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Water Resource Inventory Area 9 Stormwater Retrofit Project: Estimating cost-effective stormwater infrastructure solutions to meet flow and water quality targets

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WRIA 9 Stormwater Retrofit Project:

Modeling cost-effective solutions to meet flow and water quality targets

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Salish Sea Ecosystem Conference

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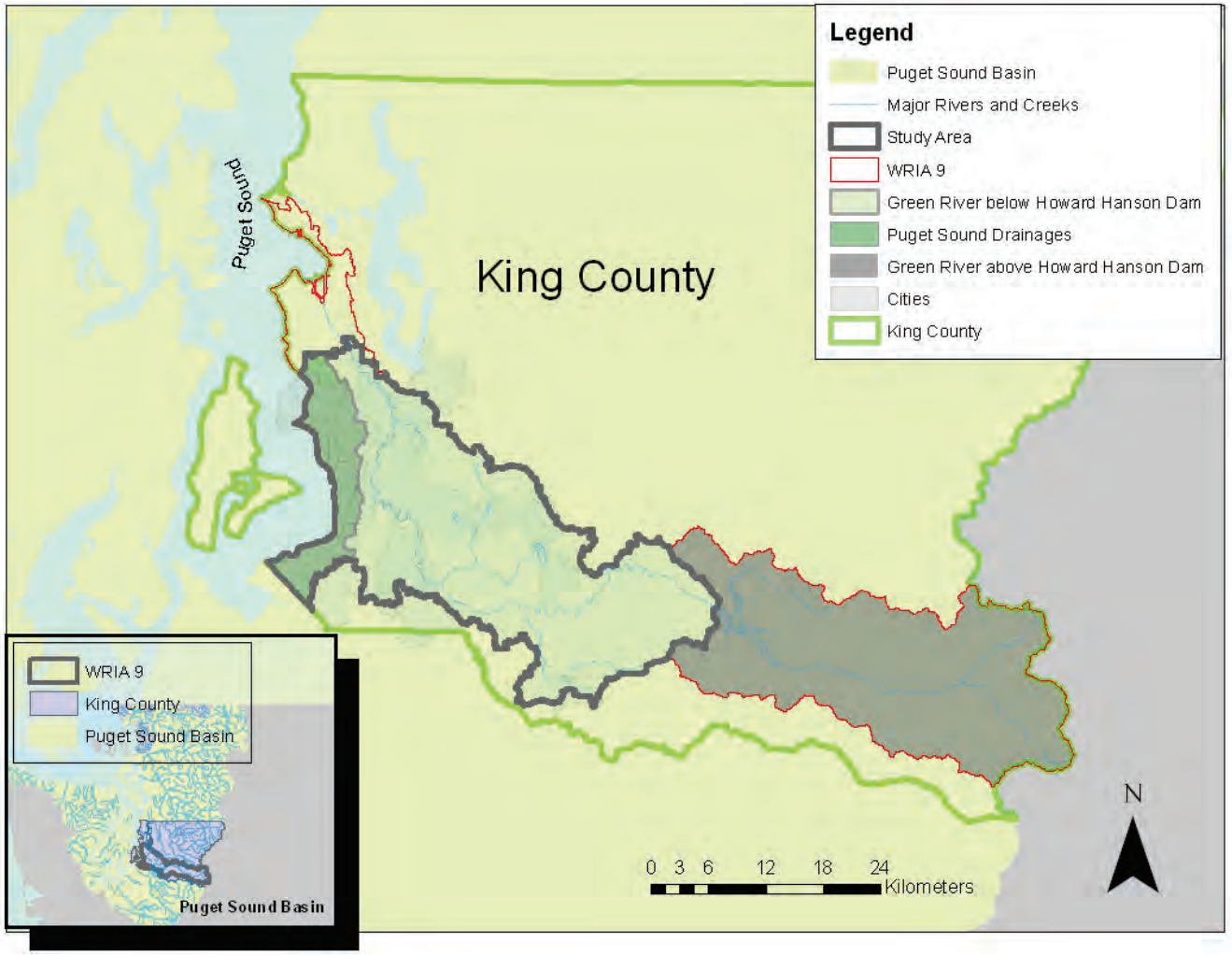
Objective

Estimate planning-level stormwater facility needs and costs for future development in the WRIA 9 study area.

