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Title: Impacts of construction practices on soil properties and water budget prediction in created mitigation wetlands

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ABSTRACT

Wetland restoration and mitigation projects strive to replicate natural wetland hydrology but little is known about how the water budgets are affected by wetland construction activities. The alteration of soil properties associated with the wetland construction process may influence the predictive power of the water budget model. We studied disturbed (i.e., by construction) and nondisturbed areas of the Blackjack (BJ) and Peter's Farm (PF) wetland mitigation banks, both located in the Piedmont region of Virginia, for a variety of soil properties. Soil physical properties at PF were used to create a water balance model to compute water budgets of the nondisturbed and disturbed areas, and to apply these models to evaluate the response of the wetlands to changes in wetland surface and soil conditions. The surface soil horizon at BJ showed an increase in clay content from 18.6% to 40%, increase in total pore space (TPS) from 36.7% to 42.6%, decrease in bulk density (D_b) from 1.56 g/cm^3 to 1.45 g/cm^3, decrease the drained volume (D_v) of water in the soil profile from 0.67 cm to 0.36 cm, decrease in available water content (AWC) from 22.7% to 15.8%, and a reduction in the ratio of AWC to TPS from 66% to 40%. Soil at the PF showed an increase in clay

content in the surface horizon from 20% to 30%, increase TPS from 37.2% to 40.0%, increase D_b from 1.52 g/cm^3 to 1.67g/cm^3, increase the D_v in the soil profile from 3.5 cm to 6.6 cm, increase in available water content (AWC) from 37.2% to 40.2%, and a decrease in the ratio of AWC to TPS from 58% to 44% in the surface horizon. The outcome of the soils investigation clearly showed the impacts of construction activities on drainable and plant available subsurface water storage, more so in fine grained soils. The portion of TPS that stores water available for plants seemed significantly affected by soil texture and disturbance regime. The evaluation of the PF wetland response to changes in soil properties were made at the PF study area in terms of 5 hydrologic performance criteria. DRAINMOD models were calibrated with automated well data from a 17 month period using inputs of precipitation, temperature, soil physical properties and site characteristics. The models were successful at predicting the hydrology of nondisturbed and disturbed areas during the calibration period with absolute deviations between predicted and measured water table depths of approximately 7.7 cm and 6.7 cm, respectively. The model successfully predicted the frequency and longest duration of criteria occurrences within the 60-year (1952 to 2011) simulation period. Results show that increasing surface storage will result in an increase in near surface saturation and ponding during the growing season.