ABSTRACT

The amount of accessible natural resources is dwindling and water could be the next world crisis. One response to this issue is the creation of methodologies which evaluate sustainability of new land development. A system to address the issues is the Sustainable Sites Initiative. This method was created in 2009 by the American Society of Landscape Architects, the Lady Bird Johnson Wildflower Center, and the United States Botanic Garden. Their primary goal was to create a metric for rating development to encourage a more sustainable approach. A piece of this evaluation is water management. Landscape architecture is poised to address the growing issues of a dwindling potable water supply. Landscape architects are uniquely trained to address the issues of water through alternative, more sustainable stormwater management. Improved stormwater management methods will decrease the amount of excessive potable water used by encouraging stormwater recycling and decreasing the amount of water processed in municipality’s water treatment facilities.

The purpose of this study is to evaluate the stormwater content of landscape architecture curricula throughout the Southeastern Conference (SEC), with reference to the stormwater management criteria of the Sustainable Sites Initiative. There were two primary questions to accomplish the study’s purpose. First, is it possible to align the SITES stormwater criteria to pedagogical goals and concepts? Second, how do the pedagogical goals drawn from SITES align with the stormwater curricula of schools in the SEC?

There are eight accredited departments that teach landscape architecture in the SEC, and one who is currently pursuing accreditation. Of these nine schools seven responded to a request for course syllabi and project statements from classes covering
stormwater management. The principles and techniques taught in these courses were compared to the Sustainable Sites water-related criteria. Six of the seven schools introduced sustainability and alternative stormwater methods. Some schools addressed the techniques and principles in more depth than others. Both of the research questions were answered in this study. A comprehensive pedagogical concept conversion table was created that successfully converts the Sustainable Sites water criteria into teachable concepts. This chart was compared to the stormwater curriculum and yielded positive results. Six schools introduce alternative stormwater techniques, and all of these schools teach at least some form of alternative techniques. This research provides a valid foundation for future research. Some improvements to the research methods and a broadening of the material surveyed would address some of the concerns discussed in the conclusion.
A Critical Examination of the Stormwater Education, based on SITES parameters, in Landscape Architecture Departments in the SEC

A thesis submitted in partial fulfillment of the requirements of the Honors Program of the Department of Landscape Architecture in the Fay Jones School of Architecture, University of Arkansas

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CHAPTER ONE: INTRODUCTION

The Environmental Protection Agency, or EPA, reports that at least 36 states will be facing water shortages by this year, 2013.¹ Water conservation is not a new idea, but it has become increasingly popular over the last few years. Alternative stormwater management is one approach to water conservation. Stormwater is rainwater and melted snow that runs off streets, lawns, and other sites.² In an undisturbed environment, rain and snow-melt will percolate into the soil. Once in the soil, it is filtered and recharges groundwater systems. Unabsorbed water drains, collects, and flows into streams and rivers. When a site is developed, this natural system of infiltration is broken by impervious cover such as roofs and pavement. Water is not allowed to percolate into the soil; it is collected by drains or swales and is transported off-site. This approach to stormwater management, the idea of purging the site of stormwater, is not a sustainable, long-term option. Water is an important resource that is necessary for all forms of life. Potable water is becoming scarce, while the demand is increasing. Water conservation is becoming, and some argue it already is, one of the most important problems of the 21st century.³

The idea of water conservation, as seen through the lens of the Sustainable Sites Initiative program, deals primarily with stormwater management. The Sustainable Sites

¹ Environmental Protection Agency
² Environmental Protection Agency
³ Pearce
Initiative (SITES) is “a system of guidelines and performance benchmarks” that evaluates the sustainability of site development.4 This system is a part of the “green” movement. This movement started in the 1960s and 1970, but it has returned to the forefront in the past 25 years. The SITES system evaluates projects based on a set of criteria. There are nine general categories that make up the SITES benchmarks. Points are awarded for complying with the information in each criterion and the sum of the points dictates the final score. One of the primary criteria is water. The Site Design—Water section addresses many of the issues mentioned in the previous paragraph, primarily the stewardship and proper practices of stormwater management. The SITES system recognizes the importance of water conservation and has included this idea as it relates to site development.

Landscape architects are poised to address the issues of water conservation in the form of stormwater management. “Landscape architects analyze, plan, design, manage, and nurture the natural and built environments.”5 A sustainable approach to stormwater tackles the natural and built environments and their interaction. Landscape architects are required to take an exam to obtain their license to practice. In this exam, the participants must be able to prepare stormwater management plans.6 Where does one obtain this knowledge? The logical answer is in school or some sort of on-the-job training like an internship or apprenticeship. There are different routes to become eligible to take the licensure exam; however, this study will focus on the applicants who hold a four or five year Landscape Architecture Accreditation Board (LAAB) or Landscape Architecture Accreditation Council (LAAC) accredited undergraduate or graduate degree.

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4 The Sustainable Sites Initiative: Guidelines and Performance Benchmarks 2009
5 American Society of Landscape Architects
6 Council of Landscape Architectural Registration Boards’ Eligibility Requirements
in landscape architecture. This study will examine the education in stormwater management in the accredited schools in the Southeastern Conference.

The purpose of this study is to evaluate the content of stormwater training in these schools with issues addressed in the SITES criteria. This assessment aims to compare the knowledge acquired by a new graduate to the knowledge required to be adept in the SITES system. The expectation of this study is to determine if students are taught the information and skills necessary to succeed within the SITES parameters.
CHAPTER 2: LITERATURE REVIEW – UNDERSTANDING THE NEED FOR CHANGE

“Landscape architecture is a professional design discipline that, in the broadest sense, deals with integrating people and the outdoor environment in a manner beneficial to both.”7 This definition given by Norman Booth in his book, Basic Elements of Landscape Architectural Design, adequately defines the profession as a whole. This definition encompasses all areas of landscape architecture from large-scale urban planning to the intimate garden design. This literature review introduces current events that illustrate the need for change in stormwater management methods and practices. Then, landscape architecture’s role in the improvement of stormwater management will be discussed, specifically how landscape architects are trained and able to address these growing problems. The governing bodies of landscape architecture will be introduced to explain how the current curricula are tied to the requirements for school accreditation and professional licensure. Finally, the Sustainable Sites Initiative and its approach to water conservation will be discussed. This review will explain the primary factors that frame the discussion on the current landscape architecture stormwater curriculum as it relates to the Sustainable Sites Initiative.

WATER, ESSENTIAL FOR LIFE

Food, water and shelter are necessary for survival. This old adage perfectly describes why water is one of the most important resources in the world. With the US population doubling over the past 50 years, our thirst for water tripling, and at least 36 states facing water shortages by 2013 the need to conserve water is becoming more and

7 Booth ix
more critical.⁸ However, water is undervalued, and often treated as waste. “In most cities and towns around the country, rainfall is treated as waste, to be funneled directly from roof gutters to sewers...this stormwater flows...to water treatment plants, thus raising the cost of purifying drinking water.”⁹ In Fred Pearce’s book, titled *When the Rivers Run Dry*, he discusses the global water shortage and its effects. He states that water will be, or is, the defining crisis of the 21st century in what he calls the “blue revolution”.¹⁰ Pearce’s predictions are illustrated in the following news articles.

In a CNN article from July 17, 2012 the National Climatic Data Center’s report describes “the largest drought since the 1950s.”¹¹ According to the Center, “about 55% of the country was in at least a moderate short-term drought in June [2012] for the first time since December 1956.”¹² The drought affected almost all of the Southeastern United States and some parts of the plains states. During the 1956 drought, crop yields dropped by as much as 50 percent which shook the economy and drove food prices up drastically. This drought affected the Southeastern and Midwestern states, but the increase in food prices were felt across the nation. According to this report, these consequences could happen again.¹³ Cattle farmers have been forced to sell cattle because they cannot afford to feed them. Crop farmers have been forced to run irrigation, which comes from ground water and/or potable water sources, almost twice as often to keep plants alive. Twenty six states declared a disaster situation which caused many areas to ban residential irrigation and “just about every other non-

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⁸ U.S. Environmental Protection Agency
⁹ “The Case for Sustainable Landscapes” 14
¹⁰ Pearce 25
¹¹ Pearson
¹² Pearson
¹³ Pearson
essential use of water.”14 This article shows the drought conditions and its affect on farming and food production in the Southeastern and Midwest United States. This article only begins to scratch the surface of water problems in the Southeastern United States.

On Wednesday, August 22, 2012 CNN also reported on the traffic jam of barges along the Mississippi River. The river reached record lows and prevented barges carrying food and other goods from traveling North or South along one of the most important waterways in the US.15 There were nearly 115 vessels that were not allowed to pass through the Greenville, Mississippi area, which sees approximately 50 ships pass on an average day.16 The Army Corps of Engineers began dredging the area to deepen the river channel in order to aid navigation. The Coast Guard spokesman whom was interviewed for the article cited the flood conditions of 2011 as a contributing factor because of increased sediment deposits in the river channel “in areas that would normally be clear.”17

Jessica Seaman, of the Arkansas Democrat-Gazette, wrote a similar article on the same day describing the low-water conditions from a more local perspective. She interviewed farmers as well as an agent with the University of Arkansas System’s Agriculture Division. “‘With the river being so low, we are having trouble getting barges to full capacity so we are storing up in [grain] bins in the county,’” said Robert Goodson, from the University of Arkansas’s Agriculture Division, who oversees two counties in Arkansas.18 The primary concern was if the grain storage areas are filled with corn,

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14 Pearson
15 Sutton
16 Sutton
17 Sutton
18 Seaman
“what are we going to do with 215,000 acres of soybeans” that were ready for harvesting? The inability to ship grain will reduce the amount of grain available for export next year as well as drive up food costs in the future, according to Debra Colber, vice-president of Waterways Council, Inc. The drought has the potential to cause a major food shortage in the US, as well as hurt the import/export market in the future. These problems are linked to unsustainable stormwater and water management practices that are creating issues facing the Southeastern region of the United States.

Perhaps the most shocking story comes from ABC News. The article, titled “Water Wars in Drought-Ridden Southeast”, discusses the battle between Alabama, Georgia, and Florida over rights to the water of two river systems. According to the article, “the Supreme Court may be forced to settle the matter.” Florida is concerned that increased use of the water systems by Alabama and Georgia will damage a nature preserve in the state. The preserve, Apalachicola Bay, “produces 70 percent of the state’s [Florida's] oysters. Changing the water supply to the bay could have devastating effects on the industry, jobs, and economy in Florida. The river systems have been deemed “among the most bio-diverse freshwater systems in the country... [and] fifth on its [American Rivers, an environmental organization] list of most endangered rivers in the nation.” Georgia wants to access the water for urban supply, farming irrigation, hydroelectric power, and lake levels which serve as drought reserves and recreation
facilities. Alabama claims to need the water for future economic and population growth.  

All three states have legitimate claims to the water because it runs through or along their borders, all want the water for justifiable reasons and all three states are suffering from the drought mentioned in the CNN article. All three states have also imposed major water use restrictions to help combat the issue. States have even considered shifting their borders to help their case for rights. If the problem is not resolved soon, the issue will be sent to the Supreme Court, almost guaranteeing years of negotiations and prolonged uncertainty in the region.

These four articles present current issues affecting the Southeastern United States, and these articles only scratch the surface. Last year there were rampant wildfire problems in Texas. Some of the problems as a result of Hurricane Katrina in 2005 can also be attributed to the current water situations and a lack of stormwater management in the region. These sorts of issues are daily hardships for western states, but “the same issues are now affecting states which once took their water supplies for granted.” Many of these issues can all be attributed to a lack of sustainable stormwater management.

**The Cost of Unsustainable Water Management**

A conventional stormwater management strategy treats runoff as a waste product. It is seen as something to be hidden in an underground pipe system, and to be removed from the site quickly. This idea is rooted in logic; excess water will pool,
inhibiting pedestrian and vehicular traffic, as well as posing a threat to flood buildings. However, this idea causes many problems.

One of the difficulties with unsustainable water management is the high monetary costs. “Municipal water—and wastewater—treatment facilities account for up to 50% of the electricity consumed by city governments in the US.” When stormwater is dumped into the waste water systems, there is more water to be processed, increasing costs. With the current state of the federal government’s budget deficit and the struggling economy, the money spent to clean water could be put into reducing the need for water treatment plants, eventually freeing that money for other uses. The use of sustainable development strategies, such as bioswales and raingardens, to reduce water runoff not only encourages infiltration and recharges groundwater but also can reduce costs for developers from 15-80 percent. This savings is then passed on to municipalities because there is less water being dumped into the system for cleaning, which results in lower costs of electricity at water treatment facilities. For example, “a study by the U.S. Environmental Protection Agency found that a 2,500 acre wetland in Georgia saves $1 million in water pollution abatement costs each year.” Lowering the amount of water needing treatment consequently lowers energy costs.

There are also costs that are not easily quantified. Water provides opportunities for restorative experiences and reflection. These activities promote healing, stress reduction, and work productivity. These social benefits are not easily quantified in monetary values. In the book *Last Child in the Woods*, by Richard Louv, nature and water are described as a “natural antibiotic.” They can effect stress and improve physical and

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27 Lawrence Berkeley National Laboratory Water Energy Technology Team
28 “The Case for Sustainable Landscapes” 6
29 U.S. Environmental Protection Agency “Wetland Functions and Values”
30 TR Herzon, AM Black, KA Fountaine, & DJ Knots
There is also no easy way to quantify the impact on the quality of life. For example, a city with zero parks, trees, flowers, or any form of vegetation would be thought of by most not an ideal place to live. People need these elements to live happily. One example of this idea is found in “Health Benefits of Gardens in Hospitals” by Roger S. Ulrich. He states that “several studies of non-patient groups...have consistently shown that simply looking at environments dominated by greenery, flowers, or water is effective in promoting recovery from stress.”

During the Industrial Revolution, when Frederick Law Olmsted designed Central Park, the city of New York recognized this problem and commissioned the park to be built.

It is also difficult to create direct cost comparisons between conventional stormwater management projects and sustainable stormwater management projects because the use of sustainable practices and sustainable rating systems is still new.

There are not many projects completed that can be evaluated, analyzed, then compared to projects without such practices. However, there are some case studies being conducted as the SITES system is being used as a design metric. The information garnered from the pilot SITES projects is still very new and not verified through repetition.

The environment also suffers when water is mismanaged. “Around the country, polluted and contaminated stormwater runoff accounts for 70 percent of water pollution in urban areas and is the leading cause of poor water quality and the degradation of aquatic habitat.”

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31 Louv 161
32 Ulrich 3
33 Rogers 348
34 “The Case for Sustainable Landscapes” 21
35 Loizeaux-Bennet “Stormwater and Nonpoint-Source Runoff” (cited in “The Case For Sustainable Landscapes” 16)
cleaned before entering the natural systems can contain heavy metals, sediment, debris, trash, oil, and other toxins. A primary source of toxins is fertilizer. Fertilizer is applied to lawns and crops to help them grow but it can also leech into the soil, and eventually into groundwater and pollute the water system. Irrigation can be a leading cause of unnecessary runoff. “Irrigation of unsustainable landscapes accounts for more than one third of residential water use—more than 7 billion gallons of potable water per day nationwide.”36 Not only is potable water being used, but many irrigation systems run too often. The ground cannot absorb the amount of water applied to it which also increases runoff. In conventional irrigation systems, half of irrigation water can be wasted as a result of evaporation, wind, improper system design, and overwatering.37 Irrigating lawns and other unsustainable landscapes with potable water is a primary misuse of water.

Erosion is another source of pollution. There are many ways for erosion to occur: slopes are too steep, vegetation is not properly planted to hold soil in place, and more. Erosion adds sediment to stormwater systems, natural or man-made, and can cause major problems. Increased sediment in pipes can cause clogs, while more sediment in streams increased turbidity. High sediment volumes lower visibility in the water and can negatively affect oxygen levels. These affects lower the ability of that ecosystem to support all forms of life, thus reducing the ecological benefits provided.38 An example of turbid water caused by erosion can be seen in Figure 2-1.

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36 U.S Environmental Protection Agency “Outdoor Water Use in the United States”
37 U.S Environmental Protection Agency “Outdoor Water Use in the United States”
38 “The Case for Sustainable Landscapes” 8
Figure 2-1: The drainage in this swale on the University of Arkansas campus is extremely turbid and erosion is threatening the integrity of the sidewalk.  

Water is an essential element to life. However, it is wasted in many ways using the current stormwater management systems and methods. Who is equipped to deal with such problems, suggest solutions, and then implement them?

**LANDSCAPE ARCHITECTURE’S ROLE**

Landscape architecture today, as defined by the American Society of Landscape Architects (ASLA), is the application of artistic, scientific, and technological principles to the research, planning, design, and management of both natural and built environments. According to Troy Erdman, landscape architects design aesthetic and

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39 Mark Boyer  
40 American Society of Landscape Architects
practical relationships to the land and address the changing needs of today’s society.41 Both of these definitions describe some of the roles that landscape architects can play in the professional world.

This study focuses on graduates from accredited landscape architecture programs. The accreditation process is conducted and overseen by the Landscape Architectural Accreditation Board (LAAB). Their mission is to “evaluate, advocate for, and advance the quality of education in landscape architecture programs.”42 The mission describes the intent of the LAAB. Many professions have these organizations. They are beneficial because they “evaluate all programs against standards that ensure the essential educational components leading to entry level professional competence.”43 This insures graduates graduate with what is deemed minimum competency, or relatively the same training.

