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 are intended *only* for the analyses in the Water Resources Element, and do not constitute official County population, housing unit, or nonresidential development projections.

Trends Scenario

In this scenario, 50% of all projected new residential units (approximately 3,077 of 6,153 projected units by 2030) would be built within the County's PFAs (incorporated municipalities only), in proportion to the existing (2007) number of housing units in each of the watersheds covered by those PFAs.

For example, in 2007, the portion of the Cambridge PFA within the Lower Choptank River watershed had approximately 65 percent of all housing units in Dorchester County's municipal PFAs. Thus, of the 3,127 units projected to be built in Dorchester County PFAs by 2030, 2,000 (65 percent of the total) would be built in the Lower Choptank portion of the Dorchester PFA.

Approximately 50 housing units were assigned to the County's smaller municipalities (Eldorado, Brookview, and Galestown), according to projections from the Maryland Department of Planning

The remaining projected 3,026 housing units were distributed amongst the rural (non-PFA) portions of the County's 8-digit watersheds in proportion to the existing (2007) number of housing units in each of those watersheds.

PFA Focus Scenario

In this scenario, 100% of all projected new residential units would be built within the County's PFAs (incorporated municipalities only), in proportion to the existing number of housing units in each of the watersheds covered by those PFAs (see the description of this distribution in the Trends Scenario above). This includes approximately 50 units assigned to the County's smaller municipalities (Eldorado, Brookview, and Galestown).

Hybrid Scenario

In this scenario, 75% of all projected new residential units (4,615 of 6,153 projected units by 2030) would be built within the County's PFAs, in proportion to the existing number of housing units in each of the watersheds covered by those PFAs (see the description of this distribution in the Trends Scenario above).

Approximately 50 housing units were assigned to the County's smaller municipalities (Eldorado, Brookview, and Galestown), according to projections from the Maryland Department of Planning

The remaining projected 1,488 housing units were distributed amongst the rural (non-PFA) portions of the County's 8-digit watersheds in proportion to the existing (2007) number of housing units in each of those watersheds.

Assignment of Acreages

This section discusses how the Existing Conditions (Year 2007) Land Use/Land Cover acreages within each 8-digit watershed were altered 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

As part of its 2006 Draft Comprehensive Plan, Dorchester County worked with the Maryland Department of Planning to prepare a residential Development Capacity analysis.

For the WRE, the New Housing Capacity (NHC—a product of the Development Capacity analysis) was summed for three categories in each PFA (divided by 8-digit watershed) and each rural 8-digit watershed (areas of the watershed outside of municipal PFAs):

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

It was assumed that new residential development would occur in the same ratio as existing residential development. For example, in the the Lower Choptank portion of the Cambridge PFA, 15 percent of existing residential development was within "Low Density" LU/LC areas, 77 percent was within "Medium Density" areas, and 8 percent was within "High" density areas. These percentages were applied to projected residential units.

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 geography was then assigned to the Urban, Agricultural, or Forest categories according to the ratio of NHC. For example, in the Lower Choptank portion of the Cambridge PFA, 96 percent of all NHC was within the Urban 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. 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. 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 acreage, within each PFA and watershed. In the nonpoint source model used to calculate total nutrient loads, nonresidential acreage is used as a surrogate for discharges from septic systems.

For example, in 2007, there were 182 acres of commercial land and 4,602 acres of residential land use in the Lower Choptank Watershed (outside of all PFAs). The ratio of 182 to 4,602 is 0.04. In 2030, the Trends scenario projected that residential uses in this watershed would account for 1,488 additional acres (excluding infill). Using the 0.04 ratio, this equates to approximately 59 acres of new commercial development in the Lower Choptank Watershed (excluding any potential infill).

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 M&G 26, page 67) was used to determine the acreage in Dorchester County that could be appropriate for future land application (spray irrigation) of treated wastewater effluent. A Soil Survey Geographic (SSURGO) database for Dorchester County was obtained from USDA-NRCS, and 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 Dorchester County

