Stormwater Runoff Reduction Plan

East Hartford, CT

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Table of Contents

Summary

During the Fall of 2022, a team of UConn students and Extension faculty performed an evaluation of potential stormwater enhancement opportunities in the Town of East Hartford, 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 benefits from each of the proposed installations. If all seven projects identified in the report are implemented, **30,144 sq ft** of impervious cover will be disconnected from the stormwater drainage system, and **793,667 gallons** of untreated stormwater, **8.2 lbs of nitrogen**, and **1.05 lbs of phosphorus** will be prevented from entering local water bodies annually.

In this Report…

Included are recommendations for green stormwater infrastructure practices at five sites in the town of East Hartford. Each site is introduced with an aerial photo from Google Maps displaying the recommended green infrastructure and an image from the field modeling the recommended practice. Information about the nitrogen and phosphorus load reduction per year is included, as well as the size of the recommended installation and the gallons of runoff treated per year. These estimations are calculated based on the drainage area, annual rainfall estimates specific to Connecticut, and literature export values. Sites that were deemed unsuitable are also listed afterwards with some additional recommendations and notes.

Impervious Surfaces and Runoff

The expansion of developed land in Connecticut has vastly increased the area of impervious cover around the state. This includes roads, rooftops, parking lots, and other development, leading to increased runoff into stormwater management systems. This not only disrupts the local water cycle, but also increases the amount of pollutants in waterways and causes erosion and flooding. The implementation of green infrastructure disconnects stormwater from local management systems and allows it to naturally infiltrate into the ground. Installations such as rain gardens, pervious pavements, tree box filters, green roofs, and rainwater harvesting benefit the local water cycle and offer great educational opportunities to the surrounding area, as well as offering a more aesthetic alternative to more traditional stormwater management systems.

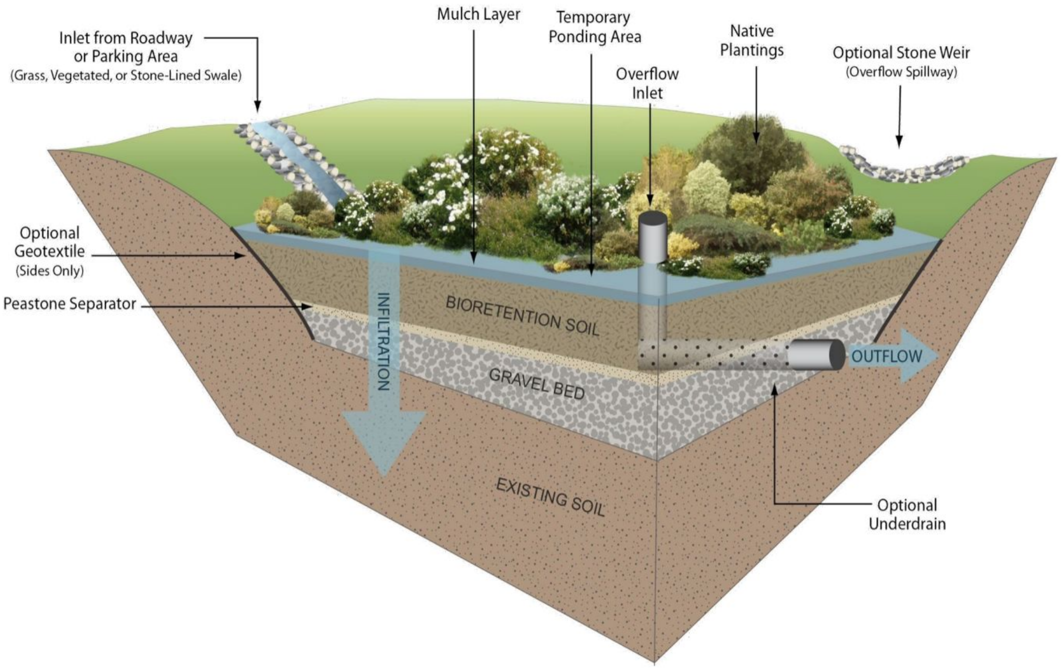
MS4 Requirements

Municipal Separate Storm Sewer Systems Permitting Program

- 2004- DEEP recognizes need for regulation of stormwater runoff
  - **Nonpoint Source Pollution:** stormwater runs across impervious surfaces, collecting pollutants as it flows into storm drains.
  - Permitting program encourages use of **Low Impact Development** practices to mitigate pollution in waterways. These practices are designed to maintain or recreate **pre-development hydrology**, with an emphasis on **treatment of stormwater onsite**.
- 2016- DEEP issues additional MS4 requirements
  - As part of the development of stormwater management plans, along with subsequent monitoring and reporting, municipalities are required to **disconnect 2% of directly connected impervious cover**.
  - **Directly connected impervious cover** is any impervious surface which conducts stormwater into the city sewer system, and which eventually flows into lakes, streams, and the ocean.

