LANDSCAPE PERFORMANCE SERIES

Buffalo Public School # 305
McKinley High School

Methodology for Landscape Performance Benefits
Cornell University
Case Study Investigation 2014

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Site Plan of the School Entrance with Project Boundary, Joy Kuebler Landscape Architect, P.C.

Introduction:

McKinley High School is a public vocational high school, located in Buffalo, New York. The reconstruction project was part of a 1.4 billion dollar renovation program for the City of Buffalo's school district aimed at modernizing the city school system. In a city with declining population, the improvements to schools are part of an effort in the State of New York to attract residents back into its urban centers. As a vocational high school serving 1100 students, McKinley offers trade certificates in nine shop areas, including horticulture and aquatic ecology.

The school reconstruction included a 13,000-sf footprint expansion of the building within the overall 40,000 sf building renovation, requiring stormwater management practices to meet regulatory requirements for increased impervious cover. Several options were initially explored by the design team and rejected by the Buffalo school district. These included allocating the school’s playing field for a detention pond or building a large sand filter under the pavement of an existing parking lot. The pond was rejected because of the need for physical education facilities at the school, while the sand filter was ultimately rejected due to cost. The firm, Joy Kuebler Landscape Architect P.C., worked with the design team to develop a treatment plan that includes a series of green infrastructure (GI) practices that would meet the requirements that would have been met by the rejected single large standard practices above.

Initially, the school district was reluctant to adopt GI practices because they had never been installed in the district and administrators were unsure of their cost effectiveness and maintenance needs. The project was designed in 2008 and pre-dates the State of New York mandate that GI practices be explored prior to adoption of standard practices. Through a process of education and collaboration with the architect and engineers, a GI program was adopted that includes a green roof, rain gardens, porous pavement and a water harvesting system.

It was also recognized that the GI practices have the benefit of augmenting on-site, hands-on education. The high school offers the first and only horticultural trade certificate in the district. Collaboration between the landscape architect and the school staff revealed opportunities to make several of the GI methods visible to the students and to allow them to become working class rooms, thus enriching the classroom experience. Students can now learn aspects of their curriculum on-site, including planting design, plant identification, weed identification, pruning, seasonal interest and hardiness.

Most of the City of Buffalo schools are in areas with combined storm/sanitary sewer systems. No water quality treatment is required in schools with combined systems because stormwater is combined with black water and directed to sewage treatment facilities. This particular school is on a separated system, sited on the banks of a major creek (greater than 'fourth order,' a stream that is not a headwater and which drains into a large water body) that drains directly to the Niagara River and then to Lake Ontario. This location results in New York State regulatory requirements for water quality only, since the creek empties into a water body so large that the run-off volumes are deemed to have little negative impact. Therefore, no quantity controls were required. Practices installed include:

Rain Gardens Highlighted in Orange, Joy Kuebler Landscape Architect, P.C., Michele Palmer

- Rain gardens which became a dynamic system of capturing rainfall off overhead canopies into open troughs that convey stormwater under sidewalks to adjacent rain gardens. As the main entry feature, the school's 1,100 students experience this landscape each day.
- The green roof is situated over a small addition and is now part of an enclosed courtyard at the school. The school's internal hallway circulation surrounds the green roof, affording views to it each day for the entire student body. The enclosed courtyard became a working classroom for the horticulture program, with areas for each grade to perform site analysis, create a design and install the design as part of the class curriculum. The surface runoff in the courtyard is directed primarily to adjacent planting beds. Excess water and excess green roof runoff is diverted to an underground harvesting system that can be accessed directly by hose or hand pump for student use in the courtyard and will also feed the school's greenhouse irrigation system on demand. To highlight the water's presence in the harvesting system, simple fountains that recirculate the stored water were added.
- Small areas of porous pavers allow infiltration while accommodating the heavy foot traffic near the main entrance and also a portion of the interior courtyard.

Research Strategy and Methods Used:

As is mandated by the format of the case study program, the performance benefits studied fall under three broad categories: Environmental, Social, and Economic. The primary source of information for the project was the design team and the construction documents for the project. Staff from the school, who consented to interviews and a site tour, also contributed to our understanding of the project. Detailed information about the performance benefits assessed follow as performance indicators.

Performance Indicators:

Environmental

Performance Indicator 1:

- *Maintains the overall peak flow rates across the site for up to a 100-year storm event despite a 14% increase in impervious area due to the school building expansion.*

Methods: Review of project Stormwater Pollution Prevention Plan (SWPPP) prepared by Watts Architecture & Engineering, P.C.

