Stormwater Disconnection Plan

City of New London



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During the autumn of 2022, a team of UConn students and Extension faculty performed an evaluation of potential stormwater enhancement opportunities in the City of New London, CT.

• The process included: **desktop analysis and field visits** to determine where Green Stormwater Infrastructure (LID/GSI) 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 the projects identified in this report were **implemented**, 52,872 sq ft of impervious cover would be disconnected from the stormwater system, and 1,243,521 gallons of untreated stormwater, 14.43 lbs. of nitrogen, and 2.63 lbs. of phosphorus would be prevented from entering local water bodies annually.

• Reviewed codes and ordinances for LID/GIS "Friendliness"

In This Report...



- Our recommendations for LID/GSI at **Seven sites** in the City of New London.
- Each site is introduced with an **aerial photo** from Google Maps displaying the recommended LID/GSI and a map displaying all **impervious cover** in that 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
- 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.

GSI/LID - Green Stormwater Infrastructure/ Low Impact Development

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- Low Impact Development (also called Green Stormwater Infrastructure) is an approach to reduce water quality issues by allowing rainwater to infiltrate into soil as close to where it falls as possible.
- This is an important step in reducing the amount of pollutants that enter larger bodies of water that many rely on for their livelihood and for recreation.
- •A reduction in pollutants ensures these larger bodies of water remain a viable natural resource.

Impervious Surfaces & Runoff

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• The expansion of developed land in Connecticut has vastly increased the area of imperious cover around the state. (i.e., roads, rooftops, parking lots, and other development), leading to an increase in runoff of stormwater into city management systems.

• This disrupts the local "Natural" water cycle and increases the amount of pollutants entering our water bodies, increases erosion as well as flooding.

• The implementation of GSI disconnects stormwater from these 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 public, while also offering a more aesthetic alternative to the traditional stormwater management style.

MS4 Requirements - Municipal Separate Storm Sewer

Systems Permitting Program

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•2004 - D.E.E.P. Recognized 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 GSI 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.

•2017 - D.E.E.P. revised and expanded MS4 requirements

• As part of the development of stormwater management plans, along with subsequent monitoring and reporting, municipalities are required to disconnect <u>1% of directly connected impervious</u> cover.

• <u>Directly connected impervious cover</u>: Any impervious surface which conducts stormwater into the city sewer system, and which eventually flows into lakes, streams, and the ocean

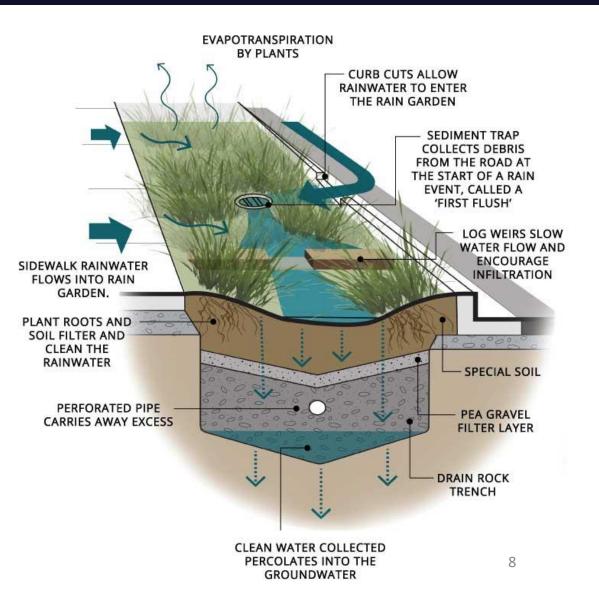
Rain Gardens and Bioretention

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• Are installations that **capture stormwater from impervious surfaces.** Which then allows said runoff to infiltrate into the soil and recharge groundwater.

• 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.

• They add to the aesthetic appeal and the biodiversity of urban areas.



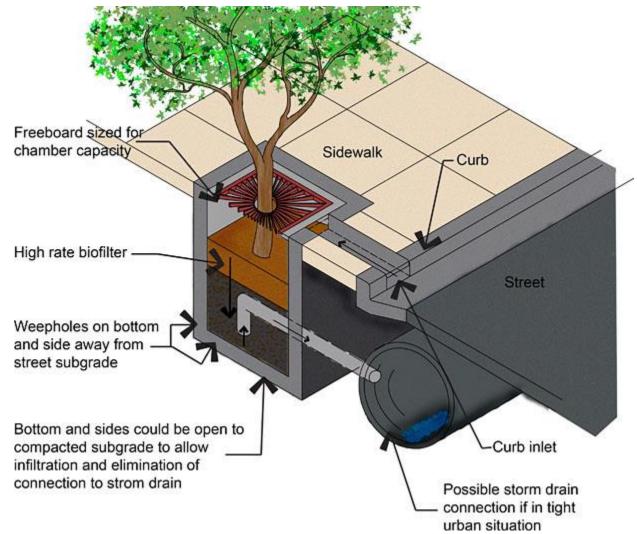
Tree Box Filters

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 Are an aesthetically pleasing GSI practice that filters 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

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• Allows runoff, that would otherwise enter an internal piping or gutter system, to instead **infiltrate substrate**.

- 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** to 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

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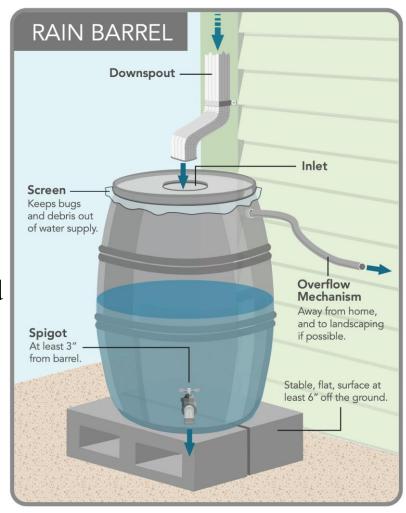
• Capture and reuse of water from gutters and downspouts which would otherwise end up in the municipal stormwater system.

• 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.

