Protection of Potable Water Supply Study and Plan

Lancaster County, VA
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Protection of Potable Water Supply

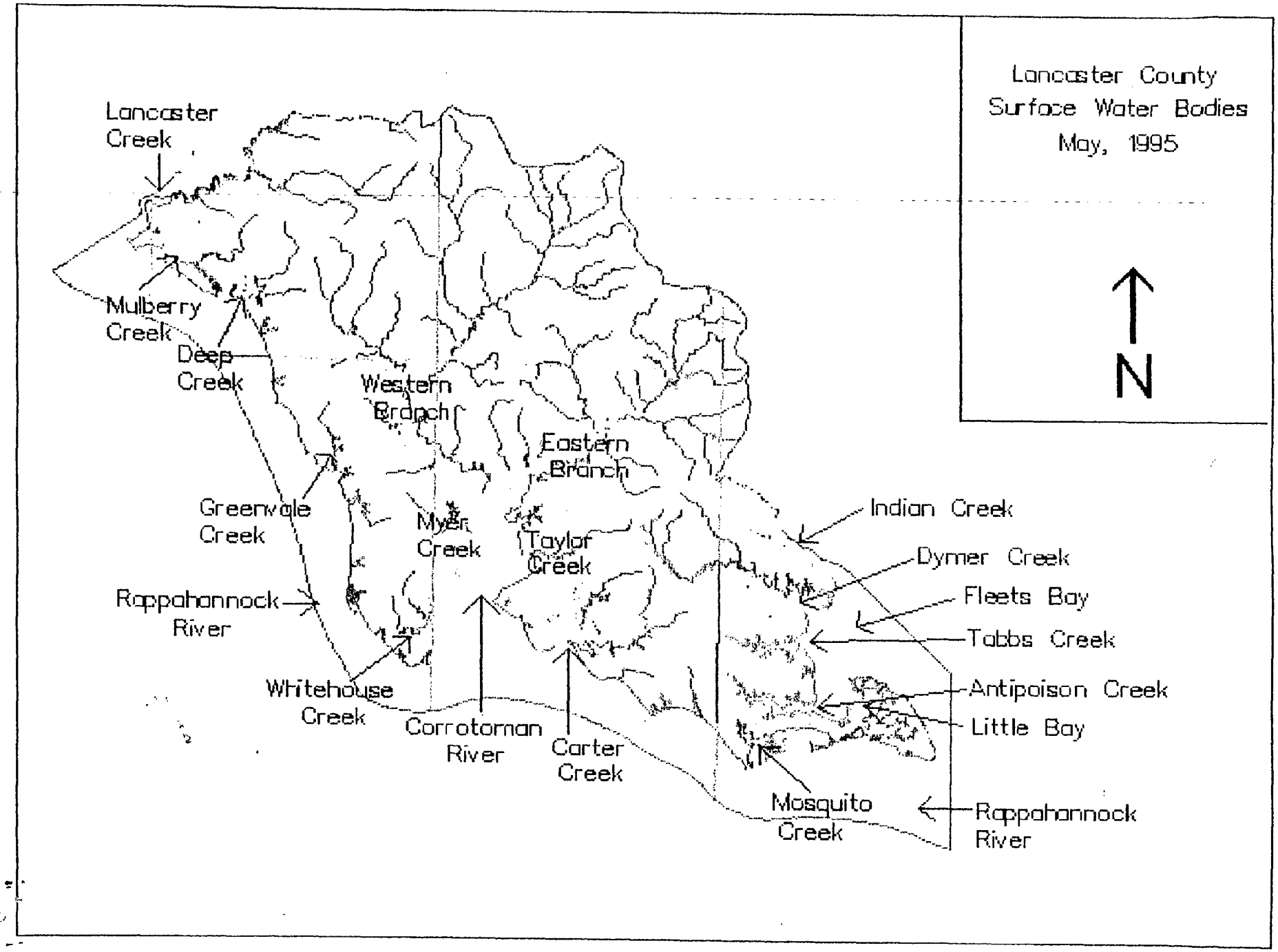
The ground water and surface water supplies of Lancaster County are recognized to be one of its most valuable natural resources. Lancaster's ground water resources provide the County with 100% of its potable water supply. Meanwhile, the County's surface water provides a source of employment for the seafood 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 are all dependent on the quality of these important water resources.

The Lancaster County Potable Water Supply Study and Plan will assess the existing state of this resource, 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 ground water resources are regionally shared and therefore require regional efforts to assure 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 will address the regional and local nature of these resources.

I. 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 Corrotoman River, including the Western and Eastern Branches, Carters Creek, Indian Creek, Dymer Creek, Tabbs Creek, Antipoison Creek, as well as many smaller creeks. Combined these water bodies give Lancaster County 264.77 miles of tidal shoreline. (See Lancaster County Surface Water Bodies Map on Next Page)

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


Lancaster County
Surface Water Bodies
May, 1995
N
Lancaster Creek
Mulberry Creek
Deep Creek
Western Branch
Eastern Branch
Greenvale Creek
Myer Creek
Taylor Creek
Rappahannock River
Whitehouse Creek
Corrotoman River
Carter Creek
Indian Creek
Dymer Creek
Fleets Bay
Tabbs Creek
Antipoison Creek
Little Bay
Mosquito Creek
Rappahannock River

A. Surface Water Quality

Quality of surface waters 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 which 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.

1. 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 fishable and swimmable waters. 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 which have been condemned for shellfishing by the Virginia Department of Health fall under the category of Partially Supporting in regards to fishing.

As of 1988, Lancaster County had 1,372 acres of condemned shellfish grounds (Pg. 84, Lancaster County Shoreline Management Study Preliminary Results, 1988). Typically shellfish condemnation areas in Lancaster County are found only in small 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. A complete listing of Lancaster County shellfish condemnations can be seen in the Appendix.

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 which 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 which are located in, or very close to, Lancaster County's boundaries. Five of these are located in the Rappahannock River, one in the Corrotoman River, and one in Indian Creek. Results from these seven stations are listed below:

W 22 (Station ID: 3-CRR003.38) - This station is located in the Corrotoman River near Red Buoy #6 in Lancaster County. This station recorded **0** violations of the Virginia Water Quality Standards. During the reporting time frame, there were 25 samples taken for temperature, 24 samples of dissolved oxygen, 26 for pH, and 14 for coliform bacteria. (p. B-7 of the Appendix, 305 (b) Report to EPA and Congress.)

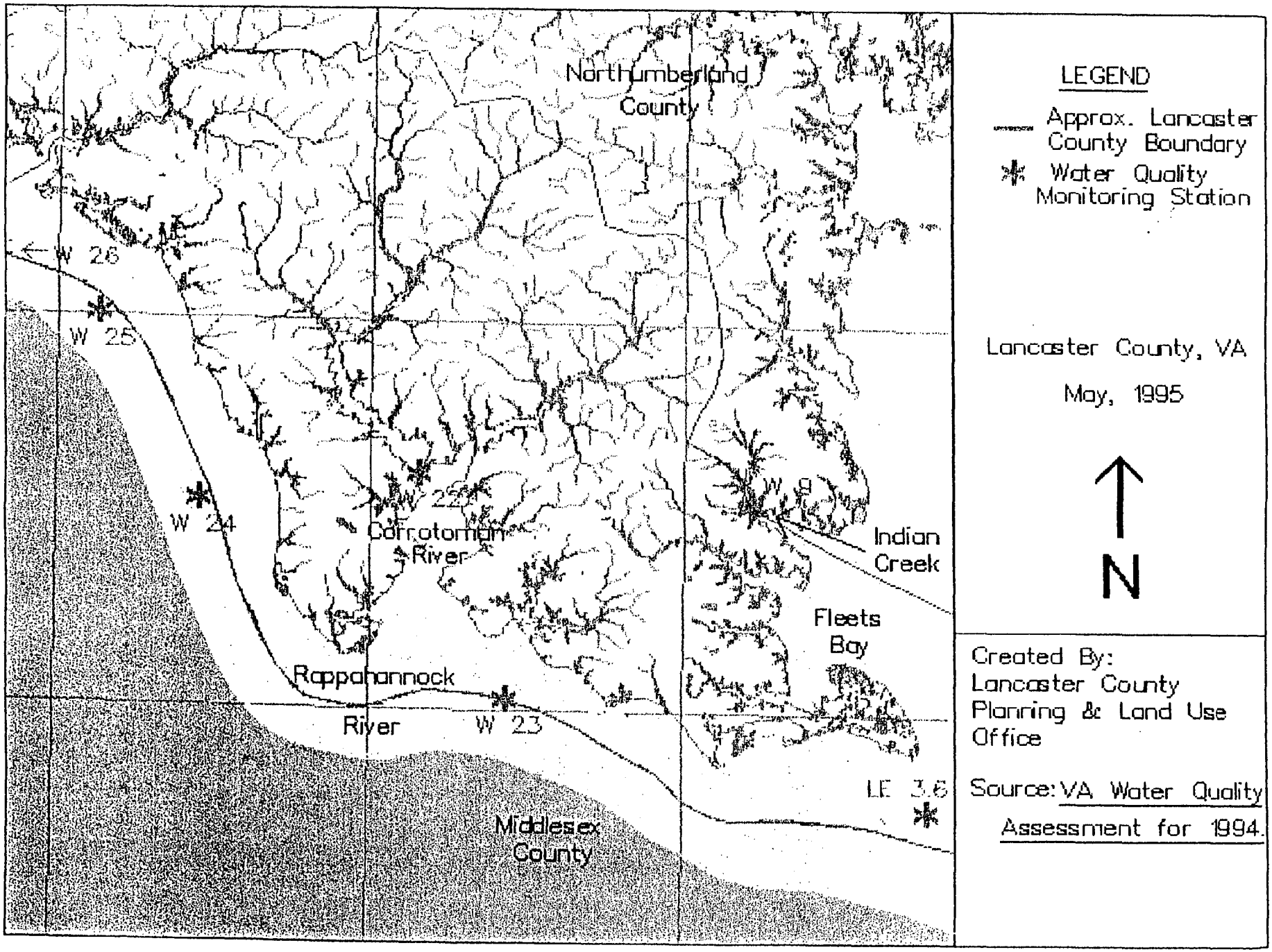
W 23 (Station ID: 3-RPP010.60) - This station is located in the Rappahannock River off Orchard Point near the Lancaster County and Middlesex County boundary in the Rappahannock River Basin. This station recorded **0** violations of the Virginia Water Quality Standards. During the reporting time frame, there were 26 samples taken for temperature, 24 samples of dissolved oxygen, 26 for pH, and 15 for coliform bacteria. (p. B-8 of the Appendix, 305 (b) Report to EPA and Congress.)

W 24 (Station ID: 3-RPP017.72) - This station is located near buoy #8 southwest of the mouth of Greenvale Creek near the Lancaster County and Middlesex County boundary in the Rappahannock River Basin. This station recorded **0** violations of the Virginia Water Quality Standards. During the reporting time frame, there were 27 samples taken for temperature, 22 samples of dissolved oxygen, 27 for pH, and 14 for coliform bacteria. (p. B-8 of the Appendix, 305 (b) Report to EPA and Congress.)

W 25 (Station ID:3-RPP025.52) - This station is located near buoy #11 off Goose Point on the Middlesex County side in the Rappahannock River Basin. This station recorded **0** violations of the Virginia Water Quality Standards. During the reporting time frame, there were 23 samples taken for temperature, 20 samples of dissolved oxygen, 23 for pH, and 0 for coliform bacteria. (p. B-8 of the Appendix, 305 (b) Report to EPA and Congress.)

W 26 (Station ID:3-RPP031.57 - This station is located opposite Morattico on the Middlesex County side in the Rappahannock River Basin. This station recorded **0** violations of the Virginia Water Quality Standards. During the reporting time frame, there were 23 samples taken for temperature, 21 samples of dissolved oxygen, 23 for pH, and 0 for coliform bacteria. (p. B-8 of the Appendix, 305 (b) Report to EPA and Congress.)

W 9 (Station ID: 7-IND002.26) - This station is located in Indian Creek opposite Kilmarnock Wharf on the Northumberland County side of the creek in the Chesapeake Bay Basin. This station recorded **0** violations of the Virginia Water Quality Standards. During the reporting time frame, there were 22 samples taken for temperature, 21 samples of dissolved oxygen, 22 for Ph, and 21 for coliform bacteria. However, there was one instance where the test of sediments


Northumberland County
W 26
W 25
W 24
W 22
Corrotoman River
W 9
Indian Creek
Fleets Bay
Rappahannock River
W 23
LE 3.6
Middlesex County
LEGEND
Approx. Lancaster County Boundary
Water Quality Monitoring Station
Lancaster County, VA
May, 1995
N
Created By:
Lancaster County
Planning & Land Use
Office
Source: VA Water Quality Assessment for 1994.

exceeded standards due to copper (metals) in the creek sediment. (p. B-14 of the Appendix, 305 (b) Report to EPA and Congress.)

LE 3.6 **(Station ID: LE3.6)** - This station is located at the mouth of the Rappahannock River between Windmill and Stingray Points in the Chesapeake Bay Basin and is designated as a Chesapeake Bay Water Quality Monitoring Station. No data could be found to determine water quality for this area.

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

2. Sensitive Surface Water Features

Lancaster County is fortunate to benefit from an abundance of marine resources which 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 seagrass, is a valuable natural marine resource which 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.

According to the 1993 Distribution of Submerged Aquatic Vegetation in the Chesapeake Bay (Virginia Institute of Marine Science, School of Marine Science; The College of William and Mary), SAV beds in Lancaster County are found in the Corrotoman River, along the north shore of the Rappahannock River from the Corrotoman River to Windmill Point; as well as in Dymer Creek, Indian Creek, Little Bay, and Fleets Bay. Furthermore, this report notes that SAV beds have declined in the area of the Rappahannock River between Carters Creek and the mouth of the Corrotoman River. However, SAV has also slowly expanded in some areas of Lancaster County. One large bed near Windmill Point is cited as having grown from 28 hectares in 1992, to 44 hectares in 1993. (Specific distribution of SAV in the lower part of Lancaster County can be seen in the "Submerged Aquatic Vegetation, 1993 Irvington, Fleets Bay, Wilton, and Deltaville, VA Quadrangles" map in the Appendix.)