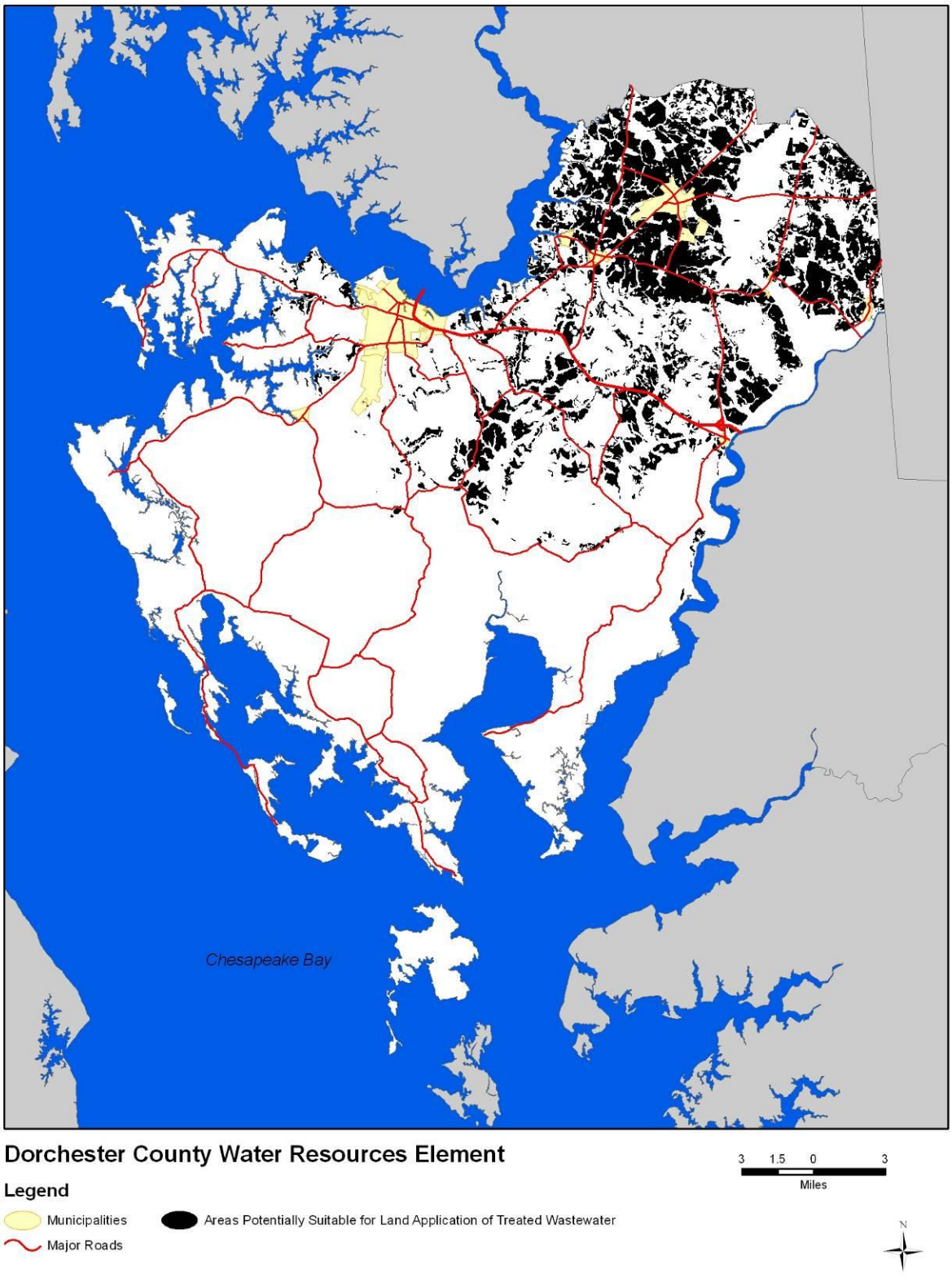
Drainage Category	Estimated Site Capacity for Each 100 Acres	Total Potential Land Area[1]
Excessively drained	640,000 gpd	34,485 acres
Well drained	480,000 gpd	15,180 acres
Moderately well drained	320,000 gpd	3,846 acres
Total		**53,511 acres**

Notes:

1: Limited to Agricultural land (Land Use/Land Cover categories 21, 22, and 23) 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 Dorchester County, 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, new County-operated wastewater collection and treatment systems tied to land application may be appropriate ways to address failing septic systems. For example, a 50-acre plot of "well drained" land (with appropriate depth to bedrock, buffers, and other favorable physical conditions) could replace as many as 1,000 septic systems.


