**AN ABSTRACT OF A THESIS**

# MATHEMATICAL DESCRIPTION OF SUBSURFACE FLOW (SF) CONSTRUCTED WETLANDS USING THE ADVECTION-DISPERSION MASS BALANCE EQUATION

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The advection-dispersion mass balance equation, an equation typically used for porous media flow, was used to describe both hydraulics and $BOD_5$ removal in subsurface flow (SF) constructed wetlands. A linear relationship between Reynolds number and axial dispersion coefficient was found and allows users to easily determine the axial dispersion coefficient of a SF wetland based on wetland media porosity, effective media size, water temperature, and pore velocity.

Using the model, the change in evapotranspiration, precipitation, temperature, and porosity were analyzed for their effect on SF wetland hydraulics and $BOD_5$ removal. A change in temperature of 10 $^{o}$C had a significant ($\alpha$=0.05) effect on the hydraulic retention time (HRT) of the SF wetland. For every degree increase in Celsius, the retention time of the wetland decreased 4.5 minutes. The HRT was found to increase 440 minutes for a 10% decrease in porosity. Only the porosity had an effect on the $BOD_5$ removal in a SF wetland, and for every 10% decrease in porosity, the $BOD_5$ effluent concentration increased 5.9 mg/L. A relationship was found between the kinetic coefficient (k) and the mass loading rate per unit reactor volume in the SF wetland.