RUTGERS
New Jersey Agricultural
Experiment Station

Impervious Cover Assessment
for
Milltown Borough, Middlesex County, New Jersey

Prepared for Milltown Borough by the
Rutgers Cooperative Extension Water Resources Program

November 24, 2014

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

Milltown Borough Impervious Cover Analysis

Located in Middlesex County in central New Jersey, Milltown Borough covers approximately 1.6 square miles east of Raritan. Figures 3 and 4 illustrate that Milltown Borough is dominated by urban land uses. A total of 88.1% of the municipality's land use is classified as urban. Of the urban land in Milltown Borough, medium 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 Milltown Borough 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 Milltown Borough. Based upon the 2007 NJDEP land use/land cover data, approximately 40.9% of Milltown Borough has impervious cover. This level of impervious cover suggests that the streams in Milltown Borough are likely non-supporting streams.

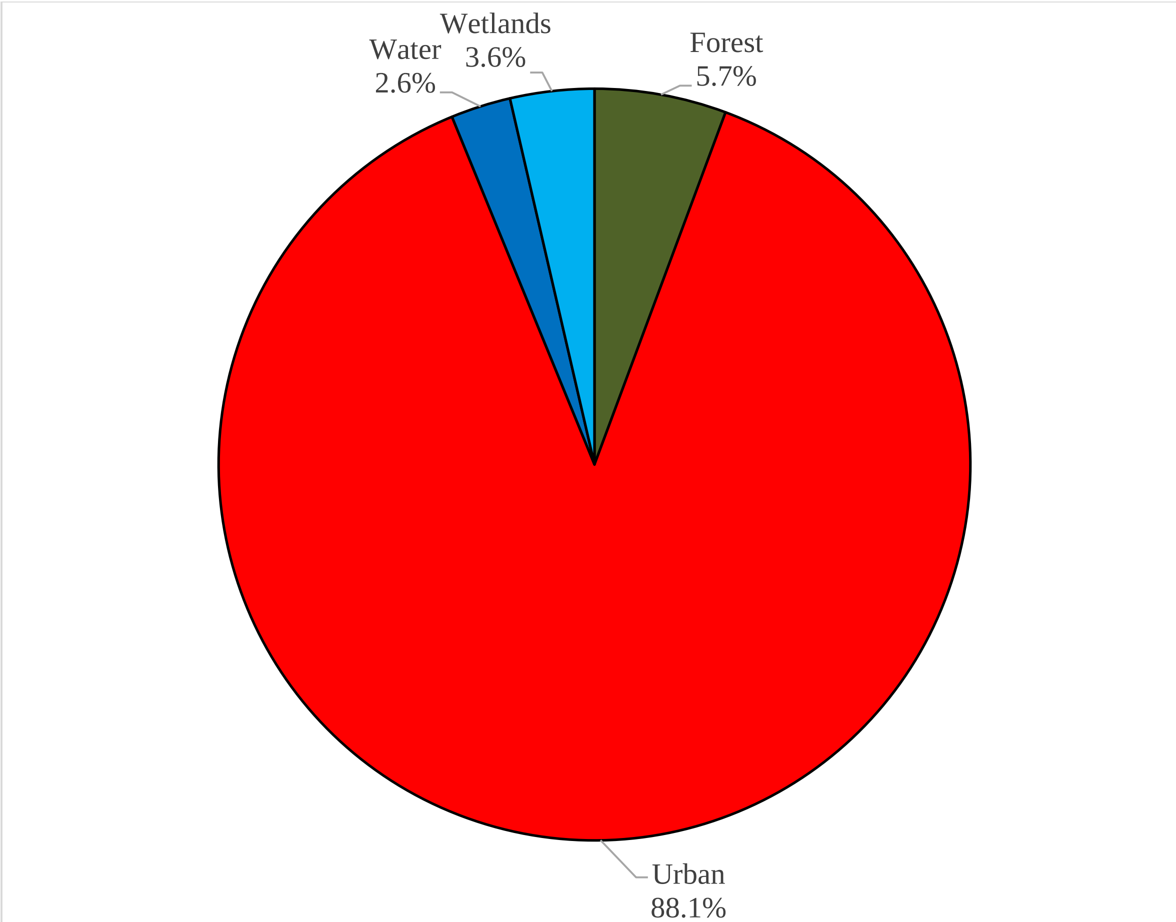


Figure 3: Pie chart illustrating the land use in Milltown Borough

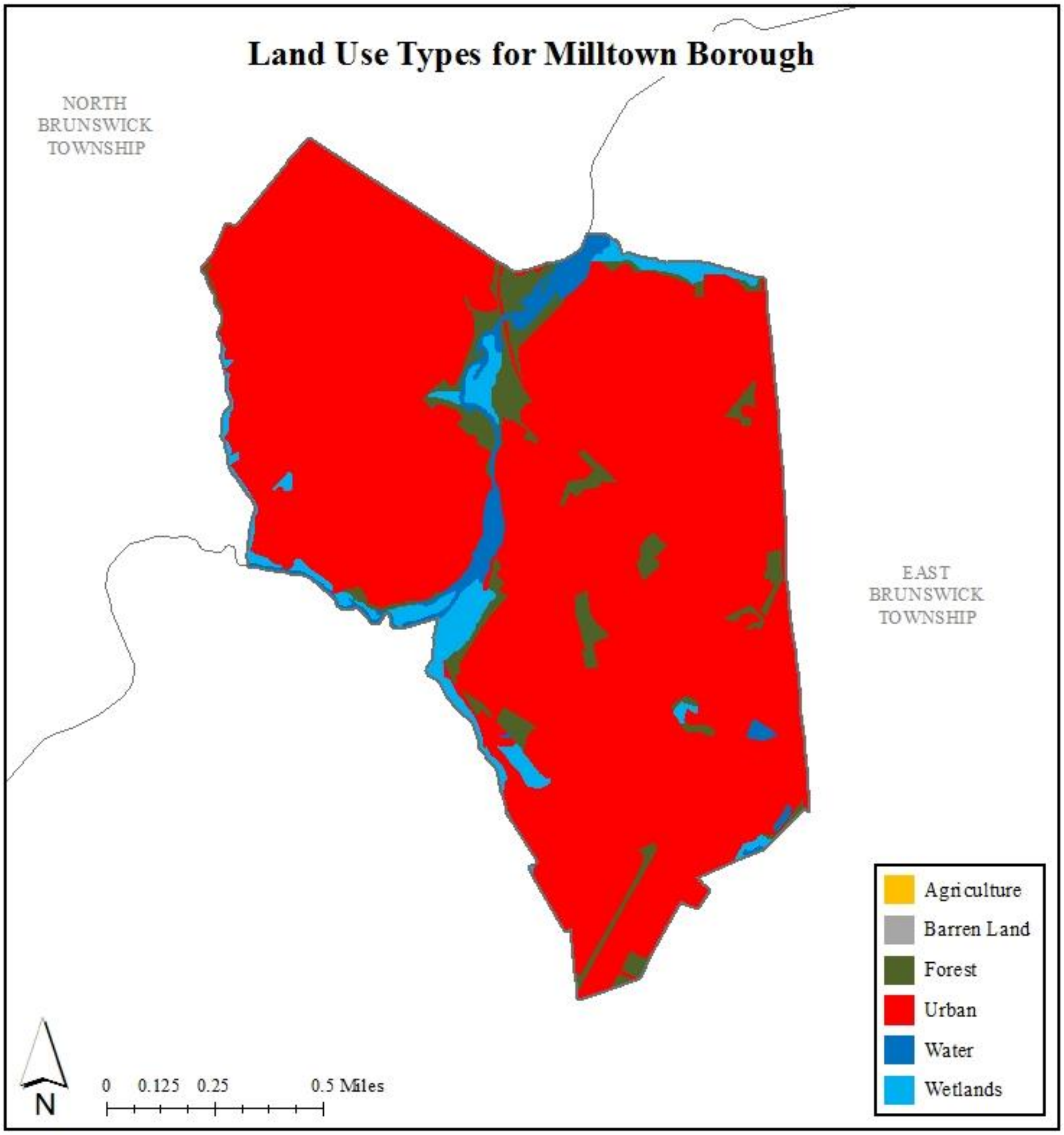


Figure 4: Map illustrating the land use in Milltown Borough

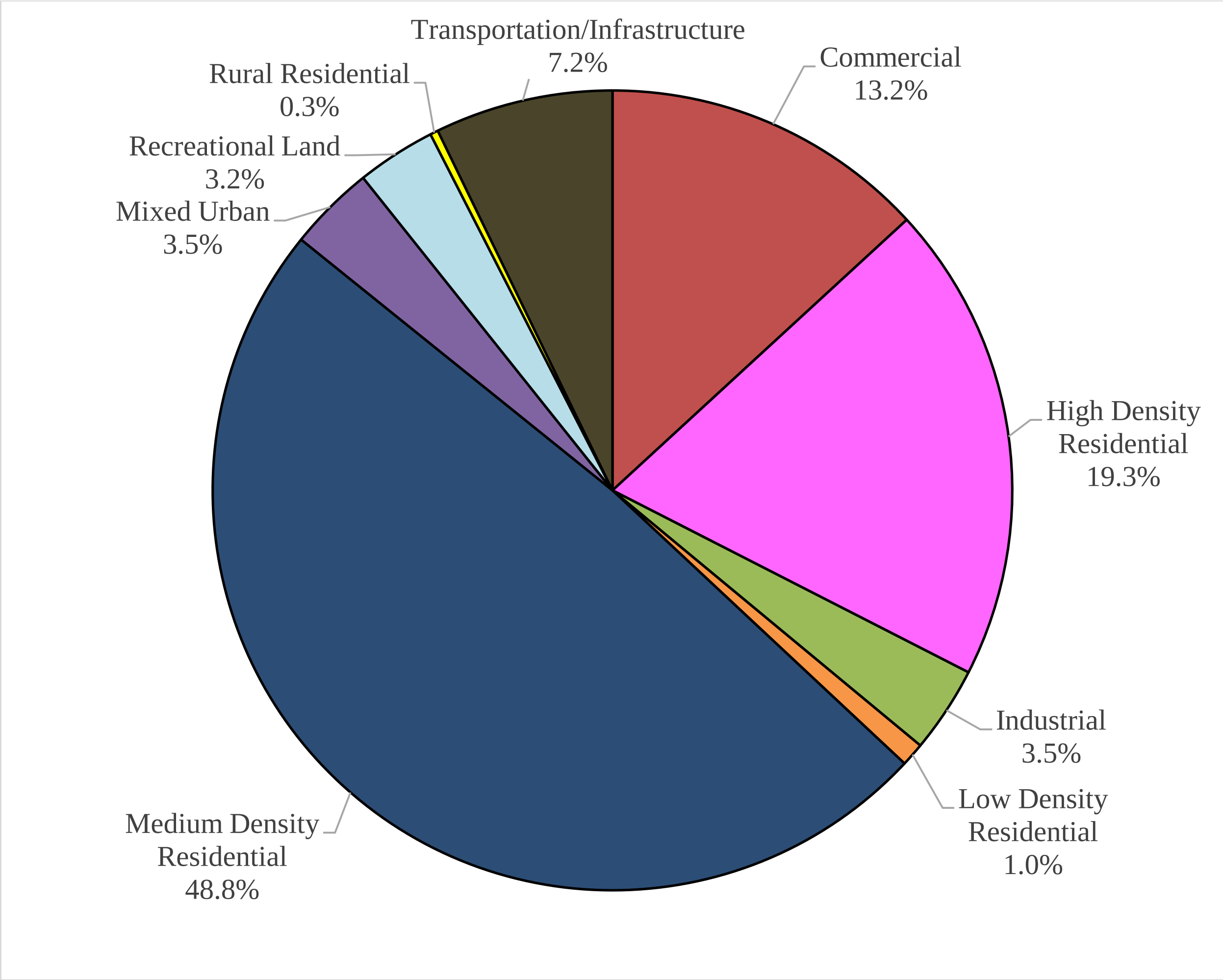


Figure 5: Pie chart illustrating the various types of urban land use in Milltown Borough

Water resources are typically managed on a watershed/subwatershed basis. All of Milltown Borough is in the Lawrence Brook Watershed, which is a subwatershed of the Raritan River Watershed (Table 1 and Figure 6). Four other municipalities have land in the Lawrence Brook Watershed (East Brunswick, New Brunswick, North Brunswick, and South Brunswick). While managing impervious cover in Milltown Borough is important to address flooding issues, efforts need to be made to partner with the other towns in the Lawrence Brook Watershed to achieve significant reductions in flooding.

