Designed Fields: Increasing the collaboration between landscape architecture and sustainable agriculture in the design of multifunctional landscapes

by

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A REPORT

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ABSTRACT

Traditionally, sustainable agriculture has been focused on soil health and the economics of production, however, this definition is now broadening to include ecology and education. The goal of sustainable agricultural practices is to minimize the adverse effects of farming on surrounding ecosystems and instead strive for long-term stability of the entire agricultural enterprise, environmental protection, and consumer safety (McDonnell 2011; Powlson et al. 2011). Landscape architecture is the design of outdoor space to achieve environmental, social, and/or aesthetic outcomes (Jellicoe 1975). Though landscape architecture has traditionally leaned towards aesthetics and social interaction, since the mid-20th century the work of many landscape architects has shifted towards ecological sensitivity while maintaining existing aesthetic and sociological functions. Today, sustainable agriculture and landscape architecture are becoming even more similar and face many of the same challenges. Although key differences remain, both fields emphasize ecology, economics, sociology, and aesthetics (Hill 2016; Yu 2016). Despite overlaps in design considerations and outcomes of intervention, the two fields and those working within them, rarely collaborate.

In this project, landscape architecture and sustainable agriculture theories, principles, and research are studied in order to clearly illustrate their similarities and differences. The fields are compared to identify areas where existing knowledge bases overlap in research, design practices, and landscape performance assessment strategies. The culmination of this research leads towards the adjustment of landscape performance metrics within landscape architecture. These adjusted metrics are then used to analyze existing multifunctional agricultural landscapes to determine successes, failures, and opportunities for improvement. The case study analysis, in combination with a rich understanding of the fields, result in suggested site considerations and programming elements for future projects. The research culminates in a single design project which acts as an example for how sustainable agriculture strategies can inform the design and assessment of multifunctional agricultural landscapes. Final design strategies and the previously determined landscape performance metrics have the potential to influence existing landscape assessment tools within landscape architecture and encourage a greater degree of collaboration between landscape architects and other related disciplines.

DESIGNED FIELDS

Increasing the collaboration between landscape architecture and sustainable agriculture in the design of multifunctional agricultural landscapes

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KEY TERMS

LANDSCAPE ARCHITECTURE

The art and science of designing outdoor space, together with the materials and objects within it, to achieve environmental, economic, social, and aesthetic outcomes (Jellicoe 1975, Newton 1971, Calkins 2015).

SUSTAINABLE AGRICULTURE

Sustainable agricultural practices allow for a sustained level of production of food, fiber or protein, while building and maintaining a healthy soil system. The goal of these practices is to minimize adverse effects to surrounding ecosystems and to achieve long-term stability of the agricultural enterprise, environmental protection, and consumer safety (McDonnell 2011; Powlson et. al. 2011).

MULTIFUNCTIONAL LANDSCAPES

Landscapes that meet multiple goals and provide multiple functions. These landscapes are generally more desirable than traditional single-purpose landscapes. Multifunctional landscape designs are often based on the multifunctionality of natural systems and can be used to save space and energy in urban environments (Kato and Ahern 2009).

PERI-URBAN ENVIRONMENT

The, “open lands and farmlands surrounding cities that are subject to commercial or housing development because of urban expansion and city growth pressures” (Hansen and Francis 2007, p. 43).

INTRODUCTION

CHAPTER ONE

INTRODUCTION

Throughout time, our environment has symbolized natural beauty, human ingenuity, and spiritual freedom. Historically, humans and their environment have been intertwined, with humans dividing the land into natural, rural, and urban spaces. Today, these boundaries are more distinct than ever before (Pregill and Volkman 1993). Farmers began the process of reconstructing natural environments into productive landscapes. Clearing forests for pastures and fields, they have exposed soils to erosion, altered the path of water, and fenced off landscapes into parcels. The altering of landscapes may have begun with farmers, but today they are not the only contributor to landscape change. Engineers, developers, city planners, and landscape architects all have significant impacts on the environments we live in and rely upon (Marsh 1964).

Landscape architecture and sustainable agriculture are both growing fields seeking to address the increasing needs of urban and rural populations. The two professions overlap significantly in their study of ecology, economics, aesthetics, and sociology. Despite significant progress being made in each discipline, limited effort is being made in either community to bond and collaborate with the other in order to more thoroughly design and create multifunctional landscapes. Multifunctional landscapes are those that meet multiple goals and provide multiple functions. These landscapes are generally more desirable than traditional single-purpose landscapes and are often based on the multifunctionality of natural systems, saving space and energy in urban environments (Kato and Ahern 2009). Multifunctional designs offer the opportunity to maintain a productive landscape while allowing for economic growth and considering the future needs of communities and the environment (Hansen and Francis 2007).

Figure 1.01
Visual report outline

This report is organized into six chapters including the Introduction, Background, Methodology, Case Studies, Design Application, and Conclusions. Each chapter serves a distinct purpose and the report documents the collection of research, case studies, and design strategies supporting increased integration between the two fields. A visual outline of the book organization can be seen in Figure 1.01.

DILEMMA + THESIS

Both, the fields of landscape architecture and sustainable agriculture have multiple systems of performance metrics in use to determine the success of sustainable project solutions. Landscape architects use the Sustainable SITES Guidelines, the Landscape Architecture Foundation (LAF) Landscape Performance Metrics, and individual firms' sustainability metrics. Sustainable agriculture lacks universal sustainability metrics; still, there are multiple options for guidelines and measurement strategies including the Field to Market National Indicators Report, the Stewardship Index Metrics, and the Performance Indicators for Sustainable Agriculture. However, despite sharing many values, goals, and practices, the professions of landscape architecture and sustainable agriculture do not collaborate on mutually relevant performance metrics. Both professions could benefit from an increased exchange of information about performance, in terms of both strategies and metrics.

In this report, the fields of landscape architecture and sustainable agriculture are studied in order to reflect upon the similarities within the disciplines and allow for integration between them. The research investigates and analyzes a set of four case studies. The case studies are analyzed according to a set of landscape performance metrics collected from both landscape architecture and sustainable agriculture and assist in the formation of projective design strategies for future implementation projects. These design strategies are integrated into the design of a multifunctional agricultural landscape. Upon the completion of the project design, the report reflects on existing and proposed landscape performance metrics in order to suggest enhancements and improvements for the future.

PURPOSE + PROJECT GOALS

The greatest challenges of humanity today serve as reminders of the ever-growing need to balance human and natural systems. The landscape should be an integral part of any conversation about the future of our society, sustainability, or resilience to oncoming climatic changes (Canfield 2018). This report acts as an argument for the collaboration between professionals in landscape architecture and in sustainable agriculture. This collaboration has the potential to benefit both disciplines as well as lead towards the improved design of critically important multifunctional landscapes, benefiting humanity and the environment.

This report seeks to combine and modify existing landscape performance metrics taken from the Sustainable SITES Guidelines, the Landscape Architecture Foundation (LAF) Landscape Performance Metrics, the Field to Market National Indicators Report, the Stewardship Index for Specialty Crops (SISC) Metrics, and the Performance Indicators for Sustainable Agriculture, in order to more successfully encompass the complex dynamics of multifunctional landscapes. These metrics can then be used as guidelines for future modifications and updates to the LAF Landscape Performance Metrics. A series of case studies will be analyzed from across the United States in order to more fully understand existing attempts at collaboration. Though these case studies come at a variety of scales and in various proximities to urban communities, the studied locations will all include a specific site design rather than larger master planning efforts.

RESEARCH QUESTION

What lessons can landscape architects learn from sustainable agriculture to inform the design and assessment of multifunctional agricultural landscapes in peri-urban settings while simultaneously increasing the collaboration between the two professions?

Due to the complexity of the research question, there are several factors in finding an answer. Prior to asking what lessons can landscape architects learn, it is important to understand the rich and dynamic histories of landscape architecture and sustainable agriculture. What do the disciplines have in common? What key differences are there in the professions today? Because the research question is looking towards improving the design of multifunctional agricultural landscapes, it is first important to understand what these landscapes are, why they are beneficial, and how improving them would benefit landscape architecture, sustainable agriculture, and society as a whole. What steps do designers need to take towards improving these landscapes? How can a greater degree of collaboration between landscape architects and sustainable agriculturalists lead towards the improved design of multifunctional agricultural landscapes? Lastly, any change comes with difficulty. What dilemmas lie in adjusting how landscape architects design and assess these landscapes, and how can they be addressed?

BACKGROUND

CHAPTER TWO

BACKGROUND

The background section of this report is used to describe and compare the professions of landscape architecture and sustainable agriculture. Each profession is studied according to where they originated historically, where they are in modern practice, and how they use assessment and analysis tools in their work. The professions are compared throughout the chapter and the chapter ends in the discussion of the relationships between the professions and what opportunities lie in their collaboration.

LANDSCAPE ARCHITECTURE

Landscape architecture is the design of outdoor space to achieve environmental, social, and/or aesthetic outcomes (Jellicoe 1975). In, *Design on the Land*, Norman Newton defines landscape architecture as, "...the art—or science, if preferred—of arranging land, together with the spaces and objects upon it, for safe, efficient, healthful, pleasant human use" (Newton 1971, p. xxi). The profession is concerned with both the creation of controlled environments, and the conservation of natural landscapes (Marsh 1964).

In the past, landscape architects were assumed by many, despite earnest efforts of practitioners, to be merely horticulturalists, and lacking the expertise to design for the human experience outside of plant selection and design (Newton 1971). Still today, landscape architects spend much of their time fighting for a position amongst architects and engineers. Continuously fighting for a role alongside more renowned professions has left many landscape architects spreading themselves thin; often playing the role of ecologist, horticulturalist, engineer, and designer when they could have asked for help from other professionals. In 2016, the Landscape Architecture Foundation came out with the *New Landscape Declaration*, a call to action amongst landscape architects to advocate for the future of the profession and to play active roles in their communities. Landscape architects were encouraged to stand up for the profession, for the people it serves, and for a sustainable future for the planet.

Landscape architecture historically leaned towards aesthetics and social interaction. But with Ian McHarg's 1969 book, *Design with Nature*, the work of many landscape architects broadened to include ecological sensitivity along with aesthetic and sociological functions. Landscape architects today often pride themselves on ecology- and resilience-focused projects that also provide strong recreational and aesthetic value to the surrounding community, however, this has not always been the primary goal of the profession (Newton 1971).

HISTORICALLY: WHAT IS LANDSCAPE ARCHITECTURE?

Our Connection to the Landscape

Landscapes have held an integral connection to people since the dawn of humanity. Humans have migrated across them, adapted to them, settled them, formed them, changed them, and lived within them. Though landscape architecture has not been called such for long, humans have been interacting with the landscape since we have been human (Rogers 2001). With the creation of agricultural civilizations and through thousands of years of rises and falls in power, humans around the world have molded the landscape to fit their needs, eventually leading to the urbanization of our planet. When enlightenment led to industrialization, humanity's relationship with the landscape shifted yet again. Farms turned to parks turned to urban plazas. Eventually, urban planning, landscape architecture, and environmental design became disciplines critical to the success of both rural and urban communities (Pregill and Volkman 1993). The profession of landscape architecture is barely more than a century old, but it has been around as an artform and practice for as long as human's have been human. Landscape architecture cannot be simply defined as what "landscape architects" do, because much of the work has been completed by men and women that called themselves something other than a landscape architect (Newton 1971). Definitions of the profession vary between qualitative descriptions of the practice and legal definitions of landscape architecture based on formal documentation. See Figure 2.01 as an example of traditional landscape architecture.

Figure 2.01 Grounds of Gateway Arch National Park designed by landscape architect Dan Kiley (Daderot 2006)

Rooted in Agriculture

As has been made clear, our design of the landscape began with agriculture. Today, despite the stark differences between the fields of agriculture and landscape architecture, it is still possible to see how deeply connected they are. Universities around the world offering landscape architecture majors often reside in the College of Agriculture and many of the schools are Land Grant institutions. A simple web search brings up universities such as U.C. Davis, Purdue, Texas Tech, and Cornell just to name a few. Landscape architecture today is rarely associated with the traditional farming societies from the Bronze Age; however, that connection is long lasting and the profession's connection to agriculture is strong. Agricultural landscapes are inherently designed. Often their design emphasizes neatness, geometry, and efficiency; design goals not lost on modern landscape architects. Despite their rich history and complex design processes, agricultural landscapes are often unappreciated by the architectural community (Collins 2012). As this report moves forward in the description of landscape architecture as a field, it is critical to consider the profession's origins and modern links towards agricultural landscapes.

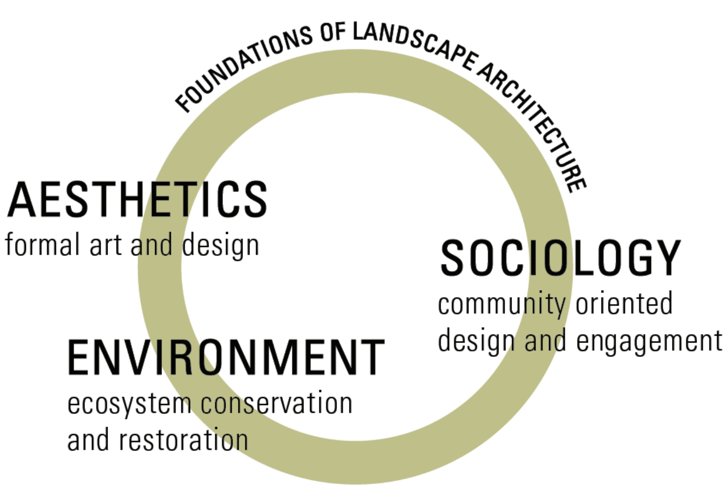

Figure 2.02 Foundations of Landscape Architecture

FOUNDING PRINCIPLES AND GOALS

The long-time art and practice of landscape architecture became a profession in 1863 when the title, Landscape Architect was used by the Board of Central Park Commissioners in New York City. Frederick Law Olmsted and Calvert Vaux had used the term professionally since 1858, when they won the competition to design Central Park (Newton 1971). Forty-one years later, in 1899, the American Society of Landscape Architects (ASLA) was founded by a small group of practicing professionals, including the sons of Frederick Law Olmsted, and Calvert Vaux. Following the founding of the professional society, Harvard University became the first university to offer a degree in landscape architecture in 1900 (About ASLA 2019).

Fundamentally a relationship between people and place, landscape architecture forms a partnership between art and nature (Rogers 2001). Although the field is based in art and design, the success of landscape architecture relies on the implementation of designed works as well as the support of the general public for projects. In *Design on the Land*, Norman Newton described the profession, "first as a social art, serving human values" (1971, p. xxii). The foundations of landscape architecture can be seen in Figure 2.02.

Social Activism

From the formative years of landscape architecture to today, the practice routinely engages in the allocation and preservation of community resources at a variety of scales, economic backgrounds, and cultures. Because of this, the profession should be considered inherently social in nature (Brown and Jennings 2003). In the late 19th century, Frederick Law Olmsted used his parks to offer a remedy for the dangerous problem of discontent among the urban masses. This social agenda was critical in the design of Central Park, and Olmsted's large city park systems became one of the few socially conscious public planning projects of their day. By offering pleasant and uplifting outlets in the cramped urban lives of city-dwellers, they promised a level of calm and tranquility for large numbers of people. (Blodgett 1976).

As landscape architecture and urban planning changed, so did the profession's social agenda and by the mid-20th century, an era of urban renewal was restructuring entire swathes of major cities. New planning practices involved large-scale demolition and reconstruction of urban areas, often bulldozing poor neighborhoods in favor of highways, skyscrapers, and turf grass (Small 2017). Although urban renewal was a popular strategy in the 1960s, it was not universally supported. Jane Jacobs, a social activist and reporter became widely known for her opposition to urban renewal in Boston. She argued that, "a city, or neighborhood, or block, cannot succeed without diversity" (Rich 2016). This diversity comes in forms of residential and commercial use, race and social classes, modes of transportation, public and private support, and architectural style. Jacobs was one of the early proponents that large numbers of people, concentrated in relatively small areas, are not necessarily a health or safety hazard, rather that these communities are the foundation of healthy cities (Rich 2016).

Today, many landscape architects continue to see it as their responsibility to address deep social and economic divides within society, dealing with issues such as access to clean water, air, and food. At times, landscape architects in history have been viewed as dismissing the desires of local citizens in support of a larger design vision that may not be appropriate for a community despite claiming to encourage participation and engagement. However, many individuals and firms are working hard to change that view by focusing their work on collaboration between disciplines and with community members, clients, and users (Hou 2018).

Aesthetics

Landscape architecture works to accommodate life, of humans, plants, and wildlife. However, the arrangement and ordering of forms and spaces work together to elicit responses and communicate a deeper meaning (Ching 2015). The overall aesthetics of a design are critical to its success. Form and space are, at the very minimum, incredibly important components of landscape architecture and arguably, they are the primary components of good design, acting as tools and materials that landscape architects can mold and shape to their needs (Newton 1971). In the design of space, it is important that every moment feel intentional, with some designers and practitioners arguing that spaces that do not feel designed are lacking the conscientiousness that designers should strive for (Newton 1971). Although modern practice is shifting towards a more natural and "wild" way of designing landscapes, it is important to understand the social aspects of design. Non-designers can be limited in their understanding of design and natural systems, correlating organization with health and wild with unkempt.

Although landscape aesthetics are highly variable and dependent on sociocultural values, there has been extensive research on landscape perception (Zube et al. 1982). Landscape aesthetics come from the interaction of humans within their environment. There are a series of factors that play into the perceived aesthetics of an environment including the educational and cultural background of a person, their motivation, the social context, and their personality. Within the landscape, aesthetics come from physical elements, climatic and locational context, and the overall composition (Zube et al. 1982). Instead of being solely based on the individual ideology, beauty is often determined on a community basis. In other words, people with similar experiences and lives have similar ideas of what beauty in the landscape means. Landscape aesthetics, especially in a rural environment, are found to be dependent on larger concepts of stewardship. The three dominant themes found by Nassauer in rural landscape aesthetics are scenic quality, neatness, and stewardship. While some of these aesthetic factors are out of the designer's control (scenic quality depends on geomorphological characteristics of a region like stream corridors, rock formations, and hills), other aspects of the assessment can be influenced by the design and maintenance of a landscape. When describing the aesthetics of a landscape, viewers tend to judge the maintenance levels, naturalness, and neatness of the project almost or just as heavily as the larger scenic quality (Nassauer 1989). Defining characteristics of appearance can help in the implementation of otherwise unattractive environmentally beneficial functions. Achieving public support for these invisible or unnoticed ecological systems can be difficult and understanding landscape aesthetics and their relationship with maintenance and care is critical (Nassauer 1997 and 2002).

Figure 2.03
New York City's Highline Park designed by landscape architecture firm James Corner Field Operations (InSapphoWeTrust 2012)

MODERN DAY: A TRANSITIONAL PERIOD

Landscape architecture has changed through time in the same way that art and music have (Newton 1971). In texts from the mid-20th century, landscape practitioners write about the shift from the design of "country parks" to those involving the complex problems of urban renewal. Since the introduction of Ian McHarg's, "Design with Nature," landscape architecture has begun to move away from the traditional form-focused and single-function work towards designs that address temporal ecosystem dynamics (Yang et al. 2013). In part due to the impending effects of climate change, this is also impacted by increased urbanization of both old and new cities around the world (Hill 2016). Although some progressive members of the profession have advocated for an ecological approach to solve landscape problems for decades, the notion did not take a strong hold on the field until its applicability and strengths in regional areas became clear (Newton 1971).

As technology and industrialization became more prevalent, environmental degradation became a possibility humanity only recently took seriously. It was in this transitionary industrialized period that landscape architects began applying landscape ecological concepts, resulting in practitioners and clients designing more ecologically sustainable parks, adjusting their vegetation choices, and improving water management systems (Hill 2016 and Rogers 2001). These strategies have continued into today, focusing on problems like environmental sustainability, resiliency planning, and ecologically sensitive urban design projects. An example of modern landscape architecture can be found in Figure 2.03 showing the Highline Park.

ASSESSMENT + ANALYSIS

Landscape architecture has shifted throughout the past 30 years due to the impending effects of climate change and increased urbanization in both new and old cities. Thus, a shift away from form-focused and single-function work has led towards designs that address temporal ecosystem dynamics. Today, urban investments often demand landscape-based, multifunctional planning and design projects. In response, designers have had to combine their pursuit of aesthetic, functional, and social goals (Hill 2016). Landscape architects rarely discuss the rural or agricultural landscape however these landscapes have been a source of inspiration for designers worldwide for centuries. Though designers have taken inspiration from the forms and patterns in agriculture, they rarely take an active role in the transformation and reformation of rural agricultural landscapes (Meyer 2013).

ENVIRONMENTAL	SOCIAL	ECONOMIC
Land and Soil Preservation and Restoration	Recreational and Social Value	Property Values
Stormwater Management	Cultural Preservation	Operations and Maintenance Savings
Habitat Creation, Preservation, and Restoration	Health and Well-Being	Construction Cost Savings
Population and Species Richness	Safety	Job Creation
Energy Use	Educational Value	Visitor Spending and Earned Income
Air Quality	Noise Mitigation	Tax Revenue
Temperature and Urban Heat Island	Food Production	Economic Development
Carbon Sequestration	Scenic Quality and Views	
Reused and Recycled Materials	Transportation	
Waste Reduction	Access and Equity	

Table 2.01 Landscape Architecture Foundation Metrics (Adapted from Canfield et. al. 2018)

Landscape Architecture Foundation: Landscape Performance Metrics

In 2010, the Landscape Architecture Foundation (LAF) launched their Landscape Performance Series. Bringing together information from researchers, industry leaders, and academia, the case studies are measured according to a series of landscape performance metrics. These metrics are now used by students, researchers, and professionals across the country to measure the benefits and performance of built work in the public and private realm. In this context, landscape performance can be defined as, “a measure of the effectiveness with which landscape solutions fulfill their intended purpose and contribute to sustainability” (Canfield et al. 2018, p. 1).

The performance series was initiated as a way to understand the multifunctionality of built work since development projects today must serve multiple functions in order to be successful in an urban environment. Additionally, stakeholders in these projects are increasingly seeking the ability to provide proof that a project is performing to a certain standard. Landscape performance metrics help to provide, “reliable and valid evidence to justify design decisions, provide quality assurance, and inform ongoing site management and maintenance activities” (Canfield et al. 2018, p. 1).

The landscape performance guidelines were informed by research and knowledge from landscape architecture, horticulture, ecology, engineering, and economics. Divided into three categories, environmental, social, and economic benefits are considered for high-performing landscape projects. Evaluation seeks to quantify outcomes within each of these three categories within implemented projects. It is important in performance evaluation to measure outcomes, not outputs. Outputs include number of planted trees or length of bike lanes. Outcomes are the impacts of those outputs, or the benefits they provide like carbon sequestration or reductions in bike accidents (Canfield et al. 2018). The three categories of performance guidelines and metrics can be seen in Table 2.01.

Sustainable SITES Initiative

The Sustainable SITES Initiative was first adopted by ASLA and the Lady Byrd Johnson Wildflower Center in 2009. SITES is now operated by the Green Business Certification Inc. and encourages landscape architecture to emphasize sustainable planning and resilient design (Sustainable ASLA 2019). Key principles of SITES include, but are not limited to, design with nature and culture, support a living process, and foster environmental stewardship. In an attempt to encourage environmental stewardship amongst landscape architects, SITES is used as a program to award highly sustainable landscape architecture projects. The SITES initiative breaks down sustainability into social equity, economic feasibility, and environmental soundness and argues the benefits of ecosystem services, both for the environment and for the economy. In order to be successful in achieving SITES recognition designers must work to be sustainable at every phase of the design process, from assessment to post-implementation monitoring. Successful projects work with water, vegetation, soil, materials and resources, human health and well-being, and maintenance and monitoring (Calkins 2015).

Well-designed sites can protect, sustain, and provide critical ecosystem services such as air and water cleansing, water supply and regulation, and productive soils. The best designs have the potential to serve multiple functions, those of ecosystem services and those of rich aesthetic experiences (Calkins 2015). The range of approaches to sustainable site design and operation specified in the handbook include water systems, vegetation, soils, materials and resources, energy systems, and cultural systems. Collaboration with engineers, architects, hydrologists, and planners is critical for the achievement of SITES goals. It is critical to work closely with stakeholders throughout the design process in order to create and maintain a practical management plan, with the encouragement of post-occupancy evaluation (Calkins 2015). Practical management plans and post-occupancy studies are both tools that designers, engineers, and contractors can use to ensure the successful performance of projects and design interventions.

ASSESSMENT OF AESTHETICS

As previously mentioned, the assessment and quantification of landscape aesthetics is a deeply intensive and difficult process due to their complex nature. Despite the difficulty, understanding and quantifying landscape aesthetics in rural environments has an inherent value as these landscapes are an essential component of people's surroundings. Landscape aesthetics also have a "tremendous power to influence public perception of and support for ecological quality and agricultural production related policies" (Nassauer 2002).

Multiple individuals and organizations have created landscape aesthetic assessment systems and have studied landscape perception in great detail. Ervin Zube (Zube et al. 1982) and Joan Nassauer have both been cited in this paper as their work has contributed significantly to the assessment of landscape aesthetics in rural and agricultural environments. One of the most commonly used methods for assessing rural environments comes from the U.S. Forest Service's *Handbook for Scenery Management* (Thomas 1995), which is used in the quantitative analysis of landscape aesthetics. The Forest Service uses key landscape elements like landform, vegetation, rocks, cultural features, and water features described in terms of line, form, color, texture, and composition in order to classify landscapes as either distinctive, typical, or indistinctive. The purpose of their analysis is to provide an overall framework to manage scenery in cases of timber harvesting, road building, stream improvements, developments, and utility line construction. The importance of these ecosystem aesthetics are described according to several basic premises including, though not limited to, (1) People value highly scenic landscapes, (2) Scenery contributes to a sense of place and, (3) Landscape character can be defined and managed (Thomas 1995).

SUSTAINABLE AGRICULTURE

One of the first ways humans interacted with the land is by farming it. Agriculture, seen in Figure 2.04, is such a complex topic that it can be difficult to define. Wendell Berry eloquently described it as, "cultivation of land" (Berry 1978, p. 87), and when discussing agriculture, it is common for literature to describe it as a heritage instead of merely a job. Historically, "agriculture is a form of culture" (Bookchin 1976, p. 3).

Figure 2.04
Peanut farming field preparation (French 2011)

Sustainable agriculture (also called agroecology) is a very specific term that encompasses a broad range of agricultural ideas. For the purpose of this report, it will be defined as the production of food, fiber, or protein while building and maintaining a healthy soil system. The term, "sustainable agriculture" is being used to include many different individual practices including, but not limited to, conservation agriculture, polycultural agriculture, perennial agriculture, and organic agriculture. Because these practices all fit within the definition of producing food, fiber, and protein while building and maintaining a healthy soil system, they all are different forms of sustainable agriculture. Sustainable agricultural practices attempt to minimize the adverse effects of farming on surrounding ecosystems and instead search to achieve long-term stability of the entire agricultural enterprise, environmental protection, and consumer safety (McDonnell 2011; Powlson et. al. 2011). It is vital in sustainable agriculture that the surrounding ecosystems are not being depleted due to the land acting as a productive site. Sustainable agriculture avoids irreversible damage to natural resources, especially soil, and instead secures a productive crop without causing unacceptable environmental impacts (Powlson et al. 2011), see Figure 2.05).

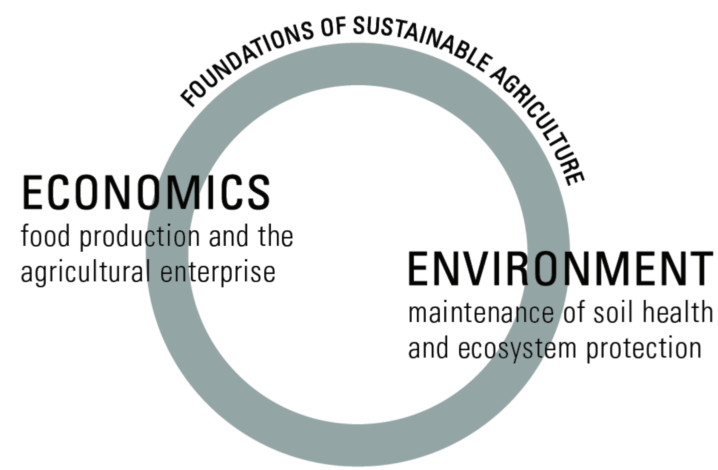

Figure 2.05
Foundations of Sustainable Agriculture

HISTORICALLY: THE ORIGINS OF SUSTAINABLE AGRICULTURE

Agriculture began as a small, diverse, and individual practice. Over time, and with the rise of industrialization, farms grew larger, more exclusive, and more single-minded. Farming became about profit instead of survival, about agricultural progress instead of cultivation of the land. Animals, plants, and soil started being regarded as machines instead of as living organisms, and eventually humanity ended up with expansive monocultures, products of elaborate schemes to make as much money off of as little land as possible (Berry 1978; Lehman 1995). In the early-mid 20th century, corporations, university specialists, and government agencies collaborated towards agricultural development aimed at increasing economic productivity of farms across the country. Rather than benefiting the small American farmer, the change in farming was detrimental to him, his land, and surrounding ecosystems (Berry 1978; Lehman 1995; Bookchin 1976). What originated as a new idea, became the expected and conventional way of farming. Conventional agricultural practices used the latest technologies to produce products for a global market at the lowest possible production price. This often results in lower profits for individual farmers and increased environmental costs (Hansen and Francis 2007).

During the Dust Bowl, soil conservation in Midwest farms became critical to any long-term stability of the rural economy. After seemingly successful soil erosion mitigation projects of the New Deal, many farmers and soil scientists stopped being concerned with soil erosion. However, in the 1970s soil conservationists began saying they had no means of measuring any actual decreases in erosion, and therefore had no means to prove or disprove the effectiveness of past policies. It was generally agreed upon that erosion had decreased since the 1930s, however the amount and the cause was still unanswered. As government policies continued to be unable to deal with soil degradation effectively, an abusive pattern of resource consumption by modern agricultural methods became clear (Lehman 1995).

With the growing environmental movement of the mid-20th century, many ecologists and farmers began to cry out for a more sustained form of agriculture, one that focused more on ecological stability and less on economic productivity. Murray Bookchin, a Vermont philosopher, described this new agricultural movement as an effort, "to restore humanity's sense of community: first, by giving full recognition to the soil as an ecosystem, a biotic community; and second, by viewing agriculture as the activity of a natural human community, a rural society and culture" (Bookchin 1976, p. 8). Proponents for sustainable agriculture argued that in addition to loss of soil, the decrease in ecological diversity was leading towards the biological instability of modern agriculture. Increasing energy dependence led to reduced labor costs, temporarily bandaging the loss of soil through increased erosion rates (Lehman 1995). However, as fertilizer usage rose in turn, costs did not always remain low. "As American agriculture became more energy-intensive it actually became less energy-efficient" (Lehman 1995, p. 63). Suggestions started being made that small farms using a sustainable growing method encourage biodiversity, reduce soil degradation, increase water quality, improve air quality, and provided valuable habitats for wildlife (Hansen and Francis 2007).

MODERN DAY: WHERE IS SUSTAINABLE AGRICULTURE AT TODAY?

In an era of technology and industry, being a farmer becomes less about heritage and more about profit (Bookchin 1976). However, some modern farmers are challenging this post-industrial mindset, arguing for a return to meaningful agriculture, one based once again on culture and food instead of profit and economic growth. Agricultural systems of today consume resources at unsustainable rates and have been, "designed to be highly productive in terms of labor, making it possible for one farmer to produce food for a large quantity of people" (McDonnell 2011, p. 2). Another major shift in agriculture is from small farms to large expanses of fields. "The number of farms in the United States for 2017 is estimated at 2.05 million, down 12 thousand farms from 2016. Total land in farms, at 910 million acres, decreased 1 million acres from 2016. The average farm size for 2017 is 444 acres, up 2 acres from the previous year" (USDA and NASS 2018, p. 4). Farms used to be much smaller and more diverse however as farms grew, they became more about profit than survival (Berry 1978).

