CHARLES COUNTY MARYLAND
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Charles County
Water Resources Element

Adopted May 24, 2011



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I. Introduction

A. Purpose and Background of the WRE

The Water Resources Element of the Charles County Comprehensive Plan creates a policy framework for sustaining public drinking water supplies and protecting the County's waterways and riparian ecosystems by effectively managing point and nonpoint source water pollution. It complies with the requirements of Article 66B of the Annotated Code of Maryland—as amended by Maryland House Bill 1141 (HB1141), adopted in 2006.

This Water Resources Element (WRE) is an amendment to the 2006 Comprehensive Plan. It evaluates the policies of the 2006 Plan through the lens of HB1141, and identifies ongoing and future strategies to manage existing water supplies, wastewater effluent, and stormwater runoff for existing and future residents and businesses (including the growth projected for the County's municipalities). It also identifies the County's policies and initiatives for—as well as the opportunities and challenges related to—achieving water quality goals and ensuring adequate drinking water for future generations of Charles County residents.

B. Interjurisdictional Coordination

The County recognizes the importance of interjurisdictional water resources planning. The Towns of Indian Head and La Plata (the County's two incorporated municipalities) own and operate their own public water systems, wastewater treatment plants, and most wastewater collection systems. Both municipalities have adopted their own WRE and Municipal Growth Elements (MGE). This Countywide Water Resources Element compiles, to the greatest degree possible, up-to-date data from these and other municipal planning documents in order to coordinate water resources, growth, and land use planning. This document will provide the nonpoint source modeling data and impervious surface data to be used by the County and its municipalities in their respective WREs.

Where possible, the County has also obtained data and information on water resources (including adopted WREs) from Calvert, St. Mary's, and Prince George's Counties in order to paint the fullest possible picture of future impacts to the Potomac, Patuxent, Wicomico and other rivers and streams that form Charles County's eastern, southern, and western boundaries.

C. Changes since the 2006 Comprehensive Plan

The Water Resources Element updates, compiles, and expands upon many of the data, goals, and policies contained in the 2006 Comprehensive Plan. In particular, this WRE contains updated information on demand, flow, and capacity for public water and wastewater systems in the County. Since the 2006 Comprehensive Plan was adopted, the following major changes have impacted public water and sewer infrastructure in the County.

1. In 2006, the County adopted a new Comprehensive Water and Sewer Plan. This document addresses water resources, water and wastewater facilities, needs projections, new and updated policies, and corrective approaches to problem areas.
2. The Waldorf and Bensville water systems were interconnected, providing system redundancy and accomplishing one of the major water goals in the County Water and Sewer Plan.
3. The Mattawoman Wastewater Treatment Plant (WWTP) was upgraded to Enhanced Nutrient Removal (ENR) technology in 2007. This facility upgrade enabled the plant's permitted discharge capacity to be rated at 20 MGD in November 2009.

4. The NPDES permit for the Swan Point water system was renewed, with a permitted capacity of 0.5 million gallons per day (MGD), and the facility was upgraded to Enhanced Nutrient Removal (ENR) technology in 2007.
5. The La Plata water system's permitted withdrawal in the month of maximum use (peak use) was increased from 1.335 MGD up to 1.715 MGD. The Town has requested an increase in their NPDES (wastewater discharge) permit to 2.0 MGD.
6. The Town of Indian Head WWTP as upgraded to ENR technology 2008.
7. The County initiated use of the Washington Suburban Sanitary Commission (WSSC) water line connection at MD 228 (Berry Road) and Bealle Hill Road on March 31, 2009 to supplement the Waldorf and Bensville water systems with potable water.
8. The Waldorf Urban Design Study (WUDS) and its associated zoning were adopted by the County Commissioners in 2009 and 2010, respectively. This significantly increased the development capacity of the US 301 corridor in Waldorf.
9. The County has moved forward with construction necessary to retire and convert the WWTPs at the College of Southern Maryland and Mt. Carmel Woods WWTPs to pumping stations in 2011. Effluent from these facilities will be conveyed effluent to the Mattawoman WWTP.

D. Key Assumptions of This Document

Surface water and groundwater are highly complex systems that involve countless inputs, outputs, and physical, chemical, and biological interactions. As a chapter of Charles County's 2006 Comprehensive Plan, the WRE is not intended to be a scientific evaluation of these systems. Rather, the WRE's summarizes the best available water resources information in a way that facilitates the establishment and implementation of land use and other policies.

That generalization requires a number of key assumptions about growth and development, infrastructure, hydrogeology, hydrology, and technology. Some of the broadest and most important assumptions used in this document are listed below.

- Charles County accepts, solely for purposes of the future-year WRE modeling required by state law, the 2030 population projections and the Development Capacity Analysis created by the Maryland Department of Planning (MDP) in 2008. The water resources impacts of the 2006 Comprehensive Plan are modeled based on these inputs.
- Analyses of water and sewer systems are based on average daily demand and/or flow. Engineering considerations such as the maximum single-day demand or the month of maximum demand are addressed in the County's Comprehensive Water and Sewer Plan.
- Average water consumption in Charles County is 208 gallons per day (gpd) per dwelling unit. Average wastewater generation is 250 gpd per dwelling unit. Non-residential water demand and wastewater generation is expressed in terms of "equivalent" dwelling units (EDU).
- The characterizations of groundwater in Charles County are intentionally general. The County recognizes that water availability in individual wells and communities does not always match the WRE's broad descriptions of water supplies.
- The characterizations of wastewater and stormwater discharges and water quality are generalized to the entire watershed in question (see Section III.A). The County recognizes that individual tributaries and stream segments have different conditions and react differently to discharges.

- Future water demand (either groundwater or surface water) from adjoining jurisdictions reflects current State-regulated allocations.
- An interconnection of the Waldorf and Bryans Road water systems will be completed by approximately 2025. Alternatively, additional groundwater appropriation in Bryans Road will be sought from the Patuxent aquifer at that time, if deemed necessary.

II. Goals for Water Resources

The following goals address water resources in Charles County.

Water Resources Goal 1: *In cooperation with the County's municipalities, the County will maintain safe and adequate drinking water supplies for existing and projected population and non-residential uses.*

Water Resources Goal 2: *In cooperation with the County's municipalities, the County will ensure that adequate wastewater treatment capacity exists in public systems for existing and projected population and non-residential uses.*

Water Resources Goal 3: *The County will take steps to meet regulatory requirements by protecting and restoring water quality in the County's rivers and streams.*

Water Resources Goal 4: *Water resources planning shall be a tool to direct the location, amount, and type of development in Charles County.*

III. County Projections and Scenarios

This section describes the population and housing projections and future growth scenarios used in the Water Resources Element. All projections and scenarios in this section are developed to support the analyses in the WRE and are intended for use in this Element only. The County's official population projections will be updated as part of the 2012 Comprehensive Plan.

A. Watersheds

This Element takes a watershed-based approach in analyzing the impact of future growth on Charles County's water resources—particularly in relation to nutrients discharged to the County's water bodies. Land in Charles County drains to one of ten major watersheds (or "8-digit watersheds," referring to the numerical classification system used by the Maryland Department of the Environment). These watersheds, shown on Figure 1, are; the Lower Patuxent River, Gilbert Swamp, Mattawoman Creek, Port Tobacco River, Nanjemoy Creek, Lower Tidal Potomac River, Middle Tidal Potomac River, Upper Tidal Potomac River, Wicomico River, and Zekiah Swamp.

B. Population Projections

The Water Resources Element uses Countywide population projections developed by MDP in 2008, shown in Table 1. These projections indicate that County population will reach approximately 204,200 by the year 2030, an annual increase of approximately 1.7 percent per year, or 45 percent overall between 2008 and 2030. The MDP projections in Table 1 differ slightly from, but are generally consistent with projections in the 2006 Comprehensive Plan (which only projected population through 2025). Projections from the 2006 Comprehensive Plan are included for reference only, and are not the basis for the analyses in this WRE.

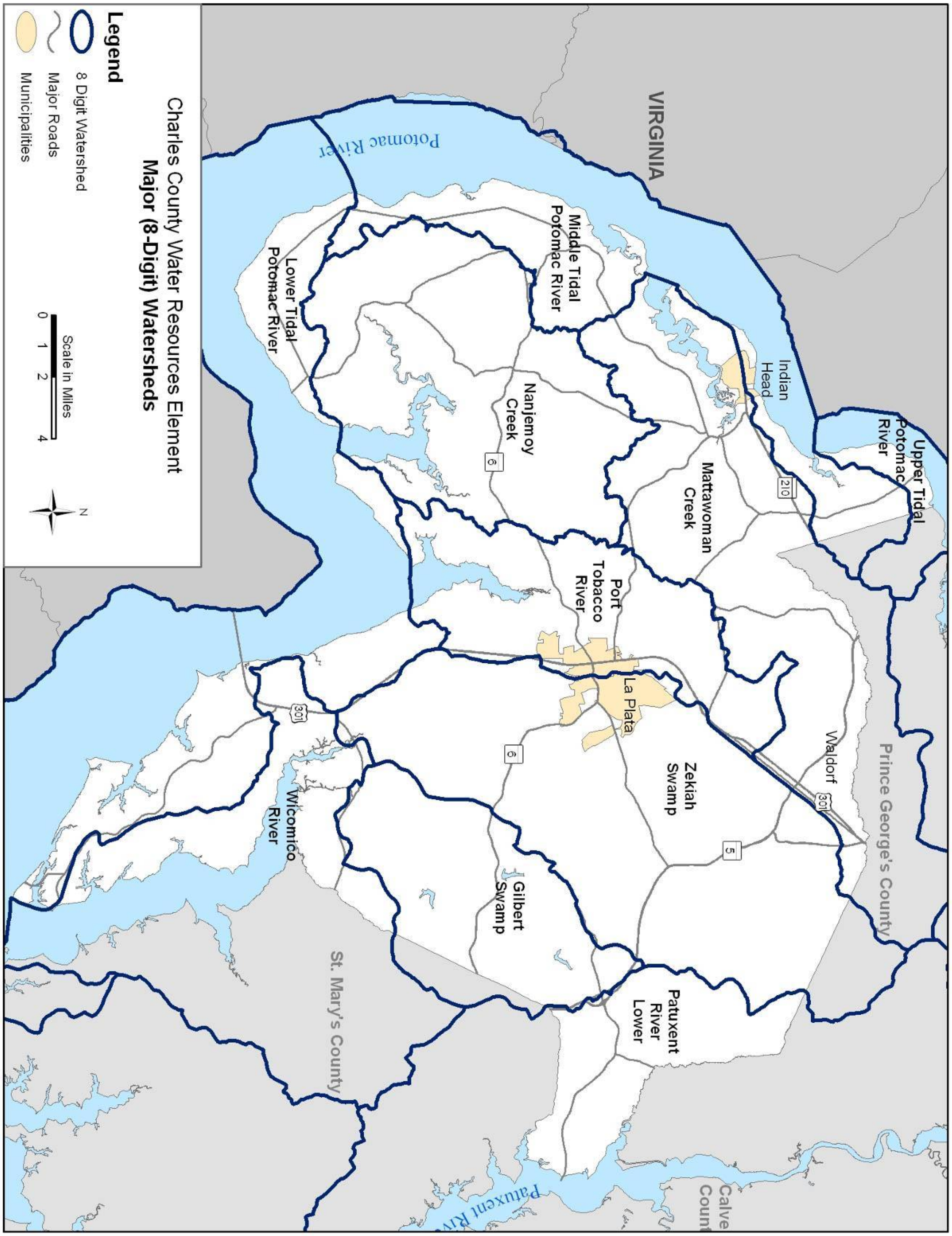

Figure 1: Major Watersheds

Table 1. Population Projections for the Water Resources Element

	Year						*Change, 2008-2030*		
Source	**2008[1]**	**2010**	**2015**	**2020**	**2025**	**2030**	**Number**	**Percent**	**Annual Increase**
MDP	140,764	144,950	160,950	177,200	193,100	204,200	63,436	45%	1.7%
2006 Comp. Plan		*147,400*	*162,293*	*177,181*	*193,914*				

Notes:
1: 2008 is the most recent available population estimate. For other data, such as land use/land cover, the most recent available information dates from 2007. For purposes of this WRE, 2007 and 2008 are considered to be "current" or "baseline" conditions.
Sources:
2008: MDP, 2008 Estimates for Maryland's Jurisdictions
All Other Years: MDP, Projected Total Population for Maryland's Jurisdictions (Revisions, December 2008).

C. Scenarios

To gauge the impacts of alternative land use and water resources policies, this Water Resources Element establishes three future land use scenarios. Each scenario assumes the same total amount of growth (e.g., new housing units and nonresidential development), with different geographic distributions, as described below. These scenarios are all reflections of the 2006 Comprehensive Plan's policies, or of significant alternative policies discussed in the 2006 Plan. Table 2 shows the watershed-level distribution of housing units in each of these scenarios.

- **A. Baseline**. This scenario reflects the 2006 Comprehensive Plan, as adopted and implemented by zoning prior to 2010. It will test the water resources impacts of implementing the adopted Comprehensive Plan, and will serve as the basis for comparing other scenarios.

- **B. Focused Growth.** This scenario tests the water resources impacts of concentrating a greater share of development in the Waldorf[1] and Bryans Road Priority Funding Areas (PFAs), while reducing development in the rural portions of the County that would be covered by the County's Priority Preservation Areas (PPA).[2] In this scenario, the Deferred Development District (DDD) would remain deferred (with permitted densities of one unit per 10 acres) through 2030. New development in the Old Woman's Run catchment area outside of the DDD would be subject to restrictions similar to those in the DDD.

- **C. Deferred Development District Focus**. This scenario would test the water resources impacts of immediately opening the entire DDD for development under its base zoning (Low Density Residential).[3] This scenario assumes that all new development in the DDD and a share of existing development would be connected to the Waldorf public water system and the Mattawoman WWTP. The 2006 Comprehensive Plan found that there is adequate

[1] Base densities in the TOD district of the US 301 corridor in Waldorf are 15 units per acre, reflecting the WUDS zoning amendment adopted in 2010, as well as MTA's Southern Maryland Transit Corridor Preservation Study. Assumed yields (the achieved residential density) throughout the Waldorf PFA are assumed to be 5 units per acre, taking into account environmental and other limitations that may prevent a parcel from achieving its maximum theoretical density. This is compared to pre-WUDS yields of 3.5 units per acre for RH (high density) zoning, and progressively lower yields for other districts.

[2] At the initiation of the WRE, both the WUDS zoning and the PPA were proposed. Since that time, the WUDS zoning has been adopted into the County zoning ordinance. As of early 2011, the PPA was under review by the Charles County Planning Commission.

[3] For modeling purposes, the typical residential yield in Low Density Residential areas was assumed to be 1.55 units per gross acre, as derived by the Department of Planning and Growth Management based on historical housing yields in the RL Zone, which includes land used as open spaces and infrastructure. This assumes the use of Transferrable Development Rights (TDRs), a common practice in the active Development District

Table 2. Charles County Water Resources Element Growth Scenarios Through 2030 (Housing Units)

Watersheds	Housing Units, 2008[1]	2030 Scenarios					
		A. Baseline		B. Focused Growth		C. DDD Focus	
		Increment	*Total*	*Increment*	*Total*	*Increment*	*Total*
Patuxent River	2,124	432	2,556	507	2,631	494	2,618
Gilbert Swamp	1,758	826	2,584	316	2,074	308	2,066
Mattawoman Creek							
Waldorf	12,168	2,843	15,011	4,007	16,175	3,016	15,184
Bryans Road	1,007	1,857	2,864	2,120	3,127	1,495	2,502
Indian Head	1,615	659	2,274	659	2,274	659	2,274
Remainder of Mattawoman Creek	5,775	1,617	7,392	1,284	7,059	4,799	10,574
Nanjemoy Creek	1,802	1,320	3,122	377	2,179	417	2,219
Port Tobacco River							
La Plata	1,706	745	2,451	635	2,341	729	2,435
Waldorf	2,422	1,009	3,431	1,741	4,163	1,773	4,195
Remainder of Port Tobacco River	2,934	882	3,816	942	3,876	981	3,915
Lower Tidal Potomac River	2,111	1,125	3,236	646	2,757	628	2,739
Middle Tidal Potomac River							
Indian Head	411	132	543	132	543	132	543
Bryans Road	955	1,306	2,261	1,377	2,332	506	1,461
Remainder of Middle Tidal Potomac	584	361	945	130	714	127	711
Upper Tidal Potomac River	114	62	176	77	191	75	189
Wicomico River	533	633	1,166	210	743	204	737
Zekiah Swamp							
Waldorf	9,808	1,909	11,717	3,946	13,754	2,249	12,057
La Plata	1,718	4,360	6,078	3,711	5,429	4,261	5,979
Remainder of Zekiah Swamp	3,782	2,095	5,877	1,356	5,138	1,320	5,102
Total	**53,327**	**24,173**	**77,500**	**24,173**	**77,500**	**24,173**	**77,500**

Notes:
1: Source: Maryland Property View 2008.
Please see the Water Resources Element Appendix for projection methodology.

development capacity in the Development District (not the DDD) through at least 2020.[4] This WRE scenario is therefore a theoretical exercise only, and does not reflect a change in County policy. The PPA would also be included in this scenario. All other parts of the County would remain unchanged from the Baseline Scenario.

Because water and sewer service is often measured in terms of Equivalent Dwelling Units, or EDU (see below), the Water Resources Element's projections of water and sewer system demand is based on housing units. The projected increase of 24,173 housing units in all scenarios represents a 45 percent overall increase. A more detailed account of how these projections were developed is included in the Water Resources Element Appendix.

D. Equivalent Dwelling Units

An EDU is the average amount of water used by one household, and is used to calculate residential and non-residential (e.g., businesses) water demand and wastewater generation. The WRE assumes that one EDU equals 208 gallons per day (gpd) for water use. While the typical statewide assumption for one EDU is 250 gpd (for both water and sewer), The County's 2006 Comprehensive Water and Sewer Plan uses 208 gpd as the basis for its water calculations.[5] This factor reflects water billing data since approximately 2000 (which show demand of approximately 180 gpd per EDU, plus a factor to account for system water loss and other inefficiencies). The County's 2010 water rate study indicates that actual residential use (including system inefficiencies) may be as low as 180 gpd per housing unit.

For sewer flows, the County does not have detailed metering. Accordingly, the sewer EDU is based on the water EDU, plus a factor to account for inflow and infiltration (see Section V) and other inefficiencies. Thus, the WRE assumes that one sewer EDU is equivalent to 250 gpd.

IV. Drinking Water Assessment

A. Summary and Analysis of Drinking Water Data

This section describes existing conditions and projected future demand for drinking water in public systems and private wells.

1. Drinking Water Sources

Although Charles County is bordered by both the Patuxent and Potomac River systems, groundwater is the primary source of water for nearly all of the County's public and private water systems. The major groundwater resources of Charles County are the aquifers of the Patuxent, Patapsco, Magothy, and Aquia Formations (see Figure 2). A more detailed description of these aquifers is included in the County's 2006 Comprehensive Water and Sewer Plan. Several studies over the last two decades have determined that the local groundwater supply may be limited in certain areas due to the natural geology and recharge rate of these aquifers.

At the same time, the ability to obtain drinking water supplies from surface water within the County is constrained because of salinity concentrations. The County supplements the groundwater supply to the Waldorf and Bensville areas by purchasing potable water from the Washington Suburban Sanitary Commission (WSSC). WSSC obtains its water from a more northern reach of the Potomac River near Washington, D.C., which has lower salinity

[4] The research conducted for this WRE found that there is adequate development capacity through 2030.

[5] The Town of La Plata uses 222 gpd for water service and approximately 253 gpd (222 gpd plus 14 percent for inflow and infiltration—see Section V) for sewer service. The Town of Indian Head uses 204 gpd for water and 250 gpd for sewer.

concentrations. Surface water treatment may be considered as a long term option for public drinking water systems in Charles County.

