Impervious Cover Assessment
for
Alpha Borough, Warren County, New Jersey

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

February 19, 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 has also 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 cart ways could be converted to one-way cart 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

Alpha Borough Impervious Cover Analysis

Located in Warren County, Alpha Borough covers approximately 1.7 square miles south of Phillipsburg. Figures 3 and 4 illustrate that Alpha Borough is dominated by urban land uses. A total of 46.9% of the municipality's land use is classified as urban. Of the urban land in Alpha 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 Alpha 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 Alpha Borough. Based upon the 2007 NJDEP land use/land cover data, approximately 17.8% of Alpha Borough has impervious cover. This level of impervious cover suggests that the streams in Alpha Borough are likely impacted.

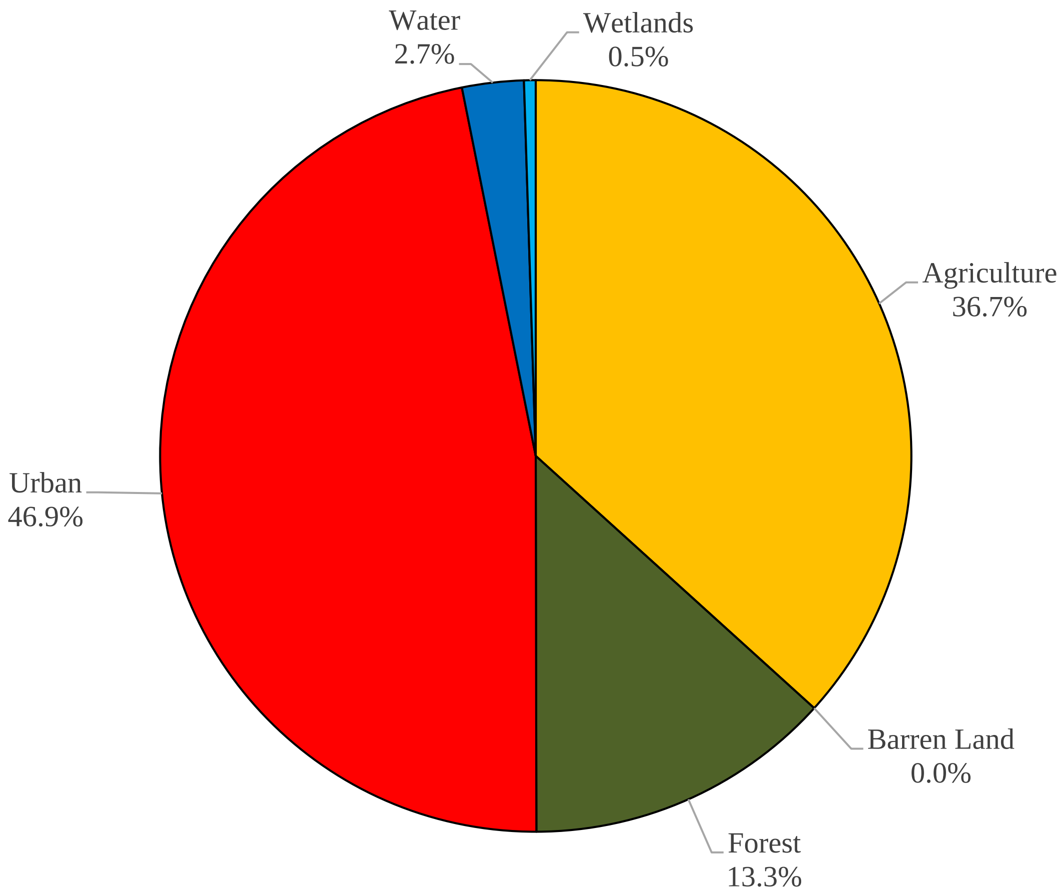


Figure 3: Pie chart illustrating the land use in Alpha Borough

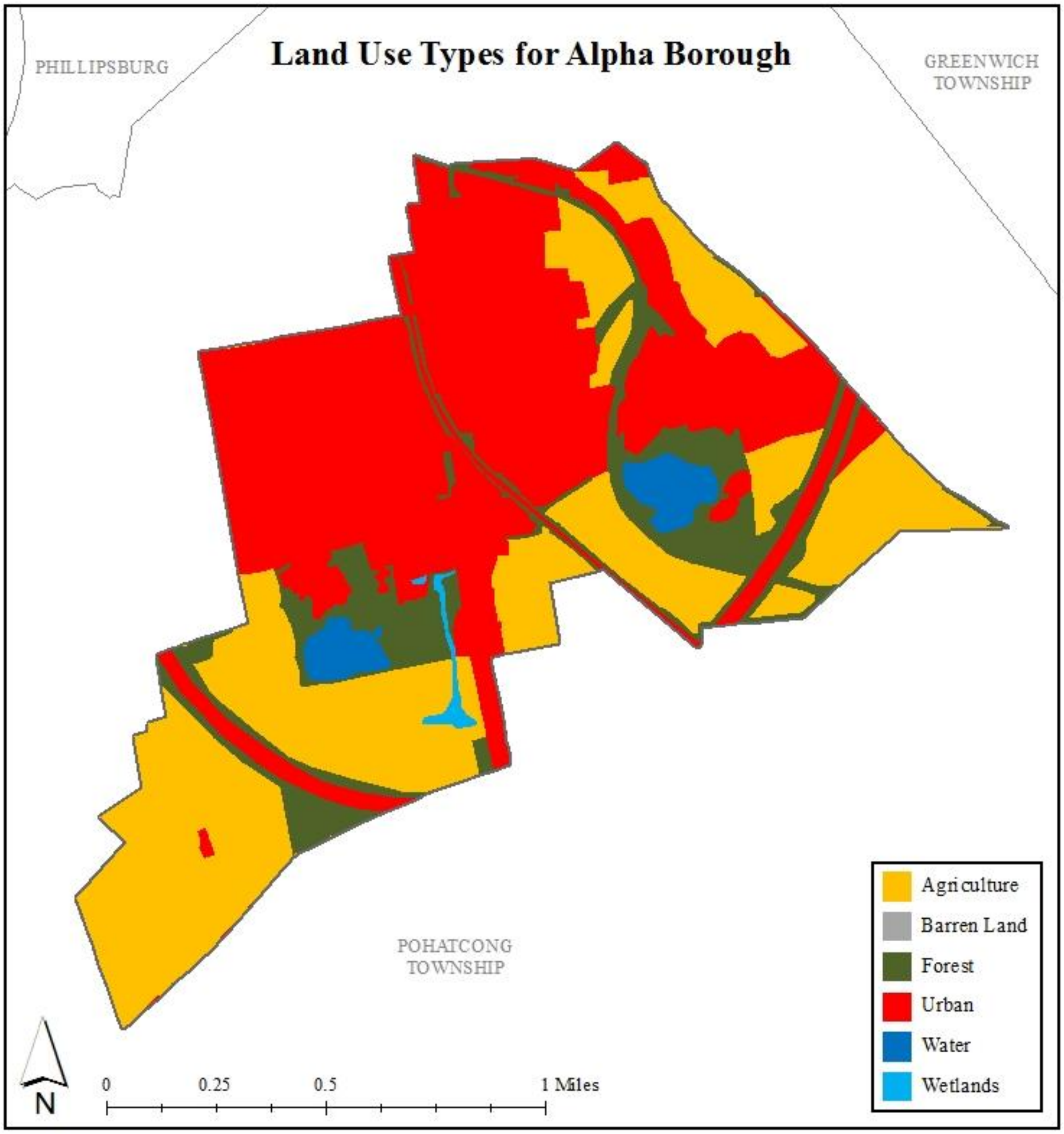


Figure 4: Map illustrating the land use in Alpha Borough

