

Appendix IV:

**NATURAL RESOURCES INVENTORY,
CONSTRAINTS ASSESSMENT AND
RECOMMENDATIONS**

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Appendix

NATURAL RESOURCES AND ENVIRONMENT

The Town of Smithfield is located in southeast Virginia, a region also referred to as Hampton Roads. The town is situated in the northeastern part of Isle of Wight County, along the Pagan River, one of the County's main water bodies. The Pagan River flows into the James River approximately 4 miles downstream from the confluence of the Pagan River and Cypress Creek. This location at the confluence of rivers and creeks contributes to the Town's unique ecological setting that is characterized by water, tidal flats, wetlands and marshes.

The impact of population growth and the resulting increase in human activity impacting local environmental quality is a growing public concern. Throughout the country, human activity is often at odds with the natural environment, and future growth and development has the potential to impact the environmental quality of the Town of Smithfield. Therefore, the impact of land use decisions on environmental resources should be the foundation for all Town zoning and development considerations. The following sections in this Appendix provide a discussion of the environmental resources and potential threats to these resources within and adjacent to the Town of Smithfield. This Appendix also provides a discussion of environmental constraints to the growth and development of the Town, and tools to deal with these constraints.

ENVIRONMENTAL SETTING

Land use

The Town of Smithfield Zoning Ordinance reflects 14 distinct zoning districts (Table A.1). This section provides a brief discussion of zoning issues that are relevant to natural resources and the environment; zoning and land use is discussed in more detail in Chapter VI.

As of January 1999, 46 percent (2,969 acres) of the Town had been zoned for development. Developed areas can be divided into residential areas (2,307 acres or 36 percent of the Town's land area), commercial areas (388 acres or 6 percent) and economic development (industrial) areas (274 acres or 4 percent).

The remaining 3,440 acres (54 percent) can be classified as undeveloped and are mostly zoned as Community Conservation District, Environmental Conservation District or Entrance Corridor. These undeveloped areas include woodlands, open spaces, tidal marshes, wetlands, major highways and rivers and other natural areas. Undeveloped areas are a valuable element of a community in that they serve as green spaces, buffers and wildlife corridors. Furthermore, they enhance the standard of living in an area because of their visual impact, positive influence as moderators of an area's climate and function as environmental filters of water and air. However, undeveloped areas could also be a source of non-point source pollution to surface and ground water, particularly if they are not managed properly. While a substantial percentage of these undeveloped areas cannot be developed because of environmental constraints, it is expected that some of these areas could be rezoned if needed as the Town continues to grow. The spatial distribution of these areas will greatly influence future development patterns and growth management strategies, including rezoning decisions. Environmental constraints to development are described later on in this section.

Table A.1
Existing Land Area within Current Zoning Districts in the Town of Smithfield
(Total area assumed to be 6,538 acres)

Zoning Designation	District	Estimated Acreage
C-C	Community Conservation District	2081 Ac. (31.8 %)
N-R	Neighborhood Residential District	1225 Ac. (18.7 %)
S-R	Suburban Residential District	761 Ac. (11.6 %)
DN-R	Downtown Residential District	181 Ac. (2.8 %)
A-R	Attached Residential District	92 Ac. (1.4 %)
MF-R	Multi-Family Residential District	81 Ac. (1.2 %)
R-O	Residential Office District	33 Ac. (0.5 %)
MH-P	Mobile Home Park District	17 Ac. (0.3 %)
D	Downtown District	68 Ac. (1 %)
HR-C	Highway Retail Commercial District	265 Ac. (4.1 %)
PS-C	Planned Shopping Center Commercial District	28 Ac. (0.4 %)
P-COR	Planned Corporate Office and Research District	0 Ac. (0.0 %)
I-1	Light Industrial District	89 Ac. (1.4 %)
I-2	Heavy Industrial District	191 Ac. (2.9 %)
Overlay and Special Districts		
E-C	Environmental Conservation District	815 Ac. (12.6 %)
HP-O	Historic Preservation Overlay District	N/A
FP-O	Floodplain Overlay District	N/A
CB-O	Chesapeake Bay Preservation Area Overlay District	N/A
ECO	Entrance Corridor Overlay District (or Other = Roads/River/Creeks)	611 Ac. (9.3 %)
TOTAL		6538 Ac.

Climate

The Town of Smithfield enjoys a warm, temperate humid climate with an average daily maximum temperature of 87.9 °F in July and average daily minimum temperature of 28.6 °F in January (Table A.2). The average first day of frost is October 25, though frost can occur as early as October 12. On average, the last day of frost in spring is April 16, though frost can occur as late as the end of April. The lowest temperature recorded in Holland, VA (Isle of Wight County) is 1 °F and the highest recorded temperature there was 105 °F.

Average precipitation is approximately 48 inches, which is evenly distributed throughout the year with a slight increase in the summer months. The average relative humidity is 60 percent. On average, during the summer months, the sun shines 70 percent of the time possible, and 60 percent in winter. The prevailing wind direction is from the southwest (USDA 1986).

Topography

Isle of Wight County is located in the Embayed section of the Coastal Plain of Virginia (USDA 1986). Elevations in the Town of Smithfield range from sea level to 70 feet in the western part of Town and 30 feet in the eastern area of Town. The topography is flat to gently rolling, and the landscape is dissected by a number of rivers, creeks and associated marshes. These streams include the Pagan River, Cypress Creek, Mount Holly Creek, Moone Creek, tributaries to these rivers and creeks, and unnamed tributaries to Jones Creek. All creeks within the Town limits drain to the James River.

Geology

The Town of Smithfield lies within the Atlantic Coastal Plain Physiographic Province of Virginia. The surficial geology in the Smithfield area consists of unconsolidated sediments of the Atlantic Coastal Plain that range in age from lower Miocene to Holocene (recent) and were deposited in fluvial, estuarine, and shallow marine environments (Mixon, et al., 1989). A more detailed description of the geological formations in the Town of Smithfield is provided below.

The area around Cypress Creek consists of alluvial deposits, mainly of Holocene age. The alluvium consists of light to medium gray and yellowish gray fine to coarse gravelly sand and sandy gravel, silt and clay. It is deposited mainly in channels and floodplains and includes sandy deposits of narrow beaches as well as mud, sand and peat in swamps and marshes bordering rivers.

The Shirley Formation can be found on either side of Cypress Creek and north of the Pagan River. This formation is of Middle Pleistocene age and consists of light to dark gray bluish gray and brown sand, gravel, silt, clay, and peat. It is comprised of surficial deposits of riverine terraces and relict baymouth barriers and bay-floor plains.

The Sedgefield Member of the Tabb Formation, which exists in the eastern portion of the Town, is an upper Pleistocene deposit of pebbly to bouldery clayey sand and fine to medium shelly sand grading upward to sandy and clayey silt. It is comprised of surficial deposits of river and coast parallel plains.

The Charles City Formation exists west of Cypress Creek and north of the Pagan River. This formation is of lower Pleistocene age, and consists of light to medium gray and light to dark yellowish and reddish brown sand, silt and clay comprised of surficial deposits of riverine terraces.

**Table A.2
Climate Information for Locations Near the Town of Smithfield**

Month	Holland, VA (1951-1981) ¹					Newport News, VA (1971-2000) ²				
	Temperatures (°F)			Precipitation (Inches)		Temperatures (°F)			Precipitation (Inches)	
	Average Daily Maximum	Average Daily Minimum	Average	Average	Average Snowfall	Average Daily Maximum	Average Daily Minimum	Average	Average	Average Snowfall
Jan	49.6	28.6	39.1	3.77	3.4	46.7	32.0	39.4	4.1	2.9
Feb	51.4	30.2	40.8	3.78	1.3	49.4	33.8	41.6	3.6	3.0
Mar	58.9	36.9	48.0	3.77	1.5	57.0	40.6	48.8	4.7	1.0
Apr	70.2	45.7	58.0	3.00	0	65.9	48.5	57.2	3.4	0
May	77.8	54.8	66.3	3.75	0	73.4	58.3	65.9	4.0	0
June	84.7	62.8	73.8	4.35	0	81.0	66.8	73.9	3.4	0
July	87.9	67.1	77.5	5.41	0	85.2	71.8	78.5	4.9	0
Aug	86.6	66.2	76.4	5.90	0	83.7	70.7	77.2	4.7	0
Sep	81.6	59.8	70.7	4.09	0	78.1	65.1	71.6	4.8	0
Oct	71.8	48.5	60.2	3.96	0	58.3	53.0	55.7	3.5	0
Nov	62.3	38.7	50.5	2.86	0	59.5	43.5	51.5	3.4	0
Dec	52.4	31.0	41.7	3.50	1.5	51.1	36.0	43.6	3.4	0.9
Average	69.6	47.5	58.6	–	–	66.6	51.7	58.7	–	–
Total	–	–	–	48.14	7.7	–	–	–	47.8	7.8

¹ USDA Soil Survey of Wight County, VA (1986)

² Office of the State Climatologist, Commonwealth of Virginia

The westernmost section of the Town consists of the Windsor Formation, a lower Pleistocene/upper Pliocene gray and yellowish to reddish brown sand, gravel, silt and clay.

The geology of northwestern section of the Town consists of the Chesapeake Group, an upper Pliocene to lower Miocene group which consists of fine to coarse, quartzose sand, silt, and clay deposited mainly in shallow inner and middle shelf waters.

The Town of Smithfield is located within the Coastal Plain Ground Water Area (V.W.C.B., 1985), which is composed of unconsolidated sediments overlying a bedrock basement. The sediments thicken from a featheredge at the fall zone eastward, to a thickness of about 2,500 feet in Norfolk, Virginia. The groundwater in the vicinity of the Town of Smithfield is divided into seven aquifers (USGS, 1988). The aquifers are separated by confining beds that restrict, but do not prevent, vertical water flow between aquifers. General groundwater flow is toward the Atlantic Ocean. Shallow ground water in the Town of Smithfield is believed to flow toward the Pagan River (based on a review of the Smithfield 7.5 minute topographic quadrangle, 1986).

Soils

Soils are important factors in evaluating land use decisions for an area. The 1986 USDA Soil Survey of Isle of Wight County, VA, provides soil information for the Town of Smithfield. Soil types found in Smithfield are described below. These descriptions include a summary discussion of the development constraints of these soils; this issue will be discussed in more detail later in this section. Figure A.1 provides an overview of the soils in the Town of Smithfield.

Alaga fine sand (map unit 1, in the Soil Survey of Wight County). This is very deep and somewhat excessively drained soil that is nearly level to gently sloping and is located on low ridges. Although this soil is loose and is not suited for excavation, it is well suited for homes without basements, septic systems and roads. This soil exists across 0.3 percent of the land surface of the Town.

Bohicket silty clay loam (map unit 2). This soil type is found in the tidal marshes of the Pagan River and Cypress Creek and is only suited as habitat for wildlife and wetlands; it is not suited for development. This is one of the most common soils in the Town of Smithfield, existing across 13.2 percent of the land surface of the Town.

Chickahominy silt loam (map unit 3). This is a very deep poorly drained soil that can be found on upland flats. It is best suited for forestry and poorly suited for crops. It has a high shrink – swell capacity and a low strength. It is therefore not well suited for septic tanks, buildings and roads. This is also one of the most common soils in the Town of Smithfield, existing across 8.3 percent of the land surface of the Town.