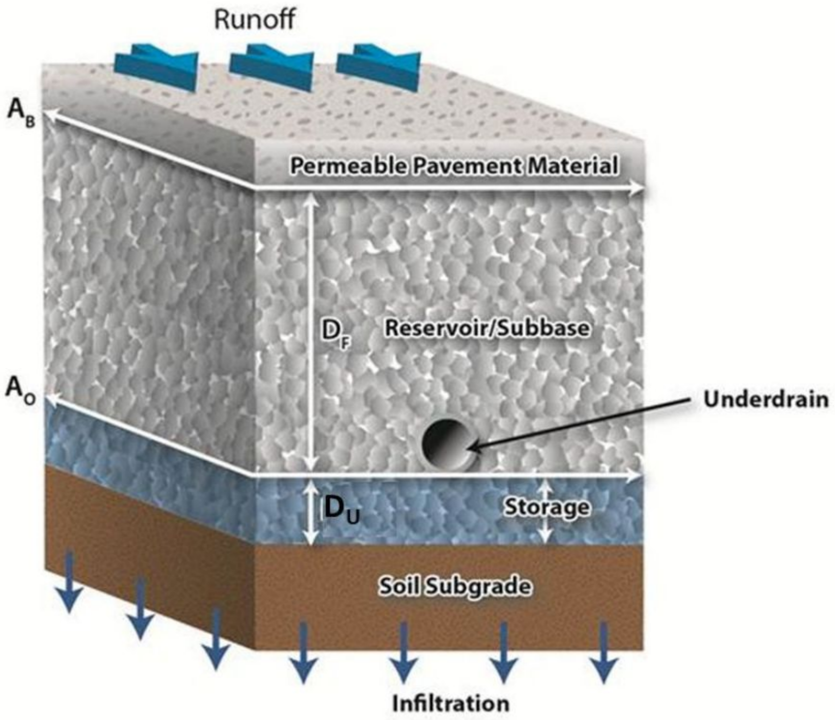
Rain Gardens and Bioretention Basins

- Capture stormwater from impervious surfaces or disconnected gutters
- Allows the runoff to infiltrate into the soil and recharge groundwater
- Consist of a depression at least 6 inches deep, may include native plants, grass, or stone
- Might involve curb cuts or gravel material as a buffer for erosion
- Add to the aesthetic appeal and biodiversity of urban areas



Pervious Pavement

- Alternative to traditional asphalt or concrete that allows for the infiltration of water
- Ideal locations: relatively flat areas that take on a fair amount of water from surrounding impervious surfaces during storm events
- Fairly costly and require maintenance such as pressure washing and vacuum sweeping to dislodge debris in the pores of the pavement
- less snow maintenance than its counterpart
- Without proper maintenance, the stormwater is unable to infiltrate and the green infrastructure is ineffective
- Pervious asphalt needs to be replaced less often than traditional asphalt and is less susceptible to seasonal expansion and contraction which reduces the occurrence of frost heaves and cracking
- Types: pervious asphalt, concrete pavers, variety of permeable pavers such as permeable interlocking concrete pavers



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Tree Box Filters

- Aesthetically pleasing practice that filter runoff
- Stormwater enters the installation through a grate, then infiltrates through the soil and root system, filtering out pollutants
- Depending on the amount of stormwater present near the practice, an underdrain may be required to prevent flooding.

Green Roofs

- Allows runoff, that would otherwise enter an internal piping or gutter system, to infiltrate substrate directly
- Disconnects about 50% of the stormwater that sheds off any given building
- Most expensive practice, but offers great educational opportunities for nearby communities and adds to the aesthetic of any location
- Green roof trays may be a more affordable option
- The implementation of a green roof depends on the structural support of the roof and proper roof access

Rainwater Harvesting

- Capture and reuse of water from gutters and downspouts which would otherwise end up in the municipal stormwater 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 uses
- Not only does this reduce runoff, but it also reduces stress on private wells and municipal water supplies
- The required size of the rain barrel depends on the collection area and materials can range from PVC to steel
- Based on the needs at the location, a filter can be installed to remove pollutants
- Cisterns require minimal maintenance; however, may need to be moved in the winter months to prevent freezing.

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Explanation of Calculations

Drainage Area: The potential watershed area of each retrofit was estimated using topographic tools in Google Maps and confirmed during site visits.

Rain Garden Size: Rain garden area and depth is heavily dependent on the estimated drainage area and amount of rainfall expected. All rain gardens in this presentation are sized to handle a 1" rainstorm event as most storms are smaller than this and most pollutants are released in the first 1" of runoff. This information allows for the calculation of the volume of stormwater on a given drainage area. Rain gardens should be able to hold the same volume so the area and depth is altered accordingly. Rain gardens deeper than 12" are typically avoided for safety reasons so gravel layers may be added instead.

