

Stormwater Runoff Reduction Plan

West Haven, Connecticut



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PROJECT TEAM

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SUMMARY

During the summer of 2018, a team of UConn students and Extension faculty performed an evaluation of potential stormwater enhancement opportunities in the Town of West Haven, CT. The process involved a desktop analysis and field visits to determine where potential green stormwater infrastructure installation opportunities existed on publicly owned land parcels. Calculations were performed to determine the potential stormwater and pollution reduction benefits from each of the proposed installations. If all projects identified in the report were implemented 8,595 sq ft of impervious cover would be disconnected from the stormwater drainage system. This means that an estimated 218,588 gallons of untreated stormwater, 1.487 pounds of nitrogen, and 0.1054 pounds of phosphorus would be prevented from entering local streams annually.

IN THIS REPORT...

Included are recommendations for green stormwater infrastructure practices at 4 sites in the town of West Haven. Each site is introduced with an aerial photo from Google Maps and includes its address, total impervious area to be disconnected from the stormwater system, and the subregional watershed. Soil type was assessed through the USDA web soil survey for properties and qualities most suitable for green infrastructure. Soil testing would be required to further analyze the permeability of substrate at each site. Following the introduction is an ArcGIS map displaying all options for the site along with a CT ECO map showing impervious surface types. Each option is then individually displayed with an ArcGIS map of the recommended practice, detailed description of our recommendations, and an informational table. Each table shows an estimated drainage area, our recommended green infrastructure, annual gallons of runoff treated, nitrogen and phosphorus pollution reduction amounts, and the suggested size of each practice. These estimations were calculated based on the drainage area, annual rainfall estimates specific to Connecticut, and literature export values.

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 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 System



