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Rolling Out "Community-enabled Lifecycle Analysis of Stormwater Infrastructure Costs" (CLASIC) Tool

(EPA National Priorities Grant #836173)

Agenda

- Acknowledgement
- Brief Overview of Stormwater and Green Infrastructure Program at WRF
- CLASIC Tool Features and Demo
- Questions and Answers

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Brief Overview of Stormwater and Green Infrastructure Program at WRF

Harry Zhang, PhD, PE

Program Director – Integrated Water & Stormwater

The Water Research Foundation

Summary of Stormwater & Green Infrastructure Program

Performance Information

* Stormwater BMP Database
* Add Stream Restoration Module to BMP Database
* Algorithm Development

Maintenance Information

* Template to compare Green vs Gray Maintenance Costs
* Update BMP Whole Lift Cost Tool

Co-Benefit Analysis

* Workshop and Template for Co-Benefit Analysis
* Subsequent Data Development and Sharing of Co-Benefit Values

Permitting Guidance

* TCR for Stream Restoration as a BMP

Stream Restoration Crediting Guidance

Stormwater Harvesting

Flood Management / Resiliency

Integrated Decision Support System:

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

(EPA National Priorities Grant #836173)

Integrated Stormwater Management: Life Cycle Cost; Co-Benefits and BMP Database

INTERNATIONAL STORMWATER BMP DATABASE
www.bmpdatabase.org

Life-Cycle Cost

- Rigorous comparison of life cycle costs associated with technologies particularly compared to similar gray infrastructure

Performance

- Runoff Volume Reduction
- Peak Flow Reduction
- Pollutant Load Reduction

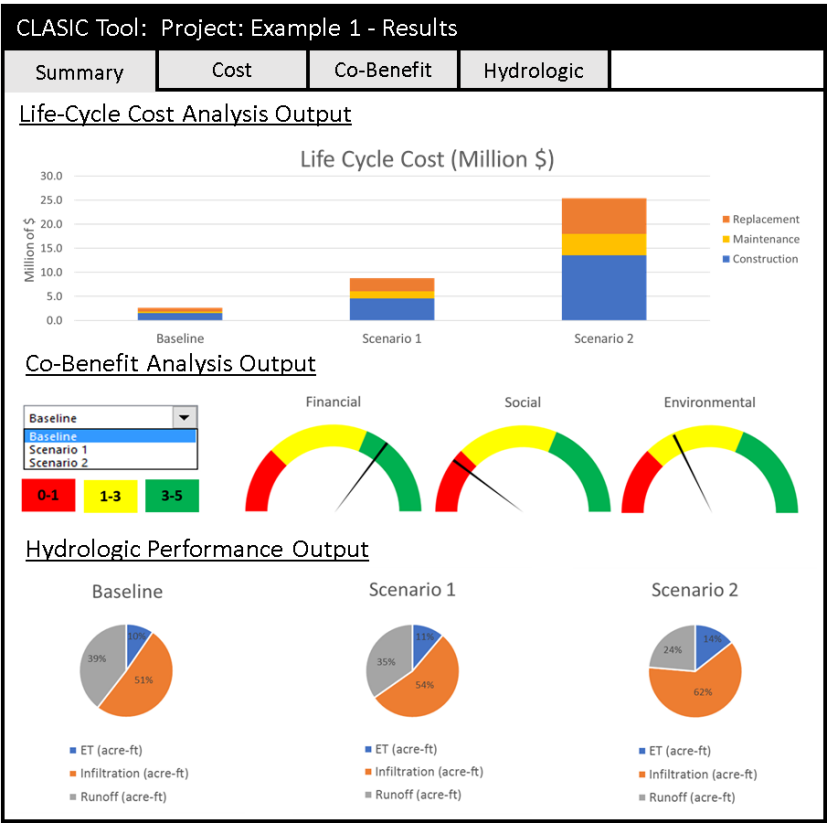
Co-Benefit Analysis

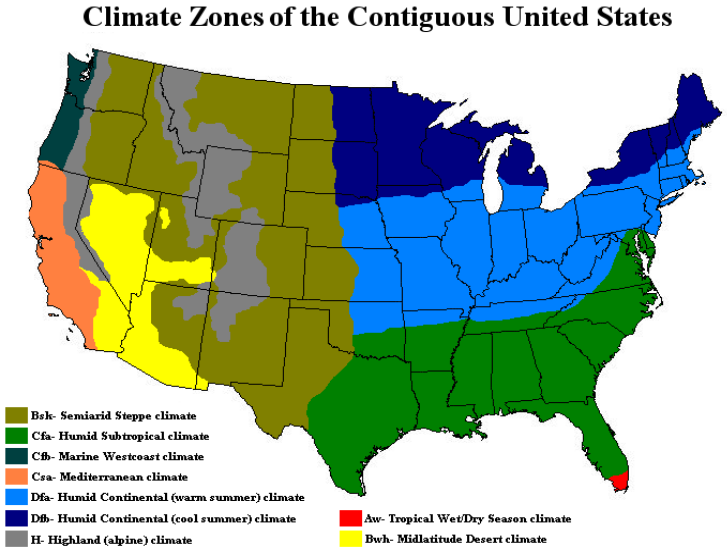
- Assesses value of co-benefits
- Multi-criteria decision analysis
- Includes criteria importance factors

Stormwater Infrastructure (Green & Gray):
- Life Cycle Cost and Co-Benefits of Green Infrastructure

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

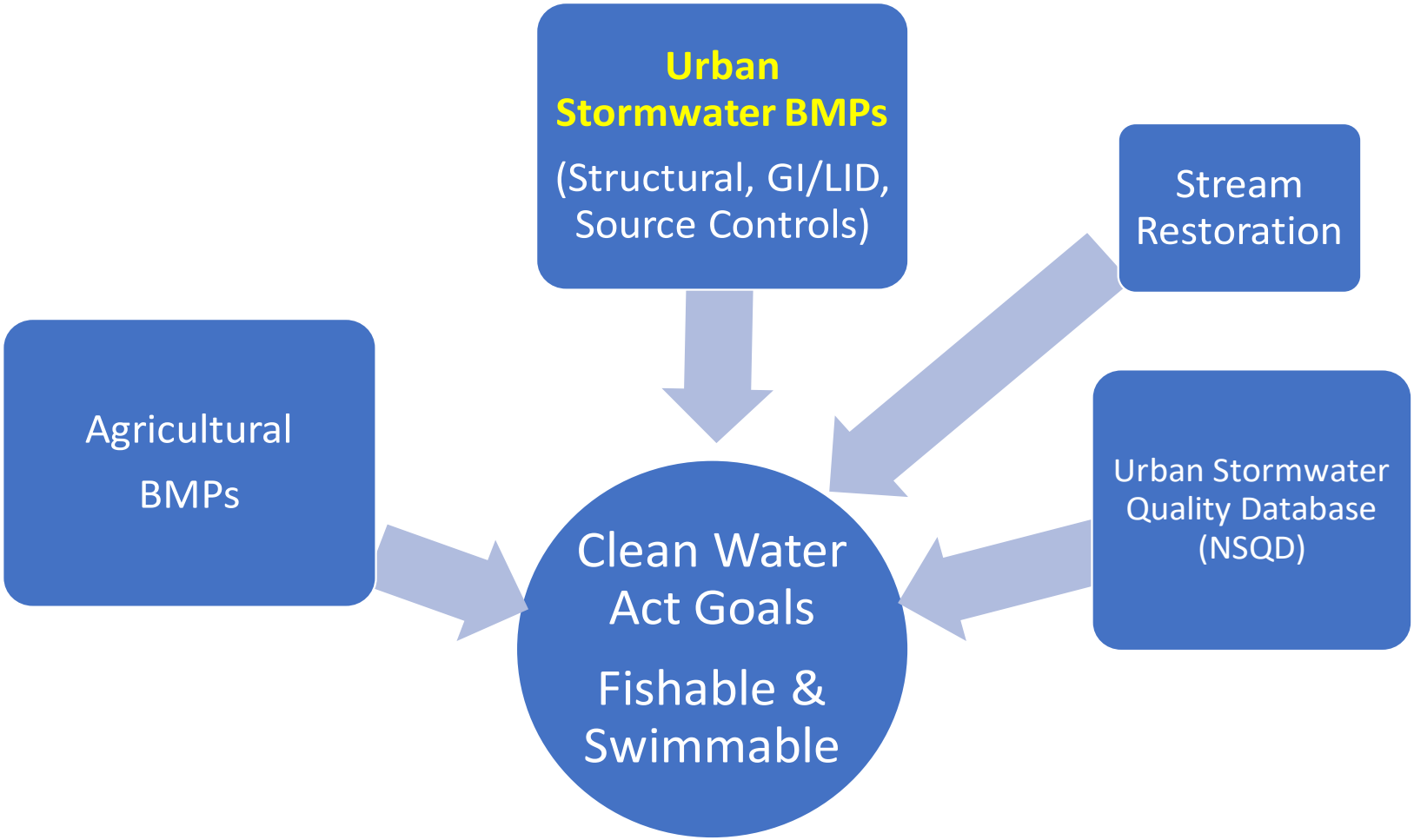
- EPA National Priorities Grant #836173





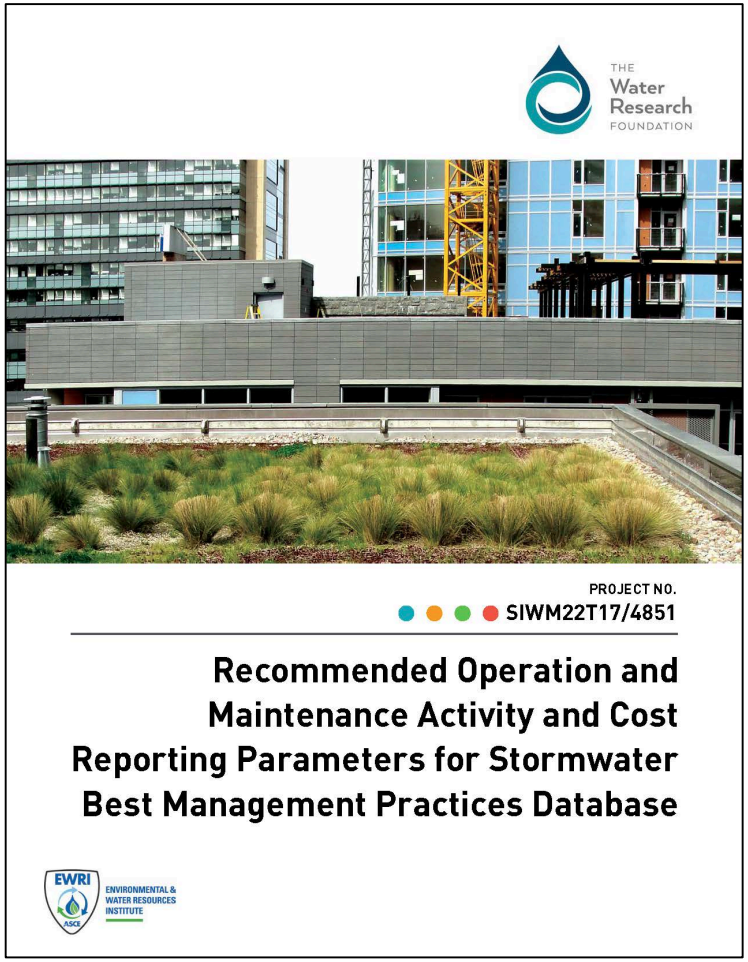
- **Project Duration:** 4 Years (2016-2020);
- **Funding:** $2M from USEPA (plus $0.5M matching funds from WRF);
- **Team:** 7 organizations plus national collaborating partners (e.g. WEF; ASCE; American Rivers);
- **Community Engagement** for Municipalities & Utilities (in all 10 EPA Regions)

International Stormwater BMP Database



Stormwater O&M Cost Tracking Protocol

- Operation & Maintenance (O&M) cost as part of lifecycle cost
  - Develop a protocol to improve tracking cost data for cross comparison



Funded by ASCE/EWRI (a matching project for EPA National Priorities Grant #836173)

Framework and Tools for Quantifying Green Infrastructure Co-Benefits and Linking with Triple Bottom Line Analysis

Social

- ✓ Reduced urban heat stress and associated health benefits
- ✓ Greater flood protection
- ✓ Increased property values
- ✓ Improved recreational opportunities
- ✓ Green job creation

Financial

- ✓ Avoided infrastructure costs
- ✓ Asset life extension
- ✓ Energy savings

Environmental

- ✓ Improved air and water quality
- ✓ Groundwater recharge
- ✓ Improved habitat/ecosystem benefits (wetlands)
- ✓ Decreased GHG emissions

Leaders Innovation Forum for Technology (LIFT) Program
- Focus Group on Stormwater & Green Infrastructure

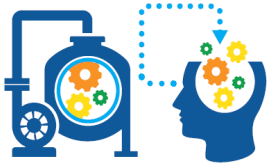
Utility Peer Network

Technology Scans

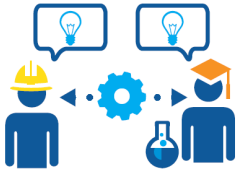
LIFT Link

FAST Water Network

Technology Survey



SEE IT



University-Utility Partnership

Hubs, Partners, and Affiliates

Water Environment Federation
the water quality people™

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Community-enabled Lifecycle Analysis of Stormwater Infrastructure Costs (CLASIC) - Tool Features and Demo

(EPA National Priorities Grant #836173)

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Primary Team Members

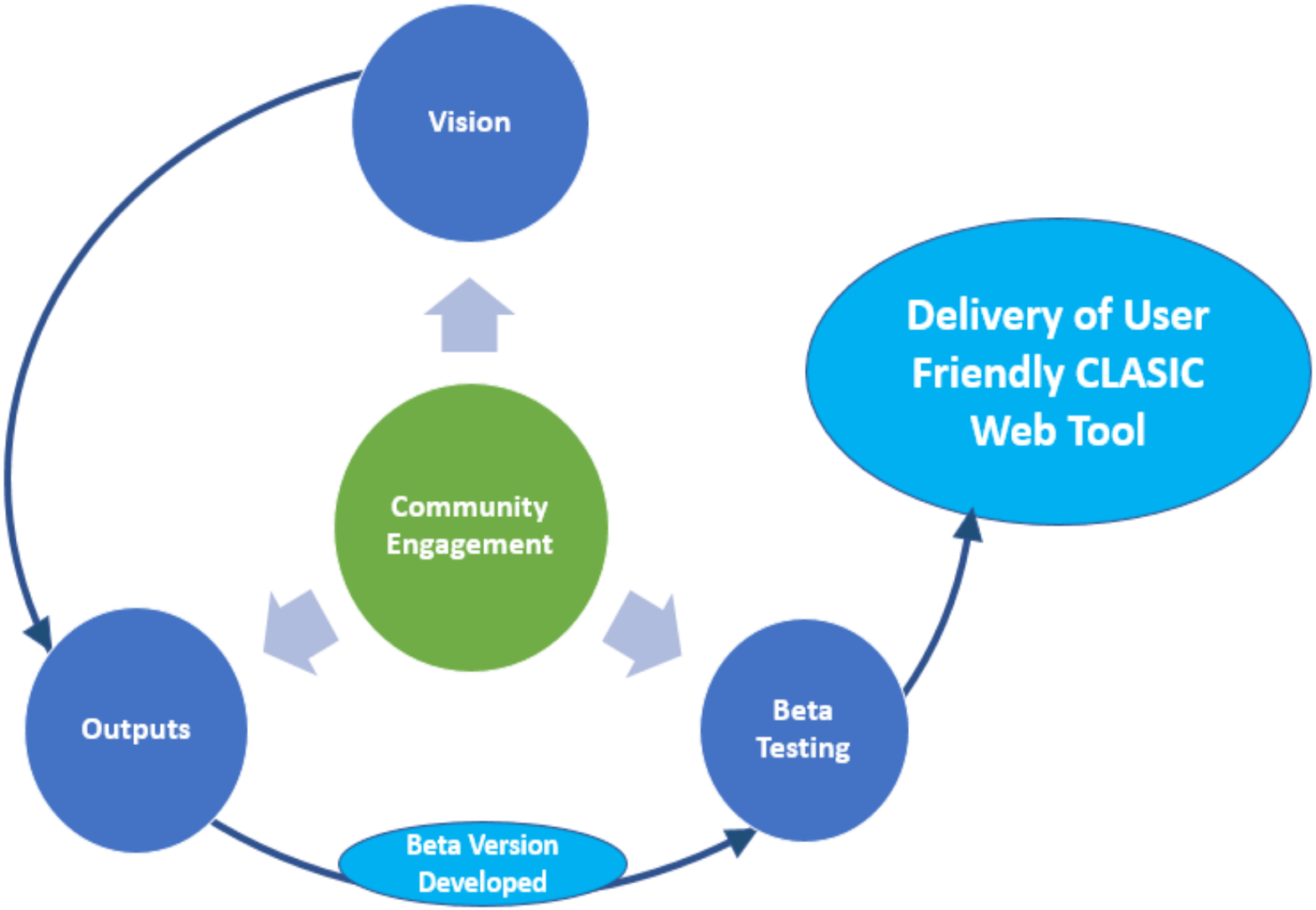
- Sybil Sharvelle, Tyler Dell, Mostafa Razzaghmanesh - CSU
- Jennifer Cotting, Jennifer Egan – UMD EFC
- Christine Pomeroy – UU
- Michele Pugh - WSU

- Dan Pankani – Geosyntec Consultants Inc.
- Jane Clary – Wright Water Engineers

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?

CLASIC will enable users to

- Assess scenarios of stormwater infrastructure via functional unit analysis for robust decision making based on preferences to evaluate:
  - Regulatory compliance
  - Runoff volume reduction
  - Water quality
  - Social and environmental benefits
  - Lifecycle cost
- Couple financial decision with holistic consideration of benefits (primary and secondary)
- Conduct analysis from neighborhood to watershed scale

Analyses not included in CLASIC

- Site specific design of stormwater infrastructure
- Comparison of spatial distribution of infrastructure within sub-unit or subcatchment
- Algorithms for optimization of design

CLASIC vs. Stormwater Calculator (SWC): *Hydrologic Simulation*

CLASIC

- Web based GIS tool
- Designed for flexibility in study area size (neighborhood to watershed)
  - Enables variation of parameters within study area subunits
  - Outputs for multiple sub-units within study area at once
- Accesses national database on land use and imperviousness to inform hydrologic model
- Includes a more comprehensive set of technologies (12 total)
  - 5 additional: sand filter, grass swales, storage vault, extended detention basins, wet ponds
- Includes water quality projections
- Considers more advanced climate change scenarios (CMIP5 datasets), including flexibility in assessing multiple climate scenarios
- Horton infiltration method

Stormwater Calculator

- Desktop and mobile-web based
- Designed for site level design and scale of analysis is limited
  - Desktop version (50 acres max)
  - Web version (12 acres max)
- User enters land use data
- More flexibility in LID design specs
- No water quality projections
- Uses older climate change scenarios (CMIP3 datasets)
- Green-Ampt infiltration method

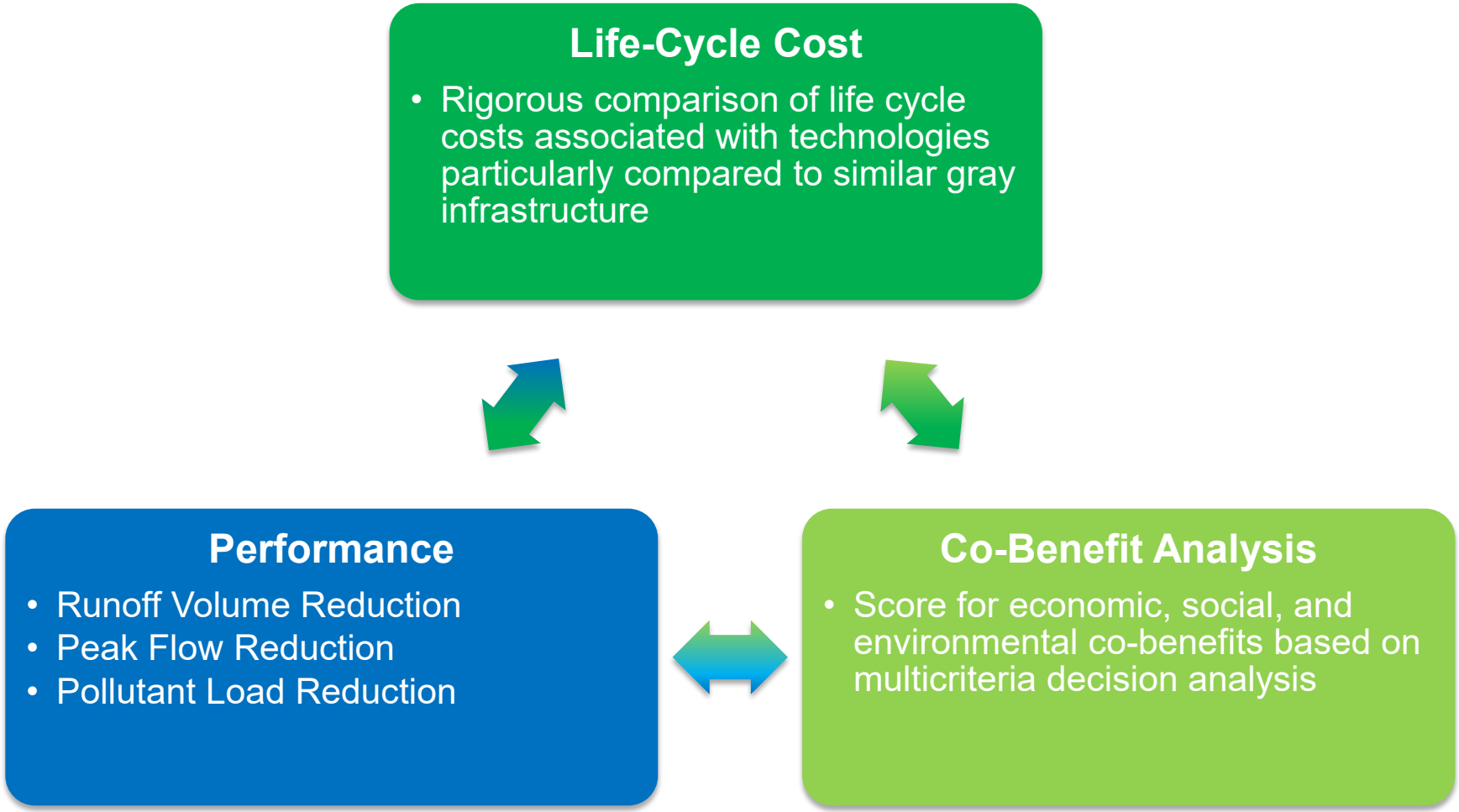
CLASIC vs. Stormwater Calculator (SWC): *Cost Approach (1)*

- Similarities between CLASIC and SWC:
  - Both tools will use a line item cost buildup approach for capital costs;
  - Costs will be reported in ranges;
  - CLASIC uses the SWC approach to regional cost factors, utilizing U.S. Bureau of Labor Statistics (BLS) regional centers across the country;
  - CLASIC uses the SWC approach to inflation factors, utilizing BLS data.