Nutrient Reductions: The nutrient reductions were determined using the estimated drainage area of the retrofit and nutrient export coefficients determined by Charles Frink in a paper discussing nutrient concentrations in CT by major type of land cover. In other words, the area of land treated and estimated concentrations of nutrients that runoff into that area gives the amount of nutrients that can be directed away from that watershed. Point source pollution were not taken into consideration in these calculations as it varies depending on site (i.e. fertilizers from farmland, animal feed, nearby industrial buildings, etc).

Gallons Treated: The volume of stormwater treated was determined with the assumption that CT experiences around 4' of rain annually and the previously determine drainage area of each retrofit.

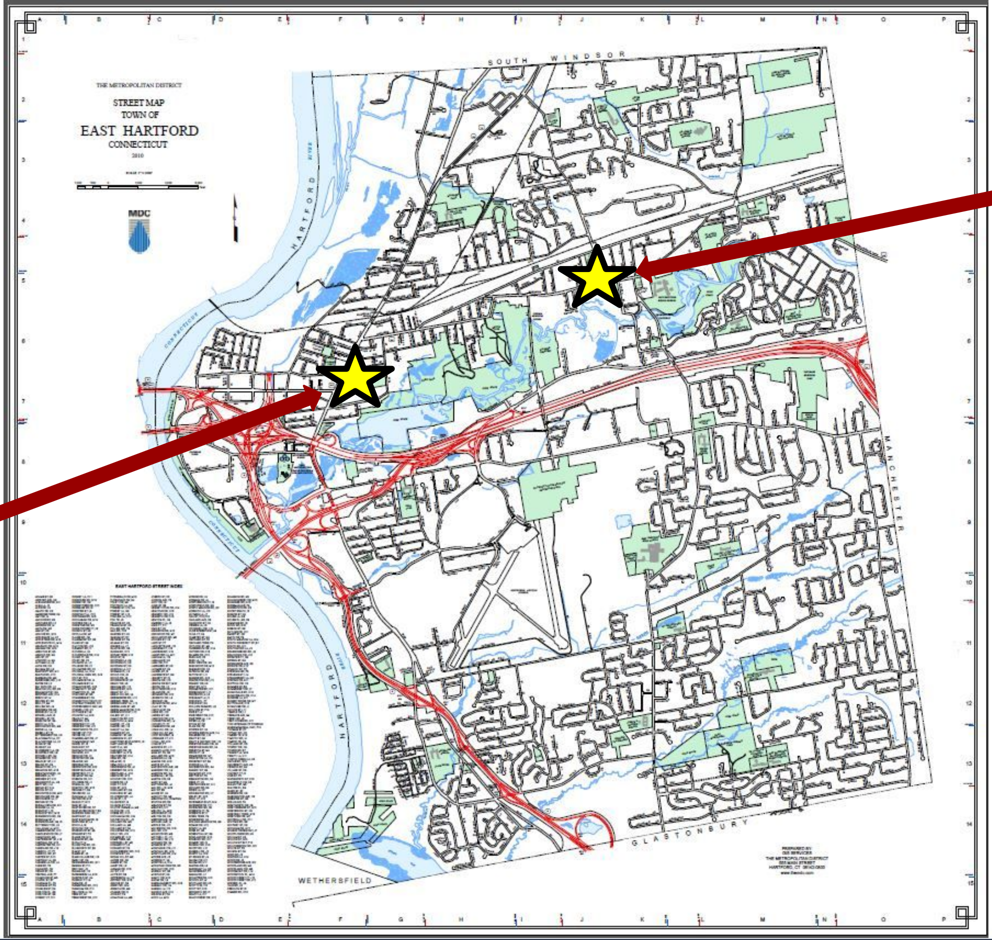
Costs: The cost range of each recommended green practice was estimated using literature, government websites/reports and installation manuals. Some prices may vary as examples are used of similar retrofits installed in the past and there subsequent cost. These prices were not determined by consulting contractors, but should fall somewhere in the presented range.

Site Selection and 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. This included using the statewide high-resolution impervious surface maps to get an overall feel for the site, following contour lines provided by ArcGIS to estimate drainage patterns, and examining images from Google Maps to locate possible disconnection sites

On location, site specific recommendations were selected based on suitability for implementation of green infrastructure practices. Whether or not a site was suitable depended on factors such as slope of surrounding land, land available for use, locations 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.

Educational value, visibility, and volunteer opportunities were also considered when determining the most beneficial locations and practices.



