RUTGERS
New Jersey Agricultural
Experiment Station

Draft

Impervious Cover Assessment
for
Bridgewater Township, Somerset County, New Jersey

Prepared for Bridgewater Township by the
Rutgers Cooperative Extension Water Resources Program

January 30, 2015

Introduction

Pervious and impervious are terms that are used to describe the ability or inability of water to flow through a surface. When rainfall hits a surface, it can soak into the surface or flow off the surface. Pervious surfaces are those which allow stormwater to readily soak into the soil and recharge groundwater. When rainfall drains from a surface, it is called "stormwater" runoff (Figure 1). An impervious surface can be any material that has been placed over soil that prevents water from soaking into the ground. Impervious surfaces include paved roadways, parking lots, sidewalks, and rooftops. As impervious areas increase, so does the volume of stormwater runoff.

Figure 1: Stormwater draining from a parking lot

New Jersey has many problems due to stormwater runoff, including:

- Pollution: According to the 2010 New Jersey Water Quality Assessment Report, 90% of the assessed waters in New Jersey are impaired, with urban-related stormwater runoff listed as the most probable source of impairment (USEPA, 2013). As stormwater flows over the ground, it picks up pollutants including animal waste, excess fertilizers, pesticides, and other toxic substances. These pollutants are then able to enter waterways.

- Flooding: Over the past decade, the state has seen an increase in flooding. Communities around the state have been affected by these floods. The amount of damage caused also has increased greatly with this trend, costing billions of dollars over this time span.

- Erosion: Increased stormwater runoff causes an increase in the velocity of flows in our waterways. The increased velocity after storm events erodes stream banks and shorelines, degrading water quality. This erosion can damage local roads and bridges and cause harm to wildlife.

The primary cause of the pollution, flooding, and erosion problems is the quantity of impervious surfaces draining directly to local waterways. New Jersey is one of the most developed states in the country. Currently, the state has the highest percent of impervious cover in the country at 12.1% of its total area (Nowak & Greenfield, 2012). Many of these impervious surfaces are directly connected to local waterways (i.e., every drop of rain that lands on these impervious surfaces ends up in a local river, lake, or bay without any chance of being treated or soaking into the ground). To repair our waterways, reduce flooding, and stop erosion, stormwater runoff from impervious surfaces has to be better managed. Surfaces need to be disconnected with green infrastructure to prevent stormwater runoff from flowing directly into New Jersey's waterways. Disconnection redirects runoff from paving and rooftops to pervious areas in the landscape.

Green infrastructure is an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly. Green infrastructure projects capture, filter, absorb, and reuse stormwater to maintain or mimic natural systems and to treat runoff as a resource. As a general principal, green infrastructure practices use soil and vegetation to recycle stormwater runoff through infiltration and evapotranspiration. When used as components of a stormwater management system, green infrastructure practices such as bioretention, green roofs, porous pavement, rain gardens, and vegetated swales can produce a variety of environmental benefits. In addition to effectively retaining and infiltrating rainfall, these technologies can simultaneously help filter air pollutants, reduce energy demands, mitigate urban heat islands, and sequester carbon while also providing communities with aesthetic and natural resource benefits (USEPA, 2013).

The first step to reducing the impacts from impervious surfaces is to conduct an impervious cover assessment. This assessment can be completed on different scales: individual lot, municipality, or watershed. Impervious surfaces need to be identified for stormwater management. Once impervious surfaces have been identified, there are three steps to better manage these surfaces.

1. ***Eliminate surfaces that are not necessary.*** For example, a paved courtyard at a public school could be converted to a grassed area.

2. ***Reduce or convert impervious surfaces.*** There may be surfaces that are required to be hardened, such as roadways or parking lots, but could be made smaller and still be functional. A parking lot that has two-way car ways could be converted to one-way car ways. There also are permeable paving materials such as porous asphalt, pervious concrete, or permeable paving stones that could be substituted for impermeable paving materials (Figure 2).

3. ***Disconnect impervious surfaces from flowing directly to local waterways.*** There are many ways to capture, treat, and infiltrate stormwater runoff from impervious surfaces. Opportunities may exist to reuse this captured water.

Figure 2: Rapid infiltration of water through porous pavement is demonstrated at the USEPA Edison New Jersey test site

Bridgewater Township Impervious Cover Analysis

Located in Somerset County in central New Jersey, Bridgewater Township covers approximately 32.4 square miles. Figures 3 and 4 illustrate that Bridgewater Township is dominated by urban land uses. A total of 61.6% of the municipality's land use is classified as urban. Of the urban land in Bridgewater Township, low density residential is the dominant land use (Figure 5).

The literature suggests a link between impervious cover and stream ecosystem impairment starting at approximately 10% impervious surface cover (Schueler, 1994; Arnold and Gibbons, 1996; May et al., 1997). Impervious cover may be linked to the quality of lakes, reservoirs, estuaries, and aquifers (Caraco et al., 1998), and the amount of impervious cover in a watershed can be used to project the current and future quality of streams. Based on the scientific literature, Caraco et al. (1998) classified urbanizing streams into the following three categories: sensitive streams, impacted streams, and non-supporting streams. Sensitive steams typically have a watershed impervious surface cover from 0 – 10%. Impacted streams have a watershed impervious cover ranging from 11-25% and typically show clear signs of degradation from urbanization. Non-supporting streams have a watershed impervious cover of greater than 25%; at this high level of impervious cover, streams are simply conduits for stormwater flow and no longer support a diverse stream community.

The New Jersey Department of Environmental Protection's (NJDEP) 2007 land use/land cover geographical information system (GIS) data layer categorizes Bridgewater Township into many unique land use areas, assigning a percent impervious cover for each delineated area. These impervious cover values were used to estimate the impervious coverage for Bridgewater Township. Based upon the 2007 NJDEP land use/land cover data, approximately 19.1% of Bridgewater Township has impervious cover. This level of impervious cover suggests that the streams in Bridgewater Township are likely impacted.

