INCREASING ENVIRONMENTAL AWARENESS BY DESIGN

by

LEAH COURTNEY GARDNER

(Under the Direction of MaryCarol Hunter)

ABSTRACT

The goal of this thesis work is two fold. First, a conceptual framework is developed for the design of outdoor recreation areas that would act to increase environmental awareness of its users. Second, a concept plan is created for a portion of the North Oconee River Greenway that is based on a set of ecological design criteria that grows out of the conceptual framework. The concept plan and its attendant management protocols serve the ecological design criteria by improving the ecological health of a human-impacted site, encouraging human engagement with nature by bringing people into the space, and increasing environmental awareness by offering positive recreational and educational experiences in nature. The ecological criteria are identified and are then met by applying appropriate ecological design principles to each design component regarding installation, use of materials, management practices, and educational objectives.

INDEX WORDS: Ecological Literacy, Greenway development, North Oconee River Greenway, Ecological design, Ecological restoration, Native plant communities of North Georgia, Granite outcrops, Vegetation management, Invasive exotic removal, Easley's Mill, Cedar Shoals, Sustainable Living

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LEAH COURTNEY GARDNER

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LEAH COURTNEY GARDNER

Major Professor: MaryCarol Hunter

Committee: Alfred Vick
David Porter
Richard Field

Electronic Version Approved:

Maureen Grasso
Dean of the Graduate School
The University of Georgia
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DEDICATION

For Dr. John W. Day

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CHAPTER 1

INTRODUCTION

Purpose of Thesis Study

This work began with a desire to grasp my role as a landscape architect in improving the quality of our environment. As human populations grow, so does the demand for the development of land to accommodate our needs. Non-human populations continuously forfeit their right to clean air, water, food, and shelter so that we may survive and be comfortable. Since human expansion is inevitable, I believe it is important to learn ways of designing, building, and managing landscapes that reflect a sense of stewardship and care towards the rest of the world rather than dominion over it.

The ultimate goal of this thesis study is to create a design that improves the ecological health of a human-impacted site, encourages interactions with nature by bringing people into the space, and increases awareness of the surrounding environment through experience and education. Many concepts are explored in efforts to reach this multi-layered goal, beginning with the vital connection between ecological literacy and environmental protection. I will then synthesize findings from background research and case studies and apply them to a site on the North Oconee River Greenway. This design can serve as a demonstration project to be monitored, adjusted, and studied over time. The knowledge gained from any success or failure on this experimental site could be used to guide future development and management of the Oconee River Greenway system.

Organization of Thesis

The link between environmental crises and the deficiency of ecological literacy is examined in the second chapter. Possible reasons for this lack of awareness are pointed out as well as things currently being done to revive environmental interest. Ways of encouraging responsible ecological behavior are also discussed, such as promoting outdoor education and other positive experiences in nature. The landscape architecture profession's involvement in environmental protection and improvement is the last issue addressed in this chapter.

In the third chapter, ecological functions of greenways are explained that serve to build the criteria for my design. Specific goals are set, then basic ecological design principles are identified that will ensure that my design ultimately meets these goals. Management objectives and strategies are then discussed that will balance the needs of both humans and nature without compromising ecological integrity. The last important greenway function described in this chapter is that they provide places for humans to engage with nature in urban environments.

The fourth chapter contains examples of contemporary landscape architecture that successfully combine art, science, and educational interpretation. The case studies are prefaced by a brief look into ecorevelatory landscapes, and then at the values of combining art and science in ecological landscape design. Each of these projects effectively communicates cultural and ecological information to the public while improving the environmental quality of their site.

The fifth chapter introduces the project site and documents the existing conditions. A short history of the North Oconee River Greenway is followed by a site analysis including significant cultural and ecological elements. Any known needs or desires for the site are also pointed out.

In the sixth chapter, the previously identified design criteria are applied to the site. A concept plan illustrates the overview, and then each design component is described in greater detail. Guidelines for managing the site after the design is in place are also stated.

The seventh and final chapter is a summary of this experience. The thesis ends with thoughts concerning the design process and outcome. Important issues are mentioned that require consideration yet were not fully addressed in this project.

CHAPTER 2

BACKGROUND THINKING

"We cannot win this battle to save species and environments without forging an emotional bond between ourselves and nature as well – for we will not fight to save what we do not love."

- Stephen Jay Gould (Orr Earth 43)

Introduction

The goal of my thesis work is to develop a design that improves the ecological health of a site, makes it an inviting and pleasurable place to be, and communicates an environmental message to the public. My approach to the design is based on the premise that people need to reconnect with the natural world and that ecological literacy affects the state of our environment. This chapter consists of three main parts, all of which help to support this premise. In the first section, I will point out the link between environmental crises and the lack of ecological literacy: what it means to be ecologically literate, possible reasons why many people are not, and what is being done now to reintroduce ecological thinking back into our lives. The second section takes a look at what motivates people to behave in ecologically responsible ways. Here I begin to define what type of educational components to incorporate into the design. The third section is a brief inquiry into what the profession of landscape architecture is doing to help our communities live more sustainably through design and education.

Why is Ecological Literacy Critical to Environmental Protection?

In the words of paleontologist and evolutionary theorist Stephen Jay Gould, "we will not fight to save what we do not love." (Orr Earth 43) Based on this concept, it is clear that developing an emotional attachment to our natural surroundings is critical to protecting our environment. Before we can love something, we must first get to know it. In *Diversity of Life*, Harvard biologist E.O.Wilson described this relationship with other living things as biophilia, or an innate urge to affiliate or connect with nature.

Wilson wrote that this affinity for the natural world is sparked at an early age when we begin learning to love what is familiar, and that it cascades throughout our lives into cultural and social patterns. He speculated that this tendency to bond with what we know is inscribed in the brain from tens of thousands of years of evolutionary experience. In *Earth in Mind*, David Orr explains that the manifestation of biophobia, the counterpart to biophilia, "has lead to a world in which it is becoming easier to be biophobic." (134) Man's urge to control nature has replaced an undefiled environment with dammed rivers, floodgates, scraped mountain tops, and drained wetlands. All too often a wooded site is cleared and graded to build an elementary school, only to spend generations of volunteer efforts and funding to re-establish landscaping around the school. The destruction of natural systems and the spread of toxic substances have led to increased risks of cancer and other detrimental side effects to human health. This is reason enough for some people to stay indoors. "Biophobia sets into motion a vicious cycle that tends to cause people to act in such a way as to undermine the integrity, beauty, and harmony of nature, creating the very conditions that make the dislike of nature more probable." (135)

With modern science and technology, we have the power to destroy our natural world as well as the knowledge of the consequences of doing so. This power was not available to cultures

before modernization. At some point between then and now, people have forgotten or have not been taught that the world is alive and worthy of respect. "Only in the last few centuries have technologies and attitudes of domination stemming from the scientific revolution turned the tables, enabling humans to threaten nature with deforestation and desertification, chemical pollution, destruction of habitats and species, nuclear fallout, and ozone depletion." (Merchant 69) We've distanced ourselves from animals and view them as goods, use them as machines. We've quieted any remaining sympathy for nature in favor of power and economic growth. Orr believes it is time for a biophilia revolution, "a combination of reverence for life and purely rational calculation by which we will *want* to both be efficient and live sufficiently. It is about finding our right place on earth and in the community of life, and it is about citizenship, duties, obligations, and celebration." (Orr Earth 145) Orr sees that denial, the belief that all problems can be fixed with technology and money, and lack of imagination have combined as the major obstacles standing in the way of a biophilia revolution. In order to make it happen, education must be reshaped to help people become not only literate, but ecologically literate.

Being or becoming ecologically literate can imply many things. Recognizing the fact that environmental crises exist is a large part of ecological or environmental literacy. Being able to identify and effectively use tools and information to deal with these crises is another component. Simply becoming familiar with one's local environment and the basic processes that sustain it is one way to become more environmentally aware. According to physicist and systems theorist Fritjof Capra, being ecologically literate, or ecoliterate, means "understanding the basic principles of ecology and being able to embody them in the daily life of human communities." He also describes it as "understanding the principles of organization that ecosystems have developed to sustain the web of life." On a basic level, it means "seeing the world as an

interconnected whole." (Capra) Environmental crises continually occur in part due to the lack of ecological literacy today. If we do not know what is happening or what the consequences of our actions might be, then how can we begin to change our behavior, or even know what needs to be changed?

The process of becoming ecologically literate is made difficult by our educational system according to David Orr. He warns that "schooling should not be confused with learning." Schooling does not necessarily increase intelligence, but has to do more with "the ability to master basic functions that can be measured by tests." (Orr Ecological xi) Learning, however, always increases intelligence, involves moral judgment, and is not so easily measured. He writes that some of the problems with modern education are that theories are emphasized rather than values toward the natural world, answers are sought instead of questions, and that technical efficiency is favored over conscience. Instead, he suggests that educators should "attempt to teach things that one might imagine the earth would teach us: silence, humility, holiness, connectedness, courtesy, beauty, celebration, giving, restoration, obligation, and wildness." (Orr Earth 52)

Orr identifies several myths associated with modern education that lead us away from ecological literacy, and new principles for rethinking it. One myth, that knowledge is increasing, further illustrates the difference between schooling and learning. Yes we are experiencing an information explosion, but we are losing wisdom, vernacular knowledge, and folk culture. Robert Thayer feels that "while science and technology have made it possible to comprehend deeper levels of ecosystem knowledge, they have also enabled the physical cover-up and subsequent concealment of dimensions of the landscape once readily accessible to more primal peoples." (Thayer 119) Another myth is that the purpose of education is to provide a means for

upward mobility and success. The problem with this was eloquently stated by Thomas Merton in *Love and Living*. He likened formal education to a "mass production of people literally unfit for anything except to take part in an elaborate and completely artificial charade." (Orr Earth 13)

On the contrary, one of the new principles is that all education be environmental education. Ecological thinking must be incorporated into all levels and layers of learning. Another principle proposes a new purpose for education. Rather than a means to success or a mastery of subject matter, a mastery of one's own self should be the goal. Peter Buckley, co-founder of the Center for Ecoliteracy, believes that in addition to developing capacities for learning, education is "also for developing values and a framework that you see the world through." (Kay) Ecological issues are really questions of value, and education is critical to forming and understanding these values in his point of view. He believes emotional arguments are more sustaining than logical ones when it comes to environmental protection. "I think you have to develop a view of what life is and develop a sense of awe and mystery about it. Once you get that in place then the idea of protecting it comes naturally." (Kay)

Fortunately, people are doing their part in changing how many of us view, comprehend, and treat our environment for the better. Orr believes that a revolution in education is beginning that will reconnect young people to their habitats and communities. The classroom will be "the ecology of the surrounding community, not the confining four walls of the traditional school" (Center for Ecoliteracy) Orr, Fritjof Capra, Peter Buckley, Zenobia Barlow, and Gay Hoagland are all directors of the Center for Ecoliteracy in Berkeley, founded in 1995. This organization is "dedicated to education for sustainable living by fostering a profound understanding of the natural world, grounded in direct experience." (Center for Ecoliteracy) This is accomplished by supporting educational organizations and communities that teach sustainable ways of life

through gardening, cooking, sustainable agriculture, and habitat restoration. Buckley says their organization is about telling stories that hopefully will inspire people to see the world in a new, positive light and lead to beneficial change.

The Center for Ecological Literacy is one of many groups and organizations working hard to promote environmental awareness and stewardship in our society. Others include the Center for Environmental Education of the Antioch New England Institute, the North American Association of Environmental Education, and the Living on Earth Ecological Literacy Project launched by National Public Radio's weekly environmental news program. Accredited Landscape Architecture programs are offering more courses in ecological and sustainable design such as the San Francisco Institute of Architecture, University of Michigan, and the University of Washington's College of Architecture and Urban Planning. At CAUP, one of the three focus areas within the landscape architecture program is designing for ecological literacy. All of these institutions and countless others like them are playing an important role in incorporating ecological thinking into our educational systems and into our lives.

Fascination: An Effective Catalyst for Behavioral Change

In many cases, environmental problems can not be solved unless large numbers of people know of them and commit to correcting them. Unfortunately, "popular awareness of ecological values seems more often to be framed in terms of one or another potential catastrophe – from nuclear winter to global warming – that must be averted through changing specific human patterns of behavior." (Howett 80) Regulations and incentives are two catalysts that aid in solving these problems. They are opposite in nature, yet their establishment relies on scientific data and human emotional response. Regulations are "usually triggered by fear of catastrophe" and are successful in some ways but not in others. (Galatowitsch 99) For example, point source

water pollution may be managed by issuing discharge permits, whereas non point pollution sources are not as easily measured and it took much longer to realize and regulate their discharge. In situations where regulating doesn't seem to work, offering incentives may be more effective. Although financial rewards can make a positive difference (opportunities were created to restore 90,000 acres of U.S. drained wetlands between 1987 and 1990 through financial incentives for farmers), other tactics which evoke emotional attachment may be more beneficial to the environment in the long run.

> "If the rewards are solely monetary, however, the interest and commitment to these environmental restorations are sure to be fleeting. Incentives likely to be more durable are those that increase appreciation for environmental quality, either directly through experiences or indirectly through education. This mode relies on people experiencing places, understanding their relevance, and wanting to have more places like them." (Galatowitsch 99)

What could it be about our experiences in nature that affects how we treat the environment? In July 2001, an article was published in *Environment and Behavior* that investigates this very topic. A study was conducted in which college students were taken to a marsh reserve and four emotive perceptions were measured: *being away*: "Spending time here gives me a break from my day to day routine"; *fascination*: "This place has fascinating qualities"; degree of *coherence*: "It is chaotic here"; and *compatibility*: "I can do things I like here" (from The Perceived Restorativeness Scale developed by Hartig, Korpela, Evans, and Garling in 1997). The results suggested that those students who were more interested in the marsh engaged in more ecological behavior, such as driving less or recycling more. In other words, "people who engage in appreciative rather than consumptive or motor-based outdoor recreation are more likely to behave proenvironmentally." (Hartig 603)

Findings from this study show that measuring these perceptions can help to prioritize measures for promoting ecological behavior. A heavier focus on fascination is encouraged because it appears to be the "sole direct predictor of ecological behavior and at the same time the mediator through which perceptions of being away, coherence, and compatibility exert their influences on ecological behavior" (Hartig 601). The findings also suggest that a link exists between emotional attachment and protective behavior, and that positive experiences in natural environments lead people to engage in ecological behavior. "As fear and threat can in some instances result in the denial of environmental hazard, such as when it is perceived to be beyond personal control, attempting to instill such negative feelings could actually work against involvement in environmentally protective activities." On the other hand, "attention to fascination, restoration, and other positive motivations might be better suited to promoting ecological behavior." The scientists who conducted this experiment suggest that one way to increase fascination with natural environments and ecological processes (which in turn will increase ecological behavior) is through environmental instruction. (Hartig 603)

Does Landscape Architecture Contribute to Environmental Awareness and Protection?

Robert France, Associate Professor at the Harvard Design School, investigates this issue in his article "Green World, Gray Heart?" with a series of questions. "What are the realities, illusions, and efficacies of nature-sustaining design?" "Does adding *green* or *sustainable* before *landscape architecture* create a redundancy or an oxymoron?" Is landscape architecture environmentally constructive or destructive? And perhaps most importantly, "*can* the designers who shape a small portion of our built environment offer anything more than better designed deck chairs more pleasingly arranged?" (France "Green" 32, questioning the futility of rearranging the deck chairs on the Titanic).

In seeking answers to these queries, France first examines landscape architecture's role in fostering environmental sustainability as a profession, then takes a closer look at site-specific designs. He notes that according to a 1992 American Society of Landscape Architects (ASLA) survey, "only three of forty-three degree programs had ever offered a full-credit course on environmental ethics." (France "Green" 33) In 1993, ASLA adopted a Declaration of Environment and Development but France sees very little improvement since then. Although he recognizes a paradigm shift in the popular press, in books like Lyle's *Design for Human Ecosystems* and Thayer's *Gray World, Green Heart*, and in academic programs, he is skeptical of whether or not this shift is evident in actual landscape design practice. He accuses many landscape architects of wrongfully claiming or only superficially attending to green or sustainable design, and that instead, their "hearts are no greener than those of the environmental engineers they are quick to criticize." (France "Green" 33)

After reviewing projects covered in *Landscape Architecture Magazine* over the last ten years, France concludes that most landscape architects ignore greenness and do not incorporate sustainability into their work. Using the US Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system, less than a third of this sample received more sustainable moderate-to-high water rating credits. "Based on this sample, "standard" landscape architecture is not "green.""(France "Green" 34)

France does, however, find hope in the "functional art" of multi-function storm water wetland parks. He believes landscape architects can contribute to sustaining nature by combining the "*feeling* of art and the *knowing* of science" to create wetland parks that not only effectively manage water but also provide opportunities for recreation and education. (France

"Green" 35) Ten examples are highlighted in this article and are praised for improving the ecology of the sites and for inspiring activism among their users.

Possible responses to the questions posed by France in the beginning of this article are as follows. First, what are the illusions and realities of nature-sustaining design? One major misconception is that built landscapes are sustainable because they happen outdoors and may include plants and other natural elements. The truth is that some projects actually harm the environment by increasing runoff, polluting water and soil, and reducing biodiversity. Second, can calling landscape architecture *green* or *sustainable* be an oxymoron? Yes. According to Robert Thayer, landscape architecture is "dominated by the creation of pleasant, illusory places which either give token service to environmental stewardship values, or ignore them altogether." (France "Green" 33) Unless the project improves or sustains the ecological quality of the site, it should not claim to. Third, does landscape architecture harm or heal the environment? The potential exists for both scenarios. As previously mentioned, some projects actually degrade the environment. However, France found from examining the projects in LAM, that even those that received little or no LEED credits may have slightly improved upon the existing site conditions. He concludes that "on average, the projects published in the profession's primary magazine neither harm nor help nature." (34) And finally, can landscape architects significantly benefit the environment by improving or sustaining nature through individual site design? Yes. France is convinced that by "melding engineering and aesthetics, developing what might be called "functional art," landscape architects can contribute to sustaining nature." (35) The functional and beautiful storm water wetland parks he describes demonstrate this honestly and successfully. Furthermore, they communicate their ecological importance to the users, and in this way contribute to increasing environmental awareness.

In reaction to "Green World, Gray Heart?" William Thompson, editor of *Landscape Architecture Magazine*, agrees with some of France's criticisms. He, too, sees that landscape architecture has the potential to play a role in sustaining the environment; but wonders if there is "a contradiction between stewardship of the land and the desire of a designer to give aesthetic form to the landscape." (Thompson 5) He admits that very few of the 2003 ASLA award winners were developed with ecology at their core, and cites only one example that was. In the end, Thompson acknowledges the existence of landscapes architects who can effectively combine aesthetics with ecological fitness. Unfortunately, there just aren't enough of them.

Summary

Several topics regarding environmental awareness and protection have been touched on in this chapter. The lack of environmental awareness is a serious problem. An obvious remedy is to provide the means by which people can become more aware. Ecological design can do this where the aim is to protect and improve elements of one particular place, and to communicate the importance of doing so in ways that many different people can understand. Sparking fascination, grabbing someone's attention, inspiring awe in someone's mind – these things can trigger the spread of ecological literacy in a community. According to Robert France, "the single most effective action that can be accomplished for the future of nature is to motivate and inspire large numbers of people." This motivation will come from various experiences, but also from "educating and directly engaging people in the recognition and repair of damaged landscapes." (France "Green" 35) The goal of my thesis application is to design a place where residents of Athens Clarke County can become aware of, connect with, and develop a sense of stewardship towards their environment.

CHAPTER 3

GREENWAY FUNCTIONS

"As ecosystems lose their diversity, so do our own patterns of thought. Designing for biodiversity will require us to break free of our monoculture of the mind and see clearly our embeddedness in the living world" -- Sim VanderRyn (VanderRyn 142)

Introduction

This chapter is divided into four sections. Ecological roles of greenways are explained in the first section. These roles will serve to begin building the criteria for my design. By exploring the ecological functions greenways perform, and then pointing out general objectives that are applicable to the scope of this project, three specific goals for the design are identified. In the next section, basic principles of ecological design relevant to greenway design are discussed and distilled into three major guidelines. When followed, these guidelines will ensure that the ecological criteria are met by the design. In the third section, I discuss management goals and strategies to preserve the ecological integrity of the site after the design is installed. The focus here is on the methods for managing for biodiversity while balancing other ecological and human needs. Finally, the fourth section describes another important greenway function – to provide a place for interactions between humans and nature.

