Quantifying ecological, social and economic benefits of designed land: A performance-based case study of Kissimmee Florida’s Lakefront Park

By: Leslie Babiak
Graduate terminal project to the Department of Landscape Architecture
University of Florida
As partial requirement for the degree of Master of Landscape Architecture 2016

Committee Chair: Michael Volk
Member: Tina Gurucharri
University of Florida
College of Design, Construction, and Planning
ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to both of my committee members for their dedicated support and guidance throughout this research process. Thank you to my thesis chair, Michael Volk, for making the time to be available and always responding in a thoughtful, constructive way. And, thank you to my thesis committee member, Tina Gurucharri, for your practical perspective and reassuring encouragement. Having you both on board has not only added to the enjoyment of this endeavor, your contributions—in time, insight, reflection, and advice—have been integral to the success of this thesis project.

I am especially grateful to Associate Professor Dr. Gail Hansen for igniting my interest in the field of landscape performance research; and, former instructor Dr. Dave Barth, for fueling that interest. I am also extremely thankful to University of Florida graduate student, Ken Weyrauch, for your excellent piloting skills and enthusiasm in this project. And, a special thanks to Belle for her death-defying skills in capturing a copious amount of high quality aerial footage, all the while managing to amuse Park visitors.

A heartfelt thank you must be paid to all of the professionals working for the City of Kissimmee that have contributed to the success of this project. First, to the former Director of City of Kissimmee Parks and Recreation Department, Dan Loubier: Without your kind devotion and diligent efforts toward furnishing critical information in response to countless numbers of inquiries—this project would be sorely lacking in its depth and richness. Next, thank you Arin Thrower, Manager of Communications and Public Information, for your generosity in enabling me to promote the study survey across the City of Kissimmee’s social media platform. The strength of participation in the park user survey was a direct result of your efforts. Thank you also, Brianne Stefek, Executive Director of Kissimmee Main Street, for granting me the opportunity to promote the survey at a major Park event. I would also like to extend my gratitude to Ken Barrett, Public Works Construction Inspector; Dawn Stapf, Secretary of Public Events and Venues; and, Natalie Lattimore and Andrea Campbell, Administrative Assistants, for your help in furnishing much-needed information. Many other professionals in various Departments of the City of Kissimmee have contributed their time and effort toward satisfying my requests for various materials. I would like to thank them all.

I must also give special thanks to my classmates and friends, for their support, inspiration, and refreshing sense of humor throughout this journey at the University of Florida. And, most of all, thank you to my incredible husband, Andrew: Words cannot explain how much your unconditional support, personal sacrifice, and unwavering faith have meant to me.
“First life, then spaces, then buildings – the other way around never works.”

Jan Gehl
ABSTRACT

According to the American Society of Landscape Architects, a critical gap currently exists in the marketplace for evidence-based landscape design. Landscape performance research, an emerging field of study, involves using environmental, social and economic metrics to evaluate a landscape project’s range of functions. The ability to properly quantify the spectrum of functions and services that may be attached to landscape architecture projects generates valuable evidence. This evidence can enhance understanding of the ways in which our built environment performs, ultimately guiding future design. Yet, the number of strategies or recommendations for quantifying landscape performance are currently limited and most landscape design professionals are unschooled in methods of land performance research.

The purpose of this performance-based case study research project was to increase understanding of the values embedded within designed landscapes, and the ways in which to quantify and communicate these values. Toward accomplishing this goal, the researcher set out to systematically capture the performance-related information of a multi-functional landscape architecture project located in Central Florida. The desired outcome for this work is that the findings may help inform future design, and help shape subsequent research by adding support to the small body of information on performance research methods.

The City of Kissimmee has recently completed a 33-million-dollar endeavor to completely reinvent historic Lakefront Park. Shaped by a heavy dose of community input, the Park was designed to benefit the community in a multitude of ways. The City’s mission in the Park’s revitalization project is to provide a civic backyard for the people of Kissimmee, increase environmental awareness, spur downtown economic development, and protect the value of Lake Toho by introducing green infrastructure to filter and treat all of downtown’s stormwater run-off. This landscape architecture project offers tremendous potential for being a high-performance landscape. As such, the site is highly appealing for conducting research that may help narrow the gap in evidence-based landscape design.
The structure of this project was adopted from the case study framework utilized by the Landscape Architecture Foundation in their Case Studies Investigative Series. Several established methods recognized as being suitable for landscape architecture case study, namely those by Francis, Gehl, and Whyte, also shaped this project. As every landscape is unique in its combination of qualities and processes, a broad range of metrics was explored in order to identify those most relevant for quantifying the functions of the study site. Project-related primary and secondary data were collected, reviewed, analyzed, and synthesized; and, within each category of sustainability (i.e., ecological, social, and economic), performance benefits of the study site were identified and organized.

Data collection methods entailed the conduction of an online survey, site observations and registrations with the aid of a drone to capture time-lapsed imagery of park user behavior, informal questioning of key informants, and systematic review of project construction drawings, online documentation, and archival records. The availability of existing data exerted significant influence upon the ability to perform robust analysis of site performance. Analytical software was utilized to perform soft statistical analyses of completed surveys. Field measurements were inputted into online diagnostic software and other online resources to generate results for ecological findings. The majority of analyses of economic impacts involved calculating and synthesizing existing data.

Landscape performance has been defined as the measure of efficiency with which landscape solutions fulfill their intended purpose while contributing toward the achievement of sustainability. The application of design solutions in Lakefront Park’s redevelopment aim to reduce pollution, stimulate the downtown economy, introduce users to the concept of native plants in the landscape, promote environmental awareness and clean water education, and provide a civic backyard where the people of Kissimmee can congregate. Results of this study provide early stages of evidence of Lakefront Park’s ability to effectively begin to fulfill these intended purposes. Findings from this study add to our understanding of how the knowledge gained from measuring the performance of the landscape can strengthen the ways in which we design for sustainable solutions by bringing together the goals of the client and the realities of the site, backed by scientific analysis of the site’s functions.

**Key words:** landscape performance, designed land, sustainability
green stormwater infrastructure, performance indicator
TABLE OF CONTENTS

Abstract .................................................................................................................................................................... i-ii

Table of Contents.................................................................................................................................................... iii-v

List of Tables .............................................................................................................................................................. vi

List of Figures ....................................................................................................................................................... vii-viii

Chapter 1 :: Introduction
1.1 Issues of Concern ............................................................................................................................................ 9-11
1.2 Research Questions and Statement of Purpose ............................................................................................ 11-12
1.3 Significance of Study and Study Limitations .............................................................................................. 12
1.4 Study Context ................................................................................................................................................ 13-21
1.5 Summary ............................................................................................................................................................. 22

Chapter 2 :: Literature Review
2.1 Introduction ......................................................................................................................................................... 23
2.2 Today’s Urban Parks ...................................................................................................................................... 24-27
2.3 Defining Green Infrastructure ......................................................................................................................... 27-31
2.4 Benefits and Practices of Green Stormwater Infrastructure .......................................................................... 31-36
2.5 Approaches to Evaluating Designed Land ................................................................................................. 37-41
2.6 Synopsis .............................................................................................................................................................. 41

Chapter 3 :: Case Studies
3.1 Canal Park ........................................................................................................................................................... 44
3.2 Carmel Clay Central Park .................................................................................................................................... 45
3.3 Klyde Warren Park ............................................................................................................................................... 46
3.4 Lowland Park ....................................................................................................................................................... 47
LIST OF TABLES

2.1 Benefits from incorporating GI into park projects at various scales of landscape architecture ................. 36
4.1 Ecological benefits, indicators, and methods suited for landscape performance evaluation .......................... 54
4.2 Social benefits, indicators, and methods suited for landscape performance evaluation ............................... 55
4.3 Economic benefits, indicators, and methods suited for landscape performance evaluation .......................... 56
5.1 Estimated carbon sequestration by newly planted trees in one year’s time .................................................. 62
5.2 Annual vehicle distances traveled and average fuel consumption ............................................................... 64
5.3 Trees’ potential for stormwater interception .................................................................................................. 67
5.4 CC values for Lakefront Park’s rain garden plant community ....................................................................... 73
5.5 PSI as indicator of ecological quality of rain gardens versus detention basin .............................................. 75
5.6 Florida’s endangered and threatened species list .......................................................................................... 78
5.7 Average amount of water pollutant removal ............................................................................................... 83
7.1 Number of BTRs by year within one-half mile of Park .................................................................................. 126
7.2 Potable and grey water cost comparison ...................................................................................................... 136
# LIST OF FIGURES

1.1 Location of study area......................................................................................................................................... 13  
1.2 Kissimmee Lakefront Park: Then and now.......................................................................................................... 14  
1.3 Lakefront Park project timeline ........................................................................................................................... 15  
1.4 Lakefront Park construction phase ..................................................................................................................... 16  
1.5 Lakefront Park construction phase ..................................................................................................................... 17  
1.6 Lakefront Park construction phase ..................................................................................................................... 18  
1.7 Lakefront Park’s viewable baffle box .................................................................................................................. 19  
1.8 Lakefront Park’s educational signage ................................................................................................................. 20  
1.9 Major Park event attendance.............................................................................................................................. 21  
2.1 Impact of impervious surface cover on stormwater runoff and infiltration ......................................................... 30  
2.2 Green Infrastructure benefits and practices........................................................................................................ 33  
3.1 Canal Park: Pre-Construction ............................................................................................................................. 44  
3.2 Canal Park: Post-Construction ............................................................................................................................ 44  
3.3 Carmel Clay Park: Pre-Construction ................................................................................................................... 45  
3.4 Carmel Clay Park: Post-Construction ................................................................................................................ 45  
3.5 Klyde Warren Park: Pre-Construction ................................................................................................................ 46  
3.6 Klyde Warren Park: Post-Construction ................................................................................................................. 46  
3.7 Lowland Park: Pre-Construction ......................................................................................................................... 47  
3.8 Lowland Park: Post-Construction ........................................................................................................................ 47  
3.9 Pennswood Village: Pre-Construction ................................................................................................................ 48  
3.10 Pennswood Village: Post-Construction ............................................................................................................. 48  
3.11 Seattle Children’s PlayGarden: Pre-Construction ............................................................................................. 49  
3.12 Seattle Children’s PlayGarden: Post-Construction.............................................................................................. 49  
4.1 Application of CSI Program framework to this study’s methodology approach ................................................. 52  
5.1 CC values and PSI formula ................................................................................................................................. 71  
5.2 Lakefront Park rain garden locations .................................................................................................................. 72  
5.3 Kissimmee Valley Audubon annual bird count boundaries ................................................................................. 79  
5.4 Bird species counts by year ................................................................................................................................ 80  
5.5 Underground baffle box ...................................................................................................................................... 83  
6.1 Facebook posting of Park user survey ................................................................................................................ 87
1:: INTRODUCTION

1.1 Issues of Concern

Land design professionals have long recognized that when the landscape is used to perform ecological functions—such as absorbing floodwaters, sheltering wildlife, and replenishing aquifers—it can also be designed to support functions that generate economic and cultural benefits that promote the health of societies. As a linked system of spaces and places, landscapes that provide environmental, social, and economic benefits have the power to contribute to the development of a sustainable future. Yet, while most landscape architects instinctively know the value of landscape design, they are uncertain as to how to go about proving its value.

In recent years, a major shift has begun to occur in the way that landscape architects, planners, and engineers address stormwater. This newer approach seeks to ameliorate the negative impacts of urban development by restoring hydrologic regimes to the way they functioned prior to development. Green infrastructure (GI), which is comprised of living systems, vegetation, and open spaces, is the key component in the design and function of this natural approach to stormwater management.

GI has been touted as contributing to carbon storage and sequestration, provision of wildlife habitat and increased biodiversity, enhanced aesthetic value, educational and recreational opportunities, stormwater infrastructure cost savings, and increased property values (Odefey et al., 2012). The potential for GI to effectively and efficiently manage stormwater while providing these benefits is garnering widespread interest: Growing numbers of communities are integrating GI systems at various land use scales, into their stormwater control agendas.

Concurrent with this paradigm shift in the way stormwater is being managed, a critical gap exists in the marketplace for evidence-based landscape design (American Society of Landscape Architects, ASLA, 2013). Evidence-based design refers to the process of using quantitative, and sometimes qualitative, research findings to...
inform the design of environments that improve outcomes for the health of all living organisms (Therapeutic landscapes.org). The research that provides this evidence involves the study of how well a given landscape is functioning or performing.

The Landscape Architecture Foundation has defined landscape performance as “The measure of efficiency with which landscape solutions fulfill their intended purpose and contribute toward achieving sustainability (2014). The goal of sustainability involves creating and maintaining conditions in which man and nature can productively coexist in ways that support present and future generations (EPA, 2015). While maintenance of designed land is integral to sustainability, the focus of this study is on the creation of site conditions. The dimensions of sustainability are referred to as the three E’s (environment, economy, equity), or the triple-bottom-line (planet, people, prosperity). According to the United Nations’ Bruntland Report, Our Common Future, the triple-bottom-line is the key to authentically sustainable development (UNWCED, 1987). For the purposes of this research project, the definition of sustainable design is borrowed from Calkins (2012): Sustainable site design addresses the overlapping aspects of ecologically sound, socially equitable, and economically feasible development.

As the main objectives of landscape performance address the three dimensions of sustainability (Rouse and Bunster-Ossa, 2013), greater understanding of how a landscape performs—and the most effective ways to measure it—will ultimately result in more sustainably built landscapes. As an emerging field of study, the number of strategies or recommendations for quantifying landscape performance are limited. Further, most designers are unschooled in performance research methods. Toward addressing this crucial need, landscape performance has been added to the curricular requirements of accredited programs starting in 2016 (Mendenhall, 2016).

In the downtown district of Kissimmee, Florida, a long-awaited metamorphosis is underway. An event that has helped trigger this change is the recent reinvention of Kissimmee’s Lakefront Park. Planning and design strategies for the Park were directed toward addressing the City’s goals of reducing pollution, conserving water, encouraging native planting, educating the public, and serving as an economic stimulus for downtown. As such, Lakefront Park holds tremendous potential for being a high-performance landscape where sustainable design solutions are being implemented through the integration of living, green technologies. The site offers a valuable opportunity toward
addressing the gap in evidence-based landscape design. It is the researcher’s hope that examining the connections between this landscape and the health of ecosystems, community members, and local economy will contribute to the understanding of landscape performance and future projects that design for sustainable solutions.

1.2 Research Questions and Statement of Purpose

**Q1:** What are the performance indicators and methods utilized in evaluating the environmental, social, and economic performance benefits of designed landscapes?

**Q2:** What are the appropriate performance indicators and corresponding methods for measuring and evaluating the environmental, social, and economic performance of Kissimmee’s Lakefront Park?

**Q3:** How is the designed landscape of Kissimmee Lakefront Park performing on environmental, social, and economic levels?

**Q4:** What are the lessons learned from this endeavor to study landscape performance, and how might these lessons be useful toward further landscape performance research and evidence-based design?

The overarching goal for this project is to systematically capture the performance information of a built landscape so that the findings may: add to our understanding of how to best quantify designed land, help inform future design, and lay down replicable research methods that may help shape subsequent research. Through a holistic lens and case study approach, this research seeks to understand the ecological, social, and economic impacts of the study site, a green infrastructure stormwater park located in central Florida. The study of landscape performance examines the effects that designed landscapes have on abiotic, biotic, and cultural systems. As parallels exist
between landscape performance and the goals of sustainability (i.e., the triple bottom line) measuring a site’s broad range of landscape functions will help paint the picture of sustainability tied to this unique place.

1.3 Significance of Study and Study Limitations

The contribution of this study is significant in several ways. First, study findings will add to the growing body of literature that is working toward showing value in multi-functional, designed landscapes. Secondly, the study may help to advance the process of measuring landscape performance and promote the use of landscape metrics as standard practice, ultimately affording designers the ability to adjust design strategies to respond to metrics. Thirdly, study results will increase awareness and appreciation of the role of landscape architects in contributing to the creation of sustainable landscape solutions. And, lastly, my greatest hope is that the knowledge gained from this study will help shift the design process (for myself and others) toward designing landscapes in ways that promote performance.

Given the constraints of time, finances, and other resources, the limitations of this study are as follows:

- Green infrastructure (G.I.) occurs at various scales. On a regional scale, G.I. is seen as a network of open spaces and natural areas that may include nature preserves, greenway corridors, forests, and wetlands. This study’s attempt to measure landscape performance is limited to the neighborhood and site scale, focusing specifically on one stormwater park located in central Florida.

- While this study aims to measure the greatest range of performance categories as is feasible, the breadth of assessment is influenced by availability of data and other resources.

- As the site’s redevelopment is a recent phenomenon, and the allotted time for study completion is relatively brief, conducting a longitudinal study is not a viable option; rather, this study will be a snap-shot in time and will serve as benchmark and reference for future research.
1.4 Study Context

Today the park is home to a growing collection of monuments and is a popular place to fish or just eat lunch overlooking the lake. The site feels somewhat disconnected from downtown despite its close proximity, but this is likely due to the fact that initially the lakefront was rather industrial in use and therefore somewhat noxious to the commerce and residences of downtown. Now that the days of sawmills and shipyards are long-gone, there is an opportunity to connect downtown to the lake like never before.

(extracted from Lakefront Park Site Analysis Report; Glatting Jackson Kercher Anglin, Inc., 2007)

Located southeast of Orlando, the city of Kissimmee is positioned on the northwest shore of Lake Tohopekaliga (or, Lake Toho, as the locals prefer to call it). The name translates to “we shall gather together here”. World renowned for its bass fishing, Lake Toho is considered Osceola County’s most important water body due to its location, size, fish and wildlife resources, and economic importance relative to its recreational value (Lakes Management Plan, 2015).
Toward renewing its downtown, one of the city’s most challenging priorities was to improve access to and use of the lake’s waterfront and strengthen the link between the waterfront and nearby areas that might be considered for future redevelopment. Proposals for private development that would spur economic growth but inhibit public access to the waterfront were rejected when the citizens of Kissimmee voiced their concerns and advocated for a friendly community park that featured sustainable design, offered diverse recreational activities, and reflected Kissimmee’s historic past.

The four-year Park renovation project, split over 3 phases, was the largest capital outlay in the City’s history. Careful attention was paid toward ensuring the design of the Park’s details would be compatible with the City’s historic aesthetic. Other sustainable design elements include traffic-calming strategies, native vegetation, and site elements that encourage sustainable practices—such as electric car charging stations, a bicycle maintenance station, and solar powered recycling bins.

The Park’s rain gardens and bio-detention basins are planted with native grasses, perennials, and trees that filter stormwater from the street and adjacent park space, and provide wildlife habitat. The edge of Lake Toho’s native aquatic vegetation
and trees offer nesting habitat for birds. The gardens, native plantings and preserved live oaks, rebuilt seawall, and educational signage enable the park to serve as a demonstration of green design principles. Distinct play areas, and a splash park, are designed to appeal to children of different ages; and, an abundance of pavilion shelters with lighting, ceiling fans, and grills are a popular amenity. The shaded fishing pier, floating dock, and marina with restaurant are a strong draw, particularly during bass fishing season.

Figure 1.3: Lakefront Park project timeline

With the aim of creating a backyard for the people of Kissimmee, the master plan for the City’s 25-acre Lakefront Park, produced by AECOM, has transformed a neglected park space into an inviting, highly functional, open green space. In addition, the adjacent parcels have been designed to attract economic development (Landscape Online, 2015.).

The project timeline is depicted at left, in figure 1.3. Site renderings and an amenities list for each project phase are shown in figures 1.4, 1.5, and 1.6, located on the following page.
Phase 1 Amenities

January 5, 2010 – August 2, 2011

- SITE CLEARING
- DEMOLITION OF STRUCTURES
- EARTHWORK AND GRADING
- CONCRETE WORK
- WATER SUPPLY
- SANITARY SEWER AND STORMWATER DRAINAGE
- ELECTRICAL AND LIGHTING
- SIGNAGE AND STRIPING
- BRICK ROADWAYS, PARKING AND 10’ SIDEWALKS
- LANDSCAPING AND IRRIGATION
- DUMPSER ENCLOSURES
- NAUTICAL RAIL FENCE

Source: City of Kissimmee Parks and Recreation
Phase 2 Amenities

March 1, 2011–April 15, 2013

- Brick Pavers and Concrete Work
- Sidewalks and Parking
- Seawall Replacement and Redesign
- Landscaping and Irrigation
- Seatwalls, Planters and Steps
- 10 Buildings: Shelters, Concession, Restrooms
- Covered Playgrounds
- Community Stage
- Civic Lawn and Wedding Lawn
- Renovate Fishing Pier
- Renovate Monuments: States and Bataan-Corregidor
- Nautical Rail Fencing
- Site Furnishings – Electrical and Lighting

Source: City of Kissimmee Parks and Recreation, with graphic enhancements by researcher
Phase 3 Amenities

- Parking Lots: Boat-Trailers and Vehicles
- Marina-Bait Shop Building
- 6 Buildings/Shelters
- Playground
- Splash Pad
- Event Lawn
- Rain Gardens – Storm Water and Retention Basins
- Boardwalks Over Rain Gardens
- Breakwater Enhancements
- Fishing Tournament Area
- Site Furnishings
- Electrical and Lighting
- Landscaping and Irrigation
- Signage

January 7, 2013—October 31, 2014

Source: City of Kissimmee Parks and Recreation, with graphic enhancements by researcher

Figure 1.6: Lakefront Park construction phase 3
One of the innovative features of Lakefront Park is its green infrastructure stormwater treatment train, whereby stormwater runoff is channeled from impervious surfaces to native planting rain gardens. The cleansed water then flows into one of the Park’s four nutrient separating baffle boxes, for further filtration. A unique feature to one of the Lakefront Park baffle boxes was the addition of a Suntree observation lid—a large, clear cover that allows the public to look inside and view the system components, as evidenced in figure 1.5. Thanks to the rain gardens and baffle boxes, the Park is able to filter and treat downtown Kissimmee’s runoff before it enters Lake Toho.

Figure 1.7: Lakefront Park’s Viewable Baffle Box  
(source: Researcher’s image)

The objective of the viewable baffle box is to serve as an educational tool: the ability to see stormwater treatment processes occurring has the potential to increase awareness of the importance of clean water practices. The City of Kissimmee received the Florida Stormwater Association’s Outstanding Treatment and Public Education Award for this project (Kissimmee.org/stormwater-award-2014.pdf).

According to the City’s Public Works Department, the education goals have been met through this innovative design:

Most days there are between 100 and 500 park visitors that take interest in the rain gardens and viewable baffle box. They read the signs that provide detailed information on how the water is treated through this state of the art system. Thus, the education has been a huge success. (Florida Stormwater Association, p2, 2014)
In addition to the viewable baffle box, $10,000 was invested in educational signage located throughout the Park. The attractive signs convey information about the history of Kissimmee and Lake Toho, the importance of water conservation and clean water practices, the role of native plants and rain gardens in the landscape, and the value of biodiversity.
The programming of local events plays a huge role in attracting visitors to Lakefront Park. In fact, the Park hosts numerous public events throughout the year, including movies and concerts, seasonal festivals and cultural events, small parades, recreational tournaments, and educational and environmental programming. Offering an ongoing array of diverse events fosters community building, attracts tourists, and creates economic value. Further, the experiences and memories tied to these events strengthen the sense of this place.

According to Director of Kissimmee Parks, Recreation, and Public Facilities department, Dan Loubier, Lakefront Park currently holds between 28 to 30 major events per year. As there is no gate or any means to differentiate event attendees from general Park attendees, event attendance is not regularly accounted for. However, information from the City’s Economic Development Department indicates pre-Park construction numbers of 250,000; and, current annual event attendance at approximately 500,000. This does not include guests that visit the Park for use of its other amenities on a daily basis.

A sampling of annual Park events, as well as attendance estimates as provided by Mr. Loubier, are shown in figure 1.9, at left.
1.5 Summary

The objectives of this study are to explore a broad range of ecological, social, and economic metrics to evaluate landscape performance; make a contribution to the knowledge of ecological, social, and economic performance within the field of landscape architecture; and, develop opportunities for application of performance-based information in future evidence-based design projects. In this introductory chapter, the questions and objectives that drive this study have been expressed and pertinent information about the site’s context has been portrayed.

The remainder of this document is organized as follows: Chapter 2 provides an assessment of the literature relevant to green stormwater infrastructure, urban parks, and measuring the designed landscape. Chapter 3 presents a number of case studies that helped inform the quantification of performance measures for the study site. This is followed by Chapter 4, an overview of the methods utilized for evaluating the performance indicators associated with the site’s potential ecological, social, and economic functions. The various performance indicators and methods are organized in a tabled format, with the indicators and methods utilized in this study highlighted. Toward facilitating a cohesive read, Chapter 5 is dedicated to ecological performance benefits, Chapter 6 pertains to the social side, and Chapter 7 features the performance benefits tied to economic sustainability. Within each of these three chapters, details pertaining to each method of analysis, as well as consequent results, are featured. And, finally, Chapter 8 provides a discussion of the findings through a revisit of the research questions, concluding thoughts on lessons learned, and recommendations for future research. Works cited and Appendices are located at the end of this document.
2 :: LITERATURE REVIEW

2.1 Introduction
Green infrastructure has been described as “the visible expression of natural and human ecosystem processes that work across scales and contexts to provide multiple benefits for people and their environments” (Rouse and Bunster-Ossa, 2013, p1). These benefits include clean water and air, healthy soils, urban heat island reductions, healthy food, enhanced biodiversity, and so on. Landscape architects are well positioned to implement and advocate for green infrastructure solutions in the design of the built environment. Through the utilization of performance metrics for assessing high-performance landscape projects, the quality and integrity of designed landscapes can be elevated and strengthened. As design professionals rely upon precedents to inform their work, the knowledge gained from case study research in landscape architecture can inform the development of guidelines, shape design strategies, and educate others outside the field of landscape architecture.

