CHAPTER 3 – ENVIRONMENTAL SUSTATINABILITY & RESILIANCE

Physiography and Topography

The Town of Bowling Green lies in the central area of Caroline County. Most of Bowling Green rests on a high point within the County with no major waterways that would flood their banks and impact any development in the town. Bowling Green contains natural resources that provide water quality benefits to the local area and to the Chesapeake Bay. These natural resources serve as part of a larger environmental ecosystem that also provides habitat for a range of wildlife species. Many natural resources consist of features that protect the waters of the Commonwealth and the Chesapeake Bay from the adverse effects of pollution by allowing for the settling of particulate matter, the infiltration of stormwater into the soil, and the biological uptake of pollutants. From the review of past records, the town does not have a history of flooding. FEMA mapping was reviewed and the areas surrounding the town are outside of the 500-year floodplain. Most of Bowling Green rests on a high point within Caroline County and there are no major waterways that would flood their banks and impact any development in the town.

This chapter contains an inventory of natural features and identifies environmental issues. Associated strategies are specified to help town officials manage and protect the environment. Bowling Green's Chesapeake Bay Preservation Ordinance and the Water Quality and Environmental Protection Plan should be consulted prior to disturbing any land in the town.

Land Cover

Land cover within the Town of Bowling Green is predominantly developed, reflecting its compact footprint and history as a commercial center and residential community. Medium- and high-intensity development is concentrated within the Main Street area and along the Town's primary transportation corridors, while lower-intensity development and open spaces occur throughout surrounding neighborhoods. The remaining land within the Town consists of natural land cover.

Land Cover vs. Land Use
Land *cover* describes the physical features of an area – such as buildings, pavement, vegetation, wetlands, and water. Land *use* refers to how land is used – such as residential, commercial, industrial, or recreational purposes. While related, the two do not always align. Similar land cover patterns can support different land uses, and a single land use may include multiple land cover types. Understanding both helps inform environmental analysis, infrastructure planning, and land use policy.

Impervious surfaces are mostly concentrated in the Main Street area and along major transportation corridors. Tree canopy provides critical ecosystem habitats, shoreline stabilization, water quality protection and flood mitigation in smaller areas of the town.

Ecological Cores and Conservation Areas

The Southeast Conservation Adaptation Strategy (SECAS) Southeast Conservation Blueprint is a regional, spatial conservation plan developed to support a connected network of lands and waters across the Southeast. The Blueprint integrates dozens of natural and cultural resource indicators to identify priority terrestrial, freshwater, and marine areas that are valuable for conservation, climate resilience, and connectivity. Priority areas include corridors that connect inland and coastal systems and span climatic gradients, helping species and ecosystems adapt to changing conditions. In Bowling Green, priority areas identified in the SECAS Blueprint align with extensive tidal wetlands, forested floodplains, and tributary networks along the York, Mattaponi, and Pamunkey Rivers.

Ecological cores are areas identified through the Virginia Natural Heritage Program as having high ecological integrity, biodiversity, and landscape functions. These areas represent the best remaining examples of natural communities and ecosystems in the state and include high-quality forests, wetlands, rare species habitat, and intact ecological processes. In Bowling Green, ecological cores are found where relatively undisturbed natural lands occur, particularly within extensive riparian corridors, tidal wetlands, and upland forest patches.

MAPS

Soils

There are various soils types found within the town boundary (See General Soil Types Map). Sassafras-Kempsville-Rumford soil association constitutes the predominant soil in the Bowling Green area. This soil association consists of light-colored and light-textured surface soil and yellowish-brown to yellowish-red sandy or silty clay subsoil. These soils tend to be deep, level, and well-drained, making them very suitable for agriculture and development purposes.

Other different types of soils exist and with different characteristics and impacts on potential development. It has been reported that there are no hydric soils in town, based on unpublished soil survey information. However, a site survey would reveal hydric soils in the wetland areas (See Hydric Soils Map). The acreage of wetlands in the town's too small for the soil survey map to pick up hydric soils. Steep slopes of 15-50% are indicated in the area of the Kempsville-Emporia-Remlik complex. Other soil types include Bama fsl of 0-2% slopes, Slagle-Kempsville complex of 2-15% slopes, Kempsville-Emporia complex of 2-6% slopes and Kempsville-Emporia complex of 6-10% slopes.

Table 3-1: Hydrologic Soil Group

A - Low runoff potential. Soils have high infiltration rates even when thoroughly saturated. B - Soils having moderate infiltration rates when thoroughly saturated.
C - Soils having slow infiltration rates when thoroughly saturated.
D - High runoff potential. Soils have very slow infiltration rates when thoroughly saturated.

Erodibility factor (K) indicates the susceptibility of different soil types to the forces of erosion.

Soil Type	Erodibility – K Factor range	Hydrologic soil group
Bama	moderate – if sandy loam	B
Emporia	moderate or high – if loamy sand	C
Kempsville	moderate	B
Remlik	low	A
Slagle	moderate or high – if loam or silt loam	C

Source: VA Erosion and Sediment Control Handbook, 1992 UPDATE NEEDED

Soil characteristics determine the extent to which a soil is suited for various land uses such as farming, forestry, and development for commercial, industrial, and residential uses. Both surface water quality and groundwater quality are to a large extent, dependent upon proper management of soil resources. Planning and management of development that considers soil characteristics will help minimize soil erosion and the seeping of wastewater into groundwater or the collection of wastewater on the soil surface. Without planning for soil erosion potential and soil permeability, sediment and pollution can reach waterways or local water supplies and degrade the water quality in the Chesapeake Bay and the town.

Soil Constraints

Soils with high and low permeability and with high erosion potential are considered to be sensitive natural features that may not be suitable for development because of the potential negative impact on water quality. Other soil characteristics that will have an impact on development suitability include hydric, shrink-swell potential, wetness, susceptibility to flooding versus absorption, depth to water table, and frost heave potential. For example, areas which have dense clay subsoil with a high shrink-swell potential are unstable and thus poorly suited for foundations, roadways, and septic tank drain fields. It is important to understand these limits and plan for land uses which require the least amount of land disturbance in areas of sensitive soils.

