Stormwater Runoff Reduction Plan

Norwalk, CT

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Summary

In the summer of 2024, UConn students and faculty conducted a stormwater retrofit assessment in the town of Norwalk, CT. A discussion with the town, a desktop analysis, and field site visits were conducted to determine where potential green stormwater infrastructure may be installed.

A total of **15 potential projects** were identified. If all projects are installed, **47,363 ft^2** of impervious cover will be disconnected.

Impervious Surfaces and Stormwater Runoff

Increased development in the state of Connecticut has ultimately caused an immense increase in the amount of impervious cover throughout the state. Impervious surfaces, such as rooftops, parking lots, roads, and more, increase the amount of stormwater runoff that flows into waterways. Traditional stormwater infrastructure disrupts the water cycle, increases the number of pollutants in our waterways, and increases flooding and erosion. By installing green stormwater infrastructure, impervious surfaces are disconnected from stormwater management systems and stormwater can naturally infiltrate into the ground.

MS4 Requirements

As part of the **Federal Clean Water Act**, the Connecticut Department of Energy and Environment Protection **(DEEP)** requires Municipalities to regulate stormwater discharges into water bodies.

- **Nonpoint Source Pollution:** stormwater runs across impervious surfaces, collecting pollutants before it flows into storm drains and eventually waterways
- **The MS4 General Permit** and other stormwater permitting programs prefer the use of Low Impact Development **(LID)** practices, including green stormwater infrastructure, wherever possible to mitigate pollution in waterways.
- **LID practices** aim to preserve pre-development hydrology, with an emphasis on treatment and retention of stormwater onsite.
- MS4 Towns are required to develop and work to implement a **plan to disconnect 1% of their impervious surfaces** from draining into the stormwater system.

What does MS4 stand for?

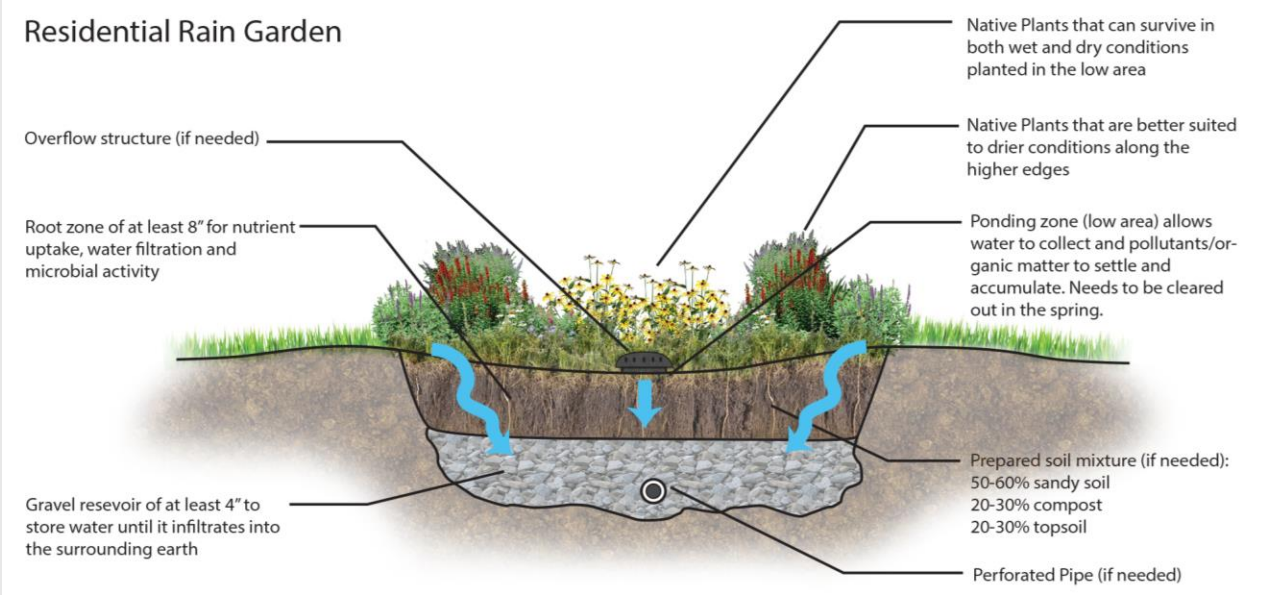
Municipal Separate Storm Sewer Systems Permitting Program

Green Stormwater Infrastructure Practices

This report centers on rain gardens as the main source of green stormwater management. However, there are several other types of green stormwater infrastructure that will be detailed in order to provide greater context and inform the town of potential practices that they may invest in in the future. Types of green stormwater infrastructure include: **rain gardens, bioretention basins, pervious pavement, tree box filters, green roofs,** and **rainwater harvesting**.

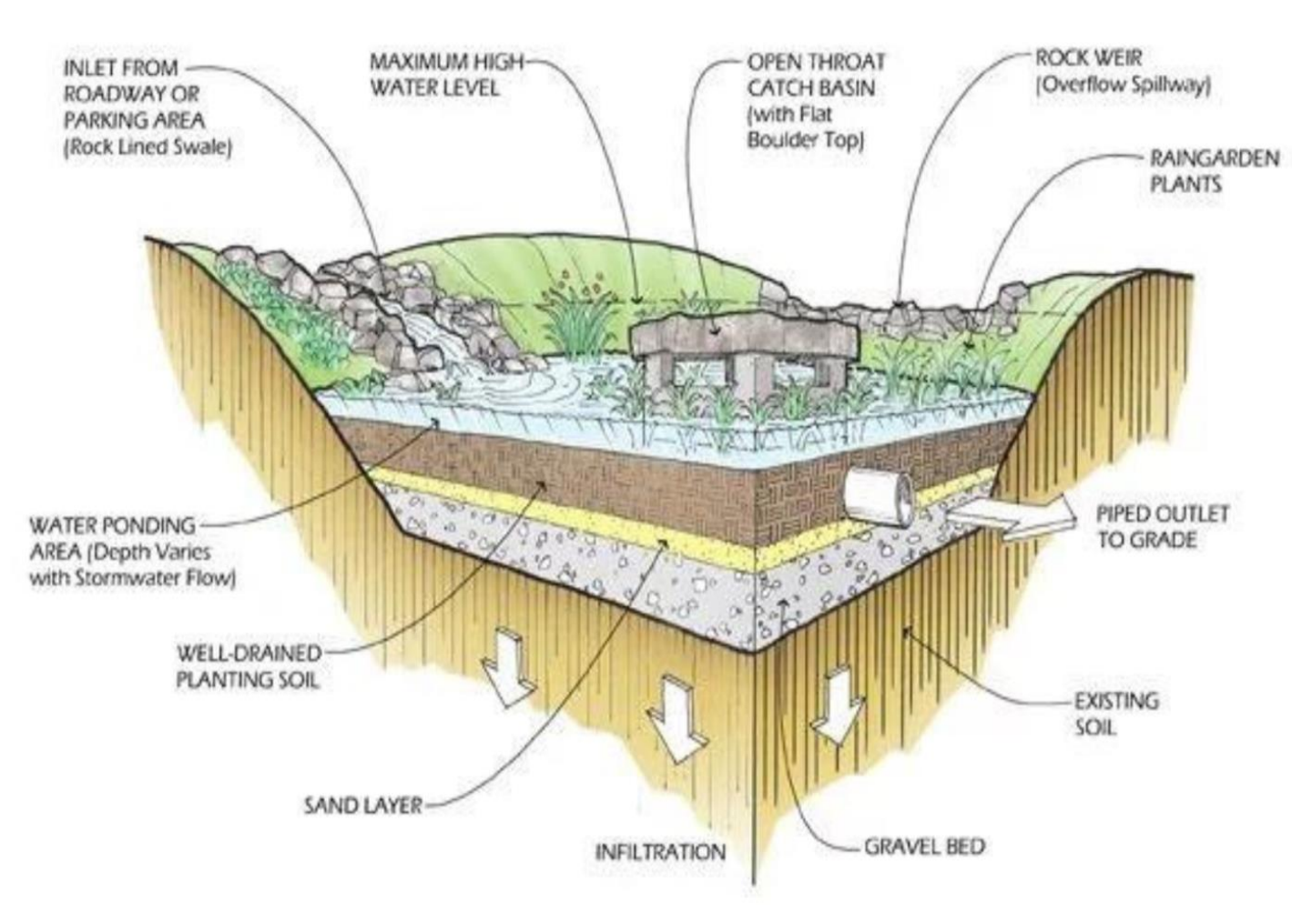
Rain Gardens

- Collects stormwater runoff from roofs via disconnected gutters or from impervious surfaces and infiltrates runoff into the ground naturally
- Involves a **6+ inch** depression, often with grass, native plants, or stone
- May include curb cuts, gravel, or stone to prevent erosion
- Aesthetically pleasing and provides greater biodiversity
  - Pollinator pathways
- **Less costly** than other types of green stormwater infrastructure
- Maintenance includes weed/invasive removal and flow path inspections
- Avoid creating mowing islands and building too close to the tree roots
- Rain gardens drain within **12-24 hours**
  - If drained in this timeframe, they would ***not*** be breeding ground for mosquitoes and other bugs



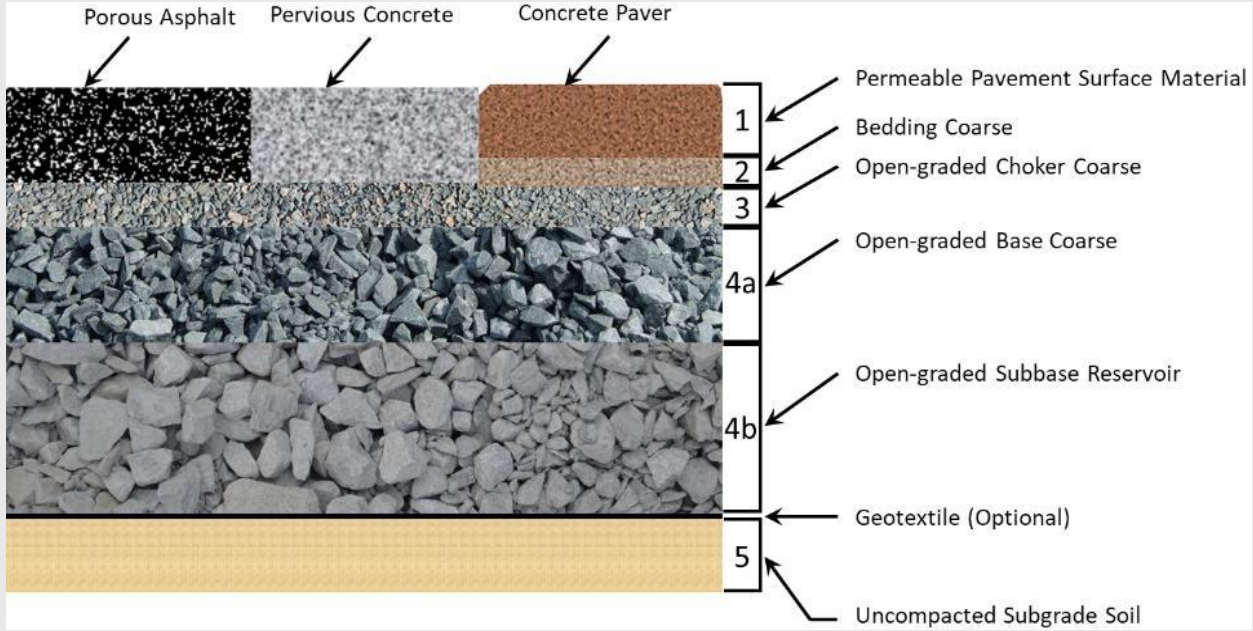
Bioretention Basins

- Serve the same function as rain gardens
- Key differences include: **special soil media, overflow structures, and underdrains**
- Essentially involve more engineering than rain gardens and are typically done in either **more developed areas or areas where the soil conditions require it**



