Stormwater Runoff Reduction Plan -

Vernon, CT 06066

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NRE 3699 - UCONN Stormwater Corps

Table of Contents:

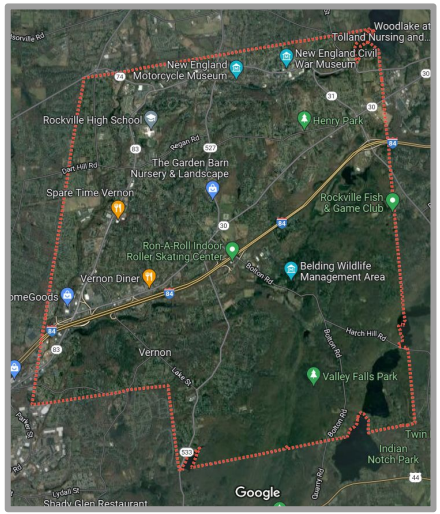
Summary:

- During the fall semester of 2022, a team of two UConn students and Extension faculty performed an evaluation of potential stormwater enhancement opportunities in the Town of Vernon, 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.

- At the end of the evaluation, **5 sites** were visited and **8 recommendations** were designed. If all recommendations are implemented, **32,016 ft^2** of impervious cover will be disconnected. A total of **574,109 gallons** of stormwater, **1.04 lbs** of phosphorus, and **8.2 lbs** of nitrogen with be prevented from entering local water bodies annually.

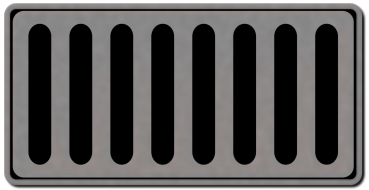
In This Report:



- Included are recommendations for green stormwater infrastructure practices at **six sites** in the town of Vernon. Each site is introduced with an aerial photo from Google Maps displaying the recommended green infrastructure and a map displaying **all impervious cover in the area**.

- The following report includes the address and total impervious area to be disconnected from the stormwater system. Information about the **nitrogen** and **phosphorus** load reduction per year is included, as well as the size of the recommended installation, the gallons of runoff treated per year and its estimated cost. These estimations are calculated based on the drainage area, annual rainfall estimates specific to Connecticut, and literature export values. Sites that did not make the top six 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 imperious cover around the state. This includes **roads, rooftops, parking lots, and other development**, leading to increased runoff into stormwater management systems.

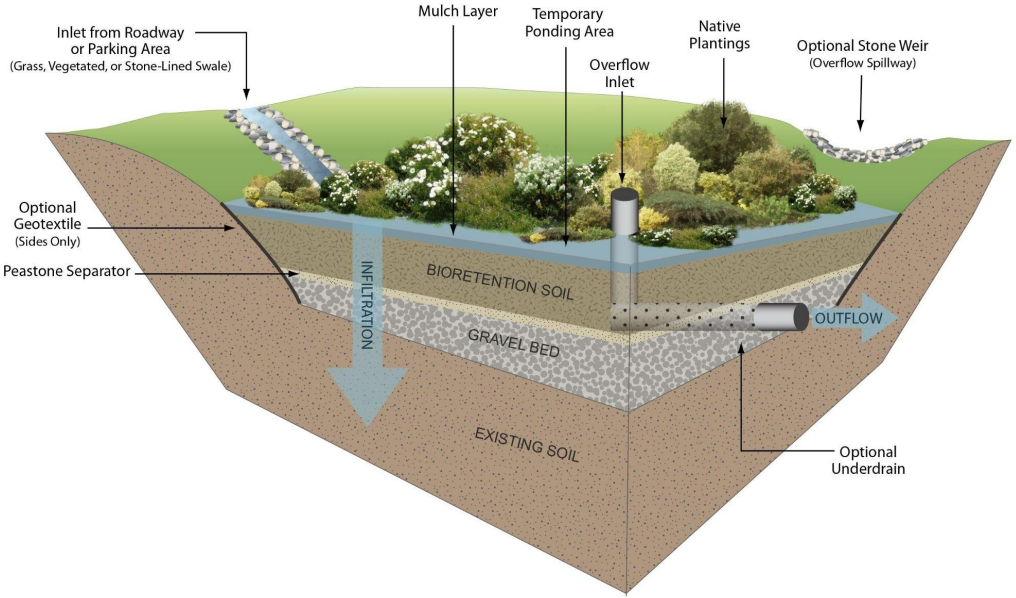
- This not only disrupts the local water cycle, but increases the amount of pollutants in waterways and causes erosion and flooding. The implementation of green infrastructure disconnects stormwater from local management systems and allows it to naturally infiltrate into the ground. Installations such as **rain gardens, green roofs, tree box filters, and pervious pavements** 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.

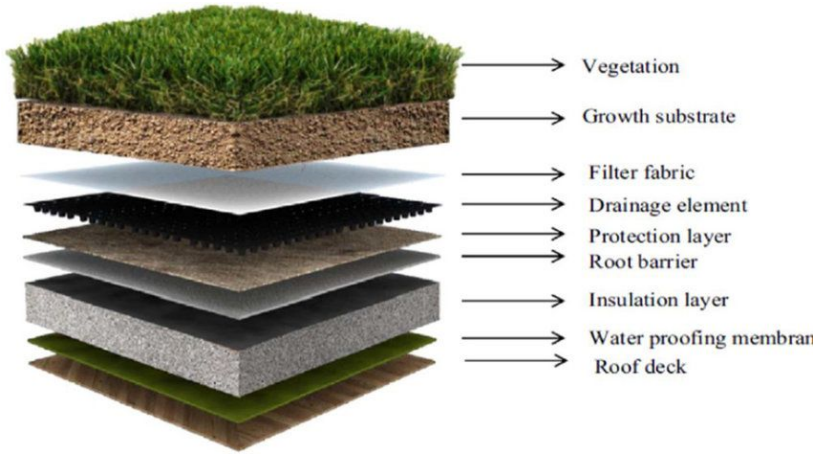
Rain Gardens and Bioretention:



- **Rain gardens** are a green infrastructure installation that capture stormwater from impervious surfaces or disconnected gutters. This practice allows the runoff to infiltrate into the soil and recharge groundwater.