The LAAB’s standards evaluate First-Professional Programs. A First-Professional Program “encompasses the body of knowledge common to the profession and promotes acquisition of knowledge and skills necessary to enter the professional practice of landscape architecture.”44 The goal of the program is to teach students the knowledge needed to be successful in the professional world. The LAAB has a very general set of curriculum requirements, one of which describe stormwater management: “Design, planning, and management at various scales and applications include but are not limited to pedestrian and vehicular circulation, grading drainage and storm water management.”45 This broad set of curriculum requirements does not specify methods or

41 Erdman
42 “Landscape Architectural Accreditation Board: Standards and Procedures” 1
43 “Landscape Architectural Accreditation Board: Standards and Procedures” 1
44 “Landscape Architectural Accreditation Board: Standards and Procedures” 1
45 “Landscape Architectural Accreditation Board: Standards and Procedures” 10
techniques required to teach stormwater management. The LAAB board does, however, show the importance of stormwater management by including it in their list of the required curriculum topics.

Another organization that drives curriculum decisions is the Council of Landscape Architectural Registration Boards, or CLARB. Their mission is “to foster the public health, safety, and welfare related to the use and protection of the natural and built environment affected by the practice of landscape architecture.” CLARB helps the state/provincial government agencies that regulate the landscape architectural profession through the enforcement of licensure laws that ensure consistency in competency of landscape architects and others involved in making decisions affecting the development and conservation of land.” One method to accomplish these goals is the establishment of the Landscape Architect Registration Examination, or L.A.R.E. This exam measures a graduate’s skills and knowledge to ensure they have the minimum competency required to practice landscape architecture without endangering the health, safety, and welfare of the general public.

The L.A.R.E. exam is broken into four sections, one of which focuses on grading, drainage and construction documentation. For this section, participants are required to prepare a stormwater management plan for a presented design problem. This stormwater plan is a piece of a larger section, but demonstrates the importance of stormwater management to landscape architects. These organizations and exams suggest the importance of stormwater management to the profession. This recurring

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46 Council of Landscape Architectural Registration Boards
47 Council of Landscape Architectural Registration Boards
48 Landscape Architecture Registration Examination (L.A.R.E.) Orientation Guide 8
theme of the importance of stormwater to landscape architects also hints that they should be well-suited to address concerns of improper stormwater management.

**THE SUSTAINABLE SITES INITIATIVE**

In the last 15 years, landscape architecture has responded to the social shift towards sustainable practices and development strategies. These resurgence of sustainable ideals initiated changes in thinking which led to a shift in the perceived responsibilities humans have to their environment. Some landscape architects have been practicing sustainability for forever, but now that there is public support and respect for the issue, these efforts have become more widely recognized. In response to this shift, the American Society of Landscape Architects, the Lady Bird Johnson Wildflower Center, the United States Botanic Garden, and other organizations developed a sustainable guideline system specific to landscape architecture. The Sustainable Sites Initiative, which was developed from 2005 to 2009, addresses the sustainability movement by creating a set of guidelines “that not only help the environment, but also enhance human health and well-being and is economically cost-effective.”

The first tangible definition of the word “sustainable”, as it applies to development, was created by the United Nations Commission on Economic Development in the “Brundtland Report.” This report defined sustainable development as “the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” This commission was the

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49 “The Case for Sustainable Landscapes”
50 WCED 8
catalyst for the beginnings of the green movement and sustainable rating systems. This movement addresses arguably one of the most important issues facing the global society as a whole. As resources, such as water and fossil fuels, have started to become scarcer, and consequently more expensive, the building industry in particular has begun to look for more efficient methods of building and developing.51

The Sustainable Sites Initiative is “designed to preserve or restore a site’s sustainability within the context of ecosystem services.”52 An ecosystem service is a concept based on the idea that healthy ecosystems provide beneficial goods and services to humans and other organisms.53 When a site is developed, the natural ecosystem services are harmed. This change causes the ecosystem to function differently and leads to fewer ecological benefits. The SITES goal is to prevent more ecosystem services from being lost because they cannot always be restored.

The initiative established guiding principles of a sustainable site. These principles are: do no harm, support a living process, precautionary process, use a systems thinking approach, design with nature and culture, use a collaborative and ethical approach, maintain integrity in leadership and research, use a decision-making hierarchy of preservation, conservation, and regeneration, and foster environmental stewardship.54 These principles address all three elements of sustainability: the environment, social issues, and economics. True sustainability does not exist unless all three areas are considered. This symbiotic relationship is shown in Figure 2-2.

51 Kilbert 20
52 “The Case for Sustainable Landscapes” 8
53 Daily 11
54 “The Case for Sustainable Landscapes” 9
“In view of the pressing need for an economy less reliant on fossil fuels and more attuned to potential climate change, the Sustainable Sites Initiative hopes to encourage land design, development, and management professionals to engage in a re-evaluation of conventional practices—and a new valuation of ecosystem services—so that built landscapes will support natural ecological functions throughout the life cycle of each site.”\textsuperscript{56} This statement takes the guiding principles and distills them into a practical and feasible goal which was used to form the developmental guidelines.

A set of criteria or benchmarks were created to evaluate the sustainability of development. This set of guidelines has five principle themes: soil, water, vegetation, materials, and human well-being.\textsuperscript{57} These five themes, derived from the guiding principles discussed earlier, were broken down into nine specific categories from site

\textsuperscript{55} “The Case for Sustainable Landscapes” 10
\textsuperscript{56} “The Case for Sustainable Landscapes” 10
\textsuperscript{57} Eisenman 48
selection to design to maintenance. Many of the ecosystem services create overlapping credits. For example, one ecosystem service is maintaining or enhancing the hydrologic cycle. Sustainable Sites is structured to promote site design techniques that protect, restore, and enhance an ecosystem service such as the hydrological cycle. In this case, vegetation and soil are critical tools in regulating hydrology.\(^{58}\) These overlaps demonstrate the complexity of natural ecosystems and show why they are difficult to recreate once they are disturbed. However, overlaps such as this are necessary to creating a functioning landscape. There is not an ecologically vibrant place that exists which has water but no plants, or plants without soil. This study, however, aims to focus on water and more specifically stormwater management. There will be overlaps into other thematic guidelines, but water will remain the primary focus for the purposes of this study.

There is one prerequisite, followed by seven credits in the “Site Design—Water” category. Completion of the prerequisite is required for any other credit in the specific section.\(^{59}\) Almost all of the credits are accompanied by caveats that apply to specific conditions, but for this study the general intent of the credit will be used. The prerequisite is to “reduce potable water use for landscape irrigation by 50 percent from established baseline.” The intent is to reduce the amount of drinkable water for irrigation after plant establishment.\(^{60}\) Each credit is listed below followed by a brief description of the intent.

1. Reduce potable water use for landscape irrigation by 75% from the established baseline. This credit is designed to limit or eliminate the use of

\(^{58}\) Eisenman 49  
\(^{59}\) “Guidelines and Performance Benchmarks 2009” 9  
\(^{60}\) “Guidelines and Performance Benchmarks 2009” 49
potable water for irrigation and to encourage alternative methods of irrigation and water conservation strategies.

2. Protect and restore riparian, wetland, and shoreline buffers. This credit is to preserve and enhance buffer regions to improve flood control, water quality, soil stabilization, erosion control, and provide wildlife corridors and habitat.

3. Rehabilitate lost streams, wetlands, and shorelines. The goal is to rehabilitate the ecosystem services lost when these ecosystems were artificially modified using unsustainable methods.

4. Manage stormwater on site. The intent is to replicate the pre-development hydrological condition with proper infiltration, runoff, and evapotranspiration. The replication should be based on historic conditions and similar regional comparisons.

5. Protect and enhance on-site water resources and receiving water quality. This credit aims to prevent stormwater pollution from entering the watershed. The pollution includes runoff, ground water, and combined sewers and stormwater systems.

6. Design rainwater/stormwater features to provide a landscape amenity. The intent is to seamlessly integrate visually and physically accessible rainwater/stormwater features in an aesthetically pleasing way. This credit deals specifically with human interaction with water to build a stronger connection with the local climate and with water.

7. Maintain water features to conserve water and other resources. This credit pushes designers to use little to no water from potable or other natural sources. Using graywater, reclaimed water, and rainwater conserves water, as well as reduces infrastructure and energy costs.61

These are the seven credits in the “Site Design—Water” category. They address sustainable management while also encouraging display of the stormwater features. This combination provides valuable opportunities to show all who see and experience the landscape that a sustainable stormwater system can be beautiful while also being ecologically friendly. The SITES program provides ecological, social, and economical benefits that improve the health, safety, and welfare of the general public.

61 “Guidelines and Performance Benchmarks 2009” 49-87
Alternative Stormwater Techniques

In order to be able to accomplish the goals of the Sustainable Sites Initiative, one must manage stormwater more sustainably. There are many techniques and tools that can be used to realize this task. The techniques discussed below do not represent all techniques possible, but do represent the majority of them. This list corresponds directly to the SITES criteria list. The primary methods for developing an alternative stormwater management plan are bioretention/detention, constructed wetlands, pervious pavements, green roofs, and habitat preservation and restoration.

Bioretention and biodetention are two ways water can be held and cleaned during a rain event. This process takes place in a basin, swale, raingarden or constructed wetland. Water that is directed to or held in these areas is allowed to move slowly so large debris, such as trash and sediment, settles out of suspension. These stormwater management areas are also planted with vegetation in order to absorb harmful chemicals and excess nutrients carried in stormwater runoff. This process further cleans the water before it infiltrates into the soil or exits the site. These methods are useful for controlling pollution released into the watershed, as well as allowing water to infiltrate and recharge groundwater systems. A constructed wetland, depicted in Figure 2-3, shows the ability to treat graywater from the building. An example of a vegetated bioswale can be seen in Figure 2-4.

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62 University of Arkansas Community Design Center 143
Figure 2-3 depicts a constructed wetland.\textsuperscript{63}

\textsuperscript{63} Mark Boyer
Figure 2-4 depicts a newly constructed vegetated bioswale in action.64

Permeable pavements are another alternative method to create a more sustainable management plan. In standard development, pavement materials such as asphalt and concrete are used to create parking lots, roads, patios, plazas, and pedestrian walkways. These materials are impervious and do not allow water to infiltrate. Rainwater moves faster across impervious pavement than it does across vegetated areas. This increase in speed can overload stormwater systems leading to increased pollution, little infiltration, and flooding. These problems can be helped by incorporating pervious pavements such as pavers, gravel, or pervious asphalt and concrete. Though these products are still not 100 percent pervious, like an undisturbed forest or meadow, they do help to increase infiltration and decrease the speed at which water moves across the surface. Below, in Figure 2-5, is a demonstration of the

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64 Mark Boyer
permeability of permeable concrete. Water is clearly moving through the pavement while also being dispersed.

Figure 2-5 Permeable pavement allows for rainwater infiltration.65

Green roofs vary in their scope and intensity, but they are used for a number of reasons. They consist of vegetation being planted on a roof, and vary from small groundcover plants to trees. The purpose of green roofs is to replace an impermeable surface, a standard roof, with one that slows, absorbs, and cleans rainwater. Green roofs can also be used as a landscape amenity when combined with rooftop patios or terraces. They can provide vegetation and soften the harshness of a conventional roof creating a more inviting atmosphere.

65 Google Images
Figure 2-6 A green roof is being used as an accessible terrace.  

Figure 2-7 Another green roof terrace creating a landscape amenity. 

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66 Mark Boyer
Water harvesting is one of the primary ways to recycle water. An example of rainwater harvesting can be seen in Figure 2-8 below. Recycled water can be used for irrigation, as can most graywater, among other things. Bioretention/detention facilities, as well as green roofs clean water naturally. The cleaned water is collected in a cistern or rain barrel and kept for other uses. This process prevents water from being sent into storm sewers, thus reducing energy costs at water treatment facilities.

Figure 2-8 The large silver rain barrel collects rainwater for this building.68

All of these techniques can be used to address concerns discussed in the beginning of Chapter 2. For example, rainwater harvesting could be used for crop irrigation in times of drought, like in the aforementioned news article describing the drought conditions last year. Farmers own large tracts of land. This land does produce

67 Mark Boyer
68 Mark Boyer
stormwater runoff which could be collected and stored to supplement the need for potable water irrigation during drought conditions. This improvement would reduce energy costs to farmers while reducing the amount of potable water used for large-scale farming irrigation.

The low-water levels of the Mississippi River can be attributed to drought. However, another cause of low-water could be low base-flow. Base-flow is defined as the water that moves in a stream, river, etc. that comes from sub-surface or delayed shallow surface water sources. When impervious surfaces dominate, stormwater is discharged quickly, not allowing time for water to infiltrate and recharge groundwater systems. This leads to low base-flow in streams and rivers causing problems like low-water conditions. Increased infiltration would increase water recharge and base-flow of streams and rivers. Green roofs can also play a role. By taking away an impervious surface and replacing it with vegetation, water is no longer shed from the roof. Water, in both bioretention/detention facilities as well as green roofs, is absorbed by vegetation. “By intercepting and evapotranspiring precipitation, plants sustain the hydrologic cycle, and by absorbing precipitation into the ground, soils maintain the water table.”

Finally, alternative stormwater management can help solve even regional issues, like the water rights problems discussed in the ABC News article. Alabama is asking for increased use of the watersheds to allow for future population growth. Similarly, Georgia claims to need more water to supplement the urban water supply and to allow for more agricultural irrigation. If either state would invest in alternative stormwater

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69 U.S. Environmental Protection Agency
70 Eisenman
management techniques such as rainwater harvesting, it could lessen the need for increased water from the already endangered watershed. These changes would lessen the impact on the watershed which would allow the oyster industry, which is vital to the Floridian economy, to continue to flourish. Alternative stormwater techniques are important and can be used to help solve current issues facing the Southeastern United States. It is important for new landscape architects to be exposed to these issues and maybe the best place for this exposure is in school.

**Bloom’s Taxonomy of Learning**

Educators use resources to enhance their teaching ability. One of the most respected and widely used resources is Bloom’s Taxonomy. Bloom’s Taxonomy is a metric that arranges levels of learning and thinking into a hierarchical system in ascending order from least to most complex.71 This system is designed to break down learning into levels that can help educators simplify topics into smaller pieces. The smaller pieces of knowledge are easier to understand because they are less complex. These pieces are taught and then built upon creating a deeper understanding and comprehension through the progression. Bloom’s Taxonomy is made up of eight levels: knowledge, comprehension, application, analysis, synthesis, and evaluation. These levels have been analyzed and revised by different experts, but the same general idea is present. Learning follows a progression of complexity and the simple concepts must be learned before more complex concepts can be understood.

There are multiple sources for explanations of the taxonomy, but Figure 2-9 below, from W. Huit’s research, gives a brief explanation of each level and the intent.

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71 Huit 2
associated with it. All of the information does not translate well to landscape architecture. However, the general idea that learning occurs in levels of comprehension is true for this field. This basic ideal is carried into the study methodology and adapted for pertinent use.

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>DEFINITION</th>
<th>SAMPLE VERBS</th>
<th>SAMPLE BEHAVIORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>KNOWLEDGE</td>
<td>Student recalls or recognizes information, ideas, and principles in the approximate form in which they were learned.</td>
<td>Write</td>
<td>The student will define the 6 levels of Bloom’s taxonomy of the cognitive domain.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>List</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Label</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Name</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>State</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Define</td>
<td></td>
</tr>
<tr>
<td>COMPREHENSION</td>
<td>Student translates, comprehends, or interprets information based on prior learning.</td>
<td>Explain</td>
<td>The student will explain the purpose of Bloom’s taxonomy of the cognitive domain.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Summarize</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Paraphrase</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Describe</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Illustrate</td>
<td></td>
</tr>
<tr>
<td>APPLICATION</td>
<td>Student selects, transfers, and uses data and principles to complete a problem or task with a minimum of direction.</td>
<td>Use</td>
<td>The student will write an instructional objective for each level of Bloom’s taxonomy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compute</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Solve</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Demonstrate</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Apply</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Construct</td>
<td></td>
</tr>
<tr>
<td>ANALYSIS</td>
<td>Student distinguishes, classifies, and relates the assumptions, hypotheses, evidence, or structure of a statement or question.</td>
<td>Analyze</td>
<td>The student will compare and contrast the cognitive and affective domains.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Categorize</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compare</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contrast</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Separate</td>
<td></td>
</tr>
<tr>
<td>SYNTHESIS</td>
<td>Student originates, integrates, and combines ideas into a product, plan or proposal that is new to him or her.</td>
<td>Create</td>
<td>The student will design a classification scheme for writing educational objectives that combines the cognitive, affective, and psychomotor domains.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hypothesize</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Invent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Develop</td>
<td></td>
</tr>
<tr>
<td>EVALUATION</td>
<td>Student appraises, assesses, or critiques on a basis of specific standards and criteria.</td>
<td>Judge</td>
<td>The student will judge the effectiveness of writing objectives using Bloom’s taxonomy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recommend</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Critique</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Justify</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2-9: The levels described in Bloom’s Taxonomy are defined in this table.\(^{72}\)

\(^{72}\) Huit 3
Chapter three: Methods & Results

Methods

The schools chosen for this study are members of the Southeastern Conference (SEC). These schools were chosen because of their regional proximity to the University of Arkansas, where the study originated. The regional proximity allows a more accurate comparison because the schools deal with similar regional issues such as drought, flooding, natural disasters, etc. For example, the Mississippi River drought directly affects Kentucky, Arkansas, Tennessee, Louisiana, and Mississippi. Figure 3-1 below shows the location of the SEC schools. When compared to Figure 3-2, the climatological similarities are obvious. This means the schools deal with similar plants and wildlife, as well as similar rainfall and weather patterns. There are differences between schools, but for this study this was the regional context chosen.