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 Milltown Borough, Middlesex 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 (5.1 inches of rain), and the 100-year design storm (8.6 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Milltown Borough. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Lawrence Brook Watershed was harvested and purified, it could supply water to 126 homes for one year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Milltown Borough

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(%)
Lawrence Brook	1021.2	1.60	994.9	1.55	26.3	0.04	406.6	0.64	40.9%
Total	1021.2	1.60	994.9	1.55	26.3	0.04	406.6	0.64	40.9%

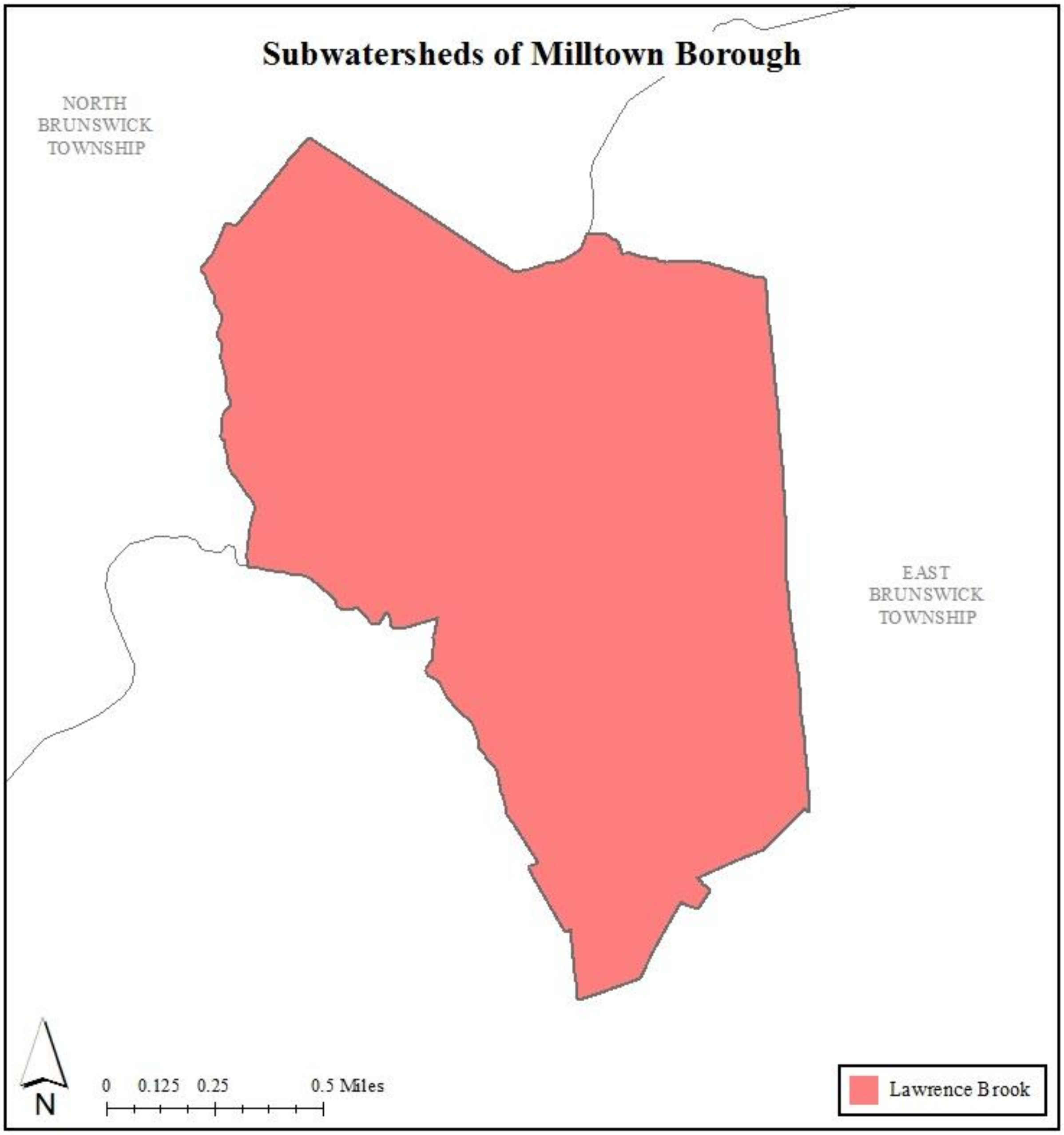


Figure 6: Map of the subwatersheds in Milltown Borough

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in Milltown Borough

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 (5.1") (MGal)	Total Runoff Volume for the 100-Year Design Storm (8.6") (MGal)
Lawrence Brook	13.8	485.8	36.4	56.3	94.9
Total	13.8	485.8	36.4	56.3	94.9

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 Milltown Borough. 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 Milltown Borough

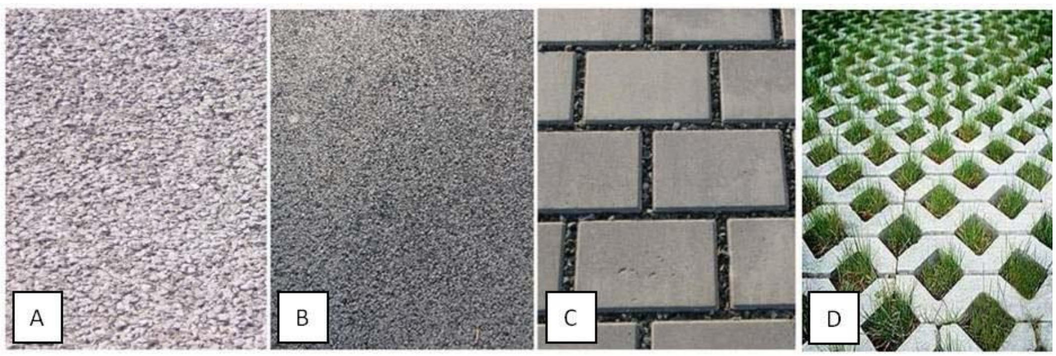
Subwatershed	Recommended Impervious Area Reduction (10%) (ac)	Annual Runoff Volume Reduction [2] (MGal)
Lawrence Brook	40.7	46.1
Total	40.7	46.1

[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 Milltown Borough

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 Milltown Borough, 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

Milltown Borough 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.

