Appendix B: Isle of Wight Bay

1.0 Introduction

As described in the main TMDL report, the Coastal Bays are a shallow coastal lagoon system comprised of several individual and distinct waterbodies. The MD 8-Digit Isle of Wight Bay is in the northern portion of the Maryland Coastal Bays. The bay is located on the Atlantic Coast of the Delmarva (Delaware-Maryland-Virginia) Peninsula, and its watershed includes portions of Worcester County, MD and Sussex County, DE. Areas of interest in the Isle of Wight Bay watershed are Ocean Pines, Ocean City, and Selbyville (DE). The MD 8-Digit Isle of Wight Bay connects to the Atlantic Ocean through the Ocean City Inlet. Figure B1 shows the location of Isle of Wight Bay and its watershed.

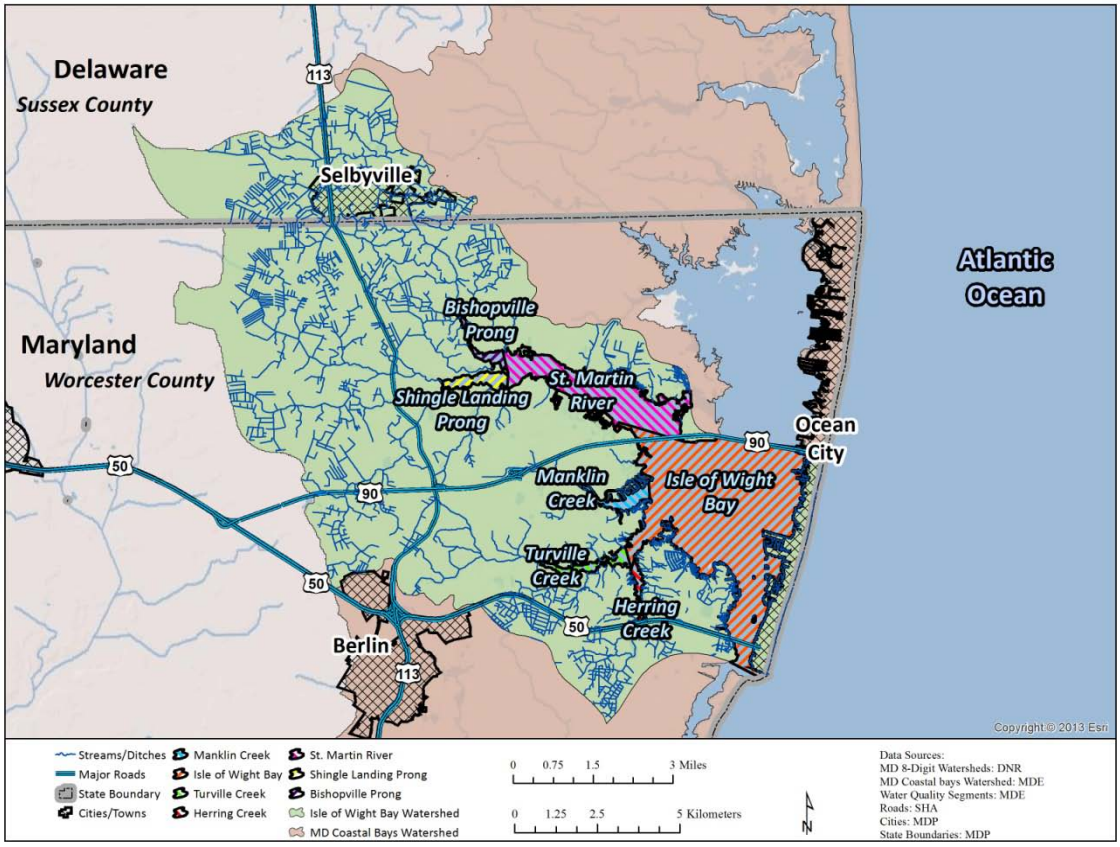

Figure B1: Location map of the Isle of Wight Bay watershed.

Major tributaries draining to MD 8-Digit Isle of Wight Bay include the Bishopville Prong, Shingle Landing Prong, St. Martin's River, Herring Creek, Turville Creek, and Manklin Creek. TMDLs have been developed for the MD 8-Digit Isle of Wight Bay and the tributaries listed above. Specific WLAs and LAs are provided for the portions of the watersheds within Maryland; however, aggregate Upstream LAs are also specified for the portions of the watersheds within Delaware. In the sections below, more detailed information regarding watershed characteristics, water quality, baseline nutrient loadings, and the specific TMDLs developed for the MD 8-Digit Isle of Wight Bay and its tributaries are provided.

2.0 Land Use

Isle of Wight Bay

The Isle of Wight Bay watershed has a drainage area of 41,071 acres and includes the St. Martin's River, Shingle Landing Prong, Bishopville Prong, Herring Creek, Turville Creek, and Manklin Creek. Although the average depth is 4 ft (1.2 m), the inlet at Ocean City has a maximum depth of 30.5 ft (9.3 m). The land uses in the watershed consist of forest and other herbaceous (12,482 acres, or 30% of the total watershed area); mixed agriculture (10,321 acres, 25%); urban (8,339 acres, 20%); water/wetlands, (2,654 acres, 6%); barren (800 acres, 2%); and upstream drainage (6,475 acres, 16%). Figure B2 shows the relative amounts of the different land uses in the Isle of Wight Bay watershed.

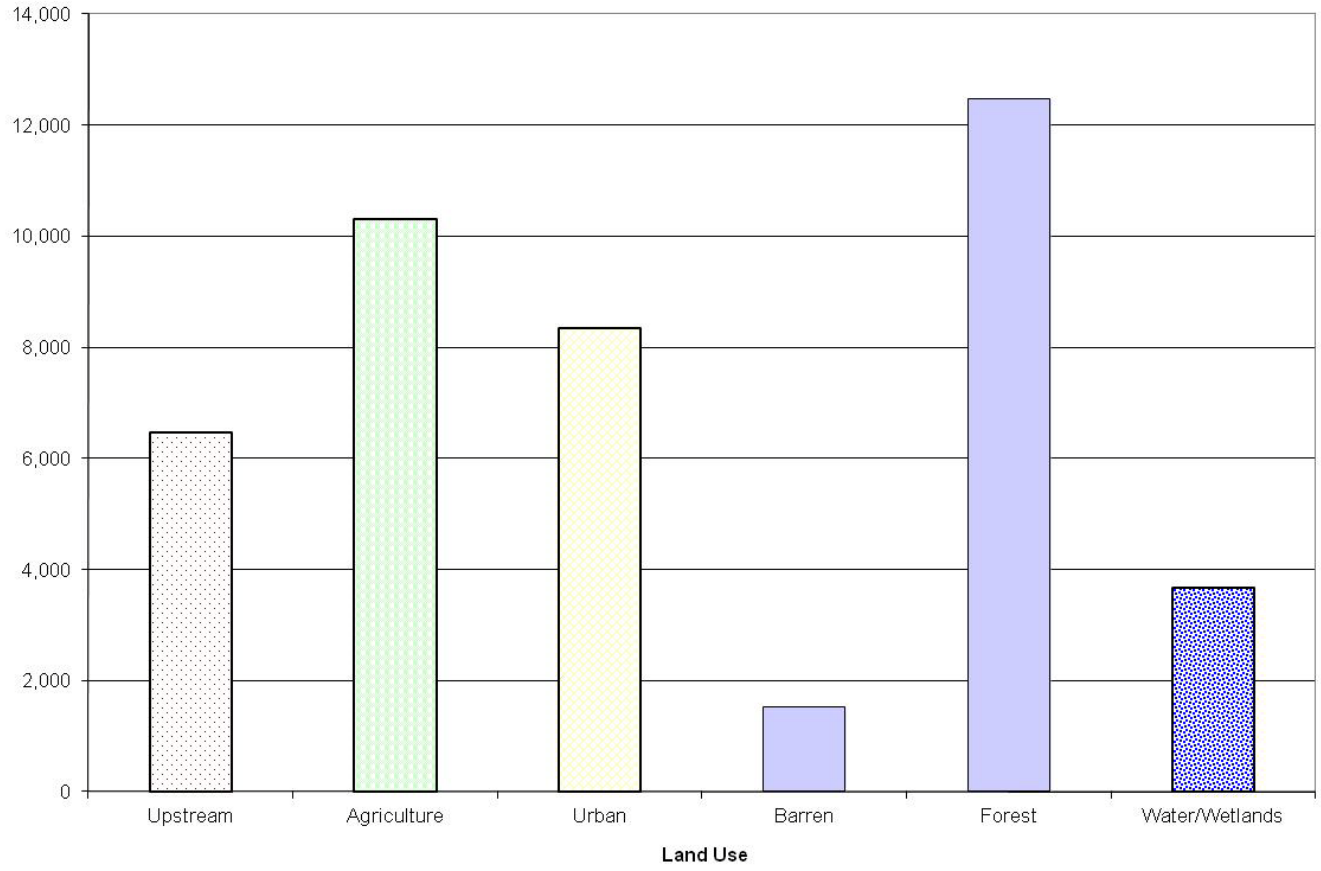

Figure B2: Proportions of land use draining the Isle of Wight Bay watershed.

St. Martin River

The St. Martin River is the largest tributary to the mainstem (*i.e.*, open water) MD 8-Digit Isle of Wight Bay. The river is approximately 3.7 miles in length, and it drains a watershed area of 28,108 acres, including Bishopville Prong and Shingle Landing Prong. Portions of the watershed area draining to St. Martin River, however, are located within Delaware. The St. Martin River watershed land use distribution consists of mixed agriculture (8,911 acres, or 32% of the total watershed area); urban (3,720 acres, 13%); water/wetlands (1,087 acres, 4%); forest and other herbaceous cover (7,601 acres, 27%); barren (314 acres, 1%); and upstream drainage (6,475 acres, 23%). Figure B3 shows the relative amounts of the different land uses in the St. Martin River watershed.