This literature review is comprised of four major sections: today’s urban parks, defining green infrastructure, green infrastructure benefits and practices, and approaches to evaluating designed landscapes. The first section provides an overview of the design opportunities and potential benefits afforded by public parks. The second section, defining green infrastructure, describes what green infrastructure is. In the third section, the wide array of benefits provided by the contribution of green infrastructure practices to the development of sustainable communities is discussed, as well as an overview of various elements that can comprise green infrastructure systems. The fourth section, approaches to evaluating designed landscapes, describes established methods for examining public space and its living systems, setting the stage for the case studies that are presented in chapter 3.
2.2 Today’s Urban Parks

Many of the great parks in the U.S. were inspired by Frederick Law Olmsted’s Central Park in New York City, which was created as a place to relax from the stress of the urban environment and connect with nature. Olmsted viewed city parks as social “mixing valves” that brought people of all walks of life onto common ground, or in other words…. (Jerke et al., 2008). While Olmsted’s take on parks as social mixing valves lives on today, the purposes and functions of urban parks, as well as their design, has changed. Changing urban conditions and demographics have created a different set of needs and desires for city parks. According to landscape architect Joe Brown, because urban parks now serve a greater array of demands, we “are no longer building the green lawns of passive parks”; instead, we “are creating smart parks that can become the hip, active centers of recreation and celebration as well as catalysts for economic investment” (as quoted in Jerke et al, 2008).

Calkins (2012) posits that the role of a sustainable site is to provide ecosystem services and habitat, to be productive, and to support connections between the cultural and natural worlds. The public realm of the urban environment offers a largely untapped opportunity to serve as a place for production, rather than consumption. Aside from pavement and buildings, the space that remains can be used for stormwater infiltration and cleansing, provision of wildlife habitat, food and energy production, and places for humans to interact with each other and with nature. Given the relatively greater degree of open space featured in most urban parks, these sites offer tremendous opportunity to design for multiple functions that synergistically create ecological, social, and economic value for the benefit of cultural and natural systems. This section describes the benefits afforded by public parks and other public, urban landscapes.

Ecological Benefits and Considerations
Given the burgeoning growth of cities, parks afford opportunities for preserving green space and the values it provides, for future generations. In addition, carefully designed parks can potentially help offset the environmental problems caused by development, via low impact development strategies, and benefits such as carbon sequestration and urban heat island reduction. Additionally, according to the Sustainable Sites Handbook, a site that is genuinely sustainable is capable of expanding environmental awareness to the extent that it impacts the behavior of its users
BE (Calkins, 2012). For example, a rainwater garden that serves as a model in a public landscape may lead people to consider replicating it within their own landscape. The benefits linked to ecological elements are covered in greater detail in the section on green infrastructure benefits.

Social Benefits and Considerations
As mentioned previously, the creation of landscapes that foster social interaction and strengthen community has been a goal of landscape design professionals ever since the work of Olmsted (Calkins 2012). Marc Francis, Professor Emeritus of Landscape Architecture at the University of California, Davis, who was commissioned by the Landscape Architecture Foundation to develop a case study methodology for application in the profession of landscape architecture, has defined successful urban open space as having a wide range of characteristics that include being democratic and open to everyone (1987). Moreover, sustainable public spaces are those that encourage opportunity for social interaction and conversation between different groups of people.

Recent findings have indicated that approximately 1 in 10 deaths worldwide are caused by lack of physical activity (Lancet 2012). Physical activity helps to control weight and reduce the risk of developing obesity and its related conditions including heart disease, type2 diabetes, and some cancers. However, nearly 80% of Americans fall short of meeting the recommended 150 minutes per week of physical activity (CDC 2013). Amount of physical activity is influenced by many factors, including degree of access to open space and presence of pedestrian and bike-friendly environments (CDC 2013). The design of the built environment can significantly impact people’s access to comfortable, convenient, and safe places to walk, bicycle, and engage in other forms of physical activity and recreation (Calkins 2012).

Due to humans’ biophilic tendencies, or innate fascination with and attraction to nature, we are able to receive the benefits from nature’s restorative powers. Contact with nature has been shown to reduce stress, improve cognitive function, and alleviate the mental fatigue tied to modern living (Kaplan et al., 1998). In fact, many health care professionals are giving park or nature prescriptions to encourage their patients to exercise outdoors in parks or on trails ((Rouse and Bunster-Ossa, 2013). According to Calkins (2012), it is important to design places in ways that
afford users the opportunity for mental restoration as well as for learning the importance of nurturing the natural environment.

Safety has become a high priority in park design (Jerke et al., 2008). Perceived risk to personal safety can strongly deter people from using a landscape; hence, site safety is directly related to the social equity facet of sustainability. Plagued by fear, vulnerable populations such as the elderly, women, and children, may be excluded from accessing public landscapes. The result is an inequitable situation in which those that may benefit the most from a civic site, such as a park, are denied the opportunity. William Whyte (1980) discovered a correlation between use of urban open space and perceptions of safety: people felt the safest in spaces that were heavily used by a wide range of people, while isolated places that had few people were perceived as remote and dangerous. Whyte also recommended several design elements for improving security. These included better lighting, improved sightlines, and programmed events to attract more people.

Parks should also be connected with each other and with a community’s other major land uses. Toward ensuring equitable access, parks should be accessible by sidewalks and trails for walking, bike paths, and public transit. People and parks should be no more than five minutes apart by foot in dense areas, or five minutes apart by bicycle in areas that are more spread out (Harnik 2003). He recommends basing the distance not on the walking pace of young adults, but on the pace of a mother pushing a stroller or a child riding a bicycle. Furthermore, cities should ensure park access to a broad range of challenged individuals, including those confined to wheelchairs.

Public spaces can play an important role in fostering social interaction and building community. Strengthening of social connections leads to a stronger sense of community and greater social capital. In turn, this creates greater capacity for handling economic, social, and environmental challenges, resulting in a higher degree of community resiliency (SITES 2009). Onsite amenities can attract people to a site and foster social interaction. Amenities such as food vendors, amphitheaters and outdoor stages, playgrounds and other recreational features should be designed in response to the needs and desires of the community and other anticipated users (Francis 2003). Large viewing screens for film events, expansive lawns for open play, and outdoor cooking and dining facilities are other important amenities to consider during programming and design. Additionally, a variety of seating options, including some
movable furniture, will enable users to configure their own realm, creating a sense of control and encouraging site use (Whyte 1980).

Calkins (2012) remarks how landscapes themselves can serve as amenities. As people are drawn to water, providing piers, boardwalks and other means to access the water’s edge can attract visitors. Riparian areas are vulnerable to stormwater runoff, erosion, and pollution that can harm aquatic habitat and compromise water quality. Linear bands of vegetation planted along a watercourse bank can intercept and filter runoff, provide shade, protection, and habitat for aquatic and other wildlife, and reduce flooding. To be most effective, riparian buffers should be planted with a diverse palette of native vegetation, providing higher quality habitat and a more resilient landscape. Designing an accessible, attractive water’s edge also invites opportunity for environmental education.

Economic Benefits and Considerations
Research has shown that well-maintained, secure parks are capable of generating higher values for properties located in close proximity, attract and retain new business, and attract visitors who support the local economy. Attractive parks can help establish positive images about a place, influencing perceptions about a city or community as being a desirable place to work, play, and live. And, parks can elevate property values in less affluent areas as well. Outdoor open spaces, such as public parks, enable celebration of community life and serve as venues for festivals, concerts, and other events and activities, including formal and informal gatherings of families, friends, and other groups. As a (tourist) attraction, parks can have a significant economic impact by bringing patrons to stores, restaurants, and hotel establishments. For example, Chicago has estimated that Millennium Park attracts nearly 4 million tourists annually, and has increased hotel, restaurant, shopping, and entertainment sales by nearly $200 million a year (Jerke et al., 2004).

2.3 Defining Green Infrastructure

A product of industrialized civilizations, infrastructure is the compilation of elements that support community viability by providing energy, water, food, and other materials, in order to maintain human health, safety, and
welfare (FL-ASLA 2008). Our built environments consist of gray, or built, infrastructure systems (i.e., buildings, transportation, water and sewer, fuels, waste management) as well as green, or natural, infrastructure systems (i.e., land, water, air, flora, fauna, and other living organisms). Green Infrastructure (GI) is a concept that has recently moved to the forefront of urban planning and landscape design. As described by Firehock (2010), the term green infrastructure was first used in a 1994 report on land conservation strategies by the Florida Greenways Commission, whereby the objective was to raise the societal value and functions of natural systems, to the same degree of importance as gray infrastructure:

The Commission’s vision for Florida represents a new way of looking at conservation, an approach that emphasizes the interconnectedness of both our natural systems and our common goals and recognizes that the state’s ‘green infrastructure’ is just as important to conserve and manage as our built infrastructure. (Florida Greenways Commission 1994)

As described in *Visions of Smart Growth and Sustainability*, produced by the Florida Chapter of the American Society of Landscape Architects (2008), there are three categories of GI systems, with regard to function and design objectives: (1) Natural wilderness areas, including rivers, streams, lakes, wetlands, forests, etc. and their adjacent buffers and conservation easements. These systems provide wildlife preservation, education and recreation, and reduction of loss and damage from natural disasters. (2) Human-manipulated open space, such as farmland parks, trails systems, and beaches. These spaces are designed to provide food and materials, aesthetics, and recreation amenities. (3) Artificially naturalized utility systems featuring plants and living organisms, such as greenroofs, bioswales, and rain gardens, designed as part of a stormwater management system to enhance environmental quality. This type of GI substitutes for, or assists with, gray infrastructure, achieving the same or improved performance as that of gray infrastructure functioning on its own. For the purposes of this study, GI will refer to classifications 2 and 3, human-manipulated open space and artificially naturalized utility systems.

The two most critical aspects of stormwater management pertain to water quantity and quality impacts resulting from storm events. Increased urbanization goes hand in hand with increased amounts of impervious surface area, as natural land cover (i.e., trees, plants, and other living ground cover) is replaced by roads, parking lots, sidewalks,
and rooftops. Stormwater runoff is created when rain flows over impervious surfaces due to inability to infiltrate into the ground. As the runoff flows over land and impervious surfaces, it picks up chemicals, sediment, debris, and other pollutants, leading to detrimental affects to water bodies. In order to prevent flooding, collection systems are necessary for handling the increased volumes of stormwater runoff. In many cities, the storm sewer system collects all the stormwater runoff from rain events and discharges the water, with all of its accumulated pollutants, directly into ponds, streams, lakes, rivers, bays, and other drinking water sources. Up until recently, this was the scenario in Kissimmee, Florida, whereby all stormwater runoff was carried directly to Lake Tohopekaliga.

When stormwater runoff volumes increase and the amount of water that infiltrates into the soil decreases, the flow of water into streams and aquifers also decreases. However, during subsequent storm events, water flowing into streams and aquifers rapidly increases, posing the threat of flooding and associated damage. In addition to the negative impacts on water quality and quantity, stream bank erosion, loss of wildlife habitat for aquatic and non-aquatic creatures, decreased storage in lakes due to sedimentation, and loss of recreational opportunities are resultant consequences.
In the state of Florida, approximately 90% of freshwater comes from the Floridian aquifer. More than 3 billion gallons of freshwater are withdrawn from the aquifer on a daily basis. Population growth leads to greater demand for freshwater: Florida Water Management districts estimate that by the year 2030, Floridians will need an estimated 1.3 billion gallons of additional water per day—nearly a 21% increase compared to the demands in 2010. This is of particular concern, as traditional sources of fresh groundwater will not be capable of completely satisfying all of the added demand (FL Dept. of Environmental Protection, 2014).

Stemming from the need to address the impacts of urban stormwater runoff on water quality through the initiation of the Clean Water Act and related regulatory mandates, a second definition of GI has recently come about. According to the U.S. Environmental Protection Agency (2007), GI refers to “systems and practices that use or
mimic natural processes to infiltrate, evapotranspirate, or reuse stormwater or runoff on the site where it is generated”. Although the definition created by the Florida Greenways Commission focuses on large landscape elements such as parks, greenways, natural areas, and productive farm lands, the EPA emphasizes smaller-scale components in urban contexts as typical elements of GI. In the design of a GI system, trees, rain gardens, bioswales, native plant palettes, vegetated median strips, green roofs and vegetated walls, and other landscape elements can be utilized to create a stormwater treatment train. Such measures are known as Best Management Practices (BMPs). In this context, the term GI has become nearly synonymous with the design strategy known as Low Impact Development (LID) (Center for Neighborhood Technology 2010).

LID practices are increasingly being integrated into city comprehensive plans, and are also used in the creation of aesthetic and open space amenities to help ameliorate the impacts of development in cities (National League of Cities 2013). Indeed, numerous environmental crises have surfaced resulting from decades of gray infrastructure system practices: depletion of water resources, ozone depletion, air and water pollution, and wildlife extinction (FL-ASLA 2008). Recognition of the significant role that GI systems can play in laying the foundation for truly sustainable development has begun to grow widespread. In August 2015, the Innovative Stormwater Infrastructure Act was reintroduced to Congress. This legislation would allow states, localities and other entities to receive grants toward planning, designing, and implementing GI projects aimed at addressing stormwater management issues. The legislation would also promote the use of GI by encouraging the EPA to integrate GI in permitting, codes, and ordinances (Library of Congress, Aug. 2015). The Senate has recently referred the Bill to the Committee on Environment and Public Works, where it is awaiting further action.

2.4 Benefits and Practices of Green Stormwater Infrastructure

Integrating GI into the planning and design of cities affords the opportunity to not only live comfortably and safely, but helps sustain our natural resources as well. While traditional stormwater infrastructure (gray infrastructure) has been engineered to convey runoff through underground pipe networks, successful application of GI BMPs results in improved quality of the water that is ultimately discharged, reduction in runoff quantity, recharged
groundwater, and increased health of surrounding water bodies. In addition to water improvements, several other benefits achieved through green infrastructure stormwater systems include healthy soils, urban heat island reductions, clean air, and enhanced biodiversity. These benefits enhance quality of life for all living organisms.

Five common GI practices and their benefits are depicted in Figure 5.2. The matrix shows how GI practices can produce various combinations of benefits. In fact, one of the advantages of utilizing GI approaches to design is that they create overlapping dimensions of value. For example, protecting environmental and public health also protects local economies. The Center for Neighborhood Technology (CNT), a nonprofit organization dedicated to improving urban environments and economies across the U.S, helping communities to be more livable and sustainable. As CNT has noted, it is important to bear in mind that these GI benefits will accrue at different scales, as they are influenced by local factors such as population and climate. This portion of the literature review will focus on GI practices currently featured on the study site: tree planting, bioretention and infiltration, and permeable pavement.
Figure 2.2: Green Infrastructure benefits and practices

<table>
<thead>
<tr>
<th>Practice</th>
<th>Reduces Stormwater Runoff</th>
<th>Improves Community Livability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reduces Water Treatment Needs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improves Water Quality</td>
<td>Increasing Recreational Opportunity</td>
</tr>
<tr>
<td></td>
<td>Reduces Grey Infrastructure Needs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduces Flooding</td>
<td>Improves Community Cohesion</td>
</tr>
<tr>
<td></td>
<td>Increases Available Water Supply</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increases Groundwater Recharge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduces Salt Use</td>
<td>Cultivates Public Education Opportunities</td>
</tr>
<tr>
<td></td>
<td>Reduces Energy Use</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improves Air Quality</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduces Eutrophication</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduces Atmospheric CO₂</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduces Urban Heat Island</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improves Livability</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Center for Neighborhood Technology (CNT), 2010.
Tree Planting

Tree planting appears to offer more benefits than any of the other GI practices. Trees are also the largest structural component of GI; and, the tree plantings that occur in the physical fabric of suburban and urban communities provide valuable contributions as members of the urban forest (Rouse and Bunster-Ossa, 2013). The ecological benefits of trees include air and water filtration, carbon sequestration, storm water retention, reduced energy consumption and urban heat island, and provision of wildlife habitat. For example, studies have estimated the amount of rainfall intercepted by a small tree (21 foot spread) to be 292 gallons annually, and 2162 gallons annually for a large tree (37 foot spread) (Kisner 2013). Findings have shown that trees also carry social benefits as they help to define and strengthen neighborhoods, reduce crime rates and noise transmission, contribute to environmental aesthetics, and increase health and well being. On the economic side, the proven effects of trees include reduced infrastructure costs, increased real estate values, energy savings, and promotion of consumer spending (Donovan and Butry, 2010).

Bioretention and Infiltration

Bioretention systems, also known as rain gardens, bioswales, and wetlands, are designed to collect, store, infiltrate, and treat runoff. For the purposes of this study, the literature review focuses on the smaller scale practices of rain gardens and bioswales. In order to collect water from proximal impervious surfaces, rain gardens are typically located at the bottom of a slope. Bioswales are usually installed adjacent to parking lots, roads, and sidewalks; and, work to trap silt and pollutants that would otherwise be carried in the runoff from impervious surfaces.

These systems function by diverting runoff through dense vegetation, and then filtering the water vertically through soil media. The biological, chemical, and physical mechanisms of plants, soil, and microbes work to remove the pollutants (e.g., suspended solids, oil and grease, heavy metals, nitrogen, phosphorous) found in the stormwater runoff. As the cleansed water infiltrates into the soil, it recharges the groundwater, rather than being piped away. The water is then collected in drains located below the soil media, and either discharged to receiving waters or
stored for reuse (Davis 2005). In addition to improving water quality and reducing runoff volumes, rain gardens and bioswales help sequester carbon, reduce urban heat island effects, create habitat and increase biodiversity, and improve air quality. With regard to social value, these bioretention systems can offer opportunities for public education, increase recreational opportunities, improve aesthetics, and contribute to sense of place and community.

**Permeable Pavement**

Permeable pavement, also referred to as pervious or porous pavement, enables stormwater to percolate into the ground where it can be naturally filtered, instead of contributing to surface runoff. The permeable surface consists of either porous asphalt or concrete, or structural pavers, which sit on top of gravel and rock that has been laid over uncompacted soil (Sustainable Cities Institute, 2012). As the stormwater seeps through the porous concrete or pavers, pollutants are removed and groundwater is replenished with water of higher quality. Permeable surfaces can also help lower the heat island effect, enhance aesthetics, and improve safety due to better traction and glare reduction. Permeable pavement can provide economic benefits, as it often results in lower overall construction costs due to elimination/reduction of the need for other, more traditional stormwater management techniques, such as curb and gutter systems (Sustainable Cities Institute, 2012).

**Scales of GI practice**

One of the merits of GI is that it can be adapted to various land uses ranging from high-density urban environments to low-density development; and, can be applied at the regional scale (e.g. multi-state, statewide, ecogregional, or large watershed), local scale (e.g., multi-county, county, city, or small watershed), and site scale (i.e., civic, institutional, commercial, residential) (EPA 2007). Table 2.1 provides examples of the triple-bottom-line benefits that can accrue from applying GI design strategies to park projects across different scales of landscape architecture practice. As one of the prominent features of the case study site is its waterfront, the project category of waterfro...
Table 2.1: Benefits from incorporating GI into park projects at various scales of landscape architecture practice
(Source: Adapted from Rouse and Bunster-Ossa, Green Infrastructure: A Landscape Approach, 2013)

<table>
<thead>
<tr>
<th>REGION</th>
<th>MULTIFUNCTIONALITY</th>
<th>CONNECTIVITY</th>
<th>HABITABILITY</th>
<th>RESILIENCY</th>
<th>IDENTITY</th>
<th>RETURN ON INVESTMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESOURCE-BASED</td>
<td>Wildlife conservation; CO₂ storage and sequestration;</td>
<td>Migratory bird flyway</td>
<td>Nature-based recreation and education (bird-</td>
<td>Food and fiber production through low-impact</td>
<td>Preservation and access to valued cultural</td>
<td>Ecotourism</td>
</tr>
<tr>
<td>PARKS</td>
<td>aquifer recharge</td>
<td></td>
<td>watching, nature centers)</td>
<td>agriculture</td>
<td>resources (e.g., historic settlements)</td>
<td></td>
</tr>
<tr>
<td>URBAN PARKS</td>
<td>CO₂ sequestration through urban forestry; biodiversity</td>
<td>Community connectivity through paths and</td>
<td>Recreation, entertainment, and learning through</td>
<td>Shelter and civic emergency support; water</td>
<td>Places for public art (permanent and</td>
<td>Attraction of residents</td>
</tr>
<tr>
<td></td>
<td>enhancements through ecological restoration</td>
<td>trails</td>
<td>cultural and performance venues</td>
<td>storage through lakes and reservoirs</td>
<td>temporary installations)</td>
<td>and visitors</td>
</tr>
<tr>
<td>WATERFRONTS</td>
<td>Water quality and aquatic habitat improvement through</td>
<td>Regional linkages through trails and</td>
<td>Marine recreation (fishing facilities, boat</td>
<td>Flood protection through floodplain management</td>
<td>Places for civic festivals and celebrations</td>
<td>Tourism destination</td>
</tr>
<tr>
<td></td>
<td>bio-engineered revetments and wetlands</td>
<td>water transit</td>
<td>ramps)</td>
<td>or man-made structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBAREA SITE</td>
<td>CO₂ sequestration and VOC mitigation through urban</td>
<td>Neighborhood connectivity through</td>
<td>Places for community activities (flea / farmers</td>
<td>Food production through community gardening</td>
<td>Civic capital through community engagement</td>
<td>Increased property</td>
</tr>
<tr>
<td>PARKS</td>
<td>forestry; stormwater management through bio-swales and</td>
<td>sidewalks and trails</td>
<td>markets, art fairs, festivals)</td>
<td></td>
<td>in planning and design</td>
<td>values of surrounding</td>
</tr>
<tr>
<td></td>
<td>drain fields</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>residential and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>commercial</td>
</tr>
</tbody>
</table>

Table 2.1: Benefits from incorporating GI into park projects at various scales of landscape architecture practice
(Source: Adapted from Rouse and Bunster-Ossa, Green Infrastructure: A Landscape Approach, 2013)
2.5 Approaches to Evaluating Designed Land

In *The Social Life of Small Urban Spaces*, William Whyte (1980) conducted a performance-based study by examining indicators, or a group of quantifiable measures for gauging performance, for New York City plazas in order to determine why some were heavily used by people while others appeared abandoned. His study findings enabled him to create guidelines and inform building codes for the successful design of public plazas. Whyte’s research methodology involved behavioral observations and mapping, through the use of time lapsed recordings of plaza use patterns. The behavior patterns that he observed (movement flows, standing patterns, activities and interactions) were social indicators that influenced plaza use. Physical design indicators were also identified, such as space that was comfortable to lounge in, exposure to sun, trees, and shade, and outward views to the street. Whyte found a correlation between the physical design indicators and the level of social interaction: optimal physical design with the right mix of elements promoted social activity within the plaza. Whyte’s seminal work has made a significant contribution to public space knowledge that has informed designers ever since its publication.

As a widely recognized research method, case studies are understood as a critical tool for the advancement of knowledge; the case study method has been used in medical, business, design, and other professional fields. It is customary for landscape architects, urban planners, and architects to rely upon precedents to inform their work; oftentimes though, precedents are more anecdotal than rigorous (Steiner 2014). Case studies, on the other hand, can help communicate project successes, challenges, and failures, and advance knowledge of best practices (Calkins 2013). Landscape architect and educator, Mark Francis, was commissioned by the Landscape Architecture Foundation in 1997 to conduct a research project toward the development of a case study method for landscape architecture. In his report, *A Case Study Method for Landscape Architecture* (1999), Francis explained that, in design related fields, case studies are used to describe or evaluate projects or processes. In regard to methodology, case study analyses entail conducting the case study, analyzing results, and disseminating the newfound knowledge. Francis concluded, the case study method was highly appropriate for landscape architecture and could add value to teaching, research, and practice in the landscape architecture field. In regard to teaching, case studies offer a way to learn problem-solving skills and develop useful strategies through an understanding of strategies applied in the past. In research, case studies can communicate advances of the profession by reaching a wide
audience. And, in practice, case studies serve to guide designers toward increased success, build upon critical theory, and publicize the value and effectiveness of landscape architecture, outside the professional circle. Francis’ work has led to recognition and adoption of the case study method within the field of landscape architecture and in prominent research-centered endeavors, including the Sustainable Sites Initiative (SITES).

According to Yin (2009), by employing a descriptive mode, the case study strategy can be used to illustrate certain topics within an evaluation; and, case studies can shed light on situations in which the intervention being evaluated lacks a clear and single set of outcomes. A prevalent limitation is that case studies typically rely heavily upon existing, or secondary, data that project designers, managers, and other parties may be unwilling or unable to provide. Francis (2000) has stated, before case studies can have a significant impact on the landscape architecture profession: case studies need to employ comparable methods so that findings can be identified across cases; methodology needs to become more systematic and rigorous through testing under a wide variety of settings; and, more post occupancy evaluations of landscape architecture projects need to be conducted, particularly where evaluation becomes a part of built projects.

