Advisory Group Kickoff Meeting

Demonstration project to develop and implement a surface runoff modeling tool

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Agenda

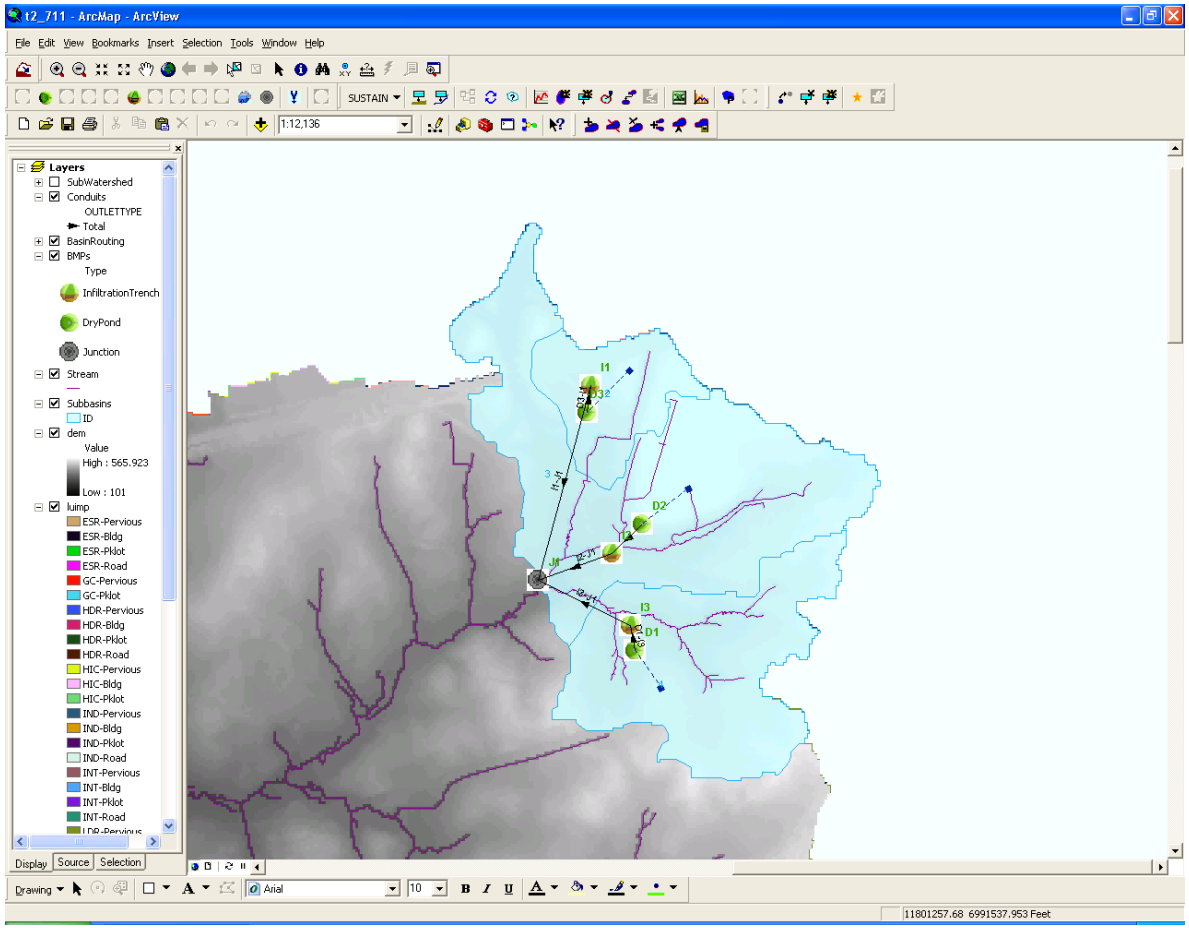
1. Introductions
2. What is SUSTAIN?
3. Project Objectives
4. Task Overview and Schedule
5. Role of Advisory Group
6. Questions and Comments

2. What is SUSTAIN?

- System for Urban Stormwater Treatment and Analysis INtegration Model
- SUSTAIN aims to answer: The most cost-effective configuration of BMPs (location, type, quantity) that are needed to reduce pollutant loading and/or runoff?
- SUSTAIN Components:
  - BMP Siting Tool
    - User supplied constraints to develop BMP feasibility maps
  - Hydrologic/Hydraulic Model
    - Routes runoff and pollutants through BMPs in an optimization algorithm

Introduction to SUSTAIN

- SUSTAIN runs in ArcGIS 9.3 and interfaces with MS-Excel and Access

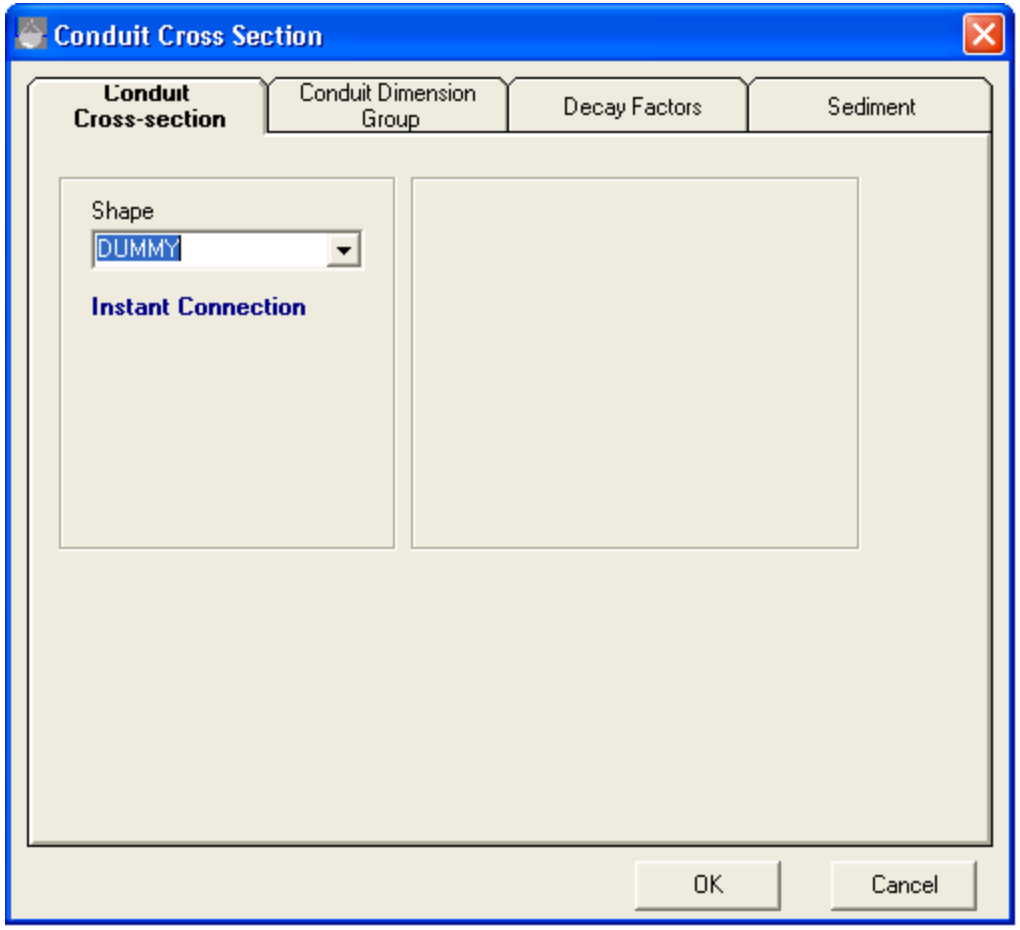


Introduction to SUSTAIN

- Hydrographs/pollutographs from the land surface are simulated internally (SWMM) or imported from an external model (e.g. HSPF)
  - Internal Simulation
    - Generally smaller watershed scales
    - Fully articulated BMP network
    - Used in cases where there isn't an existing model
  - External Simulation
    - Allows the use of aggregate BMPs
    - Larger watershed scales
    - Builds off of calibration already completed