Ecological Roles of Greenways

Charles Little, author of *Greenways for America,* defines a greenway in two ways. In some instances, it is a "linear open space established along either a natural corridor, such as a riverfront, stream valley, or ridgeline, or over land along a railroad right-of-way converted to recreational use, a canal, a scenic road, or other route." It can also be an "open space connector linking parks nature reserves, cultural features, or historic sites, with each other and populated areas." (Smith 10) Some greenways include trails for human use and emphasize recreation, while others focus on biological conservation and preservation of ecological integrity. Although these goals are different, they usually overlap and most greenways support a combination of both.

In the broadest ecological terms, greenways have the potential to both protect and connect valuable natural resources. In the wake of residential, commercial, and industrial development, the number and size of natural areas continues to shrink. The quality of natural space that does still exist is declining. If designed and managed properly, a greenway can protect these natural areas, the wildlife that live there, and the habitat they need to survive. By connecting these natural areas to each other, "naturally vegetated corridors can play a key role in allowing wildlife to move between habitat areas that would otherwise be isolated from one another." (Smith 13) One important benefit associated with providing for animal and plant movement is the increase of long-term health among populations by "increasing genetic exchange and by maintaining natural demographic process." (14)

More specifically, greenways can counteract some of the major problems associated with development including the loss of natural space which leads to loss of habitat diversity, fragmentation of existing natural space, degradation of water resources (i.e. erosion,

sedimentation, contamination), and a decrease in nature's ability to respond to perturbation. A greenway can be designed to minimize these negative impacts by operating in one or more of these six basic ways:

- as **habitat** for plant and animal communities
- as a **conduit** facilitating the movement of plants, animals, water, sediment, and nutrients
- as a **barrier** preventing movement of elements listed above
- as a **filter** allowing some elements to pass while inhibiting others
- as a **source** by helping to provide animals or seeds that can move to other parts of the landscape
- as a **sink** for trapping animals or seeds thus preventing further passage

Providing **habitat** to support biological communities is something greenways do with varying degrees of success. Depending on the species to be protected, the size and type of habitat required differs, and some species require more natural area than others. For example, a 200 foot wide greenway may provide habitat for fewer species than one that is a half a mile wide. In some instances however, a narrower greenway with more structural variation may provide habitat for just as many species as a larger one with less variation. Greenways can act as **conduits** for water, animals, plants, and even people allowing them to move from one isolated patch of a landscape to another. Alternately, a greenway can act as a **barrier** for some species or ecosystem resources. For example, a river may keep small mammals from crossing to the other side. The greenway acts as a **filter** when its vegetation strains harmful sediment and pollution out of storm water runoff before it reaches a river or stream. Even a narrow strip of green space such as a hedgerow can be a **source** of seeds for the surrounding landscape. A greenway that acts as a **sink** traps animals and plants preventing them from moving on. Not every greenway can serve all of these purposes all of the time. Of these six ecological functions, the provision of habitat and conduits are the most important for maintaining wildlife health and diversity.

Urban and rural streamside greenways can serve as buffers between waterways and adjacent lands with intensive human uses. These types of buffers can help maintain and improve water quality, stabilize hydrologic regimes, and maintain healthy and diverse aquatic habitat. As previously mentioned vegetated riparian corridors can filter out excess nutrients in groundwater through vegetative uptake and physically block eroding sediment from reaching the water and covering stream beds. Streamside greenways, especially those containing wetlands, can also help maintain natural water levels and flow rates, thus decreasing the magnitude and damage of floods. Protecting water quality is crucial for maintaining healthy aquatic communities. Riparian vegetation shades the stream and lowers water temperatures, produces organic matter the organisms need to eat, and helps to create diverse microhabitats like pools and riffles, the required habitat of certain organisms. (Smith 14)

With these ecological functions in mind, I've distilled them into three design criteria that are relevant and applicable to the project site. First and foremost, the design recommendations will be geared towards improving and protecting water quality. Second, all design recommendations regarding plant material - the addition, removal, or management of vegetation - will focus on increasing structural and species diversity. And third, negative environmental impacts of development will be minimized. In other words, any significant ecological element on the site, existing or proposed, will be protected from damage by human use. As for management recommendations, the site will be protected from further development deemed harmful to the ecological health of the greenway. And, the management plan will be flexible enough to accommodate the probability of change. This is discussed in greater detail in the section entitled Managing for Ecological Integrity later in this chapter. Although the scope of this project will produce a design for only one segment of the Oconee Rivers Greenway,

establishment of the three ecological functions will improve the ecological health of this site at least, and could theoretically have a positive effect downstream.

Designing to Perform These Roles Well: Applying Ecological Design Principles to Greenway Development

The ecological goals for this project have been identified and basic design guidelines will be used to check that the final design meets the criteria. In this section, I will define ecological design, and discuss some of the problems associated with conventional design concepts. Finally, I will point out the ecological design principles associated with the stated goals of this project.

Ecological design combines the analytical use of scientific information with creative exploration and problem solving. Joan Naasauer sees ecology and design as "two very different ways of looking at and prescribing action in the landscape;" where "ecology is scientific study and design is creative cultural action." (Johnson and Hill 217) *Ecological design*, a combination of the two, is "any form of design that minimizes environmentally destructive impacts by integrating itself with living processes." (VanderRyn 18) It requires the ability to comprehend patterns that connect as well as the knowledge of how nature works. Possessing ecological design competence means "maximizing resource and energy efficiency, taking advantage of the free services of nature, recycling wastes, making ecologically smarter things and educating ecologically smarter people." (Orr Earth 104) Some would say that ecological design is synonymous with good design. Certain characteristics typify good designs including appropriate scale, simplicity, efficiency, durability, and redundancy. Good design solves several problems at once and begins by asking "What is here? What will nature permit us to do here? What will nature help us do here?" (146, quoting Wendell Berry) Surprising synergies tend to occur when

good design is integrated in all levels of society; however, “when people fail to design carefully, lovingly, and competently, unwanted side effects and disasters multiply.” (105)

Since humans first learned to cultivate plants over 12, 000 years ago, we have been designing ecosystems. We still are and will continue to do so in order to provide basic necessities for our growing population. The ecosystems we change must still face the same natural forces and disturbances regardless of whether they are more or less diverse, stable, or productive regardless of our impact has altered their function. Without conscious understanding of how natural processes work, we have unintentionally created new ecosystems that do not work very well. How can we predict the way a new ecosystem will work if we don’t even know that it is a system? (Lyle 15) The cumulative impact of our everyday activities will continue to be devastating until we learn to preserve ecological integrity by design. We continue “substituting design intelligence for the extravagant use of energy and materials” in the name of progress (VanderRyn 19). Instead of valuing landscapes and supporting natural ecosystem processes, we seek “narrowly productive landscapes that are stripped of their wider ecological significance.” (116) When comparing nature’s cycles to that of humans, natural ones are diverse and cyclical while ours tend to be linear and wasteful. The presence of unutilized wastes is usually a symptom of poor design. Over time design has been broken apart into many separate technical disciplines, “each with its own specialized language and tools.” (20) In order to make good design decisions that are in keeping with nature’s own patterns and cycles, these disciplines must be reconnected and we must learn to effectively interweave human and natural design effectively.

Good ecological design is a partnership with nature that integrates human purpose with natural flows and cycles. It “matches biological diversity with cultural diversity rather than

compromising both the way conventional solutions do."(VanderRyn 23) Ecological design responds to the unique characteristics of each site such as the soil, vegetation, climate, topography, and wildlife. It has the ability to deepen our sense of place by acknowledging these distinctive qualities and in many cases highlighting and enhancing them. (24) Design competence is evident in nature's diverse systems; so by using nature as a basis for design "we can vastly diminish the environmental impacts of everything we make and build." (19) Designing with nature benefits both people and ecosystems. For example, a river corridor is restored to a healthier state by a design where the water is allowed to flow its natural course and diverse vegetation is added to moderate flow and control erosion. By design, this landscape can increase wildlife habitat, provide a place for human recreational opportunities, *and* help control flooding (see Table 1 on page 29).

In describing many of the general principles of ecological design, I have found three main ideas that will aptly serve as guidelines for my design. First I will recognize the connectedness of all elements involved. Understanding this will help to attain the goal of protecting and improving water quality. For example, if a parking lot must be built at a higher elevation than the river (as in the case for the project site), measures will be taken to reduce runoff of storm water directly into the river. Using porous paving materials and planting a dense vegetative buffer between the lot and the river will help keep contaminants from the automobiles from reaching the nearby river. Recognizing that uphill activities can affect downhill processes is a fundamental part of ecological design. The second principle is to design with nature and look to it for inspiration. This will be helpful in determining where to position the trail, among other things. It may be impossible to build a trail where the topography is too steep, or a boardwalk may be more appropriate than an asphalt path where the soil tends to be

wet. Looking to nature will also aid in developing a plant palette. A good starting point is noticing what type of plants grow on the sunny dry slope or which ones thrive in the shady moist soils. Once the palette is compiled, invasive exotic plants can be removed and replaced with native species. This will increase biological diversity, the second ecological goal. Finally, every component of the design should balance ecological and human needs. The aim here is "not to dominate nature but to participate creatively in its processes." (Lyle 16) In other words, people should not be allowed to trample a very sensitive ecosystem such as a restored granite outcrop. However, rather than completely restricting access in order to preserve it, a trail could come close enough for people to view it and learn about it through interpretational signs or displays. This compromise would protect the ecosystem from harm and simultaneously afford people the freedom to experience it. By following this third principle, the goal of protecting ecological elements and reducing environmental impacts will be met.

Managing for Ecological Integrity in an Urban Context

"The fundamental goal of ecological design should be to maintain ecological integrity, also referred to as ecological health." (Smith 24) Possessing ecological integrity is to have natural levels of plant productivity, a high level of native biological diversity, naturally low rates of erosion and nutrient loss, and clean water. (24) Management is crucial to maintaining the health of any landscape, but is an especially important component of ecological design. This is because the design of an ecosystem is probabilistic, meaning it is easier to predict what *might* happen in the future rather than what *will* happen. (Lyle 18) A flexible management regime will be more effective in achieving stability than following a static set of rules or guidelines. Strategies that promote stability within a designed landscape include encouraging biodiversity and paying attention to interactions within the structure of an ecosystem. These two broad

concepts will be discussed first, and then I will point out some design objectives that directly apply to an urban streamside greenway.

What is biodiversity and can it really promote stability? Biodiversity is the pattern of connections that maintains life on earth, the "most exquisite form of complexity in the world. It is holistic and dynamic." (VanderRyn 135) Biodiversity implies that diversity exists on three levels, from genetics, to species, to communities. All three levels can and must be addressed by maintaining viable populations of native species, protecting representatives of all native ecosystem types in many states of succession, and by honoring broad scale ecological processes such as fire, hydrologic cycles and movement patterns. Stability is "the tendency of a system to remain near an equilibrium point or to return to it after a disturbance," and can be characterized by seven different qualities. Constancy, persistence, inertia, elasticity, amplitude, cyclical stability, and trajectory stability all affect the stability of an ecosystem (see Appendix A for definitions of these terms). Since many factors that influence these characteristics are unique to every ecosystem, it is difficult to generalize ecosystem stability by measuring all seven. In an effort to simplify and apply ecological information to design, John Lyle suggests reducing these seven overlapping characteristics into two: resistance and resiliency. (Lyle 201) So, does biodiversity promote stability? In most instances, the answer is yes. In the broadest terms, complex and diverse structures tend to be more resistant and resilient than simpler ones. In other words, "a diverse system simply has more glue to hold it together, but we cannot conclude from this that more diverse always means more stable." (202) However, "complexity tends to protect a system from total collapse" in the face of disturbance. (201)

Every element in a landscape plays a role in keeping the ecosystems intact. By learning to identify the structure, or the major species and key interactions of a particular landscape, "we

can seek out ways of expanding or modifying or even reshaping it to accommodate human purposes." (Lyle 204) The most critical of these interactions occur between three groups: humans, plants, and animals. Regarding design issues however, the interactions between people and plants are sometimes more crucial because we influence animals by manipulating plants and water. (205) If the structure of an ecosystem is properly identified and the management strategies work as they should, "monitoring, feedback, and corrective design (management) will take care of most mistakes."(204) In an urban landscape, such as a greenway, the lack of interactions between species and their life-support systems will usually cause ecosystems to fail rather than the lack of species diversity.

> "The plants brought from all over the world and thrown indiscriminately together do not form a cohesive community. Each left its own network of relationships behind: the animals it fed and protected the other plants it shaded or took shade from, the soil that it held in place and drew nutrients from. Some important elements are conspicuously missing…thus eliminating a whole regime of ground-level interactions and breaking nutrient cycles." (Lyle 204)

It is impossible to know everything about every element and interaction in an ecosystem. We can, however, identify the major ones and make conscious design and management decisions accordingly. Whatever the scale, the main goal should be to manage for the highest level of native biological diversity that is compatible to both environmental and human needs. To do this a designer must consider "the needs of species sensitive to fragmentation and human disturbance over the needs of weedy opportunistic species that tolerate or thrive in human dominated landscapes." (Smith 62) In addition to maximizing the number of species, a wide variety of habitat types is critical to maintaining diversity on a greenway. This will lend to the ecological integrity of a site and preserve a range of habitats as local examples of biological diversity for educational and recreational purposes. (38)

So, within the over arching goal of managing for ecological integrity, a strong argument for maximizing biodiversity is made. To meet this design goal for my project I will recommend the replacement of invasive exotic plant species with diverse native vegetation; and will use the same native plant palette to restore biodiversity to human-impacted areas of the greenway corridor. The next important management issue is to recognize that relationships and interactions between all elements of the landscape exist. As previously stated, it is impossible to know everything about an ecosystem. But, through careful monitoring and corrective design, a flexible set of management guidelines will help promote a certain level of stability and health. Another relationship that requires careful consideration is the one between aesthetics and ecology. Both must be taken into account simultaneously in designing a greenway to prevent conflicts between visual preference and ecological integrity. Research has shown that people prefer high levels of visual complexity in naturalistic landscapes as long as they are perceived overall as a coherent and legible whole. (Smith, 38) Sometimes, the appearance of an ecologically healthy landscape does not fit society's aesthetic ideals, appearing too weedy or wild. Since this thesis involves combining ecological goals with human involvement in an urban greenway setting, care must be taken to balance ecological integrity with aesthetic appeal.

Where Humans and Nature Meet in Urban Settings

Humans depend on nature to fulfill both physical and emotional needs. As organisms, we breathe air, drink water, and ingest food that nature provides. But beyond basic requirements for survival, "people also have a deep psychological and spiritual need for nature as they try to balance often frenetic, stressful lives in a mechanized "human" environment by searching for serenity, beauty, and relaxation in the natural world." (Smith 209) Plants are thought by some to "take away some of the anxiety and tension of the immediate Now by showing us that there are

long enduring patterns of life." (Lyle 210) This emotional relationship between humans and nature is the focus of this section, as well describing how urban greenways can be instrumental in fostering this bond.

Today, many people spend a majority of time in man-made environments, but our species evolved in the natural world. The human eye is most sensitive to light at a wavelength of 553 nanometers, which is a yellow-green approximately the average color of plant leaves. It is believed that the physiological structure of our eyes evolved while being continuously exposed to nature, so "apart from the human face, our most essential visual imagery is probably that of the landscape." (Lyle 208) It is suggested that our ancestors developed an emotional attachment to plants over those years of evolution that may still be a fundamental part of us today. This bond between nature and people is a two-way relationship, meaning that what people gain from experiences in nature directly affects how they treat nature in return. Appreciation for the natural world grows out of positive experiences in nature whether through athletic recreation, passive viewing, or intellectual study. Developing respect for nature "can be more powerful than anything taught in the classroom or written in a book and may ultimately lead people to a more thoughtful, ethical relationship with the natural environment." (Smith 17)

Robert Searns, founding owner of Urban Edges, Inc., expresses his concern for the current human state of mind in his article entitled "Unplugged and Reconnected: Working towards a New Mentality for Trails." He contemplates our endless supply of material goods and that while we seemingly have everything we need or desire, we have created this emotional void within ourselves partly due to information and sensory overload. "We are on the verge of being overwhelmed by a constant flow, becoming a torrent of information, a constant need to process and make decisions." (Searns) He sees trails, paths, and open green spaces as perfect settings for

humans to find freedom from this artificiality and over-stimulation. Movement by our own power – walking, riding a bike, paddling a boat – reconnects us with ourselves and with nature according to Searns, and greenways provide a place for this to happen.

By creating opportunities for people to engage in direct contact with nature, greenways can be an important means of promoting environmental consciousness and stewardship. Daily travel through a greenway, as an alternative to motorized transportation, provides engagement with nature on a regular basis. This is especially important to people living in densely populated urban environments because greenways often fit easily into this type of setting. They are a "focal point of interactions between people and nature" (Smith 209) and are prime examples of what John Lyle describes as *human ecosystems*. These are "places in which human beings and nature might be brought together again after a very long and dangerous period of estrangement." (Lyle 15) Reconnecting people with nature, as discussed in chapter 2, is crucial to increasing environmental awareness.

Summary

Designing a greenway involves a great number of issues and each one holds its own level of complication and importance. Recognizing how interconnected these issues are may be the first steps towards developing a successful greenway design. Once the goals are in place, the design, implementation, and management must be thought out carefully and decisions should be made consciously and intentionally. In this case, a small section of a greenway will be designed to simultaneously improve the ecological health of the site while offering sensory rich, aesthetically pleasing, and educational experiences to its users. This design can also serve as a template for future development along the same river corridor.

In learning about the basic ecological functions greenways are capable of performing, I came up with three general ecological goals for my design. For each design component, these questions will be asked: Does this improve or reduce water quality? Will this increase or decrease biodiversity? Will this cause negative environmental impacts? The rules I follow in order to fulfill these ecological goals will be to recognize connectedness, to design with nature, and ultimately to balance the ecological needs of the site with those of its human users. This same information will be passed onto site users through educational signage and displays. People, especially those living in urban environments, need to connect with the natural world on a regular basis. A greenway where respect for nature is apparent is a good place for this to happen.

Table 1 - Characteristics of Conventional and Ecological Design

Issue	*Conventional Design*	*Ecological Design*
Energy source	Usually nonrenewable and destructive, relying on fossil fuels or nuclear power; the design consumes natural capital	Whenever feasible, renewable: solar, wind, small-scale hydro, or biomass; the design lives off solar income
Materials use	High-quality materials are used clumsily, and resulting toxic and low-quality materials are discarded in soil, air, and water	Restorative materials cycles in which waste for one process becomes food for the next; designed-in reuse, recycling, flexibility, ease of repair, and durability
Toxic substances	Common and destructive, ranging from pesticides to paints	Used extremely sparingly in very special circumstances
Design criteria	Economics, custom, and convenience	Human and ecosystem health, ecological economics
Sensitivity to ecological content	Standard templates are replicated all over the planet with little regard to culture or place; skyscrapers look the same from New York to Cairo	Responds to bioregion: the design is integrated with local soils, vegetation, materials, culture, climate, topography; the solutions grow from place
Biological, cultural, and economic diversity	Employs standardized designs with high energy and materials throughput, thereby eroding biological, cultural, and economic diversity	Maintains biodiversity: the locally adapted cultures and economies that support it
Knowledge base	Narrow disciplinary focus	Integrates multiple design disciplines and wide range of sciences; comprehensive
Whole systems	Divides systems along boundaries that do not reflect the underlying natural processes	Works with whole systems: produces designs that provide the greatest possible degree of integrity and coherence
Role of nature	Design must be imposed on nature to provide control and predictability and meet narrowly defined human needs	Includes nature as a partner: whenever possible substitutes nature's own design intelligence for heavy reliance on materials and energy
Types of learning	Nature and technology are hidden; the design does not teach us over time	Nature and technology are made visible; the design draws us closer to the systems that ultimately sustain us

(VanderRyn 26)

CHAPTER 4

CASE STUDIES

"I am convinced that most Americans have no idea what a decent forest looks like. The only way to tell them is to show them." - Aldo Leopold (Orr Earth 64)

Introduction

Three main segments make up this chapter. The first segment contains thoughts on communicating information to site users and introduces the concept of narrative landscapes. The next segment examines the connection between science and art in the designed landscape and highlights the importance of combining the two to create beautiful and ecologically functional spaces. Finally, four contemporary case studies that exemplify this combination of ecological function and beauty are examined for their ability to provide both recreational and educational opportunities.

