MARYLAND DEPARTMENT OF NATURAL RESOURCES

Tidewater Ecosystem Assessment

Lower Eastern Shore
Water Quality and Habitat Assessment
Overall Condition 2011-2013

Healthy rivers and bays support a diverse population of aquatic life as well as recreational uses, such as swimming and fishing. To be healthy, rivers and bays need to have good water and habitat quality. High levels of nutrients and sediment lead to poor water quality. Poor water quality reduces habitat quality, including water clarity (how much light can get to the bottom) and the amount of dissolved oxygen in the water. In turn, habitat quality affects where plants and animals can live. The Maryland Department of Natural Resources (DNR) is responsible for monitoring water and habitat quality in the Chesapeake Bay and rivers, as well as the health of aquatic plants and animals. DNR staff use this information to answer common questions like "How healthy is my river?", "How does my river compare to other rivers?", "What needs to be done to make my river healthy?" and "What has already been done to improve water and habitat quality in my river?"

The Lower Eastern Shore basin includes five major rivers and four embayments. Overall, this basin is dominated by agricultural land use and has a low to medium human population density in most areas. Negative impacts from urban land use, percent impervious surface and waste-water treatment plants are much lower than in the Western Shore rivers. Despite the similarities overall among the Lower Eastern Shore rivers, there are differences in water and habitat quality conditions due to localized land use and human impacts.

How healthy are the Lower Eastern Shore Rivers?
How do the Lower Eastern Shore Rivers compare to other Maryland rivers?

Fishing Bay, Chicamacomico River and Transquaking River

Water quality in the Chicamacomico River and Transquaking River is fair. Sediment levels are too high and getting worse in the upstream areas but nitrogen, phosphorus and sediment levels have improved in the lower Transquaking (Table 1). Even though dissolved nitrogen and phosphorus levels are low enough for healthy habitat for underwater grasses, total nitrogen and phosphorus levels are very high. Habitat for underwater grasses is poor because algal densities are too high and water clarity is poor. Algal densities are also getting worse.

Water quality in Fishing Bay is good and nitrogen levels and phosphorus levels decreased. Habitat quality for underwater grasses is fair but water clarity is poor. Algal densities have improved. Underwater grass beds covered approximately 80% of the restoration goal area during this period. Summer bottom dissolved oxygen levels are good, but bottom dwelling animals are unhealthy in some areas of Fishing Bay.

The Chicamacomico River and Transquaking River are considered part of the Fishing Bay system for land use assessments so are not compared separately. Fishing Bay is in the 'Low Urban, Low Agriculture' land use category. Total nitrogen, total phosphorus and sediment levels are high compared to other Maryland rivers. Algal densities are also high compared to similar rivers. Secchi depths are among the lowest of Maryland rivers.

Table 1. Summary of tidal habitat quality and water quality indicators.
Algal densities, water clarity, inorganic phosphorus and sediment either 'Meet' or 'Fail' SAV habitat requirements for 2011-2013. Dissolved nitrogen levels below the level for nitrogen limitation 'Meet' criteria, otherwise 'Fail' criteria. Summer bottom dissolved oxygen levels either 'Meet' or 'Fail' EPA open-water 30 day dissolved oxygen criteria. Annual trends for 2003-2013 either 'Increase' or 'Decrease' if significant at $p \leq 0.01$; blanks indicate no significant trend. Improving trends are in green, degrading trends are in red. Nitrogen trends are for total nitrogen, phosphorus trends are for total phosphorus, water clarity trends are for Secchi depth.