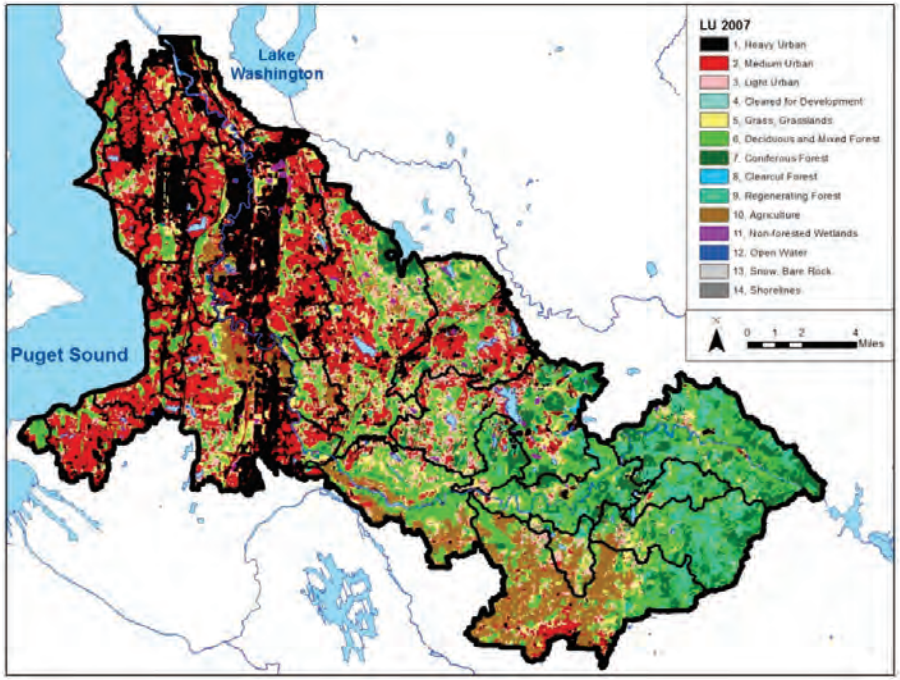
1. Model cost-effective combinations of BMPs using the EPA SUSTAIN model.
2. Extrapolate model results to future (2040) land use of the study area.