Pervious Pavement

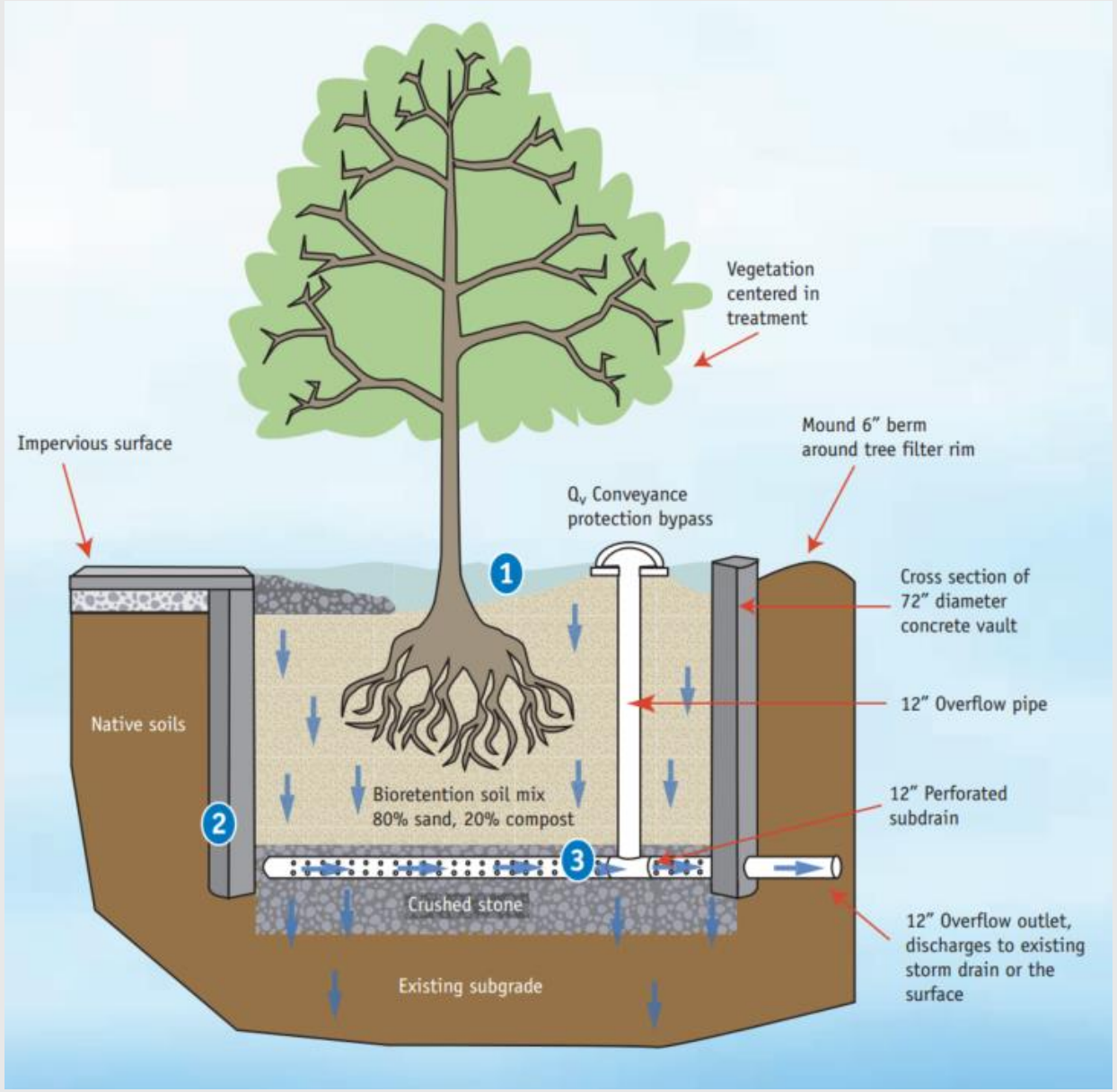
- Serve as an alternative to traditional pavement by allowing water to infiltrate into the ground instead of running off
  - Typically installed in areas that are **already being repaved** to avoid excess construction
  - **Cost competitive** with typical pavement
- Ideally installed somewhere relatively flat and already deals with large amounts of runoff



- Needs to be maintained effectively (pressure washing and vacuum sweeping) to make sure that stormwater can still infiltrate well
- Requires **less snow maintenance** than traditional pavement
- Needs to be **replaced less frequently** than traditional pavement because it doesn't contract and expand as much with the changing seasons and temperatures

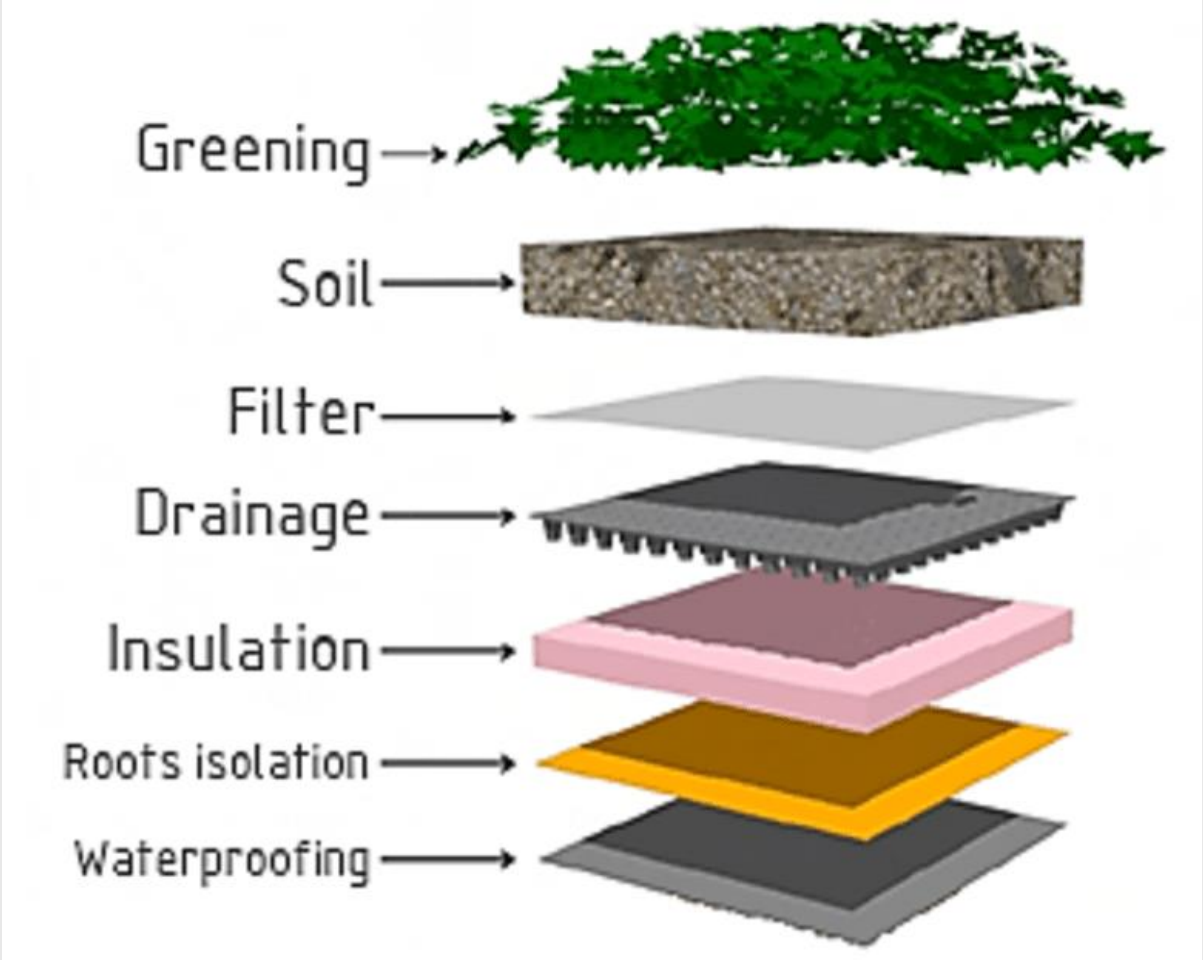
Tree Box Filters

- Aesthetically pleasing practice that filters runoff through tree roots
  - Stormwater enters the installation through a grate, then infiltrates through the soil and root system of the tree, filtering out pollutants in the process
- In the case of extreme amounts of stormwater present near the filter, an underdrain may be required to prevent flooding



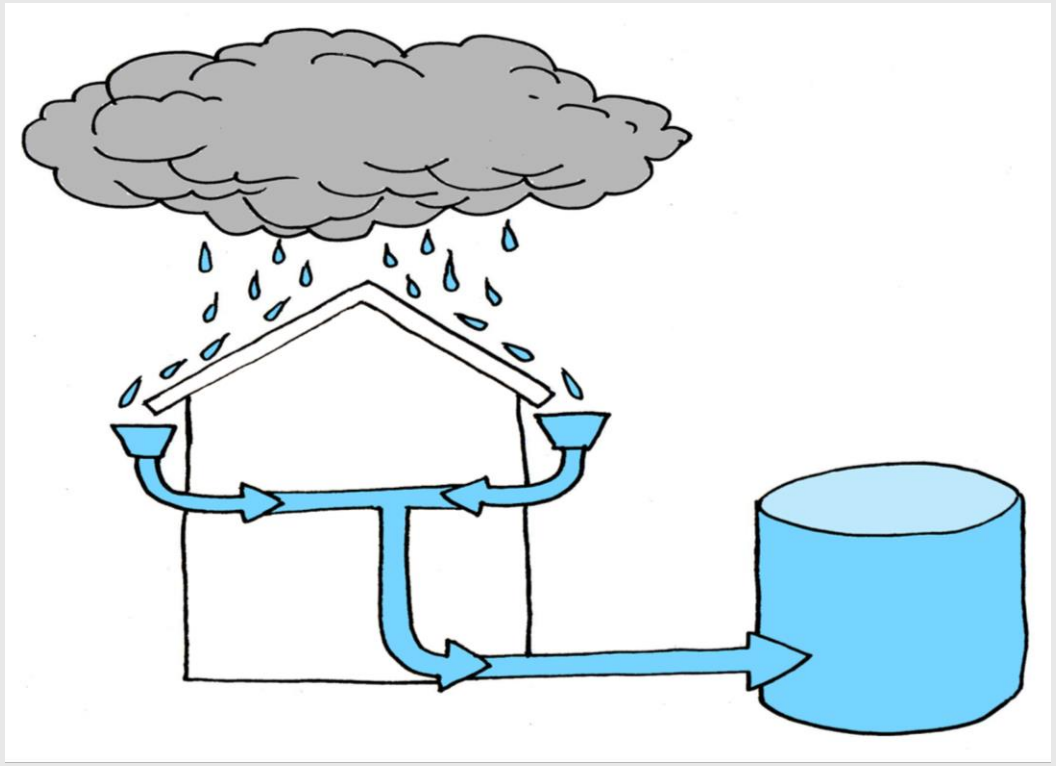
Green Roofs

- Allows runoff to infiltrate substrate directly
- Disconnects about **50%** of the stormwater from roof
- Most expensive practice, but offers great educational opportunities for nearby communities and adds to the aesthetic
- **Green roof trays** may be a more affordable option and will give many of the same benefits
- Implementation of a green roof depends on the **structural support of the roof and proper roof access**



Rainwater Harvesting

- **Rainwater harvesting** is the capture and reuse of rainwater from gutters and downspouts
- Roof runoff is fed into large cisterns which retain the water until it can be repurposed
  - Cisterns require minimal maintenance
    - May need to be moved in the winter months to prevent freezing.
- Reduces stress on private wells and municipal water supplies
- The required size of the rain barrel depends on the collection area
- Materials can range from PVC to steel
- Filters can be installed to remove pollutants if needed