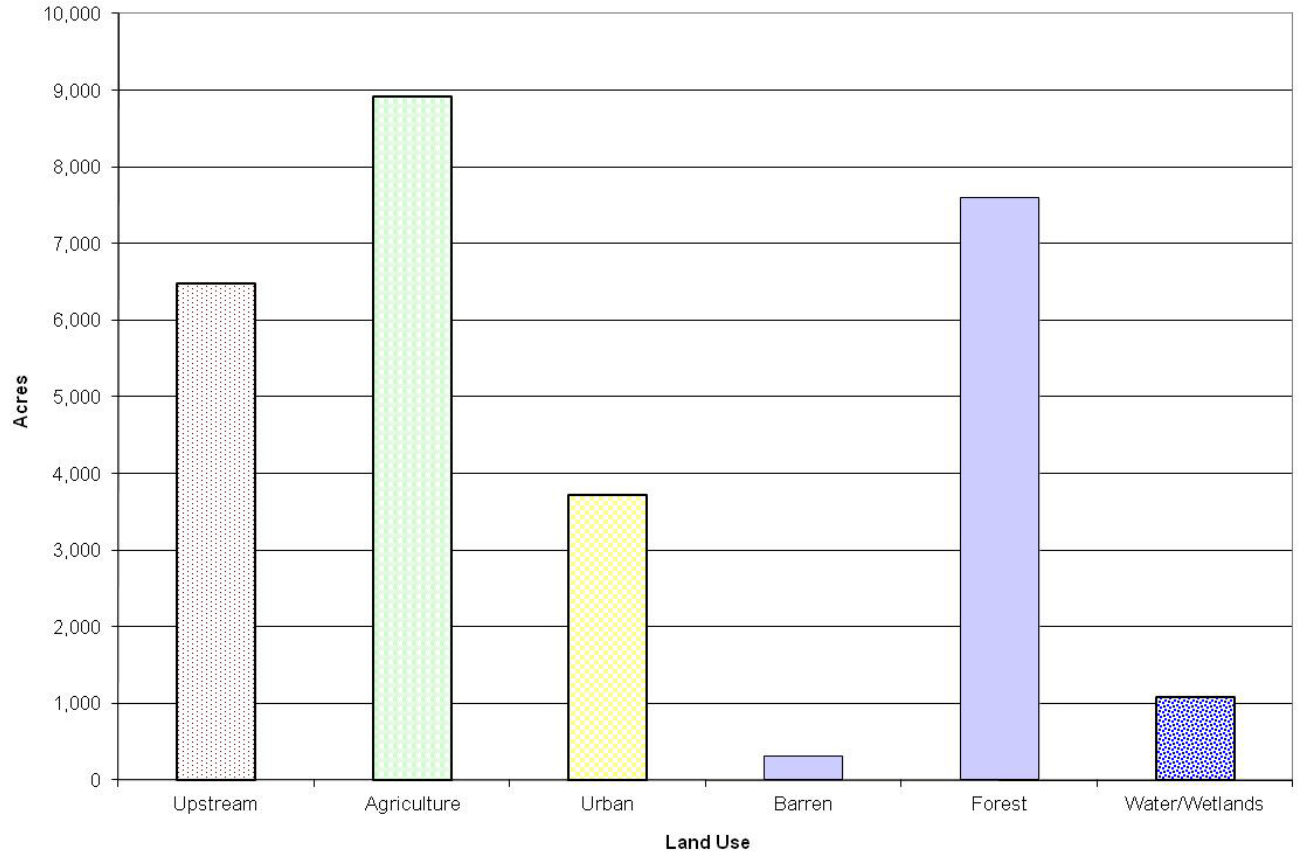

Figure B3: Proportions of land use draining the St. Martin River watershed.

Bishopville Prong

Bishopville Prong, a tidal tributary to the St. Martin River, drains a watershed area of approximately 12,529 acres. Portions of the watershed area draining to Bishopville Prong are located within Delaware. The Bishopville Prong land use distribution consists of mixed agriculture (2,815 acres, or 22% of the total watershed area); forest and other herbaceous cover (2,060 acres, 16%); water/wetlands (158 acres, 1%); urban (878 acres, 7%); upstream drainage (6,475 acres 52%); and barren (142 acres, 1%). Figure B4 shows the relative amounts of the different land uses in the Bishopville Prong watershed.

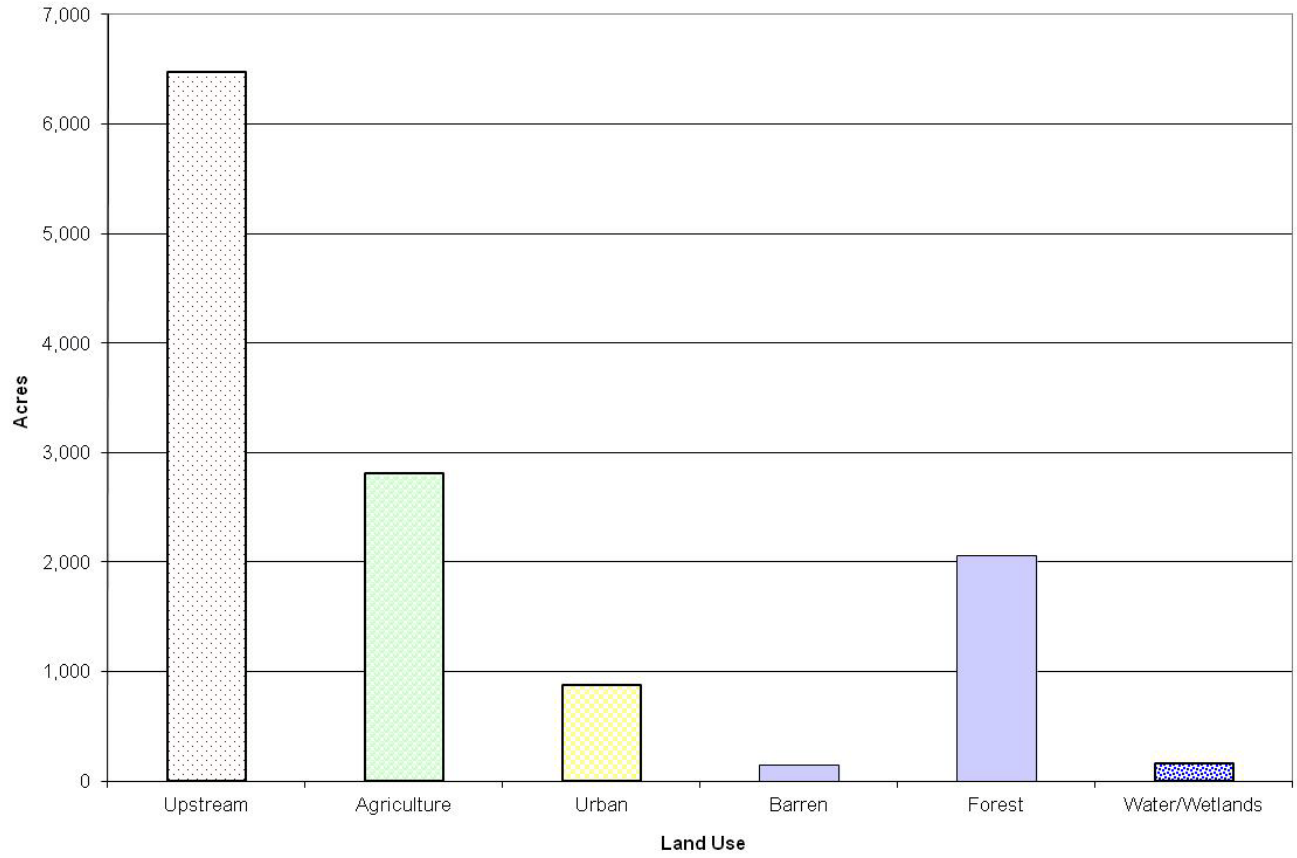

Figure B4: Proportions of land use draining the Bishopville Prong watershed.

Shingle Landing Prong

Shingle Landing Prong, a tidal tributary to the St. Martin River, drains a watershed area of approximately 12,185 acres, and its watershed is located entirely in Maryland. The Shingle Landing Prong watershed land use distribution consists of mixed agriculture (5,299 acres, or 43% of the total watershed area); urban (1,785 acres, 15%); forest and other herbaceous cover (4,649 acres, 38%); water/wetlands (299 acres, 2%); and barren (154 acres, 1%). Figure B5 shows the relative amounts of the different land uses in the Shingle Landing Prong watershed.

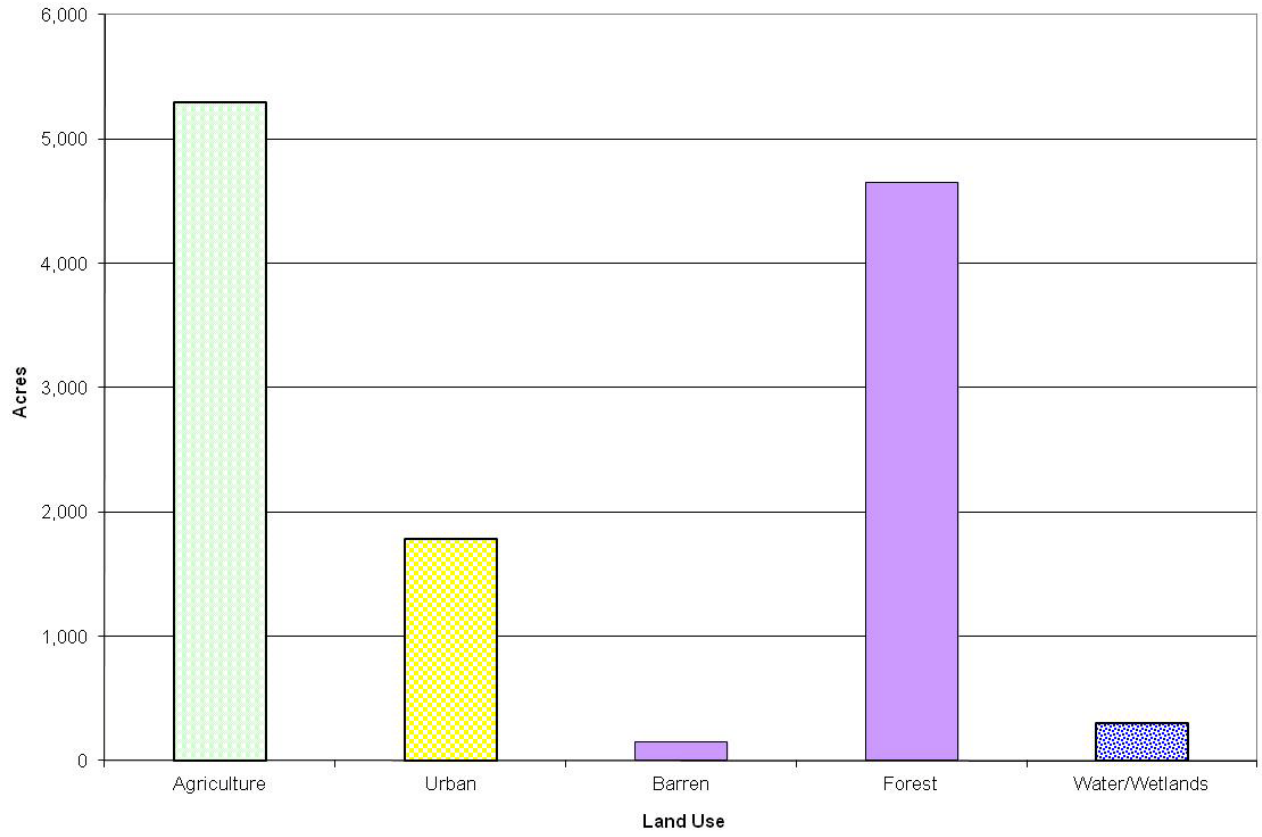

Figure B5: Proportions of land use draining the Shingle Landing Prong watershed.