Soil Permeability

Soils having permeability equal to or greater than six inches of water movement per hour in any part of the soil profile to a depth of 72 inches are considered to be highly permeable. These soils rapidly transport wastewater through the soil profile to the groundwater and/or surface water. Rapid transportation does not allow for the proper biological treatment of the wastewater. If the

wastewater is improperly treated, fecal coliform can contaminate the aquifers and/or surface waters. This situation poses a health risk and may degrade water quality by contributing organic material that reduces dissolved oxygen, creates limitations for safe drinking water, and is harmful to humans. Once groundwater is contaminated, it is difficult and expensive to correct, if correction is possible.

Soils with a permeability of less than 0.6 inches of water movement per hour are considered to be low permeability soils. Soils that display a low permeability rate tend to collect wastewater on the soil surface. The soil becomes saturated with wastewater and increases the potential for polluted runoff to enter area streams. Again, the collection of untreated wastewater on the soil surface poses a health risk and a potential risk to the water quality of surface waters. Where soils are marginal, septic systems may have a higher incidence of failure. It is important that septic systems are properly designed to minimize negative impacts on the public health and the quality of surface water and groundwater.

Since groundwater is the town's source of drinking water, it is important to prevent polluted surface water from reaching areas of highly permeable soils (See Soil Permeability Map). The better the quality of surface water, including runoff, in areas of highly permeable soils, the better the quality of groundwater for the town's consumption and use. If highly permeable soils are exposed to chemical or organic pollution from sources such as storm water or septic systems, water quality degradation can result and pose a risk to human health. Thus, soils that are highly permeable are typically unsuitable for septic system development.

Table 3-2: Tolerance and Suitability of Soils to Development

Feature	Description .	Tolerance/Suitability
Wet soil	Soil with a high moisture content because of a high water table or poor drainage; often a seasonal problem.	Such soils perform an important water storage function; when septic tanks are used, water supply may be contaminated; foundations settle and crack; stagnant pools may exist during certain periods.
Impervious soil	Dense soil inhibits the free flow of water; such soils usually have a high clay content.	Impermeability of soil may cause septic tanks to overflow and contaminate water supply; unsuitable for development without public water supply and sewage.

Poor Load bearing soil	Soils unable to support structures such as roads and buildings; usually easily compacted because of moisture content, particle size, or where excessive Internal spaces or voids are present; filled lands, mineral or industrial waste piles often have these characteristics.	Generally unsuitable for Intensive development because of difficulty and cost of construction.
Shrink/Swell soil	Soils with the potential to shrink or swell; often have high clay content.	Generally unsuitable for foundations of beds of permanent structures such as buildings and roads.

Source: CBLAD Local Assistance Manual

Soil Erodibility

Generally, sloping areas are potentially subject to soil erosion. Sheet erosion causes a loss of surface soil. Gullies can form on areas receiving concentrated water flow unless proper erosion control measures are applied. The potential for soil loss and higher erosion rates increase during land disturbance. If highly erodible soils are disturbed, the potential for soil loss is greatly increased.

Soil erosion negatively impacts water quality and the ecosystem for several reasons. It tends to make water cloudy, reducing the light penetration that is desirable to support aquatic vegetative growth for the food chain. Soil erosion congests streams and thus, potentially affects flood levels and intensities. Soil erosion can have detrimental impacts on wetlands and alter a wetland's natural function in the watershed's ecosystem. Soil can carry pollutants, especially phosphorus, to the water systems. Pollutants that enter any waterway in the town are eventually delivered to the Chesapeake Bay.

The town is located in an area that is characterized by high soil erodibility. Therefore, the town must be sensitive to soil issues in all developing areas to protect the quality of water for the town and the Chesapeake Bay.

Steep Slopes

The topography of the town varies from gentle upland slopes to lowland drainage areas with steep slopes (See Steep Slopes Map). The majority of the Town is relatively flat. There are three areas in Town which contain rolling terrain. The first area is located to the south of Maury Avenue and is part of the Old Mansion property which is protected from

development by an historic easement. The second area is located to the east and west of West Broaddus Avenue. The third area is located in the northwest section of Town which contains

slopes that are in excess of 15%. Steep slopes are considered to be those slopes which are 15% or greater. Slopes of 15% are generally difficult to develop while those of 25% or greater are usually avoided altogether. Any development which occurs on slopes of 15% or greater has great potential for water quality problems. When the unstable soils on steep slopes are disturbed, it results in increased erosion to the detriment of water quality. The potential for higher rates of erosion increases as the slope increases. These rates will also increase if the slope is disturbed and/or vegetation is removed from the slope.

The use of erosion/run-off barriers, especially during the actual development stage, can greatly reduce impacts. Careful stabilization of soils through the retention of indigenous vegetation, minimization of impervious surfaces, and installation of infiltration trenches can ensure that development on such slopes takes place in the most responsible manner possible. In these ways, steep slopes shall be taken into special consideration for any development within the Town. The Town shall work with Caroline County staff with regard to its Erosion and Sediment Control Ordinance and prevent erosion of steep slopes.

The Table 3-3 describes topographic features and their tolerance and suitability for development.

Table 3-3: Tolerance and Suitability of Topography to Development

Feature	Description	Tolerance/Suitability
Flat Land	Land with no significant slope; 0 – 2 percent	Depending upon other conditions, flat land is highly suitable for and tolerant to development.
Low Slope	Slope generally between 2 and 7 percent.	Fairly tolerant to development although excessive removal of ground cover may cause erosion; generally are good sites for residential development.
Moderate Slope	Slope generally between 8 and 15 percent.	High construction costs; loss of ground cover will cause erosion and frequent land slippage; often of scenic beauty.
Steep Slope	Slope generally between 16 and 24 percent.	Development causes erosion problems; major site engineering may be necessary; difficult to farm; suitable for recreation; often of scenic beauty.

Very Steep Slope	Slope generally greater than 25 percent.	Development causes severe problems, major site engineering necessary, unsuitable for most development, often of scenic beauty.

