

RESILIENCE IN URBAN CIVIC SPACES

GUIDELINES FOR DESIGNING RESILIENT SOCIAL-ECOLOGICAL SYSTEMS

BY

GRETCHEN GRAVENSTEIN

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Approved by:
Major Professor
Blake Belanger

Resilience in Urban Civic Spaces: Guidelines for Designing Resilient Social-Ecological Systems

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Report Committee:

Blake Belanger, Associate Professor

Dept. of Landscape Architecture/Regional and Community Planning

Dr. Timothy Keane, Professor

Dept. of Landscape Architecture/Regional and Community Planning

Dr. Kendra McLauchlan, Associate Professor

Dept. of Geography

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Abstract

Resilience in social-ecological systems, defined by ecologist C.S. Holling (1973), is the persistence of systems after a disturbance. This theory of resilience is becoming increasingly important, especially in urban areas where human systems dominate. Therefore, creating resilient social-ecological systems is emerging as a focus for many landscape architects when designing urban landscapes. Researchers and practitioners have created frameworks and strategies for applying resilience theory, but designers are still lacking tangible methods they can use to implement design strategies to create resilient landscapes. This research presents a set of resilient design strategies, so landscape architects can have a tool to design generally resilient social-ecological systems in urban areas. In order to discover strategies which improve system resilience, I conducted a literature review and created a perceptual model of the social-ecological systems operating in the study site, Washington Square Park in Kansas City, Missouri. The perceptual model determined systems and system components I focused on in this research. These systems

are soil, water, vegetation, fauna, and people. Strategies suggested by Jack Ahern (2011), Brian Walker and David Salt (2006), and Kevin Cunningham (2013) for creating resilience determined strategies which were applied to the system components in order to evaluate the park for resilience. The strategies suggested are modularity, redundancy, tight feedbacks, and ecosystem services. In addition, the system components and strategies were used to analyze case studies. I used strategies discovered in the case study analyses along with goals for the redesign of Washington Square Park, discovered by analyzing the site and previous park documents, to create the guidelines. I then used the guidelines to create a design proposal for the park. The current state of the system components in the park and the proposed state from the redesign were used to show the guidelines' success in increasing the general resilience of Washington Square Park. These guidelines have potential to increase resilience in other urban civic spaces through a similar methodology I used for Washington Square Park. In addition, the guidelines have the potential to further research in applying resilience theory to the design of landscapes.

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Introduction

Growing urban areas have struggled with rapid urbanization and its ability to coincide with natural systems. Infrastructure built in cities has severely altered the ecological systems which existed before urbanization. However, as human systems replace ecological functions, ecosystems reach a threshold of collapse (Alberti 2008, 22). Marina Alberti argues in *Advances in Urban Ecology* (2008) that crossing thresholds will inhibit systems from supporting human settlement. Brian Walker and David Salt in *Resilience Thinking* (2006) define thresholds as “crossing points that have the potential to alter the future of many of the systems that we depend on” (Walker and Salt 2006, 53). Crossing a threshold means that a system behaves in a different manner (Walker and Salt 2006, 53). Rockström et. al. in

Planetary Boundaries: Exploring the Safe Operating Space for Humanity (2009) argue that three critical global thresholds have already been crossed because of anthropomorphic changes to ecosystems. These thresholds are climate change, rate of biodiversity loss, and the nitrogen cycle (anthropomorphic actions convert nitrogen to reactive nitrogen which usually ends up polluting the atmosphere and water ways) (Rockström et. al. 2009, 13).

In order to prevent ecological as well as social systems from crossing thresholds, ecologists, researchers, and designers, such as C.S. Holling, Jack Ahern, Brian Walker and David Salt, and Kevin Cunningham, argue that social and ecological systems need to exhibit resilience. Resilience is defined by C.S. Holling as “the persistence of

relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist” (Holling 1973, 17). Holling’s theory of resilience differs from stability which he defines as “the ability of a system to return to an equilibrium state after a temporary disturbance” (Holling 1973, 17). The understanding of resilience for this report is that resilience allows systems to self-organize after disturbances, so systems can still persist after a disturbance. Jack Ahern says resilience allows systems to be “safe-to-fail” instead of “fail-safe” or maintaining a stable equilibrium which makes a system highly susceptible to a disturbance (Ahern 2011, 342).

Resilience theory, however, exists mostly as an idea with only a few applications to designed systems. This study examines how resilience theory can be further developed so that resilient strategies can be implemented in designed landscapes. The focus of this research is to create strategies so landscape architects can design social and ecological systems in landscapes to be more generally resilient.

Washington Square Park in Kansas City, Missouri is the site selected to implement and test strategies for creating resilience discovered in this research. Washington Square Park is a city-owned park located in the greater downtown area of Kansas City in the center of the popular Crossroads district and Crown Center mall, Union Station, and other commercial developments. The Kansas City

Downtown Council and the Kansas City Parks and Recreation Department (KC Parks) are heading the project to redesign the park. KC Parks has distributed money from a city grant to the major consultant on the project, Coen+Partners, a landscape architecture firm, as well as other student consultants from Kansas City Design Center and Kansas State University in Manhattan, Kansas.

As a master's of landscape architecture student at Kansas State University, I am researching strategies for designing for resilience to redesign Washington Square Park to be resilient (Figure 1.1). How can resilient strategies be implemented in social-ecological systems in Washington Square Park to create a resilient landscape? Can strategies which create resilient systems in Washington Square

Park be adapted to create resilience in other urban civic spaces?

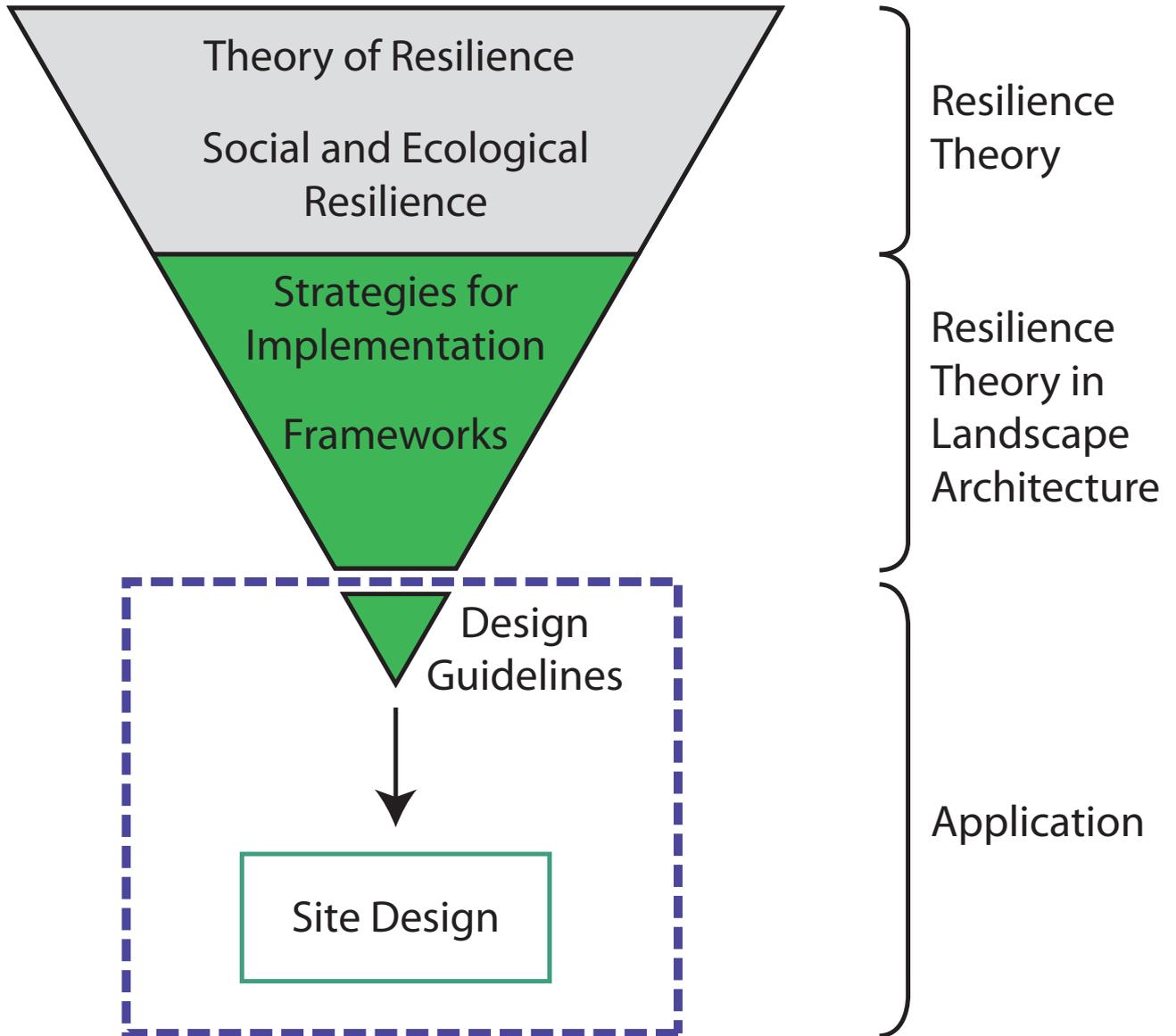
In order to discover strategies for designing resilience, I have researched previous works on resilience theory, created a perceptual model of social-ecological systems operating in Washington Square Park, conducted a site and goal analysis for the park, and have analyzed previously suggested strategies and case studies which exhibit resilience. These research methods have allowed me to create a set of guidelines so landscape architects can easily apply resilient strategies to urban civic spaces. I have then demonstrated the use of the guidelines through a design proposal of Washington Square Park. Diagrams and metric calculations of the design proposal have allowed me to determine if

the general resilience of social-ecological systems currently operating in Washington Square Park have improved with the use of the guidelines.

This report outlines the background and dilemma, methodology, literature review, guideline development, design proposal, and conclusions and findings of my research. The background and dilemma section defines and examines resilience theory and the need for more research on the application of resilience theory in design. The methodology section reviews the methods used for conducting research and creating design guidelines. The literature review describes the literature researched in this report and authors' texts which suggest strategies for creating resilience. The guideline development chapter includes the site analysis, goal analysis, and case study and strategy analyses conducted to create the guidelines. The design proposal section exhibits the proposed design I created based on the guidelines. Finally, the conclusions and findings section shows the change in resilience the design proposal will cause systems in Washington Square Park.

Figure 1.1: Philosophy

This research narrows resilience from being a theory to being a design strategy. I have created a set of guidelines from previous research and case study analyses so practitioners can actually apply the theory to landscape designs.







Background and Dilemma

Resilience Theory

Ecologist C.S. Holling first introduced his idea of resilience theory in 1973 in *Resilience and Stability of Ecological Systems*. The theory developed from global environmental changes and a need to understand the role of change in systems (Gunderson and Holling 2001, 5). Changes in systems are economic, ecological, social, and evolutionary and can be gradual or episodic, local or global (Gunderson and Holling 2001, 5). Changes which affect the behavior of systems are often random and extreme and, as Holling argues, systems should exhibit resilience to prevent these behavioral changes from pushing a system across a threshold (Holling 1973, 36). Holling's definition of resilience used in this report is "the persistence of relationships within a system and is a

measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist" (Holling 1973, 41).

Holling says resilience exists within systems which have low stability. He defines stability as a system with least fluctuation, striving for an equilibrium (Holling 1973, 42). Therefore, resilience allows systems to fluctuate and still persist. Nina-Marie Lister argues in *A Systems Approach to Biodiversity Conservation Planning* (1997) that resilience theory negates conventional science based on order, stability, and predictability in nature. She says resilience is a post-normal science formulated in the idea of nonlinearity, uncertainty, and self-organization (Lister 1997, 129).

Authors Brian Walker and David Salt have adopted Holling's theory of resilience and have attempted to apply the theory to real systems. Walker and Salt argue that resilience goes beyond the idea of "sustainability." Sustainability, formulated in the 1980's (van der Leeuw and Aschan 2000, 5), strives for efficient use of resources and for an optimal state a system should operate in (Walker and Salt 2006, 9). Walker and Salt say attempting to maintain an "optimal state" actually reduces systems' abilities to withstand disturbances and reduces their resilience. For example, parts and supplies are delivered to a factory right when they are needed which is efficient and optimal. However, this system is very susceptible to disturbances which can lead to supply shortages for the factory (Walker and Salt 2006, 9).

In addition, many sustainable practices isolate one system within a landscape or one function within a system. All functions and systems interact with each other over a varying degree of scales. Resilience accounts for this global and multi-scale operation of systems which is lacking in sustainability theories.

Complex adaptive systems have the potential to exhibit resilience. These systems include social, ecological, and economic systems. Complex adaptive systems are unpredictable, nonlinear, and can exist in multiple regimes (Walker and Salt 2006, 31).

One of the significant relationships of complex adaptive systems and the focus of this research are social-ecological systems. Walker and Salt define social-ecological systems as "linked systems of people and nature" (Walker and Salt 2012, 215). Marina Alberti in *Advances in Urban Ecology* (2008) says that many previous models of systems explored human's effects on ecological processes, but many recent models focus on how social and ecological systems are linked and function together within urban ecosystems. This report uses the term "social-ecological systems" to represent the linked functions and coexistence of people and natural systems in landscapes. Resilience of social-ecological systems is explored in this research because of the significant relationships people and ecological functions have with each other and the significance of these systems functioning within urban areas.