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" (Pg. 4, Atlas of National Wetlands Inventory Maps of Chesapeake Bay. U.S. Fish and Wildlife Services; September, 1986.). 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). (Distribution of tidal and non-tidal wetlands in Lancaster County can be viewed on the "Tidal and Non-tidal Wetlands" map in the Appendix.)

Wetlands are important natural resources which provide many positive 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 stormwater 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 which should be protected. Although it can not be determined if, or when, shellfish populations will recover from these diseases, the possibility remains that the resource could thrive again. (Distribution of shellfish grounds in Lancaster County are depicted on the Shellfish Grounds" map in the Appendix.)

3. 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 which 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 which 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 large amount of 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 rain storms and melting periods after ice or snow storms. 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 which 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, sev. 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 which are highly permeable and the percent each soil type comprises of the County's total soils:

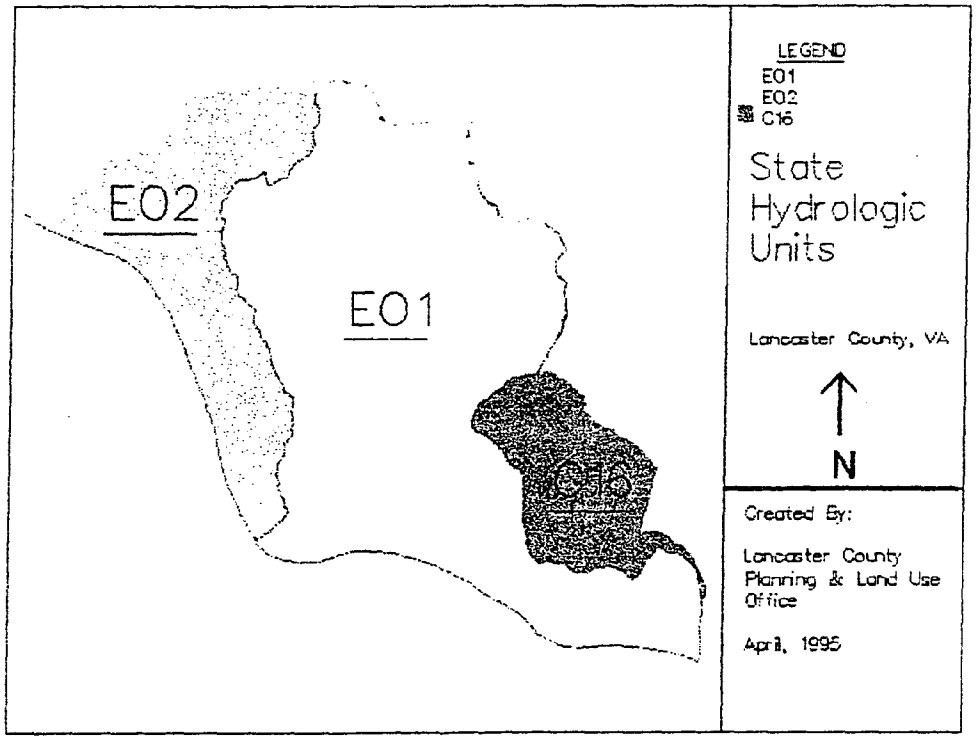
1. Coastal Beach (0.48%)
2. Dragston fine sandy loam (3.19%)
3. Lakeland loamy fine sand, gently sloping (0.61%)
4. Rumford loamy sand, gently sloping (0.16%)
5. Rumford loamy sand, sloping, eroded (0.05%)
6. Sloping sandy land (9.26%)
7. Steep sandy land (18.13%)

b. Sources of Surface Water Pollution

i. Nonpoint Source Pollution

One measure of the effect of pollution on the water quality of Lancaster County's surface water is found in the Virginia Nonpoint 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: EO1, EO2, and C16. EO1 and EO2 are part of the Rappahannock River Basin and C16 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.

State Hydrologic Units in Lancaster County



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

EO1 - This watershed is cited as having "significant levels of urban use impacts due to urban erosion and nutrient loadings, and the amount of disturbed urban land" (Pg. 138). 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

nonpoint source pollution rank of "MEDIUM -", with a rank of "High+" being the highest priority watersheds for state nonpoint source pollution protection efforts.

EQ2 - 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 nonpoint source pollution protection efforts.

C16 - This watershed is rated as a "medium priority watershed for agricultural nonpoint source pollution concerns. Due primarily to existing development, watershed C16 is rated in the top 10% statewide for urban pollution potential." Additionally, the water shed is cited as having a large number of shellfish condemnations because of "urban nonpoint 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 nonpoint source pollution rank of "High+", with a rank of "High+" being the highest priority watersheds for state nonpoint source pollution protection efforts.

ii. 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 (VAPDES) which carries out the requirements of the federal act. VAPDES is a permit program which establishes, on an individual basis, limits on the quantity and/or concentration of pollutants allowed in the discharge.

When a VAPDES 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. In Lancaster County there are currently 10 VAPDES, 14 Special Consent Orders (Extensions to VAPDES), and 1 VPA permit issued to various businesses throughout the County. The chief industry utilizing these types of permits in Lancaster County is the seafood industry, with resort hotels a distant second. (See APPENDIX for complete listing).

iii. Septic Systems/Sewage Disposal

Approximately 83% of all private residences in Lancaster County utilize septic systems for sewage disposal purposes (See Septic System Map in APPENDIX). The chart below gives some indication of the actual numbers of septic systems in the County and if they are located in or outside of the three towns.

Septic/Cesspool for Sewage Disposal
Lancaster County, VA - 1990

Towns	534	51.90% of Housing Units in Towns
County	4,370	89.38% of Housing Units in County
Total	4,904	82.87% of all Housing Units

Source: 1990 United States Census Statistics.

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 which 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' drainfields and intermix with the relatively untreated effluent. Furthermore, high water tables can cause pooling of septic effluent on the ground surface. During a rain storm, 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 drainfield, 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 which 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. The 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 shellfishing.

B. 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 water drinking water sources.

In 1973, the Northern Neck Planning District Commission conducted a water and sewage facilities plan for the Northern Neck (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:

1. Reservoir #: LBBI Streams: Balls Branch, Lancaster Creek
The drainage area for this proposed reservoir site is approximately 1,287 acres or 2.01 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.

2. Reservoir #: LCMI Streams: Camps Millpond
The drainage area for this proposed reservoir site is approximately 3,944 acres or 6.16 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.

3. Reservoir #: LLBI Streams: Little Branch, Corrotoman River
The drainage area for this proposed reservoir site is approximately 2,694 acres or 4.21 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.

4. Reservoir #: LLB2 Streams: Little Branch, Corrotoman River
The drainage area for this proposed reservoir site is approximately 1,178 acres or 1.84 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.

5. Reservoir #: LMSI Streams: McMahon Swamp, Corrotoman River
The drainage area for this proposed reservoir site is approximately 3,390 acres or 5.30 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.

6. Reservoir #: LMS2 Streams: McMahon Swamp, Corrotoman River
The drainage area for this proposed reservoir site is approximately 2,657 acres or 4.15 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.

7. Reservoir #: LCRI Streams: Upper West Branch Corrotoman River
The drainage area for this proposed reservoir site is approximately 5,495 acres or 8.59 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.

8. Reservoir #: LOCI Streams: Quarter Cove
The drainage area for this proposed reservoir site is approximately 3,944 acres or 6.16 square miles. The proposed reservoir would have a total maximum storage of 849. 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.

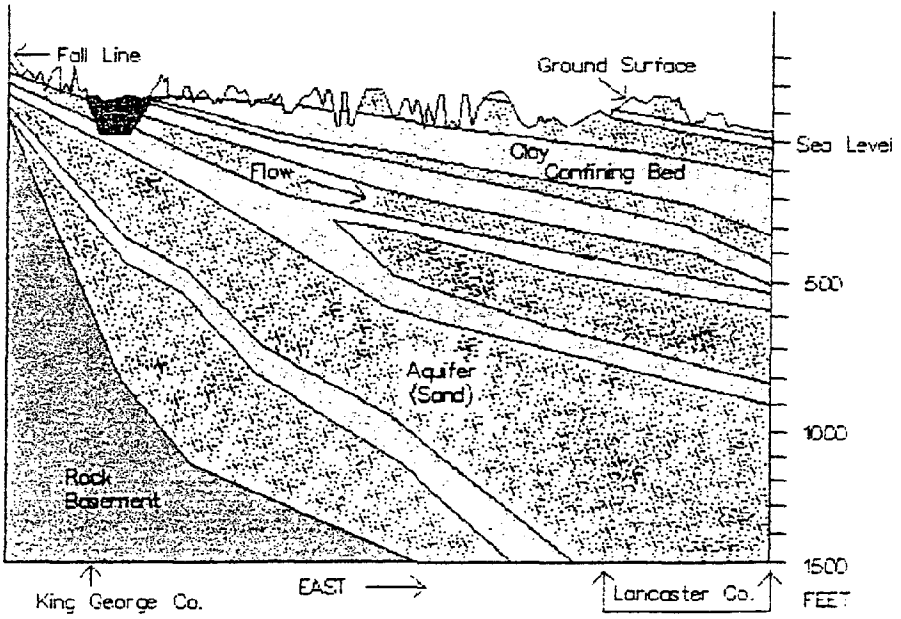
(Source: Martin, Clifford, & Associates, NEDCO Report, Volume II, Pgs. VIII-44, VIII-45.)

Precise locations and boundaries for these reservoir locations as they were identified in the 1973 plan can be viewed in the APPENDIX.

II. GROUND WATER

A. Groundwater Structure

As stated previously, Lancaster County residents are 100% dependent on groundwater for their drinking water supplies. Lancaster County's ground water resources come from an underground system of aquifers which 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, D.C.. 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. By the time the downward slope stops at the coast, the coastal plain sediments are over 6,000 feet thick.



Contained in the Coastal Plain sediments are a system of underground aquifers. These aquifers can pe pictured as underground rivers which travel through sand. These rivers also come to the surface near the fall line, then they slope downward to the east. At the fall line the aquifers are recharged, meaning this is the point where water enters them. From this point on the aquifers, except for the water table aquifer, are deep below ground. Additionally, 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. The confining beds also act to add pressure to the water, therefore, when the aquifers are tapped by a well the pressure enhances the flow of the water upward.

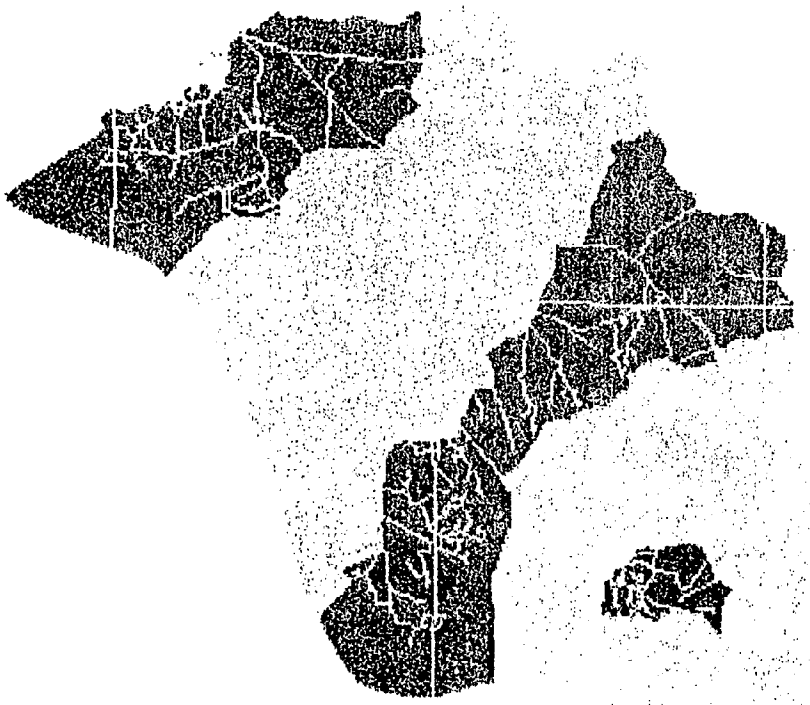
Throughout the Coastal Plain there is also an unconfined, water table aquifer. The water table aquifer is found between the ground surface and the top of the first confining bed. This aquifer is not pressurized and is the one used by shallow wells. This aquifer is recharged at ground surface level by rain water 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 Brightseat-Upper Potomac Aquifer. Detail on each of these aquifers is given below.

1. 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 (See Shallow Well Chart on Page 14 and "Dug/ Shallow Well Map" on next page). 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. The major sources of recharge are rain, ice, and snow storms on the ground level and underwater surface water body flows below the ground surface. 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).



LEGEND

- 0 – 9.9%
- 10 – 19.9%
- 20 – 29.9%
- 30 – 39.9%
- 40 – 49.9%
- Water

Percent of Housing Units in Block Group with Dug/Shallow Wells

LANCASTER COUNTY

March, 1995

N

Prepared By:
Lancaster County
Planning & Land Use
Office
Source: 1990 U.S. Census
Block Group Data

The ground water 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 which are very close to large surface water bodies.

2. 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 if 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 and "Dug/Shallow Well" Map). 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 which are very close to large surface water bodies.

