterfowl. Lastly, as evidenced by the important role it plays in the marine environment, SAV is also of great value to the County's commercial and recreational fisheries.

The amount of SAV in the waters of and around Lancaster County has generally been increasing since 1990 but can decrease in the short term as a result of excessive rain or other weather related conditions that affect the ambient quality of the water. The most current and accurate depiction of SAV can be found on the website:

http://www.vims.edu/bio/sav/sav04/segments/rppmh_page.html

b. Wetlands

Wetlands are defined by the United States Fish and Wildlife Service as "lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water". Generally, wetlands can be classified as either tidal or non-tidal. Locally, Lancaster County has approximately 4,504 acres of tidal wetlands and 1,349.26 acres of non-tidal wetlands (Figures were obtained using the Lancaster County Geographic

Information System utilizing a digital National Wetland Inventory map layer.)

Wetlands are important natural resources that provide many benefits to the man-made and natural environments. Wetlands provide aesthetic, recreational, and economic benefits to the community. Furthermore, wetlands are spawning and nursery grounds for finfish and shellfish, feeding and wintering sites for migratory waterfowl, nesting habitat for shore birds, and homes to a wide variety of wildlife. Wetlands further serve as important areas for groundwater recharge, flood control, pollution absorption, and retention of sediment from storm water run-off (Pg 1, Atlas of National Wetlands Inventory Maps of Chesapeake Bay. U.S. Fish and Wildlife Services: September, 1986.).

c. Shellfish Grounds

Lancaster County has a wealth of suitable shellfish grounds in the water adjacent to its shores. Despite dramatic decreases in shellfish populations and catches in the last decade due to the diseases MSX and Dermo, these grounds remain a valuable resource that should be protected. Although it cannot be determined if, or when, shellfish populations will recover from these diseases, the possibility remains that the resource could thrive again or disease resistant varieties of shellfish could be introduced.

4. Threats to Surface Water Quality

a. Role of Soils in Pollution

Pollutants generally affect water quality through two different methods: run-off and leaching. Run-off refers to water that is not absorbed by the soil, but is instead carried off by natural or man-made drainage courses to a surface water body. Leaching refers to water that is absorbed by the soil and percolates into the soil layers underneath. The effect of this type of pollution is usually felt on the groundwater supply. The amount of run-off or leaching in a community is usually dependent on the present land cover. Generally the more heavily an area is developed, the more susceptible the area is to run-off due to increased amounts of impervious land cover such as parking lots, buildings, and roads. The less intensely an area is used, the more the area is prone to leaching because of the extensive pervious groundwater recharge areas such as large tracts of farmland and forest.

Impacts from run-off and leaching are further complicated by the types of soils present in different areas of the County. Highly erodible soils have the potential to become a source of pollution in times of large run-off such as heavy rainstorms and melting periods after ice or snowstorms. This combination of a high amount of run-off and the presence of highly erodible soils can result in a higher concentration of sediments entering the county's surface waters. Furthermore, individual occurrences of pollution through leaching can be worsened through the presence of highly permeable soils. Awareness of these soil properties as they relate to existing and future land uses can help in pinpointing areas currently in need of mitigation efforts, as well planning for the avoidance of further

contamination of water resources through improper land use.

Lancaster County Soils that are highly erodible and the percent each soil type comprises of the County's total soils:

1. Caroline very fine sandy loam, sloping eroded (0.17%)

2. Caroline clay loam, sloping, severely eroded (0.05%)
3. Caroline clay loam, strongly sloping, see. eroded (0.18%)
4. Craven silt loam, sloping, eroded (0.02%)
5. Craven clay loam, strongly sloping, severely eroded (0.21%)
6. Kempsville fine sandy loam, sloping, severely eroded (0.09%)
7. Matapeake silt loam, strongly sloping, eroded (<0.01%)
8. Sassafras fine sandy loam, sloping, severely eroded (0.46%)
9. Sassafras fine sandy loam, strongly sloping, eroded (0.07%)
10. Sassafras fine sandy loam, str. sloping, sev. eroded (0.08%)
11. Sloping sandy land (9.26%)
12. Steep sandy land (18.13%)

Lancaster County Soils that are highly permeable and the percent each soil type comprises of the County's total soils:

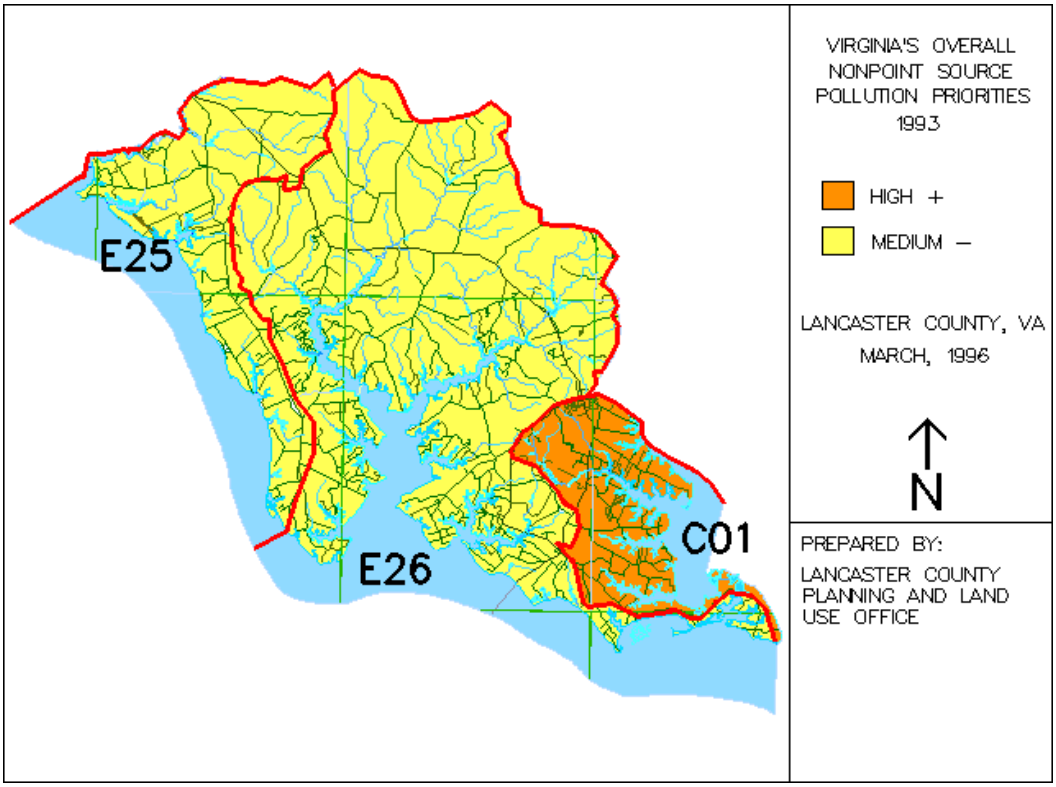
1. Coastal Beach (0.48%)
2. Dragston fine sandy loam (3.19%)
3. Lakeland loamy fine sand, gently sloping (0.61%)
4. Rumford loamy sand, gently sloping (0.16%)
5. Rumford loamy sand, sloping, eroded (0.05%)
6. Sloping sandy land (9.26%)
7. Steep sandy land (18.13%)

b. Sources of Surface Water Pollution

(1) Non-point Source Pollution

One measure of the effect of pollution on the water quality of Lancaster County's surface water is found in the Virginia Non-point Source Pollution Watershed Assessment Report (VA Department of Conservation and Recreation; March, 1993). This report divides the State of Virginia into 491 different watersheds or hydrologic units. A watershed is defined as "a land area drained by a river/stream or system of connecting rivers and streams such that all water within the area flows through a single outlet." There are three state hydrologic units in Lancaster County: E25, E26, and C01. E25 and E26 are part of the Rappahannock River Basin and C01 is part of the Chesapeake Bay Coastal Basin. This report compares water quality of hydrologic units throughout the state in order to prioritize nonpoint source pollution protection efforts.