Basins of Attraction

Holling defines resilience as systems' abilities to persist through changes (Holling 1973, 36). In other words, resilience prevents systems from crossing thresholds. A metaphor often used to describe thresholds is a ball moving inside a basin. The ball is a state of a social-ecological system and the basin is a set of states with similar functions and feedbacks (Walker and Salt 2006, 54). Feedbacks are secondary effects of an act of one variable on another (Walker and Salt 2006, 164). For example, increased deforestation has a feedback of increased carbon dioxide in the atmosphere.

When a system produces the same feedbacks, the system, or the ball, is striving for some state of equilibrium, or the bottom of the basin (Figure 2.1). For example, a lake system is a ball which strives for the bottom of a basin which represents low phosphorous levels in the water. However, systems constantly adapt, so the lake is continuously moving around the bottom of the basin. In addition, the shape of the basin is continually changing because of external change affecting the variables acting on the system (Walker and Salt 2006, 54).

If a system's dynamics are altered, like more phosphorous is drained into the lake, the system's feedbacks change, like more algae is formed in the lake. As this change occurs, the system begins to move farther from the bottom of the basin and closer to the edge of the basin. This edge is called a threshold. If a system crosses a threshold, it moves into another basin of attraction with a different structure and function. For example, increased phosphorous levels in the lake further push the system closer to the edge of the low algae and clear state basin. The lake can then be easily pushed across the edge and into a high algae and murky basin. This event could have important positive or negative consequences on society (Walker and Salt 2006, 55).

Adaptive Cycle

C.S. Holling and Lance Gunderson outline in *Panarchy: Understanding Transformations in Human and Natural Systems* (2001) phases within a recurring cycle they believe systems move through. The Adaptive Cycle, further defined by Walker and Salt (2006), "describes how an ecosystem organizes itself and how it responds

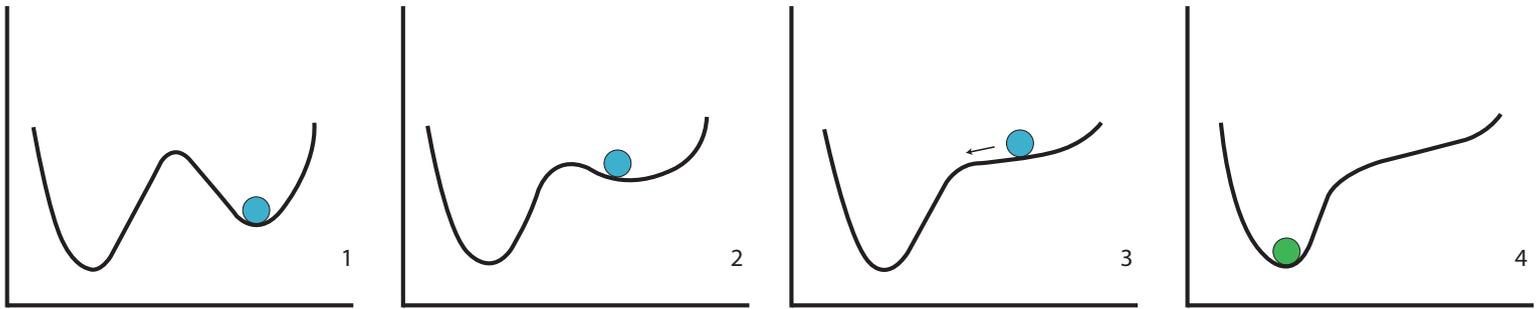


Figure 2.1: Basins of Attraction Model for a Lake Ecosystem Changing Over Time with Continued Phosphorus Inputs

(1) A lake system remains in a basin with a feedback of low phosphorus levels in the mud. (2) As phosphorus levels increase, the basin flattens and the lake becomes more vulnerable to a disturbance, such as a rain event which would dramatically increase phosphorus levels. (3) If a disturbance occurs or phosphorus levels continue to increase, the lake is pushed into a new basin. (4) The new basin creates feedbacks of murkiness because of the high phosphorus levels in the lake.

Adapted from Holling (1973), Walker and Salt (2006)

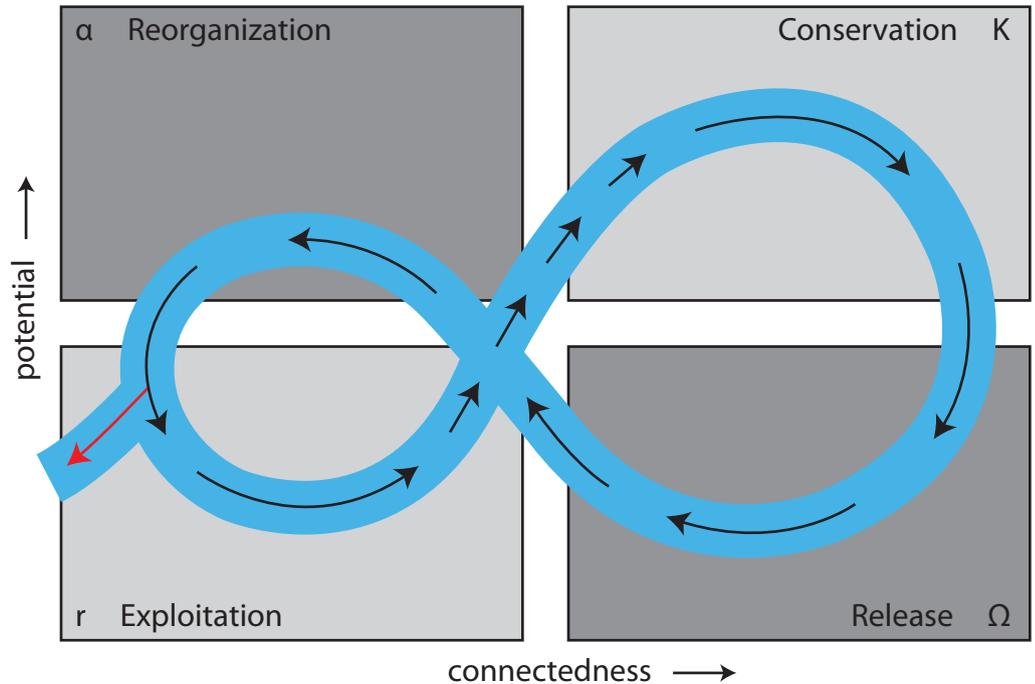
to a changing world” (Walker and Salt 2006, 75). Four phases occur in the adaptive cycle: exploitation, conservation, release, and reorganization (Gunderson and Holling 2001, 35) (Figure 2.2). The phases can occur rapidly, within minutes, or gradually, across eons. In addition, the phases do not have to occur in this order; a conservation phase can lead to an exploitation phase, for example.

The exploitation phase is the beginning of the adaptive cycle during the maximum growth period of a system (Walker and Salt 2006, 76). This phase in economic systems could be entrepreneurs starting a business or in ecological systems could be weeds and pioneer species growing on newly cleared land.

Figure 2.2: Adaptive Cycle

Systems cycle through a series of exploitation, conservation, release, and reorganization. The release phase occurs after a disturbance and the reorganization phase determines if the system continues the same cycle or becomes a different system with other feedbacks.

Adapted from Gunderson and Holling (2001)



The conservation phase occurs after exploitation when “energy gets stored and materials slowly accumulate” (Walker and Salt 2006, 76). This phase proceeds incrementally as a system’s components become stronger and create capital. Growth decreases as the system becomes more connected and more efficient. Efficiency, however, decreases flexibility, so the system

becomes more vulnerable to disturbances and less resilient (Walker and Salt 2006, 76). The longer the conservation phase persists, the more vulnerable the system will be to a disturbance. A disturbance in an ecological system could be fire, drought, insect pests, or disease. These disturbances cause the release of biomass and nutrients (Walker and Salt 2006, 77). In an economic system, a new

technology or market shock can disrupt a highly connected industry (Walker and Salt 2006, 78).

The release phase is the period after a disturbance occurs to a system. A disturbance could create a release of structural linkages and weaken regulatory controls within the system (Walker and Salt 2006, 77). This phase can occur instantly at the end of the conservation phase and cause chaos within the system.

After the release phase, there is uncertainty within the system in the reorganization phase. The system could reorganize and gather resources to begin the rapid growth phase again. On the other hand, the system could gain a new identity which could be positive or negative to different groups. In ecological systems, a tree disease could kill large patches of a forest ecosystem, but the system could revive years later from the movement of pioneer species and regrow the forest in those patches. The system could also transform into a different ecosystem or remain in a state of degradation (Walker and Salt 2006, 78).

Panarchy

Gunderson's and Holling's term "panarchy" explains the cross-scale, dynamic, and interconnected features of systems. Systems operate across a variety of space and time scales, but also interact with other systems at varying space and time scales (Figure 2.3). Therefore, the term "hierarchy" is insufficient in describing both the vertical and horizontal space and time interactions between systems (Gunderson and Holling 2001, 74). Interconnectedness and multi-scale features in systems make focusing on one system or one scale inadequate in terms of resilience.

Specified and General Resilience

Walker and Salt (2006) define two different types of resilience: specified and general. Specified resilience is resilience to specific threats and known thresholds of systems (Walker and Salt 2006, 120). This type of resilience identifies key slow variables operating within a system which exhibit threshold effects (Walker and Salt 2006, 120). The resilience of these variables to a specific disturbance is resilience "of what, to what." For example, "the resilience of the

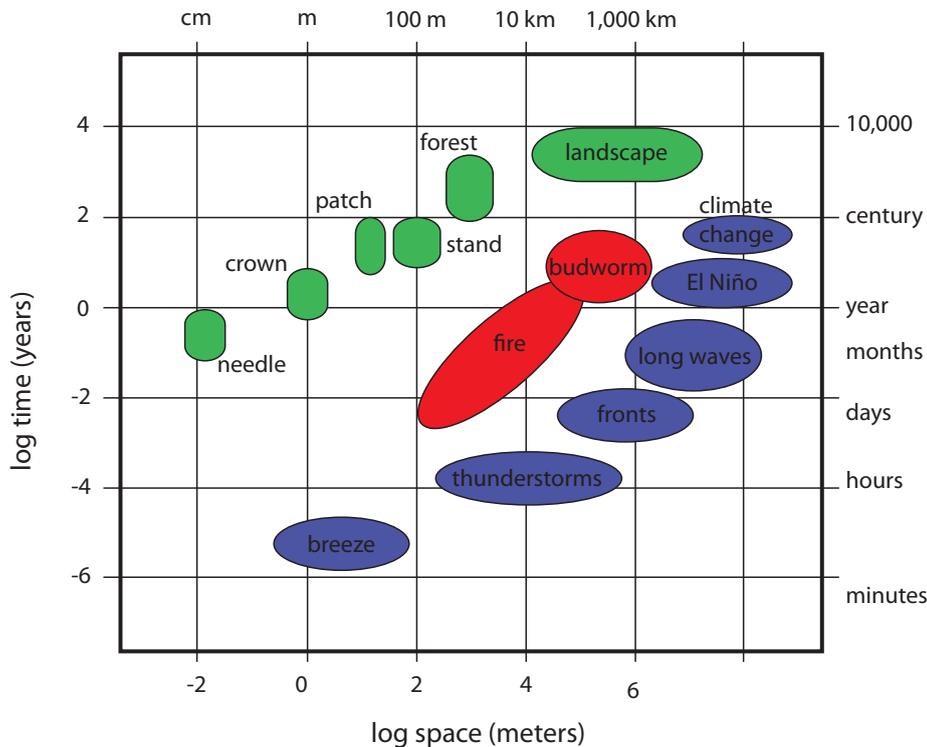


Figure 2.3: Panarchy Relationships in a Boreal Forest

A forest ecosystem interacts across space and time scales with other global systems. Disturbances affect all systems across a panarchy.

Adapted from Gunderson and Holling (2001)

Everglades vegetation to fires and droughts (as phosphate levels increase)” (Walker and Salt 2006, 120). Specified resilience is important, but resilience to unforeseen disturbances, or general resilience, is also important (Walker and Salt 2006, 121). Walker and Salt argue that too much focus on specified resilience will result in optimization which will lower the overall resilience of the system. Therefore, planning for the general resilience of a system (not any one particular disturbance or system response variable) is equally as important.

This research incorporates both specified and general resilience into the creation of design guidelines and the redesign of Washington Square Park. I have identified social-ecological systems operating in the park and the response variables within those systems in order to create resilience for specific components within the systems. Strategies to create resilience for these specific system components will help improve the general resilience of the park.

Current Research

Application of Resilience Theory

In recent years, researchers and designers, like Jack Ahern and Brian Walker and David Salt, have created strategies and

frameworks for assessing and creating resilience in social, ecological, and economic systems.

Walker’s and Salt’s *Resilience Practice* (2012) outlines methods for assessing systems for specified and general resilience. To assess for specified resilience, Walker and Salt say to list known thresholds, list suspected thresholds of concern, develop conceptual models to understand the system’s functions, and develop analytical models to build the conceptual understanding of the system with quantitative measurements (Walker and Salt 2012, 89). For general resilience, Walker and Salt suggest analyzing systems for diversity, openness, reserves, tightness of feedbacks, modularity, social capital, and levels of capital assets. These qualities can help determine if a system is generally resilient and when applied, can help a system become more resilient. In addition to these qualities, Walker and Salt list qualities of a “resilient world.” They include diversity, ecological variability, modularity, acknowledging slow variables, tight feedbacks, social capital, innovation, overlap in governance, and ecosystem services (Figure 2.4).

