



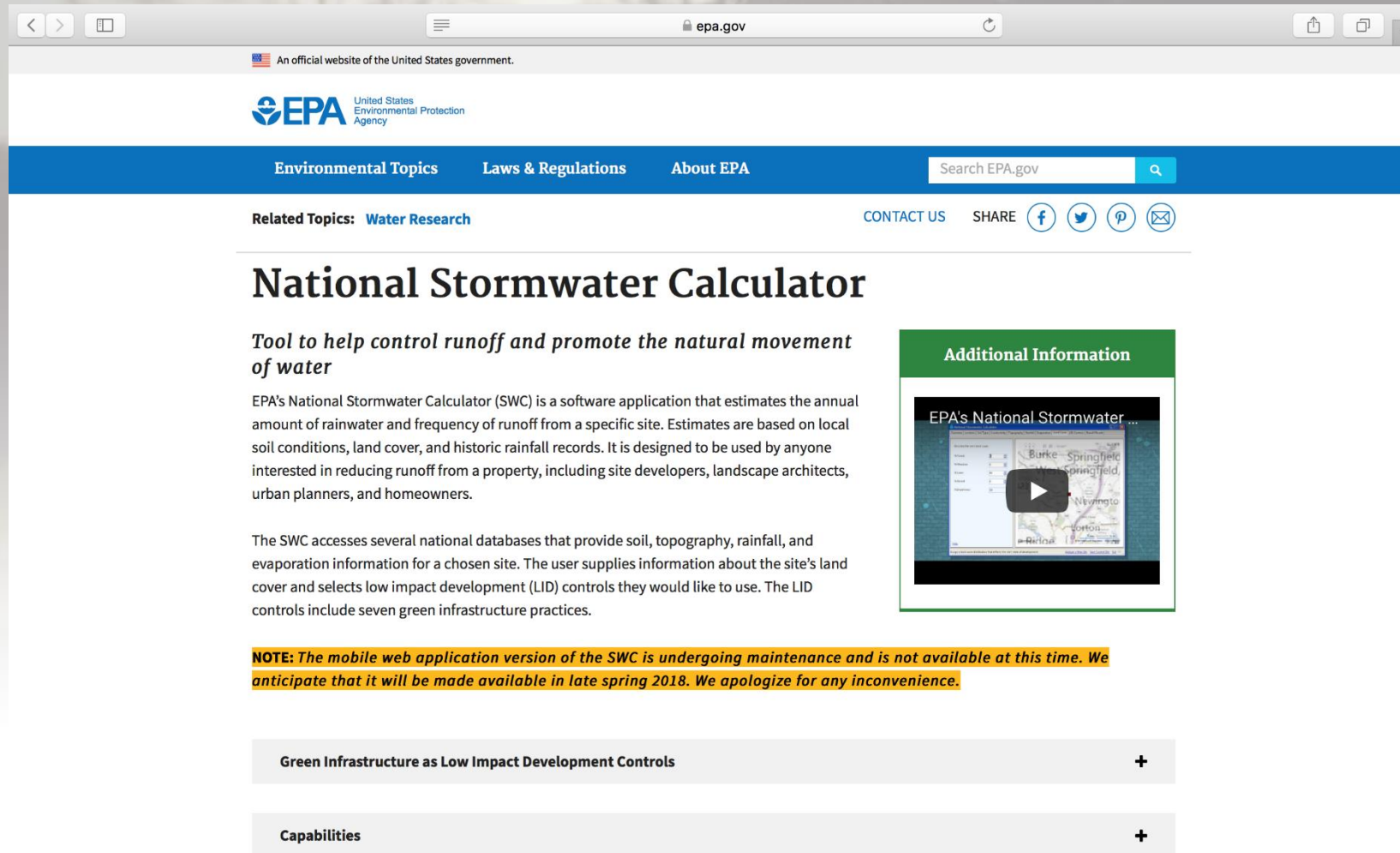
Tools and Case Studies for Green-Gray Lifecycle Cost Analysis

Ohio Stormwater Conference May 2018

Justin Kerns

ms consultants

EPA National Stormwater Calculator



The screenshot shows the EPA National Stormwater Calculator website. At the top, there's a navigation bar with "Environmental Topics", "Laws & Regulations", and "About EPA". A search bar is on the right. Below the navigation bar, there's a "Related Topics" section with "Water Research" highlighted. The main heading is "National Stormwater Calculator". Below it, a subheading reads "Tool to help control runoff and promote the natural movement of water". The main text describes the calculator as a software application that estimates annual rainfall and runoff based on local soil conditions, land cover, and historic rainfall records. It is designed for use by site developers, landscape architects, urban planners, and homeowners. A video player titled "Additional Information" shows a map of the Boston area with a play button. Below the video, a note states: "NOTE: The mobile web application version of the SWC is undergoing maintenance and is not available at this time. We anticipate that it will be made available in late spring 2018. We apologize for any inconvenience." At the bottom, there are two expandable sections: "Green Infrastructure as Low Impact Development Controls" and "Capabilities", both with plus signs to indicate they can be expanded.

An official website of the United States government.

EPA United States Environmental Protection Agency

Environmental Topics Laws & Regulations About EPA Search EPA.gov

Related Topics: [Water Research](#) CONTACT US SHARE

National Stormwater Calculator

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.

NOTE: The mobile web application version of the SWC is undergoing maintenance and is not available at this time. We anticipate that it will be made available in late spring 2018. We apologize for any inconvenience.

Green Infrastructure as Low Impact Development Controls +

Capabilities +

Low Impact Development (LID) Controls

Included LID Controls

- Disconnection (rooftop downspouts)
- Rain Harvesting (rain barrel or cistern)
- Rain Gardens
- Green Roofs
- Street Planters
- Infiltration Basins
- Permeable Pavement

Low Impact Development (LID) Controls

Included LID Controls

- Disconnection (rooftop downspouts)
- Rain Harvesting (rain barrel or cistern)
- Rain Gardens
- Green Roofs
- Street Planters
- Infiltration Basins
- Permeable Pavement

Modeling Capabilities

- Hydrologic Analysis
- Cost Analysis
- Climate Scenarios

Location and Project Information

- Site Name
- Search for Site Location
- Site Area

National Stormwater Calculator

Overview Location Soil Type Soil Drainage Topography Precipitation Evaporation Climate Change Land Cover LID Controls Results

Site Name (Optional)
College Place Improvements

Search for an address or zip code:
Defiance, OH

Site Location (Latitude, Longitude)
41.29760138044399, -84.35833213543225

Site Area (acres - Optional)
2.0

[Open a previously saved site](#)

Bring your site into view on the map and then mark its exact location by clicking the mouse pointer over it.

George Issac Pl
McKinley St
Grand Ave
College Dr
College Pl
Defiance College
E Sessions Ave

Aerial

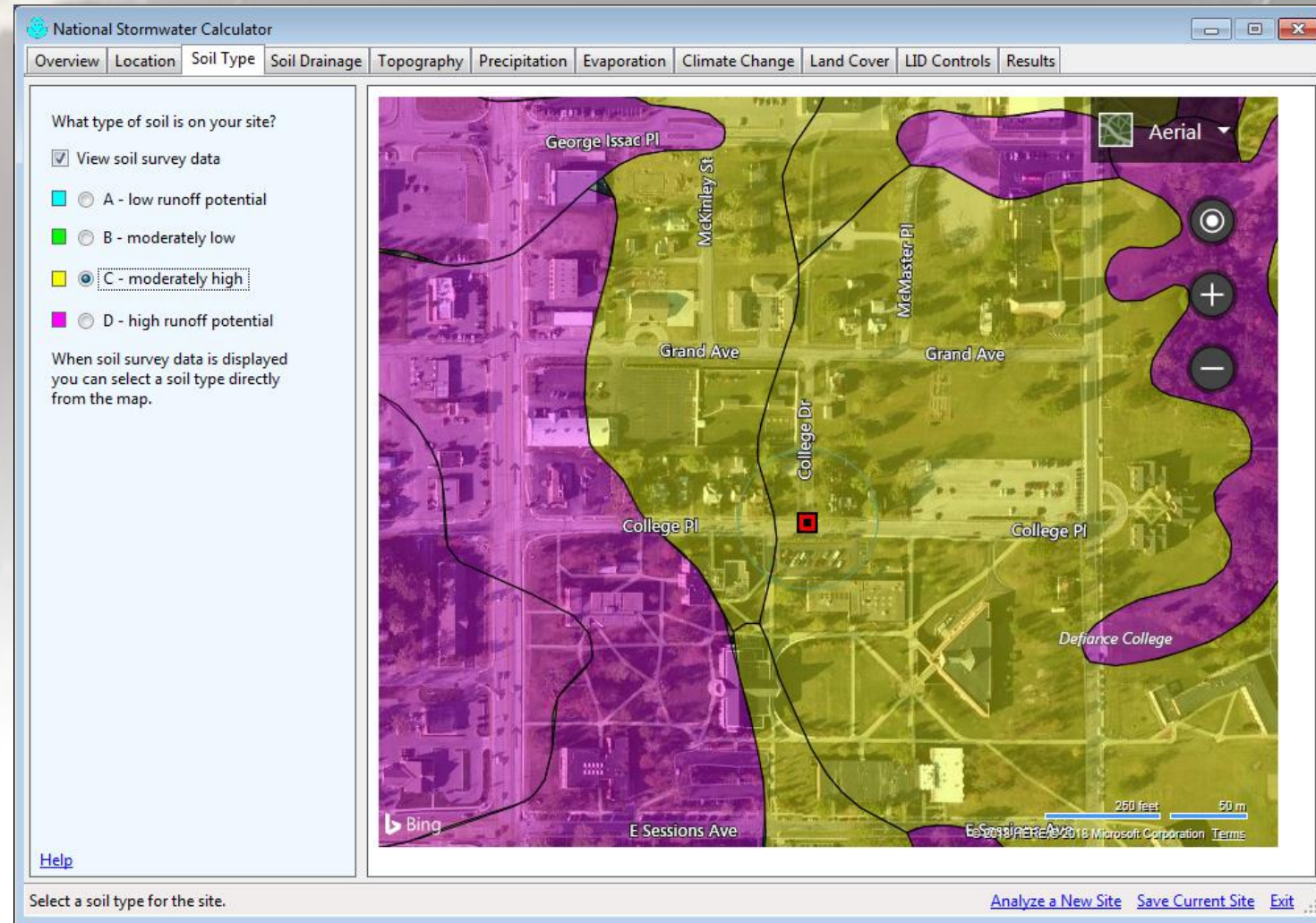
250 feet 50 m

Locate the site on the map.

[Analyze a New Site](#) [Save Current Site](#) [Exit](#)

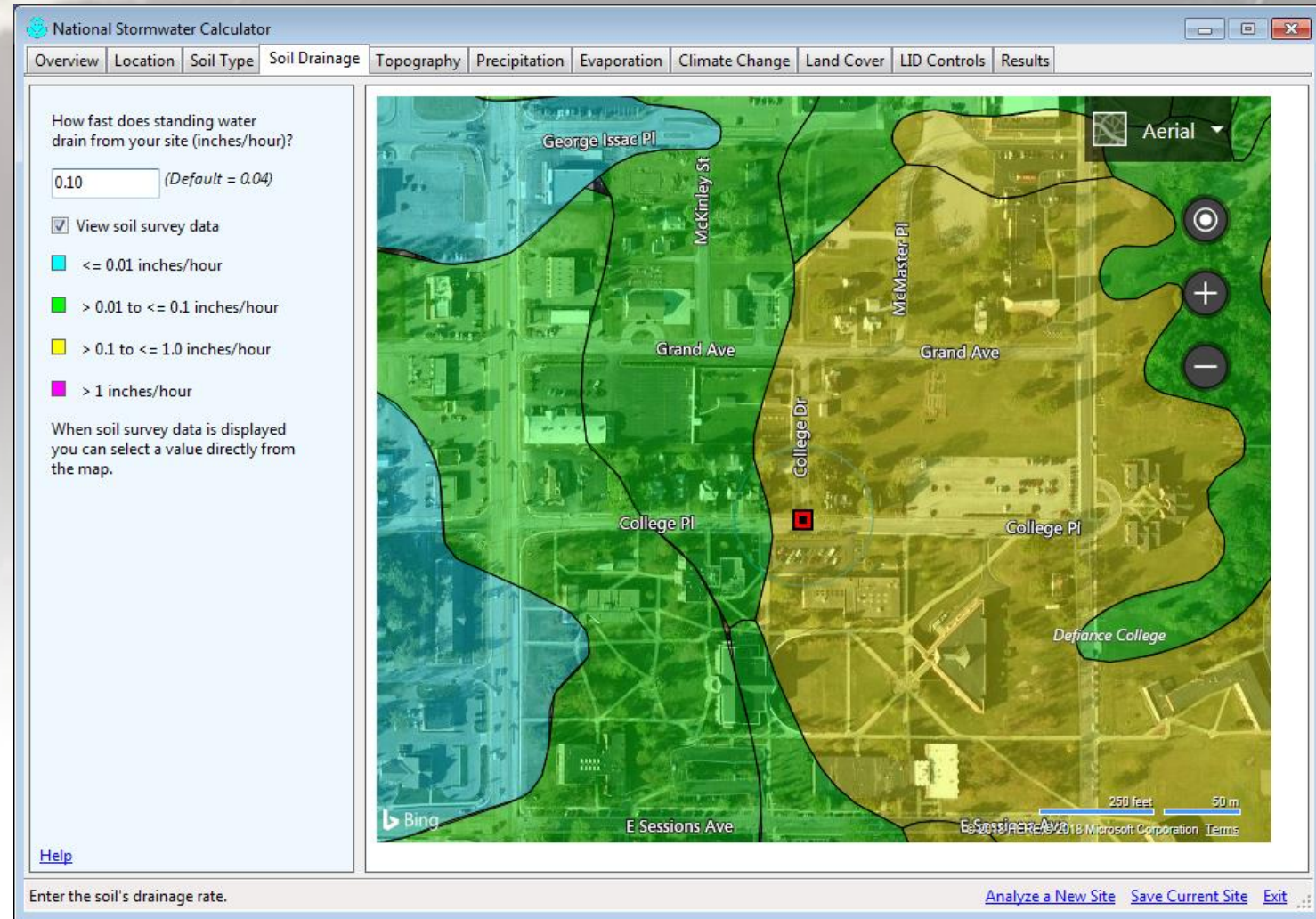
Soil Type

- NRCS Web Soil Survey
- Defined by Hydrologic Soil Group
 - Group A – Sand
 - Group B – Sandy Loam
 - Group C – Clay Loam
 - Group D – Clay



