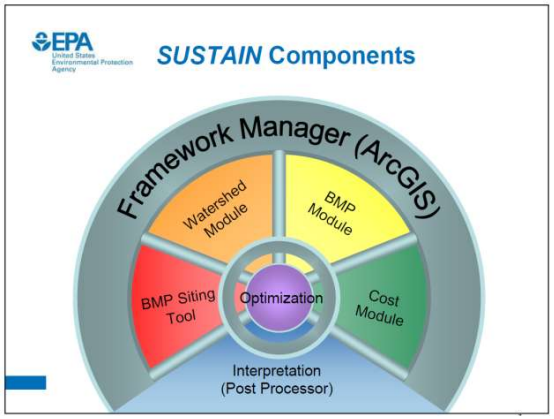
SUSTAIN Sub-Basin Scale Pilot Concept



January 26, 2012

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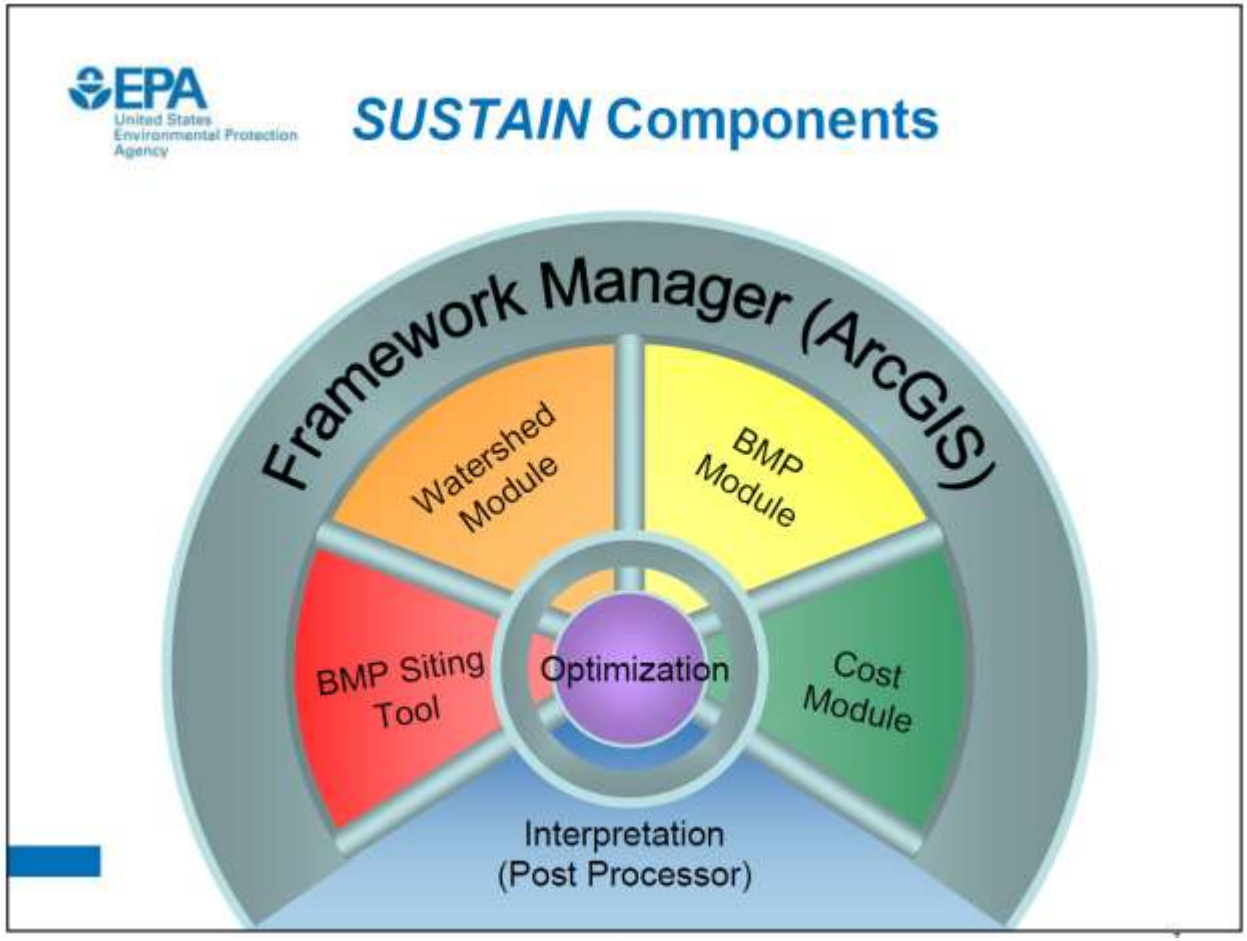
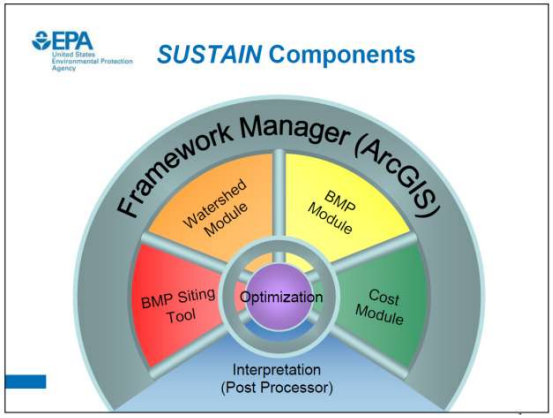
System for **U**rban **S**tormwater **T**reatment and **A**nalysis **IN**tegration ***SUSTAIN***



What is *SUSTAIN*?

- An ArcGIS-based framework designed to support evaluation and decision making:
  - How effective are green and/or gray treatment BMPs in reducing runoff and pollutant loadings?
  - What are the most cost-effective BMP options to meet specified water quantity and quality objectives?



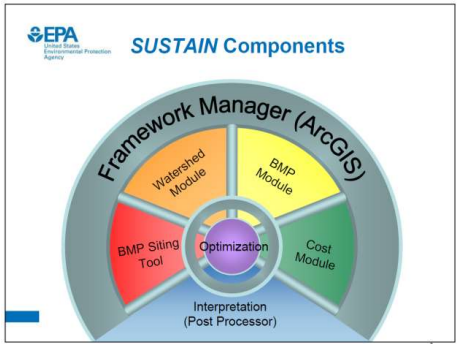
SUSTAIN Applications

- Los Angeles County, CA
- Upper North Branch Oak Creek, MI
- Little Rocky Run, VA
- Kansas City, MO
- Louisville, KY

http://www.epa.gov/nrmrl/wswrd/wq/models/sustain/#Downloads

Data Needs

- Land Use/Land Cover map
- Stream network
- Watershed model
  - Internal model in SUSTAIN
  - External model (Examples: HSPF, SWMM)
- BMP types, design configurations, costs
- Instream targets