CLASIC vs. Stormwater Calculator (SWC): *Cost Approach (2)*

- Differences between CLASIC and SWC:
  - CLASIC tool allows a user to choose from fixed design parameters (e.g., underdrain, liner, etc.) that are used to calculate BMP cost;
  - BMP costs will be developed for the finite number of designs possibilities for each BMP type;
  - Unit costs for capital cost line items are obtained from DOT bid tab data from states across the USA;
  - Maintenance costs in CLASIC are based on regional recommendations for activities and frequencies rather than equations;
  - Regionalization of maintenance costs based on climate data will be available for certain parameters where applicable;
  - CLASIC will have multiple normalized output units for users to view such as:
    - Cost per surface area of LID control
    - Cost per area treated
    - Cost per unit flow treated
    - Cost per unit volume treated
    - Cost per unit volume of LID control

Three Basic Outputs for User Allows for Integrated Assessment



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

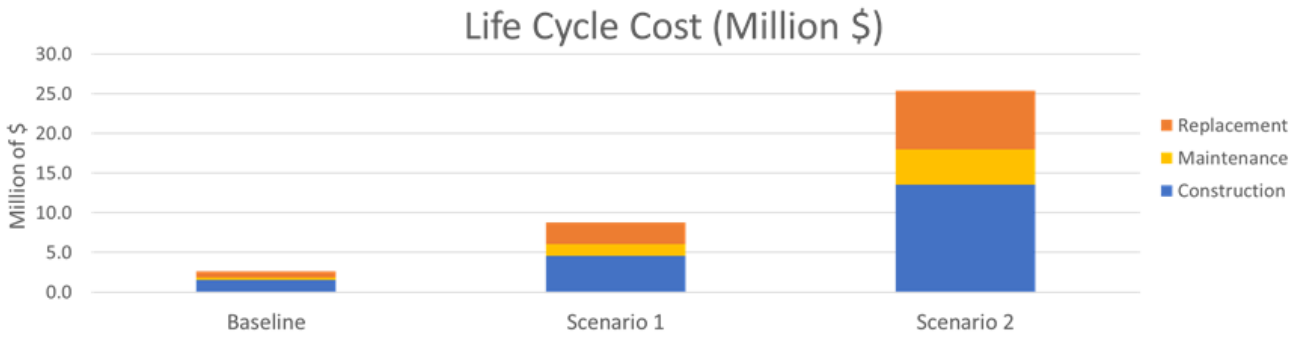
LCC	· Net Present Value
	  ○ Construction
	  ○ Maintenance
	  ○ Replacement
	· Average Annual Cost Over Design Life
	· Per unit cost for scenario comparison

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

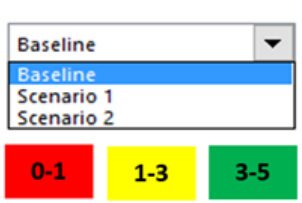
CLASIC Tool: Project: Example 1 - Results

Summary | Cost | Co-Benefit | Hydrologic

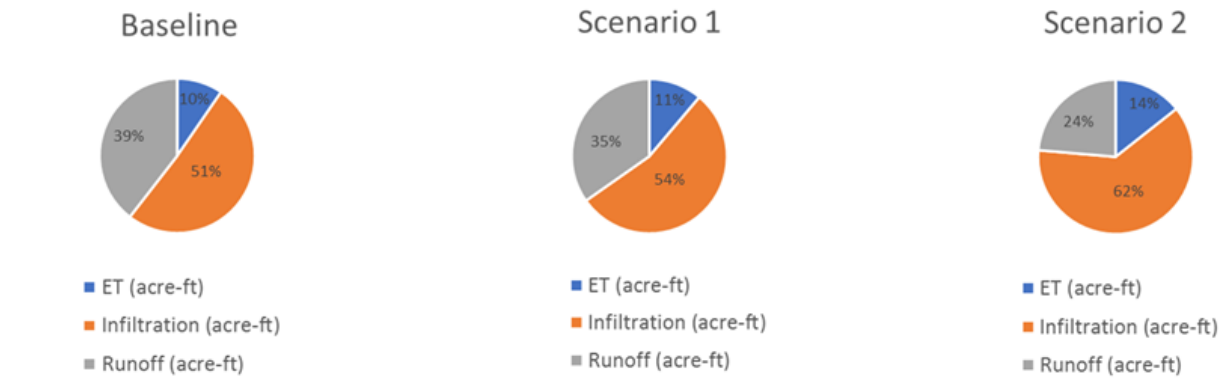
Life-Cycle Cost Analysis Output



Co-Benefit Analysis Output



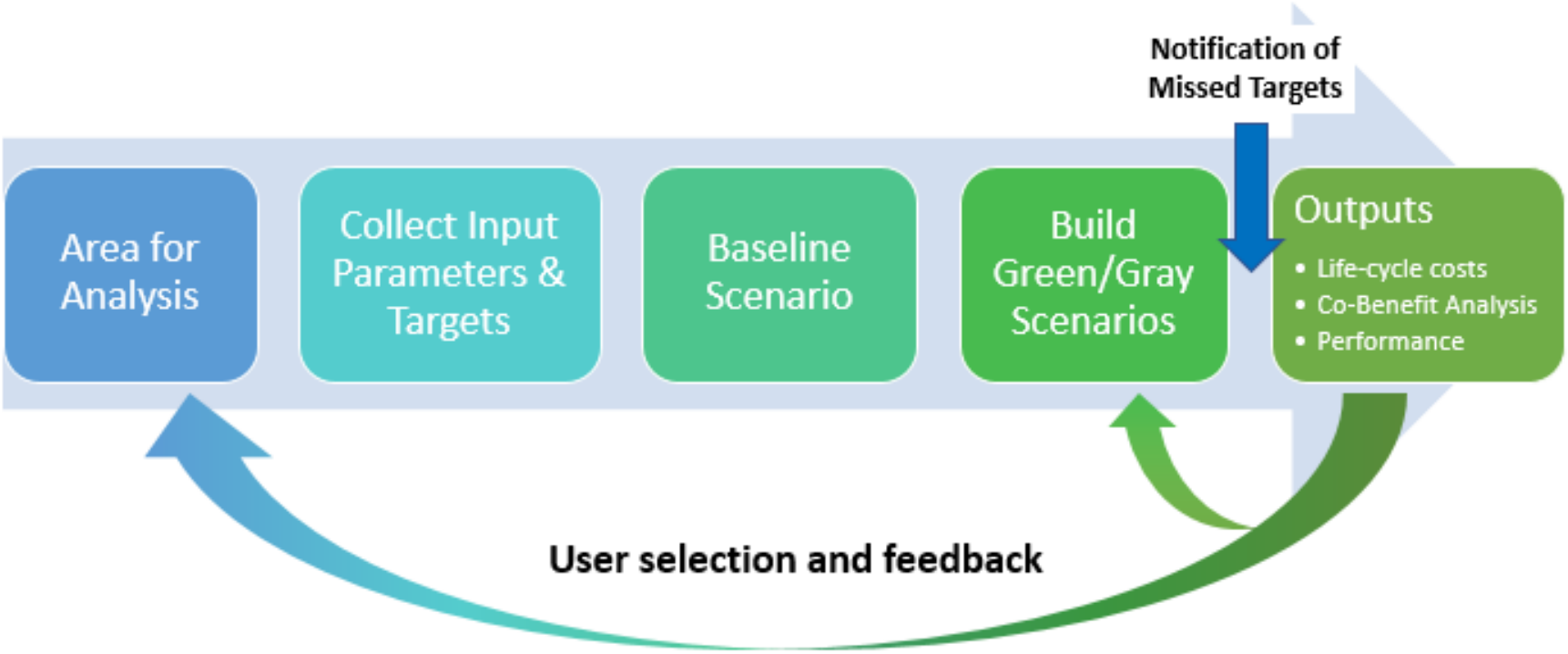
Hydrologic Performance Output



Technology Categories

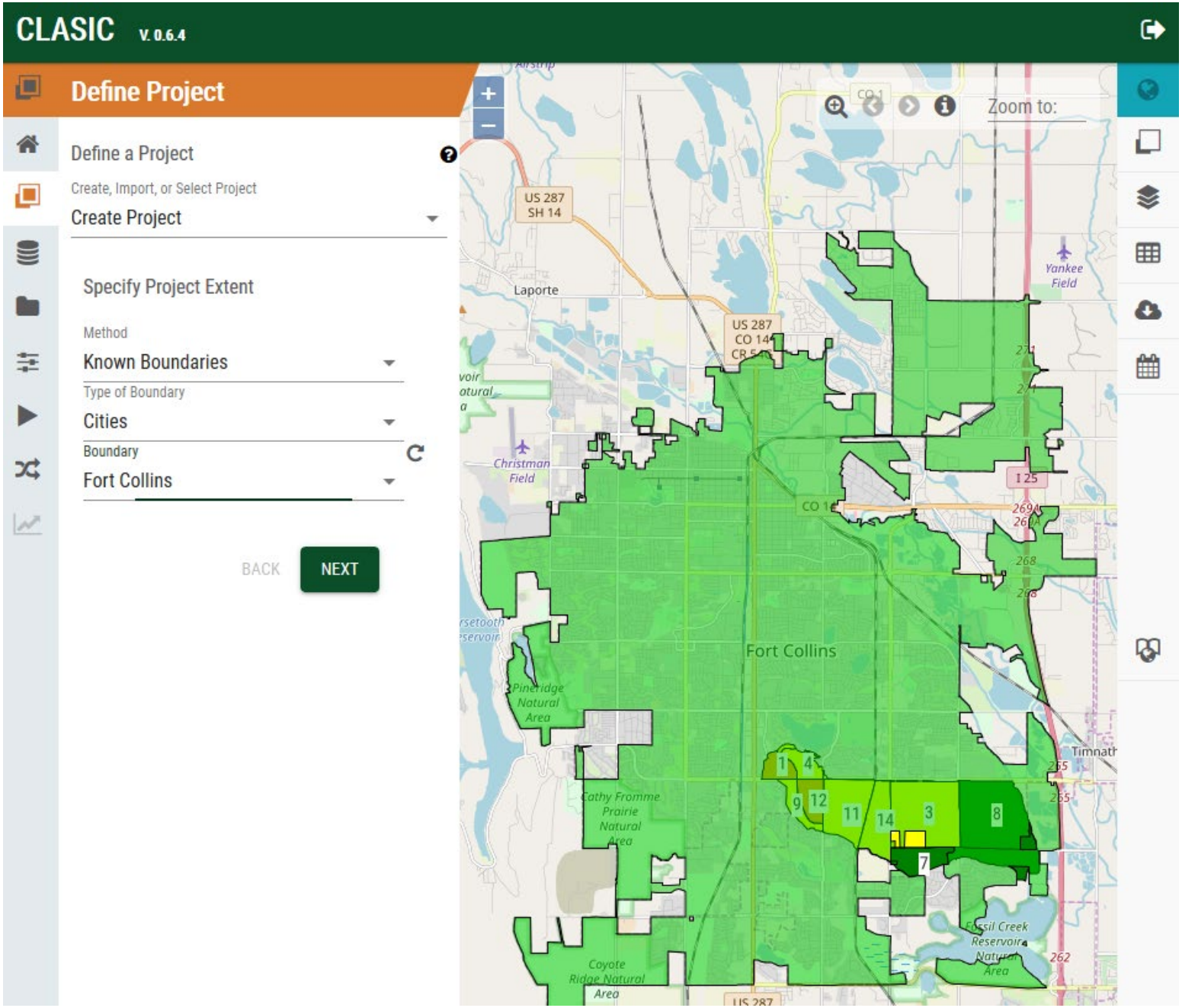
- Rain Gardens
- Sand Filter
- Infiltration Trench
- Permeable Pavement
- Green Roofs
- Disconnection
- Grass Swales
- Extended Detention Basins
- Wet Pond
- Stormwater Harvesting
- Storage Tunnel/Vault
- Stream Restoration

CLASIC Tool Interface Progression



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)

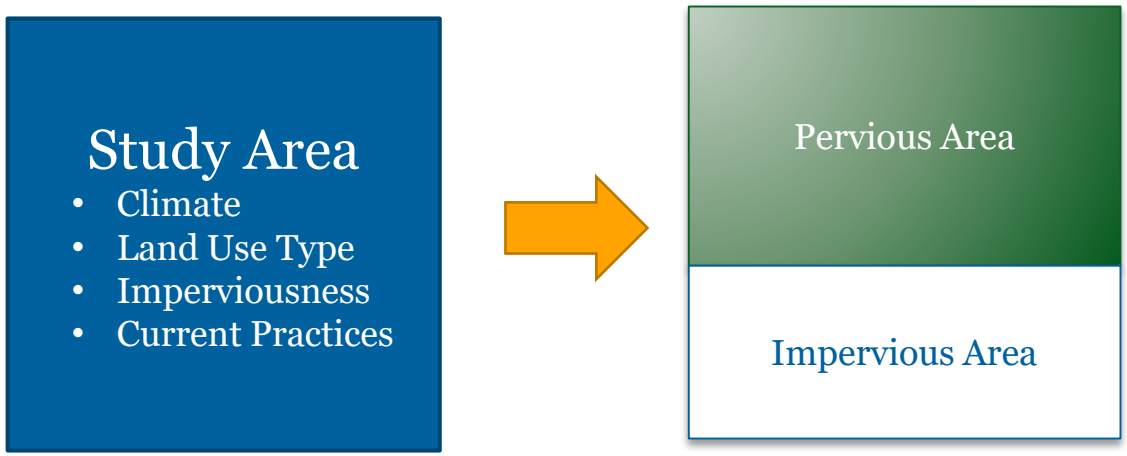


Collect Input Parameters & Targets

- Soil Datasets (SSURGO/STATSGO)
  - Soil Type
- National Digital Elevation Model (DEM)
  - 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)

Baseline Scenario Development

- Split each area/subunit into to directly connected impervious area (DCIA) and separate pervious area (SPA)
- Does not consider conveyance system

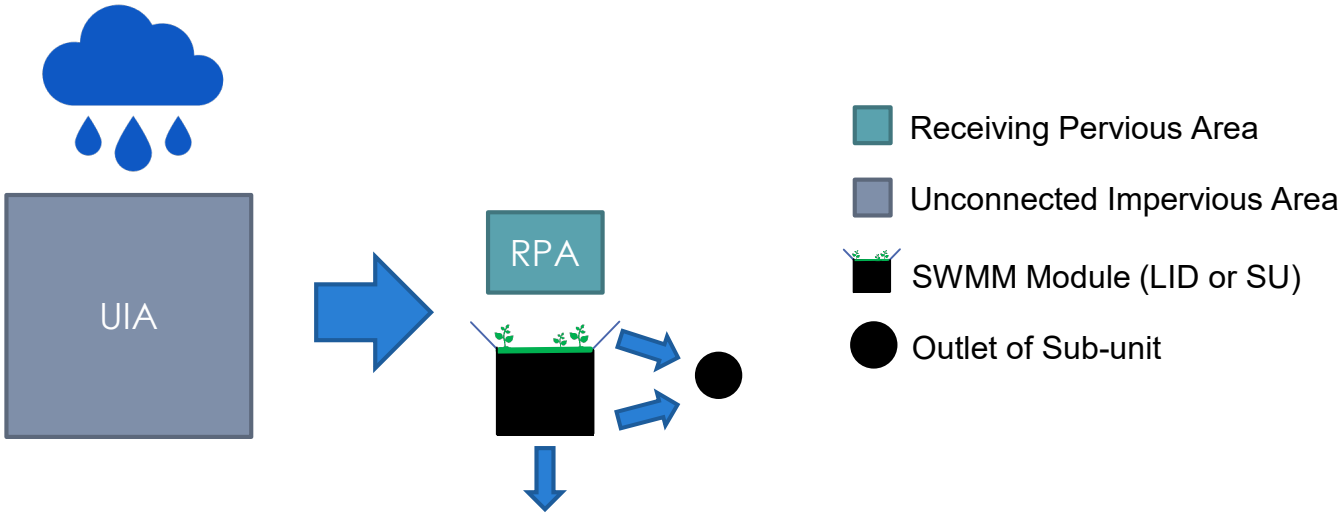


Adding Stormwater Infrastructure

- Current Stormwater Infrastructure
  - Preliminary cost/budget for maintaining traditional stormwater system
  - Types of stormwater technologies
  - Level of implementation of technologies based on current practice

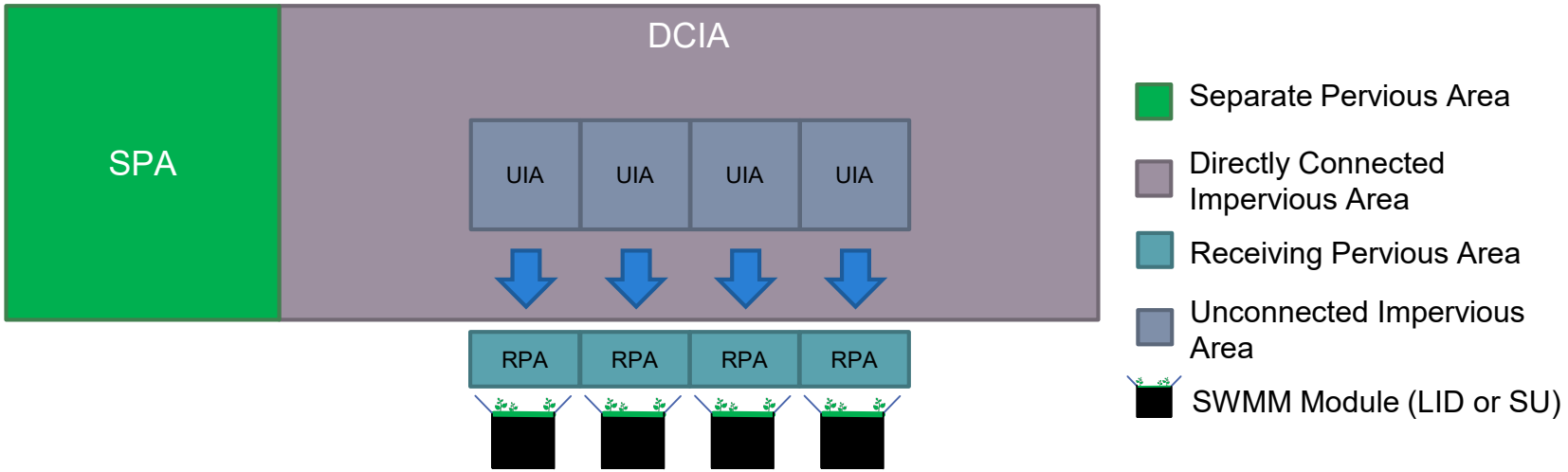
Adding Stormwater Infrastructure

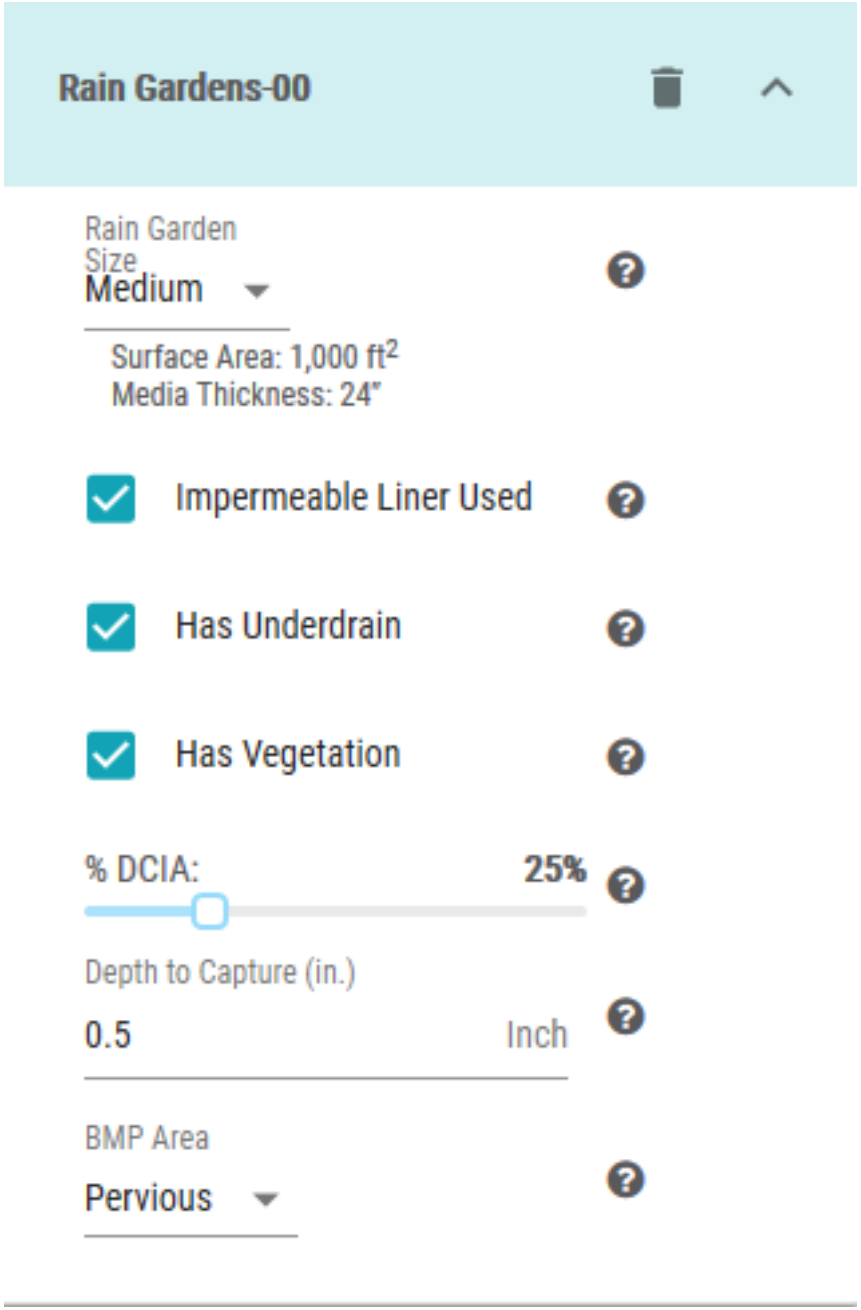
A technology unit treats a certain area or volume that has been pre-set within the CLASIC tool. Technologies may vary in terms of size and design parameters.



