Regional Watershed Resilience: Robust Decision-Making Case Studies

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Meet the Scientist Session 2A

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Problem

- Communities need to develop cost-effective integrated water management solutions in the face of deep uncertainty concerning climate change and land-use/population changes
  - Stormwater/flooding
  - Drought/water supply
  - Wastewater/CSOs, SSOs, septic performance

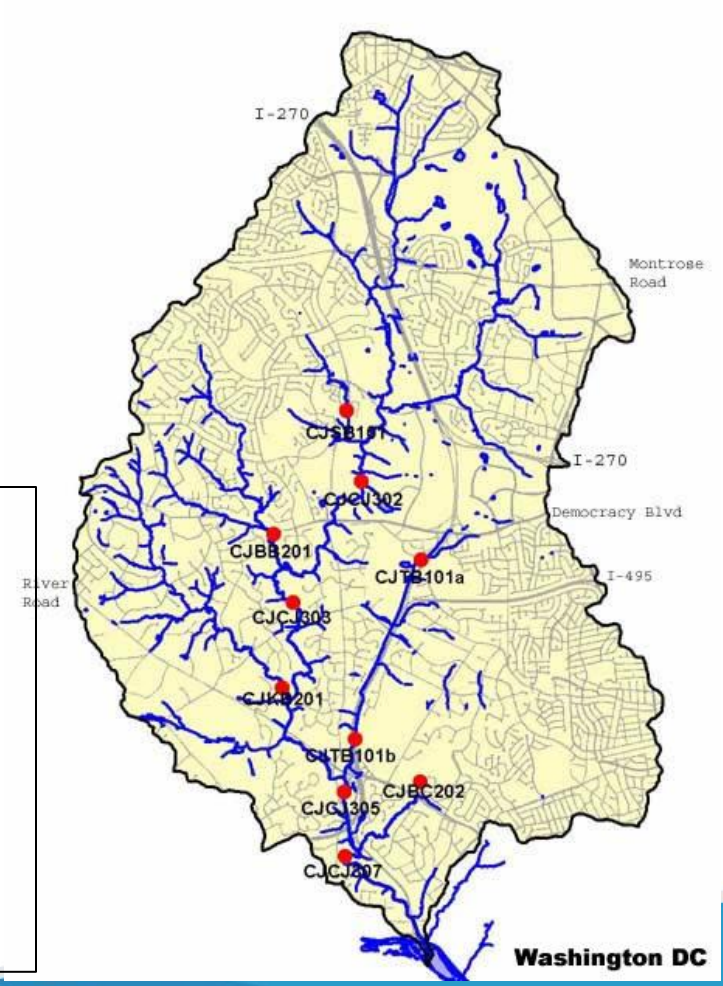
Approach: Robust Decision-Making

- Collaborative modeling approach: definition of problem, goals, assumptions, and management options under consideration
- Simulate range of potential climate and land-use change
  - LASSO plots of LOCA downscaled scenarios (Δprecip x Δtemp)=>boundary envelope
  - Maimone (2019) approach to apply changes in event/drought frequency to climate time series
- Apply EPA's Watershed Management Optimization Support Tool (WMOST) to determine most cost-effective management actions to meet water quantity/quality goals under current climate
- Test robustness of current optimal management solutions
- For cases in which goals are not met, derive new suites of cost-effective management practices to inform adaptive management

Cabin John Creek, MD *(Application)*

Partners: Maryland Department of the Environment, Montgomery County, City of Rockville

Challenge: Identifying the most cost-effective suite of stormwater BMPs in a highly urbanized watershed to meet both local sediment TMDLs and downstream N, P, suspended sediment targets for Chesapeake Bay TMDL under normal, dry, and wet years



Summary: Cabin John Creek (MD) Case Study

- TSS reduction targets required greatest BMP implementation
  - Least cost practices to meet 21% TSS runoff load reduction
    - Infiltration basins > dry to wet pond conversion > sand filters
  - Least cost practices to meet peak flow target (based on sediment TMDL target and sediment rating curve)
    - Sand filter > infiltration basins > dry to wet pond conversions > bioretention basins > riparian buffers
  - TN, TP annual load targets greatly exceeded: 30%↓TN and 40%↓TP
- Riparian buffers provided least cost solution for meeting more moderate TN and TP reduction targets but yielded infeasible results for meeting TSS reduction targets
- Street sweeping solution was infeasible for average precipitation year with one large event and more expensive than stormwater controls for wet year
- Results sensitive to inter-annual variation in mean and max precipitation events and method for establishing target
- Future: Extending work to Baltimore area urban streams subject to temperature TMDLs

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Upper Soldier Creek (KS) Case Study

- Predominantly agricultural watershed within Middle Kansas River Basin subject to TMDLs for E coli (TP proxy) and TSS
- Optimization solutions to meet TP loading target:
  - 2012 (dry year):
    - Targets for upland loading: met w existing BMPs
  - 2014 (ave precipitation year)
    - Targets for upland loading: grassed swale (urban), contouring (agriculture)
  - 2015 (wet year)
    - Targets for upland loading: sand filter with under drain (urban), contouring (agriculture)
- Targets for upland loading + streambank erosion sources could not be met with only upland BMPs considered – will require flow reductions and streambank stabilization
- In progress: test of success of current optimal solutions under future climate change scenarios

Cypress Creek, TX Case Study *(In Progress)*

- Watershed NW of Houston in Harris County, TX
- Area experiencing rapid growth
- Flood waters overflow watershed boundary to Addick's Reservoir watershed to the south
  - Near capacity
  - Putting downtown Houston at risk
- Water quality concerns

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Stakeholder Questions

- If we optimize management practices for flood mitigation, will this also benefit water quality in the Cypress Creek watershed?
- What is the potential contribution of management practices at different scales (parcel, neighborhood, regional) to flood mitigation?
- If we optimize management practices to meet water quality goals in the Cypress Creek watershed, will this benefit flood mitigation?
- What is the most cost-effective mix of green and gray infrastructure management practices to meet flood reduction goals? and water quality goals?
- How do optimal management strategies change under future land-use and climate change scenarios?
  - Are current optimal strategies robust over time?
  - Can more robust strategies be created?
- What are the other water quality benefits and non-water quality co-benefits associated with green infrastructure solutions?
  - Do these vary across different socioeconomic groups?

Focus of collaboration with US Army Corps Watershed Assessment for flood mitigation options

Application & Impact

- Cabin John Creek, MD
  - Partnered with Maryland Department of the Environment (MDE)
  - MDE plans to use results to inform management of watersheds with similar conditions
- Upper Soldier Creek, KS
  - Partnering with EPA Region 7 (Midwest), Kansas Department of Health & Environment
  - Informing adaptive management to implement TMDL for Upper Soldier Creek
- Cypress Creek, TX
  - Partnering with US Army Corps of Engineers (USACOE), state agencies, Houston-Galveston Area Council, Katy Prairie Conservancy
  - Informing watershed assessment overseen by USACOE to evaluate existing flood mitigation options and implementation planning for watershed to deal with water quality issues