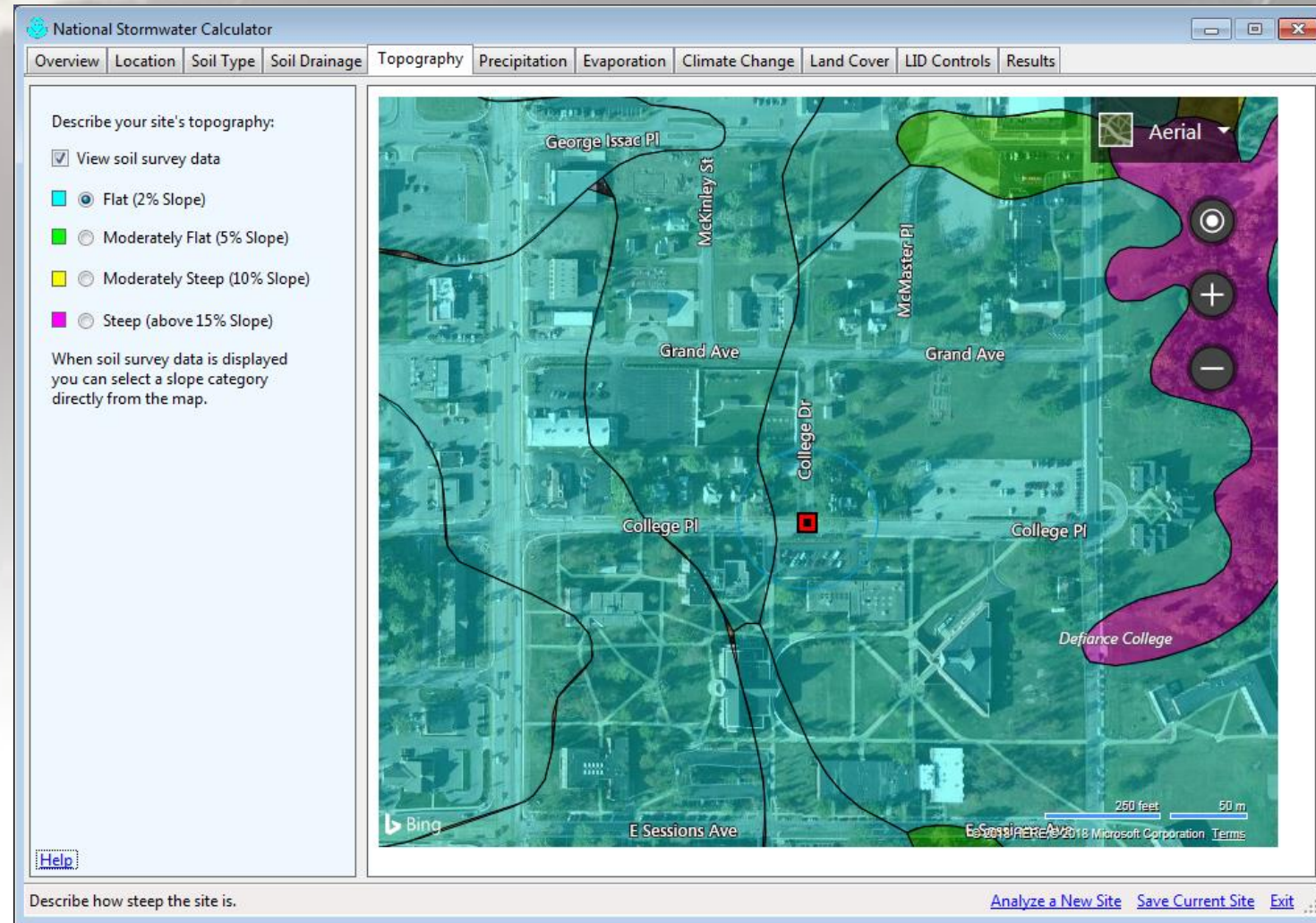
Soil Drainage

- NRCS Web Soil Survey
- Saturated Hydraulic Conductivity



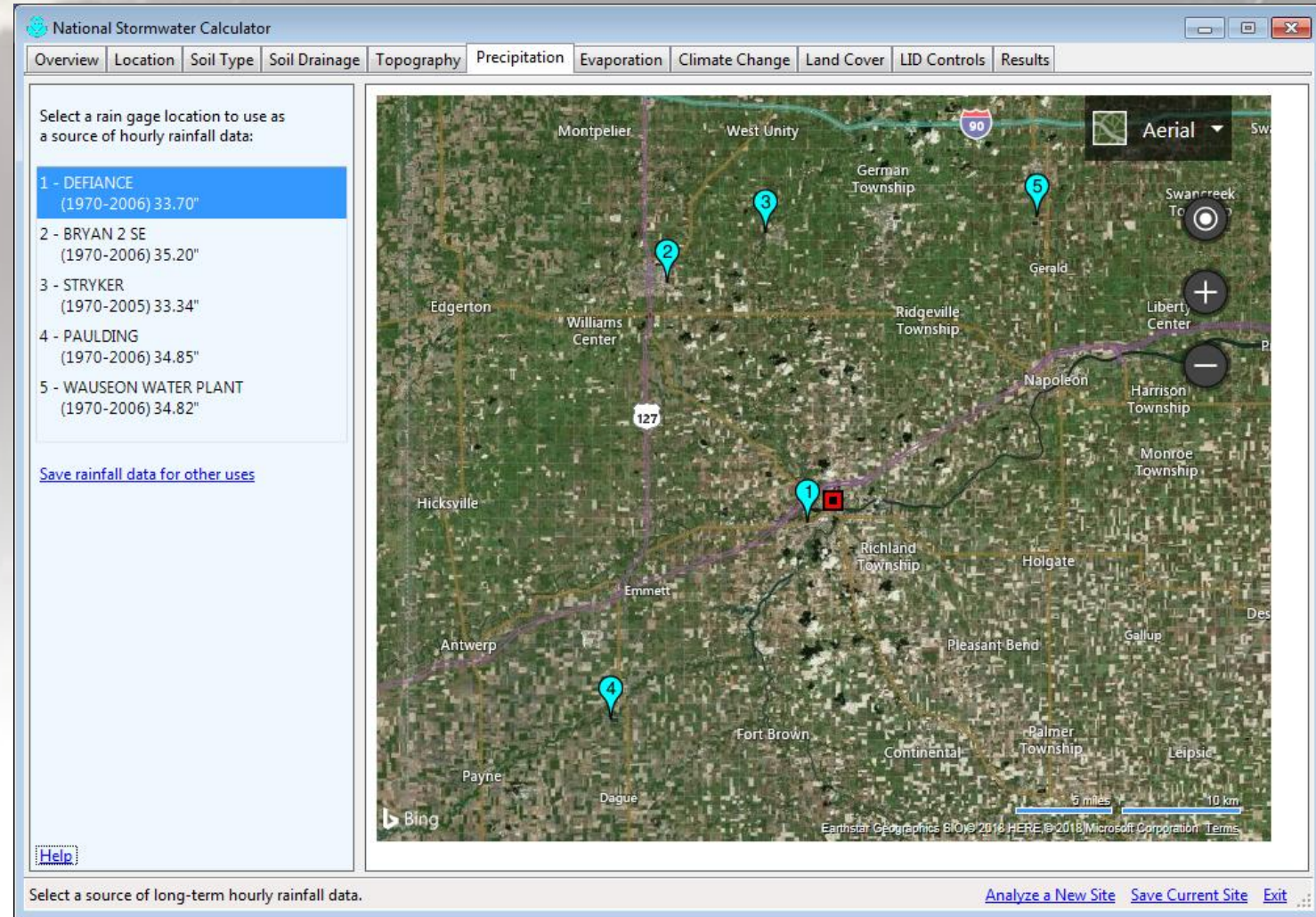
Topography

- NRCS Web Soil Survey
- Surface Slope



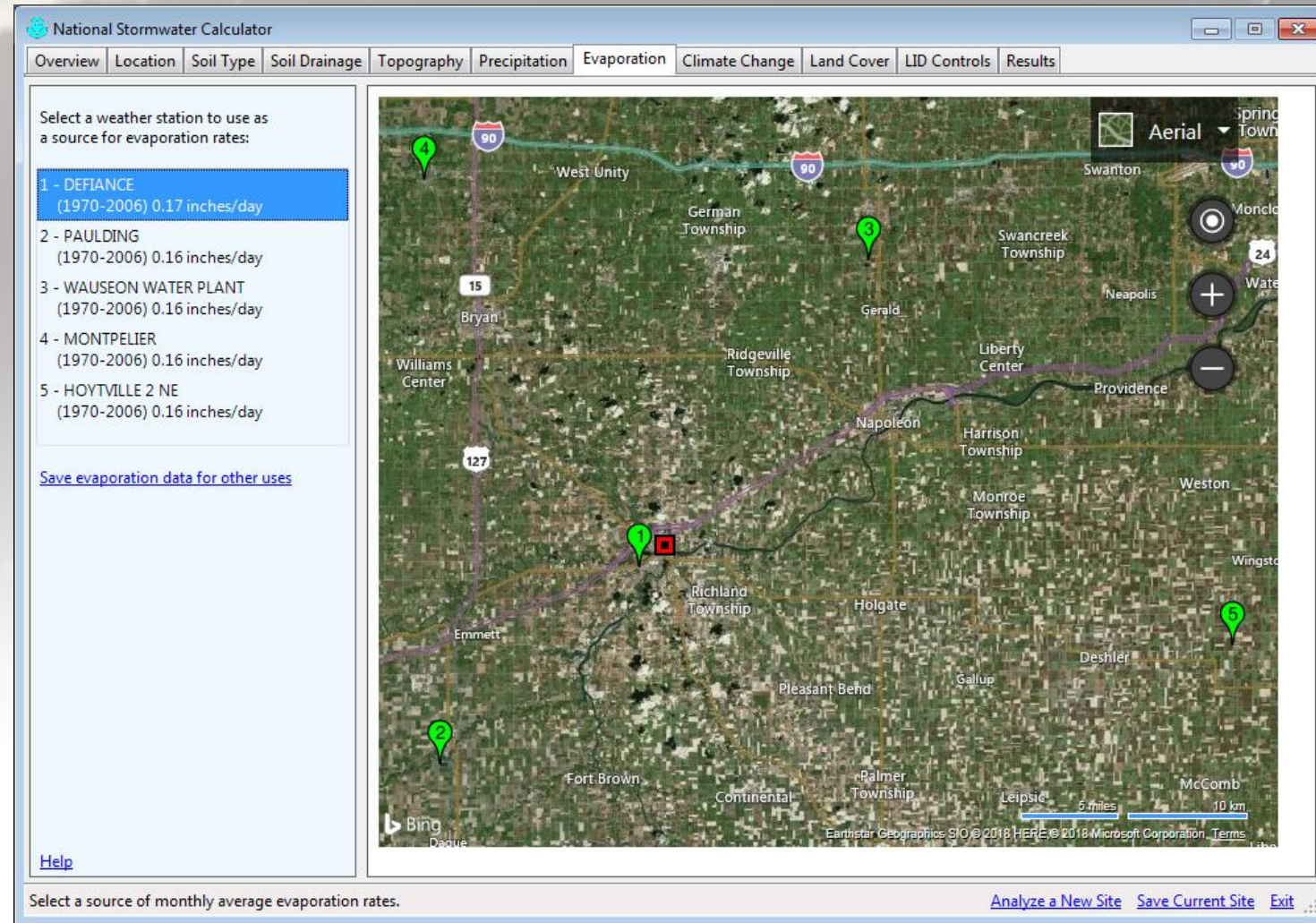
Precipitation

- Measured at nearby National Weather Service rain gage
- Average annual rainfall based on long-term historical data



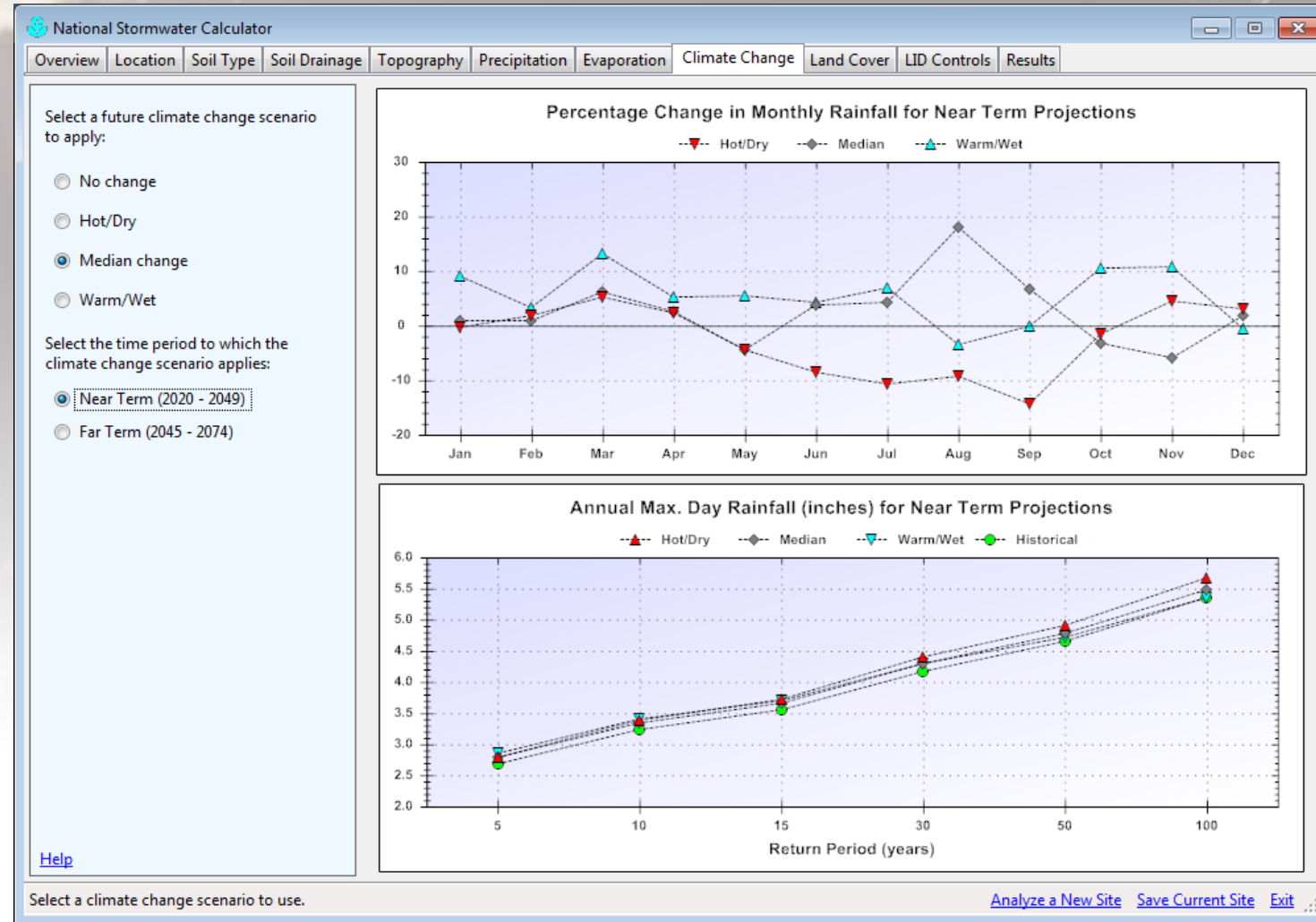
Evaporation

- Measured at nearby National Weather Service weather station
- Monthly evaporation rates calculated from long-term historical data



Climate Scenarios

- Climate projections produced by the World Climate Research Programme (WCRP)
- Scenarios model future changes in temperature and precipitation

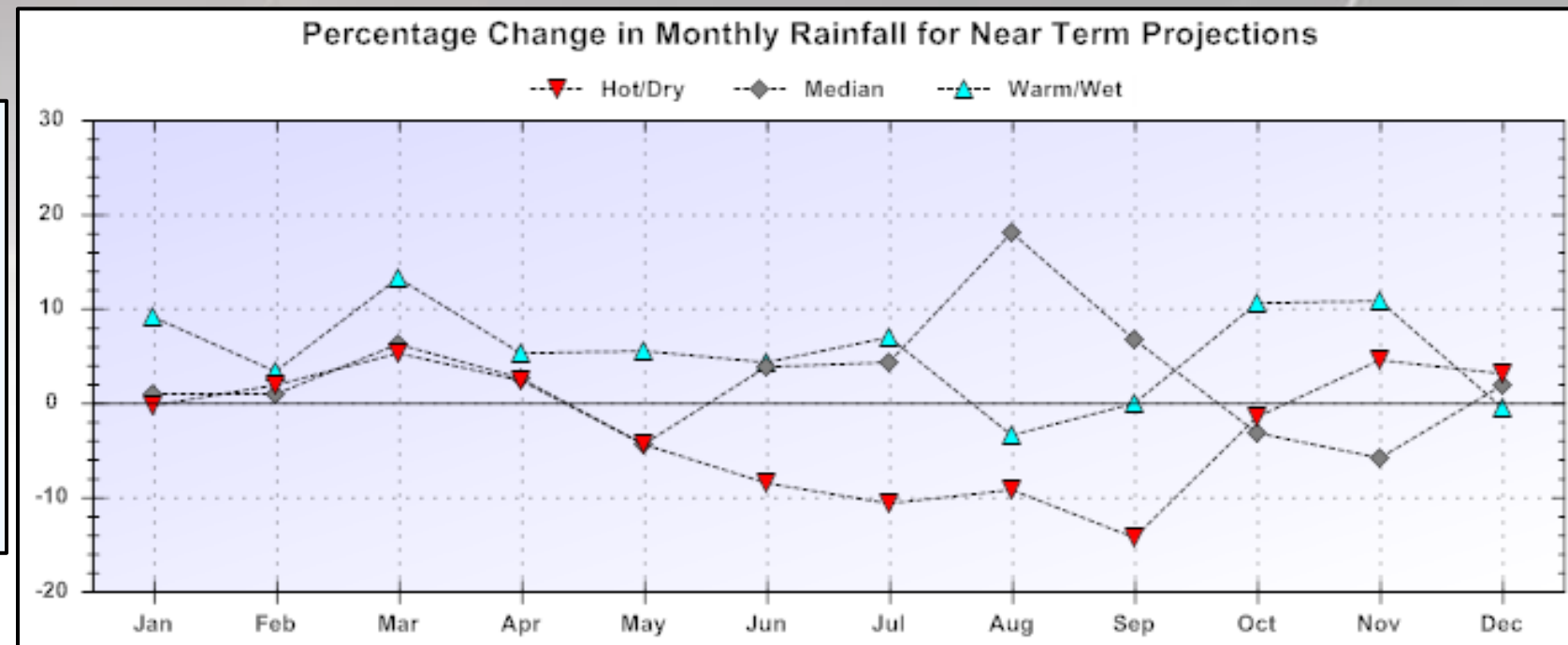


Climate Scenarios

- Climate projections affect the average monthly rainfall
- Three scenarios
- Two time periods