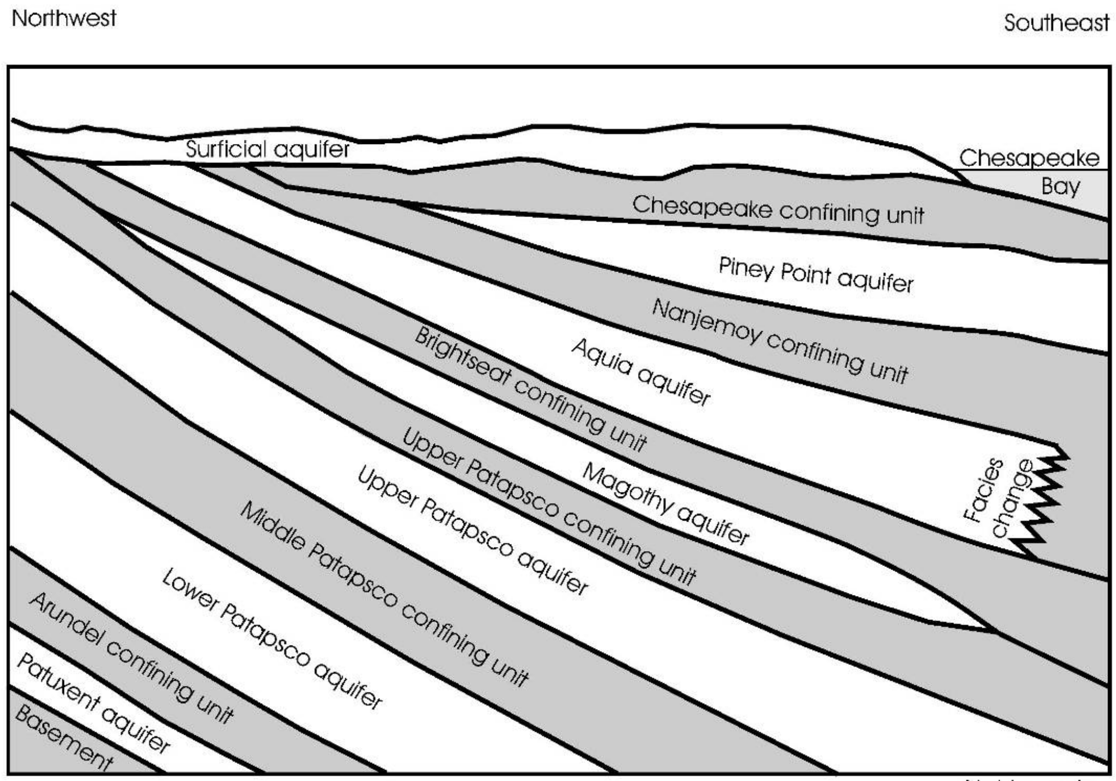

Figure 2: Major Aquifers in Southern Maryland
Source: MGS. 2007. Reports of Investigation #76

2. Public Water Systems

Groundwater is the primary source of potable water for Charles County's public water systems. There are 54 central water supply systems in Charles County that provide potable water service to approximately two-thirds of the County's housing units (or approximately 35,000 housing units).[6] Of these systems, 20 are operated by the County. The Towns of Indian Head and La Plata each operate their own water system. Table 3 shows the sources and characteristics of the 11 existing "major" public drinking water systems—those with a permitted withdrawal of more than 50,000 gpd—as well as non-public systems at the Naval Surface Warfare Center (NSWC) and Mirant Morgantown power plant.

The County's public water systems rely on four primary water-bearing formations. From the deepest to shallowest they are the confined Patuxent, Patapsco (Upper and Lower), Magothy, and Aquia aquifers. County-operated public systems primarily use the Magothy and Lower Patapsco aquifers. The Patuxent Aquifer is, for the most part, an unused water resource except in the western sections of the County. Figure 3 shows the location of water service areas in Charles County. Table 4 shows the existing and projected water supplies, demands, surpluses, and deficits for these water systems under each of the three scenarios described in Section 3.

[6] 2006 Charles County Comprehensive Water and Sewer Plan

Table 3. Drinking Water System Characteristics

Water System[1]	Source Aquifer (number of wells)	Source Concerns/System Issues
Avon Crest	Patapsco (1)	
Benedict	Aquia (2)	
Bryan's Road	Patapsco (5), Patuxent (2)	New Patuxent aquifer well and interconnection with the Waldorf/Bensville system for support and flow redundancy.
Cliffton	Patapsco (2)	Replace one existing well
Hunter's Brook	Patuxent (2)	
Indian Head	Patapsco (4)	Patuxent aquifer well planned.
La Plata	Patapsco (5)	Increased water appropriation needed to support projected growth.
Strawberry Hills Estates	Patapsco (2)	Planned interconnection to Bryans Road water system/shut down Patapsco wells
Swan Point	Patapsco (2)	
Waldorf	Magothy (9), Patapsco (7)	Additional WSSC appropriation as needed
College of Southern MD	2 wells	
Naval Surface Warfare Center	Patuxent (3), Patapsco (3)	Some past river water intrusion. Additional Patuxent aquifer well planned.
Mirant Morgantown	Surface Water, Potomac River	

Notes:
1: Source: Charles County Department of Planning and Growth Management, and Department of Public Utilities. Only lists systems with capacities greater than 50,000 gallons per day (gpd)

a. Waldorf

The Waldorf water system is the largest and most significant in the County. It serves much of the Development District, including Waldorf, St. Charles, Bensville, and portions of White Plains. The Bensville system, formerly a separate service area, was interconnected to the Waldorf system in 2008. Charles County owns, operates, and maintains the Waldorf water distribution system, as well as the sixteen production wells that provide water to the system. Nine of these wells tap the Magothy Aquifer, while another seven wells are in the Patapsco aquifers.

As described above, the Waldorf system is interconnected to WSSC. Through an agreement, Charles County can purchase up to 1.4 MGD of water from WSSC. The County is also exploring options to expand the WSSC agreement to allow purchase of up to an additional 5 MGD of water. Such expanded water purchases will involve coordination with Prince George's County, the "upstream" user of WSSC water. Other future plans for the Waldorf system include interconnection with the Bryans Road water system, which will fulfill the Comprehensive Water and Sewer Plan's interconnection goal for the Development District.

b. Other Major Systems

Other major water systems in Charles County include the municipally-owned systems serving La Plata and Indian Head, as well as County-operated systems in Bryans Road, Benedict, Swan Point, and other locations. More detailed information on existing and proposed future County water service areas can be found in the County's Comprehensive Water and Sewer Plan. The Water Resources Elements of the Indian Head and La Plata Comprehensive Plans include detailed information about these municipal water systems.

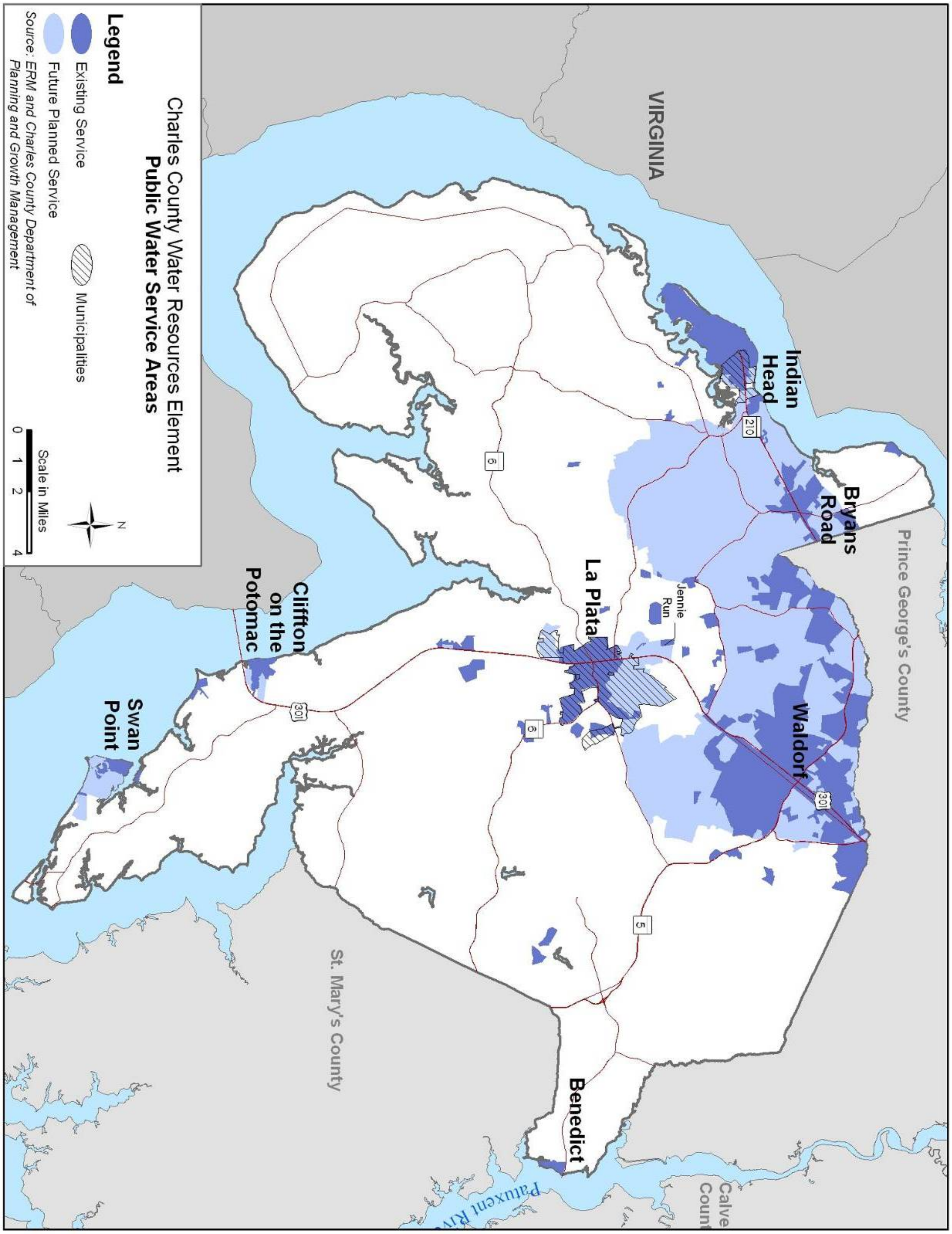

Figure 3: Public Water Service Areas

Table 4. Drinking Water System Demand and Capacity, 2030

		Benedict (St. Francis)			Bryans Road			Cliffton-on-Potomac			Hunter's Brooke	Town of Indian Head
Scenario[1]		**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**All Scenarios**	**All Scenarios**
Existing Permitted Water Production	gpd[2]			56,000			513,000			90,000	116,000	338,000
	EDU[2]			269			2,466			433	558	1,657
Demand, 2008	gpd			20,225			272,559			49,000	46,827	279,957
	EDU			97			1,310			236	225	1,372
Net Available Capacity, 2008	gpd			35,775			240,441			41,000	69,173	58,043
	EDU			172			1,156			197	333	285
Total Projected New Demand, 2008-2030[3]	gpd	4,992	5,824	5,824	821,808	905,008	531,648	4,853	4,263	4,061	-	194,250
	EDU	24	28	28	3,951	4,351	2,556	23	20	20	-	952
Grand Total Projected Demand, 2030	gpd	25,217	26,049	26,049	1,094,367	1,177,567	804,207	53,853	53,263	53,061	46,827	474,207
	EDU	121	125	125	5,261	5,661	3,866	259	256	255	225	2,325
System Capacity, 2030[4]	gpd			56,000			513,000			90,000	116,000	588,000
	EDU			269			2,446			433	446	2,882
Net Available Capacity, 2030	**gpd**	**30,783**	**29,951**	**29,951**	**(581,367)**	**(664,567)**	**(291,207)**	**36,147**	**36,737**	**36,939**	**69,173**	**113,793**
	EDU	**148**	**144**	**144**	**(2,795)**	**(3,195)**	**(1,400)**	**174**	**177**	**178**	**333**	**558**

		Town of La Plata			Strawberry Hills Estates	Swan Point			Waldorf System			Indian Head NSWC
Scenario[1]		**A**	**B**	**C**	**All Scenarios**	**A**	**B**	**C**	**A**	**B**	**C**	**All Scenarios**
Existing Permitted Water Production	gpd			1,234,000	120,000			500,000			9,647,000	1,890,000
	EDU			5,559	577			2,404			46,380	9,087
Demand, 2008	gpd			916,308	106,800			56,394			5,822,000	1,106,000
	EDU			4,128	513			271			27,990	5,317
Net Available Capacity, 2008	gpd			317,692	13,200			443,606			3,825,000	784,000
	EDU			1,431	63			2,133			18,389	3,769
Total Projected New Demand, 2008-2030[3]	gpd	1,481,628	1,279,386	1,450,922	7,696	327,405	191,280	186,185	1,593,904	2,575,664	2,901,870	-
	EDU	6,674	5,763	6,536	37	1,574	920	895	7,663	12,383	13,951	-
Grand Total Projected Demand, 2030	gpd	2,397,936	2,195,694	2,367,300	114,496	383,799	247,674	242,579	7,415,904	8,397,664	8,723,870	1,106,000
	EDU	10,802	9,891	10,664	550	1,845	1,191	1,166	35,653	40,373	41,942	5,317
System Capacity, 2030[4]	gpd			1,234,000	120,000			500,000			9,647,000	1,890,000
	EDU			5,559	577			2,404			46,380	9,087
Net Available Capacity, 2030	**gpd**	**(1,163,936)**	**(961,694)**	**(1,133,300)**	**5,504**	**116,201**	**252,326**	**257,421**	**2,231,096**	**1,249,336**	**923,130**	**784,000**
	EDU	**(5,243)**	**(4,332)**	**(5,105)**	**26**	**559**	**1,213**	**1,238**	**10,726**	**6,006**	**4,438**	**3,769**

Notes:
1: A =Baseline Scenario; B = Focused Growth Scenario; C = DDD Focus Scenario
2: gpd = gallons per day; EDU = An Equivalent Dwelling Unit (EDU) is 208 gallons per day (gpd) for County systems, 204 gpd for the Town of Indian Head, and 222 gpd for the Town of La Plata.
3: Includes projected new residential and non-residential demand, as well as new demand from system extensions. Assumes that new non-residential system demand is approximately 20 percent of total new residential demand.
4: Incorporates ongoing, planned, and recommended upgrades and expansions. La Plata has requested total allocation of 2.0 MGD. Indian Head's future supply reflects a Patuxent aquifer well with a 250,000 gpd allocation.

Sources: Maryland Property View 2007; Charles County Comprehensive Water and Sewer Plan, and Charles County Department of Planning and Growth Management, and Department of Public Utilities. Data for the Towns of La Plata and Indian Head based on adopted Municipal Growth Elements and Water Resources Elements for those jurisdictions.

c. Minor Systems

Smaller public systems in the County (those with average permitted withdrawals of less than 50,000 gpd) account for nearly 1.55 MGD of permitted withdrawals from a variety of aquifers and an annual average of 0.66 MGD of demand. Collectively, these systems—which typically serve individual subdivisions, mobile home parks, or schools throughout the County—have nearly 0.89 MGD of unused capacity.

d. Water System Capacity

The County's public water systems all have available capacity to support some additional growth and development. With no changes to current permitted water supplies, the Waldorf system would have adequate capacity to support projected demand in all future scenarios, while the Bryans Road system would need additional water supplies under all scenarios (under current permits).

The County's long-term intent is to interconnect these two systems in order to prevent such a deficit. The resulting combined Bryans Road-Waldorf system would have surplus water capacity under the Baseline scenario (1.65 MGD), Focused Growth Scenario (0.58 MGD), and the DDD Focus scenario (0.63 MGD). All other County-operated water systems would also have adequate capacity to support projected demand in all scenarios.

The Town of Indian Head's water system has adequate supply to support the growth identified in its Comprehensive Plan. The La Plata water system, operated by the Town, will need additional water supplies—nearly 1.2 MGD under the Baseline and DDD Focus scenarios—to support projected demand. The Town of La Plata has a pending request to MDE to increase permitted withdrawals to 2.0 MGD to serve the Town's future demand through 2020 (demand through 2030 could require as much as 2.5 MGD[7]).

3. Other Water Use

All residential units and businesses in Charles County outside of public water systems rely on individual or community wells. These wells are drilled in a variety of water-bearing formations, including the same confined aquifers used by public systems, as well as unconfined surficial aquifers.

Table 5 shows the distribution of countywide water use in 2005 (the most recent available data for Countywide water usage). Domestic users (public systems and individual wells) are the largest category of groundwater consumption in the County, accounting for nearly three-quarters of demand. Commercial activities outside of public systems are also major water users.

Power generation is the only substantial user of surface water, and is by far the largest single user of water (all types) in the County. This figure reflects the process water from the Potomac River that is used and discharged by the Mirant Morgantown power generation station (adjacent to the Charles County terminus of the Harry Nice Bridge over the Potomac River).

a. Private/Individual Residential Wells

Approximately one-third of the housing units in the County (approximately 18,000 households) are served by individual wells.[8] These wells draw water from several different aquifers. The Aquia aquifer is primarily used in the eastern and southern portion of the County; the Magothy is

[7] Source: La Plata Comprehensive Plan.

[8] Based on 2006 Charles County Water and Sewer Plan and MD Property View.

Table 5. Freshwater Withdrawals in Charles County, 2005

Type of Withdrawal	Groundwater (MGD)[1]	Surface Water (MGD)	Total (MGD)	Share of Total[2]
Domestic (public and individual wells)	9.00	0	**9.00**	**74%**
Commercial	2.57	0	**2.57**	**21%**
Industrial	0.02	0	**0.02**	**>1%**
Mining	0.10	0.08	**0.18**	**>1%**
Agriculture/Irrigation	0.24	0.09	**0.33**	**3%**
Livestock	0.04	0.04	**0.08**	**>1%**
Total (Excluding Power Generation)	**11.97**	**0.21**	**12.18**	**100%**
Power Generation	0.57	1,166.55	1,167.12	

Notes:
1: MGD = millions of gallons per day
2: Excludes Power Generation
Source: 2005 Maryland Water Use Report (MDE)

used by individual wells in the north-central portion of the County; and the Upper and Lower Patapsco aquifers are used in the western portion of the County. Of these major aquifers, the Aquia and Lower Patapsco are the most frequently used for individual wells.

The Maryland Department of the Environment has the responsibility for monitoring groundwater levels and managing and appropriating water withdrawals for public and domestic use. However, with the assistance of the County's Water Resources Advisory Committee (WRAC), Charles County has taken the initiative to manage groundwater levels through monitoring, and to provide outreach to operators of private community water systems. Where feasible, the County works with communities to connect aging private water systems to public water infrastructure. In a similar fashion, the County installs a connection stub to all developed properties that front a new water line, to provide an easier means of connection for the property owner. The County has established a water and sewer service area within the Development District and in several rural villages. While properties outside of those service areas will not receive public water service, the County continues to monitor water levels with the State's assistance and operates its public water systems in a way that minimizes effects on the water supply for individual homeowners, communities, and businesses outside the service area.

b. Major Commercial and Industrial Users Outside of Public Systems

Two major industries—the Mirant power plant at Morgantown and the Naval Surface Warfare Center (NSWC) at Indian Head—account for substantial water usage in Charles County.[9] NSWC withdraws groundwater primarily for domestic use, while the Mirant plant uses groundwater and a very large amount of surface water (used as a coolant) from the Potomac River.

Mirant's Chalk Point facility, at the extreme southern tip of Prince George's County (across the Patuxent River from the Benedict area in Charles County) also withdraws substantial amounts of groundwater—an average of approximately 0.45 MGD from the Magothy aquifer and 0.50 MGD from the Upper Patapsco aquifer. Beginning in 2010, the Chalk Point facility will switch to the Patuxent aquifer, withdrawing approximately 1 MGD.[10]

[9] 2006 Charles County Water and Sewer Plan, 3-2.

[10] Source: Maryland DNR (PPRP). 2007. Environmental Review of the Proposed Flue Gas Desulfurization (FGD) Project at the Chalk Point Generating Station.

c. <u>Agricultural Users</u>

As shown in Table 5, agriculture, irrigation, and livestock, largely in the eastern portion of the County, account for approximately two percent of the County's overall groundwater use and about two/thirds of surface water withdrawal (excluding power generation). The groundwater source for irrigation is typically the surficial aquifer.

B. Discussion of Water Concerns and Issues and Options

1. Water Quality

A limited number of homes and businesses in rural areas of Charles County obtain groundwater from shallow wells drilled into the surficial aquifer. These wells are at risk of bacterial contamination from individual septic systems, agricultural fertilizers, and other pollutants. Attrition of these shallow wells generally prompts these homeowners and businesses to drill a new well into a confined aquifer.

The Maryland Geological Survey (MGS)[11] and NSWC have documented river-water intrusion into the Lower Patapsco aquifer from the Potomac River in the Indian Head area. Such intrusion is most likely to occur when very high volume groundwater pumping causes a reduction in underground pressure, allowing water from the Potomac riverbed (which may be unsuitable for human consumption) to intrude. There have never been documented instances of river water intrusion in public water systems operated by Charles County.

The County's Chapel Point community well was discovered to have traces of radioactivity due to the presence of trace amounts of Polonium. The County has installed Reverse Osmosis (RO) filtration on the existing well, and successfully drilled a new well to mitigate for this water quality problem. Completion of the new well and the associated water line is anticipated in 2010.

2. Groundwater Recharge

The primary goal for Charles County's major public water systems is to ensure the adequacy of available supplies to support existing users and projected growth. County-owned water systems obtain approximately half of their drinking water from the Lower Patapsco aquifer, which has shown evidence of water level decline from increased use.[12] Other commonly used aquifers, such as the Magothy and Aquia, are heavily used across the state, particularly on the Eastern Shore, and are subject to withdrawal limitations.

The Water Balance methodology recommended by *Models and Guidelines #26* (the state's official guidance for preparation of the Water Resources Element) is not applicable for the Coastal Plain physiographic region, where Charles County is located. However, groundwater supplies in Southern Maryland, and particularly in Charles County, have been the subject of considerable study by MGS and other state agencies. The County has studied groundwater levels with the assistance of the State agencies and specialized consultants for over 25 years. These efforts have resulted in over 15 detailed studies, a widespread groundwater monitoring network, a capital program to build needed distribution infrastructure, and a local Water Resources Advisory Committee to continue the evolution of water supply techniques and sources.

[11] Source: MGS. 2007. Report of Investigations No. 76: Water-Supply Potential of the Coastal Plain Aquifers in Calvert, Charles, and St. Mary's Counties…

[12] 2006 Charles County Water Resource Advisory Committee Report, p.6.

The most recent MGS study, *Report of Investigations #76* (2007) discusses how, in 2002, the Magothy aquifer was near its "80 percent management level," the minimum acceptable level for which MDE will allow withdrawals. The County has been aware of the Magothy's limitations for many years, and has taken steps to sustain the aquifer. Beginning in the 1980s, the County shifted water production to the Lower Patapsco aquifer to preserve the Magothy. This action stopped the decline in the aquifer; and levels have generally been maintained since that time.

