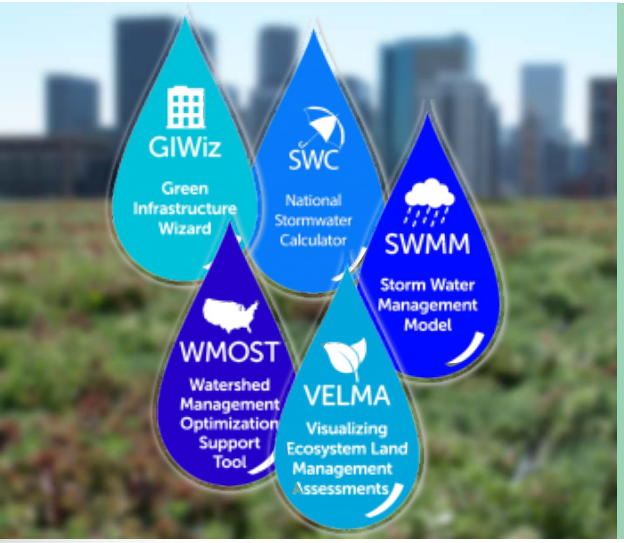
EPA

Office of Research and Development

Monthly Water Research Webinar Series

SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM



October 26, 2016

TODAY'S TOPIC:

Toolkit of Available EPA Green Infrastructure Modeling Software

Watch as you wait

Watch the Toolkit video:
https://www.epa.gov/water-research/green-infrastructure-modeling-toolkit

Webinar Support Phone Number: 1-800-263-6317
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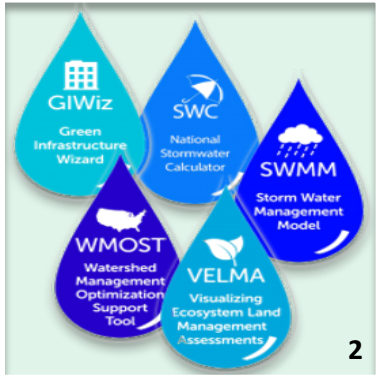
Webinar Summary

Need for Water Runoff Control: Stormwater discharges continue to cause impairment of our Nation's waterbodies. Conventional stormwater infrastructure, or gray infrastructure, is largely designed to move stormwater away from urban areas through pipes and conduit. Runoff from these surfaces can overwhelm sewer systems and end up contaminating local waterways. When stormwater runs off impervious streets, parking lots, sidewalks, and rooftops, it carries pollutants, such as motor oil, lawn chemicals, sediments, and pet waste to streams, rivers, and lakes. Runoff flows can also cause erosion and flooding that can damage property, infrastructure, and wildlife habitat. In addition to runoff problems, impervious surfaces also prevent water from penetrating the soil and recharging groundwater supplies.

Green Infrastructure: Green infrastructure, such as rain gardens, green roofs, porous pavement, cisterns, and constructed wetlands, is becoming an increasingly attractive way to recharge aquifers and reduce the amount of stormwater runoff that flows into wastewater treatment plants or into waterbodies untreated. It provides many environmental, social, and economic benefits that promote urban livability, such as improved surface water quality, water conservation, and improved aesthetics and property values. Green infrastructure is also incorporated into municipal separate storm sewer system (MS4) and National Pollutant Discharge Elimination System (NPDES) stormwater permits for retention requirements for various states across the Nation.

Green Infrastructure Modeling Toolkit: Researchers in EPA's Office of Research and Development (ORD) have been studying green infrastructure practices and developing models and tools to help communities manage their stormwater runoff and address nutrient impairment. This webinar will present a toolkit consisting of five EPA green infrastructure models and tools, along with communication material, that can be used as a teaching tool and as a quick reference resource for use by planners and developers when making green infrastructure implementation decisions, and can also be used for low impact development design competitions. The models and tools included in the toolkit will be presented during this webinar.

The toolkit is available on EPA's website: epa.gov/water-research/green-infrastructure-modeling-toolkit



Disclaimer

The views expressed in this presentation are those of the author and do not necessarily reflect the views of the U.S. Environmental Protection Agency. Any mention of trade names or commercial products does not constitute Agency endorsement or recommendation for use.

Green Infrastructure Wizard (GIWiz): GIWiz is an interactive web application that provides users with customized reports containing the EPA tools and resources they select, direct links, and overview information about each.

Dr. Marilyn ten Brink

Dr. Marilyn ten Brink is a Special Assistant to the Director of the Atlantic Ecology Division (AED) of EPA's National Health and Environmental Effects Research Laboratory (NHEERL) in Narragansett, Rhode Island. She received her Ph.D. in Environmental Geochemistry from Columbia University, New York, and has over 35 years of research experience on pollutant distribution, impacts, and management for aquatic systems. Marilyn is currently leading an interdisciplinary group of scientists to develop tools, including GiWIZ, that enable communities to better utilize Green Infrastructure approaches and improve sustainability.

Contact: tenbrink.marilyn@epa.gov

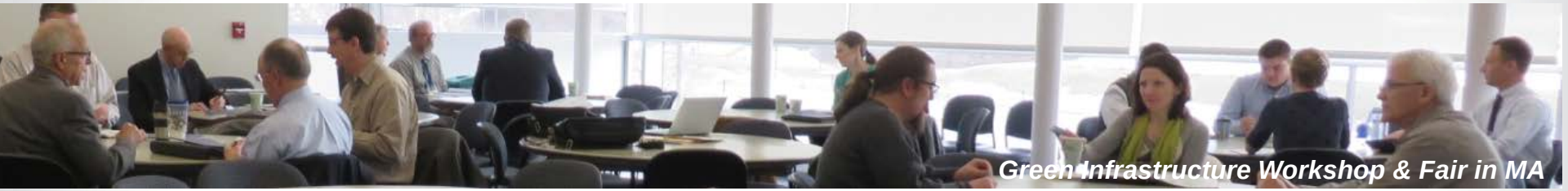
What is GIWiz?

- A database of EPA's Green Infrastructure Tools and Resources
- An interactive web application that connects communities with these Tools and Resources
- A wizard that provides customized links and exploration, based you your objectives and specifications
- A decision support tool for green infrastructure implementation
- A simple means to generate a report about tools and resources of interest

https://cfpub.epa.gov/giwiz/

https://www.epa.gov/sustainability/green-infrastructure-wizard

Why GIWiz?



Problem formulation

NEEDS:

What do communities, practitioners, and stakeholders need to make good decisions and improve compliance and sustainability outcomes?

LEARNING FROM COMMUNITIES

GI?

Connecting the Dots Between Supply and Demand of Information

Tools & Resources:

- What is already available to meet community and stakeholder needs?
- Where are the gaps in research, tools, and information?

DEVELOPING DECISION CASES

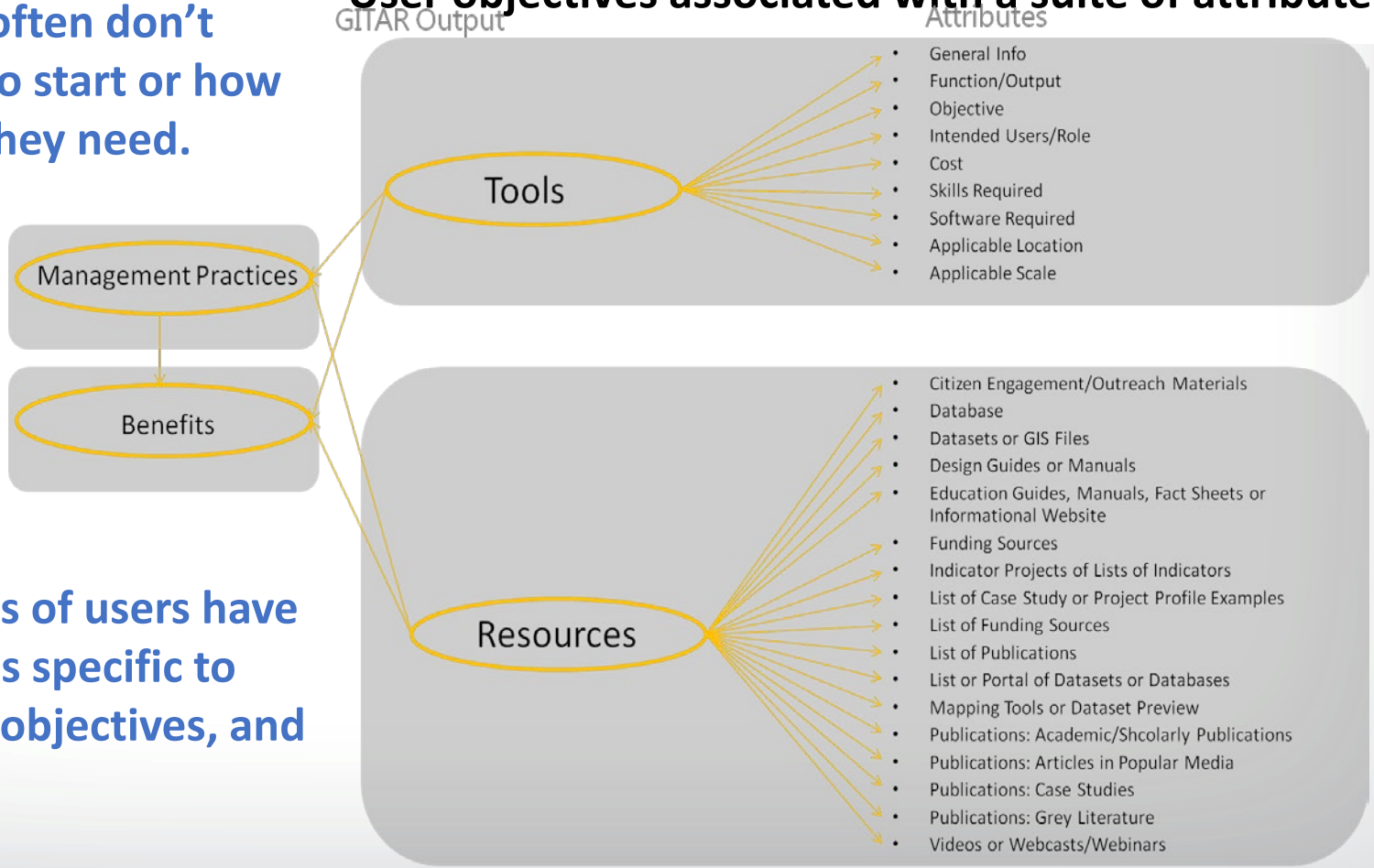
EPA has a vast array of Green Infrastructure tools, information resources, and case studies; however, this information can be difficult for users to navigate .

Decision Cases > Wizard

Attributes tagged for each Tool/Resource entry

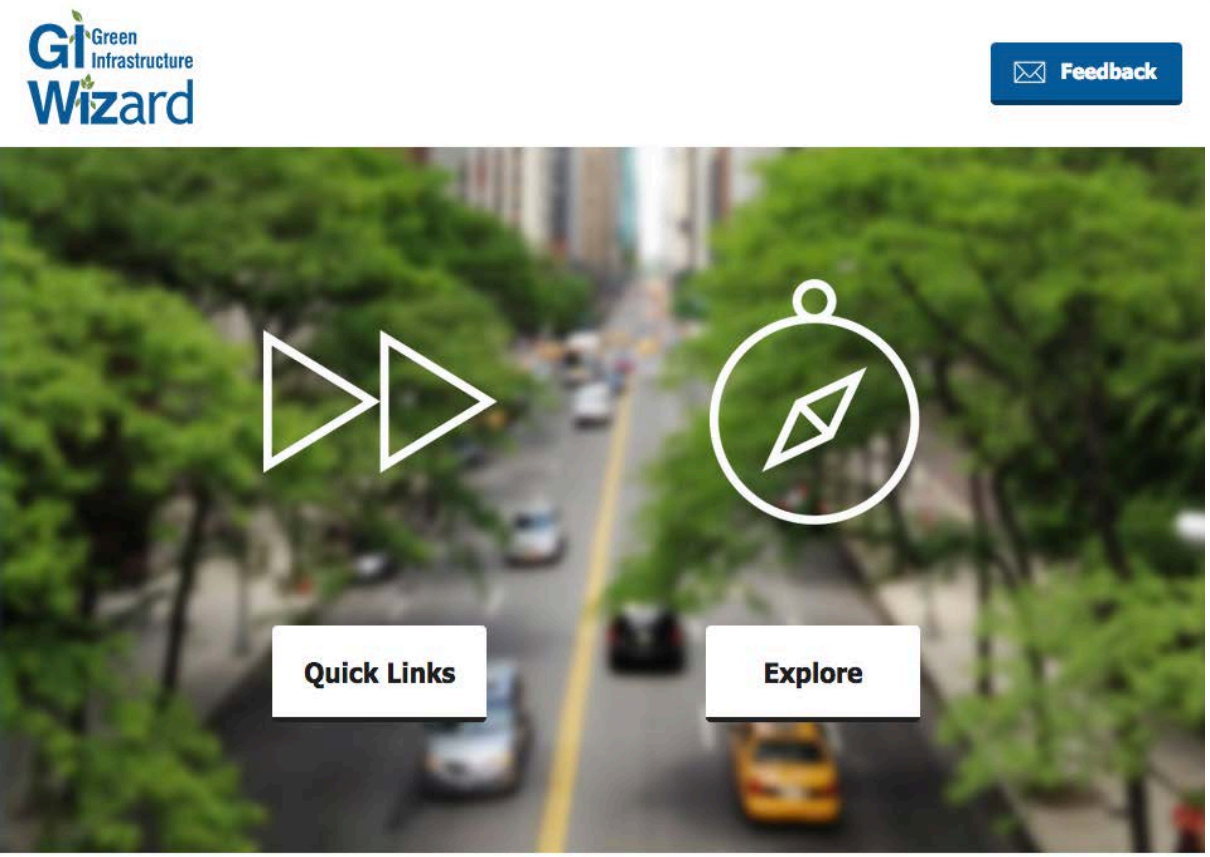
User objectives associated with a suite of attributes

Practitioners often don't know where to start or how to find what they need.



Different types of users have differing needs specific to their context, objectives, and constraints.

What does GIWiz provide?



GIWiz offers you access to a repository of EPA-sourced Green Infrastructure tools and resources designed to support and promote sustainable water management and community planning decisions. The tools and resources available through GIWiz will help you analyze problems, understand management options, calculate design parameters, analyze costs and benefits, evaluate tradeoffs, engage stakeholders, and/or develop education and outreach campaigns. GIWiz is made possible through a cross-agency collaboration involving EPA's Office of Research and Development, Office of Policy, Office of Water, and Regional staff.

Quick, direct access to EPA's Green Infrastructure tools and resources

Faster, Easier Access to Information

Searching for: [EPA, Green Infrastructure, Regulator, Compliance] can yield an overwhelming array of results:

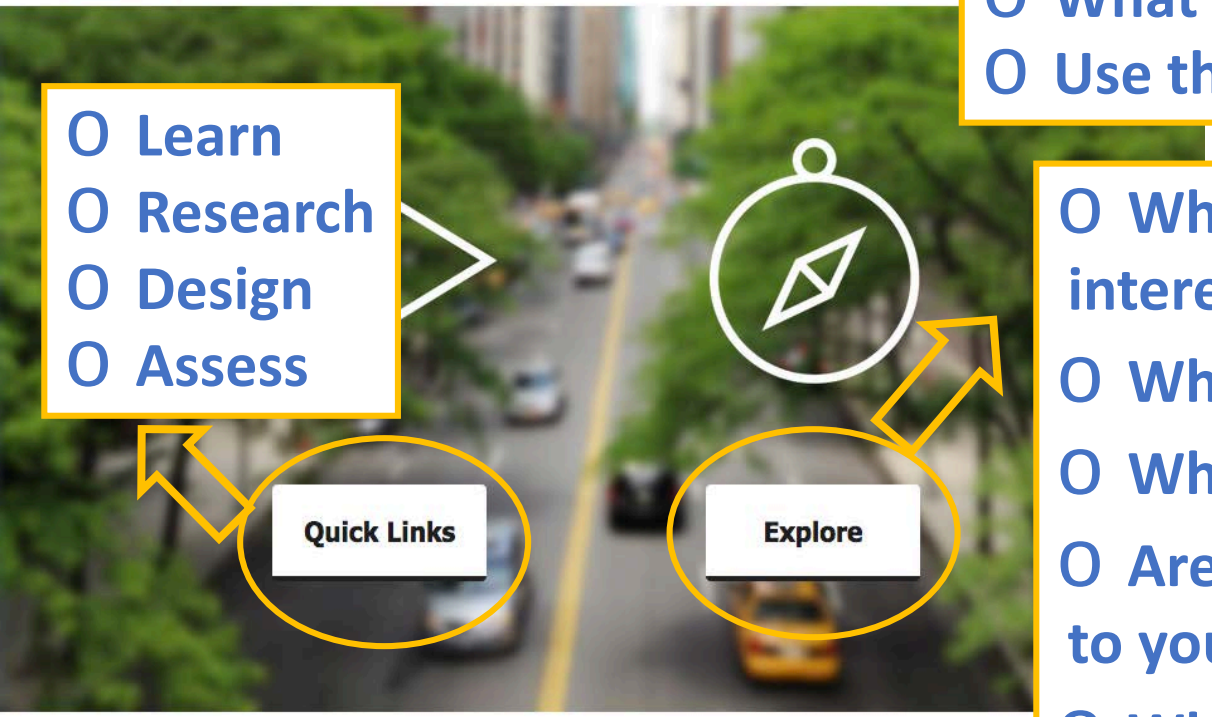
More than 7,000 users have visited GIWiz since the October 2015 launch.

How can I use GIWiz?

GI Green Infrastructure Wizard

First-level 'clicks'

- Who are you?
- What would you like to do?
- Use the keyword search



- Learn
- Research
- Design
- Assess

- What resources are you interested in?
- What are your objectives?
- What benefits interest you?
- Are these skills applicable to you?
- Which management practices best fit your needs?

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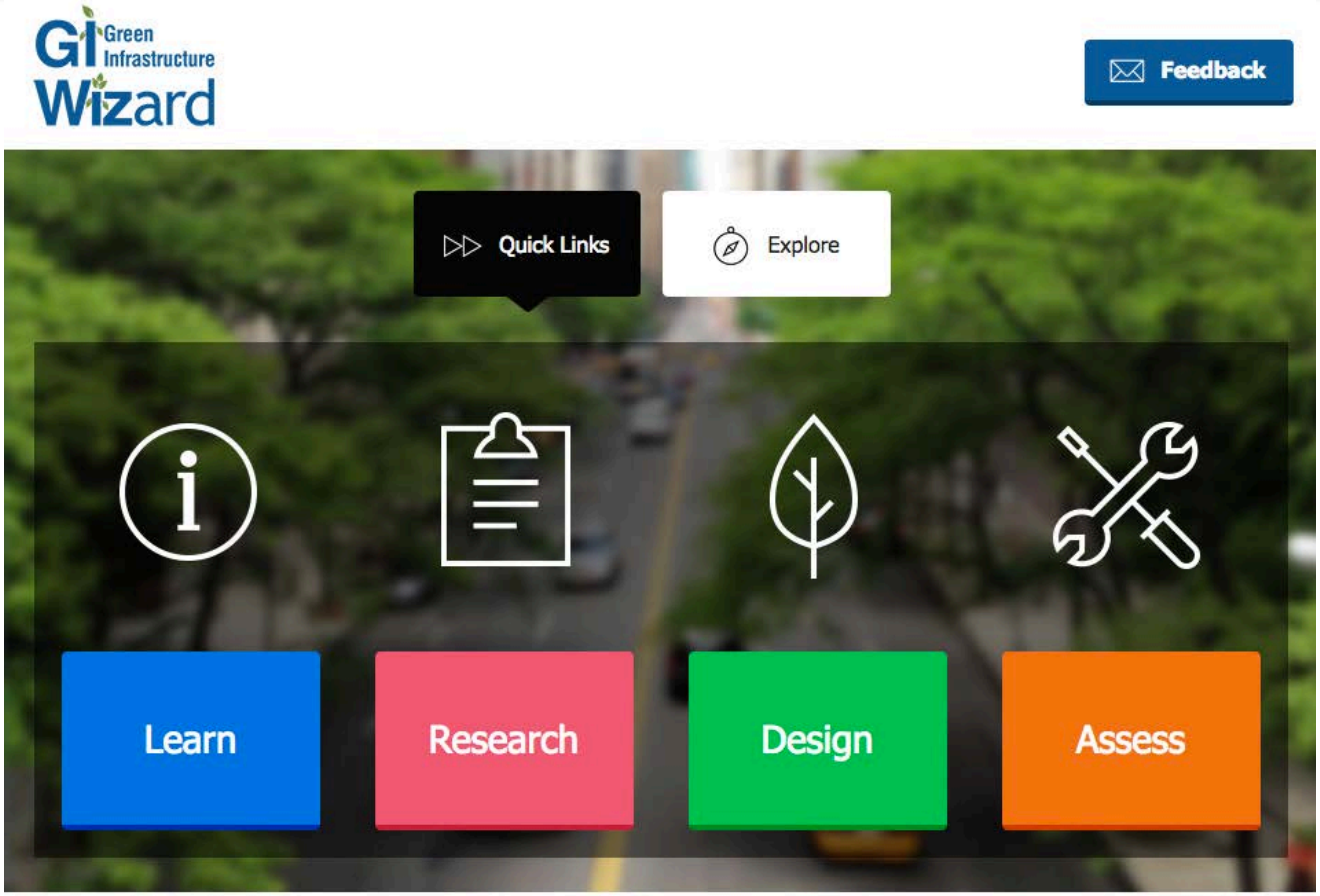
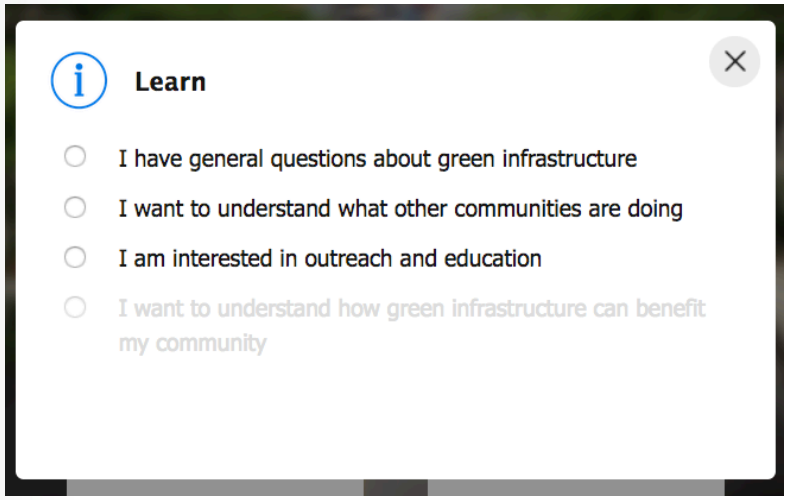
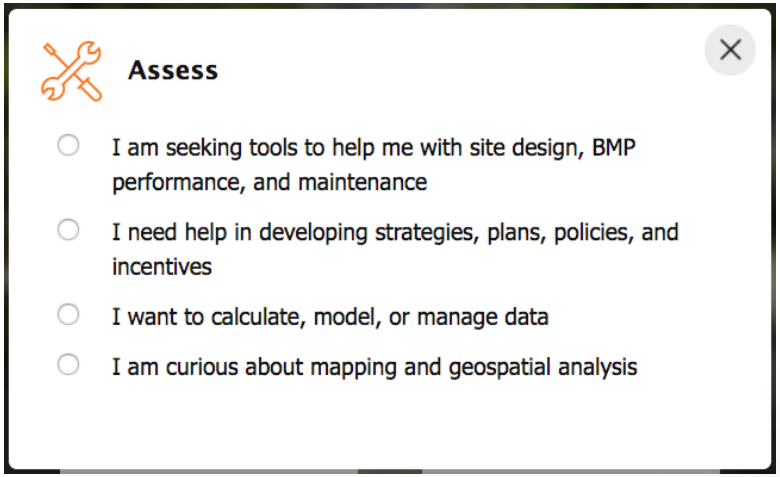
QUICK LINKS function



Use the Quick Links feature to access green infrastructure tools and resources, customized to a specific objective. Click the button that best matches your needs, and select the corresponding objective to view a tailored list of tools and resources.

