Greenways as an Integrative Framework for Campus Green Infrastructure: A Stormwater Masterplan Vision for the University of Connecticut

Kristin Schwab
Associate Professor of Landscape Architecture, University of Connecticut

Introduction

The increasingly resonant concept of green infrastructure has multiple meanings among different professional sectors and the public. For engineers and others focused on site-scale intervention, green infrastructure is quite specific to the use of low impact development (LID) techniques for stormwater management. To the general public, the concept of green infrastructure may be more simply thought of as environmentally friendly systems of transportation, energy, water, or other communal needs. For land use, urban, and landscape planners, the concept of green infrastructure more broadly represents the idea of open space networks of ecological, social and cultural value – which has its roots in the greenways movement.

This paper will present a recent national design competition submission's framework for campus stormwater masterplanning as it represents the intersection of greenway planning, green infrastructure and stormwater management. Unlike other kinds of complex communities, campuses have the potential to be totally integrated environments, with all land and infrastructure controlled by one entity. Campuses also have distinct combinations of landscape typologies such as quadrangles, pedestrian corridors, outdoor classrooms, athletic fields, and parking lots which present large scale opportunities for integrating the needs of stormwater, green space, pedestrian and vehicular movement, learning, and social interaction. As such, the basics of this greenway-based stormwater framework can be applied to any campus, regardless of setting.

Background and Literature Review

Green Infrastructure: Sustainable Stormwater Management vs. Broader Definitions

The concept of *green infrastructure* is a relatively new construct which has rapidly gained attention within the past five to ten years. The U.S. Environmental Protection Agency promotes a definition for green infrastructure which is focused on water, and the connection and distinction between sites and their multi-scalar contexts within the urban transect: "green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, [it] refers to stormwater management systems that mimic nature by soaking up and storing water." (U.S. EPA) This definition, especially at the site level, can tend to encourage a one-dimensional approach to planning and design that becomes driven by low-impact development (LID) and best-management practices (BMP) that are essentially about stormwater management.

Contrastingly, in Green Infrastructure: Linking Landscapes and Communities, Benedict and

McMahon (2006) define green infrastructure as “an interconnected green space network (including natural areas and feature, public and private conservation lands, working lands with conservation values, and other protected open spaces) that is planned and managed for it natural resource values and for the associated benefits it confers to human populations.” This definition, and the planning and implementation methods they outline, focus on preserved or restored natural ecological corridors as opposed to more human ecological corridors which integrate built landscapes and development. As such it is not directly concerned with built landscapes and is broadly aimed at the holistic values that natural networks can provide for general environmental health and connectivity. While this model for green infrastructure is useful in its holistic view, most initiatives dealing with or supporting green infrastructure are, in fact, focused on the more specialized, one-dimensional concerns of stormwater management.

Greenways: Comparison to Green Infrastructure

The more mature concept of *greenways*, which has links to the related concepts of *greenbelts* and *parkways*, has many areas of overlap, some distinct differences from, and a similar divergence of definition in comparison to green infrastructure. In *Greenways for America*, Charles Little (1990), in a call for projects he would analyze for his study, initially defined a greenways as “linear parks, open spaces, and protected natural area in cities, suburbs, or the countryside”. His study of the resulting projects led him to categorize greenways into five major project types: urban riverside corridors, recreational corridors, ecologically significant corridors, scenic and historic routes, and comprehensive systems. More recently, Hellmund and Smith (2006) consider the greenway – “linear or linear networks of lands designated or recognized for their special qualities” - as the broader concept under which green infrastructure – in concert with gray infrastructure (roads, utilities, etc.) – is one of 30 specially designated functions or qualities (though not specifically related to water or stormwater infrastructure). The breadth of these functions and qualities suggests a contemporary understanding of greenways similar to Benedict and McMahon’s holistic definition of green infrastructure.