At the same time, the Lower Patapsco aquifer in the western portion of Charles County has a relatively limited production capability and a somewhat shallow depth. Given these limitations and the proximity of some of the County's production wells to this area, water levels in the Lower Patapsco tend to have greater fluctuation based on the activities occurring in the vicinity. MGS studies of area aquifers have also suggested that lowered water tables in shallow portions of the Patapsco aquifers could also reduce base flow to streams. In 2007, MDE approached the County with concerns that the water levels observed in the Potomac Heights area were nearing the 80% management level in the Lower Patapsco aquifer. The County immediately took action by shifting nearly all well pumping in the Bryans Road water system to the deeper Patuxent wells already in place. This shift immediately resulted in a rebound of the Lower Patapsco water levels and alleviated the concerns in the Potomac Heights area wells.

At the request of Charles County (Spring 2009), MGS developed another model of the Waldorf water system to evaluate the effect of significantly reducing or even stopping production from five of the County's Lower Patapsco aquifer wells in the Bensville area, and replacing this production with surface water purchased from WSSC. The results of this model projected a substantial rebound in the Patapsco aquifer, with the greatest improvements seen in the Bryans Road area.

These studies of the County's groundwater resources are important inputs into MDE's decision process for approving and altering renewed groundwater withdrawal permits for water systems in Charles County (including systems operated by the County, municipalities, and private entities). In particular, MDE adjusts withdrawal permits in response to aquifer behavior. For example, increased or stabilized aquifer recharge rates could justify increased permit values. Conversely, a permit may be reduced at the time of renewal if there is concern over the aquifer. Generally, such changes are negotiated between MDE and the local government. For example, when MDE adjusted the County's groundwater permits for the Magothy wells in Waldorf in 2002, there was no observed decline in the Magothy aquifer. Because the County was not using all of its permitted capacity under the permit at the time, MDE reduced the permitted capacity in the Magothy in exchange for increased appropriation in the Lower Patapsco aquifer.

An additional concern is the impact that continual pumpage increases may have on overall water levels in aquifers. As demand continues to increase, the County is seeking alternatives to the increased withdrawal from the Lower Patapsco, in order to reduce or eliminate the impacts on private well users. Examples include shifting the majority of public water withdrawals for the Bryans Road system to the Patuxent aquifer (which has little to no private homeowner use due to its great depth and expense to reach) and the pending interconnection of the Strawberry Hills water system[13] to the Bryans Road water system.

[13] The County has an approved Capital project to construct a 12-inch waterline along MD 227 to interconnect the Bryans Road water System to the County's stand-alone Strawberry Hills water system. The interconnection will allow the County to supply water from the deeper Patuxent aquifer to Strawberry Hills and eliminate the two wells that currently withdraw water from the Lower Patapsco. MGS projects that this interconnection will provide additional rebound of water levels in the Lower Patapsco aquifer.

The County has a contract with MGS to perform annual groundwater monitoring from 23 observation wells in various aquifers located across the County. The County works with MGS to ensure water levels are maintained above 80 percent management levels (or other designated management levels, as appropriate).

3. Municipal Water Systems

a. La Plata Water System

Whereas the Waldorf water system has several potential water sources (including groundwater aquifers and surface water sources via WSSC), the La Plata system is currently limited to withdrawals from the Lower Patapsco aquifer. The Town will need increased permitted withdrawals to meet water demand from development planned through 2030. MDE will examine any such request from the Town's against known groundwater data and permitted capacity, and will takes into consideration existing users of the aquifer—including individual wells.

One potential approach is interconnection of the La Plata and Waldorf water systems. Interconnection could provide water supply redundancy while reducing dependence on a single aquifer. Such an option would require construction of two to four miles of distribution lines to connect the two systems. An interjurisdictional interconnection agreement would also be required, and would specifically need to address the different fee structures of the two systems.

b. Indian Head Water System

The Indian Head water system is similarly limited, in that it relies entirely on groundwater from the Lower Patapsco aquifer. Under the Town's current groundwater appropriation permits, adequate capacity exists to accommodate projected growth. However, in order to meet the needs of planned growth, and to reduce stress on the Patapsco aquifer—the primary source of drinking water for private wells in north-western Charles County—the Town recently drilled a new Patuxent well for water supply and has requested allocation of 250,000 gpd from MDE.

C. Options and Recommendations to Address Drinking Water Issues

1. Potential New Water Supplies[14]

a. Alternate Well Locations

As described above, MGS modeling efforts have demonstrated the limitations of the production wells in the Lower Patapsco aquifer—particularly in the Indian Head and Bryans Road area. One option for addressing this concern is to relocate production wells to portions of the Patapsco Aquifer located farther southeast where the aquifer has greater capabilities and capacity. This could reduce the amount of drawdown near the Lower Patapsco's most constrained area, making it a more sustainable water supply source.

b. Wellfield Management

Another recommendation of the WRAC, based on studies conducted by MGS, is to implement a Wellfield Management system. Such a system can make the most sustainable use of the County's groundwater resources. Interconnection of the Waldorf and Bryans Road systems is one aspect of wellfield management. Other key components would include the construction of new wellfields and the automation of pumping from those wells to better balance production and to avoid imbalanced drawdowns of the County's aquifers. Locating wells further south and east—where

[14] 2006 Charles County Water Resource Advisory Committee Report, p.22.

aquifers have greater production capability—could enable the system to deliver a more sustainable supply with reduced overall impacts on the aquifer.

By rotating the withdrawals among the wells in the network, adequate water can be produced for the Waldorf system, while greatly minimizing impacts to the aquifer. This plan was derived based on MGS's 2003 Bryans Road Optimization Study and 2004 Waldorf Optimization Study, which defined a series of measures to maximize pumping efficiency while minimizing aquifer drawdown. The studies also suggested the locations of new wells in areas where they do not affect each other or other area users. Finally, in order to distribute water from the "down-dip" area (the southwest) to the more limited or "up-dip" aquifer areas, the County conducted the Waldorf Water Distribution Study in 2008-2009. That study determined the infrastructure needs to transmit water from Waldorf to Bryans Road, including water source needs; the system needs to move water between different hydraulic gradients, and water pressure needs and adjustments.

c. Patuxent Aquifer Wells

The Patuxent aquifer is the deepest aquifer in Charles County. This aquifer is relatively untapped and lies just above the coastal plain bedrock. While little is known about the production capabilities of the Patuxent aquifer in north-central and northeast Charles County, the Bryans Road water system uses two wells in this aquifer, the Indian Head NSWC also has several recently drilled Patuxent aquifer wells, and the Town of Indian Head is currently completing its first Patuxent aquifer well. The 1999 MGS Patuxent Aquifer Study in the Bryans Road-Indian Head area showed that there was approximately 500 feet of available drawdown in this area of the aquifer. These activities prove that the Patuxent aquifer is a viable source of water for the western portion of the County, making it a valuable resource in combination with the other actions described in this section. Therefore, the County is focusing on the Patuxent aquifer as a potential future source of drinking water.

In 2008, the County initiated a process to acquire the appropriations from two Patuxent aquifer production wells in Chapman State Park, for which the County had negotiated during the land transfer of the Chapman's property to DNR in 1998. During their initial pump tests in the mid-1990s, these wells were shown to have good water quality and a substantial water yield. However, in 2008, the Maryland General Assembly passed a law prohibiting the use of potable water from state lands for users outside of the state property. As a result, the General Assembly appropriated funding during the 2010 legislative session to compensate the Charles County for the loss of the previously-committed Chapman Park wells.

Based on Chapman State Park pump tests, the Patuxent aquifer water source should yield a sustainable water supply for the Bryans Road Water System. Costs associated with infrastructure to connect a new Patuxent well to the Bryans Road Water System has been evaluated and budgeted in the County's Capital Budget for construction. Therefore, installing this new well is viewed as a priority project to address the issues related to private water use in the area.

d. Surface Water

The County has an existing allocation from the WSSC for up to 1.4 million MGD. WSSC water is drawn from the Potomac River before being treated and distributed to customers. To address future water needs, particularly in the Waldorf system, the County is working with WSSC to evaluate the possibility of increasing that allocation to further reduce local dependence on groundwater, thus preserving water levels in the County's aquifers.

Direct withdrawals of surface water from the Potomac River in Charles County may also be an option to increase potable water supplies while preserving aquifer levels. The County should assess the technical and engineering considerations of a new surface water source. For example:

- A surface water source would require the construction of a water intake station, a water treatment facility, and associated transmission main and distribution lines.
- Because of the Potomac's tidal characteristics adjacent to Charles County, water treatment may require desalinization, a costly process.
- The location of a water treatment plant would have a great bearing on the costs associated with a surface water source. A plant located in close proximity to the existing distribution lines (likely in the northwestern portion of the County) would minimize the length of new distribution lines. However, co-location of the water treatment facility with the Mirant Morgantown power station's existing intake facility could reduce other infrastructure costs.

In 2006, the County's Water Resources Advisory Committee issued a report on options to ensure sustainable water supplies for Charles County. The WRAC Report summarized previous studies that evaluated options for surface water reservoirs in Charles County. While some potential sites were identified, these studies concluded that reservoirs were not a feasible option in Charles County due to concerns about water quality, environmental impacts, and cost.[15]

e. Water Reuse

Water reuse refers to the process of redirecting treated effluent water from WWTPs to an industrial or other use, such as coolant at a power plant or irrigation for agriculture. This use of effluent not only diverts this water that would otherwise be discharged into a water body, but also takes the place of potable water that would have been used for the same purpose. Current state regulations strictly limit water reuse, although MDE has begun to relax some of these restrictions.

Charles County currently distributes up to 2.4 MGD of treated effluent from the Mattawoman WWTP to the PANDA Brandywine Power Plant in Prince George's County for cooling purposes. The County also has an executed Agreement with the planned Competitive Power Ventures Power Plant (to be built in Charles County) to use additional treated effluent, further diverting Potomac River discharges and preserving potable water. The County continues to work with MDE to investigate these and other water reuse options and associated regulatory measures.

2. Water Conservation

Water conservation is an often-overlooked, but critically important element of water supply. Water-conserving fixtures have been the industry standard in new construction in Charles County for years—since 1986, all development in Charles County has used water-conserving fixtures and appliances. The Maryland Water Conservation Plumbing Fixtures Act also requires the use of water-conserving plumbing fixtures for new construction statewide. As a result, the County's per-household water use has dropped from approximately 260 gpd in the 1980s to 208 gpd today. The 2010 County Water Rate Study found that the 5-year average per EDU was 179.9 GPD.

One of the Charles County's goals with regard to water supply is to increase the public's awareness of water supply limitations, and to encourage citizens and businesses to help the County reach its conservation goals. The County promotes water conservation through media and educational seminars and publications, gives guidance to homeowners interested in water conservation, and has provided water-conserving fixtures to some homeowners. Nationwide and

[15] 2006 Charles County Water Resource Advisory Committee Report.

within the County, there is also a growing emphasis on incorporating energy savings and water conservation into new building design, most notably through LEED certification and the National Association of Home Builders'(NAHB) Green Building Program. If such education, retrofit, and design efforts could reduce average water use in the County to 180 gpd per household (including allowances for system water loss), the County's Year 2030 water demand in major public systems could be reduced by approximately 1.7 MGD (more than ten percent of the projected 2030 demand shown in Table 4).

In an effort to promote water conservation and make the public water system more fiscally sustainable, the County recently replaced its uniform unit rate structure with an inclining rate structure. Through this rate structure, the unit price for water increases as the volume consumed increases. This helps to incentivize water conservation: customers who use low or average volumes of water are charged a modest unit price and rewarded for conservation; those using significantly higher volumes pay higher unit prices.

3. Source water protection

The County protects public water sources primarily through wellhead protection efforts. These include fencing around all wellheads, enclosure of wellheads within buildings where possible and installation of wellhead covers for outdoor wells. For surface water obtained from WSSC, the County performs additional water treatment at the connection point at the Prince George's County line to ensure adequate water quality.

V. Wastewater Assessment

A. Summary and Analysis of Wastewater System Data

This section describes existing conditions and projected future wastewater system needs.

1. Public Sewer Systems

Approximately 33,600 housing units in Charles County (63 percent of the County total) and a considerable share of businesses discharge wastewater to one of the eight County, municipal, or private (community) wastewater treatment plants (WWTP).[16] Indian Head Naval Surface Warfare Center (NSWC) also operates a WWTP.[17] Figure 4 shows the location of the County's public sewer service areas (including industrial systems not described in this chapter) and WWTPs. Table 6 describes these facilities, sorted by the watershed into which effluent is discharged. Table 7 shows the existing and projected water supplies, demands, surpluses, and deficits for these wastewater systems under each of the three scenarios described in Section 3.

The Mattawoman WWTP is the County's largest WWTP, with a current capacity 20 MGD (3 MGD of this total is set aside for WSSC use in Prince George's County). The existing flows to this facility in Table 7 include approximately 0.4 MGD from WSSC, while future flows assume that WSSC will utilize its entire 3 MGD capacity by 2030.18 A more detailed description of the County's public wastewater systems is found in the 2006 Comprehensive Water and Sewer Plan. The Towns of Indian Head and La Plata provide public sewer services for properties within their

[16] 2006 Charles County Water and Sewer Plan, 4-32.

[17] There are also several small (<0.1 MGD) privately-owned WWTPs scattered throughout the County. Because of their small size and private ownership, these facilities are not discussed in the WRE. However, estimates of their discharges are included in the nutrient modeling described in Section VII.

[18] Development plans for southern Prince George's County do not necessarily indicate full use of the 3 MGD allocation. However, the WRE assumes maximum use of the 3 MGD allocation for modeling purposes.

Table 6. Public Sewer System Characteristics

Wastewater Treatment Plant (by Watershed)[1]	Discharge Location	Treatment Technology	Planned/Potential Upgrades/Expansions
Patuxent River			
Benedict (future)	Land application system.	Biological Nutrient Removal (BNR)[2]	Under design. Online by 2013.
Hughesville (future)	Land application system.	BNR	Design pending. Estimated online by 2017.
Mattawoman Creek			
Indian Head	Ginny Creek	Enhanced Nutrient Removal (ENR)[2]	
Potomac River Middle Tidal			
Mattawoman	Potomac River	ENR. Some effluent used as process water at PANDA Brandywine power plant.	Re-rated to 20 MGD based on ENR.
Clifton on the Potomac	Potomac River	Secondary	BNR/ENR upgrade
NSWC	Potomac River	Secondary	ENR upgrade
Port Tobacco River			
La Plata	Tributary of Port Tobacco River	BNR	ENR upgrade by 2012.
Mt. Carmel Woods	Jennie Run	Secondary	Plants to be retired, flows pumped to Mattawoman.
College of Southern MD	Port Tobacco R.	Secondary	
Lower Tidal Potomac River			
Swan Point	Cuckold Creek	ENR	None
Cuckold Creek (Swan Point)	Spray irrigation system.	Lagoon System, with spray irrigation.	Planned interconnection to Swan Point WWTP

Notes:
1: Source: Charles County Department of Planning and Growth Management, and Department of Public Utilities. Only lists systems with capacities greater than 50,000 gallons per day (gpd)
2: ENR is the best available wastewater treatment technology, resulting in loading as low as 3 mg of Nitrogen and 0.3 mg of Phosphorus per liter of effluent, compared to 8 and 2 mg/L, respectively for BNR.

corporate limits. The Indian Head and La Plata WREs include detailed information about these municipal wastewater systems.

Charles County owns and operates the remaining WWTPs in the County. All of the County's public sewer systems have adequate capacity to serve projected development through 2030. The Mt. Carmel Woods and College of Southern Maryland WWTPs will be decommissioned, with effluent to be pumped to the Mattawoman WWTP. The Benedict WWTP is under design, and is expected to be operational by 2013. The Hughesville WWTP is in the initial planning stages, and could potentially be online by 2017 with a treatment capacity of approximately 0.15 MGD. The service area and surface discharge location of the Hughesville WWTP has not been determined. Discharge from both the Benedict and Hughesville WWTPs would be disposed via spray irrigation, or another form of land application (see sections B.1 and B.4 below).

The WWTP at Indian Head NSWC has adequate capacity to serve projected development through 2030. The Town of Indian Head WWTP will need additional discharge capacity in order to accommodate projected development. The La Plata WWTP will be able to expand to 2.0 MGD upon completion of ENR upgrades (in approximately 2012). The La Plata WRE states that the Town plans to ultimately apply for and NPDES discharge permit of 2.5 MGD, which will serve the planned growth through 2030. The Town has not yet requested this capacity, and the Town WRE expresses concern about obtaining this capacity based on MDE permitting policies.

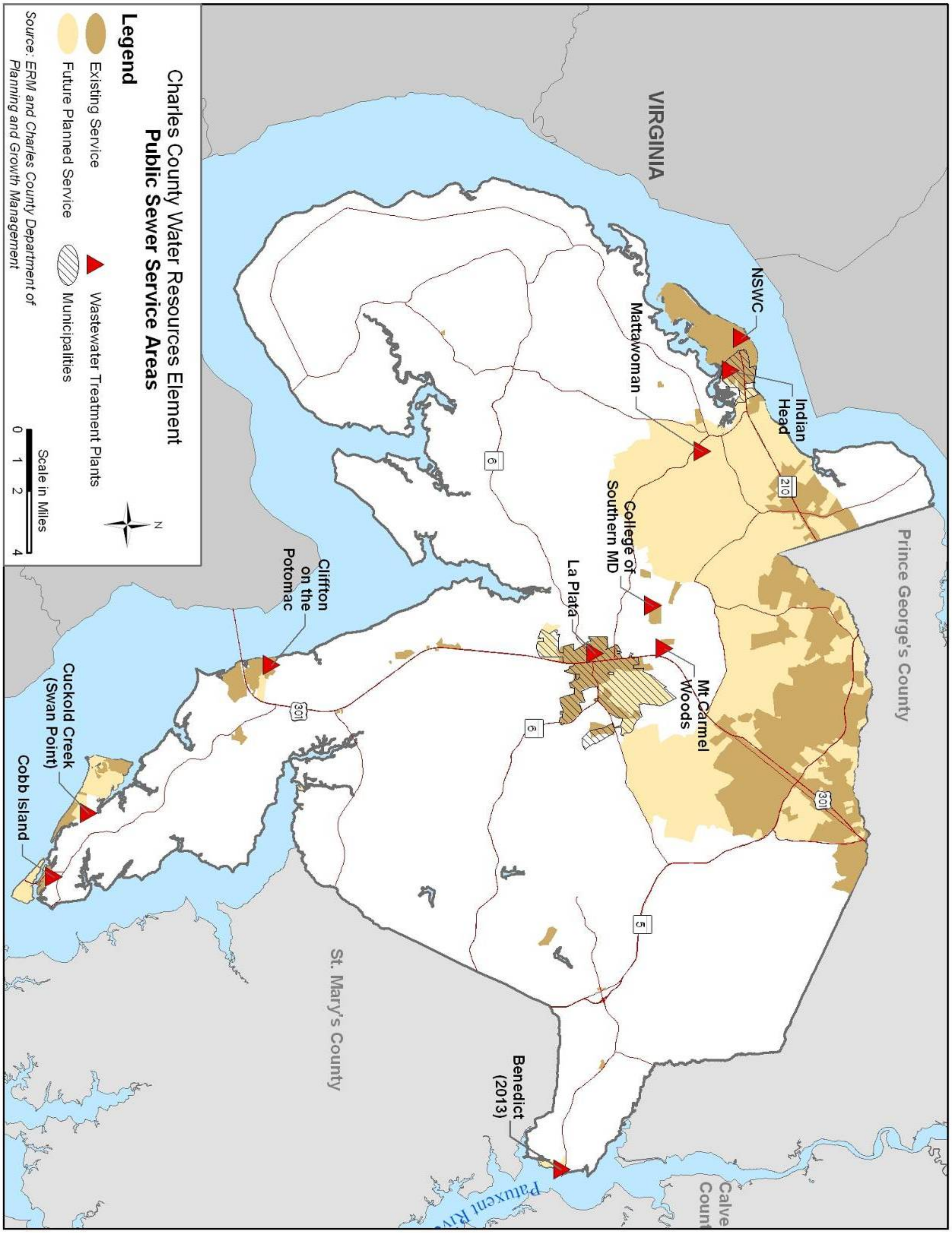

Figure 4: Public Wastewater Service Areas

Table 7. Public (and Major Private) Sewer System Flows and Capacity, 2030

Watershed		*Patuxent River*			*Middle Potomac River*							*Mattawoman Creek*
System		**Benedict[6]**			**Mattawoman[7]**			**Clifton on the Potomac**			**NSWC**	**Town of Indian Head**
Scenario[1]		**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**All Scenarios**	**All Scenarios**
Existing Treatment Capacity[2]	MGD[3]			0			20.000			0.070	0.500	0.500
	EDU[3]			0			80,000			280	2,000	2,000
Average Daily Flow, 2008	MGD			0			10.612			0.028	0.350	0.332
	EDU			0			42,449			112	1,400	1,328
Net Available Capacity, 2008	MGD			0			9.388			0.042	0.150	0.168
	EDU			0			37,551			168	600	672
Total projected new demand, 2030[4]	MGD	0.082	0.083	0.083	5.977	7.258	7.201	0.006	0.005	0.005	0	0.194
	EDU	328	332	332	23,910	29,030	28,804	23	21	20	0	776
Grand Total Projected Demand, 2030	MGD	0.082	0.083	0.083	16.590	17.870	17.813	0.034	0.033	0.033	0.350	0.526
	EDU	328	332	332	66,359	71,479	71,253	135	133	132	1,400	2,104
Future Capacity, 2030[5]	MGD			0.165			20.000			0.070	0.500	0.500
	EDU			660			80,000			280	1,923	2,000
Net Available Projected Capacity, 2030	**MGD**	**0.083**	**0.082**	**0.082**	**3.410**	**2.130**	**2.187**	**0.036**	**0.037**	**0.037**	**0.150**	**(0.026)**
	EDU	**332**	**328**	**328**	**13,641**	**8,521**	**8,747**	**145**	**147**	**148**	**600**	**(104)**