Marcus and Francis (1998) define the Post Occupancy Evaluation (POE) study as a systematic evaluation of a designed and occupied setting, from the perspective of those who use it. As POE studies uncover user perspectives, findings can inform design decisions of future projects (Preiser, Rabinowitz, and White, 1988). When evaluating behavioral performance elements, Preiser et al. (1988) strongly suggest that whenever feasible, a multimethod approach be utilized in order to enhance credibility of findings. For example, photography may be combined with observation and a survey questionnaire. And, if available, archival records may be correlated with data collected by other methods. Since a multimethod data collection strategy demands more resources, the authors also recommend focusing on a few critical behavioral performance elements. The POE method involves site observations, participant observations, measuring behavior, mapping activity, surveys and/or interviews, and analysis of the data collected. In addition, a systematic, investigative POE that conveys project performance information associated with landscape architecture requires selection of appropriate data collection, analysis, and communication methods and formats for each performance element to be measured.
Springing off from Francis’ findings and Yin’s recommendations for case study design and analysis, Ahern, Ledic, and York (2007) conducted a case study that examined the topic of biodiversity and how the concept was being applied in the work of landscape architecture and planning. Assessing strategies in biodiversity planning, design, restoration, and management, the case study research looked at approaches for maintaining or increasing biodiversity ranging from statewide to individual project scales. The case study process involved the following: review literature on biodiversity, planning, and design and apply findings to crafting the case study design, protocol, and analysis; select projects that represented innovative work and significant involvement of landscape architects and planners; identify key individuals and applications for in-depth project analysis; gather data, through interviews, project visits, literature review, and relevant records; analyze case study evidence and prepare draft report; prepare final case study (Ahern, Ledic, and York, 2007). In addition to the processes of planning and design, findings regarding site performance and post-occupancy challenges were also provided. The case study research conducted by Ahern and colleagues disseminated the importance of interdisciplinary strategies in creating sustainable landscape projects.

In response to Francis’ work, the Landscape Architecture Foundation (LAF) commissioned and developed a case study method for landscape architecture, in order to “promote an in-depth, multi-dimensional approach to case studies and provide for uniformity in format and method” (LAF 2013). The LAF’s Case Study Investigative Series (CSI) showcases exemplary projects by assessing and documenting ecological, social, and economic performance factors through case study methodology. The CSI case study briefs not only serve as reference for performance metrics, but also are used as a tool to inform design of future landscapes while increasing understanding of the roles that landscape architects play in the development of community sustainability and resilience.

Indications of Value

A newly focused area of landscape architecture study, landscape performance has been defined as “the measure of efficiency with which landscape solutions fulfill their intended purpose and contribute toward achieving sustainability” (LAF, 2014). Landscape performance assessments can be used to evaluate the effects that designed
landscapes have on ecological and cultural systems through the comparison of functions or behaviors against baselines or established norms (Ellis et al., 2014). A critical question for planners and designers is how to measure the benefits of landscapes in order to demonstrate the value that these living systems can bring to society (Rouse and Bunster-Ossa, 2013). If landscape performance can be measured in quantitative terms, it becomes easier to both recognize and share information about the ecological, cultural, and other values of landscapes. In turn, we can more easily appreciate the potential and importance of design as part of the process of creating value in landscapes at various scales. Moreover, we realize the significance of integrating landscape performance considerations into the processes of project design and evaluation (Jerke, Porter, and Lassar, 2008). Along these lines, Steiner (2014) asserts that identifying, quantifying, and monitoring the economic and cultural benefits of ecosystems will result in the establishment of higher standards for landscape performance and landscape design.

Performance indicators are quantitative or qualitative measurement tools that can be used to assess progress toward satisfying goals and objectives. As described in the American Planning Association’s report, Green Infrastructure: A Landscape Approach (2013), the following are examples of indicators that can be measured with quantitative methods: environmental indicators including degree of carbon storage and sequestration, reduction in stormwater volume, area of tree canopy coverage, etc. Economic indicators include changes in property values, jobs created, and reductions in building energy usage. Social, or community, indicators include measurements of park and open space equity (or the degree of access to open space within different demographics and populations), and access to parks and open space (usually measured by walking distance to nearest resource).

Some of the benefits provided by landscapes can be challenging to demonstrate in concrete terms. For example, environmental benefits of LID practices can be difficult to prove, due to wide variability in rainfall, runoff flows, and water quality characteristics, as well as an emphasis on small-scale, dispersed practices (Davis, 2005). Likewise, landscape architect and planner, David Rouse, and urban designer and landscape architect, Bunster-Ossa posit that, even though benefits such as enhanced aesthetic quality and increased cultural cohesion are difficult to measure, these benefits are integral to the practice of landscape architecture and other design professions. As such, it is important to develop valid ways to define and assess the culturally centered, qualitative benefits provided by GI landscapes (2013).
The Landscape Architecture Foundation initiated its case studies program for landscape performance in 2010, and currently provides documentation on over 150 studies that have quantified a diverse collection of benefits of landscape architecture projects found in the U.S. and overseas. Methods of analysis include statistics, monitoring, post occupancy evaluation, as well as other quantitative and qualitative measures deemed applicable to various performance categories. Unlike the SITES rating system which attempts to predict the outcomes of a project based upon construction related documents, the aim of LAF’s case studies initiative is to quantify the performance of landscape functions and solutions after project completion.

2.6 Synopsis

Review of the literature has shed light on the role that green stormwater infrastructure can play in contributing to quality of life and sustainable community development. At city and regional scales, GI is considered a multifunctional open-space network; while, at the local and site scale, GI is viewed as a viable approach to stormwater management that mimics natural hydrologic processes through site design and technology. Seminal studies as well as contemporary research initiatives featuring performance evaluations of natural and built environments were assessed in the literature review, in order to gain understanding of the application of these techniques for performance based research of landscape architecture projects. Landscape performance research and evaluation has gained attention in recent years; and, the primary means for communicating knowledge about the tools and methods for landscape performance remains the case study. Increased application of the performance-based case study approach will help expand the research base in landscape architecture, and communicate research, technological, and design advances to the profession and the public. The following chapter will feature an overview of several case studies that inform the structure and methodology for evaluating the ecological, social, and economic functions of the study site.
3 :: CASE STUDIES

The cases featured in this study were selected from the Landscape Architecture Foundation’s (LAF) Landscape Performance Series (LPS). Within the LPS, teams comprised of students, faculty and lead practitioners measure and document the performance benefits of exemplary landscape projects. For each case, the research team develops methods for quantifying the project’s benefits, collecting data, and documenting the project as a case study.

The methods and metrics vary somewhat from case to case, as they are dependent upon the project’s objectives and the availability of data. A mixture of qualitative and quantitative methods is typically utilized; examples of methods employed are as follows:

:: Site observations (e.g., visitor counts)
:: User surveys (in person and online)
:: Monitoring or sampling (e.g., temperature measurements, water quality testing)
:: Analysis of data that is available to the public (e.g., property values, crime reports)
:: Analysis of secondary data (e.g., municipality reports, LEED documentation)

According to the American Society of Landscape Architects (ASLA, 2015), metrics may include the following:

:: Environmental performance: Stormwater management, energy efficiency, carbon sequestration, local temperature improvements, biodiversity, waste reduction, and water conservation
:: Social performance: Recreational value, safety improvements, noise mitigation, improved access, scenic quality, walkability, and educational value
:: Economic performance: Job creation, increased investment, tax revenue, visitor spending, and operations and maintenance savings
The LPS was chosen as the main source for the cases assessed and presented in this study because it offers examples of methodological quantification that increase understanding of the values and impacts of sustainable landscape solutions. While other studies have analyzed various aspects of the built landscape, the LPS case studies employ a holistic approach toward uncovering a site’s environmental, social, and economic performance benefits.

The case studies featured in this chapter are intended to provide a brief overview of the project and the various benefits assessed. The main lesson, or take-home message, that the researcher concluded from reviewing each case is also provided. Figures 3.1 through 3.12 were sourced from the Landscape Architecture Foundation’s Landscape Performance Series (landscapeperformance.org).
### 3.1 Canal Park

**Location:** Washington, DC  
**Former Land Use:** Brownfield  
**Landscape Architect:** OLIN  
**Size:** 3 acres  
**Project Type:** Park/Open Space; Courtyard/Plaza; Stormwater Management Facility  
**Completion Date:** 2012

**Benefits:**  
Stormwater runoff capture  
Annual savings through use of reclaimed water  
Event attendance  
User survey (use & perceptions: safety; meeting new acquaintances; feeling welcome)  
User location mapping  
Job creation  
Facility rental revenue  
Increased property values  
Spurs development

**Lesson:**  
Site analysis, particularly for the site’s social functions, occurred over the span of 1 entire year. This afforded opportunity for a more in-depth study into how the park was functioning for the people.
3.2 Carmel Clay Central Park

**Location:** Indianapolis, IN

**Landscape Architect:** Smith Group J JR

**Project Type:** Park/Open Space; Nature Preserve; Created Wetland

**Former Land Use:** Park/Open Space

**Size:** 161 acres

**Completion Date:** 2007

**Benefits:**
- Stormwater runoff capture (roofs & parking)
- Visitor attendance
- Environmental education
- Linkages (bike trail connections)
- Community Center revenue generation
- Job creation
- Maintenance costs savings

**Lesson:**
In measuring social benefits, it is challenging to quantify specific benefits, due to the time span allotted for study and the assessment methods typically utilized in case study research (e.g., the rapid field assessment which entails behavior mapping). Social benefits involve relationships and relationships require the shaping and building of values over time.
3.3 Klyde Warren Park

Location: Dallas, TX
Landscape Architect: Office of James Burnett
Project Type: Park/Open Space
Former Land Use: Transportation
Size: 5.2 acres
Completion Date: 2012

Benefits:
- CO2 sequestration
- Stormwater interception by trees
- Reduced surface temperatures
- Event attendance
- User survey (uses & perceptions of Park)
- Increase in trolley ridership
- Job creation
- Increased tax revenue
- Increased property value

Lesson:
The newness of a landscape architecture project can limit the assessment of economic benefits. This limitation can be further compounded when baseline data does not exist or secondary data is minimally available.
3.4 Lowland Park

Location: Detroit, MI
Landscape Architect: Smith Group JJR
Project Type: Park/Open Space; Stormwater management facility
Former Land Use: Brownfield
Size: 6.1 acres
Completion Date: 2010

Benefits:
- Water quality improvement
- Habitat creation
- CO2 sequestration
- Linkages (non-motorized circulation)
- Educational opportunities
- Site visitor spending
- Spurs development

Lesson:
It is challenging to measure economic benefits, as many are immaterial. For example, the transformation of urban space often spurs further development; and, signs of development can ignite hope, pride, and positive energy in communities, particularly where poverty is tightly woven into the urban fabric. So...how does one go about measuring the transformational value of the built landscape? The case study of Lowland Park helped outline a method for accomplishing this difficult task, by uncovering tangible proximate benefits (e.g., real estate investment) that had sprung from the intangible benefits (e.g., opportunity and hope) created by a new public landscape.
3.5 Pennswood Village Regional Stormwater Management System

**Location:** Newtown, PA  
**Landscape Architect:** Wells Appel Land Strategies  
**Project Type:** Nature Preserve; Stormwater management facility; wetland restoration  
**Former Land Use:** Institutional  
**Size:** 20 acres  
**Completion Date:** 2000

**Benefits:**  
Stormwater runoff reduction  
Habitat creation for bird species  
CO2 sequestration  
Increased ecological quality  
Educational opportunities  
Mental outlook improvement  
Maintenance costs savings

**Lesson:**  
Instruments used for quantification of benefits can sometimes be applicable to only a specific region, climate, or other condition. While the Plant Stewardship Index (PSI) was useful in showing increased ecological integrity, its use is presently geographically constrained. This could be a limiting factor in developing standards for measuring performance.
3.6 Seattle Children’s PlayGarden

Location: Seattle, WA  
Landscape Architect: Winterbottom Design, Inc.  
Project Type: Park/Open Space; Playground; Urban Agriculture  
Former Land Use: Park/Open Space  
Size: 1.2 acres  
Completion Date: 2010

Benefits:  
Stormwater runoff reduction  
Increase in number of disabled children receiving therapeutic care  
Dollar value of annual fruit and vegetable yields

Lesson:  
When measuring performance, it is important to consider the site’s intended purpose and intended users. The metrics for this case considered ecological, social, and economic indicators by measuring the volume of stormwater runoff reduced, the increase in enrollment figures for the number of disabled children being served, and the dollar value of the produce grown on site. However, the opportunity to measure how the children use the space was missed.
3.7 Synopsis

The purpose of this case study research is to provide examples of how to measure landscape performance in order to gain understanding of how to successfully quantify the effects of a variety of landscape functions of Kissimmee’s Lakefront Park. Within the Landscape Architecture Foundation’s Case Study Investigative program, each unique project enlists the involvement of separate research teams. As such, documented landscape benefits and methods used for quantification vary from team to team and project to project. By selecting cases from the LAF’s investigative series, relevant for analysis and discussion in this chapter, the aim of providing viable representations of how various components of landscape architecture projects have previously been measured and assessed for ecological, social, and economic performance has been achieved.

Both Carmel Clay Central Park and Lowland Park share certain dimensions: they both provide important ecosystem services (in particular, stormwater runoff retention and filtration); they are public landscapes; they serve as economic drivers for their respective communities; and, each reflects the desires of the citizens of the community for a space to gather and engage in passive and active recreation. Carmel’s challenges related to assessing social benefits, while Lowland’s main challenge involved measuring the site’s economic benefits.

For the landscape projects reviewed in this chapter, the economic processes that occurred as a result of the landscape improvements were most often produced through indirect effects that benefitted adjacent properties, neighborhoods, and/or the entire city. These economic activities included increases in real estate development, property values, and retail sales. In contrast to buildings that are capable of directly fueling economic activity, the economic performance of a landscape architecture project is frequently measured through its ripple effects or indirect values.

A common factor that influenced the breadth and depth of most of these cases was, in one way or another, time. In the case of Canal Park, the influence of time was a positive factor in the quality of the study. Conversely, Carmel Clay experienced time as a factor of constraint in the form of inability to apply social metrics to the level desired, and Klyde Warren faced obstacles due to the newness of the project and associated lack of existing data.
4 :: METHODOLOGY OVERVIEW

The purpose of this portion of the study is to determine the ecological, social, and economic benefits and associated performance criteria relevant to Kissimmee Lakefront Park. This chapter provides an overview of the methods utilized: First, the performance-based case study process that frames this research is presented. Second, tabled summaries of performance indicators and data collection strategies, applicable toward conducting a landscape performance case study, are provided. Performance indicators and methods best suited for the study of Kissimmee’s Lakefront Park are highlighted within the tables. Details regarding the research methods and analyses conducted toward assessing the Park’s ecological, social, and economic benefits are featured in the following 3 chapters.

4.1 Research Framework

The research agenda for this project was based upon the case studies framework used in the Landscape Architecture Foundation’s Case Studies Investigative Series, as well as the case study methods highlighted in the literature review. Toward establishing a systematic structure for the research that supported documentation of a diverse collection of findings, the investigation strategy was organized under the three dimensions of sustainability: ecological, economic, and social. Project-related primary and secondary data were collected, reviewed, analyzed, and synthesized; and, within each category of sustainability, performance benefits of the study site were identified and organized.

Figure 4.1 illustrates the Case Study Investigative Program framework and how it was utilized for identification of performance indicators and selection of appropriate methods toward quantifying and qualifying the varied benefits of the study site. The methodology applied in the case studies helped inform the selection of methods to be utilized in this study’s assessment of various ecological, social, and economic performance indicators (or functions) of Lakefront Park.
Figure 4.1: Application of Case Study Investigative Program framework to this study’s methodology approach
4.2 Benefits, Indicators, and Methods

Data Collection Methods
In line with the case study methodology highlighted in the literature review, this project used primary and secondary data toward quantifying the site’s ecological, social, and economic performance indicators. Quantitative and qualitative methods were utilized to document the designed landscape of the study site and assess the performance benefits (Deming et al., 2011). The methods applied in this research were derived from reviewing and assessing performance variables and criteria from the following sources: the Landscape Architecture Foundation’s Landscape Performance Series (LAF, 2013); case study methods formulated for designers and planners (Francis, 1999; Gehl, 1988; Marcus et al. 1998); methods for primary data collection (Dilman, 1978; Marcus et al. 1998; Whyte 1980); and, project-related secondary data collected from project firms, public resources and databases.

Data was collected through an online and on-site survey, site observations and measurements, informal questioning of key informants, project construction drawings provided by the City, and systematic review of online documents and archival records. The gathered data was then organized, assessed for relevancy and accuracy, and utilized for documenting the case study and assessing the landscape performance of the study site.

As is the nature of case studies, the limited availability of baseline data necessitated a somewhat heavy reliance upon secondary data. The researcher feels confident in making the assumption that the data collected and synthesized in this study could serve as baseline data, contributing to the development of benchmarks for subsequent performance studies.

The information regarding potential ecological, social, and economic benefits, indicators, and research methods is furnished in tables 4.1, 4.2, and 4.3 respectively. As aforementioned, the benefits identified for the study site and associated indicators and methods applied toward evaluating site performance, are highlighted within the tables. In addition, constraining factors which prohibited the ability to perform various evaluations are described in the constraints column.
<table>
<thead>
<tr>
<th>Ecological benefit</th>
<th>Ecological indicator</th>
<th>Method of evaluation</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequesters carbon by way of the newly planted trees</td>
<td>Sequestered carbon</td>
<td>- National tree benefit calculator</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Compare with benchmark provided by EPA</td>
<td></td>
</tr>
<tr>
<td>Intercepts stormwater</td>
<td>Intercepted stormwater by tree canopy</td>
<td>- National tree benefit calculator</td>
<td></td>
</tr>
<tr>
<td>Conserves potable water <em>(also quantified as economic benefit)</em></td>
<td>Water conservation</td>
<td>Calculate based upon use of effluent water for irrigation vs. water usage from utility bill records</td>
<td></td>
</tr>
<tr>
<td>Increase in Biomass</td>
<td>Increased Biomass Density Index (BMI)</td>
<td>- BMI calculations (measured density of plant layers covering ground) and Guidelines by Sustainable Sites Initiative</td>
<td>- Time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Man-power</td>
</tr>
<tr>
<td>Increases ecological quality of the site</td>
<td>Increased ecological quality</td>
<td>- Calculate by using coefficient of conservatism values and Plant Stewardship Index (PSI)</td>
<td></td>
</tr>
<tr>
<td>Creates habitat</td>
<td>Created habitat for resident and migratory bird species, including threatened and endangered species</td>
<td>- Bird species inventory of pre and post-conditions</td>
<td></td>
</tr>
<tr>
<td>Increases biodiversity (plant species)</td>
<td>Increased number of native plant species</td>
<td>- Construction documents and key informants for calculating pre and post-conditions</td>
<td>- Time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Baseline data</td>
</tr>
<tr>
<td>Removes pollutants from stormwater runoff</td>
<td>Improved water quality</td>
<td>Analysis of secondary data (Published study)</td>
<td></td>
</tr>
<tr>
<td>Decreased amount of materials entering landfill</td>
<td>Salvaged and reused materials</td>
<td>- Construction sheet drawings and AutoCAD to calculate amount of material reused</td>
<td>- No material reuse</td>
</tr>
</tbody>
</table>

Table 4.1: Ecological benefits, indicators, and methods suited for landscape performance evaluation
<table>
<thead>
<tr>
<th>Social Benefit</th>
<th>Social Indicator</th>
<th>Method of Evaluation</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supports place-making</td>
<td>Increased sense of place</td>
<td>-Park Visitor Survey</td>
<td></td>
</tr>
<tr>
<td>Supports social connection</td>
<td>Realized opportunities for social engagement</td>
<td>-Park Visitor Survey -City records event #s -Mapping drone TL imagery</td>
<td></td>
</tr>
<tr>
<td>Provides educational value</td>
<td>Increased environmental awareness</td>
<td>-Park Visitor Survey</td>
<td></td>
</tr>
<tr>
<td>Increases eco-friendly behaviors</td>
<td>Increased behaviors that promote environmental sustainability</td>
<td>-Park Visitor Survey</td>
<td></td>
</tr>
<tr>
<td>Provides sense of personal comfort, safety and security</td>
<td>Promoted personal feelings of being welcome and safe</td>
<td>-Park Visitor Survey</td>
<td></td>
</tr>
<tr>
<td>Provides recreational value</td>
<td>Increased attendance of major public events and Realized opportunities for recreational activities</td>
<td>-City records: event #s and facility rentals -Park Visitor Survey -Mapping drone TL imagery</td>
<td></td>
</tr>
<tr>
<td>Supports human health</td>
<td>Realized opportunities for exercise, stress reduction, nature exposure</td>
<td>-Park Visitor Survey</td>
<td></td>
</tr>
<tr>
<td>Provides accessibility to amenities</td>
<td>Increased access</td>
<td>-Construction documents -Park Visitor Survey</td>
<td></td>
</tr>
<tr>
<td>Enhances walkability</td>
<td>Walkability</td>
<td>-Walkability Index to quantify street and intersection factors</td>
<td>-Time -Context</td>
</tr>
</tbody>
</table>

Table 4.2: Social benefits, indicators, and methods suited for landscape performance evaluation

Applied in this study
<table>
<thead>
<tr>
<th>Economic Benefit</th>
<th>Economic Indicator</th>
<th>Method of evaluation</th>
<th>Constraint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generates revenue for the City</td>
<td>Increased revenue for City and Dept. of Parks and Rec</td>
<td>-City Parks &amp; Rec: site facility rental records</td>
<td></td>
</tr>
<tr>
<td>Increases property values</td>
<td>Increased surrounding property values</td>
<td>-County appraiser: property tax records</td>
<td>-Newness of project</td>
</tr>
<tr>
<td>Creates jobs</td>
<td>Jobs created through project</td>
<td>-Employment data from project-related firms</td>
<td>-Data access -Jobs not local</td>
</tr>
<tr>
<td>Supports local businesses</td>
<td>Provided downtown merchants with patrons</td>
<td>-Park Visitor Survey</td>
<td></td>
</tr>
<tr>
<td>Increases sales tax revenue</td>
<td>Increased annual sales tax revenue</td>
<td>- CID, CRA: sales tax records</td>
<td>-Data access</td>
</tr>
<tr>
<td>Spurs economic development</td>
<td>Activated other projects within close proximity of project boundaries</td>
<td>-Archival research, online databases -Questioning of key informants</td>
<td></td>
</tr>
<tr>
<td>Increases growth in number of new business establishments</td>
<td>Increased the number of new businesses in the downtown region</td>
<td>- County tax collector: business tax receipt records</td>
<td></td>
</tr>
<tr>
<td>Reduces maintenance costs</td>
<td>Reduction in irrigation costs associated with maintaining site</td>
<td>-City Public Works: utility billing records -Questioning of key informants</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3: Economic benefits, indicators, and methods suited for landscape performance evaluation

Applied in this study
4.3 Disclaimer

Site specific performance indicators are continually being discovered, tested, and refined for greater reliability and validity. The list of potential landscape performance benefits and associated indicators and methods provided herein is by no means exhaustive.

Limitations specific to each method of analysis are provided in the subsequent three chapters.

4.4 Synopsis

The task of identifying, assessing, and organizing indicators and methods gleaned from the literature led to a greater understanding of the constraints, challenges and rewards associated with the performance-based research process. Selection of indicators and methods, most appropriate for this study, was dictated by the unique combination of the site’s features and functions, as well as factors of constraint such as time, skill, and access to baseline data and other information. Aside from conveying what could and could not be measured in this study, the tabled summary of indicators and strategies is meant to serve as a reference tool for other performance research projects.

In regard to the social benefits and indicators, every attempt was made to classify each variable according to the social benefit it was most closely associated with. This proved to be more challenging than anticipated. For instance, while boating and fishing offer recreational value, these activities might also be associated with (1) the benefit of health and well-being through exposure to nature and (2) the benefit of social connection. Along the same lines, while the opportunity for a pleasurable walk provides health benefits, it may also serve as an indicator of social connection and accessibility.

It became apparent that the classification of variables offering multiple benefits needed to be informed by findings in the literature, as well as by responses to some of the other survey questions. For example, one of the main ways in which the surveyed population indicated they met new acquaintances while at the Park was through their children. Since this is suggestive of the value of the playground environment as a place to build social connection (for
children as well as adults), playground use was categorized under the social connection benefit, rather than under recreation or health and well-being through increased physical activity.

It is also worth noting that the social benefits afforded by the site could also be classified under several different umbrellas. Beyond physical activity and mental restoration, safety and site accessibility, building of social connections and community cohesion, ecological awareness and associated behaviors can all be regarded as indicators for human health and well-being—as well as indicators for the sense of place tied to a site. Taken together, these considerations highlight the capacity for designed landscapes to provide layers of multifunctional benefits, as well as some of the challenges in measuring these values.

This chapter has provided an overview of the methodology framework adopted for this study. Additionally, a diverse collection of potential landscape performance benefits, performance indicators, and strategies for data collection and analysis were organized and summarized within the three arms of sustainability. Through speaking with key informants and conducting online and archival research, understanding of the unique features of Lakeshore Park grew. This understanding enabled identification of performance benefits relevant to the functions of the site. Synthesizing and tabling the potential benefits, indicators, and methods for evaluation led to the identification of performance criteria most applicable toward measuring the specific benefits of the study site. As each landscape project is unique in its combination of features, functions, and internal and external forces, the researcher hopes that the information provided on potential metrics and strategies will be of use to others interested in performance-based research of the built environment.

The following chapters present detailed accounts of utilized methods, research results, and relevant limitations associated with each of the performance criteria. Chapter 5, featuring ecological performance, and chapter 7, economic performance, replicates the format framed in tables 4.1 and 4.3. Chapter 6 follows a more fluid format, as the indicators of social performance benefits hold less tangible qualities that are often intertwined. Supplemental anecdotal evidence attesting to the Park’s value, as written by the unique perspectives of a long-time resident of Kissimmee, one of the landscape architects involved in the initial phases of the project, and a Florida Fish and Wildlife Conservation Commission biologist is provided in Appendix D.
This chapter details the methods and results for each of the selected performance criteria associated with the site’s ecological functions. For each criterion, or indicator, the data sources and procedures involved in measurement and analysis are first discussed. This is followed by details depicting the results for each analysis. Lastly, relevant limitations or caveats tied to the results are provided.