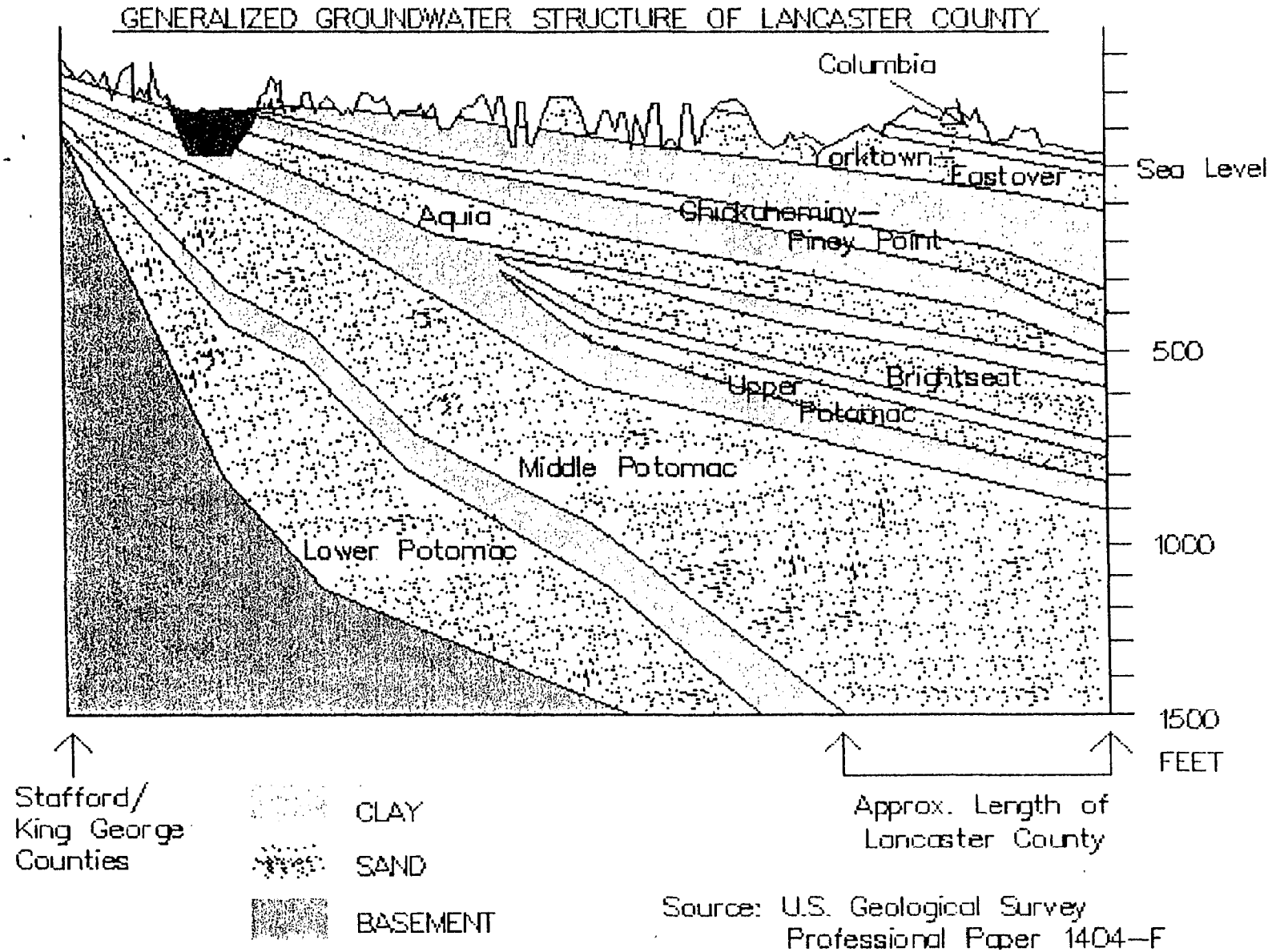
Dug (Shallow) Well for Source of Water Supply
Lancaster County, VA - 1990

Towns	27	2.62% of Housing Units in Towns
County	1,652	33.79% of Housing Units in County
Total	1,679	**28.37%** of all Housing Units

Source: 1990 United States Census

3. 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


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

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 17 and the "Drilled Well" Map on the Next Page). 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). 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 easter part of the aquifer (Pgs. 13, 14, and 15, USGS WRI Report 92-4175).

4. Brightseat-Upper Potomac Aquifer (Confined)

This aquifer is located approximately 525-725 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 pinchouts" east of the fall line and build to almost 400 feet in thickness to the east (Pg. C42, USGS Professional Paper 1404-C). Recharge areas for these aquifers are located at the start of the "pinchouts" east of the fall line. Recharge also 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 its limited recharge potential in Lancaster County. Furthermore, supply of these aquifers is not susceptible to decreases due to local drought conditions.

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 when moving east. Additionally, ground water in this aquifer becomes more mineralized the further one moves east. For Lancaster County this means that certain parts of the county utilizing this aquifer have higher concentrations of sodium, fluoride and chloride 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, and chloride concentrations exceed the 250 mg/L U.S. EPA

LEGEND

10 – 19.9%
20 – 29.9%
30 – 39.9%
40 – 49.9%
50% +
Water

Percent of Houses in Block Group with Drilled Wells

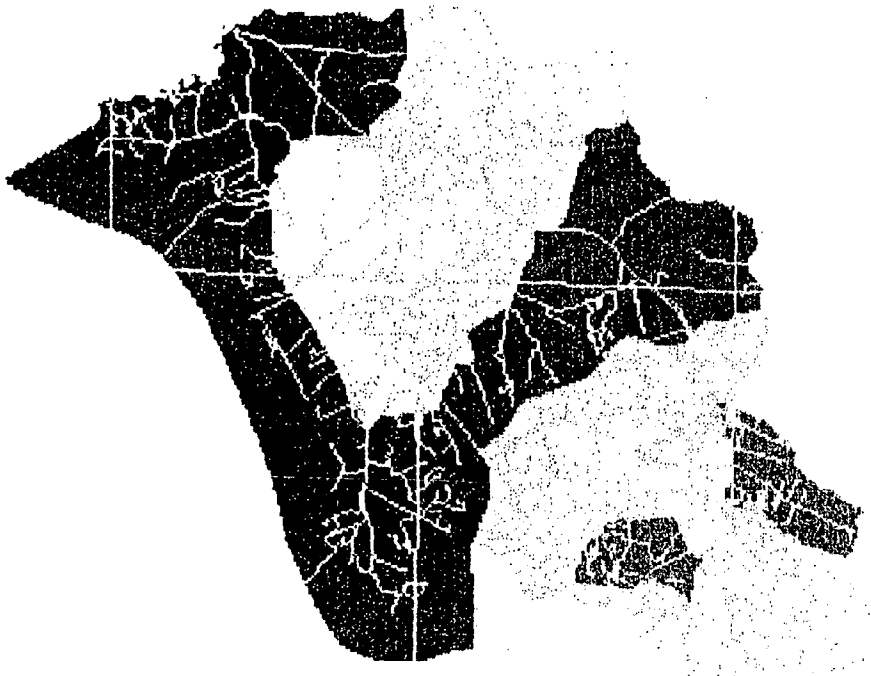
LANCASTER COUNTY

March, 1995

N

Prepared By:
Lancaster County
Planning & Land Use
Office

Source: 1990 U.S. Census
Block Group Data



LEGEND

- 0 – 19.9%
- 20 – 39.9%
- 40 – 59.9%
- 60+%

Percent of Houses in Block Group with Public Supply Water (Publicly Owned or Privately Owned)

LANCASTER COUNTY, VA

May, 1995

N

Prepared By:
Lancaster County
Planning & Land Use
Office

Source: 1990 U.S. Census
Block Group Data

SMCL in the eastern part of the aquifer (Pg. 15, USGS WRI Report 92-4175). 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.

a. 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 17 and "Drilled Well Map on the previous page). 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). Due to this heavy use there has been some regional drawdown in the aquifer throughout the Coastal Plain Region. Drawdown is caused by the withdrawal of large amounts of ground water from the confined aquifers. The result of drawdown is that water levels in the confined aquifers have declined and the underground flow of water has changed. These resulting situations could present future problems for Lancaster County deep well users.

Several United States Geological Survey reports have studied the Coastal Plain ground water 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 that the heavy withdrawals have increased vertical leakage through confining units, reduced the volume of water stored in the ground-water flow system, increased flow from the water-table aquifer into the confined flow system, and decreased 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 had 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).

For Lancaster County this means that contaminants in the water table aquifer can now more easily reach the confined aquifers. Furthermore, future underground water supplies are decreasing at faster rates than before periods of heavy pumping. Lastly, ground water supplies which 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. 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, as well as a list of major water use areas can be seen in the Appendix.)

Despite all the problems surrounding regional drawdown, it is believed that ample ground water supplies exist for the foreseeable future. The Brightseat-Upper Potomac Aquifer is documented as capable of producing large quantities of high-quality water suitable for most uses (Pg. C42, USGS Professional Paper 1404-C).

*Public Supply Well for Source of Water Supply
Lancaster County, VA - 1990

Towns	951	92.00% of Housing Units in Towns
County	1,200	25.00% of Housing Units in County
Total	2,151	36.00% of all Housing Units

*Individual Drilled Well for Source of Water Supply
Lancaster County, VA - 1990

Towns	51	5.00% of Housing Units in Towns
County	1,982	41.00% of Housing Units in County
Total	2,033	34.00% of all Housing Units

Source: 1990 United States Census Statistics

* The large majority of the wells utilize the Brightseat-Upper Potomac aquifers for ground water supplies. A smaller, but significant number use the Chickahominy-Piney Point Aquifer.

B. 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 MGD (million gallons daily) of ground water in 1990. The 9,769 people in the remainder of Lancaster County used a total of .88 MGD of ground water in 1990. This comes to a County-wide total of 1.01 MGD 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. These averages were obtained from the 1988 Rappahannock Water Supply Plan prepared by the State Water Control Board. These figures can further be used to predict future demand for ground water in Lancaster County.

First, recent population projections were obtained for Lancaster County from the Virginia Employment Commission (VA Population Projections, 2010. VEC, June 1993). The projected annualized growth rate for the County was then applied to the Town's 1990 population to calculate projections. Lastly, the previous water use average for each customer per day was multiplied by the appropriate population for the Town or County to calculated projected ground water demand. This is detailed in the chart below.

Year	Kilmarnock Population	GPCD	Town MGD's	County Pop.	GPCD	County MGD's	Total Pop.	Total MGD's
1990	1,100	117	.129	9,796	90	.88	10,896	1.01
1995	1,141	117	.133	10,162	90	.91	11,303	1.04
2000	1,183	117	.138	10,508	90	.95	11,691	1.09
2010	1,250	117	.146	11,140	90	1.00	12,390	1.15

As is evidenced in the above chart, Lancaster County's projected ground water supply needs are not expected to grow significantly. This projection would be in line with the 1988 Rappahannock Water Supply Plan which stated that the present ground water system should be adequate to meet the needs of Kilmarnock's water supply through the 50 -year planning period. These projections would indicate that despite the negative impacts of drawdown, the amount of the water supply is not the immediate problem. Instead the problems with the **quality** of the supply, as discussed under the individual aquifer sections, appear to be of more immediate concern.

C. Threats to Groundwater Supply

1. Septic Systems/Sewage Disposal

As discussed previously in the "Surface Water Section", individual home owners sewage disposal means 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. The charts below detail the number of housing units in Lancaster County utilizing septic systems for sewage disposal, as well as the number of housing units lacking complete plumbing and kitchen facilities.

Septic/Cesspool for Sewage Disposal
Lancaster County, VA - 1990

Towns	534	51.90% of Housing Units in Towns
County	4,370	89.38% of Housing Units in County
Total	4,904	82.87% of all Housing Units

Housing Units Lacking Complete Plumbing Facilities
Lancaster County, VA - 1990

Towns	8	< 1% of Housing Units in Towns
County	324	6.63% of Housing Units in County
Total	332	5.61% of all Housing Units

Housing Units Lacking Complete Kitchen Facilities
Lancaster County, VA - 1990

Towns	6	< 1% of Housing Units in Towns
County	201	4.11% of Housing Units in County
Total	207	3.50% of all Housing Units

Source: 1990 Unites States Census Statistics.

2. Underground 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. However, the percentage of these tanks located underground is undetermined.

Fuel Oil, Kerosene, etc. for House Heating Fuel
Lancaster County, VA - 1990

Towns	402	46.47% of Housing Units in Towns
County	1,491	40.31% of Housing Units in County
Total	1,893	41.48% of all Housing Units

Source: 1990 United States Census Statistics.

3. Uncapped/Abandoned Wells

Uncapped abandoned wells are potential sources for groundwater contamination. These wells, particularly shallow/dug wells, act as direct conduits to the groundwater supply. Disposal of waste into these wells can quickly lead to contamination. Furthermore, abandoned deep wells provide direct access to lower confined aquifers which are usually somewhat protected from vertical leakages. Census figures for Lancaster County indicate that there are possibly several hundred of these wells in the county.

4. 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 two transfer sites. Waste collected at these sites is then carried by a waste hauler 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 transfer sites.

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.

III. 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. Nonpoint source pollution has caused some degradation of water quality in the E01 (Corrotoman River) and C16 (Chesapeake Bay) watersheds. The EO1 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 would be attributed to new home or business construction, particularly on the water. The C16 watershed was cited as having a large number of shellfish condemnations due to urban nonpoint source influences. This type of pollution would be attributed to high densities of septic systems, or a number of failing septic systems located close to surface water. The C16 watershed also was negatively impacted from agricultural nonpoint source pollution. However, despite being mentioned for these specific nonpoint 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 which 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 would 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 aquifer. 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 dischargers. 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 are elevated near White Stone and get higher 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 area. 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, the two deeper aquifers, the Chickahominy-Piney Point and the Brightseat-Upper Potomac, primarily recharge at their outcrop areas just east of the fall line. They also recharge 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. To influence how these recharge areas are protected, the County would have to participate in some type of Ground Water Management District. One does not exist at this time, although regional interest in developing such a district is growing.

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. Additionally, recharge areas can be affected by large areas of impervious cover, local drainage patterns, vegetation, and drought conditions. Lastly, the highest concentrations of shallow well, water table aquifer users are most likely found in the older developed areas of the county.

On the surface there appears to be an adequate supply of ground water for the future. However, recent studies believe that regional drawdowns due to heavy pumpage of deeper, confined aquifers should cause concern and warrants further study.

IV. Goals and Objectives for Lancaster County Potable Water Supply Plan

Goal 1: **Protect and improve quality of surface waters of Lancaster County to assure 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 assure protection of the water quality of the Chesapeake Bay and its tributaries.

Objective: Continue review of local land use ordinances to assure that ordinances allow for siting of septic systems in the best location on new lots, and in the area of soils most suitable for their operation.