Chesapeake Bay
Dorchester County Water Resources Element
Legend
Municipalities
Major Roads
Areas Potentially Suitable for Land Application of Treated Wastewater
3 1.5 0 3
Miles
N

MAP A-1

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 Dorchester 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 Dorchester County Water Resources Element and other County 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 lbs per year of nitrogen or phosphorus that is generated by a given land use) greatly underestimated NPS nutrient loading.

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 Dorchester 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)

	Existing Conditions (2007)[1]		With Tributary Strategy Implementation[2]	
Generalized Land Use	**TN**	**TP**	**TN**	**TP**
Agriculture	16.1	1.31	9.24	0.87
Forest	1.6	0.02	1.59	0.02
Mixed Open	5.2	0.92	3.99	0.70
Urban	8.6	1.11	6.06	0.73

Notes:

1: Source: Chesapeake Bay Program Watershed Model, Phase 4.3, scenario s65prog07b (2007 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 4400, 4410, 4840, and 4845. http://www.chesapeakebay.net/data_modeling.aspx

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 Dorchester 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") used similar data for their joint Water Resources Element in 2007.

Other Modifications

The default model was also modified to reflect updated household size data. Year 2000 data were replaced with year 2007 (2.30 persons per household), and year 2030 data (2.21 persons per household) were included.

NPS Model Outputs

The tables and graphs below are the detailed output of the Dorchester County NPS model described above and in section 6 of the Water Resources Element.

Table A-4. Land Use and Septic Systems

	Existing *(Acres)*	**Trends Scenario** *(Acres)*	**PFA Focus Scenario** *(Acres)*	**Hybrid Scenario** *(Acres)*
Development	21,711	28,381	23,229	25,760
Agriculture	113,903	108,889	112,928	110,943
Forest	216,784	215,128	216,241	215,695
Water	252,207	252,207	252,207	252,207
Other	2,849	2,849	2,849	2,849
Total Area	**607,454**	**607,454**	**607,454**	**607,454**
Residential Septic (EDUs)	7,497	10,524	7,497	8,985
Non-Residential Septic (EDUs)	8,208	9,179	8,208	8,668

Table A-5. Total Nitrogen Loading

	Existing *(Lbs/Yr)*	**Trends Scenario** *(Lbs/Yr)*	**PFA Focus Scenario** *(Lbs/Yr)*	**Hybrid Scenario** *(Lbs/Yr)*
Development NPS	187,367	171,990	140,769	156,105
Agriculture NPS	1,834,855	1,005,850	1,043,159	1,024,828
Forest NPS	357,458	342,992	344,766	343,895
Water NPS	415,869	402,110	402,110	402,110
Other Terrestrial NPS	19,535	14,587	14,587	14,587
Total Terrestrial Load	**2,815,083**	**1,937,528**	**1,945,392**	**1,941,525**
Residential Septic (EDUs)	65,524	74,152	55,090	64,464
Non-Residential Septic (EDUs)	25,595	23,702	21,520	22,542
Total Septic Load	91,119	97,854	76,609	87,006
Total NPS Nitrogen Load	**2,906,202**	**2,035,383**	**2,022,001**	**2,028,531**
Total PS Load	64,386	58,304	68,682	63,579
Total Nitrogen Load (NPS+PS)	**2,970,588**	**2,093,687**	**2,090,683**	**2,092,110**