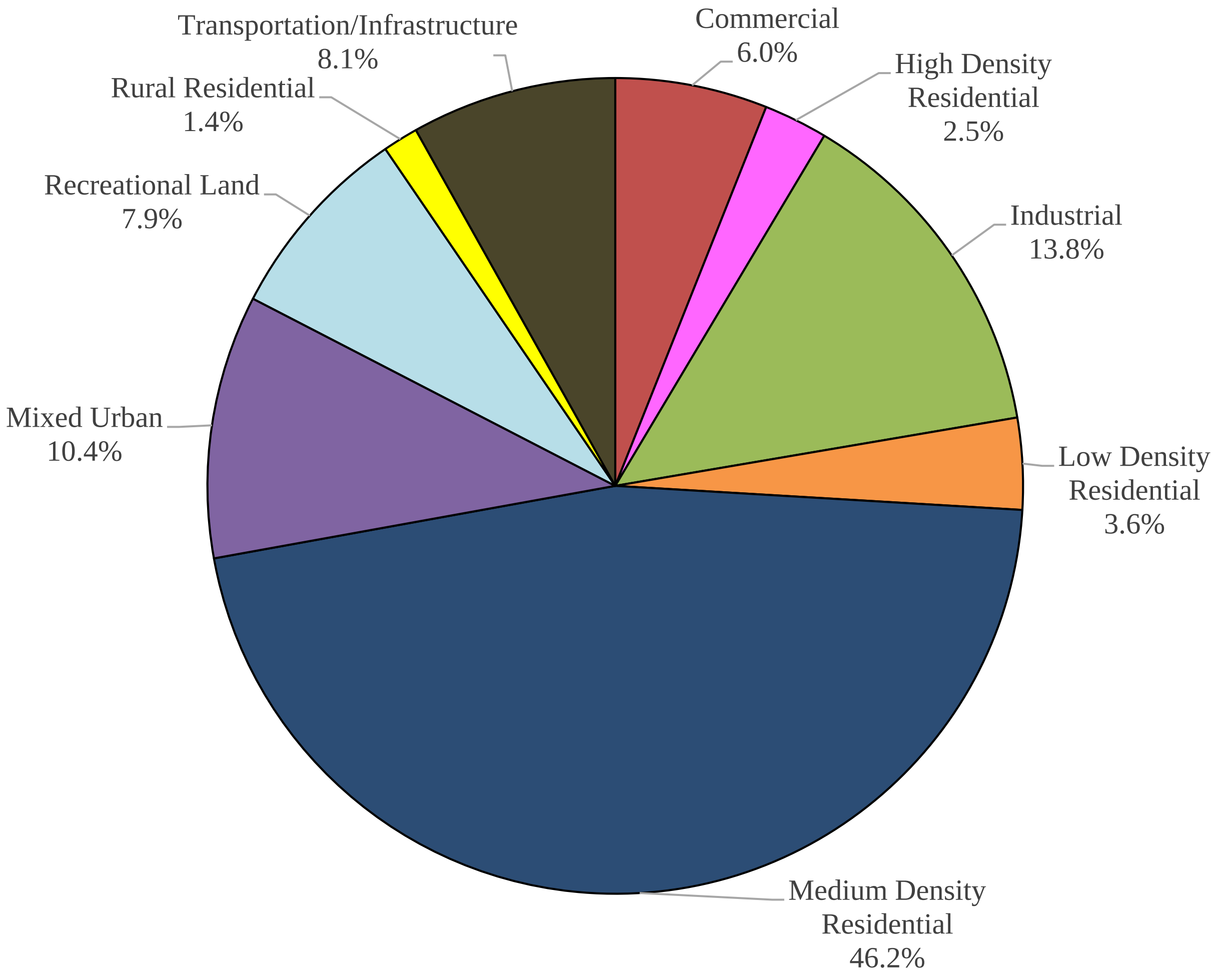


Figure 5: Pie chart illustrating the various types of urban land use in Alpha Borough

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each subwatershed within Alpha Borough (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 14.9% in the Lopatcong Creek subwatershed to 18.3% in the Pohatcong Creek 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 Alpha Borough, Warren 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 (4.9 inches of rain), and the 100-year design storm (7.8 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Alpha Borough. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Pohatcong Creek subwatershed was harvested and purified, it could supply water to 50 homes for a year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Alpha Borough

Subwatershed	**Total Area**		**Land Use Area**		**Water Area**		**Impervious Cover**		
	(ac)	**(mi^2)**	**(ac)**	**(mi^2)**	**(ac)**	**(mi^2)**	**(ac)**	**(mi^2)**	**(%)**
Lopatcong Creek	183.6	0.29	183.6	0.29	0.0	0.00	27.3	0.04	14.9%
Pohatcong Creek	914.3	1.43	885.2	1.38	29.1	0.05	162.3	0.25	18.3%
Total	1,097.9	1.72	1,068.8	1.67	29.1	0.05	189.7	0.30	17.8%

