

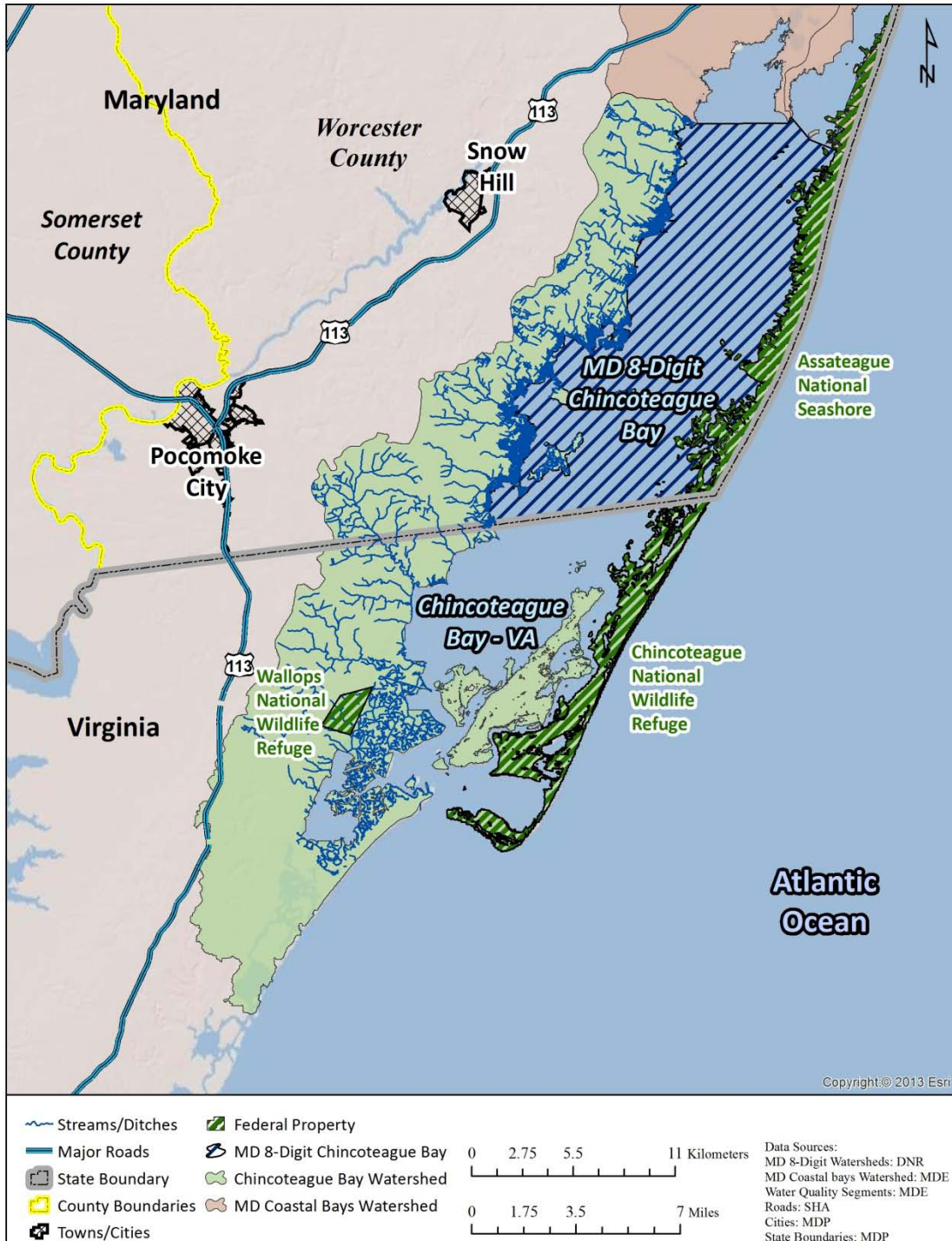
FINAL

## Appendix E: Chincoteague 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. Chincoteague Bay is located on the Atlantic Coast of the Delmarva (Delaware-Maryland-Virginia) Peninsula in Worcester County, Maryland (MD) and Accomack County, VA. Major areas of interest in the Chincoteague Bay watershed include Assateague Island National Seashore, Chincoteague National Wildlife Refuge, Wallops Island National Wildlife Refuge in Virginia, and Public Landing. The Chincoteague Bay connects to the Atlantic Ocean through the Chincoteague Inlet. Figure E1 shows the location of the Chincoteague Bay and its watershed.