WRIA 9 Study Area

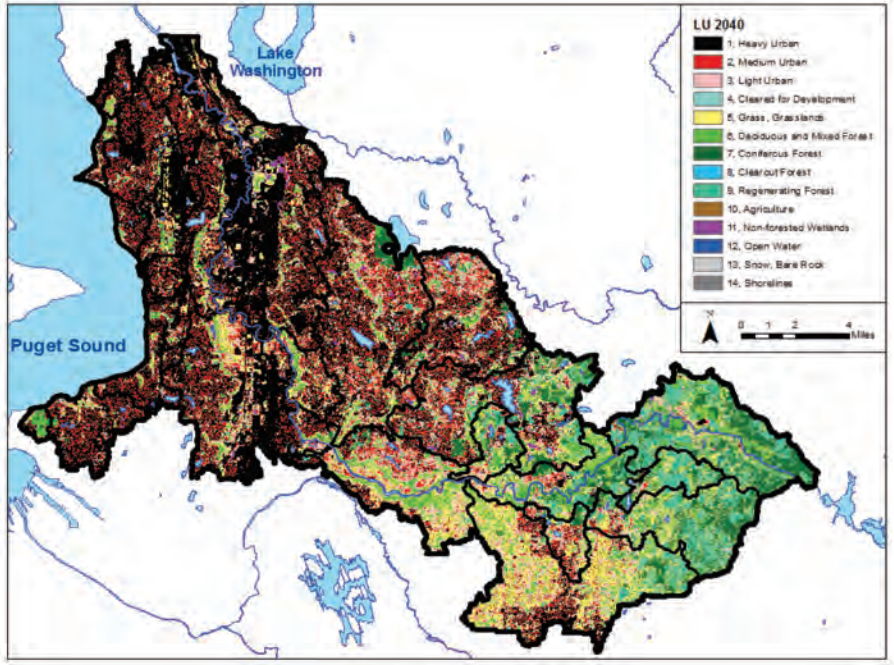


Project Need

Development is projected to increase from **65% to 77%**

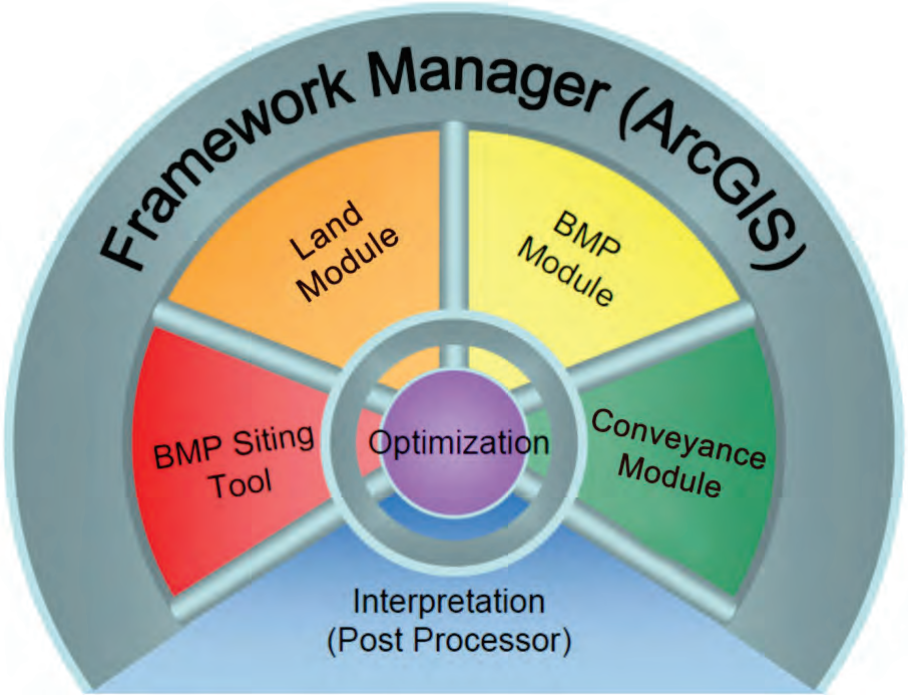


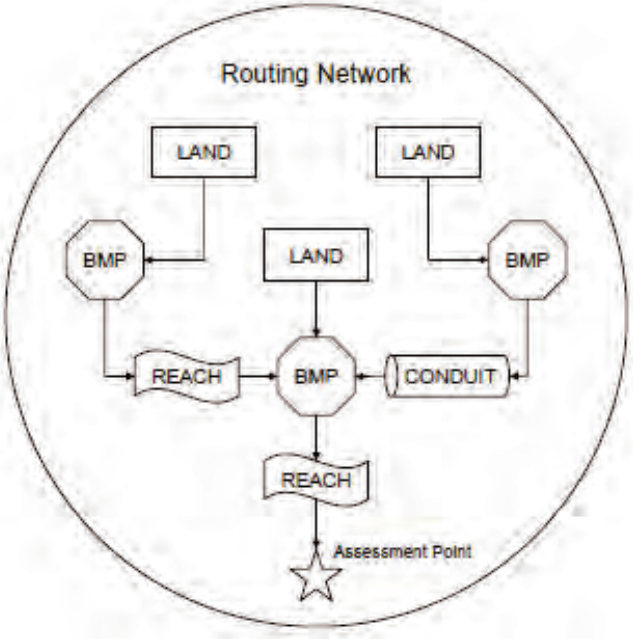
2007 Satellite-derived Existing Land Use (UW 2007)



Simulated 2040 Future Land Use (Alberti 2009)

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





Model Inputs:

