UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

AUG 07 2014

Mr. D. Lee Currey, Director
Science Services Administration
Maryland Department of the Environment
1800 Washington Blvd., Suite 540
Baltimore, Maryland 21230-1718

Dear Mr. Currey:

The U.S. Environmental Protection Agency (EPA), Region III, is pleased to approve the report, *Total Maximum Daily Loads of Nitrogen and Phosphorus for Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, Newport Bay and Chincoteague Bay in the Coastal Bays Watersheds in Worcester County, Maryland.* The TMDL report was submitted by the Maryland Department of the Environment (MDE) to EPA for final review on April 28, 2014 and received on May 1, 2014. The TMDL was established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address impairments of water quality as identified in Maryland's Section 303(d) List.

Maryland allocated loadings of Nitrogen and Phosphorus for the Maryland 8-digit Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, Newport Bay, and Chincoteague Bay (Maryland Coastal Bays). Nitrogen and Phosphorus TMDLs for areas within Maryland's Northern Coastal Bays and Nitrogen and Biological Oxygen Demand TMDLs for the MD 8-Digit Newport Bay were approved by EPA 2002 and 2003, respectively. The TMDLs approved here were developed to address the water quality impairments associated with excess nutrient loadings, and supersede the previous TMDLs.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) be designed to attain and maintain the applicable water quality standards; (2) include a total allowable loading and as appropriate, wasteload allocations for point sources and load allocations for nonpoint sources; (3) consider the impacts of background pollutant contributions; (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated); (5) consider seasonal variations; (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality); and (7) be subject to public participation. In addition, these TMDLs considered reasonable assurance that the TMDL allocations assigned to the nonpoint sources can be reasonably met. The enclosure to this letter describes how the Nitrogen and Phosphorus TMDLs for the Maryland Coastal Bays satisfies each of these requirements.

As you know, any new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL's wasteload allocation pursuant to 40 CFR §122.44(d)(1)(VII)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

If you have any questions or comments concerning this letter, please do not hesitate to contact Ms. Helene Drago, TMDL Program Manager, at 215-814-5796.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure

cc: Melissa Chatham, MDE-SSA
Jay Sakai, MDE-WMA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
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Decision Rationale
Total Maximum Daily Loads of Nitrogen and Phosphorus for Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, Newport Bay, and Chincoteague Bay in the Coastal Bays Watersheds in Worcester County, Maryland

Jon M. Capacasa, Director
Water Protection Division

Date: AUG 0 7 2014

Decision Rationale
Approval of the Total Maximum Daily Loads of Nitrogen and Phosphorus in Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, Newport Bay and Chincoteague Bay in the Coastal Bays Watershed, Worcester County, Maryland

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those waterbodies identified as impaired by the State where technology based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a Margin of Safety (MOS), that may be discharged to a water quality limited waterbody.

This document sets forth the U.S. Environmental Protection Agency's (EPA) rationale for approving the TMDL for Nitrogen and Phosphorus in the Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, Newport Bay and Chincoteague Bay in the Coastal Bays watershed (Maryland Coastal Bays). The TMDLs were established to address impairments of water quality, caused by nutrients, as identified in Maryland's Section 303(d) List for water quality limited segments. Table 1 below identifies the specific nutrient impairments for these waterbodies. The Maryland Department of the Environment (MDE) submitted the report, *Total Maximum Daily Loads of Nitrogen and Phosphorus for Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, Newport Bay and Chincoteague Bay in the Coastal Bays Watersheds in Worcester County, Maryland,* dated April 2014, to EPA for final review on April 28, 2014 and received on May 1, 2014. The TMDL was established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address impairments of water quality as identified in Maryland's Section 303(d) List. The basin identification for the each waterbody is listed in Table 1.

EPA's rationale is based on the TMDL Report and information in the computer files provided to EPA by MDE. EPA's review determined that the TMDL meets the following seven regulatory requirements pursuant to 40 CFR Part 130.

1. The TMDL is designed to implement applicable water quality standards.
2. The TMDL includes a total allowable load as well as individual wasteload allocations (WLAs) and load allocations (LAs).
3. The TMDL considers the impacts of background pollutant contributions.
4. The TMDL considers critical environmental conditions.
5. The TMDL considers seasonal environmental variations.
6. The TMDL includes a MOS.
7. The TMDL has been subject to public participation.

In addition, this TMDL considered reasonable assurance that the TMDL allocations assigned to nonpoint sources can be reasonably met.

Table 1. Nutrient Impairments for the Maryland Coastal Bays (MDE 2010)

Year listed	MD 8-Digit Tidal Basin	Basin Code	2010 IR Assessment Unit ID	Specific Area	Identified Pollutant	Listing Category
1996	Assawoman Bay	02130102	MD-02130102-T-Assawoman_Bay	Opern Water	Nitrogen	5[1]
					Phosphorus	5
			MD-02130102-T-Greys_Creek	Grey's Creek	Nitrogen	5
					Phosphorus	5
1996	Isle Of Wight Bay	02130103	MD-02130103-T-Turville_Creek	Turville Creek	Nitrogen	4a[2]
					Phosphorus	4a
			MD-02130103-T-Manklin_Creek	Manklin Creek	Nitrogen	5
					Phosphorus	5
			MD-02130103-T-Herring_Creek	Herring Creek	Nitrogen	4a
					Phosphorus	4a
			MD-02130103-T-Bishopville_Prong	Bishopville Prong	Nitrogen	4a
					Phosphorus	4a
			MD-02130103-T-StMartin_River	St. Martin River	Nitrogen	4a
					Phosphorus	4a
			MD-02130103-T-Shingle_Landing_Prong	Shingle Landing Prong	Nitrogen	4a
					Phosphorus	4a
			MD-02130103-T-Isle_Of_Wight_Bay	Open Water	Nitrogen	5
					Phosphorus	5
1996	Newport Bay	02130105	MD-02130105-T-Newport_Creek	Newport Creek	Nitrogen	4a
			MD-02130105-T-Marshall_Creek	Marshall Creek	Nitrogen	5
					Phosphorus	5
			MD-02130105-T-Kitts_Branch	Kitts Branch	Biochemical Oxygen Demand	4a
			MD-02130105-T-Ayer_Creek	Ayer Creek	Nitrogen	4a
			MD-02130105-T-Newport_Bay	Newport Bay	Nitrogen	4a
1996	Sinepuxent Bay	02130104	MD-02130104-T	Sinepuxent Bay	Nitrogen	5
					Phosphorus	5
1996	Chincoteague Bay	02130106	MD-02130106-T	Chincoteague Bay	Nitrogen	5
					Phosphorus	5

[1] Integrated Report Listing Category 5: Water body is impaired, does not attain the water quality standard, and a TMDL or other acceptable pollution abatement initiative is required.
[2] Integrated Report Listing Category 4a: TMDL already approved or established by EPA.

II. Summary

The TMDL specifically allocates the allowable Nitrogen and Phosphorus loadings to the Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, Newport Bay and Chincoteague Bay. There are fourteen permitted point sources, and an allocation for general permit for Concentrated Animal Feeding Operations (CAFOs) which are included in the WLA. The fact that the TMDL does not assign WLAs to any other sources in the watershed should not be construed as a determination by either EPA or MDE that there are no additional sources in the watershed that are subject to the National Pollutant Discharge Elimination System (NPDES) program. In addition, the fact that EPA is approving this TMDL does not mean that EPA has determined whether some of the sources discussed in the TMDL, under appropriate conditions, might be subject to the NPDES program. The Nitrogen and Phosphorus TMDLs are presented as an average annual load in pounds per year and pounds per growing season because it was calculated so as to not cause any Nitrogen and Phosphorus related impacts to the specific designated use of the Coastal Bay system. The maximum daily Phosphorus Load is presented in pounds per day. The calculation of the maximum daily loads is explained in Appendix F of the TMDL report. The growing season, average annual, and daily maximum Nitrogen and Phosphorus TMDLs for each Coastal Bay Watershed are summarized in Tables 2 through 7 below. The TMDL is the sum of the Upstream LAs, LA, Process Water WLA, CAFO WLA, and MOS. The Upstream LAs are loads from outside Maryland and may include point and nonpoint source loads. The LA include nonpoint source loads generated within each of the Maryland Coastal Bay watersheds. Individual average annual and maximum daily WLAs for permitted point sources are provided in Table 8 and 9.

