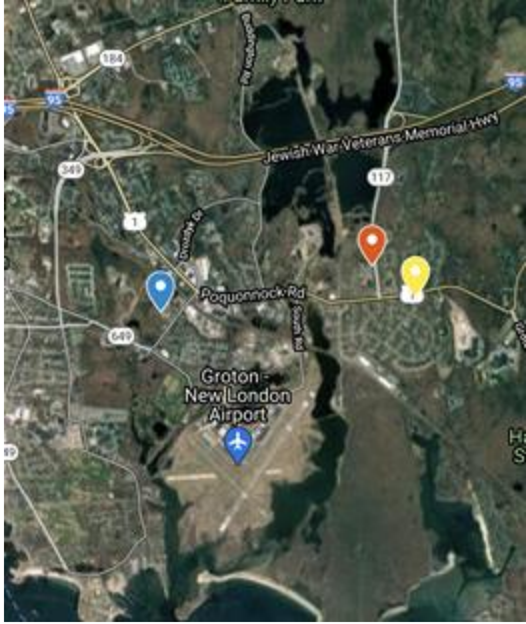


Town of Groton

By: Tyler Metsack and Sarah Schechter

Top Three Sites for the Town of Groton

These three sites were chosen based on work by a previous UConn group, input from the town, and personal research. These areas are heavily trafficked by the community and adding low-impact development (LID) measures would be beneficial to these spaces.

1. Groton Senior Center/Public Library - 102 Newtown Road
2. Public Housing Authority - 11 Village Lane
3. Poquonnock Plains Park - 1 Center Avenue

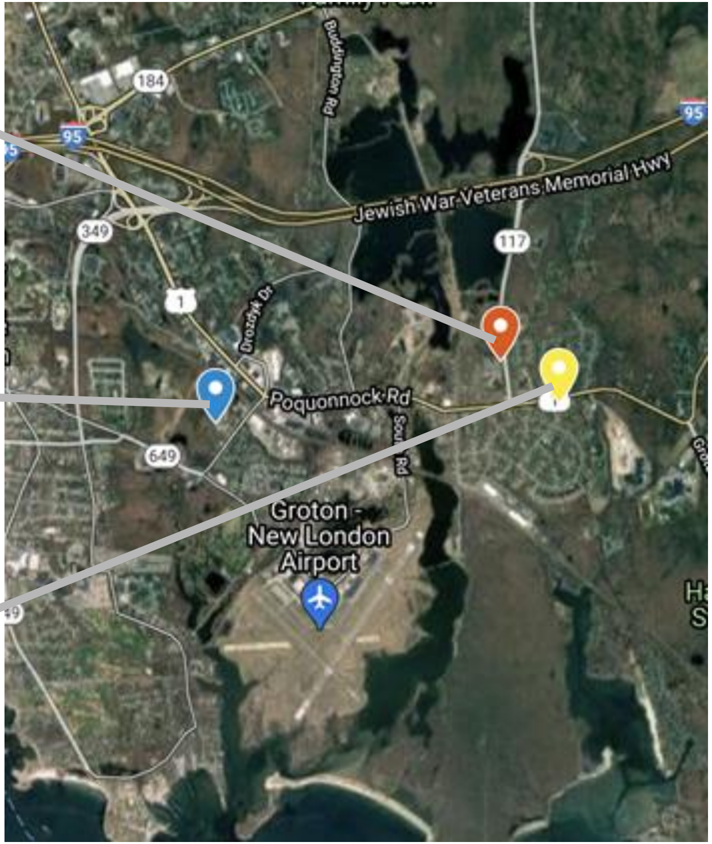
If all top three sites projects were implemented, 418,130 square feet of impervious cover will be disconnected from the stormwater drainage system. This means that 1,522,157 gallons of untreated stormwater, 103.38 pounds of nitrogen, and 13.2 pounds of phosphorus will be prevented from entering local water bodies annually.

Sites Map

Groton Senior Center/Public Library - 102 Newtown Road

Public Housing Authority - 11 Village Lane

Poquonnock Plains Park - 1 Center Avenue



Impervious Surfaces and Runoff

Impervious surfaces, including roads, rooftops, parking lots, and other developments do not allow water to penetrate through them. Natural surfaces, such as grass, leaf litter, vegetated areas, or dirt areas absorb a significant portion of water from precipitation and runoff. Once water penetrates the ground, it then flows into surface water bodies or is recharged into groundwater aquifers. When natural surfaces are replaced with impervious surfaces, the water cycle is disrupted. As a result, soil infiltration decreases, while surface runoff increases substantially, and is often diverted into stormwater management systems and discharged directly into the local water bodies. Runoff over impervious surfaces collects pollutants, and causes flooding and erosion that negatively affect the water quality of local water bodies. To prevent a decrease in water quality, runoff can to be disconnected from the stormwater management system by implementing green infrastructure practices that reduce or convert impervious practices. For instance, downspouts on buildings and large areas of impervious surface can be designed to direct runoff into rain gardens and bioretention areas, box planters, tree box filters, or rain barrels. Previously impervious surfaces (roads, parking lots, pathways) can be converted into pervious surfaces using pervious alternatives to traditional materials.