Manklin Creek

Manklin Creek, a tidal tributary to the mainstem (*i.e.*, open water) MD 8-Digit Isle of Wight Bay, drains a watershed area of approximately 2,543 acres, and its watershed is located entirely in Maryland. The Manklin Creek watershed land use distribution consists of urban (1,158 acres, or 46% of the total watershed area); forest and other herbaceous cover (1,008 acres, 40%); water/wetlands (216 acres, 8%); mixed agriculture (149 acres, 6%); and barren (12 acres, <1%). Figure B6 shows the relative amounts of the different land uses in the Manklin Creek watershed.

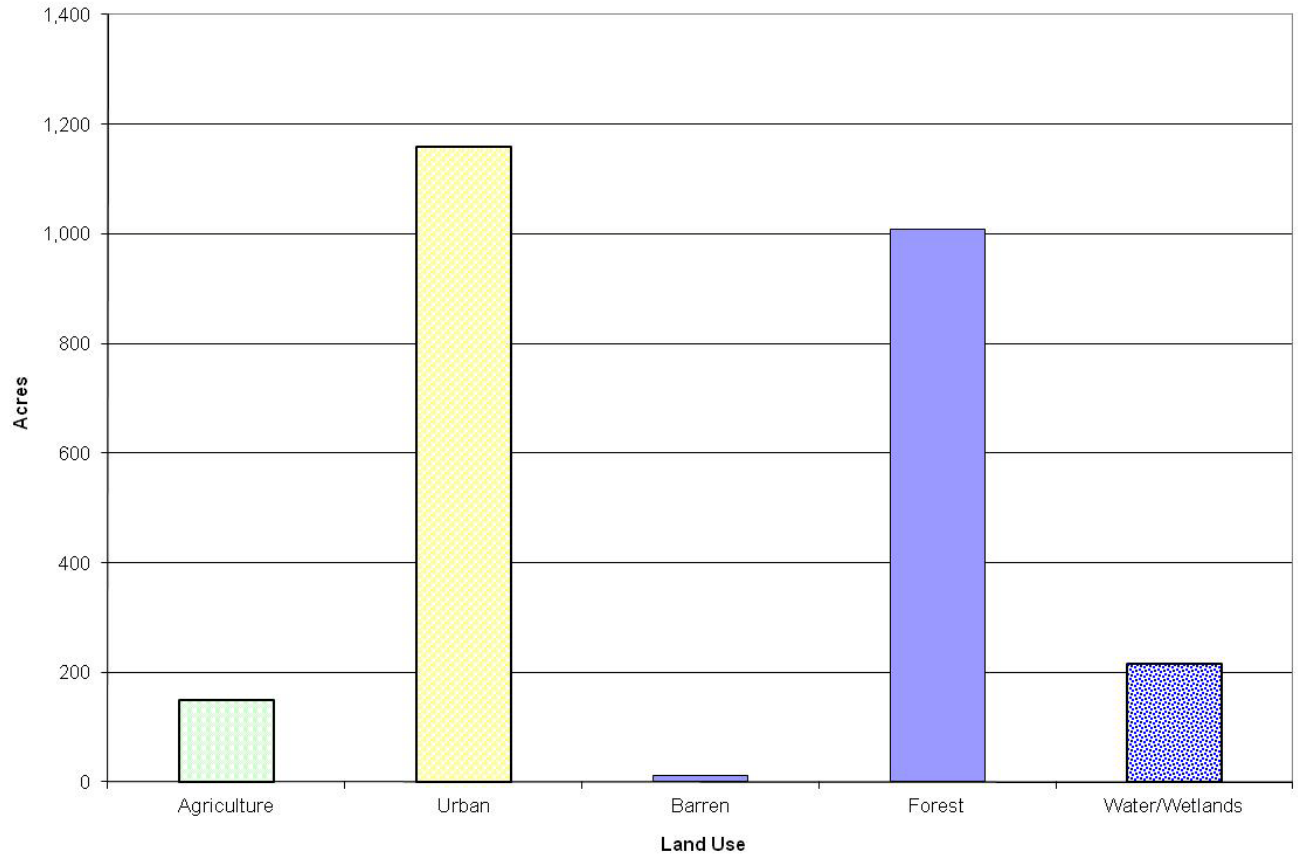

Figure B6: Proportions of land use draining the Manklin Creek watershed.

Turville Creek

Turville Creek, a tidal tributary to the mainstem (*i.e.*, open water) MD 8-Digit Isle of Wight Bay, drains a watershed area of approximately 4,373 acres, and its watershed is located entirely in Maryland. The Turville Creek watershed land use distribution consists of forest and other herbaceous cover (1,858 acres, or 42% of the total watershed area); urban (1,109 acres, 25%); mixed agriculture (854 acres, 20%); water/wetlands (299 acres, 7%); and barren (253 acres, 6%). Figure B7 shows the relative amounts of the different land uses in the Turville Creek watershed.

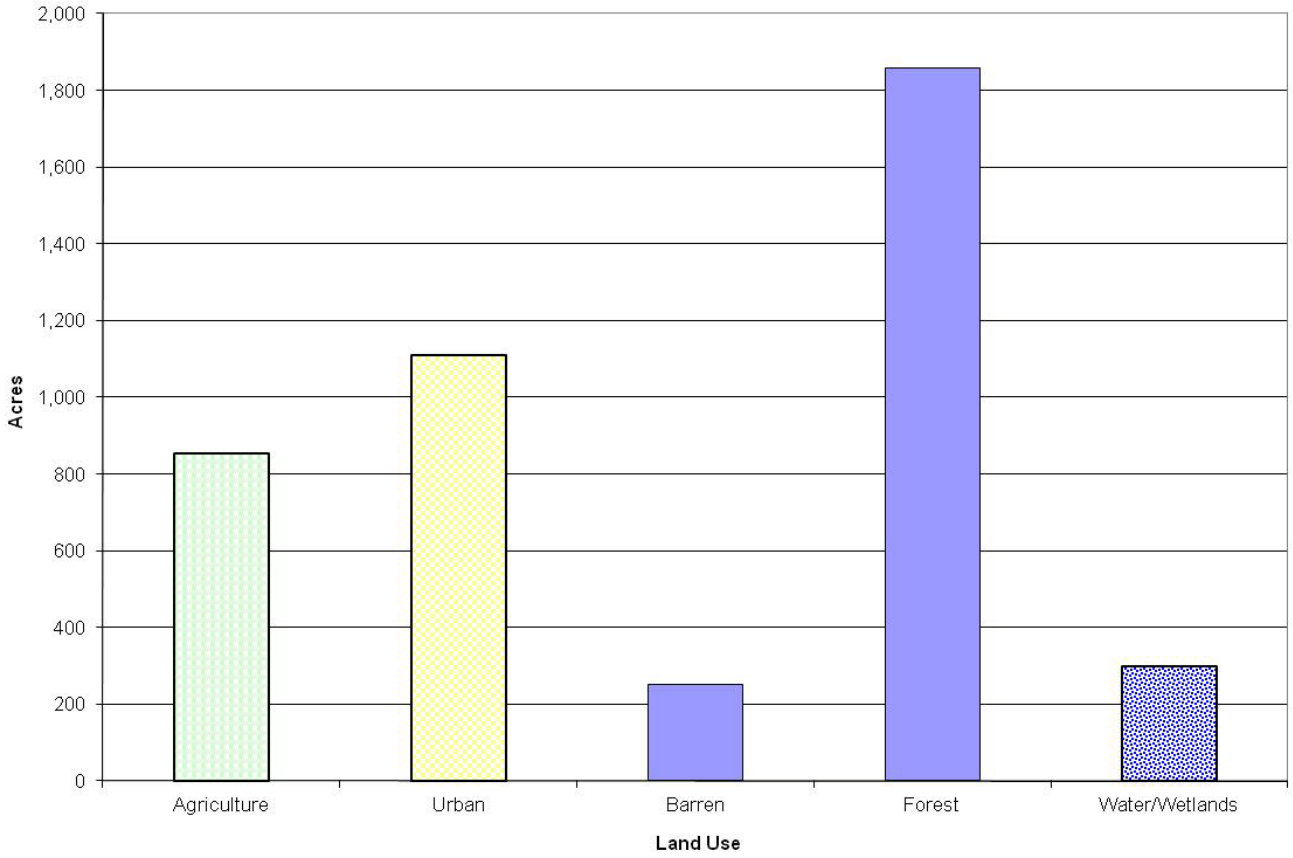

Figure B7: Proportions of land use draining the Turville Creek watershed.

Herring Creek

Herring Creek, a tidal tributary to the mainstem (*i.e.*, open water) MD 8-Digit Isle of Wight Bay, drains a watershed area of approximately 3,433 acres, and its watershed is located entirely in Maryland. The Herring Creek watershed land use distribution consists of mixed agriculture (407 acres, or 12% of the total watershed area); forest and other herbaceous cover (1,737 acres, 51%); urban (762 acres, 22%); water/wetlands (397 acres, 12%); and barren (130 acres, 4%). Figure B8 shows the relative amounts of the different land uses in the Herring Creek watershed.