Source: CBLAD Local Assistance Manual

Wetlands

Wetlands have a variety of roles in the watershed. They can act as a filter and remove nonpoint source pollutants, sediments, and nutrients from surface runoff prior to those pollutants entering rivers and the Chesapeake Bay. They can be a source of nutrients and food that is vital to the food chain. Wetlands function as a "sink", where pollutants are buried in the wetland systems and removed from surface water flow prior to entering rivers and the Chesapeake Bay. Wetlands also provide important habitats to wildlife. In addition, wetlands can serve as a point of aquifer recharge and naturally manage stormwater runoff. This natural storm water management function may reduce flooding potential and stream channel erosion.

Wetlands are generally unsuitable for development. The wetland environment may not have enough stability to support structural development. Development in these areas may have problems with regard to periodic flooding and a high water table. If wetlands are developed, wildlife habitats and natural water quality protection features are lost. Water quality degradation, flooding, and stream bank erosion may also be incurred downstream if wetlands are developed. The town has adopted a Chesapeake Bay Preservation Ordinance to protect wetland areas. The Federal government also regulates wetlands through the Army Corps of Engineers.

There are some areas of non-tidal wetlands within the town. The location and existence of these wetlands were determined upon site visits to land adjacent to streams within the town limits (See Wetlands Map).

Flood-Prone Areas

From the review of past records, the town does not have a history of flooding. FEMA mapping was reviewed and the areas surrounding the town are outside of the 500-year floodplain. Most of Bowling Green rests on a high point within the County and there are no major waterways that would flood their banks and impact any development in the town.

Natural Heritage Resources

Natural heritage resources are defined by the Virginia Natural Area Preserves Act as "the habitat of rare, threatened, or endangered plant and animal species, rare or State significant natural communities or geologic sites, and similar features of scientific interest". According to a review of information from the Virginia Division of Natural Heritage (DNH), there is a documented

location of a natural heritage resource in the vicinity of Bowling Green, but no resources have been surveyed. Prior to developing a site, the Natural Heritage office must be contacted to determine any completed surveys. The town will work with DNH to protect natural heritage resources.

Groundwater

Groundwater protection is very important to the town. Its potable water supply comes from three wells that draw water from aquifers in Caroline County. Table 3-4 provides information about the raw water withdrawals from the wells. Well #5 came on line in April 2006.

Table 3-4: Town of Bowling Green Well Information, 2006

		Well #1A	Well #4	Well #5
Location		**Chase Street**	**Cedar Lane**	**Broaddus Avenue**
VDH Permit#		6033550	6033550	6033550
Maximum Day		0.1471 MG	0.1236 MG	0.0000 MG
Water Withdrawal Amount per month in MG: January – December 06	Jan	1.7919	2.8650	0
	Feb	2.1475	2.2833	0
	Mar	2.3379	2.5561	0
	Apr	2.1686	2.0400	0.0473
	May	2.7591	2.2232	0.0671
	Jun	3.0883	2.2649	0
	Jul	2.2474	1.7513	1.2450
	Aug	1.6942	0.0614	3.3970
	Sep	1.3586	0.0589	2.3740
	Oct	1.4781	0.0596	2.5750
	Nov	1.3075	0.0553	2.3130
	Dec	1.3393	0.0562	2.2310

Source: Town of Bowling Green

Community Facilities map shows the location of the town's wells. The town has experienced no contamination problems with its water supply at the intake locations of its wells corroborated by an independent lab performing parallel sample tests with the state lab.

Abandoned wells, leaking drain fields, and failing septic systems are potential groundwater contamination sources. The Caroline County Health Department receives the complaints, investigates these complaints, and keeps records on repair work that is required to address the complaint. The local Health Department follows the Commonwealth of Virginia State Board of Health Sewage Handling & Disposal Regulations as the grounds for addressing failing sewage disposal systems. Abandoned wells are addressed by the Caroline County Health Department in

accordance with the Ground Water Act of 1973 and the Private Well Regulations of Virginia. Other failing infrastructure such as waste lagoons and dump sites are potential pollution sources. There are no waste lagoons or dump sites within the town boundary.

The majority of residential structures are on public sewer and therefore pose no risk to groundwater quality. There are 85 septic systems located in town. As these old septic systems need to be replaced they will be required to meet current standards or connect to the town sewer line. The town requires the owners of these systems to provide documentation on the five (5) year pump-out or inspection. All new residential structures built are required to connect to a public sewer line, if available.

Underground storage tanks (UST) can cause serious groundwater contamination problems if there is leakage. A survey was conducted of gasoline station owners by town staff to verify data collected from the Department of Environmental Quality on USTs. There are four gasoline stations within the town corporate limits. Other underground storage tanks are located on public land. Table 3-5 depicts the current information on USTs in Bowling Green.

Table 3-5: Underground Storage Tanks in Bowling Green

Owner and Product	Tax Parcel Number	Tank size (gallons)	Tank Composition	Date Installed
Q Mart Shell 150 E. Broaddus Avenue	43A2-2B-1A			
Gasoline		12,000	Steel	June 1995
Gasoline		12,000	Steel	June 1995
Diesel and Kerosene compartments		12,000 (two 6,000 compartments)	Steel	June 1995
Q Mart Sunoco 133 E. Broaddus Avenue	43A2-A-4			
Gasoline		8,000	Fiberglass	May 1988
Gasoline		8,000	Fiberglass	May 1988
Gasoline/Diesel		8,000	Fiberglass	May 1988
Kerosene		2,000	Fiberglass	May 1988
Main Street Auto Care 101 S. Main Street	43A2-A-35			
Gasoline		4,000	Fiberglass	2000
Gasoline		4,000	Fiberglass	2000

Food Mart Chevron 18131 AP Hill Boulevard	44-A-1B			
Gasoline		4,000	Steel	1981
Diesel		4,000	Steel	1981
Kerosene		3,000	Steel	1981
Bowling Green Fire Dept. 130 Courthouse Lane	43A2-A5-1A			
Gasoline		1,000	Fiberglass	May 1981
Caroline County Ennis Street	43A2-A56			
Gasoline		3,000	Steel	May 1971
Diesel		2,500	Steel	May 1968

Source: Virginia Department of Environmental Quality/Town of Bowling Green

Stream Bank Erosion

There are three areas of the Town of Bowling Green that have been identified as areas of potential stream bank erosion. They are, generally, an area to the North of West Broaddus Avenue behind the Town's Sewage Treatment Plant which acts as the receiving stream for effluent from the plant and is an unnamed tributary of the Mattaponi River, an area on both sides of Lakewood Road extending from Lakewood Road to Route 301 which is associated with the Maracossic Creek system, and an area near the Southeast corner of Bowling Green on the Bowling Green Farm property.