- **Rain gardens** consist of a depression at least 6 inches deep which may include native plants, grass, or stone. The practice might involve curb cuts or gravel material as a buffer for erosion depending on the individual site. Rain gardens add to the aesthetic appeal and the biodiversity of urban areas.

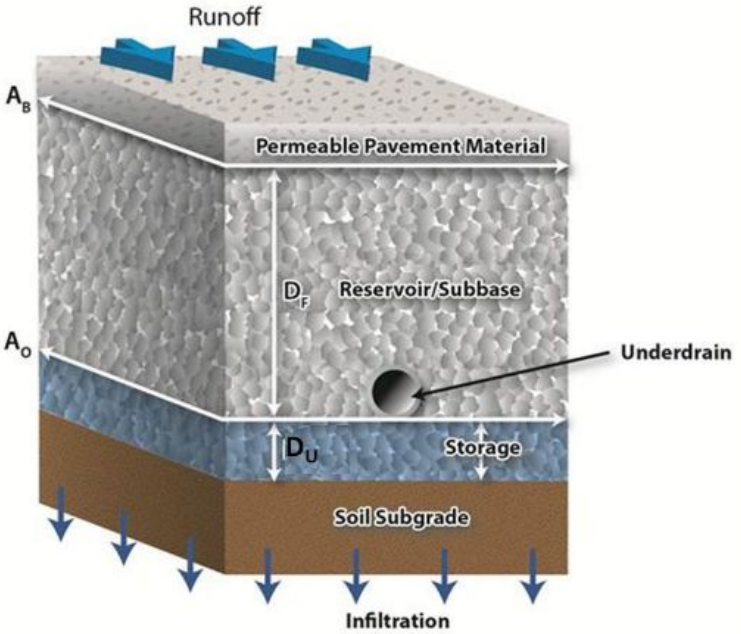
Green Roofs:



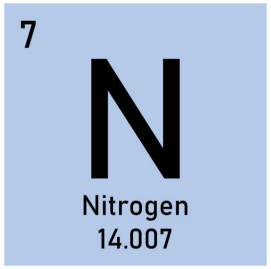
- A **green roof** is a form of green infrastructure that allows runoff, that would otherwise enter an internal piping or gutter system, to infiltrate substrate directly. This installation disconnects about 50% of the stormwater that sheds off any given building.
- It is the most expensive practice, 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.

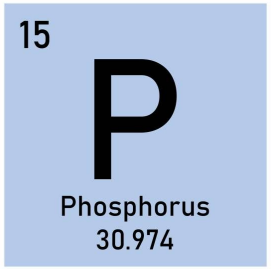
Permeable Pavement

- **Pervious paving** is an alternative to traditional asphalt or concrete that allows for the infiltration of water. Ideal locations for pervious pavement are relatively flat areas that take on a fair amount of water from surrounding impervious surfaces during storm events.
- Advantages:
  - Replaced less often
  - Not susceptible to frost heaves
  - Competitive costs with regular pavements
  - Less snow maintenance
- Types include **pervious asphalt, concrete, and a variety of pavers**



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.

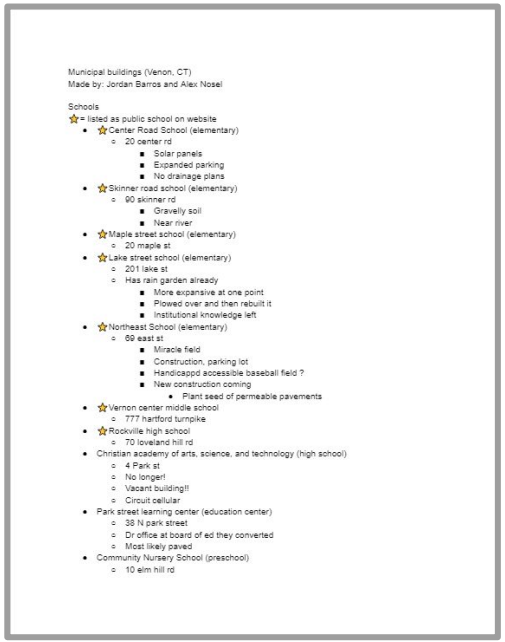
Rain Garden Size: Rain garden area and depth is heavily dependent on the estimated drainage area and amount of rainfall expected. All rain gardens in this presentation are sized to handle a 1" rainstorm event as most storms are smaller than this and most pollutants are released in the first 1" of runoff. 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:



Municipal buildings (Venon, CT)
Made by: Jordan Barros and Alex Nosel

Schools
☆= listed as public school on website

- ☆Center Road School (elementary)
  - 20 center rd
    - Solar panels
    - Expanded parking
    - No drainage plans
- ☆Skinner road school (elementary)
  - 90 skinner rd
    - Gravelly soil
    - Near river
- ☆Maple street school (elementary)
  - 20 maple st
- ☆Lake street school (elementary)
  - 201 lake st
  - Has rain garden already
    - More expansive at one point
    - Plowed over and then rebuilt it
    - Institutional knowledge left
- ☆Northeast School (elementary)
  - 69 east st
    - Miracle field
    - Construction, parking lot
    - Handicappd accessible baseball field ?
    - New construction coming
      - Plant seed of permeable pavements
- ☆Vernon center middle school
  - 777 hartford turnpike
- ☆Rockville high school
  - 70 loveland hill rd
- Christian academy of arts, science, and technology (high school)
  - 4 Park st
  - No longer!
  - Vacant building!!
  - Circuit cellular
- Park street learning center (education center)
  - 38 N park street
  - Dr office at board of ed they converted
  - Most likely paved
- Community Nursery School (preschool)
  - 10 elm hill rd