Because the stormwater system on the site flows directly into the adjacent Scajaquada Creek, which is a fourth order or greater stream and thus so large that the runoff volumes are deemed to have little impact, the design team was not required to implement stormwater quantity control. The school expansion (13,000 sf in footprint 4,500 sf in pavements) caused small increases in the quantity of impervious surfaces and the quantity of stormwater generated on-site. However, peak stormwater runoff rates have been maintained or reduced for up to a 100 year storm event according to runoff modeling performed by the Civil Engineer using the SCS unit hydrograph method with HydroCAD Software Solutions. A comparison of Pre- & Post-Development peak discharge is shown below:

Rainfall Event	Existing Pre-Development	Post-Development Total
WQ Event (0.85”)	Peak Q_{WQ}= 4.21 cfs	Peak Q_{WQ}= 4.10 cfs
1-Year Event (2.2”)	Peak Q_1= 14.43 cfs	Peak Q_1= 14.18 cfs
10-Year Event (3.5”)	Peak Q_{10}= 24.84 cfs	Peak Q_{10}= 24.14 cfs
100-Year Event (4.8”)	Peak Q_{100}= 35.38 cfs	Peak Q_{100}= 34.10 cfs

Limitations: Because the project was a redevelopment of an existing school property, only the disturbed areas of the site were required to be considered in the SWPPP for the site. In terms of impact, the undisturbed areas would not cause any impact, but since there was no stormwater treatment on-site previously, areas of the site continue to be untreated.

Performance Indicator 2:

- *Reduces annual runoff by approximately 80,400 gallons through the use of green infrastructure. While runoff increased overall following the expansion, it is 32% less than it would have been without the green infrastructure practices.*

Even though volume reduction was not a regulatory requirement, the design reduced the volume of stormwater runoff through green infrastructure practices. The following are the run-off reduction values for each of the GI practices:

29,998 Gallons reduced run-off provided by Rain Gardens (1,872 sf)

22,599 Gallons reduced run-off provided by the Green Roof (1,553 sf)

14,142 Gallons Reduced run-off provided by the Porous Pavers (675 sf)

13,668 Gallons reduced run-off provided by the Cistern (3,000 gallon capacity)

Methods: The Virginia Runoff Reduction Method (RRM) Worksheet developed by the Center for Watershed Protection was used to model the pre and post stormwater conditions of the site. The worksheet is a spreadsheet-based tool designed for users to determine compliance with Virginia stormwater legislation by estimating runoff reduction from the first one inch of rainfall. The spreadsheet is based on the “Runoff Reduction Method” developed by the Center for Watershed Protection (CWP) to estimate changes in site runoff volume and pollutant load as well as the reductions in runoff and pollutant loadings associated with management practices installed on site. The “Runoff Reduction Method” was developed by the CWP in order to provide a new regulatory framework which incentivizes sustainable site design strategies and more accurately accounts for overall management practice effectiveness. The RRM uses current research to isolate pollutant concentration reduction efficiency from previously unaccounted for reductions in runoff by certain management practices. The method assigns efficiency credits for nutrient removal and runoff reduction by each practice based on median efficiency rates reflected in current research.

For the purpose of this case study, the calculator was run twice in order to compare pre-development runoff and pollutant levels to post-development, post-treatment levels. The following steps were used to calculate runoff and pollutant levels in both pre-development and post-development conditions:

1. Determine site conditions including annual rainfall as well as the acreage of forest, turf and impervious cover (broken down by hydrologic soil class) for each drainage area. In the case of McKinley, the soil was predominantly ‘urban land’ so a worst case scenario ‘D’ soil was used in the calculations. Values were collected using area takeoffs from aerial photos of the site, construction documents, and the project engineer’s calculations. These values are used to calculate the runoff coefficients (Rv) for each drainage area which are then used to calculate the total quantity of runoff generated, or initial ‘treatment volume’ (Tv) on the site. This step is competed in both pre-development calculations as well as post-development calculations.

2. Determine the catchment area and connections of each stormwater management practice on site. These values were collected using area takeoffs from construction documents and based on calculations provided in the project documentation.

3. Enter local values for 1-year, 2-year and 10-year storm events (2.20 inches, 3.5 inches, and 4.8 inches respectively for Buffalo, NY) and 40.5” average annual rainfall in Buffalo.