Storytelling

The vital link between environmental awareness and protection was established in the preceding chapters. To create ecologically sound landscapes that promote sustainability, a designer must look for opportunities to creatively communicate information to the site users. Sometimes "the *story told* may be as important as the functions fulfilled." (Thompson and Sorvig 293) Various methods of storytelling include interpretive signage, self-guided tours, and literally telling visitors the story of a place through lectures, movies, or displays.

Less overtly, landscapes can tell their own stories when their ecological processes are visible rather than hidden beneath the surface. This narrative type of landscape is sometimes called *ecorevelatory*, a term coined by members of the Landscape Architecture department at the University of Illinois and formalized through a conference and its published account. (Thompson and Sorvig 17) An ecorevelatory landscape is one where ecological phenomena, processes, and relationships are made visible or revealed. By definition, this term "would best apply to the design of nature trails, where an educational path points out elements of an existing ecosystem, and among other things, human effects on it." (18) Juxtaposing natural and cultural systems is an effective way of illuminating their differences and is "inherently interesting and increasingly necessary." (Galatowitsch 101) Catherine Howett cautions that losing sight of these differences could be detrimental to our society:

> "However much contemporary culture may distance us from intense awareness of our primal engagement with nature, it is impossible to imagine that the kind of human life to which most of us aspire could be psychologically or spiritually sustained if human culture so dominated the natural world that the very image of its differences disappeared." (Howett, 94)

It is clear that teaching people about the ecology of a place is vital to protecting nature. Experiencing an ecorevelatory greenway is an effective means of revealing both ecological and cultural elements rather than hiding them. An important aspect of ecological design is that each site's unique qualities and limitations must be carefully considered during the design process. Consequently, decisions on which aspects of human cultural history should remain evident or be erased must be carefully weighed. "To argue that human influence should never be hidden, without also asking whether that influence is destructive or sustainable, is to trivialize the complexity of relations between humans and the rest of the world." (Thompson and Sorvig18)

Art and Science

A perceived dichotomy exists between art and science as they relate to landscape design. Some feel that art alone does little to solve environmental problems or improve ecological health, and even undermines these goals in some instances. "The conception of a designed landscape as purely a work of art – as a visual object arrayed "out there" in space to be admired as beautiful by a distanced human observer – obviously works against awareness of the landscape as a dynamic, changing, and exchanging force field of ecological process in which humans are actively immersed and engaged." (Howett 84) Although art can draw attention to environmental dilemmas and spark conversation concerning controversial issues, some speculate that art itself does little to make wrongs right. In his essay entitled "Landscape as an Ecologically Revealing Language," Robert Thayer writes that responsible ecological design should go further than making an artistic statement:

> "Art may be content only to *comment* on unstable, unsustainable, or consumptive conditions; responsible design should *remedy* them. This dimension of healing – the deliberate manifestation of a normative, corrective process in the landscape – is to me the obvious "end" of a revelatory process. Why diagnose if not to cure? Why reveal if not ultimately to heal?" (Thayer 118)

Robert France agrees that art and design cannot heal ecosystems without science. His belief that the two entities must be combined to foster positive change is evident in the following excerpt:

> "…neither art and design nor science and engineering alone have done much to instill love and motivate action for the natural world. No one would be inspired by a sterile engineered waterway (like the LA river) to protect other rivers, just as no one would become dedicated to preserving rainforests because they contemplated a tree clipped to look like a giant puppy." (France "Green" 35)

France feels that landscape architecture can be an effective means of sustaining nature if a marriage exists between "the feeling of art and the knowing of science"(35) He sees this in

recent storm water and wetland projects where art and science, beauty and ecological function, environmental management and ecotourism are synthesized successfully. France welcomes the trend towards multi-functional wetland parks where education, water management, and wildlife habitat are all equally important; and no element dominates at the expense of others. "Functional art lies at the success of ecologically sustainable designs that will inspire action beyond the bounds of the site." (36)

Projects

In seeking current examples of good ecological design, I felt it necessary to narrow the search by looking for specific qualities. First, does the project protect or improve the ecological health of the site? Second, does the project address more than one design issue successfully? And, third, does the project communicate this information to its users creatively and effectively?

All four of the following projects meet these criteria. The first two projects are water treatment facilities and the last two are stream restoration/greenway projects. Each is an interesting and unique mix of science, art, and storytelling.

1) Water Pollution Control Laboratory, Landscape Design – Portland, Oregon

Client: City of Portland's Bureau of Environmental Services

Architects: Miller Hull Partnership – Seattle, Washington; SERA Architects – Portland, Oregon

Landscape Design: Murase Associates – Portland, Oregon

The Water Pollution Control Lab in Portland was completed in February 1997 and is now a city landmark. Here, Portland's water quality is monitored and people are educated about "the use of natural systems to mitigate pollutants from storm water runoff." (Murase Associates) The lab itself conducts full-service analysis of water, soil, sediment and sludge for the city's

environmental monitoring projects. Storm water, sewage, surface water from local creeks, and groundwater are all monitored, as well as the water after it is treated and reused.

Murase Associates created an ecologically sensitive landscape design for 6.5 acres of the 7.6 acre site along 900 linear feet of the Willamette River. Storm water is directed to a detention pond through a flume (Figure 1) where sedimentation and biofiltration naturally occur thanks to a variety of aquatic and emergent plant material. Bioswales also help to mitigate the storm water. The river bank has been stabilized with bioengineering practices and the industrial debris and pollution has been removed. (Portland Bureau of Environmental Services)

This site contains interpretive and educational signage and is connected by a series of paths to neighboring Cathedral Park and the surrounding community. A sculpture celebrating the importance of water by Don Merkt is displayed along a public path that stretches along the river. A pier overlooking the detention pond brings people further into the site to see water quality improvement at work. To date the project has won 14 awards for building/site design and energy efficiency. (Portland Bureau of Environmental Services)

2) Waterworks Gardens – Renton, Washington

Client: King County South Treatment Plant

Artist: Lorna Jordan

Landscape Architect: Jones & Jones Architects and Landscape Architects Ltd.

Consulting Engineer: Brown and Caldwell --Walnut Creek, CA

Waterworks Gardens, opened in 1996, is an eight acre public park adjacent to King County's South Treatment Plant. Here, a network of eleven ponds and enhanced wetlands filter then clean storm water running off from fifty acres of the treatment plant's paved surfaces (Figure 2). The gardens were designed to comply with state and county rules and are so

successful at cleaning the water that King County received a permit to discharge it into Springbrook Creek. The park is designed to handle a peak twenty-four hour, two-year storm. A pump recirculates the water from the last pond back to the first one helping to avoid stagnation, prevent ice build up, minimize mosquitoes, and provide a constant flow through the water features. (Blankenship)

In addition to the scientific aspects, Waterworks Gardens "is a place where art, technology, and nature join in a unique way."(Department of Natural Resources and Parks) Artist Lorna Jordan designed the park as a series of garden rooms that together resemble a large flowering plant (Figure 3). The path, or Water Walk, begins in what is called the Knoll which represents the plant's root, then passes through leaf-shaped ponds to a mosaic grotto which resembles a sprouting seedpod. Circular ponds after the grotto symbolize the fruit, while several wetlands make up the flower. Even the planting scheme is symbolic in that the plants used where the water is still contaminated are species known to Native Americans as bad omens. The path parallels the treatment course of the water from where it enters metal grates to the wetlands, and connects the park to two adjacent cities. (Blankenship)

The idea for this park originated when artist Lorna Jordan was asked by process control supervisor Richard Butler to "dress up" an addition to the plant. Jordan "had no interest in simply plopping down some public art." She was on a mission to "help people reconnect with the systems that sustain them." (Blankenship) She felt in order to do this, the infrastructure of the water treatment plant should be made more accessible to the public, and also be more beautiful. After the initial design phase, Jordan involved landscape architects and environmental engineers to complete the project. This is a truly innovative park that creatively fuses storm water

treatment and art. (Blankenship) Waterworks Gardens has won several awards including the 1996 Outstanding Local Civil Engineering Award and the 1998 Place Design Award.

3) Prince Memorial Greenway -- Santa Rosa, California

Client: City of Santa Rosa

Architect/Landscape Architects: RRM Design Group – San Luis Obispo, California

Civil Engineers: Carlile-Macy Engineers

Geotechnical Engineer: Kleinfelder, Inc.

Structural Engineers: Winzler & Kelly

Ecology: Golden Bear Biostudios

Hydrology: Phil Williams & Associates

Citizens concerned with the state of the Santa Rosa Creek sparked the revitalization of it in 1989. Degradation of the creek began in the 1960s when the U.S. Army Corps of Engineers & Soil Conservation Service channeled half of the thirteen miles of it for fear of downtown being flooded (Figure 4 and 5). In doing so, the aesthetic quality of Santa Rosa Creek was compromised as well as native fish populations (including the endangered steelhead trout). The concrete floor and walls of the stream caused the shallow water to reach temperatures over 80 degrees, too hot for the fish to survive. (Viani 42, 44)

RRM Design Group – as part of a team of civil, geotechnical, and structural engineers, ecologists, hydrologists, environmental planners – were hired to help find funding for the project as well as to design landscape and recreational features. The Prince Memorial Greenway, a 1.2 mile-long path along the Santa Rosa Creek, was designed to connect the downtown area to existing bikeways and commercial sites. An important part of this project was creek restoration which involved jack hammering the sides and bottom of the creek to create a deeper and

narrower channel. In doing so, underground diesel and heavy fuel oil tanks from 1920s-30s were found as well as rubble from a 1930's earthquake. Even though toxic clean up doubled the estimated cost of the project, no one involved seems to regret restoring Santa Rosa Creek.

RRM found that in order to make this project successful, they "needed to get people down to the creek; we needed their eyes and ears on it." (Viani 45) Converting industrial facilities into restaurants and shops facing the water would attract bicyclists and pedestrians, while benches, plazas, paths, and art would draw them even closer to the water. In summer of 2001, a nonprofit organization called ArtStart brought in six high school students to create a mural that would relate to the site, make an environmental statement, and would tell something about the history of Santa Rosa. They came up with an image of a steelhead trout breaking through a concrete barrier which would symbolize a breakthrough for the city, for the fish, and for the students themselves (Figure 6).

Due to the success of the Santa Rosa Creek Restoration Project, the Army Corps plans to restore yet another section they had channeled in the 1960s. Bill Cox from the California Department of Fish and Game says "this project will have major benefits over the next many years as people become more aware of and tuned in to the stream. They've taken the stream out of the back alley and put it in the front yard." (Viani 48)

The Prince Memorial Greenway/Santa Rosa Creek Restoration Project was awarded the 2001 Planning Project Award by the California Chapter of the American Planning Association.

4) Ohlone Greenway/ Codornices Creek Restoration – Berkeley, California

The Olhone Greenway is a walking, biking, and in-line skating trail that stretches the entire length of the city of El Cerrito, California from Berkeley to Richmond. It is located

underneath the BART, or the Bay Area Rapid Transit structure, and connects many community parks and gardens.

There have been many riparian restoration projects along this greenway thanks to several groups including the Friends of Five Creeks, a volunteer group affiliated with the Urban Creeks Council of California. The FFC is dedicated to protecting and restoring watersheds and aquatic and riparian habitat of five local creeks. Codornices Creek in Berkeley is one of these creeks and "may well become one of the premier models for urban creek restoration" with its history of successful restoration efforts (Urban Creeks Council of California). Building on past daylighting, bank stabilization, and trail construction projects, a new watershed restoration action plan will further improve Codornices Creek. Plans include removing barriers to fish migration, restoring wildlife habitat throughout the creek corridor, removal of invasive exotic species and re-vegetating with native plants (Figure 7), creating a water quality monitoring program, and protecting endangered species such as the threatened steelhead trout. (Urban Creeks Council of California)

Public art is also a major component of many Ohlone Greenway projects. Steel sculptures of quail (Codornice is Spanish for "quail") are perched on new bridge railings over Codornices Creek (Figure 8). An exhibit featuring art installations, interpretive signs, and a native plant restoration was installed in 1992 along the Westbrae section of the greenway, to "tell the many-layered stories of the place and its inhabitants in a lively and engaging manner." (Berkeley Partners for Parks) California's agricultural period in history is represented by steel sculptures of cows (Figure 9) surrounded by old tractor seats. A seventy-two foot long mural painted on a wall supporting the BART rails depicts the evolution of transportation systems from pre-settlement times to the present. (Berkeley Partners for Parks)

In recent news, an interpretive natural and cultural history exhibit was dedicated on the Ohlone Greenway in North Berkeley on October 10, 2004. The Ohlone Peoples' Exhibit features sculptural objects and native plantings that represent aspects of early Ohlone life before European migration to the area. A sculptural bench displays traditional basket weaving patterns, and steel grizzly bears are being built to commemorate the past abundance of wildlife. Native plantings help tell the story of how the Ohlone People used them for food and making tools. Storyboard panels are also being created that will illustrate a brief history of these Native Americans, and will be permanent features of the greenway. (City of Berkeley)

Summary

All four case studies share certain goals, yet each is unique in the way the goals are met. The Stormwater Gardens in Portland employ a mix of highly scientific technology and functional landscape features to remove runoff water "from the shadowy realm of catch basins and pipes and renders it a visible component of the landscape." (Thompson and Sorvig 17) Local sculptures are featured, while paths and educational signage are provided for the public. Storm water management is visible in Renton's Waterworks as well, yet environmental art is taken a step further than displayed sculpture. Here, art is part of everything from the symbolic use of plant species to the flower-like master plan. The Prince Memorial Greenway also incorporates art and technology into its restoration of Santa Rosa Creek. Here, the goals of revitalizing native fish populations and reconnecting people with the creek are met by physically restoring the previously channeled stream and building pedestrian paths close to the water. Paintings done by local high school students convey environmental and historic information and help to tell the story of Santa Rosa Creek. Finally, the Ohlone Greenway showcases a variety of revitalization projects including creek restorations, art installations, and educational exhibits. This greenway

connects people with their local waterways, with public gardens and parks, with Ohlone history, and with other people in their community.

Figure 1 - Flume at Portland's Stormwater Gardens (Scott Murase)

Figure 2 - Paths through wetlands and ponds at Renton, Washington's Waterworks Gardens (Ned Ahrens)

Figure 3 - Aerial view of Waterworks Gardens during construction (Ned Ahrens)

Figure 4 - Santa Rosa Creek before restoration (Frank Kasimov)

Figure 5 - Santa Rosa Creek after restoration (Mike Sheppard)

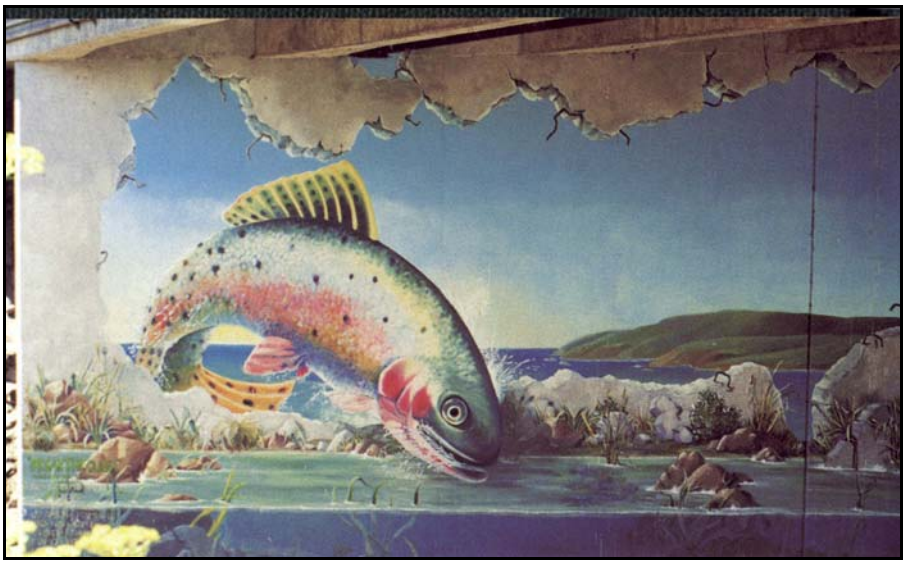


Figure 6 - Painting of Steelhead Trout breaking through a concrete barrier (Mike Sheppard)

Figure 7 - Volunteers planting natives along Codornices Creek (Friends of Five Creeks)

Figure 8 - Quail sculptures on Ohlone Greenway (Friends of Five Creeks)

Figure 9 - Metal cow sculpture (Berkeley Partners for Parks)

CHAPTER 5

THE PROJECT SITE

"Here they all learned to swim, an accomplishment which every boy in Athens acquired at an early age. This pool continued to be the delightful resort of the small fry until destroyed by the blasting for the waterway for the cotton mill." - Augustus Longstreet Hull (Hull 78)

Introduction

This chapter contains five sections that are meant to acquaint the reader with the project site and the opportunities and constraints for greenway development. First, a brief evolution of the Oconee Rivers Greenway is described, from its inception to its current status. Second, the project site location is identified and existing conditions are documented with written accounts and photographs. Third, the story of Easley's Mill is told including historic descriptions of the Shoals and the establishment of the University of Georgia and the town of Athens. Fourth, the habitats and flora of granite outcrops are described, demonstrating the ecological significance of these unique ecosystems. Finally, known needs and constraints of the site are recognized such as SPLOST requests and utility easements.

Oconee Rivers Greenway: A Brief History

Charles Aguar, former Professor of Landscape Architecture at the University of Georgia, envisioned a greenway for Athens over thirty years ago. His wife, Berdeana Aguar, recalls Charlie proposing ideas for what is now the Oconee River Greenway and Heritage Trail in 1973.

"He started talking to all the garden clubs in the area and started pushing it," she said. (Hammes) First-phase groundbreaking for these trails didn't begin until November 1999, almost thirty years after Charlie envisioned it, and only a few months before he died. "It's common knowledge that Charlie Aguar is the father of our Greenway system in Athens-Clarke County," said Richard C. Field, member of the Oconee River Greenway Commission and former Chair. "What we have now is his vision."(Hammes)

In 1975, Charlie Aguar and a group of ten others founded the Sandy Creek Nature Center (see Appendix B for list of founding members). Sandy Creek Park was later established. Cook's Trail, a 4.1 mile footpath with bridges and boardwalks, connects the nature center to the park and officially opened for public use on December 8, 1990. It was built over the course of three years by volunteers including former UGA Professor Walter Cook, for whom the trail is named. ("Sandy")

Another grassroots movement beginning in the 1970s led to the creation of the Oconee Rivers Greenway Commission, a secondary agency of the Athens-Clarke County Unified Government formalized by county ordinance in 1992. As stated on the Oconee Rivers Greenway Commission's brochure, their mission is:

> "To protect the Oconee Rivers and insure the long-term integrity, natural beauty and life support functions of the rivers; to provide citizens the opportunity to enjoy healthy river-oriented recreational activities; to develop an economically viable plan for a Greenway system based on sound environmental principles; and to assist in the implementation of the plan."

