

Implementing Green Infrastructure Practices for Water Resource Protection in the Robinson's Branch Watershed

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The Robinson's Branch is a tributary of the Rahway River located in Union and Middlesex Counties. Its watershed is approximately 22 square miles and over 80% of the land use is urban.

Rutgers Cooperative Extension Water Resources Program (RCE WRP) completed a Regional Stormwater Management Plan for the Robinson's Branch Watershed. In 2010, a 319 (h) nonpoint source pollution reduction grant was awarded to Rutgers Cooperative Extension (RCE) of Union County and the WRP in cooperation with the Township of Clark to implement a portion of the plan. One of the goals of the project is to disconnect impervious surfaces and treat stormwater runoff from the 1.25" rainfall event. An additional goal is to use the implementation projects to demonstrate how stormwater can be managed using green infrastructure techniques in heavily urbanized communities of New Jersey.

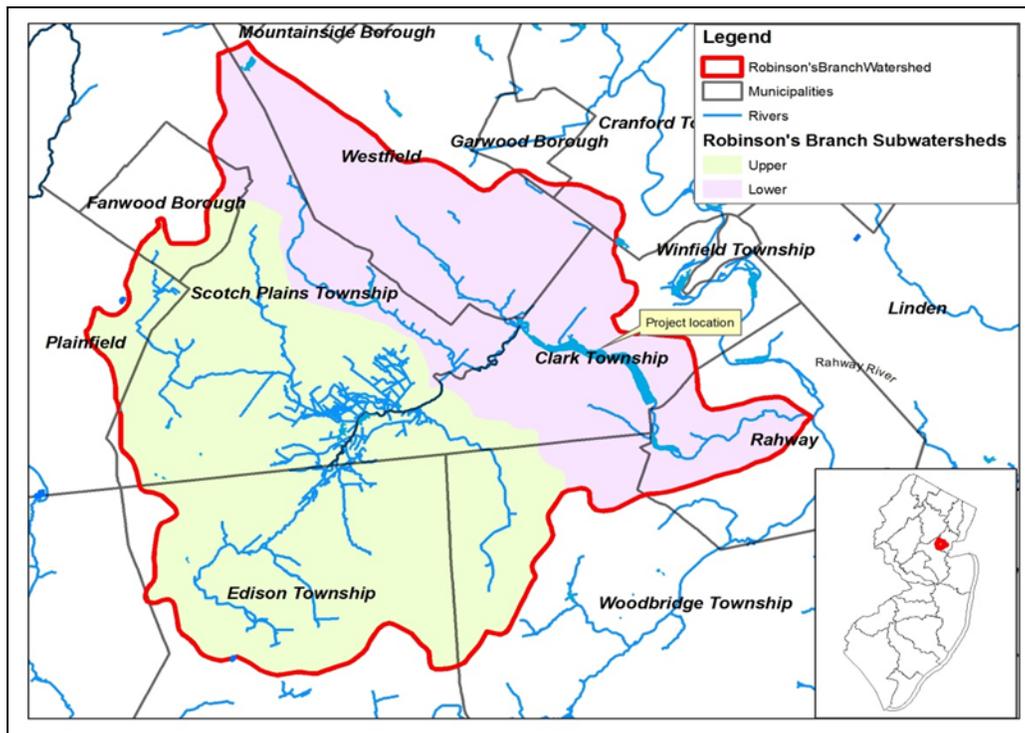


Figure 1. Map of Robinson's Branch Subwatershed

Green Infrastructure Implementation

Green infrastructure is an approach to managing stormwater by infiltrating it in the ground where it is generated using vegetation or porous surfaces, or by capturing it for later reuse. There are many benefits to green infrastructure including reducing stormwater volume, decreasing impervious cover, and reducing nonpoint source pollution. In addition, green infrastructure can help save money by reducing energy costs, maintenance, and reducing potable water demand.

Working closely with Clark Township, project partners identified two municipal properties to disconnect within the watershed using green infrastructure practices; the public works building and the town hall parking lot. Both of these properties, in addition to Arthur L. Johnson High School, are located next to each other on the banks of the Clark Reservoir, part of the Robinson's Branch stream.

The first project focused on the new town hall parking lot. The township's engineering department (Grotto Engineering Associates, LLC), worked with RCE WRP to design and install 650 ft² of permeable asphalt in the lot. The project was installed in the spring of 2012 by a subcontractor. In order to reduce costs, conventional asphalt was used in the driving lane, and a 4" layer of permeable asphalt was used in the parking spaces and gutter. Sub-base materials consisted of a 6" choker coarse layer to help remove sediment, and a 20" reservoir coarse layer to provide storage. The reservoir layer was designed to be deeper than normal because of the underlying clay soils, which are slow to drain. Additionally, a perforated, 4" underdrain pipe was installed in the reservoir to carry excess drainage to the storm drain inlet.

In a 1.25" rainfall event, approximately 10,000 gallons of water will be captured for potential infiltration via the 1,233 ft² parking lot. This project demonstrates how green infrastructure practices can be utilized to reduce stormwater runoff in communities with poorly drained soils.



