THE Water Research FOUNDATION

Community-enabled Lifecycle Analysis of Stormwater Infrastructure Costs (CLASIC)

EPA National Priorities Grant #836173

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UNIVERSITY OF MARYLAND
ENVIRONMENTAL FINANCE CENTER

The UMD EFC is one of ten regional centers across the country providing communities with the tools and information necessary to manage change for a healthy environment and an enhanced quality of life. The UMD EFC has worked with communities and watershed organizations on environmental challenges throughout the Mid-Atlantic region for over 25 years. While also partnering with other EFC's on projects across the country, the UMD EFC specifically serves the EPA Region 3 states - Delaware, Maryland, Pennsylvania, Virginia, West Virginia - and the District of Columbia.

Community-enabled Lifecycle Analysis of Stormwater Infrastructure Costs

CLASIC Vision

The CLASIC tool is a user-informed screening tool which utilizes a lifecycle cost framework to support stormwater infrastructure decisions on extent and combinations of green, hybrid green-gray and gray infrastructure practices.

Questions the CLASIC Tool Seeks to Answer

- How do various scenarios of stormwater infrastructure compare in terms of:
  - Lifecycle cost
  - Runoff volume reduction
  - Pollutant removal
  - Social benefits
  - Environmental benefits
- How does climate change and land use change effect future performance of scenarios of green and gray infrastructure?
- How do maintenance and long-run costs compare for user selected scenarios?

Community engaged

- 10 EPA Regions
- 30 different municipalities
- User profiles
  - Stormwater treatment and storage
  - Compliance
  - Operations planning and long term maintenance
  - GI policy maker
  - Business/developers

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Getting Started

- Vision
- Functionality
- Components
- Steps
- User Guide

CLASIC Tool Steps

The icons on the left panel will guide you through the steps of the CLASIC tool (Figure 3). Click on the Select Area icon on the left panel to get started.

https://clasic.erams.com/docs/tool-steps?token=H7ZDyz

Output	Included in CLASIC tool
Pollutant Load Reduction	· TSS · TN · TP · FIB
Hydrologic	· Runoff Volume · Volume Infiltrated · Volume Evapo-transpired · Number of runoff events

LCC	· Present Value
	  ○ Construction
	  ○ Maintenance
	  ○ Rehabilitation
	· Average Annual Cost Over Design Life
	· Per unit cost for scenario comparison

Co-Benefits	· Score of economic, environmental, social performance based on user selected importance factors and performance output

Web-based Geospatial Tool

- Web-based platform developed at Colorado State University
  - Interface
  - Input Parameters
  - Outputs
- Deployed using the Environmental Resource Assessment and Management System (eRAMS)

Collect Input Parameters & Targets

- Soil Datasets (SSURGO/STATSGO)
  - Soil Type
  - Slope
- Land Use/Land Cover (NLCD)
  - % Open, Low, Medium, High, and Other
    - Water Quality (TSS, TP, TN)
    - Overland Flow Length
- Imperviousness (NLCD)
- Climate
  - Precipitation (NOAA – Stormwater Calculator)
  - Evaporation (NOAA – Stormwater Calculator)

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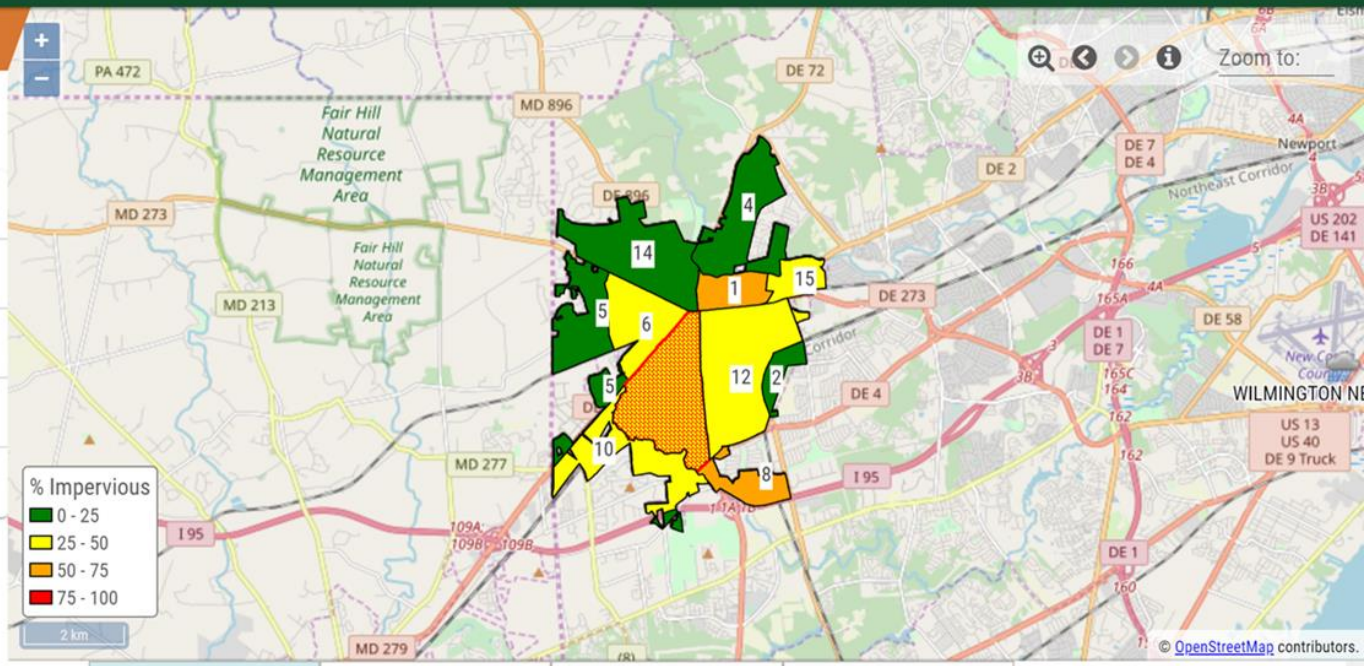
Model Defaults