Campus Planning, Sustainability Initiatives and the University of Connecticut

Paralleling the recent national focus on green infrastructure and stormwater management, campus environments have embraced the broader sustainability movement on a broad array of academic, administrative, student life and campus planning fronts. Some observe that this fervor has become unbalanced and misplaced. Political scientist Sheryl Breen suggests that the race to join the campus sustainability band wagon has become marked by “an unsettling lack of theoretical and ideological analysis. In fact far from challenging the structural barriers that inhibit holistic, democratic green education, the contemporary drive toward campus sustainability can validate and reinforce the power relations that undermine the rhetoric of green principles now filling campus publications and Web pages on sustainability.” (2010) She describes such power relations in terms of decision-making about sustainability initiatives that are often based on reducing costs and attracting external funding, supporters and students rather than their educational, ethical or ecological justifications. Decision-making of this sort is systematized and rewarded by campus sustainability ranking systems that have proliferated.

The University of Connecticut, founded in 1881 as Storrs Agricultural College, is the state’s Land Grant institution. Located in the rural northwestern corner of Connecticut, the Storrs campus has undergone a major transformation and period of growth since the late 1990's, facilitated by the $2 billion UConn 2000 campus development program. UConn's heretofore sleepy rural community of Mansfield has a strong track record of conservation and smart growth planning which has focused recent compact, centralized development in the campus/downtown district and preserved an impressive network of protected open space. However, as the campus has implemented its unprecedented period of development and expansion over the past 15 years, it has not been without growing pains, many of them environmental in nature. In addressing these early challenges, the University developed an Office of Environmental Policy which was charged with leading campus sustainability initiatives. Recently UConn has leapt to the top in

national and even international campus sustainability rankings (UConn 2013), with aggressive initiatives in green building, climate action, and alternative energy research. However, the single- minded and super-sized focus on initiatives such as LEED-certified buildings and low-impact development (LID) stormwater management, has created a bewildering lack of integration and coordination with the greater whole of the campus physical environment and social community.

A catalyst for the intense focus on water quality and LID's was the issuance of a Total Maximum Daily Loading analysis from the Connecticut Department of Environmental Protection in 2007. This study was the first of its kind in which the compromised quality of water discharged from one of two major campus watersheds into Eagleville Brook was evaluated and linked to the growth in campus impervious cover (U.S. EPA). The apparent directive of the study was to reduce impervious cover, and there has ensued a flurry of projects all over the related campus watershed area which are aimed at this single goal.

GOALS AND OBJECTIVES

The U.S. Environmental Protection Agency (EPA) has turned its promotion of green infrastructure to the attention of colleges and universities with its first ever 2012-13 Campus Rainworks Challenge student design competition. With a decided focus on the more specific stormwater management definition of green infrastructure, the EPA's general goals are to:

- "engage students in assessing the technical and economic potential of green infrastructure solutions on college and university campuses
- provide hands-on, interdisciplinary learning experience through which students and faculty gain practical experience that they may apply in their future practice; and
- promote the use of green infrastructure practices that provide multiple environmental, social, and economic benefits on college and university campuses." (U.S. EPA)

The Campus Rainworks Challenge was used as a class project for a senior undergraduate landscape architecture studio focused on community planning and sustainable design in fall 2012. Particular to our project submission for this competition, the students were directed by the instructional team to provide an alternative to the current approach to campus planning and design where:

- stormwater management concerns are separated from other campus landscape systems such as vegetation, circulation and wayfinding and
- individual sites' stormwater regimes are treated in a vacuum and not considered in their larger context

- the potential for using the campus landscape as a vehicle for teaching, research and outreach in sustainable design is under-realized

As such, the primary goal is to **frame a holistic greenways approach to campus green infrastructure development**. Specific objectives toward this goal include: 1) developing a general analysis of watershed-level opportunities and constraints; 2) identification of key stormwater problems and innovative successes at specific sites, 3) identification of important connective cultural and ecological corridors 4) integration of the concerns and prior planning work from the of existing campus masterplan, landscape masterplan, LID implementation sites.