Select a future climate change scenario to apply:

- ☒ No change
- ☐ Hot/Dry
- ☐ Median change
- ☐ Warm/Wet

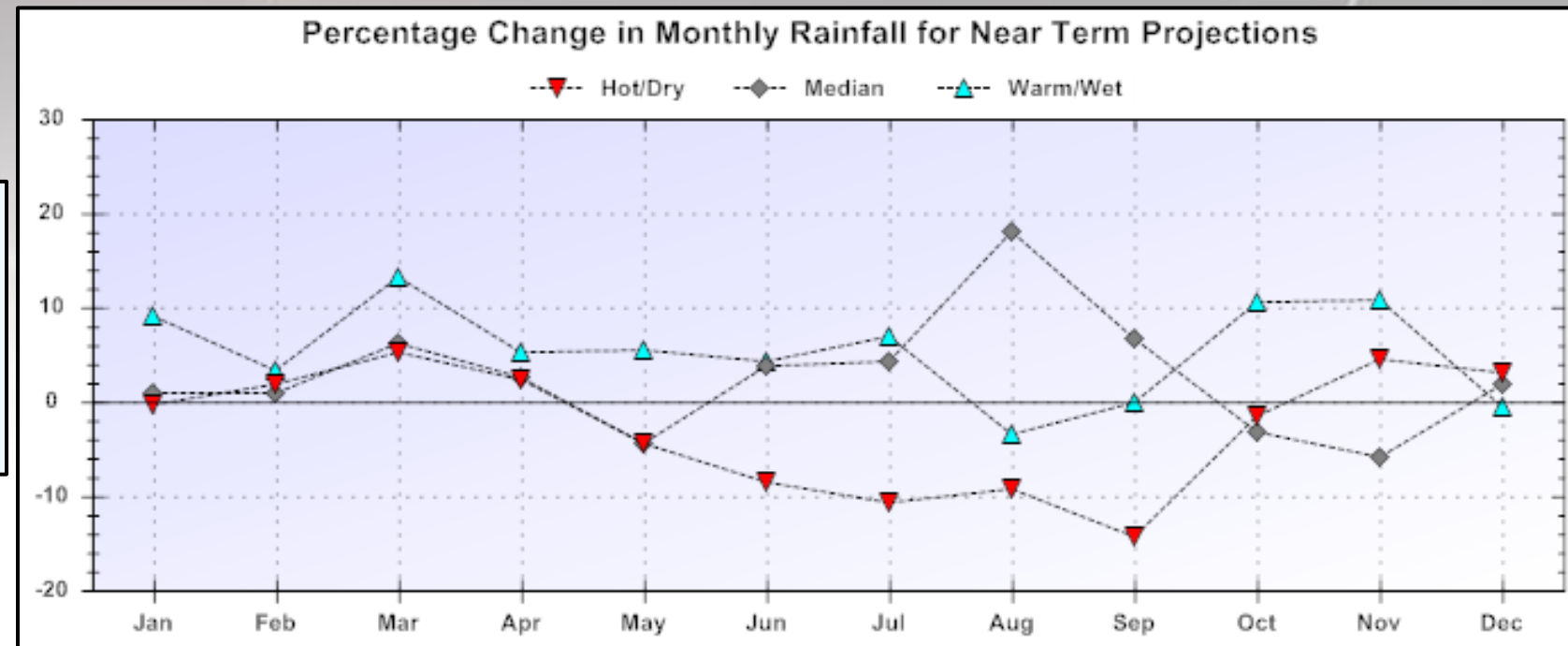


Climate Scenarios

- Climate projections affect the average monthly rainfall
- Three scenarios
- Two time periods

Select the time period to which the climate change scenario applies:

- ☒ Near Term (2020 - 2049)
- ☐ Far Term (2045 - 2074)

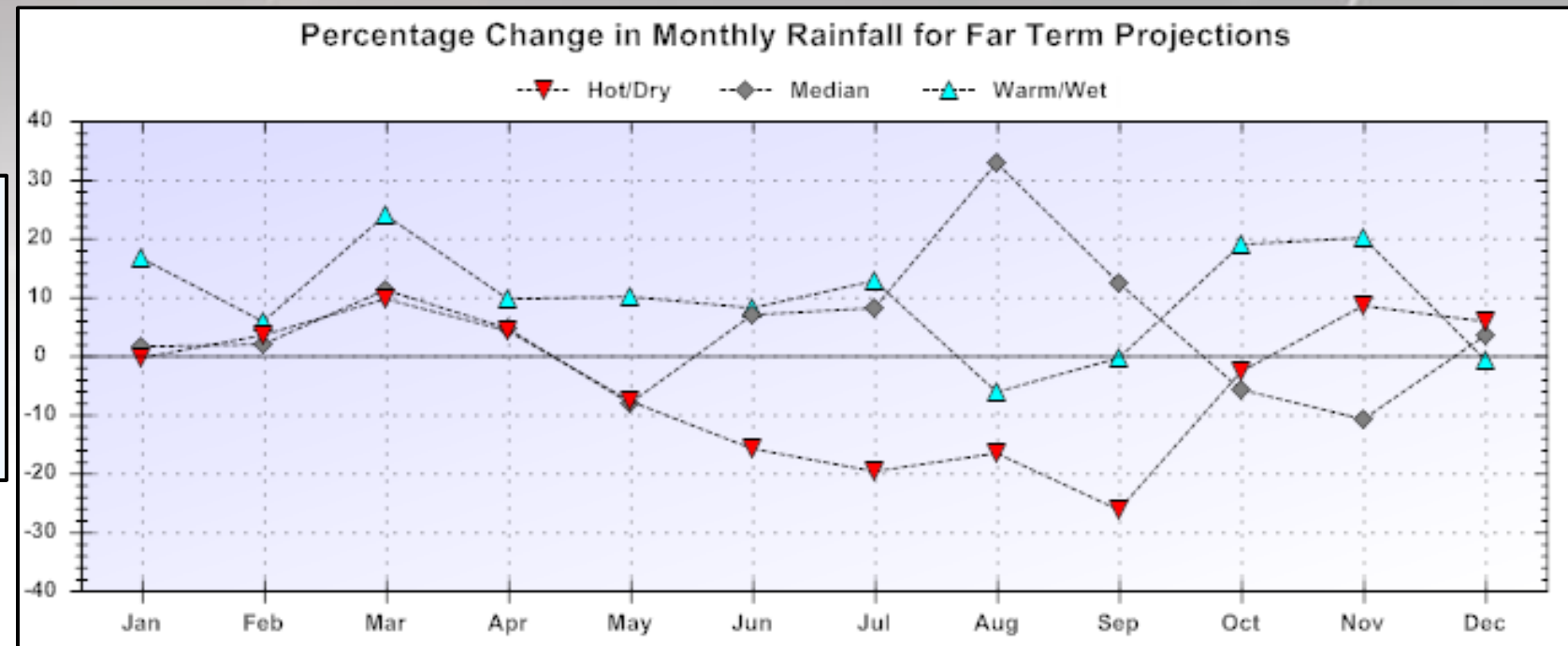


Climate Scenarios

- Climate projections affect the average monthly rainfall
- Three scenarios
- Two time periods

Select the time period to which the climate change scenario applies:

- ☐ Near Term (2020 - 2049)
- ☒ Far Term (2045 - 2074)



Land Cover

Select the percent of site area covered by:

- Forest
- Meadow
- Lawn
- Desert
- Impervious

National Stormwater Calculator

Overview | Location | Soil Type | Soil Drainage | Topography | Precipitation | Evaporation | Climate Change | **Land Cover** | LID Controls | Results

Describe the site's land cover for the development scenario being analyzed:

% Forest	0
% Meadow	0
% Lawn	30
% Desert	0
% Impervious	70

Hover the mouse over a cover category to see a more detailed description.

[Help](#)

Describe the site's land cover.

Aerial

George Issac Pl
McKinley St
Grand Ave
College Dr
College Pl
Defiance College
E Sessions Ave

250 feet 50 m

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[Analyze a New Site](#) [Save Current Site](#) [Exit](#)

Low Impact Development (LID) Controls

Select percent of impervious area to be treated by each LID type

Enter design storm to be used for LID sizing

National Stormwater Calculator

Overview | Location | Soil Type | Soil Drainage | Topography | Precipitation | Evaporation | Climate Change | Land Cover | **LID Controls** | Results

What % of your site's impervious area will be treated by the following LID practices?

Disconnection	0
Rain Harvesting	0
Rain Gardens	0
Green Roofs	0
Street Planters	12
Infiltration Basins	0
Permeable Pavement	0

Design Storm for Sizing (inches) (see Help): 3.74

Click a practice to customize its design.

Verify cost-estimation variables below

☒ Project is [Re-Development](#)
☐ Project is [New Development](#)

☐ Site Suitability - [Poor](#)
☒ Site Suitability - [Moderate](#)
☐ Site Suitability - [Excellent](#)

[Cost Region](#): Cincinnati (94 miles) 1.0'

Regional Multiplier: 1.07

[Help](#)

Assign LID practices to capture runoff from impervious areas.

[Analyze a New Site](#) [Save Current Site](#) [Exit](#)

Aerial map showing site location near Defiance College, with streets like College Pl, Grand Ave, and E Sessions Ave. Scale: 250 feet / 50 m.

LID Controls

Rain Gardens

- Ponding Height
- Soil Media Thickness
- Soil Media Conductivity
- % Capture Ratio
(ratio of LID area to desired captured area)

National Stormwater Calculator

Overview Location LID Design

What % of your site will be treated by the practices?

[Disconnection](#)
[Rain Harvesting](#)
[Rain Gardens](#)
[Green Roofs](#)
[Street Planters](#)
[Infiltration Basins](#)
[Permeable Pavement](#)

Design Storm for Size (inches) (see Help)

Click a practice to capture runoff from impervious areas.

Verify cost-estimation

☒ Project is [Re-Design](#)
☐ Project is [New Development](#)

☐ Site Suitability -
☒ Site Suitability -
☐ Site Suitability -

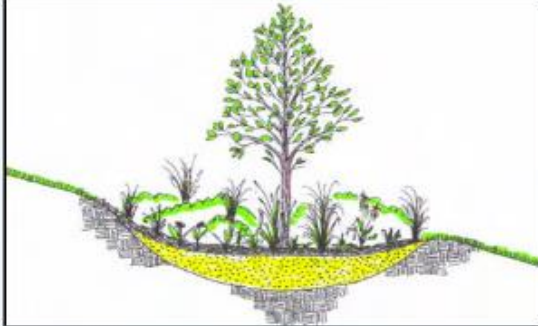
[Cost Region](#) Cincinnati

Regional Multiplier

[Help](#)

Assign LID practices to capture runoff from impervious areas.


Rain Garden



Rain Gardens are shallow depressions filled with an engineered soil mix that supports vegetative growth. They are usually used on individual home lots to capture roof runoff.

Typical soil depths range from 6 to 18 inches.

The Capture Ratio is the ratio of the rain garden's area to the impervious area that drains onto it.



[Learn more ...](#)

Ponding Height (inches) 6

Soil Media Thickness (inches) 12

Soil Media Conductivity (in/hr) 10.00

% Capture Ratio 5

[Has Pre-treatment](#) ☐

Size for Design Storm Restore Defaults Accept Cancel

[Analyze a New Site](#) [Save Current Site](#) [Exit](#)

LID Controls

Street Planter

- Ponding Height
- Soil Media Thickness
- Soil Media Conductivity
- Gravel Bed Thickness
- % Capture Ratio
(ratio of LID area to desired captured area)

National Stormwater Calculator

Overview Location LID Design

What % of your site will be treated by the practices?

[Disconnection](#)
[Rain Harvesting](#)
[Rain Gardens](#)
[Green Roofs](#)
[Street Planters](#)
[Infiltration Basins](#)
[Permeable Pavement](#)

Design Storm for Size (inches) (see Help)

Click a practice to capture runoff from impervious areas.

Verify cost-estimation

☒ Project is [Re-Design](#)
☐ Project is [New Development](#)

☐ Site Suitability -
☒ Site Suitability -
☐ Site Suitability -

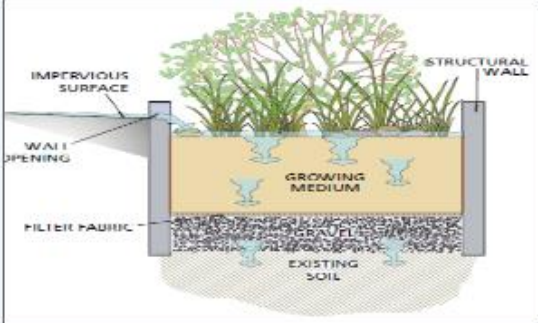
[Cost Region](#) Cincinnati

Regional Multiplier

[Help](#)

Assign LID practices to capture runoff from impervious areas.


Street Planter



Street Planters consist of concrete boxes filled with an engineered soil that supports vegetative growth. Beneath the soil is a gravel bed that provides additional storage.

The walls of a planter extend 3 to 12 inches above the soil bed to allow for ponding within the unit. The thickness of the soil growing medium ranges from 6 to 24 inches while gravel beds are 6 to 18 inches in depth.

The planter's Capture Ratio is the ratio of its area to



[Learn more ...](#)

Ponding Height (inches) 6

Soil Media Thickness (inches) 18

Soil Media Conductivity (in/hr) 10.00

Gravel Bed Thickness (inches) 12

% Capture Ratio 6

Size for Design Storm Restore Defaults Accept Cancel

[Analyze a New Site](#) [Save Current Site](#) [Exit](#)

LID Controls

Permeable Pavement

- Pavement Thickness
- Gravel Layer Thickness
- % Capture Ratio (ratio of LID area to desired captured area)

National Stormwater Calculator

Overview Location LID Design

What % of your site will be treated by the practices?

[Disconnection](#)
[Rain Harvesting](#)
[Rain Gardens](#)
[Green Roofs](#)
[Street Planters](#)
[Infiltration Basins](#)
[Permeable Pavement](#)

Design Storm for Size (inches) (see Help)

Click a practice to calculate

Verify cost-estimation

☒ Project is [Re-Design](#)
☐ Project is [New Development](#)

☐ Site Suitability -
☒ Site Suitability -
☐ Site Suitability -

[Cost Region](#) Cincinnati

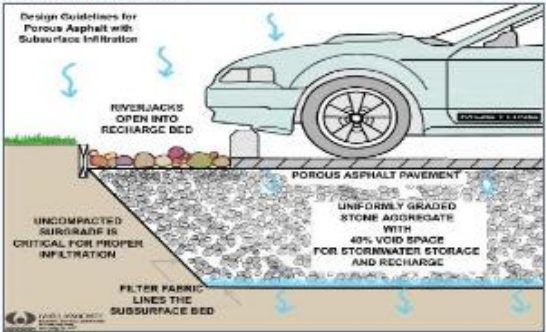
Regional Multiplier

[Help](#)

Assign LID practices to capture runoff from impervious areas.

