Green Stormwater Infrastructure

Stonington, CT

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Contents

Summary

The following report created in early 2019 contains the evaluation of multiple locations in the town of Stonington, CT for the potential implementation of green stormwater infrastructure. Each site discussed was evaluated using aerial imagery and field visits to determine where the infrastructure could be implemented most effectively. For each practice, the recommended location, size, and the calculations for the predicted runoff and pollution reductions are provided. If all practices were implemented, 38,955.55 square feet of impervious cover would be disconnected from the stormwater system. This would also prevent 1,025,684.05 gallons of runoff, 10.669 pounds of nitrogen, and 1.354 pounds of phosphorus from entering the stormwater system annually.

What is Green Stormwater Infrastructure?

Green stormwater infrastructure is a way of building that emulates natural processes to better manage stormwater on impervious surfaces. Impervious surfaces are areas that do not allow water to infiltrate through them such as rooftops, parking lots, and roads. When precipitation falls on these areas, there is an increased quantity of runoff. This runoff collects pollutants as it flows over impervious surfaces, causes erosion, and can lead to flooding. Green stormwater infrastructure works to reduce runoff by creating more pervious surfaces for water to infiltrate into, changing or reducing impervious areas. The stormwater will infiltrate into the ground where pollutants are naturally removed and the amount of runoff is reduced.

Common Green Infrastructure Practices

Pervious Pavement

Rain Garden and Bioretention Systems

Rainwater Harvesting

Tree Boxes

Rain Garden

A rain garden is a shallow depression planted with vegetation to capture and absorb runoff. Rain gardens can collect water from a nearby impervious surface and divert it from entering a stormwater management system. They are usually built adjacent to the impervious area water is being diverted from and are about six inches deep. A variety of shrubs, perennials, and grasses suitable for an environment with standing water and high salt concentrations are used to aid in the efficient infiltration of water into the ground.

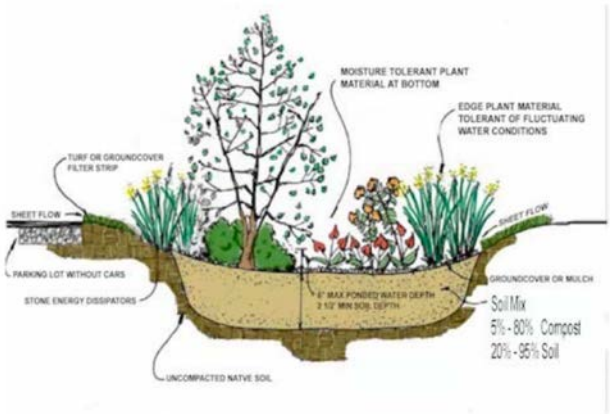
Depending on the source the runoff is being captured from, construction may vary. Rain gardens collecting runoff from parking lots and roads may require a section of the curb be removed to allow water to drain to the garden over a cobble or gravel path. Runoff collected from rooftops can be directed into a rain garden using gutters. A bioretention basin is an enlarged rain garden constructed to absorb a larger quantity of runoff.