Objective: Work in coordination with the local health department to inventory and map septic systems in the county to develop locations where there are already high numbers of septic systems in use.

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

Objective: Support strengthened county ordinances to assure protection of proposed impoundment areas.

Goal 2: **Develop methods to prevent ground water pollution in order to protect the supply of ground water in Lancaster County and to assure that an adequate future supply exists for the continued growth of the County.**

Objective: Organize a hazardous home waste collection day to give residents an opportunity to safely dispose of their waste.

Objective: Inventory and map uncapped, inactive wells in the county and identify procedures to encourage property owners to cap off wells.

Objective: Seek state and federal funding to initiate an Inactive Well Capping Project.

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

Goal 3: **Develop methods to improve and protect ground water quality in Lancaster County to assure 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 in improving drinking water quality.

Objective: Inventory and map active shallow wells in the county to lay groundwork for identification of concentrations of contaminated shallow wells and if feasible prioritize for upgrading to small community deep well systems.

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. Plan would encompass county, as well as the towns of Irvington, Kilmarnock, and White Stone. Plan would emphasize cost savings of using a coordinated, regional approach to address future water supply.

V. The 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, it is strongly recommended that a parcel specific inventory 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, water samples will be taken to see if these shallow wells are contaminated by fecal coliform, nitrates, or some other foreign matter. After the well sample results are determined, areas with large numbers of contaminated wells will be targeted for local water system improvements.

If there are existing clusters of contaminated wells it is recommended that outside funds again be pursued for improvements to these wells. Specifically, if there are enough affected shallow wells in an area, the possibility of drilling a shared artesian well should be explored. After the well is in place houses which were previously on shallow wells should be hooked up to the new deep well. Abandoned shallow wells would then be capped off to prevent them from becoming new sources of groundwater contamination.

It is further recommended that as these new community systems are established, care be taken to keep the total number of hook-ups to each system to a maximum of 10. The reason is that at 15 hook-ups a well becomes an official public supply well which must be monitored and regulated by the State Department of Environmental Quality (DEQ). Public Supply wells must be regularly tested with samples submitted to DEQ. The result is that the well requires careful monitoring, and costs more money to operate due to required sampling. Keeping the number of hook-ups below 10 will keep the new well from becoming designated public supply system, while still leaving a small number of hook-ups available for future development.

Furthermore, it is recommended that a blanket well user agreement be established for users wanting to switch to the new well. This agreement will be a legally binding document which each homeowner signs on to. The agreement will assure that each homeowner is fully responsible for their fair share of maintenance or repair costs for the new well system. This will hopefully obstruct any future disagreements over who is financially responsible for any well maintenance or repairs.

2. Abandoned Wells

As part of the effort to control threats to the county's groundwater supply, it is recommended that the county 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 county-wide abandoned well-capping project.

The abandoned well-capping project would utilize available outside funding offered for protection of groundwater supplies. The county would 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 ground water resources it is recommended that Lancaster County establish a semi-annual Household Hazardous Waste Collection Day. This event could be held at the existing solid waste refuse sites. To sponsor such an event the County would have to hire a certified waste disposal contractor who would have proper authorization to handle and dispose of this type of waste. The event would be widely marketed to the public, and on this particular day Lancaster County residents would be allowed to come and properly dispose of household hazardous waste. This type of event is offered by other localities and provides an alternative disposal option for residents with this type of waste.

4. Ground Water Management District

As a way to gain influence over the protection of ground water resources found outside the County's boundaries, it is recommended that Lancaster County support any future proposals in the region for the creation of a State Ground Water Management District. Ground Water Management Districts are found in other areas of the state such as Hampton Roads and the City of Richmond. However, there is presently no such District to coordinate management and protection of ground water resources in the Middle Peninsula and the Northern Neck. Participation in a Ground Water Management District would enable Lancaster County to expand its ability to protect the supply and quality of ground water resources.

5. Drilling Test Wells

To expand existing knowledge of the ground water resources of Lancaster County and the Northern Neck, it is proposed that the County endorse previous 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, it is recommended that a monitoring well 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 assure protection of less affected supplies located nearby in the more densely populated areas in and around Kilmarnock.

6. Regional Water System Plan

To prepare for the coordination and efficient use of the future water supply in Lancaster County, it is recommended that the County support the preparation of a regional water system plan. The original proposal for such a plan was made by the State Water Control Board in the 1988 Rappahannock Water Supply Plan. The goal was to develop a plan which would encompass the County as well as the Towns of Irvington, Kilmarnock, and White Stone. The plan would emphasize the cost savings of using a coordinated, regional approach to address the future water supply needs, and water quality problems of Lancaster County. This plan could also provide the opportunity to explore possible water impoundment sites for future potable surface water supplies.

B. Surface Water

1. Septic System Inventory

As part of the effort to assure continued protection of Lancaster County's Surface and Ground Water Resources, it is proposed that the County inventory and map existing septic systems in the County. This effort would help to pinpoint high concentrations of septic systems in the County, which could act cumulatively to negatively impact the quality of Lancaster's surface and ground water supplies. Information obtained from this inventory would 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 waste water treatment works.

2. Identify Possible Impoundment Areas

This recommendation can be carried out in conjunction with the proposal to support creation of a Regional Water System Plan. (See #6 in the Ground Water Recommendations)

3. Continue Present Enforcement Levels

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

GLOSSARY OF TERMS

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

Water-Resources Investigations Report 92-4175, "Quality of Ground Water 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. The 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 ground water 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.

Cited Sources

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Management Program for Control of Potential Sources of Contamination Wellhead Protection Areas; Lancaster, Lively, and Irvington Public Water Supply Systems, County of Lancaster, Virginia. Acer Engineers & Consultants, Inc.; Hagerstown, MD: October, 1994.

1993 Distribution of Submerged Aquatic Vegetation in the Chesapeake Bay. Virginia Institute of Marine Science, School of Marine Science, The College of William and Mary; Williamsburg, VA: December, 1994.

Rappahannock Water Supply Plan. **(Planning Bulletin 338)** Commonwealth of Virginia, State Water Control Board; Richmond, VA: March, 1988.

Selected Statistics. United States Department of Agriculture, Bureau of the Census; Suitland, MD: 1990.

U.S. Environmental Protection Agency, 1990a, Maximum contaminant levels (subpart B of part 141, National primary drinking water regulations): U.S. Code of Federal Regulations, Title 40, Parts 100 to 149, revised as of July 1, 1990, p. 559-563.

U.S. Environmental Protection Agency, 1990a, Maximum contaminant level goals (subpart F of part 141, National primary drinking water regulations): U.S. Code of Federal Regulations, Title 40, Parts 100 to 149, revised as of July 1, 1990, p. 620-621.

U.S. Environmental Protection Agency, 1990a, Secondary maximum contaminant level goals (section 143.3 of part 143, National secondary drinking water regulations): U.S. Code of Federal Regulations, Title 40, Parts 100 to 149, revised as of July 1, 1990, p. 674.

U.S. Geological Survey Professional Paper 1404-C. **(Professional Paper 1404-C)** "Hydrogeologic Framework of the Virginia Coastal Plain". Meng, Andrew A. III, and Harsh, John F.; United States Government Printing Office, Washington: 1988.

U.S. Geological Survey Professional Paper 1404-F. **(Professional Paper 1404-F)** "Conceptualization and Analysis of Ground-Water Flow System in the Coastal Plain of Virginia and Adjacent Parts of Maryland and North Carolina". Harsh, John F., and Laczniak, Randell, J.; United States Government Printing Office, Washington: 1990.

Virginia Nonpoint Source Pollution Watershed Assessment Report. Virginia Department of Conservation and Recreation; Richmond, VA: March, 1993.

Virginia Water Quality Assessment for 1994: 305(b) Report to EPA and Congress **(Information Bulletin #597)**. Virginia Department of Environmental Quality; Richmond: April, 1994.

Water Quality Management Plan - Planning District 17. Northern Neck Planning District Commission and Deward M. Martin and Associates, Inc.; Callao, VA: 1973.

Water Resources Data - Virginia, Water Year 1993: Volume 1. Surface-Water Discharge and Surface-Water Quality Records. United States Geological Survey Water-Data Report VA-93-1; Prepared in cooperation with the Virginia Department of Environmental Quality and with other agencies.

Water Resources Data - Virginia, Water Year 1993: Volume 2. Ground -Water Level and Ground-Water Quality Records. United States Geological Survey Water-Data Report VA-93-2; Prepared in cooperation with the Virginia Department of Environmental Quality and with other agencies.

Water-Resources Investigations Report 92-4175. **(WRI 92-4175)** "Quality of Ground Water 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.

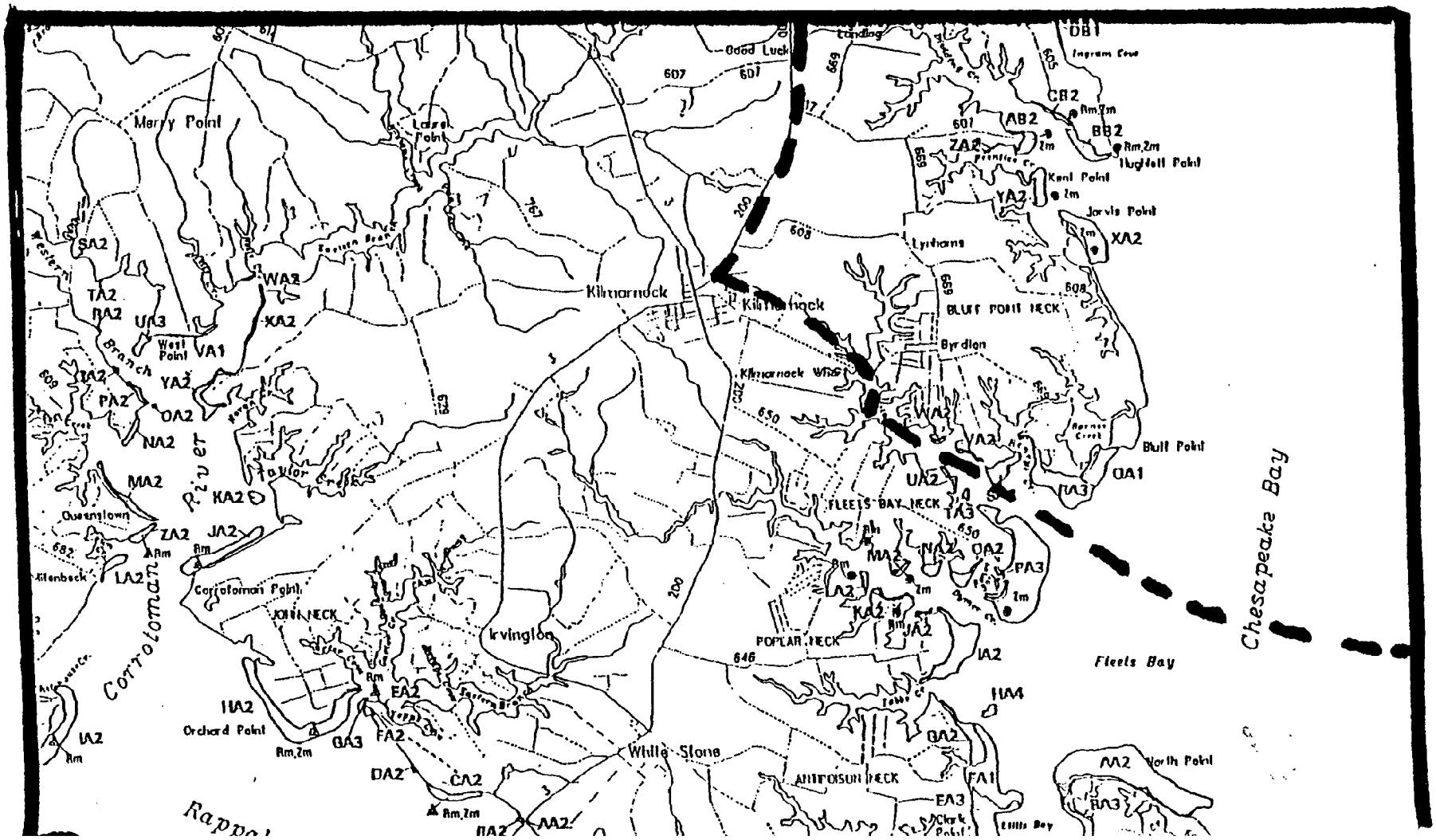
Water Quality Management Plan - Planning District 17. Northern Neck Planning District Commission and Deward M. Martin and Associates, Inc.; Callao, VA: 1973.