BMP Scale Considerations

Site

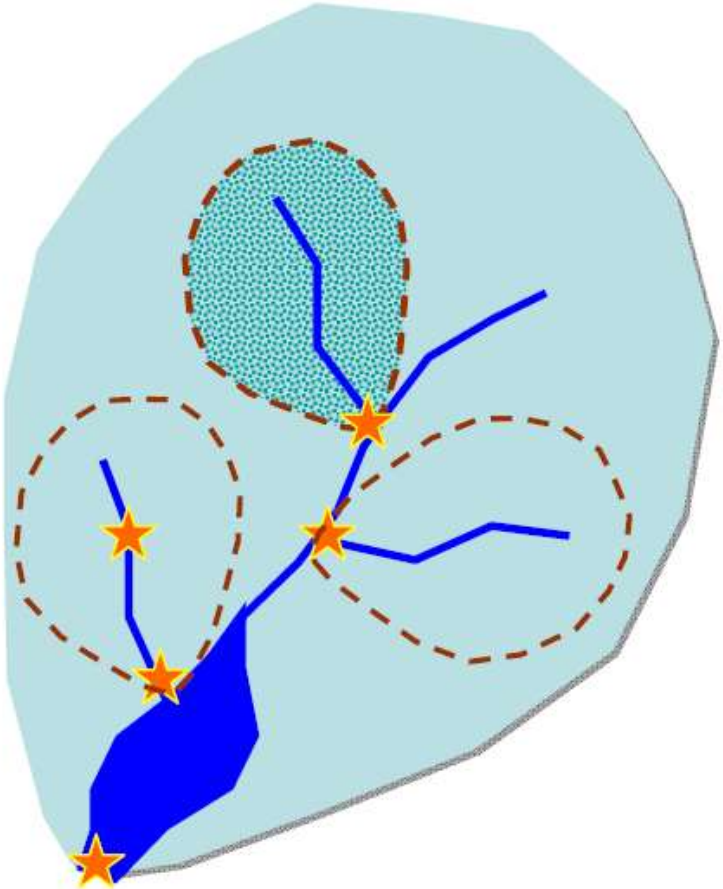
Regional

10s of BMPs

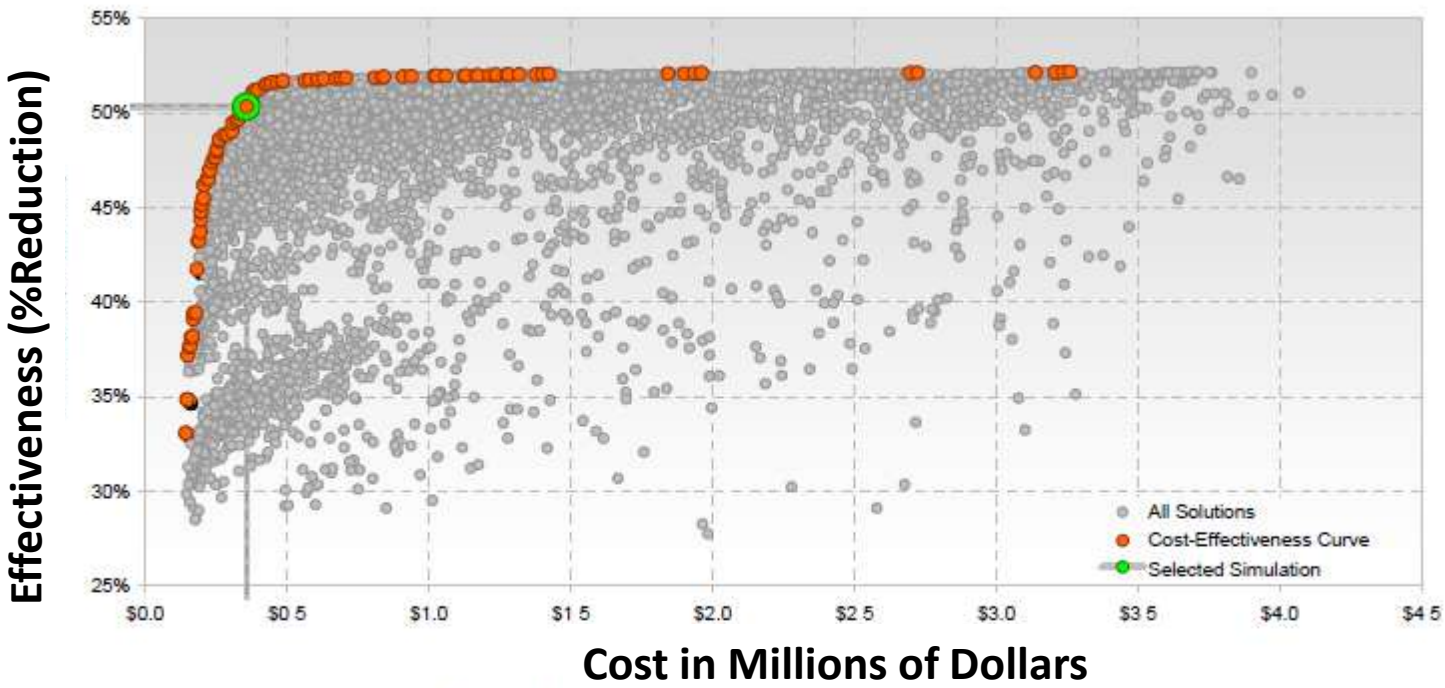
1,000s of BMPs

Optimization and Spatial Scale

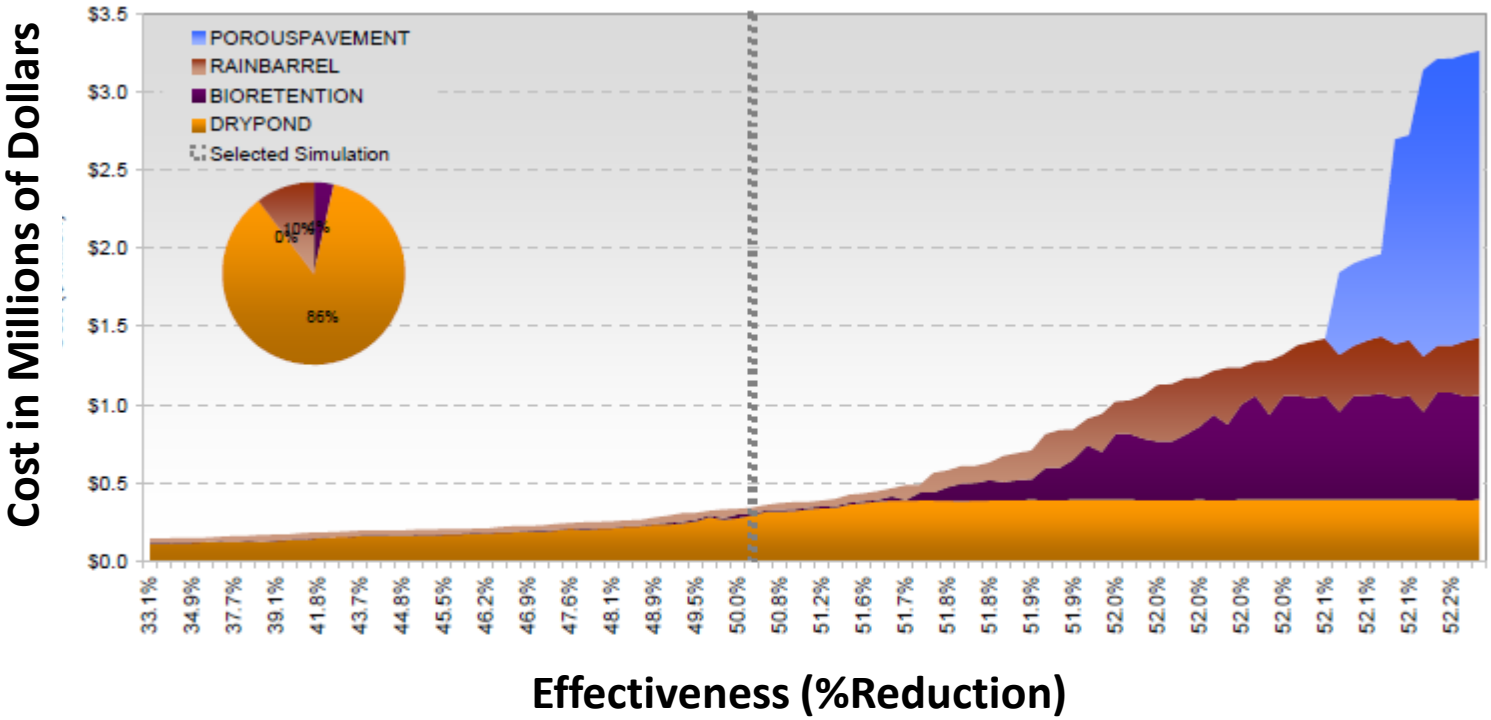
- Site scale
  - Detailed network articulation is both informative and practical
- Regional scale
  - "Nested" or tiered approach
  - Efficiency in optimization
  - "Building blocks" address localized impacts
  - Simplification of analysis
  - Preserves physical linkages and watershed integrity



