National Stormwater Calculator

Webcast sponsored by EPA's Watershed Academy

Wednesday, October 16, 2013
2:00pm – 3:30pm Eastern

Instructors:

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Webcast Logistics

- **To Ask a Question** – Type your question in the "Questions" tool box on the right side of your screen and click "Send."
- **To report any technical issues** (such as audio problems) – Type your issue in the "Questions" tool box on the right side of your screen and click "Send" and we will respond by posting an answer in the "Questions" box.

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Overview of Today's Webcast

- Introduction
  - Urban stormwater impacts
  - Green infrastructure solutions
  - Overview of the application
- Live demonstration of the National Stormwater Calculator application
- Case Study
  - Comparison of stormwater utility credit programs in the United States

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NATIONAL STORMWATER CALCULATOR

EPA

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Urban Stormwater

Tamara Mittman, MS
Environmental Engineer
US EPA – Office of Wastewater Management

Urban Stormwater Impacts

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Urban stormwater is one of the biggest problems facing our waterways today

- Urban stormwater is listed as the "primary" source of impairment for 13% of all rivers, 18% of all lakes, and 32% of all estuaries. (NRC 2008)
- In 2010, stormwater caused more than 8,700 beach closing and advisory days; sewage spills and overflows caused more than 1,800. (NRDC 2011)
- Insecticides often occur at higher concentrations in urban streams than in agricultural streams. (USGS Circular 1225)
- Total phosphorus concentrations in urban streams exceed EPA's goal for nuisance plant growth in 70% of streams. (USGS NAWQA Program)
- Fecal coliform bacteria commonly exceed recommended standards for water recreation. (USGS NAWQA Program)

Urban Stormwater Impacts

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Urban stormwater is a fast growing water resource concern

- U.S. developed land is projected to increase from 5.2% to 9.2% of the total land base by 2030. (Alig et al. 2004)
- Development increases the amount of impervious cover in the landscape.
- Small increases in impervious cover lead to large impacts in receiving waters.
- Development upstream can cause downstream impacts.

Causes of Stormwater Impacts

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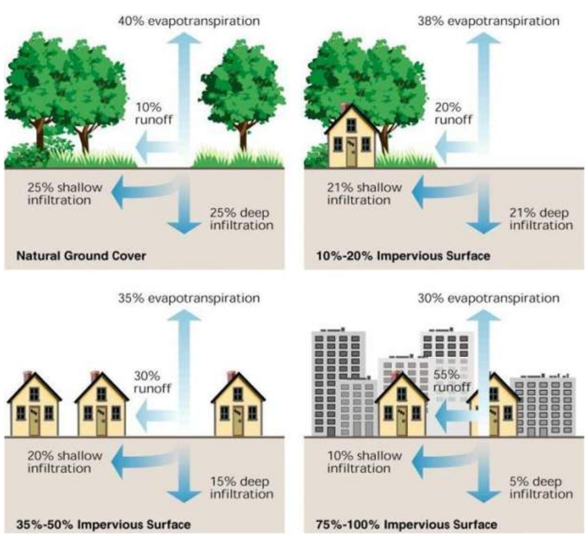

Urbanization causes changes in hydrologic cycle:

- Soils and vegetation are replaced with impervious surfaces
- Impervious surfaces are connected to dense drainage networks
- Runoff drains directly into streams, lakes, wetlands, and coastal waters
- Even small storms generate significant runoff

Causes of Stormwater Impacts

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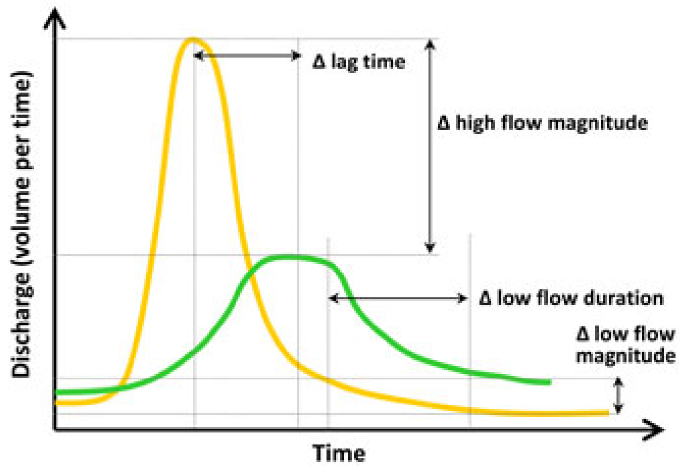
Changes in the urban hydrologic cycle increase runoff volumes and rates



Causes of Stormwater Impacts

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Increased runoff volumes and rates are the most significant cause of stormwater impacts, causing:

- Flooding and sewer overflows.
- Stream erosion and channel degradation.
- Increased property damage.
- Loss of habitat and aquatic life.
- Increased pollutant loads.