Rain Garden Cost Calculator: https://nemo.uconn.edu/raingardens/calculator.htm

Suggested Rain Garden Vegetation

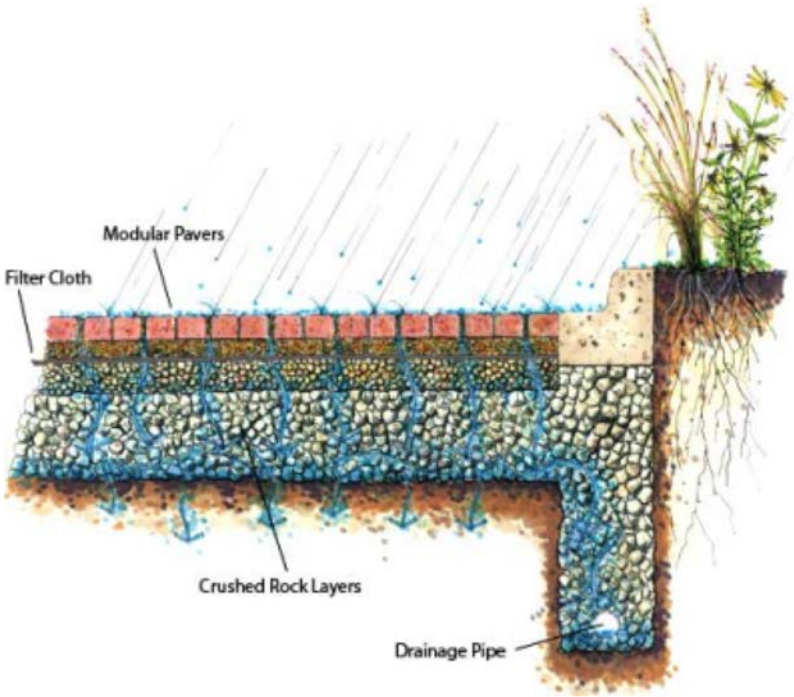
When selecting vegetation for a rain garden, the plants must be capable of withstanding fluctuating conditions. It is also beneficial to use vegetation native to the area to support local pollinators and wildlife. When choosing potential vegetation, we looked for plants with a variety of colors and heights to make the bioretention gardens as aesthetically pleasing as possible. We recommend the following options:

- Sweet Fern (*Comptonia peregrina*)
- Orange Coneflower (*Rudbeckia fulgida 'Goldstrum'*)
- Lowbush Blueberry (*Vaccinium angustifolium*)
- Sweet Pepperbush (*Clethra alnifolia*)
- Red Chokeberry (*Aronia arbutifolia*)
- Labrador Tea (*Ledum groenlandicum*)



For additional information on rain garden vegetation visit: https://nemo.uconn.edu/raingardens/plants.php