Table 2. Total Nitrogen growing season TMDLs for the Maryland Coastal Bays (lbs/growing season)

Basin Name	TMDL (lbs/growing season)	Upstream Loads[1] (WLA+LA)	$WLA_{Process Water}$	WLA_{CAFO}	LA	MOS
Greys Creek	46,422	29,042	0	339	17,041	Implicit
Assawoman Bay[2,4]	**143,441**	**96,044**	**0**	**339**	**47,058**	**Implicit**
Bishopville Prong	25,592	11,777	333	1,411	12,071	Implicit
Shingle Landing Prong	27,750	0	7,520	678	19,552	Implicit
St. Martin River[2]	68,348	11,777	7,853	2,224	46,494	Implicit
Herring Creek	7,250	0	0	0	7,250	Implicit
Turville Creek	12,998	0	0	373	12,625	Implicit
Manklin Creek	7,541	0	0	0	7,541	Implicit
Isle of Wight Bay[2,4]	**133,238**	**11,777**	**21,664[3]**	**2,597**	**97,200**	**Implicit**
Ayer Creek/Kitts Branch	37,036	0	5,463	268	31,305	Implicit
Newport Creek	9,361	0	0	440	8,921	Implicit
Marshall Creek	16,796	0	1,934	562	14,300	Implicit
Newport Bay[2,4]	**88,819**	**0**	**7,397**	**1,526**	**79,896**	**Implicit**
Sinepuxent Bay[4]	**45,442**	**0**	**1,859**	**0**	**43,583**	**Implicit**
Chincoteague Bay[4]	**569,121**	**308,377**	**0**	**2,118**	**258,626**	**Implicit**

[1] Upstream Loads 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 applicable sub-basins.
[3] This allocation does not include the Ocean City WWTP loads.
[4] TMDL represents assimilative capacity of the tidal MD 8-Digit waterbody.

Table 3. Total Phosphorus growing season TMDLs for the Maryland Coastal Bays (lbs/growing season)

Basin Name	TMDL (lbs/growing season)	Upstream Loads[1] (WLA+LA)	$WLA_{Process\ Water}$	WLA_{CAFO}	LA	MOS
Greys Creek	3,446	2,194	0	28	1,223	Implicit
Assawoman Bay[2,4]	**10,196**	**6,887**	**0**	**28**	**3,281**	**Implicit**
Bishopville Prong	2,797	1,450	0	116	1,231	Implicit
Shingle Landing Prong	2,639	0	614	56	1,969	Implicit
St. Martin River[2]	6,486	1,450	614	183	4,239	Implicit
Herring Creek	586	0	0	0	586	Implicit
Turville Creek	924	0	0	31	893	Implicit
Manklin Creek	645	0	0	0	645	Implicit
Isle of Wight Bay[2,4]	**12,451**	**1,450**	**2,916[3]**	**214**	**7,871**	**Implicit**
Ayer Creek/Kitts Branch	2,990	0	632	22	2,335	Implicit
Newport Creek	648	0	0	36	612	Implicit
Marshall Creek	1,208	0	322	46	840	Implicit
Newport Bay[2,4]	**6,673**	**0**	**955**	**125**	**5,594**	**Implicit**
Sinepuxent Bay[4]	**3,269**	**0**	**6**	**0**	**3,264**	**Implicit**
Chincoteague Bay[4]	**41,488**	**24,122**	**0**	**174**	**17,191**	**Implicit**

[1] Upstream Loads 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 applicable sub-basins.
[3] This allocation does not include the Ocean City WWTP loads.
[4] TMDL represents assimilative capacity of the tidal MD 8-Digit waterbody.

Table 4. Total Nitrogen average annual TMDLs for the Maryland Coastal Bays (lbs/year)

Basin Name	TMDL (lbs/yr)	Upstream Loads[1] (WLA+LA)	$WLA_{Process\ Water}$	WLA_{CAFO}	LA	MOS
Greys Creek	101,333	64,962	0	678	35,693	Implicit
Assawoman Bay[2,4]	**300,669**	**204,889**	**183**	**678**	**94,919**	**Implicit**
Bishopville Prong	54,619	25,434	665	2,823	25,697	Implicit
Shingle Landing Prong	58,520	0	15,278	1,357	41,885	Implicit
St. Martin River[2]	143,671	25,435	15,943	4,451	97,843	Implicit
Herring Creek	14,413	0	0	0	14,413	Implicit
Turville Creek	26,311	0	0	747	25,564	Implicit
Manklin Creek	14,692	0	0	0	14,692	Implicit
Isle of Wight Bay[2,4]	**276,986**	**25,435**	**47,869[3]**	**5,198**	**198,484**	**Implicit**
Ayer Creek/Kitts Branch	80,669	0	14,215	535	65,919	Implicit
Newport Creek	20,465	0	0	879	19,586	Implicit
Marshall Creek	30,827	0	3,836	1,124	25,867	Implicit

Newport Bay[2,4]	**185,471**	**0**	**18,051**	**3,050**	**164,370**	**Implicit**
Sinepuxent Bay[4]	**90,347**	**0**	**3,741**	**0**	**86,606**	**Implicit**
Chincoteague Bay[4]	**1,166,469**	**633,578**	**0**	**4,236**	**528,655**	**Implicit**

[1] Upstream Loads 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 applicable sub-basins.
[3] This allocation does not include the Ocean City WWTP loads.
[4] TMDL represents assimilative capacity of the tidal MD 8-Digit waterbody.

Table 5. Total Phosphorus average annual TMDLs for the Maryland Coastal Bays (lbs/year)

Basin Name	TMDL (lbs/yr)	Upstream Loads[1] (WLA+LA)	$WLA_{Process\ Water}$	WLA_{CAFO}	LA	MOS
Greys Creek	6,847	4,375	0	56	2,416	Implicit
Assawoman Bay[2,4]	**19,985**	**13,501**	**0**	**56**	**6,428**	**Implicit**
Bishopville Prong	5,603	2,890	0	232	2,481	Implicit
Shingle Landing Prong	5,316	0	1,218	112	3,987	Implicit
St. Martin River[2]	12,988	2,890	1,218	366	8,514	Implicit
Herring Creek	1,146	0	0	0	1,146	Implicit
Turville Creek	1,813	0	0	61	1,752	Implicit
Manklin Creek	1,240	0	0	0	1,240	Implicit
Isle of Wight Bay[2,4]	**24,715**	**2,890**	**5,784[3]**	**427**	**15,613**	**Implicit**
Ayer Creek/Kitts Branch	6,233	0	1,629	44	4,560	Implicit
Newport Creek	1,295	0	0	72	1,223	Implicit
Marshall Creek	2,425	0	639	92	1,694	Implicit
Newport Bay[2,4]	**13,589**	**0**	**2,268**	**251**	**11,070**	**Implicit**
Sinepuxent Bay[4]	**6,381**	**0**	**11**	**0**	**6,370**	**Implicit**
Chincoteague Bay[4]	**82,304**	**47,797**	**0**	**348**	**34,159**	**Implicit**

[1] Upstream Loads 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 applicable sub-basins.
[3] This allocation does not include the Ocean City WWTP loads.
[4] TMDL represents assimilative capacity of the tidal MD 8-Digit waterbody.

