Urban Stormwater Research at Colorado School of Mines: Observations in Denver – Applications Nationwide

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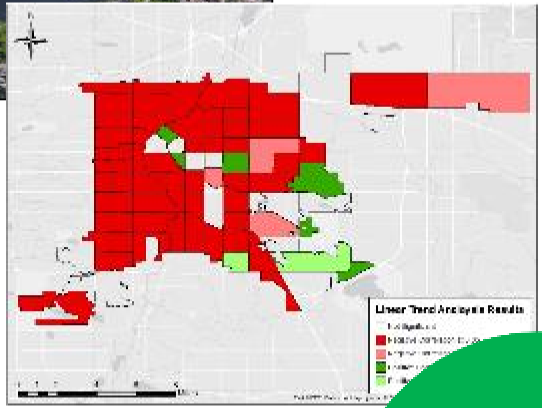
Overview of Regional Projects

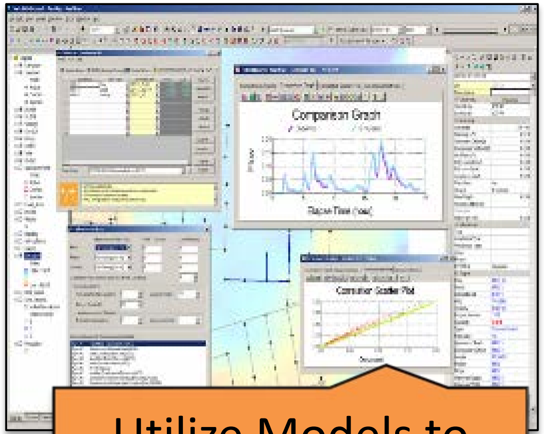
- Stormwater capture and treatment in Denver's Berkeley neighborhood
- Impacts of Denver infill development on city greenness
- Integrated decision support tool for grey/green/hybrid stormwater infrastructure



Denver’s Berkeley Neighborhood

- Feasibility study to model and implement green infrastructure to treat increased stormwater due to infill in Denver Neighborhoods

Build Land Cover Development Models



Utilize Models to Evaluate Stormwater Change

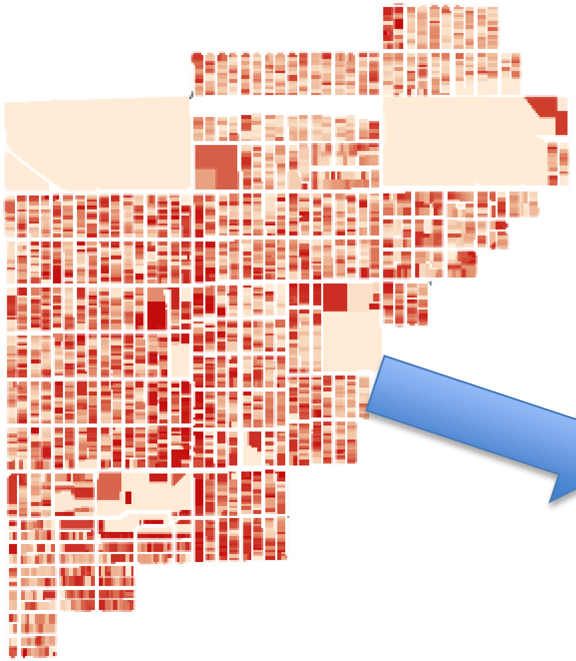
Design Treatment Systems to Capture and Re-use Water