TMDLs for nitrogen and phosphorus have been developed for the Maryland portion of the Chincoteague Bay, referred to as the MD 8-Digit Chincoteague Bay (basin code: 02130106). 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 watershed within Virginia. In the sections below, more detailed information regarding watershed characteristics, baseline nutrient loadings, and the specific TMDLs developed for the MD 8-Digit Chincoteague Bay are provided.

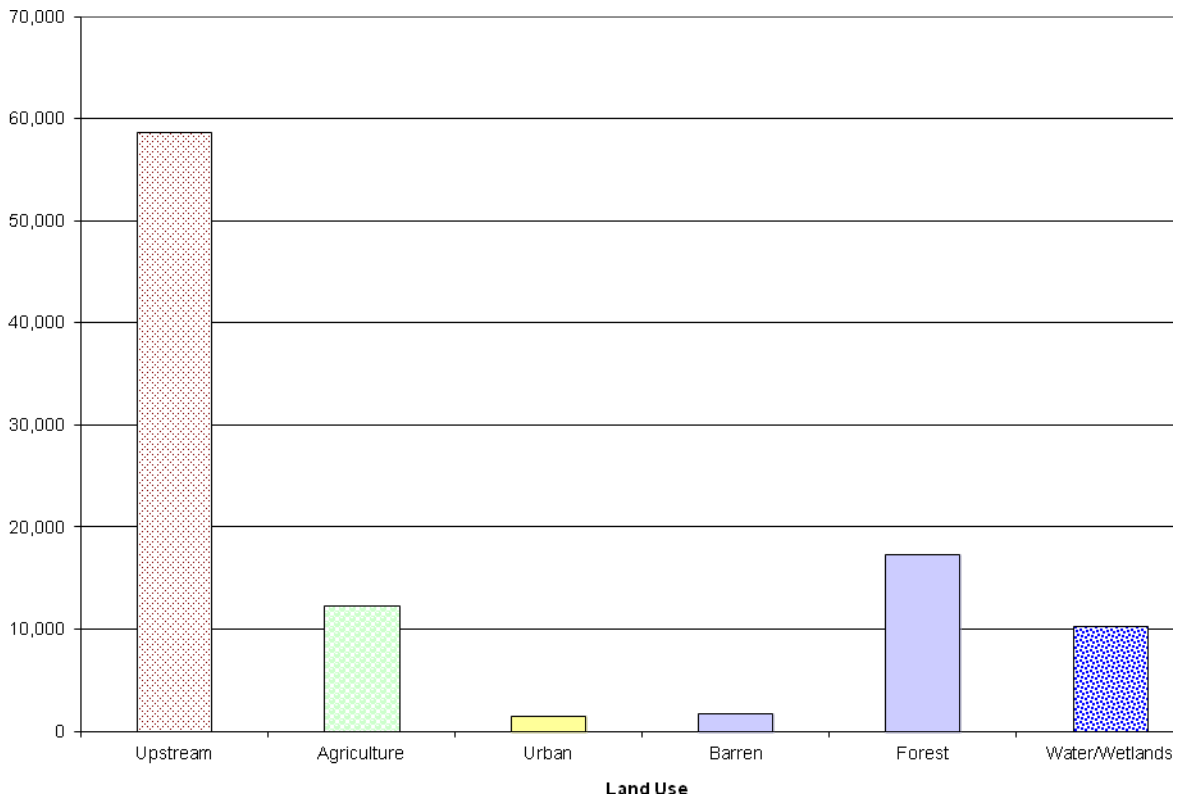


**Figure E1: Location Map of the Chincoteague Bay Watershed.**

## 2.0 Land Use

### Chincoteague Bay

The Chincoteague Bay watershed has a drainage area of 101,473 acres. The average depth is 4 ft (1.22 m). The land use distribution in the watershed consists of upstream (VA) drainage (58,536 acres, or 58% of the total watershed area); water/wetlands (10,556 acres, 10%); forest and other herbaceous (17,230 acres, 17%); mixed agriculture (12,234 acres, 12%); urban (1,446 acres, 1%); and barren (1,471 acres, 2%). Figure E2 shows the relative amounts of the different land uses in the Chincoteague Bay watershed.