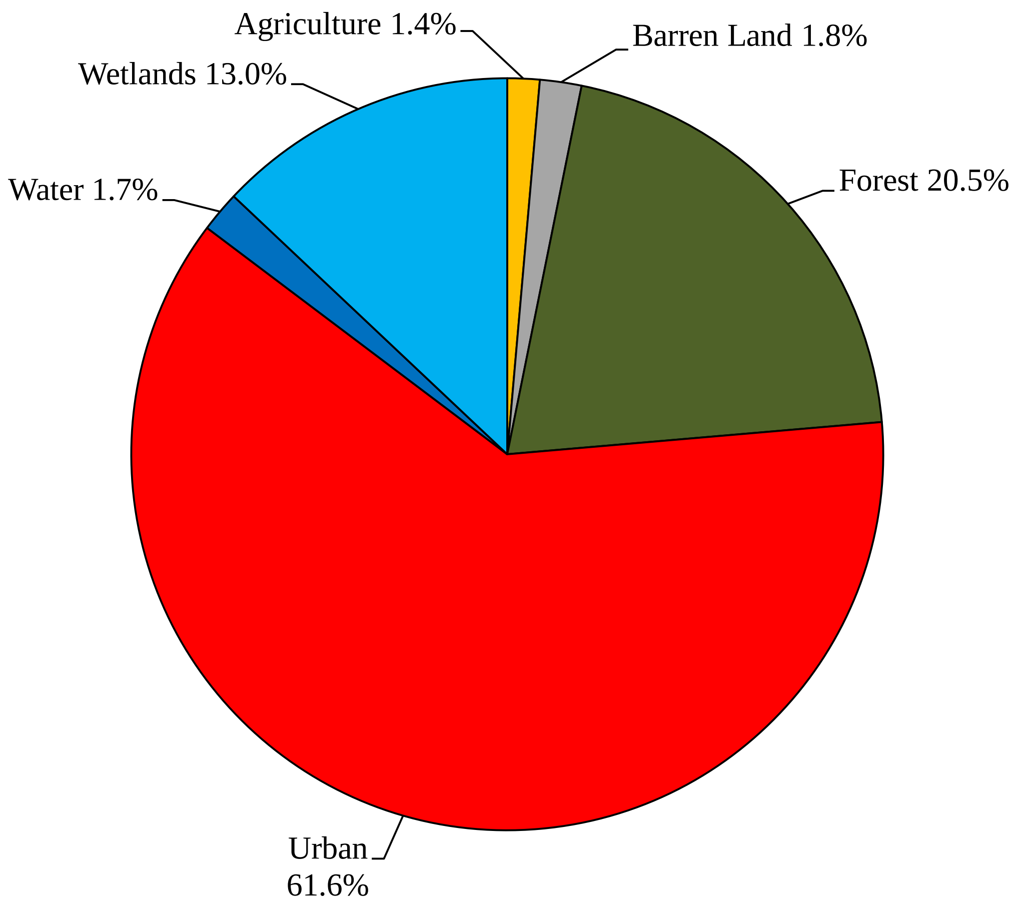


Figure 3: Pie chart illustrating the land use in Bridgewater Township

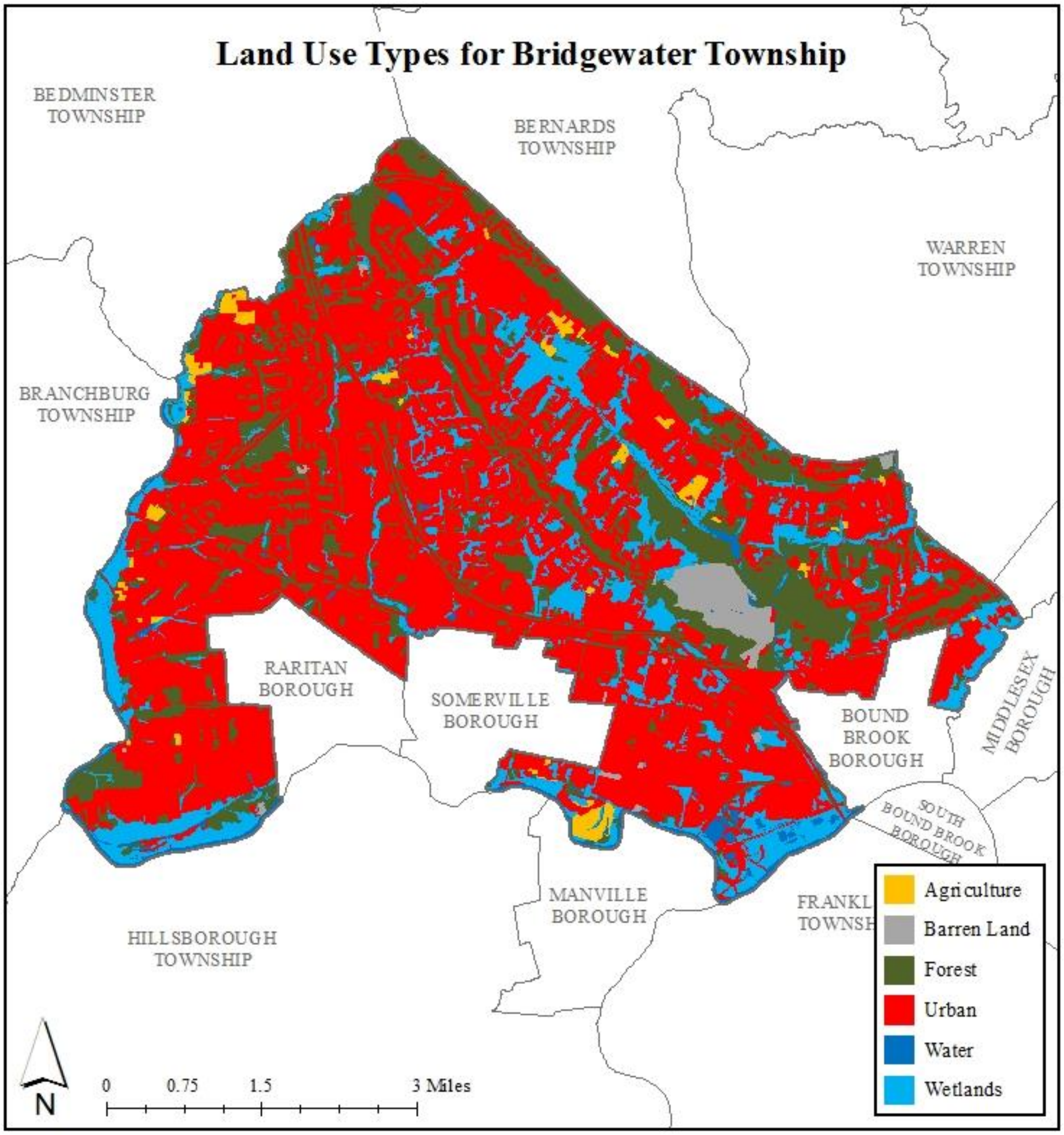


Figure 4: Map illustrating the land use in Bridgewater Township

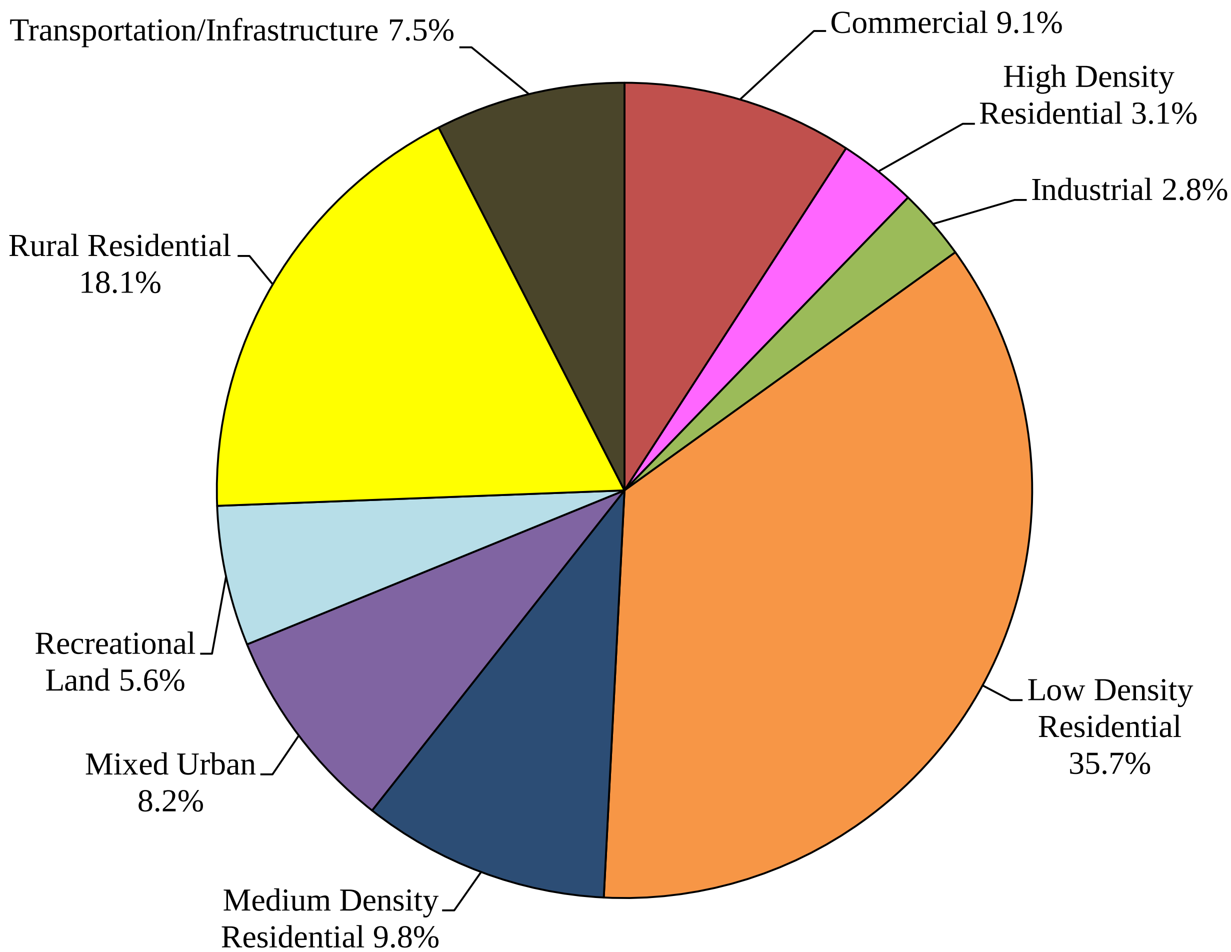


Figure 5: Pie chart illustrating the various types of urban land use in Bridgewater Township

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each Raritan River subwatershed within Bridgewater Township (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 5.5% in the Dead River subwatershed to 29.0% in the Cuckles Brook subwatershed. Evaluating impervious cover on a subwatershed basis allows the municipality to focus impervious cover reduction or disconnection efforts in the subwatersheds where frequent flooding occurs.

In developed landscapes, stormwater runoff from parking lots, driveways, sidewalks, and rooftops flows to drainage pipes that feed the sewer system. The cumulative effect of these impervious surfaces and thousands of connected downspouts reduces the amount of water that can infiltrate into soils and greatly increases the volume and rate of runoff that flows to waterways. Stormwater runoff volumes (specific to Bridgewater Township, Somerset County) associated with impervious surfaces were calculated for the following storms: the New Jersey water quality design storm of 1.25 inches of rain, an annual rainfall of 44 inches, the 2-year design storm (3.3 inches of rain), the 10-year design storm (5.0 inches of rain), and the 100-year design storm (8.2 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Bridgewater Township. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Peters Brook subwatershed was harvested and purified, it could supply water to 379 homes for one year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Bridgewater Township

Subwatershed	**Total Area**		**Land Use Area**		**Water Area**		**Impervious Cover**		
	(ac)	**(mi^2)**	**(ac)**	**(mi^2)**	**(ac)**	**(mi^2)**	**(ac)**	**(mi^2)**	**(%)**
Cuckles Brook	1,870.8	2.92	1,842.0	2.88	28.9	0.05	533.8	0.83	29.0%
Dead River	10.5	0.02	10.5	0.02	0.00	0.00	0.57	0.00	5.5%
Green Brook	617.2	0.96	611.6	0.96	5.59	0.01	93.5	0.15	15.3%
Middle Brook	5,047.3	7.89	4,997.2	7.81	50.1	0.08	509.3	0.80	10.2%
Millstone River	0.46	0.00	0.00	0.00	0.46	0.00	0.00	0.00	0.00%
Peters Brook	5,247.8	8.20	5,226.9	8.17	20.9	0.03	1,222.5	1.91	23.4%
Lower Raritan River	3,170.2	4.95	2,986.8	4.67	183.4	0.29	659.5	1.03	22.1%
Raritan River North Branch	4,747.2	7.42	4,674.0	7.30	73.2	0.11	868.9	1.36	18.6%
Total	20,711.2	32.4	20,348.8	31.80	362.4	0.57	3,888.0	6.08	19.1%