Figure 2. Image shows porous asphalt in parking lanes and conventional asphalt in the driving lane.

The second project focused on the public works building and installing a 5000 gallon cistern to store water for washing public vehicles. In addition, the students at Arthur L. Johnson High School in Clark were in need of a more environmentally friendly method for holding their car wash fundraiser events. The high school students and local youth groups frequently use the high school parking lot to hold car wash

fundraiser events. Based on personal communications with the township and youth groups, over 100 cars are washed at each of these events discharging polluted car wash runoff directly into the storm drain. Car wash runoff has been shown to be a source of petroleum hydrocarbon waste, heavy metals, phosphorus, nitrogen, ammonia, total suspended solids (TSS), and surfactants from car wash soap. In an effort to reduce polluted runoff, conserve water, and facilitate more environmentally friendly car wash events, this “green” car wash was designed and installed in the fall of 2011 and spring of 2012. The car wash consists of:

- A 5000 gallon cistern that harvests stormwater runoff from the roof of the 4,900 ft² public works building. With the help of a booster pump, harvested stormwater is used to wash cars and public works vehicles;
- A concrete vehicle wash pad where cars and public works vehicles are washed and a swale that discharges dirty car wash runoff to a rain garden;
- A 360 ft² rain garden located next door in the high school parking lot. Car wash pollutants that would have otherwise discharged directly to the stream are now removed by the rain garden. Due to the slow draining, clay soils, the rain garden was installed with a 4” perforated underdrain that flows to a storm drain overflow and connects to a french drain in the adjacent soccer field.



Figure 3. Cistern draining Clark’s Public Works building

The cistern and wash pad were subcontracted out through the township. RCE, WRP, and the public works department worked together to install the rain garden. Public works donated skilled labor, and equipment for the excavation.

The car wash project will not only will reduce stormwater runoff from the public works building, but also demonstrates stormwater re-use, conservation, and a unique solution to a wide-spread problem: pollutants

generated from car wash runoff. In addition to providing stormwater and water quality benefits, rain gardens are often installed on school grounds in order to engage students in hands-on activities and provide watershed and nonpoint source pollution education. Considering the popularity of car wash fundraisers for student activity clubs, an enormous potential exists to use this project as a model for other schools and utilize rain gardens to help reduce the negative impacts of car wash runoff contaminants. Car wash events could become an education and outreach opportunity not just for students, but also for parents who help organize these activities and drivers who have their cars washed.

Education

Over 190, 9th grade environmental science students and 6 teachers at ALJ high school participated in the design and installation of the car wash rain garden. RCE County Agents and WRP staff spent over 30 hours in the classroom teaching students about the importance of watershed protection, sources of nonpoint source pollution, methods for reducing stormwater runoff, and rain garden design. As part of the lessons, the students explored the Robinson's Branch watershed through a virtual watershed tour developed using Google™ earth software.

Students were given a mock "Request for Bids" and worked in teams to submit design proposals for the car wash and rain garden. They calculated the cistern size based on building dimensions, researched native plants, and created a rain garden landscape design based on national wetland indicator species, mature plant size, and seasonal interest. Over 50 design proposals were submitted by the students and the winning team's design was used to plant the rain garden.



Figure 4. The winning student rain garden design team.

Research

Additional funding was acquired through the New Jersey Water Resources Research Institute to investigate whether rain gardens are an appropriate management practice for reducing car wash pollutants, specifically surfactants. The study involves measuring concentrations of total phosphorus (TP), total suspended solids (TSS), surfactants, and hydrocarbons in car wash runoff before and after treatment in three rain garden mesocosms (model experimental rain gardens built in containers). Preliminary data has been collected for TP, TSS, and surfactants.

Results showed that for all three mesocosms, mean TSS and surfactant effluent concentrations were significantly lower than the car wash runoff. Mean TP effluent concentrations were higher than the car wash runoff, although the increase was not significant. Removal efficiencies for surfactants were above 89% in all three mesocosms, although these removals were not enough to reduce concentrations below literature based values for aquatic toxicity. Additional research is underway investigating surfactant solubility of hydrocarbons, the physical, chemical, and biological processes occurring to remove the target analytical parameters (TP, TSS, and surfactants) as well as the influence of age on removal

efficiency. Results of this research will be used to improve designs for rain gardens and quantify pollutant reductions for car wash runoff when rain gardens are utilized as a best management practice.



Figure 5. Applying car wash runoff to experimental rain gardens.

In summary, this project demonstrates the utilization of green infrastructure techniques to reduce stormwater runoff and nonpoint source pollution in a heavily urbanized watershed with poor draining soils. The success of the project to date is entirely due to the unique collaboration and dedication of the project partners; the township's public works and engineering department, the students and teachers of Arthur L. Johnson High School, Rutgers Cooperative Extension of Union County, and the Water Resources Program. Work has started on the second phase of the grant, working with local schools within the City of Rahway to develop similar stormwater management projects. For further information on this project contact Michele Bakacs, Environmental and Resource Management Agent-Middlesex/Union Counties at bakacs@njaes.rutgers.edu, or (732) 398-5274.