Table 6. Total Nitrogen Maximum Daily Load by TMDL Basin (lbs/day)

Basin Name	MDL	Upstream Loads[1] (WLA+LA)	WLA (Process Water)	WLA (CAFO)	LA	MOS
Greys Creek	782.1	516.5	0.0	1.9	263.7	Implicit
Assawoman Bay[2]	**2,080.4**	**1,542.2**	**0.5**	**1.9**	**535.8**	**Implicit**
Bishopville Prong	410.1	184.1	1.8	7.7	216.4	Implicit
Shingle Landing Prong	433.1	0.0	41.9	3.7	387.5	Implicit
St. Martin River[2]	1,025.6	184.1	43.7	12.2	785.6	Implicit

Herring Creek	104.2	0.0	0.0	0.0	104.2	Implicit
Turville Creek	182.5	0.0	0.0	2.0	180.4	Implicit
Manklin Creek	108.6	0.0	0.0	0.0	108.6	Implicit
Isle of Wight Bay[2]	**1,710.0**	**184.1**	**131.1**	**14.2**	**1,380.5**	**Implicit**
Ayer Creek/Kitts Branch	621.7	0.0	38.9	1.5	581.3	Implicit
Newport Creek	177.3	0.0	0.0	2.4	174.9	Implicit
Marshall Creek	231.9	0.0	10.5	3.1	218.3	Implicit
Newport Bay[2]	**1,364.7**	**0.0**	**49.5**	**8.4**	**1,306.9**	**Implicit**
Sinepuxent Bay	**465.2**	**0.0**	**10.2**	**0.0**	**454.9**	**Implicit**
Chincoteague Bay	**6,193.6**	**3,591.7**	**0.0**	**11.6**	**2,590.3**	**Implicit**

[1] Upstream Loads denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.
[2] This allocation includes the allocations from other subwatersheds draining to this MD 8-digit watershed.

Table 7. Total Phosphorus Maximum Daily Load by TMDL Basin (lbs/day)

Basin Name	MDL	Upstream Loads[1] (WLA+LA)	WLA (Process Water)	WLA (CAFO)	LA	MOS
Greys Creek	53.4	33.8	0.0	0.2	19.4	Implicit
Assawoman Bay[2]	**147.4**	**106.2**	**0.0**	**0.2**	**41.1**	**Implicit**
Bishopville Prong	45.8	21.6	0.0	0.6	23.5	Implicit
Shingle Landing Prong	42.4	0.0	3.3	0.3	38.8	Implicit
St. Martin River[2]	102.0	21.6	3.3	1.0	76.0	Implicit
Herring Creek	8.7	0.0	0.0	0.0	8.7	Implicit
Turville Creek	14.2	0.0	0.0	0.2	14.0	Implicit
Manklin Creek	9.7	0.0	0.0	0.0	9.7	Implicit
Isle of Wight Bay[2]	**161.9**	**21.6**	**15.8**	**1.2**	**123.3**	**Implicit**
Ayer Creek/Kitts Branch	49.0	0.0	4.5	0.1	44.4	Implicit
Newport Creek	12.3	0.0	0.0	0.2	12.1	Implicit
Marshall Creek	16.8	0.0	1.8	0.3	14.8	Implicit
Newport Bay[2]	**101.9**	**0.0**	**6.2**	**0.7**	**95.0**	**Implicit**
Sinepuxent Bay	**37.5**	**0.0**	**0.0**	**0.0**	**37.5**	**Implicit**
Chincoteague Bay	**425.5**	**255.7**	**0.0**	**1.0**	**168.9**	**Implicit**

[1] Upstream Loads denotes loadings from outside Maryland's portion of the watershed. This allocation includes point and nonpoint sources.
[2] This allocation includes the allocations from other subwatersheds draining to this MD 8-digit watershed

Table 8. Process Water Point Source WLA – Average Annual

Basin Name	Sub-basin Name	Facility	Type[1]	Permit Number[1]	Nutrient Loads (lbs/year)		Flow	Concentration (mg/L)		Daily Maximum Load	
				NPDES/MD #	TN	TP	(MGD)	TN	TP	TN	TP
Assawoman Bay	Direct Drainage	Lighthouse Sound WWTP	Spray Irrigation	DP3155	183	-	0.038	12	-	0.5	0
Isle of Wight Bay	Direct Drainage	Ocean Pines WWTP	Municipal WWTP	MD0023477	31,926	4,566	3.0	3/4***	0.5	87.5	12.5
	Bishopville Prong	Perdue Farms Inc-Bishopville Hatchery	Spray Irrigation	DP0814	665	-	0.004	N/A	-	1.8	0
	Shingle Landing Prong	River Run WWTP	Spray Irrigation	DP2394	3,102	-	0.11	10/18*	-	8.5	0
		Reserved[2]	Surface Discharge		12,176	1,218	0.80	5	0.5	33.4	3.3
	Turville Creek	Riddle Farm WWTP-001	Spray Irrigation	DP2710B	0	-	0.058	5	-	0.0	0.0
		Riddle Farm WWTP-002	Spray Irrigation	DP2710B	0	-	0.20	5	-	0.0	0.0
Newport Bay	Ayer Creek/Kitts Branch	Berlin WWTP	Municipal WWTP	MD0022632	3,378	375	0/0.6**	0/4.5**	0/0.5**	9.3	1.0
		Kelly Foods Corp	Industrial	MD0001309	1,096	37	0.020	18	0.6	3.0	0.1
		Reserved[2]	Surface Discharge		9,741	1,218	0.80	4	0.5	26.7	3.3
	Marshall Creek	Newark WWTP	Municipal WWTP	MD0020630	3,836	639	0.070	18	3	10.5	1.8
Sinepuxent Bay	Direct Drainage	Assateague Island National Seashore WWTP	Municipal WWTP	MD0021091	110	11	0.012	3	0.3	0.3	0.0
		The Mystic Harbour	Injection Well	DP2273	2,283	-	0.25	3	-	6.3	0.0
		Assateague Pointe WWTP	Spray Irrigation	DP2608	435	-	0.042	10/18*	-	1.2	0.0
		The Landings	Injection Well	DP0121	913	-	0.10	10	-	2.5	0.0
Chincoteague Bay	-	-	-	-	-	-	-	-	-	-	-
		Total			**836,957**	**135,915**	**N/A**	**N/A**	**N/A**		
		* (Mar-Oct)/(Nov-Feb)									
		**(Apr-Oct)/(Nov-Mar)									
		***(May-Oct)/(Nov-Apr)									

[1] Spray irrigation and groundwater injection wastewater disposal practices have Maryland state permits only. They do not have NPDES permits.

[2] The Berlin North WWTP and Perdue Farms Showell Complex are not currently in operation. A 'reserved' allocation has been set aside, should the Department determine that some or all of this allocation remains applicable if these permits are renewed and the facilities come back online, or if the permit(s) is transferred to another operation in the watershed.