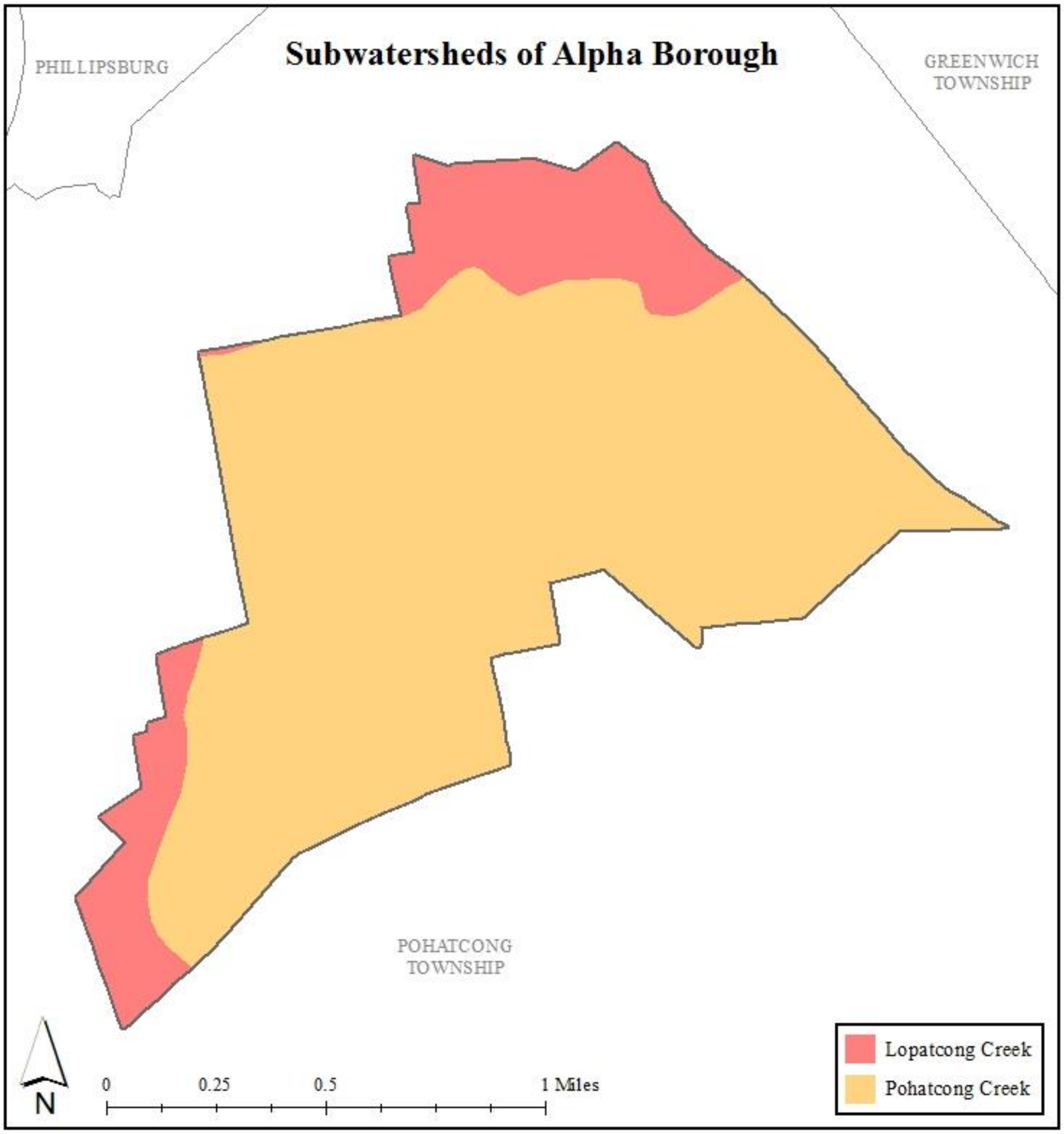


Figure 6: Map of the subwatersheds in Alpha Borough

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in Alpha 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 (4.9") (Mgal)**	**Total Runoff Volume for the 100-Year Design Storm (7.8") (Mgal)**
Lopatcong Creek	0.9	32.3	2.4	3.6	5.7
Pohatcong Creek	5.5	193.5	14.5	21.6	34.3
Total	6.4	225.8	16.9	25.1	40.0

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 Alpha 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, there 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 Alpha Borough

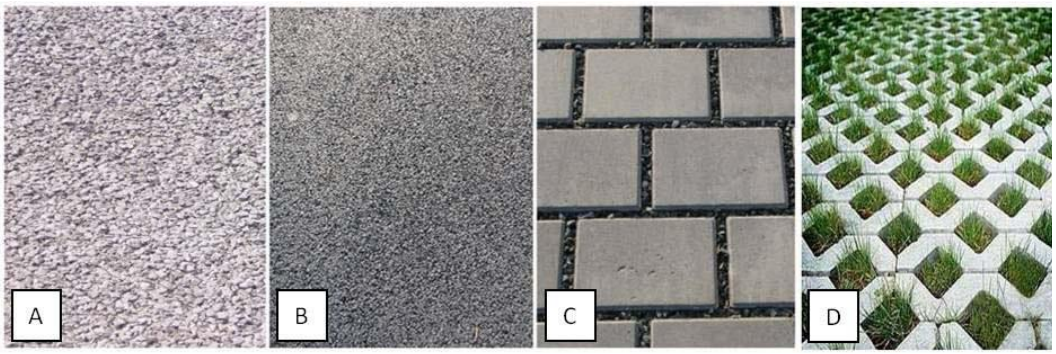
Subwatershed	Recommended Impervious Area Reduction (10%)	Annual Runoff Volume Reduction [2]
	(ac)	(MGal)
Lopatcong Creek	2.7	3.1
Pohatcong Creek	16.2	18.4
Total	18.9	21.5

[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 and treat a variety of impervious surfaces (Figure 7).

Figure 7: Rain garden outside the RCE of Gloucester County office 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 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 Alpha 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 Alpha 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

Alpha 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

Arnold, C.L. Jr. and C.J. Gibbons. 1996. Impervious Surface Coverage The Emergence of a Key Environmental Indicator. *Journal of the American Planning Association* 62(2): 243-258.

Caraco, D., R. Claytor, P. Hinkle, H. Kwon, T. Schueler, C. Swann, S. Vysotsky, and J. Zielinski. 1998. Rapid Watershed Planning Handbook. A Comprehensive Guide for Managing Urbanizing Watersheds. Prepared by Center For Watershed Protection, Ellicott City, MD. Prepared for U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds and Region V. October 1998.

May, C.W., R.R. Horner, J.R. Karr, B.W. Mar, E.G. Welch. 1997. Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion. *Watershed Protection Techniques* 2(4): 483-493.

Nowak, D. J., and E. J. Greenfield, 2012. Trees and Impervious Cover in the United States. *Landscape and Urban Planning* 107 (2012): 21-30.
http://www.nrs.fs.fed.us/pubs/jrnl/2012/nrs_2012_nowak_002.pdf

Rowe, A., 2012. Green Infrastructure Practices: An Introduction to Permeable Pavement. Rutgers NJAES Cooperative Extension, FS1177, pp. 4.
http://njaes.rutgers.edu/pubs/publication.asp?pid=FS1177

Schueler, T. 1994. The Importance of Imperviousness. *Watershed Protection Techniques*1(3): 100-111.

United States Environmental Protection Agency (USEPA), 2013. Watershed Assessment, Tracking, and Environmental Results, New Jersey Water Quality Assessment Report.
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

