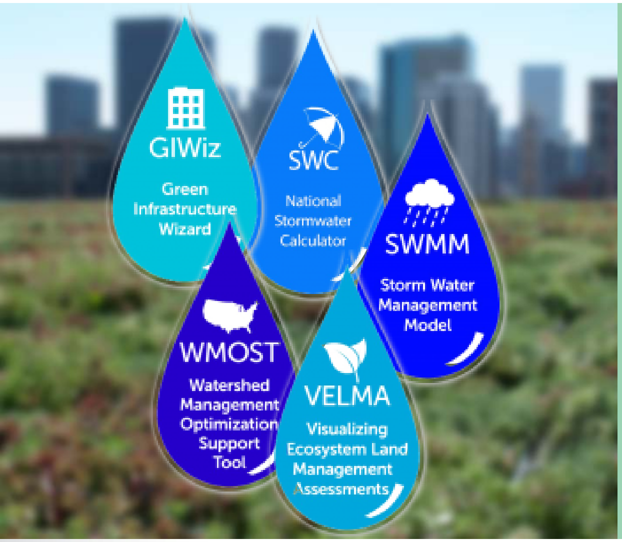
Office of Research and Development

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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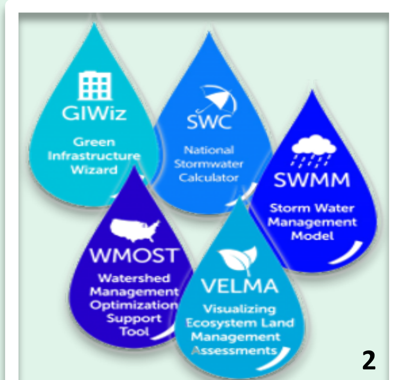
Webinar Summary

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

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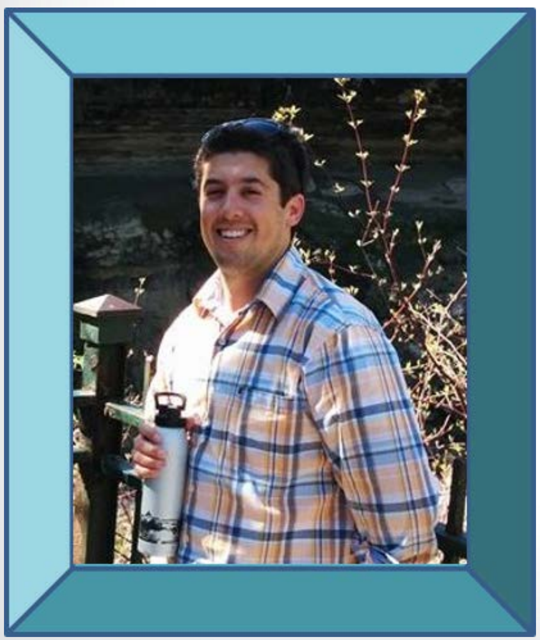
Presentation 5

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 Bernagros

Jason Bernagros 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.

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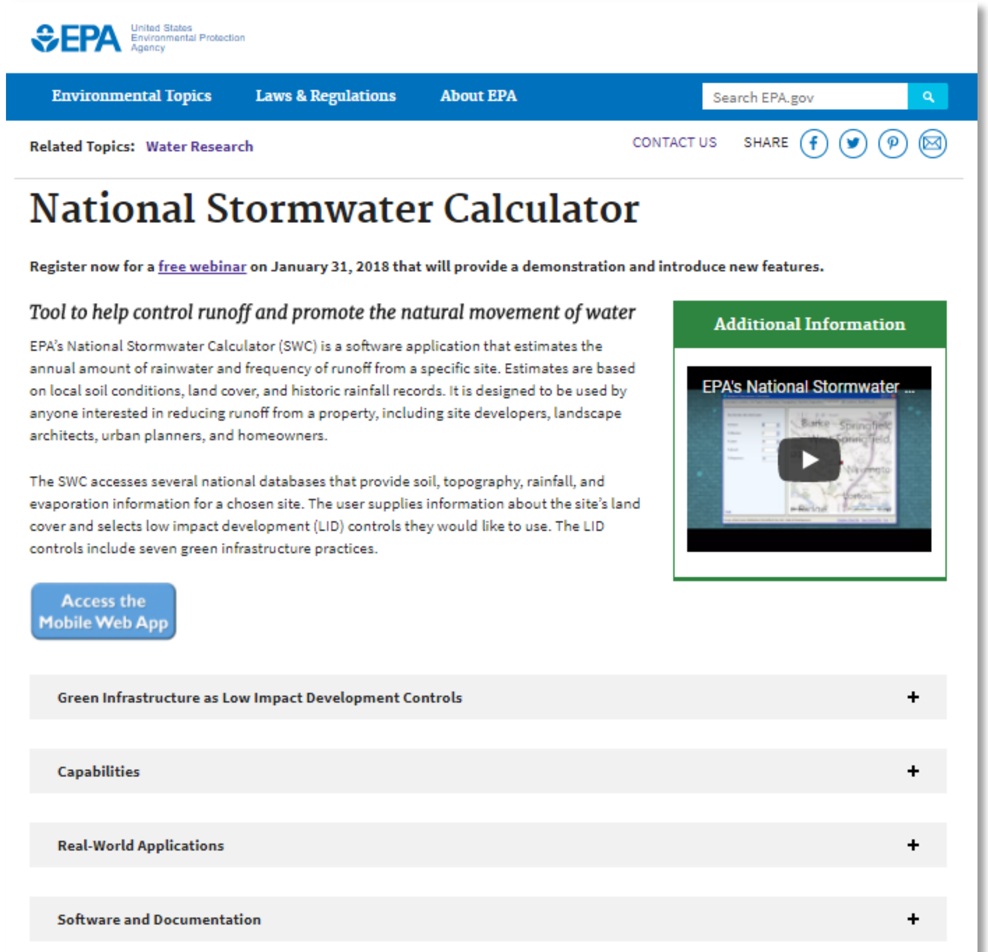
Outline

U.S. EPA National Stormwater Calculator (SWC)

- Stormwater Calculator Background Information
- Low Impact Development (LID) Cost Estimation Module
- SWC Web Application
- Example Application: Northport, MI

Website



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National Stormwater Calculator

Register now for a free webinar on January 31, 2018 that will provide a demonstration and introduce new features.

Tool to help control runoff and promote the natural movement of water

EPA's National Stormwater Calculator (SWC) is a software application that estimates the annual amount of rainwater and frequency of runoff from a specific site. 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 SWC accesses several national databases that provide soil, topography, rainfall, and evaporation information for a chosen site. The user supplies information about the site's land cover and selects low impact development (LID) controls they would like to use. The LID controls include seven green infrastructure practices.

Access the Mobile Web App

Additional Information

EPA's National Stormwater ...

Green Infrastructure as Low Impact Development Controls +

Capabilities +

Real-World Applications +

Software and Documentation +

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

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 12 acres) urban development sites**

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.

Communities Using the SWC

- Northeastern Regional Ohio Sewer District (Cleveland, OH):

Home > Stormwater > Green Infrastructure Grant Program

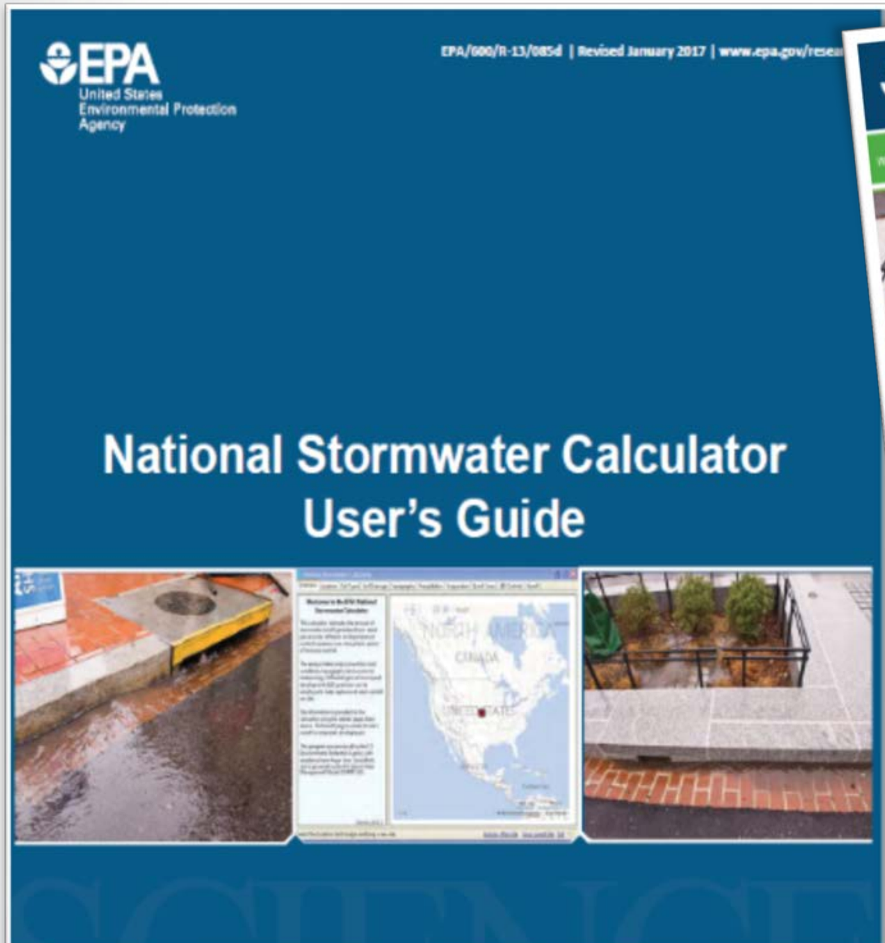
Green Infrastructure Grant Program

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

Training and Outreach Materials: User's Manual and Fact Sheet


EPA United States Environmental Protection Agency

EPA/600/R-13/085d | Revised January 2017 | www.epa.gov/resea

National Stormwater Calculator User's Guide


EPA

science in ACTION

INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE

www.epa.gov/research

(1) Green Infrastructure

(2) Traditional Grey Infrastructure

The National Stormwater Calculator shows users how land use decisions and green infrastructure practices affect the amount of stormwater runoff produced. Green infrastructure, such as the street planter and porous pavers shown above (Image 1), are low impact development controls that promote the natural movement of water within an ecosystem or watershed, instead of allowing it to wash into streets and down storm drains, as it does with traditional grey infrastructure shown above (Image 2).

These practices allow the stormwater to be used as a resource rather than a waste product. Having less water runoff into storm drains and roadways can help prevent contamination of waterways, infrastructure degradation, flooding, and overwhelming of treatment plants.