QUICK LINKS to Tools and Resources

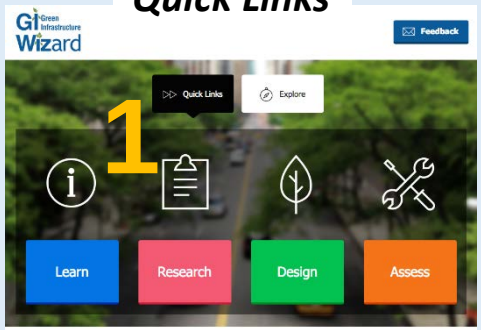




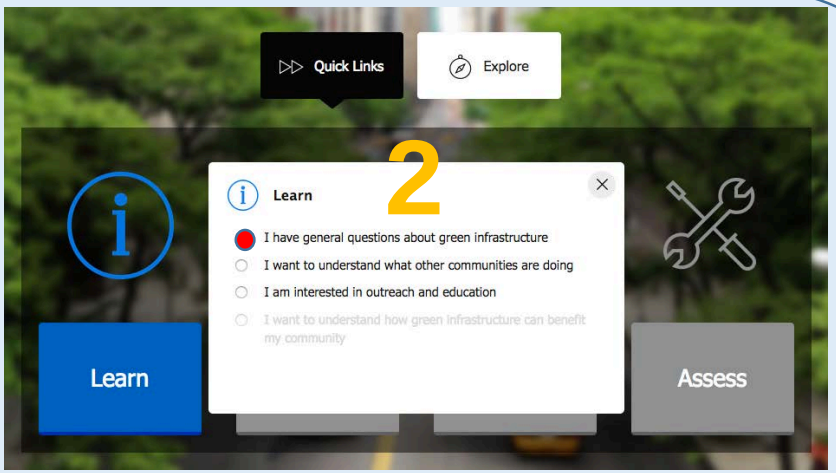
Find the 'who, when, where, why and how' of Green Infrastructure Implementation

Using QUICK LINKS

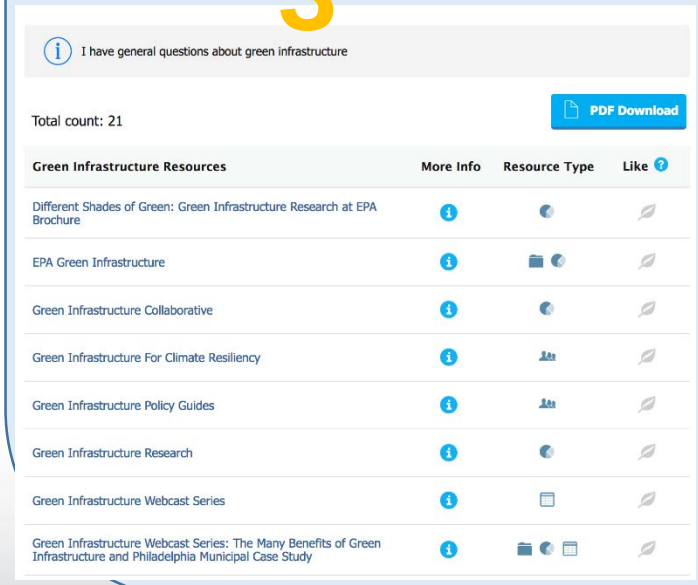
Quick Links



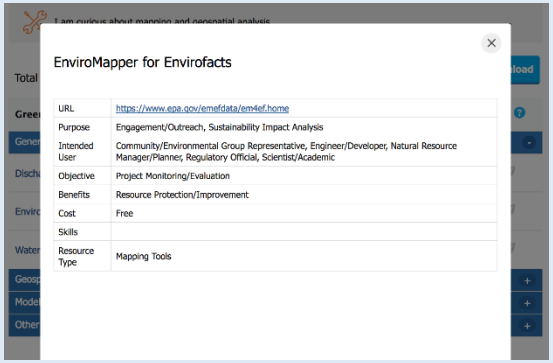
Use to access a pre-selected list of GI tools and resources grouped by specific objectives and sorted by topic



Selection(s) delivers list of pertinent tools and resources



with links to more information and to resource websites

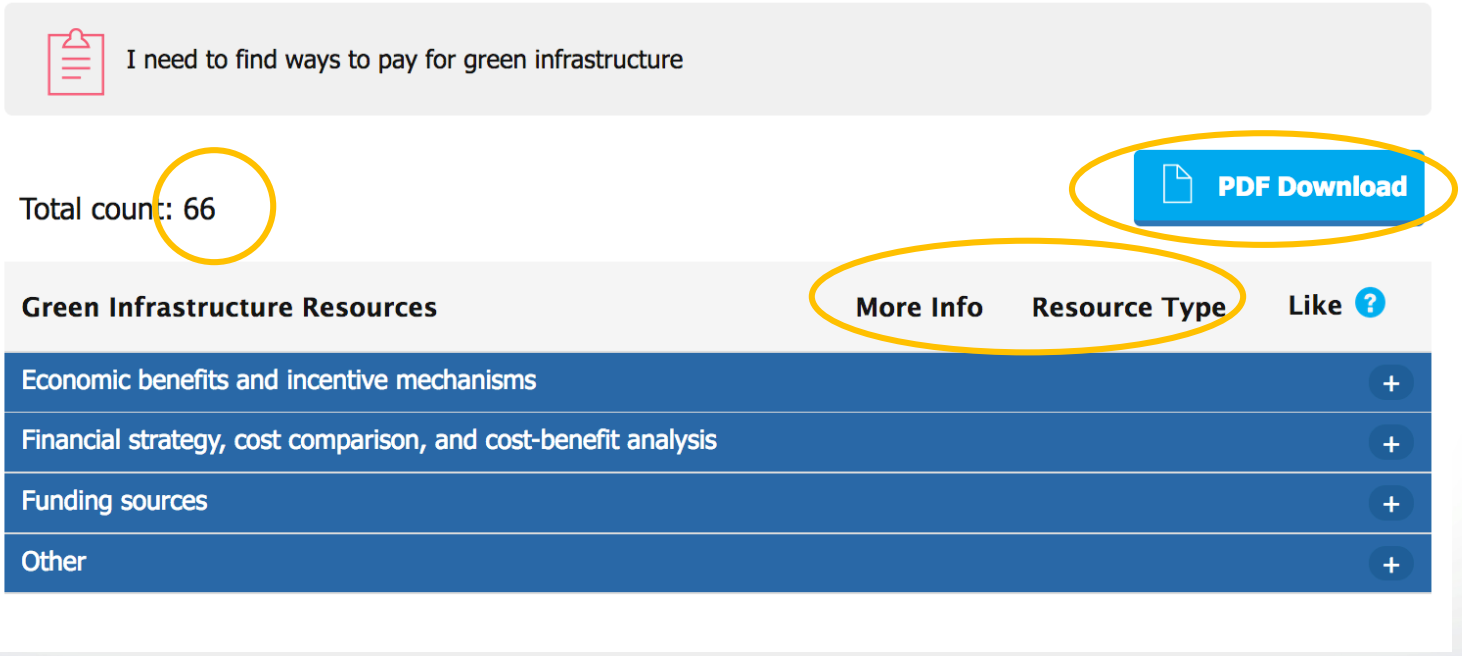


GIWiz Reports

- Quick Link Organized by categories
- Include number of returns
- 'More info' and 'Resource Type'
- Downloadable
- Have links to each tool/ resource
- "Feedback" function

Example (Quick Links: *Research*)

1



2

GIWiz Navigation for Your Needs

Viewing the Resources

I need to find ways to pay for green infrastructure

Total count: 66

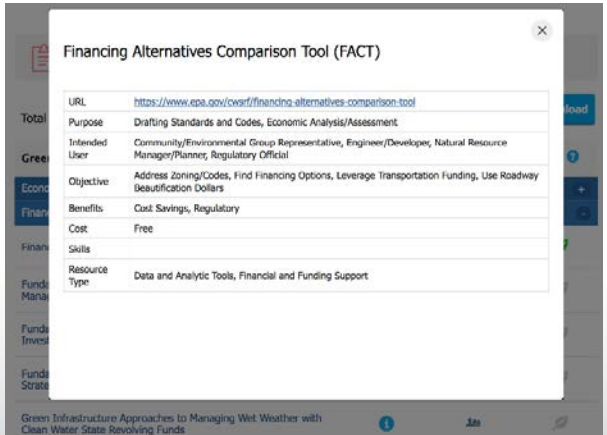
PDF Download

Green Infrastructure Resources	More Info	Resource Type	Like
Economic benefits and incentive mechanisms			
Financial strategy, cost comparison, and cost-benefit analysis			
Financing Alternatives Comparison Tool (FACT)			
Fundamentals of Asset Management Step 10. Build Asset Management Plan A Hands-On Approach			
Fundamentals of Asset Management Step 8. Optimize Capital Investment: A Hands-On Approach			
Fundamentals of Asset Management Step 9. Determine Funding Strategy A Hands-On Approach			
Green Infrastructure Approaches to Managing Wet Weather with Clean Water State Revolving Funds			

3

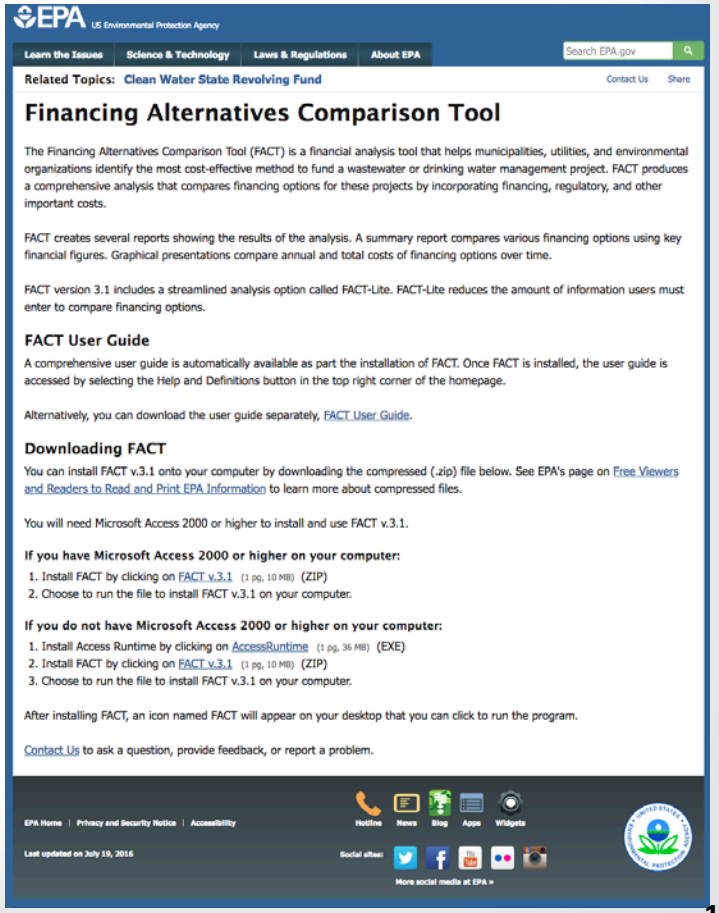
More info

4

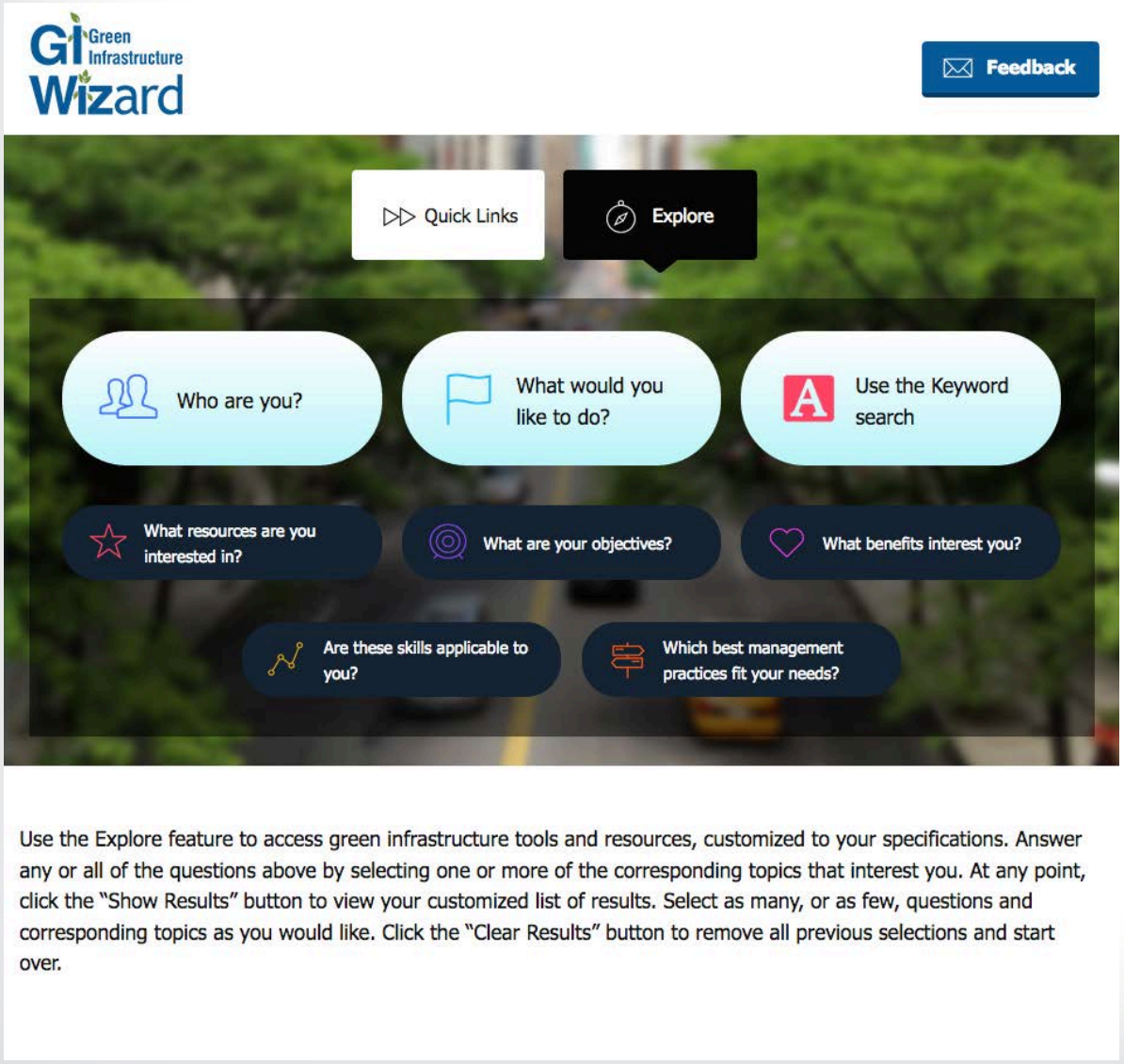


Linked url

5



EXPLORE Function



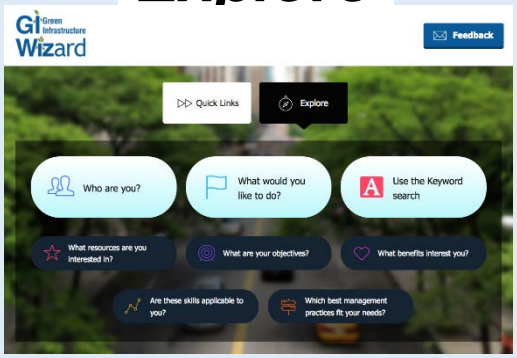
Access GI tools and resources. Get a highly targeted report customized to your specifications….

For example:

*"I am a **city planner** in a medium sized-city trying to do **a green streets program**. I want to **find design manuals** for various **tree planting scenarios** and for **stormwater management** within a business district.*

Using EXPLORE

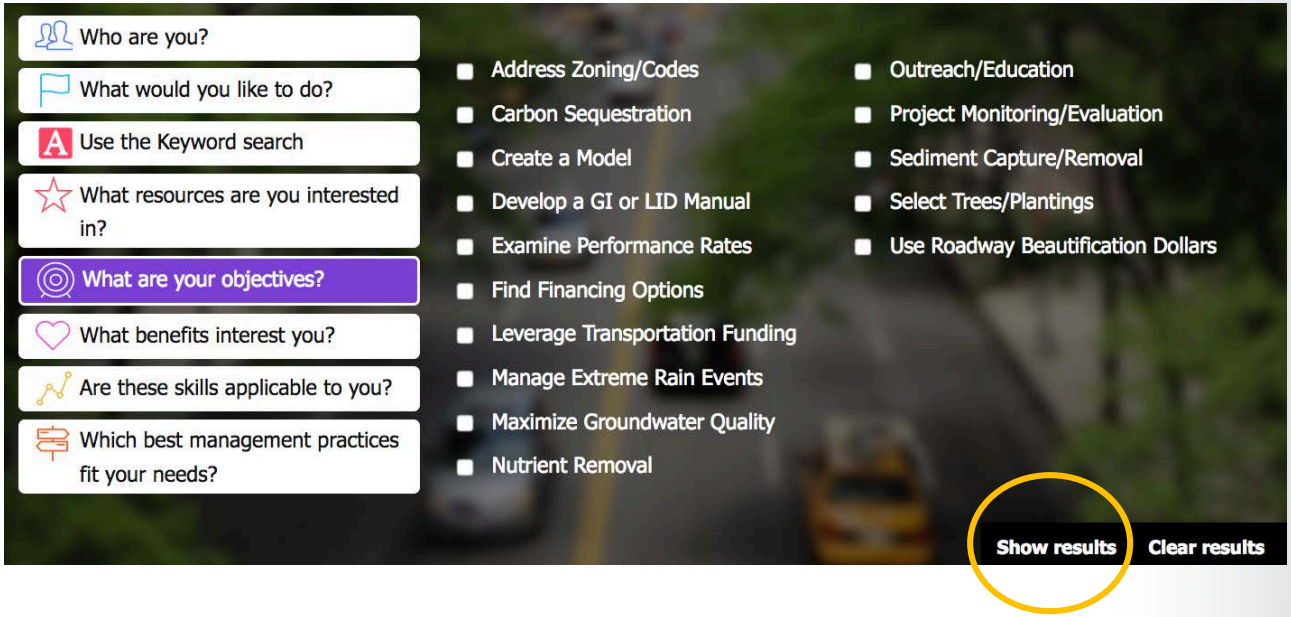
Explore



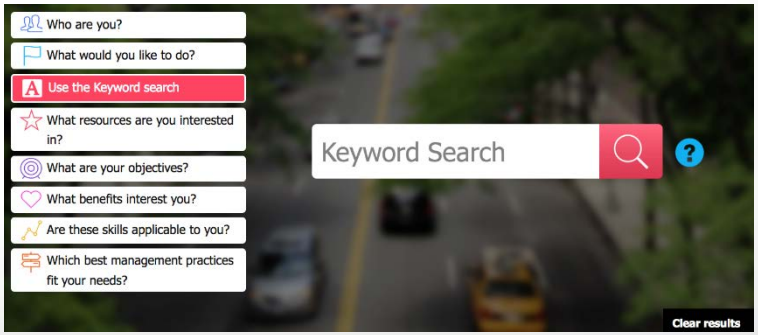
Answer any or all of the questions and click 'show results' to view your customized list of tools and resources

'Clear Results' to start a new search

1 **2** ***Select as many or few as you wish***



Or SEARCH the database using keyword



User-Selected Criteria

Wizard matches Tools and Resources to all user-selected criteria

What benefits interest you?

- Aesthetics/Livability
- Civic/Community Involvement
- Cost Savings
- Economic Development
- Ecosystem Health
- Grey Infrastructure Footprint
- Hydrological Improvements
- Pollution/Climate Change Mitigation
- Property Value Increases
- Public Health/Safety
- Recreational
- Regulatory
- Resource Protection/Improvement
- Right-of-Way Enhancements
- Runoff Nutrient Loading

Are these skills applicable to you?

- Concept Mapping
- Content Management
- Cost Estimation
- Data and Analysis
- Engineering
- Environmental / Program Management
- Geospatial Analysis
- Scientific Knowledge
- Statistics
- Teaching

What would you like to do?

- Compliance
- Data and Modeling
- Decision-Making and Planning
- Drafting Standards and Codes
- Economic Analysis/Assessment
- Engagement/Outreach
- Environmental Footprint Analysis
- Mapping and Visualization
- Other Environmental Analysis
- Other Environmental Assessment
- Performance Analysis
- Project Management and Reporting
- Sustainability Impact Analysis

Which best management practices fit your needs?

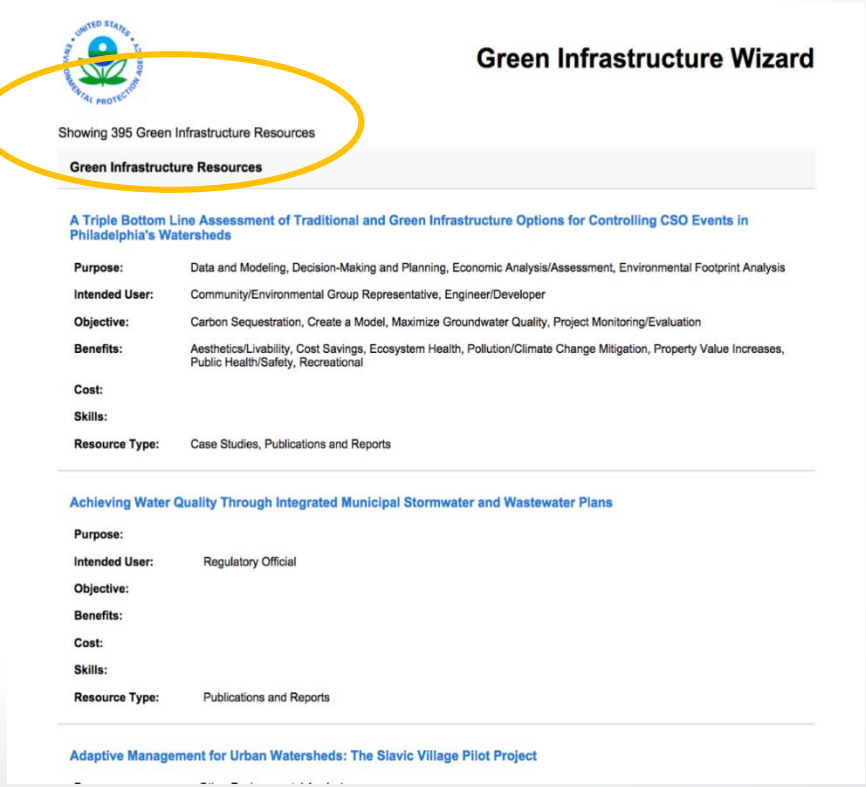
- Conservation/Restoration
- Construction
- Education and Outreach
- Environmental Management
- Municipal Management
- Stormwater/Flood Management
- Transportation
- Wastewater Management

GIWiz Database

Connecting the dots between Supply and demand for GI information

Database content is expanding

- V1 Sept 2015: 270 Tools and Resources
- V2 Sept 2016: **395 Tools and Resources**



Green Infrastructure Wizard

Showing 395 Green Infrastructure Resources

Green Infrastructure Resources

A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds

Purpose:	Data and Modeling, Decision-Making and Planning, Economic Analysis/Assessment, Environmental Footprint Analysis
Intended User:	Community/Environmental Group Representative, Engineer/Developer
Objective:	Carbon Sequestration, Create a Model, Maximize Groundwater Quality, Project Monitoring/Evaluation
Benefits:	Aesthetics/Livability, Cost Savings, Ecosystem Health, Pollution/Climate Change Mitigation, Property Value Increases, Public Health/Safety, Recreational
Cost:	
Skills:	
Resource Type:	Case Studies, Publications and Reports

Achieving Water Quality Through Integrated Municipal Stormwater and Wastewater Plans

Purpose:	
Intended User:	Regulatory Official
Objective:	
Benefits:	
Cost:	
Skills:	
Resource Type:	Publications and Reports

Adaptive Management for Urban Watersheds: The Slavic Village Pilot Project

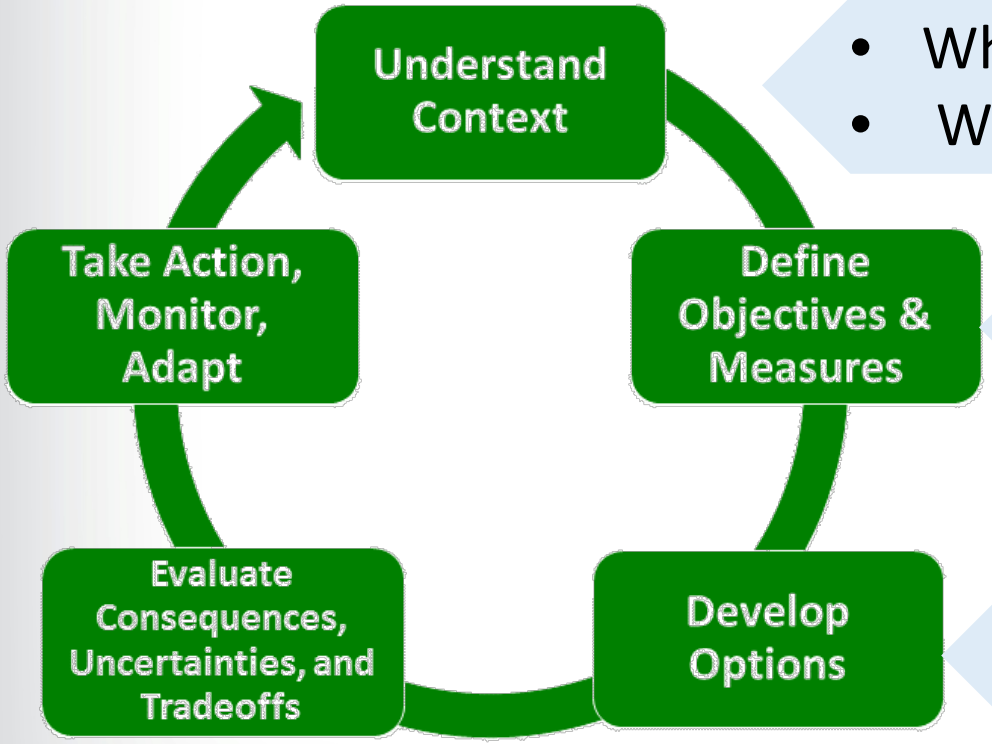
To create a report of the full GIWiz content, Select all in 'EXPLORE/ What Resources are you interested in?'