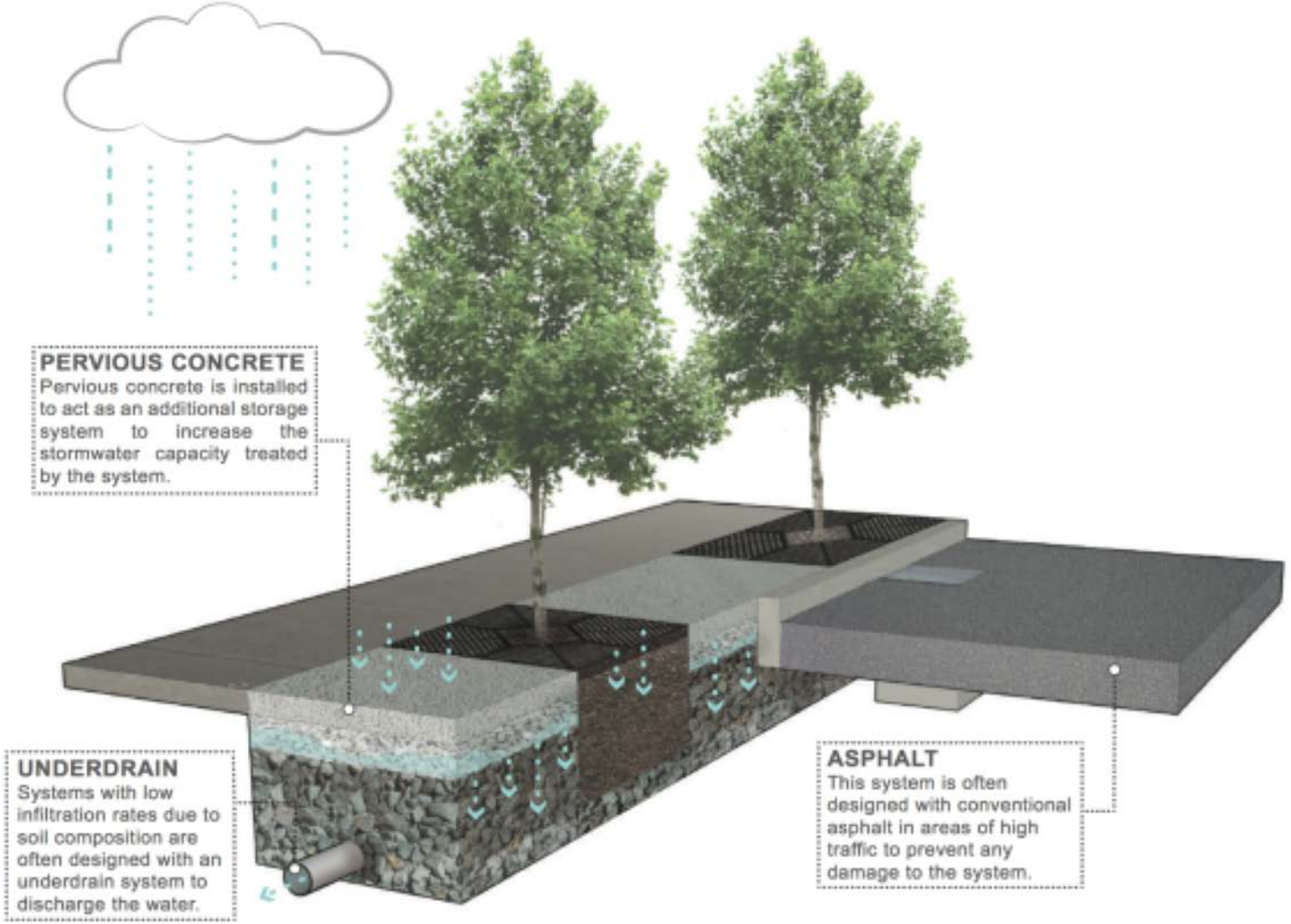
Pervious Pavement



Pervious pavement is a replacement for traditional asphalt and concrete which allows for water infiltration. The porous pavement imitates the natural infiltration of water, trapping suspended solids and pollutants as the water filters through. Pervious pavement is best suited for flat areas that receive large quantities of stormwater from surrounding areas during storm events. To maintain optimal functionality, it requires cleaning through techniques such as vacuum sweeping and pressure washing to remove dirt and debris lodged in the pavement. Pervious pavement is less susceptible to seasonal expansion and contraction than traditional pavement and reduces the need for snow removal due to its permeability.

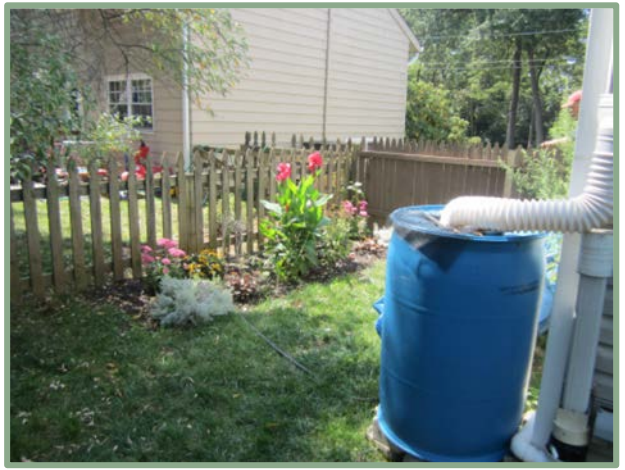
Tree Box Filters

Tree boxes filters are a green infrastructure practice using the same techniques as rain gardens and bioretention areas. Stormwater runoff is directed to the filter through a grate, where it infiltrates through the soil and other substrates. The runoff acts as additional irrigation to the tree, and the tree root system and soil work to filter out any pollutants in the runoff. Tree boxes are often a great way to enhance the attractiveness of a sidewalk or road edge.


PERVIOUS CONCRETE
Pervious concrete is installed to act as an additional storage system to increase the stormwater capacity treated by the system.
UNDERDRAIN
Systems with low infiltration rates due to soil composition are often designed with an underdrain system to discharge the water.
ASPHALT
This system is often designed with conventional asphalt in areas of high traffic to prevent any damage to the system.

