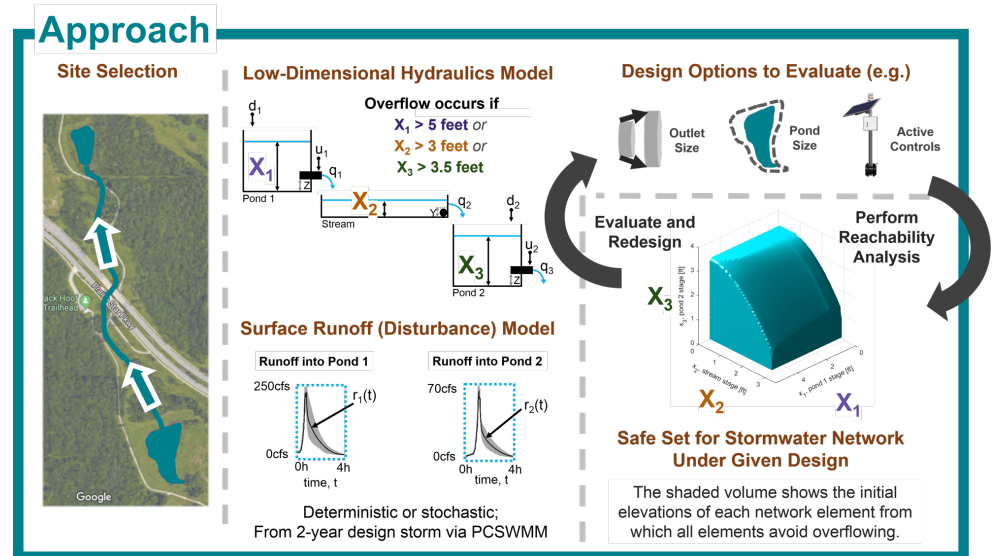


## September 2019 Project Spotlight

### Unclogging the DRAIN: Designing Robust Autonomous Infrastructure Networks

#### DESCRIPTION

Stormwater infrastructure is required to safely manage uncertain precipitation events of varying intensity, while protecting natural ecosystems, under restricted financial budgets. In practice, candidate designs for stormwater detention or retention systems are commonly evaluated assuming that a given system operates independently from nearby systems and is initially empty prior to an extreme storm event. Quantifying system behavior from many initial conditions under more realistic hydrographs is a critical need for enhancing the safety and resiliency of urban water infrastructure. The necessary computations would be intractable via sampling but are tractable via a formal verification method called *reachability analysis*. By further developing this technique, we seek to devise more realistic (yet still interpretable) design-phase indicators of stormwater system performance.



*Evaluating design trade-offs using reachability analysis.*

#### INDUSTRY IMPACT

Quantifying system behavior from many initial conditions under stochastic hydrographs (in a computationally tractable manner) is a critical development for next-generation design practices of urban water infrastructure.

#### ADDITIONAL RESOURCES

- Chapman, et al., "Reachability Analysis as a Design Tool for Stormwater Systems," in *6th IEEE Conference on Technologies for Sustainability (SusTech)*, November 2018.
- Chapman, et al., "Reachability Analysis as a Design Tool for Stormwater Systems: Towards Planning in the Presence of Stochastic Surface Runoff," *AGU Fall Meeting Abstracts*, December 2018.
- Chapman, et al., "A Risk-Sensitive Finite-Time Reachability Approach for Safety of Stochastic Dynamic Systems," in *2019 American Control Conference (ACC)*, July 2019.

#### PROJECT INFORMATION

Thrust: U – Urban Systems and Institutions  
 Theme: U2 – Visioning, assessment, and implementation tools for regional and municipal water planning  
 No. & Title: U2.14 Reachability analysis as a design tool for stormwater systems  
 Team: Claire Tomlin (PI), David Freyberg, Kevin Smith, Margaret Chapman