Chipleys sand (map unit 4). This is a very deep, moderately well drained soil located on ridges and in depressions next to flood plains. This soil is best suited for woodland. Because this soil is loose, it is not well suited for excavation, dwellings, septic systems and roads. Furthermore, the soil survey mentions that this soil should not be used for leach or spray fields because of the soil's high permeability. This soil is not common in Town, limited to approximately 30 acres.

Emporia fine sandy loam (map unit 5). This soil type contains two classes: map unit 5A has 0 to 2 percent slope, and map unit 5B has 2 to 6 percent slope. These soils are very deep and well drained. They are well suited for agricultural crops and pasture. In particular because of the wetness of the subsoil, these soils are considered ill-suited for dwellings, septic systems and roads. This soil exists across 2.2 percent of the land surface of the Town.

Place Holder for figure A.1

Kenansville loamy sand (map unit 6). This is a very deep, well drained soil. It is well suited for crops and woodlands. Because of the soil's looseness, it is not suited for excavation, dwellings, septic systems and roads. Furthermore, the soil survey mentions that this soil should not be used for leach or spray fields because of the soil's high permeability. This soil exists across 1.6 percent of the land surface of the Town.

Kinston loam (map unit 7). This is a very deep poorly drained soil located in depressions and drainage ways that is mostly used for forestry in Isle of Wight County. Because this soil is loose and has low strength, it is not well suited for excavation, dwellings, septic systems and roads. This soil exists across 2.3 percent of the land surface of the Town.

Nawney loam (map unit 10). This soil type is mostly found in flood plains. It is very deep and poorly drained. Frequent flooding and wetness makes this soil unsuitable for development. This soil exists across 0.1 percent of the land surface of the Town.

Nevarc and Remlik Soils (map unit 11E). These are very deep soils located on steep slopes (15 to 60 percent slope) along well-incised drainage ways. These soils' steepness makes them unsuitable for development. These are common soils in the Town of Smithfield, existing across 11.0 percent of the land surface of the Town.

Peawick silt loam (map unit 12). This soil types contains three classes: map unit 12A has 0 to 2 percent slope; map unit 12B has 2 to 6 percent slope; and map unit 12C has 6 to 10 percent slope. These soils are very deep and moderately well drained soils on ridge tops and side slopes, and have a high shrink – swell potential. Because of the soil's inherent low fertility it is not well suited for crops. However it is well suited for pasture and forestry. Wetness, low strength, and the shrink – swell capacity are limitations to the use of this soil for building site development, septic tanks and roads. This is the most common soil unit in the Town of Smithfield, existing across 26.5 percent of the land surface of the Town.

Peawick clay loam (map unit 13B3). This map unit represents severely eroded Peawick soils. They are generally found in areas with 2 to 6 percent slope. Erosion has removed much of the original surface layer and exposed the subsoil. This soil exists across 0.7 percent of the land surface of the Town.

Peawick – Slagle complex (map unit 14B). This complex contains 40 percent Peawick soils, 40 percent Slagle soils and 20 other soil types. It is very deep and moderately well drained and can be found on gentle slopes (2 to 6 percent slope). These soils are very well suited for agriculture and forestry. Wetness, permeability, low strength, and the shrink – swell capacity are limitations to the use of this soil for building site development, septic tanks and roads and streets. This soil exists across 2.9 percent of the land surface of the Town.

Rumford loamy sand (map unit 16). Rumford soils are very deep and somewhat excessively drained. They are nearly level to gently sloping and have a moderately rapid infiltration. These soils are well suited for cultivated crops. Wetness, low strength, and the shrink – swell capacity are limitations to the use of this soil for building site development, septic tanks and roads. This is one of the most common soils in the Town of Smithfield, existing across 11.2 percent of the land surface of the Town.

Slagle sandy loam (map unit 17B3). This map unit represents severely eroded Slagle soils with a 2 to 6 percent slope. This soil unit is very deep, moderately well drained and gently sloping. It is generally encountered at the toe of slopes, and therefore is not common in the Town of Smithfield. Wetness and low strength are limitations to the use of this soil for building site development, septic tanks and roads. This soil exists across 0.5 percent of the land surface of the Town.

Slagle sandy loam (map unit 18). This soil type contains three classes: map unit 18A has 0 to 2 percent slope; map unit 18B has 2 to 6 percent slope; and map unit 18C has 6 to 10 percent slope. Slagle sandy loams are very deep, moderately well drained soils located on a variety of slopes. Wetness, low strength, and moderately slow permeability in the subsoil are limitations to the use of this soil for building

site development, septic tanks and roads. This soil exists across 4.5 percent of the land surface of the Town.

Uchee loamy sand (map unit 19). This soil type contains two classes: map unit 19A has 0 to 2 percent slope, and map unit 19B has 2 to 6 percent slope. Uchee soils are very deep, well drained and located mostly in broad, interstream areas. Wetness, low strength and moderately slow permeability in the subsoil are limitations to the use of this soil for building site development, septic tanks and roads. This soil exists across 4.4 percent of the land surface of the Town.

Udorthents, loamy (map unit 21). Udorthents are young soils that are forming in areas that have been excavated for construction. Excavations are generally 2 to 15 feet deep. Because of the nature of these soils, a range of properties can be expected but they are generally not suited for farming. Udorthents have not been investigated for limitations. This soil exists across 0.7 percent of the land surface of the Town.

Urban land (map unit 22). These are soils where more than 85 percent of the surface is covered by asphalt, concrete, buildings or other impervious surfaces. Approximately 1.4 percent of the land surface of the Town Smithfield is classified as Urban land by the 1986 soil survey.

Yemassee fine sandy loam (map unit 23). This soil type is a very deep, somewhat poorly drained soil on broad flats and along shallow drainage ways. It is well suited for cultivated crops and agriculture land. Moderate permeability of the subsoil and low strength are limitations to the use of this soil for building site development, septic tanks and roads. This soil exists across 0.2 percent of the land surface of the Town.

Open water (map unit W). The soil survey classifies 8.9 percent of the Town of Smithfield corporate limits as open water.

Soils types are generally consolidated into units based on common soil property, location in the landscape and proximity to each other (Figure A.2). These units have a generalized suitability for a given use that is usually sufficient for planning purposes. The soil survey of Isle of Wight County indicates that Smithfield has four soil units within the Town boundaries:

Slagle-Uchee-Yemassee: This soil unit is moderately well drained, well drained and somewhat poorly drained. It is nearly level to gently sloping. It contains mostly loamy soils and can generally be found in uplands. In the Town of Smithfield, this soil unit is located west and north of downtown and in a small area west of Moon Creek. In the County, these soils are traditionally used for agriculture and forestry. Sites with this soil type have a limited suitability to development of sanitary facilities (septic systems), but are moderately well suited to building site development. Seasonal wetness is the main limitation.

Rumford-Kenansville: This loamy soil unit is somewhat excessively drained and well drained, nearly level to gently sloping. In Smithfield it can be found in a narrow strip that runs north-south from the Pagan River along Highway 10 east of Cypress Creek. In the County, these soils are traditionally used for agriculture. Sites with this soil type are well suited to sanitary facilities (septic systems) and to building site development.

Peawick-Chickahominy: This soil unit has moderately well drained and poorly drained soils that are nearly level to gently sloping. Soils are clayey and can be found in broad uplands. In the Town of Smithfield, these soils can be found in a narrow strip east of the Rumford-Kenansville soil unit. In the County, 35% of these soils are cleared for pasture and crops; the remainder is used for forestry. Sites with this soil type are poorly suited to sanitary facilities (septic systems) and to building site development. Seasonal wetness is the main limitation.

Place Holder for figure A.2

Bohicket-Rappahannock: This soil unit contains soils that are very poorly drained and nearly level. These soils are clayey and mucky and are located in the tidal marshes of the Pagan River, Cypress Creek and Moon Creek. These soils are not suited for development and are used as wetland and habitat for wetland wildlife. In the Town of Smithfield, these soils are mostly located in the Resource Protection Area (RPA) along the main drainages.

WATER RESOURCES

Surface Water

Surface Water Bodies in the Town of Smithfield

The Town of Smithfield and the Pagan River are located within Hydrologic Unit Code (HUC) 0208026093 of the Virginia Hydrologic map. Four main water bodies exist within the town limits: the Pagan River and its tributaries Cypress Creek, Moon Creek and Mount Holly Creek. The far eastern section of the town contains a few drainage ways that are tributaries to Jones Creek.

Surface water circulation in the Pagan River is mainly driven by tidal movements and to a lesser extent by groundwater and overland flow from rain in the surrounding watersheds. Waters within the Pagan River and its tributaries are predominately brackish with a salt wedge that has been noted to extend to the headwaters of the Pagan River during slack tides (Hampton Roads Water Quality Assessment 1993).

Surface Water Quality

On September 30, 2002, the Virginia Department of Environmental Quality (DEQ) published a report on Impaired Waters in Virginia. In this report, DEQ identified a total of 4,318 stream miles that are impaired because of human activity. DEQ designated the upper and middle segments of the Pagan River in the Town of Smithfield as impaired waters. Both reaches exist within the Town boundaries although the upper Pagan River reach begins west of Smithfield. These reaches were determined to be impaired because of fecal coliform contamination and failure to meet the general standard for benthic macroinvertebrates. Furthermore, the upper reach was determined to have a low Dissolved Oxygen level. Both reaches were included on the list for the first time in 1996 with the noted pollution source as "unknown".

As part of an agreement between the EPA and the State of Virginia a Total Maximum Daily Load (TMDL) must be developed for all waters included on the Virginia list of impaired waters. The TMDL will set a maximum loading rate from all pollution sources within the specified watershed. The EPA and the State have agreed that TMDLs for the upper and middle reach of the Pagan River will be developed by 2010.

Currently, surface water is not being used as a source of potable water within the Town limits; therefore, no surface water withdrawals exist within the Town.

Submerged Aquatic Vegetation

Submerged aquatic vegetation (SAV) is a diverse assembly of rooted macrophytes (aquatic plants) found in shoal areas of the Chesapeake Bay, from its mouth to the headwaters of its tributaries. The presence of SAV is an important contributor to, and indicator of, the health and productivity of the bay. In addition, SAV serves as breeding grounds and nurseries for many aquatic species. A dramatic bay wide decline of

all SAV species was seen in the late 1960's and 1970's, a decline correlated with increasing nutrient and sediment inputs from development of the surrounding watershed.

No Submerged Aquatic Vegetation (SAV) beds were reported in the 1975 Shoreline survey of the Pagan River by VIMS. Recently, the Chesapeake Bay Program (CBP) has developed a three-tiered framework of SAV restoration goals or targets:

- Tier I goal: To restore or establish SAV in areas of historic (1971 to 1990) distribution.
- Tier II target: To restore or establish SAV in potential habitat to a depth of 1 meter.
- Tier III target: To restore or establish SAV in potential habitat to a depth of 2 meters.

The Pagan River is considered a CBP Tier III restoration area. More information regarding the SAV restoration areas can be found at the website of the CBP (<http://www.chesapeakebay.net/savrest.htm>) and in the Hampton Roads Shoreline Stability Report (not dated).

Condemned Shellfish Beds

The Virginia Department of Health has condemned the taking of shellfish from the Pagan River, Cypress Creek and Jones Creek since 1972, as the result of the "Shoreline Sanitary Survey" that is detailed in the section on Threats to Surface Water Quality (Figure A.3). The condemned area is known as "*Closed Shellfish Harvest Area Number 64*" and includes all of the Pagan River, Jones Creek, Williams Creek, Cypress Creek, Titus Creek and their tributaries. Improved water quality may serve to boost the commercial fisheries markets and would allow for greater profits from the commercial harvesting of both fish and shellfish in the future.