An on-site inspection of the three areas was conducted during the second week of September of 2006 by staff of the Bowling Green Public Works Department. This inspection occurred shortly after several days of relatively heavy rain storms, some associated with the remnants of a hurricane that had taken a course up the East coast from Florida. There were no areas of active or inactive erosion that were noted. It is a fact that there have been no land disturbing activities in any of these areas for an extended period of time. The area behind the treatment plant remains undeveloped. The area on Lakewood Road has had no new construction for over twenty years and retains firm, well-vegetated stream banks or banks around a lake where water movement is very slow. The entire acreage of Bowling Green Farm is in a Conservation Easement and remains well-vegetated. Part of the Farm area was stabilized when the Virginia Department of Transportation constructed a portion of the Bowling Green by-pass near the boundary of the farm. This area remains untouched.

Discussions regarding this matter were held with staff of the Caroline County Planning Department which is the group that enforces the Erosion and Sediment Control Regulations and inspects proposals that require Chesapeake Bay Regulation compliance in the Town of Bowling Green. Confirmation was received that no areas of shoreline or stream bank erosion have been observed in Bowling Green.

Vegetation

Preservation of indigenous vegetation is an important component of the Chesapeake Bay program. Water quality benefits include decreasing the runoff rate and trapping pollutants before they reach waterways. Streamside vegetation, especially forested areas, can provide tremendous benefit to water quality. These streamside forests can be effective in removing excess nutrients and sediment from surface runoff and shallow groundwater. The shade that is provided to streams optimizes light and temperature conditions for aquatic plants and animals. The town's intermittent streams are shaded by trees and other vegetation. The steep slopes adjacent to the streams are anchored by trees. Due to the presence of this streamside forest, the slopes are stabilized, and the stream is vibrant with aquatic life. The town recognizes the importance of preserving this indigenous vegetation as much as possible.

Trees and other vegetation preservation and maintenance are addressed in the Downtown Bowling Green Revitalization Action Plan. The town will, through the guidance of this plan, continue with its ongoing effort to provide trees in the downtown area.

Existing Pollution Sources

While the protection of environmentally sensitive features serves as an integral part of water quality management, the identification of sources of pollution and the development of strategies to address them are equally important. Pollution can come from a variety of sources. It can be classified into two forms, point and nonpoint source pollution. Point source pollution is pollution which originates from a single source such as a wastewater outfall or an underground storage tank. Nonpoint source pollution is pollution which has a diffuse source such as agricultural or storm water runoff. While it is not possible to eliminate all existing or potential pollution sources, it is desirable to minimize the amount of pollution generated from the desired use of land within the town. By managing both types of pollution, the Town of Bowling Green enhances water quality protection.

Point Source Pollution

Point sources are typically points where wastewater from sewage treatment systems, water treatment systems and industrial facilities are discharged to surface waters. The type of pollutants generally associated with point sources includes toxics, fecal coliform, nutrients, and metals. Each point source discharger must have a Virginia Pollutant Discharge Elimination System (VPDES)

permit prior to discharging treated wastewater to ensure that water quality standards are met before discharge. The Town of Bowling Green has only one point source discharge of wastewater, the municipal wastewater treatment facility which discharges to an unnamed tributary of the Mattaponi River. As with other point source dischargers, the town's treatment facility maintains the required standards for their VPDES permit.

Other potential point source pollution sources include leaking underground and aboveground storage tanks such as those used by gas stations, heating fuel suppliers, home heating oil tanks, and chemical storage facilities. Storage tanks have the potential of contaminating the immediate area, and the pollutants can also migrate and contaminate groundwater and surface water located away from the tank site. Table 3-5 provides information on regulated underground storage tanks. The groundwater issues section of this document provides more information on this subject.

Add VPDES Permit Outfall Sites

Nonpoint Source Pollution

Nonpoint source pollution may originate from sources such as farm fields, roads, developed areas, land disturbing activities, parking lots and other paved areas, fertilized lawns, deposition of pollution from the air, septic systems, and stormwater. These pollutants may be heavy metals, petroleum products, sediment, herbicides, pesticides, fecal coliform, and nutrients. The effect of these pollutants on local waterways is a general degradation of the quality of the waterways and in some cases, a phenomenon known as eutrophication.

Eutrophic conditions, which are caused by excessive nutrients in the water, are characterized by low dissolved oxygen levels and high algal growth. A relatively high content of dissolved oxygen in water is necessary to ensure the growth and propagation of aquatic ecosystems. The primary detrimental effect on water resources is algae blooms, which block sunlight from aquatic life and deplete the dissolved oxygen content during decay. General water quality degradation from oil contamination, sediments, pesticides, metals, and other toxic substances can kill fish and destroy benthic (bottom-dwelling) life. Hazardous wastes that are improperly used and disposed of can reach waterways. Examples of hazardous wastes include pesticides; wood preservatives; cleaners, paint, and solvent wastes; automotive wastes such as oil, transmission fluid, antifreeze, gasoline, and batteries. These wastes can destroy aquatic life and severely damage water quality.