Secondary goals for the project include:

- Exploration of a metrics system for supporting a greenways approach to campus stormwater management through both conventional metrics regarding water quality,

- Examining methods for interdisciplinary approaches to green infrastructure by comparing and contrasting the work of two different submissions from UConn

- Developing a **pedagogical framework** for presenting greenway planning and green infrastructure design in an integrated fashion through analysis of a pilot campus planning project in a senior undergraduate landscape planning and design studio in fall 2012

Methods

The project was structured around a two-step process:

1) **Large--group program exploration, watershed inventory & analysis, and framework development** The entire class of 14 students was divided into two teams, each covering one of two main campus watersheds (one being the westerly Eagleville Brook subject of the TMDL study, the being the easterly Fenton River watershed). The intent of the first part of the project was to allow the students to study the concept of green infrastructure, the specifics of the design competition charge, and the campus context for both general planning and design, as well as for stormwater management, in order to develop conceptual planning frameworks, and specific program ideas. During this phase, strategies for collaboration and stakeholder involvement were explored. Students met with various campus planning and stormwater experts, and the possibility of partnering with a small team of interdisciplinary students also engaged in the competition was explored.

2) **Masterplan synthesis and development** In the second part of the project, a smaller group of six students were identified to evaluate the initial planning framework and program ideas, and develop one unified plan. By this time, the other interdisciplinary team which we had considered working with had decided on a small site-based project in one of the dormitory complexes, as opposed to our larger scale masterplanning approach. The students continued to engage with campus planning professionals and stormwater experts involved in the existing LID and TMDL initiatives to integrate the concerns of each. The required products for the competition were produced from the resulting masterplan vision, including a three minute video, a 12 page narrative and two competition boards.

Results

The stormwater masterplan vision that was developed out of this process addresses the entire main campus, including both watersheds that were studied. The final products outline and refine much of the early analysis, articulate a program based on the analysis and a theoretical framework , and provide a specific and detailed layout of the masterplan elements:

Analysis and Program Development

The context analysis locates the campus at the divide of two highly impacted watersheds. Two central waterbodies on campus act as primary sinks for stormwater and disperse their outflow into the Fenton River and the Willimantic River respectively. The aim of the overall project was to develop a series of treatment trains that would clean runoff in a linear and progressive manner before impacting downstream, off-campus areas. Important existing BMP projects were located and linked with a series of additional proposed stormwater projects to act as connective tissue which would overlay with a greenway system of primary campus landscape corridors and nodes. The composition creates an integration of stormwater, wayfinding, and public engagement and awareness.