Collaborative project between ReNUWIt/CSM and City and County of Denver

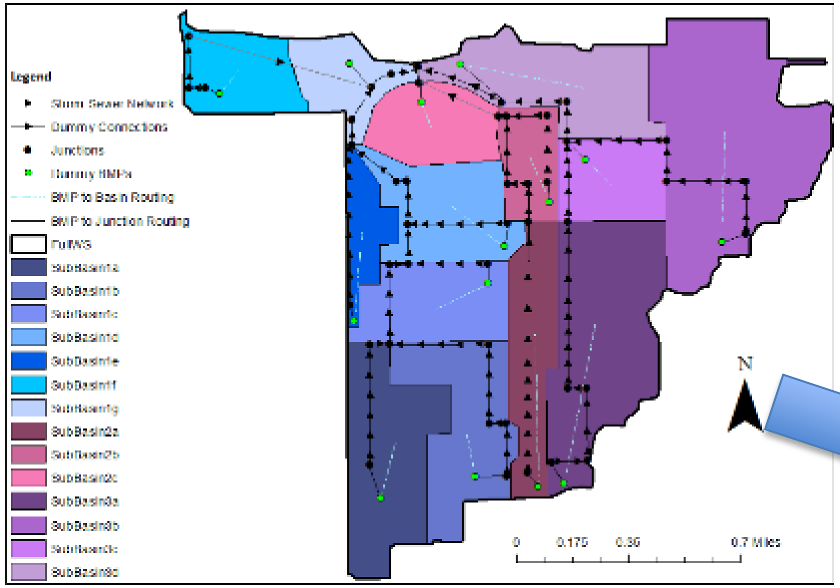
Example of Infill Development

Example of Infill Development

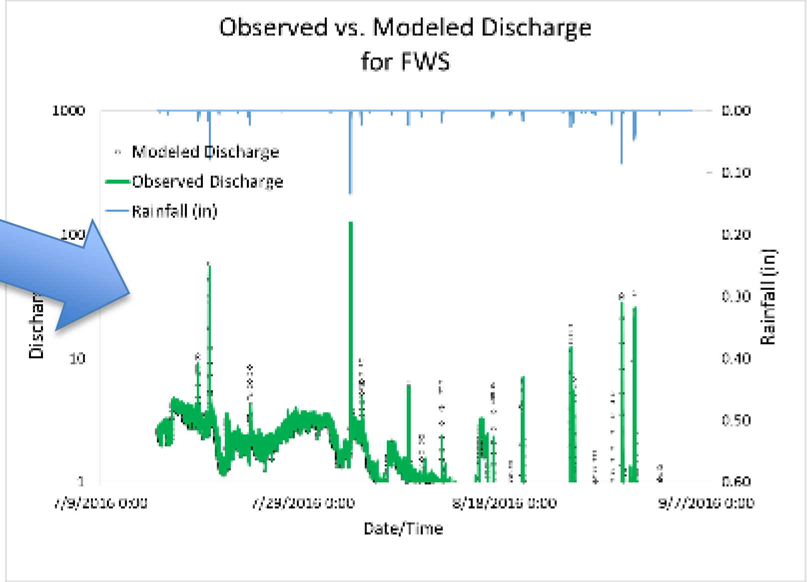
Simulating Impacts on Hydrology



Land use change



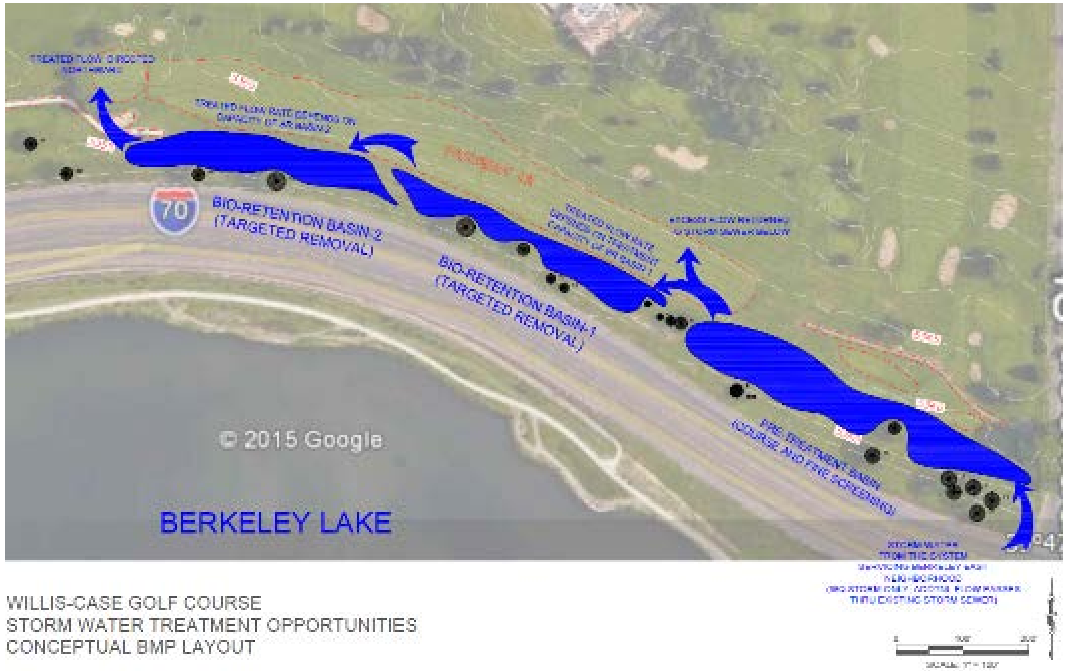
SWMM hydrologic model



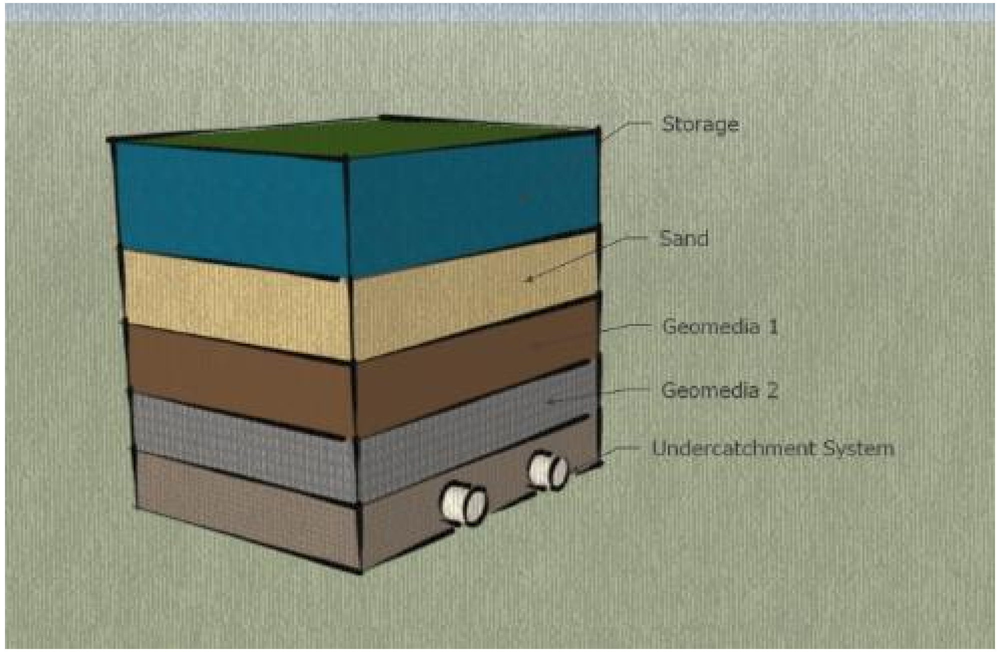
Impacts on stream flow, water quality

Use Projections to Design BMP

- Use **simulated hydrology** post infill to design size of treatment train
- Use **observed water quality** to design biofilter media