Rainwater Harvesting

Rainwater harvesting is the process of diverting water from gutters and downspouts which would otherwise enter the municipal stormwater system. The roof runoff is retained in a container positioned adjacent to the building, where the water can then be used for a variety of purposes such as gardening and washing vehicles. Using rainwater can reduce water bills and reduce the demand on private wells and the local water supply. The size of the retaining container is dependent on the size of the drainage area and the amount of water needed. PVC is suitable for small drainage areas containers, but larger areas may require steel or concrete containers.



Site Selection and Approach

Before on site research, group members used Stonington GIS, CT ECO and Google map to locate possible municipal sites to implement low impact development (LID) practices. We analyzed the data presented and developed LID plans that could be implemented. Once on site, we collected data such as elevation, waterflow direction and drainage area that were unavailable to us while searching online. Using the combined data, we eliminated sites that were impractical to implement LID practices and focused on the remaining sites.

Top Three Practices for Stonington

The selection of the top three sites was based on the estimated cost, total impervious cover, maintenance, and education potential.

1. Mystic Middle School
2. Stonington Town Clerk
3. Stonington Human Services

If the above green infrastructure practices are all implemented, 19,137.11 square feet of impervious cover will be disconnected from the stormwater system. This would include preventing 503,872.45 gallons of treated water, 5.241 pounds of nitrogen, and .665 pounds of phosphorus from entering the stormwater system annually.

Site: Pawcatuck Middle School

Location:

40 Field St, Pawcatuck, CT

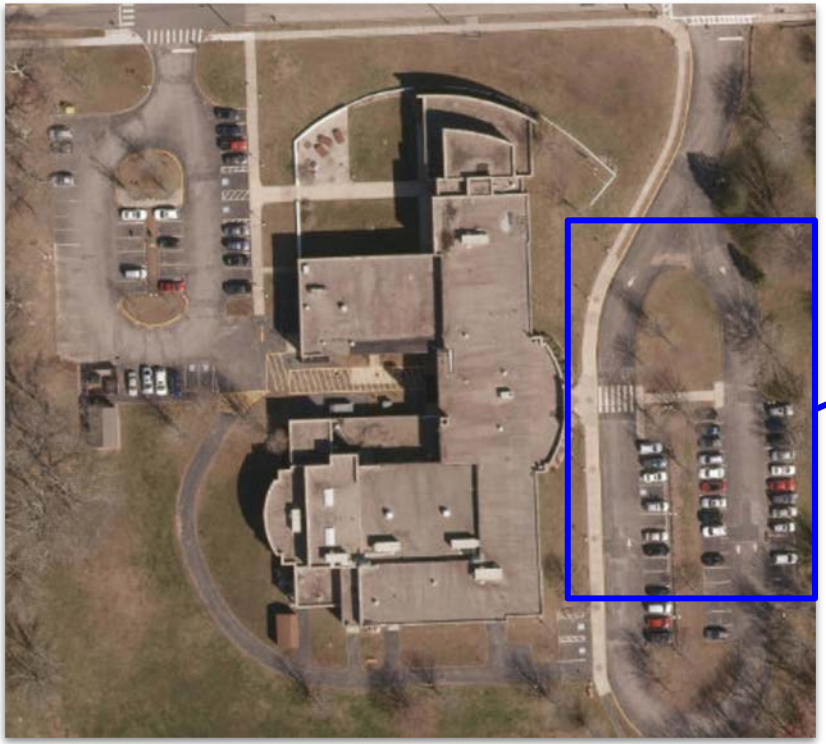
Total Impervious Area:

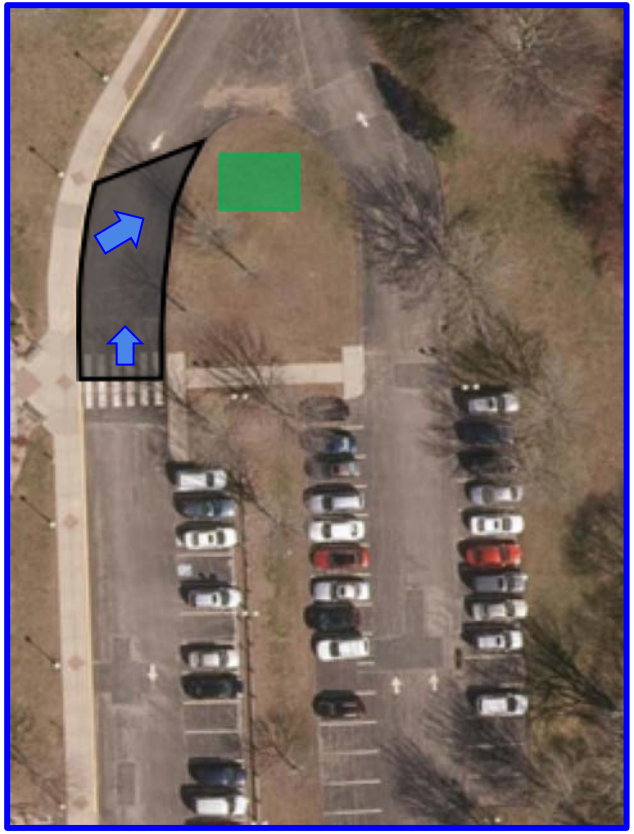
70,816 sq feet

Impervious Area Removing:

2,825.88 sq feet

Pawcatuck Middle School
Option 1:





Direction of Water Flow

Drainage Area

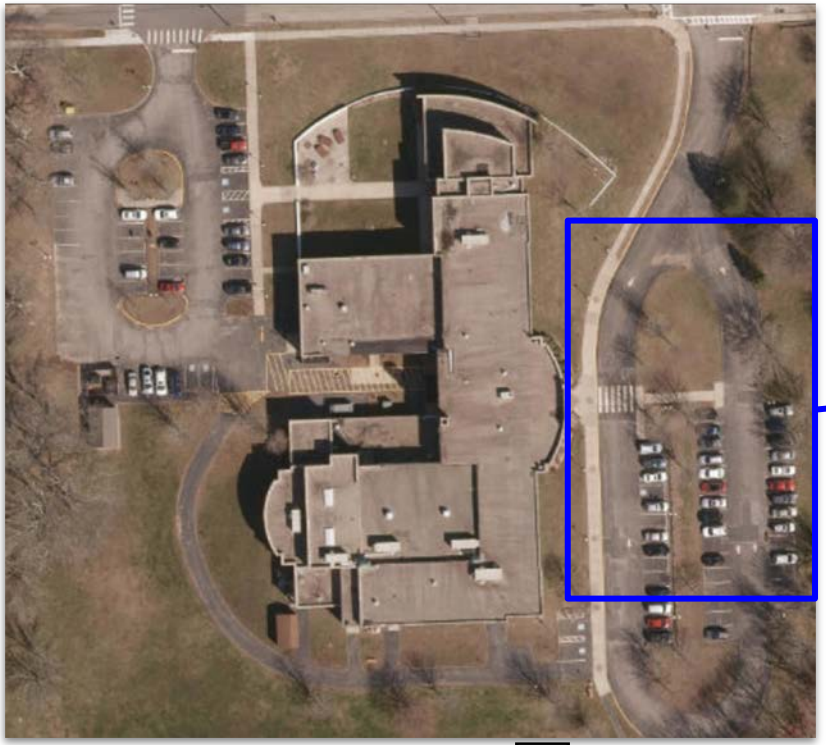
Rain Garden / Bioretention Area

Drainage Area (sq. ft.)	Suggested Practice	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
1,628.50	Rain Garden	42,877.75	0.446	0.057	272

The grass pictured on the left is a potential location for a rain garden. Runoff from the upper portion of the parking lot near the school entrance would be captured by this practice using one curb cut to direct runoff to the grass. The slight slope of the grass needs to be considered during construction, so water is directed toward the deepest area of the rain garden.