		Water Quality			Habitat Quality		
River	River portion	Nitrogen	Phoshporus	Sediments	Algal Densities	Water Clarity	Summer Bottom DO
Fishing Bay	Chicamacomico	Meet Increasing	Meet	Fail Increasing	Fail Increasing	Fail	
	Transquaking	Meet	Meet	Fail	Fail Increasing	Fail	
		Meet Decreasing	Meet Decreasing	Fail Decreasing	Fail	Fail	
	Fishing Bay	Meet Decreasing	Meet Decreasing	Meet	Meet Decreasing	Fail	Meet
Nanticoke	Upstream Upper	Fail Decreasing	Meet	Fail Increasing	Fail Increasing	Fail Decreasing	Meet Increasing
	Downstream Upper	Fail	Meet	Fail	Fail Increasing	Fail	
	Middle	Fail Decreasing	Meet	Fail	Meet	Fail	Meet
Wicomico	Upper	Fail Decreasing	Meet	Fail Increasing	Fail Increasing	Fail	
	Middle	Meet Decreasing	Meet	Fail	Meet	Fail	
	Lower	Fail Decreasing	Meet Decreasing	Fail	Meet	Fail	Fail
Manokin	Upper	Meet Decreasing	Fail	Fail	Meet	Fail	
	Upper	Meet	Fail	Fail	Fail	Fail	
	Lower	Meet Decreasing	Meet Decreasing	Meet Decreasing	Meet Decreasing	Fail Increasing	Meet Increasing
Big Annemessex	Big Annemessex	Meet Decreasing	Meet Decreasing	Meet	Meet	Fail	Meet
Pocomoke River	Upper	Fail Decreasing	Fail	Meet	Meet	Fail	Fail
	Middle	Fail Decreasing	Fail	Fail Increasing	Meet	Fail	
	Lower	Fail Decreasing	Fail	Fail	Meet	Fail	
Pocomoke Sound	Pocomoke Sound	Meet	Meet	Meet	Meet Decreasing	Fail	Meet
N. Tangier Sound	N. Tangier Sound	Fail Decreasing	Meet	Meet	Meet	Meet	Meet
S. Tangier Sound	S. Tangier Sound	Meet Decreasing	Meet	Meet	Meet	Meet Increasing	Meet Increasing

