APPENDIX I:

Gap Analyses

The gap analyses by source sectors address the sectors listed below in a sequential order.

Nonpoint Sources: The analysis accounts for ten broad categories of

- Agriculture
- Urban and Suburban Stormwater
- Septic Systems
- Atmospheric Deposition to Non-tidal Streams[1]

Waste Water Treatment Plants (WWTPs): The analysis accounts for ten broad categories of waste water treatment plants, which are grouped and presented in six categories below.

- Major Municipal Plants (including Maryland's part of Blue Plains WWTP)
- Federal Major and Minor Municipal Plants
- Minor Municipal Plants
- Major Industrial Plants (Includes Federal plants)
- Minor Industrial Plants
- Combined Sewer Overflows (CSOs)

The reduction projections are based on estimates of current capacity. A clear example of this is the upgrade of major municipal waste water treatment plants, for which there is a shortfall in meeting current upgrade plans. The analysis shows the gap without "full funding" for WWTP upgrades to enhanced nutrient removal (ENR).

Sediment reduction estimates are not included due to time constraints; however, sediment loads from point sources are fairly negligible on a Bay scale, and nonpoint sources generally follow the trend of phosphorus.

Nitrogen Gap Analysis: Table I.1 shows the 2009 Baseline loads and projected 2017 and 2020 loads for nitrogen. These loads are estimated on the basis of current capacity for achieving reductions and account for growth. All estimates in this appendix are delivered loads. A table is provided at the end of the appendix for converting delivered loads to edge-of-stream (EOS) loads, which approximate the loads coming from the land's surface.

[1] EPA's load estimates account for atmospheric load reductions, which are not part of this analysis.

Table I.1
Nitrogen
Baseline and Projected Loads
(Pounds)

	2009 Baseline	2017 Projected	2020 Projected
Agriculture	17,792,597	16,477,605	15,972,197
Urban Runoff	5,648,738	5,723,864	5,752,118
Point Sources	14,147,691	11,384,270	11,772,706
Septic Systems	4,007,416	4,211,430	4,287,939
Forest	7,133,371	7,085,898	7,068,107
Atmospheric Deposition to Nontidal Streams	691,394	691,394	691,394
Total	49,421,206	45,574,461	45,544,460

Estimated load reductions with current capacity and accounting for growth. These are delivered loads.

Table I.2 summarizes key statistics needed to compute Maryland's projected load reduction gaps. The Final Target was provided by EPA. The Interim Target is computed as follows:

Baseline - 0.7 * (Baseline – Final Target), or
49.42 – 0.7 * (49.2 – 39.08) = 42.19

The 70% Reduction is computed as seventy percent of the difference between the current (2009) load and the Final Target load, or 0.70 * (49.42 – 39.08). The Interim Target in this Analysis is based on meeting the 70% goal. The Strategies (Chapter 5) are expected to meet this goal or exceed it. The 100% Reduction is simply the difference (49.42 – 39.08).

Table I.2
Nitrogen
Key Statistics for Computing Maryland's
Projected Load Reduction Gaps
(Pounds)

Current 2009 Baseline	49,421,206
Interim Target*	42,186,562
Final Target	39,086,000
70% Reduction	7,234,644
100% Reduction	10,335,206

*The Interim Target is based on meeting a 70% goal. The Strategies (Chapter 5) may meet or exceed this goal.

Table I.3 summarizes the reduction estimates and percentages of progress towards the targets accounting for current capacity and growth. The reduction between 2009 and 2017 is estimated to be 3.8 million pounds.

The gap analysis shows that very little additional reduction is anticipated between 2017 and 2020 with current capacity when accounting for growth[2]. Thus, the remaining gap in achieving the Final Target is approximately equal to the sum of the remaining gap in meeting the Interim Target and the gap between 2017 and 2020.

Table I.3
Nitrogen
Key Summary Estimates of the Gap Analysis
(Pounds)

	Interim Target	Final Target
Reduction	3,846,745	3,876,746
Remaining Gap	3,387,899	6,458,460
Pct of Target Achieved	53%	38%
Pct of Target Remaining	47%	62%

The following narrative describes how each source sector contributes to the load projections used in the gap analysis. It describes the assumptions about future load reductions with current capacity and the impacts of future changes in loads due to growth in flow increases at treatment plants and land use changes.