Common Green Infrastructure Practices

Rain Gardens and Bioretention

Pervious Pavement

Tree Box Filters

Rainwater Harvesting

Planters

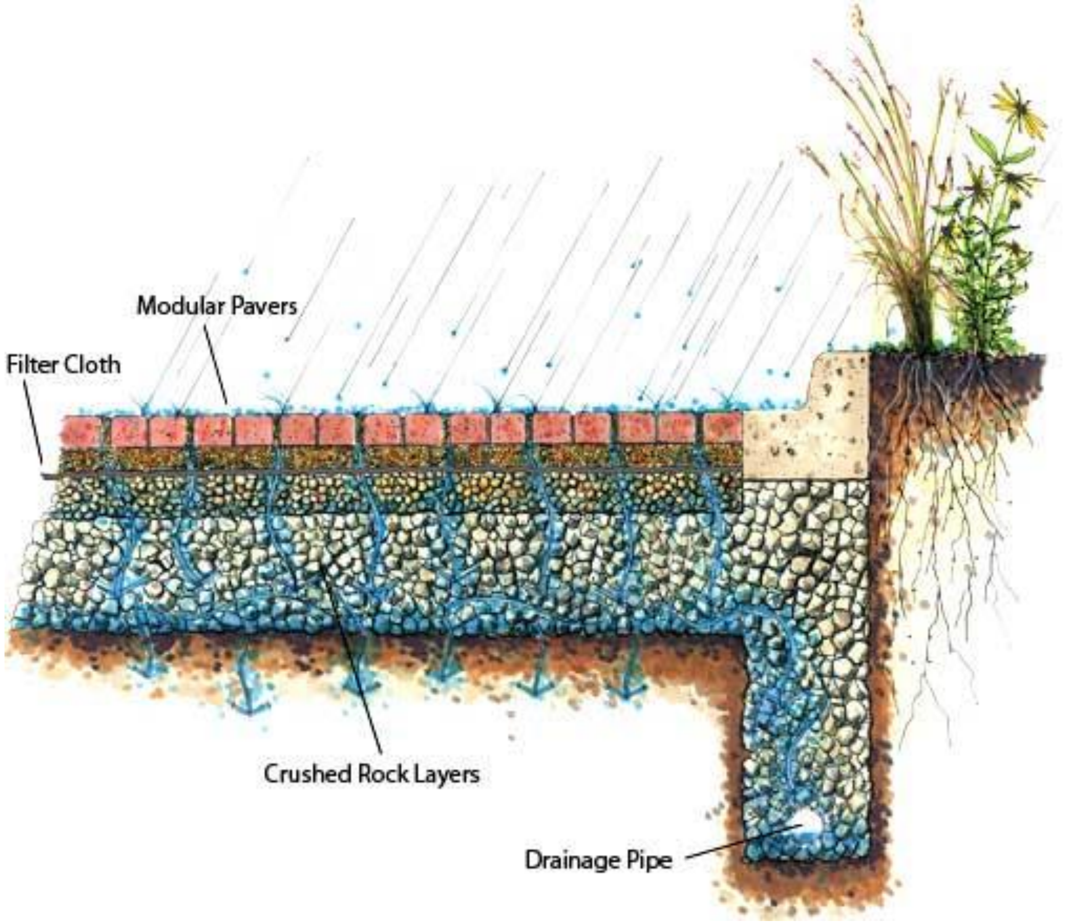
Rain Gardens

A **rain garden** is a piece of green infrastructure designed to capture precipitation runoff from an impervious surface. By doing so, water is allowed to percolate into the ground rather than directly entering stormwater management systems. They are usually built adjacent to the impervious area in question and are depressed approximately around 6 inches, depending on how much area is available. Rain gardens not only help to reduce pollution of local waters, but also add to the aesthetic appeal and biodiversity of urban areas.

When built next to a parking lot, one or more sections of curb is cut and water is directed through a path composed of cobble or gravel to minimize erosion. If implemented next to a building, gutters can direct water into the garden. From here, the water is either taken up by plants or enters the soil, and eventually, the water table via percolation. Appropriate plants for a rain garden tend to be shrubs or grasses that are tolerant to drought, flooding, and exposure to high salt concentrations. Ideally, these gardens are planted with hardy native perennials to minimize the need for maintenance. A **bioretention** is an enlarged rain garden specifically engineered to handle larger quantities of water.