Forms of Sustainable Agriculture

As mentioned previously, sustainable agriculture is a broad term that represents many smaller agricultural concepts. Some of these agricultural systems include conservation agriculture, organic agriculture, polycultural agriculture, and perennial agriculture.

Conservation Agriculture

Conservation agriculture began as a challenge to the need for continual soil tillage (Bellotti and Rochecouste 2014). Characterized by minimal soil movement, increased residue and vegetation coverage, and economically viable crop rotations, conservation agriculture takes the emphasis off of tillage and instead focuses on an entire agricultural system (Cociu and Cizmas 2015). Conservation agriculture practices are intended to increase crop water use efficiency while simultaneously improving crop nutrition, disease management, weed management, and reducing long term soil loss (Bellotti and Rochecouste 2014). Conservation agriculture often creates a framework for reconciling traditional production focused farming practices with conservation practices that protect wildlife habitat as well as local ecosystems and watersheds (Meyer 2013).

Organic Agriculture

Making up 0.3% of farmland worldwide, organic agriculture does not use synthetic compounds for crop nutrition, pest, disease, or weed control, and often does not even use genetically modified cultivars (Connor 2008). In 1980, organic farming was defined as, “a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives” (Youngberg and DeMuth 2013, p. 303). When combined with conservation agriculture practices, organic agriculture can have such long-term benefits as a reduced rate of soil loss (Bellotti and Rochecouste 2014). Organic agriculture is related to other low-input production practices and strongly differs from modern agriculture’s dependence on fertilizers, herbicides, and pesticides (Diebel et al. 1992; Gonzalez 2018). Where organic agriculture differs from many other sustainable agriculture strategies, its lack of dependence on chemical inputs may also be where it fails to be successful at a large scale. According to some sources, organic nutrients are good and necessary, but are not enough to maintain the food supply for the trajectory of our population. We need fertilizers in order to increase yields to the needs of future generations (Connor 2008).

Polycultural Agriculture

Traditional agriculture is made up of monocultures which, “are much more susceptible to pests and diseases than mixed cultures and are therefore more dependent on chemicals” (Berry 1978, p. 90). Because of this, polyculture agriculture is becoming increasingly popular. The agriculture with the best chance to regain soil organic matter of historic native ecosystems, is the agriculture that resembles the native ecosystem the most closely. Meaning, perennial polycultures have a higher change of regaining soil organic matter than annual, low diversity communities (Crews and Rumsey 2017). Polyculture agriculture can be defined as, “growing multiple crops or cover crops in the same space at the same time...” (Duiker et al. 2017, p. 25). Some organizations are working towards creating agricultural environments like those mentioned above. The Land Institute in Salina, Kansas is a great example of a non-profit organization working to create diverse ecosystems within agriculture, like those in the natural environment and surrounding ecosystems (Land Institute 2017).

Perennial Agriculture

Many argue that agriculture should shift away from annual crops and towards perennial crop systems. This is common in many natural ecosystems and would help soils shift back to their natural state in a similar way that they would under a polyculture agriculture environment. Jackson et al. (2018) argues that there should be a framework with the goal being to create a perennial culture to challenge the modern, unsustainable vision of monoculture farming. The Land Institute in Salina, Kansas is researching strategies to create a high-yield, perennial crop system to more sustainably continue agriculture in the future (Jackson 1987). Jackson decided to build an agriculture that is based on the native prairie. Wheat fields are monocultures and need replanting annually, prairie is a polyculture and perennial (Jackson, 1987). His work with the Land Institute seeks to combine these native perennial ecosystems with high-yield monocultures by modifying and adjusting cereal grain crops. Also working on new sustainable cropping systems is the Great Lakes Bioenergy Research Center (GLBRC), a U.S. Department of Energy funded research center funded by the University of Wisconsin-Madison. The GLBRC is working to develop sustainable biofuels and bioproducts through the use of perennial bioenergy crops and other sustainable farming strategies (GLBRC 2020).

Common Practices within Sustainable Agriculture

There is an extremely wide range of individual practices within sustainable agriculture. These practices are sometimes used individually however many sustainable farmers combine practices. Sustainable agriculture includes practices such as intercropping, interseeding, cover crops, and crop rotations.

Intercropping and Interseeding

Intercropping is defined as, "the agricultural practice of cultivating two or more crops in the same space at the same time," and is not a new technique (Lithourgidis 2011, p. 396). Very similar to polyculture agriculture, they are considered by some to be interchangeable. To put it simply, intercropping makes more efficient use of the land. Intercropping uses crops, "of different rooting ability, canopy structure, height, and nutrient requirements based on the complementary utilization of growth resources by the component crops," in order to increase the use of the land (Lithourgidis 2011, p. 396). Intercropping helps to improve soil fertility and overall health, increasing soil conservation and limiting erosion while simultaneously offering effective weed suppression, as well as pest and disease control (Lithourgidis 2011). There are different types of intercropping. Crops can be intermingled, rows can be mixed together or shifted so they alternate. Sometimes there will be a few rows of one crop and then a few rows of another crop. Like any agricultural practice, it depends on the climate, location, and crop type. Intercropping is valuable because it uses the available space more efficiently and can increase productivity of the land as a whole. Intercropping offers a higher likelihood that some crops will make it and helps with soil conservation, soil fertility, forage quality, pests and disease resistance, and the promotion of biodiversity. It does however sometimes reduce yields if crops are competing for light, water, or nutrients (which can happen if the wrong crops are mixed together) (Lithourgidis 2011).

Interseeding is defined as, "planting or drilling a crop or cover crop into an already established crop" (Duiker et al. 2017, p. 25). Almost the exact same as intercropping, the only difference with interseeding is that farmers are planting the crops at different times instead of the same time. Interseeding and intercropping use a variety of crop types including, but not limited to, corn, beans, squash, and grains.

Cover Crops

Cover crops can dramatically improve soil health and are defined as, "crops grown between two economic crops with the primary aim to protect and improve the soil" (Duiker et al. 2017, p. 6). They have the potential to reduce runoff, build soil organic matter, retain soil nutrients, maintain soil nitrogen content, reduce and alleviate soil compaction, provide natural weed control, and improve overall soil health. Cover crops are critical to many sustainable agriculture practices and are absolutely necessary in any no-till agriculture system (Duiker et al. 2017; Islam and Reeder 2014). "Mixing different cover crops and planting them together allows better use of water, light, and nutrients, often resulting in greater biomass production and better resource utilization" (Duiker et al. 2017, p. 12).

Crop Rotations

Crop rotations can be defined as the, "repetitive growing of an ordered succession of crops on the same land over multiple years…" (Duiker et al. 2017, p. 9). Crop rotations are common in conservation agriculture as well as many traditional agriculture practices (Atwood 2017). Key to soil health, crop rotations are important to improve crop yields as they help to fix nitrogen deficiencies in the soil through legume rotations. Crop rotations are an important tool for pest management as well as weed control and can even help machinery be used more efficiently (Duiker et al. 2017).

THE IMPORTANCE OF SOIL AND ITS HEALTH

Soil connects people to other living things. As the most basic element in agriculture, it is variable and consistently responding to its surroundings (Berry, 1978). Scientifically speaking, soil is the, "granular matter which forms the skin of a great part of the planet, and in which vegetables grow…" (Hyams 1952, p. 17). Soil is a broad term for the layer above bedrock that forms the Earth's crust. This layer has been weathered both physically and chemically to form a unique substance that is prime for the growth of vegetation. Soil formation is affected by several factors including parent material, climate, living organisms, topography, and time. Weathering processes can change the soil over time, affecting the upper layers of the soil profile. The soil profile includes the topsoil, subsoil, and parent material. Soils are made up of mineral matter, organic matter, air, and water. There are thousands of different soil types, each with their own characteristics (Keefer 2000).

Soil health is defined as, "the continued capacity of soil to function as a living ecosystem that sustains plants, animals, and humans" (Duiker et al. 2017, p. 1). Understanding soil health means understanding the need to view the soil as a living ecosystem. Healthy soil has large and small organisms living together in a, "dynamic, complex web of relationships. Farm crops and animals become part of this unique cycle of life" (Duiker et al. 2017, p. 1). Researchers argue that soil organic matter is the key to soil health (Land Institute 2017).

Soil Organic Matter

Soil organic matter is the most important part of soil and is the key to soil health. It is only 1-5% of the soil itself but it is one of the most complex of all naturally occurring substances and it is critical in providing nutrients for plant growth. Because we need healthy soil to grow healthy plants, we also need healthy soil to grow healthy people (Keefer 2000; Land Institute 2017). Soil organic matter is, "…a complex, heterogeneous mixture of plant and animal remains in various stages of decay, microbial cells… microbially synthesized compounds, and derivatives of all of the above through microbial activity" (Keefer 2000, p. 183). Not only is soil organic matter affected by soil erosion, but it is also affected by the vegetation growing in the soil itself. Annual crops lose soil organic matter, "because tillage with plow or disc disintegrates the stable bonds between carbon molecules and minerals, especially clay particulates" (Land Institute 2017, p. 20).

Carbon Sequestration

Carbon sequestration is the, collection and holding of carbon in the soil. Carbon is removed in many ways but most commonly by soil disturbance from tillage and from the mining of coal (Baker et al. 2007; Islam and Reeder 2014). "The restoration of degraded soils is a high global priority. If about 1.5 x 109 ha of soils in the world prone to erosion can be managed to effectively control soil erosion, it would improve air and water quality, sequester C in the pedosphere at the rate of about 1.5 Pg/year, and increase food production" (Lal 1998, p. 319). In other words, if a little more than 1/2 mile^2 of erosion prone soil can be better managed to control that erosion, it would take in about 1.1 billion tons of carbon every year.

Erosion: Control and Mitigation

Robert Keefer defines soil erosion as, "the physical wearing away of the land surface by running water, wind, or ice. Soil or rock is initially detached by falling water, running water, wind, ice, or freezing conditions, or gravity…" (Keefer 2000, p. 53). Put most simply, soil erosion is the relocation of the topsoil involving soil loosening, transportation, and deposition that takes place when soil is left bare to the elements (Isaaka and Ashraf 2017). Ultimately, the erosion process moves these soil particles from the parent material to a deep body of water downstream from its original source. The sediment's movement results in both beneficial and adverse effects (Taylor 1987). Crop production, vegetative cover and slope all have an impact on soil erosion though it mostly occurs because of wind, water, and tillage (Isaaka and Ashraf 2017; Powlson et al. 2011). The effects include difficulties with land management, damage to crops and other vegetation, the removal of nutrients or other valuable elements of the topsoil, and a dramatic loss of water storage capacity within the uppermost layers of the soil (Posthumus et al. 2015).

Although soil erosion can be beneficial to some environments, it can also present a threat to agricultural productivity as it removes beneficial nutrients from the soil's upper layers. This is true in particular, "in regions where agronomic inputs are low, vegetation cover is poor, soils are not resilient and where intense rainfall sometimes occurs," (Powlson et al. 2011, p. S81). Offsite impacts of erosion include the blockage of drains, dams, and other water courses by sediment, the pollution of water bodies, damage to nearby infrastructure caused by sediment rich floodwaters and multiple associated public health problems (Posthumus et al. 2015).

Soil Erosion as a Major Issue

Due to its severe economic and environmental impacts, soil erosion is a global issue (Lal 1998). One-third of topsoil on farmland has been lost in the past 200 years and the nation's supply of farmland is continuously decreasing" (Alexander and English 1992, Eckbo et al. 1939). Despite a history of conservation programs, soil erosion is a major problem in the United States and has been for decades (Diebel et al. 1992). Soil erosion on cropland does not only matter due to the soil lost on the farm itself. Sediment pollutes ponds, streams, rivers, and more and reduces water holding capacity while hurting water bodies as a whole (Alexander and English 1992; Diebel et al. 1992). There is considerable evidence to suggest a relationship between soil erosion and degradation with diminished water quality. This shows that erosion can dramatically affect the quality of surrounding water bodies (Isaaka and Ashraf 2017). It is determined by researchers that, "decreasing soil erosion is essential, both to maintain the soil resource and to minimize downstream damage such as sedimentation of rivers with adverse impacts on fisheries" (Powlson et al. 2011, p. S72).

In addition to the dramatic impact of soil erosion on water quality, soil erosion also plays a part in the economics of productivity. This is, in part, "due to direct effects on crops/plants on-site and off-site, and environmental consequences are primarily off-site due either to pollution of natural waters or adverse effects on air quality due to dust and emissions of radioactive gases" (Lal 1998, p. 319). Alongside effects on the farmland directly, there are also many effects off-site. These economic effects, "are related to the damage to civil structure, siltation of water ways and reservoirs, and additional costs involved in water treatment" (Lal 1998, p. 319). Regardless of the economic impacts, the need for sustainable food production is rising with the world population and erosion control is a critical component of any sustainable agriculture (Busari et al. 2015).

The relationship between soil erosion and the use of sustainable agriculture practices like perennial farming or conservation tillage should not be understated. Many sustainable practices emphasize the importance of soil health and limiting erosion on a larger scale, thereby also enhancing the soil's ability to sequester carbon from the atmosphere. The practices described throughout this report are all deeply related and should not be considered individually but rather as a set of tools with the ability to impact the future of farming, food systems, energy production, and the global climate.

Accelerated Erosion

Soil erosion is a natural process that has occurred since the dawn of the earth. However, humans have had a significant impact on soils that we inhabit. Erosion caused by mankind is also known as accelerated erosion as it typically occurs much more quickly than natural erosional processes. Accelerated erosion occurs when there are changes made to the soil, "…by cultivation, construction, or any movement of earth…" (Keefer 2000, p. 53). There are several types of accelerated erosion including raindrop erosion, sheet erosion, gully erosion, rill erosion, and surface flow. The amount of erosion is determined by precipitation amounts, intensities, and duration, as well as the amount of surface flow over an area (Keefer 2000; Duiker et al. 2017). The total cost of accelerated soil erosion is immense in terms of monetary value, food production, and human suffering, though the exact value has yet to be calculated (Dunne and Leopold 1978; Lal 1998).

Tillage: Conservation and No-Till Systems

"Tillage is defined as the mechanical manipulation of the soil for the purpose of crop production affecting significantly the soil characteristics such as soil water conservation, soil temperature, infiltration and evapotranspiration processes" (Busari et al. 2015, p. 119). Tillage breaks up the soil into smaller pieces and chunks and is the strategic use of soil disturbance used to help remove weeds from the seedbeds of crops prior to sowing (Atwood 2017 and Cociu and Cizmas 2015). There are a variety of tillage practices and they vary from one farmer to another as well as over time.

Tillage practices help determine water absorption, soil erosion, and vegetation diversity among other things (Alexander and English 1992). Tillage can also drastically affect insect habitat. According to Lesley Atwood, "tillage may be the agricultural practice that most strongly affects the soil arthropod food web community, as it quickly changes both the biophysical and biochemical attributes of the soil. By redistributing litter and other organic materials throughout the soil profile, tillage changes the availability of habitats (e.g. provision of shelter and favorable microclimates) and resources (e.g. animal and floral food sources) which affects the activity density, species richness, and community composition of soil arthropods" (Atwood 2017).

It has been widely thought that soil disturbance by tillage was the primary cause of soil organic carbon loss in the United States (though this has been disputed by Baker et al. in 2007). In combination with a lack of plant cover on cropland and agricultural fields, tillage allows soils to erode quickly, losing soil organic matter and releasing carbon into the atmosphere. Because of this, many farmers have shifted from conventional tillage practices to less intensive methods, including conservation tillage (Baker et al. 2007; Crews and Rumsey 2017). Conservation tillage is defined as, "any tillage method that leaves sufficient crop residue in place to cover at least 30% of the soil surface after planting" (Baker et al. 2007, p. 1). This tillage practice can improve soil structure, help manage erosion, conserve water, and improve productivity and sustainability. (Lal, 1998)

Similar to conservation tillage, no-till agriculture reduces soil erosion and increases surface infiltration by limiting soil tillage by machinery. Strictly defined, no-till agriculture is, "a conservation farming system, in which seeds are placed into otherwise untilled soil by opening a narrow slot, trench, or hole of only sufficient width and depth to obtain proper seed placement and coverage" (Ruisi et al. 2016, p. 51). After growing in popularity in the 1960s, no-till agriculture has become a powerful tool to fight soil erosion (Islam and Reeder 2014). "It increases residue cover and creates firmer soil and better soil structure" (Duiker et al. 2017, p. 4). No-till helps to mitigate soil erosion, enhance aggregate stability, reduce fuel consumption of up to 70%, and save in labor and time. It also may lead to more soil carbon sequestration. (Ruisi et al., 2016) Today, no-till agriculture is, "considered by many to be an environmentally friendly soil management technique that can help enable sustainable development due to its potential to generate economic, environmental, and social benefits" (Ruisi et al. 2016, p. 51). In some cases, it has even been determined that continuous soil tillage can disturb the soil and that for well-maintained soils, tillage was unnecessary or even destructive (Bellotti and Rochecouste 2014). No-till can also increase aggregate distribution and stability and while directing and encouraging surface infiltration (Cociu and Cizmas 2015).

In many cases, conservation agriculture improves the overall soil health of a farm and in some places, farmers even receive a stipend for using conservation tillage methods to help replace carbon previously removed from the soil by coal companies (Baker et al. 2007). However, these tillage practices do not come without any negative consequences. In fact, "reducing tillage for the purpose of erosion control and environmental improvement often results in soil conditions that promote pest populations (invertebrate soil pests and soil borne pathogens). This, in turn, has increased farmer reliance on pesticides to address the pest management challenges that arise from reducing tillage" (Atwood 2017, p. 2). In order to successfully implement conservation tillage, it is necessary to understand the consequences of reducing tillage as it changes weed populations. It is necessary, if not critical, to integrate weed management into the maintenance of a system (Bellotti and Rochecouste 2014).

ASSESSMENT + ANALYSIS

Today, sustainable agriculture is expanding from its origins as a means of soil conservation and pest prevention in agricultural fields. Non-profit organizations are working with universities, extension offices, and companies around the world in order to expand the view and understanding of sustainable agriculture. From the protection of ecosystem diversity and integration of conservation buffers, to the educational opportunities from urban youth programs, sustainable agriculture is working intensely to make a difference in the world. Some of this collaboration can be seen in residential developments, community gardens, permaculture projects, polycultural productive landscapes, or even in USDA riparian buffer zones.

Because of the higher production capabilities of conventional agriculture, some members of the agricultural industry are worried about food security dilemmas upon the integration of sustainable agricultural practices. With the looming threat of climate change, some large companies are beginning to support the mission of sustainable farmers and are partnering with local farmers to come up with sustainable solutions that could still feed a global population. General Mills, Danone, and Kellogg have all announced goals to advance sustainable agriculture and help rebuild biodiversity (Wozniacka 2019). Rabobank, a Dutch food and agricultural bank, is partnering with farmers to support experimentation with new crops and sustainable agriculture techniques (Mundahl 2017). Although the commitments from these companies may be more for surface-level marketing than the good of agriculture, the results could still have a tremendous impact on the future of sustainable agriculture.

There are an increasing number of performance metrics and indicators to measure the success of sustainable agriculture projects. Because the field has yet to select one system as the primary tool for measuring agricultural performance, this report will look at three separate systems: The Field to Market National Indicators Report (Thomson et al. 2016), the Stewardship Index for Specialty Crops Metrics (Stewardship Index 2013), and the Performance Indicators for Sustainable Agriculture (Dumanksi et.al 1998).

Field to Market National Indicators Report

The Field to Market National Indicators Report was brought together by a group of agricultural organizations, agribusinesses, conservation groups, and universities with the goal of creating opportunities for continuous improvement in productivity, environmental quality, and human well-being. Field to Market offers a framework for sustainability measurement to better assess and understand agricultural performance and sustainability (Thomson et al. 2016). The report looks at national trends in environmental and socioeconomic indicators. These indicators include biodiversity, soil carbon, water quality, energy use, soil conservation, greenhouse gas emissions, land use, and generation of economic value (see Table 2.02).

Stewardship Index for Specialty Crops Metrics

The Stewardship Index for Specialty Crops (SISC) Metrics are a system for measuring the sustainable performance of crops and the agricultural system. The metrics are developed with multiple stakeholders' involvement and are currently in the pilot phases of testing. Stakeholders include producers, buyers, and public interest groups in agreement on the most important measurement indicators of stewardship (Stewardship Index 2013). SISC Metrics include applied water use efficiency, habitat and biodiversity, energy use, nitrogen use, phosphorus use, soil organic matter, and irrigation efficiency (see Table 2.02).

Performance Indicators for Sustainable Agriculture

The Performance Indicators for Sustainable Agriculture address agricultural sustainability as a means for benefiting future generations while "maintaining and enhancing the quality of the environment and natural resource base that supports production…" (Dumanski et al. 1998, pg. 1). In the October 1998 World Bank workshop on Sustainability in Agricultural Systems, researchers and professionals described the dimensions of sustainability and how it works with agriculture (Dumanski et al. 1998). Indicators for sustainability assessments included but were not limited to productivity and yield, plant grown, risk management and security, total soil erosion, cropping intensity and extent of protection, net farm income, off farm income, land tenure, and training in soil conservation (see Table 2.02).

Table 2.02 Sustainable Agriculture Performance Indicators

FIELD TO MARKET NATIONAL INDICATORS REPORT	STEWARDSHIP INDEX FOR SPECIALTY CROPS METRICS	PERFORMANCE INDICATORS FOR SUSTAINABLE AGRICULTURE
Biodiversity	Applied Water Use Efficiency	Productivity and Yield
Generation of Economic Value	Habitat and Biodiversity	Plant Growth
Energy Use	Energy Use	Risk Management and Security
Greenhouse Gas Emissions	Nitrogen Use	Total Soil Erosion
Irrigation Water Use	Phosphorus Use	Cropping Intensity and Extent of Protection
Land Use	Soil Organic Matter	Net Farm Income
Soil Carbon	Simple Irrigation Efficiency	Off Farm Income
Soil Conservation		Land Tenure
Water Quality		Training in Soil Conservation

RELATIONSHIPS + OPPORTUNITIES

Landscape architecture has evolved significantly since its origins in the late 19th century. The work of modern landscape architects includes everything from small urban plazas to region-scale master planning. Some professionals focus their career on community development, others on ecosystem resilience. The broad range of landscape architecture lends itself to the field's tendency to collaborate with an extensive array of professionals.

Sustainable agriculture is quickly including more than just traditional farming practices. Although sustainable farming practices have been around for thousands of years, many sustainable practices have not expanded beyond horticulture until the past 50 years. Today, sustainable agriculture includes everything from soil health and pest control to educational opportunities for youth groups.

Traditionally, landscape architects worked primarily in sociology and aesthetics of environmental design. Today however, the reaches of landscape architecture are spreading. Modern landscape architecture integrates sociology, aesthetics, ecology, recreation, education, economics, and soil health—all at varying degrees—into the design process. Sustainable agriculture originally focused its effort on maintaining soil health, and the economics of food production. Today, the field is expanding, integrating ecology, education, recreation, and sociology into its network. The interconnected relationship between the pursuits of the respective fields can be seen in Figure 2.06. Despite their separate origins, landscape architecture and sustainable agriculture are both working on similar solutions to similar problems.

The future of sustainable site design is reliant on the integration of multiple functions within one project, one project that must simultaneously create environmental, economic, social, and aesthetic value (Calkins 2015). One of the most effective ways to successfully design these multifunctional landscapes is to synthesize the work of existing professions into interdisciplinary design practices and metrics that are applicable to multiple professions. As the fields of landscape architecture and sustainable agriculture continue to overlap more and more, there is a growing indication of the need for interdisciplinary work and the exchange of information. Landscape architects have a rich history of working with engineers, ecologists, horticulturists, architects, and urban planners, however, they still rarely work with agriculturalists.

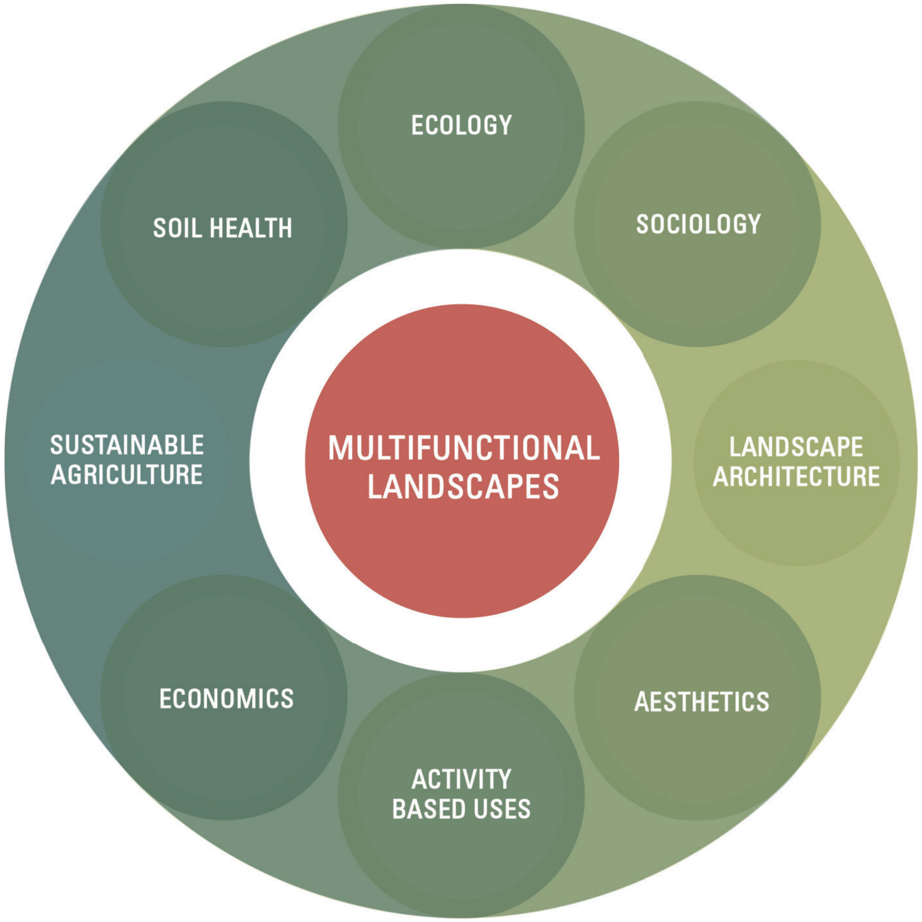

Figure 2.06
Interconnected relationship between sustainable agriculture and landscape architecture in multifunctional landscape design

PERI-URBAN LAND USES

In recent years rural landscapes across the midwestern United States have been developed, changing from agricultural lands to suburbs, warehouses, and commercial areas. Despite a continuously increasing population, the country is steadily decreasing in the amount of cropland (Hansen and Francis 2007). With a rate of farmland loss of approximately 2 million acres per year (Hansen and Francis 2007), it is becoming critical that future development consider the conservation of agricultural land. The rural-urban boundary is made up of peri-urban landscapes. Peri-urban landscapes are the, "open lands and farmlands surrounding cities that are subject to commercial or housing development because of urban expansion and city growth pressures" (Hansen and Francis 2007, p. 43). The rural-urban boundary often poses problems for both the city dwellers and the farmers themselves. Urban community members complain of noise from large machinery and tractors, odors, dust, soil erosion, pesticide drift from agricultural fields, and slow-moving vehicles on roads. Farmers complain of lawncare pesticide drift, gates being left open, fast-moving cars on gravel roads, security issues, and litter problems (Hansen and Francis 2007). However, the rural-urban interface presents opportunities for integration that can benefit both sides socially and economically. Conservation buffers, which bridge agricultural fields with natural areas and natural areas with peri-urban developments, provide a promising land use solution for multifunctional agricultural landscapes. Benefiting urban and rural residents alike.

Conservation buffers are the small areas or strips of land planted with permanent vegetation that are designed to intercept pollutants and manage environmental concerns. Buffers can provide habitat for wildlife, act as a conduit for biodiversity, slow wind and erosion, and provide additional nutrients for surrounding areas (NRCS 2019; Hansen and Francis 2007). Conservation buffers along agricultural edges can use woody plantings and pathways as attractive areas for recreation including hiking, biking, and birdwatching. The benefits of conservation buffers include slowing water runoff, trapping loose sediment, chemicals, and heavy metals, enhancing infiltration, and protecting livestock and wildlife from harsh weather conditions. These buffers can be instrumental to environmental sustainability due to their ability to control soil erosion, improve soil and water quality, enhance wildlife habitat, reduce flooding, and conserve biodiversity (NRCS 2019).

MULTIFUNCTIONAL LANDSCAPES

As urban landscapes become denser, the importance of protecting remaining open space grows more critical. Multifunctional landscapes are being used to design landscapes for performance, ecological health, and social uses. Despite natural landscapes having multiple functions, humans have been transforming them to serve simpler functions throughout the course of our existence (Lovell and Johnston 2009a). These landscapes are often used as cropland for the production of food, or parks for recreation however they have the ability to do much more. Multifunctional landscapes are widely considered to be more desirable than traditional single-purpose landscapes and can be used to save space and energy in urban environments (Kato and Ahern 2009). It is common for multifunctional landscapes to encourage the development of sustainable food production alongside biodiversity conservation, protection of ecosystem services, and poverty alleviation. Many of these agricultural landscapes work to improve production and ecological functions simultaneously (Lovell and Johnston 2009b and McNeely and Scherr 2003). Some research uses multifunctional landscapes to solely describe multifunctional agriculture however, they can be considerably more complex. These landscapes are often used to support sustainable land use and development at the same time and are often used to integrate agriculture with environmental stewardship. In the context of sustainable development, multifunctionality often suggests that multiple environmental, social, and economic functions are provided by the landscape in question (Wiggering et. al. 2003).

METHODOLOGY

CHAPTER THREE

INTRODUCTION
a. dilemma + thesis
b. purpose + project goals
c. research question

BACKROUND
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b. sustainable agriculture
c. relationships + opportuunities

METHODOLOGY
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- criteria for study
- analysis + adjusted metrics

CASE STUDIES
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DESIGN APPLICATION
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CONCLUSION
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c. broader impacts

METHODOLOGY

Upon completion of an in-depth literature review on the fields of landscape architecture and sustainable agriculture, research was used by the author to perform a pilot study. In the Fall 2019 semester, this pilot study identified leaders within the fields of landscape architecture and sustainable agriculture. Though not all-inclusive, the research identified professionals, firms, and non-profit organizations gleaned from published work, award-winning design projects, and features in online and/or journal articles. The author then investigated the design, engagement, and implementation practices of the selected individuals and organizations using online and print media to study design practices, built work, and collaborative experiences. This closer look identified a set of built multifunctional agricultural parks to research as case studies. More information on the pilot study and the professionals, firms, and non-profit organizations can be found in Appendix C.

The combination of literature review and preliminary case study research was used to create a set of landscape performance metrics used to quantitatively evaluate each case study for this report, and for future case studies. Case studies are used in this report to form a set of projective design strategies and programming elements for future multifunctional agricultural landscapes. A visual of the entire methodology can be seen below in Figure 3.01.