Permeable Pavement

Design Guidelines for Porous Asphalt with Subsurface Infiltration



POUR JACKS OPEN INTO RECHARGE BED

POROUS ASPHALT PAVEMENT

UNCOMPACTED SUBGRADE IS CRITICAL FOR PROPER INFILTRATION

UNIFORMLY GRADED STONE AGGREGATE WITH 40% VOID SPACE FOR STORMWATER STORAGE AND RECHARGE


FILTER FABRIC LINES THE SUBSURFACE BED

Continuous Permeable Pavement systems are excavated areas filled with gravel and paved over with a porous concrete or asphalt mix.

Modular Block systems are similar except that permeable block pavers are used instead.

Normally all rainfall will immediately pass through the pavement into the gravel storage layer below it where it can infiltrate at natural rates into the site's native soil.

Pavement layers are usually 4 to 6 inches in height



[Learn more ...](#)

Pavement Thickness (inches) 6

Gravel Layer Thickness (inches) 18

% Capture Ratio 100

[Has Pre-treatment](#)

☐

Size for Design Storm Restore Defaults Accept Cancel

[Analyze a New Site](#) [Save Current Site](#) [Exit](#)

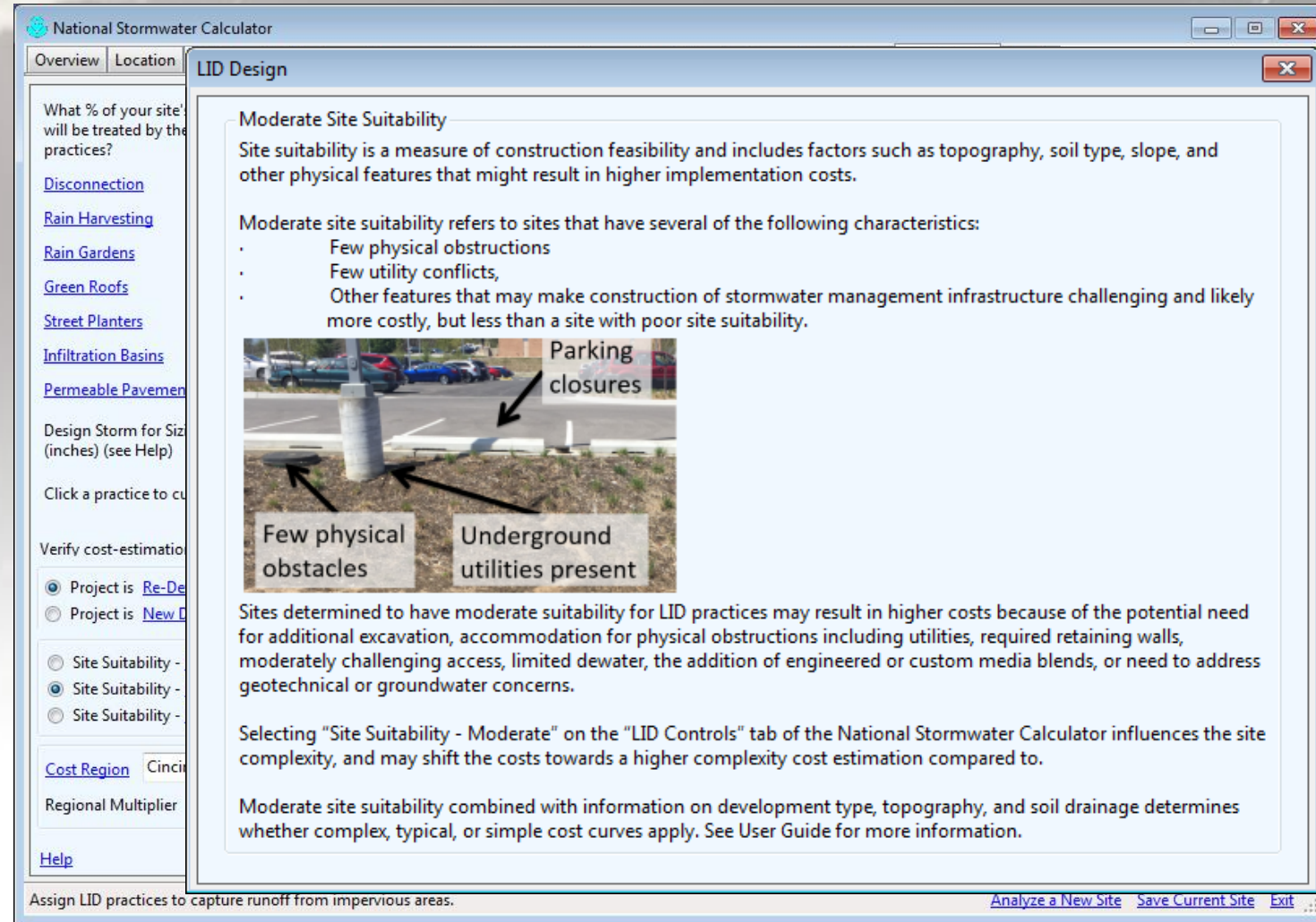
LID Controls

Site Suitability

- Physical Obstructions
- Utility Conflicts
- Ease of Access

Impacts

- Construction Cost
- Maintenance Cost



LID Controls

Select cost region

Impacts

- Construction Cost
- Maintenance Cost

National Stormwater Calculator

Overview | Location | Soil Type | Soil Drainage | Topography | Precipitation | Evaporation | Climate Change | Land Cover | **LID Controls** | Results

What % of your site's impervious area will be treated by the following LID practices?

Disconnection	0
Rain Harvesting	0
Rain Gardens	0
Green Roofs	0
Street Planters	12
Infiltration Basins	0
Permeable Pavement	0

Design Storm for Sizing (inches) (see Help) 3.74

Click a practice to customize its design.

Verify cost-estimation variables below

☒ Project is [Re-Development](#)
☐ Project is [New Development](#)

☐ Site Suitability - [Poor](#)
☒ Site Suitability - [Moderate](#)
☐ Site Suitability - [Excellent](#)

[Cost Region](#) Cincinnati (94 miles) 1.07
Regional Multiplier
Cincinnati (94 miles) 1.07
Cleveland (126 miles) 0.94
Pittsburgh (165 miles) 1.09
NATIONAL (NA) 1.03
Other (NA) 1

[Help](#)

Assign LID practices to capture runoff from impervious areas.

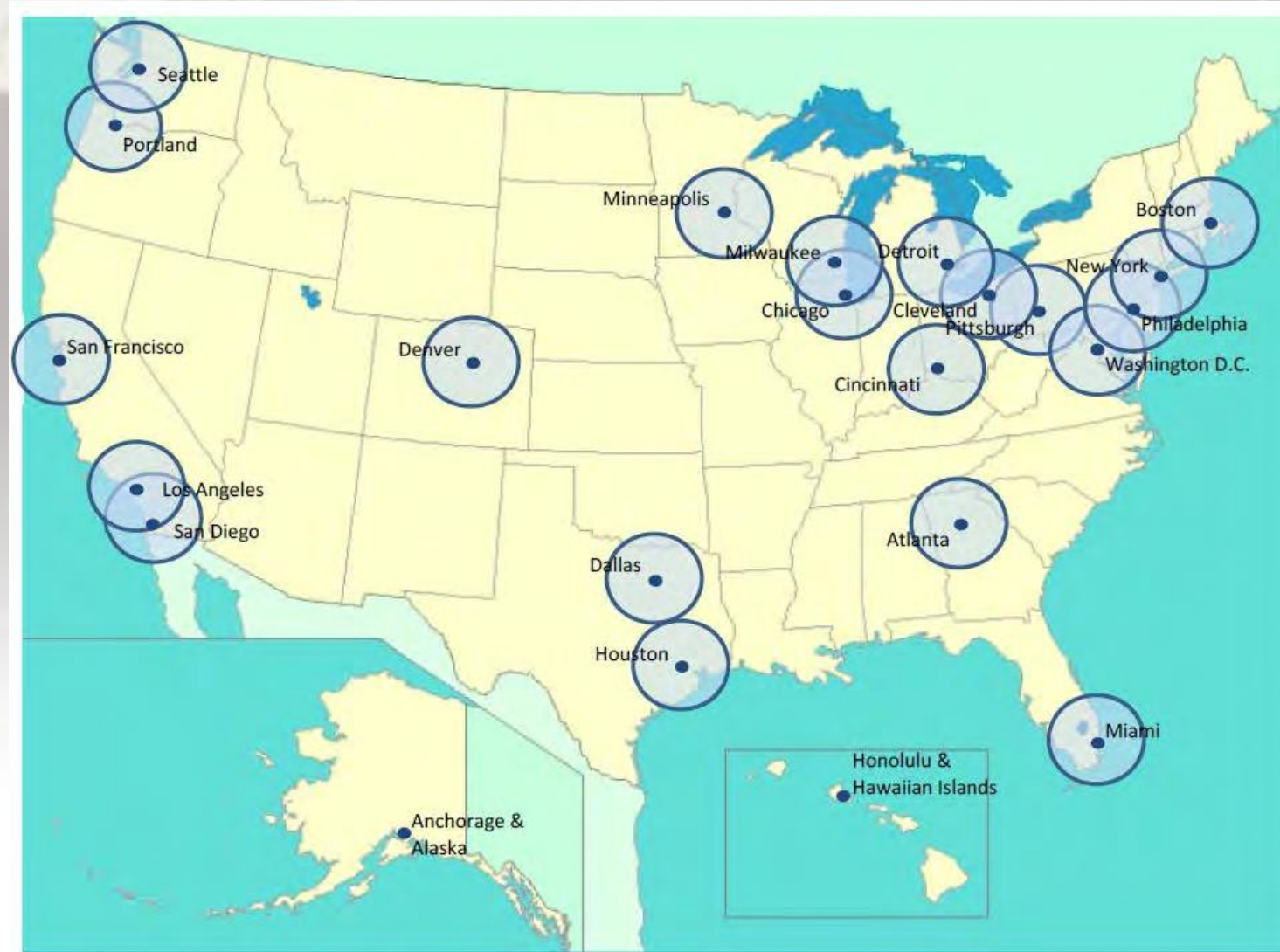
Analyze a New Site | Save Current Site | Exit

LID Controls

Select cost region

Impacts

- Construction Cost
- Maintenance Cost



LID Controls

Select cost region

[Cost Region](#) Cincinnati (94 miles) 1.07

Regional Multiplier

[Help](#)

Assign LID practices to capture runoff from impervious areas.

Cincinnati (94 miles) 1.07
Cleveland (126 miles) 0.94
Pittsburgh (165 miles) 1.09
NATIONAL (NA) 1.03
Other (NA) 1

National Stormwater Calculator

Overview Location Soil Type Soil Drainage Topography Precipitation Evaporation Climate Change Land Cover LID Controls Results

What % of your site's impervious area will be treated by the following LID practices?

Disconnection 0
Rain Harvesting 0
Rain Gardens 0
Green Roofs 0
Street Planters 12
Infiltration Basins 0
Permeable Pavement 0

Design Storm for Sizing (inches) (see Help) 3.74

Click a practice to customize its design.

Verify cost-estimation variables below

☒ Project is Re-Development
☐ Project is New Development

☐ Site Suitability - Poor
☒ Site Suitability - Moderate

[Cost Region](#) Cincinnati (94 miles) 1.07

Regional Multiplier

[Help](#)

Assign LID practices to capture runoff from impervious areas.

Cincinnati (94 miles) 1.07
Cleveland (126 miles) 0.94
Pittsburgh (165 miles) 1.09
NATIONAL (NA) 1.03
Other (NA) 1

George Issac Pl
McKinley St
Grand Ave
College Dr
College Pl
E Sessions Ave
Defiance College