Shoreline Conditions and Shoreline Erosion Characteristics

The shorelines of the Pagan River are generally stable. However, a 1975 VIMS shoreline condition report identified several areas of concern which are most likely caused by boat wakes. Erosion in the area from Days Point to Williams Creek in the mouth of the Pagan River was designated an erosion rate of 3.4 ft/yr. The area from Williams Creek to the Mouth of the Pagan was assigned an erosion rate of 2.6 ft/yr that was described as moderate and non-critical. Severe erosion was noted in a ¾ mile stretch from Goodwin Point east. The 1975 VIMS shoreline condition report recommended the establishment and enforcement of no wake zones in all areas experiencing significant shoreline erosion.

As part of the preparation of this document, a brief review of the shorelines in the Pagan River and Cypress Creek was conducted to identify highly erodible areas. Aerial photographs were reviewed and areas identified as having potential shoreline erosion were thereafter visited in the field. Furthermore, VIMS was contacted for information on shoreline erodibility in Isle of Wight County. From these reviews, it appears that the shorelines of the Pagan River and tributaries are relatively stable. Furthermore, VIMS affirmed that an Isle of Wight Co. shoreline erosion assessment report will be published in the spring of 2003.

Public Access

Boating access is important to the Town of Smithfield as shown by the number of private and public boat docks. Through review of aerial photographs, the amount of boat docks was counted within the three navigable waterways within the town (Figure A.3): the Pagan River, Moon Creek, and Cypress Creek. The distribution of boat docks includes 73 private docks and 3 public docks. The Pagan River has 40 private and 3 public boat docks along the banks. Moon Creek has 11 private docks, and Cypress Creek has 22 private boat docks. There are no public docks in Moon Creek or Cypress Creek. The Virginia Outdoors Plan recommends that more public boat docks should be installed to enhance the use of Smithfield's navigable waters (Virginia Outdoors Plan 2002).

Place Holder for figure A.3

Place Holder for figure A.4

Ground Water Resources

Groundwater Aquifers

Groundwater in the vicinity of the Town of Smithfield is divided into seven aquifers, which are subdivided by six confining units or aquacludes (USGS 1988). The stratification of the aquifers and aquacludes is provided in Table A.3. These aquifers and aquacludes exist in sediments ranging in age from the relatively recent Holocene (the Columbia aquifer) to older Early Cretaceous (the Middle and Lower Potomac aquifers and aquacludes).

Location of Groundwater Wells

The Town of Smithfield has owned and operated its water system since 1905 (AES 1999). With the exception of a small number of private wells and the packing plants, the Town water system supplies water to all businesses and residences within the Town limits. The Town's water system currently consists of 2,918 connections.

Four public groundwater wells are currently operated by the Town of Smithfield. The four public water wells are located as follows: (1) Cary Street, (2) West Street (Jersey Park), (3) Edgewood-Jefferson Drive and (4) South Church Street. The Town of Smithfield's Public Works web page indicates that the shallow wells draw water from the Upper Potomac aquifer whereas the deeper South Church Street well draws water from the Middle Potomac Aquifer. Table A.4 provides additional information regarding the Town's public drinking water wells.

Some residences and businesses operate private ground water wells within the Town limits. The Town of Smithfield Water Master Plan lists the following thirteen private wells (AES 1999):

- Smithfield Foods, Inc. operates six wells.
- Felts well at Red Point Drive serves eight residences.
- Chapman well at Red Point Drive serves one residence.
- Dashiell Drive and Pleasant Lane well serves seventeen residences.
- River Oaks well serves nine residences.
- Old Jericho well serves nine residences.
- Magette well on Battery Park Road serves four businesses.
- Battery Park Road well serves an unknown number of residences.

The VDEQ files indicate that seventeen private wells (including two abandoned wells) exist within the Town of Smithfield's corporate limits. Records indicate that all but one of these wells appear to be owned and operated by Smithfield Packing/Gwaltney Foods. It is likely that VDEQ's records are incomplete and do not include all existing wells.

The Town of Smithfield has issued approximately seventeen zoning permits for irrigation wells in recent years. These wells do not appear to be included in the above lists of wells.

Table A.3
Stratification of the Aquifers and Aquicludes in the vicinity of Smithfield

Aquifer/Aquaclude	Epoch	Geologic Formation	Location
Columbia aquifer	Pleistocene and Holocene	Undifferentiated sediments	Shallow
Yorktown confining unit	Pliocene	Yorktown Formation	
Yorktown-Eastover aquifer	Pliocene	Yorktown Formation	
Calvert confining unit	Miocene	Calvert Formation	
Chickahominy-Piney Point aquifer	Eocene and Oligocene	Old Church, Chickahominy, and Piney Point Formations	
Nanjemoy-Marlboro confining unit	Eocene	Nanjemoy Formation and Marlboro Clay	
Aquia aquifer	Palocene	Aquia Formation	
Upper Potomac confining unit	Late Cretaceous	Potomac Formation	
Upper Potomac aquifer	Late Cretaceous	Potomac Formation	
Middle Potomac confining unit	Late Cretaceous	Potomac Formation	
Middle Potomac aquifer	Late Cretaceous	Potomac Formation	
Lower Potomac confining unit	Early Cretaceous	Potomac Formation	
Lower Potomac aquifer	Early Cretaceous	Potomac Formation	
Bedrock Basement			Deep

The Town currently regulates through ordinance the installation of private wells; however, it appears that many residents are not aware of the regulations. In addition, the ordinance does not regulate the abandonment of wells. Therefore, wells may have been installed within the Town limits without the Town's knowledge.

It is recommended that the Town create a database of privately owned and operated wells within the Town limits. A mechanism to identify abandoned wells and implement reporting requirements and standards for the installation of new wells, the retrofitting of existing wells and the abandonment of wells should be incorporated by the Town. This reporting requirement should be widely publicized to prevent wells being installed, retrofitted and abandoned without the Town's knowledge. Information pertaining to regulated wells should be forwarded to VDEQ and the Virginia Department of Health. A database of this sort will help to identify threats to ground water quality and potable water sources. In addition, this requirement would prevent the improper abandonment of wells.

**Table A.4.
Public Water Well Information for the Town of Smithfield**

Location	Date Constructed	Capacity	Depth	Aquifer
Well #1 Edgewood-Jefferson Drive	1991	250 GPM	454 feet	Upper Potomac
Well #2 S. Church Street	1984	1,000 GPM	1,005 feet	Middle Potomac
Well #3 Cary Street	n.a.	213 GPM	407 feet	Upper Potomac
Well #4 Jersey Park	n.a.	216 GPM	437 feet	Upper Potomac

Note: Information in this table, with the exception of the aquifer column, was taken from the Town of Smithfield Water Master Plan, Master Utility Plan Final Report (AES, 1999).
n.a. = not available; GPM = Gallons per Minute

Groundwater Quantity and Quality

Quality

The United States Geological Survey (USGS, 1993) describes water quality within each aquifer of the Coastal Plain of Virginia. This report indicates that the Upper Potomac aquifer, from which five of The Town of Smithfield's public water wells draw, is slightly basic throughout the aquifer. The above referenced report indicates that natural concentrations of fluoride, sodium, and dissolved solids in the Upper Potomac and Middle Potomac aquifers in the vicinity of Smithfield appear to exceed state and federal clean drinking water standards. Natural concentrations of chloride, silica, sulfate, alkalinity, hardness and pH in the Upper Potomac and Middle Potomac aquifers in the vicinity of Smithfield appear to be below state and federal standards.

The Town's annual drinking water quality report for its public water system is available on the Town of Smithfield Public Works website. Data from this report reveals that for the past year, public drinking water in the Town met all federal and state requirements. It is noted that fluoride levels exceed the Secondary Maximum Contaminant Level (SMCL) of 2.0 mg/L, but lie below the Primary Maximum Contaminant Level (PMCL) of 4.0 mg/L. The Town of Smithfield is under a Consent Order with the Virginia Department of Health (VDH) to reduce naturally-occurring levels of fluoride found in our drinking water. The Town awaits final approvals to construct a Reverse Osmosis System with a new well to reduce the amount of fluoride in the drinking water. In addition, regular monitoring and testing as required by Federal and State laws will ensure that the ground water in the Town of Smithfield remains safe for drinking or that impaired water is detected quickly.

Quantity/Growth Projections

The Hampton Roads Ground Water Use Analysis (HRPDC, 2002) discusses what would occur if every ground water permit in the Hampton Roads area was operated at its maximum permitted level versus its current level. This document states that wells withdrawing water from the Upper Potomac aquifer could experience head losses ranging from five to twenty feet in the western portion of Hampton Roads. In

addition, wells pumping from the Middle Potomac aquifer (i.e. one of the public drinking water wells in Smithfield and the proposed wells) could experience from forty to fifty feet of head loss.

The Town of Smithfield is currently participating in the Hampton Roads regional water supply plan with the Hampton Roads Planning District Commission.

Land Use and Water Use

The Town of Smithfield lies within the James River watershed. Thirty-six (36) percent of the land within the town is zoned for residential areas, six (6) percent of the Town is commercial, and four (4) percent is zoned for industrial use. The remainder of the land within the town limits (54 percent) is undeveloped, with a minor portion containing highways. The undeveloped areas also include agricultural lands.

Within the residential areas, water is primarily used for drinking and irrigation of lawns and gardens. The industrial and commercial areas within the Town use water for industrial purposes including cooling and heating, watering livestock and food processing. The undeveloped areas use water for irrigating crops and watering livestock, and provide for ground water filtration and recharge. The Town sells a portion of its water to Isle of Wight County to provide water to Gatling Pointe and Battery Park northeast of Town.

Alternative Sources of Potable Water

The Town may be able to purchase some water from Isle of Wight County for the south side of Town. This water could be supplied through an 8-inch water main that runs along Route 10. Other alternative sources of potable water do not appear to be practical for the Town of Smithfield. The rivers and creeks in the vicinity of the Town have a high salinity and would require extensive removal of contaminants. The 1979 study entitled the "Hampton Roads Water Management Plan" stated that the maximum salinity in the Pagan River near Smithfield was 4.5 parts per thousand. The Town owns a lake; however, it would not be large enough to provide an adequate supply of drinking water to the Town. Therefore, it appears that ground water is the only practical source of potable water for the Town.

Ground Water Protection and Conservation

The State Water Control Board established the Eastern Virginia Ground Water Management Area (9VAC25-600-20) to include Isle of Wight County. All aquifers located between the land surface and basement rock within the Eastern Virginia Ground Water Management Area are subject to the corrective controls set forth in the Ground Water Management Act of 1992. The purpose of this Act is to ensure public welfare, safety and health by managing and controlling ground water resources through conservation and protection.

The Town of Smithfield realizes that it is important to protect and conserve groundwater and cooperates with adjacent jurisdictions in advancing planning and implementation programs that ensure the continued availability of raw water supply sources. The Town also plans to protect the quality and reliability of the regional aquifer by ensuring judicious use of ground water supplies, thus ensuring that the long-range municipal water supply requirements of Smithfield are served.

For the Town of Smithfield to develop an effective ground water protection program it should prepare a ground water management plan consisting of locally appropriate management techniques and community specific goals and objectives. In completing this management plan, the Groundwater Protection Handbook for Southeast Virginia (Carlock and Wickham, 1990) may be a valuable resource.