Types of Urban Pollutants

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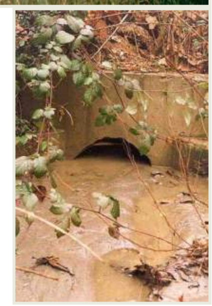
Pollutants in urban stormwater include sediment, nutrients, oil and grease, trash, heavy metals, fertilizers, pesticides, and pathogens.



Sources of Urban Pollutants

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Traditional Stormwater Management

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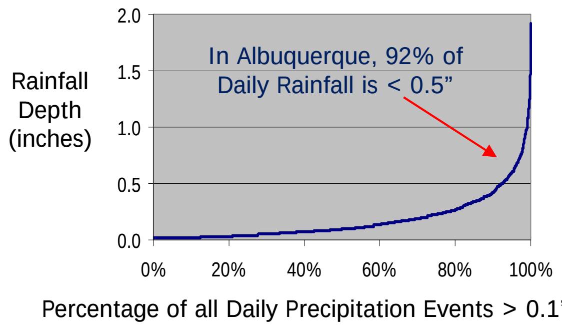
Traditional Approach

- Drain stormwater quickly from site to receiving water or detention pond
- Manage peak flows for flood control and channel protection
- Neglect the most frequent precipitation events



Green Infrastructure: An Emerging Solution

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Green infrastructure practices use or mimic natural processes (interception, infiltration, evapotranspiration) to retain and treat stormwater on site.

Green Infrastructure Approach

- Integrate practices into the site to manage stormwater at its source.
- Treat stormwater as a resource, not a waste.
- Manage the full range of precipitation events.

Additional Benefits of Green Infrastructure

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- Reduces heat island effect
- Improves air quality
- Provides wildlife habitat and recreational space
- Improves energy efficiency
- Improves urban aesthetics
- Increases property values
- Often less expensive than conventional approaches

Lincoln Mercury Headquarters Green Roof, Irvine, CA.
Photo courtesy of Roofscapes, Inc.

Non-Structural Practices

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- Protect sensitive areas such as wetlands and riparian areas
- Preserve natural vegetation and soils (minimize soil compaction)
- Reduce impervious footprint (minimize street widths and parking area)
- Disconnect impervious area

Structural Practices

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- Bioretention
  - Rain gardens
  - Bioswales
  - Planter boxes
- Infiltration basins
- Green roofs
- Compost amendments
- Permeable pavement
  - Green streets
  - Green parking lots
- Rainwater harvesting

Rain garden in parking lot island.

Rain Gardens

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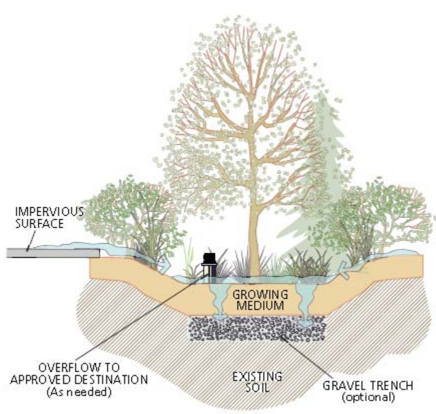
- Rain gardens are landscaped depressior either excavated or created with berme
- Runoff from impervious surfaces is conv rain garden, where it is temporarily stor infiltrates into the ground.
- Important design parameters include the drainage area to surface area ratio, ponding depth, rooting layer depth, anc storage layer depth.
- Overflow or underdrain structures may also be included.