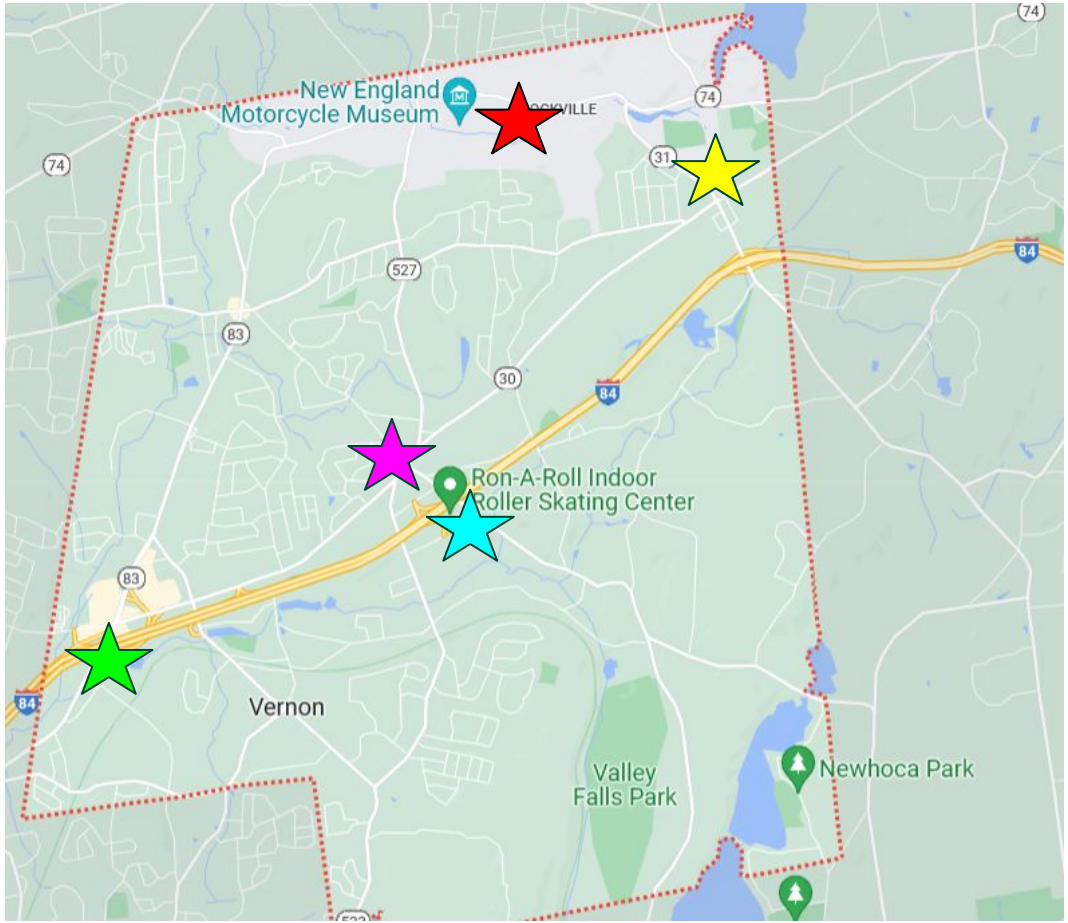
- The first step in the design process was to compile a list of all local **public** or **government** owned locations that would benefit from stormwater retrofits.

- The team then used imagery tools such as **Google Maps** to locate potential areas for green infrastructure practices. Google maps can be a powerful tool in determining **contour lines** and **drainage patterns**.

- 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.

Map of All Sites

- Center Road School
- Judicial Court
- Senior Center
- Fire Dpt. 341
- Northeast School



Site #1: Center Road Elementary School

20 Center Road, Vernon, CT 06066

Recommendation 1a:

- Bioretention at the bottom of the parking lot, reducing the amount of stormwater to enter the corner storm drain

Recommendation 1b:

- Bioretention swale in island of parking lot, treating runoff from both sides of the lot
- Going to be undersized due to existing size of island

Recommendation 1: Bioretention 1a

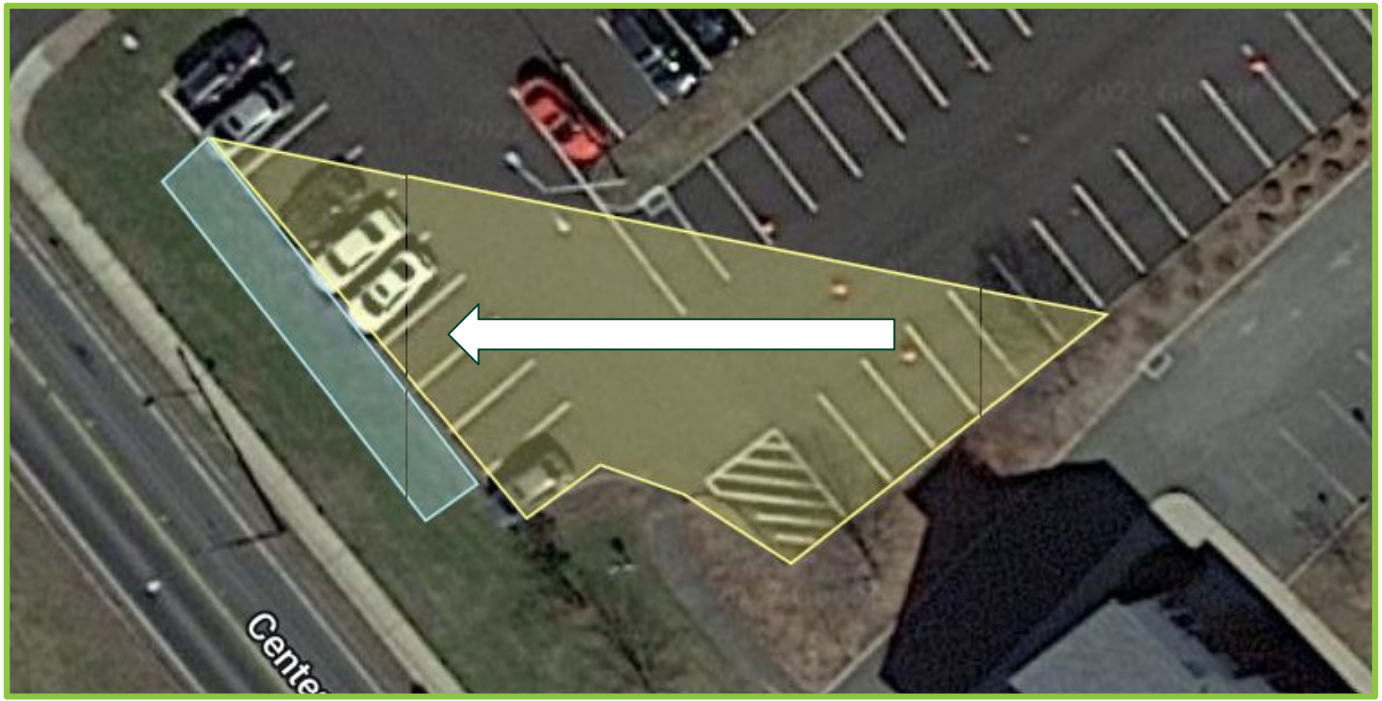
Notes:

= Drainage Area

= Practice Area

- White Arrow depicts direction of flow observed on site

- Install curb cuts along the recommendation area to direct stormwater



Drainage Area (ft^2)	**Recommended Size** (@ 6in depth) (ft^2)	**Runoff Treated per Year** (gallons)	**Phosphorus Reduction** (lb/year)	**Nitrogen Reduction** (lb/year)
4704 ft^2	**784 ft^2**	**123,884 gallons**	**0.16 lb/year**	**1.29 lb/year**

Recommendation 1: Bioretention 1a

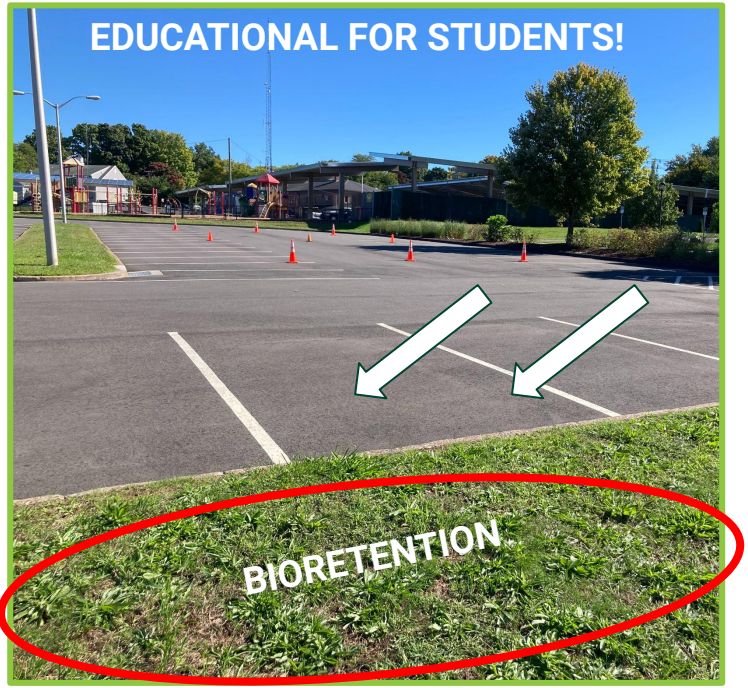
Notes:

= Drainage Area

= Practice Area

- White Arrow depicts direction of flow observed on site

- Plenty of space for a Bioretention that can also be visible from the street



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4704 ft^2	**784 ft^2**	**123,884 gallons**	**0.16 lb/year**	**1.29 lb/year**

Recommendation 2: Bioretention: Parking Lot Island 1b

Notes:

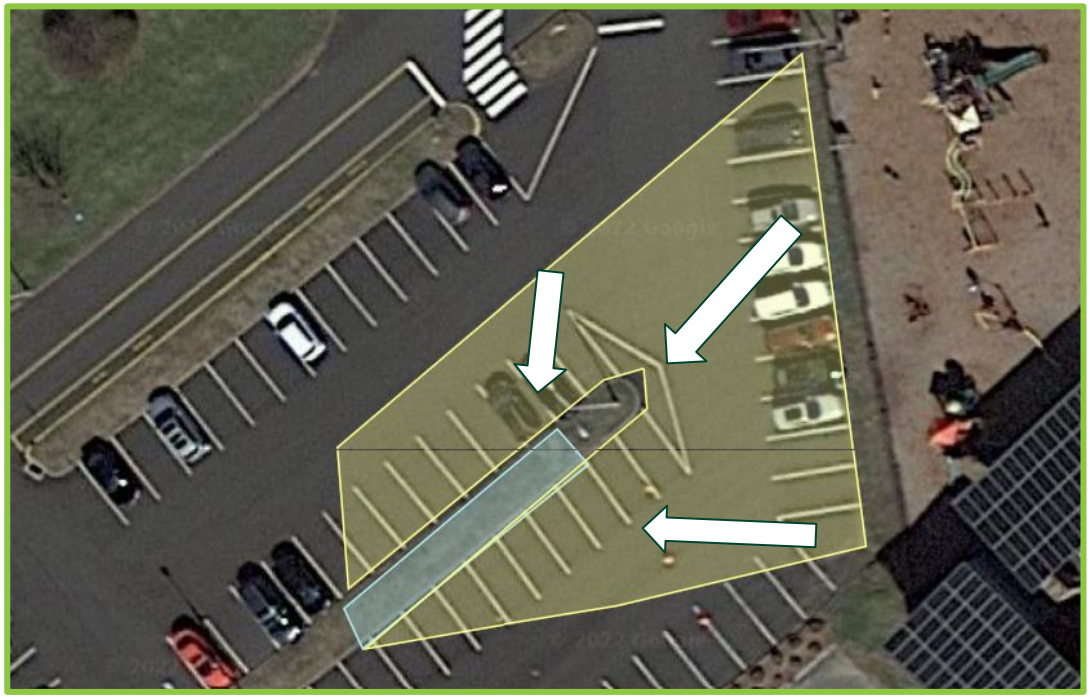
= Drainage Area

= Practice Area

- White Arrow depicts direction of flow observed on site

- Undersized, will not capture all the water

- Volume treated is adjusted by: -25%



Drainage Area (ft^2)	**Recommended Size** (@ 6in depth) (ft^2)	**Runoff Treated per Year** (gallons)	**Phosphorus Reduction** (lb/year)	**Nitrogen Reduction** (lb/year)
8276 ft^2	**653 ft^2**	**163,457 gallons**	**0.22 lb/year**	**1.70 lb/year**