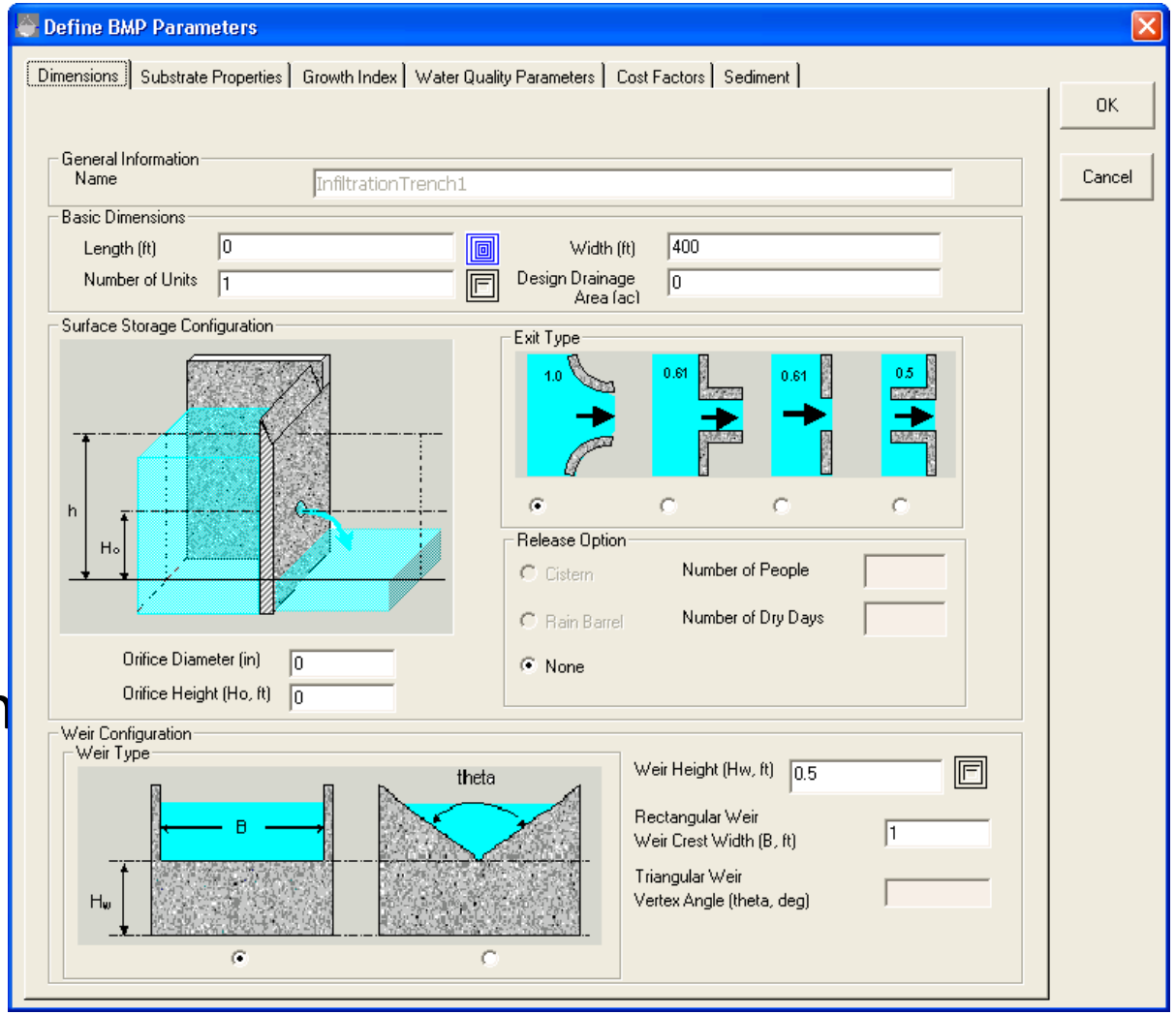
Introduction to SUSTAIN

- Two choices for hydraulic routing through BMPs/conduits:
  - Instantaneous
    - Flows and pollutant loads are summed without accounting for delay/decay in transit
  - Kinematic Wave
    - The SWMM kinematic wave routing function is used
    - Pipe/channel dimensions and roughness are entered
    - Pollutant decay factors along conduits are entered



Introduction to SUSTAIN

- Once the simulation of hydrographs and pollutographs is set up, the next step is to define BMP templates
- The BMP dimensions are typically “decision variables” in the optimization algorithm

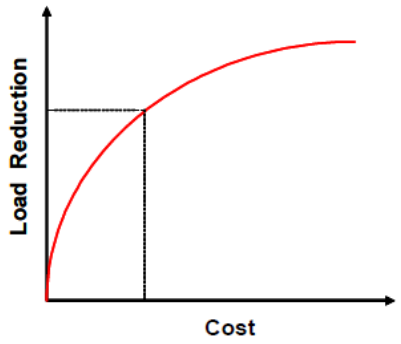


Introduction to SUSTAIN

- BMPs can be placed one by one or in aggregate
- Users construct templates for aggregate BMPs consisting of individual BMPs with similar functions:
  - On-site interception BMPs
  - On-site treatment BMPs
  - Routing/attenuation BMPs
  - Regional storage/treatment BMPs
- Aggregate BMP approach:
  - Does not require detailed siting of BMPs
  - Apparently only available if using the external hydrology simulation option

Introduction to SUSTAIN

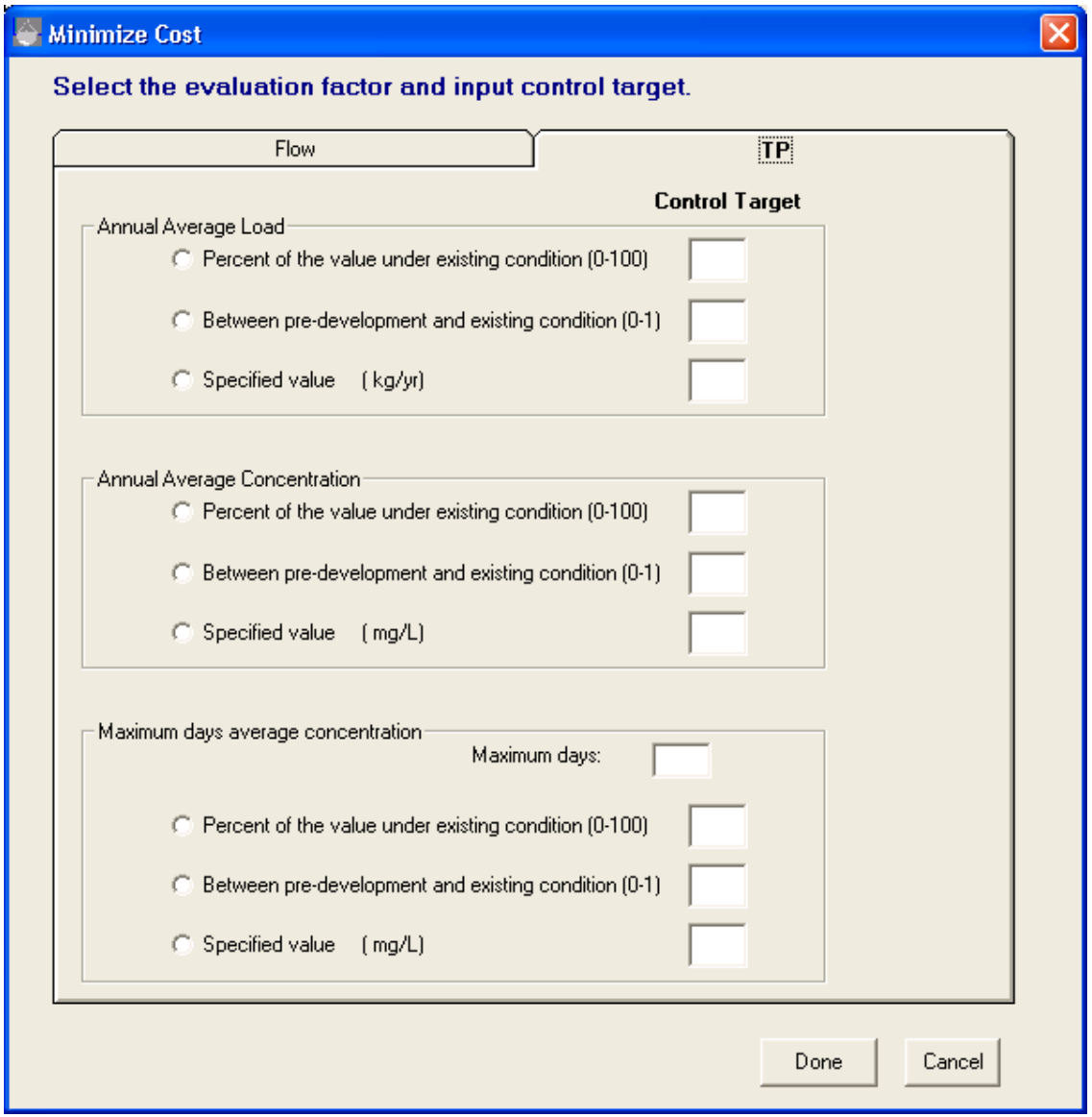
- Two choices for optimization:
  - Cost effectiveness curve (NSGA-II)
    - Applicable when there is one target pollutant or flow