National Stormwater Calculator (SWC)

Tool that helps users control runoff to promote the natural movement of water

Stormwater discharges continue to cause impairment of our Nation's waterbodies. In order to reduce impairment, EPA has developed the National Stormwater Calculator (SWC) to help support local, state, and national stormwater management objectives and regulatory efforts to reduce runoff through infiltration and retention using green infrastructure practices as low impact development (LID) controls. The primary focus of the SWC is to inform site developers on how well they can meet a desired stormwater retention target with and without the use of green infrastructure. It can also be used by landscapers and homeowners.

Platform. The SWC is a Windows-based desktop program that requires an internet connection. A mobile web application version that will be compatible with all operating systems is currently being developed.

Cost Module. An LID cost estimation module within the application allows planners and managers to evaluate LID controls based on comparison of regional and national project planning level cost estimates (capital and average annual maintenance) and predicted LID control performance. Cost estimation is accomplished based on user-identified size configuration of the LID control infrastructure and other key project and site-specific variables. This includes whether the project is being applied as part of new development or redevelopment and if there are existing site constraints.

Climate Scenarios. The SWC allows users to consider how runoff may vary based both on historical weather and potential future climate conditions. To better inform decisions, it is recommended that the user develop a range of SWC results with various assumptions about model inputs such as percent of impervious surface, soil type, sizing of green infrastructure, as well as historical weather and future climate scenarios. Please check with local authorities about whether and how use of these tools may support local stormwater management goals.

The SWC is comprised of ten tabbed pages:

1–Location. This step has an address lookup feature that allows the user to easily navigate to a site selected anywhere within the United States.

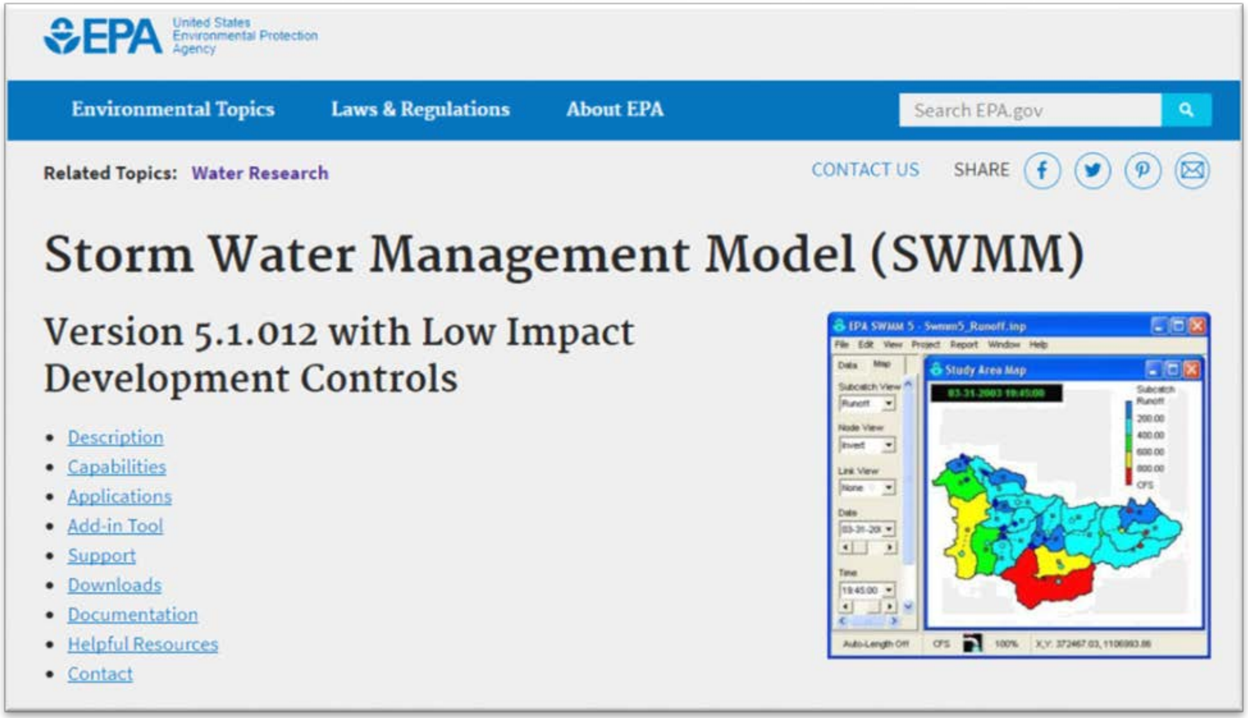
2–Soil Type. In this step, soil type is identified and is used to infer infiltration properties. It can be selected based on local knowledge or from the online database.

3–Soil Drainage. This step identifies how quickly water drains into the soil. Conductivity can be selected based on local knowledge or retrieved from the online database.

4–Topography. Here, the site's surface topography is characterized, as measured by the surface slope. The user can rely on the slope data display as a guide or can use local knowledge to