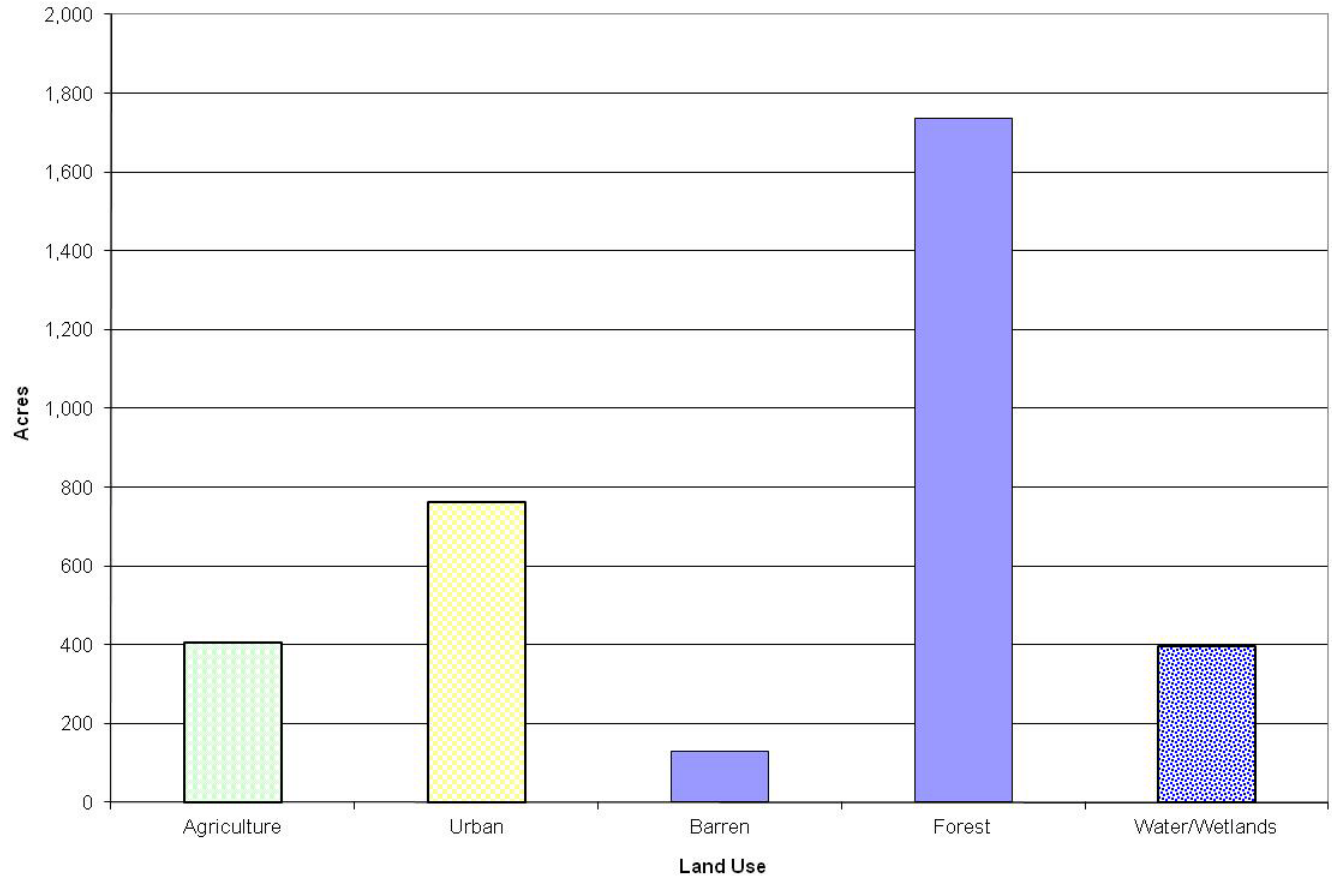

Figure B8: Proportions of land use draining the Herring Creek watershed.

3.0 Watershed Model Information

The applicable Isle of Wight Bay and tributary watershed model segments and water quality monitoring stations are presented in Tables B1 and B2 below.

Table B1: Watershed model segments associated with Isle of Wight Bay and subwatersheds

Watershed Name	Watershed Model Segments
Isle of Wight Bay	36,37,54,55,56,57,158,165,166,167, 168,510 and all segments listed below
St. Martin River	21,22,23,24,25,26,27,28,29,30,31,35, 151,152,153,154,155,156,157 and all segments in Bishopville Prong and Shingle Landing Prong.
Bishopville Prong	1,4,5,34,186
Shingle Landing Prong	2,3,32,33,144,187
Herring Creek	43,48,49,50,51,52,53,163,164
Turville Creek	41,42,44,45,46,47,161,162,520
Manklin Creek	38,39,40,159,160

Table B2: Isle of Wight Bay water quality monitoring stations

Waterbody	Stations
Isle of Wight Bay[1]	All stations listed below and XDN2438, XDN2340, XDN0146
St. Martin River	All stations in Bishopville Prong and Shingle Landing Prong and XDN3724, XDN4312, XDN4797
Bishopville Prong	BSH0008, XDM4486
Shingle Landing Prong	SPR0009, SPR0002
Manklin Creek	MKL0010
Turville Creek	TUV0019 and TUV0011 (confluence of Turville and Herring Creeks)
Herring Creek	TUV0011

[1] All stations located in MD 8-Digit portion of Isle of Wight Bay

4.0 Point Sources: National Pollutant Discharge Elimination System (NPDES) Loads

Table B3 below provides information on process water point source facilities with permits regulating the discharge of nutrients within the Isle of Wight watershed. As described in the main TMDL report, there are no NPDES regulated stormwater facilities in the entire Maryland Coastal Bays watershed.

Table B3: Average daily flows and estimated TN and TP loads for process water point sources discharging to the MD 8-Digit Isle of Wight Bay, 2001 – 2004.

Watershed Model Segment	State	Facility	Type	Average Flow (MGD)	Estimated Delivered TN Load (lbs/yr)	Estimated Delivered TP Load (lbs/yr)
36	Maryland	Ocean Pines WWTP	Municipal	0.9	10,093	867
187	Maryland	Perdue Farms, Inc.: Showell Facility	Industrial	0.63	5,279	193
45	Maryland	Riddle Farm WWTP – outfall 001	Spray Irrigation	0.0576	0	0
45	Maryland	Riddle Farm WWTP – outfall 002	Spray Irrigation	0.198	0	0
32	Maryland	River Run WWTP	Spray Irrigation	0.11	2,614	0
186	Maryland	Perdue Farms – Bishopville Hatchery	Spray Irrigation	0.004	549	0
N/A	Delaware	Upstream - Delaware	N/A	N/A	2,359	484

*The Ocean City WWTP is located within the watershed but discharges to the Atlantic Ocean, outside of the boundary of the Coastal Bays system. The water quality modeling domain extends into the Atlantic Ocean along Fenwick Island. The facility was incorporated into the analysis for completeness with an average flow of 5MGD, estimated delivered TN load of 298,240 lbs/year and estimated delivered TP load of 41,754 lbs/year.

5.0 Nonpoint Source Loads

Urban Stormwater, Agricultural, Atmospheric Deposition and Shoreline Erosion Loads

Nonpoint source loads and urban stormwater loads were estimated using the HSPF watershed model. Urban stormwater regulated by an NPDES stormwater permit, such as a Municipal Separate Storm Sewer System (MS4) permit, industrial stormwater permit, etc., is considered a point source by USEPA. However, since there are no NPDES stormwater permits within the watershed, urban stormwater loads are presented here as nonpoint sources. Atmospheric deposition loads were estimated using data from the National Atmospheric Deposition Program, which collects data at Assateague Island National Seashore. Shoreline erosion loads were estimated based on the work of Wells, Hennessee, and Hill (2002 and 2003), and Wells *et al*. (2008). Methods are described in the main report, with full details available in Wang *et al.* (2013) and VIMS (2013).

On-Site Wastewater Disposal (Septic Systems) Loads

Septic system loading estimates were calculated using 2000 U.S. Census data, the USEPA-CBP sewer service area GIS coverage, the USEPA-CBP land river segment GIS coverage, the 1997 DNREC septic system GIS coverage, the MDE-WMA septic system GIS coverage, and the Maryland Coastal Bays TMDL HSPF watershed model GIS segmentation created by MDE. The assumptions used in the analysis are presented in Table B4. These loads were calculated based on a methodology used by the USEPA-CBP. Table B5 presents the calculated septic system loads for all segments.

Table B4. Assumptions used in the septic load analysis.

Assumption	Within 1,000ft of surface water	Greater than 1,000ft from surface water
Average # persons/septic	3.2	
Nitrogen loading per Person (lbs/year)	9.5	
Nitrogen loading per septic (lbs/year)	30.4	
Nitrogen attenuation rate	0.2	0.7
Surface water delivered nitrogen load per septic with attenuation (lbs/year)	24.32	9.12

Table B5: Delivered septic loads and values used in the Coastal Bays Model for Isle of Wight Bay and its tributaries.

SEGMENT	*MD # Septics (within 1,000 ft)*	*MD # Septics (outside 1,000 ft)*	*Upstream # Septics (within 1,000 ft)*	*Upstream # Septics (outside 1,000 ft)*	*Total # Septics (within 1,000 ft)*	*Total # Septics (outside 1,000 ft)*	*Total Surface Water Delivered Nitrogen Load with Loss (Within 1,000 ft) (lbs/year)*	*Total Surface Water Delivered Nitrogen Load with Loss (Outside 1,000 ft) (lbs/year)*	*Total Surface Water Delivered Nitrogen Load with Loss (Within 1,000 ft) (lbs/day)*	*Total Surface Water Delivered Nitrogen Load with Loss (Outside 1,000 ft) (lbs/day)*	*Total Surface Water Delivered Nitrogen Load with Loss (lbs/day)*
1	95	6	0	0	95	6	2,310	55	6.33	0.15	6.48
2	76	13	0	0	76	13	1,848	119	5.06	0.32	5.39
3	1	1	0	0	1	1	24	9	0.07	0.02	0.09
4	3	2	0	0	3	2	73	18	0.20	0.05	0.25
5	36	0	0	0	36	0	876	0	2.40	0.00	2.40
21	0	2	0	0	0	2	0	18	0.00	0.05	0.05
22	2	0	0	0	2	0	49	0	0.13	0.00	0.13
23	3	11	0	0	3	11	73	100	0.20	0.27	0.47
24	18	7	0	0	18	7	438	64	1.20	0.17	1.37
27	3	0	0	0	3	0	73	0	0.20	0.00	0.20
28	0	10	0	0	0	10	0	91	0.00	0.25	0.25
29	0	7	0	0	0	7	0	64	0.00	0.17	0.17
30	36	19	0	0	36	19	876	173	2.40	0.47	2.87
31	69	11	0	0	69	11	1,678	100	4.60	0.27	4.87
32	11	1	0	0	11	1	268	9	0.73	0.02	0.76
33	11	26	0	0	11	26	268	237	0.73	0.65	1.38
34	6	0	0	0	6	0	146	0	0.40	0.00	0.40
37	1	0	0	0	1	0	24	0	0.07	0.00	0.07
38	8	116	0	0	8	116	195	1,058	0.53	2.90	3.43
39	3	0	0	0	3	0	73	0	0.20	0.00	0.20
42	1	0	0	0	1	0	24	0	0.07	0.00	0.07
44	237	92	0	0	237	92	5,764	839	15.79	2.30	18.09
45	25	1	0	0	25	1	608	9	1.67	0.02	1.69

SEGMENT	*MD # Septics (within 1,000 ft)*	*MD # Septics (outside 1,000 ft)*	*Upstream # Septics (within 1,000 ft)*	*Upstream # Septics (outside 1,000 ft)*	*Total # Septics (within 1,000 ft)*	*Total # Septics (outside 1,000 ft)*	*Total Surface Water Delivered Nitrogen Load with Loss (Within 1,000 ft) (lbs/year)*	*Total Surface Water Delivered Nitrogen Load with Loss (Outside 1,000 ft) (lbs/year)*	*Total Surface Water Delivered Nitrogen Load with Loss (Within 1,000 ft) (lbs/day)*	*Total Surface Water Delivered Nitrogen Load with Loss (Outside 1,000 ft) (lbs/day)*	*Total Surface Water Delivered Nitrogen Load with Loss (lbs/day)*
46	36	0	0	0	36	0	876	0	2.40	0.00	2.40
49	17	0	0	0	17	0	413	0	1.13	0.00	1.13
50	0	1	0	0	0	1	0	9	0.00	0.02	0.02
51	75	11	0	0	75	11	1,824	100	5.00	0.27	5.27
57	0	1	0	0	0	1	0	9	0.00	0.02	0.02
144	120	29	0	0	120	29	2,918	264	8.00	0.72	8.72
154	1	0	0	0	1	0	24	0	0.07	0.00	0.07
155	3	1	0	0	3	1	73	9	0.20	0.02	0.22
156	42	0	0	0	42	0	1,021	0	2.80	0.00	2.80
157	5	0	0	0	5	0	122	0	0.33	0.00	0.33
160	1	0	0	0	1	0	24	0	0.07	0.00	0.07
161	47	0	0	0	47	0	1,143	0	3.13	0.00	3.13
163	11	0	0	0	11	0	268	0	0.73	0.00	0.73
167	1	0	0	0	1	0	24	0	0.07	0.00	0.07
186	239	48	0	292	239	340	5,812	3101	15.92	8.50	24.42
187	107	42	0	0	107	42	2,602	383	7.13	1.05	8.18
Totals	1,350	458	0	292	1,350	750	32,832	6,840	89.95	18.74	108.69