Alpha Borough

Impervious Cover Assessment

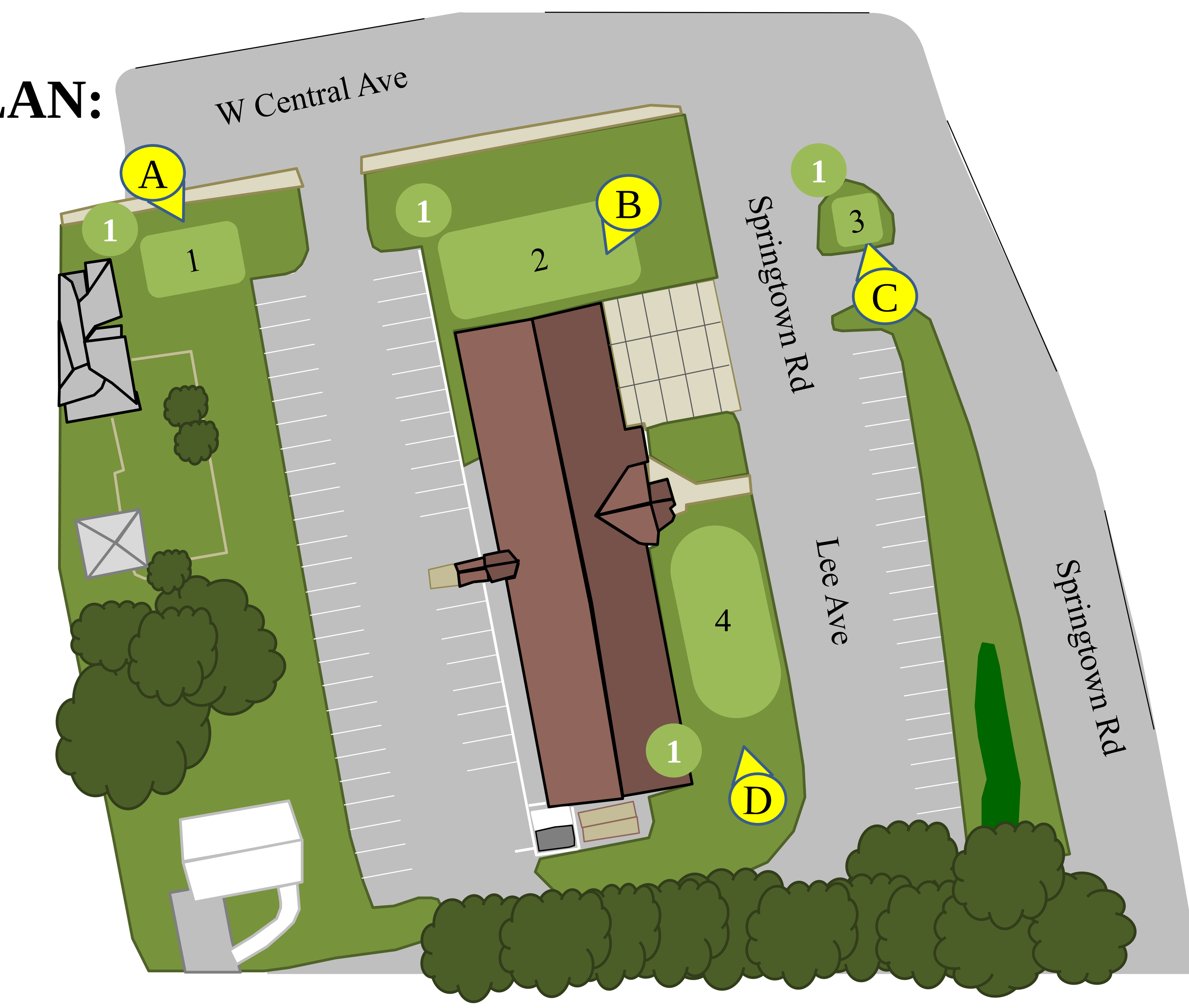
Alpha Fire Department, 1109 Lee Avenue

PROJECT LOCATION:

A

B

SITE PLAN:



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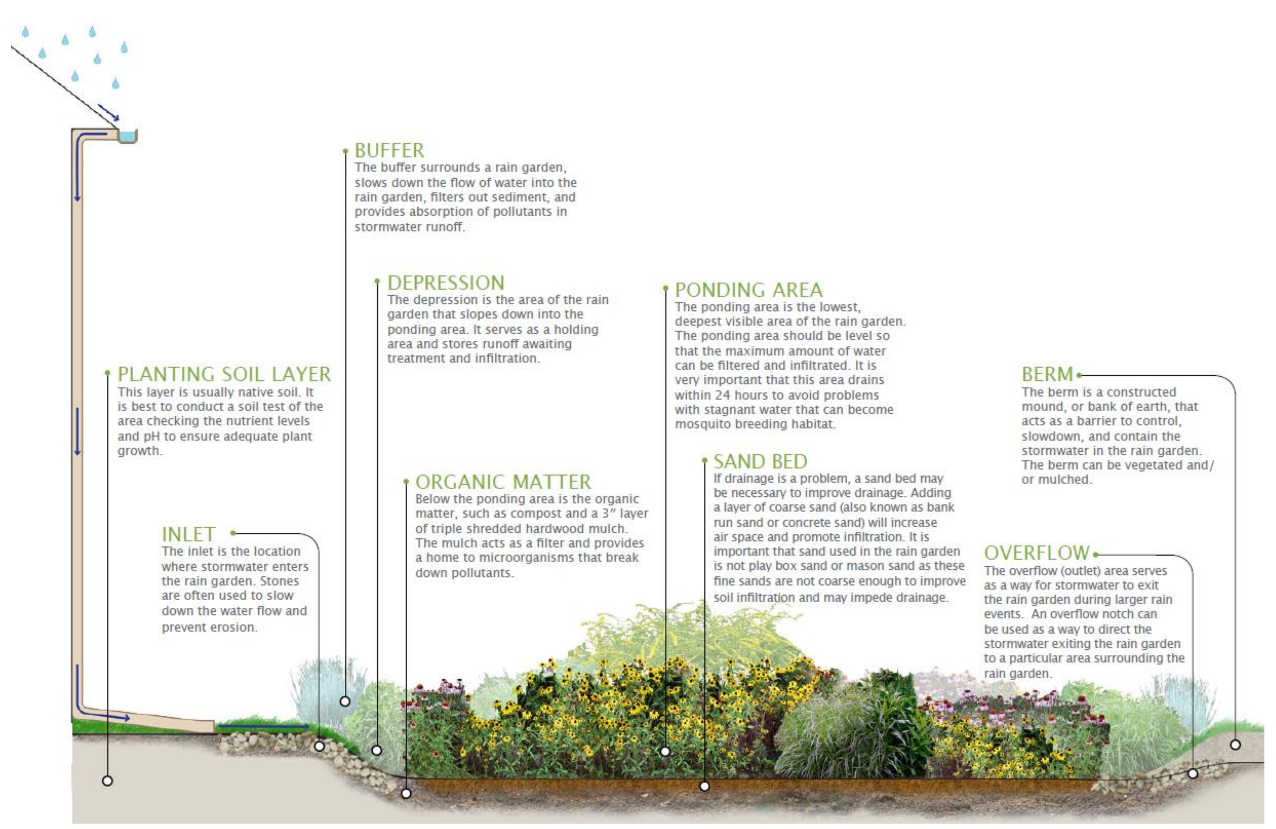
1 **BIORETENTION SYSTEM:** There is potential to install two bioretention systems at the Alpha Fire Department to capture runoff coming from roadways: one at the northwest end of the parking lot and the second in the island near the parking area on Springtown Road. Rooftop runoff can also be captured in bioretention systems at the north end of the building and on the southeast side of the building. Bioretention systems will reduce runoff and allow stormwater infiltration, decreasing the amount of contaminants that reach catch basins as well as creating habitat for wildlife.

1 BIORETENTION SYSTEM



Location: 1109 Lee Avenue Alpha, NJ 08865	**Municipality:** Alpha Borough **Subwatershed:** Pohatcong Creek
Green Infrastructure Description: bioretention systems (rain gardens)	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), 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: 57,322 gal. rain garden #2: 70,349 gal. rain garden #3: 52,111 gal. rain garden #4: 70,349 gal.