5.1: Ecological Performance Benefit 1: Carbon Sequestration

Methodology
Indicator: Total CO2 sequestered by the planted trees
Metric: Equivalency of amount of CO2 sequestered by the planted trees to the number of passenger vehicles that would be removed from the road per year
Data Source: Landscape plan documents and onsite measurements; i-tree National tree benefits calculator

Carbon sequestration is the estimated amount of carbon that a tree’s stem and branches take up during one year of tree growth. Estimating the amount of carbon removed by trees helps determine the role of the trees on this site in mitigating climate change and offsetting local carbon dioxide emissions.

The U.S. Forest Service developed the i-Tree software suite, based upon 20 years of urban forest science. The software was created with landscape architects (and others) in mind who might be interested in analyzing the benefits and costs of trees in urban areas. A program within i-Tree, the National Tree Benefits Calculator, provides the means to calculate the estimated value of trees. Greg McPherson, director of the Center for Urban Forest Research in Davis, California and the developer of the software makes a strong case for the logic behind its methodology:
The approach was to first divide the US into 16 climate zones (based upon length of growing season, minimum temperature, building energy use patterns); then, select a representative city within each zone to study intensively. The representative cities had to have updated tree inventories (20,000-100,000 trees); accurate information on planting dates for aging a sample of approx. 900 trees; and large old trees present in the community. In each reference city, 30 to 60 trees from each of the 22 major tree species were ages and measured. Then linear regression was used to fit predictive models with diameter at breast height (DBH) as a function of age for each species. Predictions of leaf surface area, crown diameter, and height metrics were modeled as a function of DBH using best-fit models. Geographic data were collected for use in i-Tree’s numerical models. That data included temperature, precipitation, air pollutant concentrations, and fuel mix for energy production. (McPherson, p. 231)

Toward calculating CO2 sequestration, tree diameter measurements are required. The method of measurement for determining tree-trunk diameter, as prescribed by the U.S. Forest Service, is as follows: Tree-trunk diameters are measured at breast height (referred to as diameter at breast height or DBH), defined as the diameter of the tree 4-1/2 feet above ground on the uphill side of the tree. If a tree forks below breast height, each trunk is treated as a separate tree. DBH can be measured with a tree caliper, a Biltmore stick, a tree diameter tape, or a flexible measuring tape (e.g., cloth or steel). The flexible measuring tape can be used to measure tree trunk circumference, and circumference is divided by 3.14 inches to determine diameter (Heiligmann & Bratkovich 2002). For purposes of this study, a flexible cloth measuring tape was utilized, trees were cross-referenced from the landscape plan to site locations, and tree trunk circumferences were recorded. Diameter was calculated by dividing the recorded circumference by 3.14:

\[ d = \frac{C}{\pi} \]

The species and quantities of trees planted on the site were extracted from the landscape plan construction documents, confirmed through a site visit, and entered into an MS Excel spreadsheet. The benefits from each tree were calculated with the use of the i-Tree Calculator (http://www.treebenefits.com/calculator/). The calculator requires a zip code tree location, diameter at breast height, and common name species. The calculator determines annual carbon sequestered based on these factors. The site location (zip code of 34741) and land-use type (‘park’) were inputted. Each tree was selected from the dropdown list of options, and tree sizes (diameter calculated at approximately 4.5” from the ground) were entered. The model uses only common names, so species were matched
as best as possible with those common names. Annual carbon sequestration was determined for each tree species, multiplied by the quantity of trees for each species, and then summed to get the total annual carbon sequestration for the site. As an example: A single *Quercus virginiana* of 6.5” sequesters 150 pounds of carbon per year. If there were 10 *Quercus virginiana* in the planting plan of Kissimmee Lakefront Park, the total amount of carbon sequestered by 10 *Quercus virginiana* with a diameter-at-breast-height measurement of 6.5” would be:

\[
150 \text{ lbs.} \times 10 = 1500 \text{ lbs.}
\]

**Results**

The amount of carbon sequestered was calculated with the use of i-Tree’s Tree Benefit Calculator. Results are shown in table 5.1. A * and (#) denotes the trees specified in the planting schedule as having varied heights. These trees are ordered by ascending height.

A single *Quercus virginiana* of 6.5” sequesters 150 pounds of carbon per year. There are 35 Quercus virginiana in the planting plan of Kissimmee Lakefront Park. Thus, the total amount of carbon sequestered per year by 35 *Quercus virginiana* with a diameter-at-breast-height measurement of 6.5” is:

\[
150 \text{ lbs.} \times 35 = 5250 \text{ lbs./year}
\]

The total number of newly planted trees is 1003. Findings indicate the total amount of CO2 sequestered annually by the newly planted trees is 123,203 pounds.

One metric ton comprises 2204 lbs. Thus, the total CO2 sequestered with the help of all the newly planted trees would be:

\[
123,203/2204 \approx 55.90 \text{ metric tons}
\]
### Table 5.1: Estimated carbon sequestration by newly planted trees in one year’s time

<table>
<thead>
<tr>
<th>BOTANICAL NAME</th>
<th>COMMON NAME</th>
<th>AVERAGE CIRCUMFERENCE (inches)</th>
<th>AVERAGE DBH (inches) (d=c/π)</th>
<th>Average CO2 SEQUESTERED by ONE TREE (pounds)</th>
<th>QUANTITY OF TREES</th>
<th>TOTAL CO2 SEQUESTERED (pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gordonia lasianthus</td>
<td>loblolly bay</td>
<td>12</td>
<td>4</td>
<td>20</td>
<td>39</td>
<td>780</td>
</tr>
<tr>
<td>Lagerstroemia indica 'Natchez'</td>
<td>white crape myrtle</td>
<td>40</td>
<td>12.5</td>
<td>120</td>
<td>22</td>
<td>2640</td>
</tr>
<tr>
<td>Liquidambar styraciflua</td>
<td>sweet gum</td>
<td>9.5</td>
<td>3</td>
<td>15</td>
<td>57</td>
<td>855</td>
</tr>
<tr>
<td>Prunus angustifolia</td>
<td>chickasaw plum</td>
<td>12</td>
<td>4</td>
<td>23</td>
<td>6</td>
<td>138</td>
</tr>
<tr>
<td>Pinus elliottii</td>
<td>slash pine</td>
<td>15.5</td>
<td>5</td>
<td>33</td>
<td>44</td>
<td>1452</td>
</tr>
<tr>
<td>Quercus nuttallii</td>
<td>nuttallii oak</td>
<td>17</td>
<td>5.5</td>
<td>90</td>
<td>13</td>
<td>1170</td>
</tr>
<tr>
<td>Quercus virginiana</td>
<td>live oak (1)*</td>
<td>17</td>
<td>5.5</td>
<td>115</td>
<td>114</td>
<td>13110</td>
</tr>
<tr>
<td>Quercus virginiana</td>
<td>live oak (2)</td>
<td>21</td>
<td>6.5</td>
<td>150</td>
<td>35</td>
<td>5250</td>
</tr>
<tr>
<td>Quercus virginiana</td>
<td>live oak (3)</td>
<td>68</td>
<td>21.5</td>
<td>900</td>
<td>3</td>
<td>2700</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (1)</td>
<td>28</td>
<td>9</td>
<td>6</td>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (2)</td>
<td>31</td>
<td>10</td>
<td>5</td>
<td>12</td>
<td>60</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (3)</td>
<td>33</td>
<td>10.5</td>
<td>5</td>
<td>31</td>
<td>155</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (4)</td>
<td>37</td>
<td>12</td>
<td>5</td>
<td>55</td>
<td>275</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (5)</td>
<td>39</td>
<td>12.5</td>
<td>5</td>
<td>64</td>
<td>320</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (6)</td>
<td>41</td>
<td>13</td>
<td>5</td>
<td>87</td>
<td>435</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (7)</td>
<td>44</td>
<td>14</td>
<td>4.5</td>
<td>107</td>
<td>481.5</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (8)</td>
<td>46</td>
<td>14.5</td>
<td>4.5</td>
<td>31</td>
<td>139.5</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (9)</td>
<td>52</td>
<td>16.5</td>
<td>4.5</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>Taxodium distichum</td>
<td>bald cypress</td>
<td>41</td>
<td>13</td>
<td>360</td>
<td>222</td>
<td>79920</td>
</tr>
<tr>
<td>Tabebuia impetignosa</td>
<td>purple trumpet</td>
<td>14</td>
<td>4.5</td>
<td>23</td>
<td>28</td>
<td>644</td>
</tr>
<tr>
<td>Ulmus parvifolia 'Allee'</td>
<td>allee elm (1)</td>
<td>56.5</td>
<td>18</td>
<td>600</td>
<td>13</td>
<td>7800</td>
</tr>
<tr>
<td>Ulmus parvifolia 'Allee'</td>
<td>allee elm (2)</td>
<td>70</td>
<td>22</td>
<td>800</td>
<td>6</td>
<td>4800</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>1003</strong></td>
<td><strong>123203</strong></td>
</tr>
</tbody>
</table>
As shown in the table, one Live Oak with a DBH of 5.5 inches is capable of sequestering 15 times more pounds of carbon over the course of the year, than one Sabal Palm with a DBH of 10 inches. This finding reflects the fact that the rate of carbon sequestration depends on the growth characteristics of the tree species and the density of the tree’s wood. Hence, from the perspective of carbon sequestration, planting oak trees rather than palm trees will most likely yield greater benefits. Similarly, the White Crape Myrtle and Bald Cypress have nearly the same DBH dimensions at 12.5 and 13 respectively. Yet, the Bald Cypress was found to sequester 3 times as many pounds of carbon as the Crape Myrtle. It is also important to note that sequestration is greatest in the younger stages of tree growth, which typically encompasses the first 50 years.

The numbers for the miles traveled in a year (11,287) and average (21.4 mpg) of the passenger vehicle is set as benchmark for comparison of CO2 emitted, from Federal Highway Administration (FHWA) 2015 data. This information is highlighted in table 5.2, provided on the following page.

With the help of the American Forests’ Carbon Calculator (http://www.americanforests.org/discover-forests/carbon-calculator/), a gas fueled passenger vehicle traveling 11,287 miles in one year at 21.4 mpg average, emits 9324.4 lbs. CO2, which is equivalent to 4.23 metric tons. (1 ton = 2204 lbs.)

\[
\frac{9324.4}{2204} \approx 4.23 \text{ metric tons}
\]

The total CO2 sequestered with the help of all the newly planted trees was found to be 55.90 tons. The total CO2 sequestered by the planted trees is equivalent to the amount of CO2 emitted from approximately 13 passenger vehicles in a year, or from driving 146,731 miles in a single passenger vehicle.

\[
\frac{55.90}{4.23} \approx 13 \text{ passenger vehicles (13.22)}
\]
\[
11,287 \text{ miles} \times 13 = 146,731 \text{ miles}
\]
### Table 5.2: Annual vehicle distances traveled and average fuel consumption

#### Annual Vehicle Distance Traveled in Miles and Related Data - 2014
By Highway Category and Vehicle Type December 2015

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MOTORVEHICLE TRAVEL (millions of vehicle-miles)</th>
<th>LIGHT DUTY VEHICLES</th>
<th>MOTORCYCLES</th>
<th>SUBTOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of motor vehicles registered</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>187,554,928</td>
<td>8,417,718</td>
<td>240,155,238</td>
<td>260,350,938</td>
</tr>
<tr>
<td>2013</td>
<td>184,497,490</td>
<td>8,404,687</td>
<td>236,010,230</td>
<td>255,876,822</td>
</tr>
<tr>
<td>2014</td>
<td>Average miles traveled per vehicle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11,048</td>
<td>2,372</td>
<td>11,287</td>
<td>11,621</td>
</tr>
<tr>
<td>2013</td>
<td>11,244</td>
<td>2,423</td>
<td>11,346</td>
<td>11,679</td>
</tr>
<tr>
<td>2014</td>
<td>Average fuel consumption per vehicle (gallons)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>476</td>
<td>54</td>
<td>527</td>
<td>666</td>
</tr>
<tr>
<td>2013</td>
<td>480</td>
<td>56</td>
<td>524</td>
<td>663</td>
</tr>
<tr>
<td>2014</td>
<td>Average miles traveled per gallon of fuel consumed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>23.2</td>
<td>43.5</td>
<td>21.4</td>
<td>17.5</td>
</tr>
<tr>
<td>2013</td>
<td>23.4</td>
<td>43.5</td>
<td>21.6</td>
<td>17.6</td>
</tr>
</tbody>
</table>

Source: Federal Highway Administration (2015)
Limitations

:: While the i-tree software is convenient and simple to use, the information generated is an estimation of tree benefits. As such, the software is not recommended for a scientific accounting of precise values.

:: As the project was completed in November 2014, the trees are not fully matured. The dynamics of carbon capture and storage by trees changes through time as trees grow, die, and decay.

:: The data highlighted in the table for the passenger vehicle to set as a benchmark is the US national average of the year 2014. (Data was retrieved in 2016 from FHWA website)

5.2: Ecological Performance Benefit 2: Stormwater Interception

Methodology

Indicator: Total stormwater runoff intercepted by tree canopy

Metric: Equivalency in number of gallons of stormwater runoff intercepted through tree canopies to number of American residents’ daily water usage

Data Source: Landscape plan documents and onsite measurements; i-tree National tree benefits calculator

The brief retention of rainwater by the tree canopy is referred to as rainfall interception. To quantify the stormwater benefits of trees, the species and quantities of trees planted on the site were extracted from the construction documents, confirmed through a site visit, and entered into MS Excel. The National i-Tree Benefits Calculator was used to calculate the benefits from each tree (www.treebenefits.com/calculator/). The calculator requires a zip code, tree location, diameter at breast height measurement, and a common name species. The calculator then determines annual stormwater intercepted based on these factors. The zip code for Kissimmee Lakefront Park is 34741. The model uses only common names, so species were matched as closely as possible. Annual stormwater interception
was determined for each tree species, multiplied by the quantity of each tree species, and then summed to get the total annual stormwater interception for the site.

\[
\text{Total Interception} = \text{Sum (Interception by Species x # of Trees in Species)}
\]

**Results**

Located on the following page, table 5.3 shows that the potential for stormwater runoff interception by the 1003 trees amounts to 1,653,081 gallons of water. Rainfall interception studies indicate that interception rates primarily depend upon the type and amount of tree leaves (Escobedo 2014). As an example, *Gordonia lasianthus*, commonly known as Loblolly Bay, is an evergreen tree. Findings indicate that a single *Gordonia lasianthus* of 4 inches DBH intercepts an estimated 959 gallons of stormwater runoff. The planting plan of Lakefront Park has 39 *Gordonia lasianthus*; hence, the total amount of stormwater intercepted by 39 *Gordonia lasianthus* would be:

\[959 \text{ gallons} \times 39 = 37,401 \text{ gallons}\]

On the other hand, the deciduous tree *Prunus angustifolia*, or Chickasaw Plum, with the same DBH of 4 inches as the Loblolly Bay, intercepts approximately 145 gallons of stormwater. To a large extent, the marked difference in the amount of interception is caused by the Chickasaw Plum’s loss of leaves in winter, resulting in less stormwater interception.

According to the EPA’s Water Trivia Facts, an American resident uses 100 gallons of water in a day’s time (http://www3.epa.gov/safewater/drinkingwater/water_trivia_facts_2016.html).

\[1,653,081 \text{ gallons} / 100 \text{ gallons} \sim 16,530 \text{ American residents}\]

In other words, the amount of stormwater intercepted by the trees planted in Lakefront Park equates to the amount of water used by approximately 16,530 Americans in one day.
Table 5.3: Trees’ potential for stormwater interception

<table>
<thead>
<tr>
<th>BOTANICAL NAME</th>
<th>COMMON NAME</th>
<th>AVERAGE CIRCUMFERENCE (inches)</th>
<th>AVERAGE DBH (d=c/pi)</th>
<th>STORMWATER INTERCEPTED by ONE TREE (gallons)</th>
<th>QUANTITY OF TREES</th>
<th>TOTAL STORMWATER INTERCEPTED (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gordonia lasianthus</td>
<td>loblolly bay</td>
<td>12</td>
<td>4</td>
<td>959</td>
<td>39</td>
<td>37401</td>
</tr>
<tr>
<td>Lagerstroemia indica</td>
<td>white crape myrtle</td>
<td>40</td>
<td>12.5</td>
<td>913</td>
<td>22</td>
<td>20,086</td>
</tr>
<tr>
<td>Liquidambar styraciflua</td>
<td>sweet gum</td>
<td>9.5</td>
<td>3</td>
<td>134</td>
<td>57</td>
<td>7638</td>
</tr>
<tr>
<td>Prunus angustifolia</td>
<td>chickasaw plum</td>
<td>12</td>
<td>4</td>
<td>145</td>
<td>6</td>
<td>870</td>
</tr>
<tr>
<td>Pinus elliottii</td>
<td>slash pine</td>
<td>15.5</td>
<td>5</td>
<td>247</td>
<td>44</td>
<td>10868</td>
</tr>
<tr>
<td>Quercus nuttallii</td>
<td>nuttallii oak</td>
<td>17</td>
<td>5.5</td>
<td>1057</td>
<td>13</td>
<td>13741</td>
</tr>
<tr>
<td>Quercus virginiana</td>
<td>live oak (1)</td>
<td>17</td>
<td>5.5</td>
<td>1289</td>
<td>114</td>
<td>146946</td>
</tr>
<tr>
<td>Quercus virginiana</td>
<td>live oak (2)</td>
<td>21</td>
<td>6.5</td>
<td>1656</td>
<td>35</td>
<td>57960</td>
</tr>
<tr>
<td>Quercus virginiana</td>
<td>live oak (3)</td>
<td>68</td>
<td>21.5</td>
<td>11803</td>
<td>3</td>
<td>35409</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (1)*</td>
<td>28</td>
<td>9</td>
<td>558</td>
<td>10</td>
<td>5580</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (2)</td>
<td>31</td>
<td>10</td>
<td>624</td>
<td>12</td>
<td>7488</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (3)</td>
<td>33</td>
<td>10.5</td>
<td>657</td>
<td>31</td>
<td>20367</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (4)</td>
<td>37</td>
<td>12</td>
<td>756</td>
<td>55</td>
<td>41580</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (5)</td>
<td>39</td>
<td>12.5</td>
<td>789</td>
<td>64</td>
<td>50496</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (6)</td>
<td>41</td>
<td>13</td>
<td>822</td>
<td>87</td>
<td>71514</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (7)</td>
<td>44</td>
<td>14</td>
<td>888</td>
<td>107</td>
<td>95016</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (8)</td>
<td>46</td>
<td>14.5</td>
<td>920</td>
<td>31</td>
<td>28520</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palm (9)</td>
<td>52</td>
<td>16.5</td>
<td>953</td>
<td>4</td>
<td>3812</td>
</tr>
<tr>
<td>Taxodium distichum</td>
<td>bald cypress</td>
<td>41</td>
<td>13</td>
<td>3769</td>
<td>222</td>
<td>836718</td>
</tr>
<tr>
<td>Tabebuia impetignosa</td>
<td>purple trumpet</td>
<td>14</td>
<td>4.5</td>
<td>1143</td>
<td>28</td>
<td>32004</td>
</tr>
<tr>
<td>Ulmus parvifolia 'Allee'</td>
<td>allee elm (1)</td>
<td>56.5</td>
<td>18</td>
<td>6133</td>
<td>13</td>
<td>79729</td>
</tr>
<tr>
<td>Ulmus parvifolia 'Allee'</td>
<td>allee elm (2)</td>
<td>70</td>
<td>22</td>
<td>8223</td>
<td>6</td>
<td>49338</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>1003</td>
<td></td>
<td><strong>1,653,081</strong></td>
</tr>
</tbody>
</table>
Limitations
:: Some tree species were not available on i-Tree and had to be substituted with the most similar species available. Depending on the substitution, the stormwater interception may be slightly under or over-estimated.

:: Limited knowledge about physical processes at work and their interactions makes estimates imprecise (e.g., fate of air pollutants trapped by trees and then washed to the ground by rainfall).

:: Degree of performance also varies, depending on differences in climate, time of year (rainfall in winter when deciduous trees lose their leaves results in less interception), soil types, the types of plants growing under the tree canopy, pollutant concentrations, maintenance practices, and other factors.

5.3: Ecological Performance Benefit 3: Conserves Potable Water

Methodology
Indicator: Water conservation
Metric: Gallons of water saved by using greywater in place of municipal water as irrigation source
Data Source: Water bill records from Kissimmee Water Authority (KWA)

According to the City of Kissimmee Parks and Recreation Department, the total quantity of potable water used to irrigate the Park during 2015 was 8737 gallons. During the Park’s renovation, the site was plumbed for effluent irrigation; and, the City is awaiting connection between the Park and the greywater treatment facility. Upon successful tie-in, the conversion to the use of greywater for the Park’s irrigation needs will conserve roughly 8737 gallons of drinking water.
Limitations
:: The findings reflect estimates based upon the water usage amount for 2015. As usage will vary from year to year according to weather conditions and other factors, the amount of potable water conserved will also vary.

5.4: Ecological Performance Benefit 4: Increases Ecological Quality

Methodology
Indicator: Increased ecological quality of plant communities
Metric: Degree of ecological quality of rain gardens as compared to ecological quality of standard stormwater detention/retention basin
Data Source: Landscape plan documents, Plant Stewardship Index (PSI), Coefficients of Conservatism (CC)

The composition of vegetation on a site can serve as an indicator of ecological quality or integrity. Traditional methods to assess plant community quality have relied on descriptive wording such as degraded, marginal, good, high, low, etc. But, these descriptors are vague and subjective. A numerical index describing floristic quality based on species conservatism or ‘nativeness’ ratings of individual species, was first developed by Wilhelm (1977). Species conservatism is expressed as a coefficient of conservatism (C) value, and is the metric in the floristic quality index (FQI). The FQI was designed as an objective standard to judge plant community quality in a repeatable manner.

Expanding upon this, Bowman’s Hill Wildflower Preserve developed the Plant Stewardship Index (PSI) for the Piedmont region of New Jersey and Pennsylvania. The PSI has been adapted and modified for many regions, including Florida. Leslie Sauer, founder of landscape architecture firm Andropogon and Associates, has stated that the PSI is the first sampling methodology that enables monitoring of a site’s natural state (as cited in Wilson, 2005,
Environmental Building News). Once the PSI has been extended throughout the U.S., programs such as SITES will be able to address ecosystem health by providing credit for sites that achieve a certain threshold of floristic quality.

The PSI was utilized in this study, in order to first, develop a baseline for the floristic quality of the rain gardens that are part of the site’s stormwater treatment train; and, second, compare the findings to the ecological quality of a standard detention/retention basin. The PSI is calculated based on averaging numbers assigned to each plant by a group of leading botanists and ecologists in the state. These numbers are referred to as "CC" or coefficients of conservatism. The CC is a numerical representation of a plant’s likelihood to occur in a particular habitat. Plants have a geographic range based on their level of tolerance to physiological conditions such as soil pH, light levels, and moisture. These conditions collectively define the plant’s niche.

According to the botanists that developed the PSI, CC values range from 0 to 10: Zero being those "generalist" plants that can be found in any area (including parking lots, plowed fields and other disrupted sites), because they have a wide ecological tolerance to human disturbance. Ten being "specialist" plants that are unable to tolerate any disturbance or loss of natural quality; and, as such, can be found in very specific habitats. Many of our threatened and endangered plants have been assigned a 10 because they are so specialized and their required habitats are disappearing. The average of all these numbers is called the Mean C. The calculation also accounts for the total diversity of plants on a site (www.bhwp.org.psi).

Figure 5.1, presented on the following page, provides a description of the CC values range, as well as the steps for calculating the PSI of a site. A PSI Online Calculator is conveniently available on the Bowman’s Hill Wildflower Preserve website. However, the PSI-related metrics generated by the calculator only pertain to the eco-regions of New Jersey and Pennsylvania; and, as such, was not utilized for data collection.

The researcher conducted the following prescribed steps for calculating the PSI of the rain garden: CC values were assigned to each plant in the study area; CC values were summed and then divided by the total number of plant species (native and non-native), in order to obtain the Total Mean C. Lastly, the Total Mean C was multiplied by the square root of the total number of native plants, to obtain the PSI. “Native” is defined as native to the state of
Florida. It is important to note that non-native species always have a CC of zero, as they are assumed to have no positive effect on ecological quality.

<table>
<thead>
<tr>
<th>Plant Stewardship Index ~ PSI</th>
<th>Assignment of Index Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 to 10</td>
<td>Plants with high degree of fidelity to a narrow range of habitats.</td>
</tr>
<tr>
<td>7 to 8</td>
<td>Plants with a poor range of ecological tolerances. Found in well established ecosystems that sustain only minor disturbance.</td>
</tr>
<tr>
<td>4 to 6</td>
<td>Plants with an intermediate range of ecological tolerances. Found in a specific plant community but tolerant of moderate disturbance.</td>
</tr>
<tr>
<td>1 to 3</td>
<td>Plants with high range of ecological tolerances. Found in a variety of plant communities, including disturbed ecosystems.</td>
</tr>
<tr>
<td>0</td>
<td>Includes non-native and invasive plants that adapt to severe disturbances.</td>
</tr>
</tbody>
</table>

**Method for evaluating the stewardship of a site using the PSI**

1. Compile an inventory of plant species within the assessment area
2. Record the Coefficient of Conservatism (CC) value assigned to each plant
3. Calculate the Total Mean C by adding the CC values and dividing by the number of plant species found, including both native and non-native plant species
4. Multiply the Total Mean C by the square root of the total number of native plants, to get the PSI

\[
\text{PSI} = \text{Total Mean } C \times \text{Sq.rt.} N
\]

Figure 5.1: CC values and PSI formula (modified from bhwp.org: floristic assessment and analysis)
The aerial view of Lakefront Park, figure 5.2 shows the location of the rain gardens, hatched in brown.