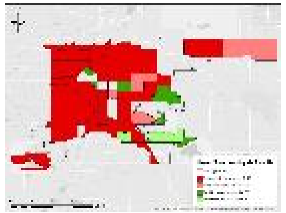


Proposed Treatment Train Location

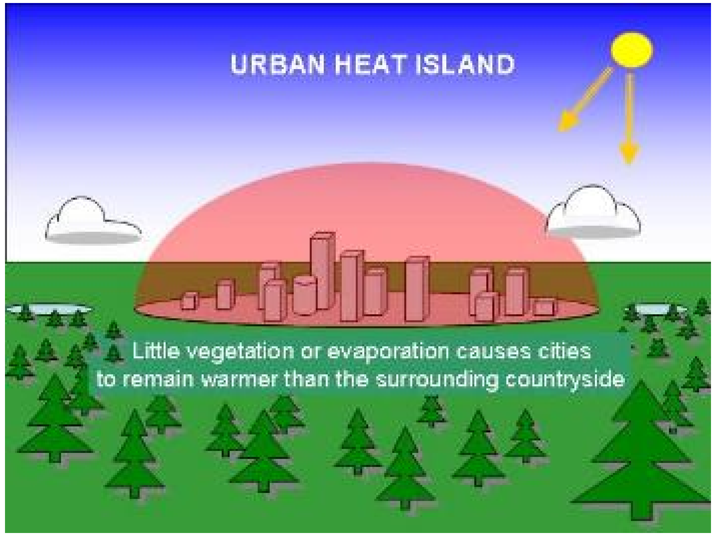


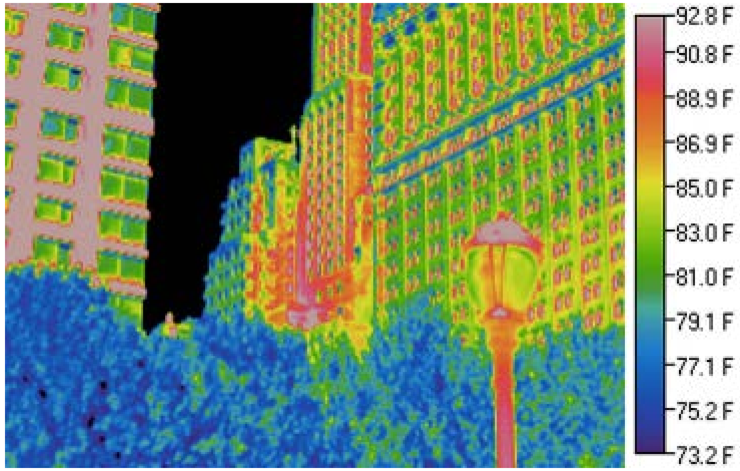
Filter Media Schematic

Vegetation Change in Denver



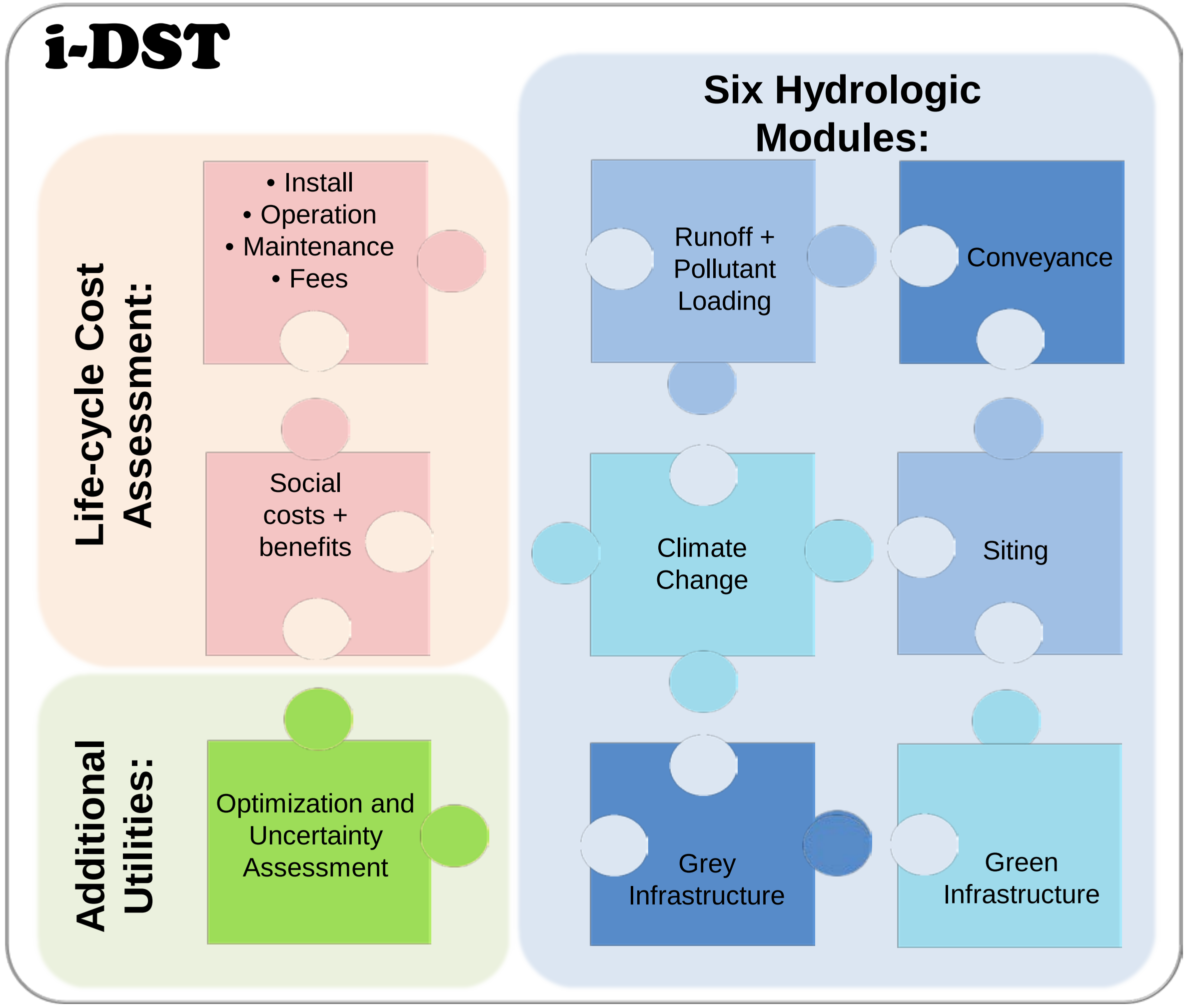
- Denver was fastest growing city in America in 2015