19

Decision Support with EXPLORE

Community/Environmental Group Representative
Engineer// Developer
Natural Resource Manager/ Planner
Landowner/Homeowner
Scientist/ Academic
Regulatory Official

ROLES & STAKEHOLDERS



- Who are you?
- What benefits interest you?

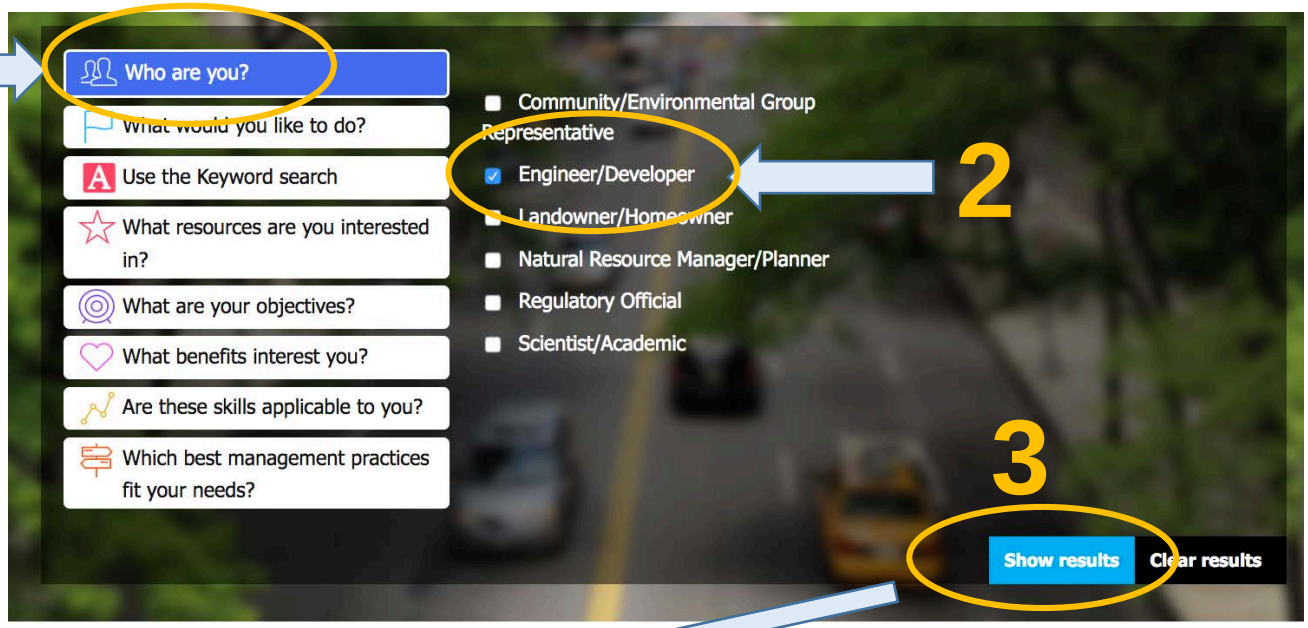
- What are your objectives?
- What would you like to do?

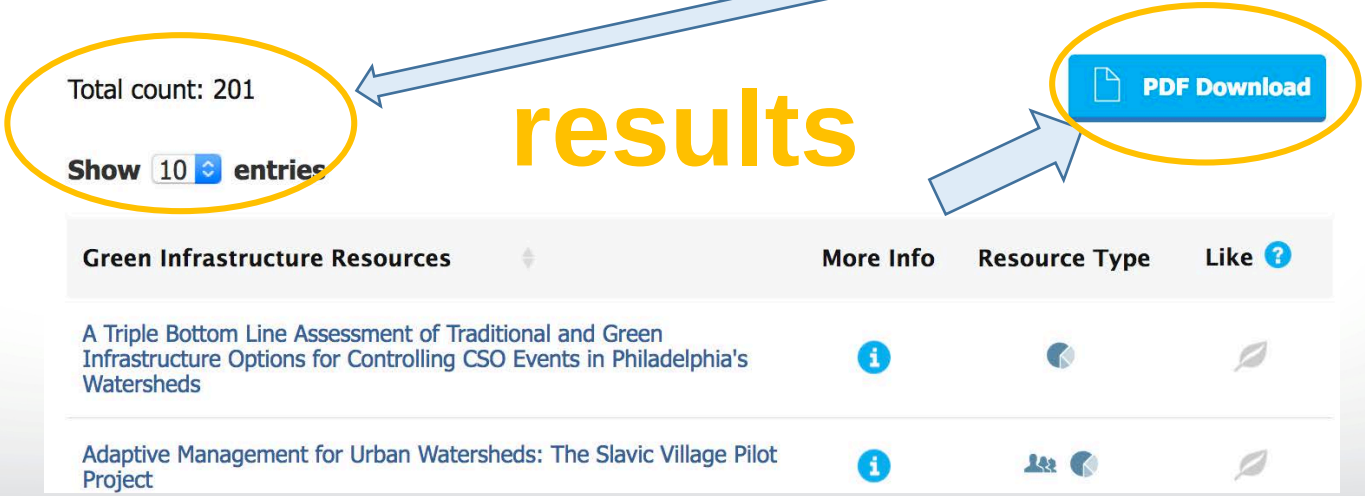
- Which best management practices fit your needs?

Green Infrastructure Implementation in DASEES Decision Analysis Framework

GIWiz Reports

Example of report from user-customized criteria in EXPLORE pathway





Knowledge Base through Collaboration

This is a collaborative project aimed at bridging the gap between the expert knowledge contained within our Green Infrastructure Tools and Resources, and the institutional and user knowledge about where they are located and what they are for.

GI Green Infrastructure Wizard

www.epa.gov/giwiz

GIWiz

- **Helps people considering Green Infrastructure**
- **to find the tools and resources they need**
- **to make sound decisions and advance Green Infrastructure implementation**

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EPA Office of Research and Development (ORD) Safe and Sustainable Waters Research (SSWR) and Sustainable and Healthy Communities Research (SHC), Office of Policy, Office of Water, Office of Environmental Information, Regions 1, 2 and 3 and Community partners.

Marilyn Buchholtz ten Brink, Ph.D. (ORD/NHEERL) RI
Michael Nye, Ph.D. (ORD/NERL) CO
Robert Sachs (AA/Office of Policy) DC
Ingrid Heilke, MCP (ORISE Fellow) RI

Watershed Management Optimization Support Tool (WMOST): WMOST is a software application designed to facilitate integrated water resources management across wet and dry climate regions. It allows water resources managers and planners to screen a wide range of practices across their watershed or jurisdiction for cost-effectiveness and environmental and economic sustainability. WMOST allows users to select up to fifteen stormwater management practices, including traditional grey infrastructure, green infrastructure, and other low impact development practices.

Dr. Naomi Detenbeck

Dr. Naomi Detenbeck is an ecologist in NHEERL AED in Narragansett, RI, with an adjunct faculty appointment in Natural Resources Science at the University of Rhode Island. Her current research is focused on the watershed-scale effects of natural and constructed green infrastructure, development of decision-support tools for integrated water resources management, such as WMOST, and development of EPA's Estuary Data Mapper. Naomi's past research has included work on biogeochemistry, wetlands, landscape ecology, nutrient criteria development, and watershed classification. She earned her M.S. and Ph.D. in Ecology from the University of Minnesota.

Contact: detenbeck.naomi@epa.gov

What is WMOST?

Decision-support tool for integrated water management at the small watershed/community scale

- Optimizes cost (given targets for base flows, peak flows, water storage, water quality*)
- Evaluates management options in multiple programs
  - Stormwater, including green infrastructure (GI)
  - Wastewater
  - Drinking water
  - Land conservation

* Water quality module available for beta testing in fall 2016

Who and What is WMOST Designed For?

- Community decision-makers:
  - Municipal, regional, or watershed planners
  - Utility managers
  - Community consultants
- Planning level assessments within the following:
  - Watershed Implementation Plans
  - Applications for Grants, State Revolving Fund loans, FEMA Community Rating System credits,…
  - Long-range strategies (utility 20-year horizons, smart growth, climate resilience)
  - Integrated management plans (e.g. wastewater + stormwater)

Example Applications

- **Ipswich River, MA**

  What is the most cost-effective suite of management actions to meet target baseflows in the Ipswich River?

- **Monponsett Ponds watershed, Halifax, MA**

  What are the tradeoffs among flood control, recreational use, downstream aquatic life use, and sustainable water supply?

- **Subwatersheds of Taunton River, MA (multiple communities)**

  What is the value of natural and constructed green infrastructure in reducing flooding and water quality impairments under different development and climate change scenarios?

- **Subwatersheds of Montgomery County, MD**

  What are the most cost effective management practices and tradeoffs involved in meeting both local sediment TMDLs and N/P/SS targets for the Chesapeake Bay TMDL?

- **Subwatersheds of Middle Kansas River, KS**

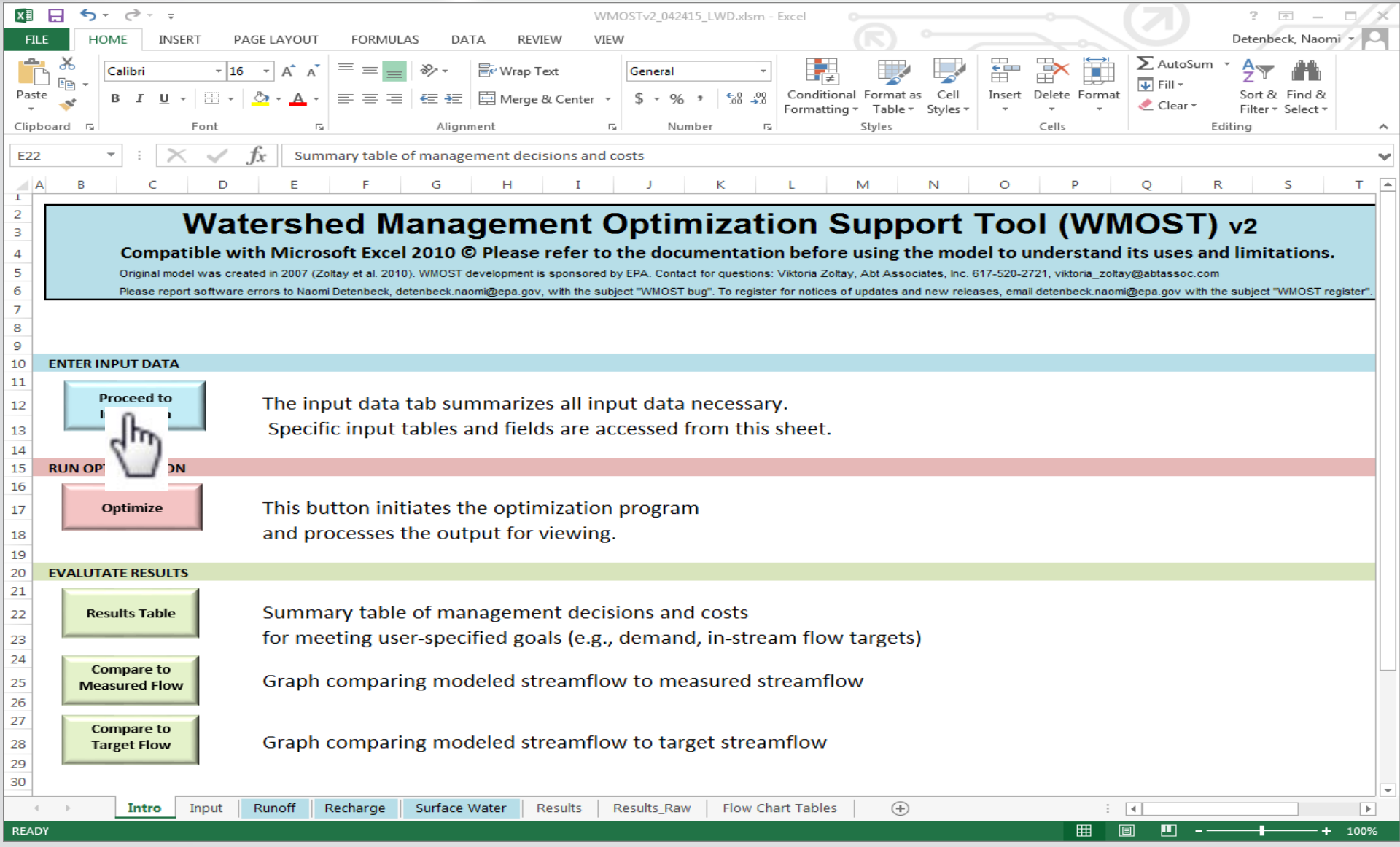
  What are the most cost-effective management practices to both reduce water quality impairments and manage for resilience in the face of climate change?

Compatibility

- Accepts inputs from commonly used hydrology models, e.g.,
  - HSPF, SWAT (HAWQS*), SWMM, GWLF, PRMS
  - National USGS Monthly Water Balance Model (Bock et al. 2016)
- Allows automated import of time series from existing calibrated models or addition of user-supplied datasets
- Links with EPA SUSTAIN/SWMM to automate calculation of gray and green infrastructure BMP runoff (v1-2) and load reductions (v3)**
- Accepts flood-cost curves derived using FEMA HAZUS tool with publically available data from Flood Insurance Studies

- *beta version tests underway
- **Beta version available for testing Fall 2016

MS-Excel interface



Management options in WMOST

- Land conservation
- Water conservation
- Changes in drinking water infrastructure
- Changes in wastewater infrastructure
- Water reuse facility and aquifer storage/recharge
- Interbasin transfer
- Best Management Practices (BMPs), including green infrastructure (GI)

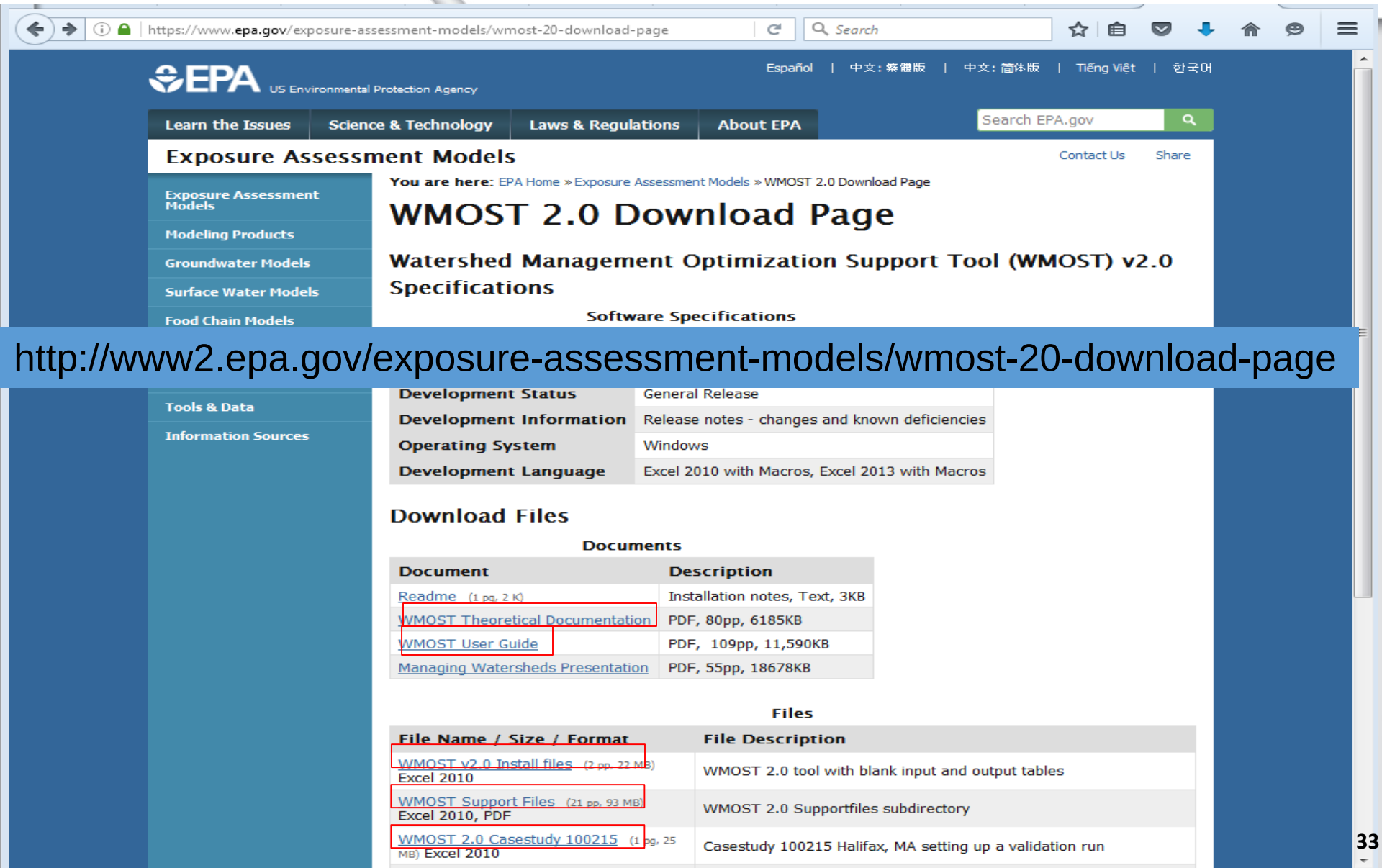
BMPs in WMOST

- Existing
  - Detention (dry) ponds (gray infrastructure)
  - Bioretention (GI)
  - Infiltration trench (GI)
- In progress
  - Forested riparian buffers
  - Biofiltration with internal storage reservoir (denitrification)
  - Grass swale
  - Gravel wetland
  - Infiltration basin
  - Infiltration chambers
  - Porous pavement
  - Sand filter
  - Wet pond

Ongoing WMOST Activities

- Water quality module – beta version available for testing Fall 2016
- Reduced Sewer Overflows module (Winter 2016)
- More input time series
  - New England loading time series (Fall 2016)
  - New England HSPF models: climate change scenarios
  - EPA 20 watershed study sites (historic and future climate change scenarios)
  - HAWQS (nationwide SWAT; undergoing testing now)
  - USGS Monthly water balance model (nationwide)
- Climate change/robust decision making modules (Fall 2016 - 2017)
- Co-benefit estimation (2017-2018)
  - Ecosystem benefits
  - Human health
  - Energy savings
- Training/tech transfer (workshops, support for 4 ongoing case studies)
- Optimize results across multiple objectives (2018)
- Strategies for scaling up and linking watersheds (2018)

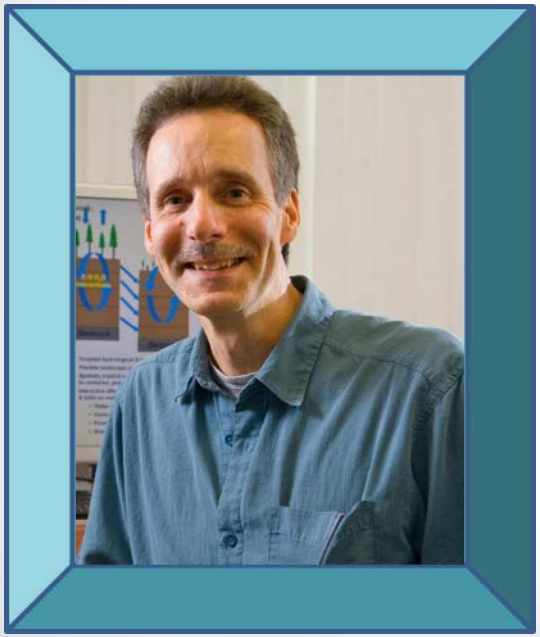
WMOST Download Site



http://www2.epa.gov/exposure-assessment-models/wmost-20-download-page

Visualizing Ecosystems for Land Management Assessment (VELMA) Model:

VELMA is a computer software model that regional planners and land managers can use to quantify the effectiveness of natural and engineered green infrastructure management practices for reducing nonpoint sources of nutrients and contaminants in streams, estuaries, and groundwater. These practices include riparian buffers, cover crops, and constructed wetlands.



Dr. Bob McKane

Dr. Bob McKane is a Research Ecologist with NHEERL's Western Ecology Division in Corvallis, Oregon. He received his Ph.D. in Soil Science from the University of Minnesota, and has over 25 years of experience in the use of simulation models for analyzing effects of climate, soils, and land use on biogeochemical and hydrological processes. Bob is currently leading an interdisciplinary group of scientists to develop and apply the VELMA ecohydrology model, which is currently being used by EPA's ORD and Regions 7 and 10, tribes, and community groups to evaluate the effectiveness of alternative green infrastructure scenarios for improving water quality and ecosystem service co-benefits.