BUFFER
The buffer surrounds a rain garden, slows down the flow of water into the rain garden, filters out sediment, and provides absorption of pollutants in stormwater runoff.
DEPRESSION
The depression is the area of the rain garden that slopes down into the ponding area. It serves as a holding area and stores runoff awaiting treatment and infiltration.
PONDING AREA
The ponding area is the lowest, deepest visible area of the rain garden. The ponding area should be level so that the maximum amount of water can be filtered and infiltrated. It is very important that this area drains within 24 hours to avoid problems with stagnant water that can become mosquito breeding habitat.
PLANTING SOIL LAYER
This layer is usually native soil. It is best to conduct a soil test of the area checking the nutrient levels and pH to ensure adequate plant growth.
BERM
The berm is a constructed mound, or bank of earth, that acts as a barrier to control, slowdown, and contain the stormwater in the rain garden. The berm can be vegetated and/ or mulched.
SAND BED
If drainage is a problem, a sand bed may be necessary to improve drainage. Adding a layer of coarse sand (also known as bank run sand or concrete sand) will increase air space and promote infiltration. It is important that sand used in the rain garden is not play box sand or mason sand as these fine sands are not coarse enough to improve soil infiltration and may impede drainage.
ORGANIC MATTER
Below the ponding area is the organic matter, such as compost and a 3" layer of triple shredded hardwood mulch. The mulch acts as a filter and provides a home to microorganisms that break down pollutants.
INLET
The inlet is the location where stormwater enters the rain garden. Stones are often used to slow down the water flow and prevent erosion.
OVERFLOW
The overflow (outlet) area serves as a way for stormwater to exit the rain garden during larger rain events. An overflow notch can be used as a way to direct the stormwater exiting the rain garden to a particular area surrounding the rain garden.

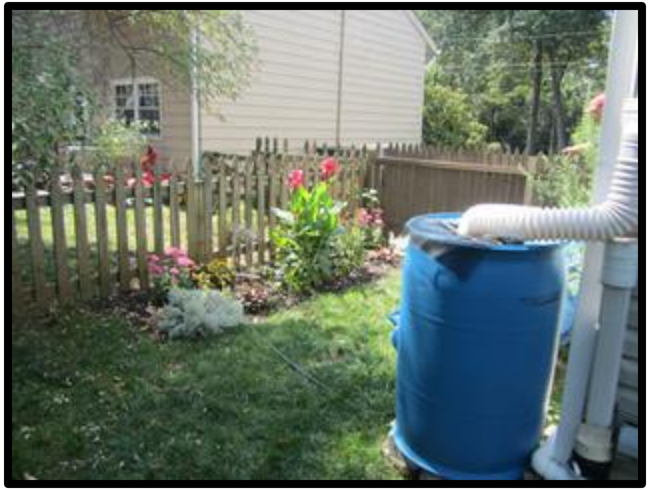
Pervious Pavement



Pervious paving is an alternative to traditional asphalt or concrete that allows for the infiltration of water. Ideal locations for pervious paving are relatively flat areas that take on a fair amount of water from surrounding impervious surfaces during storm events. Pervious asphalt needs to be replaced less often than traditional asphalt. As a result of the material being porous, it is less susceptible to seasonal expansion and contraction than traditional asphalt. This reduces the occurrence of frost heaves and seasonal cracks and prolongs its lifespan. Pervious paving is the most costly green infrastructure practice as it covers a large area and maintenance is required. Maintenance practices include cleaning techniques such as pressure washing and vacuum sweeping to dislodge sand, dirt, leaves and other debris that infiltrate the void structure of the pervious concrete and inhibit its permeability.

Pervious paving often reduces the need for snow removal as well. With traditional concrete and asphalt, water from melted snow cannot infiltrate so it often freezes into black ice or acts as runoff and takes salt with it. Pervious paving allow this water to enter the ground, resulting in a decreased need for salting as well as less cost for snow removal maintenance. This not only puts less stress on the stormwater management system, but relevies local aquatic ecosystems as well.

Rainwater Harvesting



Rainwater harvesting is the diversion of water from gutters and downspouts which would otherwise end up in the municipal stormwater management system. Roof runoff is fed into large **cisterns** which retain the water until it can be repurposed for garden watering, domestic use, fire protection and a variety of other ways. Not only does this aid in reducing runoff and the issues that come with that, but it also reduces stress on private well and municipal water supplies. Cisterns are usually situated beside buildings where gutters drain water from the roof.

Both the amount of water needed as well as the area of impermeable surface are important to pay attention to when deciding how large a cistern to install. The size of the cistern also dictates what material it should be made of. For small drainage areas, PVC is appropriate, but as the size increases steel or even concrete may be necessary. Depending on the anticipated use of the water, a filter may be imperative to prevent contaminants from entering the cistern. Maintenance practices include relocation of cisterns in the winter months to prevent them from freezing.