Site Selection and Approach

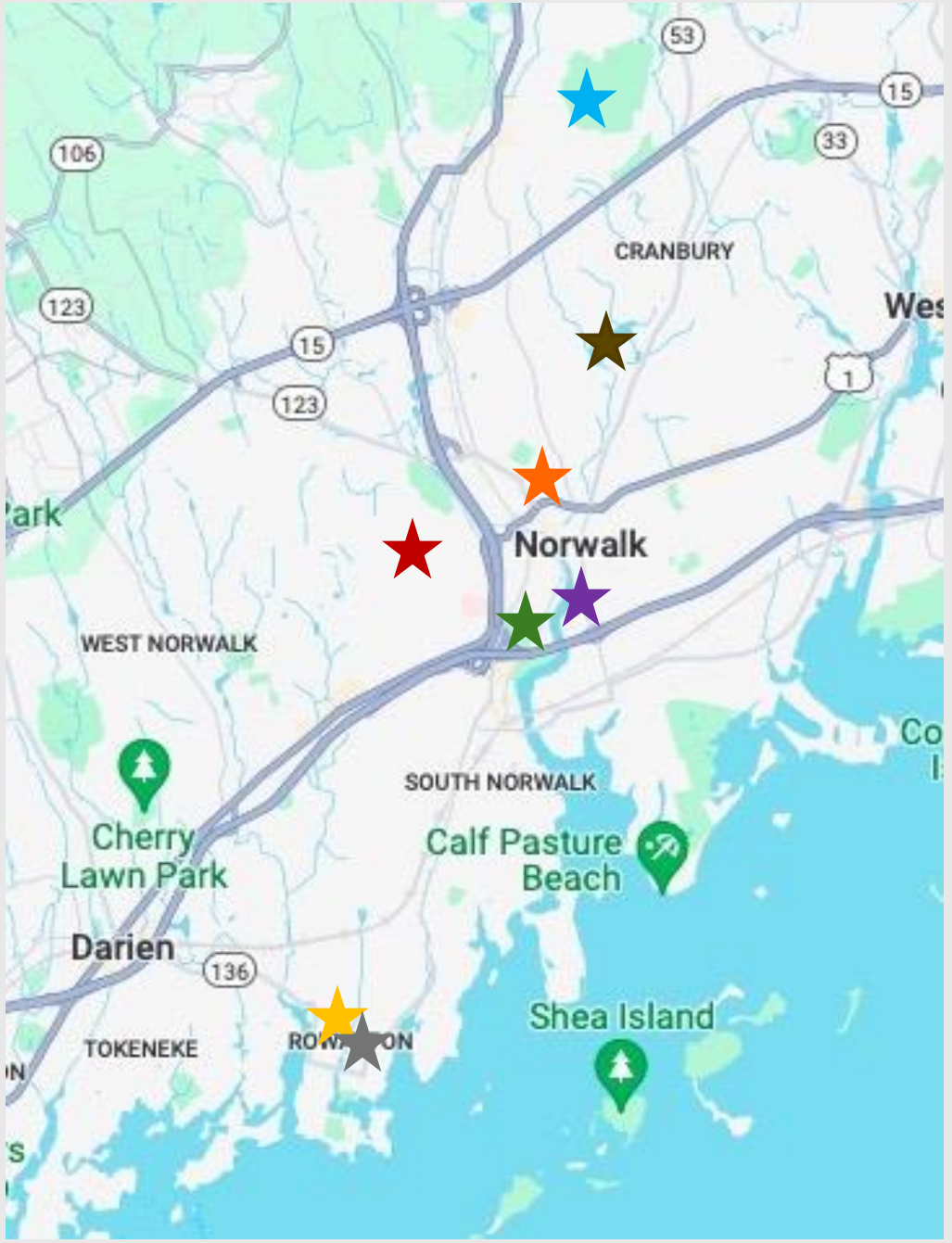
Before visiting sites, team members used aerial imagery tools to view different locations to determine possible sites suitable for green infrastructure practices. This work included using the statewide **high-resolution impervious surface maps** to get an overall feel for the site, following **contour 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. Criteria used include:

- **Slope** of surrounding land
- **Land available** for use
- Locations of existing **storm drains or other overflow opportunities**
- Above ground and underground **obstructions** (large trees, pipes, utilities, etc.)
- Pre-existing **green infrastructure practices**
- **Maintenance** concerns
- **Educational** value
- Visibility
- Safety
- Volunteer opportunities
- **Size** of disconnect/impact

Site Overview

- Mathews Park
- Norwalk City Hall
- Rowayton Community Center
- Cranbury Park
- Rowayton Elementary School
- Kendall Elementary School
- Senior Center
- Tracey Magnet School



Explanation of calculations

- **Drainage Area:** The potential watershed area for each retrofit was estimated using topographic tools 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 **1.3 inch rainstorm event**. Rain gardens should be able to hold the same volume so the area and depth is altered accordingly. Rain gardens deeper than 12 inches are avoided for safety reasons.
- **Nutrient Reductions:** The area of land treated and estimated concentrations of nutrients that runoff into that area is equal to the amount of nutrients that can be directed away from that watershed, as calculated by **Charles Frink** in a paper discussing nutrient concentrations in Connecticut by major type of land cover**.** *Point source pollution was not taken into consideration in these calculations as it varies depending on the site.*
- **Gallons Treated:** The volume of stormwater treated was determined with the assumption that Connecticut experiences around 48 inches of rain annually.

Mathews Park

295 West Avenue

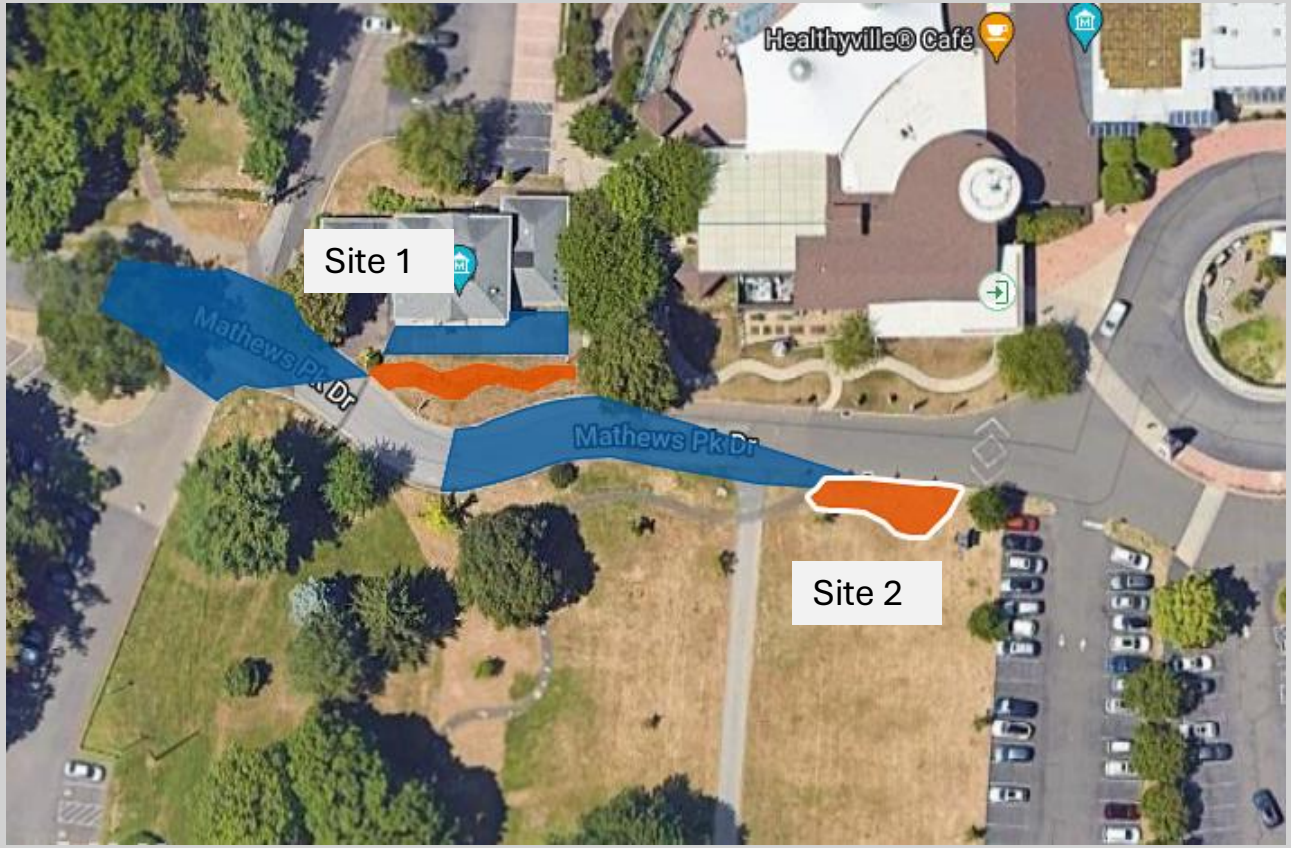
At this site, we recommend the installation of two rain gardens to help reduce the storm water runoff in this park, educate the park patrons and to overall beautify this space. Both Rain Garden locations are highly visible making these the perfect educational opportunity.

Possible **disconnection of 8,406 feet^2** of impervious cover with the implementation of a rain garden.

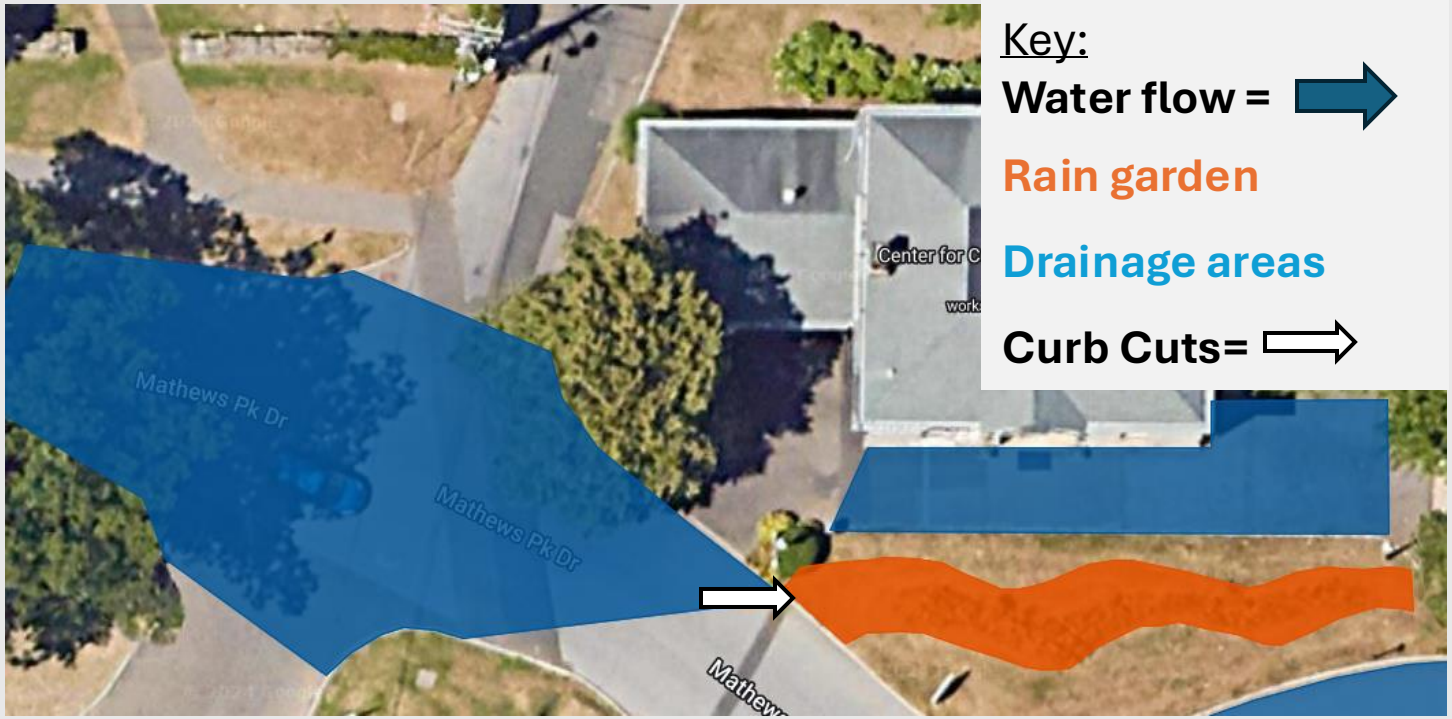
Key:

Drainage areas

Rain gardens



Mathews Park Site 1



Mathews Park Site 1

Site Notes: The installation of a rain garden in this space would not only make this stretch of grass a beautiful sight but can also provide an opportunity for a pollinator pathway. Located at the entrance of the park and in front of the center for contemporary printmaking, this site is highly visible. The rain garden installed must be at an 8-inch depth to accommodate for the small space.