BMP Design and Cost Assumptions

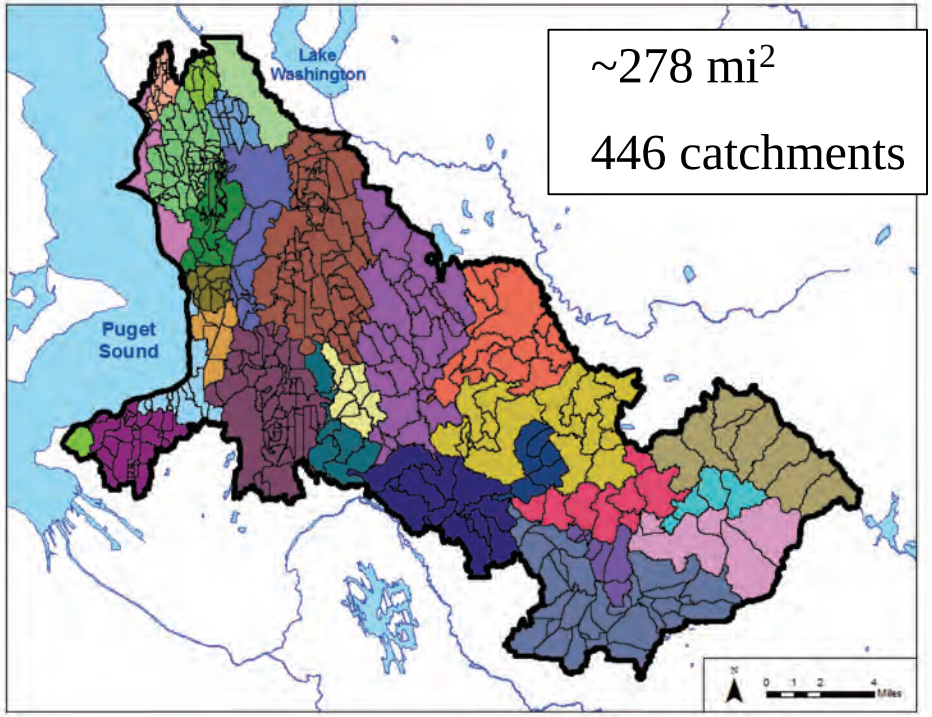
Flow or water quality goals

Decision variables

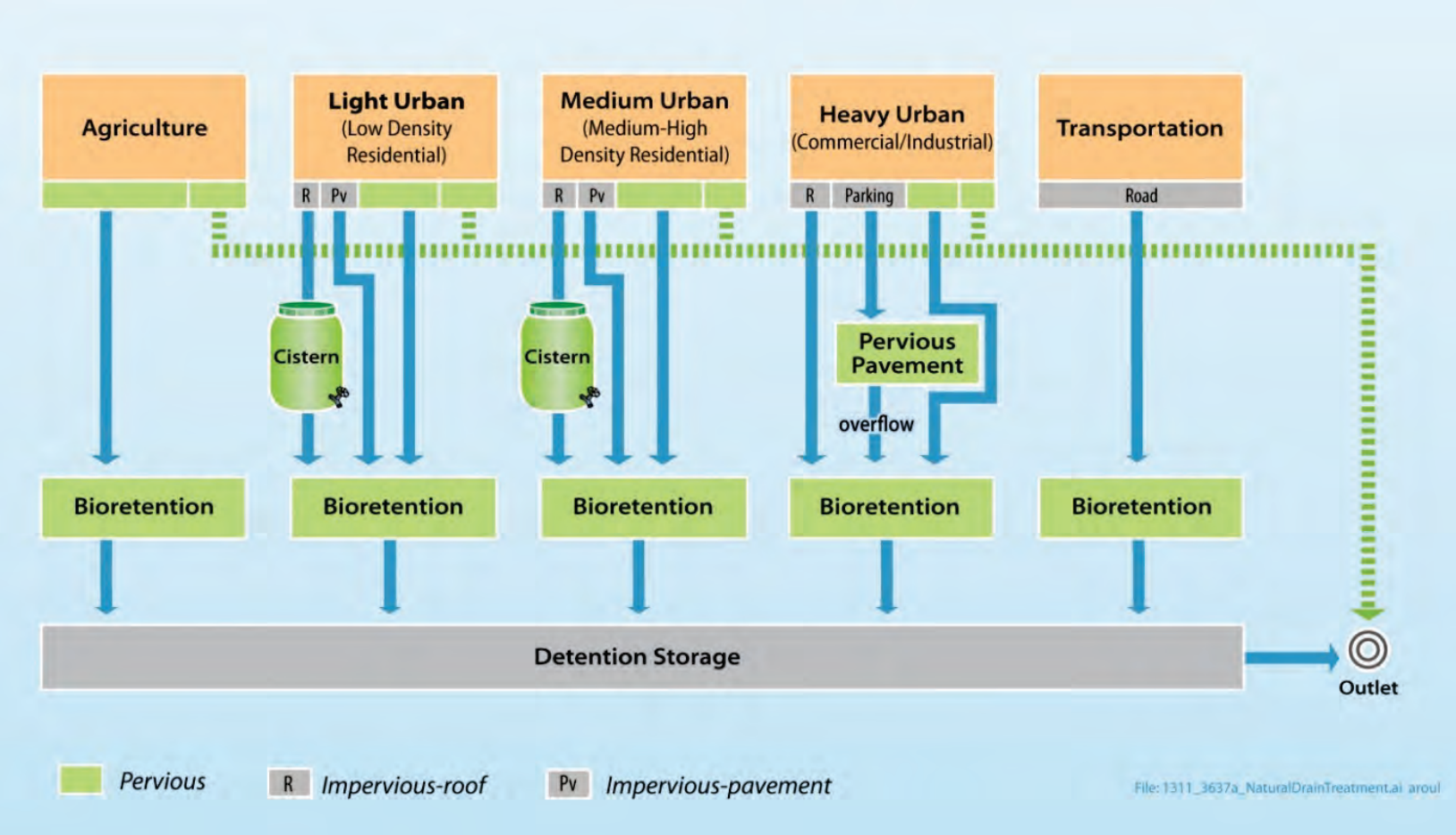
Source: EPA

Modeling Approach

- Model 135 hypothetical 100-acre catchments representing combinations of:
  - **5 generic land uses**
  - **3 soil types**
  - **2 slopes**
  - **3 precipitation zones**
  - **2 land costs**



