Tidewater Ecosystem Assessment

Upper Eastern Shore Basin
Water Quality and Habitat Assessment
Overall Condition 2010-2012

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 fair. Phosphorus and sediment levels have improved but nitrogen 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 more than twice the restoration goal in 2010, but underwater grass beds dropped to only 60% of the restoration goal in 2012. Summer bottom dissolved oxygen levels are good.

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

Back Creek: Water quality in Back Creek is poor because nitrogen, phosphorus and sediment levels that 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. Summer bottom dissolved oxygen levels are good.

Back Creek is in the 'Low Urban, High Agriculture' land use category. Nitrogen and phosphorus levels are moderate but sediment levels are among the highest compared with all of the other rivers. Water clarity is low and algal densities are very low despite the high nutrient levels, suggesting that algae have limited light to grow.

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 may have increased. Bohemia River underwater grass beds covered 60% of the restoration goal area in 2010, but less than 20% in 2011-2012. 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, phosphorus and sediment levels are moderate compared to other high agricultural rivers. Algal densities are among the highest of all rivers. Water clarity is low compared to other rivers. Summer bottom dissolved oxygen levels are among the highest of all Maryland rivers.

Elk River: Water quality in the Elk River is poor with nitrogen and sediment levels that are too high. 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 met the restoration goal in 2010 but dropped to less than 10% of the goal in 2011-2012. Summer bottom dissolved oxygen levels are good, but benthic animal populations are not healthy in the lower river.

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, and total nitrogen and total phosphorus levels are moderate compared to high agricultural rivers. Water clarity is low and algal levels are very 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 more than 75% of the restoration goal in 2010 but dropped to less than 25% in 2012. Summer bottom dissolved oxygen levels are good, and benthic animal populations were 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 2010-2012. Dissolved nitrogen levels below the level for nitrogen limitation 'Meet' criteria, otherwise 'Fail' criteria. Summer bottom dissolved oxygen levels above 3 mg/l 'Meet' criteria, otherwise 'Fail' criteria. Annual trends for 1999-2012 either 'Increase' or 'Decrease' if significant at $p \leq 0.01$ or 'Maybe Increase' or 'Maybe Decrease' at $0.01 < p < 0.05$; 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	Nitrogen	Phosphorus	Sediment	Algal Densities	Water Clarity	Summer Bottom Dissolved Oxygen
Northeast	Fail	Meet Decrease	Meet Decrease	Fail	Fail	Meet
Back Creek	Fail	Fail	Fail	Meet Increase	Fail Decrease	Meet
Bohemia	Meet	Meet	Fail	Fail Maybe Inc	Fail	Meet Maybe Inc
Elk	Fail Decrease	Meet	Fail	Meet Increase	Fail Decrease	Meet
Sassafras	Meet	Meet	Fail	Fail	Fail	Meet
Upper Chester	Fail Decrease	Fail Decrease	Fail Decrease	Meet Decrease	Fail	Meet
Lower Chester	Fail	Meet	Meet	Fail Maybe Inc	Fail Maybe Dec	Fail
Eastern Bay	Meet	Meet	Meet	Fail Maybe Inc	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. The lower Chester has fair water quality but nitrogen levels are too high. Habitat quality for underwater grasses in the Upper Chester is fair due to poor water clarity but algal densities are low and have decreased. Habitat quality for underwater grasses in the Lower Chester is poor due to high algal densities and poor water clarity, and may have gotten worse. The upper Chester has very little underwater grass beds. Underwater grass beds in the lower Chester were very large in 1998 but by 2010-2012 have dropped to 10% of the restoration goal. Habitat quality for bottom-dwelling animals is good in the upper Chester but poor in the Lower Chester. Bottom dwelling animal populations were not healthy in some areas sampled.

The Chester River is in the 'Low Urban, High Agriculture' land use category. As a whole, the Chester has low to moderate nitrogen, phosphorus and 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.