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

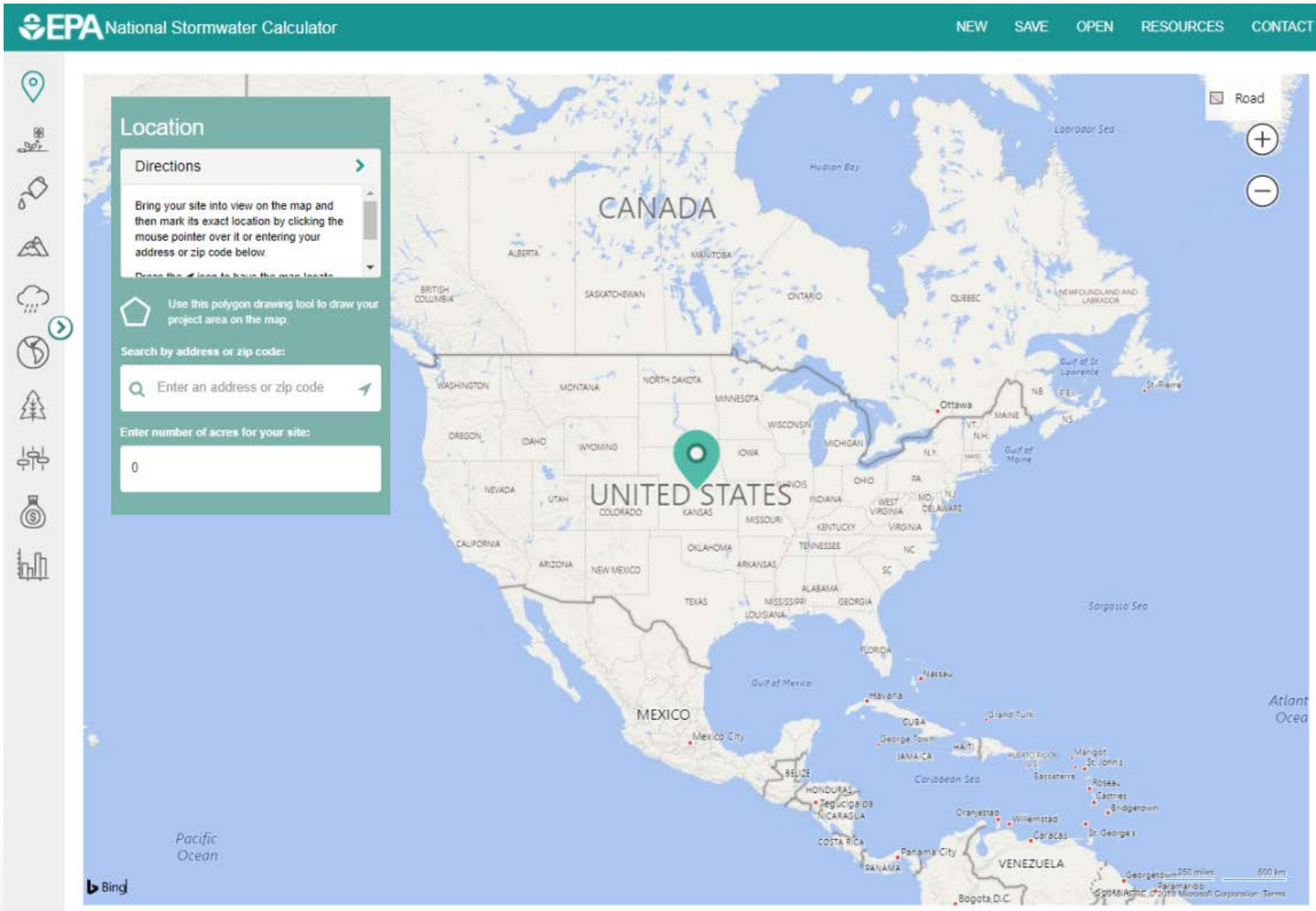
SWMM



- 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

Web Application



Web App Link: https://swcweb.epa.gov/stormwatercalculator

LID Cost Estimation Module

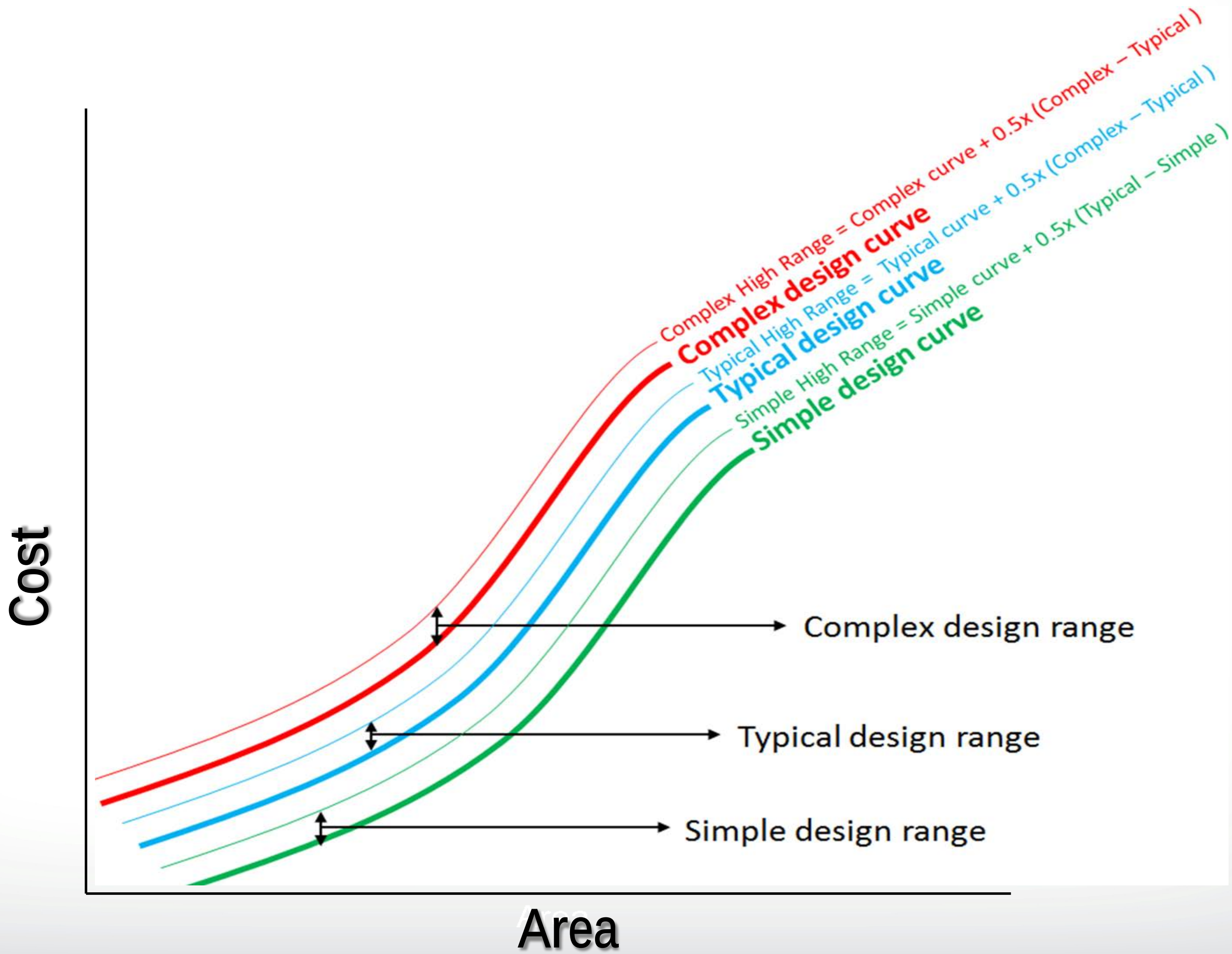
- **Intended Uses:**
  - Planning level cost estimates (magnitude of costs between planning scenarios)

- **Limitations:**
  - Doesn’t provide final construction/build 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: Site Complexity Effects on Costs

Criteria	Degree of Complexity		
	Simple	**Typical**	**Complex**
New vs. existing development	New	Existing	Existing
***(Pretreatment)* Outflow and overflow discharge safety constraints**	Safe & unconstrained	Slightly constrained & may require some grading or pipe infrastructure for safe discharge	Likely constrained & may require significant grading or pipe infrastructure for safe discharge
Equipment accessibility	Easy access	Fairly easy	Difficult access
Slope for LID control placement	Flat to moderately flat (0 – 4%)	Moderately flat (4 – 7%)	Steeper slope (greater than 7%)
Soil infiltration rate	High infiltration (HSG: A)	Moderate infiltration (HSG: B)	Low infiltration (HSG: C and D)

LID Cost Estimation Module:
Accounting For Uncertainty (Regression Cost Curves)



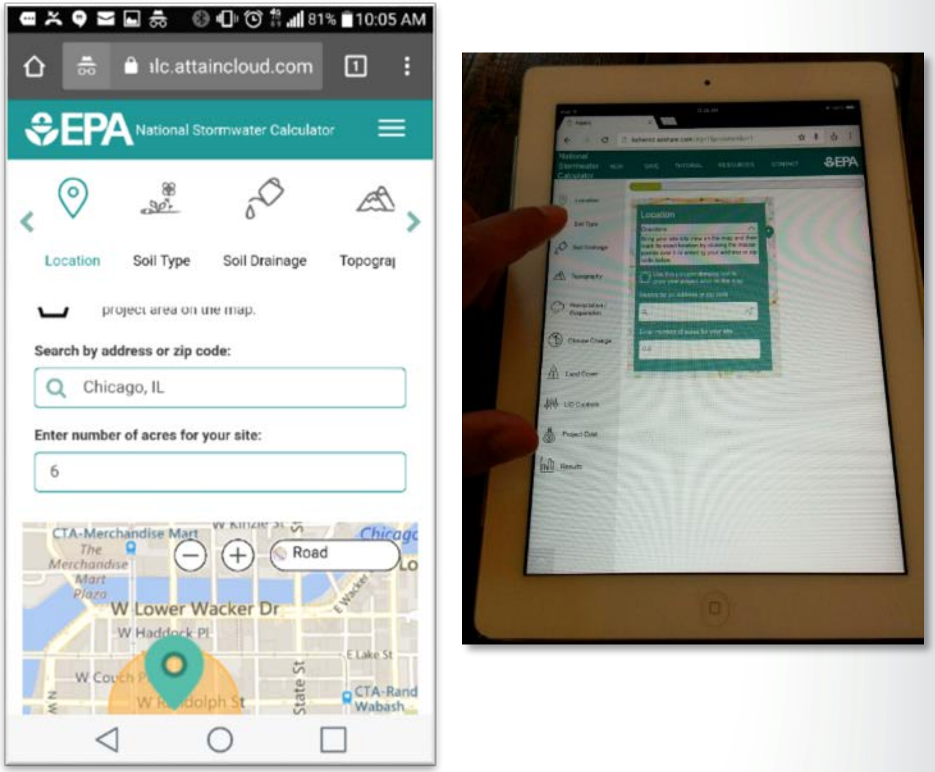
- **Utilization of Bureau of Labor Statistics (BLS) Data for regional costs**
  - *National Producer Price Index*: outputs of service, construction, utilities, and other goods producing entities
    - Examples include: concrete storm sewer pipe, construction sand and gravel, etc.
  - *Consumer Price 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**

New SWC Web App

- **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**
- ***<u>Requires a live Internet connection</u>***

