

ABSTRACT

McCahon, Margaret. M.S.E., Purdue University, August, 2010. Strategically Siting Constructed Wetlands to Target Nitrate Removal in Tile-Drained Agricultural Watersheds. Major Professor: Indrajeet Chaubey.

Wetlands offer a variety of services, such as pollutant removal from point and nonpoint sources, flood attenuation, and habitat for biodiversity. Constructed wetlands can be used in agricultural watersheds to protect surface waters from pollution by agricultural activities. A particular concern for the agricultural Midwest is the high nitrate export from agricultural fields that affects water quality at local and regional scales, including hypoxia in the Gulf of Mexico. Nitrogen export primarily originates in the Upper Mississippi and Ohio River Basins. Tile-drained lands, characteristic of west central Indiana, have greater nitrate losses than un-tiled lands. Constructed wetlands have been proposed as a partial solution to intercept nitrate between agricultural lands and downstream waters.

In order to most efficiently use constructed wetlands to treat nitrate exported from tile-drained lands, these wetlands should be carefully placed in the landscape to intercept high nitrate loads and sized according to their contributing areas. In this thesis a methodology is presented for strategically placing constructed wetlands in the landscape, and this methodology is applied to an 8-digit hydrologic unit (HUC) in west central Indiana. Results showed 19 sites that are suitable for wetland placement, requiring conversion of 0.1% of the entire 8-digit watershed. These wetlands would intercept approximately 3% of nitrate-rich waters from tile-drained lands, removing approximately 1% of all nitrate exported.

To better estimate nitrate removal in these headwater wetlands, the Soil and Water Assessment Tool (SWAT) was applied to a watershed within the 8-digit HUC where three potential wetland sites were found. Simulated wetlands removed nitrate in every month having flow. These three modeled wetlands consistently removed 17-36% of annual incoming nitrate, culminating in a 5% decrease in average nitrate loads at the watershed outlet. If placed strategically, wetlands can efficiently remove nitrate from tile-drained flow, but the extent of their impact in the landscape is dependent on the suitability of local conditions for wetland placement, as well as the specific criteria used for siting wetlands.