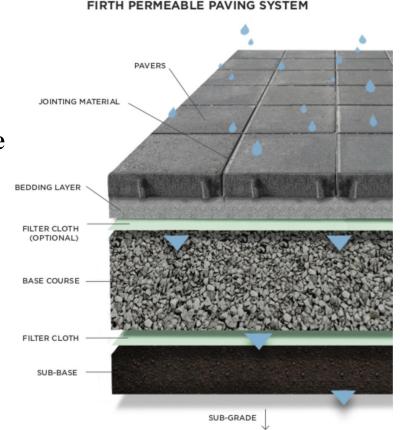
• Cisterns require **minimal maintenance**; however, may need to be **moved in the winter months to prevent freezing**.



Pervious Paving

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- An alternative to traditional pavement that allows for water infiltration.
- Ideal for relatively flat areas that take on a fair amounts of water from surrounding impervious surfaces during storm events.
- Pervious asphalt can 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.
- Pervious pavements can be costly and **require maintenance such as pressure washing and vacuum sweeping** to dislodge debris from pores to ensure proper infiltration.
- Without adequate maintenance this GIS practice is ineffective. Pervious pavement requires less snow maintenance than its counterpart.
- Pavement types available: pervious asphalt, concrete, and a variety of permeable pavers.





Drainage Area: Potential watershed area of each retrofit, 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. All rain gardens in this presentation are sized to handle a 1" rainstorm event.

<u>Nutrient Reductions</u>: 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.

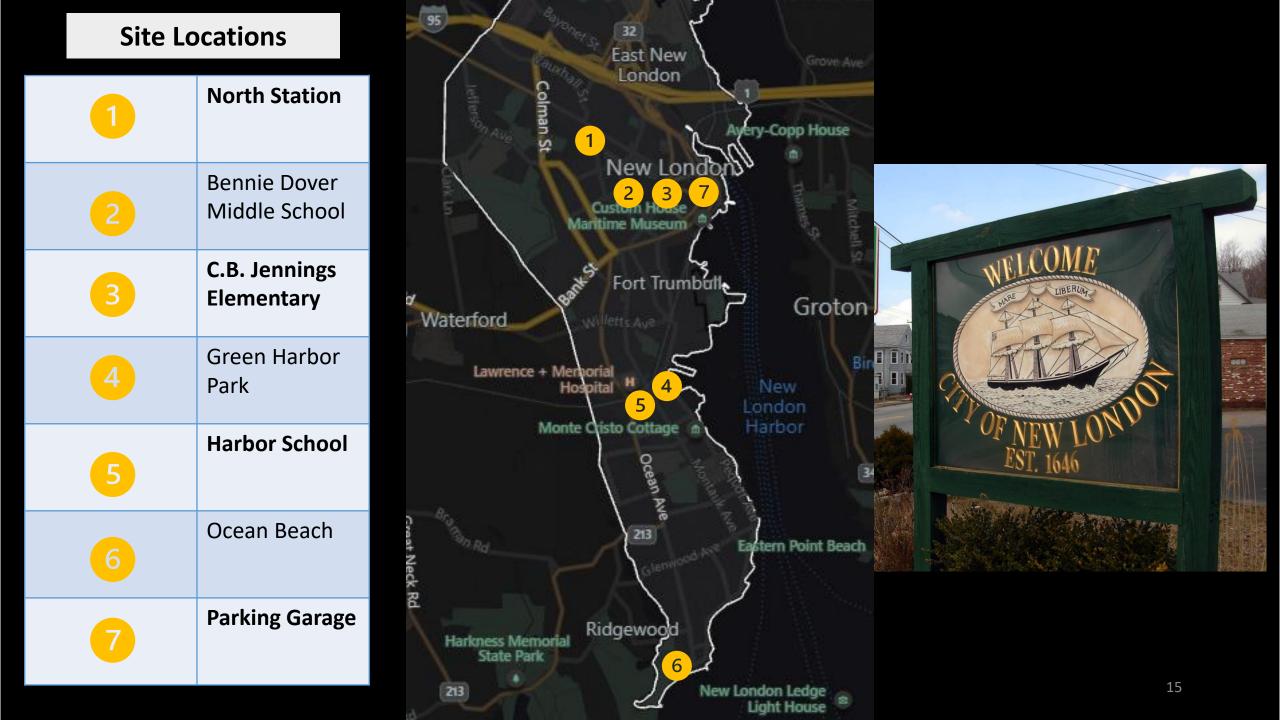
<u>Gallons Treated</u>: The volume of stormwater treated was determined with the assumption that CT experiences around 4' of rain annually and the previously determine drainage area of each retrofit.

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<u>Before visiting sites</u>: we used various aerial imagery tools to view locations and determine sites suitable for GSI retrofits.

<u>**On location**</u>: site specific recommendations were selected based on suitability for implementation of practices.

<u>Other considerations</u>: Educational value, visibility, and volunteer opportunities were also considered when determining the most beneficial locations and practices.



Impervious Cover Map

North Station and Bartlett Park: Site Overview

240 Broad Street

Recommended Practices:

- A bioretention between park and fire house.
- 2) A rain garden out front around sign.
- 3) A rain garden in the rear parking lot.

<u>Notes:</u>

-The area is like a bowl; residents across the street from the site experience regular flooding.& damage.

Visual signs of erosion,
 lots of sediment buildup





Potential Disconnection:

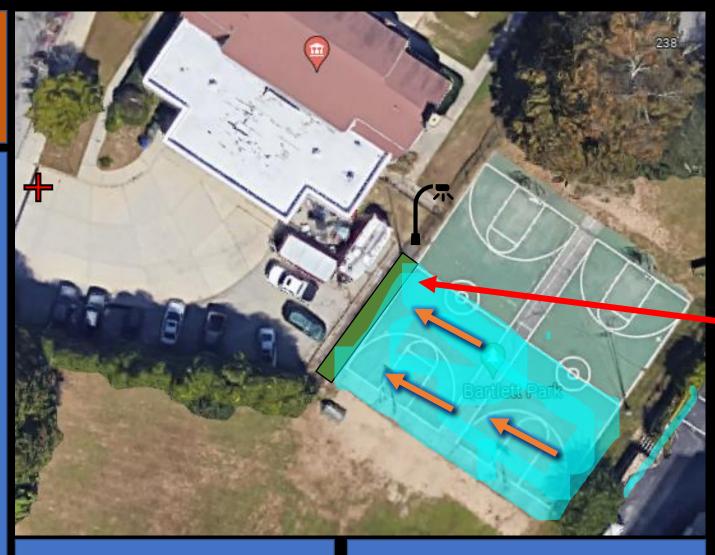
Practice 1: 4,265 s.f. Practice 2: 1,975 s.f. Practice 3: 2,700 s.f.