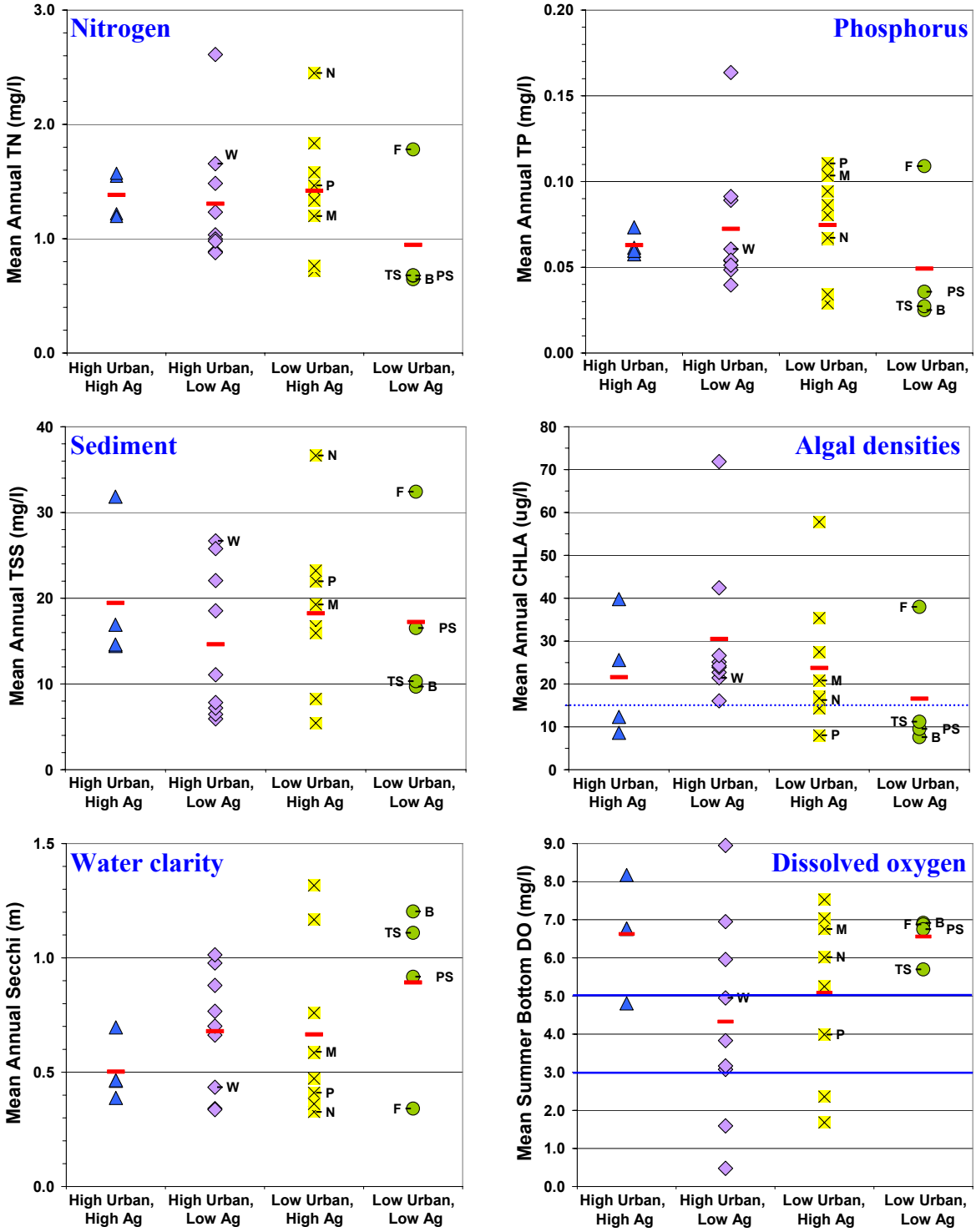

Figure 1. Comparison of the Lower Eastern Shore Rivers to similar rivers.
The mean annual concentration or depth (bottom dissolved oxygen is only summer) for 2011-2013 data. Total nitrogen (TN), total phosphorus (TP), total suspended solids (TSS), chlorophyll *a* (CHLA), Secchi depth and summer bottom dissolved oxygen (DO). Red bars indicate the mean of all rivers within a category. Reference lines are included on the CHLA and summer bottom DO graphs. Abbreviations are: N (Nanticoke), W (Wicomico), M (Manokin), B (Big Annemessex), P (Pocomoke River), F (Fishing Bay), TS (Tangier Sound) and PS (Pocomoke Sound). The Chicamacomico River and Transquaking River are considered part of the Fishing Bay system for land use assessments so are not compared separately

Nanticoke River Water quality in the Nanticoke River is poor in the upper and middle river due to high nitrogen and sediment levels. Nitrogen levels improved in both the upper and middle river, but sediment levels have gotten worse in the upper river. Habitat quality for underwater grasses is poor. Water clarity is poor throughout the river and has gotten worse in the upper river Algal densities in the upper river are too high and increased. No underwater grasses have been found in the Nanticoke. Summer bottom dissolved oxygen levels are good and increased in the upper river, but bottom dwelling animals are unhealthy in many areas of the river.

Nanticoke River is a 'Low Urban, High Agriculture' river. Nitrogen and sediment levels are very high in comparison to the other rivers in Maryland, while phosphorus levels are moderate. Algal densities are low, but so is water clarity.

Wicomico River Water quality in the Wicomico River is poor in the upper and lower river due to high nitrogen and high sediment levels. Water quality is fair in the middle river but sediment levels are still too high. Nitrogen levels improved throughout the river and phosphorus levels improved in the lower river. Sediment levels degraded in the upper river. Habitat quality for underwater grasses is poor in the upper river due to high algal densities and poor water clarity. Habitat quality for underwater grasses in the middle river is fair but water clarity is poor. No underwater grass beds are found in the Wicomico River. Summer bottom dissolved oxygen levels are poor in the lower river.