Existing Conditions and Issues:
There are impervious surfaces at this site that contribute to stormwater runoff volumes and nonpoint source pollution. The external downspouts drain directly to the stormwater sewer system. Runoff from the property is carrying nonpoint source pollution such as sediments, nutrients, oil, and grease to local waterways.

Proposed Solution(s):
Many of the impervious surfaces can be disconnected by directing stormwater runoff from these surfaces to bioretention systems. The external downspouts can be disconnected from the storm drainage system. In most cases, existing catch basins could be used to manage high flows and any overflow from the rain gardens. There is potential to install two bioretention systems at the Alpha Fire Department to capture runoff coming from roadways: one at the northwest (#1) end of the parking lot and the second in the island (#3) above the parking area on Springtown Road. Rooftop runoff can also be captured in bioretention systems at the north corner (#2) of the building and on the southwest side (#4) of the building.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. These bioretention systems would provide additional benefits such as aesthetic appeal and enhanced wildlife habitat. Disconnecting the downspouts reduces the loading to the stormwater sewer system and allows sediments to settle out as the water infiltrates into the grass or rain garden.

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

Partners/Stakeholders: Alpha Borough residents Alpha Fire Department volunteers local community groups (Boy Scouts, Girl Scouts, etc.) Rutgers Cooperative Extension
Estimated Cost: Rain gardens 1, 2, 3 and 4 will need to be approximately 550, 680, 500, and 680 square feet, respectively. At $5 per square foot, the estimated cost of these gardens is $2,750, $3,400, $2,500 and $3,400, respectively. The total estimated cost of these gardens is approximately $12,050.

Alpha Borough

Impervious Cover Assessment

WH Walters Free Public Library, 1003 East Boulevard

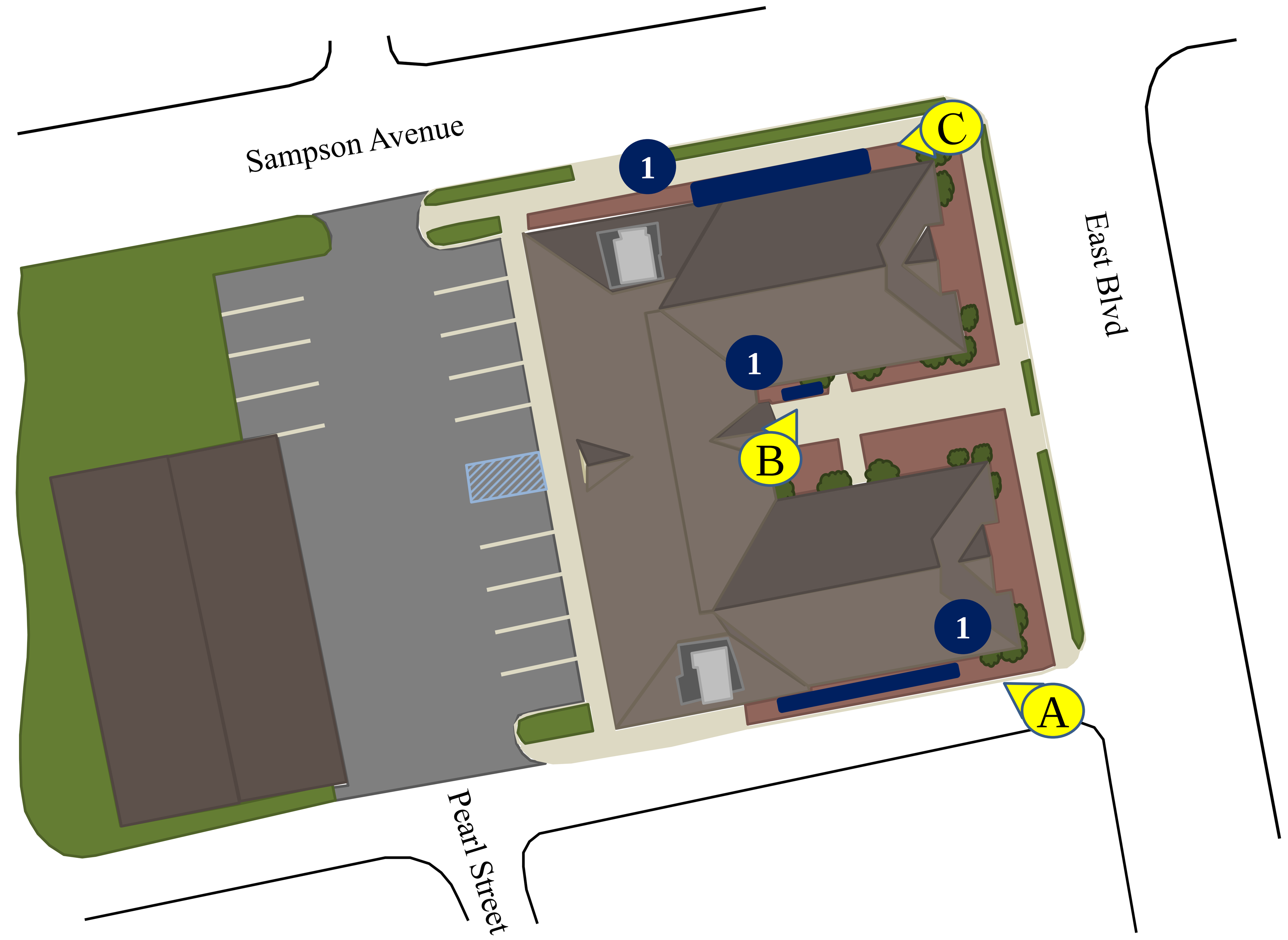
PROJECT LOCATION:

A

B

SITE PLAN:

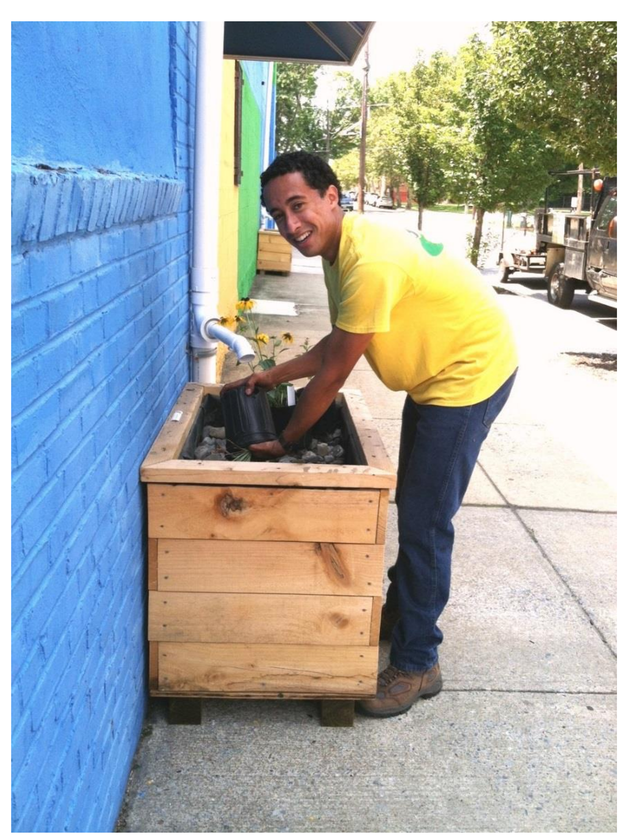
N



1 **DOWNSPOUT PLANTER BOX:** Downspout planter boxes can be installed by disconnecting and redirecting the connected downspouts into the planter boxes to allow stormwater runoff from the roof to flow into them. Planter boxes can intercept, treat, and filter a portion of the rooftop runoff.