<u>Total : 8,940 s.f</u>.

North Station and Bartlett Park: Practice 1 Bio Retention

Summary:

- Currently there is a stretch of pavement between the park and firehouse.
- We recommend creating a bioretention area to capture runoff from the park. The practice would be at least one foot deep and 355 s.f
- Potential disconnected area = 4,265 s.f.



Storm Drain =

<u>Bioretention Area =</u>

Drainage area: Blue highlighted area Drainage pattern = Streetlight =



North Station and Bartlett Park: Practice 1



Notes:

Light posts in the area Currently the water runs over where the firemen do car demolition training. Would have to be designed by an engineer. The park offers a great opportunity for community engagement with GSI practices.



Gal. Runoff **Treated**: 112,337 Gallons **Phosphorus** reduction: 0.15 lb./year Nitrogen **<u>Reduction</u>**:

1.17

lb./year 18

Suggested

Retention

Practice: Bio

North Station and Bartlett Park: Practice 2 Raingarden

Summary:

- Currently there is a sign out front in a grassed area.
- We are recommending a raingarden be placed around the sign. The practice would be 6 in. deep and about 329 s.f.
- Potential disconnected area = 1,975 s.f.



North Station and Bartlett Park: Practice 2

- Could remove some of the directly connected gutters from the building, but this design left them as is because we were unsure of the excess water from up the hill and from washing the fire trucks.
 Soil suitability should be done BEFORE installation.
- Ensure during construction natural soils aren't compressed.

<u>Notes:</u>

- Depending on where trucks are washed, Salt tolerant plants should be used.
- Maintenance: Weeding, and general upkeep.
- Aesthetically pleasing
- Visibility of the rain garden would be good for education and awareness



Gal. Runoff Treated:

52,600 Gallons

Phosphorus reduction:

0.07 lb./year



<u>Nitrogen</u> <u>Reduction</u>:

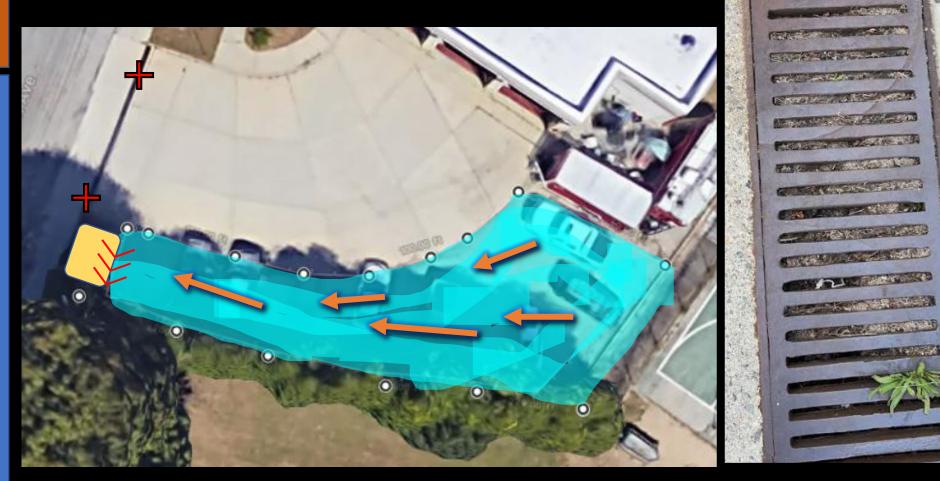
0.55 lb./year 20



North Station and Bartlett Park: Practice 3 Raingarden

Summary:

- Currently the water runs down the parking lot and into a curtain drain.
- We are recommending a rain garden be placed here in the grassed area, with curb cuts. The practice would be 6 in. deep and about 450 s.f.
- Potential disconnected area = 2,700 s.f.



Storm Drain =



Drainage area: Blue highlighted area Drainage pattern = Street Light =

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Contraction and the

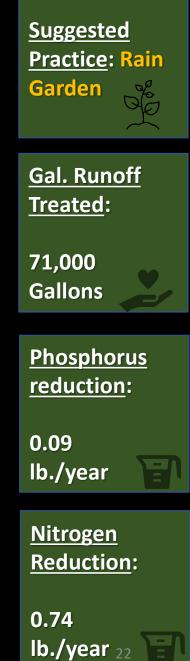
North Station and Bartlett Park: Practice 3



Notes:

- Overflow could be directed into the curtain drain
- Maintenance: Weeding, and general upkeep.
- Curtain drain was clogged; may be adding to the flooding issue.





Green Harbor Beach and Park: Overview

Pequot Ave.

Impervious Cover Map

Recommended Practices:

 A grass swale that would collect runoff from railroad tracks
 Two tree boxes on the street to collect rain from parking lot and road

Notes:

- High bacteria levels at beach could be from runoff. Catching runoff could help reduce manage this problem.
- Visual signs of erosion from railroad tracks into park



Potential Disconnection:

<u>Practice 1:</u> N/A <u>Practice 2:</u> 6,670 s.f<u>.</u>

Total: 6,670 s.f.