Jack Ahern (2011)		
Strategy	Author’s Description	Resilient Effects
Multifunctionality	“...intertwining/combining functions, stacking or time-shifting” (Ahern 2011, 342)	“...supports response diversity in the functions provided. Examples...urban stormwater wetlands...floodplain parks...” (Ahern 2011, 342)
Redundancy and Modularization	“...achieved when multiple elements or components provide the same, similar, or backup functions” (Ahern 2011, 342)	“...spread[s] risks - across time, across geographical areas, and across multiple systems” (Ahern 2011, 342)
(Bio and social) diversity	“...social, physical, and economic...diversity of species within functional groups that have different responses to disturbance and stress...” (Ahern 2011, 342)	“...functional group[s]...are more likely to be sustained over a wider range of conditions...have a greater capacity to recover from disturbance...” (Ahern 2011, 342)
Multi-scale networks and Connectivity	“...walking trails that link to bus routes...urban drainage swales that connect to non-channelized low-order streams...” (Ahern 2011, 342)	“...build resilience capacity through redundant circuitry that maintains functional connectivity after newtork disturbance(s)” (Ahern 2011, 342)
Adaptive Planning and Design	“...urban plans and designs can be understood as hypotheses of how a policy or project will influence particular landscape processes or functions” (Ahern 2011, 343)	“...experts, professionals, and decision makers may gain new knowledge through monitoring and analysis” (Ahern 2011, 343)

Figure 2.4: Suggested Strategies for Creating Resilience in Systems

Jack Ahern in *From fail-safe to safe-to-fail: sustainability and resilience in the new urban world* (2011) and Brian Walker and David Salt in *Resilience Thinking* (2006) suggest strategies for creating resilience in systems. Kevin Cunningham in his thesis, *Resilience Theory/A Framework for Engaging Urban Design* (2013) synthesizes the strategies of Ahern and Walker and Salt.

Walker and Salt (2006)		
Strategy	Authors' Description	Resilient Effects
Diversity	"The different kinds of components that make up a system: functional...different kinds of species...response...range of different response types" (Walker and Salt 2006, 145)	"...a major source of future options and a system's capacity to respond to change and disturbance in different ways..." (Walker and Salt 2006, 145)
Ecological Variability	"Controlling flood levels and preventing species population 'outbreaks'...embrace and work with ecological variability..." (Walker and Salt 2006, 146)	"A forest that is never allowed to burn soon loses its fire-resistant species, and becomes very vulnerable to fire" (Walker and Salt 2006, 146)
Modularity	"...the degree and pattern of connections in a system..." (Walker and Salt 2012, 215)	"Overconnected systems are susceptible to shocks...a resilient system opposes such a trend..." (Walker and Salt 2006, 146)
Acknowledging Slow Variables	"Controlling biophysical variables (e.g., sediment concentration, population age structures) tend to change slowly" (Walker and Salt 2012, 216)	"By focusing on the key slow variables...we have a greater capacity to manage the resilience of a system" (Walker and Salt 2006, 146)
Tight Feedbacks	"...the secondary effects of a direct effect of one variable on another, they cause a change in the magnitude of that effect" (Walker and Salt 2006, 164)	"...allow us to detect thresholds before we cross them. Globalization is leading to delayed feedbacks that were once tighter..." (Walker and Salt 2006, 146)
Social Capital	"...promote trust, well-developed social networks, and leadership (adaptability)" (Walker and Salt 2006, 147)	"Resilience...is very strongly connected to the capacity of the people in that system to respond...to change any disturbance" (Walker and Salt 2006, 147)
Innovation	"...emphasis on learning, experimentation, locally developed rules, and embracing change" (Walker and Salt 2006, 147)	"...embracing change and disturbance rather than denying or constraining it" (Walker and Salt 2006, 147)
Overlap in Governance	"...institutions that include 'redundancy' in their governance structures and a mix of...property with overlapping access rights" (Walker and Salt 2006, 148)	"Redundancy in institutions increases the response diversity and flexibility of a system" (Walker and Salt 2006, 148)
Ecosystem Services	"The combined actions of the species in an ecosystem that perform functions of value to society" (Walker and Salt 2006, 164)	"These services are often the ones that change in a regime shift and are only recognized and appreciated when they are lost" (Walker and Salt 2006, 147)

Cunningham (2013)	
Strategy	Previous Strategies
Identify and Respond to Critical Thresholds	Walker and Salt: acknowledgement of slow variables, tighter feedback loops, and innovation
Promote Diversity	Walker and Salt: diversity and ecological variability Ahern: (Bio and social) diversity
Develop Redundancies	Ahern: spatial connectivity of the urban landscape
Create Multi-scale Networks and Connectivity	Walker and Salt: modularity Ahern: multifunctionality, redundancy and modularization
Implement Adaptive Planning/ Management Strategies	Walker and Salt: overlap in governance Ahern: adaptive planning and design

In addition, Jack Ahern suggests strategies for designing resilient systems in *From fail-safe to safe-to-fail: sustainability and resilience in the new urban world* (2011). As the title suggests, Ahern believes systems should not be designed as no-fail, optimal systems, but as “safe-to-fail” systems which can self-organize and regrow after a failure. His strategies for designing resilience in systems are multifunctionality, redundancy and modularization, (bio and social) diversity, multi-scale networks and connectivity, and adaptive planning and design (Figure 2.4).

Building on these two sets of strategies, Kevin Cunningham created a resilience framework to analyze case studies in his thesis *Resilience Theory/A Framework for Engaging Urban Design* (2013). Cunningham’s framework is a synthesis of Walker’s and Salt’s and Ahern’s suggested strategies (Figure 2.4). Cunningham used his framework to analyze case studies for methods for designing resilience in landscapes. This allowed Cunningham to provide broad possible strategies for applying resilience to systems as the findings for his thesis.

Existing Guidelines

Organizations such as the Resilience Alliance, Sustainable Sites Initiative (SITES), and Landscape Architecture Foundation (LAF) have made efforts to help practitioners apply resilience theory to landscape designs. The Resilience Alliance is concentrated on research of resilience theory. The Sustainable Sites Initiative and Landscape Architecture Foundation do not directly relate to resilience theory, but their work overlaps with the work of the Resilience Alliance. All three organizations focus on social-ecological systems and implementing design solutions to create more sustainable and resilient landscapes.

The Resilience Alliance, created in 1999, is a research organization focused on resilient and sustainable practices and exploring social-ecological systems (Resilience Alliance 2013). The organization has created a workbook entitled, *Assessing Resilience in Social-Ecological Systems: Workbook for Practitioners* (2010) in order to help practitioners analyze their systems for resilience and determine necessary actions. The workbook guides users to assessing their site for key issues,

thresholds, cross-scale interactions, social networks, and finally synthesizing and initiating transformation (Resilience Alliance 2010). This workbook provides guidelines for assessing systems for resilience, but does not continue to guide practitioners or landscape architects to design implementations based on the assessment.

The Sustainable Sites Initiative's *Guidelines and Performance Benchmarks 2009* consists of more precise guidelines in the form of a rating system. The system allows the sustainability of landscapes to be measured and assessed for their social equity, economic feasibility, and environmental soundness at the site scale (SITES 2009). Some strategies are required for a SITES rating, such as “preserve wetlands” and “reduce potable water use for landscape irrigation by 50 percent from established baselines” (SITES 2009). Other strategies are only recommended, but if a site demonstrates them, the rating will improve. The *Guidelines and Performance Benchmarks 2009* is relevant to this research because it offers design strategies which SITES

suggests implementing to create sustainable landscapes.

Another implementation and learning tool is the Landscape Architecture Foundation's Landscape Performance Series. This program provides case studies and a toolkit of research works to inform designers and others of the performance benefits of landscapes (LAF 2013). Guidelines or a rating system are not included in this program and resilience theory is not a specific focus of the program. However, the case studies presented offer a thorough description of their landscape benefits, research methodologies, challenges and solutions, and lessons learned from the studies (LAF 2013). The Landscape Performance Series is relevant to this research by offering resilient strategies which have been implemented in specific landscape designs and descriptions of the methods leading to these strategies.

The Resilience Alliance provides guidelines for assessing resilience in systems, but does not combine landscape architecture design principles to the broad strategies

suggested. The alliance's workbook begins to help practitioners adapt resilience theory to real systems, however, it is inadequate in supplying designers with a tool they need to design landscapes using resilient strategies. On the other hand, SITES offers guidelines with more specific design strategies, but the focus of the guidelines is on sustainable natural systems and not on resilient social, ecological, and economic systems. Lastly, LAF only presents sustainable strategies used in specific sites which is only generally helpful for practitioners and for this research.

Dilemma

Existing sustainability and resilience organizations and guidelines begin to connect resilience with design, but they are inadequate in providing easy and clear methods for landscape architects to use to design systems to exhibit resilience.

Currently, research regarding the application of resilience theory to landscape architecture is based on theory and suggestions. The actual application of resilience to designed systems is the next step to further developing resilience theory and the application of resilience in design.

Study Site

The study site for this research is Washington Square Park in Kansas City, Missouri (Figure 2.5). The Kansas City Park Board acquired the property for Washington Square Park in 1921 when the city commandeered it to create Pershing Road (Parks and Recreation Kansas City 2013). At the time, the park was simply a green space and 23rd Street separated the lower rectangle portion from the upper triangle portion. The park served as a relaxation area for train travelers coming and going from the new Union Station (KCDC 2013). The park also became a part of the Kessler System which is a series of parks and boulevards throughout Kansas City designed by George Kessler in 1893 (Kessler Society of Kansas City 2013). The statue of George Washington mounted on a horse was moved to the new park in 1925, therefore, the park become known as Washington Square Park (Parks and Recreation Kansas City 2013). In 1938, 23rd street was closed off and the upper triangle portion of the park was added (KCDC 2013). The park took on a new identity as the landscape architecture firm Hare

Figure 2.5: Washington Square Park, Kansas City

Washington Square Park is the study site for this research. The park is a triangular shape and is named for a statue of George Washington which resides in the park.

Google Earth (2014)



and Hare redesigned the park. The design incorporated over 200 Elm and Sycamore trees and shrubs into the park (KCDC 2013). Meandering sidewalks were added throughout the park and formal sidewalks created entrances and framed the Washington statue. The park then became a destination area to view the statue, Union Station, and the surrounding downtown.

As the 20th century progressed, however, train ridership and use of Union Station declined along with use of the park (KCDC 2013). In 1986, concrete pavers and light posts were added to the park to encourage visitation. The following year, the Washington statue was moved to its current location on the southeast corner of the park and a new formal entrance to the park was created (KCDC 2013).

Today, Washington Square Park is an urban park space, but lacks programs which invite users to stay and participate in activities in the space. The park acts mainly as a pass-through space and does not interact with its surrounding programs. Cydney Millstein and Paul Novick of Architectural and Historical Research, LLC state about Washington Square Park that “in community planning, it has potential significance as a civic space in an area of major public buildings, astride an important Kessler crosstown boulevard. But that significance has been lost along with those qualities contributing to its integrity” (Millstein and Novick 2013, 41).

The establishment of Washington Square Park and the surrounding urbanization changed the identity of that landscape in Kansas City. Human interventions changed the basins of attraction the systems in the landscape were operating in. The park has been maintained as an urban park through two site designs, changes in surrounding development, and declined use of Union Station. Therefore, by Gunderson’s and Holling’s definition, Washington Square Park is in the conservation phase of the Adaptive Cycle. Systems operating in the park could experience a disturbance which

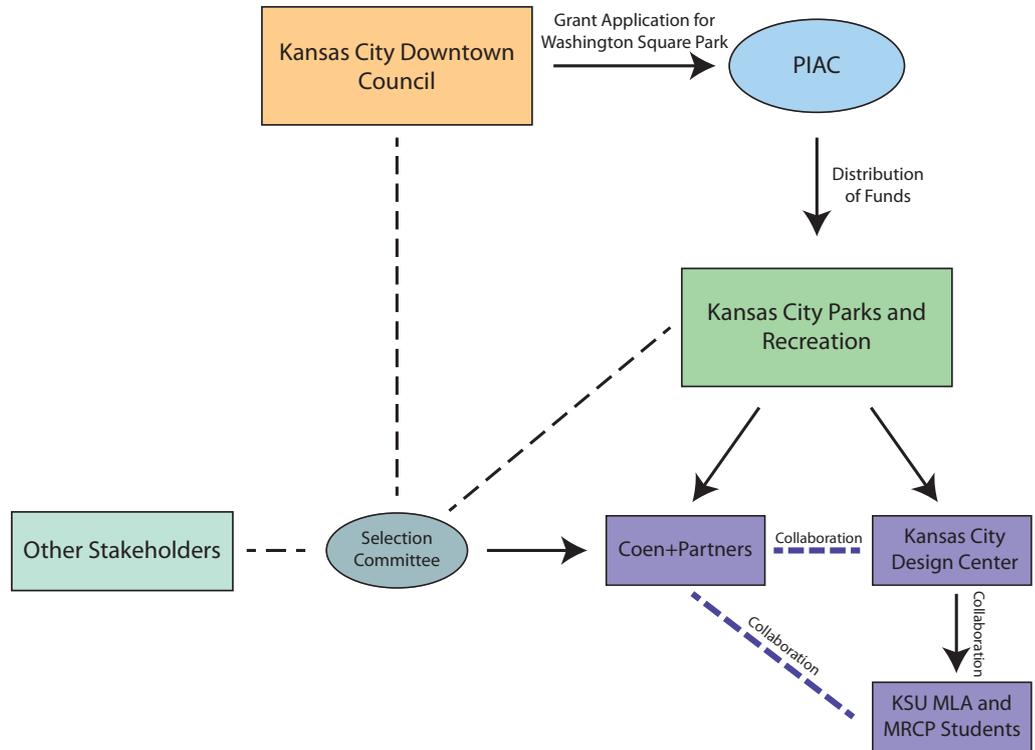
could push the park across a threshold and change its identity. In order to create a resilient and self-organizing urban civic space which can absorb urban and unknown disturbances, design interventions which will allow the park’s systems to operate more resiliently are necessary.