The responsibilities of this advisory committee include developing a plan for a river-oriented greenway system in Athens Clarke County and also recommending additional ways to protect the Oconee Rivers and their tributaries. The ORGC has successfully lobbied for 100 foot river and 75 foot perennial stream buffers and has persuaded the county to adopt a community

greenspace program. This group continues to guide the development of two pilot programs, the Heritage Trail and the North Oconee River Greenway, as part of a countywide greenway network plan. (The Oconee Rivers Greenway Commission)

The Oconee Rivers Greenway Commission sought the talents of local landscape architecture firm Robinson Fisher Associates in drafting a concept plant for the entire river. Fisher presented design ideas for greenway development to the Athens community in December 1996. The plan included a 10 foot multi-purpose path with buffers and conservation strips along both sides of the river. Fisher believed that the greenway would help to destroy the myth that outdoor recreation only happens far from home. "There are 10,000 people living within a five-minute walk of the river," he said. (McCarthy)

While many Athens residents strongly supported greenway plans, some riverfront property owners vehemently opposed having a public path built literally in their back yards. Safety and loss of privacy were among the major concerns of those in opposition. In an article published January 1, 1997 in the Athens Observer, Athens resident Ed Mingledorff made his opinion known on the front steps of the Athens Daily News building carrying his shotgun and pistol. He was "mad as hell about it" when he discovered surveyor stakes on his property and assumed they were associated with greenway construction. The only way he would allow greenway development on his property was if his entire lot was purchased for $1 million. Later that same month, another Athens Observer article stated that construction for the east side greenway trail had been postponed due to a high volume of opposition.

Despite setbacks like these and many other unforeseen disruptions, the Oconee River Greenway in Athens has made remarkable progress over the last six years. Several important things happened in 1999: project ownership shifted from ORGC to Athens-Clarke County,

construction of the Heritage Trail and the North Oconee River Greenway began, and a greenway coordinator position was created by the Department of Leisure Services. (Oconee Rivers Greenway Commission 1999 Annual Report) Since then, Phase I of the North Oconee River Greenway has been completed including the Willow Street Trail and the Sandy Creek Connector at Sandy Creek Bridge. The multi-use concrete path is approximately 10 foot wide and three miles long. It connects to Cook's Trail at Sandy Creek Nature Center and follows the North Oconee River south towards downtown Athens and UGA. Several sections of the Heritage Trail, a component of the North Oconee River Greenway, have been completed including the Dudley Park/Oconee Street Trail, the Chicopee Interpretive Center, and three bridges over the North Oconee River and connecting creeks (Figure 10). The Williams Street Connector is complete except for interpretive sign installation, and additional funding for the Easley's Mill section, the focus of this thesis project, is still pending. The Oconee Rivers Greenway Commission has submitted a monetary request "for easement acquisition and possible land purchase along the East side of the North Oconee River from Oconee Street to the University of Georgia East Campus Village." (SPLOST 2005 Project Request Form) The SPLOST IV request has passed including a description of a North Oconee River Greenway Project. Robinson Fisher Associates remains the primary design consultant for all Heritage Trail and North Oconee River Greenway Trail Projects. (SPLOST IV Progress Report)

Project Location and Existing Conditions

The design application of this thesis takes place on the Easley's Mill site as referred to in the SPLOST 2005 Request Form. Although a plan for the entire section from Oconee Street to UGA East Campus Village has been requested, this project addresses a small but very important segment of it. There are several challenging issues involved on this site including the

management of both historic and ecological resources. I will now describe these elements from Oconee Street to the second island in the river, approximately 800 feet to the south. Please refer to the aerial photograph (Figure 11) and the images that follow it (Figure 12 illustrates current property ownership).

The Greenway's Oconee Street entrance has a one-way circular drive with seven parking spaces. The Salvation Army occupied a building that stood here before Athens-Clarke County purchased the lot in 2000. A large stone sign bearing the Greenway symbol stands in the grassy area between the road and the parking (Figure 13). There are some garbage cans, a small informational kiosk, and a yellow metal gate on the south edge of the parking. The elevation is 612 feet.

Just past the gate is what appears to be a worn utility driveway over a granite outcrop (Figure 14). Fill dirt and asphalt cover the rock outcrop in some places (Figure 15). To the west of the driveway there is a gradual drop in elevation of 10-12 feet. At the base of the slope the vegetation is very thick with *Rubus allegheniensis* (Blackberry), patches of *Rhus* sp. (Sumac), and a mix of native and exotic tree seedlings, grasses, and herbaceous plants.

A portion of the city's sanitary sewer system runs along the river. Cast-iron sewer pipes run underground near the river and the utility easement is kept clear for maintenance reasons (Figure 16). Following this mown path further south, the sound of rushing water becomes louder as one approaches Easley's Mill site. The historic significance of this site is discussed in the next section. In the clearing under the power line that spans the river stands a large stone wall, presumably part of the former dam, with a steep drop on its south side (Figure 17). Looking north from on top of the wall, one will see white, fast-moving water cascading over rocks and rubble (Figure 18). Apartments are visible on the other side of the river, although they are

partially screened by a wooded island in the middle of the river (Figure 19). The rapids continue south of the wall, and then flatten out before reaching a second wooded island (Figure 20). Below the stone wall is a flat, low area along the bank with patches of native *Chasmanthium latifolium* (River Oats) close to the water (Figure 21). There are also thick stands of invasive exotics *Ligustrum sinense* (Chinese Privet) and *Lonicera japonica* (Japanese Honeysuckle).

On the east side of the mown utility easement in the same general location of the wall is a large open granite outcrop. The area uphill from the outcrop appears to have been backfilled and converted to a grass play area with a wooden retaining wall holding the soil (Figure 22). There is playground equipment and a covered picnic shelter above the wall (Figure 24). A wooden amphitheater, dedicated to Tommy Harris October 10, 1991, sits on the outcrop below the retaining wall with the stage facing east (Figure 23). Another open wooden structure with a metal roof has been built south of the amphitheater in the wooded edge surrounding the outcrop (Figure 25). Lichens, mosses, and other species typical of a granite outcrop community are present. However, the wooded edges of the outcrop are dominated by invasive exotic species including *Ligustrum sinense* (Chinese Privet), *Lonicera japonica* (Japanese Honeysuckle), and *Albizia julibrissin* (Mimosa).

Georgia Power transmission poles and lines run through the center of the entire project site, then southwest across the river (Figure 11). The bank of the river along this entire site is wooded except for the area cleared under the power lines. Native tree species identified by the author in this zone include:

Acer negundo	Box Elder
Acer rubrum	Red Maple
Acer saccharinum	Silver Maple

Betula nigra	River Birch
Carpinus caroliniana	American Hornbeam
Cercis Canadensis	Eastern Redbud
Maclura pomifera	Osageorange
Ostrya virginiana	American Hophornbeam
Platanus occidentalis	Sycamore
Quercus nigra	Water Oak
Quercus phellos	Willow Oak

Invasive exotic species of trees, shrubs, and vines identified by the author in this zone include:

Albizia julibrissin	Mimosa
Ailanthus altissima	Tree of Heaven
Broussonetia papyrifera	Paper Mulberry
Elaeagnus angustifolia	Russian Olive
Ligustrum sinense	Chinese Privet
Lonicera japonica	Japanese Honeysuckle
Morus alba	White Mulberry
Pureraria lobata	Kudzu

Also seen in the wooded areas along the river bank are several homeless camps. Some campsites appear relatively elaborate complete with tents, make-shift kitchens, laundry lines, and stacked firewood. These campsites appear to change frequently. Some expand and some disappear leaving trash and other items behind (Figure 26).

Easley's Mill: The Beginning of Athens and the University of Georgia

"Georgia removed all the Cherokee Indians from her soil in the year 1738." (Rowe 3) The Cherokee and the Creek inhabited the Athens area before white settlement and were informally divided by the "east-west line running between what are now Athens and Watkinsville." (Hynds 1) Ownership shifted to the white settlers after seven treaties with the tribes and Franklin County was formed. In February of 1796, Jackson County was created out of Franklin County "provided that the courts and elections be held at the home of Daniel W. Easley, one of the commissioners, until a courthouse could be erected." (Hynds 3)

Daniel Easley was a Revolutionary soldier who owned a great deal of land on both sides of the Oconee River. Records show that the land was granted to him by the State of Georgia in 1800, but some speculate there was an earlier grant. (Rowe 3) In 1801, Easley was operating flour, saw, and grist mills at a place called Cedar Shoals on the North Oconee.

In the summer of 1801, a committee chartered by the State Legislature in 1795, visited Easley's land while searching for an appropriate site to build a university. John Milledge, Abram Baldwin, George Walton, John Twiggs, and Hugh Lawson met at Billups' Tavern on Lexington Road and proceeded to scout out Cedar Shoals. "The committee was so pleased with the location, then a forest of grand oaks," that they decided on it for the University of Georgia. (Rowe 3) An article published July 20, 1801 in The Augusta Chronicle describes this event:

> "the Committee repaired to the county of Jackson and proceeded with attention and deliberation to examine a number of situations as well upon the tracts belonging to the University as upon others of private individuals. Having completed their views, they proceeded by ballot to make the choice, when the vote was unanimous in favor of a place belonging to Mr. Daniel Easley, at the Cedar Shoals, upon the North Fork of the Oconee River, and the same was resolved to be selected and chosen for the seat of the University of Georgia. For this purpose, the tract containing 633 acres was purchased of Mr. Easley by Mr. Milledge, one of the Committee, and made a donation of the Trustees, and it was called Athens." (Hull 1)

The University of Georgia was built on the South side of the river, about a half mile upslope from Easley's Mill, and the town of Athens soon began to grow around it. (Hull 2) The lack of facilities and equipment was quite a problem in the early days of UGA, so the legislature loaned $5000 to the University in November of 1802 to erect several buildings. In 1803 Classes were moved into a "one and a half story, twenty-foot square building constructed for that purpose by Daniel W. Easley for $187." (Hynds 69) Easley later built the Athens Grammar School in 1804 for $1,000 and a house for Josiah Meigs, the first President of the University of Georgia. (Hynds 8, 82)

There are many theories as to why the Committee chose Easley's land for the college. John Milledge's generosity and the natural beauty of Cedar Shoals are considered highly probable reasons. President Meigs once described the area as windy and pleasant and "if there is a healthy and beautiful spot in Georgia this is one." (Hynds 4) There were several freshwater springs above the river and fish, shad in particular, were plentiful. According to Augustus Longstreet Hull, Easley once grew a small crop of cotton at the shoals and fondly recalls this river landscape:

> "I am reminded, by the speaking of Easley's cotton patch on the river, of the most beautiful place for small boys to bathe and learn to swim was ever made. It was just below the site of the factory, and seemed to be made for the purpose. It was between the bank of the river and a small island, and was about fifty yards long, and in no place more than four feet deep, with a smooth sandy bottom, and was made by a ledge of rocks which extended from the bank to the island at its lower end. It was perfectly secluded, and the limbs of the large trees that grew on the banks almost met over the pool. The greater portion of the ledge was above the water and made a dry, clean table for the boys to undress. Here they all learned to swim, an accomplishment which every boy in Athens acquired at an early age. This pool continued to be the delightful resort of the small fry until destroyed by the blasting for the waterway for the cotton mill." (78)

In 1832, William Dearing, John Nisbet, Augustin Clayton, and Abram Walker bought 55 acres including Easley's mill complex for $8,000. Here, Athens' second large textile plant was built called the Athens Manufacturing Company (the first being the Georgia Factory at Whitehall) and was in operation by late summer of 1833. (De Vorsey 43)

Currently, the site where Easley's Mill once stood belongs to Athens Boys and Girls Club on the East side of the North Oconee River, and Athens Manufacturing Company, LLC owns the West side. Part of the dam and a few remnants of brick mill structures still stand today, while an original brick building once housed a bar called O'Malley's, a health club, and is now leased by Dial America (Figures 27 and 28).

Ecological Significance of Granite Outcrops

There are over 36,000 square feet of visible granite outcrop on this project site, and the amount covered by fill is unknown. Granite outcrops, also called flatrocks, occur in the Piedmont from North Carolina to eastern Alabama with the largest concentration existing between Atlanta and Athens, Georgia. They usually share the same slope as the surrounding hillsides and their surfaces are generally smooth with scattered islands of vegetation. The plants living on these outcrops have evolved to survive harsh environmental conditions including "extreme temperatures, drought, intense light, strong winds, erosion, fire, and shallow soils". (Popp 34) Because of this harsh environment, invading species from surrounding wooded areas cannot survive on the outcrops. Likewise, outcrop species cannot compete with those found in neighboring plant communities. Therefore, plant species of granite outcrops are quite specialized and unique and should therefore be protected and restored as needed. (Popp 41)

In a healthy outcrop community there are six different plant habitats: bare rock, crevices in the rock, marginal zone, rock rubble, solution pits, and vegetative mats. (Popp 36)

Approximately two hundred plant species of lichens, mosses, annuals, perennials, and woody plants depend on these habitats to survive. Forty-four of these species are considered typical of an outcrop, and seventeen of the forty-four are regarded as common (see Appendix C for list of endemic species). (Popp 42)

Opportunities and Constraints at the Project Site

According to the Athens Clarke County SPLOST (Special Purpose Local Options Sales Tax) 2005 Project Request Form, there are two specific goals and eight desired features listed for what is called Greenway Project 1, or the Oconee Street - East Campus Village Greenway. The project site of this thesis has been identified as approximately the first 800 linear feet of this section. The goals for the entire section include an extension of the existing Greenway that will make a riverside connection from Oconee Street to UGA's East Campus Village and College Station Road. This is intended to provide a 'blue' trail for canoes and kayaks from the Easley's Mill site to Whitehall. Desired features for this section as stated in the SPLOST 2005 form are as follows:

1. Approximately 1.5 miles of improved trail (12' width) along the east side of North Oconee River from Oconee Street Greenway parking area to UGA's East Campus Village.
2. Restroom facilities near the Oconee St. Greenway parking area.
3. Canoe and kayak launching site below the former Easley Mill (River Mill).
4. Overlook and associated side trails for river view and rock outcrop display and protection.
5. Expanded parking at Oconee Street Greenway parking area.
6. Canoe/kayak landing site at the Whitehall Road Bridge over the North Oconee River.
7. Exhibits and interpretive areas to complete Bartram Area, Trail Ecology, Dudley Park, and Shoals Zones of existing Heritage Trail.
8. Design and planning for the next phase of the Greenway network on the North Oconee River.

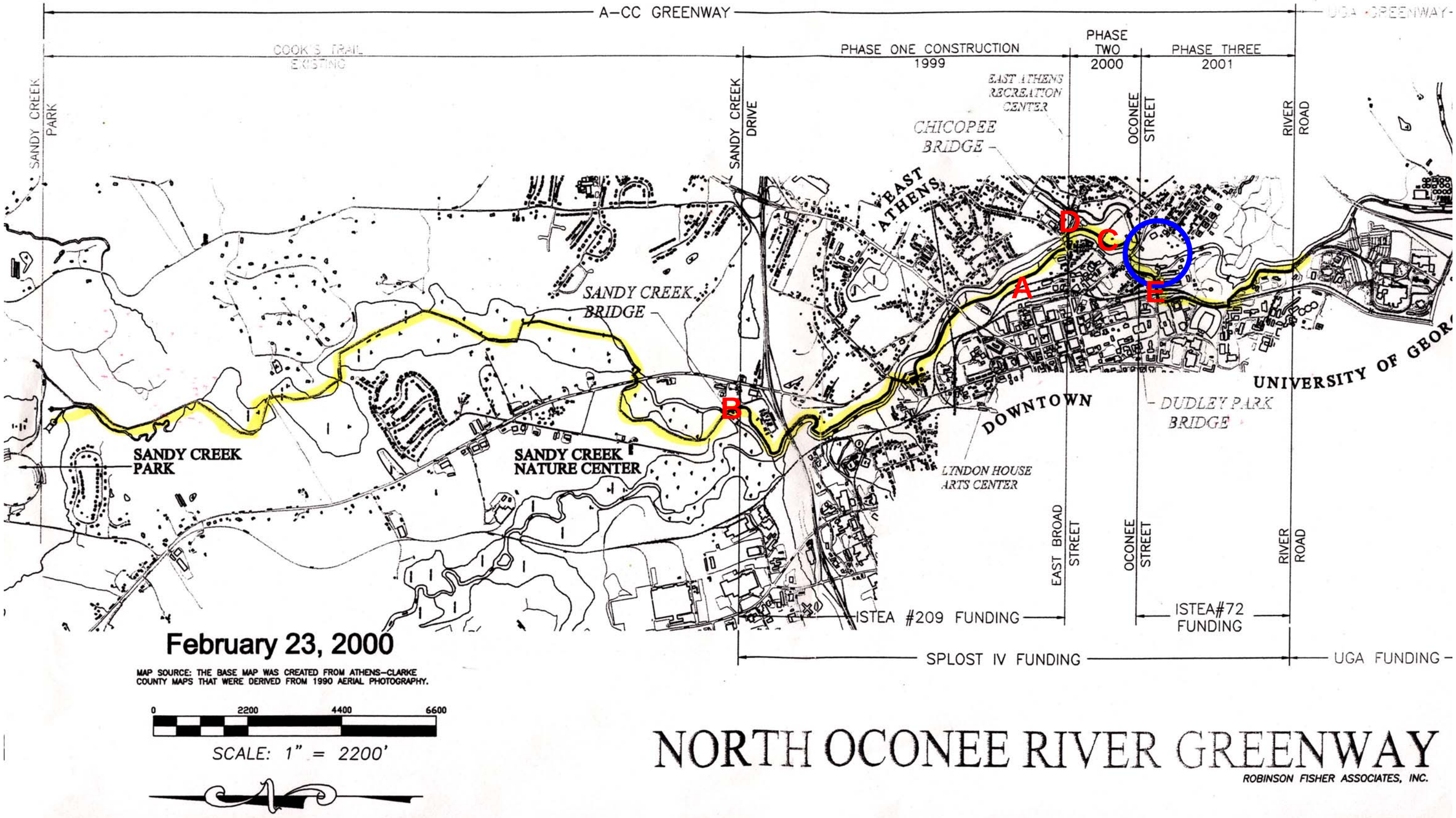
The presence of sewer pipes and power transmission poles and lines was described earlier in this chapter. There are many regulations and limitations associated with public utilities regarding what is allowed or prohibited within each right-of-way.

The mown sewer line easement provides a logical location for the proposed greenway trail. It is already cleared and relatively flat, meaning there will be a minimal amount of grading or clearing needed. It is close enough to the river for nice views, yet far enough away from the water to allow space for an adequate vegetative buffer. For sewer maintenance and repair reasons, the trail may not run directly above the sewer lines, but it could run along side them instead. Plans to replace sewer lines on this site are underway and construction is scheduled to take place within the 2005-2007 period. (ACC Capitol Improvements Element) Any future greenway development should be coordinated with these efforts.

As seen in the aerial photograph (Figure 11), power transmission poles and lines are present on this project site. According to Rick Boswell, Engineering Supervisor at Georgia Power, it is their main goal to preserve the integrity of the power lines. According to Joel W. Johnson, with the Athens Transmission Center of Georgia Power, these particular lines serve the North Athens Substation and require a 100' right-of-way. The following are not allowed within this right-of-way: permanent structures, large growth trees over 15' tall, street lights, parking areas that restrict Georgia Power access, and septic fields or tanks. Roads may be built that cross the lines perpendicularly, but cannot run parallel to the lines within the right-of-way. Each transmission pole has an underground grid at its base called a "ground field." Consequently, grading is not allowed within 25'of any pole and should not exceed a 3:1 slope elsewhere in the R.O.W. An encroachment permit from Georgia Power is required before any construction begins in a power line R.O.W. (Boswell) (Johnson)

Summary

This project site will be a valuable addition to the Oconee River Greenway system due to its rich cultural history and unique landscapes. The stories of Athens' first settlement, industrial past, and establishment of UGA make the Easley's Mill site an ideal stop along the Heritage Trail. The presence of two granite outcrops provides a rare opportunity to simultaneously restore a specialized ecosystem and educate the public about their ecological significance. With careful consideration of the sewer and power easement limitations, a comprehensive greenway plan based on sound ecological principles can insure the protection, improvement, and public enjoyment of this special place.



NORTH OCONEE RIVER GREENWAY

ROBINSON FISHER ASSOCIATES, INC.

