
CHAPTER 8: NATURAL RESOURCES

OVERVIEW

The natural resources of Henrico County contribute to the quality of life enjoyed by its residents. The County recognizes these resources can be protected and enjoyed in conjunction with population growth and even enhance economic development. The existing preserved natural, historic and cultural resources have become attractive recreation facilities and provide amenities that help draw tourists to the County. This chapter provides guidance on incorporating these features into the fabric of the County to sustain a unique sense of place, history, and environmental quality.

The County desires to protect, preserve and conserve its natural resources. To protect these resources the County will provide on-going guidelines and strategies to guard against their degradation and loss. Preservation involves actively saving significant resources, and conservation provides guidance for safekeeping of resources before they are damaged or lost.

Environmental considerations are important in Henrico County land use decisions. The County firmly believes that population growth and economic development do not need to degrade environmental quality. Additionally, economic prosperity does not automatically diminish with development practices incorporating accountability for preservation of natural resources. The County understands continued economic development can be enhanced and supported by its rich natural resources.

CHESAPEAKE BAY PRESERVATION ACT

In July 1988, the Chesapeake Bay Preservation Act (the Act) became law. The Act requires localities to protect the public interest in the Chesapeake Bay, its tributaries and other State waters, by incorporating general water quality protection measures into comprehensive plans, zoning ordinances and subdivision ordinances. In addition, localities are also required to establish programs to (1) define and protect certain lands called Chesapeake Bay Preservation Areas which, if improperly developed, could result in substantial damage to the water quality of the Chesapeake Bay and its tributaries; (2) reduce non-point source pollution to State waters; and (3) promote and restore the high quality of State waters in order to provide for the health, safety and welfare of the present and future residents of the County and the Commonwealth of Virginia.

The *Chesapeake Bay Preservation Area Designation and Management Regulations (9VAC 10-20-10 et seq.)* establishes criteria to identify Chesapeake Bay Preservation Areas, which are composed of Resource Protection Areas (RPAs) and Resource Management Areas (RMAs).

RESOURCE PROTECTION AREAS

Resource Protection Areas (RPAs) are as—"lands adjacent to water bodies with perennial flow that have an intrinsic water quality value due to the ecological and biological processes they perform or are sensitive to impacts which may cause significant degradation to the quality of state waters."

RPAs include the following:

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1. Tidal wetlands;
2. Non-tidal wetlands connected by surface flow and contiguous to tidal wetlands or tributary streams;
3. Tidal shores;
4. Other lands which the Board of Supervisors may designate by ordinance; and
5. A 100-foot buffer located contiguous to and landward of the components listed in items 1-4 above, and along both sides of any tributary stream.

RESOURCE MANAGEMENT AREAS

Resource Management Areas (RMAs) are defined as “land types, which if improperly used or developed, have a potential for causing significant water quality degradation or for diminishing the functional value of the Resource Protection Areas.”

RMAs include the following:

1. All areas specifically designated as RMAs by ordinance approved by the Board of Supervisors because of their potential effect on water quality;
2. All of the following land types which are directly contiguous to RPAs:
 - a. Highly erodible soils, including steep slopes;
 - b. Highly permeable soils;
 - c. Non-tidal wetlands not included in the RPAs;
3. Base flood hazard areas (100-year floodplains); and
4. Where the land contiguous to the RPA is not a RMA as defined above, the 100-foot areas contiguous to the RPA.

A composite map showing the Chesapeake Bay Resource Areas is included in this chapter. The County’s Geographic Information System (GIS) contains data on the location of floodplains, soils with septic limitations, highly erodible/highly permeable soils (including steep slopes) and hydric soils. The Department of Public Works may be contacted for further information.

To support this initiative, the **Future Land Use Plan Map** includes areas identified as Environmental Protection Areas which are encouraged to remain in their natural state.

For many years now, the County has adhered to the Act and has amended past plans and the County’s Code to incorporate the Chesapeake Bay Preservation Area program into the Zoning Ordinance. Through this program, approximately 25 percent of the County was designated as Chesapeake Bay Preservation Area. The program consists of a map delineating these areas and amendments to the zoning, subdivision, landscape, controlled density, and erosion and sediment control ordinances as the means of implementing the performance criteria. The 2000-scale **Chesapeake Bay Resource Areas Map** (RPAs and RMAs) and individual maps showing the approximate location of 100-year flood plains, highly erodible/highly permeable soils (including steep slopes), and hydric soils are on file in the Department of Public Works.



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PHYSIOGRAPHIC PROVINCES

Henrico County is located in two physiographic provinces: the Middle Atlantic Coastal Plain to the east and the Southern Appalachian Piedmont to the west. These two provinces form distinct natural features in terms of geology, topography, soils, etc. (See the **Physiographic Provinces Map**.) The fall line between the two provinces generally follows the CSX Transportation System right-of-way (formerly, the RF&P Railroad), located approximately two miles west of U.S. Route 1, from the County's northern boundary south to Hungary Road. From that point, the fall line continues in a southerly direction to cross the County line. The fall line marks the head of navigation on major streams; rapids are upstream and tidal waters downstream.



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CHESAPEAKE BAY RESOURCE AREAS MAP



PHYSIOGRAPHIC PROVINCES MAP

PHYSICAL CONSTRAINTS TO DEVELOPMENT

FLOOD-PRONE AREAS

Flood-prone areas (or floodplains), designated by the County as Chesapeake Bay Resource Management Areas, are lands that would be inundated by flood water as a result of a storm event of a 100-year return interval (that is, a flood with a one percent probability of occurring within any given year). These areas are found mainly along shorelines, wetlands, and low-lying areas adjacent to tributary and intermittent streams. The areas shown as flood prone areas on the **Physical Constraints to Development Map** are from the GIS layer on file with the County. This is an imprecise source and should only be used as a general guide to their location.

The floodplain acts as a natural reservoir for excess water during periods of flooding. Holding excess water during floods reduces the danger to life and property. Floodplains also provide areas for recreation, and they usually contain substantial groundwater.