c. State Hydrologic Units in Lancaster County



(1) A brief summary of watersheds in Lancaster County is given below:

E25 - This watershed is cited as having "significant levels of urban use impacts due to urban erosion and nutrient loading, and the amount of disturbed urban land." However, this watershed is not described as having any significant water quality violations for fecal coliforms or pH levels. Statewide this watershed is given a final non-point source pollution rank of "MEDIUM -", with a rank of "High+" being the highest priority watersheds for state non-point source pollution protection efforts.

E26 - This watershed is not described as having any significant water quality violations due to fecal coliforms or pH level. Additionally, this watershed is not cited for having "significant levels of urban use impacts." Statewide this watershed is given a final nonpoint source pollution rank of "MEDIUM -", with a rank of "High+" being the highest priority watersheds for state non-point source pollution protection efforts.

C01 - This watershed is rated as a "medium priority watershed for agricultural non-point source pollution concerns. Due primarily to existing development, watershed C01 is rated in the top 10% statewide for urban pollution potential." Additionally, the watershed is cited as having a large number of shellfish condemnations because of "urban non-point source influences." However, the watershed was not cited for having any significant violations of state water quality standards. Statewide this watershed is given a final non-point source pollution rank of "High+," with
a rank of "High+" being the highest priority watersheds for state non-point

source pollution protection efforts.

(2) Point Sources/Permitted Discharges

Point source pollution sources are often referred to as the "end of the pipe" type of pollution. This means that the discharge into the water body can be traced to a single, identifiable source. The Federal Water Pollution Control Act requires a uniform permit program nationwide which acts to regulate this type of pollution. In Virginia, the Department of Environmental Quality runs a permitting program named the Virginia Pollutant Discharge Elimination System (VPDES) that carries out the requirements of the federal act. VPDES is a permit program that establishes, on an individual basis, limits on the quantity and/or concentration of pollutants allowed in the discharge.

When a VPDES permit is issued, guidelines are established which discharged effluent is required to meet. Moreover, the owner of the discharging facility is required to monitor the quality of the effluent and report the results of testing to the state. Additionally, the Virginia Department of Health designates condemned shellfish areas around certain point source discharges to act as a buffer zone from the impact of the discharge. The chief industry utilizing these types of permits in Lancaster County is the seafood industry, with resort hotels a distant second.

(3) Septic Systems/Sewage Disposal

Approximately 89% of all private residences in Lancaster County utilize septic systems for sewage disposal purposes.

The potential for septic systems causing pollution of surface water bodies can stem from the initial improper siting of the system, or from the failing of aged or not properly maintained systems. Often septic systems have been placed in soils that can act to heighten the negative impact of the system. In soils with seasonally high water tables, the water table can rise into the septic systems' drain fields and intermix with the relatively untreated effluent. Furthermore, high water tables can cause pooling of septic effluent on the ground surface. During a rainstorm, pooled effluent can then quickly drain into nearby surface water bodies.

Highly permeable soils also can act to increase negative impacts of septic systems. These soils allow septic effluent to percolate more quickly through soils underneath the drain field, while not allowing for proper filtration. If the effluent percolates before it is properly treated then it can become a threat to the ground or surface water that it acts to recharge. The combination of high water tables and highly permeable soils is particularly a problem in densely developed areas close to the county's shoreline. A high number of septic systems in conjunction with poor soil conditions can lead to elevated levels of fecal coliform bacteria in adjacent surface water bodies, which can then result in the condemnation of the

area for shell fishing.

d. Potential of Surface Waters for Future Water Supply

Much of the surface water in Lancaster County is tidally influenced and has saline levels too high to be considered as a potential drinking water source. Additionally, in the upper reaches of the creeks where the water is fresh enough to be used for drinking water, there is not enough stream flow to allow for direct intakes from the water body. However, at the headwaters of these creeks there are a number of existing millponds. Furthermore, with improved, higher impoundment structures there is the potential to create larger ponds or reservoirs. The existing millponds, or the potential new ponds, could be possible surface drinking water sources, subject to the Joint Permit Application review process for activities in the waters and wetlands of the Commonwealth of Virginia.

In 1973, the Northern Neck Planning District Commission conducted a water and sewage facilities plan for the Northern Neck that, until determined otherwise, remains valid in 2006 (Water Quality Management Plan - Planning District 17. Northern Neck Planning District Commission and Deward M. Martin and Associates, Inc.; Callao, VA: 1973). This plan recommended several possible impoundment sites for each of the counties of the Northern Neck. In most cases the proposed impoundment sites roughly coincided with existing millpond locations at the headwaters of the creeks. However, the proposed impoundments were usually larger than the existing millponds, with new impoundment structures located a little further downstream than the existing structures. Eight possible impoundment sites and their proposed sizes were identified in Lancaster County. They included:

Reservoir #: LBBI Streams: Balls Branch, Lancaster Creek
The drainage area for this proposed reservoir site is approximately 1,287 acres or two square miles. The proposed reservoir would have a total maximum storage of 1,212 acres. The 1,212 acres would be divided into 483 acres allotted for flood and sediment volume, 561 acres for water supply volume, and 167 acres for fish and wildlife volume. The maximum water supply draft from the reservoir would be 0.58 Million Gallons Daily.

Reservoir #: LCMI Streams: Kamps Millpond
The drainage area for this proposed reservoir site is approximately 3,944 acres or six square miles. The proposed reservoir would have a total maximum storage of 849 acres. The 849 acres would be divided into 164 acres allotted for flood and sediment volume, 685 acres for water supply volume, and 0 acres for fish and wildlife volume. The maximum water supply draft from the reservoir would be 1.78 Million Gallons Daily.

Reservoir #: LLBI Streams: Little Branch, Corrotoman River
The drainage area for this proposed reservoir site is approximately 2,694 acres or four square miles. The proposed reservoir would have a total maximum storage of 1,736 acres. The 1,736 acres would be divided into 562 acres allotted for flood and sediment volume, 1,174 acres for water supply volume, and 0 acres for fish and wildlife volume. The maximum water supply draft from the reservoir would be 1.22 Million Gallons Daily.