References

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http://ofmpub.epa.gov/waters10/attains_state.control?p_state=NJ

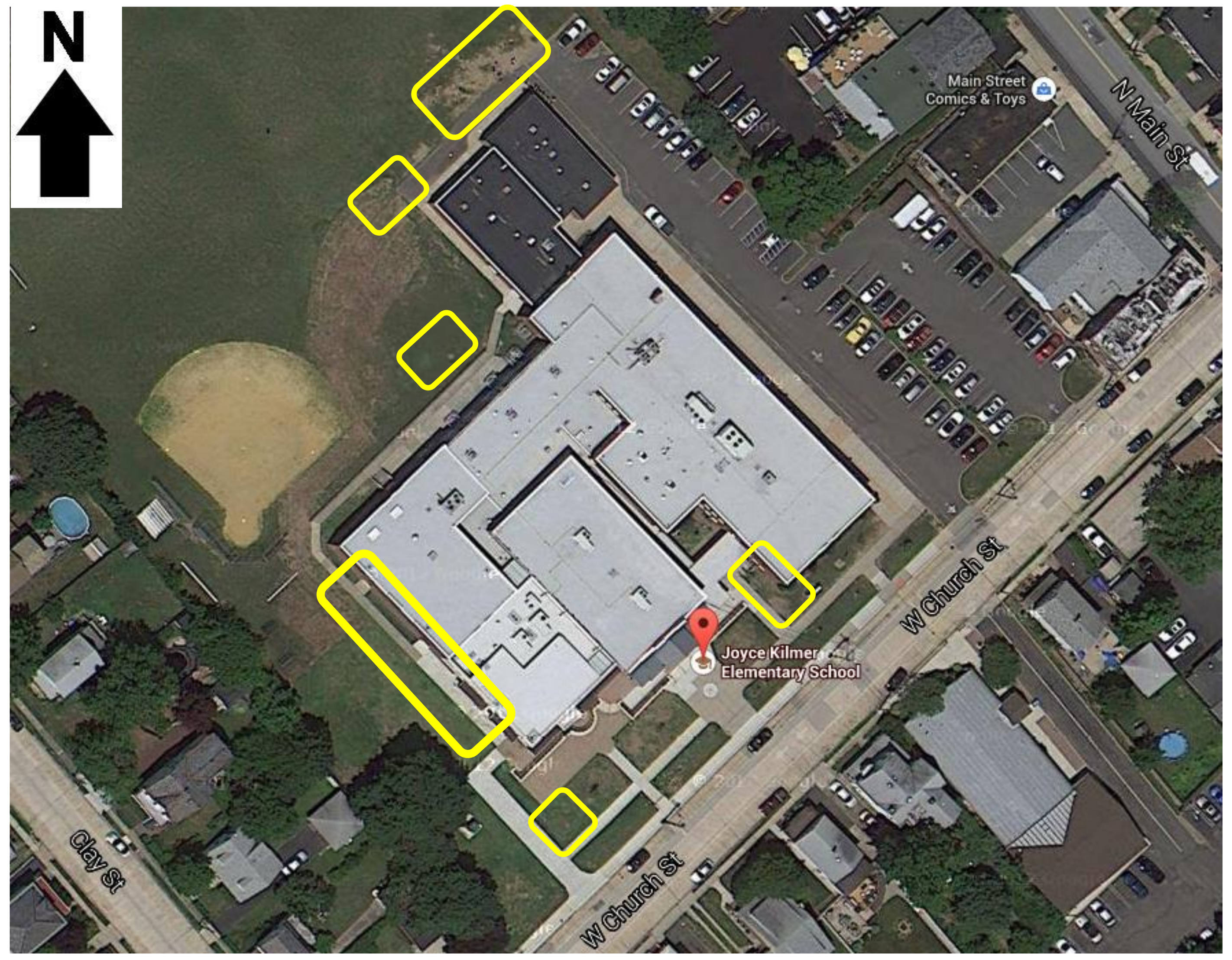
Appendix A

Examples of Impervious Cover Reduction Action Plan Projects

Concept Plans and Detailed Green Infrastructure Information Sheets

Milltown Borough
Impervious Cover Assessment
Joyce Kilmer School, 21 W Church Street

PROJECT LOCATION:



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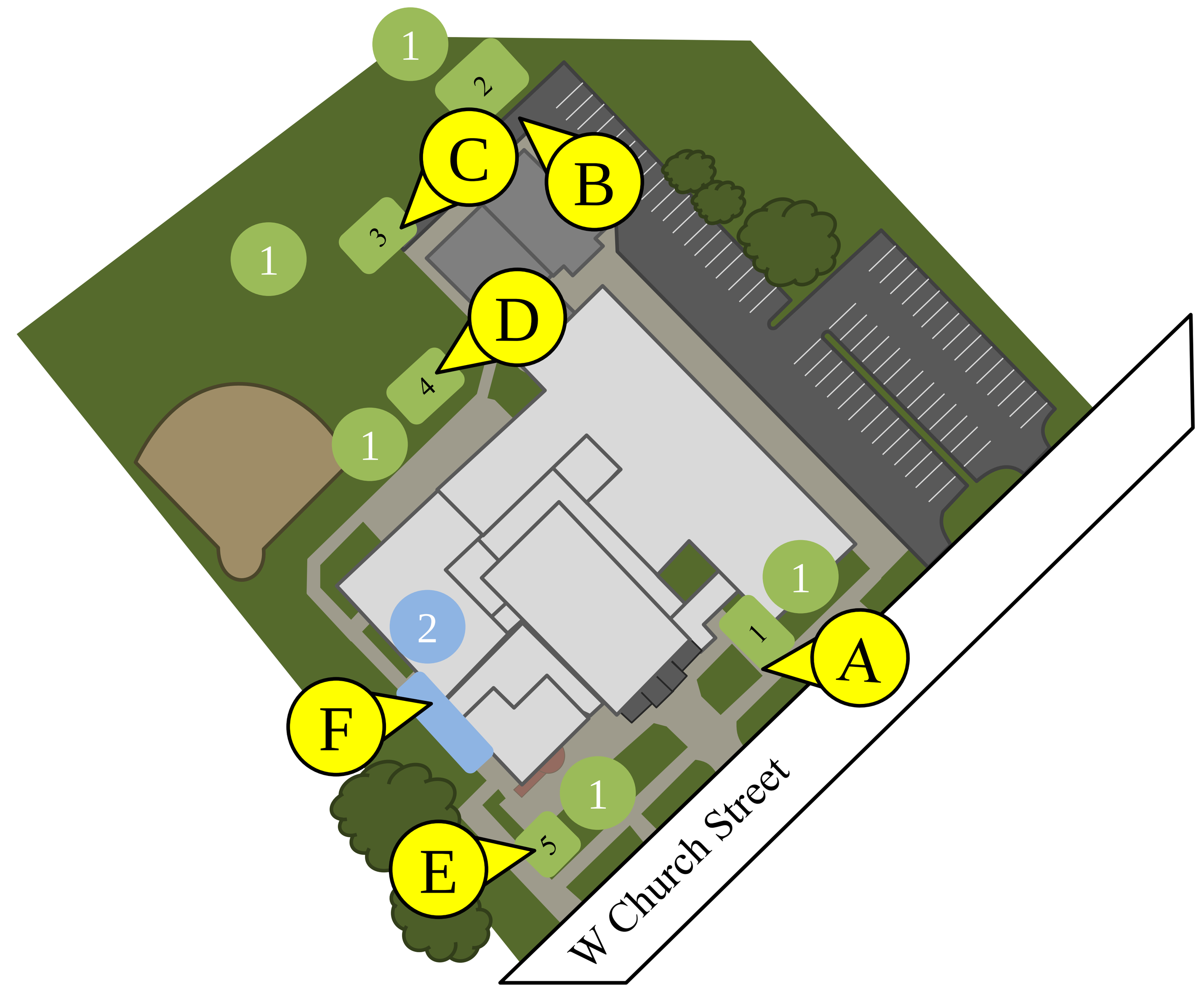
SITE PLAN:



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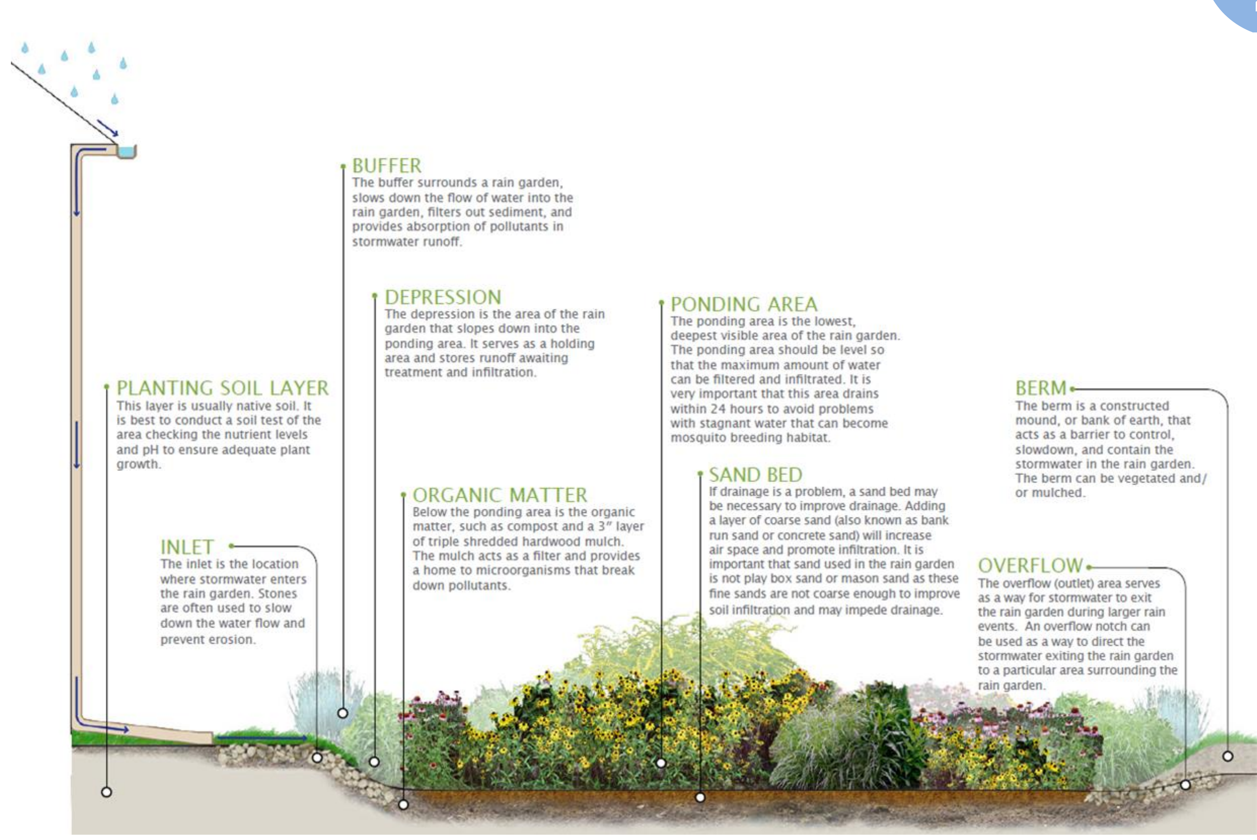
1 **BIORETENTION SYSTEMS:** On this property rain gardens can be used to reduce sediment and nutrient loading to the local watershed and increase groundwater recharge. There are five areas which may be able to accommodate these systems, treating the building's runoff.

2 **RAINWATER HARVESTING:** A rain barrel can be used to collect rain water from a downspout. This water can then be used to water plants and gardens.

EDUCATIONAL OPPORTUNITY: The RCE Water Resources Program's *Stormwater Management in Your Schoolyard* can be delivered at Joyce Kilmer School to educate the students about stormwater management and engage them in the design and construction of the bioretention systems.

1 BIORETENTION SYSTEM



2 RAINWATER HARVESTING

EDUCATIONAL PROGRAM

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Joyce Kilmer School
Green Infrastructure Information Sheet

Location:
21 W. Church Street
Milltown, NJ 08850

Municipality: Milltown Borough

Subwatershed:
Lawrence Brook (Milltown to Church Lane)

Green Infrastructure Description:
bioretention system
rainwater harvesting (rain barrel)

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:
bioretention system #1: 32,960 gal.
bioretention system #2: 232,778 gal.
bioretention system #3: 44,998 gal.
bioretention system #4: 203,232 gal.
bioretention system #5: 99,193 gal.
rain barrel/cistern: 2,468 gal.

Existing Conditions and Issues:
This front of the building of this site is located along W. Church Street. To the right of the main entrance there is a grassy area with a nearby disconnected downspout and two additional connected downspouts nearby. At the building's northeast corner there is an eroded turf grass area with a catch basin that slopes toward the nearby parking lot. There is also a catch basin at the building's protruding portion's northwest corner and an additional one south of here and east of the baseball field. On the buildings southwest face, there are four connected downspouts.

Proposed Solution(s):
At the right of the main entrance, the disconnected downspout could be extended to flow into the turf grass area, and the connected downspouts could potentially be disconnected and rerouted into the turf grass area where a bioretention system could be constructed. At the northeast corner and the building's protruding portion's northwest corner, bioretention systems could be built with the overflow allowed to flow into the catch basin. At the location east of the baseball field, another bioretention system could be constructed with the overflow draining into the catch basin. On the southwest face, a rain barrel could be installed to harvest rain water to water the nearby garden.

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 the local residents, employees, and students of the Joyce Kilmer School. Rutgers Cooperative Extension could additionally present the *Stormwater Management in Your Schoolyard* program to students and include them in bioretention system planting efforts to enhance the program. This may also be used as a demonstration project for Milltown's Department of Public Works staff to launch educational

programming. Rain barrels can harvest rainwater which can be used for watering plants or other purposes which cuts back on use of potable water for nondrinking purposes.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
grants from foundations
home and school associations

Partners/Stakeholders:
The Borough of Milltown
students and parents
local community groups (Boy Scouts, Girl Scouts, etc.)
Rutgers Cooperative Extension

Estimated Cost:
The five rain gardens on the property are each individually sized and are priced accordingly at $5/ft^2. The size of rain gardens 1,2,3,4, and 5 are approximately 350, 2,250, 450, 1,950 and 1,000 ft^2, respectively. The estimated cost of the gardens are $1,750, $11,250, $2,250, $9,750 and $5,000, respectively. The rain barrel/cistern optimal for this site is 200 gallons. The estimated cost for purchase and installation of the rain barrel is $400. The total estimated cost of the project is $30,400.

RUTGERS
New Jersey Agricultural
Experiment Station

Milltown Borough
Impervious Cover Assessment
Milltown Public Library, 20 West Church Street

PROJECT LOCATION:

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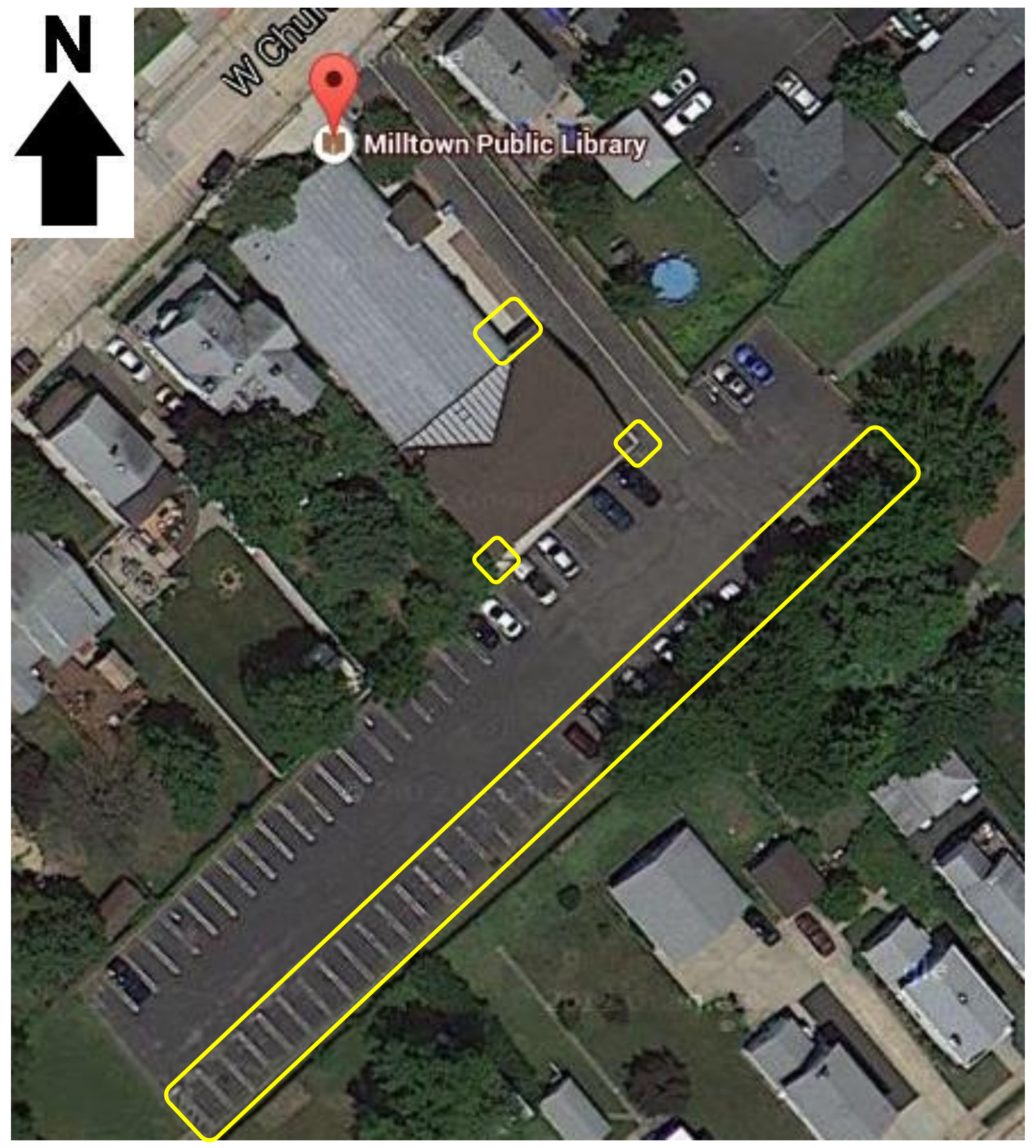

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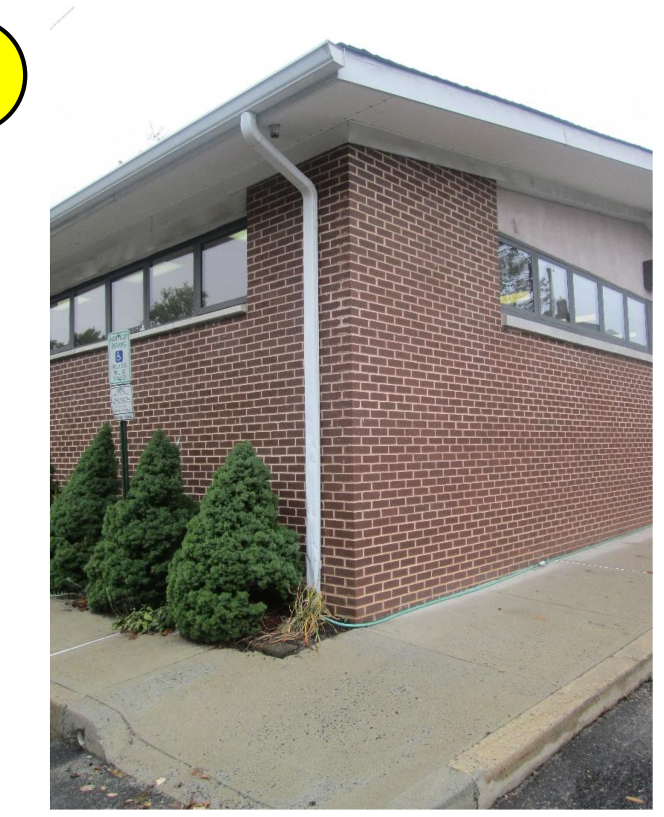

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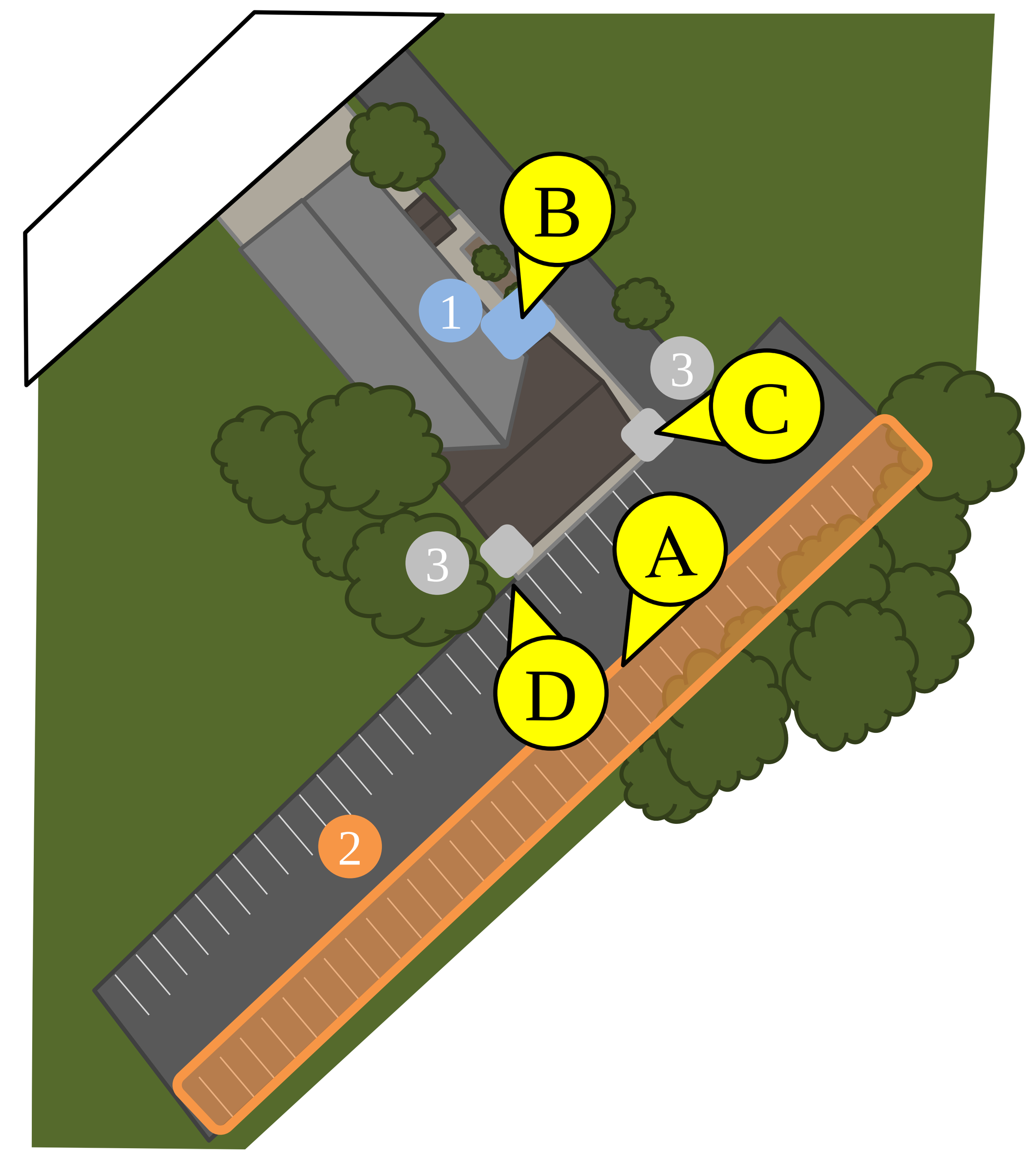