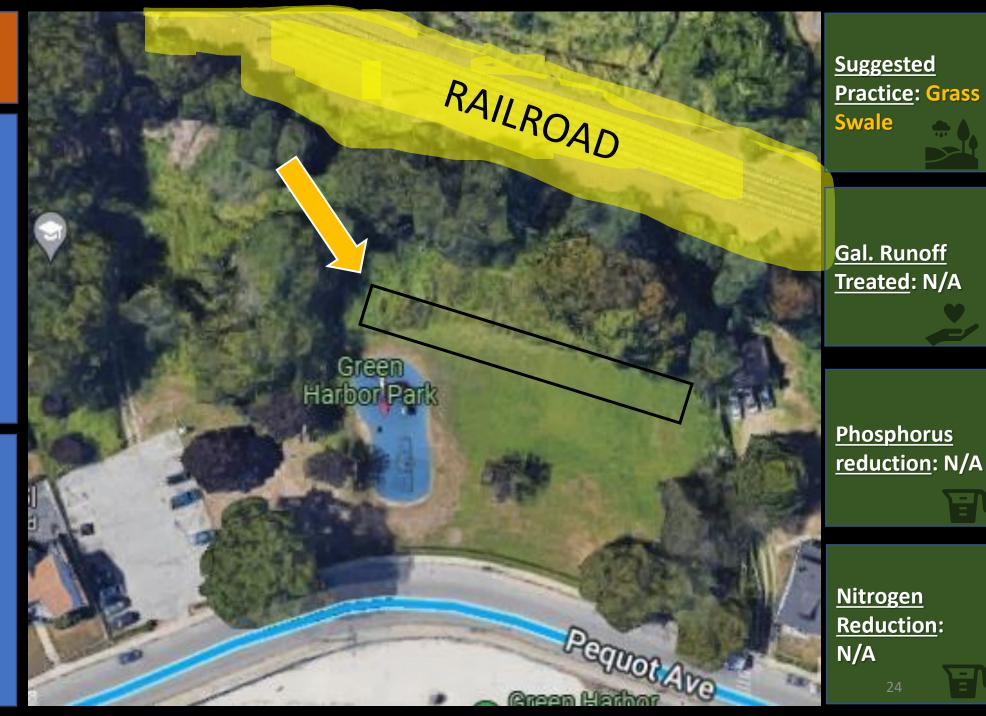
Green Harbor Beach and Park: Practice 1

Summary: Visual signs of erosion: A sedimentation trap is recommended with routine cleaning. The trap would feed into <u>a long-grassed swale:</u> Which would be easily maintained with routine mowing. Currently water runs off the track towards parking lot and into the road.

Notes:

The park offers a great opportunity for community engagement with GSI practices.

- The drainage area could not be assessed since the runoff appears to originate from the track which we could not access.



Green Harbor Beach and Park: Practice 1 (Grass swale)

Green Harbor Park

- The area is already sloped well for a swale to run water the length of the park. (Photo 1)
- It would be easy to maintain
- The swale could be designed so that safety isn't a concern. Example: (Photo 2)





Green Harbor Beach and Park: Practice 2

Summary:

- We are recommending two tree boxes be placed near the entrance to the green harbor park.
- Sizing recommendation is
 6x6 filter for every ¼ acre treated. Having two will keep things symmetrical and allow for adequate storage.
- Potential disconnected area = 6,670

<u>Notes:</u>

- We recommend groundwater level is checked.
- The park offers a great opportunity for community engagement with GSI practices.



Green Harbor Beach and Park: Practice 2 (Tree Boxes)



 Maintenance like trees already planted in the city, leaf cleanup and raking near openings.

Just one example of what a tree box filter can look like.

Bennie Dover Jackson Middle School: Overview

36 Waller Street

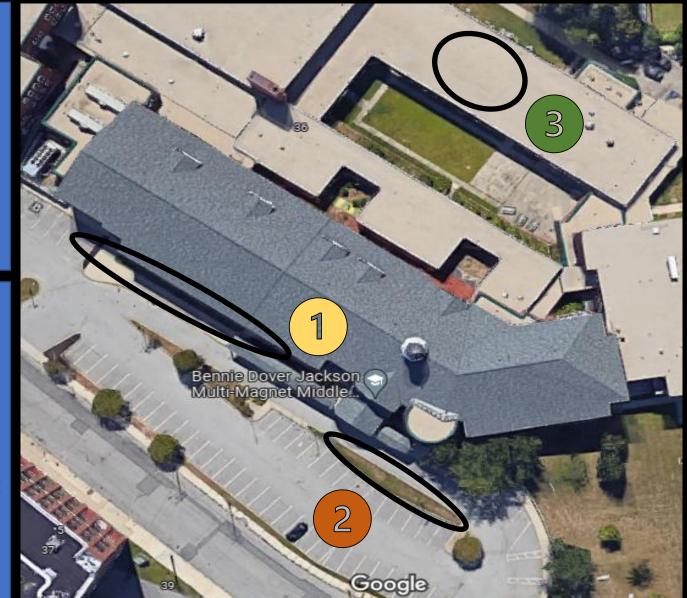
Impervious Cover Map

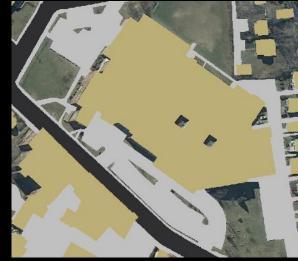
Recommended Practices:

 A rain garden in front of school
 One Tree box in grassed median (Front)
 Green roof (trays) on back building

<u>Notes:</u>

-Visual signs of erosion,
lots of sediment in
between walkway and
building, looks like the
gutter might be inundated.
Tree box in the parking lot
could help reduce the load
on storm drains down
gradient.