Recommendation 2: Bioretention: Parking Lot Island 1b

Notes:

= Drainage Area

= Practice Area

- White Arrow depicts direction of flow observed on site

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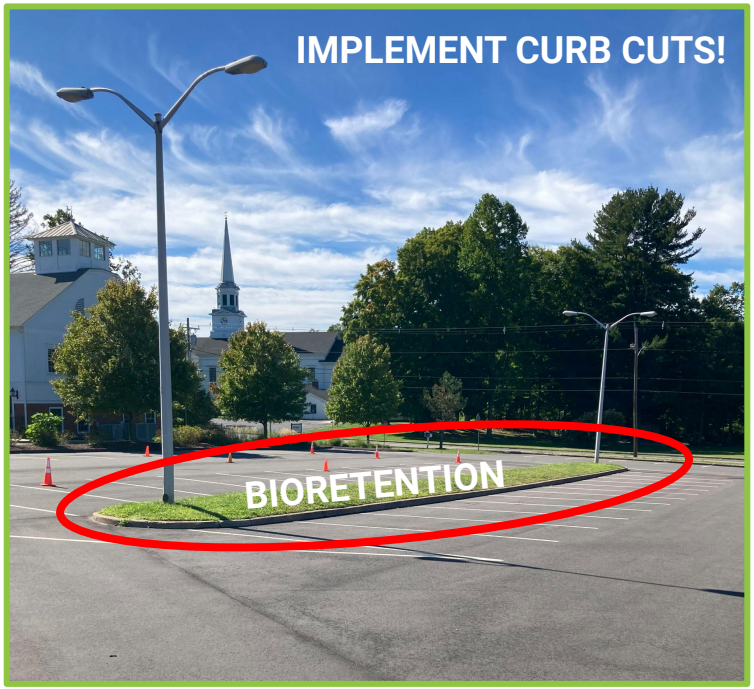

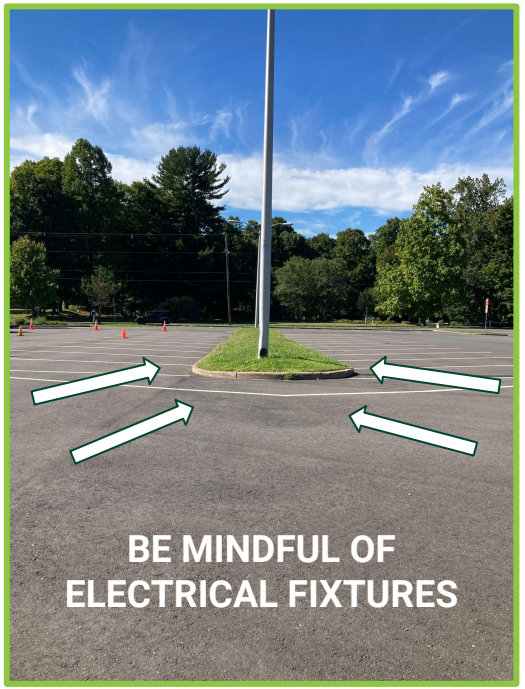

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8276 ft^2	**653 ft^2**	**163,457 gallons**	**0.22 lb/year**	**1.70 lb/year**

Site #2: Tolland Judicial Dist. Superior Court

69 Brooklyn Street, Vernon Rockville, CT 06066

Recommendation 1:

- Bioretention around storm drain in parking lot to the right of the building when facing it
- Lot is in need of maintenance at the moment; this project can be easily added in
- Spans area of 6 parking spaces directly surrounding storm drain

Recommendation 1: Bioretention 2b

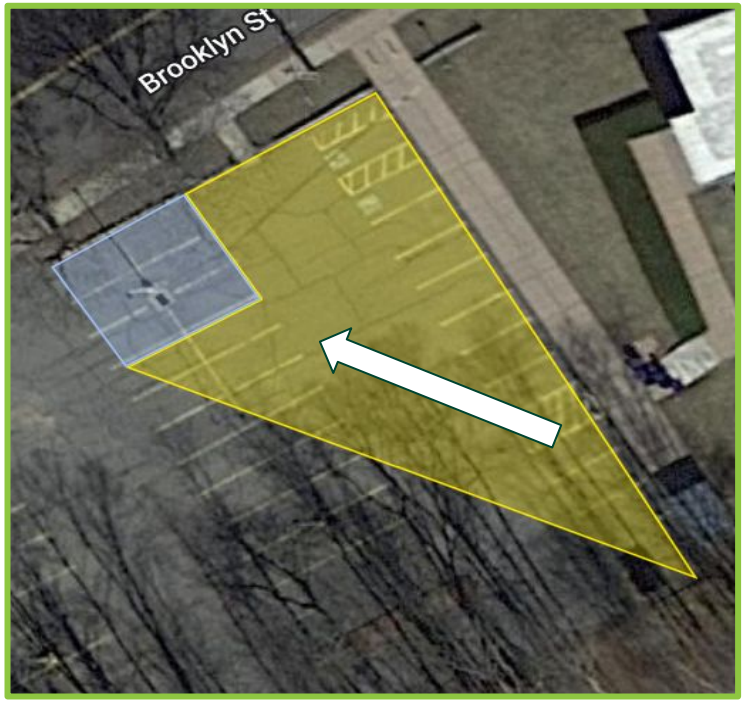
Notes:

= Drainage Area

= Practice Area

- White Arrow depicts direction of flow observed on site

- Removal of 6 parking spaces is required for installation



Drainage Area (ft^2)	Recommended Size (@ 6in depth) (ft^2)	Runoff Treated per Year (gallons)	Phosphorus Reduction (lb/year)	Nitrogen Reduction (lb/year)
5358 ft^2	**958 ft^2**	**141,090 gallons**	**0.19 lb/year**	**1.47 lb/year**

