MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Tidewater Ecosystem Assessment

Upper Eastern Shore Basin
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 Upper Eastern Shore basin includes five major rivers and one embayment. 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 Upper Eastern Shore rivers, there are differences in water and habitat quality conditions due to localized land use and human impacts.

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

Northeast River: Water quality in the Northeast River is poor. Nitrogen and sediment levels are too high (Table 1). Habitat quality for underwater grasses is poor due to poor water clarity and high algal densities. Even with reduced habitat quality, the area covered by underwater grass beds was greater than the restoration goal during this period. Summer bottom dissolved oxygen levels in bottom waters are good.

The Northeast River is in the 'High Urban, High Agriculture' land use category. Nitrogen levels are among the highest among rivers in this land use category and algal densities are among the highest of all rivers (Figure 1). Phosphorus and sediment levels are moderate, but water clarity is worse than in similar rivers. Summer dissolved oxygen levels are higher than in almost all of the other Maryland rivers.

Back Creek**:** Water quality in Back Creek is poor because nitrogen and sediment levels are too high. Habitat quality is fair for underwater grasses due to poor water clarity, but habitat quality has gotten worse as algal densities increased and water clarity decreased. There is no underwater grass bed restoration goal for Back Creek. Summer bottom water dissolved oxygen levels are good.

Back Creek is part of the Elk River watershed for land use assessments and is not evaluated separately.

Bohemia River**:** Water quality in the Bohemia River is fair but sediment levels are too high. Habitat quality is poor for underwater grasses due to poor water clarity and high algal densities, and algal densities have increased. Bohemia River underwater grass beds covered less than 20% of the area needed to meet restoration goals during this period. Summer bottom dissolved oxygen levels are good.

The Bohemia River is in the 'Low Urban, High Agriculture' land use category. Agricultural land use in this basin is among the highest of all systems in Maryland. Nitrogen and phosphorus levels are moderate compared to other high agricultural rivers, but sediment levels are high. Algal densities are among the highest of all rivers. Water clarity is very low compared to other rivers. Summer bottom water dissolved oxygen levels are among the highest of all Maryland rivers.

Elk River**:** Water quality in the Elk River is poor because nitrogen and sediment levels are too high. However, nitrogen levels have improved. Habitat quality is fair for underwater grasses but has gotten worse as algal densities increased and water clarity decreased. The area covered by underwater grass beds dropped to less than 10% of the area needed to meet restoration goals during this period. Summer bottom water dissolved oxygen levels are good.

The Elk River is in the 'High Urban, High Agriculture' land use category. Sediment levels are among the highest compared with all of the other rivers. Nitrogen and phosphorus levels are moderate compared to high agricultural rivers. Water clarity is very low, and algal levels are also low despite the high nutrient levels, suggesting that light conditions limit algal densities.

Sassafras River**:** Water quality in the Sassafras River is fair due to high sediment levels. Habitat quality for underwater grasses is poor due to poor water clarity and high algal densities. Harmful algal blooms of blue-green algae occur in most years and have led to human health impacts and beach closures at Betterton Beach. The area covered with underwater grass beds was 44% of the restoration goal during this period. Summer bottom dissolved oxygen levels are good, and bottom dwelling animal populations are healthy in most locations.

The Sassafras River is in the 'Low Urban, High Agriculture' land use category. Nitrogen and phosphorus levels are higher than most rivers, and sediment levels are moderate. Water clarity is low and algal levels are among the highest of all the 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 1999-2013 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	Phosphorus	Sediments	Algal Densities	Water Clarity	Summer Bottom DO
Northeast	Northeast	Fail	Meet	Fail	Fail	Fail	Meet
Back Creek	Back Creek	Fail	Meet	Fail	Meet Increasing	Fail Decreasing	Meet
Bohemia	Bohemia	Meet	Meet	Fail	Fail Increasing	Fail	Meet
Elk	Elk	Fail Decreasing	Meet	Fail	Meet Increasing	Fail Decreasing	Meet
Sassafras	Sassafras	Meet	Meet	Fail	Fail	Fail	Meet
Chester	Upper Chester	Fail Decreasing	Fail Decreasing	Fail Decreasing	Meet Decreasing	Fail	Meet
Chester	Lower Chester	Fail	Meet	Meet	Fail Increasing	Fail Decreasing	Fail
Chester	Corsica	Meet	Fail	Fail	Fail	Fail	Meet
Eastern Bay	Eastern Bay	Meet	Meet	Meet	Fail	Meet	Fail

***Chester River*:** Water and habitat quality differs between the upper and lower Chester River. The upper Chester has poor but improving water quality. Habitat quality for underwater grasses in the upper Chester is fair due to poor water clarity but algal densities are low and have decreased. The upper Chester has very little underwater grass beds, but summer bottom dissolved oxygen levels are good.