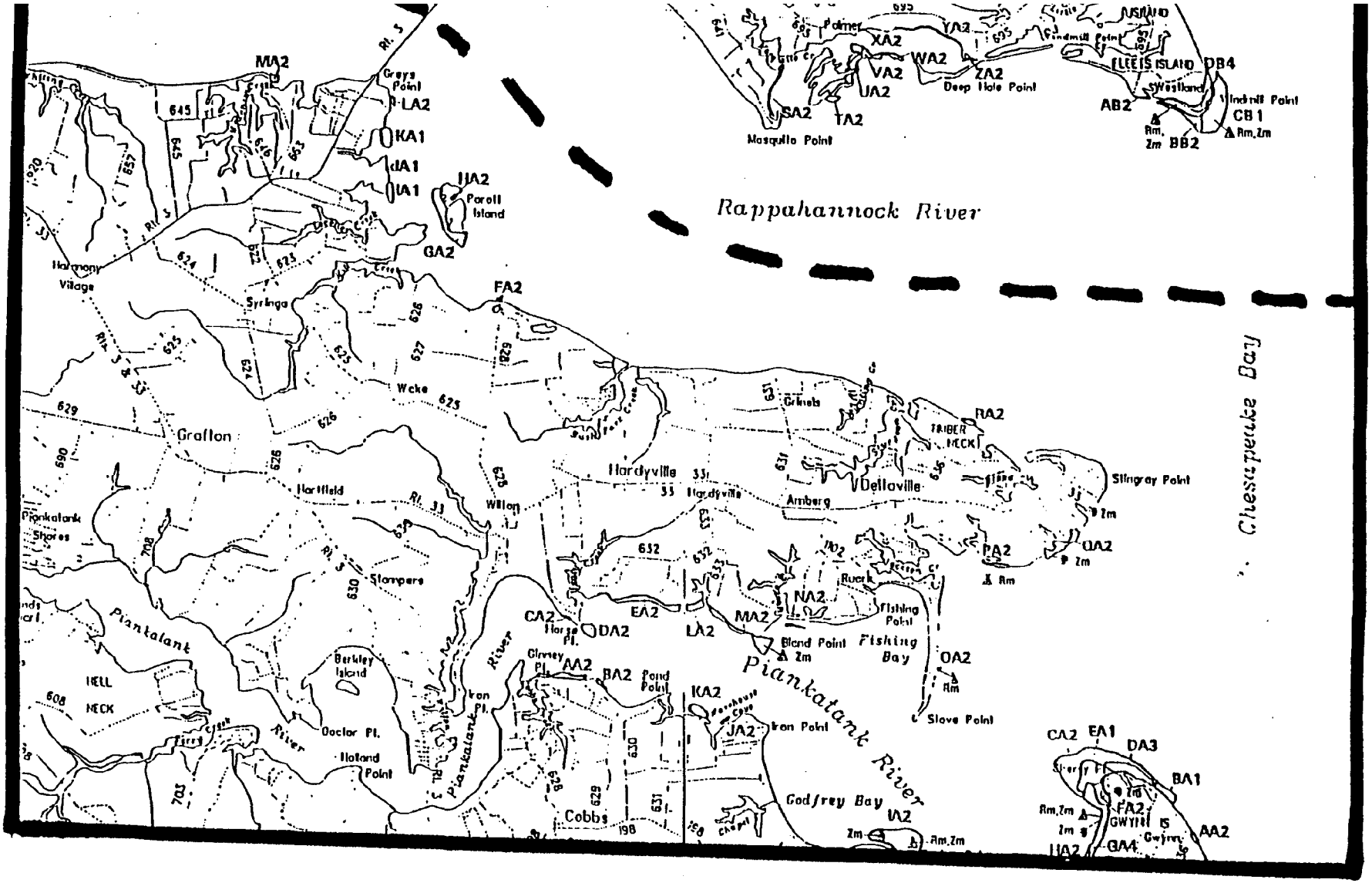
APPENDIX

Virginia Department of Health
Shellfish Condemnation Areas in Lancaster County

1. Dymer Creek
2. Carter Creek
3. Rappahannock River (at Windmill Point Marina)
4. Indian Creek
5. Eastern Branch, Corrotoman River
6. Rappahannock River/Greenvale Creek
7. Rappahannock River/Paynes Creek
8. Rappahannock River/Beach Creek
9. Rappahannock River/Wyatt Creek
10. Lancaster and Mulberry Creeks
11. Deep Creek
12. Western Branch, Corrotoman River
13. Tabbs Creek
14. Oyster Creek (Rescinded, December 1994)
15. Corrotoman River/Whitehouse Creek
16. Antipoision Creek

Submerged Aquatic Vegetation, 1993
Irvington, Fleets Bay, Wilton and Deltaville, VA Quadrangles





Scale (meters): 0 1000 2000 3000

Sources: Virginia Institute of Marine Science
U.S. Geological Survey

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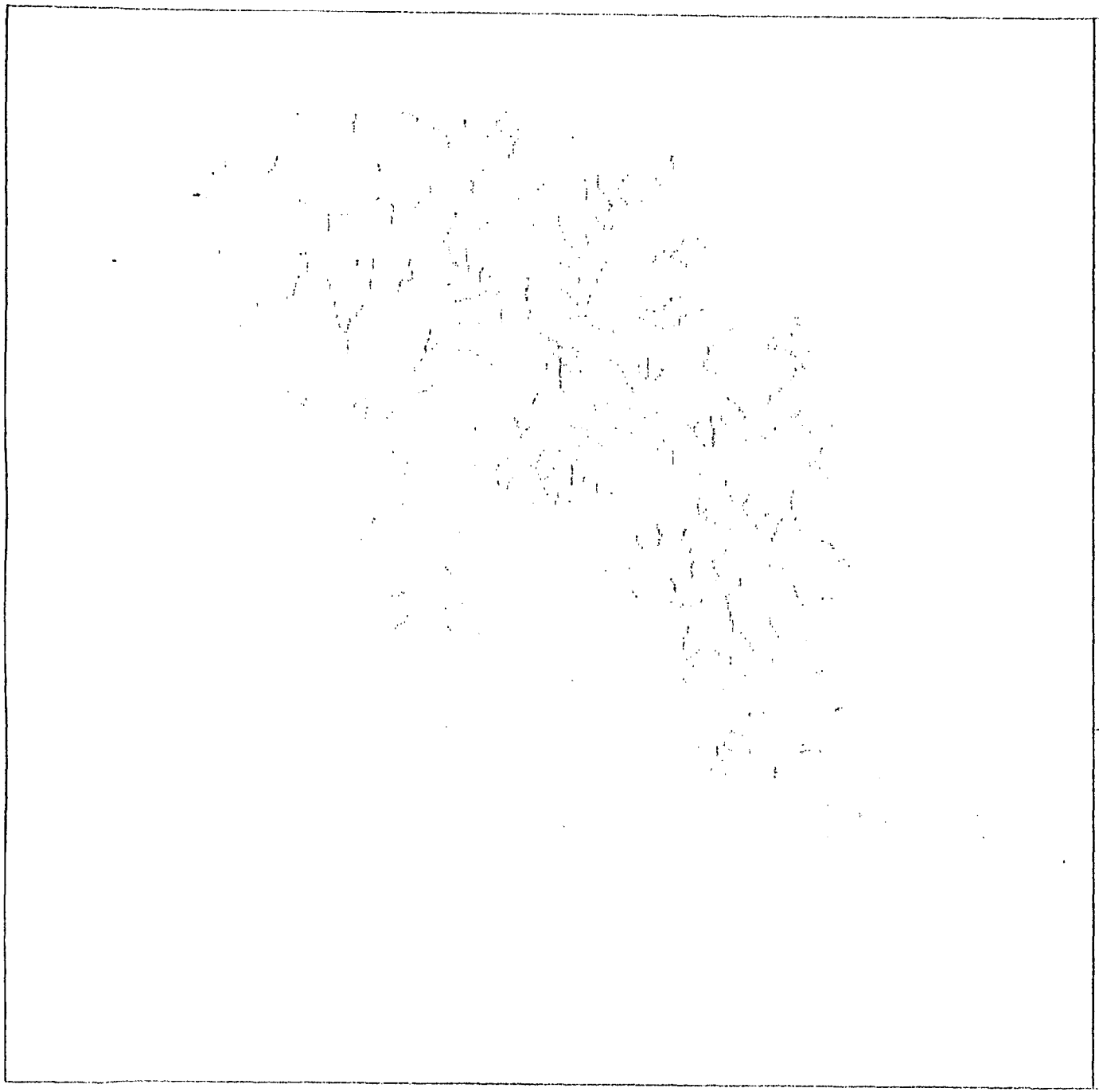

LEGEND

- Deepwater
- Non-Tidal
- Tidal
- Upland

Tidal and Non-Tidal Wetlands

LANCASTER COUNTY, VA

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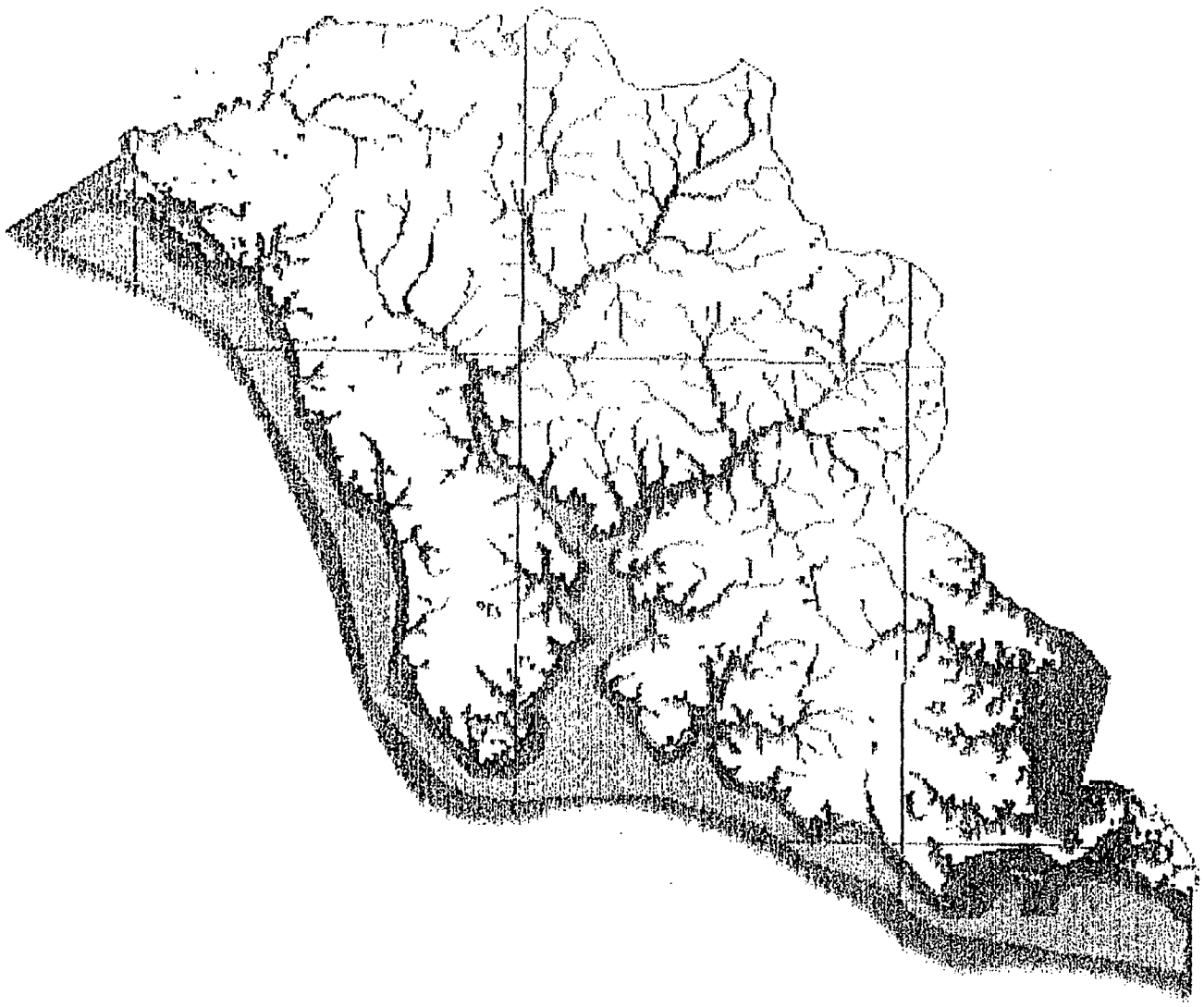
Created By:
Lancaster County
Planning & Land Use
Office

April, 1995



LEGEND

Land

Water

Shellfish Beds

Shellfish Grounds

LANCASTER COUNTY, VA
April, 1995

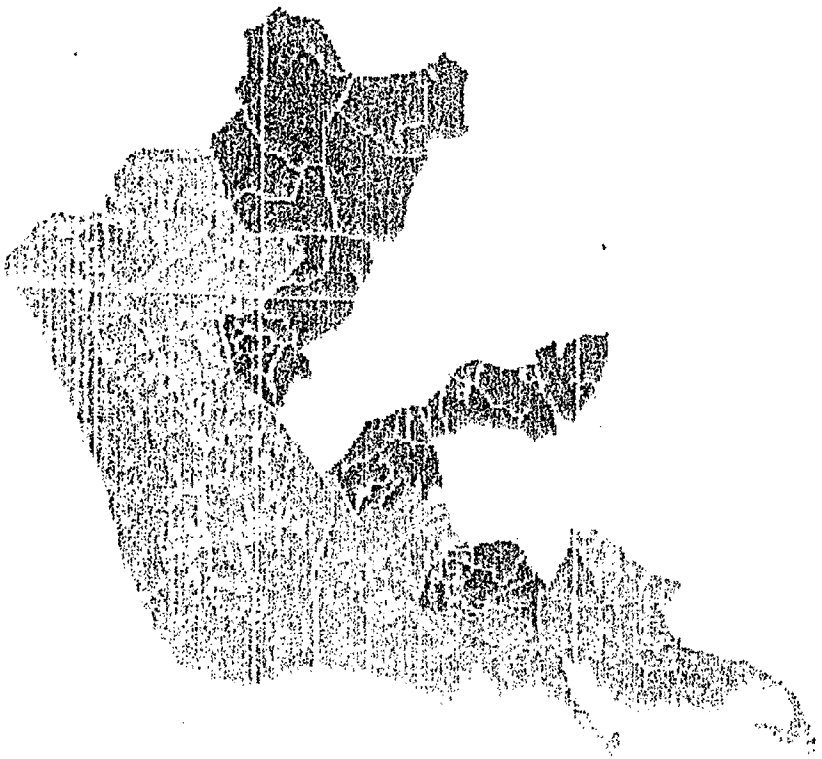
N

Created By:
Lancaster County
Planning & Land Use
Office

Source: Lancaster Co.
Shoreline Mgmt. Study
Preliminary Results, 1988

Permitted Dischargers to State Waters
Lancaster County, Virginia
(DEQ VAPDES Permits, VPA Permits, & Special Consent Orders)