A Willow Street Trail

B Sandy Creek Connector

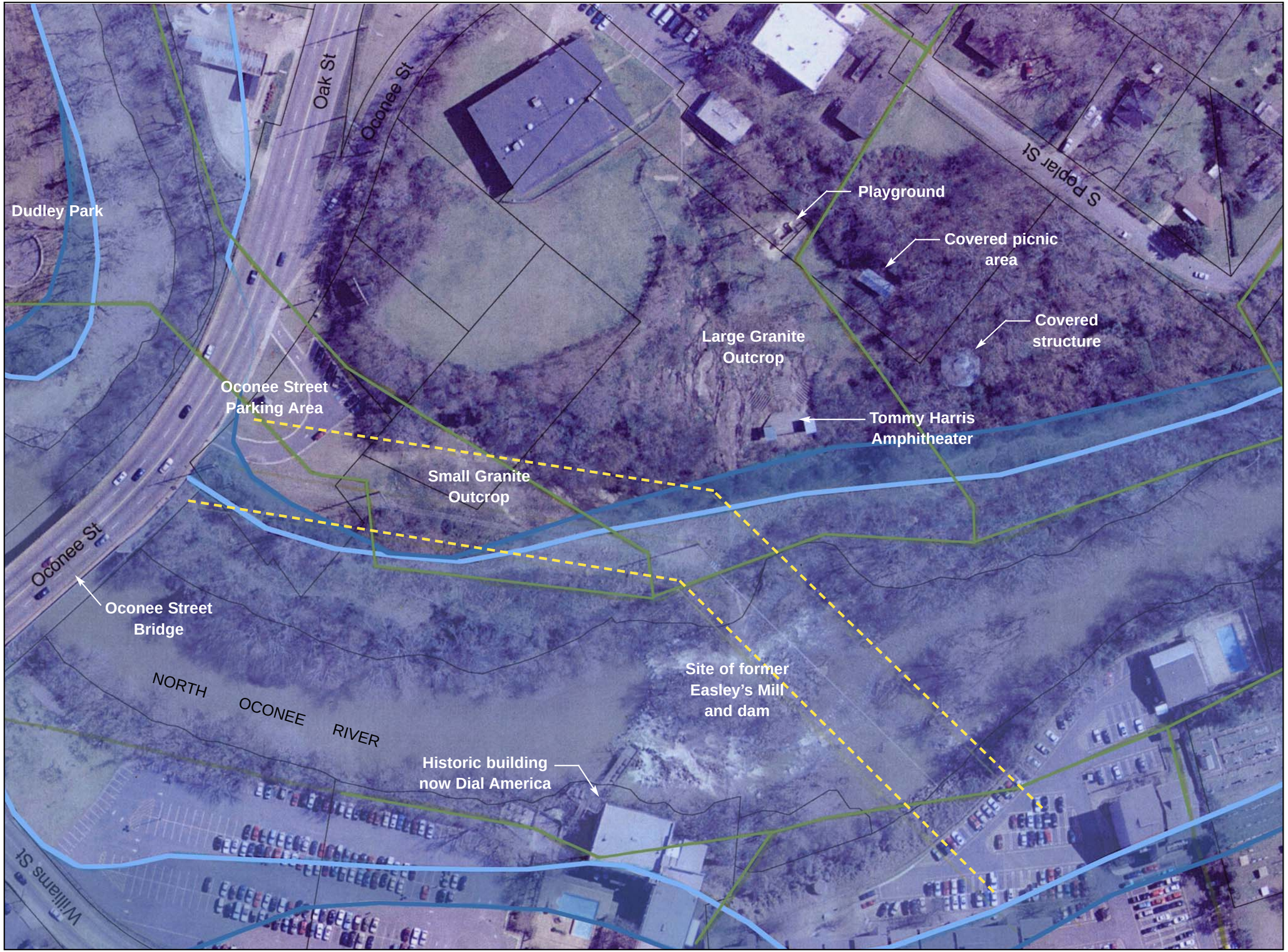
C Dudley Park/Oconee Street Trail

D Chicopee Interpretive Center

E Williams Street Connector

O Proposed Project Location

Figure 10
Map of North Oconee
River Greenway
58



LEGEND

- Power Line R.O.W.
- Sewer Line
- 100 yr Flood Zone
- 500 yr Flood Zone

NORTH

scale: 1"=100' - 0"

Figure 11
Project Site Existing Conditions

LEGEND

- Athens Boys & Girls Club
- Athens Clarke County
- Action Inc.
- Athens Mfg. Co.
- Summerglen Assoc.
- Oconee Hill Cemetery

(2’ contours)

NORTH

scale: 1”=100’ - 0”

Figure 12
Current Ownership
60

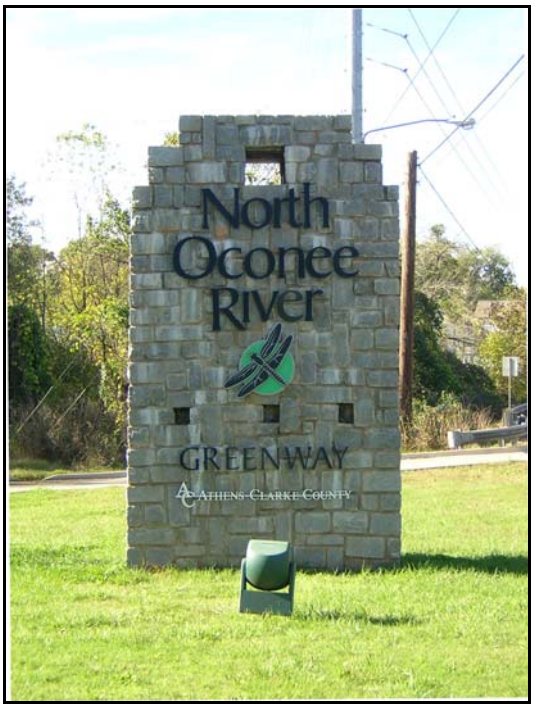


Figure 13 - Existing sign in Oconee Street Parking Area

Figure 14 - Utility access drive into greenway site over granite outcrop

Figure 15 - Asphalt on granite outcrop

Figure 16 - Mown utility easement looking south (David Porter)

Figure 17 - Historic stone and brick wall

Figure 18 - View of rapids looking north from wall (David Porter)

Figure 19 - View west across the North Oconee River, John Devine standing on top of the wall (David Porter)

Figure 20 - View south below rapids (David Porter)

Figure 21 - River Oats, *Chasmanthium latifolium*, on the bank of The North Oconee River (David Porter)

Figure 22 - Retaining wall on granite outcrop

Figure 23 - Tommy Harris Amphitheater below retaining wall (David Porter)

Figure 24 - Covered structure and playground above retaining wall

Figure 25 - Covered structure on south edge of granite outcrop

Figure 26 - Homeless camp (David Porter)

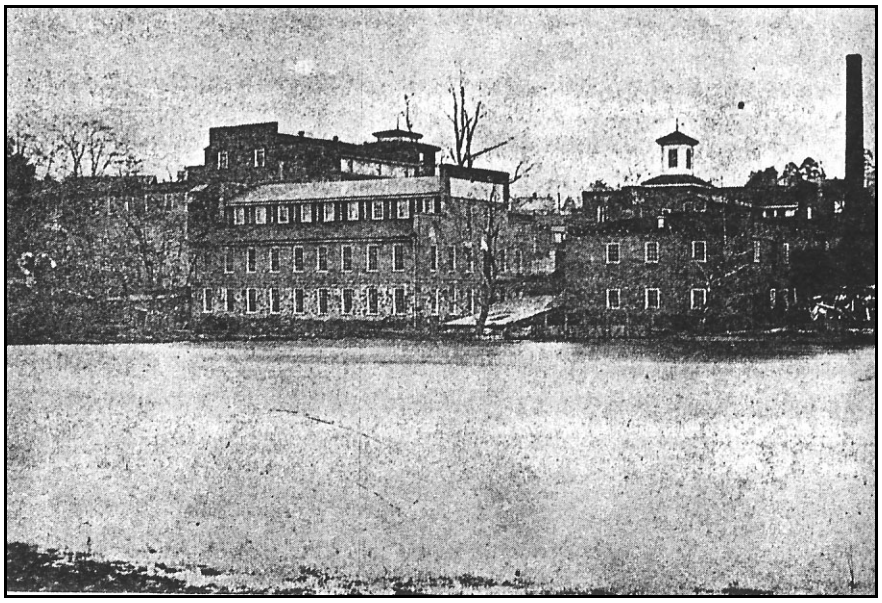


Figure 27 - Athens Factory ca. 1890 (Rare Books and Manuscripts, UGA Libraries)

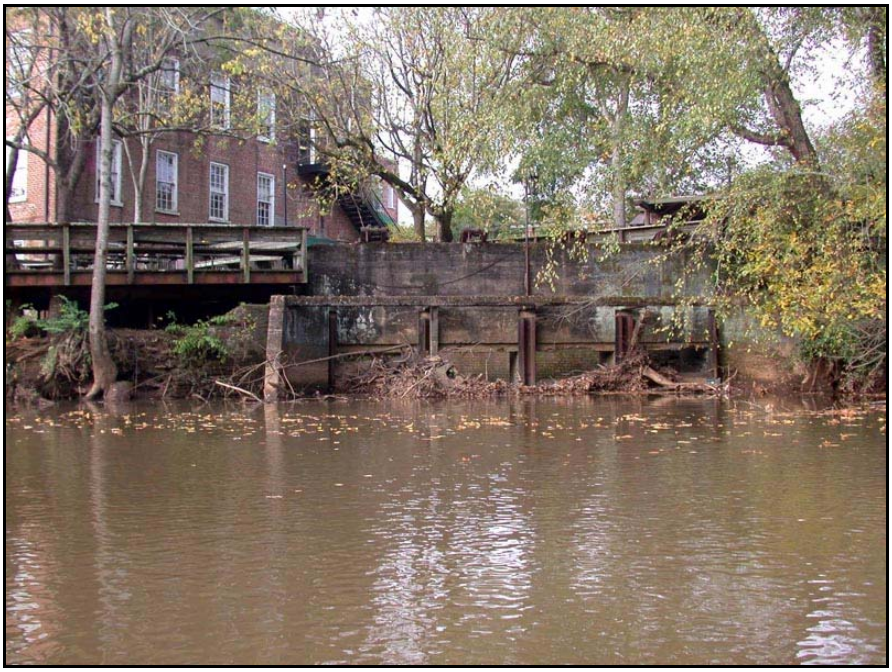


Figure 28 - Dial America building and mill race October 30, 2004 (David Porter)

CHAPTER 6

DESIGN RECOMMENDATIONS

"When we walk, we naturally go to the fields and woods: what would become of us, if we walked only in a garden or a mall?"-- Henry David Thoreau

Introduction

This chapter applies the insight gained from the research described in earlier chapters as it applies to the project site, a portion of the Oconee River Greenway in Athens-Clarke County. The ecological design criteria identified in Chapter 3 are reiterated as a prelude to the concept plan developed in response to these criteria. Each major design element of the concept plan is then discussed in greater detail as to how the criteria are met regarding installation, the use of materials, and management practices. Design elements include plans for the Oconee Street parking area, the North Oconee River Greenway trail, Easley's Mill Overlook, a vegetation management plan, and an educational component plan. Illustrative drawings and other images that further describe the design plans are located at the end of this chapter.

This application portion of the thesis contains a series of design recommendations rather than specific detailed design plans. It is meant to provide conceptual guidelines for future development of the next leg of the North Oconee River Greenway.

Ecological Design Criteria

Three criteria were established to enable development of a concept plan based on an appropriate ecological premise. First, all design recommendations are geared towards protecting

and improving the quality of the North Oconee River. Second, all recommendations regarding vegetation management focus on increasing species and habitat diversity. And third, all negative impacts associated with development on this site are kept to a minimum. To insure that the criteria are met, three rules based on ecological design principles were followed in developing this plan: to recognize the interconnectedness of everything on site, to design with nature by looking to it for inspiration, and to balance the ecological needs of the site with those of its human users.

Concept Plan

Using these criteria and principles as guidelines, I have produced a concept plan that will improve the environmental and aesthetic quality of the site while offering recreational and educational opportunities. For orientation to the site and location of specific design elements, see the concept plan (Figure 29). The major design components on this plan are: an expanded parking area with restroom facilities, greenway trail placement, a plaza and overlook at the Easley's Mill site, boat launch placement, and vegetation management zones. Appropriate locations for educational signage or displays are also marked, as are possible future greenway connections and spur trails. Each of these components meets the defined ecological design criteria which are described in greater detail below.

Oconee Street Parking Area

The proposed parking area expands upon the existing driveway and parking area, increasing the number of parking spaces from seven to twenty-four. There is a mix of large (10x 20'), compact (8 1/2x 18'0'), and disabled (12 x 20') parking spaces and a drop-off/pick-up zone near the greenway entrance for disabled users. (Flink 242) Space for canoe/kayak loading and unloading is also provided near the trail entrance. A 20 x 25' building sited outside of the power

line right-of-way offers restroom facilities, water fountains, and an information kiosk. Next to the building, a semi-circular stone seat wall is proposed, similar in style to existing stone walls on other parts of the greenway. This wall offers a convenient gathering or resting place near the parking and facilities while blocking vehicular access to an existing path through a granite outcrop. Restoration of the outcrop is proposed and will require restricted access. This is explained in the Vegetation Management section of this chapter.

The driveway will remain one-way, but the exit will be shifted to meet Oconee Street at a safer angle, closer to the ideal of ninety degrees. Installing a porous driving surface like gravel with an appropriate sized underbase will slow traffic and minimize storm water runoff. Porous pavement also reduces runoff by allowing the water to absorb into the ground where it falls. If it is decided that the driveway must be paved with impervious materials, then storm water runoff leaving the driveway for release into the river nearby will be reduced by following the other recommendations offered below. The parking bays will be permeable (gravel or porous pavement) to help infiltrate rainwater. Since disabled parking spaces and loading zones require hard surfaces for safety reasons, these will be surfaced with a paving material that is smooth and stable (i.e. not gravel) whether permeable or not. (Flink 242)

The entire proposed parking area can be accommodated by the existing grade. This will minimize erosion during construction. Vegetated shoulders around the parking area will absorb and filter runoff. This will eliminate any need for storm inlets, drains, or concrete curbs and gutters. Native plants will be installed to visually soften the appearance of the parking lot and help to screen it from Oconee Street. Installation and maintenance of these plantings is discussed in the Vegetation Management section of this chapter. Due to the power line right-of-way restrictions, it is not possible to plant many tall trees to shade this area. One medium-sized

Scarlet Oak is placed where it will not obstruct the power lines. Otherwise, small trees such as Redbuds, Shining Sumac, and Eastern Red Cedars are acceptable and will provide shade without interfering with power line maintenance. These species are part of a plant community that is typical of North Georgia's interstate roadsides and will be attractive to drivers on Oconee Street/Lexington Highway. See Figure 30 for an enlarged plan of the parking area and plantings, and Figures 31 and 32 for views of the parking area before and after the proposed plantings are installed.

Greenway Trail

A concrete path along the west perimeter of the parking area links the sidewalk on Oconee Street to the main entrance of this proposed greenway section. By following this path, greenway users will access the new trail without crossing traffic in the parking lot. Originally, access from the parking area to the river area of this site was made by driving or walking over the granite outcrop. I am proposing that the trail be relocated for a couple of reasons. First, since one of the objectives of this project is to restore the granite outcrop, then that area should be avoided. Second, the power line right-of-way prohibits any grading within 25' of the transmission pole. The slope on either side of the pole is very steep and would require extensive grading to install an A.D.A accessible trail (see Appendix E for A.D.A., Americans with Disabilities Act, trail requirements). The proposed trail will follow the gentlest slope available. If installed as shown in Figure 29, some grading will be required to achieve the 6% slope of the path shown. In this case, stabilizing the soil will be of the utmost importance during and after construction to prevent erosion and resulting sedimentation in the river. Alternately, carefully designed switchbacks and retaining walls could be used to install a trail of appropriate grade.

Constructing the trail as proposed will require removal of existing vegetation on the west side of the parking area. The quality of this vegetation is questionable being that much of it consists of invasive exotic species including Mimosa, Kudzu, Chinese Privet, Japanese Honeysuckle, and Russian Olive. The few tall Sycamore and Box Elder trees there have been topped or sheared along one side because of their proximity to the power line right-of-way. If the existing vegetation is removed for trail construction, this area will be replanted with vegetation of higher quality including native shrubs and small trees that will not interfere with power line maintenance (see Appendix J for suggested species list).

From the parking area, the proposed greenway trail leads to a canoe take out/put in (described later in this chapter) and then runs along the river. I propose that the greenway should eventually extend north under the Oconee Street bridge and connect to Dudley Park by way of a cantilevered boardwalk. To the south, the greenway follows the sewer line easement to Easley's Mill Overlook, past the second granite outcrop, and ultimately to the University of Georgia's East Campus Village. As mentioned in Chapter 5, plans are underway for sewer line repair and greenway development should be coordinated with these efforts to avoid unnecessary conflicts.

In keeping with existing greenway trails, the proposed greenway will be a 12' wide concrete path. Boardwalks or bridges will be incorporated where there is overly wet soil or abrupt elevation changes. Vehicular access along the greenway will be restricted to Georgia Power, Athens-Clarke County Public Utilities, and greenway personnel and volunteers working on the trail. Locked removable bollards will deter unauthorized vehicles. A 2 to 4 foot wide swath will be kept relatively clear on either side of the trail for vehicular access and safety reasons. Managing the trail edge in this way will also lend a "tidy" appearance to an otherwise natural landscape that may be considered by some as "too wild." These strips will be planted

with low-growing native vegetation that require infrequent or no mowing such as *Carex Pensylvanica*, Pennsylvania Sedge, or *Juncus tenuis*, Path Rush.

There are two spur trails shown as dashed lines on the concept plan (Figure 29). These will be put in after all other proposed elements are installed. One is a foot path with stairs from the Oconee Street parking lot to the boardwalk connecting this greenway with Dudley Park. The other is a path through the larger granite outcrop to the open air pavilion. This path will be marked with cairn rock piles instead of painted markers on the granite. This trail will not be accessible until educational signage about the sensitivity of the outcrop ecosystem has been installed.

Easley's Mill Overlook

Just across the proposed greenway trail from the large granite outcrop is a scenic view of the Oconee River and the site of what used to be Easley's Mill (Figure 19). A historic brick and stone wall provides a platform with a fabulous view of rapids above and below the dam. However, this is a dangerous place to stand because of steep drops on both sides. A boardwalk with handrails along the north side of the wall will offer visitors a safer opportunity to walk out over the whitewater. A semi-circular stone seat wall will partially enclose a central plaza adjacent to the boardwalk. The plaza will be surfaced with fine gravel or concrete pavers, depending upon the level of formality desired. A wooden ramp connected to the boardwalk will lead down to the area below the wall. This lower space is ideal for picnic tables and for viewing the historic wall (see Figure 35 for an appropriate picnic table example). Canoes and kayaks will be easily carried down the ramp to a put-in below the rapids (described later in this chapter). The surface of the wooden ramp will be amended to prevent slipping. Two concrete paths will

connect the plaza and ramp to the greenway trail. One path will connect directly with the ramp so that boaters can bypass the plaza and avoid negotiating awkward turns (Figure 33).

Educational signs will be installed on the boardwalk to convey the history of this important site. Their style and materials will be compatible with those already installed in other areas along the greenway (Figure 36). The juxtaposition of two power sources here (at Easley's Mill Overlook on the concept plan Figure 29), historically the dam and currently the power lines over head, will be used as the topical premise of a sign about local cultural change.

Negative impacts of development in this riverside area are minimized by building the walking surfaces above the existing features of water, rock, and sudden changes in elevation. With "floating" boardwalks, grading will be avoided and the amount of impervious surface will be kept to a minimum. The wood or any other materials used to construct the boardwalk overlook and ramp must not be treated with toxic chemicals that could contaminate the soil or water. Whenever questions regarding the treatment of historic structures arise, these will be resolved through consultation with the State Historic Preservation Office, located in Atlanta.

Boat Launches

There are three boat launch/take out sites indicated on the concept plan (Figure 29). The first is located approximately 250' above the dam at the base of the trail to the parking lot. This is considered the primary take out for portaging around the dam and carrying boats to the Oconee Street parking lot. The second take out is 50' above the dam and will be used by only by experienced boaters due to its close proximity to the dam. The third put in is approximately 300' downriver from the top of the dam. This is accessible by way of the proposed ramp (shown with an 8.33% slope) from the boardwalk (Figure 33).