[3] 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 5 MGD, an estimated delivered load of 767,113 lbs/year and an estimated delivered TP load of 127,852 lbs/year

Table 9. Process Water Point Source WLA – Growing Season (May 1st – October 31)

Basin Name	Sub-basin Name	Facility	Type[1]	Permit Number[1] NPDES/MD #	Nutrient Loads (lbs/growing season)[2]		Flow (MGD)[3]	Concentration (mg/L)[4]		Maximum Daily Load	
					TN	TP		TN	TP		
Assawoman Bay	Direct Drainage	Lighthouse Sound WWTP	Spray Irrigation	DP3155	0	-	0.038	12	-	0.0	0.0
Isle of Wight Bay	Direct Drainage	Ocean Pines WWTP	Municipal WWTP	MD0023477	13,811	2,302	3.0	3	0.5	37.8	6.3
	Bishopville Prong	Perdue Farms Inc-Bishopville Hatchery	Spray Irrigation	DP0814	333	-	0.004	N/A	-	0.9	0.0
	Shingle Landing Prong	River Run WWTP	Spray Irrigation	DP2394	1,382	-	0.11	10	-	3.8	0.0
		Reserved[5]	Surface Discharge		6,138	614	0.80	5	0.5	16.8	1.7
	TurvilleCreek	Riddle Farm WWTP-001	Spray Irrigation	DP2710B	0	-	0.058	5	-	0.0	0.0
		Riddle Farm WWTP-002	Spray Irrigation	DP2710B	0	-	0.20	5	-	0.0	0.0
Newport Bay	Ayer Creek/Kitts Branch	Berlin WWTP	Municipal WWTP	MD0022632	0	0	0	0	0	0.0	0.0
		Kelly Foods Corp	Industrial	MD0001309	552	18	0.020	18	0.6	1.5	0.1
		Reserved[5]	Surface Discharge		4,911	614	0.80	4	0.5	13.5	1.7
	Marshall Creek	Newark WWTP	Municipal WWTP	MD0020630	1,934	322	0.070	18	3	5.3	0.9
Sinepuxent Bay	Direct Drainage	Assateague Island National Seashore WWTP	Municipal WWTP	MD0021091	55	6	0.012	3	0.3	0.2	0.0
		Assateague Pointe WWTP	Spray Irrigation	DP2608	193	-	0.042	10		0.5	0.0
		The Mystic Harbour	Injection Well	DP2273	1,151	-	0.25	3	-	3.2	0.0
		The Landings	Injection Well	DP0121	460	-	0.10	10		1.3	0.0
Chincoteague Bay		-	-	-	-	-	-	-	-	-	-
		Total			**415,327**	**67,944**	**N/A**	**N/A**	**N/A**		

[1] Spray irrigation and groundwater injection wastewater disposal practices have Maryland state permits only. They do not have NPDES permits.
[2] lbs: pounds
[3] MGD: millions of gallons per day
[4] mg/L: milligrams per liter
[5] The Berlin North WWTP and Perdue Farms Showell Complex are not currently in operation. A 'reserved' allocation has been set aside, should the Department determine that some or all of this allocation remains applicable if these permits are renewed and the facilities come back online, or if the permit(s) is transferred to another operation in the watershed.
[6] 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 5 MGD, an estimated delivered load of 386,709 lbs/growing season and an estimated delivered TP load of 64,452 lbs/growing.

The TMDL is a written plan established to ensure that a waterbody will attain and maintain water quality standards. The TMDL is a scientifically based strategy that considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of a MOS value. The option is always available to refine the TMDL for resubmittal to EPA for approval if environmental conditions, new data, or the understanding of the natural processes change more than what was anticipated by the MOS.

III. Background

The Coastal Bays are a shallow coastal lagoon system that spans three states; however, the majority of the system is located in Maryland. The Maryland Coastal Bays are comprised of several individual MD 8-Digit waterbodies: Assawoman Bay, Isle of Wight Bay (including the St. Martin's River), Sinepuxent Bay, Newport Bay and Chincoteague Bay. The Coastal Bays are located on the eastern side of the Delmarva (Delaware-Maryland-Virginia) Peninsula and include portions of Worcester County (Maryland), Sussex County (Delaware), and Accomack County (Virginia). Areas of interest in the watershed are Ocean City (Maryland), Assateague Island National Seashore, Ocean Pines (Maryland), Berlin (Maryland), Chincoteague National Wildlife Refuge (Virginia), Wallops Island National Wildlife Refuge (Virginia), Selbyville (Delaware), Fenwick Island (Delaware), South Bethany (Delaware), Bethany Beach (Delaware), and Ocean View (Delaware). The system connects to the Atlantic Ocean through two inlets: Ocean City Inlet and Chincoteague Inlet. The total watershed area (land area only) draining to the Coastal Bays is 210,360 acres (851 square kilometers).

Tier II watershed are areas identified by the State of Maryland that drain to high quality waters, which need to be preserved with respect to current anti-degradation policies and regulations. In the MD 8-Digit Chincoteague Bay watershed, Maryland has identified the Little Mill Creek 1, which has a drainage area of 3,096 acres, as being a Tier II stream segment. There are no other Tier II waters within the Maryland Coastal Bays watershed (COMAR 2012).

Natural water depths in the Coastal Bays are generally less than 8 feet (ft), except for the main navigation channels around the inlets. The tidal range varies by location. Tidal range near the Ocean City Inlet is more than 3.4 ft, dropping to 0.4 ft in the middle of the Chincoteague Bay and 1.5 ft in Assawoman Bay. Strong mixing usually occurs when wind blows across these shallow waters. The residence times for the entire system range from 71.7 to 96.2 days, depending on flow regime and waterbody (see Table 3 for residence times of the individual waterbodies) (Wang 2009). The total watershed area (land area only) draining to the Coastal Bays is 210,360 acres (851 square kilometers).

Land use in the Coastal Bays watershed varies widely. Upstream areas in Virginia and Delaware comprise 89,920 acres or 43% of the total watershed area. The Maryland land uses are comprised of forest and other herbaceous growth - 45,367 acres (22% of the total watershed area); mixed agriculture - 32,140 acres (15%); water features - 21,478 acres (10%); urban land - 17,525 acres (8%), and barren or beaches – 3,660 acres (2%). Land use information was derived from the 2002 Delaware Land Use and Land Cover (Delaware Spatial Data Implementation

Team 2003), Worcester County (Maryland) Land Use Database (Worcester County Department of Planning 2007), and, for Virginia, from the National Land Cover Database [U.S. Geological Survey (USGS) 1999]. The Worcester County land use information is highly detailed and for the purposes of this study was reclassified and aggregated to match the Chesapeake Bay Program Phase 5 Community Watershed Model (CBP-P5) land use classifications.

The Maryland Department of the Environment (MDE) has identified the waters of the Maryland Coastal Bays on the Integrated Report as impaired by nutrients (see Table 1 above) (MDE 2010). Nitrogen and Biological Oxygen Demand (BOD) TMDLs for the MD 8-Digit Newport Bay were approved by the USEPA in 2003. The TMDLs described within this document were developed to address the water quality impairments associated with excess nutrient loadings, and supersede the previous TMDLs.

The designated use for the tidal Maryland 8-Digit (MD 8-Digit) Assawoman Bay, Isle of Wight Bay, Newport Bay, Sinepuxent Bay, and Chincoteague Bay (Maryland Coastal Bays) is Use II: *Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting* (COMAR 2009a and 2011). Two categories of water quality criteria apply to this designated use - a set of numeric criteria for DO and narrative criteria for Chl *a*.

Eutrophication is the over-enrichment of aquatic systems from excessive nutrient inputs (nitrogen and/or phosphorus). The nutrients act as a fertilizer leading to excessive growth of algae. The algae grow rapidly, die and are subsequently consumed by bacteria. The bacterial consumption of algae uses the available oxygen in the water column, which produces hypoxic (low oxygen) or anoxic (no oxygen) conditions. Typically, problems associated with eutrophication are most likely to occur during the growing season (May 1 – October 31). The two key water quality parameters associated with eutrophication are Chl *a* and DO.

CWA Section 303(d) and its implementing regulations require that TMDLs be developed for waterbodies identified as impaired by the State where technology based and other required controls do not provide for attainment of water quality standards. The objective of the nutrient TMDLs established in this document is to ensure that DO and Chl *a* concentrations in the Maryland Coastal Bays meet the applicable water quality criteria associated with the specific designated use of the coastal bays system. Specifically, the TMDLs of nitrogen and phosphorus are intended to control excessive algal growth and increase DO concentrations in areas not currently meeting water quality criteria.

The TMDL was developed using data collected from 2000-2005. There are a total of forty-five stations with available data. These stations are operated by the Maryland Department of Natural Resources (DNR) (twenty-seven stations) and the U.S. National Park Service-Assateague Island National Seashore (ASIS) (eighteen stations). These datasets were combined to give the best possible range and coverage for the analysis.