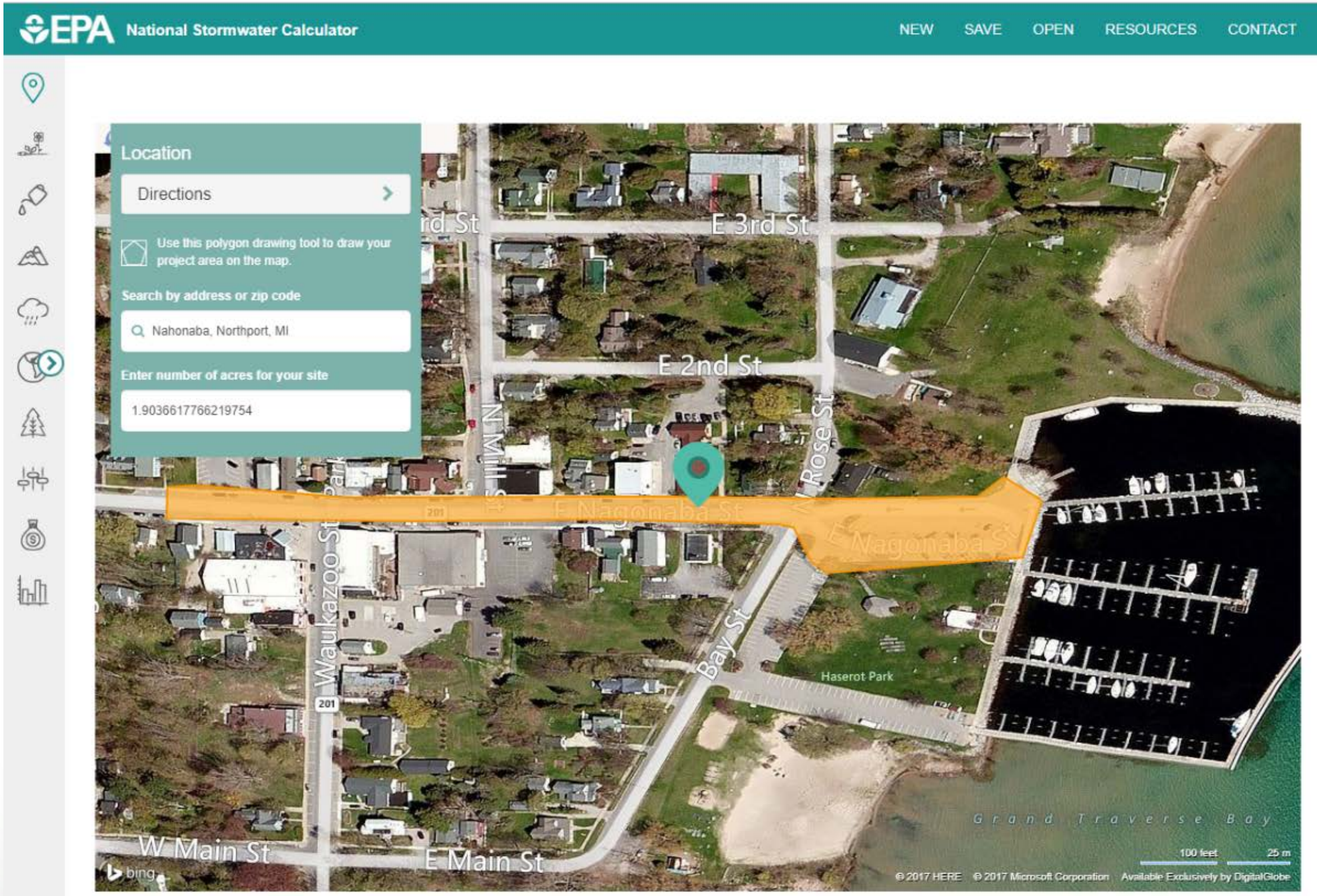


Example views from smartphone and tablet

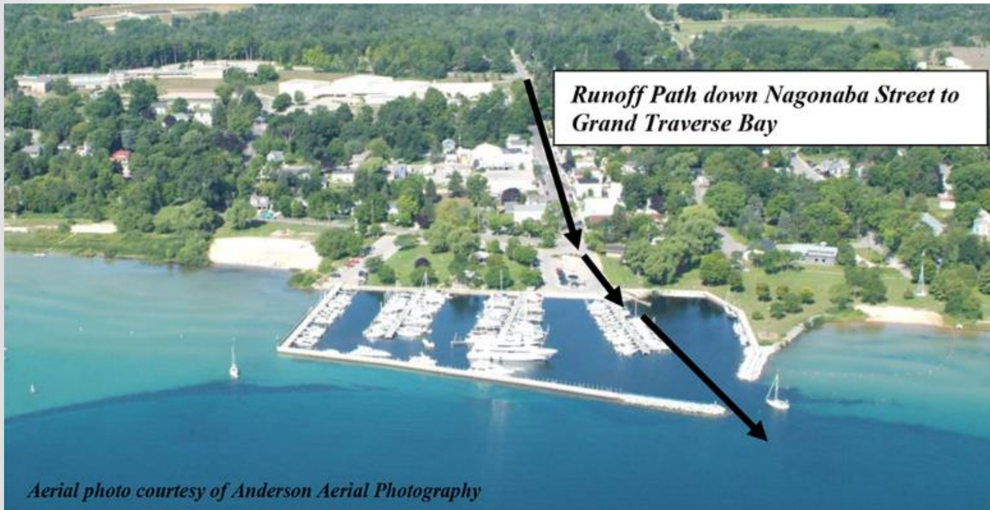
SWC: Site Parameters and Data-Sets

- **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

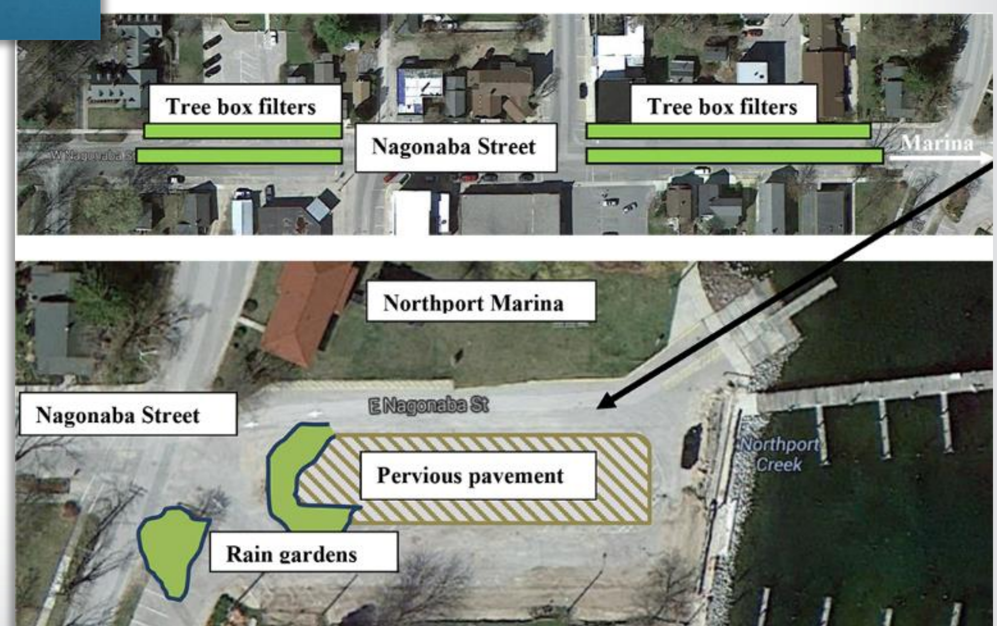
SWC Web App Application: Northport, MI



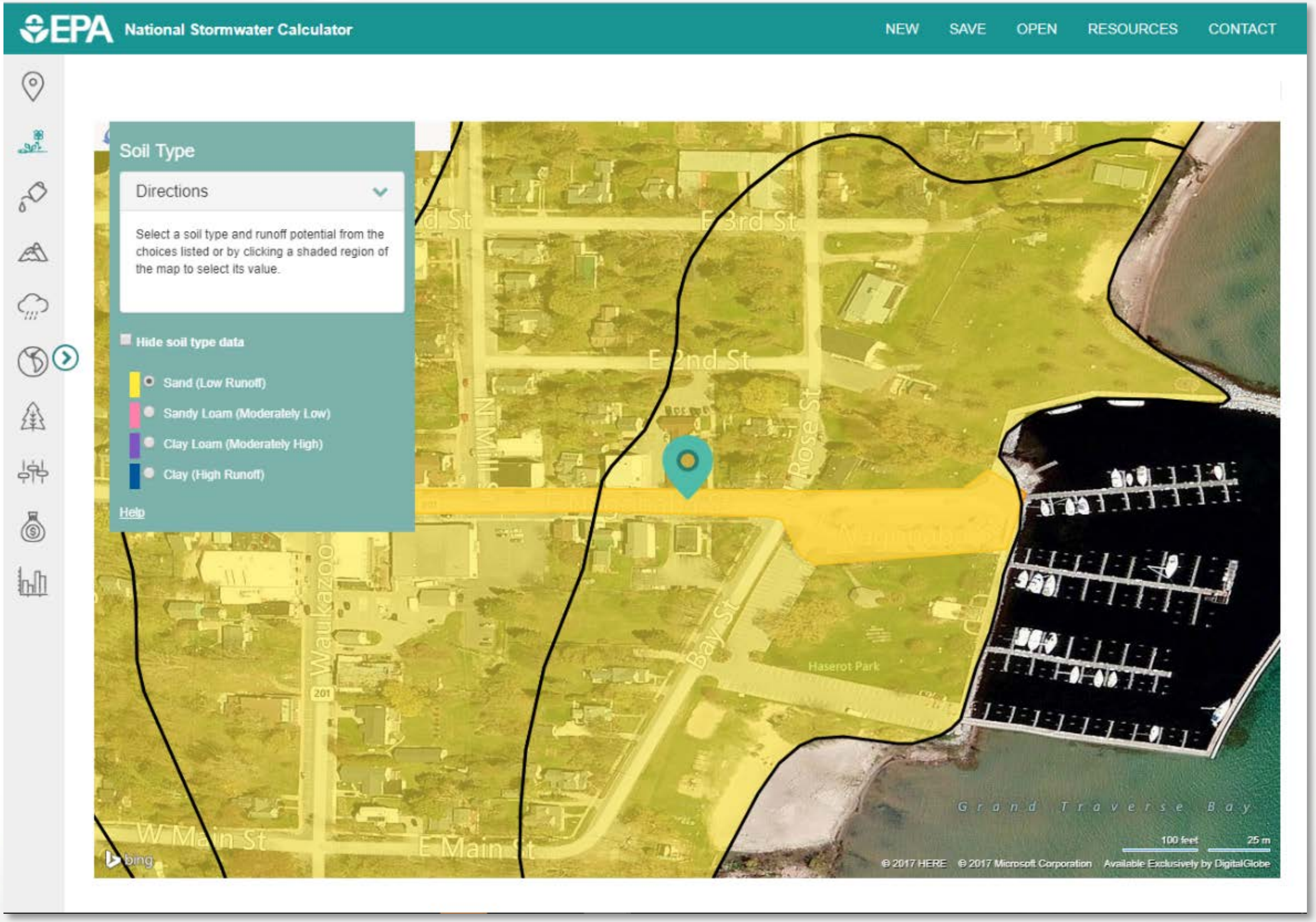
SWC Web App Application: Northport, MI



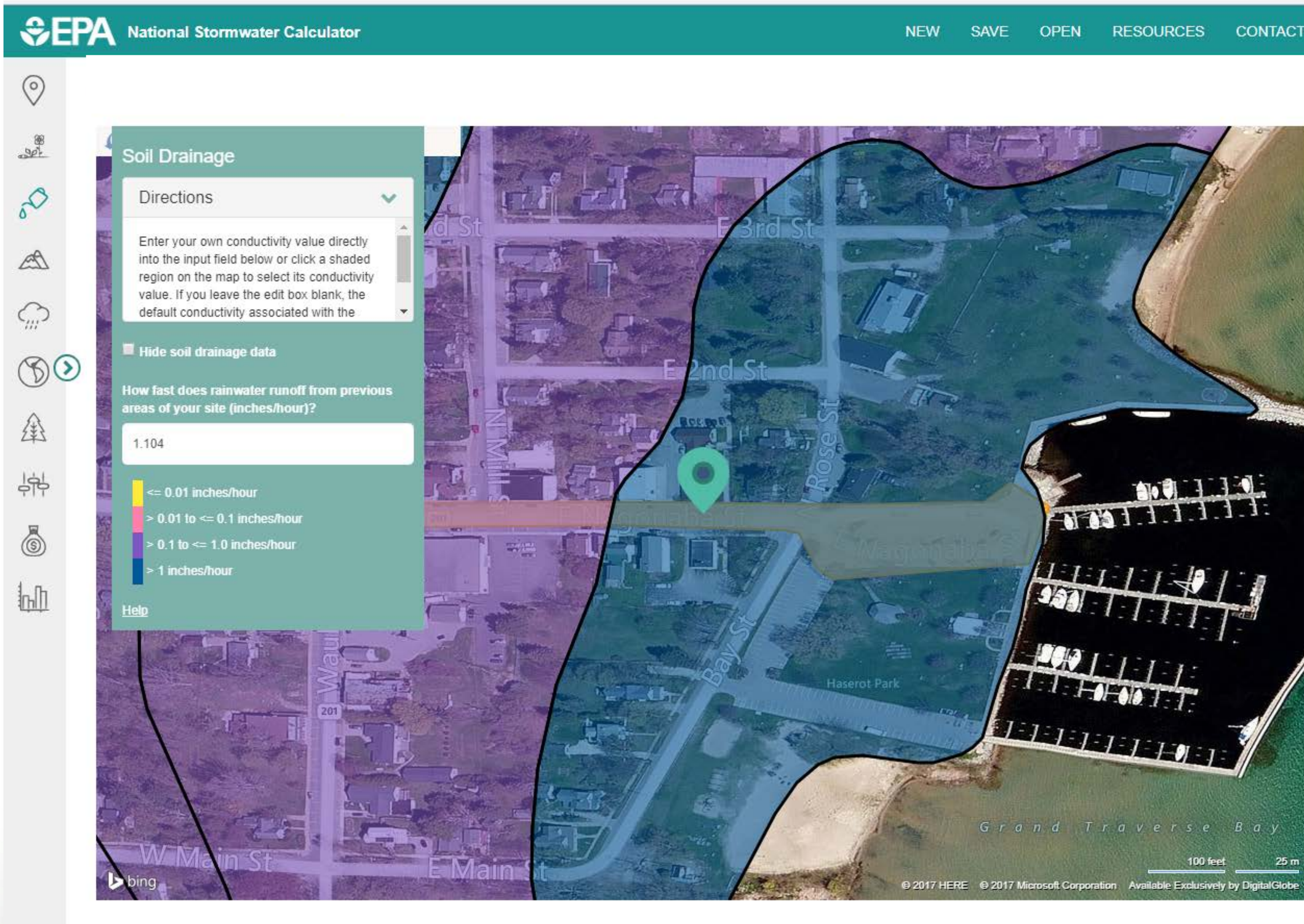
The Watershed Center Grand Traverse Bay (2016)



