Growing a Green Campus

A Case Study of Sustainable Landscaping at Skidmore College

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INTRODUCTION

Landscaping is the act of cultivating the natural world. There is an ideological disconnect between the manmade and natural worlds apparent in landscaping and all other forms of human development. This paradigm of separation between man and nature is the root of all environmental problems today (Salleh 2010). In a literal attempt to tame and control nature, current landscaping practices impose a manmade pattern on the land (Cronon 1983) and cause a wide range of ecological disruptions. This makes landscaping practices the ideal medium for transforming the current paradigm. By working in conjunction with ecological cycles rather than attempting to express dominion over nature, landscaping practices can transform our lifestyles to regenerate rather than degrade the environment. The problem is not landscaping itself, but practices utilized. Through thoughtful ecosystem engineering in landscaping, communities can cultivate a culture of long term sustainability where humans act as a keystone species in our local environments rather than as a parasite.

Collegiate institutions are vital for sustainable development because they produce future leaders, command large spending power, and attract public respect and focus. With a primary goal of education, colleges and universities have a responsibility to spearhead the development of solutions to global problems. Institutional adoption of sustainable practices, provides the opportunity for each community member to become educated, personally involved in addressing current challenges, and empowered with strategies to do so. Teaching, learning and living according to tenets of sustainability is integral to Skidmore's mission of promoting civic engagement and developing informed, active, and responsible citizens. Implementing sustainable development in landscaping offers an opportunity to practice what Skidmore preaches and apply the lessons of a liberal arts education.

LITERATURE REVIEW

History of the American Landscape

The United States has a long history of poor land management practices. When colonists first arrived in the Americas, they imported a land use doctrine appropriate for the European environment. They saw the landscape they found themselves in as "wild," something to be feared and needing to be tamed (Koole, Van den Berg 2005). To provide comfort and familiarity in a new world, "the human tendency was to systemize the [diversity] and impose a more regular pattern on it." (Cronon 1983). Indigenous peoples also practiced widespread landscape management, however, once the colonists arrived, the dominant paradigm was influenced by the Old World. Settlers projected symbolic meaning on the land, so cultivated landscapes came to represent success and development among American people. The lawn is especially emblematic of this ideology. "The ubiquitous form of the domestic yard in the US is the turfgrass lawn, an imported British landscape aesthetic that has come to symbolize prosperity, community, and good citizenship" (Jenkins 1994). The symbolic significance of the highly manicured lawn is still relevant today where it is seen as humankind's dominion over nature (Smith 1999). Lawns, initially a status symbol of the English elite, became attainable for the average person with the invention of the mower and is now a staple of American suburbia (Daanish et al. 2010). The desire for manicured green spaces translated beyond the average homeowner to country clubs, golf courses, the White House and the American college campus. The traditional landscape of American colleges and universities is dominated by expansive lawns and a highly manicured aesthetic. In addition to offering visually pleasing environments, lawns serve practical purposes on college campuses. The iconic green quad provides a place for studying, recreation, and other outdoor events such as graduation (McCoy 2014).

Redesigning this method of high-maintenance landscaping on college campuses would have a positive impact on ecology, but it would require a shift in culture and aesthetics.

Ecological Impacts of Landscaping

Traditional landscaping practices utilize ornamental lawns and annual, non-native species that require large quantities of inputs such as water, fossil fuels, toxic chemicals, and labor in order to maintain a certain aesthetic. (Dober 2000). The lawn is perhaps the most ecologically unsustainable of all landscaping features in the United States. "Lawns use ten times as many chemicals per acre as industrial farmland…The pollution emitted from a power mower in just one hour is equal to a car being driven 350 miles. In fact, lawns use more equipment, labor, fuel, and agricultural toxins than industrial farming, making lawns the largest agricultural sector in the United States" (Coburn 2005). High-maintenance landscaping practices such as lawns, contribute to pollution, erosion, biodiversity loss, unsustainable use of resources and climate change. Inputs such as fuel, fertilizers, pesticides, and extensive irrigation, are detrimental to ecosystems, causing environmental issues in air, water, and soil, as well as harm to biological populations (Coburn 2005).

Traditional landscapes are water-inefficient, requiring significant amounts of irrigation in order to survive the North American climate. Plants that require copious amounts of water are planted even in desert climates. Water is applied inefficiently using sprinklers and hoses, which lose water to evaporation. And since landscaping practices tend to disregard topography in their design, water runs off quickly into water bodies rather than sinking into the soil where plants can absorb it. This wasted water is especially problematic in Western and Southern states where water resources are already scarce and expensive. Further, inefficient watering practices contribute to soil salinization, water pollution and erosion (Reisner 1989).

Loss of topsoil is a common problem across American landscapes and can be caused by agriculture, construction and poor land management practices (*The Plow That Broke the Plains* 1936). It can take up to 500 years to create just one inch of topsoil, and that topsoil holds water, nutrients, and beneficial microbes that allow plants to grow. In addition soil acts as a carbon sequestration system so stopping erosion is a vitally important task for sustainability (Natural Resources Conservation Service).

Poor soil requires extensive fertilization in order to support plant life. On traditional American landscapes, this means consistent application of chemical fertilizers. Additionally, planting in monoculture leads to a dependence on chemical pesticides. These inputs pollute soil and water with toxic chemicals and high levels of nutrients. High concentrations of nutrients can create dead zones when they enter streams, rivers, and oceans (Natural Resources Defense Council, 2000). Beyond their contribution to pollution, chemicals from pesticides and fertilizers, are made of nonrenewable fossil fuel resources that perpetuate global warming.

Landscaping practices contribute to a massive loss of habitat through the use of toxic chemicals and non-native plant species. Exotic plant species have been introduced both by accident and on purpose and many of those species have spread rapidly, taking over American ecosystems and pushing out native species (Reichard and White 2001). Invasive species have no natural predators in local ecosystems and so they can outcompete native species that support local wildlife (Reichard and White 2001).

Landscaping practices contribute to a loss of biodiversity by relying on only a few species for cultivation, which is detrimental to natural ecosystems and human resilience. Lawns in America consist primarily of Kentucky bluegrass and a few other species. Pests and diseases are now accustomed to these varieties and have developed resistance to chemical controls. Without a diversity of beneficial species such as birds to keep pests under control, monoculture perpetuates the

need for large amounts of chemical and mechanical inputs. The use of chemical and mechanical inputs leads to further environmental degradation and initiates a cycle of input dependency.

Benefits of Sustainable Landscaping

Sustainable landscaping practices seek to strengthen ecosystems by preventing erosion, pollution and biodiversity loss. Rather than relying on chemical controls to promote plant growth, sustainable landscaping nurtures healthy ecosystems in order to promote plant growth. Practices such as the use of native species, composting, and integrated pest management regenerate ecosystems and ensure long-term resilience of the landscape. Since native plants are adapted to the local climate, they require little to no inputs. Perennial plants are highly beneficial in preventing soil erosion, nutrient loss, and runoff (Jackson 1980). Perennial grasses have deeper root systems compared to the typical lawn grass. When the green turf grasses die, their shallow roots do little to hold back the soil, unlike native grasses. Contouring, or designing to reflect the natural slope of the land, as well as swale-building and terracing are design features that actively shape the land with surface runoff, and erosion in mind (Mollison, 1997). These topographical approaches to sustainable landscaping also help to store water and maximize its use by plants. By creating stable ecosystems, sustainably designed landscapes are not as susceptible to pests and disease because they attract beneficial species that mitigate these problems (Mollison, 1997). By acting as a self-sustaining ecosystem, sustainable landscapes do not require many inputs and can help to absorb pollution rather than contributing to toxicity.

Requiring fewer inputs has many economic benefits. By not requiring annual restorations, sustainable landscapes offer financial savings in labor and inputs. Chemical pesticides and fertilizers as well as oil and gas used in machinery are made of nonrenewable resources such as petroleum. With rising oil prices, decreasing our dependence on fossil fuels will have increasing financial

benefits for years to come. On a college campus specifically, addressing ecological problems while providing aesthetically pleasing environments can attract publicity, prospective students and investors, whose contributions to the institution are immeasurable. Landscaping practices are beneficial for social systems and a growing body of scientific research demonstrates that access to green spaces has a positive impact on people's mental well-being, and can even lower crime rates (Wolf 1998). Sustainable landscaping offers ecological, economic and social benefits and its implementation is supported by a wide demographic.

The Sustainable Landscaping Movement

The sustainable landscaping movement has been growing traction since it was labeled as such over 50 years ago. The movement began as a response to regional ecological issues in the 1960s and 1970s when the environmental movement seriously questioned humans' impact on the land (Fábos 2003). The Western United States began to ardently implement water conservation practices in response to social, political, economic and environmental issues around water scarcity. This was due to the impracticality of the green aesthetic in a desert climate (Addink 2004). Places in California such as North Marin, Santa Clara Valley, and Irvine Ranch, as well as Albuquerque, New Mexico began pursuing xeriscaping practices as efficient alternatives to high-maintenance green landscapes. These changes in land use patterns occurred in direct responses to water mismanagement and droughts, typical of the Southwestern United States (Addnik 2004). The Southeast faced similar water issues, making water-efficient landscapes a logical and cost-effective choice. A 1988 drought in Cobb-County Marrietta, just outside of Atlanta, coupled with the demands of a growing city, prompted the implementation of smart water use and xeriscaping practices (McCarthy 1999). In Georgia, Florida and Texas, Wise Use Councils formed as a response to water scarcity.

The Northeast and the Midwest demonstrated a different response to degrading

environments. Sustainable landscaping in the West and South stemmed from a lack of resources, while Northeastern landscaping initiatives were inspired by overdevelopment and urban sprawl. From the early 1800's to the mid 1900s, pioneers of the Greenway Movement such as Ralph Waldo Emerson, Henry David Thoreau, Frederick Law Olmsted, and Charles Eliot responded to a lack of green space by encouraging forest restoration and protection; glorification of waterways; and the development of beautiful green spaces for people to enjoy (Fábos 2003). The influx of the aforementioned environmental movement of the 1960s and 1970s, slightly altered the Greenway Movement by changing the focus from anthropocentric goals for green space to integrating more biocentric viewpoints (Fábos 1991). The sustainable landscaping movement in America differs regionally in the impetus for changing practices, but the effect on development is uniform across the country. Sustainable landscaping efforts have attempted to shift the widely accepted aesthetic to one that is suitable for local climates, bioregions and human necessities.

The Campus Sustainability Movement

Institutions of higher education are vitally important in the movement towards ecological sustainability for many reasons. First, they have large ecological footprints and consume resources at a greater rate than any individual household (Orr 2006). Second, they have purchasing power. According to the *Chronicle of Higher Education*, the 4,100 institutions of higher education in the United States had annual operational budgets totaling $200 billion in 2000 making them large economic engines with the power to influence market trends (Cortese 2003). Third, with the goal of preparing students to act as responsible world citizens, institutions of higher education have a responsibility to develop sustainable operations on campus. Public focus on research at these institutions could

initiate large scale implementation of sustainability initiatives beyond campus boundaries. As David Orr from Oberlin College put it,

> No institutions in modern society are better able to catalyze the necessary transition than schools, colleges and universities. They have access to the leaders of tomorrow, and through alumni, to the leaders of today...The question is not whether colleges and universities could have catalyzed the transition to a sustainable society, but whether they have the vision and courage to do so (Orr 1992).