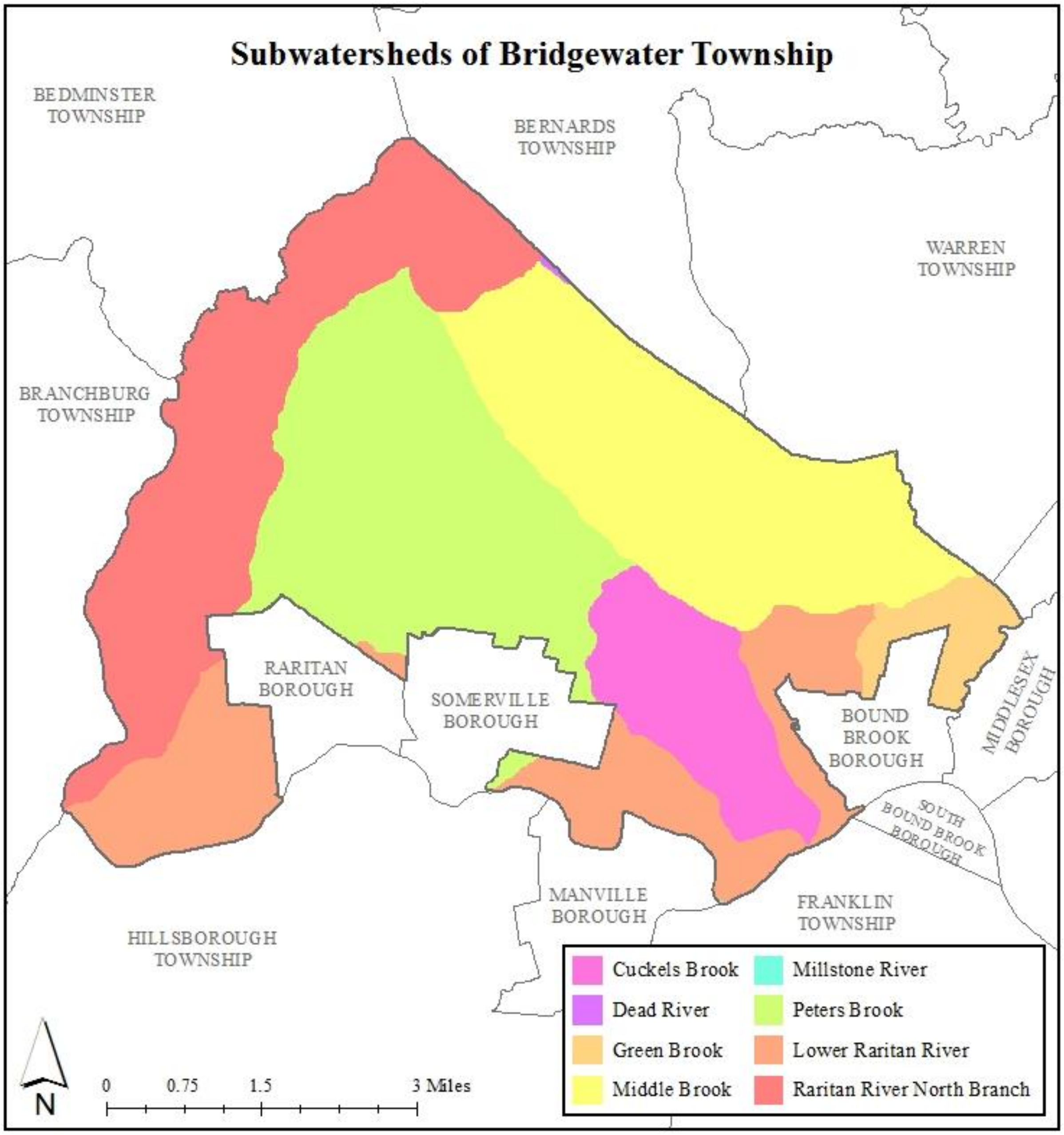


Figure 6: Map of the subwatersheds in Bridgewater Township

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in Bridgewater Township

Subwatershed	Total Runoff Volume for the 1.25" NJ Water Quality Storm (MGal)	Total Runoff Volume for the NJ Annual Rainfall of 44" (MGal)	Total Runoff Volume for the 2-Year Design Storm (3.3") (MGal)	Total Runoff Volume for the 10-Year Design Storm (5.0") (MGal)	Total Runoff Volume for the 100-Year Design Storm (8.2") (MGal)
Cuckles Brook	18.1	637.7	47.8	72.5	118.9
Dead River	0.0	0.7	0.1	0.1	0.1
Green Brook	3.2	111.7	8.4	12.7	20.8
Middle Brook	17.3	608.5	45.6	69.1	113.4
Millstone River	0.0	0.0	0.0	0.0	0.0
Peters Brook	41.5	1,460.5	109.5	166.0	272.2
Lower Raritan River	22.4	787.9	59.1	89.5	146.8
Raritan River North Branch	29.5	1,038.1	77.9	118.0	193.5
Total	132.0	4,645.1	348.4	527.8	865.7

The next step is to set a reduction goal for impervious area in each subwatershed. Based upon the Rutgers Cooperative Extension (RCE) Water Resources Program's experience, a 10% reduction would be a reasonably achievable reduction for these subwatersheds in Bridgewater Township. While it may be difficult to eliminate paved areas or replace paved areas with permeable pavement, it is relatively easy to identify impervious surfaces that can be disconnected using green infrastructure practices. For all practical purposes, disconnecting an impervious surface from a storm sewer system or a water body is an "impervious area reduction." The RCE Water Resources Program recommends that all green infrastructure practices that are installed to disconnect impervious surfaces should be designed for the 2-year design storm (3.3 inches of rain over 24-hours). Although this results in management practices that are slightly over-designed by NJDEP standards, which require systems to be designed for the New Jersey water quality storm (1.25 inches of rain over 2-hours), these systems will be able to handle the increase in storm intensities that are expected to occur due to climate change. By designing these management practices for the 2-year design storm, these practices will be able to manage 95% of the annual rainfall volume. The recommended annual reductions in runoff volumes are shown in Table 3.

As previously mentioned, once impervious surfaces have been identified, the next steps for managing impervious surfaces are to 1) eliminate surfaces that are not necessary, 2) reduce or convert impervious surfaces to pervious surfaces, and 3) disconnect impervious surfaces from flowing directly to local waterways.

Elimination of Impervious Surfaces

One method to reduce impervious cover is to "depave." Depaving is the act of removing paved impervious surfaces and replacing them with pervious soil and vegetation that will allow for the infiltration of rainwater. Depaving leads to the re-creation of natural space that will help reduce flooding, increase wildlife habitat, and positively enhance water quality as well as beautify neighborhoods. Depaving also can bring communities together around a shared vision to work together to reconnect their neighborhood to the natural environment.

Table 3: Impervious cover reductions by subwatershed in Bridgewater Township

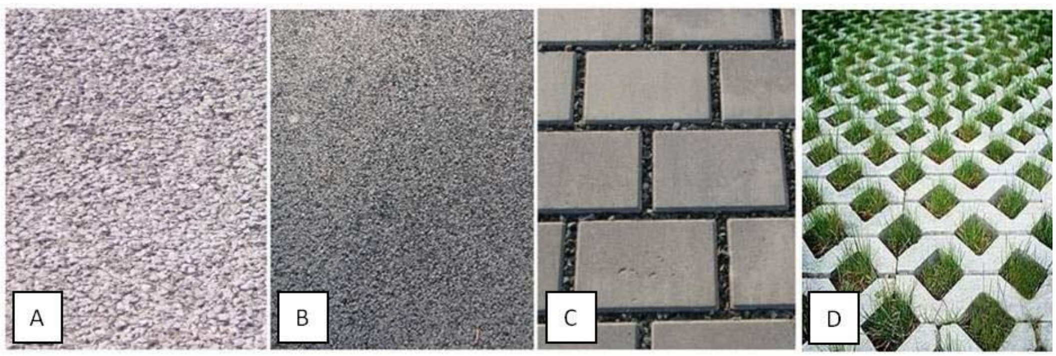
Subwatershed	Recommended Impervious Area Reduction (10%) (ac)	Annual Runoff Volume Reduction [2] (MGal)
Cuckles Brook	53.4	60.6
Dead River	0.1	0.1
Green Brook	9.4	10.6
Middle Brook	50.9	57.8
Millstone River	0.0	0.0
Peters Brook	122.3	138.9
Lower Raritan River	66.0	74.9
Raritan River North Branch	86.9	98.6
Total	389.0	441.5

[2] Annual Runoff Volume Reduction =
Acres of impervious cover x 43,560 ft^2/ac x 44 in x (1 ft/12 in) x 0.95 x (7.48 gal/ft^3) x (1 MGal/1,000,000 gal)
All green infrastructure should be designed to capture the first 3.3 inches of rain from each storm. This would allow the green infrastructure to capture 95% of the annual rainfall of 44 inches.

Pervious Pavement

There are four different types of permeable pavement systems that are commonly being used throughout the country to reduce the environmental impacts from impervious surfaces. These surfaces include pervious concrete, porous asphalt, interlocking concrete pavers, and grid pavers.