Watershed		*Port Tobacco River*					*Lower Potomac River*			
System		**Town of La Plata[8]**			**Mt. Carmel Woods**	**College of Southern MD**	**Swan Point**			**Cobb Island**
Scenario[1]		**A**	**B**	**C**	**All Scenarios**	**All Scenarios**	**A**	**B**	**C**	**All Scenarios**
Existing Treatment Capacity[2]	MGD			1.500	0.021	0.060			0.600	0.158
	EDU			5,929	84	240			2,400	632
Average Daily Flow, 2008	MGD			1.134	0.008	0.030			0.083	0.051
	EDU			4,482	32	120			333	205
Net Available Capacity, 2008	MGD			0.366	0.013	0.030			0.517	0.107
	EDU			1,447	52	120			2,067	427
Total projected new demand, 2030[4]	MGD	1.752	1.521	1.717	Retired. Transferred to Mattawoman WWTP.	Retired. Transferred to Mattawoman WWTP	0.394	0.230	0.224	-
	EDU	6,924	6,013	6,786			1,574	920	895	-
Grand Total Projected Demand, 2030	MGD	2.886	2.655	2.851			0.477	0.313	0.307	0.051
	EDU	11,406	10,495	11,268			1,907	1,252	1,228	205
Future Capacity, 2030[5]	MGD			2.000					0.600	0.158
	EDU			7,905					2,400	632
Net Available Projected Capacity, 2030	**MGD**	**(0.886)**	**(0.655)**	**(0.851)**			**0.123**	**0.287**	**0.293**	**0.107**
	EDU	**(3,501)**	**(2,590)**	**(3,363)**			**493**	**1,148**	**1,172**	**427**

Notes:
1: A = Baseline Scenario; B = Focused Growth Scenario; C = DDD Focus Scenario
2: Indicates the more restrictive of either MDE's discharge permit or the system's design capacity.
3: MGD = Million Gallons per Day; EDU = Equivalent Dwelling Unit: 250 gallons per day for County systems and the Town of Indian Head; 253 gpd for the Town of La Plata.
4: Includes projected new residential and non-residential demand, as well as new demand from system extensions. Assumes that new non-residential system demand is approximately 20 percent of total new residential demand. Projected new demand for the Mattawoman WWTP includes 3 MGD dedicated to WSSC.
5: Incorporates ongoing, planned, and recommended upgrades.
6: Benedict WWTP was being designed as of 2011, and is expected to be operational by 2013. Initial capacity is 165,000 gpd, with potential ultimate capacity of up to 304,000 gpd.
7: Mattawoman WWTP's permitted capacity is 20 MGD. Of this capacity, 3 MGD is allocated to WSSC. This table shows the capacity available to support development in Charles County only.
8: For La Plata, new demand includes 250 EDU to account for the connection of failing residential and nonresidential septic systems, as described in the Town's WRE.

Sources: Maryland Property View 2007; Charles County Water and Sewer Plan, Charles County Department of Planning and Growth Management, and Department of Public Utilities. Data for the Towns of La Plata and Indian Head based on draft Municipal Growth Elements and Water Resources Elements for those jurisdictions.

2. Nutrient Discharges and Assimilative Capacity

Along with sediments, nitrogen and phosphorus (more generally referred to as "nutrients") from WWTPs and from stormwater and other "non-point sources" are the primary contributors to degraded water quality in the Chesapeake Bay and its tributaries. Nutrients are generated by a wide variety of sources, such as WWTPs, residential and agricultural fertilizer, waste from livestock and wild animals, and airborne deposition of nitrogen and phosphorus. Water and sewer planning must take into account the "assimilative capacity" of a receiving body of water—the mass of nutrients that the water body can receive while still maintaining acceptable water quality. This section describes the key limits on assimilative capacity as they apply to the County's WWTPs.

a. TMDL

One measure of assimilative capacity is the Total Maximum Daily Load (TMDL), an expression of the maximum amount of pollutant that a water body, such as a river or a lake, can receive without impairing water quality. TMDLs are established for "impaired" waters, as required by the Clean Water Act. Water bodies are classified as impaired when they are too polluted or otherwise degraded to support their designated and existing uses. The impaired waters list is called the 303(d) list, named after the section in the Clean Water Act that establishes TMDLs. The TMDL is typically expressed as separate discharge limits for point sources such as WWTPs and nonpoint sources such as stormwater or agricultural runoff. In Maryland, MDE is responsible for identifying impaired waters, developing TMDLs, and coordinating TMDL implementation with local governments and other state agencies.

Table 8 lists the nutrient-impaired watersheds that are partially or entirely found within Charles County: Mattawoman Creek, Nanjemoy Creek, Patuxent River Lower, Port Tobacco River, Potomac River Lower Tidal, and the Potomac River Upper Tidal.[19] MDE has established (and EPA has approved) nutrient TMDLs for the Mattawoman Creek and Port Tobacco River watersheds. No other draft or final nutrient TMDLs have been prepared for impaired waters inCharles County. In addition to nutrients, some watersheds in Charles County are impaired by other substances, such as Bacteria, Fecal Coliform, or excess amounts of sediment.[19]

Table 8. Approved Nutrient TMDLs for Charles County Watersheds

Watershed	Impairing Nutrient	Nonpoint Source TMDL (lbs/year)	Point Source TMDL (lbs/year)
Mattawoman Creek[1]	Nitrogen	116,699	85,784
	Phosphorus	5,304	11,786
Port Tobacco River	Nitrogen	194,750	42,720
	Phosphorus	13,300	1,870

Notes:
1: The Point Source component of the Mattawoman TMDL includes approximately 52,006 lbs/year of nitrogen and 5,815 lbs/year of phosphorus from urban stormwater in Charles County. This runoff is regulated as a point source discharge through the County's MS4 NPDES permit.

In addition to these specific watersheds, USEPA (in conjunction with MDE and agencies from the other six jurisdictions in the Bay watershed) has established a TMDL for nitrogen, phosphorus, and sediments in the entire Chesapeake Bay watershed. The statewide TMDLs and Maryland's Phase 1 Watershed Implementation Plan (or WIP which allocates the TMDL to

[19] MDE maintains a full listing of impairments and available TMDLs at http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/index_new.asp

portions of the Bay watershed) was published in December 2010. The final Phase 2 WIP, which will allocate the TMDL to 8-digit watersheds (or comparable geographies), and which will describe the measures necessary to implement the Bay TMDL, is anticipated in November 2011. The information contained in the Phase 2 WIP should inform the WRE in the 2012 Charles County Comprehensive Plan.

USEPA has established a variety of penalties and other federal actions that can be applied if a jurisdiction fails to achieve the pollutant reductions specified in the Chesapeake Bay or other TMDLs:[20]

- Expansion of National Pollution Discharge Elimination System (NPDES) permit coverage to currently unregulated sources;
- Federal objections to state-issued NPDES permits, and increased NPDES program oversight;
- Requirement of additional offsets for new or increased point source discharges (beyond replacement of anticipated new/increased loadings);
- Establishment of more geographically-specific TMDLs by the State;
- Requirement of additional reductions of loadings from point sources, such as wastewater treatment plants;
- Increased federal enforcement of air and water regulations in the affected watershed;
- Redirection of EPA grants away from the local jurisdiction, and/or incorporating more stringent criteria into future grants; and
- Federal promulgation of more stringent local nutrient water quality standards.

b. WWTP Point Source Caps

To address nutrient loads from point sources such as WWTPs, the state has established Chesapeake Bay Tributary Strategy point source caps. These caps are numerical limits on the amount of nitrogen and phosphorus that WWTPs can discharge to the Bay and its tributaries (expressed as pounds per year of nitrogen and phosphorus). Nitrogen and phosphorus point source caps have been established for the Mattawoman, Indian Head, Swan Point, and La Plata WWTPs. The caps for the Indian Head and La Plata WWTPs are both more stringent than the TMDL point source caps for the Mattawoman and Port Tobacco River watersheds (respectively), the receiving bodies for these point sources. The receiving bodies of water for other WWTPs in the County do not have final nutrient TMDLs (see Section V.2.a.). Thus, the point source caps for these WWTPs determine their allowable nutrient discharges.

c. WWTP Point Source Discharges

Table 9 lists the nutrient caps, as well as existing and projected future nutrient discharges for the County's WWTPs under each future land use scenario. By 2030, the County projects that most WWTPs will be upgraded to ENR technology. Because the Cobb Island WWTP discharges effluent via spray irrigation, its point source discharges to the Potomac River are assumed to be minimal; the same assumption is made for the Benedict and Hughesville WWTPs and the Patuxent River.[21]

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[20] Source: US EPA. 2009. Letter to the Chesapeake Executive Council, 29 December. Accessed at http://www.epa.gov/region03/chesapeake/bay_letter_1209.pdf

[21] This assumption is consistent with the discussion on page 30 of *Models and Guidelines 26*.

All County-operated WWTPs would meet the requirements of their nutrient caps under all future land use scenarios. The Mattawoman WWTP would have substantial available capacity. If the wastewater from all future development in La Plata were discharged via the Town's existing NPDES permit requirements and design, that facility would exceed its nitrogen and phosphorus caps. Upon completion of ENR upgrades, the Town will be able to expand to 2.0 MGD, which will meet the Town's wastewater needs through approximately 2020. The Town of Indian Head will evaluate its treatment capacity and nutrient discharges once ongoing I/I problems are addressed.

d. Antidegradation

Maryland's antidegradation policy significantly limits new or expanded discharge permits that would degrade water quality. The focus of the antidegradation policy is on Tier II (high quality) waters, as defined by the US Environmental Protection Agency (EPA), which are subject to special protections to maintain high water quality. Within Tier II watersheds, new or expanded nutrient discharges can only be permitted in limited circumstances.

Charles County has 31 segments of Tier II waters. The Mount Carmel Woods WWTP currently discharges to Jennie Run, a Tier II stream. However, this discharge is in the process of being eliminated, with flows transferred to the Mattawoman WWTP via a new pump station. None of the other WWTPs evaluated in this WRE discharge to a Tier II stream segment.

B. Alternative Wastewater Disposal Options

While County-operated WWTPs have sufficient capacity to support projected development through 2030 (and beyond, in most cases), it is nonetheless important to understand options for obtaining additional treatment capacity. Such options may become necessary in the case of unexpected changes in flows, changes to environmental regulations, or other unforeseen factors. This section summarizes key concepts that the County and its municipalities could consider.

1. Wastewater Reuse

Following the full treatment process, effluent from a WWTP can be recollected and returned for a variety of types of reuse (see Section IV.C.1.e) of this document. The County has a strict allocation policy to manage the distribution of treated effluent, and continues to promote the use of the effluent water to reduce discharge into the rivers and streams and reduce unnecessary use of potable water. Three methods for wastewater reuse are briefly described below; however, more detailed investigation, in conjunction with MDE will be required on a case-by-case basis prior to implementation.

a. Industrial Water Reuse

Charles County is especially familiar with industrial water reuse. The PANDA power plant in the Brandywine area of Prince George's County (within the Mattawoman watershed) uses effluent from the Mattawoman WWTP for cooling purposes. In addition, the County has an executed agreement with the operators of the proposed Competitive Power Ventures power plant project in eastern Charles County to reuse treated effluent from the Mattawoman WWTP for turbine cooling purposes, as well as for steam in the power generation process.[22] Together, the two power plants could divert as much as 8.4 MGD of treated effluent that would otherwise be discharged to the Potomac River.

[22] Nutrients that remain in the reused effluent following ENR treatment are typically dispersed through evaporation; a small portion of these nutrients are collected in the plant's wastewater stream (source: ERM).

Table 9. Point Source Nutrient Discharges, Public WWTPs

Watershed		*Middle Potomac River*						*Mattawoman Creek*	*Port Tobacco River*			*Lower Potomac River*		
System		**Mattawoman[6]**			**Clifton on the Potomac**			**Town of Indian Head**	**Town of La Plata**			**Swan Point**		
Scenario[1]		**A**	**B**	**C**	**A**	**B**	**C**	**All Scenarios**	**A**	**B**	**C**	**A**	**B**	**C**
Projected Capacity, 2030	MGD	20.000			0.070			0.500	2.000			0.600		
Existing Nutrient Loads[2]	TN[3]	60,000			1,537			4,042	11,000			2,500		
	TP[3]	2,500			512			303	500			50		
Likely Nutrient Caps, 2030[4]	TN	243,645			2,820			6,091	18,273			7,309		
	TP	10,964			470			457	1,371			548		
Projected ADF, 2030 (from Table 7)	MGD	16.590	17.870	17.813	0.034	0.033	0.033	0.526	2.891	2.660	2.856	0.478	0.314	0.308
Treatment Technology, 2030		ENR			ENR			ENR	ENR			ENR		
Estimated Nutrient Discharges, 2030[5]	TN	151,393	163,075	162,558	309	304	301	6,403	26,335	24,232	26,016	4,350	2,857	2,801
	TP	9,084	9,784	9,754	19	18	18	480	2,633	2,423	2,602	435	286	280
Remaining Discharge Capacity (Overage)	**TN**	**92,252**	**80,570**	**81,087**	**2,511**	**2,516**	**2,519**	**(312)**	**(8,062)**	**(5,959)**	**(7,743)**	**2,959**	**4,452**	**4,508**
	TP	**1,880**	**1,180**	**1,210**	**451**	**452**	**452**	**(23)**	**(1,262)**	**(1,052)**	**(1,231)**	**113**	**262**	**268**

Notes:
1: A = Baseline Scenario; B = Focused Growth Scenario; C = DDD Focus Scenario
2: Estimates for Mattawoman, La Plata, and Swan Point based on MDE's ENR Fact Sheets for (http://www.mde.state.md.us/Water/CBWRF/pop_up/enr_status_map.asp). Estimates for Indian Head reprinted from the Town's WRE. Estimates for Cliffton calculated, assuming discharges of 18 mg/L TN, 6mg/L TP (existing non-BNR).
3: TN = Total Nitrogen (lbs/year); TP = Total Nitrogen (lbs/year)
4: Source: MDE (list of nutrient caps for public systems in Charles County).
5: Assumes discharge concentrations of 3 mg/L TN and 0.3 mg/L TP.
6: Mattawoman discharges assume full use of the 3 MGD allocated to WSSC, as well as flows from the Mt. Carmel Woods and College of Southern MD facilities.

b. Urban Irrigation Reuse

Urban irrigation includes providing reclaimed wastewater (or stormwater) to virtually any irrigated land within the developed portion of Charles County. In other states, reclaimed water is used to irrigate golf courses, parks, playing fields, cemeteries, commercial/industrial areas, multifamily residential lawns, single-family residential lawns, medians, and right-of-ways. Since urban irrigation involves applying reclaimed water to areas accessible to the public, secondary treatment with filtration and high-level disinfection is required. The County's ENR facilities achieve this level of treatment. Such uses are rarely seen in Maryland, due largely to extremely restrictive state requirements. A MDE-sponsored panel (which includes representatives from Charles County) is evaluating revised restrictions and regulations to encourage treated effluent reuse for urban irrigation.

c. Agricultural Reuse

Irrigation of agricultural crops with reclaimed effluent also requires high levels of treatment. A major restriction with agricultural reuse is that it cannot come in direct contact with foods that will not be cooked, peeled, skinned, or thermally processed prior to consumption. This restriction does not prohibit the irrigation of crops with reclaimed water, but restricts the irrigation method that can be utilized, as well as the types of crops involved.[23]

d. Potable Reuse

Potable reuse (i.e., drinking water) is not currently permitted in Maryland, but is allowed in other states. Direct potable reuse of treated effluent—e.g., the transmittal of treated effluent directly to water treatment facilities—is not seen as a near-term alternative for Charles County due to current state restrictions.

Indirect potable reuse is practiced in other parts of the United States, and may be a long-term (beyond 2030) option. In the most common indirect reuse methodology, effluent is treated to potable (or better) standards before being injected into groundwater aquifers and later withdrawn (and treated) as potable water. One large-scale example of such a system is in place in Orange County, California.[24] In that system, treated effluent is used not only to recharge the aquifer (and to provide drinking water as a result), but also to halt and even reverse saltwater intrusion into the aquifer. Maryland has no regulations permitting this type of activity. However, given the potential benefits to aquifers, this approach may have merit for further investigation, and the County should coordinate with MDE in any future investigations.[25]

2. Nutrient Trading

Under the state's Policy for Nutrient Cap Management and Trading,[26] nutrient discharges can be traded between one point source and another within the same trading basin (for Charles County, this includes the entire Potomac River basin from St. Mary's County to Garrett County). In such a scenario, an existing WWTP outside of Charles County (likely in Maryland, but trades from Virginia could also be considered) would agree to forego a certain amount of development in exchange for payment, and then send or "trade" that excess treatment capacity to one of the County's WWTPs. The receiving WWTP would then be allowed to expand beyond its current

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[23] For more information, see http://www.mde.state.md.us/researchcenter/publications/general/emde/vol2no4/spray_irriqation.asp

[24] For more information, see http://www.gwrsystem.com/

[25] In addition to California, other states in the Western and Southeastern United States—notably, Florida—also use similar practices. The USEPA website contains information on Aquifer Recharge, including best practices and some of the key technological concerns that would need to be addressed before implementation: http://www.epa.gov/safewater/asr/index.html

[26] Information available at: http://www.mde.state.md.us/Water/nutrientcap.asp

permitted capacity (as long as its discharges would not exceed the limits set by a TMDL). Conversely, a WWTP in Charles County could act as the "seller" of nutrient credits.

Credits can also be accrued through other methods, such as:

- Upgrading an existing minor WWTP to Biological Nutrient Removal (BNR) or ENR technology (in Charles County, the Bel Alton, Clifton-on-the-Potomac and Cobb Island facilities are the only publicly-owned WWTPs that would be eligible);
- Retiring an existing minor WWTP after connecting its flow to a BNR or ENR facility, as is the case with the Mt. Carmel Woods and the College of Southern Maryland WWTPs, which will be retired and connected to the Mattawoman sewer system; or
- Retiring an existing On Site Disposal System (OSDS or septic system) by connecting its flow to an ENR facility. Under the state policy, a County WWTP could receive the following nutrient credits for each type of septic system retired:
    - Septic systems in the Chesapeake Bay Critical Area: approximately 5.3 EDU per OSDS.
    - Septic systems within 1,000 feet of any perennial surface water: approximately 3.3 EDU per OSDS.
    - Any other OSDS: 2 EDU per OSDS

  As an example, there are approximately 1,700 residential units on septic systems in the Critical Area in Charles County. By connecting half of those units to a WWTP (assuming that the other half are too scattered to extend service), the County's WWTPs could gain approximately 4,500 EDU (or 1.125 MGD) of capacity. Such an option could also be pursued with a new WWTP, as is the case in Benedict and Hughesville, as long as the new WWTP does not establish a new surface water discharge.

In addition to these point-to-point trading opportunities, MDE and the Maryland Department of Agriculture (MDA) recently adopted guidelines that allow trades between nonpoint sources (such as agriculture) and point sources. Under these guidelines, a WWTP could receive nutrient credits for reducing nutrient flows from agricultural areas or developed areas not governed by a municipal stormwater (MS4) permit.

3. Continue System Repairs

In some public wastewater collection systems in the County, considerable capacity is taken up by Inflow and Infiltration (I/I).[27]. While the County and its municipalities do not expect to be able to remove all I/I from public sewer systems—since it is impossible to police every property to ensure disconnection of roof drains and sump pumps—repairing the worst I/I problems is the most efficient means of securing additional capacity for public systems.

4. Land Application of Treated Wastewater

Land treatment of wastewater may involve a wide variety (or combination) of techniques such as spray irrigation, drip irrigation, subsurface discharge, rapid infiltration basins, and overland flow. In a land application system, the soil and vegetative cover purify and dissipate the effluent (which has already been treated by a BNR or ENR process) as it percolates into the ground. In addition to the primary benefit of keeping harmful pollutants from water bodies, land application can also

[27] Inflow is water from storm events entering the system through roof drains sump pumps, and similar sources. Infiltration is groundwater entering the system through leaking pipes, manholes, and other elements. I/I takes up sewer capacity that should be reserved only for wastewater, effectively limiting the system's overall capacity.

serve to recharge groundwater supplies, allow recovery and reuse of nutrients, and may provide an economic return if used for some agricultural purposes.

Major design parameters for land application systems include topography, permeability of the soils, depth to groundwater, and the location of nearby residences. Disposal of effluent via spray irrigation requires large amounts of land that are sprayed with effluent at very low application rates (1 to 2 inches per week). Seasonal limitations on spray irrigation are also a factor. State requirements mandate the provision of three months of effluent storage capacity, to account for times when the ground may be frozen or have limited permeability. Suitable spray irrigation areas are characterized by permeable to highly permeable soils.

On dedicated lands, spray irrigation would be considered a non-public-access method of effluent disposal. The Cobb Island wastewater system disposes of treated effluent via spray irrigation on the Breeze Farm property. The planned Benedict and Hughesville WWTPs will also use land application techniques, although the specific technique and disposal location has not been determined.