6.0 Baseline Load Summary

Isle of Wight Bay

The baseline average annual total nitrogen load to the MD 8-Digit Isle of Wight Bay watershed is 425,192 lbs/yr. Upstream loads account for 16% of the total baseline nitrogen load. In Maryland's portion of the watershed, direct atmospheric deposition to the water's surface accounts for approximately 12% and shoreline erosion comprises 4% of the baseline nitrogen load. Mixed agriculture (32%), urban (22%), point source (3%), septics (9%) and forest/barren (2%) within Maryland's portion of the watershed account for the remaining nitrogen baseline load. The estimated average annual total phosphorus load is 29,523 lbs/yr. Upstream loads account for 16% of the total baseline phosphorus load. In Maryland's portion of the watershed, direct atmospheric deposition to the water's surface accounts for approximately 12% and shoreline erosion comprises 7% of the baseline phosphorus load. Mixed agriculture (29%), urban (29%), point source (5%) and forest/barren (2%) within Maryland's portion of the watershed account for the remaining phosphorus baseline load. There are seven NPDES-regulated point source facilities with permits regulating the discharge of nutrients in the Maryland portion of the watershed; however, the nonpoint source load comprises the majority of the total load to the waterbody. Figure B9 shows the relative contributions of nitrogen and phosphorus from the various sources. Details can be found in Wang *et al*. (2013) and VIMS (2013).

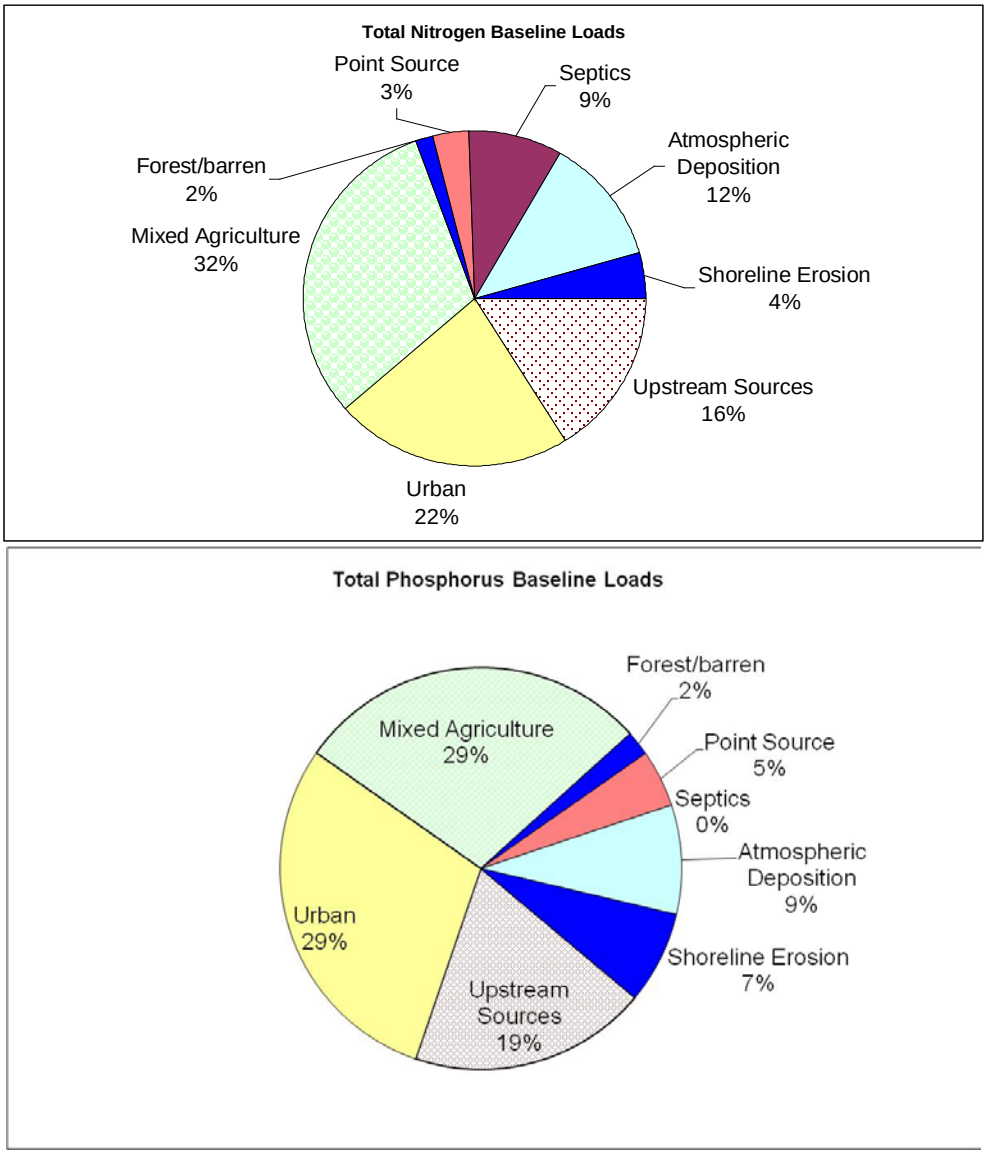

Figure B9: Nitrogen and phosphorus contributions from various sources to the MD 8-Digit Isle of Wight Bay.

St. Martin River

The baseline average annual total nitrogen load to the St. Martin River is 276,990 lbs/yr. Upstream loads account for 25% of the total baseline nitrogen load. In Maryland's portion of the watershed, direct atmospheric deposition to the water's surface accounts for approximately 5% and shoreline erosion comprises 2% of the baseline nitrogen load. Mixed agriculture (40%), urban (16%), point source (1%), septics (9%) and forest/barren (2%) within Maryland's portion of the watershed account for the remaining nitrogen baseline load. The estimated average annual total phosphorus load is 18,903 lbs/yr. Upstream loads account for 30% of the total baseline phosphorus load. In Maryland's portion of the watershed, direct atmospheric deposition to the water's surface accounts for approximately 4% and shoreline erosion comprises 4% of the baseline phosphorus load. Mixed agriculture (38%), urban (21%), point source (1%) and forest/barren (2%) within Maryland's portion of the watershed account for the remaining phosphorus baseline load. There are no process water point sources facilities with permits regulating the discharge of nutrients directly to St. Martin River, other than those identified in watersheds upstream (see next sections). Figure B10 shows the relative contributions of nitrogen and phosphorus from the various sources to the St. Martin River. Details can be found in Wang *et al*. (2013) and VIMS (2013).

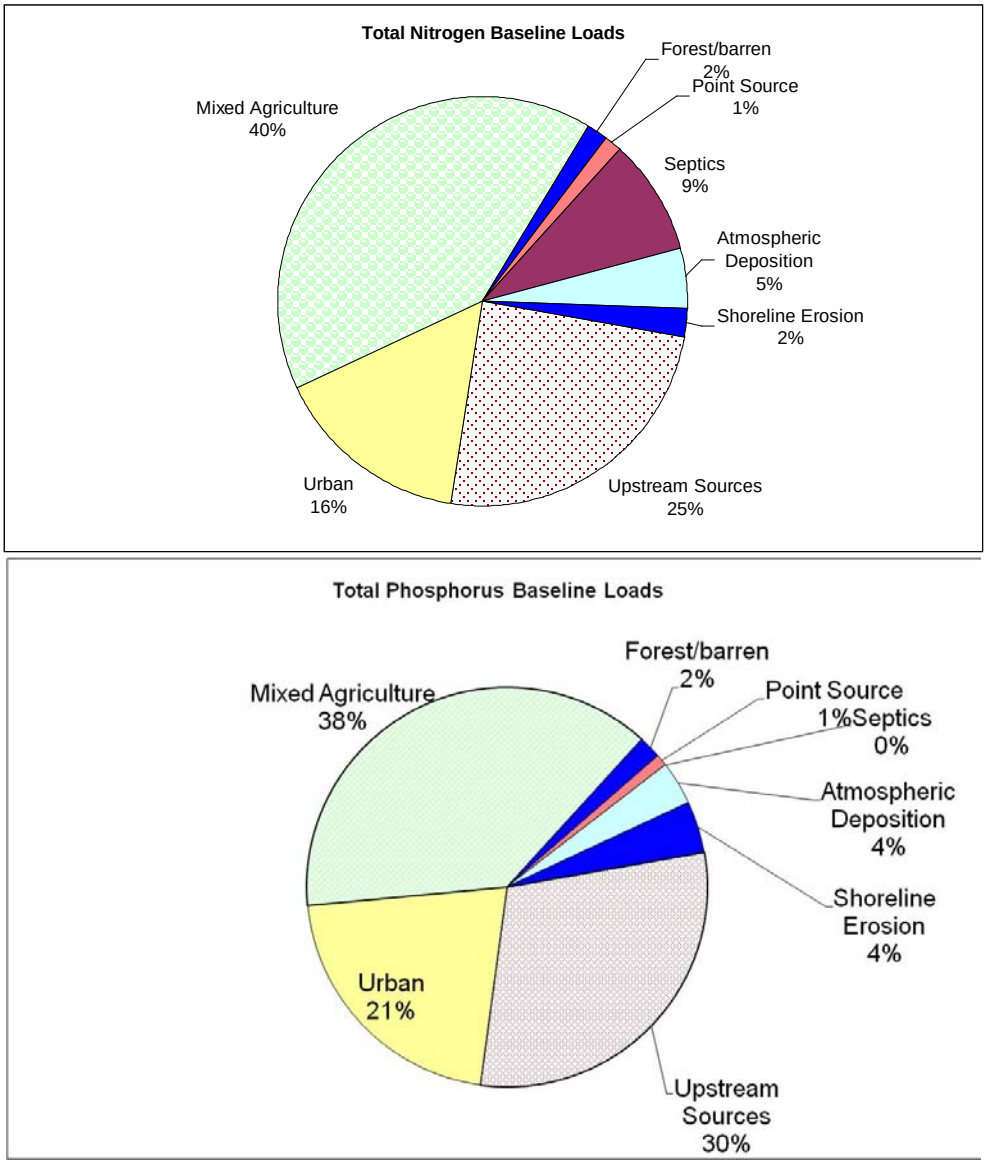

Figure B10: Nitrogen and phosphorus contributions from various sources to the St. Martin River.