Pervious Pavement



Rainwater Harvesting

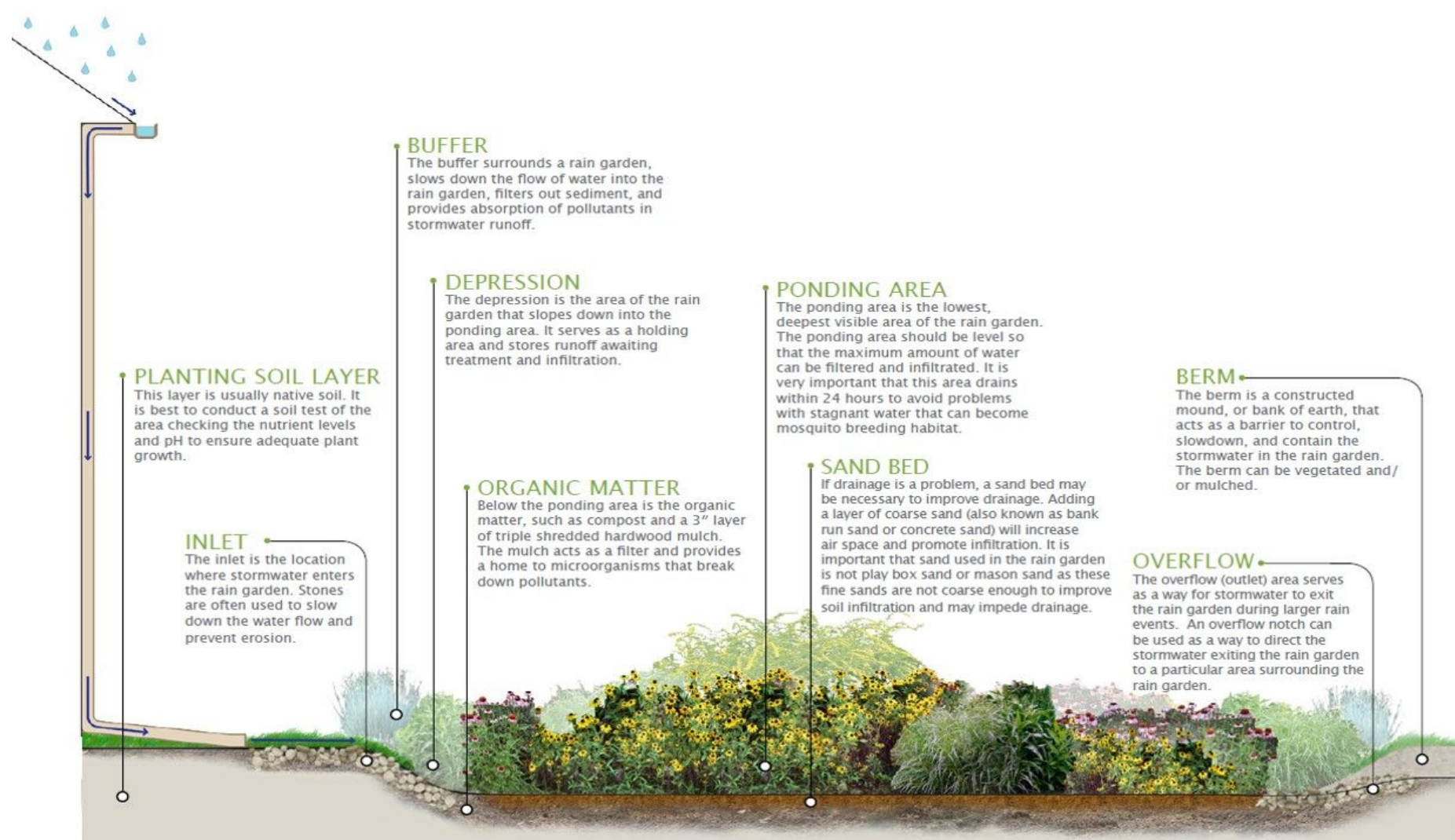
Planters

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.



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.

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.

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.

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.

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.

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.