- Minimum **0.3% Annual Increase** in Infill Development by 2035
- Importance of Greenness:
  - Importance control of urban heat island effect
  - Implications for air temperatures and outdoor water use





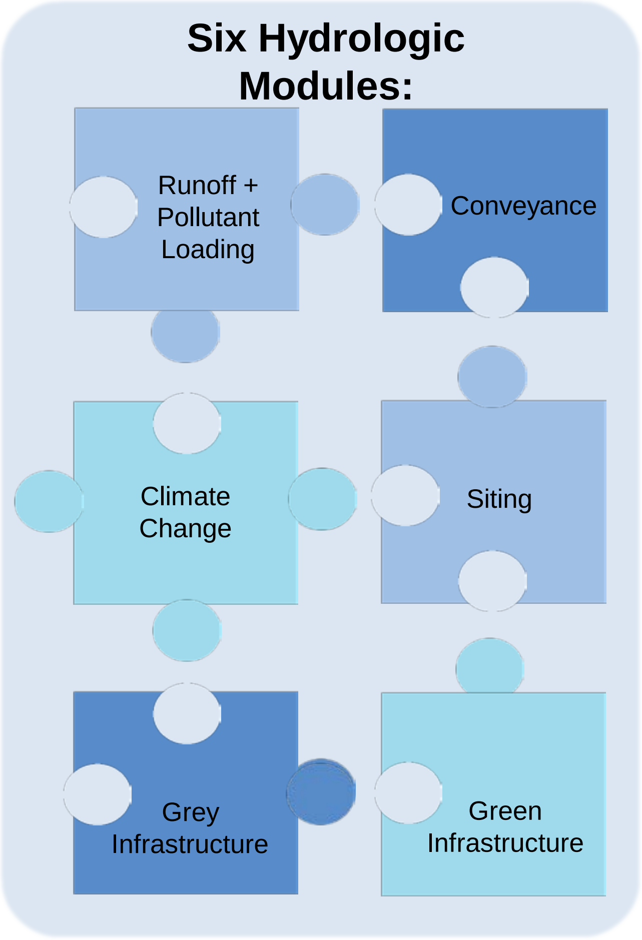
i-DST: Decision Support Tool for Stormwater Infrastructure