Water conservation is one way of achieving water quantity and quality goals, according to the Virginia Department of Health, Division of Drinking Water, and local water conservation measures should

therefore be developed and implemented. In addition, water conservation can have major public health, environmental, and economic benefits. Reducing drinking water demand helps improve water quality, maintain aquatic ecosystems and protect potable water resources. Furthermore, using drinking water efficiently can reduce wastewater flows and require less energy, thereby reducing pollution. The Environmental Protection Agency prepared Guidelines for Preparing Water Conservation Plans (Virginia Department of Health, Division of Drinking Water) which localities can use in designing water conservation programs. The Town recently adopted a new Water Conservation and Management Program.

Threats to Water Quality

Land use

Land use in the Town of Smithfield can be divided into four major land use categories. As mentioned previously, 36 percent of the land within the town is zoned for residential areas, 6 percent of the Town is commercial, and 4 percent is zoned for industrial use. The remainder of the land within the town limits (54 percent) is undeveloped, with a minor portion containing highways. The undeveloped areas also include agricultural lands.

The Virginia Department of Health, Division of Drinking Water, developed a Source Water Assessment Program (Virginia Department of Health 1999). A section of the document provides an inventory of various land use activities as they relate to potential risks to surface water and ground water. Only eleven land use activities are considered to be of high risk to community and non-transient, non-community waterworks. These eleven include confined animal feeding operations (permitted and non-permitted), hazardous waste recovery facilities, hazardous waste transfer, storage, or disposal facilities, military bases, superfund sites, underground injection wells, underground storage tanks (USTs), unlined landfills, tire piles, and open dumps. Based on the research conducted as part of this Comprehensive Plan, it appears that the majority of these high-risk land uses do not exist within the Town limits. Animal feeding operations and USTs appear to be the only land uses within the Town limits that are classified as a high risk to surface water and groundwater by the Division of Drinking Water.

Surface Water Quality Threats

The Virginia Department of Health (VDH) conducted a Shoreline Sanitary Survey from July 1998 through May 1999 in Isle of Wight County to identify potential sanitary problems. Sixteen sites were identified within the limits of the Town of Smithfield with either known or potential threats to water quality. These potential threats to water quality were categorized as follows: (1) sewage and potential sewage deficiencies, (2) industrial waste sites, (3) boating activities (marinas), and (4) animal pollution sites.

Anecdotal reports indicate that water quality in the Pagan River has improved over the last several decades. The most likely reason for this improvement is the recent connection of the Town to the Hampton Roads Sanitation District transmission and treatment facilities. This step is anticipated to result in long-term improvements to the water quality in the Pagan River and its tributaries. Current threats to water quality are primarily surface water runoff from impervious areas within the watershed, including the historic downtown area.

Septic Systems

In 1999 approximately 115 residences and businesses in Smithfield (approximately 6% of the Town) used private septic systems, according to the Town of Smithfield Wastewater Master Plan (AES 1999). The Shoreline Sanitary Survey identified five of the Town's ten planning areas as having problems with their septic systems including Battery Park South, Battery Park North, the Southern Gateway Planning area,

the West Main Planning area and the Pagan Pines Planning area. The problems typically consisted of bubbling septic tanks, kitchen waste discharge through a pipe into an open ditch and effluent leakage from drainfields onto the ground surface. Furthermore, two potential sanitary deficiencies were observed at residential sites where the septic systems appeared not to work properly during wet weather conditions. The VDH report noted that all sites with sanitary deficiencies were potential indirect contributors to surface water pollution. The Town has recently adopted a Septic Tank Pump-out Program, whereby septic tanks must be pumped out once every five years in order to decrease the potential for problems.

All new development is required by the Town to connect to the public sewer system, reducing the threat of septic systems to the surface water and ground water. As existing septic systems are disconnected, they should be properly abandoned to ensure that no contamination from them occurs over time. Therefore, septic systems are believed to represent a minor potential source of impairment to the groundwater. With proper maintenance and abandonment this potential source of pollution can be further minimized.

Industrial Sites

The VDH report identified two potential industrial/commercial sites that might be a threat to surface water in the Town of Smithfield, including a combined garden center and concrete plant and a fuel oil company. The combined garden center and concrete plant contains a 4,000-gallon fuel oil tank. Excess concrete materials are discharged into a pond and holding tanks for treatment. The other site is a fuel oil company, having two 20,000 gallon #2 fuel oil tanks, a 20,000-gallon kerosene tank, a 20,000 unleaded fuel tank, and a 15,000-gallon super unleaded fuel tank. Test wells surround the fuel oil site. The Department of Environmental Quality (VDEQ) inspects both sites and these facilities are not expected to pose a threat to surface water if they remain in compliance with the regulations, their classifications and permits.

Highly Erodible Areas and Shoreline Erosion

Living on the waterfront is highly desirable throughout the country and building and living along the waterfront has the potential of exposing private property and the adjacent waters to erosion and high sediment loads. Furthermore, these activities may actually accelerate shoreline erosion in some cases. Similarly, erosion in general, and in particular shoreline erosion, is a major threat to surface water quality in the Pagan River, Cypress Creek and the Chesapeake Bay. The Hampton Roads Planning District Commission published a guidance manual on addressing shoreline erosion (HRPDC 1999), in which it provides a description of erosion, its causes and suggested remedies. It also provides examples of slope stabilization measures. These guidelines need to be considered when reviewing waterfront and shoreline development proposals as well as in the treatment of highly erodible sites.

Evidence of the link between erosion and bay water quality has been illustrated by the drought of the recent years. Reports abound that the recent lack of precipitation has decreased sediment loads in the Chesapeake Bay and upstream erosion and greatly improved the water quality and SAV cover in the Bay. This illustrates the potential beneficial effect of erosion control and shoreline stabilization.

Non-point Source Pollution

Non-point source pollution is a form of contamination that cannot be tracked to a single source. It originates from a diverse and diffused group of sources including water runoff from impervious areas such as roadways, parking lots, sidewalks, rooftops and from highly developed area such as residential yards and urban landscaped areas. Table A.5 provides an example of some non-point source pollutants. Under natural conditions, water from rainfall soaks into the ground and is filtered by the soil before it reaches the groundwater. Under developed conditions, not all rainwater can infiltrate the soil and the amount and velocity of rainwater runoff is directly correlated to the intensity of land use and percent impervious area in a watershed. Runoff will pick up the various pollutants and deposit them in the surface water.

**Table A.5.
Non-Point Source Pollutants**

Pollutant	Potential Sources
Lead	Automobile exhaust, (old) exterior paint, (old) roofing materials
Zinc	Leaching and abrasion of galvanized iron and steel and atmospheric fallout
Copper	Leaching and abrasion of copper pipes, brass fittings, and roofing materials; automobile brake linings
Chromium	Atmospheric fallout from cement plants; automobile exhaust, and leaching and abrasion of chromed metal on automobiles and machinery
Biological Oxygen Demand (BOD)	Vegetation, yard waste, litter, garbage and animal wastes
Phosphates	Vegetation, yard waste, litter, garbage, animal wastes, fertilizer and car wash soap
Nitrogen	Vegetation, yard waste, litter, garbage, animal wastes and fertilizer
Pesticides	Vegetation, landscaped areas, yards and yard waste
Total Suspended Solids (TSS)	Construction sites, land disturbing activities, erosion and yard waste
Oil and grease	Leakage from automobiles and machinery and improper disposal of waste oil after "at home" oil changes

The increased volume and velocity will also cause erosion on non-developed sites, in particular when these sites do not have a vegetative cover. Furthermore, increased flow and sediment load has the potential to further increase erosion and sedimentation in the streams.

Minimizing the amount of impervious surface can reduce urban non-point source pollution. The preservation of open space and natural vegetation can slow down the runoff and allow it to infiltrate into the soil. Moreover, the use of Best Management Practices (BMPs) can also reduce the non-point source pollutants entering a stream, by increasing the retention, detention and filtering of the runoff. The Town of Smithfield has developed specific guidelines for the total amount of impervious areas in specific zoning districts, the use of BMPs, and other erosion control measures. Adherence to these guidelines should be beneficial in minimizing non-point source pollution in the Town limits.

Groundwater Quality Threats

In August 2002, the Virginia Department of Health prepared a source water assessment report for the five active groundwater wells in the Town of Smithfield (VDH 2002). While the assessment report mentions that no known contamination of the Town's drinking water wells has occurred in the past 5 years, it examines the vicinity of all wells for four activities that could potentially contaminate the groundwater and therefore the drinking water quality in the Town of Smithfield. For the assessment, the areas around the wells were divided into two zones: Zone I is an area with a 1000-foot radius around the well and Zone II is an area with a 1-mile radius. Potentially contaminating activities examined in these zones include: (1) Land Use Activities of Concern in Zone I; (2) Conduits to Groundwater in Zone I, (3) Potential Sources of Contamination in Zone II; and (4) Best Management Practices (BMP) in Zone II. The report is summarized in Table A.6. "Land Use Activities of Concern" were observed within 1000 feet of all wells. These activities range from the storage of fuel oil and crop production to furniture refinishing. Two of the wells have potential "Conduits to Groundwater" within 1000 feet, including the Pagan River and an unnamed pond. Three of the wells have "Potential Sources of Contamination" within one mile of the well and all wells have at least one nearby BMP. The VDH ranks the potential threats of all activities as either low or medium, but the overall susceptibility of the groundwater to contamination is considered high for all wells. This high susceptibility of the groundwater to contamination is partly caused by the relatively small size of the Town and the lack of undeveloped land. Smithfield does not appear to have any area where the groundwater is not potentially impacted by any of the four listed threats.

Underground Storage Tanks (USTs)

Regulations and standards for underground storage tanks (UST's) in Virginia are provided by the VDEQ Storage Tank Program Technical Manual (1997). Through these regulations, VDEQ is required to maintain a database of regulated underground storage tanks (USTs) in the State of Virginia. Regulated USTs include USTs that are currently in use, USTs that have been removed from the ground, USTs that are closed in the ground, and USTs that have been reported as leaking underground storage tanks (LUSTs). Heating oil tanks with a capacity of less than 5,000 gallons, USTs with a capacity of 1,100 gallons or less containing motor fuel for noncommercial purposes, wastewater treatment tanks and USTs holding hazardous wastes are exempt from VDEQ's UST regulations.

The Storage Tank Program Technical Manual (1997) also provides standards for UST and piping construction, release detection, corrosion protection and overflow and spill prevention to which all regulated USTs are required to adhere.