Flood activity has a potentially detrimental effect on water quality. Soil erosion resulting from a flood event is a source of pollution. If floodplains are developed and the natural vegetative cover removed, the natural flood controls are altered or eliminated with the possible consequence of increasing the level of soil erosion.

Two primary flood-prone areas in Henrico are associated with the Chickahominy and James Rivers. The Chickahominy River originates in the Eastern Piedmont region where it flows from a relatively narrow, defined valley to a point near U.S. Highway 1. From this point eastward, the channel spreads out into a wide, flat, marshy area which can be described as a flood basin. Because of this terrain, even a small rise in elevation of the water will cause the river to overflow its banks for hundreds of feet on either side. With regard to the James River, maximum accumulation of floodwaters normally occurs two to three days after the cessation of heavy rainfall over the basin. (See **Physical Constraints to Development Map**.)

TIDAL/NON-TIDAL WETLANDS

Wetlands are areas of continually wet soils, where water is normally found on, or slightly below, the surface of the land. They are transition areas between drier uplands and the deep waters of streams, rivers, lakes and bays. Wetlands can be either vegetated or non-vegetated.

The ecological value of wetlands has become better understood over the years. Wetland loss can be a major contributor to water quality damage. Wetlands help purify water by filtering out nutrients, wastes, and sediment from runoff. They also absorb the energy of fast moving erosive water (as in a flood event), and help to minimize coastal erosion from wave action. Wetlands also serve as reservoirs from which groundwater supplies can be replenished during dry seasons.

Two extensive wetland features in Henrico are the White Oak Swamp, located in the east end of the County, and the wetlands contiguous to the Chickahominy River. The source of the wetland mapping information is the National Wetland Inventory. This information should be used as a general guide and a study should be conducted for specific parcels being considered for development to determine the true extent of any potential wetlands. (See **Physical Constraints to Development Map**.)

TOPOGRAPHY/STEEP SLOPES

Elevations in the County range from sea level along the lower James River to about 340 feet above sea level on the highest ridges in the western section of the County. Slopes in the County may be categorized in the following four groups:

- **Very steep (greater than 25 percent)** – If disturbed by construction or forest removal, widespread failure of the slope is highly probable. These slopes may be better used as natural areas, trails and observation points. Land in this category is the least suitable for development.
- **Steep (16-25 percent)** – If plant cover is removed, these slopes are highly susceptible to erosion and gully formation. Special design consideration is required for buildings on slopes greater than 15 percent. Development on these areas is suitable with restrictions to manage erosion.
- **Moderate (5 to 15 percent)** – These slopes will support residential and agricultural land uses; if misused, they are susceptible to serious erosion. These areas are moderately suitable for development.
- **Gentle (less than 5 percent)** – These slopes will sustain the most intensive use with the least erosion management needed. However, it is common in the flat areas of the County to encounter drainage problems where standing water can collect.

Locating and categorizing these slopes is useful for gauging the degree of caution required to evaluate and recommend a particular site for development. The **Physical Constraints to Development Map** shows the areas of the County with slopes in excess of 15 percent (Steep and Very Steep Slopes).

Generally, the Coastal Plain consists of broad, nearly level and gently sloping ridges. Steep slopes occur more frequently in the Piedmont Plateau region than in the Coastal Plain. Areas of steep slopes may present limitations to certain types of development. The presence of steep slopes in combination with particular soil types may have the potential for severe erosion or slope failure.

Steep slopes are located in four general areas of the County. They are scattered along the James River; in the vicinity of Horse Swamp; along bluffs adjacent to the Chickahominy floodplain; and in the southeastern corner of the County.



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PHYSICAL CONSTRAINTS TO DEVELOPMENT MAP

SOILS

According to the Henrico **County Soil Survey**, the soils in the County were formed from a wide range of parent materials, from granite and gneiss rock in the Piedmont Plateau, to clay and loam alluvium deposits (i.e., soil material, such as sand, silt, or clay, deposited on land by streams) in the Coastal Plain. Generally the soils are characterized as deep – (the depth to rock level is greater than three feet) - and well-drained or moderately well-drained. Some areas in the Coastal Plain range from excessively-drained to very poorly-drained. Drainage is also poor in some areas of the Piedmont plateau.

The soils are classified into associations, or a landscape with a distinctive proportional pattern of soils. An association normally consists of one or more major soils and at least one minor soil; it is named for the major soils, which themselves are named for the localities where they are found. The soils in one association may occur in another, but in a different pattern.

The soil associations in Henrico County are: (1) Colfax-Helena-Bourne; (2) Appling-Wedowee-State; (3) Kempsville-Atlee-Duplin; (4) Ochrepts and Udults-Norfolk-Caroline; (5) Lynchburg-Rains-Coxville; (6) Angie-Pamunkey-Lenoir; and (7) Chewacla-Riverview-Toccoa. **Table NR-1: Soil Properties and Development Limitations** illustrates additional characteristics of each of these associations and their suitability for certain types of development.

The **General Soil Associations Map** shows the general location of the soil associations in the County. A soil association map is useful for providing a general idea of the soils in a locality, for comparing different sections of a locality, or for identifying large tracts of land suitable for a particular land use. The **General Soil Associations Map** is for general information only and is not suitable for planning the land use for a specific site because the soils in the same association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics affecting their management. There may also be extensive areas with other soils in each association.

Sensitive Soils

Soil characteristics affect the capacity of land to support structures, roads, foundations, and septic systems. Soil suitability is determined based upon degree of wetness, degree of slope, and size and texture of the particles in the soil. Sensitive soils include those with high erodibility, low or high permeability, high water tables or high shrink-swell potential.

Highly erodible soils have a high potential for erosion and sedimentation due in part to excessive steepness and length of slope. The permeability of soils is a factor related to the rate at which water moves through the soil. Soils with extremely low permeability (i.e., soils with high clay content) allow water to move through the soil at less than 0.6 inches per hour. Highly permeable soils, such as sand, allow water to move too rapidly through it to properly filter or treat any contaminations which might be present in the soil. Areas with seasonally high water tables are those where the water table is less than four feet from the surface.