Potential Disconnection:

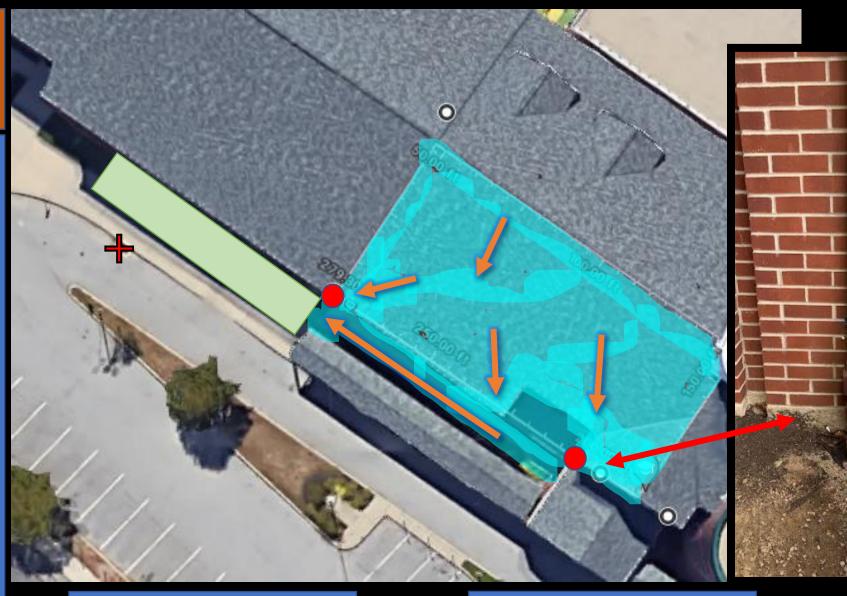
Practice 1: 4,500 s.f. Practice 2: 3,800 s.f. Practice 3: 2,500 s.f.

<u>Total: 10,800 s.f.</u>

Bennie Dover Jackson Middle School: Practice 1 Raingarden

Summary:

- Currently this down spout seems to be backflowing and causing a great deal of erosion.
- We recommend
 creating a raingarden
 and disconnecting two
 downspouts. The
 raingarden would be 8
 in. deep and about 563
 s.f.
- Potential disconnected area = 4,500 s.f.

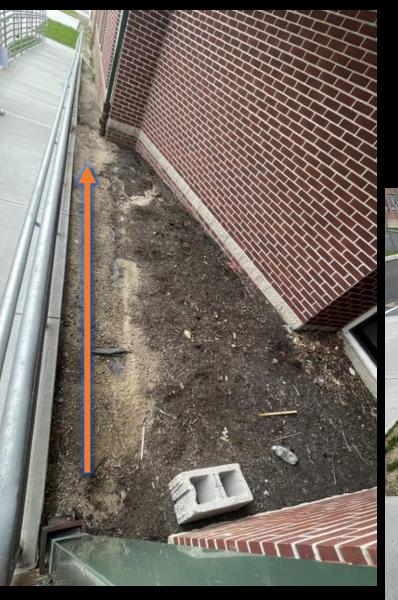


Down Spout = Rain Garden = Strom Drain = Drainage area: Blue highlighted area Drainage pattern =

Bennie Dover Jackson Middle School: Practice 1

Notes:

- Maintenance: Weeding, and general upkeep.
- Fenced in to reduce safety concern.
- The School offers a great opportunity for community engagement with GSI practices.





Garden Gal. Runoff Treated: 118,449 Gallons **Phosphorus** reduction: 0.16 lb./year Nitrogen **Reduction**:

1.29

lb./year 30

Suggested

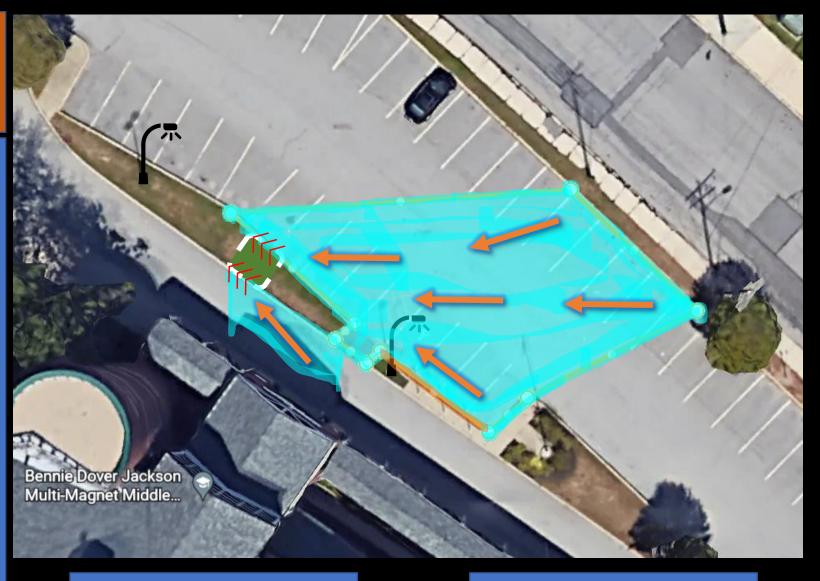
Practice: Rain

Bennie Dover Jackson Middle School: Practice 2 Tree box filter

Summary:

- Currently all the water in this lot runs towards the curtain drain just out of this photo.
- Sizing recommendation is 6X6 filter for every ¼ acre treated. Having one will allow for adequate storage.

Potential disconnected area = 3,800 s.f.

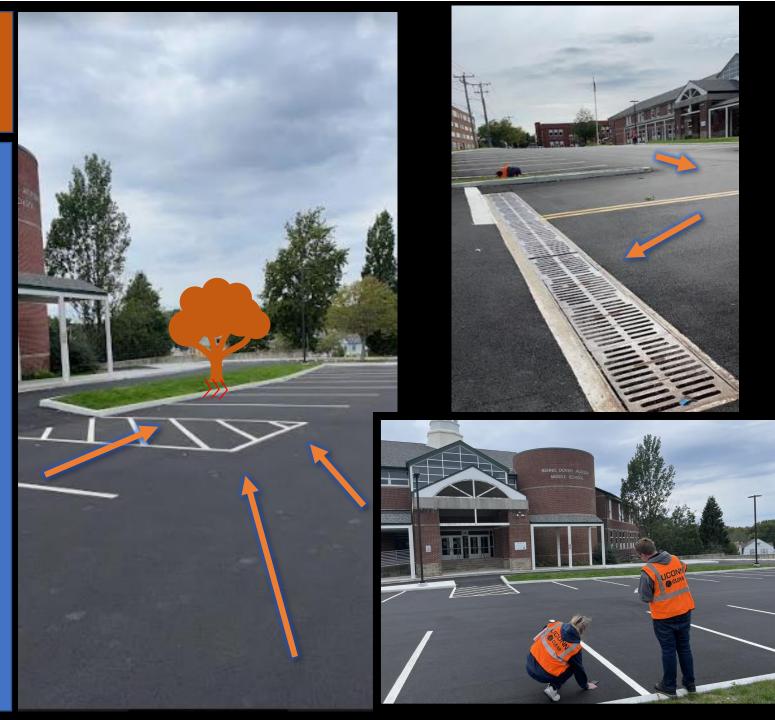


 $\frac{\text{Streetlight} = }{\text{Tree box} = }$ $\frac{\text{Curb Cut} = }{\text{Curb Cut} = }$

Drainage area: Blue highlighted area Drainage pattern = Bennie Dover Jackson Middle School: Practice 2

Notes:

- Tree box blends in well with surrounding landscape
- Maintenance: Weeding, and general upkeep.
- Light posts in the area: consider underground wires.