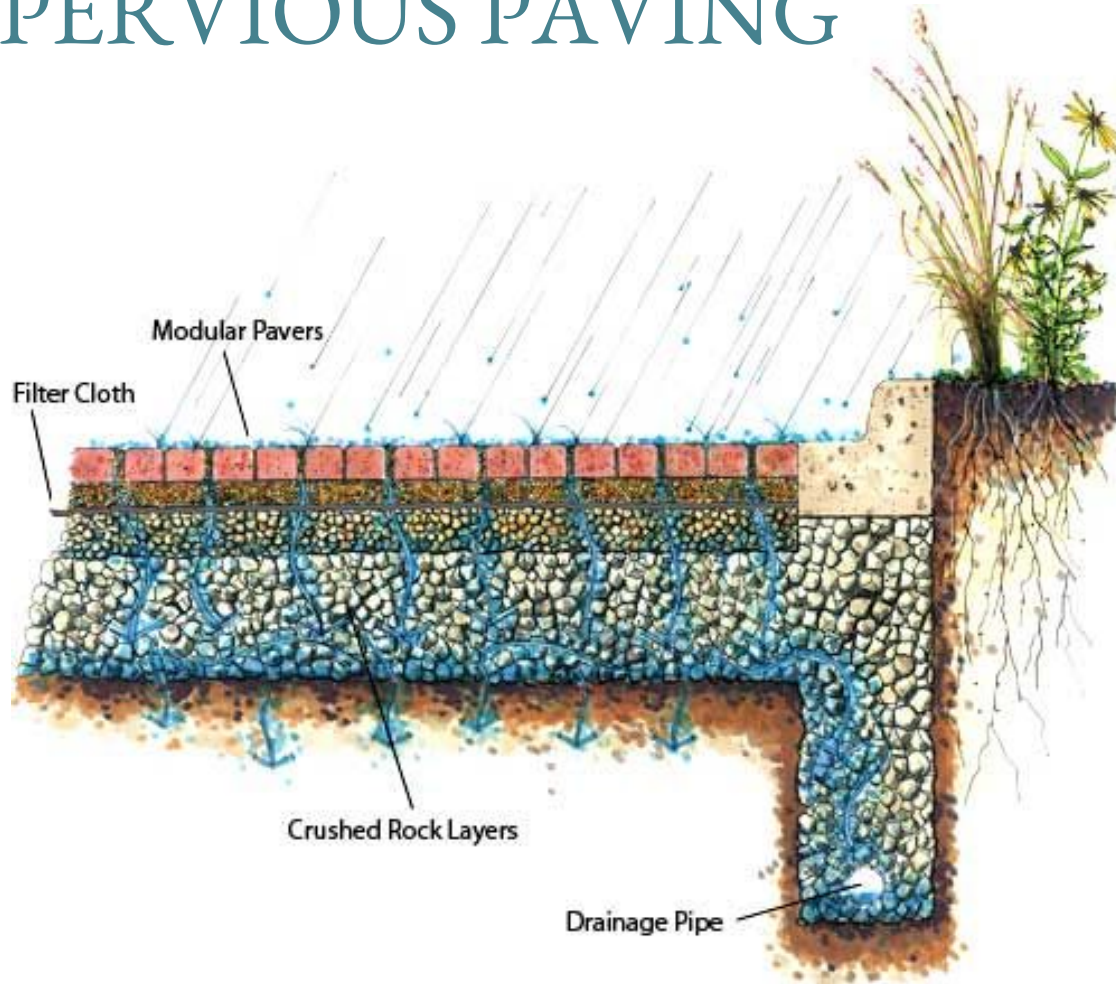
BERM

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.

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 PAVING



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 relieves 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.



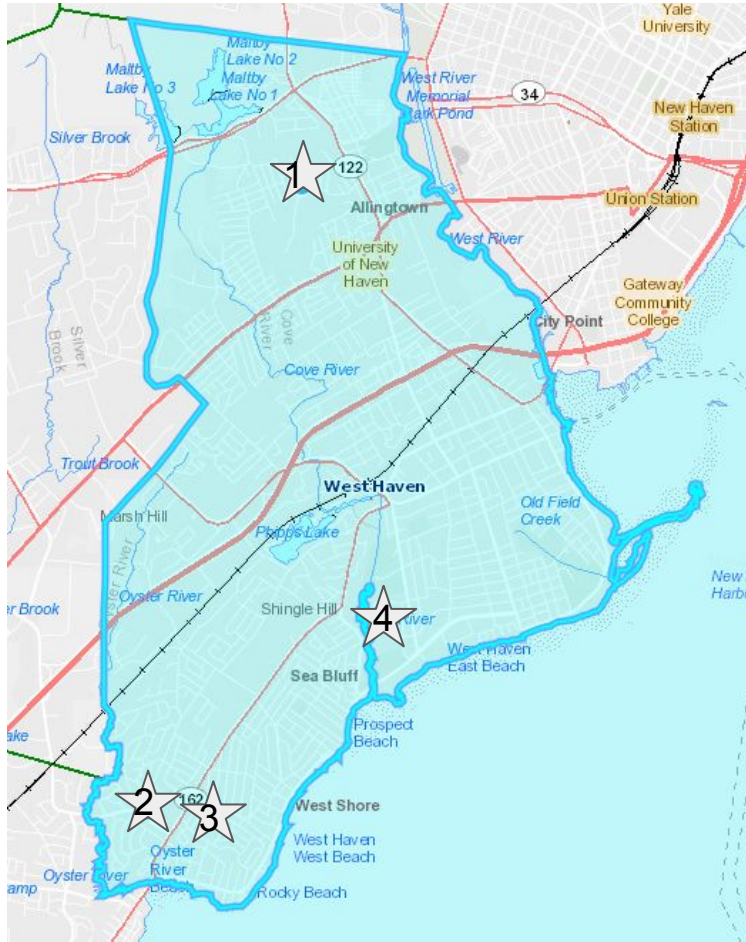
Both the amount of water needed as well as the area of impermeable surface are important to pay attention to when deciding how large a cistern to install. The size of the cistern also dictates what material it should be made of. For small drainage areas, PVC is appropriate, but as the size increases 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 SELECTION & APPROACH

Before visiting sites, team members used various aerial imagery tools to view locations within each town to determine possible sites suitable for green infrastructure practices. The focus was towards sites under municipal control that would otherwise allow for quick installation of practices while also serving to educate the public.

On location, sites and site specific recommendations were selected based on suitability for implementation of green infrastructure practices. The factors used included slope of surrounding land, land available for use, location of existing storm drains, location of above ground and underground obstructions (large trees, pipes, utilities, etc.), and whether or not some form of green infrastructure practice was already in place.