Recommendation 1: Bioretention 2b

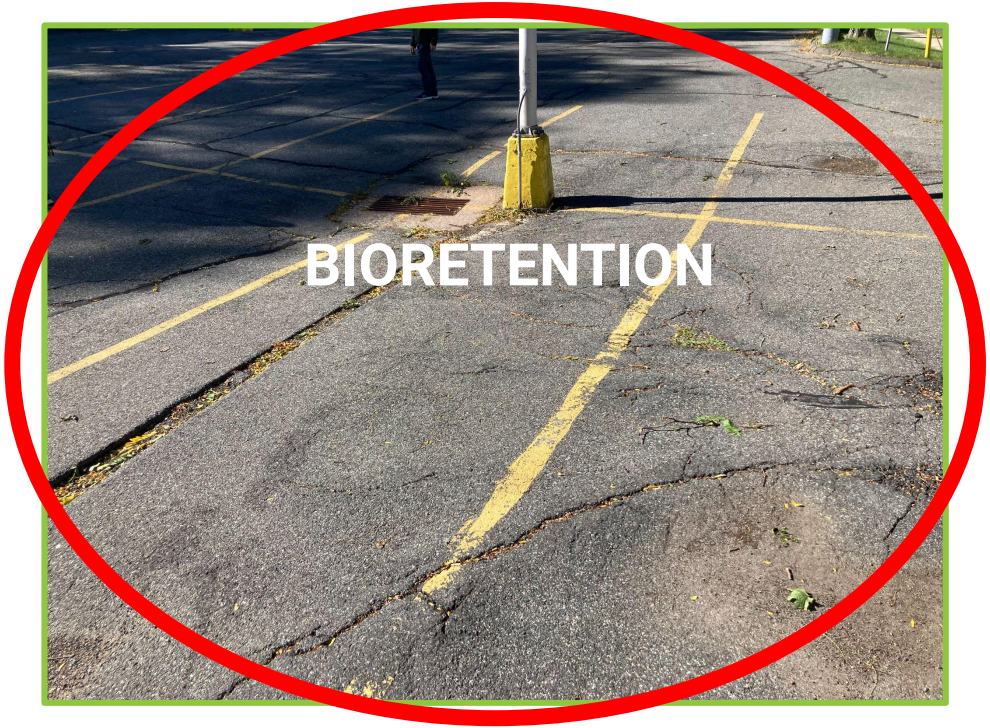
Notes:

= Drainage Area

= Practice Area

- White Arrow depicts direction of flow observed on site

- Removal of 6 parking spaces is required for installation



- The existing storm drain can serve the purpose of handling storm overflow if necessary.
- Size may vary if limiting parking spaces is not possible. The design could be efficient with four spaces removed.

Drainage Area (ft^2)	**Recommended Size** (@ 6in depth) (ft^2)	**Runoff Treated per Year** (gallons)	**Phosphorus Reduction** (lb/year)	**Nitrogen Reduction** (lb/year)
5358 ft^2	**958 ft^2**	**141,090 gallons**	**0.19 lb/year**	**1.47 lb/year**

Site #3: Vernon Senior Center

135 Bolton Road, Vernon, CT 06066

Recommendation 1:

- Rain garden on southern side of the building, to the left of the sidewalk
- Hugged as tightly to the curb as possible

Recommendation 2:

- Sister rain garden to recommendation one, to the right of the sidewalk
- Hugged as tightly to the curb as possible

Recommendation 3:

- Rain garden on eastern side of the building

Recommendation 1: Rain Garden: 3A

Notes:

= Drainage Area

= Practice Area

- Direction of waterflow follows the slope of the roof into the gutter and downspouts

- Downspouts must be disconnected and directed toward RG

Drainage Area (ft^2)	Recommended Size (@ 6in depth) (ft^2)	Runoff Treated per Year (gallons)	Phosphorus Reduction (lb/year)	Nitrogen Reduction (lb/year)
1220 ft^2	**218 ft^2**	**32,118 gallons**	**0.04 lb/year**	**0.33 lb/year**

Recommendation 2: Rain Garden: 3B

Notes:

= Drainage Area

= Practice Area

- Direction of waterflow follows the slope of the roof into the gutter and downspouts

- Downspouts must be disconnected and directed toward RG

Drainage Area (ft^2)	**Recommended Size** (@ 6in depth) (ft^2)	**Runoff Treated per Year** (gallons)	**Phosphorus Reduction** (lb/year)	**Nitrogen Reduction** (lb/year)
1089 ft^2	**174 ft^2**	**28,677 gallons**	**0.04 lb/year**	**0.30 lb/year**

Recommendation 3: Rain Garden: 3C

Notes:

= Drainage Area

= Practice Area

- Direction of waterflow follows the slope of the roof into the gutter and downspouts

- Downspouts must be disconnected and directed toward RG

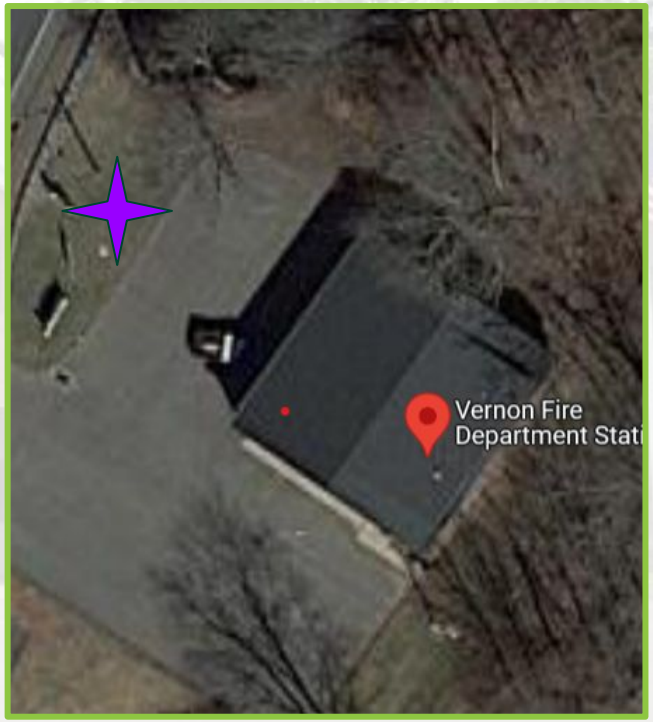
Drainage Area (ft^2)	**Recommended Size** (@ 6in depth) (ft^2)	**Runoff Treated per Year** (gallons)	**Phosphorus Reduction** (lb/year)	**Nitrogen Reduction** (lb/year)
1089 ft^2	**305 ft^2**	**28,677 gallons**	**0.04 lb/year**	**0.30 lb/year**