Wicomico River is the only 'High Urban, Low Agriculture' river in the Lower Eastern Shore Basin. Nitrogen and sediment levels are high compared to other Maryland rivers. Phosphorus levels and algal densities are low within this land use category. Water clarity is low compared to similar rivers.

Manokin River Water quality in the Manokin River is poor in the upper river but good in the lower river. Phosphorus levels are extremely high in the creeks, and sediment levels are also too high. Water quality improved due to decreases in nitrogen throughout the river. Phosphorus and sediment levels have improved in the lower river. Habitat quality for underwater grasses is fair to poor because water clarity is low. Algal densities have decreased in the lower river. Water clarity and bottom dissolved oxygen levels have also improved in the lower river. Underwater grass beds covered 20% of the restoration goal area during this period. Summer bottom dissolved oxygen levels are good. Bottom dwelling animals are healthy in the central portion of the lower river but are very unhealthy in areas closer to shore and in the upper river.

Manokin River is in the 'Low Urban, High Agriculture' land use category. Nitrogen levels and algal densities are moderate compared to all Maryland rivers. Phosphorus levels are high and sediment levels are moderate compared to similar rivers. Water clarity is moderate compared to similar rivers.

Big Annemessex River Water quality in the Big Annemessex River is good and nitrogen and phosphorus levels improved. Habitat quality for underwater grasses is fair because water clarity is low. Underwater grass beds covered about 45% of the restoration goal area during this period. Summer bottom dissolved oxygen levels are good. Bottom dwelling animals are marginally healthy in most areas sampled during this period.

Big Annemessex is a 'Low Urban, Low Agriculture' river. Nitrogen, phosphorus and sediment levels and algal densities are low or very low compared to other Maryland rivers and water clarity is high.

Pocomoke River Water quality in the Pocomoke River is poor due to high nitrogen, phosphorus and sediment levels. Nitrogen levels improved in the entire river but sediment levels have degraded in the middle river. Habitat quality for underwater grasses is fair because water clarity is poor. Underwater grass beds are almost never found in the river.

Pocomoke River is in the 'Low Urban, High Agriculture' category. Nitrogen levels are moderate but phosphorus and sediment levels are high compared to similar rivers. Algal densities are very low and water clarity is low.

Tangier Sound Water and habitat quality is fair in North Tangier Sound and good in South Tangier Sound. Nitrogen levels improved in both North and South Tangier Sound. Habitat quality for underwater grasses is good in North and South Tangier Sound and water clarity is improving in South Tangier Sound. Underwater grasses covered approximately 30% of the restoration goal area in the Maryland portions of Tangier Sound during this period. Summer bottom dissolved oxygen levels are good and bottom dwelling animals are healthy in Tangier Sound.

Tangier Sound is in the 'Low Urban, Low Agriculture' category. Nitrogen, phosphorus and sediment levels in Tangier Sound are low. Algal densities in Tangier Sound are low and water clarity is high in comparison to all of Maryland's rivers and bays.

Pocomoke Sound Water and habitat quality in Pocomoke Sound is good. Habitat quality for underwater grasses is fair because water clarity is poor. Underwater grasses covered less than 20% of the restoration goal area in the Maryland portions of Pocomoke Sound during this period. Summer bottom dissolved oxygen levels are good, and bottom dwelling animals are healthy in Pocomoke Sound.

Pocomoke Sound is in the 'Low Urban, Low Agriculture' category. Pocomoke Sound has low nitrogen and phosphorus levels compared to all rivers and bays in Maryland. Sediment levels are moderate. Algal densities are low. Water clarity is high compared to all other rivers but moderate within this land use category.

What needs to be done to make the Lower Eastern Shore Rivers healthy?

The biggest water quality issue, shared by all the rivers and most embayments, is poor water clarity. By lowering nutrients and sediment, water clarity should improve which will improve habitat quality for underwater grasses. Reductions in nutrients will also lead to lower algal densities and further improve habitat quality. Dissolved oxygen levels on average are adequate for healthy habitat for bottom dwelling animals in most rivers, but on shorter time periods very low oxygen levels can and do occur. Reducing algal densities by reducing nutrients will improve dissolved oxygen conditions, especially in shallow water areas.