Permit I.D. #	Permitted Discharger	Contact	Telephone	Address	City	State	Zip	Latitude	Longitu
VA0002828	Oyster World, Inc.	W.M. Cornwell	(804) 438-5470	P.O. Box 732	Weems	VA	22576	373915N	762625
VA0003735	Abbott Brothers, Inc.	Gerald L. Abbott	(804) 438-5274	Rt. 1, Box 242	Weems	VA	22576	373937N	762635
VA0003786	Barrack & Reynolds Seafood, Inc.	W.M. Reynolds	(804) 438-5730	P.O. Box 38	Irvington	VA	22480	373939N	762559
VA0004481	E.J. Conrad & Sons Seafood, Inc.	J.M. Conrad	(804) 462-7400	Rt. 3, Box 971	Lancaster	VA	22503	374238N	763239
VA0020788	Town of Kilmarnock STP	E.L. Faison	(804) 435-1552	P.O. Box 1357	Kilmarnock	VA	22482	374231N	762138
VA0029343	The Tides Golf Lodge, Inc.	Mac Brockelbank	(804) 438-6000	P.O. Box 309	Irvington	VA	22480	374010N	762541
VA0029351	The Tides Inn, Inc.	Tom Saunders	(804) 438-5000	P.O. Box 480	Irvington	VA	22480	373953N	762557
VA0060569	Windmill Point Marine Resort	Ronald Rickard	(804) 435-1166	P.O. Box 368, VSH 695	White Stone	VA	22578	373703N	761724
VA0071579	Bay Seafood and Bait Co., Inc.	Meredith Robbins	(804) 435-3349	Rt. 2, Box 105	White Stone	VA	22578	373740N	762100
VA0071595	Dymer Creek Seafood	W.R. Davenport, Jr.	(804) 435-2173	Rt. 1, Box 3025	White Stone	VA	22578	374000N	762109
VASEA1002	Stingray Point Oyster Co., Inc.	Joseph S. Jenkins	(804) 438-5237	P.O. Box 504	Irvington	VA	22480	373930N	762607
VASEA1009	J. Henry Talbott Seafood	J. Henry Talbott	(804) 438-5227	162 Hatton Avenue	Kilmarnock	VA	22482	373930N	762615
VASEA1011	Callis Seafood, Inc.	Terry Hayden	(804) 462-7634	Rt. 2, Box 1034	Lancaster	VA	22503	374030N	762911
VASEA1015	RCV Seafood Corporation	Weston F. Conley, Jr.	(804) 462-5101	P.O. Box 85	Morattico	VA	22523	374712N	763712
VASEA1019	Cap'n Tom's Seafood	Thomas E. Stevens	(804) 462-5507	Rt. 2, Box 539	Lancaster	VA	22503	373921N	763043
VASEA1022	W. Ellery Kellum, Inc.	Joseph A. Kellum	(804) 438-5476	P.O. Box 230	Weems	VA	22576	373935N	762633
VASEA1024	Julia's Seafood	Lewis D. George	(804) 435-3764	P.O. Box 832	White Stone	VA	22578	373800N	761830
VASEA1025	Doggett Brothers, Inc.	Morris C. Doggett	(804) 462-7970	P.O. Box 66	Mollusk	VA	22517	374314N	763240
VASEA1028	Irvington Packing Co., Inc.	Harmon C. Treakle	(804) 435-1600	P.O. Box 86	White Stone	VA	22578	373906N	762529
VASEA1030	T/A Pride of VA Seafood Products WSP	Stanley O'Bier	(804) 435-2063	Rt. 1, Box 4955	White Stone	VA	22578	373753N	762054
VASEA1034	W.M. Cornwell Seafood, Inc.#2	W.M. Cornwell	(804) 438-6281	P.O. Box 16	Weems	VA	22576	373925N	762618
VASEA1036	W/R. Pittman & Sons, Inc.	Edward R. Pittman	(804) 462-7955	Rt. 3, Box 332	Lancaster	VA	22503	374620N	763453
VASEA1044	Chesapeake Fish and Oyster Co.	Marvin E. George	(804) 435-2958	P.O. Box 332	White Stone	VA	22578	373737N	762059
VASEA1047	W.F. Morgan & Sons, Inc	William C. Morgan	(804) 438-5154	Rt. 1, Box 241	Weems	VA	22576	373926N	762615
VPA01401	Rappahannock Westminster-Cant.	Daniel Oetzel		10 Lancaster Drive	Irvington	VA	22480		