  - Minimize cost (Scatter Search)
    - Applies several pollutant loading and runoff reduction targets as constraints in a cost minimization
- In either case, the optimization takes place at “assessment points,” typically located at the mouth of the basin

Introduction to SUSTAIN

- Optimization Evaluation Factors for each Pollutant:
  - Annual average load
  - Annual average concentrations
  - Maximum days average concentration



3. Project Objectives

- Evaluate a real-world example of how to maximize water quality benefits and minimize stormwater management costs in subbasins.
- Determine whether SUSTAIN can be used locally to evaluate toxics controls.
- Develop an application outside of specific regulatory-based requirements to explore how it may or may not be useful in future stormwater permits (*Ecology and permittees*)

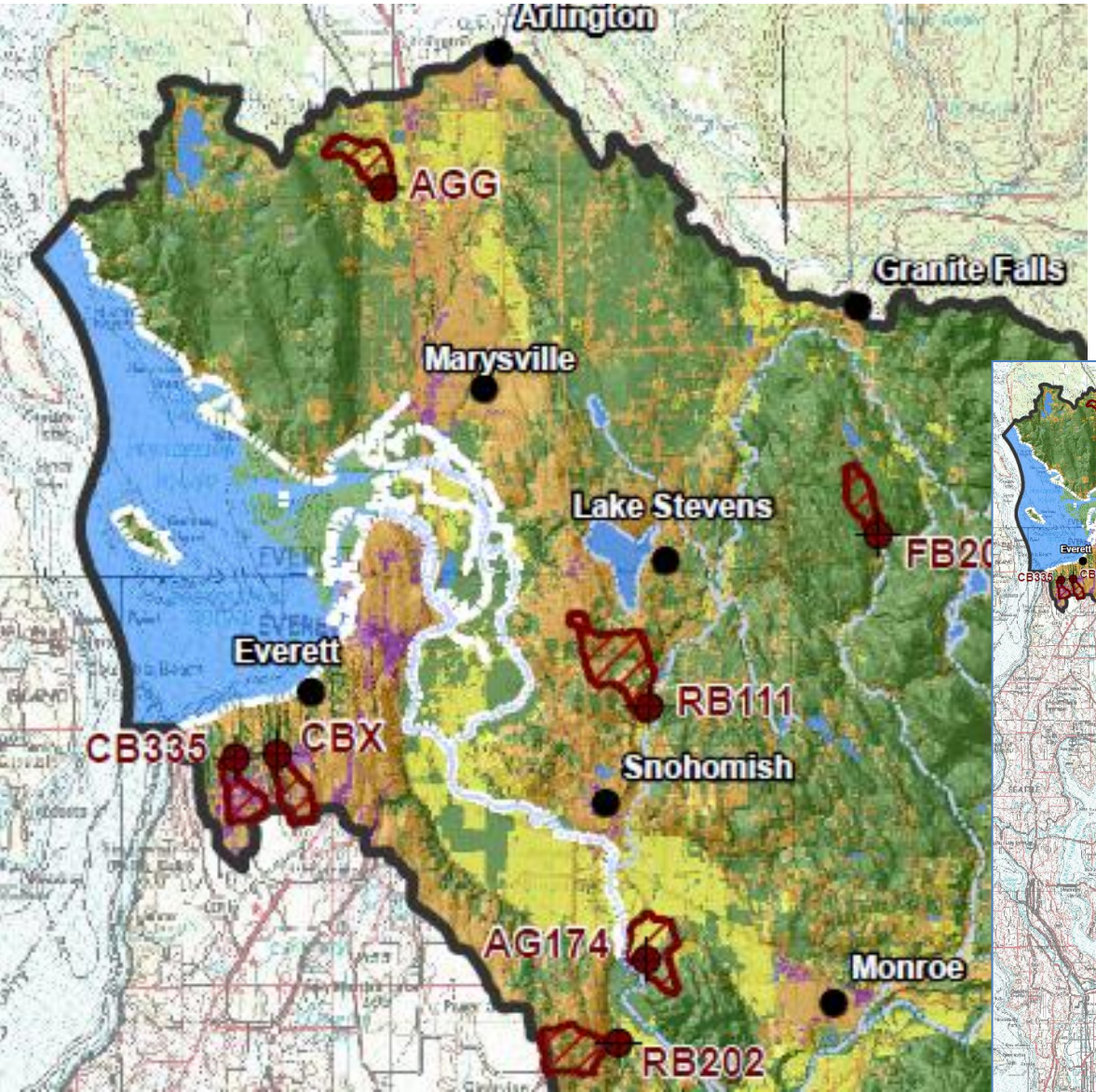
Why toxics?

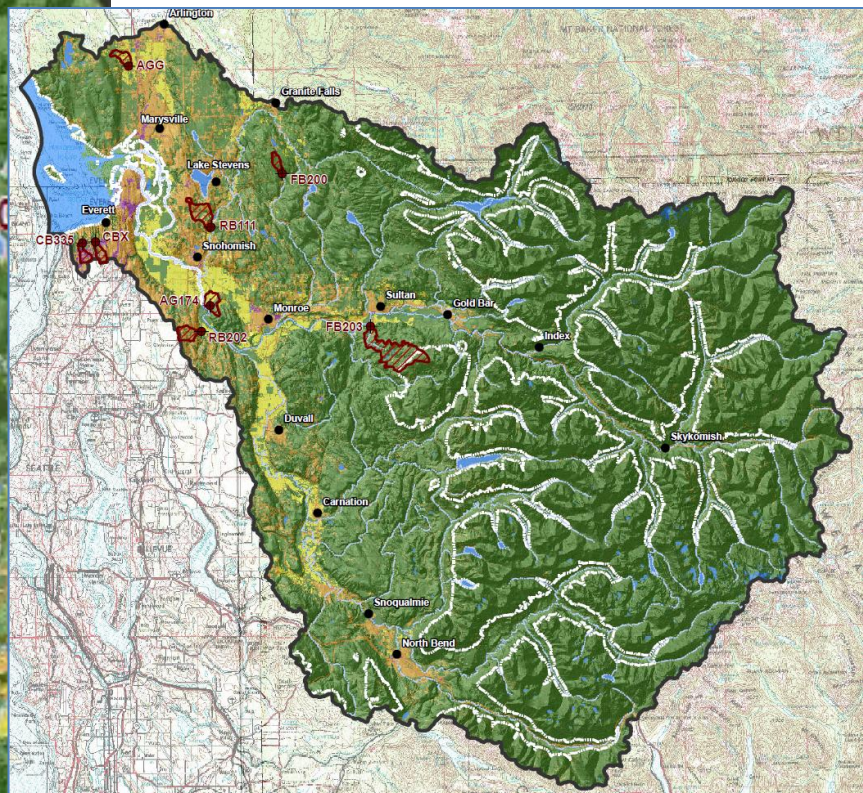
- Part of Control of Toxic Chemicals in Puget Sound (www.ecy.wa.gov/programs/wq/pstoxics/index.html)
  - Goal: inform decisions about actions to restore Puget Sound
  - Surface runoff is a major pathway for most toxics
    - WWTPs, CSOs, spills, atmosphere, sediments, ocean …
  - Will conclude in 2011 with Assessment Report
    - What are the major sources?
    - What are the major pathways?
    - Which have the highest toxicity?

