OPERATING AT THE INTERSECTION OF SOCIAL, ENGINEERED, AND NATURAL SYSTEMS: THE HYDROLOGIC IMPACT OF GREEN STORMWATER INFRASTRUCTURE BASED ON ADOPTION RATES

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ABSTRACT

Urbanization disrupts natural hydrologic processes, causing increased risks of flooding, higher runoff volumes, and reduced infiltration volumes, among other challenges. Implementing green stormwater infrastructure (GSI) can potentially mitigate such impacts. This study employs Gridded Surface Subsurface Hydrologic Analysis to model subwatershed-scale impacts of installing residential-scale GSI—specifically rain gardens and cisterns. The Waller Creek watershed in Austin, Texas serves as a case study, integrating social systems into the hydrologic modeling process that traditionally focuses on studying the integration of engineered and natural systems. Residents in the Waller Creek watershed were surveyed to identify the percentage of residents who had or were willing to implement or expand capacity of rain gardens or cisterns. These stated rates of adoption were used to estimate the current and potential residential GSI in the watershed. Using a parent-child model calibration approach, a watershed-scale model of Waller Creek was used to calibrate a neighborhood-scale subcatchment of interest. The subcatchment was used to model a "pre-GSI" control scenario and four "post-GSI" scenarios that captured the varied levels of potential GSI adoption—20%-50% adoption across single family homes—based on survey results. Each scenario was modeled with 1-hour design storm sizes ranging from a less than 1-year return period (0.65") to a 25-year return period (3.58"). A Wilcoxon paired sign-rank test indicated that all post-GSI scenarios had a statistically significant decrease in peak discharge from the control. The GSI performed best in the scenario with maximum potential adoption modeled under a 1-yr return period storm, which had a 25% decrease in peak discharge (from 67.55 cfs to 50.70 cfs) from the control scenario.

Key words: green stormwater infrastructure (GSI); urban stormwater management; rain garden; cistern; Gridded Surface Subsurface Hydrologic Analysis (GSSHA); streamflow regionalization

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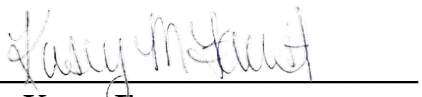

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