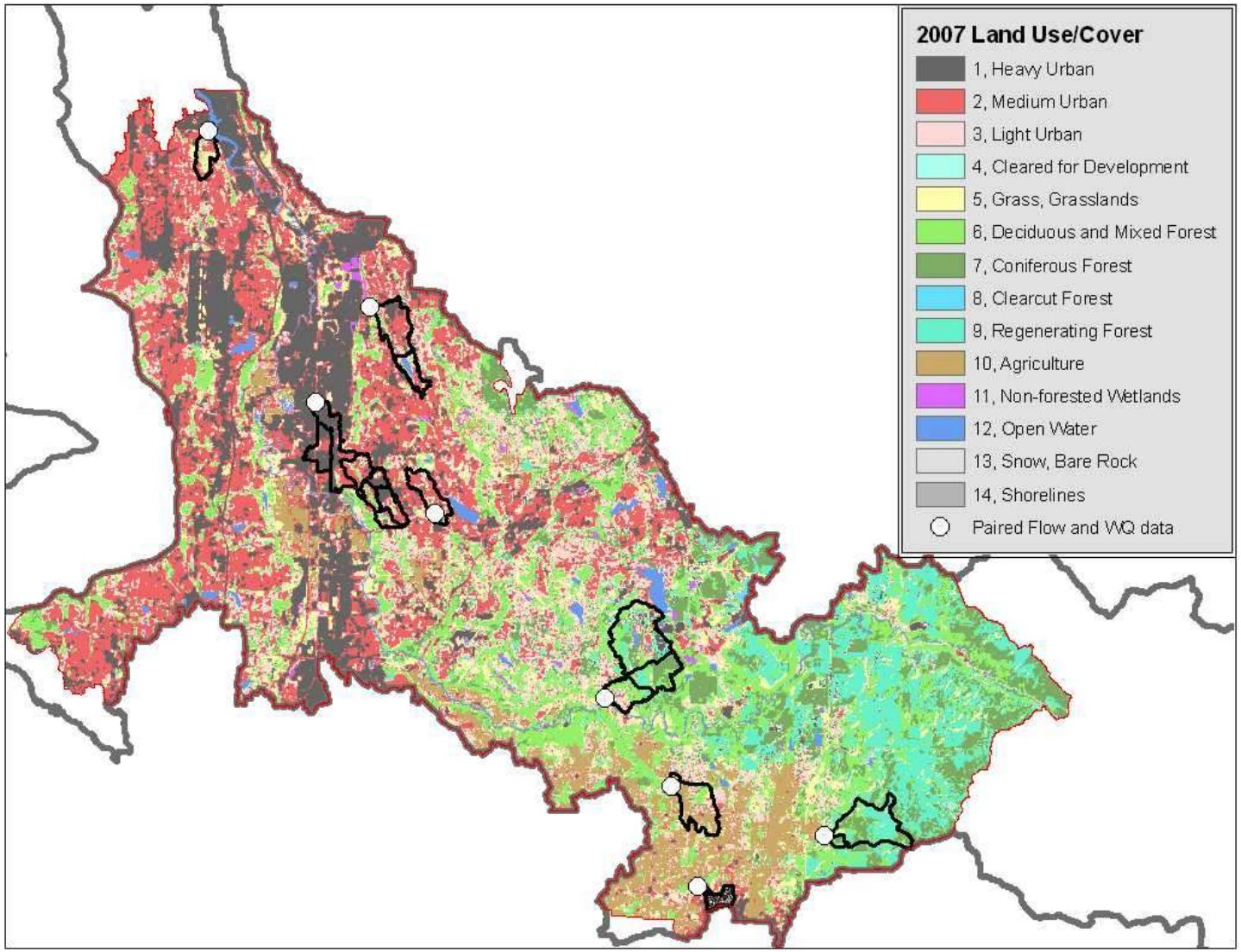
Cost-Effectiveness Optimization



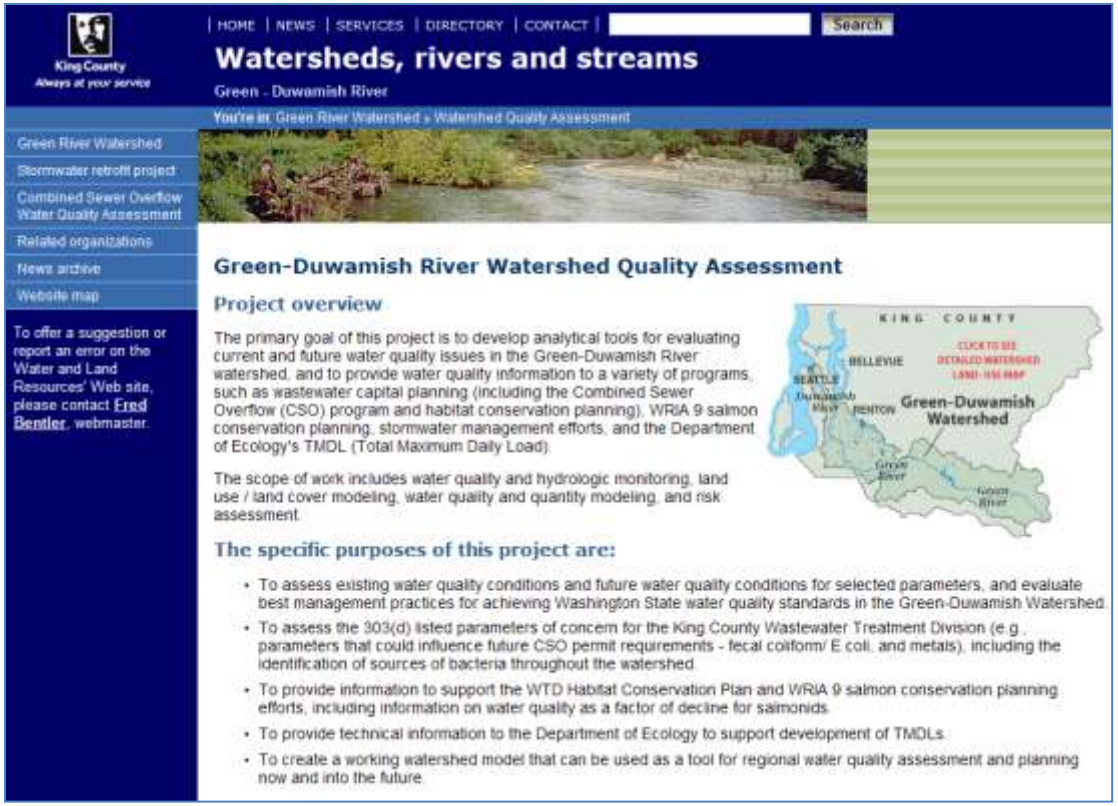
Cost Optimization



Sub-Basin Pilot Scale Study



Sub-Basin Pilot Scale Study



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Watersheds, rivers and streams

Green - Duwamish River

You're in: Green River Watershed » Watershed Quality Assessment

- Green River Watershed
- Stormwater retrofit project
- Combined Sewer Overflow Water Quality Assessment
- Related organizations
- News archive
- Website map

To offer a suggestion or report an error on the Water and Land Resources' Web site, please contact Fred Bentler, webmaster.

Green-Duwamish River Watershed Quality Assessment

Project overview

The primary goal of this project is to develop analytical tools for evaluating current and future water quality issues in the Green-Duwamish River watershed, and to provide water quality information to a variety of programs, such as wastewater capital planning (including the Combined Sewer Overflow (CSO) program and habitat conservation planning), WRIA 9 salmon conservation planning, stormwater management efforts, and the Department of Ecology's TMDL (Total Maximum Daily Load).