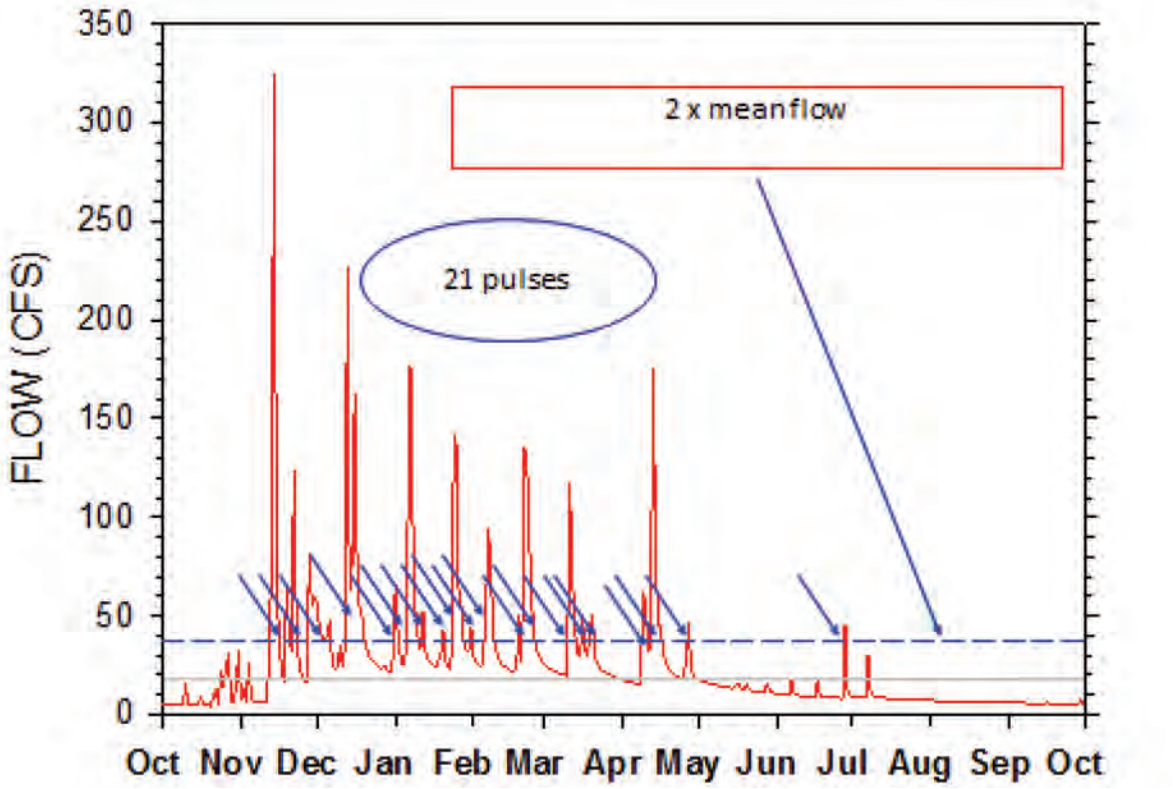
BMP Treatment Train



BMP Unit Design and Cost Assumptions

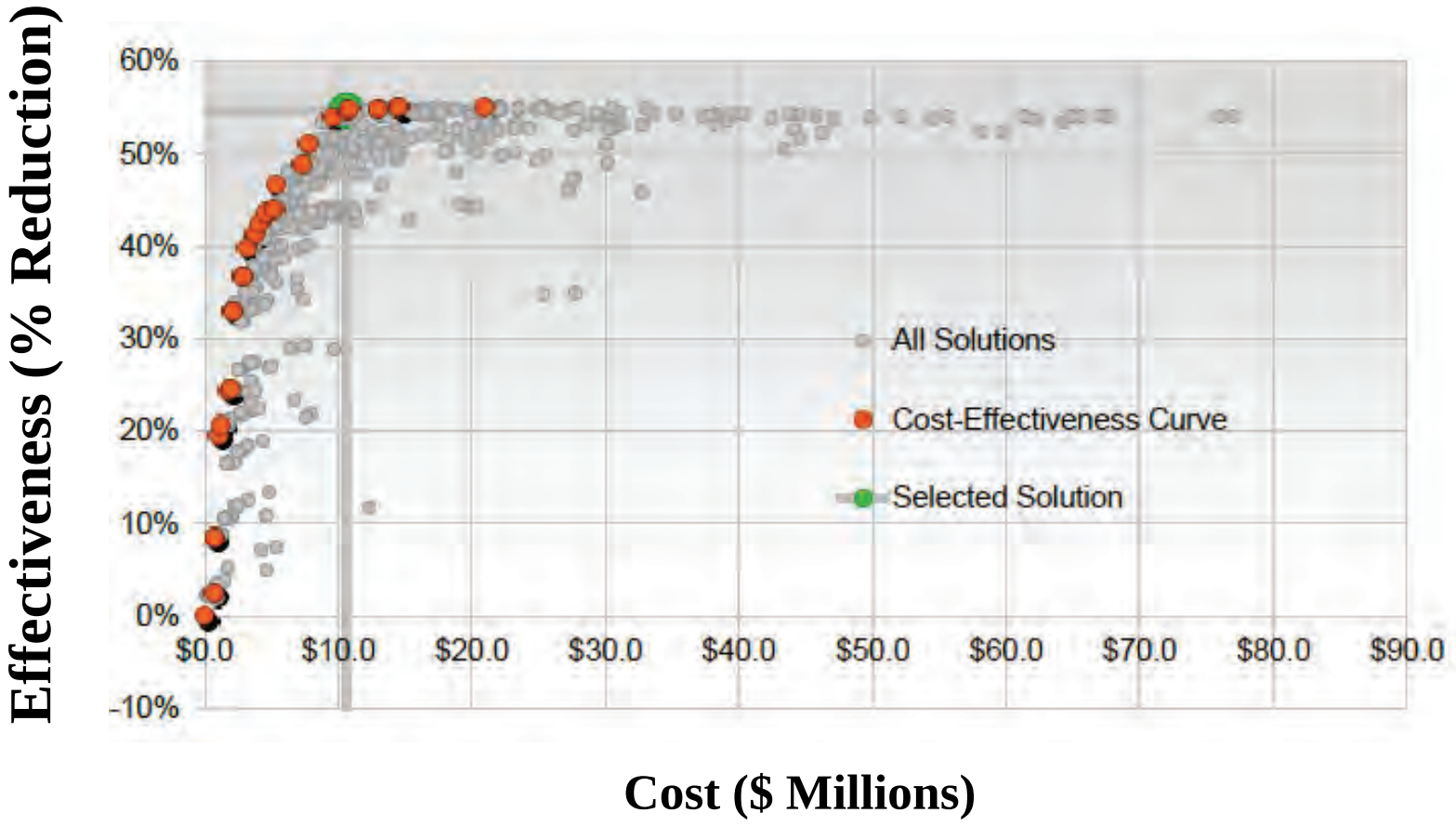
- Develop conceptual BMP unit designs
- 30-year life cycle costs assuming 5% real discount rate:
  - **Capital**
  - **Operation and Maintenance** (O&M)
  - **Inspection and enforcement** (I&E)
  - **Land acquisition cost**
- Assume construction of modeled BMP units are distributed over the 30-year period.