The lower Chester has fair water quality but nitrogen levels are too high. Habitat quality for underwater grasses in the lower Chester is poor due to high algal densities and poor water clarity, and has gotten worse. Underwater grass beds in the lower Chester were very large in 1998 but have dropped to less than 10% of the restoration goal during this period. Summer bottom dissolved oxygen levels are too low in the lower Chester, and bottom dwelling animal populations are not healthy in some areas sampled.

The Corsica River is a tributary of the Chester River. Water quality is fair because phosphorus and sediment levels are too high. Habitat quality for underwater grasses is poor because algal densities are high and water clarity is low. Summer bottom dissolved oxygen levels are good.

The Chester River is in the 'Low Urban, High Agriculture' land use category. As a whole, the Chester has high nitrogen and phosphorus levels and moderate sediment levels, algal densities and water clarity. However, harmful algal blooms occur often in the higher salinity portions of the Chester River and its tributaries.

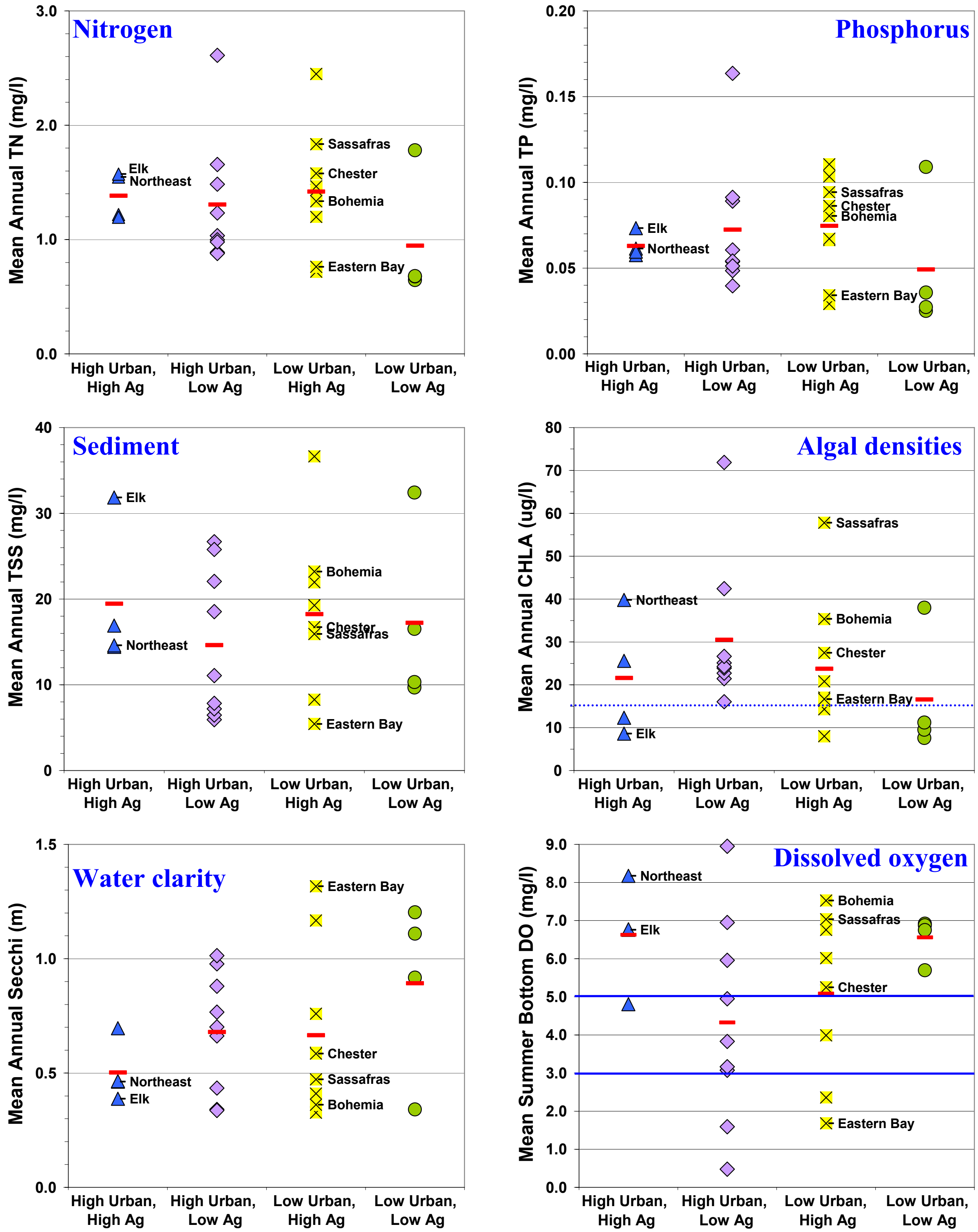

Figure 1. Comparison of the Upper Eastern Shore rivers to similar rivers.
The mean annual concentration or depth (bottom dissolved oxygen is only summer) for 2011-2013 data. Total nitrogen (TN), total phosphorus (TP), total suspended solids (TSS), chlorophyll *a* (CHLA), Secchi depth and summer bottom 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. Back Creek is part of the Elk River watershed for land use assessments and is not evaluated separately.

***Eastern Bay*:** Water quality of Eastern Bay is good. Habitat quality is fair for underwater grasses because algal densities are too high. Underwater grass beds covered more than 25% of the restoration goal area during this period. Summer bottom dissolved oxygen levels are extremely low and indicate impaired habitat for bottom dwelling animals. Bottom dwelling animal populations are unhealthy in most areas sampled.

Eastern Bay is in the 'Low Urban, High Agriculture' land use category, Total nitrogen, total phosphorus and total suspended solids levels are among the lowest of all rivers. Water clarity is very high and algal levels are low. However, summer bottom dissolved oxygen levels are extremely low and indicate impaired habitat.

What needs to be done to make the Upper Eastern Shore rivers and Eastern Bay healthy?

The biggest water quality issues, shared by most of the rivers, are high nitrogen and sediment levels and poor water clarity. By lowering nutrients and sediment levels, 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. In particular, lower nutrients will help reduce the frequency and duration of harmful algal blooms that occur in the Upper Eastern Shore rivers in most years.

