5. SUMMARY AND CONCLUSIONS

In wetland mitigation, it is essential to accurately estimate the amount of water available for potential storage in the wetland. This implies estimating the components of the wetland water budget. In this study, the water budget components, precipitation, runoff, evapotranspiration (ET), and groundwater seepage were calculated on a monthly basis using the methods specified in the modified Pierce water budget model (tentatively recommended for use by the Army Corps of Engineers) and compared to on-site field measurements made over 10 months in 1996-1997 at a wetland in Manassas, Prince William County, VA.

Comparison of monthly precipitation from the closest off-site weather station 32.18 km away (Dulles Airport) to on-site measurements indicated that precipitation off-site differed by as much as 2.9 times the on-site precipitation.

The calculated runoff estimates using the SCS runoff method with an antecedent moisture condition (AMC) II were very different from the runoff measured from hydrographs of stream discharge into the wetland during rainstorms. Percent differences ranged from 32 % to 100 %. Using AMC III instead of AMC II provided more accurate runoff estimates, probably because 1996 was a relatively wet year. These results demonstrated that the choice of AMC can greatly affect the water budget for the Manassas wetland. Runoff dominated the water available for potential storage at this site. The choice of AMC affected the runoff estimate for the Manassas wetland more than the use of off-site versus on-site precipitation data.

The diurnal cyclic changes of the water table taken in an observation well in the wetland were used to measure ET as proposed by White (1932). This method is applicable only during periods with no rain and when the water table is below the ground surface. It depends on accurate estimates of the specific yield of the soil and is very sensitive to errors in measuring specific yield. These results were compared to the calculated potential ET (PET) using the Thornthwaite method as specified for the modified Pierce model. The results indicated that the Thornthwaite PET underpredicted ET for some months and overpredicted ET for the other months. The largest differences from the diurnal cycle method was 4.87 cm higher in July and 4.28 cm lower in May. The effect of such differences on the water budget was usually negligible since stream inflow dominant water inputs, contributing as much as 357 cm depth of water per month to the Manassas wetland. Groundwater seepage losses (cm/day) was estimated by the modified Pierce water budget model using Darcy's equation and a hydraulic gradient of 1. The net groundwater seepage loss was estimated to be 0.086 cm/day (2.58 cm/month). Similar loss estimates calculated using Darcy's equation, but with hydraulic head gradients measured with nested piezometers at the site ranged from 0.034 to 0.002 cm/day. A net groundwater gain to the wetland of 0.003 cm/day was also observed for one set of hydraulic gradients. These groundwater flow rates are all very slow and will add or remove relatively small amounts (1.02 cm/month maximum) of water to the wetland. However, groundwater estimates using a hydraulic gradient of one overestimated the loss of water from the wetland by groundwater seepage and therefore provides the most conservative estimate for wetland design.

The potential storage of the Manassas wetland was obtained as the algebraic sum of inflows and outflows not including the baseflow component of stream inflow, stream outflow, and groundwater inflow. The potential storage calculated from on-site measurements and the modified Pierce model was dominated by runoff. However, the lower runoff values obtained using the modified Pierce model resulted in a relatively greater effect of the other water budget components on the modeled potential storage than on the measured values.

The modified Pierce model underpredicted potential storage for every month of the study period. It indicated low or deficit potential storage, whereas the on-site measured potential storage consistently showed a surplus of water. These findings indicated that the modified Pierce water budget model was conservative for a relatively wet year. Therefore, a wetland design based on the modified Pierce water budget model may be more likely to maintain wet conditions due to the overall conservative estimates of the potential storage. However, if estimates are too conservative, a site suitable for wetland mitigation may not qualify due to an underestimated potential storage.

Overall, the results of the study show that the methods used to estimate each water budget component can have an effect on the potential storage. For the Manassas wetland, this study shows that there is a suitable water supply to expand the existing size of the wetland to create new wetland areas as proposed by VDOT. However, it should be noted that changing the natural setting of the wetland could alter the water budget and create a different hydrological regime that may not support existing wetland functions. Such changes could occur from soil grading if the impermeable soils that prevent groundwater losses are removed. In addition, too conservative water level predictions can cause the wetland to remain at its maximum water level during wet years and this may be detrimental to some wetland species. It would also be advisable for VDOT to conduct a study similar to this at the Manassas wetland but during a dry year to assess the modified Pierce model during a dry year. Expanding such studies to other wetlands would also provide more confidence in extrapolating the results and findings on wetland water budgets.

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