Adding Stormwater Infrastructure

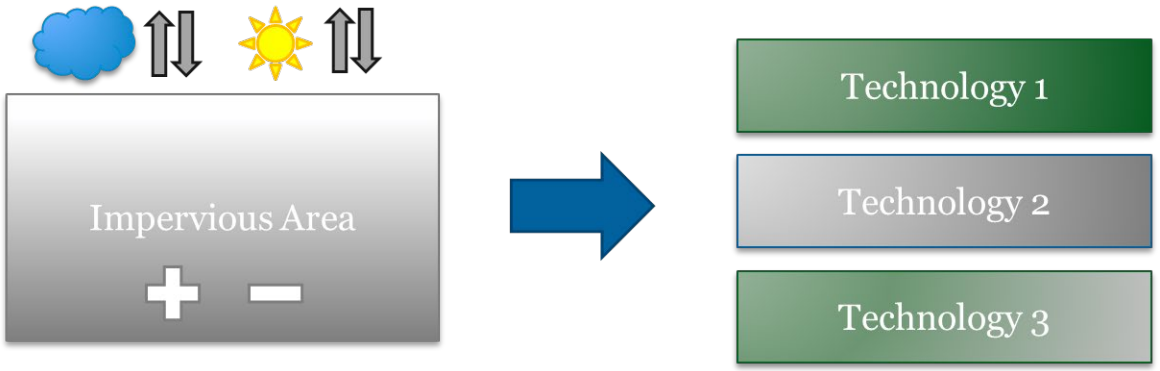
Technology units are sized to capture a particular volume or area. The user then specifies a total volume or area that should be captured and the number of technology units are selected to accomplish the level of capture.





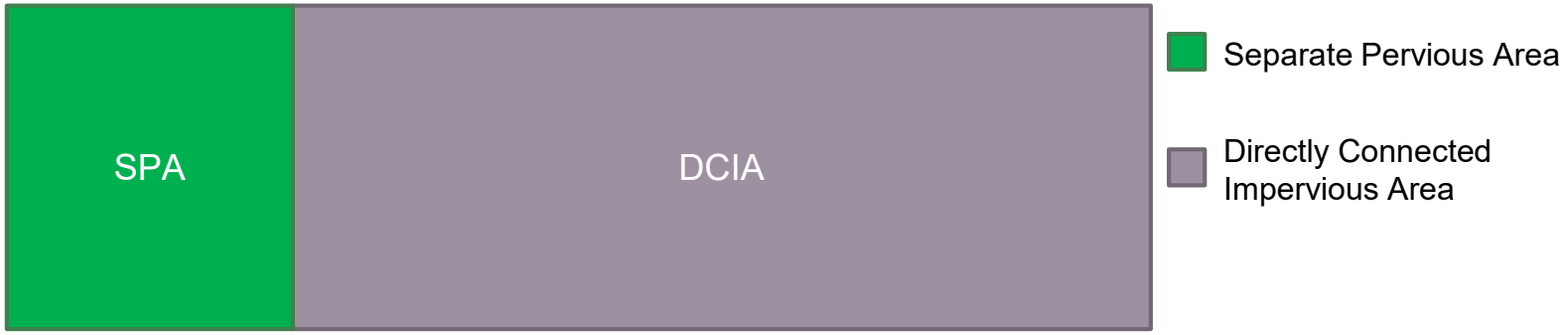
Scenario Development

- Create scenarios to evaluate changes of:
  - Stormwater infrastructure adoption
  - Land development pattern
  - Increased impervious area
  - Climate (precipitation/temperature)



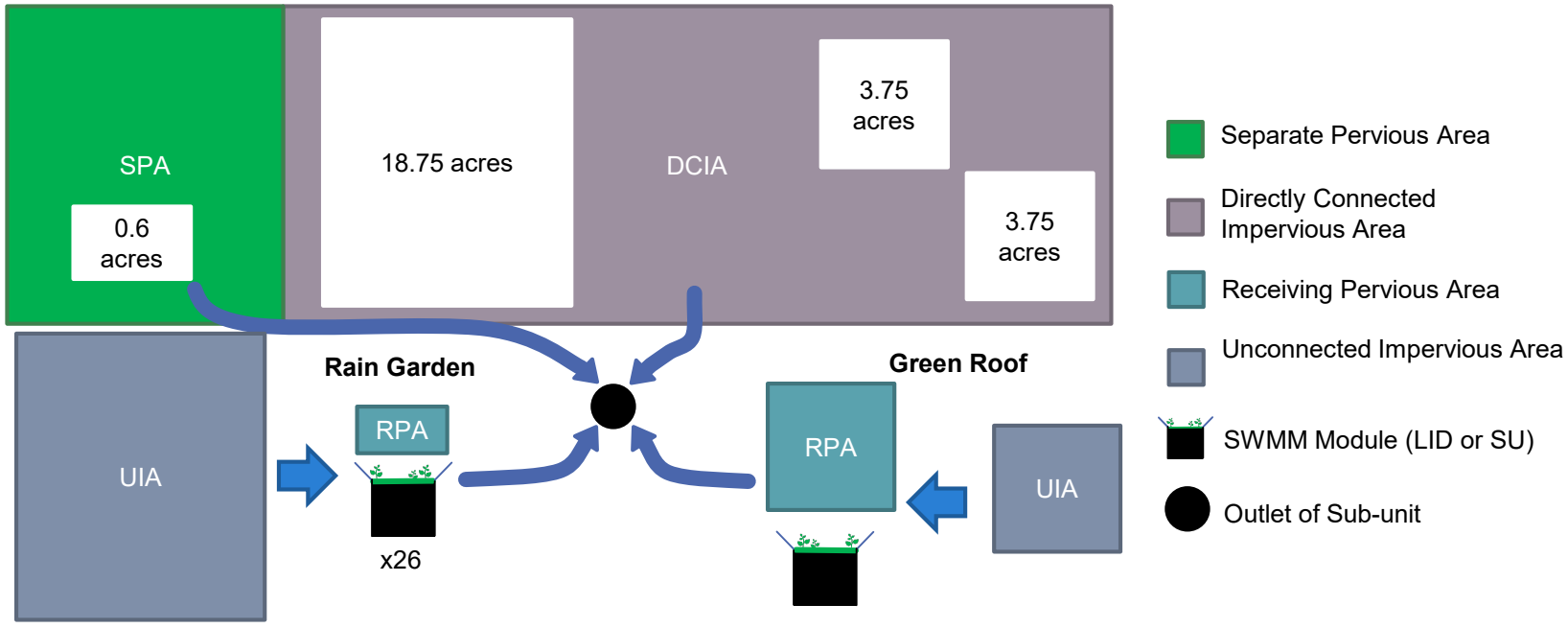
A simple example…

A user-defined subcatchment with 75% impervious and total area of 100 acres.
(75 acres of impervious area and 25 acres of pervious area)

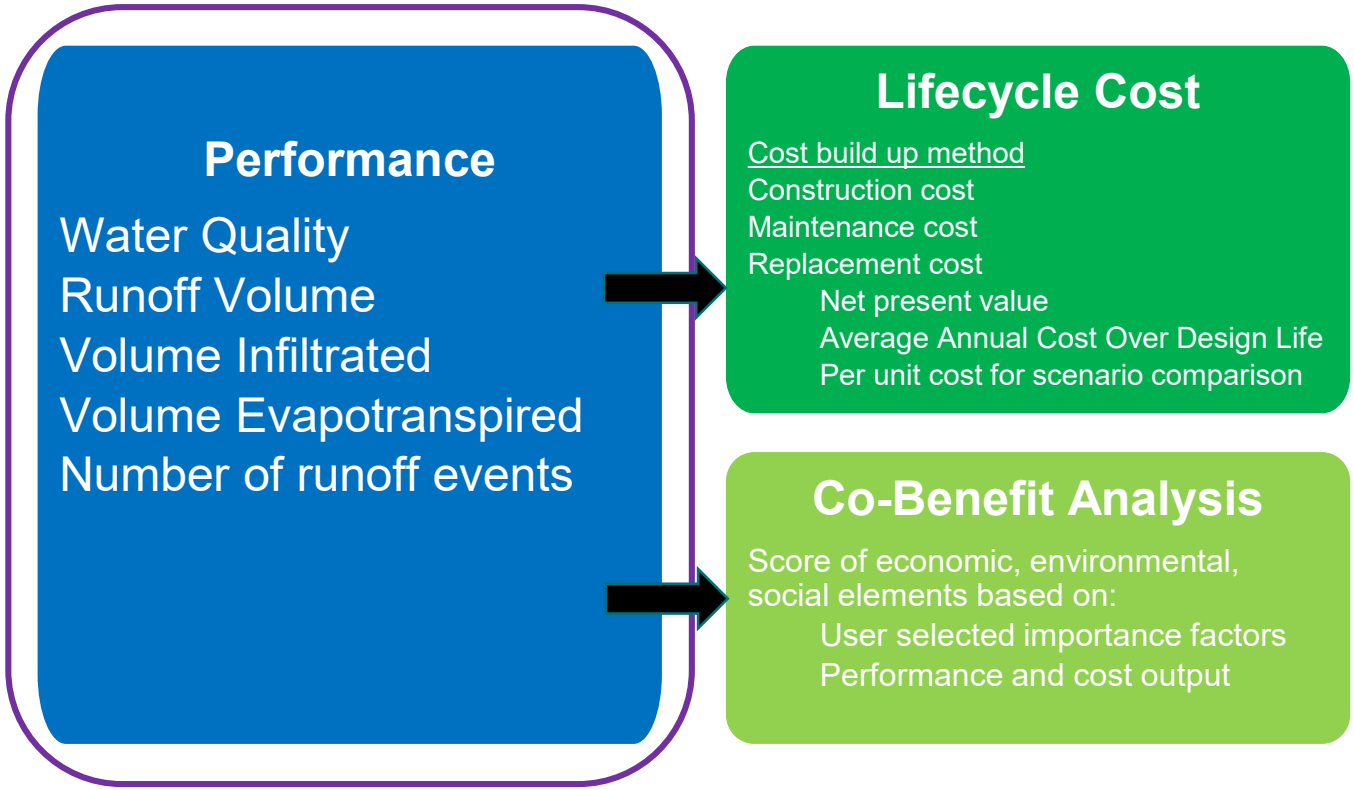


A simple example…

The user-specified impervious capture areas are removed from DCIA, and the BMP area is removed from either the SPA (rain garden) or from the impervious capture area (green roof).



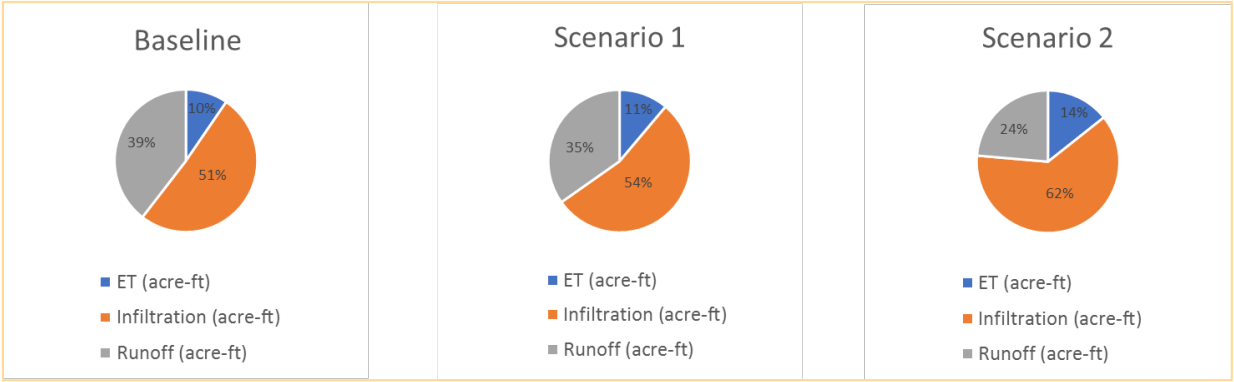
Three Basic Outputs

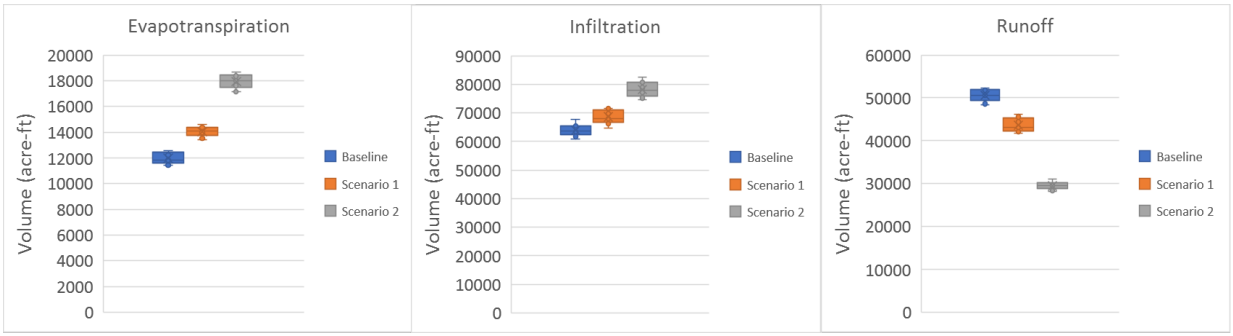


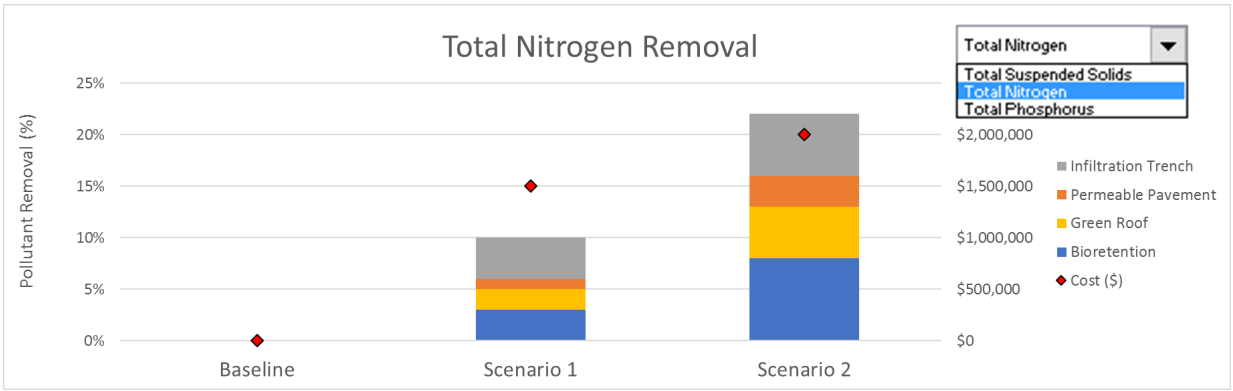
CLASIC Tool: Project: Example 1 - Results

Summary | Cost | Co-Benefit | Performance

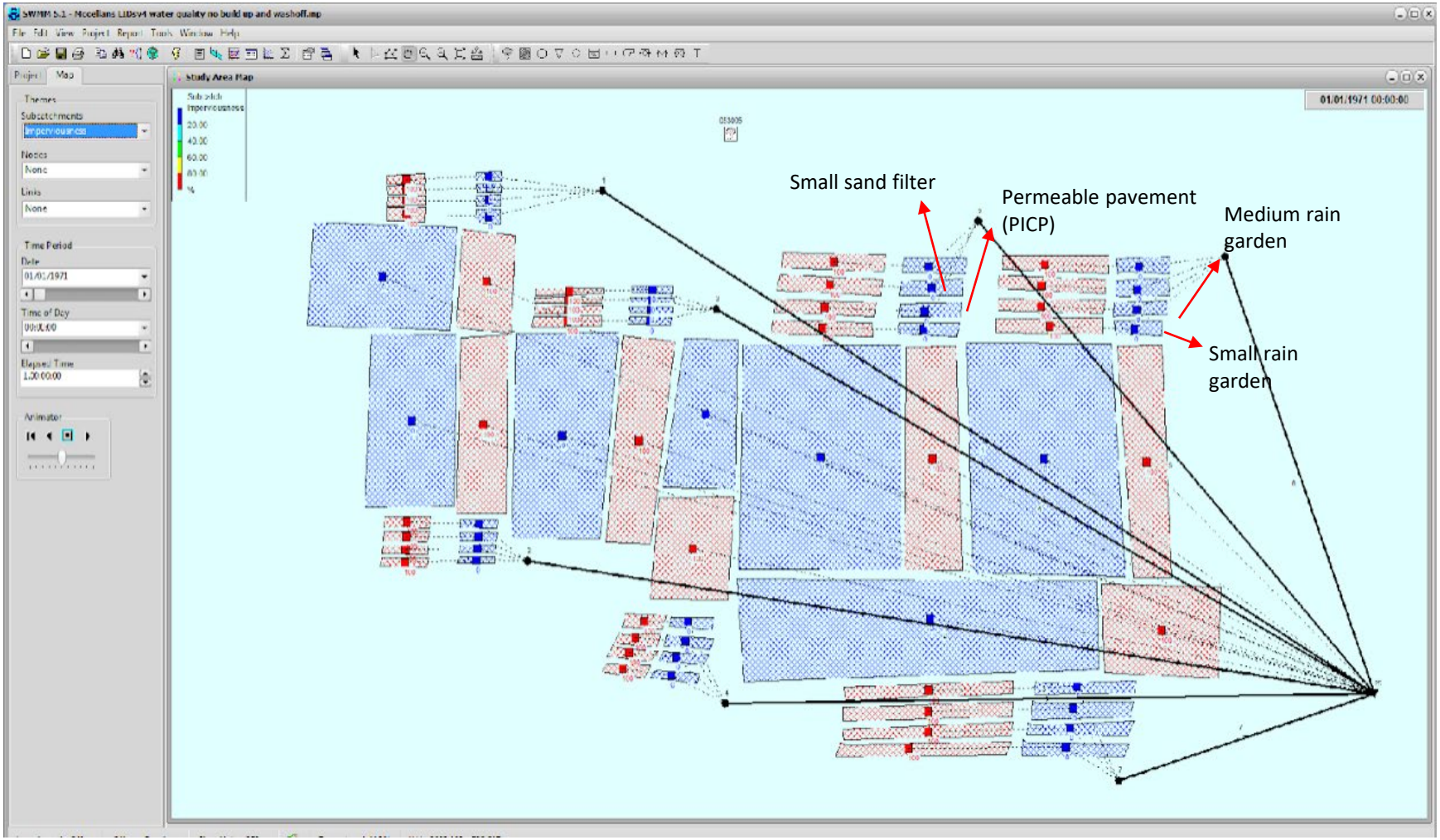
Hydrologic Performance Output







Model developed in SWMM



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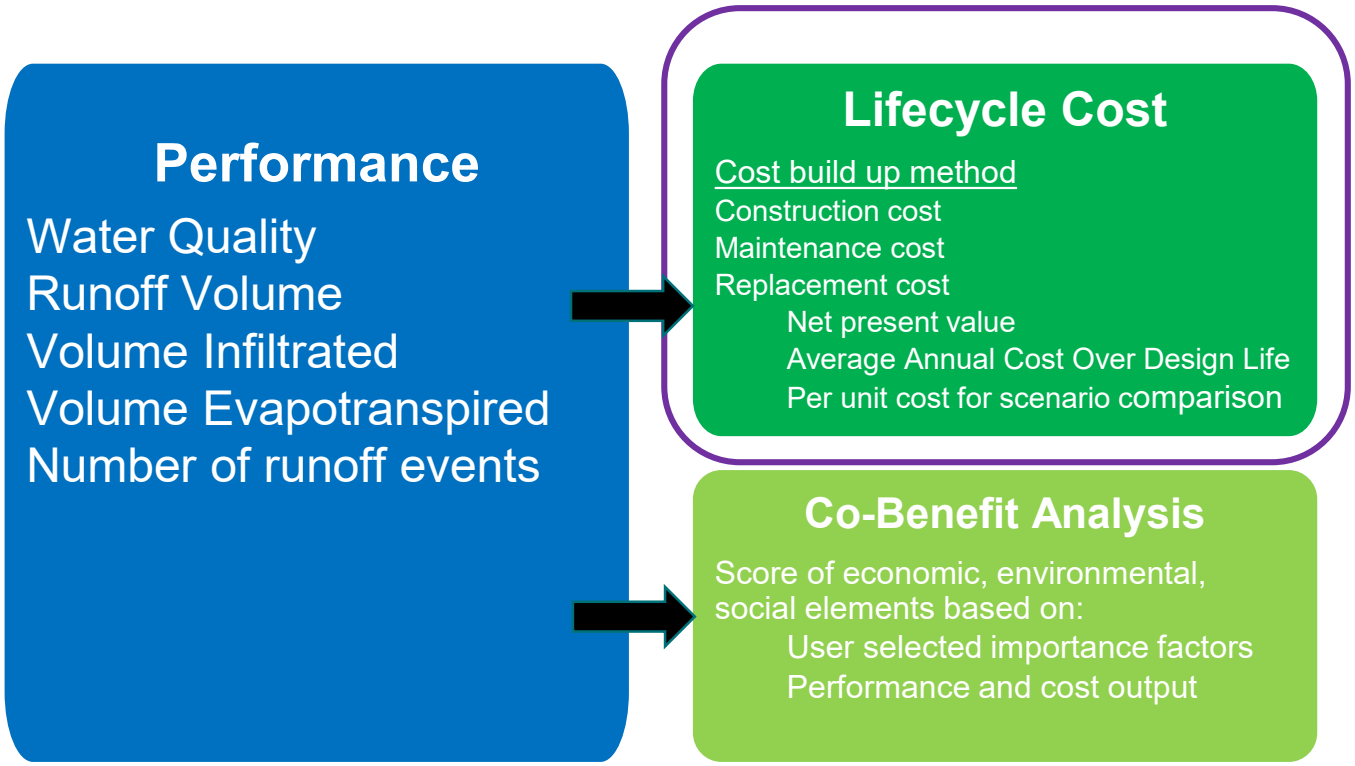
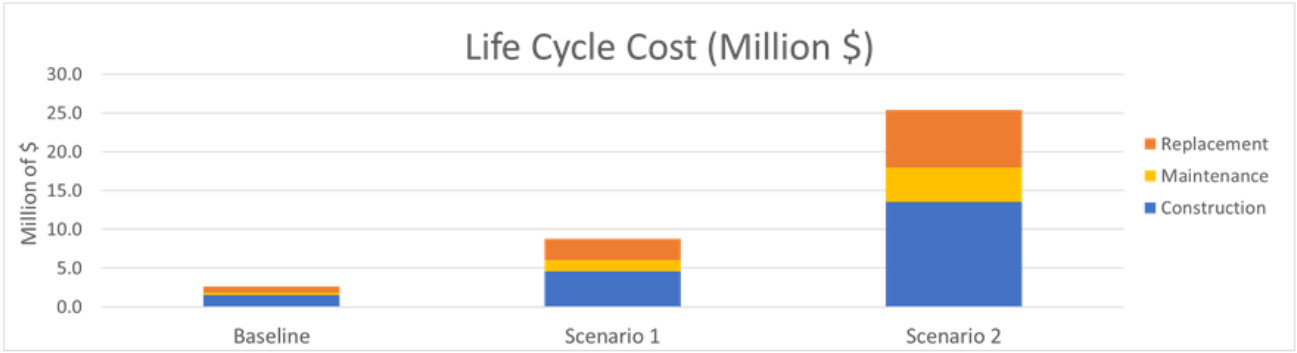
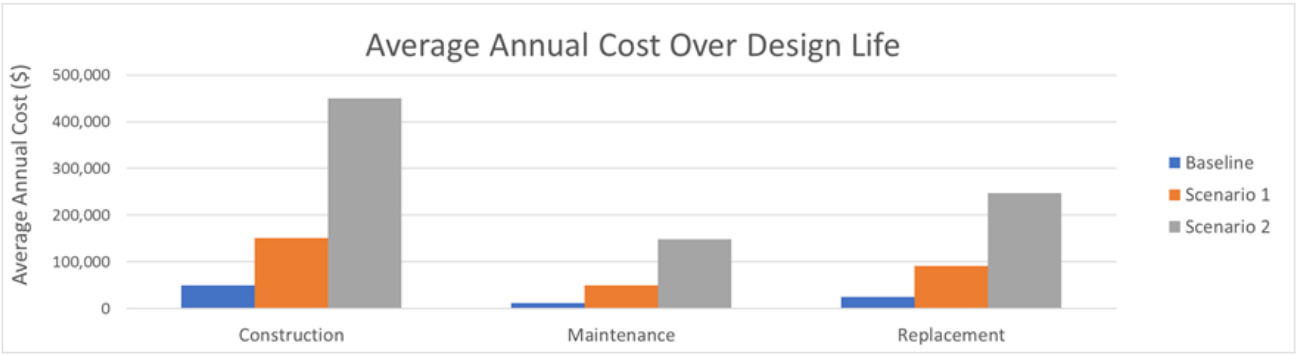