Figure 3-1 This SEC Conference map shows the approximate school locations. 73

73 Google Images
There are nine schools in the SEC that offer landscape architecture. These schools were contacted via email and asked to contribute to the study. Originally, the department head in each department was the primary contact. Throughout the communication process other faculty was included, primarily the faculty who taught classes relating to stormwater management. The course descriptions, many of which were found online in the course catalogue, were used to evaluate the content of courses offered at the universities. Related courses were then included in the study and course syllabi and project outlines were analyzed. Course syllabi describe a class as a whole, the overall concepts and goals, whereas the project statements or descriptions provide details of specific techniques or skills being taught in the course. Seven of the nine schools responded to the request for information.
The information, once gathered, was reviewed and the content that relate to stormwater management were identified. This information was sorted by school and a matrix was created to organize the data. The data was also organized by subject matter. For example, a project that dealt with stormwater calculations, pipe sizing, and detention basin sizing are all related to stormwater management. These principles, and the skills needed to complete the exercise are grouped together. A project that is focused on riparian buffers requires a different knowledge base and set of skills to successfully address the problem. This data would also be grouped together. These matrices provide the information that will be compared to the SITES criteria to assess whether or not the content of these courses addresses the areas pertinent to the Sustainable Sites stormwater criteria.

After extracting data from the material and organizing it into a useable matrix, the results were ready to be compared to the SITES water criteria. The SITES “Site Design—Water” standards do not easily convert to pedagogical concepts. This approach is based on a personal interpretation of the intent of the SITES criteria. The SITES water criteria were distilled down from the original format into a set of pedagogical concepts. Each criterion was broken into three stages of learning: introduction, application, and reinforcement. The three stages were loosely based on Bloom’s Taxonomy of Learning. For this study, the taxonomy was simplified. Graduating students are not experts in landscape architecture, and are not expected to be. So, the ideas were compressed into three stages of learning, all of which are more related to the basic levels in the taxonomy. The first stage represents an awareness of the material, the second a working knowledge of the material, and the final suggests reinforcement of the topic and skills needed to complete it as well as the introduction of more advanced ideas. The
concepts and skills taught in university courses were then compared to the concepts and skills needed to understand and work within each SITES criterion. This system formed the basis of the project.

Based on the results from this study, some explanations can be made regarding the stormwater curriculum and its correlation to the SITES Water criteria. However, it is important to note that this information is not guaranteed to be an accurate representation of each University’s curriculum. These results were based on data provided in response to a request for information from classes which teach stormwater management. For one reason or another, a class could have been accidentally omitted from the data collected and therefore not included in the study. There could also be classes that relate indirectly to this topic, and therefore were overlooked during the information-gathering process. Most of the classes analyzed were in the technical courses. Though stormwater is a common topic in these courses, it is also likely that stormwater concepts are discussed in other courses. For example, the course analyzed from the University of Tennessee is a studio course, not a technical or construction course. This proves that relevant topics could be discussed in courses not included in this study.
RESULTS

There are nine schools in the SEC who offer landscape architecture as an area of study: University of Arkansas, Auburn University, University of Florida, University of Georgia, University of Kentucky, Louisiana State University, Mississippi State, University of Tennessee, and Texas A&M. Of these schools, eight are currently accredited by the Landscape Architecture Accreditation Board (LAAB). One, the University of Tennessee, is a new department and is in the process of becoming accredited. Because Tennessee’s LA department is still developing, many of the stormwater management principles have not yet been incorporated. According to faculty, they are working to incorporate more stormwater management principles, techniques, and skills soon. Of these nine schools, seven have responded to the request for information: Arkansas, Florida, Georgia, Kentucky, Mississippi State, Tennessee, and Texas A&M. Syllabi were received from all seven schools, but not all were able to provide project descriptions. The syllabi were analyzed and the findings organized into the following tables. These tables represent the raw data taken from the evaluated syllabi and project statements. Copies of relevant pages of the syllabi and project statements can be found in Appendix I.
### Arkansas

<table>
<thead>
<tr>
<th>Course</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>LARC 2714: Landscape Architecture Construction 1</td>
<td>Siting bldgs, roadways, paths etc. and grade appropriately to accommodate drainage</td>
</tr>
<tr>
<td></td>
<td>Combining technical and artist skills to use grading, drainage, etc to create a beautiful landscape design</td>
</tr>
<tr>
<td>LARC 4717: Landscape Systems</td>
<td>Advance Site Grading: complete difficult grading plans, evaluate erosion problems and identify appropriate control methods</td>
</tr>
<tr>
<td></td>
<td>Foundation for Stormwater Drainage &amp; Retention/Detention Systems: use Rational Method to calculate runoff; calculate pipe sizes, inlets, locations, elevations, &amp; slopes for various sites and storm intensities; calculate detention facility; intro to alternative methods</td>
</tr>
<tr>
<td></td>
<td>Foundation for Irrigation System: understanding of basic principles of hydraulics &amp; industry standards; basic system layout</td>
</tr>
<tr>
<td></td>
<td>Foundation for Pool &amp; Fountain Systems: choose appropriate materials &amp; mechanisms for water feature; design a safe, yet accessible water feature</td>
</tr>
</tbody>
</table>

Figure 3-3 Arkansas Analyzed Courses Table

### Florida

<table>
<thead>
<tr>
<th>Course</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAA 3420: Landscape Architecture Construction 1</td>
<td>Understanding and demonstrated ability to site, grade, and layout structures and landscape surfaces (Grading)</td>
</tr>
<tr>
<td></td>
<td>Understanding and demonstrated ability to apply earthwork calculations and understand their role in design implementation and cost estimation (Grading)</td>
</tr>
<tr>
<td></td>
<td>Understanding and demonstrated ability to apply principles of drainage and site water management as it relates to grading and other forms of landscape design</td>
</tr>
<tr>
<td>LAA 3421: Landscape Architecture Construction 2</td>
<td>Stormwater runoff calculations: Rational Method; sizing conveyance systems (pipes, inlets, etc.); water harvesting</td>
</tr>
<tr>
<td></td>
<td>Understanding and demonstrated ability to design water harvesting and smart irrigation systems</td>
</tr>
<tr>
<td></td>
<td>Intelligent uses of water</td>
</tr>
<tr>
<td>LAA 4260: Water Conservation through Site Design &amp; Green Roofs</td>
<td>Intro to sustainability (emphasis on site and land development); Sustainability theory and metrics (LEED, FGBC, Ecological Footprint, LCA)</td>
</tr>
<tr>
<td></td>
<td>Overview of the principles of low impact development (LID)</td>
</tr>
<tr>
<td></td>
<td>Basic stormwater management: bioremediation, raingardens, bioswales, bioretention, porous pavement</td>
</tr>
<tr>
<td></td>
<td>History, technology, and application of green roof design</td>
</tr>
<tr>
<td></td>
<td>Overview of green walls</td>
</tr>
</tbody>
</table>

Figure 3-4 Florida Analyzed Courses Table
<table>
<thead>
<tr>
<th><strong>GEORGIA</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course</strong></td>
<td><strong>Skills</strong></td>
</tr>
<tr>
<td>LAND 2310: Landscape Ecology Processes and Materials</td>
<td>Develop an understanding of the relationship between human populations and the environment</td>
</tr>
<tr>
<td></td>
<td>Develop an understanding of the availability of environmental resources and the need to sustain them; to understand and value the &quot;ecosystem services&quot;</td>
</tr>
<tr>
<td>LAND 3330: Landscape Engineering Processes and Materials</td>
<td>Calculate stormwater runoff and size drainage structure accordingly; understanding of consequences of surface vs. sub-surface drainage for stormwater mgmt &amp; infiltration</td>
</tr>
<tr>
<td></td>
<td>Acceptable slopes for erosion control</td>
</tr>
<tr>
<td>LAND 4350: Soil &amp; Stormwater Management</td>
<td>Understanding of role of erosion control and stormwater management in protecting the environment as well as human health, safety &amp; welfare</td>
</tr>
<tr>
<td></td>
<td>Understanding of Georgia standards for soil erosion, sediment control, and stormwater management</td>
</tr>
<tr>
<td></td>
<td>Understanding of best management practices (BMPs) for LID &amp; SITES</td>
</tr>
<tr>
<td></td>
<td>Calculate stormwater runoff (multiple methods); design swales, pipes and detention; design &amp; size bioretention</td>
</tr>
<tr>
<td></td>
<td>Calculate and apply soil erosion &amp; sediment control methods</td>
</tr>
<tr>
<td>LAND 4360: Applied Landscape Ecology</td>
<td>Develop an understanding of principle of habitat preservation, conservation, restoration &amp; how to integrate these ideas into design; a sense of the cost of development</td>
</tr>
</tbody>
</table>

Figure 3-5 Georgia Analyzed Courses Table

<table>
<thead>
<tr>
<th><strong>KENTUCKY</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course</strong></td>
<td><strong>Skills</strong></td>
</tr>
<tr>
<td>LA 871: Design Implementation I</td>
<td>Understanding and manipulation of landforms in plan and elevation, as well as the relationship to built forms (Grading)</td>
</tr>
<tr>
<td></td>
<td>Grading Calculations</td>
</tr>
<tr>
<td></td>
<td>Drainage</td>
</tr>
<tr>
<td>LA 973: Advanced Design Implementation</td>
<td>Understand and experience the theory and practicum of the construction document aspects of landscape architecture including site design, site engineering, implementation, and standards</td>
</tr>
<tr>
<td></td>
<td>Students should be able to produce: base information, design plan, contract document set, technical calculations</td>
</tr>
</tbody>
</table>

Figure 3-6 Kentucky Analyzed Courses Table
### Mississippi State

<table>
<thead>
<tr>
<th>Course</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA 3534: Construction II</td>
<td>Overall knowledge of how water can be used as a resource throughout site design</td>
</tr>
<tr>
<td></td>
<td>Working knowledge of calculating runoff rates, volumes, and required detention storage sizing and design using traditional methods</td>
</tr>
<tr>
<td></td>
<td>Working knowledge of innovative uses of stormwater best management practices (BMP’s) within the context of Low Impact Development: cistern, infiltration, pervious pavers, green roof</td>
</tr>
<tr>
<td></td>
<td>Working knowledge of constructed wetlands: habitat construction, storage, &quot;beautiful&quot; design</td>
</tr>
<tr>
<td></td>
<td>Installation project to apply techniques and principles learned to a real-world situation</td>
</tr>
</tbody>
</table>

Figure 3-7 Mississippi State Analyzed Course Table

### Tennessee

<table>
<thead>
<tr>
<th>Course</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAR 544: Landscape Architecture Design III (6)</td>
<td>Understand pre- and post-development site hydrological systems: infiltration, aquifer/groundwater recharge; pollution sources, pollution types (sediment, heavy metals, excess nutrients), soil compaction</td>
</tr>
<tr>
<td></td>
<td>Demonstrate an understanding of the relationships between regional sustainability issues and site design approaches</td>
</tr>
<tr>
<td></td>
<td>Demonstrate an understanding of the quantitative and quantitative benefits of LID storm water best management practices: understanding of LID techniques (bioretention, permeable pavements, rainwater harvesting, green roofs, canopy trees, reduced parking)</td>
</tr>
<tr>
<td></td>
<td>Demonstrate an understanding of LID BMPs as integral components of a multi-functional landscape system: creating a stormwater plan that adheres to Clean Water Act regulations while contributing to the project function &amp; performance</td>
</tr>
<tr>
<td></td>
<td>Regional watershed improvement suggestions presented to City of Knoxville as a class</td>
</tr>
</tbody>
</table>

Figure 3-8 Tennessee Analyzed Course Table: This course is a masters course.

### Texas A&M

<table>
<thead>
<tr>
<th>Course</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAND 329: Landscape Construction I</td>
<td>Entry level knowledge and skill of grading</td>
</tr>
<tr>
<td></td>
<td>Entry level knowledge in hydraulics, hydrology, drainage design and surface hydraulics</td>
</tr>
<tr>
<td></td>
<td>Introduction to stormwater best management practices (BMPs)</td>
</tr>
<tr>
<td></td>
<td>Runoff calculations, detention sizing, pipe sizing</td>
</tr>
</tbody>
</table>

Figure 3-9 Texas A&M Analyzed Course Table
To be able to draw comparisons between the SITES criteria and the topics, concepts, and skills covered by the curricula, a table was created. This table identifies possible areas to be included by schools at three different knowledge levels based upon and adapted version of Bloom’s Taxonomy. Pedagogical concepts were interpolated from the SITES criteria and the criteria’s intent, and then separated into the categories. This table, seen in Figure 3-10, does not provide a strict framework, but more of a starting point from which to organize the comparisons of the two bodies of information.

<table>
<thead>
<tr>
<th>Sites Criteria</th>
<th>Introduction</th>
<th>Application</th>
<th>Reinforcement/Alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce potable water use for landscape irrigation by 50% from established baseline. (Prerequisite)</td>
<td>Ethics of the misuse of potable water: How is it misused? What are affects of misuse?</td>
<td>Stormwater Calculations (any method) On-site Storage</td>
<td>Re-use techniques (cistern, greywater use &amp; on-site circulation)</td>
</tr>
<tr>
<td>Reduce potable water use for landscape irrigation by 75% from established baseline.</td>
<td>Ethics of the misuse of potable water: How is it misused? What are affects of misuse?</td>
<td>Stormwater Calculations (any method) On-site Storage</td>
<td>Re-use techniques (cistern, greywater use &amp; on-site circulation)</td>
</tr>
<tr>
<td>Protect and restore riparian, wetland, and shoreline buffers</td>
<td>Importance of these environments; Why is it important to protect/restore them?</td>
<td>Natural systems: how do they work?</td>
<td>Management of wetlands, streams &amp; shorelines (invasive plant control, habitat monitoring &amp; management, watershed &amp; water quality management)</td>
</tr>
<tr>
<td>Rehabilitate lost streams, wetlands, and shorelines.</td>
<td>Denudation of habitats through insensitive development; Why? How? What are the affects?</td>
<td>How do natural systems work?</td>
<td>Management of wetlands, streams &amp; shorelines (invasive plant control, habitat monitoring &amp; management, watershed &amp; water quality management)</td>
</tr>
<tr>
<td>Manage stormwater on site.</td>
<td>Ethics of the allowing stormwater to flow directly into streams, rivers, etc; increased runoff decreases base flow, reducing useable habitat, groundwater levels, etc.</td>
<td>Stormwater Detention/Retention: storing water on-site long enough for infiltration, allowing water to drain naturally and reduce amount in pipes</td>
<td>Practical methods for infiltration &amp; re-use to reduce discharge: bioswales, constructed wetlands, retention/detention, re-use techniques (cistern, greywater use, etc.),</td>
</tr>
<tr>
<td>Protect and enhance on-site water resources and receiving water quality,</td>
<td>importance of allowing vegetation buffers between development and natural environments; pollution of stormwater: the effects it has on water quality, wildlife, &amp; plants</td>
<td>Natural Buffers: native vegetation, proper grading to reduce erosion, how to create buffer zones, impervious vs. pervious cover: techniques for slowing water to improve quality,</td>
<td>Responsible construction and management of Bioswales, Infiltration &amp; Water Recycling systems, Vegetation for cleaning, Constructed wetlands</td>
</tr>
<tr>
<td>Design rainwater/stormwater features to provide a landscape amenity.</td>
<td>Value and ethics of using stormwater as amenity</td>
<td>Landscape systems: fountains, pools, wetlands, bioswales etc; Making stormwater visible</td>
<td>Creating access to stormwater features, using them as educational tools; proper maintenance techniques</td>
</tr>
<tr>
<td>Maintain water features to conserve water and other resources.</td>
<td>Ethics of the misuse of potable water: How is it misused? What are affects of misuse?</td>
<td>Knowledge of landscape water feature systems: proper design, placement, use, etc.</td>
<td>Re-use techniques (cistern, greywater use &amp; on-site circulation)</td>
</tr>
</tbody>
</table>

Figure 3-10: This table shows the SITES criteria converted into pedagogical concepts.
“Introduction”

Of the seven responding schools, six discuss alternative stormwater management theory and the reasons why it is important. The introduction to these techniques corresponds to the “Introduction” section of Table 3-10. This introductory level of understanding, as established by Bloom’s Taxonomy, forms the base layer of knowledge. This layer is pivotal to comprehend before students can be taught specific techniques mentioned in the “Application” and “Reinforcement/Alternative” sections.