According to the National Park Service's design guidelines for canoe and kayak launches, "a logical, lasting launch provides safe and easy access for paddlers while accommodating the topographic, climatic, and ecological characteristics of its location. Ideally, its construction is cost-efficient and durable and has little impact on the environment and riparian ecology." ("Logical" 5) The proposed boat launch sites are relatively flat areas with no visible signs of erosion and do not appear to be cut by river currents. This is important for the siting of the put-ins because, according to the National Park Service, areas of heavy flow on a river should be avoided since strong currents can be dangerous to paddlers and erode the site over time. Installing low-impact launches (see "General recommendations for designing a launch that is environment- friendly" in Appendix E) with non-toxic materials will help to protect the water quality, riparian vegetation, and aquatic habitats while enabling sustainable recreation. ("Logical" 7)

Average water level information and any applicable environmental regulations will be investigated before construction documents are drawn so that the specific design is safe. See Appendix F for general recommendations regarding launch design, and refer to "Logical Lasting Launches," a National Park Service publication available in PDF format on the NPS website for additional information. The fact that these launches are near a historic site may also adjust the options for techniques and materials used in the construction of the boat launches.

Vegetation Management

There are six vegetation management zones illustrated in Figure 34. For each of these zones, I am proposing different management goals and strategies based on zone characteristics. These include moisture and soil conditions, sun exposure, existing plant species, site constraints (such as power line right-of-way), and aesthetic qualities.

Zone A encompasses the plantings in the parking area and at Easley's Mill Overlook. This zone is slightly more formal than the other zones and will require frequent maintenance such as watering, mulching and pruning until the plantings becomes established. Large shade trees may not be planted in either area due to the power line right-of-way, so smaller trees and shrubs are recommended. Suggested species in the parking area are native to the Piedmont region and well adapted to hot dry conditions (see Figure 30 for planting plan). The species selected for the Easley's Mill Overlook area are also native and adapted to hot and dry conditions, but will tolerate flooding as well (Figure 33). Trees and shrubs should be planted in the fall, mulched, and watered. Watering, mulching, weeding and monitoring over the next few growing seasons will help to insure survival. Grasses and herbaceous plants in Zone A can be planted in the fall or early spring. Since the plantings in this zone are the most formal of all on the project site, selection of 1-gallon containers or plugs for grasses and herbaceous plants is a better option than seeding. In this way, the desired visual outcome will be easier to achieve since plant placement is more predictable. The plants in both areas will require little if any soil amendment or special care to survive. In keeping with the ecological design criteria, no chemical fertilizers or pest controls will be applied.

Zone B includes both granite outcrops on the project site. Since the integrity of both rock outcrops has been compromised by previous land-uses, their restoration and protection is critical to the establishment of a nature aesthetic along the greenway. As discussed in Chapter 5, plant communities of granite outcrops are unique and specialized. Prior to restoration, a complete plant inventory in these areas will be made and the presence of any rare or endangered species will be recorded. The smaller rock outcrop has been partially covered with asphalt and currently serves as a driveway into the site. To begin restoration of this outcrop, the asphalt will be removed,

vehicular access will be prohibited, and pedestrian access will be restricted until signs discouraging trampling are installed. After the signs are posted, and a spur foot path will skirt the western edge of the outcrop and connect with the main greenway trail (Figure 29). For the larger outcrop, the retaining wall and the back-filled soil it supports will be removed. Soil in rock depressions will remain. On a rock outcrop, harsh conditions allow survival of only the toughest plants. These same harsh conditions also cause discomfort for people, especially in the hot months. Consequently, the amphitheater, playground, and covered structure at the top of the slope should be removed. The covered structure on the southern side of the outcrop can remain because it is located in the wooded edge and will not interfere with restoration efforts. The proposed spur trail from the greenway (Figure 29) will eventually lead to this structure through the granite outcrop after signs discouraging trampling are installed. Both spur foot paths will be marked with rock pile cairns or other discreet method. The wooded edge of both outcrops will be managed for invasive exotic removal and soil pockets in the rock will be seeded with appropriate species (see Appendix G for invasive exotic list and Appendix C for native granite outcrop species).

Zone C includes the riparian vegetation along the river bank. As described in Chapter 5, the shrub layer in this zone is dominated by invasive exotic species. In order to improve the ecological and aesthetic quality of this vegetative buffer, the exotic species will be eradicated. In keeping with the ecological design criteria, soil disturbance and chemical use must be kept to a minimum during this process. However, removal of extensive root systems (such as those created by Privet) is highly disruptive to the soil community. Consequently, I recommend using the “cut-treat” method on all woody species. This is described in greater detail in Appendix G. This method involves cutting a woody plant close to the ground and then painting the base

immediately with a glyphosate herbicide. "Cut-treat" is most effective when performed in late winter and summer, although each time has its advantages. Although the kill is slightly more effective in the growing season, the absence of leaves in winter makes for more efficient application. Non-woody herbaceous plants can be removed by hand-pulling when soils are wet. (Miller 3)

According to James Miller, author of Nonnative Invasive Plants of Southern Forests: A Field Guide for Identification and Control, "rehabilitation is the most important final phase of an integrated invasive plant eradication and reclamation program." (Miller 7) In some cases, native plant communities may initiate regeneration on their own after invasive removal if the soil seed bank remains intact. Light-seeded plants, both native and invasive exotic, are likely to be present in the seed bank while heavier seeds will be deposited over time by birds and other animals. Often times, the native plants in the seed bank do not grow fast enough to out-compete the invasive exotics. For this reason, continuous removal of invasive exotic species is necessary until the native plants become well established. Planting native trees, shrubs, and herbaceous species immediately after invasive removal will help to suppress invasive exotic growth. See Appendix H for a list of native species suitable for Zone C.

Once the greenway trail is constructed, Zone C will be more accessible than it currently is and an invasive exotic removal program can begin. This will present opportunities for service learning by involving local volunteer groups. Students from UGA or local high schools could receive course credit in exchange for community service. This type of program would benefit both people and the environment by providing the chance to learn about riparian ecosystems while improving them.

Zones D and E refer to the open areas located roughly in the center of the project site. These zones are to be managed as open fields or meadows varying somewhat in species composition. Zone D occurs where the soil is slightly higher and drier while Zone E is at a lower elevation and occasionally wet. Consequently there will be overlap of species although some will flourish in one zone or the other. Currently, both zones are dominated by *Rubus allegheniensis* (Blackberry), with patches of *Rhus* sp. (Sumac), and a mix of native and exotic tree seedlings, grasses, and herbaceous plants. Although *Rubus allegheniensis* is a native plant, its invasive nature in this situation decreases species diversity and should therefore be removed. Growth of desirable native species can be encouraged by mowing and seeding at strategic times. For example, after mowing the area close to the ground, it is seeded using a no-till drill method in the fall. For the first year, the area is mowed to a height of 6 inches to suppress fast growing weeds. Since most wildflower grass seedlings will not exceed 6" in one year, they will not be damaged by the mowing. ("Prairie") An alternative and sometimes more effective method of establishing a native grass and wildflower meadow is to eradicate all existing exotic weeds. This is accomplished by an end of summer mowing, followed by an application of glyphosate herbicide in the fall when the vegetation has re-grown to a height of about 1 foot. The herbicide is reapplied three to four times throughout the growing season of the following year. ("Prairie") Once the area is completely free of weeds, it may be seeded or plugged with native grasses and wildflowers (see Appendix I for native species lists for both zones). Either way that the meadow is prepared and planted, rotational mowing of half of the meadow every other year after it is established will prevent any certain species from dominating the others, thus maximizing species diversity. A rotational mowing regime also increases habitat diversity by leaving some sections standing for animals to over winter in. ("Prairie") This management regime also prevents the

establishment of woody species in the meadow. This is important because tall trees will interfere with the utility right-of-way. Existing stands of native *Rhus sp*., Sumac, should be allowed to remain because they are of an acceptable height for the right-of-way and can easily be mown around.

In keeping with the ecological criteria, the preparation, planting and maintenance of all zones including D and E should increase the environmental quality of the site. Therefore, if herbicide is applied in preparing the land for planting then every precaution will be taken to make sure it is done safely. Other approaches to meadow establishment involve tilling the soil but are not recommended for this site because Zone D is on a slope and prone to erosion problems and Zone E is at an elevation that may flood periodically. Tilling will exacerbate the associated sediment movement. A controlled fire regime is another method of meadow establishment and management but is not recommended here because of site constraints such as power lines, the sewer system, and proximity to buildings.

Zone F refers to the slope between the Oconee Street parking lot and the North Oconee River. It is vital that this area be densely vegetated to help slow and filter any storm water running off from the parking area to protect the water quality of the nearby North Oconee River. The proposed trail location calls for the removal of some existing trees and shrubs in this zone. The quality of this vegetation is poor, being dominated by invasive exotic species and severely cut back out of the right-of-way. Vegetation of higher ecological and aesthetic quality will replace it once the trail is installed. Since this zone is rather steep in many places, mowing is not possible as in Zones D and E, and formal planting is not recommended as in Zone A. Consequently, this area will be planted in the fall with small trees, spreading shrubs that tend to colonize, and other characteristic species of fields and roadsides of north Georgia (see Appendix

J for suggested species list). Bare root shrubs and herbaceous/grass plugs are ideal for this situation because plants are sometimes cheaper and easier to transport on slopes in this form compared to large containers. Weeds will be suppressed until the plantings are able to shade out undesirable competitors. Hand pulling, mulching, and under-planting with annual cover crops can aid in combating weeds. All plantings in Zone F will be watered regularly for a few growing seasons to help insure survival.

Educational Components

Educational signage will be installed at Easley's Mill Overlook and at the larger granite outcrop. An information kiosk will be located on the side of the restroom facility facing the parking area. Since these facilities will attract people to the building, this is an appropriate place for a greenway map and educational displays about porous pavement or other water quality issues. There are many opportunities to share knowledge about the environment along the greenway and some key locations are marked on the concept plan (Figure 29). Some messages the signs will convey are: plant species identification, the importance of managing for biodiversity, information on how to manage for biodiversity on private property, and specific water quality issues associated with the site. Some will point out the significance of protecting ecologically sensitive habitats such as the granite outcrops and the river bank and will aid in reducing damage from trampling or vandalism. Directional signage should also be incorporated throughout the site including on the river or "blue trail." Take outs and portage routes must be clearly marked.

Service learning can remedy several problems at once (see Appendix K for a definition of service learning). Labor intensive tasks such as clearing, planting, mulching, and watering can be accomplished with little or no cost while volunteers learn about plants and ecology. Other

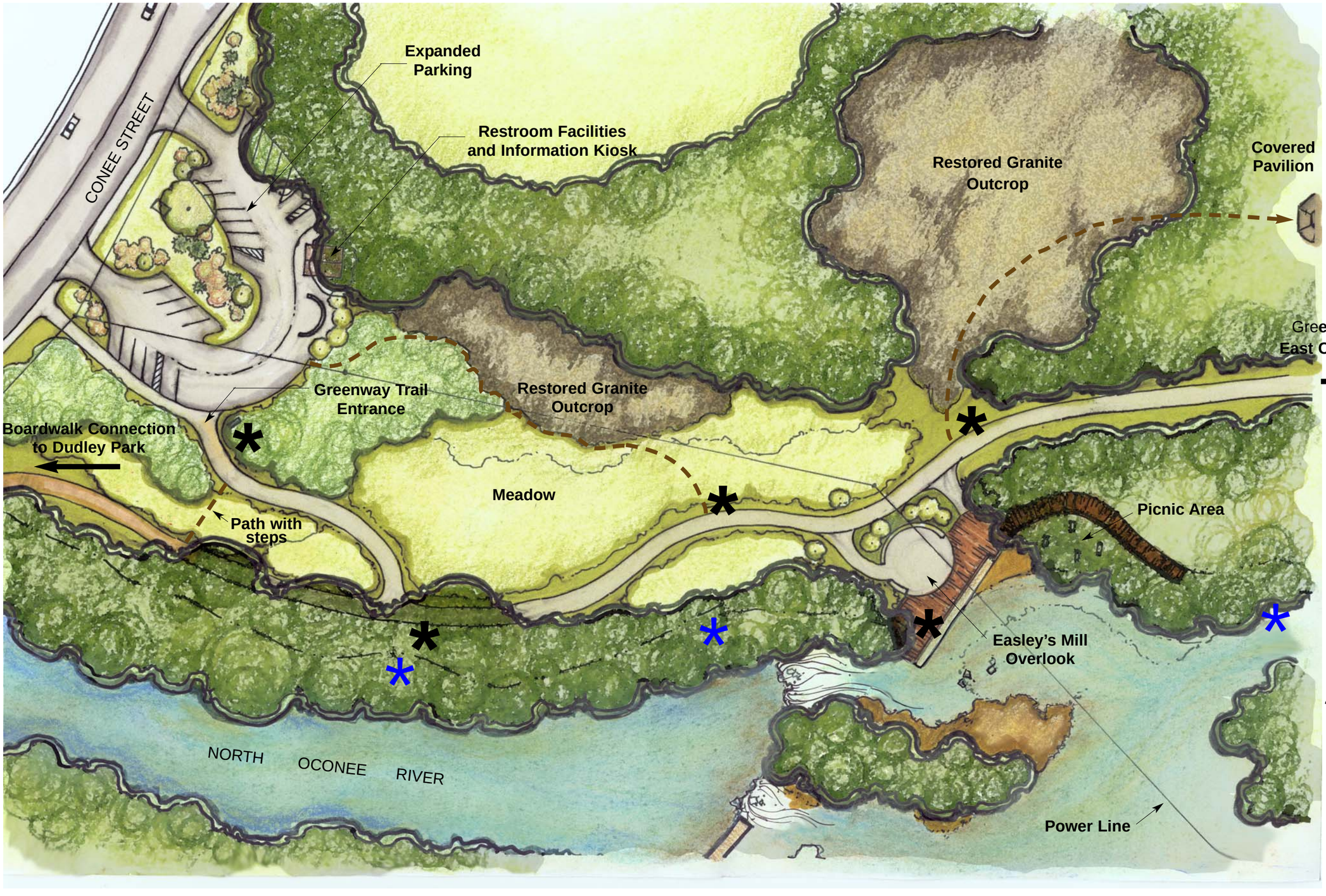
incentives for volunteering time and labor could include college course credit and community service awards.

The entire site can serve as an outdoor laboratory where standard classroom education is enriched with hands on experiences in nature. Easley's Mill Overlook would provide an ideal setting for an outdoor classroom. This would also be an appropriate place for interpretive signage or art installations that convey an environmental or historic message related to the site (Figures 37 and 38). Students, volunteers, and visitors aren't the only ones who could benefit from these educational opportunities. Those in charge of the greenway system can learn from experimental restoration and management projects on this site. Regarding the invasive exotic management in Zone C, certain sections could receive different treatments and the results might guide future riparian vegetation management. For example, some sections can be replanted with natives once the invasive species are removed. The exotics might be suppressed in other sections without replanting. The outcomes may reveal which treatment is the most effective over time.

Summary

This comprehensive plan attempts to balance human desires and environmental health through the application of specific ecological design criteria to greenway development. Every element of this design, including the installation, use of materials, and management plan attends to protecting and improving water quality, increasing biodiversity, and minimizing negative environmental impacts. Furthermore, educational opportunities are incorporated in the design in hopes of increasing public awareness of these efforts and other environmental issues. As the term *concept plan* implies, these recommendations are ideas meant to illustrate a vision of what this site has the potential to become. By building upon the premises of this design, the ultimate

goal of improving ecological health while offering sensory rich, educational, and recreational experiences in nature to people can be attained.



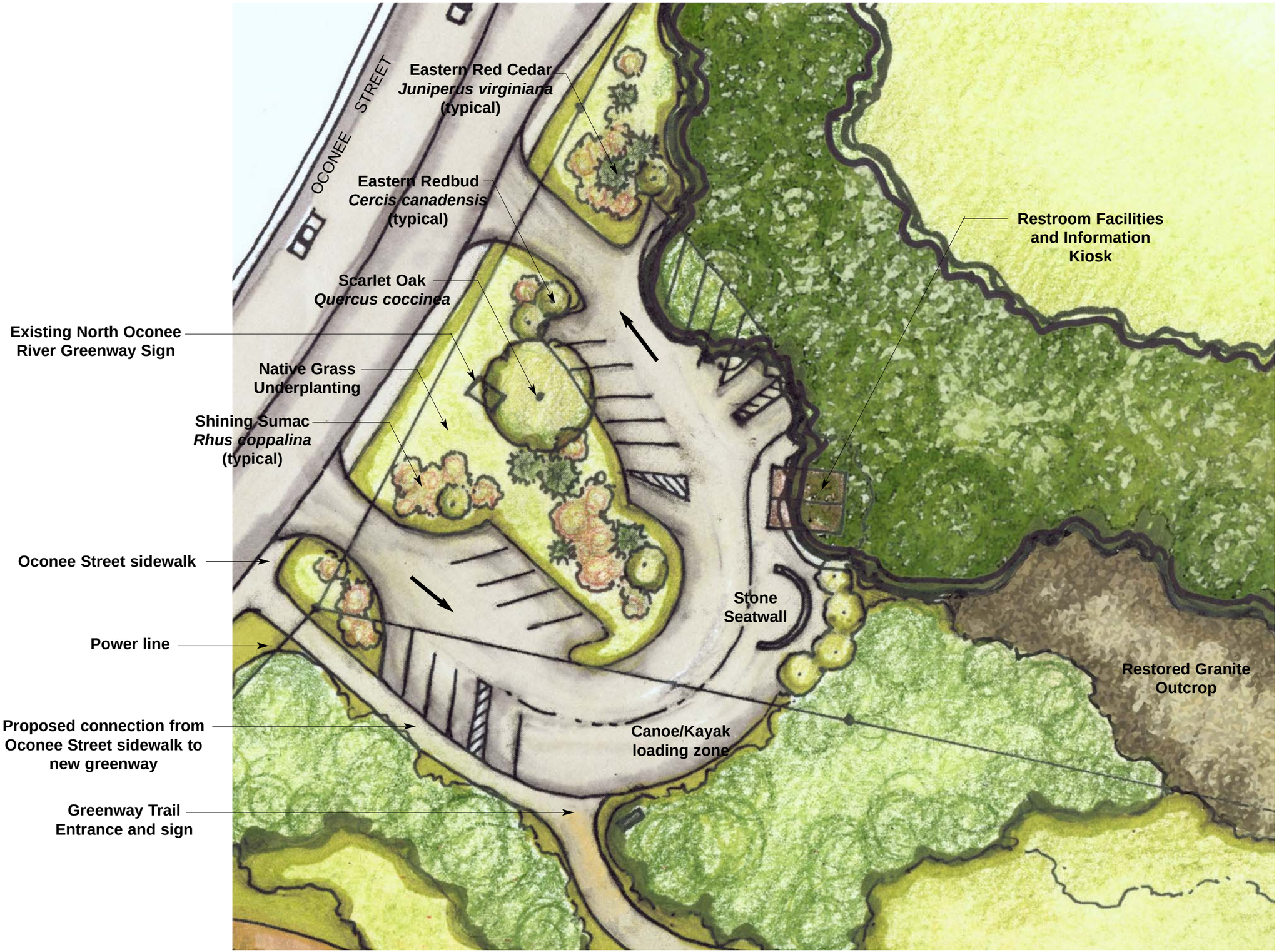
LEGEND

- Educational Signs
- Boat Launch/Take out
- Future Spur Trail
- Existing Vegetation

NORTH

scale: 1"=60' - 0"

Figure 29
Concept Plan
85



Native Grass Underplanting species include:

Andropogon virginicus
Broomsedge
Andropogon ternarius
Splitbeard Bluestem
Schyzachyrium scoparium
Little Bluestem
Muhlenbergia capillaris
Pink Muhly

