Construction sites are among the most common areas to experience soil erosion and sediment transport due to the mandatory foundation tasks such as excavation and land grubbing. Thus, temporary sediment barriers are installed along the perimeter to prevent sediment transport from the site. Erosion and sediment transport control measures may include, but not limited to, physical and chemical processes such as the use of silt fence and polyacrylamide. Runoff from construction sites and other impervious surfaces are routinely discharged into ponds for treatment before being released into a receiving water body. Stormwater harvesting from a pond for irrigation of adjacent lands is promoted as one approach to reducing pond discharge while supplementing valuable potable water used for irrigation. The reduction of pond discharge reduces the mass of pollutants in the discharge. This dissertation presents the investigation of the effectiveness of temporary sediment barriers and then develops a modeling approach to a stormwater harvesting pond to provide a comprehensive stormwater management pollution reduction assessment tool.

The first part of the research presents the investigation of the performance efficiencies of two silt fence fabrics in turbidity and sediment concentration removal, and the determination of flow-through-rate on simulated construction sites in real time. Two silt fence fabrics, one woven and the other nonwoven are subjected to material index property tests and a series of field-scale tests with different rainfall intensities and events, for different embankment slopes on a tilting test-bed. Collected influent and effluent samples were analyzed for sediment concentration and turbidity, and the flow rate through the fabrics was calculated. Test results revealed that the woven and nonwoven silt fence achieved 11 and 56 percent average turbidity reduction efficiency, respectively. Each fabric also achieved 20 and 56 percent average sediment concentration removal efficiency, respectively. Fabric flow-through-rates were functions of the rainfall intensity and embankment slope, but the nonwoven fabric exhibited higher flow-through-rates than the woven fabric in both field-scale and laboratory tests.

In the second part of the study, a Stormwater Harvesting and Assessment for Reduction of Pollution (SHARP) model is developed to predict operation of wet pond used for stormwater harvesting. The model is validated with actual data from a stormwater pond at Miramar Lakes, Miramar, Florida. The model integrates the interaction of surface water and groundwater in a catchment area. The SHARP model was calibrated and validated for pond water elevation. Model evaluation showed adequate prediction of pond water elevation with root mean square error between 0.07 and 0.12 m; mean absolute error between 0.018 and 0.07 m; and relative index of agreement between 0.74 and 0.98 for both calibration and validation periods. The SHARP model is capable of assessing harvest safe-yield and discharge from a pond, including the prediction of the percentage of runoff into a harvesting pond that is not discharged. The combination of silt fence and/or polyacrylamide to stormwater harvesting pond in a treatment train for the reduction of pollutants from construction sites has the potential of significantly exceeding the performance standards of 85 percent reduction typically required by local authorities. In fact, the stringent requirement of equaling pre- and post-development pollutant loading is highly achievable by the treatment train approach. The significant contribution from the integration of the SHARP model to the treatment train is that real-time assessment of pollutant loading reduction by volume can be planned and controlled to achieve target performance standards.

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