EDUCATIONAL PROGRAM: The RCE Water Resources Program's *Stormwater Management in Your Backyard* program can be delivered at the WH Walters Public Library to educate the community about stormwater management.

1 DOWNSPOUT PLANTER BOX



EDUCATIONAL PROGRAM

C

RUTGERS

New Jersey Agricultural Experiment Station

Location: 1003 East Boulevard Alpha, NJ 08865	**Municipality:** Alpha Borough **Subwatershed:** Pohatcong Creek
Green Infrastructure Description: downspout planter boxes	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (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:** northern downspout planter box: 1,400 gal. center downspout planter box: 1,400 gal. southern downspout planter box: 1,400 gal.

Existing Conditions and Issues:
There are 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 are catch basins that capture the stormwater runoff.

Proposed Solution(s):
Due to the lack of open space on this site, it is suggested that all downspouts on the building be connected to downspout planter boxes. These boxes are relatively small and do not require large amounts of open space to function. By connecting the downspout planter boxes to the downspouts of the building, water can be captured and treated for pollutants. These planter boxes can also function as educational tools, helping to inform visitors to the library about the importance of stormwater management.

Anticipated Benefits:
Since the downspout planter boxes would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 90% pollutant load reduction for TN, TP, and TSS. These downspout planter boxes would provide additional benefits such as aesthetic appeal and an educational opportunity to the local residents.

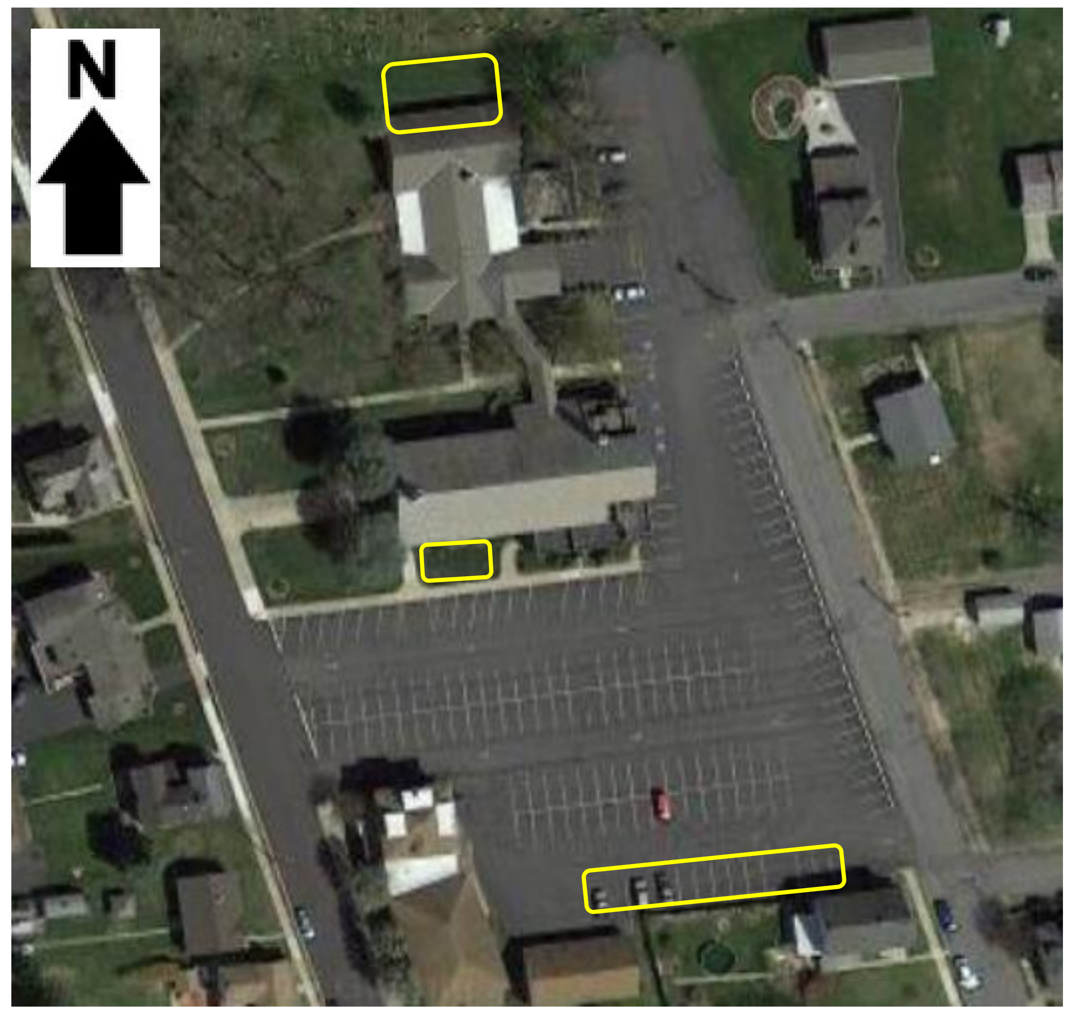
Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
grants from foundations