Site 1: Groton Senior Center/Public Library

Location

102 Newtown Road

Impervious Area

158,019 Square Feet

Total Area Disconnected

17,379

Key

Yellow - Rink Rain Gardens:

parking lot and paved area around the hockey field, drainage area 2

Purple:

Rain gardens 2a and 2b that take water from the yellow

Red - Library Parking Lot:

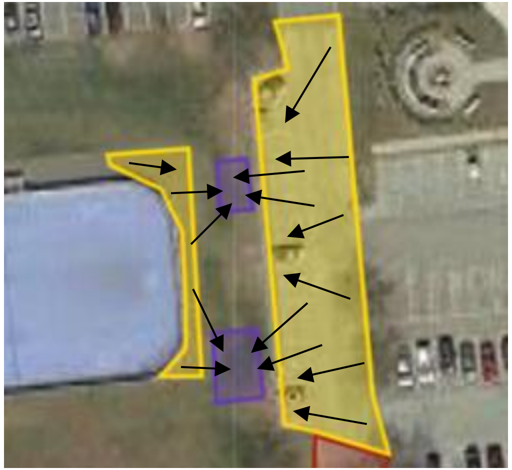
parking lot drainage area 1

Blue:

Rain garden 1 taking the water from the red area

Option 1: Rink Rain Gardens

Drainage Area (sq. ft.)	Suggested Green Infrastructure	Annual gallons treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb P/yr)	Suggested Practice Size (cubic ft.)
8,493	Rain garden	33,976	2.32	0.2947	704



The parking lot and walkway provide a great deal of impervious cover that drains to two catch basins - one at either end of the presented area. It is recommended that two rain gardens be installed to infiltrate the runoff from this area. By splitting this space into two watersheds, each directed towards a different rain garden, we can then use the catch basins for overflow and disconnect the system.

Pros:

- Aesthetic appeal
- Easy to install
- Educational - this is a high visibility area near the library, senior center, and athletic facilities.

Cons:

- Maintenance is required
- Placement should consider maintaining mowing access to grassy areas

Option 2: Library Parking Lot

Drainage Area (sq. ft.)	Suggested Green Infrastructure	Annual gallons treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb P/yr)	Suggested Practice Size (cubic ft.)
8,886	Rain garden	35,544	2.43	0.308	738

A rain garden is recommended to drain a portion of the parking lot in the library parking lot. This rain garden will be placed near the library and will help to lessen the amount of water from the sidewalk and parking lot that ends up in the catch basin. Due to the elevation change of the parking lot and tree cover, we might not be able to capture all of the water, but we will be able to less the amount of water that enters the system by directing it to

Pros:

- Aesthetic appeal
- Easy to install
- Educational - high visibility near the library, senior center, and athletic field

Cons:

- Limited space due to tree cover and a water line
- Maintenance required

Site 2: Public Housing Authority

Location

11 Village Lane

Impervious Area

53,959 Square Feet

Total Area Disconnected

20,865

Key

Red - Drainage area 1, visitor parking

5,096 Square Feet

Blue - Drainage area 2, handicapped parking

3,441 Square Feet

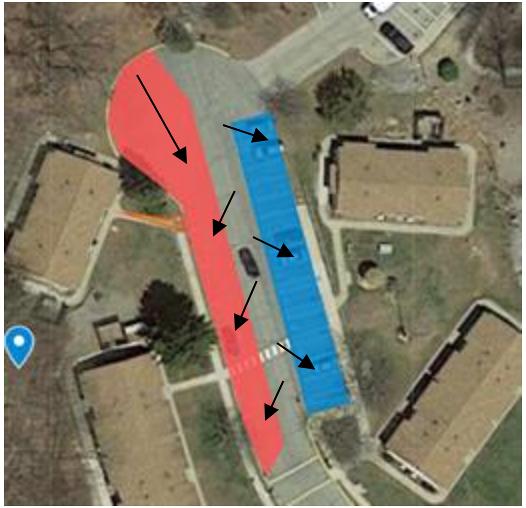
Green - Drainage area 3, resident parking

4,660 Square Feet

Yellow - Drainage area 4, resident parking

1,873 Square Feet

Drainage Area (sq. ft.)	Suggested Green Infrastructure	Annual gallons treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb P/yr)	Suggested Practice Size (sq. ft.)
20,865	Pervious pavement/ precast slabs	83,460	5.71	0.724	15,071



It is recommended that pervious asphalt or concrete be installed in the parking spaces throughout the site as indicated by the colored areas.There is quite a bit of impervious cover due to the parking lot and sidewalks. Rain gardens are not possible because of the way the driveway and parking stalls are pitched and the catch basins aren't located close to sufficiently large grassy areas. Pervious pavement/precast pervious concrete slabs would allow for water to infiltrate into the ground, generating less runoff, recharging ground water, and reducing flooding.Pervious concrete/pavement is advantageous in the winter as melted snow/ice seeps into the ground, avoiding refreezing/icing issues. The driveway will remain as regular asphalt.

Pros:

- Less likely to re-freeze - less ice
- Precast slabs are easy to install
- Longer lasting that normal asphalt as long as it is maintained

Cons:

- Requires maintenance - vacuuming
- Seams must be fit precisely during the installation process.