Colleges and universities have been active participants in the sustainable landscaping movement for decades and have altered campus practices to reflect environmental values (Fábos 2003). Landscaping is an important piece of campus sustainability because maintenance of grounds comprises a considerable portion of the total ecological footprint of the College. Multiple conferences and declarations over the past 50 years have helped to promote environmental education. This includes the UNESCO conference in Tbilisi, Georgia in 1977 and the Taillores declaration of 1990 that was signed by University leaders from over 47 countries. "A total of 280 higher education institutions chancellors and presidents have pledged to devise and adopt operational activities and change curricula to promote the idea of sustainability and the enhancement of environmental awareness" (Nicolaides 2006). This number of signatories is promising but represents only a small fraction of the total colleges and universities in the US. The Association for the Advancement of Sustainability in Higher Education (AASHE) provides a recent list of colleges and universities with sustainable landscaping practices. The list is far from comprehensive and includes over 60 institutions that report sustainable landscaping practices (AASHE 2012). These colleges represent nearly 40 states and almost every different climatic zone of the US. It is clear that there is a trend in higher education towards making the campus grounds more ecologically sound, but practices vary in their impact on ecology and the level of institutional commitment involved.

Institutions of higher education may be motivated to implement sustainable landscaping practices for social, environmental and economic reasons. Social motivations include: upholding the

College's mission statement, practicing corporate social responsibility, increasing educational opportunities, enhancing the College's public image, and improving quality of life for students and faculty (Weenan 2000). Financial motivations include: monetary savings, resource availability, and attracting incoming students (Nicolaides 2006). Ecological motivations include: managing stormwater runoff, mitigating pollution, preventing invasive species, providing suitable habitat for wildlife, minimizing the use of nonrenewable resources, increasing biodiversity, and reducing greenhouse gas emissions. There is overlap among these three pillars of sustainability. For example, the financial motivations of monetary savings and resource availability work cohesively with the ecological motivation of minimizing the use of fossil fuels. Additionally, ecological motivation of mitigating pollution goes hand in hand with the social motivation of increasing quality of life for students and faculty by providing people with a healthy, non-toxic environment. An important overlap among all three pillars is apparent in the fact that ecologically friendly landscapes provide an institution with prestige and acclaim that may attract publicity, prospective students, and investors.

Changes in landscaping practices at college campuses can occur through a design-integrated or a reactionary approach. The reactionary approach consists of band-aid fixes to environmental and social complaints. The increasing number of sustainability offices on campuses demonstrates how colleges have responded to growing concerns about the environment. Sustainability coordinators and offices have a small sphere of influence and are not fully integrated into the administration. Sustainability coordinators have time, training, and the resources to bring the value of sustainability to decisions on campus. However, this type of reactionary approach is far less effective than a philosophical approach where sustainability becomes an integral part of the College's mission statement (Sharp 2002). This policy and planning involves reworking the design process to integrate sustainability as a fundamental value for the institution and requires an investment in ecosystem services. Ultimately when sustainability is integrated into the design process and the institutional

philosophy, a campus can implement changes more effectively and will realize more social, environmental and economic benefits than if sustainability is implemented after the fact (McIntosh et al. 2001).

Defining a Sustainable Landscape

Traditional landscaping practices in America are problematic because they ignore the rules of ecology in their design. Landscaping can be sustainable and even regenerative if it mimics natural biological process, maximizing the productivity of land in the long term. Many people, organizations, and private entities refer to sustainable landscaping as a more ecologically sensitive method of landscaping that will benefit both humans and the environment.

There are discrepancies among definitions of sustainable landscaping as well as certain underlying commonalities. Some standardized methods for measuring the sustainability of a landscape have been developed. Organizations such as Tree Campus USA, Green Star Awards, LEED, and Sustainable Sites Initiative (or SITES), offer tools for evaluating the ecological impact of landscaping practices. Still, these evaluation tools rely on vague measurements and many landscape design organizations tend to develop their own definitions.

Cardinal Direction Landscape Architecture PLLC, a self-described sustainable landscape architecture firm, describes these practices as components of sustainable landscaping: "perennials & grasses used to reduce maintenance," "soil restoration and revegetation of disturbed sites," "native plantings and edible landscape design," "lawn reduction plans (mowing reduction, chemical reduction, composting)," "habitat restoration plans," "stormwater reduction strategy," "sustainable landscape training and education for facilities and grounds staff" (Cardinal Direction Landscape Architecture PLLC, 2014). Beyond listing these practices, the firm does not provide a clear definition of sustainable landscaping. Other firms are more specific. Sustainable Landscape Design

LLC describes sustainable landscapes as ones that "are managed with practices that conserve limited, valuable natural resources, reduce waste, and prevent pollution of the air, water, and soil. The goal is to provide as much value as possible with the least environmental impact" (Sustainable Landscape Design LLC, 2014).

Some groups call sustainable landscaping by a different name altogether. The Ecological Landscaping Association, in its pamphlet *Discover Ecological Landscaping*, defines "ecological landscaping" as a "method of designing, building, and maintaining landscapes that considers the ecology of a site and creates gardens that enhance the surrounding environment for the benefit of humans and all other life in the ecosystem" (Ecological Landscaping Association 2005). Within this organization, members appear to use the terms "ecological landscaping" and "sustainable landscaping" interchangeably.

Perhaps the most definitive source of a sustainable landscape definition is the one provided by SITES in their report, "The Case for Sustainable Landscapes". SITES defines "sustainability" as the SITES provides a rating system for individuals, design firms, companies, and institutions to determine the sustainability of a landscape project: "...the Initiative's rating system gives credits for the sustainable use of water, the conservation of soils, wise choices of vegetation and materials, and design that supports human health and well-being" (Sustainable Sites Initiative 2009).

We define "sustainable landscaping" as a landscape designed to invoke naturally-occurring biological processes in order to provide long term viability of the surrounding environment for social, economic, and environmental benefits. We consider certain practices integral to this design: the use of native, low maintenance, and/or edible plant species; efficient water management; efficient waste management; organic pest control and fertilization; and/or minimal fossil fuel inputs, as well as a commitment to education. Sustainable landscapes, unlike high-maintenance landscaping systems, output "ecosystem services." This term is defined as "the goods and services provided by

healthy systems" that are not reflected in our current methods of measuring economic success (i.e. pollinators responsible for crop health) (Sustainable Sites Initiative 2009). Sustainable landscaping practices have the ability to provide these services because they are modeled on healthy ecosystems. Strategies that would be included under the overarching definition of sustainable landscaping include, but are not limited to: permaculture, biomimicry, ecological design, organic gardening, xeriscaping, edible landscaping, native plant gardens, ecological stormwater management practices, and more **(See Glossary)**.

At colleges and universities, sustainable landscaping practices can be categorized based on the level of impact on campus ecology and the culture of the institution. Some practices such as native plant purchasing policies and sustainability master plans have a major impact on local ecology and the campus culture, while low impact practices include mowing at 3 inches instead of 2 or building a small campus garden. We categorized sustainable landscaping practices based on these impacts and ranked them from most influential (dark green) to least influential (light green) (See Appendix A, Figure 1). Dark green practices have a larger impact on the campus' ecological footprint and require long term strategies by the administration. Light green practices have less institutional commitment and do not dramatically decrease the campus' footprint. Through both dark green premeditated practices and light green reactionary strategies, colleges and universities have the potential to cultivate social, financial and ecological benefits on campus and beyond.

METHODS

Landscaping at Other Institutions

We reviewed databases, journals and scholarly literature to understand the sustainable landscaping movement on college campuses. We conducted online research via schools websites, master plans, and aerial imaging to get a sense of the landscape at other institutions. We then

identified 10 schools that are similar to Skidmore in location, climate, size, and are a peer or aspirant school. We conducted semi-structured phone interviews with: Mike Wetzel, Associate Vice President for Facilities Management and Campus Planning at Franklin & Marshall College; Tim Parsons, Middlebury College's Landscape Horticulturist; Jennifer Kleindienst, the Sustainability Coordinator at Wesleyan University; Louise Gava, Coordinator of Sustainability Projects at St. Lawrence University; and Marcus Sherburne, Grounds Manager of Facilities Operations at St Lawrence University. We chose these individuals because they are influential stakeholders on their campuses and could explain the campus' landscaping practices. Through these interviews, each about an hour in length, we evaluated sustainable landscaping practices at these institutions. The interview questions were designed to identify major successes and failures within the institution, motivations for their landscaping changes, the key stakeholders that caused the change to a more sustainable landscape, and what recommendations they had for other campuses (See Appendix A, Table 1). From this information we identified many forms of sustainable landscaping practices and categorized their landscaping practices on a scale of dark green to light green. We also identified the major motivating factors for implementing a sustainable landscape based on the three pillars of sustainability. We used a Venn Diagram to categorize schools by what we found to be their primary motivation: social, economic, or environmental (See Appendix A, Figure 2).

Landscaping at Skidmore

As members of the Skidmore community, we already had an idea of the campus landscape aesthetic and what goes into maintaining it. In order to fully understand the costs and benefits of landscaping practices, we needed to find out not only how Skidmore manages the campus, but why they implement certain practices and how decisions are made. We mapped the campus to understand land coverage and uses (See Appendix B, Figure 1). This map was based off of aerial

photos taken by Google on September 19, 2013 and categorized the campus landscape through GIS mapping. Due to shadows, tree cover, the angle of photos, and human error, these are just estimates, however, they gave us an idea of the size and percentage of different types of land coverage.

To deepen our understand of the landscape maintenance at Skidmore we interviewed: Dan Rodecker, Director of Facilities; David Nicholson, Assistant Director of Facilities; and Bruce Murray, Grounds and Fleet Maintenance Supervisor. We developed a spreadsheet of landscaping inputs and asked Mr. Rodecker to gather data on how much money, fuel, fertilizer, pesticides etc. are required annually (See Appendix B, Table 1). We also asked questions to find out how much and what type of labor is involved, how decisions are made and how aesthetic is defined and measured (See Appendix B, Table 2). We also held a focus group with the 10 groundskeepers. We asked them to identify areas of campus that are easiest and most difficult to maintain. We asked questions of each individual about their jobs and daily activities (See Appendix B, Table 3). These interviews helped us to understand the complexity of the Skidmore landscape and the costs of maintaining it, as well as sustainable landscaping practices that facilities has already implemented and opportunities for further change.

To expand our knowledge of Skidmore's sustainability efforts, we interviewed: Karen Kellogg, Dean of Sustainability; Sue Van Hook, Former Professor of Biology at Skidmore and current Mycologist At Ecovative Design; and Kim Marsella, Former Professor of Environmental Studies and current Director of the Office of Academic Advising. In these semi-structured interviews, we asked questions about the timeline of sustainability initiatives at Skidmore and what motivated changes in the past (See Appendix B, Table 4). These interviews provided an administrative perspective on the campus landscape as well as an understanding of the political process involved in decision making.

RESULTS

Best Practices from Other Institutions:

Franklin & Marshall College:

Franklin and Marshall College is located in Lancaster, PA, a very suburban environment. The College is located in the Chesapeake Bay Watershed, a water body with a long history of pollution, so stormwater management projects were among the first to be implemented. Because of this, the College thoroughly measures its water use. Franklin and Marshall has a 200 acre campus, a student body of about 2,300 students and an endowment size of $337 million.

Many sustainable landscaping practices were initiated as a response to the campus Sustainability Master Plan. Another major factor in the implementation of these practices was the creation of a "rolling account," that utilized financial savings from sustainability initiatives to implement further sustainability initiatives. With this funding, the College implements both light and dark green practices. The College implemented rain gardens, permeable pavement and roof top gardens on five buildings. They reduced the number of lawns on campus, began mowing less often, and started mulching grass clippings into the soil. The College also converted some lawns into native planting areas. These areas decrease labor costs while providing the ecological benefits to the soil and surrounding vegetation. The College uses only organic fertilizer and native plant species. There are no pesticides and herbicides used on campus.

St. Lawrence University

St. Lawrence University is located in Canton, NY. The 1000 acre property is relatively wooded and has wetlands and a river going through campus. A main feature of the campus is the 18-hole golf course, which informs the campus design and aesthetic. The University has an enrollment of 2,414 students and an endowment size of $337 million.