Street Planters

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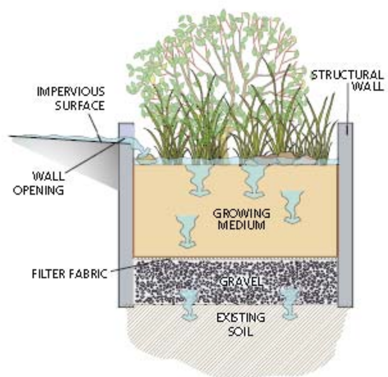
- Street planters are structures or containers wi open bottoms to allow stormwater to infiltrat into the ground.
- Planters are ideal for space-limited sites.
- Important design parameters include the drainage area to surface area ratio, ponding depth, growing medium depth, and storage layer depth.
- Overflow or underdrain structures may also be included.



Green Roofs

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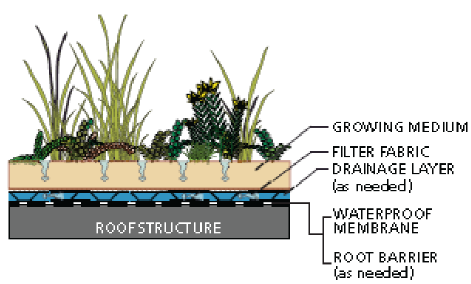
- Green roofs are vegetated systems placed on roof surfaces that capture and temporarily store rainwater in a growing medium.
- Green roofs typically consist of a waterproof membrane, drainage material, a lightweight layer of soil, and a cover of plants.
- The most significant design paramete in determining runoff capture is the growing medium thickness.
- A typical green roof has a growing medium thickness of 3 to 6 inches.



Permeable Pavements

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- Permeable pavements may be constructed from pervious concrete, porous asphalt, permeable interlocking pavers, and several other materials.
- Permeable pavements are particularly cost effective where land values are high and where flooding or icing is a problem.
- Permeable pavements typically consist of a surface pavement layer and a stone aggregate storage layer (often 6-18 inches thick).
- Important design parameters include the drainage area to surface area ratio and the aggregate layer thickness.

Modeling Green Infrastructure Performance

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- To meet environmental and regulatory goals, designers must be able to model the impact of green infrastructure on runoff volumes.
  - Stormwater runoff volumes are a key driver of urban stormwater impacts.
  - Many states and municipalities are adopting volume-based regulatory standards.
- Continuous simulation modeling is a robust approach to hydrologic modeling that takes into account the sequence of precipitation events.
- Many continuous simulation models are available, however most are not readily accessible to designers and engineers.
  - Data requirements
  - Modeling expertise

The National Stormwater Calculator

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Goals

- Predict runoff from a site given different land cover scenarios and green infrastructure controls
- Analyze site hydrology over a continuous, long-term meteorological record
- Be intelligible to users without prior modeling experience or hydrology expertise
- Require only a minimum amount of readily available site information
- Produce technically sound and defensible results for screening level analysis

The National Stormwater Calculator

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Intended Users

- Site developers
- Landscape architects
- Urban Planners
- Homeowners
- Others

Intended Uses

- Screening level analysis.
- Assess long term performance of stormwater management practices.
- Identify practices that can help meet stated performance goals.
- Not intended to be used for construction-level design.

The National Stormwater Calculator

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Basic Features

- SWMM modeling engine
- Simple map-based user interface
- Automated retrieval of meteorological, soil, slope data
- Automated calculation of rainfall and runoff statistics

Hydrology Modeled by the SWC

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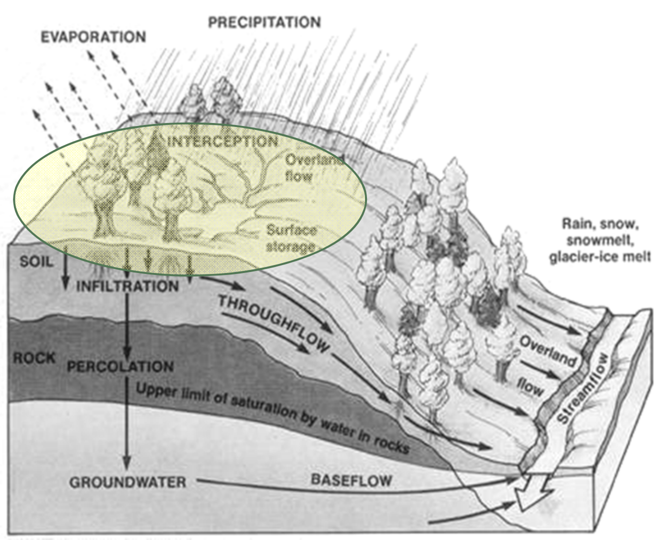

Download Instructions

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- Downloading the National Stormwater Calculator is simple and only takes a couple of minutes.
- Visit the page below to download the Calculator to your computer and access the User's Guide:

http://www.epa.gov/nrmrl/wswrd/wq/models/swc/

Questions?