Site #4: Vernon Fire Dept. Station 341

100 Hartford Turnpike, Vernon, CT 06066

Recommendation 1:

- Bioretention on western area of the property towards Hartford Turnpike
- Includes a disconnection from the roof for the Northwestern gutter pipe facing the river



Recommendation 1: Rain Garden 4a

Notes:

= Drainage Area

= Practice Area

- White Arrow depicts direction of flow observed on site

- Building downspout and underground PVC pipe must be removed to allow surface flow

Drainage Area (ft^2)	Recommended Size (@ 6in depth) (ft^2)	Runoff Treated per Year (gallons)	Phosphorus Reduction (lb/year)	Nitrogen Reduction (lb/year)
2134 ft^2	**436 ft^2**	**56,206 gallons**	**0.07 lb/year**	**0.58 lb/year**

Recommendation 1: Rain Garden 4a

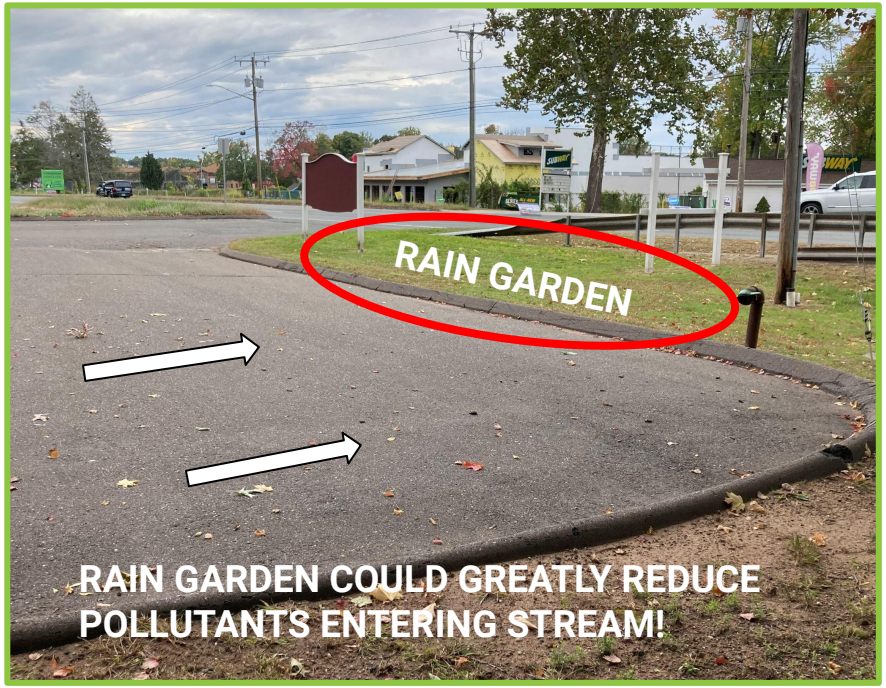
Notes:

= Drainage Area

= Practice Area

- White Arrow depicts direction of flow observed on site

- Building downspout and underground PVC pipe must be removed to allow surface flow



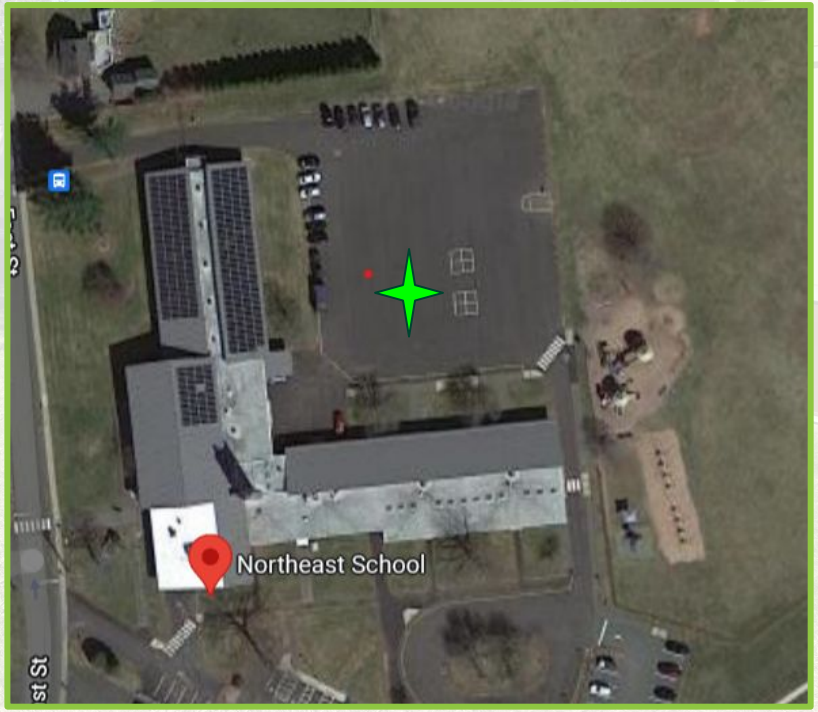
Drainage Area (ft^2)	Recommended Size (@ 6in depth) (ft^2)	Runoff Treated per Year (gallons)	Phosphorus Reduction (lb/year)	Nitrogen Reduction (lb/year)
2134 ft^2	**436 ft^2**	**56,206 gallons**	**0.07 lb/year**	**0.58 lb/year**

Site #5: Northeast School

69 East Street, Vernon Rockville, CT 06066

Recommendation 1:

- Bioretention in the back lot where children take Recess
- Placed in middle, mindful of existing Four Square spaces



