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Evaluating uncertainty in stormwater control measures (SCMs) using the EPA Stormwater Management Model (SWMM) linked with Markov Chain Monte Carlo uncertainty technique

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Abstract: Stormwater Control Measures (SCMs) are commonly used to mitigate the effects of urban development on floods and water quality. SCMs have been shown to reduce stormwater volume and peak discharge from impervious areas, and through using natural processes, improve the water quality. With increasing adoption across the U.S. due largely to flood control regulations, SCMs are installed in most newly developed or redeveloped areas. Simultaneously, since the promulgation of the total maximum daily loads (TMDLs) program municipalities seek to prevent stormwater pollution to the nation's water bodies through implementation of SCMs. This study aims to investigate the effectiveness of SCMs for simultaneous flood and water control purposes. Specifically, we examine the role of modeling uncertainties on the estimated effects of SCMs. Statistically rigorous methods were used to propagate modeling uncertainties forward into the design of practices. The Storm Water Management Model (SWMM) was linked with a Markov Chain Monte Carlo (MCMC) uncertainty analysis technique to quantify predictive uncertainty in the estimated effectiveness of SCMs from varying types of urban drainage areas. The assessment was conducted for eight commonly used SCMs to inform design guidelines. The effectiveness of practices, modeling uncertainties, and the effects of climate change were carefully examined and synthesized using robust system reliability and resilience metrics.

Keywords*:* Stormwater; SWMM; Uncertainty; Performance