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
4,530	Rain Garden	119,295	0.99	0.13	736 (8 inch depth)

Mathews Park Site 2

Mathews Park Site 2

Site Notes: This site can provide a great educational opportunity considering its closeness to an existing walking path making it a perfect place for park patrons to sit next to. The shape of this rain garden is rendered to avoid the small tree close by.

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
3,877	Rain Garden	102,089	0.85	0.11	8,276 (6 inch depth)

Norwalk City Hall

125 East Avenue

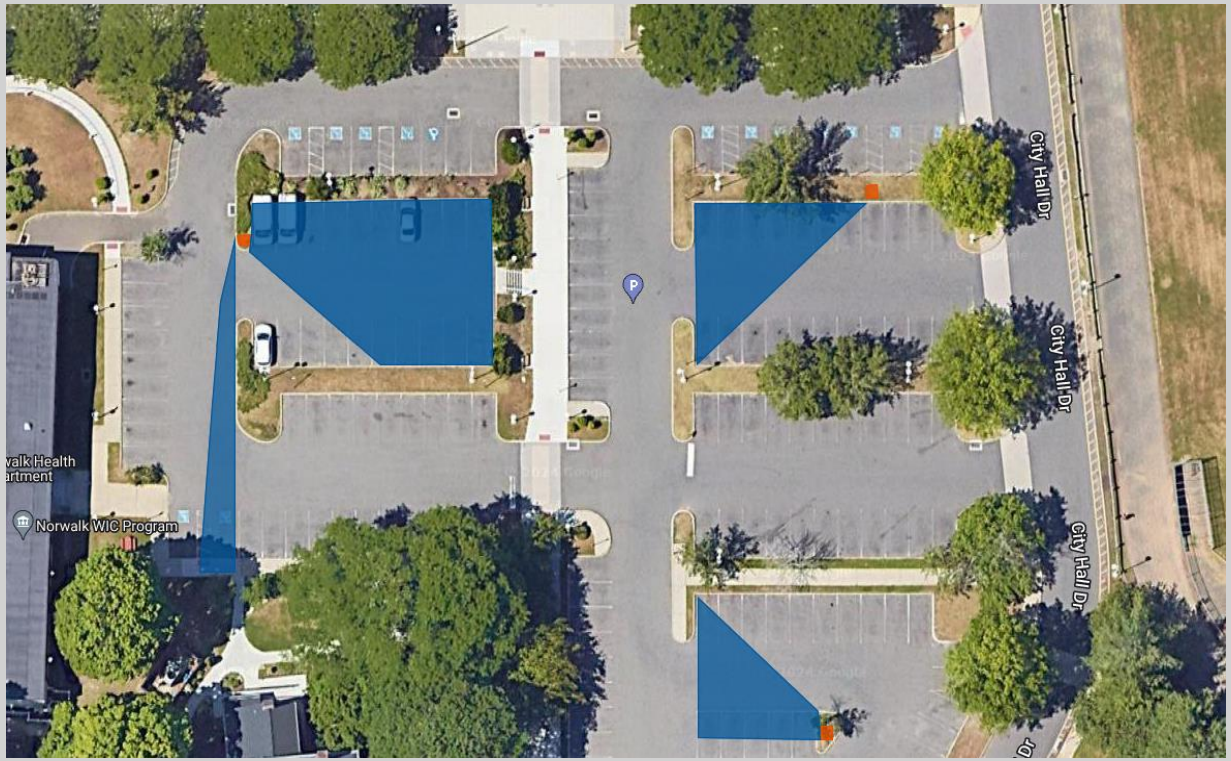
At this site, we recommend the installation of three Tree Box filters to not only help with the drainage but to provide additional shade and aesthetic to this parking lot.

Possible disconnection of **8,146 feet^2** of impervious cover with the implementation of three tree box filters.

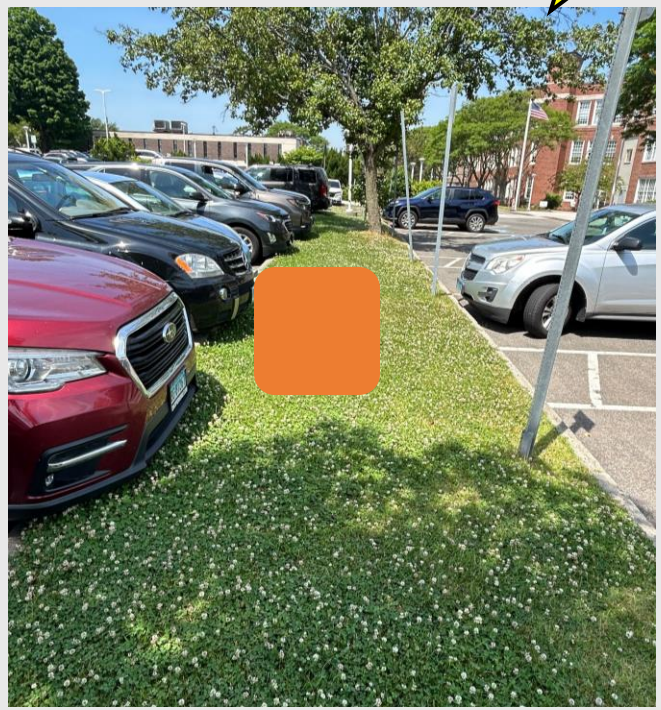
Key:

Drainage areas

Tree box filters



Norwalk City Hall Sites 1-3



Key:
Tree box filters

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)
8,146	Tree Box Filters	214,502	1.78	.23

Rowayton Library
33 Highland Avenue

At this location, we recommend the installation of a rain garden and a nearby rain barrel. These projects have high visibility and high educational value as they are near the library and within walking distance of Rowayton Elementary School.

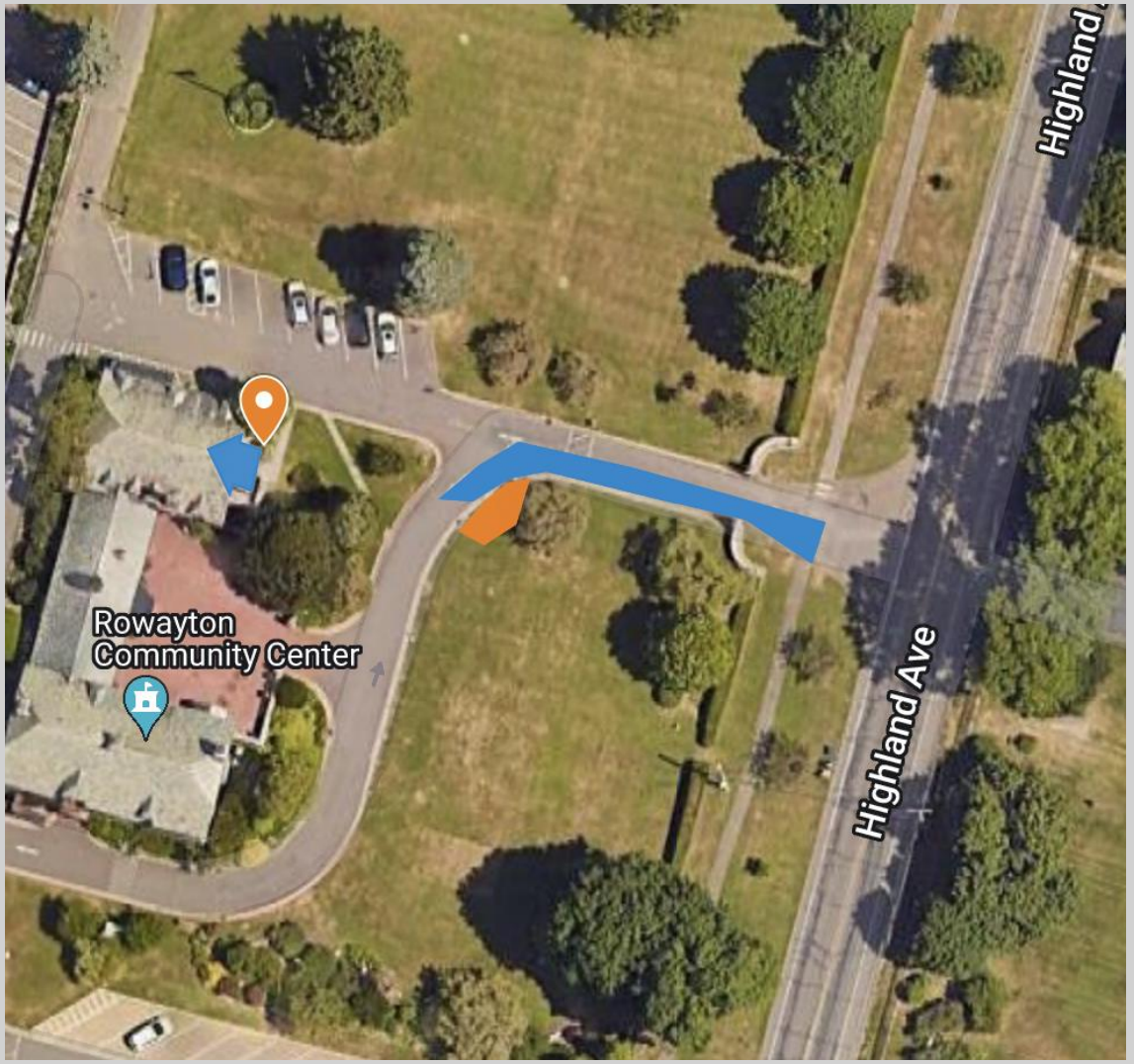
Possible **disconnection of 1,045 feet^2** of impervious cover with the implementation of the green infrastructure.