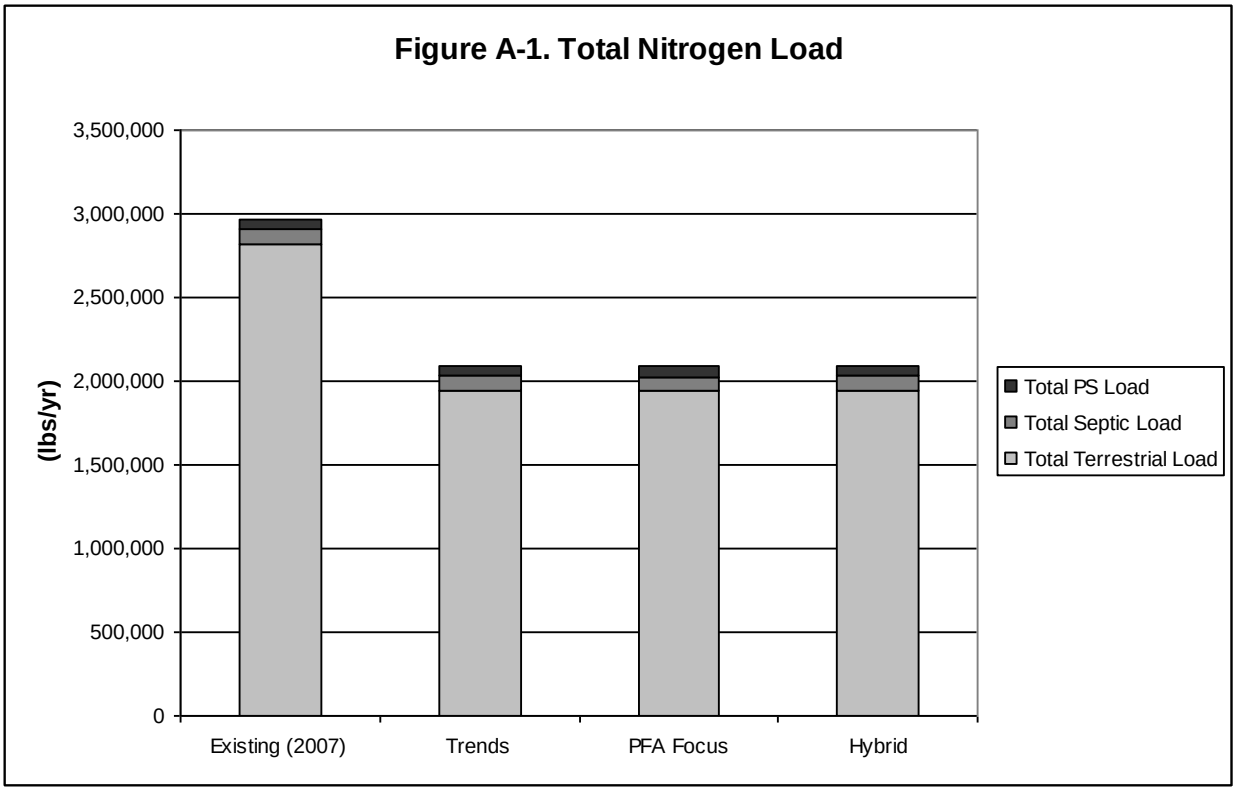


Figure A-1. Total Nitrogen Load
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
(lbs/yr)
Existing (2007)
Trends
PFA Focus
Hybrid
Total PS Load
Total Septic Load
Total Terrestrial Load