Surface runoff study design

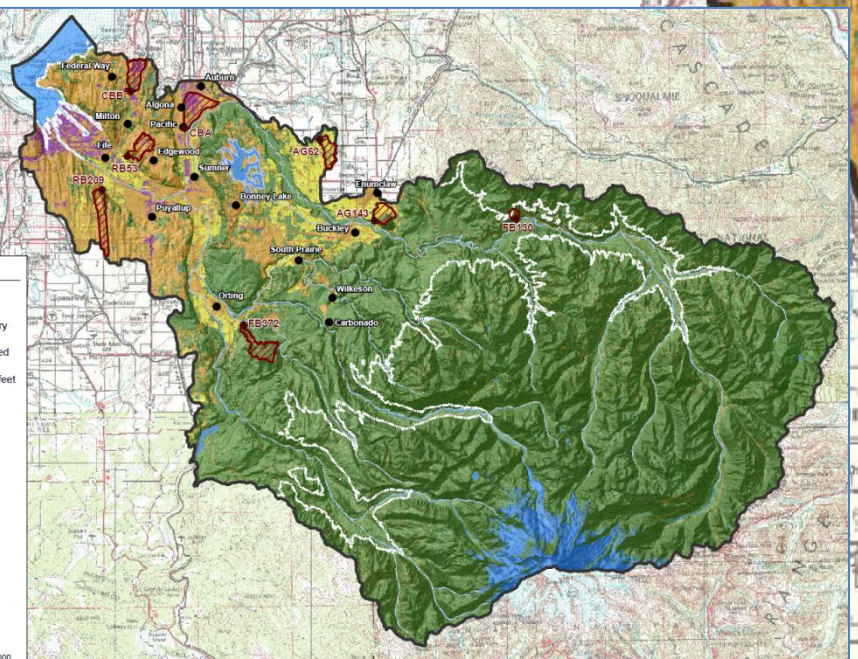
- 16 small (0.3 to 6 mi^2) subbasins
  - 8 Snohomish River watershed subbasins
    - 2 x forest, field, other (“forested”)
    - 2 x residential
    - 2 x agriculture
    - 2 x commercial/industrial (“commercial”)
  - 8 Puyallup River watershed (2 x 4 land covers)
- 6 storm events, 2 baseflow, continuous flow over 12 months
- Metals, PCBs, PBDEs, PAHs, herbicides, pesticides, TPH, oil and grease, nutrients, etc.

