

## Memorandum

To: James Davis-Martin (Virginia Department of Conservation & Recreation)  
From: John Paine (URS)  
CC: Steve McLaughlin (City of Virginia Beach), David Kuzma (City of Newport News),  
Sam Sawan (City of Chesapeake)  
Date: 4 November 2011  
Subject: Harvested Wetlands BMP

In preparing Watershed Implementation Plans (WIPs) to meet the requirements of the Chesapeake Bay TMDL, several municipalities in southeastern Virginia have asked about the ability to employ floating wetland systems as retrofit BMPs to reduce Nitrogen, Phosphorus, and Suspended Solid discharges into the Bay. After researching the scientific literature on these systems, URS would like to propose using “Harvested Wetlands” as a provisionally-approved BMP for compliance planning purposes.

Watersheds in southeastern Virginia are typically flat, with high water tables, poorly drained soils, and low topography. Developed areas have many retention or detention basins that have been constructed over the decades, often to facilitate drainage or reduce flooding where there is no longitudinal slope available for pipes and channels. As we have looked in detail for potential BMP retrofit sites, it is clear that TMDL compliance costs could be significantly reduced if harvested wetlands could be employed in existing basins and lakes.

However, the potential benefits deriving from retrofit harvested wetlands systems extend beyond simple economic considerations. The Chesapeake Bay Phase 5 Watershed model does not have a groundwater transport mechanism. Any BMP that is supposed to work by infiltration provides a “model world” improvement in pollutant discharges to the Bay, but in reality the infiltrated nutrients get slowly and steadily transported into the Bay through groundwater. A 1998 study published by USGS stated that groundwater contributes nearly half (48%) of the total Nitrogen load to streams in the Bay watershed. Our point is that even if it were possible to employ large numbers of retention, detention, and infiltration BMPs, that approach to meeting the Chesbay TMDL may be ultimately ineffective.

Using wetlands to treat stormwater effluent is not a new idea. In addition to reducing nutrient and sediment discharges to receiving streams, these systems can improve water quality by the uptake of metals and toxics, and provide other benefits not directly targeted by the Chesapeake Bay TMDL—such as shoreline stabilization and preservation or creation of wildlife habitat. When compared to simply constructing additional excavated detention or retention basins, using wetlands to treat stormwater runoff is a more cost-effective solution, and produces greater environmental benefits.

It is also important to consider the time to implement any type of BMP as a retrofit. In the case of harvested wetlands, municipalities can do so quickly. Just as an example, to construct a new detention basin, the land acquisition alone can take several years. For harvested wetlands, they could be implemented and producing water quality benefits within a single year.

As widely reported in scientific literature, wetlands can have inherent issues and problems, that should be given due consideration when designing a treatment BMP. These issues can include:

1. Harvesting (necessary to prevent re-introduction of pollutants when the plants die, such as after the first frost in Virginia),
2. Takeover Potential (some species when introduced can predominate the ecosystem as invasive plants), and
3. Nutrient Leaching (some floating treatment systems—typically constructed on earthen media—yield a net increase in nutrients from their bedding material),

to name but a few.

Yet credible research over extended periods of time has quantified the efficacy of using treatment wetlands to remove nutrients and sediment from stormwater runoff. The best single source we have found to document the removal efficiencies of treatment wetlands is

*Treatment Wetlands, Second Edition*  
Robert H. Kadlec and Scott D. Wallace  
CRC Press 2008  
Print ISBN: 978-1-56670-526-4  
eBook ISBN: 978-1-4200-1251-4

This [text can be purchased online](#). A [digital version](#) can be purchased directly from the publisher. *Treatment Wetlands* summarizes sampling from multiple urban stormwater treatment systems to have median removal efficiencies for TSS, TP, and TN of 68, 41, and 30 percent, respectively. All three summaries published in *Treatment Wetlands* (Tables 14.5, 14.7, and 14.9) include Virginia sites.

We have reviewed several other studies and documents that suggest these removal values are reasonable and attainable in Virginia ecosystems. Specifically, [research published by Dr. Sarah White at Clemson University](#) on a floating wetlands system, found TN and TP removal to be 64.5 and 63.8 percent, respectively. This particular study was limited to a single growing season and used plant species that thrive in warmer, southeastern climates (not Virginia), but used [commercial floating mat products](#) that could be effectively employed in Virginia using native species. [Videos are available online](#) that describe this system and several site-specific applications. While this technology is relatively new and unproven, it appears to have good potential, and the details (cost, installation procedures, supply sources, specifications) have been worked through and demonstrated. Additional applications and studies are currently underway to further study the performance metrics.

There are several other documents and sources describing the pollutant removal efficiencies of treatment wetlands, but they are limited in scope and applicability to Virginia. Communities in southeastern Virginia recognize the potential value of using treatment wetlands systems for Chesapeake Bay TMDL compliance, and are exploring specific studies that could be undertaken by Virginia researchers, such as Dr. Laurie Fox at Virginia Tech. The City of Virginia Beach is particularly interested in quantifying the TSS, TP, and TN removal efficiencies of floating wetlands and similar systems, and is currently soliciting funding assistance and interest from neighboring localities. An obvious related goal of such a study would be to produce design recommendations regarding specific species, planting methods, harvest requirements, coverage ratios, and application limitations.

In the meantime, WIP II deadlines are quickly approaching, and there is currently no approved floating wetland BMP they can use in preparing their WIPs. We understand the BMP approval process can take more than a year to navigate with EPA and State agencies, and that published data to substantiate the removal efficiencies is not yet widely available.

Having reviewed the literature on these treatment systems, and respecting the time constraints imposed by the TMDL, we request the addition of the following BMP on a provisional basis, to be included in the Virginia Assessment Tool (VAST) and Phase 5.3.2 Watershed Model, for use in achieving compliance with the Chesapeake Bay TMDL:

**BMP: “Harvested Wetlands”**

**Description:** “Wetlands treatment systems, including floating wetlands, designed to achieve the pollutant removal efficiencies indicated herein, and to produce water quality improvements in their treatment of stormwater runoff. The technology used in the design will be based upon *Treatment Wetlands, Second Edition* by Robert H. Kadlec and Scott D. Wallace (CRC Press, 2008), with measures taken to reduce potential adverse impacts such as leaching of nutrients from the bed media and the proliferation of invasive plant species. These wetlands systems will be positioned and harvested annually, not more than two weeks before or after the first frost.”

<b>TSS Removal Efficiency:</b>	61.2 %
<b>TP Removal Efficiency:</b>	36.9 %
<b>TN Removal Efficiency:</b>	27.0 %

The justification for the removal efficiencies is based on professional judgment, citing the above research, and specifically setting the provisional values at 90% of the published values from *Treatment Wetlands, 2<sup>nd</sup> Edition*. These published values include Virginia sites, and represent the medians from numerous sampled urban applications.

We appreciate your consideration of Harvested Wetlands as a provisional BMP. Please let us know if there is any other information we can provide to facilitate the inclusion of this important and cost-effective BMP into the Chesapeake Bay Program.

Thank you!