Shrink-swell soils are soils with horizons containing clays that excessively shrink when dry and swell when wet. Various areas of the County have soils that may have the potential to shrink and/or swell with changes in moisture content. The **Shrink Swell Soils Map** shows the general

location of the soils with those characteristics. The County's Department of Building Inspections has detailed residential soil testing requirements.

Soil Suitability for Septic Tank Use

The suitability for septic systems is determined by a combination of the degree of slope, wetness, soil erodibility and permeability. A suitable soil for a septic system should absorb all effluent, provide a high level of treatment before the effluent reaches the groundwater, and should have a long useful life. Sand lets wastewater run through too quickly, and heavy clays impede wastewater movement, allowing it to pool or pond on the surface instead of moving through the soil (*Threats to Virginia's Groundwater*, Virginia Water Resources Research Center, VPI).

The degree of limitation of the soils for septic tank absorption fields is rated slight, moderate, or severe. A slight limitation means that soil properties are generally favorable and limitations can easily be overcome. A moderate limitation can be overcome or modified by planning, design, or by special maintenance. A severe limitation means that costly soil reclamation, special design or intense maintenance, or a combination of these is required (See the **Soil Suitability for Septic Map** for more information).

The Henrico County Code was amended in accordance with the Chesapeake Bay regulations to include the requirements for a 100 percent reserve drainfield area for all buildings served by on-site sewage disposal systems (septic systems) and a mandatory five-year pump out requirement for all septic tank systems in Chesapeake Bay preservation Areas. Estimates from the County's Septic Pump-out Notification Program in 2008 indicated that approximately 8,853 properties have on-site systems. Of this figure 4,171 are located in Chesapeake Bay Preservation Areas. According to the Henrico County Health Department, the majority of the households on septic systems are in the east end of the County. The Health Department monitors new and existing sewage systems by investigating reports of sewage system malfunctions, and assists owners in correcting the problems according to State and County regulations.



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GENERAL SOILS ASSOCIATION MAP



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SHRINK SWELL SOILS MAP

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TABLE NR-1: SOIL PROPERTIES AND DEVELOPMENT LIMITATIONS

Soil Associations		Colfax-Helena-Bourn	Appling-Wedowee-State	Kempsville-Atlee-Duplin	Ochrepts and Udults-Norfolk-Caroline	Lynchburg-Rains-Coxville	Angie-Pamunkey-Lenoir	Chewacla-Riverview-Tocoa
PROPERTIES	County Percent	18	16	21	18	4	21	2
	Slope Percent	0-6; up to 15; nearly level to gently rolling uplands	2-15; up to 45; gently rolling uplands, steeper slopes near larger streams	0-15; nearly level to gently rolling uplands	10-25; up to 60 in some areas; rolling to hilly uplands	0-2 nearly level uplands	0-6; scattered up to 50; nearly level to gently sloping terraces	0-2; nearly level stream bottoms
	Seasonal High Water Table (ft)	1.5-3	Over 5	1.5 to over 5	Over 5	0-1.5	1 to over 5	1.5 to over 5
	Permeability	Slow	Moderate	Moderately Slow to Moderate	Moderately Slow to Moderately Rapid	Moderately Slow to Moderate	Slow to Moderate	Moderate to Moderately Rapid
	Shrink-Swell Potential	Low to High	Low to Moderate	Low to Moderate	Low to Moderate	Low to Moderate	Low to Moderate	Low to Moderate
LIMITATIONS	Septic Systems	Severe	Slight to Moderate	Slight to Severe	Moderate to Severe	Severe	Slight to Severe	Severe
	Dwellings	Severe	Slight to Moderate	Slight to Moderate	Slight to Moderate	Severe	Slight to Severe	Severe
	Shallow Excavation	Severe	Slight to Severe	Slight to Severe	Slight to Moderate	Severe	Slight to Severe	Severe
	Local Roads and Streets	Moderate to Severe	Slight to Severe	Moderate to Severe	Moderate to Severe	Severe	Moderate to Severe	Severe

Source: Soil Survey of Henrico County, Virginia, 1975.

- Subject to Flooding
- May be hazard of groundwater pollution or pollution of nearby streams.

Note: See Map for the general locations of these soil associations.



SOIL SUITABILITY FOR SEPTIC MAP



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NATURAL HERITAGE RESOURCES

The Virginia Department of Conservation and Recreation's Division of Natural Heritage (DCR-DNH) and the Virginia Department of Game and Inland Fisheries catalog the occurrences of Natural Heritage Resources documented within Henrico County. Natural Heritage Resources are defined by the Virginia Natural Area Preserves Act as "the habitat of rare, threatened, or endangered plant and animal species, rare or state-significant natural communities or geologic sites, and similar features of scientific interest."

The **Natural Heritage Resources Map** shows the approximate location of the federally-listed sensitive areas in Henrico County. DCR-DNH states that these locations should act as indicators for resources during land use planning so that projects can be modified to avoid impact before they are approved. However, the center points should not be interpreted as precise resource locations. The use of this identification can facilitate project permitting by identifying sensitive areas before projects are submitted for approval.



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NATURAL HERITAGE RESOURCE MAP

PROTECTION OF POTABLE WATER

Potable water (water suitable for drinking) includes both groundwater and surface water. The “hydrologic cycle” describes the interaction among groundwater, surface water and atmospheric water vapor. Precipitation and the resulting surface runoff supplies most of the water that feeds streams, lakes, rivers, and oceans. This water is then returned to the atmosphere through evaporation from the earth’s surface or transpiration by the roots and leaves of plants.