5. Tertiary Treatment Wetlands

Wetland application is rapidly gaining recognition as a viable alternative for effluent disposal. It represents an extension of the land application and reuse concepts, and has been encouraged by USEPA. In this system, effluent is treated by a BNR or ENR facility and is then discharged into a series of constructed, vegetated (typically forested) wetlands. These wetlands purify the effluent to the point where the eventual discharge meets water quality standards with regard to nutrients and other pollutants. The best-known large-scale application of this technology occurs in Clayton County, Georgia.[28] This system treats 9.3 MGD of effluent on a 4,000 acre site, with a final discharge that meets drinking water standards. Other smaller applications of tertiary treatment wetlands—typically at schools or other institutional facilities—can be found in Maryland. Implementation of a large-scale tertiary treatment wetland facility in Charles County would depend heavily on soil characteristics and other site conditions. Considerable permitting and monitoring requirements are also associated with tertiary treatment wetlands.

VI. Assessment of Nonpoint Source and Stormwater Policies

This section characterizes the policies and procedures in place to manage nonpoint source pollution in Charles County. Nonpoint sources (NPS) of nutrient pollution include agricultural runoff, erosion, and sediment from development, stormwater runoff from roads, parking lots, and rooftops, as well as atmospheric deposition and any source other than an outfall pipe. These sources are called nonpoint because they involve widely dispersed activities, and hence are difficult to measure. All non-point sources of pollution eventually reach the waters of the Chesapeake Bay unless filtered or retained by a structural system or non-structural techniques.

Various technologies reduce nutrients from agricultural and developed lands. Nutrient reduction technologies for nonpoint source pollution are generally referred to as "Best Management Practices" (BMPs). Examples of these technologies include agricultural nutrient management planning, stormwater settling ponds, and erosion controls. Non-structural controls are extremely effective in reducing the amount of pollutants that reach waterways. Woodlands and wetlands release fewer nutrients into the Bay than any other land use. For these reasons, forests, grasslands, and wetlands are critical to restoring and maintaining the health of the aquatic environment.

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[28] For more information, see http://www.ccwa1.com/operations/water.reclamation.aspx

A. Major Policies and Initiatives

This section characterizes the policies and procedures in place to manage nonpoint source pollution in Charles County.

1. Maryland Stormwater Design Manual

The 2007 Maryland Stormwater Management Act, passed by the General Assembly, mandated substantial revision of the state's stormwater regulations. The most notable provision of the 2007 Act was the requirement that new development and redevelopment use Environmental Site Design (ESD) techniques (to the maximum extent possible). ESD is a menu of stormwater management options that are intended to "maintain pre-development runoff characteristics" on the site. ESD techniques are based on the premise that stormwater management should not be seen as stormwater disposal. Instead of conveying and treating stormwater in large, costly end-of-pipe facilities located at the bottom of drainage areas, ESD addresses stormwater through the use of small, cost-effective landscape features that are frequently located onsite. It is an effective means of managing both stormwater quality and quantity.

The County adopted its Stormwater Management Ordinance (incorporating ESD and other stormwater management policies contained in the Stormwater Management Act of 2007) in 2010. These revisions include implementation of an ESD compliance program.

2. Chesapeake Bay TMDL and Watershed Implementation Plan

As described in Section V.A.2.a, USEPA and MDE have begun the process of establishing a TMDL for the Chesapeake Bay watershed and its sub-watersheds, including two Phases of progressively more detailed Watershed Implementation Plans (WIPs). The TMDL and WIPs addresses both point and nonpoint source discharges of nutrients and sediments. With regard to NPS discharges, the key provisions of Maryland's Phase 1 WIP (December 2010) are:

- New development and redevelopment must offset NPS pollution loads. The amount of offset will depend upon the location of that development—development or redevelopment in relatively dense areas (especially areas already served by public sewer systems) will have less stringent offset burdens; development in rural areas will be required to offset significantly larger amounts of nutrients. ESD alone typically will not be sufficient to meet these requirements.
- More stringent treatment requirements for urban stormwater system (which are regulated as a point source under the MS4 permit system), including the system operated by Charles County.
- More stringent requirements for the content of fertilizer used in urban areas.
- Numerous agricultural and rural strategies such as keeping livestock out of streams through fencing or other techniques, better management of animal waste, planting additional cover crops, increasing the extent of stream buffers, and more widespread use of tillage techniques that minimize soil disturbance.

B. Other Nonpoint Source Management Policies and Considerations

1. Failing Septic Systems

Numerous factors can lead to the failure or malfunction of individual septic systems: unsuitable soil characteristics, high water tables, improper installation and maintenance, and system age. The Comprehensive Water and Sewer Plan's objectives include (in part): the provision of opportunities for residents in identified failing septic areas or with failing wells to correct existing supply, health, and environmental problems; education regarding the proper maintenance of home septic systems; and where possible, provisions for financial assistance or grant opportunities to homeowners in areas of failing septic systems. Charles County is working with MDE and local citizen groups to seek grant funding through the state's Bay Restoration Fund to assist in the repair and enhancement of the existing systems.

The Comprehensive Water and Sewer Plan lists numerous areas of failing septic systems throughout the County, totaling approximately 1,200 homes with failing septic tanks. The vast majority (more than 1,000 homes) are in the Mattawoman Sewer Service Area, while the remaining homes are scattered throughout other parts of the County. To address failing or potentially failing septic systems, the County has:

- amended the Comprehensive Water and Sewer Plan[29] to define and allow the use of shared sewage disposal systems for major subdivisions outside of the Development District (and in "no planned service" areas);
- established a failing septic tank area petition process, whereby failing areas can appeal to the County for assistance in mitigating their failing systems;[30] approximately 150 homeowners have received grants to rehabilitate failing septic systems; and
- initiated plans to construct and manage sewer systems to address failing or potentially failing septic systems in the rural villages of Benedict and Hughesville. These new wastewater treatment plants will utilize land application techniques that avoid the establishment of a new point source discharge.

2. Septic Denitrification Systems

Maryland Senate Bill 554 (from the 2009 legislative session) now requires all new development on septic systems in the Chesapeake Bay Critical Area to include Best Available Technology (BAT) for nitrogen removal, as defined by MDE.31 BAT for nitrogen removal (or "denitrification") can reduce the nitrogen loading from septic systems by approximately 50 percent. The County does not require denitrification for new septic systems, but Bay Restoration Funds have been used to install some denitrification systems in the Port Tobacco River watershed and other areas. Overall, approximately 40 homes in Charles County utilize denitrification units.

Septic denitrification (in any location—not just the Critical Area) can be one approach to meeting TMDL requirements. Denitrification systems are encouraged throughout the remainder of the County to reduce NPS nitrogen loads. The nonpoint source analysis (Section 7) assumes that one-quarter of all new residential and non-residential development outside of public sewer systems will utilize denitrification units, and that ten percent of existing septic systems will be retrofitted with BAT for nitrogen removal. Although not explicitly a goal of the County's existing Comprehensive Plan, this level of implementation is reasonably foreseeable by 2030.

3. Stormwater Retrofits and Maintenance

Since 1997, the stormwater discharge from Charles County's Development District has been regulated by a National Pollutant Discharge Elimination System (NPDES) permit, under the

[29] County Commissioners Resolution 09-16

[30] Charles County Health Department, 2006

[31] More information is available at: http://www.mde.state.md.us/Water/CBWRF/osds/brf_bat.asp. County regulations requiring denitrification in the Critical Area were being reviewed as of early 2010.

Municipal Separate Storm Sewer Discharge (or MS4) permit system. The need for such a permit is based on population thresholds established by the Clean Water Act. Its purpose is to eliminate non-stormwater discharges and reduce the discharge of pollutants in stormwater to the maximum extent possible. The MS4 NPDES permit requires significant monitoring, maintenance and improvements of the stormwater system.

Maintaining existing stormwater management (SWM) facilities to function properly helps reduce pollutants entering the County's streams and waterways. Additionally, providing new or improved stormwater management facilities where none exist, or retrofitting existing facilities that provide minimal benefit, can help to reduce nonpoint source pollution. The need for additional and improved urban SWM and for increased maintenance of existing SWM facilities is of particular concern to the County, especially in the Development District, where considerable development occurred prior to the codification of state and County SWM requirements.

a. Retrofits

There are approximately 2,863 acres of impervious surface (see VII.C below) in the Development District that lacks adequate (or, in some cases, any) SWM facilities.32 Three Watershed Restoration Studies (2004, 2007, and 2010) have been completed for the Development District. Together, these Studies recommend improvements reduce stormwater-borne pollutants from entering streams and waterways. Recommended improvements include upgrading existing SWM facilities, construction of new facilities in areas developed prior to SWM regulations, installing rain gardens and pervious paving, stream channel restoration, and educational outreach activities such as rain barrel distribution events and trash removal from streams. As of 2010, the County has completed construction of new stormwater management facilities for 45 acres that previously lacked appropriate SWM. Several additional projects totaling nearly 240 acres of impervious surface are in the design and/or engineering phase.

b. Maintenance

To function properly and provide the most environmental benefits, stormwater facilities must be regularly maintained and inspected. State and local codes require Charles County to inspect the 1,075 SWM facilities located within its boundaries every three years. Charles County owns approximately 240 of these SWM facilities. Homeowners associations and private property owners own—and shoulder the maintenance burden of—the vast majority of the remaining SWM facilities.

The Charles County Homeowners' Association Task Force reported in 2001 that in many cases, the owners of properties containing SWM facilities are responsible for maintenance that benefits other private or public users. Yet, these owners have no practical recourse to collect a proportional share of the maintenance expense from these other parties. Dealing with these issues involves a gray area between public and private ownership interests and rights of access. The County is working with affected parties to attempt to resolve these issues to meet public health, safety, and natural resource objectives.

c. Monitoring

The County monitors its stormwater system as required by the NPDES permit. This includes monitoring nutrients, other contaminants, and the physical condition of receiving waters. Monitoring is the basis for status and progress assessments. In addition to stream monitoring, the County inspects large storm drain outfall pipes for stormwater flow during dry weather. If water

[32] Source: NPDES Annual Report (2009-10), Charles County, Maryland. Municipal Separate Storm Sewer Discharge Permit.

is observed flowing from a pipe when there hasn't been a storm event, the water is tested to see whether it contains pollutants. This test helps determine if there has been an illicit discharge into the system. Discharges into the County's stormwater system are not allowed unless individually permitted by MDE.

4. Watershed Management Planning

Watershed management planning is important for maintaining water quality. Several County watersheds have management plans and commissions to support their implementation. These include the Wicomico River and Zekiah Swamp, the Patuxent River,[33] and the Potomac River. The most recently completed watershed plans include the Mattawoman Creek Watershed Management Plan and the Port Tobacco River Watershed Restoration Action Strategy.

a. Mattawoman Creek Watershed Management Plan

In 2003, the U.S. Army Corps of Engineers completed a watershed management plan for Mattawoman Creek in Charles County. The plan was written in response to concerns that development within the Development District had the potential to significantly affect Mattawoman Creek, with water quality and biota (plants and animals) the primary concerns. The purpose of the plan was to balance the protection of the Mattawoman Creek's natural resources and water quality with the development plans of the County. A computer model assessed future pollutant loads within the watershed in a variety of land use scenarios and time scales. Based on the model results, and considering natural resources protection needs and the County's development plans, the Corps made three recommendations to minimize pollutant loads in Mattawoman Creek and its tributaries:

- For future development, implement low impact design techniques [these techniques are largely required by the ESD provisions of the County's 2010 stormwater regulations], minimize impervious surfaces, retaining forest to the maximum extent possible, and promoting stormwater disconnects.
- Delineate and protect the stream valley—defined as the top of the slope to the stream.
- Examine existing developments for stormwater retrofit opportunities.

b. Port Tobacco Watershed Restoration Action Strategy

The Port Tobacco River watershed is fully contained within the County, but overlaps a portion of the Town of La Plata. In 2007, the County prepared a Watershed Restoration Action Strategy (WRAS) for the Port Tobacco watershed. The WRAS was adopted for implementation by the Charles County Commissioners in 2007[34] and by the Town of La Plata in 2008. The WRAS includes a plan to achieve the residents' visions for restoration of the Port Tobacco River watershed. These include:

- Reduce bacteria levels below the State limits for contact recreation.
- Mitigate future changes to watershed hydrology.
- Reduce sedimentation rates.

[33] The County formally adopted the 1984 Patuxent River Policy Plan (County Commissioners Resolution 84-18) and its 1997 update (CR 00-77).

[34] County Commissioners Resolution 07-57.

- Prevent summer algal blooms by reducing summer nutrient levels from non-point sources to the low-flow load allocation as specified by the TMDL.

Based on extensive fieldwork, data review, discussion, and computer pollutant modeling, nine recommendations were made to achieve these goals:

- Eliminate septic system failures.
- Eliminate sanitary sewer overflows [i.e., from the La Plata WWTP].
- Protect a greater percentage of the watershed.
- Reduce the volume of runoff generated at new developments through better site design [e.g., ESD] and well-designed and constructed stormwater management.
- Reduce stream bank erosion caused by existing development without stormwater management practices by constructing stormwater retrofits.
- Enforce sediment and erosion control regulations.
- Eliminate illicit discharges to reduce nutrient and bacteria loads and protect the biological functions of streams.
- Educate the watershed residents about water quality impacts of individual actions.
- Exclude livestock from streams.

Many specific implementation projects were identified to achieve the above recommendations, some of which have been completed—primarily through the efforts of the Port Tobacco River Conservancy. These include installation of rain gardens, wetland restoration, and education on water quality impacts of individual actions. Additional implementation progress is being pursued by the County and Town of La Plata.

5. Sludge

Most sewage treatment plants in Charles County process sludge via aerobic digestion processes followed by dewatering on sand beds. These plants produce approximately 7 wet tons per year. Of that total, approximately 93 percent (6.5 tons) is processed at the Mattawoman WWTP. The Mattawoman WWTP uses gravity thickening, aerobic digestion, and Belt Filter Processing with the County's Land Application Contracts. The County’s sludge is applied to farmland.

Sludge from the La Plata WWTP is processed in aerobic digesters and taken to a landfill in Virginia. This facility also has anaerobic digesters, which are not currently in use. La Plata’s intent is to eventually dispose of this sludge via land application. The Town of Indian Head processes sludge in an aerobic digester and dewaters it on drying beds. Currently, the town trucks its sludge to the Mattawoman WWTP. Smaller plants located in the County do not have the facilities to process excess sludge. These plants contract haulers to dispose of excess sludge, either at the Mattawoman WWTP or via land spreading.

State regulations require that all septage gathered by sewage pumping trucks be treated at a sewage treatment plant. According to these regulations, raw septage may not be applied directly to any land surface in the State.

6. Land Preservation, Parks, and Recreation Plan

Charles County’s 2005 Land Preservation, Parks, and Recreation Plan (LPPRP) was adopted as an amendment to the Comprehensive Plan. While the LPPRP contains few goals, objectives, policies, and implementation actions that directly relate to the analyses in this WRE, its overall emphases on the preservation of rural and agricultural land, and the use of waterways for recreation are consistent with the WRE.

7. Agriculture

Maintaining rural character and agriculture as an industry is a major goal of the County. However, runoff from cropland, feedlots, and pastures can carry nutrients and pollutants from manure, fertilizers, ammonia, pesticides, livestock waste, soil, and sediment into waterways. Across the Chesapeake Bay basin, agriculture is one of the largest contributors of nitrogen and phosphorus to the Bay and its tributaries. However, this impact can be reduced through the application of agricultural Best Management Practices (BMPs) such as planting cover crops, judicious use of fertilizer (especially animal manure), and maintaining appropriate buffers along rivers and streams. The County continues to work with the agricultural community to ensure that agricultural BMPs are implemented to the greatest degree feasible.

8. Sedimentation and Erosion

Sedimentation and other impacts resulting from construction activity, and increased stormwater flows to streams and rivers from development are also a potential threat to water quality. Most new non-agricultural development in Charles County requires a sedimentation and erosion control plan. The County also inspects construction sites to ensure proper sediment and erosion control. The Charles County bureau of the Natural Resources Conservation Service (NRCS) also reviews Erosion and Sediment permits for every construction site that disturbs land.

9. Roads and Stormwater Management

The design of roads can impact nonpoint source nutrient loading. Open section roads (roads without curbs and gutters) can help to reduce impacts on water quality by dispersing runoff from pavement. Such roads are most appropriate outside of towns, urban areas, and populated areas where pedestrian facilities are a priority.

“Green streets” provide similar water quality benefits, but are used in towns and urban areas where pedestrian facilities are priority. Green streets make use of many ESD practices and can be applied to new development or to retrofit existing development. The green street design approach blends natural hydrological features and processes within the designed urban landscape. Components of green streets often include:

- Landscaped curb extensions,
- Swales that store and promote infiltration of stormwater runoff,
- Lowered or raised planter strips,
- Permeable surfaces, such as porous paver blocks and pervious asphalt or concrete, and
- Street trees.

Where reasonably feasible and fiscally practicable, new roads in such areas of the County are designed with open sections.

VII. Total Nutrient Loads and Assimilative Capacity

Nutrient loads from point sources (WWTPs), stormwater, and other nonpoint sources are major contributors to degraded water quality in the Chesapeake Bay and its tributaries. This section evaluates existing and projected nonpoint source and total nutrient loads.

A. Nonpoint Source Loading

Table 10 shows the estimated existing and future nonpoint source (NPS) loading (nitrogen and phosphorus) in each 8-digit watershed under each of the three scenarios, while Table 11 shows the nonpoint source loading from septic systems only. NPS nutrient loads (including septic systems) were estimated using methodology developed by MDE, as modified by the County to reflect revised nutrient loading rates. More detail on the nonpoint source evaluation methodology is presented in the Water Resources Element Appendix. The loadings described in Tables 10-12 represent estimates only, and intended only to facilitate comparison between scenarios.

As shown in Table 10, all three future land use scenarios would result in reduced NPS nutrient loads in all watersheds. This is due largely to the nonpoint source model's assumption[35] that nutrient-reducing BMPs for urban stormwater and agricultural runoff would be more widely implemented by 2030. The Focused Growth Scenario would result in the lowest overall NPS discharges, as well as the lowest NPS discharges in the Mattawoman Creek watershed, due largely to the amount of redevelopment (as opposed to consumption of forest land for development) that could occur if actual development matches the density/intensity envisioned in the Waldorf Urban Design Study. As shown in table 11, the Focused Growth Scenario would also result in the lowest nitrogen loading from septic systems, since development in this scenario would be concentrated in areas served by public sewer systems.

Based on the MDE NPS modeling, all future land use scenarios would meet the nonpoint source TMDLs for nitrogen and phosphorus in the Port Tobacco River watershed. MDE has stated that its NPS model should be used primarily to compare land use scenarios against each other, and not to determine TMDL compliance.[36] However, even with this caveat, it is apparent that none of the WRE future land use scenarios would meet the nutrient TMDLs for the Mattawoman Creek watershed by 2030 (although all would reduce NPS nutrient discharges below current levels).

The County will continue to work with MDE, MDA, and other appropriate agencies to reduce nonpoint source nutrient loads in impaired watersheds, and to further define the actual and projected loadings in these watersheds.

[35] The model uses loading rates from the Chesapeake Bay Program Watershed Model, Phase 4.3.

[36] MDE officials have made this or similar statements in numerous public forums.

Table 10. Nonpoint Source Nutrient Loading[1]

(all data in lbs/year)			Patuxent Lower[2]	Gilbert Swamp	Mattawoman Creek[2]	Nanjemoy Creek[2]	Port Tobacco River[2]	Potomac Lower[2]	Potomac Middle	Potomac Upper[2]	Wicomico River	Zekiah Swamp	Total
Existing	Nonpoint Source Loading	TN[4]	141,903	207,231	252,882	236,498	229,217	272,250	113,415	14,529	139,945	481,630	**2,089,500**
		TP[4]	6,409	13,773	13,231	13,991	13,876	13,296	4,974	616	9,491	31,356	**121,013**
	TMDL Caps	TN			116,699		194,750						
		TP			5,304		13,300						
	Available Capacity (Overage)[3]	TN			(136,183)		(34,467)						
		TP			(7,927)		(576)						
A. Baseline	Nonpoint Source Loading	TN	106,765	154,900	191,335	199,139	179,434	231,585	100,433	13,229	109,314	375,041	**1,661,175**
		TP	4,905	10,436	8,477	11,595	10,644	10,883	4,173	543	7,804	24,279	**93,739**
	Available Capacity (Overage)	TN			(74,636)		15,316						
		TP			(3,173)		2,656						
B. Focused Growth	Nonpoint Source Loading	TN	107,841	148,746	188,066	181,090	180,913	225,469	95,910	13,557	101,965	366,045	**1,609,602**
		TP	4,924	10,401	8,456	10,867	10,718	10,775	3,978	559	7,606	24,188	**92,472**
	Available Capacity (Overage)	TN			(71,375)		13,837						
		TP			(3,152)		2,582						
C. DDD Focus	Nonpoint Source Loading	TN	107,657	148,647	231,268	181,861	181,676	225,243	95,382	13,510	101,863	364,197	**1,651,304**
		TP	4,921	10,400	9,343	10,898	10,748	10,771	3,934	556	7,603	24,071	**93,245**
	Available Capacity (Overage)	TN			(114,569)		13,074						
		TP			(4,039)		2,552						

Notes:
1: Includes septic systems. For development outside of public wastewater systems in all future scenarios, assumes that 25% of new development and 10% of existing development (via retrofit) will utilize Best Available Technology for nutrient removal.
2: Indicates a watershed that is impaired by nutrients.
3: Reflects Load Allocation (LA) limits set by adopted TMDLs for each watershed. Where no TMDL has been adopted, or where the watershed is not impaired, no numerical standards are shown.
4: TN = Total Nitrogen; TP = Total Phosphorus

Table 11. Septic System Nutrient Loading, By Land Use Scenario[1]

Watershed	Total Nitrogen (lbs/year)[1]			
	Existing	A. Baseline	B. Focused Growth	C. DDD Focus
Patuxent River	25,479	25,448	26,126	26,008
Gilbert Swamp	21,249	26,249	21,635	21,562
Mattawoman Creek	33,224	44,162	41,113	73,300
Nanjemoy Creek	22,160	31,562	23,002	23,365
Port Tobacco River	35,711	39,621	40,170	40,526
Potomac Lower Tidal	12,426	21,476	17,007	16,839
Potomac Middle Tidal	7,949	10,364	8,226	8,198
Potomac Upper Tidal	1,445	1,843	1,980	1,962
Wicomico River	5,987	11,096	7,216	7,161
Zekiah Swamp	50,117	63,858	56,952	56,616
Total Septic Loading	**215,747**	**275,679**	**243,427**	**275,538**

Notes:
1: MDE does not consider septic systems to be a significant source of phosphorus.