A set of time-variable models, which constitute the Coastal Bays Eutrophication Model (CBEM), was developed as the computational framework to link the sources of nutrient loadings to the DO criteria and chlorophyll *a* goals. The overall CBEM package is linked to a watershed model, which applies Hydrological Simulation Program – FORTRAN (HSPF) language. The

CBEM incorporates a hydrodynamic model, the Semi-implicit Eulerian-LaGrangian Finite Element model (SELFE), and a water quality model with a sediment flux sub-model, the Corps of Engineers Water Quality Compartment Model (CE-QUAL-ICM). This water quality simulation package provides a generalized framework for modeling nutrient fate and transport in tidal surface waters (Cerco and Cole 1995).

The HSPF model is used to estimate flows, suspended solids, and nutrient loads from the watersheds' sub-basins. The HSPF model consists of 199 watershed segments. Two of the segments, Birch Branch and Bassett Creek, have measured flow data collected by the USGS, and therefore include simulated stream reaches. The model generates simulated runoff and loads for many different parameters (see VIMS 2013 for details). The HSPF watershed model utilized land use information and hydrology associated with the 2001-2004 period to generate loading estimates for this scenario. The model timeframe spanned the period of 2000-2005. The TMDL analysis was conducted using the 2001-2004 period as a baseline, which includes dry, wet and average years. The year 2000 served as the model's initialization period, and the available water quality data was only available up to August of 2005; therefore, the delivered loads in the figures represent an average for the 2001-2004 period.

The nonpoint source nutrient loads, including urban stormwater loads, were estimated using the Coastal Bays HSPF watershed model. The HSPF watershed model simulates urban stormwater and nonpoint source loadings for all natural and human-induced sources, including atmospheric deposition (both indirectly to the watershed and directly to the surface of the tidal waters), septic systems, cropland, pasture, feedlots, urban areas, and forest. Table 10 presents the delivered loads from the different land uses within the watershed.

Table 10. Average annual nonpoint source delivered TN and TP loads, 2001-2004

TN Load(lbs/yr)					
MD 8-Digit Waterbody	**Upstream**	**MD 8-Digit Contribution**			
		Forest/ Barren	**Mixed Agricultural**	**Urban**	**Total Land Use Load for Watershed**
Assawoman Bay	215,432	1,657	17,645	21,568	256,302
Isle of Wight Bay	64,813	6,951	131,088	95,578	298,431
Newport Bay	0	6,203	92,167	46,188	144,558
Sinepuxent Bay	0	1,671	6,054	21,662	29,387
Chincoteague Bay	239,951	10,916	158,537	18,289	427,693
Total	**520,196**	**23,476**	**388,674**	**200,979**	**1,156,371**
TP-lbs/yr					
Assawoman Bay	16,527	80	1,103	2,038	19,748
Isle of Wight Bay	5,171	585	8,435	8,704	22,895
Newport Bay	0	529	5,927	4,407	10,863
Sinepuxent Bay	0	143	388	2,060	2,591
Chincoteague Bay	16,600	882	10,108	1,910	29,500
Total	**39,359**	**2,270**	**25,310**	**18,659**	**85,597**

lbs/yr = pounds per year

The loads for septics were calculated based on a methodology used by the EPA-CBP. The average septic system delivers about 30 lbs of nitrogen per year to the groundwater. Of the estimated 420,000 septic systems in Maryland, 52,000 septic systems are in the Critical Area (within 1000 ft of tidal waters of the State); approximately 80 percent of the nitrogen from a septic system in the Critical Area will reach surface waters (MDE 2009b). In the Maryland Coastal Bays watershed, there are 4,188 septics, of which 3,021 (72%) are in the Critical Area. Therefore, septic system nutrient loads need to be taken into account as a source of nutrients within the Coastal Bays watershed. The estimated delivered load from septic systems is 184,067 lbs/yr TN.

Table 11. Average annual on-site wastewater disposal (septic systems) delivered TN loads, 2001-2004

MD 8-Digit Waterbody	**TN Load (lbs/yr)**	
	Upstream	**MD 8-Digit Contribution**
Assawoman Bay	19,225	10,658
Isle of Wight Bay	1,145	38,527
Sinepuxent Bay	0	6,971
Newport Bay	0	21,183
Chincoteague Bay	73,259	13,099
Total	**93,629**	**90,438**

The atmospheric deposition is simulated as part of the nonpoint source loads. The estimated TN deposition per area is applied to all the simulated land uses, as well as to the simulated streams in the two segments in which there are USGS gaging stations (Birch Branch and Bassett Creek). For the other segments within the watershed model, the loading rates for the different land uses inherently capture the loadings from atmospheric deposition because they were added to the land-use loads during model calibration in the Birch and Bassett Creek segments. For more details, see the documentation for the USEPA's CBP-P5 Model (USEPA 2010). The time series used for estimating direct atmospheric deposition to the surface waters of the Coastal Bays for the model simulation period was obtained from the National Atmospheric Deposition Program, which collected data at Assateague Island National Seashore for the period of 2001 – 2004. Only wet-deposited nitrogen is collected at the station. Scientific consensus is that dry-deposited nitrogen is roughly equal to wet (MDE 2013). Accordingly, the deposition amount was doubled to account for both wet and dry conditions. In keeping with the Chesapeake Bay TMDL/Community Multi-scale Air Quality Model methodology, a 20:1 nitrogen to phosphorus ratio was assumed, so as to incorporate phosphorus deposition (USEPA 2010). For more detailed information, see Wang *et al.* (2013).

Table 12. Average annual TN and TP atmospheric deposition, 2001-2004

MD 8-Digit Waterbody	TN Load (lbs/yr)		TP Load (lbs/yr)	
	Upstream	MD 8-Digit Contribution	Upstream	MD 8-Digit Contribution
Assawoman Bay	18,337	45,025	918	2,249
Isle of Wight Bay	0	51,901	0	2,594
Newport Bay	0	30,214	0	1,510
Sinepuxent Bay	0	43,396	0	2,169
Chincoteague Bay	213,444	334,129	10,668	16,700
Total	**231,781**	**504,665**	**11,586**	**25,222**

The entire length of the natural shoreline within Maryland's tidal zone consists of unconsolidated sands, silts, and clays. Consequently, it is relatively easy for water to erode the unconsolidated sediments in Maryland's coastal plain. The challenges posed by shoreline erosion in Maryland reflect the unique combination of both natural and man-made conditions affecting a particular shoreline region. In addition to direct economic, environmental, and cultural impacts, shore erosion has important off-site impacts; the most obvious and pervasive being the deposition of sediment into the State's tidal waters. Given the extent of coastline in the Coastal Bays system, nutrient inputs from shoreline erosion had to be taken into account in the model. The estimated TN and TP loads associated with shoreline erosion for the Coastal Bays system were calculated based on information presented in Wells, Hennessee, and Hill (2002 and 2003), and Wells *et al.* (2008).

Table 13. Average annual TN and TP loads associated with shoreline erosion, 2001-2004

MD 8-Digit Waterbody	TN Load (lbs/yr)		TP Load (lbs/yr)	
	Upstream	MD 8-Digit Contribution	Upstream	MD 8-Digit Contribution
Assawoman Bay	0	10,923	0	1,008
Isle of Wight Bay	0	18,729	0	2,196
Newport Bay	0	6,221	0	833
Sinepuxent Bay	0	9,064	0	1,469
Chincoteague Bay	91,807	53,918	12,649	7,429
Total	**91,807**	**98,855**	**12,649**	**12,935**

There are twenty four process water point source facilities within the Coastal Bays watershed from all jurisdictions. In the upstream watershed areas, there are ten facilities with permits regulating the discharge of nutrients. In Maryland, there are five municipal WWTPs with surface discharge NPDES permits located within the Coastal Bays modeling domain. One of these municipal WWTPs (Ocean City WWTP) discharges into the Atlantic Ocean, outside of the Maryland Coastal Bays watershed. Also, in Maryland, there are five spray irrigation facilities, two injection well facilities, and three industrial point sources. Table 14 presents the delivered total nitrogen (TN) and total phosphorus (TP) loads for each identified facility.