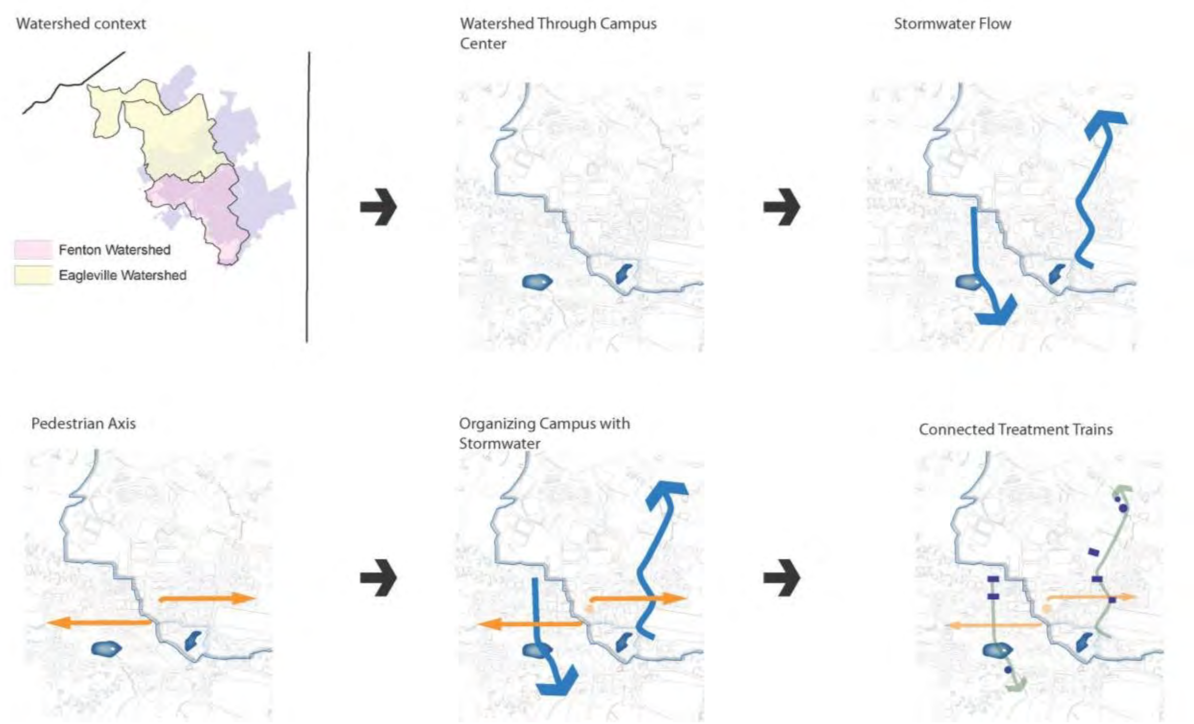

Figure 1 Analysis and program development: watershed-scale stormwater, pedestrian systems.

A **theoretical planning framework** for organizing and giving hierarchical form to the stormwater/ greenway system was developed in which the concept of *density* (building coverage, massing and impervious cover) was examined in relation to the form and function of *greenspace*. (Figure 2) Rural college campuses, as exemplified by UConn, have typically developed and evolved slowly over time into concentric rings of density. High density development occurs in the center of the campus, perhaps with some socially significant outdoor spaces, but relatively little integration of ecologically functional greenspace. Surrounding the high density district a medium density district incorporates more greenspace, though often a pastoral or ornamental approach to landscape form is adopted which is counter to the form and function of typical BMP's and LID's which may be inserted there. The low density external ring is often marked by larger open green spaces and large remote parking surfaces. Generally speaking, these rings are relatively discrete and unrelated to each other, except perhaps through circulation.

In the new model for the density/greenspace relationship, an ecologically functional greenspace node becomes the heart of the campus, integrating social use and meaning with visible natural systems form and function, including stormwater flows and collection. In addition to the ecological services benefits, the integration of ecological and social space can lend a restorative capacity to the space which is often absent in highly competitive and stressful academic environments: "The central core of many of our universities have reached densities of urban proportions, which prompts physical and mental stress. Carefully designed open space provides a welcome contrast to the compact academic core", according to the Journal of Higher Education. To accommodate an expanded central green node, core and medium densities are reinforced with compact infill development to further define and optimize the functional and organizing greenspace. This node extends as connective greenways, or corridors, that link through density rings, and integrated with pedestrian and vehicular circulation route, to the outlying rural landscape matrix. As aging facilities become renovated or replaced, building systems and campus landscape interfaces can be adapted to contribute to this new connective infrastructure of greenspace.

