U.S. EPA National Stormwater Calculator: Cost Module & Mobile Web App

Jason Bernagros
U.S. EPA’s Office of Research and Development
Outline

U.S. EPA National Stormwater Calculator

• Stormwater Calculator (SWC) Background Information
• Low Impact Development (LID) Cost Estimation Module
• SWC Web Application
• Example Application: Northport, MI
• Interpreting Results
• Training & Outreach
• Discussion & Questions
National Stormwater Calculator Website

http://www2.epa.gov/water-research/national-stormwater-calculator
What We Developed and Why?

A Stormwater Management (Green Infrastructure/LID) Design and Planning Tool

— To estimate post-construction urban stormwater runoff discharges

— Screening-level stormwater runoff reduction and cost analyses of various green infrastructure/LID practices, including:
  • Green roofs, rain gardens, cisterns, etc. throughout the U.S.

— Allow non-technical professionals to conduct screening level stormwater runoff for small to medium sized (less than 1 - 12 acres) sites
Green Infrastructure Modeling Toolkit

Toolkit website: https://www.epa.gov/water-research/green-infrastructure-modeling-toolkit

*Toolkit video: https://www.youtube.com/watch?time_continue=2&v=xHp-OeUneqQ
Potential Applications

- State or MS4 (Municipal Separate Storm Sewer System) Post Construction Stormwater Design Standards
- Voluntary Stormwater Retrofits for private property owners
- LID/Green Infrastructure Design Competitions: DC Water Green Infrastructure Challenge, etc.
- Climate Resiliency Planning: Rockefeller Foundation’s 100 Resilient Cities
- Green Building Programs: LEED (U.S. Green Building Council) and Sustainable Sites Initiative stormwater credits
Recent Examples of Urban Stormwater Management Projects: Great Lakes Region

- **Wisconsin:**
  - Manitowoc: rain garden along Blue Rail Marina Beach
  - Oak Creek: porous pavement parking area and bioretention along lakeside bluff

- **Michigan:**
  - Northport: pervious pavement, rain gardens, and tree box filters for Grand Traverse Bay

- **Indiana:**
  - Michigan City: green infrastructure streetscape (rain gardens & bioswales)
Communities using the SWC

• Northeastern Regional Ohio Sewer District (Cleveland, OH):
  https://www.neorsd.org/stormwater-2/green-infrastructure-grant-program

• EPA’s Green & Complete Streets Building Blocks Program Recipients (2016-2017):
  — Manatee County, FL
  — Baltimore, MD
  — Central Falls, RI
  https://www.epa.gov/smartgrowth/building-blocks-sustainable-communities
Storm Water Management Model (SWMM)

- SWC is based on SWMM: dynamic rainfall-runoff simulation model for long-term simulation of runoff quantity
- SWMM produces stormwater runoff estimates in the background of the SWC
Welcome to the EPA National Stormwater Calculator

This calculator estimates the amount of stormwater runoff generated from a land parcel under different development and control scenarios over a long-term period of historical rainfall.

The analysis takes into account local soil conditions, topography, land cover, and meteorology. Different types of low impact development (LID) practices can be employed to help capture and retain rainfall on-site. Localized climate change scenarios can also be analyzed.

Site information is provided to the calculator using the tabbed pages listed above. The Results page is where the site's runoff is computed and displayed.

This program was produced by the U.S. Environmental Protection Agency and was subject to both internal and external technical review. Please check with local authorities about whether and how it can be used to support local stormwater management goals and requirements.