4. Use the final one inch storm event runoff volumes and pollutant loads to estimate annual runoff quantities and loads. Because this runoff calculation only accounts for runoff generating storm events, the equation below only accounts for the 90% of annual rain events which produce runoff. While 10% of the remaining runoff producing rain events are in fact larger than the 1”

event used by the Virginia spreadsheet, the RRM accounts for these larger events by using management practice credit values based on efficiency rates reported in a wide variety of existing research, including larger storm events (larger than 1"). With the one inch storm event used by the Virginia spreadsheet, one can approximate annual runoff using the following equation:

Where RVR = Runoff Volume Reduction

$$1"\ Storm\ RVR \times \frac{37"\ runoff}{1"\ runoff} \times 90\% = RVR\ Annual\ Volume$$

Limitations: Area values used in the modeling were calculated by area take-offs from construction documents. This introduces potential for human error in the calculations. The modeling developed by the Center for Watershed Protection was developed for the State of Virginia rather than New York. All of the state specific models developed by the Center are based on the same underlying scientific studies but reflect a particular state's regulations that are all regional implementations of the Federal Clean Water Act. While the spreadsheet is designed to evaluate projects based on Virginia's local WQv rain event size of 1" which is sized to account for 90% of annual runoff producing storm events, this does not affect the final calculation of annual impact used in this study. Also, the CWP notes that the credit values assigned to calculate the nutrient removal efficiencies and runoff reduction efficiencies of certain management practices are based on limited existing research. In these cases, the CWP assigns values based on its best judgment based on the currently available data. Finally, the accuracy of results produced by this methodology requires that the practices studied were designed according to certain 'minimum eligibility criteria', built within the last three years, and maintained properly.

Cisterns are problematic as they require the stored water to be used, otherwise they are simply static storage. A volume reduction coefficient of 45% was used in the above calculation, partly based on the demand of 2,034 gallons of water per month required peak use calculated in Performance Indicator 4 below. The cistern may actually result in a greater reduction depending on usage.

Performance Indicator 3:

- *Estimated to reduce nutrient loads exiting the site by 0.5 pounds of phosphorous and 2.4 pounds of nitrogen annually through green infrastructure practices.*

Green infrastructure on site including 1,872 sf of rain gardens, a 1,553 sf green roof, 675 sf of permeable pavers, and a 3,000 gallon rainwater storage cistern.

Methods: As described above in Performance Indicator 2, the Virginia Runoff Reduction Method Worksheet developed by the Center for Watershed Protection was used to model the pre and post stormwater conditions of the site and calculate the reductions in phosphorus and nitrogen released from the site.

Limitations: Because the project is classified as re-development, only the disturbed portion of the site is being treated by the GI practices therefore, the load reductions appear small. The modeling developed by the Center for Watershed Protection was developed for the State of Virginia rather than New York. All of the state specific models developed by the Center are based on the same underlying scientific studies but reflect a particular state's regulations that are all regional implementations of the Federal Clean Water Act. The spreadsheet does allow for the input of local rainfall data and should produce an acceptable estimation of the benefits of the practices incorporated into the project. No on-site water testing was available to test the model's results. The soils on-site have adequate infiltration so no outfalls or underdrains were installed that would allow a post filter sample point.

Performance Indicator 4:

- *Saves approximately 9,600 gallons of potable water per year by capturing and reusing rainwater for courtyard irrigation. This meets 98% of the demand and saves up to $290 annually.*

Approximately 14,142 gallons per year are potentially harvested through the porous pavement and from the runoff from the green roof, and stored in the 3,000-gallon cistern located within the courtyard.

The approximate water needs for the courtyard in the peak month of July in Buffalo New York is calculated to be 2,034 gallons of water per month.

Methods: A spreadsheet developed in cooperation with the Center for Watershed Protection for South Carolina was modified to include local rainfall data. 100% of the porous pavement and gravel mulch areas in the courtyard and 40% of the Green Roof (assumes a 60% efficiency) area were input as contributing drainage areas. Watering was presumed to occur May-September. Total potential harvested includes both the Supplied Volume and the Overflow Volume. The results from the spreadsheet are below.