A review of VDEQ's database revealed that sixty-three USTs are registered with VDEQ as being "currently in use" within the Town of Smithfield. These sixty-three gasoline, diesel, kerosene, used oil, and heating oil USTs exist at twenty-five distinct facilities. A review of VDEQ's LUST database reveals that twenty-one leaking underground storage tanks have been reported within the Town limits in the past

**Table A.6.
Potential Threats to Groundwater**

Location	Potential Threats to Groundwater Quality				VDH Susceptibility Rating
	Land Use Activities (within 1000 feet of well) and other Potential Sources of Contamination (within 1 mile of well)	VDH Risk type	Potential Conduits to Groundwater (within 1000 feet of well)	Number of Best Management Practice (within a 1 mile of well)	
Well #1 Edgewood- Jefferson Drive	<ul style="list-style-type: none"> ➤ Fuel storage system ➤ Crop and fodder production ➤ 2 Meat products, pork, ham facilities ^a ➤ Ham and sauces facility ^a 	<ul style="list-style-type: none"> - Medium - Medium - Medium - Low 	Pagan River within 318 feet from well	1	High
Well #2 S. Church Street	<ul style="list-style-type: none"> ➤ Furniture/boat refinisher/boat yard ➤ Fuel storage system ➤ 2 Gasoline stations/service centers ➤ Storm sewer discharge/infiltration ponds ➤ Car wash ➤ Primary roadways ➤ Parking lot 	<ul style="list-style-type: none"> - Medium - Medium - Medium - Low - Low - Low 	Unnamed pond	1	High
Well #3 Cary Street	<ul style="list-style-type: none"> ➤ Fuel storage system ➤ Crop and fodder production ➤ Gasoline station/service center ➤ 3 Fuel storage systems ➤ Ham & Bacon ^a ➤ Commercial offset printing, glue, plastic ^a ➤ Weekly newspaper publishing ^a ➤ Sheet metal fabrication ^a ➤ 2 Meat products, pork, ham facilities ^a ➤ Discharge without facility ^a ➤ Car wash ➤ Primary roadways ➤ Ham and sauces facility ^a 	<ul style="list-style-type: none"> - Medium - Low - Low - Low 	None	1	High
Well #4 Jersey Park	<ul style="list-style-type: none"> ➤ Above ground storage tank ➤ 27 Fuel storage systems ➤ Discharge without facility ^a ➤ Ham & bacon facility ^a ➤ Commercial offset printing, glue, plastic ^a ➤ Weekly newspaper publishing ^a 	<ul style="list-style-type: none"> - Medium - Medium - Medium - Medium - Medium - Medium 	None	1	High

Location	Potential Threats to Groundwater Quality				VDH Susceptibility Rating
	Land Use Activities (within 1000 feet of well) and other Potential Sources of Contamination (within 1 mile of well)	VDH Risk type	Potential Conduits to Groundwater (within 1000 feet of well)	Number of Best Management Practice (within a 1 mile of well)	
	<ul style="list-style-type: none"> ➤ Sheet metal fabrication ^a ➤ 2 Parking lots ➤ Primary roadways ➤ Wastewater pumping station 	<ul style="list-style-type: none"> - Medium - Low - Low - Low 			
Well #5 Pinewood Heights	No data available, well used only in case of emergencies				

^a While no contamination was detected, these activities were identified by the VDH as “Potential Source(s) of Contamination” within a 1 mile radius of the well.

13 years. VDEQ has closed a majority of these cases. Potentially, these USTs, as well as the currently in use USTs within the Town limits, may represent sources of impairment to the groundwater aquifers (primarily the shallow Columbia aquifer) if they are not properly monitored and maintained per VDEQ's UST standards.

Landfills

A review of the "Solid Waste Facilities" registered in Virginia's DEQ Tidewater Regional Office (April 23, 2002) revealed that no permitted solid waste facilities exist within Smithfield's town limits. However, numerous solid waste facilities exist in Isle of Wight County, some of which are owned or operated by companies from Smithfield. These solid waste facilities are not believed to represent sources of impairment to the Town's groundwater, as they are not located within the Town limits.

Hazardous Waste Facilities

A review of the Environmental Protection Agency's Envirofacts website revealed that twelve facilities within Smithfield have reported hazardous waste activities. None of these facilities are Superfund sites or Resource Conservation and Recovery Act (RCRA) large quantity generators (facilities which generate 1,000 kg or greater per month). Two of these facilities are RCRA Small Quantity Generators (facilities which generate more than 100 kg, but less than 1,000 kg per month), three are classified as RCRA Conditionally Exempt Small Quantity Generators (facilities which generate up to 100 kg per month) and the remaining sites do not have a handler or facility classification. Two of these facilities (Gwaltney of Smithfield Limited Incorporated and the Smithfield Packing Company Incorporated) have reported toxic releases to surface water from their facilities. The remainder of the facilities, according to a review of the Envirofacts website, have not had any reported violations. Current environmental regulations are protective of the surface water and groundwater, and if these regulated facilities remain in compliance with their classification and permits, they are not believed to represent a source of impairment to groundwater. However, should a release occur from one of these hazardous waste facilities, groundwater (primarily within the Columbia aquifer) might be impacted.

Mining Activities

Mining activities within the State of Virginia, including borrow pits and "sand operations", are regulated by the Virginia Division of Mineral Mining. The Town of Smithfield has one borrow pit located in the southernmost section of Town. This was a pre-existing borrow pit when the Town annexed land from Isle of Wight County in January 1998. An interview with Mr. David Benner of the Virginia Division of Mineral Mining revealed that no additional permitted mining activities exist in the Town of Smithfield. However, numerous "sand operations" exist in Isle of Wight County, three of which are between one half and one mile distant from the Town of Smithfield. These operations are not believed to represent a source of impairment to the Town's groundwater.

Septic Systems

In 1999, approximately 115 residences and businesses in Smithfield (approximately 6% of the Town) used private septic systems, according to the Town of Smithfield Wastewater Master Plan (AES, 1999). These septic systems can be grouped into six, or possibly seven areas, according to an interview with Bill Hopkins and Jeff Holland with the Town of Smithfield Planning Department. Fourteen septic systems existed in the Rising Star neighborhood until recently when the residences connected to the Town sewer system as part of a Community Development Block Grant obtained from the Virginia Department of Housing and Community Development. At that time the septic tanks were properly abandoned.

All new development is required by the Town to connect to the public sewer system, reducing the threat of septic systems to the ground water. As existing septic systems are disconnected, they should be properly abandoned to ensure that no contamination from them occurs over time. Therefore, septic systems are believed to represent a minor potential source of impairment to the groundwater. With proper maintenance and abandonment, this potential source of pollution can be further minimized.

Point Source Discharges

The National Pollutant Discharge Elimination System (NPDES) was established by the Clean Water Act to limit pollutant discharges into streams, rivers and bays. VDEQ administers this program in Virginia through the Virginia Pollutant Discharge Elimination System (VPDES). VPDES permits are required for all point source discharges (such as pipes or ditches) to surface waters by businesses, individuals, or governments. VPDES also regulates storm water discharges for certain industrial storm water discharges and larger municipal storm water systems.

In humid areas, such as southeastern Virginia, groundwater of the Columbia aquifer is in direct contact with water in the streams. Carlock and Wickham (1990) estimate that 70-80% of a stream's annual discharge may consist of groundwater. Therefore, it is likely that surface water discharges impact the ground water, primarily the Columbia aquifer.

A review of the Environmental Protection Agency's Envirofacts website indicates that one facility within the Town of Smithfield holds NPDES permits. Smithfield Foods holds the second NPDES permit in the Town. Smithfield Foods conducts sampling and monitoring of their discharge on a regular basis, per its permit requirements. Review of the data on the Envirofacts website indicates that these facilities were not in violation of their permits.

An interview with Carolyn Putnam, with the VDEQ, revealed that three VPDES permits have been issued in the vicinity of the Town limits. One permit is for Gwaltney Foods and one for Smithfield Foods. The third is for Coastal Borrow Pit, which is located on Casper Circle outside of the Town limits. All three hold general storm water permits and, according to VDEQ records; these facilities appear to be in compliance with their permits.

Poorly Constructed and Abandoned Wells

Records of public and private wells and well abandonment are maintained by the Virginia Department of Health. Furthermore, the Isle of Wight Health Department, Environmental Health Services Division, maintains records on wells in the Town of Smithfield. An interview with an employee of the Isle of Wight Environmental Health Services Division revealed that prior to 1996, private wells were not regulated. He also stated that their records are organized by property and that they do not maintain a master list of permitted or abandoned wells. Due to this organization system, these records were not deemed to be practically reviewable, and therefore were not examined.

The Virginia Department of Environmental Quality also maintains a record of permitted wells. A file review at VDEQ revealed that 25 permitted wells exist in the Town of Smithfield. Three of these wells have been abandoned according to VDEQ's records. All three appear to have been properly abandoned. Many of the files contained well construction logs, which indicated the depth of the well and the materials used to construct the well. However, based on these records it was difficult to determine if the wells were properly constructed.

A letter from the Smithfield Town Manager to Erinn Tisdale of the VDEQ, dated August 30, 2002, mentioned that the Town performs regular maintenance and inspections and conducts repairs as necessary on the public drinking water wells. Therefore, these wells are not believed to be poorly constructed and do not appear to represent a source of impairment to the ground water. In a previous section of this report, it was recommended that the Town create a database of privately owned and operated wells and abandoned wells within the Town limits. A database of this sort would help to identify poorly constructed and improperly abandoned wells within the Town limits and would prevent the improper abandonment and poor construction of wells in the future. Therefore, such a database would help prevent future ground water pollution.

NATURAL RESOURCES

Wildlife

The number and diversity of wildlife species present in an area is correlated to the quality and quantity of available wildlife habitat, and in particular, food and cover. In addition, most species have minimum population size requirements in order to be self-sustaining, and habitat fragmentation that is often the result of development is considered a major threat to indigenous species. In urban situations, parts of a habitat are often cleared for development, and this may impact the long-term sustainability of certain species in an area. Development also increases the total edge of a habitat, which makes it more prone to invasion of competing species.

The Virginia Department of Conservation and Recreation's Historic Resources' Natural Heritage Program and the Department of Game and Inland Fisheries' Fish and Wildlife Information System maintain inventories of wildlife resources and habitats for the Town of Smithfield and Isle of Wight County. In addition to deer and small mammals such as raccoons and squirrels, the wetland habitat in the area fosters a large population of waterfowl. Several species of waterfowl that are on the list of Birds of Special Concern use the tributaries within Smithfield as a stopover and feeding ground during migration periods. The Virginia Institute of Marine Science (VIMS) Environmental Sensitivity Index Maps indicate the following dabbling and diving ducks in the area:

Mallard	Black Duck	Ring necked Duck
Blue-winged Teal	Wood Duck	Ruddy Duck
Lesser Scaup	Greater Scaup	
Common Goldeneye	Canvasback	

Hunting is only allowed on land within the Town of Smithfield that is zoned Community Conservation (C-C) District and Environmental Conservation (E-C) District.

Commercially and Recreationally Important Fisheries

The United States Corps of Engineers released a Final Feasibility Study and Environmental Assessment for Jones Creek, Isle of Wight County, Virginia, in 1996. This study identified the Atlantic silversides, Atlantic croaker, striped anchovy, spot, weakfish, hogchoker, bluefish, naked goby, oystertoad fish, skilletfish, blackcheek tonguefish, summer flounder, and black seabass as the species of fish commonly found in the Lower James River, Pagan River and Jones Creek (U.S. Army Corps of Engineers 1996). While most of these species are not economically exploited, commercial fisheries data published by the Virginia Marine Resource Commission indicate that commercial fisheries are a valuable resource for the Town of Smithfield, with more than \$85,000 produced in 2001 (Table A.7). Most of the income from commercial fisheries comes from the harvesting of blue crab.

Forest Resources

Southeastern Virginia is one of the top lumber producing areas in the Commonwealth of Virginia and primarily produces loblolly pine. International Paper, Inc., a paper and wood products manufacturer, operates a plant in Franklin and is a large employer for the region. As a result of this and other nearby wood product plants, the demand for forest products in the area is high, and pine plantations can yield favorable long-term financial returns. In addition to economic value, forests also provide ecological benefits by maintaining water quality, providing essential habitat for a variety of plants and animals and functioning as windbreaks to prevent soil erosion.