“Application”

In the “Application” section, specific techniques and skills are outlined. These skills can be applied to both conventional and alternative stormwater management, as will be explained in more depth in Chapter 4. Some of the skills in this section of Table 3-10 are required by the LAAB standards. It is, therefore, not surprising that they are being taught. Of the seven responding schools, all of them showed evidence of teaching site grading as it relates to stormwater management. This skill provides the basis for almost all of the technical aspects of calculations to follow. The ability to create a cohesive grading plan is instrumental in being able to delineate watersheds and calculate runoff volumes for stormwater. Grading would be considered the prerequisite to all other techniques and skills required to complete a stormwater management plan.

Another basic skill is to site landscape elements appropriately to accommodate drainage. All seven schools mention or allude to teaching the skill of siting structures with drainage in mind. This skill is also necessary to creating a working stormwater plan. The ability to control and direct drainage to the desired locations is critical to
accomplish all seven criteria in the SITES standards. Some schools take grading a step further and teach erosion control. Based on the information gathered for this study, six of the seven schools explicitly discuss erosion control.

One of the most important topics, from the stormwater curriculum as it relates to SITES, is stormwater calculations. Of the seven schools, six have stormwater calculations in their syllabi and/or project statements. Stormwater calculations entail, but are not limited to, calculating runoff, calculating pipe sizes, locating drainage inlets, and calculating detention. This information is also discussed in the Council of Landscape Architecture Registration Boards (CLARB) material for the Landscape Architecture Registration Examination (LARE). This is the test required for licensure. The ability to complete stormwater calculations is necessary for both current stormwater management practices and new sustainable stormwater management practices.

“Reinforcement/Alternatives”

Of the six schools that teach stormwater calculations, five introduce what are referred to as BMPs, or best management practices, for sustainable stormwater management. Three of the five schools also teach to a “working knowledge” of these best management practices. BMPs include bioretention, bioswales, raingardens, porous pavement, constructed wetlands, and water harvesting. These techniques can be used to reduce potable water use in irrigation, manage stormwater on site, protect and enhance receiving water quality, and protect and restore buffers between riparian and developed areas. Five out of seven schools represent 71 percent of the departments that introduce and/or apply principles of sustainable stormwater management techniques in the current curriculum.
There are also schools that go above and beyond introducing sustainable stormwater practices. Five schools introduce sustainable theory and metrics such as Leadership in Energy and Environmental Design (LEED) and SITES. This knowledge includes the ethics of sustainability and the history of the movement. Three schools introduce rainwater harvesting as it relates to irrigation design, and one of these three teaches a working knowledge of what they call “smart irrigation design.” Four of the seven schools also discuss creating beautiful stormwater designs, and how stormwater can be viewed as an amenity instead of as a waste product. This content is parallel to the SITES criteria “design stormwater features to provide a landscape amenity.” One school incorporates a community design and installation project. This public installation gives students experience in designing and constructing stormwater systems. Two of the seven schools specifically introduce other sustainable ideas such as green roofs or vegetated walls.

This information is compared in the following table. The SITES criteria are shown with the corresponding techniques taken from the courses analyzed. Only the methods specifically mentioned in the analyzed courses in this study are included. These techniques do not represent an exhaustive list of alternative stormwater skills to accomplish the SITES goals. The schools who teach the principles, again based on the courses analyzed, are listed in the third column. They have been assigned an anonymous and random number.
<table>
<thead>
<tr>
<th>SITES Criteria</th>
<th>Principles from Data Addressing the SITES criteria</th>
<th>Schools who Teach these Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce potable water use for landscape irrigation by 50% from established baseline. (Prerequisite)</td>
<td>water harvesting</td>
<td>5, 6, 7</td>
</tr>
<tr>
<td>Reduce potable water use for landscape irrigation by 75% from established baseline.</td>
<td>water harvesting</td>
<td>5, 6, 7</td>
</tr>
<tr>
<td>Protect and restore riparian, wetland, and shoreline buffers</td>
<td>bioretention, permeable pavement, green roof</td>
<td>Bioretention: 1, 5, 6, 7 Permeable Pavement: 5, 6, 7 Green Roof: 5, 6, 7</td>
</tr>
<tr>
<td>Rehabilitate lost streams, wetlands, and shorelines.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manage stormwater on site.</td>
<td>bioretention, permeable pavement, green roof, water harvesting</td>
<td>Bioretention: 1, 5, 6, 7 Permeable Pavement: 5, 6, 7 Green Roof: 5, 6, 7 Water Harvesting: 5, 6, 7</td>
</tr>
<tr>
<td>Protect and enhance on-site water resources and receiving water quality,</td>
<td>bioretention, permeable pavement</td>
<td>Bioretention: 1, 5, 6, 7 Green Roof: 5, 6, 7</td>
</tr>
<tr>
<td>Design rainwater/stormwater features to provide a landscape amenity.</td>
<td>bioretention, green roof</td>
<td>Bioretention: 1, 5, 6, 7 Green Roof: 5, 6, 7</td>
</tr>
<tr>
<td>Maintain water features to conserve water and other resources.</td>
<td>water harvesting</td>
<td>5, 6, 7</td>
</tr>
</tbody>
</table>

Figure 3-11: This table shows the SITES criteria in direct comparison to techniques taught in the analyzed classes with corresponding schools represented by a random number.
CHAPTER FOUR: DISCUSSION

It is not surprising that the six out of seven schools that are fully accredited teach basic stormwater management given that the LAAB requires this topic. These schools, by teaching the current stormwater standard pipe transportation system, are simply doing what is required to be accredited. The conventional stormwater system treats runoff as a waste product and something to be hidden and purged from the site quickly. However, this strategy is not sustainable; it requires large amounts of costly infrastructure and robs citizens of the benefits water possesses. Teaching only this method does not provide graduates with the necessary knowledge to be competent in the SITES system.

Five out of the seven schools introduce sustainable stormwater management. All five schools include the theoretical and ethical concepts that are driving the sustainability movement. These concepts include the ethics of mismanaging stormwater and its effects on the environment, as discussed in the literary review. It is not clear whether schools also discuss the social and economic viewpoints on sustainability. A couple schools mentioned cost analysis, but it was unclear from the data if this topic referred to a cost-benefit analysis of conventional management compared to sustainable management. Using the definition and illustration of sustainability in Figure 2-2, students may not be receiving necessary contextual information to truly understand the sustainability movement and apply it to stormwater management. However, this knowledge could be taught in classes that were not included in this study such as design studio or a design theory class. It is unclear if the full theoretical background and reasoning is addressed in the classes.
polled in this study. However, the theoretical knowledge that is discussed is instrumental in priming graduates for success within the framework of SITES and the stormwater management criteria.

**Shared Principles & Skills**

There are principles taught that apply to both conventional and alternative stormwater management strategies. Understanding basic principles of runoff such as slope and its affect on water speed and infiltration rates, how grading affects water flow, etc. is necessary to understanding both a standard approach and a more sustainable approach. These ideas are facts and do not change when viewed from either perspective. The principles of grading, siting buildings and landscape elements, and basic drainage apply to both management theories. These principles are the same, but the difference lies in the way in which they are applied. In a conventional approach, grading is typically used to accommodate the necessary stormwater drainage from a site. The drainage is hidden in pipes and taken offsite. In a sustainable approach, the grading is designed in a way that celebrates the drainage. The drainage is allowed to enter bioswales where it moves slowly. This allows sediment and other debris to settle out of the flow, cleaning the water. Drainage is also allowed to infiltrate into the ground and recharge groundwater systems.

There are specific skills needed for both approaches. Watershed delineation is necessary to calculate water runoff. The ability to calculate the amount of runoff is vital to correctly sizing pipes and vegetated bioswales. In fact, nearly all of the basic technical skills taught in school are applicable to both methods of stormwater
management. But, like the stormwater principles, the application of the skills is much different.

The principles and technical skills taught in design classes are necessary basics that form the foundation for both conventional and sustainable stormwater management. This set of basic tools can be applied to either approach. Teaching these skills is necessary to fulfilling LAAB accreditation and provides the foundation for schools to go above and beyond and teach sustainable stormwater management practices. Students are graduating with the exposure to foundational skills needed to be capable of comprehending the technical aspect of the SITES system.

Five of the seven schools are incorporating the sustainable application of these foundational skills. This number is better than expected considering the Sustainable Sites Initiative has been introduced in the last four years.

**A B O V E & B E Y O N D**

Schools that teach more than the standard stormwater approach teach a variety of methods and practices. One of the categories discussed by the schools that introduce alternative stormwater management is LID or Low Impact Development. LID is not a metric or rating system like the Sustainable Sites Initiative, but it is a set of techniques and methods that are designed to negate the impacts of development. LID strategies can be used to accomplish the goals of the SITES criteria.

Of the six schools who introduce alternative stormwater methods, only four identify specific techniques. The other two schools do not identify specific techniques in the syllabi and project statements provided, making it difficult to gauge the depth of knowledge imparted to students. Some of the alternative techniques described include
bioretention/detention, constructed wetlands, pervious pavements, green roofs, and bioremediation.

Bioretention and Biodetention are two tools to address specific SITES criteria. The benefits discussed in Chapter 2 address several SITES criterion in the Site Design—Water section. Improving water quality by preventing pollution from entering the watershed is the main focus for criteria number five. When raingardens, constructed wetlands, and other forms of bioretention/detention are built, wildlife habitat is created. Habitat creation is one of the goals in criteria number two. These facilities also increase infiltration accomplishing a piece of criteria number four. Bioretention/detention facilities can provide a landscape amenity. By integrating these areas into a site design, not hiding the process in pipes, people can see and experience the management methods creating a stronger connection to the environment. These accomplish the goals of criteria number six. Bioretention/detention facilities benefit the environment and help address some of the goals in the SITES water criteria.

Another alternative management strategy discussed in three schools is permeable pavement. Permeable pavement, like bioretention/detention, is another method to increase infiltration which satisfies one of the elements of SITES water criteria number four. Decreasing the speed at which water drains leads to less erosion and less flooding potential. Both of these benefits accomplish goals described in criteria number two. The decrease in stormwater pollution carried by permeable pavement also accomplishes a goal of criteria number five. Permeable pavement provides ecological benefits and is a tool to accomplish some of the goals of the SITES water criteria.

Green roofs are introduced in three schools as an alternative stormwater management technique. Green roofs are a technique to accomplish some of the SITES
water criteria goals. They absorb water and therefore decrease the volume of runoff to be managed from roofs. This satisfies requirements for criteria number four by allowing designers to manage some of the stormwater on-site. A green roof can create habitat, satisfying goals for criteria number two. If paired with a rooftop patio or terrace, these environments create a landscape amenity addressing goals in criteria number six. This can also be accomplished if the green roof is visible from building windows. The green space creates a visible amenity. Green roofs are another tool that can be used to satisfy the Sustainable Sites water criteria.

Water harvesting is another method to control the amount of runoff deposited into the natural system. Three schools specifically mention water harvesting as an alternative technique in the material analyzed for this study. One of these schools does mention irrigation, but does not give specific techniques to combat common irrigation mistakes. Stored water can be used to supplement potable water used for irrigation. Depending on the storage capacity, this can accomplish a goal for the prerequisite and first credit in the Site Design—Water section. Stored water can also be used to supplement potable water needed in water features. This satisfies the primary goal for criteria number seven. Water harvesting is necessary to accomplish the prerequisite of reducing potable water used for irrigation, and two other credits. This is a vital skill necessary to be adept in the SITES guidelines.

Only two schools specifically mention using stormwater to create landscape amenities. When designing green roofs, bioretention/detention, etc., these elements can become amenities if they are celebrated and seamlessly integrated into a design. SITES criteria number six specifically displays the importance of visual and accessible stormwater treatment areas to build connections between people and the environment.
Only one school mentions habitat preservation and conservation. This idea is an integral part of the second and third credits.

**Room for Improvement**

As a whole, sustainable stormwater management is present in stormwater curriculums in the Southeastern Conference. However, there may be room for improvement. As the Sustainable Sites Initiative system develops and becomes a permanent fixture in landscape architecture and as potable water becomes scarcer, schools would do well to teach alternative stormwater techniques.

First, all seven schools should introduce sustainability in their courses and all schools should also discuss the specific problems associated with improper stormwater management. Based on the courses analyzed for this study, all schools do not discuss these ideas. This statement is based solely on the classes analyzed, and it is understood that there could be classes not included from each school that do introduce sustainability and discuss the issues associated with irresponsible stormwater management but were not included. Increased erosion, pollution, habitat degradation, etc. are all problems that distress the environment.

One rather obvious improvement is for more schools to teach the alternative techniques already being taught by some departments in the SEC. These techniques are pivotal methods to achieving credits in the SITES system. Attaining these credits helps to reduce the amount of stormwater runoff created by development. This change alone reduces the cost of infrastructure needed on site, as well as reduces the amount of
water that needs to be processed in water treatment facilities.75 These techniques also help address problems with drought conditions referring back to the CNN articles about barge traffic along the Mississippi River last year.76 One of the causes of low water is drought, but another could be the low base-flow of streams in the Mississippi River watershed. When impervious surfaces dominate, stormwater is discharged quickly, not allowing time for water to infiltrate and recharge groundwater systems. This leads to low base-flow in streams and rivers causing problems like low water conditions. Increased areas of bioretention/detention would lead to better infiltration increasing water recharge and base-flow of streams and rivers. Green roofs can also play a role. By taking away an impervious surface and replacing it with vegetation, water is no longer shed from the roof. Water, in both bioretention/detention facilities as well as green roofs, is absorbed by vegetation. “By intercepting and evapotranspiring precipitation, plants sustain the hydrologic cycle, and by absorbing precipitation into the ground, soils maintain the water table.”77

Another way to improve the curriculum is to create multi-disciplinary classes. Though landscape architects are instrumental in stormwater management, other professions play important roles as well. Civil engineers handle stormwater management on a day-to-day basis. Their classes are not included in this study, and from the information gathered there was no indication of multi-disciplinary classes. Increasing the involvement of other disciplines could improve the effectiveness and awareness of the Sustainable Sites Initiative’s mission.

75 “Case for Sustainable Landscapes”
76 Sutton/Seaman
77 Eisenman
So who can implement these changes to improve the awareness of SITES and the importance of alternative stormwater management? In the LAAB’s Accreditation Standards and Procedures, there are a list of values set forth to achieve the mission of the accreditation board. One of these values is to “encourage education that prepares students to succeed in a changing world.”\textsuperscript{78} As mentioned in Chapter Two, the theoretical shift to sustainability is happening now. To accomplish the mission of the LAAB, students must be prepared to address these changes. If the LAAB adapted their accreditation standards to include alternative stormwater uses, schools would be enticed to comply.

Another possible approach to encouraging schools to change their curriculum would be to change the standards of the L.A.R.E exam. Passing this exam is required for licensure. If the L.A.R.E, under the direction of the Council of Landscape Architectural Registration Boards, updated their section addressing stormwater management to include alternative techniques, schools could be more apt to update their curriculum. Naturally, schools want their students to become licensed professionals. Therefore, schools hopefully would be inclined to change their curriculum to better prepare their graduates for the licensure exam.

\textsuperscript{78} “Landscape Architectural Accreditation Board: Standards and Procedures” 1
**CHAPTER FIVE: CONCLUSION**

Compared to the Sustainable Sites criteria, the analyzed stormwater curricula teach many of the basic skills, such as stormwater calculations, needed to comprehend and execute alternative stormwater management strategies. The responding departments also teach valuable techniques to attain SITES credits. At least three schools introduce techniques to accomplish most of the goals and gain credits in the Sustainable Sites Initiative’s Site Design—Water section. The introduction of sustainable techniques has the potential to provide graduates with the tools to create and restore natural ecosystems thus providing ecosystem services beneficial to all living things. There may be areas to be improved, but many schools are already incorporating sustainable principles and techniques into their curricula.

The purpose of this study was to evaluate the stormwater content of landscape architecture curricula throughout the SEC, with reference to the stormwater management criteria of the Sustainable Sites Initiative. Both primary research questions, is it possible to align the SITES stormwater criteria to pedagogical goals and concepts? And How do the pedagogical goals drawn from SITES align with the stormwater curricula of schools in the SEC?, were answered. A chart converting the SITES stormwater criteria into pedagogical goals was created. This chart formed the basis for the comparison between stormwater curricula in the SEC and the SITES stormwater guidelines.

As expected, some schools provide more opportunities to learn alternative stormwater management than others. These discrepancies in curricula could be for a variety of reasons; some professors have different areas of expertise and may be well-
versed in sustainable design techniques and the SITES system. Professors accentuate certain aspects of their classes depending on their expertise and interest. Further work through a longitudinal study might shed light on the effect of changing instructor personnel on stormwater class content.

Some of the analyzed syllabi did not provide a great deal of detail on the contents of the semester. More detailed descriptions of projects, techniques, and deliverables would provide further information on the specific content of classes. Interviewing professors who teach the courses analyzed would allow a better understanding of their classes.

As discussed in the literature review, truly sustainable designs are dependent on the balance of economic, social, and environmental issues. Generally speaking, the information received from the seven schools described construction and technical courses that typically do not address social or economic issues. Though other classes at these institutions may address these topics, there would be an obvious benefit in touching on these aspects during stormwater classes. Nevertheless, further study could evaluate whether or not the environmental, cultural, and economic benefits of stormwater are being addressed elsewhere in the SEC’s landscape programs.