**Figure E2: Proportions of land use draining the Chincoteague Bay watershed.**

### 3.0 Watershed Model Information

The applicable Chincoteague Bay watershed model segments and water quality monitoring stations are presented in the Tables E1 and E2 below.

**Table E1: Chincoteague Bay watershed model segments**

<b>Watershed Name</b>	<b>Watershed Model Segments</b>
MD 8-Digit Chincoteague Bay	85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100, 101,102,103,104,105,106,107,108,109,110,111,112, 113,114,115,116,117,118,120,179,180,181,182,183, 184,237,238,239,500
Upstream Chincoteague Bay	116,117,118,119,120,121,122,123,124,125,126,127, 128,129,130,131,132,133,134,135,136,137,138,139, 140,141,142,185,240,241,242,254,255,256,257,259, 260,261,263,264,265

**Table E2: Chincoteague Bay water quality monitoring stations**

<b>Waterbody Name</b>	<b>Stations</b>
Chincoteague Bay <sup>1</sup>	XCM1562
	XCM0159
	ASSA5
	XBM5932
	ASSA6
	XBM8149
	ASSA7
	ASSA14
	ASSA15
	XBM3418
	XBM1301

<sup>1</sup> All stations located in MD 8-digit portion of Chincoteague Bay

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

As described in the main TMDL report, there are no NPDES regulated stormwater facilities in the entire Maryland portion of the Coastal Bays watershed. In the MD 8-Digit Chincoteague Bay, there are no process water point sources.

#### 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. As explained in the main document, there are no NPDES stormwater permits within the watershed, therefore, 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 System) 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 segmentation created by MDE. The assumptions used in the analysis are presented in Table E3. These loads were calculated based on a methodology used by the USEPA-CBP. Table E4 presents the calculated septic system loads for all segments.

**Table E3: 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 E4: Delivered septic loads and values used in the Coastal Bays Model for the MD 8-Digit Chincoteague Bay.**

<i>SEG-MENT</i>	<i>MD # Septics (within 1,000 ft)</i>	<i>MD # Septics (outside 1,000 ft)</i>	<i>Upstream # Septics (within 1,000 ft)</i>	<i>Upstream # Septics (outside 1,000 ft)</i>	<i>Total # Septics (within 1,000 ft)</i>	<i>Total # Septics (outside 1,000 ft)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (Within 1,000 ft) (lbs/year)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (Outside 1,000 ft) (lbs/year)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (Within 1,000 ft) (lbs/day)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (Outside 1,000 ft) (lbs/day)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (lbs/day)</i>
85	6	3	0	0	6	3	146	27	0.40	0.07	0.47
86	8	10	0	0	8	10	195	91	0.53	0.25	0.78
87	0	1	0	0	0	1	0	9	0.00	0.02	0.02
88	4	0	0	0	4	0	97	0	0.27	0.00	0.27
89	0	1	0	0	0	1	0	9	0.00	0.02	0.02
90	16	8	0	0	16	8	389	73	1.07	0.20	1.27
92	10	9	0	0	10	9	243	82	0.67	0.22	0.89
93	35	19	0	0	35	19	851	173	2.33	0.47	2.81
94	4	0	0	0	4	0	97	0	0.27	0.00	0.27
95	33	5	0	0	33	5	803	46	2.20	0.12	2.32
96	11	1	0	0	11	1	268	9	0.73	0.02	0.76
99	5	0	0	0	5	0	122	0	0.33	0.00	0.33
100	3	3	0	0	3	3	73	27	0.20	0.07	0.27
101	20	24	0	0	20	24	486	219	1.33	0.60	1.93
103	1	0	0	0	1	0	24	0	0.07	0.00	0.07
104	0	1	0	0	0	1	0	9	0.00	0.02	0.02
105	0	4	0	0	0	4	0	36	0.00	0.10	0.10
106	7	11	0	0	7	11	170	100	0.47	0.27	0.74
107	15	29	0	0	15	29	365	264	1.00	0.72	1.72
108	48	45	0	0	48	45	1167	410	3.20	1.12	4.32
111	4	35	0	0	4	35	97	319	0.27	0.87	1.14
112	0	4	0	0	0	4	0	36	0.00	0.10	0.10
113	69	11	0	0	69	11	1678	100	4.60	0.27	4.87