The idea to revamp and redesign this park was put into motion by the Kansas City Downtown Council, a non-profit group focused on creating a vibrant urban environment in downtown Kansas City (Figure 2.6). The council applied for a grant to fund the redevelopment of Washington Square Park from the Public Improvements Advisory Committee (PIAC) who solicits resident input and makes decisions on which neighborhood projects to fund. The PIAC grant was approved for Washington Square Park and was given to the Kansas City Parks and Recreation department to distribute to players to work to improve the park.

The major player working to redesign the park is Coen+Partners. This landscape architecture firm responded to the Request for Qualifications/

Figure 2.6: Relationships between Players in the Redesign of Washington Square Park

The main players in the redesign of Washington Square Park are the Kansas City Downtown Council and the Kansas City Parks and Recreation Department. Stakeholders have chosen a design consultant, Coen+Partners, who is a collaboration partner with students from Kansas City Design Center and Kansas State University.



Proposals (RFQ/P) which was distributed by the Parks and Recreation Department. The Kansas City Downtown Council, Kansas City Parks and Recreation, and other stakeholders chose the firm as the major consultant in redesigning Washington Square Park.

Other players are Kansas City Design Center (KCDC) and two Masters

report student groups at Kansas State University: Masters of Landscape Architecture and Masters of Regional and Community Planning. I am conducting this research as a Masters of Landscape Architecture student at Kansas State University in the “Civic Spaces in Urban Resilience” umbrella group.



Methodology



The methodology for this report began with a literature review which provided the basis of knowledge of resilience theory and urban social-ecological systems (Figure 3.1). The literature review contributed to the development of a perceptual model of social-ecological systems operating in Washington Square Park. The model reveals system components and feedbacks operating within social-ecological systems in Washington Square Park. I grouped these system components and feedbacks according to strategies which can help each component and feedback be more resilient. The strategies are suggested by authors Jack Ahern (2011), Brian Walker and David Salt (2006 and 2012), and Kevin Cunningham (2013).

The system components and suggested strategies allowed me to analyze the site and case studies which produced the information for the resilient design guidelines. Goals for Washington Square Park created from the site analysis and an analysis of park documents also contributed to the creation of the guidelines.

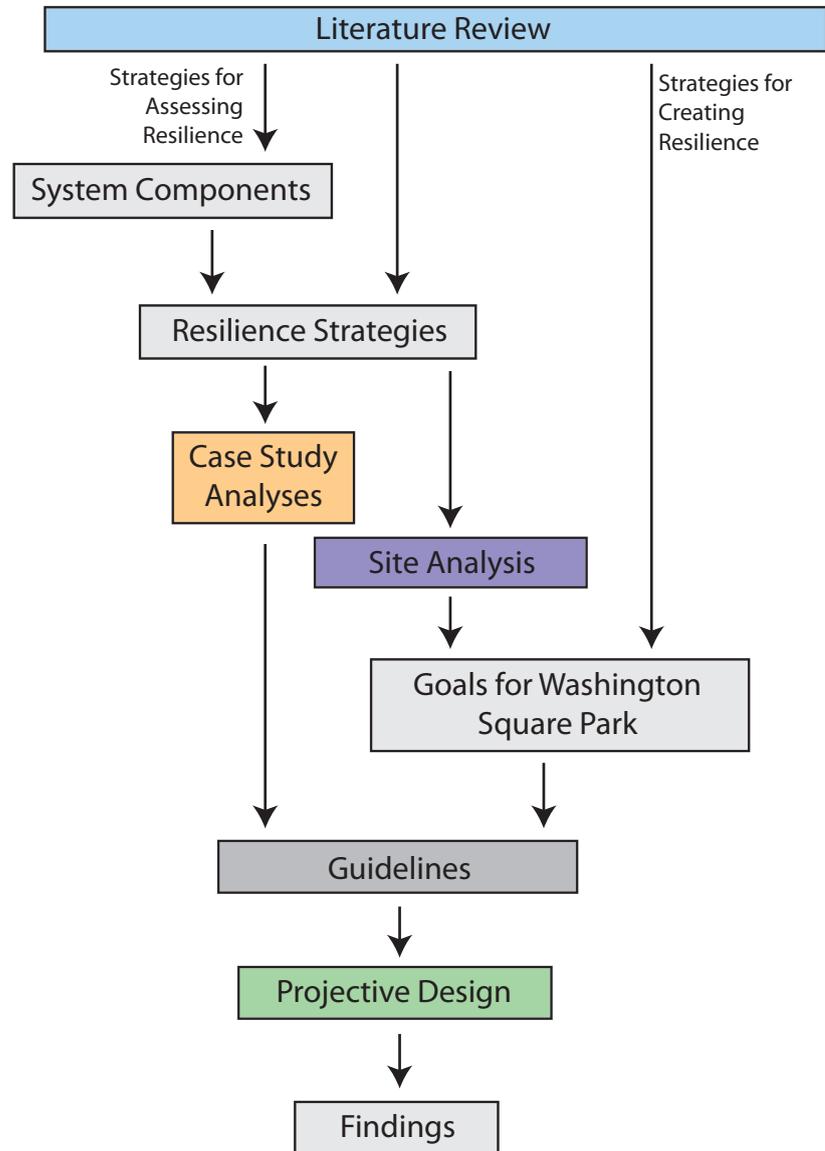
I then used a design proposal to test the success of the guidelines for creating a more resilient urban civic space. An analysis of the general resilience of the park after the redesign is measured by comparing diagrams and metrics for the system components from the site analysis with diagrams and metrics for the same system components created in the design proposal.

Literature Review

A review of the literature surrounding resilience theory and complex adaptive systems provided a basis of knowledge for this research. The literature review consists of four sections: Theory and Application of Resilience, Case Studies, Urban and Ecological Systems, and Implementing Resilience Theory in Urban Civic Spaces. These sections explore the fundamental aspects of resilience theory, the case studies used to determine resilient design strategies, the linkages between urban and ecological systems, and the documents which outline the goals of the Washington Square Park redesign.

System Perceptual Model

The literature review provided strategies for assessing resilience and creating resilience which guided the creation of a perceptual model. Brian Walker and David Salt in *Resilience Practice* (2012) describe that conceptual models make known one's understanding of how systems function within a site (Walker and Salt 2012, 89). Walker and Salt explain that many conceptual models may exist between stakeholders, but differences should be resolved to create an agreed-on model (Walker and Salt 2012, 77).



The perceptual model for this report is built on my understanding of the significant components that function within social-ecological systems in Washington Square Park (Figure 3.2). The model is similar to Walker and Salt's idea of conceptual models, however, this model does not use quantitative measurements.

The perceptual model allows specific components of social-ecological systems operating in Washington Square Park to be understood. The system components consist of physical elements within systems which create feedbacks for the system. For example, in the water system, permeable and impermeable surfaces, stormwater collection areas, and vegetation interception all affect the amount of time stormwater is absorbed or drained and how much water is drained into the watershed.

The social-ecological systems operating in Washington Square Park and most urban civic spaces and the systems expressed in the conceptual model are soil, water, vegetation, fauna, and people. These systems are defined as ecological or social systems which function together in the urban ecosystem. These systems

and their components interact together to create feedbacks which affect all systems within a landscape. However, I have categorized the physical elements and feedbacks I am focusing on in this research to refer to the system which the component relates closely to.

The soil system refers to the types of soils within the site, areas of compacted soil, and the location of tree roots. These elements contribute to the erodibility of the soil in the park and the amount of nutrients in the soil.

The water system in Washington Square Park and in this report refers to the stormwater drainage system. Permeable or impermeable surfaces, stormwater collection areas, and vegetation interception all contribute to the amount of time stormwater drains. The stormwater then drains through infrastructure and into the watershed.

Vegetation refers to the amount of species which can be native, exotic, or invasive and the number of different kinds of species, or biodiversity. An increased number of native plants and biodiversity help mitigate the need for

Figure 3.1: Methodology Path

A literature review provides the necessary information needed to conduct a perceptual model of system components and apply strategies to those components to create resilience. The strategies allow for case study analyses and a site analysis. The site analysis and the literature review produce information for the goals of Washington Square Park which is combined with the case study analyses to create design guidelines for creating resilient systems. The guidelines are tested with a projective design which produces the findings for this report.

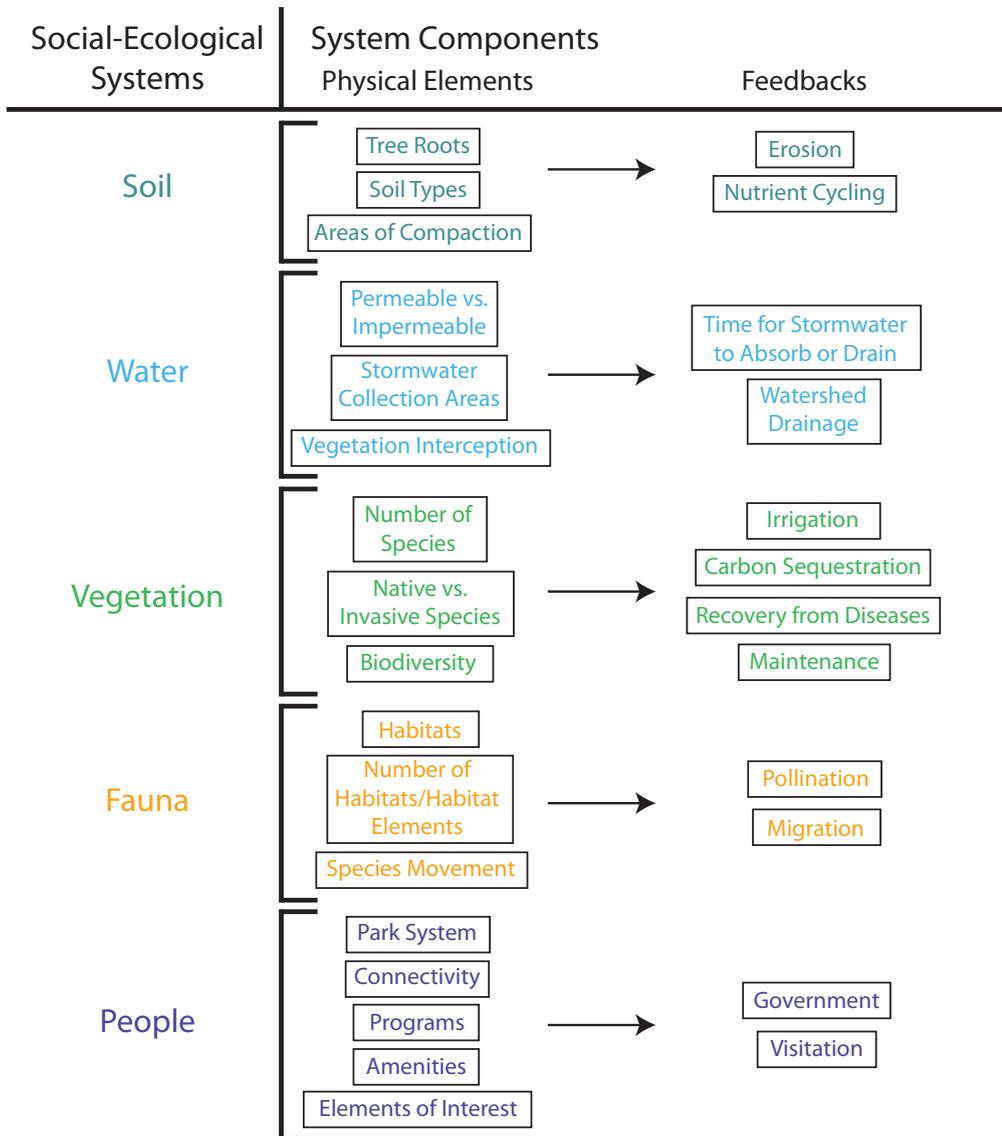


Figure 3.2: Conceptual Model of System Components of Social-Ecological Systems Operating in Washington Square Park

Soil, water, vegetation, fauna, and people represent the social-ecological systems functioning together within Washington Square Park, as defined by Alberti (2008) and Walker and Salt (2012). These systems consist of many functioning components which interact and influence other components within the same and other systems.

irrigation which reduces maintenance and the spread of a disease contracted by a specific plant species.