This research took place during one semester; time played a role in the breadth of information analyzed in the study. However, this study provides a base of information describing and analyzing the current stormwater content in landscape curricula and how it compares to the Sustainable Sites Initiative’s guidelines and benchmarks related to stormwater management. Six out of seven schools introduce sustainable, alternative stormwater techniques and theories to differing degrees. This
represents the first step in educating the landscape architects of tomorrow to be better stewards of natural resources.
**BIBLIOGRAPHY:**


http://water-energy.lbl.gov


http://www.epa.gov/watertrain/wetlands


Appendix I:

This section contains copies of pages used for data-gathering. The syllabi and project statements, if included in the study, are arranged in alphabetical order beginning with Arkansas and ending with Texas A&M. The syllabi can be matched to the corresponding school’s chart within Chapter 3 in the Results section of the document. All syllabi titles can be found in the “Course” column of the corresponding school.
LARC 2714: LANDSCAPE ARCHITECTURE CONSTRUCTION 1
University of Arkansas
Department of Landscape Architecture

Nikki Springer, Garvan Chair
Spring 2010

Course Description
This is a lecture and laboratory course that will provide the foundation for grading, earth
work, road construction, and site drainage. It will also cover the basics of roadway
alignment, land survey system, and general construction practices/documentation.

This class is taught in conjunction to LA Design IV, which focuses on site development at
several scales. It is expected that the material learned in this class will influence and help
further develop your studio work. The course will expect mastery of material from previous
courses, especially LARC 2113 Design Communication and LARC 2336 Design III. This
material is also fundamental to all further academic and professional work in the area of
landscape architecture.

Significance to Professional Practice
As a landscape architect, you must be in command of three-dimensional spatial analysis and
the crafting of three-dimensional spaces and experiences. This course will provide the
foundation for mastering design of the landscape in three dimensions, including industry-
standard terminology, drawing conventions, and standards of methodology and practice.
Students will better develop their ability to analyze, critique, and replicate aspects of
landscape architecture as well as accurately and critically analyze a given site to best
capitalize on its constraints and unique opportunities. Students will also gain proficiency in
ADA code compliance and other legal requirements related to design in three-dimensions.

Pedagogic Objectives
1. To gain command of the three-dimensional aspects of landscape architecture, and
develop capabilities of reading and analyzing grading plans, developing an accurate
topographical map from field analysis, and designing three-dimensional landforms
with grading methods that are technically sound and follow professional conventions.
2. Develop the ability to site and accommodate built structures and paved surfaces –
buildings, terraces, roadways, paths – that meet technical standards for drainage,
accessibility, and cultural expectation and integrate distinct site elements into a
unified site design.
3. To develop an understanding, appreciation for, and critique of historic and
contemporary landscape architecture devices that utilize the manipulation of the
ground plain as a fundamental technique to achieving overall design and spatial
conditions.
4. To combine the technical and artistic elements of earthwork, grading, drainage, and
accessibility to explore and create design proposals that evoke a distinct design
concept. Application of grading principles will be explored in a series of class
projects as well as application to studio projects outside of this course.

Text
Required:

Please bring your text book to class each day unless otherwise instructed.
Course Description:

The catalog description is: Introduction to systems of landscape architectural construction including stormwater management, lighting, irrigation, water features and erosion control. Emphasis on advanced grading and landform manipulation skills, and stormwater system design and calculations. Significant integration of computer generated drawings. Lecture and laboratory. Prerequisite: LARC 2714.

This course will cover several systems that landscape architects design. In contrast to materials & methods and structures, “systems” of landscape architecture are less discrete and require more consideration and coordination with other elements of the design and implementation process. More importantly, systems are characterized by multiple components working in concert to make a dynamic, functioning entity. For example, a stormwater drainage system contains, among other elements, inlets, piping, catchbasins and detention storage areas and requires careful consideration of and coordination with the grading plan, other underground utilities, and other systems and elements during construction phases. This course will apply what you have learned in Construction I & II and new information presented will be applied in some way to solve advanced problems.

Relationship to Professional/General Education:

LA Construction IV emphasizes system elements and implementation drawings. This course will build upon the foundations laid in LA Construction I & II (LARC 2714 & 3724) and introduce new concepts, terms and techniques required to address more complex scenario of sitework. Instruction will be aimed at enabling you to expand your knowledge of landscape architectural systems, give you a foundation for decision making when applying this knowledge to particular situations, and continue the development of your technical skills required to complete designs and construction documents of the above mentioned items.

Relationship to Professional Practice:

As a professional, you will frequently be called upon to provide the design of elements and systems which require complex technical skills to be successful. These elements include complex grading plans, stormwater drainage systems and detention facilities, irrigation systems, lighting systems, and pool and fountain design. In many instances, these are the very elements on which the public’s health safety and welfare are in potential jeopardy. You must be able to provide competent, safe, yet aesthetically appropriate solutions, know when the complexity dictates the wisdom to acquire the services of a professional engineer, and be able to intelligently communicate with those engineers and understand the drawings they produce.

Goals & Objectives:

The goals and learning objectives (what you should be able to do at the end of the course) of this course are to:
• Provide a foundation of lighting system knowledge.
  • Select appropriate lighting sources, fixtures and applications for design scenario.
  • Apply the known minimum light requirements for safety in selecting light fixtures, poles and lamps in given scenario.
• Increase student mastery of advanced site grading skills.
  • Successfully complete grading plans with difficult site constraints.
  • Assess the erosion potential and identify appropriate control methods for a given site.
  • Assess the appropriateness of multi-objective strategy application to a given scenario.
• Provide a foundation of stormwater drainage and detention system knowledge.
  • Using the Rational Method, calculate the stormwater runoff for a given site.
  • Calculate pipe sizes, inlets, locations, elevations, and slopes for a given site and storm intensity.
  • Calculate the required detention facility for a given site.
  • Identify drainage systems on a given site and evaluate detention requirements.
  • Assess a given site and identify appropriate alternative detention solutions.
• Provide a foundation of irrigation system knowledge.
  • Demonstrate an understanding of the principles of hydraulics and industry standards used to design irrigation systems by selecting proper irrigation components.
  • Layout a irrigation system which will function safely and effectively for its intended purpose.
• Provide a foundation of pool and fountain system knowledge.
  • Choose appropriate materials and mechanisms for an appropriate water feature in a given context.
  • Choose appropriate safety equipment for public and user protection for water features.
• Develop your ability to generate complete and appropriate construction documents.
  • Apply the knowledge of detail design and detail drafting learned in previous courses to produce complete and legible construction documents for given projects.

Resources:

The required text for this course is Landscape Architectural Graphic Standards (full or student version), Leonard Hopper editor. However, there are also several books available in the Fine Arts Library which would be useful this semester and which you may want to add to your collection. You will need to have all of your drafting equipment and computers in the studio for in-class work. You should bring the following to class (lecture included) everyday:
  1. Note paper, writing instrument of your choice and course notes taken to date.
  2. A scientific calculator that you know how to use.
  3. Your sense of humor.
  4. A sense of great anticipation about what new and exciting things you will learn.
  5. 4" X 6" lined index cards.

Course Format:

Each class will usually begin with a lecture covering the relevant topic material. Students are expected to have read the required reading material prior to the lecture on that given subject. The lecture may be interrupted with a short learning exercise and will be followed by studio work time or, if necessary, a field trip. Additionally, several guest lectures/seminars are planned with outside guests to give additional information.
PROJECT 4
Stormwater Plan

Project Statement

This project is designed to reinforce your understanding of stormwater principles. Remember that grading plans are concerned with the vertical location of various site elements, both existing and proposed, and the proposed landforms or sculpting of the site. Whereas drainage plans are concerned with the collection, conduction and disposal of storm runoff. Grading and drainage plans are combined as a single plan for small scale and simple projects. Conversely, although very closely coordinated, they are developed as separate plans for larger and comprehensive projects. This project is an example of the first category and you will be showing both plans simultaneously.

Your task is to prepare a stormwater plan, and stormwater calculations for the grading plan for the parking lot from project 1.

Given Information

The site is located in Fayetteville, Arkansas.

Design for the 2 and 50 year storm based on the City of Fayetteville storm intensity table.

The soils on your site are typical heavy clay soils of NWA.

The design and layout of vehicular and pedestrian circulation systems have been approved as shown and can only be revised if the firm’s principal agrees with your justification.

The site shall be designed for barrier-free access from the parking lots to the pathways.

Project Requirements

Drainage

• Direct stormwater runoff of curbed areas to curb inlet.
• Direct stormwater runoff of other areas to catch basins and swales.
• Walks must have positive drainage without concentrated flow.
• Use contour lines, spot elevations and flow arrows to convey the design intent and indicate proper drainage. Surface runoff may not be concentrated flow off of the property.
• If utilized, centerlines of swales must be located off all fill areas. Show centerlines of all swales, direction and channel flow arrows and spot elevations at swale high points (SHP). The minimum swale slope is 2.5%.
• Set rim and invert (inlet and/or outlet) elevations for the curb inlets and catch basins. Set the invert elevations and the top of the wall (TOW) for the endwall at the detention basin. Provide a minimum of 24 inches of earth cover over the storm pipes. Maintain a minimum of 0.5% slope and a maximum of 10% slope on the storm pipes and 2.5-10 FPS velocity.
• Pipe type, diameter and length must be provided and pipe slopes calculated to work with your grading plan. Show pipe type, diameter, length and slope for each pipe on the drainage plan.
• Detention basin sizing and pipe sizing calculations shall be neatly done and handed in on separate 8 1/2” x 11” landscape orientation sheets and include a storage to contour curve diagram and Cd calculation.
• Use a trace overlay to determine site watersheds for pipe sizing and routing calculations or set up a separate layer on Cadd drawings and provide a watersheds plan.
• Detention basin grading shall indicate locations and elevations of endwall(s), outlet pipe, low points, weir, flow lines and emergency spillway and indicate 2 & 50 year high water levels.

Communication
• Spot elevations and notes are to be legible, well organized and relate to a specific reference point.
• Proposed contours are to be continuous, clearly drawn and properly labeled. Use proper line weight.
• Proposed contours and spot elevations are to be clearly drawn and properly labeled.
• Drawing quality must be clear, legible and must demonstrate a hierarchy of line weights. Drawing technique must adhere to professional standards and practice. Develop a professional title block to enable you to organize your plan information properly, accurately, and completely.

Submittal Requirements
You will be required to submit progress drawings and calculations as announced in class. These progress drawings and calculations will be factored into your final grades for this project. You will be required to submit one copy of a 24” X 36” print each of your revised grading plan and stormwater plan at 1” = 20’0”. These plans should demonstrate a high degree of professional quality and precision presented in an orderly fashion with good legibility. Include necessary notes, legend and title block. No original drawings will be accepted.

Provide your site watershed boundaries on 24” X 36” tracing paper that is neatly trimmed and labeled or as a separate Cadd print.

Provide your pipe sizing and basin sizing calculations (including basin routing calculations) neatly on separate 8-1/2” X 11” landscape oriented sheets with column headings and header with ‘titleblock’ and column headings information on each sheet. You are welcome to use the computer for completing and printing your calculations. Order of sheets is: Predevelopment Q, Post development Q, Pipe schedule, Basin routing, Actual basin volume calculations, Outlet sizing calculations

Provide a copy of a pipe profile for the pipe run to include the basin outlet structure on a 24” X 36” sheet.

Plans shall be bound as sets.

Project assigned: Tuesday, September 19, 2011
SYLLABUS

Credits: 3
Prerequisites: None
Class Times: T, R Periods 2, 3
Classroom: FAC 127
Instructor: Glenn Acomb, FASLA, Department of Landscape Architecture
Office Location: Room 434 ARCH
Office Hours: M, W: 11:30 AM-12:30 PM; T, R: 10:45-11:45 AM (Appointments are recommended)
Office Phone: 352.392.6098 x 315
Email: acomb@ufl.edu

Description
The design of site and built-environment systems play a significant role in sustainability and accounts for impacts far beyond site boundaries, especially on the hydrologic system through removal of vegetation, soil compaction, stormwater runoff and the related effects upon surface and ground water. This is further complicated by the consumption of approximately 50% of potable water for use in the landscape. This course will explore water resource conservation through sustainable site design methodologies with a focus on the design of green roofs and living walls.

Course Objectives
The primary objective of this course is to provide students with an understanding of sustainability through the technology of design strategies for the site and vegetated roofs. Students will be exposed to:

- Sustainability principles and metrics of the site at scales of community, site (50 acres or less), and the residential lot with a focus on the interrelationship of site natural systems with emphasis on water resources.
- An overview of the principles of low impact development (LID), including rain gardens, bioremediation and other examples of LID tools for the individual site.
- The history of green roof technology as well as contemporary approaches and applications of green roofs in the United States, Europe and Asia.
- The technology of green roof assemblies including the relationship of the roof, waterproofing, roof drainage, water harvesting components (cisterns and irrigation), growth media and plant selections with a focus on green roofs in hot-humid climates.
- An overview of green wall applications.

Evaluation Criteria
It is required that each student demonstrates qualitative growth for each of the objectives of the course. The evaluation criteria by which student work will be measured include:

- Participation (attendance, participation in class and attention to deadlines)
- Craft in Communication (documentation, computational skills/abilities, and limited graphic communication)
- Focus on Assignment Objectives (understanding the instructional purpose of an assignment)
- Exploration and Persistence (pursuit of excellence in solving the assigned work)
University of Florida  
Department of Landscape Architecture  
Fall Semester  

SYLLABUS  

LAA 3420  Landscape Architecture Construction 1  
Prerequisites:  LAA 2376/2379 Design Communications 1 & 2  

Instructor:  
Robert Grist FASLA, Associate Professor  

General  
The first course in Landscape Construction is designed to integrate the theories and principles of landscape design with the technical skills and knowledge needed for the following:  
- Grading and (basic to intermediate skill level)  
- Landform modeling 3D visualization  
- Storm water management including introduction to storm water conveyance structures  
- Road alignment (Horizontal and vertical road alignment as it pertains to local streets, and on-site roads)  
- Surveying and measurement as it pertains to LA practice  

Course Objectives  
It is expected at the end of the semester that the student will have developed the following:  
- an understanding and demonstrated ability to site, grade and layout of structures and surfaces in the landscape  
- an understanding and demonstrated ability to apply earthwork calculations and understand their role in design implementation and cost estimation.  
- an understanding and demonstrated ability to apply the principles of drainage and site water management as it relates to grading and other forms of landscape design.  
- an understanding and demonstrated ability to apply the principles of horizontal and vertical road alignment in circulation design  
- discipline, accuracy and graphic communication skills necessary for the production of contract document drawings.  
- skills and familiarity with CAD and to understand its possibilities and limitations  
- an understanding and demonstrated ability to apply the guidelines for accessibility as it relates to site design  

Course Outline / Content  
It is expected that the student will be able to demonstrate qualitative growth for each of the objectives by the end of the course. Course grade will be based on problem solving skills as they relate to the achievement of the objectives.  

Grading  
Detailed grading criteria for each offering of this course can be found in the course handout for the specific instructor and semester.  

Grading will adhere to the University of Florida Grade Policy:  

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University of Florida  
Department of Landscape Architecture  
Spring Semester 2013  
Course Outline

LAA 3421  Landscape Architecture Construction 2  5 Credits  Studio  
Prerequisites:  LAA 3420 Landscape Architecture Construction 1

Class Times:  Lecture Monday/Wednesday/Friday at 1:55 PM – 2:45 PM  
            Studio Tuesday, Thursday at 8:30-11:30 AM  
Class Location:  Arch Studio 322

Instructor:  
Robert Grist, Associate Professor  
e-mail: grist@ufl.edu  phone 392-6098 ext.323

Teaching Assistant:  Chris Cook, Graduate Student  
Email: cdcook18@ufl.edu

General  
The second course in Landscape Construction is to integrate the theories and principles of  
landscape design with structural design, selection and specification of materials, material take-  
offs, and cost estimating. Implementation processes are emphasized at detail design levels.

Course Objectives:  
It is expected at the end of the semester that the student will have developed the following:

- an understanding and demonstration of the interrelationship of construction and  
design, and the development of skills of organization, precision and accuracy in  
construction documentation.

- an understanding and demonstrated ability to design structural systems common to  
landscape architecture (paving, freestanding and retaining walls, non-habitable wood  
construction)

- an understanding and demonstration of the proper use of construction materials  
commonly used to implement landscape architectural design and the related  
connections with other materials

- an understanding and demonstrated ability to design water harvesting and smart  
irrigation systems

- an understanding and demonstrated ability to properly layout and dimension site  
elements

- an understanding and demonstrated ability to provide conceptual cost estimation of  
proposed design

Course Outline / Content  
It is expected that the student will be able to demonstrate qualitative growth for each of the  
objectives by the end of the course. Course grade will be based on problem solving skills as  
they relate to the achievement of the objectives.
Lecture: MWF, 1:25 p.m. – 2:15 p.m.
Room 214 MLC

Instructors: Alfie Vick, Associate Professor
Office: 202 Denmark Hall
Office Hours: come by anytime or make an appointment
Phone: 542-6550
email: ravick@uga.edu

Course Description:
The range of natural processes and materials relevant to landscape architecture (e.g., climate, geomorphology, geology, hydrology, soils, and vegetation communities.) The relationship between these materials and natural processes. Credit: 3 hours.