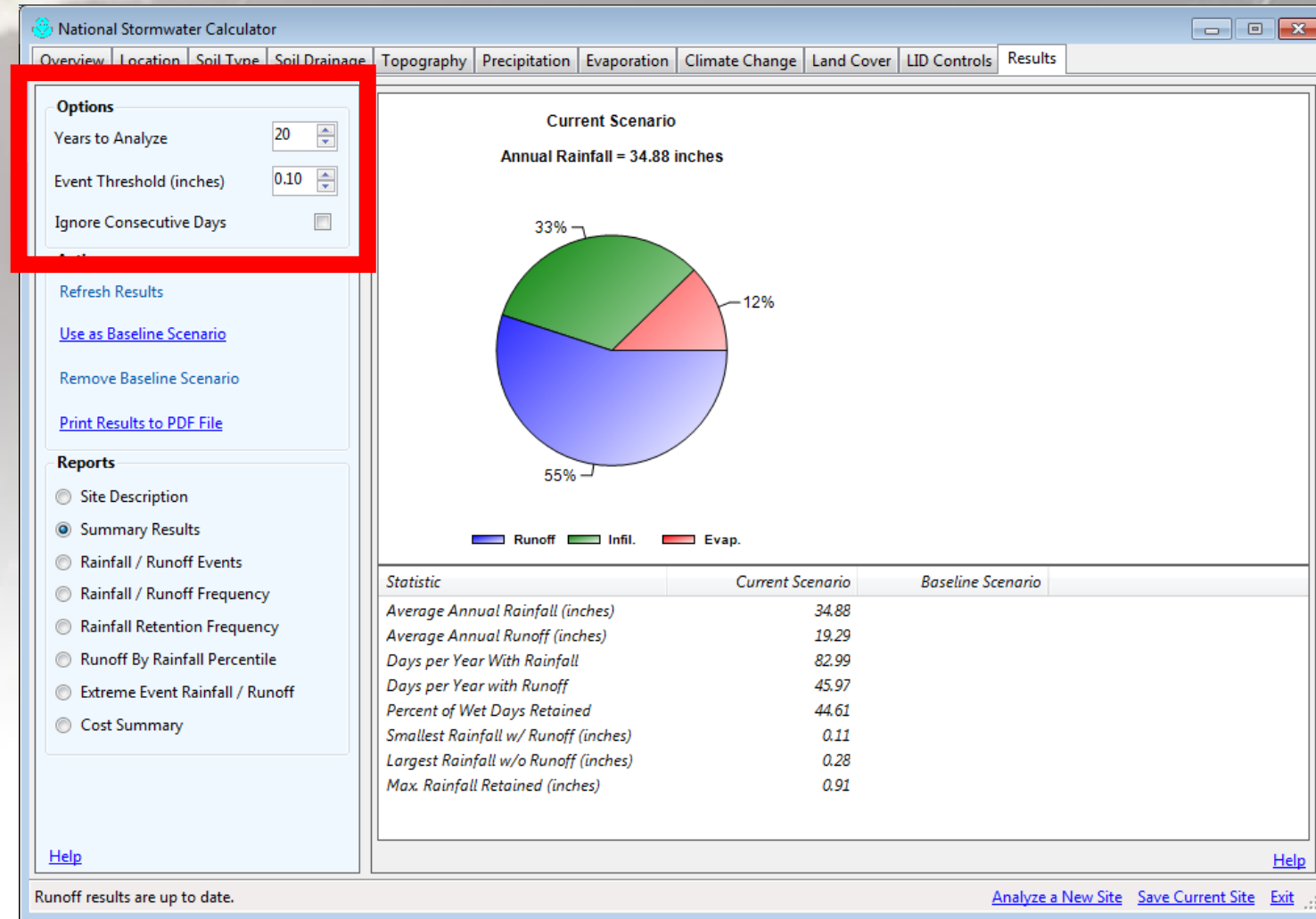
Aerial

250 feet 50 m

Analyze a New Site Save Current Site Exit

Model Options

- Select number of years to analyze
- Enter event threshold
- Consecutive Days

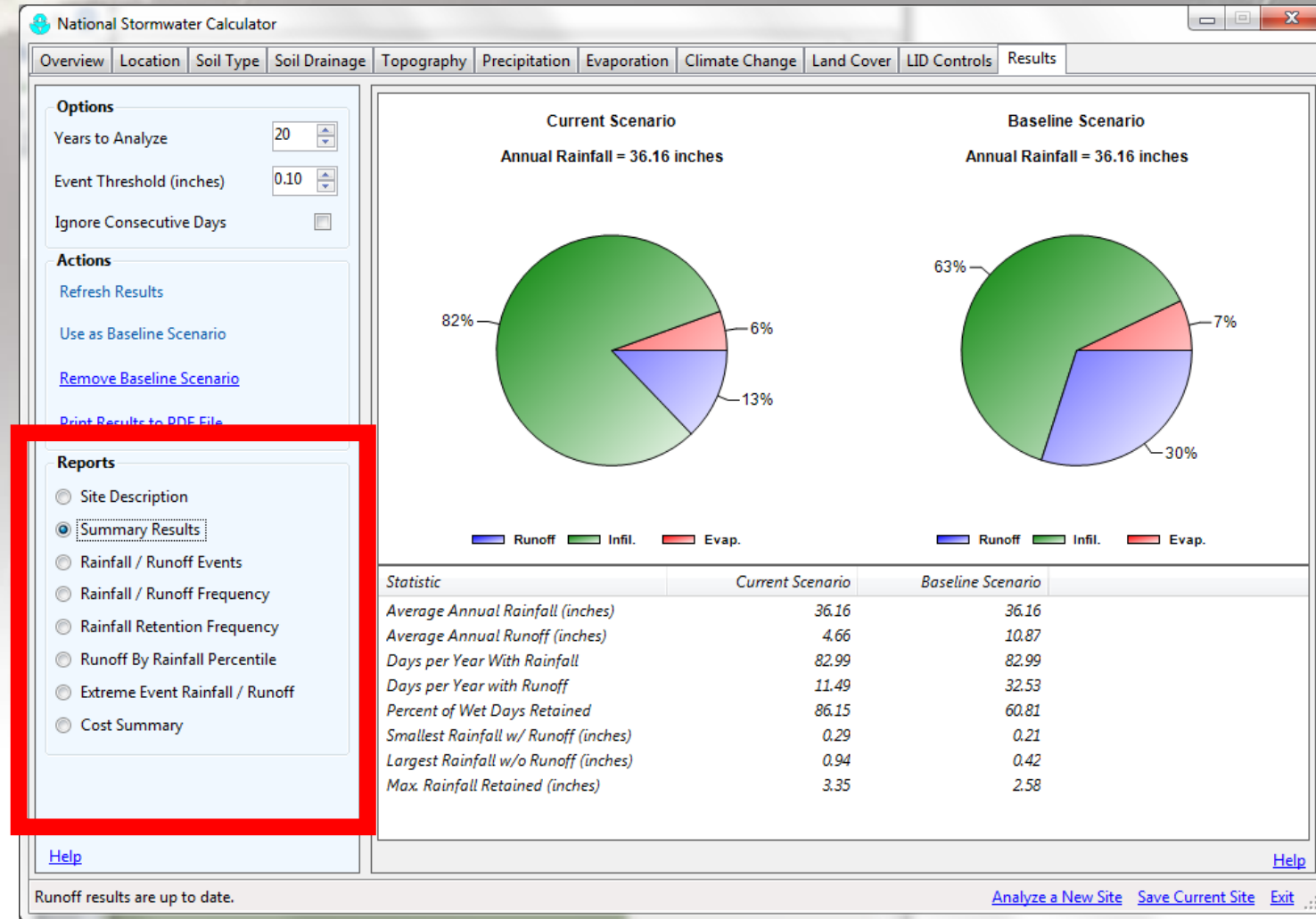


Results

- Compare multiple scenarios at once

Reports

- ☐ Site Description
- ☒ Summary Results
- ☐ Rainfall / Runoff Events
- ☐ Rainfall / Runoff Frequency
- ☐ Rainfall Retention Frequency
- ☐ Runoff By Rainfall Percentile
- ☐ Extreme Event Rainfall / Runoff
- ☐ Cost Summary



Results

Site Description

National Stormwater Calculator

Overview Location Soil Type Soil Drainage Topography Precipitation Evaporation Climate Change Land Cover LID Controls Results

Options

Years to Analyze: 20

Event Threshold (inches): 0.10

Ignore Consecutive Days: ☐

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 Frequency

☐ Rainfall Retention Frequency

☐ Runoff By Rainfall Percentile

☐ Extreme Event Rainfall / Runoff

☐ Cost Summary

[Help](#)

Parameter	Current Scenario	Baseline Scenario
Site Characteristics		
Site Area (acres)	2	2
Hydrologic Soil Group	C	C
Hydraulic Conductivity (in/hr)	.4	.4
Surface Slope (%)	2	2
Precip. Data Source	BRYAN 2 SE	BRYAN 2 SE
Evap. Data Source	DEFIANCE	DEFIANCE
Climate Change Scenario	Median/Near Term	Median/Near Term
Land Cover		
% Forest	0	0
% Meadow	0	0
% Lawn	40	40
% Desert	0	0
% Impervious	60	60
LID Controls		
Disconnection	15 / 100	6 / 100
Rain Harvesting	0	0
Rain Gardens	10 / 5	12 / 5
Green Roofs	0	0
Street Planters	10 / 6	0
Infiltration Basins	0	0
Porous Pavement	50 / 100	30 / 100
Analysis Options		
Years Analyzed	20	20
Ignore Consecutive Wet Days	False	False
Wet Day Threshold (inches)	0.10	0.10

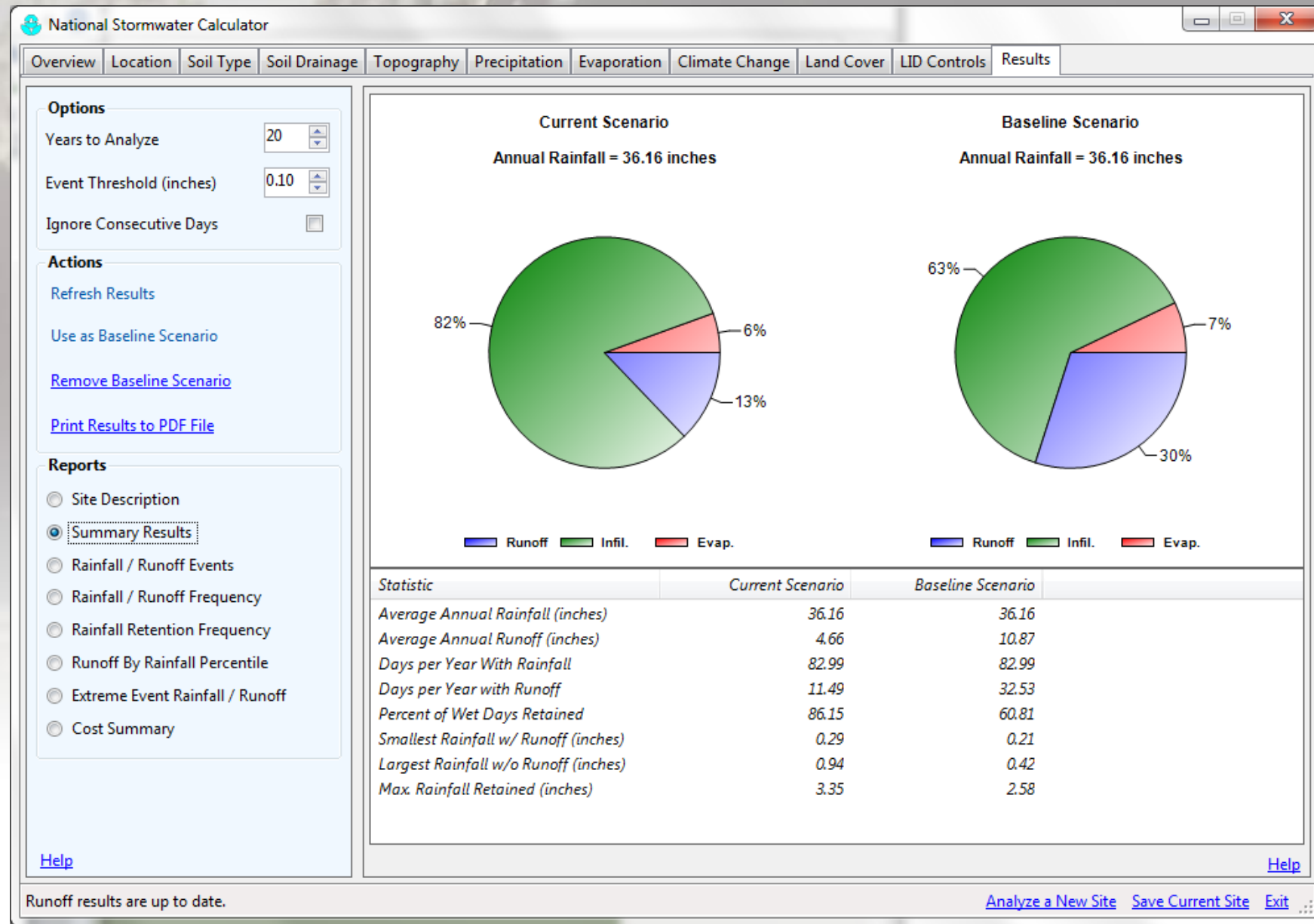
[Help](#)

Runoff results are up to date.

[Analyze a New Site](#) [Save Current Site](#) [Exit](#)