Surface water is also fed by groundwater through what is called baseflow. The U.S. Geological Survey estimates that 30 percent of the annual average flow of streams in Virginia is derived from groundwater (*Threats to Virginia’s Groundwater*). Most perennial streams occur where the groundwater table is exposed to the surface. The groundwater table, or water table aquifer, is a common term used to describe the level of water trapped within the soil just beneath the surface. The water table aquifer is replenished by water which infiltrates the ground’s surface through permeable soils, wetlands, and other groundwater recharge areas.

Because of the interdependence of the hydrologic cycle, anything affecting one part of the system (e.g., water withdrawals, introducing pollutants) has the potential to affect other parts of the system. This interconnected cycle explains how pollutants introduced into the water table aquifer in a distant area of the Chesapeake Bay basin can be transported to one of its tributaries (surface water) and eventually end up in the Bay.

Proper planning can both ensure an adequate supply of drinking water by protecting the quantity and quality of water, and it can minimize costs for providing drinking water. Henrico County is involved in many programs designed to improve water quality and water conservation including: adoption of local ordinances to comply with the Chesapeake Bay Regulations; the five-year septic system pump-out program; development review procedures to address water quality, participation in the National Pollution Discharge Elimination System (NPDES) program, adoption of the County’s Storm Water Management Plan and others.

SURFACE AND GROUNDWATER WITHDRAWALS

Information on water withdrawals is useful for determining existing demand on water supply systems. Currently all of Henrico County’s water supply is surface water withdrawals from the James River. The Department of Public Utilities operates a water treatment plant with the current capacity of 55 million gallons per day (MGD). In addition, the County has an agreement with the City of Richmond to purchase between a minimum of 12 MGD and a maximum of 35 MGD. This provides the County with an available maximum day water supply of 90 MGD. The County’s current demand is for average day use of approximately 40 MGD and maximum day use of 61 MGD. The remaining 29 MGD is available for growth until the Water Treatment Plant capacity is increased. Design to further increase the capacity of the plant by an additional 25 MGD began in 2006.

The greatest use of the water supply is for residential development followed by commercial and industrial development. **Table NR-2: Average Daily Water Withdrawals** shows the average daily supply from both surface water and County wells for the fiscal years ending in 2000 to 2005.



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TABLE NR-2: AVERAGE DAILY WATER WITHDRAWALS

Fiscal Year (ending June 30)	Avg. Daily Supply City Purchase + County Withdrawals (mgd)
2000	35.77
2001	36.53
2002	39.20
2003	35.05
2004	35.71
2005	35.41
2006	37.67
2007	41.64

Source: Henrico County Department of Public Utilities.

Most of the existing development in Henrico County is served by County-owned water lines distributing treated surface water that is either produced by the County’s water treatment facility or purchased from the City of Richmond. The Henrico water treatment plant has provided treated water from the James River since the spring of 2004. There are a number of privately owned public water supply wells in use throughout the County, some of which are owned by state and federal agencies. Any well that provides water to the public as defined in the Virginia Department of Health (VDH) Waterworks Regulations is considered a public supply well, and its owner is subject to the requirements of those regulations.

There are approximately 11 privately owned public water supply wells permitted by the VDH to provide water to citizens, businesses, and public facilities in the County. The Department of Public Utilities took all County-owned wells out of service in 1997 and does not withdraw ground water for public water supply to its customers. Five County wells are maintained in operable condition to serve as an emergency back up supply if they are needed. These wells are identified as Memorial Drive Well, Old Williamsburg Road Well, Elko Road Well, White Oak Road Well and Bradley Acres Well. All other County-owned supply wells have either been or will be abandoned in accordance with VDH Regulations.

In addition to the public supply wells, two freshwater springs, located off of Turner Road in the east end of the County, provide commercial bottled water. According to Camp Holly Springs, Inc., water from Camp Holly Springs and Diamond Springs is distributed to thousands of consumers daily in Virginia, North Carolina, South Carolina, Maryland, Pennsylvania, West Virginia and the District of Columbia.

Camp Holly Springs and Diamond Springs appear to originate in separate shallow aquifers or distinct horizons within a single aquifer. Recharge for the springs is from surface water infiltration (e.g., ponds, creeks and precipitation). The **Hydrologic Unit Boundaries Map** provides the general location of Camp Holly Springs and Diamond Springs.



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AQUIFERS

Aquifers are areas within the earth or bedrock where potable water is stored. According to the Wellhead Protection Pilot Study conducted by Henrico County in 1993, groundwater in Henrico County is found in two different types of aquifers - surface and confined (or artesian) aquifers. The study describes the recommended method for protecting the water supplied from each of these sources.

The surface aquifers (not deep enough to be protected by layers of clay) are particularly vulnerable to contamination from any pollutants introduced at the land's surface. To protect this type of aquifer, the recharge area (i.e., areas where groundwater flow replenishes the aquifer) around the well needs to be protected.

Beneath the surface aquifers, between thick layers of marine clay are the confined or artesian aquifers known as the Middle and Lower Potomac. Most of the public water supply wells in the eastern portion of the County draw water from these aquifers. Rather than protecting the recharge area around individual wells that draw from the confined aquifer, protecting the entire recharge area of the aquifer is more effective. The confined aquifers are especially important to protect because they recharge regional flow systems.

WATER QUALITY ASSESSMENT

For water quality assessment and reporting, the Commonwealth of Virginia is subdivided into hydrologic river basins, which are further subdivided into smaller watersheds called "waterbodies." Henrico County is included in portions of the five waterbodies listed below:

1. VAP-G06R-Chickahominy River/White Oak Swamp/Beaverdam Creek (G06)
2. VAP-G05R-Upper Chickahominy River/Upham Brook/Lickinghole Creek (G05)
3. VAP-G02R,E-James River/Turkey Island Creek/Fourmile Creek (G02)
4. VAP-G01R,E-James River/Almond Creek/Gillies Creek (G01)
5. VAP-H39R-James River/Tuckahoe Creek/Norwood Creek (H39)

The **Hydrologic Unit Boundaries Map** illustrates the location of these watershed sub areas.