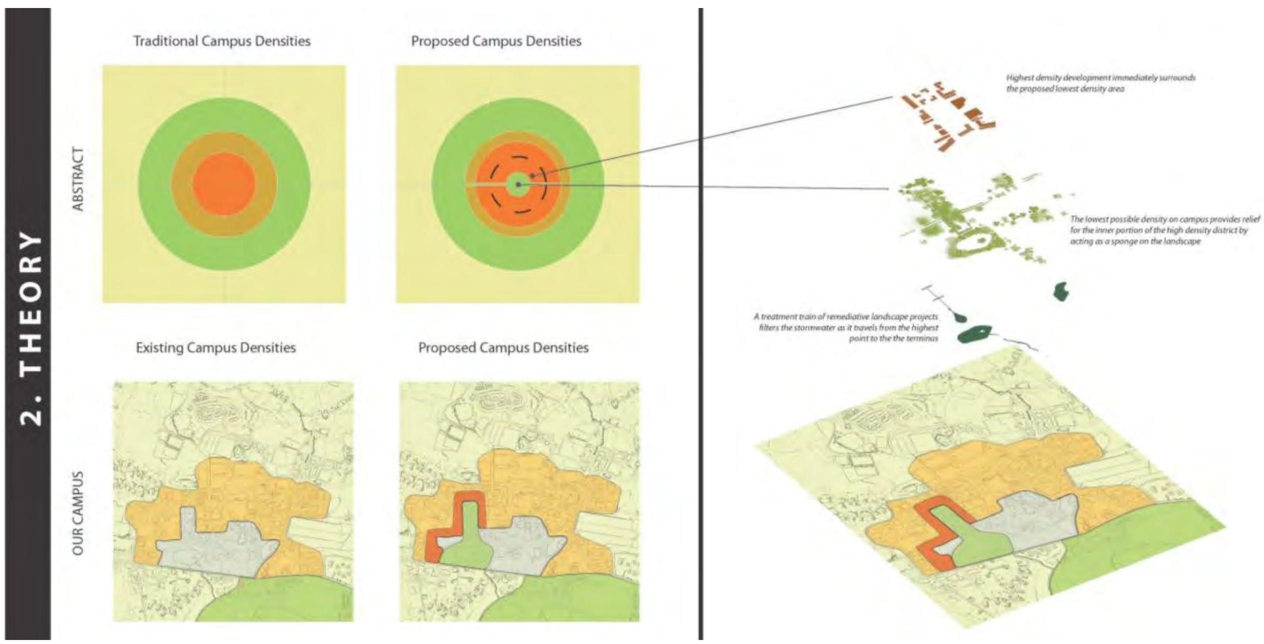

Figure 2 Theoretical framework: campus density and greenspace relationships.

Masterplan Layout (Figures 3 and 4) Applying this general program and theoretical framework to the layout of the UConn campus takes the form of first identifying the optimal greenspace core. The selected core area is centered on a natural landscape remnant in an underutilized part of the current medium density core, known as the Oak Lawn, which provides a direct link to the campus' most important water body, Mirror Lake. This shift to the southeast of the current core, also brings the campus green infrastructure core closer to the new town center core nearby, while still allowing the current main quad to remain as an ancillary node. The campus density districts are shifted (through infill and functional open space creation) to create the highest density district to surround the new greenspace core- to become known as the Oak Lawn Waterway. Plans for new student recreation facility and School of Fine Arts expansion provide needed program for the new density. The waterway function of this space will perform as a sponge for the new high density surrounds.

The second part of the system involves the corridors which extend out from the new core along the existing campus cross-axial pathway system which provide a visual, experiential and functional linkage of the stormwater treatment elements.

Comparative mapping of pre- and post-design stormwater greenway systems are shown in Figure 5. Quantitative analysis of the proposed reductions in impervious cover and resulting stormwater volumes were compared to pre-design conditions (Figure 6).