- EPA RFP: "**National Priorities: Life Cycle Costs of Water Infrastructure Alternatives"**
- Response: Develop an integrated, scalable, decision support tool (**i-DST**) for grey, green, and hybrid infrastructure PLANNING
- Components:
  - life-cycle cost assessment (LCCA) with traditional costs/benefits AND co-benefits of ecosystems
  - Hydrologic modules
  - Siting utility
  - Optimization
  - Uncertainty assessment



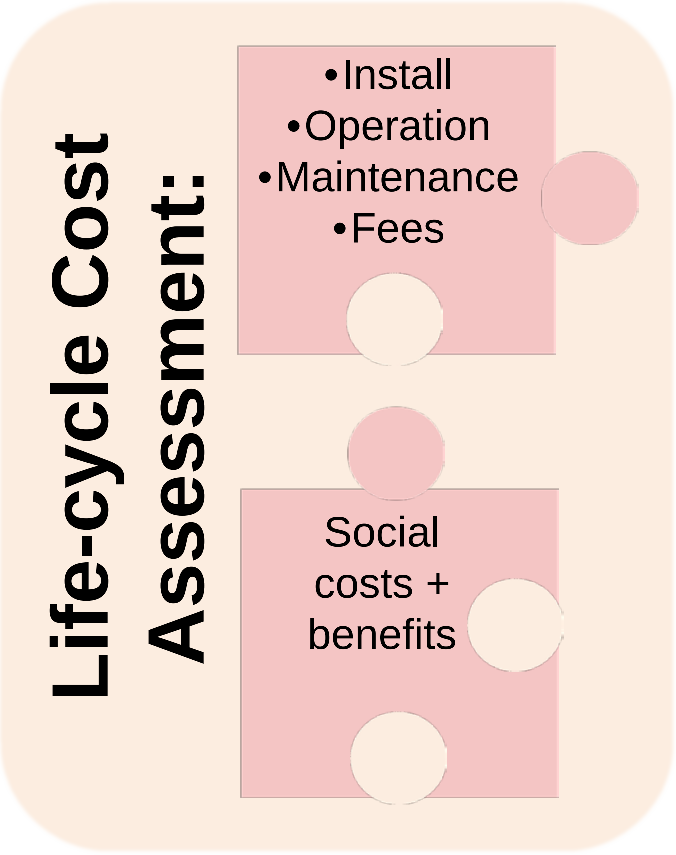
Hydrologic Modules

- Runoff and pollutant loading. Conveyance through drainage network.
  - We will provide simple, sub-hourly model. But users can also output from any hydrologic model as long as time series are formatted
  - We will provide utility for that
- Grey + green infrastructure changing water balance and pollutant loading
- Climate change projections
  - SWMM CAT scalars



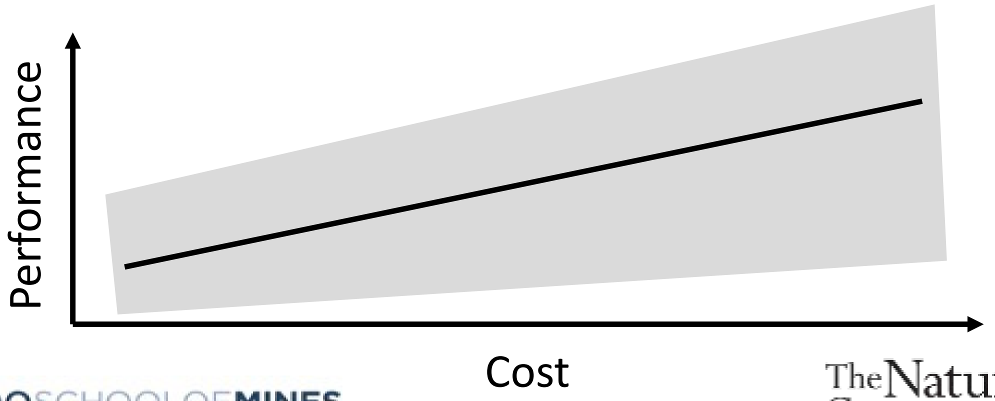
Life-Cycle Cost Assessment (LCCA)