Review and Modify Default Parameters

- Subunit Parameters
- Water Quality
- Overland Flow Length
- Infiltration
- Technology Effluent



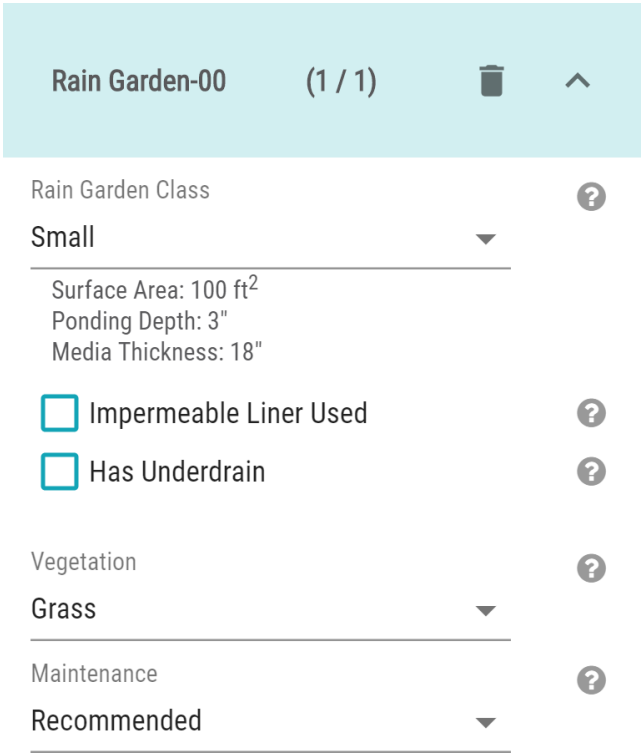
Subunits | Water Quality | Overland Flow Length | Infiltration

subunit_id	Area (Ac)	Impervious (%)	Slope (%)	Open (%)	Low (%)	Medium (%)	High (%)	
1	244.98	54	5	12	19	35	26	8
2	137.13	22	5	23	13	22	2	40
4	657.05	19	6	26	25	9	4	37
5	577.38	24	3	28	36	11	3	21

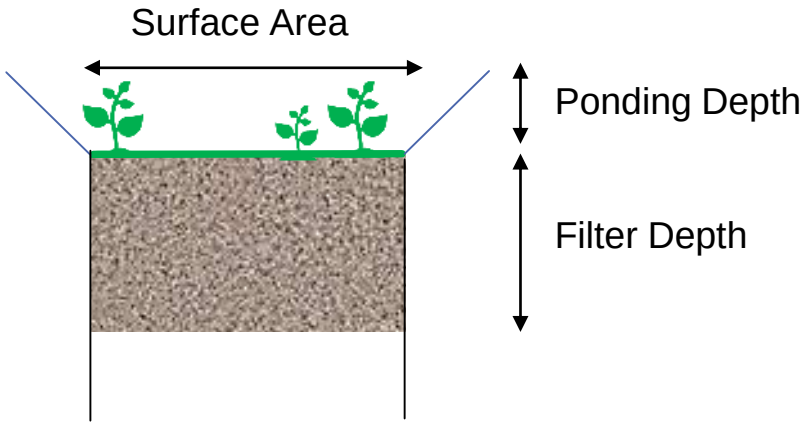
Technology Categories

- Rain Gardens
- Sand Filter
- Infiltration Trench
- Permeable Pavement
- Green Roofs
- Disconnection
- Grass Swales
- Extended Detention Basins
- Wet Pond
- Stormwater Harvesting
- Storage Tunnel/Vault

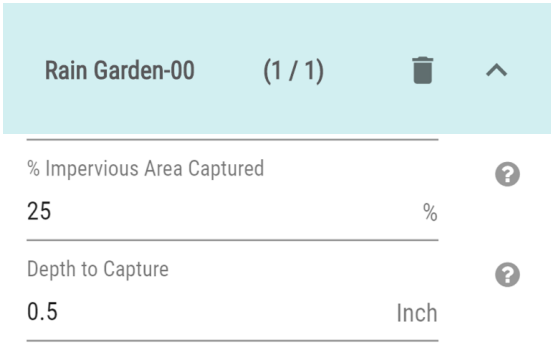
Adding Stormwater Infrastructure



A technology unit treats a specific **volume** or **area** that is defined within the CLASIC tool. Technologies may vary in terms of size and design parameters.