St Lawrence has successfully implemented a variety of sustainable landscaping practices that offer ecological, social and financial benefits. A campus-wide integrated pest management system was implemented in response to a student initiative called Project Dandelion. Pesticides are not used on the campus except for the athletic fields, that need to maintain a certain aesthetic. However, even on these athletic fields, the grounds crews use very few herbicides. The grounds crew physically removes weeds rather than using chemical controls. Grass is allowed to grow between 3 to 3 and a half inches, which promotes healthier grass, decreases the need for herbicides and reduces time and energy spent mowing. The areas selected for reduced mowing were used as an educational tool for the University's related Biology department. After the implementation of no and low mow zones, the University saw savings of $623.92 on average per week for the 46 acres of main campus. At first, there was pushback from the local community regarding the aesthetics of no mow zones. However, as wildflowers eventually grew into those areas, the public response quickly changed to a positive one. The campus also stopped using annual flowers in the ground and switched to all perennials. With the implementation of this practice, Facilities reduced their flower spending from $12,000-$15,000 per year to $0. This effort required a creative and tactful use of resources since the landscape needed to uphold a certain aesthetic. Whenever campus events require flowers or centerpieces for tables, potted flowers are used for alumni weekend and graduation events and then repurposed in outdoor planters around campus. The grounds department uses annual flowers in 80 pots and containers strategically placed in highly trafficked areas on campus. Light green practices include the creation of two farm programs, one directly associated with their Environmental Studies Department and another off campus, utilized by the new Sustainability Semester Program. Through innovation grants many light green practices such as a permaculture garden and an arboretum have been implemented. The innovation grants, given by the University for pilot projects, are a vital part of moving sustainable landscaping practices foreword.

Wesleyan University:

Wesleyan University is situated in Middletown, CT along the Connecticut River. The University is located near the heart of this suburban town and has around 3,100 students including graduate students. The physical campus of Wesleyan is 316 acres with more than 300 buildings. The University has an endowment size of $688.8 million.

Wesleyan has implemented a series of sustainable landscaping practices. The University uses 80% organic pesticides, the remaining 20% are synthetic pesticides used only on the athletic fields. They successfully implemented other light green practices such as creating a 9-acre no mow zone that was planted with native wildflowers. The College is experimenting with other areas for reduced mowing. In fact, there is an institutional priority to reduce the total amount of mowed campus by 5% annually. They utilize native plants and wildflowers on 89 acres of the campus. The University composts and mulches 80% of its landscaping wastes and the grounds crews leaves grass clippings on the lawns in order to reduce the use of leaf blowers and fertilizers. There is also a student-run organization called WILD (Working for Intelligent Landscape Design) Wesleyan that was able to transform unattractive landscapes by installing a rain garden, a forested area, a meadow, and a wildflower area. They also were able to create a permaculture garden on campus. At first their projects received a negative response due its untraditional aesthetic, but their efforts eventually gained widespread student support. These projects are intrinsically valuable to the College due to their education benefits regardless of the fact that there are little to no financial savings. The College is in the process of drafting a Green Building Policy in order to solidify the institution's commitment to reducing its ecological footprint and to open the door for more sustainable landscaping practices.

Middlebury College

Middlebury College is situated in Middlebury, Vermont on a 350 acre, rural campus with many wooded areas. It has over 75 acres of lawns, 89 acres of athletic fields, 21 acres of parking lots, 16 miles of sidewalks and has an "urban forest" of over 2500 trees, making Middlebury a Tree Campus. The College has 2,516 students with an endowment size of $954 million.

Middlebury College represents an example of an institutional with a dark green sustainable landscaping plan. The basis for Middlebury College's commitment to sustainability stems from their Campus Master Plan created in 2006. The plan included a wide array of stipulations that integrate sustainable landscaping into all future construction practices. This Master Plan has also helped to institute sophisticated tracking systems that encourage the grounds crew to meticulously measure their expenditures and increase efficiency on campus. The College implemented 20 acres of no mow zones and saved over a 1,000 hours of labor and 700 gallons of fuel. These no mow areas were expanded even further after the community exhibited a positive response. The grounds crews were able to focus on other areas, students enjoyed the scenery and increase in wildlife, and the faculty found educational opportunities for biology labs and painting classes. The College also stopped raking and gathering leaves and instead chops them up with lawn mowers so that they mulch into the soil. This practice increased soil health, reduced the amount of time the grounds crews needed to focus on leaves and saved money. On top of this, the College also spreads compost on it's lawns. The College has an in depth planting policy. Middlebury strictly uses natives plants and is in the process of eradicating invasives. No more than 30% of trees come from one family, no more than 20% from one genus and no more than 10% of one species.

Costs and Benefits of Landscaping at Skidmore

Skidmore is a small, liberal arts college in Saratoga Springs, NY. With about 2,500 students and a $298.3 million endowment, Skidmore has a wide sphere of influence. The campus is

comprised of many different landscapes and encompasses a variety of ecosystems. The campus landscape includes Haupt Pond, the adjacent green known as South Park, the highly manicured performance lawn of Case Green, small lawns with tree cover, and a few unmaintained forested areas. These landscapes raise the quality of life at Skidmore by giving access to greenspace, and providing health and educational benefits. These landscapes also have specific needs in order to maintain a certain aesthetic. Maintenance of the landscape has a significant impact on the campus' ecological footprint.

As shown in the maps we created of what we call "campus proper" or the cultivated campus, the landscape is broken up into 11 different components (See Appendix B, Figure 1). Campus proper consists of about 10% roads, 12% parking lots, and 15% buildings and covered walkways. Patios, which are large impermeable surfaces such as in front of Case, take up only 1% of campus proper. Forested lands take up about 20% of campus proper. The North Woods is excluded from campus proper since Facilities services does not maintain that forest. Planters are the mulched areas with ornamental plants. Chemical fertilizers, pesticides, and herbicides are used on most planters. Planters take up less than 2% of campus proper. Athletic Fields, which are all astroturf or tennis courts and need very little maintenance, take up about 5.5% of campus proper. Stormwater management systems like the rocks and gravel around the Sussman and the Northwoods Apartments take up about 0.6% of campus. Water bodies include the stream that leads into the pond, the pond, and the overflow outlet for the pond. Water features take up less than 1% of campus proper. Lawns such as the Case Green, which need a high level of maintenance, are about 8.5% of campus proper. Lawns with tree cover such as the eastern part of Case Green and the area between Saisselin and Dana still require significant maintenance and take up more than 6% of campus proper. Green spaces, are areas that we have established as either less maintained or less utilized lawns. Green spaces include the residential lawns around Northwoods Village, underutilized

lawns near Zankel, and the hills leading from the Northwoods Apartments to the North Woods Forest. These areas take up just over 25% of campus proper. Green spaces offer opportunities for sustainable landscaping pilot projects since they are small areas maintained to a lower standard of aesthetic.

Due to the different types of landscapes within campus proper, Facilities must utilize many different kinds of landscaping practices. The landscape requires significant labor expenditures to including 3 hours per day on riding lawn mowers from May to June and 3 hours per day blowing and collecting leaves from August to October. Members of the crew have either focal areas or focal practices. One member of the team is in charge of watering almost all of the planters and green spaces, while another is in charge of cultivating and growing all of the ornamentals for campus. Other members of team are in charge of cleaning Case walkway or mowing and leaf blowing in front of the academic buildings. These groundskeepers take pride in what they do and feel a sense of ownership over their areas. When asked which areas are easiest or most difficult to maintain, they responded that "the job is maintenance" and that no one area was more difficult to maintain. The groundskeepers have come accustomed to their daily tasks and are not averse to activities such as leaf blowing or mowing. Regardless, they are generally willing to change their practices as long as they are not put under more stress or hardship, and in some cases they would prefer to be more ecologically friendly. The only area they had complaints about was the stream leading into the pond. The stream bed was once fully vegetated and acted as a bioswale, but facilities has recently started mowing the reeds. Groundskeepers responded negatively to this task because mowing around that area is difficult and because the lack of vegetation led to a decrease in wildlife that once lived in the bioswale. However, they feel that they have little say in Skidmore's landscaping practices and what they do on a day to day basis.

Since there are many people who hold stake in the landscape there are competing values and

opinions that must be taken into consideration. Some of these stakeholders include: members of the Saratoga community, the board of trustees, campus sustainability subcommittee, office of student life, and academic councils. There is a lack of communication between these stakeholders and a lack of ownership in terms of the campus' ecological footprint.

Saratoga Springs is a traditionally beautiful and affluent city with strict regulations on the visual appearance of campus, especially areas located on North Broadway, so Skidmore must maintain a pristine aesthetic. Facilities may receive complaints if the grass looks unkempt, but with proper communication about the landscape, the College may be able to implement sustainability projects such as no mow zones with little or no community resistance. In addition to maintaining a visual aesthetic, facilities must maintain a performance-based landscape. The campus is utilized for events such as Fun Day, Earth Day and athletic events so facilities must ensure that the landscape is functional as well as beautiful.

Through interviews with stakeholders in Facilities Services, we were able to get an understanding of the costs of landscaping including: fuel expenditure, pesticide and herbicide use, fertilizer use, species planted, labor hours, and aesthetic expectations.

Fuel

Gasoline usage is measured for the entire department in an imprecise way. Tanks are refilled monthly and fuel usage is not monitored by vehicle. From December to March, the main activity is snow removal. The entire Facilities department consumed 339.1 gallons of gasoline and 944.5 gallons of diesel during the winter season last year. The main activity in April is lawn care and repairing areas that were damaged in snow removal. Tasks include: laying sod, cleaning up trash and leaves, fertilizing, seeding, mowing, mulching and cultivating planters. This season goes from April when the snow melts, to July and facilities consumed about 1,123.3 gallons of gasoline and 720.6

gallons of diesel during this season last year. August to November is the season of removing dead plants and leaves. Facilities consumed about 920.9 gallons of gasoline and about 622.3 gallon of diesel during this season (See Appendix B, Table 5) Fuel usage throughout the year includes lawn mowers, tractors, snow plows, leaf blowers, and other handheld gas powered machines and off road vehicles.

Pesticides and Herbicides

Facilities has stopped applying pesticides and herbicides prophylactically over the whole campus. Instead, they are applied in the form of spot treatments. Because of this, the amount used changes year to year depending on when and where they have issues. To obfuscate the process more, most of the pesticide and herbicide use on campus is contracted out to other landscaping agencies that change each year. When speaking to one sub-contracted landscaping crew on Tuesday April 8th 2014 they said that this was the first time their company had been hired and that they were only contracted for three full days. The pesticide that is used mainly is called Dilox and is applied to all mulched landscaping areas.

Soil Nutrition

The fertilizers used are granular and water soluble. Facilities used about 14,550 pounds of fertilizer last year (See Appendix B, Table 6). Fertilizer is used mainly on athletic fields that need to function as aesthetically pleasing performance-based landscapes. The mulch and soil used on campus comes mostly from local vendors and is applied by third party contractors.

Plant Species

The grass on campus is called "Trilogy Mix" and is mainly rye grasses. In general, rye grasses

are very quick to grow and die. It is inexpensive and thick with a lifespan of 1-3 years but can die after the first frost.(J&J Materials 2014). Annual flowers and other plantings are cultivated in an on-site greenhouse by a single member of facilities. Invasive species such as burning bush (*Euonymus alatus*) and Japanese barberry (*Berberis thunbergii*) are planted on campus and contribute to ecological disruption in the forested areas on campus. Student and faculty have attempted to eradicate these invasives from the North Woods, but their efforts have been unsuccessful since the species still exist on campus where birds and other animals help to propagate their seeds. Facilities has recently committed to removing invasive species in the cultivated landscape and utilizing native plants instead.

Water

Due to water shortages in the summer, facilities uses its own well rather than city drinking water on the landscape. One person is in charge of watering the whole campus and spends about 40 hours per week watering in the summer. Areas such as the Case Green are watered with a sprinkler system, while planters are watered with a mobile water truck. Facilities meters water usage on the whole campus but does not track water used in landscaping.