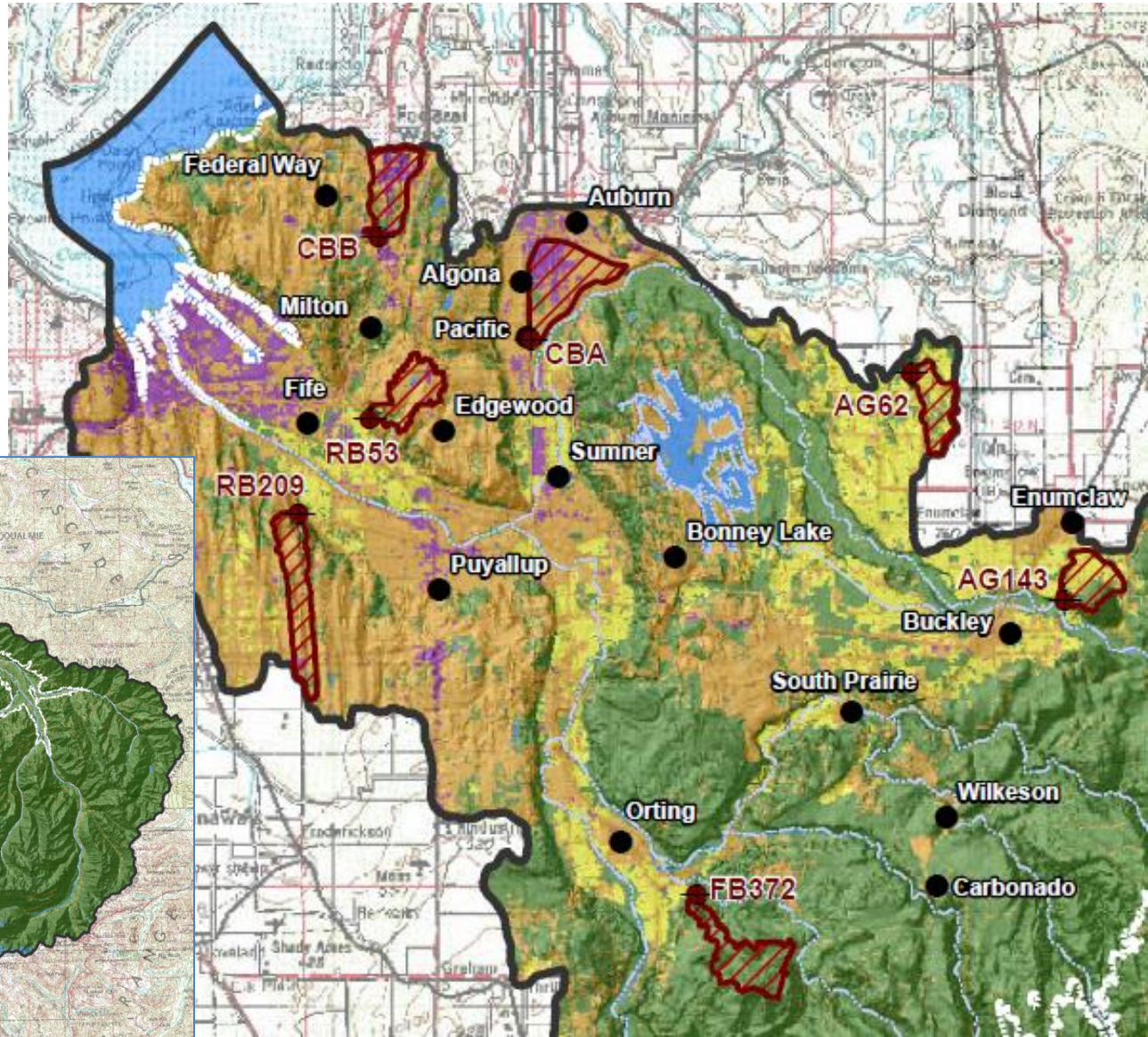
Snohomish River watershed





Puyallup River watershed

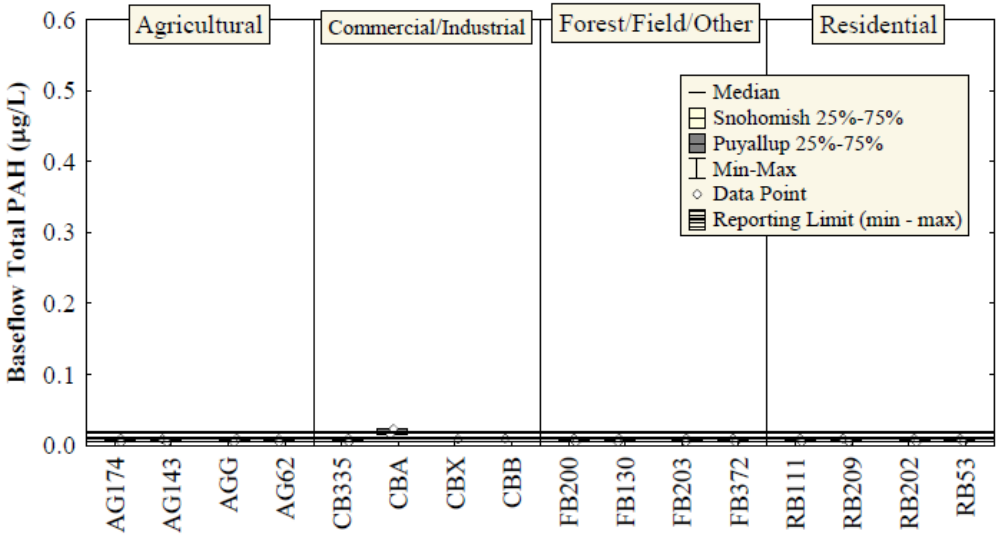


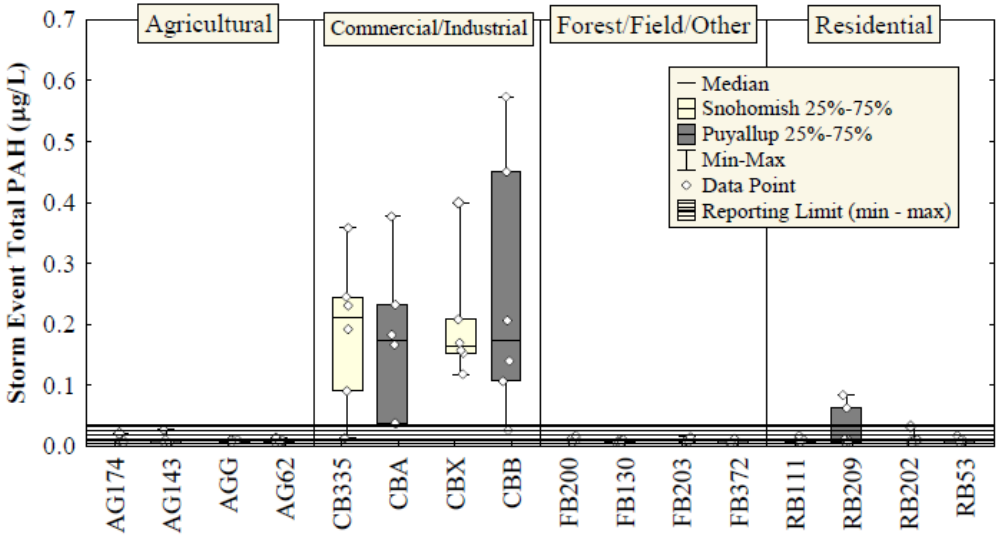


Surface Runoff Study Findings

- Focus on toxics in surface runoff to Puget Sound (www.ecy.wa.gov/pubs/1103025.pdf)
- Pollutant levels higher during storms
- Levels higher from developed lands than from forested lands
- Commercial lands have highest loading rate
- Forested lands have highest total load
  - 83% forested watershed
- *Lower than initial screening-level estimates when added across Puget Sound*

Total PAHs


Agricultural
Commercial/Industrial
Forest/Field/Other
Residential
Median
Snohomish 25%-75%
Puyallup 25%-75%
Min-Max
Data Point
Reporting Limit (min - max)
Baseflow Total PAH (µg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
AG174
AG143
AGG
AG62
CB335
CBA
CBX
CBB
FB200
FB130
FB203
FB372
RB111
RB209
RB202
RB53


Agricultural
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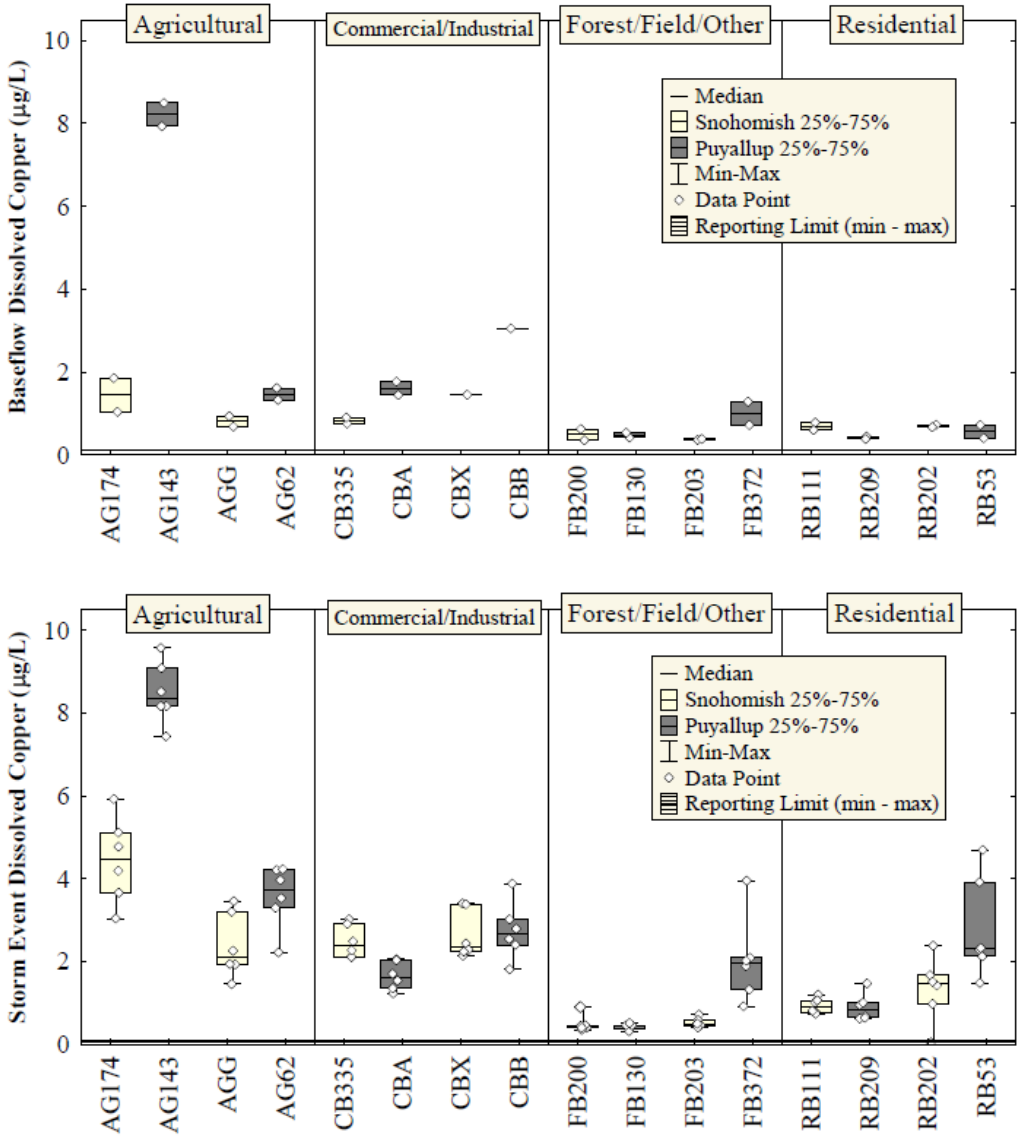
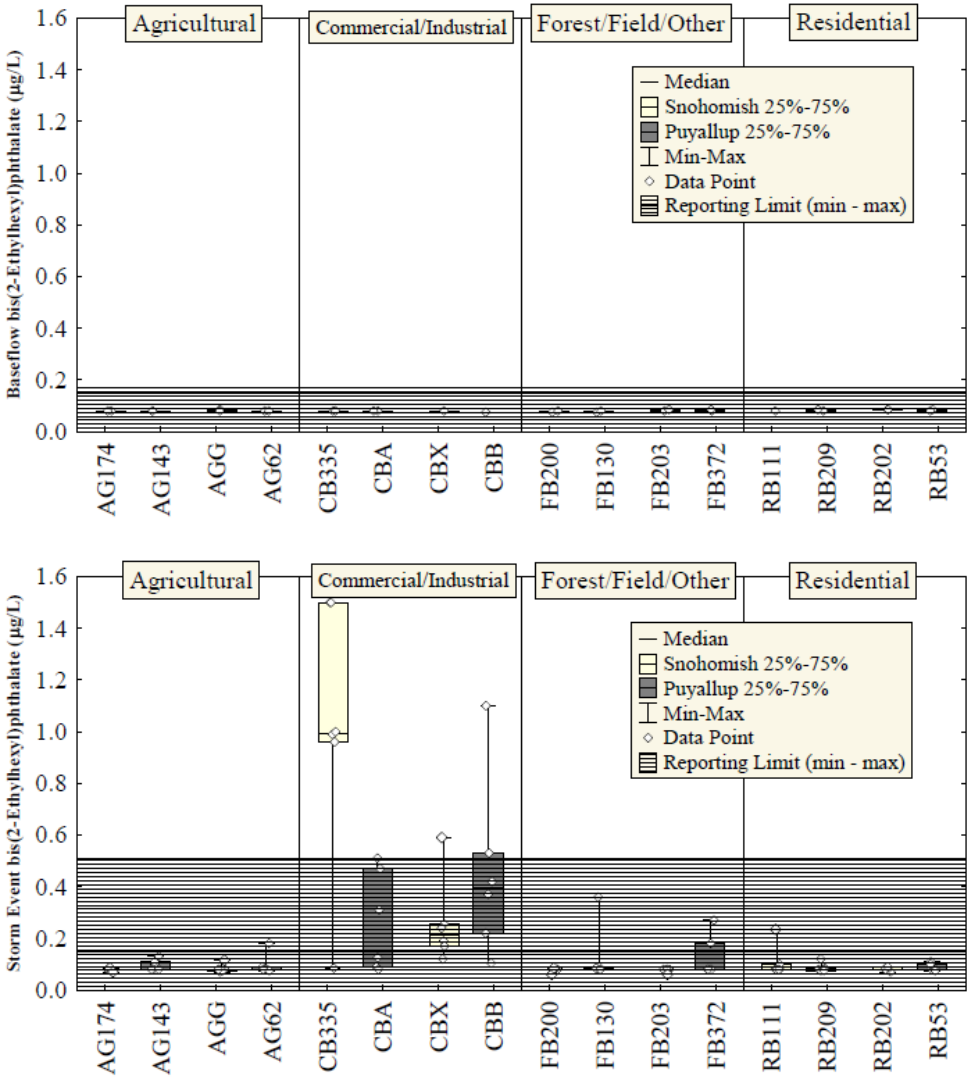
Min-Max
Data Point
Reporting Limit (min - max)
Storm Event Total PAH (µg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
AG174
AG143
AGG
AG62
CB335
CBA
CBX
CBB
FB200
FB130
FB203
FB372
RB111
RB209
RB202
RB53