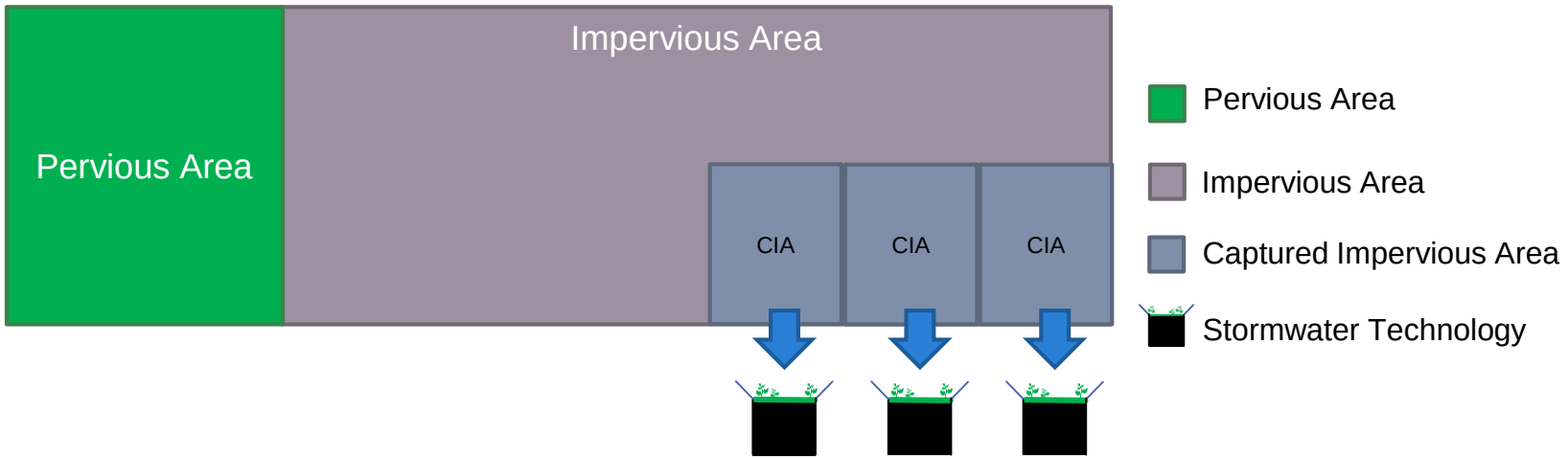


Adding Stormwater Infrastructure

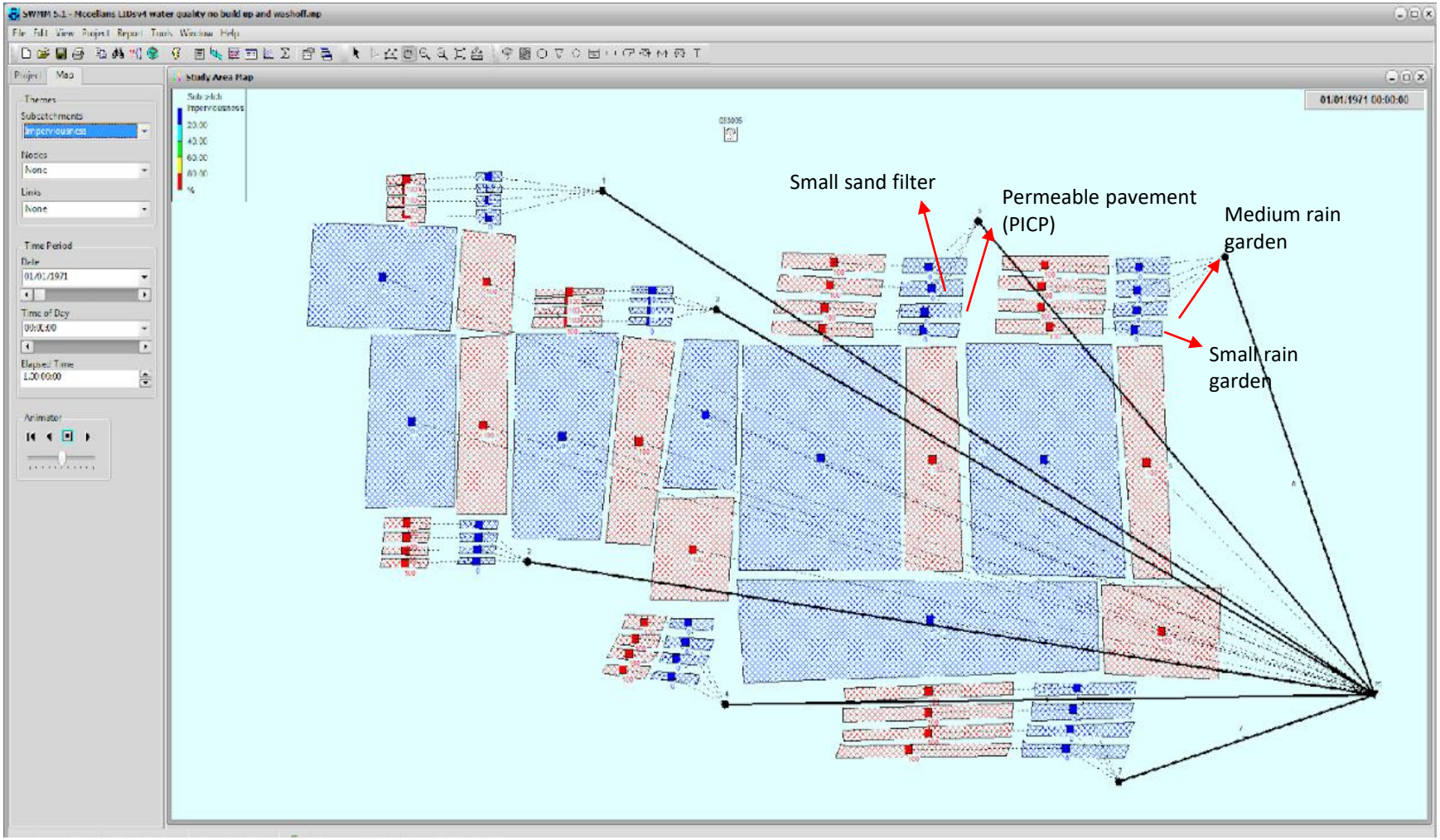


Stormwater technologies are then scaled based on:

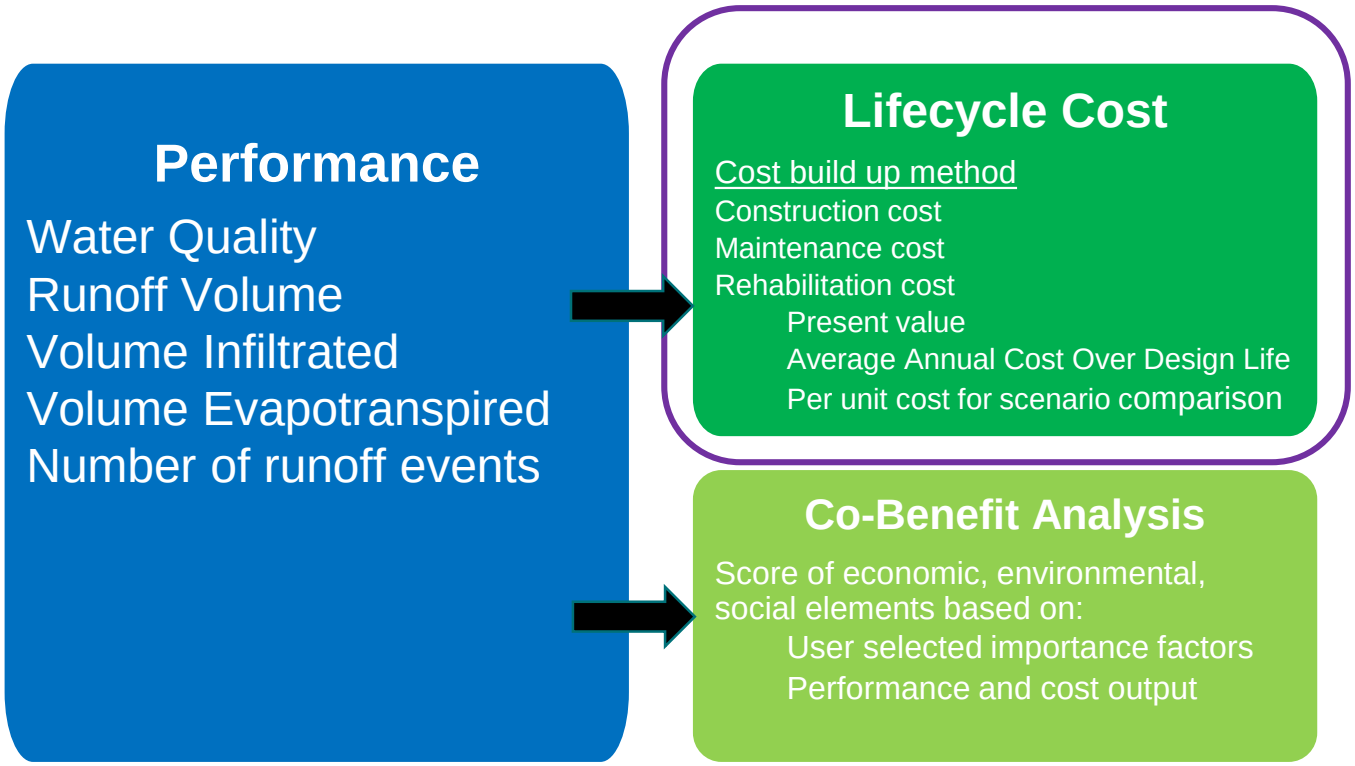
1) Area desired to be captured
2) Rainfall depth or run-on ratio



Model developed in SWMM



Three Basic Outputs



Lifecycle Cost

Following NIST, 1996; USACE/EPA, 2000; USEPA, 2008

$$LCC = C_0 + \left[\sum_{t=1}^{T} M_t + \sum_{t=1}^{T} C_r \right]$$

LCC = life cycle cost

C_0 = initial construction costs

M = routine and periodic maintenance costs

LCC Inputs, Assumptions

- Costs include regional adjustments
- Current dollar value includes “escalation” and/or “discount”
- Study period is user specified: 10, 20, 30, 50 years
- User adjusted discount rate 1 – 5%, default zero
- Rehabilitation value = portion of initial construction cost dependent on maintenance

Construction Cost Approach

- Line item build up for each technology
- Replacement cost calculated as a subset of initial construction line items counting salvage of select components
- Unit costs from DOT bid tabs
- Bid tab unit costs compared to RSMeans for validation

- Fixed combination of designs for each technology including small, medium and large sizes along with additional select parameters

Design Parameters Affecting Cost: Rain Gardens

Design Parameter	Small	Medium	Large
Surface Area (sq.ft)	100	1,000	10,000
Total Volume To Capture (cu.ft)	166	1656	16555
Ponding Depth (inches)	12	12	12
Filter Media Depth (inches)	18	18	18
Liner	Yes or No	Yes or No	Yes or No
Underdrain	Yes or No	Yes or No	Yes or No
Vegetation	Yes or No	Yes or No	Yes or No

Construction Cost Example: Rain Garden

Small Rain Garden (100 ft^2)