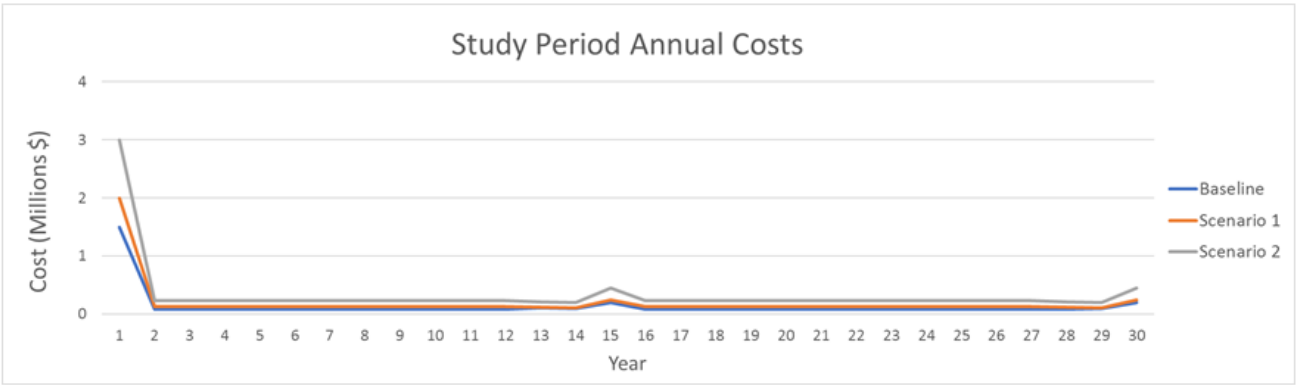
CLASIC Tool: Project: Example 1 - Results

Summary | Cost | Co-Benefit | Hydrologic

Life-Cycle Cost Analysis Output







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_t = routine and periodic maintenance costs

C_r = rehabilitation (major) costs

T = study period

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
- No added discount rate (current dollar value throughout study periods)
- Rehabilitation value = portion of initial construction cost dependent on maintenance

Initial Construction Cost

- 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

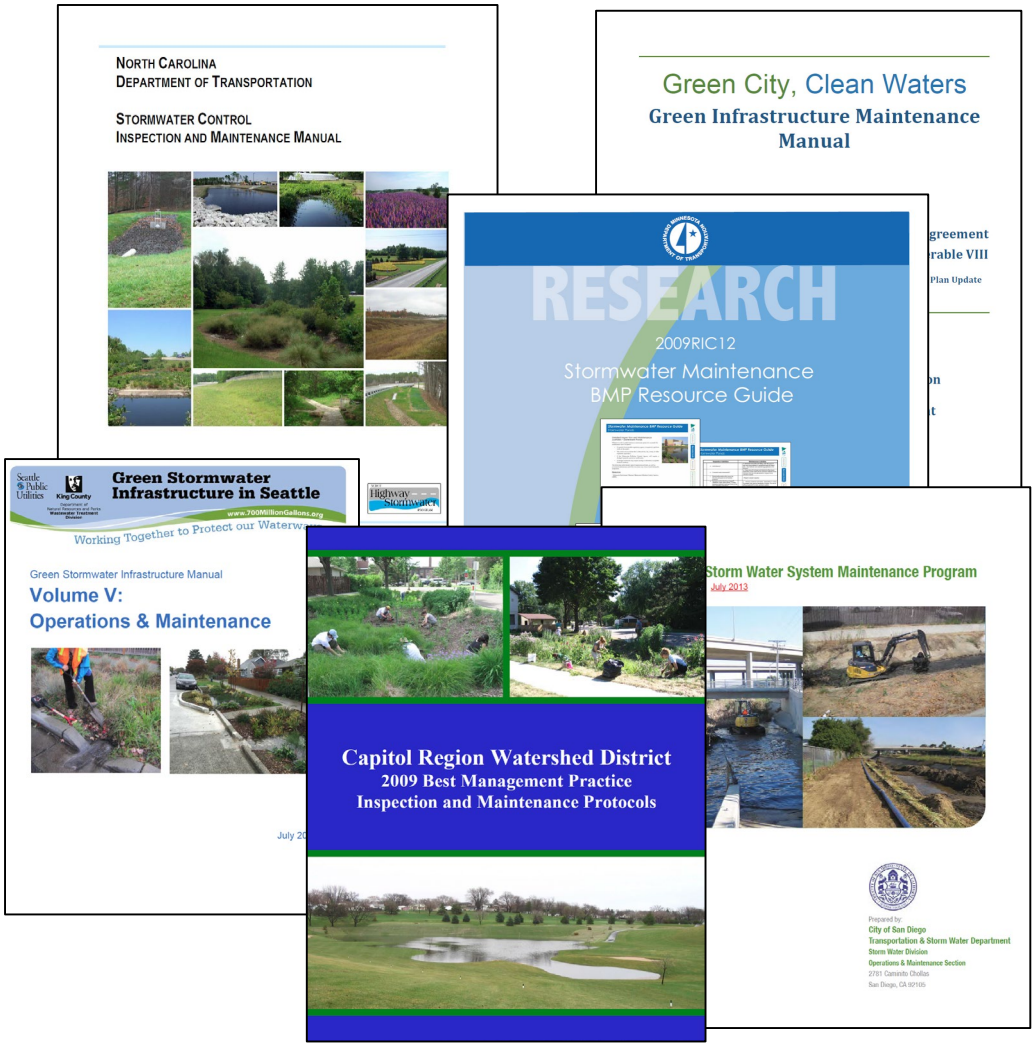
- Fixed combination of designs for each technology including small, medium and large sizes along with additional select parameters

Design Parameters Affecting Cost: Rain Gardens

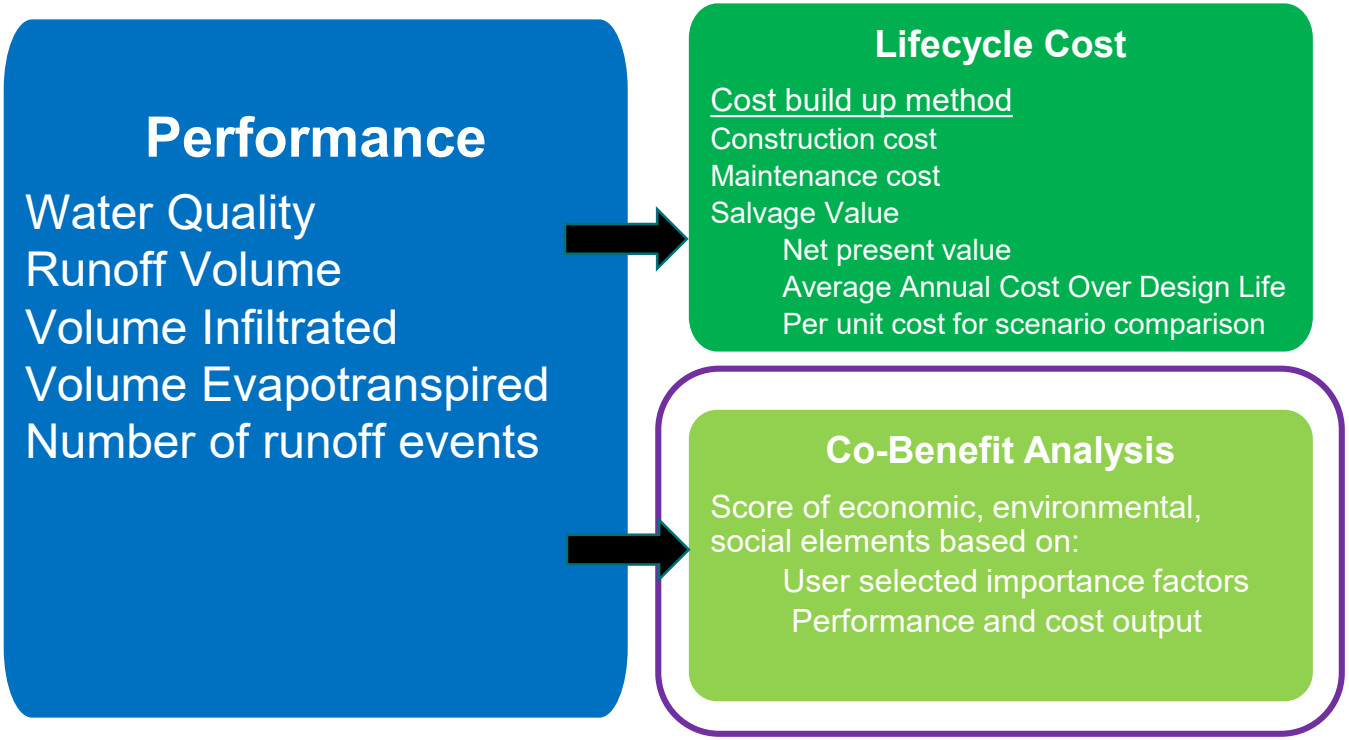
Design Parameter	Small	Medium	Large
Surface Area (sq.ft)	100	1,000	10,000
Total Volume To Capture (cu.ft)	166	1656	16555
Ponding Depth (inches)	12	12	12
Filter Media Depth (inches)	18	18	18
Liner	Yes or No	Yes or No	Yes or No
Underdrain	Yes or No	Yes or No	Yes or No
Vegetation	Yes or No	Yes or No	Yes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

Maintenance Cost

- Line item build up based on recommended maintenance activities for each technology
- Routine & periodic activities
- Maintenance manuals from agencies across USA reviewed for recommended activities and frequency
- Regional adjustments for climate influenced activities such as mowing and vacuuming of permeable pavement



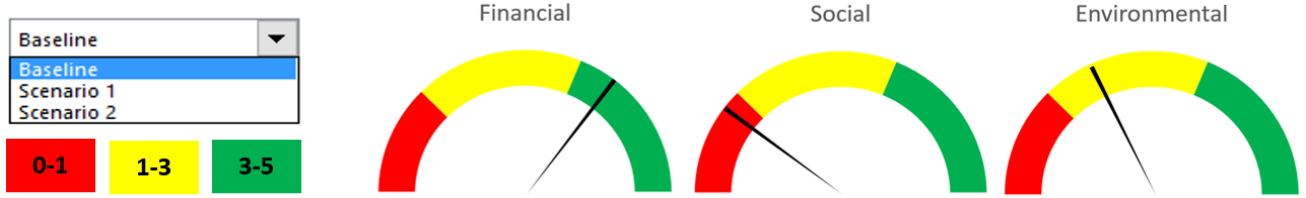
3 Basic Outputs

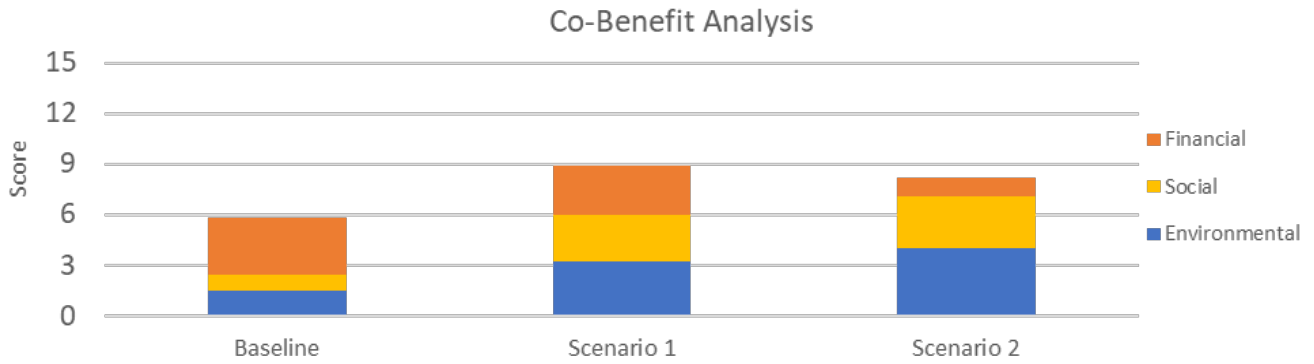


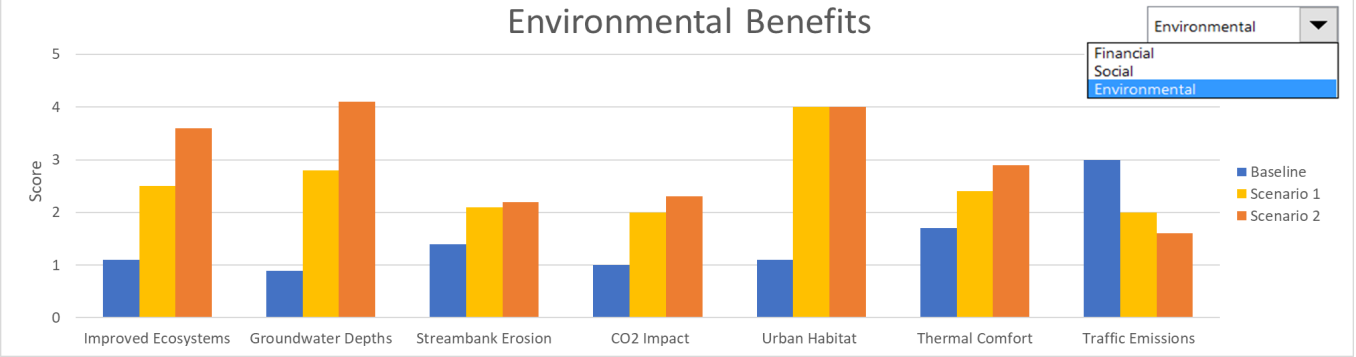
CLASIC Tool: Project: Example 1 - Results

Summary | Cost | Co-Benefit | Performance

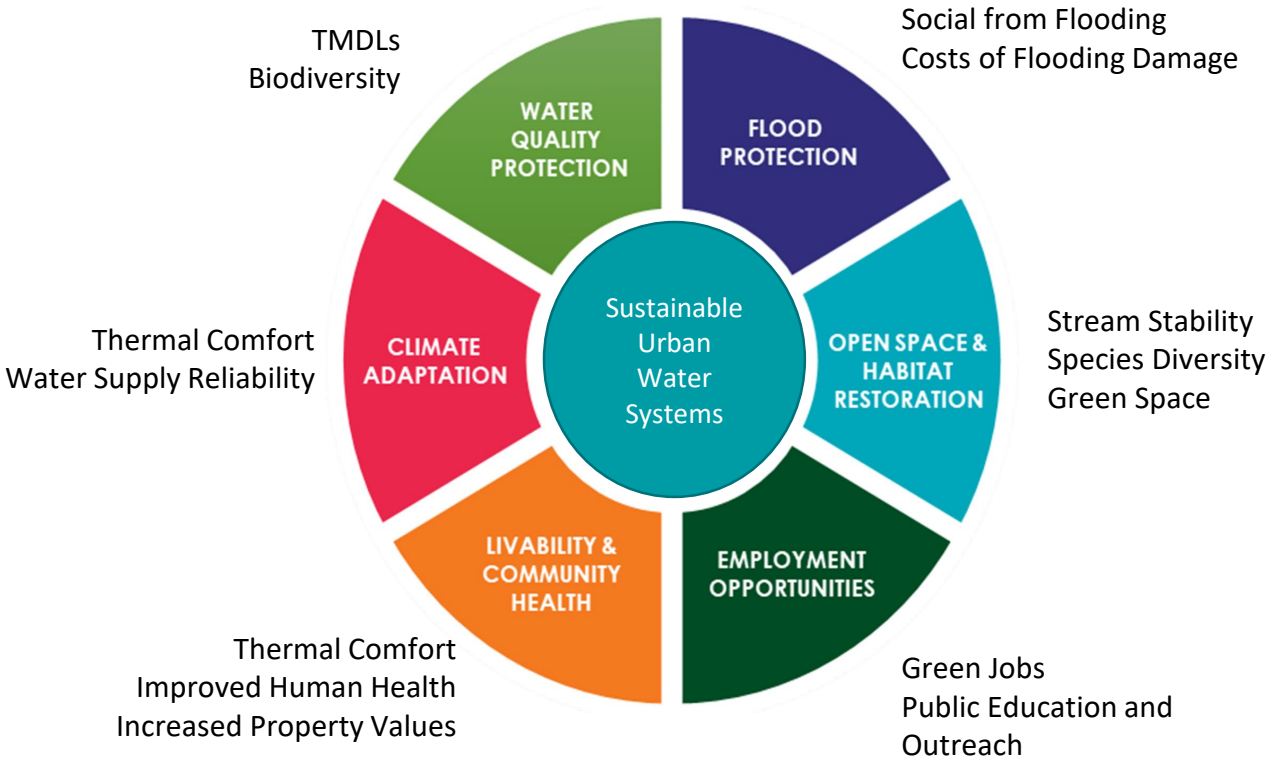
Co-Benefit Analysis Output: (Scores of 0-5 with 5 being highest score)