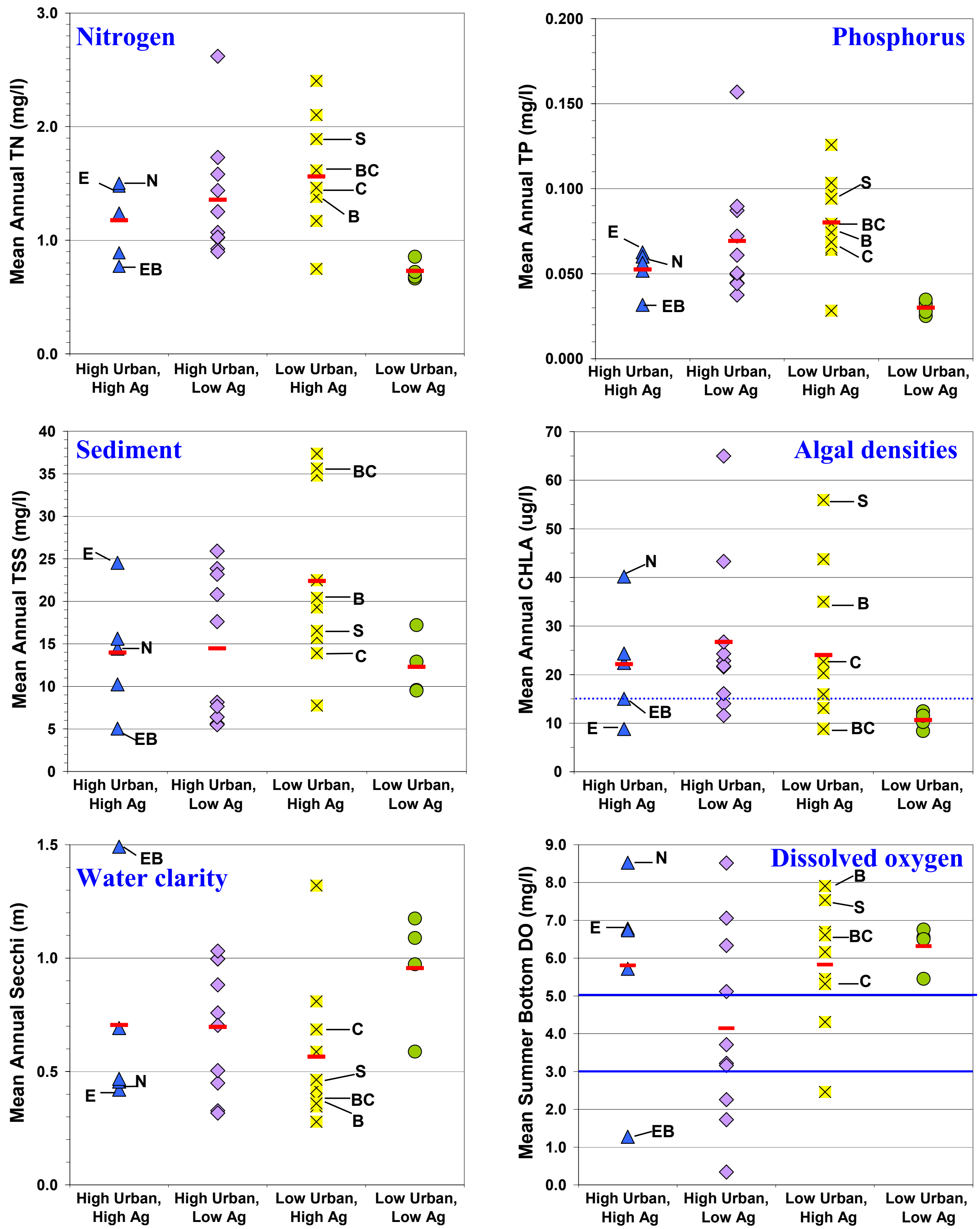

Figure 1. Comparison of the Upper Eastern Shore rivers to similar rivers.
The mean annual concentration or depth (bottom dissolved oxygen is only summer) for 2010-2012 data. Total nitrogen (TN), total phosphorus (TP), total suspended solids (TSS), chlorophyll *a* (CHLA), Secchi depth and summer bottom 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: E (Elk), N (Northeast), EB (Eastern Bay), B (Bohemia), BC (Back Creek), C (Chester) and S (Sassafras).

***Eastern Bay*:** Water quality of Eastern Bay is good. Habitat quality is fair for underwater grasses because algal densities are too high and may be increasing. Underwater grass bed sizes have been variable and covered less than 10% of restoration goal in 2010 and 2012, but covered more than 25% of the goal area in 2011. Summer bottom dissolved oxygen levels are extremely low and indicate impaired habitat for bottom dwelling animals. Bottom dwelling animal populations are unhealthy in all areas sampled.

Eastern Bay is in the 'High Urban, High Agriculture' land use category, due to the high population density on Kent Island. 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 to moderate. 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 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.

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.

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 over the last ten years. 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.

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

A variety of actions have already 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 2011 there were almost 105,850 acres of cover crops planted in between growing seasons to absorb excess nutrients and prevent sediment erosion. Fencing on almost 1,100 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 to allow these nutrients to be applied to the land in the most effective manner at the appropriate time. More than 22,700 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 largest wastewater treatment plant that discharges to the Northeast, Elk and Chester rivers have been implemented or are under construction. In all three rivers, these upgrades have reduced nitrogen and phosphorus levels to or below management goals. In the rest of the basin, nearly 390 septic system retrofits were completed between 2008-2011, 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 more than 2,000 acres of land for outdoor recreation opportunities. Rural Legacy Program projects have protected more than 9,700 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 13,500 acres. Maryland Agricultural Land Preservation Program projects have preserved more than 7,100 acres of agricultural land from development.

For more information
An integrative assessment of the water and habitat quality of the Upper Eastern Shore Rivers is available online at **http://mddnr.chesapeakebay.net/eyesonthebay/tribsums.cfm**.
The full report includes:

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