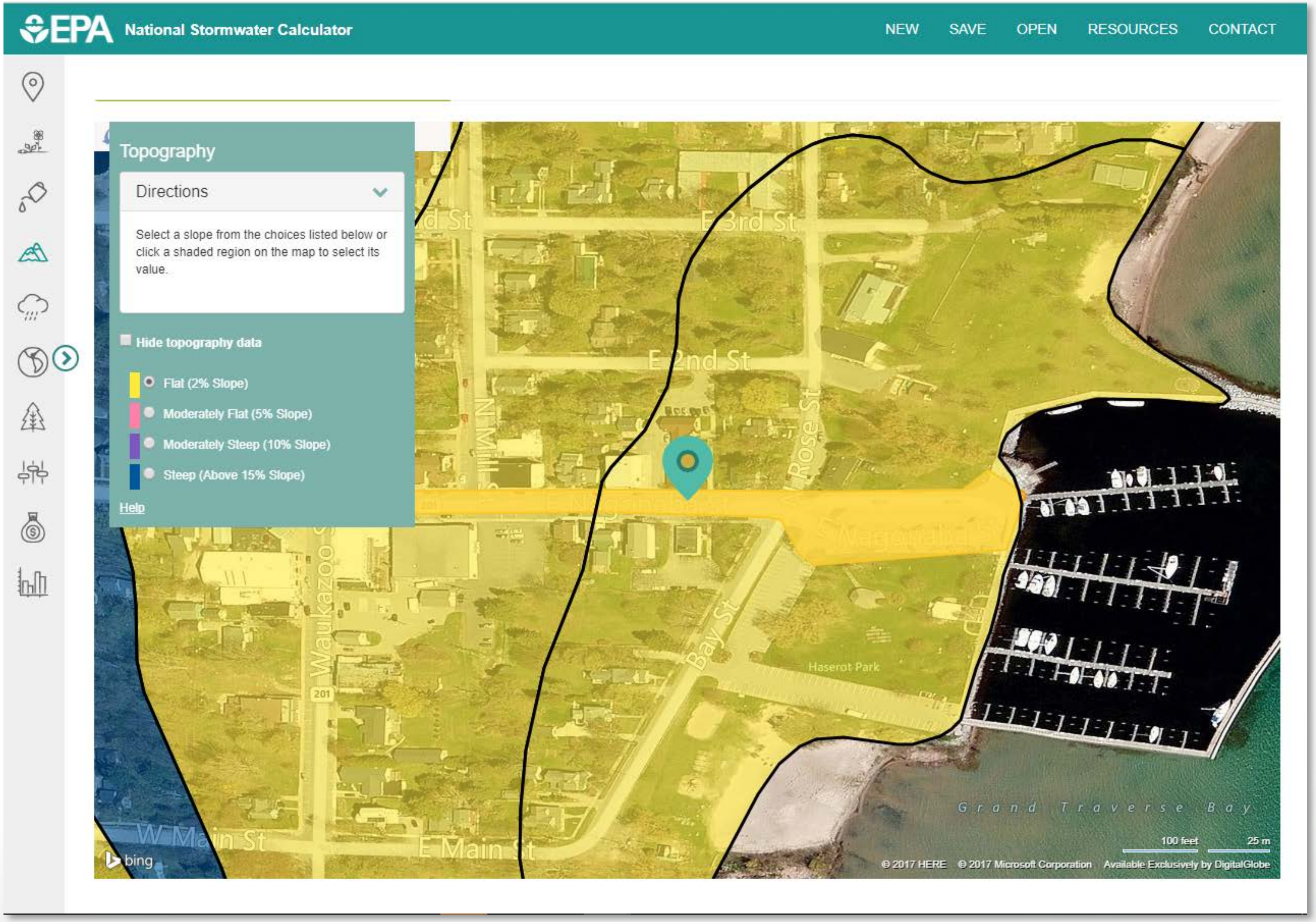
Soil Runoff Potential



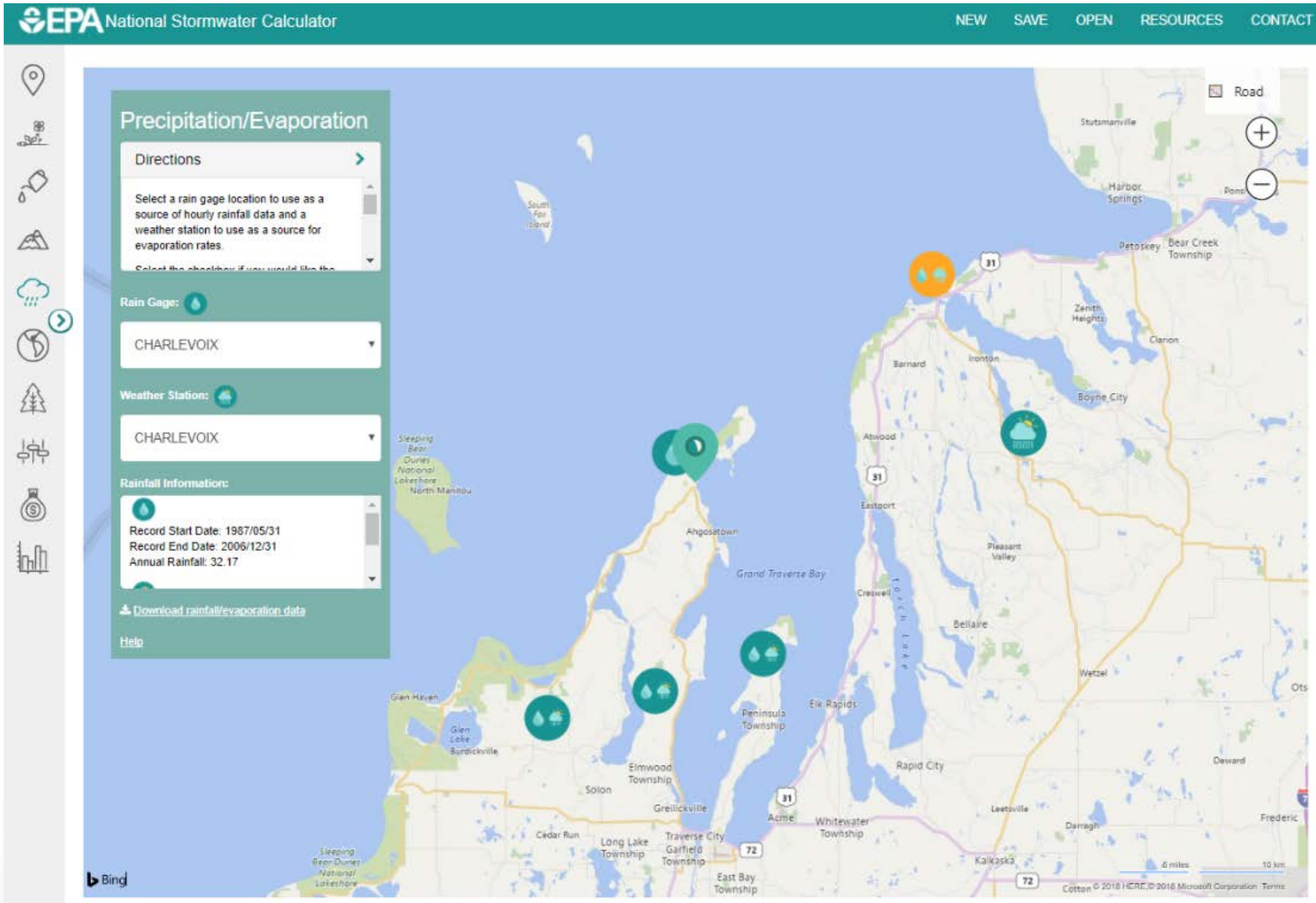
Soil Infiltration Capacity



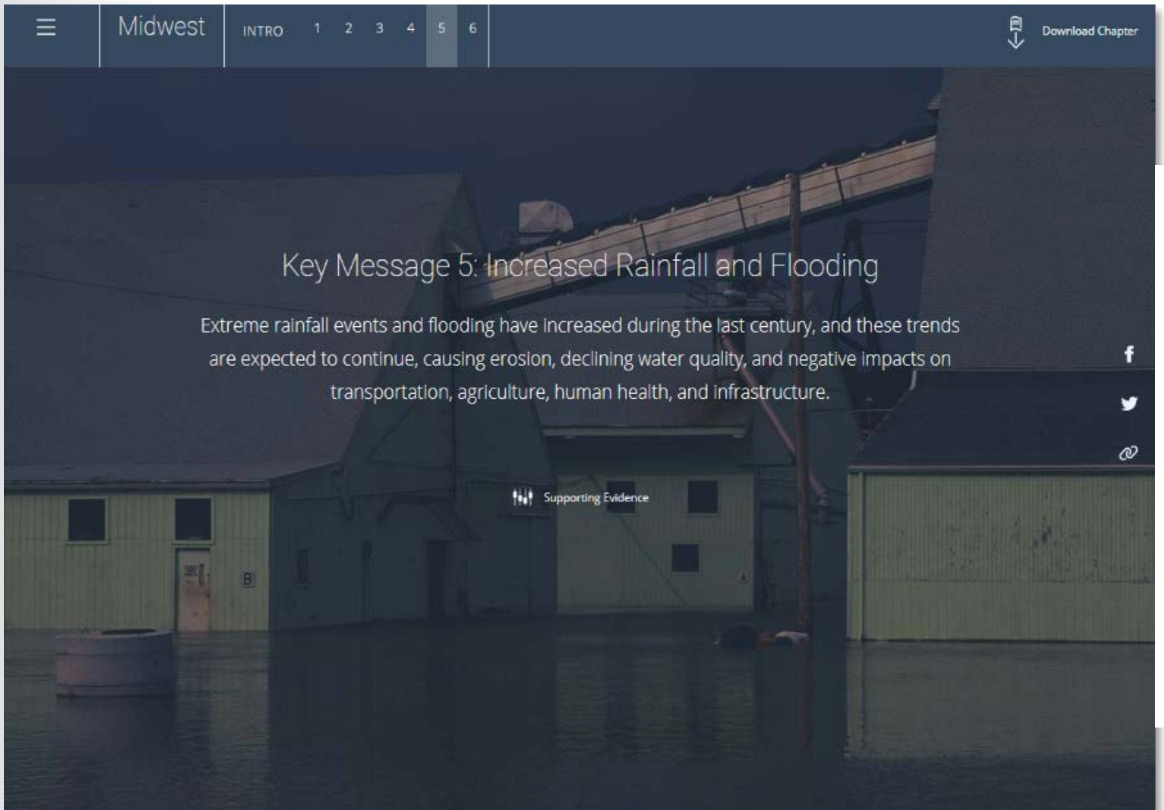
Topography/Slope

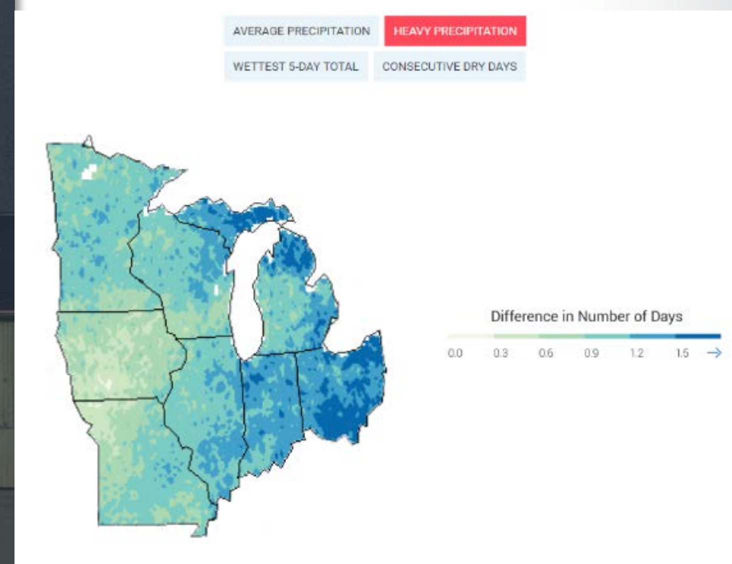


Historical Weather (Precipitation & Evaporation)