LEGEND

40 – 49.9%
60 – 69.9%
70 – 79.9%
20 – 29.9%
90 – 100%
Water

Percent of Housing Units in Block Group with Septic Systems

LANCASTER COUNTY

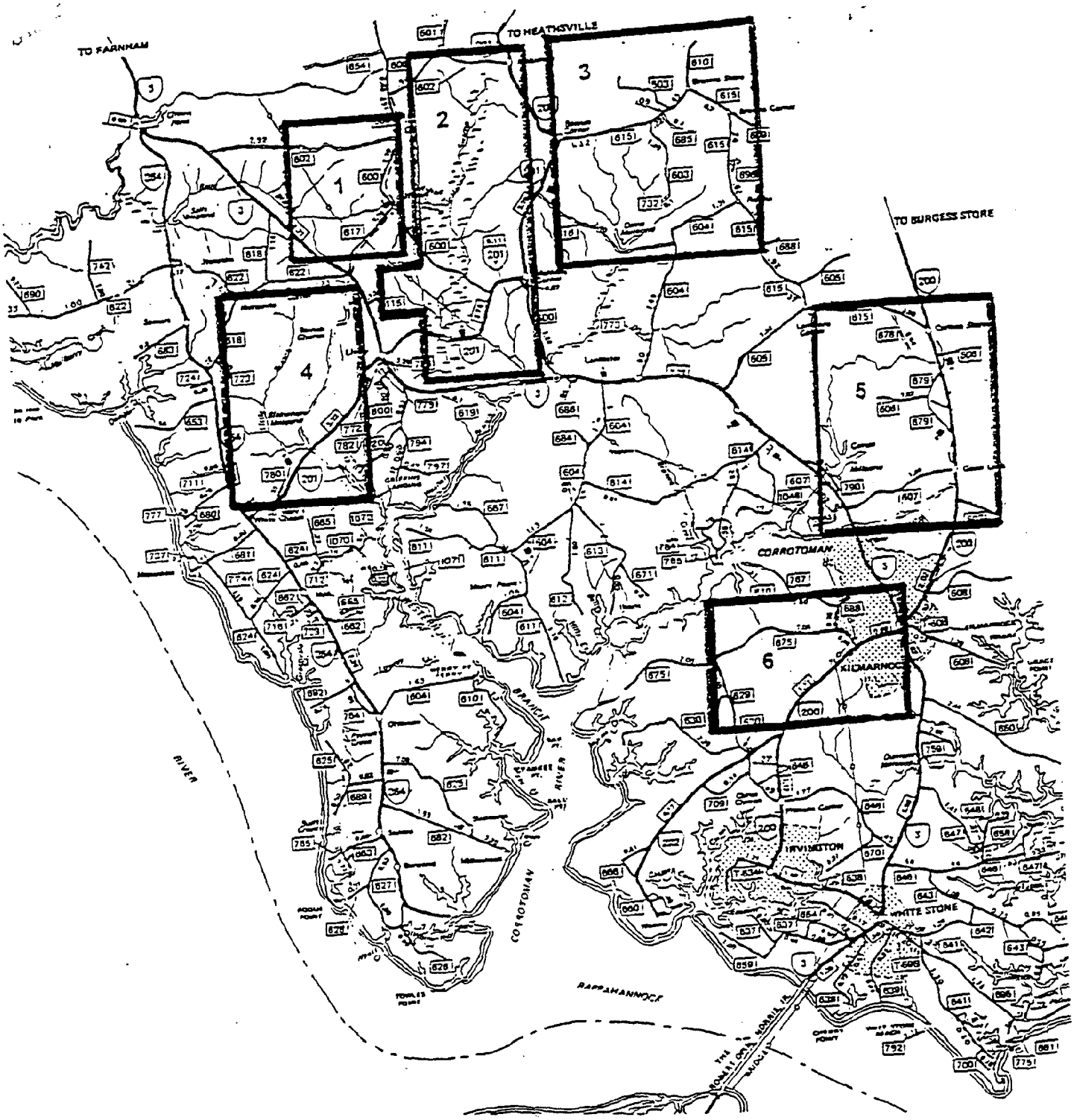
March, 1995

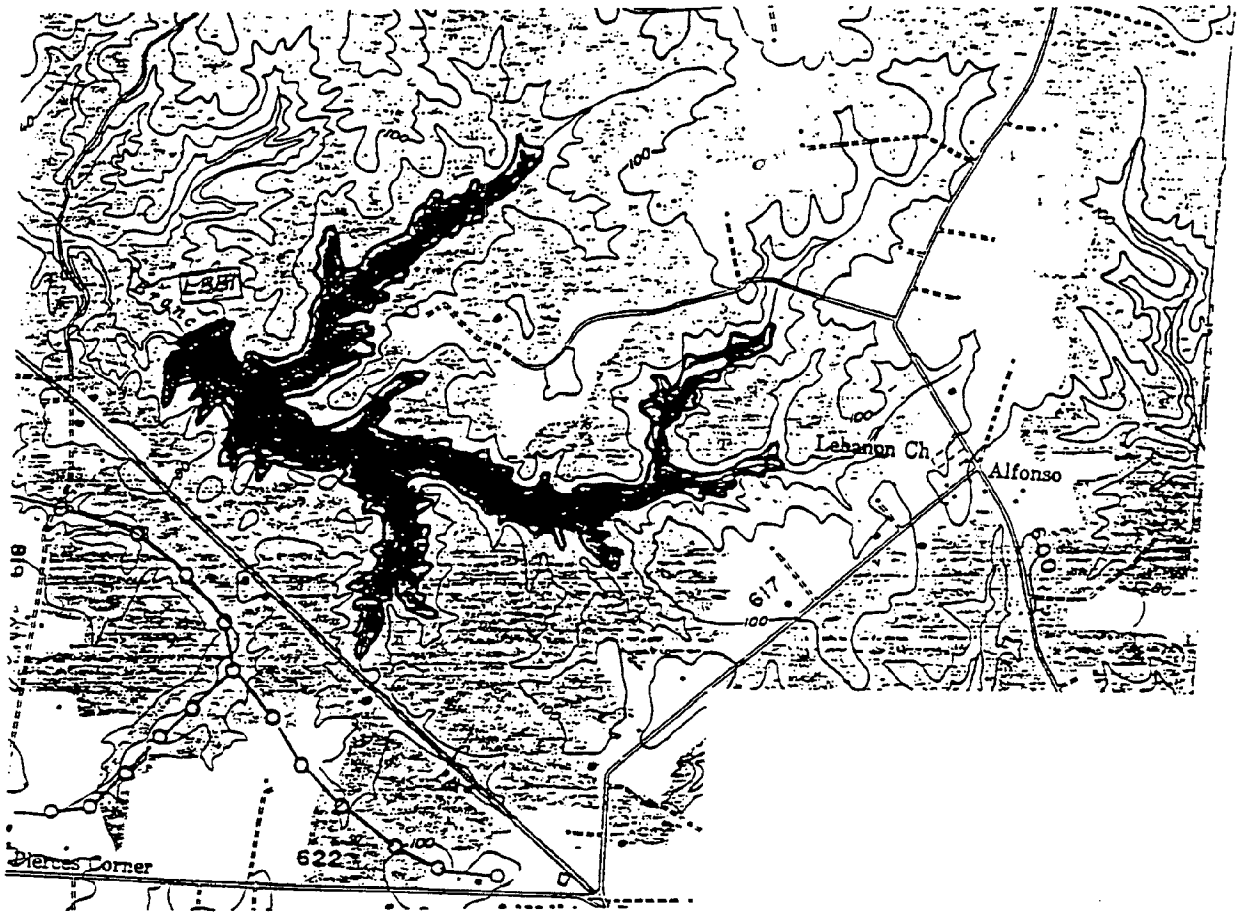
N

Prepared By:
Lancaster County
Planning & Land Use
Office

Source: 1990 U.S. Census
Block Group Data

Insets of Proposed Reservoir Locations





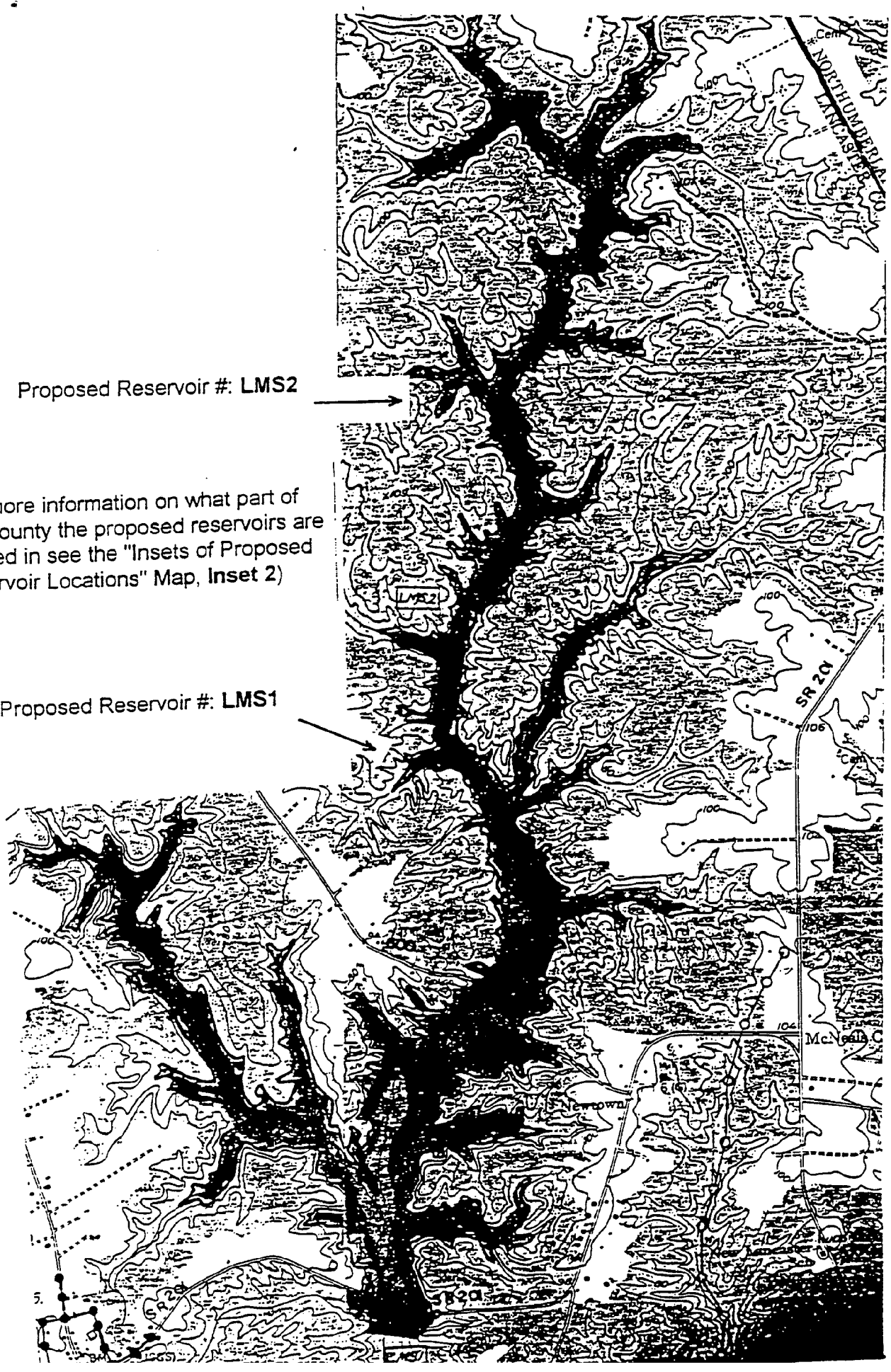
Proposed Reservoir #: **LBB1**

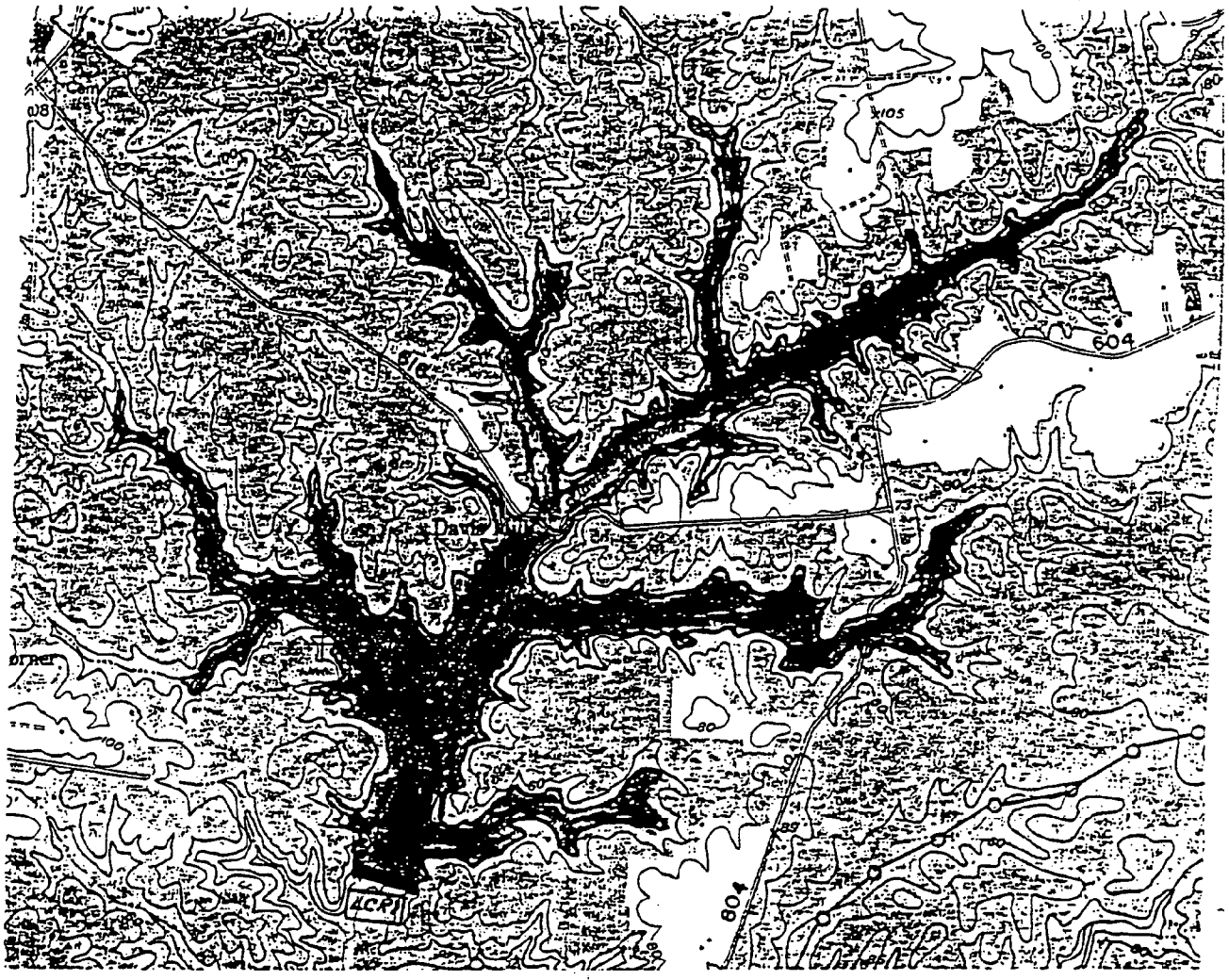
(For more information on what part of the County the proposed reservoir is located in see the "Insets of Proposed Reservoir Locations" Map, **Inset 1**)

Proposed Reservoir #: **LMS2**

(For more information on what part of the County the proposed reservoirs are located in see the "Insets of Proposed Reservoir Locations" Map, **Inset 2**)

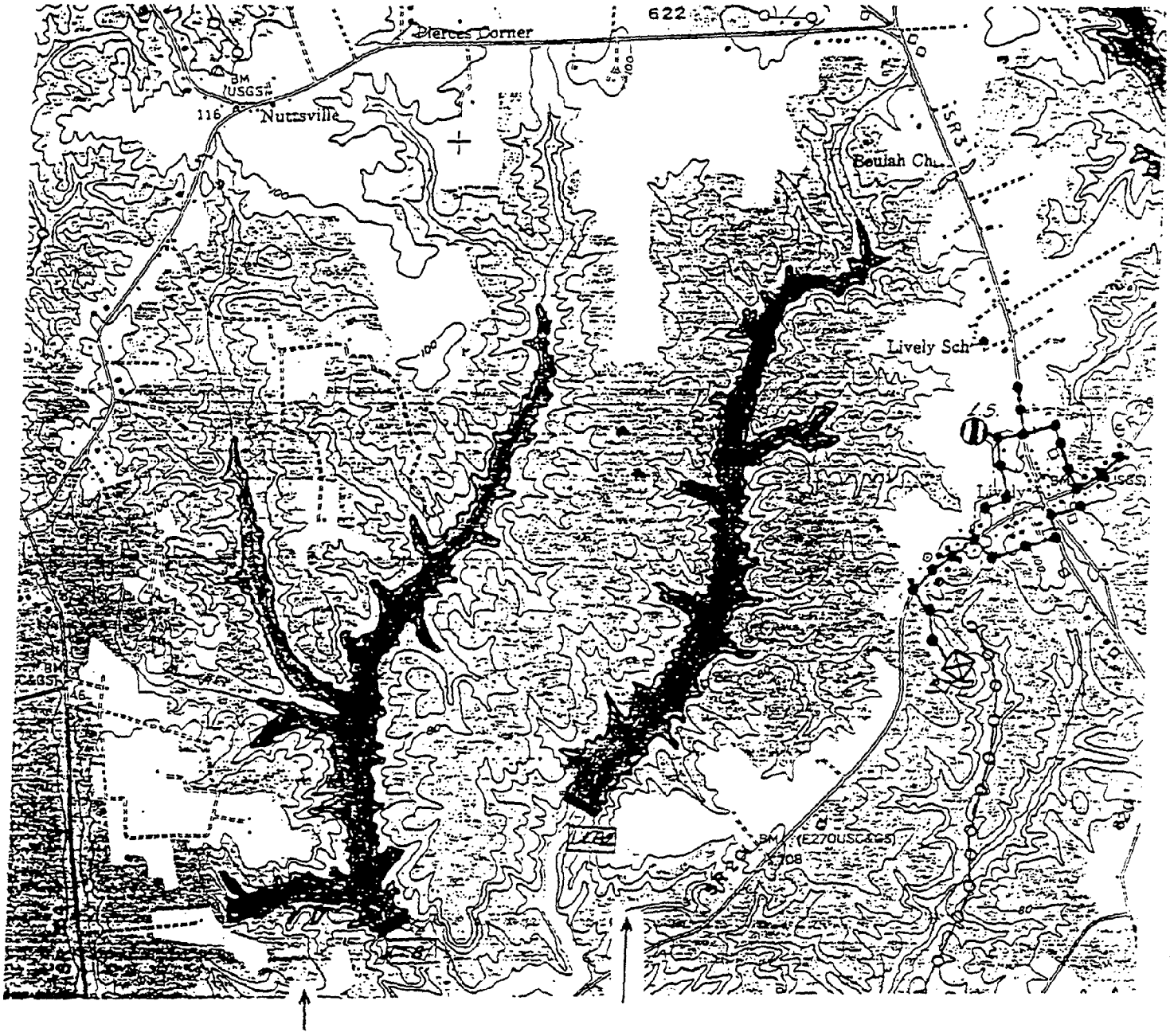
Proposed Reservoir #: **LMS1**





Proposed Reservoir #: **LCR1**

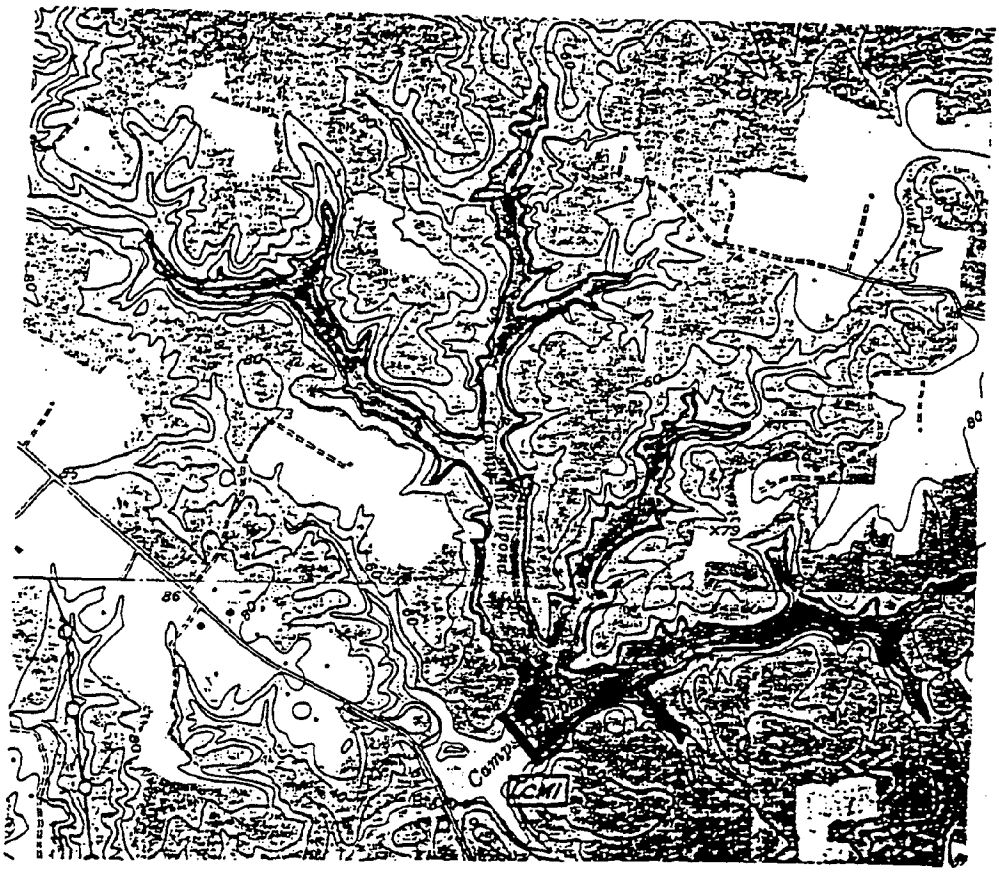
(For more information on what part of the County the proposed reservoir is located in see the "Insets of Proposed Reservoir Locations" Map, **Inset 3**)