Table 14. Average daily flows and estimated annual TN and TP loads for process water point sources discharging into the Maryland Coastal Bays modeling domain, 2001-2004.

Facility	Type	Average Flow [Million gallons per day(MGD)]	Estimated Delivered TN Load [pounds per year (lbs/yr)]	Estimated Delivered TP Load (lbs/yr)
Maryland				
Berlin WWTP	Municipal	0.070	751	14
Newark WWTP	Municipal	0.039	1,034	300
Ocean Pines WWTP	Municipal	0.9	10,093	867
Berlin North WWTP	Industrial	0.044	5,378	484
Assateague Island National Seashore	Municipal	0.004	662	191
Perdue Farms, Inc.: Showell Facility	Industrial	0.63	5,279	193
Kelly Foods Corporation	Industrial	0.006	112	2
Riddle Farm WWTP – outfall 001	Spray Irrigation	0.0576	0	0
Riddle Farm WWTP – outfall 002	Spray Irrigation	0.198	0	0
Lighthouse Sound WWTP	Spray Irrigation	0.038	183	0
Assateague Pointe WWTP	Spray Irrigation	0.042	367	0
River Run WWTP	Spray Irrigation	0.11	2,614	0
Perdue Farms – Bishopville Hatchery	Spray Irrigation	0.004	549	0
The Mystic Harbour	Injection Well	0.103	853	0
The Landings	Injection Well	0.10	0.00	0
Upstream - Delaware			**2,359**	**484**
Upstream - Virginia			**26,507**	**7,596**
Total			**354,981**	**51,885**

*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. Average flow shown for Berlin North WWTP is surface discharge only.

In January 2009, Maryland implemented new regulations governing CAFOs (COMAR 2013a,b,c), which were approved by the USEPA in January, 2010. Under these regulations, CAFOs are required to fulfill the conditions of a general permit. These conditions include instituting a Comprehensive Nutrient Management Plan (CNMP) that meets the Nine Minimum Standards to Protect Water Quality, which include: 1) ensure adequate storage capacity, 2) ensure proper management of mortalities to prevent the discharge of pollutants into waters of the State, 3) divert clean water, as appropriate, from the production area to keep it separate from process wastewater, 4) prevent direct contact of confined animals with waters of the State, 5) chemical handling, 6) conservation practices to control nutrient loss, 7) protocols for manure and soil testing, 8) protocols for the land application of manure and wastewater, and 9) record keeping. These are described in further detail in the general CAFO permit (MDE 2009a). The general permit also prohibits the discharge of pollutants, including nutrients, from CAFO production areas, except as a result of events greater than the 25-year, 24-hour storm. There are twenty-two operators in the Maryland Coastal Bays watershed that have filed notices of intent to apply for permits under Maryland's CAFO or Maryland Animal Feeding Operation (MAFO) regulations.

The nutrient TMDL analysis consists of two components: an assessment of growing season loading conditions and an assessment of average annual loading conditions. Both the growing season and the average annual TMDL analyses investigate the critical conditions under which symptoms of eutrophication are typically most acute. During excessively dry or wet years, the flux in loadings has a significant impact on water quality. Additionally, water quality is most impacted by nutrient inputs during late summer when flows are low, the system is poorly flushed, and sunlight and temperatures are most conducive to excessive algal production. The TMDL analysis allows a comparison of current nutrient loading conditions to future conditions that project the water quality response to various simulated nutrient load reductions.

The scenario results are grouped according to baseline conditions and future conditions. The baseline condition is intended to provide a point of reference with which to compare future scenarios that simulate conditions of a TMDL. The baseline conditions scenario represents the nutrient loadings associated with the observed water quality conditions in the Maryland Coastal Bays and its tributaries from 2001-2004. This four year model simulation accounts for various loading and hydrologic conditions in the system, which captures the possible critical conditions and seasonal variations of the system.

The future conditions scenario is associated with the TMDLs. Additional scenarios were tested including the following: a natural conditions scenario (in which land is assumed to be all forested and atmospheric deposition is reduced by 90%) to simulate the removal of all anthropogenic sources possible water quality conditions; a maximum practicable anthropogenic reduction scenario (MPAR) to determine the maximum reduction achievable with current technologies; incremental reduction scenarios (20%, 40%, and 60% reductions); and multiple geographic isolation scenarios to tailor the final TMDL scenario. These scenarios were used as guides to develop the future conditions scenario. These scenarios are described more fully in Wang *et al.* (2013). Of note, for the MPAR scenario percent reductions are calculated from CBP-P5 scenario results for the Eastern Shore for total nitrogen and total phosphorus. CBP-P5 scenario results are available for the following scenarios: no-action (no reductions applied to the baseline); E-3 (Everyone, Everything, Everywhere – maximum reductions from all sources); 2009 Progress (incorporates reductions from implementation through 2009); and 2010 progress (incorporates reductions from implementation through 2010). For each land use sector, the mean percent reduction from the baseline and the three available reduction scenarios was used to calculate the reduction rate for the Coastal Bays watershed model: no-action to E3; 2009 progress to E3; and 2010 progress to E3.

Using the exploratory scenarios mentioned above, the future conditions or TMDL scenario was compiled. See Wang *et al.* 2013 for more detailed information about the TMDL scenario. Based on the results of the exploratory scenarios, it was determined that the Bishopville Prong/Shingle Landing Prong tributaries required the highest nutrient reductions in order to meet water quality standards, i.e., MPAR reductions. The reductions applied to atmospheric deposition were based off the allocation scenario (2025) for Worcester County in the Chesapeake Bay TMDL. See USEPA (2010) for further details regarding atmospheric deposition reductions. The reductions from controllable sources required to meet water quality standards in the future conditions scenario are presented in Table 15. See Wang *et al.* 2013 for more detailed information about the TMDL scenario.

Table 15. Future condition (TMDL) scenario TN and TP reductions by watershed

Waterbody	Reduction percent needed to meet Water Quality Standards
Assawoman Bay (including Greys Creek)	20%
Bishopville Prong/Shingle Landing Prong (Isle of Wight Bay)	Maximum Practical Anthropogenic Reduction (MPAR)
Isle of Wight Bay (all areas except those identified above)	40%
Newport Bay	20%
Sinepuxent Bay	0%
Chincoteague Bay	20% to Maryland's portion of the watershed

IV. Discussion of Regulatory Conditions

EPA finds that MDE has provided sufficient information to meet all seven of the basic requirements for establishing Nitrogen and Phosphorus TMDL for the Maryland Coastal Bays. EPA, therefore, approves these Nitrogen and Phosphorus TMDLs for the Maryland Coastal Bays. This approval is outlined below according to the seven regulatory requirements.

1) The TMDLs are designed to implement applicable water quality standards.

Water Quality Standards consist of three components: designated and existing uses; narrative and/or numerical water quality criteria necessary to support those uses; and an anti-degradation statement. The designated use for the tidal Maryland 8-Digit (MD 8-Digit) Assawoman Bay, Isle of Wight Bay, Newport Bay, Sinepuxent Bay, and Chincoteague Bay is Use II: *Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting* (COMAR 2009a and 2011).

Two categories of water quality criteria apply to this designated use - a set of numeric criteria for DO and narrative criteria for Chl *a*. Maryland requires a minimum DO concentration of 5.0 milligrams per Liter (mg/L) at any time (COMAR 2009b). Maryland does not have numeric criteria for Chl *a*. Maryland's narrative criterion for Chl *a* states that "Concentrations of chlorophyll *a* in free-floating microscopic aquatic plants (algae), may not exceed levels that result in ecologically undesirable consequences that would render tidal waters unsuitable for designated uses" (COMAR 2009b).