SITES MAP



1. Forest Elementary School
2. Alma E. Pagels Elementary School
3. Seth G. Haley Elementary School
4. West Haven High School

Site 1: FOREST ELEMENTARY SCHOOL

LOCATION:

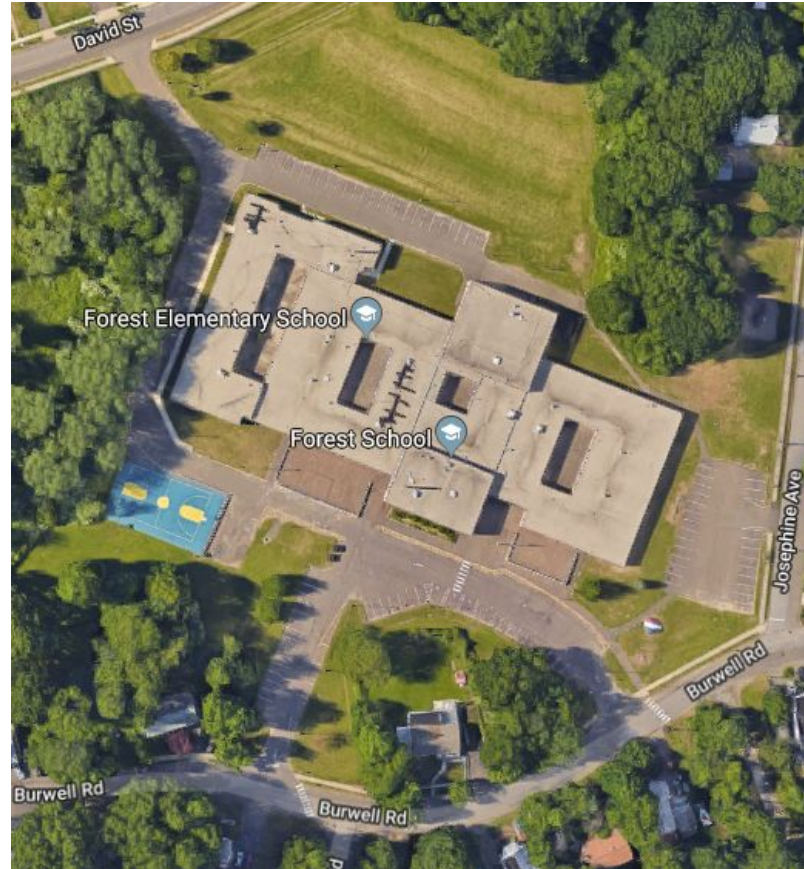
95 Burwell Rd ,West Haven, CT

IMPERVIOUS AREA:

19,141 sq ft

SUBREGIONAL WATERSHED:

South Central Shoreline; 5000





FOREST ELEMENTARY SCHOOL

Option 1: Parking Lot East of School



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)
10,199	Rain Garden/ Bioswale	259,416	1.76	0.125	1,700



Our recommendation for this location is to build a bioswale that leads to a rain garden near the storm drain. Making the rain garden by the storm drain will allow access to an already established overflow. The rain garden would need to be large enough to handle the rain from the entire parking lot. This location near the bus loop will get much attention by those passing the school and those entering the school.