Figure 5.2: Lakefront Park rain garden locations (shown by brown hatch-patterned areas)
(source: Kissimmee Parks and Recreation department)
Results
The benefit of using a rain garden planted with native species, versus a detention basin planted with non-native species, was calculated by using the PSI. Table 5.4 contains the rain garden plant species and their CC values.

Table 5.4: CC values for Lakefront Park’s rain garden plant community

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>CC</th>
<th>CC Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Callicarpa americana</td>
<td>American beautyberry</td>
<td>2.4</td>
<td>2</td>
</tr>
<tr>
<td>Canna flaccida</td>
<td>yellow canna</td>
<td>5.7</td>
<td>2</td>
</tr>
<tr>
<td>Gordonia lasianthus</td>
<td>loblolly bay</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Hamelia patens</td>
<td>firebush</td>
<td>*nr</td>
<td>1,2,3</td>
</tr>
<tr>
<td>Liatris spicata</td>
<td>blazing star</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Muhlenbergia capilaris</td>
<td>muhly grass</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Pinus elliottii</td>
<td>slash pine</td>
<td>3.4</td>
<td>1</td>
</tr>
<tr>
<td>Quercus virginiana</td>
<td>live oak</td>
<td>3.7</td>
<td>1</td>
</tr>
<tr>
<td>Sabal palmetto</td>
<td>sabal palmetto</td>
<td>4.5</td>
<td>2</td>
</tr>
<tr>
<td>Serenoa repens</td>
<td>saw palmetto</td>
<td>5.5</td>
<td>1</td>
</tr>
<tr>
<td>Spartina bakeri</td>
<td>cordgrass</td>
<td>4.5</td>
<td>1</td>
</tr>
<tr>
<td>Taxodium distichum</td>
<td>bald cypress</td>
<td>5.5</td>
<td>1</td>
</tr>
<tr>
<td>Tripsacum floridanum</td>
<td>Florida gamma grass</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Zamia pumila</td>
<td>coontie</td>
<td>*nr</td>
<td>1,2,3</td>
</tr>
<tr>
<td>TOTAL</td>
<td>14 - 2 (nr) = 12</td>
<td>61.2</td>
<td></td>
</tr>
</tbody>
</table>

* nr: no rank
1: Cohen et al., 2004
2: Reiss and Brown, 2005
3: Gianopulus, 2014

The 14 plant species are all native to the state of Florida; hence, there are no CC values of 0.

It is important to note that Florida gamma grass is classified as a threatened plant species in the state of Florida (DACS 2012).

The assignment of plant species CC values, performed by Florida botanists, is typically conducted for a specific eco-region or plant classification (e.g., wetland plants vs. upland plants). In order to uncover as many CC scores as possible, the researcher was able to locate and utilize 3 literary sources of Florida CC values. While the number of Florida plants having CC scores continues to expand, 2 of the species in this study currently remain unranked. The 2 species were omitted from this analysis.

The sum of the CC values for the rain garden plant community is 61.2.

\[
\frac{61.2}{12} = 5.1 \quad \text{Total Mean } C = 5.1
\]

\[
\text{SQRT of 12} = 3.46
\]

\[
5.1 \times 3.46 = 17.65 \quad \text{PSI} = 17.7
\]
The results indicate that American beautyberry, slash pine, and live oak, with low CC scores of 2.4, 3.4, and 3.7 respectively, are tolerant of a wide range of disturbances and habitats. Conversely, loblolly bay (7), muhly grass (7), and blazing star (8) have a lower tolerance range for disturbance and require a more specific habitat.

The Lakefront Park rain garden landscape was compared with a nearby retention basin, visited by the researcher, and observed to be mowed grass. The University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) Extension Office of Osceola County indicated that the 3 main species used for detention/retention basin landscapes are Cynodon dactylon (Bermuda: native to east Africa), Paspalum notatum (Bahia: native to Mexico), and Stenotaphrum secundatum (St. Augustine), or a combination thereof. As the first 2 species are non-native to Florida, they each have a CC value of 0, as confirmed by Reisse and Brown (2005). Hence, their PSI score is also 0. There is conflicting information in the literature regarding whether or not S. secundatum (St. Augustine) is native to Florida. This species is not listed in the CC values records of Cohen et al. (2004). Gianopulus (2014) has assigned a CC of 0 to S. secundatum; and, has noted the species as non-native, adventive—meaning the species has arrived in a specific geographic area from a different region, and its population is not self-sustaining, but, after some time, may become naturalized. On the other hand, Reiss and Brown (2005) have assigned a CC of 0.8 to this same species.

To err on the side of caution, this study has applied the CC of 0.8 to St. Augustine. Assuming the scenario that a standard detention basin consisted of St. Augustine as the ground cover planting, the following calculations were applied:

The sum of the CC values for the detention basin community is 0.8.
0.8/1 = 0.8
SQRT of 1 = 1
0.8 x 1 = 0.8 \(\text{PSI} = 0.8\)

Table 5.5 shows the PSI values (highlighted in blue) for 4 possible scenarios of plantings for a standard detention basin. Calculations were performed, as demonstrated above, and PSI values were compared to the PSI value for the Park’s rain garden.
Table 5.5: PSI as indicator of ecological quality of rain garden versus detention basin

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>CC Value</th>
<th>Source</th>
<th>Potential scenarios for Standard Detention Basin</th>
<th>Lakefront Park Rain Garden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cynodon dactylon</td>
<td>Bermuda</td>
<td>0.0</td>
<td>2</td>
<td>(1) Bermuda and/or Bahia (no St. Augustine): PSI = 0</td>
<td>12 native species</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(2) St. Augustine mixed with Bermuda and Bahia: PSI = 0.45</td>
<td>0 non-native species</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$0.8/3 = 0.26$ (Total Mean C) $\sqrt{3} = 1.73$ $1.73 \times 0.26 = 0.45$</td>
<td>PSI = 17.7</td>
</tr>
<tr>
<td>Paspalum notatum</td>
<td>Bahia</td>
<td>0.0</td>
<td>2</td>
<td>(3) St. Augustine mixed with Bermuda or Bahia: PSI = 0.56</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$0.8/2 = 0.4$ (Total Mean C) $\sqrt{2} = 1.41$ $1.41 \times 0.4 = 0.56$</td>
<td></td>
</tr>
<tr>
<td>Stenotaphrum secundatum</td>
<td>St. Augustine</td>
<td>0.8</td>
<td>2</td>
<td>(4) St. Augustine only: PSI = 0.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$0.8/1 = 0.8$ (Total Mean C) $\sqrt{1} = 1$ $1 \times 0.8 = 0.8$</td>
<td></td>
</tr>
</tbody>
</table>

1: Cohen et al., 2004
2: Reiss and Brown, 2005
3: Gianopulus, 2014

As measured by the PSI in scenario 1, results indicate that the rain gardens that are part of Lakefront Park’s stormwater system treatment train presently have an ecological quality that is 17.7 times that of a standard stormwater detention/retention basin planted with Bermuda and/or Bahia (PSI of 0). As measured by the PSI in scenario 4, results indicate that the rain gardens that are part of the Park’s stormwater treatment system presently
have an ecological quality that is approximately 17 times greater than that of a standard detention/retention basin planted with St. Augustine only (PSI of 0.8). With the use of the PSI, this study has succeeded in gauging the ecological quality of the site, by seeing what plants live there; and, then comparing the quality of this rain garden to that of a detention/retention basin—both of which could be used for stormwater management. As landscapes change through time, findings may be useful as baseline data in subsequent, longitudinal monitoring of the ecological quality of the Park’s rain gardens.

**Limitations**

:: Plant and tree species inventory created for running CC values and PSI calculations was based upon the plant list provided in the construction sheet set. Despite site observations to confirm the planting inventory, potential exists for some plant species to have been removed between time of installation and time of data collection.

:: A portion of CC values for Florida native, vascular plants remain unassigned. Two of these plant species, Hamelia patens and Zamia pumila, are members of the study site’s plant community. Removing these two species from the analysis due to their lack of CC ranking, may have biased the study results.

:: The PSI only characterizes one aspect of the present ecological conditions of a site, and does not provide information on wildlife that may utilize a plant community. Toward a more comprehensive understanding of the ecological integrity of an area, other biological parameters should be investigated.
5.5: Ecological Performance Benefit 5: Increases Avian Biodiversity

Methodology

Indicator: Creation of habitat for bird species, including those threatened and endangered
Metric: Bird species counts before and after Park redevelopment
Data Source: National Audubon Society Christmas Bird Count records

In the past 40 years, almost all bird species populations in North America have decreased somewhere between 40 and 80 percent (National Audubon Society.org). This is due primarily to habitat destruction through the pressure of ongoing development. At its basic level, biodiversity is the variety of life within a particular habitat or ecosystem. As such, it is an indicator of the health of an ecosystem: the more biodiverse the ecosystem, the healthier and more stable it is.

Loss of biodiversity through species disappearance threatens ecosystem integrity. In turn, a vulnerable ecosystem poses risks to the health and well-being of all living organisms. Thus, efforts toward protecting bird species, such as improvements in habitat and breeding conditions, can result not only in increased bird populations but enhanced ecosystem functions and benefits to a diverse variety of living species, including man.
According to a report by the Florida Fish and Wildlife Conservation Commission (FWC), Species Action Plan for Six Imperiled Wading Birds (2014), the Little Blue Heron and the Tricolored Heron (listed as Species of Special Concern) had met the criteria for being upgraded to the status of Threatened.

The FWC estimated a population size reduction of at least 30% over the next 3 generations (one generation = 12 years), for each of these species. This was based on a decline in quality of habitat. Both are members of Lake Toho’s resident bird population. The Snail Kite and Wood Stork, both Federally Endangered species, the Sandhill Crane, a State Threatened species, and the Limkin, Osprey, Snowy Egret, and White Ibis—all Species of Special Concern—are also important members of Lake Toho’s bird population.

A list of Florida’s Endangered and Threatened species is shown in table 5.6. The designated status of the nine species that reside in Lakeshore Park are highlighted in blue.
The annual Christmas Bird Count (CBC) is a long-standing program of the National Audubon Society that has depended upon citizen science involvement for more than 100 years (www.audubon.org). The CBC is an early-winter census, where volunteers across North and South America spend a 24-hour period on one calendar day between December 14 and January 5, counting birds. The volunteers follow specified routes within a circular region measuring 15 miles in diameter, counting every bird they see or hear all day. The map in figure 5.3 depicts the region in which the CBC is conducted by the Kissimmee Valley Audubon group. The 15-mile circle radiates from the center of Lake Toho, as confirmed by the director of the Kissimmee Valley group. As shown in the map, Kissimmee Lakefront Park falls within the bird-counting region. The database on the Audubon’s CBC website was used to obtain information on bird species sighted, counted, and recorded for the Kissimmee Valley bird count region. The database search engine requires a start and end year, country and state, and count code (the 4 letter code, or count code, assigned to each bird count circle is provided in a drop down list). The following information was inputted: 2005, 2015,
United States, Florida, FLKV. Bird count data was extracted from the CBC database and entered into an MS Excel spreadsheet. A chart was created in order to visually depict changes in annual numbers of bird species counted.

**Results**

Figure 5.4: Bird species counts by year

Figure 5.4 illustrates the bird species counts over the ten-year time span. The bird count for the year 2015, conducted January 3, 2016, resulted in the sighting of 138 different bird species. According to Audubon records, this is the highest species count for this site during the past 25 years of annual reporting. Prior to 1990, tallies were recorded for the number of birds within each species, rather than the number of different species.

The population trends of birds can serve as an indication of how well an ecosystem is functioning. The project construction timeline indicates Phase 1 was completed August 2, 2011, Phase 2 April 15, 2013, and Phase 3 October 31, 2014. The line chart shows a trend in the increase of bird species since 2012; and, a 51.6% increase in bird species from 2009 (pre-construction) to 2015 (post-construction).

While the CBC region extends well beyond the bounds of the Park, a listing of Lakefront Park sightings recorded during the winter of 2016, (hotspotbirding.com/LakefrontPark), includes all of the species highlighted in the Florida’s Endangered and Threatened Species List. The site’s habitat is now a regular nesting area for the White Ibis.
(designated as Species of Special Concern), an indication of the initial success of the habitat quality. Worthy of note, the increase in the number of bird species in recent years may be associated with the improvement in Lake Toho’s water quality, stemming from the water filtration and purification processes going on at the Park. Further investigation regarding this potential association is needed.

Another important consideration regards whether there may be any association between the number of observers conducting the bird counts and the number of bird species reported. While the observers that report the bird counts for each 15-mile region are organized into small groups assigned to specific sub-regions, the number of observers who participate varies year by year. For the years under study, (2005-2015), the number of participants for the Kissimmee Valley bird count has ranged from 21 to 44. Date of recording, year for recorded species, and number of participants serving as observers who count and record the birds are as follows:

<table>
<thead>
<tr>
<th>Date</th>
<th>Observers</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/02/06</td>
<td>39</td>
</tr>
<tr>
<td>12/30/06 (2006)</td>
<td>37</td>
</tr>
<tr>
<td>12/30/07 (2007)</td>
<td>38</td>
</tr>
<tr>
<td>12/27/08 (2008)</td>
<td>29</td>
</tr>
<tr>
<td>12/26/09 (2009)</td>
<td>22</td>
</tr>
<tr>
<td>12/18/10 (2010)</td>
<td>30</td>
</tr>
<tr>
<td>12/17/11 (2011)</td>
<td>21</td>
</tr>
<tr>
<td>01/05/13 (2012)</td>
<td>40</td>
</tr>
<tr>
<td>01/04/14 (2013)</td>
<td>44</td>
</tr>
<tr>
<td>12/27/14 (2014)</td>
<td>41</td>
</tr>
<tr>
<td>01/03/16 (2015)</td>
<td>44</td>
</tr>
</tbody>
</table>

As the determination of any correlation between the number of bird counters and number of bird species reported is beyond the scope of this study, further research is needed to confirm or refute this possibility.

**Limitations**

:: Records of bird species counts reflect bird sightings beyond the boundaries of Lakeshore Park. As it was not possible to distinguish Lakefront Park bird counts from the other bird counts within the 15-mile region, study results are biased.
As aforementioned, the possibility exists of an association between the number of bird count participants and the number of bird species recorded: 2012 through 2015 experienced the highest number of bird species recorded, as well as the greatest number of observers participating in the bird count recordings.

In addition to external, unidentifiable variables that influence study findings, there is strong probability that the swamp lands located throughout the southern portion of the study sight bore a positive impact upon bird species counts.

Results for quantification of increased biodiversity was limited to the evidence for bird species. Addressing some of the site’s other animals would have strengthened the validity of the study: numbers of species of fish, amphibians, or small mammals may have, in fact, decreased.

5.6: Ecological Performance Benefit 6: Improves Water Quality

Methodology
Indicator: Improved Water Quality
Metric: Removal of total suspended solids, nitrogen, and phosphorous from stormwater runoff
Data Source: Published results of water quality testing performed on-site

Organic pollutant loads that are transported by stormwater runoff contain nitrogen and phosphorous. When an excess of nitrogen and phosphorous enter water bodies, it causes significant increases in algae. This in turn harms water quality, degrades food resources and habitats, and decreases the oxygen that aquatic life forms need for survival. An over-abundance of algae can also harm humans, as the algae produce elevated toxins and bacterial growth that contaminates fish, shellfish, and drinking water.

The Park’s stormwater treatment train contains several baffle boxes, or underground chambers, as shown in Figure 5.5. Vegetation and litter are captured in the baffle box’s filtration screen system, and sediment settles to the bottom. The vegetation and litter rests above the static water, and dries out between storm events. This process separates the organic pollutant load from the water.
The University of Central Florida’s Stormwater Management Academy measured water flow and water quality before and after the installation of the Park’s baffle boxes. Samples were monitored for total suspended solids (TSS), total nitrogen (TN), and total phosphorous (TP). Table 5.7, above, shows the baffle box being monitored was effective at removing over 80% TSS, approximately 67% TN, and roughly 75% TP.

### Table 5.7 Average amount of water pollutant removal
(source: Wanielista, 2014)

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Amount Removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Suspended Solids (TSS)</td>
<td>~81%</td>
</tr>
<tr>
<td>Total Nitrogen (TN)</td>
<td>~67%</td>
</tr>
<tr>
<td>Total Phosphorous (TP)</td>
<td>~75%</td>
</tr>
</tbody>
</table>

**Limitations**
:: The findings were obtained from a secondary source; any errors or omissions are beyond the knowledge of the researcher.
5.7 Synopsis

The research herein has attempted to quantify the ways in which Lakefront Park is functioning as determined by the provision of various ecological benefits. A summary of these findings are as follows:

- Sequesters approximately 55.9 tons of carbon annually in 1003 newly planted trees onsite.
- Intercepts over 1.6 million gallons of rainwater annually by the 1003 newly planted trees onsite.
- Expected to conserve approximately 8737 gallons of drinking water per year upon completed conversion to greywater use as source for irrigation.
- Achieved ecological quality 17 times that of a standard stormwater detention/retention basin, as measured by the Plant Stewardship Index.
- Increased biodiversity of resident and migratory bird species by 51.6%, several of which are state designated as threatened, endangered, or of special concern, based on pre-construction and post-construction citizen-recorded bird count data generated by the Audubon Society.
- Improves the overall quality of stormwater runoff by reducing pollutant load by approximately 81% of total suspended solids, 67% total nitrogen, and 75% total phosphorous.

From the researcher’s perspective, the role of baseline data toward the ability to conduct meaningful analyses was consistently recognized throughout each measure of performance. The following chapter provides methods and results for site functions that provide social benefits.
6 :: SOCIAL PERFORMANCE: RESEARCH METHODS AND RESULTS

Aside from the program elements that promote the generation of ecosystem services in a designed landscape, the ways in which the site is being used after project completion play a central role in the site’s sustainability. The behaviors and perceptions of park users were examined through a wide lens: methodology for quantifying the socially related benefits of the site entailed site and flight observations, mapping, and the execution of a structured survey.

This chapter details the methods and results for each of the selected performance criteria associated with the site’s social functions. The survey instrument was designed to assess a host of social benefit indicators, many of which are linked to common social benefits. As such, several of the survey questions provide findings for multiple benefits. Hence, the format of this chapter is organized somewhat differently than the chapters on ecological and economic performance, in order to better synthesize and convey social performance results.

Information is first provided on the survey design and promotion process. Survey questions are then presented in their original order, along with results and interpretation of their significance in performing associated benefits. Next, the methods for capturing Park user activity and results for the site and flight observational mapping are provided. As two main instruments were repeatedly utilized in the assessment of the socially related benefits, limitations are provided towards the end of the chapter. The chapter concludes with a summarized list of key findings for the social performance of Kissimmee Lakefront Park.

6.1 Park User Survey

Toward gaining understanding of park user views and behaviors, a digital survey was developed through the use of the online survey tool, SurveyMonkey. According to the literature reviewed, one of the best units of data for measuring social benefits is the personal response. Survey administration through an online platform held appeal due to its convenient nature and its preservation of respondent anonymity. The survey was informed by relevant literature and other survey instruments utilized for landscape performance, was kept short (15 minutes or less to
complete), and was voluntary. The City of Kissimmee’s manager of Communications and Public Information assisted the survey process by posting the URL link to SurveyMonkey on the City’s Parks and Recreation events page of their Facebook Page. The URL link was also shared on Kissimmee’s City Hall Facebook Page. The survey went live on February 5th, 2016 and generated 76 responses within the next 4 weeks.

In addition to the social media platform, the survey was advertised during a public event held at the Park on Saturday, February 20th, 2016. Promotional fliers printed with a Quick Response (QR) code to the survey, were distributed to park visitors. A QR code is a mobile phone readable bar code that stores a website’s URL (i.e., the link to the Park user survey on SurveyMonkey). The QR code was created as a way to direct people to the online survey: After scanning the bar code with a cell phone, the survey and informed consent opens on the mobile device, ready for response.

Park visitors were approached and asked whether they would be interested in participating in a survey about their park experience. Those that answered affirmatively were handed a flier, and were provided with an explanation on the use of the QR code. 100 fliers were distributed at the one-time event. 12 participants completed the online survey within the following 2 weeks. A total of 88 respondents participated in the online survey.

Following the standard protocol (for the protection of human subjects under study) required by the University of Florida’s Internal Review Board (IRB), the first item in the survey was an informed consent page that explained the risks and the benefits of participation. The remainder of the survey measured park visitors’ behaviors and perceptions through responses to single-answer, multiple choice, and 5-point Likert scale questions on various topics including health and educational benefits, safety and security, social capital, and eco-friendly behaviors.

Following the close of the survey, data was interpreted through Survey Monkey analytics. Various formats for reporting and displaying the descriptive data (bar graphs, donut charts, etc.) were then explored. The IRB approval letter, informed consent and complete survey may be referenced in Appendices A, B, and C. In addition, supplementary, anecdotal evidence regarding the values of Lakefront Park, as expressed by a long-time resident of
Kissimmee, a professional involved in the early stages of the project, and a biologist having knowledge of Lakefront Park’s new approach to managing stormwater.

### 6.2 Survey Results

The online survey was structured to allow participants to skip questions, if and when desired, while still having the ability to move through the survey. While 88 adults (N=88) participated in the survey, the number of participants that responded to each of the 17 questions varied somewhat, as depicted by the line chart in figure 6.4. For each of the charts in this section, the letter N is used to represent the number of responses to each answer to any given question.

The first 10 questions received the greatest rate of completion, with question 11 and 12 having a relative drop in response rate. However, the overall response rate was higher than average, with 10 out of 17 questions receiving a response rate of 100%, and all surveys having a completion rate of at least 93%.

---

**Figure 6.1:** Facebook posting of Park user survey

**Figure 6.2:** Survey question response rate
On average, how often do you visit Kissimmee Lakefront Park?

- N 38 (43.2%) visit once a month
- N 15 (17.0%) visit about once a week
- N 14 (15.9%) visit several times a week
- N 11 (12.5%) visit about once a month
- N 4 (4.5%) visit once every six months
- N 4 (4.5%) visit once a year, or less
- N 2 (2.3%) visit every day
- N 88

**Figure 6.3: Q1: Frequency of Park visitation**

The opening question in the survey examines the rate in which survey participants frequent the Park.

The majority of the study population indicated visiting Lakefront Park approximately once a month (43%, N38).

As shown in the doughnut chart, 35% visit the Park at least once a week. And, accumulatively, 78% reported visiting at least once a month.
Social Benefit: Promotes Access

This question examines the time of day in which the survey respondents use the Park. Each survey participant (N88) answered this question. As more than one answer could be selected, the total number of responses (n229) exceeds 100%.

As expected, results show afternoons and weekends as being the most popular times for using the Park. However, over one-third of the respondents use the Park after dark, and nearly 41% visit during the week.

Findings suggest that users are able to successfully experience the Park, not only throughout various times of the day, but also various times of the week.
This question examines the ways in which the members of the survey population access the Park. Convenience is an intangible quality associated with access. When users can reach a destination, without having to rely upon the automobile, it is indicative of a site’s ability to promote access. In addition, alternative forms of transportation often promote health through physical activity.

While approximately 13% of the surveyed Park users reported arriving on foot or by bicycle, the majority of respondents, (85%), reach the Park by automobile. Public transportation was utilized by just one respondent.

The addition of the downtown SunRail station, as well as the extension of pedestrian corridors that will aesthetically and conveniently link the Park with downtown, the rail station, and surrounding neighborhood, are slated for construction near the end of 2016. Future research could be conducted to understand the impacts of this infrastructure and the ways in which it enhances visitor access to the Park.
Social Benefit: Supports Social Connection ::: Supports Health and Well-Being

Figure 6.6: Q4: Motives for Park visitation

This question attempts to uncover the extent to which various health-related motives drive the decision to visit Lakefront Park. The question was answered by 100% (N88) of survey participants. As more than one answer could be selected, the total number of responses (n210) exceeds 88.

Of interest, the most common reason for wanting to visit this Park—the opportunity to *enjoy nature and the outdoors*—received 36% more mentions than *socializing with friends and family*. This finding suggests that the site’s natural features are a strong draw for the survey population. Given that 26% of the respondents selected *other* as a reason for visiting, the opportunity for a qualitative response would have provided insight regarding unknown motives behind Park visitation.

The number of total mentions (n210) across these variables demonstrates the Park’s value in promoting healthy living through a place to be physically active, benefit from the restorative powers of nature, and socially connect with others.
What are the primary activities you participate in, while at the Park? (please select all that apply)

- Community events: 8.0% (N 7)
- Boating: 15.9% (N 14)
- Fishing: 17.0% (N 15)
- Bird watching: 9.1% (N 8)
- Outdoor education: 15.9% (N 14)
- Relaxation: 25.0% (N 22)
- Use playgrounds: 20.5% (N 18)
- Playing: 43.2% (N 38)
- Picnicking/eating: 15.9% (N 14)
- Walking dog: 6.8% (N 6)
- Skating: 15.9% (N 14)
- Cycling: 14.8% (N 13)
- Jogging/running: 78.4% (N 69)
- Walking: 70.5% (N 62)
- Health and well-being: 45.5% (N 40)
- Social connection: 54.5% (N 48)
- Recreational value: 20.5% (N 18)
- Educational value: 8.0% (N 7)

Figure 6.7: Q5: Primary Park activities
The bar graph in figure 6.9, located on the previous page, shows the results of question 5: the extent in which the survey population engages in a range of Park-related activities. Findings indicate the four most popular of the listed activities are walking (78%, N69), attending community events (71%, N62), relaxation (55%, N48), and use of the playgrounds (46%, N40).