* 24 proposed parking spaces

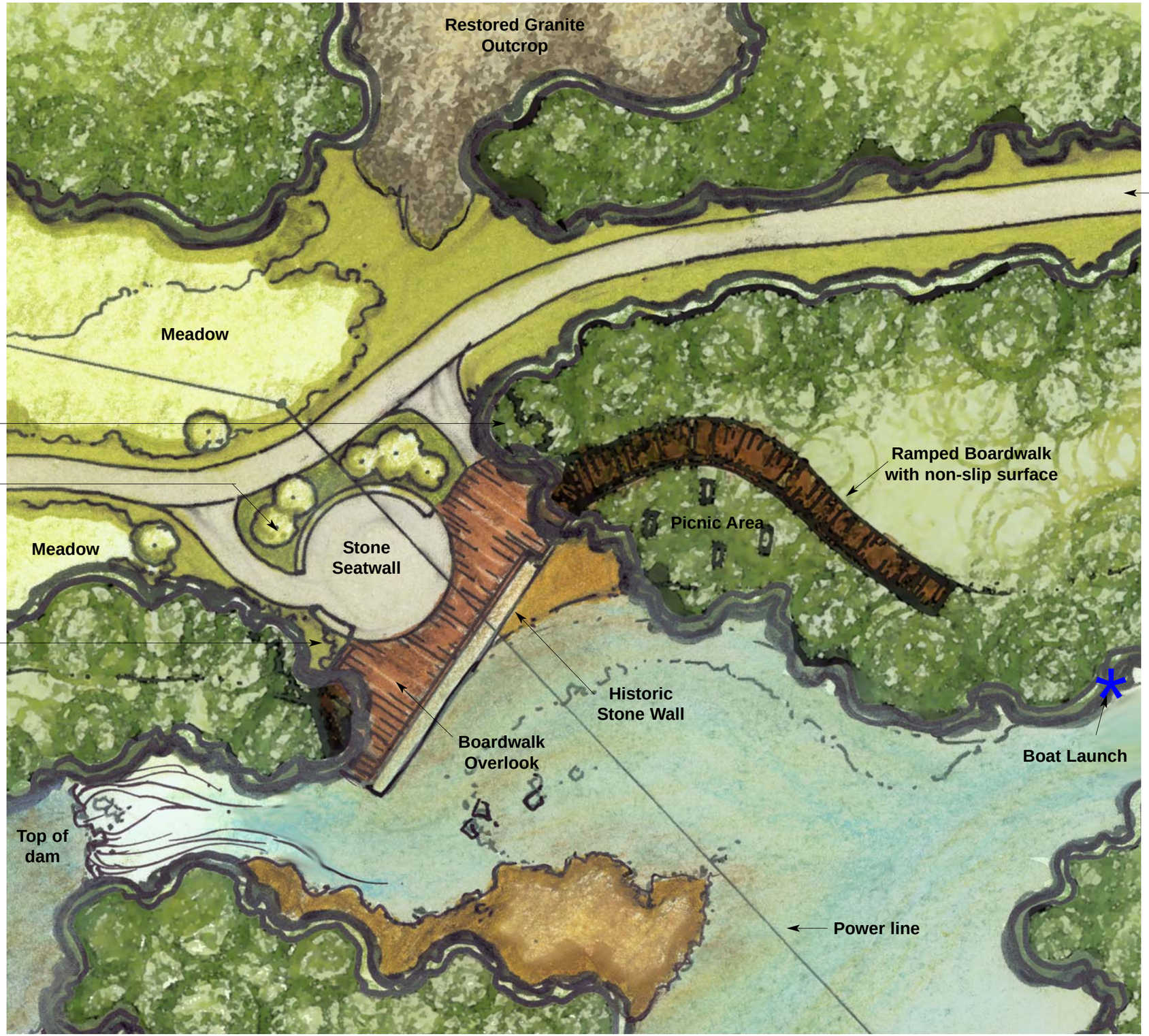
NORTH

scale: 1”=30’ - 0”

Figure 30
Oconee Street Parking Plan

Figure 31 – Existing Oconee Street parking area

Figure 32 – Oconee Street parking area with proposed plantings



Redbud Underplanting species include:

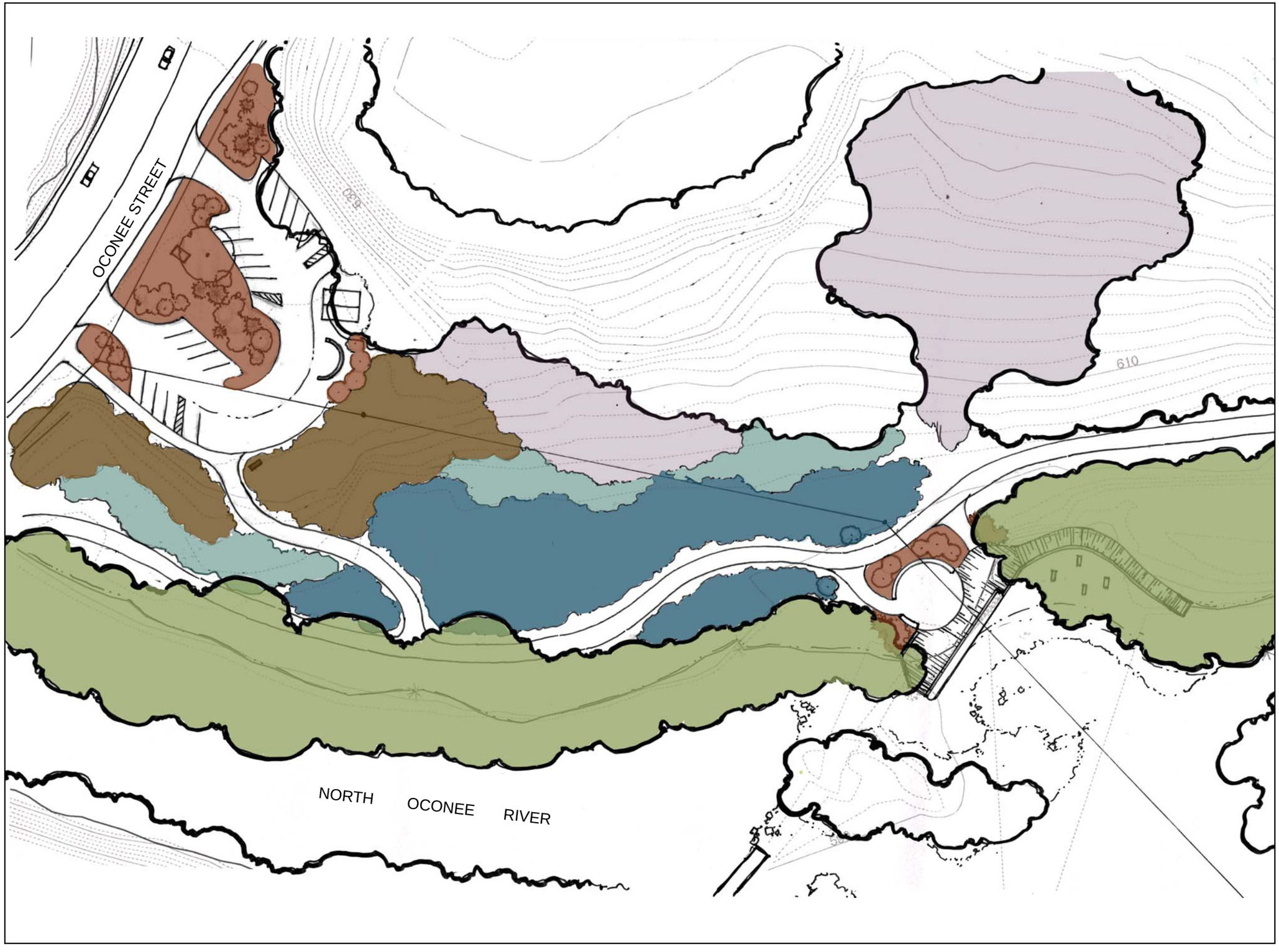
Aquilegia canadensis
Columbine
Aster oblongifolius
Aromatic Aster
Echinacea purpurea
Purple Coneflower
Muhlenbergia capillaris
Pink Muhly
Rudbeckia triloba
Tri-lobed Rudbeckia

* Note: Additional historic mill and dam structures remain standing on site and must be located before implementation of this plan.

NORTH

scale: 1”=30’ - 0”

Figure 33
Easley’s Mill
Overlook Plan



LEGEND

Zone A: Parking area and Easley's Mill Overlook

Zone B: Granite Outcrops

Zone C: Riparian Edge

Zone D: Dry Meadow

Zone E: Seasonally Wet Meadow

Zone F: Dry Slope

(2' contours)

NORTH

scale: 1"=60' - 0"

Figure 34
Vegetation Management Plan

Figure 35 – Stone and concrete picnic table in Dudley Park

Figure 36 – Existing educational sign on North Oconee River Greenway Trail

Figure 37 – Metal sculpture, bench, and educational sign on North Oconee River Greenway

(sculpture and bench by local artist Harold Rittenberry)

Figure 38 – Detail of metal bench

CHAPTER 7

CONCLUSIONS

Looking Back

The goal of this thesis work was two fold. First, a conceptual framework was developed for the design of outdoor recreation areas that would act to increase environmental awareness of its users. Second, a concept plan was created for a portion of the North Oconee River Greenway that was based on a set of ecological design criteria that grew out of the conceptual framework. The concept plan and its attendant management protocols served the ecological design criteria by improving the ecological health of a human-impacted site, encouraging human engagement with nature by bringing people into the space, and increasing environmental awareness by offering positive recreational and educational experiences in nature.

A location on the North Oconee River Greenway was chosen as the site for the application portion of this thesis for two main reasons. First, the site is one of several proposed sections of the Oconee Rivers Greenway system not yet constructed. Second, the site has a rich combination of cultural history, unique ecosystems, and a variety of opportunities and constraints. The task of sorting out such a challenging mix of issues was appealing.

Many topics were considered in an effort to meet this goal, beginning with an exploration of the link between environmental awareness and environmental protection in the second chapter. Basic greenway functions and principles of ecological design were considered in the third chapter. Examination and distillation of this body of information produced three guidelines

that would steer the final plan towards meeting the ecological design criteria. In the fourth chapter I considered contemporary examples of public- sector landscape architecture that contain elements of ecological design and environmental education. The case studies were prefaced by discussions regarding storytelling and the fusion of art in science in ecological design. The project site was described in the fifth chapter through written accounts and photographs of existing conditions, opportunities, and constraints. Finally, a conceptual plan was presented in the sixth chapter that attends to the selected ecological design criteria and addresses site design, use of materials, vegetation management, and education goals. What follows is a brief summary of lessons learned from each chapter.

Lessons Learned

Widespread environmental awareness is essential to environmental protection. Based on the premise that people learn to love what is familiar to them, it is clear that developing an emotional attachment to nature is a critical step towards protecting it. The lack of ecological literacy is a prevalent problem in modern society and is linked with ongoing environmental crises. Some people attribute this dilemma to the absence of ecological teaching in most formal educational systems. Incorporating outdoor learning into standard curricula can help to diminish biophobia by encouraging positive experiences in nature. Findings from a 2001 study published in Environment and Behavior suggest that a link does indeed exist between emotional attachment and protective behavior. Furthermore, the results imply that positive experiences in natural environments can lead people to engage in ecologically protective behavior. Agencies such as the Center for Ecoliteracy and the North American Center for Environmental Education play an important role in seeing that ecological thinking becomes an integral part of our educational systems and our daily lives.

According to authorities in the field of Landscape Architecture (including William Thompson, editor of Landscape Architecture Magazine, and Robert France, professor of Landscape Architecture at the Harvard Design School), some landscape designers contribute to environmental protection by basing their work on sound ecological principles. Unfortunately, the majority of them do not. Since human expansion and consequential land development are inevitable, the one thing that can be controlled is our approach to development. I believe landscape architects possess the power to change the way we shape our environment by designing, building, and managing landscapes that reflect a sense of stewardship towards nature rather than dominion over it.

Designing landscapes based on ecological design principles is one way to improve the quality of our environment. Designing greenways, in particular, is one of the most viable strategies for protecting and improving ecological health. This is because they often fit easily into urban situations and provide places for people to interact with nature on a regular basis. Urban greenways along streams or rivers can help to maintain and improve water quality by acting as a buffer between intensive human use and waterways. They can also aid in stabilizing hydrologic regimes and maintaining healthy aquatic systems. The project site is located on a proposed urban riverside greenway and has the potential to fulfill these functions if designed to meet the following criteria: 1) each component must strive to maintain or improve water quality, 2) each component must strive to maintain or increase biodiversity where applicable, and 3) each component must strive to eliminate or minimize negative environmental impacts on the site. The rules to be followed in efforts to meet these criteria are: 1) to recognize that all elements of the site are interconnected, 2) to design with nature and look to it for inspiration, and 3) to balance the ecological needs of the site with those of its human users. Furthermore, all management

practices must be in keeping with the criteria and should be geared towards maintaining a sufficient level of ecological integrity throughout the site.

The perceived dichotomy existing between art and science as they relate to landscape design is just that, a *perception*. While some feel art is ill-equipped to solve environmental problems on its own, it does seem quite capable of drawing attention to the problems which is the first step towards change. Others view science as something not especially inspirational or beautiful on its own account. However, I see art and science as different ways of telling similar stories. Robert France says that landscape architecture can be an effective means of sustaining nature if there exists a marriage between "the feeling of art and the knowing of science." (France "Green" 35) Contemporary examples of landscape architecture exemplify successful ecological design through a fusion of science and art. The Water Pollution Control Lab in Portland, Oregon is a demonstration of scientific purpose with art overlaid and intertwined. Waterworks Gardens in Renton, Washington began with an artist's vision, displaying combinations of artistic expression and technical function on every level. The restoration projects on Prince Memorial Greenway in Santa Rosa, California, utilize science and technology to restore native fish populations and art installations to tell the story of their efforts. The Ohlone Greenway in Berkeley, California is the one example of the four that best unites science and art in a way that is most relevant to this thesis project. Local agencies and volunteers have joined forces in a variety of creek restoration projects including daylighting culverted streams, stabilizing banks, removing barriers to fish migration, restoring wildlife habitat, removing invasive exotic species and replanting with native plants, creating a water quality monitoring program, and protecting endangered species. Art is an integral part of this greenway in communicating information regarding these restorative efforts to the public. Sculptures from local artists are featured along

the greenway, as well as other art installations (temporary and permanent), interpretive signs, and exhibits featuring significant aspects of natural and cultural history unique to the area. Similar opportunities exist on the site chosen for this thesis project.

The site chosen as the focus of my design application is located on the North Oconee River near the Oconee Street parking area. It is the northern-most segment of the proposed section of the North Oconee River Greenway that is to connect Oconee Street to the University of Georgia's East Campus Village. The site of the former Easley's Mill, Athens' first settlement and founding place of the University of Georgia, is located at Cedar Shoals (Figure 11). Some historic structures remain standing today including an original mill building across the river and a stone wall that appears to have been part of the dam. The presence of two granite outcrops provides a rare opportunity to restore specialized ecosystems while educating people about their ecological significance. Because of the rich cultural past and distinctive landscapes, I believe this site will be a valuable addition to the North Oconee River Greenway and Heritage Trail.

The final plan developed for this site is a synthesis of the research and analyses discussed in earlier chapters. The major components of the design are greenway trail placement, expanded parking on Oconee Street, a plaza and overlook at Easley's Mill, boat launch/takeout locations, planting plans, and vegetation management zones. Each of these components attends to protecting and improving water quality, increasing biodiversity, and minimizing negative environmental impacts in the most appropriate manner. See Table 2 for a detailed list of how each design component attends to the ecological design criteria, human desires, site constraints, and education. For example, by building a boardwalk at the Easley's Mill site rather than installing a paved surface, erosion and sedimentation caused by grading can be avoided. The boardwalk will provide a safe place for people to view the rapids yet doesn't compromise the

integrity of the historic stone wall adjacent to it. Educating visitors about the cultural and industrial past of this site is accomplished by installing interpretive signs at this overlook.

Other educational opportunities are incorporated into the rest of the plan such as signs that highlight the ecological significance of the granite outcrops and riparian vegetation. I speculate that a service-learning program would also prove to be an effective means of educating volunteers while accomplishing labor intensive tasks. Not everyone learns in the same way or at the same pace. That is why I believe a variety of educational opportunities should be integrated into this site. Doing this would help to attain the ultimate goal which is to create a place where residents of Athens Clarke County can become aware of, connect with, and develop a sense of stewardship towards their environment.

Looking Ahead

I envision this design as an experimental project and/or demonstration model. The successes and failures of various management strategies applied here could offer valuable insight into what management practices are best suited for the rest of the greenway system. By successfully replacing invasive exotic species with attractive native plants, people might realize that what they see now is not the way a healthy Georgia floodplain should look. This, in turn, could spark enthusiasm and summon support for more invasive exotic removal projects. For the sake of quantifiable comparison, I recommend that extensive inventories of flora and fauna be conducted prior to any design implementation.

I also recommend that the trail from Dudley Park be extended to meet this new greenway trail (Figure 29). As briefly mentioned in the sixth chapter, the connection would have to occur by way of cantilevered boardwalk under the Oconee Street Bridge. Currently, greenway trail users coming from Dudley Park must walk through a parking lot, cross Oconee Street, and walk

through the Oconee Street parking area to get back down to the river. While walking on the trail in Dudley Park, I felt the urge to continue walking along the river without having to confront automobiles. Although constructing a cantilevered boardwalk might come with a high initial cost, I believe it would greatly improve the North Oconee River Greenway experience.

I also suggest that the mill building on the east side of the river, currently Dial America, be purchased and made into a restaurant or bar. One step towards protecting and improving the quality of the North Oconee River is to make sure people can see it. By returning the building to public use and building a safer deck, this could become a pleasurable gathering place that brings river issues to the forefront.

Appropriate permits regarding floodplain allowances, Georgia Power right-of-ways, utility easements, historic preservation requirements, herbicide applications, and all other items subject to regulation must be acquired before design implementation to avoid unnecessary conflicts.

Final Thoughts

The plan presented in this thesis is conceptual. It is meant to illustrate one person's vision of what this site could become. I'm confident that this design would serve as strong starting point for the development of a working plan for this section of the North Oconee River Greenway. The ideas presented in this thesis, if expanded upon with careful consideration of site opportunities and constraints, can lead to the protection and enhancement of this place and others like it.

This proposed segment of the North Oconee River Greenway offers a variety of unique educational opportunities to its users. Implementing this plan will bring people closer to the North Oconee River on a daily basis and will bring water quality issues to the forefront as a

result. The trail, overlook, picnic area, and spur paths will provide public access to the river and to other significant cultural and ecological elements that might otherwise remain unrecognized. Restoration efforts will improve the ecological health of this site while demonstrating a sense of stewardship and care towards the environment. Signs communicating these efforts to greenway users will point out the values of restoring habitat, managing for biodiversity, and protecting the environment. Art installations on this greenway will have the potential to draw even more attention to the restoration efforts and their importance, as well as conveying other environmental messages. Service-learning programs will further increase environmental awareness by offering positive hands-on experiences in nature to student groups and volunteers. Overall, the implementation of this concept plan will increase ecological literacy in the community and thereby galvanize us toward more sustainable living.