Agriculture: The agricultural load projections are based on a trend of reductions associated with the current 2-year Milestone commitments summarized in Table I.4. Maryland's BayStat Website provides a more detailed description of Maryland's 2-year Milestones.

The projected loads account for an estimated loss of 4,200 acres of cropland annually. This estimate is based on the EPA Chesapeake Bay Program's land use forecast. The loading rate used to determine the load reduction was based on pasture land use at a rate 11.6 lbs/acre.

[2] This is a limitation of the analysis. It is likely that capacity will be available for greater reductions; however, the analysis does not attempt to identify control activities to which that capacity can be applied. Thus, the remaining gap could be an over estimate.

Table I.4
Agricultural Practices in
Maryland's 2-year Milestones

Cover Crops on Private Lands
Cover Crops on Public Lands
Nutrient Management Plan Enforcement
Soil Conservation & Water Quality Plans
Continuous No-Till Conservation
Precision Agriculture
Heavy Use Poultry Area Concrete Pads
Livestock Waste Structures
Water Control Structures
Dairy Manure Incorporation Technology
Stream Protection with Fencing
Manure Transport
Poultry Manure Incorporation Technology
Poultry Waste Structures
Stream Protection without Fencing
Runoff Control Systems

Urban Runoff: The urban runoff load projections are based on reductions associated with past performance of stormwater retrofits by jurisdictions with MS4 Phase I permits. Load reductions expected from non-MS4 Phase I jurisdictions are also accounted for; however, they are relatively small. The projected loads account for an estimated increase of 7,300 acres of developed land annually. This estimate is based on the EPA Chesapeake Bay Program's land use forecast. The loading rate used to determine the load increase was Urban No Action at a rate for Nitrogen of 10.6 lbs/acre with a stormwater management control efficiency of 50%, for a net loading rate of 5.3 lbs/acre.

Wastewater Discharges: The point source load projections are based projections for each sector under current program expectations, which reflect Maryland's point source cap management strategy. The projections account for estimated future increases in flow.

Major Municipal Plants: Loads for major municipal plants, those with flows of 500,000 gallons per day (gpd) or greater, account for ENR upgrades through 2014, which are estimated to achieve about a 2.7 million pound reduction. Due to a funding shortfall, the gap analysis estimate does not credit additional load reductions that are planned to occur between 2014 and 2017.

Federal Major and Minor Plants: Loads for major federal municipal plants and minor plants, those with lows less than 500,000 gpd, account for commitments to reduce loads

that have been negotiated with individual facilities. Upgrades and associated reductions of about 20,000 lbs are scheduled to occur between 2012 and 2014. These upgrades are assumed to reflect current capacity.

Minor Municipal Plants: Loads for minor municipal plants, those with flows below 500,000 gpd, are estimated on the basis of projected future increases in flow. Their loads are projected to increase from about 331,000 lbs/yr in 2009 to about 373,000 lbs/yr in 2020.

Major Industrial Plants: Loads for major industrial plants, those with loads similar to major municipal plants, regardless of flow, account for commitments to reduce loads that have been negotiated with individual facilities. These plants include one federal facility. Load reductions of approximately 493,000 pounds are expected between 2009 and 2014. This represents a one-third reduction in load to a level of about 1 million lbs/yr to be maintained into the future.

Minor Industrial Discharges: Minor industrial discharges account for a very large number of discharges, including a wide variety of activities from swimming pools to seafood packaging plants. As described in Section 2 of Maryland's Phase I Plan, MDE has performed a preliminary evaluation of the potential for reductions from subcategories of minor industrial sources based on an understanding of technical feasibility. The preliminary evaluation suggests a nutrient reduction potential from current loads of approximately 30% by 2020. This evaluation is the basis of the strategy option for this sector, which is included in the set of options that are projected to go beyond the 2017 Interim Target Load. However, any future reductions were not considered to involve current capacity. Thus, the gap analysis assumes that the estimated 2009 load of 590,000 lbs/yr will continue in 2017 and 2020.