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Live Demo of the Calculator

Lewis Rossman, PhD
Environmental Scientist
US EPA – National Risk Management Research Laboratory

Overview of the Demo

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- Site Description
- Pre-Development Hydrology
- 95th Percentile Storm
- Post-Development Hydrology
- Sizing a Rain Garden
- Comparison with Porous Pavement

Questions?

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Applying the Calculator: Evaluating Stormwater Utility Credit Programs

Olivia Odom Green, JD and Ruben Kertesz, PhD
ORISE Fellows
US EPA – National Risk Management Research Laboratory

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Research Questions

How do projected reductions in stormwater runoff from a standard home lot compare between cities offering green infrastructure discount programs?

What relation is there to runoff reduction and size of discount being offered?

Stormwater Utilities

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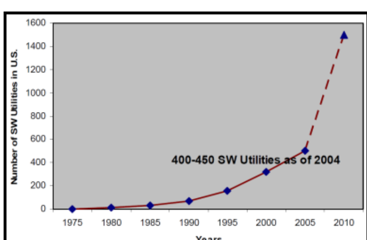
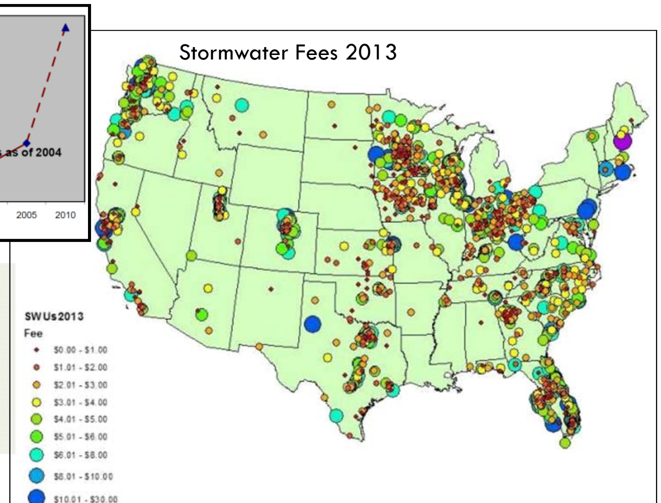


- •Fee charged per IA
- •>1400 identified
- •Avg SFR fee= $4.57/mnth
- •Median= $3.75
- •No correlation to politics, affluence, tax burden
- •Product of state law (NB, MD)



Stormwater Utility Survey, Western Kentucky University 2013

Stormwater Utility Credits

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- Discount for reducing runoff
  - *Curb opposition- solution to problem*
  - *Ability to reduce fee may be factor in state law*
- Single family residences & rain gardens
- Efficacy & Sustainability:
  - Economy
    - Financial incentives
    - Municipal finance
  - Community
    - Outreach & Accessibility
  - Environment
    - Hydrology

Hydrologic Research Question

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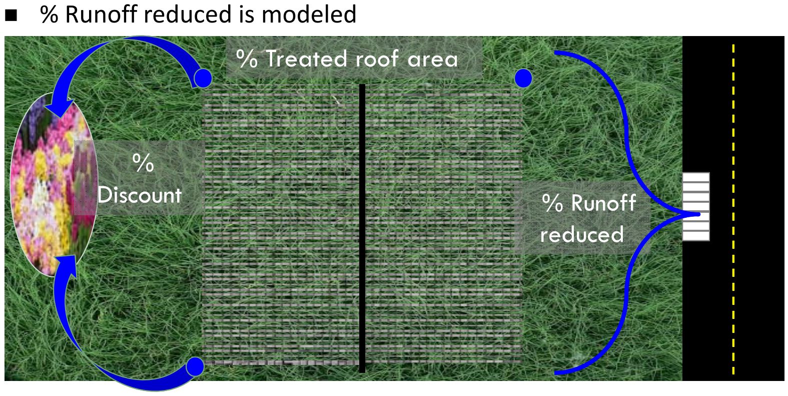
- Treating x% of impervious area, results in y% discount and z% runoff reduction
  - Treated IA and Discount % are products of administrative rules
  - % Runoff reduced is modeled