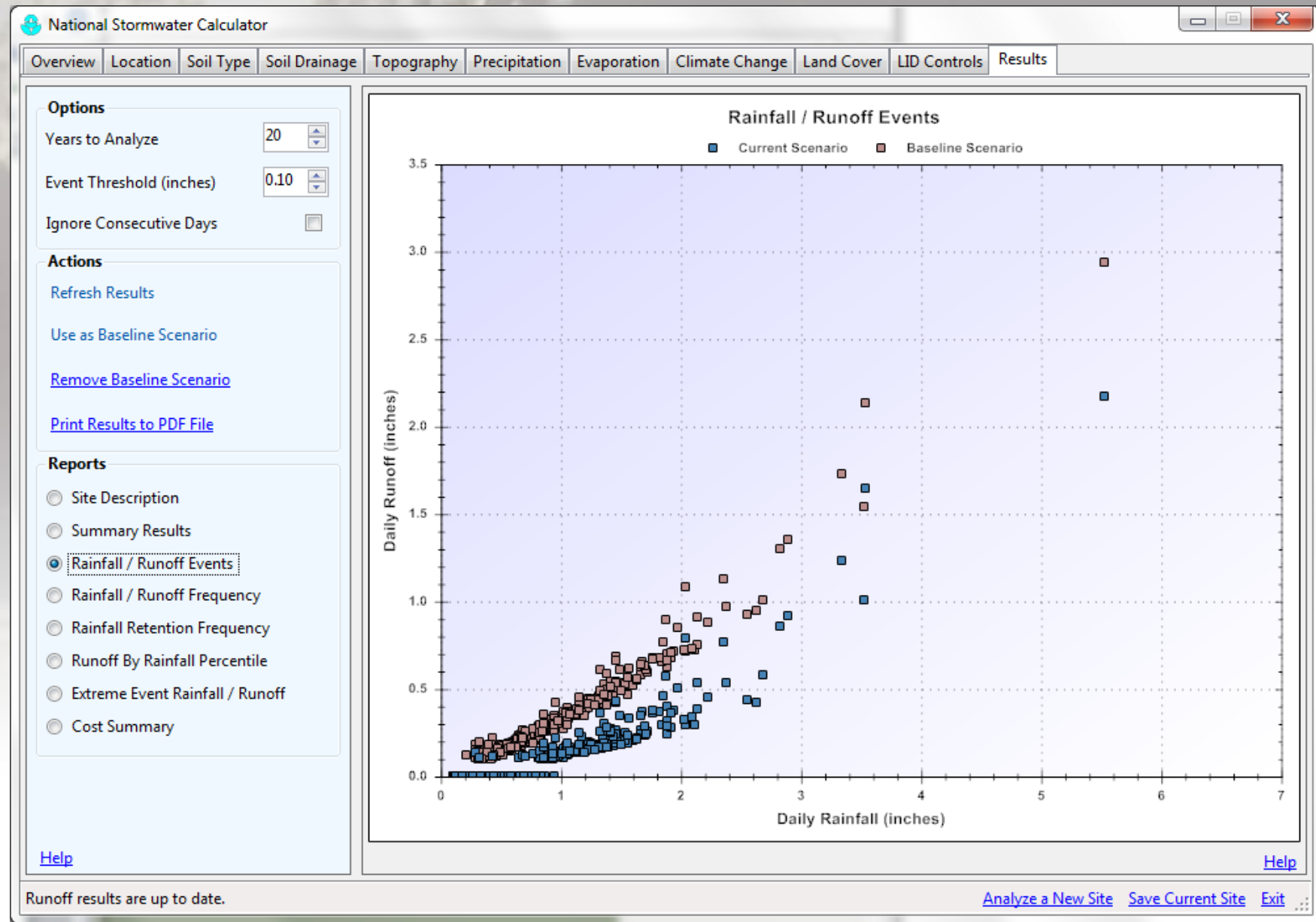
Results

Summary



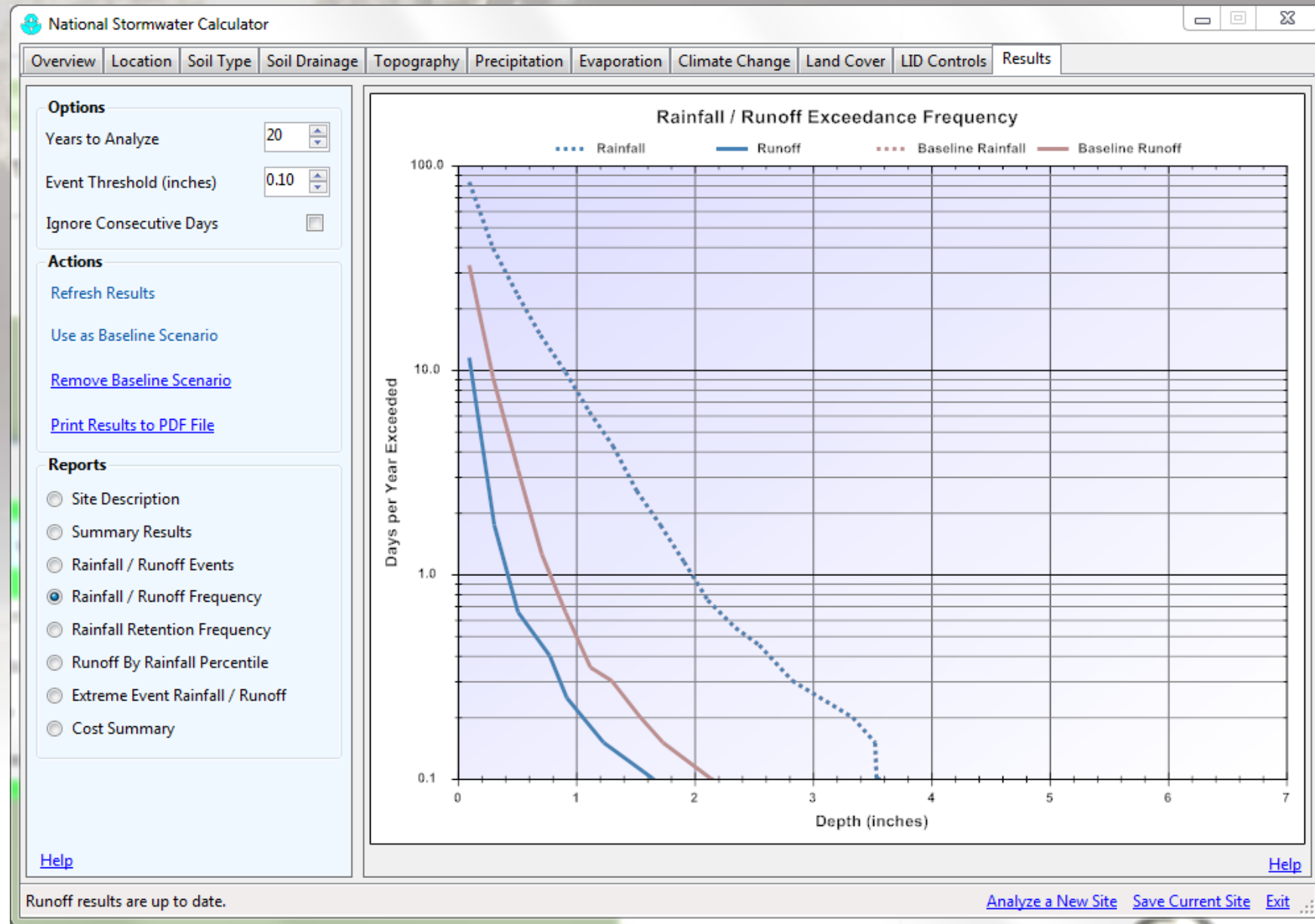
Results

Rainfall / Runoff Events



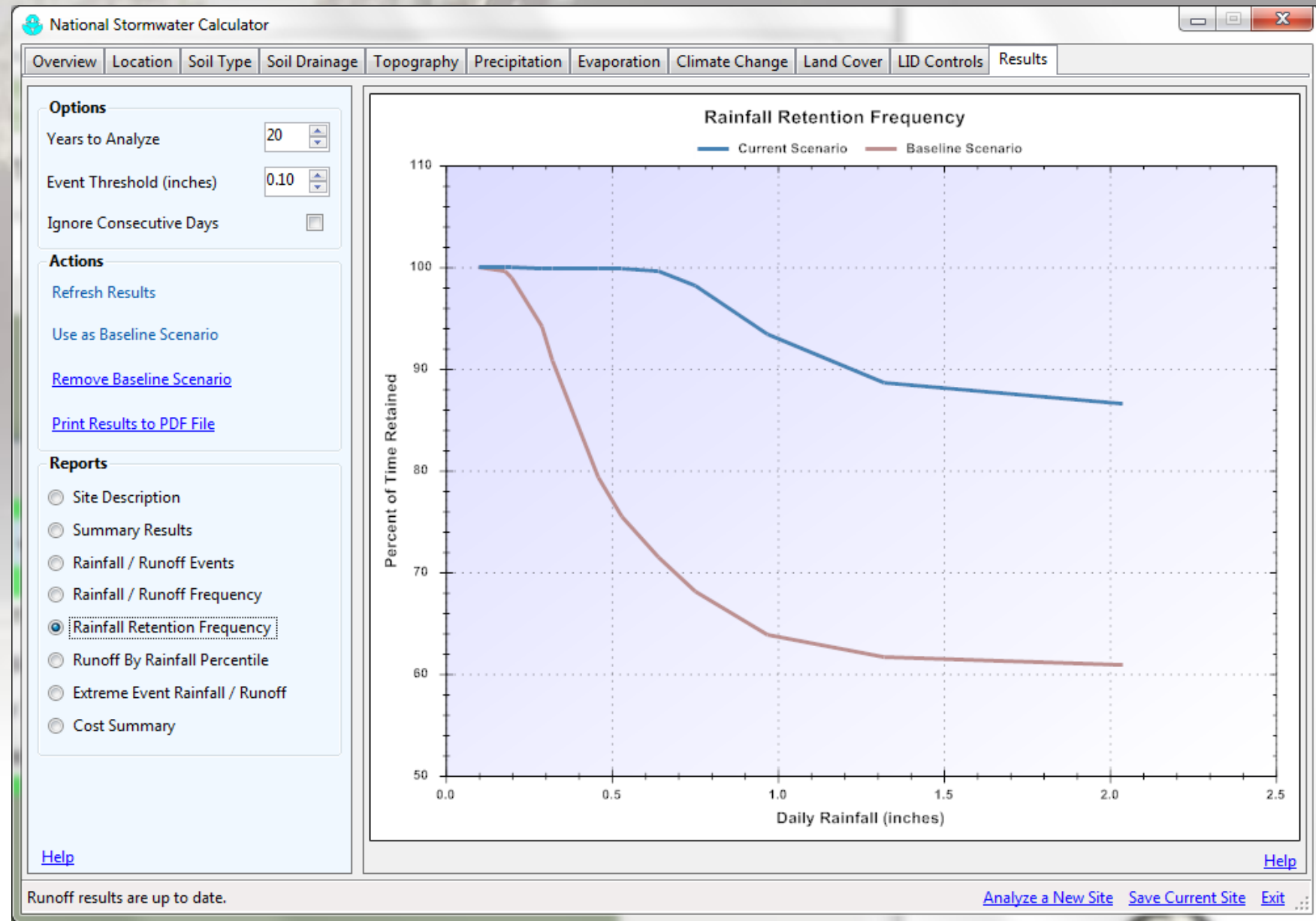
Results

Rainfall / Runoff Frequency



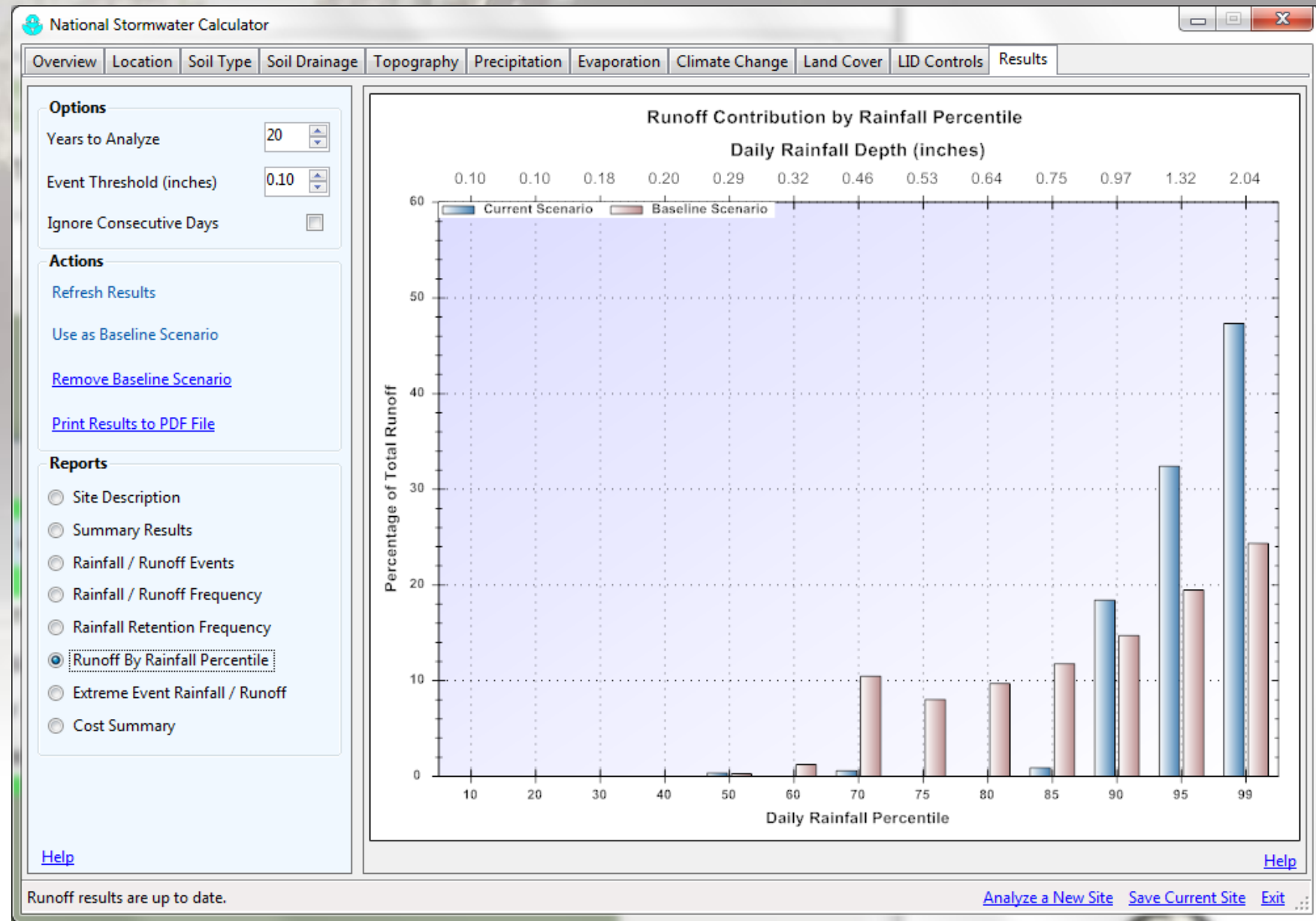
Results

Rainfall / Retention Frequency



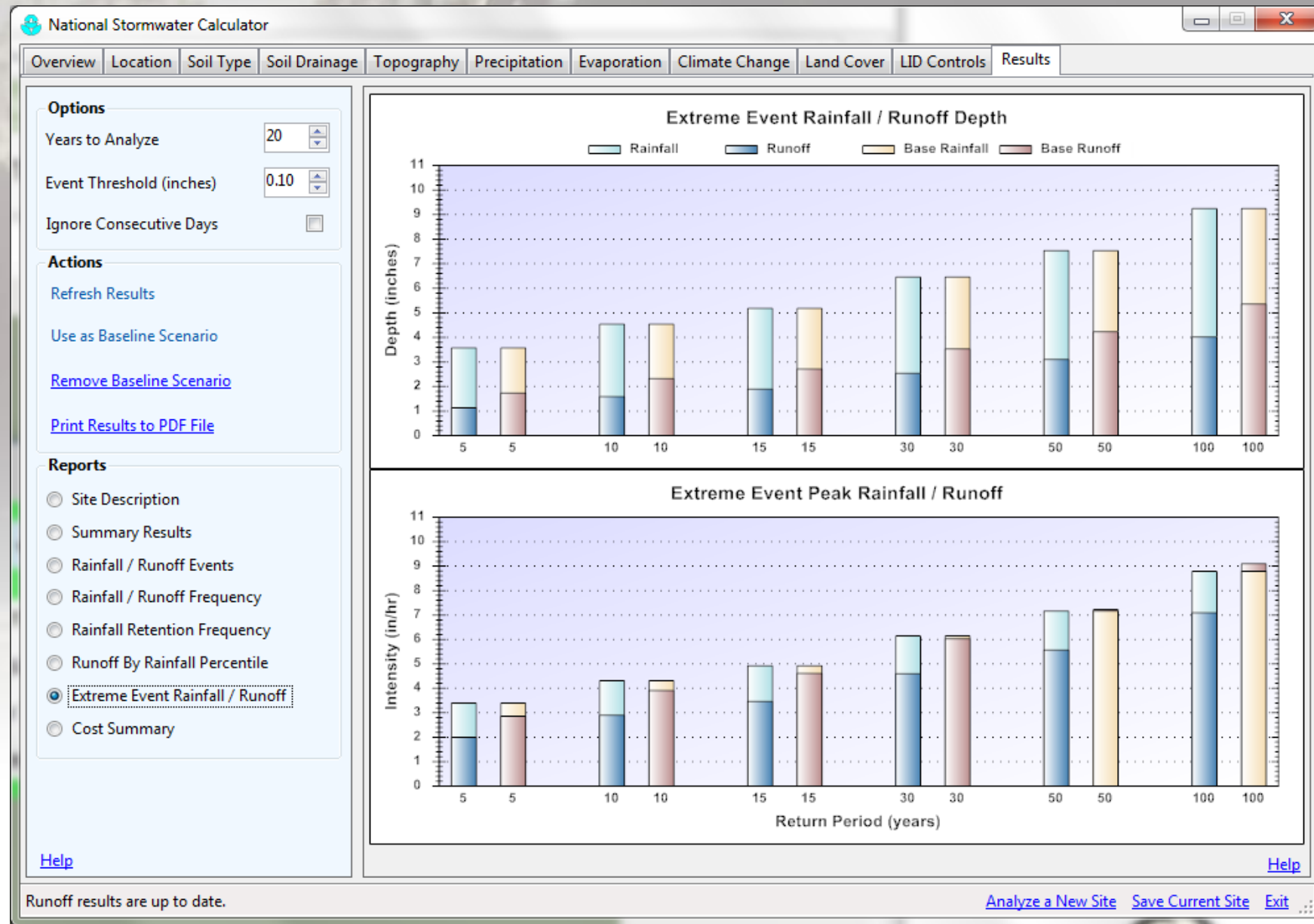
Results

Runoff by Rainfall Percentile



Results

Extreme Event Rainfall / Runoff



Results

Capital Cost (tabular)

National Stormwater Calculator

Overview | Location | Soil Type | Soil Drainage | Topography | Precipitation | Evaporation | Climate Change | Land Cover | LID Controls | Results

Options

Years to Analyze: 20

Event Threshold (inches): 0.10

Ignore Consecutive Days: ☐

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 Frequency

☐ Rainfall Retention Frequency

☐ Runoff By Rainfall Percentile

☐ Extreme Event Rainfall / Runoff

☒ Cost Summary

[Help](#)

Runoff results are up to date.

Estimate of Probable Capital Costs (estimates in 2017 US.\$)

[Maintenance Costs](#) | [Graphical View](#)

Cost By LID Control Type	Drainage Area %	Has Pre-trt?	Current Scenario (C) Area Treated 2.00 ac		Baseline Scenario (B) Area Treated 2.00 ac		Difference (C - B) Area Treated 0.00 ac	
			Low	High	Low	High	Low	High
Disconnection	15 / 6	No / No	\$89,995	\$106,588	\$38,612	\$45,896	\$51,383	\$60,693
Rainwater Harvesting	NA / NA	No / No	\$0	\$0	\$0	\$0	\$0	\$0
Rain Gardens	10 / 12	No / No	\$14,010	\$18,506	\$14,509	\$19,177	-\$499	-\$671
Green Roofs	NA / NA	No / No	\$0	\$0	\$0	\$0	\$0	\$0
Street Planters	10 / NA	No / No	\$22,417	\$31,337	\$0	\$0	\$22,417	\$31,337
Infiltration Basins	NA / NA	No / No	\$0	\$0	\$0	\$0	\$0	\$0
Permeable Pavement	50 / 30	No / No	\$396,755	\$476,384	\$239,770	\$287,994	\$156,985	\$188,390
Total	85 / 48	Varies	\$523,177	\$632,816	\$292,891	\$353,067	\$230,286	\$279,749

Note: site complexity variables that affect cost shown below:

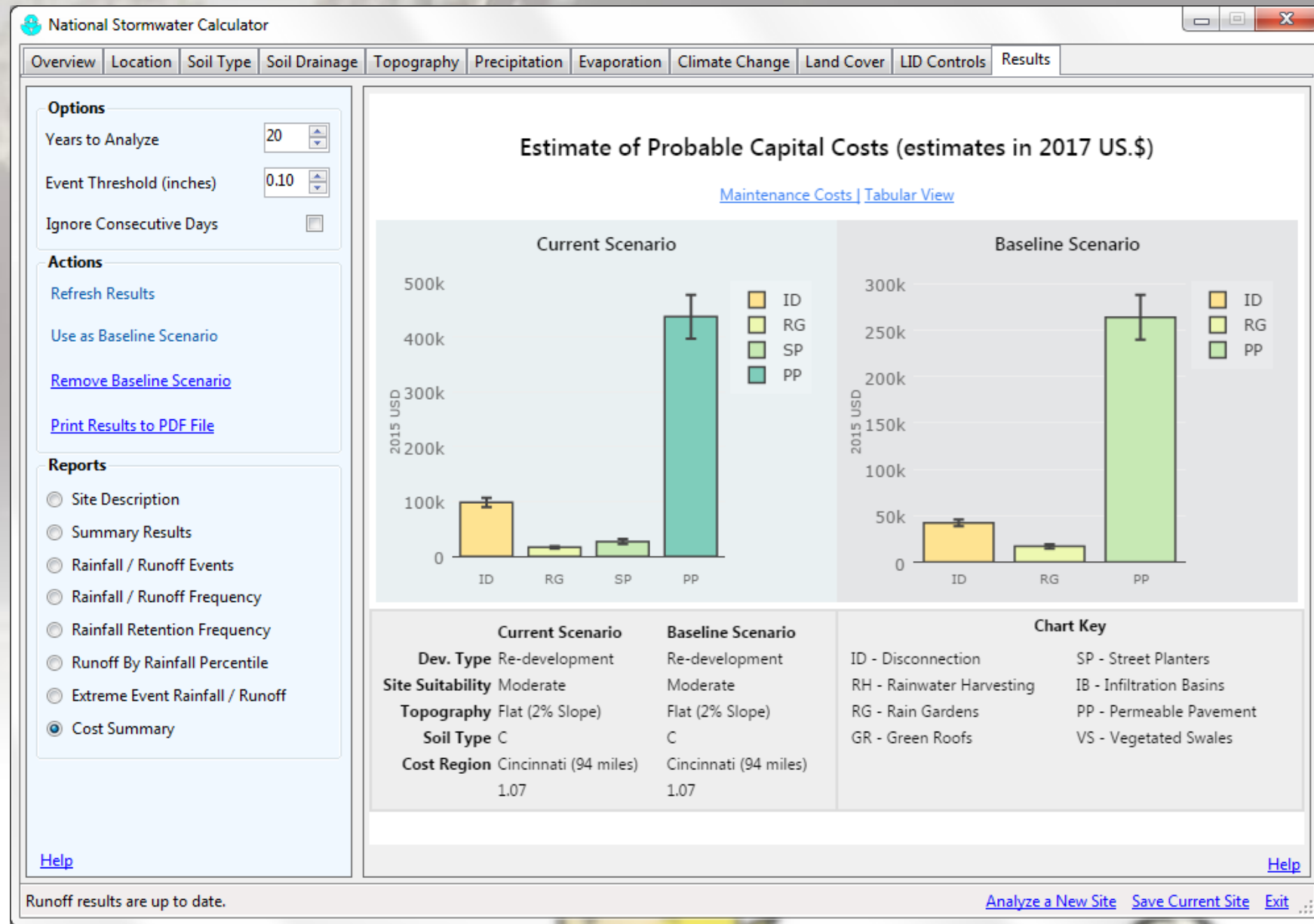
Current Scenario	Baseline Scenario
Dev. Type Re-development	Re-development
Site Suitability Moderate	Moderate
Topography Flat (2% Slope)	Flat (2% Slope)
Soil Type C	C
Cost Region Cincinnati (94 miles) 1.07	Cincinnati (94 miles) 1.07

[Help](#)

[Analyze a New Site](#) [Save Current Site](#) [Exit](#)

Results

Capital Cost (graphical)



Results

Maintenance Cost (tabular)

Options

Years to Analyze20

Event Threshold (inches)0.10

Ignore Consecutive Days☐

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 Frequency

☐ Rainfall Retention Frequency

☐ Runoff By Rainfall Percentile

☐ Extreme Event Rainfall / Runoff

☒ Cost Summary

[Help](#)

Runoff results are up to date.

[Analyze a New Site](#)

[Save Current Site](#)

[Exit](#)

National Stormwater Calculator

Overview

Location

Soil Type

Soil Drainage

Topography

Precipitation

Evaporation

Climate Change

Land Cover

LID Controls

Results

Estimate of Probable Maintenance Costs (estimates in 2017 US.\$)

[Capital Costs](#) [Graphical View](#)

Cost By LID Control Type	Current Scenario (C)		Baseline Scenario (B)		Difference (C - B)	
	Low	High	Low	High	Low	High
Disconnection	\$748	\$1,124	\$299	\$449	\$449	\$674
Rainwater Harvesting	\$0	\$0	\$0	\$0	\$0	\$0
Rain Gardens	\$34	\$815	\$40	\$977	-\$7	-\$163
Green Roofs	\$0	\$0	\$0	\$0	\$0	\$0
Street Planters	\$27	\$641	\$0	\$0	\$27	\$641
Infiltration Basins	\$0	\$0	\$0	\$0	\$0	\$0
Permeable Pavement	\$2,808	\$15,336	\$1,685	\$9,201	\$1,123	\$6,134
Total	\$3,617	\$17,914	\$2,024	\$10,628	\$1,592	\$7,286

Note: site complexity variables that affect cost shown below:


Current Scenario		Baseline Scenario	
Dev. Type	Re-development	Re-development	
Site Suitability	Moderate	Moderate	
Topography	Flat (2% Slope)	Flat (2% Slope)	
Soil Type	C	C	
Cost Region	Cincinnati (94 miles) 1.07	Cincinnati (94 miles) 1.07	

[Help](#)

May 2018

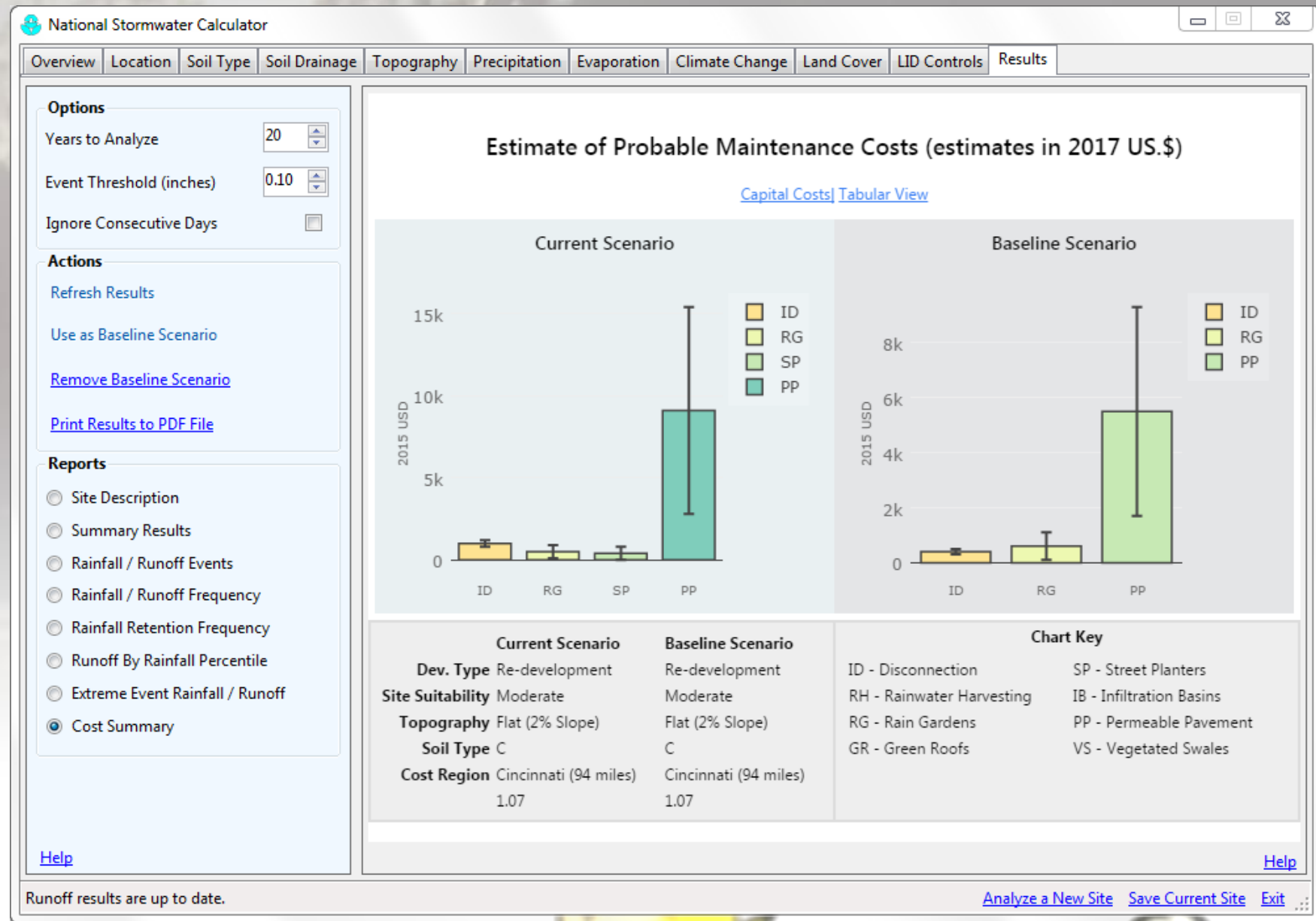
Ohio Stormwater Conference | Green-Gray Cost Analysis

35



Results

Maintenance Cost (graphical)



Quantifying Costs

Traditional Costs

- Capital Costs
- Maintenance Costs

Indirect Costs

- R/W Acquisition Costs
- Treatment Plant Costs
- Snow removal
- Water Re-Use
- Energy Savings
- Tax Incentives / Utility Fees

Quantifying Costs

Traditional Costs

- Capital Costs
- Maintenance Costs

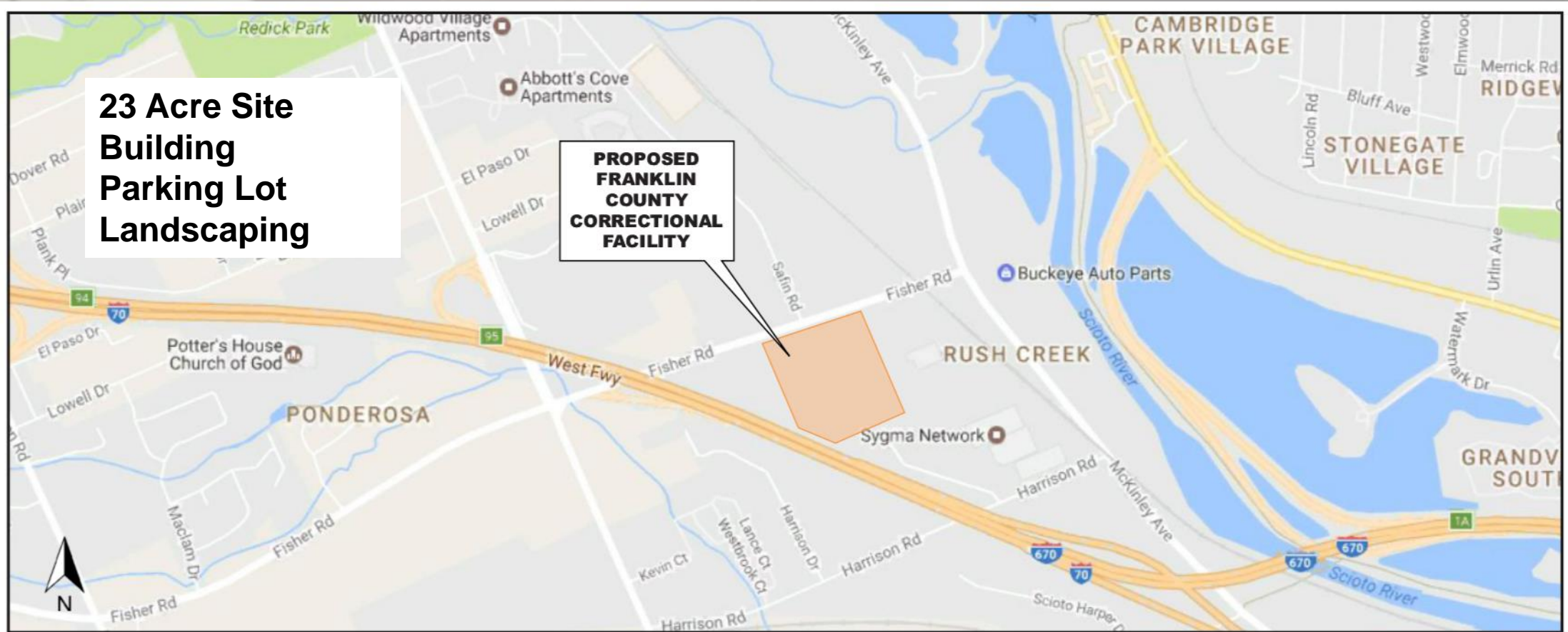
Non-Monetary Costs

- Air Quality
- Water Quality
- Habitat Quality

Indirect Costs

- R/W Acquisition Costs
- Treatment Plant Costs
- Snow removal
- Water Re-Use
- Energy Savings
- Tax Incentives / Utility Fees

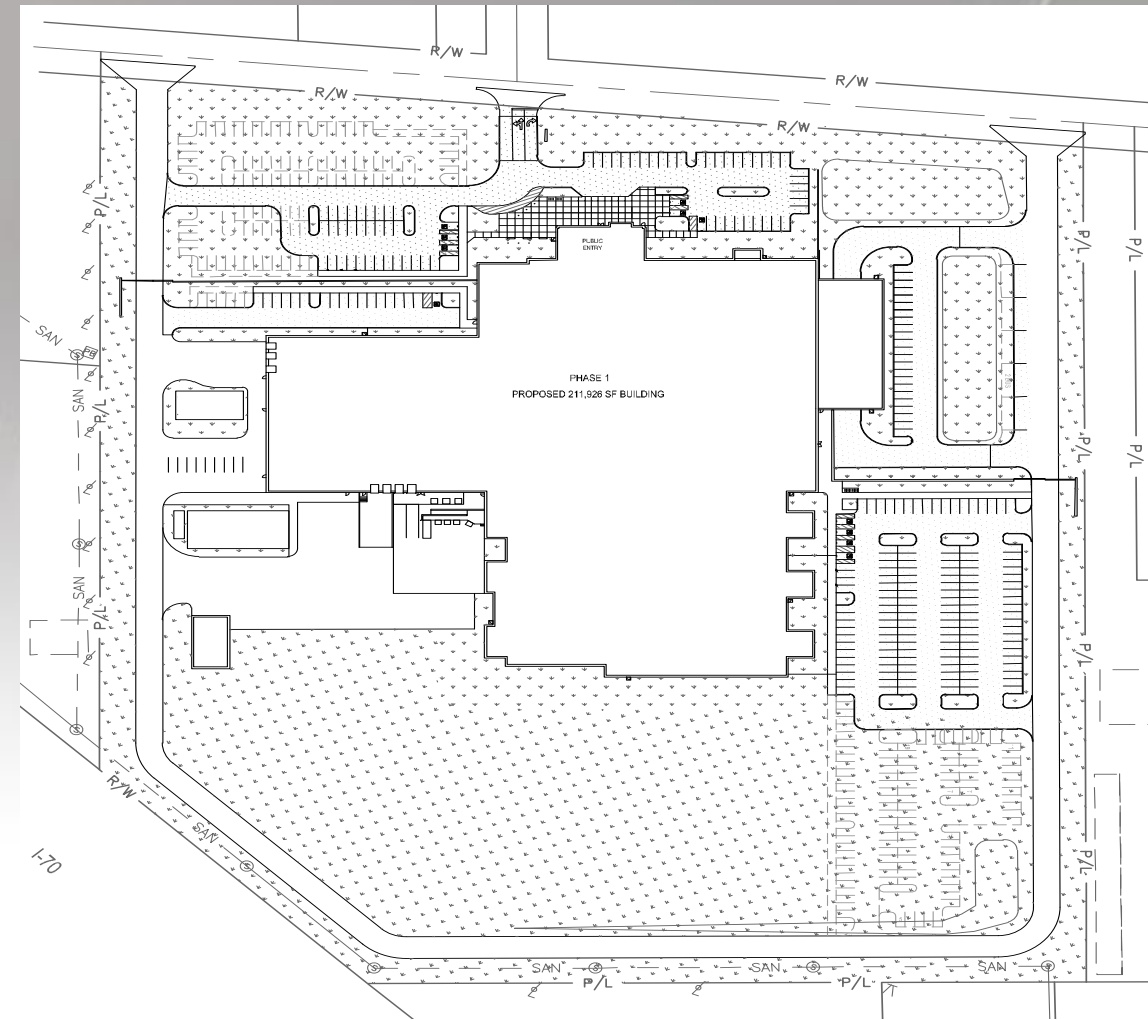
Franklin County Correctional Facility



Lifecycle Cost Analysis

Traditional Stormwater Gray Infrastructure

- Asphalt Parking Lot
- Storm Sewer
- Catch Basins
- Detention Basin
- Maintenance (30 Years)