Public Safety Complex

Raymond Library

Location #1: Raymond Library

Possible **disconnect of 1,133 sq. ft** of impervious cover with use of rain gardens and PICPs

840 Main St, East Hartford, CT

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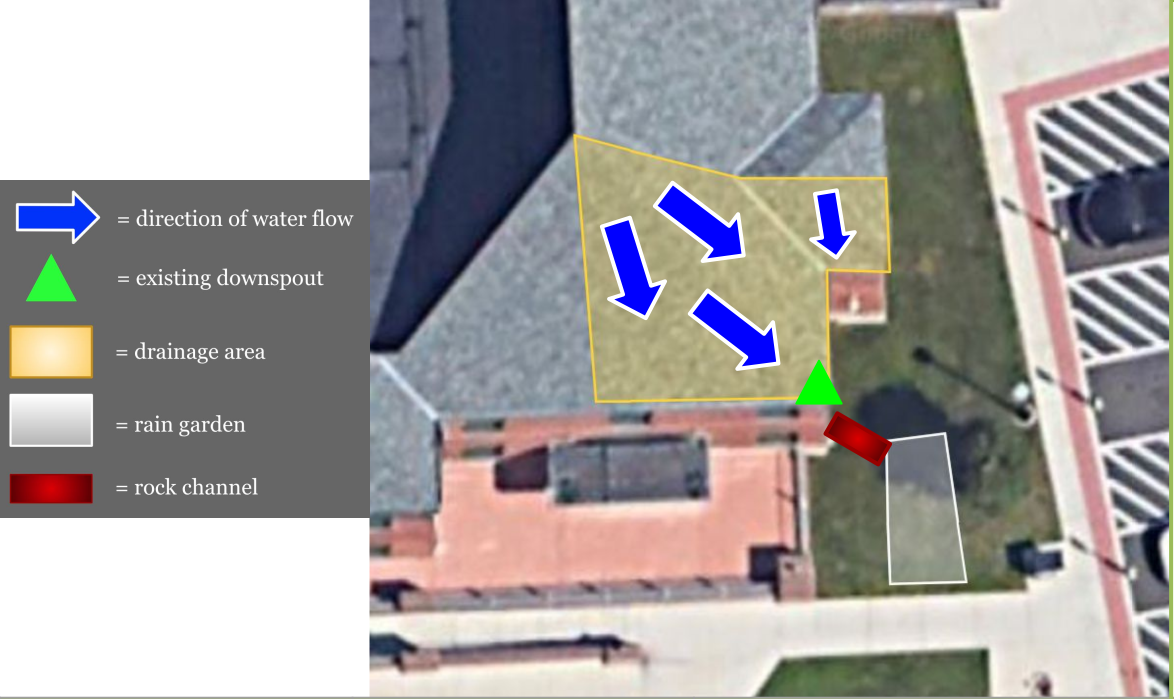

In this location we suggest a **vegetated rain garden**. There is a small area available to work with, and since this is a site that many people walk by, it would add an aesthetic benefit to have a planted garden bed. The shape of the rain garden within the space can be adjusted to make maintenance (such as mowing) easier.

To avoid water infiltrating too close to the basement, we suggest a **rock channel** that directs the water from the disconnected downspout to the rain garden.

Drainage Area (ft²)	Suggested Green Infrastructure	Suggested Practice Size (ft²)	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / year)	Annual Phosphorus Reductions (lb P / year)
570	Rain Garden	98 (depth: 6”)	14,910	.15	.02

Project #1: Rain Garden at Raymond Library

Project #1: Rain Garden at Raymond Library

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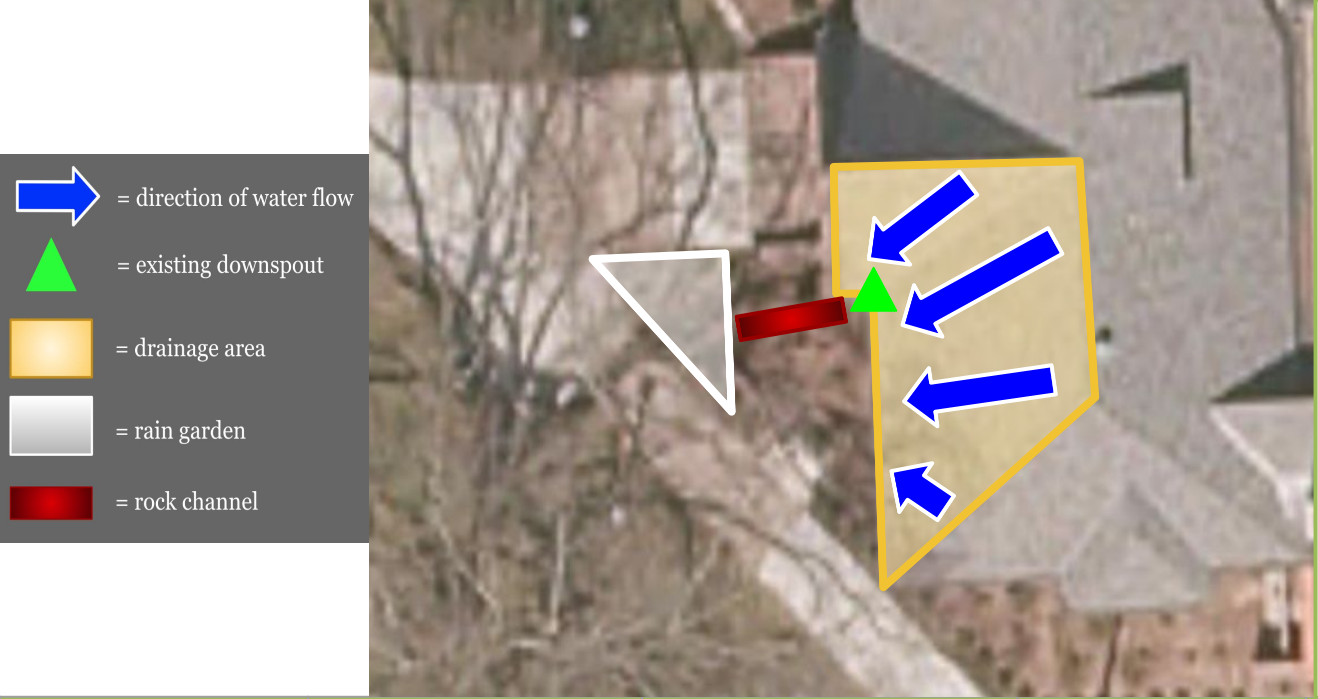