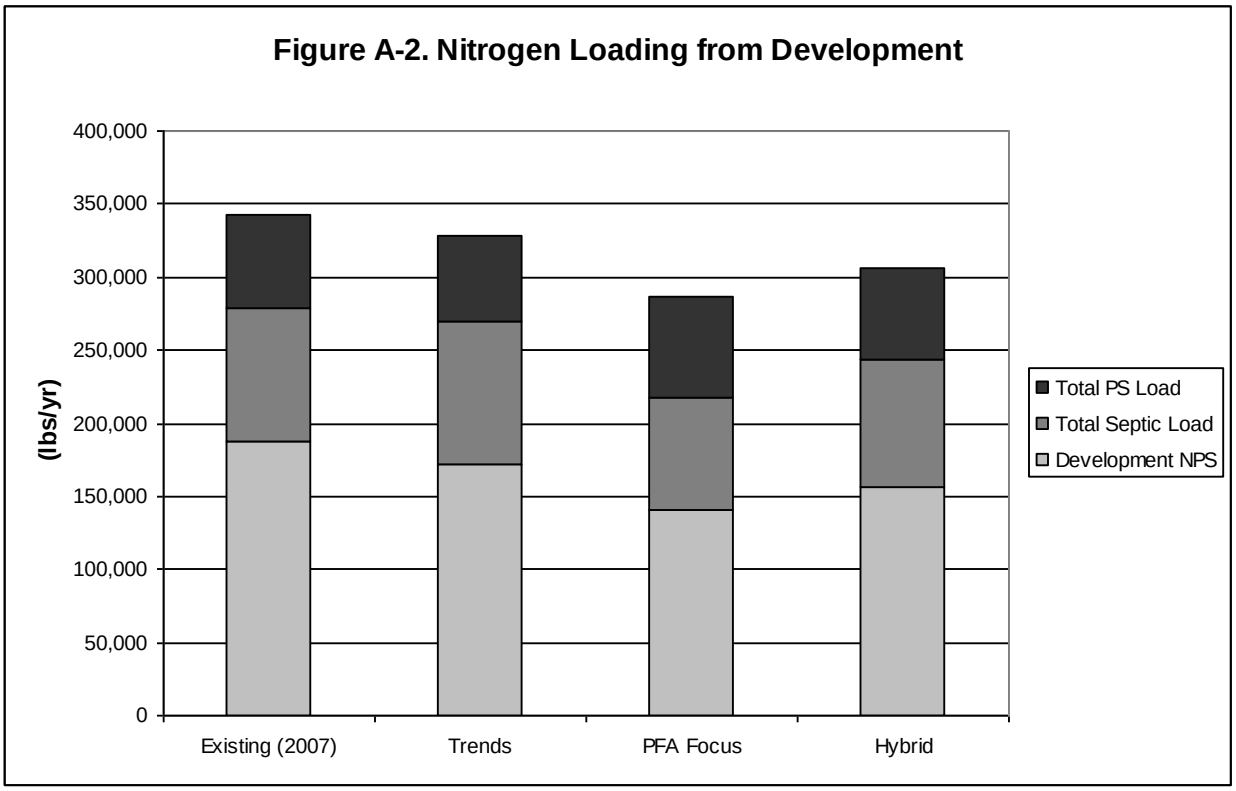
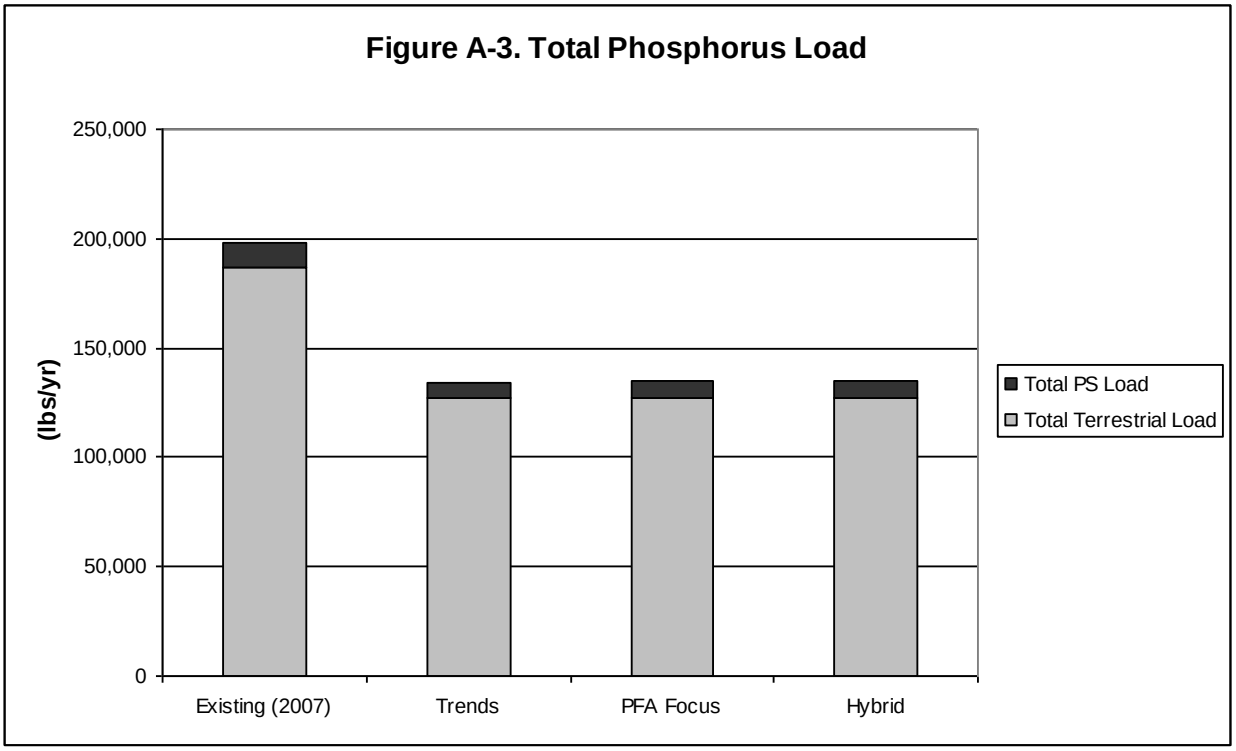


Figure A-2. Nitrogen Loading from Development
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
(lbs/yr)
Existing (2007)
Trends
PFA Focus
Hybrid
Total PS Load
Total Septic Load
Development NPS