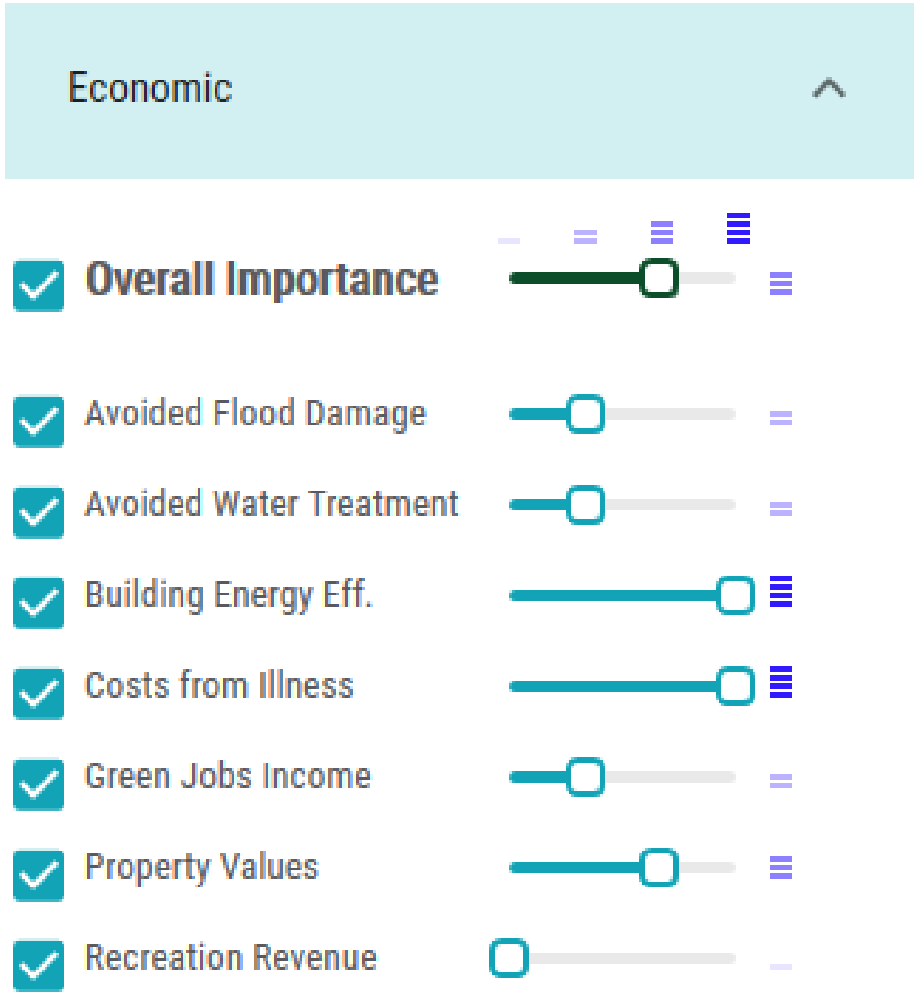






Co-Benefits Analysis



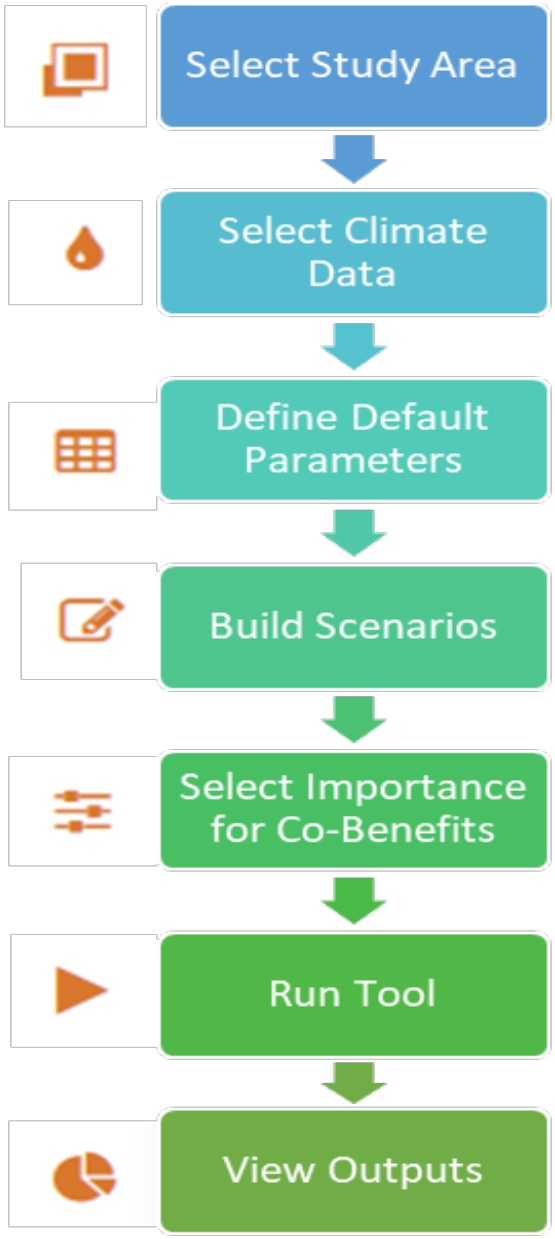


Indicator	CLASIC Output	Min/Max
Economic		
Revenue from water recreation	Pollutant load (TSS, TN, TP)	Min
Property Values	Pollutant load (TSS, TN, TP)	Min
	Area of added green space	Max
Avoided costs for illness resulting from air quality improvements	Area of added green space	Max
Building energy efficiency	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: April 2019 – May 2019
  - Contact: michele.pugh@wichita.edu
- CLASIC tool refinement: August 2019
- CLASIC tool final testing and case studies: September 2019 – October 2019
- CLASIC Tool Delivered: December 2019

CLASIC Tool Steps



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

CLASIC Tool Vision

The CLASIC tool is a screening tool utilizing a lifecycle cost framework to support stormwater infrastructure decisions on extent and combinations of green, hybrid green-gray and gray infrastructure practices. Users can create scenarios of stormwater control measures including climate and land use projections to assess lifecycle costs, performance, and co-benefits associated with those scenarios.

CLASIC Tool Functionality

CLASIC is a screening tool and is not intended for optimization of design. The scope of CLASIC is shown in Figure 1.

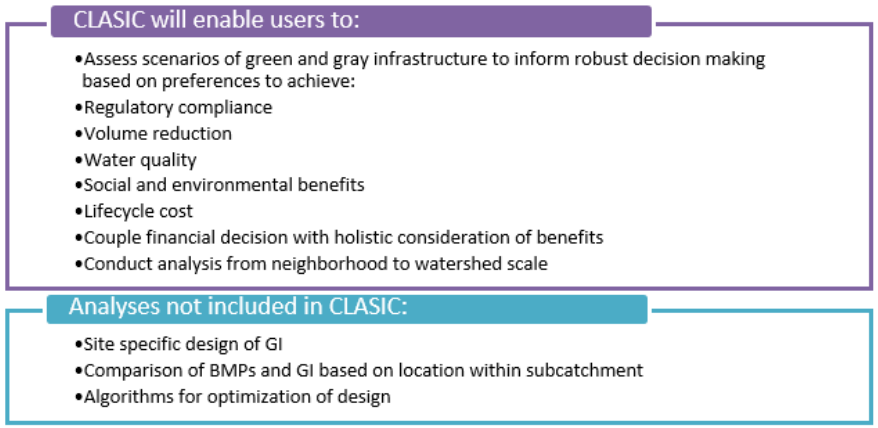
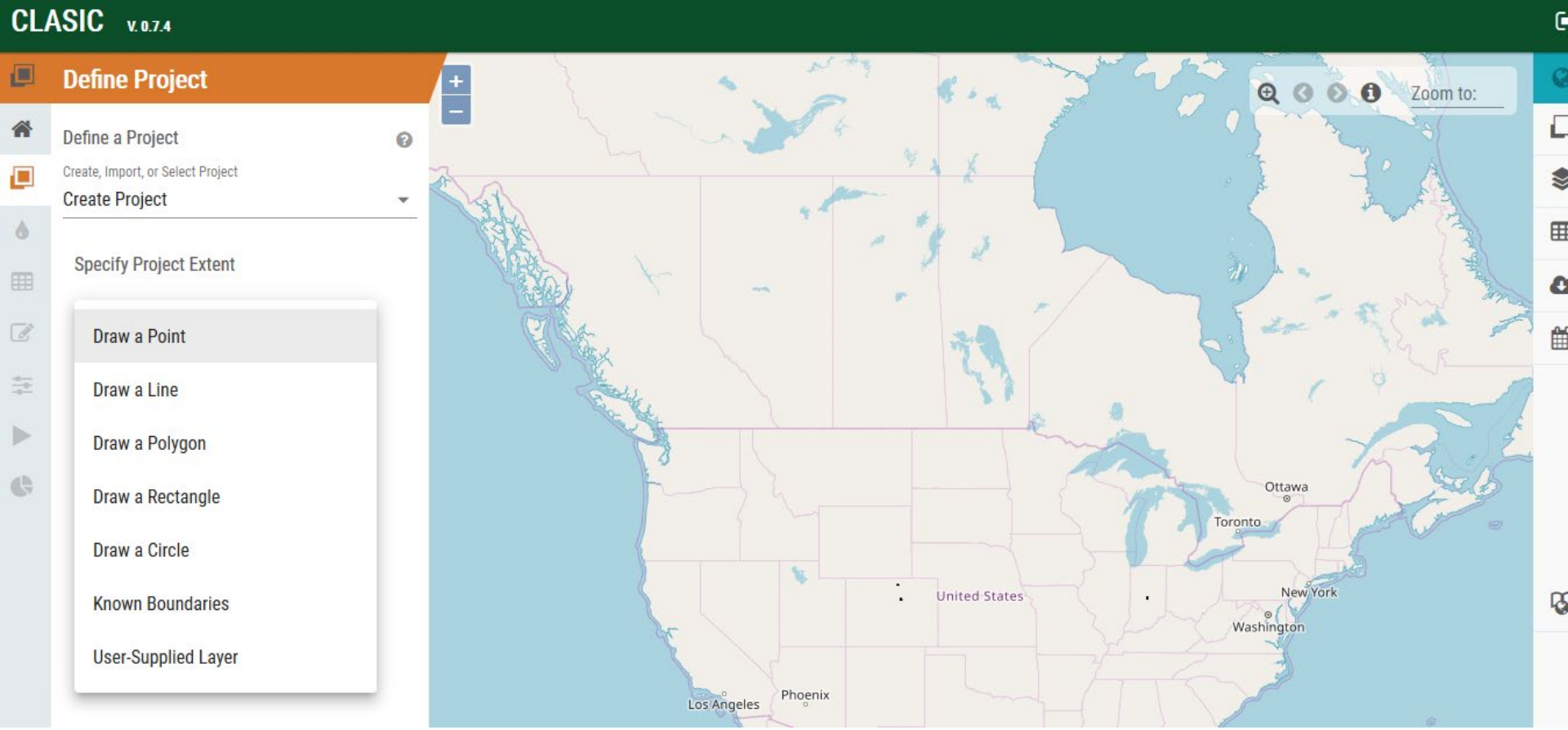
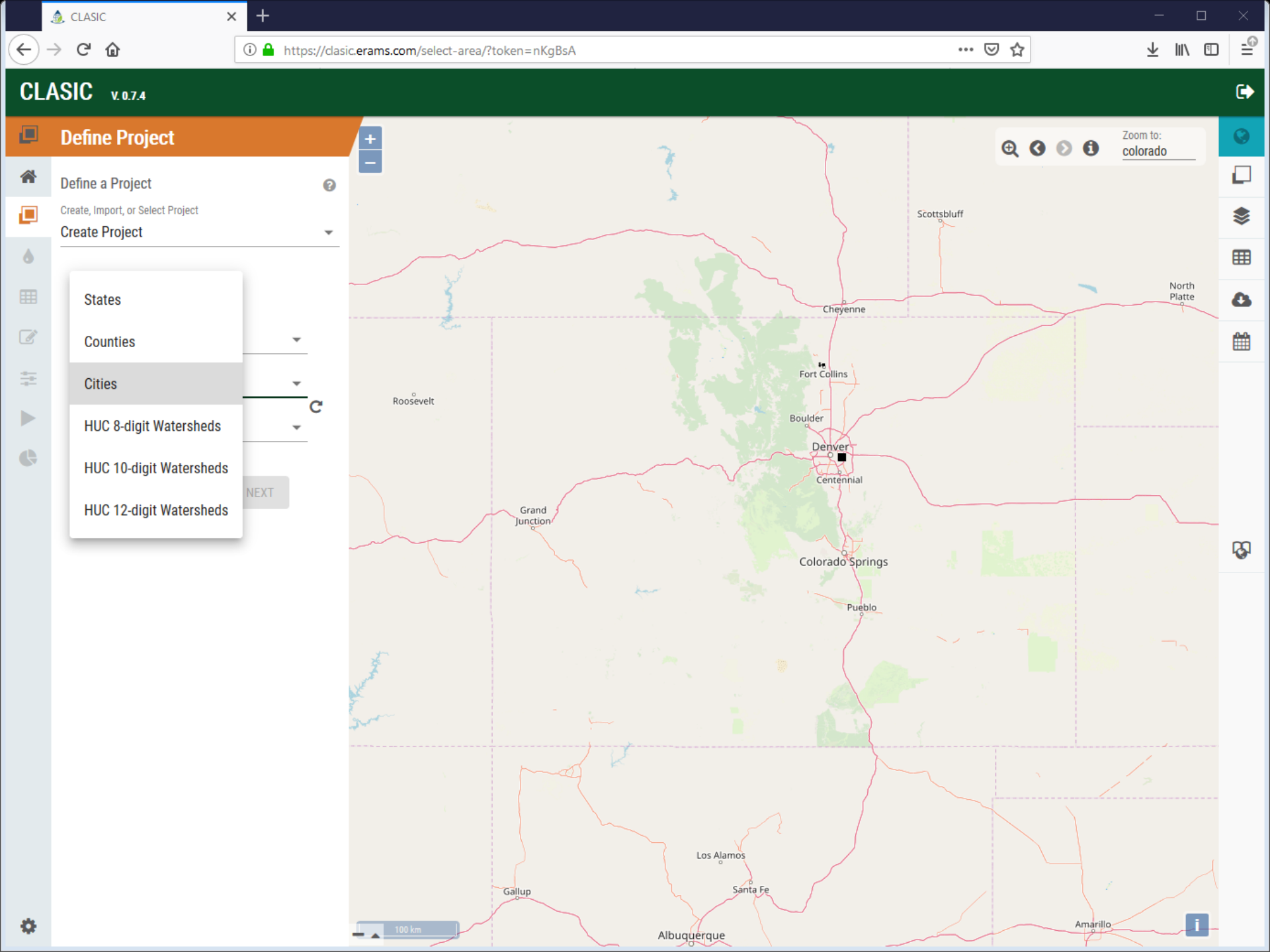


Figure 1. CLASIC Tool Functionality

CLASIC Tool Components

There are three main components to the CLASIC tool outputs: life cycle costs (LCC), Co-benefits and performance (Figure 2).


CLASIC
V. 0.7.4
Define Project
Define a Project
Create, Import, or Select Project
Create Project
Specify Project Extent
Draw a Point
Draw a Line
Draw a Polygon
Draw a Rectangle
Draw a Circle
Known Boundaries
User-Supplied Layer
Zoom to:
Ottawa
Toronto
United States
New York
Washington
Phoenix
Los Angeles


CLASIC
https://clasic.erams.com/select-area/?token=nKgBsA
CLASIC V. 0.7.4
Define Project
Define a Project
Create, Import, or Select Project
Create Project
States
Counties
Cities
HUC 8-digit Watersheds
HUC 10-digit Watersheds
HUC 12-digit Watersheds
NEXT
Zoom to:
colorado
Scottsbluff
North Platte
Cheyenne
Fort Collins
Roosevelt
Boulder
Denver
Centennial
Grand Junction
Colorado Springs
Pueblo
Los Alamos
Gallup
Santa Fe
Albuquerque
Amarillo
100 km

CLASIC

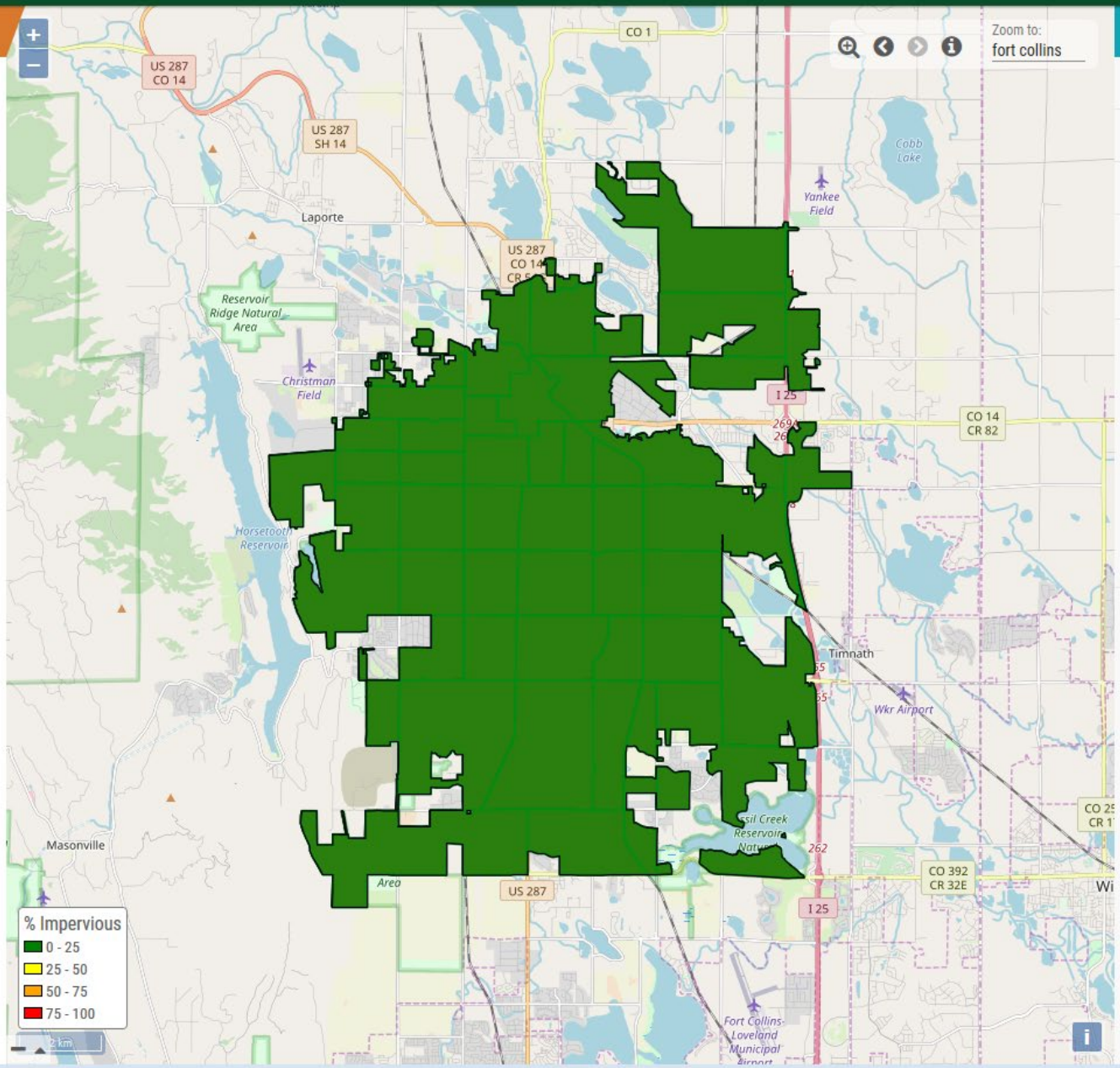
https://clasic.erams.com/select-area/?token=nKgBsA

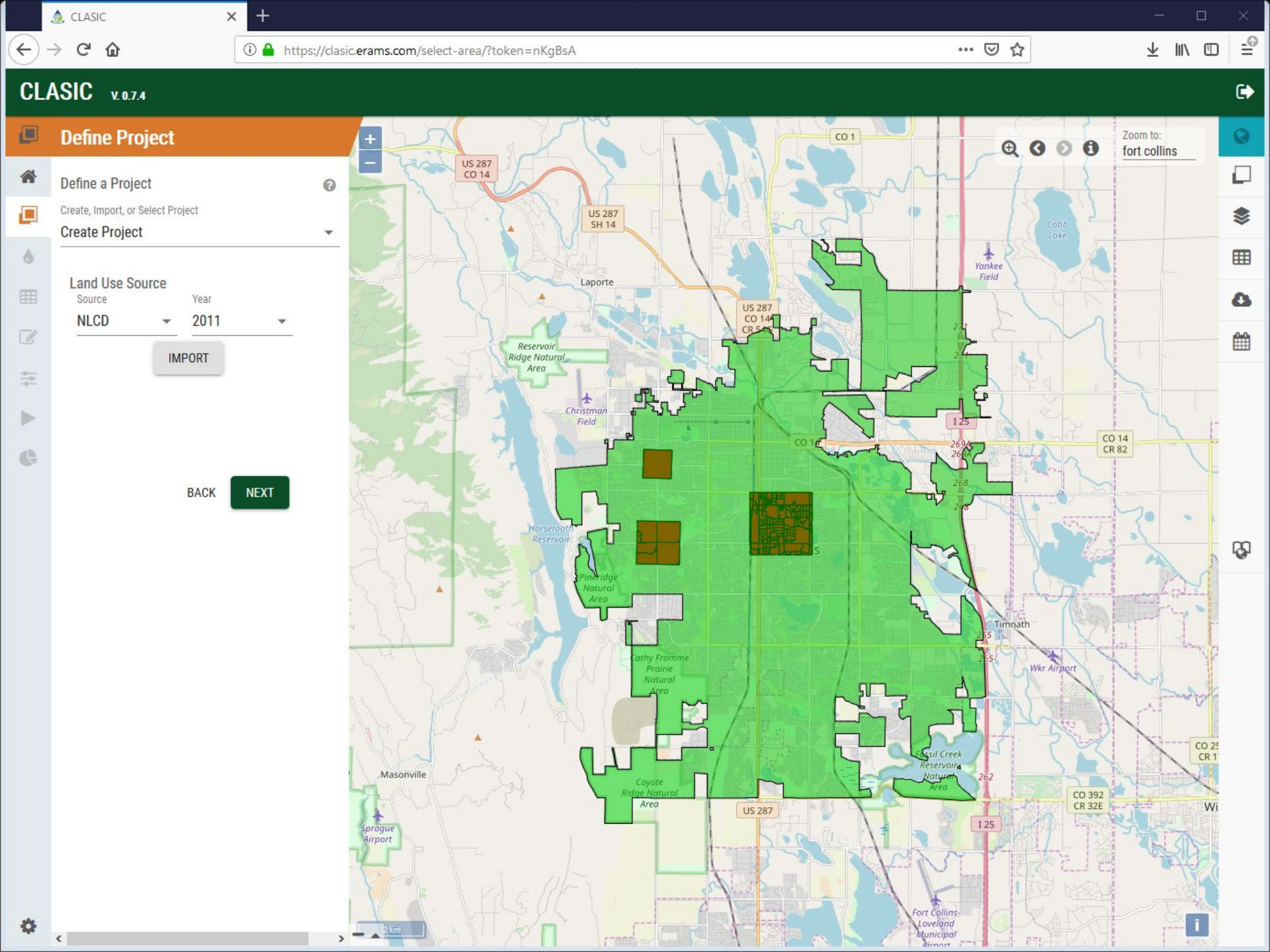
CLASIC V. 0.7.4

Define Project

Define a Project

Create, Import, or Select Project




CLASIC
https://clasic.erams.com/select-area/?token=nKgBsA
CLASIC V. 0.7.4
Define Project
Define a Project
Create, Import, or Select Project
Create Project
Land Use Source
Source
NLCD
Year
2011
IMPORT
BACK
NEXT
Zoom to:
fort collins
US 287 CO 14
US 287 SH 14
CO 1
Laporte
Cobb Lake
Yankee Field
US 287 CO 14 CR 5
Reservoir Ridge Natural Area
Christman Field
I 25
CO 14 CR 82
Horsetooth Reservoir
Pineridge Natural Area
Timnath
Cathy Fromme Prairie Natural Area
Wkr Airport
Fossil Creek Reservoir Natural Area
Masonville
Coyote Ridge Natural Area
US 287
CO 392 CR 32E
Sprague Airport
Fort Collins-Loveland Municipal Airport