The **2006 Water Quality Assessment and Impaired Waters Report** was released by the Virginia Department of Environmental Quality on July 10, 2006. The report is a summary of the water quality conditions in Virginia from January 1, 2000, to December 31, 2004. This document indicates overall quality standards are being met in most streams throughout Henrico County. However, several segments or waterbodies are impaired because of contamination, low dissolved oxygen levels, or acidic pH levels. From 2002 to 2004, six additional stream segments/waterbodies were added to the impaired list within the County. Additional subcategories of aquatic life were adopted between the 2002 and 2004 dates which may account for the addition of these bodies rather than a decline in the conditions in these six stream segments/waterbodies. An impaired waterbody is defined as a water body that due to contamination levels will not support one or more of its designated uses. The assessment identified waterbodies with more than ten (10) impairments; most of these were in the central and eastern portions of the state. Five waterbodies in Henrico County had Category 5

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impairments (i.e., the highest level of impairment). Table NR-3 below lists the waterbodies with Category 5 Impairments.

TABLE NR-3: DEQ IMPAIRED WATERBODIES

Water body	Total number of Impairments	General Description of Category 5 Impairments
VAP-G06	10	<ul style="list-style-type: none"> • Chickahominy River-(10.3 miles-RT 360 bridge to RT 156 bridge)-Not supporting recreational uses due to fecal coliform levels which have risen since 1996. The source of the fecal coliform levels is unknown. The segment also is not supporting aquatic life due to low levels of dissolved oxygen (DO) and pH violations, likely caused by natural conditions in the watershed. • White Oak Swamp-(6.51 miles-White Oak Swamp from White Oak Swamp Creek downstream to mouth at Chickahominy River, and 3.47 miles from its headwaters to the confluence with White Oak Swamp Creek)-Not supporting recreation or aquatic life due to pH and fecal coliform. The source for the pH is attributed to natural conditions; the source for fecal coliform is unknown. • White Oak Swamp Creek-(3.9 miles from headwaters to mouth at White Oak Swamp)-Not supporting aquatic life due to pH from natural conditions. • Canal Swamp-(2.94 miles, from its headwaters to its mouth at White Oak Swamp)-Not supporting aquatic life due to pH. The source is unknown. • Deep Run-(2.33 miles, from its headwaters to the mouth at the White Oak Swamp)-Not supporting aquatic life due to pH. Source unknown.
VAP-G05	4	<ul style="list-style-type: none"> • Upham Brook Watershed-(48.4 miles, from its headwaters to confluence with the Chickahominy, includes all tributaries)-Not supporting recreational activities because of high levels of fecal coliform, and e. Coli. Contamination source is non-point source runoff from urban development in the watershed. <p>Chickahominy River-(14.98 Miles, from its headwaters to its confluence with Stony Run)-Not supporting aquatic life or recreation uses because of presence of fecal coliform and low levels of dissolved oxygen. The source of the fecal coliform is unknown; the dissolved oxygen levels are attributed to natural conditions.</p> <ul style="list-style-type: none"> • Stony Run-(.22 miles, from the confluence with Lickinghole Creek downstream to its mouth at the Chickahominy River)-Not supporting recreational use due to presence of fecal coliform. The source is unknown.

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Water body	Total number of Impairments	General Description of Category 5 Impairments
VAP-G05-continued		
VAP-G02	7	<ul style="list-style-type: none"> • Fourmile Creek- (30.99 miles, the watershed from its headwaters to the mouth at the James River)-Not supporting recreation or aquatic life due to fecal coliform and pH. The source of the fecal coliform is unknown, and the pH levels are attributed to the runoff from pine forests in the headwaters. • The following water bodies were found to not support aquatic life due to the pH levels which are attributed to the runoff from pine forests in the headwaters: A pond at mile 2.04 in Roundabout Creek, Western Run, and Crewes Channel.
VAP-G01	11	<ul style="list-style-type: none"> • James River-(10.84 Sq. Mi., from the fall line at Mayo’s Bridge downstream to the Appomattox River)-Not supporting recreation use, due to the presence of e.Coli and fecal coliform the source of which is believed to be non-point source urban runoff and the combined sewer overflow events from the Richmond combined sewer system. • James River-(0.02 Sq. Mi., from the fall line at Flowerdew Hundred)-Not supporting fish consumption due to contaminants whose source is unknown. • Almond Creek-(2.26 miles, from headwaters to its mouth at the James River, includes unnamed tributaries) Not supporting recreation or aquatic life due to fecal coliform, and pH levels. The fecal coliform is suspected to be from urban runoff and overflow discharges from the City of Richmond’s combined sewer, and the pH is suspected to be caused by runoff from a nearby landfill. • Gillies Creek-(5.79 miles, from headwaters to its mouth at the James River)-Not supporting aquatic life or recreation uses due to fecal coliform and pH. The source of impairment is unknown.
VAP-H39	10	<ul style="list-style-type: none"> • Tuckahoe Creek Watershed-(52.67 miles, the entire watershed)-The watershed is not supporting aquatic life,



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Water body	Total number of Impairments	General Description of Category 5 Impairments
		<p>recreation or public water supply uses. The watershed has low levels of dissolved oxygen, pH level imbalance, fecal coliform, and elevated sulfate levels in portions of the stream. The impairments are attributed to a combination of sources including urban runoff, and natural conditions.</p> <ul style="list-style-type: none"> James River-(10.06 miles, from the confluence of Tuckahoe Creek to the Williams' Island Dam)-Not supporting recreation uses due to the presence of fecal coliform, the source of which is unknown.

Source: 2004 305(b) Water Quality Assessment Report Appendix A.



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HYDROLOGIC UNIT BOUNDARIES MAP



POINT AND NON-POINT SOURCES OF POLLUTION

Virginia's Groundwater Steering Committee has identified 32 potential sources of groundwater contamination. The top potential threats statewide are: failed septic systems, poor well construction, landfills, and pesticides and fertilizers. These are termed non-point sources of pollution (i.e., not coming from a discernible point). Other sources are poorly constructed or abandoned wells, and point source discharges. The threat each of these poses to water quality in Henrico County is discussed below.