Suggested Practice: Tree box Gal. Runoff **Treated**: 100,060 Gallons **Phosphorus** reduction: 0.13 lb./year Nitrogen **Reduction**:

1.04

lb./year₃₂

Bennie Dover Jackson Middle School: Practice 3

Summary:

- Recommending a tray style
 green roof, so that they are
 easily moved and changed
 out as needed. Trays tend
 to be cheaper as well as
 the lighter option.
- Potential disconnected area = 2,500 s.f.

Notes:

- Would have to have an engineer confirm the roof could support the added weight
- Great view from school windows.
- Maintenance: Weeding, and general upkeep.



Green roof and drainage area area the same area =

<u>Reduction</u>:

lb./year 33

0.68

C.B. Jennings Elementary: Site: Overview

50 Mercer Street

Impervious Cover Map



Potential Disconnection:

Practice 1: 870 s.f. Practice 2: 2,711 s.f.

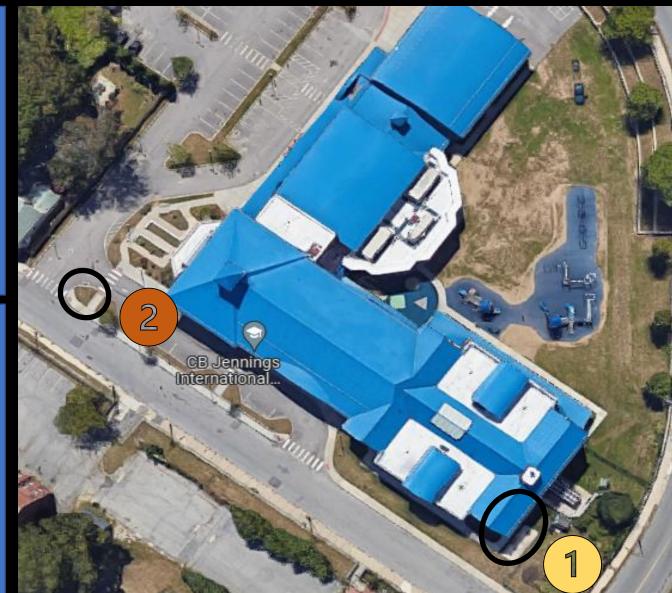
<u>Total: 3,581 s.f.</u>

Recommended Practices:

- 1) A rain barrel for community garden
- 2) One tree box in grassed median (Front)

Notes:

- Tree boxes in the parking lot could help reduce the water load on storm drains.
- The rain barrels could be used in place of the hose being used currently



C.B. Jennings Elementary: Site: Practice 1

Summary:

- Disconnect the two visible down spouts and divert water into barrels for the garden.
- Disconnected potential area = 870 s. f.

<u>Notes:</u>

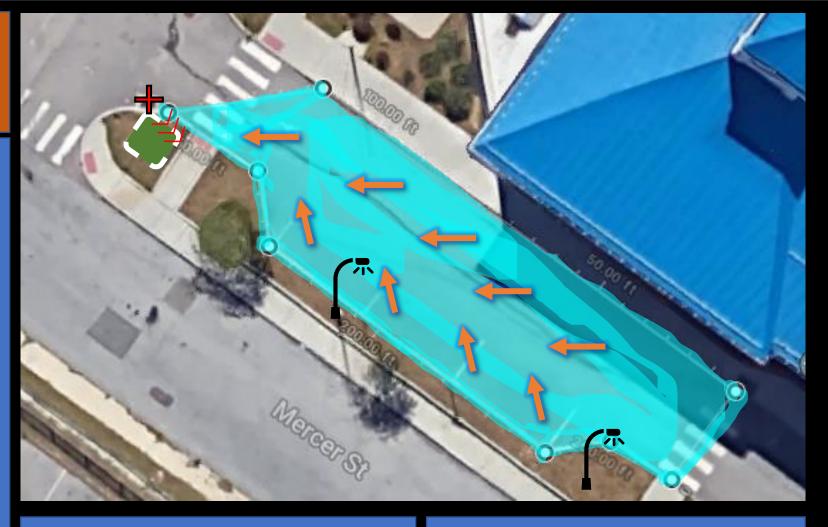
- Maintenance: Must be stored for the winter and reinstalled in spring
- Only used seasonally, so stormwater reduction is from April – October.
- The School offers a great opportunity for community engagement with GSI practices



C.B. Jennings Elementary: Site: Practice 2 Tree Box Filter

Summary:

- Currently all the water in this lot runs towards the marked storm drain.
- Sizing recommendation is 6X6 filter for every ¼ acre treated. Having one will allow for adequate storage.
- Potential disconnected area = 2,711 s.f.



Drainage area: Blue highlighted area



Drainage pattern =

C.B. Jennings Elementary: Site: Practice 2





<u>Notes:</u>

- Maintenance: Weeding, and general upkeep.
- Light posts in the area.
- A curb cut could be created just before the storm drain. The storm drain can act for overflow.