Table A.7
Total Weight (lbs.) and Value (\$) of Commercial Fisheries in the Pagan River, 1996 through 2001

Species	1996		1997		1999		2000		2001	
	Weight (lbs)	Value								
Stripped bass	2,453	\$ 4,245	1,476	\$ 2,037	1,512	\$ 2,669	190	\$ 277	1,282	\$ 2,192
Blue crab	28,049	\$ 17,545	11,497	\$ 11,947	18,056	\$ 13,835	22,497	\$ 18,551	96,464	\$ 82,738
White perch	30	\$ 19			183	\$ 47	92	\$ 23	35	\$ 17
American Eel			1,526	\$ 2,291	1,010	\$ 420	240	\$ 108	284	\$ 380
Atlantic croaker			333	\$ 112						
Catfish							79	\$ 18	23	\$ 13
Carp									359	\$ 36
Red drum									30	\$ 38
Mullet									20	\$ 4
Other fish	20	\$ 6	146	\$ 74						
Total	30,552	\$ 21,815	14,978	\$ 16,461	20,761	\$ 16,971	23,098	\$ 18,977	98,497	\$ 85,418

Note: No harvest reports were available for 1998

Forestland comprises 1,843 acres or 29% of the total land area in the Town of Smithfield, and the timber industry could potentially be an important component of the Town's economy. Existing forests in the Town of Smithfield are mostly zoned as Community Conservation District and Environmental Conservation District. Best management practices (BMPs) performed by landowners and the timber industry should help to ensure the conservation of the Town's forest resources. It is important that the valuable economic and ecological benefits provided by forestlands be conserved and managed to benefit the Town of Smithfield.

Wetlands

Wetlands areas are highly productive ecosystems that perform various vital functions in the environment. Wetlands filter pollutants from water and air, provide critical habitat for a variety of species and potentially reduce flood damage. The U.S. Congress recognized these benefits and passed legislation protecting wetlands in the 1972 Clean Water Act (CWA).

The physical definition of wetlands in the CWA is as follows:

“Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas (33 CFR §328.3(b))”

In order to determine if an area is a wetland, physical conditions in an area are investigated to determine whether the each of the following mandatory parameters exist at the site:

- The dominance of hydrophytic vegetation (wetland plants)
- The presence of hydric soils
- The presence of wetland hydrology

A review of the National Wetland Inventory (NWI) maps for the Town of Smithfield show that there are 1841 acres of wetland within the Town limits (Figure A.5). The wetlands in Smithfield can be divided into two major wetland types: Estuarine (Tidal) Wetlands (1509 acres) and Palustrine (Non-tidal) Wetlands (332 acres). NWI maps provide an indication of the approximate location of wetlands; however, recent reviews show that on a national level, NWI maps are approximately 80 percent accurate. Therefore, NWI maps should not be solely relied upon for the confirmation of wetland areas.

Tidal Wetlands

Tidal (estuarine) wetlands are wetlands that experience periodic flooding by ocean-driven tides. They include salt marshes (emergent wetlands) and salt ponds that contain salt-tolerant grasses, including smooth cordgrass, salt hay grass, giant cordgrass and switchgrass. Other herbaceous plants such as black needlebrush, three-squares, narrow-leaved cattail and rose mallow may be abundant, especially in brackish water areas.

Estuarine wetlands are particularly important habitats for brackish and marine fishes, shellfish, various waterfowl, shorebirds, wading birds and several mammals. Most commercial and game fishes use the tidal marshes and nearby estuaries as nurseries and spawning grounds. Menhaden, bluefish, flounder, sea trout, mullet, croaker and striped bass are some of the most familiar fish species that depend on these areas. The Chesapeake Bay and its tributaries are the major spawning and nursery grounds for striped bass on the East Coast.

Place Holder for figure A.5

Blue crabs, an economically important species to the Town of Smithfield, also depend on the tidal marshes in the area. Other tidal marsh dependent shellfish include oysters, clams and shrimp.

Tidal wetlands in the Town of Smithfield are located along the Pagan River, Cypress Creek and Moon Creek and at the mouth of Mount Holly Creek and the tributaries to Jones Creek. There are approximately 1500 acres of tidal wetlands in the Town of Smithfield. They are generally located in soil type 2 (Bohicket silty clay loam). The location of the tidal wetlands is shown on Figure A.5. Tidal wetlands in Virginia are protected under § 62.1 – 13.2 of the Code of Virginia, and are part of the Resource Protection Area (also zoned C-C with the overlay CB-O).

Non-Tidal Wetlands

According to the NWI maps, the Town of Smithfield has 332 acres of non-tidal (palustrine) wetlands consisting of emergent wetlands (6 acres), forested wetlands (299 acres) and scrub-shrub wetlands (7 acres). Like tidal wetlands, non-tidal wetlands are important components in a landscape. They filter water and air and are an important habitat to a variety of species. While tidal wetlands are flooded twice a day during high tides, non-tidal wetlands are generally the result of prolonged (days or weeks) saturated soil conditions. The determination as to whether an area contains non-tidal wetlands can only be made by investigating an area to determine if the three mandatory wetland parameters can be observed in the field.

Flood Plains

According to the Town's zoning map and a review of the Federal Emergency Management Agency's (FEMA) flood insurance maps, floodplains within the Town of Smithfield are located in the Resource Protection Areas (RPA). The floodplains are constrained by steep slopes, and a review of the maps show that a large part of the town is not impacted by the 100-year flood.

Natural Heritage Resources and Threatened & Endangered Species

According to the College of William and Mary's Center for Conservation Biology, two active bald eagle breeding territories are located within Isle of Wight County. One of these sites is located approximately 4 miles west of the Town of Smithfield at the headwaters of the Pagan River (Watts, B.D., M.A. Byrd, and G.E. Kratimenos 1994).

Prime Farmlands

The United States Department of Agriculture (USDA) defines prime farmland as the land best suited to food, feed, forage, fiber and oilseed crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming this type of land results in the least damage to the environment. Prime farmlands are of major importance in meeting the nation's short- and long-range needs for food and fiber, and the designation is intended to encourage and facilitate the wise use of these resources. Loss of these resources to other uses such as urban or industrial use encourages the farming of marginal lands including forests.

The Isle of Wight County Soil Survey (USDA 1986) follows this productivity-based approach to identifying prime farmland by providing yield data for crops and pasture. Based on these criteria, the NRCS assigned the prime farmland status to the following soils located in the Town of Smithfield: Emporia fine sandy loam (map unit 5), Slagle fine sandy loam (map unit 18), and Yemassee fine sandy loam (map unit 23). The Town of Smithfield contains approximately 2000 acres of prime farmland. Agricultural lands in Town are typically zoned C-C.

ENVIRONMENTAL CONSTRAINTS

Since its incorporation in 1752, the Town of Smithfield has benefited from its location on the Pagan River, and its proximity near the James River and Chesapeake Bay. Despite its location four miles upstream of the confluence with the James River, the Town's waterfront is still navigable by ships and has provided citizens with protection during severe storms. Prior to the building of the James River Bridge between Newport News and Isle of Wight County, the Town was serviced by a passenger ferry and freight lines. Currently, the rivers and creeks near Smithfield define part of the quality of life for its residents. Water-based recreation and the vistas are important factors influencing this quality of life and in attracting tourism. In addition to the rivers and creeks, the surrounding natural resources are also very important in protecting the quality of life for the Town's residents. Natural areas are important filters of pollutants and they serve as habitat to a large variety of species.

The preservation and protection of the natural resources of the Town of Smithfield is not only essential for the aesthetic characteristics of the Town, but also for the maintenance of surface water and groundwater quality in the Town. Unregulated development can have an adverse impact on these resources. This is particularly important since the Town relies so heavily on surface water for recreation and groundwater for its population and industry. While environmental considerations were not an explicit consideration during the early growth of the Town of Smithfield, properly managed growth can provide the Town with healthy and robust economic growth while protecting the environment and preserving the Town's natural resources, its heritage and the general quality of life. The following section provides an overview of the primary growth determinants within the Town of Smithfield.

Chesapeake Bay Preservation Act

The Chesapeake Bay Preservation Act (Chapter 25, Title 10.1 of the Code of Virginia) established a program to protect and improve the quality of water of the Chesapeake Bay. The Act provides a framework for local governments to identify and protect sensitive areas adjacent to tributaries of the Bay, which if improperly used or developed can contribute to water quality degradation of the Bay and its tributaries. The Act also requires that local governments enact regulations for use during land use planning activities including the identification of sensitive land areas.

The Town of Smithfield adopted the Chesapeake Bay Preservation Area Ordinance in 1990. This ordinance was superseded by article 3.P. of the current Zoning Ordinance. The Ordinance addresses many significant environmental features outlined below. Individual environmental constraints will reference the requirements of the Act and the Ordinance where appropriate. Under the Ordinance, the Town is required to promote the following:

- Protection of existing high quality state waters and restoration of all other state waters to a condition or quality that will permit all reasonable public uses, and will support the propagation and growth of all aquatic life which might reasonably be expected to inhabit them;
- Safeguarding the clean waters of the Commonwealth from pollution;
- Prevention of any increase in pollution;
- Reduction of existing pollution; and
- Promotion of water resource conservation in order to provide for the health, safety, and welfare of the present and future citizens of the Commonwealth.

The Town of Smithfield mapped all the Chesapeake Bay Preservation Act Preservation Areas. These include Resource Protection Areas (RPAs), Resource Management Areas (RMAs) and Intensely Developed Areas (IDAs). Identification was based on items such as the United States Geological Survey

(USGS) 7.5 minute topographic quadrangles and other materials such as National Wetland Inventory (NWI) Maps and soil survey maps.

To minimize water quality impacts from land use and development, the Town has delineated Chesapeake Bay Preservation Areas according to criteria outlined by the Chesapeake Bay Local Assistance Board in the Regulations. The Regulations also include criteria for local governments to use in granting, denying or modifying requests to rezone, subdivide or use and develop land in the Chesapeake Bay Preservation Area. The criteria are implemented through various land use ordinances and include the use of Best Management Practices as well as planning and zoning concepts to reduce the impacts of the use and the development on sensitive lands and ultimately upon water quality. Figure A.6 shows the location of the town's Chesapeake Bay Preservation Areas.

Resource Protection Areas (RPAs)

RPAs are sensitive areas at or near the shoreline of the Chesapeake Bay and its tributaries. This sensitivity is based on the land's intrinsic ecological and biological relationship to water quality, including the potential degradation to the water that could be the result of the development of these lands. Therefore, the RPA regulations established by the Chesapeake Bay Preservation Area Ordinance and Article 3.P. of the zoning ordinance are designed to protect and improve the water quality of the Chesapeake Bay, its tributaries, buffer areas and other sensitive environmental lands near shorelines by minimizing the potential effects of human activities among these areas. Furthermore, the Town adopted the Chesapeake Bay Preservation Overlay District, Article 3.P as part of the Town of Smithfield's Zoning Ordinance.

The RPAs in the Town of Smithfield include: 1) tidal wetlands, 2) non-tidal wetlands connected by surface flow and contiguous to tidal wetlands and tributary streams, 3) tidal shores (as measured at mean high tide), 4) a 100-foot buffer around items 1-3 and along both sides of any tributary stream, river or channel, and 5) other sensitive lands at or near the shoreline that provide for the removal, reduction or assimilation of sediments, nutrients, and potentially harmful or toxic substances in runoff. The 100-foot buffer areas are designed to impede runoff, prevent erosion and filter non-point source pollutants from runoff.