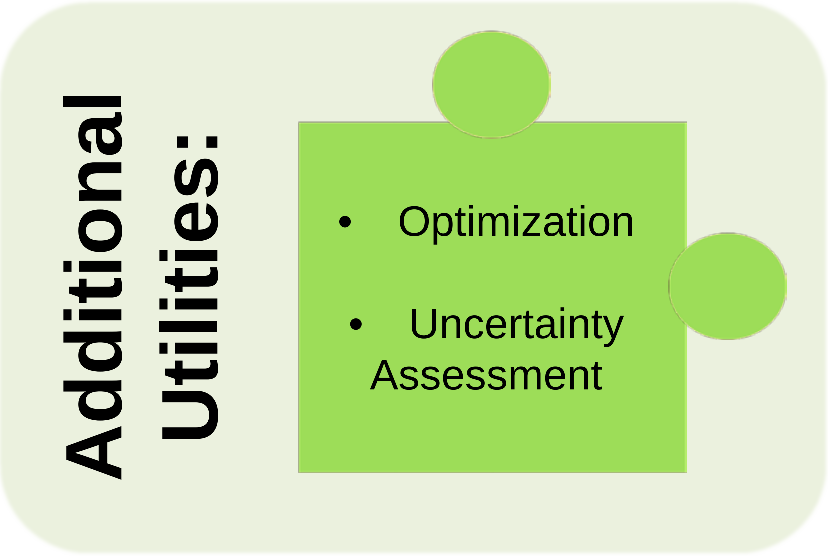
- Objective: Fully understand the life-cycle decisions by quantifying ***direct*** and ***indirect*** costs and benefits:
  - Economic
    - Life-cycle costs (construction, operation, maintenance, end of life).
  - Environmental benefits
    - Flood control / TMDL compliance
  - Social
    - Green infrastructure may create livability benefits
    - Increased property values, biodiversity, public health
  - Institutional barriers
- The core will be the UC Berkeley WEST tool for life cycle assessment



Other Utilities

- Optimization
  - Ensure design meets regulations, and user-defined constraints
  - Minimize both direct and holistic life cycle costs
- Uncertainty assessment
  - Provide a range of possible performance
  - Especially valuable as there is intrinsic uncertainty due to climate change projections and GI performance