File Edit View History Bookmarks Tools Help

CLASIC | CLASIC

https://clasic.erams.com/model-parameters/?token=nKgBsA

Search

CLASIC V. 0.7.5

Climate Data

Select Climate Data

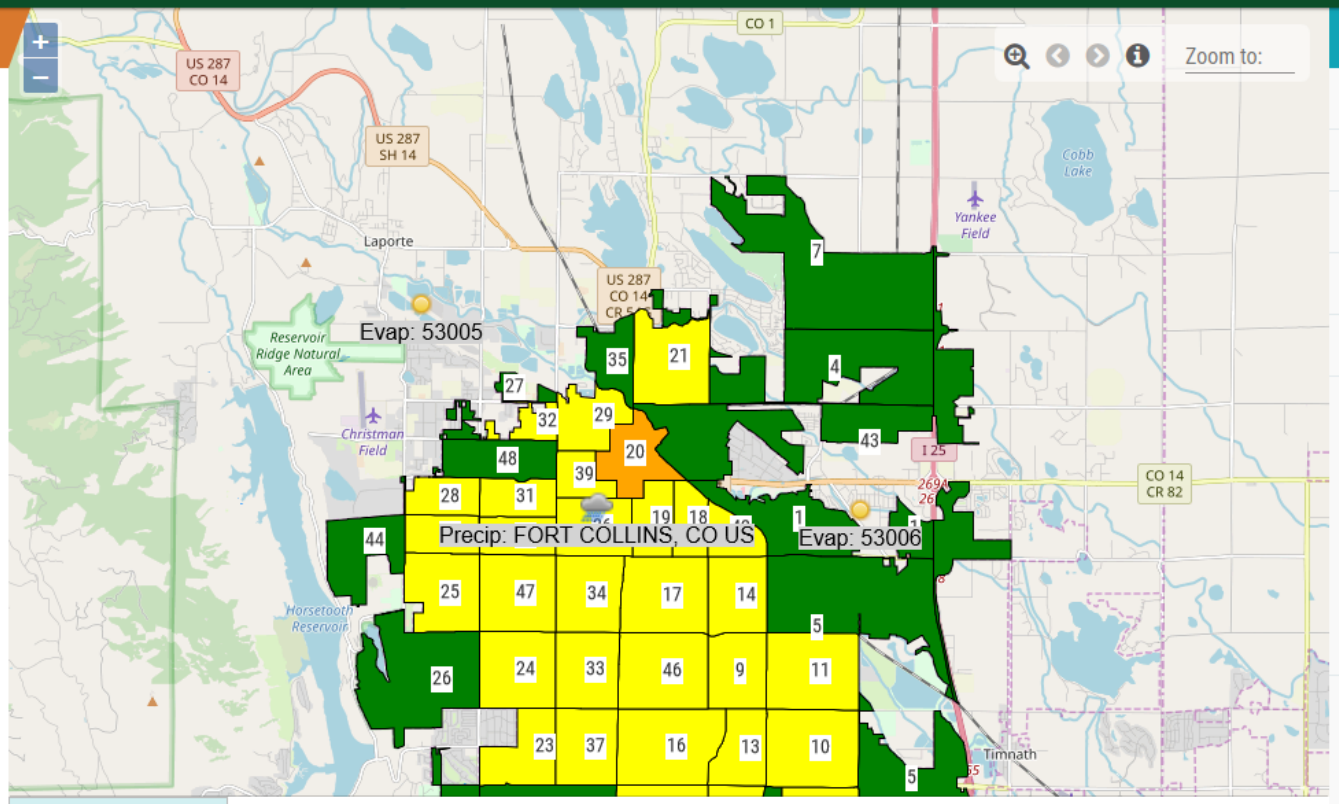
UPDATE CLIMATE

Select Precip Station

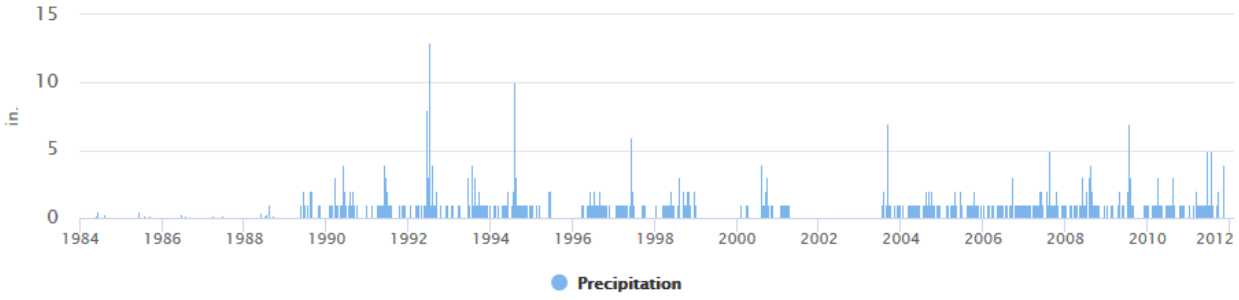
FORT COLLINS, CO US

on Station

- 53006
- 53005
- 58839
- 51060
- 530070



PRECIP



File Edit View History Bookmarks Tools Help

CLASIC | CLASIC

https://clasic.erams.com/model-defaults/?token=nKgBsA

Search

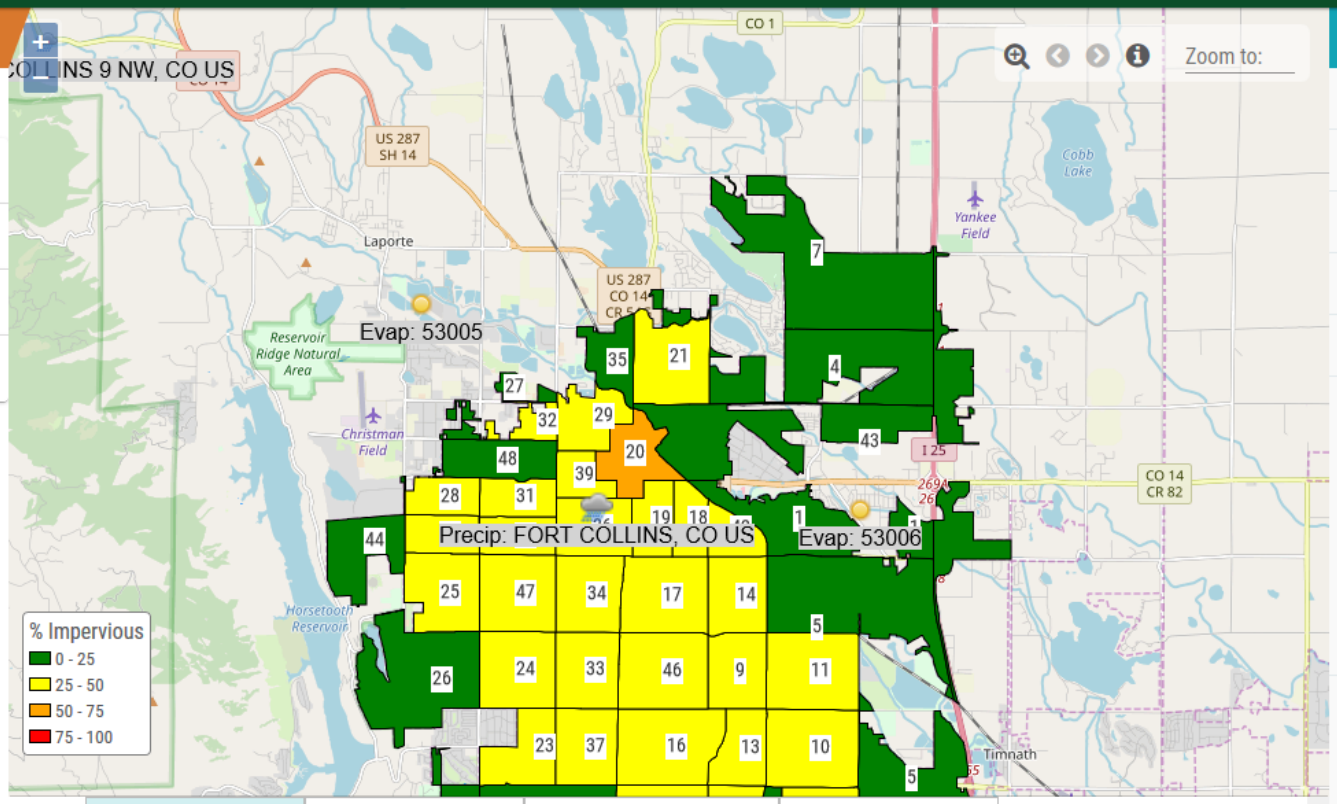
CLASIC V. 0.7.5

Model Defaults

Review and Modify Default Parameters

- Subunits
- Water Quality
- Overland Flow Length
- Infiltration

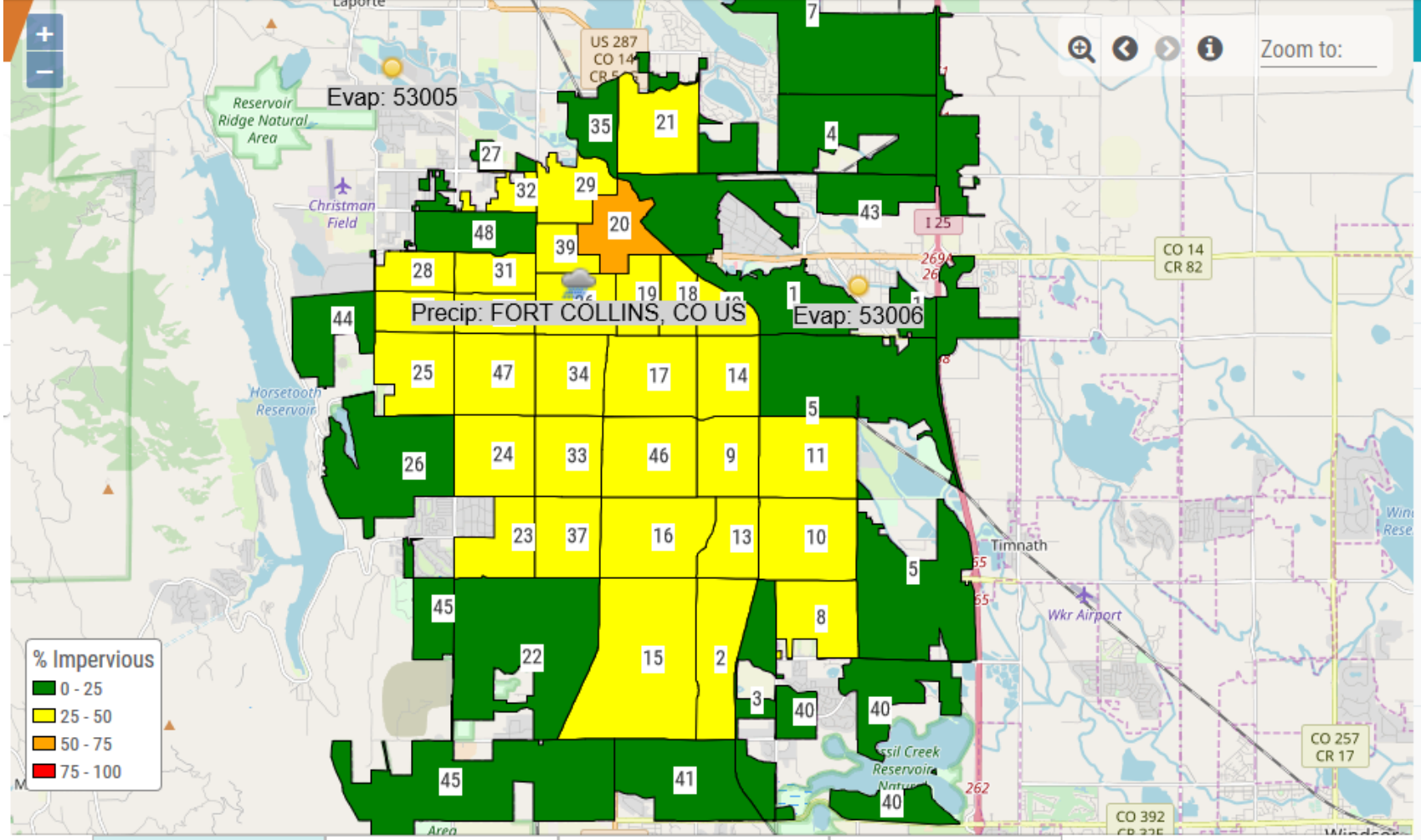
EDIT



SUBUNITS | WATER QUALITY | OVERLAND FLOW LENGTH | INFILTRATION

subunit_id	Area (Ac)	Impervious (%)	Slope (%)	Open (%)	Low (%)	Medium (%)	High (%)	Other (%)	Leng
1	1592.68	9	2.00	7	10	6	2	75	186
2	1239.86	28	7.00	33	33	20	2	12	160.5
3	941.98	24	4.00	7	16	23	4	50	163
4	2423.72	9	1.00	6	18	4	0	72	187
5	5062.02	14	2.00	9	11	10	3	66	178
6	1396.35	10	2.00	7	10	8	1	74	185.5

Previous | Page 1 of 8 | Next



SUBUNITS | WATER QUALITY | OVERLAND FLOW LENGTH | INFILTRATION

subunit_id	Area (Ac)	Impervious (%)	Slope (%)	Open (%)	Low (%)	Medium (%)	High (%)	Other (%)	Length
1	1592.68	9	2.00	7	10	6	2	75	186
2	1239.86	28	7.00	33	33	20	2	12	160.5
3	941.98	24	4.00	7	16	23	4	50	163
4	2423.72	9	1.00	6	18	4	0	72	187

File Edit View History Bookmarks Tools Help

CLASIC | CLASIC

https://clasic.erams.com/model-defaults/?token=nKgBsA

Search

CLASIC V. 0.7.5

Model Defaults

Review and Modify Default Parameters

Subunits

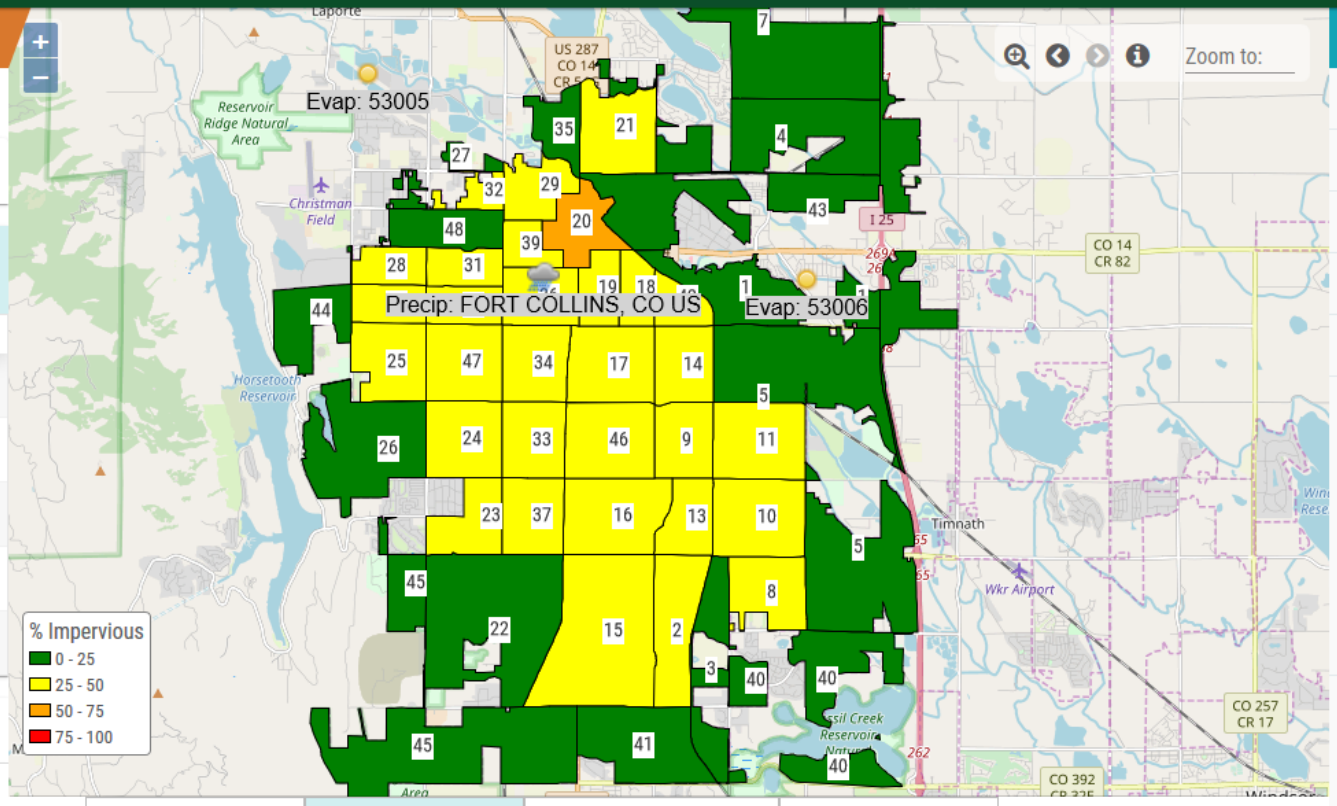
Water Quality

Land Use	C_{TSS}	C_{TP}	C_{TN}	C_{FIB}
open	49.32	0.25	2.52	863.03
low	51.44	0.27	2.65	864.03
medium	49.69	0.24	2.37	1035.9
high	47.8	0.21	2.04	1281.8
other	42.82	0.21	2.15	824.67

Overland Flow Length

Infiltration

EDIT



SUBUNITS | WATER QUALITY | OVERLAND FLOW LENGTH | INFILTRATION

subunit_id	Open (%)	Low (%)	Medium (%)	High (%)	Other (%)	C_{TSS} (mg/L)	C_{TP} (mg/L)	C_{TN} (mg/L)	C_{FIB} (cfu/1
1	7	10	6	2	75	44.65	0.22	2.24	853.11
2	33	33	20	2	12	49.28	0.25	2.48	901.71
3	7	16	23	4	50	46.43	0.23	2.3	900.52
4	6	18	4	0	72	45.04	0.22	2.27	842.51