Liner	Under-drain	Land-scaping	Initial Cost	Major Rehab Cost
		YES	$7,693	$2,741
	YES	YES	$7,843	$2,741
YES	YES	YES	$7,974	$2,741
			$7,277	$2,590
	YES		$7,427	$2,590
YES	YES		$7,558	$2,590

Large Rain Garden (10,000 ft^2)

Liner	Under-drain	Land-scaping	Initial Cost	Major Rehab Cost
		YES	$ 105,734	$ 74,554
		YES	$ 107,233	$ 74,554
YES	YES	YES	$ 115,915	$ 74,554
			$ 64,121	$ 59,434
			$ 65,621	$ 59,434
YES	YES		$ 74,302	$ 59,434

Maintenance Cost Build Up: Rain Garden

Vegetated

Activity	Units	Freq-uency	Hours per Unit	Labor Crew Size	Labor Rate/ hour	Overhead Factor (%)	Equip Cost/ hour	Other Costs / Unit	Total
Compliance Inspection	***Each***	***1***	***1***	***1***	***$23.21***	***100%***	***$10.15***		***$56.77***
Spring/Fall Landscaping	MSF	2	2	2	$23.21	100%	$10.15		$393.26
Spot Revegetation	MSF	0.33	1	2	$23.21	100%	$10.15	$300.00	$139.92
Trash/Debris Removal	MSF	8	0.33	1	$23.21	100%	$10.15		$126.43

Base Cost: $56.77/year

Size Related Cost: $0.66/ft^2/year

Rain Garden-00 (1 / 1)

Rain Garden Class

Small

Surface Area: 100 ft^2
Ponding Depth: 3"
Media Thickness: 18"