Bishopville Prong

The baseline average annual total nitrogen load to Bishopville Prong is 128,760 lbs/yr. Upstream loads account for 53% of the total baseline nitrogen load. In Maryland's portion of the watershed, direct atmospheric deposition to the water's surface accounts for approximately 1% and shoreline erosion comprises 1% of the baseline nitrogen load. Mixed agriculture (27%), urban (8%), septics (9%) and forest/barren (1%) within Maryland's portion of the watershed account for the remaining nitrogen baseline load. The estimated average annual total phosphorus load is 9,095 lbs/yr. Upstream loads account for 62% of the total baseline phosphorus load. In Maryland's portion of the watershed, direct atmospheric deposition to the water's surface accounts for approximately 1% and shoreline erosion comprises 2% of the baseline phosphorus load. Mixed agriculture (24%), urban (10%) and forest/barren (1%) within Maryland's portion of the watershed account for the remaining phosphorus baseline load. There is one process water point source facility with a permit regulating the discharge of nutrients in the Maryland portion of the Bishopville Prong watershed; however, the nonpoint source load comprises the majority of the total load to the waterbody. Figure B11 shows the relative contributions of nitrogen and phosphorus from the various sources to Bishopville Prong. Details can be found in Wang *et al*. (2013) and VIMS (2013).

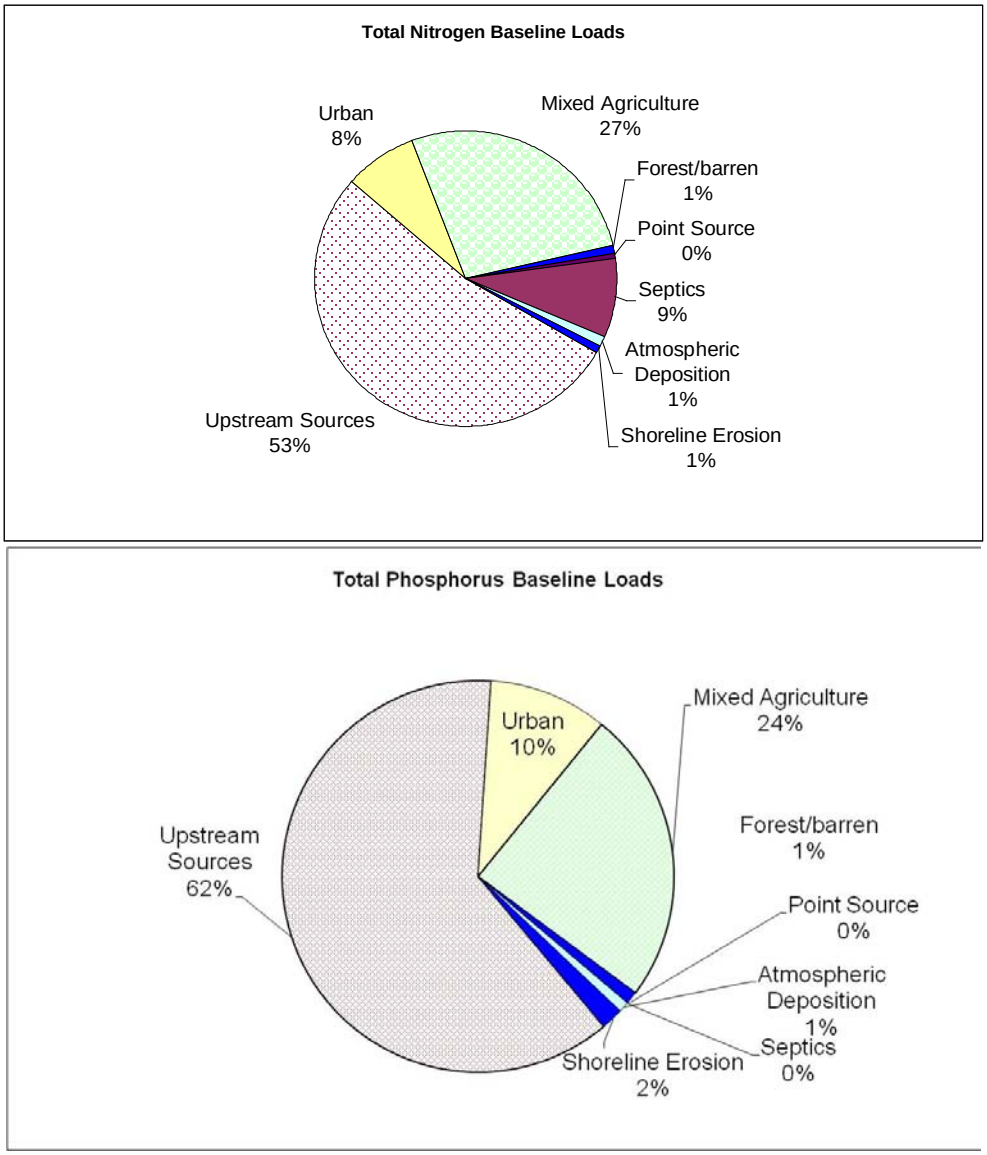

Figure B11: Nitrogen and phosphorus contributions from various sources to Bishopville Prong.

Shingle Landing Prong

The baseline average annual total nitrogen load to Shingle Landing Prong is 106,055 lbs/yr. Direct atmospheric deposition to the water's surface accounts for approximately 1% of the baseline nitrogen load. Shoreline erosion comprises 1%. Mixed agriculture (65%), urban (20%), septics (8%), point source (3%) and forest/barren (2%) account for the remaining nitrogen baseline load. The estimated average annual total phosphorus load is 7,065 lbs/yr. Direct atmospheric deposition to the water's surface accounts for approximately 1% of the baseline phosphorus load. Shoreline erosion comprises 3%. Mixed agriculture (62%), urban (29%) point source (2%) and forest/barren (3%) account for the remaining phosphorus baseline load. There is one process water point source facility with a permit regulating the discharge of nutrients in the Shingle Landing Prong watershed; however, the nonpoint source load comprises the majority of the total load to the waterbody. Figure B12 shows the relative contributions of nitrogen and phosphorus from the various sources to Shingle Landing Prong. Details can be found in Wang *et al*. (2013) and VIMS (2013).

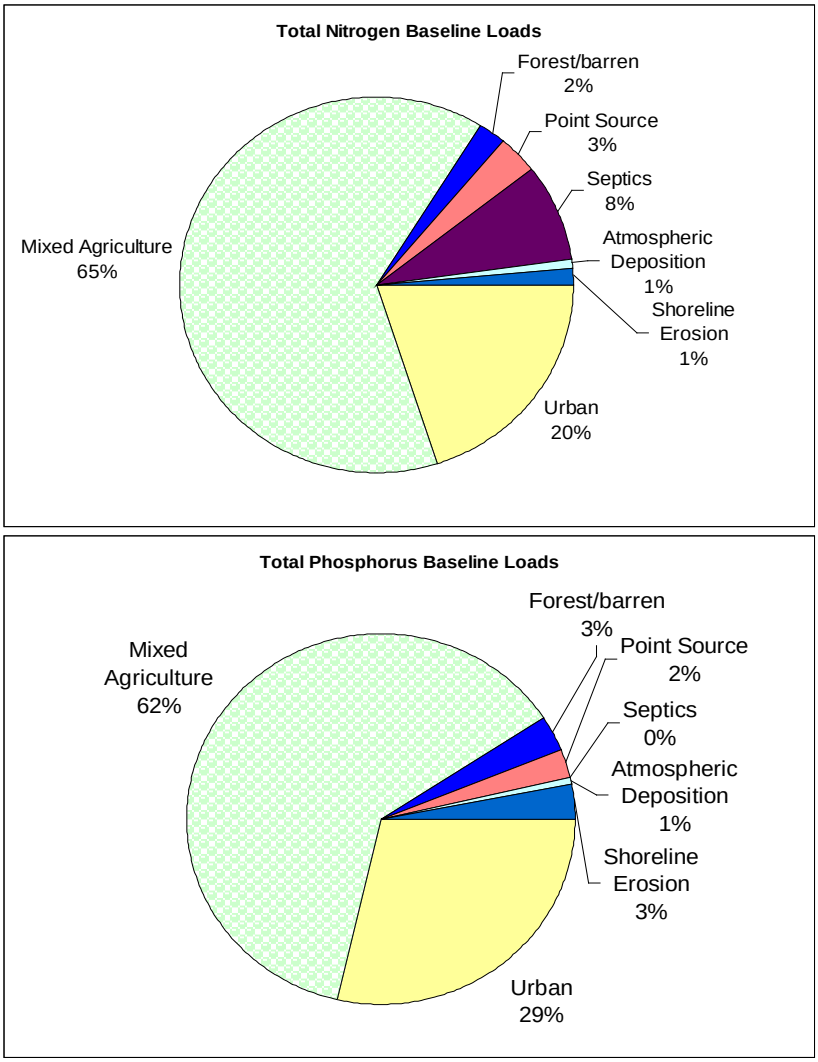

Figure B12: Nitrogen and phosphorus contributions from various sources to Shingle Landing Prong.

Manklin Creek

The baseline average annual total nitrogen load to Manklin Creek is 21,516 lbs/yr. Direct atmospheric deposition to the water's surface accounts for approximately 9% of the baseline nitrogen load. Shoreline erosion comprises 12%. Mixed agriculture (9%), urban (62%), septics (6%) and forest/barren (2%) account for the remaining nitrogen baseline load. The estimated average annual total phosphorus load is 84,809 lbs/yr. The estimated average annual total phosphorus load is 1,739 lbs/yr. Direct atmospheric deposition to the water's surface accounts for approximately 6% of the baseline phosphorus load. Shoreline erosion comprises 16%. Mixed agriculture (7%), urban (68%) and forest/barren (3%) account for the remaining phosphorus baseline load. There are no NPDES-regualted point source facilities with permits regulating the discharge of nutrients within the Manklin Creek watershed; therefore, the nonpoint source load comprises the entire load to the waterbody. Figure B13 shows the relative contributions of nitrogen and phosphorus from the various sources to Manklin Creek. Details can be found in Wang *et al*. (2013) and VIMS (2013).