Previous | Page 1 of 12 | Next

File Edit View History Bookmarks Tools Help

CLASIC | CLASIC

https://clasic.erams.com/scenarios/?token=nKgBsA

Search

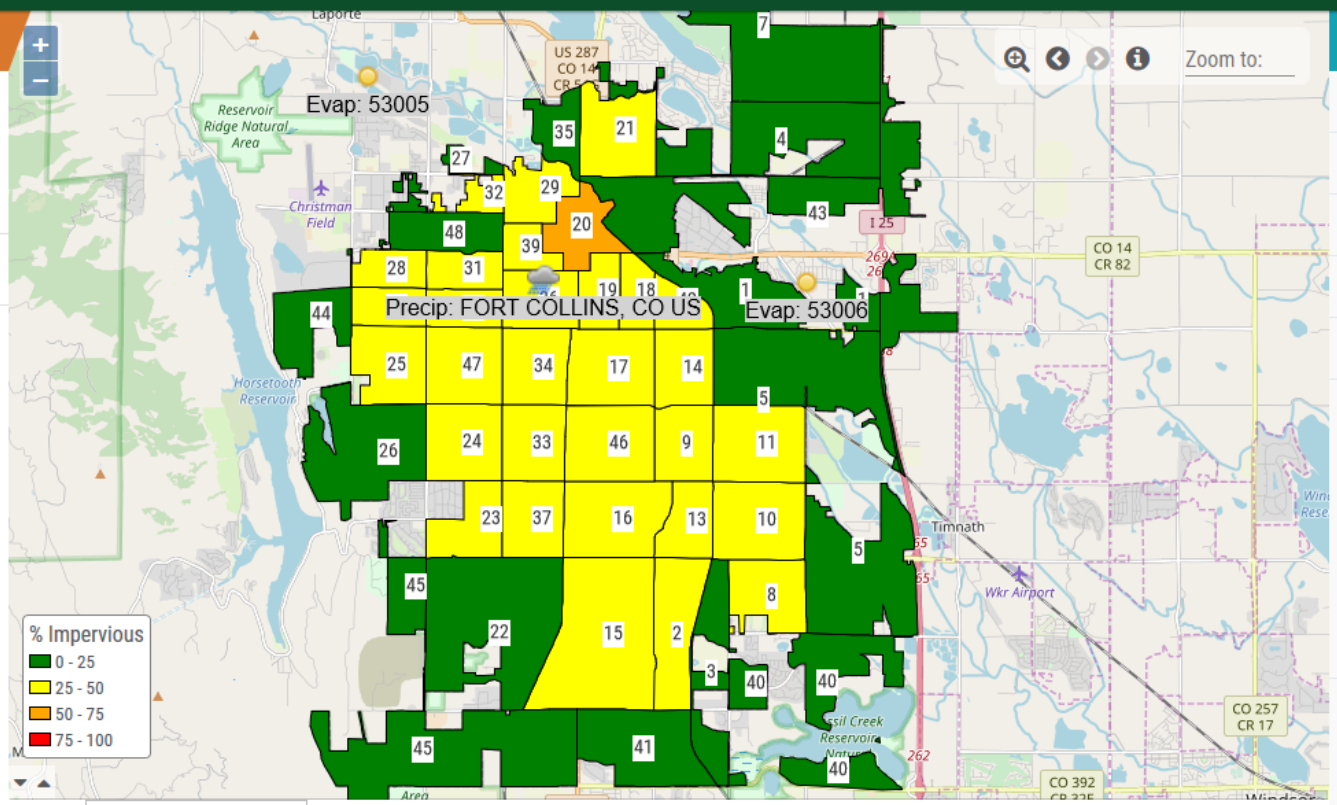
CLASIC V. 0.7.5

Scenario Development

Green infrastructure (GI) scenario development

Scenarios

Baseline



SCENARIO SUMMARY

File Edit View History Bookmarks Tools Help

CLASIC | CLASIC

https://clasic.erams.com/scenarios/?token=nKgBsA

Search

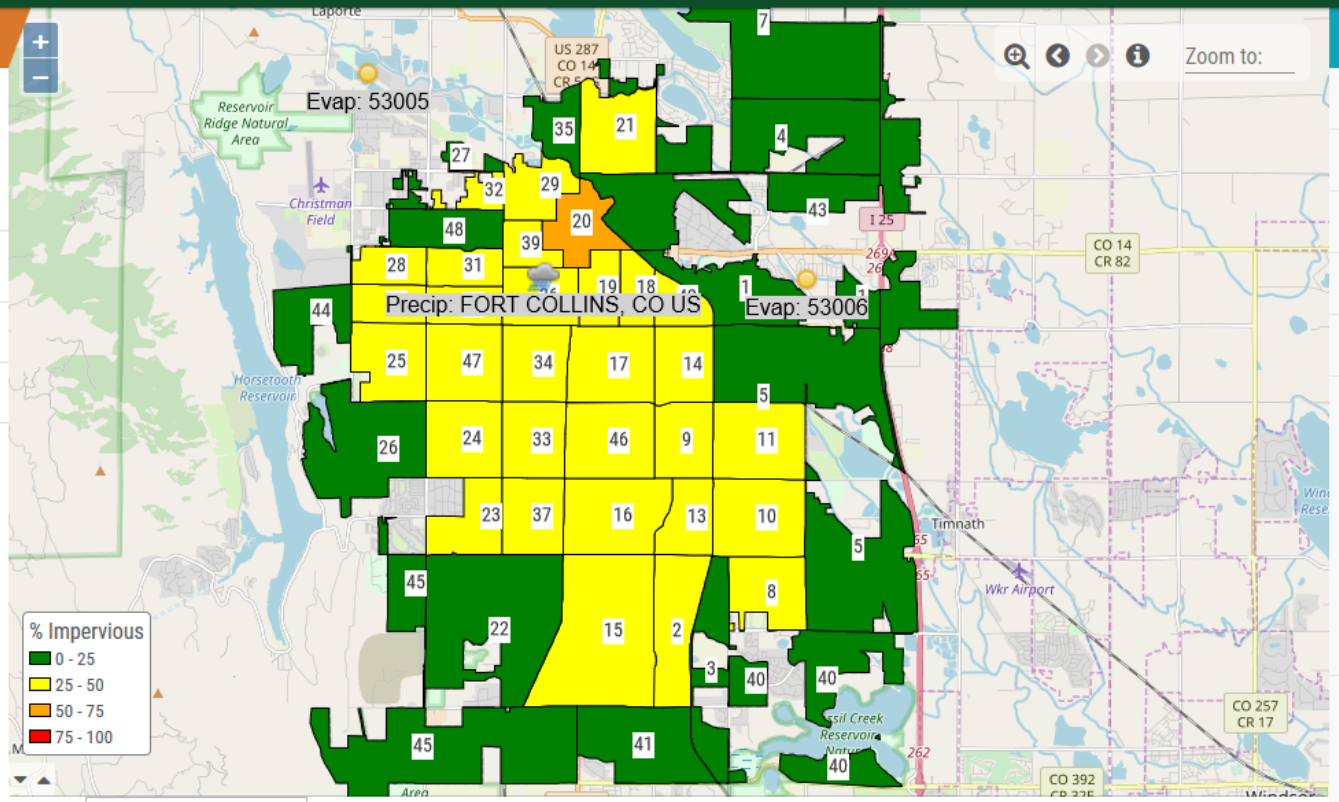
CLASIC V. 0.7.5

Scenario Development

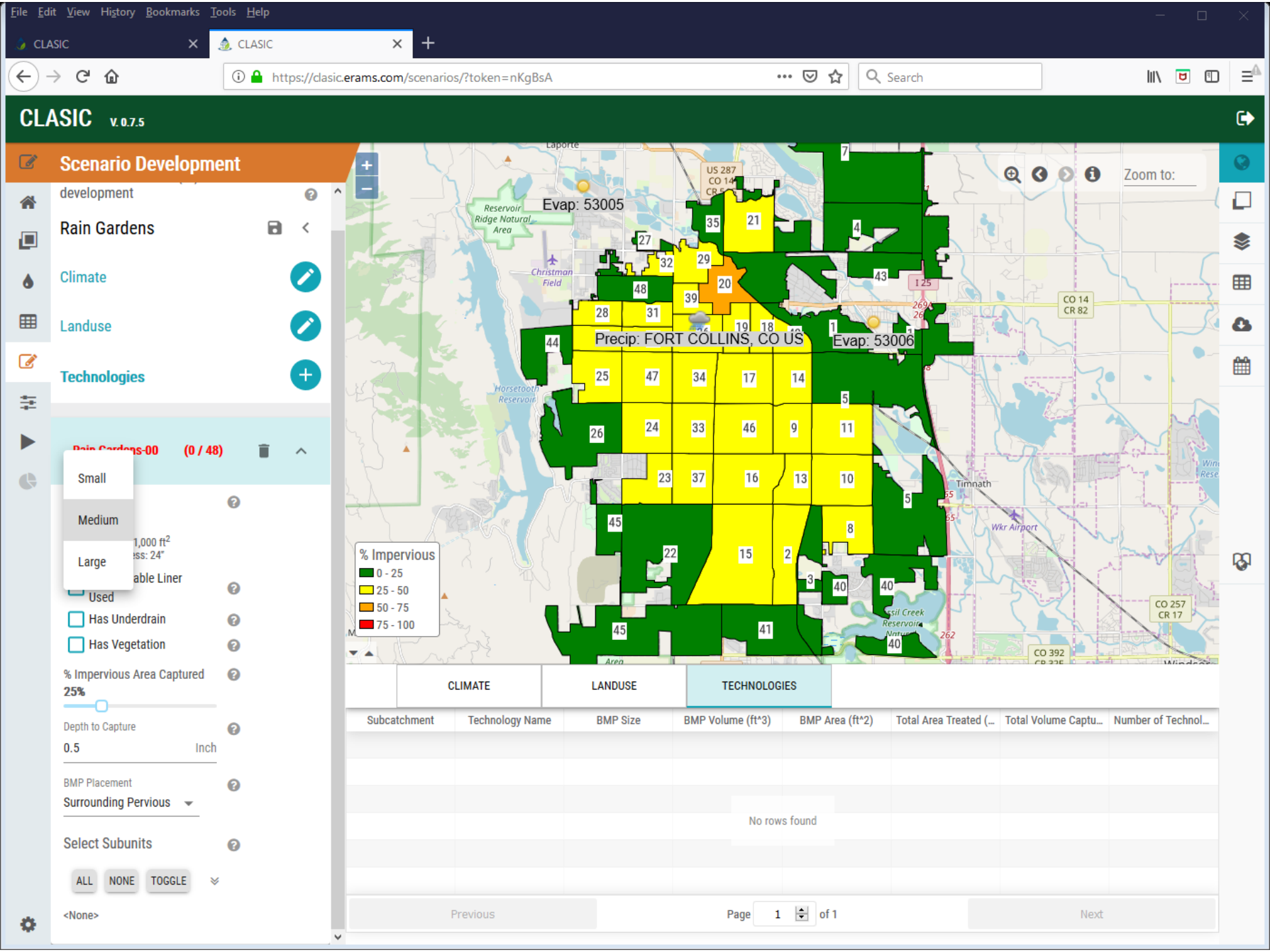
Green infrastructure (GI) scenario development

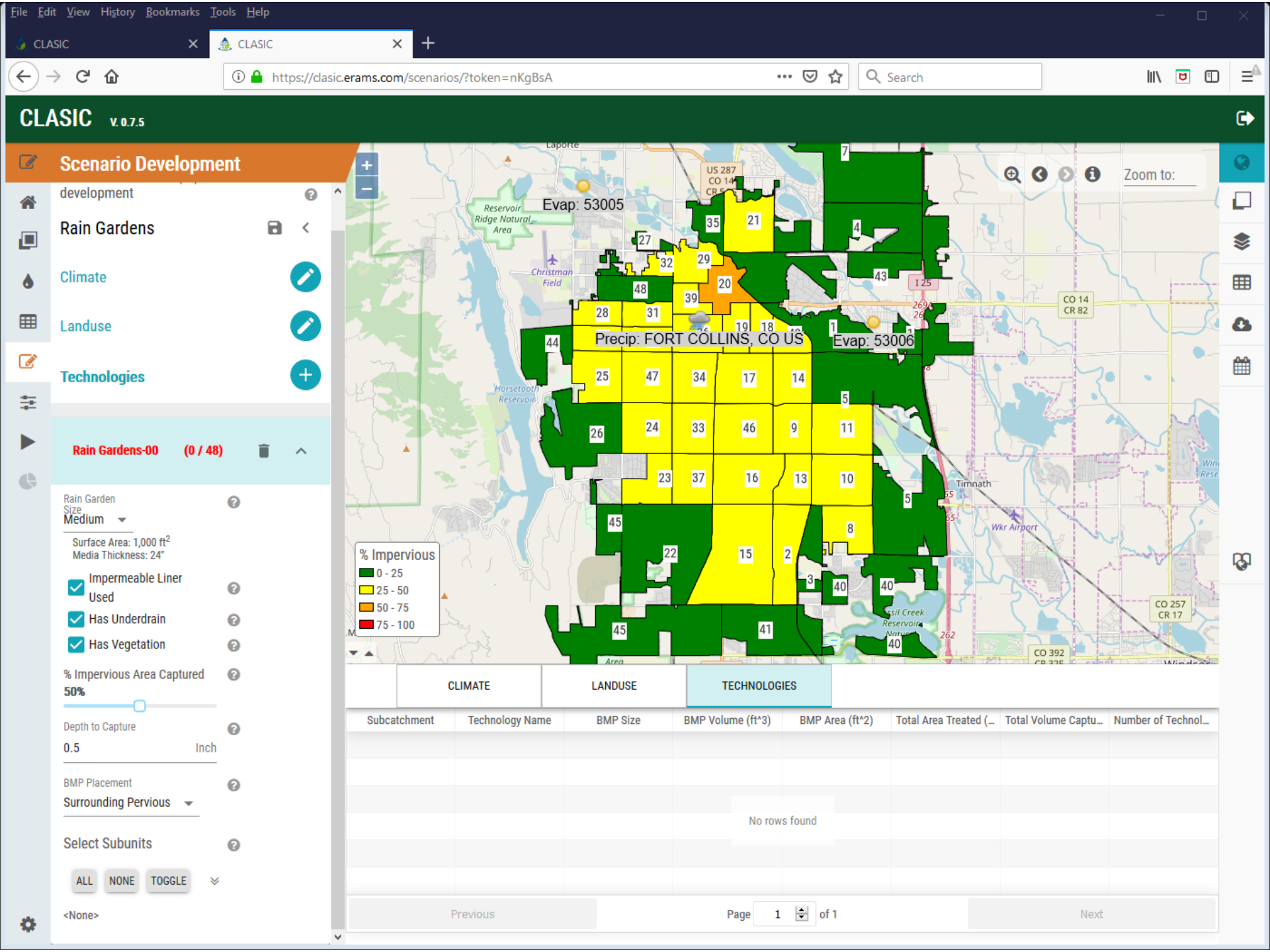
Scenarios

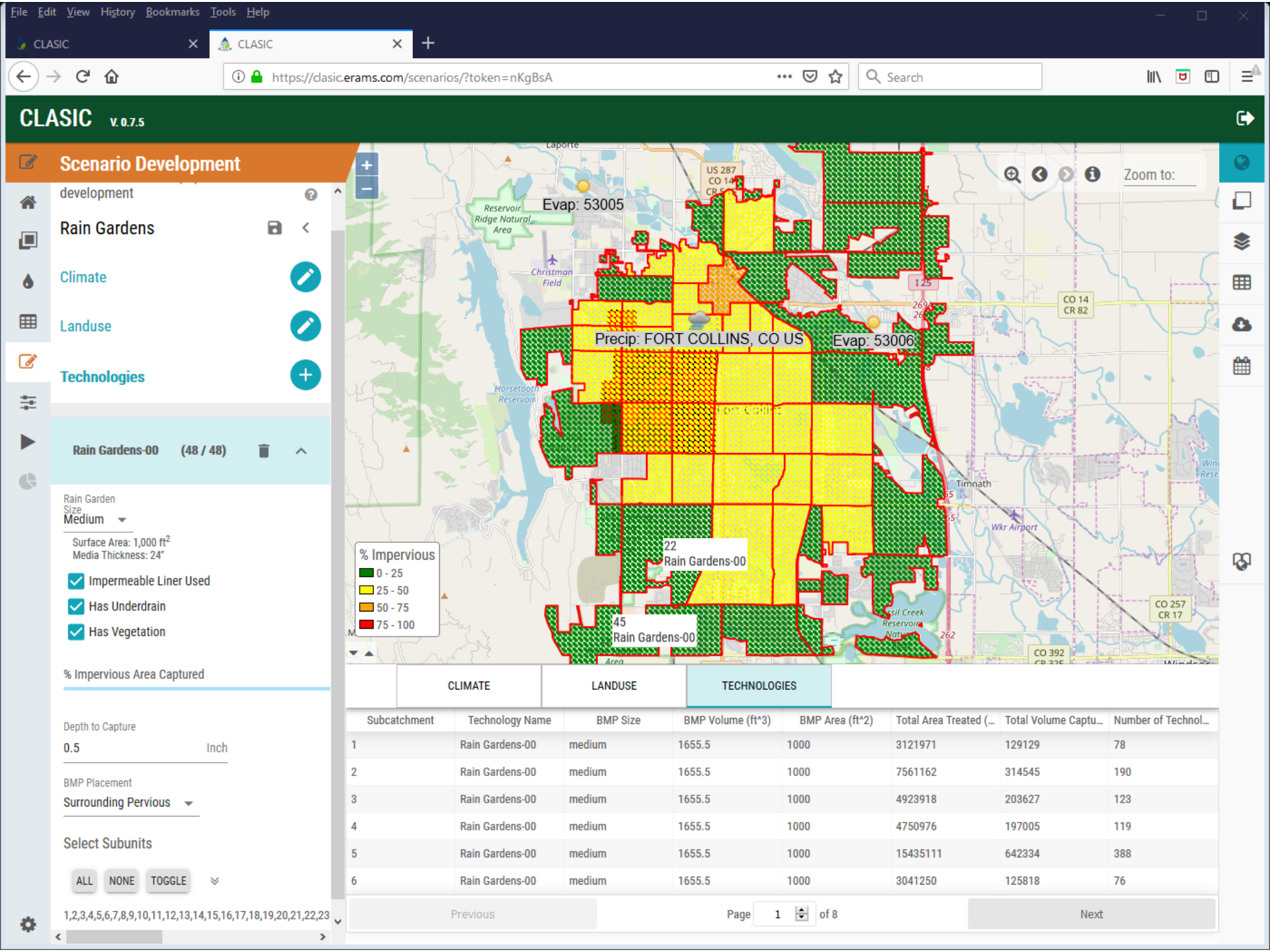
- Baseline
- Rain Gardens
- RG + SF



SCENARIO SUMMARY


File Edit View History Bookmarks Tools Help
CLASIC
CLASIC
https://clasic.erams.com/scenarios/?token=nKgBsA
Search
CLASIC V. 0.7.5
Scenario Development
development
Rain Gardens
Climate
Landuse
Technologies
(0 / 48)
Small
Medium
Large
Used
Has Underdrain
Has Vegetation
% Impervious Area Captured
25%
Depth to Capture
0.5
Inch
BMP Placement
Surrounding Pervious
Select Subunits
ALL
NONE
TOGGLE
<None>
Evap: 53005
Precip: FORT COLLINS, CO US
Evap: 53006
Zoom to:
% Impervious
0 - 25
25 - 50
50 - 75
75 - 100
CLIMATE
LANDUSE
TECHNOLOGIES
Subcatchment
Technology Name
BMP Size
BMP Volume (ft^3)
BMP Area (ft^2)
Total Area Treated (...
Total Volume Captu...
Number of Technol...
No rows found
Previous
Page 1 of 1
Next


File Edit View History Bookmarks Tools Help
CLASIC
CLASIC
https://clasic.erams.com/scenarios/?token=nKgBsA
Search
CLASIC V. 0.7.5
Scenario Development
development
Rain Gardens
Climate
Landuse
Technologies
Rain Gardens-00 (0 / 48)
Rain Garden Size
Medium
Surface Area: 1,000 ft2
Media Thickness: 24"
Impermeable Liner Used
Has Underdrain
Has Vegetation
% Impervious Area Captured
50%
Depth to Capture
0.5 Inch
BMP Placement
Surrounding Pervious
Select Subunits
ALL NONE TOGGLE
<None>
Evap: 53005
Precip: FORT COLLINS, CO US
Evap: 53006
Zoom to:
% Impervious
0 - 25
25 - 50
50 - 75
75 - 100
CLIMATE
LANDUSE
TECHNOLOGIES
Subcatchment
Technology Name
BMP Size
BMP Volume (ft^3)
BMP Area (ft^2)
Total Area Treated (...
Total Volume Captu...
Number of Technol...
No rows found
Previous
Page 1 of 1
Next


File Edit View History Bookmarks Tools Help
CLASIC
CLASIC
https://clasic.erams.com/scenarios/?token=nKgBsA
Search
CLASIC V. 0.7.5
Scenario Development
development
Rain Gardens
Climate
Landuse
Technologies
Rain Gardens-00 (48 / 48)
Rain Garden Size
Medium
Surface Area: 1,000 ft2
Media Thickness: 24"
Impermeable Liner Used
Has Underdrain
Has Vegetation
% Impervious Area Captured
Depth to Capture
0.5
Inch
BMP Placement
Surrounding Pervious
Select Subunits
ALL
NONE
TOGGLE
1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23
Evap: 53005
Precip: FORT COLLINS, CO US
Evap: 53006
Zoom to:
% Impervious
0 - 25
25 - 50
50 - 75
75 - 100
22
Rain Gardens-00
45
Rain Gardens-00
Timnath
CLIMATE
LANDUSE
TECHNOLOGIES
Subcatchment
Technology Name
BMP Size
BMP Volume (ft^3)
BMP Area (ft^2)
Total Area Treated (...
Total Volume Captu...
Number of Technol...
1 Rain Gardens-00 medium 1655.5 1000 3121971 129129 78
2 Rain Gardens-00 medium 1655.5 1000 7561162 314545 190
3 Rain Gardens-00 medium 1655.5 1000 4923918 203627 123
4 Rain Gardens-00 medium 1655.5 1000 4750976 197005 119
5 Rain Gardens-00 medium 1655.5 1000 15435111 642334 388
6 Rain Gardens-00 medium 1655.5 1000 3041250 125818 76
Previous
Page 1 of 8
Next

File Edit View History Bookmarks Tools Help

CLASIC | CLASIC

https://clasic.erams.com/scenarios/?token=nKgBsA

Search

CLASIC V. 0.7.5

Scenario Development

Climate

Landuse

Technologies

Rain Gardens-00 (5 / 48)

Rain Garden Size
Medium

Surface Area: 1,000 ft²
Media Thickness: 24"

- [x] Impermeable Liner Used
- [x] Has Underdrain
- [x] Has Vegetation

% Impervious Area Captured 50%

Depth to Capture
0.5 Inch

BMP Placement
Surrounding Pervious

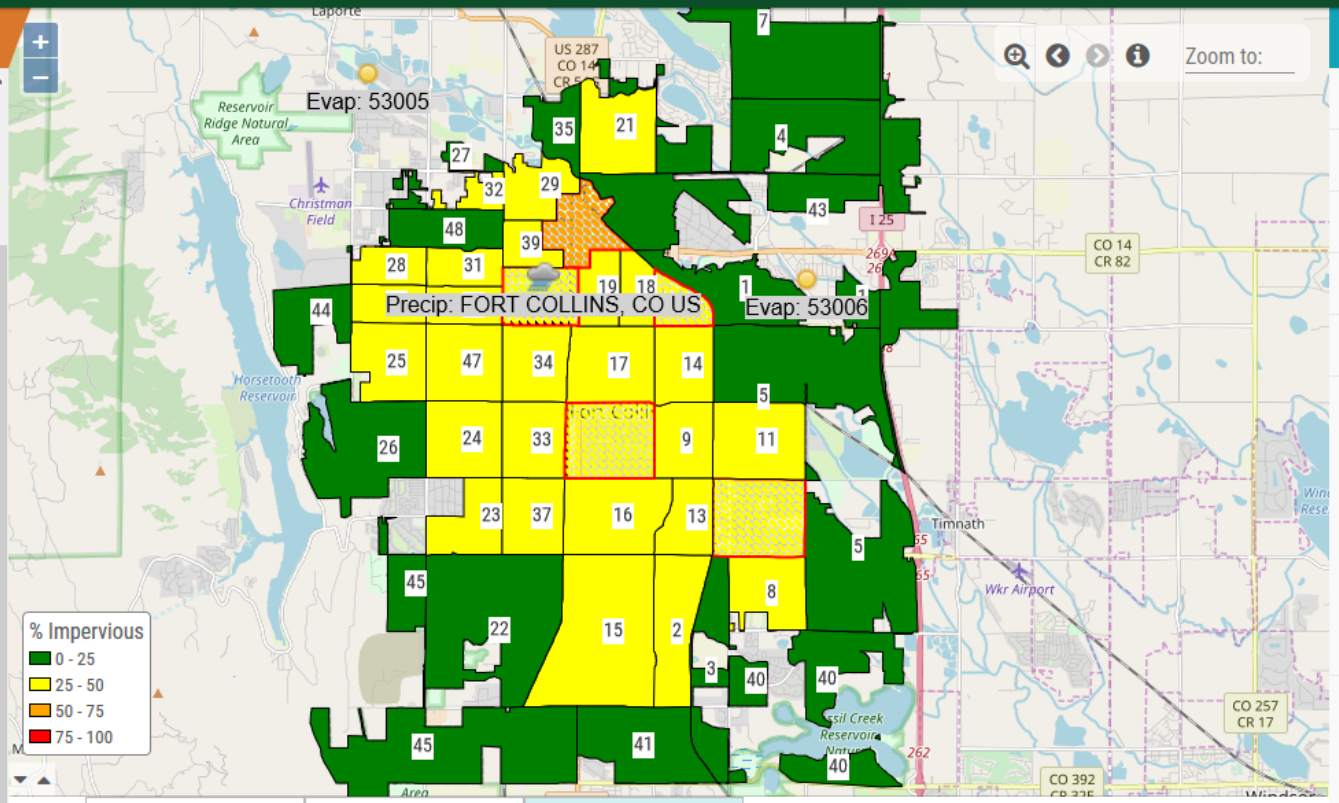
Select Subunits

ALL NONE TOGGLE

Assign this technology to subunits where

Field	Op	<value>
impervious	>=	40

10,20,36,42,46



CLIMATE | LANDUSE | TECHNOLOGIES

Subcatchment	Technology Name	BMP Size	BMP Volume (ft^3)	BMP Area (ft^2)	Total Area Treated (...	Total Volume Captu...	Number of Technol...
10	Rain Gardens-00	medium	1655.5	1000	12851857	534727	323
20	Rain Gardens-00	medium	1655.5	1000	9323460	387387	234
36	Rain Gardens-00	medium	1655.5	1000	8048067	334411	202
42	Rain Gardens-00	medium	1655.5	1000	4863147	201971	122
46	Rain Gardens-00	medium	1655.5	1000	12741790	529760	320