The scope of work includes water quality and hydrologic monitoring, land use / land cover modeling, water quality and quantity modeling, and risk assessment.

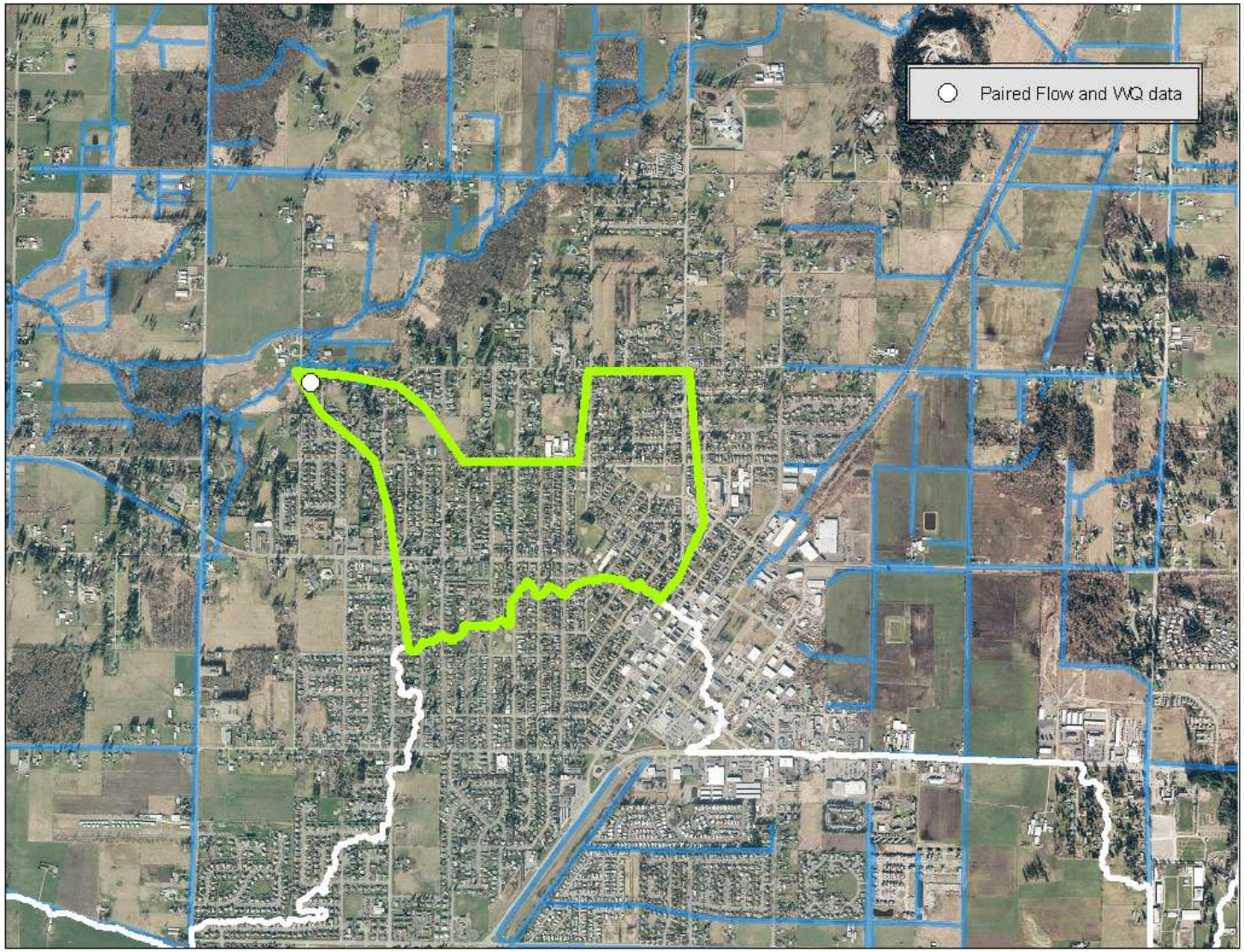
The specific purposes of this project are:

- To assess existing water quality conditions and future water quality conditions for selected parameters, and evaluate best management practices for achieving Washington State water quality standards in the Green-Duwamish Watershed.
- To assess the 303(d) listed parameters of concern for the King County Wastewater Treatment Division (e.g., parameters that could influence future CSO permit requirements - fecal coliform/ E.coli, and metals), including the identification of sources of bacteria throughout the watershed.
- To provide information to support the WTD Habitat Conservation Plan and WRIA 9 salmon conservation planning efforts, including information on water quality as a factor of decline for salmonids.
- To provide technical information to the Department of Ecology to support development of TMDLs.
- To create a working watershed model that can be used as a tool for regional water quality assessment and planning now and into the future.

