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Assessing Stormwater Pond Resilience to Climate Change and Rising Groundwater Levels Using Integrated Modeling

Abstract: Florida's coastal regions face escalating risks of flooding due to the combined effects of sea level rise, climate change, and rapid land development, which increase impervious surfaces. Rising groundwater levels, driven by sea level rise, and altered hydrologic processes from climate change challenge the reliability of stormwater ponds, which are crucial for managing excess runoff and reducing pollution. Groundwater rise reduces soil storage and infiltration capacity, leading to extended recovery times and diminished capacity to manage consecutive storms. Additionally, sea level rise and increased rainfall due to climate change elevate the seasonal high water levels in retention ponds, impairing their effectiveness in flood control and pollutant capture. This study evaluates these impacts on stormwater pond reliability in central and coastal Florida using a fully coupled surface water and groundwater model. Future projections were generated using the Multi-Model Ensemble method, incorporating data from General Circulation Models (GCMs). The analysis projects a 13% increase in rainfall and a 40 cm rise in groundwater levels by mid-century. Results reveal that these changes could decrease pond reliability by up to 45%, increasing the duration of road flooding by 200%, alongside a 67% rise in nitrogen and phosphorus loads. The increased pollutant load could adversely impact downstream wetlands and their wildlife. These findings underscore the urgent need for adaptive stormwater management strategies that integrate future sea level rise and climate change projections, ensuring the resilience of Florida's infrastructure against intensifying environmental challenges.

Biography: Rahman Davtalab is a civil engineer with over 20 years of experience in the industry, specializing in water resources management. Alongside his professional work, he remains active in academia, having published an extensive number of conference and journal papers. Rahman has conducted research as a visiting scholar at the University of Central Florida, focusing on climate change impacts and water resources management. Currently, he is engaged in developing advanced hydrologic and hydraulic models at Halff Associates, where his work centers on flood management and groundwater interactions.