Biodiversity and native plant species also contribute to habitats and species movement which is listed in the fauna system. Increased habitats and movement of species contribute to migration of species and pollination.

Last, the people system involves Washington Square Park's contribution to a park system, the connectivity pedestrians have with the areas surrounding the space, the programs, amenities for people, and elements of interest. These elements affect the governing bodies of the park and the amount of visitation to the park.

The programs, amenities, elements of interest, and visitation aspects of the people system contribute to the notion of legibility. Kevin Lynch defines legibility in *The Image of the City* (1960) as "one whose districts or landmarks or pathways are easily identifiable and are easily grouped into an over-all pattern" (Lynch 1960, 3). Julia Czerniak in *Legibility and Resilience* (2007) says that legibility and

resilience are essential characteristics of the social, ecological, and generative roles in parks. Czerniak defines legibility as "the capacity of a project to be understood in its intentions (its evolution and goals), identity (its distinguishing character and organization), and image (both its appearance, whether pastoral or post-industrial, and its marketing strategies)" (Czerniak 2007, 215). Achieving the goals of humans and creating an identity for the park contributes to the resilience of the park.

Applying Previous Strategies

In addition to understanding and assessing systems, the literature review also provided general strategies to creating resilient systems, as said in the previous chapter. Jack Ahern (2011), Brian Walker and David Salt (2006), and Kevin Cunningham (2013) have all suggested strategies for creating resilience within systems. Cunningham's strategies used for analyzing case studies in his thesis have been adapted from Ahern's and Walker's and Salt's strategies in *From fail-safe to safe-to-fail: sustainability and resilience in the new urban world* (2011) and in *Resilience Thinking* (2006), respectively.

I have selected four strategies adapted from Ahern's, Walker's and Salt's, and Cunningham's suggestions to apply to the system components outlined in the perceptual model. The four strategies are modularity, redundancy, tight feedbacks, and ecosystem services (Figure 3.3). These strategies represent a synthesized list of the authors' suggested strategies for applying resilience to components in social-ecological systems.

Modularity

Modularity refers to "the degree and pattern of connections in a system" (Walker and Salt 2012, 215). Walker and Salt argue that maintaining a degree of modularity will oppose the trend of overconnected systems which are more susceptible to shocks and spread disturbances quickly through the system (Walker and Salt 2006, 146). Jianguo Wu and Tong Wu argue that modularity decreases as urban land cover expands, increases connectedness, and becomes more homogeneous (Wu and Wu 2013, 221). Ahern refers to both redundancy and modularization as multiple components providing "the same, similar, or backup functions" (Ahern 2011, 342).

I have grouped the three author's ideas of modularity, diversity, multifunctionality, and connectivity into modularity. This is because modularity refers to a system's connectivity which should not be overly connected, but contain diverse components. Therefore, these strategies all contribute to modularity's capability of creating resilience in a system.

Redundancy

Redundancy increases a system's resilience because multiple elements can react to a disturbance (Walker and Salt 2006, 71). Ahern refers to redundancy as a strategy which "avoid(s) putting 'all your eggs in one basket'" (Ahern 2011, 5). Redundancy is especially significant to ecological systems because the more functions fighting a disturbance, the better the chance a system has of not crossing a threshold.

Redundancy is an important strategy to apply because some diverse elements within systems should be multiplied to increase the system's response time.

Tight Feedbacks

Feedbacks are "the secondary effects of a direct effect of one variable on

Jack Ahern (2011)	Walker and Salt (2006)	Cunningham (2013)
Multifunctionality	Diversity	Identify and Respond to Critical Thresholds
Redundancy and Modularization	Ecological Variability	
(Bio and social) diversity	Modularity	Promote Diversity
Multi-scale networks and Connectivity	Acknowledging Slow Variables	Develop Redundancies
	Tight Feedbacks	Create Multi-scale Networks and Connectivity
Adaptive Planning and Design	Social Capital	Implement Adaptive Planning/Management Strategies
	Innovation	
	Overlap in Governance	
	Ecosystem Services	

Figure 3.3: Suggested Strategies for Creating Resilient Systems

From the literature review, Jack Ahern (2011), Brian Walker and David Salt (2006), and Kevin Cunningham (2013) suggest strategies which can be applied to system components to create resilient systems. I have synthesized these strategies to modularity, redundancy, tight feedbacks, and ecosystem services in order to apply them to the system components.

- Modularity
- Redundancy
- Tight Feedbacks
- Ecosystem Services

another” (Walker and Salt 2006, 164). The tightness of feedbacks refers to “how quickly and strongly the consequences of a change in one part of the system are felt and responded to in other parts” (Walker and Salt 2006, 121). Shortening, or tightening, the amount of feedback time decreases the chance of a system crossing a threshold (Walker and Salt 2006, 121). The strategy of tight

feedbacks applies to the feedbacks of the social-ecological systems identified in the perceptual model. These feedbacks identified in Washington Square Park should be tightened to create general resilience in the park.

Governments and other institutions and social networks are main factors for determining the tightness of feedbacks

(Walker and Salt 2006, 121). These organizations' quickness in decision-making and taking action determines how quick a disturbance to one part of a system is felt in other parts. Therefore, overlap in governance and innovation are grouped as a part of tight feedbacks. Innovation involves "an emphasis on learning, experimentation, locally developed rules, and embracing change" (Walker and Salt 2006, 147). These elements must be embraced by the governing bodies of the park.

Ecosystem Services

Some of the system components which can help the system become more resilient through modularity, redundancy, and tight feedbacks, also contribute to an ecosystem service. Ecosystem services, as argued by Walker and Salt (2006) are also strategies for creating resilient systems. Societies depend on ecosystem services and often do not recognize them until they are gone (Walker and Salt 2006, 7). Ecosystem services are divided into four categories: supporting, regulating, provisioning, and cultural (Millennium Ecosystem Assessment 2005, vi). Supporting services include soils and nutrients, regulating services include

food regulation and climate regulation, provisioning services include food and fresh water, and cultural services include aesthetics and recreation (Millennium Ecosystem Assessment 2005, vi). People often take advantage of ecosystem services to ensure optimization, such as timber production (Walker and Salt 2006, 7). However, optimization and efficiency decrease resilience. Civic spaces within urban areas offer a chance to accommodate unpriced ecosystem services. The ecosystem services identified from the system components are tree roots, nutrient cycling, vegetation interception, carbon sequestration, and pollination.

I have applied these strategies to the system components outlined in the perceptual model to determine which strategies can help each component become more resilient (Figure 3.4). Modularity and redundancy are strategies which can be applied to the physical elements in the systems. For example, the number of stormwater drains can help the water system become more resilient by increasing in number, or becoming more redundant. The feedbacks identified for the systems

Figure 3.4: System Components Applied to Strategies for Creating Resilient Systems
System strategies for creating resilient systems suggested by Ahern (2011), Walker and Salt (2006), and Cunningham (2013) can be applied to the system components discovered in the perceptual model. The resilient strategies supply a method for how to design the system components at the site, downtown, and metric scales to create resilient social-ecological systems.

Items written in gray represent components which contribute to supplying an ecosystem service.

Social-Ecological Systems	System Components		
	Physical Elements		Feedbacks
	Modularity	Redundancy	Tight Feedbacks
Soil	<ul style="list-style-type: none"> Soil Types Areas of Compaction 	<ul style="list-style-type: none"> Tree Roots 	<ul style="list-style-type: none"> Erosion Nutrient Cycling
Water	<ul style="list-style-type: none"> Permeable vs. Impermeable Vegetation Interception 	<ul style="list-style-type: none"> Stormwater Collection Areas 	<ul style="list-style-type: none"> Time for Stormwater to Absorb or Drain Watershed Drainage
Vegetation	<ul style="list-style-type: none"> Native vs. Invasive Species Biodiversity 	<ul style="list-style-type: none"> Number of Species 	<ul style="list-style-type: none"> Irrigation Carbon Sequestration Recovery from Diseases Maintenance
Fauna	<ul style="list-style-type: none"> Species Movement Habitats 	<ul style="list-style-type: none"> Number of Habitats/Habitat Elements 	<ul style="list-style-type: none"> Pollination Migration
People	<ul style="list-style-type: none"> Park System Connectivity 	<ul style="list-style-type: none"> Amenities Elements of Interest Programs 	<ul style="list-style-type: none"> Government Visitation

are listed under the tight feedbacks strategy because these elements should become tighter to increase the resilience of the system.

Guideline Development

This report produces a set of guidelines for designing resilient urban civic spaces. I have conducted a site analysis of Washington Square Park which establishes existing conditions of the park and produces goals for the park, along with an analysis of park documents. These goals are combined with a synthesis of case study and strategy analyses to create the guidelines.

Site Analysis

The site analysis I conducted for Washington Square Park is based on the system components identified in the perceptual model of Washington Square Park's social-ecological systems. The site analysis reveals existing conditions which determined goals for Washington Square Park and established metrics for the park in terms of resilience.

Washington Square Park Goals

The goals discovered in the site analysis is one set of goals which contributed to

determining the overall goals of the redesign of Washington Square Park. The other set of goals was determined by an analysis of park documents which outline goals for Washington Square Park and downtown Kansas City. The park documents analyzed are the Greater Downtown Area Plan (2010), the Kansas City Downtown Corridor Strategy (2005) by Sasaki Associates, and the Request for Qualifications/ Proposals (2013).

The overall goals provide a set of objectives for the redesign of the park. In addition, the goals of the park are combined with a synthesis of the case study and strategy analyses to develop the guidelines for designing resilient urban civic spaces. Using the goals of the park to help create the guidelines ensures the guidelines address design objectives for an urban civic space.

Case Study and Strategy Analyses

The case studies and set of strategies are analyzed based on the system components and resilient strategies discovered in the perceptual model. I have created a matrix which allows

each case study and set of strategies to be analyzed for their methods in creating resilient systems in urban spaces (Figure 3.5).

The set of strategies I have analyzed are the strategies suggested in Kevin Cunningham's thesis (2013) to create resilient systems. Cunningham uses case studies to determine goals and potential strategies for creating resilient systems.

The case studies I researched are designs of urban areas which have made strides in using resilient design strategies. These projects include design proposals of Downsview Park in Toronto by James Corner and Stan Allen (1999) and by OMA (1999). Also, Field Operation's design for Fresh Kills Park in Staten Island, Joan Hirschman Woodward's studio work on Los Angeles (2008), and Stoss Landscape Urbanism's design for the Lower Don Lands in Toronto.

A synthesis of the case study and strategy analyses were combined with the goals of Washington Square Park to create the design guidelines.

Design Proposal

In order to demonstrate the guidelines' application in an urban civic space, I have created a site design of Washington Square Park. The design addresses the goals of the site while creating more resilient systems at the site scale. At the downtown and metro scales, I have made design suggestions stakeholders should consider and strive for in future plans.

I have used the design proposal to evaluate the success of the guidelines in creating more resilient systems in an urban civic space. I have created diagrams from the design proposal to demonstrate system components and metrics to compare to the site analysis diagrams showing the system components as they currently exist within the park. These comparable diagrams show the difference in resilient qualities from the existing conditions and the design proposal.