Course Objectives:
Knowledge
• To develop an understanding that science provides a critical underpinning for land use and landscape design decisions.
• To develop an understanding of the relationship between human populations and the environment.
• To develop an understanding of the availability of environmental resources and the need to sustain them in the future.

Skills
• To develop an ability to anticipate the environmental impact of different land use and landscape design decisions.
• To develop an ability to critically evaluate environmental problems and solutions.
• To develop an appreciation for interdisciplinary collaboration and an ability to integrate information from a variety of sources.

Values
• To develop a land ethic.
• To understand and value the services provided by intact ecosystems.
• To recognize and appreciate the global scale of environmental issues.
• To develop an understanding of the social impact of environmental problems.

Readings: Readings will be assigned primarily from the required text, but may include various books, articles and papers, as announced in weekly lectures. Material covered in readings will not necessarily be repeated in class, but may be included in exams. If you have questions about material in the readings, bring questions to the course instructors for discussion and clarification.
LAND 3330 Landscape Engineering Processes and Materials

When: Monday, Wednesday & Friday 1:25 – 3:20 PM
Where: 3rd Year Studio, Environment Design Building (26 CED)

Professor: Katherine Melcher
Office: 9 Bishop House
Office hours: after class or by appointment
Phone: (706) 372-4934
E-Mail: kmelcher@uga.edu

Prerequisites: LAND 2020 and LAND 2210

COURSE DESCRIPTION:
The forming and building of landscapes with emphasis on the values of sustainability. Includes an introduction to landscape engineering: grading, drainage, and roadway alignment. 3 credits. 6 hours lab per week.

COURSE OBJECTIVES:
Knowledge - by the end of the class, you should know:
- How three dimensional land forms are represented in two dimensional drawings.
- The relationship between land forms, contours, and water flow.
- The basic formulas for calculating slopes, road alignment, and cut and fill volumes.
- The role grading and drainage plays in landscape architectural design.
- The graphic standards for grading plans.
- Acceptable slope ranges for accessibility and erosion control.

Skills – by the end of the class, you should be able to:
- Read a contour map and develop scaled sections from a contour map.
- Prepare basic grading plans for roads, parking lots, and building swales.
- Calculate horizontal and vertical curves for roads.
- Calculate storm water runoff and size drainage structure accordingly.
- Calculate cut and fill volumes for grading plans.

Values - by the end of the class, you should have developed:
- A sensitivity to land forms and the consequences of grading when designing for human use of the landscape.
• An understanding of the consequences of surface drainage vs. subsurface drainage for storm water management and infiltration.

**METHOD:**
The course will consist of a series of short projects designed to introduce the students to the basic concepts of landform recognition, site grading, earthwork calculations, and stormwater runoff. Generally, each class period will consist of a brief lecture by the professor, followed by one or more problems. Both the lectures and work problems will cover the reading assignments, which must be completed prior to class.

Lecture material will be handled in the studio, usually at the beginning of class. Some studio problems must be completed during the scheduled studio hours. Campus walks and field trips will supplement the lectures and exercises. Quizzes and exams will be similar to the exercises assigned in class and will be open-book and open-note.

**REQUIRED TEXT AND WORKBOOK:**
Copies of *Fundamental Land* by Roberts and Lane, and the LAND 3330 Workbook are available at Bel Jeans on Broad Street. Ask for the course material under Professors Melcher and Nichols names. Class reading assignments are to be read before each day's class meeting. **You are required to have your workbook, pencil, calculator, and engineering scale for each class period.**

**REQUIRED SUPPLIES:**
- Engineering scale
- Drafting supplies (T-square, triangle, compass, pencils, trace paper)
- A laptop with AutoCAD loaded by Oct. 1
- A calculator with trigonometry functions (sin, cos, tan) by Oct. 10
- Additional material (foam core, exacto knives, hot glue) will be required on a project by project basis

**GRADING SUMMARY:**
Your graded work includes studio problems, exams and comprehensive design application problems. This portion of your work will be 100% of your grade.

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<td>Final Comprehensive Exam</td>
<td>Fri., Dec. 7, 12-3 pm</td>
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Prerequisites: LAND 3330 and LAND 3340

Course: 3 Hours; 2 lectures and 1 lab per week

Meeting: Friday 8:30-12:30 at Center in Covington

Faculty: Donnie Longenecker 678.873.3531 longneck@uga.edu

Course Description
Site design and construction have direct impacts upon the exposure of soils to erosion and the quantity and quality of stormwater runoff. Proper site design, the sizing and placement of stormwater components and systems, and the design of soil erosion and sediment control practices are addressed. NPDES standards are identified and practices described in the Georgia Stormwater Manual and the Manual for Soil Erosion and Sediment Control in Georgia are applied.

Guiding Thoughts
“Conservation is a state of harmony between men and land.” Aldo Leopold “There can be no purpose more enspiriting than to begin the age of restoration, reweaving the wondrous diversity of life that still surrounds us.” Edward O. Wilson Development and redevelopment are processes essential to human community; harmonizing them with the natural environment is essential to sustaining human community. The specific tasks necessary to fit man and nature together, to conserve what we now share and to restore what has been lost is the task of the landscape architect.

Landscape Architects are directly involved in shaping the land in most projects. Respect for the nature of the land and its related communities and systems, protection of the environment from degradation, and the importance of preserving and enhancing the condition of natural resources are essential ethical standards. How we meet these standards requires attention to both broad planning concepts and detailed analytical skills.

Federal and State ordinances and regulations address important issues such as soil erosion and sediment control and stormwater management. Ordinances and regulations establish minimum standards for acceptance and must be satisfied in order to permit a project, but the principles behind such ordinances and regulations as well as their intended goals are important to grasp. As a landscape architect, respecting these standards is necessary, but they should never become the measure of excellence.

Objectives
Students satisfactorily completing this course will be able to demonstrate through testing and through the completion of site design projects/problems the following:

Knowledge
an understanding of role of erosion control and stormwater management in protecting the environment as well as human health, safety and welfare.
an understanding of the NPDES permit process
an understanding of Georgia standards for soil erosion and sediment control
an understanding of Georgia standards for stormwater management
an understanding of Best Management Practices for Low Impact Development and meeting Sustainable Sites Initiative guidelines
an understanding of stormwater calculation methods: rational formula, SCS method, and other runoff volume formulae.
Skills:
the ability to apply the rational formula, SCS method and the water quality volume formula for stormwater calculation to a variety of site development situations.
the ability to design and size swales, piping and detention facilities
the ability to design and size bioretention facilities
the ability to utilize a set of computer based programs for stormwater calculations
the ability to select and apply appropriate soil erosion and sediment control measures to a variety of site development situations.

Values: To recognize, respect and implement principles of sustainability in site development with particular emphasis on minimizing the production of soil erosion and stormwater runoff, maximizing on-site stormwater treatment, and integrating stormwater facilities into the landscape artfully.

Method: Instruction will include lectures, field site visits, small site design exercises, computer application exercises, quizzes and tests.

Lectures:
Most lecture sessions will provide pertinent instruction regarding the responsibilities of the landscape architect in both soil and stormwater management. Lectures will highlight important material from readings associated with the class, but will not serve as a replacement for reading assigned articles, chapters or posted information. This course is intended to be very practical in focus because the drawings and reports associated with this material are required on nearly every project an office produces.

Lab Activities
Most lab sessions will contain exercises to apply lecture material to site problems and incorporate practical methods and computer applications for designing site facilities. Homework that consists of similarly important exercises will be assigned. Computer applications will be required for many of these exercises; please note that the WinTR-55 program only runs on Windows; as per CED Technology policy you must come to class with a Windows compatible laptop.

Field Trips:
We may take a series of local walks during class and possibly one or two off-campus site visits; if any field trips should require time outside of the standard class time you will be informed in advance. Information viewed or discussed on field trips may be incorporated into exam questions or have assignment applications. IMPORTANT: Because this class deals with the relationship between the land and water, be prepared (wear appropriate clothing) to walk and observe the landscape, ESPECIALLY when rain is forecast or when it is raining – particularly on lab days.

Testing
This course will include periodic quizzes, tests and a final examination. Tests may require the use of a calculator and or a windows-based computer. Use of a cell phone or other electronic communications medium during testing is not permitted. References for tests/exams include all class lectures, demonstrations, class handouts, desk critiques, red-lined drawings, required texts, and any materials in the class folder or on eLC.
Exercise: Lab 01 Part 1

In your previous courses you have prepared grading plans for everything from small gardens to residential subdivisions, including roadway plan and profile sheets. The first two labs this semester will review grading skills focusing mostly on moving and storing water in the landscape. Applications of these skills will be essential for the remainder of the semester.

Depression Ponds

The simplest kind of surface water storage is a depression. The simplest depression is created by excavating earth only. The outlet for the depression is the lowest at-grade existing elevation along the perimeter of the depression. Locate the appropriate outlet point for a depression and then grade the interior of the depression to service that outlet. After working the in-class example, prepare the second one for homework.

Berms

An earth berm is a landform created by adding fill to the surface of a site. Shaping that berm to facilitate screening, aesthetic qualities, and redirection of water flows is an essential skill. The simplest berms are created by establishing desired vertical elevations at each end of the berm and then by establishing the side slope gradient back to existing grade. Berms can be made much more complex if desired. After working the in-class example, prepare the second sheet for homework.

Lab 01 Due: Beginning of Class Wednesday

Evaluation:

40% Fulfilled problem requirements
40% Correctly graded within minimum and maximum grade requirements
10% Graphics are well executed and meaningful; adheres to grading plan graphic conventions
10% Text is clear, legible and complete
Swale and Pavement Grading Skills

This lab will focus on a review of swale and pavement grading. Follow along with the in-class demonstration on your own exercise sheet, then prepare a solution for the second parking lot and the third residential site for homework. Graphic quality and clarity is included in the evaluation.

Parking Lot 2 Scoring:
12 points - (1 pt each) for correct elevations at the 7 required points (top and bottom elev at 5)
5 points - correctly labeling TC & BC at 5 locations
5 points - (1 pt each) Proposed contours correct on parking lot surface
5 points - (1 pt each) Proposed contours correct on curbs
4 points - (1 pt each) Proposed contours correct on sidewalk
13 pts - (1 pt each for each segment not clearly continuous) Proposed contours labeled
2 points - (1 pt each) Swale contours properly shown
12 points - (1 pt each side 63 thru 67, + 1 pt each 61-62) Contours return to grade properly
2 points - No return slopes exceed 2:1

Total 60 pts

House with 24” Oak tree

5 pts no slopes exceed 3:1 anywhere
5 pts swales are min. 2% slope
2 pts FFE is indicated
5 pts Grnd level adjacent to FFE is clearly marked min. 6” below FFE. Spots are indicated outside bldg.
2 pts HP of swale is clearly marked
2 pts HP satisfies min. 6” drop over first 10 feet away from bldg edge.
2 pts Ending elevations of swales are clearly marked
4 pts Both swale longitudinal slopes are clearly marked in percent
6 pts Swale slopes and lengths are consistent mathematically
10 pts Swale return contours are correctly executed
4 pts Return contours around house are correctly executed based on selected FFE
3 pts 24” Oak is preserved (no grading in drip line)
10 pts All contours are properly labeled

Total 60 pts
Erosion control plans must include a variety of BMP’s to be effective. This lab requires you to apply what has been presented in recent lectures to a development site. Use the Georgia Soil Erosion and Sediment Control Manual in the class folder to guide your design and designation of both vegetative and structural BMP’s necessary to control erosion and sedimentation on these two drawings.

Objectives:

1. Use and become familiar with the appropriate symbols to designate BMP measures on an erosion control plan.
2. Design structural BMP placements and specify type.
3. Properly interpret grading plans and storm drainage plans to place necessary BMP’s.
4. Apply professional quality graphics that can be clearly understood by a reviewing agency.

Steps:

1. Determine limits of disturbance
2. Determine and indicate the appropriate vegetative BMPs to address erosion control for the entire site
3. Determine where structural BMPs are necessary.
4. Indicate location, spacing, extent and any additional design criteria necessary

Notes:

1. All storm system structures are either inlets or outlets except for C-4 and C-5; they are junction boxes and do not have to be protected.
2. Inlet watershed area for E-2-2 is approximately 4 acres
3. A temporary sediment basin is not required
4. You may attach an additional sheet(s) of paper with any further documentation you deem necessary to communicate your solution.
In the class folder on the Caldwell Server, select a watershed map and sign up for a watershed location by the letter designated watershed outlet point (red dots). Each class member will be responsible for producing the following:

1. A delineated watershed map printed on an 11x17 sheet of paper at an appropriate measurable scale (labeled) using a proper engineering scale. (can show both exist. & dev. condition). Show the hydraulic length on the map and label it with length(s) and percent slope.
2. A calculation of the area of the watershed in acres.
3. A determination of the peak rate of runoff for the watershed existing condition (1 & 25 yr. freq.)
4. A completed rational formula worksheet for the watershed existing condition
5. A determination of the peak rate of runoff for the watershed (1 & 25 yr. freq.) assuming 30% of its area is developed into residential having a runoff coefficient of 0.50. Draw on your map where that 30% of the total watershed is located and develop a new average weighted C for the watershed.
6. A completed rational formula worksheet for the watershed developed condition.
7. Any additional documentation necessary to explain your runoff determination

Submit on Wednesday, Feb 27, at the beginning of class.

Notes:
Use the FAA time of concentration spreadsheet for calculating overland flow travel time
Use the Mannings formula spreadsheet for calculating channel flow travel time

Use the following rainfall intensity tables for the watershed maps:
Blairsville: Toccoa
Joanna: Peachtree City
Henderson: Metro-Chattanooga

Evaluation:
Completeness: 30%
Watershed delineation: 10%
Watershed area calculation: 10%
Hydraulic length determination: 10%
Coefficient of runoff determination: 10%
Time of concentration determination: 10%
Qp determination: 10%
Graphic/written clarity and quality: 10%
Land Use & Runoff Reduction

As described in the lectures, land use has direct impact on runoff rates and volumes. On sites with multiple soil types and multiple land use characteristics, the selection of where those land uses are placed will affect the resultant peak rates and total runoff volumes for the site. Using what you know of the SCS model and land use change implications, determine the best placement of land uses on the following 64-acres site to minimize both runoff peak rates and runoff volumes in the after development condition. By proposing this arrangement of land uses you will save the developer significant expenses related to stormwater management, while still providing the desired mix of land uses and land use areas.

Process:
1. Run the before development model and record Qp and Qvol for the 1, 10 and 100 year events.
2. Make your best guess as to the most desirable land use placements and re-run the model. Record the results for each of the three frequencies and determine the percentage increase in runoff.
3. Propose other solutions and compare the results. Report all results and explain why the one with the lowest increase in runoff performs best.
4. Submit all results and graphic layout diagrams. Include:
   a. Sub-areas land use and curve number details table
   b. Sub area time of concentration details table
   c. Watershed peak table
   d. TR-20 Printed Page Report summary showing drainage area and runoff amount in inches
   e. Your calculations of Qvol based on the TR-20 report

Site:
Location: Athens, GA
Exist Conditions: TB Assigned
Storm Frequency: 1, 10 and 100 year events
LH Sheet Flow: 100 LF
Area: 64 Acres
LH Shallow Conc. Flow: 1,080 LF
HSG: As assigned on each sheet
LH Channel Flow: 1,180 LF
Slope: 4%

Required After Development Land Uses:

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Channel Configuration

3’ n=0.040
8’
Lecture: Tuesday / Thursday: 11:00 a.m. – 12:15 p.m.
Room B2, Main Library

Lab: Tuesday: 8:00 – 10:45 a.m. (Zeichner)
Thursday: 2:00 – 4:45 p.m. (Zeichner)
EDB Studio

Instructors:

Prof. Alfie Vick  Prof. Lauren Zeichner
Office: 202 Denmark Hall  Office: 207 Denmark Hall
Office Hours: by appointment  Office Hours: by appointment
Phone: 542-6550  Phone: 706-540-4645
email: ravick@uga.edu  email: lzeich@uga.edu

Prerequisite: Landscape Architecture (LAND) 2310

Course Description:
Introduction to the relationship between the functioning of ecosystems and landscape planning, design, restoration and management.

Course Objectives:

Knowledge and Skills
To develop an understanding of how principles of landscape ecology can inform the processes of landscape design, planning and management.

To apply principles of landscape ecology to the planning of communities and the design of individual sites.

To develop an understanding of the principles of habitat preservation, conservation and restoration and how these can be integrated into landscape design and planning.

To develop an understanding of methods and practices of landscape design.

Values
To develop a sense of the importance of respecting unique physical and ecological characteristics in landscape planning and design.

To acquire a sense of the ecological costs of development and the potential for minimizing those costs.

To become aware of the potential positive relationship between ecologically-sound landscapes and aesthetic quality.