In this location we suggest a **smaller, deeper vegetated rain garden**. There is a small area available to work with, and since this is a site that many people walk by, it would add an aesthetic benefit to have a planted garden bed.
To avoid water infiltrating too close to the basement, we suggest a **rock channel** that directs the water from the disconnected downspout to the rain garden.

Drainage Area (ft²)	Suggested Green Infrastructure	Suggested Practice Size (ft²)	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / year)	Annual Phosphorus Reductions (lb P / year)
480	Rain Garden	57 (depth: 12")	12,620	.13	.016

Project #2: Rain Garden at Raymond Library

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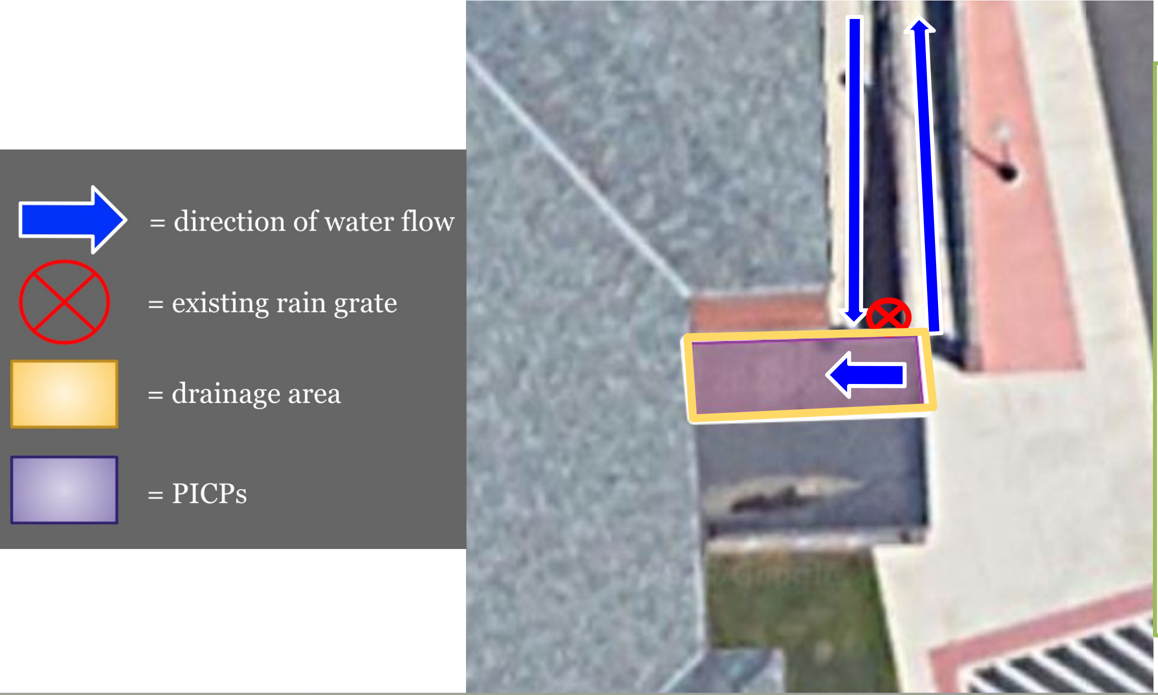
Project #2: Rain Garden at Raymond Library



In this location, we suggest installing **Permeable Interlocking Concrete Pavement (PICPs)**. The drainage area and practice size are the same because the rain grate catches most of the water that goes down the ramp.
These **PICPs** will prevent ice (from standing water) during the winter season by infiltrating water into the ground. It is also easy to roll over which makes it accessible for wheelchairs.

