



CASE STUDY

Community Life-Cycle Analysis for Stormwater Infrastructure Costs



Carmel Indiana

CLASIC Case Studies showcase the variety of ways that the online tool can assist communities with stormwater project planning and decision-making.

CASE STUDY HIGHLIGHTS

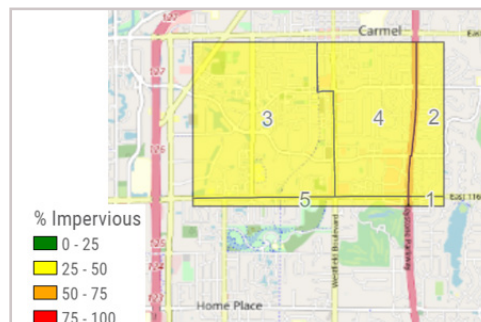
- ➔ Subunits (block, block group or tract) allow users to select different technology scenarios for each subunit.
- ➔ Co-benefits can be selected and ranked to target results to community goals and objectives.
- ➔ Performance and cost targets can be set. Output results will indicate when scenarios do not meet targets.

Background and Project Purpose

Carmel is a growing community north of Indianapolis, Indiana that is home to more than 125 corporate headquarters. In this case study, two scenarios are considered as redevelopment opportunities for stormwater management.

Project Area Selection

The project area and tract subunits were selected. The land use data that CLASIC automatically uploads is from the 2016 National Land Cover Database, and the soil database is from the Soil Survey Geographic Database.



Project area in Carmel, north of Indianapolis

CLASIC INPUTS

Scenario Building

Baseline Scenario

No stormwater controls

Rain Garden Scenario

Added 23 large (10,000 ft²) rain gardens, located in the captured impervious area, that capture 10% of the impervious area. Each subunit includes between 1 and 12 rain gardens. Each rain garden is planted with sod, requires six months of routine mowing, and includes three trees.

Detention Basin Scenario

Added five large (805,000 ft³) detention basins, located in the surrounding pervious area, that capture 10% of the impervious area. Each subunit includes one detention basin. Each basin is planted from seed and requires six months of routine mowing.

Co-Benefit Indicators

A few co-benefits are preselected; however, each co-benefit can be selected or unselected, and given a low, medium or high level of importance. In this case study, along with the preselected co-benefits, combined sewer treatment was selected, and the importance of property value and public awareness of stormwater and water systems were increased in importance to medium and high, respectively.

Co-Benefit Indicators: Each indicator can be selected, un-selected and ranked (low, medium or high importance) depending on the goals and values in your community.

Economic Indicators

- Property Values
- Costs from Illness
- Avoided Cost from Combined Sewer Treatment
- Potential Impacts from Nuisance Floods
- Building Energy Efficiency
- Avoided Water Treatment
- Employment Opportunity

Social Indicators

- Health Impacts from Air Quality
- Mental Health
- Thermal Comfort
- Increased Supply from Harvested Stormwater
- Public Awareness of Stormwater and Water Systems
- Potential Avoided Social Strain Associated with Nuisance Flooding

Environmental Indicators

- Ecosystem Services
- Groundwater Flow Increase
- Carbon Sequestration

Setting Targets

Each CLASIC project can choose to set performance and/or cost targets. The outputs will indicate scenarios that do not meet those targets. In this project, a pollutant reduction performance target was set for a 5% reduction in total nitrogen load.

Target Input Opportunities

Pollutant Reduction

- Total Suspended Solids
- Total Nitrogen Load
- Total Phosphorous Load
- Fecal Indicator Bacteria