B. Total Nutrient Loading

Table 12 shows the total combined point and nonpoint source discharge in each 8-digit watershed under each of the three scenarios. This table combines data from Tables 9 and 10. The total nutrient loading in Table 12 includes the public-system point sources listed in Table 10, as well as estimates of point source discharges from NSWC, Mirant-Morgantown, and other commercial WWTPs listed in the County Water and Sewer Plan.

As with NPS loading, all three future land use scenarios would result in reduced total nutrient loads Countywide, as well as in all watersheds except for the Middle Potomac.[37] This occurs not because of a specific assumption in this WRE, but because of the assumptions (made by MDE in developing the NPS model) that substantial progress will be made in the implementation of various nutrient-reducing strategies. The increased discharges in the Middle Potomac watershed reflect the increased point source discharges from the Mattawoman WWTP. The Focused Growth Scenario would result in the lowest total nutrient discharges Countywide, as well as the lowest nutrient discharges in the Mattawoman Creek watershed.

C. Impervious Surface

Impervious surfaces are primarily human-made surfaces that do not allow rainwater to enter the ground. Impervious surfaces can create or worsen runoff that causes stream bank erosion, sediment deposition into stream channels, increases in stream temperatures, and potentially degradation of water quality and aquatic life. The amount of impervious surface in a watershed—particularly impervious surfaces that are not treated by stormwater management facilities—can be a key indicator of water quality. All other factors being equal, water quality in streams tends to decline as impervious coverage increases in a watershed. Table 13 summarizes existing and potential impervious coverage in Charles County by watershed.

[37] The increase in total loading in the Middle Potomac is due to the increased discharge from the Mattawoman WWTP

Table 12. Total Nutrient Loading, All Scenarios

(all data in lbs/year)			*Watershed*										
			Patuxent Lower[1]	Gilbert Swamp	Mattawoman Creek[1]	Nanjemoy Creek[1]	Port Tobacco River[1]	Lower Potomac[1]	Middle Potomac	Upper Potomac[1]	Wicomico River	Zekiah Swamp	**Total**
Existing	Nonpoint	TN[2]	141,903	207,231	252,882	236,498	229,217	272,250	113,415	14,529	139,945	481,630	2,089,500
		TP[2]	6,409	13,773	13,231	13,991	13,876	13,296	4,974	616	9,491	31,356	121,013
	Point	TN	0	0	4,042	0	11,602	3,048	74,283	0	0	219	93,194
		TP	0	0	303	0	701	233	15,758	0	0	73	17,068
	Total	**TN**	**141,903**	**207,231**	**256,924**	**236,498**	**240,819**	**275,298**	**187,698**	**14,529**	**139,945**	**481,849**	**2,182,694**
		TP	**6,409**	**13,773**	**13,534**	**13,991**	**14,577**	**13,529**	**20,732**	**616**	**9,491**	**31,429**	**138,081**
A. Baseline	Nonpoint	TN	106,765	154,900	191,335	199,139	179,434	231,585	100,433	13,229	109,314	375,041	1,661,175
		TP	4,905	10,436	8,477	11,595	10,644	10,883	4,173	543	7,804	24,279	93,739
	Point	TN	0	0	6,403	0	26,937	4,898	155,960	0	0	219	194,417
		TP	0	0	480	0	2,834	618	9,422	0	0	73	13,427
	Total	**TN**	**106,765**	**154,900**	**197,738**	**199,139**	**206,371**	**236,483**	**256,393**	**13,229**	**109,314**	**375,260**	**1,855,592**
		TP	**4,905**	**10,436**	**8,957**	**11,595**	**13,478**	**11,501**	**13,595**	**543**	**7,804**	**24,352**	**107,166**
B. Focused Growth	Nonpoint	TN	107,841	148,746	188,066	181,090	180,913	225,469	95,910	13,557	101,965	366,045	1,609,602
		TP	4,924	10,401	8,456	10,867	10,718	10,775	3,978	559	7,606	24,188	92,472
	Point	TN	0	0	6,403	0	24,834	3,405	167,637	0	0	219	202,498
		TP	0	0	480	0	2,624	468	10,122	0	0	73	13,767
	Total	**TN**	**107,841**	**148,746**	**194,469**	**181,090**	**205,747**	**228,874**	**263,547**	**13,557**	**101,965**	**366,264**	**1,812,100**
		TP	**4,924**	**10,401**	**8,936**	**10,867**	**13,342**	**11,243**	**14,100**	**559**	**7,606**	**24,261**	**106,239**
C. DDD Focus	Nonpoint	TN	107,657	148,647	231,268	181,861	181,676	225,243	95,382	13,510	101,863	364,197	1,651,304
		TP	4,921	10,400	9,343	10,898	10,748	10,771	3,934	556	7,603	24,071	93,245
	Point	TN	0	0	6,403	0	26,618	3,348	167,118	0	0	219	203,706
		TP	0	0	480	0	2,802	463	10,091	0	0	73	13,909
	Total	**TN**	**107,657**	**148,647**	**237,671**	**181,861**	**208,294**	**228,591**	**262,500**	**13,510**	**101,863**	**364,416**	**1,855,010**
		TP	**4,921**	**10,400**	**9,823**	**10,898**	**13,550**	**11,234**	**14,025**	**556**	**7,603**	**24,144**	**107,154**

Notes:
1: Indicates a watershed that is impaired by nutrients.
2: TN = Total Nitrogen; TP = Total Phosphorus.

Table 13. Impervious Surface Coverage

Watershed	Total Acreage[1]	Existing		A. Baseline		B. Focused Growth		C. DDD Focus	
		Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Patuxent River	18,030	939	5.2%	985	5.5%	993	5.5%	991	5.5%
Gilbert Swamp	24,756	782	3.2%	884	3.6%	821	3.3%	820	3.3%
Mattawoman Creek	44,662	4,361	9.8%	4,772	10.7%	4,836	10.8%	4,944	11.1%
Nanjemoy Creek	46,692	701	1.5%	870	1.9%	749	1.6%	754	1.6%
Port Tobacco River	28,068	1,890	6.7%	2,194	7.8%	2,244	8.0%	2,266	8.1%
Potomac Lower Tidal	28,312	914	3.2%	1,090	3.8%	1,014	3.6%	1,012	3.6%
Potomac Middle Tidal	19,223	524	2.7%	595	3.1%	569	3.0%	553	2.9%
Potomac Upper Tidal	2,039	44	2.2%	60	2.9%	63	3.1%	63	3.1%
Wicomico River	17,430	221	1.3%	385	2.2%	275	1.6%	274	1.6%
Zekiah Swamp	65,238	3,607	5.5%	4,168	6.4%	4,213	6.5%	4,086	6.3%
Total	**294,450**	**13,981**	**4.7%**	**16,003**	**5.4%**	**15,777**	**5.4%**	**15,763**	**5.4%**

Notes:
1: Acreage excludes areas of open water.
Source: MDE Nonpoint Source Model, based on existing and projected land use/land cover.

Countywide, less than five percent of all land (excluding open water within the County's boundaries) is impervious. On a percentage basis, impervious surface coverage is highest in the Mattawoman and Port Tobacco watersheds, where much of the County's developed land is found (i.e. within the County's Development District and the Towns of La Plata and Indian Head). Impervious coverage percentage in most other watersheds is moderate to low.

The use of Environmental Site Design (ESD) for new development, redevelopment, and targeted stormwater retrofits can help to mitigate some of the impacts of impervious surfaces by reducing the amount, velocity, and pollutant content of stormwater entering streams. The NPS model used in this WRE accounts for some impervious surface benefits in the form of reduced nutrient loading. However, the model's outputs, in the form of impervious acreages and percentages, can be misleading. An acre of existing untreated or minimally treated impervious surface generates more substantial adverse stormwater impacts than an acre of ESD-treated impervious surface. It is therefore most helpful to compare the impervious surface acreages and percentages from the three future land use scenarios against each other—and not against existing conditions.

VIII. Choice of Land Use Plan

A major goal of the Water Resources Element is to more closely link land use and development policies with water quality goals. This section describes those linkages, and makes land use recommendations to be considered in the next update of the 2012 Comprehensive Plan.

A. Identification of Suitable Receiving Waters

Ideally, the Water Resources Element should use measures of assimilative capacity, such as completed TMDLs for nutrients, to guide direction of growth and land use patterns within the County. Article 66B specifically requires the WRE to identify suitable receiving waters for point and nonpoint source nutrient discharges. While nutrient TMDLs have been completed for two of the County's watersheds, the Port Tobacco River and Mattawoman Creek, TMDLs remain incomplete for the County's other impaired watersheds. Lacking such complete information on assimilative capacity, it is not possible for the County to identify "appropriate" receiving waters for nutrients. Instead, this WRE uses the best available information to make land use and water resources infrastructure recommendations.

The available TMDLs indicate the need to reduce nutrient loads in Mattawoman Creek and the Port Tobacco River. However, the lack of TMDLs for other watersheds makes it difficult to understand the relative degree of impairment in each of the County's six nutrient-impaired watershed—an important factor for future land use recommendations. Another consideration is that while the majority of the County's Priority Funding Areas (PFAs) fall within impaired watersheds, Maryland's Smart Growth principles fundamentally encourage the continued concentration of new development within these already-developed areas. The opposite approach—dispersal of development to unimpaired watersheds—could help to improve water quality in Mattawoman Creek and other impaired watersheds, but would encourage inefficient use of water and sewer infrastructure, and would impact (and potentially degrade) a larger number of watersheds.

B. Preferred Land Use Plan

As shown in Tables 10, 11, and 12, there are notable differences in potential nutrient loadings under each of the future land use scenarios. The Focused Growth scenario would generate the lowest overall nutrient discharges Countywide and in the Mattawoman Creek and Port Tobacco River watersheds. The Focused Growth scenario also supports the state's Smart Growth goals by concentrating new development in Waldorf—the County's primary PFA and an area where water and sewer infrastructure is already available or can be more efficiently provided. In addition to making efficient use of existing infrastructure, concentrating growth (including redevelopment) in the County's PFAs provides opportunities to construct and retrofit stormwater management facilities that can efficiently and cost-effectively treat larger amounts of urban stormwater runoff.

Charles County has begun implementation of the Focused Growth Scenario through the zoning and density provisions from Waldorf Urban Design Study.[38] Using Transferrable Development Rights (TDR) and bonuses for affordable housing, these provisions allow densities of nearly 30 residential units per acre in some parts of the US 301 corridor. The County is also working to identify a Priority Preservation Area (another component of the Focused Growth scenario).

Although preferred over Scenarios A and C, the Focused Growth Scenario alone does not achieve water quality goals in Mattawoman Creek or the Port Tobacco River. In part, this finding reflects the purpose of this WRE: to evaluate the policies of the 2006 Comprehensive Plan. The 2012 Comprehensive Plan update will evaluate a wider range of land use options and will more holistically incorporate water quality and water supply concerns into decisions about the location and intensity of future development.

C. Relationship to Senate Bill 276

Senate Bill 276 (from the 2009 General Assembly session) amends Article 66B, requiring the establishment of a statewide goal for increasing the amount of development within PFAs and decreasing development outside of PFAs. As part of this law, jurisdictions must also establish (beginning in 2011) local land use goals for the amount of development inside of PFAs. To the degree that its recommendations with regard to land use (and the preference for the Focused Growth Scenario) are followed, this WRE will result in progress toward the statewide and local land use goals by directing more development to PFAs and employment centers.

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[38] These zoning provisions were adopted in 2009, more than a year after the start of the WRE process.

IX. Objectives, Policies, and Recommendations

The following objectives, policies, and implementation actions address water resources in Charles County.

Water Resources Goal 1: *In cooperation with the County's municipalities, the County will maintain safe and adequate drinking water supplies for existing and projected population and non-residential uses.*

Objective: *Measure supply and demand on an annual basis to determine future public water needs and take other actions needed to ensure adequate supply is available to meet demand.*

Policies and Recommendations

1. *Work with MDE, WSSC, and other agencies, as necessary, to identify, access, and sustainably utilize groundwater resources. Specifically, install an additional Patuxent well through the state-appropriated funds for western Charles County/Bryans Road.*
2. *Implement a wellfield management strategy, as recommended by the 2006 WRAC Report to the County Commissioners.*
3. *Continue to pursue expanded purchases of water from WSSC, coordinating with Prince George's County as necessary.*
4. *Consider interconnection between the County-operated Waldorf water system and the Town of La Plata's water system. In addition to engineering challenges, a key concern for such a connection is the fair distribution of system costs.*
5. *Begin to evaluate the feasibility of establishing a new surface water source (likely incorporating desalinization). Specific considerations include the location, engineering requirements, and funding of such a facility.*
6. *Work with MDE to investigate the feasibility of indirect wastewater reuse options.*
7. *Continue to promote water conservation through media and educational seminars and publications, staff guidance to homeowners, and coordination with home builders to advocate water-conserving designs.*

Water Resources Goal 2: *In cooperation with the County's municipalities, the County will ensure that adequate wastewater treatment capacity exists in public systems for existing and projected residential and non-residential uses.*

Objective: *Measure supply and demand on an annual basis to determine future public wastewater treatment needs and take other actions needed to ensure adequate supply is available to meet demand.*

Policies and Recommendations

1. *Consider extending public sewer service to existing communities identified as failing septic areas in the County's Comprehensive Water and Sewer Plan, and to septic systems in the Chesapeake Bay Critical Area.*
2. *Correct sanitary sewage problems in existing problem areas to provide a safe environment for all of the County's residents.*

Water Resources Goal 3: *In cooperation with the County's municipalities, the County will maintain or improve water quality in its streams and rivers through the establishment and continued use of appropriate development policies and enforcement actions.*

Objective 1: *Continue to monitor point-source discharges to ensure compliance with NPDES permit requirements.*

Policies and Recommendations

1. *Ensure that point source pollution discharges stay within safe levels through strict enforcement of state water quality standards for sewage effluent.*
2. *Ensure that industrial facilities are appropriately permitted under the NPDES industrial discharge program and that the necessary Pollution Prevention Plans are in place and implemented in accordance with the County's NPDES Municipal Stormwater permit.*

Objective 2: *Continue to identify and participate in programs and initiatives that reduce nonpoint source discharges of nutrients and other pollutants.*

Policies and Recommendations

1. *Participate in the development of Watershed Implementation Plans to achieve Total Maximum Daily Loads for the County's watersheds, to be established by MDE and US EPA.*
2. *Continue to implement the Mattawoman Creek Watershed Management Plan.*
3. *Continue to implement the Port Tobacco River WRAS per County Commissioners Resolution 07-57.*
4. *Continue to encourage the installation of septic denitrification systems as part of new development throughout the County.*
5. *In conjunction with MDE and the Department of Natural Resources, identify and map areas of failing septic systems, and reduce nonpoint source nutrient loads from such septic systems through retrofits, replacement, or where appropriate, connection to public sewer systems (focusing on the Chesapeake Bay Critical Area as a first priority).*
6. *Ensure that the County receives nutrient credits for any connection of septic systems to public sewer systems, as well as other actions enumerated in Maryland's Policy for Nutrient Cap Management and Trading.*
7. *Continue to retrofit untreated impervious surface area in the County with stormwater management in accordance with the NPDES Municipal Stormwater permit.*
8. *Work with MDE, DNR, and the Maryland Department of Agriculture (MDA) to assist farmers in adopting best management practices to reduce nonpoint source loads of nutrients and other pollutants. As part of this effort, develop an educational program and assistance for farmers to improve or limit their runoff.*
9. *Encourage the establishment of Soil Conservation and Water Quality Plans on all farms in Charles County to reduce sediment and nutrient export from agricultural activities.*

Water Resources Goal 4: *Water resources planning shall be a tool to direct the location, amount, and type of development in Charles County.*

Objective: *Utilize planning and design standards that focus on environmental impacts on a watershed level, to better mitigate the impacts from development within the watershed.*

Policies and Recommendations

1. *Continue to implement regulations that require the use of Environmental Site Design (ESD) stormwater techniques in all new construction and redevelopment to the maximum extent practicable.*
2. *Build on the Port Tobacco WRAS by identifying stormwater "hotspots" in other parts of the County. Through the Capital Improvement Plan (CIP) or other funding mechanisms, design and implement stormwater retrofits and stream restoration projects at these locations.*
3. *Continue and improve programs and policies to assure the functional maintenance of stormwater management systems.*
4. *As part of future Comprehensive Plan updates, re-run the nonpoint source loading analysis, incorporating up-to-date land use and any changes to the state's model.*
5. *Plan capital improvements consistent with growth in areas where development is encouraged to locate, especially in the Mattawoman Sewer Service Area.*
6. *Place special emphasis on management of the Mattawoman Creek and Port Tobacco River watersheds (the location of most existing and planned development in the County) to balance the protection of natural resources and water quality with development plans and Smart Growth strategies.*
7. *Limit the provision of water and sewer infrastructure in rural areas to avoid inefficient investment and to discourage more growth than is desired. Continue to use small scale biological treatment facilities (such as the planned Benedict WWTP) to serve rural villages.*
8. *Continue public education and outreach efforts, such as rain barrel distribution, pet waste education, and dry well installation programs focused in neighborhoods with untreated impervious surfaces.*
9. *Continue to explore and implement new techniques and technologies to reduce the impacts to streams during mass grading for development.*
10. *Encourage the use of open section roads and green streets for stormwater management on new and existing roads.*
11. *Consider developing an urban canopy program to maintain the water quality benefits provided by healthy trees in the Priority Funding Areas.*

Water Resources Element Appendix

Housing Unit Projection Methodology

The following assumptions were used to develop the housing unit projections for each Water Resources Element Scenario. **All projections described in the Water Resources Element and this Appendix—including the number and location of projected or new housing units—are intended *only* for the analyses in the Water Resources Element, and are not official County projections.**

The year 2030 housing unit projections for each scenario rely primarily on a residential Development Capacity Analysis prepared by the Maryland Department of Planning. The Capacity Analysis estimates the amount of new residential development that could occur on each parcel in the County, based on: zoning yield (assumed residential units per acre based on zoning); environmental constraints such as wetlands and floodplains; and the amount of existing development on the parcel.

New residential units were distributed among portions of the County's 8-digit watersheds. Where applicable, each 8-digit watershed was divided into Priority Funding Area (PFA) and "Rural" (areas outside of PFAs) sub-watersheds. Thus, the 8-digit Mattawoman watershed was divided into four "segments:" Mattawoman (Waldorf PFA); Mattawoman (Bryans Road PFA); Mattawoman (Indian Head PFA); and the Remainder of Mattawoman Creek Watershed.

Note Regarding Municipal Growth

In addition to the Development Capacity Analysis, the housing unit projections in Table 2 of the Charles County Water Resources Element reflect information provided in the Municipal Growth Elements (MGE) of the Comprehensive Plans for the Towns of Indian Head and La Plata. The Indian Head MGE projects approximately 791 new households in the Town through 2030 [1] This represent growth of approximately 40 percent, which is consistent with the County's projected 45 percent growth through 2030. Thus, the County WRE incorporates Indian Head's projections without exception (except to divide these new units among the two watersheds that the Town straddles).

The WRE does not directly incorporate the Town of La Plata's projections. The La Plata MGE (July 2009) indicates that the Town will grow (through annexation and increased residential development) from a population of approximately 9,000 to 25,000 by 2030. This is a growth rate of more than 250 percent, approximately six times faster than the County's overall projected growth rate through 2030. This population growth translates to more than 5,700 additional housing units (using the Town's assumption of 2.8 persons per household)—including approximately 700 existing housing units are present in the Growth Areas (i.e., annexation areas) shown in the Town's MGE. While there is adequate land capacity to support this projected growth, it seems unlikely that actual development through 2030 in La Plata will reach the levels projected by the Town's MGE.

Accordingly, the Charles County WRE uses its own projections for development in La Plata. These projections, based on the Development Capacity Analysis, assume 4,300 to 5,100 additional housing units in La Plata (including the 700 annexed units described above), depending on the scenario. This represents approximately a doubling of the Town's housing unit totals through 2030.

[1] Although "households" are different from "housing units" (the basis for the data in the County WRE), these two terms are comparable. For Indian Head, "households" were used interchangeably with "housing units."