0.74 lb./year 37

Harbor Elementary: Site Overview

432 Montauk Ave

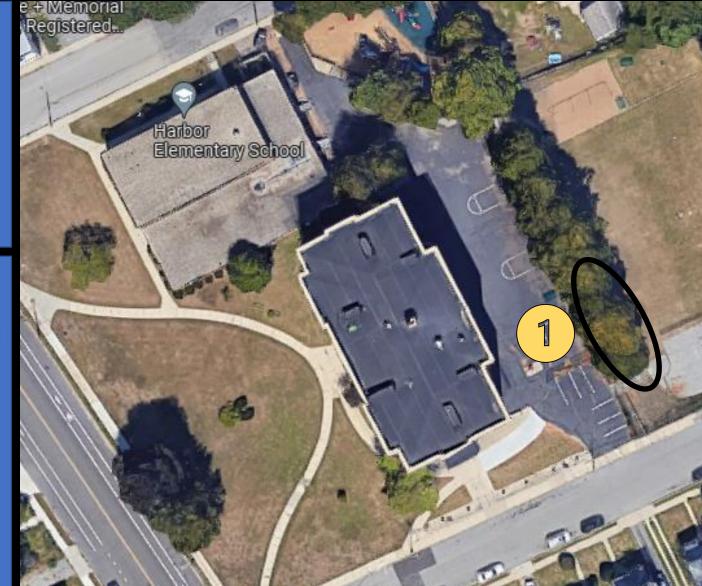
Recommended Practice:

 1) One tiered rain garden (transition from parking lot to field. On either side of the stairs

Notes:

The parking lot is sloped so that the water runs towards the field/ road Creating curb cuts and allowing water to flow into the rain garden will help elevate flooding

down gradient.



Impervious Cover Map



Potential Disconnection:

Practice 1: 6,339 s.f. Total: 6,339 s.f. Harbor Elementary: Practice 1 Rain Garden

Summary:

- We recommend creating curb cuts and a tiered rain garden.
- The practice would be 6 in deep and around 1,057 s.f.
- Potential disconnected area = 6,339 s.f.

Rain Garden =

<u>Curb Cut =</u> _



Drainage area: Blue highlighted area

Drainage pattern =



Harbor Elementary: Practice 1





- Aesthetically Pleasing
- The School offers a great opportunity for community engagement with GSI practices
- Maintenance: Weeding, and general upkeep.
- Trees are no longer there.

Suggested Practice: Rain Garden

Gal. Runoff **Treated**:

166,926 Gallons

Phosphorus reduction:

0.22 lb./year

1.73



Nitrogen **<u>Reduction</u>**:

lb./year 40

Ocean Beach: Site Overview

98 Neptune Ave

Recommended Practice:

1) A large rain garden between parking lot and waterslide

Notes:

- The area is very close to the beach, high water table expected.
- Sand deposition in practice another concern



Impervious Cover Map



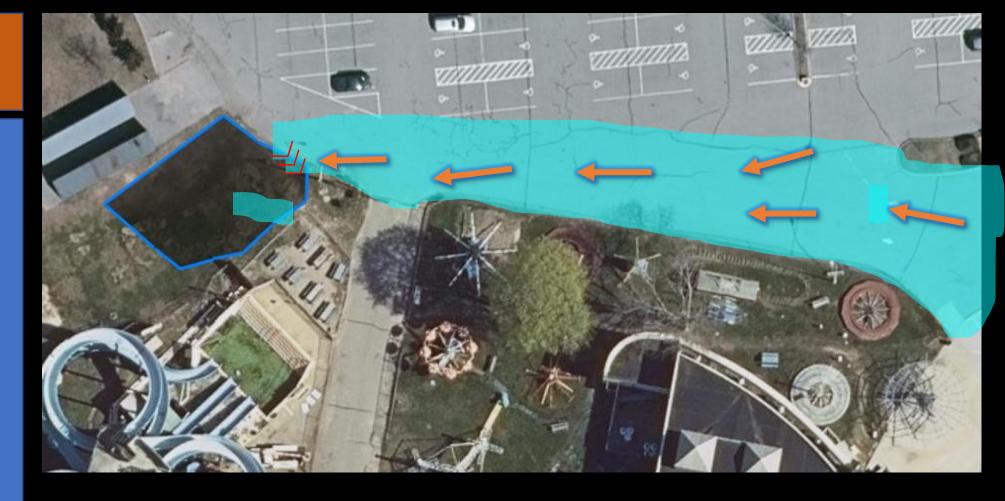
Potential Disconnection:

Practice 1: 10,800 s.f. Total: 10,800 s.f.

Ocean Beach: Practice 1 Rain Garden

<u>Summary:</u>

- Currently water runs from the lot directly into the nearby cove.
- We recommend a raingarden that is 6 in. deep and about 1,800 s.f.
- Potential disconnected area = 10,800 s.f.



<u>Rain Garden =</u>dark area encircled in blue

<u>Curb Cut = -</u>

Drainage area: Blue highlighted area

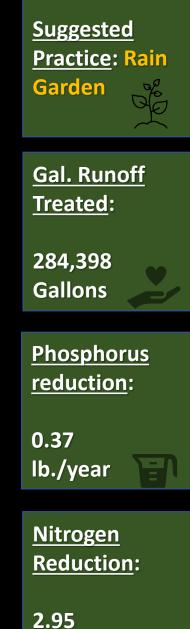
<u>Drainage pattern =</u>

Ocean Beach: Practice 1

Notes:

- The Nature Park offers a great opportunity for community engagement with GSI practices
- Maintenance: Weeding, and general upkeep.
- Recommend having expert check soil suitability BEFORE installation due to water table.