Proposed Reservoir #: **LLB1**

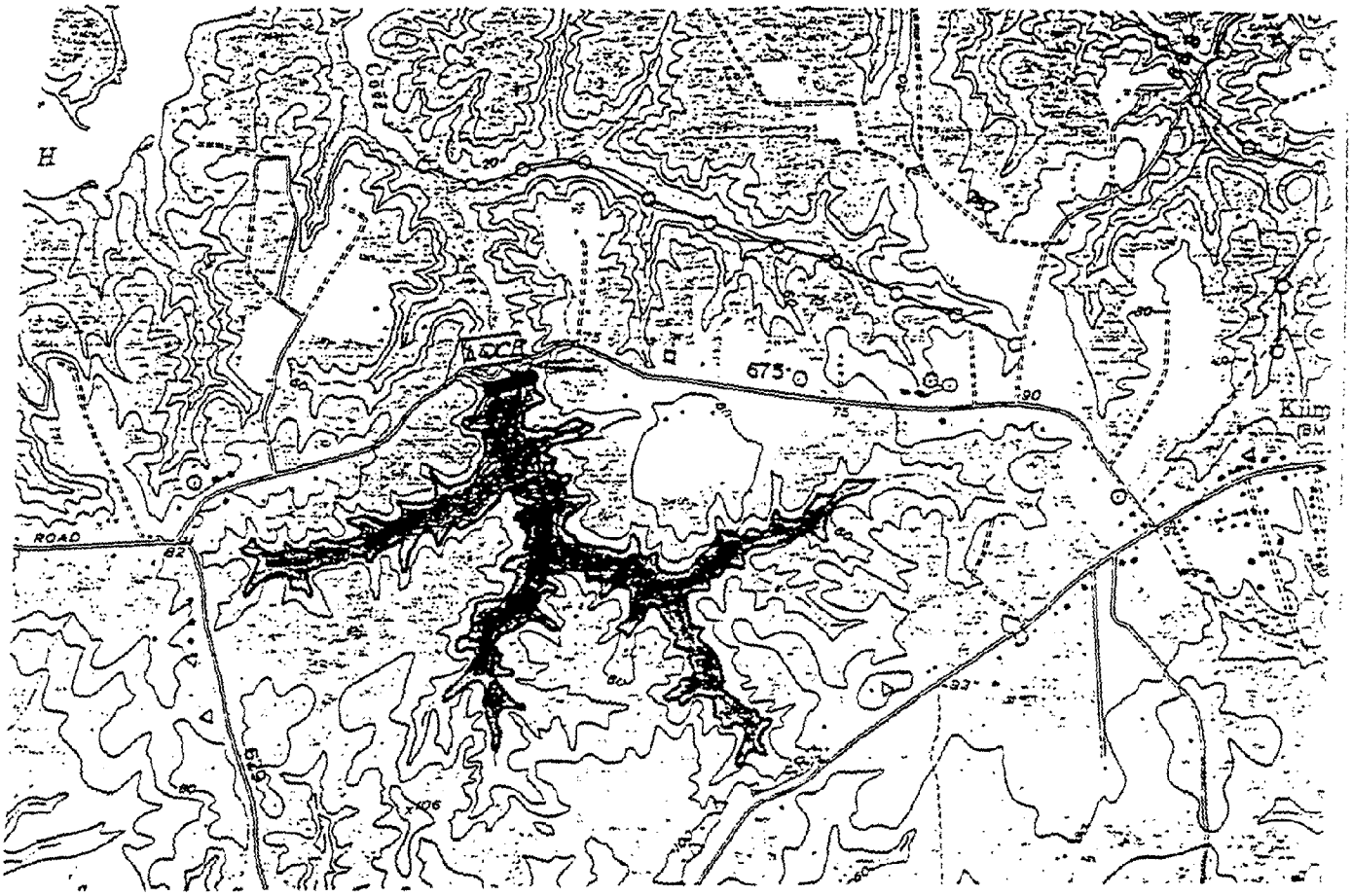
Proposed Reservoir #: **LLB2**

(For more information on what part of the County the proposed reservoir is located in see the "Insets of Proposed Reservoir Locations" Map, **Inset 4**)



Proposed Reservoir #: **LCM1**

(For more information on what part of the County the proposed reservoir is located in see the "Insets of Proposed Reservoir Locations" Map, **Inset 5**)



Proposed Reservoir #: **LOC1**

(For more information on what part of the County the proposed reservoir is located in see the "Insets of Proposed Reservoir Locations" Map, **Inset 6**)

LANCASTER COUNTY

374248076230101. Local number, 58K 1 SOW 015.

LOCATION.--Lat 37°42'48", long 76°23'01", Hydrologic Unit 02080104, at Lancaster County High School in Kilmarnock. Owner: Lancaster County Public Schools.

AQUIFER.--Brightseat-upper Potomac aquifer of Cretaceous-Paleocene age.

WELL CHARACTERISTICS.--Drilled unused water well, diameter 4 in. to 163 ft, diameter 2 in. from 163 to 716 ft, depth 716 ft, screened 706 to 716 ft.

INSTRUMENTATION.--Bimonthly measurement with chalked tape by Virginia Department of Environmental Quality - Water Division personnel. Sept. 30, 1976, to Oct. 1, 1985, occasional measurement with chalked tape. Prior to Sept. 30, 1976, continuous strip-chart recorder.

DATUM.--Elevation of land-surface datum is 85 ft above mean sea level, from topographic map. Measuring point: Top of casing, at land-surface datum prior to July 29, 1991; 0.75 ft above land-surface datum thereafter.

REMARKS.--Records provided by the Virginia Department of Environmental Quality - Water Division. Water level affected by local pumpage and regional drawdown.

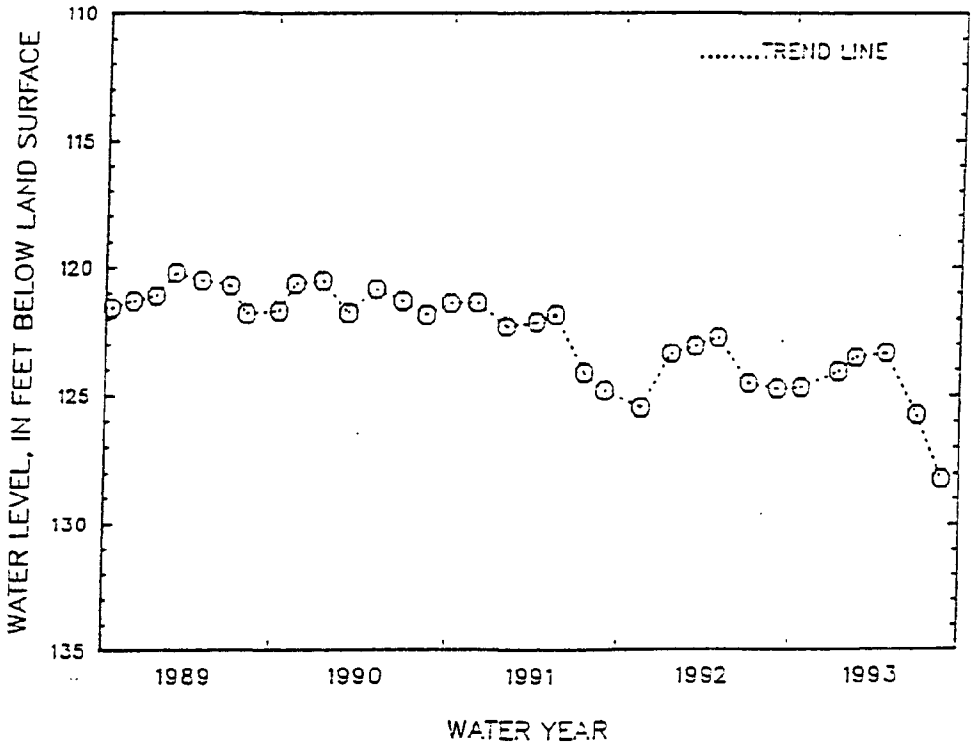
PERIOD OF RECORD.--October 1967 to current year. Unpublished records available prior to October 1985 in files of the Virginia Department of Environmental Quality - Water Division.

EXTREMES FOR PERIOD OF RECORD.--Highest water level recorded, 95.89 ft below land-surface datum, Feb. 20, 1968; lowest measured, 128.23 ft below land-surface datum, Aug. 23, 1993.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1992 TO SEPTEMBER 1993

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
OCT 22	124.70	JAN 11	124.08	FEB 18	123.52	APR 22	123.34	JUN 29	125.75	AUG 23	128.23

WATER YEAR 1993 HIGHEST 123.34 APR 22, 1993 LOWEST 128.23 AUG 23, 1993



LANCASTER COUNTY

374941076254501. Local number, 39L 3.

LOCATION.--Lat 37°49'41", long 76°25'45", Hydrologic Unit 02080104, 100 ft southwest of State Highway 615 at Browns Store and 450 ft southeast of the intersection of State Highways 610 and 615. Owner: Alpha Water Company (Sydnor Hydrodynamics).

AQUIFER.--Brightseat-upper Potomac aquifer of Cretaceous-Paleocene age.

WELL CHARACTERISTICS.--Drilled withdrawal water well, diameter 4 in. to 210 ft, diameter 2 in. from 210 to 802 ft, depth 802 ft, screened 770 to 800 ft.

INSTRUMENTATION.--Occasional measurement with chalked tape by USGS personnel.

DATUM.--Elevation of land-surface datum is 101 ft above mean sea level, from topographic map. Measuring point: Top of 0.5 in. copper nipple, 1.35 ft above land-surface datum. Prior to Feb. 10, 1981, measuring point was top of casing, 0.9 ft above land-surface datum.

REMARKS.--Water level affected by regional drawdown.

PERIOD OF RECORD.--April 1966 to current year. Unpublished records available prior to October 1988 in files of the Geological Survey.

EXTREMES FOR PERIOD OF RECORD.--Highest water level measured, 97.00 ft below land-surface datum, Apr. 26, 1966; lowest measured, 124.27 ft below land-surface datum, Oct. 19, 1992.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1992 TO SEPTEMBER 1993

DATE	WATER LEVEL	DATE	WATER LEVEL
OCT 19	124.27	MAR 18	123.91

WATER YEAR 1993 HIGHEST 123.91 MAR 18, 1993 LOWEST 124.27 OCT 19, 1992

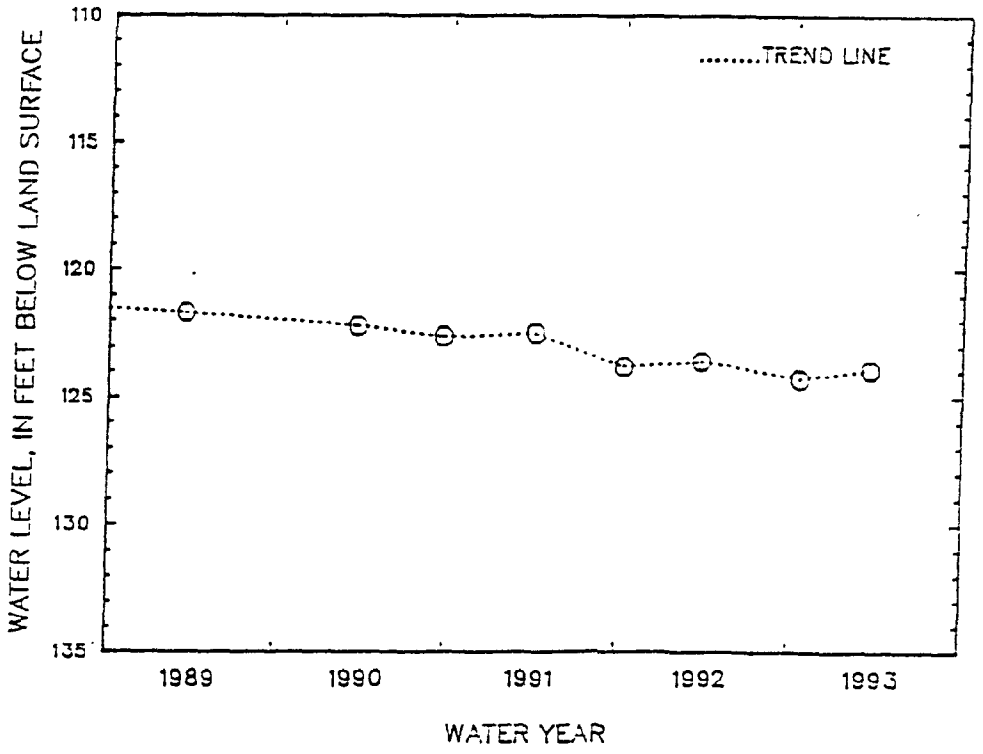


TABLE 5.—*Major withdrawals by aquifer, 1980*

[Mgal/d, million gallons per day; do., ditto. Locations of water users shown in fig. 8]

Water user number	Geographic location	Aquifer	1980 withdrawal (Mgal/d)
020	Franklin	Lower Potomac	10.29
025	West Point	do.	3.79
020	Franklin	Middle Potomac	25.21
023	Williamsburg	do.	1.95
025	West Point	do.	6.57
038	Franklin	do.	1.44
039	Franklin	do.	3.66
045	Tidewater	do.	4.96
048	Tidewater	do.	2.29
068	Henrico County	do.	1.96
071	Alexandria	do.	1.12
016	Smithfield	Brightseat-upper Potomac	1.12
018	Smithfield	do.	1.38
023	Williamsburg	do.	1.33
025	West Point	do.	2.61
028	Urbanna	do.	1.65
045	Tidewater	do.	2.71
054	Williamsburg	do.	1.70
025	West Point	Aquia	.71
434	Southern Maryland	do.	.39
445	Southern Maryland	do.	.21
024	James City	Chickahominy-Piney Point	.35
025	West Point	do.	2.37
309	Edenton	do.	.68
006	Delmarva Peninsula	Yorktown-Eastover	1.55
031	Delmarva Peninsula	do.	.78
300	Elizabeth City	do.	1.30

LANCASTER COUNTY

374142076272701. Local number, 59K 9.

LOCATION.--Lat 37°41'42", long 76°27'27", Hydrologic Unit 02080104, on the south bank of Moran Creek, 1,000 ft northwest of the intersection of State Highway 630 and a private dirt drive, 0.8 mi west of Wesley Church, 3 mi north of Weems, 4 mi west of Kilmarnock and the intersection of State Highways 628 and 630, and near Weems. Owner: Fred Hansen.

AQUIFER.--Brightseat-upper Potomac aquifer of Cretaceous-Paleocene age.

WELL CHARACTERISTICS.--Drilled withdrawal water well, diameter 4 in. to 147 ft, diameter 2 in. from 147 to 585 ft, depth 585 ft, screened 565 to 580 ft.

INSTRUMENTATION.--Occasional measurement with chalked tape by USGS personnel.

DATUM.--Elevation of land-surface datum is 10 ft above mean sea level, from topographic map. Measuring point: Top of casing, 1.2 ft above land-surface datum.

REMARKS.--Water level affected by regional drawdown.

PERIOD OF RECORD.--September 1969 to current year. Unpublished records available prior to October 1988 in files of the Geological Survey.

EXTREMES FOR PERIOD OF RECORD.--Highest water level measured, 40.00 ft below land-surface datum, Sept. 16, 1969; lowest measured, 63.44 ft below land-surface datum, Oct. 10, 1991.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1992 TO SEPTEMBER 1993

	DATE	WATER LEVEL	DATE	WATER LEVEL
	OCT 19	63.00	MAR 16	62.89

WATER YEAR 1993 HIGHEST 62.89 MAR 16, 1993 LOWEST 63.00 OCT 19, 1992