Waste

Organic matter collected in landscaping are composted at an off-site facility. Skidmore pays to haul yard wastes and must buy finished compost back from the off-site facility. The College is in the process of developing a large-scale composting facility for leaves and horse manure in order to recycle valuable resources and use them on site.

Aesthetic

Skidmore College does not have explicit rules on aesthetics. Mr. Rodecker and Mr. Nicholson have learned through trial and error that "the College" expects leaf litter to be gone for aesthetic reasons. Mr. Rodecker says that "a lot of it is grandfathered in... its like the unwritten rule... I do have a boss... if he says the expectation is X, I'm fine with that... if it's not mowing, then we'll do that." When North Woods Village Apartments were first constructed, parts were intended to be no mow zones until complaints were filed (though it is unclear who filed the complaints). Now facilities must mow and maintain the hilly lawns surrounding the North Woods Village Apartments and had to purchase a new mower specifically for these steep areas. Other lawns on campus are mowed to 3 inches, except Case Green which is mowed to 2 inches. Mowing at 3 inches allows the grass to be cut less often while still pleasing those who desire a more manicured look. When new buildings are constructed, a third party contractor is hired and determines the landscape design. The contractor will provide their plan and either Mr. Murray, Mr. Rodecker, or Mr. Nicholson will comment. Ultimately, the administration does not say forthright what is "beautiful" or "aesthetic" but any complaints are sent to Facilities Services.

The Beginnings of Sustainable Landscaping at Skidmore

In the past 10 years, Skidmore has demonstrated its commitment to sustainability. Skidmore hired two sustainability coordinators in an office of Sustainability, as well as a Dean of Sustainability who works in the presidents office. Skidmore's sustainable landscaping efforts are also mostly light green. Among Skidmore's first steps to decrease its ecological footprint, was the termination of most pesticide use on lawns. This initiative was sparked primarily by public health concerns among members of the Skidmore community and resulted in immediate social benefits and financial savings. Irrigation practices were also changed to be more efficient. Facilities switched from using a large water cannon, to more efficient sprinkler systems in the highly maintained areas, and a water

truck for planters. Recently, there was an organized effort by students and faculty to eradicate invasive species around campus. These species included common reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*), Japanese knotweed (*Fallopia japonic*), garlic mustard (*Alliaria petiolata*), Japanese barberry (*Berberis thunbergii)* and burning bush (*Euonymous alatus*). Purple loosestrife was almost completely removed from its hold on the wetlands next to Falstaff's, however burning bush, Japanese knotweed and Japanese barberry are not easy to eradicate and have continued to endure in the cultivated and uncultivated campus landscapes. Institutional planning is required to holistically address this problem. There is a current effort to draft a sustainability strategic plan for the College and lands and grounds is a subtopic for this institutional master plan.

Skidmore's Facilities Services is committed to sustainability so long as landscaping practices do not increase in the amount of costs or labor required. However, with little administrative commitment to sustainability and no long term strategies or guidelines for maintaining the campus or decreasing its ecological footprint, facilities lacks the necessary impetus, resources and support for dark green sustainable landscaping initiatives.

DISCUSSION

Themes at Other Institutions

Impetus

Case studies of other institutions demonstrated key motivations and practices for sustainable landscaping. We found that most schools are motivated by all three pillars of sustainability (See Appendix A, Figure 2). Social motivations such as educational opportunities and upholding the mission statement of the College are often noted as primary motivators. Ecological motivations such as reducing toxic runoff and minimizing greenhouse gas emissions were also cited as important in every interview. Ecological and social motivations often sparked the conversation about sustainable

landscaping and led to light green actions such as supporting student-run initiatives such as WILD Wes at Wesleyan University. However, social and ecological factors alone rarely led to concrete change. While these factors more often than financial ones got the conversation going, cost is the main limiting factor. As stated in the St Lawrence Interview, "getting money for green projects is hard" (Gava and Sherburne 2014). Or at Wesleyan University where the implementation of some sustainability projects was viewed as either, "too expensive or not possible" (Kleindienst 2014). Projects that are ecologically and socially beneficial will not be implemented unless they are economically feasible. This being said, many campuses implemented sustainability projects regardless of economic expenditures. As stated in the Wesleyan University interview, there is support for "projects that don't necessarily have economic value but have intrinsic values (educational value)" (Kleindienst 2014). Many institutions of higher education do not value financial savings as much as they may claim to. This is evident in the lack of concrete data demonstrating proclaimed financial savings from these institutions, with only Middlebury and St Lawrence University able to provide numbers of dollars saved. Regardless of the assertion that money is a limiting factor, there is no shortage of finance streams for sustainability projects on campus. Despite expensive initial capital investments, many institutions make sustainability initiatives financially feasible by utilizing grants, rebates, green funds, and revolving accounts as in the case of Franklin & Marshall College.

Implementation

Students and faculty were heavily involved in the conversation at a preliminary level at all four schools but successful implementation required administrative support. As in the case of St. Lawrence University, the push for no pesticide use was a student initiative backed by the faculty. However, the environmental science department, sustainability office and student-led clubs, did not actually implement the changes. Projects cannot be successful unless the facilities that would

implement changes are receptive to adjustments. For instance, at St Lawrence University, the grounds manager only began to consider changes to their practices when his own son demonstrated the importance of a environmental mindset. Students and faculty may be useful resources in maintaining sustainable landscaping projects, providing that there is good communication and planning for long term success, but it was clear that no sustainable actions can be taken without endorsement from facilities and the administration. Each school we interviewed noted that the administration and local community can act as a barrier if sustainable landscaping practices threaten the campus' aesthetic.

Success/Evolution

Concrete change can occur in two main levels: as a solution to a problem or integrated into the initial design. Initiatives that are incorporated in the design are far more effective than those that are implemented after the fact. For example, lawn maintenance can change to organic and low mow but if sustainable landscaping was considered in the design of the lawn, it could be a native lawn, or a native planting area with only a small lawn section, or no lawn all. Furthermore, designing for sustainability often leads to recognition. Recognition from the community often acts as a motivation factor and leads to more initiatives. Institutions that have embedded environmental values and use this as a marketing tool (i.e. Middlebury), are more likely to implement successful initiatives, receive support and recognition for these initiatives and thus will continue to pursue sustainability projects on campus. Marketing sustainability, even if it is greenwashing, can be useful in initiating projects on campus. If the administration does not recognize sustainable landscaping as a marketing tool, they are unlikely to promote these projects on campus.

Sustainability initiatives are more difficult to implement on campuses where environmentalism is not a part of the school culture. Community values are longstanding and have

evolved over many years so attempting to shift the College's paradigm requires patience and persistence. Community values can inhibit the implementation and efficacy of projects, which is especially apparent in the value of aesthetics. At many colleges and universities, no mow zones are rejected by the administration, trustees or local community because they are seen as unsightly and wild. As Jennifer Kleindienst, the Sustainability Coordinator at Wesleyan said, "they are not beautiful in traditional collegiate sense of the word beauty." However, effective communication, marketing and education can increase public acceptance. No mow zones tend to be more accepted if they are called "prairies," planted with native wildflowers, and are used by academic department for research. Additionally, pilot projects are vitally important since they allow for experimentation and community feedback. There are some aspects of campus climate that cannot be changed. Colleges may shift to organic, native and low maintenance lawns, but they will never do away with the iconic campus green. Landscapes must be functional for the College's use. Sustainable landscaping projects must promote environmental stewardship in ways that still meet the community's needs.

The Future of Sustainable Landscaping at Skidmore

Skidmore College's primary mission is to educate. Skidmore has the opportunity to continue that mission by adopting sustainable landscaping principles and has the potential to transform the campus culture to one with a more ecological mindset. Sustainable landscaping at Skidmore could include a number of practices such as stormwater management, xeriscaping, rain gardens, edible landscaping, permaculture, terracing, use of native plants, integrated pest management, compost and compost tea in place of fertilizers, bioswales, riparian buffer zones, the creation of wildlife habitat, and reducing inputs such as water, fuel and chemicals.

The primary obstacle to the implementation of sustainable landscaping practices is aesthetics. Many stakeholders have expressed concern that many sustainable practices and plants

lack aesthetic value. While prairie gardens or meadows are very vibrant and naturally beautiful, it may require some awareness, outreach and education for people to become accustomed to the "unkempt" appearance. In accordance with the community's emphasis on aesthetics, we have developed sustainable landscaping plans that do not compromise the appearance of the campus.

Sustainable Landscaping Master Plan

Our sustainable landscaping plan is inspired by the following ten basic tenants:

> "Diverse forms of life live and work together interdependently; soils are covered and protected from the impacts of excessive wind, sun, and rain; rainfall is filtered, conserved, and available when needed; soil organisms are fed by the cycling and recycling of nutrients; humus holds fertility reserves within the upper layers of the soil; diversity builds over time, keeping plant insect damage and diseases in check; plants supply fresh air, above and below the ground, as well as cool shade; the subsoil provides inorganic compounds required for living and nonliving processes; natural systems are dynamic and will change over time; humans experience sensory, intellectual, emotional, and spiritual stimulation, opportunities for learning, and insights into the wonder of complex natural processes" (Chase-Rowell et al. 2007)

The proposed campus master landscaping plan is divided into the following categories of practices:

1) Integrated Pest Management
2) Planting Policy
3) Water Management Plan
4) Waste Management Plan
5) Soil Management Plan
6) Education, Communication, & Planning

Integrated Pest Management

Integrated Pest Management (IPM) is an approach to pest management that utilizes a combination of ecosystem-based strategies, focusing on the source of problems rather than dealing with the symptoms as they emerge. IPM uses ecological information about the life cycles of pests and the environment to solve landscaping pest issues. Some examples of IPM are crop rotation, soil preparation, physical traps, using plants that are hardy, and timing planting to avoid pests (IPM

Institute of North America, Inc. 2012). IPM is a dark green, holistic practice. If the College requires the use of pesticides, they should select organic versus chemical products in transition to a completely pesticide-free campus.

Simultaneously, acceptance of a new lawn aesthetic is needed. In order to completely phase out all chemical use (such as pesticides & herbicides), the College needs to embrace certain "pests" or "weeds." Weeds such as dandelions and clover are regular colonizers of lawns and provide ecosystem services. Instead of continuing inputs of chemicals, a diversity of plants and wildlife should be welcomed since they offer provide same benefits as these chemicals. If the College cannot accept new lawn standards, manual pest management can be implemented.

Planting Policy

All plants on campus should be evaluated from the perspective of their social, economic, and ecological benefit. For example, though daffodils hold little ecological and economic value, they do not pose a serious environmental threat and they offer social benefits since they were favorites of Lucy Scribner (CSS meeting, 2014). We have determined that their presence on campus, would be a good alternative to high-maintenance annual flowers at campus entrances and other highly trafficked areas. Because they have a short blooming period, daffodils should be planted in front of other beneficial plants, such as low-growing evergreen shrubs that offer ecosystem services.

The College has already agreed to exclusively purchase native plants in the future, however, this policy could be implemented more aggressively. Targeting and eradicating all invasive species on campus should be a priority. Solely native perennials should be brought in to replace those plants (see Appendix C, Table 1). Ideally, the College should aspire for the landscape to be 70-90% native. There are however, many beneficial plants that are not native but provide other ecological, social,

and economic services without becoming invasive (See Appendix C, Table 2) and these should not be excluded from the landscape.

For the most part, the College has a diverse array of plants with seasonal interest and coverage, meaning that, in addition to providing aesthetic appeal year-round, these plants also provide valuable ecological services by protecting the soil from the elements. For this reason, plants brought into the landscape should be perennial, with some exceptions. Ornamental and high-maintenance annuals that are preferred for special events, can continue to be propagated if raised in pots as in the example of St. Lawrence University.

Most of the green space on campus is underutilized or unused entirely. 10-20% of the lawns and green spaces should be converted to gardens. We have identified several areas on campus that experience low foot traffic and little to no use for recreational purposes. For example, the space in front of Bolton facing the Library should be replanted with native, perennial groundcovers, wildflowers, grasses and shrubs (see Appendix C, Figure 1).