Key:

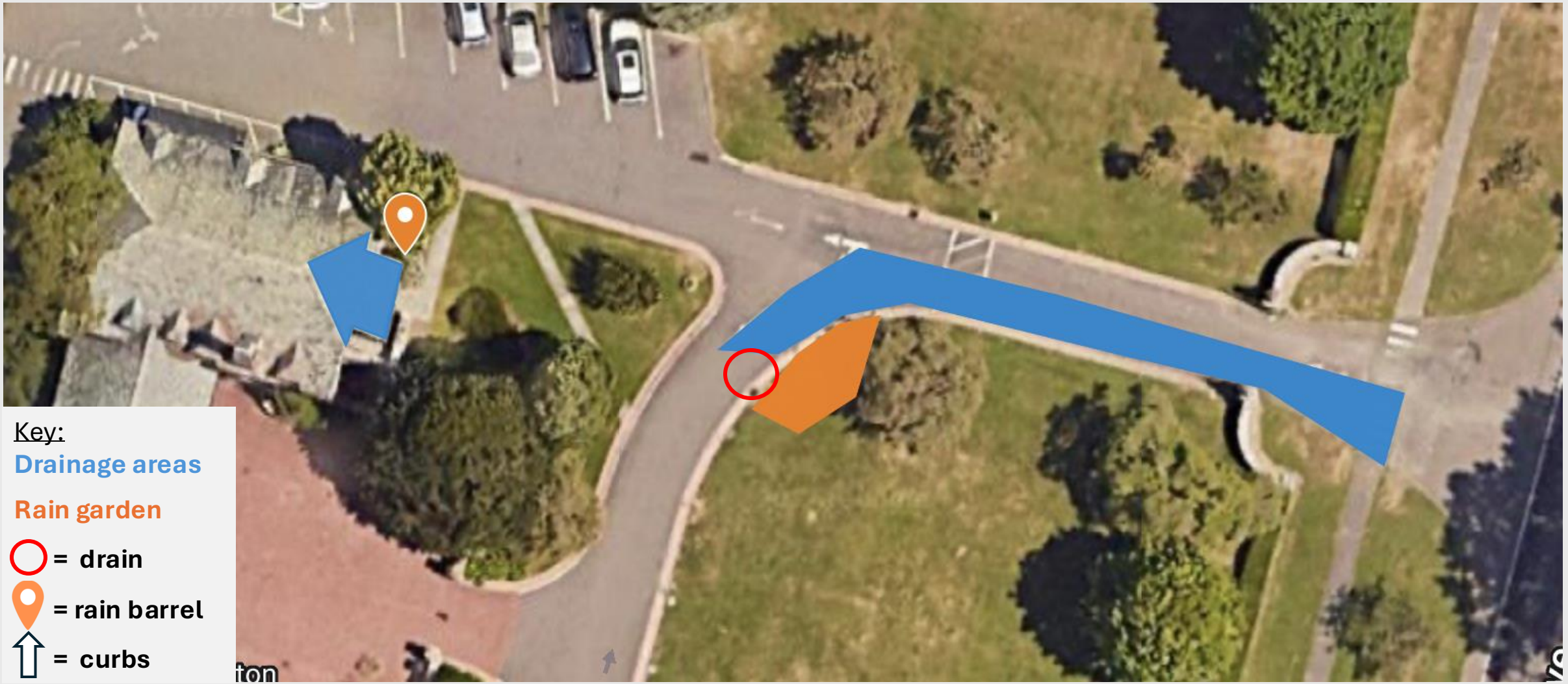
Drainage areas

Rain garden

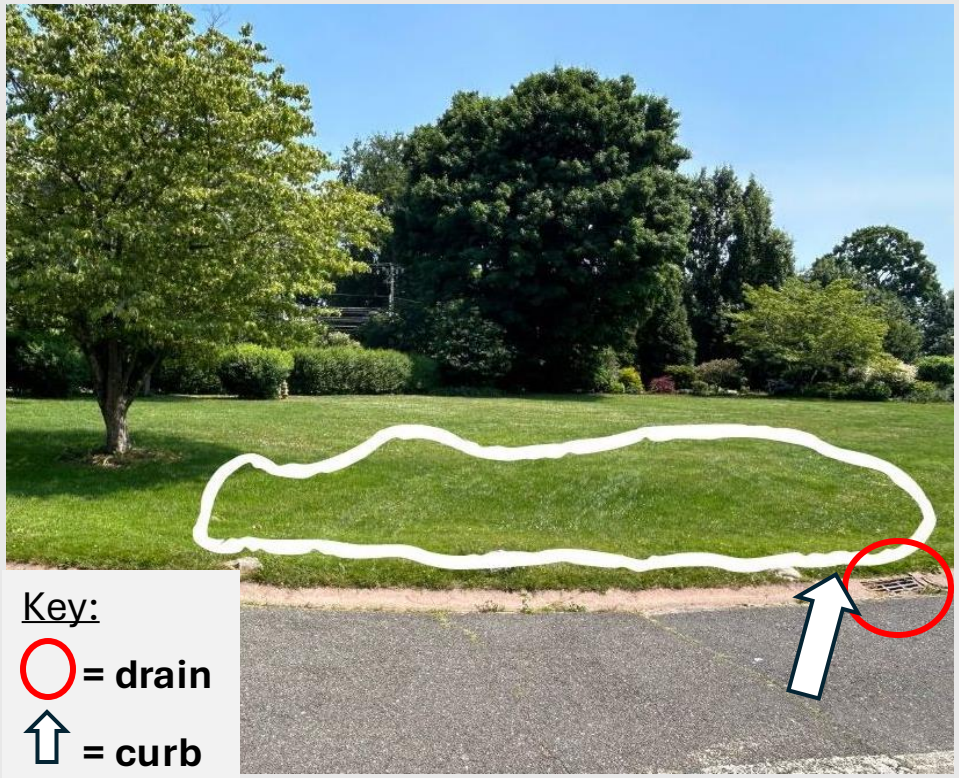
= Rain barrel



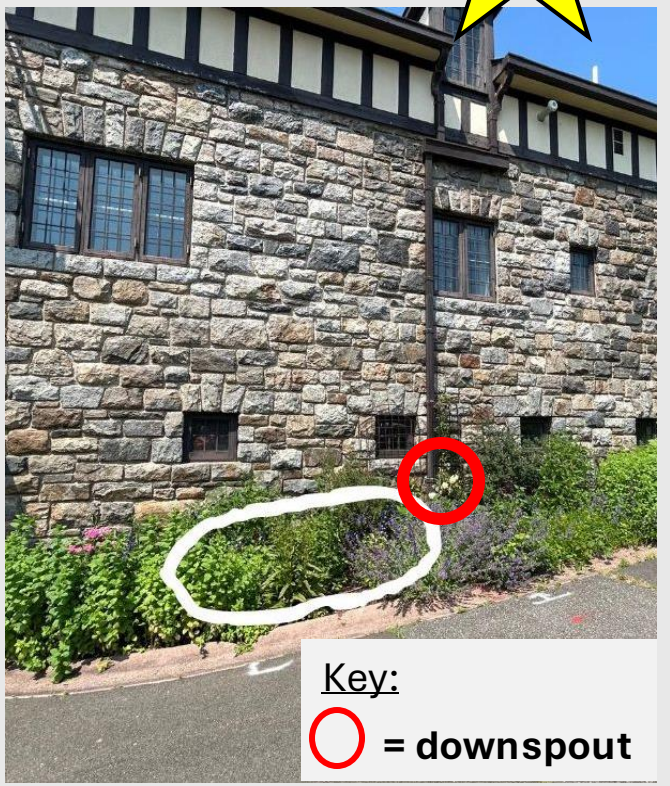
Rowayton Library Site 1



Rowayton Library Site 1



Site Notes:
With the *addition* of curbs, water will be directed into the rain garden, creating a visual representation of the rain garden's function and adding to the educational value of the site. This will also lessen stress on the existing drain nearby.
The garden will be relatively shallow to be safe for children. The rain barrel nearby will help provide an alternative for watering the existing plants in the area.
The rain barrel will potentially disconnect **an additional 218 ft^2.**



Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
1,045	Rain Garden	27,530	0.23	0.03	227 (6 inch depth)

Cranbury Park

300 Grumman Avenue

At this site, we recommend the installation of four rain gardens. These rain gardens have high visibility and high educational value due to their placement. They will also contribute to the aesthetics of the park.

Possible **disconnection of 7,518 feet^2** of impervious cover with the implementation of rain gardens.

Key:

Drainage areas

Rain gardens

Cranbury Park Rain Garden Site 1

Key:

Drainage area

Rain garden

= drain

= water flow

Cranbury Park Site 1

Site Notes
This site has high visibility and would match the aesthetic of the rest of the park. Since there are already plantings in this area a rain garden can essentially extend that space and fit in quite nicely.

There is a basement behind this area, which it seems can be accessed by the cellar doors in the previous slide. The rain garden should be at least 10 feet from the basement and it should not obstruct access to the basement.

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
518	Rain Garden	13,641	0.11	0.01	112 (6 inch depth)

Cranbury Park Site 2

Key:

Drainage area

Rain garden

= drain

= water flow

Cranbury Park Site 2

Site Notes
This site has high visibility and matches the aesthetic of the rest of the park. Due to the visibility this is a great area for a sign, thus increasing the educational value of the space. The garden can also be incorporated along the edge of the ring with the other plants.

There is likely electrical nearby, since there seemed to be a light, so that is something to be mindful of.

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
211	Rain Garden	5,556	0.05	0.01	46 (6 inch depth)

Cranbury Park Site 3

Key:

Drainage area

Rain garden

= drain

= water flow

Cranbury Park Site 3

Site Notes
This site is highly visible at the front entrance and would extend existing landscaping. This particular spot seems under-utilized and could be turned in a rain garden with relative ease.

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
225	Rain Garden	5,925	0.05	0.01	49 (6 inch depth)

Cranbury Park Site 4

Key:

Drainage area

Rain garden

= drain

= water flow

Cranbury Park Site 4

Overflow drain

Cranbury Park Site 4

Site Notes
This site requires a high degree of engineering and labor. In order to properly size the rain garden, four of the parking spaces, along with the corner of the parking lot that isn't parking, would need to be converted into a rain garden. If these parking spaces are rarely utilized that would give even greater reasoning to convert this space.

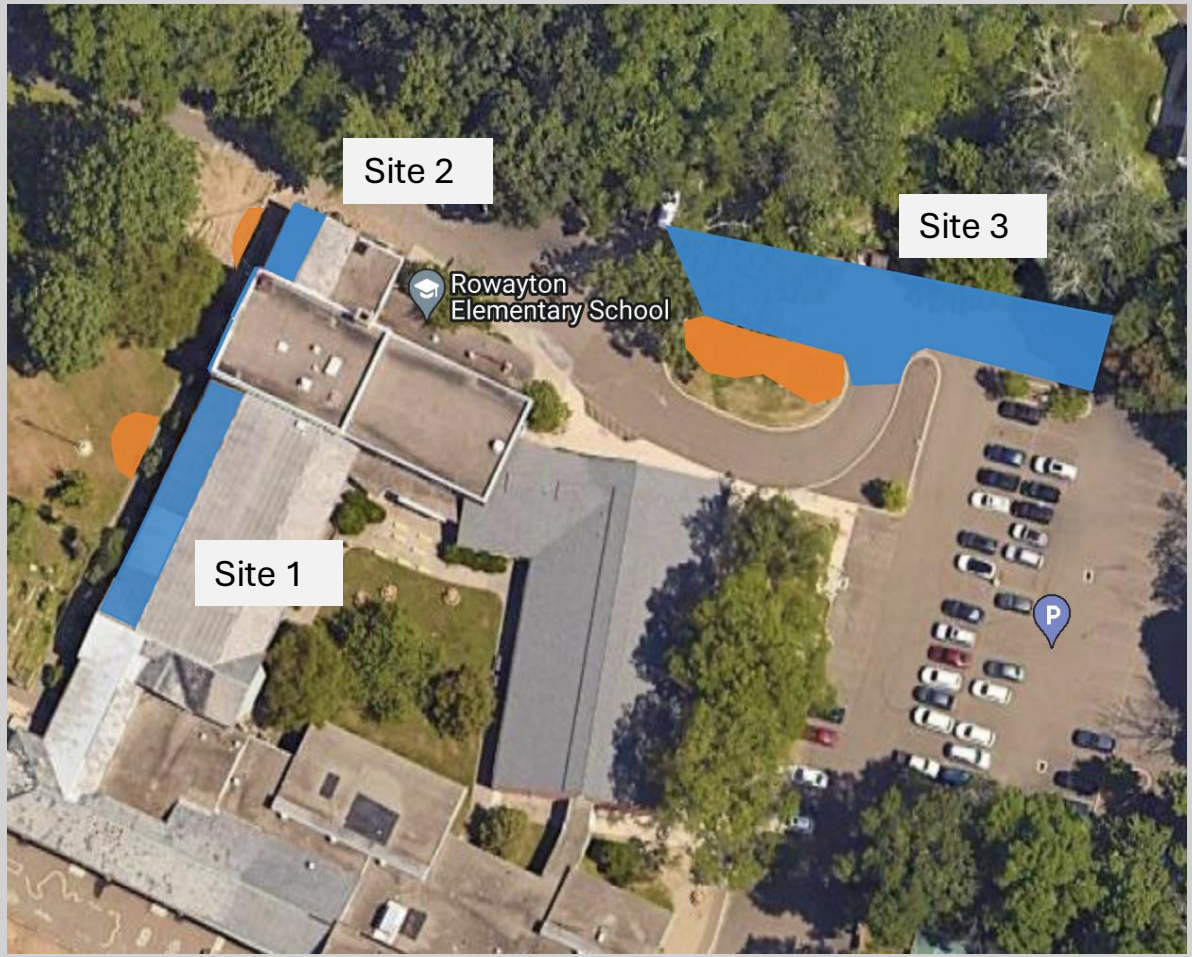
This would be far be the largest disconnection at this site. There is also a drain that is currently well placed to serve as an overflow basin.