Rain Garden Dimensions: 17 ft x 16 ft
Cost Range: $1,360 - $12,240

Pawcatuck Middle School
Option 2:



Direction of Water Flow

Drainage Area

Rain Garden / Bioretention Area

Drainage Area (sq. ft.)	Suggested Practice	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
1,197.38	Rain Garden	31,526.54	0.328	0.042	200

The lower portion of the parking lot could also drain toward a bioretention garden. Two curb cuts would direct the water away from the current storm drain toward the practice. The garden would provide an aesthetic benefit near the parking spaces, while also eliminating runoff.

Rain Garden Dimensions: 15 ft x 14 ft
Cost Range: $1,000 - $9,000

Site: Mystic Middle School

Location:

204 Mistuxet Ave, Mystic, CT

Total Impervious Area:

75,257 sq feet

Impervious Area Removing:

6,536.30 sq feet

Mystic Middle School
Option 1:

Direction of Water Flow

Drainage Area

Rain Garden / Bioretention Area

Drainage Area (sq. ft.)	Suggested Practice	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
5,497.39	Rain Garden	144,744.08	1.506	0.191	920

A rain garden could be implemented near the school entrance, providing a learning opportunity for the students and community. The upper portion of the parking lot would drain into the new garden using two curb cuts on both sides of the existing stormwater drain. The current vegetation surrounding the flagpole would be incorporated into the practice.

Rain Garden Dimensions: 80 ft x 11.5 ft

Cost Range: $4,600 - $41,400

Mystic Middle School
Option 2:

Direction of Water Flow

Drainage Area

Rain Garden / Bioretention Area

Drainage Area (sq. ft.)	Suggested Practice	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
1,038.91	Rain Garden	27,354.08	0.285	0.036	176

The other practice for this location is another rain garden placed near the parking lot exit. Currently, the grass alongside the asphalt is eroding from runoff rushing toward the stormwater drain on Mistuxet Avenue. To prevent this, a channel would be created to direct water off of the parking lot toward the new rain garden a few yards away from the parking lot. This redirection of water would prevent continued erosion and remove runoff.

Rain Garden Dimensions: 11 ft x 16 ft
Cost Range: $880 - $7,920

Site: Stonington Town Clerk

Location:

152 Elm St, Stonington, CT

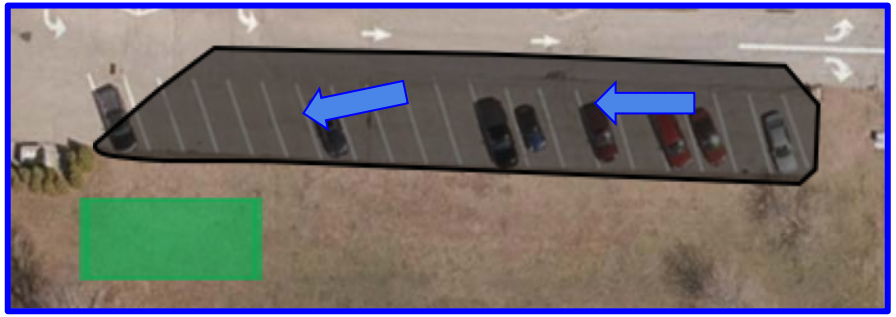
Total Impervious Area:

24,000 sq feet

Impervious Area Removing:

7,715.75 sq feet

Stonington Town Clerk
Option 1:



Direction of Water Flow

Drainage Area

Rain Garden / Bioretention Area

Drainage Area (sq. ft.)	Suggested Practice	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
5,312.83	Rain Garden	139,884.689	1.455	0.184	885.472

The implementation of a rain garden here can reduce runoff generated from the parking lot . The rain that fall on the south side of the road will flow to the side and a curb cut at the end of the driveway can direct the water to the the bioretention garden, where it will be collected.