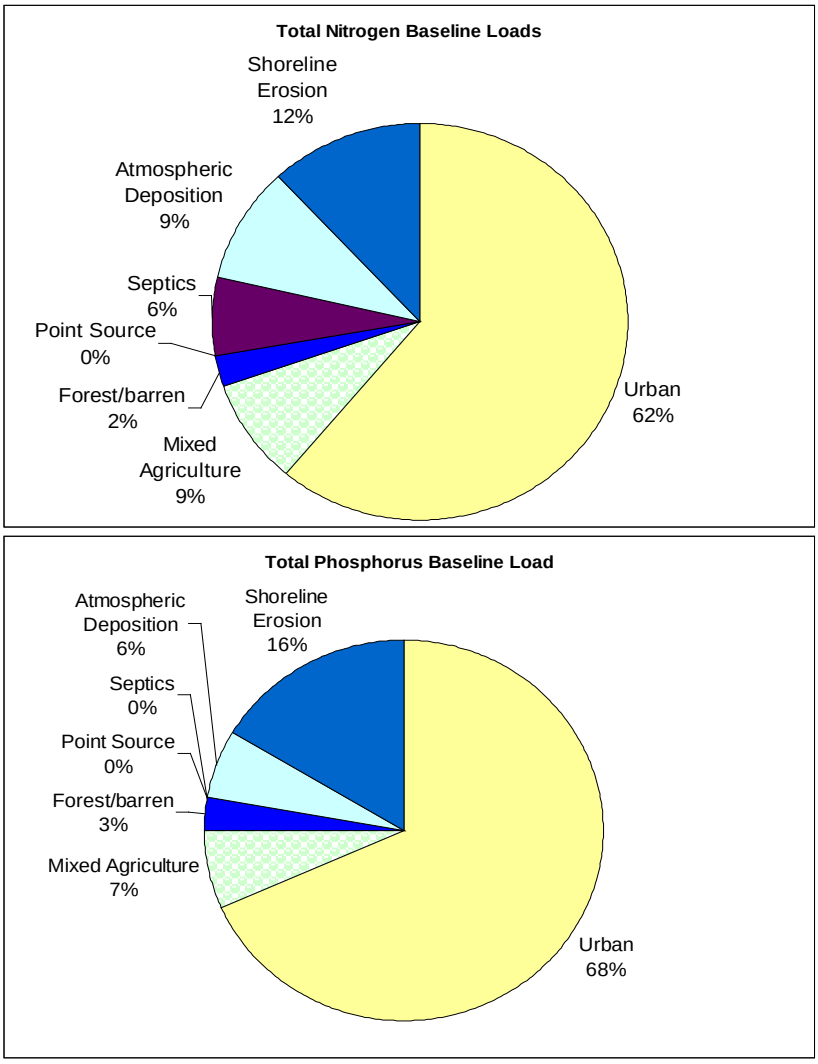

Figure B13: Nitrogen and phosphorus contributions from various sources to Manklin Creek.

Turville Creek

The baseline average annual total nitrogen load to Turville Creek is 40,515 lbs/yr. Direct atmospheric deposition to the water's surface accounts for approximately 3% of the baseline nitrogen load. Shoreline erosion comprises 10%. Mixed agriculture (29%), urban (32%), septics (23%) and forest/barren (3%) account for the remaining nitrogen baseline load. The estimated average annual total phosphorus load is 2,604 lbs/yr. Direct atmospheric deposition to the water's surface accounts for approximately 2% of the baseline phosphorus load. Shoreline erosion comprises 18%. Mixed agriculture (30%), urban (46%) and forest/barren (4%) account for the remaining phosphorus baseline load. There is one process water point source facility with a permit regulating the discharge of nutrients in the Turville Creek watershed; however, the nonpoint source load comprises the majority of the total load to the waterbody. Figure B14 shows the relative contributions of nitrogen and phosphorus from the various sources to Turville Creek. Details can be found in Wang *et al*. (2013) and VIMS (2013).

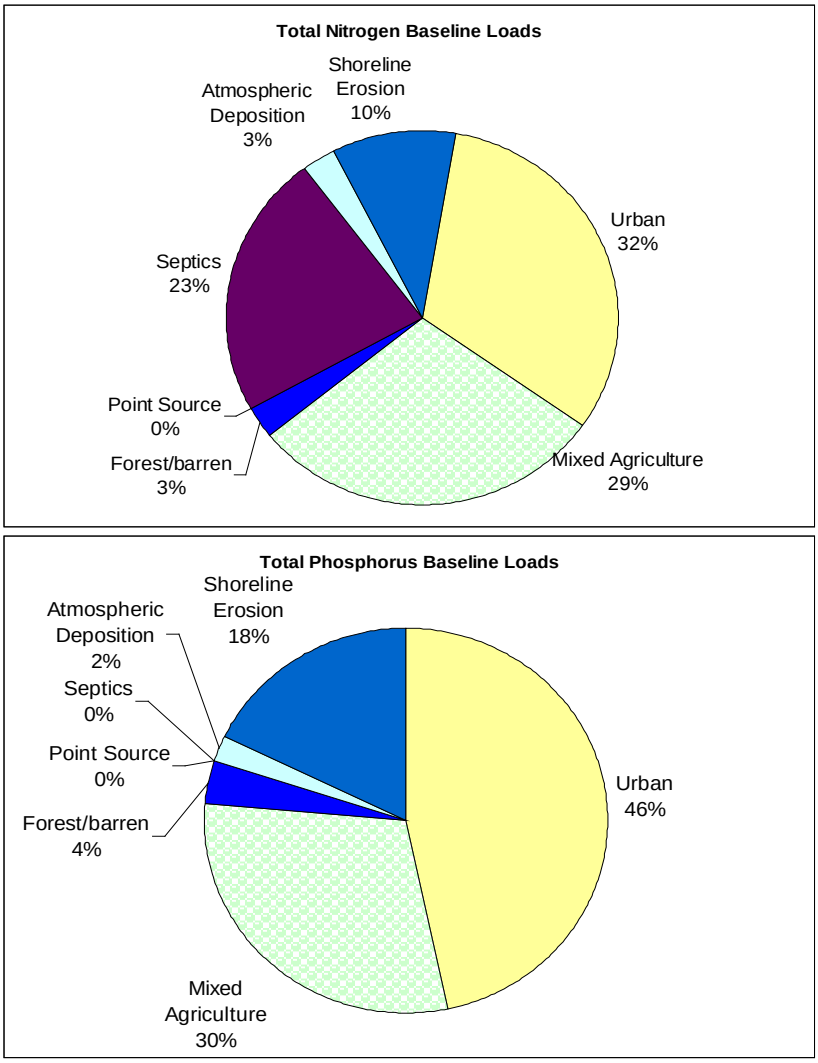

Figure B14: Nitrogen and phosphorus contributions from various sources to Turville Creek.

Herring Creek

The baseline average annual total nitrogen load to Herring Creek is 21,357 lbs/yr. Direct atmospheric deposition to the water's surface accounts for approximately 5% of the baseline nitrogen load. Shoreline erosion comprises 15%. Mixed agriculture (23%), urban (40%), septics (12%) and forest/barren (5%) account for the remaining nitrogen baseline load. The estimated average annual total phosphorus load is 1,598 lbs/yr. Direct atmospheric deposition to the water's surface accounts for approximately 3% of the baseline phosphorus load. Shoreline erosion comprises 22%. Mixed agriculture (20%), urban (50%) and forest/barren (5%) account for the remaining phosphorus baseline load. There are no process water point source facilities with permits regulating the discharge of nutrients in the Herring Creek watershed; therefore, the nonpoint source load comprises the entire load to the waterbody. Figure B15 shows the relative contributions of nitrogen and phosphorus from the various sources to Herring Creek. Details can be found in Wang *et al*. (2013) and VIMS (2013).

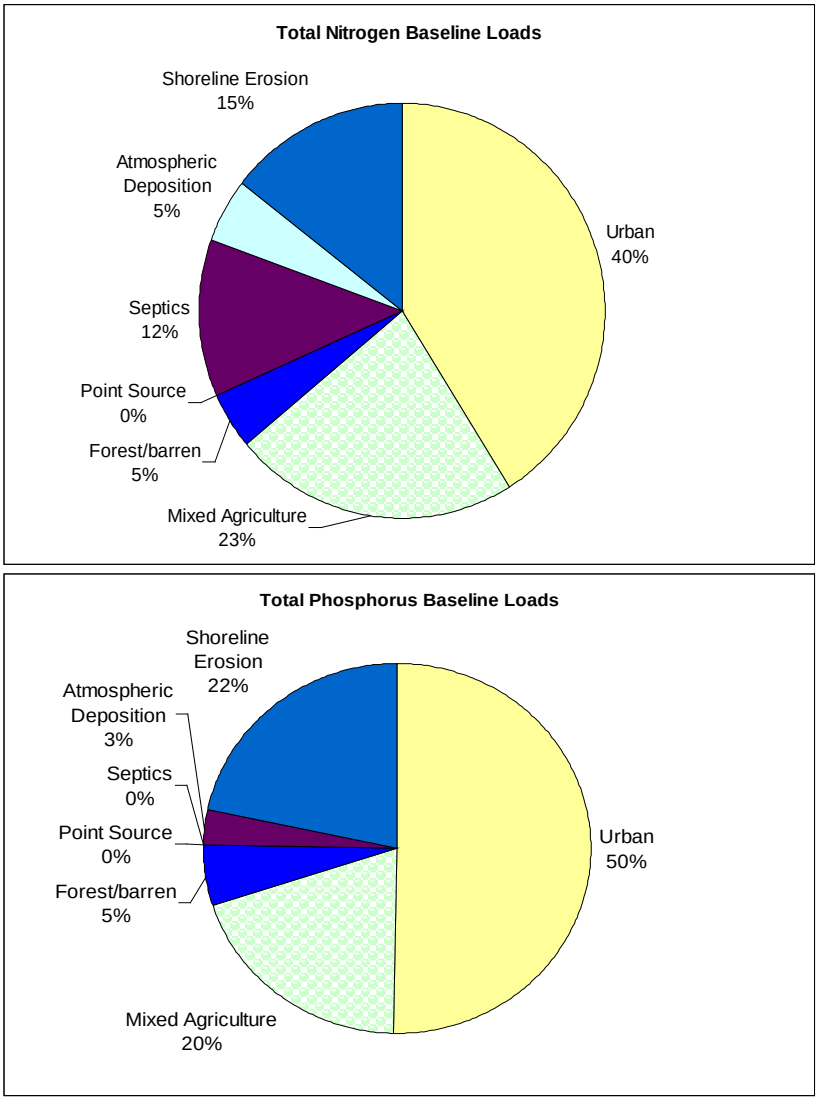

Figure B15: Nitrogen and phosphorus contributions from various sources to Herring Creek.

7.0 Summary of TMDLs for the MD 8-Digit Isle of Wight Bay and Tributaries

Load reductions are applied only to controllable sources. Controllable sources are urban land, mixed agricultural land, and septic sources (nitrogen). For the purposes of this TMDL, shoreline erosion is not considered a controllable source. The reductions applied to atmospheric deposition were based on the allocation scenario (2025) for Worcester County in the Chesapeake Bay TMDL. See USEPA (2010) for further details regarding atmospheric deposition reductions. A load reduction of 40% was applied to controllable sources within the watershed with the exception of Bishopville Prong and Shingle Landing Prong. The MPAR scenario was applied to Bishopville and Shingle Landing Prongs. See the main TMDL report for specific reductions by source.

The TMDLs for TN and TP for the MD 8-Digit Isle of Wight Bay and its major tributaries are summarized in the tables below, where:

TMDL Equation:

$$TMDL = \text{Upstream Loads} + WLA_{ProcessWater} + WLA_{CAFO} + LA + MOS$$

Table B7: MD 8-Digit Isle of Wight Bay Average Annual Nitrogen TMDL (lbs/year)

Basin Name	TMDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
Isle of Wight Bay[2]	276,986	25,435	47,869[3]	5,198	198,484	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.
[2] This allocation includes the allocations for the St. Martin River, Manklin Creek, Herring Creek, and Turville Creek.
[3] This allocation does not include the Ocean City WWTP loads.