lb./year 43

Impervious Cover Map

Parking Garage: Site Overview

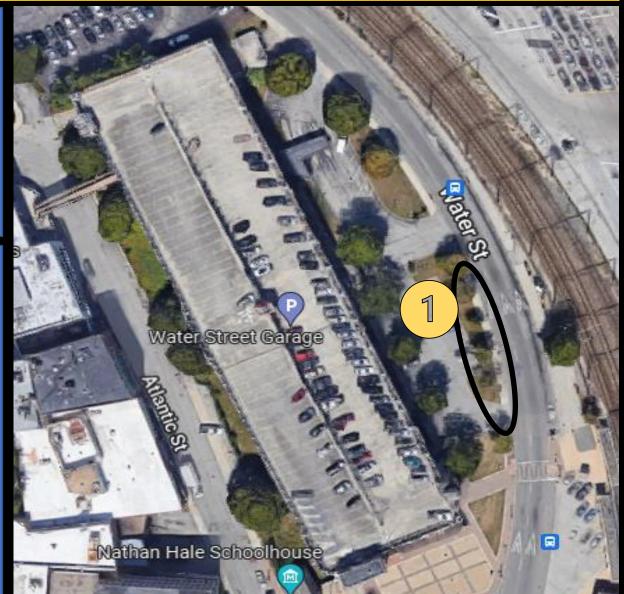
160 Water Street

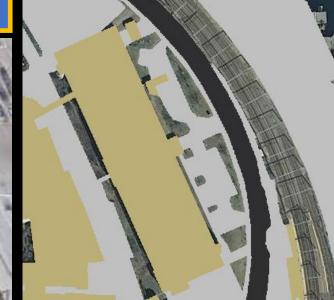
Recommended Practice:

1) A large rain garden broken up into two smaller sections so tree can remain

Notes:

- Right off Bank Street, very urban area
- Close to river, could have a high-water table.





Potential Disconnection:

Practice 1: 5,742 s.f.

<u>Total: 5,742 s.f.</u>

Parking Garage: Practice 1 Rain Garden

Summary:

- Currently water runs from the lot directly into the storm drain.
- We recommend a raingarden that is 6 in. deep and about 975 s.f.
- Potential disconnected area = 5,742 s.f.



Storm Drain =

Drainage area: Blue highlighted area Curb Cut = -Drainage pattern =

Parking Garage: Practice 1



Notes:

- Commuter hub offers a great opportunity for community engagement with GSI practices
- Maintenance: Weeding, and general upkeep.
- Existing storm drain could act as overflow
- Must be mindful of the trees and their roots.



Suggested

Garden

Practice: Rain

Site Recommendation Figures

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Site	Practice	Area disconnected (s.f)	Runoff treated (Gallons)	Phosphorus reduction (lb./yr)	Nitrogen reduction (lb./yr)	Practice Size
North Station	Bioretention	4,265	112.337	0.15	1.17	355 (s.f)
North Station	Rain Garden	1,975	52,600	0.07	0.55	329 (s.f)
North Station	Rain Garden	2,700	71,000	0.09	0.74	450 (s.f)
Bennie Dover	Rain Garden	4,500	118,449	0.16	1.29	563 (s.f)
Bennie Dover	Tree Box	3,800	100,060	0.13	1.04	6x6 box
Bennie Dover	Green Roof	2,500	37,405	0.09	0.68	2500 (s.f)
C.B. Jennings	Rain Barrel	870	14,335	0.02	0.15	500 (gallons)
C.B. Jennings	Tree Box	2,711	71,389	0.9	0.74	6X6 box
Green Harbor	Grass Swale	N/A	N/A	N/A	N/A	N/A
Green Harbor	Tree Box	6,670	175,642	0.23	1.82	6X6 box
Harbor (school)	Rain Garden	6,339	166,926	0.22	1.73	1057 (s.f)
Ocean Beach	Rain Garden	10,800	284,398	0.37	2.95	1800 (s.f)
Parking Garage	Rain Garden	5,742	151,205	0.2	1.57	957 (s.f)
Total:		52,872	1,243,521	2.63	14.43	

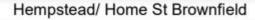
Sites Not Chosen

COMPANY

FLALLEN HOOK & LADDE

Bank Street Fire House: while it would have been great to try and do something with this area, since the area is prone to flooding and has high visibility, however there is no green space available to create a bioretention and the roof is not suitable for a green retrofit. Brownfield: We recommend that this site not be designed with (GSI) without soil testing. Because there is a potential for residual contamination spreading more easily down gradient.





UCONN

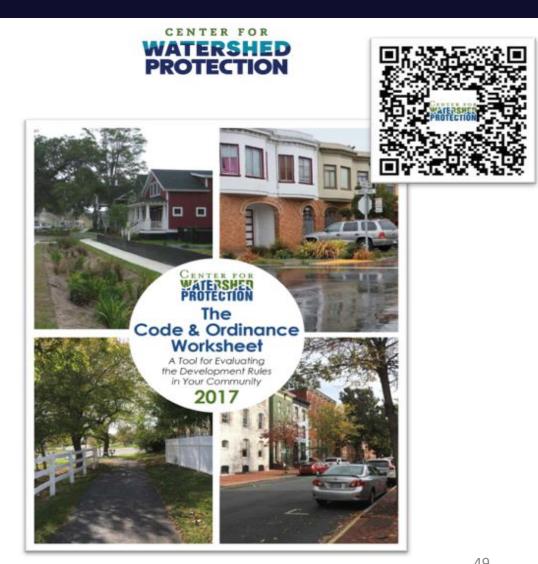
What Are Cows?

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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

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Advantages

The zoning regulations often mentions Best Management Practices and leave room for exceptions to rules with consent for the governing body.

For example, in the Drainage section: In addition to the requirements of other sections of these regulations, the use of on-site natural filtration functions is <u>encouraged</u> as part of currently accepted Best Management Practices in the reduction of sediment and pollutants.

Disadvantages

The GSI measures are just options, For many, it is unfamiliar territory, resulting in non implementations in favor of what is familiar and known.

COW Statistics



- Out of a possible 128 points, New London achieved 36 points, giving the score of 28%
- This seems to be on par with other Connecticut towns.
- Most points were lost because the codes were not specific about what should or should not be done. Most practices are left to be ruled on by the local governing body during the permit process.

Contacts

UCONN

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Questions Comments Concerns



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Photo of raingarden- https://www.courtenay.ca/EN/main/community/downtown-revitalization/5th-street-complete-street/5th-street-rain-garden.html

Photo of pavement-

https://productspec.co.nz/en/articles/firth-s-new-stylish-300-x-300mm-permeable-patio-system/

photo of tree box filter- NA'

photo of green roof-

https://greenroofoutfitters.com/products/green-roof-systems/