Contact: mckane.bob@epa.gov

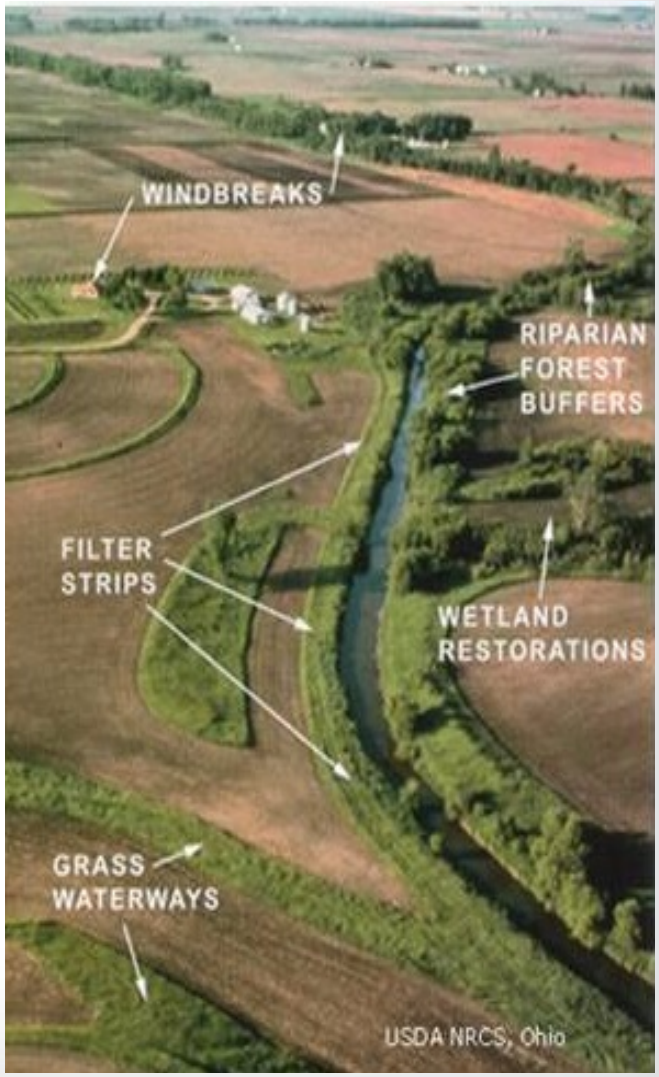
VELMA

Green Infrastructure

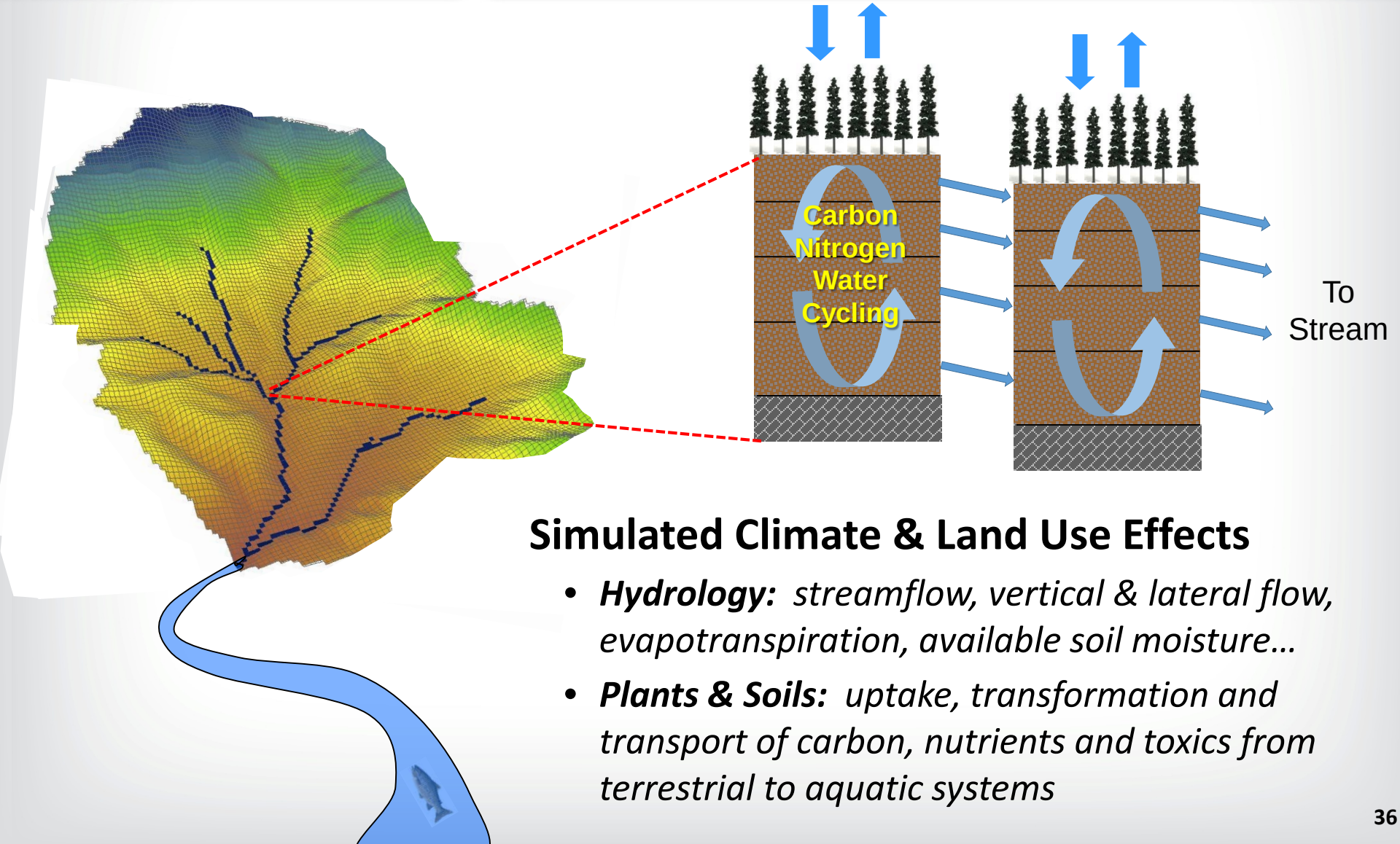
Purpose: Identify green infrastructure (GI) best management practices for enhancing water quality & ecosystem service co-benefits.

Results: Modeled effects of riparian buffers and other GI on water quality and quantity are well validated for ag, forest & rangeland systems

Applications: Users include communities, tribes, land managers, and EPA regions and scientists in Pacific Northwest, Central Plains, Midwest and East Coast



Fate & Transport of Water & Nutrients
plots → watersheds, days → centuries



Simulated Climate & Land Use Effects

- ***Hydrology:*** *streamflow, vertical & lateral flow, evapotranspiration, available soil moisture…*
- ***Plants & Soils:*** *uptake, transformation and transport of carbon, nutrients and toxics from terrestrial to aquatic systems*

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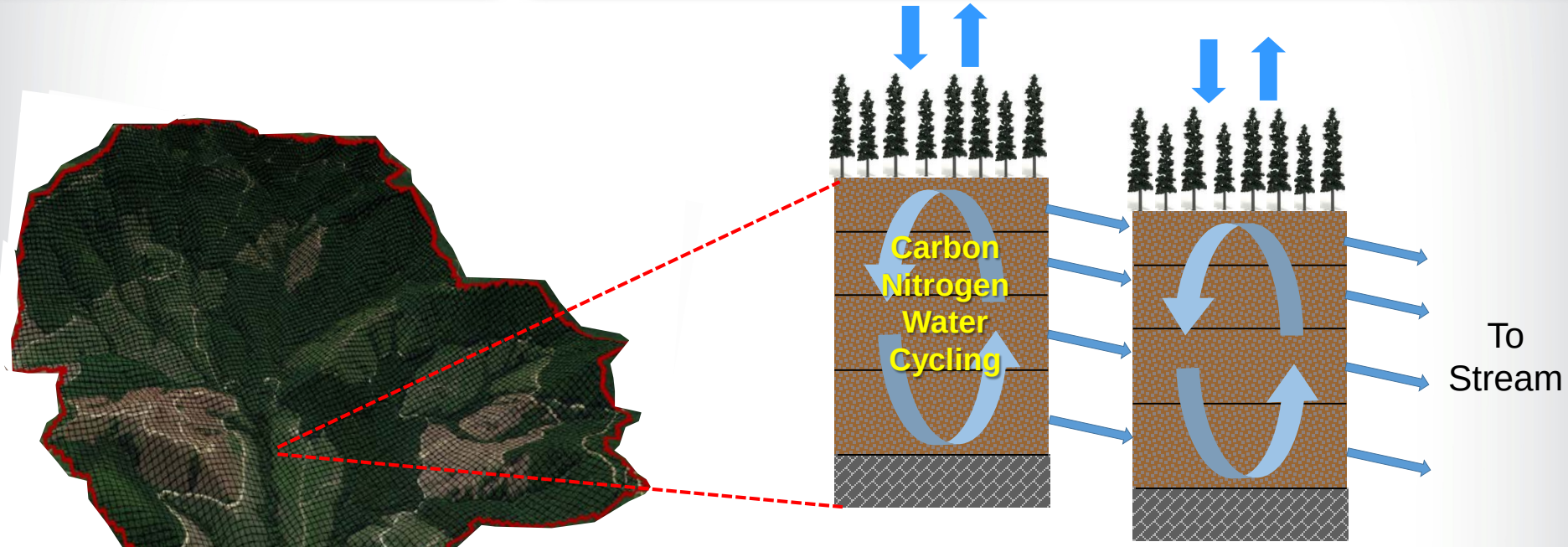

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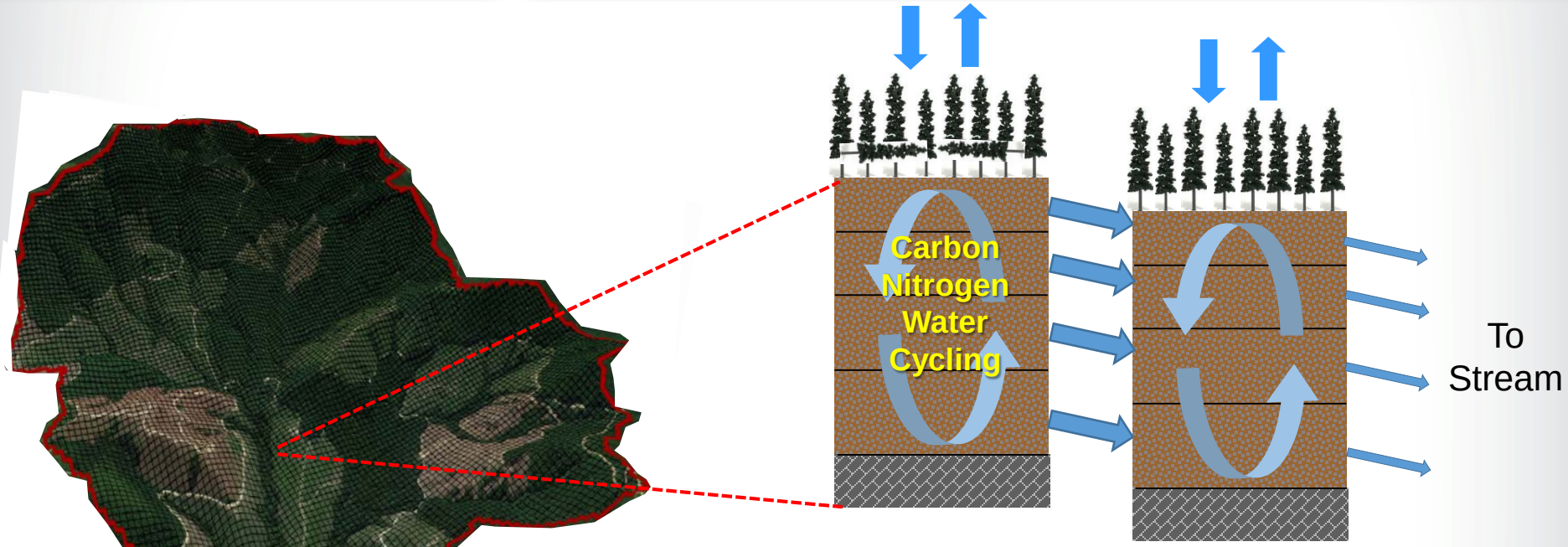

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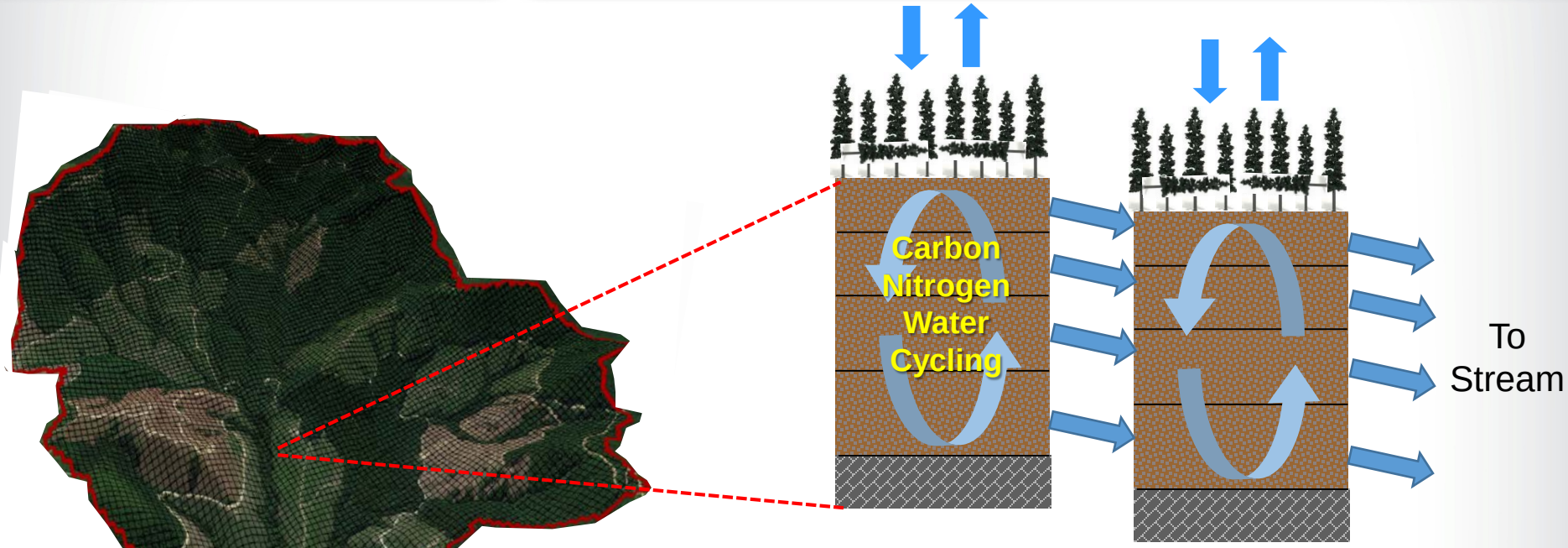

Climate & Land Use Simulated Effects

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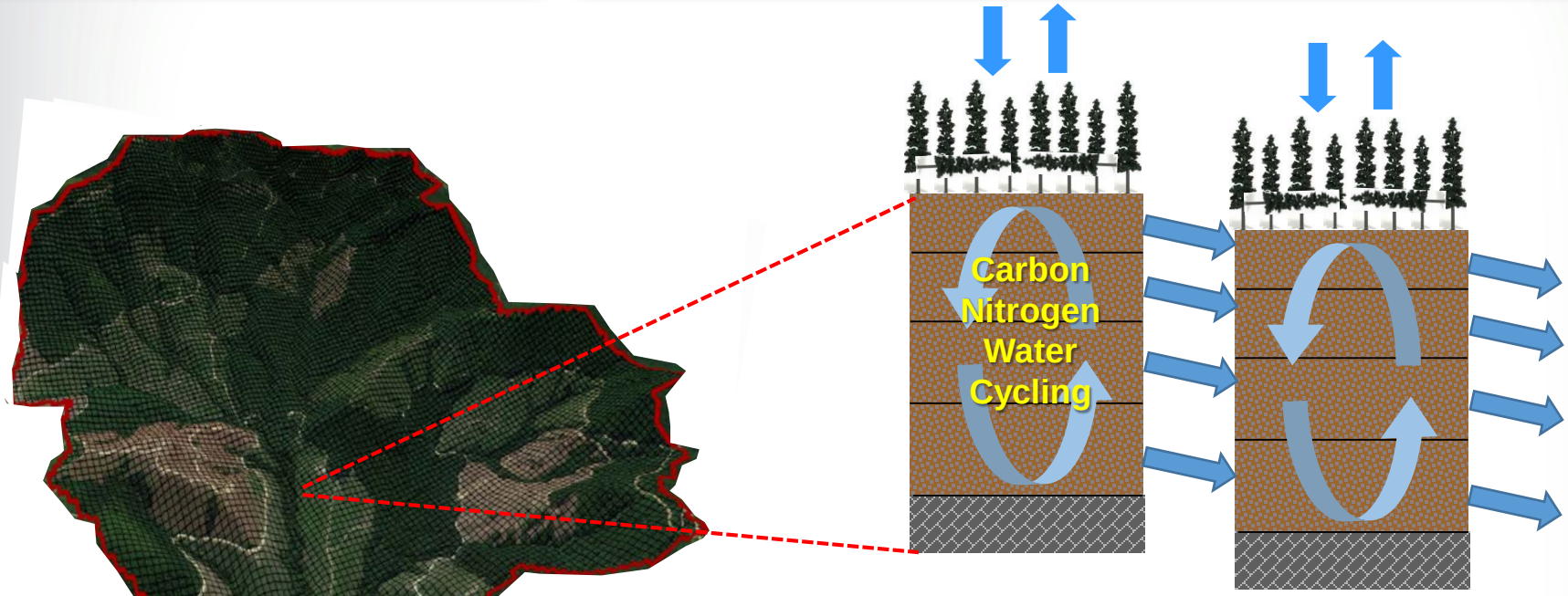


Simulated Ecosystem Services

- *Water quality & quantity*
- *Food & fiber production*
- *Carbon sequestration*
- *Greenhouse gas reduction (CO_2, N_2O, NO_x)*
- *Fish & wildlife habitat (links to population models)*

Broad Applicability

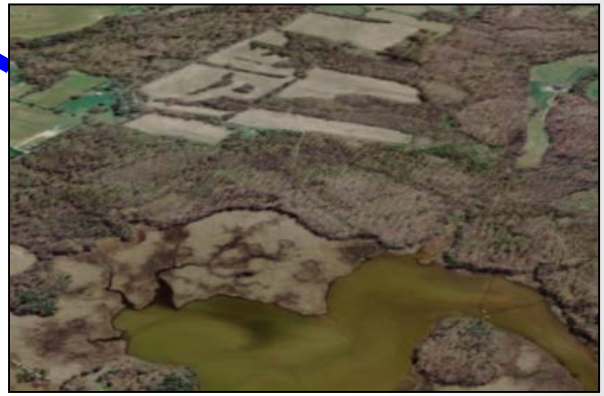
Salmon Recovery Planning
Puget Sound, WA

Urban GI Effectiveness
Seattle, Duluth, Mobile Bay

Constructed Wetland Effectiveness
Agricultural Watershed, OH

Estuarine Water Quality
Tillamook Bay Estuary, OR

Smoke Management Planning
Central Plains Rangelands, KS



Forest Buffer Effectiveness
Chesapeake Bay Agriculture, MD

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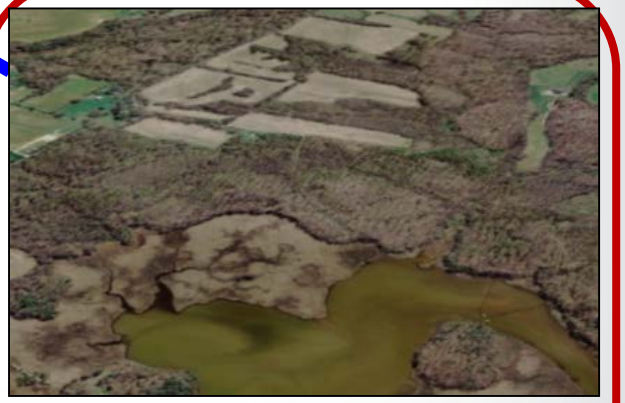

Forest Buffer Effectiveness
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Chesapeake Ag Water Quality
Effectiveness of Riparian Forest Buffers

Product: Validated VELMA model for informing green infrastructure planning for Chesapeake ag systems

Goal: Transfer VELMA to ***Smithsonian Environmental Research Center*** *and* ***EPA Region 3***

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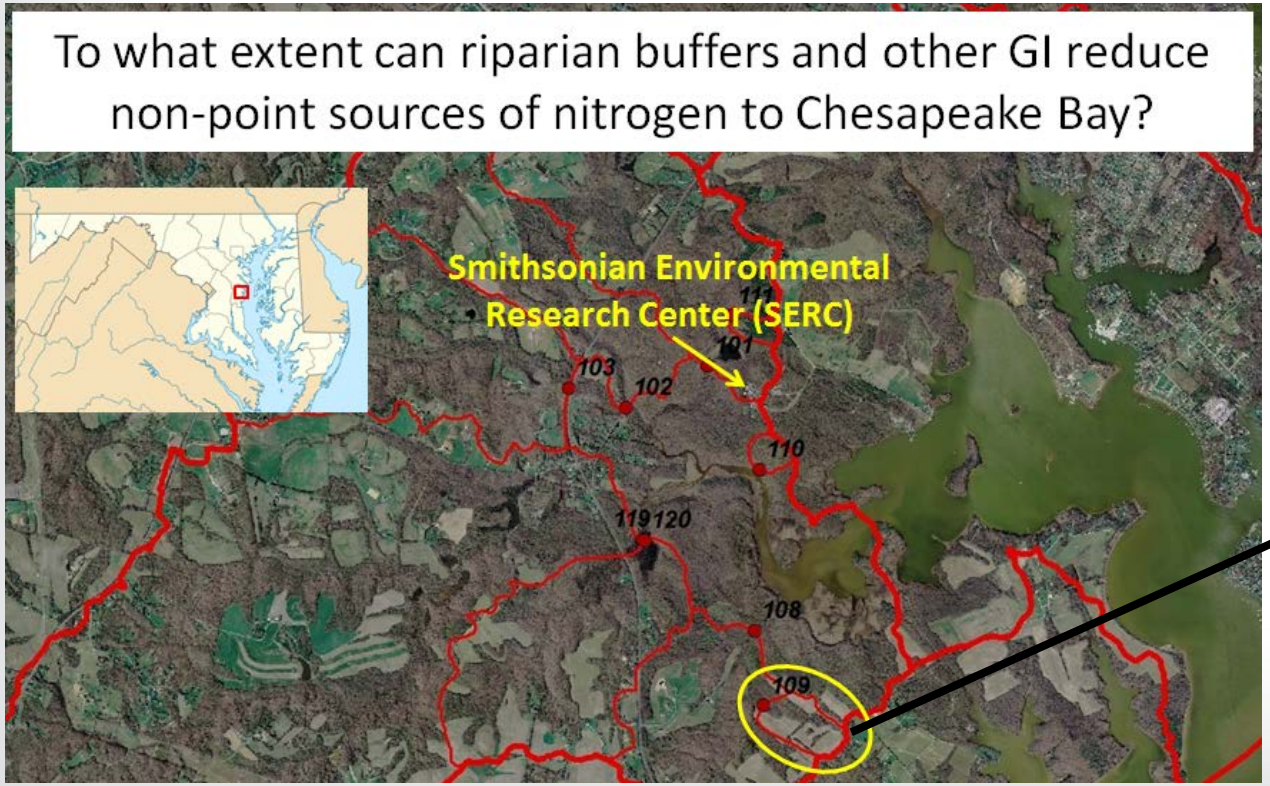
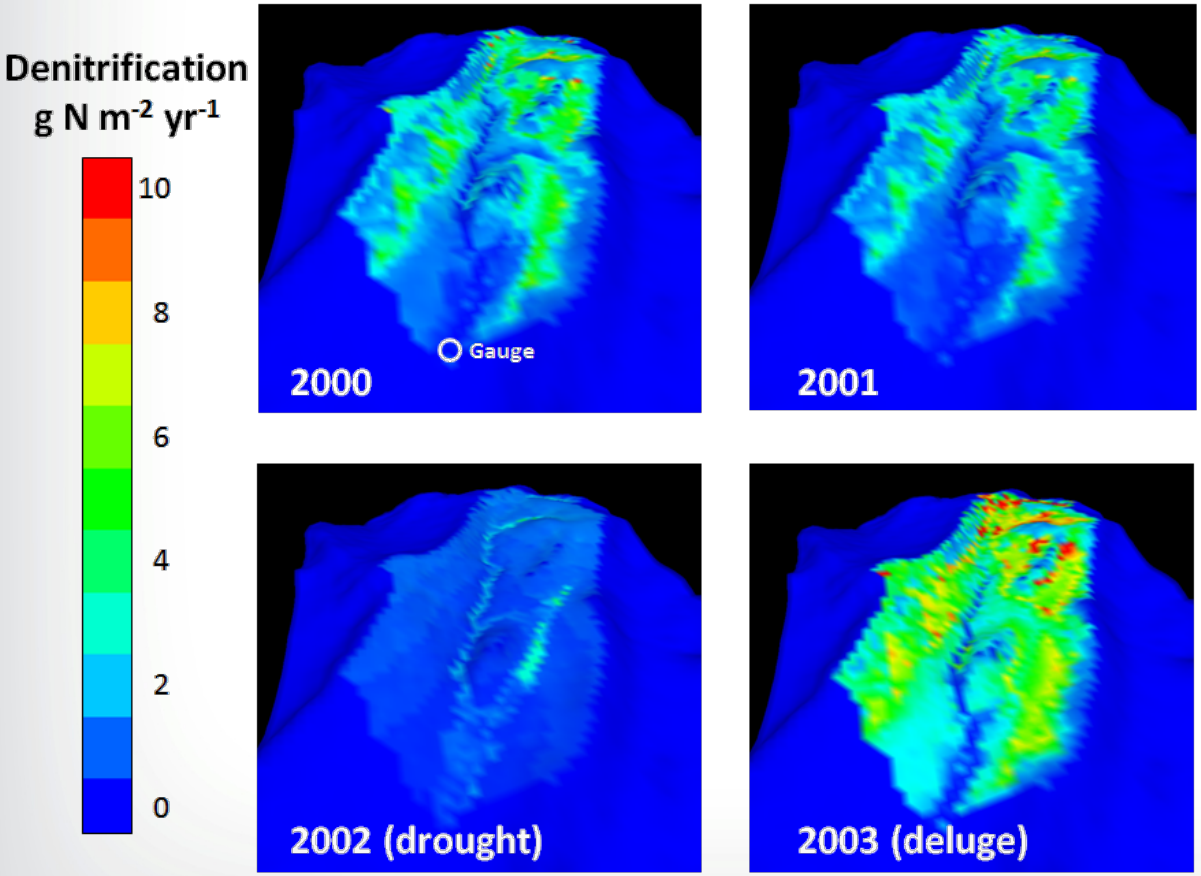