Development within the RPAs is restricted with the following exceptions: (1) the development is water dependent, (2) constitutes redevelopment within an IDA, or (3) is otherwise specifically allowed by provisions of Article 3.P. Land disturbance exemptions of the Chesapeake Bay Preservation Overlay District (Article 3.P), include water wells, passive recreation facilities such as boardwalks, trails, and pathways, and historic preservation and archaeological activities, provided that it is demonstrated to the satisfaction of the Zoning Administrator that these activities will not unduly and negatively affect the RPA resources.

Performance standards for development and redevelopment in RPAs have been established; they include: limitations on land disturbance, preservation of indigenous vegetation, limitation on impervious cover, sewage disposal requirements (Article 11, Section I.9), storm water runoff requirements and buffer area requirements. These standards are explained in further detail in Article 3.P of the Zoning Ordinance.

A Water Quality Impact Assessment (WQIA) is required on any proposed development within an RPA, including any buffer area modification or reduction. The purpose of the WQIA is to ensure that development within RPAs will be located on those portions of a site and in a manner that will be least disruptive to the natural functions of RPAs and other sensitive lands.

Place Holder for figure A.6

Resource Management Areas (RMAs)

RMAs include land types that, if improperly developed, have the potential for causing significant water quality degradation or for diminishing the functional value of the RPAs. Because of the physiographic location of the Town and the various creeks that are tributaries to the Chesapeake Bay, all land not classified as RPA was designated as RMA.

There are no restrictions to development in the RMAs as long as a project proposal meets the requirements of the underlying zoning of the land. The development of land in the RMA must conform to the requirements outlined in the Town's Zoning Ordinance.

Intensely Developed Areas (IDAs)

The Chesapeake Bay Act established IDAs as an overlay to the RPA designation to allow for the redevelopment of an area, which may include portions of the RPA and RMA. IDAs typically consist of infill sites where little of the natural environment remains. They include historically developed areas along the waterfront mainly utilized for commerce and industry. Selection criteria for an IDA include (1) previous development in such a way that 50% of the soil surface is impervious; (2) the area is currently served by public water and sewer; or (3) the housing density is equal to or greater than 4 dwelling units per acre. The Town of Smithfield has two certified IDAs (IDA-1 and IDA-2) located on the Pagan River, and a proposed IDA on Cypress Creek (P-IDA).

IDA-1 is located along the Pagan River and includes the corporate headquarters of Smithfield Foods, a set of five townhouses and two maintained lawns. The area extends to the Pagan River with a hardened shoreline (rip rap) and boardwalks. Historic use of this area was a main port for the Town with many merchants and ships bringing cargo to Smithfield from along the James River and beyond. Aerial photography shows this area in 1954 as a busy port and commercial area. Aerial photography indicates that this IDA was cleared before 1980 and Smithfield Foods corporate headquarters was built in 1999.

IDA-2 is located across the Pagan River from IDA-1. Historically, this area was a dog food processing plant, and the land use was almost entirely industrial. The dog food plant has since been removed and a Town-maintained park (Clontz Park) was built on the site. Aerial photography indicates that IDA-2 was developed in 1989 and cleared previous to 1995. The majority of the current IDA-2 is maintained lawn with a few trees. A hardened shoreline and a boardwalk extend along the entire riverfront.

The Chesapeake Bay Preservation Act requires that any future development within these IDAs reduce nutrient loadings by 10% from that of the previous development. To estimate the runoff and nutrient loading characteristics for these areas, aerial photography and historic planning documents may be utilized to obtain an historical estimate of the impervious surface for both IDAs.

Wetlands

Wetlands are protected under the Federal Clean Water Act (CWA), Section 404, the State of Virginia Tidal Wetlands Act, and the Virginia Water Protection Permit Program under Section 401 of the CWA. Impacts to wetlands are regulated by the U.S. Army Corps of Engineers (COE), the Virginia Marine Resources Commission (VMRC) and the Virginia DEQ. The Norfolk District Office of the COE is responsible for regulating most wetlands throughout Hampton Roads Virginia and detailed permitting information can be obtained from this office, or from their website: www.nao.usace.army.mil/Regulatory/Regulatory.html. The Virginia DEQ has implemented a wetlands program in 2002 and now takes the lead on permitting wetland impacts associated with linear transportation projects and commercial, residential and institutional development and detailed permitting information and general information regarding their program can be obtained from their website: www.deq.state.va.us/regulations/xwaterregs.html. When a project qualifies for a permit, the applicant

prepares a Joint Permit Application (JPA) which must be submitted to the VMRC, a Pre-Construction Notification (PCN) which is submitted to the Corps or a registration statement which is submitted to Virginia DEQ, depending on the lead agency involved.

The Town of Smithfield has various tidal and non-tidal wetlands as observed on the NWI maps (Fig A.5). Any activity in these areas is restricted by local ordinances, state and federal laws, and this should be a consideration before developing the area. Furthermore, areas that have hydric soils (Fig A.7) may contain wetlands, and these areas will need to be examined in more detail prior to development. In general, a developer will be required to conduct a wetland delineation to determine the presence and location of any wetlands on the property. If wetlands are discovered, the delineation is verified by the COE. Subsequently, the developer may either opt to avoid wetland impacts or apply for a permit to fill in all or parts of the wetlands. The developer is required to submit a permit application to VMRC for the fill of wetlands, and having adopted a “no-net-loss” policy, both the state and federal government likely will require some form of mitigation for wetland impacts.

Topographic Constraints

Limitations to the development of steep slopes are detailed in Table A.8 and Figure A.7. According to the soil survey, 11 percent of the total surface area of the Town of Smithfield has soils with slopes between 10 and 60 percent slope. These steep areas are located along the Pagan River, Cypress Creek and the other creeks in Town. Areas with these slope characteristics are mostly undeveloped. Moreover, these slopes are likely located in the RPA; however, development of all steep slopes outside the RPA should also be discouraged. Limiting development of these steep slopes should limit the degradation of water quality caused by stormwater runoff and erosion. HRPDC (1999) provides various design alternatives for protecting highly erodible areas and steep slopes.

Flat areas in Town may also pose development problems because of stormwater issues caused by potential slow runoff and poor drainage. Flat areas also contain all tidal and most non-tidal wetlands.

Flood Hazards

Based on a review of the Federal Flood Insurance Maps, the Town of Smithfield has few flood prone areas, with the exception of areas along the Pagan River, Cypress Creek and the minor tributaries. Most flood prone areas are within the RPA and are undeveloped and bordered by steep slopes. The area along U.S. Highway 10 from the bridge over the Cypress Creek to the bridge over the Pagan River is developed and appears to be within a flood prone area.

Sensitive Soils

Soils are important natural resources that affect surface and ground water quality in the Town of Smithfield. A detailed discussion of the various soil types was provided earlier on in this Appendix. Figure A.7 shows the location of hydric soils, highly erodible soils, soils with high and low infiltration rates, prime farmlands and soils with topographic limitations. As specified by the Chesapeake Bay Preservation Act and local ordinances, disturbance of these types of soils pose the largest threat to the water quality of the Chesapeake Bay and its tributaries.

Hydric soils are soils that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part of the soil column. The concept of hydric soils includes soils developed under sufficiently wet conditions to support the growth and regeneration of hydrophytic vegetation. These soils either supported wetlands in the past or are currently supporting wetlands. Further investigations should provide an indication whether an area with hydric soils still contain wetlands.

Place Holder for figure A.7

**Table A.8.
Topographic Limitations in Smithfield**

Slope	Percentage of Town	Limitation	Remark
Water	8.9 %	Open water	Areas of open water (Pagan River etc.)
0-2 %	59.2 %	Slow runoff, may be subject to poor drainage, slight danger from erosion	
2-6 %	18.4 %	Slow to medium runoff, slight danger from erosion	
6-10 %	2.5 %	Medium to rapid runoff, potential for serious erosion	
10 % +	11.0 %	Rapid to very rapid runoff, serious potential erosion, land should be kept under permanent vegetative cover	Located along the Pagan River and creeks.

In agricultural regions such as Isle of Wight County, some areas with hydric soils were converted to croplands. An area with hydric soils may be considered a prior converted cropland if it was cropped before 23 December 1985 and is still being used for agricultural production. These areas are exempt from wetland regulations, including permitting; however, the NRCS is required to make the “prior converted cropland” determination before development. The area will be considered a wetland if prior converted cropland is abandoned and wetland conditions return. Development of the site is then subject to regulation under section 404, and a permit may be required. An area will be considered abandoned if for five consecutive years there has been no cropping, management or maintenance activities related to agricultural production.

Highly erodible soils are those soils that have a high potential for eroding and release of sediments to waterways. The erosion potential is caused by a combination of steepness and length of slope, which act together to increase the speed of water running down the slope. Three soil types in the Town have a high erodibility potential. HRPDC (1999) provides various design alternatives for protecting highly erodible areas and steep slopes.

Highly permeable soils are soils that are susceptible to pollutants leaching through the soil profile and thus contaminating the groundwater. These are soils with low water holding capacity and open texture. Three soils in the Town are highly permeable. Highly permeable soils are particularly unsuitable for the construction of septic systems.

Other soil characteristics may also impact the development suitability of an area to some extent. These include low infiltration rate, shrink-swell potential, wetness, flooding and depth to water table. The soil descriptions earlier on in this section and the Isle of Wight County Soil Survey provide a discussion concerning some of these constraints.

Based on a review of the Soil Survey of Isle of Wight, 128 acres have soils with high infiltration rates; 729 acres contain highly erodible steep slopes; 539 acres have soils are highly erodible; and 1579 acres contain hydric soils. It appears that 1896 acres contain soil with no constraints to development, while the Town contains 584 acres of open water. The soils most suited to development include Rumford loamy sand (unit 16), the flat Slagle fine sandy loams (unit 18A) and the flat Uchee loamy sand (unit 19A).

The Isle of Wight County Soil Survey follows this productivity-based approach to identifying prime farmland by providing yield data for crops and pasture. Based on these criteria, the NRCS assigned the prime farmland status to the following soils located in the Town of Smithfield: Emporia fine sandy loam (map unit 5), Slagle fine sandy loam (map unit 18), and Yemassee fine sandy loam (map unit 23). The Town of Smithfield contains approximately 2000 acres of prime farmland (Figure A.1). Agriculture lands in Town are zoned C-C.

Shoreline Erosion

As noted previously the shorelines of the Pagan river and tributaries are relatively stable. Noted erosion in the area should be addressed utilizing non-structural erosion control methods, such as marsh creation. Structural erosion controls should be limited to areas used for boat docking and areas of severe erosion. Otherwise structural controls should be used as a last resort. HRPDC (1999) provides various design alternatives for protecting highly erodible areas and steep slopes.

Marina Siting Criteria

The navigable waterways in the Town of Smithfield are important to the Town. Recreational boating and other water activities create significant revenue. Smithfield would like to increase the waterway-based activities and create more revenue by increasing the number and capacity of marinas along the Pagan River, Moon Creek and Cypress Creek, while avoiding negative impacts to the environment. There are several legal aspects that have to be considered before siting a marina. The Virginia Marine Resources Commission (VMRC), the Corps of Engineers and the Virginia DEQ all require a Joint Permit Application (JPA) to secure authorization for building marinas in tidal waters. The JPA is reviewed by the above three agencies which issue permits accordingly. Criteria considered in determining any permit for a boat mooring facility was adopted from The Virginia Marine Resources Commission's Publication: *Subaqueous Guidelines*, in the Virginia Clean Marina Program by the Virginia Department of Environmental Quality. Criteria for siting a marina are presented in Table A.9 below.