> "*Permeable pavement is a stormwater drainage system that allows rainwater and runoff to move through the pavement's surface to a storage layer below, with the water eventually seeping into the underlying soil. Permeable pavement is beneficial to the environment because it can reduce stormwater volume, treat stormwater water quality, replenish the groundwater supply, and lower air temperatures on hot days (Rowe, 2012).*"



Permeable surfaces: (A) pervious concrete, (B) porous asphalt, (C) interlocking concrete pavers, (D) grid pavers (Rowe, 2012)

Pervious concrete and porous asphalt are the most common of the permeable surfaces. They are similar to regular concrete and asphalt but without the fine materials. This allows water to quickly pass through the material into an underlying layered system of stone that holds the water allowing it to infiltrate into the underlying uncompacted soil.

Impervious Cover Disconnection Practices

By redirecting runoff from paving and rooftops to pervious areas in the landscape, the amount of directly connected impervious area in a drainage area can be greatly reduced. There are many cost-effective ways to disconnect impervious surfaces from local waterways.

- Simple Disconnection: This is the easiest and least costly method to reduce stormwater runoff for smaller storm events. Instead of piping rooftop runoff to the street where it enters the catch basin and is piped to the river, the rooftop runoff is released onto a grassed area to allow the water to be filtered by the grass and soak into the ground. A healthy lawn typically can absorb the first one to two inches of stormwater runoff from a rooftop. Simple disconnection also can be used to manage stormwater runoff from paved areas. Designing a parking lot or driveway to drain onto a grassed area, instead of the street, can dramatically reduce pollution and runoff volumes.

- Rain Gardens: Stormwater can be diverted into shallow landscaped depressed areas (i.e., rain gardens) where the vegetation filters the water, and it is allowed to soak into the ground. Rain gardens, also known as bioretention systems, come in all shapes and sizes and can be designed to disconnect a variety of impervious surfaces (Figure 7).

Figure 7: Rain garden outside the RCE of Gloucester County office which was designed to disconnect rooftop runoff from the local storm sewer system

- Rainwater Harvesting: Rainwater harvesting includes the use of rain barrels and cisterns (Figures 8a and 8b). These can be placed below downspouts to collect rooftop runoff. The collected water has a variety of uses including watering plants and washing cars. This practice also helps cut down on the use of potable water for nondrinking purposes. It is important to divert the overflow from the rainwater harvesting system to a pervious area.

Figure 8a: Rain barrel used to disconnect a downspout with the overflow going to a flower bed

Figure 8b: A 5,000 gallon cistern used to disconnect the rooftop of the Department of Public Works in Clark Township to harvest rainwater for nonprofit car wash events

Examples of Opportunities in Bridgewater Township

To address the impact of stormwater runoff from impervious surfaces, the next step is to identify opportunities in the municipality for eliminating, reducing, or disconnecting directly connected impervious surfaces. To accomplish this task, an impervious cover reduction action plan should be prepared. Aerial photographs are used to identify sites with impervious surfaces in the municipality that may be suitable for inclusion in the action plan. After sites are identified, site visits are conducted to photo-document all opportunities and evaluate the feasibility of eliminating, reducing or disconnecting directly connected impervious surfaces. A brief description of each site discussing the existing conditions and recommendations for treatment of the impervious surfaces is developed. After a number of sites have been selected for inclusion in the action plan, concept plans and detailed green infrastructure information sheets are prepared for a selection of representative sites.

For Bridgewater Township, three sites have been included in this assessment. Examples of concept plans and detailed green infrastructure information sheets are provided in Appendix A. The detailed green infrastructure information sheets describe existing conditions and issues, proposed solutions, anticipated benefits, possible funding sources, potential partners and stakeholders, and estimated costs. Additionally, each project has been classified as a mitigation opportunity for recharge potential, total suspended solids removal, and stormwater peak reduction. Finally, these detailed green infrastructure information sheets provide an estimate of gallons of stormwater captured and treated per year by each proposed green infrastructure practice. The concept plans provide an aerial photograph of the site and details of the proposed green infrastructure practices.

Conclusions

Bridgewater Township can reduce flooding and improve its waterways by better managing stormwater runoff from impervious surfaces. This impervious cover assessment is the first step toward better managing stormwater runoff. The next step is to develop an action plan to eliminate, reduce, or disconnect impervious surfaces where possible and practical. Many of the highly effective disconnection practices are inexpensive. The entire community can be engaged in implementing these disconnection practices.

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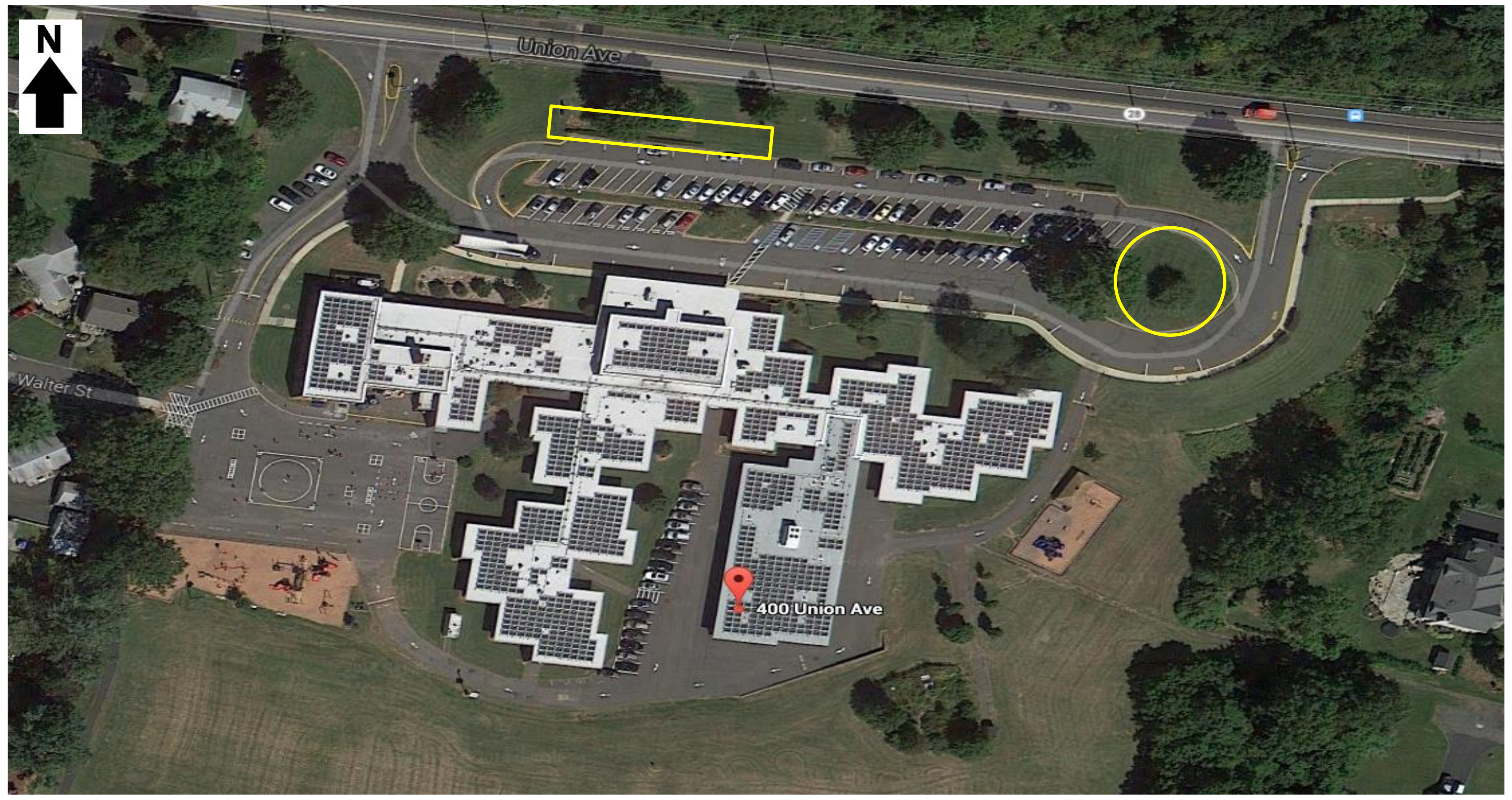
Appendix A

Examples of Impervious Cover Reduction Action Plan Projects

Concept Plans and Detailed Green Infrastructure Information Sheets

Bridgewater Township
Impervious Cover Assessment
Adamsville Primary School, 400 Union Avenue

PROJECT LOCATION:



A

B

SITE PLAN:

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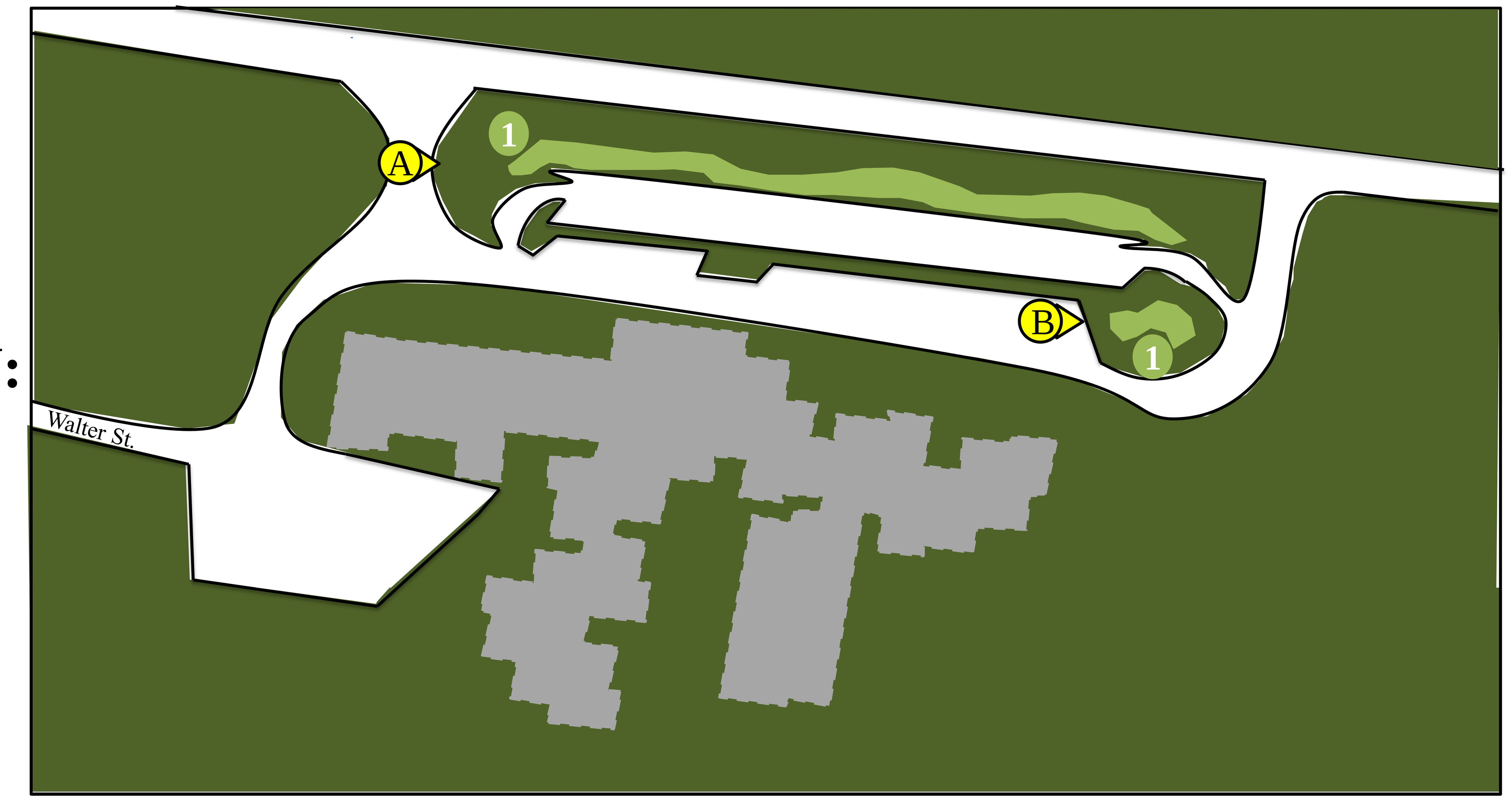
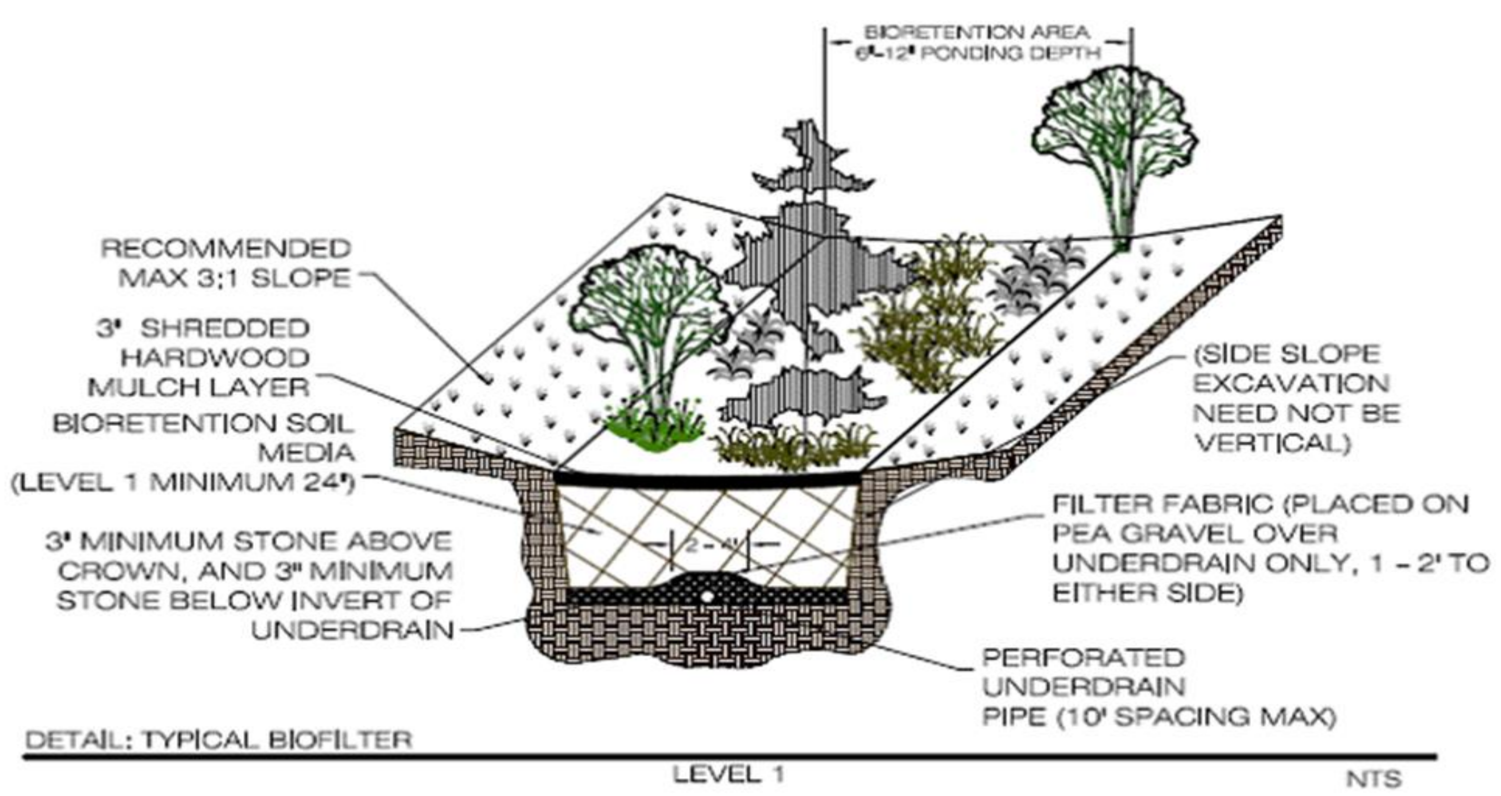


1 **BIORETENTION SYSTEMS:** A bioretention system could be installed on the grassed area parallel to Union Avenue (a). This will capture, treat, and infiltrate stormwater runoff from the parking lot closest to the road. Another bioretention system could be installed on the grassed circular area at the end of the parking lot closest to the school by the driveway exit (b). This will intercept, infiltrate, and treat runoff from a portion of the upper and lower parking lots. Curb cuts are recommended to allow the flow of runoff into the bioretention systems.

EDUCATIONAL PROGRAM: The RCE Water Resources Program's *Stormwater Management in Your Schoolyard* program can be delivered at the Adamsville Primary School to educate the students about stormwater management and engage them in building the bioretention systems.

1 BIORETENTION SYSTEM



CURB CUT

EDUCATIONAL PROGRAM

Location: 400 Union Avenue Bridgewater, NJ 08807	**Municipality:** Bridgewater **Subwatershed:** Middle Brook
Green Infrastructure Description: bioretention system (rain garden) *Stormwater Management in Your Schoolyard* education program	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** rain garden #1: 402,456 gal. rain garden #2: 348,666 gal.

Existing Conditions and Issues:
There are large amounts of impervious surfaces at this site that contribute to stormwater runoff volumes and nonpoint source pollution. Runoff is carrying nonpoint source pollution, such as sediments, nutrients, oil and grease, to local waterways. There is a single catch basin along the curb at the far end of the parking lot which captures the stormwater runoff from the lower parking lot. In the upper parking lot closest to the school, there is an inlet in the corner of the last parking spot which captures the stormwater runoff from the upper parking lot.

Proposed Solution(s):
Bioretention systems or rain gardens could be installed on the circular piece of lawn at the end of the parking lot to the left of the school when looking at it from the street. There also could be another bioretention system or rain garden installed at the front of the school along the parking lot where there are currently shrubs. The existing stormwater system could be used as overflow for both bioretention systems. These bioretention systems would make for a great educational opportunity for the students and visitors to the school. The Rutgers Cooperative Extension (RCE) Water Resources Program has a youth education program called *Stormwater Management in Your Schoolyard* that could be used at this school. The stormwater runoff from the parking lot closest to the school could be treated with bioretention system #1. The stormwater runoff from the parking lot closest to the road also could be treated with bioretention system #2. These bioretention systems would capture, treat, and infiltrate the stormwater runoff, thereby reducing localized flooding and improving water quality.