Rhode River Watershed #109

Chesapeake Ag Water Quality
Effectiveness of Riparian Forest Buffers

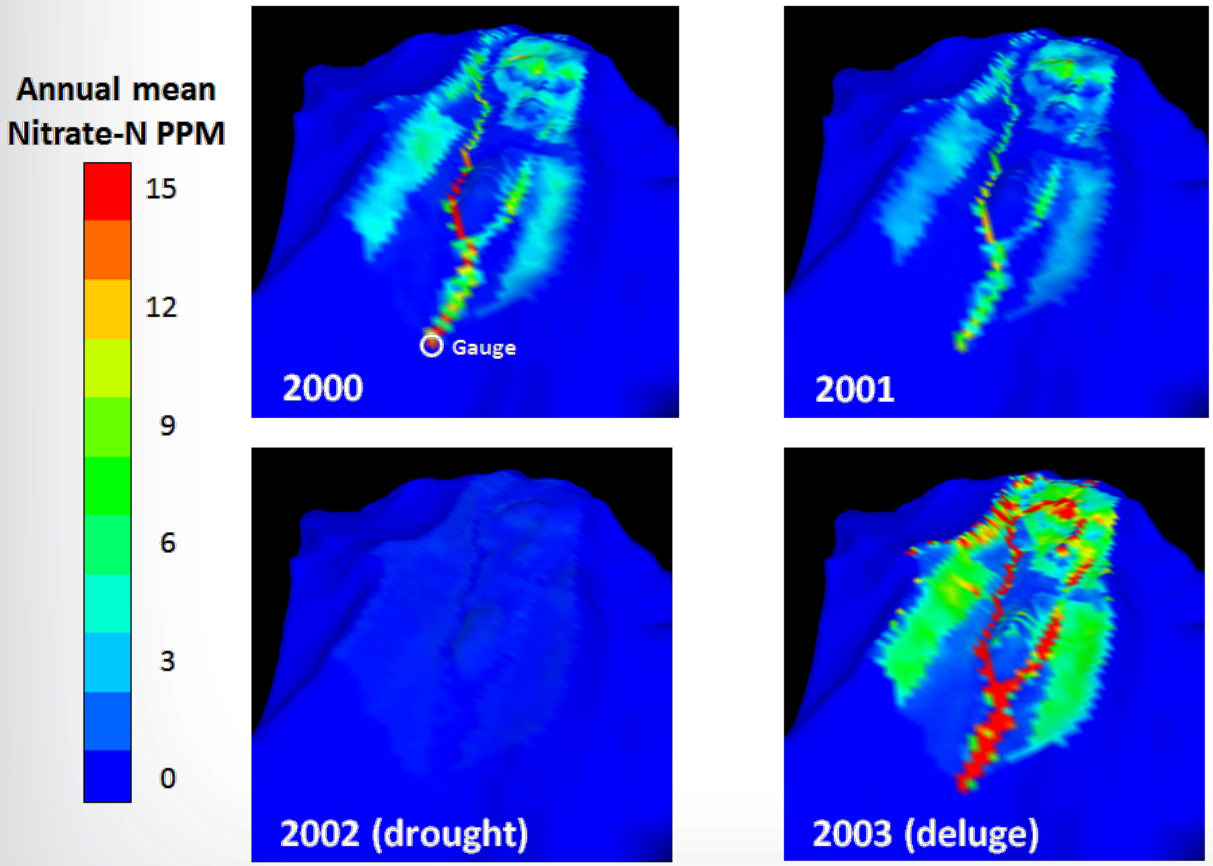
$NO_3 \rightarrow N_2O \rightarrow N_2$

Simulated Annual Denitrification



Chesapeake Ag Water Quality
Effectiveness of Riparian Forest Buffers

Simulated Nitrate PPM in Groundwater Flow



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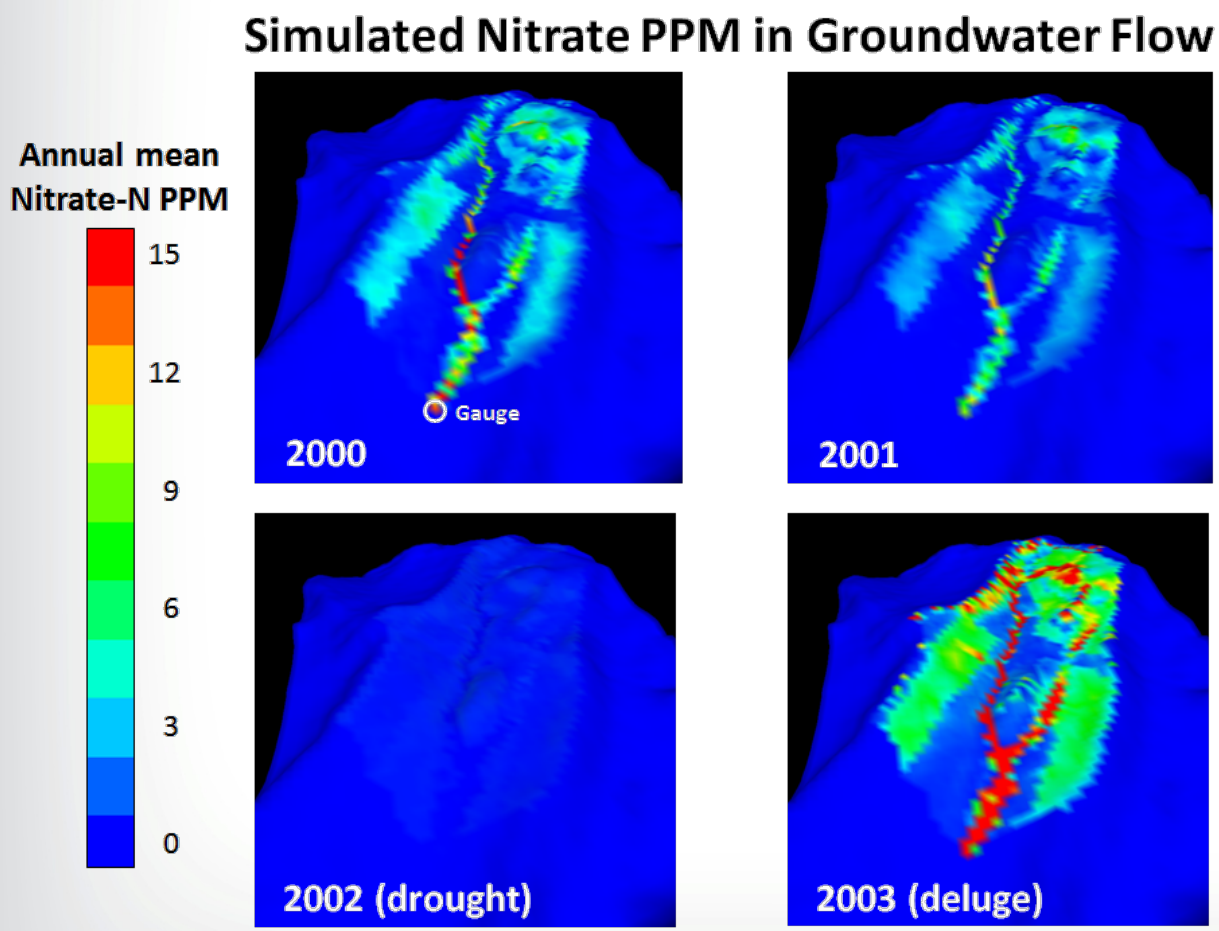
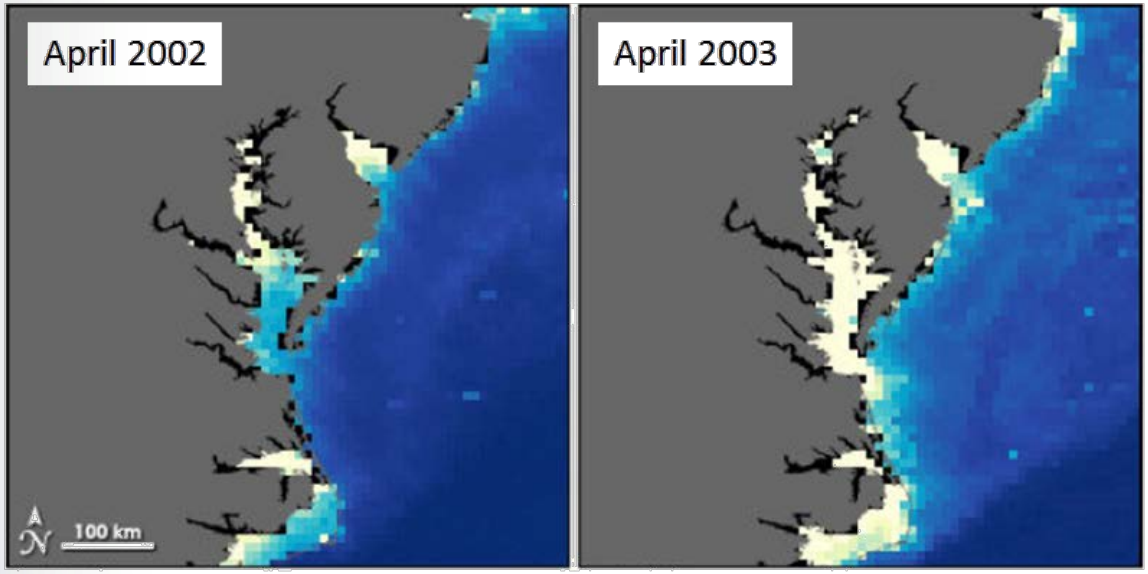


Summary

- Riparian forest buffers 20-30 meters wide can decrease ag nitrate stream loads by >90%
- 10m buffers = +50% load
- Buffers can be overwhelmed by extreme climatic events, such as a very dry year (2002) followed by a very wet year (2003)
- Model results are consistent with the observed sharp decrease in Chesapeake Bay water quality in 2003

Chesapeake Ag Water Quality
Effectiveness of Riparian Forest Buffers

Source: James Acker
earthobservatory.nasa.gov/Features/ChesapeakeBay/chesapeake_bay3.php



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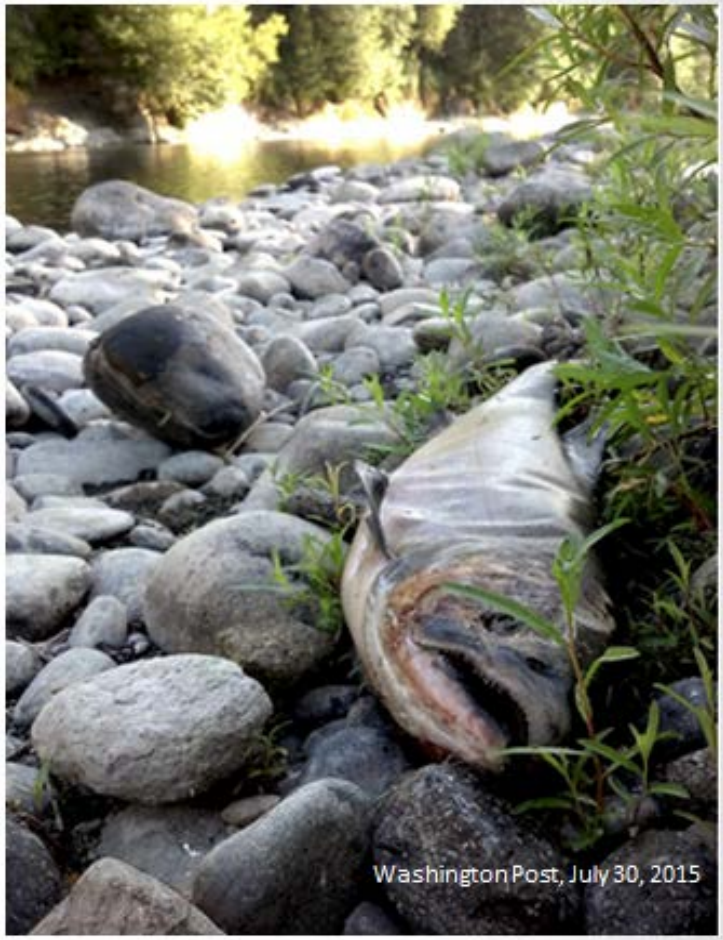
- **Model results are consistent with the observed sharp decrease in Chesapeake Bay water quality in 2003, about 2x 2002 chlorophyll**

Puget Sound, WA
Salmon Recovery Planning

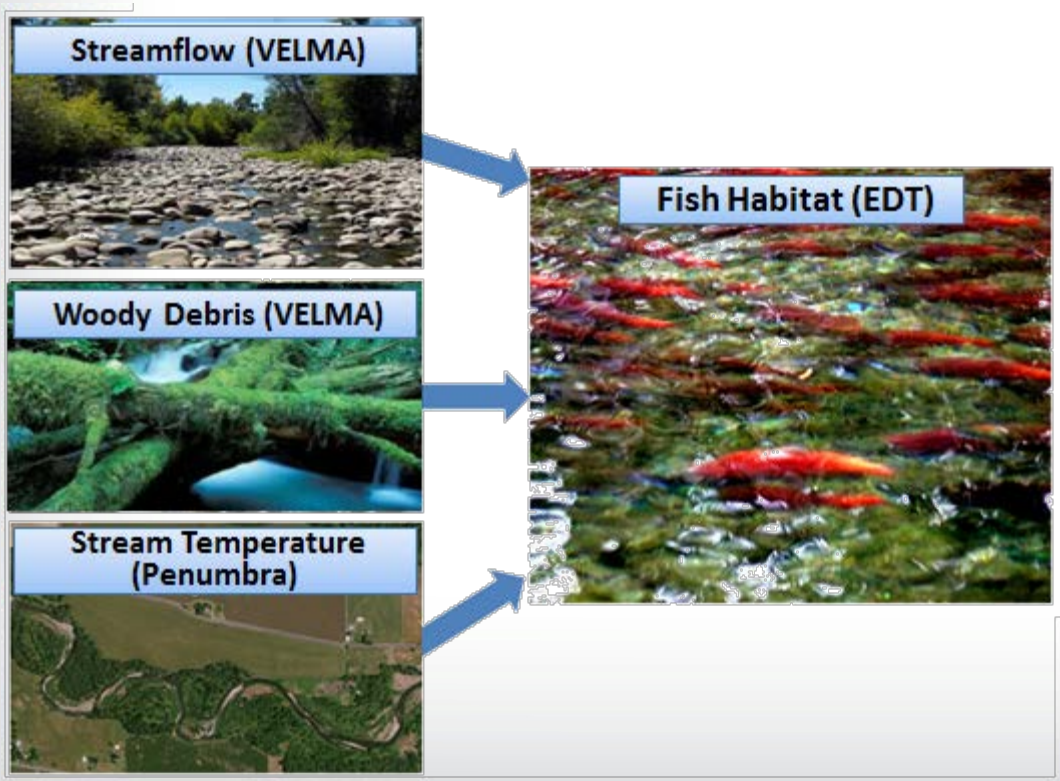


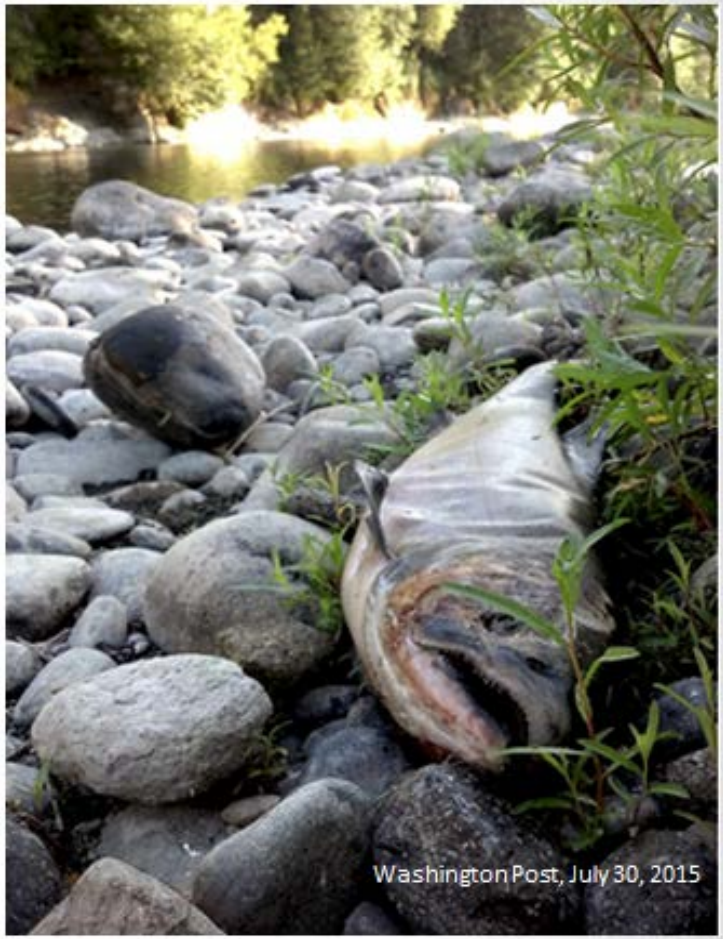
Puget Sound salmon populations have decreased by about 90% during the last 30 years. Tribes, communities and others have mobilized to develop salmon recovery plans.

Puget Sound, WA
Salmon Recovery Planning

Product: Integrated modeling framework for informing community-based salmon recovery planning in Puget Sound

Goal: Transfer VELMA-Penumbra-EDT to ***tribes, communities, state agencies and EPA Region 10***





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Results:

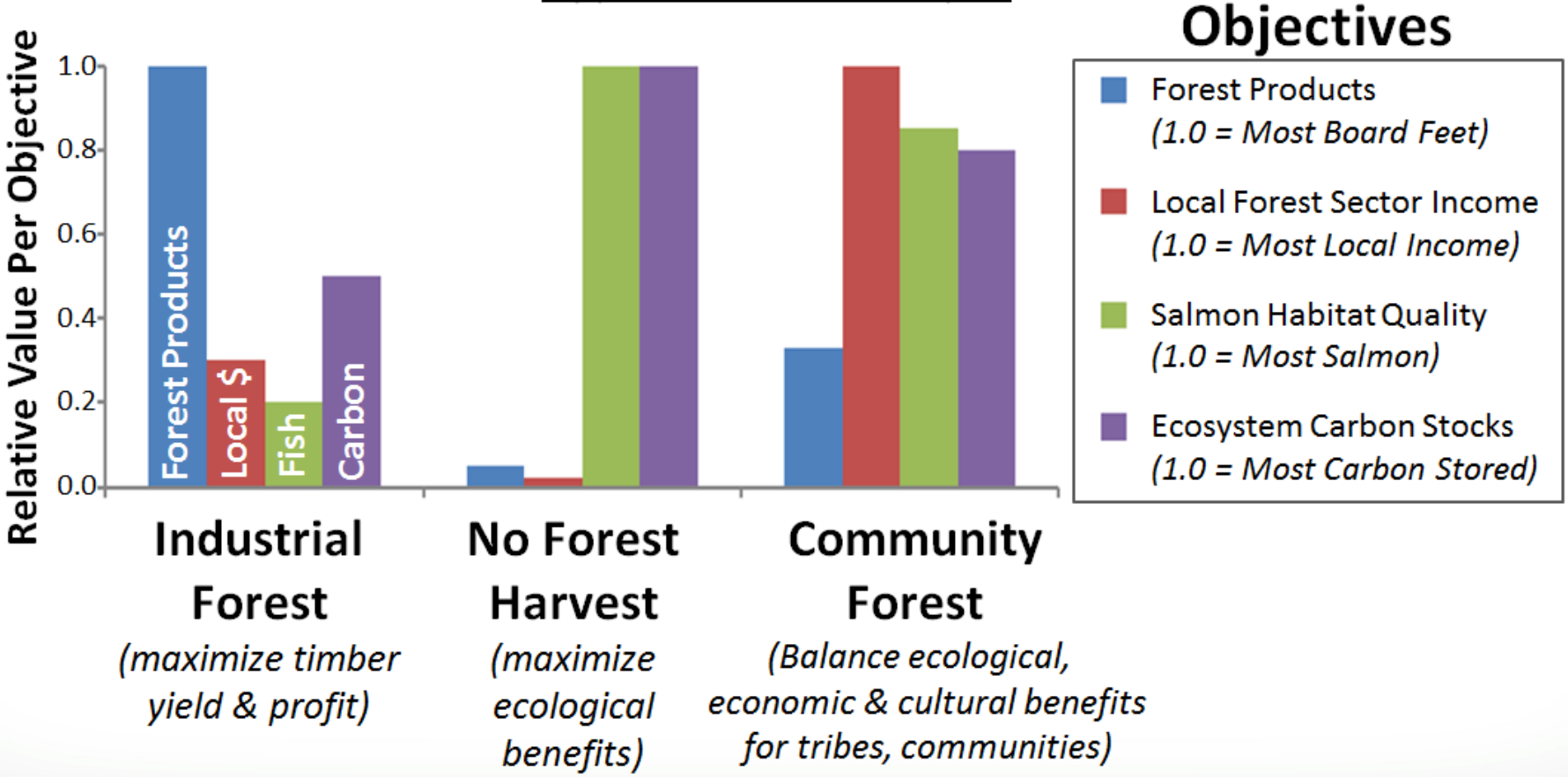
- ✓ **VELMA is now being used by Nisqually Community Forest managers for land acquisition & salmon recovery planning in 80 mi² Mashel River Watershed.**
- ✓ **VELMA predicts that increasing current forest harvest intervals from 40-50 yr to >80 yr would double streamflow during the summer dry season, a critical time for salmon migration & spawning.**

VELMA-EDT Training Workshop for Nisqually Community Forest manager and collaborating EPA & ICF scientists

Puget Sound, WA
Salmon Recovery Planning

Tradeoffs for Alternative Forest Management Scenarios

Hypothetical Example



VELMA Team

Bob McKane (mckane.bob@epa.gov)
Allen Brookes, Kevin Djang, Brad Barnhart
Jonathan Halama, Paul Pettus, Don Phillips
Marc Stieglitz, Feifei Pan, Alex Abdelnour

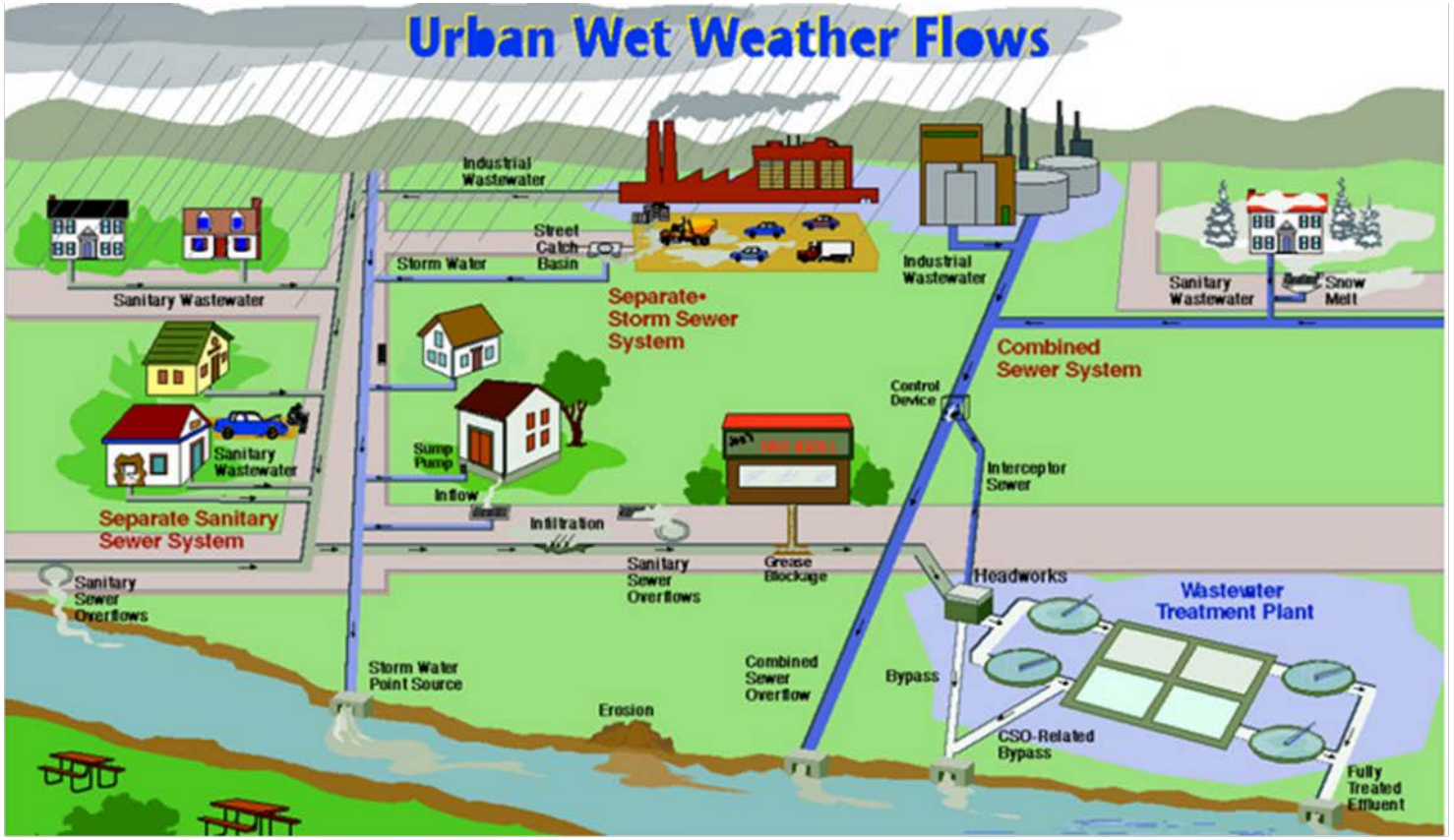
Storm Water Management Model (SWMM): SWMM is a software application that is used widely throughout the world for large-scale planning, analysis, and design related to stormwater runoff, combined and sanitary sewers, and other drainage systems in urban areas – although there are many applications for drainage systems in non-urban areas as well. It allows users to represent combinations of green infrastructure practices to determine their effectiveness in managing runoff. SWMM was developed to help support local, state, and national stormwater management objectives to reduce runoff through infiltration and retention.