Runoff Reduction

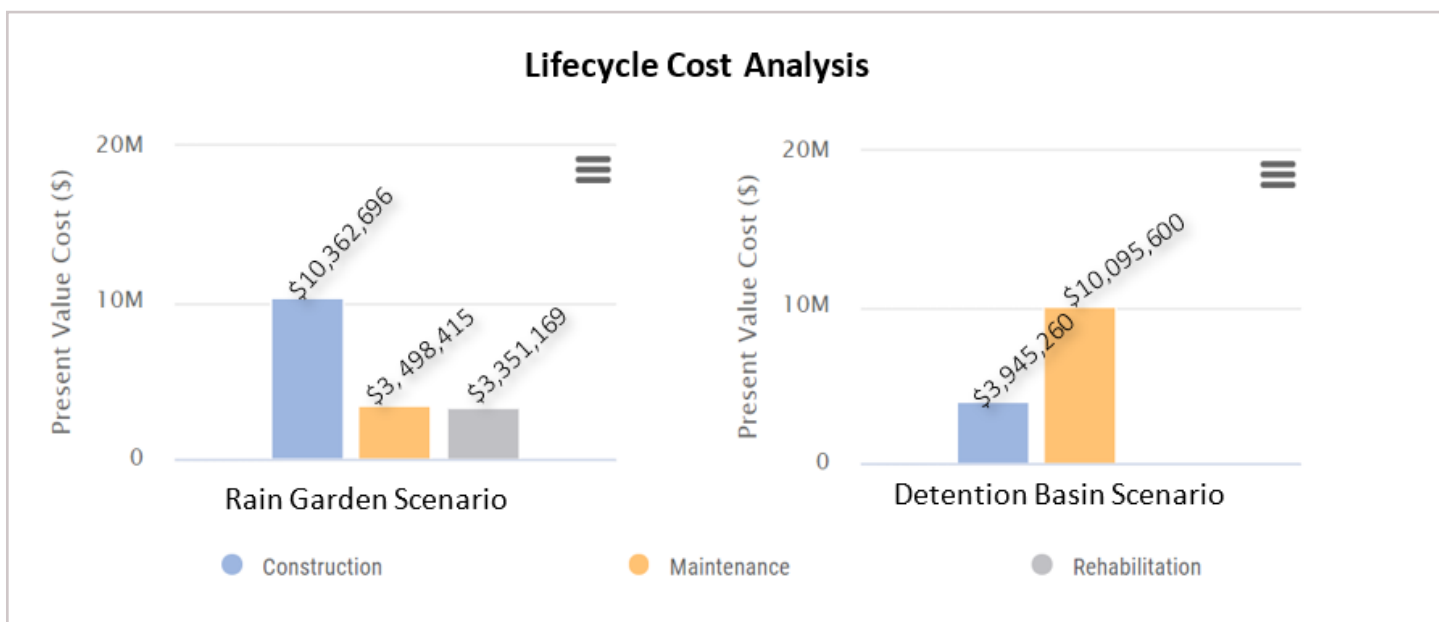
Total Cost

Annual Average Cost

CLASIC OUTPUTS

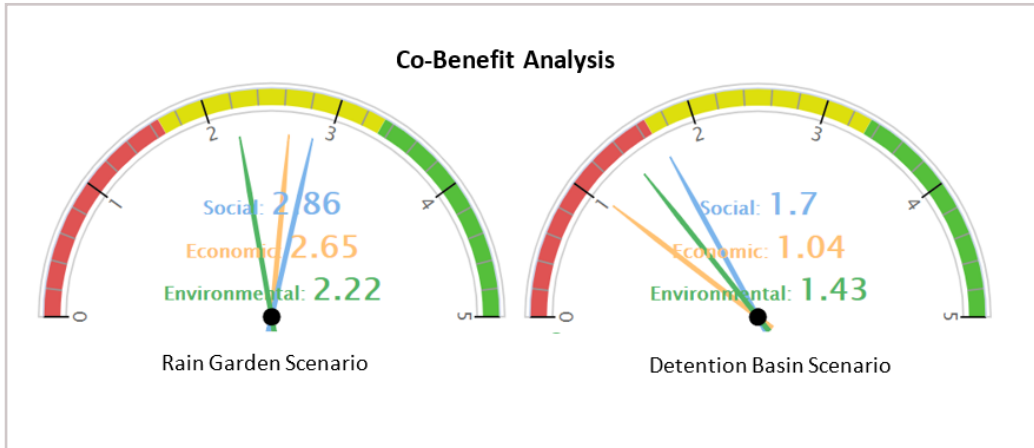
Lifecycle Cost Analysis

Construction, maintenance and rehabilitation costs are compared across scenarios. The Baseline Scenario indicates no costs because it is the status quo scenario with no technologies added. The Rain Garden Scenario indicates higher costs than the Detention Basin Scenario. The total lifecycle cost of the Rain Garden Scenario is \$3.1 million. (22.6% more than the Detention Basic Scenario.)



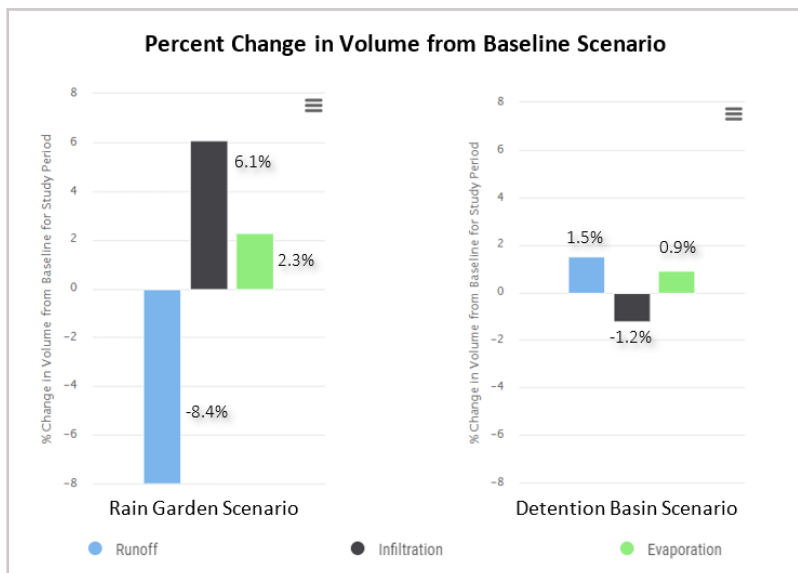
Co-Benefit Analysis

Co-benefit scores are calculated using the indicators and importance level users select. Scores are divided into three categories: social, economic and environmental. The Baseline Scenario's co-benefit score is zero across all categories because no new technologies were added. The Rain Garden Scenario's co-benefit scores, in all three categories, are higher than the Detention Basin Scenario's scores. The Rain Garden Scenario is higher in cost; however, there are additional co-benefits to installing rain gardens in the project area compared to detention basins.