Water Management Plan

Stormwater

Much of the campus grounds is open green space or lawns, left exposed to the elements. There are multiple areas on campus that suffer from erosion such as the slope off of Case Walkway heading down to the Case Parking lot, and the area covered by trees between Dana Science Center and Filene. To remedy these places, the green space must be converted to perennial vegetated zones with low-input and low-maintenance plants (See Appendix C, Figure 2).

We have identified all the impervious surfaces on the Main Campus, which should be bordered by planting swaths of vegetated buffers, also known as bioretention zones. Types of

bioretention include bioswales (dry or wet), riparian zones, and rain gardens. Case Parking Lot is one such impervious surface on campus. To properly manage stormwater, the meridians in the lot should be repurposed as bioswales to conduct runoff coming from the pavement (see Appendix C, Figure 3). There are already existing examples of bioswales on campus. The stream draining into Haupt Pond was protected by a bioswale until recently when Facilities started cutting it. This stream should be allowed to return to its vegetated state and the pond would benefit from additional vegetated swales bordering its entirety (see Appendix C, Figure 4).

Irrigation

Irrigation is not the problem it once was at Skidmore, but there are many ways to improve the current system. Skidmore could reduce its water usage by xeriscaping, implementing drip irrigation, and swale building. Many other institutions have taken advantage of water-efficient irrigation systems built into the ground that utilize technology to respond to changes in the weather and apply water accordingly. Skidmore could also look into the collection of rainwater from the rooftops of campus buildings to help irrigate the grounds.

Waste Management Plan

Instead of sending its yard waste to an off-site facility, it would be more cost-efficient for Skidmore to build a large-scale composting facility on campus. Due to the high-volume of yard waste, food waste, manure from the Stables, there are ample materials for this system to happen. Students, faculty, and the Sustainability Office have been actively researching and advocating for this system for more than four years; all that is lacking is an institutional commitment to this project.

Soil Management Plan

Soil health can be a limiting factor for landscaping. While other plants work to build soil and provide soil nutrients, lawns have no nutritional value for the soil and contribute to erosion. Lawns require significant quantities of fertilizer and chemical inputs to survive. A large-scale composting facility on campus could provide much needed nutrients for the grounds, and help to decrease fertilizer inputs. The College should also consider leaving certain areas as rake free, or no blow. In these areas, leaf removal would not occur. These could be located in out-of-the-way or hard-to-reach areas. In low mow areas that are more central to campus and must meet a higher aesthetic standard, leaf litter can be mulched into the soil by repeatedly mowing over the area. Grass clippings can also be mulched into the ground instead of being gathered as yard waste to improve soil quality. Other institutions have successfully implemented these mulching strategies.

In areas of campus dealing with erosion, long-rooted vegetation can help mitigate the problem (as briefly discussed in the Stormwater Management section above). Additionally, practices such as terracing can help prevent soil loss. One of the areas discussed in the section on Water Management, the forested green between the Dana Science Center and the Saisselin art building is an area that would benefit from erosion mitigation practices. The area should be converted from lawn to a woodland shade garden, with wildflowers, ferns, and shrubs to help hold the soil in place. Additionally, the green could be terraced, making the descent more gradual and helping to secure the soil. Another potential area for soil management practices is the slope from Case Walkway to Case Parking Lot between Ladd Hall and Wilmarth Hall. Native and perennial plantings as well as the construction of two stone staircases to direct foot traffic would mitigate erosion on this slope (see Appendix C, Figure 3).

Education, Communication, & Planning

Possibly the most important component of the master plan is communication. Our research of other institutions has demonstrated that without a continuous dialogue between all stakeholders and a commitment amongst all of these individuals to sustainable practices, these initiatives often fail. On our Green to Green scale, we have indicated that the "darkest" green initiatives are campus master plans, or anything that demonstrates long-term institutional commitment to sustainable landscaping. In order to have such commitment there needs to be greater understanding about the fundamental value of sustainability on campus.

There needs to be outreach to both Facilities and the greater campus community about sustainable landscaping. In its Strategic Plan for 2025, the College should allocate funds and support to Facilities and/or the Sustainability Office specifically for education. This should cover costs of training in sustainable landscaping practices: workshop and conference fees and the cost of consultants and student interns. The greater campus community would benefit from educational outreach such as signage, explaining the various sustainable landscaping projects around campus and their benefits, as well the various plants. Ecology and biology-oriented classes would benefit from this signage and could integrate their curriculum into the landscape (i.e. plant identification courses, conservation courses, etc). This integration with the landscape is not exclusive to the sciences, however. Ultimately, signage is key, and art or business students could be commissioned to create marketing tools and structures that help to educate the community about the landscape in visually appealing ways.

The College should consider looking into the establishment of the North Woods as a wildlife sanctuary. Currently, the area is perpetually considered for development. However, the Woods provides value as an educational space for classes and the community, as well as an important recreational area. In addition to protecting the North Woods, the College has the opportunity to further its prioritization of education by protecting all of the campus landscape.

Something for the College to plan for in the future is the designation of all of campus as a Nature Sanctuary, Preserve, Botanical Garden or Arboretum. Such designation would help the College market itself as an environmentally conscious institution, particularly to prospective students.

On a planning and communication level, we call for the permanent establishment of a Sustainable Landscaping and Grounds Committee (SLGC) that meets at least once a month to continue to pursue sustainable landscaping options at Skidmore. We recommend the presence of the following participants for this committee: Director of Facilities, Sustainability Coordinator, Dean of Sustainability, chairs of Biology, Environmental Studies, and Geoscience departments (more chairs are welcome to join the committee if interested), a representative from finances, Dean of Student Affairs, two Skidmore students (the Sustainability liaison for SuCo, and an open position for internship credit), and a representative of the groundskeeping staff (elected by the staff). This committee would not only be responsible for decisions regarding the campus landscape and for implementing sustainable landscaping measures, but also for coordinating educational events and outreach programs for the campus and greater community. This would be a transparent committee with open meetings where any individual with stake in the campus landscape would be welcome to attend.

Additionally, working in coordination with science departments, related student groups (such as eCoaltion and Skidmore Community Garden), as well as Facilities, a new student group should be formed for the sole purpose of creating sustainable landscape features, following the example of the Oberlin Student Bioswale Project or WILD Wesleyan. Student volunteers would be able to learn about various sustainable landscaping practices and help to implement them alongside the groundskeeping staff. The student group would have the responsibility of keeping records of these project (i.e. how they were implemented, financial savings, the failures and successes, among other things). Facilities should also be responsible for meticulous record-keeping. There should be ample

record-keeping and archiving of all business transactions, costs, and resource usage. These records should be accessible for student, staff and faculty research.

Implementation Process Timeline (Phases 1-3):

The implementation process of converting the campus landscape to a sustainable one would be done in stages, approximately three. During the implementation process, priority should be given to landscaping projects in areas of high erosion, nutrient depletion, unused or low-use (little to no foot traffic or use recreationally)

Phase 1: (1-5 years)

Integrated Pest Management

- Conversion to solely organic soil inputs (i.e. fertilizers); in the case of herbicides, the Sustainable Landscaping and Grounds Committee (SLGC) should decide whether they are necessary
- Implement principles of IPM (if necessary, the College should provide the funding for education on IPM - i.e. workshops, off-site courses etc.)

Planting Policy

- Begin eradication of all invasive species on campus
- Begin purchasing native plants to replace invasive species
- Begin conversion of specified "low-use" green spaces to native and/or perennial vegetated zones, and/or no mow zones
- Begin policy of potted annual flowers and plant perennial flowers in the ground

Water Management Plan

- Begin implementation of recommended bioswales & riparian buffers

Waste Management Plan

- Create large-scale composting facility on-campus for use on campus grounds

- Compost Managers work with the Sustainability Office, Facilities and the SLGC monitor and catalogue the amount of yard waste

Soil Management Plan

- Implement pilot projects of no rake or no blow zones

- Begin mulching grass and leaf litter into mowed lawns

- Implement pilot projects of vegetative zones for mitigating

Education, Communication, & Planning

- Establishment of the Sustainable Landscaping and Grounds Committee (SLGC)

- SLGC determines a definition of aesthetics at Skidmore and guiding principles for Facilities

- SLGC enlists student artists to create sculptures & plaque/signs that explain sustainability initiatives

- Training of groundskeepers on components and practices of sustainable landscaping

- Improve record-keeping of all activities and resource inputs by Facilities (fuel usage and costs, water usage and cost, plant lists and locations on campus, workshops and trainings, landscaping budget and spending)

- Encourage admissions to advertise sustainable landscaping practices

Phase 2: (5-10 years)

Integrated Pest Management

- Expand IPM program to include studies within science departments about biological and physical pest controls

Planting Policy

- Complete eradication of invasive species

- Continued expansion of no mow areas and native prairies

Water Management Plan

- Expand areas of bioswales and riparian buffer zones

- Implement weather-sensitive irrigation system and/or drip irrigation

- Implement campus wide stormwater management strategy

Waste Management Plan

- Enlist student Compost Managers to study the efficacy of campus-wide composting system

- Expand composting program to include food waste from the dining hall

Soil Management Plan

- Expand no rake and no blow zones

- Increase use of compost and compost tea on lands and grounds

Education, Communication, & Planning

- Continued outreach by the SLGC with other academic departments on campus to integrate the landscape into their curriculum

- Establishment of student landscaping group that helps to physically implement practices while learning about their benefits

- SLGC enlists biology classes & Northwoods Stewards to identify plant species on campus & create botanic tags

- Tree Campus USA certification

- Designate the North Woods as a preserve or Wildlife Sanctuary

Phase 3: (10 years+)

Since the landscape is dynamic and constantly changing, it is impossible to predict where it will be in 10 years. During Phase 3 of the Sustainable Landscaping Master Plan, the College should begin a comprehensive analysis of these programs and make decisions about how to move forward.

Integrated Pest Management

- Develop comprehensive, campus-wide IPM strategies that include new ideals of what species are considered "pests and weeds"

Planting Policy

- Implement 100% perennial, native and useful plantings on campus
- Expand no mow zones, campus gardens and edible landscaping features

Water Management Plan

- Implement rainwater collection off of buildings and recycle grey water for landscaping
- All impervious surfaces bordered with vegetated buffer zones

Waste Management Plan

- Expand campus-wide composting system to include all buildings
- Research the possibility of selling compost produced on site

Soil Management Plan

- Develop strategic erosion management strategy

Education, Communication, & Planning

- Designate other areas of campus as Wildlife Sanctuaries
- Develop pre-orientation program about the campus landscape
- Develop interdisciplinary landscape design courses on campus

CONCLUSION

This project gave an initial look at the costs and benefits of sustainable landscaping at

Skidmore, but is far from comprehensive. Skidmore occupies a diverse and complex landscape and the decision making process on campus is convoluted. Facilities has already initiated many light green sustainable landscaping practices, though it has not made efforts to publicize these initiatives and long term administrative commitment is lacking. Skidmore should follow the lead of its peer and aspirant institutions who have already paved the way in developing sustainable campus operations in order to provide ecological, social and financial benefits.

Future studies could expand on our research and implement sustainable landscaping practices by addressing specific practices, sections of the master plan, or areas of campus. Studies that analyze the ecological footprint of other aspects of campus maintenance would also be valuable. Future studies could address specific practices such as energy use, waste, and food purchasing or specific areas of campus such as the art building or the residential halls. Marketing studies would help to determine the efficacy of communication about sustainability projects and curriculum analyses could demonstrate the level of success in integrating sustainability into academic departments. We believe that interdisciplinary research on the holistic ecological footprint of the College is the perfect application of a liberal arts education.