Dissolved copper



Bis(2-ethylhexyl) phthalate



Why this modeling project?

- We know relative contributions of various land covers from Surface Runoff Study
- Now what?
- Stormwater managers know what to do
- Optimizing $$ and water quality benefits
- EPA has funded the development of SUSTAIN
- Test SUSTAIN in the study subbasins

Proposed for this project:

- Identify 1 or 2 of the 16 subbasins monitored
- Work closely with a local partner on stormwater infrastructure, modeling, utility
- Select parameters that span those that are well known and stormwater BMPs are effective, partially known or stormwater BMPs are not effective, or not characterized well at all
  - TSS, total zinc, total copper
  - Dissolved Zn and Cu, petroleum-related compounds
  - Phthalates
- *Demonstration project: how well does this work?*

Subbasin Selection Criteria:

- Landuse Type
  - 1st priority - commercial basin
  - 2nd priority - residential basin
- Quality of Flow Data for Model Calibration
  - Rating curve
  - Data gaps
  - Hydrograph form
- Input Data Availability
  - Land use
  - Soils
  - Stream network
  - Pipes
  - Groundwater depth

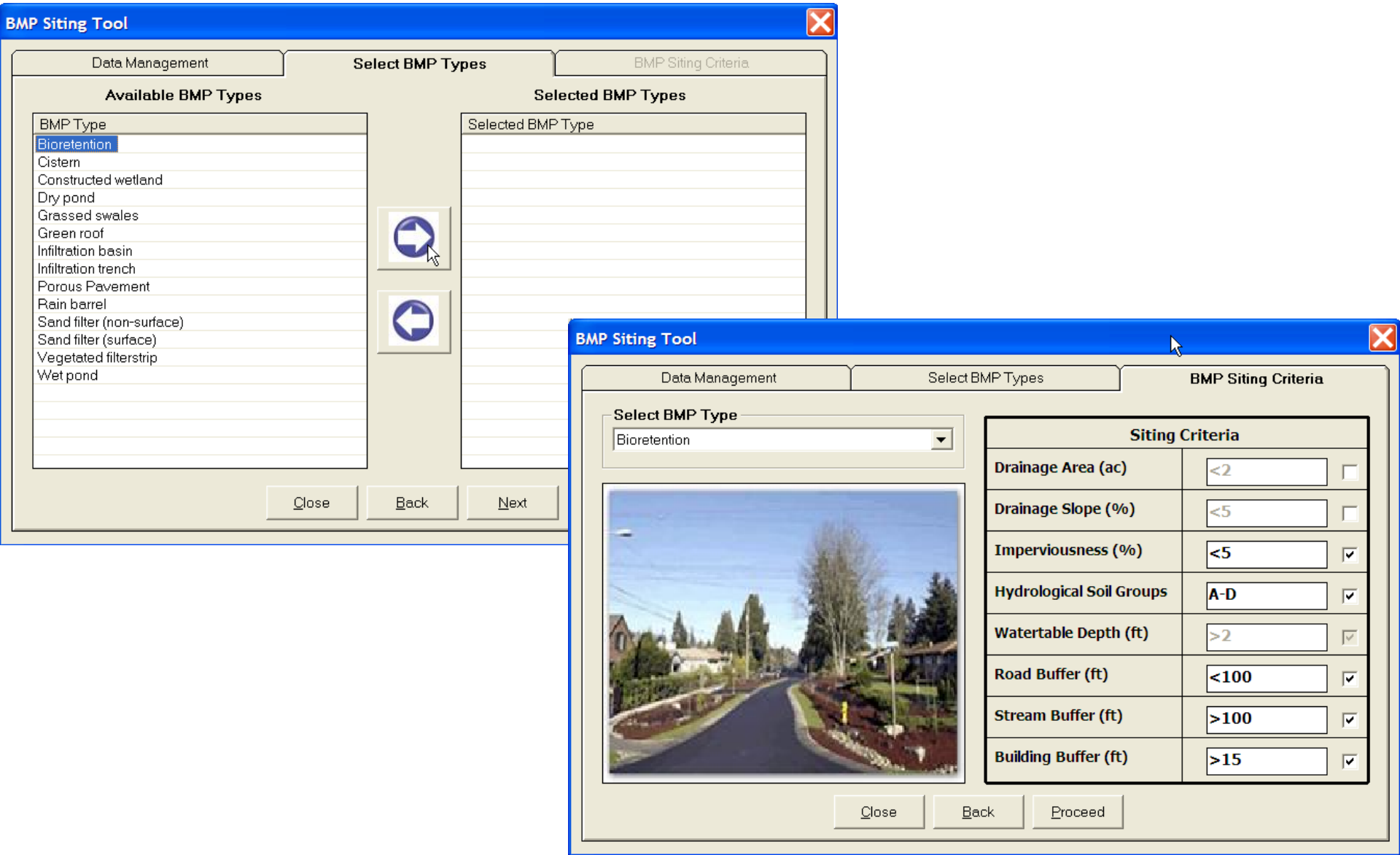
4. Task Overview and Schedule

- Project Tasks
  - Quality Assurance Project Plan (QAPP)
  - Modified BMP Database
  - SUSTAIN Model Development
  - Report and Workshop