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

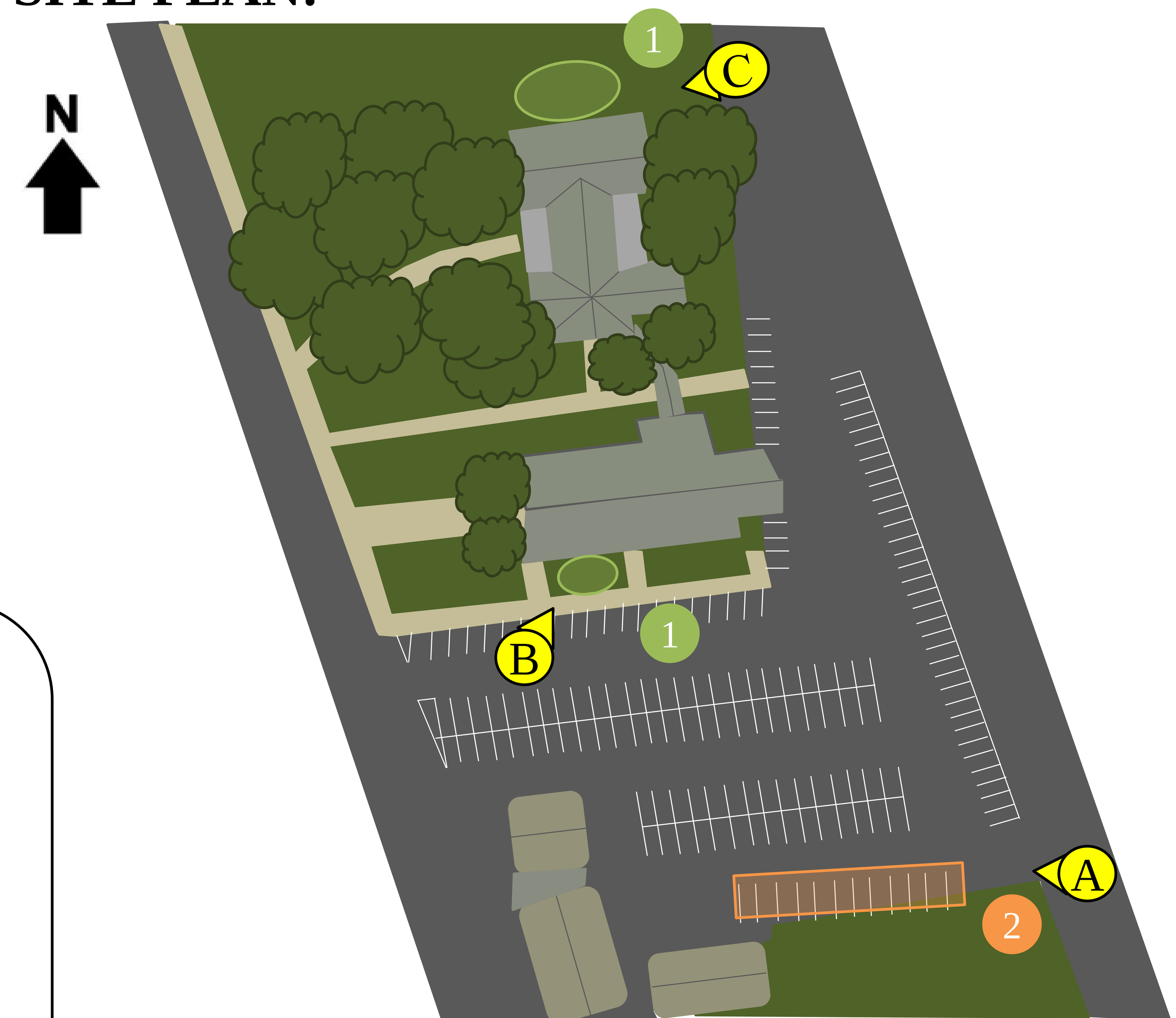
Estimated Cost:
Each downspout planter box will cost approximately $300, so the total estimated cost of the project is $900.

Alpha Borough
Impervious Cover Assessment
St. Mary Roman Catholic Church, 830 5th Avenue

PROJECT LOCATION:



SITE PLAN:



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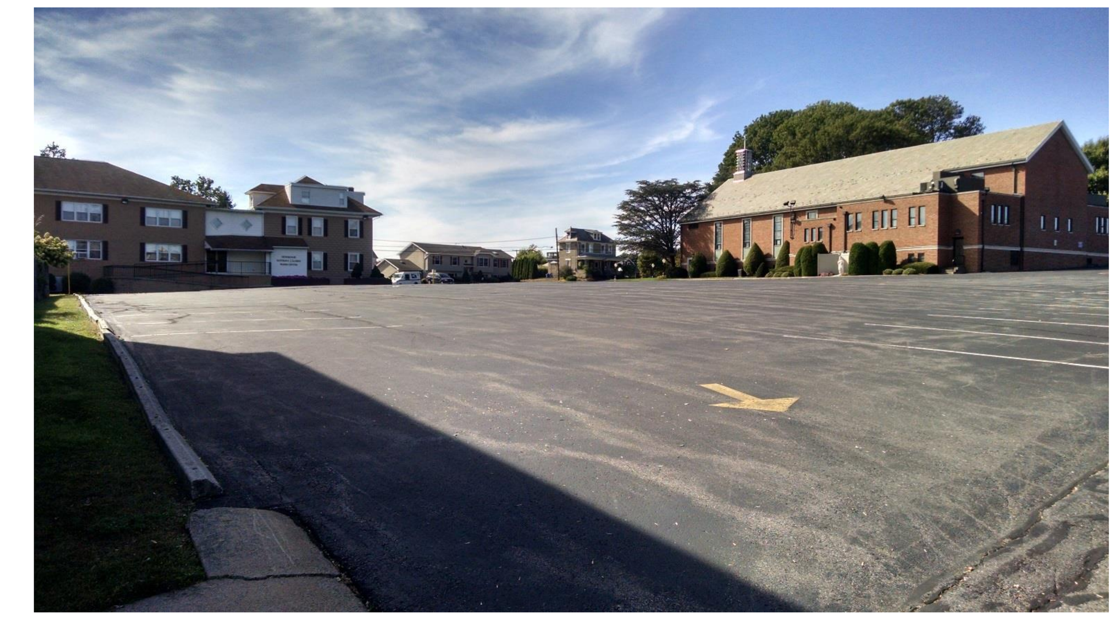