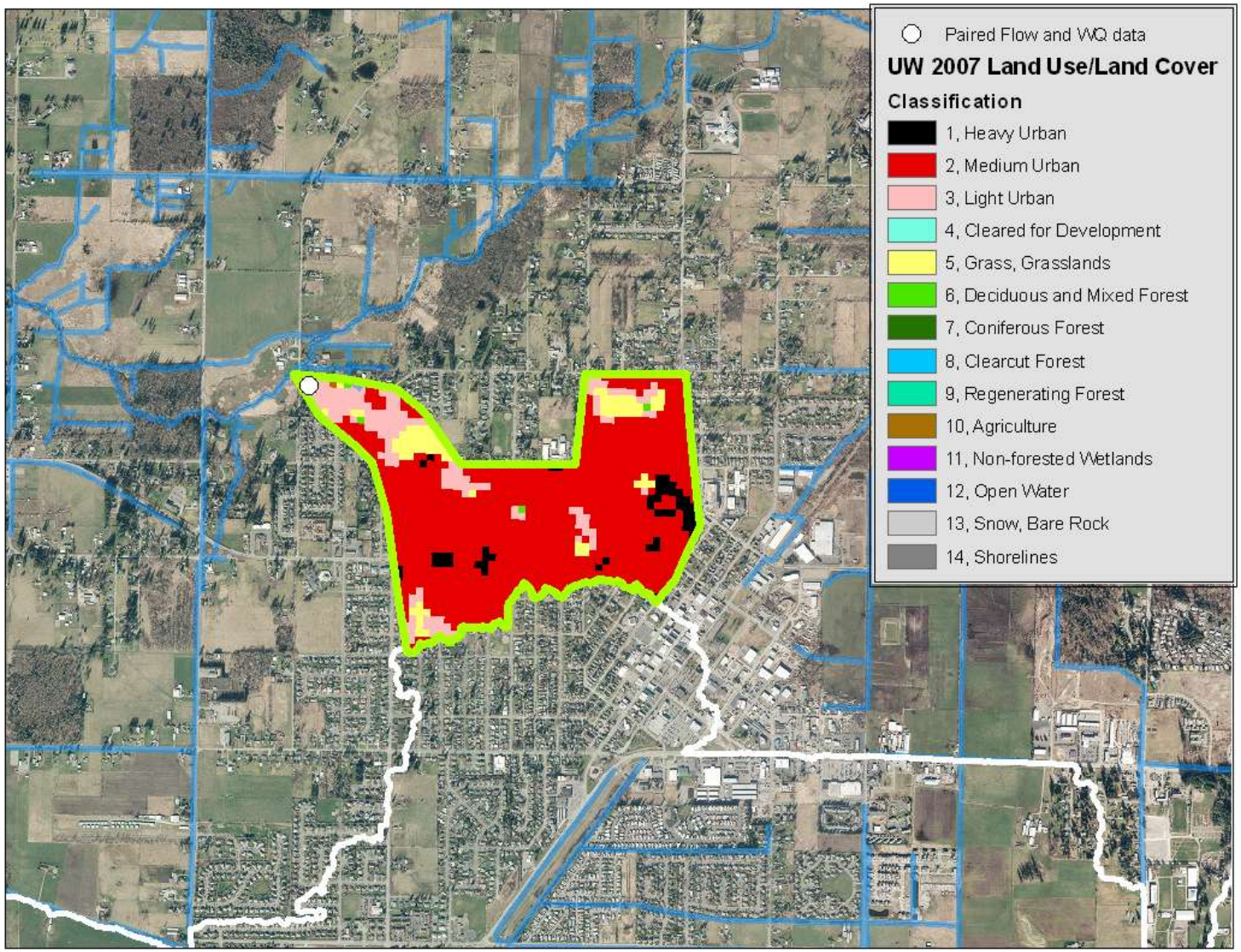
Green-Duwamish River Watershed Quality Assessment

http://www.kingcounty.gov/environment/watersheds/green-river/watershed-quality-assessment.aspx

Newaukum Urban Sub-basin

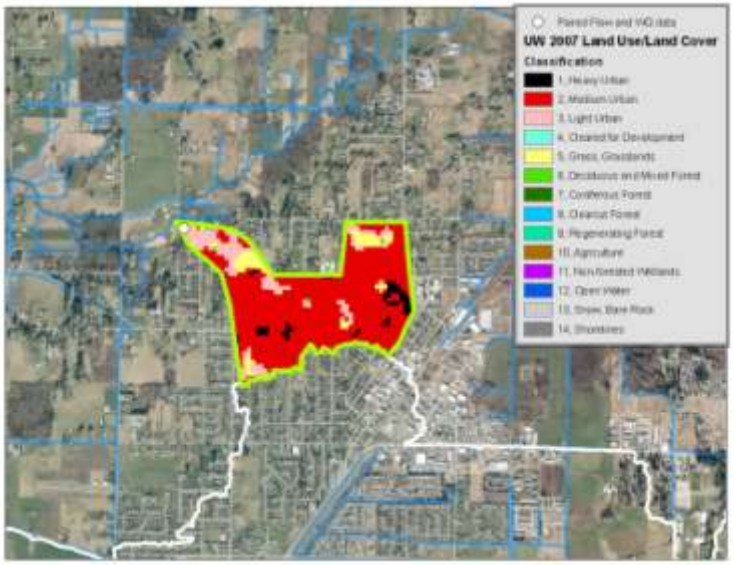


Newaukum Urban Sub-basin



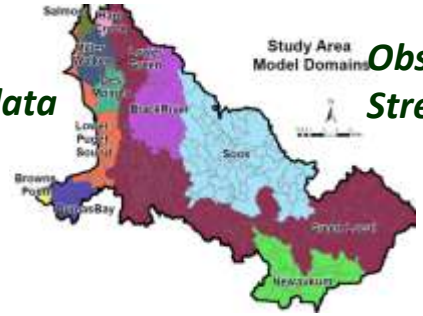
Three Approaches

1. SUSTAIN/HSPF Aggregate BMPs
2. Land Use analysis approach
3. Stream flow disaggregation approach



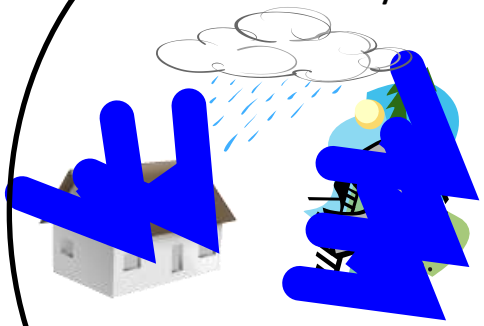
Stormwater Retrofit: Two Alternative Approaches

Observed Precipitation data



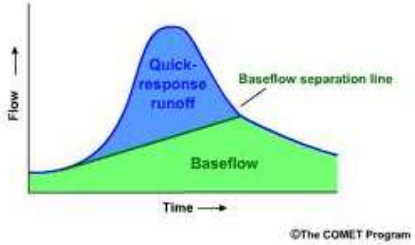
Observed Streamflow Data

Approach 1:
Land Use Analysis



Estimate rainfall generated surface runoff from impervious and pervious land use cover

Approach 2:
Stream Flow Disaggregation



Separate baseflow from the streamflow hydrograph to calculate contributing surface runoff

Calculate surface runoff volume

How many BMPs are needed to capture surface runoff volume to meet water quality goals?