Nitrogen levels and/or sediment levels are too high in the rivers. Reductions in nitrogen, phosphorus and sediment loadings from agricultural lands and upgrades to septic systems should be a priority in these rivers. Upgrades to wastewater treatment plants will reduce nitrogen loadings in the Wicomico and Nanticoke rivers and these improvements are already in place or planned.

Wicomico River is the most impacted by urban land use in the Lower Eastern Shore basin. Reducing nutrients and sediment that enter the river with urban runoff are needed. Urban runoff of sediment should also be a priority in the Manokin River. As more areas of the Lower Eastern Shore basin are developed, alternatives to conventional methods should be used to reduce the amount of impervious surfaces and prevent additional degradation of water quality in the other rivers.

In Tangier Sound and Pocomoke Sound, most of the needed improvements will be due to reducing the nutrient and sediment levels in the rivers. Direct inputs to these water bodies are relatively very small.

What has already been done to improve water and habitat quality in the Lower Eastern Shore Rivers?

A variety of actions have been taken to lower nitrogen, phosphorus and sediment loadings from agricultural lands. While specific goals have not been set for this basin, improvements are being made. In 2013 there were more than 82,150 acres of cover crops planted in between growing seasons to absorb excess nutrients and prevent sediment erosion. Fencing on almost 150 acres of farmland was used to keep livestock out of streams and prevent streambank erosion. More than 1,030 containment structures had been built to store animal wastes and allow these nutrients to be applied to the land in the most effective manner at the appropriate time. More than 31,450 acres of stream buffers were also in place, allowing areas next to streams to remain in a natural state with grasses, trees and wetlands.

To reduce nutrient inputs from urban lands, additional actions have been taken. Upgrades to six of the largest wastewater treatment plants in the basin have been completed and upgrades at the remaining three will be completed by 2017. Almost 1,100 septic system retrofits were completed between 2008-2013, and stormwater retrofits have reduced nitrogen loadings and prevented 1,080 pounds of nitrogen from entering the rivers since 2003.

Maryland also has a number of programs in place to reduce the impacts of continued development and increasing amounts of impervious surfaces in the Lower Eastern Shore basin. Program Open Space projects have conserved more than 19,000 acres of land for outdoor recreation opportunities. Rural Legacy Program projects have protected more than 15,700 acres, with special focus on areas with important cultural sites and natural resources and to ensure large areas of habitat. Maryland Environmental Trust projects have helped individual land owners protect more than 9,600 acres. Maryland Agricultural Land Preservation Program projects have preserved more than 5,800 acres of agricultural land from development.

For more information
An integrative assessment of the water and habitat quality of the Lower Eastern Shore Rivers for 1985-2010 is available online at
http://mddnr.chesapeakebay.net/eyesonthebay/tribsums.cfm.

The full report includes:

- Information on land use and human population densities within the basin, including the health of streams and location of Maryland Trust Fund Priority watersheds
- Information on land use in 2010, change in land use since 2000 and percent impervious surfaces in watershed
- Nutrient and sediment loadings information, including breakdown of nitrogen, phosphorus and sediment load by source (agriculture, urban runoff, point source, etc.)
- Loadings information for major wastewater treatment plants including status of upgrades and progress toward loading caps
- Water and habitat quality results for tidal waters from long-term monitoring programs
- Shallow-water monitoring results including percent failures of dissolved oxygen, chlorophyll and turbidity thresholds and comparison to long-term monitoring stations
- Submerged aquatic vegetation coverages
- Benthic program results
- Appendices with station locations, analysis methods and tabular results

Current water and habitat quality information is also available from Maryland DNR's Eyes on the Bay website **www.eyesonthebay.net**

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Chesapeake Bay Program
A Watershed Partnership