Table 2 - Design components in response to ecological design criteria, human desires, site constraints, and education goals

DESIGN COMPONENT	PROTECT/IMPROVE WATER QUALITY	MAXIMIZE BIODIVERSITY	MINIMIZE ENVIRONMENTAL IMPACT	ADDRESS HUMAN DESIRES	RESPOND TO SITE CONSTRAINTS	COMMUNICATE INFORMATION TO USERS
Parking Lot	• porous pavement or gravel recommended to reduce stormwater runoff • vegetated shoulders rather than curb/gutter help evenly distribute stormwater • dense planting areas in and around perimeter help absorb and filter stormwater runoff • plantings shade and cool any stormwater runoff	• recommended species are part of a native plant community and will increase current species diversity • grass, shrub and tree layers provide different wildlife habitats • native grass underplantings require infrequent mowing thus providing wildlife habitat for longer periods of time	• parking located on currently level contour so no grading is required that would cause erosion and sedimentation • no additional impervious surface	• increase number of parking spaces from 7 to 24 • provides loading zone close to trail entrance for boats and disabled users • restroom facilities provided • seat wall provides gathering/resting place	• suggested plants will not interfere with power line right-of-way. • no grading required that would interfere with ground field of power transmission poles	• information kiosk could display information regarding water quality, porous pavement, site restoration projects, greenway map
Greenway Trail	• proposed location in sewer easement so minimal clearing of vegetation required • mostly follows same contour (designed with the land) so no grading required except for parking/main trail link • trail edge planted with low-growing native vegetation that requires no chemical fertilizers or mowing	• trail edge planted with several species of low-growing native vegetation rather than turf • trail located along edge of management zones so disruption of habitats is minimized.	• clearing and grading reduced by sensitive placement • immediate soil stabilization recommended where grading does occur	• provides recreational opportunities for pedestrians, bikers, and boaters • provides connection from Oconee Street to Dudley Park and eventually to UGA's East Campus Village	• allows sufficient room for maintenance vehicular access • not sited directly above sewer lines to avoid conflicts • construction recommended to coordinate with scheduled sewer line repair • no grading required that would interfere with ground field of power transmission poles	• provides place for humans to engage with nature • provides access to unique cultural and ecological elements • educational nodes located along trail for interpretive signs and displays conveying ecological information
Easley's Mill Overlook	• boardwalk floats above ground to avoid disturbance of soil and water • seat wall and plaza located on relatively level ground so minimal to no grading required • boardwalk and plaza surface are porous • non-toxic materials	• suggested species for plantings around overlook are native, typical of riparian vegetation • overlook and ramp sited and designed in such a way as to minimize necessary clearing of existing vegetation.	• floating boardwalk overlook and ramp above ground reduced disturbance of soil, water, and historic elements • seat wall and plaza sited on level ground so minimal to no grading required	• provides river access and view of rapids • provides gathering/ resting/ outdoor classroom place along greenway • provides access to boat launch and picnic area	• construction and materials are sensitive to flood plain restraints • suggested plants will not interfere with power line right-of-way	• signs tell history of site • located under power lines and above historic dam: juxtaposition of modern/historic power source displays cultural change over time
Boat Launches	• recommended location and type cause minimal to no erosion • non-toxic materials	• any soil disturbed during installation must be immediately stabilized with native plantings • any existing vegetation disturbed during installation must be replaced with native plants	• sited to require minimal to no grading • any soil disturbed by construction should be immediately stabilized	• provide river access to boaters • conveniently located to trail, parking,and loading area	• located in level spots along riverbank, not in strong currents	• marked with signs for boaters conveying parking lot and loading location as well as portage route around dam

DESIGN COMPONENT (Vegetation Management Zones)	PROTECT/IMPROVE WATER QUALITY	MAXIMIZE BIODIVERSITY	MINIMIZE ENVIRONMENTAL IMPACT	ADDRESS HUMAN DESIRES	RESPOND TO SITE CONSTRAINTS	COMMUNICATE INFORMATION TO USERS
Zone A: organized plantings in parking area and Easley's Mill Overlook	• suggested native plant species are easily adaptable to site conditions so will not require chemical fertilizers or pesticides and will require minimal to no watering after established	• suggested native plants will increase species diversity • ground, shrub, and tree layers provide different habitat types • native grass underplantings require infrequent mowing so provide habitat longer	• suggested plants require no chemical fertilizers or pesticides that could leach into soil and water	• enhance aesthetic quality of parking lot, overlook • shade automobiles, seat walls	• suggested species will tolerate and even thrive in existing conditions • plantings will not interfere with power line right-of-way	• if labeled, could help greenway users to become familiar with native plants
Zone B: granite outcrops	• recommended restoration and management practices will not harm water quality	• restoration management practices will encourage native plant growth that will increase both species and habitat diversity	• restoration and management practices will protect sensitive ecosystems	• access allowed to larger outcrop once sufficiently restored	• suggested management practices are best suited to existing conditions	• restoration of granite outcrops provide opportunities for people to learn about their ecological significance
Zone C: riparian vegetation	• invasive exotic removal practices will cause minimal to no soil disturbance; careful chemical application by "cut-treat" method will reduce risk of water contamination	• suppressing invasive exotics will encourage native plant growth, increasing species and habitat diversity	• recommended invasive exotic removal practices will cause minimal to no soil disturbance; careful chemical application using "cut-treat" method reduces risk of soil and water contamination	• selective vegetation management will open up scenic views of the river	• suggested management practices are best suited to existing conditions	• service learning offers hands-on educational experiences to volunteers regarding riparian issues, plant id, etc. • signs about restoration efforts can help people learn about invasive exotics, plant id, etc.
Zone D and E: dry (D) and seasonally wet (E) meadow	• if chemical herbicide is used in meadow establishment, careful application will reduce risk of water contamination • established native grass/ wildflower meadow requires no chemical fertilizers or pesticides; infrequent mowing	• suppressing dominant species (exotic grasses and blackberry) will encourage native plant, growth increasing species and habitat diversity • tall grasses left standing over winter provide winter habitat for wildlife	• meadow requires minimal mowing so reduces fuel use and exhaust from mowers • chemical application needed for meadow establishment will not harm soil, water, or other vegetation if correct procedure is carefully followed	• provide aesthetic interest • requires little maintenance	• plantings will not interfere with power line right-of-way	• demonstrate ecologically sensitive alternative to frequently mown lawns
Zone F: dry slope below parking area	• provides vegetative buffer between parking lot and river, will filter contaminants and slow run off flow •will require minimal to no maintenance (watering) once established	• spreading and colonizing native plants will increase species diversity and provide year-round habitat for wildlife	• no mowing or other maintenance required of established native plantings •provides vegetative buffer between parking lot and river, slowing and absorbing rainfall and filtering contaminants	• provide aesthetic interest • requires little maintenance	• plantings will not interfere with power line right-of-way	• demonstrate ecologically sensitive way to manage slopes

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APPENDICES

Appendix A – Definition of terms characterizing ecosystem stability (Lyle 201)

- *constancy*: the lack of in some parameter of the system
- *persistence*: survival time
- *inertia*: the ability to resist external perturbations
- *elasticity*: the speed with which the former state is returned to following a perturbation
- *amplitude*: area over which the system is stable
- *cyclical stability:* oscillation around some central point or zone
- *trajectory stability:* movement towards some end point

Appendix B – Founding members of Sandy Creek Nature Center

Charles Aguar (deceased)

Ben Chappell

Walter Cook

Mahala Harrison

Daniel Hope

Albert Ike

Suzanne Lindsay

Robert Saveland

Don Scott (deceased)

AlmaWalker (deceased)

Mary Lamar West (deceased)

Appendix C – Endemic species of granite outcrops (Popp 42)

Agrostis uniflora, Bentgrass

Amphianthus pusillus, an aquatic

Arenaria uniflora, Sandwort

Crotonopsis elliptica

Cyperus granitophilus, Sedge

Diamorpha smalii, Diamorpha

Hypericum splendens, Pineweed

Isoetes melanospora, an aquatic quillwort

Juncus georgiana, Rush

Liatris microcephala, Blazing Star

Oenothera fruticosa var. *sublosa*, Primrose

Phacelia dubia var. g*eorgiana*

Quercus georgiana, Georgian Oak

Sedum pusillum, Sedum

Talinum teretifolium, Rock Portulaca

Viguiera porteri, Confederate Daisy

* see pages 34-49, and Appendix C of Mathew Popp's thesis for an extensive list of granite outcrop plant species and related information.

Appendix D – A.D.A., Americans with Disabilities Act, trail requirements (MacDonald)

Under the proposed guidelines, an accessible trail would meet these minimum technical provisions:

- Clear tread width: 36” minimum
- Tread obstacles: 2” high maximum (up to 3” high where running and cross slopes are 5% or less)
- Cross slope: 5% max.
- Running slope (trail grade) meets one or more of the following:
    - 5% or less for any distance.
    - Up to 8.33% for 200’ max. Resting intervals no more than 200’ apart.
    - Up to 10% for 30’ max. Resting intervals 30’.
    - Up to 12.5% for 10’ max. Resting intervals 10’.
- No more than 30% of the total trail length may exceed a running slope of 8.33%.
- Passing space: provided at least every 1000’ where trail width is less than 60”.
- Signs: shall be provided indicating the length of the accessible trail segment.

Appendix E – General recommendations regarding canoe launch design (“Logical” 5-7)

General recommendations for designing an accessible launch

- Height above water: Between 9" and 2' from highest expected water level
- Width: At least 5' wide, preferably 6' to 12'
- Length: At least 25' to allow paddlers “dry” access to entire length of their boats
- Slope: ADA Accessibility Guidelines require that slopes not exceed 8.33% whenever possible; A slope exceeding 15% will make transition from land to water difficult for any paddler
- Support: Handrails or other support structures, including step-down designs or ropes, help paddlers balance their weight during put-in and take-out
- Location: Ideally in areas without heavy flow, erosion, exposure to elements, heavy boat traffic,or fragile riparian habitats

General recommendations for designing a launch that is “best-suited”

(The type of launch chosen should be suitable for a particular access location, meaning that it should be the most sensible choice considering the characteristics of the water body, as well as relevant climatic and ecological factors.)

- Is constructed in accordance with any applicable regulations
- Provides safe access, away from potential river hazards, especially at different flow level
- Can withstand flow levels, currents, and exposure to elements at a particular site
- Accommodates paddlers in varying water depths
- Provides a firm surface for launching, despite changes in sedimentation levels
- Will not be easily damaged due to climatic or seasonal conditions
- Does not cause damage to riparian habitats or vegetation during its construction and is unlikely to have environmental impacts over time and through usage
- Is not constructed in an area vulnerable to erosion
- Is constructed with consideration to its intended uses and frequency of use

General recommendations for designing a launch that is cost-effective

- Use construction only when absolutely necessary. In many cases, an actual launch structure may not be needed; firm or sandy banks, level rocks, and beaches can often provide sufficient access (see Chapter IV); kayakers may only need a hardened bank for access
- Choose access sites with minimal exposure to winds and heavy currents, preferably near calmer areas of water, such as near eddies; if this is not possible, consider creating a vegetative or other type of buffer to provide protection from the elements
- To reduce construction needs and costs, make modifications to existing boat docks or shoreline structures to make them more “paddler-friendly”
- Construct launches that serve multiple purposes, such as mitigating erosion or restoring wetland vegetation; simple ramps or implanted beaches may help to stabilize a fragile bank or provide “soft treatments” while also enabling access

General recommendations for designing a launch that is environment-friendly

(Use of low-impact designs and non-toxic materials is essential to watershed health, from protecting water quality, vegetation, and riparian habitats to enabling sustainable recreation. In many states, environmental regulations must be considered prior to, and during, launch construction.)

- Investigate any applicable regulations; develop launch designs in accordance with these regulations
- Use structures requiring minimal construction or alteration to the shoreline (see Chapter XI for information on low-impact designs)
- Consult with local natural resource specialist during the planning and construction phases to screen for the presence of ecologically sensitive nesting sites, rookeries, spawning areas, or endangered species; an optimal put-in site may not be feasible for ecological reasons
- Merge the needs of natural functions and the desired recreational uses of the water; with rivers and streams, avoid making any channel modifications and preserve in-stream habitats as much as possible
- Monitor watershed conditions and changes in stream morphology continually
- Gather data from local or state agencies that monitor water levels and flows to develop a launch that will accommodate the conditions of the water body over time
- Avoid using hard reinforcements (e.g., concrete, steel, rock) where shorelines are eroding; use bioengineering methods, such as developing a riparian buffer planted with native species, to protect vegetation and habitats and stabilize shorelines while sheltering the launch area from the elements; along streams, wider buffers can allow space for lateral movements and can help to reestablish meander over time -- these methods allow plant species to become self-sustaining and can also improve aesthetics

Appendix F – Top ten exotic plant pests in Georgia (Georgia Exotic Pest Plant Council)

Pueraria montana, Kudzu

Ligustrum sinense, Chinese Privet

Lonicera japonica, Japanese Honeysuckle

Hydrilla verticillata, Hydrilla

Sapium sebiferum, Chinese Tallow Tree

Microstegium vimineum, Nepalese Browntop

Phyllostachys aurea, Bamboo

Elaeagnus umbellata, Autumn Olive

Wisteria sinense, Chinese Wisteria

Albizia julibrissin, Mimosa

Appendix G – “Cut-treat” method of invasive exotic removal (Miller 3)

Cut-treat involves herbicide concentrates or herbicide-water mixtures applied to the outer circumference of freshly cut stumps or the entire top surface of cut stems, applied with a backpack sprayer, spray bottle, wick, or paint brush. Freshly cut stems and stumps of woody stems, including canes and bamboo, can be treated with herbicide mixtures to prevent resprouting and to kill roots. Cutting is usually by chainsaw or brush saw, but can be accomplished by handsaws or cutting blades. To minimize deactivation of the herbicide, remove sawdust from stumps before treatment. Treat stems and stumps as quickly as possible after cutting with a backpack sprayer or utility spray bottle for spray applications or a wick applicator, lab wash bottle, or paintbrush for small stems. Add a non-ionic surfactant to the mix to aid in penetration, if permitted by the label.

For stumps over 3 inches in diameter, completely wet the outer edge with the herbicide or herbicide mixture. Completely wet the tops of smaller stumps and all cut stems in a clump. Apply a basal spray mixture of herbicide, oil, and penetrant to stumps that have remained untreated for over 2 hours.

The most effective time for the stump spray method is late winter and summer. Although winter treatments are slightly less effective than growing season applications, the absence of foliage on cut stems and branches produces some offsetting gains in application efficiency.

Appendix H – Suggested native plant list for Zone C/Riparian

(Hightshoe, Midgley, Morrison, Wasowski)

Trees
Acer rubrum, Red Maple
Acer sacharinum, Silver Maple
Aesculus pavia, Red Buckeye
Asimina triloba, Pawpaw
Betula nigra, River Birch
Carpinus carolininana, Musclewood
Carya ovata, Shagbark hickory
Celtis laevigata, Hackberry
Cornus florida, Flowering Dogwood
Fagus grandifolia, American Beech
Halesia Carolina, Carolina Silverbell
Ilex opaca, American holly
Liriodendron tulipifera, Tulip Poplar
Magnolia virginiana, Sweetbay Magnolia
Morus rubra, Red Mulberry
Nyssa sylvatica, Blackgum
Ostrya virginiana, Hophornbeam
Oxydendrum arboretum, Sourwood
Platanus occidentalis, Sycamore
Quercus nigra, Water Oak
Ulmus rubra, Slippery Elm

Shrubs
Aesculus sylvatica, Painted Buckeye
Alnus serrulata, Common Alder
Aronia arbutifoia, Red Chokeberry
Cephalanthus occidentalis, Buttonbush
Cornus amomum, Silky Dogwood
Euonymus americanus, Hearts-a-burstin'
Hamamelis virginiana, Witchhazel
Hydrangea arborescens, Wild hydrangea
Ilex deciduas, Possumhaw
Ilex verticillata, Winterberry
Itea virginica, Virginia Sweetspire
Lindera benzoin, Spicebush
Rhododendron canescens, Piedmont Azalea
Rhododendron nudiflorum, Pinxterbloom Azalea
Sambucus canadensis, Elderberry
Vaccineum corymbosum, Highbush Blueberry
Viburnum acerifolium, Maple-leaf Viburnum

Viburnum dentatum, Arrowwood Viburnum
Xanthorhiza simplicissima, Yellowroot

Vines
Bignonia capreolata, Crossvine
Clematis virginiana, Virgin's Bower
Decumaria Barbara, Climbing Hydrangea
Parthenocissus quinquefolia, Virginia Creeper

Grasses and Herbaceous Plants
Antennaria plantaginifolia, Pussy-toes
Aquilegia canadensis, Columbine
Aster spp., Aster
Asarum arifolium, Wild Ginger
Asclepias incarnata, Swamp Milkweed
Chasmanthium latifolium, River Oats
Elymus virginicus, Virginia Wild Rye
Lobelia cardinalis, Cardinal Flower
Lobelia syphilitica, Blue Lobelia
Impatiens capensis, Jewelweed
Tradescantia virginiana, Spiderwort

Ferns
Onoclea sensibilis, Sensitive Fern
Polystichum acrostichoides, Christmas Fern
Thelypteris noveboracensis, New York Fern

Appendix I -- Suggested native plant list for Zones D and E/Warm Season Grass and Wildflower Meadow

(Hightshoe, Midgley, Morrison, Wasowski)

Zone D (Relatively Dry)
Amsonia ciliata, Texas Bluestar
Andropogon gerrardii, Big Bluestem
Andropogon virginicus, Broomsedge
Andropogon ternarius , Splitbeard Bluestem
Asclepias tuberosa, Butterfly Weed
Aster spp., Aster
Coreopsis spp., Coreopsis
Echinacea spp., Coneflower
Eryngium yuccifolium, Rattlesnake Master
Monarda fistulosa, Beebalm
Muhlenbergia capillaris, Pink Muhly
Schyzachyrium scoparium, LittleBluestem
Solidago spp., Goldenrod
Sporobolus heterolepis, Prairie Dropseed

Zone E (Seasonally Wet)
Andropogon Glomeratus, Wooly Broomsedge
Andropogon virginicus, Broomsedge
Asclepias incarnata, Swamp Milkweed
Baptisia alba, White Wild Indigo
Coreopsis rosea, Pink Coreopsis
Erianthus giganteus, PlumeGrass
Eryngium yuccifolium, Rattlesnake Master
Eupatorium coelestinum, Wild Ageratum
Eupatorium fistulosum, Joe pye Weed
Helianthus angustifolius, Swamp Sunflower
Liatris spicata, Blazing Star
Lobelia cardinalis, Cardinal Flower
Monarda didyma, Beebalm
Muhlenbergia capillaris, Pink Muhly
Panicum virgatum, Switchgrass
Rudbeckia spp. Black eyed Susan
Solidago odora, Sweet Goldenrod
Vernonia gigantean, Ironweed

Appendix J– Suggested native plant list for Zone F/Dry slope in power line right-of-way

(Hightshoe, Midgley, Morrison, Wasowski)

Small Trees
Cercis canadensis, Redbud
Cornus florida, Flowering Dogwood
Juniperus virginiana, Eastern Red Cedar
Morus rubra, Red Mulberry
Rhus coppalina, Shining Sumac
Rhus glabra, Smooth Sumac
Viburnum prunifolium, Blackhaw Viburnum
Viburnum rufidulum, Rusty Blackhaw Viburnum

Shrubs
Ceanothus retusus, Jerseytea Ceanothus
Hypericum prolificum, Shrubby St. John's Wort
Rhus aromatica, Fragrant Sumac
Rhus aromatica var. Gro-low, Gro-low Fragrant Sumac
Robinia hispida, Prickly Locust
Rosa Carolina, Carolina Rose
Symphorocarpus orbiculatus, Indiancurrant Coralberry
Vaccinium corymbosum, Highbush Blueberry
Vaccinium stamineum, Common Deerberry
Yucca filamentosa, Yucca

Vines
Lonicera sempervirens, Honeysuckle
Parthenocissus quinquefolia, Virginia Creeper

Grasses
Andropogon gerrardii, Big Bluestem
Andropogon virginicus, Broomsedge
Andropogon ternarius , Splitbeard Bluestem
Muhlenbergia capillaris, Pink Muhly
Schyzachyrium scoparium, LittleBluestem
Sporobolus heterolepis, Prairie Dropseed

Appendix K– Definition of Service Learning (Learn and Serve)

What is Service Learning?

Service-learning combines service to the community with student learning in a way that improves both the student and the community. According to the National and Community Service Trust Act of 1993:

Service-Learning:

-Is a method whereby students learn and develop through active participation in thoughtfully organized service that is conducted in and meets the needs of communities Is coordinated with an elementary school, secondary school, institution of higher education, or community service program and the community
–Helps foster civic responsibility
–Is integrated into and enhances the academic curriculum of the students, or the education components of the community service program in which the participants are enrolled
–And provides structured time for students or participants to reflect on the service experience

What Does Service-Learning Look Like?
In colleges and schools, service-learning is part of the academic curriculum. In community organizations, youth develop practical skills, self-esteem, and a sense of civic responsibility. Examples of service-learning projects include: preserving native plants, designing neighborhood playgrounds, teaching younger children to read, testing the local water quality, creating wheelchair ramps, preparing food for the homeless, developing urban community gardens, starting school recycling programs, and much more.

Why is Service-Learning Important?
A national study of Learn and Serve America programs suggests that effective service-learning programs improve academic grades, increase attendance in school, and develop personal and social responsibility. Whether the goal is academic improvement, personal development, or both, students learn critical thinking, communication, teamwork, civic responsibility, mathematical reasoning, problem solving, public speaking, vocational skills, computer skills, scientific method, research skills, and analysis.