Recommendation 1: Bioretention Swale 5a

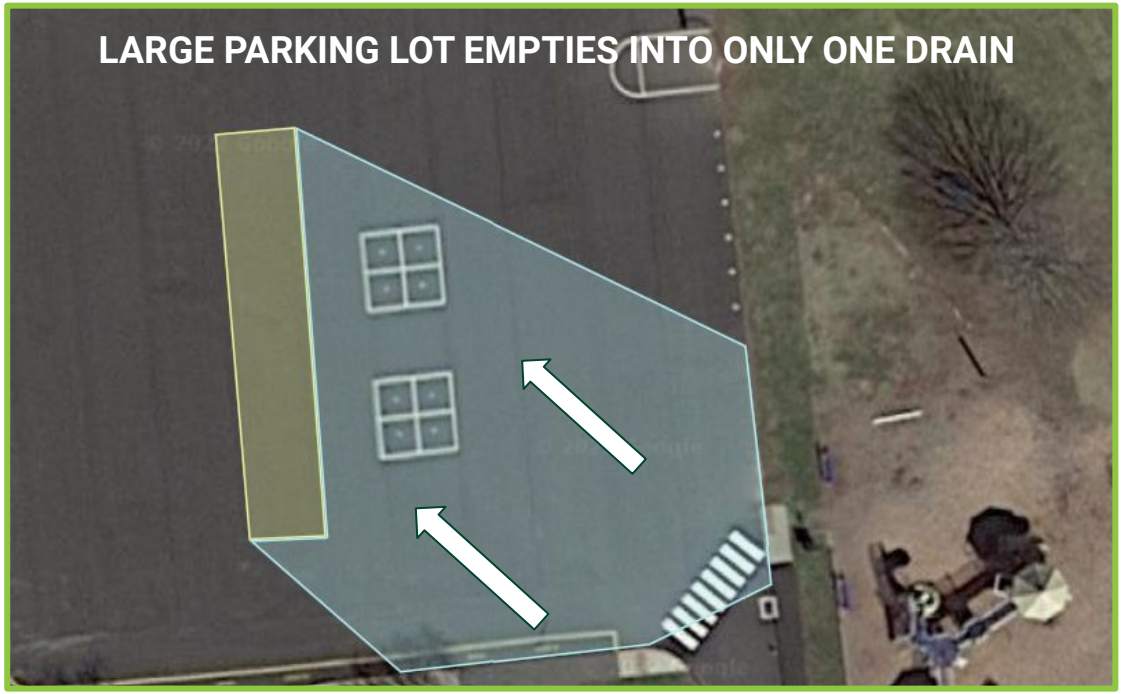
Notes:

= Drainage Area

= Practice Area

- White Arrow depicts direction of flow observed on site

- Depth is 6” for student safety



Drainage Area (ft^2)	**Recommended Size** (@ 6in depth) (ft^2)	**Runoff Treated per Year** (gallons)	**Phosphorus Reduction** (lb/year)	**Nitrogen Reduction** (lb/year)
8,146 ft^2	**1437 ft^2**	**214, 502 gal**	**.28 lb/yr**	**2.23 lb/yr**

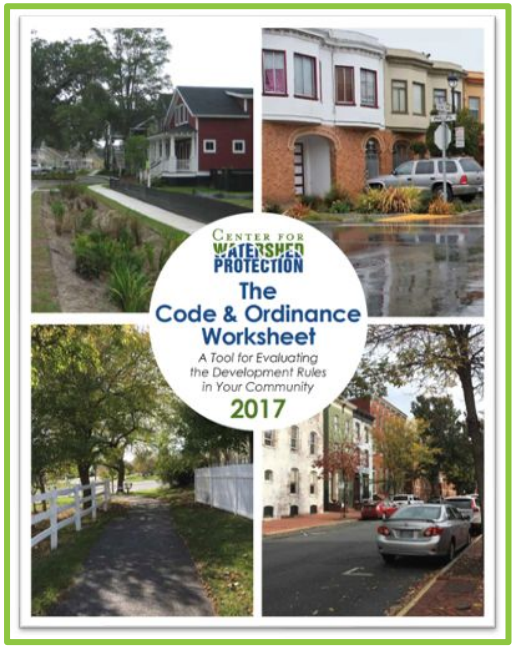
Summary and Final Results

Total Site Recommendation Figures:

		Disconnection Area (ft^2)	Annual Volume Treated (gal)	Phosphorus Reduction (lb/year)	Nitrogen Reduction (lb/year)
Center School	Biotention 1a	4,704	123,884	0.16	1.29
	Bioretention 1b	8,276	163,457	0.22	1.70
Judicial Court	Bioretention 2a	5,358	141,090	0.19	1.47
Senior Center	Rain Garden 3a	1,220	32,118	0.04	0.33
	Rain Garden 3b	1,089	28,677	0.04	0.30
	Rain Garden 3c	1,089	28,677	0.04	0.30
Fire Dept. 341	Rain Garden 4a	2,134	56,206	0.07	0.58
Northeast School	Bioretention Swale 5a	8,146	214,502	0.28	2.23
	Total	**32,016 ft^2**	**788,611 gal**	**1.04 lb/year**	**8.20 lb/year**

Codes & Ordinances Review

Used Code and Ordinances Worksheet (COW)



- Developed by Center for Watershed Protection (CWP) w/ input from panel of national experts
- **94** recommended policies designed to:
  - Reduce IC
  - Conserve open space
  - Prevent stormwater pollution
- 4 versions: ultra-urban, urban, **suburban,** rural
- Don't stress - Typical scores in the 30-40% range (always room for improvement)
- Helps to meet MS4 requirement to remove barriers to LID/GSI

Codes and Ordinances Review for Vernon, Ct

Final Score: 58%

CENTER FOR WATERSHED PROTECTION

What Was Done Well

- Alternative sidewalk designs allows for **pervious pavement** and can be reduced to a 5ft width when safe
  - This allowed for a disconnection for the stormwater system and allows a smaller space to be directly connected
- **Rooftop runoff can be disconnected** from the gutter system
  - This lets green stormwater infrastructure be designed to treat the runoff on site

What Can Be Improved Upon

- Making **vegetative buffers required** near waterways can help improve the quality of the water and act as a natural filtration system
- Having a required preservation of the land in **clearing and grading** laws which will improve the quality of the area and support natural stormwater filtration

Sites Not Chosen:

- Agriculture Department
  - No storm drains connected
  - Flooding issue at end of parking lot, but not connected to stormwater system
- Saxony Dog Park
  - No storm drains connected
  - No directly connected impervious cover
- Animal Control Facility
  - Could not access

Contacts and Partners:

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CLEAR
Center for Land Use Education & Research