Anticipated Benefits:
A bioretention system is estimated to achieve a 30% removal rate for TN and a 60% removal rate for TP (NJDEP BMP Manual). TSS loadings may be reduced by up to 80%. If these bioretention systems are designed to capture and infiltrate stormwater runoff from the 2-year design storm (3.3 inches of rain over 24 hours), these systems will prevent approximately 95% of the TN, TP and TSS from flowing directly into local waterways. A bioretention system would also provide ancillary benefits such as enhanced wildlife and aesthetic appeal to faculty and students. Since the proposed site is located at Adamsville Primary School, there is an opportunity to educate school

children about the importance of watersheds and stormwater management. This could be completed through the RCE Water Resources Program's *Stormwater Management in Your Schoolyard* program. The students could assist with installing the bioretention systems as part of a hands-on class activity.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs like 319(h) and 604(b)
Bridgewater Township home and school associations
Boy Scouts, Girl Scouts, or service project
Adamsville Home and School Association

Partners/Stakeholders:
Bridgewater Township
teachers, students and parents
Rutgers Cooperative Extension

Estimated Cost:
Rain garden #1 would need to be approximately 3,100 square feet. At $5 per square foot, the estimated cost of the rain garden is $15,500. Rain garden #2 would need to be approximately 2,700 square feet in size. At $5 per square foot, the estimated cost of the rain garden is $13,500. The total cost of the project would be approximately $29,000.

Bridgewater Township
Impervious Cover Assessment

Bridgewater- Raritan Middle School, 425 Foothill Road

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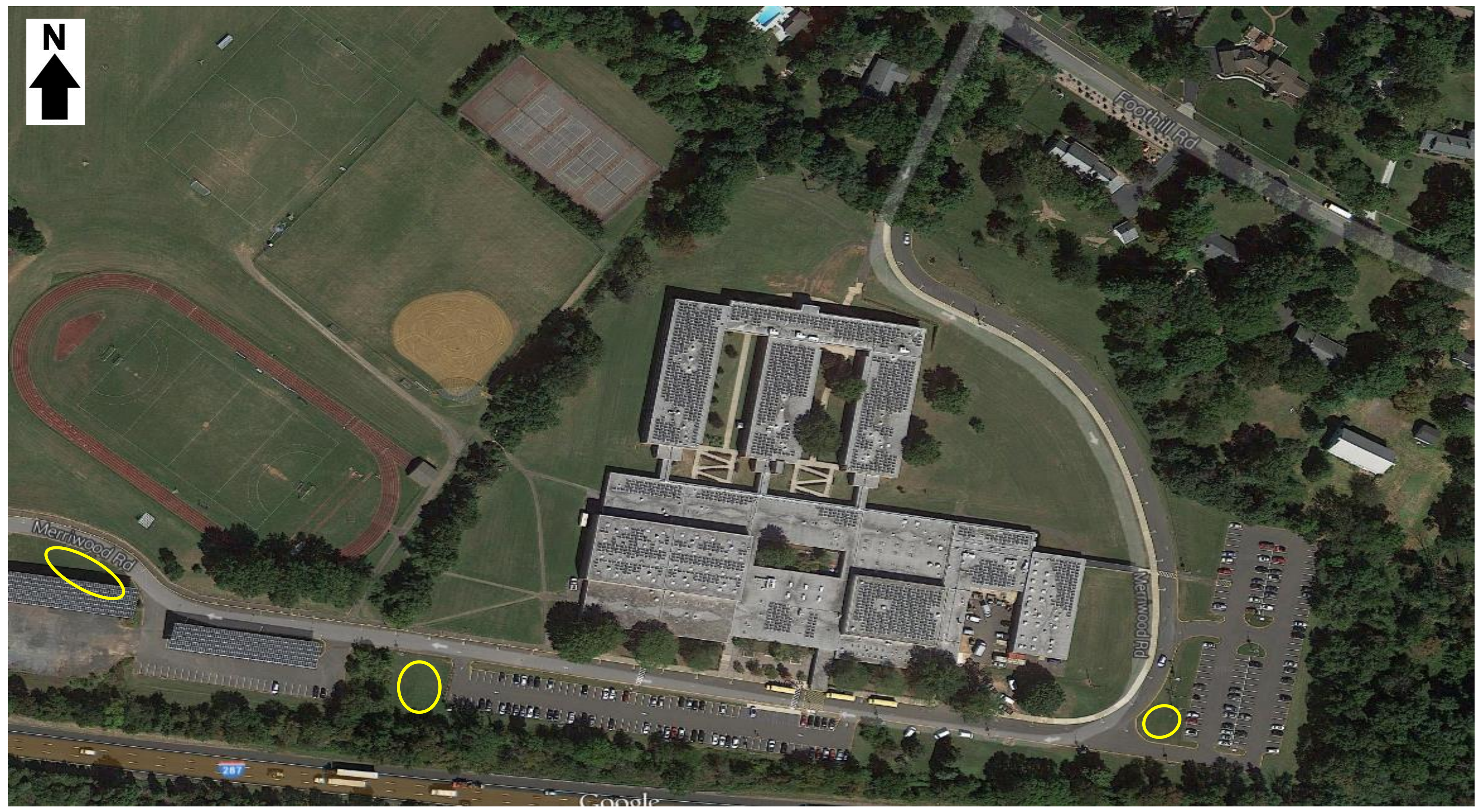
B

C

PROJECT LOCATION:



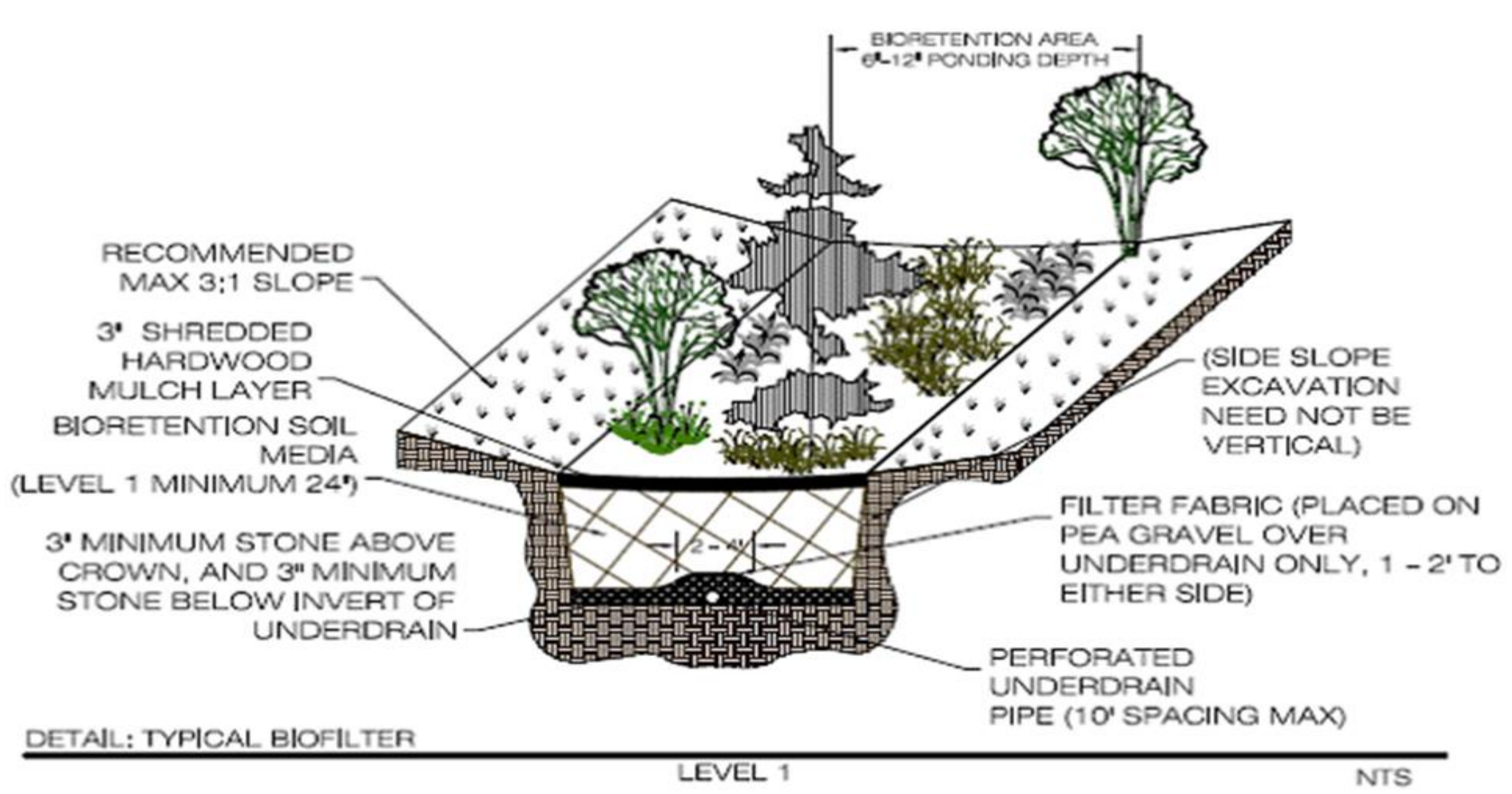
SITE PLAN:

N

1 **BIORETENTION SYSTEMS:** A bioretention system (#1) could be installed on the grassed island in the first parking lot to the right of the school. There was noticeable flooding at the far end of the lot. Another bioretention system (#2) could be installed in the grassed area between the two southern parking lots. This area is flooding and has pooling water. Bioretention systems can be used to capture runoff from the parking lots. Bioretention system (#3) could be installed underneath the solar panels in the back parking lot. This will help solve existing drainage problems as well as treat stormwater runoff from the solar panels. Curb cuts are recommended to allow the flow of runoff into the bioretention system.