Table A-6. Total Phosphorus Loading

	Existing *(Lbs/Yr)*	Trends Scenario *(Lbs/Yr)*	PFA Focus Scenario *(Lbs/Yr)*	Hybrid Scenario *(Lbs/Yr)*
Development NPS	24,180	20,653	16,904	18,746
Agriculture NPS	148,668	94,911	98,431	96,702
Forest NPS	2,966	2,555	2,578	2,567
Water NPS	5,909	5,159	5,159	5,159
Other Terrestrial NPS	2,925	2,040	2,040	2,040
Total Terrestrial Load	**186,761**	**127,164**	**126,958**	**127,059**
Total PS Load	11,129	7,107	8,198	7,662
Total Phosphorus Load (NPS+PS)	**197,889**	**134,271**	**135,157**	**134,720**



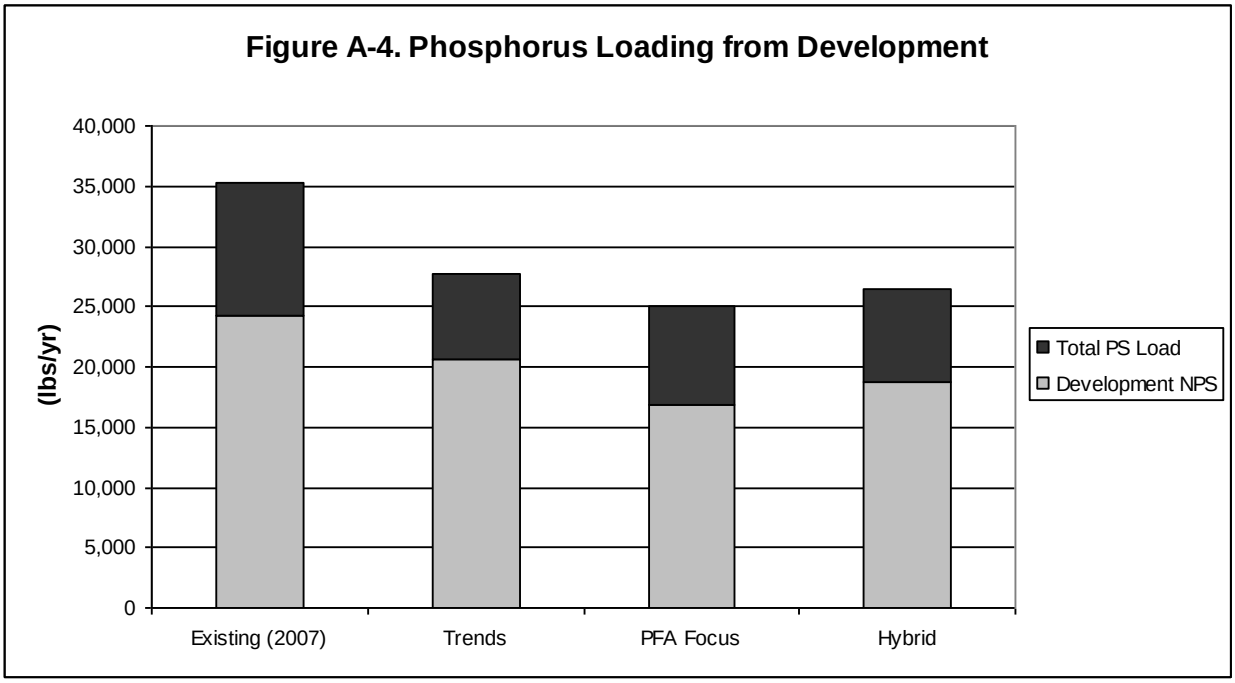


Table A-7. Impervious Cover and Open Space

	Existing (2007)	Trends	PFA Focus	Hybrid
Total Impervious Cover	8,714	13,872	9,273	11,534
Countywide Impervious Percentage	1.4%	2.3%	1.5%	1.9%
County Land in Agriculture	113,903	108,889	112,928	110,943
County Land in Forest	126,581	124,925	126,038	125,492