B

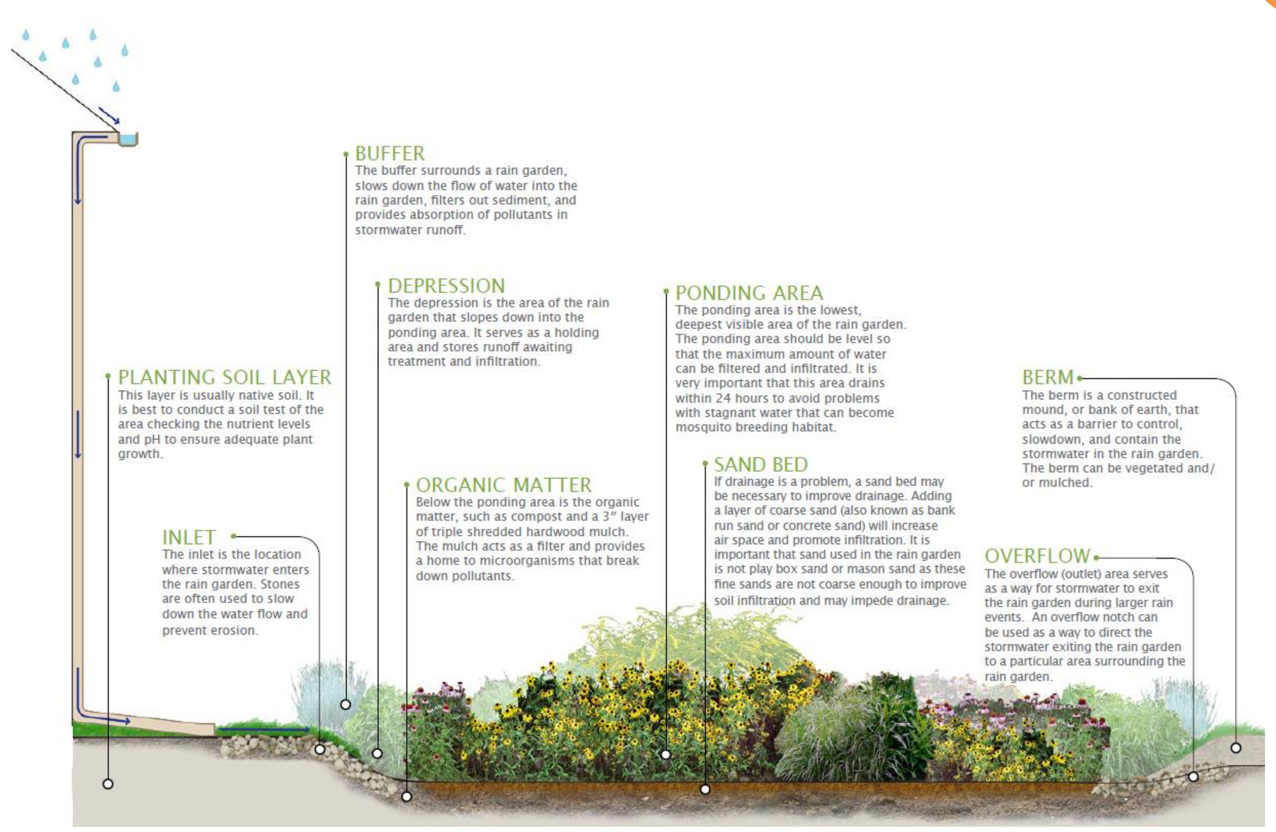
C

1 **BIORETENTION SYSTEMS:** Rain gardens can be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge. This site has two areas that would be good locations for rain gardens. The proposed rain gardens sites are on the north side of the church and the south side of the school.

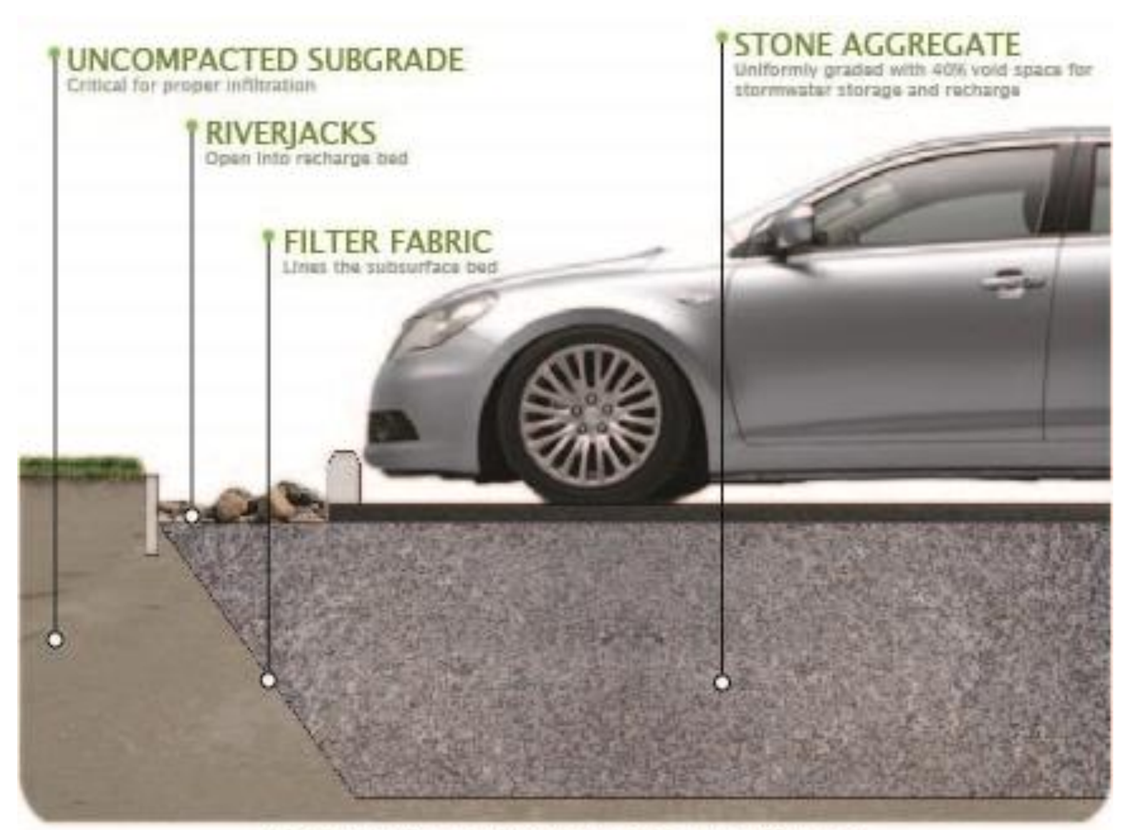
2 **POROUS PAVEMENT:** A portion of the southern parking lot can be retrofitted with porous pavement to allow some of the runoff from the parking lot to infiltrate. Additional runoff could be captured by redirecting roof runoff into porous parking spaces near the building.

EDUCATIONAL PROGRAM: The RCE Water Resources Program's *Stormwater Management in Your Backyard* program can be delivered at St. Mary's Roman Catholic Church to educate the community about stormwater management.

1 BIORETENTION SYSTEM



2 POROUS PAVEMENT



EDUCATIONAL PROGRAM

Location: 830 5th Avenue Alpha, NJ 08865	**Municipality:** Alpha Borough **Subwatershed:** Pohatcong Creek
Green Infrastructure Description: bioretention systems (rain gardens) porous pavement	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), 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: 36,220 gal. rain garden #2: 52,110 gal. porous pavement: 306,410 gal.

Existing Conditions and Issues:
There are impervious surfaces at this site such as the parking lot and building rooftops that contribute to stormwater runoff volumes and nonpoint source pollution. Runoff from the property is carrying nonpoint source pollution such as sediments, nutrients, oil, and grease to local waterways.

Proposed Solution(s):
The downspouts at the north face of the church can be redirected into rain garden #1 to capture runoff from the rooftop. Rain garden #2 can be installed in the grassed area enclosed by sidewalks along the south face of the school to capture runoff from nearby downspouts. A portion of the parking lot can be captured by installing porous pavement along the south end of the church.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. These bioretention systems would provide additional benefits such as aesthetic appeal and enhanced wildlife habitat. Disconnecting the downspouts reduces the loading to the stormwater sewer system and allows sediments to settle out as the water infiltrates into the grass or rain garden.

Porous pavement allows stormwater to infiltrate through to soil layers which will promote groundwater recharge as well as intercept and filter stormwater runoff. The porous pavement system will achieve the same level of pollutant load reduction for TN, TP and TSS as the bioretention system.

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

Partners/Stakeholders:
Alpha Borough residents
St. Mary Roman Catholic Church
parishioners
local community groups (Boy Scouts, Girl Scouts, etc.)
Rutgers Cooperative Extension

Estimated Cost:
Rain gardens 1 and 2 will need to be approximately 350 and 500 square feet, respectively. At $5 per square foot, the estimated costs of these gardens are $1,750 and $2,500 respectively.

The porous asphalt would cover 2,100 square feet and have a 2-foot stone reservoir under the surface. At $25 per square foot, the cost of the porous asphalt system would be $52,500.

The total estimated cost of these projects is approximately $56,750.