Parking Spaces that would be redone with permeable pavement and the driving lanes will not be altered

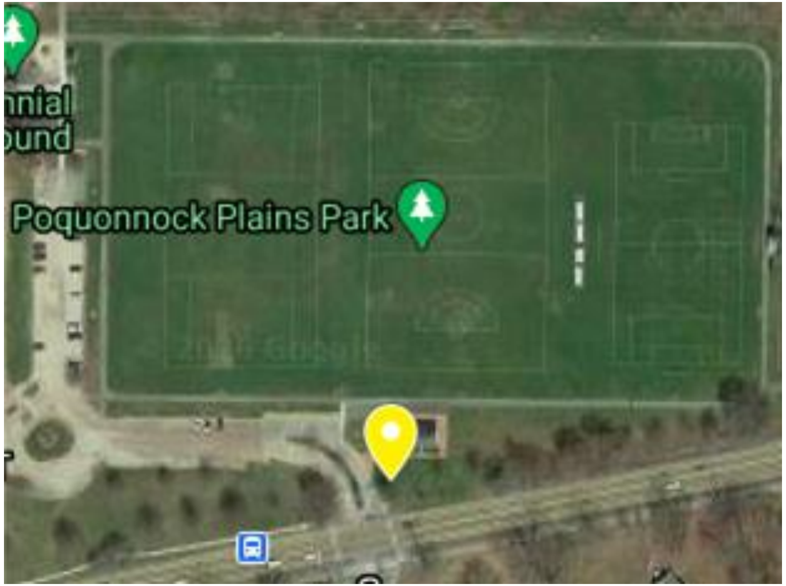
Site 3: Poquonnock Plains Park

Location

1 Center Avenue

Impervious Area

94,568 Square Feet



Key

Orange - Paved Entrance:

The Entrance/Exit

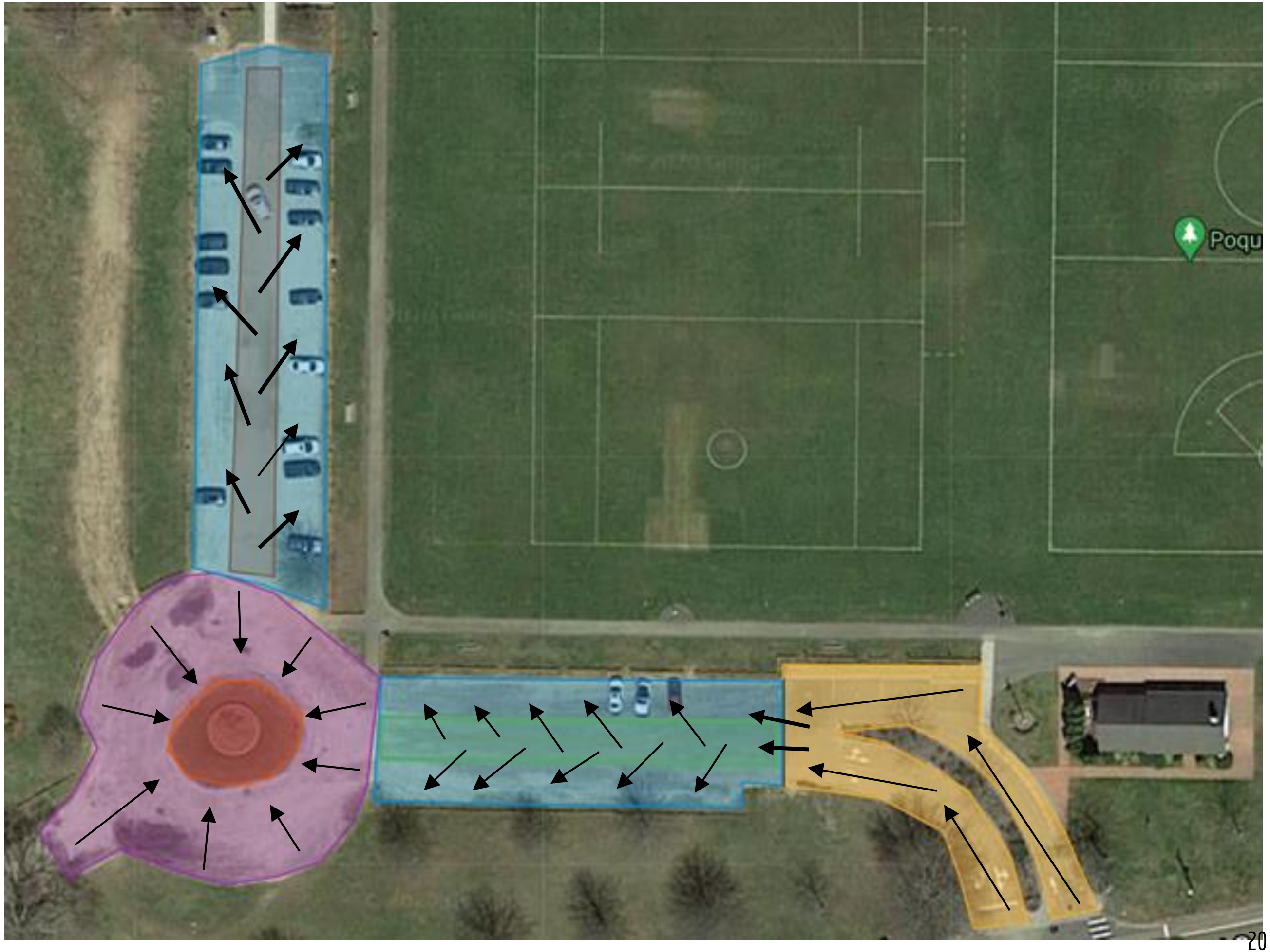
Blue - Parking lot 1 and 2

Green - Travel lane parking lot 1

Brown - Travel lane parking lot 2

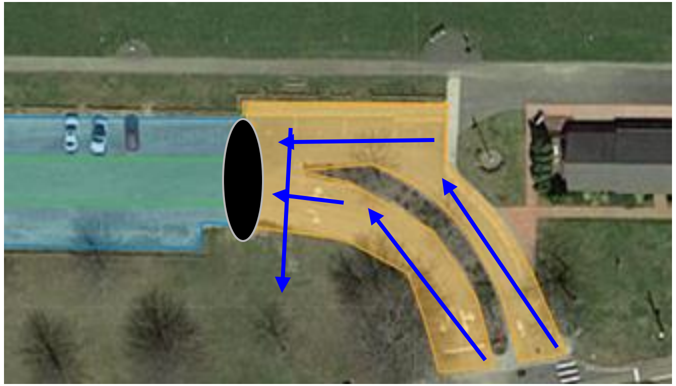
Purple - Traffic circle

Red - center of traffic circle/possible rain garden site



Option 1: The Entrance/Exit

Drainage Area (sq. ft.)	Suggested Green Infrastructure	Annual gallons treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb P/yr)	Suggested Practice Size (sq. ft.)
8,145	Speed Bump and Grass Swale	43,560	2.98	0.378	1,352



This option would involve adding a speed bump along the end of the pavement pushing water into a grass swale between the road and the parking lot, where the rest of the water from the street is already drains This would also slow down cars, which would reduce the abuse on the gravel where the parking lot changes from pavement to gravel. Soil remediation or other such techniques could be used to increase infiltration in the grassy area.

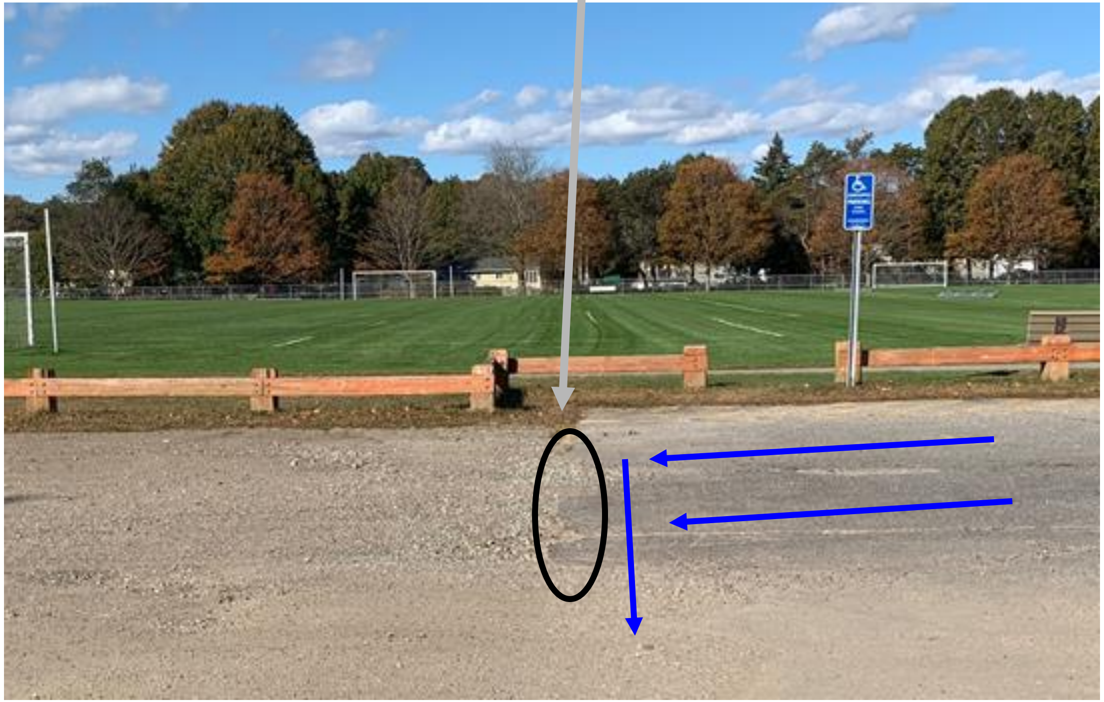
Pros:

- Slows cars down
- Diverts water from the parking lot
- Quick, cheap, and easy
- Out of the way of the park
- Would lessen the erosion at the end of the pavement

Cons:

- Intermittent flooding without soil amendments to increase infiltration

Speed bump



The “armpit” of the parking lot collects water and leaves

Water Rushing off of the pavement has caused small channels through the parking lot

Option 2: Gravel Grid in Stalls

Drainage Area (sq. ft.)	Suggested Green Infrastructure	Annual gallons treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb P/yr)	Suggested Practice Size (sq. ft.)
40,075	Plastic Grid	43,560	2.98	0.378	17,380

The second option would be to use gravel grid - a permeable pavement option - in the parking stalls and place asphalt millings - which are produced during mechanical grinding of concrete and can be packed down to create a flat surface for driving - down the driving lanes. Gravel grid works better in parking stalls than it does in drivelines because there is less wear and tear. While this would add some impervious cover with the millings, however the value is that it would stop sediment from the direct driveway from gradually filling in the voids in the gravel grid and allow for water to travel from the crown of the road, directly into the permeable grid area. While this would add some impermeable cover, it would make the parking lot more structurally sound and offset the impermeable cover with permeable options.