On the other hand, the three activities that these respondents were least likely to engage in were skating (7%, N6), boating (8%, N7), and outdoor education (9%, N8). As aforementioned, many of these activities provide multiple benefits: As an example, playground experiences have the potential to offer social, recreational, human health, and educational rewards.

According to local, key informants, throughout most of the year, countless numbers of boats set out from the Lake Toho Marina, located on the western edge of the Park, in search of big bass. In addition, the Park attracts schools and other groups who travel to Kissimmee’s Lakefront Park, interested in environmental education. Future research could incorporate additional sampling strategies in order to capture a wider range of perspectives. Nonetheless, the findings for the Park activities that this study’s users primarily engage in are in line with the findings in the previous question, further supporting the Park’s role in supporting social connection and strengthening physical and emotional well-being.
This question pertains to whether or not survey respondents feel that their presence is accepted, throughout the Park. Feeling welcome in a public setting translates to feelings of comfort and safety. Studies have associated the lack of feeling welcome with inaccessibility, or inequity.

As shown in the donut graph, 92% of the survey population indicated feeling welcome throughout all parts of Lakefront Park. The finding represents a positive indication of the site’s performance in terms of supporting social connection and providing access by promoting feelings of comfort and security.

The opportunity for a qualitative response to this question would have provided insight regarding the factors behind not feeling welcome throughout the Park.
Social Benefit: Supports Social Connection :::: Strengthens Place-Making

Question 7, represented in figure 6.11, pertains to the Park’s potential for building community cohesion through increased social interaction and bonding by way of common experience. The question was answered by 100% (N88) of survey takers. More than one answer could be chosen; hence, the total number of responses (n170) exceeds the number of survey participants.

Results show 60% of the surveyed Park users have met new acquaintances at the Park. The most common means appears to be through attendance of movie night and other scheduled Park events (49, N43), and through one’s children (34%, N30). This finding suggests that the design of the splash-pad area and two playgrounds affords
opportunity for nearby, supervising parents to socialize in meaningful ways. In addition, the public events hosted at the Park appear to be helping these Park users connect with other community members. Conversely, cycling and involvement of park staff were the least common means of meeting new people, at 1% and 5% respectively.

Survey Question 8 inquired about Park visitors’ patronage to the downtown district during days of park usage. Findings and interpretation are provided in Chapter 8, Economic Performance.

**Social Benefit: Strengthens Place-Making**

Did you happen to attend any of the community meetings where Kissimmee residents voiced their ideas, opinions, and desires for the redesign of the Park?

![Figure 6.10: Q9: Attendance at public meetings](image)

This question pertains to involvement in the City’s public input meetings, by the park users surveyed.

The findings indicate that 10% (N9) of survey participants that completed this question (N87) attended at least one of the three meetings in which residents expressed their opinions regarding the Park’s redevelopment.
**Social Benefit:** Supports Social Connection  :::  Provides Recreational Value  :::  Promotes Access  :::  Strengthens Place-Making  :::  Provides Educational Value  :::  Supports Health and Well-Being

Figure 6.11: Q10: User perception of Park benefits

Please select all with which you agree, based on your experience and use of the Park: Kissimmee Lakefront Park...

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Response Rate</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>contributes to the area’s sense of identity</td>
<td>65.9%</td>
<td>n58</td>
</tr>
<tr>
<td>promotes a healthy lifestyle</td>
<td>72.7%</td>
<td>n64</td>
</tr>
<tr>
<td>enhances the aesthetic (beauty) of the downtown lakefront</td>
<td>85.2%</td>
<td>n75</td>
</tr>
<tr>
<td>improves my quality of life</td>
<td>51.1%</td>
<td>n45</td>
</tr>
<tr>
<td>increases my outdoor activity</td>
<td>68.2%</td>
<td>n60</td>
</tr>
<tr>
<td>enhances my understanding of the area’s cultural history</td>
<td>34.1%</td>
<td>n30</td>
</tr>
<tr>
<td>contributes to my understanding of alternative stormwater management practices</td>
<td>29.5%</td>
<td>n26</td>
</tr>
<tr>
<td>creates habitat for wildlife</td>
<td>55.7%</td>
<td>n49</td>
</tr>
<tr>
<td>is accessible for people with disabilities</td>
<td>65.9%</td>
<td>n58</td>
</tr>
<tr>
<td>promotes educational opportunities</td>
<td>38.6%</td>
<td>n34</td>
</tr>
<tr>
<td>promotes get-togethers with friends, family, or others</td>
<td>81.8%</td>
<td>n72</td>
</tr>
<tr>
<td>promotes scheduled outdoor events</td>
<td>78.4%</td>
<td>n69</td>
</tr>
</tbody>
</table>

Place-Making  Health and well-being  Educational value  Recreational value  Social connection
Question 10, depicted in the bar graph on the preceding page, assesses the perception of an array of social benefits afforded by Lakefront Park. The question was answered by 100% (N88) of the study’s park user population. More than one answer could be chosen; hence, the total number of responses (n640) exceeds 88.

Based on all possible answer choices, the aesthetic value afforded by the Park’s role in enhancing the beauty of the downtown lakefront was the benefit most frequently selected (85%; N75). This was closely followed by the Park’s ability to promote personal social gatherings (82%; N74) and scheduled outdoor events (78%, N69). The survey results for the strong number of Park users that choose to visit the Park for community events augments the evidence for the City’s offering of public events and activities at the Park, and the doubling of event attendance in the first year after Park redevelopment.

An indicator of social performance relates to how a site is designed to be useful to people with diverse abilities. Sixty-six percent of the respondents agreed that the Park is accessible for people with disabilities. Toward appealing to the needs and desires of more citizens, the Park features the first wheelchair-accessible boat slips in Osceola County. In addition, the binocular-type viewers that swivel for panoramic views of scenic overlooks are typically a coin-operated amenity at Parks. Lakefront Park’s viewers, overlooking Lake Toho, are free of charge and wheelchair-accessible.

According to Osceola County Lakes Management Plan (2015), the County recognizes the vital role that its parks can play in building public awareness of water quality and its link to healthy ecosystems, by providing exhibits and educational signage. In accord, one of Lakefront Park’s main goals lies in strengthening environmental awareness and the importance of water conservation. Hence, the relatively weak response rate for the Park’s perceived value in contributing toward an understanding of alternative stormwater management practices (30%; N26) and serving as a place that offers opportunity for educational opportunity (39%; N34) must be noted. In retrospect, perhaps more clarity in the construction of these two answer selections may have captured a more realistic response. More robust research is needed to determine the validity of this finding and gain greater understanding of how the Park is functioning in terms of educating the public.
The installation of various arrangements of native plant species in the Park introduced a new planting typology to the citizens of Kissimmee. The aim of this question was to understand how Park visitors perceive the plantings and whether or not they would consider using native planting schemes for their own residential landscapes.

Out of the 85 individual responses to this question, 94% (N80) indicated they liked the native plantings featured in the Park. Within this group, 60 Park users agreed they would use native plants in their home landscape, while 20 indicated they would not use native planting at home. Aside from promoting aesthetic appreciation for the native plant palette, the results hint at the Park’s value in its ability to spark environmentally-friendly lifestyle change. Given the inherent benefits afforded by native plants in a landscape, further research to uncover the drivers behind the apparent satisfaction and interest in the native plantings is needed.
This question examines the impact of various factors in helping Park users feel safe and secure.

Findings indicate 94%, or 80, of the respondents that completed the question feel safe when they are visiting Lakefront Park. Of interest, results of question 6 showed 81 respondents felt welcome in all parts of the Park.

With a response rate of 60% (N50), the most common factor that contributed to this feeling of safety was the *openness of the Park and the ability to see around oneself*. This finding supports the recognized concept of natural surveillance through the provision of visibility, and the power of design toward impacting user experience.
Social Benefit: Increases Eco-Friendly Behaviors and Attitudes

For the following statement, please select one answer:
Visiting Kissimmee Lakefront Park has led to an increase in behaviors, by myself and/or my family, that contribute to sustainability.

N 84

<table>
<thead>
<tr>
<th></th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>strongly agree</td>
<td>N 38</td>
<td>45.3%</td>
</tr>
<tr>
<td>agree</td>
<td>N 24</td>
<td>28.6%</td>
</tr>
<tr>
<td>neutral (neither agree nor disagree)</td>
<td>N 14</td>
<td>16.7%</td>
</tr>
<tr>
<td>disagree</td>
<td>N 7</td>
<td>8.3%</td>
</tr>
<tr>
<td>strongly disagree</td>
<td>N 2</td>
<td>2.4%</td>
</tr>
</tbody>
</table>

Results show that 45% of the 84 survey participants completing this question agreed with the statement that visiting Lakefront Park has led to an increase in sustainable behaviors. While 44% of the respondents neither agreed or disagreed with the statement, only 11% believed that visiting the Park did not have any effect upon their environmentally-friendly actions.

This question attempts to uncover associations between Park visitation and a positive change in environmentally-friendly behaviors. In the survey, the question also included the following information: Examples of sustainable behaviors might include conserving water, using drought tolerant plants in the home landscape, reducing the use of fertilizers or pesticides, etcetera.
Social Benefit: Strengthens Place-Making

For the following statement, please select one answer:
The re-design of Kissimmee Lakefront Park reflects what the local residents wanted in their park.

<table>
<thead>
<tr>
<th>N</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.2%</td>
</tr>
<tr>
<td>2</td>
<td>2.4%</td>
</tr>
<tr>
<td>19</td>
<td>22.6%</td>
</tr>
<tr>
<td>62</td>
<td>73.8%</td>
</tr>
<tr>
<td>35</td>
<td>41.7%</td>
</tr>
<tr>
<td>27</td>
<td>32.1%</td>
</tr>
</tbody>
</table>

This question is related to the idea that sustainability requires understanding and responding to human needs. The City of Kissimmee began the Park redevelopment process with a human perspective approach by conducting a series of public meetings where citizens and City officials could freely express their ideas and desires for the new Park.

Results show roughly 74% (N62) of the respondents that completed this question agree with the statement that the re-designed Park reflects the desires of local residents. Recognition by local citizens that this space was indeed reinvented in response to their desires helps strengthen sense of place and social cohesion. Within this group, 42% (N35) held strong agreement with this statement. Additionally, the 9 respondents that indicated attending at least one of the public meetings concerning the Park’s redesign (survey question 9), all showed strong agreement for the Park’s outcome in reflecting citizen needs. In turn, this shows that 68% (N78) of the respondents that did not attend any of the public meetings believed the redevelopment project was effectively addressing user needs. These findings hint at the effective approaches for the programming of the Park, shedding light on the project’s democratic design process and its consequential impact.
One of the aims of the Lakefront Park redevelopment project was to encourage native planting and educate the public, through the addition of attractive educational signage, innovative structures that make stormwater management processes visible, and introduction of native plant communities throughout the site. (Discussion and imagery of these features has been provided in this paper’s section on Kissimmee’s background.) Toward determining whether the Park is meeting its goal, this survey question examines the extent of increased environmental awareness through park use. The topics for the 5 answer choices reflect information conveyed by the
Park’s signage. The question was answered by 85 survey participants; as more than one answer could be chosen, the total number of responses (n183) exceeds 85.

Results show 72% of the surveyed users have experienced an increase in environmental awareness due to visiting the Park. With a total of 43 responses (51%), this is particularly evident in the understanding of Lake Toho’s ecological and historical connections to Kissimmee. This finding is suggestive of the Park’s role in fostering interpretation of the relationship between a site’s historical and ecological history, which helps build a sense of place. Awareness in the value of rain gardens for improving water quality was reported by approximately 44% (N37) of the survey respondents, followed by the role of native plants in supporting wildlife (39%, N33). Further research is needed toward identifying the Park mechanisms that are effectively working to increase ecological awareness.

Of particular interest is the relatively low response rate for water conservation (34%, N29) and clean water practices (20%, N17), as water quality and water conservation awareness is a major focus of the Park. These findings are in line with the results of question 10, in which 30% (N26) of the participants agreed that the Park increased their understanding of alternative stormwater practices.
The aim of this question was to capture a small picture of the diversity of Park users. As shown by the doughnut chart, the majority of park users surveyed indicated being White (56%, N46). This was followed by Hispanic or Latino responses (34%, N28).

While the results reflect a cross-section of survey respondents, the finding for the demographic make-up of these Park users is somewhat surprising. As shown in figure 6.18 on the following page, approximately 64% of Kissimmee’s population is Hispanic, while roughly 23% is White. Although this finding is suggestive of the Park’s underuse by the Hispanic population, no conclusions can be made in terms of equitable access and Park usage due to the lack of a representative sampling of Park users. Hence, more robust research is needed toward understanding the ethnic make-up of the site.
Social Benefit: Promotes Access

Figure 6.18: Census estimates for Kissimmee demographics

The doughnut graph in figure 6.18 represents the demographic estimates for race and ethnicity for the population of Kissimmee. The estimates were provided by the US Census, for the years 2010 through 2014.

In contrast to the demographic composition of the Park users who participated in the study’s survey, the majority of people living in Kissimmee are Hispanic or Latino, as they comprise approximately 64% of the total population.
The aim of this question was to provide a glimpse into the resident reach of the Park, as one of the City’s main goals in reinventing the Park was to create a civic backyard for the people of Kissimmee. 94% (N68) of the respondents that completed this question live in Osceola County, with 76% of this group (N64) residing within Kissimmee city limits. The results suggest that the Park is fulfilling its intended goal of serving its citizens. However, the finding for the small proportion of Park visitors from other parts of Florida and beyond the U.S. might infer a less than desirable rate of visitation by tourists. This may reflect the lack of a full representation of all Park visitors, by the study’s narrow sample population. Again, completion of the proximate mixed-use development and the SunRail station opening within walking distance to the Park will no doubt exert a strong influence upon the Park’s connectivity. Further research could be beneficial.

Results also help inform interpretation of question14: A portion of respondents indicated living outside Osceola County. Living in other parts of Florida might impact the likelihood of having much knowledge surrounding the local residents’ vision for their new Park; hence, influencing the number of neutral responses to this question.
Summary of the social performance benefits afforded by Kissimmee Lakefront Park

According to the Lakefront Park User digital survey (N:88), users reported that Kissimmee Lakefront Park:

- Promotes a safe and secure environment for 94% of survey respondents, through its open design, lighting, and presence of others.
- Promotes socializing and celebrating with friends and family for 82% of the survey respondents.
- Enhances the beauty of Kissimmee’s downtown lakefront for 85% of the survey respondents.
- Promotes cultural cohesion through the promotion of community events for 78% of the survey respondents. (City records estimate a 100% increase in event attendance for the first year following the Park’s redevelopment project)
- Reflects the needs and desires of local residents, in its redeveloped design, for 74% of the survey respondents (while 23% neither agreed or disagreed with this statement).
- Promotes healthy living for 73% of the survey respondents, primarily through a place to walk and exercise, reduce mental stress, enjoy nature, and socialize with others.
- Promotes a better understanding of ecological sustainability for 72% of the survey respondents, primarily through increased awareness of the value of rain gardens and role of native plants in promoting wildlife diversity.
- Encourages the use of native plantings in the home landscape for 71% of the survey respondents.
- Is accessible for people of all abilities (American Disability Act-ADA) for 66% of the survey respondents.
- Contributes to the area’s sense of identify for 66% of the survey respondents.
- Promotes social connection through the opportunity to meet new acquaintances for 60% of the survey respondents.
- Promotes cultural understanding, particularly of Lake Tohopekaliga’s ecological and historical contributions to Kissimmee, for 51% of the survey respondents.
- Contributes to an increase in sustainable behaviors at home by themselves and/or their family, such as conserving water and reducing pesticide or fertilizer use, for 45% of the survey respondents.
6.3 Survey Limitations
:: While face-to-face recruitment was coupled with the use of a social media platform as a means to capture a broader sample of Park users, the sampling method utilized was convenience sampling, rather than randomized. Convenience sampling was chosen due to its ease in accessing prospective subjects (through the internet, in this case). Although this method saves costs in time and money, it often results in not being representative of the population being studied (i.e., the users of Kissimmee Lakefront Park). Therefore, the views expressed by these park users cannot account for the views of all other park users.

:: Promoting the survey through an online platform resulted in over 6 times as many survey participants, than promoting the survey face-to-face during a public event at the Park (N76 versus N12). Using a flier with a QR code removed the immediacy of participating in the survey. Distributing a hard copy of the survey, to be completed in real time by those interested, may have resulted in a greater number of respondents from the on-site group.

6.4 Park User Behavior Mapping

Toward a better understanding of the way the site’s spaces are being used, behavior mapping was performed by using unmanned aerial systems (UAS) technology to capture video registrations of site activity. This was accomplished through the use of a Phantom III drone, known as Belle. Prior to the day’s nine drone flights, an overall flight path was determined. Every attempt was made toward ensuring precise and comparable registrations; however, limitations in navigating a drone repeatedly across the same course did result in some inconsistencies between flight patterns. The image in figure 6.1, located on following page, shows the path of the drone during one of the flights performed on site. The drone’s capability of surveying an expansive area of ground from overhead enabled the pilot to capture all areas of the Park without necessarily having to fly along each of the Park’s boundaries.

Figure 6.20: Flight lift-off from study site
The aerial imagery was carefully and repeatedly scrutinized. Data points were first transferred by hand from video frames to site maps. Using this graphic information, the final maps were then created through the application of digital rendering software.

Figure 6.21: Drone flight path
(source: Ken Weyrauch: GIS specialist and drone pilot)
6.5 Behavior Mapping Results
The aim of the mapping was to show locations and densities of people throughout the day, in order to paint a picture of the general pattern of activities and degree of uses for the different areas within the Park. The video footage, along with personal site observations, adds an insightful window into how life and form interact in this space.

Each colored circle represents a Park user, captured in time and location at the moment of aerial registration by the drone. First, a full color site map with features labeled is provided for reference purposes, in figure 6.22. Next, the three user activity maps are displayed successively. Third, the site observation narrative is provided, describing the activity occurring in the Park during the time of the flights. Lastly, several concluding thoughts are discussed.

On the day of this site and flight visit, over 1000 people visited the Park between the hours of 9:00 am and 6:00 pm.
Figure 6.22: Lakefront Park site plan rendering

Source: City of Kissimmee Parks and Recreation
Figure 6.23: Park users’ morning activity

Please refer to figure 6.22 for labeled locations of Park features.
Figure 6.24: Park users’ early afternoon activity

Please refer to figure 6.22 for labeled locations of Park features.
Figure 6.25: Park visitors late afternoon activity

Please refer to figure 6.22 for labeled locations of Park features.
6.6 Site and Flight Narrative

Figure 6.23 is a map of user activity as registered between 9:03 and 9:19 am (yellow); 10:06 and 10:22 am (orange); and 11:03 and 11:18am (red).

----During the first hour of Sunday, November 29, the Park is fairly quiet and still, as depicted by the relatively small number of yellow circles. At this time, most of the users are walking or jogging along the promenade and boardwalk, several families are enjoying the playgrounds, and a few isolated individuals can be seen throwing their lines out from the docks near the marina.

----During the second hour of the morning, activity increases near the playgrounds and around Ruby Plaza and Pier, but the Park still appears to be sleeping. Belle’s pilot and I postulate this might be due to Sunday being a day of worship, and I wonder how different this scene might appear on a Saturday morning.

---- By the morning’s third flight, visitors are seen lugging picnic and party supplies to various pavilions. People pause from hanging festive decorations, to warmly greet the newcomers while the children run off to play. A few people can be seen near the marina, just west of the event lawn. As shown, both the event and civic lawns remain mostly unoccupied during the morning hours.

Figure 6.24 depicts user activity as registered between 12:05 and 12:21 pm (light green); 1:03 and 1:19 pm (moderate green); and 2:05-2:23 pm (dark green).

----As the early afternoon map shows, user activity begins to generate on both lawns after 12 noon. A game of soccer or Frisbee, or just chatting beneath the oak trees appear to be favored activities. The users of the two playgrounds, as well most of the pavilions, continue to increase in number. Two individuals are seen at the sea wall near the far western corner of the site.
Around 1pm, the use of the promenade has decreased, as compared to just one hour earlier. Pavilions continue to fill with people attending birthday, baby shower, and other celebrations.

By 2pm, the density is quite apparent around Ruby plaza and the pier (several waterfront pavilions and a concession stand are located here).

Figure 6.25 shows user activity as registered between 3:03 and 3:33 pm (light blue); 4:03-4:20 pm (lavender); and 5:10 -5:34 pm (purple).

The 3pm flight captures the busiest time of Park use for this particular day. The majority of the pavilions are overflowing with people. The two lawns are bustling with activity and people spill off the event lawn and onto the adjacent, circular walk. A few venture along the boardwalk that winds through one of the rain gardens, stopping to read the signs about water and wildlife. The playgrounds are packed; and, if it were not for the recent re-painting of the splash pad, this area would most likely be teeming with kids and observant parents as well. The pier near the marina and the lighthouse walk are now filling with life. People gather at the large pavilion, opposite lighthouse walk, for a wedding ceremony and reception. Across the way, a group of kids stop to peer into the baffle box, and then decide it's better suited for climbing than viewing stormwater.

Just after 4pm, at the Civic lawn on the east side of the Park, a young lady adorned in a turquoise gown marks her passage from childhood to adulthood in the celebration of her quinceanera, or fifteenth birthday. Nearby skateboarders, enticed by the varied grade of the concrete, practice their tricks along the open stage area, while a lively flow of people pushing strollers, biking with their children, and walking their dogs buzz up and down the promenade. Several fishermen are at the boat ramps, pulling their boats out of the water for the day. People begin to claim their spot in which to perch along the seawall. Others navigate over to the Adirondack chairs that offer front row views of promenade activity and the Lake beyond.
The ninth flight occurs just before dusk. The Park begins to thin somewhat, as some of the visitors begin to pack up and head to their cars. Children are called away from the playgrounds to join the adults at the pavilions, where food is being served and games are being played. Although the approaching darkness necessitates that this be the final flight, there isn’t much indication that this Park action is stopping anytime soon. It appears, from this brief yet full experience at the Park, that the City has succeeded in giving the people of Kissimmee the civic backyard they had hoped for.

### 6.7 Behavior Mapping Limitations

:: A sampling of days throughout the seasons of the year would provide a more representative picture of the number of people on the site at different times of the day, and how the various areas of the site are being utilized. Time, weather, and schedule conflicts were constraining factors in the opportunity to conduct site observations and flights. This resulted in a relatively small sample size and only serves as a snapshot of the site for the 1 day. The recorded performance of the site does not take into account special events or other phenomena that might impact park usage. For example, on the day of flights and observation, the children’s splash pad—one of the most popular features at the park—was closed due to repainting and related maintenance.

### 6.8 Synopsis

The density and location of points helped to show the Park features that people value the most (including the 2 playgrounds, the pavilions, and the promenade), as well as features that did not get much use (such as the lawns in the morning, the area near the wedding lawn, and the southeastern corner of the Park). While on site, the most popular areas of the Park were fairly easy to identify. The mapping, however, appeared to be more effective, than direct site observation, in highlighting the areas of the Park that were not being utilized. For example, throughout the day, the maps show the far western corner of the Park receiving very little usage. Located on the far side of an expansive parking lot, this intimate spot is segregated from the rest of the Park. Along these lines, the few pavilions that are distanced from their neighbors appear to receive less usage. Overall, this snapshot of a day of life at the Park shows the site is successfully attracting users who freely engage in a wide range of activities and celebrations afforded by the site’s programming and amenities.
7:: ECONOMIC PERFORMANCE: METHODS AND RESULTS

This chapter details the methods and results for each of the selected performance criteria associated with the site’s economic functions. For each criterion, or indicator, the data sources and procedures involved in measurement and analysis are first discussed. This is followed by details depicting the results for each analysis. Lastly, relevant limitations or caveats tied to the results are provided.

In addition to the formulation of primary data, research on the economic effects of Lakeshore Park benefited from the archival and secondary data obtained from various sources including project firms and stakeholders, scholarly literature, and public resources. The secondary data was collected and organized, and content was closely reviewed and assessed for integrity. Relevant data was then applied in documenting and assessing the site’s landscape performance.

7.1 Economic Performance Benefit 1: Stimulates Economic Development

Methodology
Indicator: Spurred economic development
Metric: Activation of additional projects within close proximity of Lakeshore Park boundaries
Data Source: Questioning of key informants, archival research

Results
According to Belinda Ortiz Kirkegard, Economic Development Director for the City of Kissimmee, the Park enhancements have generated an improved impact on real estate – specifically on 2 parcels owned by the City: Hansel Plant, a 10-acre site directly across the street from the park; and, Toho Square, which is currently a 200 space parking lot. Both sites have been purchased by Mosaic, a land development corporation based out of
Fort Myers. The City has recently approved Mosaic’s plan, a medium-density mix of residential, hotel, and retail uses. With an estimated downtown population increase of 1800 to 2000 people, the 66-million-dollar project is slated to break ground in the latter part of 2016. Mosaic anticipates that Park accessibility, as well as the Park views featured in all residential units, will be strong selling points. Mosaic’s master plan, with its frontage on Lakefront Park, is shown on the following page, in Figure 7.1.

It is presumed that the enhancements to Lakefront Park will impact the proposed 186-million-dollar SunRail transit plaza located north east and within walking distance of the Park. SunRail is a 61-mile light rail system that connects 4 counties. The greatest number of passengers is expected to come from the 3 Osceola county stops - with passengers heading north bound on a 20-minute train ride to downtown Orlando for work. Bicycle and pedestrian paths will link the Park to the SunRail station, commercial areas, and the Downtown neighborhoods. SunRail’s concept plan for Kissimmee, along with the walking shed containing the transit station and proposed multi-modal connections, Lakefront Park, and downtown business district is provided in Figure 7.2.