Social-Ecological Systems

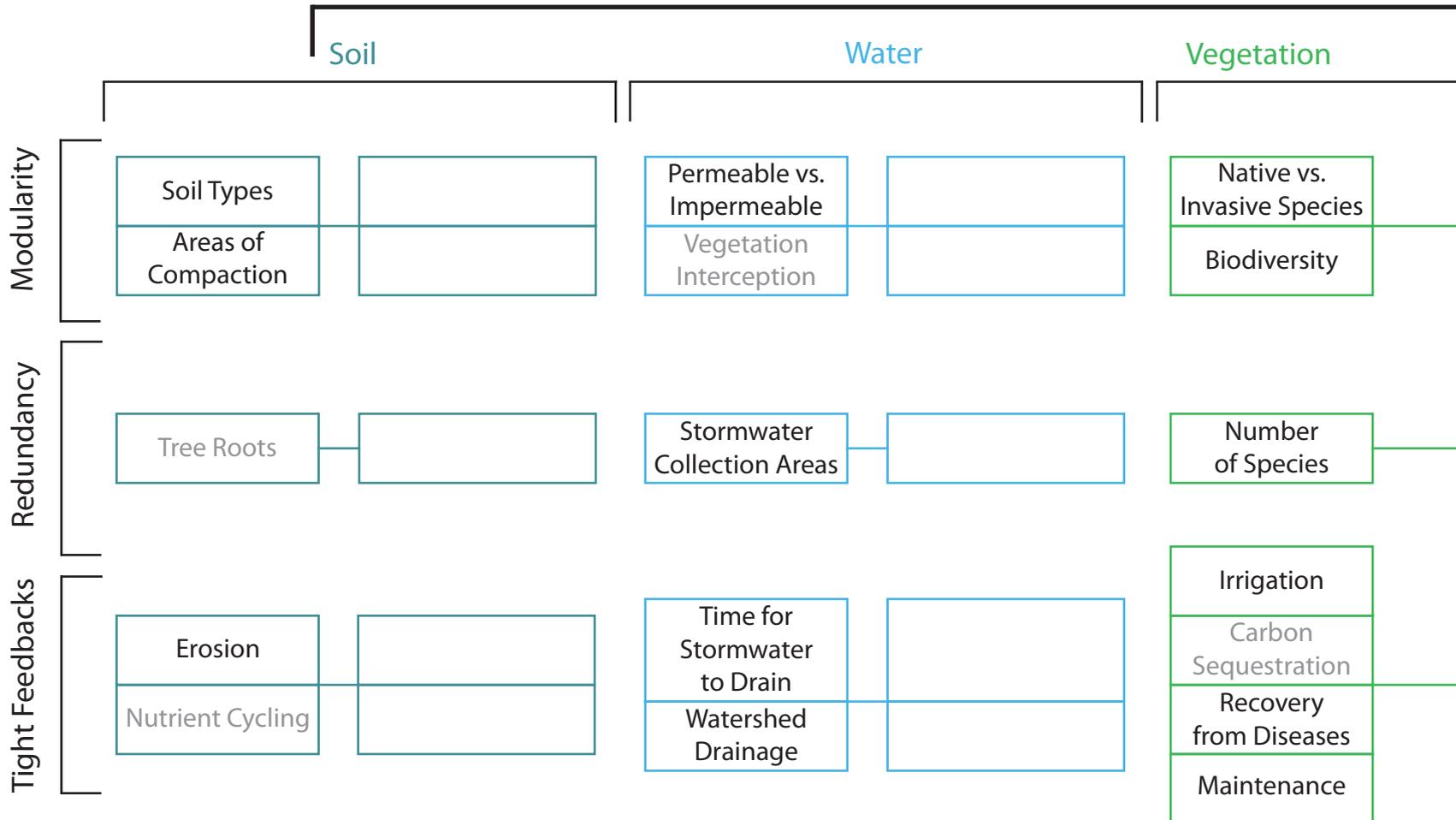
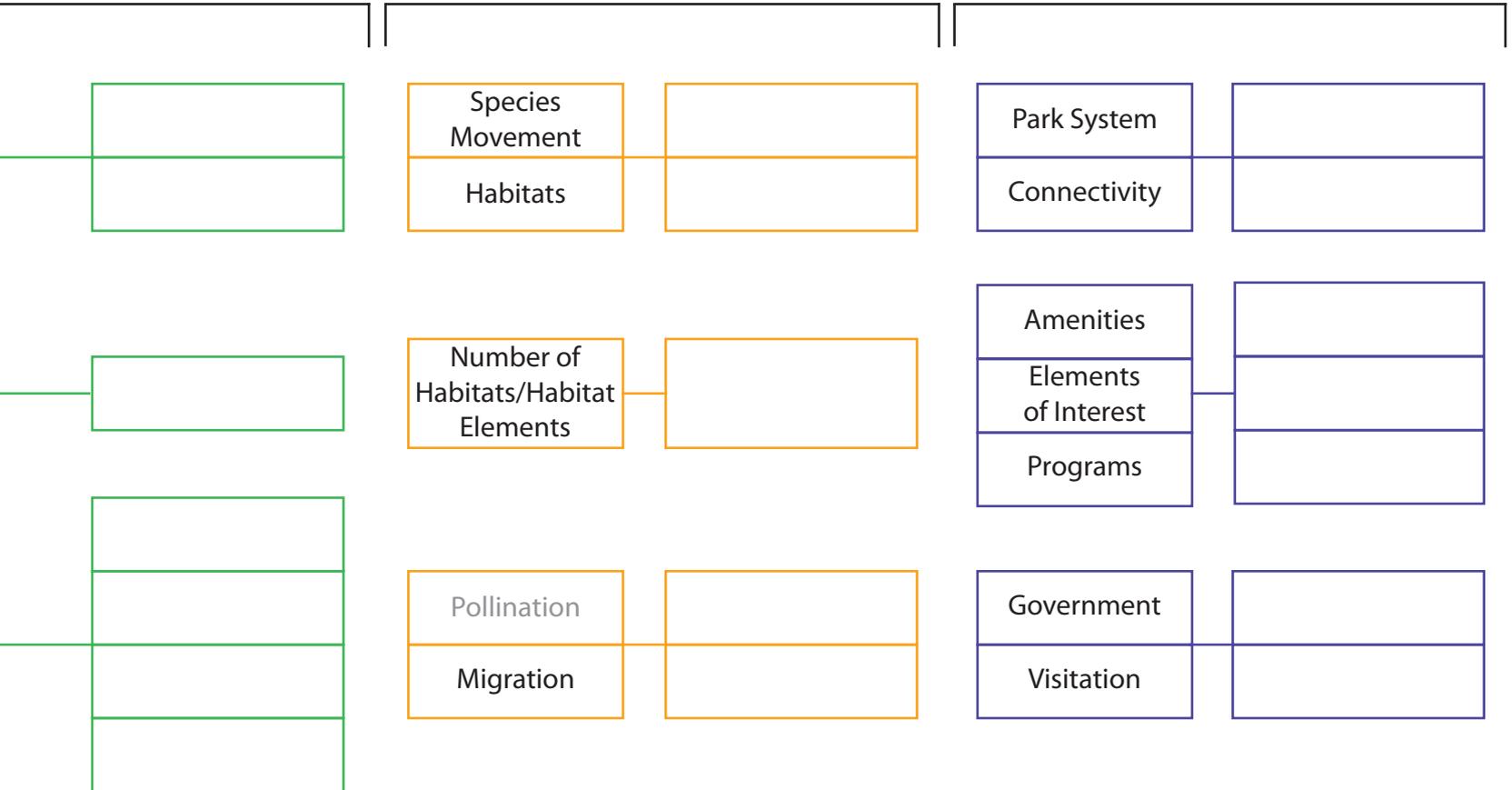


Figure 3.5: Case Study and Strategy Analyses Matrix

Each case study or set of strategies is evaluated based on this matrix. Elements from each design or set of strategies are analyzed based on the system components and either modularity, redundancy, or tight feedbacks. A synthesis of these matrices then contributes to creating the guidelines for designing resilient social-ecological systems in urban civic spaces.

Fauna

People





WESTERN
AUTO

MISSOURI
KOREAN WAR
VETERANS MEMORIAL



Literature Review

In order to narrow the topic of resilience and provide background information on resilience theory, a literature review is necessary. A literature review introduces key authors who have explored resilience theory and their texts as well as introducing the documentation regarding the redesign of Washington Square Park.

The literature is divided into four sections: Theory and Application of Resilience, Case Studies, Urban and Ecological Systems, and Implementation of Resilience Theory in Urban Civic Spaces (Figure 4.1). Literature within the Theory and Application of Resilience section explores resilience theory and focuses the topic from a broad idea to social-ecological systems, and then to synthesized application strategies. This section also explores opposing views

and resistance towards resilience theory. The second section, Case Studies, further exemplifies the application of resilience theory through real projects and describes the projects I have analyzed in the case study and strategy analyses. The third section, Urban Ecology, discusses sources which explore the relationships between ecological systems and urban systems and how these relationships can make an urban environment resilient. The final section, Implementation of Resilience Theory in Urban Civic Spaces, presents documentation regarding the site, Washington Square Park.

Theory and Application of Resilience

Foundations of Resilience Theory

In 1973, an ecologist, C.S. Holling, introduced resilience theory. Holling's

first paper on resilience theory, titled *Resilience and Stability of Ecological Systems* (1973), was published in Annual Review of Ecology and Systematics. Holling brought a new perspective of systems thinking, arguing that “with a system profoundly affected by changes external to it, and continually confronted by the unexpected, the constancy of its behavior becomes less important than the persistence of the relationships” (Holling 1973, 20). He later adds that a focus on persistence in system relationships instead of the degree of fluctuation is important (Holling 1973, 41). This understanding led to Holling’s theory of resilience. He defines resilience as determining “the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist” (Holling 1973, 41).

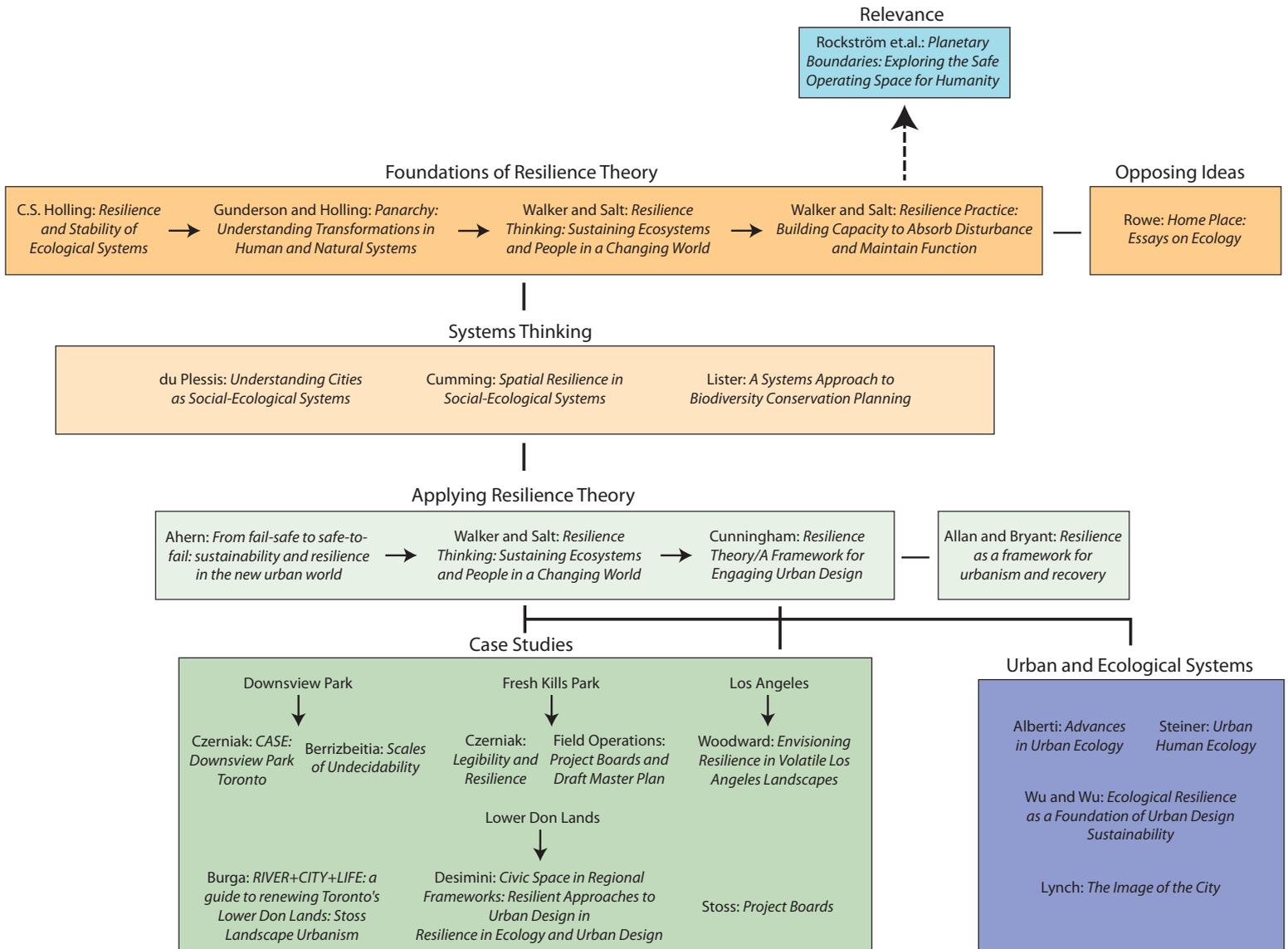
Resilience is classified into two categories: engineering resilience and ecological resilience (Gunderson et.al. 2001, 27). Ecological resilience is based on Holling’s 1973 definition while engineering resilience is defined as concentrating “on stability near

an equilibrium steady state, where resistance to disturbance and speed of return to the equilibrium are used to measure the property” (Gunderson et.al. 2001, 27). Gunderson and Holling warn against engineering resilience in *Panarchy: Understanding Transformations in Human and Natural Systems* (2001). They argue engineering resilience assumes that natural systems are predictable and controlled. However, “sustainable relationships between people and nature require an emphasis on [ecological resilience], i.e., as the amount of disturbance that can be sustained before a change in system control and structure occurs” (Gunderson et.al. 2001, 28).

A change in a system’s structure caused by a disturbance could lead to a threshold cross. When a system crosses a threshold, the feedbacks have changed and have caused the system to change identities (Walker and Salt 2006, 165). Resilience theory accounts for thresholds which makes resilience the “key to sustainability,” as argued by Brian Walker and David Salt in *Resilience Thinking: Sustaining*

Figure 4.1: Literature Map

The literature review contains primary texts on resilience theory and then explores more narrowed topics, such as resilience within systems, applying resilience, urban and ecological systems, and case studies which exhibit resilience.



Ecosystems and People in a Changing World (2006). Resilience in social-ecological systems is key because it can help create global sustainability. Some thresholds, like the seven described by Rockström et.al. in *Planetary Boundaries: Exploring the Safe Operating Space for Humanity* (2009) should not be crossed to achieve global sustainability. Rockström et. al. estimate three thresholds, climate change, rate of biodiversity loss, and the global nitrogen cycle (anthropomorphic actions convert nitrogen to reactive nitrogen which usually ends up polluting the atmosphere and water ways), have already crossed the planet's thresholds. Walker and Salt argue that resilience theory should become practiced or the planet's boundaries are going to be crossed and its systems will continue along a different trajectory (Walker and Salt 2012, 188). Meaning, Earth will continue to exist, but not in the way we know it and not necessarily with humans (Walker and Salt 2012, 188).