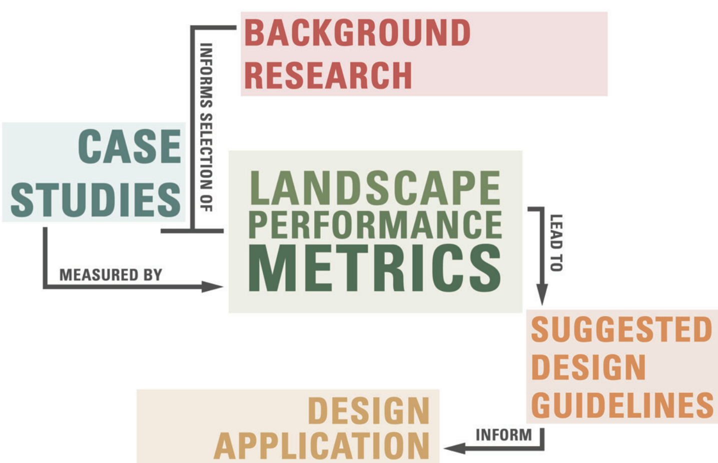


Figure 3.01 Methodology diagram

CASE STUDIES

Case studies are integral to the development of this project because they provide examples of projects similar in scale, location, and with similar project goals. These cases can act as inspiration for additional projects and help to generate program elements, further influencing the development of future design strategies. Examples of successful, and unsuccessful, collaboration between the fields of landscape architecture and sustainable agriculture to design and implement multifunctional landscapes in urban and peri-urban environments are researched and analyzed according to a series of metrics to determine successes, failures, and opportunities for improvement. The analysis of existing projects in combination with a rich understanding of the fields result in a series of projective design strategies that can be implemented in future projects.

Case studies are defined by Mark Francis in, "A Case Study Method for Landscape Architecture," as a well-documented and systematic examination of a project (2019). Case studies can be used to learn valuable information about the successes and failures of a project and its context. In addition to site specific research, case studies should include the following information: baseline information and content, key participants, process, project goals, program and design description, project scale, maintenance and management, and lessons learned.

CRITERIA FOR STUDY

After the pilot study, a list of built work was narrowed down to four projects of interest. Selected cases were required to fit the following criteria.

1. The site must be at least 1 acre in size in order to limit small scale interventions. Although small urban-agriculture projects can be extremely beneficial, this report is looking at larger-scale design projects.

2. The site must be located in proximity to a town with a population of at least 100,000. This is to limit the selection of sites to those that impact a large number of people. There are many agriculture projects that work within suburban communities or small towns, however in order to understand how these projects can positively impact a large number of people, the cases being studied must be within this range.

3. The project must incorporate multiple activities for communities to take advantage of. This must include the implementation of agriculture but could also include educational opportunities, sports fields, event centers, or nature trails.

4. The project must have been designed as a multidisciplinary project. This includes the help of either a landscape architect, planner, or architect AND the additional assistance from farmers, ecologists, or engineers.

5. The project must be built.

Selected cases can be seen in Figure 3.02 and include (1) Lone Oak Farm in Tennessee, (2) the Seattle Children's Playgarden in Seattle, WA, (3) the Grow Dat Youth Farm in New Orleans, LA, and (4) Sunol Water Temple Agricultural Park in San Francisco, CA. Positioned across the country, these four cases are designed and built by a variety of landscape architects, planners, and sustainable farmers.

ANALYSIS AND LANDSCAPE PERFORMANCE METRICS

A series of landscape performance metrics were used to quantify the successes of these case studies. The evaluation involved the analysis of existing information in order to answer key questions and to gauge the success of a project. Projects were assessed on their performance in four key categories: environmental, economic, social, and aesthetic.

This assessment is a modified version of the LAF Landscape Performance Metrics (Canfield et al. 2018) in combination with strategies from the Sustainable Sites Guidelines (Calkins 2015), the Field to Market National Indicators Report (Thomson et al. 2016), the Performance Indicators for Sustainable Agriculture (Dumanski et al. 1998), and the Stewardship Index for Specialty Crops (Stewardship Index 2013). The existing sustainable agriculture assessment tools, with their focus on a scientific evaluation of soil and ecosystem health, were a helpful complement to those within landscape architecture. In addition to the integration of sustainable agriculture factors, aesthetic metrics were added from Ervin Zube's research on landscape perception (Zube et al. 1982), Joan Nassauer's research on rural landscape aesthetics (Nassauer 1989, 1997, and 2002), and the U.S. Forest Service's report on Scenic Assessment (Thomas 1995). The research on existing assessment strategies in both fields led to a long and redundant list of potential metrics to use in this report. The final metrics and categories were selected based on their frequency of appearance in existing reports, ability to be measured in quantitative terms, and relevance to the fields of sustainable agriculture and landscape architecture. The existing assessment tools in sustainable agriculture were helpful in expanding existing assessment strategies within landscape architecture. Sustainable agriculture metrics are often based more on scientific evaluation and their emphasis on soil and ecosystem health proved valuable to this work.

The goal of landscape performance assessments is to understand the benefits of an implemented design to the site and to the surrounding community. In this report, benefits are divided into four sections:

Figure 3.02
Map of case study locations (Images from Lone Oaks Farm 2016, Seattle Parks 2011, Grow Dat Youth Farm 2015, Alexandrov 2015)

environmental, economic, social, and aesthetic. Each of these sections is further divided into six categories for more specific assessment. Within each category is a set of metrics- a type of data or information that serves as a descriptor for understanding the benefits of a site design element or practice. Each metric, in turn, can be measured via a specific method- a specific strategy used to quantify information for an assessment (Canfield et al. 2018). A graphic representation of the relationship between benefit section, benefit category, metrics, and methods can be seen in Figure 3.03. The complete list of benefit categories can be seen on the opposite page in Table 3.01, divided by benefit section.

SECTION	CATEGORY	METRIC	METHOD
Environmental	Soil Health	Improvement in soil health	Comparative soil surveys
Social	Safety	Reduction in crime	Analysis of GIS data

Figure 3.03 Relationship between landscape performance assessment sections, categories, metrics, and methods

For each case study, individual metrics and the specific methods used to measure them were identified. Some metrics were impossible to measure in certain case studies and as such will not be counted for this study. Due to time and information constraints, additional surveys, participant counts, or stormwater facility measurement cannot be done for this report. Because of the availability of information and data, collected from design documents, reports, photographs, and/or award submittals for each case, some metrics are described in qualitative terms rather than with quantitative methods. If these performance metrics were to be used again, it is suggested that any researcher use strictly quantitative methods in order to ensure accuracy and replicability. This information can come from the sources used for this report in addition to on-site measurements, user surveys, and environmental impact assessments.

It is important to note that despite the landscape performance metrics being separated into four individual categories, they are all deeply related. Carbon sequestration, soil health, and habitat creation in the environment category are directly associated with planting material and vegetation in the aesthetic category. Stormwater management in the environmental category goes hand in hand with operations and maintenance in economics. When considering a project as a whole, it is important that many benefits cross over, affecting all aspects of a design.

ENVIRONMENTAL	Soil Health (Preservation + Restoration)
	Land Use and Preservation
	Air Quality
	Carbon Sequestration
	Habitat Creation, Preservation, and Restoration
	Stormwater Management, Water Quality, and Irrigation Efficiency
ECONOMIC	Operations and Maintenance
	Visitor Spending and Earned Income
	Job Creation
	Tax Revenue
	Economic Development
	Energy Use
SOCIAL	Recreational Activities
	Educational Opportunities
	Health and Wellbeing
	Safety
	Cultural Preservation
	Transportation and Accessibility Standards
AESTHETIC	Scenic Quality and Views
	Regional Context and Material Usage
	Historical Context
	Human Comfort
	Planting Material and Vegetation
	Composition, Form, Geometry, Space, Scale

Table 3.01 Landscape Performance Topics

Table 3.02 Environmental Performance Metrics

ENVIRONMENTAL BENEFITS	POTENTIAL METRICS
Soil Health (Preservation + Restoration)	Improvement in soil health or fertility
	Increased soil infiltration rate
	Increased area of fertile soils
Land Use and Preservation	Area of valuable features protected or left undisturbed
	Amount of disturbance confined to previously developed portions of the site
	Area of existing topography preserved
Air Quality	Amount of air pollutants removed by woody vegetation
	Reduction in air temperature (avoiding heat island)
Carbon Sequestration	Amount of atmospheric CO_2 sequestered
	Reduction in CO_2 emissions from maintenance or energy savings
	Reduction in CO_2 emissions from a reduction in vehicle miles traveled
Habitat Creation, Preservation, and Restoration	Increased area for habitat for species of interest
	Increase in continuous habitat area
	Increase in species diversity/richness for an area of interest
Stormwater Management, Water Quality, and Irrigation Efficiency	Improvement in water quality/reduction in sediment load
	Reduction in irrigation costs
	Annual volume and percent of runoff retained on-site/ increased flood storage capacity

Environmental

Environmental metrics (Table 3.02) are often one of the most commonly measured within landscape architecture and in other professions. These metrics often use calculators and prediction models to understand how a project impacts the surrounding landscape. Many environmental metrics are centered around ecosystem services, horticultural production, and conservation practices.

Table 3.03 Economic Performance Metrics

ECONOMIC BENEFITS	POTENTIAL METRICS
Operations and Maintenance	Savings on water costs
	Savings on energy costs
	Savings on maintenance costs
Visitor Spending and Earned Income	Monetary value of food or other products produced on site
	Revenue or net revenue from facility rentals, parking fees, or sales
	Total visitor spending
Job Creation	Number of temporary jobs created during design and construction
	Number of permanent or seasonal jobs created
	Number of people learning job skills on site
Tax Revenue	Increase in property tax revenue from site or nearby properties
	Increase in sales tax revenue
	Decrease in stormwater tax spending
Economic Development	Increased in assessed property value or sales price
	Number of additional projects catalyzed
	Increase in occupancy rate of nearby properties
Energy Use	Reduction in annual energy use
	Annual cost savings from reduced energy use
	Adjustment to renewable energy sources

Economic

Arguably one of the easiest sections to measure and understand, economic metrics are used to highlight cost savings, project profits, and economic development. Often economic metrics (Table 3.03) are used to show how sustainable strategies can be used to save money on water, energy, or maintenance but these metrics can also highlight produce sales, project revenue, or job creation.

Table 3.04
Social
Performance
Metrics

SOCIAL BENEFITS	POTENTIAL METRICS
Recreational Activities	Visitors engaged in recreational or social activities
	Quality of visitor experience
	Number of or attendance at recreational events
Educational Opportunities	Visitors engaged in educational activities and accessing resources
	Extent of facility use
	Increase in knowledge
Health and Wellbeing	Improvement in mood, level of satisfaction, or quality of life
	Improvement in physical health or activity
	Level of physical activity
Safety	Reduction in traffic incidents
	Reduction in crime
	Perception of safety
Cultural Preservation	Area or quantity of culturally valuable elements protected or restored
	Quality of visitor experience
	Quantity of cultural goods produced
Transportation and Accessibility Standards	Increase in walking, biking, or mass transit use
	Reduction in vehicle miles traveled
	Increase in level of service

Social

Social metrics (Table 3.04) can be more difficult to measure and quantify than environmental or economic metrics due to the need for visitor surveys. However, these metrics are extremely beneficial in understanding how a community interacts with a project. Social metrics are used to understand recreational and education opportunities onsite, as well as visitor's perception of safety, health, and accessibility standards.

Table 3.05
Aesthetic
Performance
Metrics

AESTHETIC BENEFITS	POTENTIAL METRICS
Scenic Quality and Views	Score on established visual quality scale
	Percentage of unwanted views screened, or desirable views maintained
	Inclusion of vegetation, water features, landform, monuments
Regional Context and Material Usage	Amount of virgin materials saved or local materials used
	Associated color theory prinicples used in material selection
	Perception of aesthetic value
Historical Context	Area or quantity of historically valuable elements protected or restored
	Relationship of design to cultural heritage and local traditions
	Amount of disturbance confined to previously disturbed site areas
Human Comfort	Increase in amount of time visitors spend on site
	Number of seating elements and locations on site
	Neatness of landscape, maintenance levels, sight-lines
Planting Material and Vegetation	Percentage of native vegetation planted on site
	Vegetation species diversity
	Amount of time bare soil is exposed to elements
Composition and Form	Number of awards won for landscape design
	Abidance to traditional design rules of symmetry, hierarchy, repetition, etc.

Aesthetic

Not included in the LAF Landscape Performance Guidelines, aesthetic metrics (Table 3.05) are arguably one of the most difficult to quantify. Aesthetic metrics were selected based on adjusted LAF metrics in combination with the U.S. Forest Service's Scenic Assessments, professional awards criteria, and landscape perception research. Complexity of design, the coordination of color themes, historic origin, and symmetry pattern are all key factors in the determination of aesthetic preference (Hirschfield 1977). Aesthetic guidelines and metrics are used in this report to quantify the benefits of regional and historic context, scenic quality, human comfort levels, and composition and form.

CASE STUDIES

CHAPTER FOUR

INTRODUCTION
a. dilemma + thesis
b. purpose + project goals
c. research question

BACKROUND
a. landscape architecture
b. sustainable agriculture
c. relationships + opportuunities

METHODOLOGY
a. case studies
- criteria for study
- analysis + adjusted metrics

CASE STUDIES
a. individual case analysis
b. synthesis + suggested design guidelines

DESIGN APPLICATION
a. existing conditions
b. guiding principles
c. design solution

CONCLUSION
a. assessment of metrics
b. limitations of study
c. broader impacts

CASE STUDIES

After identifying the cases for further study, sources of information on each were investigated to determine whether or not sufficient information existed for metric analyses. Information sources were variable, and some projects had limited information that was both available to and accessible by the public. However, four cases emerged from the rest as having the most useful information available: Lone Oaks Farm, Seattle Children's PlayGarden, Grow Dat Youth Farm, and Sunol Water Temple Agricultural Park. Information on these four projects was found via multiple online sources including local newspaper articles, design firm project descriptions, non-profit organization websites, and community blogs. Designers, clients, and owners of the projects were contacted via email in the hopes of retrieving more information, however, none responded. Background information of each case was researched to provide context for each of the four project cases which were then analyzed according to the established metrics.

LONE OAKS FARM

BACKGROUND INFORMATION

Location Middleton, Tennessee

Size 1,200 acres

Date Redesigned in 2017

Client University of Tennessee

Designer El Dorado Architects, W.M. Whitaker & Associates and Nelson Byrd Woltz LA

Principles “A working farm with livestock and hay production, the master plan will enable the farm’s continued and sustainable growth, provide for the conservation and restoration of its natural landscape, and create a national model that encourages a deep appreciate for the land, conservation, and agriculture for generations to come” (NBWLA 2019).

History Lone Oaks Farm (Figure 4.01-4.03) has been a working farm since 1998 (SCUP 2018). After its donation to the University of Tennessee in 2015 the university hired landscape architecture firm Nelson Byrd Woltz to develop a 100-year master plan (Lone Oaks Farm 2019). A multipurpose campus including housing, gathering places, food preparation and serving areas, demonstration farms, recreation areas, roadways and infrastructure was redesigned and expanded from the existing site in 2017 (University of Tennessee 2017). The design and planning process began with detailed research and documentation of the local and regional history of the project site. The topography and hydrology included lakes, streams, hills, and valleys, all of which acted as design cues for further development (NBWLA 2019). Three major programming elements of the project include youth education and developmental programs, agricultural production and research, and facilitation of entertainment and recreation for the surrounding community (NBWLA 2019).

Figure 4.01
Lone Oaks Farm
(Image courtesy of Lone Oaks Farm 2016)

Figure 4.02
Lone Oaks Farm
Map

METRICS ANALYSIS

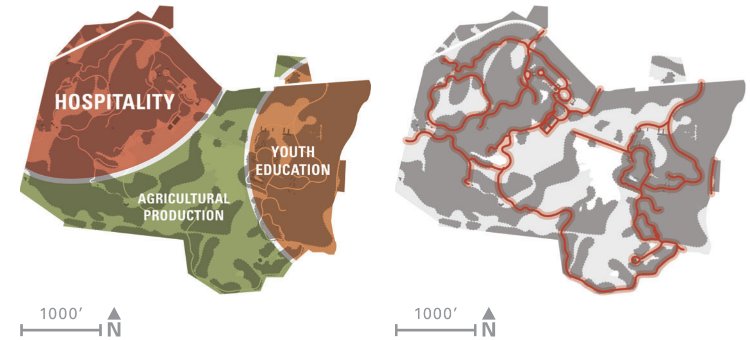
BENEFIT	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Habitat Creation, Preservation, and Restoration	Increase in continuous habitat area	Lone Oaks Farm Biological Baseline Survey camera trapping and observations from 2017	An increase in forest coverage in early successional stages would boost prey abundance and provide good stalking habitat for bobcats, an elusive animal that has been found on-site	(Guthrie 2017)
--				

BENEFIT	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Visitor Spending and Earned Income	Total visitor spending	Numbers from 2017 master plan	The future hospitality complex uses existing and proposed buildings to provide hospitality services to between 30-40 people. Services include a restaurant, inn, cabins, meeting rooms, and a health and wellness center	(Nelson Byrd Woltz LA et. al. 2017)
--				

BENEFIT	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Educational Opportunities	Visitors engaged in educational activities and accessing resources	Numbers from 2017 master plan	Will annually hose upwards of 1,500 students between 4th through 12th grade from surrounding communities	(SCUP 2018)
--				

BENEFIT	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Scenic Quality and Views	Inclusion of vegetation, water features, landform, monuments	Observation and analysis from project leads	The property includes a diverse mixture of pasture, woodlands, trails, and sixteen lakes, epitomizing Tennessee's natural beauty	(Lone Oaks Farm 2015)
Composition, form, geometry, space, scale	Number of awards won for landscape design	Research of awards	3-time award winner: VA ASLA Merit Award, Analysis and Planning 2018, AIA KC Concept Design Award 2019, SCUP Excellence in Planning for a New Campus 2018,	(SCUP 2018, NBWLA 2019, AIAKC 2019)

Figure 4.03 Programming and Circulation Routes at Lone Oaks Park



SUMMARY + REFLECTION

Lone Oaks Farm is different from the other case studies because of its level of completion. Although the farm is built and functional, the design done by Nelson Byrd Woltz and others has yet to be fully implemented. Their design and master plan lays the groundwork for the farm over the next several decades, guiding future projects and suggesting strategies for implementation. Despite the fact that the master plan has yet to be completed, the existing site is already being used as a multifunctional agricultural landscape and the property will only improve as construction phases are completed. The use of site physiography and history as a design guideline for future projects was critical to the success of the master plan and continued environmental monitoring efforts ensure that the goals of the project are met. See Table 4.01 for further analysis.

The 1,200-acre property includes approximately 250 acres of agriculture, 60 acres of hospitality and event space, 35 acres of educational space, and 855 acres of natural area which is often used alongside the hospitality and educational areas. The project is a successful example of interdisciplinary collaboration as work was completed by landscape architects, architects, ecologists, landowners, and students. Lone Oaks Farm acts as a model landscape for retreats, weddings, community outreach events, youth education, and an agricultural environment.

Table 4.01 Lone Oaks Farm Metrics Assessment

SEATTLE CHILDREN'S PLAYGARDEN

BACKGROUND INFORMATION

Location Seattle, Washington

Size 1.2 acres

Date Founded in 2002, completed 2010

Client Seattle Children's PlayGarden

Designer Winterbottom Design, Inc.

Principles The project design sought to create outdoor play spaces that accommodate and nurture children with special needs through accessible outdoor learning environments.

History Founded on the core principles of adventure play, the Seattle Children's PlayGarden (Figure 4.04-4.06) is designed to be fully inclusive, save and accessible for children of all abilities to learn and play in the outdoor environment. The park provides recreational and therapeutic opportunities for children of all ages and abilities to interact with nature, learn, explore, and develop their sense of wonder and independence (Forkner 2019, Seattle Children's PlayGarden 2010).

The project site was selected by the Seattle Parks Department in 2003 and after schematic design and the first phase of construction, it began holding summer programs in 2006. Phases 2 and 3 were completed in the summer of 2010 and included the addition of a garden house, play plaza, vegetable gardens and the renovation of the Field House. By the end of the fourth phase, the gardens had been extended to include a bioswale raingarden and an accessible tree fort and musical sculpture. Today the PlayGarden offers classes, camps, and events for children with special needs alongside typically developing children (Seattle Children's PlayGarden 2010) The 1.2 acre site includes approximately half an acre of playground space, half an acre of natural areas, .1 acre of agriculture/farming and .1 acre of event space.

Figure 4.04
Play mounds in the Seattle Children's PlayGarden (Seattle Parks 2011)

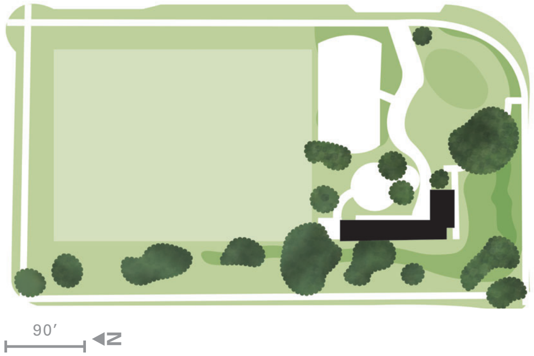


Figure 4.05
Seattle Children's PlayGarden Map

METRICS ANALYSIS

BENEFIT	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Stormwater Management, Water Quality, and Irrigation Efficiency	Annual volume and percentage of runoff retained on site	Runoff calculated using Washington State Department of Ecology Rain Harvesting Toolkit	The project captures and infiltrates 150,040 gallons of stormwater runoff annually from 7,500 sf of impervious surfaces	(Yocom and Lacson 2011)

BENEFIT	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Visitor Spending and Earned Income	Monetary value of food or other products produced on site	Using a formula developed for vineyards and adapted for produce to calculate average annual potential yield	Yields and estimated 940 lbs of fruits and vegetables each year with an estimated value of $1,100.	(Yocom and Lacson 2011)
Operations and Maintenance	Savings on water costs	Direct cost comparison	The green roof, rain garden, and cistern are estimated to reduce the site's surface water management fee by $300 each year when compared to the same sized parcel without any onsite stormwater management	(Yocom and Lacson 2011)

BENEFIT	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Educational Opportunities	Visitors engaged in educational activities and accessing resources	Counting numbers of participants in educational programming	Provided therapeutic conditioning and outdoor education to nearly 400 children since opening in 2010.	(Yocom and Lacson 2011)
Health and Wellbeing	Improvement in mood, level of satisfaction, or quality of life	Utilizing the toolkit produced by the organization to understand	Educating and allowing families and friends to break down barriers and create inclusive and open environments for children with disabilities	(Johnson 2019)

BENEFIT	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Regional Context and Material Usage	Associated color theory prinicples used in material selection	Visual analysis	Play plazas are made of bright complementary colors that match the flowering vegetation, a bright red pickup truck, and swings on the site.	Photographs and aerial imagery
Composition, form, geometry, space, scale	Number of awards won for landscape design	Research of awards	2012 Excellence in Concrete Construction: Sustainable Merit, 2015 Winner of the Great American Gardeners Award from the American Horticultural Society	(Braden 2015 and Babienko Architects 2020)

Table 4.02 Seattle Children's Garden Metrics Assessment

Figure 4.06 Programming in the Seattle Children's PlayGarden

SUMMARY + REFLECTION

The garden is an active and fun space for children with and without disabilities in the Seattle area. Children get to spend time running and playing in multiple environments both indoors and outdoors, with opportunities for kids of all ages and levels of socialization. The park allows for multiple types of informal play alongside formal activities and classes. The gardens are designed with pollinator plants and help to capture and infiltrate more than 150,000 gallons of stormwater runoff annually. The gardens produce fruits and vegetables used in the kitchen for activities and special programs. The park has been extremely successful and is loved by the surrounding community however, it is not self-maintaining. The gardens take approximately $50,000 per year to maintain, money that comes from donations and grants (Easton 2015). See Table 4.02 for further analysis.

The park overall is a successful example of small-scale multifunctional landscapes. However, the multiple functions all serve the same purpose, to support and provide play environments for children with special needs. Although the types of support and play spaces are variable across the project site, they all serve that goal, so the project is not a good example of larger multifunctionality.

GROW DAT YOUTH FARM

BACKGROUND INFORMATION

Location New Orleans, Louisiana

Size 7 acres

Date 2009-2011

Client Tulane City Center and New Orleans City Park

Designer Small Center and Grow Dat Youth Farm

Principles The farm seeks to use sustainable methods to build resilient agricultural systems and nurture a diverse group of youth leaders within a supportive environment designed to help young people develop leadership skills and initiate change in their local communities.

History Grow Dat Youth Farm (Figure 4.07-4.09) started as a sustainable 4-acre campus designed in collaboration with the Albert and Tina Small Center for Collaborative Design out of the Tulane School of Architecture. The farm's location in New Orleans City Park was designed over two spring semester studios focused on a 6,000 square foot urban farming campus and a 4-acre organic farm with sophisticated water and soil management systems (Small Center 2017). The space today includes outdoor classrooms, teaching kitchen, locker rooms, administrative offices, a post-harvest area, and several acres of farms (Quirck 2012). Grow Dat Youth Farm works to develop a sense of responsibility, community and multiculturalism, environmental stewardship, and food justice among city high schoolers through the collaborative growth of organic foods. Their youth leadership programs help students throughout the community and work to maintain the land and the organization in a way that ensures they remain productive over time (Grow Dat 2020).

Figure 4.07
Youth Farm Facilities (Image Courtesy of Grow Dat Youth Farm 2015)

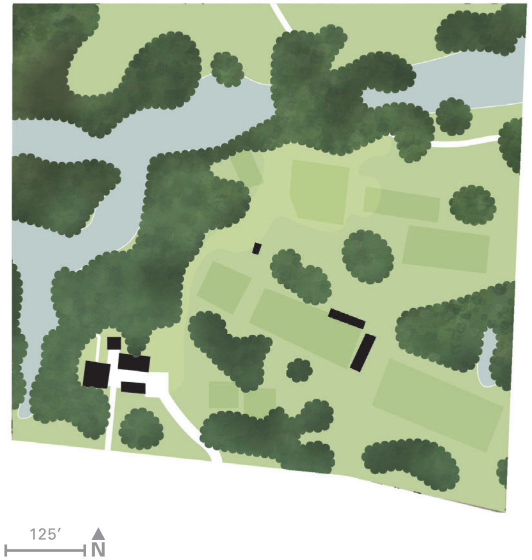


Figure 4.08
Grow Dat Youth Farm Map

METRICS ANALYSIS

BENEFIT	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Stormwater Management, Water Quality, and Irrigation Efficiency	Annual volume and percent of runoff retained on-site	Analysis according to the Tulane School of Architecture	All rainfall is sequestered on site, all gray-water is bio-filtered on site and all black-water is composted on site.	(Small Center 2017)

BENEFIT	**METRIC**	**METHOD/TOOL**	**DETERMINATION**	**SOURCE**
Visitor Spending and Earned Income	Monetary value of food or other products produced on site	Assessment of total produce harvested and sold	In 2015-2016 they grew and harvested 18,000 pounds of fresh produce, 70% sold at farm stand and markets and 30% distributed through harvest program to low income residents, made $56,115 in produce sales	(Grow Dat Youth Farm 2016)
Job Creation	Number of permanent or seasonal jobs created	Counting numbers of graduates from leadership program	Between 2011-2017 the farm has graduated more than 250 young people from their leadership program, sending them into the world with increased experience and a higher likelihood of finding a permanent job.	(Grow Dat Youth Farm 2017)
BENEFIT	**METRIC**	**METHOD/TOOL**	**DETERMINATION**	**SOURCE**
Educational Opportunities	Visitors engaged in educational activities and accessing resources	Counting numbers of attendees within the primary leadership program	50 young people from 12 different schools participated in the 5-month leadership program where they spend time running a market farm and learning valuable teambuilding skills	(Grow Dat Youth Farm 2016)
Health and Wellbeing	Improvement in mood, level of satisfaction, or quality of life	Surveys of students after their involvement in the core leadership program	Youth involved in the program reported that because of the farm they are more likely to categorize themselves as leaders, feel more comfortable receiving feedback, and have improved their ability to communicate with other demographics.	("Grow Dat Youth Farm" 2020)
BENEFIT	**METRIC**	**METHOD/TOOL**	**DETERMINATION**	**SOURCE**
Composition, form, geometry, space, scale	Number of awards won for landscape design	Research of awards	4-time award winner, 2014 AIA Louisiana Honor and Members Choice Awards, 2012 Members Choice Awards, 2012 SEED Award, and 2012 AIA New Orleans Design Award of Honor	(Small Center 2017)

Table 4.03 Grow Dat Youth Farm Metrics Assessment

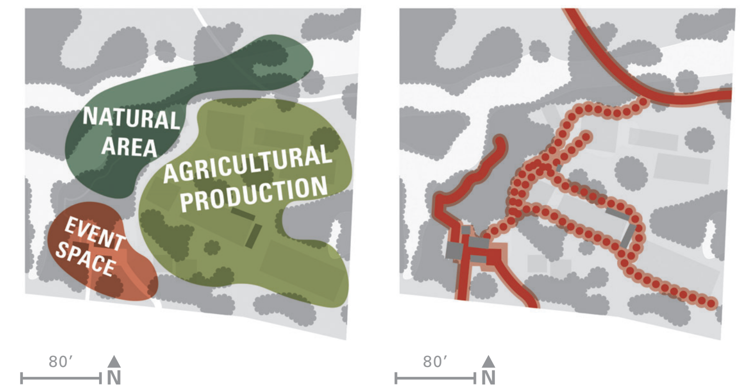


Figure 4.09 Programming and Circulation Routes at Grow Dat Youth Farm

SUMMARY + REFLECTION

Today, Grow Dat Youth Farm is an extremely successful example of a multifunctional working farm. The site is used as a learning campus for local youth, an event space for community programs, and as a productive farm. The farm almost always makes more money in income than it loses in expenses however almost half of its annual income is from grants. The other portions come from individual donations, fundraising events, and produce sales. This means that despite the farm's continued success, it is not self-sustaining and relies heavily on outside support. However, this is arguably worth it considering the overall benefits to the community that the farm provides. Grow Dat's opportunities for local teenagers to engage with one another, other members of the community, and their environment in a positive way provides opportunities for jobs, education, and increased health and well-being. Alongside the benefits to the community, the farm has also won multiple awards for design and collects and stores all on-site water on the property. See Table 4.03 for further analysis.

The 7-acre property includes approximately four acres of agriculture, one acre of event space, and two acres of natural areas. Collectively, the project has achieved its goals of supporting local youth while also educating the surrounding community. Grow Dat Youth Farm's organizational commitments to sustainability, youth leadership, food justice, inclusion, and multiculturalism shine through all of their work and into the community around them.

SUNOL WATER TEMPLE AGRICULTURAL PARK

BACKGROUND INFORMATION

Location San Francisco Bay Area, California (Sunol Valley)

Size 20 acres

Date Founded in 2006 and expanded in 2011

Client Owned by SFPUC and managed by SAGE

Designer SFPUC and SAGE

Principles Integrate sustainable agriculture, natural resource stewardship, and public education to create a working farm that provides multiple small farmers with access to good quality land and opportunities to develop a small business enterprise (SAGE 2014).

History The Sunol Water Temple Agricultural Park (Figure 4.11-4.13) sits within the Sunol Valley, an area that, despite its close proximity to San Francisco, feels remarkably rural. The park was named after the adjacent Sunol Water Temple, a 59-ft beaux arts structure designed by architect Willis Polk in 1910 to honor the water resources of the area. The agricultural park was designed as a model of peri-urban, multifunctional agriculture. The park was built when the SFPUC agreed to let SAGE use it as a case study for their Urban-Edge Agricultural Park Feasibility Study. Historically, the region around the park supported scrub grasslands, and oak and riparian woodlands. In the early 1900s the area became walnut orchards along with growing specialty crops like strawberries, chives, and lettuce. For several decades prior to the development of the park, the area was used for hay production. In 2006, three separate farmers began farming at the park and by 2008 all the land was being farmed (SAGE 2015, SAGE and SFPUC 2014).