Project #	Description
1A	Use curb cuts to direct run off onto vegetated slope.
1B	Redirect stormwater towards oak lawn.
1C	Redirect stormwater towards oak lawn.
1D	Add five stories on the existing buildings and increase tree canopy.
1E	Remove existing cottages and increase tree canopy.
1F	Install retention basin near the bottom of oak lawn. The retention basin would collect sediment that can be removed before entering the lake.
1G	Create a constructed wetland on the edge of the lake nearest the interstate. Designed 1 ft. water level rise by replacing existing dam with a v notch weir.
1H	Create a vegetated berm adjacent to wet meadow to treat stormwater and create a buffer between active grazing by live stock and the wet meadow habitat.
2A	Construct a v notched weir prior to the brook being piped underground. The weir would create awarness about the brook and serve as a visual education oppurtunity about the brook being piped underground through the university campus.
2B	Use a bioretention median to collect run off from the road. The median would also increase pedestrain safety by concentrating opportunities to cross the road.
2C	Recommend the implementation of the existing LID project designed by the Department of Architecture and Engineering Services.
2D	Daylight the storm pipe between the parking garage and North Eagleville Road.
2E	Increase the size of the storm grate over the eagleville brook to increase awarness of the underground brook
2F	Use retention pools along eagleville brook to control water flow. Paths and user areas along the brook will increase awarness of LID projects and create an entrance to the campus.
3A	Increase the amount of vegetation to slow down runoff into Mirror Lake.
3B	Lawn restoration
3C	Remove the existing cottages and increase tree canopy.
3D	Planned project with LID features
3E	Existing building with LID features
3F	Existing building with LID features
4A	Nucleous of the pedestrain axis
4B	Existing green roof
4C	Existing bioretention
4D	Existing dry well
4E	Grade the quad at 2% toward bioretention. The bioretention will create a stronger edge of the quad. Increase tree canopy within the quad and use organic landscape mainteance techniques to restore the lawn.
4F	Use a rain garden to collect run off from the roof of the Center for Performing Arts.
4G	Future project with LID features
4H	Reforest the lawn behind the parking garage.

Figure 3 Masterplan diagram: central open space core, shifted density districts, stormwater treatment trains and pedestrian corridors.

Figure 4 Illustrative Masterplan

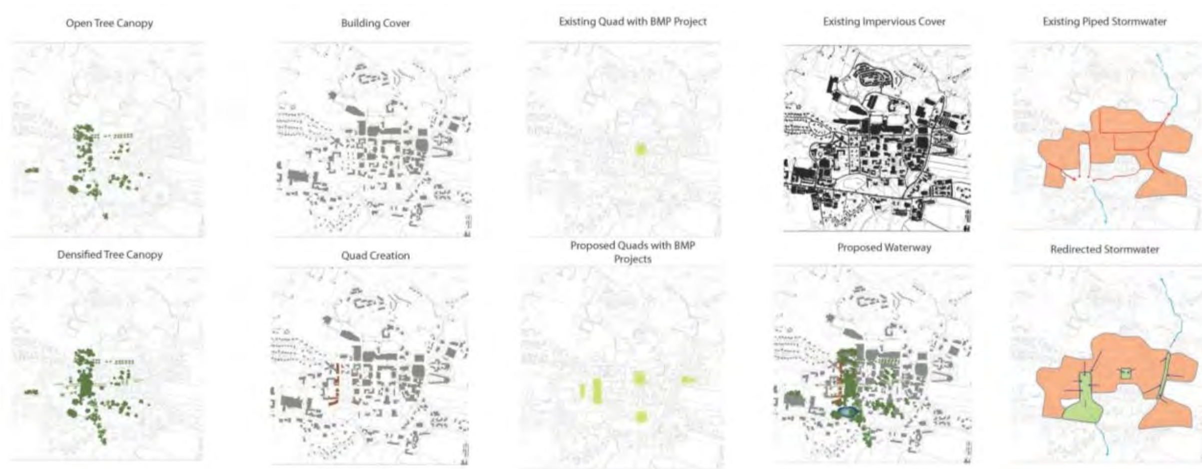

Figure 5 Comparison of pre-design and post design landscape and stormwater systems.