Baseline Scenario

In this scenario, the Development Capacity Analysis was applied without modification. In this scenario, 791 projected housing units would be assigned to Indian Head, and the remaining 23,382 projected housing units would be distributed around Charles County as follows:

- Reflecting past housing unit development trends, 60 percent of housing units (14,029 units) would be built within the County's PFAs (Waldorf and Bryans Road), in proportion to the development capacity in each of the watersheds covered by those PFAs. For example, in 2008, the portion of the Waldorf PFA within the Mattawoman Creek watershed had approximately 20.3 percent of the total residential development capacity in all of Charles County's PFAs. Thus, of the 14,029 units projected to be built in Charles County PFAs by 2030, 2,843 (20.3 percent of the PFA total) would be built in the Mattawoman portion of the Waldorf PFA.

- The remaining 40 percent of housing units (9,353 housing units) would be built in the rural (non-PFA) portions of the County's 8-digit watersheds in proportion to the development capacity in each of the watersheds covered by those PFAs. For example, in 2008, the portion of the Mattawoman Creek watershed not within a PFA (the "Remainder of the Mattawoman Watershed") had approximately 17.3 percent of the total residential development capacity in all of Charles County's rural areas. Thus, of the 9,353 units projected to be built in Charles County's rural areas by 2030, 1,617 (17.3 percent of the rural total) would be built in the Mattawoman "remainder" watershed.

Focused Growth Scenario

This scenario assumes that 75 percent of all projected new residential units would be built within the County's PFAs, while the remaining 30 percent would be built in rural areas. This assumption is based on increased densities in the Waldorf and Bryans Road PFAs, and reduced development capacity in rural areas as the result of the implementation of Priority Preservation Areas (PPA). To model this assumption, the Development Capacity Analysis was modified to increase densities and assumed yields (units per acre) in the portion of the Waldorf area along US 301 (see Figure A-1).

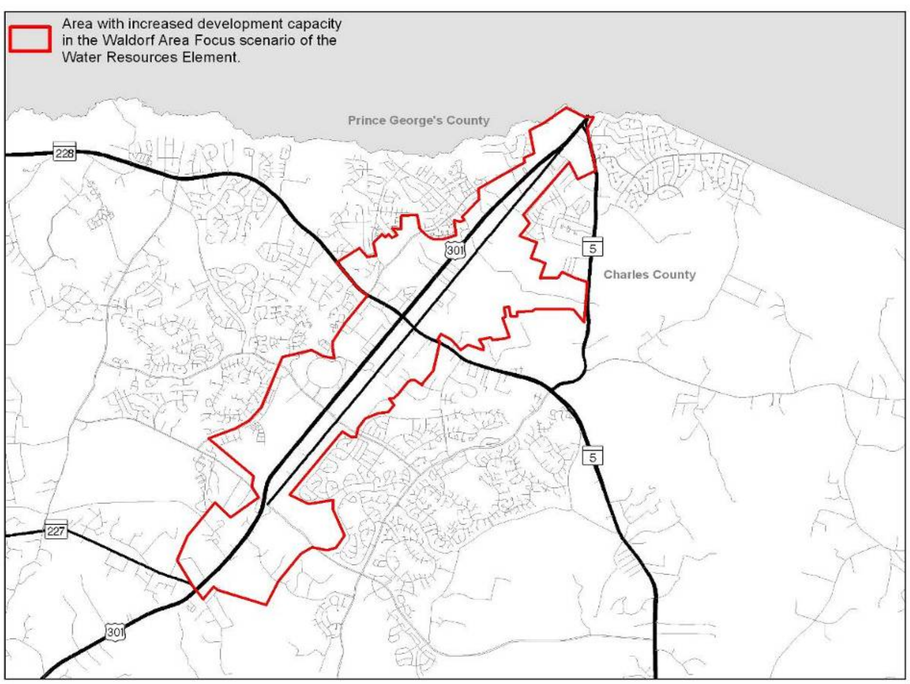


Figure A-1: Area of Increased Development Capacity for Waldorf Scenario

The geography of this "increased density" portion of Waldorf is based on 2010 zoning amendments to implement the Waldorf Urban Design Study, as well as the recommendations of the Maryland Transit Administration's Southern Maryland Transit Corridor Preservation Study.

Priority Preservation Areas are shown in Figure A-2. Within these areas, development capacities were substantially reduced, reflecting an assumed future maximum density of one unit per 20 acres. These assumptions are not based on, nor do they set County policy. Rather, they are assumptions for purposes of the WRE only.

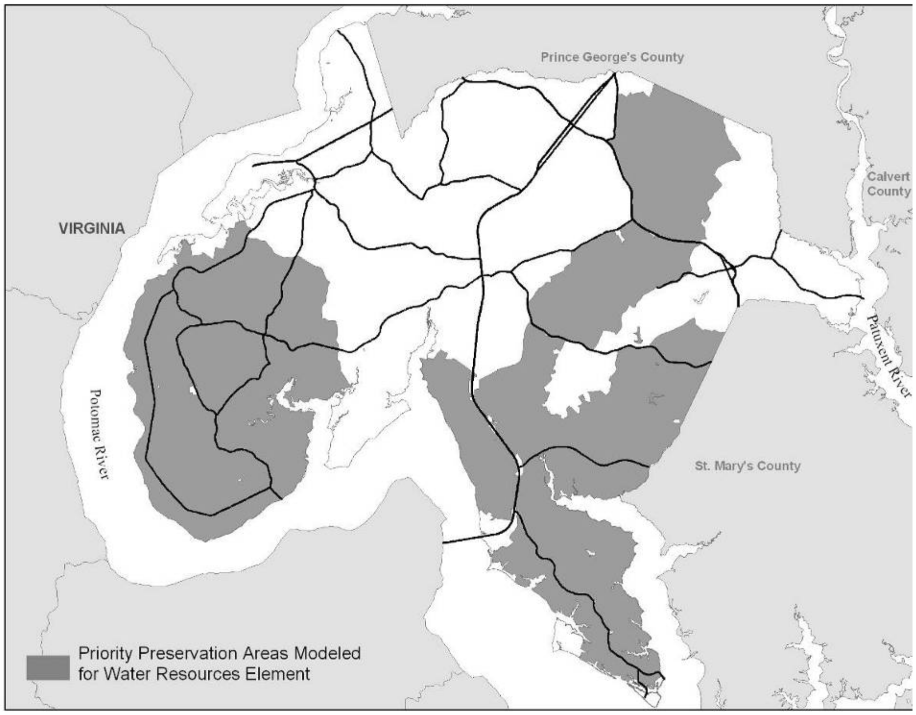


Figure A-2: Priority Preservation Areas

Within each watershed subdivision—e.g., "Mattawoman (Waldorf)"—projected new housing units were distributed in proportion to development capacity (revised for the Waldorf and PPA areas), in the same manner as described for the Baseline scenario.

DDD Focus Scenario

In this scenario, 60 percent of all projected new residential units would be built within the County's PFAs, while the remaining 40 percent would be built within the County's rural areas. This scenario assumed implementation of the PPAs as described in the Waldorf scenario, and also assumed that development constraints in the Deferred Development District (DDD) would be removed. To model this assumption, the Development Capacity Analysis was modified to decrease densities and assumed yields in the PPAs. Yields were increased to 1.55 units per acre in the DDD. All other densities and yields in the County were unchanged from the Baseline scenario.

Within each watershed subdivision—e.g., "Mattawoman (Waldorf)"—projected new housing units were distributed in proportion to development capacity (revised for the Waldorf and PPA areas), in the same manner as described for the Baseline scenario.

Assignment of Acreages for Nonpoint Source Model

This section discusses how the Existing Conditions (Year 2007) Land Use/Land Cover (LU/LC) acreages within each 8-digit watershed were amended to reflect projected development under each of the three growth scenarios analyzed in the Water Resources Element. Year 2007 Land Use/Land Cover data and categories were provided by the Maryland Department of Planning.

Residential Development

For the WRE, the New Housing Capacity (NHC—a product of the Development Capacity analysis) was summed for three categories in each watershed segment.

- Urban (LU/LC Codes 11-18, 191, and 192)
- Agricultural (LU/LC Codes 21-25, 241, and 242)
- Forest, Water, and Wetlands (LU/LC Codes 41-44, 50, and 60)

It was assumed that new residential development would occur in the same ratio as existing residential development. For example, in the Mattawoman (Waldorf) watershed segment, 16 percent of existing residential development was within “Low Density” LU/LC areas, 69 percent was within “Medium Density” areas, and 15 percent was within “High” density areas. These percentages were applied to projected residential units assigned to this watershed segment.

The following gross densities were used for all geographies to convert new units into new acreage:

- Rural (LU/LC 191, 192): 0.2 units/acre. Not used within PFAs.
- Low Density (LU/LC 11): 2 units/acre
- Medium Density (LU/LC 12): 5 units/acre
- High Density (LU/LC 13): 10 units/acre

New residential acreage within each watershed segment was then assigned to the Urban, Agricultural, or Forest categories according to the ratio of NHC. For example, in the Mattawoman (Waldorf) watershed segment, 38 percent of all NHC was within the Forest category.

New development assigned to the urban category was deemed to be “infill,” and thus would not result in any land use acreage change. In theory, there would be shifts from low density to medium density, and so on. However, because the nonpoint source model’s loading rates are the same for all urban development types, there was no need to further parse the urban category.

New development assigned to the agricultural category would result in an equal loss of agricultural land in that watershed segment. Reductions in agricultural land were concentrated in the LU/LC 21 (cropland) category for simplicity (since the nonpoint source model’s loading rates do not distinguish among agriculture types).

Similarly, new development assigned to the forest category would result in an equal loss of forest land in that watershed segment. Reductions in agricultural land were concentrated in the LU/LC 41 (deciduous forest) category for simplicity (since the nonpoint source model’s loading rates do not distinguish among forest types).

Nonresidential Development

In all scenarios, nonresidential acreage (commercial and industrial land) was projected to grow proportionately with new residential development, within each watershed segment. For example, in 2007, there were 187 acres of commercial land and 6,477 acres of residential land use in the Port Tobacco (Remainder) watershed segment. The ratio of 187 to 6,477 is 0.03. In 2030, the Baseline scenario projected that residential uses in this watershed would account for 1,363 additional acres (excluding infill). Using the 0.03 ratio, this equates to approximately 41 acres of new commercial development in the Port Tobacco (Remainder) watershed segment.

Nonresidential acreage replaced agricultural and forest acreage using the same methodology as described above for residential acreage.

Wastewater Reuse—Spray Irrigation

Option A, Preliminary Spray Irrigation Site Capacity Estimate (from *Models and Guidelines 26*, page 67) was used to estimate the acreage in Charles County that could be appropriate for future land application (spray irrigation) of treated wastewater effluent. Charles County's GIS soils database was used to identify soil types and permeability classes that most closely matched the drainage categories listed in the state guidelines. Table A-1 shows the results of this analysis. Map A-1 shows areas that, based on this analysis, might be suitable for land application.

Table A-1. Potential Land Application Acreage in Charles County

Drainage Category	Estimated Site Capacity for Each 100 Acres	Total Potential Land Area[1]
Excessively drained	640,000 gpd	1,846 acres
Well drained	480,000 gpd	12,061 acres
Moderately well drained	320,000 gpd	22,504 acres
Total		**36,411 acres**

Notes:

1: Limited to Agricultural land (Land Use/Land Cover categories 21, 22, 23, and 24) outside of municipal boundaries. Does not include buffers from streams or developed areas.

Developed areas, bare ground, wetlands, and forests were not considered appropriate for land application. Forests, in particular, should be preserved due to their ability to filter and reduce nonpoint source pollution. Because spray irrigation (with groundwater) is already a common agricultural practice in Maryland, agricultural areas are considered to be the most appropriate locations for future land application of treated wastewater.

It is understood that Option A is a coarse level of analysis, and is preliminary in nature. More detailed evaluations of soil characteristics, water table, and other factors are necessary before identifying specific locations for land application. However, these results indicate that, in some areas, land application may be an appropriate way to expand existing public wastewater system capacity (or to establish new public wastewater systems) without increasing nutrient loads to receiving bodies of water. For example, a 50-acre plot of "well drained" land (with appropriate depth to bedrock, buffers, and other favorable physical conditions) could translate to as much as 900 EDU of capacity.

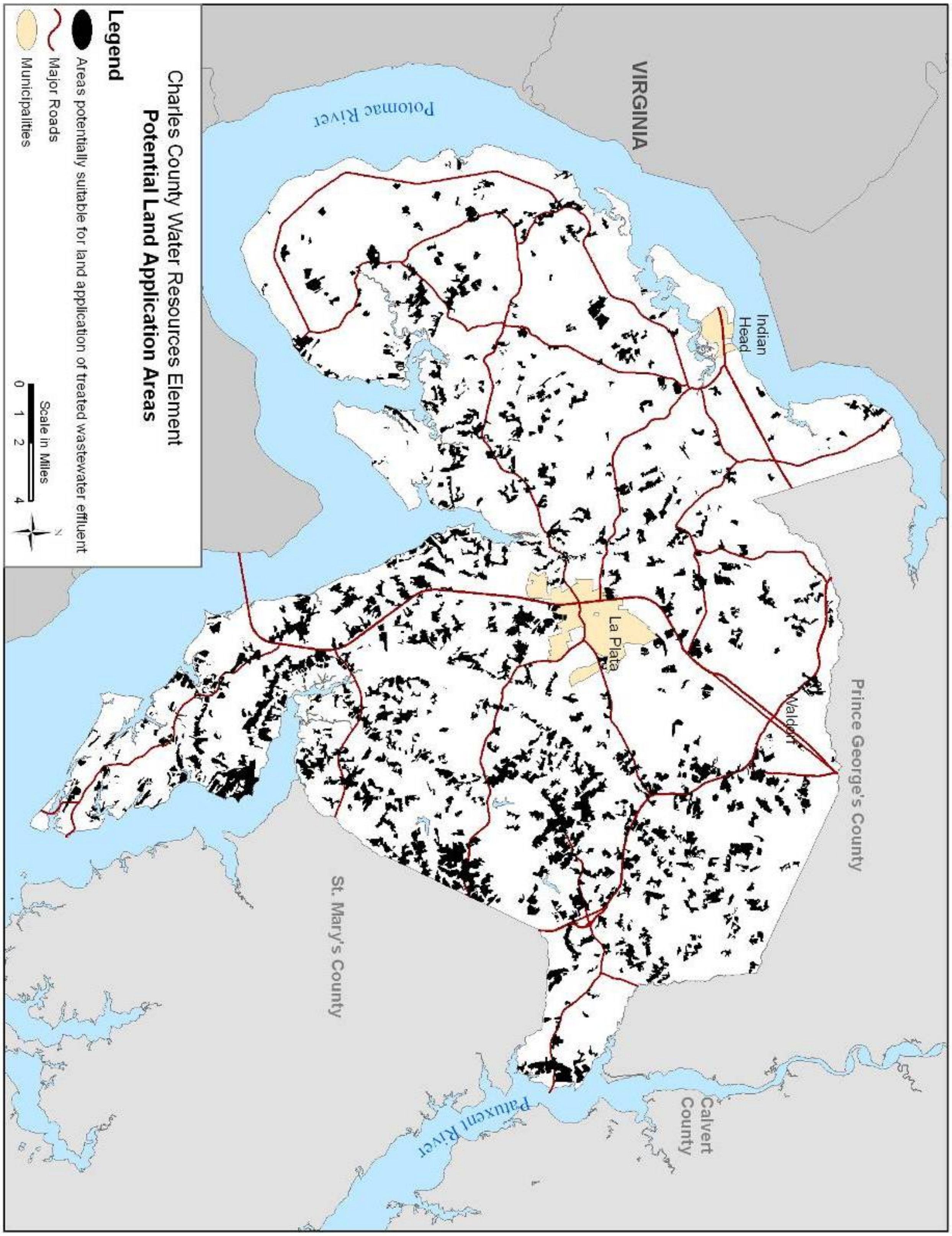


Figure A-3. Areas Potentially Suitable for Land Application of Treated Effluent

Nonpoint Source Modeling Methodology

In conjunction with *Models and Guidelines 26*, the official guidance for preparing the Water Resources Element, MDE developed a spreadsheet-based model for Charles County to use in calculating existing and projected future nitrogen and phosphorus loads from nonpoint sources, based on land use (specifically, GIS layers showing existing and projected future land use).

Modifications to the MDE Model

The County used the MDE default model as a framework for estimating nonpoint source (NPS) nutrient loading for the Water Resources Element. However, in the course of developing the Charles County Water Resources Element and other Water Resources Elements in Maryland, the County and its consultant, Environmental Resources Management, Inc. (ERM), received public comments about the nature of the loading rates contained in the state's default model. In particular, there were concerns that the loading rates (which state the pounds per year of nitrogen or phosphorus that is generated by a given land use) greatly underestimated NPS nutrient loading, especially from agricultural land.

ERM and the County decided to use an alternative set of loading rates and methodology for the NPS model. Loading rates were obtained from the Chesapeake Bay Program Watershed Model, Phase 4.3. Loading rates for Agriculture, Forest, Urban, and Mixed Open Space were amalgamated for all of the segments of the Watershed Model in Charles County. Table A-2 shows the loading rates used for existing and future year projections. Table A-3 shows how the generalized land uses correspond to the Land Use/Land Cover (LU/LC) categories in the default model. A digital version of the NPS model used for this WRE is available from the Planning and Zoning Office upon request (the spreadsheets themselves are difficult to reproduce in print form).

Table A-2. Nonpoint Source Loading Rates (Lbs/Acre/Year)

Generalized Land Use	Existing Conditions (2008)[1]					
	TN (Lbs/Ac/Year)		*TP (Lbs/Acre/Year)*		*Sediments (T/Ac/Year)*	
	Patuxent[3]	*Potomac*[3]	*Patuxent*	*Potomac*	*Patuxent*	*Potomac*
Agriculture	12.2	16.3	0.9	1.3	1.1	0.7
Forest	1.3	1.3	0.0	0.0	0.0	0.0
Mixed Open	4.3	4.4	0.4	0.6	0.2	0.1
Urban	10.3	10.6	0.5	0.8	0.2	0.1
Generalized Land Use	**With Tributary Strategy Implementation[2]**					
	TN (Lbs/Ac/Year)		*TN (Lbs/Ac/Year)*		*TN (Lbs/Ac/Year)*	
	Patuxent	*Patuxent*	*Patuxent*	*Patuxent*	*Patuxent*	*Patuxent*
Agriculture	7.58	7.58	7.58	7.58	7.58	7.58
Forest	1.21	1.21	1.21	1.21	1.21	1.21
Mixed Open	3.32	3.32	3.32	3.32	3.32	3.32
Urban	6.75	6.75	6.75	6.75	6.75	6.75

Notes:

1: Source: Chesapeake Bay Program Watershed Model, Phase 4.3, scenario s65prog08b (2008 Annual Model Assessment), http://www.chesapeakebay.net/data_modeling.aspx

2: Source: Chesapeake Bay Program Watershed Model, Phase 4.3, scenario s66mdts06 (Maryland Tributary Strategy 06 - FINAL). Coefficients represent combined loading for state segments 4500 (Patuxent River), 4910, 4915, and 4920 (Potomac River). http://www.chesapeakebay.net/data_modeling.aspx

3: The Chesapeake Bay Program Watershed Model's loading rates are differentiated by 6-digit watershed. Charles County has two such basins: the Patuxent and Potomac River basins. The Patuxent River basin includes only the Lower Patuxent River 8-digit watershed. All other 8-digit watersheds in Charles County fall within the Potomac basin.

**Table A-3. Correspondence Table:
Chesapeake Bay Model Generalized Land use to MDP LU/LC**

CBP Generalized Land Use	MDP Land Use/Land Cover[1]	
	Category	Code
Agriculture	Cropland	21
	Pasture	22
	Orchards	23
	Row and Garden Crops	25
	Feeding Operations	241
	Agricultural Buildings	242
Forest	Deciduous Forest	41
	Evergreen Forest	42
	Mixed Forest	43
	Brush	44
	Water	50
	Wetlands	60
Mixed Open	Urban Open Space	18
	Bare Ground	73
Urban	Low Density Residential	11
	Medium Density Residential	12
	High Density Residential	13
	Commercial	14
	Industrial	15
	Institutional	16
	Extractive	17
	Transportation	80
	Rural Residential	191, 192

The default state model uses separate loading rates for the pervious and impervious portion of each LU/LC category. Because the Chesapeake Bay Watershed Model's data do not distinguish between pervious and impervious, the Charles County NPS model applied the loading rates in Table A-2 directly to the LU/LC acreage, without segregating pervious and impervious. It should be noted that the Towns of Secretary and East New Market (Dorchester County's "Twin Cities") and Dorchester County used similar data and assumptions for their Water Resources Elements.

Septic Denitrification

For purposes of modeling, it was assumed that one quarter of new development outside of public sewer systems (residential and non-residential) would incorporate Best Available Technology (BAT) for nutrient removal (a.k.a. denitrification), and that ten percent of existing development would be retrofitted with denitrification technology through 2030.

Other Modifications

The default model was also modified to reflect updated household size data. Year 2000 data were replaced with year 2008 (2.86 persons per household), and year 2030 data (2.66 persons per household) were included.

NPS Model Outputs

The tables and graphs below are the detailed output of the Charles County NPS model described above and in section VII of the Water Resources Element.