Cistern Size Associated with Credit Volume (gallons)	Overflow days (days/year)	Overflow frequency (% of rainfall days causing overflow/year)	Dry Frequency (% of days cistern cannot provide water/year)	Mean Overflow volume (avg. gallons/year)	Supplied volume per year, demand that is met (avg. gallons/year)	% of demand met by rainwater
3,000	103	64%	1%	18,641	9,649	98%

Water use was calculated by anticipated demand. The EPA WaterSense tool was used to calculate peak irrigation demand for the plantings in the courtyard.

Cost savings are based actual water usage costs of $0.03 per gallon provided by Buffalo Water/Violia to estimate annual cost savings.

The calculations show that there is excess water that could be used in the greenhouse should the school choose to do so. Peak demand for the greenhouse would be earlier in the year as plants are grown for sales in early spring so would not conflict with watering the courtyard later in the season.

Limitations: The school does not monitor their water usage in the courtyard. Since the water harvesting is modeled rather than metered, it is approximate. The supplied volume calculated from the spreadsheet is greater than the demand calculated by the EPA Watersense tool so it was decided that the lower volume would be used as being a more conservative estimate of the benefit. In peak months, the cistern water volume is sometimes entirely used and is re-filled with potable water from a hose. There is no way to calculate how much the cistern is actually being supplemented but anecdotally, it appears to be infrequent, which corresponds with the results of the spreadsheet.

Social

Performance Indicator 5:

- *Provides hands-on educational opportunities for approximately 100 students who annually participate in the school's horticulture certificate program.*

Anecdotally, students are able to find part-time jobs after school performing maintenance but no statistics on the number of students earning income from casual labor are available.

Methods: Personal Communications regarding the programs was provided by certificate program director, Dan Robillard. The horticulture certificate program includes floriculture, landscaping and greenhouse operations. The landscape installation benefits these educational programs providing on-site training in plant identification, weed identification, pruning methods, IPM, how to use hand tools, benefits of mulch, area take-offs for calculating mulch requirements, and learning to work in teams to accomplish maintenance tasks.

Limitations:

Performance Indicator 6:

- *Contributed to an increase in student enrollment to the McKinley H.S. horticulture certificate program.*

Methods: Statistics on applications to the school and the horticulture program were provided by school staff. Enrollment of the 2013/2014 school year was: 45 freshmen, 14 sophomores, 20 juniors, and 20 seniors. The program can accommodate 48 students and with the freshman class, is nearing capacity. No previous years' historic data was available in time for publication but anecdotally, the program's director Dan Robillard believes that the appearance and opportunity to learn hands-on skills right on the school grounds has increased interest in the program and has a positive impact on students visiting the school to consider applying to the program. He believes the increase in the size of the freshman class is a real increase and not simply a reflection of attrition in higher grade levels and notes the program's attrition rate is low with most students who begin the program completing it unless they move to another school. He suggested the attrition rate was 10-15%.

Limitations: Landscape likely contributes to the increase in applications but is only one part of a complex project to improve the quality of public schools in Buffalo. The improvements to the building are an important factor as well. Historical data about enrollment was not provided.

Economic

Performance Indicator 7:

- *Provides the training ground for 20 students who participate in two summer employment programs, earning $400-$1,275 each over 6 weeks.*

Program	Number of Students	Hours per Week	Number of Weeks	Wage Rate/hour	Potential Summer Income per Student	Total Potential Summer Income Generated
McKinley H.S.	10	8	6	$8.50	$408	$4,080
University of Buffalo	10	25	6	$8.50	$1,275	$12,750

Methods: Personal Communications regarding the programs was provide by horticulture program director, Dan Robillard. The first program is school-run and provides maintenance at Buffalo City Schools and the Buffalo Botanical Gardens. The second program is managed by the University of Buffalo, State University of New York. Students who participate in this program are also eligible to apply for college credits. McKinley H.S. serves a student population in need of financial resources. As a measure of need, 70% of its student body is eligible for the free lunch program.

Students in the Horticulture Program, Joy Kuebler Landscape Architect, P.C.

Limitations: Income earned by students is based on the hours available to work in the program. No information was available on actual hours worked.

Cost Comparison:

Capital Cost Comparison:

- *The design team originally intended to treat stormwater in a large sub-surface sand filter beneath a parking lot, which would have cost approximately $106,000. The green infrastructure practices installed to treat the same volume of stormwater cost $118,731. For roughly the same cost, the green infrastructure practices provide a visually appealing landscape that contributes to the school's educational programs.*

The design team originally intended to use a 'grey' solution, treating stormwater in a large sub-surface sand filter beneath a parking lot. Costs would have amounted to approximately $106,000, but were never finalized as each time calculations were completed, the filter needed to be sized larger, causing more disturbance and requiring yet a larger filter. The cost estimating was abandoned before an equilibrium cost between size and disturbance was calculated, but certainly would have been higher.