To develop an awareness of our potential to restore ecological function, productivity and aesthetic quality to previously-degraded sites.
PHILOSOPHY

In the “grading and drainage world,” the manipulation of land for aesthetic, ecological and/or functional purposes is considered the mainstay of the profession of Landscape Architecture. The ability to understand land, including the factors that influence its utilization, is the fundamental basis upon which the profession is built. Without a near comprehensive understanding of land, no matter the quality of the design to which it is imposed, there is little hope of a successful outcome. You, in previous classes, have seen that civilizations rose and fell on the basis of their ability to utilize land resources in a sustainable manner (e.g., the mythical Garden of Eden, the Greek and Roman empires, the Persian empire, etc.). And, you have experienced, in an introductory sense, the basic concepts of design as related to form and form giving. As you progress through your landscape architectural learning experience, you will be offered more pieces to the puzzle called landscape architecture. Your main task will be to figure out where the pieces go. At first the pieces will emerge as strange amorphous shapes. There will be no obvious spaces in which to place them. Nothing will be constant. Just when you think you have it figured out and you are ready to insert the piece, the form will change and the piece won’t fit at all. Puzzle pieces are like that, as is landscape architecture. Frustrating, isn’t it? But, therein lies the challenge. Not everyone has the opportunity and the ability to become part of the greatest profession known to human kind. Are you up to the challenge?

OBJECTIVES
As this is an introductory course, the objectives will center around:

- **Knowledge**
  Knowledge consists of learning information from lectures, readings and desk “crits.” Knowledge will be assessed via the standard quiz format and by your in class participation. You will be expected to know material and procedural specifics, in addition to their applications.

- **Skills and Ability**
  Skills and abilitys consist of applying the knowledge base to the assigned vignettes (problem sheets) and to demonstrate your prowess in solving problems. Learning will be assessed via the “vignette” format.
COURSE CONTENT

Design Implementation I is the first of a sequence of landscape technology courses that will culminate in your ability to produce the documentation necessary to construct a project. **Remember a great design is rather useless if it cannot be actualized.** In fact, I firmly believe that a drawing that cannot meet its intended function is not a design. It may be a good piece of art, but that is all. It is not a design. You can hang it on your wall but that is about all it is good for!

This course will consist of four basic aspects of implementation as related to site development:
1. Understanding land forms in plan and elevation.
2. Manipulation of land form as related to built form.
3. Calculations relative to earth movement and shaping.
4. Drainage - surface and subsurface situation

Each of the above aspects is important to your continuing success in the program and ultimately the profession. As you progress through this sequence you will be expected to draw on the knowledge previously gained earlier in the course and apply it to new problems as they are presented. This course is much like the first course in a foreign language where upon passing you cannot speak the language but you understand its structure. However, if you barely squeaked by you will have an extremely difficult time with the following sequence. So, the moral of the story is: **Learn and understand the basic principles or you will have a very difficult time as your education proceeds.**

QUIZZES

There will be a series of unannounced quizzes (some may be open book but don’t count on it) given at the beginning of class. The information for these quizzes will be taken entirely from class handouts and/or from notes taken during previous classes. **If the quiz is open book you will only be allowed to use the Notebook (see below) you are keeping as the information resource.** Therefore, it is to your advantage to keep all handouts in an orderly fashion and to take and keep a good set of notes from the lecture/discussion sessions. If you review your notes prior to each class there should be no reason why you would not get full credit for a quiz. The quizzes cannot be made up and if you arrive late you get the time remaining, if any, to finish the quiz. **I reserve the right to have as many or as few quizzes as I deem necessary.**
SYLLABUS

“Everything you do must be done with the idea of impressing people with your ability.” (Anon.)

COURSE PURPOSE

The purpose of this course is to understand and experience the theory and practicum of the construction document (technical) aspects of landscape architecture, including site design, site engineering, implementation and commonly utilized standards. In general this includes the production of:

1. Base Information
2. Design Plan
3. Contract Document Set
4. Technical Calculations

While there are many ways of producing a set of construction documents, for purposes of this class, each individual is responsible for the development and completion of his/her own set. You are urged to develop a personal style, however it must comply with commonly acceptable, industry wide standards. The studio time period will be utilized to introduce topics and methodologies, to perform exercises critical to the total process, to critique various phases of the procedure and to provide feedback relevant to individual progress. It is IMPERATIVE that you establish a detailed, rigid work schedule and that you utilize it to guide your progress in the formulation of a successful and timely set of construction documents.

By conscientious participation you will find that the level of difficulty of producing the construction document set will not be as great as expected. If you take good notes, work for the entire class period and ask good questions, you will be amazed at the amount and quality of work that will result. You may even grow to enjoy it and, more importantly, you will be proud of your effort. Under no circumstances are you to allow yourself to get behind in the process. It makes the task more difficult, you will not learn as much, you will not do as well, you will not enjoy the class, the learning curve will steepen and success will be more difficult to attain.
LA 3534 Construction II Gallo 2012

COURSE SYLLABUS

general information

Credits: 4
Course Type: Lecture and Lab
Class Meetings: Monday and Wednesday, 9:00-12:00
Assigned Room: Landscape Architecture Building A 200
Instructor: Cory Gallo  Assistant: Robert Jackson
P: 662-325-3249  rj1856@msstate.edu
E: cgallo@lalc.msstate.edu
O: C-113
Hours: Monday, 1:00 – 2:00

Required Texts: Strom, Steven. Site Engineering for Landscape Architects, Wiley. 2009. (4th or 5th edition)

course overview

Catalog Description: (Prerequisites: LA 2644). Two hours lecture. Four hours studio. Calculations for storm- water management, best management practices, surface and subsurface drainage systems, basic hydrology and erosion and sediment control design and practices.

Course Goal: To introduce students to the methods, procedures, and office practices of landscape architectural construction emphasizing the use of BMPs to control the quality and quantity of stormwater runoff.

Course Objectives: Upon satisfactory completion of this course students will:

- Have an overall knowledge of how water can be used as a resource throughout site design.
- Have a working knowledge of calculating runoff rates, volumes, and required detention storage using traditional methods.
- Have a working knowledge of innovative uses of stormwater BMP's within the context of Low Impact Development.
- Have a working knowledge of constructed wetlands.
- Demonstrate this knowledge by installing solutions on a site in Starkville.

general schedule
The following class schedule is an overview of when materials and topics will be covered. Dates will become more refined as the semester moves forward.

**Part 1**  Traditional Stormwater Management  
August 20th – September 19th

**Part 2**  Best Management Strategies  
September 24th – October 24th

**Part 3**  Infrastructure Design  
October 29th – November 28th

**Part 4**  Implementation Project  
November 26th – December 7th

### evaluation and grading

The following grading scheme will be used to evaluate all work:

- **A = 90-100%**  
  Excellent work. All required work for the project or assignment turned in on time with a superior product or effort.

- **B = 80-89%**  
  Good work. Good understanding of the subject area with some possible improvement.

- **C = 70-79%**  
  Satisfactory work. Assignment complete but improvement possible in all areas.

- **D = 60-69%**  
  Poor work. Passing but not acceptable for degree requirements in the Department of Landscape Architecture.

- **F = < 60%**  
  Failure. Work incomplete or lack of effort.

The following percentage points will be used to make up a possible 100% of your grade:

- **20%**  
  Project 1: Traditional Basin Design

- **20%**  
  Project 2: BMP Design

- **15%**  
  Project 3: Infrastructure Design

- **15%**  
  Lab Assignments/Quizzes

- **10%**  
  Mid-term Exam

- **10%**  
  Final Exam

- **10%**  
  Implementation Project
**LA 3534 \ LA Construction II \ Fall 2012**

**PROJECT 1 \ Dry Detention Basin**

**introduction**

Detention basin sizing is usually the responsibility of a civil engineer. However, landscape architects typically have to communicate technical requirements with engineers and have to use sizing information to shape a basin into the site. In either case landscape architects needs to understand the principles of how basins work and how they are sized.

For this exercise you will use the rational and modified rational methods, described in class to determine the required basin volume for the 25-year rain event for Starkville, MS. While the rational method is the oldest still in use, it is still considered appropriate for determining peak rates and volumes on sites under 100-acres.

Your project area will be the LA campus, which has type “C” soils throughout. The project limits is provided within the project base map.

**project requirements**

You are required to complete the following tasks for this project:

- **Watershed Delineation**
  - Assuming surface conveyance, the entire project area will be conveyed to your detention basin.
  - Determine the area of each material that will have a unique run-off coefficient value.

- **Detention Basin Sizing**
  - Using the rational and modified rational methods, determine the pre and post peak CFS leaving the site and the necessary detention volume necessary to maintain pre-development CFS rates to the 25-year storm event.
  - All calculations will be provided during class lectures.
  - The runoff coefficients will be provided on my-courses.
  - The Nomograph for Overland Flow Time is provided in your textbook.

- **Detention Basin Design**
  - Based on your sizing calculations, design and grade a dry detention basin where the 25-year event is detained at the emergency spillway elevation and embankment elevation is set 1’ above the 25-year detention volume.
  - Basins must be vegetated and include inflow location(s), a low-flow channel, barrel outlet structure, emergency spillway, and outfall.
  - All existing site structures are to remain in place.
  - Use lectures and information available in section 3-4-1 of the Georgia Stormwater Manual for reference.
deliverables

All deliverables are to be submitted in a professionally published 11”x17” half-size booklet. All of the deliverables below are described in terms of full-size, so a 10-scale plan will be submitted at 20-scale. All sheets are to have proper scale bars, notes, and north arrows. All sheets are to be in black and white and use appropriate line-weights to differentiate elements. NO PHOTOSHOP FILES!!!

- **Cover Sheet (NTS)**
  - Project title, date, name, class, instructors, table of contents, project location map, (at a minimum). **Due on 9/10.**
- **L-1 Watershed Delineation Plan (1”=50’)**
  - Watershed area contributing to basin, each surface material identified with unique hatch pattern, legend with material totals. **Due on 9/10.**
- **L-2 Detention Basin Sizing Calculation Sheets**
  - All necessary rational and modified rational method calculations, including charts, tables and formulas. **Due on 9/10.**
- **L-3 Site Plan (1”=10’ or 1”=20’)**
  - Site Plan with grading as a base which includes plant material massings, trees, walks and at least one pavilion and/or outdoor classroom. **Due on 9/19.**
- **L-4 Grading Plan (1”=10’ or 1”=20’)**
  - 1’ contours with spot elevations at inflow, outfall, spillway and top of embankment describing the proposed basin. Indicate the location of the 25-year detention volume. **Due on 9/19.**
- **L-5 Basin Volume Calculations**
  - Calculations with supporting diagram identifying the actual size of the basin designed. Must be equal or greater then required volume identified on L-2. **Due on 9/19.**
- **L-6 and L-7 Basin Sections (1”=10’ with 4x vertical exaggeration)**
  - 2 construction sections identifying the major elements of the basin including the location of the 25-year detention volume. **Due on 9/19.**

schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture</th>
<th>Lab</th>
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<tbody>
<tr>
<td>8/20</td>
<td>Class syllabus</td>
<td>Campus Walk</td>
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<td>8/22</td>
<td>Stormwater Basics</td>
<td>CAD Workshop</td>
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<td>8/27</td>
<td>Rational Method</td>
<td>Rational Method Review</td>
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<tr>
<td>8/29</td>
<td>Modified Rational Method</td>
<td>Basin Sizing</td>
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<td>9/3</td>
<td>Labor Day Holiday</td>
<td>Beach??</td>
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<td>9/5</td>
<td>Detention Basin Design</td>
<td>Basin Grading</td>
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<td>9/10</td>
<td>Work Day</td>
<td><strong>Cover Sheet, L-1 and L-2 Due by 12:00 P.M.</strong></td>
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<tr>
<td>9/12</td>
<td>SCS Curve Based Modeling</td>
<td>Using SCS Curve Models</td>
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<tr>
<td>9/17</td>
<td>SCS Curve Based Modeling</td>
<td>Using SCS Curve Models</td>
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<tr>
<td>9/19</td>
<td>Work Day</td>
<td><strong>L-3, L-4 and L-5 Due by 12:00 P.M.</strong></td>
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grading criteria

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<td>Cover Sheet and Title Blocks</td>
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<td>Site Plan</td>
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<td>Watershed Delineation and Surface Material Take-offs</td>
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<td>Detention Basin Sizing Calculation Sheets</td>
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<td>Grading Plan</td>
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<td>Basin Volume Calculations</td>
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<td>Basin Sections</td>
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<td><strong>Total</strong></td>
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introduction

Over the next few weeks you will be exposed to various forms of site-level Best Management Practices or BMPs. You are to develop a site plan for the Landscape Architecture courtyard that integrates sustainable stormwater facilities into a holistic site design. **This will be a two-part design problem.** First, you will develop an illustrative site plan to show your design concept. Second, you will develop a construction drawing package explaining the detailed components of your plan. To help you through the process, there will be pin-ups at the end of each lab.

This project description contains the following chapters that will provide more detailed information:

- **Project.** The project area and intent of this project.
- **Program Elements.** The site and stormwater elements required for your design solution.
- **Design Criteria.** How you should approach sizing your facilities.
- **Deliverables.** What will be required in each package.
- **Schedule.** A detailed schedule of class activities until the due date.
- **Grading Criteria.** How your work will be graded.

project

The “watershed” for your project area (shown below) is the roof and ground area, which produces stormwater and is collected in the inner courtyard of the Landscape Architecture complex.

![COURTYARD](image)

Within the defined project area, design a courtyard that fulfills the required program and manages stormwater at the source. You are to design your stormwater plan in terms of collection, conveyance, management, and conveyance; considering water management at every step of the process. For this project, assume that there are no existing drain inlets or downspouts in the courtyard. Your plan must be able to move all surface and sub-surface stormwater safely out of the courtyard and direct it to the swale to the west of the complex.
program elements

Your design should include the following site elements:

- a central plaza
- circulation
- seating
- a pavilion
- planting areas

Additionally, your design should include the following stormwater management facilities:

- 10,000 gallons of cistern storage
- flow-through planters/basins
- infiltration planters/basins
- pervious pavers
- green roof (over pavilion)

design criteria

All impervious surfaces must be managed by one of the following stormwater facilities using their associated sizing factors, which are calibrated to manage the 2-year design storm. **You must use at least one of each of the following facilities**! Use details provided in lectures and/or see the Portland Stormwater Manual for BMP design details.

**Cisterns**

Provide a total of 10,000 gallons (1,337 cu.ft.) of storage. Can be accommodated in multiple locations, but cisterns must be able to receive water from building roof areas.

**Flow-through and Infiltration Basins** (roof areas)

- Reservoir Depth: 12”
- Side Slopes: 3:1
- Sizing Factor: .20
- Minimum Width: 9’

**Flow-through and Infiltration Planters** (roof areas)

- Reservoir Depth: 12”
- Sizing Factor: .15

**Pervious Pavers** (plaza and circulation)

- Depth of Storage Gravel at 40% Void: 10”
- Sizing Factor: 1

**Green Roof** (pavilion)

- Soil Depth: 4” Minimum
- Maximum Slope: 5%
- Sizing Factor: 1
introduction

You have been hired by the City of Starkville to design a new Community Park. The park will be located in a new residential neighborhood that will manage water quality on each residential lot and surface convey the additional runoff to a regional facility to be located within the park. You are to arrange the required program elements and stormwater facilities within the site area in a way that both satisfies the needs of a community park and manages stormwater. The elements that you are to include in your plan include: an entrance drive, parking lot, walks, open-air pavilion, a trail head that leads to a nature trail, and a regional stormwater management facility. Your design should stay within the designated “limits of work” identified on your base map.

This project will take place over a 4-week period. In order to keep you on track, the project has been broken into two packages, each with its own due date. Pin-up sessions will also be held to allow students to ask questions and work toward deadlines. You are expected to work in lab throughout the assignment.

program elements and design criteria

Entrance Drive
Size: Adequate to accommodate two lanes of traffic and connect Park Drive to the parking lot. It should also have a designated pick-up and drop-off area.
Location: Connected to Park Drive and aligned with Village Blvd.
Materials: Asphalt with concrete curb and gutter.
Stormwater Management: Infiltration basin. Use sizing and design criteria from BMP Courtyard Project 2.

Parking Lot
Size: 14 spaces with 2 ADA spaces for a total of 16 spaces.
Location: Up to designer.
Materials: Asphalt with concrete curb and gutter.
Stormwater Management: Infiltration basin. Use sizing and design criteria from BMP Courtyard Project 2.

Walks
Size: All walks should be 6'-8' wide.
Location: Connect all elements in the park to each other and to the Park Drive sidewalks. Connects to parking lot and pavilion must meet ADA guidelines. Additionally, the walk network is encouraged to take advantage of the regional stormwater facility as an educational opportunity.
Materials: Pervious material to be picked by the designer. Use sizing and design criteria from BMP Courtyard Project 2.

Pavilion and Amphitheater
Size: Able to accommodate 30 people.
Location: Up to Designer
Pavilion Materials: Concrete slab and wood structure with green roof to manage stormwater. Use sizing and design criteria from BMP Courtyard Project 2.
Trail Head

Size: Up to designer.
Location: At the beginning of the nature trail located on the base map.
Materials: Should include trail sign and seating. Ground should be pervious material picked by the designer.