Release 1.2.0.0

Select the Location tab to begin analyzing a new site.
SWC Mobile Web App

Web App Link: https://swcweb.epa.gov/stormwatercalculator
LID Cost Estimation Module (Released May 2017):

• **Intended Uses:**
  ─ Planning level cost estimates (magnitude of costs between planning scenarios)

• **Limitations:**
  ─ Doesn’t provide final construction costs
  ─ Doesn’t provide lifecycle costs (gives annual operation and maintenance (O & M) costs, not replacement costs)
  ─ Regional costs not available for all areas of the US (many of the Western states)
LID Cost Estimation Module:
Accounting for Uncertainty with Cost Estimates
(Regression Cost Curves)
LID Cost Estimation Module:
Development of Regionalized LID/Green Infrastructure Costs

- Utilization of Bureau of Labor Statistics (BLS) Data for regional costs
  - *National Producer Price Index*: outputs of service, construction, utilities, and other goods producing entities
    - Examples include: concrete storm sewer pipe, construction sand and gravel, etc.
  - *Consumer Price Index*: regional/city data (23 major US cities)
    - Examples include: fuels and utilities, energy, and diesel fuel

- Data easily updated and maintained annually by EPA

- Development of regional costs comparable to Engineering News Record (ENR) and RS Means
Release of SWC Web App
Sept. 2017

- Ability to function on any web browser
- Mobile friendly design (tablets and smartphones)
- Platform neutral: functions on Windows, Apple, and Linux computers
- Not found in an “app store” (Google Play or Apple Store)
  - Save it as a “favorite” website
- Requires a live Internet connection

Example views from smartphone and tablet
SWC Mobile Web App Application (Northport, MI)

**Location:**
Bing Maps:

*new streetside view for major urban areas*
SWC Mobile Web App Application (Northport, MI)

The Watershed Center Grand Traverse Bay (2016)
Soil Runoff Potential:
Soil Infiltration Capacity:
Topography/Slope:
Historical Weather (precipitation & evaporation):
Climate Change Scenarios & Extreme Storm Events:

Key Message 5: Increased Rainfall and Flooding

Extreme rainfall events and flooding have increased during the last century, and these trends are expected to continue, causing erosion, declining water quality, and negative impacts on transportation, agriculture, human health, and infrastructure.
Climate Change Scenarios & Extreme Storm Events:

Climate Change

Directions

Helpful Resources
- Scenarios for Climate Assessment and Adaptation - Regions
- GlobalChange.gov - Regions & Topics
- US Environmental Protection Agency - Future of Climate Change
- World Climate Research Programme

Select a future climate change scenario to apply:
- No Change
- Hot/Dry
- Median Change
- Warm/Wet

Select the time period to which the climate change scenario applies:
- Near Term (2020 - 2049)
- Far Term (2045 - 2074)

Percentage Change in Monthly Rainfall for Far Term Projections

Annual Max. Day Rainfall (inches) for Far Term Projections
Land Cover:
LID Controls:

[Image of LID Controls interface with various controls and options for stormwater management.]
**Project Cost (Development Type):**

- **Choose a Project Type**
  - Re-Development
  - New Development

- **Choose your Site Suitability**
  - Poor
  - Moderate
  - Excellent

- **Choose your Cost Region**
  - Milwaukee (190.0 miles)

- **Re-Development**
  - Re-Development is construction that is a change in existing development (land cover, land use, or similar development alteration) which requires new or alteration of existing stormwater management facilities.
  - Costs of removal, decommissioning, or alteration of existing structures or additional (new) infrastructure is typically required to connect existing structures and results in costs that are greater than what would be anticipated with a new development site.
  - Re-development and extensive retrofit costs are typically higher than new development costs because existing structures might have to be removed or new structures may be required but may not be located in a preferred location.
  - Selecting “Re-development” on the “Project Cost” tab of the National Stormwater Calculator influences the site complexity, and shifts the costs towards a higher complexity cost estimation.
  - Re-development combined with information on site suitability, topography, and soil drainage determines whether complex, typical, or simple cost curves apply. See User Guide for more information.
Project Cost (Site Suitability):

Moderate Site Suitability

Site suitability is a measure of construction feasibility and includes factors such as topography, soil type, slope, and other physical features that might result in higher implementation costs.

Moderate site suitability refers to sites that have several of the following characteristics:

- Few physical obstructions.
- Few utility conflicts.
- Other features that may make construction of stormwater management infrastructure challenging and likely more costly, but less than a site with poor site suitability.