One of the greatest non-point source pollution threats to the Chesapeake Bay and its tributary systems is soil erosion. This erosion can stem from many sources. It is a pressing problem. The Town of Bowling Green has implemented cooperative programs with Caroline County to address erosion control for all appropriate land disturbing activities in the town. These agreements have been in place for some time. Erosion and sediment contribution to local waterways is minimized

because of these inspection and enforcement agreements with the County. This proactive approach provides maximum benefits for aquatic life in the area. These cooperative arrangements are important because nutrients and pollutants attach themselves to sediment which is, ultimately, carried into water bodies, and harmful conditions are created. The Town of Bowling Green realizes the importance of removing these threats to the health of local waterways and ultimately, the Chesapeake Bay. This preventative measure is accomplished by appropriate implementation and enforcement of our sediment and erosion control regulations through a strong working relationship with Caroline County.

Add List of Registered Petroleum Tanks

Septic Systems

The town relies on both a central wastewater treatment facility and individual septic systems. Septic systems can contribute fecal coliform, nitrogen, and other contaminants to groundwater and surface water. This is especially true if they are improperly installed and maintained, or they are installed on steep slopes or in soils that are unsuitable for their operation. Unsuitable soils include those that are highly permeable or demonstrate low permeability. Such soils do not provide adequate filtration of impurities. If appropriate waste filtration is not achieved, these polluted wastewaters may enter the ground and surface water systems and degrade water quality. Septic systems located in soils that have low permeability tend to have wastewater that accumulates at the surface. This wastewater does not receive adequate treatment and may run off to nearby streams as part of the surface runoff.

Any new construction within the town is required to connect to the town wastewater system if it is available to the site. The septic systems in the town were built before the requirement to have two drain fields. The existing systems will be monitored to ensure documentation of the five (5) year pump-out or inspection is provided to the town by the system owner. The first monitored pump-out deadline is February 29, 2008.

There are 85 residential and commercial septic systems located within the town boundary. A total of 51 septic systems fell within the town boundary as the result of the 1998 land annexation from Caroline County. The Table 3-6 shows location by street and type of use.

Table 3-6: List of Septic Tanks by Street and Use.

Street	Total Number	Residential	Commercial
A.P. Hill Boulevard	11	2	9

Alsop Lane	1	1	0
E. Broaddus Avenue	7	2	5
W. Broaddus Avenue	1	1	0
Cedar Lane	2	2	0
Chase Street	10	9	1
Courthouse Lane	5	5	0
Elliott Drive	2	2	0
Gill Street	2	2	0
Hoomes Circle	3	3	0
Lacy Lane	3	3	0
Lafayette Avenue	13	13	0
Lakewood Road	6	6	0
N. Main Street	3	3	0
Martin Street	1	1	0
Maury Avenue	2	2	0
Milford Street	1	1	0
Paige Road	1	1	0
Sunset Drive	6	6	0
Travis Street	1	1	0
Trewalla Lane	4	4	0
Total	**85**	**70**	**15**

UPDATE WITH NEW INFO Source: Town of Bowling Green, 2026

Best Management Practices

Best Management Practices (including detention and retention ponds, as well as infiltration trenches), when functioning properly, are essential elements of a storm water quality management program. However, if BMPs are allowed to deteriorate (clogging by debris and sediments, deteriorated structural integrity, and denuded vegetation) their water quality benefits can be severely diminished or lost. The town requires that any private owner or operator of a BMP enter into a legally-binding memorandum of understanding with the town regarding BMP maintenance.

Storm Water Runoff

Storm water runoff from developed areas tends to collect and carry surface pollutants including soil sediments, nutrients (such as phosphorus and nitrogen), heavy metals, petroleum products, and hydrocarbons. Storm water is a carrier for these pollutants to enter surface waters and thus, degrade water quality. As the natural environment becomes developed, vegetative land cover is removed, and an impervious surface is created.

Vegetation slows down storm water, thus preventing erosion, allowing pollutant entrapment and/or giving pollutant laden water the opportunity to filter through the soil. Removing vegetation and adding impervious surfaces allows for storm water runoff to quickly add pollutants to aquatic systems.

As storm water volumes increase and flow to area streams, the stream channels tend to deepen and widen to accommodate the additional water flow. This increases stream bank instability and erosion which increases sediment loading downstream. Sediment loading may destroy shellfish and fin fish habitats, and it can cause the loss of vital aquatic vegetation. Heavy storm water runoff can increase the potential for flooding with the associated environmental and human impacts.

Potable Water Supply

The Town of Bowling Green relies totally on groundwater for its water supply. Currently, the system consists of three deep wells, located on Chase Street, Cedar Lane, and West Broaddus Avenue. The wells access water in a deep underground aquifer. According to the Virginia Department of Health, the town's wells are not under direct surface water influence. The maximum water withdrawals per day as of 2006 are 0.0236 MG (Chase Street), 0.0151 MG (Cedar Lane), and 0.0184 MG (West Broaddus Avenue – online April 2006).

The town has two elevated storage tanks with a volume of 60,000 gallons and 100,000 gallons, respectively. There is one surface storage tank with a volume of 200,000 gallons. The water system design capacity is permitted for 216,800 gallons/day. The need for additional well capacity to meet the town's water requirements for the future was met with a new well online in April 2006.

Table 3-7. Water Withdrawal Requirements Prior to New Well Put Online in 2006

Category of Need	**Reduced Residential Connection Demand**	**Standard Residential Connection Demand**
Current/Existing Demand	Well capacity adequate	Additional 136 gpm well capacity required
Immediate need	Well capacity adequate	Additional 156 gpm well capacity required
Short Term and Immediate Need	Well capacity adequate	Additional 174 gpm well capacity required
Total Need Including Future/Potential Need	Additional 151 gpm well capacity needed	Additional 345 gpm well capacity needed

Source: R. Stuart Royer, Consulting Engineers, 2000

The source wells for drinking water have consistently remained free from contamination. In the past, contamination within the distribution system was eliminated with chlorination. The town has experienced no contamination problems with its water supply at the intake locations of its wells corroborated by an independent lab performing parallel sample tests with the state lab.

Future Water Demand

The population of the Town of Bowling Green has been projected to increase by just over three hundred (300) people in the next twenty-five years. This would bring the town's population to 1315 by the year 2030. Estimated total current water usage is approximately 150,000 gallons per day. This figure includes areas both inside the town boundary and areas in adjacent Caroline County. Based on the output of the town's newest well, the capacity of the system is estimated to be at 216,800 gallons per day. Although this output is felt to be an adequate capacity to meet the anticipated demand, the town is currently in discussions with a developer concerning the development of another well that will be added to the town's water system.