Rain barrels

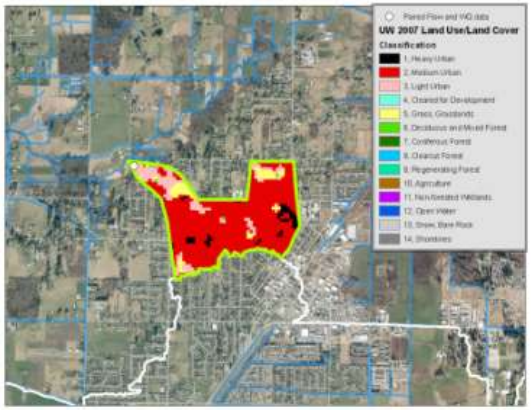
Bioretention cells

surface runoff volume (gallons) = x number of + x number of =

Cost

Products

- SUSTAIN BMP cost optimization results
- Comparison of SUSTAIN optimization results to two independent methods
- Foundation for evaluation of other sub-basins and scaling up results to WRIA 9 and Puget Sound basin



Questions ?

SUSTAIN BMP Modeling Approach

January 26, 2012

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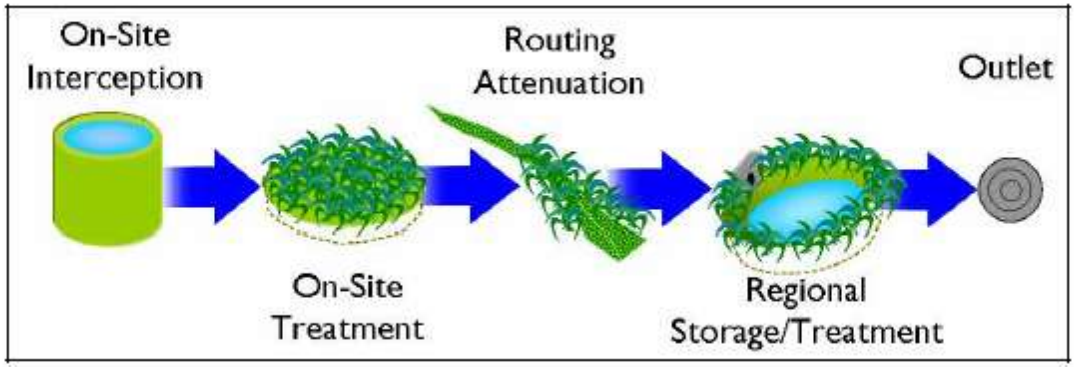
SUSTAIN Aggregate BMPs

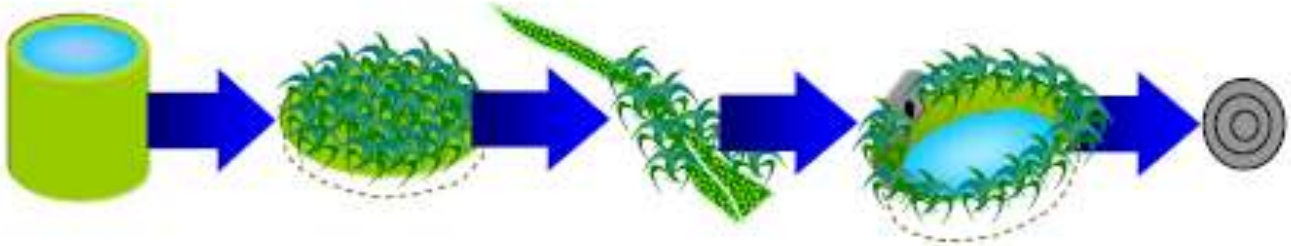
- On-site interception
  - Rain barrel
  - Cistern
  - Green roof
- On-site treatment
  - Bioretention
  - Porous pavement
  - Infiltration trench
- Routing attenuation
  - Vegetative swale
  - Conduit
- Regional storage/treatment
  - Wet Pond
  - Dry Pond



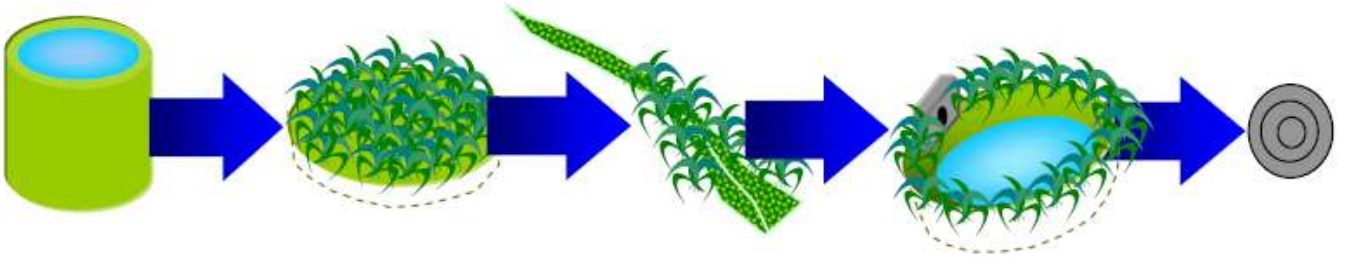
HSPF Hydrologic Response Units

- Effective Impervious Area
  - Commercial/Industrial
  - High-medium density residential
  - Low density residential
  - Roads
- Pervious Area (Till/Outwash)
  - Pasture
  - Forest
  - Grass