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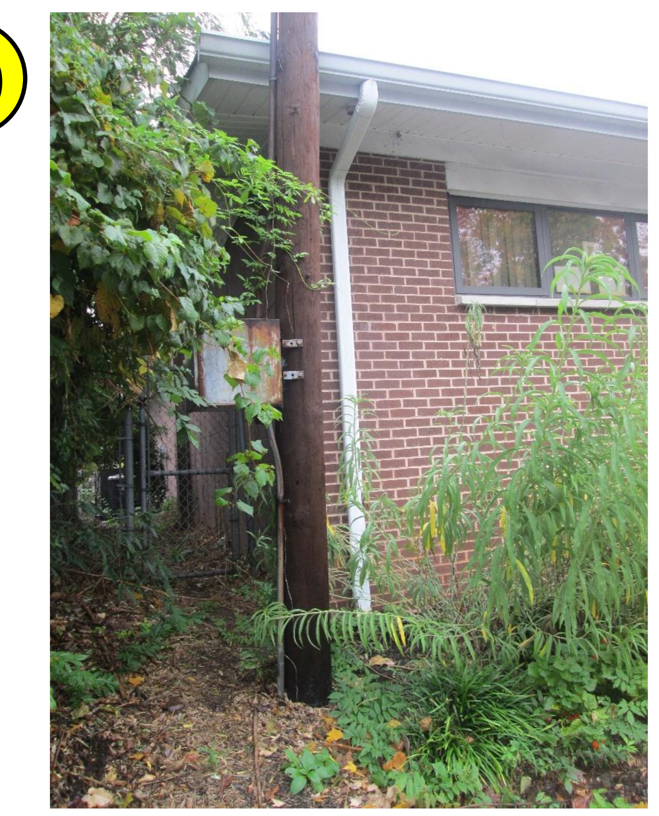


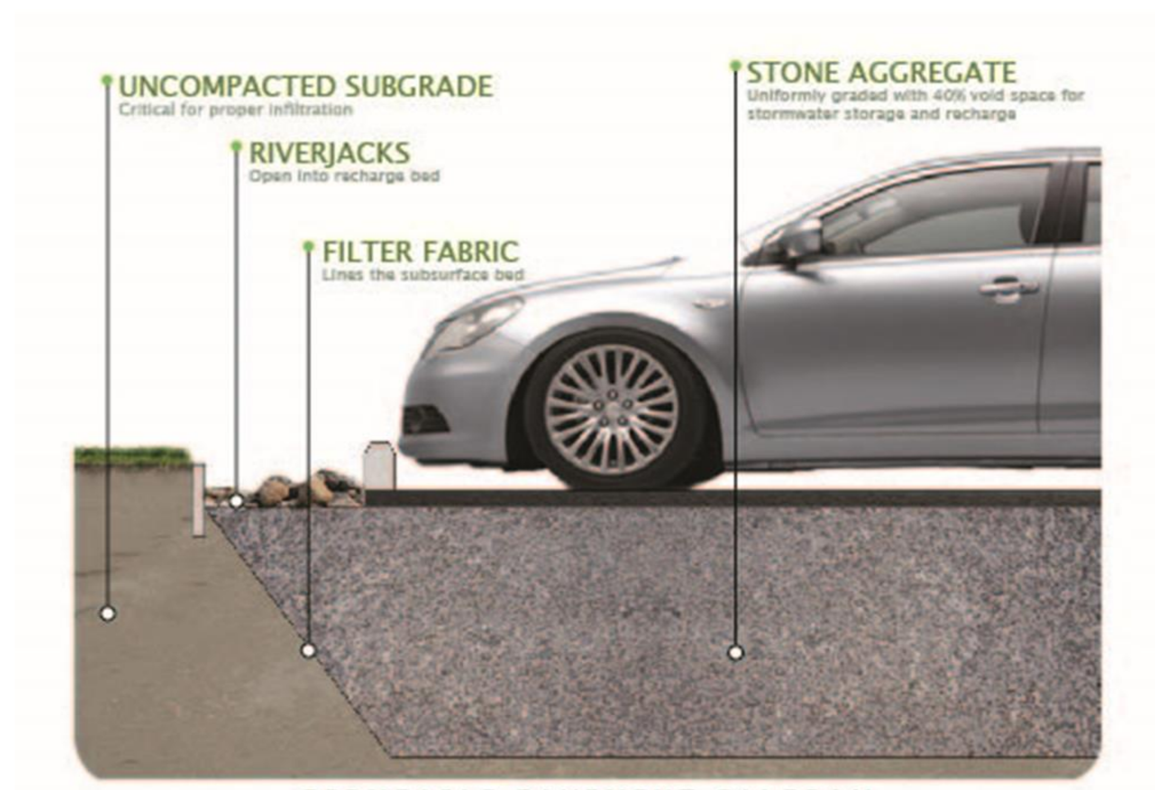
1 **RAINWATER HARVESTING:** Rain barrels or a cistern can help capture the stormwater that runs off of the building's rooftop. Connecting the library's downspouts to rain barrels will allow the stormwater to be slowed, collected, and used for gardening.

2 **POROUS ASPHALT:** Porous pavement promotes groundwater recharge and filters stormwater.

3 **DISCONNECTED DOWNSPOUTS:** Disconnecting downspouts from draining directly into storm sewer drains will allow pollutants to settle out and groundwater to be recharged.

1 RAINWATER HARVESTING

2 POROUS ASPHALT



3 DISCONNECTED DOWNSPOUTS

Location: 20 W. Church Street Milltown, NJ 08850	**Municipality:** Milltown Borough **Subwatershed:** Lawrence Brook (Milltown to Church Lane)
Green Infrastructure Description: disconnecting downspouts porous asphalt rainwater harvesting (rain barrels/cistern)	**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 barrels/cistern: 35,792 gal. porous asphalt: 584,812 gal. downspout disconnection: 34,558 gal.

Existing Conditions and Issues:
This site is located on W. Church Street across from the Joyce Kilmer School with the building's northwest front facing the street. On the building's north face there are two connected downspouts near a small garden that appear to flow into the driveway. At the southeast and southwest corners, there is one downspout each that is connected and flows into the parking lot area. The parking lot has some decent wear to it, and there is some pooling which occurs.

Proposed Solution(s):
One of the downspouts at the north face could be disconnected to flow into the small garden, and the other could be disconnected into a cistern which could harvest rain water for use in watering the library's gardens. At the building's south corners, the downspouts could be disconnected to flow into the gardens. Either the entire parking lot or some strips of it could be redone with porous asphalt.

Anticipated Benefits:
Porous asphalt allows water to infiltrate through to soil layers which will promote groundwater recharge as well as intercept and filter stormwater runoff. It will also hopefully mitigate some of the pooling. A rainwater harvesting system can be used for watering plants or other purposes which cut back on the use of potable water for nondrinking purposes.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs

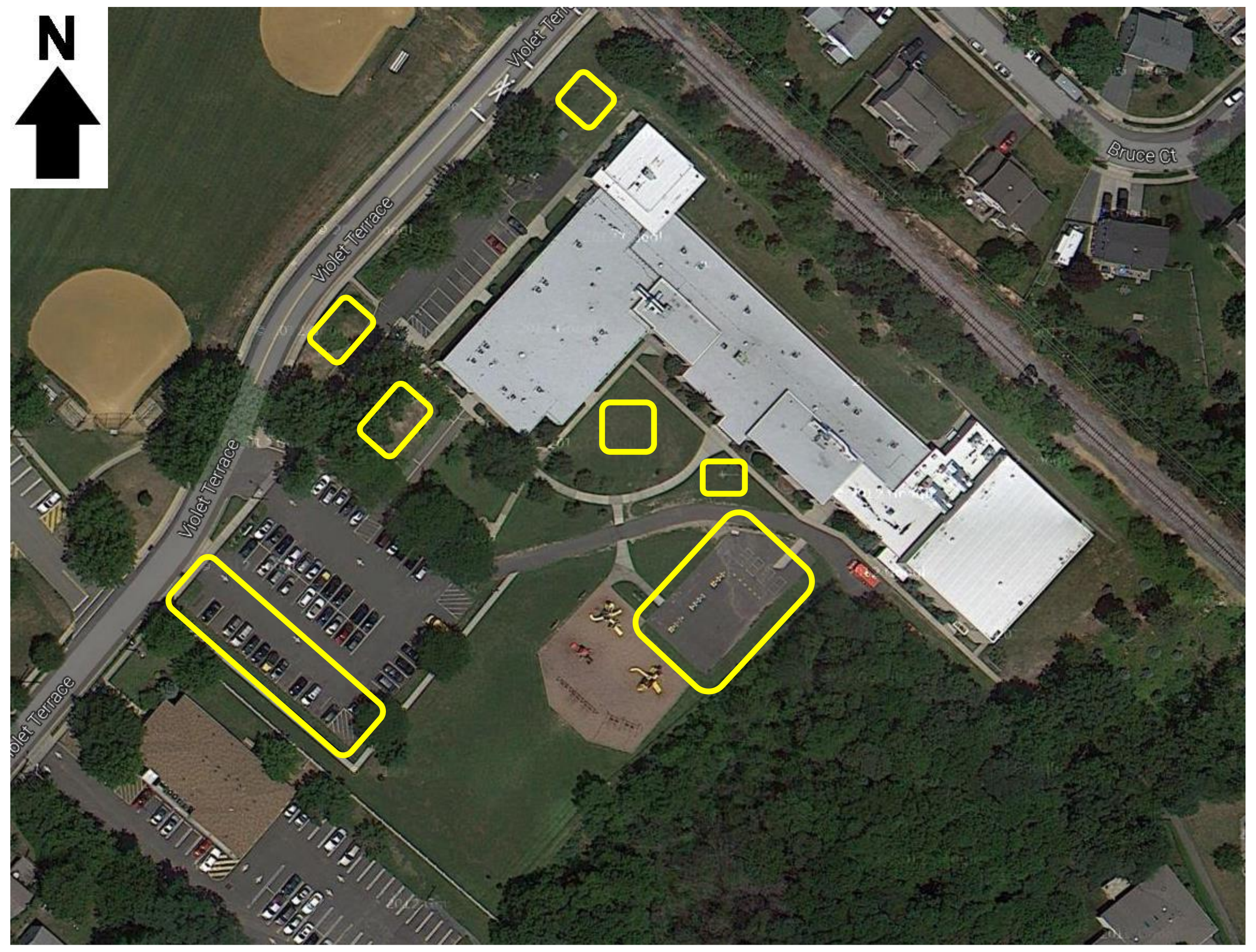
Partners/Stakeholders:
Milltown Borough residents
local community groups (Boy Scouts, Girl Scouts, etc.)
Rutgers Cooperative Extension