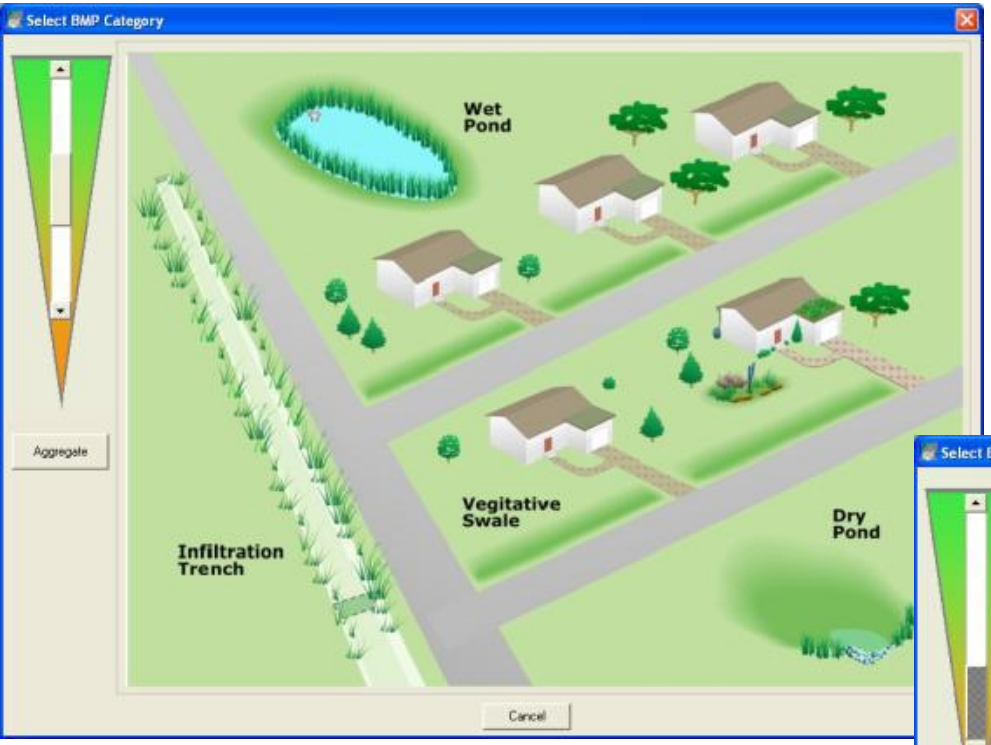
Quality Assurance Project Plan

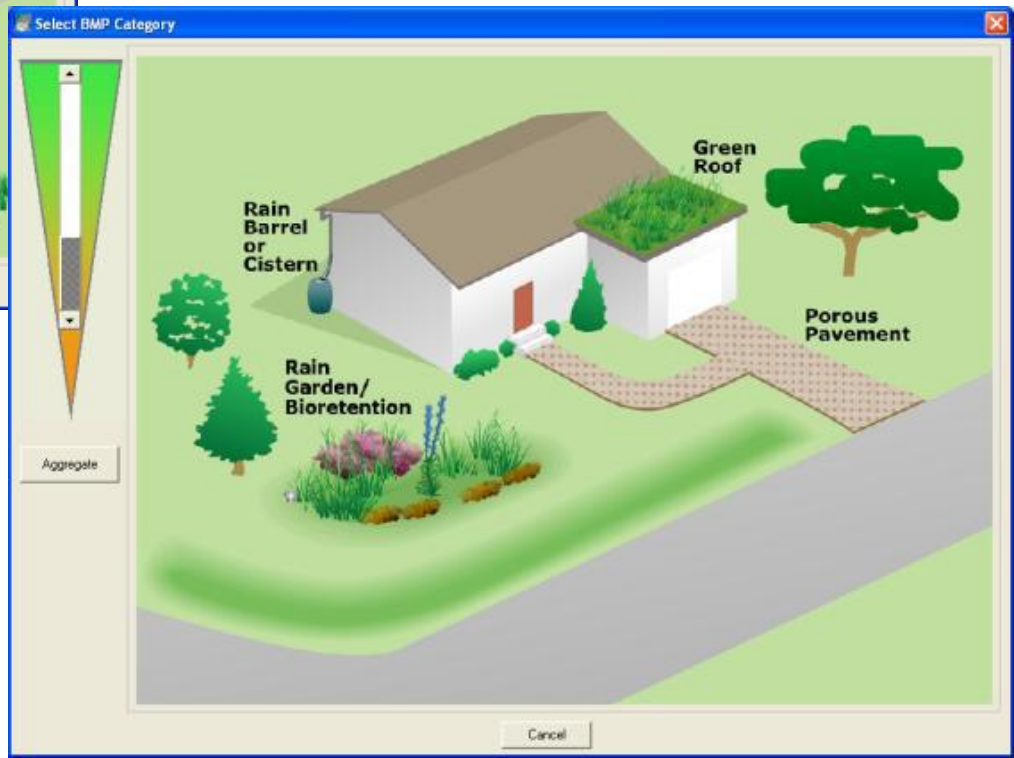
- Abstract
- Background and Project Overview
- SUSTAIN Model Development
  - Model Overview
  - Geographic and Temporal Extent
  - Land Module
  - BMP Module
  - Conveyance Module
  - Optimization Module
  - Runtime Considerations
- Model Calibration
- Evaluation of Model Scenarios
  - Water Quality
  - Flow control benefit
- Model Output Quality (Usability) Assessment
- Project Deliverable