Reservoir #: LLB2 Streams: Little Branch, Corrotoman River
The drainage area for this proposed reservoir site is approximately 1,178 acres or two square miles. The proposed reservoir would have a total maximum storage of 1,350 acres. The 1,350 acres would be divided into 442 acres allotted for flood and sediment volume, 792 acres for water supply volume, and 116 acres for fish and wildlife volume. The maximum water supply draft from the reservoir would be 0.53 Million Gallons Daily.

Reservoir #: LMSI Streams: McMahon Swamp, Corrotoman River
The drainage area for this proposed reservoir site is approximately 3,390 acres or five square miles. The proposed reservoir would have a total maximum storage of 4,693 acres. The 4,693 acres would be divided into 1,271 acres allotted for flood and sediment volume, 1,479 acres for water supply volume, and 1,943 acres for fish and wildlife volume. The maximum water supply draft from the reservoir would be 1.53 Million Gallons Daily.

Reservoir #: LMS2 Streams: McMahon Swamp, Corrotoman River
The drainage area for this proposed reservoir site is approximately 2,657 acres or four square miles. The proposed reservoir would have a total maximum storage of 2,365 acres. The 2,365 acres would be divided into 996 acres allotted for flood and sediment volume, 1,159 acres for water supply volume, and 210 acres for fish and wildlife volume. The maximum water supply draft from the reservoir would be 1.20 Million Gallons Daily.

Reservoir #: LCRI Streams: Upper West Branch Corrotoman River
The drainage area for this proposed reservoir site is approximately 5,495 acres or nine square miles. The proposed reservoir would have a total maximum storage of 3,719 acres. The 3,719 acres would be divided into 1,322 acres allotted for flood and sediment volume, 2,397 acres for water supply volume, and 0 acres for fish and wildlife volume. The maximum water supply draft from the reservoir would be 2.48 Million Gallons Daily.

Precise locations and boundaries for these reservoir locations can be viewed in the Future Land Use Map found in Chapter 8.

B. GROUNDWATER

1. Groundwater Structure

As stated previously, Lancaster County residents are 100% dependent on groundwater for their drinking water supplies. Lancaster County's groundwater resources come from an underground system of aquifers that reflect the geology of the Coastal Plain Region of Virginia. Underground, the coastal plain is made up of unconsolidated gravels, sands, silts, and clays in addition to variable amounts of shells. This mixture of deposits rest on an underground rock surface called the basement, which slopes gently eastward. The basement rocks actually come out of the earth's surface at the fall line of the rivers, which is the dividing line between the Piedmont and Coastal Plain Regions of Virginia. As a point of reference the fall line of the Rappahannock River is at Fredericksburg, the fall line of the James River is at Richmond, and the fall line of the Potomac River is at

Washington, DC. At the fall line the thickness of the coastal plain sediments is zero; however, going east from the fall line the basement rock slopes down and the coastal plain sediments become thick. At the coastline the coastal plain sediments are over 6,000 feet thick and continue to deepen under the continental shelf.

Contained in the Coastal Plain sediments are a system of underground aquifers, or water-bearing units. Aquifers are recharged at the fall line, except for the Brightseat-Upper Potomac that is not recharged directly from the land surface. The Brightseat-Upper Potomac aquifer offers the best source of potable water.

Each aquifer is separated from those above and below by clay confining beds, from which they get the name, confined aquifers. These confining beds act to trap the water in between, allowing water to escape up and down only at very slow rates. When the aquifers are tapped by a well, the pressure enhances the flow of the water upward.

Throughout the Coastal Plain there is also an unconfined, water table aquifer. The water table aquifer is found between the ground surface and the top of the first confining bed. This aquifer is not pressurized and is the one used by shallow wells. This aquifer is recharged at ground surface level by rainwater and below the ground surface by water bodies such as creeks and rivers. Because this aquifer is unconfined and recharges from the surface, it is very susceptible to contamination. Anything that permeates the ground surface can quickly reach the water table aquifer.

Wells in Lancaster County tap four underground aquifers. Shallow wells utilize the Columbia and Yorktown-Eastover Aquifers, which are the water table aquifers. Deep wells, or artesians, tap the Chickahominy-Piney Point Aquifer and the deeper Brightest-Upper Potomac Aquifer. Detail on each of these aquifers is given below.

a. Columbia Aquifer (Water Table)

The water table aquifer in the higher elevated parts of the western and central, and throughout the entire eastern section of Lancaster County is actually an aquifer named the Columbia. The Columbia Aquifer is moderately used as a drinking water supply by the residents and businesses utilizing shallow wells in Lancaster County. This aquifer is unconfined and made up of sand and sediment deposits found underground from an elevation approximately at sea level, to about 100 feet above sea level. However, clayey sediments can produce localized confined or semi-confined conditions (Pg. C52, USGS Professional Paper 1404-C).

The saturated thickness of the Columbia Aquifer ranges from 15 feet at the aquifer's western limit to about 80 feet in the southeastern part of the Coastal Plain (Pg. F5, USGS Professional Paper 1404-F). The local recharge area for the Columbia Aquifer is the ground surface of Lancaster County. Sources of recharge are rain, ice, and snow. This aquifer affects lower aquifers because the Columbia is also a source of recharge for the underlying confined aquifers (Pg. F5, USGS Professional Paper 1404-F). However, recharge by cross-formational flow is exceedingly slow, requiring hundreds or even thousands of years. Contamination through this process is essentially negligible.

Local conditions including topography, drainage patterns, and land cover influence where the most important recharge areas in the county are located. However, because the aquifer recharges primarily from the surface, it is very susceptible to contamination. Septic system discharge, agricultural and lawn fertilizers, leaking underground storage tanks, and improper disposal of hazardous home waste can cause contamination of this aquifer. Contamination in this aquifer also affects lower aquifers, because the Columbia is also a source of recharge for the underlying confined aquifers (Pg. F5, USGS Professional Paper 1404-F).

The groundwater supplies of the Columbia Aquifer usually fluctuate according to the seasons of the year, with lowest supplies present during local drought conditions. Lastly, localized high chloride concentrations in wells utilizing the Columbia are due to local intrusion of water from the Chesapeake Bay and its major estuaries (Pg. 11, USGS WRI Report 92-4175). This condition is reported to be present in shallow wells in some parts of Lancaster County that are very close to large surface water bodies.

Water samples from some wells in this aquifer have elevated levels of nitrate, above the Maximum Contaminant Level recommended by the U.S. Environmental Protection Agency. High nitrate concentrations in groundwater are the result of human activities, especially agricultural fertilization practices and septic systems.

b. Yorktown-Eastover (Unconfined, Water Table and Confined)

The Yorktown-Eastover Aquifer is unconfined in its western limits, but becomes confined as the aquifer slopes eastward (Pg. F7, USGS Professional Paper 1404-F). The western limit of the Yorktown-Eastover is in the western part of Lancaster County. In this part of the County, the Yorktown-Eastover acts as the water table aquifer. This area also serves as the recharge area for the confined part of the aquifer (Pg. F7, USGS Professional Paper 1404-F). The unconfined, water table recharge areas of the Yorktown-Eastover are important because it is where contaminants can quickly reach the aquifer through the ground surface. This is of further concern because the Yorktown-Eastover Aquifer is a primary source of drinking water for the Eastern Shore of Virginia (Pg. C51, USGS Professional Paper 1404-C).