☐ Impermeable Liner Used

☐ Has Underdrain

Vegetation

Grass

Maintenance

Recommended

% Impervious Area Captured

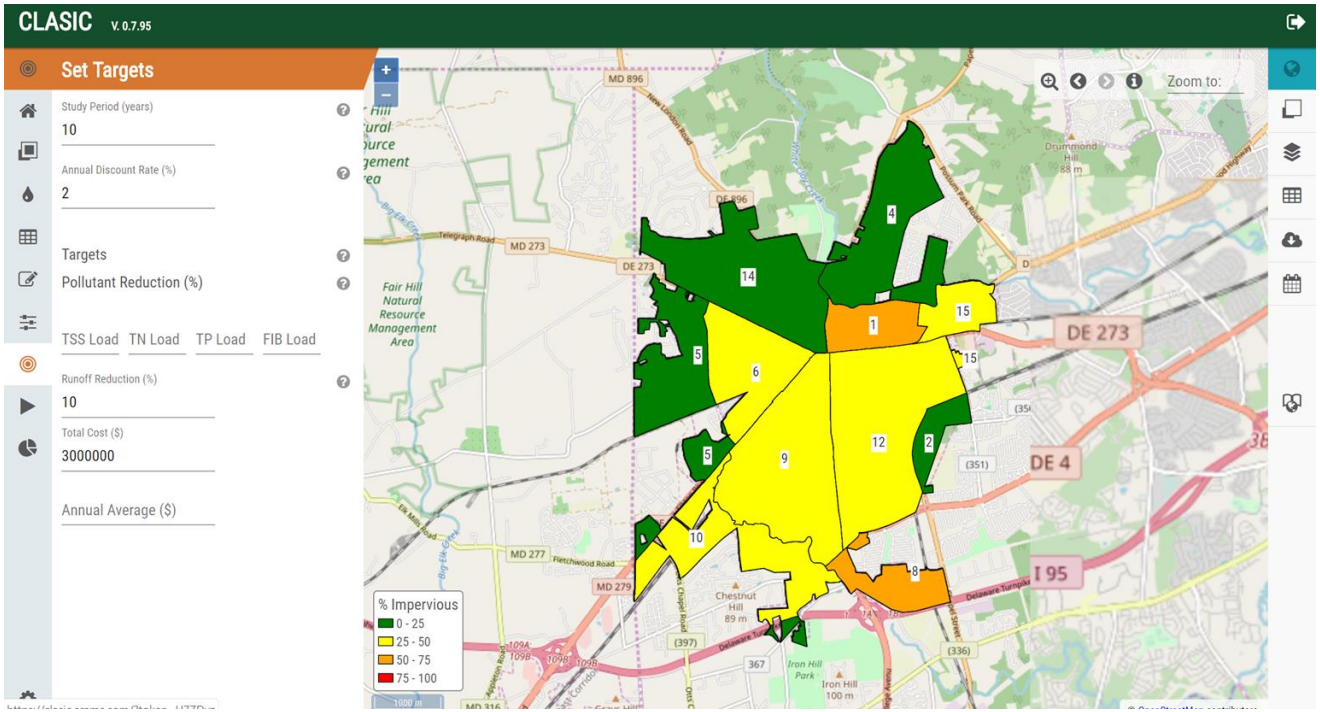
25 %

Depth to Capture

0.5 Inch

Technology Placement

Surrounding Pervious



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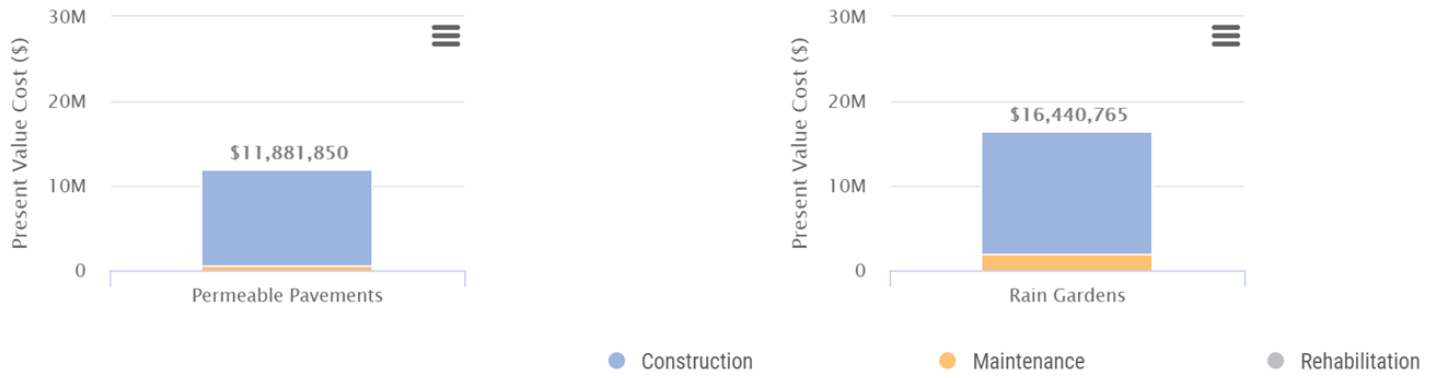
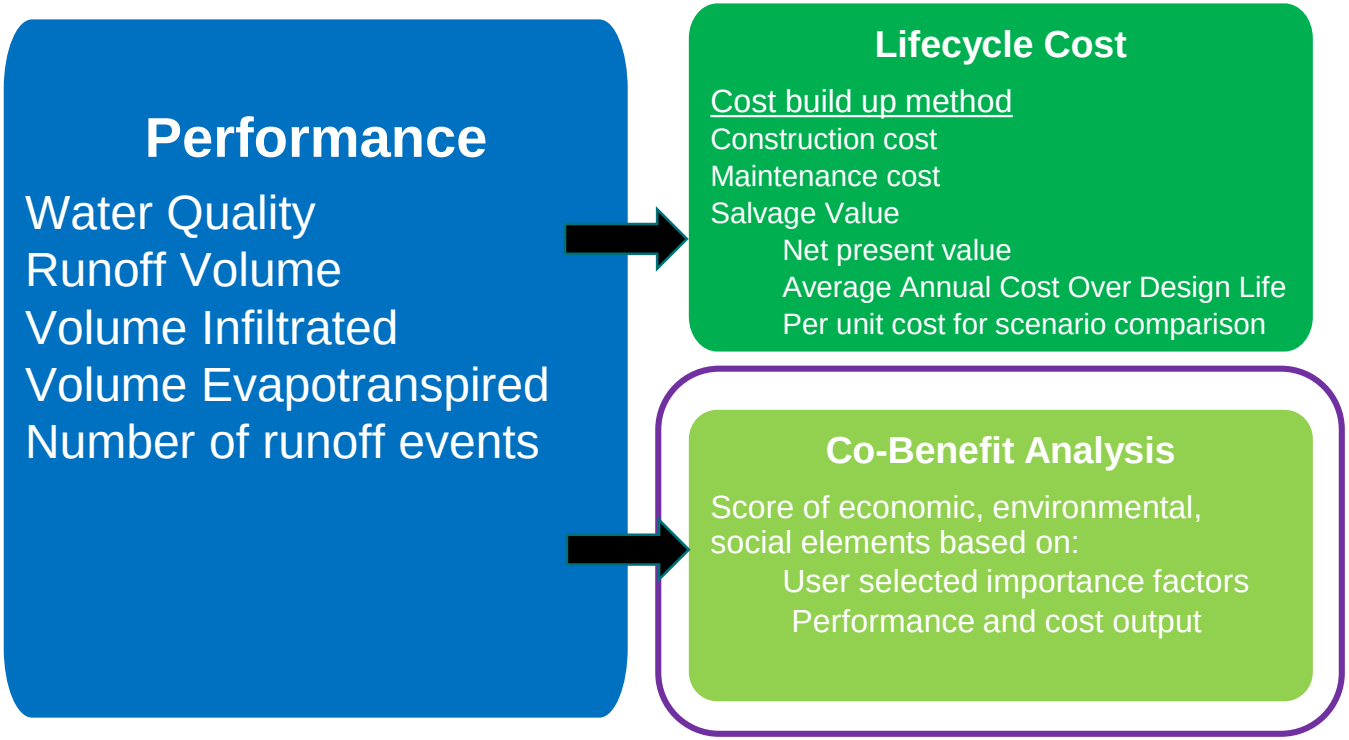
SUMMARY | COST | CO-BENEFIT | PERFORMANCE