Previous Page 1 of 1 Next

File Edit View History Bookmarks Tools Help

CLASIC | CLASIC

https://clasic.erams.com/scenarios/?token=nKgBsA

Search

CLASIC V. 0.7.5

Scenario Development

Green infrastructure (GI) scenario development

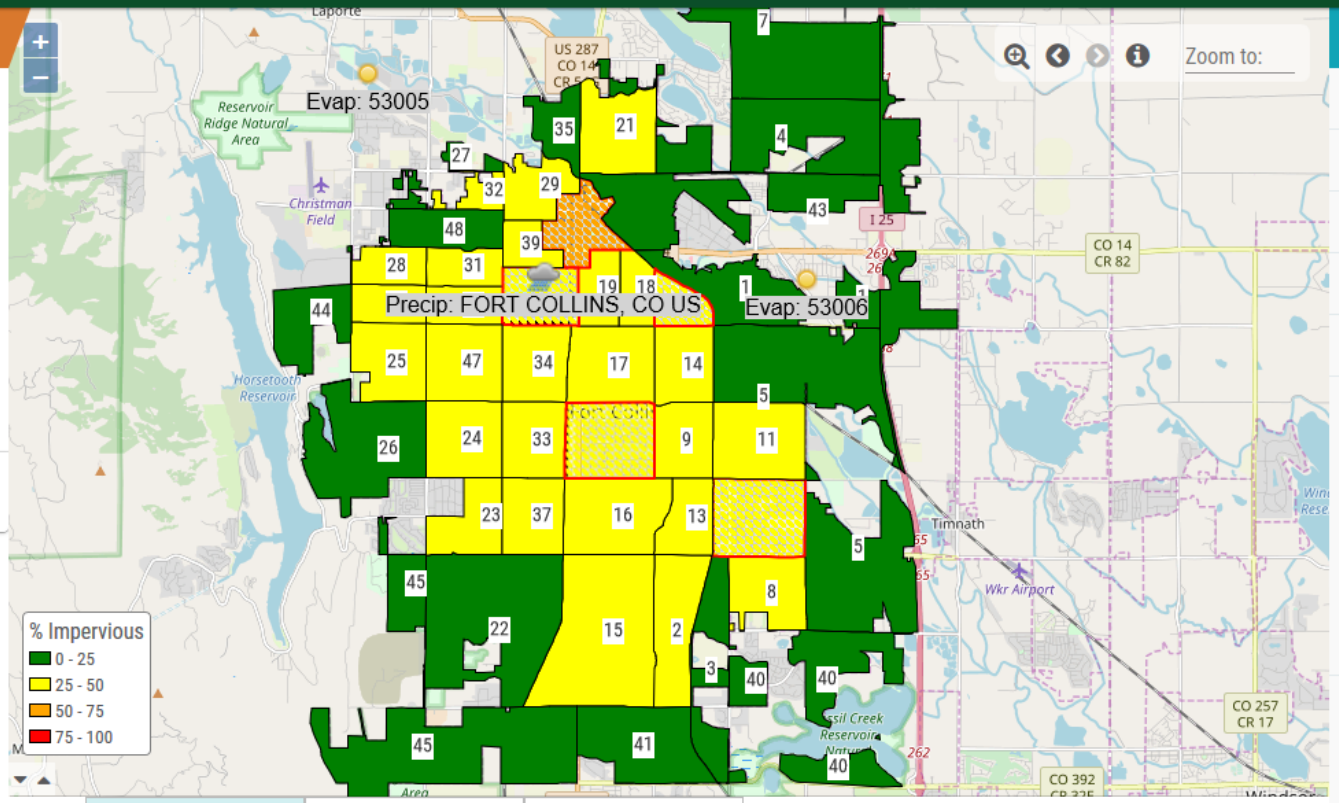
Rain Gardens

Climate

Landuse

Technologies

Rain Gardens-00 (5 / 48)

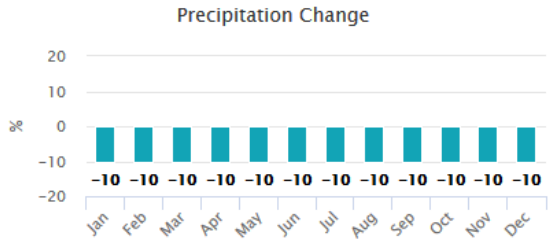


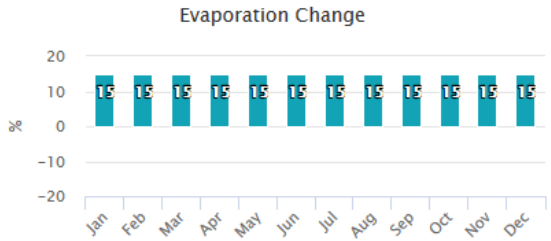
CLIMATE | LANDUSE | TECHNOLOGIES

Climate: Custom

% Precip: -10

% Evap: 15





File Edit View History Bookmarks Tools Help

CLASIC | CLASIC

https://clasic.erams.com/scenarios/?token=nKgBsA

Search

CLASIC V. 0.7.5

Scenario Development

Green infrastructure (GI) scenario development

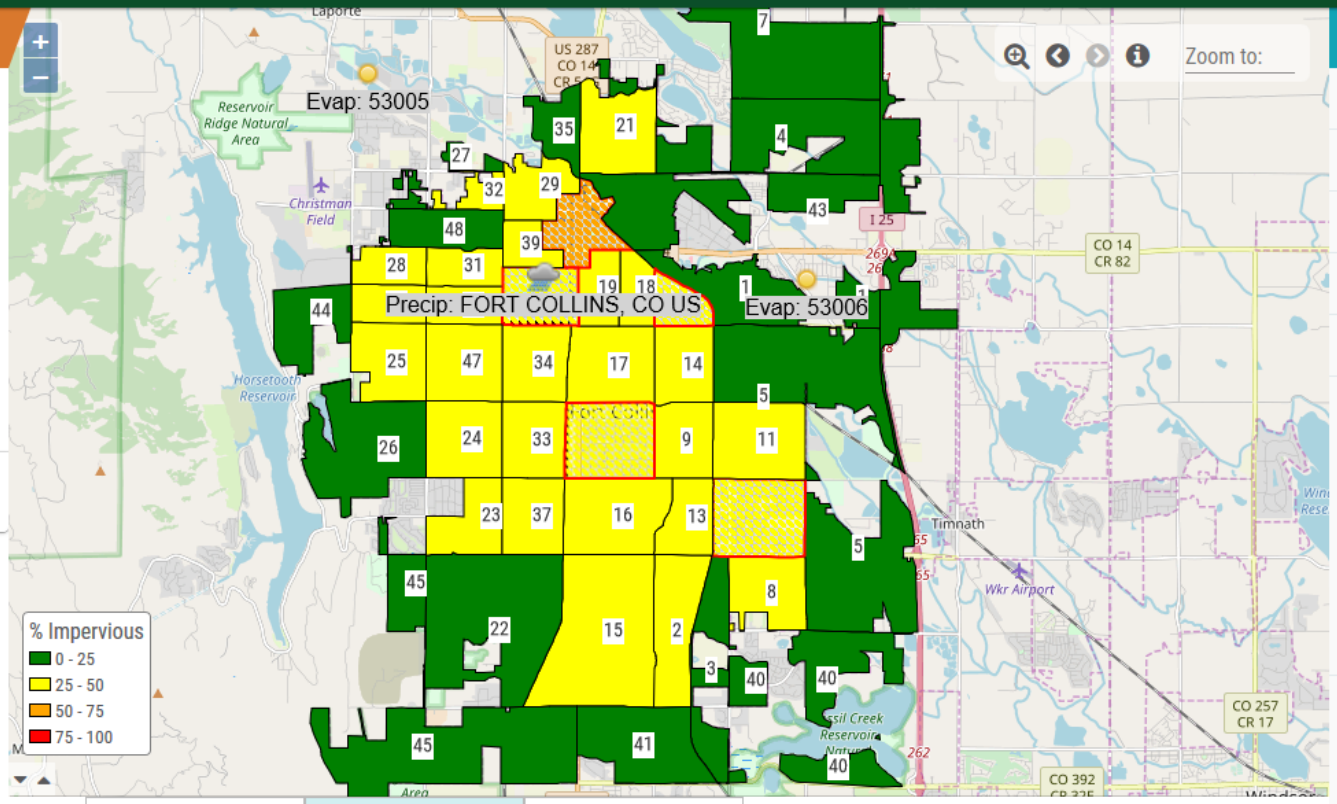
Rain Gardens

Climate

Landuse

Technologies

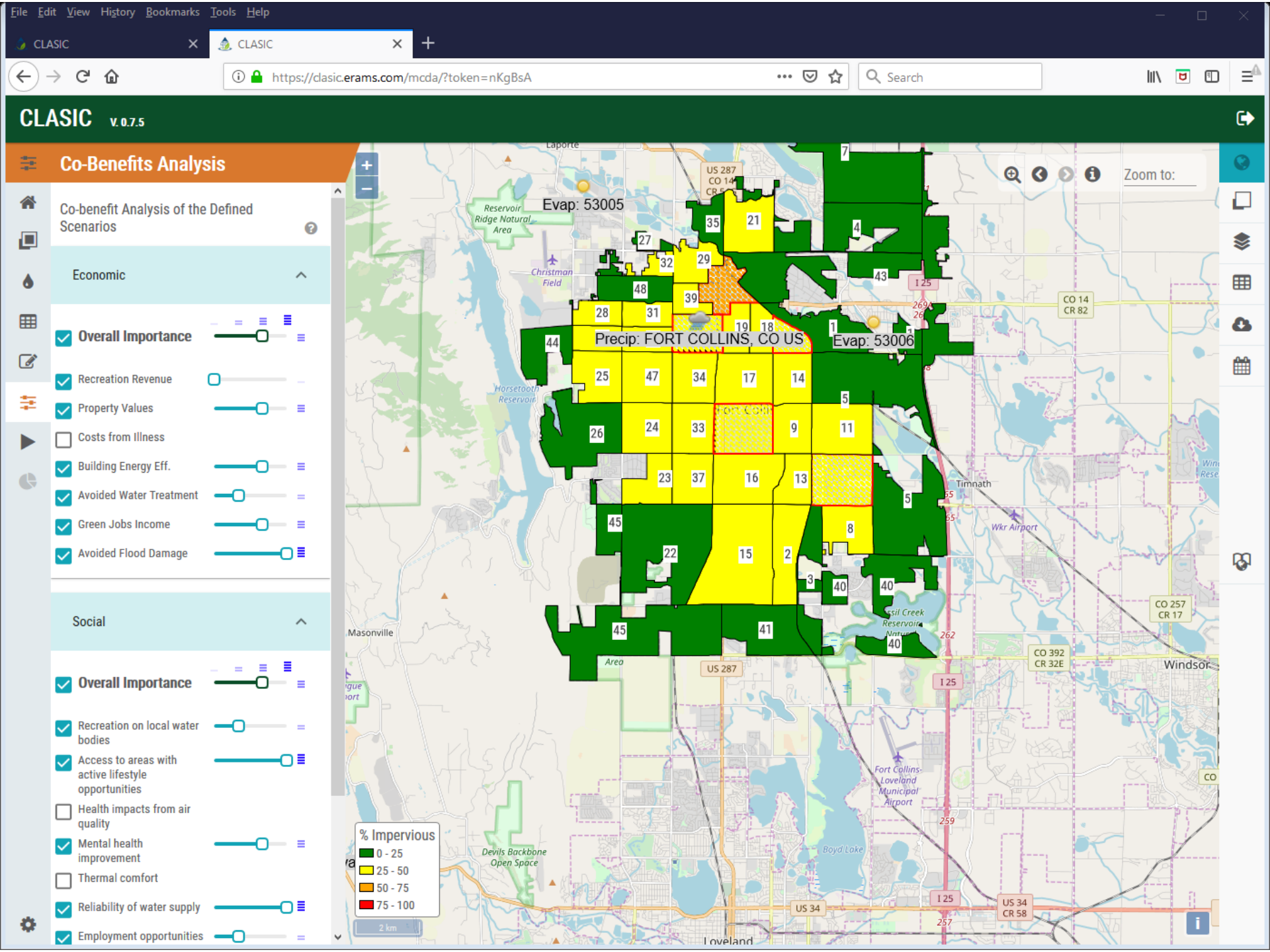
Rain Gardens-00 (5 / 48)

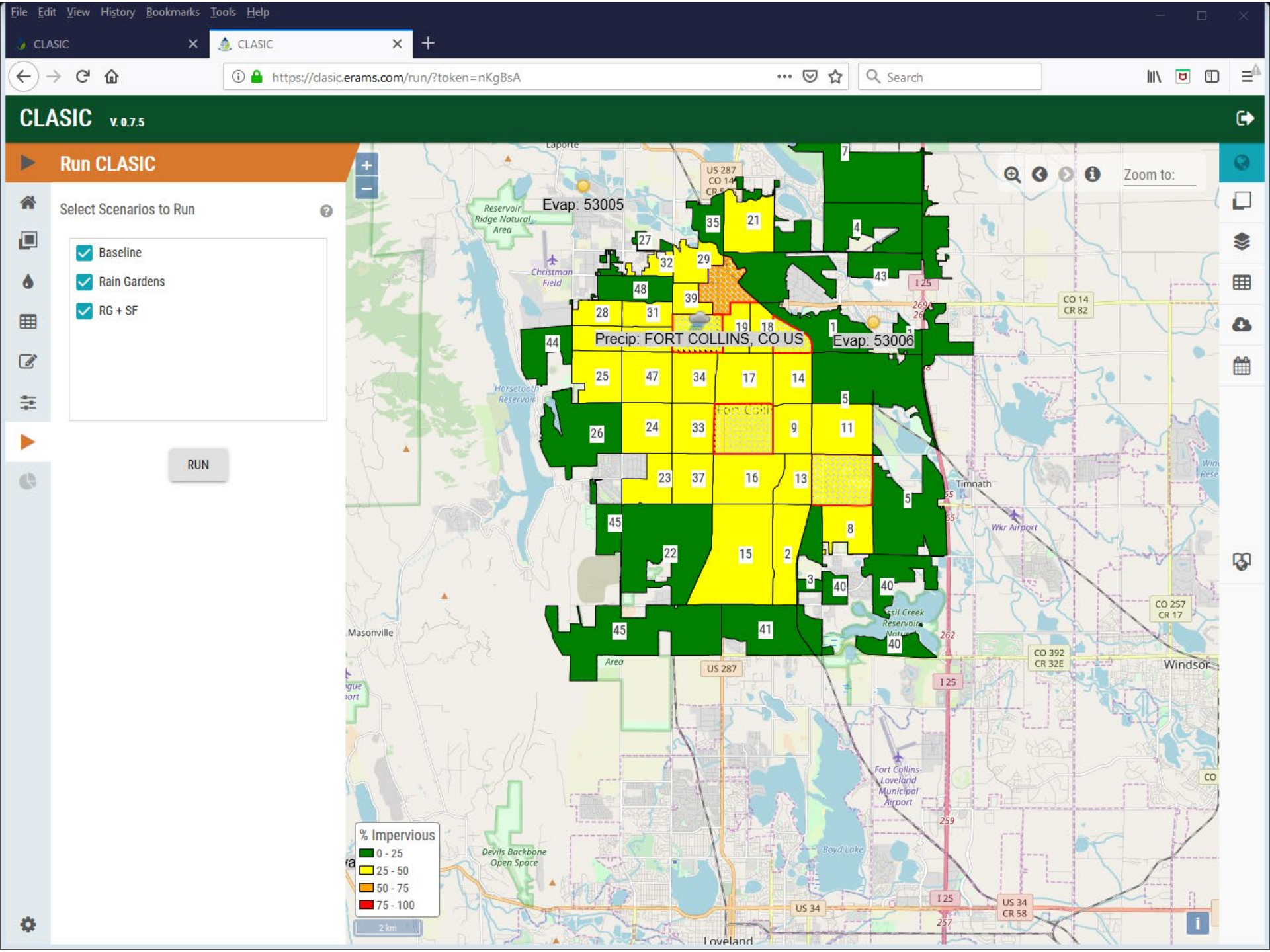


CLIMATE | LANDUSE | TECHNOLOGIES

subunit_id	Impervious (%)	Open (%)	Low (%)	Medium (%)	High (%)	Other (%)
1	9	7	10	6	2	75
2	28	33	33	20	2	12
3	24	7	16	23	4	50
4	9	6	18	4	0	72

Previous | Page 1 of 12 | Next

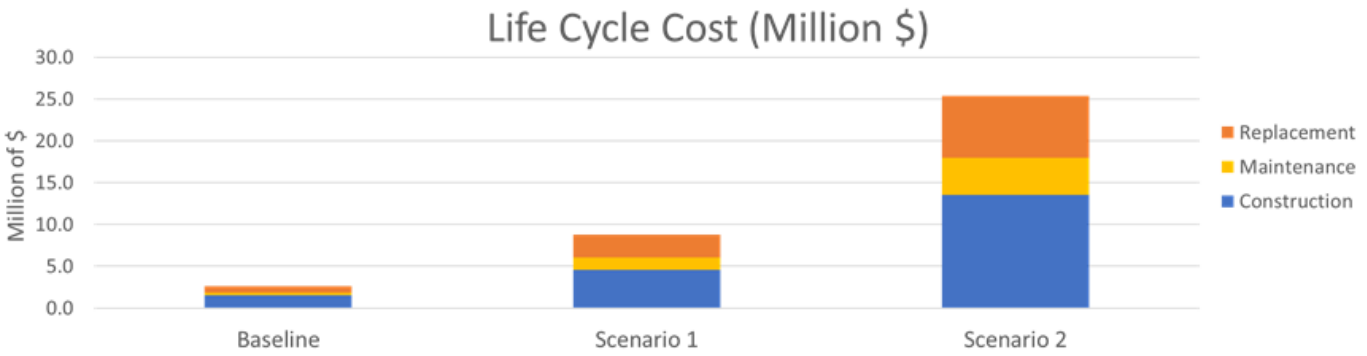

File Edit View History Bookmarks Tools Help
CLASIC
CLASIC
https://clasic.erams.com/mcda/?token=nKgBsA
Search
CLASIC V. 0.7.5
Co-Benefits Analysis
Co-benefit Analysis of the Defined Scenarios
Economic
Overall Importance
Recreation Revenue
Property Values
Costs from Illness
Building Energy Eff.
Avoided Water Treatment
Green Jobs Income
Avoided Flood Damage
Social
Overall Importance
Recreation on local water bodies
Access to areas with active lifestyle opportunities
Health impacts from air quality
Mental health improvement
Thermal comfort
Reliability of water supply
Employment opportunities
Evap: 53005
Precip: FORT COLLINS, CO US
Evap: 53006
Zoom to:
% Impervious
0 - 25
25 - 50
50 - 75
75 - 100
Laporte
Timnath
Masonville
Windsor
Loveland
Horsetooth Reservoir
Boyd Lake
Devils Backbone Open Space
Fort Collins-Loveland Municipal Airport
Wkr Airport
US 287
I 25
US 34
CO 14 CR 82
CO 257 CR 17
CO 392 CR 32E
US 34 CR 58


File Edit View History Bookmarks Tools Help
CLASIC
CLASIC
https://clasic.erams.com/run/?token=nKgBsA
Search
CLASIC V. 0.7.5
Run CLASIC
Select Scenarios to Run
Baseline
Rain Gardens
RG + SF
RUN
Evap: 53005
Precip: FORT COLLINS, CO US
Evap: 53006
Zoom to:
Timnath
Windsor
Loveland
Masonville
Wkr Airport
Christman Field
Horsetooth Reservoir
Reservoir Ridge Natural Area
Fort Collins-Loveland Municipal Airport
Boyd Lake
Devils Backbone Open Space
US 287
I 25
US 34
CO 14 CR 82
CO 257 CR 17
CO 392 CR 32E
US 34 CR 58
% Impervious
0 - 25
25 - 50
50 - 75
75 - 100
2 km

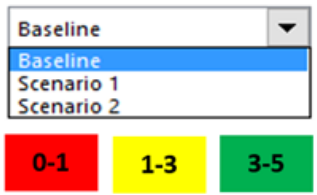
CLASIC Tool: Project: Example 1 - Results

Summary | Cost | Co-Benefit | Hydrologic

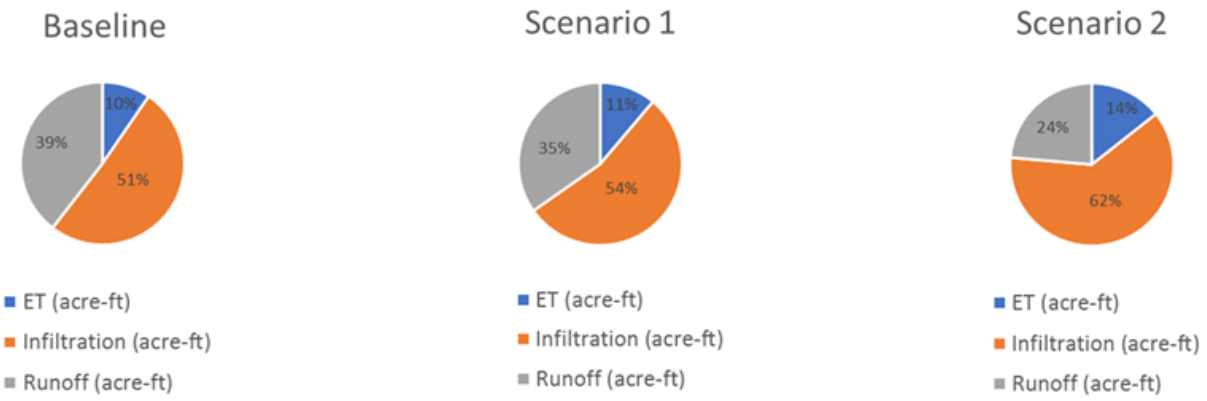
Life-Cycle Cost Analysis Output



Co-Benefit Analysis Output



Hydrologic Performance Output



THE Water Research FOUNDATION

Thank you!

CLASIC Tool Beta Testing:

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