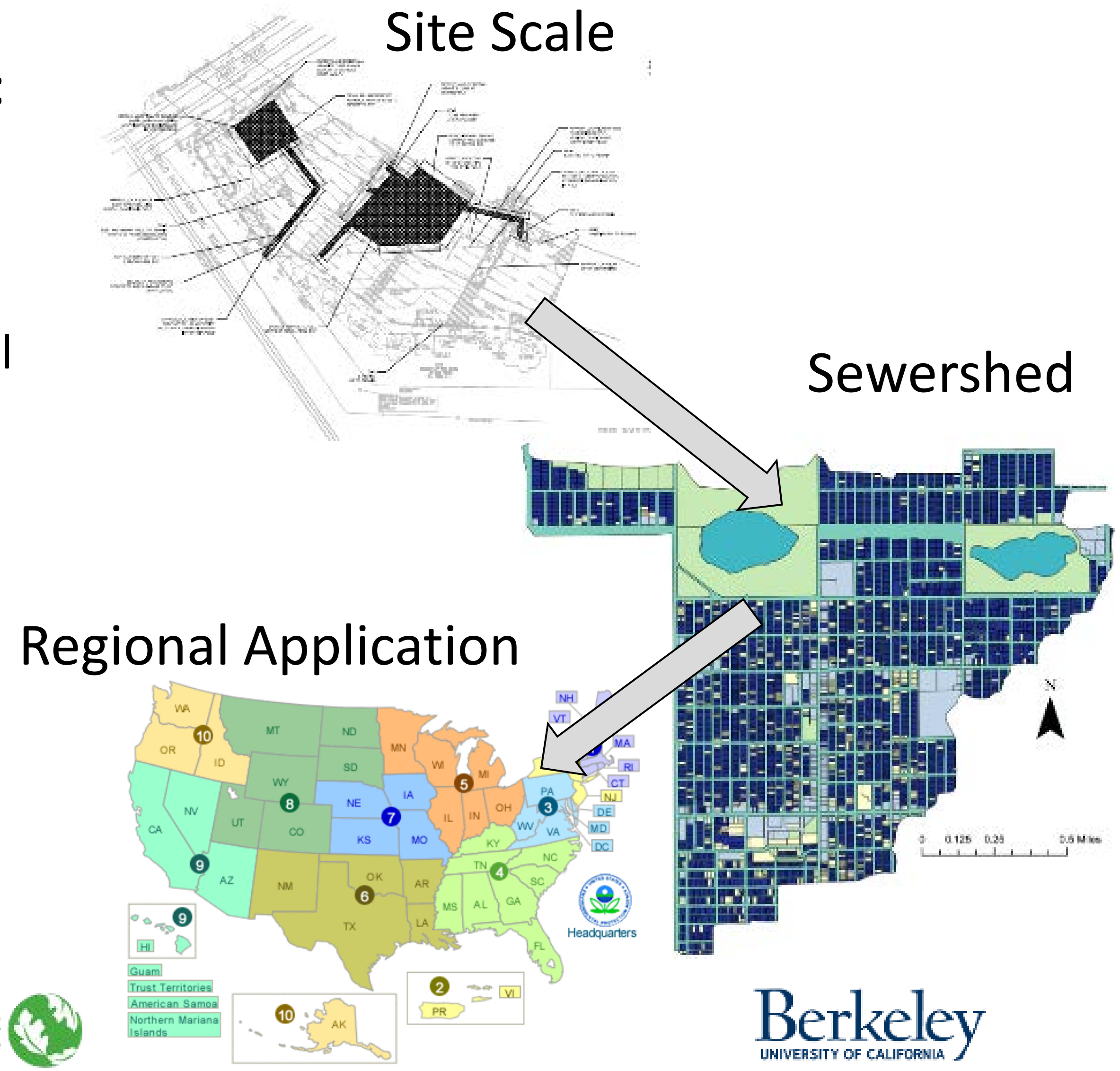


i-DST: Scalable and region-specific

- Tool will be developed at a individual site scale: **i-DST-SB**
  - “SB” = **S**ite or **B**usiness scale
  - Excel platform for ease of use
  - Will include runoff + pollutant load module, as well as reductions from GI

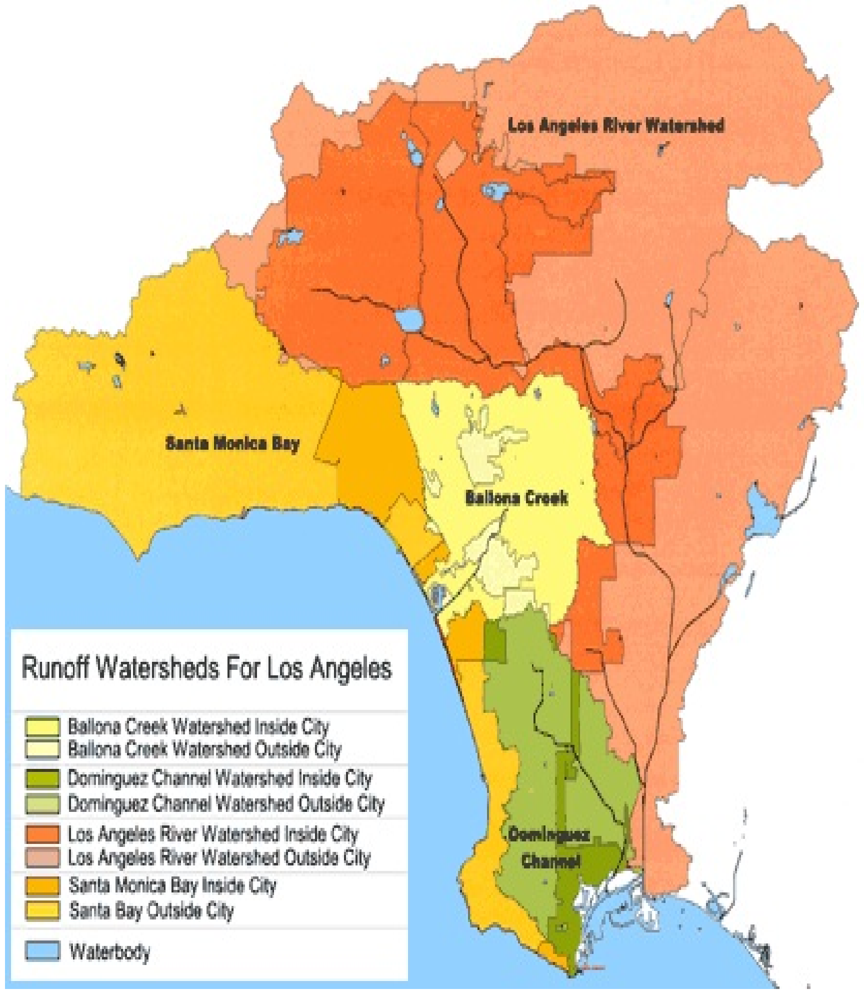
- Also, full model will harness more advanced runoff model for applicability at sewershed scale

- Model will use **region-specific data** on loading, GI performance, cost, materials and climate change so it can be used across the U.S.



Potential Study Sites

- **Denver, CO**
- Los Angeles, CA
- Washington, DC
- Seattle, WA
- Others?