SUSTAIN Optimization Target:
Reduce Stream Flashiness



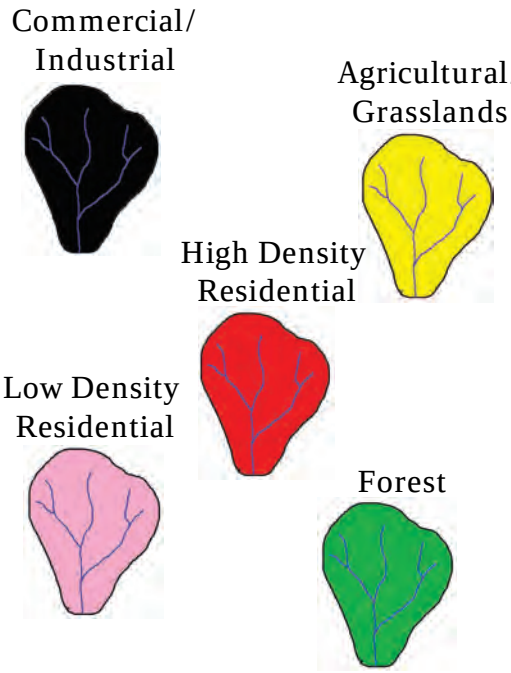
High Pulse Count (HPC): Number of times mean daily flows ≥ high-flow threshold set at 2 X long-term mean daily flow rate

SUSTAIN Output

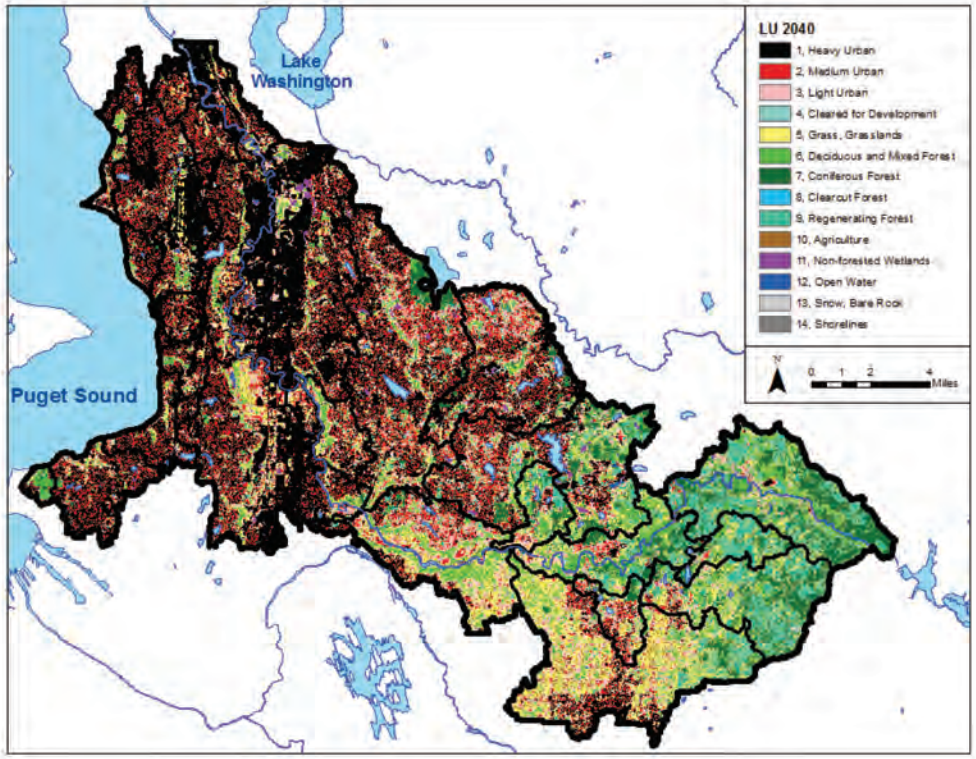


Scale to Future Land Use

SUSTAIN Modeled Hypothetical Catchments



Scale



Simulated 2040 Future Land Use (Alberti 2009)

Results: BMP Units and Storage

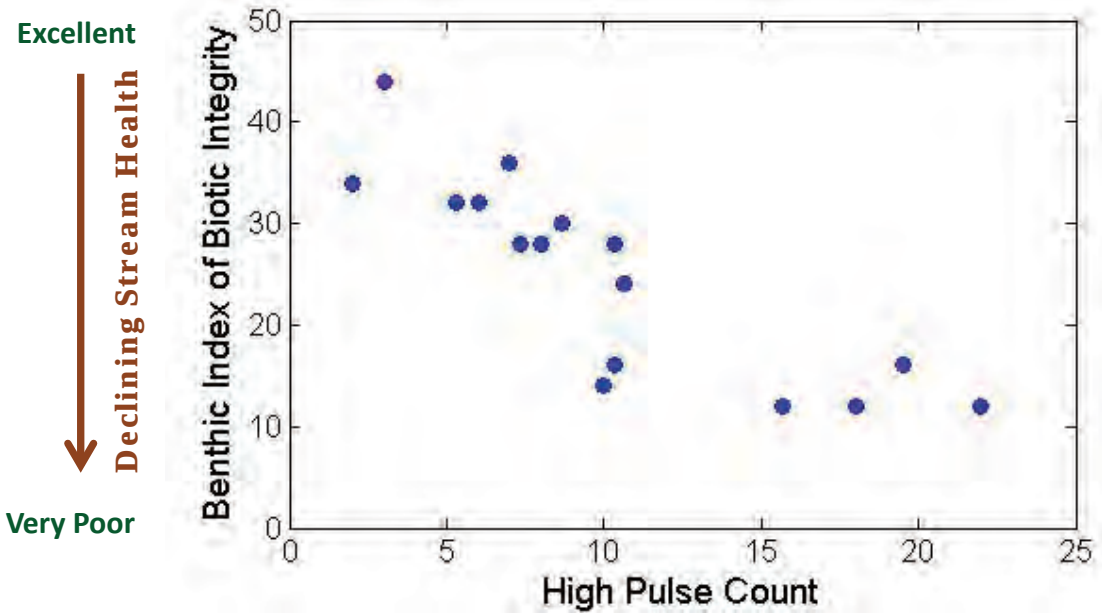
BMP Unit	#Units	Volume (acre-ft)	Storage (inches)
Cisterns	24,000	200	0.02
Rain Gardens	2,600,000	9,600	0.90
Roadside Bioretention	190,000	700	0.07
Detention Ponds	75,000	19,000	1.80