Measures to Protect Water Supply

Wellhead protection is aimed at preventing occurrences of groundwater pollution from potential threats such as failing septic systems, underground storage tanks, and abandoned wells. Land use controls can be employed by local governments to protect public water supply well. Bowling Green has been fortunate in that its wells have remained free from contamination since chlorination was instituted.

A wellhead protection area is defined as an area that consists of land in the vicinity of a public water supply well chosen for special protection to prevent pollution of the groundwater by nearby surface and subsurface activities. A wellhead protection program may include measures such as a wellhead protection ordinance, a wellhead overlay district, zoning limitations for wellhead areas, performance standards to manage potential pollutants, and coordination between property owners and local government.

The town has taken numerous steps to protect the quality of its potable water supply. Daily testing occurs at six sites throughout the water supply system. A chlorination system was installed in February of 1994. The town has experienced no contamination problems with its water supply at the intake locations of its wells corroborated by an independent lab performing parallel sample tests with the state lab.

The town also initiated a cross connection control and inspection program that requires annual testing of applicable cross control devices. Hazard inspections have been established which requires checking valves for hazards of medium degree and reduced pressure zones for hazards

of high degree. A multi-year residential backflow prevention device installation program was initiated. Through this program, a backflow prevention device is installed when residential and commercial meters are replaced. Eventually, all residential and commercial meters will have a backflow prevention device.

To ensure the long-term viability of the water supply, the town plans to continue with the chlorination program, the cross connection control and inspection program, the hazard inspection program, and the residential and commercial backflow prevention device installation program. A wellhead protection program can be developed and implemented, if needed.

Groundwater recharge areas in the town and in the surrounding area should be identified and should be protected from pollution and from impervious surfaces which hinder recharge. The recharge areas are the land areas from which water filters down to enter an aquifer. The town is serviced with drinking water from a confined aquifer with a recharge area that may not reside within the town boundaries. Land use in these areas should be compatible with clean and abundant groundwater. The quality of the aquifer's water is a regional concern, and plans to protect it should be coordinated through the GWRC Planning District. The town will consider working with surrounding localities that contain the aquifer recharge areas for appropriate activities such as forming a groundwater protection overlay district for long range protection of the town's water supply.

Potential for Redevelopment

The most likely area for redevelopment activities is the downtown area. Selected downtown properties could be redeveloped on an individual basis. This generally involves bringing the building up to code or performing alterations to the building to better suit the next tenant. Building new buildings in place of old ones that are razed does not generally occur in town. By encouraging redevelopment in certain areas, it can decrease the need to develop new areas.

The town recently upgraded/replaced several wastewater lines during a street upgrade and the construction of the new Caroline County Courthouse. The town will continue to upgrade/replace older wastewater lines as redevelopment occurs or the lines are identified as requiring replacement.

Redevelopment of Intensely Developed Areas and Other Targeted Areas

There are no areas of the Town of Bowling Green that have been identified as Redevelopment Areas and none are envisioned for such designation. Discussions about Downtown Revitalization deal more with the appearance of building facades and the placement of benches and potted plants along Main Street. Meetings were held with a group of representatives from the business community in Town and it is clear to the Town that there will not be substantial investment in the ”redevelopment” of structures in commercial areas of Bowling Green, especially on Main Street.

In other areas where single, residential structures may receive some rehabilitation treatment, the action of applying for appropriate zoning and building permits will trigger the review of the proposed activity for an Erosion Control Permit. This will ensure that no problems will be created by the redevelopment of individual structures and soil is appropriately stabilized during and after the period in which work is being completed.

Chesapeake Bay Preservation Area Designation

The following section includes the designation of Chesapeake Bay Preservation Areas for Comprehensive Plan and Ordinance implementation and Chesapeake Bay Preservation Act enforcement purposes. Portions of the environmentally sensitive areas described above qualify for designation as a Chesapeake Bay Preservation Area. There are two levels of CBPAs: Resource Protection Areas (RPA) and Resource Management Areas (RMA). Resource Protection Areas are prevented from being developed except for water dependent uses, with some exceptions, as outlined in the Bowling Green Chesapeake Bay Preservation Ordinance. Resource Management Areas include land types that if not properly used or developed, have a potential to cause significant water quality degradation or diminish the functional value of the Resource Protection Areas.

In order to help protect the water quality of the Chesapeake Bay's tributaries, higher performance standards for land use in the Town's Chesapeake Bay Preservation Areas should be met. The performance standards include the implementation of erosion and sediment control, stormwater management, minimizing impervious surfaces, preserving natural vegetation, periodic septic tank pump out, and other standards that are outlined in the Chesapeake Bay Preservation Ordinance of the town.

Resource Protection Areas

RPAs include a 100-foot vegetated buffer area located adjacent to and landward along both sides of a perennial stream. These areas have intrinsic water quality value due to the ecological and biological processes they perform and are sensitive to impacts which may result in significant degradation of the water quality of State waters. In their natural condition, these lands provide for the removal, reduction, or assimilation of sediments, nutrients, and potentially harmful or toxic substances in runoff. Land development, except for water-dependent uses, redevelopment, public roads, utilities, and uses for which rights have been grandfathered, is prohibited in RPAs. In the case of water-dependent facilities, all non-water-dependent components of the project must be located in the RMA.

Resource Management Areas

Areas in the Town of Bowling Green not identified as Resource Management Areas include land types that, if improperly used or developed, may have a potential for causing significant water quality degradation. When developing land in the RMA, some of the performance standards include a reduction in the nonpoint source pollutant loadings entering receiving streams and other waterways and include a reduction in the potential for contamination of surface water and groundwater from failed septic systems. To achieve these standards, certain pollution prevention measures will need to be employed during development and maintained after development. Due to the current land use within the RMA, there are no potential redevelopment areas within this CBPA. However, there is the potential for redevelopment in non-CBPA lands.