Systems Thinking

Nina-Marie Lister in *A Systems Approach to Biodiversity Conservation Planning* (1997) makes the distinction that biodiversity and conservation planning

and management has begun to look at a systems-based or post-normal approach (Lister 1997, 128). This approach focuses on "a plural 'systemism' in which both the parts and the whole, and analysis and synthesis are necessary elements" (Lister 1997, 129). Lister calls for a reform in the management of the environment to be adaptive and flexible instead of the continued homogenization of landscapes by human manipulation of natural systems (Lister 1997, 142).

Social systems and ecological systems are linked and are complex adaptive systems, meaning they have independent and interacting components and variation is constantly being added" (Walker and Salt 2006, 35). Chrisna du Plessis in *Understanding Cities as Social-Ecological Systems* (2008) proposes that social-ecological systems span across matter, life, and mind, consist between a number of scales, are complex and adaptive, and contain abstract thought and symbolic construction (du Plessis 2008). The idea of social-ecological systems spanning across scales is known as panarchy. Gunderson and Holling (2001) define panarchy as a series of interconnected

adaptive cycles across vertical and horizontal time and space scales (Gunderson and Holling 2001, 64). Social-ecological systems are unique because social systems, unlike physical systems, often alter their behavior in response to anticipated outcomes (du Plessis 2008). Therefore, social-ecological systems have the capacity for abstract thought and symbolic construction (du Plessis 2008). Du Plessis argues that these social-ecological systems exist in cities and are necessary to understand so cities can embrace change and build resilience.

Understanding the connectivity and context of social-ecological systems is known as spatial resilience and is critical to resilience of systems. Graeme S. Cumming defines spatial resilience in *Spatial Resilience in Social-Ecological Systems* (2011) as “the ways in which spatial variation in relevant variables, both inside and outside the system of interest, influences (and is influenced by) system resilience across multiple spatial and temporal scales” (Cumming 2011, 21). In other words, spatial resilience refers to the way elements such as spatial location, context, connectivity, and

dispersal influence the resilience of social-ecological systems (Cumming 2011, 4).

Applying Resilience Theory

In order for cities to become resilient, resilience theory must be applied to systems. Ecologists, designers, and other academics have suggested strategies to analyze and design systems for resilience.

Jack Ahern, a landscape architect, researcher, and professor, describes his strategies for applying resilience theory in his article *From fail-safe to safe-to-fail: sustainability and resilience in the new urban world* (2011). Ahern argues that sustainability in the coming century will “be won or lost in cities and their larger urban regions” (Ahern 2011, 1). He also suggests resilience offers a solution to the paradox of sustainability (Ahern 2011, 2).

The paradox Ahern refers to is designing for systems to be “fail-safe.” Disturbances to systems are dynamic, so designing them to be “fail-safe” and static is paradoxical (Ahern 2011, 2). Instead, Ahern suggests designing systems as “safe-to-fail,” so failures are anticipated, contained, and minimized (Ahern 2011, 2). His strategies for designing

resilient systems are: multifunctionality, redundancy and modularization, (bio and social) diversity, multi-scale networks and connectivity, and adaptive planning and design (Ahern 2011, 4).

Walker and Salt also propose strategies for applying resilience theory in *Resilience Thinking* (2006) and reiterate them in *Resilience Practice: Building Capacity to Absorb Disturbance and Maintain Function* (2012). They further enforce Ahern's idea of "fail-safe" not being a sustainable solution by stating, "There is no such thing as an optimal state of a dynamic system. The systems with which we live are always shifting, always changing, and in doing so they maintain their resilience – their ability to withstand shocks and to keep delivering what we want" (Walker and Salt 2006, 141). The strategies they propose would promote and sustain diversity in all forms, embrace and work with ecological variability, consist of modular components, acknowledge slow variables, possess tight feedbacks, promote social capital, emphasize experimentation, overlap in governance, and would include all unpriced ecosystem services in development proposals and assessments (Walker and Salt 2006, 145-148).

Kevin Cunningham analyzes and combines the strategies by Ahern and Walker and Salt in his thesis, *Resilience Theory/A Framework for Engaging Urban Design* (2013). Cunningham develops a set of strategies for analyzing case studies for resilience theory based on the strategies of Ahern and Walker and Salt. Cunningham's strategies are: identify and respond to critical thresholds, promote diversity, develop redundancies, create multi-scale networks and connectivity, and implement adaptive planning/management strategies (Cunningham 2013, 25). He then analyzes case studies based on a matrix formed from these strategies. The matrix identifies if each case study applies resilience practice in the social, ecological, economic, or spatial areas of planning, connectivity, redundancy, diversity, and thresholds.

Cunningham further narrows these categories into regional, metro, and site scales. By extracting the methods discovered in the case study matrices, Cunningham was able to create a resilience framework with methods that explain the goals and potential strategies for implementing resilience theory. He then applies these strategies and

methods for resilience to a projective site design.

Another framework based on case studies is in *Resilience as a framework for urbanism and recovery* (2012) by Penny Allan and Martin Bryant. This framework defines diversity, modularity, innovation, tight feedbacks, overlap in governance, ecosystem services, social capital, and variability, in terms of resilience. The framework then offers evidence of attributes of these topics in urban theory. For example, applying a polycentric urban form implements modularity. This framework not only identifies resilience attributes, but demonstrates how they could be applied to systems. Allan and Bryant conclude with a suggestion that “the framework is qualitative and relative rather than quantitative and absolute, and interventions need to be calibrated with the specifics of place over time and across a range of scales” (Allan and Bryant 2012, 43).

Opposition to Resilience Theory

Although resilience theory has been explored by researchers, ecologists, and landscape architects, many do not

believe designing for resilience will benefit ecosystems. Others believe resilience is too complex, cannot be defined, or is not a proven theory. This leads to many believing “resilience,” similar to “sustainability,” is a buzzword or a fad which will digress in popularity.

Other researchers and ecologists, such as Stan Rowe, have different views on ecosystems and relationships between humans and nature. Rowe in his book of essays, *Home Place: Essays on Ecology* (1990, rev. 2002), describes Earth as an Ecosphere where humans are a part of ecosystems, not an individual entity separate from nature. He also says humans see themselves as powerful centers who can work to improve society and the environment. He explains that humans see that “nature needs our help, and she can be improved for our own betterment” (Rowe 2002, 230). However, Rowe claims that we are steering evolution in our own direction without knowing which direction is best. This idea exemplifies resilience theory as counter intuitive. Resilience strives to better the operation of natural systems with human interventions. Rowe suggests humans taking charge will only “do us in more

quickly, not make things better” (Rowe 2002, 230).

While the term “resilience” and the theory as applied to landscapes is disputed, most ecologists and landscape architects can agree that humans and natural systems should function cohesively. In order to work towards this goal, practitioners should explore resilience theory and gain the values produced from this exploration. This research intends to further enhance ideas on resilience theory, so values of the theory in the design of landscapes can be seen and further understood and explored.

Case Studies

In order to research resilience and create guidelines for designing resiliently, I have analyzed case studies. One of the case studies analyzed in Cunningham’s thesis and one I will analyze in my research is James Corner’s and Stan Allen’s design of Downsview Park near Toronto. This proposal, “Emergent Ecologies,” layers social and ecological systems onto the site to achieve flexibility and adaptability. The proposal focuses on the long-term state of the park, its increasing self-organization, and continued adaptability

(Czerniak 2001, 63). Cunningham concludes in his analysis that this design lacks regional and metro resilient strategies and is a demonstration of how resilience practice is an addendum to current design approaches (Cunningham 2013, 82). At the site scale, however, Corner and Allen concentrate their design on the meshing of social and ecological systems through patches, diversity, and redundancy (Cunningham 2013, 81).

The OMA proposal for Downsview Park, titled “Tree City,” is a diagram of clusters which are unassigned of program elements. The design’s intention is that over time, functions will be assigned to the clusters to ensure their existence (Czerniak 2001). Anita Berrizbeitia describes this proposal in her article *Scales of Undecidability in CASE: Downsview Park Toronto* (Czerniak 2001) as “open” because the significant systems do not interfere with each other. Therefore, many aspects of the proposal can be undetermined (Berrizbeitia 2001, 124). The OMA proposal caters to resilient strategies by allowing the site to be adaptable and self-organize itself in terms of both social and ecological systems.

An additional case study by James Corner and Field Operations is their proposal, "Lifescape," for Fresh Kills Park in Staten Island. This site was previously a landfill, but it has been covered and converted into a park. Lifescape aims to create a resilient identity for Staten Island by forming "an expansive green matrix of infinite horizons and newly connected ecosystems," (Field Operations 2014).

Julia Czerniak in *Legibility and Resilience* in the text, *Large Parks* (Czerniak and Hargreaves 2007), states the Lifescape design proposal results in "a landscape that promises ecological and social interconnectivity at many scales, defragmenting an urban mosaic as it extends beyond the boundaries of the site," (Czerniak 2007, 224). A central point to understanding this proposal is that Lifescape is a process and must be "grown" on the site (Field Operations 2006).

The Lifescape proposal consists of three 10-year phases and has evolved from its initial design in 2001 into a draft master plan (Field Operations 2006). The draft plan is consistent with

the original design proposal. Therefore, I will evaluate the updated plan for this case study analysis.

Another case study is by Joan Hirschman Woodward, titled *Envisioning Resilience in Volatile Los Angeles Landscapes* (2008). This case study was part of a studio which explored the city of Los Angeles and how planning could improve the issues of water availability, population growth, and disruptions, such as earthquakes, fire, and neglect (Woodward 2008, 104).

The studio utilized resilient strategies to design patches of landscapes in Los Angeles's dense, urban environment. The students determined strategies for designing resiliently are: establishing diverse structural conditions to support processes, utilizing ambient processes to spread self-maintaining structure, optimizing conditions when establishing new designs, and utilizing strategic communication to "tip" the acceptability of resilient landscapes (Woodward 2008, 102-103). The studio combined the resilient strategies with urban planning principles and relevant Los Angeles landscape issues to determine a site design for each landscape selected.

The final case study is a design proposal for the Lower Don Lands in Toronto. This proposal, by the firm Stoss Landscape Urbanism, meshes land and water to reopen the mouth of the Don River (Stoss Landscape Urbanism n.d.). Hector Fernando Burga states in his article *RIVER+CITY+LIFE: a guide to renewing Toronto's Lower Don Lands: Stoss Landscape Urbanism in Places* (2008) that the Stoss proposal “established two clear goals: an ecological interface between river and lake and an expanded cultural interface between Toronto and its lakefront,” (Burga 2008, 20).

In this proposal, Stoss designs the river to flow through the middle of the site and provide a wetland habitat which is able to flood. Recreation is integrated into the park and housing is placed on higher slopes between the wetlands (Stoss Landscape Urbanism n.d.). Jill Desimini writes in *Civic Space in Regional Frameworks: Resilient Approaches to Urban Design in Resilience in Ecology and Urban Design* (2013) that the Stoss design responds to the site’s disturbances created from being in an urban environment. “The Lower Don Lands proposal illustrates how an understanding

of the landscape systems at work—the river, the lake, the marshes and the civic open spaces—drives the urban design” (Desimini 2013, 313).

Urban and Ecological Systems

Jack Ahern has argued that urban areas will determine the outcome of sustainability on our planet. A part of understanding social and ecological relationships in urban areas is to gain an understanding of the relationships between urban and ecological systems.

Urban systems and ecological systems are linked and affect one another. Fredrick Steiner calls this “general systems theory” in *Urban Human Ecology* (2004). Steiner explains this theory as a closed feedback loop. For example, local officials make decisions on land use and resource allocation, but changes in those resources inform the officials’ decisions, closing the feedback loop (Steiner 2004, 183). Because of this close relationship between human and ecological systems, Marina Alberti argues that human systems and ecological systems need to operate simultaneously to create resilient

cities. Alberti states in *Advances in Urban Ecology* that “resilience in urban ecosystems is defined by the system’s ability to maintain human and ecosystem functions simultaneously” (Alberti 2008, 22).

Marina Alberti argues that human functions are continuing to replace ecological functions which will cause ecosystems to reach a threshold and collapse (Alberti 2008, 22). She says that a number of necessary ecological functions, such as hydrology, nutrient cycles, and biodiversity, are being replaced by human functions, such as infrastructure, land cultivation, and pollution. These systems should instead operate simultaneously. Alberti’s solution is to understand the evolution of cities as a part of nature and develop a hybrid urban landscape theory (Alberti 2008, 29). The idea of hybrid landscapes is similar to Ahern’s (2011) strategy of multifunctionality.

One way urban and ecological systems can operate simultaneously is through ecosystem services. Resilient ecological systems which provide services for social systems can create

resilient urban systems. Jianguo Wu and Tong Wu say in *Ecological Resilience as a Foundation of Urban Design Sustainability* (2013) that without ecosystem services, a decrease in a city’s cross-scale resilience will occur (Pickett 2013, 222). Wu and Wu also argue patch dynamics are important to designing resilient cities. Patch dynamics can create connectedness, modularity, and tight feedbacks in the urban environment.

