MS Thesis
Department of Environmental Science and Policy
George Mason University

Candidate: Brendan McAndrew
Defense Date and Time: 1/18/17, 11:00am
Defense Location: 3006 David King Hall
Title: Sustainable stormwater management using a floating treatment wetland—a system approach

Thesis Director: Dr. Changwoo Ahn
Committee: Dr. Younsung Kim and Dr. Dianna Hogan

ABSTRACT

Nitrogen is widely recognized as a chronic urban stormwater pollutant. In the United States, wet retention ponds have become widely used to treat urban runoff for quantity and quality. While wet ponds typically function well for the removal of sediments, nitrogen removal performance can be inconsistent due to poor design and/or lack of maintenance. Renovating ponds to improve their nitrogen capture performance, however, is typically expensive. A relatively untested technology called floating treatment wetlands (FTWs) has been proposed as a sustainable means of improving the nitrogen capture performance of stormwater wet ponds. The FTWs are comprised of an artificial floating island that supports the hydroponic growth of plants on a pond, lake, or canal. As the plants grow on the floating island, their roots remove nitrogen directly from the water column and may trap waterborne sediments. Few studies have been performed on the effectiveness real-world stormwater systems, however. In this study, the nitrogen and sediment capture performance of a 50 m^2 floating treatment wetland deployed for 137 days on Mason Pond was investigated. A total of 2684 g of biomass was produced, 3100 g of sediment captured, and 191 g of nitrogen removed from the pond. Although biomass production was relatively low (53 g/m^2), we found that nitrogen uptake rate by the plants (0.009 g/m^2/day) was comparable to contemporary FTW studies. A system model was then developed from the collected data to simulate nitrogen removal performance of the FTW on Mason Pond. The model was then used to test the nitrogen removal efficiency of the FTW over longer deployment periods and with greater surface area coverage. While the literature suggests that FTWs must cover at least 10-15% of the pond to significantly aid nitrogen removal, the model suggests only modest nitrogen removal efficiency (~6%) by an FTW covering 25% of the surface of Mason Pond. These results may inform municipalities or developers that are considering the use of FTWs on stormwater ponds.