The town will implement and enforce all pertinent ordinances including stormwater, and erosion and sediment control. In addition, the town will minimize the amount of impervious area in redevelopment or development sites in non-CBPAs. The town's Chesapeake Bay Preservation Ordinance should be consulted for further explanation and detail of the performance standards needed for the RMA and for the town. In September 1999, the Town Council adopted the performance standards for RMAs for all property within the town limits. See Code of the Town of Bowling Green, Zoning Ordinance.

Suitability for Development

Wetlands, flood-prone areas, steep slopes, and poor soils are land characteristics that determine whether land is suitable or unsuitable for development. The wetland areas have been identified in the town and are discussed above. The wetlands have been included in the CBPAs of the town. There are numerous legal constraints to development of wetlands. Pertinent laws are taken into consideration when developing an area with wetlands. Federal laws include Section 404 of the Clean Water Act of 1977 (33 U.S.C. 1251) which addresses dredge and fill operations in wetlands and Section 10 of the Rivers and Harbors Appropriations Act of 1899 (33 U.S.C. 403) which addresses activities affecting navigation. State laws include the Tidal Wetlands Act. Localities adopt their own zoning ordinances to regulate the use of their wetlands.

Under the Chesapeake Bay Preservation Act localities must establish a program to protect and delineate environmentally sensitive features. The Act directs the local jurisdictions to establish Resource Protection Areas (RPAs), in which only water related activities with very stringent environmental requirements are permitted. The wetlands associated with the town's intermittent stream and the adjacent steep slopes are designated as Resource Protection and Management Areas by the town. Through the employment of the performance criteria developed as a result of the Chesapeake Bay Preservation Act, these designations will provide significant water quality protection.

Flood-prone areas include the 100-year floodplain as a minimum. Floodplains provide numerous functions and value to an area including aquifer recharge, habitat, and water quality benefits. Floodplains supply natural flood control for properties located outside of the floodplain. Peak volumes are retained in the floodplain, and vegetation filters contaminants and traps sediments. However, there are no identified flood-prone areas in the town according to the review of FEMA maps.

Very localized areas of steep slopes do exist within the town. Most of the slopes of 15% or greater are designated as CBPAs. Steep slopes outside of the CBPAs have also been mapped. Slopes of 15 to 25 percent, while developable, should only be done so with proper erosion and sediment controls because of the rapid to very rapid runoff associated with these slopes. Slopes of 25% or greater should be kept under permanent vegetative cover. Those steep slopes associated with waterways have been included in the CBPAs of the town.

Certain soil characteristics affect the suitability of land for septic drain field use. These include slope, susceptibility to severe wetness, flooding potential, permeability, percolation, and filtering characteristics. Sewage may not be sufficiently treated if these characteristics are present on the site which can result in degradation of water quality. Areas of the town which are unsuitable for septic systems should be designated as unsuitable for development until public sewer lines are installed.

Aquifer Recharge Areas

Neither the Town of Bowling Green nor Caroline County has identified specific aquifer recharge areas. There is, however, a potential recharge area in town which is the area around the receiving stream behind the town's sewage treatment plant on West Broaddus Avenue. This area is not expected to be developed because of its relatively wet nature and proximity to the treatment plant. The certification of the treatment plant and its continued compliance with all Federal and State laws provides protection for any recharge activities. In addition, the entire Town of Bowling Green is officially classified as a Resource Management Area (RMA). This designation and its associated enforcement requirements will provide appropriate protection for all areas of town, whether or not recharge areas exist within the town boundary.

Caroline County has not, as yet, developed a timeframe for the identification of recharge areas or the creation of policies for their protection. The town will remain in contact with the County and seek cooperative arrangements with the County to provide for joint identification of areas and the creation of appropriate policies for such recharge areas.

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Chesapeake Bay Preservation Areas and Areas Unsuitable for Development

The following discussion provides information about current and future land use and physical characteristics in areas of town that contain sensitive natural features. There are several areas which deserve consideration for protection under the Chesapeake Bay Preservation Act with a designation of Chesapeake Bay Preservation Area (CBPA) (See Chesapeake Bay Preservation Areas Map).

1. An area is located in the northern corner of town between Routes 2 and 301. It is characterized by hardwood forest and rolling topography with flat ridges and steep slopes. The bottoms display non-tidal wetland areas possibly fed by groundwater and intermittent streams. However, neither intermittent streams nor wetlands appear in this area on the most recent U.S.G.S., 7.5' Topographic Map or the National Wetlands Inventory Maps. In an open area on Route 2 near the intersection of Routes 2 and 301, there is a private community recreation facility with a community building, swimming pool and tennis courts. This entire area is vegetated. Current zoning in the area is residential, with a small amount of commercial. As identified in the Comprehensive Plan, future land use for this area is designated as conservation areas, low density residential, and a small amount of commercial. This area is not considered to require designation as a Chesapeake Bay Preservation Area.
2. An area further out from the intersection of Routes 2 and 301 within the same section of town, sensitive environmental areas have been identified and characterized by a pond, wetlands and a creek. These areas are associated with Maracossic Creek. Broaddus Pond extends from the town boundary to Lakewood Road. Maracossic Creek and wetlands extend from the east side of Lakewood Road to the town boundary on the southeast side of Route 301. This aquatic system drains to the Mattaponi, a tributary of the York River. The waters described above with an adjacent 100 foot buffer measured from mean high water are designated as RPA or a Resource Protection Area of the Chesapeake Bay. The

Resource Management Area (RMA) includes a buffer adjacent to the RPA of 100 feet. Land use designations include conservation areas and residential uses along Lakewood Road. Business development exists along the Route 301 corridor. Business and residential land uses are consistent with future land use plans for the area. The RPA cannot be developed because of

creeks, ponds, wetlands and steep slopes in some areas. Any development planned for the RMA must abide by the town's Chesapeake Bay Preservation Ordinance.

3. An area in the southern part of town between Maury Avenue and Route 301. It includes a stream that drains into the Mattaponi River. Wetlands are associated with this water body. The stream and wetlands should be protected by a 100 foot RPA buffer. Due to the location of The Bowling Green Farm (formerly called The Old Mansion) on the west side of Route 301 near the sensitive area, no development will occur in this area. The Bowling Green Farm is listed as a historic site on the National Register of Historic Places. An easement around this structure and its property restricts development. Current and future land uses include protection of this area through its historic easement.