United States Environmental Protection Agency



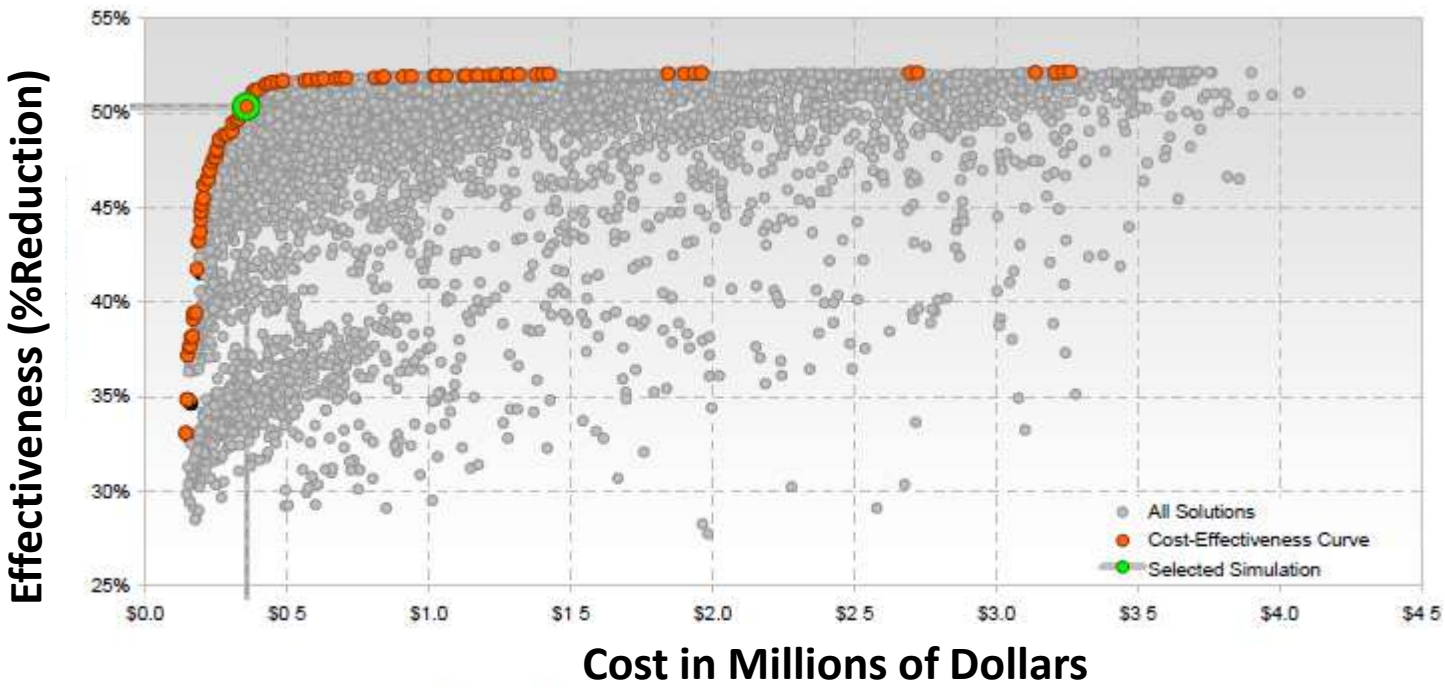
- Each component is sized and parameterized using existing BMP templates
- User determines unit size per unit area for scalable representation
- Decision variables and cost functions for optimization are specified using existing BMP templates



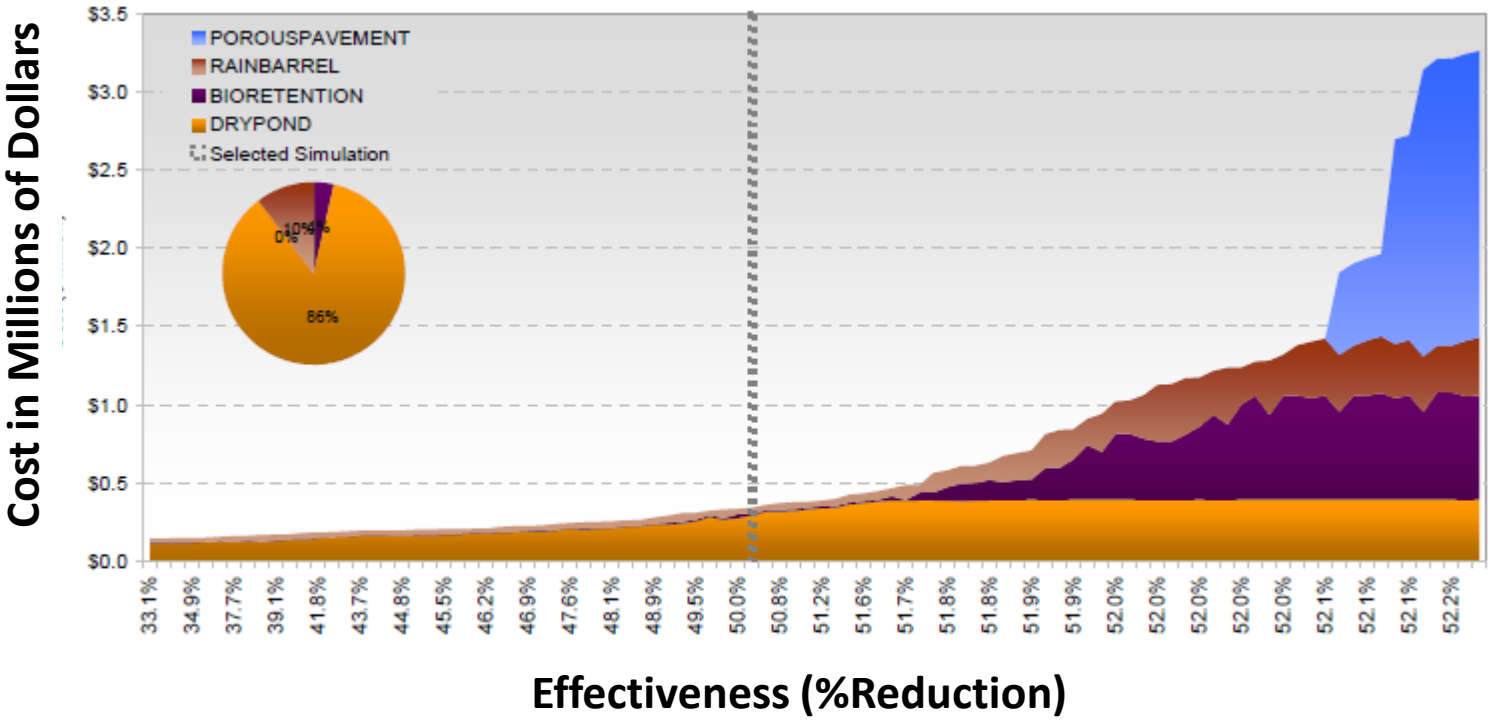
Landuse Category	Area (Acres)	Treatment Distribution				
		Interception	Treatment	Routing	Storage	Outlet
Rooftop	60	67%				33%
Roads	120		28%	48%	17%	8%
Parking Lots	83		61%		24%	14%
Sidewalks	20		100%			
Grass	53		100%			
Barren	150		8%	22%	3%	67%

- Individual treatment train components can be disabled.
- Routing order is maintained.