FOREST ELEMENTARY SCHOOL

Option 2: South Parking Lot



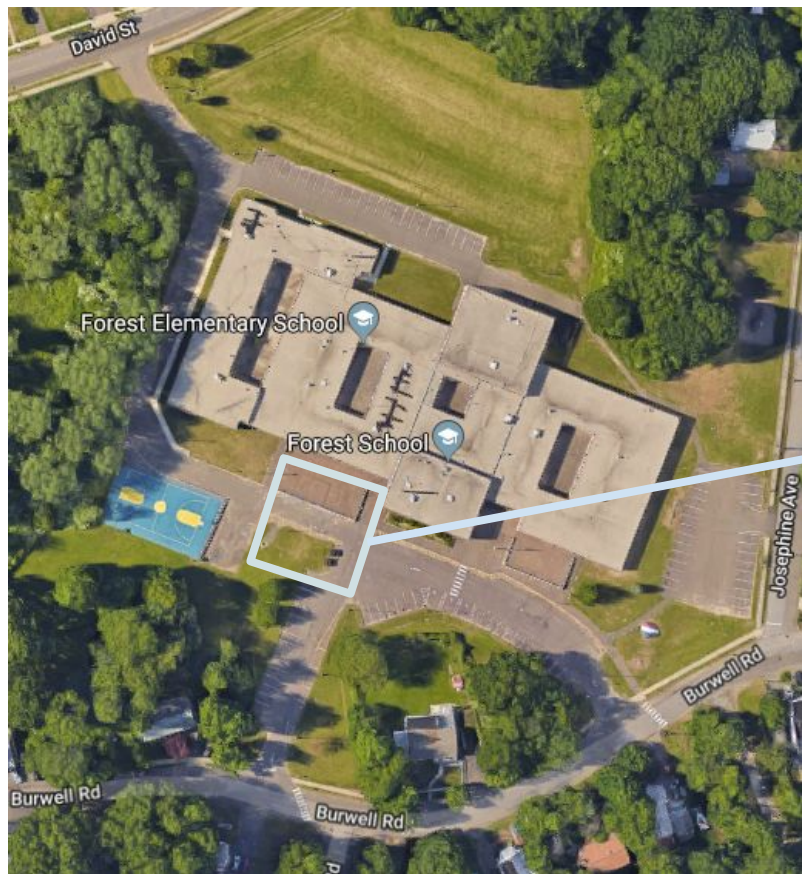
Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
6,740	Rain Garden	171,435	1.67	0.083	1,123



Our recommendation here is to bypass the storm drain at the low point of the parking lot and implement a rain garden. There is a large amount of area that could handle water from the entire lot. As the drainage in the area is fairly poor, we suggest to make the rain garden a bit larger than what seems necessary. This is to ensure proper drainage and minimize the risk of flooding.

FOREST ELEMENTARY SCHOOL

Option 3: Patch of Road South of School



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)
2,202	Rain Garden	56,009	0.381	0.027	367



For this location we recommend using the pavement leading to the storm drain as a bioswale and build a rain garden in the vicinity. This would not need to handle much water and so it wouldn't need to be very large. The visibility here isn't fantastic as it is behind the corner of the school, but it could still be a great educational opportunity to construct.

Site 2: ALMA E. PAGELS ELEMENTARY SCHOOL

LOCATION:

26 Benham Hill Rd, West Haven, CT

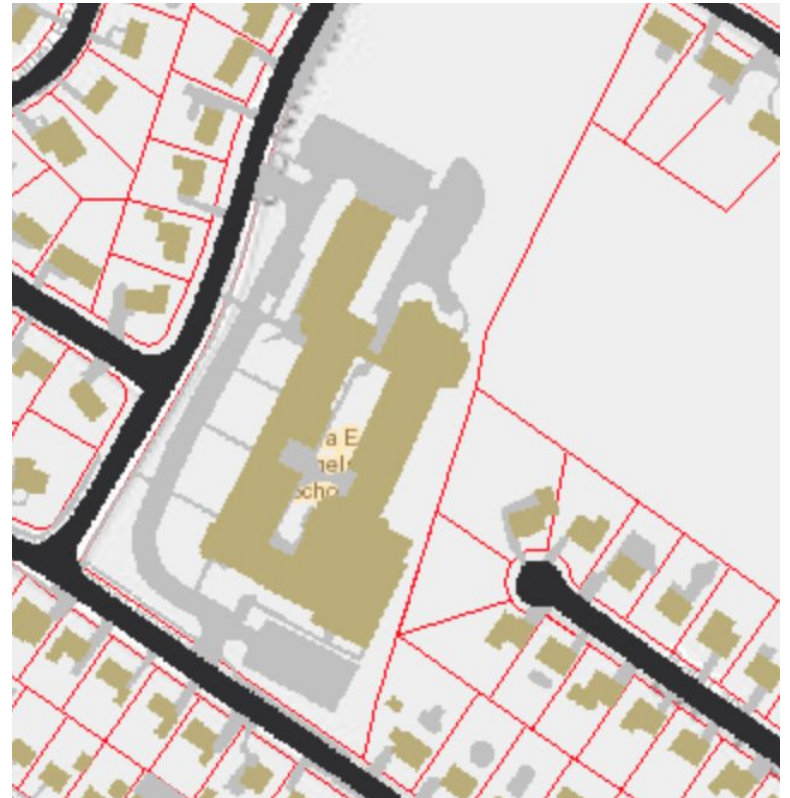
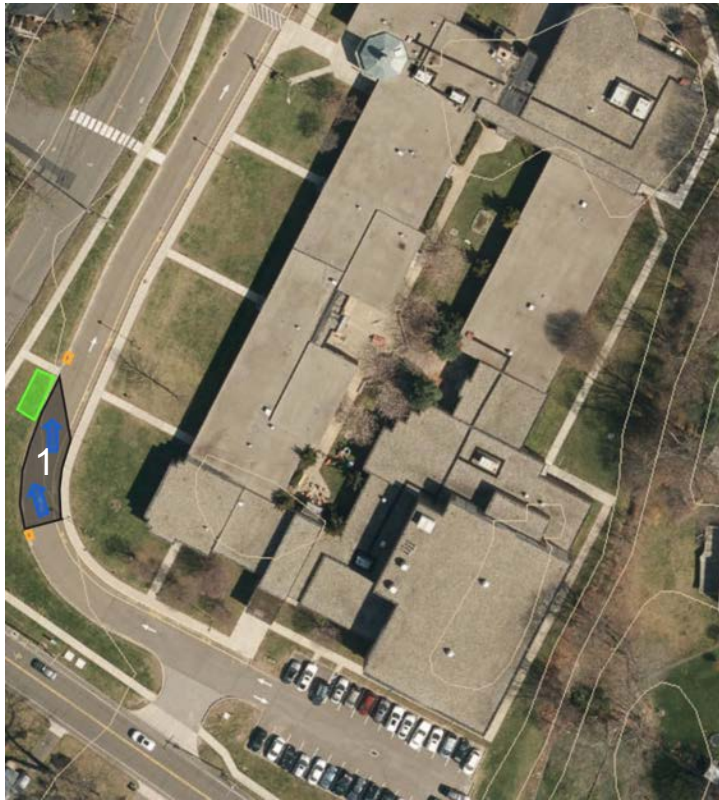
IMPERVIOUS AREA:

1,600 sq ft

SUBREGIONAL WATERSHED:

South Central Shoreline; 5000





ALMA E. PAGELS ELEMENTARY SCHOOL

Option 1: Southwest Corner of Driveway



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)
1,600	Rain Garden	40,690	0.277	0.019	270



Runoff originating downslope from the southern storm drain can be diverted from entering the storm drain by constructing a rain garden. The runoff could be redirected with curb cuts. Due to this locations close proximity to the road, a rain garden here would receive a lot of visibility and would enhance the school's curb appeal.

Site 3: SETH G. HALEY ELEMENTARY

LOCATION:

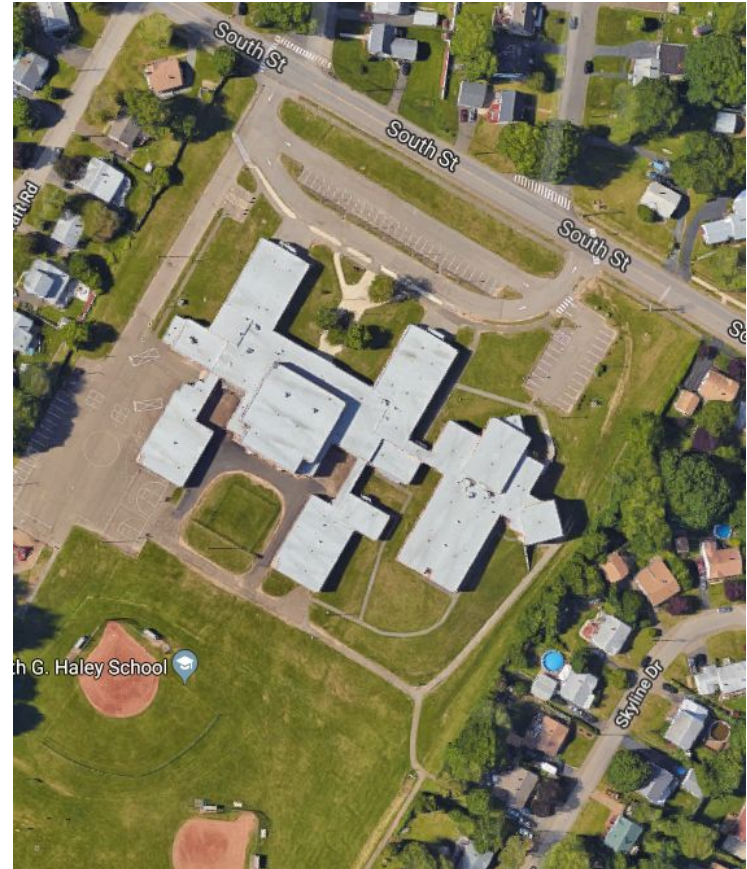
148 South St, West Haven, CT

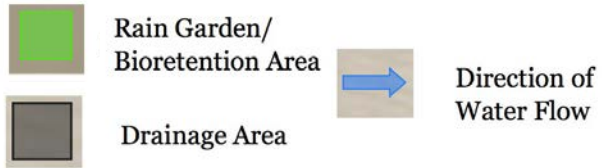
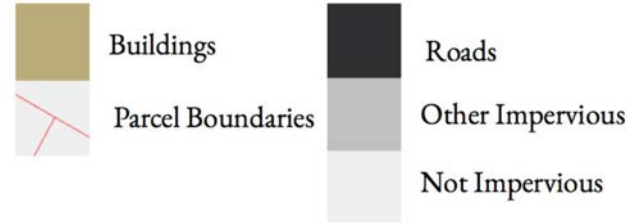
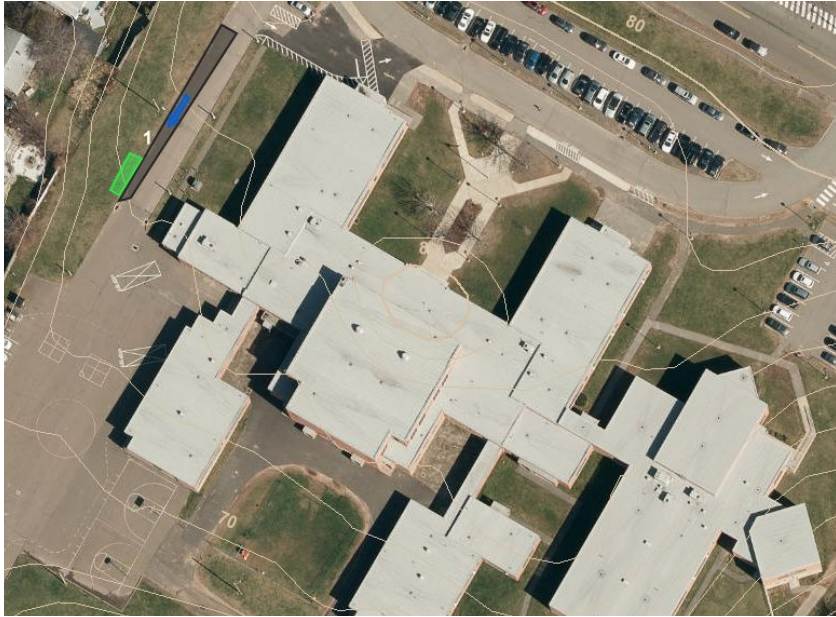
IMPERVIOUS AREA:

1,230 sq ft

SUBREGIONAL WATERSHED:

South Central Shoreline; 5000





SETH G. HALEY ELEMENTARY SCHOOL

Option 1: Northwest Entrance Driveway



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)
1,230	Rain Garden	31,281	0.213	0.015	205



Our recommendation for this site is to create curb cuts before the storm drain to lead the runoff from the driveway into a rain garden. This would disconnect the runoff from the storm water system. The runoff could be lead to water a garden and percolate slowly back into natural groundwater storage. This location of the school could also be used to educate students on green infrastructure practices.