~2.7 inches of flow control needed for future development

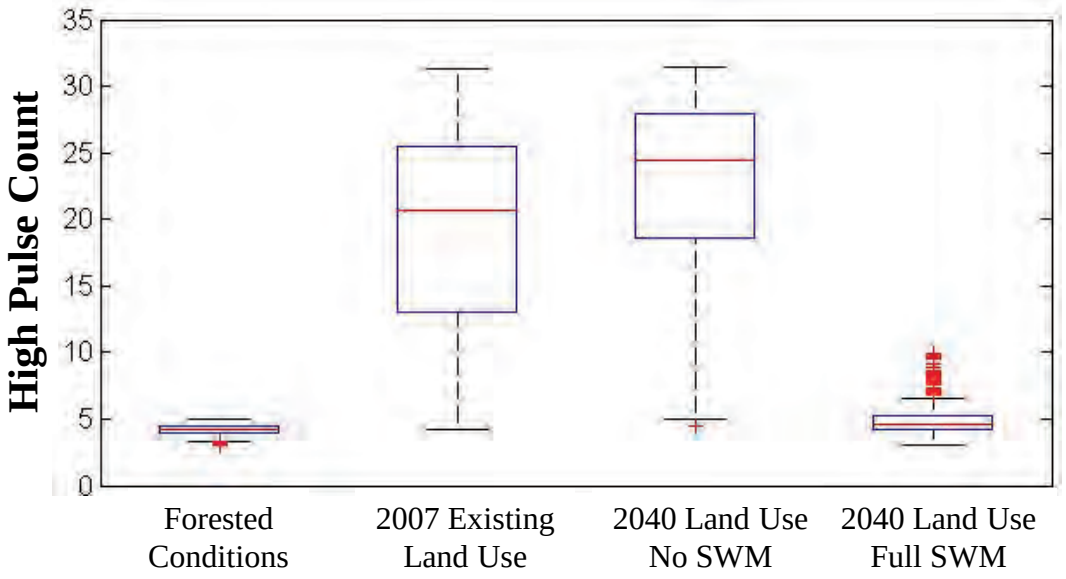
$$\text{storage} = \frac{\text{volume of facilities}}{\text{developed area}}$$

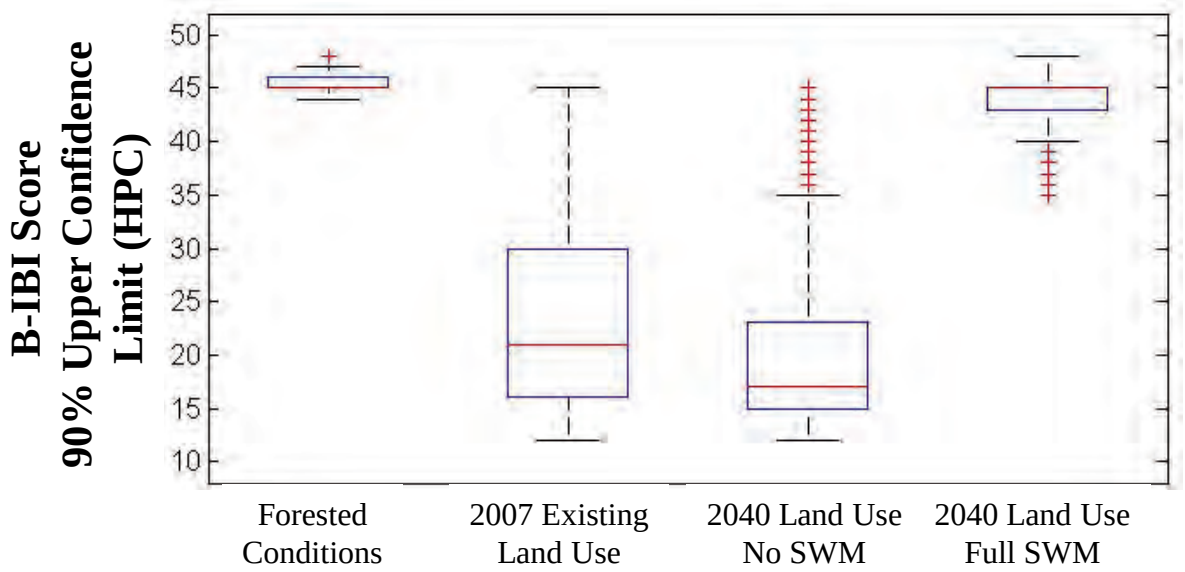
BMP Effectiveness:
Improvement in Biological Health