Table B8: MD 8-Digit Isle of Wight Bay Growing Season Nitrogen TMDL (lbs/growing season)

Basin Name	TMDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
Isle of Wight Bay[2]	133,238	11,777	21,664[3]	2,597	97,200	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.
[2] This allocation includes the allocations for the St. Martin River, Manklin Creek, Herring Creek, and Turville Creek.
[3] This allocation does not include the Ocean City WWTP loads.

Table B9: MD 8-Digit Isle of Wight Bay Nitrogen Maximum Daily Load (lbs/day)

Basin Name	MDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
Isle of Wight Bay[2]	1,710	184	131.1[3]	14	1,380	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.
[2] This allocation includes the allocations for the St. Martin River, Manklin Creek, Herring Creek, and Turville Creek.
[3] This allocation does not include the Ocean City WWTP loads.

Table B10: MD 8-Digit Isle of Wight Bay Average Annual Phosphorus TMDL (lbs/year)

Basin Name	TMDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
Isle of Wight Bay[2]	24,715	2,890	5,784[3]	427	15,612	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.
[2] This allocation includes the allocations for the St. Martin River, Manklin Creek, Herring Creek, and Turville Creek.
[3] This allocation does not include the Ocean City WWTP loads.

Table B11: MD 8-Digit Isle of Wight Bay Growing Season Phosphorus TMDL (lbs/growing season)

Basin Name	TMDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
Isle of Wight Bay[2]	12,451	1,450	2,916[3]	214	7,871	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.
[2] This allocation includes the allocations for the St. Martin River, Manklin Creek, Herring Creek, and Turville Creek.
[3] This allocation does not include the Ocean City WWTP loads.

Table B12: MD 8-Digit Isle of Wight Bay Phosphorus Maximum Daily Load (lbs/day)

Basin Name	MDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
Isle of Wight Bay[2]	162	22	15.8[3]	1.2	123	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.
[2] This allocation includes the allocations for the St. Martin River, Manklin Creek, Herring Creek, and Turville Creek.
[3] This allocation does not include the Ocean City WWTP loads.

Table B13: MD 8-Digit Isle of Wight Bay Baseline Nitrogen Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
425,192	276,986	35%

Table B14: MD 8-Digit Isle of Wight Bay Baseline Phosphorus Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
29,523	24,715	16%

Table B15: St. Martin River Average Annual Nitrogen TMDL (lbs/yr)

Basin Name	TMDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
St. Martin River[2]	143,671	25,435	15,943	4,451	97,843	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.
[2] This allocation includes the allocations for Bishopville Prong and Shingle Landing Prong.

Table B16: St. Martin River Growing Season Nitrogen TMDL of (lbs/growing season)

Basin Name	TMDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
St. Martin River[2]	68,348	11,777	7,853	2,224	46,494	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.
[2] This allocation includes the allocations for Bishopville Prong and Shingle Landing Prong.

Table B17: St. Martin River Nitrogen Maximum Daily Load (lbs/day)

Basin Name	MDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
St. Martin River[2]	1,026	184	43.7	12	786	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.
[2] This allocation includes the allocations for Bishopville Prong and Shingle Landing Prong.

Table B18: St. Martin River Average Annual Phosphorus TMDL (lbs/yr)

Basin Name	TMDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
St. Martin River[2]	12,988	2,890	1,218	366	8,514	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.
[2] This allocation includes the allocations for Bishopville Prong and Shingle Landing Prong.

Table B19: St. Martin River Growing Season Phosphorus TMDL (lbs/growing season)

Basin Name	TMDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
St. Martin River[2]	6,486	1,450	614	183	4,239	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.
[2] This allocation includes the allocations for Bishopville Prong and Shingle Landing Prong.

Table B20: St. Martin River Phosphorus Maximum Daily Load (lbs/day)

Basin Name	MDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
St. Martin River[2]	102	22	3.3	1.0	76	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.
[2] This allocation includes the allocations for Bishopville Prong and Shingle Landing Prong.

Table B21: St. Martin River Baseline Nitrogen Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
276,990	143,671	48%

Table B22: St. Martin River Baseline Phosphorus Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
18,903	12,988	31%

Table B23: Bishopville Prong Average Annual Nitrogen TMDL (lbs/yr)

Basin Name	TMDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
Bishopville Prong	54,619	25,434	655	2,823	25,697	Implicit

[1] Upstream Loads denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources

Table B24: Bishopville Prong Growing Season Nitrogen TMDL (lbs/growing season)

Basin Name	TMDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
Bishopville Prong	25,592	11,777	333	1,411	12,071	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

Table B25: Bishopville Prong Nitrogen Maximum Daily Load (lbs/day)

Basin Name	MDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
Bishopville Prong	410	184	2	8	216	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

Table B26: Bishopville Prong Average Annual Phosphorus TMDL (lbs/yr)

Basin Name	TMDL	Upstream Loads[1] (WLA+LA)	WLA Process Water	WLA_{CAFO}	LA	MOS
Bishopville Prong	5,603	2,890	0	232	2,481	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

Table B27: Bishopville Prong Growing Season Phosphorus TMDL (lbs/growing season)

Basin Name	TMDL	Upstream LA[1]	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Bishopville Prong	2,797	1,450	0	116	1,231	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

Table B28: Bishopville Prong Phosphorus Maximum Daily Load (lbs/day)

Basin Name	MDL	Upstream LA[1]	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Bishopville Prong	46	22	0.00	0.6	24	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

Table B29: Bishopville Prong Baseline Nitrogen Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
128,760	54,619	58%

Table B30: Bishopville Prong Baseline Phosphorus Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
9,095	5,603	38%

Table B31: Shingle Landing Prong Average Annual Nitrogen TMDL (lbs/yr)

Basin Name	TMDL	Upstream LA[1]	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Shingle Landing Prong	58,520	0	15,278	1,357	41,885	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

Table B32: Shingle Landing Prong Growing Season Nitrogen TMDL (lbs/growing season)

Basin Name	TMDL	Upstream LA[1]	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Shingle Landing Prong	27,750	0	7,520	678	19,552	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

Table B33: Shingle Landing Prong Nitrogen Maximum Daily Load (lbs/day)

Basin Name	MDL	Upstream LA[1]	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Shingle Landing Prong	433	0	41.9	4	387	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

Table B34: Shingle Landing Prong Average Annual Phosphorus TMDL (lbs/yr)

Basin Name	TMDL	Upstream LA[1]	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Shingle Landing Prong	5,317	0	1,218	112	3,987	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

Table B35: Shingle Landing Prong Growing Season Phosphorus TMDL (lbs/growing season)

Basin Name	TMDL	Upstream LA[1]	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Shingle Landing Prong	2,639	0	614	56	1,969	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

Table B36: Shingle Landing Prong Phosphorus Maximum Daily Load (lbs/day)

Basin Name	MDL	Upstream LA[1]	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Shingle Landing Prong	42	0	3.3	0.3	39	Implicit

[1] Upstream Load denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

Table B37: Shingle Landing Prong Baseline Nitrogen Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
106,055	58,520	45%

Table B38: Shingle Landing Prong Baseline Phosphorus Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
7,065	5,317	25%

Table B39: Manklin Creek Average Annual Nitrogen TMDL (lbs/yr)

Basin Name	TMDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Manklin Creek	14,692	0	0	14,692	Implicit

Table B40: Manklin Creek Growing Season Nitrogen TMDL (lbs/growing season)

Basin Name	TMDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Manklin Creek	7,541	0	0	7,541	Implicit

Table B41: Manklin Creek Nitrogen Maximum Daily Load (lbs/day)

Basin Name	MDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Manklin Creek	109	0	0	109	Implicit

Table B42: Manklin Creek Average Annual Phosphorus TMDL (lbs/yr)

Basin Name	TMDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Manklin Creek	1,240	0	0	1,240	Implicit

Table B43: Manklin Creek Growing Season Phosphorus TMDL (lbs/growing season)

Basin Name	TMDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Manklin Creek	645	0	0	645	Implicit

Table B44: Manklin Creek Phosphorus Maximum Daily Load (lbs/day)

Basin Name	MDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Manklin Creek	9.65	0.00	0.00	9.65	Implicit

Table B45: Manklin Creek Baseline Nitrogen Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
21,516	14,692	32%

Table B46: Manklin Creek Baseline Phosphorus Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
1,739	1,240	29%

Table B47: Turville Creek Average Annual Nitrogen TMDL (lbs/yr)

Basin Name	TMDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Turville Creek	26,311	0	747	25,564	Implicit

Table B48: Turville Creek Growing Season Nitrogen TMDL (lbs/growing season)

Basin Name	TMDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Turville Creek	12,998	0	373	12,625	Implicit

Table B49: Turville Creek Nitrogen Maximum Daily Load (lbs/day)

Basin Name	MDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Turville Creek	182	0	2	180	Implicit

Table B50: Turville Creek Average Annual Phosphorus TMDL (lbs/yr)

Basin Name	TMDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Turville Creek	1,813	0	61	1,752	Implicit

Table B51: Turville Creek Growing Season Phosphorus TMDL (lbs/growing season)

Basin Name	TMDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Turville Creek	924	0	31	893	Implicit

Table B52: Turville Creek Phosphorus Maximum Daily Load (lbs/day)

Basin Name	MDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Turville Creek	14.21	0.00	0.17	14.04	Implicit

Table B53: Turville Creek Baseline Nitrogen Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
40,515	26,311	35%

Table B54: Turville Creek Baseline Phosphorus Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
2,604	1,813	30%

Table B55: Herring Creek Average Annual Nitrogen TMDL (lbs/yr)

Basin Name	TMDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Herring Creek	14,413	0	0	14,413	Implicit

Table B56: Herring Creek Growing Season Nitrogen TMDL (lbs/growing season)

Basin Name	TMDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Herring Creek	7,250	0	0	7,250	Implicit

Table B57: Herring Creek Maximum Nitrogen Daily Load (lbs/day)

Basin Name	MDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Herring Creek	104	0	0	104	Implicit

Table B58: Herring Creek Average Annual Phosphorus TMDL (lbs/yr)

Basin Name	TMDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Herring Creek	1,146	0	0	1,146	Implicit

Table B59: Herring Creek Growing Season Phosphorus TMDL (lbs/growing season)

Basin Name	TMDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Herring Creek	586	0	0	586	Implicit

Table B60: Herring Creek Phosphorus Maximum Daily Load (lbs/day)

Basin Name	MDL	WLA $_{\text{Process Water}}$	WLA_{CAFO}	LA	MOS
Herring Creek	8.70	0.00	0.00	8.70	Implicit

Table B61: Herring Creek Baseline Nitrogen Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
21,357	14,413	33%

Table B62: Herring Creek Baseline Phosphorus Load, TMDL, and Total Reduction Percentage

Baseline Load (lbs/yr)	TMDL (lbs/yr)	Total Reduction (%)
1,598	1,146	28%