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
6,564	Rain Garden	172,851	1.44	0.18	1,219 (7 inch depth)

Rowayton Elementary School

1 Roton Avenue

At this location, we recommend the installation of three different to help beautify these underused areas and work toward the town goals of preventing excess storm water runoff. These recommendations have high visibility and high educational value.



Possible **disconnection of 7,100 feet^2** of impervious cover with the implementation of the green infrastructure.

Key:

Drainage areas

Rain gardens

= Rain barrel

Rowayton Elementary School Site 1

Rowayton Elementary School Site 1

Site Notes:
This site has high visibility and high educational value because it is near the front entrance of the school and next to a preexisting garden. However, the downspouts would need to be rerouted to go underneath the sidewalk which would add to the cost of this potential recommendation. There are also some existing trees to make note of during installation.

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
1,481	Rain Garden	38,999	0.32	0.04	321 (6 inch depth)

Rowayton Elementary School Site 2

Rowayton Elementary School Site 2

Key:

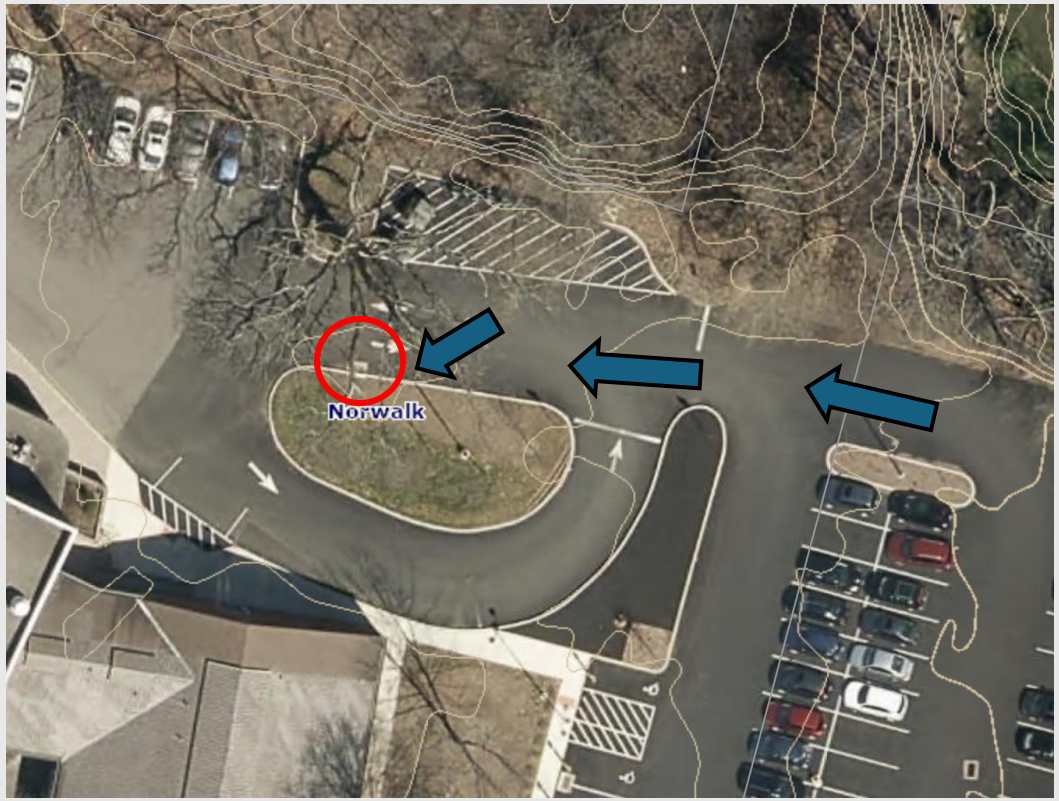
= downspouts

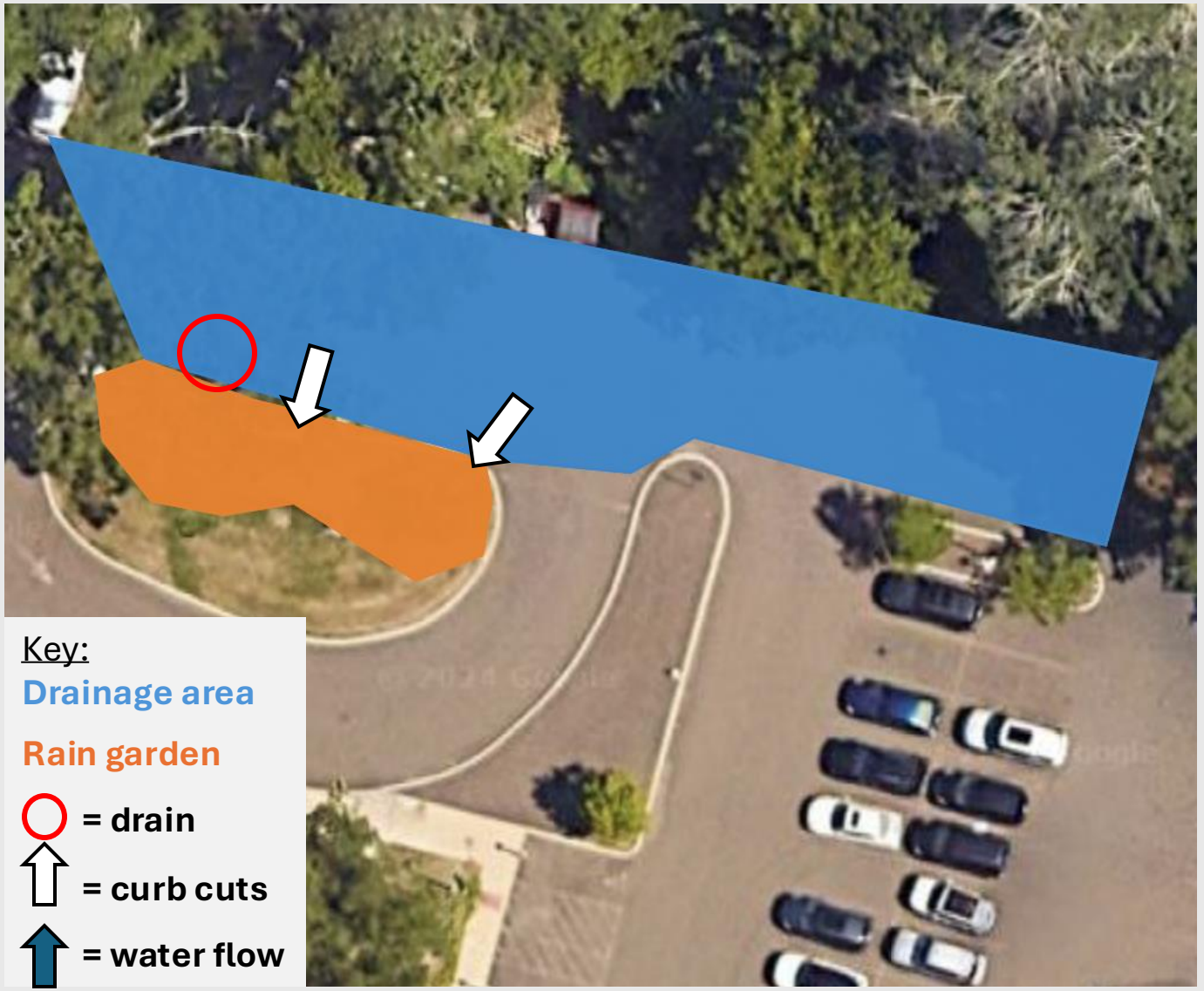
Site Notes:

This site has high visibility since it is near the front entrance of the school. However, the downspouts would need to be rerouted to go underneath the sidewalk which would add to the cost of this potential recommendation. There are also some existing trees to make note of during installation.

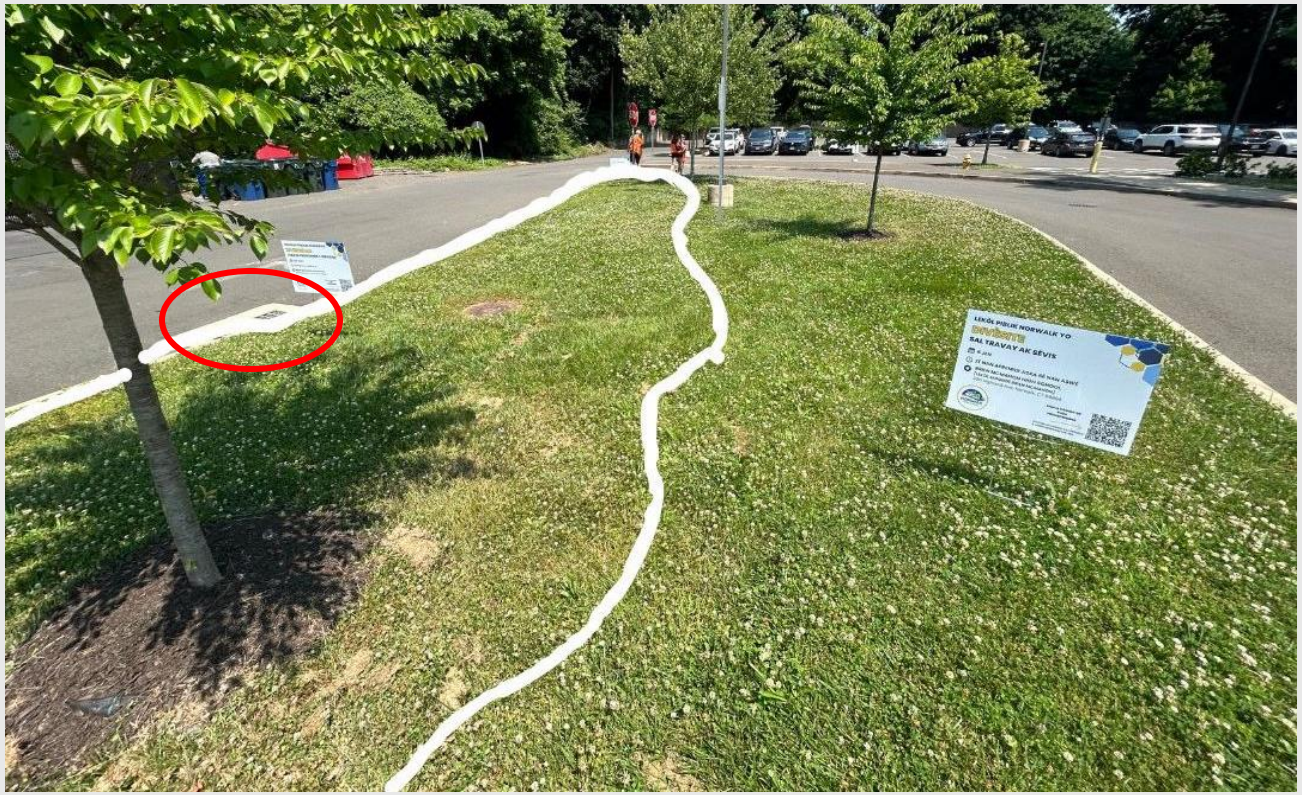
Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
392	Rain Garden	10,234	0.09	0.01	85 (6 inch depth)

Rowayton Elementary School Site 3





Rowayton Elementary School Site 3



Site Notes:
Although this site disconnects a large area of impervious cover, it does not have high visibility. It is recommended to include the tree in the rain garden to reduce maintenance disruptions. This rain garden will help to reduce stress on the existing drain since a lot of water drains there. There is some run off from the nearby dumpsters that would need to be addressed before implementing the garden.