**Table E4: Delivered septic loads and values used in the Coastal Bays Model for the MD 8-Digit Chincoteague Bay.**

<i>SEG- MENT</i>	<i>MD # Septics (within 1,000 ft)</i>	<i>MD # Septics (outside 1,000 ft)</i>	<i>Upstream # Septics (within 1,000 ft)</i>	<i>Upstream # Septics (outside 1,000 ft)</i>	<i>Total # Septics (within 1,000 ft)</i>	<i>Total # Septics (outside 1,000 ft)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (Within 1,000 ft) (lbs/year)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (Outside 1,000 ft) (lbs/year)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (Within 1,000 ft) (lbs/day)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (Outside 1,000 ft) (lbs/day)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (lbs/day)</i>
114	11	2	0	0	11	2	268	18	0.73	0.05	0.78
115	0	1	0	0	0	1	0	9	0.00	0.02	0.02
116	0	0	16	16	16	16	378	142	1.04	0.39	1.43
117	2	7	16	16	18	23	433	208	1.19	0.57	1.76
118	15	5	29	29	44	34	1,081	314	2.96	0.86	3.82
119	0	0	12	12	12	12	304	114	0.83	0.31	1.14
120	72	16	175	175	247	191	5,998	1,739	16.43	4.76	21.20
121	0	0	8	8	8	8	189	71	0.52	0.19	0.71
122	0	0	36	36	36	36	874	328	2.40	0.90	3.29
123	0	0	67	67	67	67	1,624	609	4.45	1.67	6.12
124	0	0	20	20	20	20	488	183	1.34	0.50	1.84
125	0	0	14	14	14	14	339	127	0.93	0.35	1.28
126	0	0	12	12	12	12	288	108	0.79	0.30	1.09
128	0	0	10	10	10	10	245	92	0.67	0.25	0.92
129	0	0	533	533	533	533	12,964	4,861	35.52	13.32	48.84
130	0	0	20	20	20	20	480	180	1.31	0.49	1.81
131	0	0	6	6	6	6	143	53	0.39	0.15	0.54
132	0	0	7	7	7	7	165	62	0.45	0.17	0.62
133	0	0	15	15	15	15	368	138	1.01	0.38	1.38
134	0	0	5	5	5	5	111	41	0.30	0.11	0.42
135	0	0	7	7	7	7	177	66	0.49	0.18	0.67
136	0	0	6	6	6	6	144	54	0.40	0.15	0.54
137	0	0	5	5	5	5	112	42	0.31	0.11	0.42
138	0	0	9	9	9	9	207	78	0.57	0.21	0.78