Cost-Effectiveness Optimization

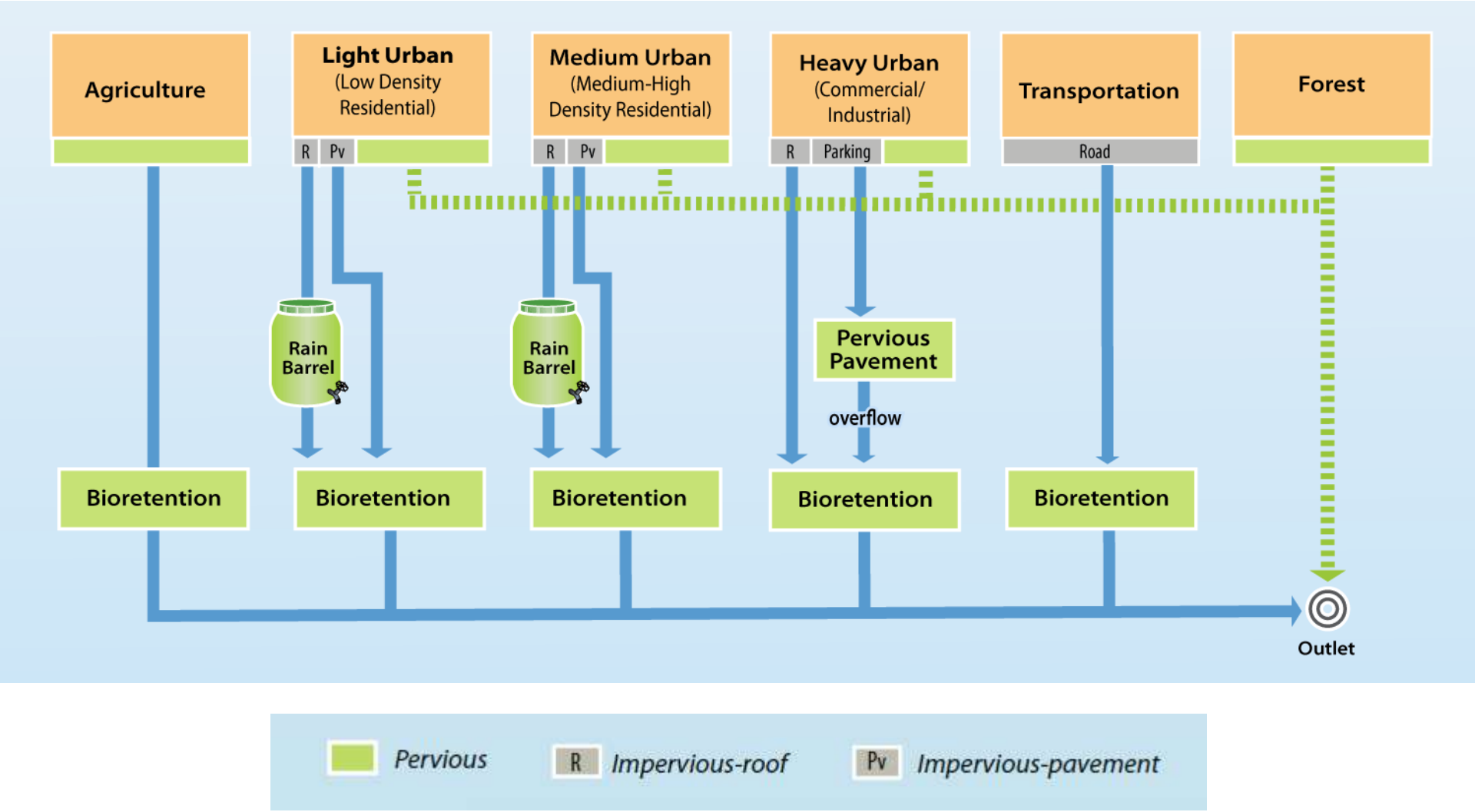


Cost Optimization



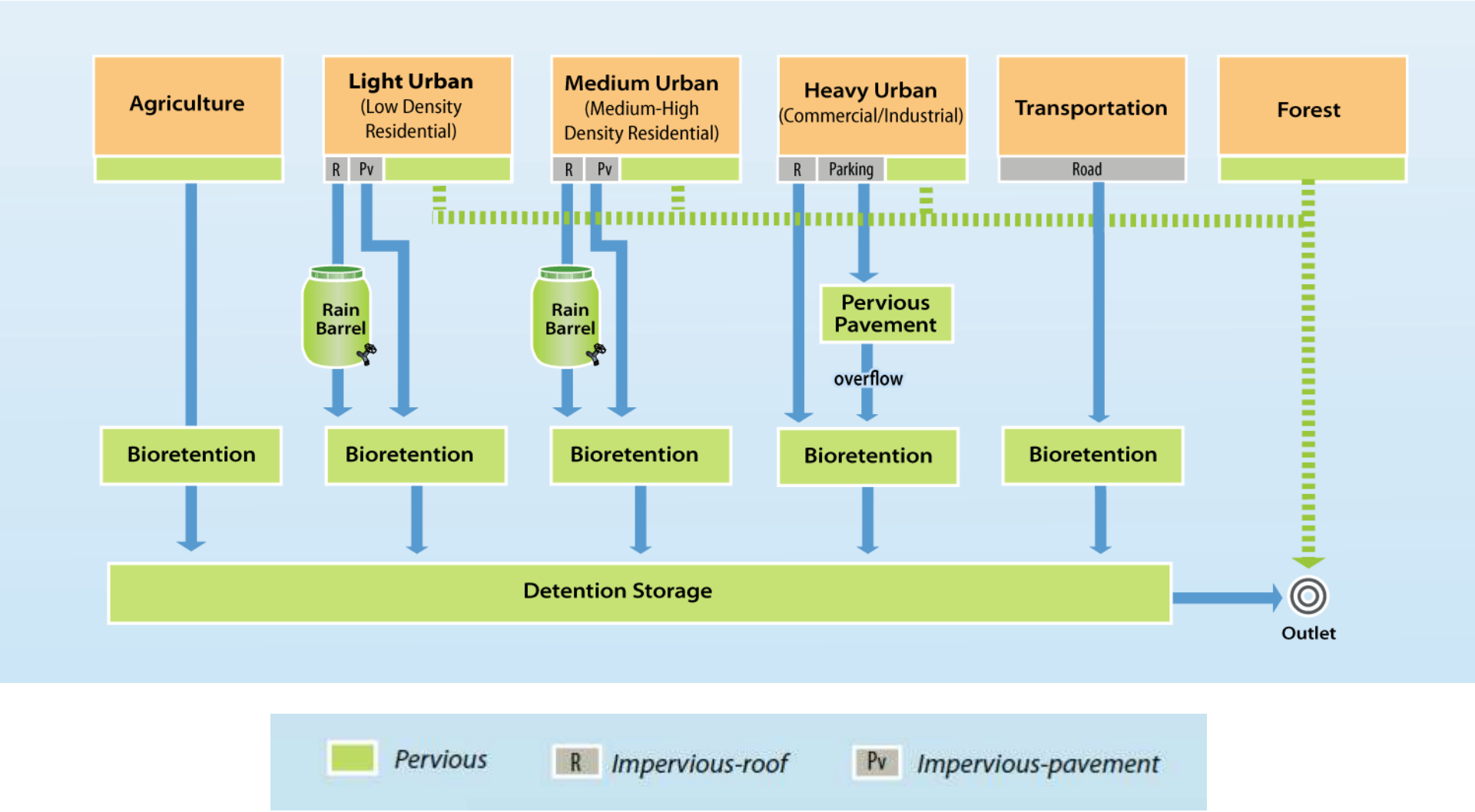
Proposed Land Use-BMP Treatments

Natural Drainage Design



Proposed Land Use-BMP Treatments

Natural Drainage Design + Gray Infrastructure



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