Combined Sewer Overflows: Maryland's combined sewer overflows (CSOs) are under consent decrees to remediate their systems. The gap analysis accounts for very little reduction from the current loads as a reflection of the need to acquire additional capacity. The 2009 estimated load is approximately 282,000 lbs/yr. The 2017 and 2020 estimated loads for the gap analysis are set at 252,000 lbs/yr.

Phosphorus Gap Analysis: Table I.5 shows the 2009 Baseline loads and projected 2017 and 2020 loads for phosphorus. These loads are estimated on the basis of current capacity for achieving reductions and account for growth. As with nitrogen, all estimates in this appendix are delivered loads. A table is provided at the end of the appendix for converting delivered loads to edge-of-stream (EOS) loads, which approximate the loads coming from the land's surface.

Table I.5
Phosphorus
Baseline and Projected Loads
(Pounds)

	2009 Baseline	2017 Projected	2020 Projected
Agriculture	1,370,473	1,278,972	1,245,427
Urban Runoff	672,562	681,059	682,952
Point Sources	870,704	627,940	650,861
Septic Systems	0	0	0
Forest	348,912	346,419	345,484
Atmospheric Deposition to Nontidal Streams	41,145	41,145	41,145
Total	3,303,796	2,975,536	2,965,868

Estimated load reductions with current capacity and accounting for growth. These are delivered loads.

Table I.6 summarizes key statistics needed to compute Maryland's projected load reduction gaps.). The Interim Target in this Analysis is based on meeting the 70% goal. The Strategies (Chapter 5) are expected to meet this goal or exceed it. The Final Target was provided by EPA. The Interim Target is computed as follows:

Baseline - 0.7 * (Baseline – Final Target), or
3.03 – 0.7 * (3.03 – 2.715) = 2.891

The 70% Reduction is computed as seventy percent of the difference between the current (2009) load and the Final Target load, or 0.70 * (3.03 – 2.715). The 100% Reduction is simply the difference (3.03 – 2.715).

Table I.6
Phosphorus
Key Statistics for Computing Maryland's
Projected Load Reduction Gaps
(Pounds)

Current 2009 Baseline	3,303,796
Interim Target*	2,891,639
Final Target	2,715,000
70% Reduction	412,157
100% Reduction	588,796

*The Interim Target is based on meeting a 70% goal. The Strategies (Chapter 5) may meet or exceed this goal.

Table I.7 summarizes the reduction estimates and percentages of progress towards the targets accounting for current capacity and growth. The reduction between 2009 and 2017 is estimated to be 0.328 million pounds.

The gap analysis shows that very little additional reduction is anticipated between 2017 and 2020 with current capacity when accounting for growth[3]. Thus, the remaining gap in achieving the Final Target is approximately equal to the sum of the remaining gap in meeting the Interim Target and the gap between 2017 and 2020.

Table I.7
Phosphorus
Key Summary Estimates of the Gap Analysis
(Pounds)

	Interim Target	Final Target
Reduction	328,260	337,927
Remaining Gap	83,897	250,868
Pct of Target Achieved	80%	57%
Pct of Target Remaining	20 %	43%

The following narrative describes how each source sector contributes to the load projections used in the gap analysis. It describes the assumptions about future load reductions with current capacity and the impacts of future changes in loads due to growth in flow increases at treatment plants and land use changes.

Agriculture: The agricultural load projections are based on a trend of reductions associated with the current 2-year Milestone commitments summarized in Table I.4. Maryland's BayStat Website provides a more detailed description of Maryland's 2-year Milestones.

The projected loads account for an estimated loss of 4,200 acres of cropland annually. This estimate is based on the EPA Chesapeake Bay Program's land use forecast. The loading rate used to determine the load reduction was based on pasture land use at a rate 1.06 lbs/acre.