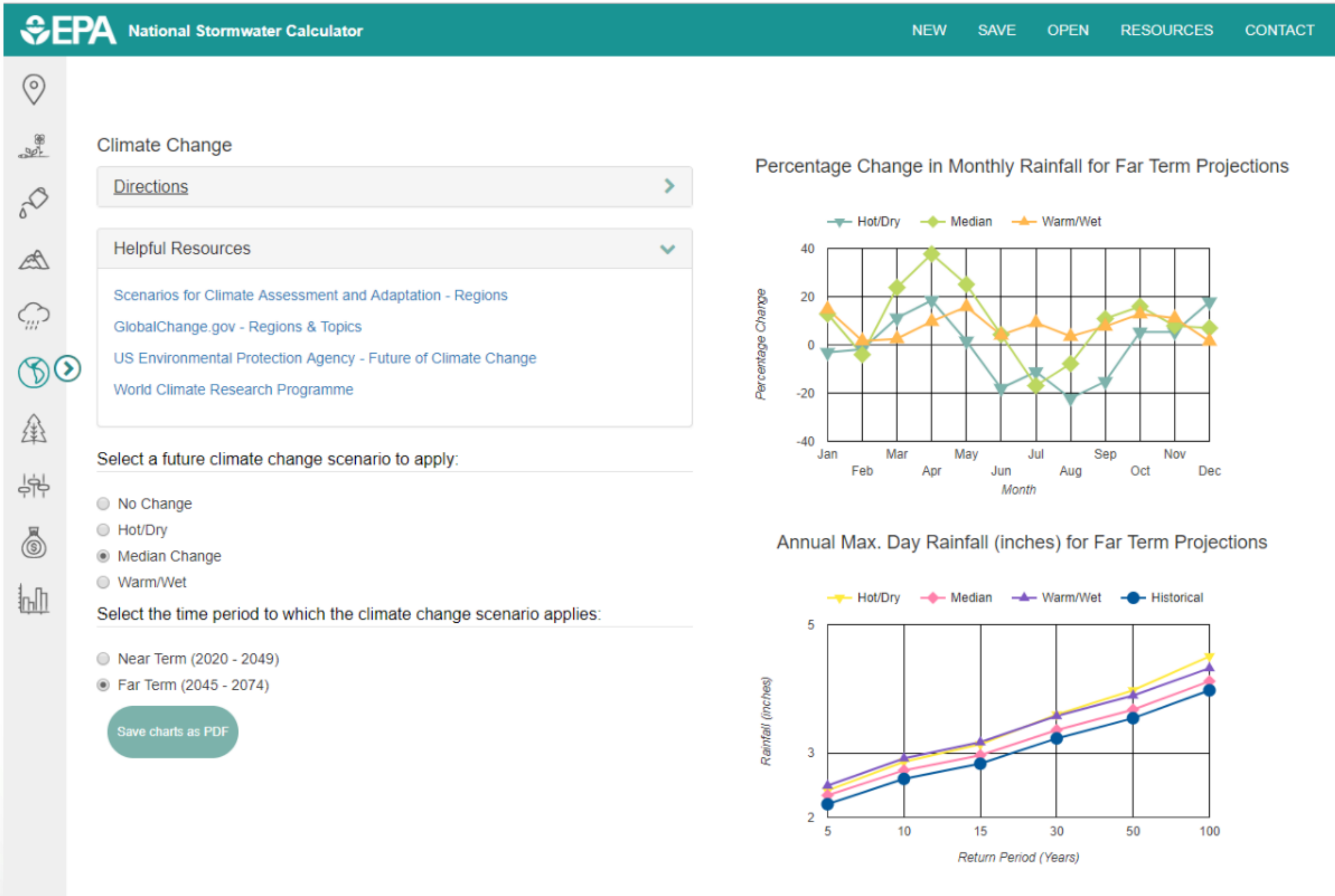


Climate Change Scenarios & Extreme Storm Events

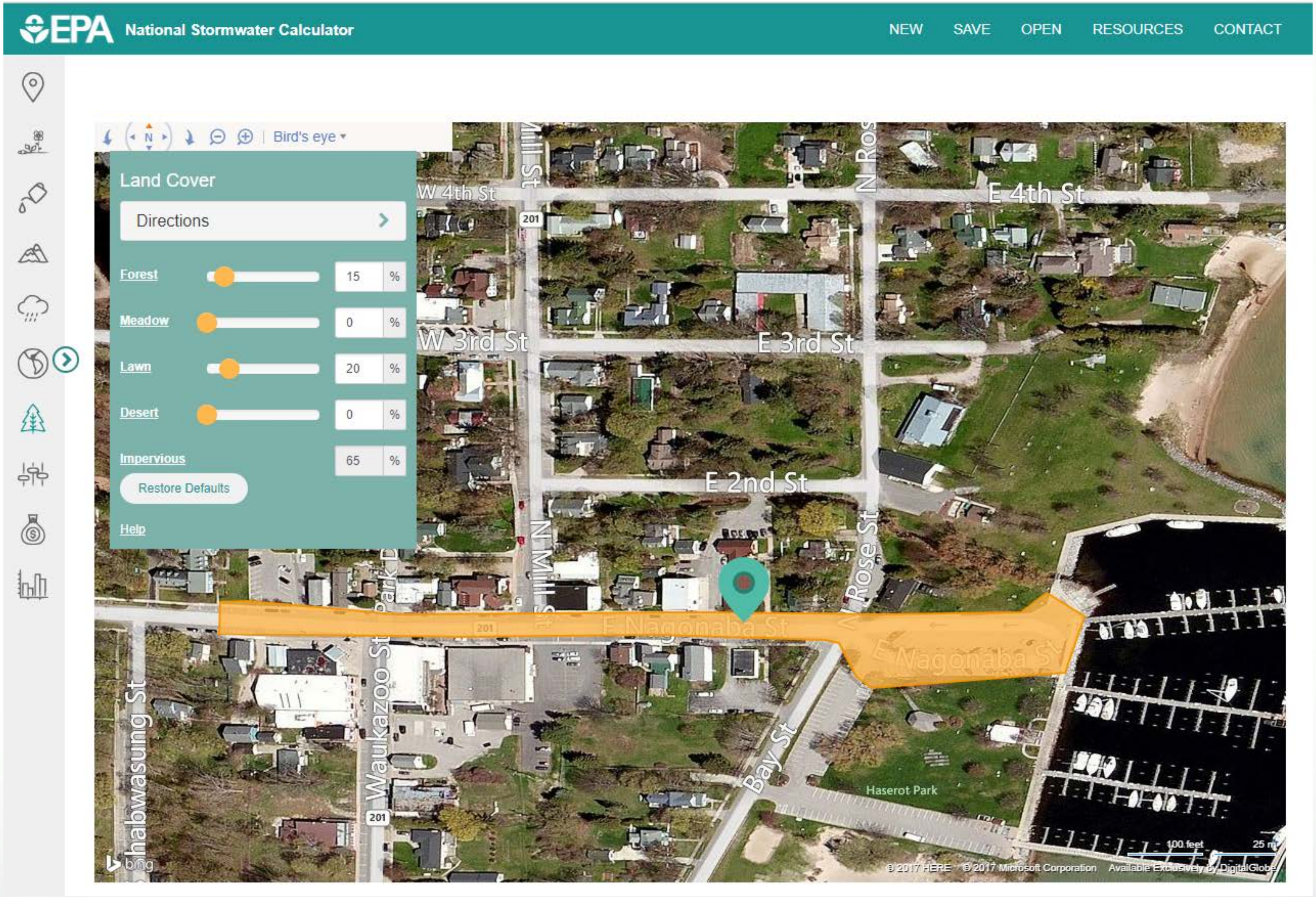




Climate Change Scenarios & Extreme Storm Events



Land Cover



EPA National Stormwater Calculator
NEW
SAVE
OPEN
RESOURCES
CONTACT
Bird's eye
Land Cover
Directions
Forest 15 %
Meadow 0 %
Lawn 20 %
Desert 0 %