In all of the rivers, reducing nutrient and sediment loadings from agricultural land use should be the focus of management actions. In the Northeast River, reductions in phosphorus and sediment loadings from urban runoff are also needed, especially with the increase in urban land use since 2000. In the Elk River, urban, point source and septic sources of nutrients and sediment are also important. A management strategy in the Elk River watershed needs to address all of these sources. Nitrogen and phosphorus loadings from the Elkton wastewater treatment plant have already been greatly reduced by upgrades implemented in 2009, but septic system loadings of nitrogen still need to be addressed.

As more areas of the Upper Eastern Shore basin are developed, controlling loadings from urban land use will become even more important. Alternatives to conventional building methods and materials should be used to reduce the amount of impervious surfaces and prevent additional degradation of water quality in the rivers. Reducing algal densities by reducing nutrients will improve dissolved oxygen conditions, which is especially important in the lower Chester and Eastern Bay.

What has already been done to improve water and habitat quality in the Upper 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 almost 115,100 acres of cover crops planted in between growing seasons to absorb excess nutrients and prevent sediment erosion. Fencing on 1,500 acres of farmland was used to keep livestock out of streams and prevent streambank erosion. More than 280 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 24,100 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 the six of the seven largest wastewater treatment plants in the basin have been completed, and upgrades at the final facility are scheduled for completion in 2016. In the rest of the basin, 710 septic system retrofits were completed between 2008 and 2013, and stormwater retrofits have reduced nitrogen loadings and prevented 2,500 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 Upper Eastern Shore basin. Program Open Space projects have conserved almost 2,800 acres of land for outdoor recreation opportunities. Rural Legacy Program projects have protected more than 10,300 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 almost 14,900 acres. Maryland Agricultural Land Preservation Program projects have preserved more than 8,000 acres of agricultural land from development.

For more information
An integrative assessment of the water and habitat quality of the Upper 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