Skidmore is situated in an opportune position to implement sustainable campus operations. As a small, liberal arts college, Skidmore creates its own sort of "bubble" which allows it to cultivate a culture, a climate, and a way of thinking amongst its community members. We see Skidmore as a microcosm of society, and that can work to the College's advantage. As a microcosm, or a lab, potential solutions to real-world problems can be tested on a small scale without the pressure of real-world consequences. Sustainable landscaping initiatives are potential solutions to real-world problems, and as an institution of higher education, Skidmore has the not just the opportunity to implement these changes, but the responsibility to do so.

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Glossary:

Aesthetic: The subjective perceptions of a visual appearance by a given individual or group. That could elicit emotion.

Biomimicry: A principle of design that seeks to emulate the naturally occurring functions of ecosystems.

Developed (Development): An anthropocentric alteration to an environment (i.e. buildings).

Ecosystems: A biological community where organisms interact with each other and their physical environment.

Edible landscaping design: landscape designs that utilizes plants that can be consumed.

Environment: All external factors surrounding and affecting an organism at any time.

Green Space: any open piece of land that is vegetated and "undeveloped" (see definition of "developed").

Indigenous: Indigenous species are species that reside in the area from which they originated; "indigenous" is more specific than "native," which takes a broader view.

Invasive: Species that are not indigenous to an area in which they currently thrive and compete with plants that are.

Landscapes: Forman and Godron (1986) define "landscape" as a "heterogeneous land area composed of a cluster of ecosystems that is repeated in similar form throughout."

Landscaping: The alteration of the appearance and/or function of a landscape.

Monoculture: a type of cultivation that uses only one specific plant variety for a certain acreage; this method is susceptible to disease and climate changes, but is very popular in agriculture where it is used to produce high yields of a single crop.

Native: "Native species" is used when discussing indigenous on a broader, regional scale (i.e. the United States, or the Northeastern states) and can include hybrid varieties.

Nature: The concept of an environment completely without anthropogenic effects.

Organic: ecologically based practices such as cultural and biological pest management, exclusion of all synthetic chemicals, antibiotics, and hormones in crop and livestock production.

Permaculture: A design science that's rooted in the observation of natural systems and biomimicry, used to add the stability and resiliency of the natural ecosystem to all forms life and life cycles.

Stormwater management: a variety of landscaping methods designed to negate the harmful

impacts of stormwater runoff; some of these methods include bioretention ponds, catchment basins, riparian buffer zones, vegetated swales or bioswales, terracing, rain gardens, etc.

Sustainable: "provides equitable opportunities for satisfying livelihoods and a safe, healthy, high quality of life for current and future generations" (Hodas, 1998).

Sustainable Development: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
— from the World Commission on Environment and Development's (the Brundtland Commission) report *Our Common Future* (World Commission on Environment and Development, 1987).

Sustainable Landscaping: A method of landscape design intended to invoke naturally-occurring biological processes in order to provide long term viability of the surrounding environment for social, economic, and ecological benefits.

Xeriscaping: A method of landscaping designed around principles of water-efficiency, advocating the use of plants that negate, or at least reduce, the use of water; many xeriscaping plants are indigenous to the areas they are most useful for, however that is not a restriction of xeriscaping; xeriscaping could be considered a method of stormwater management.

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Appendix A: Other Institutions

Figure 1: Green to Green Scale

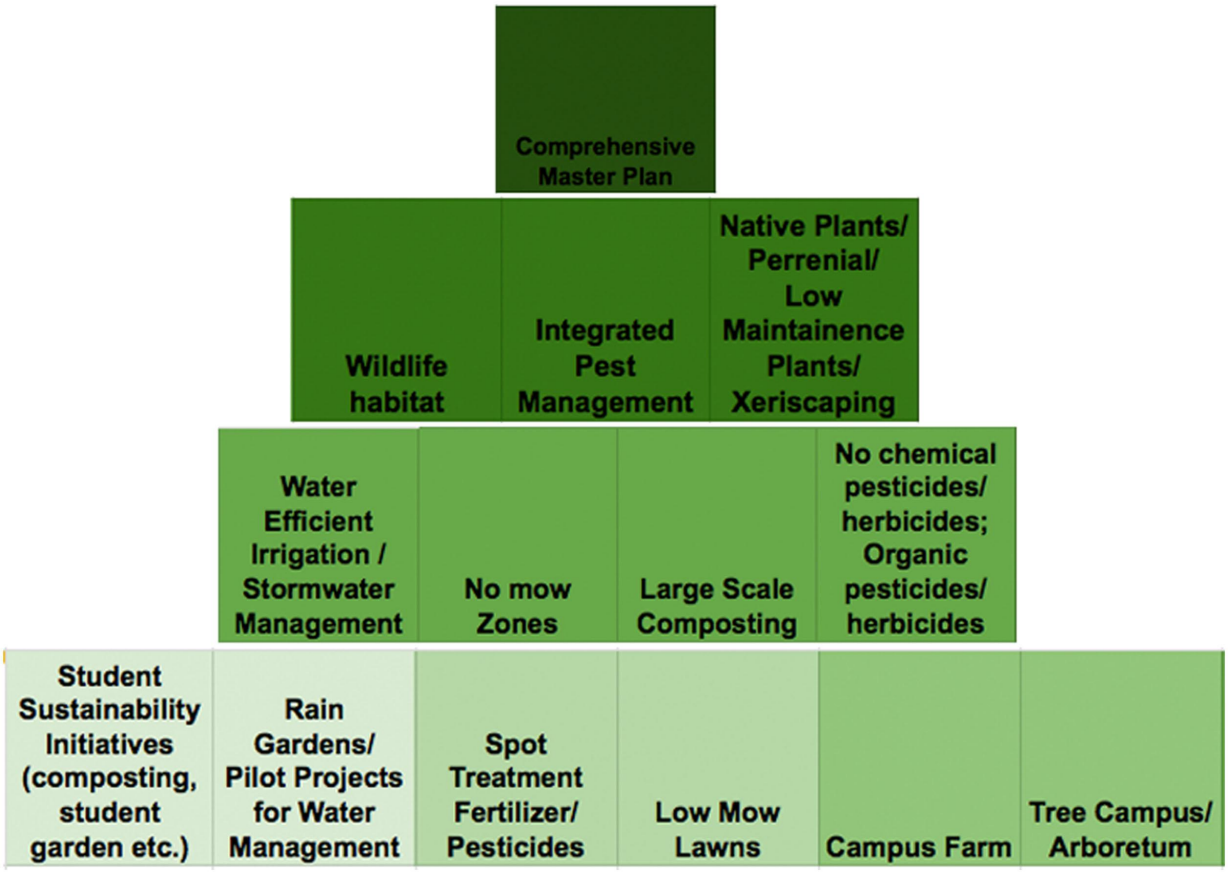


Table 1: Interview Questions for Other Institutions

1. What sustainable landscaping initiatives have been implemented at your institution?

2. Which efforts have been the most successful? Have the efforts had a significant impact on the college? (in terms of economic, social and environmental effects) What initiatives have been most well received by the students? academic departments/professors? facilities/grounds/landscaping crews? the administration?

3.What have been major obstacles or failures? Are there things that you would have liked to achieve that you didn't? What were the 2 biggest failures?

4. Who/what were the motivating factors for this change? Who implemented the changes? (students, administration, faculty, facilities?) Was there a particular deciding factor? (e.g. economics, or grounds crew getting on board etc.) How important were economic, social (educational), environmental factors?

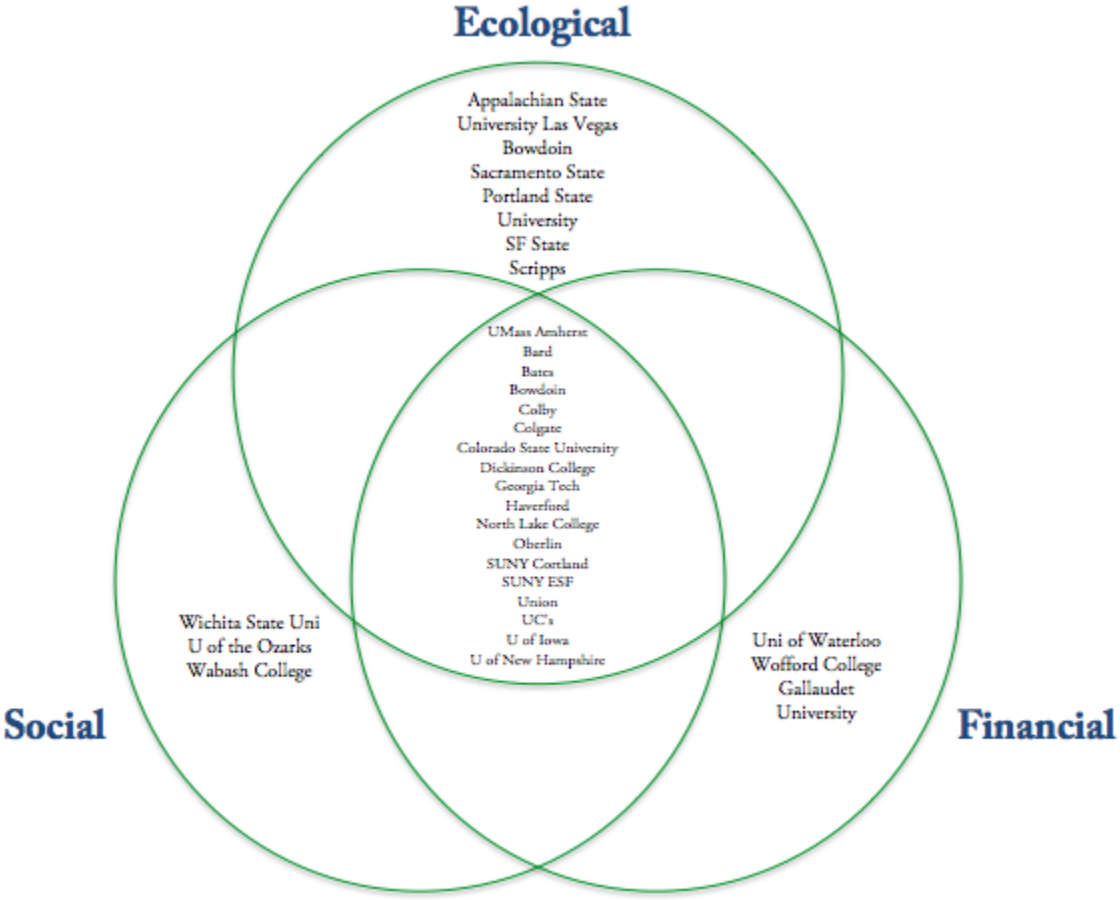
5. Where did you learn the information you needed to make this happen? What outside resources/organizations were important? How important were outside consultants etc?

6. What are 1 or 2 things you would like to do in the future? Do you have goals for these projects for 5-10 years in the future?