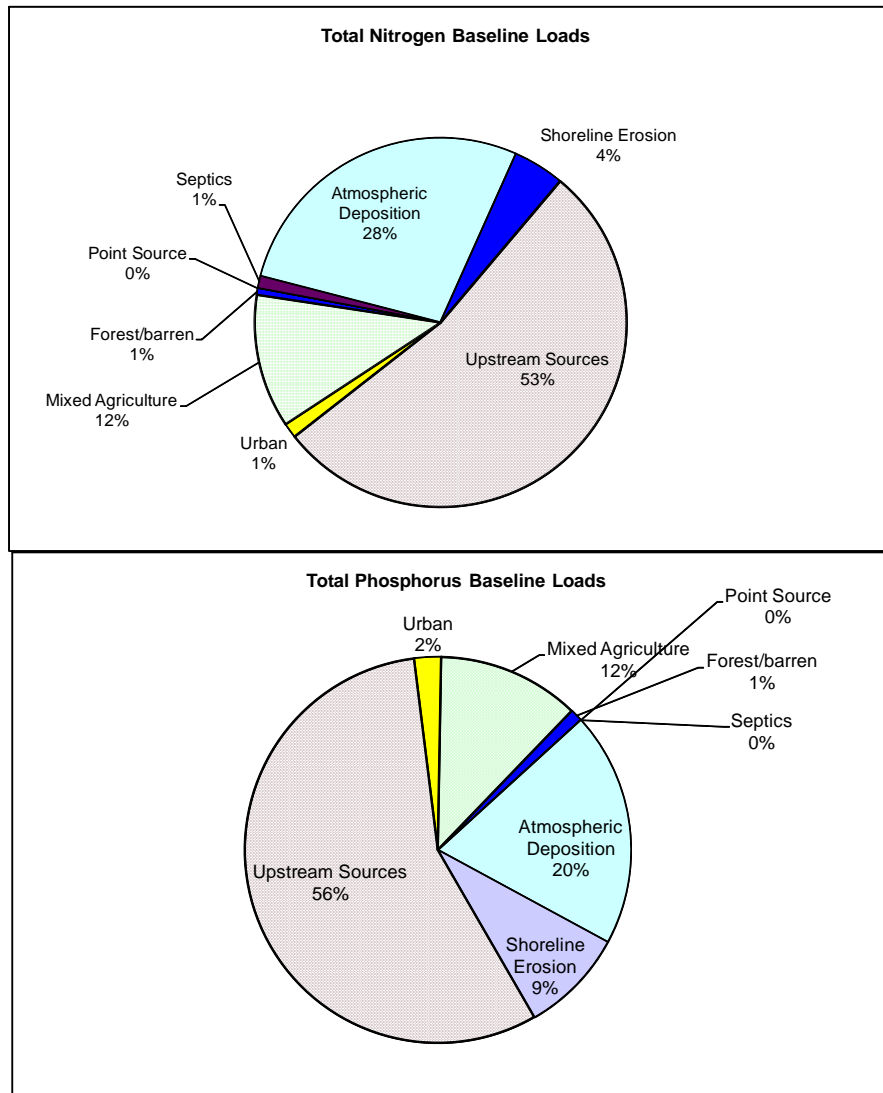


**Table E4: Delivered septic loads and values used in the Coastal Bays Model for the MD 8-Digit Chincoteague Bay.**

<i>SEG- MENT</i>	<i>MD # Septics (within 1,000 ft)</i>	<i>MD # Septics (outside 1,000 ft)</i>	<i>Upstream # Septics (within 1,000 ft)</i>	<i>Upstream # Septics (outside 1,000 ft)</i>	<i>Total # Septics (within 1,000 ft)</i>	<i>Total # Septics (outside 1,000 ft)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (Within 1,000 ft) (lbs/year)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (Outside 1,000 ft) (lbs/year)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (Within 1,000 ft) (lbs/day)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (Outside 1,000 ft) (lbs/day)</i>	<i>Total Surface Water Delivered Nitrogen Load with Loss (lbs/day)</i>
139	0	0	26	26	26	26	625	234	1.71	0.64	2.35
140	0	0	2	2	2	2	40	15	0.11	0.04	0.15
141	0	0	182	182	182	182	4,438	1,664	12.16	4.56	16.72
142	0	0	92	92	92	92	2,237	839	6.13	2.30	8.43
179	1	0	0	0	1	0	24	0	0.07	0.00	0.07
180	38	0	0	0	38	0	924	0	2.53	0.00	2.53
184	3	0	0	0	3	0	73	0	0.20	0.00	0.20
185	0	0	7	7	7	7	163	61	0.45	0.17	0.61
237	1	0	0	0	1	0	24	0	0.07	0.00	0.07
239	1	0	0	0	1	0	24	0	0.07	0.00	0.07
240	0	0	647	647	647	647	15,731	5,899	43.10	16.16	59.26
241	0	0	210	210	210	210	5,097	1,911	13.96	5.24	19.20
<b>Totals</b>	<b>443</b>	<b>255</b>	<b>2,194</b>	<b>2,194</b>	<b>2,637</b>	<b>2,449</b>	<b>64,051</b>	<b>22,299</b>	<b>175.53</b>	<b>61.03</b>	<b>236.57</b>

## 6.0 Baseline Load Summary

The baseline average annual total nitrogen load to the MD 8-Digit Chincoteague Bay is 1,233,856 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 28% and shoreline erosion comprises 4% of the baseline nitrogen load. Mixed agriculture (12%), urban (1%), septic (1%) 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 84,809 lbs/yr. Upstream loads account for 56% of the total baseline phosphorus load. In Maryland's portion of the watershed, direct atmospheric deposition to the water's surface accounts for approximately 20% and shoreline erosion comprises 9% of the baseline phosphorus load. Mixed agriculture (12%), urban (2%) and forest/barren (1%), within Maryland's portion of the watershed, account for the remaining phosphorus baseline load. There are no process water point source facilities with permits regulating the discharge of nutrients in the Maryland portion of the Chincoteague Bay watershed. Figure E3 shows the relative contributions of nitrogen and phosphorus from the various sources to the MD 8-Digit Chincoteague Bay. Details can be found in Wang *et al.* (2013) and VIMS (2013).