Figure 4.11
Sunol Water Temple and the surrounding area (Alexandrov 2015)

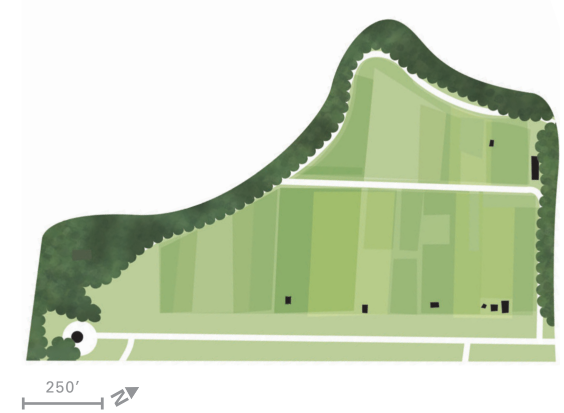


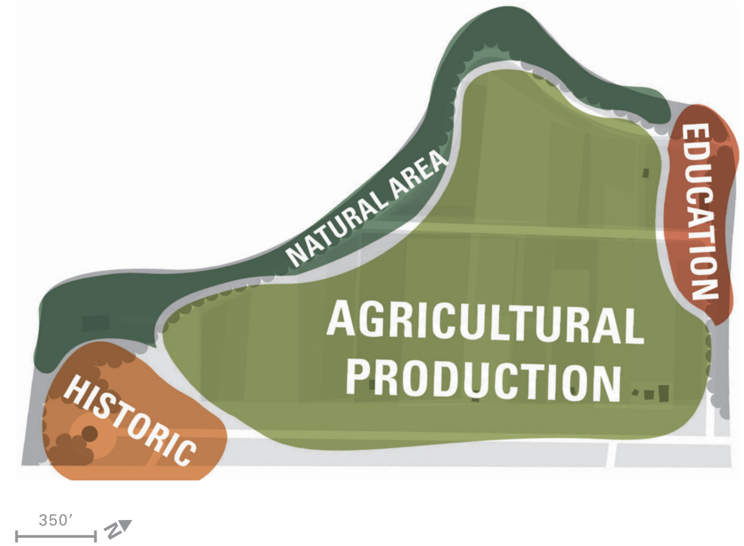
Figure 4.12
Sunol Water Temple AgPark Map

METRICS ANALYSIS

BENEFIT	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Soil Health (Preservation + Restoration)	Improvement in soil health	Annual soil tests for soil fertility showing year by year improved soil fertility	The once-compacted hay fields have becomemore fertile, more permeable and far more biodiverse at the plot scale and also at the landscape scale	(SAGE 2014, p. 31)
Habitat Creation, Preservation, and Restoration	Increased habitat area and an increase in numbers and diversity of wildlife	Counting numbers and diversity of song birds and pollinators	There has been a marked increase in the number and variety of song birds and pollinators in the park. This is in part due to the establishment of a half acre grass buffer and habitat hedgerow	(SAGE 2014, p. 31)
BENEFIT	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Operations and Maintenance	Savings on water, energy, maintenance costs	Assessment of costs for farmers in comparison with a traditional farm environment	Land fees and water fees were considerably reduced for farmers as a result of lowered management costs and renegotiated water rates	(SAGE 2014, p. 45)
Visitor Spending and Earned Income	Monetary value of products purchased on site or produced on site	Descriptions of successes, failures, and profit margins by farmers	Some farmers struggle to cover the costs of running the farm just through the sales of crops. However, some farmers, who started as part-time, now are full-time and can even afford paying a part-time worker.	(SAGE 2014, p. 59-64)
BENEFIT	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Recreational Activities	Visitors engaged in recreational or social activities, number or attendance at recreational events	Counting attendance at public engagement events through the years	The park has increased the number of events and attendance over the first four years of opening. In 2013-2014 more than 1,700 people were involved in tours, work days, and farmer events	(SAGE 2014, p. 39)
Educational Opportunities	Visitors engaged in educational activities, extent of facility use	Counting attendance at educational events via records from tours, school group visits, and educational programming	The park has increased the number of students attending for formal education porgrams every year for the first four years of opening. In 2013-2014 almost 3,000 students attended	(SAGE 2014, p. 37)
BENEFIT	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Scenic Quality and Views	Inclusion of vegetation, water features, landform, monuments	Visual assessment of site location	Scenic setting in a valley framed by oak-dotted hills and adjacent to the banks of the Arroyo de la Laguna.	(SAGE 2014)
Historical Context	Relationship of design to cultural heritage and local traditions	Visual assessment of site location	Located alongside the Sunol Water Temple which has been restored	(SAGE 2015)

Table 4.04 Sunol Water Temple AgPark Metrics Assessment

Figure 4.13 Programming in Sunol Water Temple Agricultural Park



SUMMARY + REFLECTION

The Sunol Water Temple Agricultural Park is a working example of a multifunctional productive farm. The non-profit organization has successfully combined public education and a working agricultural landscape, creating a popular destination for students, farmers, and visitors. Its position surrounding and supporting the existing historic landmark of the Sunol Water Temple allows for easier recognition by locals and adds to the aesthetic value of the site itself. Environmental improvements to soil health and habitat biodiversity have increased site fertility and the numbers of songbirds and pollinators within the park. Although the park is supported in part by the SFPUC, many farmers are able to support themselves off of their product sales from the farm. Water and energy costs are lower on the property than they would be as a typical park development as a result of lowered management costs and renegotiated water rates with the city. Students attending for informal and formal tours and educational programs learn the value of natural resource stewardship, and the processes for farming food. See Table 4.04 for further analysis.

The 20-acre property includes approximately 16 acres of agriculture, half an acre of educational space, one acre of historical space, and the remaining two and a half acres as natural area. Overall, the Sunol Water Temple Agricultural Park is a successful experiment in multifunctional peri-urban landscapes. Beloved by the local community, its mix of private farmers with public lands is quickly benefiting everyone involved.

SYNTHESIS

Located all over the country, the selected case studies present multiple successful renditions of a multifunctional agricultural landscape. From 1.2 to 1,200 acres, these projects offer examples of ways to integrate multiple programming elements, connect to surrounding communities, and conserve or restore natural ecosystems.

One of the over-arching themes among the successful cases is their deep-rooted connection to the surrounding communities. Whether the projects were formed from a community effort, or were simply embraced by the community after implementation, it was the support and passion from the surrounding neighborhoods that made the project successful. This is in part due to the high costs and low profits in maintaining an urban farm. Seattle Children's PlayGarden and Grow Dat Youth Farm both rely heavily on grants, donations, and local funding sources in order to survive. Sunol Water Temple Agricultural Park relies on grants to maintain itself though some of the individual farmers are able to make a living wage off their produce. Lone Oak's Farm offers more spaces for high-grossing events such as weddings and corporate retreats but is still owned and run by the University of Tennessee, a state-run institution. With all of this said, it seems unlikely that an urban agricultural landscape is capable of being completely self-sustaining without support from other sources. Because this support is so needed, communities have to be willing to work hard to gain funds for and maintain their urban farms and parks.

In order to successfully convince the surrounding community of the benefit of these landscapes, it is critical that people find multifunctional agricultural parks beautiful. The cases accomplished this task in different ways, but all of them worked and continue to work hard to ensure the farms are well-maintained and comfortable to spend time in even when you are not digging in the dirt. Sunol Water Temple Agricultural Park relied heavily on the beauty of the surrounding landscape. The scenic qualities of rural California immediately make the park more comfortable and aesthetically pleasing. In addition, SAGE, the organization in charge of Sunol Water Temple Agricultural Park's upkeep and maintenance, works throughout the year to restore and expand a conservation buffer around the perimeter of the property. Lone Oaks Farm also has the opportunity to rely on a beautiful natural landscape within Tennessee. However, with such a large property, the farm is able to retain vast spaces of the natural landscape for conservation. The rolling hills, forests, lakes, and streams on the farm ensure that visitors are able to experience the beautiful Tennessee countryside. At a very different scale, Grow Dat Youth Farm sits in the middle of New Orleans on a small portion of City Park. They utilize award winning buildings alongside dense native trees and vegetation for event and gathering spaces, allowing visitors to experience architecture, nature, and agriculture all in one place. At a smaller scale still, the Seattle Children's PlayGarden packs multiple programming and design elements into a site less than 1.5 acres. Densely planted pollinator gardens and well-maintained flower, herb, and vegetable beds all allow local children to experience the beauty and wonder of the outdoors in multifunctional spaces and with aesthetic variety.

All of the case studies provide multiple types of spaces for visitors to enjoy. Some of the case studies include small areas for urban gardening while others allow for acres of crops and pasture. The variety in landscapes also translates to programming requirements. Successful projects provide spaces for indoor and outdoor events, community programs, children's play gardens, and more. Having this variety ensures that the park is flexible and can serve the demands of diverse communities, allowing for changes in organization and structure of the agricultural landscape as needed.

SUGGESTED DESIGN GUIDELINES

Site Considerations

Analysis of the case studies revealed a set of site considerations (Table 4.05) and programmatic elements (Table 4.06) that are common among successful multifunctional agricultural landscapes In the design application of this project (described in the following chapter), these strategies served as guidelines in the landscape architecture and sustainable agricultural design processes, and the elements were used to define the site program. When designing a site at either a large or small scale, it is critical to synthesize and analyze any information about the project and the site prior to beginning the design process. Any multifunctional landscape project with agricultural programming should consider the following design strategies in detail.

Table 4.05
Site Design Considerations

SITE CONSIDERATIONS

Physiographic Context	Physiographic context and understanding of a landscape is critical to a well-designed outdoor environment. Any design project should include a detailed inventory and analysis of existing and past site and surrounding conditions.
Stormwater	Having a detailed understanding of stormwater and drainage processes on-site are critical to any landscape design but they are especially crucial when designing for agriculture programming. Assume any runoff should be collected and infiltrated on-site.
Trees and Vegetation	Understand the benefits of maintaining existing healthy and beneficial trees and shrubs; use proposed vegetation to shape spaces for future use. Carefully consider vegetation selection in each microclimate and avoid any unwanted or invasive species. How does vegetation change between agricultural areas and areas intended for aesthetics or restoration?
Microclimatic Factors	Outdoor conditions vary widely across a site due to differences in wind exposure, sun and shade, and humidity.
Indoor/ Outdoor Connections	Indoor environments are often just as important in parks and farms as outdoor ones. The connection between these spaces should be both spatially and functionally strong, reinforced by elements of landscape and building.
Accessibility	Required for any public space; accessibility concerns should be at the forefront of any design solution. Although the entire site does not need to be wheelchair accessible, there needs to be a variety of spaces for children and adults of all ages with varying degrees of movement and socialization skills.
Security and Safety	Consider what areas of a site are accessible to the public and what areas should be controlled access. Entrances should be clearly marked and able to be closed if needed. Consider sight lines across the property and ensure visibility is clear where needed.

Programmatic Elements

Site programs typically come from the client seeking to build a project. In the case of a multifunctional agricultural landscape, this is often the local government, a university, or a non-profit organization. A site program is a list of places and things that should be included in the final design of a landscape. In landscape architecture these often include elements like athletic fields, community centers, pollinator gardens, etc., whereas in sustainable agriculture, these often include elements like vegetable fields, orchards, produce wash/package station, farm stand, etc., The site program for any multifunctional agricultural landscape should include the following amenities (Table 4.06). Although these six elements are highly recommended and are common among successful studied projects, they are not the only elements that can be integrated into a project. Any design will also have additional, location specific elements that support the larger function of the site.

Table 4.06
Site Program Elements

PROGRAMMATIC ELEMENTS

Multiple Types of Productive Gardens and Agricultural Fields	Any agricultural park should provide a variety of sizes for visitors to experience and farmers to manage. Large farms can use multiple-acre fields for production alongside smaller gardens. Raised beds can be used for wheelchair accessible gardening and edible sensory gardens are perfect for children learning where their food comes from. Food forests and community gardens are more examples of productive ways to use space.
Native Plant Gardens	In order to remind visitors and farmers of site origins and the importance of land management and conservation, native plants should be used where possible across the park. These gardens can be used as learning tools to better understand the physiographic context of the surrounding landscape.
Storage and Utility Areas	Any park needs areas to store maintenance equipment and utilities however, farms have even more storage needs. Machinery, tools, compost, and any fertilizers used should have space to be stored onsite (or nearby if the park is small) and away from public access. Farms should also provide access to clean water and electricity.
Natural Play Areas	A variety of play spaces should be available for children of all ages and physical ability to engage with their environment. These play areas should incorporate natural elements and encourage children to learn while experiencing the outdoors in a fun way.
Indoor/ Outdoor Educational Environments	Educational programming can be integrated between indoors and out and allow for various learning environment types for the target age ranges and accessibilities. Consider the levels of enclosure needed for different learning environments and how spaces can accommodate youth programs from local schools.
Indoor/ Outdoor Event Spaces	Multifunctional agricultural landscapes need to be able to support and host a variety of events both indoors and outdoors. Areas should be available outdoors for large gatherings and indoor spaces should at least provide seating spaces, offices, and a kitchen.

DESIGN APPLICATION

CHAPTER FIVE

DESIGN APPLICATION

The intent of this chapter is to utilize the findings from the previous chapter, *Case Studies*, to provide an example of how a multifunctional agricultural landscape could be designed in a peri-urban environment. In particular the design phase of this report looks at Twin Lakes Park in Homer Glen, IL. As the previous chapter has illustrated, any design solution should carefully address a series of site considerations through an inventory and analysis phase to fully understand the site-specific opportunities and constraints. Prior to beginning this process any design concerns should be clear. For the purpose of this report the primary design concerns are accessibility, ecological restoration and protection, youth education, community development, and agricultural production. These individual concerns all lead towards the larger goal of creating a multifunctional agricultural landscape that instills joy within its visitors and the surrounding community.

The design process varies between projects due to time constraints, designer personality, and project requirements. In many landscape architecture offices, the traditional design process includes the following stages: site inventory and analysis, design program development, schematic program diagramming, schematic circulation diagramming, and functional program and circulation diagramming. Upon completion of these stages (they can be repeated multiple times), the design is resolved to a master plan level. For the purpose of this report, the design process has been slightly adjusted to successfully integrate the findings presented in the previous chapter. The design process for Twin Lakes Park includes the following stages: an inventory and analysis of critical existing conditions at a regional scale and a site scale, case study informed analysis at a site scale, case study informed schematic programming, functional programming development, and circulation diagramming. As is traditional, upon completion of these stages the design is resolved to a master plan level. The design of Twin Lakes Park is not developed beyond master planning. Final design graphics include inventory and analysis diagrams, plan images, design diagrams, axonometric circulation sections, and perspectives. Graphics are used alongside written descriptions of inventory and analysis, the design process, programming, circulation, and performance assessment.

PROJECT INTRODUCTION

The design goals for Twin Lakes Park are threefold; to restore and conserve natural forest and wetland landscapes, to integrate agriculture into a peri-urban park for education and food production, and to provide spaces for community members to gather, learn, play, and celebrate. These goals hope to strengthen the connection between the community of Homer Glen, IL, to the landscape, to one another, and to agriculture. Twin Lakes Park is a 260-acre property that is currently used as farmland with areas of natural vegetation surrounding small lakes. The existing property is made up of approximately 150 acres of corn and soybean fields (see Figure 5.01 and 5.02). The remaining 110 acres are a mixture of natural lakes, wetlands, woodlands, and grasses. The redesign of the park includes areas for agricultural production, conservation, education, and community development. This project was not affiliated with the city of Homer Glen or with the property owner, Gallagher & Henry. Neither party was made aware of the design project as the purpose of the project is merely to act as an example of a multifunctional landscape design in the context of this report.

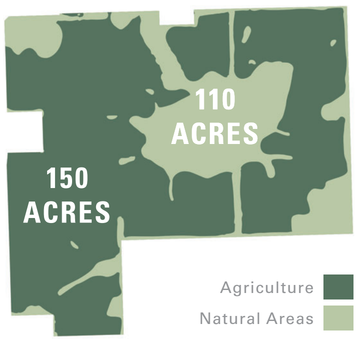


Figure 5.01
Existing areas of crops and other types of vegetation

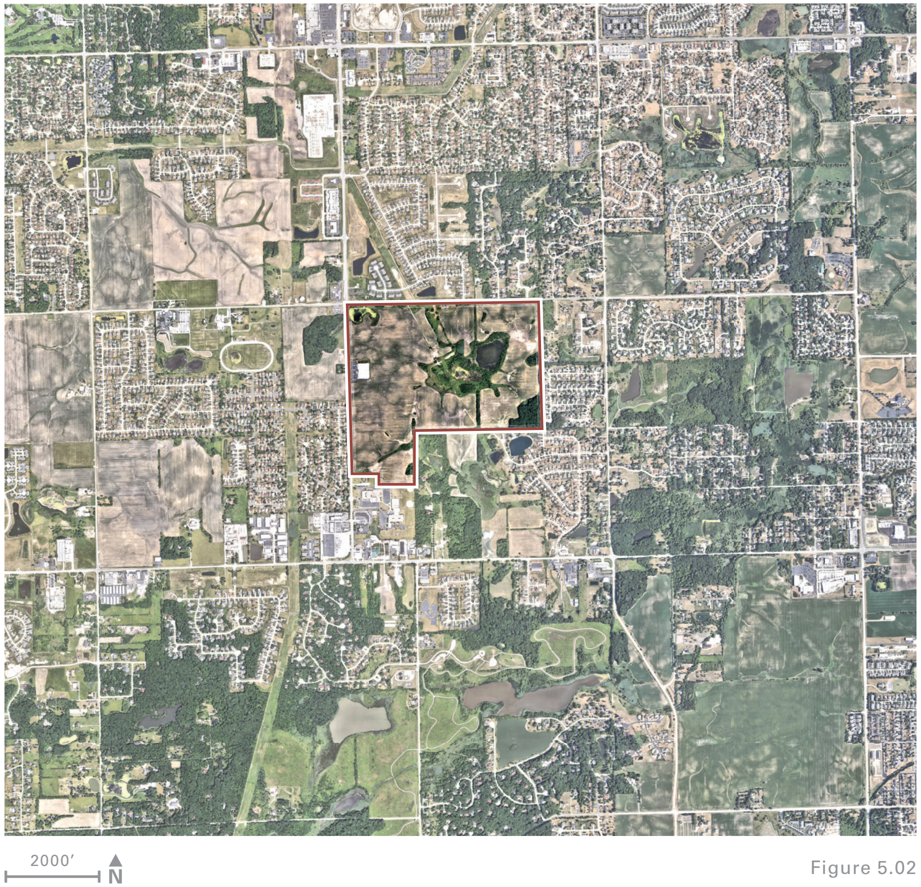


Figure 5.02
Aerial of Homer Glen and Twin Lakes Park (Adapted from Google Earth 2020)

PROJECT LOCATION

Twin Lakes Park is located in the Village of Homer Glen in Will County, IL (Figures 5.03-5.05). Positioned on the fringes of Chicago (approximately 30 miles from downtown), the 260-acre site includes existing agricultural fields surrounding a wetland and two lakes. The project site was selected based on aerial imagery, its proximity to the community, and the availability of GIS information for it. Twin Lakes Park is adjacent to a community church, fitness center, honey farm, middle school, and a middle-class suburban development. The project location is informed by goals and future projects of the community, the project is hypothetical and is not expected to be built.

Figure 5.04 Twin Lakes Park Site Photography (Mader 2019)

Figure 5.05 Twin Lakes Park Existing Site Map Photography (Adapted from ArcGIS 2020)

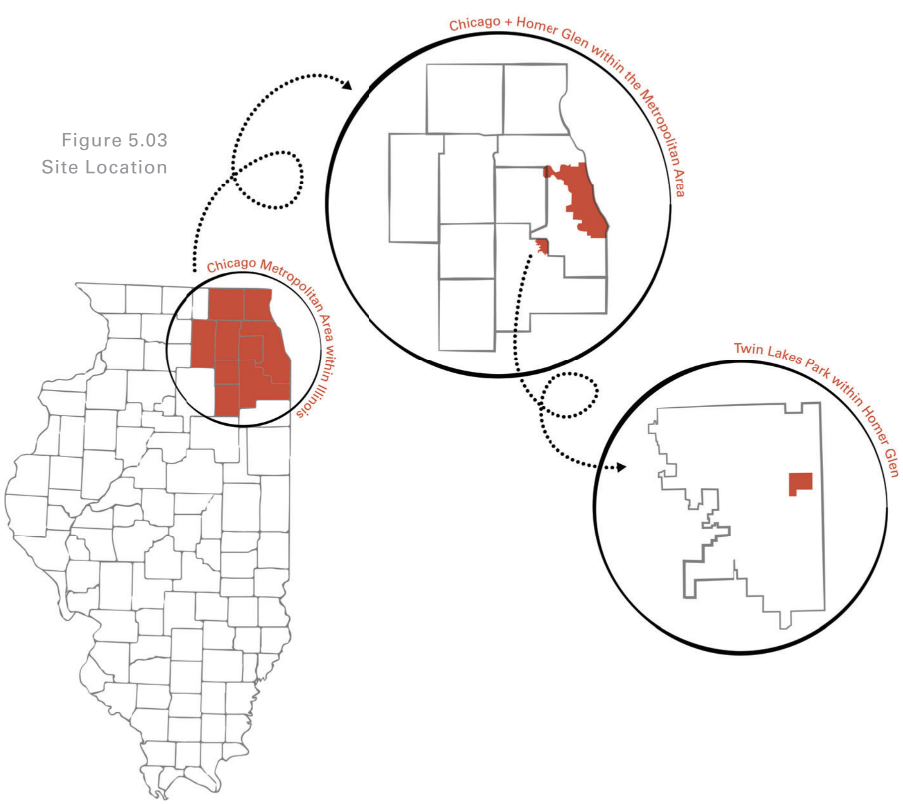


Figure 5.03 Site Location

CRITICAL EXISTING CONDITIONS

Homer Glen, located southwest of Chicago, IL, encompasses approximately 22 square miles with a population of almost 25,000 (U.S. Census Bureau 2016). Homer Glen sits within the Metropolitan Area of Chicago (Chicagoland) which has a total population of approximately 9.5 million people (World Population Review 2020). The study area is owned by the development company Gallagher & Henry (Novak 2018). As seen in Figure 5.01, the property consists of about 150 acres of crops and 110 acres of woodland, grasses, water, and utility buffer zones. The site is accessible via a single drive located on W 151st street. Adjacent to the property sits a gym, church, middle school, residential development, and a small honeybee and fruit business operated out of home. The site is connected to other areas of Homer Glen via S Bell Rd. and W 151st St., though few sidewalks are available outside of residential areas. Public transit in the community is limited to one bus route, with the closest stop about 2 miles (or a 40-minute walk) away from the park. The route services train stops in Joliet and Orland Park which can be used to commute to downtown Chicago (Pace 2019).

The median household income of Homer Glen is a little over $100,000 with a poverty rate of only 3.9% and an employment rate of 63.7%. The median age in Homer Glen is 44, 6 years older than the national average. The area is made up primarily of English speakers with about 18% of people speaking another language at home. The population has low levels of diversity; 94% of residents being white with Asians as the second most represented group at 2%. Average citizens are more educated achieve than the national average, with 94% of residents having graduated from high school and 47% recipients of some type of degree. Residents have an average of a 35-minute commute to work and over 90% of people drive or carpool (U. S. Census 2020). More information on the demographics, education, and commute of the residents of Homer Glen can be seen in Figure 5.06.

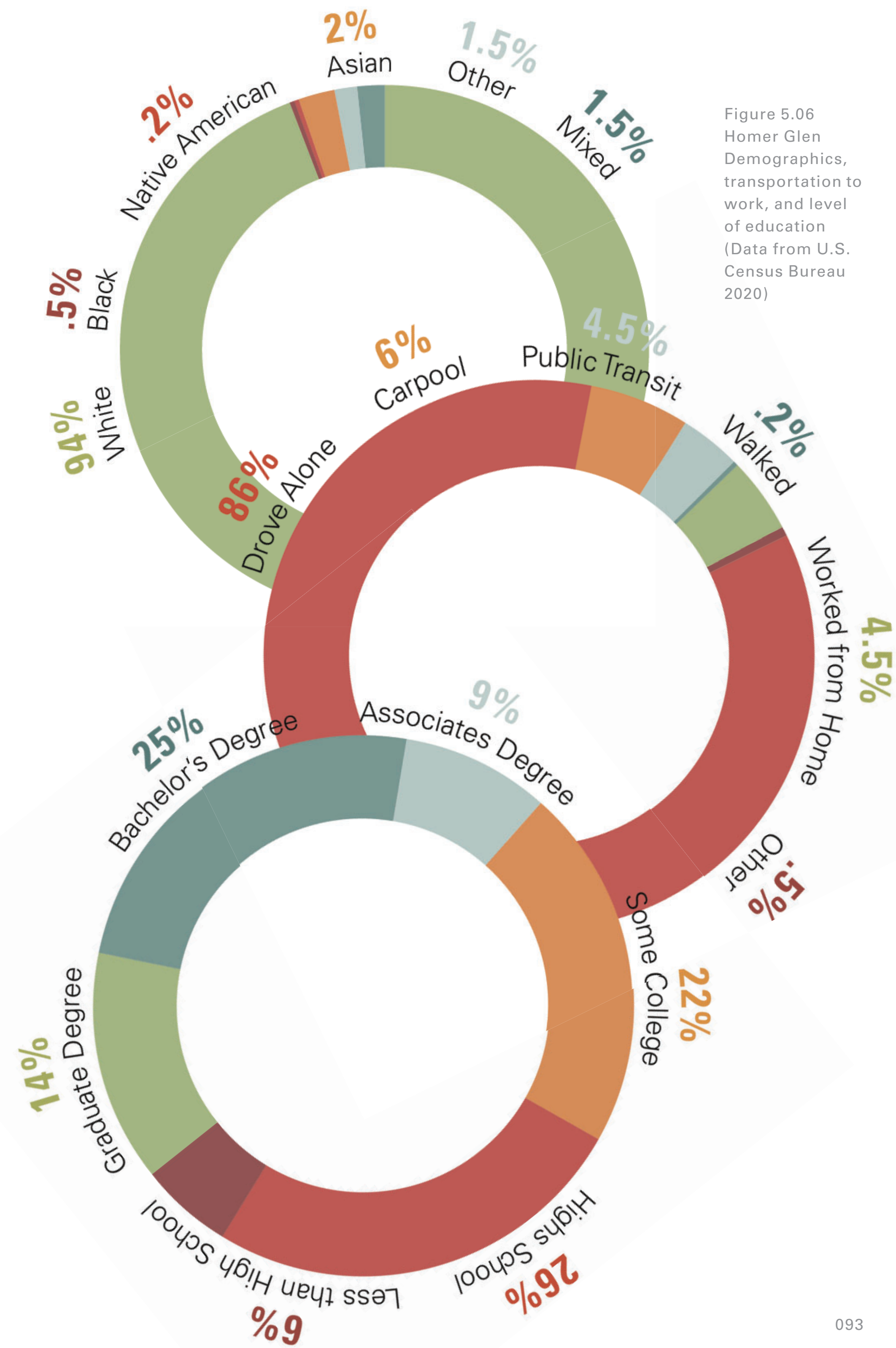


Figure 5.06
Homer Glen Demographics, transportation to work, and level of education (Data from U.S. Census Bureau 2020)

GEOMORPHIC HISTORY

During the late Pleistocene Epoch, glaciers covered much of what is now Illinois, with the last entering this region approximately 25,000 years ago. When the last of these glaciers melted, millions of tons of water were left behind forming lakes, rivers, and thick deposits of silt (Baiden 2020). The Chicago Metropolitan Area sits within the Wheaton Morainal physiographic region of Illinois. The area is characterized by glacial morainal topography with complex lakes and swamps alongside a series of broad parallel morainic ridges encircling Lake Michigan. Kames, kame terraces, kettles, basins, and eskers occur more commonly in this region than anywhere else in the state and many lakes in the areas are built from these small basins left behind by glaciers after the Pleistocene (Leighton et. al. 1948).

REGIONAL SPECIES OF CONCERN

As seen in Table 5.01, federally threatened or endangered animal species found in Will County include the northern long-eared bat (*Myotis septentrionalis)*, the eastern Massasauga rattlesnake *(Sistrurus catenatus)*, the sheepnose mussel (*Plethobasus cyphyus*), Hine's emerald dragonfly *(Somatochlora hineana*), and the rattlesnake-master borer moth *(Papaipema eryngii)*. Federally threatened or endangered plant species include the eastern prairie fringed orchid *(Platanthera leucophaea*), the lakeside daisy (*Hymenopsis herbacea*), leafy prairie clover *(Dalea foliosa)*, and Mead's milkweed *(Asclepias meadii)* (U.S. Fish & Wildlife Service 2017).

As seen in Table 5.02, invasive animal species found in Illinois include (but are not limited to) the zebra mussel *(Dreissena polymorpha)*, wild boar *(Sus scrofa)*, the Asian carp *(Hypophthalmichthys nobilis)*, emerald ash borer *(Agrilus planipennis)*, and the Asian longhorned beetle *(Anoplophora glabripennis)*. Invasive plant species include (but are not limited to) mimosa *(Albizia julibrissin)*, Japanese barberry *(Berberis thunbergii)*, multiple species of honeysuckle *(Lonicera* spp.*)*, Callery pear *(Pyrus calleryana)*, multiple species of buckthorn *(Rhamnus* spp.*)*, black locust *(Robinia pseudoacacia)*, winged burning bush *(Euonymus alatus)*, multiflora rose *(Rosa multiflora)*, Chinese privet *(Ligustrum sinense)*, multiple species of thistle *(Carduus* spp.*)* and *(Cirsium* spp.*)*, crownvetch *(Securigera varia)*, tall fescue *(Festuca arundinacea)*, and winter creeper *(Euonymus fortunei)* (Center for Invasive Species n.d.).

Table 5.01 Threatened or Endangered Species (Information from U.S. Fish & Wildlife Service 2017)

Threatened or Endangered Species	
Animals	
Northern long-eared bat	*Myotis septentrionalis*
Eastern Massasauga rattlesnake	*Sistrurus catenatus*
Sheepnose mussel	*Plethobasus cyphyus*
Hine's emerald dragonfly	*Somatochlora hineana*
Rattlesnake-master borer moth	*Papaipema eryngii*
Plants	
Eastern prairie fringed orchid	*Platanthera leucophaea*
Lakeside daisy	*Hymenopsis herbacea*
Leafy prairie clover	*Dalea foliosa*
Mead's milkweed	*Asclepias meadii*

Table 5.02 Invasive Species (Information from Center for Invasive Species n.d)

Invasive Species	
Animals	
Zebra mussel	*Dreissena polymorpha*
Wild boar	*Sus scrofa*
Asian carp	*Hypophthalmichthys nobilis*
Emerald ash borer	*Agrilus planipennis*
Asian longhorned beetle	*Anoplophora glabripennis*
Plants	
Mimosa	*Albizia julibrissin*
Japanese barberry	*Berberis thunbergii*
Honeysuckle	*Lonicera*
Callery pear	*Pyrus calleryana*
Buckthorn	*Rhamnus*
Black locust	*Robinia pseudoacacia*
Winged burning bush	*Euonymus alatus*
Multiflora rose	*Rosa multiflora*
Chinese privet	*Ligustrum sinense*
Thistle	*Carduus/Cirsium*
Crownvetch	*Securigera varia*
Tall fescue	*Festuca arundinacea*
Winter creeper	*Euonymus fortunei*

EXISTING CLIMATIC CONDITIONS

The Chicago Metropolitan Area has a continental climate with cold winters and warm summers, often with frequent and short fluctuations in temperature, humidity, cloud coverage, and wind direction and speeds. The four key factors contributing to climate control in northeastern Illinois include the sun, weather patterns and systems, urban development, and Lake Michigan (CMAP 2016). Chicago experiences a similar climate similar to that of other midwestern towns, although it is affected by Lake Michigan, moderating temperatures and increasing snow fall. The coldest days usually occur in January with average daily high temperatures of 32°F and low of 18°F. The warmest month is typically July with a daily average high temperature of 84°F and low of 68°F. Chicago receives an average of 39.04 inches of precipitation in rainfall annually (U.S. Climate Data 2020). The growing season for the Chicago area is about 170 days long and begins late April to late May, extending through mid-October to early November (Angel 2003). This environment provides a climate that is conducive to the production of crops for about six months a year with the area sitting in plant hardiness zone 5b and the city of Chicago is classified instead as 6a (USDA 2012).