Methodology

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- Identify programs
  - Bioretention (rain gardens) for single family residences
- Model runoff pre- vs post-treatment
  - Follow instructions for designing/installing rain garden
  - Vary site conditions
  - Compare reduction in annual runoff between all factors
- Compare reduction in runoff to financial discount

EPA SWC: Pre-treatment

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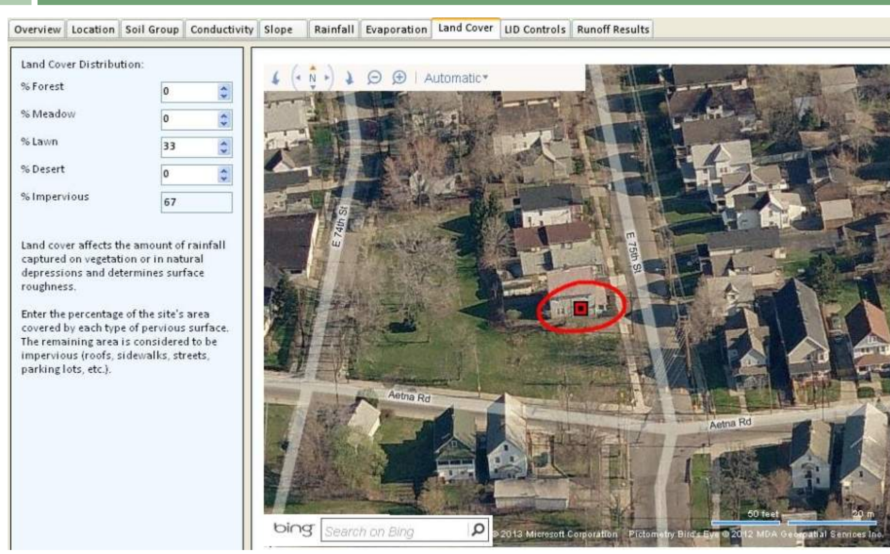

EPA SWC: Post-Treatment

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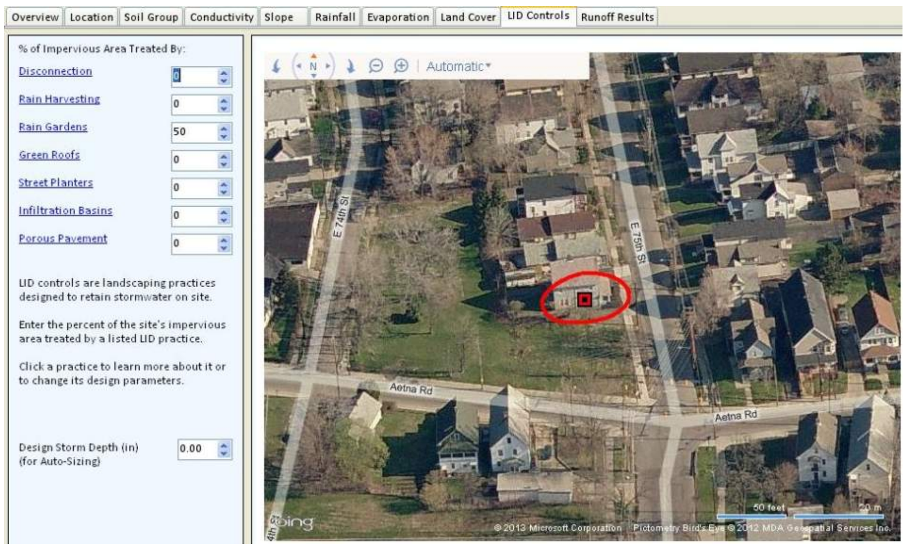

Adjusted Parameters

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Utility	Slope %	Ponding Depth (in.)	Soil Group*	Ksat* (in/hr)	% Roof Treated
Portland	5, 10	6, 12	a, c	2, 0.25	66, 100
Cleveland (NEORSD)	4, 6, 10	f(slope)	sand (a), silt (c), clay (d)	1.4, 0.57, 0.06	25, 100
Ft. Myers	2, 5	6, 12	a, b	5, 1.5	10, 100
Lynchburg⁺	2, 5	6	a, b	1.5, 1	50, 100+