The GI practices installed to treat approximately the same volume of stormwater cost approximately $30,000 for the Green Roof, $31,325 for the Rain Gardens, $11,900 for the porous pavers (upcharge from standard concrete pavement), $45,500 for the demonstration troughs and $6,000 for the cistern. Total approximate cost for GI practices $118,731.

Methods: Contemporary cost estimates were provided for the constructed green infrastructure practices and the grey solutions, which the design team originally intended to use. The provider for the Green Roof was also consulted for cost information. Since the roof type chosen is very light weight, no additional structure was required.

Limitations: Costs are based on estimates prepared by the design team and may not reflect exact construction costs. The $45,500 for the demonstration troughs is a discretionary expense. The water could have been directed to the rain gardens much less expensively with a gutter and downspout system but as installed the conveyance is a visual enhancement and reveals the functioning of the stormwater collection system to students.

Maintenance & Operations Cost Comparison:

- *Because student volunteers help to maintain the planting beds, maintenance costs are similar to what they would be for an equivalent area of lawn, even though the unit cost for planting beds is higher. Maintaining the planting beds is estimated to cost approximately $577 per year, and student participation reduces this by $93. The same area of lawn would cost approximately $514 per year to maintain.*

The courtyard is being maintained entirely by student volunteers. The rain gardens are being partially maintained by student volunteers. Maintaining the planting beds would cost approximately $577 per year with approximately $93 of the cost reduced by student participation for a net anticipated cost of $484. The same square footage of lawn would cost approximately $514 to maintain. Due to student participation, approximately $30 per year in maintenance cost could be saved.

Methods: The cost to maintain 1000 sf of lawn and 1000 sf of planting beds were calculated. School staff member and director of the horticulture program Dan Robillard was interviewed regarding maintenance practices at McKinley. Dan described the courtyard as entirely maintained by students but he was unable to give a definitive estimate of the percentage of maintenance of other planting beds provided by his students. Therefore, the planting beds outside the courtyard were assumed to be maintained by grounds staff.

Unit Prices for 1000 sf Lawn Mowing Cost (R. S. Means)

Unit Cost/1000 sf	Area sf	Times per Year	Total Cost Per Year
$1.75	1000	28	$49.00

Unit Prices for Planting Bed Maintenance Cost (R. S. Means)

Unit Cost/1000 sf	Area sf	Times per Year	Total Cost Per Year
$55.00	1000	2	$110.00

Courtyard Being Maintained by Students

Unit Cost/1000 sf	Area sf	Times per Year	Total Cost Per Year
$55.00	1,682	2	($92.51) no cost

Rain Gardens and Planting Beds, Outside the Courtyard (student labor not included)

Unit Cost/1000 sf	Area sf	Times per Year	Total Cost Per Year
$55.00	8,803	2	$484.17

Lawn Mowing Cost if Beds Were Lawn

Unit Cost/1000 sf	Area sf	Times per Year	Total Cost Per Year
1.75	10,485	28	$513.76

Limitations: We were unable to obtain actual costs to the school district for maintenance so relied upon calculators to develop the cost comparison. Costs for lawn mowing and hand weeding are from R.S. Means for Buffalo New York at a standard union wage rate. Actual wage rates may be higher.

Acknowledgments:

We would like to thank everyone who generously shared their time with us, helping to strengthen the study methods and collect the information necessary to complete this case study. In particular, Dan Robillard, Director of the Horticulture program at McKinley H.S. met with us twice and answered questions about the program and the functioning of the completed project.

We would also like to acknowledge the assistance of Deborah Caraco P.E. of the Center for Watershed Protection in Ellicott City, Maryland. She helped us select the best worksheet to model the conditions on the site and critiqued our process for inputting the data in order to have the most accurate result. We believe that the tools developed by the Center could be more widely used in the LAF's Case Study program as they are relatively straightforward and are based on widely accepted underlying studies in the science of stormwater.

Resources:

Battiata, J., Collins, K., Hirschman, D., and Hoffmann, G. "The Runoff Reduction Method." *Journal of Contemporary Water Research & Education*, ISSN 1936-7031, 12/2010, Volume 146.