Site 4: WEST HAVEN HIGH SCHOOL

LOCATION:

1 McDonough Plz, West Haven, CT

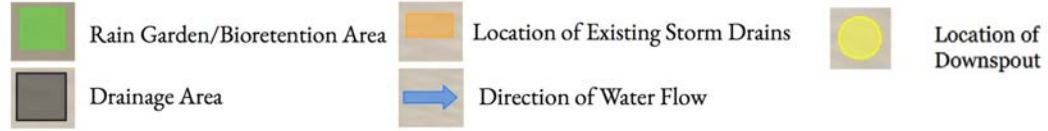
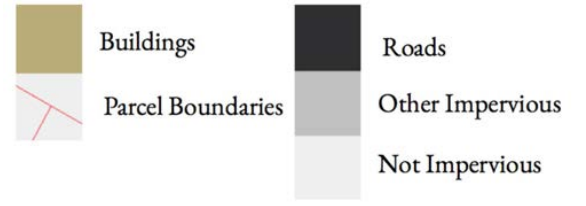
IMPERVIOUS AREA:

5,735 sq ft

SUBREGIONAL WATERSHED:

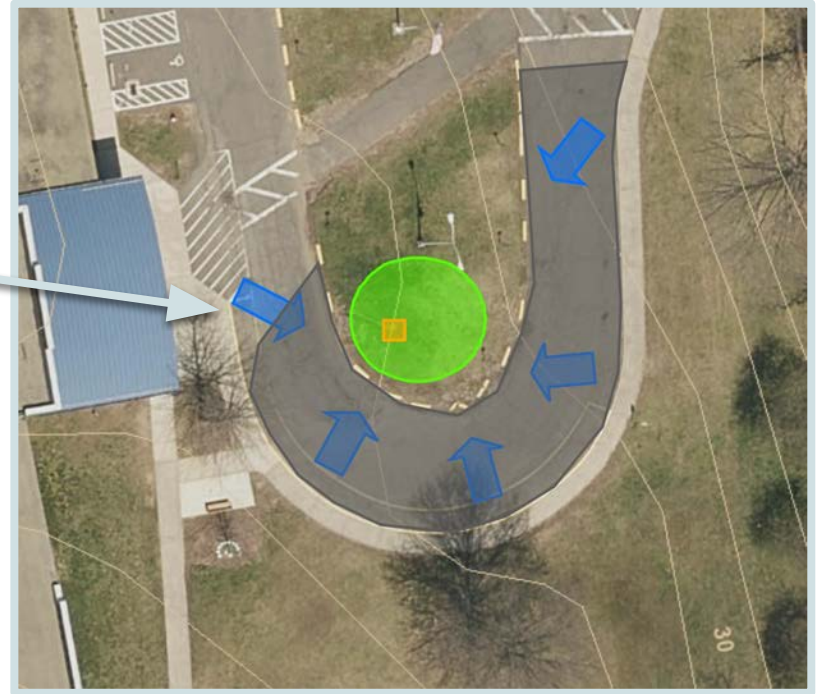
South Central Shoreline; 5000





WEST HAVEN HIGH SCHOOL

Option 1: Northeast Entrance to McDonough Plaza



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)
4,942	Rain Garden	125,690	0.86	0.06	824



At this location we recommend implementing a rain garden in the depressed area of the grass. The rain garden would collect the water running off the road on either side. This garden would prevent erosion of the grass along the pavement. In addition, it would be a great educational opportunity for the students to learn about green infrastructure practices.

WEST HAVEN HIGH SCHOOL

Option 2: Southeast Courtyard



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)
793	Rain Garden	20,162	0.137	0.009	132



The depression in the grass in this area would allow for an easy installation of a rain garden. Here the downspout can be disconnected and led off into the rain garden. This would allow all the water that drains from the roof to go into a rain garden instead of the stormwater system. This would also be a good educational opportunity since there is another garden area near this site.

CONTACT & PARTNERS

This project was funded by a grant from the Long Island Sound Futures Fund of the [National Fish and Wildlife Foundation](#). It is a partnership of the [University of Connecticut Center for Land Use Education and Research \(CLEAR\)](#) and [Rutgers University Water Resources Program](#), and is adapted from a process developed by the latter.

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