PREDICTED CLIMATIC CHANGES

When discussing climate change this report refers to the long-term effects of persistent changes in the climate of a region. These include the changes in climate trends over multiple decades to precipitation or temperature (NASA 2020). Continental climates are subject to a large degree of natural variability between one year and the next. This variability is a characteristic of the Chicago region's climate and is likely to only increase in future years (CMAP 2016). Year-to-year variability is not the equivalent of climate change but is instead a fundamental component of a region's climate. The primary fundamentals of Chicago's climate expected to change include temperature, humidity, precipitation (rain and snow), and plant hardiness.

Consistent with the predictions globally, studies for the region suggest that annual temperatures will increase by about 5-9°F by the end of the 21st century, though studies do not all agree on the exact number of increase with some suggesting 2-5°F higher and some predicting 9-13°F higher. Although the climate is expected to warm, it is not necessarily going to warm equally throughout the seasons. Some studies suggest a steeper increase in summer temperatures compared to other studies. Extreme temperatures are also predicted to occur more frequently, and climate models suggest that the hottest day of the year will rise from around 99°F to 107°F (CMAP 2016).

Studies on humidity suggest that an increase in dew points mean the hot days will feel even hotter. Higher temperatures and humidity levels will combine to increase the frequency, intensity, and duration of heat waves likely meaning an associated increase in more than 2,000 heat related deaths per year by the end of the century. In addition to more heat waves, the annual period in which heat waves occur is expected to increase in length by almost double (CMAP 2016).

The degree of uncertainty regarding the future of precipitation remains high amongst the scientific community. Some scientists suggest increases and other suggest decreases. Regardless, most models indicate that precipitation will not change uniformly across the seasons. Intensity of storm events however is expected to increase, meaning that more rain and snow is expected to come with each precipitation event (CMAP 216). Floods and droughts will both increase in frequency in the Midwest (Lofgren and Gronewold 2012). Winter weather is expected to shift from snow events to rain and the average winter snowfall could drop by as many as 10 inches per year by the end of the century (Climate Change and Chicago 2007).

While the Chicago area is currently described as a USDA hardiness zone of 5b and 6a, this is expected to shift to 6b or 7a by the end of the century depending on the continued levels of emissions (CMAP 2016).

GUIDING PRINCIPLES

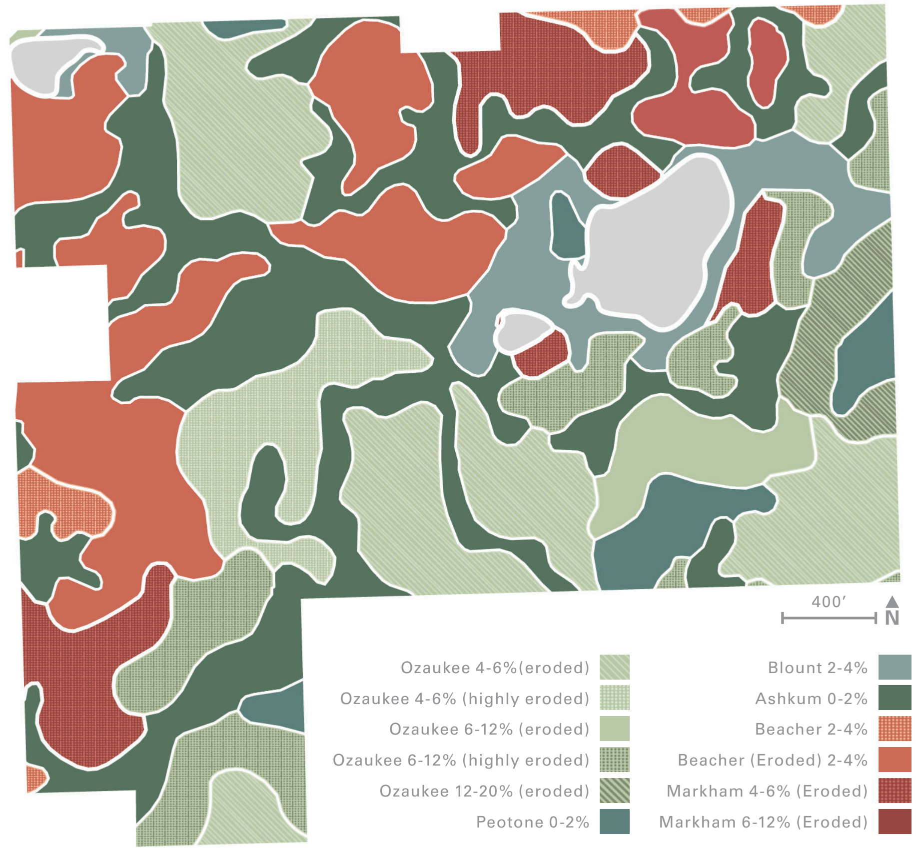
As noted, the design process begins with a site inventory and analysis. For Twin Lakes Park this was done via aerial imagery, GIS mapping, site visits, and documentation. Due to the distance away from Manhattan, KS, the site was visited once during the writing of the report. That visit occurred in December 2019 and included walking the site, visiting Homer Glen, and taking notes and photos of the site. A map of the site visit route can be seen in Figure 5.07.

SITE CONSIDERATIONS

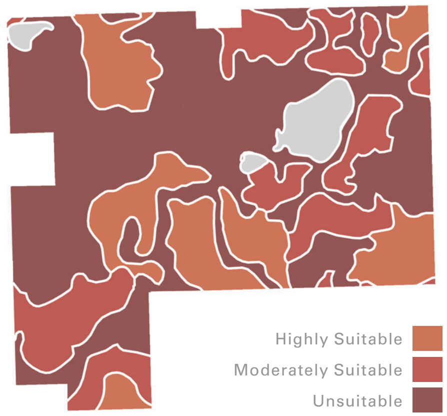
Site considerations include the inventory and analysis of the project site (Figures 5.08-5.10) and the immediate surrounding area. The inventory and analysis phase was completed using a combination of aerial imagery, information collected in the site visit, and NRCS Soil Survey Data (NRCS 2020). Prior to the completion of any design work, the following factors derived from the case study findings were considered: physiographic context, stormwater, trees and vegetation, microclimate, indoor/outdoor connections, accessibility, and security and safety. Physiographic context was discussed earlier in this chapter. Existing stormwater systems and trees and vegetation can be seen in Figure 5.09. Microclimatic factors can be seen in Figure 5.09. Development on the existing site is limited; therefore, indoor/outdoor connections, accessibility, and security and safety were less relevant at this phase of the design process.

Figure 5.07
Site Visit
Diagram

Figure 5.08
Site Inventory
Diagrams: Soil
Properties

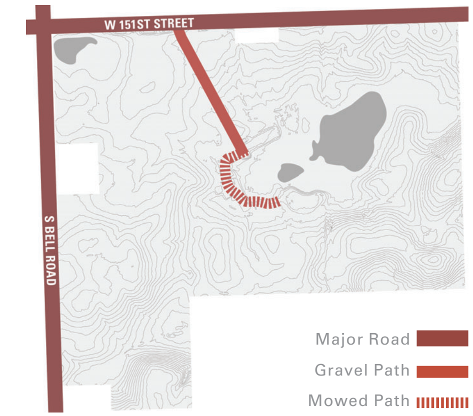


Soil Types and Slope Percentages
(Adapted from NRCS 2020)

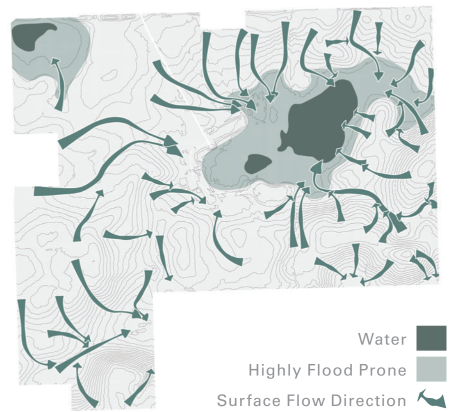


Building Development Suitability
(Adapted from NRCS 2020)

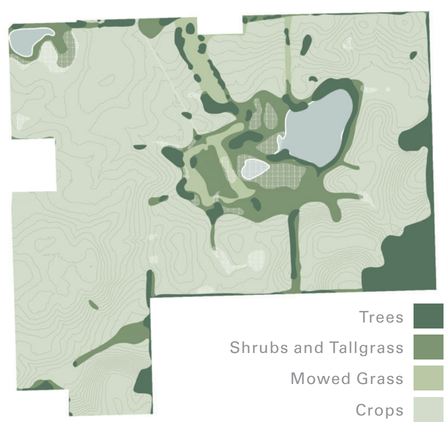
Crop Productivity
(Adapted from NRCS 2020)



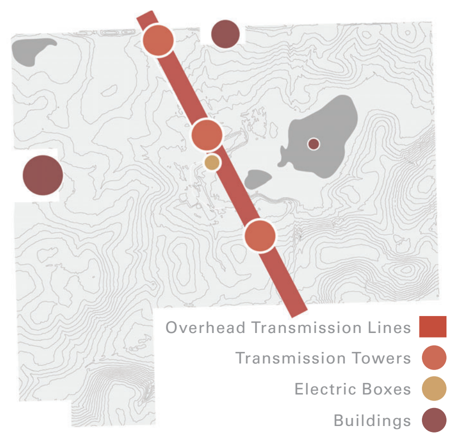
Existing Site Circulation Patterns



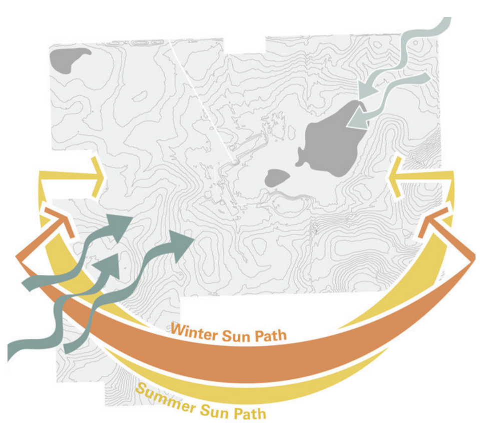
Existing Hydrology and Runoff Patterns



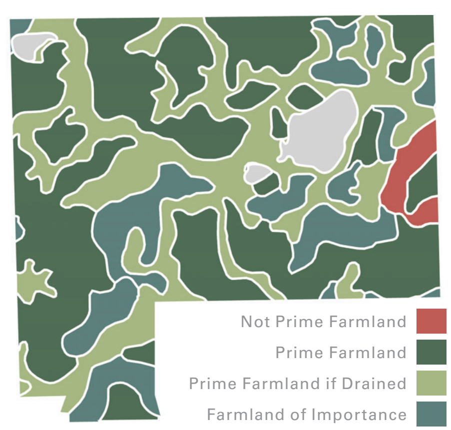
Existing Vegetation Patterns



Site Infrastructure



Sun and Wind Directional Patterns
(Data from Angel 2004 and Tutkiainen 2020)



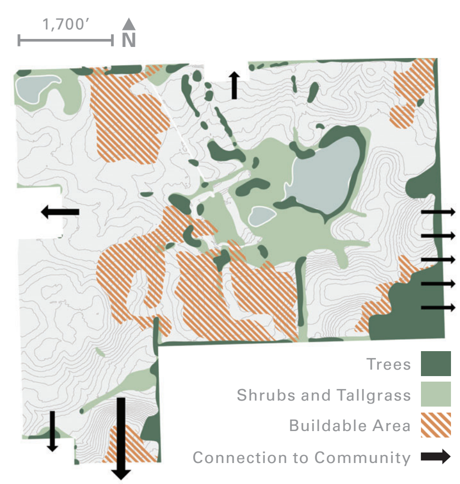
Farmland Classification
(Adapted from NRCS 2020)

Figure 5.09
Site Inventory
Diagrams:
Physical Factors

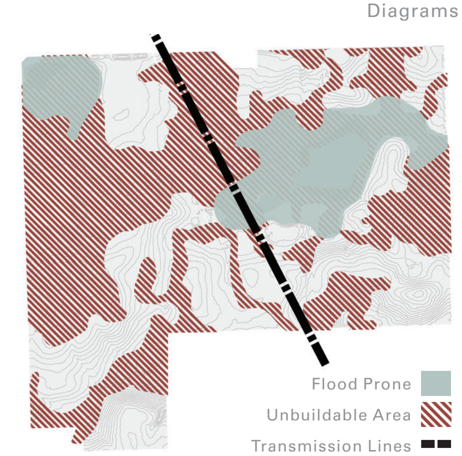
Because of the planned agricultural use of the park, soil studies were extremely important in addition to the aforementioned considerations. Soil types and slope percentages are shown in Figure 5.08. Soils were mapped by the NRCS and were used to help determine areas of the site suitable for building development, crop productivity, and prime farmland areas (also seen in Figure 5.08). Figure 5.09 highlights additional physical factors considered for the project including existing circulation patterns, site infrastructure, farmland classification, and the previously mentioned stormwater, vegetation, and microclimatic factors.

An analysis of the site revealed a series of opportunities and constraints which can be seen in Figure 5.10. Notable opportunities include the natural areas on site, the proximity to adjacent community features, and the points for new site entryways. Key constraints include the overhead transmission lines bisecting the property, the large expanse of flood-prone areas, and the areas unsuitable for development without extensive soil mitigation.

Figure 5.10
Site Analysis
Diagrams



Opportunities



Constraints

PROGRAMMING ELEMENTS

Upon completion of site inventory and analysis, the design moved into design program development and schematic program diagramming. A design program is essentially the “list” of components and elements designers should include in a project. In many cases the program is decided by the client (often the property owner, developer, or municipal government). However, because this project is being used as an example, the program was set as those elements identified in the case study analysis. With the programming elements decided, a process was used to begin to organize them spatially. This process includes an abstract phase of idea correlation, a preliminary spatial phase where elements begin to shape space around one another, and a more detailed phase where the programming is laid out at a site scale. This last phase is when programming elements are used to begin shaping space on the project site while considering all the information collected in the previous inventory and analysis phase. The programming process can be seen in Figure 5.11.

Upon completion of programmatic diagramming, the design is finalized and represented digitally. These digital representations include the master plan (Figures 5.11-5.12, and Figure 5.25), diagrams (Figures 5.13-5.19), and perspective images (Figures 5.20-5.24, and Figure 5.28).

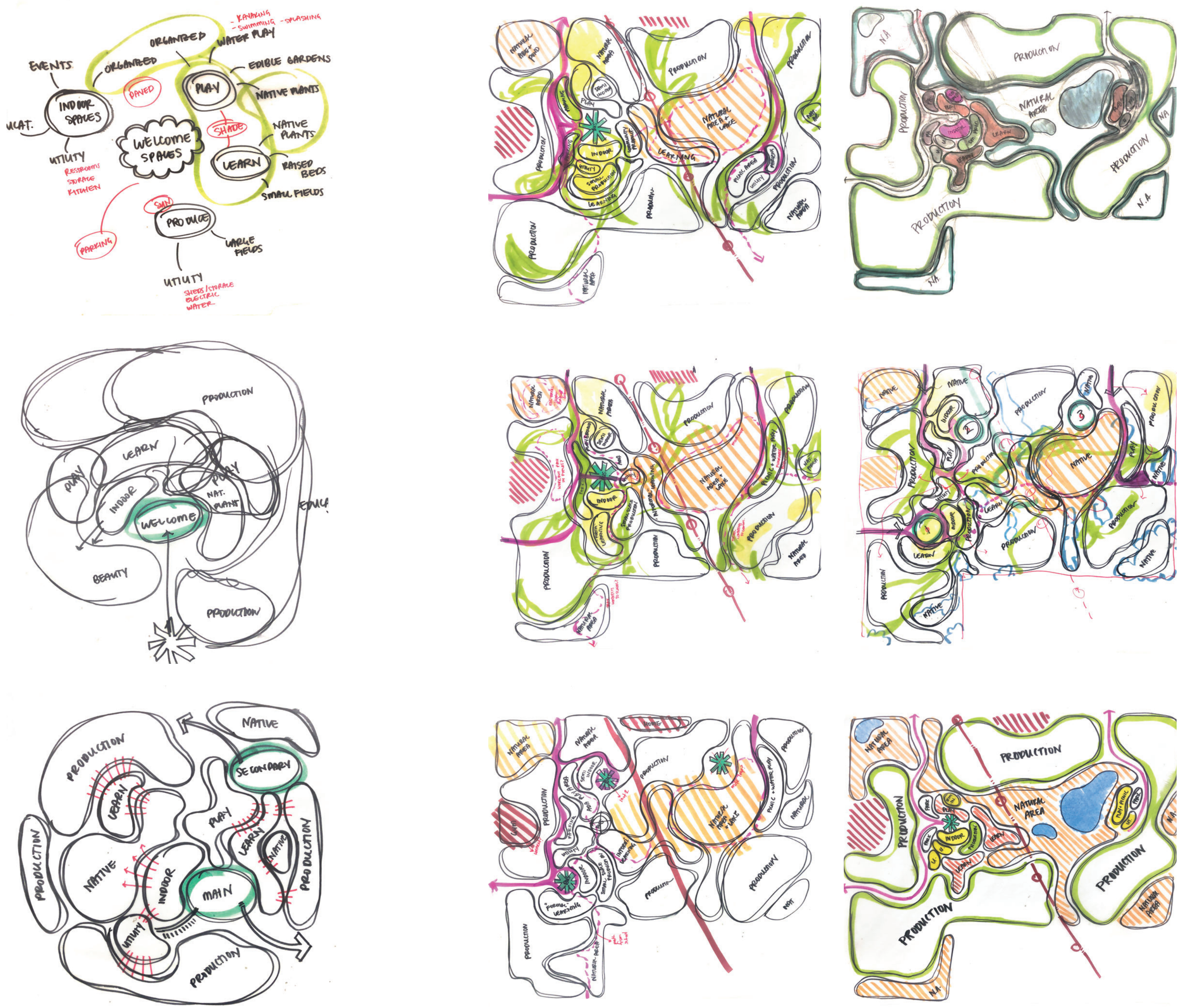


Figure 5.11
Programming
Process
Sketches

LEGEND

1. Exercise Trail
2. Play Area
3. Community Gardens
4. Picnic Area
5. Parking
6. Bus Loop
7. Pollinator Garden
8. Utility Shed
9. Event Center
10. Learning Area
11. Kayak Launch

Figure 5.12
Existing Site
Aerial Imagery
(Google Earth
2020)

Figure 5.13
Proposed Site
Master Plan
(Adapted from
Google Earth
2020)

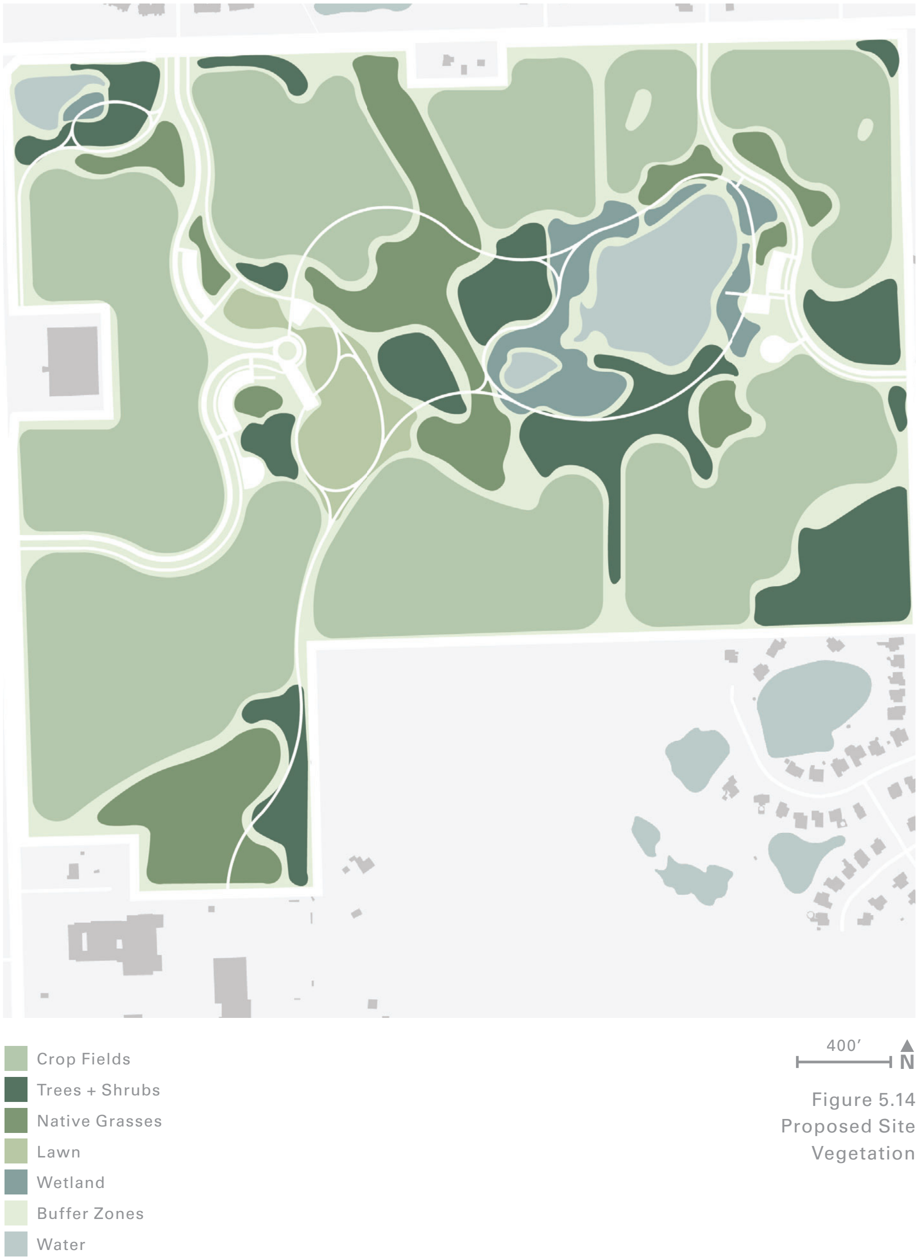


Figure 5.14
Proposed Site
Vegetation

COMPREHENSIVE DESIGN

The initial design goals for Twin Lakes park emphasize the importance of ecological restoration and conservation, agricultural production, and accessible spaces for community development through education, play, and gathering. Twin Lakes Park is intended to be both multifunctional and multi-programmatic. Multifunctional landscapes achieve multiple goals—often related to ecosystem functions and production—where multi-programmatic landscapes are those that include multiple programs, like a playground and a learning garden. The design of Twin Lakes Park emphasizes the importance of environmental education and community engagement in the function of an agricultural park, using signage, outdoor classrooms, and sensory gardens to encourage learning in multiple stages for all age groups. Due to the nature and constraints of this report, any design decisions made for the development of Twin Lakes Park are preliminary and should not represent a final design. Future development of the park should include a high degree of collaboration between property developers, city planners, community organizations, landscape architects, and sustainable farmers. See Figures 5.12-5.14.

Key features of the proposed design include an exercise trail, play area, community gardens, picnic areas, bus loop, pollinator gardens, event center, learning areas, and utility sheds. The western portion of the site alongside the bus loop contains the densest programming and is the location of the play area, community and pollinator gardens, one of the picnic areas, the event center, and some of the outdoor learning areas. All of the park programs are accessible, and playgrounds and the event center are positioned adjacent to parking lots to ensure easy access. Learning areas take up a large portion of the entry area, hugging the event center and a small area for community farming and edible sensory gardens. The learning areas include outdoor classrooms, test plots for sustainable farming strategies, and pollinator gardens. On the eastern side of the park, a small parking area and picnic area connect to the larger trail system. A gathering area along the lake provides space for picnicking and launching kayaks into the water. The remaining portions of the site are used for various levels of production and ecosystem restoration. Different-sized farming plots are used for diverse crop yields with different farming practices. Agricultural plots use a variety of sustainable practices including no till, polyculture, perennial agriculture, and cover cropping. Surrounding the fields are buffer zones of varying width and plant material. These zones are used for filtering pollutants between roads, crop fields, and natural areas while providing additional space for stormwater retention and pollinator habitat. Two utility sheds are accessible to the fields via direct connection and roads to ensure easy access between farm plots and any needed large machinery.

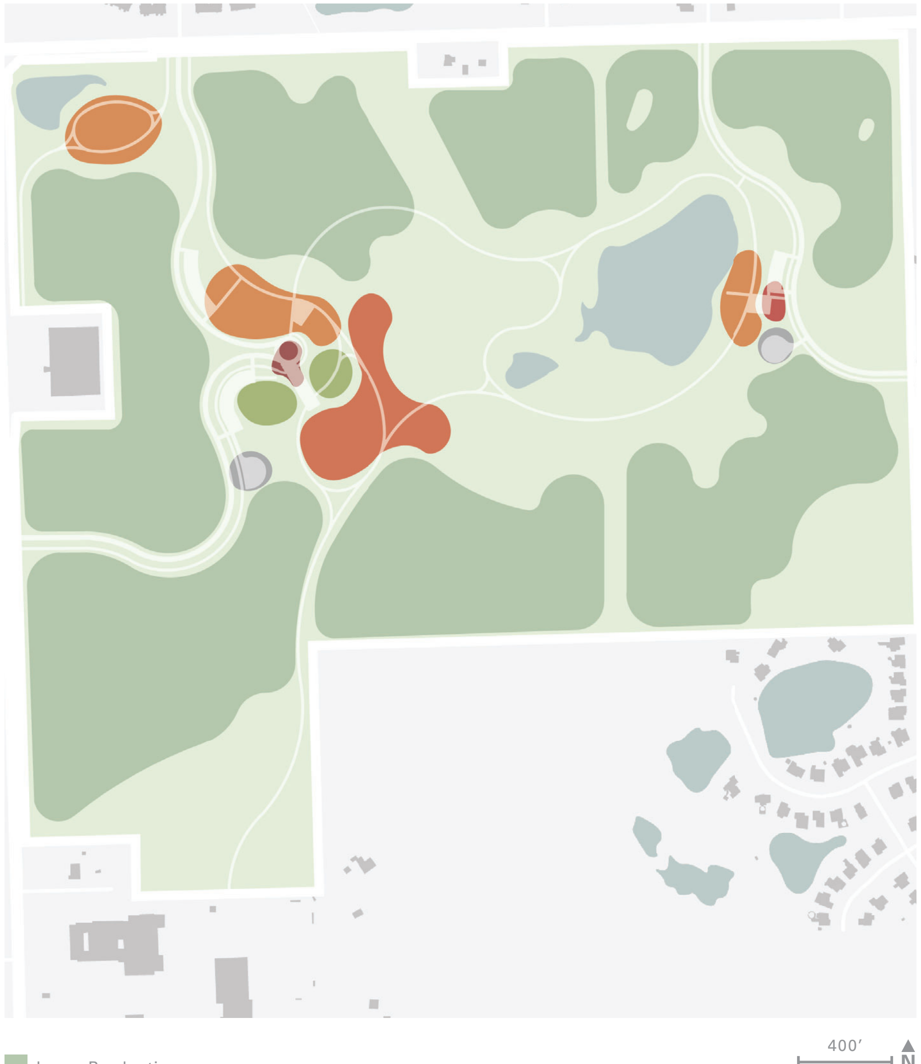


Figure 5.15
Proposed Site
Programming

PROGRAM DESCRIPTIONS

As previously mentioned, the design program was determined by the results of the case studies. The program included the following themes: large production zones, small production zones, various types of natural areas (wetland, prairie, woodland), indoor and outdoor event spaces, indoor and outdoor educational areas, natural play areas, and storage and utility zones. The design program can be seen in Figure 5.15.

When selecting areas for specific programming, areas for buildings were chosen first. The event center, utility structures, and pavilions were positioned in zones with suitable soil for structures without basements. The built areas were also chosen to be towards the interior of the site to limit noise and traffic from adjacent roads. Existing natural areas were then expanded to increase the amount of habitat on the property while also allowing for increased stormwater retention to limit flooding in other areas of the site. Agricultural production areas were placed primarily based on the crop productivity rating of existing soils. Utility and storage zones were positioned adjacent to fields and roads to ensure all plots of farmable land would be accessible with large machinery. Learning and play areas were then woven around structures, alongside roads, and adjacent to natural and production areas to encourage visitors to experience multiple parts of the park. The western portion of site progragramming can be seen in Figure 5.25 on p. 117.

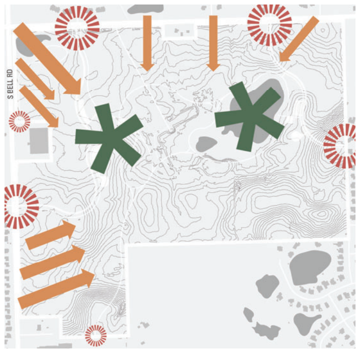


Figure 5.16
Views and Entry Points

Focal Points
Pedestrian Entry
Vehicular and Pedestrian Entry
Views Into Site

Figure 5.16 Integration into Surrounding Environment

Twin Lakes Park is positioned within the growing peri-urban community of Homer Glen. Most visitors to the site will either walk/bike from adjacent residential developments or will drive from further away. Those that drive will approach the site at speeds of more than 40 mph so signage and views into the property are crucial for its success. Corners of the property provide the opportunity for people driving quickly by to see into the site prior to the entry drive, encouraging potential visitors to enter. Drives are clearly marked with signage and allées of trees create distinct gateways into the park.

Figure 5.17
Planting Buffer Types

Agricultural Buffer Zones
Aesthetic Buffer Zones

Figure 5.17 Buffer Zone Planting Patterns

Buffer zones are used alongside fields and roads to filter pollutants before they enter other areas of the park. These buffers or border strips are made of different plant varieties depending on the location within the park. In areas with a higher density of pedestrians (near the entry zone, alongside walking trails, near picnic zones) buffer plants are often flowering, providing aesthetic benefits as well as pollinator habitats. In more agricultural areas, border strips are more densely planted with native grasses and non-flowering sedges that are less aesthetically pleasing but more cost effective. Buffer zones are also used to fill gaps along field margins that are difficult to seed, harvest, or till with large equipment.