The Center for Watershed Protection, 3290 North Ridge Road, Suite 290, Ellicott City, MD 21043
http://www.cwp.org/

http://www.cwp.org/online-watershed-library/cat_view/65-tools/91-watershed-treatment-model

Joy Kuebler Landscape Architect, P.C., 65 Zimmerman St, North Tonawanda, NY 14120
http://www.jklastudio.com/

Reed Construction Data 2014, R.S. Means Online, cost estimating figures. http://rsmeansonline.com/

Stormwater Pollution Prevention Plan (SWPPP) prepared by Watts Architecture & Engineering, P.C.

Vegetal i.D. Inc. 7939 Bank St. Road Batavia, NY 14020 USA, supplier of green roof,
http://www.vegetalid.us/

The WaterSense Water Budget Tool, United States Environmental Protection Agency
http://www.epa.gov/WaterSense/water_budget/

Appendices:

Summary Data from CWP Virginia Runoff Reduction Method Worksheet

Virginia Runoff Reduction Method Worksheet -- Revised 1/25/12

Site Data Summary

Total Rainfall = 40.54 inches

Site Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest (acres)	0.00	0.00	0.00	0.24	0.24	*1.78*
Turf (acres)	0.00	0.00	0.00	4.82	4.82	*35.81*
Impervious (acres)	0.00	0.00	0.00	8.40	8.40	*62.41*
					13.46	*100.00*

Site Rv	0.68
Post Development Treatment Volume (ft3)	33385
Post Development TP Load (lb/yr)	19.78
Post Development TN Load (lb/yr)	141.47
Total TP Load Reduction Required (lb/yr)	14.26

Total Runoff Volume Reduction (ft^3)	295
Total TP Load Reduction Achieved (lb/yr)	0
Total TN Load Reduction Achieved (lb/yr)	2.42
Adjusted Post Development TP Load (lb/yr)	19.28
Remaining Phosphorous Load Reduction (Lb/yr) Required	13.77

Drainage Area Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
Forest (acres)	0.24	0.00	0.00	0.00	0.00	*0.24*
Turf (acres)	4.82	0.00	0.00	0.00	0.00	*4.82*
Impervious (acres)	8.40	0.00	0.00	0.00	0.00	*8.40*
						13.46

Drainage Area Compliance Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
TP Load Red. (lb/yr)	0.49	0.00	0.00	0.00	0.00	*0.49*
TN Load Red. (lb/yr)	2.42	0.00	0.00	0.00	0.00	*2.42*

Drainage Area A Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest (acres)	0.00	0.00	0.00	0.24	0.24	*1.78*
Turf (acres)	0.00	0.00	0.00	4.82	4.82	*35.81*
Impervious (acres)	0.00	0.00	0.00	8.40	8.40	*62.41*
					13.46	

BMP Selections

Practice	Credit Area (acres)		Downstream Practice
1.a. Vegetated Roof #1 (Spec #5)	acres of green roof	0.25	6.a. Bioretention #1
4.b. Grass Channel C/D Soils (Spec #3)	Impervious:	0	9.b. Sheetflow to Conservation Area with C/D Soils
	Turf (Pervious):	0	9.b. Sheetflow to Conservation Area with C/D Soils
6.a. Bioretention #1 or Urban Bioretention (Spec #9)	Impervious:	0.75	4.b. Grass Channel C/D Soils
	Turf (Pervious):	0.5	4.b. Grass Channel C/D Soils
9.b. Sheetflow to Conservation Area with C/D Soils (Spec #2)	Impervious:	0	
	Turf (Pervious):	0	

Total Impervious Cover Treated (acres)	0.37
Total Turf Area Treated (acres)	0.00
Total TP Load Reduction Achieved in D.A. A (lb/yr)	0.49
Total TN Load Reduction Achieved in D.A. A (lb/yr)	2.42

Channel and Flood Protection

	Weighted CN	1-year storm Adjusted CN	2-year storm Adjusted CN	10-year storm Adjusted CN
Target Rainfall Event (in)		2.20	3.50	4.80
D.A. A CN	91	91	91	91
D.A. B CN	0	48	#N/A	#N/A
D.A. C CN	0	48	#N/A	#N/A
D.A. D CN	0	48	#N/A	#N/A
D.A. E CN	0	48	#N/A	#N/A