Rain Garden Dimensions: 20 ft x 44 ft
Cost Range: $4,427.36 - $39,846.24

Stonington Town Clerk
Option 2:

Direction of Water Flow

Drainage Area

Rain Garden / Bioretention Area

Drainage Area (sq. ft.)	Suggested Practice	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
2,402.92	Rain Garden	63,267.92	0.658	0.083	400.49

The rain on this side will all run towards the end of the road and accumulate, and we can implement a curb cut that leads to a rain garden to decrease runoff. The rain garden in the town clerk area can serve as symbol of the commitment of the town towards low impact development.

Rain Garden Dimensions: 25 ft x 16 ft
Cost Range: $2,002.45 - $18,022.05

Site: Stonington High School

Location:

176 S Broad St, Pawcatuck, CT

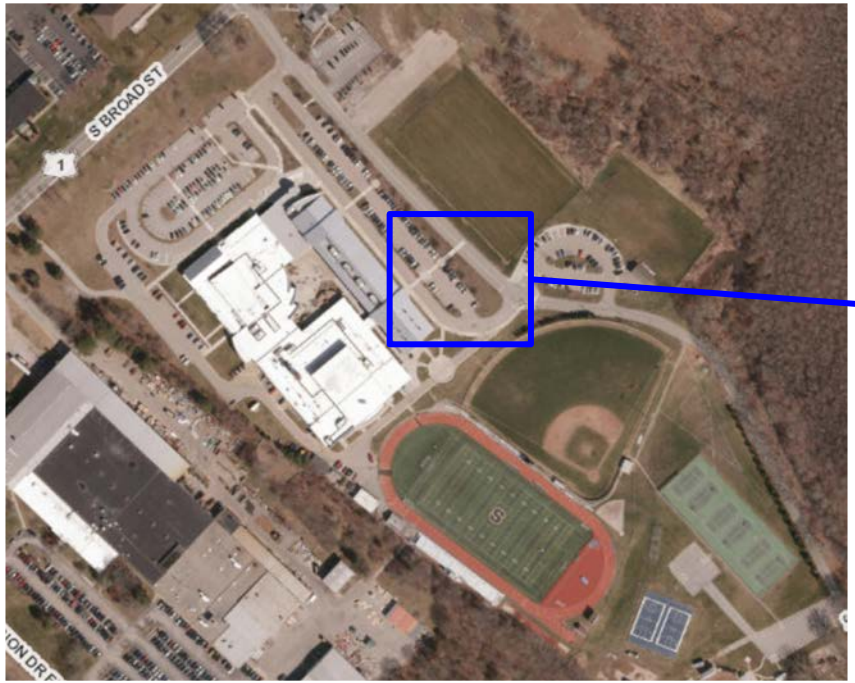
Total Impervious Area:

92,500.00 sq ft

Impervious Area Removing:

11,128.56 sq ft

Stonington High School
Option 1:



Direction of Water Flow

Drainage Area

Rain Garden / Bioretention Area

Drainage Area (sq. ft.)	Suggested Practice	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
5,094.15	Rain Garden	134,126.93	1.395	0.177	849.025

A rain garden can help to capture the runoff generated from the parking lot shown in the picture. A curb cut would be needed to direct the water to the rain garden. The already existing vegetation can also help the garden to process collected rain water. Because this is a high school, a bioretention garden can also have educational benefits.

Rain Garden Dimensions 20 ft x 42 ft
Cost Range: $4,245.13 - $38,206.13

Stonington High School
Option 2:

Direction of Water Flow

Drainage Area

Rain Garden / Bioretention Area

Drainage Area (sq. ft.)	Suggested Practice	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
6,034.41	Rain Garden	158,883.60	1.653	0.209	1,005.735

This bioretention area can capture most of the water coming from the crossway and the parking lot. The well originally placed there can be raised and serves as an emergency drain in case of an overflow. A curb cut would be needed to direct the water to the rain garden.