The Yorktown-Eastover Aquifer is not used heavily in Lancaster County (See Shallow Well Chart Below). Use in Lancaster County would be by people with shallow wells in the western part of the County, and with wells reaching 75-85 feet in depth in the eastern parts of the County. Lastly, localized high chloride concentrations in wells utilizing the Yorktown-Eastover, like the Columbia, are due to local intrusion of water from the Chesapeake Bay and its major estuaries. This condition is reported to be present in shallow wells in some parts of Lancaster County that are very close to large surface water bodies.

c. Chickahominy-Piney Point Aquifer (Confined)

This confined aquifer is located approximately 200-425 feet below the ground surface in Lancaster County and averages 50 to 100 feet in thickness throughout its reach, with a maximum thickness of 140 feet in Lancaster County (Pg. C46, USGS Professional Paper 1404-C). The Chickahominy-Piney Point starts at outcrop areas near the major stream valleys in Stafford and King George Counties, on down through Caroline, Hanover, and Henrico Counties, just east of the fall line (Pg. C46, USGS Professional Paper 1404-C). The major recharge area for this aquifer is also found at the outcrop location. Water entering from the recharge area flows down and eastward to reach Lancaster County. Lesser recharge of the aquifer also occurs in smaller amounts from vertical seepage between the confining beds of the other aquifers and along existing well conduits. This aquifer is not as prone to contamination as the water table aquifer due to its limited recharge potential in Lancaster County. Furthermore, supply in this aquifer is not as susceptible to decreases due to local drought conditions.

This aquifer is moderately used as a deep/artesian well supply by many light industrial, small municipal, and domestic users in Lancaster County (See Individual Drilled Well Chart on Page 3-18. Furthermore, the aquifer is thought to be capable of supplying large quantities of water suitable for most uses (Pg. C47, USGS Professional Paper 1404-C). However, there have been scattered reports of odor and other water quality problems in wells dug in this aquifer. Water in this aquifer contains concentrations of sodium, dissolved solids, and fluoride, which decrease while moving west in the aquifer. Specifically, sodium concentrations exceed 20mg/L throughout most of the aquifer, fluoride concentrations exceed 2mg/L in the south-central part of the aquifer, and concentrations of sulfate, chloride, and dissolved solids exceed the U.S. EPA Secondary Maximum Contaminant Level in the eastern part of the aquifer (Pgs. 13, 14, and 15, USGS WRI Report 92-4175).

d. Brightseat-Upper Potomac Aquifer (Confined)

This aquifer is located approximately 525-820 feet below the ground surface in Lancaster County. The aquifer is actually two aquifers located very close together, and separated by a thin confining bed. The Brightseat is the smaller aquifer and is located above the Upper Potomac Aquifer. The Upper Potomac Aquifer is located further below the surface at depths of 750 feet to 820 feet. These aquifers start from "subsurface pinch outs" east of the fall line and build to almost 400 feet in thickness to the east (Pg. C42, USGS Professional Paper 1404-C). These aquifers have no significant source of surface recharge. Recharge occurs in much smaller amounts from vertical seepage between aquifers and along existing well conduits. These aquifers are not as prone to contamination as the water table aquifer due to their limited recharge potential in Lancaster County. Supply of these aquifers is not susceptible to decreases due to local drought conditions either.

Most deep wells in Lancaster County tap the Brightseat Aquifer, not the Upper-Potomac. Water in the Brightseat Aquifer is of the sodium bicarbonate type in the central part of the aquifer, and becomes of the sodium chloride type to the east and southeast of Lancaster County under the Bay. Groundwater in this aquifer

also becomes more mineralized the further one moves southeast. For Lancaster County this means that certain parts of the county utilizing this aquifer have higher concentrations of sodium and fluoride in their drinking water. Specifically, dissolved-solid concentrations exceed the 500 mg/L U.S. EPA SMCL in the eastern part of the aquifer, fluoride concentrations exceed the 4mg/L U.S. EPA MCL in the south-central part of the aquifer and the 2mg/L U.S. EPA SMCL in the rest of the aquifer. Chloride concentrations exceed the 250 mg/L U.S. EPA SMCL in the southeastern part of the aquifer (Pg. 15, USGS WRI Report 92-4175). However, Virginia Department of Health records do not show chloride concentrations exceeding 132 ppm in Lancaster County. The highest chloride concentration is 132 ppm at Foxwells and the next highest is 71 at Mosquito Point. Locally, there are elevated concentrations of sodium, fluoride, and chloride in water drawn from this aquifer. These levels are particularly high in areas from White Stone east including Palmer, Foxwells, and Windmill Point. Sodium levels are approximately 230 mg/L in White Stone, 300 mg/L in Palmer, 400 mg/L in Foxwells, and as high as 500 mg/L at Windmill Point. Sodium levels in the artesian aquifers in the entire County exceed the USEPA advisory limits for persons with health conditions requiring limitation of sodium intake.

(1) Effects of Drawdown in the Brightseat-Upper Potomac

The Brightseat-Upper Potomac Aquifers are heavily tapped for deep/artesian well supplies in Lancaster County and regionally (See Individual Drilled Well Chart on Page 3-18). The aquifers are a principal source of groundwater for municipal, industrial, and agricultural use in the York-James, Middle, and Northern Neck Peninsulas of Virginia (Pg. F9, USGS Professional Paper 1404-F). In 2004 the Maryland Geological Survey released a report on the need to assess the sustainability of the Ground-water Resources in the Atlantic Coastal Plain and in 2006 began a cooperative effort with the U.S. Geological Survey (development in Maryland draws from aquifers shared with the Northern Neck of Virginia).

Due to heavy use there has been some regional draw down in the aquifer throughout the Coastal Plain Region. Draw down is caused by the withdrawal of large amounts of groundwater from the confined aquifers. The result of draw down is that water levels in the confined aquifers have declined and the underground flow of water has changed. This situation presents future problems for Lancaster County deep well users.

Several United States Geological Survey reports have studied the Coastal Plain groundwater aquifers, as well as the effect of drawdown caused by heavy pumping. According to one report, the decline in the level of water in the aquifers has changed the direction of ground-water flow toward the major pumping centers. When considering the Brightseat-Upper Potomac Aquifers, these centers are located near the cities of Franklin, Williamsburg, Suffolk, and Alexandria and the towns of West Point and Smithfield. Total withdrawal from these centers is estimated to have been

65 MGD in 1980. Franklin alone had withdrawals over 40 MGD in 1980 (Pg. F83, USGS Professional Paper 1404-F).

Furthermore, this report states as a general principle that heavy withdrawals increase vertical leakage through confining units, reduce the volume of water stored in the ground-water flow system, increase flow from the water-table aquifer into the confined flow system, and decrease local ground-water discharge to streams and regional discharge to coastal water. Basically the natural balance between recharge and discharge that existed prior to periods of heavy pumping has been disturbed. Areas of heavy pumping now capture a large part of the water previously discharged from the ground-water flow system to surface water, such as the Chesapeake Bay and the Rappahannock River (Pgs. F10, F11, and F12, USGS Professional Paper 1404-F).