Regional Stormwater Facility

Configuration: Must be designed as a shallow wetland stormwater detention facility as defined by the Georgia Stormwater Manual. The facility should have no more than 20% (1:5) side slopes above the normal water level (WQ Level) and 33% (1:3) below the normal water level. The overall width should be no more than half of the overall length of the facility.
Size: Must be able to provide 60,000 cu. ft. of storage above the normal water level in order to manage a 25-year design storm for the neighborhood, and the embankment should be 1’ above the 25-year water elevation.
Location: The facility should be located to receive stormwater flows from the planned conveyance swales on Park Drive (only swales upstream of the park) and Village Blvd. and from impervious areas within the community park. Elevations of swales where you are to connect to them are given on your base map.
University of Tennessee-Knoxville
Master of Landscape Architecture
LAR 545 Landscape Architecture Design III (6)

Fall Semester 2011

MEETING TIME AND LOCATION
MWF 1:25 pm- 5:30 pm, Fourth Floor Studio, CoAD

INSTRUCTOR
Assistant Professor Brad Collett
Faculty office: 106 Environment and Landscape Lab
Office hours: By appointment
Office Phone: 865.974.7176
E-mail: bcollett@utk.edu

COURSE DESCRIPTION
Advanced studio with urban design focus. Particular emphasis on design of urban projects and infrastructure that enhance human knowledge of and sensual engagement with regional civic, cultural, and ecological aspects of urban place while sustaining sustain human health and natural environments. Exploration of topical/thematic issues using a mixture of analog and digital media.

REQUIRED BACKGROUND OR EXPERIENCE
Prerequisite(s): LAR 542

LEARNING OBJECTIVES
Upon completion of the course each student should be able to:
-Understand pre- and post-development site hydrological systems
-Demonstrate the ability to attain information pertinent to issues that impact regional and site design and planning decisions.
-Demonstrate an understanding of the relationships between regional sustainability issues and site design approaches
-Demonstrate an understanding of the quantitative and quantitative benefits of LID storm water best management practices
- Demonstrate an understanding of LIDBMPs as integral components of a multi-functional landscape system
- Demonstrate the ability to develop a site design from site experiences, inventory and analyses that meets programmatic requirements in the context of existing conditions, quantitative objectives and jurisdictional regulations
- Achieve function, form, and system performance through design synthesis
- Demonstrate project management skills, an understanding of critical path and design as process
- Demonstrate the ability to communicate research, analyses, design and systems/processes clearly and succinctly in visual formats
- Demonstrate open-mindedness and the ability to collaborate with peers productively.
- Demonstrate the ability to scale spaces appropriately to fit occupancy by people.

UNIVERSITY AND COLLEGE POLICIES
All necessary and appropriate sanctions will be issued to all parties involved with plagiarizing any and all course work. Plagiarism and any other form of academic dishonesty that is in violation with the Student Code of Conduct will not be tolerated.

REQUIRED TEXTBOOKS
No books are required for class members to purchase.
Hydrology noun \ˈhī-ˈdrä-lə-jē\  
a science dealing with the properties, distribution, and circulation of water on and below the earth’s surface and in the atmosphere

Problem Statement:  
Water is constantly moving above, on and below the earth’s surface. The developed condition, or undeveloped condition as it may be of a landscape affects the quantity, quality, and velocity of water moving through a site. For our first exercise this semester, we will be researching the macro and micro-hydrological systems of two sites; one in its native undeveloped condition, and a second intensely developed site in an urbanized area.

The studio will be divided into two groups by the instructor, each intensely researching the hydrological characteristics, systems and variables that affect the movement of water through their respective site condition.

Group 1 – Native Site Condition: Focus areas of your research should include but not be limited to soil structure/types, infiltration, subsurface geology, karst, aquifer/groundwater recharge, phytihydrology

Group 2 – Developed Site Condition: Focus areas of your research should include but not be limited to point and non-point pollution sources, total suspended solids, heavy metals, nutrient loading, eutrophication, temperature, soil compaction, sanitary sewer overflows.

For this exercise we will be working with hypothetical sites located in East Tennessee. Each site should exhibit characteristics of native environments/geology and development/stormwater management practices typical to our region.

Exercise Deliverables:  
Each team is responsible for communicating their research findings on one, or a series of 24”x36” drawing sheets. The quantity of sheets necessary to thoroughly, yet succinctly communicate the research is to be determined by each group.

Groups must communicate the hydrological systems of their respective site condition using a series of sections, axonometric drawings and other graphic techniques. Diagrams used must be crafted by students specifically for this course. Using previously published systems diagrams is not be acceptable. Photographs from previously published sources are acceptable so long as proper credit is provided. Supporting text is to be provided but shall not dominate the presentation.

Both Groups shall coordinate sheet layout/design and font type/size so that both appear as a single cohesive presentation. Fonts shall be sized so that all text is legible when printed “to fit” on an 11”x17” sheet.

Groups will present their research to each other at the beginning of class on Monday, August 22nd.

Deadline:  
All presentation exhibits are to be uploaded to the course drop box by noon on August 22nd. Presentations will begin promptly at 1:45pm.
The region’s problems are not isolated in pockets throughout the region, rather they span the entire area… the Knoxville MSA has over 100 lakes and streams listed by the Tennessee Department of Environment and Conservation (TDEC) as impaired in 2010.”

Problem Statement:
With our newly developed understanding of regional pre and post-development site conditions that affect the quantity, quality and velocity of water movement, we now take a step back to inventory regionally-specific characteristics affecting the same and identify correlations/trends that may inform future development policy.

To initiate this exercise, an in-class charette will be conducted to brainstorm pertinent regional issues affecting surface and ground water quantity, quality and velocity. Subsequently, the class must collectively agree on what is to be considered an appropriate scope for our region in the context of the larger regional plan for livability in East Tennessee (PlanET). The five-county MSA is to be considered as the basis for a region, though the final definition of the regional study area may vary at the class’ discretion based on research findings of a more hydrologically appropriate boundary.

Exercise Deliverables:
The group as a whole will be responsible for producing a series of inventory exhibits that identify characteristics pertinent to identifying and predicting regional storm water quality, quantity and velocity issues. Students are to use their hydrology research as a starting point to identify these critical characteristics.

Additional analyses exhibit(s) are to be prepared that identify regional correlations and trends. For example, is there a correlation between land use designations and % impervious? Is there a correlation between land use types, developed areas, and slope? Students are to think critically on their understanding of hyrology and regional characteristics inventories to identify hypothesis and analysis outcomes. Project managers may assign specific inventory topics to individuals based on expertise and interests.

In addition to the regional inventory and analysis effort, the class is to generate a list of development typologies typical to the region. Look to New Urbanism’s concept of density transect to initiate this study, but understand this represents a (re)development ideology, not necessarily a development pattern prevalent in our region today. Each student is required to research and document in a uniform way (graphics, metrics etc.) an actual site in the region demonstrative of an identified development typology. Project managers are to ensure that each identified typology is studied.

Research findings are to be communicated on a series of 24”x36” drawing sheets. The quantity of sheets necessary to thoroughly, yet succinctly communicate the research is to be determined by the class as a whole. All exhibits shall demonstrate a coordinated sheet layout/design and font type/size so that both appear as a single cohesive presentation. Fonts shall be sized so that all text is legible when printed “to fit” on an 11”x17” sheet.

The class will present their research at the beginning of class on Monday, August 29th.

Suggested Resources:
Students are encouraged to use the full breadth of GIS map information available to them. The following resources are also recommended:
http://cfpub.epa.gov/surf/huc.cfm?huc_code=06010201
http://www.mrlc.gov/nlcd06_data.php

Doss

90
“Low Impact Development employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat storm water as a resource rather than a waste product.”

Problem Statement:
Our regional inventory and site-based reconnaissance has shed light on the Knoxville MSA’s historic approach to dealing with storm water and site runoff. With this understanding in mind, and recalling our research of native site hydrologic flow, we turn our attention to developing an understanding of the following Low Impact Development (LID) storm water management methods that seek to reintroduce these processes into developed sites:

- Bioretention / Biodetention
  - Basins
  - Swales
  - Cells
  - Constructed Wetlands
- Permeable Pavements
  - Concrete
  - Asphalt
  - Pavers
- Rainwater Harvesting
  - Cisterns, Barrels
  - Commercial, Residential
- Green Roofs
  - Extensive
  - Intensive
- Canopy Trees
  - On streets and Parking Lots
- Reduced Parking
  - Typical Space Size
  - Space Requirements
  - Shared Parking

Project mangers shall divide these methods amongst the class. The depth of information within some methods may justify more than one individual to that topic, and some members of the class may be assigned to research more than one method.

- What design/conditions variable impact a method’s effectiveness
  - Soil Structure
  - Soil Depth
- What Plant Types are better suited for our region than others for applicable methods?
- How much water could a particular method detain/retain/infiltrate/treat – think on a per sf basis
- What are the space/land requirements of a particular method?
- Is it a dual use of an existing site feature, or is it a new element?
- Does the method address storm water quantity? Quality? Both?
- How much do these methods cost? Per tree, per sf, per cf as applicable

Exercise Deliverables:
The group as a collective whole will be responsible for producing a series of research exhibits that identify design characteristics, hydrologic processes, details, images, product information and recommended applications for each LID storm water management method. Research findings are to be communicated on one, or a series of 24”x36” drawing sheets. Each method shall have not less than one dedicated sheet.
**design** \(\text{di-'zīn}\)

**verb**: to create, fashion, execute, or construct according to plan

**noun**: The purposeful or inventive arrangement of parts or details

**Problem Statement:**
Over the course of this semester, we have traversed multiple scales of inventory and analysis to develop an understanding of how stormwater quantity and quality impact agrarian and urbanized watersheds. From the continental scale of the Mississippi River basin to micro-watersheds on our project sites, runoff contaminated by point/non-point pollution sources is degrading the quality of our surface and groundwater resources, overwhelming municipal stormwater infrastructure, scouring our creek and stream banks, compromising freshwater habitats, and threatening our economy and regional identity which is defined in part by these same resources.

Working independently, each student is now to synthesize completed research and analysis to create a master plan that retrofits selected project sites as performing, multi-functional landscape systems. Students are to develop their own project goals, objectives and program to focus their design interventions. Interventions must respond to site analysis and identified opportunities and constraints, including but not limited to site program, function, connectivity, evocation of regional culture and aesthetics, accessibility and hydrology.

Armed with a tool box of Low Impact Development stormwater management methods, each student is to integrate into their master plan a stormwater management (SWM) system that satisfies Clean Water Act regulations currently or soon-to-be effective in our region. Not unlike case studies reviewed during course lectures, integrated here shall mean that SWM is not simply included in the plan, but that SWM system contributes to the overall project function, form and performance and is of principle, yet subtle importance to the overall intervention. The proposed master plan must address site stormwater quantity and quality while retaining post-retrofit runoff from a 1” storm event.

**Exercise Deliverables:**
Based on the scale and scope of proposed design interventions, each student is to independently assess and identify appropriate instruments - meaning plans, perspectives, axons, sections, elevations, models, animations, graphs etc. - through which their proposal is to be communicated. Those instruments of communications must include the following:

1) Site master plan drawn to a scale at which design interventions are legible
2) Site sections, elevations, and/or perspectives illustrating spatial qualities of the proposed interventions
3) Plan, section, and/or diagrammatic enlargement(s) illustrating principle SWM/hydrological feature(s)
4) Hydrological diagram(s) illustrating post-intervention hydrological processes and the movement of water through the site. Include spot elevations, water levels etc. to ensure positive drainage
5) Comparative exhibits, graphs and metrics illustrating
   a. Pre-development site surface characteristics – pervious v. impervious surfaces
   b. Pre-intervention runoff during a 1” storm event and post-intervention retention capacity
6) One site-specific construction detail of principle SWM/hydrological feature(s)
7) Planting plan including the following:
   a. Tree planting plan for the entire master plan
   b. Shrub & Groundcover planting plan for enlargement(s) per item 3) above
   c. Proposed plant palette with specifications (size, form, notes)
**con·clu·sion** noun \ˈkuh-ˈn-kloo-zhuh-n\  
the last main division of a discourse, usually containing a summing up of the points and a statement of opinion or decisions reached.

**Problem Statement:**  
Over the course of this semester, we have traversed multiple scales of inventory and analysis to develop an understanding of how stormwater quantity and quality impact agrarian and urbanized watersheds. From the continental scale of the Mississippi River basin to micro-watersheds on our project sites, runoff contaminated by point/non-point pollution sources is degrading the quality of our surface and groundwater resources, overwhelming municipal stormwater infrastructure, scouring our creek and stream banks, compromising freshwater habitats, and threatening our economy and regional identity which is defined in part by these same resources.

Each student then had an opportunity to synthesize this multi-scalar watershed research with an understanding of Low Impact Development stormwater methods, case studies of integrated stormwater management solutions and site specific hydrologic inventory and analysis to craft their own integrated stormwater management solution for one of three urbanized sites to satisfy Clean Water Act regulations.

We now take a moment to reflect back on what we have learned about water resources and water resource management in our region and distill our research and experiences into succinct observations and recommendations. Each observations of existing conditions – such as gaps in policy, practice, or process – is to be accompanied by actionable recommendations to address those gaps in order to achieve the broader strategic outcome of healthy, sustainable water resources. These observations, recommendations and conclusions will be offered to the City of Knoxville as the principle outcome of this studio.

**Exercise Deliverables:**  
To kick off this exercise, each student is asked to independently contemplate and record the observations that especially resonated with them through previous research and independent study. Each student shall bring no less than 5 different observations to class on Nov. 16th.

The class will discuss these observations and work together to refine them and to identify additional observations that may not have already been covered.

Examples of observations that we have made as a class and may wish to document further for the City of Knoxville include:

1) Political boundaries are not an appropriate means to define a study area for the sustainability of regional water resources
2) Parking codes for regional jurisdictions appear out-dated relative to peer jurisdictions and contribute to the proliferation of impervious surfaces.
3) Historic water resource management policy has led to the degradation of regional water resources and threatens public safety, wildlife habitat and local recreation and tourism industries.
4) Projected urban sprawl beyond the existing development fringes threatens productive agricultural resources and further proliferates stormwater quality and quantity issues, thus stressing existing stormwater infrastructure and wildlife habitat
LAND 329 Landscape Construction I

Fall 2010

Course Time and Location
TR 8:00-10:30am; Langford C111 and BLA Studio

Course Description
Landscape Architecture Site Development provides a technical background and practical exercises in the fundamental knowledge and skills of Grading, Earthwork, Drainage, Hydrology and Surface Hydraulics, and Transportation Planning and Basic Geometric Design.

Learning Outcomes and Course Objectives
The objectives of the course are:

1. To acquire an entry level knowledge and skill in the principles of land form manipulation and preparation of grading plans and to demonstrate their knowledge by achieving passing scores on examinations and practical exercises in preparation of grading plans;

2. To acquire an entry level knowledge and skill in the computation of earthwork volumes and to demonstrate their proficiency by achieving passing scores on written examinations and successful completion of practical earthwork computation exercises;

3. To acquire an entry level knowledge and skill in the use of computer spreadsheets applied to earthwork calculations by developing basic spreadsheets for earthwork projects;

4. To acquire basic knowledge in hydraulics, hydrology, drainage design and the analysis of surface hydraulics and demonstrate that knowledge by achieving passing grades on a written examination and successfully completing a studio exercise in drainage design and analysis;

5. To acquire a general understanding of intermodal transportation planning and to acquire an entry level understanding of the geometric design of highways and streets and demonstrate that understanding by achieving a passing score on a written examination and successfully completing a street alignment project.

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Exercise 13: Grading a mixed use center

You are required to apply what you have learned in this semester to this exercise. You are responsible for all the technical issues including but not limited to drainage, cut and fill estimates, safety, ADA, and so on. Any ignorance, errors or omissions of critical issues will result in significant point deductions.

The base plan shows a proposed mixed-use center and parking, located in Austin, Texas. Existing land use is grass and a few trees. Soil is sandy loam (Hydrologic Soil Group B). You are asked to provide a grading plan of the center that includes a stormwater best management practice (BMP). (Use the Austin IDF curves on text page 220 for this exercise.)

The paving is conventional reinforced concrete (impermeable), rooftop is green roof (C = 0.4) and the stormwater BMP is a detention pond. Conduct the following tasks:

1. Use the modified rational method to estimate the storage volume for runoff (use 10-year design). Type your process and use Excel spreadsheets to determine the storage volume. The calculation must include land use information in terms of surface type, area, runoff coefficient and etc.
2. Use the rational method to estimate the peak flows for pre- and post-development conditions. Type your calculation process.
3. Use the nomograph OR the continuity and Manning’s equations to size pipes that connect (1) the parking lot and the stormwater BMP, and (2) the stormwater BMP and the drainage channel. Show all invert elevations of pipes.
4. Complete landform grading.
5. Estimate cut and fill quantity.

Submittals and Schedule:
(Only typed or professionally drafted submittals will be accepted. Submitted works that are not drafted will receive zero point.)

1. Preliminary grading plan. Focus on the building and parking lot. Sketch quality. (Due end of class, November 13, 2012) (100 points)
2. Final grading plan. Focus on the building and parking lot. (Due end of class, November 29, 2012) (100 points)
3. Calculation details of the runoff storage volume and peak flows. (Due November 29, 2012) (100 points)
4. Final submission (Due December 4, 2012, 5pm) (200 points)
   a. Final grading plan
   b. Sheets that show paired contours for cut and fill calculation
   c. Land use sheet showing the areas of different surface types
   d. Attach Ex 13.3 submissions

Grading Criteria same as Exercise 12.