Dr. Michael Tryby

Dr. Michael Tryby joined the Water Supply and Water Resources Division in EPA's National Risk Management Research Laboratory located in Cincinnati, Ohio in September 2011. He holds a B.S. in Civil Engineering and an M.S. in Environmental Engineering from the University of Cincinnati, where he worked on drinking water treatment for disinfection byproduct control and systems analysis of water distribution system disinfection practices. Michael received his Ph.D. in Civil Engineering from North Carolina State University while working in commercial software development as a water distribution modeling domain expert. His immediate responsibilities include work on modeling green infrastructure and low impact development best management practices using EPA's SWMM 5.0.

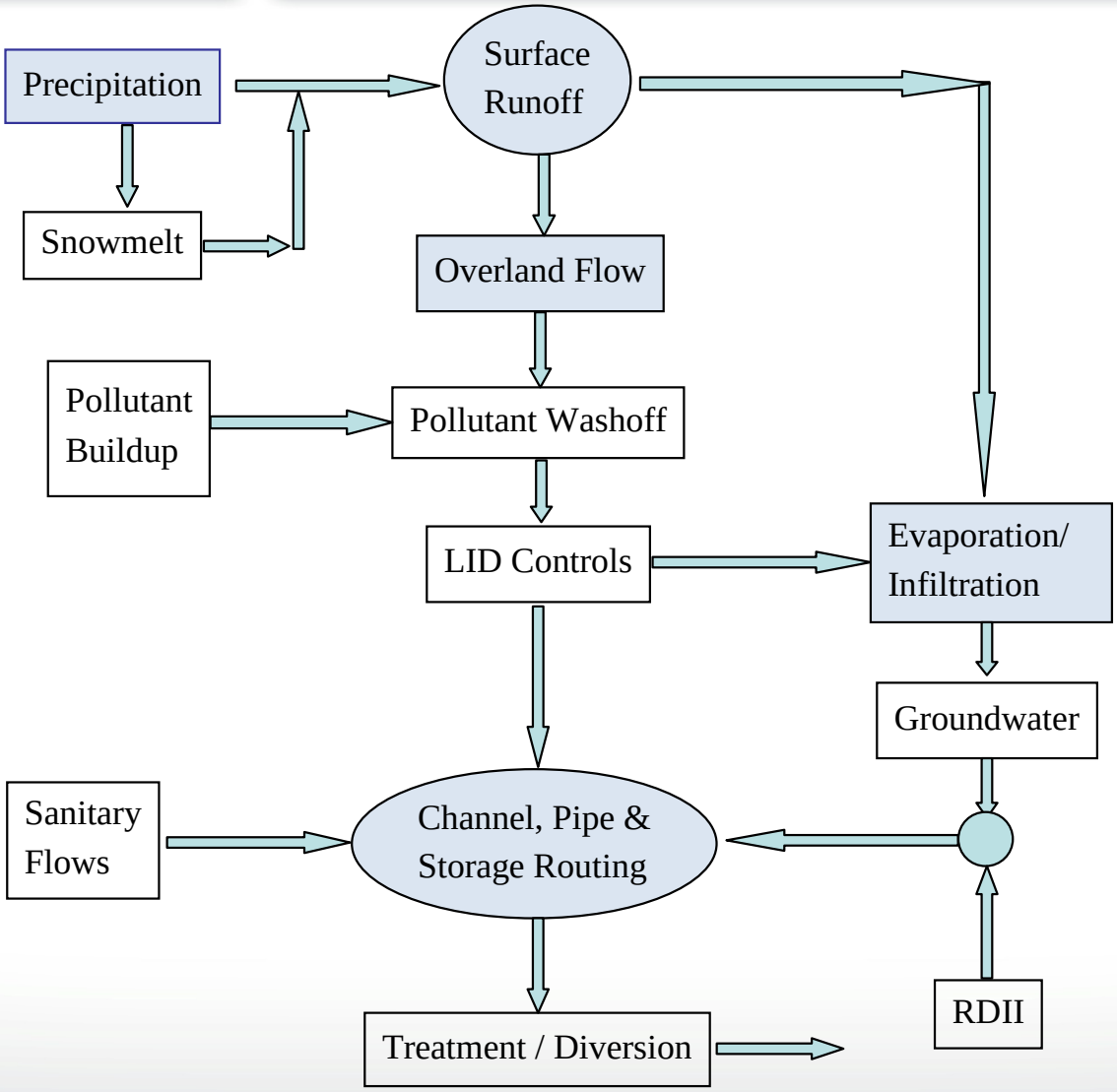
Contact: tryby.michael@epa.gov

SWMM: What is it?

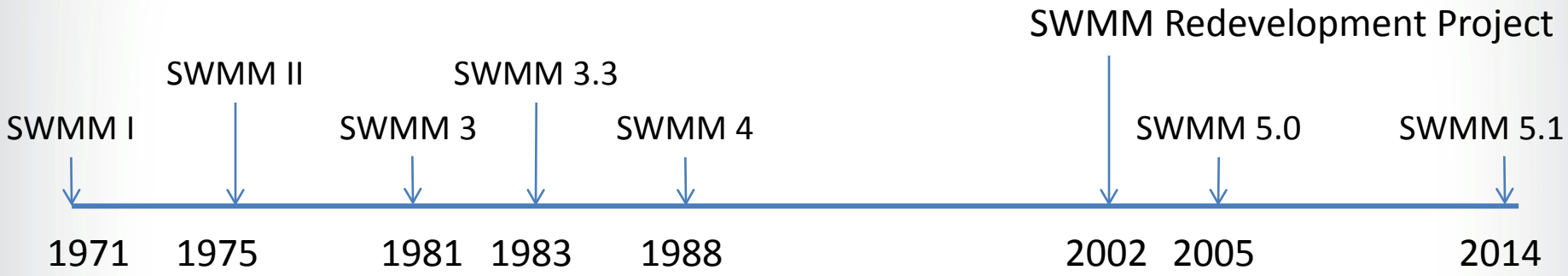


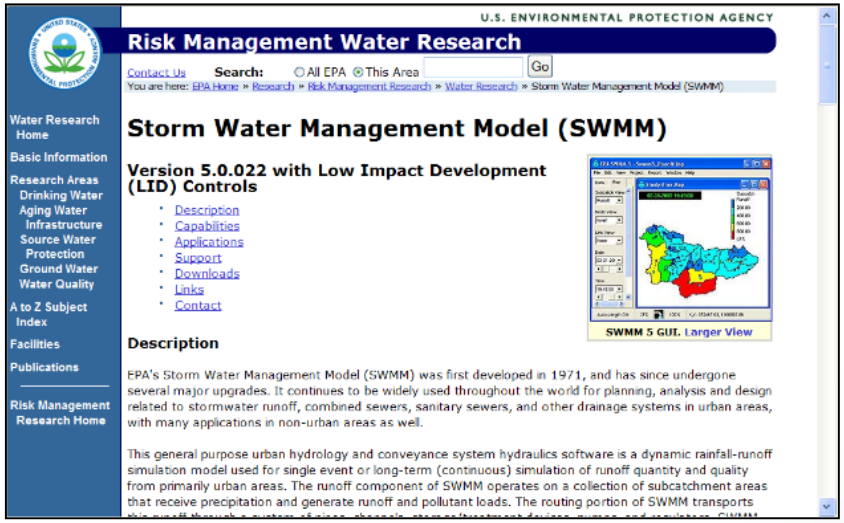
SWMM is a public domain, distributed, dynamic hydrologic - hydraulic - water quality model used for continuous simulation of runoff quantity and quality from primarily urban areas.

SWMM's Process Models



SWMM's History





SWMM: Who uses it?

- SWMM is a professional tool used by Civil / Environmental Engineers
- SWMM is used at the municipal level to design and manage stormwater and sanitary sewer infrastructure
- Many large cities across the US and around the world rely on SWMM

SWMM: What is it used for?

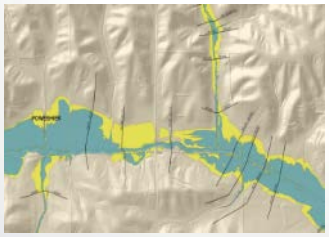
Design and sizing of drainage system components including detention facilities.

Control of combined and sanitary sewer overflows.

Modeling I&I in sanitary sewer systems.

Generating non-point source pollutant loadings for waste load allocation studies.

Evaluating BMPs and LIDs for sustainability goals.



Flood plain mapping of natural channel systems.

Source Control BMPs

Disconnection

Infiltration Basin

Rain Garden

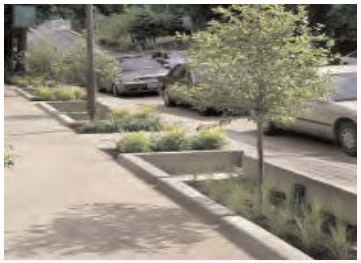
Cistern

Infiltration Trench

Green Roof

Permeable Pavement

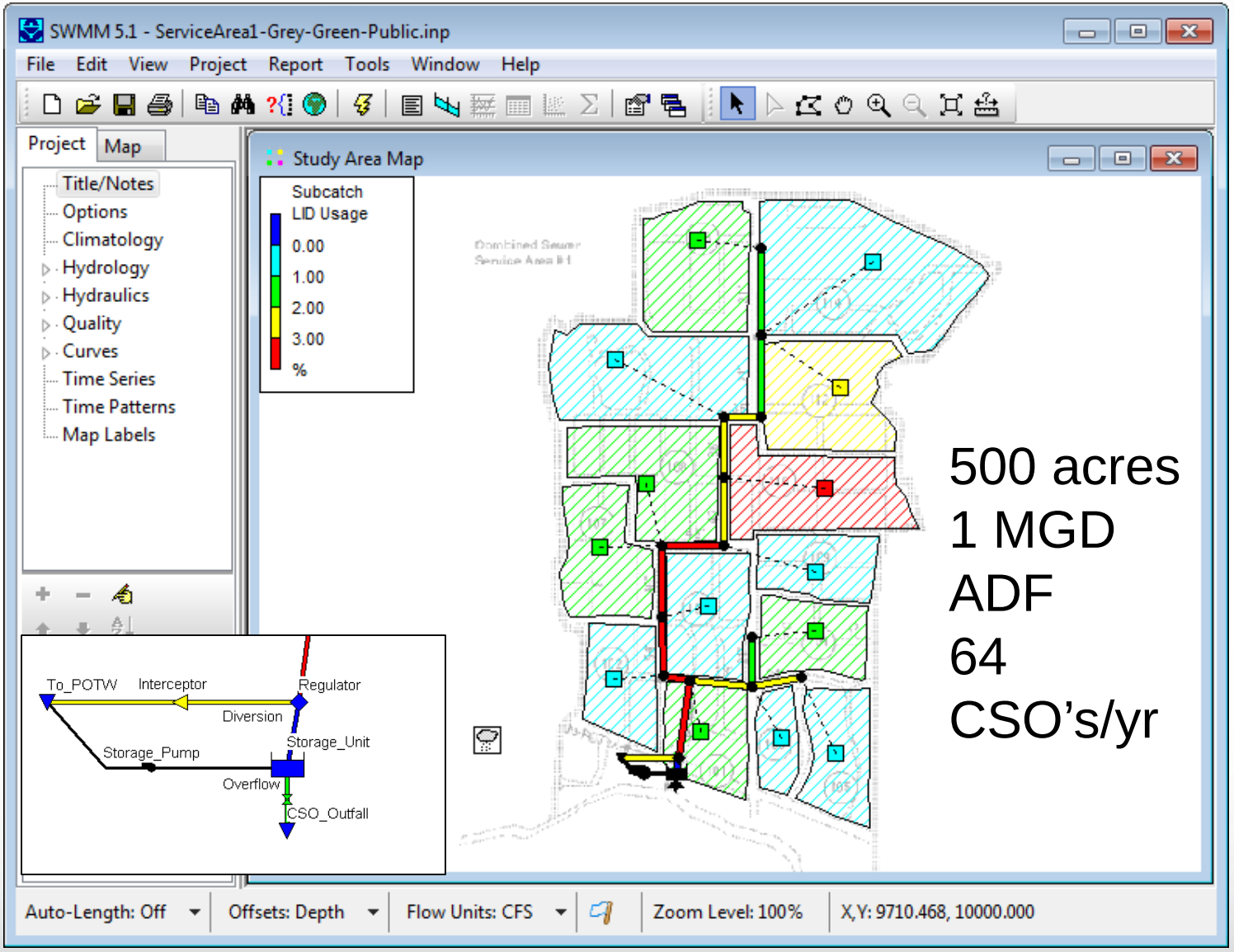
Vegetative Swale



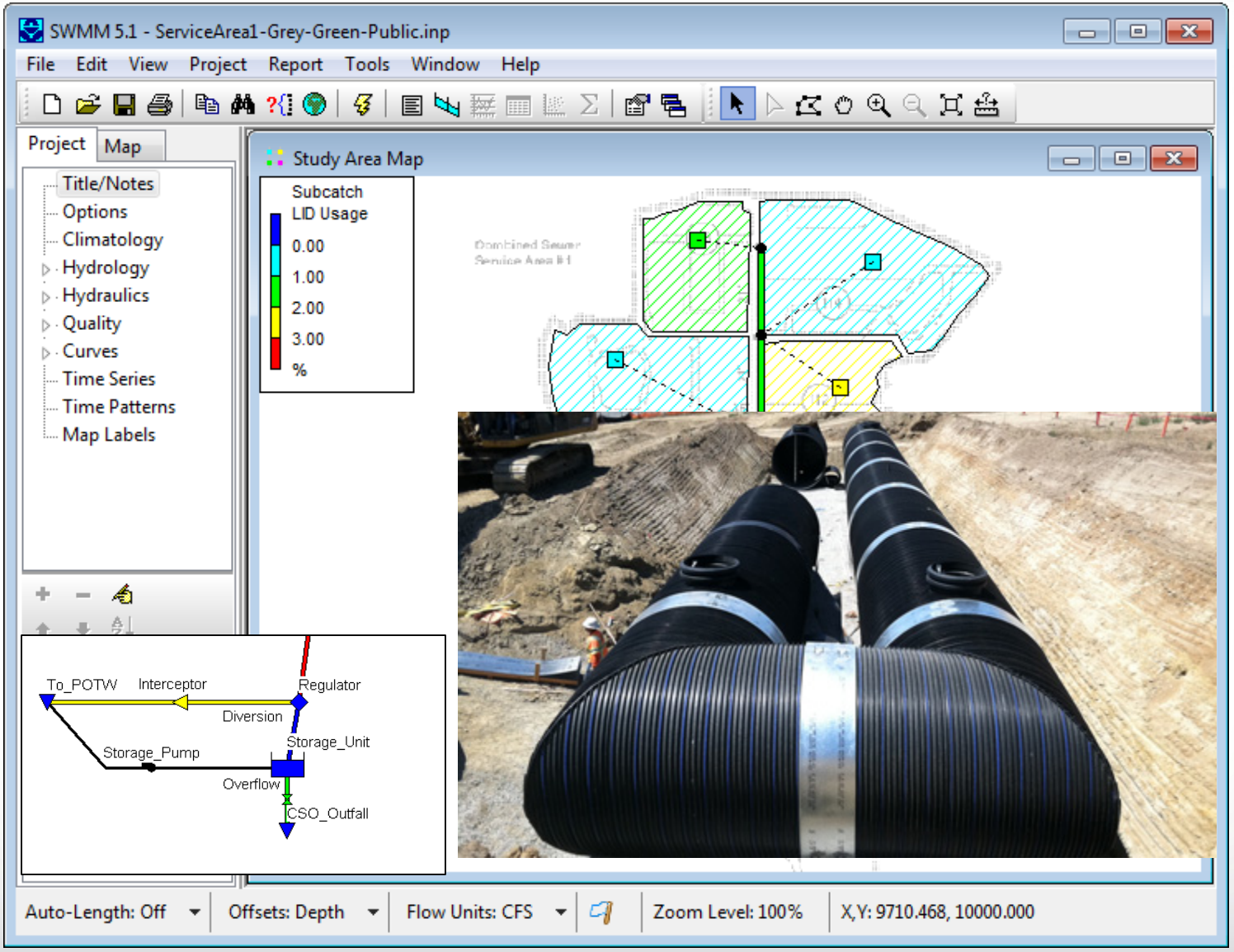
Street Planter

SWMM CSO Example

CSO Example


SWMM 5.1 - ServiceArea1-Grey-Green-Public.inp
File Edit View Project Report Tools Window Help
Project Map
Title/Notes
Options
Climatology
Hydrology
Hydraulics
Quality
Curves
Time Series
Time Patterns
Map Labels
Study Area Map
Subcatch
LID Usage
0.00
1.00
2.00
3.00
%
To_POTW
Interceptor
Regulator
Diversion
Storage_Pump
Storage_Unit
Overflow
CSO_Outfall
500 acres
1 MGD
ADF
64
CSO's/yr
Auto-Length: Off
Offsets: Depth
Flow Units: CFS
Zoom Level: 100%
X,Y: 9710.468, 10000.000

CSO Example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Storage_Unit
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Offsets: Depth
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CSO Example

SWMM 5.1 - ServiceArea1-Grey-Green-Public.inp

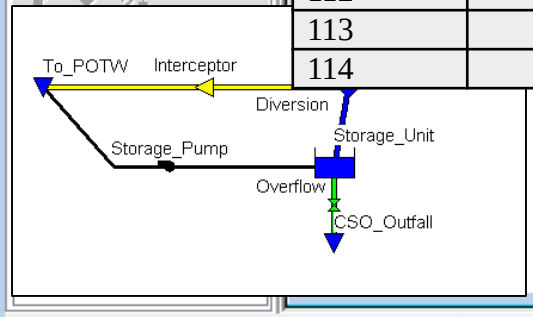
File Edit View Project Report Tools Window Help

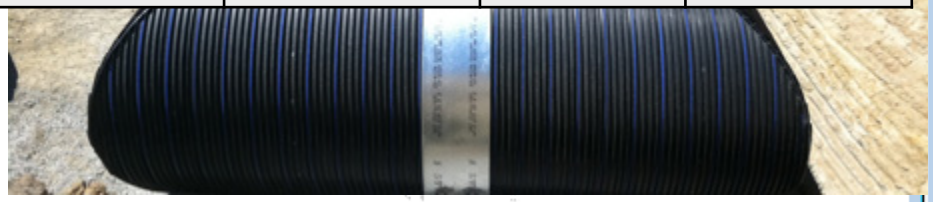
Project Map

- Title/Notes
- Options
- Climatology
- Hydrology
- Hydraulics
- Quality
- Curves
- Time Series
- Time Patterns
- Map Labels

Study Area Map

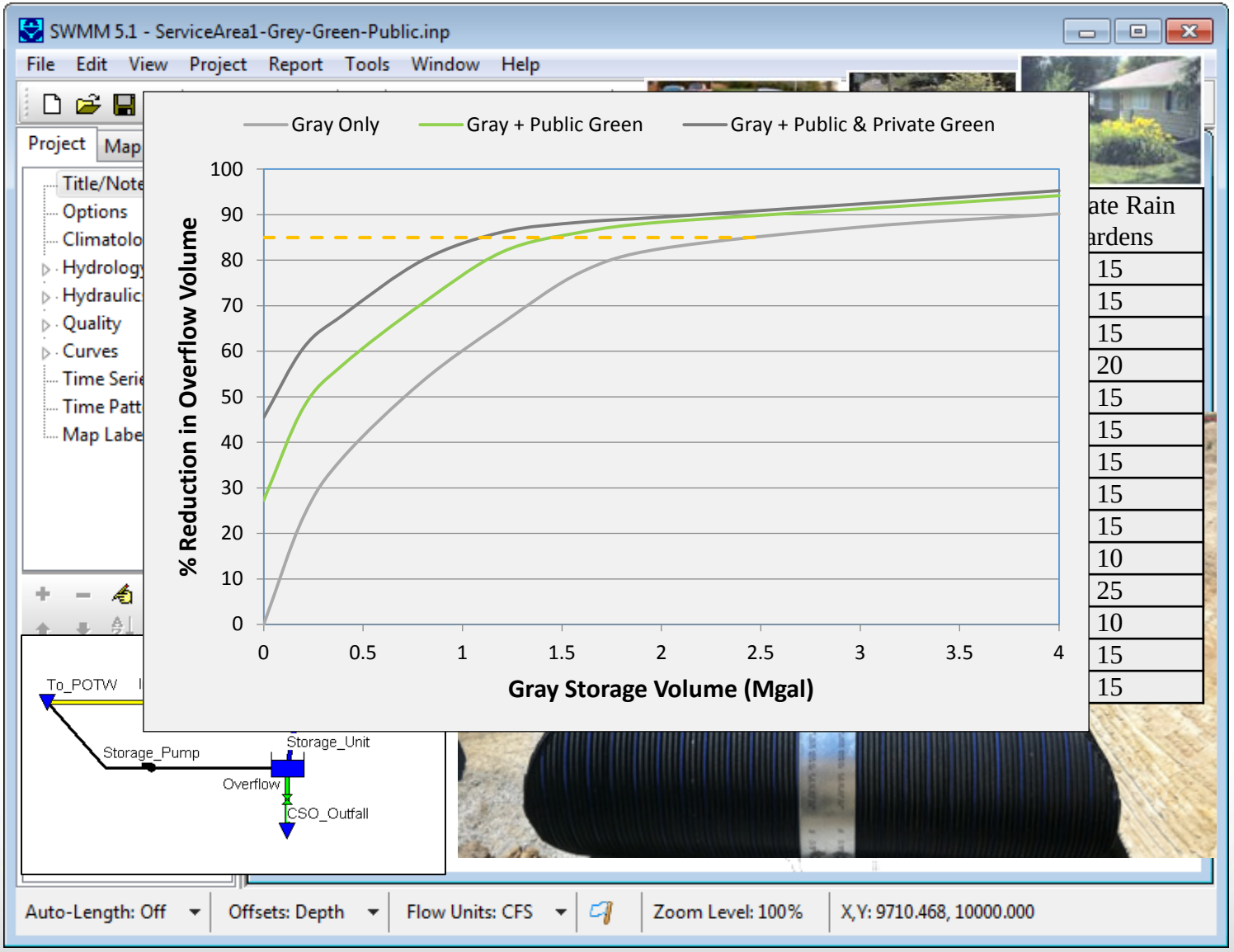
Sub-Area	Percent Impervious	Public Porous Pavement	Public Street Planters	Private Rain Gardens
101	55	10	10	15
102	35	10	5	15
103	28	10	5	15
104	55	10	10	20
105	22	10	5	15
106	31	10	5	15
107	46	10	10	15
108	38	10	5	15
109	35	10	5	15
110	75	20	20	10
111	17	0	5	25
112	59	15	10	10
113	39	10	5	15
114	29	10	5	15





Auto-Length: Off | Offsets: Depth | Flow Units: CFS | Zoom Level: 100% | X,Y: 9710.468, 10000.000

CSO Example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Curves
Time Serie
Time Patt
Map Labe
Gray Only
Gray + Public Green
Gray + Public & Private Green
% Reduction in Overflow Volume
100
90
80
70
60
50
40
30
20
10
0
0
0.5
1
1.5
2
2.5
3
3.5
4
Gray Storage Volume (Mgal)
To_POTW
Storage_Pump
Storage_Unit
Overflow
CSO_Outfall
ate Rain
ardens
15
15
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20
15
15
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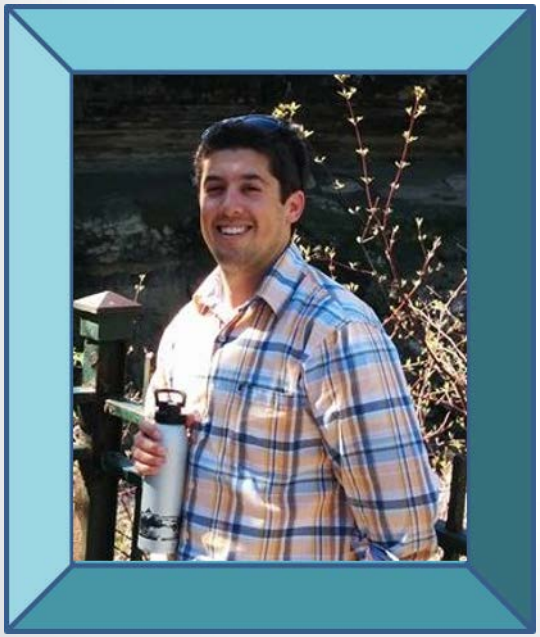
25
10
15
15
Auto-Length: Off
Offsets: Depth
Flow Units: CFS
Zoom Level: 100%
X,Y: 9710.468, 10000.000

Conclusions

- SWMM is widely used to evaluate gray infrastructure stormwater control strategies
- SWMM now offers a useful complement of LID stormwater controls
- SWMM is a useful tool for creating cost effective green / gray hybrid stormwater control solutions

National Stormwater Calculator (SWC): SWC is a desktop application that estimates the annual amount of stormwater runoff from a specific location in the United States (including Puerto Rico), based on local soil conditions, land cover, and historic rainfall records. It is used to inform site developers on how well they can meet a desired stormwater retention target with and without the use of green infrastructure. It also allows users to consider how runoff may vary based both on historical weather and potential future climate. SWC was mentioned in President Obama's Climate Action Plan and is now a resource for LEED Project Credit 16 (Rainwater Management) certification by the U.S. Green Building Council for projects that are designed to reduce runoff volume and improve water quality of a site.