Impervious 65 %
Restore Defaults
Help
W 4th St
E 4th St
W 3rd St
E 3rd St
E 2nd St
N Mill St
N Rose St
E Nagonaba St
Bay St
Waukazoo St
Haserot Park
100 feet
25 m
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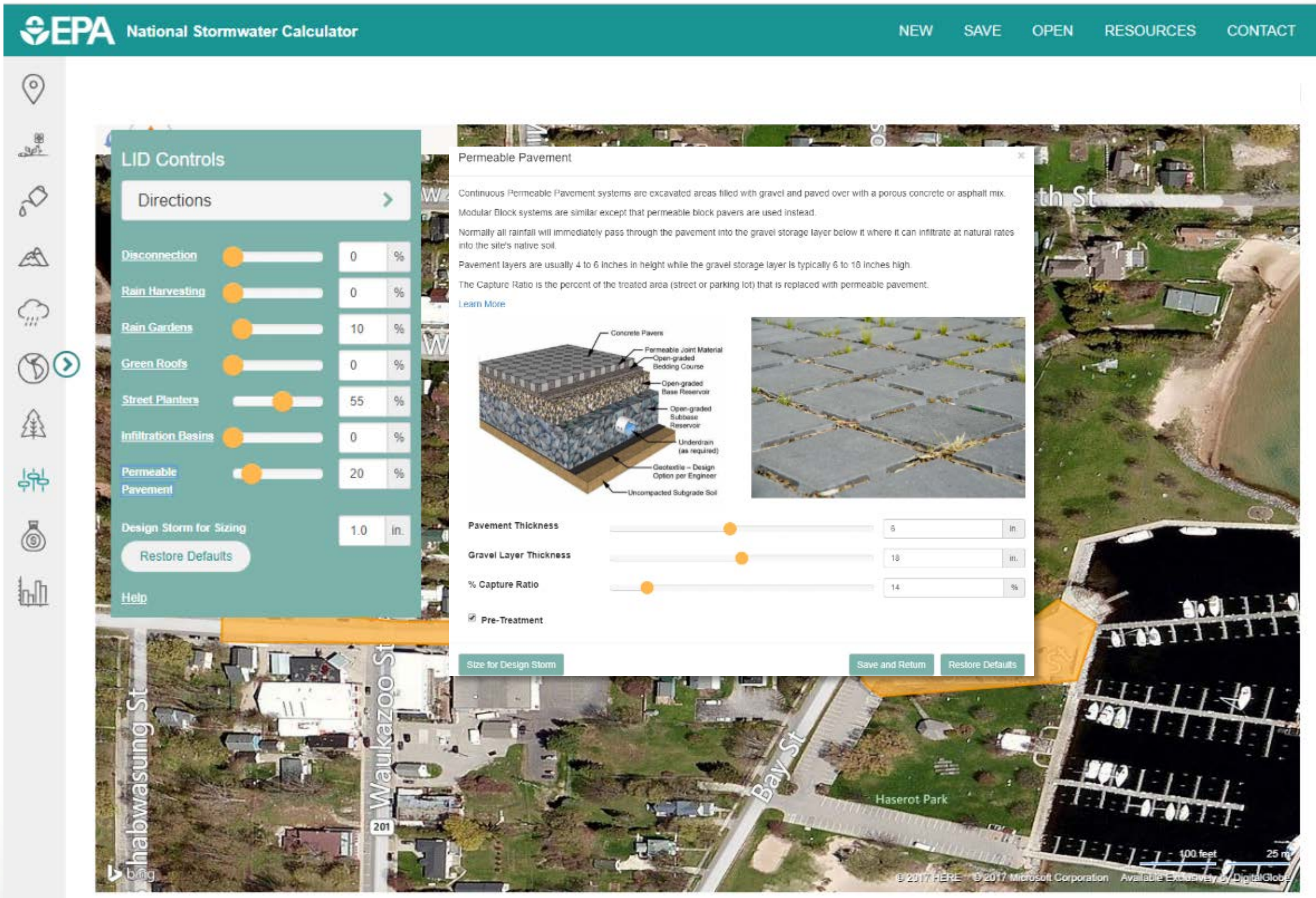
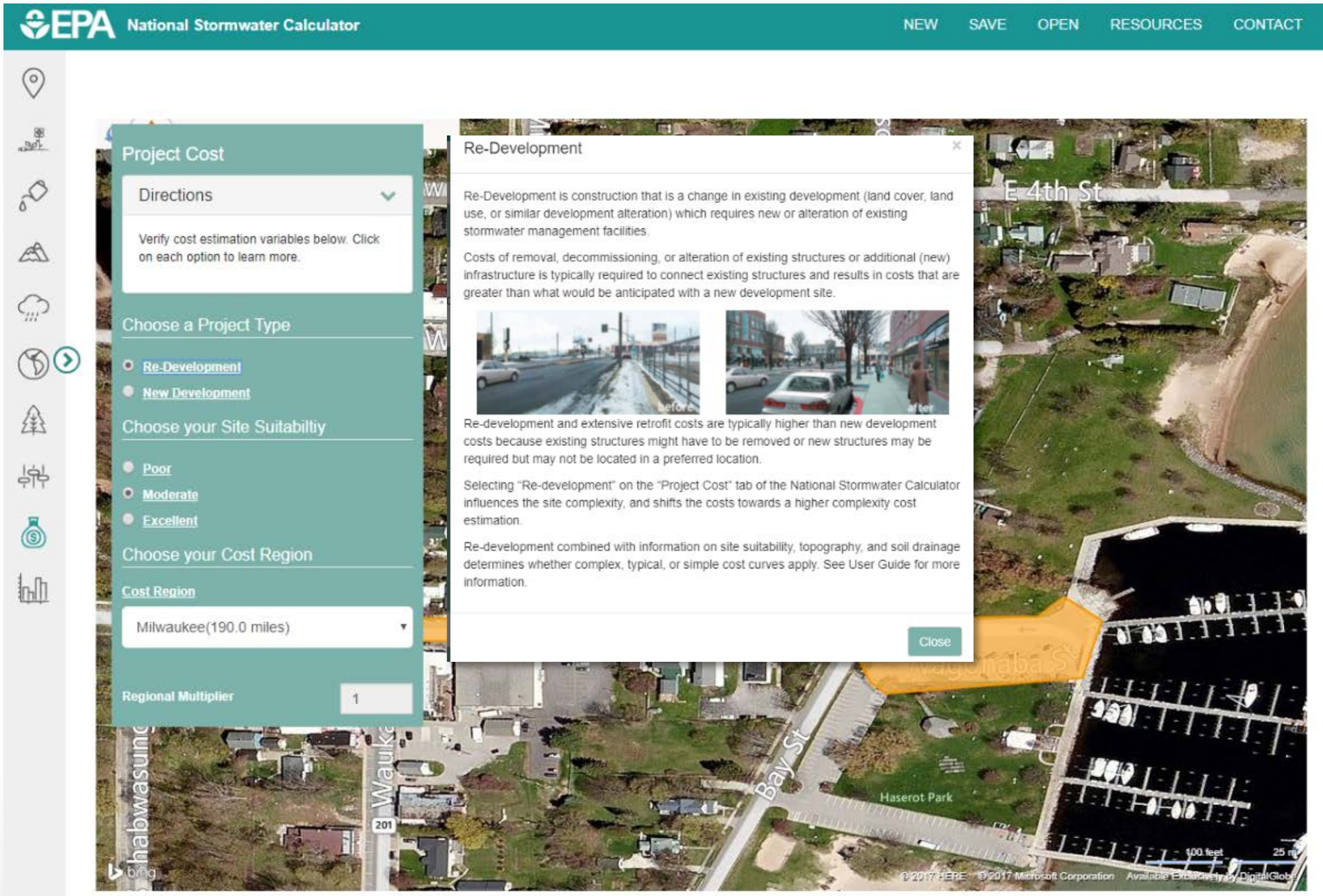
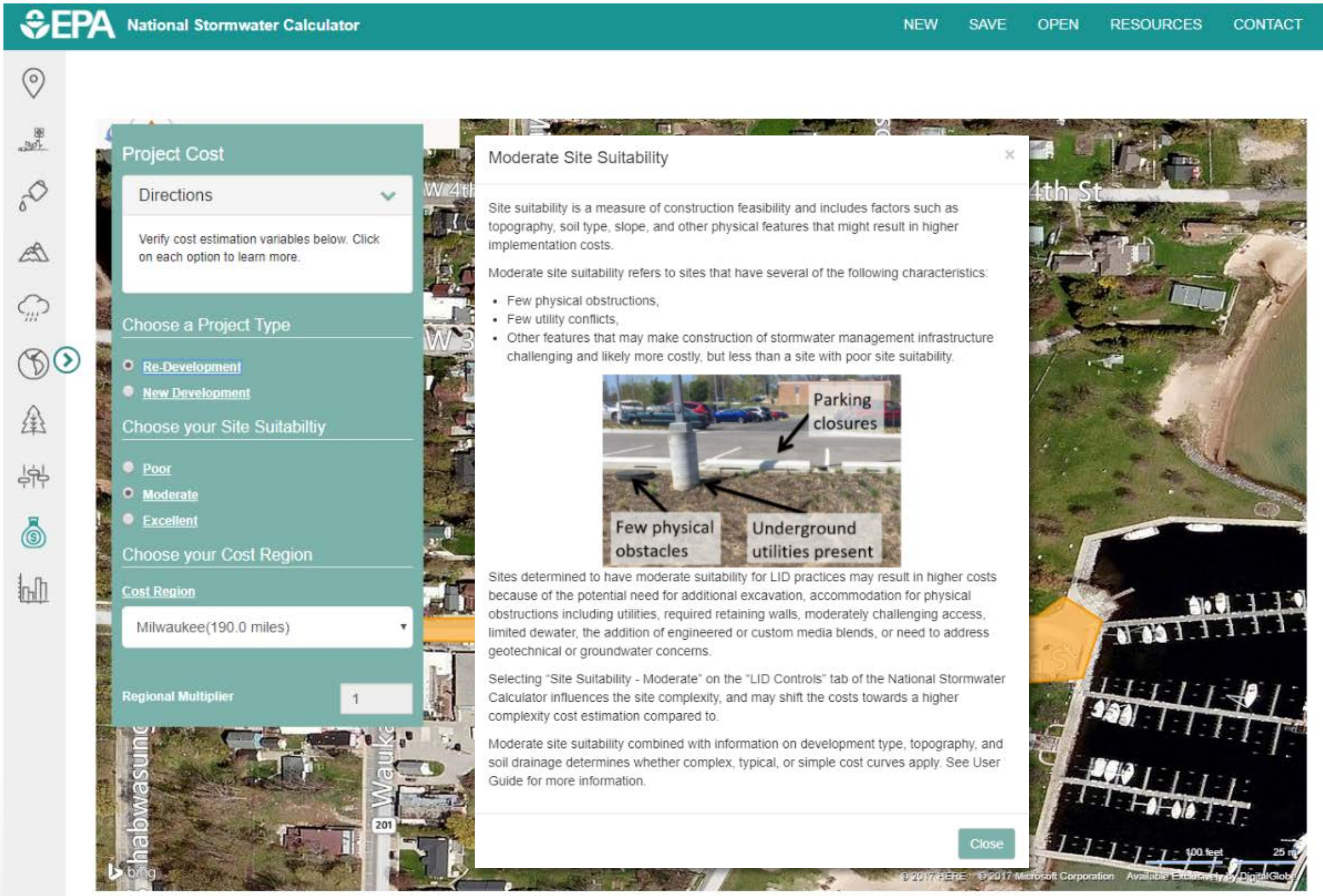
LID Controls