Drainage Area (ft²)	Suggested Green Infrastructure	Suggested Practice Size (ft²)	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / year)	Annual Phosphorus Reductions (lb P / year)
87	PICPs	87	2,294	.02	.003

Project #3: PICPs at Raymond Library

Project #3: PICPs at Raymond Library

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Sites not Chosen and Reasoning

@ Raymond Library

<u>Downspouts on South and East sides of building:</u> these areas are **<u>too close</u>** to the building to disconnect the downspout and dig a rain garden given the basement underneath the building. There would be a risk of infiltrated water damaging below-ground infrastructure.

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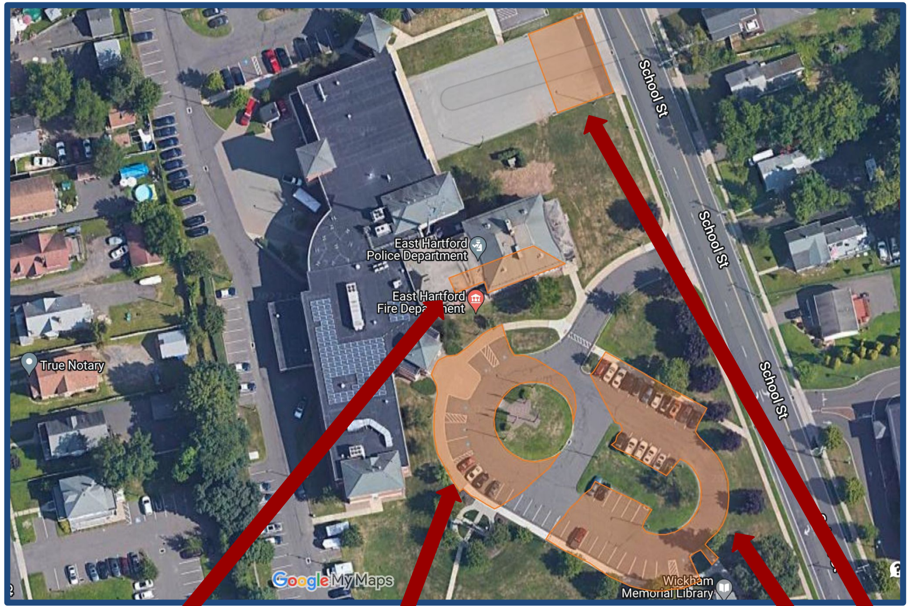
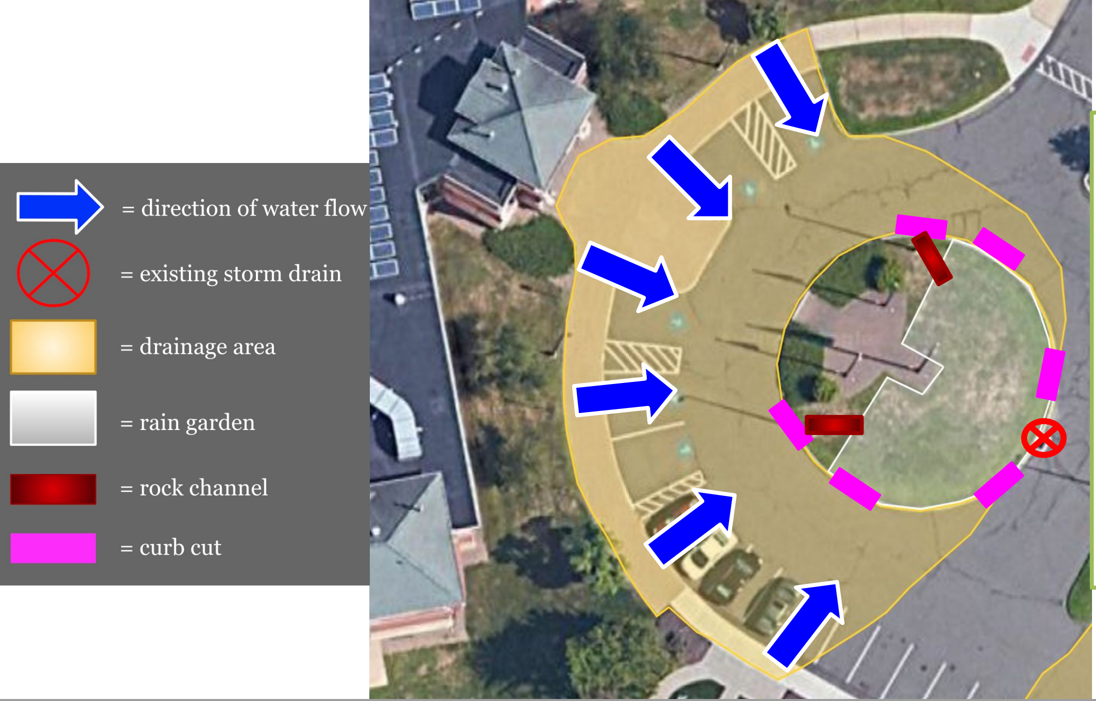
Location #2: Public Safety Complex



Possible **disconnect of 29,010.96 sq. ft** of impervious cover with use of rain gardens and concrete pavers

31 School St, East Hartford, CT



In this location we suggest a **medium-sized, deeper vegetated rain garden**. The existing grass in the bed is not aesthetically pleasing, and there is an abundance of space to plant up a bed. For water to enter the bed, we suggest 5 **curb cuts** be made, with **rock channels** that direct the water from the curb cuts to the rain garden.