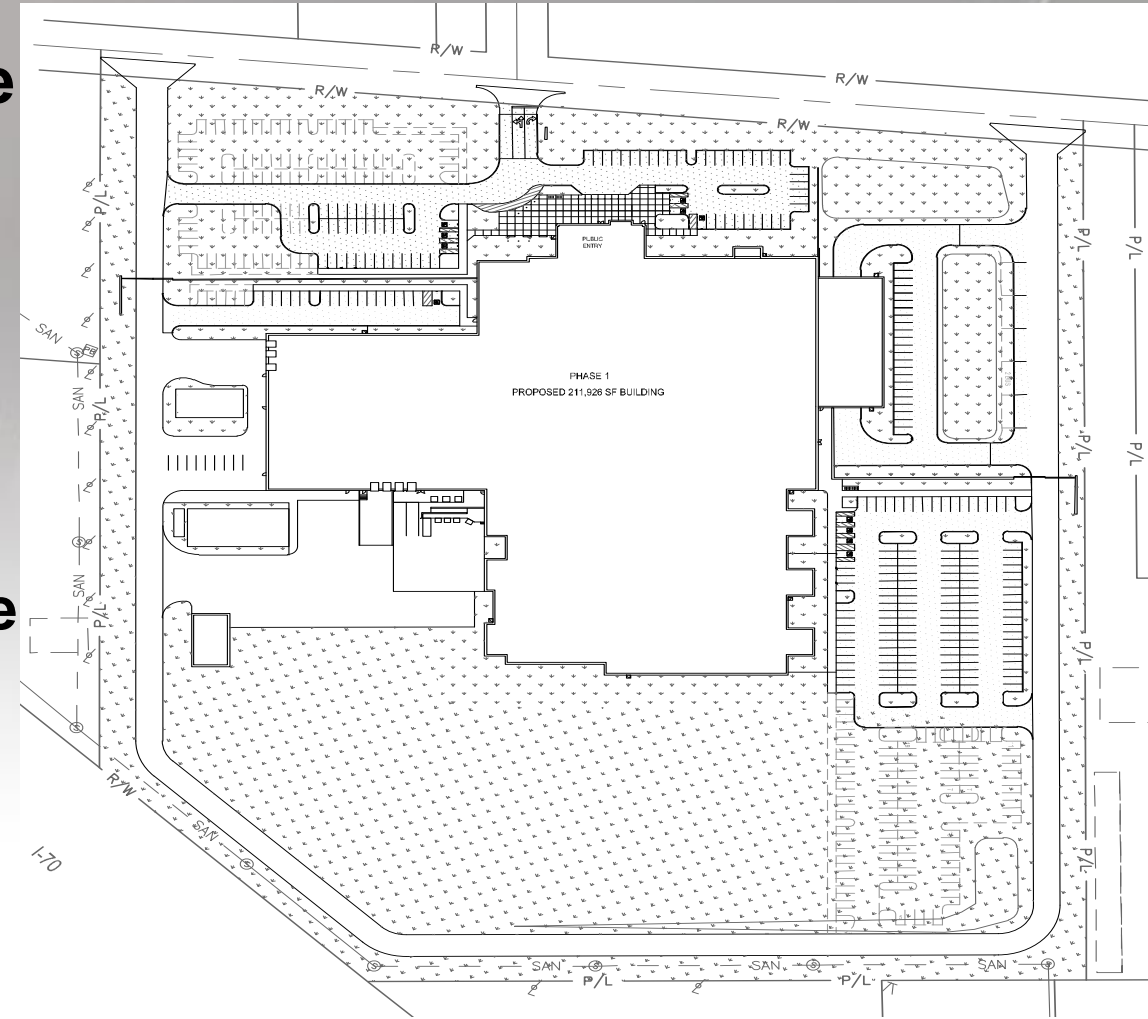
Lifecycle Cost Analysis

Traditional Stormwater Gray Infrastructure

- Asphalt Parking Lot
- Storm Sewer
- Catch Basins
- Detention Basin
- Maintenance (30 Years)

Low Impact Development Green Infrastructure

- Permeable Pavers
- Storm Sewer
- Catch Basins
- Detention Basin
- Maintenance (30 Years)



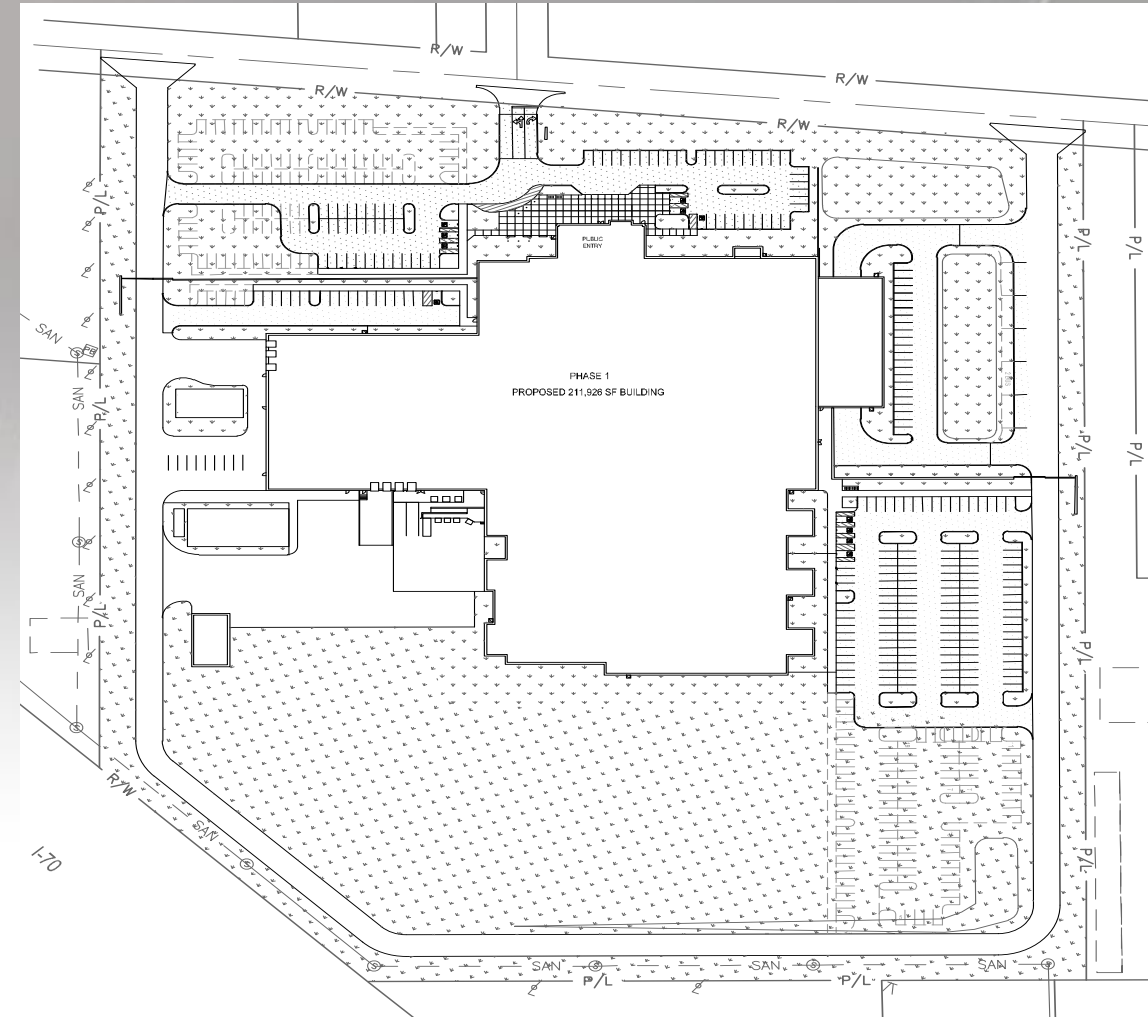
Lifecycle Cost Analysis

Traditional Stormwater Gray Infrastructure

- Capital Cost = \$1,350,000
- Maintenance Cost (30 years) = \$430,000
- **Total = \$1,780,000**

Low Impact Development Green Infrastructure

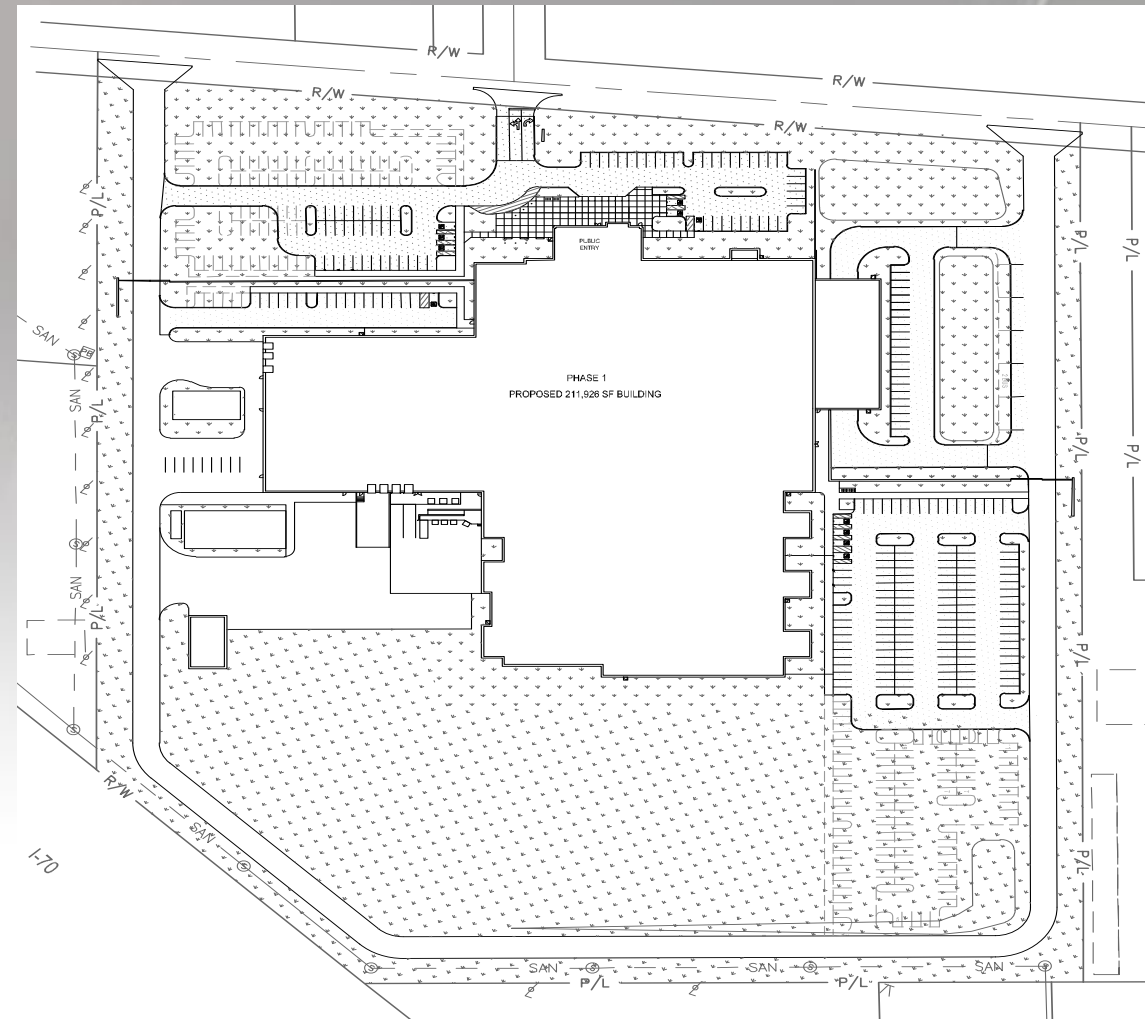
- Capital Cost = \$1,710,000
- Maintenance Cost (30 years) = \$380,000
- **Total = \$2,090,000**



Lifecycle Cost Analysis

City of Columbus Stormwater Utility Fee

- Based on property's contribution to stormwater runoff
- 2,000 SF Impervious Area = 1 ERU (Equivalent Residential Unit)
- 23 Acres Impervious = 500 ERU
- Annual Stormwater Fee = \$27,040
- 30 Year Fee = \$811,200
- GI used to meet all water quantity and quality requirement = 100% credit



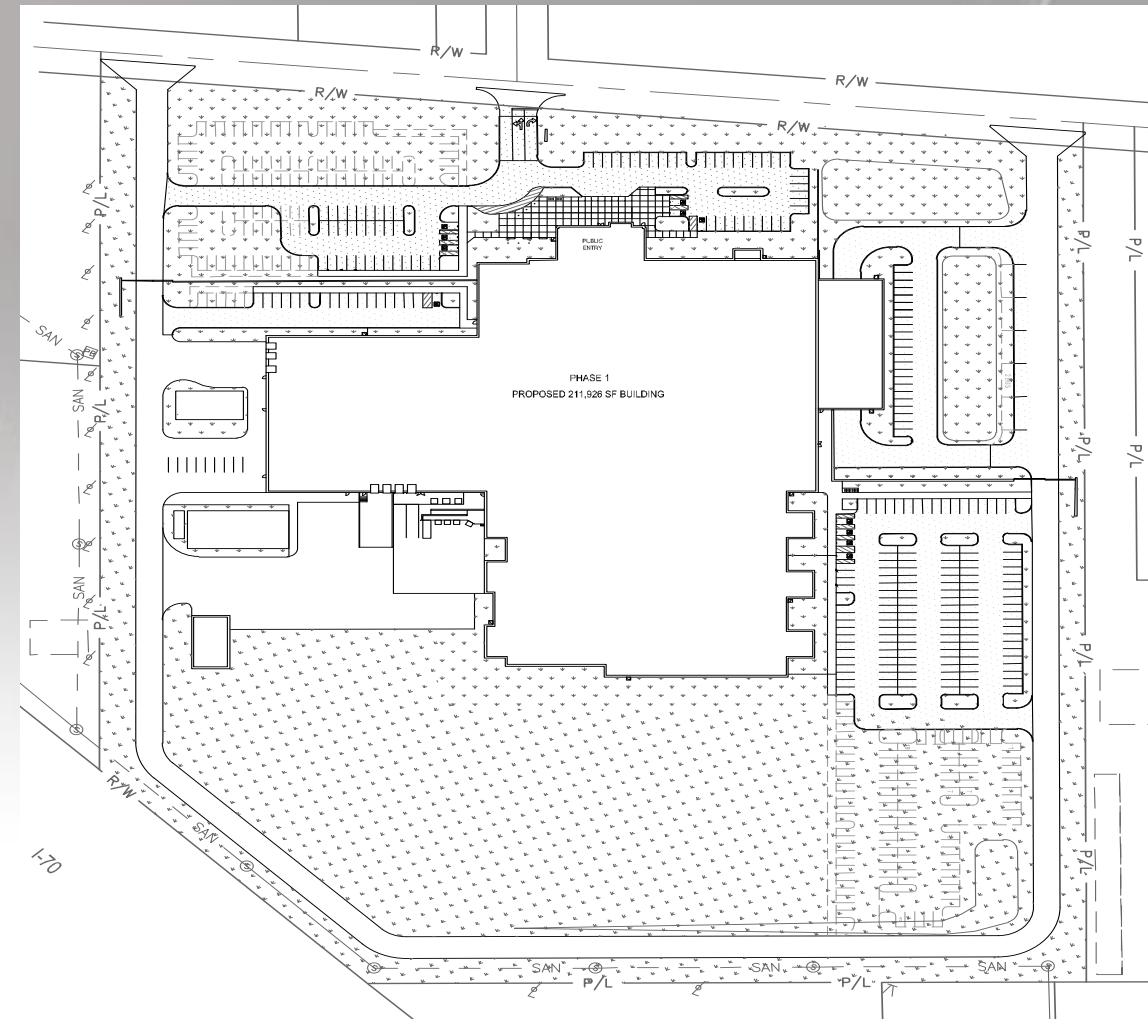
Lifecycle Cost Analysis

Traditional Stormwater Gray Infrastructure

- Capital Cost = \$1,350,000
- Maintenance Cost (30 years) = \$430,000
- **Stormwater Fee (30 years) = \$811,000**
- **Total = \$2,590,000**

Low Impact Development Green Infrastructure

- Capital Cost = \$1,710,000
- Maintenance Cost (30 years) = \$380,000
- **Total = \$2,090,000**



Questions?

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