EDUCATIONAL PROGRAM: The RCE Water Resources Program's *Stormwater Management in Your Schoolyard* program can be delivered at the Bridgewater- Raritan Middle School to educate the students about stormwater management and engage them in designing and building the bioretention systems.

1 BIORETENTION SYSTEM



CURB CUT

EDUCATIONAL PROGRAM

Location: 425 Foothill Road Bridgewater, NJ 08807	**Municipality:** Bridgewater **Subwatershed:** Cuckles Brook
Green Infrastructure Description: bioretention system (rain garden) *Stormwater Management in Your Schoolyard* education program	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** rain garden #1: 83,377 gal. rain garden #2: 135,488 gal. rain garden #3: 156,332 gal.

Existing Conditions and Issues:
There are large amounts of impervious surfaces at this site that contribute to stormwater runoff volumes and nonpoint source pollution. Runoff is carrying nonpoint source pollution, such as sediments, nutrients, oil, and grease to local waterways. This project focuses on the turf grass island off of Meriwood Road west of the building, a turf grass area between the second and third parking lots to the south, and the small turf grass area next to the west set of solar panels where puddles of water appear to settle. There doesn't appear to be any stormwater management in the first parking lot near the turf grass island, and the curbs are eroded. Presumably, there isn't any stormwater management in the second parking lot, and the parking lot with the solar panels contains a rain garden that needs to be cleaned and maintained. Flooding is a possibility in these parking lots off of Meriwood Road, which would be a major concern for faculty, parents of students, and nearby homeowners who frequent this road.

Proposed Solution(s):
The turf grass island off of Meriwood Road could benefit from implementing a bioretention system as well as curb cuts so the stormwater that accumulates from the street and parking lot could flow directly into a bioretention system (#1). The turf grass area between the southern parking lots could have a bioretention system (#2) installed as well to collect stormwater from the road and parking lot. The small section in front of the solar panels where puddles of water appear to settle is an ideal place for a bioretention system (#3) to filter stormwater runoff and reduce pooling.

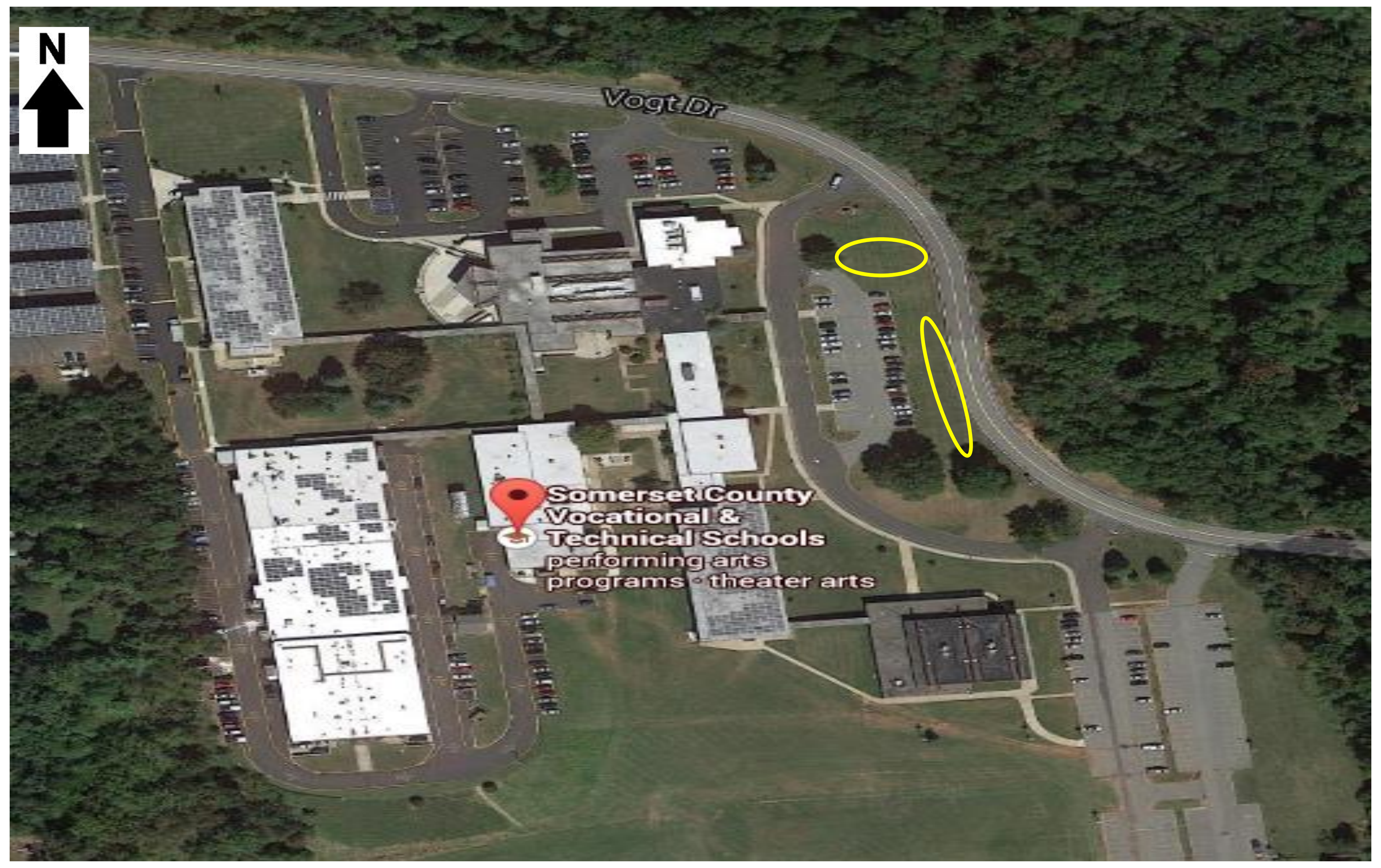
Anticipated Benefits:
A bioretention system is estimated to achieve a 30% removal rate for TN and a 60% removal rate for TP (NJDEP BMP Manual). TSS loadings may be reduced by up to 80%. If these bioretention systems are designed to capture and infiltrate stormwater runoff from the 2-year design storm (3.3 inches of rain over 24 hours), these systems will prevent approximately 95% of the TN, TP and TSS from flowing directly into local waterways. A bioretention system would also provide ancillary benefits such as enhanced wildlife and aesthetic appeal to faculty and students. Since the proposed site is located at Bridgewater-Raritan Middle School, there is an opportunity to educate school children about the importance of watershed and stormwater management. This could be completed through the RCE Water Resources Program's *Stormwater Management in Your Schoolyard* program. The students could assist with installing the bioretention systems as part of a hands-on class activity.

Possible Funding Sources: mitigation funds from local developers NJDEP grant programs like 319(h) and 604(b) Bridgewater Township home and school associations Boy Scouts, Girl Scouts, or service projects Bridgewater-Raritan Home and School Association
Partners/Stakeholders: Bridgewater Township Bridgewater-Raritan Middle School teachers, students, parents Rutgers Cooperative Extension
Estimated Cost: Rain garden #1 would need to be approximately 800 square feet in size. At $5 per square foot, the estimated cost of the rain garden is $4,000. Rain garden #2 would need to be approximately 1,300 square feet. At $5 per square foot, the estimated cost of the rain garden is $6,500. Rain garden #3 would need to be approximately 1,500 square feet. At $5 per square foot, the estimated cost of the rain garden is $7,500. Thus, the total estimated price of the project would be $18,000.

Bridgewater Township
Impervious Cover Assessment

Somerset County Vocational and Technical School, 14 Vogt Drive

PROJECT LOCATION:



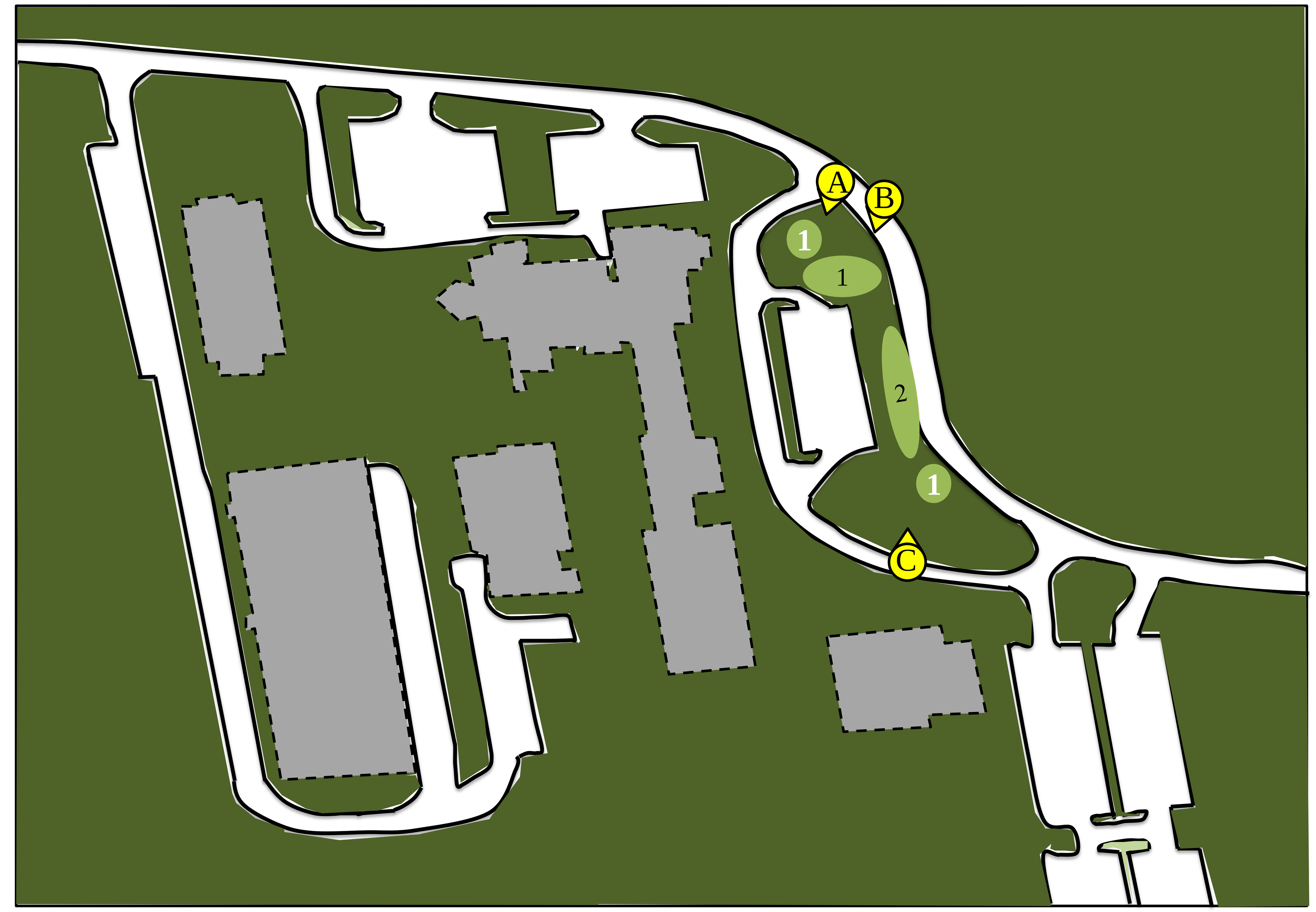
A

B

C

SITE PLAN:

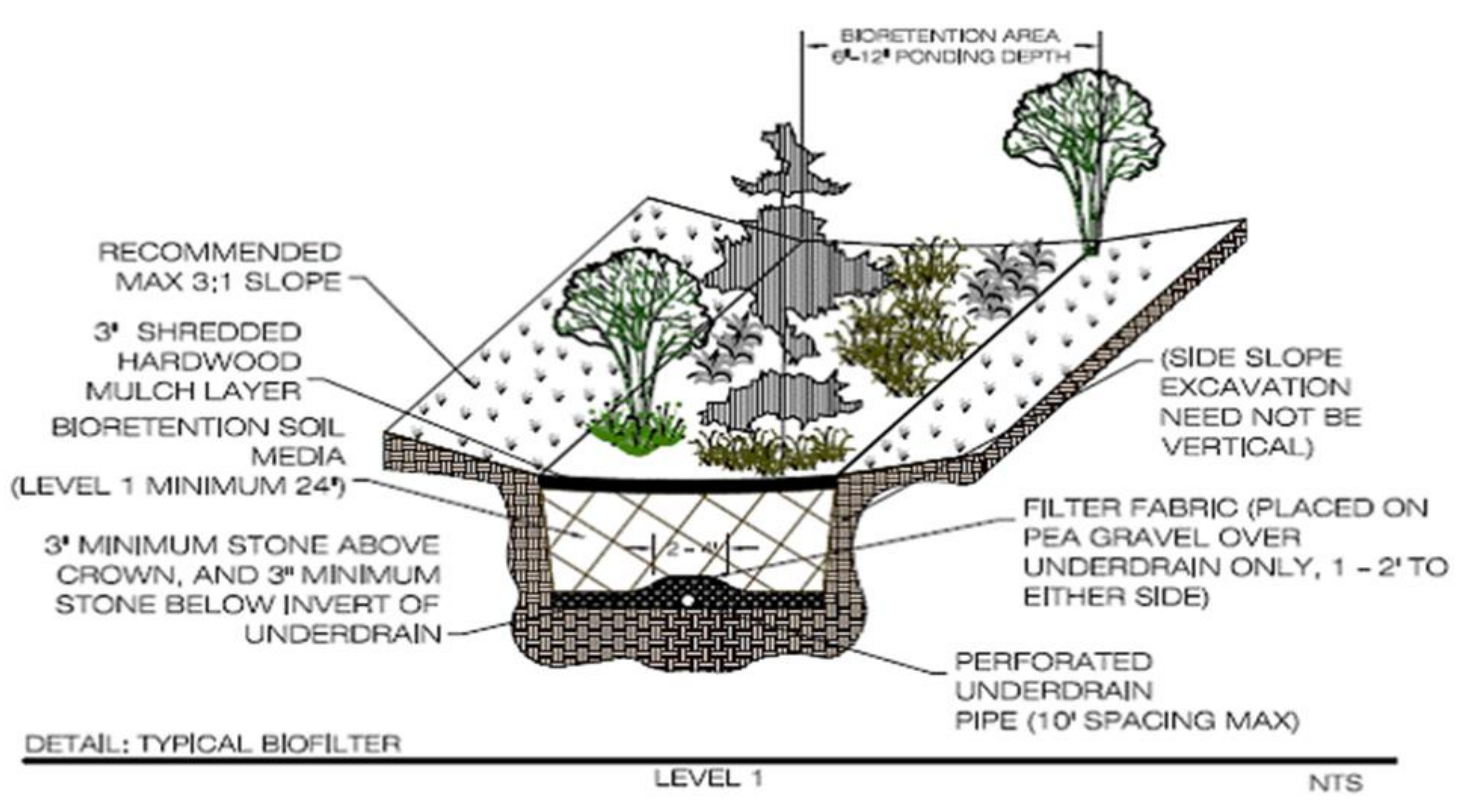
N



1 **BIORETENTION SYSTEMS:** A bioretention system could be installed across from the front of the building parallel to the front parking lot. The bioretention system would be used to capture runoff from the parking lot in the front of the school and the adjacent road through curb cuts.

EDUCATIONAL PROGRAM: The RCE Water Resources Program's *Stormwater Management in Your Schoolyard* program can be delivered at Somerset County Vocational and Technical Schools to educate the students about stormwater management and engage them in designing and building the bioretention systems.

1 BIORETENTION SYSTEM



CURB CUT

EDUCATIONAL PROGRAM

Location: 14 Vogt Drive Bridgewater, NJ 08807	**Municipality:** Bridgewater **Subwatershed:** Peters Brook
Green Infrastructure Description: bioretention system (rain garden) *Stormwater Management in Your Schoolyard* education program	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** rain garden #1: 373,164 gal. rain garden #2: 164,930 gal.

Existing Conditions and Issues:

This site contains the lawn in front of the Somerset County Vocational and Technical School. There are two inlets in the street along the length of this area, one from the end of the existing rain garden and another one approximately 210 feet past it, which catches stormwater runoff from the street. Currently, there are two inlets catching stormwater from the parking lot. Due to a lack of prior treatment of the runoff, contaminants from the parking lot and street (e.g., oils, grease, metals, coolants from vehicles, and particulate matter) drain into the stormwater system. During large storm events, there is a possibility of flooding on Vogt Drive and in the faculty parking lot in the front of the building. Flooding is a major concern for homeowners, and this road is frequented by cars because of its location relative to a residential neighborhood and school.

Proposed Solution(s):

The lawn in front of the Somerset County Vocational and Technical School could benefit from a bioretention system or rain garden to catch the water from the road and faculty parking lot before it gets into the catch basin. The area is large enough for an abundance of vegetation to effectively infiltrate stormwater before it reaches the catch basin. Additionally, curb cuts could be installed from the parking lot to allow water to drain into the bioretention system. Bioretention system #1 would collect the stormwater runoff from the parking lot in front of the school. Bioretention system #2 would collect the stormwater runoff from the street in front of the school between the two inlets.

Anticipated Benefits:

A bioretention system is estimated to achieve a 30% removal rate for TN and a 60% removal rate for TP (NJDEP BMP Manual). TSS loadings may be reduced by up to 80%. If these bioretention systems are designed to capture and infiltrate stormwater runoff from the 2-year design storm (3.3 inches of rain over 24 hours), these systems will prevent approximately 95% of the TN, TP and TSS from flowing directly into local waterways. A bioretention system would also provide ancillary benefits such as enhanced wildlife and aesthetic appeal to faculty and students. Since the proposed site is located at Somerset County Vocational and Technical School, there is an opportunity to educate students about the importance of watershed and stormwater management.

This could be completed through the RCE Water Resources Program's *Stormwater Management in Your Schoolyard* program. The students could assist with installing the bioretention systems as part of a hands-on class activity.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs like 319(h) and 604(b)
Bridgewater Township home and school associations
Somerset County
Votech student clubs
capstone projects/service projects

Partners/Stakeholders:
Bridgewater Township
Somerset County Vocational and Technical School
teachers, students, parents
Rutgers Cooperative Extension

Estimated Cost:
Rain garden #1 would need to be approximately 2,900 square feet in size. At $5 per square foot, the estimated cost of the rain garden is $14,500. Rain garden #2 would need to be approximately 1,300 square feet. At $5 per square foot, the estimated cost of the rain garden is $6,500. In total the estimated price would be $21,000.