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
5,227	Rain Garden	137,648	1.14	0.15	1,133 (6 inch depth)

Kendall Elementary School

57 Fillow Street

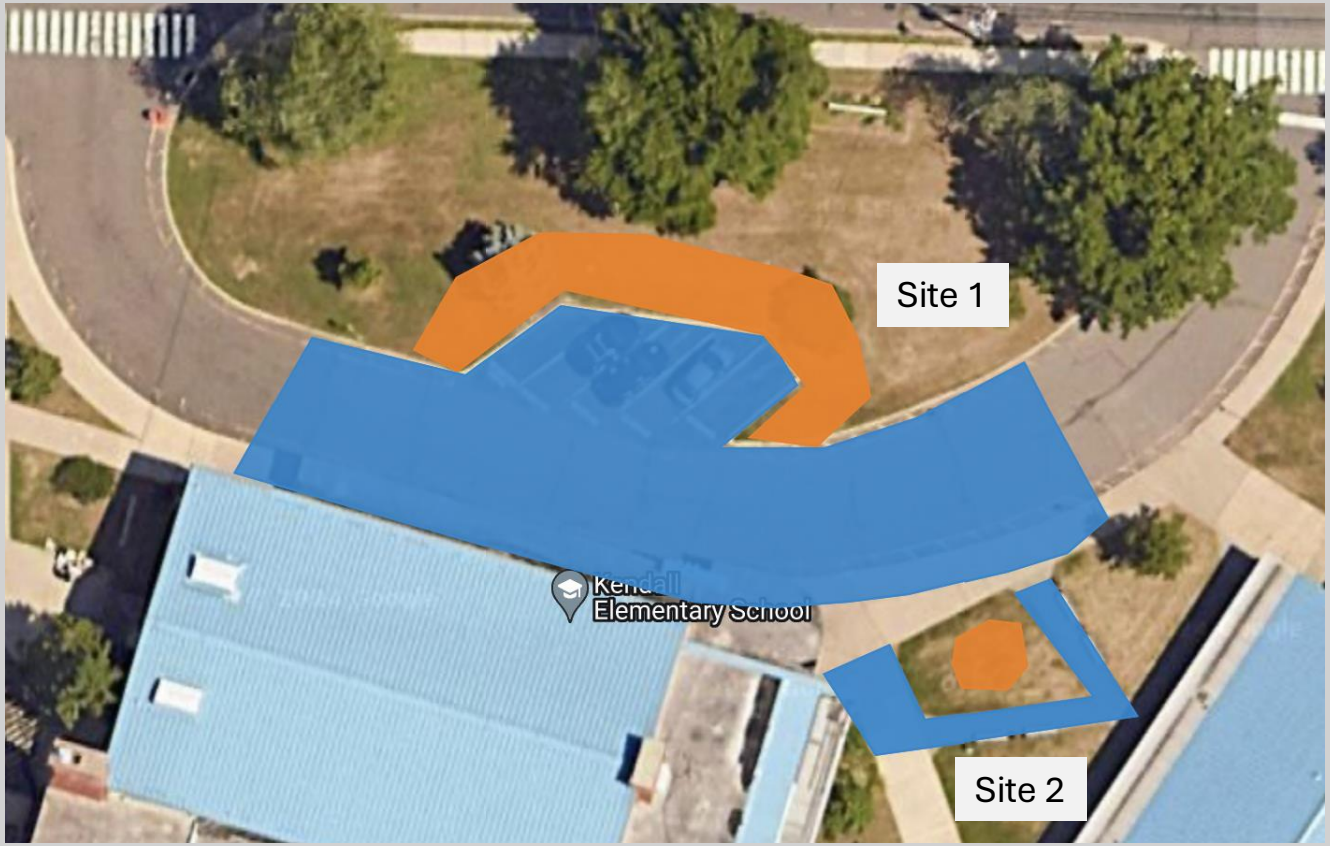
At this site, we recommend the installation of two rain gardens to help beautify these underused areas. Both rain gardens have high visibility and high educational value as they are near the front entrance of the school.

Possible **disconnection of 6,969 feet^2** of impervious cover with the implementation of the rain gardens.

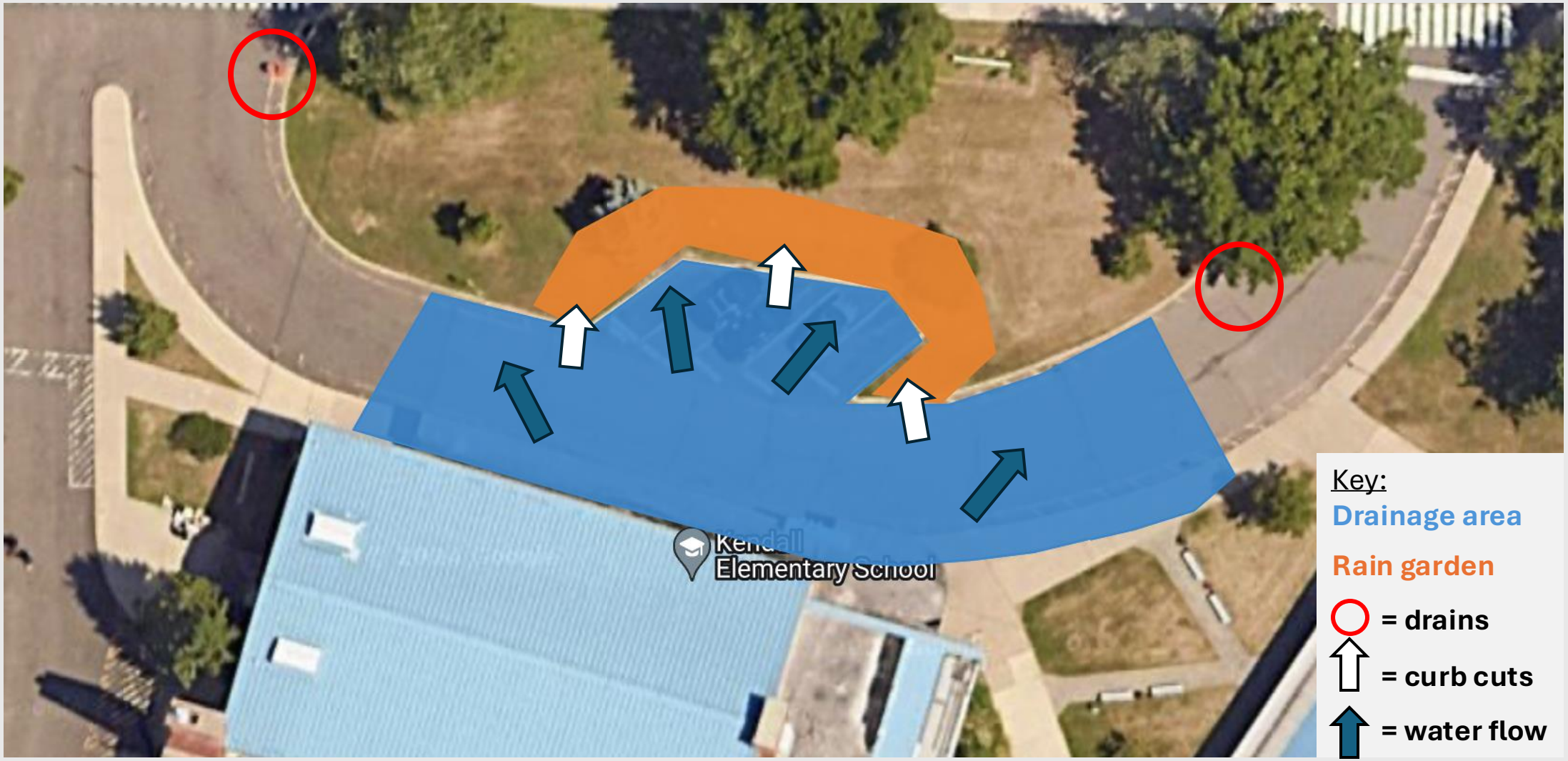
Key:

Drainage areas

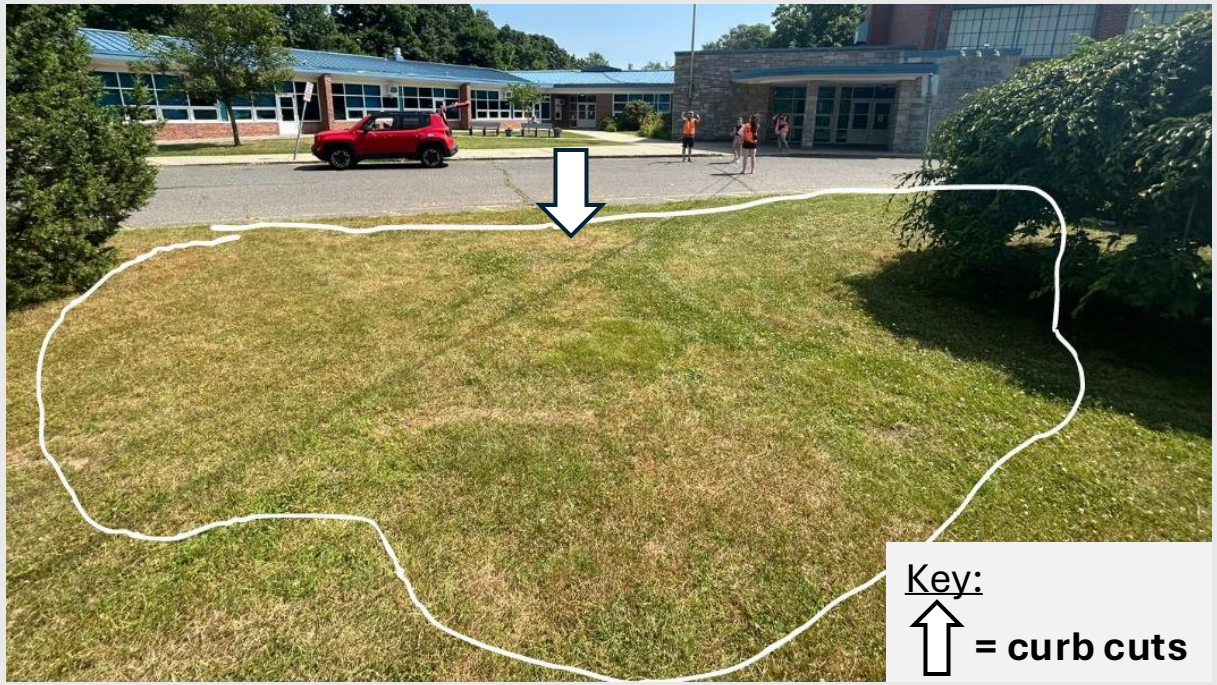
Rain gardens



Kendall Elementary School Site 1



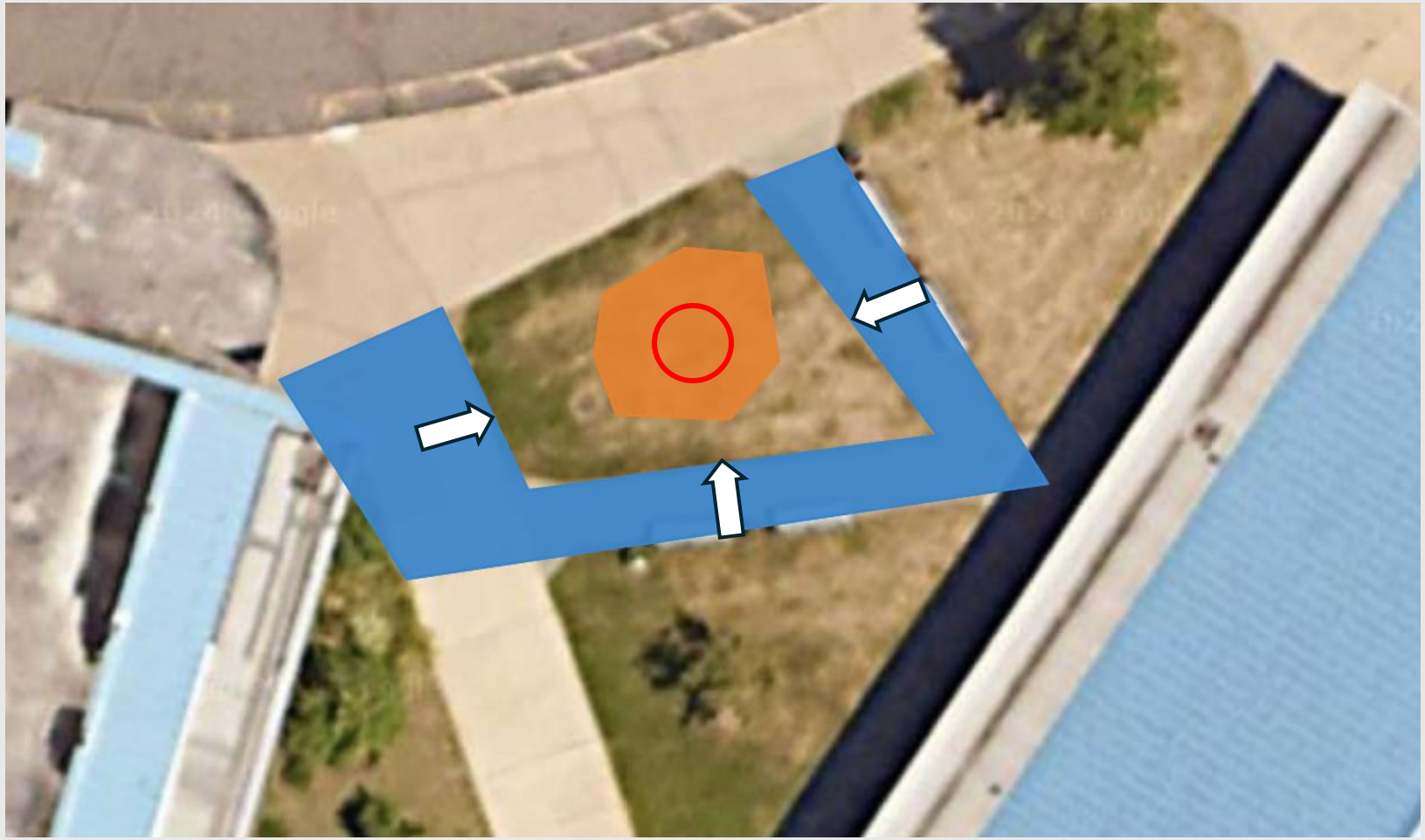
Kendall Elementary School Site 1



Site Notes: This site has high visibility and high educational value. If installed, minimize the maintenance disruptions. This site would also disconnect a large portion of this lot and make use of this otherwise underused area. The parking spots in this area would be unaffected if this garden is installed.

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
6,316	Rain Garden	166,325	1.38	0.18	1,369 (6 inch depth)

Kendall Elementary School Site 2



Key:
Drainage area
Rain garden
= drain
= curb cuts

Kendall Elementary School Site 2

Key:

= drain

= curb cuts

Site Notes: The nearby benches indicate the high visibility of this site. This site is also near the front of the school meaning there will be many cars driving by that will see the garden if implemented. The drain in the middle of the garden will act as an overflow drain in heavier rainstorms. Since this area is surrounded by sidewalks, cuts in the sidewalks would need to be made to ensure the full functionality of the rain garden

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
653	Rain Garden	17,196	0.14	0.02	141 (6 inch depth)

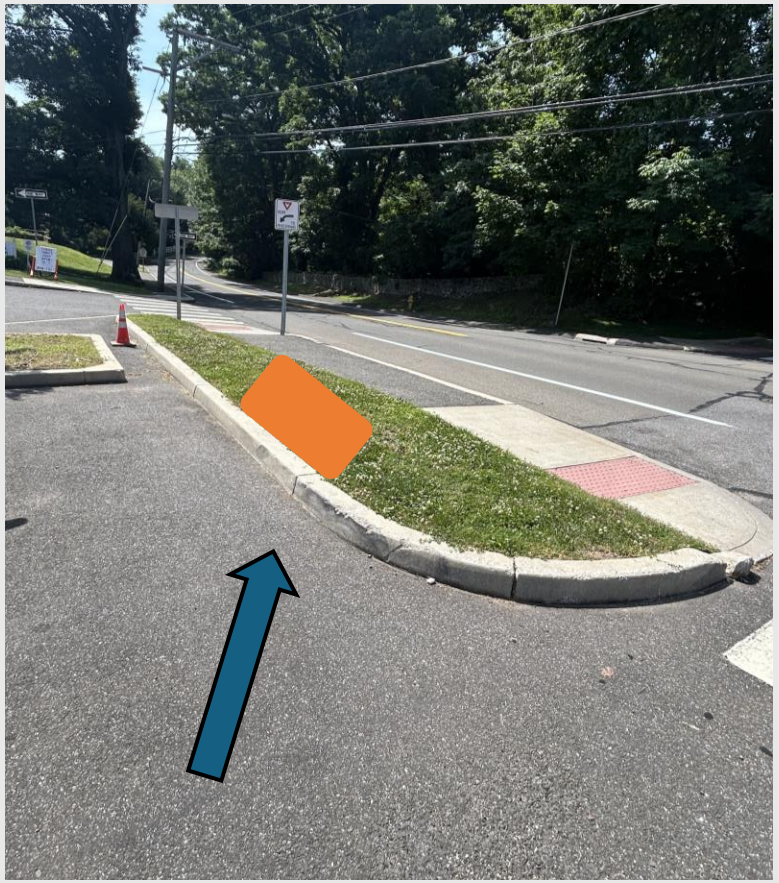
Senior Center
11 Allen Road

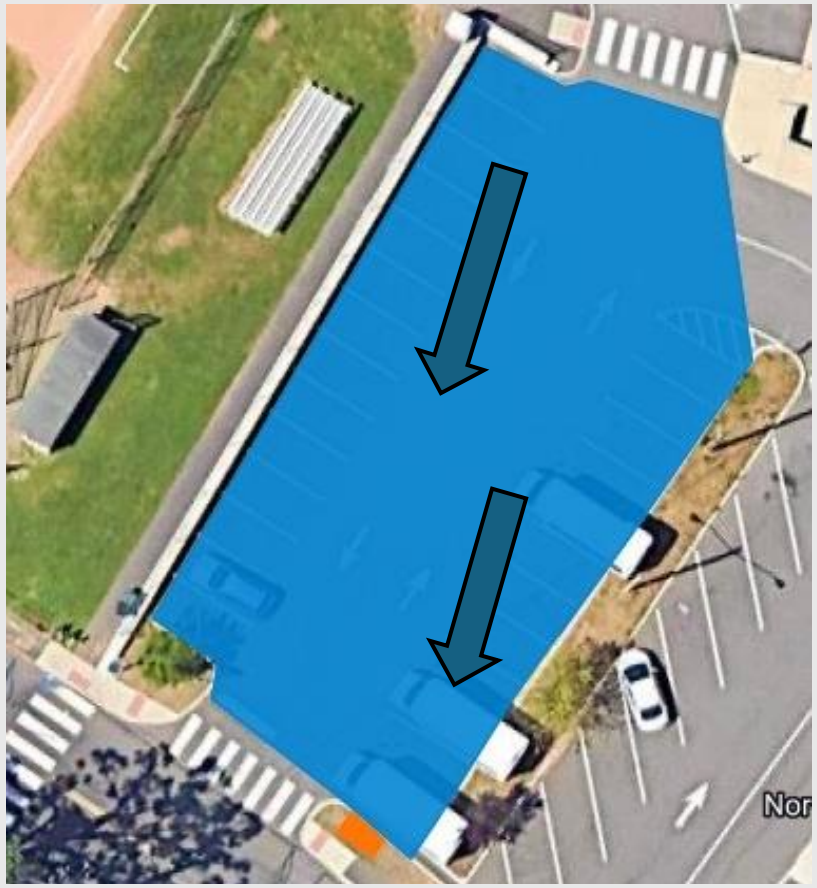
At this site, we recommend the installation of a tree box filter. This will help reduce the storm water runoff in the parking lot, educate members of the senior center and preschool, and add to the aesthetics of the space.

Possible **disconnection of 8,178 feet^2** of impervious cover with the implementation of a rain garden.

Key:
Drainage area
Tree box filter

Senior Center Site 1





Site Notes: This site can disconnect a significant part of the parking lot. The garden club may be able to aid in the maintenance and educational aspects of the tree box filter.

Key:
Drainage area
Tree box filter
= water flow

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)
8,178	Tree Box Filter	215,352	1.79	0.23

Tracey Magnet School
20 Camp Street

We recommend installing two rain barrels in the existing Certified School Yard habitat and Monarch Waystation to help reduce run off from the roofs and provide educational opportunities for students.

Key:

Drainage areas

= Downspouts

= Rain barrels

Partial **disconnection of 3,920 feet^2** of impervious cover with the implementation of the rain barrels.

Calculation Totals

Site	Disconnected Area (ft^2)	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)
Mathews Park #1	4,530	119,295	0.99	0.13
Mathews Park #2	3,877	102,089	0.85	0.11
City Hall #1	8,146	214,502	1.78	0.23
Rowayton Library Site #1	1,045	27,530	0.23	0.03
Cranbury Park #1	518	13,641	0.11	0.01
Cranbury Park #2	211	5,556	0.05	0.01
Cranbury Park #3	225	5,925	0.05	0.01
Cranbury Park #4	6,564	172,851	1.44	0.18
Rowayton Elementary #1	1,481	38,999	0.32	0.04
Rowayton Elementary #2	392	10,234	0.09	0.01
Rowayton Elementary #3	5,227	137,648	1.14	0.15
Kendall Elementary #1	6,316	166,325	1.38	0.18
Kendall Elementary #2	653	17,196	0.14	0.02
Senior Center #1	8,178	215,352	1.79	0.23
Total	**47,363**	**1,247,143**	**10.36**	**1.34**

Our Top 5 Recommendations

1. **Mathews Park Site 2**
    - Large disconnection
    - High educational value and visibility
2. **Rowayton Library Site 1**
    - High educational value
    - Decent disconnection
        - Rain barrel adds to potential disconnection
3. **Mathews Park Site 1**
    - Large disconnection
    - High educational value and visibility
4. **City Hall**
    - Large disconnection area
    - High cost
5. **Cranbury Park Site 2**
    - Highest visibility at this site
    - Low cost, high reward
    - Small disconnection

Sites not selected

Covewood Drive: There was a limited drainage area. It would have also significantly impeded residential life.

Springwood Park: The disconnection area was too large compared to the limited amount of space for a rain garden.

Irving Freese Park: There was a limited drainage area and limited functional green space.

Marvin Elementary School: The placement of the drains in the parking lot and the flat roofs on the school limited the ability for GSI placements.

Questions/Discussion

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