*Conductivity (Ksat) related to soil type by USDA NRCS National Engineering Handbook: Part 630 Hydrology – Note that in Portland, 2 in/hr minimum for full credit; Lynchburg, 1 in/hr minimum without requiring underdrain. Ft Myers shows higher required infiltration rate due to proximity of water table to the ground surface.
⁺Garden depth is prescribed, 18-36 inches

Results – Minimum Treatment

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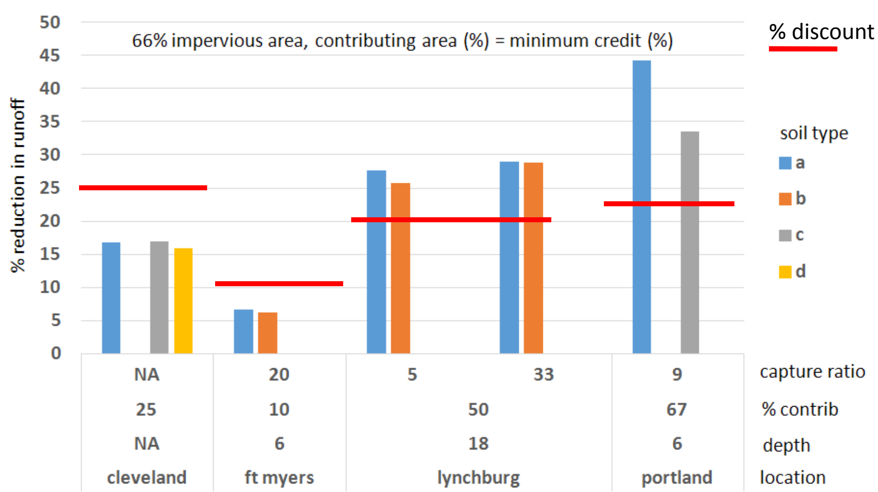

Results: 2/3 of Lot Impervious

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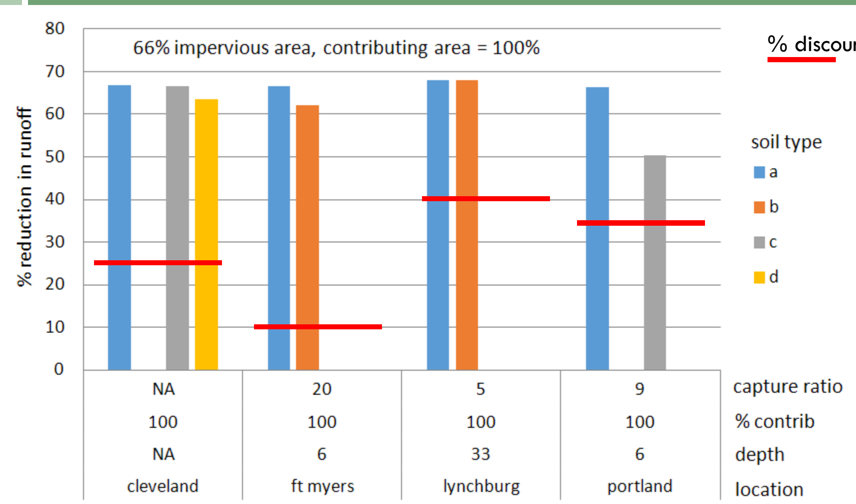

Results: 1/3 of Lot Impervious

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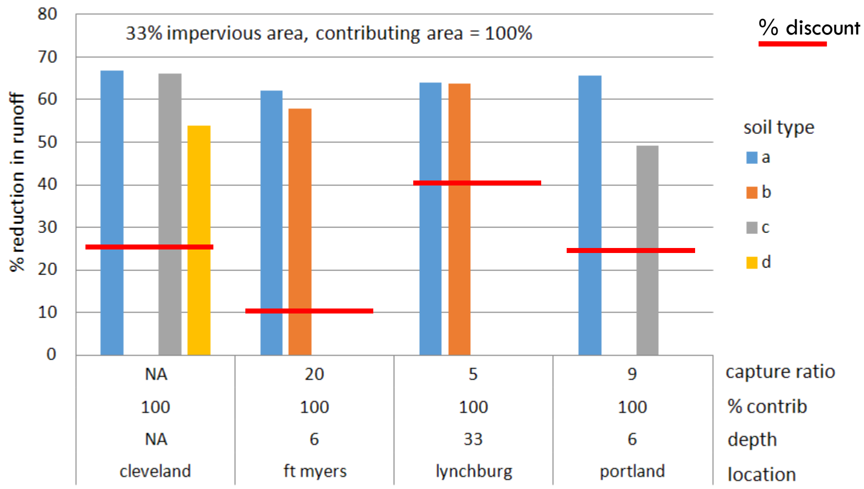