Future underground water supplies are decreasing at faster rates than before periods of heavy pumping. Lastly, groundwater supplies that used to travel all the way to the coast to recharge surface water bodies with fresh water get detoured before they reach the surface water bodies. Impacts of this situation on the water quality of the Chesapeake Bay and its tributaries is unknown. (Specific data on water levels in wells monitored in Lancaster and surrounding counties by the United States Geological Survey, documentation of artesian aquifer recharge areas and declining water supplies, as well as a list of major water use areas can be seen in Appendix VII.)

The Brightseat-Upper Potomac Aquifer were documented in 1988 as capable of producing large quantities of high-quality water suitable for most uses (Pg. C42, USGS Professional Paper 1404-C). However, more recent activities of the USGS suggest a serious concern over declining artesian water supplies.

2. Existing And Projected Demand For Groundwater in Lancaster County, VA

In 1990 there were 10,896 people in Lancaster County, including approximately 1,100 people in the Town of Kilmarnock. (1,053 in Lancaster, and 56 in Northumberland) The 1,100 people in Kilmarnock used a total of 129,000 gallons daily of groundwater in 1990. The 9,769 people in the remainder of Lancaster County used a total of 880,000 gallons daily of groundwater in 1990. This comes to a countywide total of 1.01 MGD (million gallons daily) for 1990. These figures were approximating a 117 gallons used per customer per day (GPCD) in the Town of Kilmarnock and 90 gallons used per customer per day in the remainder of Lancaster County. A weighted average usage would be 93 gallons per day for all citizens. Using this average, countywide consumption increased to 1.08 MGD (based on 2000 Census of 11,576). If population increases by one percent per year, consumption will be 1.18 MGD by 2010, 1.30 MGD by 2020 and 1.44 MGD by 2030.

The above stated projections are not the greatest source of alarm given the relatively low rate of increase and are in line with the 1988 Rappahannock Water Supply Plan.

However, new large commercial users, any one of which could use as much as all of Lancaster County combined, may very well affect overall availability, requiring continuous study and action as appropriate. Problems with the quality of the supply, as discussed under the individual aquifer sections, appear to be of more immediate concern.

3. Threats to Groundwater Supply

a. Septic Systems/Sewage Disposal

As discussed previously in the "Surface Water Section," individual homeowner sewage disposal systems can act to negatively impact groundwater supplies. The aquifers most susceptible to contamination from individual sewage disposal systems are the Columbia and the unconfined water table part of the Yorktown-Eastover. Localized soil conditions such as high water tables and highly permeable soils in conjunction with large concentrations of septic systems can threaten the quality of the water table aquifers.

An additional concern is the recently approved engineered wastewater treatment systems. A means to monitor their long term effectiveness and impact must be developed. This is even more imperative given that these systems are almost always placed in areas with high water tables and/or percolation problems.

b. Underground and Aboveground Storage Tanks

According to the Department of Environmental Quality's Underground Storage Tank database there are approximately 326 regulated underground storage tanks in Lancaster County (Local Inventory of Regulated Underground Storage Tanks can be viewed at the Lancaster County Planning and Land Use Office). Additionally, many people in the county have unregulated storage tanks which contain fuel for the home heating source or their personal vehicles. These underground storage tanks can be a possible source of contamination for groundwater in Lancaster County.

Regulated storage tanks in the county are all tanks over 110 gallons, except for residential/non-commercial tanks less than 1,100 gallons, farm tanks less than 1,100 gallons, and residential/commercial heating fuel tanks less than 5,000 gallons. Therefore, regulated tanks are generally the tanks found at most gas stations, convenience stores, and automobile distributors in the county. Current state regulations have strict requirements for the operation of regulated underground storage tanks. First, these tanks must be protected from corrosion if they are to be placed underground. Second, owners and operators of new and existing tanks must provide a method, or combination of methods for release detection. Additionally, these tanks are required to be monitored periodically by the owners for leaks. Lastly, the owner and operator must report, investigate, and clean up any spills and overfills in accordance with state regulations.

Residential underground storage tanks are not regulated by the Department of Environmental Quality. Most leaks are discovered and taken care of by the

owners of the tanks. Information available from local oil companies suggests that problems with leaks are only found in areas with low groundwater tables. In areas with high water tables, water leaks into leaking tanks instead of fuel leaking out. Leaks in these cases will often be detected when water levels in the tank cause the
owner's furnace or heating source not to light. However, in areas with low water

tables fuel will often leak out and down when a leak occurs. Leaks in these cases will be detected only by noticing a drop in tank levels, or an increase in the usage of the fuel. The chart below indicates the number of housing units in the county which utilize fuel oil, kerosene, propane, etc. for the home heating fuel. It is assumed that these individual heating supplies are stored in either above or underground storage tanks. The percentage of these tanks located underground is undetermined.

Aboveground storage tanks for home heating oil have also proven to be a serious hazard to water wells drawing from the surface aquifer. Even when the tank is secure, leaks around the valve and oil line have contaminated water wells beyond repair. Currently a program exists under the Virginia Department of Environmental Quality to replace shallow wells contaminated by fuel oil with artesian wells

c. Uncapped/Abandoned Wells

Uncapped and abandoned wells are potential sources for groundwater contamination. These wells act as direct conduits to the groundwater supply. Disposal of waste into these wells can quickly lead to contamination. Abandoned artesian wells may allow direct access to deep aquifers. Census figures for Lancaster County indicate that there are possibly several hundred wells in the county that are no longer used but have not been properly abandoned. Procedures for abandoning a well are established by the Virginia Department of Health and can be costly.

d. Improper Disposal of Household Hazardous Waste

Due to tightened regulations and prohibitive costs, many rural counties no longer operate their own landfills to dispose of solid waste. In the Northern Neck each of the four counties have switched to waste transfer types of waste collection and disposal. In Lancaster County, waste and recyclable material are collected at three transfer sites. Waste collected at these sites is then carried by a waste carrier to a large regional landfill in King & Queen County. Furthermore, marketable recyclable materials such as cardboard, paper, aluminum, and glass collected at
these sites are sold by the county to generate revenue to support the costs of operating the collection centers.

However, due to limitations on the type of waste accepted by the regional landfill and the high costs of collection and proper disposal of household hazardous waste, Lancaster County has no system in place for citizens to dispose of this type

of waste. Household hazardous waste can include used motor oil, paint thinners, solvents, antifreeze, etc. Therefore, limited options can lead homeowners to choose improper means for disposing of this type of waste, which in turn becomes a threat to groundwater supplies.