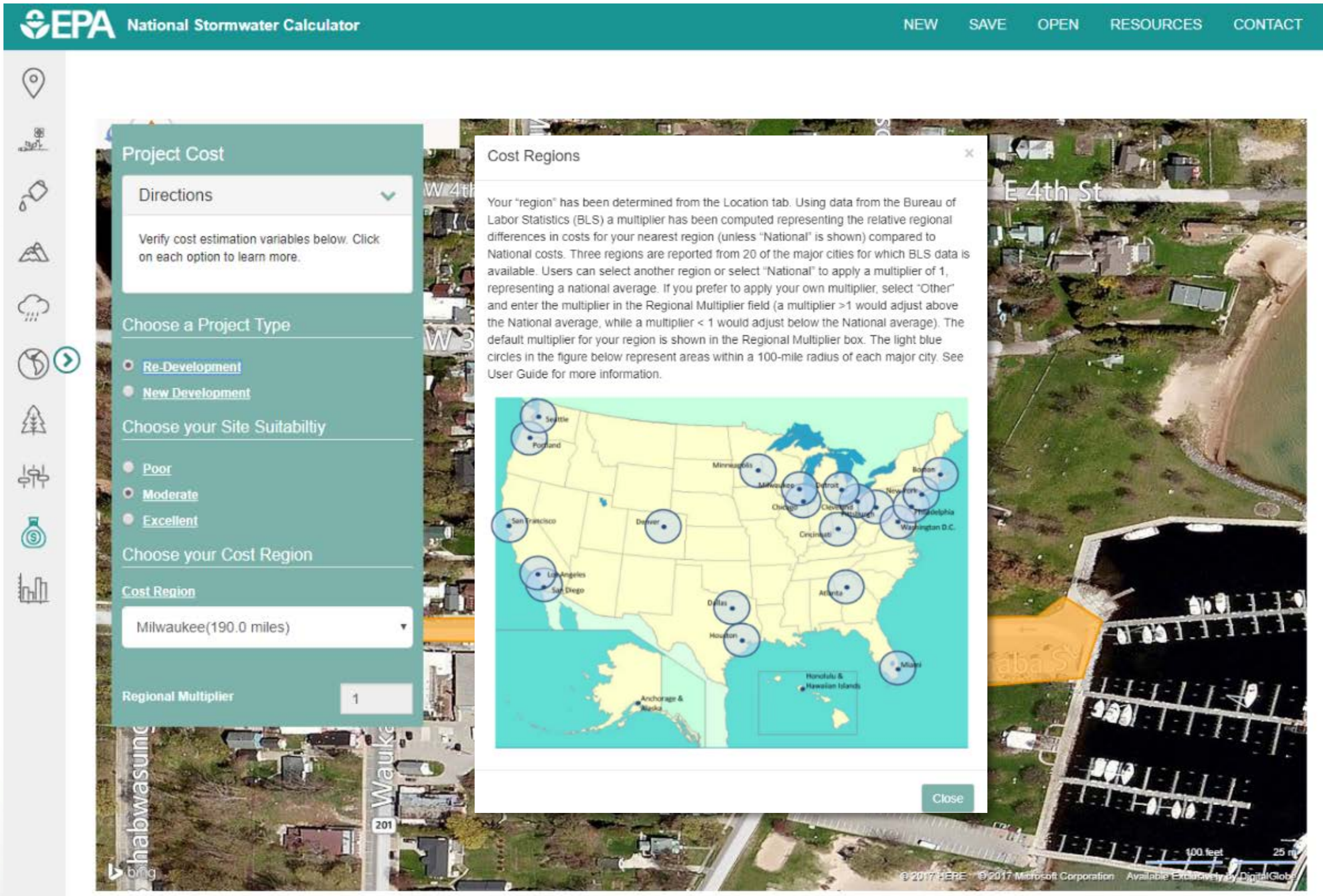
Project Costs: Development Type



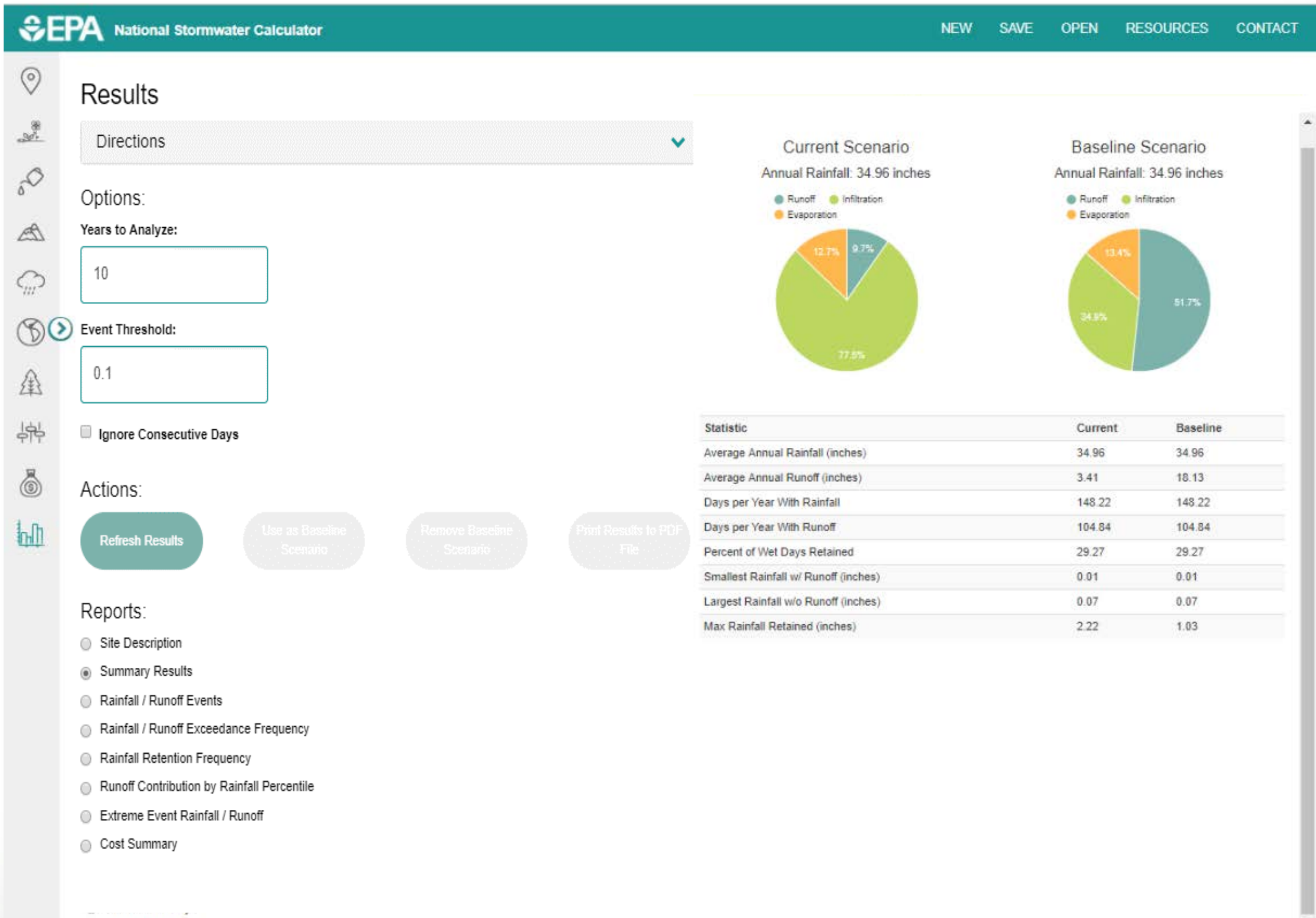
Project Costs: Site Suitability



Project Costs:
Bureau of Labor Statistics Cost Region



Results Summary



Results: Costs Summary

EPA National Stormwater Calculator — NEW | SAVE | OPEN | RESOURCES | CONTACT

Directions

Options:

Years to analyze: 10

Event threshold (inches): 0.00

Ignore Consecutive Days

Actions:

Actions:

Refresh Results | Use as Baseline Scenario | Remove Baseline Scenario | Print Results to PDF File

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

Cost Summary

Tabular View | Graphical View

Estimate of Probable Capital Costs (estimates in 2016 US $)

LID Control Type	Drainage Area %		Has Pre-Treatment?		Current Scenario (C)		Baseline Scenario (B)		Difference (C - B)	
	Current	Baseline	Current	Baseline	Low	High	Low	High	Low	High
Disconnection	0	0	No	No	$0	$0	$0	$0	$0	$0
Rainwater Harvesting	0	0	No	No	$0	$0	$0	$0	$0	$0
Rain Gardens	10	0	Yes	No	$4,867	$9,329	$0	$0	$4,867	$9,329
Green Roofs	0	0	No	No	$0	$0	$0	$0	$0	$0
Street Planters	55	0	No	No	$8,766	$23,274	$0	$0	$8,766	$23,274
Infiltration Basins	0	0	No	No	$0	$0	$0	$0	$0	$0
Permeable Pavement	20	0	Yes	No	$12,761	$17,391	$0	$0	$12,761	$17,391
Total	85%	0%			$26,394	$49,994	$0	$0	$26,394	$49,994

Estimate of Annual Probable Maintenance Costs (estimates in 2016 US $)

LID Control Type	Current Scenario (C)		Baseline Scenario (B)		Difference (C - B)	
	Low	High	Low	High	Low	High
Disconnection	$0	$0	$0	$0	$0	$0
Rainwater Harvesting	$0	$0	$0	$0	$0	$0
Rain Gardens	$50	$1,218	$0	$0	$50	$1,218
Green Roofs	$0	$0	$0	$0	$0	$0
Street Planters	$103	$2,439	$0	$0	$103	$2,439
Infiltration Basins	$0	$0	$0	$0	$0	$0
Permeable Pavement	$131	$714	$0	$0	$131	$714
Total	$284	$4,371	$0	$0	$284	$4,371

Note: Site complexity variables that affect cost shown below:

Potential Next Steps After Using the SWC

- Sharing planning results with decision-makers
- Applying for funding
- Developing construction plans/designs
- Construction

http://news.maryland.gov/dnr/2017/06/29/over-800000-announced-to-support-local-green-infrastructure-projects-to-improve-communities-and-provide-jobs/

Contact Information

- **Jason T. Bernagros** (Office of Research and Development (ORD), National Risk Management Research Laboratory):
berner.jason@epa.gov , 202-566-1671

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

Office of Research and Development

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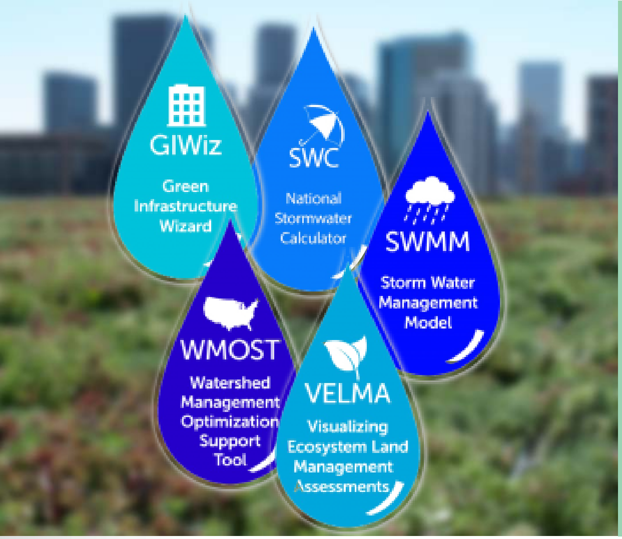

Questions and Answers Session