Conclusions

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- Hydrology
  - Prominent factors
    - % captured roof area, Soil
  - Less prominent factors
    - Slope, Depth, Site imperviousness
- Economics
  - % runoff reduced v. % discount
    - Efficiency based on perspective
      - Even a windfall to a citizen (% discount> % runoff reduction) may be efficient to municipality
      - Especially when goodwill, social contagion considered

Questions?

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Future Developments

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Environmental Scientist
US EPA – National Risk Management Research Laboratory

Calculator Enhancements

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- Climate Change Extension (January 2014)
- LID Practices Cost Estimates (June 2014)
- Interactive Site Characterization Tools (TBD)
- Conversion to a Web-Based Application (TBD)

Climate Change Extension

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- Will allow the SWC to evaluate the effects of climate change predictions for both precipitation and temperature.
- Uses a set of three different climate scenarios at two different future time points that spans the set of results in the WCRP Phase 3 projections (CMIP3) .
- Statistically downscaled changes in monthly average precipitation, monthly average evaporation rate, and annual daily maximum rainfall have been associated with each precipitation station location (>7,000) in the calculator.
- Will be part of the Climate Resilience Toolkit being developed as part of the President's Climate Action Plan.

Climate Change User Interface

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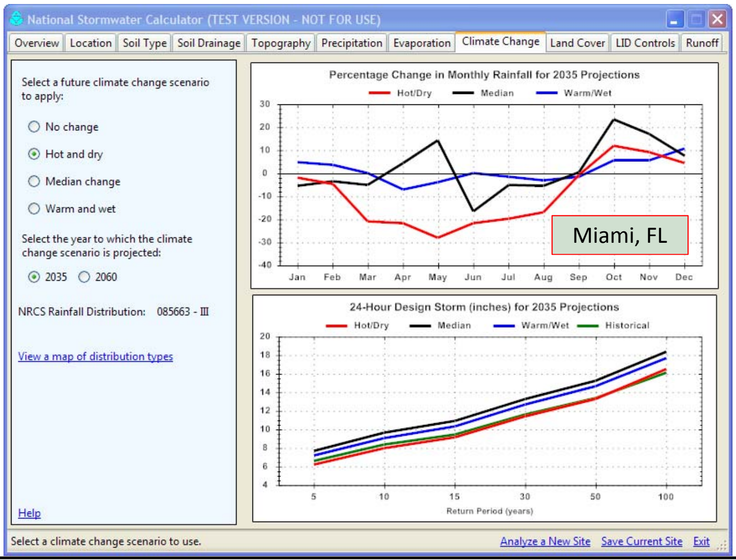

THANK YOU

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- National Stormwater Calculator Website

  http://www.epa.gov/nrmrl/wswrd/wq/models/swc/

- Address Any Follow-up Questions to:

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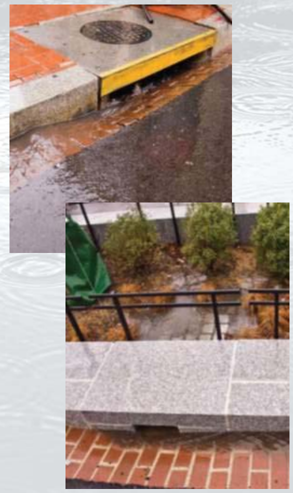

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Next Watershed Academy Webcast

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The Watershed Academy

Volunteer Monitoring

Date TBD

Information will be posted at
www.epa.gov/watershedwebcasts

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Participation Certificate

If you would like to obtain participation certificates **type the link below into your web browser:**

http://water.epa.gov/learn/training/wacademy/upload/2013-10-02-certificate.pdf

You can type each of the attendees names into the PDF and print the certificates.