Estimated Cost:
The rain barrels/cistern on the west side will need to be 900 gallons to accommodate the runoff from building's roof. The estimated cost for the purchase and installation of the cistern is $1,800. The southwestern parking area within the parking lot will be porous asphalt with dimensions of

approximately 315ft. x 18ft. (5,670ft^2). At roughly \$22.50/ft^2 for porous asphalt with a stone depth of 1.5ft, the estimated cost is \$127,575. Simple disconnection of the downspouts on the property amount to an estimated cost of \$250. The total cost of the project would be approximately \$129,625.

Milltown Borough
Impervious Cover Assessment
Parkview Elementary School, 80 Violet Terrace

PROJECT LOCATION:



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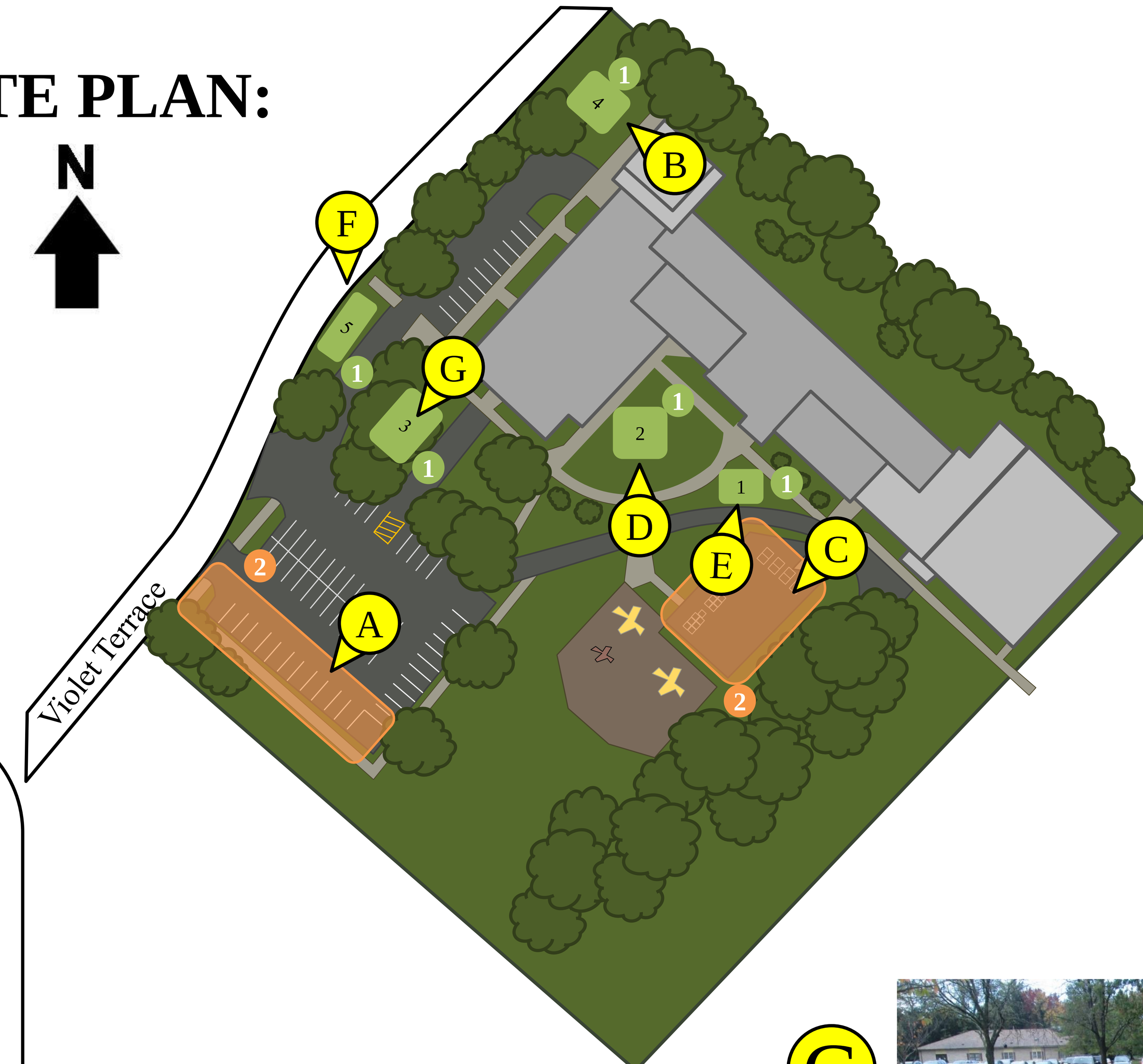
SITE PLAN:



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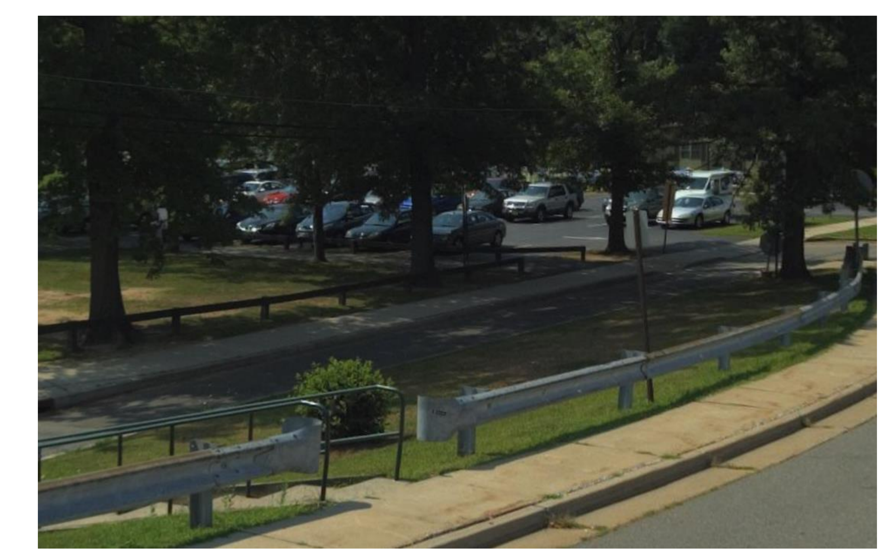