Drainage Area (ft²)	Suggested Green Infrastructure	Suggested Practice Size (ft²)	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / year)	Annual Phosphorus Reductions (lb P / year)
9,278	Rain Garden	2,048 (depth: 6”)	244,300	2.54	.32

Project #4: Rain Garden at the Public Safety Complex

Project #4: Rain Garden at the Public Safety Complex

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In this location we suggest a **vegetated rain garden**. 6 **curb cuts** also would allow water to enter the bed instead of the storm drain. The slope in the grass will have to be cut into to create a depression for water to enter into. There is an abundance of space to plant up a bed. **White birches** in the bed will be great start to be aesthetically pleasing for rain gardens.

Drainage Area (ft^2)	Suggested Green Infrastructure	Suggested Practice Size (ft^2)	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / year)	Annual Phosphorus Reductions (lb P / year)
14,300	Rain Garden	3,400 (depth: 6")	376,200	3.9	.5

Project #5: Rain Garden at the Public Safety Complex

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Project #5: Rain Garden at the Public Safety Complex

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Notes:

There is a **<u>bioretention basin</u>** outside of the building next door to the Public Safety Complex. This is a great example of:

- the types of plants that can be used in a rain garden
- the natural aesthetic addition to the landscape a rain garden adds

In this location we suggest a **medium-sized, deeper vegetated rain garden.** The existing grass in the bed is not aesthetically pleasing, and there is an abundance of space to plant up a bed.
To avoid water infiltrating too close to the basement, we suggest a **rock channel** that directs the water from the disconnected downspout to the rain garden.

Drainage Area (ft²)	Suggested Green Infrastructure	Suggested Practice Size (ft²)	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / year)	Annual Phosphorus Reductions (lb P / year)
1,830	Rain Garden	305 (depth: 6")	48,170	.5	.06

Project #6: Rain Garden at the Public Safety Complex

Project #6: Rain Garden at the Public Safety Complex

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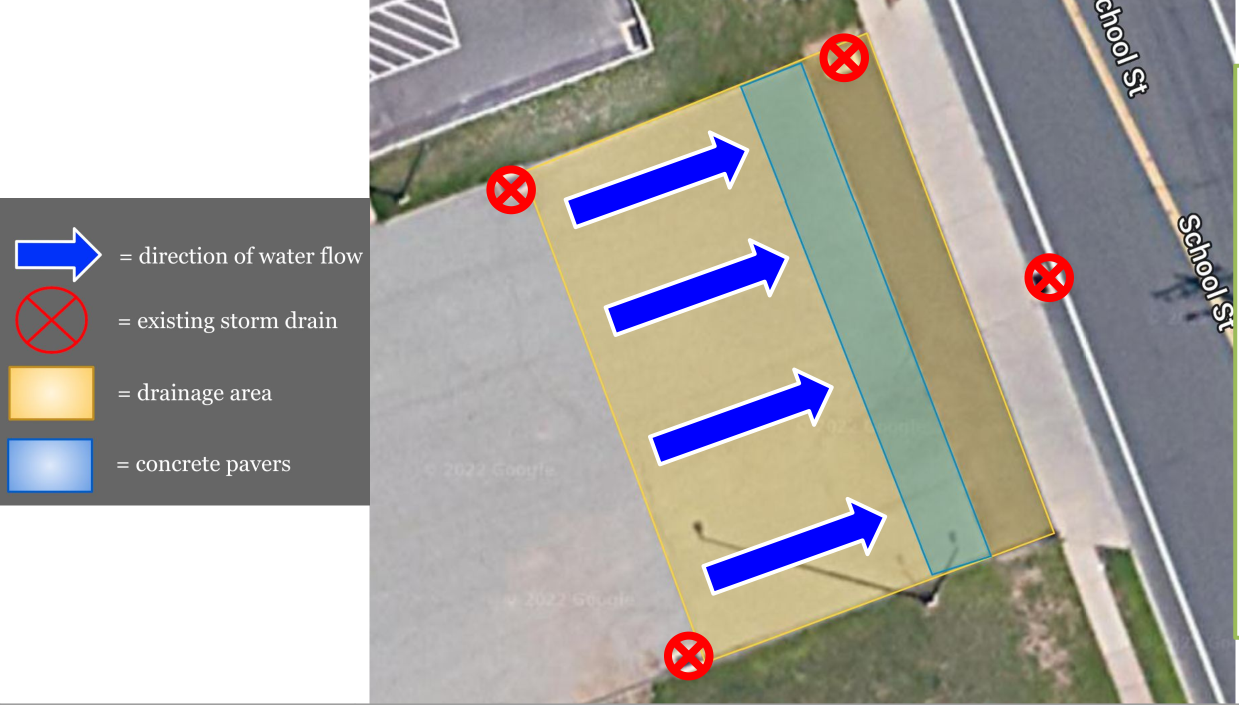
Notes and Concerns:

Existing catch basin in grass could be raised within the rain garden for **overflow**.