Toward furthering the City’s goals of making Downtown a regional destination, the combined effects from Mosaic’s development and its resultant impact on the growth of downtown venues, the transportation infrastructure improvement by SunRail, and the reinvented Lakefront Park should generate more visitors (i.e., economic activity) to the community while enhancing quality of life for the citizens of Kissimmee.

Limitations
:: The 250-million-dollars worth of economic development activity planned for the properties proximate to Lakefront Park cannot exclusively be attributed to the renaissance of the Park. Local and regional forces were also at play prior to and during the study period. These forces include public private partnerships and investments and strategic infrastructure projects. Specifically, these events include improvements to downtown’s transit-oriented development, the approved plans to restore and extend Brinson Park—located just east of Lakeshore Park, and the recent expansion of the regional stormwater facility and wet detention treatment pond to accommodate stormwater runoff from any new development occurring downtown. In the near future, the downtown region and adjacent Lakeshore neighborhood may be one of the most desirable places to live, play, and do business in
Kissimmee. It is safe to assume that Lakefront Park is as much a product of downtown’s invigoration as it is a catalyst for it.

Figure 7.1: Mosaic’s mixed-use Master Plan

Source: Kissimmee.org
Graphically enhanced by researcher
Figure 7.2: Downtown Kissimmee SunRail station concept plan
Source: Kissimmee.org
7.2 Economic Performance Benefit 2: Increases Growth of New Businesses

**Methodology**

**Indicator:** Increase in number of business establishments in downtown district located 0.5 miles or less from Park.

**Metric:** Increase in local Business Tax Receipts (BTRs)

**Data Source:** Osceola County Tax Collector website

The Osceola County Tax Collector issues a local BTR (formerly referred to as an Occupational License) for the privilege of operating a business within the county. Any provider of merchandise or services to the public must obtain a county permit prior to the operation of business; existing local BTRs are renewed on an annual basis.

To run reports, the Osceola County Tax Collector’s website requires a street name, city name, and year. The website then generates a list of BTRs issued, based on these factors. Streets located within the downtown business district, along with the address numbers that fell within 0.5 mile of the Park’s Ruby Plaza (located approximately in the center of the Park), were selected for input. The map in figure 7.3 depicts the region of analysis, with streets highlighted in red (Lakeshore Boulevard, Broadway Avenue, Main Street, Dakin Avenue, Neptune Road, Church Street, Ruby Avenue, and Monument Avenue.) The remaining streets located within 0.5 mile of the Park, being residential, were disregarded in this analysis.

The years 2004 through 2015 were chosen, as this enabled a comparison of the 6-year time span before construction began (2004-2009), with the 6 years from project construction through the first year of the Park’s re-opening (2010-2015). Once the BTR report for each year and each street was generated, any addresses listed that fell within 0.5 mile of the Park were identified and recorded. Finally, the number of BTRs for each year was calculated by summing the BTRs that had been recorded for each of the streets.
Figure 7.3: Region of analysis for Business Tax Receipt activity (examined streets highlighted in red)
Results

Table 7.1 shows the number of BTRs recorded by the Osceola County Tax Collector, organized by year, for each street. Toward closer examination of BTR activity before, during, and after project construction, the project timeline is layered with a bar graph illustrating the number of new BTRs issued across the time span of major events related to the Park’s redevelopment, as shown in figure 7.4.

Noting the Park’s Grand Opening date of January 31, 2015, it is interesting to find that 2015 experienced the greatest number of new BTRs issued in the 13-year time frame. Bearing in mind the lingering repercussions from the economic downturn of 2008 and 2009, findings suggest that as the Park began to take shape through construction efforts, this redevelopment activity spurred interest in the establishment of new businesses. In addition, results indicate a 144% increase in the number of BTRs over the studied time frame: For the year prior to commencement of phase I project construction (2009), a total of 109 BTRs were issued within the downtown study region, as compared to the issue of 266 BTRs for the first year following the Park’s completion (2015). In regard to new business establishments, the downtown Kissimmee study region experienced a 112% increase in the issue of new BTRs: 74 new BTRs were issued during the five years prior to project construction commencement (2004-2009), versus a total of 157 new BTRs from project construction through the Park’s grand opening (2010-2015).

The pattern of growth uncovered in the number of operating businesses located within the downtown business district boundary of one-half mile or less from Lakeshore Park is indicative of the Park’s indirect economic benefit of catalyzing business growth for downtown Kissimmee. It is important to note that this analysis does not consider other potential catalysts, nor does it compare this increase to the increase in BTRs for all of Kissimmee during the same time period.
Table 7.1: Number of BTRs by year within one-half mile of Park

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lakeshore Blvd.</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Broadway Ave.</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>9</td>
<td>14</td>
<td>15</td>
<td>20</td>
<td>23</td>
<td>28</td>
<td>31</td>
</tr>
<tr>
<td>Main St.</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>9</td>
<td>11</td>
<td>13</td>
<td>17</td>
<td>18</td>
<td>17</td>
<td>22</td>
<td>25</td>
<td>26</td>
<td>35</td>
</tr>
<tr>
<td>Church St.</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>12</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>26</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Ruby Ave.</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Monument Ave.</td>
<td>5</td>
<td>8</td>
<td>8</td>
<td>12</td>
<td>14</td>
<td>24</td>
<td>27</td>
<td>29</td>
<td>39</td>
<td>63</td>
<td>81</td>
<td>91</td>
<td>104</td>
</tr>
<tr>
<td>Dakin Ave.</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>7</td>
<td>10</td>
<td>11</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Neptune Rd.</td>
<td>4</td>
<td>7</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>10</td>
<td>13</td>
<td>14</td>
<td>18</td>
<td>20</td>
<td>21</td>
<td>23</td>
<td>30</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>35</strong></td>
<td><strong>41</strong></td>
<td><strong>49</strong></td>
<td><strong>56</strong></td>
<td><strong>65</strong></td>
<td><strong>93</strong></td>
<td><strong>109</strong></td>
<td><strong>119</strong></td>
<td><strong>140</strong></td>
<td><strong>179</strong></td>
<td><strong>205</strong></td>
<td><strong>226</strong></td>
<td><strong>266</strong></td>
</tr>
<tr>
<td>Increase from year prior (N)</td>
<td>6</td>
<td>8</td>
<td>7</td>
<td>9</td>
<td>28</td>
<td>16</td>
<td>10</td>
<td>21</td>
<td>39</td>
<td>26</td>
<td>21</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>
Number of New Business Tax Receipts by Year
Before, During, and After Project Construction

Figure 7.4: New BTRs within one-half mile of Park: 2004 - 2015
Limitations
:: The dataset is based on the period 2003 through 2015. This relatively short period of time lessens the ability for a statistically powerful economic analysis.

:: The project period coincided with America’s most significant economic crisis in over 40 years; hence, an objective analysis was more challenging to make.

7.3 Economic Performance Benefit 3: Generates City Revenue

Methodology
Indicator: Increase in revenue for the City’s Department of Parks and Recreation fund, and city via taxes
Metric: Net income from rental bookings of Lakeshore Park’s facilities
Data Source: Facility Bottom Line reports prepared by the City’s Department of Parks and Recreation

Upon request, Kissimmee Parks and Rec personnel generated reports on facility rental reservations and resultant net income. The Park’s 12 pavilions, lakefront gazebo, and fireplace became available for use on January 1, 2015. Designed to reflect local history, the pavilions were crafted in a turn-of-the-20th-century style with tin roofs and wooden ceilings and are outfitted with moveable furniture, lighting, electrical outlets, and bar-b-que grills. The reservation date range for the Pavilion Facilities Bottom Line report runs from January 1, 2015 through May 30, 2016. A copy of the Pavilion Facility report is contained in figure 7.5.

In addition to the newly built pavilions, the Berlinsky Community House, a historic building on the Park’s property, has been available for rentals for the past several decades. The 5000 square foot facility accommodates up to 140 people and is popular for wedding receptions and other social events. The Berlinsky Community House Bottom Line report contains reservation records for the years 2008 through 2015, as well as year to date reservations for 2016.
Kissimmee Recreation
Facility Bottom Line Report

<table>
<thead>
<tr>
<th>Facility</th>
<th>Description</th>
<th>Resv Count</th>
<th>Fees &amp; SC Discount</th>
<th>Paid &amp; SC</th>
<th>Misc Amt</th>
<th>Net Inc/Exp Refunds</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAVIL-BASS-BASS</td>
<td>Bass Pavilion</td>
<td>126</td>
<td>10,300.00</td>
<td>600.00</td>
<td>9,700.00</td>
<td>0.00</td>
</tr>
<tr>
<td>PAVIL-BOAR-BOAR</td>
<td>Boar Pavilion</td>
<td>115</td>
<td>9,100.00</td>
<td>500.00</td>
<td>8,600.00</td>
<td>0.00</td>
</tr>
<tr>
<td>PAVIL-CORO-CORO</td>
<td>Cormorant Pavilion</td>
<td>229</td>
<td>15,800.00</td>
<td>637.50</td>
<td>14,962.50</td>
<td>0.00</td>
</tr>
<tr>
<td>PAVIL-EGRET-EGRET</td>
<td>Egret Pavilion</td>
<td>192</td>
<td>13,070.00</td>
<td>750.00</td>
<td>12,320.80</td>
<td>0.00</td>
</tr>
<tr>
<td>PAVIL-FFPL-FFPL</td>
<td>Fireplace</td>
<td>5</td>
<td>400.00</td>
<td>0.00</td>
<td>400.00</td>
<td>0.00</td>
</tr>
<tr>
<td>PAVIL-GAZEB-KCC</td>
<td>Lakefront Gazebo</td>
<td>31</td>
<td>1,425.70</td>
<td>8.95</td>
<td>1,416.75</td>
<td>0.00</td>
</tr>
<tr>
<td>PAVIL-HAWK-HAWK</td>
<td>Hawk Pavilion</td>
<td>305</td>
<td>26,625.00</td>
<td>3,049.90</td>
<td>23,475.10</td>
<td>0.00</td>
</tr>
<tr>
<td>PAVIL-HERON-HERON</td>
<td>Heron Pavilion</td>
<td>460</td>
<td>45,439.81</td>
<td>2,931.25</td>
<td>42,508.56</td>
<td>0.00</td>
</tr>
<tr>
<td>PAVIL-LAKFR-PAV</td>
<td>Lakefront Pavilion</td>
<td>363</td>
<td>23,621.08</td>
<td>75.00</td>
<td>23,546.08</td>
<td>0.00</td>
</tr>
<tr>
<td>PAVIL-OSPRE-OSPRE</td>
<td>Osprey Pavilion</td>
<td>460</td>
<td>44,942.50</td>
<td>2,500.00</td>
<td>42,417.50</td>
<td>0.00</td>
</tr>
<tr>
<td>PAVIL-OTTER-OTTER</td>
<td>Otter Pavilion</td>
<td>106</td>
<td>6,478.00</td>
<td>200.00</td>
<td>6,278.00</td>
<td>0.00</td>
</tr>
<tr>
<td>PAVIL-PANTH-PANTH</td>
<td>Panther Pavilion</td>
<td>131</td>
<td>12,400.00</td>
<td>330.00</td>
<td>12,070.00</td>
<td>0.00</td>
</tr>
<tr>
<td>PAVIL-SPON-SPON</td>
<td>Spoonbill Pavilion</td>
<td>175</td>
<td>11,475.00</td>
<td>600.00</td>
<td>10,875.00</td>
<td>0.00</td>
</tr>
<tr>
<td>PAVIL-TURT-TURT</td>
<td>Turtle Pavilion</td>
<td>149</td>
<td>12,800.00</td>
<td>500.00</td>
<td>12,300.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

TOTAL NUMBER OF FACILITIES FOR RANGE SELECTED: 14
TOTAL NUMBER OF RESERVATIONS FOR RANGE SELECTED: 2,792
TOTAL FEES CHARGED FOR RESERVATIONS: 236,674.89
TOTAL DISCOUNT APPLIED AGAINST FEES: 12,782.60
NET AMOUNT STILL DUE: 223,892.29
TOTAL AMOUNT REFUNDED: 10,660.18
TOTAL AMOUNT PAID FOR ALL FEES LESS DISCOUNT (+): 223,339.19
TOTAL SURCHARGES PAID FOR CANCELS (+): 328.10
TOTAL MISCELLANEOUS FACILITY INCOME (+): 0.00
TOTAL MISCELLANEOUS FACILITY EXPENSES (-): 0.00

NET INCOME/EXPENSE FOR FACILITY RANGE SELECTED (+): 223,677.29

TOTAL RECEIPTS IN FACILITY RANGE SELECTED: 2,821
AVERAGE DOLLAR AMOUNT PER RECEIPT: 79.37

SELECTION CRITERIA:
Resv Date Range 01/01/15 Thru 05/30/16
Refund Date Range 01/01/15 Thru 05/30/16
Booking Date Range 01/01/15 Thru 05/30/16
Individual Selections: PAVIL BASS BASS.PAVIL BOAR BOAR.PAVIL CORO CORO...
Include Canceled Reservations: Yes
Ind Fac: Yes Ind Activ: Yes Ind Actv Hold: Yes Ind Leag: Yes Ind PT: Yes Ind Int: Yes Ind Maint: Yes
## Facility Description Resv Count Fees & SC Discount Paid & SC Misc Amt Net Inc/Exp Refunds

<table>
<thead>
<tr>
<th>Facility</th>
<th>Description</th>
<th>Resv Count</th>
<th>Fees &amp; SC</th>
<th>Discount</th>
<th>Paid &amp; SC</th>
<th>Misc Amt</th>
<th>Net Inc/Exp</th>
<th>Refunds</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLLRM-KCC-C HOU</td>
<td>Community House</td>
<td>628</td>
<td>323,481.50</td>
<td>158,116.21</td>
<td>165,365.29</td>
<td>0.00</td>
<td>165,365.29</td>
<td>10,427.85</td>
</tr>
</tbody>
</table>

TOTAL NUMBER OF FACILITIES FOR RANGE SELECTED: 1
TOTAL NUMBER OF RESERVATIONS FOR RANGE SELECTED: 628
TOTAL FEES CHARGED FOR RESERVATIONS: 323,481.50
TOTAL DISCOUNT APPLIED AGAINST FEES: 158,116.21
NET AMOUNT STILL DUE: 0.00
TOTAL AMOUNT REFUNDED: 10,427.85
TOTAL AMOUNT PAID FOR ALL FEES LESS DISCOUNT (+): 159,512.66
TOTAL SURCHARGES PAID FOR CANCELS (+): 5,852.63
TOTAL MISCELLANEOUS FACILITY INCOME (+): 0.00
TOTAL MISCELLANEOUS FACILITY EXPENSES (-): 0.00

NET INCOME/EXPENSE FOR FACILITY RANGE SELECTED (=): 165,365.29
TOTAL RECEIPTS IN FACILITY RANGE SELECTED: 921
AVERAGE DOLLAR AMOUNT PER RECEIPT: 179.55

**SELECTION CRITERIA:**
- Resv Date Range: 01/01/09 Thru 02/12/16
- Refund Date Range: 01/01/09 Thru 02/12/16
- Misc Post Date Range: 01/01/09 Thru 02/12/16
- Booking Date Range: 01/01/09 Thru 02/12/16
- Individual Selections: BLLRM KCC C HOU
- Include Cancelled Reservations: Yes
- Incl Fac: Yes  Incl Actv: Yes  Incl Actv Hold: Yes  Incl Leag: Yes  Incl PT: Yes  Incl Int: Yes  Incl Maint: Yes
Results
At the time of this writing, the pavilion facilities had been available for use by the public for about thirteen months. Findings from the Bottom Line report indicated a total of 2821 bookings to date (as of February 12, 2016). As shown in figure 7.5, pavilion, gazebo, and fireplace bookings generated $223,667.29 in net revenue, excluding tax. When averaged, the provision of these facilities equates to $17,205.18 in monthly net income across the thirteen-month time span.

The information provided in the Facility Report for the Berlinsky House, shown in figure 7.6, spans the reservation date range of January 1, 2009 through February 12, 2016. During this time frame, the City received net revenue in the amount of $165,365.29. A breakdown of the number of annual reservations and associated revenue was also obtained; and, close examination revealed discrepancies between the amounts of revenue received in relation to the number of bookings. Upon further inquiry, the researcher learned that a significant number of the bookings had been granted reduced rental rates; thus, an accurate analysis regarding the impact of the Park’s redesign on revenue generation from the Berlinsky Community House reservations could not be conducted. With that being said, findings regarding reservation activity, particularly growth in the number of reservations in recent years, suggest that the Park’s redevelopment has exerted a positive influence on the number of Berlinsky facility reservations. In turn, substantial increases in reservations should result in greater revenue for the City.

The number of Berlinsky Community House reservations for the years 2008 through 2015, and the first six weeks of 2016, is depicted in figure 7.7, below. Phase 2 of the redevelopment project, completed April 15, 2013, resulted in site improvements and new amenities located in close proximity to the Community House. As seen in the graph, the number of reservations for the following year (2014) totaled more than the previous six years combined. Results also show that 2015 suffered a 32% drop in reservations from the previous year. This finding may be partially attributed to the addition of the pavilions in 2015, providing people with significantly greater access to a wider range of rental facility possibilities.
Figure 7.7: Berlinsky Community House reservations by year

* The reservation counts for 2016 reflect year-to-date bookings (February 12, 2016)

Limitations
:: Given that the data was collected from secondary sources, the chance exists that the data may contain inherent errors and/or omissions that are beyond the researcher's control.
:: Discrepancies exist between reservation counts and fees collected, particularly with regard to the Berlinsky report. Some of the bookings were city events, which were not charged for. Additionally, some bookings were for multiple days but counted as one booking; and, some events received a discounted reservation rate. This suggests that the potential for revenue generation from these facilities may be significantly greater than what is being realized. Inconsistencies in the dollar amounts charged and collected inhibited the execution of a comparative analysis of revenue generated by the Community House reservations, before and after the Park’s redevelopment.

7.4 Economic Performance Benefit 4: Supports Economic Viability of Local Businesses

Methodology
Indicator: Patronage of downtown businesses by Park users
Metric: Portion of survey respondents indicating downtown spending before or after Park usage
Data Source: Survey administered to Park users

A survey was developed to gather information on user perceptions and experiences related to visiting the Park. One of the survey questions was whether Lakeshore Park influenced patronage of nearby businesses before or after visiting the Park. The survey generated 88 participants: 76 participants were recruited from the Facebook Pages of the City of Kissimmee’s Park and Rec and of City Hall; 12 participants were recruited from promotional fliers distributed at the Park during a public event.

Results
Results regarding the survey question assessing economic benefits to downtown Kissimmee through park visitor spending are depicted on the following page, Figure 7.8.
This survey question pertains to the Park’s potential for contributing to the economic viability of downtown business establishments. 79.5% of the people surveyed spend money on shopping and/or dining downtown, either before or after they visit Lakefront Park. Survey results also indicate the mean spending range in the downtown area by these Park users is $10-$20. If the majority of all Park users spent just a few dollars downtown, the multiplier effect would be quite powerful. These findings suggest that one of the direct economic benefits from Lakefront Park is the increased patronage to downtown retail and dining establishments. In addition, tax revenue tied to this patronage also benefits the City. One dollar spent at a locally owned establishment is typically spent 6 to 15 times before it leaves the community. From each dollar, $5-$14 in value is created, enriching the whole community (Amundsen 2013). Much of this is attributed to the fact that local businesses recycle a much larger share of their revenue back into the local economy. With the majority of Lakeshore Park users being Kissimmee residents, study findings hint at the Park’s role in helping to retain the local dollar.
Limitations

:: The relatively small sample size (N 88) captured a narrow spectrum of Park users; and, as such, may not accurately represent the spending habits of all Park users.

:: Lack of data on visitor spending prior to Park redevelopment prevented any comparative analysis; however, as Park attendance numbers have doubled since the January 2015 Grand Opening, it stands to reason that the downtown district has experienced revenue growth related to the increased number of Park users.

7.5 Economic Performance Benefit 5: Reduces Maintenance Costs

Methodology

Indicator: Decrease in expenses associated with maintaining Park site
Metric: Projected savings in use of effluent water for site irrigation
Data Source: Irrigation rates—City of Kissimmee Public Works and Parks and Recreation Departments

The reuse of effluent water for irrigation purposes (effluent water is also known as treated waste water or grey water) is recognized as a sustainable practice that plays an important role in our overall water supply for the future. While this application of recycled water helps to conserve high quality water (as discussed in the ecological performance benefits chapter), it also provides the economic benefit of reducing the costs associated with City water usage.

Kissimmee’s City owned water authority, Toho Water Authority (TWA), controls the treatment, storage, and distribution of grey water. The treated water is stored at their facilities and is pumped to the specific locations that have the proper water lines in place. During project construction, Lakefront Park was plumbed with the piping required for effluent irrigation; and, is currently awaiting connection between the Park and TWA's nearest treatment plant. In the meantime, Lakefront Park has been utilizing municipal potable water for all of its irrigation needs.
Results
Table 7.2 displays the estimated water usage rates associated with the use of potable water and grey water for the study site. Grey water estimates are based upon the Park’s 2015 potable usage rates and costs.

Table 7.2: Potable and grey water cost comparison

<table>
<thead>
<tr>
<th></th>
<th>Water Meter Cost (N5)</th>
<th>Water Usage Rate ($/gallon)</th>
<th>Water Usage Quantity (gallons)</th>
<th>Water Usage Cost ($)</th>
<th>Estimated Total Annual Cost (usage + meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Potable Water</strong></td>
<td>$21.50 ea. x 5</td>
<td>$3.00</td>
<td>8737</td>
<td>$26,211.00</td>
<td>26,211.00 + 1,290.00</td>
</tr>
<tr>
<td>(2015)</td>
<td>$107.50/month</td>
<td></td>
<td></td>
<td></td>
<td>$27,501.00</td>
</tr>
<tr>
<td></td>
<td>$107.50 x 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$1290/year</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grey Water</strong></td>
<td>$26.35 ea. x 5</td>
<td>$1.34</td>
<td>8737</td>
<td>$11,707.58</td>
<td>11,707.58 + 1581.00</td>
</tr>
<tr>
<td>(near future)</td>
<td>$131.75/month</td>
<td></td>
<td></td>
<td></td>
<td>$13,288.58</td>
</tr>
<tr>
<td></td>
<td>$131.75 x 12</td>
<td></td>
<td></td>
<td></td>
<td>[+$14,212.42]</td>
</tr>
<tr>
<td></td>
<td>$1581/year</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total municipal water irrigation costs for 2015 were $27,501.00. Projected estimates for grey water irrigation, based on the 2015 figures and the effluent water meter fees, were $13,288.58. The findings demonstrate how the use of grey water, versus potable, for the Park’s irrigation needs may result in an estimated cost reduction of more than 50%, with an annual cost benefit savings of $14,212.42. Irrigating the Park with grey water would also provide an important benefit by conserving nearly 9000 gallons of potable water each year. While greywater decomposes rather quickly in soils after infiltration, and does not travel to pollute nearby drinking water nearly as much as combined wastewater discharge (Greywater.com, 2014), concern arises in regard to any potential threat to the water quality of the Lake through the use of greywater for irrigation.
Limitations
:: The findings reflect calculated estimates based upon water usage amounts, which will vary from year to year according to weather conditions and other factors.

7.6 Synopsis
The following indicators reflect Kissimmee Lakefront Park’s performance in providing economic benefits:

- Generated nearly one-quarter of 1 million dollars in Park facility rental revenue during the first year following the Park’s Grand Opening

- Increased the number of new Business Tax Receipts (occupational licenses) by 112% from 2010-2015 (project construction through Grand Opening: 157 new BTRs), as compared to 2004-2009 (pre-construction: 74 new BTRs), in the downtown area located within one-half mile of the Park

- Expected to save over an estimated $14,000 per year in maintenance costs upon completed conversion to greywater irrigation, while conserving over 8700 gallons of drinking water.

- Improves economic viability of downtown businesses by helping to retain the local dollar, with 79% of surveyed Park users shopping and/or dining downtown during Park visit days.

- Contributes to the continuing growth of the area with $250 million in new private real estate and public transportation infrastructure development in the surrounding ¼ mile neighborhood projected to enhance the live, work, play climate for downtown and provide an additional link to the Park and downtown area, as well as to employment opportunities reaching past Orlando.
The research herein has attempted to quantify and qualify tangible proximate benefits resulting from the intangible benefits of this landscape architecture project. Findings point to the real estate and infrastructure investments slated for commencement in proximate location to Lakefront Park, as well as the increased activity of issued Business Tax Receipts as tangible benefits. These benefits have taken root through the hope, opportunity, energy, and pride (the intangibles) borne from the reinvention of this public landscape.

Indirect economic effects of the Lakefront Park project were evidenced through the stimulated interest in new businesses as well as the commercial redevelopment opportunities. In addition, downtown patronage by Park users and revenue generation through the availability of new Park facilities were found to be direct economic impacts of the recently redeveloped Park. For example, pavilion rentals generated nearly one-quarter of $1 million in revenue during the first 13 months following completion of the Park’s redevelopment. In comparison, rental income from the Berlinsky Community House, the primary revenue generator for the Park prior to redevelopment, was just over $160,000 over the course of the past 6 years.

From the researcher’s perspective, this experience has shown that economic improvement can be problematic to quantify due to challenges in selecting variables and collecting data. Economic data is typically collected at city, county, regional, and national scales, making it quite difficult to assess the degree of economic impact generated by a specific landscape architecture project. One approach to overcoming these challenges was to gather historical data (i.e., local Business Tax Receipts) in proximity to the project area and conduct a longitudinal comparison that demonstrated how local business growth increased over time. Continued research in the years ahead will be required in order to develop a more complete picture and conclusive determination of the extent of economic benefits provided by Kissimmee’s Lakefront Park.
8 :: DISCUSSION AND CONCLUSION

In the attempt to quantify the performance benefits of a landscape architecture project located in Kissimmee, Florida, this research also shed light on the ways in which these values—generated or promoted by designing the land—can be measured and conveyed, and uncovered some of the challenges associated with doing so.