**Figure E3: Nitrogen and phosphorus contributions from various sources to the MD 8-Digit Chincoteague Bay.**

**7.0 Summary of TMDLs for the MD 8-Digit Chincoteague Bay**

Load reductions are applied only within Maryland’s portion of the watershed, and 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 20% was applied to controllable sources within Maryland’s portion of the watershed.

The TMDLs for TN and TP for the MD 8-Digit Chincoteague Bay are summarized in the tables below, where:

TMDL Equation:

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

**Table E5: MD 8-digit Chincoteague Bay Average Annual Nitrogen TMDL (lbs/year)**

Basin Name	TMDL	Upstream Loads <sup>1</sup> (WLA+LA)	WLA <sub>ProcessWater</sub>	WLA <sub>CAFO</sub>	LA	MOS
Chincoteague Bay	1,166,469	633,578	0	4,236	528,655	Implicit

<sup>1</sup> Upstream Loads denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

**Table E6: MD 8-digit Chincoteague Bay Growing Season Nitrogen TMDL (lbs/growing season)**

Basin Name	TMDL	Upstream Loads <sup>1</sup> (WLA+LA)	WLA <sub>ProcessWater</sub>	WLA <sub>CAFO</sub>	LA	MOS
Chincoteague Bay	569,121	308,377	0	2,118	258,626	Implicit

<sup>1</sup> Upstream Loads denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

**Table E7: MD 8-digit Chincoteague Bay Nitrogen Maximum Daily Load (lbs/day)**

Basin Name	MDL	Upstream Loads <sup>1</sup> (WLA+LA)	WLA <sub>ProcessWater</sub>	WLA <sub>CAF</sub> o	LA	MOS
Chincoteague Bay	6,194	3,592	0	12	2,590	Implicit

<sup>1</sup> Upstream Loads denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

**Table E8: MD 8-digit Chincoteague Bay Average Annual Phosphorus TMDL (lbs/yr)**

Basin Name	TMDL	Upstream Loads <sup>1</sup> (WLA+LA)	WLA <sub>ProcessWater</sub>	WLA <sub>CAFO</sub>	LA	MOS
Chincoteague Bay	82,304	47,797	0	348	34,159	Implicit

<sup>1</sup> Upstream Loads denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

**Table E9: MD 8-digit Chincoteague Bay Growing Season Phosphorus TMDL (lbs/growing season)**

Basin Name	TMDL	Upstream Loads <sup>1</sup> (WLA+LA)	WLA <sub>ProcessWater</sub>	WLA <sub>CAFO</sub>	LA	MOS
Chincoteague Bay	41,488	24,122	0	174	17,191	Implicit

<sup>1</sup> Upstream Loads denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

**Table E10: MD 8-digit Chincoteague Bay Phosphorus Maximum Daily Load (lbs/day)**

<b>Basin Name</b>	<b>MDL</b>	<b>Upstream Loads<sup>1</sup> (WLA+LA)</b>	<b>WLA<sub>ProcessWater</sub></b>	<b>WLA<sub>CAFO</sub></b>	<b>LA</b>	<b>MOS</b>
Chincoteague Bay	426	256	0.00	1.0	169	Implicit

<sup>1</sup> Upstream Loads denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.

**Table E11: MD 8-Digit Chincoteague Bay Baseline Nitrogen Load, TMDL, and Total Reduction Percentage**

<b>Baseline Load (lbs/yr)</b>	<b>TMDL (lbs/yr)</b>	<b>Total Reduction (%)</b>
1,233,856	1,166,469	5%

**Table E12: MD 8-Digit Chincoteague Bay Baseline Phosphorus Load, TMDL, and Total Reduction Percentage**

<b>Baseline Load (lbs/yr)</b>	<b>TMDL (lbs/yr)</b>	<b>Total Reduction (%)</b>
84,809	82,304	3%