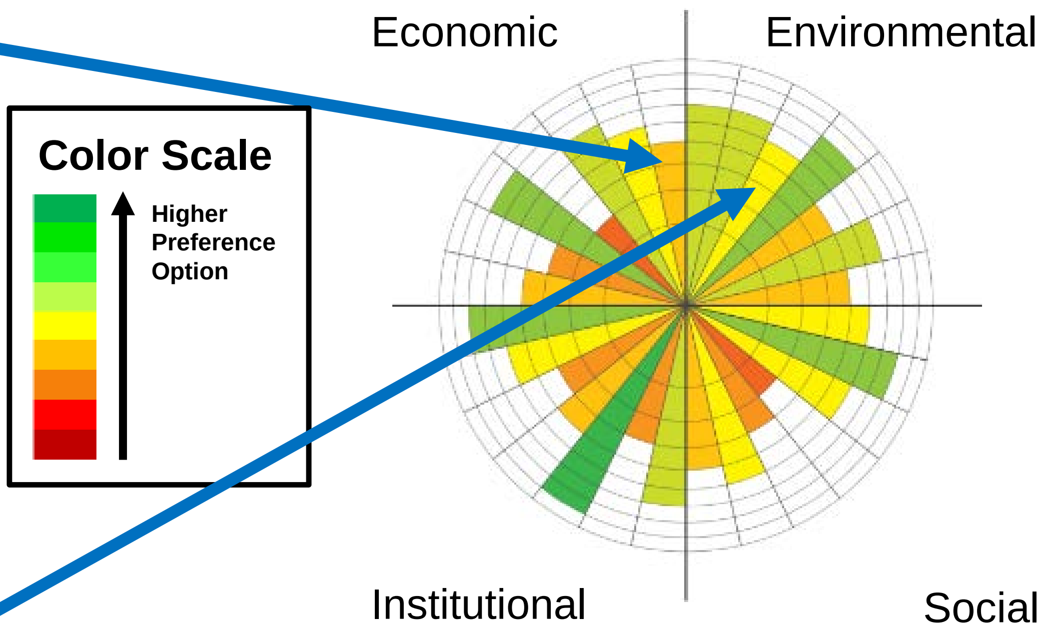
Example i-DST Output (Co-Benefit Analysis)

Economic Quadrant for Hybrid Alternative						
	Value	Units	Ranking	…	Preferred Value	Color
Life Cycle Costs	10 M	$	5		Low	
Operation and Maintenance	10 k	$ / yr	5		Low	
Capital Costs	2 M	$ PV	3		Low	
…						

(a) Assign Color Based on User Input

Environmental Quadrant for Hybrid Alternative						
	Value	Units	Ranking	…	Preferred Value	Color
Peak Flow Attenuation	15	cfs	5		High	
Pollutant Load Reduction	80	%	4		High	
Green Space Created	.5	acres	1		High	
…						

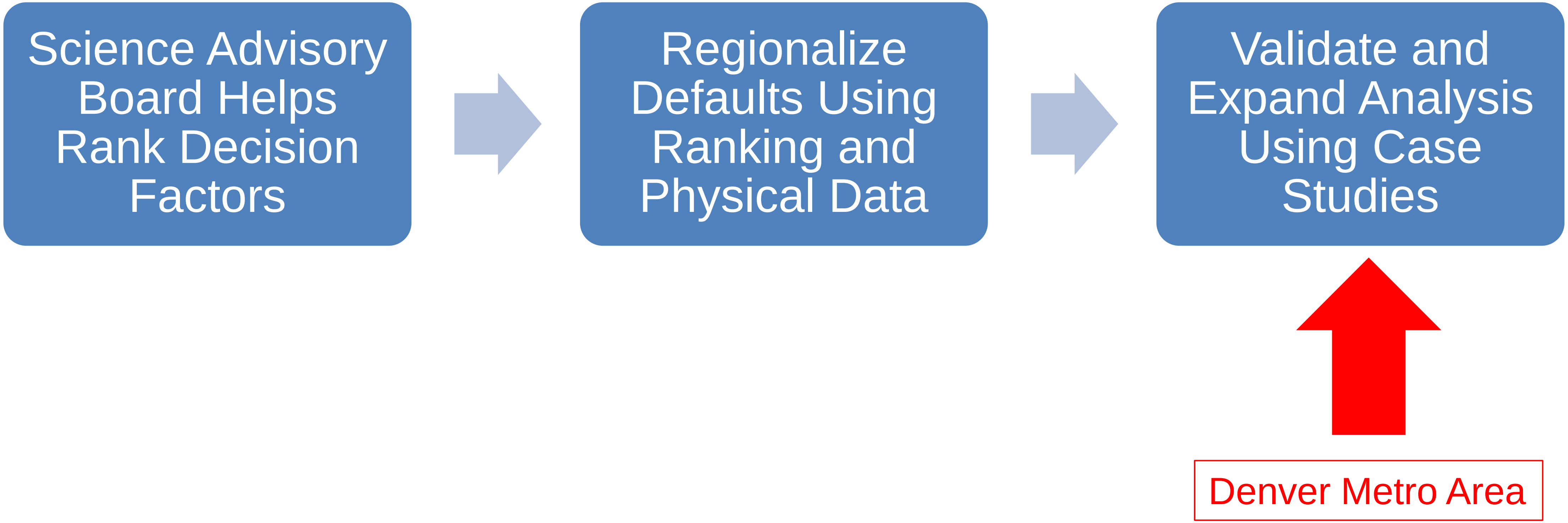
(b) Graphically Display MCA Results



Hybrid Infrastructure Option

Template from: http://www.circlesofsustainability.org/circles-overview/profile-circles/

Co-Benefit Analysis Workflow Process



Questions?

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