POINT SOURCE DISCHARGES

Point sources of pollution are those which reach State waters through a single source such as a pipe outlet. The outfall structures of sewage treatment plants and industrial plants are examples. All legal point source discharges to surface waters are regulated by the Virginia Pollution Discharge Elimination System (VPDES) permit program. Depending upon the permit requirements, some permittees must monitor their outfall to ensure the discharge meets certain quantity and quality parameters. As of 2007, there were fifty-eight (58) VPDES permitted discharge sites in Henrico County regulated by the State Department of Environmental Quality.

NON-POINT SOURCES

Underground Storage Tanks

One of the most common groundwater contamination complaints reported to Virginia Department of Environmental Quality (DEQ) concerns underground petroleum storage tanks and lines. State regulations enacted in 1989 require owners of underground storage tanks with storage capacities of 5,000 gallons or more to register the tanks with DEQ, to test the tanks periodically, and to report any tanks that are leaking. The owner is liable for any clean up costs.

According to DEQ, Henrico County currently has 2,297 regulated and unregulated underground storage tanks reporting leaks. These sites are scattered throughout the County. The types of facilities range from gas stations, to schools, to cemeteries but do not include home heating oil tanks.

Septic Tanks

Leaking or poorly maintained septic tanks can contribute a significant amount of contamination as a non-point source discharge. The Department of Public Works is developing a database and mapping effort to identify the parcels within Chesapeake Bay Preservation Areas that are also served by on-site septic systems. This database will be cross-referenced with the County's Geographic Information System (GIS) and various sources of data, including the Henrico County Planning Department 1993 Septic Pump Out Notification database. The approximate number of parcels within CBPAs that are also served by septic systems is 4,171.

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The Department of Public Works is developing a process it will use to manage on-site septic system maintenance. This process will help the County uphold the mission of the Chesapeake Bay Preservation Act by protecting perennial streams and other tributaries from potential contamination from on-site septic systems.

Pesticides and Fertilizers

Pesticides and fertilizers are used for agriculture, forestry, parks, golf courses, and residential landscapes. The potential for contamination of aquifers by pesticides and fertilizers occurs not necessarily because these chemicals are misapplied, but because the chemicals are applied repeatedly to vast tracts of land. Contamination of groundwater from these sources can occur as water percolates through the soil. Soil erosion and surface runoff can compound the problems.

When pesticides and fertilizers are properly applied at the recommended time and rate, plant growth is enhanced. Actively growing ground covers such as trees, shrubs, and turf grasses, reduce nutrient movement through the soil and promote the natural decomposition of these materials. Living ground covers also prevent erosion of the soils that contain fertilizers and other chemicals. Additionally, living plants actually remove these materials from the soil.

Poorly Constructed or Abandoned Wells

Improperly constructed and abandoned wells are considered by health officials to be threats to public safety and among some of the most significant sources of groundwater contamination in Virginia. A well improperly constructed or abandoned can provide a direct conduit for pollutants.

There are many types of wells in Henrico County; some of the more typical types include dug wells, bored wells, and drilled wells. The oldest type is the dug well which is extremely susceptible to contamination and should be taken out of service and properly abandoned. Bored wells are another form of shallow well (usually about 3 feet in diameter) which are bored to bedrock or the green marine clay layer. These wells are susceptible to droughts and provide water closer to the surface and therefore the source of contamination. Drilled wells are much deeper (100 feet or more into the ground) and the well is sealed from contaminants.

The Henrico Department of Public Utilities maintains information on County water supply wells that are out of service. The Department has documentation about the handling of County-owned wells, and the Virginia Department of Health provides guidance to private well owners on proper abandonment methods to prevent groundwater contamination.

Landfills

Landfills are soil excavations filled with solid waste. The waste is covered with soil to help prevent odors, disease, and pest infestations. The soil cannot, however, prevent precipitation and other water sources from contacting the waste. Water dissolves various materials to form "leachate" which has the potential to percolate through the soil and contaminate groundwater below the landfill.

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Strict regulations in Virginia require permits for proper siting and construction of landfills with regard for the geology and hydrology of a potential landfill location. This permitting process diminishes the likelihood of significant groundwater contamination. At the local level, Henrico County uses its Soil Survey maps to evaluate sites for proposed land uses such as landfills, storage facilities for hazardous materials, and mining activities, all of which have a high potential for groundwater pollution.

The County owns three landfills: two inactive sites located in the east end of the County and one active landfill. The active landfill is located on Ford's Country Lane off of Nuckols Road in northwestern Henrico County. It is a 188-acre site and has a projected life span of approximately three more years at current acceptance rates of 300 tons/day. Of the inactive landfills, the landfill on Nine Mile Road was closed in 1978, and the Charles City Road landfill was closed in 1990. The Charles City Road site has 76 acres remaining which potentially could be used for landfill development. This site also has recycling bins available.

There are three private landfills in the County. Old Dominion, owned by Allied Waste Systems, Inc., and Cox landfills are located near the County's landfill on Charles City Road. Simon Landfill is on Darbytown Road. Old Dominion is a sanitary landfill; the Cox and Simon landfills only accept debris (i.e. clippings from trees, lawns, etc.).

Virginia's Corrective Action Program regulates groundwater contamination from leaking landfills by requiring solid waste management facilities (landfills) that received solid waste after December 21, 1988 to have groundwater monitoring wells. The County's landfills have been monitored and have been found to have no contamination leaving the sites. In 2005/2006, a project to correct on-site groundwater contamination within the facility's boundaries at the Springfield landfill was completed.

SHORELINE/STREAMBANK EROSION

Shoreline/streambank erosion is caused by natural forces such as wave motion and upland runoff. Land development activity such as grading and clearing can also increase stormwater runoff and erosion.