Toward reflecting upon the outcome of this research endeavor, the questions that drove this project are listed below.

- What are the performance indicators and methods utilized in evaluating the ecological, social, and economic performance benefits of designed landscapes?
- What are the appropriate performance indicators and corresponding methods for measuring and evaluating the ecological, social, and economic performance of Kissimmee’s Lakefront Park?
- How is the designed landscape of Kissimmee Lakefront Park performing, on ecological, social, and economic levels?
- What are the lessons learned from this endeavor to study landscape performance, and how might these lessons be useful toward further landscape performance research?

By reviewing landscape performance literature, including the LAF’s CSI series, the Sustainable Sites Initiative handbook, and the work of Marc Francis and others, this research was able to identify a multitude of landscape performance criteria and methods that could be applied toward the evaluation of designed landscapes. The performance indicators associated with various functions, or benefits, of a landscape architecture project, and potential methods and instruments for evaluating these functions were organized and tabled within the 3 classifications of benefits—ecological, social, and economic.
From the generated list of potential performance indicators and methods, those deemed most appropriate for measuring and evaluating the ecological, social, and economic performance of Kissimmee Lakefront Park were selected. Stormwater interception, increased biodiversity, realized opportunity for social engagement and recreational activity, and increased growth of new businesses are examples of a few of the performance criteria determined as suitable for study. The decision of what could be studied was largely dictated by the estimated cost, in time and finances, that might be involved in learning and performing software and/or field techniques, as well as the availability of existing data.

Given that the site is a green infrastructure stormwater park, and the researcher’s academic focus lies within the field of landscape architecture, the initial intent was to examine more of the site’s functions directly associated with stormwater management. From time to time in the research process, unanticipated factors of constraint (namely lack of baseline data or lack of access to such data) interfered with the ability to successfully carry out analysis on a given performance indicator. Adopting a flexible mindset and being able to revisit the lists of potential performance criteria to consider the feasibility of an alternative measure, or alternative indicator and measure, was critical to the success of this project. The end result was the evaluation of as many relevant performance criteria as possible, within the study time frame. In evaluating a multi-functioning, high performance landscape, the question becomes one of what can’t be studied, rather than of what can.

8.1 Key Findings

As the study progressed, it became evident that a greater time span between the Park’s grand opening and the time of research would have afforded a stronger performance study, particularly in regard to ecologic and economic indicators. In turn, this would have resulted in a stronger argument for Lakefront Park’s effect upon Kissimmee’s downtown renaissance. With that being said, study findings for a number of the indicators, such as the dollar savings in converting to grey water to satisfy site irrigation needs, provides the sort of quantifiable evidence that landscape architects need, in order to make the case for sustainable infrastructure and help clients move beyond concern for immediate costs by understanding the potential for future gain.
Findings from the Park user survey helped shed light on how Lakefront Park is being harnessed as an asset to the community. The Project for Public Spaces lists four key qualities in the making of a successful place: sociability (pertaining to ‘welcoming’, ‘friendly’); uses and activities (traits such as ‘celebratory’, ‘educational’); comfort and image (associated with ‘safe’, ‘attractive’); and, access (described as ‘accessible’, ‘walkable’). Toward determining whether this project is succeeding as a place-making landscape, this study has brought forth Park users’ attitudes and behaviors associated with the meaning of these intangible qualities.

Judging by the results, this reinvented landscape has begun to create a new focal point while building upon downtown Kissimmee’s sense of place. This was evidenced by the strong perception of the Park’s value in all of the following: enhancing the downtown lakefront, adding to the area’s identity, enabling people to feel safe within its boundaries, promoting environmentally sustainable behavior at home and awareness of natural resources, and serving as a place to meet new people and attend civic events and family celebrations. Findings were supported by the behavior maps showing extensive use of nearly all parts of the Park throughout the span of the day.

Findings also showed the Park is providing an array of ecological functions that benefit the environment and society. These include carbon sequestration and stormwater interception, the reduction of stormwater runoff pollutant loads, increased ecological integrity of plant communities, and an increase in the number of bird species that utilize the site for habitat. These benefits would not have been realized if it were not for the Park’s redesign and its newly planted trees, rain gardens and baffle boxes, and riparian vegetation.

Hope, faith, and reinvestment in a community are powerful, yet intangible social benefits that can be challenging to measure. Similar to the Lowland Park case study, evidence was collected in search of any patterns of the tangible proximate benefits (e.g., increased business activity) resulting from the intangible benefits (pride, energy, opportunity, etc.) of this redesigned public landscape. Overall, results suggest the redeveloped Lakefront Park has already begun to have positive economic impact upon the downtown area. The uptick in the pattern of activity in revenue generated from the onsite facilities and number of new business tax receipts (or occupational licenses) was evidenced through this research.
8.2 Recommendations

More needs to be done in regard to establishing credible data collection methods that are consistent for both pre-construction and post-construction means of data collection.

One of the aims of this study was to generate baseline data regarding the ecological, social, and economic benefits of Lakeshore Park following its first year of project completion, with the hope that the baseline results would be utilized in subsequent studies. Toward this end, every attempt was made to carefully document the steps and procedures for each collection method. The development of acceptable standards that can be employed across ranges of similar projects will greatly increase the reliability of performance-based study of the built landscape.

Performance studies employing survey instruments to collect human response should not underestimate the value in augmenting the survey with open-ended questions.

Social performance is the central purpose of public space, yet it is the least developed dimension in the sustainability literature. The main challenge lies in the qualitative, heterogeneous nature of social metrics. This study attempted to counter this limitation by utilizing a user survey with closed-end questions, supplemented by behavior mapping through registration and transfer of specific data points. Through the process of analyzing the online survey, it became clear that study results would have benefitted from the addition of qualitative responses, as this would have allowed for personal expression of opinions and beliefs held by Park users, resulting in richer analysis.

Research toward development of more sophisticated landscape performance analyses is needed, as this will help make the case for landscape projects that require significant buy-in.

Toward this end, more work needs to be done in stepping up quantified findings for benefits by assigning tangible valuation. As demonstrated in this study, valuation in CO2 sequestration, as measured by the number of passenger vehicles removed from the road, was a relatively straightforward process. However, the assignment of equated value to health care savings, or added days of employment, attributed to a decrease in asthma-related doctor visits due to greater CO2 sequestration, would be much more challenging to realize.
Change and time need to be incorporated into the research (and design) process. At present, most of the landscape performance research cases appear to base conclusions on findings captured over a very brief period of time. Yet, one of the inherent qualities of landscapes is their constant state of flux. One-time recordings can not show an accurate picture of sustainability. Systematic performance monitoring and data collection throughout the life of a project would be one of the most valid approaches for generating evidence toward greater understanding of landscape performance. In addition, monitoring and modeling programs may lead to identification of designs that hold potential for producing the most significant impacts. As discussed in the Case Studies Chapter, the Canal Park case study is a rare example within the LAF’s CSI series, dedicating a full year to monitoring the social values of the site.

Conducting ongoing research in the performance of the site featured in this study would be very useful. The study site presents opportunity to learn more about the performance of the rain gardens, by assessing stormwater water filtration and retention capacity through water quality and water quantity measures, as well as evaluating biodiversity through the provision of habitat for reptiles, amphibians, butterflies, bees, and other insects. In regard to social benefits linked to the Park, more needs to be known about the educational value of the site and its effectiveness for promoting ecological awareness. In addition, the aspect of social equity and access to public open space, an integral key to sustainability, should receive further attention by studying the users of this site. For greater insight into economic effects of this landscape architecture project, the progression of time will offer opportunity for robust analyses of economic benefits stemming from increased property values and tax revenues of proximate land parcels.
8.3 Lessons Learned

One of the anticipated outcomes of this research project was that the knowledge gained would contribute to the researcher’s ability to adopt a performance-based approach in planning and designing landscapes. Several lessons came to light during the processes of this study.

*The first lesson highlights the importance of collecting data long before the commencement of construction*

The application of baseline data (i.e., pre-construction conditions) with primary or secondary data (post-occupancy conditions) would have made a significant contribution toward the rigor of the analysis. For example, analysis of primary data revealed that the 1003 newly planted trees were capable of sequestering 123,203 pounds of CO2 and intercepting 1.65 million gallons of stormwater runoff. These results are insightful and encouraging; however, they fail to provide a complete picture. A total of 297 trees were removed during project construction phases 1 and 2. Key informants confirmed that some were diseased or invasive. If DBH measurements had been recorded on the remaining trees prior to their removal, the baseline data would have afforded opportunity for comparative analysis.

Findings would have then indicated the degree of change in amount of carbon sequestered or stormwater runoff intercepted, and whether this result was in fact an improvement. Albeit, the primary data collected and the resultant findings for the trees planted does serve a useful purpose as baseline data, enabling future comparative analysis on how well the site is performing carbon sequestration and stormwater interception functions. However, for landscape architects to better make the case for how the outlay of financial resources is justified in the creation of a proposed project, the importance of collecting baseline data for communicating landscape performance must be underscored.
The second lesson deals with the role that the availability of resources (i.e., knowledge, expertise, time, access to data) plays in procuring robust results.

This was brought to light on several occasions throughout the research process, but I will use the case of measuring biodiversity to illustrate the point. In some instances, it is not just the number of species present but the assemblage that can indicate habitat quality. While beyond the scope of this research, conducting a longitudinal study examining shifts in generalist and specialist species would have contributed to a more rigorous analysis of biodiversity. In the case of bird species, a valid way to accomplish this involves the use of an instrument known as the Bird Community Index Score, which calculates the types of birds present. However, most landscape architects lack the time, and degree of (bird) knowledge, to undertake such a task. As the field of landscape performance expands, the importance of using more complex measuring methods that produce a greater degree of reliability and validity will also increase. Recognition of (1) the role that allied specialists can play in assisting with conducting these measures, and, (2) furthering the development of resources available to design professionals interested in sharpening their performance research skills, will be important steps toward strengthening the accuracy of quantified landscape performance benefits.

A third lesson learned touches upon the potential role that performance research can exert upon improving the sustainability of land design.

The Coefficient for Conservatism (CC) and Plant Stewardship Index (PSI) are fairly underutilized, yet valuable tools that can guide the fate of a landscape. Having knowledge of plant species’ habitat tolerance ranges can better inform plant selection, particularly when addressing the management of landscapes over time, as well as throughout changes in ecosystems. When specific habitat requirements are not present, plants with higher CC values will not exist for very long, and this is not a sustainable way in which to design. In situations where a high degree of natural and/or anthropogenic disturbance is anticipated, plants with lower CC scores can be utilized, resulting in less maintenance, greater plant longevity, and a greater degree of habitat preservation. In applications for a more natural landscape where the only maintenance may be the removal of invasive species, knowing the stage of
succession that one is designing for, and then using the CC scores to inform design, could result in designed landscapes that are more resilient.

Along these same lines, measuring landscape performance can lead to successful design for the creation of real habitat. This can be accomplished through site inventory of pre-construction vegetation and living organisms in order to provide a picture of the site’s biodiversity and the conservation opportunities and challenges unique to the site. From this data, the plan for the site’s design can be adjusted to benefit species of concern and protocol for future monitoring can be developed. The information generated from site monitoring would provide evidence of whether the biodiversity and conservation goals are succeeding, as well as speak to the effectiveness of management practices in support of these goals.

The fourth lesson pertains to the factor of time and its consideration when mapping out a performance-based case study.

By nature, case studies rely heavily on secondary data sources. The hunt for this type of data is a time-consuming process that requires persistence and patience, as well as organization and flexibility. During the planning phase of the research project, it is important to allot more time than one would initially predict for accomplishing the task of secondary data collection.

The fifth lesson is the reminder that, whether it be research or design, the project will always be fraught with opportunities that will go unrealized.

The Lake Toho Restoration Initiative includes a stormwater reuse component that would provide water quality, supply, and storage benefits to the local area as well as the greater Kissimmee-Okeechobee-Everglades watershed. This begs the question of why stormwater reuse features were not incorporated into the re-design of Lakefront Park. Aside from the water conservation benefits, approaches to capture and store rain water (potentially from the rooftops of the pavilions and other structures) could have also served as an opportunity for artistic expression as well as furthering stormwater education.
8.4 Concluding Words

Landscape performance has been defined as the measure of efficiency with which landscape solutions fulfill their intended purpose while contributing toward the achievement of sustainability. The application of design solutions in Lakefront Park’s redevelopment aim to reduce pollution, stimulate downtown economics, introduce users to the concept of native plants in the landscape, promote environmental awareness and clean water education, and provide a civic backyard where the people of Kissimmee could congregate. Results of this study provide early stages of evidence of Lakefront Park’s ability to successfully begin to fulfill these intended purposes. As designed landscapes are constant works in process, ongoing research will be necessary toward the determination of Lakefront Park’s contribution to Kissimmee’s goals toward achieving sustainability.

Findings from this study add to our understanding of how the knowledge gained from measuring the performance of the landscape can strengthen the ways in which we design for sustainable solutions by bringing together the goals of the client and the realities of the site, backed by scientific analysis of the site’s functions. Amidst the attention and excitement currently wrapped in the evolution of landscape performance and its application to designing land in ways that maximize functions which help satisfy the ongoing pursuit of sustainability, it is important to remember that, first and foremost, public spaces must work in ways that make our hearts sing. It would appear that Kissimmee’s newly (re) invented Lakefront Park is succeeding on both fronts.
WORKS CITED


APPENDIX A :: IRB APPROVAL LETTER

January 6, 2016

TO: Leslie Babiak

FROM: Ira S. Fischie, PhD; Chair
University of Florida
Institutional Review Board 02

SUBJECT: Exemption of Protocol #2015-U-1484
Quantifying Ecological, Social, and Economic Benefits of the Designed Landscape: A Performance Based Case Study of Kasımee, Florida’s Lakefront Park

SPONSOR: None

Your protocol submission was reviewed by the IRB. The Board determined that your protocol is exempt based on the following category:

45 CFR 46.101(b)(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior

Should the nature of your study change or if you need to revise this protocol in any manner, please contact this office before implementing the changes.

IF: df
APPENDIX B :: INFORMED CONSENT

Title: Quantifying ecological, social, and economic benefits of designed land: A performance-based case study of Kissimmee Florida’s Lakefront Park

Please read this consent document before you decide to participate in this study.

Study purpose
This is a research project being conducted by a graduate student in the Department of Landscape Architecture at the University of Florida. The purpose of this study is to determine the ecological, social, and economic benefits provided by Kissimmee Lakefront Park.

What you will be asked to do in this study
You will be asked to fill out an online survey. The short survey contains 15 multiple choice questions about your use and experience of Kissimmee Lakefront Park. Your answers will provide information regarding the social benefits provided by the park.

Time required
Less than 10 minutes

Risks and Benefits
There is a minimal risk that security of any online data may be breached, but since (1) no identifying information will be collected, (2) the online host uses several layers of encryption, and (3) your data will be removed from the server soon after you complete the study, it is highly unlikely that a security breach of the online data will result in any adverse consequence for you. If you would like further details regarding your security during survey participation, please use the following link: https://www.surveymonkey.com/mp/policy/security/

Confidentiality
Your responses will be confidential, as we will not collect identifying information such as your name, email address, or IP address. The results of this survey will be used for scholarly purposes.

Voluntary participation
Your participation in this survey is voluntary. If you decide not to participate, you will not be penalized.

Right to withdraw from study
If you decide to participate in this research survey, you may withdraw at any time without penalty.
Who to contact if you have questions about the study
Leslie Babiak, Graduate Student  Dept. of Landscape Architecture  lesliebab@ufl.edu
Michael Volk, Research Assistant Professor  Dept. of Landscape Architecture  mikevolk@ufl.edu

Who to contact about your rights as a research participant in the study
IRB02 Office  Box 112250  University of Florida  Gainesville, FL 32611  352-392-0433

Electronic Consent
Clicking on the “agree” button below indicates that:
• You have read the above information
• You voluntarily agree to participate
• You are at least 18 years of age

If you do not wish to participate in the research study, please decline participation by clicking on the “disagree” button.

agree  disagree
APPENDIX C :: Lakefront Park Visitor Survey

1. On average, how often do you visit Kissimmee Lakefront Park?
   (note: answer selection will have radio buttons, enabling only 1 response)
   
   Every day
   Several times a week
   About once a week
   About once a month
   Once every six months
   Once a year or less
   Not sure
   I’ve visited one time

2. When do you use the park?
   Please select all that apply.
   (note: answer selection will have check boxes, enabling multiple responses)

   morning
   afternoon
   after sunset
   weekdays
   weekends

3. How do you usually arrive at the park?

   on foot
   by bicycle
   by car
   by motorcycle
   by public transportation
4. What is your motivation for visiting Kissimmee Lakefront Park? 
   Please select all that apply.

   - exercise/fitness activities
   - enjoying nature and being outdoors
   - socializing with friends and family
   - stress reduction
   - other

5. What are the primary activities in which you participate while in the park? 
   Please select all that apply.

   - walking
   - jogging/running
   - cycling
   - skating
   - walking dog
   - picnicking/eating
   - use splash pad
   - use playgrounds
   - relaxation
   - outdoor education
   - fishing
   - boating
   - community events

6. Please select one answer to complete the following statement:

   When I am at the park, _____________________________

   - I feel welcome in all parts of the park
   - I do not feel welcome in all parts of the park
7. While in the park, how have you met new acquaintances?
   Please select all that apply.
   
   through my kids
   through my dog or pet
   sitting
   marina
   restaurant
   through park staff
   fishing
   cycling
   movie night
   scheduled event
   other activity
   I have not made any new acquaintances at the park

8. Before or after visiting Kissimmee Lakefront Park, how much do you typically spend on shopping or dining within the downtown area?
   
   $1 - $10
   $10 - $20
   $20 - $30
   $30 - $40
   $40 - $50
   more than $50
   I do not shop or dine downtown before or after visiting the Park

9. Did you happen to attend any of the community meetings where Kissimmee residents voiced their ideas, opinions, and desires for the redesign of the park?
   
   yes
   no
10. Please select all with which you agree, based on your experience and use of the park: Kissimmee Lakefront Park …….

- contributes to the area’s sense of identity
- promotes a healthy lifestyle
- enhances the aesthetic (beauty) of the downtown lakefront
- improves my quality of life
- increases my outdoor activity
- enhances my understanding of the area’s cultural history
- contributes to my understanding of alternative stormwater management practices
- creates habitat for wildlife
- is accessible for people with disabilities
- promotes educational opportunities
- promotes get-togethers with friends, family, or others
- promotes scheduled outdoor events

11. For the following question, please select one answer.

   How do you perceive the native plantings used throughout the park?

   - I like the planting at the park, and I would use native planting at home
   - I like the planting at the park, but would not use native planting at home
   - I do not like the look of the native planting at the park

12. What aspect of Kissimmee Lakefront Park contributes the most to making you feel safe and secure?

   - It is open, so it easy to see the area around me
   - It is well lit at night
   - It is busy; I feel safe when there are people around
   - The presence of security personnel
   - I do not feel safe and secure when I visit Kissimmee Lakefront Park
13. For the following statement, please select one response:
Visiting Kissimmee Lakefront Park has led to an increase in behaviors, by myself and/or my family, that contribute to sustainability (such as conserving water, reducing the use of fertilizers or pesticides, using drought tolerant plants in the home landscape, etc.):

   strongly agree
   agree
   neutral (neither agree nor disagree)
   disagree
   strongly disagree

14. For the following statement, please select one response:
The re-design of Kissimmee Lakefront Park reflects what local residents wanted in their park.

   strongly agree
   agree
   neutral (neither agree nor disagree)
   disagree
   strongly disagree

15. For the following statement, please select all that apply.
After visiting Kissimmee Lakefront Park, I have a better understanding of:

   the role of rain gardens in capturing and cleaning storm water
   the importance of water conservation
   Kissimmee's cultural meaning and/or historic foundation
   the role of plants and trees in providing food and shelter for wildlife
   Lake Toho's ecological and/or historical contribution to Kissimmee
   how common activities, like watering lawns or washing cars, can harm the quality of our waterways
   none of the above
16. Please specify your race or ethnicity

   White
   Hispanic or Latino
   African American or Black
   Native American or American Indian
   Asian or Pacific Islander
   Filipino or Filipino American
   Other

17. Where is your place of residence?

   Within walking or biking distance of Kissimmee Lakefront Park
   Kissimmee, but beyond walking or biking distance of the Park
   Osceola county, but outside of Kissimmee
   Florida, but outside Osceola county
   In another state within the United States
   In another country outside of the United States

YOUR FEEDBACK IS GREATLY APPRECIATED
THANK YOU FOR TAKING THE TIME TO PARTICIPATE IN THIS SURVEY
APPENDIX D :: Anecdotal Supplements

The following excerpts provide anecdotal evidence as to the value provided by Lakefront Park. The first piece is a blog entry by real estate broker, Mark Horan. A resident of Kissimmee since 1986, Mr. Horan’s words shed light upon the Park’s unique character and special features. The second piece is a commentary featured on the LinkedIn page of Brandon Cappellari, one of the registered landscape architects involved in the early stages of the project’s design phase. Mr. Cappellari speaks about the strategic layout of the Park and the creation of important linkages. The third and final piece of evidence rests within a letter written by Florida Fish and Wildlife Conservation Commission’s fisheries biologist, Marty Mann, who provides a testament to the Park’s ecological and social value through its ability to enhance and protect the water quality of Lake Toho.

Activerain.com  (a Realtor’s blog by Mark Horan)
http://activerain.com/blogsview/4591343/-30m-lakefront-park-renovation-in-kissimmee-florida
Jan 29, 2015
This park was built with the people of our city in mind. The road that used to bisect the lakefront park area has been removed, making the park safer for pedestrians. There are new interior sea walls designed as places someone could sit if they liked, and drainage areas leading to the lake are cleverly disguised as hidden “retention gardens” to be pleasing to residents’ eyes. The retention ponds are designed to exist as water features during our rainier months (sorry, they’re bone dry in my pictures today) as well as filter out less desirable pollutants from the water before it reaches our lake systems.

New, wider sidewalks make biking, jogging and walking your furry friend easier for pedestrians. Some sidewalks branch off into wooden trails that meander through native plant and rock gardens featuring stones mined in Florida quarries. Most of the new park facilities are booked—a year in advance at this time—and were built with history in mind. Each of the fifteen rentable pavilions were built in the early 1900’s style with tin roofs and wooden ceilings.
The marina was moved from its former place in the center of the park, to where it should have always been, down by the boat slips on the other end of the park. The park is expected to draw people from outside the city and county in 2016 when the new SunRail station is extended into Downtown Kissimmee. The station will be just two blocks away, making it easier for Orlando and Winter Park natives to make a day of enjoying our new facilities and downtown areas.

LinkedIn.com
Page of Brandon Cappellari, RLA, ASLA, LEED AP

While at Glatting Jackson/AECOM I was a key team member during the design and implementation of Kissimmee’s new Lakefront Park. Realigned streets border the park and were part of the initial phase of construction to get all necessary infrastructure and road network completed prior to park construction. The streets are now open to the public and have been well received.

A bold, yet important aspect of the project was reconfiguring an existing waterfront park and roadway system to create a more functional public open space as well as highly attractive and usable adjacent parcels for economic development. The result is a repositioned 25-acre community park on Lake Toho, new ‘Green Street’ streetscapes connecting the lake to Downtown, and approximately 8 acres of new redevelopment property-addressed on the new Lakeview Drive and proximate to a planned future downtown commuter rail station.

The new park strengthens the relationship of Lake Tohopekaliga to the Downtown, and provides a variety of community engagement opportunities. The northern half of the park is designed to reinforce the garden like character of the park, respond to a significant Live Oak canopy and several important civic monuments and community buildings. The southern half accommodates large community events, including an enhanced marina/restaurant complex which will become the focus of the fishing tournaments that Kissimmee is known for. The park is unified in the center by Ruby Avenue plaza and pier, market pavilion and waterfront steps. Rain gardens, native plantings, rebuilt seawall and educational signage make the park a demonstration of green design.
principles. The waterfront promenade, walking trails, playgrounds, small and large pavilions, splash park and events areas insure that this park will be meaningful to all members of the community for big events and breezy afternoons on the waterfront.

Letter of Recommendation from Fisheries Biologist Marty Mann

February 18, 2014

To Whom It May Concern:

I am writing in support of the nomination of the Stormwater Project at Kissimmee Lakefront Park for the Florida Stormwater Association’s Project Excellence Award. The project is located in Kissimmee, Florida in Osceola County and borders Lake Tohopekaliga. Lake Tohopekaliga is recognized as an important recreational destination by the state of Florida, Osceola County and the City of Kissimmee. It is especially known for its outstanding fisheries. People from all over the world come to Lake Tohopekaliga to fish for trophy largemouth bass of which the lake is famous for producing year-in and year-out, resulting in millions of dollars annually for the local economy.

One of the most important aspects to our fisheries and to Lake Tohopekaliga overall is good water quality and sufficient water quantity. In the past, runoff from rainfall emptied into the lake with absolutely no treatment. However, this stormwater project curtails that and is a positive step in maintaining the critical needs of water quality and quantity for Lake Tohopekaliga.

Once a lake becomes “polluted” it is very difficult and expensive to restore back to health. Therefore, an aggressive and proactive approach will not only decrease costs to the citizens, but it will maintain the economic value and improve the quality of life for all who enjoy Lake Tohopekaliga and the City of Kissimmee Lakefront Park. This project helps accomplish these important goals.

Sincerely,

Marty Mann

Fisheries Biologist, Florida Fish and Wildlife Conservation Commission