Sites determined to have moderate suitability for LID practices may result in higher costs because of the potential need for additional excavation, accommodation for physical obstructions including utilities, required retaining walls, moderately challenging access, limited dewater, the addition of engineered or custom media blends, or need to address geotechnical or groundwater concerns.

Selecting “Site Suitability - Moderate” on the “LID Controls” tab of the National Stormwater Calculator influences site complexity, and may shift the costs towards a higher complexity cost estimation compared to.

Moderate site suitability combined with information on development type, topography, and soil drainage determines whether complex, typical, or simple cost curves apply. See User Guide for more information.
Project Cost (Bureau of Labor Statistics Cost Region):
Results (Summary):

- **Results**
  - **Directions**
  - **Options**
    - Years to Analyze: 10
    - Event Threshold: 0.1
    - Ignore Consecutive Days
  - **Actions**
    - Refresh Results
    - Use as Baseline Scenario
    - Remove Baseline Scenario
  - **Reports**
    - Site Description
    - Summary Results
    - Rainfall / Runoff Events
    - Rainfall / Runoff Exceedance Frequency
    - Rainfall Retention Frequency
    - Runoff Contribution by Rainfall Percentile
    - Extreme Event Rainfall / Runoff
    - Cost Summary

- **Current Scenario**
  - Annual Rainfall: 34.96 inches
  - Runoff: 15.3%
  - Infiltration: 17.3%
  - Evaporation: 67.4%

- **Baseline Scenario**
  - Annual Rainfall: 34.96 inches
  - Runoff: 15.3%
  - Infiltration: 17.3%
  - Evaporation: 67.4%

- **Statistical Table**
  - | Statistic                      | Current | Baseline |
  - |--------------------------------|---------|----------|
  - | Average Annual Rainfall (inches) | 34.96   | 34.96    |
  - | Average Annual Runoff (inches)  | 3.41    | 16.13    |
  - | Days per Year With Rainfall     | 148.22  | 148.22   |
  - | Days per Year With Runoff       | 164.04  | 164.04   |
  - | Percent of Wet Days Retained    | 29.27   | 29.27    |
  - | Smallest Rainfall w/ Runoff (inches) | 0.91    | 0.91     |
  - | Largest Rainfall w/o Runoff (inches) | 0.77    | 0.77     |
  - | Max Rainfall Retained (inches)   | 3.22    | 1.03     |
Results (Cost Summary):
Interpreting the Results

- Informing next steps for finalizing costs of stormwater projects and construction plans/designs

- Comparing the relative magnitude of planning level costs for different stormwater management solutions
  — Finding least cost option(s) while meeting performance goals

- Comparisons may be made between national and regional cost estimates:
  — Using local knowledge in selection of regional BLS cost multipliers
SWC Analysis: Potential Next Steps

• Sharing planning results with decision-makers

• Applying for funding

• Developing construction plans/designs

Training and Outreach Materials: User’s Guide & Fact Sheet

http://www2.epa.gov/water-research/national-stormwater-calculator
Discussion and Questions
Thank You!

Jason Bernagros
Landscape Architect
U.S. EPA Office of Research and Development (ORD)
(202) 566-1671
bernagros.jason@epa.gov

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

Contact: SWC@epa.gov
SWC:
Site Parameters and Embedded GIS Data-sets

- **Location:** Bing Maps
- **Soils:** NRCS SSURGO *(web service)*
- **Slope:** NRCS SSURGO
- **Hydraulic Conductivity:** NRCS SSURGO
- **Precipitation and Temperature:** National Climate Center (NCDC)-NOAA *(EPA’s BASINS Model)*
- **Evaporation:** Calculation based on meteorological data
- **Climate Change Future Scenarios:** Precipitation & evaporation *(EPA’s CREAT 2.0)*
- **Land-Cover/Use:** User provided
- **LID Practices (**new costing module available**): User provided