II. ASSESSMENT OF EXISTING CONDITIONS

A. SURFACE WATER

Lancaster County is fortunate to have large areas of surface water within its boundaries. Overall, the condition of these surface waters is good; however, there are some areas for concern. Non-point source pollution has caused some degradation of water quality in the E25 (Corrotoman River) and C01 (Chesapeake Bay) watersheds. The E25 watershed was cited as having significant levels of urban use impacts due to urban erosion and nutrient loadings, and the amount of disturbed land. This type of pollution can be attributed to new home or business construction, particularly on the water. The C01 watershed was cited as having a large number of shellfish condemnations due to urban non-point source influences. This type of pollution can be attributed to high densities of septic systems, or a number of failing septic systems located close to surface water. The C01 watershed also was negatively impacted from agricultural non-point source pollution. However, despite being mentioned for these specific non-point source pollution impacts, none of the three watersheds were cited as having violations of state water quality standards.

Lancaster County's surface water resources also have potential, although limited, for use as a future potable water supply. In the County, there are no smaller fresh water streams that have suitable flow to allow for raw intake for drinking water purposes. Furthermore, saline conditions in the larger tidal portions of the County's surface water bodies make them unsuitable as a supply for drinking water. However, the County does have a large number of existing millponds, as well as other possible locations for impoundment of fresh surface water supplies.

The existing millponds already serve an important function, since they act as areas of recharge for water table aquifers. Furthermore, the existing millponds are generally located at the headwaters of streams or creeks, and many have sparsely populated areas surrounding them. With enlarged impoundment structures, these millponds could be potential surface water supplies for drinking water. Lastly, all the millponds are located upstream of permitted discharges. This situation would prevent discharges from affecting millpond or reservoir waters.

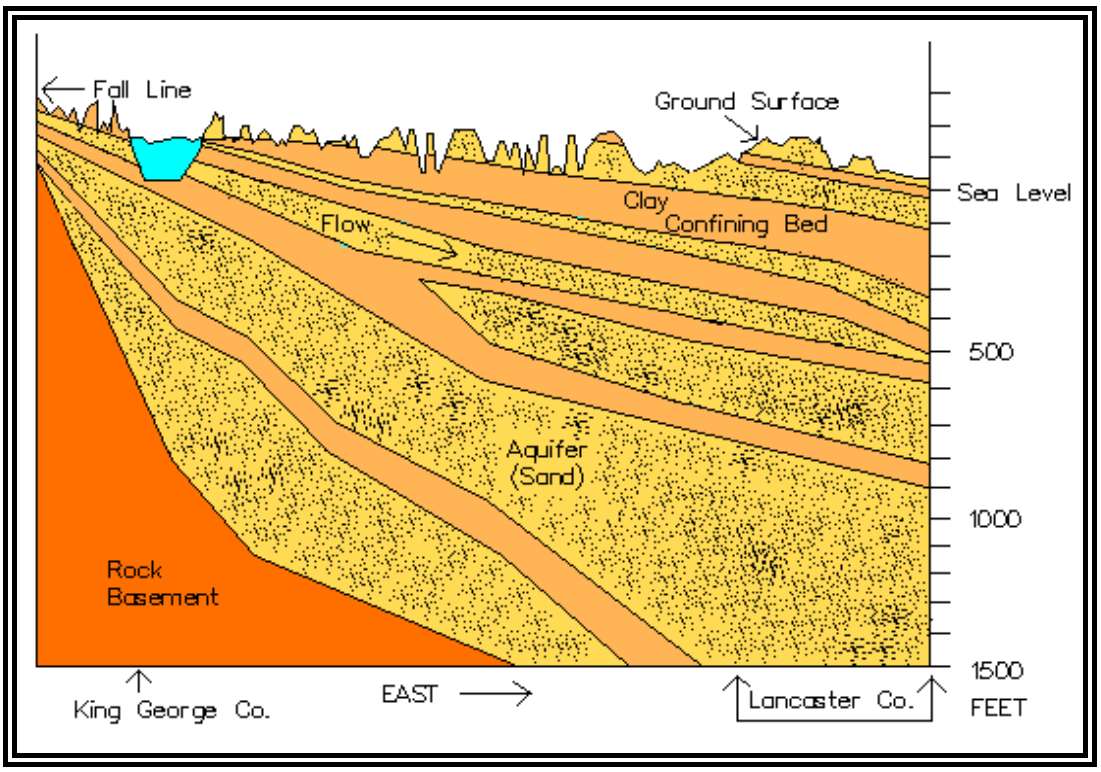
B. GROUNDWATER

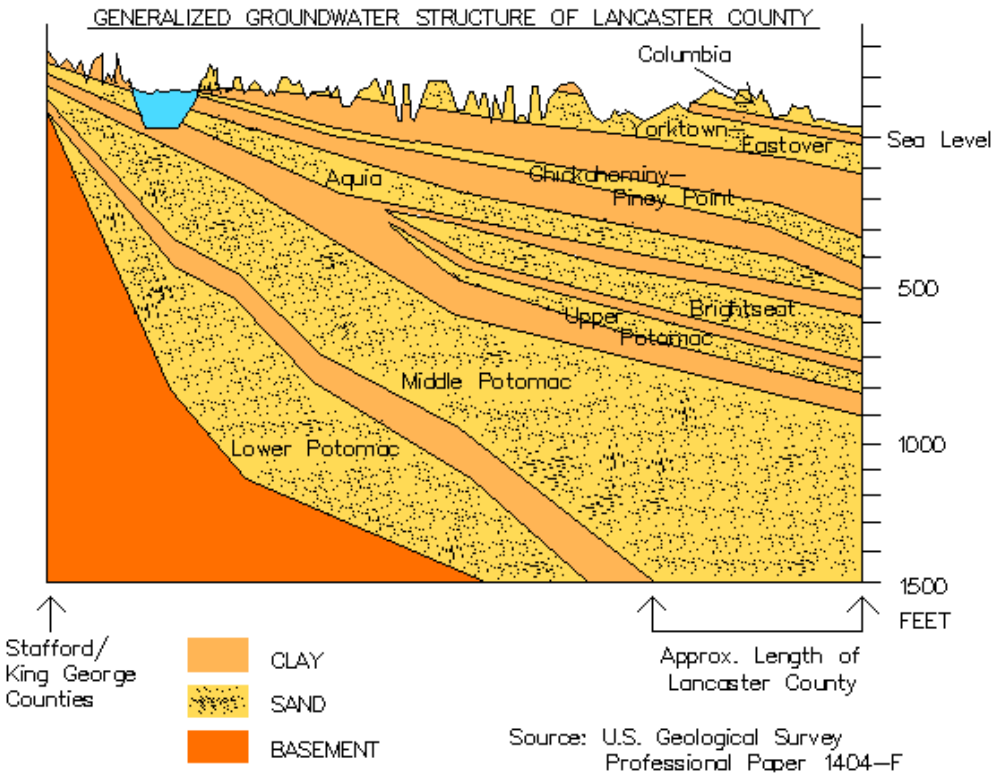
Lancaster County's citizens get their water from four aquifers; the Columbia, the Yorktown-Eastover, the Chickahominy-Piney Point, and the Brightseat/Upper Potomac. The Chickahominy-Piney Point and the Brightseat/Upper Potomac are the deeper, confined aquifers. The two deeper confined aquifers also supply other regions of Virginia with water, as well as parts of Maryland. Quality problems exist in the Chickahominy-Piney Point and Brightseat-Upper Potomac aquifers, mainly due to elevated levels of chloride, sodium, and fluoride. Levels of sodium and fluoride are of particular concern in Lancaster County. Sodium levels in the artesian aquifers are elevated in the entire county with the highest levels near White Stone and going towards Windmill Point. Patterns of fluoride levels are more random, but tend to be high throughout the County.