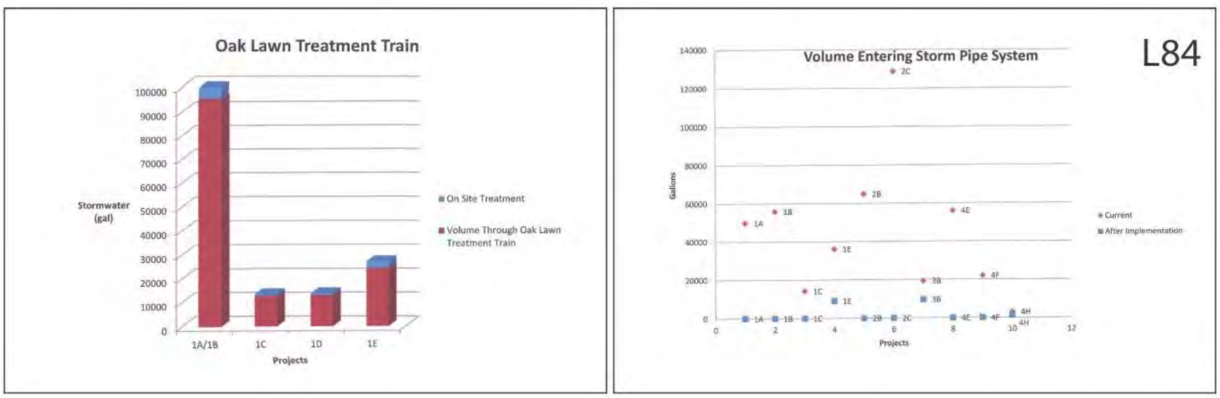

Figure 6 Analysis of Oak Lawn Waterway capacity and comparison of pre- and post-design piped water volumes.

Discussion and Conclusion

Campus landscapes have long been prized for their pedestrian experiences and cultural landscape typologies such as the quadrangle and the lake. The UConn Stormwater Masterplan demonstrates that the contemporary interest in sustainable campus development and green infrastructure can be effectively and efficiently pursued by integrated planning of primary pedestrian systems, social spaces, stormwater systems and vegetated landscapes. Utilizing the greenway concept of interconnected landscape nodes and corridors works well as a mechanism for this integration and realizes the more holistic potential of green infrastructure, which is often overlooked and undervalued. Campus planning staff at UConn have shown interest in pursuing a stormwater masterplan concept based on the students' vision, independent of the competition outcome.

In terms of interdisciplinary collaboration and pedagogical models it is interesting to compare the outcomes of the two teams that submitted to the EPA competition from UConn. The interdisciplinary team, which included natural resource science, engineering, landscape architecture and economics students, was led by engineering and natural resource faculty. Their result was a small site design that focused completely on stormwater treatment. The landscape architecture student reported feeling frustrated by the lack of social and contextual considerations given to the final design. Conversely, the masterplan vision detailed in this study, conducted by landscape architecture students and faculty, was driven by landscape planning and integrated site design approaches. Although engineering and campus planning consultation was conducted throughout the process, the desire and need for more effective and substantive collaboration and exchange was expressed during and after the process. Successful and well-balanced interdisciplinary processes and exchange are critical to both the enterprise of sustainability education as well as the function and perception of sustainable campus environments.

References

Breen, Sheryl D. (2010). The Mixed Political Blessing of Campus Sustainability. PS: Political Science & Politics, Volume 43, Issue 04, pp 685-690.
Benedict, Mark A. and Edward T. McMahon. (2006). Green Infrastructure: Linking Landscapes and Communities. Washington - Island Press.
Hellmund, Paul C. and Daniel S. Smith. (2006). Designing Greenways: Sustainable Landscapes for Nature and People. Washington: Island Press.
Little, Charles E. (1990). Greenways for America. Baltimore - Johns Hopkins University Press.
NEMO (Non-Point-source Education for Municipal Officials). Impervious Cover TMDL. http://clear.uconn.edu/projects/tmdl/
U.S. Environmental Protection Agency. (2012). Campus Rainworks Challenge. http://water.epa.gov/infrastructure/greeninfrastructure/crw_challenge.cfm
U.S. Environmental Protection Agency. Total Maximum Daily Loads (TMDLs) at Work: Connecticut. http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/eagleville_brook.cfm
U.S. Environmental Protection Agency. Water: Green Infrastructure http://water.epa.gov/infrastructure/greeninfrastructure/gi_what.cfm
University of Connecticut, Office of Environmental Policy http://ecohusky.uconn.edu