Manhole in grass suggests **underground wires or infrastructure** that should be kept in mind and avoided when digging.



In the fire truck entrance, we suggest installing **concrete pavers** to infiltrate water that falls in the area from the existing storm drains to the sidewalk. These will **prevent ice** (from puddling) during the winter season by infiltrating water into the ground. This installation can give good impact not only to the fire truck entrance but also to the sidewalk by preventing water flow.

Drainage Area (ft²)	Suggested Green Infrastructure	Suggested Practice Size (ft²)	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / year)	Annual Phosphorus Reductions (lb P / year)
3,620	Concrete Pavers	610 (8ft wide)	95,200	1	.125

Project #7: Concrete Pavers at the Public Safety Complex

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Project #7: Concrete Pavers at the Public Safety Complex

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Notes:

There is evidence of **water pooling** and not flowing into storm sewers. This could become an issue in the winter if standing water froze and created a **slip hazard** for vehicles and people. To prevent this kind of accidents, pervious concrete pavers would be installed in this area, allowing water to infiltrate into the ground below.

Sites not Chosen and Reasoning

@ Public Safety Complex

<u>Storm sewer in middle of parking lot:</u> this could have been raised and turned into a rain garden, but it would have required **<u>losing 4 parking spaces</u>**.

<u>Downspouts on east side of building:</u> these downspouts have **<u>already been disconnected</u>** and water can flow and infiltrate into the grass.

Summary:

5 Rain Gardens / 1 PICPs /1 Concrete Pavers

Total Drainage Area (ft²) AKA Total Impervious Cover Disconnected	Total Suggested Practice Size (ft²)	Total Annual Gallons Treated	Total Annual Nitrogen Reduction (lb N / year)	Total Annual Phosphorus Reductions (lb P / year)
30,144	6,605	793,667	8.2	1.05

That's more water than an Olympic swimming pool holds! (660,000 gallons)

Review of Codes and Ordinances

The Center for Watershed Protection's

"COW Scoring Spreadsheet":

- To evaluate the land-use regulations of the town of East Hartford
- Done with the intent of assisting the town of East Hartford with compliance for MS4 requirements
- Reviewed East Hartford's regulations to find codes that could be revised in order to minimize impervious cover, conserve natural areas, and use runoff reduction practices to manage stormwater

Final score: 31%

- **Strong** wetland protection and conservation
- **Lacked** clear rules surrounding the use of GSI Practices or their maintenance after installation

Review of Codes and Ordinances

Strengths:

- Focus on **wetland protection and conservation**
- *East Hartford Inland Wetlands Environment Commission Regulations*
  - Definition of waterway was quite expansive
  - Under the section *Definitions as Used in these Regulations*, watercourses defined as "rivers, streams, brooks, waterways, lakes, ponds, marshes, swamps, bogs, and all other bodies of water, natural or artificial, vernal or intermittent, public or private, which are contained within, flow through, or border upon this state or any portion thereof"
  - Important aspect of GSI because it expands the number of water bodies subject to protection from stormwater contamination

Review of Codes and Ordinances

Room for Improvement:

- **Lack of clear rules surrounding the use of GSI Practices or their maintenance after installation**
- *Town of East Hartford Zoning Regulations*
  - Under the section *Site-Plan Financial Guarantee Requirements*, "The Planning and Zoning Commission shall not require a financial guarantee for the maintenance of roads, streets, retention or detention basins or other improvements approved with a site plan for more than one year after the date on which such improvements have been completed…"
  - Maintenance of GSI practices was not guaranteed in the long term
  - Creates **barriers to GSI** because these practices require maintenance to remain effective at infiltrating water into the ground

Review of Codes and Ordinances

Conclusion:

- East Hartford's *Zoning Regulations* provide a **solid groundwork** from which GSI practices can begin to be encouraged and required.
- To improve the zoning and subdivision regulations of the town, we would suggest focusing on **compiling** all references to Best Management Practices and Green Stormwater Infrastructure Practices into one section of the *Zoning Regulations*.
  - More accessible to those in charge of new developments, making it more likely that GSI practices are considered and employed.
  - Could be expanded so that it includes more details on the types of practices that should be implemented in various locations and situations.

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