Long-Range Planning for Environmental Protection

Land use planning in Bowling Green will help protect its water quality and natural features and provide for appropriate land use in the town. In considering future development, the town must consider protecting vital resources such as a clean water supply for the town's current and future residents. Land use planning must consider the town's connection to other areas through its waterways and the importance of those waterways to residents, wildlife, and vegetation in other localities.

Establishing Chesapeake Bay Preservation Areas (CBPAs) in the town is important to protect the Chesapeake Bay system for the Commonwealth of Virginia and the transient wildlife that depend on those waters. The town is located in the Chesapeake Bay Drainage Area and its streams and water system drain into the Mattaponi River which flows into the York River, a major tributary of the Chesapeake Bay. The town's Chesapeake Bay Preservation Ordinance includes town-wide measures to ensure water quality protection.

This chapter contains valuable information about the current condition of the town's natural environment. It also outlined factors that may have a negative impact on the environment. The town has a number of resources available to address environmental concerns. The town's Comprehensive Plan and the Zoning and Subdivision Ordinances provide the town staff with powerful tools to manage the way developments are proposed and constructed. Chapter 9 of the Comprehensive Plan which deals with land use should be used in conjunction with this chapter on the environment when planning for and reviewing development proposals. The land use chapter contains a map which outlines where certain types of development should be placed, along with Development Standards and Design Features that outline how developments should be built into the landscape.

Objectives and Strategies

Strategy		Type	Time-frame	Cost	Potential Partners	Potential Next Steps
Objective 1. Protect and improve water quality and natural resources through conservation, restoration, education, and stewardship.						
ESR-1	Continue to implement and periodically update the Town's CBPA program to protect water quality, wetlands, riparian buffers, and other environmentally sensitive resources.	Policy	Ongoing	$	DEQ	• Regularly review the Town's existing CBPA Ordinance for consistency with current state regulations. • Coordinate with DEQ to identify recent regulatory updates and technical assistance opportunities.
ESR-2	Identify opportunities to protect and restore wetlands, riparian buffers, shorelines, and other environmentally sensitive areas.	Capital	Short-Term	$-$$	DEQ; DCR; VIMS; Property Owners; The Land Trust of Virginia	• Inventory publicly owned and environmentally sensitive properties that may be suitable for restoration or conservation. • Meet with DEQ, DCR, and local property owners to identify potential restoration projects and funding opportunities.
ESR-3	Support environmental stewardship through partnerships, education, and public outreach to increase awareness of Bowling Green's natural resources, CBPA, and opportunities to protect water quality.	Policy	Immediate	$	DEQ; RRPDC; DCR; Community Organizations	• Meet with partners to identify existing educational resources and partnership opportunities. • Share any readily-available materials on the Town website. • Develop a public outreach plan highlighting Bowling Green's natural resources, CBPA requirements, and stewardship practices.
Objective 2. Guide growth and redevelopment in environmentally responsible locations.						

ESR-4	Amend the Zoning and Subdivision Ordinances to protect resources, address environmental constraints, encourage resilient site design, support context-sensitive infill development, and reduce runoff.	Policy	Short-Term	$	RRPDC; Consulting Services	• Review the development ordinances to identify opportunities to reduce impervious surface coverage; require or encourage low-impact development and green infrastructure; and strengthen SWM and resilient site design. • Prepare a list of recommended ordinance amendments for Planning Commission consideration.
ESR-6	Ensure that the siting and design of docks, piers, marinas, and other riverfront facilities protect water quality, natural habitats, shoreline stability, and navigation, and provide adequate public water access.	Policy	Ongoing	$	VMRC; DEQ; VIMS; Property Owners	• Coordinate with partners early in the development review process to identify environmental constraints, permitting requirements, and opportunities to minimize impacts.
Objective 3. Improve resilience to flooding, erosion, severe weather, and other natural hazards.						
ESR-6	Prioritize investments in stormwater BMPs, shoreline stabilization, streambank restoration, and nature-based solutions that reduce flooding, improve resilience to sea level rise and coastal storms, and protect water quality.	Capital	Mid-Term	$$$	DEQ; DCR; FEMA; HRSD; VDOT	• Maintain an inventory of known flooding, erosion, and shoreline problem areas. • Prioritize projects for inclusion in the Capital Improvement Program and future grant applications.

ESR-7	Coordinate the implementation of Bowling Green-specific recommendations from the regional Hazard Mitigation Plan (HMP) through capital improvements, infrastructure planning, grant funding, and emergency preparedness initiatives.	Policy; Capital	Ongoing	$-$$$	RRPDC; FEMA; VDEM; DEQ; Neighbor Localities	• Review the Bowling Green-specific mitigation actions identified in the regional Hazard Mitigation Plan. • Assign lead departments and identify funding opportunities. • Incorporate priority actions into the Town's Capital Improvement Program.
ESR-8	Work with Caroline County to pursue National Weather Service StormReady designation to strengthen emergency preparedness, public warning systems, severe weather response, and community resilience.	Policy	Mid-Term	S	Caroline County; National Weather Service; MPPDC	• Meet with Caroline County Fire and Emergency Services to determine which StormReady criteria are already met through existing emergency management programs. • Complete a gap assessment of the Town's emergency communications, warning systems, public outreach, and emergency operations using the National Weather Service StormReady criteria. • Develop and implement an action plan to address any remaining requirements and submit a StormReady application.

ESR-9	Pursue participation in FEMA's Community Rating System (CRS) to strengthen floodplain management, improve community resilience, and reduce flood insurance premiums for eligible property owners.	Policy	Mid-Term	$	FEMA; DCR; VDEM; Caroline County; MPPDC	• Coordinate with partners to evaluate the Town's eligibility and capacity to participate in the CRS. • Determine whether pursuing CRS independently or in coordination with Caroline County would provide the greatest benefit and administrative efficiency.