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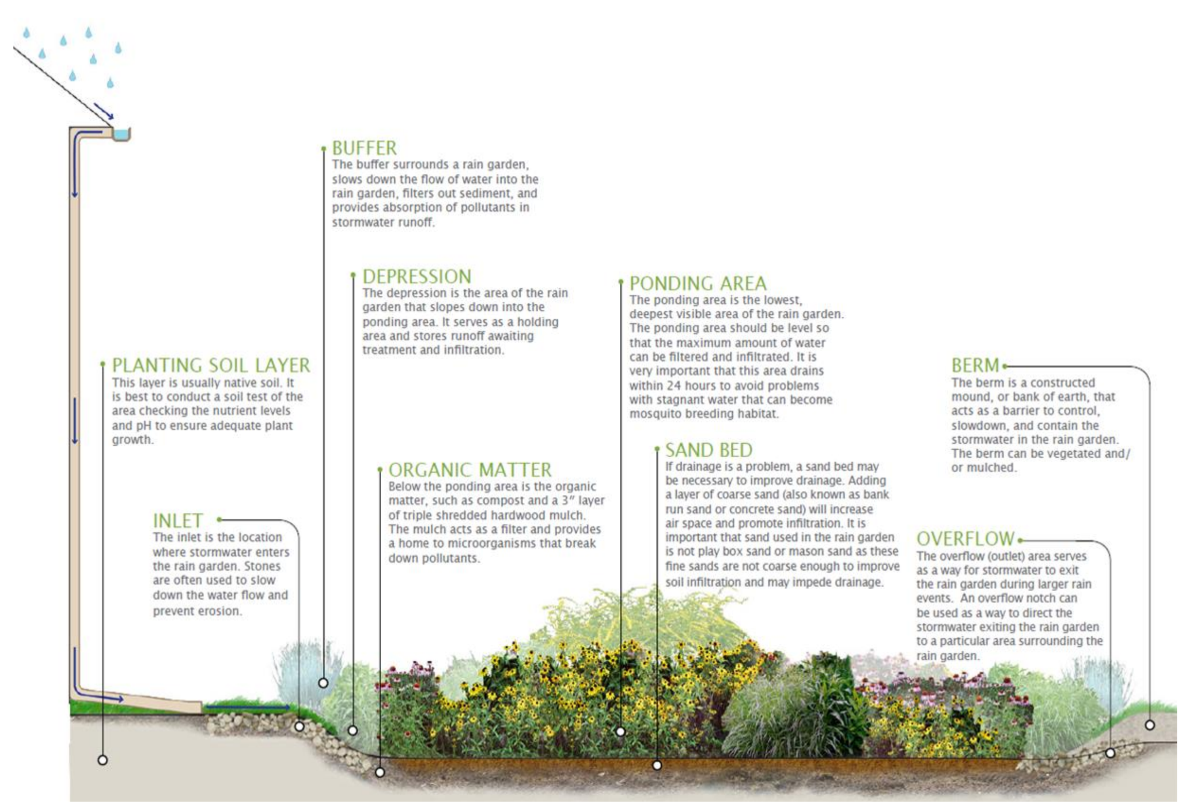
1 **BIORETENTION SYSTEMS:** These rain gardens will capture, treat, and infiltrate runoff from the grass and paved areas around the school. A trench drain can be installed to carry stormwater from Violet Terrace into bioretention system 5 for treatment. The existing catch basins will handle any overflow from the gardens. The rain gardens will reduce sediment and nutrient loading to the local waterway while providing beautiful landscaping to the school grounds. The gardens will also provide habitat for birds, butterflies, and pollinators. They also can be incorporated into the elementary school science curriculum.

2 **POROUS ASPHALT:** Porous pavement promotes groundwater recharge and filters stormwater and will help capture runoff from the parking lot and surrounding walkways.

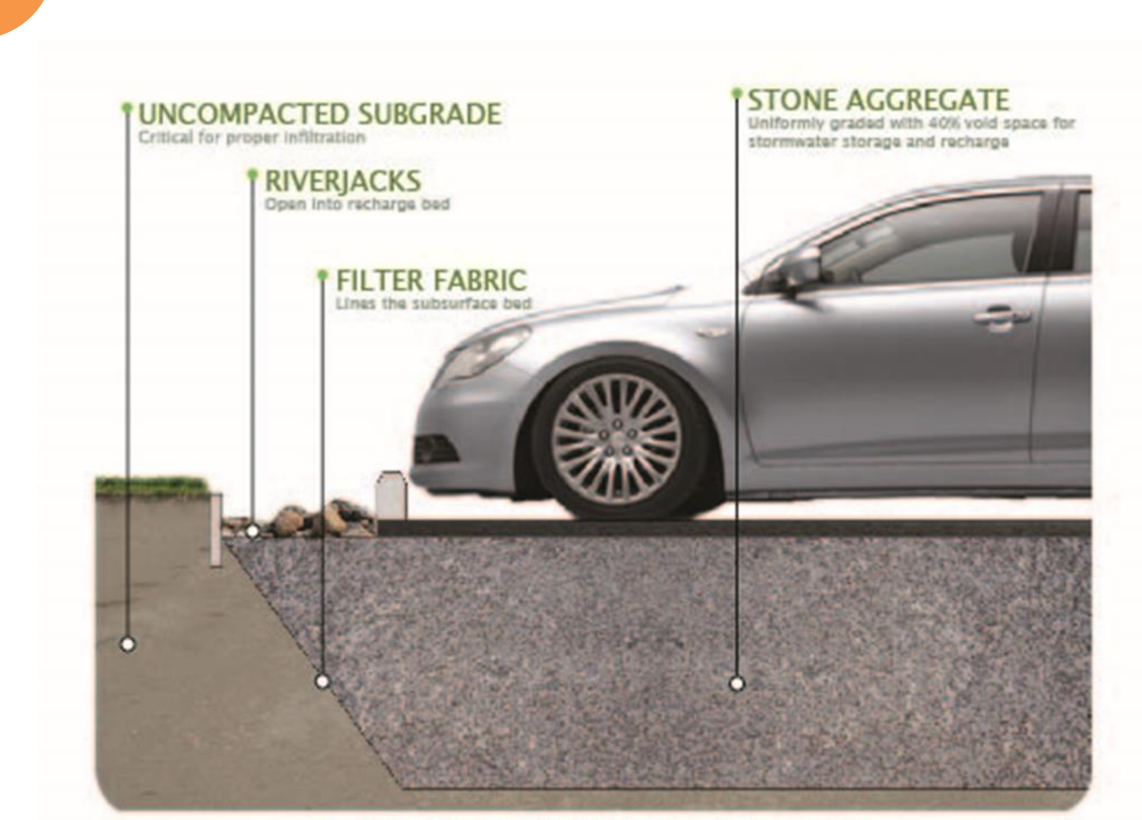
EDUCATIONAL OPPORTUNITY: The RCE Water Resources Program, *Stormwater Management in Your Schoolyard*, can be delivered at Parkview Elementary School to educate the students about stormwater management.

1 BIORETENTION SYSTEM



TRENCH DRAIN

2 POROUS ASPHALT



EDUCATIONAL PROGRAM

Location: 80 Violet Terrace Milltown, NJ 08850	**Municipality:** Milltown Borough **Subwatershed:** Lawrence Brook (Below Milltown/Herberts Brook)
Green Infrastructure Description: bioretention system porous asphalt	**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:** bioretention systems #1: 110,631 gal. bioretention systems #2: 178,505 gal. bioretention systems #3: 103,049 gal. bioretention systems #4: 67,249 gal. bioretention systems #5: 88,354 gal. porous asphalt parking lot: 544,713 gal. porous asphalt recreation area: 217,432 gal.

Existing Conditions and Issues:

This site is located on Violet Terrace with the main entrance at the southwest face's inner corner. To the right of the main entrance there is a large grassy area with a catch basin, and there is another location slightly further right with another catch basin. Near the southeast corner, there is an area with significant erosion. At the northwest corner, there is a heavily sloped area with a catch basin, and at the northwest inner corner, there is another area with a catch basin. Near the southeast face, there is an asphalt play area which has some bad pooling. The parking lot also has a severe pooling problem throughout with some significant flooding in the southwest end.

Proposed Solution(s):

Bioretention systems could be installed to the right of the main entrance near the two catch basins to use for overflow. The eroded area at the southwest corner could also potentially benefit from a bioretention system which may reduce some erosion caused from runoff. Two more bioretention systems could be constructed at the northwest corner catch basins, although these locations are less ideal. The asphalt play area could either be removed or replaced with porous asphalt to mitigate the pooling issue in this area. The parking lot could be redone with porous asphalt, or at least the spots at the southwest end, to reduce pooling and flooding in the area.

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 the local residents, employees, and students of Parkview Elementary. Rutgers Cooperative Extension could additionally present the *Stormwater Management in Your Schoolyard* program to students and include them in bioretention system planting efforts to enhance the program. This may also be used as a demonstration project for Milltown's Department of Public Works staff to launch educational programming. Porous asphalt allows water to penetrate through to soil layers which will promote groundwater recharge as well as intercept and filter stormwater runoff. It will also hopefully deal with the flooding issue in the parking lot.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs

Partners/Stakeholders:
Milltown residents
local community groups (Boy Scouts, Girl Scouts, etc.)
students and parents
Rutgers Cooperative Extension

Estimated Cost:
The five rain gardens on the property are each individually sized and are priced accordingly at $5/ft^2. The size of rain gardens 1, 2, 3, 4, and 5 are approximately 1,100, 1,750, 1,000, 650, and 850 ft^2, respectively. The estimated cost of the gardens are $5,500, $8,750, $5,000, $3,250, and $4,250, respectively. The porous asphalt in the parking lot requires a 3 foot bed of gravel which, in total, amounts to approximately $30/ft^2. The size of the porous section of asphalt is approximately 2,850 ft^2 with an estimated cost of $85,500. The section of porous asphalt in the recreation area is approximately 1,700 ft^2 and requires a 2 foot gravel bed to accommodate the runoff. At $25/ ft^2, the estimated cost is $42,500. The total estimated cost of the project is $154,750.