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USE OF VEGETATION TO MITIGATE NUTRIENT DISCHARGES IN CONTAINER NURSERY RUNOFF

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ABSTRACT. Sedimentation in an abandoned irrigation pond (lower pond) at a container nursery facility in Cumberland County, New Jersey, has created a shallow wetland area. This wetland receives nutrient-rich overflow from an on-site tailwater recovery system. Three years of surface water quality monitoring data revealed that this discharge was negatively impacting receiving waters. In the fall of 2004 and summer of 2005, 4,000 native wetland plants were used to modify existing conditions at the wetland. Almost one year of water quality monitoring data was collected to determine the effectiveness of these plants in removing nutrients from the system and mitigating the impact of the system discharge on water quality. Monitoring results show that the addition of vegetation to the lower pond reduced total phosphorus (TP) loads to Harrow Run, a tributary to the Cohansey River. In addition, concentrations of nitrogen in the form of nitrite and nitrate (NO2 + NO3-N) in Harrow Run were found to have very little correlation to those discharged from the tailwater recovery system.

Keywords. *Constructed wetland, Nursery, Nutrient removal, Phosphorus, Restoration.*

The high cost of land in New Jersey has led to a shift towards non-traditional agricultural sectors, such as production of ornamentals at container nurseries. This surge in nursery production has resulted in a 100% increase in sales in the past five years. As the number of nurseries continues to rise in New Jersey, so will the need for best management practices (BMPs) that provide effective economic benefits for this industry. Container nurseries often utilize overhead irrigation and are built on land overlaid by an impermeable liner. Typical of overhead irrigation, only 12% to 50% of irrigation water is intercepted by the planting container (Beeson and Knox, 1991). Of the water intercepted, Weatherspoon and Harrell (1980) found that only 13% to 20% of the irrigation water will be utilized for plant growth. The unused water can lead to large amounts of runoff, which decrease the overall water use efficiency of the operation and can result in contamination of receiving waters (Irmak et al., 2003).

Agriculture is a targeted source of phosphorus in natural waters. Excessive phosphorus and nitrogen loading to surface waters has been indicated as a primary cause of eutrophication. By definition, eutrophication is the natural aging of lakes and streams, often accelerated by the addition of excess nutrients to surface waters. The U.S. Environmental Protection Agency (USEPA) has identified agricultural land use as the dominant source of nutrients leading to eutrophication of the nation's lakes and streams (Sturgel and Bundy, 2004).

Mean annual nutrient concentrations in runoff from a container nursery in New South Wales, Australia, were revealed to be 9 and 2 mg L^{-1} for nitrate (NO3) and phosphate (PO4) (Huett, 1999). Nutrient concentrations decreased to 0.6 mg L^{-1} NO3 and 0.8 mg L^{-1} PO4 with the addition of a storage dam to the system, creating a constructed wetland (Huett et al., 2005). The contribution of plants to nutrient removal from tailwater runoff was found to be significant. Aquatic plants aid in net reduction of nutrients through the accumulation of biomass, fixation of inorganic and organic particulates, and where ammonium-nitrogen is present, the creation of an oxidized rhizosphere (Brix, 1994; Burgoon et al., 1989, 1995). Aside from plant contribution, sedimentation, decomposition, and adsorption-fixation reactions aid in pollutant removal (Tchobanoglous, 1993).

A constructed wetland, as defined by Hammer (1992), is built exclusively for water quality treatment. Constructed wetlands are a designed and man-made complex of saturated substrates, emergent and submergent vegetation, animal life, and water that mimics natural wetland systems for human benefits and use (Hammer and Bastian, 1989). According to Kadlec and Knight (1996), wetlands are engineered and constructed for four principal reasons: (1) to offset the rate of wetland loss to agriculture or urban development (constructed habitat wetlands), (2) to improve water quality (constructed treatment wetlands), (3) to mitigate flooding (constructed flood control wetlands), and (4) to be used in the production of food and dietary needs (constructed aquaculture wetlands). Constructed wetlands may be utilized in the treatment of municipal, industrial, and agricultural wastewaters, along with the treatment of polluted surface waters and stormwater.

Nutrient removal by a constructed wetland was determined for a shopping mall site in Newton, Massachusetts. The efficiencies were 60% to 85% for total phosphorus (TP)

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