Shoreline/streambank erosion can have a negative effect on water quality by contributing to the nutrients and other controllable pollutant loads entering the Bay each year. Increased sedimentation in the Chesapeake Bay is another result of shoreline erosion.

Shoreline/streambank erosion, however, is not a major issue in Henrico County. In 1985, the *Shoreline Situation Report: Henrico, Chesterfield and Richmond*, states that there are no areas noted which are subject to rapid (i.e. severe) erosion in the County. While somewhat dated, the document is the only data of this kind currently available. It also reports that the historical erosion rate in this area averages less than one foot per year. The Chesapeake Bay Public Access plan identifies two areas along the James River in the east end of the County where erosion was noted as being greater than two feet per year. These instances of shoreline erosion along the James River have been from major flooding events, boat wakes, ship traffic to the Deep Water Terminal in the City of Richmond, and from current and tidal action.



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Stormwater detention is one of several techniques, implemented by the County, to minimize shoreline/streambank erosion. Detaining stormwater on-site decreases the runoff into the receiving channel (waterway) which minimizes erosion activity along the channel. This is particularly important if the receiving channel is inadequate to accommodate the runoff. Henrico County requires all development and redevelopment provide an adequate receiving channel. In some watersheds, detention is also required of commercial and industrial development to address downstream flooding issues. Stormwater quality requirements are applied throughout the County and compliance may require the construction of facilities known as Best Management Practices (BMPs).

Determining which watersheds require stormwater detention is based on the County's **Comprehensive Drainage Study**. This study requires stormwater detention in all watersheds identified as 50/10 Watersheds. The **Henrico County Environmental Program Manual** provides guidance on watershed plans and stormwater management measures required to prevent erosion, overtopping of stream crossings and building flooding. Regional and on-site detention basins must be evaluated in conjunction with other measures to determine the impact on erosion control, flood control and water quality.

PUBLIC AND PRIVATE ACCESS TO WATERFRONT AREAS

In 1989, the Board of Supervisors approved a resolution designating a portion of the Chickahominy River, from Mechanicsville Turnpike (Route 360) east to the County line, as a Scenic River.

The Chesapeake Bay Public Access Plan (DCR, Dec. 1990) identifies existing and potential areas in the County for access to the James and Chickahominy Rivers. The Access Plan recommends criteria for determining the appropriate location, type and intensity for a variety of waterfront access activities. This Plan also provides information on shoreline planning factors, and existing and potential site uses (e.g. boat launch ramp, bank and pier fishing, hiking, picnicking, and marina sites). The Chesapeake Bay Public Access Plan contains information on public and private access sites in map format. While not a comprehensive list of environmental considerations, it includes four factors (i.e., shoreline erosion, wetlands, natural heritage areas and cultural resources) which should be evaluated in the siting of an access area. See the **Waterfront Access Map** for existing waterfront access sites.



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WATERFRONT ACCESS MAPS

Existing Public and Private Access Areas

There are currently four public access sites to waterfront areas (Osborne Pike Landing, Richmond National Battlefield Park-Fort Brady, Osborne Park and Deep Bottom Boat Landing) as well as two private marinas along the James River, all in the east end of the County. Henrico County Recreation and Parks Department maintains the State-owned Osborne Pike Landing and the County's Deep Bottom Boat Landing and Osborne Park. The National Park Service is responsible for the location at the Richmond National Battlefield Park.

Potential Impacts from Public and Private Access

The four general types of public and private water access are boat-related, swimming, fishing and natural area access. Boat-related access is discussed in more detail below because it has a greater potential impact on water quality and is usually a major element in access programs.

The physical characteristics of a site that influence suitability for access include topography, geologic features, capacity to sustain the proposed use, and presence of fragile environmental resources, including threatened or endangered species. Significant shoreline erosion and potential impact on water quality are other important factors to consider.

The volume, flushing characteristics, and tidal action of each waterbody are important to support docking facilities. Consideration also should be given to the appropriateness of community facilities over individual docks in some areas, and the visual character of predominantly natural areas. Numerous facilities could diminish visual amenities.

Boat Related Facilities

Boating is generally recognized as a non-point source of pollution. Pollutants that can result from the operation of boats include spilled petroleum products, non-biodegradable litter, and sanitary waste. Boat traffic increases the waterway's turbidity by increasing wave action, which in turn increases the rate of shoreline erosion. This turbidity also impacts the ecology of marsh areas.

Clearing shoreline vegetation for access, structures and adjacent parking areas can generate additional runoff which carries pollutants and eroded sediments, and impacts marine wildlife habitats. On-shore storage of fuel, oil, and sewage waste at such facilities can pose a threat to water quality if these substances are not properly managed. Dredging and channel widening, in situations where it is necessary for the function of boat-related facilities, can release settled pollutants and increase turbidity in the water.

The Chesapeake Bay Public Access Plan was developed to help ensure maximum water quality protection in the siting and development of boat related and other access facilities. The Access Plan suggests criteria for determining the appropriate location, type and intensity for a variety of access activities. Information from this resource can be incorporated into the County's planning efforts with respect to public and private waterfront access facilities.

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The Osborne Pike Boat Landing (a State owned facility leased to the County) had a significant increase in boat traffic during the early part of the 1990s. To improve operations, the County Board of Supervisors authorized an application to the Virginia Department of Game and Inland Fisheries to establish a "No Wake Area." This area would extend fifty (50) feet from the shoreline into the James River and run parallel to the landing for approximately 150 feet. Pilings near the landing are sometimes hidden during high tide and pose a safety concern. Although safety is the main concern for this request, this "No Wake Area" would also help to minimize siltation along the shoreline from the increased boat traffic.

REDEVELOPMENT IN INTENSELY DEVELOPED AREAS

Intensely Developed Areas (IDAs) consist of existing development and infill sites where little of the natural environment remains. These areas represent urban centers, heavy industrial areas, and other densely developed areas characterized by extensive pavement and other impervious surfaces. Research has shown that the increase in stormwater runoff pollution is directly proportional to increases in impervious surfaces. Runoff in these areas is typically collected in an underground drainage network which carries untreated stormwater directly into adjacent waterways. At this time Henrico County does not have any areas officially designated as IDAs in accordance with the Chesapeake Bay Program.

