Article 97

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Vegetated Rock Filter Treats Stormwater Pollutants in Florida

In recent years, a growing number of communities have employed rock or gravel-based media to grow emergent wetland plants to treat domestic wastewater. Known by many names, including rock-reed filters, vegetated submerged bed (VSB) wetlands, and shallow horizontal flow wetlands, they all apply the same basic technique (Figure 1). Wastewater is introduced into a shallow cell of rock or gravel in which wetland plants are rooted. Flow then travels slowly between the pore spaces in the rock, where it is subject to settling, algal and wetland uptake, and microbial breakdown. A recent technology assessment suggests that, when designed properly, VSB systems are a reliable and promising technique for reducing sediment, nutrient and organic carbon levels in wastewater (Reed, 1995).

In contrast, most stormwater wetlands are designed only to treat surface flows (and not subsurface flows). The question naturally arises whether the inclusion of rock or gravel cells could increase the pollutant removal performance of stormwater wetlands. Some preliminary answers have been recently reported by Egan and his colleagues (1995) in Central Florida. They designed and constructed an experimental "stormwater treatment train" to treat runoff from a 121-acre industrial subwatershed to protect a sensitive lake from eutrophication. The off-line system featured packed bed filter cells. Each packed bed filter cell was excavated into the soil, and had dimensions of 80 feet wide by 30 feet long and three feet deep. The bottom of each cell was sealed with a plastic liner, and then filled with either crushed concrete or granite rock. Eight filter cells were planted with one or more of the following emergent wetland plant species: maidencane, giant bulrush, and fireflag. Two cells were not planted to serve as controls, i.e., to test the pollutant removal capability of the rock media itself.

The packed bed filters were but one component of a larger treatment train. The first component was an off-line storage facility designed to capture the first flush of runoff from the watershed. Diversion weirs shunted the water quality volume into a sedimentation chamber to provide pretreatment. Next, runoff was diverted into one of 10 packed filter beds cells. Flow into each cell was regulated by submersible pumps that distributed runoff evenly into each cell at one of three flow rates: 0.067, 0.13 and 0.27 cfs (or about 0.1 to 0.5 acre-feet of runoff treated per cell per day). The experimental system was instrumented with automated sampling monitors, and 15 simulated storms were withdrawn from the sedimentation chamber during the spring and summer.

The overall pollutant removal performance of the packed bed filter system is summarized in Table 1. It should be noted that the mass removal reported does not include any prior removal that may have occurred in the sedimentation chamber that supplied runoff to the filter cells. As can be seen, the removal rates for total suspended solids, total phosphorus, and fecal coliforms all approached or even exceeded 80%. In addition, the removal of both inorganic and organic nitrogen was

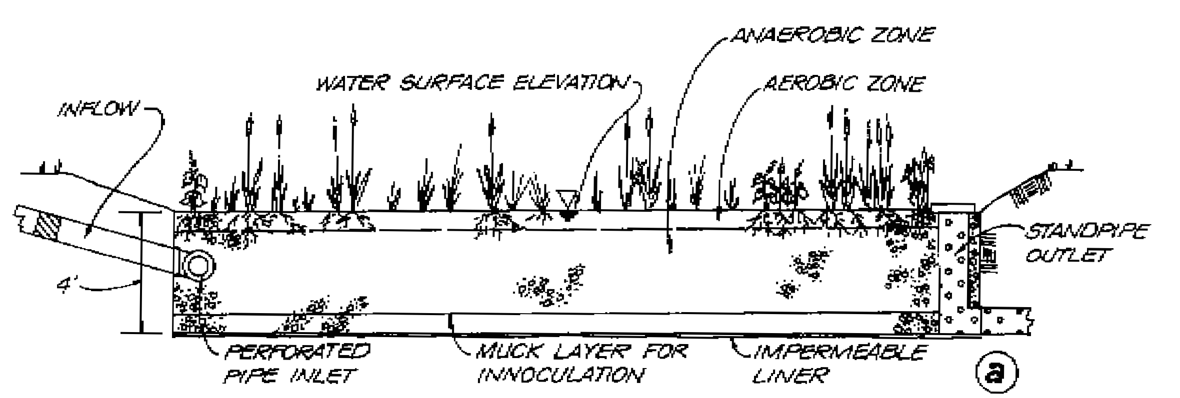

Figure 1: Schematic of a Vegetated Submerged Bed Wetland System