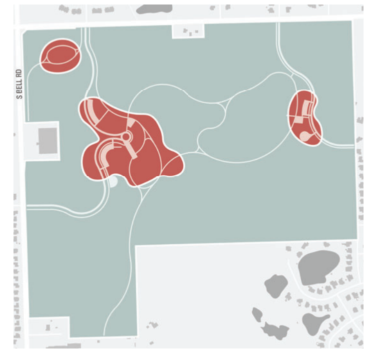


Figure 5.18
Passive and Active Spaces

Active Areas
Passive Areas

Figure 5.18 Passive and Active Spaces

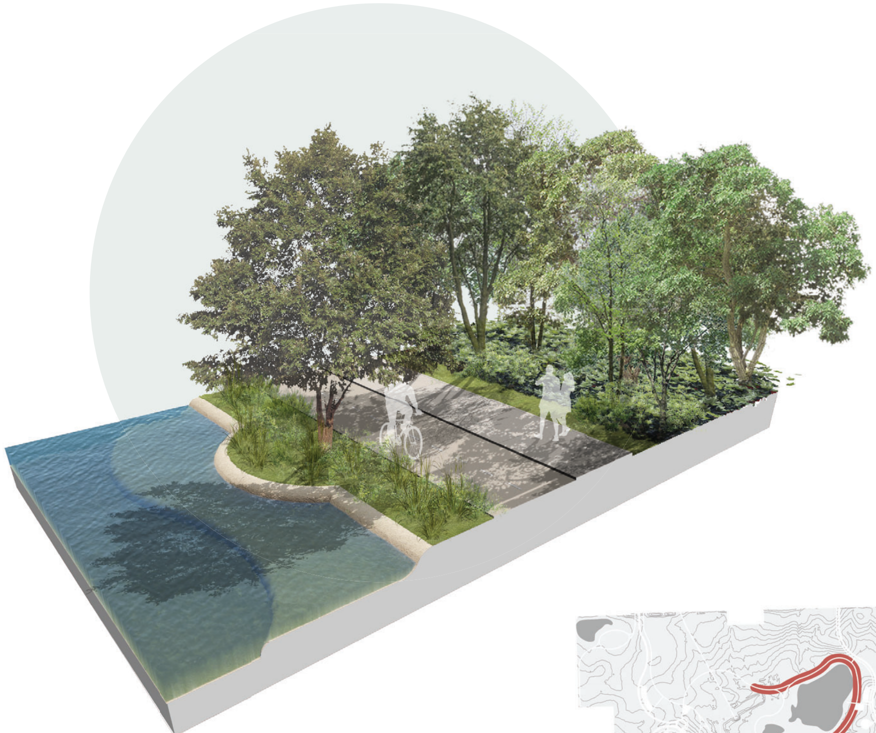
Most of the site uses can be considered passive including activities like farming, walking, biking, running, or watching wildlife. Three areas of the property are designed for more active use. In the Northwest corner of the site an exercise trail features workout stations and easy access to the neighboring fitness center. The largest active area provides two parking lots and a bus loop for access to park features. This active zone includes a playground, picnic area, community gardens, pollinator gardens, learning facilities, and event center. The last active zone is positioned on the eastern side of the park and features a small play area, picnic spaces, and kayak launch zone.

Figure 5.19
Views and Entry Points

Vehicular Drives
Bike Lanes
Pedestrian Paths

Figure 5.19 Circulation Strategies

Movement throughout the site is encouraged in three key modes: vehicular, bicycling, and pedestrian. Vehicles can access the park in four locations. One entry sits on S Bell Road, south of the fitness center, two entries are located on W 151st Street, and one entry from the eastern suburb on Arlene Drive. Bike lanes are integrated alongside roads and some key pedestrian walkways to allow for easier travel from one side of the park to another while limiting the need for cars. Three small parking lots are available within the park, one adjacent to the play area, one next to the event center, and one near the lake and picnic area. A bus stop and drop off is positioned between the event center and playgrounds, near to community garden spaces and learning areas. Paths for pedestrians are often asphalt but, in some areas, transition to raised boardwalks or crushed and compacted gravel.



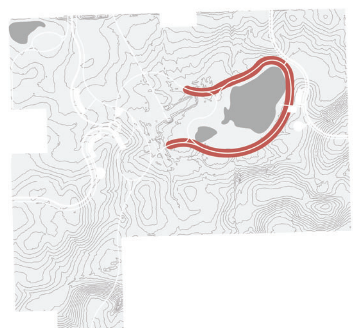


Figure 5.20 Lakeshore Circulation

Paths along the lake consist of a bike lane and walking trail. Located alongside the waterfront, the path is often shaded as it moves through the natural areas. Bike paths provide easy access from one side of the park to the other, encouraging visitors to leave their cars at home. Vegetation surrounding the lake is a mixture of native grasses and shrubs along with existing trees. Tree species around the lake include Maple, Birch, Hickory, Sycamore, Cottonwood, and Oak. Many zones around the lake will also include low understory vegetation. Although mostly inaccessible, the lake is open to catch-and-release fishing and features a kayak launch area near the eastern picnic zone.

Figure 5.20 Lakeshore circulation strategies and key map

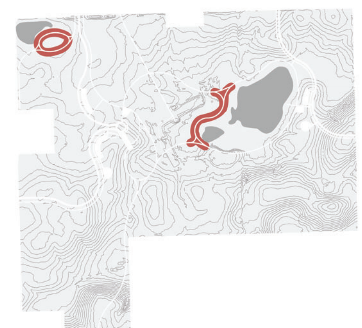


Figure 5.21 Wetland circulation strategies and key map

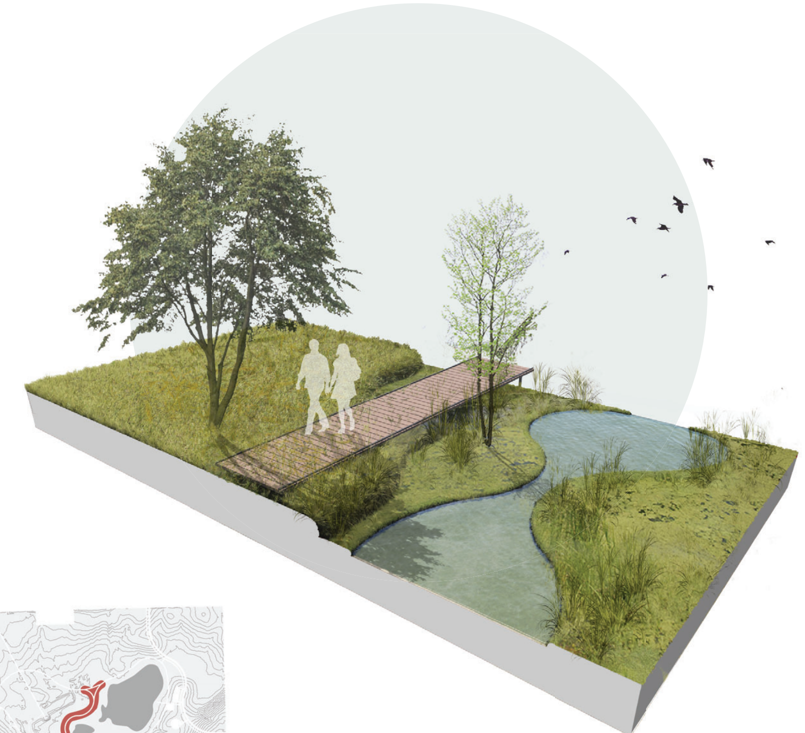
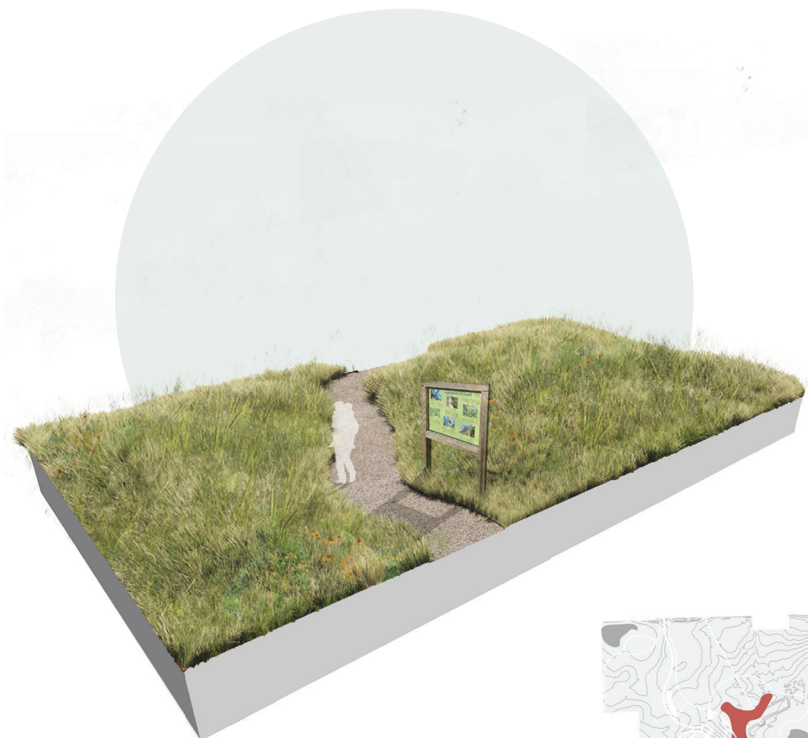


Figure 5.21 Wetland Circulation

Wetlands utilize boardwalks to move across flood-prone areas. Paths move throughout the zone, encouraging visitors to pause and watch the wildlife. Bat boxes and bird houses are placed within the natural area to encourage species to inhabit the spaces. Signage is provided at various stages along the paths to describe the critical role these animals have in the ecosystem. The wetland are made up of a variety of shrubs, grasses and trees including Cottonwood, Willow, Birch, Dogwood, Goldenrod, Bluestem, and Wild Rye. Wetland boardwalks are used to connect the eastern edge of the half-mile walking trail around the lake.



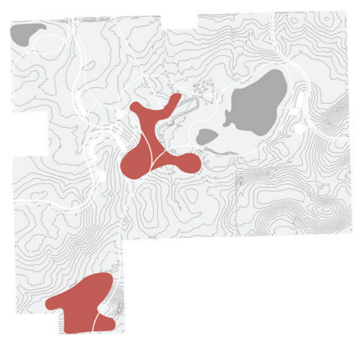


Figure 5.22 Tallgrass Prairie Circulation

Tallgrass prairie, a native ecosystem of Illinois, is used in various areas across the property including the southern tip, and large swathes under the overhead transmission lines. These zones provide habitat for wildlife and educational opportunities for visitors. Many paths through the prairie are made of crushed and compacted gravel to limit the amount of impervious surface though some may only be mowed grass. Vegetation in the prairie is a mixture of grasses and forbs including Bluestem, Indiangrass, Cordgrass, Goldenrod, and Coneflower. Trails through the prairie are ephemeral and can be adjusted over the years to provide more variety for visitors. Due to their inconsistency in nature, these trails are not shown on the larger site plan.

Figure 5.22
Tallgrass prairie circulation strategies and key map

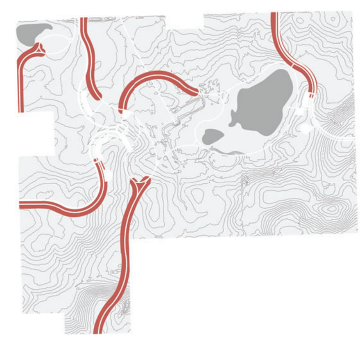


Figure 5.23
Agriculture circulation strategies and key map

Figure 5.23 Agriculture Circulation

Paths through farmed areas on the property are designed for moving visitors from one area to another quickly, while allowing them to learn about and experience the agricultural environment. These paths include an integrated bike lane for easy and fast movement and are bordered by buffer strips and fields. Buffer zones vary in width and in vegetation but are used for filtering pollutants, retaining stormwater, and providing habitat for pollinator species. Agricultural fields integrate multiple strategies for sustainable farming depending on plot size and location. Strategies include polycultural and perennial fields, intercropping, no-till systems, and the utilization of cover crops.

Figure 5.24 Community Circulation

In activity dense areas of the site, paths widen to allow for more pedestrians and utilize artfully considered paving patterns emphasizing a playful environment. Fully accessible paths weave between playgrounds, pavilions, and learning gardens, connecting various areas for adults and children to spend their time. Pollinator gardens provide habitat for insect and bird species while raised bed community gardens offer space to plant and grow food for use on-site and in surrounding non-profit organizations. All spaces are designed to playfully encourage natural learning and instill a love for the land in children and adults.

Figure 5.24 Community circulation strategies and key map

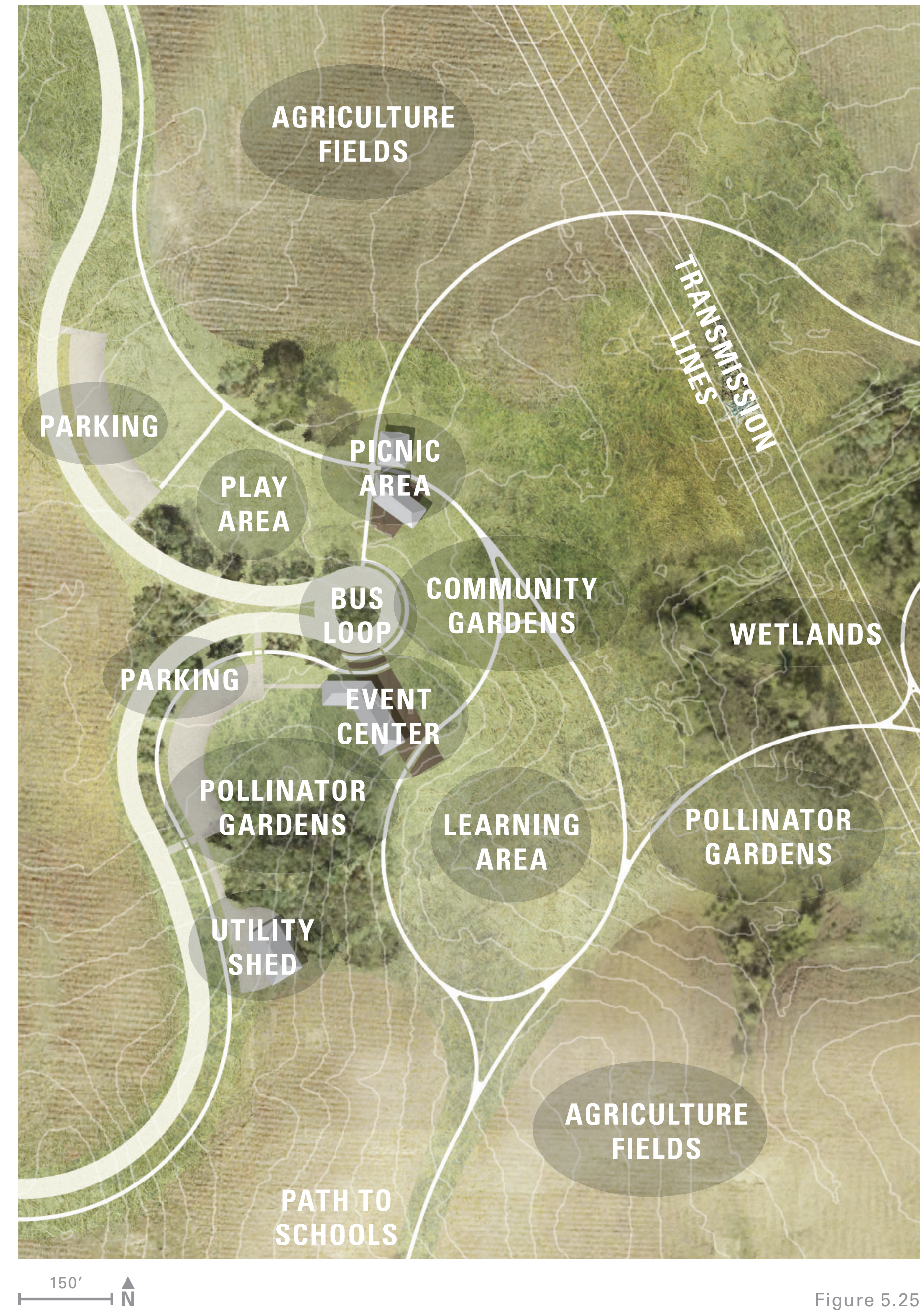


Figure 5.25 Twin Lakes Park zoomed in site design plan

DESIGN ASSESSMENT + SUMMARY

PROJECT GOALS

The purpose of the redesign of Twin Lakes Park was to provide an example of how sustainable agriculture strategies could be integrated into landscape architecture to improve the design of a multifunctional agricultural landscape. The design of Twin Lakes Park emphasizes the importance of ecological restoration and conservation, agricultural production, and accessible spaces for community development through education, play, and gathering. This is shown through the integration of signage, outdoor classrooms, and sensory gardens to encourage learning in multiple stages for all age groups alongside agricultural production, ecosystem restoration, and community play spaces.

LANDSCAPE PERFORMANCE ASSESSMENT

Although the design is preliminary, it is still possible to understand how it could be analyzed using landscape performance metrics (see Table 5.03). Twin Lakes Park was studied in the same manner as the case studies were in the previous chapter. Because of the nature of an unbuilt project, metrics and methods were selected that could be studied if the project was completed. Determinations were made based on background research and case studies presented earlier in this report. In the environmental section, soil health and stormwater management have both been improved due to the reduction of traditional agricultural practices and the integration of sustainable agriculture strategies. The economic performance of the design is more difficult to assume; however, it is clear that the park could earn a revenue from facility rentals and could spend less money on fertilizers, pesticides, and herbicides using sustainable practices than in a traditional farm or park. Social opportunities are dramatically increased from the previous use of the property through the integration of recreational and learning areas on-site. Providing walking and biking trails from nearby residential areas alongside an additional bus stop, could limit the use of personal vehicles to travel to the park itself. Aesthetics of the site would be improved through the addition of flowering shrubs and forbs and well-designed native ecosystems. Changes to the site can be seen in Figures 5.26 and 5.27.

Table 5.03 Twin Lakes Park Metrics Assessment

METRICS ANALYSIS

BENEFIT	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Soil Health (Preservation + Restoration)	Improvement in soil health or fertility	Soil tests prior to design and at several intervals after implementation	Improved farming practices like cover crops and intercropping help to mitigate nutrient and organic matter loss in soils due to agriculture	
Stormwater Management, Water Quality, and Irrigation Efficiency	Annual volume and percent of runoff retained on-site/ increased flood storage capacity	Runoff calculation models prior to design and after implementation	Decreased sizes of tilled cropland and bare soil while increased amounts of native vegetation and wetland areas	
	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Operations and Maintenance	Savings on maintenance costs	Comparison of cost of equipment, labor, fertilizers, pesticides and herbicides to costs after sustainable practices have been implemented	Limits the amounts of fertilizers, pesticides, and herbicides used on the property through the use of sustainable farming practices and the encouragement of beneficial insects for pest control	
Visitor Spending and Earned Income	Revenue or net revenue from facility rentals, parking fees, or sales	Calculation of earned revenue from event center and park area rentals	Event center and park areas can be rented out for educational and community events, family gatherings and receptions, or large parties	
	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Educational Opportunities	Visitors engaged in educational activities and accessing resources	Visitor counts for educational and learning events	Programs in coordination with local schools and churches can help provide youth and their families with an increased desire to learn about ecosystems and food production	
Transportation and Accessibility Standards	Increase in walking, biking, or mass transit use	Community surveys asking nearby residents about their transportation patterns	Increases the ease of access to the park via sidewalks and bike lanes from nearby residential areas while also providing an additional bus stop to reach further into the surrounding community	
	METRIC	METHOD/TOOL	DETERMINATION	SOURCE
Scenic Quality and Views	Inclusion of vegetation, water features, landform, monuments	Visual assessment of included water features and vegetation patterns	Expansion and restoration of existing natural areas surrounding lakes and wetlands while also providing additional vegetation in other areas to enhance the aesthetic value	
Human Comfort	Increase in amount of time visitors spend on site	Survey of visitors after design implementation	Provides areas for visitors to come and stay for periods of time where they are comfortable and relaxed	

TWIN LAKES PARK BEFORE DESIGN INTERVENTION

Figure 5.26 Twin Lakes Park before design intervention

TWIN LAKES PARK AFTER DESIGN INTERVENTION

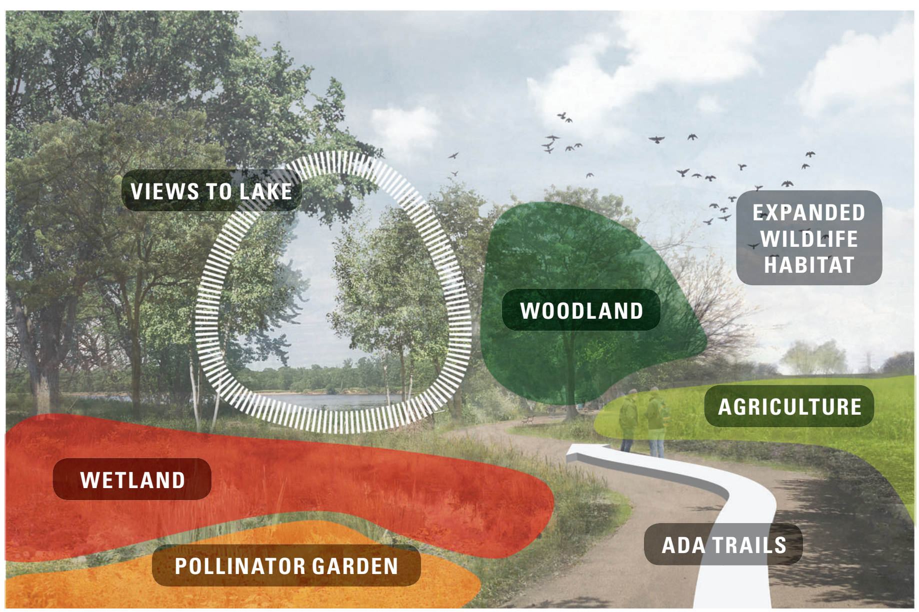


Figure 5.27 Twin Lakes Park after design intervention

LARGER SCALE ECOLOGICAL THINKING

The design is limited to the property boundary however a larger, regional scale planning perspective would present the unique opportunity to utilize overhead transmission lines as ecological corridors throughout the Chicago Metropolitan area. These corridors could connect urban and peri-urban green spaces at all scales, allowing for a cohesive network of planned open space within the larger urban fabric and expanding into the design and planning of multifunctional open spaces throughout the region. A larger network of green space would provide the opportunity to connect parks like Twin Lakes Park and other patches of habitat while also allowing for a network of trails and parks for Chicago residents.

DESIGN INTEGRATION OF DISCIPLINES

Overall, the design of Twin Lakes Park acts as an example for how landscape architects can use knowledge learned from other disciplines to inform the design and assessment of multifunctional agricultural landscapes. Ideally, this integration of information would be done through consistent collaboration with those in sustainable agriculture (and other related professions). In the case of Twin Lakes Park, the research into sustainable agriculture provided a rich understanding of agricultural strategies, the importance of soil and ecosystem health in production, and how conservation buffer zones and border strips could be used to benefit visitors, the environment, and the farmer. Previously determined landscape performance metrics were modified to include important factors for sustainable agriculture, a field in which measuring ongoing landscape performance is critical. Landscape architecture practices were used alongside these sustainable agriculture strategies to enhance the design, combining multiple programs, integrating clear circulation patterns, and allowing productive farms to work alongside educational and recreational community gathering areas. The final design serves as an example for a clear path to follow when working to integrate strategies from multiple professions while utilizing landscape performance metrics to assess the lasting impact of a design.

Figure 5.28
Twin Lakes
Park site design
perspective

CONCLUSIONS

CHAPTER SIX

CONCLUSIONS

The relationship between landscape architecture and sustainable agriculture is much deeper than traditionally understood, going back to the origins of humanity and our interaction with our environment. This report recognizes the existing theories, principles, and research within the two disciplines, illustrating their similarities and differences. The fields are compared to identify areas where existing knowledge bases overlap and examples of successful and unsuccessful collaboration are studied. In particular, this report emphasizes the growing need for interdisciplinary collaboration in the design of multifunctional agricultural landscapes. Such landscapes offer the opportunity to integrate agricultural production with ecosystem restoration, conservation practices, local food production, and recreational and educational opportunities for greater community and environmental benefits. Landscape architects have the unique opportunity to not only learn from research in other disciplines, but to integrate that research into design work in a collaborative and dynamic way.

Quantitative landscape performance assessment strategies have proven themselves to be a valuable tool in understanding the benefits of multifunctional and environmentally sustainable landscape design. When arguing for interdisciplinary collaboration, it is crucial to provide clear means to compare design strategies in quantitative ways to all members of a team, regardless of their educational or professional background. Landscape performance metrics offer teams the opportunity to use quantitative information to describe design strategies and goals, encouraging more collaboration and resulting in a more thoughtful design. The fields of landscape architecture and sustainable agriculture both have existing systems of landscape assessment. Despite the existence and overlapping information in these performance metrics, the professions rarely collaborate or compare their strategies.

ASSESSMENT OF LANDSCAPE PERFORMANCE METRICS

The landscape performance assessment used in this report is a modified version of the LAF Landscape Performance Metrics (Canfield et al. 2018) in combination with strategies from the Sustainable Sites Guidelines (Calkins 2015), the Field to Market National Indicators Report (Thomson et al. 2016), the Performance Indicators for Sustainable Agriculture (Dumanski et al. 1998), the Stewardship Index for Specialty Crops (Stewardship Index 2013), and research from multiple authors on landscape perception and aesthetic assessment strategies (Zube et al. 1982, Thomas 1995, Nassauer 1989, 1997, and 2002). The final landscape performance metrics were selected from an extensive collection of important design and performance factors found during the research process. The final metrics and categories were selected based on repetition of metrics found in existing research, their ability to be measured in quantitative terms, and their relevance to the fields of landscape architecture and sustainable agriculture.

Modifications to the LAF Landscape Performance Metrics were deemed necessary in order to better integrate important assessment strategies from an agricultural perspective. Although existing assessment tools in landscape architecture are using quantitative research and data, they often lack an emphasis on specific ecosystem functions that are important to other disciplines. The greatest amount of change to existing performance metrics came with the addition of a section on aesthetics. Aesthetics have often been left out of landscape performance assessments as it has been deemed too difficult to quantify aesthetic perception. However, with the growing amount of literature on landscape perception and aesthetics (Zube et al. 1982, Thomas 1995, Nassauer 1989, 1997, and 2002), it is becoming more feasible to incorporate aesthetics into the quantitative analysis of landscapes. Because design disciplines rely heavily on aesthetics in their work, it is critical that professionals are able to explain the value and benefits of aesthetics to other disciplines that they are working with and for.

Upon completion of this research, several suggestions can be made regarding landscape performance assessment moving forward. First, landscape performance metrics should be considered at all phases of the design process, not just after its implementation. The goal of these metrics is to quantify successful design strategies so that their value to the project and larger community can be clearly understood. Understanding the performance goals of a project at the earliest stages is critical to encouraging the development of design strategies to successfully achieve those goals. Many of the performance metrics are easiest to quantify using comparative data from prior to design implementation as well as at various stages after implementation. Knowing what should be studied and at what phases of the project makes analysis and assessment much easier.

Second, the metrics categories and the impact of specific performance metrics often overlap. This is in part due to the deeply connected relationship between each metric however it also occurs because some of the metrics are ambiguous. For example, many of the social and aesthetic metrics depend on perception by a viewer and allow for multiple interpretations of safety, comfort, or beauty. This ambiguity is intentional and allows designers and assessors the freedom to adapt the performance metrics to his/her own project, while still maintaining a replicable assessment tool kit. Understanding this ambiguity and the relationships between measured performance metrics is important in the assessment of any project.

Lastly, these metrics were selected based on highly regarded existing assessment strategies in landscape architecture and sustainable agriculture. Moving forward, metrics should continue to evolve to include research from other related fields including ecology, engineering, and planning. The goal in adjusting existing performance metrics for this report was to highlight areas that landscape architects may miss in their existing assessment of landscapes. Although these metrics are considered by the author to be an improvement on existing ones, they should not be considered final and should continue to change with time and more research.

LIMITATIONS OF STUDY

Sustainable agriculture is a growing field with new literature and ideas being published and discussed every day. Likewise, landscape architects are working quickly to adapt to a changing climate alongside their partners in planning, ecology, and environmental design. Because of the broad scope of both fields, this report was only able to touch on a small piece of each discipline's history, goals, and future development. On top of the brevity on the backgrounds of each profession, this report did not deeply address the growing importance of multifunctional landscapes. These designed environments have the potential to combat global issues including food insecurity, water shortages, air quality concerns, public space opportunities, and urban heat island effect. The benefits of multifunctional landscapes are truly wide ranging.

Sustainable agriculture in this report was limited in its definition as it only considered landscapes with crops and did not include livestock, poultry, aquaculture, or permaculture projects. All of these forms of agriculture are important, but each come with their own set of opportunities and concerns that would need to be addressed when implementing them in a multifunctional environment.

For this report, the use of landscape performance metrics to analyze and assess case studies had to be adjusted due to time restrictions and the limited accessibility of information. Because most of the projects were not designed with landscape performance metrics in mind, finding quantitative information about the design of these projects was difficult. To counter that dilemma, this report used qualitative terms to understand how each case performed according to the metrics. The strategy was successful and still provided an in-depth understanding of each case study however, quantitative information and data would have made the comparison between projects simpler and more effective. Future studies of projects could follow this model in cases where quantitative information is unavailable, but studies would be stronger if they were integrated into the design of a project from the beginning stages.

Lastly, this report only considered case studies and performance metrics from the United States. Although literature was studied from around the world, it was necessary to limit the application of the research to a smaller area. Future studies should consider how the ideas from this report could be translated to various continents and cultures.

BROADER IMPACTS

Because this report is written from a landscape architecture perspective, it has the most potential to have an impact on the discipline of landscape architecture rather than sustainable agriculture. Landscape architects often pride themselves on their ability to collaborate and work with other disciplines however, this is sometimes lost in professional practice and in educational environments. With the growing challenges our world is facing—environmentally and socially—our role as interdisciplinary mediators has never been more important. Landscape architects have the unique opportunity to work between designers and engineers, act as the voice between communities and governments, and reach across public and private sectors. However, when fulfilling our role as a team member rather than solo agents of change, it's critical to understand how to successfully relay design ideas to our teams. This report looks at successful examples of this interdisciplinary collaboration and presents the opportunity to change how landscape architects communicate their ideas and decision-making processes to other disciplines. The report provides evidence of successful collaboration, offering specific examples of projects where that collaboration has been key and arguing for the implementation of clear and quantitative landscape performance metrics. All of these ideas are intended to be used outside of the context of this research. No ideas brought forth are complete nor are they final. The landscape itself never ceases to change or adapt. Landscape architecture shouldn't either.

FUTURE STUDIES

Moving forward landscape architects and landscape architecture students should continue to push for a greater degree of interdisciplinary collaboration. Our profession will only be strengthened with the inclusion of research and practices from related fields. As our work diversifies, our strategies for landscape performance assessment should as well. Future studies should look towards the enhancement of existing performance metrics presented by the Landscape Architecture Foundation. As a representative of the profession as a whole, the Landscape Architecture Foundation has a unique opportunity to engage members of related fields with those in landscape architecture, encouraging success and diversity within both professions.

REFERENCES

REFERENCES

"About ASLA." 2019. *American Society of Landscape Architects (ASLA).* Accessed November 3, 2019. https://www.asla.org/FAQAnswer.aspx?CategoryTitle=%20About%20the%20American%20Society%20of%20Landscape%20Architects&Category=3146.

AIAKC. 2019. "AIA Kansas City Design Excellence 2019." Issuu. https://issuu.com/aiakc/docs/aia_book_2019__2_sm.

Alexander, Robert R., and Burton C. English. 1992. "Modeling Soil Erosion Control Policy: A Multi-Level Dynamic Analysis." *American Agricultural Economics Association Meeting*, 1–32. Baltimore, Maryland: Department of Agricultural Economics and Rural Sociology, University of Tennessee.

Alexandrov, Oleg. 2015. *Sunol Water Temple*. Photograph. https://en.wikipedia.org/wiki/Sunol_Water_Temple#/media/File:Sunol_Water_Temple_2.JPG.

Altieri, Miguel A. 1995. *Agroecology: The Science of Sustainable Agriculture*. 2nd Edition. Boulder, CO: London: Westview Press.

Angel, Jim. 2003. "Illinois Growing Season: Days Between Last Spring and First Fall Frost (Occurrence of 32°F)." State Climatologist Office for Illinois. https://www.isws.illinois.edu/statecli/Frost/growing_season.htm.

Angel, Jim. 2004. "1961-1990 Annual Average: Wind Roses and Wind Frequency Tables for Illinois." State Climatologist Office for Illinois. https://www.isws.illinois.edu/statecli/roses/wind_climatology.htm.

ArcGIS. 2020. Homer Glen, IL. ESRI Aerial Imagery. Data from Will County GIS. https://www.willcountyillinois.com/County-Offices/Administration/GIS-Division

Atwood, Lesley Wren. 2017. "Effects of Agricultural Practices on Soil Communities and Their Associated Ecosystem Services." Ph.D., New Hampshire: University of New Hampshire.

Babienko Architects. 2020. "Seattle Children's PlayGarden." *Babienko Architects*. https://babienkoarchitects.com/build/seattle-childrens-playgarden.