7. Have you thought about no mow zones/no pesticides/native plant landscaping etc.?

8. What would you recommend for other schools trying to change institutional practices to be more sustainable?

Figure 2: Motivations for Adopting Sustainable Landscaping Practices



Appendix B: Skidmore

Figure 1: Map of Land Coverage in Campus Proper

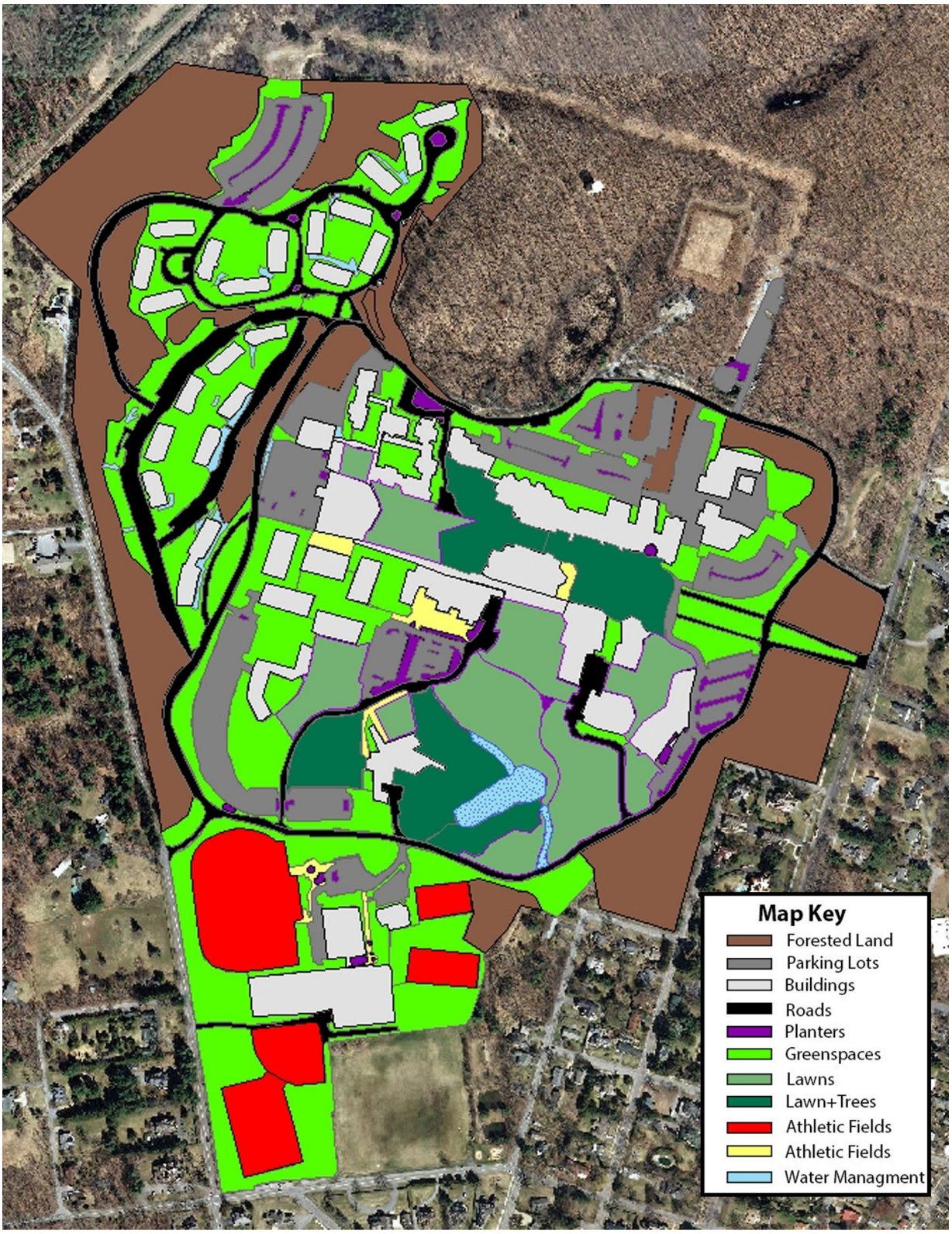


Table 1: Spreadsheet for Facilities

		Quantity	Units	Cost/Unit	Upfront Costs	Wages	Environmental Costs	Totals
Lawncare								
Mowing			hours					
	Known fuel consumption per hour		gallons					
	List equipment used							
	1		hours					
	2		hours					
	3		hours					
Aerating or Thatching			hours					
	Known fuel consumption per hour		gallons					
	List equipment							
	1		hours					
	2		hours					
	3		hours					
Leaf Removal			hours					
	Known fuel consumption per hour		gallons					
	List equipment							
	1		hours					
	2		hours					
	3		hours					
Watering			hours					
			gallons					
Plantings								
Tree & Shrub Care			hours					
	Known fuel consumption per hour		gallons					
	List equipment							
	1		hours					
	2		hours					
	3		hours					
Flower Bed Maintenance			hours					
	1							
	2							
	3							
Annual Plantings			hours					
	Annual cash expense		dollars					
	Watering		gallons					
			hours					
Pesticides & Fertilizers								
Lawn Applications			hours					
	Type pesticide and fertilizer							
	1		lbs					
	2		lbs					
	3		lbs					
	4		lbs					
	5		lbs					
Perennial Garden Bed Applications			hours					
	Type pesticide and fertilizer							
	1		lbs					
	2		lbs					
	3		lbs					
	4		lbs					
	5		lbs					

Tree and Shrub Application			hours					
	Type pesticide and fertilizer							
	1		hours					
	2		gallons					
	3		hours					
	4		hours					
	5		hours					
Waste								
Material Generated			lbs					
	Portion as grass clippings							
	Portion as leaf litter							

Table 2: Interview Questions for Dan Rodecker and Dave Nicholson

Find out who has responsibility for:
a. maintaining the landscape
b. designing the landscape
c. division of responsibilities

1. Can you explain exactly what the department does and what its exact responsibilities are?
2. What is the hierarchy within the department?
3. How many groundskeepers do you have?
4. What are the various duties and responsibilities of individual groundskeepers?

Grand Tour question

1. What does a year of landscaping look like?
2. What do you do each calendar month?
3. How do things work seasonally?
4. Is there a calendar? For planting? For landscape maintenance?

Design Questions

1. Are your landscaping decisions influenced by aesthetics, economics, or from somewhere else (possibly administration, donors, architects, etc?)
2. Who designs your landscaping like gardens, flower beds, etc?
3. Who decides to put flowers in X places?
4. Who decided on the landscaping for the Sussman Village, etc.
5. Are landscape architects or designers involved? Is anyone on staff a landscape designer/architects?
6. Is there a future design vision for Skidmore's landscape or any plans for major change?

Maintenance Questions

1. How much time, energy, and effort you put into maintaining the landscape?
2. What would you say is the most challenging aspect of landscaping?
3. What would you say requires the most time in landscape maintenance? How are the groundskeepers' time allocated?
4. (Using map) Can you identify the highest areas of maintenance on the Skidmore campus, as far as green space (i.e. lawns, beds) goes?

5. How much time is spent in plant care (i.e. tree, shrub, & bed maintenance)?
6. How many hours are dedicated to mowing per day? What kind of equipment do you use?
7. How many hours are dedicated to leaf removal? What kind of equipment do you use?
8. How much fuel is consumed per hour? Week?
9. What are your annual, bi-annual, monthly fuel costs?
10. How many hours are spent watering?
11. How much water is used?
12. Do you use fertilizers? What kind of fertilizer do you use? Why do you use fertilizers?
13. How much fertilizer is used and how many hours are spent applying it? Where are fertilizers used (use map)? How is it used (describe process)?
14. Do you use pesticides? What kinds? Why (what are the purposes)?
15. If you don't use pesticides, why not?
16. How much pesticide is used and how many hours are spent in application? Where are pesticides used on campus (use map)? How are pesticides used (describe process)?
17. (List waste byproducts?) What do you do with your waste byproducts like grass clippings and leaf litter?
18. At what height do you mow the grass?

Table 2: Questions for Groundskeeper Focus

1) On an average work day, how are your hours spent?

2) Where do you spend most of your time working on campus?

3) What are your favorite areas to work on?

4) What areas require the most amount of maintenance?

5) What areas are the least maintained?

6) What are the easiest areas to maintain? (may be the same answer as above or not)

7) What areas are the most difficult to maintain and why?

8) Are there areas of campus that are heavily maintained and rarely used?

9) What would you change about your job or about Skidmore's landscaping practices if anything? Is there anything you wish you didn't have to do? Or anything you wish you could do while maintaining skidmores landscape?

10) Do you think that there is a uniform aesthetic on campus? Could you define or describe it?

11) Do you ever get feedback from the Greater Skidmore community or even the saratoga community?

12) What feedback do you get from your bosses at facilities, what kind of things do you see them most concerned with?

13) Do you feel like you have a say in Skidmore's landscaping practices?

Table 4: Interview questions for Karen Kellogg, Kim Marsella and Sue Van Hook

1) What is the history of sustainability at skidmore?

2) What major changes have occurred in landscaping practices? What were the motivating factors?

3) What were the most influential projects? How did they come about? Who maintains them now?

4) What projects have been failures or less effective?

5) What is the role of CEC? Sustainability office? Admin? Admissions? Faculty?

6) Does Skidmore see sustainability as a selling point?

7) How do you get stakeholders interested in these projects? How do you convince them?

Table 5: Facilities Fuel Usage

Grounds Fuel			
Date Purchased	Vendor	Description	Gallons
1/16/13	Ray Energy	Midgrade Ethanol Gasoline	102.2
3/13/13	Ray Energy	Midgrade Ethanol Gasoline	141.9
4/10/13	Ray Energy	Midgrade Ethanol Gasoline	85.4
5/31/13	Ray Energy	Midgrade Ethanol Gasoline	254.0
6/4/13	Ray Energy	Midgrade Ethanol Gasoline	182.0
6/18/13	Ray Energy	Midgrade Ethanol Gasoline	154.0
7/2/13	Ray Energy	Midgrade Ethanol Gasoline	170.5
7/17/13	Ray Energy	Midgrade Ethanol Gasoline	172.8
7/30/13	Ray Energy	Midgrade Ethanol Gasoline	104.6
8/14/13	Ray Energy	Midgrade Ethanol Gasoline	138.9
9/12/13	Ray Energy	Midgrade Ethanol Gasoline	260.6
9/26/13	Ray Energy	Midgrade Ethanol Gasoline	108.3
10/23/13	Ray Energy	Midgrade Ethanol Gasoline	353.4
11/5/13	Ray Energy	Regular Ethanol Gasoline	184.0
11/20/13	Ray Energy	Regular Ethanol Gasoline	229.1
12/11/13	Ray Energy	Regular Ethanol Gasoline	105.1
12/24/13	Ray Energy	Regular Ethanol Gasoline	95.0
		Total Gasoline	2,841.8
3/19/13	John Ray and Sons	ULSD-Dyed 15ppm	500.2
5/13/13	John Ray and Sons	ULSD-Dyed 15ppm	346.1
6/19/13	John Ray and Sons	ULSD-Dyed 15ppm	286.7
7/10/13	John Ray and Sons	ULSD-Dyed 15ppm	87.8
9/5/13	John Ray and Sons	ULSD-Dyed 15ppm	306.9
11/6/13	John Ray and Sons	ULSD-Dyed 15ppm	315.4
12/12/13	John Ray and Sons	Winterized ULSD-Dyed 15ppm	261.2
12/19/13	John Ray and Sons	Winterized ULSD-Dyed 15ppm	183.1
		Total Diesel	2,287.4

Table 6: Facilities Fertilizer Usage

Fertilizer			
Date Purchased	**Vendor**	**Description**	**Weight**
4/27/13	John Deere Landscapes	PRE-M 0.86% 19-0-11 30% Polyplus	300
5/20/13	John Deere Landscapes	28-0-12 50% Polyplus 3Fe	250
9/25/13	John Deere Landscapes	32-0-3 20% Polyplus Mop 1Fe	2,000
4/4/13	Agrium Advanced Tech.	SIG 25XCU 28-00-05 STD	6,000
4/25/13	Agrium Advanced Tech.	SIG 50XCU 30-00-05 STD	4,000
4/25/13	Agrium Advanced Tech.	SIG 25XCU .10DIM 18-00-00 STD	2,000
		Total Fertilizer	14,550

Appendix C: Recommendations

Table 1: Planting List

Botanical Name	Common Name
Groundcovers	
Arctostaphylos uva-ursi	**Bearberry**
Asarum candense	**Wild ginger**
Athyrium filix-femina	**Lady fern**
Coreopsis rosea	**Rose coreopsis**
Dennstaedtia punctiloba	**Hayscented fern**
Fragaria virginiana	**Wild strawberry**
Gaultheria procumbens	**Wintergreen**
Mitchella repens	**Partridgeberry**
Phlox divaricata	**Woodland phlox**
Perennial Wildflowers	
Actaea rubra	**Red baneberry**
Agastache foeniculum	**Lavender hyssop**
Allium cernuum	**Nodding pink onion**
Aquilegia canadensis	**Wild columbine**
Aruncus dioicus	**Goatsbeard**
Asclepias incarnata	**Swamp milkweed**
Asclepias tuberosa	**Butterflyweed**
Aster azureas	**Sky blue aster**
Aster divicaratus	**White woodland aster**
Aster macrophyllus	**Big lead aster**
Aster novae-angliae	**New England aster**
Dalea candida	**White prairie clover**
Dalea purpurea	**Purple prairie clover**
Echinacea purpurea	**Purple coneflower**
Eupatorium coelestinum	**Mistflower**
Eupatorium perfoliatum	**Boneset**
Eupatorium purpureum	**Joe-pye weed**
Liatris aspera	**Rough blazingstar**