Jason Berner

Jason Berner is trained as a landscape architect and has been with EPA for over nine years. He has worked in EPA's Region 2 and Office of Water, and is currently working as a biologist in ORD. His research focuses on the application of green infrastructure planning tools, urban planning and design, community capacity building with municipalities and utilities, and supporting innovative water technologies. Jason has a Master of Landscape Architecture and a B.S. in Environmental Sciences from the University of Illinois at Urbana-Champaign.

Contact: berner.jason@epa.gov

Outline

U.S. EPA National Stormwater Calculator

- **What, Why, and Who?**
- **Stormwater Calculator & Stormwater Management Model (SWMM)**
  - Green Infrastructure/Low Impact Development (LID) practices
- **Using the Calculator**
- **Potential Applications:** Post Construction Stormwater Standards, LEED, Sustainable Sites, Stormwater Concept Designs, LID Design Competitions
- **Example Applications:**
  - **Redevelopment Plan for Spartanburg, SC: Green Street Design** (EPA Green Infrastructure 2013 Technical Assistance Project)
  - **U.S. Climate Resilience Toolkit**
- **Development of Cost Estimation Module and Mobile Web App**

What Have We Created and Why?

Stormwater Management (Green Infrastructure/Low Impact Development) Design and Planning Tool

- **Model pre- and post-construction stormwater runoff discharges**
- **Allow for screening-level analysis of various green infrastructure practices (green roofs, rain gardens, cisterns, etc.) throughout the U.S.**
- **Allow non-modelers to conduct screening level stormwater runoff analyses for small to medium sized (less than 1 acre to 1 dozen of acres) urban development sites**

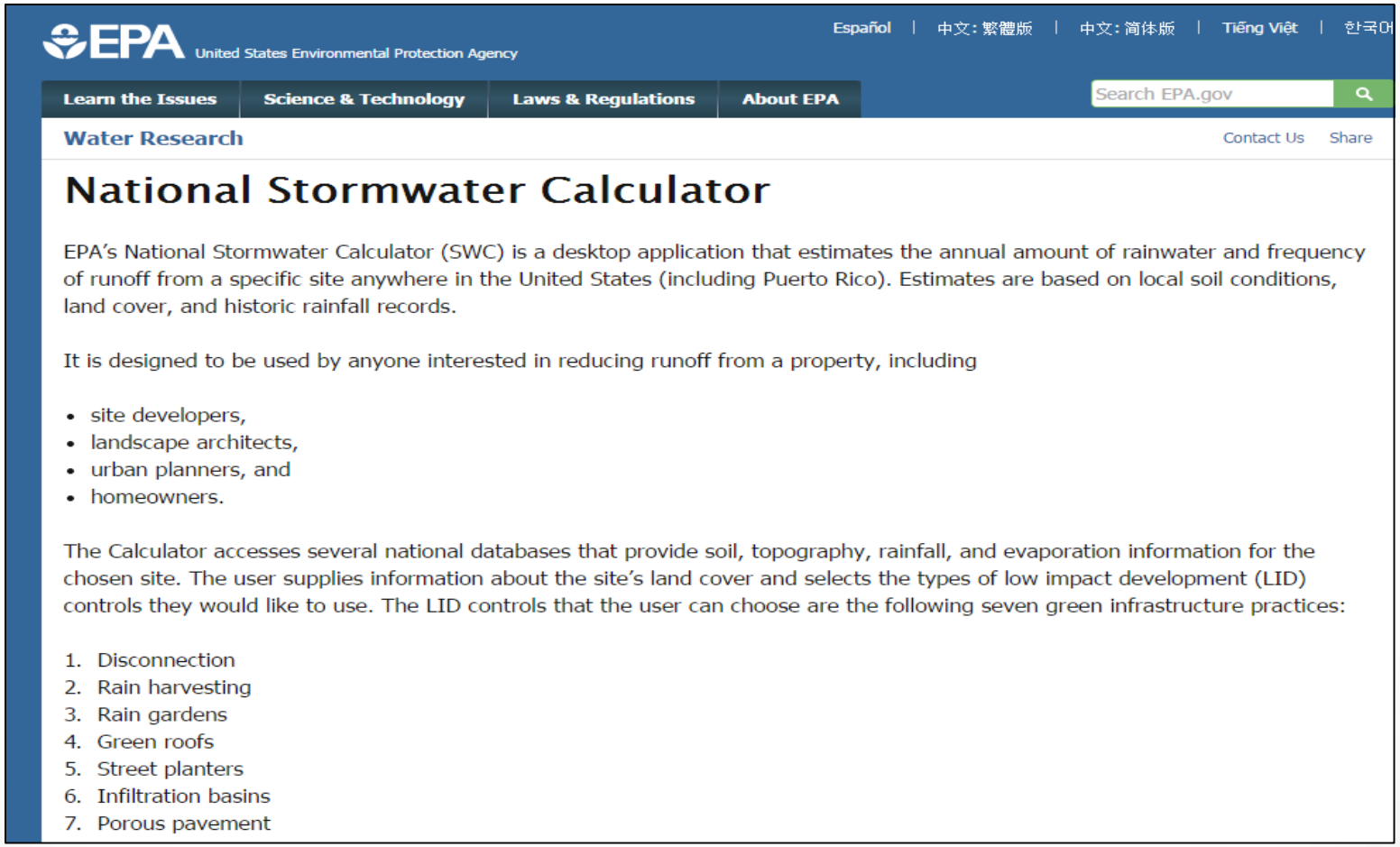
Who We Created the Calculator for…

- **Urban & municipal planners**
- **Land developers**
- **Landscape architects**
- **Homeowners, etc.**

…to meet stormwater design goals or requirements.

- ✓ **What kind of user are you?**
- ✓ **How do you perform conceptual planning or design for stormwater management?**

Website



EPA United States Environmental Protection Agency

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National Stormwater Calculator

EPA's National Stormwater Calculator (SWC) is a desktop application that estimates the annual amount of rainwater and frequency of runoff from a specific site anywhere in the United States (including Puerto Rico). Estimates are based on local soil conditions, land cover, and historic rainfall records.

It is designed to be used by anyone interested in reducing runoff from a property, including

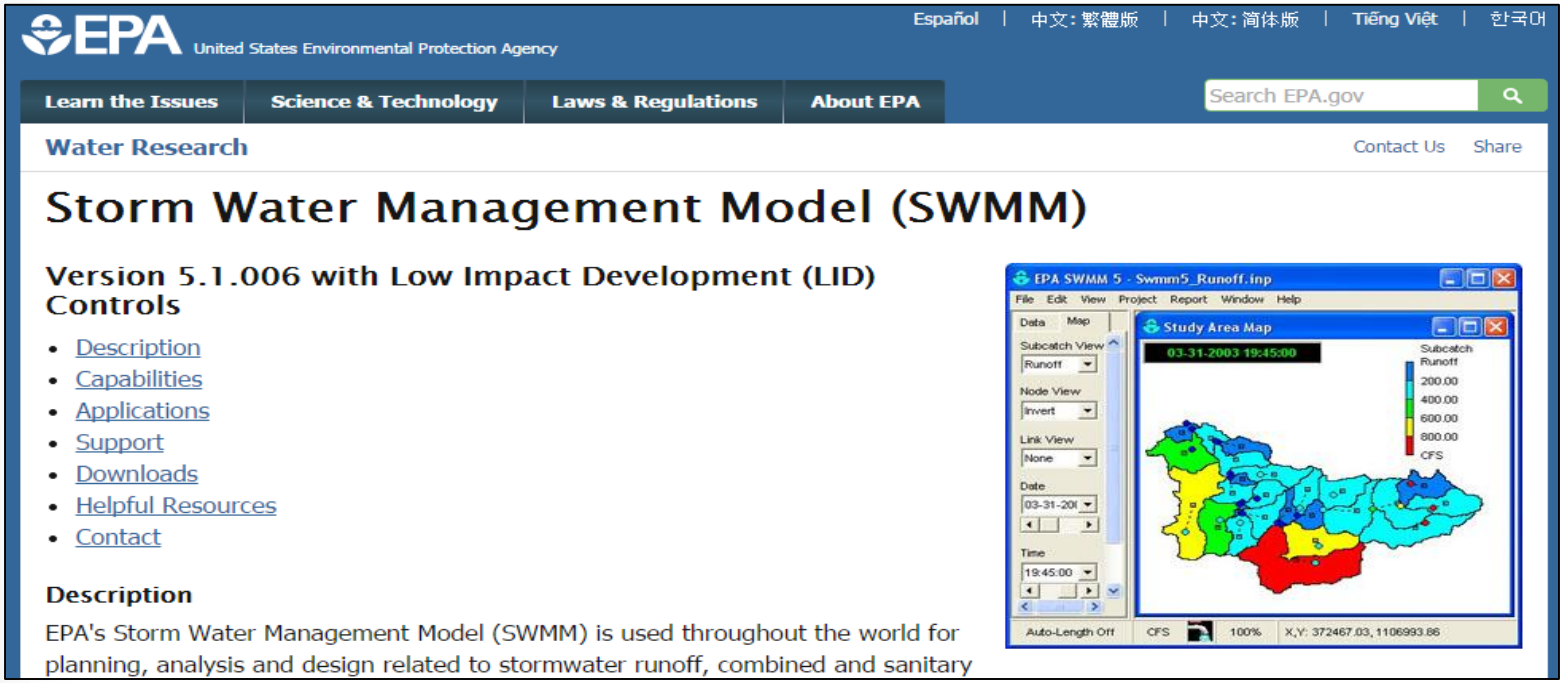
- site developers,
- landscape architects,
- urban planners, and
- homeowners.

The Calculator accesses several national databases that provide soil, topography, rainfall, and evaporation information for the chosen site. The user supplies information about the site's land cover and selects the types of low impact development (LID) controls they would like to use. The LID controls that the user can choose are the following seven green infrastructure practices:

1. Disconnection
2. Rain harvesting
3. Rain gardens
4. Green roofs
5. Street planters
6. Infiltration basins
7. Porous pavement

http://www2.epa.gov/water-research/national-stormwater-calculator

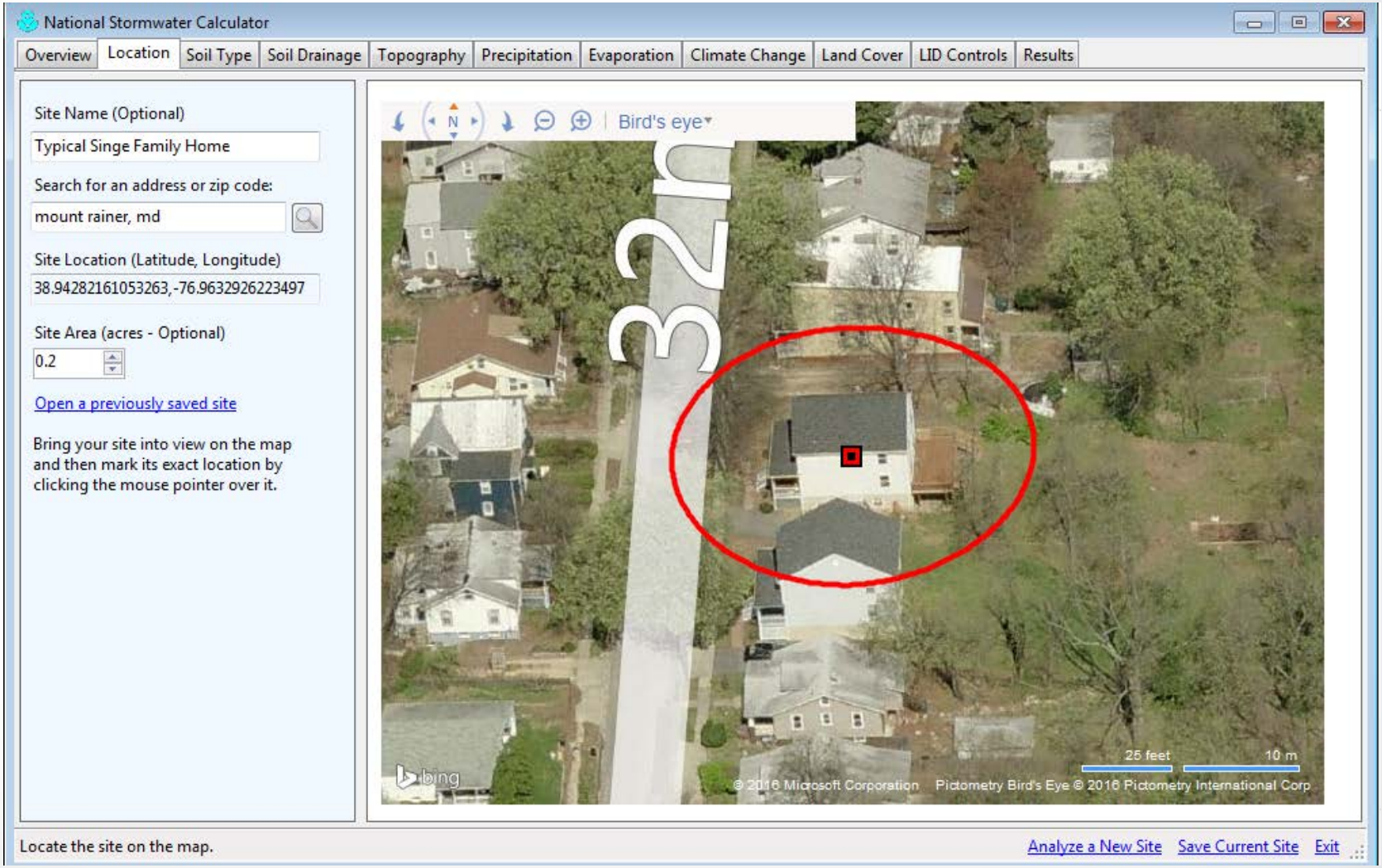
SWMM



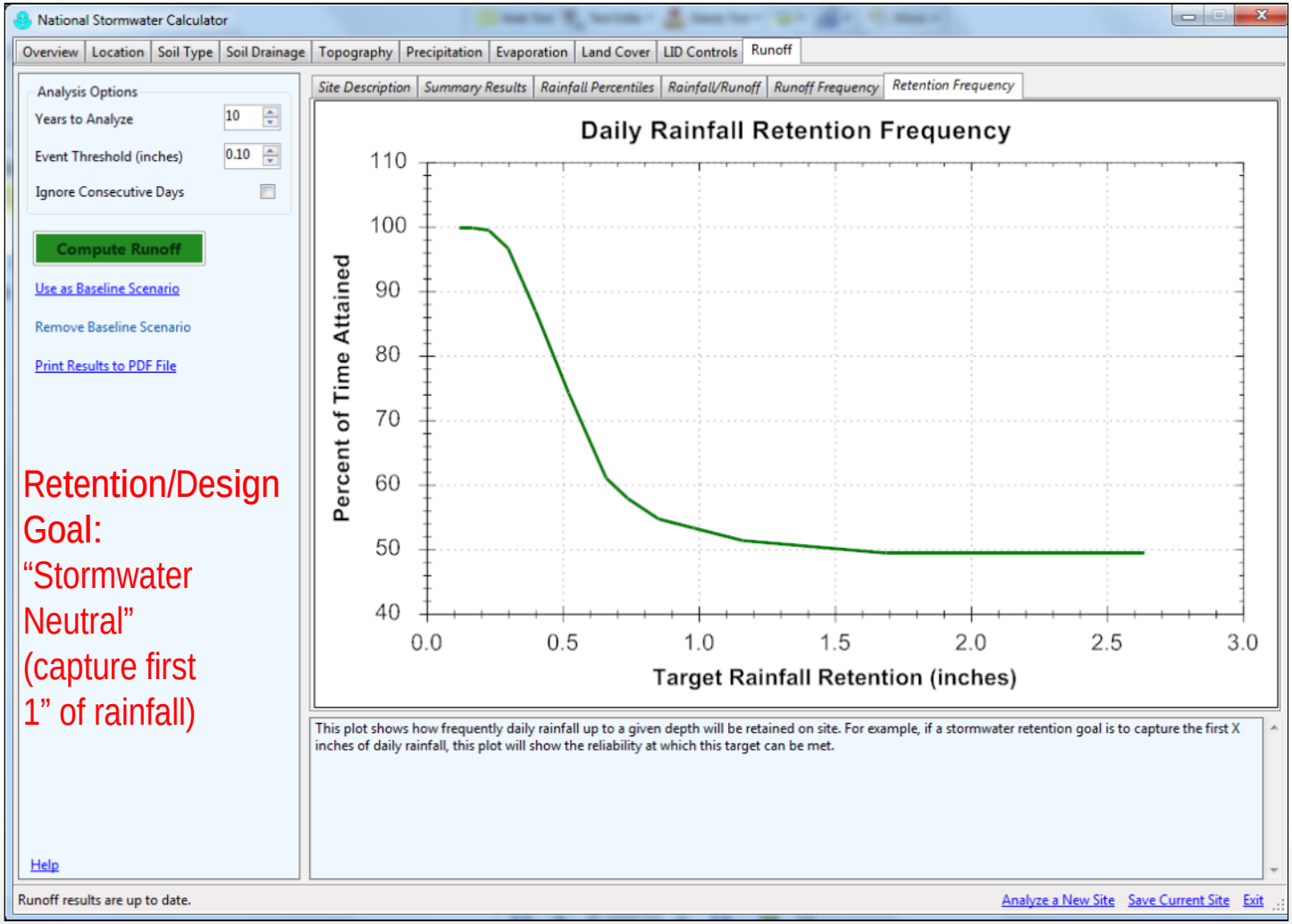
- Calculator is based on SWMM: dynamic rainfall-runoff simulation model for long-term simulation of runoff quantity
- SWMM runs in background of Stormwater Calculator