Baiden, Robert C. 2020. "Build Illinois: The Last 500 Million Years." Illinois State Geological Survey: Prairie Research Institute. http://isgs.illinois.edu/outreach/geology-resources/build-illinois-last-500-million-years.

Baker, John M., Tyson E. Ochsner, Rodney T. Venterea, and Timothy J. Griffis. 2007. "Tillage and Soil Carbon Sequestration—What Do We Really Know?" *Agriculture, Ecosystems & Environment* 118 (1): 1–5.

Bellotti, B., and J. F. Rochecouste. 2014. "The Development of Conservation Agriculture in Australia—Farmers as Innovators." *International Soil and Water Conservation Research* 2 (1): 21–34.

Berry, Wendell. 1978. *The Unsettling of America: Culture & Agriculture*. San Francisco: Sierra Club Books.

"Beth Meyer." n.d. University of Virginia School of Architecture. Accessed December 10, 2019. https://www.arch.virginia.edu/people/beth-meyer.

Beyond Pesticides. 2019. "USDA 'People's Garden' Turned Over to Agrichemical Corporations to Promote Pesticides and GE Crops." *Beyond Pesticides Daily News Blog* (blog). August 29, 2019. https://beyondpesticides.org/dailynewsblog/2019/08/usda-peoples-garden-turned-over-to-agrichemical-corporations-to-promote-pesticides-and-ge-crops/.

Blodgett, Geoffrey. 1976. "Frederick Law Olmsted: Landscape Architecture as Conservative Reform." *The Journal of American History* 62 (4): 869–89. https://doi.org/10.2307/1903842.

Bookchin, Murray. 1976. "Radical Agriculture." In *Radical Agriculture*, by Richard Merrill, 3–13. New York, NY: Harper & Row, Publishers.

Braden, Lauren. 2015. "Nature Therapy at Seattle Children's PlayGarden." *ParentMap*. September 29, 2015. https://www.parentmap.com/article/nature-therapy-at-seattle-childrens-playgarden.

Breyer, Michelle. 2018. "Mia Lehrer, 65 | Landscape Architect | AGEIST Profile." *AGEIST*. https://www.weareageist.com/profile/mia-lehrer-65/.

Brown, Kyle D., and Todd Jennings. 2003. "Social Consciousness in Landscape Architecture Education: Toward a Conceptual Framework." *Landscape Journal* 22 (2): 99–112. https://doi.org/10.3368/lj.22.2.99.

Busari, Mutiu Abolanle, Surinder Singh Kukal, Amanpreet Kaur, Rajan Bhatt, and Ashura Ally Dulazi. 2015. "Conservation Tillage Impacts on Soil, Crop and the Environment." *International Soil and Water Conservation Research* 3 (2): 119–29.

Calkins, Meg. 2015. The Sustainable Sites Handbook: A Complete Guide to the Principles, Strategies, and Best Practices for Sustainable Landscapes. Hoboken, New Jersey: John Wiley & Sons, Inc.

Canfield, Jessica, Bo Yang, and Heather Whitlow. 2018. "Evaluating Landscape Performance: A Guidebook for Metrics and Methods Selection." *Landscape Architecture Foundation*. https://doi.org/10.31353/gb001.

Center for Invasive Species and Ecosystem Health at the University of Georgia. n.d. "Invasive Species of Concern." Illinois Invasive Species. Accessed February 5, 2020. https://www.invasive.org/illinois/speciesofconcern.html.

CFA. n.d. "Elizabeth K. Meyer | Commission of Fine Arts." *U.S. Commission of Fine Arts*. Accessed December 10, 2019. https://www.cfa.gov/about-cfa/who-we-are/elizabeth-k-meyer.

Chicago Metropolitan Agency for Planning (CMAP). 2016. "Appendix A: Primary Impacts of Climate Change in the Chicago Region." Climate Adaptation Guidebook for Municipalities in the Chicago Region. Chicago, IL. https://www.cmap.illinois.gov/documents/10180/14193/Appendix+A+-+Primary+Impacts+of+Climate+Change+in+the+Chicago+Region.pdf/2a85b021-f3bd-4b98-81d1-f64890adc5a7.

Ching, Francis D.K. 2015. *Architecture: Form, Space & Order*. 4th ed. Hoboken, New Jersey: John Wiley & Sons, Inc.

Climate Change and Chicago – Projections and Potential Impacts. 2007. Chapter Two – Climate. Chicago Climate Action Plan: November 7, 2007.

Cociu, Alexandru, and George Daniel Cizmaş. 2015. "Conservation Agriculture - an Option of a Sustainable Agriculture Proposed for Eastern Romanian Danube Plain. Results from a Long-Term Experiment Intended to Establish Conservation Agriculture Practices in the Respective Area. I. The Effect of Residue Retention on Important Soil Quality Indicators." *ProEnvironment* 8 (22): 112–18.

Collins, Sarah Ellis. 2012. "Landscape Agriculture: Landscape Design Lessons Learned from the Farming Communities of Rural Appalachia." Master of Landscape Architecture, Athens, Georgia: The University of Georgia. https://getd.libs.uga.edu/pdfs/collins_sarah_e_201208_mla.pdf.

Connor, D. J. 2008. "Organic Agriculture Cannot Feed the World." *Field Crops Research* 106 (2): 187–90.

Crews, Timothy, and Brian Rumsey. 2017. "What Agriculture Can Learn from Native Ecosystems in Building Soil Organic Matter: A Review." *Sustainability* 9(4):1-18.

Cultivating Great Places [Firm Profile]. (n.d.). Retrieved September 23, 2019, from Cultivate Studio website: http://www.cultivate-ca.com/

Daderot. 2006. *Grounds of the Gateway Arch National Park in St. Louis, Missouri*. Photograph. https://en.wikipedia.org/wiki/Dan_Kiley#/media/File:Jefferson_National_Expansion_Memorial_grounds_-_Dan_Kiley_landscape_designer.JPG.

Diebel, Penelope L., Daniel B. Taylor, Sandra S. Batie, and Conrad D. Heatwole. 1992. "An Economic Analysis of Soil Erosion Control and Low-Input Agriculture." In *Soil and Water Conservation Society Meeting*, 1-17. Baltimore, Maryland: Department of Agricultural Economics, Kansas State University.

Duiker, Sjoerd W., Joel C. Myers, and Lisa C. Blazure. 2017. "Soil Health in Field and Forage Crop Production." *USDA Natural Resources Conservation Service*.

Dumanski, Julian, Eugene Terry, Derek Byerlee, and Christian Pieri. 1998. "Performance Indicators for Sustainable Agriculture." *World Bank*. https://www.academia.edu/26092842/Performance_Indicators_for_Sustainable_Agriculture.

Dunne, Thomas and Luna Leopold. 1978. "Hillslope Processes." In *Water in Environmental Planning*, 506–89. New York, NY: W. H. Freeman and Company.

Easton, Valerie. 2015. "Seattle Children's PlayGarden Is Fun for Kids of All Abilities." The Seattle Times. August 19, 2015. https://www.seattletimes.com/pacific-nw-magazine/seattle-childrens-playgarden-is-fun-for-kids-of-all-abilities/.

Eckbo, Garrett, Daniel Kiley, and James Rose. 1939. "Landscape Design in the Rural Environment." *Architectural Record*, Accessed 2019.

Farmer D Consulting. 2019. "Growing Community Through Agriculture." Farmer D Consulting. Accessed December 9, 2019. https://farmerdconsulting.com.

Forkner, Lorene Edwards. 2019. "Color Life Brilliant at Seattle Children's PlayGarden." *Pacific Horticulture Society 80* (2). https://www.pacifichorticulture.org/articles/help-grow-the-seattle-childrens-playgarden/.

Francis, Mark. 2019. "A Case Study Method for Landscape Architecture." Washington, DC: *Landscape Architecture Foundation*.

French Sr., John C. 2011 (upload date). *Field Preparation, Bed Forming Peanuts*. Photograph. https://www.forestryimages.org/browse/detail.cfm?imgnum=1599010&.

"Google Earth." 2020. Homer Glen, IL. https://www.google.com/earth/.

Gonzalez, Javier M. 2018. "Runoff and Losses of Nutrients and Herbicides under Long-Term Conservation Practices (No-till and Crop Rotation) in the U.S. Midwest: A Variable Intensity Simulated Rainfall Approach." *International Soil and Water Conservation Research* 6(4):265–74.

Great Lakes Bioenergy Research Center (GLBRC). 2019. "Great Lakes Bioenergy Research Center." https://www.glbrc.org/.

Green, Jared. n.d. "Interview with Mia Lehrer, FASLA." *American Society of Landscape Architects*. Accessed December 2019. https://www.asla.org/ContentDetail.aspx?id=26558.

Grow Dat Youth Farm. 2015. *Grow Dat Youth Farm*. Photograph.

Grow Dat Youth Farm. 2016. "Growing Together: 2016 Impact Report." *Annual Report*. https://static1.squarespace.com/static/52a213fce4b0a5794c59856f/t/54135734e4b0f30bade8f7bf/1410553652395/Full+Citation-+1989-+RRJ.pdf.

Grow Dat Youth Farm. 2017. "Growing Together: 2017 Impact Report." *Annual Report*. https://static1.squarespace.com/static/542ec6f2e4b019a868a3dfb3/t/5a7c8db624a6948120b72441/1518112260121/Grow+Dat+Annual+Report+2017.pdf.

"Grow Dat Youth Farm." 2020. https://growdatyouthfarm.org/by-the-numbers.

"GrowTown." 2019. http://growtown.org/about/.

Guthrie, Joseph. 2017. "Lone Oaks Farm BioBlitz." INaturalist. https://www.inaturalist.org/projects/lone-oaks-farm-bioblitz.

Hansen, Twyla M, and Charles A. Francis. 2007. "Multifunctional Rural Landscapes: Economic, Environmental, Policy, and Social Impacts of Land Use Changes in Nebraska." *University of Nebraska - Lincoln*.

Hayden-Smith, Rose. 2016. "Q&A: Bob Snieckus, the National Landscape Architect." *UC Food Observer* (blog). http://ucfoodobserver.com/2016/05/16/qa-bob-snieckus-the-national-landscape-architect/.

Hill, Kristina. 2016. "Form Follows Flows: Systems, Design, and the Aesthetic Experience of Change." In *Nature and Cities: The Ecological Imperative in Urban Design and Planning*, edited by Frederick R. Steiner, George F. Thompson, and Armando Carbonell. Cambridge, MA: Lincoln Institute of Land Policy.

Hirschfeld, Lawrence A. 1977. "Cuna Aesthetics: A Quantitative Analysis." *Ethnology* 16 (2): 147–66. https://doi.org/10.2307/3773383.

Hou, Jeffrey. 2018. "Perspectives: Jeffrey Hou." Landscape Architecture Foundation. https://www.lafoundation.org/news/2018/11/perspectives-jeff-hou.

Hyams, Edward. 1952. *Soil and Civilization*. London; New York: Thames and Hudson.

InSapphoWeTrust. 2012. *High Line Park*. Photograph. https://commons.wikimedia.org/wiki/File:High_Line_Park_(7355180882).jpg.

IRS. 2019. "GrowTown Inc." Tax Exempt Organization Search. Accessed December 9, 2019.

Islam, R., and R. Reeder. 2014. "No-till and Conservation Agriculture in the United States: An Example from the David Brandt Farm, Carroll, Ohio." *International Soil and Water Conservation Research* 2 (1): 97–107.

Isaaka, Sakinatu, and Muhammad Aqeel Ashraf. 2017. "Impact of Soil Erosion and Degradation on Water Quality: A Review." *Geology, Ecology, and Landscapes* 1(1):1–11.

Jackson, Wes. 1987. *Altars of Unhewn Stone: Science and the Earth*. San Francisco: North Point Press.

Jackson, Wes, Aubrey Streit Krug, Bill Vitek, and Robert Jensen. 2018. "Transforming Human Life on Our Home Planet, Perennially." *The Ecological Citizen*, 2(1):43-46.

Jellicoe, Geoffrey. 1975. *The Landscape of Man: Shaping the Environment from Prehistory to the Present Day*. Viking Press. http://hdl.handle.net/2027/umn.31951000173088.

Johnson, Hannah. 2019. "Everybody Can Play! Easy Ways to Say 'Yes!' To Kids with Disabilities." *Say "Yes!" To Kids with Disabilities* (blog). January 14, 2019. https://www.childrensplaygarden.org/post/2020/01/15/every-body-can-play-easy-ways-to-say-yes-to-kids-with-disabilities.

Kato, Sadahisa, and Jack Ahern. 2009. "Multifunctional Landscapes as a Basis for Sustainable Landscape Development." *Landscape Research Japan* 72 (5): 799–804.

Keefer, Robert F. 2000. *Handbook of Soils for Landscape Architects*. New York, NY: Oxford University

Lal, R. 1998. "Soil Erosion Impact on Agronomic Productivity and Environment Quality." *Critical Reviews in Plant Sciences* 17(4):319–464.

Land Institute. 2017. "Carbon in Soil: Why, How." *The Land Report*, no. 118: 17–26.

Land Institute. 2019. "The Land Institute." The Land Institute. Accessed December 9, 2019. https://landinstitute.org/about-us/.

Landscape as Necessity. n.d. "Kristina Hill, Ph.D." *Landscape Architecture as Necessity Conference | USC*. Accessed December 10, 2019. http://landscapeasnecessity.uscarch.com/presenters/kristina-hill-ph-d/.

Lehman, Tim. 1995. *Public Values, Private Lands: Farmland Preservation Policy, 1933-1985*. Chapel Hill: The University of North Carolina Press.

Lehrer, Mia, and Maya Dunne. 2011. "Urban Agriculture: Practices to Improve Cities." *Urban Land Institute*, https://urbanland.uli.org/news/urban-agriculture-practices-to-improve-cities/.

Leighton, M. M., George E. Ekblaw, and Leland Horberg. 1948. "Physiographic Divisions of Illinois." *The Journal of Geology* 56 (1): 16–33.

Lister, Nina-Marie E. 2016. "Resilience Beyond Rhetoric in Urban Landscape Planning and Design." In *Nature and Cities: The Ecological Imperative in Urban Design and Planning*, edited by Frederick R. Steiner, George F. Thompson, and Armando Carbonell. Cambridge, MA: Lincoln Institute of Land Policy.

Lithourgidis, A S, C A Dordas, C A Damalas, and D N Vlachostergios. 2011. "Annual Intercrops: An Alternative Pathway for Sustainable Agriculture." *Australian Journal of Crop Science*, 5(4):396-410.

Lofgren, B. and A. Gronewold, 2012: Water Resources. In: U.S. National Climate Assessment Midwest Technical Input Report.

Lone Oaks Farm. 2015. "The Story." Lone Oaks Farm. Accessed February 11, 2020. https://www.loneoaksfarm.com/about/the-story/.

Lone Oaks Farm. 2016. *Lone Oaks Farm*. Photograph. https://www.loneoaksfarm.com/wp-content/uploads/2016/01/DSC_0598sm-960x500_c.jpg.

Lovell, Sarah Taylor, and Douglas M. Johnston. 2009a. "Creating Multifunctional Landscapes: How Can the Field of Ecology Inform the Design of the Landscape?" *Frontiers in Ecology and the Environment* 7 (4): 212–20. https://doi.org/10.1890/070178.

Lovell, Sarah Taylor, and Douglas M. Johnston. 2009b. "Designing Landscapes for Performance Based on Emerging Principles in Landscape Ecology." *Ecology and Society* 14 (1): art44. https://doi.org/10.5751/ES-02912-140144.

Mader, Grace. 2019. *Homer Glen IL, Twin Lakes Park Site Photography*.

Marsh, Warner L. 1964. *Landscape Vocabulary*. Los Angeles, CA: Miramar Publishing Co.

McDonnell, Timothy Gerard. 2011. "Urban Fusion: Creating Integrated Productive Landscapes." Master's Thesis, Manhattan, Kansas: Kansas State University.

McNeely, Jeffrey A., Sara J. Scherr, and Future Harvest. 2003. *Ecoagriculture: Strategies to Feed the World and Save Wild Biodiversity*. Island Press.

Merriam-Webster. 2019. "Definition of Resiliency." https://www.merriam-webster.com/dictionary/resiliency.

Meyer, Elizabeth. 2013. "Part IV: Farm." In *Nelson Byrd Woltz: Garden Park Community Farm*, by Warren T. Byrd Jr. and Thomas L. Woltz, edited by Stephen Orr, 1st ed., 170–173. New York, NY: Princeton Architectural Press.

Mundahl, Erin. 2017. "More Mouths to Feed: What Is the Future of Sustainable Agriculture?" *InsideSources: Iowa.* October 16, 2017. https://www.insidesources.com/more-mouths-to-feed-what-is-the-future-of-sustainable-agriculture/.

NASA. 2020. "Overview: Weather, Global Warming and Climate Change." Climate Change: Vital Signs of the Planet. https://climate.nasa.gov/resources/global-warming-vs-climate-change.

Nassauer, Joan. 1989. "Agricultural Policy and Aesthetic Objectives." *Soil and Water Conservation* 44 (5): 384–87.

Nassauer, Joan. 1997. "Cultural Sustainability: Aligning Aesthetics and Ecology." In *Placing Nature*, 67–83. Washington, D.C.: Island Press. https://static1.squarespace.com/static/52a213fce4b0a5794c59856f/t/54a702c4e4b02cb3ce0d1e21/1420231364875/1997+Placing+Nature.pdf.

Nassauer, Joan. 2002. "Methodological Challenges for Defining and Measuring Agricultural Landscape Indicators." *NIJOS/OECD Expert Meeting on Agricultural Landscape*, 1-10. Oslo, Norway.

Nature of Cities. n.d. "Kristina Hill, Author at The Nature of Cities." *The Nature of Cities*. Accessed December 10, 2019. https://www.thenatureofcities.com/author/kristinahill/.

NBWLA. 2019. "Farm | Nelson Byrd Woltz." *Nelson Byrd Woltz Landscape Architects*. Accessed November 15, 2019. https://www.nbwla.com/projects/farm.

Nelson Byrd Woltz LA, El Dorado Architecture, and WMWA Landscape Architects. 2017. "Lone Oaks Farm: Master Plan Executive Summary." https://www.loneoaksfarm.com/wp-content/uploads/2017/12/LOF-Master-Plan-Exec-Summary.pdf.

Newton, Norman. 1971. *Design on the Land: The Development of Landscape Architecture*. Cambridge, MA: The Belknap Press of Harvard University Press.

Novak, Rhonda. 2018. "Levy Real Estate Tax Information." Will County Property Information. 2018. http://willtax.willcountydata.com/maintax/ccgis08?1605131000120000.

NRCS. 2019. "Buffer Strips: Common Sense Conservation." *NRCS*. 2019. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/home/?cid=nrcs143_023568.

NRCS. 2020. Soil Survey Data. Custom Soil Resource Report for Will County, IL. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

Pace. 2019. "Route 832 Timetable." Pace Suburban Bus Route. 2019. https://www.pacebus.com/pdf/full.new/Pacert832.pdf.

Posthumus, H., L. K. Deeks, R. J. Rickson, and J. N. Quinton. 2015. "Costs and Benefits of Erosion Control Measures in the UK." *Soil Use and Management* 31(1):16–33.

Powlson, D. S., P. J. Gregory, W. R. Whalley, J. N. Quinton, D. W. Hopkins, A. P. Whitmore, P. R. Hirsch, and K. W. T. Goulding. 2011. "Soil Management in Relation to Sustainable Agriculture and Ecosystem Services." *Food Policy* 36(1):S72–S87.

Pregill, Philip, and Nancy Volkman. 1993. *Landscapes in History: Design and Planning in the Western Tradition*. New York, NY: Van Nostrand Reinhold.

"Professional Practice: Resilient Design." 2019. *American Society of Landscape Architects*. https://www.asla.org/resilientdesign.aspx.

Quirck, Vanessa. 2012. "The Grow Dat Youth Farm & SEEDocs: Mini-Documentaries on the Power of Public-Interest Design." ArchDaily. http://www.archdaily.com/245235/the-grow-dat-youth-farm-seedocs-mini-documentaries-on-the-power-of-public-interest-design/.

Rich, Nathaniel. 2016. "The Prophecies of Jane Jacobs: She is Renowned for Championing Urban Diversity, but Her Real Prescience Lay in Her Fears about the Fragility of Democracy." *The Atlantic*. https://www.theatlantic.com/magazine/archive/2016/11/the-prophecies-of-jane-jacobs/501104/.

Rogers, Elizabeth Barlow. 2001. *Landscape Design: A Cultural and Architectural History*. New York, NY: Harry N. Abrams.

Ruisi, Paolo, Sergio Saia, Giuseppe Badagliacca, Gaetano Amato, Alfonso Salvatore Frenda, Dario Giambalvo, and Giuseppe Di Miceli. 2016. "Long-Term Effects of No Tillage Treatment on Soil N Availability, N Uptake, and 15N-Fertilizer Recovery of Durum Wheat Differ in Relation to Crop Sequence." *Field Crops Research* 189 (March): 51–58.

Sustainable Agriculture Education (SAGE). 2015. *SAGE Center*. https://www.sagecenter.org/about-us/

Sustainable Agriculture Education (SAGE), and San Francisco Public Utilities Commission (SFPUC). 2014. "A Case Study of the Urban-Edge Sunol Water Temple Agricultural Park: A Model for Collaborative Beginning Farming Integrated with Public Education and Natural Resources Stewardship." https://www.sagecenter.org/wp-content/uploads/2015/11/Sunol-Water-Temple-Agricultural-Park-Case-Study.pdf.

Satterfield, Stephen. 2018. "Behind the Rise and Fall of Growing Power." Civil Eats. March 13, 2018. https://civileats.com/2018/03/13/behind-the-rise-and-fall-of-growing-power/.

SCUP. 2018. "University of Tennessee Extension - Lone Oaks Farm Master Plan." The Society for College and University Planning. https://www.scup.org/award-winner/university-of-tennessee-extension-lone-oaks-farm-master-plan/.

Seattle Children's PlayGarden. 2010. "The PlayGarden Story." *Seattle Children's PlayGarden: A Garden for Everyone*. https://0f602425-556a-4bdf-a68e-5602ace19b5b.filesusr.com/ugd/338eb8_852af4879e8a4f75b604b1310d64990b.pdf.

Seattle Parks. 2011. *Children's PlayGarden Colman* Playground. Photograph. https://www.flickr.com/photos/seattleparks/5592509541/in/photostream/.

Small, Andrew. 2017. "How Urban Renewal Battled 'Waste' While Creating More of It." CityLab. 2017. http://www.citylab.com/housing/2017/02/urban-renewal-wastelands/516378/.

Small Center. 2017. "Grow Dat Youth Farm | The Albert and Tina Small Center for Collaborative Design." Tulane School of Architecture. April 6, 2017. http://small.tulane.edu/project/grow-dat-youth-farm/.

Stewardship Index for Specialty Crops. 2013. "Metrics." *StewardshipIndex.org*. https://www.stewardshipindex.org/metrics.php.

Studio-MLA. 2019. "Landscape Architecture and Planning | Los Angeles and San Francisco." *Studio-MLA*. http://studio-mla.com/studio/.

"Sustainable ASLA." 2019. *American Society of Landscape Architects*. https://www.asla.org/sustainableasla.aspx.

Sustainable Agriculture Education (SAGE). 2015. "Sunol Water Temple Agricultural Park." *SAGE Center*. Accessed January 10, 2020. https://www.sagecenter.org/portfolio/sunol-water-temple-agricultural-park/.

Sustainable Agriculture Education (SAGE), and San Francisco Public Utilities Commission (SFPUC). 2014. "A Case Study of the Urban-Edge Sunol Water Temple Agricultural Park: A Model for Collaborative Beginning Farming Integrated with Public Education and Natural Resources Stewardship." https://www.sagecenter.org/wp-content/uploads/2015/11/Sunol-Water-Temple-Agricultural-Park-Case-Study.pdf.

Taylor, Gary C. 1987. "Soil Erosion Control: Observations from the US Experience." In *International Association of Agricultural Economists Occasional Papers*, 114–19. 4. AgEcon Search.

Thomas, Jack Ward. 1995. "Landscape Aesthetics: A Handbook for Scenery Management." Agriculture Handbook 701. United States Department of Agriculture (USDA) Forest Service.

Thomson, Allison, Grant Wick, Stewart Ramsey, and Brandon Kleithermes. 2016. "Environmental and Socioeconomic Indicators for Measuring Outcomes of On-Farm Agricultural Production in the United States." *Field to Market: The Alliance for Sustainable Agriculture*. http://fieldtomarket.org/media/2016/12/Field-to-Market_2016-National-Indicators-Report.pdf.

Tukiainen, Matti. 2020. "Chicago, Illinois - Sunrise, Sunset, Dawn and Dusk Times for the Whole Year." Gaisma. https://www.gaisma.com/en/location/chicago-illinois.html.

UC Berkeley. n.d. "Kristina Hill." *UC Berkeley Environmental Design Faculty + Staff*. Accessed December 1, 2019. https://ced.berkeley.edu/ced/faculty-staff/kristina-hill.

UCLA. 2019. "What Is Sustainability?" *UCLA Sustainability*. https://www.sustain.ucla.edu/about-us/what-is-sustainability/.

United States Census Bureau. 2016. "U.S. Gazetteer Files." 2016. https://www2.census.gov/geo/docs/maps-data/data/gazetteer/2016_Gazetteer/2016_gaz_place_17.txt.

United States Department of Agriculture (USDA). 2007. "Sustainable Agriculture: Definitions and Terms." *National Agricultural Library*. https://www.nal.usda.gov/afsic/sustainable-agriculture-definitions-and-terms.

United States Department of Agriculture (USDA). 2012. "USDA Plant Hardiness Zone Map." *USDA Agricultural Research Service*. https://planthardiness.ars.usda.gov/PHZMWeb/#.

United States Department of Agriculture. (USDA). 2015. "USDA Coexistence Factsheets - Conventional Farming."

United States Department of Agriculture (USDA), and National Agricultural Statistics Service (NASS). 2018. "Farms and Land in Farms 2017 Summary." *NASS Report*.

University of Tennessee. 2017. "Lone Oaks Farm." UTK College of Architecture + Design. https://archdesign.utk.edu/projects/lone-oaks-farm/.

U.S. Climate Data. 2020. "Climate Illinois - Chicago." U.S. Climate Data: Temperature - Precipitation - Sunshine - Snowfall. https://www.usclimatedata.com/climate/illinois/united-states/3183.

U.S. Fish & Wildlife Service. 2017. "Illinois County List of Endangered Species - by Species." Midwest Region Endangered Species. https://www.fws.gov/midwest/endangered/lists/illinois-spp.html.

Veenhuizen, René van. 2005. "Introduction: Cities Farming for the Future." In *Cities Farming for the Future: Urban Agriculture for Green and Productive Cities*. Ottawa, CANADA: IDRC Books/Les Éditions du CRDI, http://ebookcentral.proquest.com/lib/ksu/detail.action?docID=3012105.

Viljoen, Andre, Joe Howe, and Katrin Bohn. 2012. *Continuous Productive Urban Landscapes*. Burlington, MA: Routledge.

Wiggering, Hubert, Klaus Müller, Armin Werner, and Katharina Helming. 2003. "The Concept of Multifunctionality in Sustainable Land Development." In *Sustainable Development of Multifunctional Landscapes*, edited by Katharina Helming and Hubert Wiggering, 3–18. Berlin, Heidelberg: Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-662-05240-2_1.

World Population Review. 2020. "Chicago, Illinois Population 2020." 2020. http://worldpopulationreview.com/us-cities/chicago-population/.

Wozniacka, Gosia. 2019. "Big Food Is Betting on Regenerative Agriculture to Thwart Climate Change." *Civil Eats.* https://civileats.com/2019/10/29/big-food-is-betting-on-regenerative-agriculture-to-thwart-climate-change/.

Yang, Bo, Ming-Han Li, and Shujuan Li. 2013. "Design-with-Nature for Multifunctional Landscapes: Environmental Benefits and Social Barriers in Community Development." *International Journal of Environmental Research and Public Health* 10 (11): 5433–58. https://doi.org/10.3390/ijerph10115433.

Yocom, Ken and Delia Lacson. 2011. "Seattle Children's PlayGarden." *Landscape Performance Series*. https://www.landscapeperformance.org/case-study-briefs/seattle-childrens-playgarden.

Youngberg, Garth, and Suzanne P. DeMuth. 2013. "Organic Agriculture in the United States: A 30-Year Retrospective." *Renewable Agriculture and Food Systems;* Cambridge 28(4):294–328.

Yu, Kongjian. 2016. "Creating Deep Forms in Urban Nature: The Peasant's Approach to Urban Design." In *Nature and Cities: The Ecological Imperative in Urban Design and Planning*, edited by Frederick R. Steiner, George F. Thompson, and Armando Carbonell. Cambridge, MA: Lincoln Institute of Land Policy.

Zube, Ervin H., James L. Sell, and Jonathan G. Taylor. 1982. "Landscape Perception: Research, Application and Theory." *Landscape Planning* 9 (1): 1–33. https://doi.org/10.1016/0304-3924(82)90009-0.

RECOMMENDED READING FOR FUTURE RESEARCHERS

ON LANDSCAPE AESTHETICS

Nassauer, Joan. 1995. "Messy Ecosystems Orderly Frames." *Landscape Journal*, 161–70.

Nassauer, Joan. 1997. "Cultural Sustainability: Aligning Aesthetics and Ecology." In *Placing Nature*, 67–83. Washington, D.C.: Island Press. https://static1.squarespace.com/static/52a213fce4b0a5794c59856f/t/54a702c4e4b02cb3ce0d1e21/1420231364875/1997+Placing+Nature.pdf.

Zube, Ervin H., James L. Sell, and Jonathan G. Taylor. 1982. "Landscape Perception: Research, Application and Theory." *Landscape Planning* 9 (1): 1–33. https://doi.org/10.1016/0304-3924(82)90009-0.

ON LANDSCAPE ARCHITECTURE

Jacobs, Jane. 1961. *The Death and Life of Great American Cities*. New York, NY: Random House.

Newton, Norman. 1971. *Design on the Land: The Development of Landscape Architecture*. Cambridge, MA: The Belknap Press of Harvard University Press.

Rogers, Elizabeth Barlow. 2001. *Landscape Design: A Cultural and Architectural History*. New York, NY: Harry N. Abrams.

ON LANDSCAPE PERFORMANCE

Calkins, Meg. 2015. The Sustainable Sites Handbook: A Complete Guide to the Principles, Strategies, and Best Practices for Sustainable Landscapes. Hoboken, New Jersey: John Wiley & Sons, Inc.

Canfield, Jessica, Bo Yang, and Heather Whitlow. 2018. "Evaluating Landscape Performance: A Guidebook for Metrics and Methods Selection." *Landscape Architecture Foundation*. https://doi.org/10.31353/gb001.

ON MULTIFUNCTIONAL LANDSCAPES

Lovell, Sarah Taylor, and Douglas M. Johnston. 2009a. "Creating Multifunctional Landscapes: How Can the Field of Ecology Inform the Design of the Landscape?" *Frontiers in Ecology and the Environment* 7 (4): 212–20. https://doi.org/10.1890/070178.

Kato, Sadahisa, and Jack Ahern. 2009. "Multifunctional Landscapes as a Basis for Sustainable Landscape Development." *Landscape Research Japan* 72 (5): 799–804.

Wiggering, Hubert, Klaus Müller, Armin Werner, and Katharina Helming. 2003. "The Concept of Multifunctionality in Sustainable Land Development." In *Sustainable Development of Multifunctional Landscapes*, edited by Katharina Helming and Hubert Wiggering, 3–18. Berlin, Heidelberg: Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-662-05240-2_1.