Table A-4. Land Use and Septic Systems

	Existing (Acres)	Baseline Scenario (Acres)	Focused Growth Scenario (Acres)	DDD Focus Scenario (Acres)
Development	68,233	87,552	80,986	83,153
Agriculture	47,978	42,886	44,892	44,573
Forest	170,219	155,993	160,553	158,702
Water	119,837	119,837	119,837	119,837
Other	8,019	8,019	8,019	8,019
Total Area	**414,288**	**414,288**	**414,287**	**414,286**
Residential Septic (EDUs)	16,749	26,012	22,504	26,012
Non-Residential Septic (EDUs)	8,696	9,724	9,336	9,680

Table A-5. Total Nitrogen Loading

	Existing (Lbs/Yr)	Baseline Scenario (Lbs/Yr)	Focused Growth Scenario (Lbs/Yr)	DDD Focus Scenario (Lbs/Yr)
Development NPS	720,782	611,774	565,715	580,915
Agriculture NPS	772,295	444,783	466,005	462,634
Forest NPS	212,774	188,751	194,269	192,030
Water NPS	149,797	145,003	145,003	145,003
Other Terrestrial NPS	69,713	51,327	51,327	51,327
Total Terrestrial Load	**1,925,361**	**1,441,639**	**1,422,319**	**1,431,908**
Residential Septic (EDUs)	182,028	242,647	211,620	242,647
Non-Residential Septic (EDUs)	33,719	33,032	31,806	32,892
Total Septic Load	215,747	275,679	243,427	275,538
Total NPS Nitrogen Load	**2,141,108**	**1,717,318**	**1,665,745**	**1,707,446**
Total PS Load	93,193	194,417	202,498	203,707
Total Nitrogen Load (NPS+PS)	**2,234,302**	**1,911,735**	**1,868,243**	**1,911,154**

Table A-6. Total Phosphorus Loading

	Existing (Lbs/Yr)	Baseline Scenario (Lbs/Yr)	Focused Growth Scenario (Lbs/Yr)	DDD Focus Scenario (Lbs/Yr)
Development NPS	52,842	45,343	41,848	42,999
Agriculture NPS	62,216	44,677	46,812	46,473
Forest NPS	3,404	3,041	3,133	3,096
Water NPS	2,397	2,385	2,385	2,385
Other Terrestrial NPS	5,968	4,108	4,108	4,108
Total Terrestrial Load	**126,827**	**99,554**	**98,286**	**99,061**
Total PS Load	17,067	13,426	13,767	13,909
Total Phosphorus Load (NPS+PS)	**143,894**	**112,980**	**112,053**	**112,970**

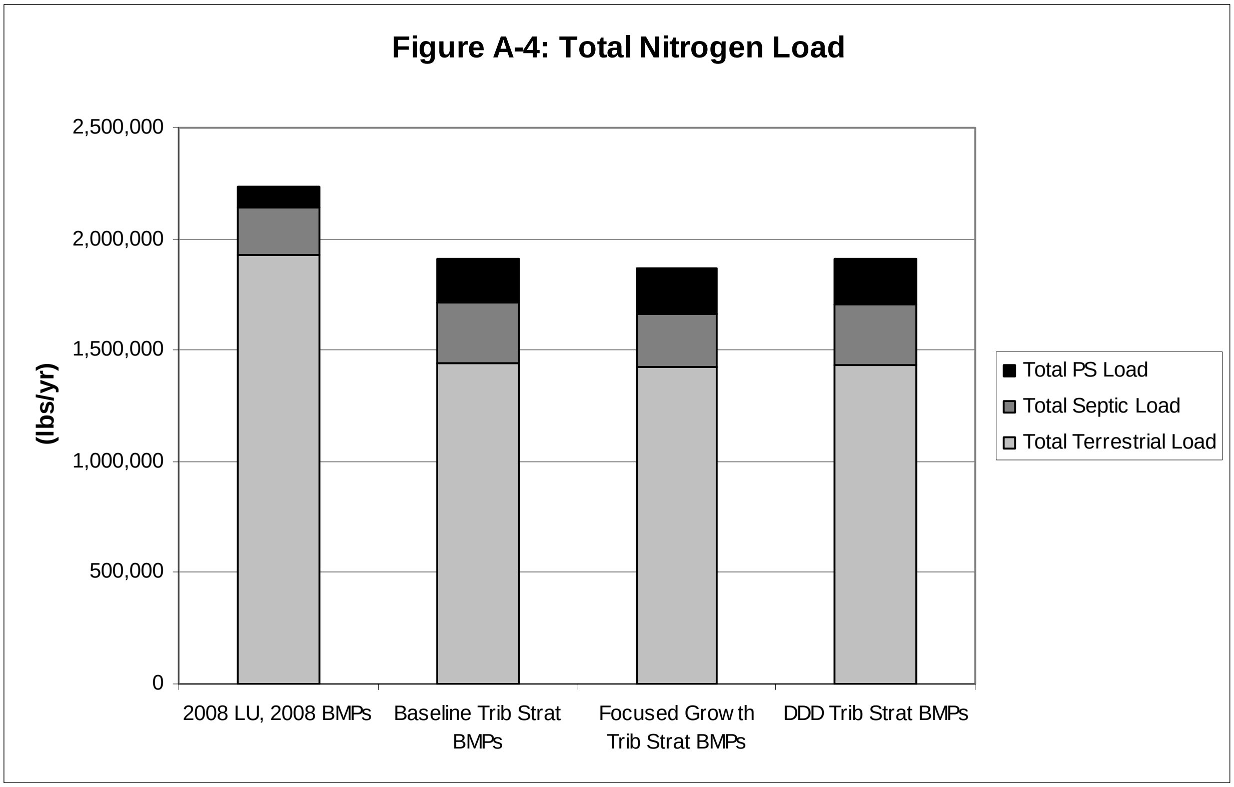


Figure A-4: Total Nitrogen Load
(lbs/yr)
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
2008 LU, 2008 BMPs
Baseline Trib Strat BMPs
Focused Grow th Trib Strat BMPs
DDD Trib Strat BMPs
Total PS Load
Total Septic Load
Total Terrestrial Load

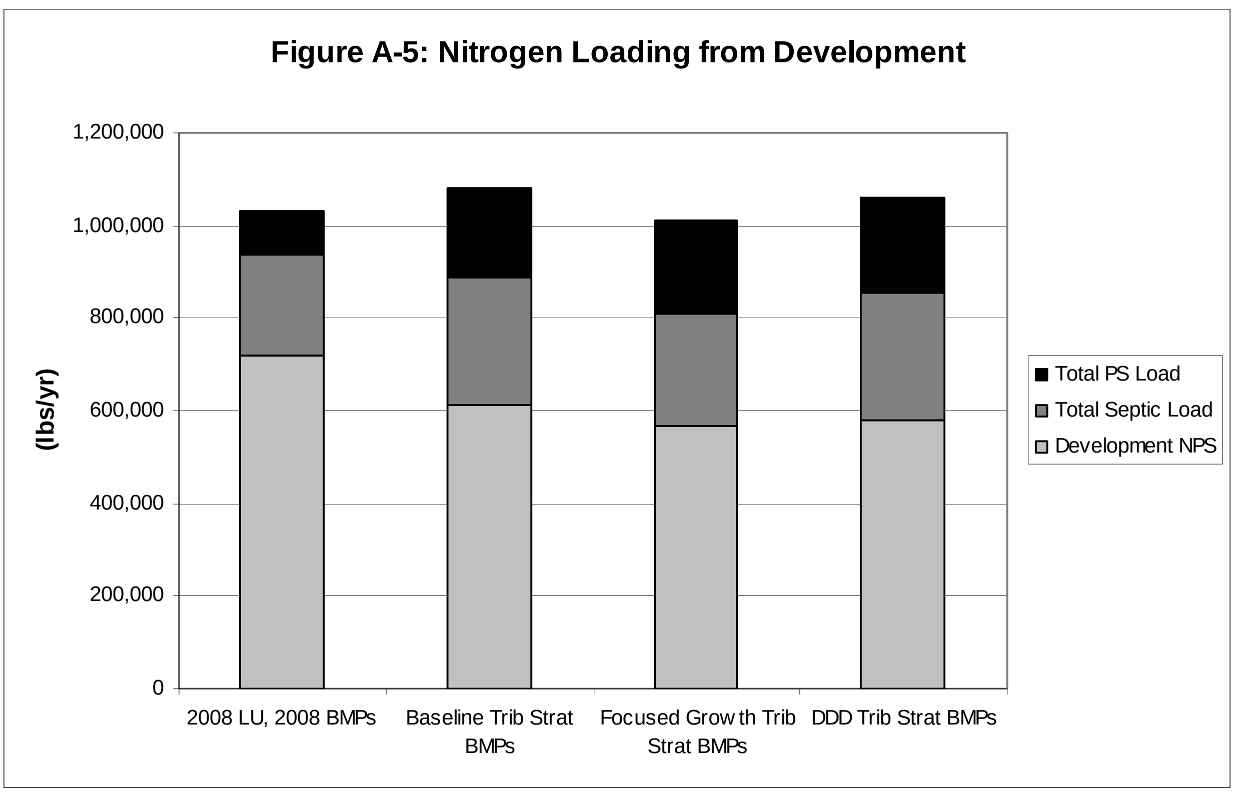


Figure A-5: Nitrogen Loading from Development
(lbs/yr)
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
2008 LU, 2008 BMPs
Baseline Trib Strat BMPs
Focused Grow th Trib Strat BMPs
DDD Trib Strat BMPs
Total PS Load
Total Septic Load
Development NPS

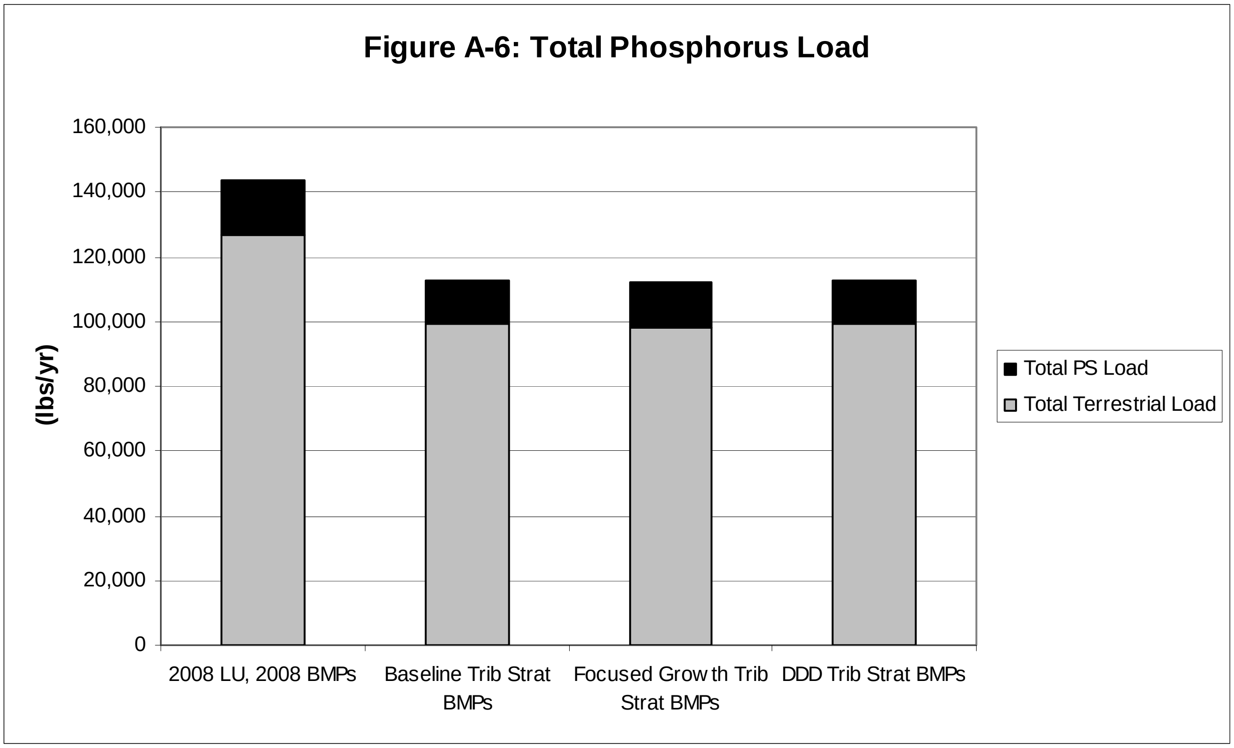


Figure A-6: Total Phosphorus Load
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
(lbs/yr)
2008 LU, 2008 BMPs
Baseline Trib Strat BMPs
Focused Grow th Trib Strat BMPs
DDD Trib Strat BMPs
Total PS Load
Total Terrestrial Load

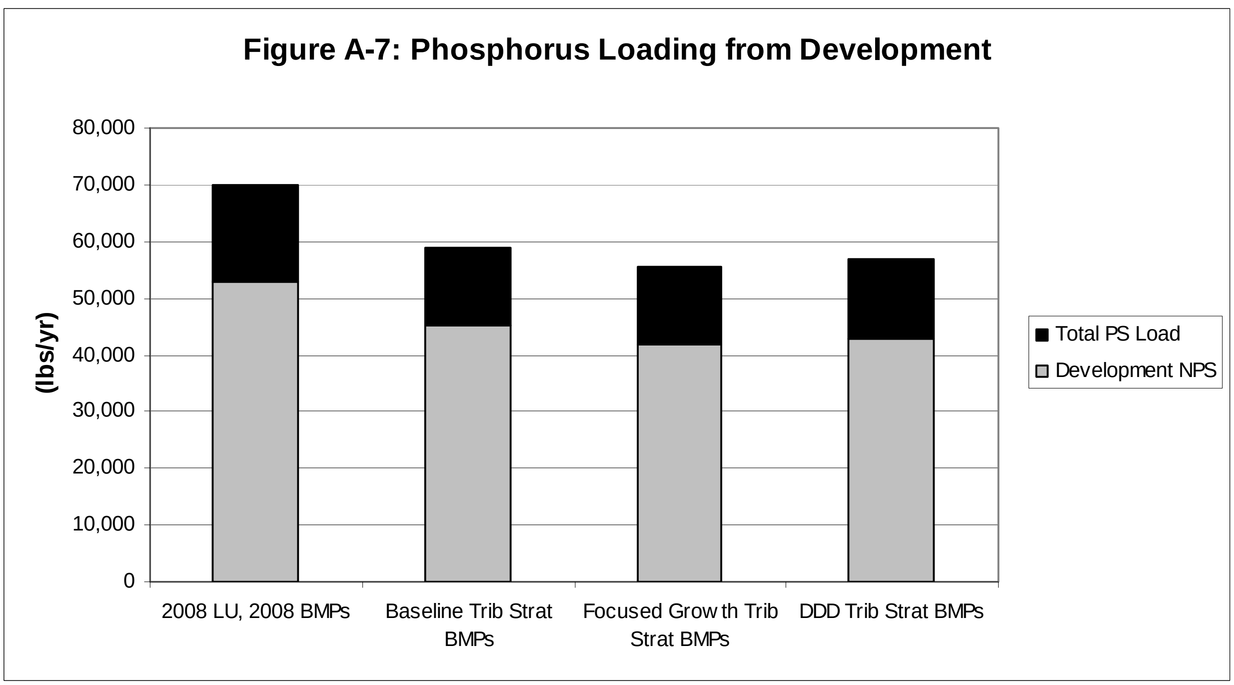


Figure A-7: Phosphorus Loading from Development
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
(lbs/yr)
2008 LU, 2008 BMPs
Baseline Trib Strat BMPs
Focused Grow th Trib Strat BMPs
DDD Trib Strat BMPs
Total PS Load
Development NPS

Table A-7. Impervious Cover and Open Space

	Existing	Baseline Scenario	Waldorf Area Focus Scenario	DDD Focus Scenario
Total Impervious Cover	13,981	16,003	15,777	15,762
Countywide Impervious Percentage	3.4%	3.9%	3.8%	3.8%
County Land in Agriculture	47,978	42,886	44,892	44,573
County Land in Forest	163,451	149,225	153,785	151,934

Figure A-8: Open Space

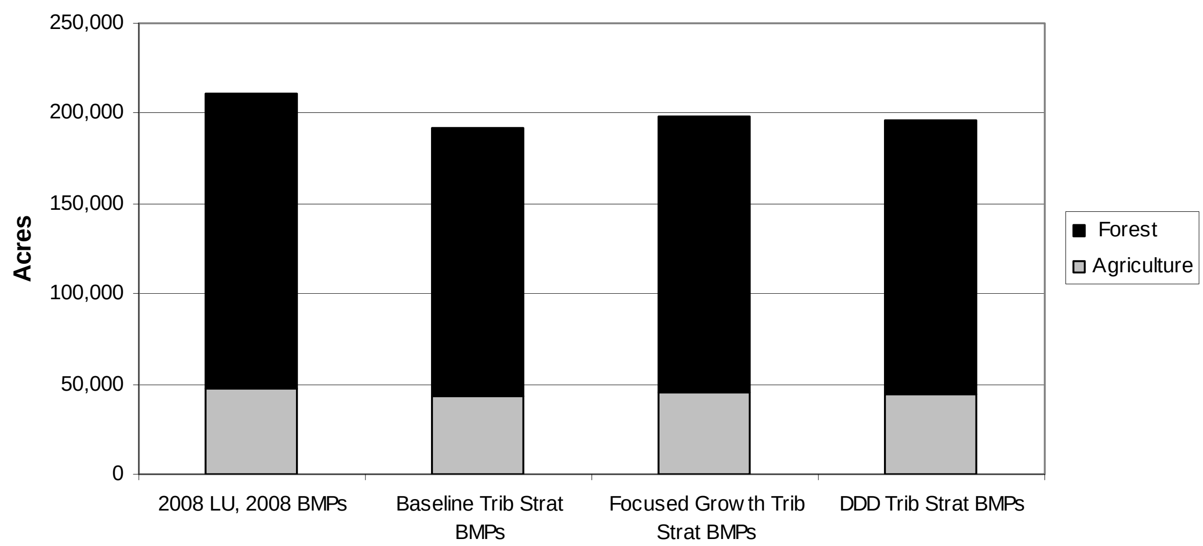
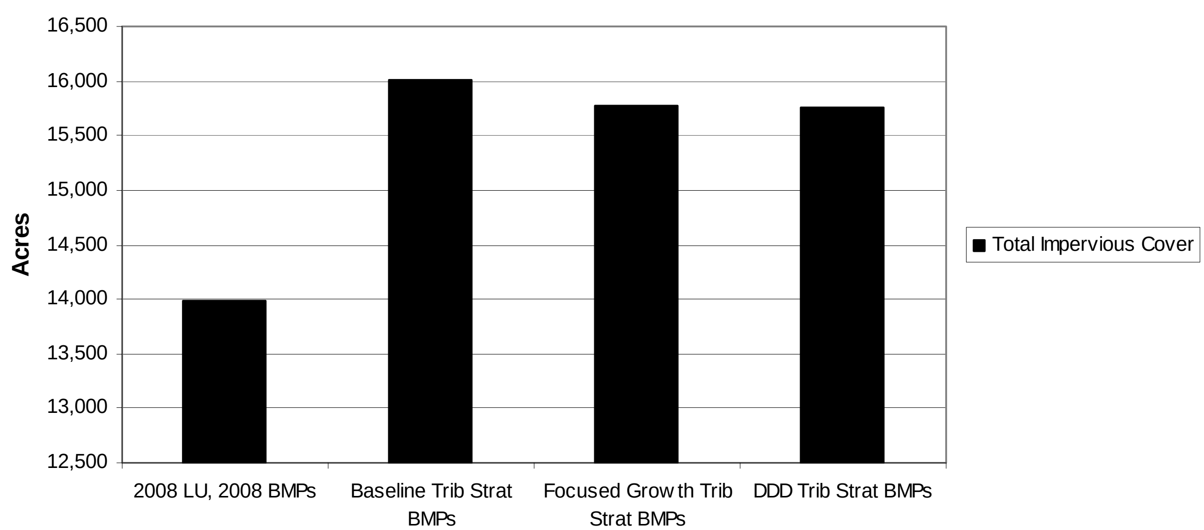


Figure A-9: Total Impervious Cover



Alternative NPS Model

For comparison, the County ran the default state NPS model using the same scenarios, acreages, housing unit totals, and septic system assumptions as in the model described above and in the Water Resources Element. The results of that model are shown in Table A-8. A digital version of the default state NPS model is available from the Planning and Zoning Office upon request.

Table A-8. Total Nutrient Loading, Default MDE Nonpoint Source Model

		Watershed										
(all data in lbs/year)		Patuxent Lower*	Gilbert Swamp	Mattawoman Creek*	Nanjemoy Creek*	Port Tobacco River*	Lower Potomac*	Middle Potomac	Upper Potomac*	Wicomico River	Zekiah Swamp	**Total**
Existing	TN	126,139	191,028	232,130	233,595	222,287	891,259	330,435	44,255	178,282	440,878	**2,890,289**
	TP	6,594	14,018	17,248	15,489	15,523	53,238	20,193	2,560	10,462	34,011	**189,336**
Baseline	TN	99,501	155,045	198,533	213,767	188,206	755,858	287,333	38,523	147,150	377,674	**2,461,590**
	TP	5,342	11,958	18,085	14,796	12,821	51,901	19,616	2,533	10,186	29,209	**170,633**
Focused Growth	TN	100,385	147,865	194,330	193,582	188,462	749,388	282,221	38,823	138,526	365,671	**2,399,253**
	TP	5,373	11,605	18,036	13,454	12,933	51,655	19,298	2,557	9,594	28,754	**167,445**
DDD Focus	TN	100,234	147,759	211,911	194,419	189,225	749,172	281,705	38,774	138,409	363,892	**2,415,501**
	TP	6,651	15,533	34,490	28,313	24,076	300,875	108,310	15,027	33,349	38,892	**598,703**

** Indicates a watershed that is impaired by nutrients.*