Lifecycle Cost Analysis

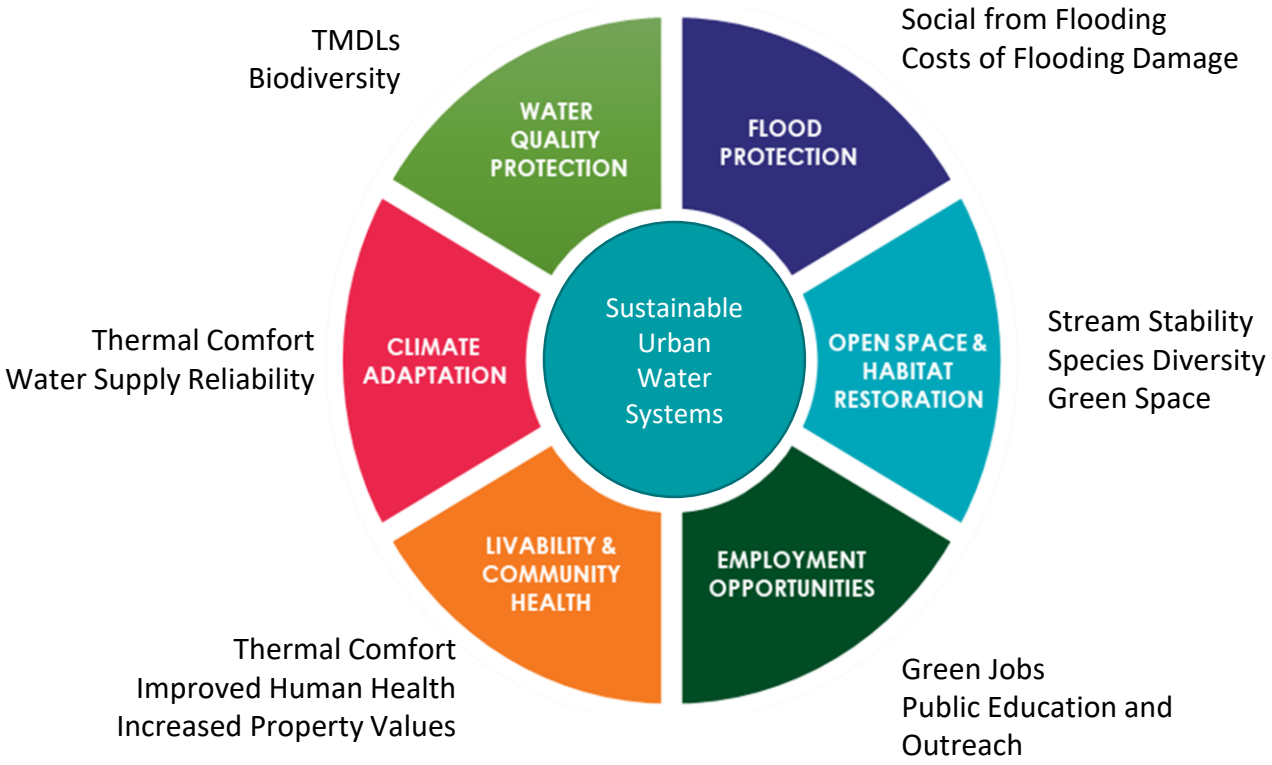


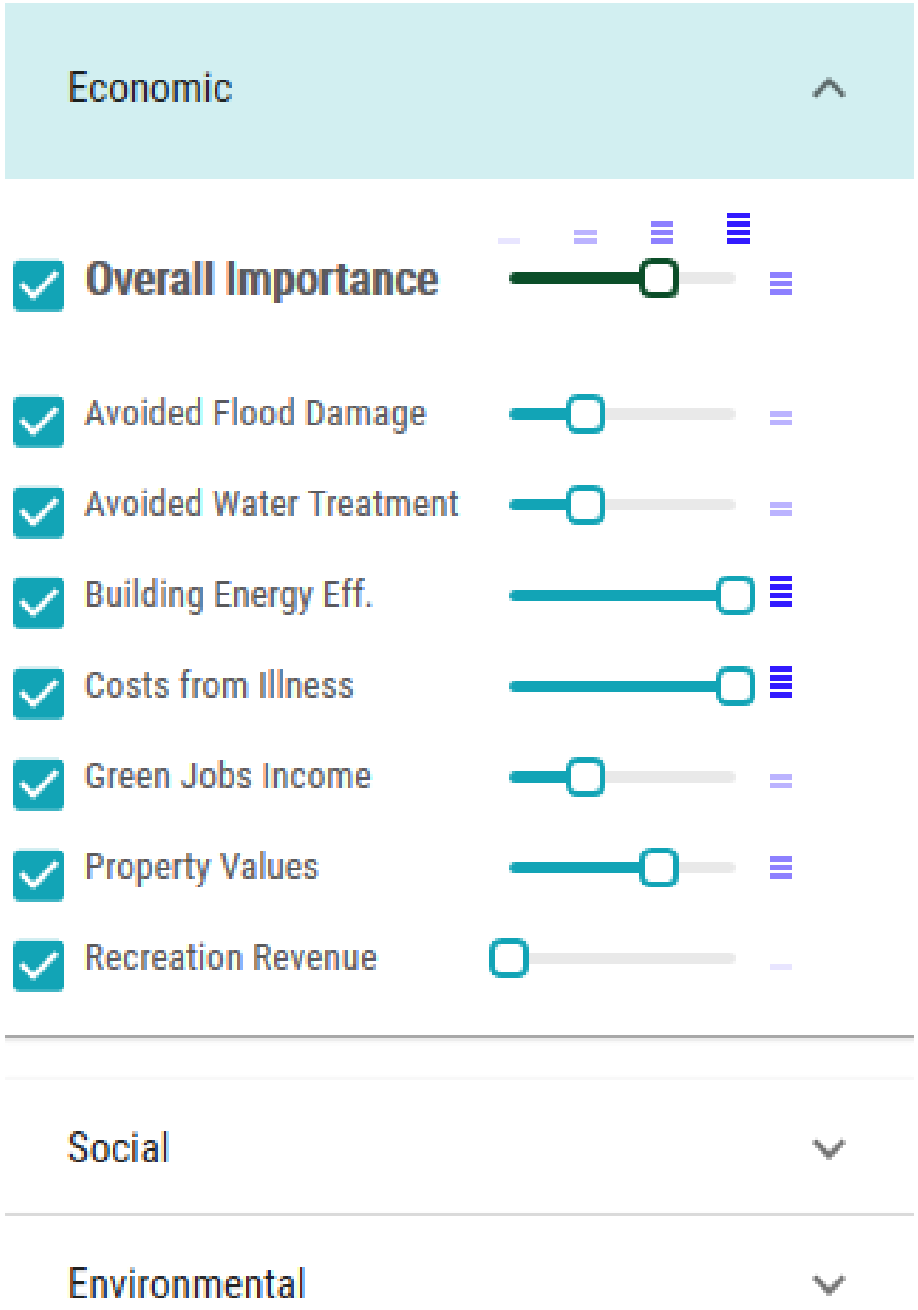
Average Annual Cost Over Design Life

3 Basic Outputs

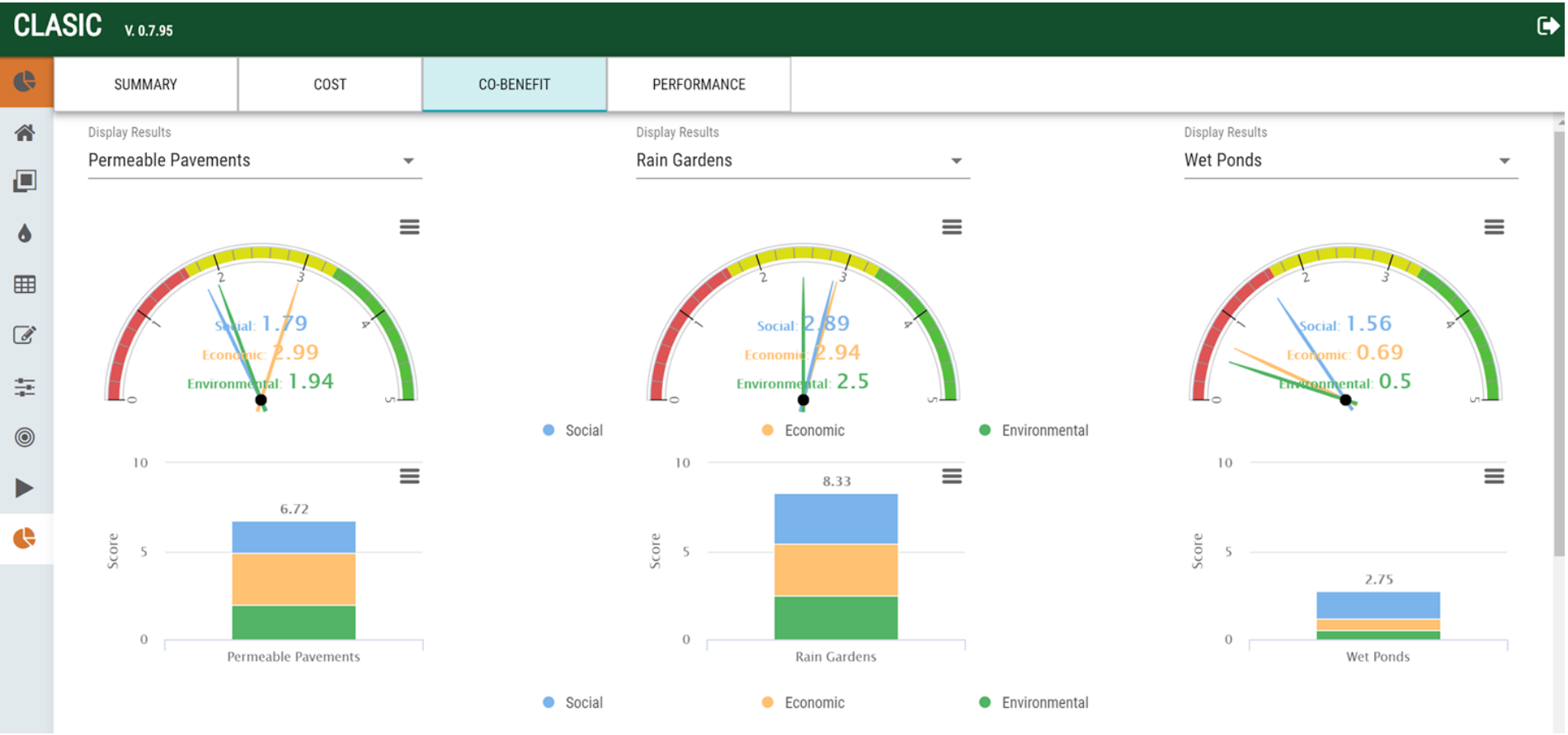


Co-Benefits Analysis





Indicator	CLASIC Output	Min/Max
Economic		
Revenue from water recreation	Pollutant load (TSS, TN, TP)	Min
Property Values	Pollutant load (TSS, TN, TP)	Min
	Area of added green space	Max
Avoided costs for illness resulting from air quality improvements	Area of added green space	Max
Building energy efficiency	Area of green roofs	Max
Avoided costs for water treatment due to reduced municipal water demand	Volume water harvested used	Max



Schedule for CLASIC Release

- Beta Testing: Complete
- CLASIC tool refinement: September – March 2020
- CLASIC tool final testing and case studies: March 2019 – May 2020
- Final refinement: June 2020
- CLASIC Tool Delivered: July 2020

Thank you!

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