Hydrologic Performance Analysis

The CLASIC hydrologic performance analysis indicates the percent change from the baseline scenario for runoff, infiltration and evaporation. The Rain Garden Scenario reduces runoff by 8.4% and increases infiltration and evaporation by 6.1% and 2.3% respectively. Results indicate that the Detention Basin Scenario shows an increase in runoff by 1.5%, a decrease in infiltration by 1.2% and an increase in evaporation by 0.9%. Although higher in cost, the Rain Garden Scenario performs better according to the hydrological analysis.



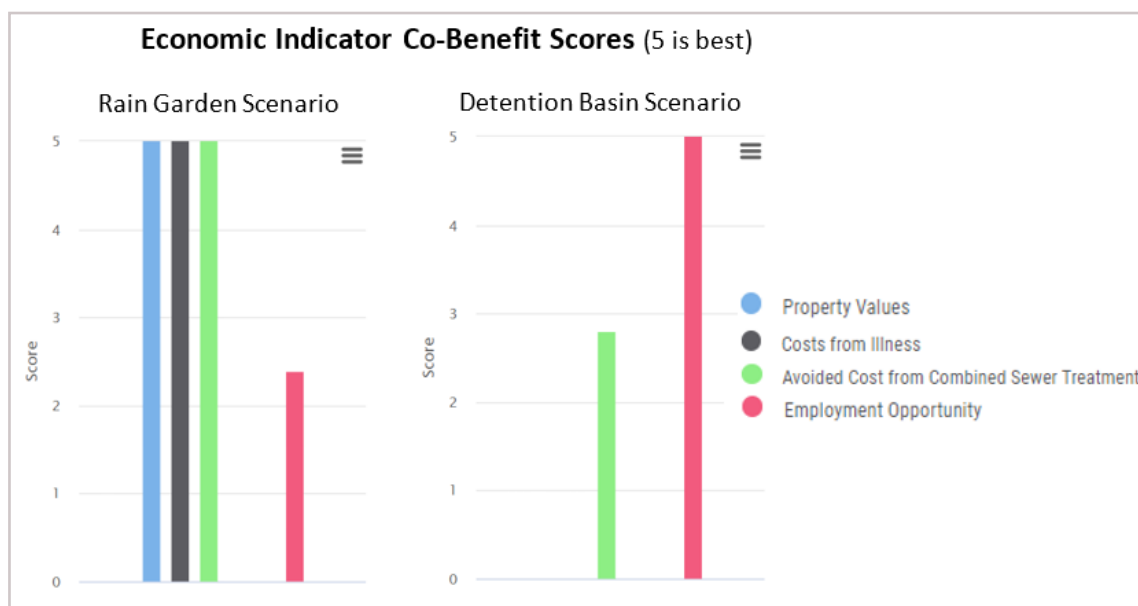
APPLICATION

Using the results from CLASIC, stormwater professionals, community planners and local decision makers will be able to understand and weigh the estimated costs, hydrologic performance and co-benefits of various stormwater scenarios as they consider redevelopment opportunities in Carmel.

In this case study, comparing rain garden and detention basin scenarios, the lifecycle cost of the Rain Garden Scenario was \$3.1M higher than the Detention Basin Scenario. If cost is the only criteria of interest, detention basins may be chosen for this project area; however, various other community goals may influence decision-making.

- If runoff reduction is an objective of stormwater planners, then the Rain Garden Scenario, with a predicted 8.4% reduction in runoff, outcompetes the predicted increase in runoff by 1.5% for the Detention Basin Scenario.
- If local elected leaders and their constituents want to increase the community's overall sustainability, then, despite the increased cost, the Rain Garden Scenario might be a more attractive option based on the social, economic and environmental co-benefits and their alignment with the broader community goals.
- If stormwater managers and decision-makers want to save public dollars on the future costs of combined sewer treatment, the Economic Co-Benefit Score for "avoided cost from combined sewer treatment" indicates that the Rain Garden Scenario will provide much higher avoided costs (see graph below).

CLASIC helps communities consider stormwater scenarios through a multi-faceted lens to allow decision-making that considers wise use of public funds, high quality performance to meet level of service goals, and community benefits.



This case study is based on a hypothetical project in a real-world location. The project and results do not represent any actual construction or spending in the city listed.