ON URBAN AGRICULTURE

Veenhuizen, René van. 2005. "Introduction: Cities Farming for the Future." In *Cities Farming for the Future: Urban Agriculture for Green and Productive Cities*. Ottawa, CANADA: IDRC Books/Les Éditions du CRDI, http://ebookcentral.proquest.com/lib/ksu/detail.action?docID=3012105.

Viljoen, Andre, Joe Howe, and Katrin Bohn. 2012. *Continuous Productive Urban Landscapes*. Burlington, MA: Routledge.

ON SUSTAINABLE AGRICULTURE

Altieri, Miguel A. 1995. *Agroecology: The Science of Sustainable Agriculture*. 2nd Edition. Boulder, CO: London: Westview Press.

Berry, Wendell. 1978. *The Unsettling of America: Culture & Agriculture*. San Francisco: Sierra Club Books.

Bookchin, Murray. 1976. "Radical Agriculture." In *Radical Agriculture*, by Richard Merrill, 3–13. New York, NY: Harper & Row, Publishers.

Jackson, Wes. 1987. *Altars of Unhewn Stone: Science and the Earth*. San Francisco: North Point Press.

APPENDICES

APPENDIX A

GLOSSARY

AGROECOLOGY

Used interchangeably with sustainable agriculture in an informal context, “agroecology often incorporates ideas about a more environmentally and socially sensitive approach to agriculture, one that focuses not only on production, but also on the ecological sustainability of the production system” (Altieri 1995, p. 4). Like the definition being used for sustainable agriculture, agroecology is a broad term to describe many different forms of sustainable agricultural practices. The practices of agroecology and sustainable agriculture have an ecological, economic, and social view.

CASE STUDY

“...A well-documented and systematic examination of the process, decision-making, and outcomes of a project that is undertaken for the purpose of informing future practice, policy, theory, and/or education” (Francis 2019).

CLIMATE CHANGE

“Climate change is a long-term change in the average weather patterns that have come to define Earth’s local, regional and global climates. These changes have a broad range of observed effects that are synonymous with the term” (NASA 2020).

CONSERVATION AGRICULTURE

Characterized by minimal soil movement, increased residue and vegetation coverage, and economically viable crop rotations, conservation agriculture takes the emphasis off of tillage and instead focuses on an entire agricultural system (Cociu and Cizmas 2015). Conservation agriculture practices are intended to increase crop water use efficiency while simultaneously improving crop nutrition, disease management, weed management, and reducing long term soil loss (Bellotti and Rochecouste 2014). Conservation agriculture often creates a framework for reconciling traditional production focused farming practices with conservation practices that protect wildlife habitat as well as local ecosystems and watersheds (Meyer 2013).

CONSERVATION BUFFERS

Conservation buffers are the small areas or strips of land planted with permanent vegetation that are designed to intercept pollutants and manage environmental concerns. Buffers can provide habitat for wildlife, act as a conduit for biodiversity, slow wind and erosion, and provide additional nutrients for surrounding areas (NRCS 2019, Hansen and Francis 2007).

CONSERVATION TILLAGE

"Any tillage method that leaves sufficient crop residue in place to cover at least 30% of the soil surface after planting" (Baker et al. 2007, p. 1).

CONVENTIONAL AGRICULTURE

Also known as production agriculture, industrial agriculture, or traditional agriculture, conventional agriculture refers to farming systems that use industrial technology as a means to produce products for a global market at the lowest possible production price. Conventional agriculture typically uses genetically altered seeds and chemical fertilizers, pesticides, and herbicides rather than natural means of soil improvements and pest management. Practices also include heavy irrigation, intensive tillage, and monoculture production (Hansen and Francis 2007, USDA 2015).

COVER CROPS

"Crops grown between two economic crops with the primary aim to protect and improve the soil" (Duiker et al. 2017, p. 6).

CROP ROTATIONS

The, "repetitive growing of an ordered succession of crops on the same land over multiple years…" (Duiker et al. 2017, p. 9).

INTERCROPPING

"The agricultural practice of cultivating two or more crops in the same space at the same time" (Lithourgidis 2011, p. 396). Intercropping uses crops, "of different rooting ability, canopy structure, height, and nutrient requirements based on the complementary utilization of growth resources by the component crops," in order to increase the use of the land (Lithourgidis 2011, p. 396).

LANDSCAPE ARCHITECTURE

The art and science of designing outdoor space, together with the materials and objects within it, to achieve environmental, economic, social, and aesthetic outcomes (Jellicoe 1975, Newton 1971, Calkins 2015).

METHOD

The specific strategy used to quantify information for assessment. Examples include soil studies, demographics data from the U.S. Census Bureau, visitor surveys, or direct visual assessment. (Canfield et. al. 2018).

METRIC

A type of data or information that serves as a descriptor for understanding the benefits of a site design element or practice. Examples include improved soil fertility, number of permanent jobs created, perception of safety, or increased number of seating elements. (Canfield et. al. 2018).

MULTIFUNCTIONAL LANDSCAPES

Landscapes that meet multiple goals and provide multiple functions. These landscapes are generally more desirable than traditional single-purpose landscapes. Multifunctional landscape designs are often based on the multifunctionality of natural systems and can be used to save space and energy in urban environments (Kato and Ahern 2009).

MULTI-PROGRAMMATIC LANDSCAPES

Landscapes that include multiple programming types. This can include playgrounds, sports fields, community gardens, trail systems, etc. but is often limited to activity-oriented elements.

NO-TILL AGRICULTURE

"A conservation farming system, in which seeds are placed into otherwise untilled soil by opening a narrow slot, trench, or hole of only sufficient width and depth to obtain proper seed placement and coverage" (Ruisi et al. 2016, p. 51).

ORGANIC AGRICULTURE

Organic agriculture is a production system which avoids or excludes the use of synthetic compounds for crop nutrition, pest, disease, or weed control and often also excludes genetically modified cultivars (Connor 2008, Youngberg and DeMuth 2013).

PERENNIAL AGRICULTURE

Crops that, like many natural ecosystems, do not need to be replanted annually.

PERI-URBAN AGRICULTURE

Agriculture occurring on the urban-rural fringe, or within peripheral low-density suburban areas. It is similar to urban agriculture though the sizes of lots are often larger. Peri-urban agriculture is often based on temporary use of vacant lands (in contrast to urban agriculture which typically is a more permanent feature). (Viljoen et al. 2012, Veenhuizen 2005)

PERI-URBAN AREAS

The, "open lands and farmlands surrounding cities that are subject to commercial or housing development because of urban expansion and city growth pressures" (Hansen and Francis 2007, p. 43).

POLYCULTURE AGRICULTURE

"Growing multiple crops or cover crops in the same space at the same time…" (Duiker et al. 2017, p. 25).

RESILIENCY

The ability to recover from or adjust to adversity or change. In the landscape, long-term resiliency is often sought by working with nature to adapt to climatic and community changes (Lister 2016, Merriam-Webster 2019, Professional Practice: Resilient Design 2019)

SOIL

Scientifically speaking, soil is the, "granular matter which forms the skin of a great part of the planet, and in which vegetables grow…" (Hyams 1952, p. 17) or, "the weathered, and biologically altered, upper part of the regolith" (Marsh 1964 p. 276). However, "to a farmer or landscape architect, the soil is the part of the surface of the earth with supports the growth of plants. The soil is a variable mixture of weathered rock fragments, minerals, and decomposing and living organic matter, generally arranged in distinct layers or horizons" (Marsh 1964, p. 276).

SOIL EROSION

"The physical wearing away of the land surface by running water, wind, or ice. Soil or rock is initially detached by falling water, running water, wind, ice, or freezing conditions, or gravity…" (Keefer 2000, p. 53). Put most simply, soil erosion is the relocation of the topsoil involving soil loosening, transportation, and deposition that takes place when soil is left bare to the elements (Isaaka and Ashraf 2017). Ultimately, the erosion process moves these soil particles from the parent material to a deep body of water downstream from its original source. Although the exact dimensions of this process are unknown, the sediment's movement results in both beneficial and adverse effects (Taylor 1987).

SOIL HEALTH

"The continued capacity of soil to function as a living ecosystem that sustains plants, animals, and humans" (Duiker et al. 2017, p. 1).

SOIL ORGANIC MATTER

"…a complex, heterogeneous mixture of plant and animal remains in various stages of decay, microbial cells… microbially synthesized compounds, and derivatives of all of the above through microbial activity" (Keefer 2000, p. 183).

SUSTAINABILITY

A process that can be maintained (including harvest, pollution creation, resource depletion) at a rate that can be continued indefinitely. Sustainable systems meet the needs of present generations without compromising the ability of future generations to meet theirs (Calkins 2015, UCLA 2019, USDA 2007).

SUSTAINABLE AGRICULTURE

Sustainable agricultural practices allow for a sustained level of production of food, fiber or protein, while building and maintaining a healthy soil system. The goal of these practices is to minimize adverse effects to surrounding ecosystems and to achieve long-term stability of the agricultural enterprise, environmental protection, and consumer safety (McDonnell 2011; Powlson et al. 2011).

TILLAGE

"Tillage is defined as the mechanical manipulation of the soil for the purpose of crop production affecting significantly the soil characteristics such as soil water conservation, soil temperature, infiltration and evapotranspiration processes" (Busari et al. 2015, p. 119).

URBAN AGRICULTURE

Agriculture that occurs within close proximity to a town, city or a metropolis, which grows, raises, processes, and distributes a diversity of food to that urban area. This food can be in the form of fruits, vegetables or livestock and can be developed to include fish production. Urban agriculture is generally characterized by closeness to markets, high competition for land, limited space, use of urban resources such as organic solid wastes and wastewater, low degree of farmer organization, mainly perishable products, and a high degree of specialization. (Viljoen et al. 2012, McDonnell 2011, Veenhuizen 2005)

APPENDIX B

PROJECT SCHEDULE + TIMELINE

The development of the master's project timeline was critical to establish at the earliest phase of the process. The original, two-semester, timeline was adjusted slightly as the academic year continued to allow for variations in project goals and results. An additional timeline was created for the spring semester at the end of the fall semester. Creating these timelines helped in the overall project organization and made communication between the author and major professor easier. The timelines allowed for a greater degree of planning and understanding of the project schedule. Key deadlines were noted on the timeline throughout the year regarding submittal dates, reviews, and life events. The schedules broke the project process down into phases including topic selection, initial research and literature review, report proposal, case study research, design development, and final report submittal.

Figure A.01
Two semester project timeline from Fall 2019

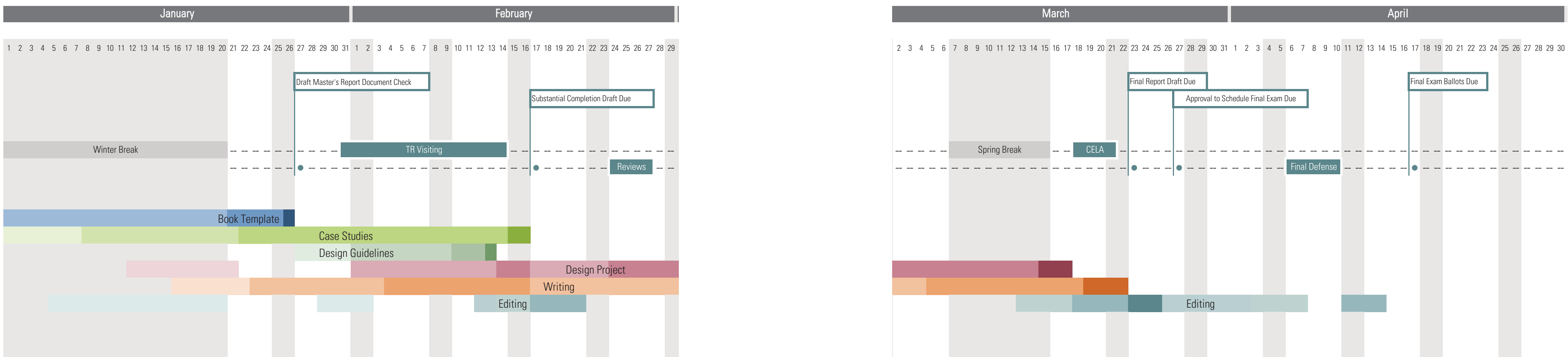


Figure A.02
One semester
project timeline
from Spring
2020

APPENDIX C

PILOT STUDY

During the Fall 2019 semester, a pilot study was performed to analyze and understand leaders within the fields of landscape architecture and sustainable agriculture. Though not exhaustive, the research identified professionals, firms, and non-profit organizations from published work, award-winning design projects, and features in online and/or journal articles. Selected individuals and organizations were studied according to design practices, built work, and collaborative experience. The study utilized online and print media research and analysis of built work and results in the selection of a series of cases. This assessment served as a basis for the case studies completed in this master's report. The following selection of professionals, firms, and non-profit organizations are located across the United States and are renowned as current or past leaders in the fields of landscape architecture and sustainable agriculture.

PROFESSIONALS

Professionals provide a better understanding of how leaders in landscape architecture work in multidisciplinary environments. The selected individuals are located on either side of the country with Bob Snieckus and Elizabeth Meyer on the East Coast and Kristina Hill and Mia Lehrer on the West Coast. The professionals are all licensed landscape architects with one working for the U.S. government, one owning and operating a landscape architecture studio, and two more teaching at well-regarded universities.

Professionals were selected based upon previous research and recommendations. They were primarily determined through their published work and featured interviews in online articles or with the American Society of Landscape Architects. Individuals in this research had to meet the following criteria.

1. Have experience working in interdisciplinary environments
2. Have been recognized as a leader in their fields by other professionals or professional society
3. Have experience with community engagement and community driven design projects

BOB SNIECKUS

Bob Snieckus has degrees from Rutgers University, Harvard University, the USDA Graduate School, and California State University. As a registered landscape architect, he was elected to the ASLA Council of Fellows in 2011 (ASLA Fellows Database 2019). Formerly the National Landscape Architect for the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), Bob Snieckus is passionate about public education within the governmental organization and served as a strong promoter of “The People’s Garden” (Hayden-Smith 2016). Snieckus worked within the Conservation Engineering Staff in Washington D.C., an agency with a strong environmental focus. Snieckus worked at a variety of scales, from the protection of infrastructure and improvement of wildlife habitats to the design of recreation trails and historic landscape restoration (Hayden-Smith 2016). Snieckus, a long proponent of environmental stewardship among the agricultural community once said, “I love that farmers have a strong sense of stewardship about their land. They are proud of the food and fiber they produce and how well their farms look on the landscape. NRCS makes sure that our designs not only solve environmental problems, but that they complement the farm and surrounding landscape” (Hayden-Smith 2016).

The People’s Garden, a sustainable agriculture and community garden in Washington D.C. was shut down in 2017 and has been adjusted and reopened as an example for new technologies and genetically modified crops (Beyond Pesticides 2019). Snieckus no longer works for the NRCS and his position as National Landscape Architect has not been filled.

KRISTINA HILL

Kristina Hill is an associate professor at the University of California, Berkeley where she studies urban ecology and hydrology while considering physical design and social justice issues. Hill received both her MLA and her Ph.D. from Harvard University and uses much of her time researching adaptation and coastal design strategies (UC Berkeley n.d.). As a scholar of urban design based on ecological and geomorphological research, Hill focuses on biodiversity, new development approaches and social justice (Nature of Cities n.d.). Hill’s research often includes an increased understanding of new technologies used for coastal protection, and infrastructure in urban districts. This technology works hand-in-hand with her work in ecology, biodiversity, and the environment (Landscape as Necessity n.d.).

Hill’s work in ecology-oriented design may not be directly related to the agricultural landscapes that other designers work within, but her cutting-edge thinking on the importance of natural environments, multidisciplinary collaboration, and solutions to larger climatic problems is critical for the future of landscape architecture and sustainable agriculture.

ELIZABETH MEYER

Elizabeth Meyer works as a professor at the University of Virginia teaching landscape architecture as a socio-ecological spatial practice (“Beth Meyer” n.d.). Formerly the Chair of the Department of Landscape Architecture and the Dean of the School of Architecture, she holds degrees from the University of Virginia and Cornell. Meyer has worked with the U.S. Commission of Fine Arts since 2012 and has engaged nationally as a lecturer and author of landscape design practice and theory (CFA n.d.). Meyer has produced a substantial body of written work on landscape design theory grounded in contemporary cultural issues and challenging conventional design practices separating aesthetics and sustainability. Her work argues the value of multifunctional landscape design and she is a leader in understanding how sustainability, community, culture, and aesthetics all play a critical role in the design of the modern landscape ("Beth Meyer" n.d.). As evidence of her continued work in multidisciplinary environments, Meyer founded the Center for Cultural Landscapes at UVA, a research and teaching community combining the environmental humanities, biological sciences, law, and design and planning.

Meyer has been widely recognized as one of the most influential landscape architecture theorists in the country and her positions as a Fellow of the American Society of Landscape Architects and the Council of Educators in Landscape Architecture show that. Alongside these honors, Meyer has given lectures around the world and participated as a jury member for multiple national design competitions ("Beth Meyer" n.d.). Through her collaboration with a variety of fields professionals, Elizabeth Meyer was able to revolutionize landscape architecture theory and design strategies, teaching young professionals every step of the way.

MIA LEHRER

Founder of Mia Lehrer + Associates, now Studio-MLA, Mia Lehrer is a leader in design and advocacy in landscape architecture (Studio-MLA 2019). Now a Fellow of the American Society of Landscape Architects, Lehrer's work began with residential gardens and has transitioned to large-scale community improvement projects with an emphasis on connecting people to the natural environment, offering places for meaningful recreation, reflection, and exploration (Breyer 2018). Lehrer has spent her professional career as an advocate and in 2011 she co-authored the article, *Urban Agriculture: Practices to Improve Cities*, with Maya Dunne. The article points out the necessity for designers, government officials, and citizens to think proactively about food and its environmental cost. The authors write of the benefits of urban agriculture in the form of backyard and community gardening, or broader system responses (Lehrer and Dunne 2011). Lehrer's work always celebrates the culture of a place, and for the Orange County Great Park, a 1,300-acre park now in development in California, agriculture is celebrated. The park design features 200 acres of agricultural land allowing for educational and production opportunities (Green n.d.).

Lehrer's work with communities and her writings on the importance of agriculture in landscape architecture are key to her being selected for this study. Lehrer is a prime example of a landscape architect that, though she may not design agricultural landscapes, understands and supports the integration of the two disciplines.

FIRMS AND COMPANIES

Landscape architecture, planning, and consulting firms around the country are working with communities to design multifunctional outdoor environments. The selected firms are located on either side of the country with Nelson Byrd Woltz Landscape Architects in Virginia and Cultivate Studio and Farmer D Consulting based in California. Work from the firms is spread across the country and the globe.

Firms and companies were selected based upon previous research and recommendations. They were primarily determined through their engagement with the American Society of Landscape Architects and award-winning projects. Firms in this research had to meet the following criteria.

1. Have experience working in interdisciplinary environments
2. Have projects that include both multifunctional landscapes and agricultural environments
3. Work in both urban and rural environments

NELSON BYRD WOLTZ LANDSCAPE ARCHITECTS

Nelson Byrd Woltz Landscape Architects is a multidisciplinary landscape architecture firm based out of Charlottesville, Virginia with additional offices in New York and Houston. Committed to design excellence, education, and conservation, the firm works on public and private projects including, but not limited to, public parks, memorial landscapes, corporate campuses, botanic gardens, and residential farms. The firm's divers staff backgrounds include the fields of landscape architecture, architecture, biology, economics, philosophy, horticulture, history, art, and zoology (NBWLA 2019.). In addition to a consistent goal of sustainable design and conservation, the firm also features a conservation agriculture studio. The studio brings together landowners, conservation biologists, landscape ecologists, soil scientists, and farm managers and, "demonstrates the expanded contribution that landscape architects can make to the protection of rural cultural landscapes" (Meyer 2013, p. 172), and works across disciplines to create frameworks that combine the protection of ecosystems with the production of crops. Designing beautiful and ecologically healthy places, the studio acts as a catalyst for the conservation of multifunctional agricultural landscapes (NBWLA 2019.).

Winner of a 2018 Virginia ASLA Merit Award for Analysis and Planning, as well as a SCUP Special Citation for Excellence in Planning for a New Campus, Lone Oaks Farm was completed as a partnership with the University of Tennessee Institute of Agriculture. Located in Middleton, Tennessee, the farm includes 1,200 acres of pasture, woodlands, trails, and lakes. The design of this working farm provides opportunity for sustainable growth, conservation of the natural landscape, and key programming elements for youth education, agriculture, and hospitality (NBWLA 2019.). Today, Lone Oaks Farm is administered by the University of Tennessee Extension offices and works closely with local 4-H groups (Lone Oaks Farm 2015).

Nelson Byrd Woltz Landscape Architects are one of the few landscape architecture firms leading the way to a greater degree of integration and collaboration with the sciences. Their work on integrating ecologists into their studios and ensuring landscapes are conserved in their design projects makes them one of the leading firms for sustainable agricultural landscape design.

CULTIVATE STUDIO

Cultivate Studio is a landscape architecture and conservation planning firm based out of San Francisco, California. This 4-person firm specializes in innovative design and conservation tools and looks holistically at land stewardship across public and private projects. The firm advocates for breaking down the segregation of land uses that often lead to sprawl and reintegrating our built landscape in new, innovative way. (Cultivating n.d.). Founded by Amie MacPhee in 2011, the firm specializes in consulting, collaborating, and communicating with clients and other professionals. Cultivate Studio supports an ongoing pursuit of knowledge and conducts research leading to innovative planning solutions and policies (Cultivating n.d.). The firm does a lot of work with agricultural landscapes and offers solutions for agricultural economic development, conservation programs, and sustainable land uses.

One of their many projects, the Santa Clara Valley Agricultural Plan had five main goals including, 1) mapping and prioritizing agricultural lands for conservation, 2) identifying regional greenhouse gas reduction potential of agricultural protection, 3) bringing the county, municipalities, and agricultural communities together to work for agricultural preservation, 4) revising the county zoning ordinance for additional agricultural preservation, and 5) blueprinting a regional agricultural conservation easement program (Cultivating n.d.).

Cultivate Studio's work is making large strides in southern California to make sustainable agriculture a key component of landscape architecture and environmental design. Their projects are a combination of the science of agriculture and the aesthetics of design, with a deep consideration for the economy of local communities.

FARMER D CONSULTING

Farmer D Consulting is a nationally recognized company based out of Encinitas, CA and founded by Daron Joffe. Author of, *Citizen Farmers: The Biodynamic Way to Grow Healthy Food, Build Thriving Communities, and Give Back to the Earth*, Joffe has spent the past 20 years as a designer, speaker, farmer, educator, and entrepreneur. The consulting firm has worked on projects ranging from residential agricultural neighborhoods to non-profit camps and youth farms. The list of project types includes, but is not limited to, master planned communities, resorts and retreats, city parks, senior centers, schools and universities, corporate campuses, private estates, camps and community centers, and prisons. This broad array of work acts as an example of the wide range agriculture can play in the design and development of open space (Farmer D Consulting 2019).

The consulting firm has worked on projects across the country including Honeywood Farms in Barnesville, GA. Designed in 2012, this permaculture showcase education farm is a 20-acre piece of a conventional cattle operation and is a certified organic farm including a market garden, orchards, food forest, permaculture gardens, retail store, café, and events barn. This multifunctional landscape is part of a family legacy of land stewardship and sustainable farming focused on education and community (Farmer D Consulting 2019).

As an agricultural consulting firm, Farmer D Consulting and Daron Joffe have made large strides in connecting the gap between landscape architecture and sustainable agriculture. Giving lectures across the country on designing agricultural landscapes, Joffe has paved the way for his firm and others to make an impact on local communities.

NON-PROFIT ORGANIZATIONS

Non-profit organizations are the most common owners and operators of successful urban farms. Paid for by farm income, research grants, and outside donations, these working farms, consulting agencies, and research institutions are all in search of the same thing: a better way to grow our food and support our communities. The selected non-profit organizations are located across the country with an emphasis on the Midwest. SAGE is based out of southern California, the Land Institute in Kansas, GrowTown in Michigan, and Growing Power in Wisconsin. Each organization has supporters and partners around the world.

Organizations were selected based upon previous research and recommendations. They were primarily determined from highlights in journal articles, recommendations from professionals, and built work. Organizations in this report had to meet the following criteria.

1. Have experience working in agricultural landscapes
2. Be listed as a non-profit organization according to the U.S. government
3. Be recognized as a leader in the field
4. Have experience working in multidisciplinary environments

SAGE

The Sustainable Agriculture Education (SAGE) program began in 2001 in southern California. This non-profit organization works to foster healthy food systems, revitalize urban-fringe agriculture, and connect urban communities with the people that grow their food. The organization collaborates with a wide variety of people to develop projects in the Bay Area (SAGE 2015). SAGE works closely with two linked programs, Urban-Edge Agricultural Revitalization, and Urban-Rural Connections. The goals of all three organizations are to cultivate urban-edge places with sustainable agriculture integrated within resilient communities while broadening the community of supporters for peri-urban farming (SAGE 2015). The non-profit organization partners with public agencies, land trusts, farmers, planning and economic consulting firms, public interest organizations, educators, health experts, and urban and rural community groups.

Most of the work completed by the firm is located in the Bay Area though many of their consulting or planning practices could be adopted at various scales and applied to different regions. Specializing in the design and development of agricultural parks, their work is based on an innovative, scalable model that facilitates land access and technical assistance for multiple farmers, providing fresh food and educational opportunities for nearby communities. The model is used throughout the U.S. and Europe and would be a good model to utilize in my own design project. SAGE's work has helped pave the way for for-profit design firms and professionals of all disciplines to work with communities and develop local farming opportunities across California.

One of the organizations featured projects is the Sunol Water Temple Agricultural Park, a collaborative farm providing land access and technical assistance for beginning farmers, public education, and natural resources stewardship. This 20-acre property was developed in partnership with the San Francisco Public Utilities Commission and the Alameda Resource Conservation District. Today, the project is a thriving peri-urban farm and produces fresh food for local markets, community events, and educational field trips for local low-income schools and communities.

THE LAND INSTITUTE

The Land Institute is a research based agricultural organization based out of Salina, Kansas working to develop polycultural and perennial farming solutions. Founded in 1976 by Wes Jackson, the organization is committed to researching and developing agricultural production methods that sustain the land and the soil. Led by a team of plant breeders and ecologists, the Land Institute is focused on developing perennial grains to be grown in perennial polyculture farms. The goal of the organization is to create an agricultural system that mimics natural systems, producing ample food and reducing the negative impacts of conventional agriculture (Land Institute 2019). The institute hopes to, "[change] the way the world grows its food"

(Land Institute 2019). With research partners in 41 locations around the world including the U.S., Canada, Mexico, South America, Europe, the Middle East, Africa, Asia, and Australia (Land Institute 2019), the institute is quickly changing the face of sustainable agriculture. Much of the work done by the organization is research, and the institute regularly publishes journal articles with new findings.

The Land Institute is a good example of how research institutions can play a critical role in the development of new sustainable agricultural solutions. The organization's work with researchers and collaborators around the world means that despite its small beginnings in rural Kansas, the Land Institute is changing the world.

GROWTOWN

GrowTown is a non-profit landscape architecture studio founded in 2009 in Detroit, Michigan (IRS 2019). The organization is dedicated to transforming the landscapes and neighborhoods of post-industrial cities and uses grassroots community organizations as catalysts for resilient and sustainable neighborhoods. The firm was founded by Kenneth Weikal and Beth Hagenbuch and uses neighborhood analysis, planning, and a set of low-cost solutions to harness positive community energy and work to design and develop improvements in low-income neighborhoods (GrowTown 2019).

One of the most well-known projects of the firm is the Penrose market garden. This stage of a larger community plan is a step in growing the neighborhood into a profitable garden district. The neighborhood covers approximately 200 acres and 335 homes, with about 10% of them vacant. The area GrowTown focuses on is a 30-acre housing community, called Penrose Village. GrowTown has worked with other non-profit foundations, housing developers, and local school groups (GrowTown 2019). This collection of stakeholders designed a preliminary neighborhood framework that envisioned the possibilities for a larger park, a Four-Season Market Farm, community gardens, natural playgrounds, and affordable housing. The market garden itself is a half-acre entrepreneurial garden integrated into the Penrose neighborhood. The project includes a community building and is associated with the Penrose Art House and garden educational programs for the youth. The financially viable and replicable garden uses Small Plot Intensive SPIN-Farming and has been documented to generate more than $65,000 per ½ acre (GrowTown 2019).

GrowTown acts as a good example of landscape architecture in a non-profit environment and their work with local partners contributes to multifunctional and interdisciplinary design throughout the communities they serve. Employees are landscapes architects with specialties in land planning, affordable housing, and industrial design and their advisory board includes men with specialties in microeconomics, organic farming and horticulture, financial management, architecture, and watershed resource management (GrowTown 2019).

GROWING POWER

Founded in the mid-1990s by former professional athlete Will Allen, Growing Power was once a world-renowned urban agriculture organization. In 2018, amid legal troubles, it was shut down. Prior to its demise the organization was renowned worldwide as a leader in underserved community engagement and sustainable agriculture (Satterfield 2018). In 2008 Allen won the MacArthur Genius Award and with the help of the half-million-dollar prize and media attention, he was able to expand the organization from a staff of a dozen to almost 200 people. Educational and urban farming programs spread throughout the region with leadership programs, hands-on workshops, and job training opportunities. Despite the foundation's successes, high operating costs required continual funding and scrutiny arose as to the origins of said funding. Eventually, despite its founder's passion and dedication, the organization collapsed (Satterfield 2018).

The causes of the organization's downfall are arguable however two themes seem to be repeated: the lack of collaboration, and the need for more financial oversight. Growing Power had many lofty goals that proved to be too much for one organization to take on. Instead of acting as a partner to other organizations with similar goals, it tried to do everything, and failed. Alongside these lofty goals were lofty price tags, and despite the outside funding the organization received, its expensive training programs and facilities proved too much (Satterfield 2018). Although Growing Power was dissolved, its mission of empowering vulnerable communities to learn and grow was successful and other non-profit organizations will always be able to learn from its successes and failures.

SUMMARY

The relationship between landscape architecture and sustainable agriculture is deeply related to the men and women who practice it. This pilot study worked to identify some of the leaders in the design and implementation of multifunctional and sustainable agricultural landscapes. The research utilized published work, award-winning design projects, and online and print media research in order to select and research design professionals, firms, companies, and non-profit organizations. Through this research a series of case studies were collected that can be reintroduced to the larger master's report for further analysis. These case studies are located across the country and include the Penrose Neighborhood and market garden in Detroit, MI (done by GrowTown), Greensgrow Farms in Philadelphia, PA (written about by Mia Lehrer), Honeywood Farms in Georgia (from Farmer D Consulting), Lone Oak Farm in Tennessee (from Nelson Byrd Woltz Landscape Architects), and Sunol Water Temple Agricultural Park in San Francisco, CA (done by SAGE).

The individuals in this pilot study offer an array of examples of successful multidisciplinary collaboration, multifunctional landscape design, and sustainable agricultural environments. Upon the completion of this study it is possible to more fully understand the benefits of professional collaboration, funding opportunities, research, and sustainable development. However, not all of the studied projects and organizations were successful. Growing Power, the non-profit urban agriculture organization out of Wisconsin collapsed due to impending legal trouble and the People's Garden from the USDA was shutdown amidst changing government leaders and goals. When designing future projects, it will be important to consider both the successful and unsuccessful past examples.

APPENDIX D

IMAGE PERMISSIONS

All images used in the report were either done by the author or were free to use under Creative Commons with the exception of two images. Photographs of the Lone Oaks Farm and Grow Dat Youth Farm were provided as a courtesy of the property owners. Lone Oaks Farm photo permission was given via email from Ron Blair the Farm and S.T.E.M Director at Lone Oaks Farm. Grow Dat Youth Farm photo permissions were given via email from Emilie Taylor Welty, the Assistant Director of Design Build at the Small Center and one of the team members for the Grow Dat Youth Farm design build project at Tulane University.