SUSTAIN BMPs – BMP Siting Tool



SUSTAIN BMPs – BMP Module





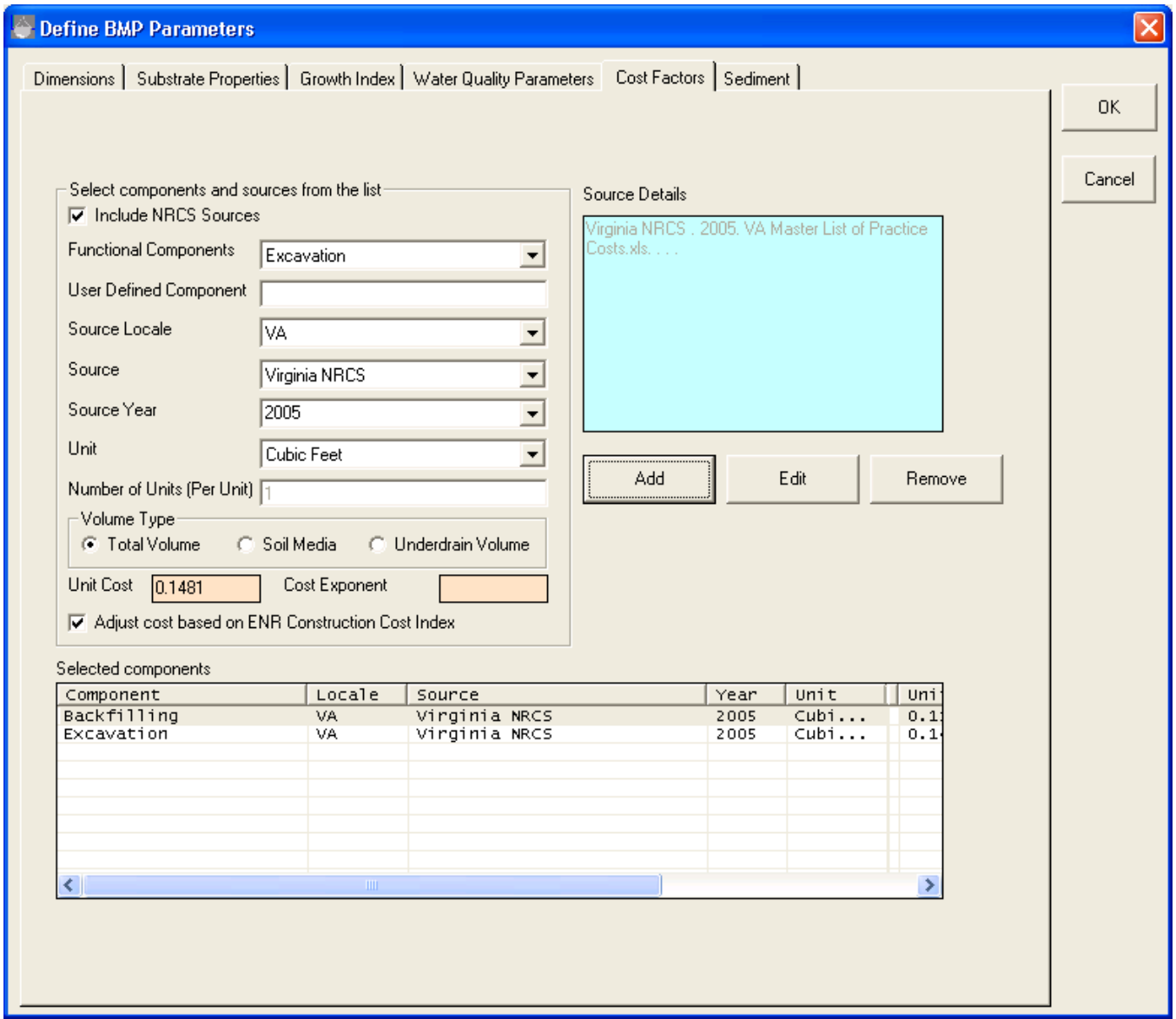
SUSTAIN BMPs

BMP Siting Tool	BMP Module (or BMP Template)	BMP Cost Database
Bioretention	Bioretention	Bioretention
Cistern	Cistern	Cistern *
Constructed Wetland		Constructed Wetland
Dry Pond	Dry Pond	
Grassed Swale	Grassed Swale	Grassed Swale
Green Roof	Green Roof	Green Roof
Infiltration Basin		
Infiltration Trench	Infiltration Trench	Infiltration Trench
Porous Pavement	Porous Pavement	Porous Pavement
Rain Barrel	Rain Barrel	Rain Barrel
Sand Filter (non-surface)		
Sand Filter (surface)		
Vegetated Filterstrip	Vegetated Filterstrip *	Vegetated Filterstrip
Wet Pond	Wet Pond	Wet Pond

SUSTAIN BMPs – Recommendations for Puget Sound Cost Database

1. Bioretention
2. Cistern
3. Constructed Wetland
4. Grassed Swale
5. Green Roof
6. Infiltration Trench
7. Porous Pavement
8. Rain Barrel
9. Vegetated Filterstrip
10. Wet Pond

SUSTAIN BMPs – Cost Factors



SUSTAIN BMPs – Unit Cost Components

- Backfilling
- Cistern *
- Excavation
- Filter Fabric
- Grading/finishing
- Grass
- Gravel1
- Gravel2
- Gravel3
- Green Roof System
- Gutter Connection
- Inlet Structure
- Mulch
- O&M *
- Observation Well
- Outlet Structure
- Perennials
- Porous Paving Material
- Rain Barrel
- Seal
- Small Trees
- Soil/Planting Media
- Underdrain Pipe
- Woody Shrubs

SUSTAIN BMPs – Cost References

- 1990s - CALTRANS
- 1999 - EPA Stormwater Technology Fact Sheets
- 1999-2005 - NRCS Cost Share Data for 34 states (not including WA, mainly rural)
- 2005 - Fairfax County BMP Fact Sheets
- 2006 - MN Stormwater Manual (version 1.1)
- 2007 - MI Department of Environmental Quality's 319 BMP Cost Database
- 2007 - Cost info for Green Roofs from EPA's Heat Island website and the Great Lakes Water Institute's website
- 2007 - Wholesale/Retail Bulk Material Pricing (mulch, sand, stone, commercial landscape materials, rain barrels)

SUSTAIN BMPs – Recommendations for Puget Sound Cost Database

- Need to gather cost information specific to Puget Sound
- Add O&M cost data
- Add design cost data
- Add unit cost components (compost for bioretention, screen and water treatment for cistern)
- Break down green roof into components?
- Break down porous pavement and cisterns into subcategories?

SUSTAIN BMPs – Recommendations for Puget Sound Cost Database

HERRERA

Wet Pond Cost Request Form

Contact Name: _____
Contact Email: _____
Contact Phone: _____

Project Information

Project Name: _____
Construction Date(s): _____
Total Project Cost: _____

Brief Project Description (include number and types of BMPs installed):

Estimated Unit Costs

Item	Units	Unit Cost	Notes
Excavation	cubic feet		
Grading/finishing	square feet		
Grass	square feet		
Gravel	cubic feet		
Inlet Structure	per unit		
Outlet Structure	per unit		
Seal	square feet		
Design	square feet		
Annual O&M (if known)	square feet		

Additional Notes or Information

SUSTAIN Model Development

- Project would be designed to demonstrate "real world" application of SUSTAIN
- Partner with local jurisdiction to determine:
  - BMP of interest for stormwater treatment
  - Siting criteria for BMPs of interest
  - Decision variables that will be used to explore the various possible BMP configurations (e.g., size or number)

SUSTAIN Modeling Questions

- We are leaning towards internal simulation of hydrographs/ pollutographs because:
  - Watershed scale= ~1 square mile
  - There is no existing hydrology model
  - The internal simulation option has not been used extensively and needs a local validation/ verification
- Detailed modeling and optimization of management practices versus aggregate BMP approach
  - Need input from model developers on best approach given subbasin size

SUSTAIN Modeling Questions

- Optimization options: cost effectiveness curve vs cost minimization with constraints
- Considerations:
  - Cost effectiveness curve requires a single pollutant where we have multiple pollutants
  - Minimize cost option requires setting target percent reductions in pollutant loading

SUSTAIN Modeling Questions

- Instantaneous vs. kinematic wave hydraulic routing
  - Kinematic wave routing
    - More realistic travel time in hydrographs
    - Better assessment of flow control benefits
    - Requires the user to enter pollutant decay rates along conduits
  - Instantaneous routing
    - Fewer input data requirements (e.g. pipe network data)
    - Does not require setting pollutant decay rates for conduits

Report and Workshop

- Report will document results from the SUSTAIN modeling effort
- Workshop will describe the SUSTAIN modeling process
  - Workshop will target local jurisdictions that are interested in using SUSTAIN
  - Objective of the workshop will be to inform potential users on the level effort required develop a SUSTAIN model, the key decisions, and the lessons learned from this project

Schedule

Task	Deliverable	Draft to Ecology	Draft to External Review	Final to Ecology
11.1 QAPP	Quality Assurance Project Plan	7/31/11*	8/15/11	9/15/11
11.2 BMP database	SUSTAIN BMP Database with cover memo	8/31/11	9/30/11	10/31/11
11.3 SUSTAIN model development	SUSTAIN application inputs and output files for up to 2 subwatersheds			4/30/12
11.4 Model calibration and application report and workshop	Report summarizing the SUSTAIN model calibration and application Workshop overview of SUSTAIN application	3/30/12	4/30/12	6/30/12 (coincident with external review)

* Contingent on SUSTAIN technical support from TetraTech

5. Role of Advisory Group

- Local partners are critical
  - Demonstration project needs these perspectives
  - Provide local infrastructure information, feedback
- Permittee experience
- Information experts
  - Tackle some topics that are not well characterized
- Lessons learned will reflect perspectives
  - Regulators, regulated entities, technical experts

➢ *Suggestions for involvement?*

6. Questions and Comments?

- How often to meet? interact?
- Proposed:
  - Fall 2011 if questions on QAPP, approach
  - January 2012 – modeling update
  - April 2012 – Briefing on major findings
  - Contact individuals as needed
  - Primarily email