Desktop Application

Stormwater Runoff Analysis

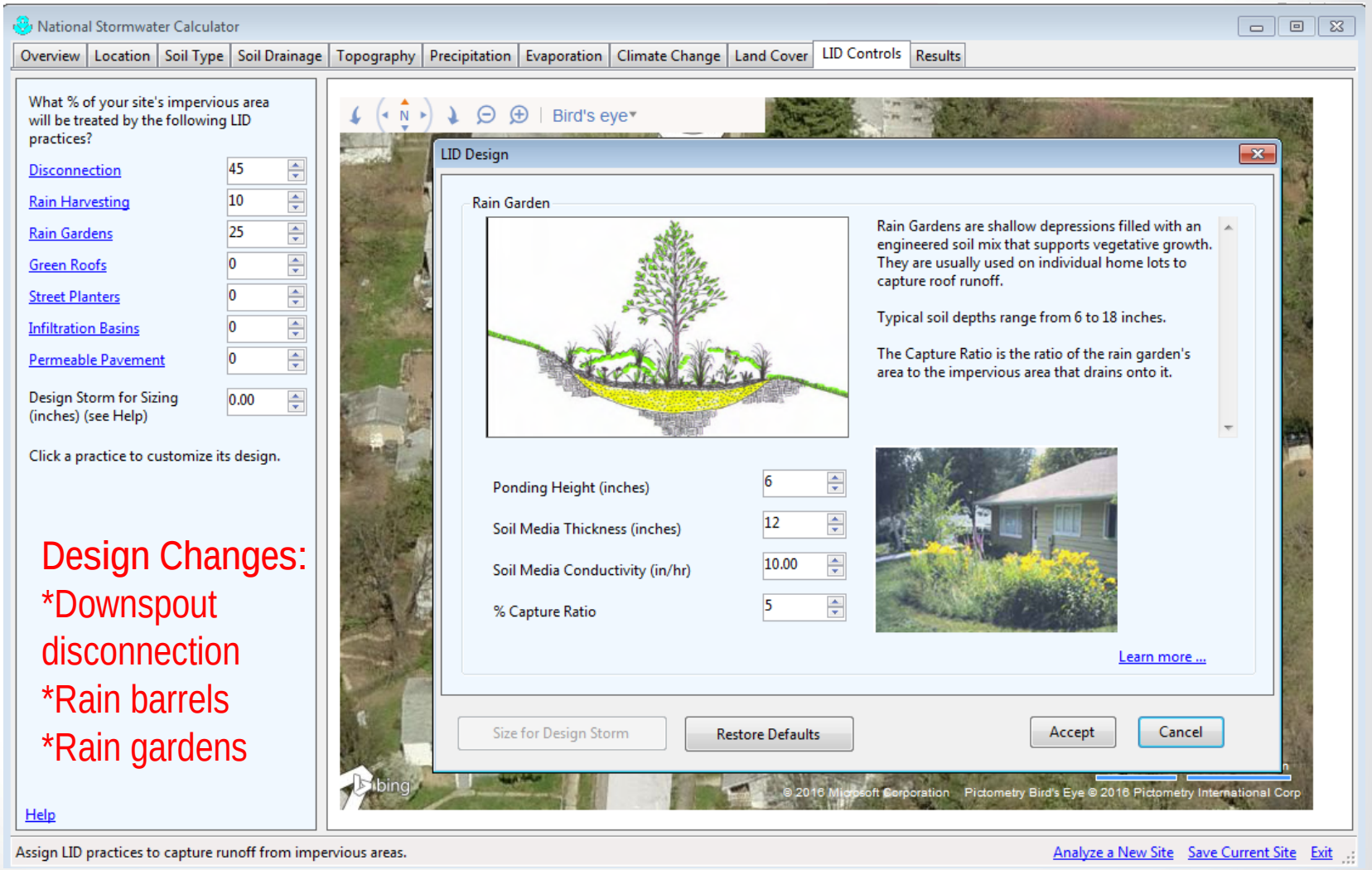


Meeting Stormwater Runoff Design Goals

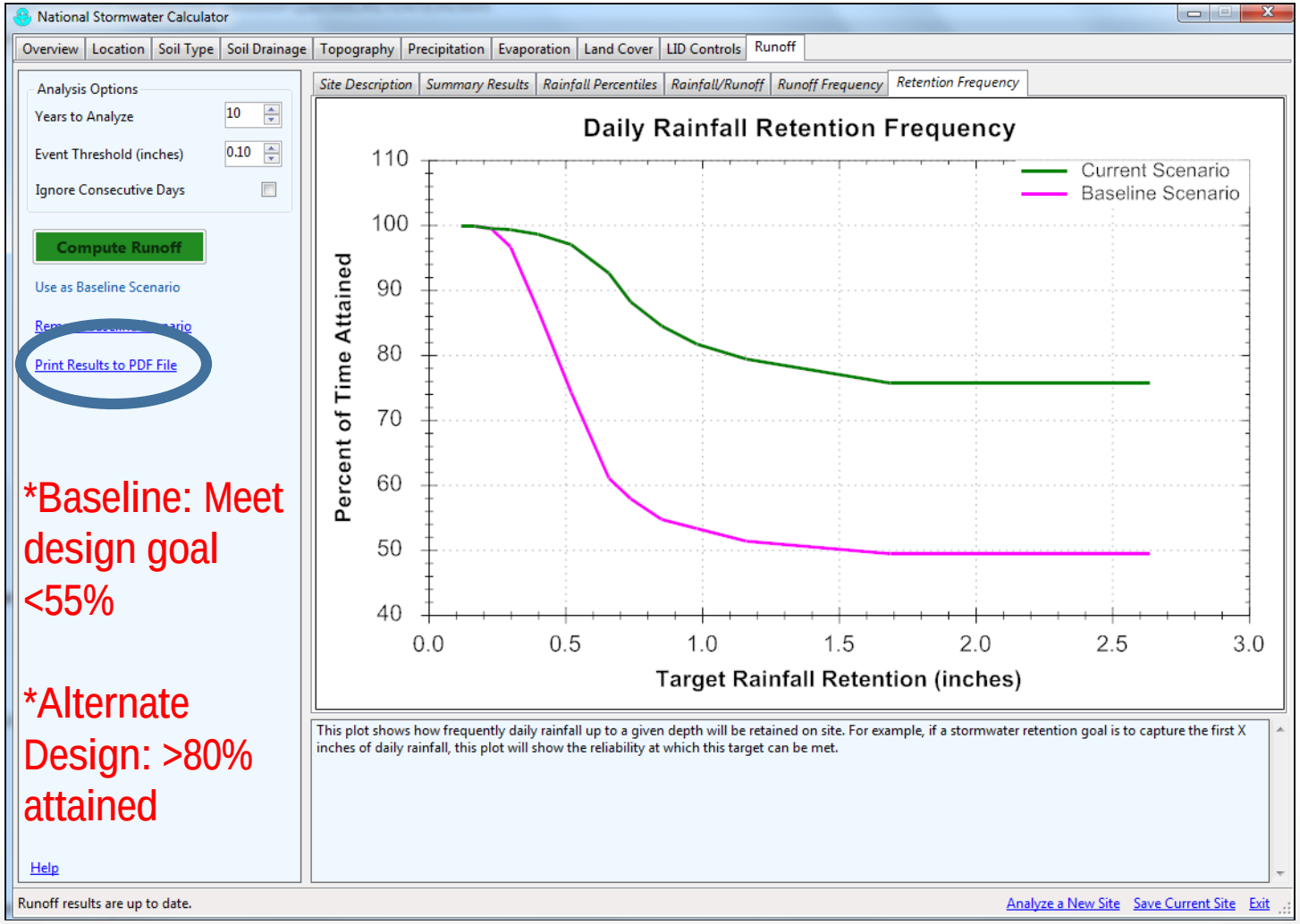


Retention/Design Goal: "Stormwater Neutral" (capture first 1" of rainfall)

Sizing LID Controls



Comparing Design Scenarios: Meeting Runoff Reduction Goals



*Baseline: Meet design goal <55%

*Alternate Design: >80% attained

Potential Applications

- State or MS4 (Municipal Separate Storm Sewer System) Post Construction Stormwater Design Standards
- Voluntary Stormwater Retrofits for private property owners
- Voluntary Programs: LEED (US Green Building Council) and Sustainable Sites Initiative stormwater credits, Rockefeller Foundation's 100 Resilient Cities
- Climate Resiliency Planning
- LID/Green Infrastructure Design Competitions: Campus RainWorks Challenge, DC Water Green Infrastructure Challenge, etc.

Applications and Outreach

- Design competitions
- Tools demonstration workshops

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PUBLIC RELEASE: 22-APR-2016

UTA student team wins EPA Campus RainWorks Challenge for plan to reduce stormwater runoff

Sustainable environment

UNIVERSITY OF TEXAS AT ARLINGTON

SHARE PRINT E-MAIL

A University of Texas at Arlington student team's design to reduce stormwater runoff that could result from future campus construction projects has won a national Environmental Protection Agency's Office of Water award as part of the agency's 2015 Campus RainWorks Challenge.

The College of Architecture, Planning and Public Affairs team included landscape architecture graduate students Baishaki Biswas, Sherry Fabricant, Jacob Schwarz and Ahoura Zandiatashbar, a doctoral student in urban planning and public policy. Their winning entry in the Master Plan category was called "Eco-Flow: A Water-Sensitive Placemaking Response to Climate Change" and centered on water runoff rates at sites of potential UTA student living, dining, recreation and parking facilities.

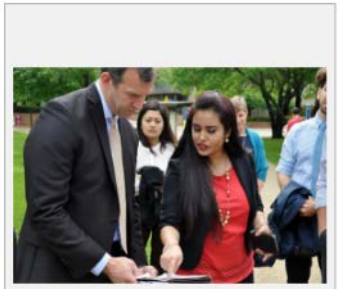
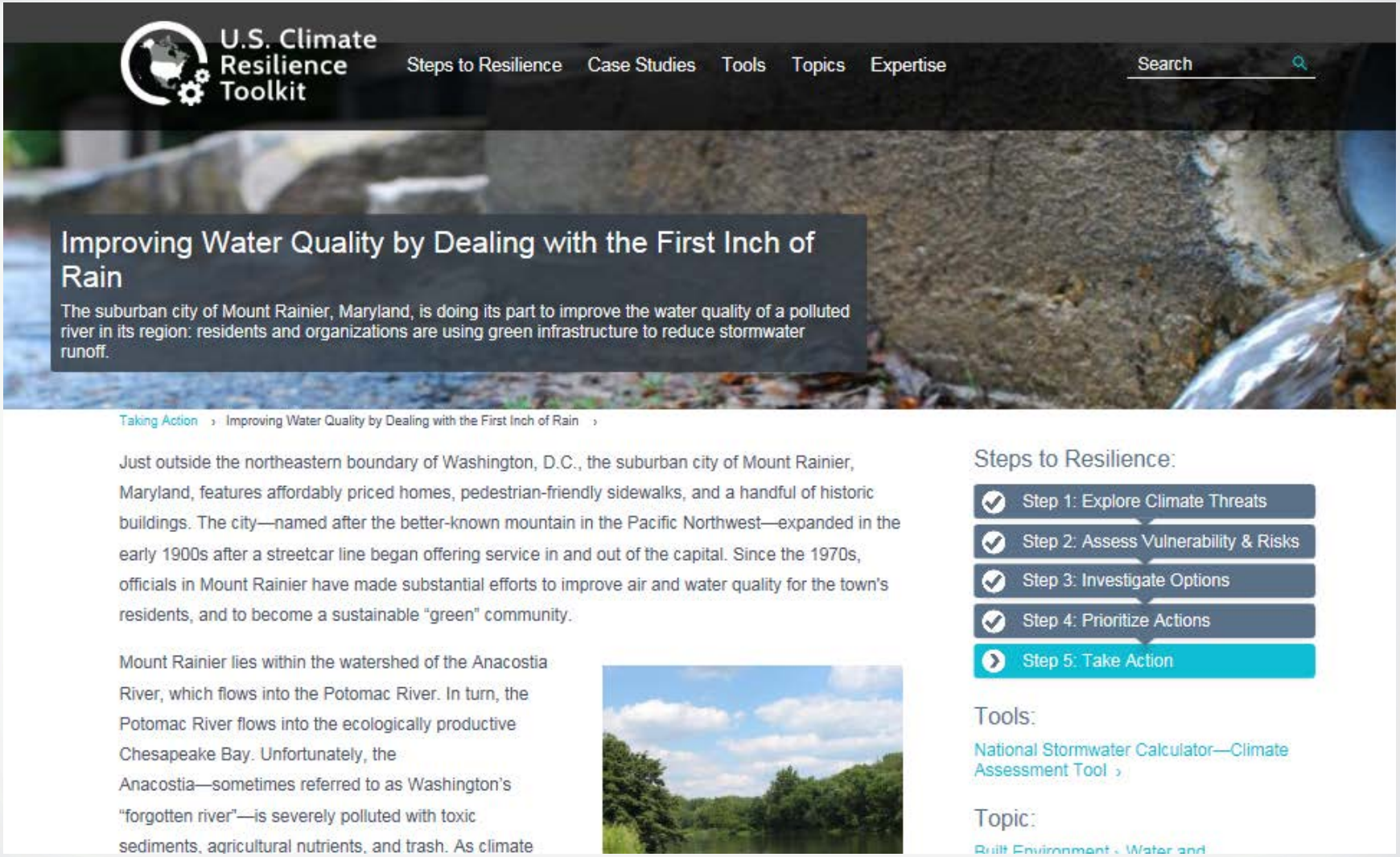


IMAGE: BAISHAKHI BISWAS, A UTA COLLEGE OF ARCHITECTURE, PLANNING AND PUBLIC AFFAIRS STUDENT, SHOWS STORMWATER-REDUCTION PLANS TO JOEL BEAUVAIS, EPA'S DEPUTY ASSISTANT ADMINISTRATOR IN THE OFFICE OF WATER. view more ›

CREDIT: UT ARLINGTON

AAAS (American Association for the Advancement of Science): http://www.eurekalert.org/pub_releases/2016-04/uota-ust042216.php

Climate Resiliency Planning Application



http://toolkit.climate.gov/case-studies/improving-water-quality-dealing-first-inch-rain

Conceptual Design of Green Streets: Spartanburg, SC

EPA Green Infrastructure Technical Assistance

https://www.epa.gov/green-infrastructure/northside-neighborhood-green-infrastructure-master-plan-spartanburg-sc

Spartanburg, SC Green Street Design

Stormwater runoff results from EPA Stormwater Calculator

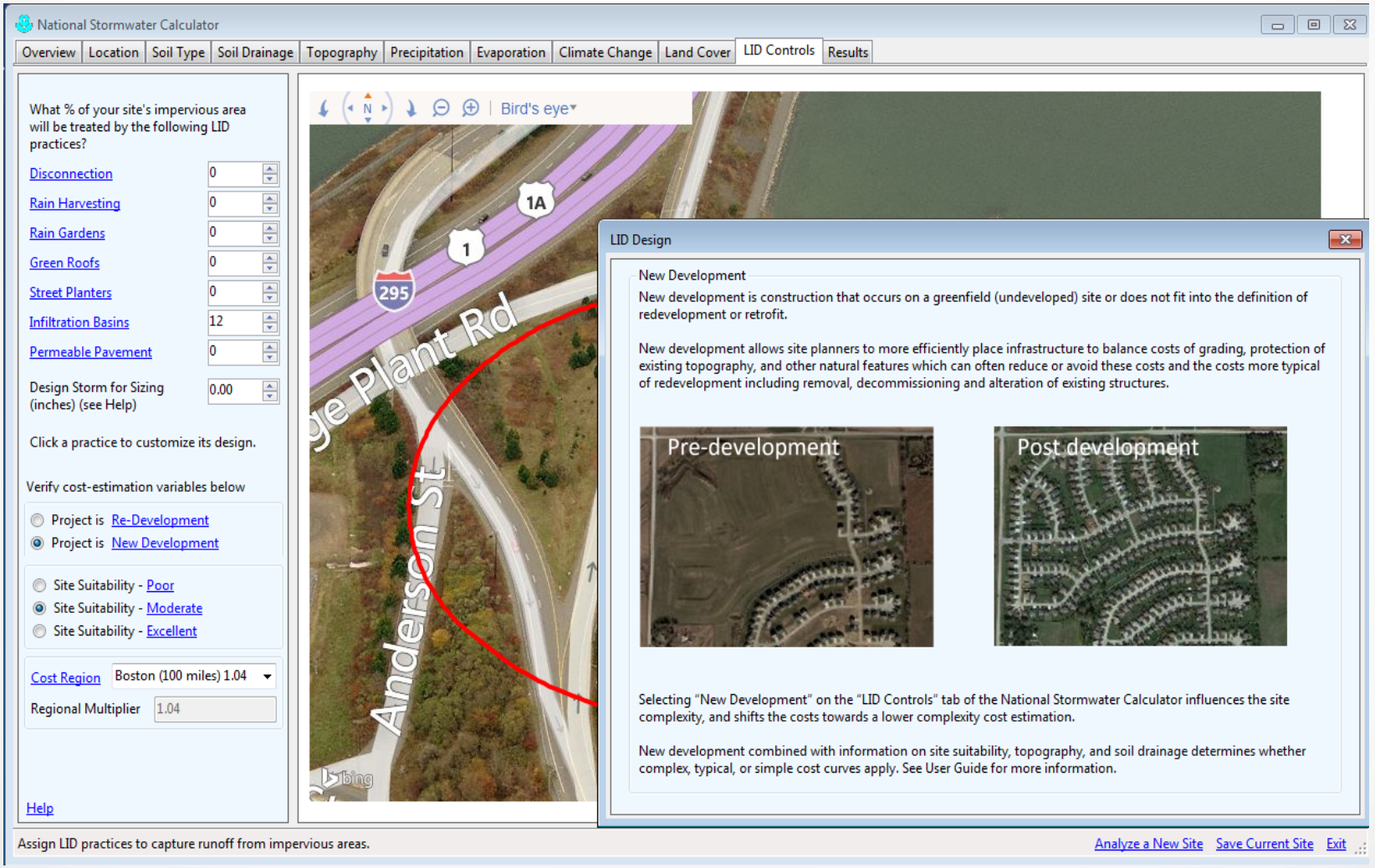
Scenario	Runoff	Infiltration	Evapo-transpiration
Baseline	84%	5%	11%
Scenario 1 (Street Planters)	18%	67%	15%
Scenario 2 (Pervious Pavement)	17%	75%	8%

https://www.epa.gov/green-infrastructure/northside-neighborhood-green-infrastructure-master-plan-spartanburg-sc

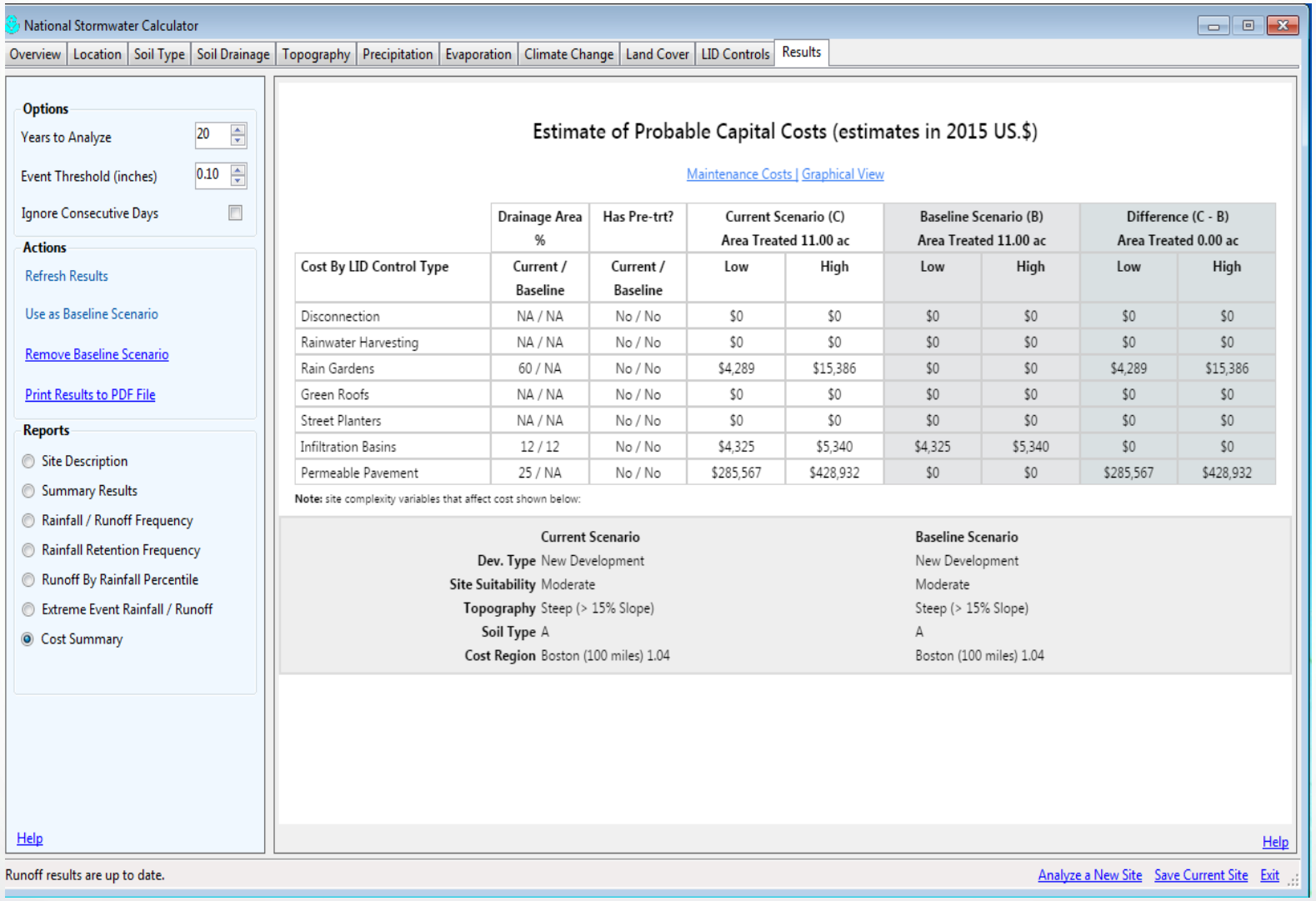
Development of Cost Estimation Module

- Intended Uses:
  - Planning level capital and operations & maintenance cost estimates (magnitude of costs between planning scenarios)
  - Regionalized and national cost estimates

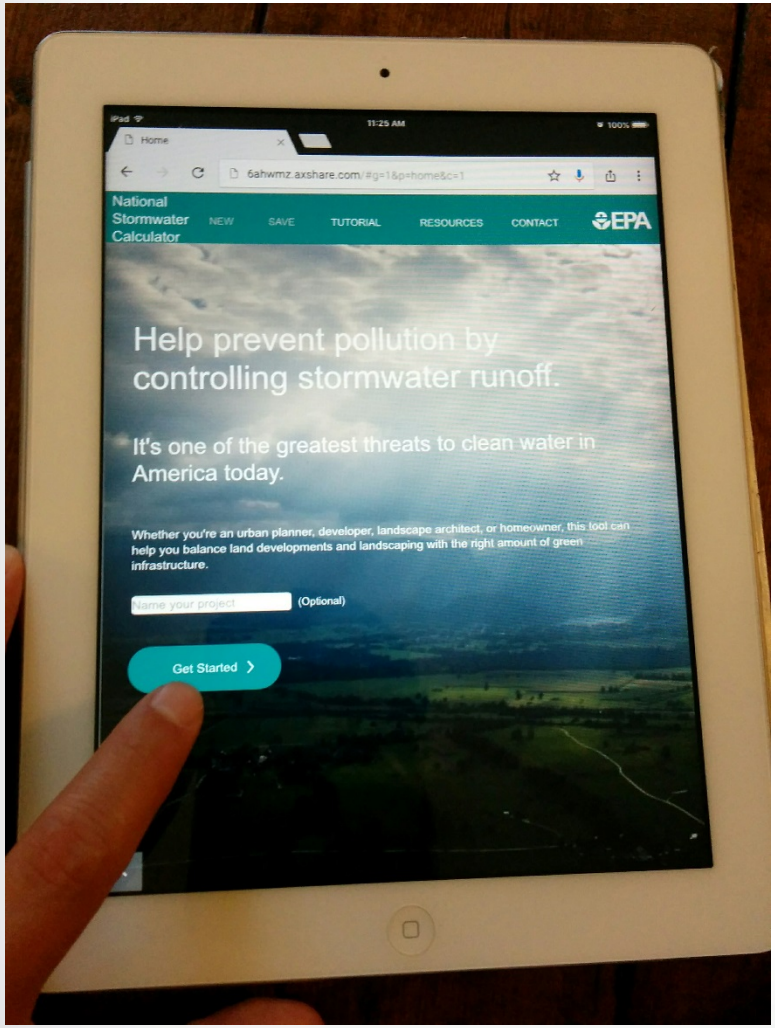
LID Controls: Cost Estimation Enhancements

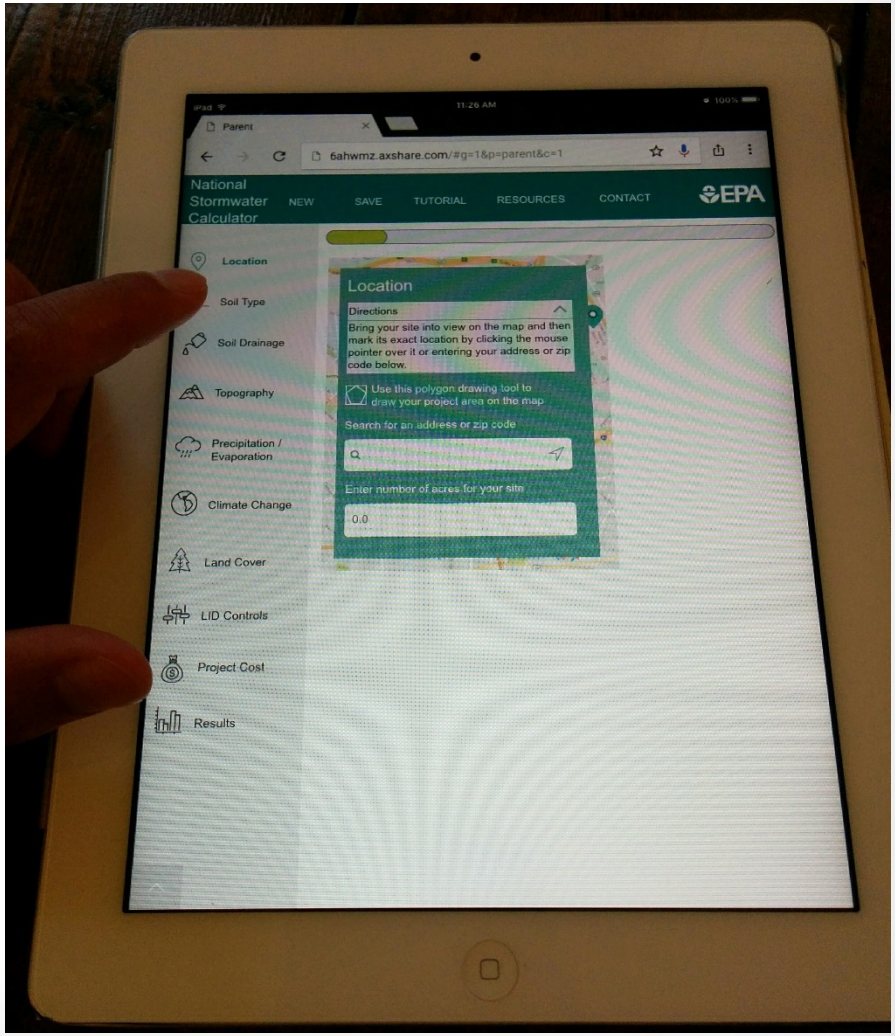


Capital and Maintenance Cost Estimates



Mobile Web App Development





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National Stormwater Calculator Website:
epa.gov/water-research/national-stormwater-calculator

Questions and Answers Session