**Table A.9.
Virginia Marine Resources Commission
Marina Siting Criteria Checklist**

Criteria	Undesirable	Desirable
<i>Water Depth</i>	Less than 3 ft. mlw *	Greater than 3 ft. mlw
<i>Salinity</i>	Suitable for shellfish growth	Unsuitable for shellfish growth
<i>Water Quality</i>	Approved, conditionally approved or seasonally approved for shellfish harvesting.	Closed for direct marketing of shellfish. Little or no potential for future productivity.
<i>Designated Shellfish Grounds</i>	Private leases or public oyster ground in proximity.	No private leases or public ground within affected area. No potential for future productivity.
<i>Maximum Wave Height</i>	Greater than 1 ft.	Less than 1 ft.
<i>Current</i>	Greater than 1 knot.	Less than 1 knot.
<i>Dredging</i>	Requires frequent dredging. No suitable site for dredged material.	Does not require frequent maintenance. Suitable for all dredged material.
<i>Flushing Rate (Tidal Exchange)</i>	Inadequate to maintain water quality.	Adequate to maintain water quality.
<i>Proximity to Natural or Improved Channel</i>	Greater than 50 ft. to navigable water depths.	Less than 50 ft. to navigable channel.
<i>Threatened or Endangered Species</i>	Present as defined in existing regulations, or project has potential to affect habitat.	Absent: project will not affect.
<i>Adjacent Wetlands</i>	Cannot maintain suitable buffer.	Suitable buffer to be maintained.
<i>Navigation and Safety</i>	Water body difficult to navigate or presently overcrowded conditions exist.	Navigation not impeded.
<i>Existing Use of Site</i>	Presently used for skiing, crabbing, fishing, swimming or other potentially conflicting uses.	Not presently used for skiing, fishing, swimming or other recreational uses.
<i>Submerged Aquatic Vegetation</i>	Present	Absent
<i>Shoreline Stabilization</i>	Bulkheading required.	Shoreline protected by natural or planted vegetation or riprap.
<i>Erosion Control Structures</i>	Groins and/or jetties necessary.	No artificial structures needed.
<i>Finfish Habitat Usage</i>	Important spawning and nursery areas.	Unimportant area of spawning or nursery for any commercially or recreationally valuable species.

* mlw=mean low water

IMPLEMENTATION

This section provides a specific discussion of the actions that will be used to implement the goals and objectives intended to protect the natural resources of the Town of Smithfield, including surface water, groundwater and ecologically sensitive areas. Other plans associated with the Comprehensive Plan are detailed in sections VI, VII, VII, IX, X, XI and XII of this plan, and the actions in those sections will need to be considered in combination with those outlined in this Appendix.

The Town of Smithfield recognizes that land use and the environment are integrally linked and has implemented a set of land use policies and strategies that are in harmony with the environment, which include: (1) the management and protection of groundwater resources, (2) the protection of surface water resources, and (3) the protection of sensitive ecological resources in the Town. This can be achieved through the control of point source and non-point source pollution and appropriate land use planning and zoning. As mentioned in this Appendix, the expected eventual result of these policies will be the protection of the waters of the Chesapeake Bay and the protection and improvement of the quality of life within the Town of Smithfield. The Town relies on groundwater resources for its potable water supply and is proud of the aesthetic beauty of its natural areas and the tidal wetlands along its rivers and creeks. The following section provides the steps that the Town should take to ensure the continued protection of the Town's natural resources and recommendations for additional steps.

Manage and Protect the Surface Water and Groundwater Resources within Town

The Town of Smithfield employs a multi-faceted approach to water quality protection and enhancement. General guidance is provided by the Town's environmental goals, objectives and strategies and by the specific land use designations shown on the Future Land Use Plan. Specific performance criteria and implementation mechanisms for the protection of water quality have been adopted in the Town's local Chesapeake Bay Preservation Ordinance, Floodplain Ordinance and Subdivision and Zoning Ordinances. The Town also complies with State and Federal guidelines concerning wetland protection and management, a vital aspect of water quality.

The following general concepts and approaches to water quality protection are utilized throughout the Town's various land use control ordinances:

- **Performance standards**: standards that regulate (1) land use activities by setting limits on the amount of disturbance a particular development may cause rather than defining what that land use might be; and standards that regulate (2) the development, operation and closure of groundwater wells by the Town and private entities.
- **Buffer Strips**: a strip of land, usually left in or returned to native vegetation that protects an area from adjacent or nearby land uses by filtering sediment and runoff along rivers and streams.
- **Setbacks**: the minimum distance a building or other development must be from a watercourse or sensitive area.
- **Density Requirements**: requirements that govern the average number of families, persons, or housing units on a parcel of land. Density requirements can be flexible, and when combined with cluster development, can help maintain open space by permitting higher densities in one area as a tradeoff for lower densities and open space in other areas. Density limits for water quality protection tend to encourage large lot zoning, although cluster development could also result.
- **Stormwater management**: specially developed criteria that address stormwater runoff by limiting the amount of impervious surfaces, or by using retention basins, porous pavement or created wetlands or ponds to slow and filter runoff (for more detail see section XI of the Comprehensive Plan).

- Best Management Practices (BMPs): special structural and non-structural practices such as filter strips, no-till farming, retention basins and any number of other management techniques that are successful in limiting or controlling the downstream impacts of land disturbing activities.
- Streambank Erosion: stormwater runoff can cause bluffs to cave in or steep slopes to become easily eroded, with large quantities of unwanted sediment carried down streams or onto nearby properties. By tradition and logic, the upper plateaus in Smithfield have primarily been used for building single-family detached residences.

Protection of the surface water resources in particular will also protect the other sensitive natural resources including tidal wetlands, non-tidal wetlands, wildlife, fisheries resources, sensitive species, silvicultural areas, agricultural lands and other green space.

Surface and Groundwater Recommendations

1. **Continue enforcing well regulations.** The Town currently has a local ordinance regulating the installation of private wells; however, it appears that many residents are not aware of its existence. In addition, this ordinance does not regulate the abandonment of wells. Therefore, wells may have been installed within the Town limits without the Town's knowledge. The public should be made aware of permitting and reporting requirements.
2. **Develop a groundwater well database.** The Town should work with VDEQ to develop a comprehensive database of privately owned and operated wells within the Town limits. A mechanism to identify abandoned wells and implement reporting requirements and standards for the installation of new wells, the retrofitting of existing wells, and the abandonment of wells should be incorporated by the Town. This reporting requirement should be made widely known, to prevent wells from being installed, retrofitted and /or abandoned without the Town's knowledge. Information pertaining to regulated wells should be forwarded to VDEQ and the Virginia Department of Health. A database of this sort will help to identify threats to ground water quality and potable water sources. In addition, this requirement would prevent the improper abandonment of wells.
3. **CBPA.** Continue enforcing the Chesapeake Bay Preservation Act Overlay District and all other Code requirements in Town that are protective of surface water, minimize runoff and erosion, protect sensitive natural features, such as wetlands, and other areas with intrinsic water quality value. Minimize the generation of point source and non-point source pollution by using innovative pollution control measures including the continued use of BMPs.
4. **Impermeable cover estimate.** Develop an estimate of impermeable cover for each land use category in Town. Encourage developments that minimize the creation of impervious cover.
5. **Protect steep slope areas from erosion.** Generally, areas with slopes equal to or greater than 15 percent generate additional construction costs, which in itself has tended to discourage development. However, valuable "waterfront" property and modern construction techniques will lead to future use of the more challenging slopes. It is therefore important that sensitive steep areas be protected from erosion through the implementation of the new slope provisions included in the Town's revised Zoning Ordinance that were added to protect creeks and rivers from erosion, high sediment loads and the erosional effects on water quality.
6. **Stabilize areas with high rates of shoreline erosion.** It is expected that the Virginia Institute of Marine Science (VIMS) will publish a shoreline assessment for Isle of Wight County in the spring of 2003. Town personnel will review this document and develop action plans for any highly erodible areas within the Town limits as identified by the VIMS report. Potential action plans can be found in HRPDC's Guidance Manual for erosion control (HRPDC 1999).

Land Use & Development

The Town has adopted a comprehensive set of land use and development criteria, the purpose of which is to achieve the goals of the Chesapeake Bay Preservation Act and to implement the following objectives:

- Prevent a net increase in non-point source pollution from new development;
- Achieve a 10 percent reduction in non-point source pollution from redevelopment; and
- Achieve a 40 percent reduction in non-point source pollution from agricultural and silvicultural (forestry) uses.

In order to achieve the stated goals and objectives, these criteria establish performance standards to minimize erosion and sedimentation potential, reduce land application of nutrients and toxins, maximize rainwater infiltration and ensure the long-term performance of the measures employed.

The Town has evaluated, analyzed and modified the model ordinance provided by the Chesapeake Bay Local Assistance Department. The Town adopted the criteria established for land use developments in the RPAs and the IDAs, and strengthened their application to govern development in the RMAs. Sections of the ordinance provide for site plan review to control non-point source pollution and best management practices for development. Criteria address development siting and set backs, buildable areas, impervious surfaces, buffer vegetation and landscaping and shoreline and wetlands protection. Water quality impact assessments are required for major developments.

Land Use and Development Recommendations

1. **Development.** The development of land in Smithfield should be designed to be in harmony with the natural environment. Designation of suitable sites for future development and conservation are of prime importance in the Future Land Use Plan in order to fully protect the water quality and living resources of the Bay. Some areas are more conducive to development than others, while others are inappropriate. Harmonious development should take place along the major tributaries and adjacent to secondary waterways and intermittent streams, lakes and ponds and isolated wetlands. Actions that prevent direct, indirect and cumulative adverse impacts on the environment as a result of land use activities are essential.
2. **Preserve and protect.** A fundamental intent of the Future Land Use Plan is to preserve and protect the most environmentally sensitive areas in the Town. Accordingly, an “Environmentally Sensitive Areas” land use classification is included on the Future Land Use Map for all tidal marshlands and Resource Protection Areas established in the Smithfield CBPA Ordinance. Furthermore, this Comprehensive Plan contains a map that depicts areas with physical constraints to development including areas with hydric soils, steep slopes, highly erodible soils, and soils with high infiltration rates. In addition, the Town’s sensitive environmental areas include the areas in the Resource Management Areas characterized by 100-year floodplains and steep slopes prone to erosion. Isolated upland wetlands are also incorporated in the Sensitive Environmental Areas, pending site-specific identification and delineation.
3. **Land use intensity.** The Future Land Use Plan gives consideration to the proper location, type and density of development in the less critical Resource Management Areas throughout the Town. Accordingly, less intensive land uses are designated for areas adjacent, or in proximity, to the established environmentally sensitive area or in areas themselves characterized by other environmental limitations (such as intermittent streams, hydric and erodible soils). The “Community Conservation” land use designation allows for minimal residential use and promotes the preservation of open space and lands adjacent to sensitive environmental areas. Wherever possible, this land use designation has been applied for the more sensitive RMA lands abutting the major creeks, slopes and drainageways protected for planning purposes as environmentally sensitive areas.

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