In other estuarine areas, Maryland has previously used a TMDL endpoint for Chl *a* of 50 µg/L, or in some cases, a goal of 50 µg/L with a maximum allowable absolute value of 100 µg/L as in guidelines set forth by Thomann and Mueller (1987) and by the "EPA Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2, Part 1" (1997). These guidelines acknowledge that it is acceptable to maintain Chl *a* concentrations below a maximum of 100 µg/L, with a target threshold of less than 50 µg/L. However, for the Maryland Coastal Bays

TMDL, Maryland is interpreting "protection of aquatic life" to include the protection of submerged aquatic vegetation (SAV). SAV are an important component of the Coastal Bays ecosystem. In the Coastal Bays system, many factors (*e.g.* substrate composition, depth, and current speed) affect the suitability of a given area to serve as habitat for SAV. However, a consensus has emerged among scientists most familiar with this particular system that, in SAV growth areas, a chlorophyll *a* concentration whereby the 90th percentile does not exceed 15 μg/L is supportive of SAV survival and growth (Dennison *et al.* 1993).

The Maryland Coastal Bays Program has identified several SAV grow zones within the Maryland Coastal Bays. In order to be protective of these areas, a 2,500-foot buffer was applied to the identified SAV grow zones, and the water quality monitoring stations within the buffered grow zones have been identified. The majority of the stations within the Maryland Coastal Bays (54%) are being treated as SAV growth areas. The stations that are not located in the grow zones are generally located in the headwaters of the system. Therefore, depending on station location and proximity to SAV grow zones, two Chl *a* endpoints have been chosen: <15 μg/L within the SAV growth zone, and 50 μg/L outside of the SAV growth zone.

The objective of the Nitrogen and Phosphorus TMDLs established in this document is to ensure that DO and Chl *a* concentrations in the Maryland Coastal Bays meet the applicable water quality criteria associated with the specific designated use of the system. EPA believes these are reasonable and appropriate water quality goals.

2) The TMDLs include a total allowable load as well as individual wasteload allocations and load allocations.

Total Allowable Load

EPA regulations at 40 CFR §130.2(i) state that *the total allowable load shall be the sum of individual WLAs for point sources, Las for nonpoint sources, and natural background concentrations.* The TMDLs of Nitrogen and Phosphorus for the Maryland Coastal Bays is consistent with 40 CFR §130.2(i) because the total loads provided by MDE equal the sum of the individual WLAs for point sources and the land based LAs for nonpoint sources.

TMDL loading caps were developed using the results of the scenarios described above. The loads are considered the maximum allowable load the watershed can sustain and support the Maryland Coastal Bays designated use. The Nitrogen and Phosphorus TMDLs and allocations are presented as mass loading rates of pounds per growing season for the growing season (May 1st – October 31), pounds per year for the average annual load, and pounds per day for the maximum daily load. Expressing TMDLs as growing season, annual average and maximum daily mass loading rates is consistent with Federal regulations at 40 CFR §130.2(i), which states that *TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure.* The growing season, annual average annual and maximum daily Nitrogen and Phosphorus loads are presented in Tables 2 through 7.

Load Allocations

According to Federal regulations at 40 CFR §130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loadings should be distinguished. The TMDLs summary in Table 2 through 7 contains the LA for the Maryland Coastal Bays for all conditions.

An LA was assigned to the nonpoint source loads in the watershed. These include loads from the various land uses within the watershed, septic systems, shoreline erosion, and atmospheric deposition. There are no NPDES regulated stormwater permits in the Maryland Coastal Bays watershed. Thus, the urban stormwater nitrogen and phosphorus loadings in the watershed are included within the LA portion of the TMDL. Reductions required from these sources varied among the different TMDL watersheds. Bishopville Prong and Shingle Landing Prong required the greatest reductions from nonpoint sources. No reductions were applied to shoreline erosion in any of the TMDL watersheds. The reductions applied to atmospheric deposition were based off the allocation scenario (2025) for Worcester County in the Chesapeake Bay TMDL. See USEPA (2010) for further details regarding atmospheric deposition reductions.

The *Significant Nutrient NonPoint Sources in the Maryland Coastal Bays Watershed.* Technical Memorandum includes a possible scenario for the distribution of the growing season and average annual nitrogen and phosphorus nonpoint source LAs among the various land use categories and source sectors. These loading distributions are based on the percentages of each particular land use/source sector relative to the total area of that land use/source sector in the watershed.

Wasteload Allocations

WLAs were assigned to all of the process water point source discharges in the watershed. During the 2001-2004 baseline conditions time period, there were fourteen active process water point sources in Maryland, one active process water point source in Delaware, and nine active process water point sources in Virginia with permits regulating the discharge of nutrients. All of these point sources were accounted for in the TMDL scenario; however, WLAs were only assigned to the Maryland process water point sources. The loads associated with the Virginia and Delaware process water point sources are included as part of the aggregate upstream loads. The current maximum permitted flows for the facilities were used in the allocation/TMDL scenario. Five of the sixteen process water point source facilities in Maryland discharge via spray irrigation for the treatment of effluent rather than directly discharging to surface waters. There are three industrial process water point sources. The flows and concentrations from these facilities vary from plant to plant, and their permits, the flows and concentrations are set at levels based on the implementation of best available technologies to achieve water quality criteria. There are also two injection well facilities in the watershed.

As indicated above, in January, 2009, Maryland implemented new regulations governing CAFOs (COMAR 2013a,b,c), which were approved by the USEPA in January, 2010. Under these regulations, CAFOs are required to fulfill the conditions of a general permit. There are twenty-two operators in the Maryland Coastal Bays watershed that have filed notices of intent to apply for permits under Maryland's CAFO or Maryland Animal Feeding Operation (MAFO) regulations. Estimated TN and TP loads under TMDL conditions for these facilities were derived from CAFO loading rates for Worcester and Somerset Counties, which were in turn derived from the Chesapeake Bay Program Phase 5.3.2 Watershed Model (USEPA 2010).

Federal regulations at 40 CFR §122.44(d)(1)(vii)(B) require that, for an NPDES permit for an individual point source, the effluent limitations must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the State and approved by EPA. There is no express or implied statutory requirement that effluent limitations in NPDES permits necessarily be expressed in daily terms. The CWA definition of "effluent limitation" is quite broad (effluent limitation is "any restriction on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources ...)." See CWA 502(11). Unlike the CWA's definition of TMDL, the CWA definition of "effluent limitation" does not contain a "daily" temporal restriction. NPDES permit regulations do not require that effluent limits in permits be expressed as maximum daily limits or even as numeric limitations in all circumstances, and such discretion exists regardless of the time increment chosen to express the TMDL. For further guidance, refer to Benjamin H. Grumbles memo (November 15, 2006) titled *Establishing TMDL Daily Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA, et al., No. 05-5015 (April 25, 2006) and Implications for NPDES Permits.*

EPA has authority to object to the issuance of an NPDES permit that is inconsistent with WLAs established for that point source. It is expected that MDE will require periodic monitoring of the point source(s), through the NPDES permit process, in order to monitor and determine compliance with the TMDL's WLAs. Based on the foregoing, EPA has determined that the TMDLs are consistent with the regulations and requirements of 40 CFR Part 130.

3) The TMDLs consider the impacts of background pollutant contributions.

The TMDLs consider the impact of background pollutants by considering the nitrogen and phosphorus load from natural sources such as forested land.

4) The TMDLs consider critical environmental conditions.

EPA regulations at 40 CFR §130.7(c)(1) require TMDLs to account for critical conditions for stream flow, loading, and water quality parameters. The intent of the regulations is to ensure that: (1) the TMDLs are protective of human health, and (2) the water quality of the waterbodies is protected during the times when they are most vulnerable. Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[1]. Critical conditions are a combination of environmental factors (e.g., flow,

[1] EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable worst-case scenario condition.