- King County data set from 16 flow and B-IBI stream stations (*DeGasperi et al. 2009*)
- Logarithmic-linear regression equation and confidence limits estimate improvement in B-IBI scores based on improvement in HPC (*Horner 2013*)



Potential Improvement in Hydrologic Indicators and B-IBI Scores

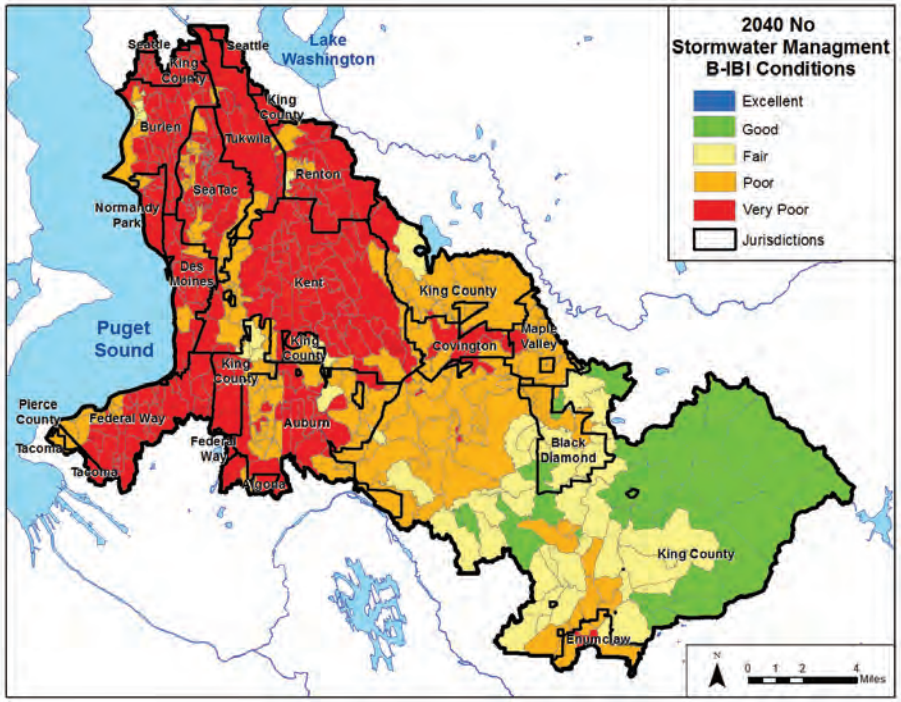




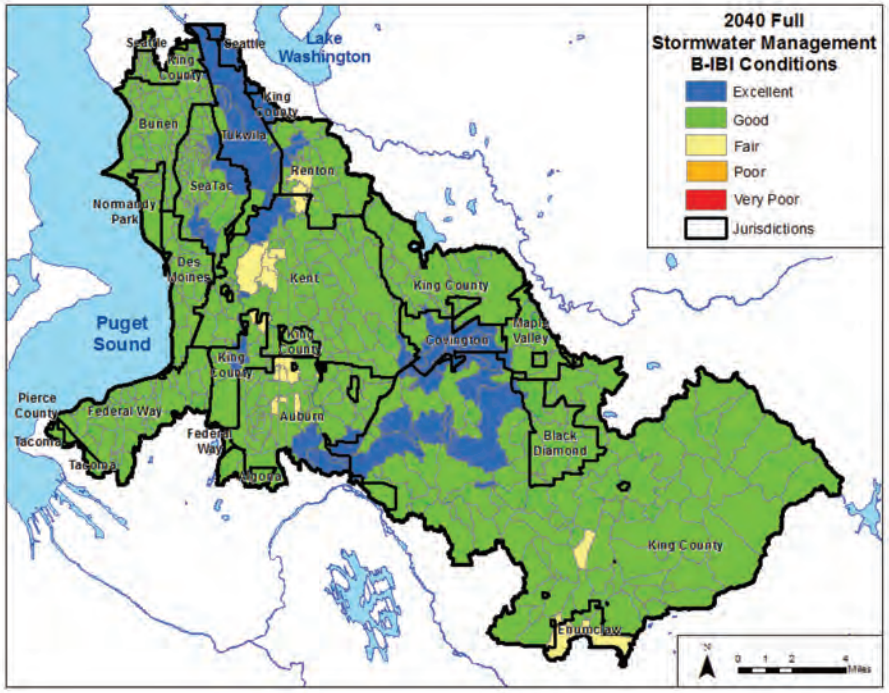
*Results for 446 catchments of study area

Potential B-IBI Improvement

2040 Land Use
No Stormwater Management



2040 Land Use
Full Stormwater Management



Biological Condition	B-IBI Range
Excellent	46 - 50
Good	38 - 44
Fair	28 - 36
Poor	18 - 26
Very Poor	10 - 16

Source: http://pugetsoundstreambenthos.org/

Next step: Estimating Costs

- How will BMPs be implemented across the study area?
- Evaluate implementation strategies:
  - Mitigation required with new and redevelopment
  - Potential public stormwater program
- Identify existing facilities in study area

Questions?

For more details: King County's WRIA 9 Retrofit Project SUSTAIN Modeling Report

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