Urban Runoff: The urban runoff load projections are based on reductions associated with past performance of stormwater retrofits by jurisdictions with MS4 Phase I permits. Load reductions expected from non-MS4 Phase I jurisdictions are also accounted for; however, they are relatively small. The projected loads account for an estimated increase of 7,300 acres of developed land annually. The projected loads account for an estimated increase of 7,300 acres of developed land annually. This estimate is based on the EPA

[3] This is a limitation of the analysis. It is likely that capacity will be available for greater reductions; however, the analysis does not attempt to identify control activities to which that capacity can be applied. Thus, the remaining gap could be an over estimate.

Chesapeake Bay Program's land use forecast. The loading rate used to determine the load increase was Urban No Action at a rate for phosphorus of 1.08 lbs/acre with a stormwater management control efficiency of 80%, for a net loading rate of 0.864 lbs/acre.

Wastewater Discharges: The point source load projections are based projections for each sector under current program expectations, which reflect Maryland's point source cap management strategy. The projections account for estimated future increases in flow.

Major Municipal Plants: Loads for major municipal plants, those with flows of 500,000 gallons per day (gpd) or greater, account for ENR upgrades through 2014, which are estimated to achieve about a 174,000 million pound reduction. Due to a funding shortfall, the gap analysis estimate does not credit additional load reductions that are planned to occur between 2014 and 2017.

Federal Major and Minor Plants: Loads for major federal municipal plants and minor plants, those with lows less than 500,000 gpd, account for commitments to reduce loads that have been negotiated with individual facilities. Upgrades and associated reductions of about 4,000 lbs are scheduled to occur between 2012 and 2014. These upgrades are assumed to reflect current capacity.

Minor Municipal Plants: Loads for minor municipal plants, those with flows below 500,000 gpd, are estimated on the basis of projected future increases in flow. Their loads are projected to increase about 9,000 lbs/yr between 2009 and 2020.

Major Industrial Plants: Loads for major industrial plants, those with loads similar to major municipal plants, regardless of flow, account for commitments to reduce loads that have been negotiated with individual facilities. These plants include one federal facility. Loads are expected to be capped in 2014 a level of about 53,300 lbs/yr to be maintained into the future.

Minor Industrial Discharges: Minor industrial discharges account for a very large number of discharges, including a wide variety of activities from swimming pools to seafood packaging plants. As described in Section 2 of Maryland's Phase I Plan, MDE has performed a preliminary evaluation of the potential for reductions from subcategories of minor industrial sources based on an understanding of technical feasibility. The preliminary evaluation suggests a nutrient reduction potential from current loads of approximately 30% by 2020. This evaluation is the basis of the strategy option for this sector, which is included in the set of options that are projected to go beyond the 2017 Interim Target Load. However, any future reductions were not considered to involve current capacity. Thus, the gap analysis assumes that the estimated 2009 load of 81,000 lbs/yr will continue in 2017 and 2020.

Combined Sewer Overflows: Maryland's combined sewer overflows (CSOs) are under consent decrees to remediate their systems. The gap analysis accounts for very little reduction from the current loads as a reflection of the need to acquire additional capacity.

The 2009 estimated load is approximately 31,000 lbs/yr. The 2017 and 2020 estimated loads for the gap analysis are set at about 25,000 lbs/yr.

As noted above, the loads presented in this appendix are loads delivered to the Bay, which accounts for transport losses. Loads estimated at the edge-of-stream (EOS), near the source of the load, are larger. Table I.8 provides factors for computing EOS loads[4].

Table I.8
Factors for Converting Delivered Loads to Edge-of-Stream Loads

	Sector	TN Conversion Factor	TP Conversion Factor
Nonpoint Sources	Agriculture	1.466	1.307
	Nontidal Streams Air	1.160	1.208
	Forest	1.589	1.334
	Septic	1.282	-
	Urban	1.390	1.248
Point Sources	Municipal Major	1.090	1.106
	Municipal Minor	1.338	1.305
	Industrial Major	1.074	1.270
	Industrial Minor	1.268	1.340

[4] These factors are approximations of the factors used in the EPA Chesapeake Bay model, which uses many individual deliver factors for the large number of sources and locations represented in the model.