The TMDL estimates nutrient loadings associated with the observed water quality conditions in the Maryland Coastal Bays and its tributaries from 2001-2004. This four year model simulation accounts for various loading and hydrologic conditions in the system, which captures critical conditions and seasonal variations of the system. The modeling approach also specifically examines conditions during the growing season months when the river system is poorly flushed, and sunlight and warm water temperatures are more conducive to causing water quality problems associated with excessive nutrient enrichment.

5) The TMDLs consider seasonal environmental variations.

As indicated above, the TMDL estimates nutrient loadings associated with the observed water quality conditions in the Maryland Coastal Bays and its tributaries from 2001-2004. This four year model simulation accounts for various loading and hydrologic conditions in the system, which captures critical conditions and seasonal variations of the system. The modeling approach also specifically examines conditions during the growing season months when the river system is poorly flushed, and sunlight and warm water temperatures are more conducive to causing water quality problems associated with excessive nutrient enrichment.

6) The TMDLs include a Margin of Safety.

The requirement for a MOS is intended to add a level of conservatism to the modeling process in order to account for uncertainty. Based on EPA guidance, the MOS can be achieved through two approaches. One approach is to reserve a portion of the loading capacity as a separate term, and the other approach is to incorporate the MOS as part of the design conditions..

Maryland has adopted an implicit MOS for this TMDL for the Maryland Coastal Bays nutrient TMDLs using several conservative assumptions. The model was calibrated to forty-five water quality monitoring stations located throughout the Coastal Bays. The station locations represent the geographic areas where available water quality data can be compared to water quality modeling results for the purpose of model calibration and evaluation. With the extensive geographic coverage and the known confidence in the model simulation at the monitoring stations, as well as the fine scale of the model segmentation and the time-variable qualities of the model framework, the analysis provides the most robust analysis possible given the available data. The simulation period selected for establishing the allowable loads includes a typical flow year (2001), a very dry year (2002), and two very wet years (2003 and 2004). Generally, during dry years, the system can experience higher water temperatures combined with low flows. During wet years, higher flows and consequently increased pollutant loadings are expected. The two very wet years in this analysis produced the highest nutrient loadings in the model results. Since 50% of the model simulation period is comprised of high nutrient loadings, a conservative assumption is inherently included in the analysis. Additional conservative assumptions include the following:

- A 2,500-foot buffer was extended around the identified SAV grow zones, effectively increasing the SAV area - and the area to which the more stringent Chl *a* criterion is applied - more than two-fold;
- Animal manure application to agricultural lands was taken into consideration at the local level, and the maximum application rates reported by Parker and Li (2006) were also applied;
- The post-processing of modeling results incorporates an accounting of the diel swing of dissolved oxygen;
- The analysis used a daily average, which is the smallest timescale supported by the modeling framework;
- For SAV grow zones and surrounding buffer areas, the model assessment used a threshold of <15 μg/L Chl *a*, rather than a 90^{th} percentile of 15 μg/L;
- The watershed model assumes all land acres discharge directly to streams;
- Nutrient sequestration and/or transformation in wetlands is not considered; and
- Point source discharges in the model scenarios are set at permitted discharge and concentration limits.

Incorporation of these conservative assumptions, the robust nature of the modeling framework, and the critical periods in the modeling used to develop the TMDL supports the assertion of an implicit MOS. Therefore, a MOS accounting for uncertainties in the analysis of water quality conditions in the Maryland Coastal Bays is considered as being implicitly included in the model simulation, and consequently, in the TMDL.

7) The TMDLs have been subject to public participation.

MDE provided an opportunity for public review and comment on the Nitrogen and Phosphorus TMDL for the Maryland Coastal Bays. The public review and comment period was open from January 2, 2014 through February 17, 2014. MDE received nine sets of written comments. The comments were considered and addressed appropriately.

A letter was sent to the U.S. Fish and Wildlife Service pursuant to Section 7(c) of the Endangered Species Act, requesting the Service's concurrence with EPA's findings that approval of this TMDL does not adversely affect any listed endangered and threatened species, and their critical habitats.

V. Discussion of Reasonable Assurance

EPA requires that there be a reasonable assurance that the TMDLs can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR §122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the State and approved by EPA. Furthermore, EPA has the authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

In the Coastal Bays watershed, the maximum anthropogenic reduction demonstrates that water quality standards can be met. However, only two of the subwatersheds needs these extreme reductions to meet water quality standards.

The implementation of point source nutrient controls, which will be an integral component to meet water quality standards in the Maryland Coastal Bays, will be executed through NPDES permits. Worcester County has in place a no new discharge policy, whereby no new surface discharges will be permitted within the watershed (Worcester County Comprehensive Management Plan 2006). New facilities will have to employ spray irrigation, and new development will need to connect to an existing disposal system and still maintain the facility's nutrient loading cap.

The implementation of nonpoint source nutrient controls, which will be an integral component to achieve water quality standards in the Maryland Coastal Bays, will be executed through changes in land use and cooperative reductions from the agricultural sector. Worcester County's current stormwater management requirements, adopted in 2000, incorporate changes mandated by the State. Specifically, they include a menu of non-structural best management practices (BMPs) that allow for a more environmentally sensitive approach to site development (Worcester County Water Resources Element 2011). Worcester County has also developed a Watershed Restoration Action Strategy for the Assawoman Bay. The county will utilize this strategy to identify and prioritize watershed restoration efforts, which will include the reduction of nutrient loads from the watershed. Additional planned implementation measures in the Maryland Coastal Bays watershed involve the upgrade of septic systems, whether by connecting these systems to currently operating facilities or the addition of de-nitrification. Funding for upgrading to the denitrifying systems can be provided through the Bay Restoration Fund (BRF).

Maryland's Water Quality Improvement Act requires that comprehensive and enforceable nutrient management plans be developed, approved, and implemented for all agricultural lands throughout Maryland. This act specifically required that nutrient management plans for nitrogen are developed and implemented by 2002, and plans for phosphorus be completed by 2005. It is reasonable to expect that nonpoint loads can be reduced during the growing season conditions. The nutrient loading sources during the growing season include groundwater discharges of the dissolved forms of the impairing substances, the effects of agricultural ditching and the presence of animals in watershed stream, and the deposition of nutrients and organic matter to the streambed from higher flow events. When these sources are controlled in conjunction with one another, it is reasonable to assume that nonpoint source reductions from the agricultural sector of the magnitude required by this TMDL can be achieved.

In the Coastal Bays watershed, the lag time from actions taken on the land surface and reaction within the waterbodies may be substantial. Phillips, Focazio and Bachman (1999) report that groundwater travel times can vary from 6 to 12 years on the Coastal Plain portion of the Chesapeake Bay Watershed. Sanford et al. (2012) developed a model for predicting the trends in nitrate transport in groundwater. Sanford et al. estimate a return time (from recharge area to discharge to a receiving waterbody) of less than 10 years (near streams) to over 100 years (near stream divides). This needs to be taken into consideration when analyzing the results of post TMDL water quality monitoring data for the purposes of assessing implementation practices.

Additional potential funding sources for implementation include Maryland's Agricultural Cost Share Program (MACS), which provides grants to farmers to help protect natural resources, and the Environmental Quality and Incentives Program, which focuses on implementing conservation practices and BMPs on land involved with livestock and production. Finally, many of the statewide practices designed to meet the nutrient TMDLs within the Chesapeake Bay watershed will also assist in meeting nutrient reduction goals within the Maryland Coastal Bays.

Maryland notes that a portion of the drainage basin of the Maryland Coastal Bays (also referred to as "Upstream Loads") lies in Delaware and/or Virginia, beyond the jurisdictional and regulatory authority of Maryland. The upstream loads assigned to Delaware and/or Virginia sources are consistent with and equitable to allocations given to sources in Maryland, and are reasonable and achievable with existing technology and practices.