Each of the four aquifers has a particular recharge area. The Columbia Aquifer recharges from the ground surface in Lancaster County. The County has some influence through land use controls on protecting these areas. The Yorktown-Eastover Aquifer recharges at the outcrop of this aquifer in the western part of Lancaster County. Again, the County has some control over the protection of these areas through land use ordinances. This area is of particular importance because the Yorktown-Eastover Aquifer is the primary supply of drinking water for the Eastern Shore of Virginia. Lastly, of the two deeper aquifers, the Chickahominy-Piney Point and the Brightseat-Upper Potomac, the Chickahominy-Piney Point Aquifer primarily recharges at its outcrop areas just east of the fall line. It also recharges to a lesser degree through vertical leakage from the water table aquifers. However, the outcrop recharge areas are located near Westmoreland, King George, and Stafford Counties, and the City of Fredericksburg. The Brightseat-Upper Potomac Aquifer does not extend to the fall line and has no significant recharge from the surface. The Groundwater Management Study Committee, under the direction of the Northern Neck Planning District is developing methods to protect the recharge areas.

Locally, Lancaster County can act to protect the two water table aquifers. The Columbia is the principal water table aquifer, and the Yorktown-Eastover is the secondary aquifer. The main users of the water table aquifers are owners of shallow wells. The water table aquifers are the most susceptible to pollution, and the recharge area is the land above the aquifers in Lancaster County. Direct threats include septic systems, underground storage tanks, improper disposal of hazardous home waste (oil, gas, etc.), and abandoned, uncapped wells. It has been the experience of SAIF Water Wells in investigations and laboratory analyses of hundreds of shallow wells that the primary cause of pollution is indadequately maintained wells and general lack of knowledge on the part of homeowners and plumbers as to what is needed to protect the water supply. Holes are often quite visible in the well curbs and caps, and interior inspections reveal unsealed damage from the installation of pipes. Additionally, large areas of impervious cover, local drainage patterns, vegetation, and drought conditions can affect recharge areas. Lastly, the highest concentrations of shallow well, water table aquifer users are most likely found in the older developed areas of the county.

Recent studies conclude that regional draw downs due to heavy pumping of deeper, confined aquifers should cause concern and warrant further study. Specific plans for a more diverse water supply to include the use of surface water, or reservoirs will be made.


Fall Line
Ground Surface
Sea Level
Clay
Confining Bed
Flow
500
Aquifer
(Sand)
1000
Rock
Basement
1500
FEET
King George Co.
EAST
Lancaster Co.


GENERALIZED GROUNDWATER STRUCTURE OF LANCASTER COUNTY
Columbia
Yorktown
Eastover
Sea Level
Aquia
Chickahominy
Piney Point
500
Brightseat
Upper
Potomac
Middle Potomac
Lower Potomac
1000
1500
FEET
Stafford/
King George
Counties
Approx. Length of
Lancaster County
CLAY
SAND
BASEMENT
Source: U.S. Geological Survey
Professional Paper 1404-F

III. POTABLE WATER SUPPLY PLAN

A. GROUNDWATER

1. Water Table Aquifers

In Lancaster County, the water table aquifers are those most susceptible to contamination. Failing septic systems, agricultural fertilizers, hazardous home wastes, etc. can act to pollute water table aquifer resources. Furthermore, no regular water quality testing is done on these shallow wells to determine present areas of contamination. Therefore, a parcel specific inventory will be taken of homeowners utilizing shallow wells for their drinking water supply. After the inventory is completed, parcels with shallow wells in high septic system and agricultural areas will be targeted for water sampling. Available outside resources for water quality testing will be explored and pursued. When funds are obtained, a series of water samples will be taken to see if fecal coliform, organic and inorganic chemicals, and nitrates or some other foreign matter contaminate these shallow wells. Determination of contamination of water will be based on MCL's, as specified in the Waterworks Regulation. Areas with large numbers of contaminated wells will be targeted for local water system improvements and homeowner education.

If there are existing clusters of contaminated wells, obtaining outside funds will be pursued for improvements to these wells or replacement with shared artesian systems. If a new well is created, blanket well user agreement for users wanting to switch to the new well will be considered. This agreement will be a legally binding document that each homeowner signs. The agreement will ensure that homeowners are fully responsible for their fair share of maintenance or repair costs for the new well system. This will hopefully reduce any future disagreements over who is financially responsible for any well maintenance or repairs.

2. Abandoned Wells

The county will undertake a parcel specific inventory of all abandoned wells in the county. After wells are identified, an informative mailing will be prepared to send to each property owner with an abandoned well. The mailing will caution owners to protect the well area and not to use it for disposal of solid or liquid waste. Furthermore, it will ask the owners if they would be interested in participating in a countywide permanent well abandonment.

The County will launch an intensive campaign on well care and pursue grants for upgrading wells. Wells will be fitted with a seal under the well cap.

A project to properly cap existing wells or abandon wells would utilize available outside funding offered. The county will explore sources of such funding and apply for any available amounts.

3. Household Hazardous Waste Collection Day

To provide further protection to the County's groundwater resources Lancaster County has established a recurring Household Hazardous Waste Collection Day. This event is held at the existing solid waste refuse sites that, while currently done annually, could be done on a more frequent basis as need dictates. The County obtains the services of a certified waste disposal contractor who has proper authorization to handle and dispose of this type of waste. The event is widely marketed to the public, and on this particular day Lancaster County residents are allowed to properly dispose of a reasonable amount of household hazardous waste at no cost. A charge is only applied when the amount offered for disposal exceeds a set level.

4. Groundwater Management Area (GMA)

Lancaster County will actively support efforts to have the Eastern Virginia Groundwater Management Area extended through the Middle Peninsula and the Northern Neck. This will ensure that future entities that wish to withdraw large amounts of water will be required to seek a permit and report to the Virginia Department of Environmental Quality. See Appendix A for a map of the current Eastern Virginia GMA.

The County will also encourage conservation efforts on the part of current and future users. Any future golf courses will be required to develop plans that include surface or recycled water sources for their needs rather than being totally dependent on groundwater withdrawals.

5. Drilling Test Monitoring Wells

To expand existing knowledge of the groundwater resources of Lancaster County and the Northern Neck, the County endorses recommendations made by the Department of Environmental Quality (then the State Water Control Board) to establish monitoring wells in Lancaster County and the Northern Neck. Specifically, these recommendations call for a monitoring well to be developed to track the possible inland migration of elevated sodium, chloride, and fluoride levels in the White Stone, Palmer, Foxwells, Windmill Point area. Understanding water quality problems in the southeastern part of the County is vital to ensure protection of less affected supplies located nearby in the more densely populated areas in and around Kilmarnock. Additional monitoring wells are desirable to provide a more adequate information base on the decline of water in the artesian aquifers and possible tapping of deeper aquifers.