Liatris pycnostachya	**Prairie blazingstar**
Mertensia virginica	**Virginia bluebells**
Monarda didyma	**Bee balm**
Monarda fistulosa	**Wild bergamot**
Polemenium reptans	**Jacob's ladder**
Rudbeckia fulgida	**Orange coneflower**
Rudbeckia triloba	**Brown-eyed susan**
Spigelia marilandica	**Indian pink**
Solidago flexicaulis	**Zigzag goldenrod**
Solidago odora	**Anise-scented goldenrod**
Solidago speciosa	**Showy goldenrod**
Verbena hastata	**Blue vervain**
Vernonia altissima	**Tall ironweed**
Vernonia fasciculata	**Ironweed**
Vernonicastrum virginicum	**Culver's root**
Grasses, Sedges, & Vines	
Adiantum pedatum	**Maidenhair fern**
Carex pennsylvanica	**Pennsylvania sedge**
Clematis virginian	**Virgin's bower**
Deschampsia sespitosa	**Tufted hairgrass**
Eragrostis spectabilis	**Purple lovegrass**
Lonicera sempervirens	**Trumpet honeysuckle**
Panicum virgatum	**Switchgrass**
Parthenocissus quinquefolia	**Virginia creeper**
Rosa sertiga	**Climbing prairie rose**
Schizachyrium scoparium	**Little bluestem**
Sorghastrum nutans	**Indiangrass**
Sporobolus heterolepis	**Prairie dropseed**
Shrubs & Small Trees	
Aronia melanocarpa	**Black chokeberry**
Ceanothus americanus	**New Jersey tea**
Cephalanthus occidentalis	**Buttonbush**
Cornus amomum	**Silky dogwood**

Cornus racemosa	**Gray dogwood**
Cornus rugosa	**Roundleaf dogwood**
Cornus sericea (stolonifera)	**Red-osier dogwood**
Corylus americana	**American hazelnut**
Diervilla lonicera	**Dwarf bush-honeysuckle**
Gaylussacia baccata	**Black huckleberry**
Hydrangea quercifolia	**Oakleaf hydrangea**
Hypericum kalmianum	**Kalm St. Johnswort**
Ilex glabra	**Inkberry**
Ilex verticillata	**Winterberry holly**
Juniperus communis	**Common juniper**
Kalmia latifolia	**Mountain laurel**
Lindera benzoin	**Common spicebush**
Myrica pensylvanica	**Northern bayberry**
Nemopanthus mucronata	**Mountain holly**
Rhodendron maximum	**Rosebay rhododendron**
Rhodendron prinophyllum	**Roseshell azalea**
Rhododendron vaseyi	**Pinkshell azalea**
Rhodendron viscosum	**Swamp azalea**
Rhus copallina	**Shining sumac; Winged sumac**
Rosa carolina	**Pasture rose**
Rosa palustris	**Swamp rose**
Rosa virginiana	**Virginia rose**
Sambucus canadense	**Common elderberry**
Spirea alba car. latifolia	**Meadowsweet**
Spirea tomentosum	**Steeplebush spirea**
Symphoricarpos albus	**Snowberry**
Vaccinium angustifolium	**Lowbrush blueberry**
Vaccinium corymbosum	**Highbrush blueberry**
Viburnum lentago	**Nannyberry viburnum**
Viburnum trilobum	**American cranberrybush; High bush cranberry**
Trees	
Abies balsamea	**Balsam fir**

Acer pensylvanica	**Striped maple**
Acer rubrum	**Red maple**
Acer saccharinum	**Silver maple**
Acer saccarum	**Sugar maple**
Amelanchier arborea	**Downy serviceberry**
Amelanchier canadensis	**Shadblow serviceberry**
Amelanchier laevis	**Allegheny serviceberry**
Amelanchier x. grandiflora	**Serviceberry**
Betula alleghaniensis	**Yellow birch**
Betula lenta	**Black birch**
Betula nigra	**River birch**
Betula papyriferus	**Paper birch**
Carya glabra	**Pignut hickory**
Carya ovata	**Shagbark hickory**
Chamaecyparis thyoides	**Atlantic white cedar**
Cornus alternifolia	**Pagoda dogwood**
Cornus florida	**Eastern flowering dogwood**
Fagus grandifolia	**Beech**
Fraxinus nigra	**Black ash**
Fraxinus pensylvanica	**Green ash**
Gingko biloba	**Gingko**
Hamamelis virginiana	**Common witchhazel**
Juniperus virginiana	**Eastern red cedar**
Larix laricina	**American larch**
Magnolia virginiana	**Sweetbay magnolia**
Picea mariana	**Black spruce**
Platanus occidentalis	**American sycamore**
Prunus pensylvanica	**Pin or Fire Cherry**
Quercus bicolor	**Swamp white oak**
Quercus illicifolia	**Scrub oak**
Quercus palustrus	**Pin oak**
Quercus rubra	**Red oak**
Rhododendron arborescens	**Sweet azalea**
Salix discolor	**Pussy willow**
Salix nigra	**Black willow**
Sorbus americana	**American mountain ash**

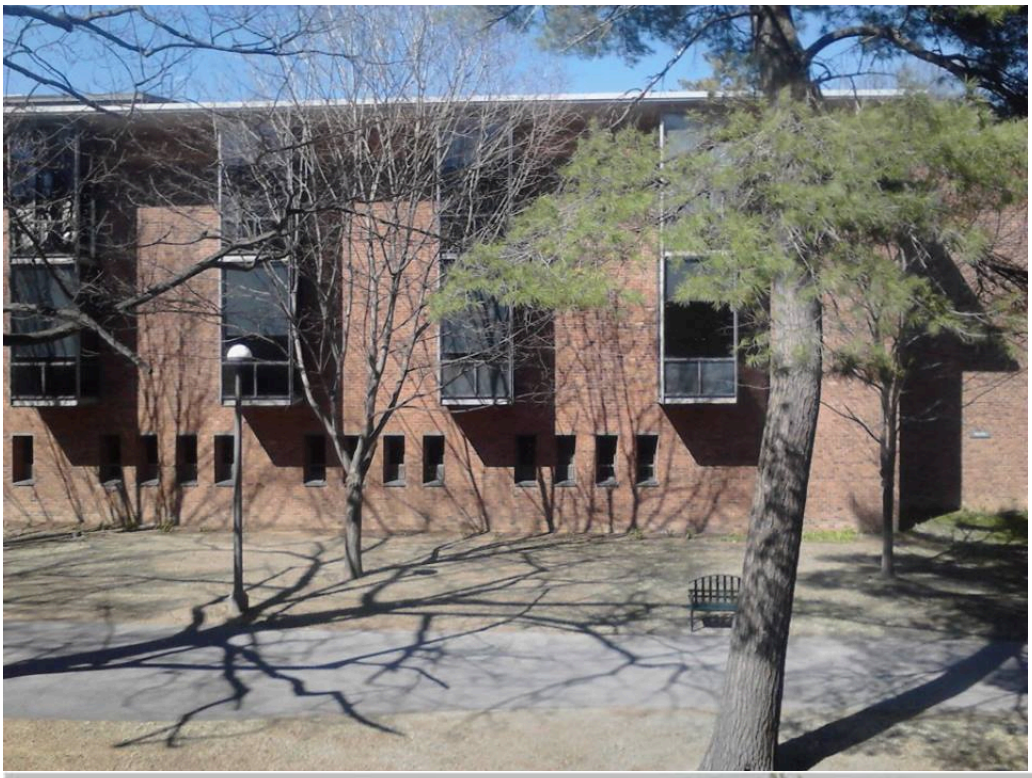
Sorbus decor	**Showy mountain ash**
Thuja occidentalis	**Eastern arborvitae**
Tilia americana	**Basswood**
Tsuga canadensis	**Hemlock**

Table 2: List of Beneficial Non-Native Plant Qualities

Non-Native Plants Utilized in the Landscape should have one or more of these beneficial qualities:

- ★ Accumulate Nutrients
- ★ Fix Nitrogen
- ★ Protect against Disease
- ★ Attract Beneficial Insects such as Pollinators
- ★ Provide Habitat for Wildlife
- ★ Remediate Pollution
- ★ Prevent Erosion
- ★ Edible
- ★ Medicinal
- ★ Historical/Cultural Value

Figure 1: Bolton Lawn Before and After



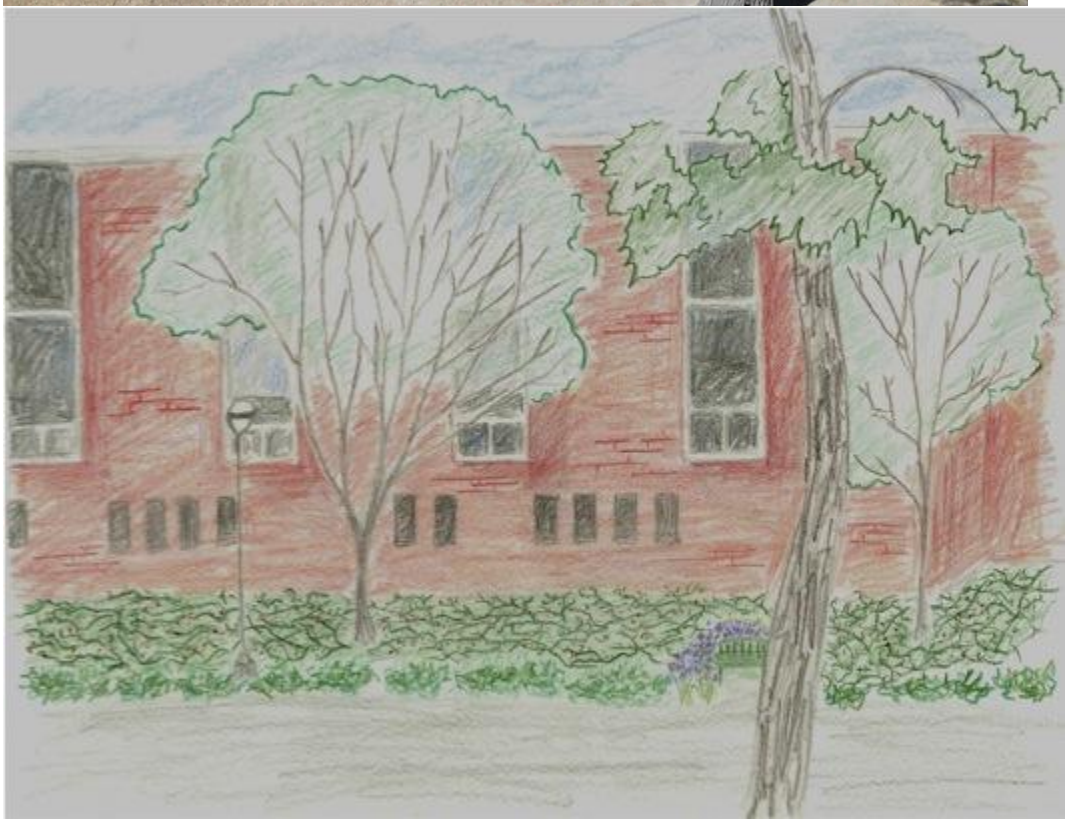


Figure 2: Case Walkway Before and After

Figure 3: Case Parking Lot Before and After

Figure 4: Haupt Pond Before and After

Further Reading:

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