Pros:

- Millings are cheap
- Less wear and tear on the grid
- Can handle heavy loads
- Provides impermeable durability with pervious benefits
- Wouldn't need to be regarded every six months

Cons:

- Would add impermeable cover
- Maintenance would be different than an asphalt parking lot - care methods must be altered
- Driving lane is plowable but the parking stalls are not.

Option 3: Gravel Grid in Stalls and Travel Lane

Drainage Area (sq. ft.)	Suggested Green Infrastructure	Annual gallons treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb P/yr)	Suggested Practice Size (sq. ft.)
40,075	Plastic Grid	43,560	2.98	0.378	39,639

This option involves placing the grid in the parking stalls and down the travel lanes. This option would be more costly because it would involve altering the entire parking lot. However, that would mean that no impermeable cover is added and hopefully stopping the water in its tracks to prevent erosion. The idea is to prevent the fines in the gravel from plugging up the stone in the grid.

Pros:

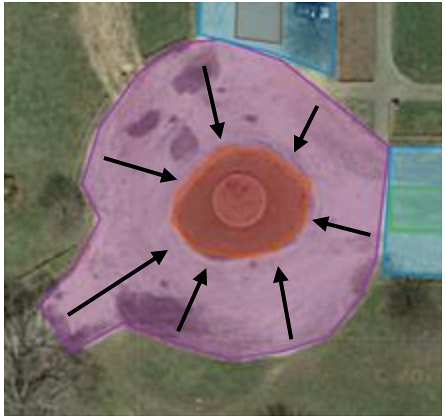
- Lots of permeable area
- “Pro Plus” pavers are meant to withstand the wear and tear or a parking lot

Cons:

- More costly
- Cannot be plowed

Option 4: The Turn-Around

Drainage Area (sq. ft.)	Suggested Green Infrastructure	Annual gallons treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb P/yr)	Suggested Practice Size (sq. ft.)
13,852	Rain Garden	55,408	3.79	0.48	1,150



The fourth option is to place **millings around the circle with a rain garden in the center**. This would allow for water to drain into the rain garden, thus removing it from the parking lot, rather than pooling and leading to flooding. This option could also be combined with any of the previously mentioned options, which could be done in phases.

Pros:

- Easy to install
- Would create a beautiful landscaped area in the park around the turn around
- Easily combined with other options

Cons:

- Millings are impermeable (but would would flow into pervious area)
- Maintenance - plant care and mowing

The area in red is the center circle of the garden shown in the photo below. Our garden would surround that shown in blue

Rain Garden

Site 4: Town Hall Annex/Police Station*

Location

134 Groton Long Point Rd

Impervious Area

* Site was inaccessible during field visit so not fully evaluated.