6. Regional Water System Plan

To prepare for the coordination and efficient use of the future water supply in Lancaster County, the County will support the preparation of a regional water system plan. The State Water Control Board made the original proposal for such a plan in the 1988 Rappahannock Water Supply Plan. The goal was to develop a plan that would encompass the County as well as the Towns of Irvington, Kilmarnock, and White Stone. The plan emphasized the cost savings of using a coordinated, regional approach to

address the future water supply needs, and water quality problems of Lancaster County.

B. SURFACE WATER

1. Inventory Septic Systems

As part of the effort to ensure continued protection of Lancaster County's Surface and Groundwater Resources, the County will inventory and map existing septic systems. This effort would help to pinpoint high concentrations of septic systems in the County, which could act cumulatively to deteriorate the quality of Lancaster's surface and groundwater supplies. Information obtained from this inventory will be valuable in developing a future land use map for Lancaster County. Additionally, once compiled this information would aid in any future efforts to identify and prioritize areas for efficient placement of a wastewater treatment plant. Inventories done to date have included only permitted systems and do not account for systems placed prior to 1985.

2. Identify Possible Impoundment Areas

Lancaster County will take action as necessary to ensure that potential reservoir sites are protected for use as such. This step will take priority in its own right without waiting for any further coordinated efforts.

3. Continue Present Enforcement Levels

To ensure continued protection of the quality of Lancaster County's surface water bodies, the County will continue its present, active enforcement of the Chesapeake Bay Preservation Act and the Erosion and Sediment Control Acts.

IV. GOALS AND OBJECTIVES FOR LANCASTER COUNTY POTABLE WATER SUPPLY PLAN

GOAL #1: **Protect and improve quality of surface waters of Lancaster County to ensure their continued benefit to the economy, recreation, and health of the County.**

Objective: Continue strict enforcement of the Chesapeake Bay Preservation Act and Erosion and Sediment Control Act Regulations to ensure protection of the water quality of the Chesapeake Bay and its tributaries.

Objective: Explore possible water impoundment areas presented in this plan for Lancaster County.

Objective: *Develop* strengthened county ordinances to ensure protection of proposed impoundment areas.

GOAL #2: **Develop methods to prevent groundwater pollution in order to protect the supply of groundwater in Lancaster County and to ensure that an adequate future supply exists for the continued growth of the County.**

Objective: Inventory all wells in the County for environmental hazards and structural defects. Encourage the upgrading of well structure, removal of environmental hazards near wells, wellhead protection measures, and regular laboratory analyses of water samples.

Objective: Seek state and federal funding to assist in upgrading wells or installing purification systems.

Objective: Develop a method of collecting waste oil in the county to give residents a safe disposal option.

Objective: Discourage the placement of shallow wells near agricultural operations.

Objective: Collect and analyze data that will show the impact on Lancaster County of draws from the aquifers in other jurisdictions

GOAL #3: **Develop methods to improve and protect groundwater quality in Lancaster County to ensure the continued safe health of the local people and the economy.**

Objective: Work in coordination with existing community organizations and the health department in efficiently utilizing existing local resources to improve drinking water quality.

Objective: Endorse regulations by the Virginia Department of Professional and Occupational Regulation that will take effect July 2007, limiting all work on wells to qualified professionals.

Objective: Inventory and map active shallow wells in the county to lay groundwork for identification of concentrations of contaminated shallow wells, investigate the causes, and recommend appropriate action by homeowners.

Objective: Identify possible funding for community well improvements.

Objective: Strongly support Department of Environmental Quality proposals to drill test wells in the eastern half of the county to monitor water quality problems. (Track inland movement of dissolved solids; chloride, sodium, and fluoride in groundwater aquifers.)

Objective: Support future regional efforts to establish a groundwater management district for the Northern Neck and Middle Peninsula areas of Virginia.

Objective: Support preparation of a regional water system plan for the southeastern part of Lancaster County. The plan would encompass the county, as well as the towns of Irvington, Kilmarnock, and White Stone. The plan would emphasize cost savings of using a coordinated, regional approach to address future water supply.

GOAL #4: Develop methods to ensure the continued availability of potable water.

Objective: Actively participate in efforts on a state and regional basis to address the issue of over pumping of artesian aquifers by other localities in Virginia and Maryland.

Objective: Support future regional efforts to establish a groundwater management district for the Northern Neck and Middle Peninsula of Virginia.

Objective: Explore technology and alternative sources of potable water that would enable the County to have diverse sources of water for the future.

Objective: Support water conservation measures through building ordinances.

GLOSSARY OF TERMS

Terms and measurements used to further understanding of groundwater quality descriptions are listed and detailed. They have been obtained from the following United States Geological Survey Report:

Water-Resources Investigations Report 92-4175, "Quality of Groundwater in the Coastal Plain Physiographic Province of Virginia." Focazio, Michael J.; Speiran, Gary K.; and Rowan, M. Eileen; U.S. Geological Survey; Richmond, VA: 1993.

Chloride - The U.S. EPA has established a SMCL for chloride of 250 mg/L. (U.S. Environmental Protection Agency, 1990c;) Furthermore, the State of Virginia maintains an antidegradation standard for chloride in groundwater in the Coastal Plain of 50 mg/L

(Commonwealth of Virginia, 1988)

Dissolved Solids - This refers to the measure of the concentration of all dissolved material in the water. The U.S. EPA SMCL for dissolved solids is 500 mg.L (U.S. EPA, 1990c). The State of Virginia's antidegradation standard for dissolved solids in groundwater in the Coastal Plain is 1,000 mg/L. (Commonwealth of Virginia, 1988)

Fluoride - The U.S. EPA has established both an MCL of 4.0 mg/L and an SMCL of 2.0 mg/L for fluoride. The State of Virginia enforces a standard of 1.8 mg/L. (Commonwealth of Virginia, 1982)

MCL - This refers to Maximum Contaminant Levels, which is a U.S. Environmental Protection Agency (1990a) designation. Reported MCL's are set for health concerns. This is the maximum permissible level of a contaminant in water that is delivered to any user of a public-water system. These levels are enforceable.

SMCL - This refers to Secondary Maximum Contaminant Levels, which is a U.S. Environmental Protection Agency (1990a) designation. Reported SMCL's are set for aesthetics (such as taste or odor) or for limits on properties that affect use of the water (such as chemical aggressiveness, or potential for the water to deposit solid chemicals). These levels are not enforceable.

Sodium - Presently, there are no Federal drinking water regulations concerning sodium; however, the State of Virginia maintains an antidegradation standard for sodium in groundwater in the Coastal Plain of 100 mg/L. The State also advises that persons on sodium-restricted diets avoid drinking water with sodium concentrations greater than 20mg/L, if the restriction is severe, and 270 mg/L, if moderate.