Rain Garden Dimensions: 17 ft x 60 ft
Cost Range: $5,028.68 - $45,258.08

Site: Stonington Human Services

Location:

166 S Broad Street, Pawcatuck, CT

Total Impervious Area:

13,060 sq ft

Impervious Area Removing:

4,885.06 sq ft

Stonington Human Services
Option 1:

Direction of Water Flow

Drainage Area

Rain Garden / Bioretention Area

Drainage Area (sq. ft.)	Suggested Practice	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
3,201.06	Rain Garden	84,282.63	0.887	0.111	530

By installing a rain garden in this area, water will be captured coming from either side of Spellman street. A curb cut will have to be made to allow water to drain into the rain garden, instead of into the current stormwater drain on Spellman Drive. This will also help avoid pooling of water that takes place at the top of the street/South Broad street.

Rain Garden Dimensions: 17 ft x 15 ft
Cost Range: $2,650.00 - $23,850.00

Stonington Human Services
Option 2: Rain Barrels

Direction of Water Flow

Drainage Area

Rain Barrel

Drainage Area (sq. ft.)	Suggested Practice	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
1,684	Rain Barrels	5,930.91	0.461	0.059	0

By installing 3 rain barrels on the back of the building, there is now the ability to catch and harvest runoff. The water coming from the roof will lead through the gutters connected to the storage tanks. The harvested rain can be used on the garden located directly in front of the storage tanks and to the right of the building.

Cost Range: $150.00 - $345.00

Site: Stonington Board of Education

Location:

49 N Stonington Rd, Old Mystic, CT

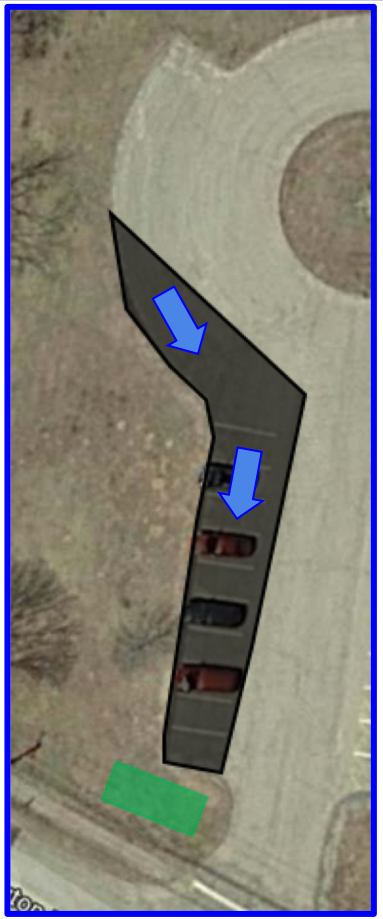
Total Impervious Area:

42,491 sq ft

Impervious Area Removing:

5,864 sq ft

Stonington Board of Education
Option 1:



Direction of Water Flow

Drainage Area

Rain Garden / Bioretention Area

Drainage Area (sq. ft.)	Suggested Practice	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
2,262	Rain Garden	59,557	0.620	0.079	377

This rain garden will help capture water coming from the upper part of the parking lot where the circle is located (the highest elevation of the parking lot). It will help prevent water from rushing into the road by created a curb cut at the bottom left of the parking lot, allowing water to drain from the parking spaces into the bioretention area.

Rain Garden Dimensions: 22 ft x 15 ft
Cost Range: $1,885.00 - $16,965.00

Stonington Board of Education
Option 2:

Direction of Water Flow

Drainage Area

Rain Garden / Bioretention Area

Pervious Pavement

Drainage Area (sq. ft.)	Suggested Practice	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
3,602	Rain Garden	94,839	0.987	0.125	450

By putting a rain garden in this area, it will serve a similar purpose as the first option for the site. It will receive runoff from the top of the parking lot and prevent it from flooding into the road. In addition to the rain garden, pervious pavers will also be implemented in order for people to continue to have access to the sidewalk as it is infiltrating water. If overflow does occur, the rain garden will catch the runoff and a sidewalk could be implemented for precaution. The sidewalk could be connected from the middle of the parking lot to the right of the pervious pavers. Therefore, individuals still have access to the sidewalk.

Rain Garden Dimensions: 30 ft x 17 ft
Cost Range: $2,250.00 - $20,250.00