The Chesapeake Bay Program's intent is to reclaim some natural areas through stormwater quality management techniques as redevelopment occurs. Pollution entering the Bay from older, densely developed areas is the primary reason that the regulations now require redevelopment projects within these areas to reduce stormwater runoff pollutant loadings by 10 percent. In many cases, the 10 percent reduction in pollutant loading is accomplished through the use of a BMP, and not necessarily through a reduction of impervious surface.

The County requires stormwater quality management, not only in the Chesapeake Bay areas, but for all new and redevelopment sites with impervious areas in excess of 16 percent. The County inspects all industrial activities that drain into the County's drainage system (i.e. storm sewer, roadside ditches, etc.).

AIR QUALITY

Ground level ozone is a precursor to smog and is emitted both from mobile (e.g. cars and trucks) and stationary (e.g. industrial plants) sources, and is one of the elements that the Environmental Protection Agency uses to determine air quality. An ozone concentration of greater than 0.08 parts per million is the threshold for an eight hour period. The number of days Henrico County exceeded this threshold is listed in **Table NR-6** below.

As of December 2007, the U.S. Environmental Protection Agency (EPA) has classified Henrico County as a "Marginal" nonattainment area for ozone. This means the air quality in the County exceeded the acceptable level of ozone during three different eight hour periods in the last year. A marginal rating also indicates that there is a range of 0.085-0.092 parts of ozone per billion for the eight hour period. This is the lowest (least severe) classification for ozone nonattainment areas.



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TABLE NR-6: NUMBER OF DAYS WITH EIGHT HOUR OZONE EXCEEDENCES (2000-2005)

2000	2001	2002	2003	2004	2005	2006	2007
3	10	11	3	0	3	4	4

Source: Virginia Department of Environmental Quality, Air Quality Monitoring, 2007.

In 1990, amendments to the Clean Air Act required states to submit revisions to their State Implementation Plans (SIP) for air quality by November 1993. In addition to the requirements for a revised SIP, Virginia also submitted a plan to EPA which committed to a measured reduction in urban smog of 15 percent by 1996. The result of this action was a long term reduction in smog of at least three percent per year to reach attainment compliance with air quality standards by 2010.

NOISE

On a daily basis, the greatest noise generator is the Richmond International Airport. Aircraft noise prediction models have been used to assess noise levels in areas surrounding the Airport. The noise impacts are expressed in terms of contours of equal noise exposure in the Day/Night Average Sound Level (DNL) noise metric.

The following noise exposure levels were identified for Richmond International Airport:

- 65 DNL-Noise level considered to have an adverse effect upon land use activities. Land use limitations and controls should be considered.
- 70 DNL- Noise level considered to have significant adverse effects upon land use activities. Land use limitations, easements, and other compatibility controls should be considered.
- 75 DNL- Noise level considered to have the most severe adverse effect upon land use activities. Land uses other than airport related facilities should generally be excluded from this area.

The County has adopted an Airport Overlay District to assist in the management of development activities within the high DNL areas. This overlay district is illustrated on the **Richmond International Airport Overlay District Map**.

Additional locations that generate high decibels of noise for extended periods of time include the interstate corridors, and the Richmond International Raceway. Efforts should be made to mitigate the impact of noise in areas affected by these sources.



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RICHMOND INTERNATIONAL AIRPORT OVERLAY DISTRICT

NATURAL ENVIRONMENTAL RESOURCE POLICIES

The following policies should be used to guide development decisions related to natural environmental features in the County.

1. Promote the protection of Chesapeake Bay Preservation Areas from development that may have an adverse environmental impact on the Chesapeake Bay ecosystem.
2. Require assessment and survey of on-site environmental conditions to identify specific environmental status and resources.
3. Require mapping of environmentally sensitive lands for individual sites, including floodplains, aquifer recharge areas, wetlands, steep slopes, woodlands, and natural habitat areas in addition to areas generally identified as Chesapeake Bay Preservation Areas in this Plan.
4. Require the design and construction of developments to meet the surface and groundwater quality standards established by the Virginia Department of Conservation and Recreation's Division of Chesapeake Bay Local Assistance in the *Chesapeake Bay Preservation Area Designation and Management Regulations (9 VAC 10-20-10 et seq.)*.
5. Evaluate land development or disturbing activities for compliance with the requirements of Chapter 10, Environment, of the Code of Henrico County.
6. Monitor shoreline development to ensure proper erosion control methods are employed.
7. Require regular or periodic maintenance of Best Management Practices (BMPs) used for the management of stormwater to ensure their continued function and removal of pollutants.
8. Use the standards established in the *Henrico County Environmental Program Manual* as a guide for the design of BMPs.
9. Encourage alternative development practices which minimize impervious surfaces while still being consistent with the permitted uses to reduce the impacts of stormwater runoff.
10. Require soil testing when development is proposed in areas without public sewer, to ensure the site can support on-site septic systems.
11. Discourage on-site septic systems which may adversely impact the water quality of aquifers or state waters.
12. Promote restoration of land areas containing mineral deposits after being mined to keep with future development plans and to protect existing development.
13. Require the location of all sealed mines be provided to the County for future reference.
14. Encourage alternative development practices which can lessen the adverse impact to air and water quality.
15. Encourage public and private cooperation in the preservation and use of environmentally sensitive areas for public open space, or park and recreation activities that results in minimal impact on environmentally valuable sites.



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16. Promote the preservation and enhancement of the scenic, historic, natural, and open space qualities of the James River and Chickahominy River Corridors in balance with economic development.
17. Provide access to the James and Chickahominy Rivers through public and private locations. Public access to the rivers could include public park locations and the public amenities associated with large master planned developments.
18. Protect the quality of the Camp Holly Springs and Diamond Springs recharge area to the extent reasonably practicable.