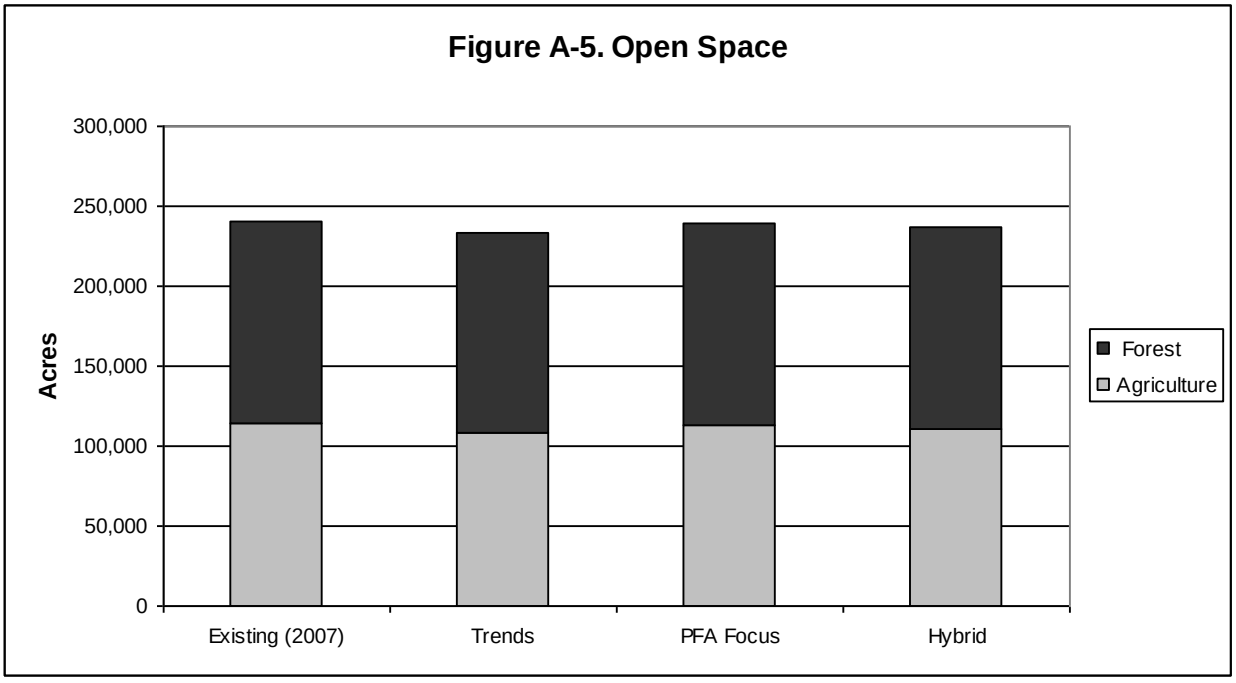


Figure A-5. Open Space
300,000
250,000
200,000
150,000
100,000
50,000
0
Acres
Existing (2007)
Trends
PFA Focus
Hybrid
Forest
Agriculture