Key

Yellow Areas potential disconnected IC

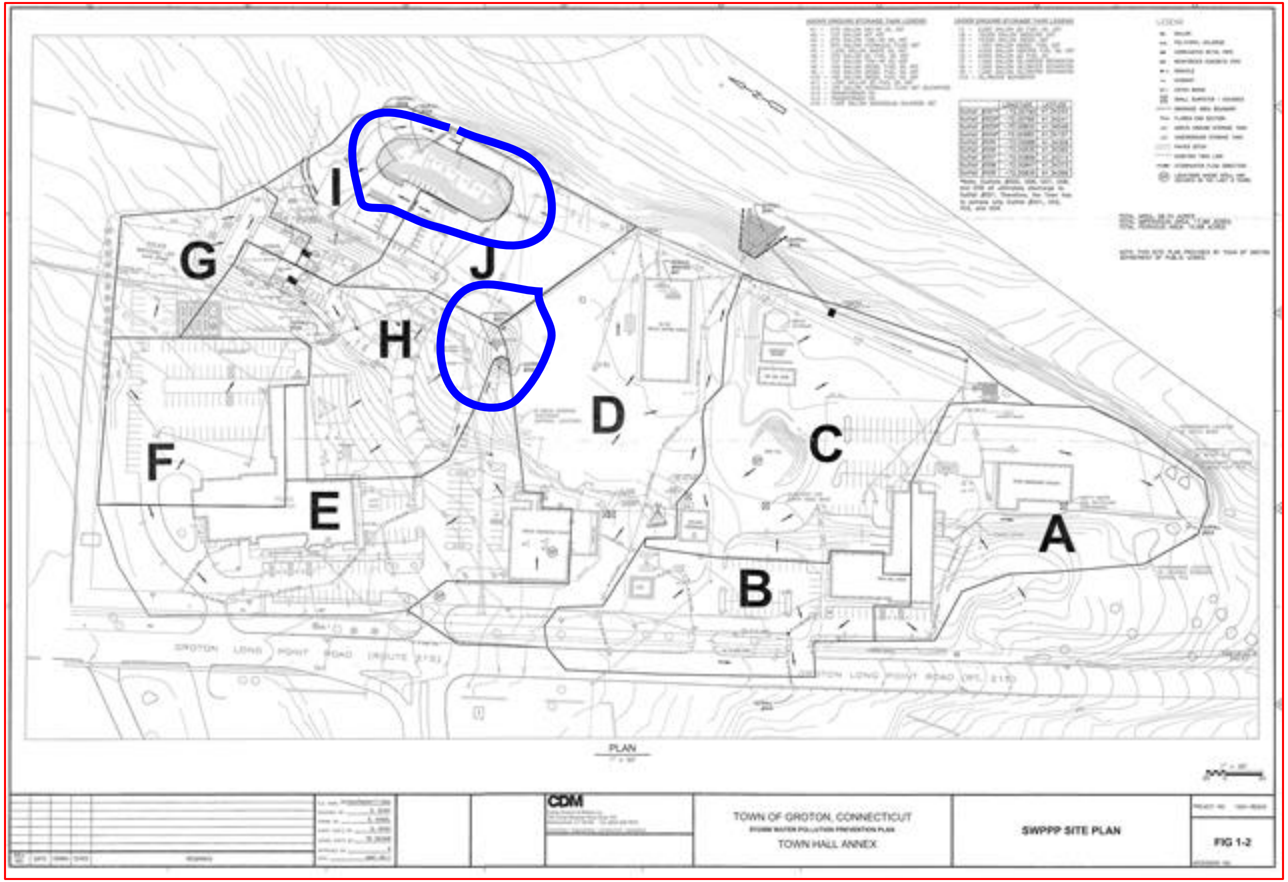
317,814 Square Feet

Blue Areas potential bioretention areas

52,713 Square Feet

This area was inaccessible to us, so we could not explore in the field. We were provided the information from the site SWPPP. Based on that, we recommend exploring the possibility of retrofitting (& potentially expanding) the sedimentation basins in the two circled areas as bioretention basins that allow for infiltration.

This would disconnect The drainage areas identified on the SWPPP as areas E, F, H, I, J, resulting in a significant IC disconnection.



Option 1

Drainage Area (sq. ft.)	Suggested Green Infrastructure	Annual gallons treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb P/yr)	Suggested Practice Size (Cubic ft.)
317,814	Bioretention basins	1,270,209	86.9	11.02	52,713

Recommendation is to explore retrofitting existing sedimentation basins as bioretention basins designed for infiltration. Site was not partially fenced off, so not fully explored. Any exploration would also have to consider maintaining compliance with the SWPPP requirements.

Pros:

- Large disconnection footprint
- Retrofitting area already receiving runoff

Cons:

- Need to ensure complies with SWPPP
- No real education component
- No field visit conducted

Contact and Partners

This project was completed by students enrolled in the Stormwater Corps course at the University of Connecticut as part of the University's E-Corps Program, funded by the National Science Foundation. For more information, visit the websites and contacts below.

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CLEAR
Center for Land Use Education & Research

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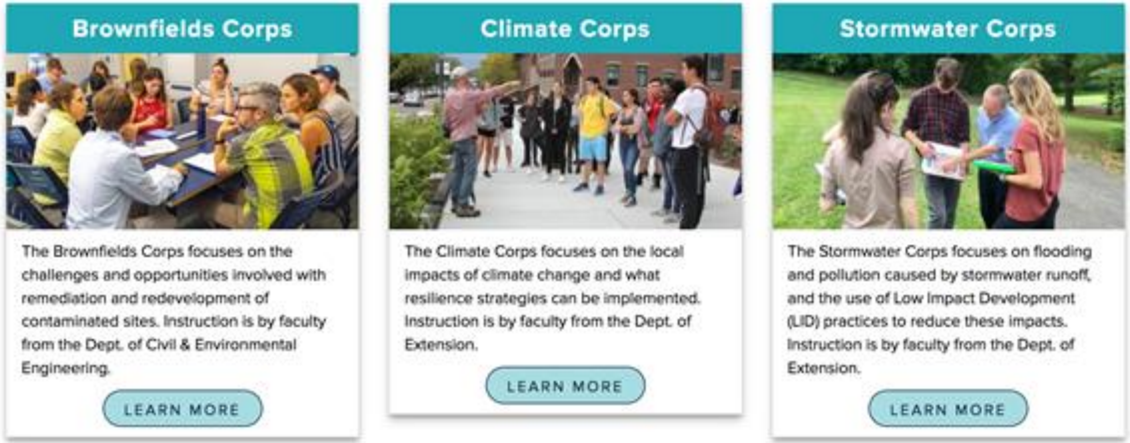
From our classrooms to your community



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