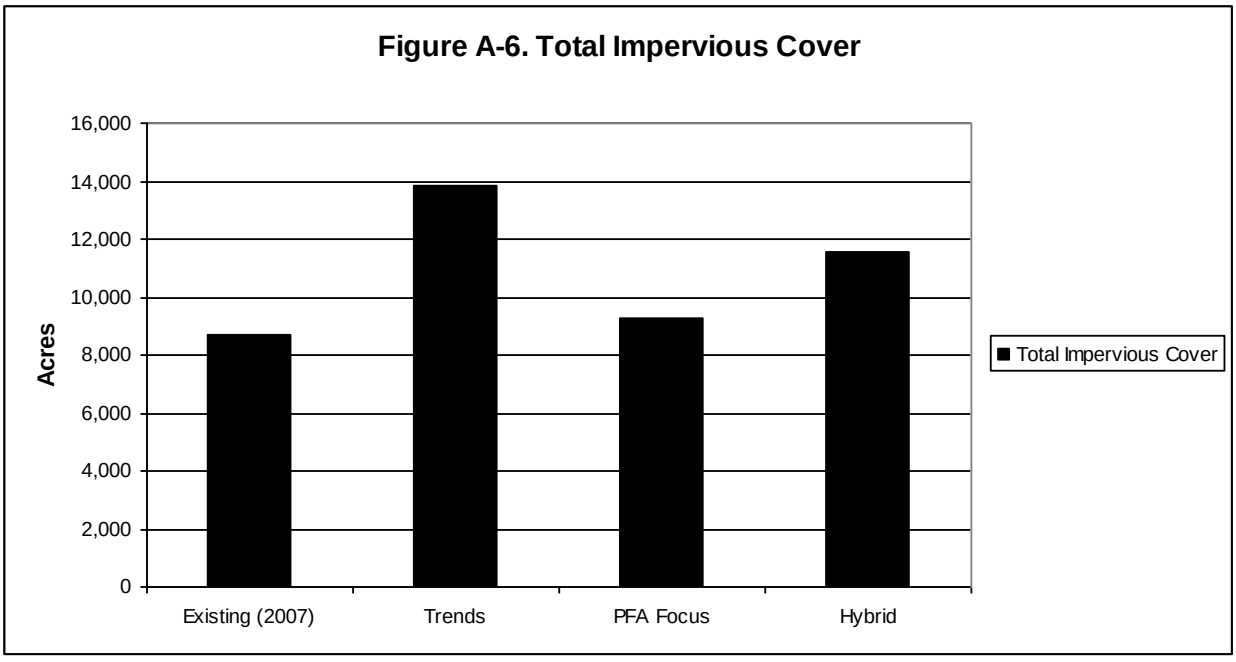


Figure A-6. Total Impervious Cover
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Acres
Existing (2007)
Trends
PFA Focus
Hybrid
Total Impervious Cover

Alternative NPS Model

At MDE's request, the County ran the default state NPS model using the same acreages, housing unit totals, and scenarios as in the model described above. The results of that model are shown in Table A-3. 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, State Default NPS Model

(lbs/acre/year)		Lower Choptank River	Little Choptank River	Lower Chesapeake Bay	Honga River	Fishing Bay	Transquaking River	Nanticoke River	Marshyhope Creek	Total
Existing (2007)	**TN**	810,277	541,459	1,282,391	379,169	694,199	570,647	341,810	372,509	**4,992,461**
	TP	58,114	33,427	71,699	21,014	37,741	37,696	22,914	26,449	**309,054**
Trends Scenario	**TN**	584,902	391,536	1,061,927	308,819	527,768	352,019	231,688	236,458	**3,695,117**
	TP	10,020	27,364	71,679	19,780	32,285	27,483	17,500	19,347	**225,458**
PFA Focus Scenario	**TN**	580,803	387,964	1,061,927	306,787	525,639	350,383	231,135	235,656	**3,680,294**
	TP	46,349	27,447	71,679	19,778	32,276	27,578	17,582	19,615	**262,304**
Hybrid Scenario	**TN**	582,814	389,672	1,061,927	307,786	526,684	351,188	231,411	236,051	**3,687,533**
	TP	46,184	27,407	71,679	19,779	32,280	27,531	17,542	19,483	**261,885**

Alternative Impervious Coverage Calculations

Per a request from MDE, Table A-9 shows the existing and potential impervious coverage, by watershed, in Dorchester County, if all areas of open water and wetlands were excluded from the calculation. This calculation results in uniformly higher impervious coverage rates than the standard analysis. The impervious rates in Table A-9 do not correspond to the indicator thresholds (ten percent and 25 percent impervious surface coverage) described in Section 6 of the WRE.

Table A-9. Impervious Coverage (Excluding Wetlands)

Watershed	Total Acreage[1]	Impervious Surface							
		Existing		Trends		PFA Focus		Hybrid	
		Acres	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*
Lower Choptank River	36,715	2,892	7.9%	4,330	11.8%	3,277	8.9%	3,794	10.3%
Little Choptank River	41,498	1,696	4.1%	2,719	6.6%	1,705	4.1%	2,204	5.3%
Lower Chesapeake	3	1	33.3%	1	33.3%	1	33.3%	1	33.3%
Honga River	11,417	676	5.9%	949	8.3%	676	5.9%	811	7.1%
Fishing Bay	57,081	1,094	1.9%	1,627	2.9%	1,220	2.1%	1,419	2.5%
Transquaking River	57,030	733	1.3%	1,289	2.3%	733	1.3%	1,006	1.8%
Nanticoke River	26,057	481	1.8%	886	3.4%	493	1.9%	686	2.6%
Marshyhope Creek	35,243	1,140	3.2%	2,071	5.9%	1,167	3.3%	1,612	4.6%
Dorchester County	**265,044**	**8,713**	**3.3%**	**13,872**	**5.2%**	**9,273**	**3.5%**	**11,534**	**4.4%**

Notes:

1: Excludes open water within County boundaries.