Creating areas where people can feel comfortable and find meaning is a significant part of creating resilient urban spaces. Kevin Lynch in *The Image of the City* states the cityscape should be “legible” and provoke a strong image to observers (Lynch 1960, 2). He argues that the elements of the city which can evoke images are classified into paths, edges, districts, nodes, and landmarks (Lynch 1960, 46).

Creating a district is imperative to the area containing Washington Square Park. Lynch defines a district as “an area of homogeneous character, recognized by clues which are continuous throughout the district and discontinuous elsewhere” (Lynch 1960, 103). He says the

homogeneity can come from thematic continuities and spatial characteristics, such as building types, topography, textures, and forms (Lynch 1960, 66).

Implementing Resilience Theory in Urban Civic Spaces

It is evident from the writings of C.S. Holling, Lance Gunderson, Jack Ahern, and Brian Walker and David Salt that resilience theory is a significant concept that plays a major role on our shrinking planet. Issues arise when trying to implement resilience theory into a landscape design.

A thorough understanding of the relationships between social and ecological systems and of urban ecology has begun to take shape in research. Ahern, Walker and Salt, Cunningham, and Allan and Bryant have taken another step in providing frameworks and suggesting broad strategies for applying resilience theory to designed landscapes. The next step of creating guidelines so landscape architects can easily apply resilience methods to design methods has fallen short with the Resilience Alliance, Sustainable Sites Initiative, and

the Landscape Architecture Foundation. However, this step can be completed by focusing on one particular type of landscape and design, the urban civic space.

The Request for Qualifications/Proposals (RFQ/P) to improve Washington Square Park in Kansas City, Missouri was issued on September 11, 2013 with a due date of October 3, 2013. The request called for proposals by design professionals with an emphasis in urban design or landscape architecture. The goals written in the RFQ/P are: provide a dynamic place for all ages, provide use for everyday and for special events, provide areas for recreation, accommodate multi-modal transit, and build on existing assets, previous proposals, and community engagement (Parks and Recreation Kansas City 2013). The Scope of Services outlined in the RFQ/P are, but are not limited to, a site analysis and assessment, community outreach and public input, master plan schematics, preparation of a plan document, and a park programming plan (Parks and Recreation Kansas City 2013).

Currently, downtown Kansas City has a master plan known as the Greater Downtown Area Plan (2010) that the

Kansas City Downtown Council uses to improve downtown Kansas City. The City Planning and Development Department, BNIM, El Dorado Inc., Taliaferro & Browne Inc., HDR, KC Consulting, ETC Institute, and Architectural & Historical Research created this plan. It addresses all areas of downtown and creates goals for the different types of developments found in the larger downtown area.

For parks in downtown, the Greater Downtown Area Plan's goals are: promote sustainability, improve air and water quality, reduce the "heat island" effect, and be more transit friendly (Greater Downtown Area Plan 2010). More specifically, Washington Square Park is located in the center of main activity centers, so creating an activity hub in the park has become the main goal of the redesign. Other goals for the park include enhancing the gateway at the southwest intersection, connecting and creating a cohesive identity with the surrounding activity centers, promote diverse activities, improve security, and promote residential development (Greater Downtown Area Plan 2010).

Another plan created for the downtown area is the Kansas City Downtown Corridor Strategy created by Sasaki Associates in 2005. This plan identifies Washington Square Park as a specialty area in downtown and proposes access to the park be mainly from 22nd Street, north of the site. Sasaki Associates envision the park becoming a hub of public transportation as well as an activity center connected to Union Station, Penn Valley Park, Crown Center, and the Crossroads district (Sasaki 2005).





Guideline Development

I have created the design guidelines for designing resilience in systems in Washington Square Park from a site analysis, goal analysis, and case study and strategy analyses. A site analysis reveals the existing conditions of system components within the park and establishes goals for the redesign of the park. A goal analysis examines park documents on improvements to the park and downtown and establishes additional goals for the redesign. Goals determined in the site and goal analyses determine the overall goals for the redesign of Washington Square Park. The overall goals are combined with a synthesis of strategies discovered by analyzing case studies of resilient design proposals for urban areas. This combination of goals and strategies produces design guidelines landscape architects can use

as a tool to create resilience in urban civic spaces.

Site Analysis

A site analysis for Washington Square Park reveals the opportunities and constraints for the redesign of the park as well as expresses the existing conditions in terms of the system components identified in the perceptual model. The site analysis information, diagrams, and metrics are also used as a comparison for information from the design proposal to express the proposal's increased resilience of the site.

I have collected data for the site analysis by critically mapping the park, surrounding area, and the Kansas City regional area. I used Geographic Information Systems (GIS) and Google

Earth to create maps and have collected data from the Mid-America Regional Council (MARC), the United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS), from maps created by Kansas City Design Center students, aerial photographs, and site observations.

The soil types located in Washington Square Park are labeled by the USDA NRCS as “urban land, upland, 5 to 9 percent slopes.” This rating reveals soils in this urban park have been heavily disturbed and several different types of soils exist within the park. The soils, however, are capable of supporting turf grass and woody vegetation, such as native mature trees. I pursued finding more detailed soil data than the USDA NRCS provides through a variety of sources at Kansas State University as well as professional practices in Kansas City. However, detailed soil data for Washington Square Park or downtown Kansas City is unavailable.

Compacted soils within the park are determined by the location of sidewalks, streets, and buildings in and around the park (Figure 5.1.1). The “urban land” soil

rating suggests some soil compaction throughout the entire park, but known compacted areas are the soils supporting sidewalks, streets, and buildings.

Compacted areas as well as tree roots affect the erosion feedback in the park. Tree roots help mitigate the amount of eroded soils which are carried by stormwater into drains. I have estimated the spread of tree roots by the size of tree canopies located in the park (Figure 5.1.2).

Permeable or impermeable patches are represented by the locations and amount of permeable and impermeable surfaces in Washington Square Park and its immediate surroundings (Figure 5.1.3). Directly surrounding the park are asphalt streets and a parking lot which are impermeable, so all stormwater drains into infrastructure. Some permeable turf grasses and planting beds exist within the surrounding properties. The sidewalks within the park mainly consist of permeable concrete pavers. Only the sidewalk on the north border of the park and the area beneath the Missouri Korean War Veterans monument consist of impermeable concrete. The rest of the park contains turf grass and some planting beds.



Figure 5.1.1: Areas of Compaction

Compacted soils within Washington Square Park can be estimated by the location of sidewalks, streets, and buildings. Sidewalks and green areas within urban blocks suggest little compaction while streets and buildings suggest a high level of compaction.

- Highly Compacted Soils**
 904.9 square feet of highly compacted soils within Washington Square Park
- Moderately Compacted Soils**
 146,350.9 square feet of moderately compacted soils within Washington Square Park and the surrounding streets
- Low Compaction**
 159,130.8 square feet of low compacted soils within Washington Square Park

Figure 5.1.2: Tree Root Locations

Tree roots located in Washington Square Park are estimated based on trees' canopy sizes. Tree roots help mitigate soil erosion within the park.

 Spread of Tree Roots
131,715.4 square feet of tree roots
within Washington Square Park and the
surrounding streets



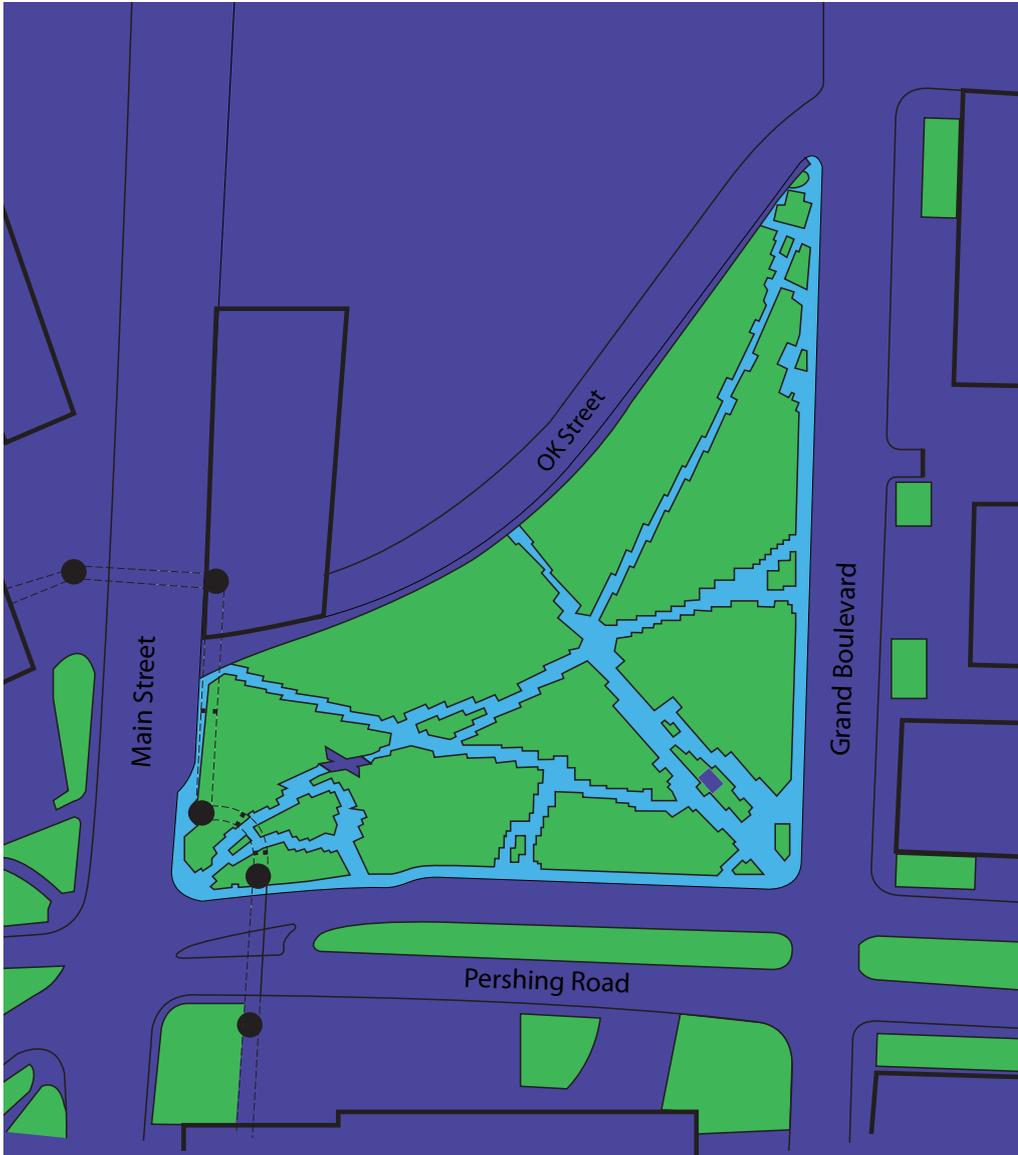


Figure 5.1.3: Permeable vs. Impermeable Surfaces

Washington Square Park provides a large area of permeable land among a greatly impermeable downtown. Sidewalks made up of permeable concrete pavers contribute to the park's permeability.

- Impermeable Surface**
 9,378.6 square feet of impermeable surface within Washington Square Park

- Permeable Paving Surface**
 104,535.7 square feet of total permeable paving within Washington Square Park

- Permeable Planting Surface**
 182,118.8 square feet of permeable planting area within Washington Square Park and the surrounding streets

The stormwater and watershed systems in the park and the surrounding area are critical water systems easily susceptible to disturbances. Washington Square Park is located in the Turkey Creek watershed along with a large portion of developed land in Kansas City (Figure 5.1.4). A major portion of Turkey Creek located in Missouri is contained in an underground tunnel which runs in the right of way of the railroad, located just north of the park. The underground creek then drains into the Kansas River located west of the park. The Greater Downtown Area Plan has identified Turkey Creek basin as a critical basin to incorporate green stormwater solutions.

The water on the site drains from the southeast corner of the park to the north and northwest (Figure 5.1.5). Three stormwater drains are located in the park to capture water runoff. One drain is located in the very north point of the site and the other two are located near the northwest corner. After stormwater runoff is captured, the water drains into the underground Turkey Creek and then the Kansas River. Stormwater drains serve to take runoff away from the site and protect from flooding and pollution.

Therefore, the number of stormwater drains plays an integral role in the time it takes for stormwater to drain and not cause flooding.

Vegetation interception also plays a role in the amount of time stormwater is absorbed. Trees, shrubs, and grass areas all absorb stormwater in the park. Foliage on vegetation also helps intercept stormwater and reduce the amount of runoff traveling to drains. Trees and grass areas in Washington Square Park contribute to vegetation interception (Figure 5.1.6).

In addition to intercepting stormwater, vegetation in the site sequesters carbon. Carbon sequestration is a critical ecosystem service in urban areas because pollution increases the amount of carbon in the air. Carbon sequestration is also a feedback in the vegetation system. I have estimated the amount of carbon currently sequestered in Washington Square Park by the amount of tree cover (Figure 5.1.6). The estimation is based on the research of Rowan A. Rowntree and David J. Nowak in *Quantifying the Role of Urban Forests in Removing Atmospheric Carbon*

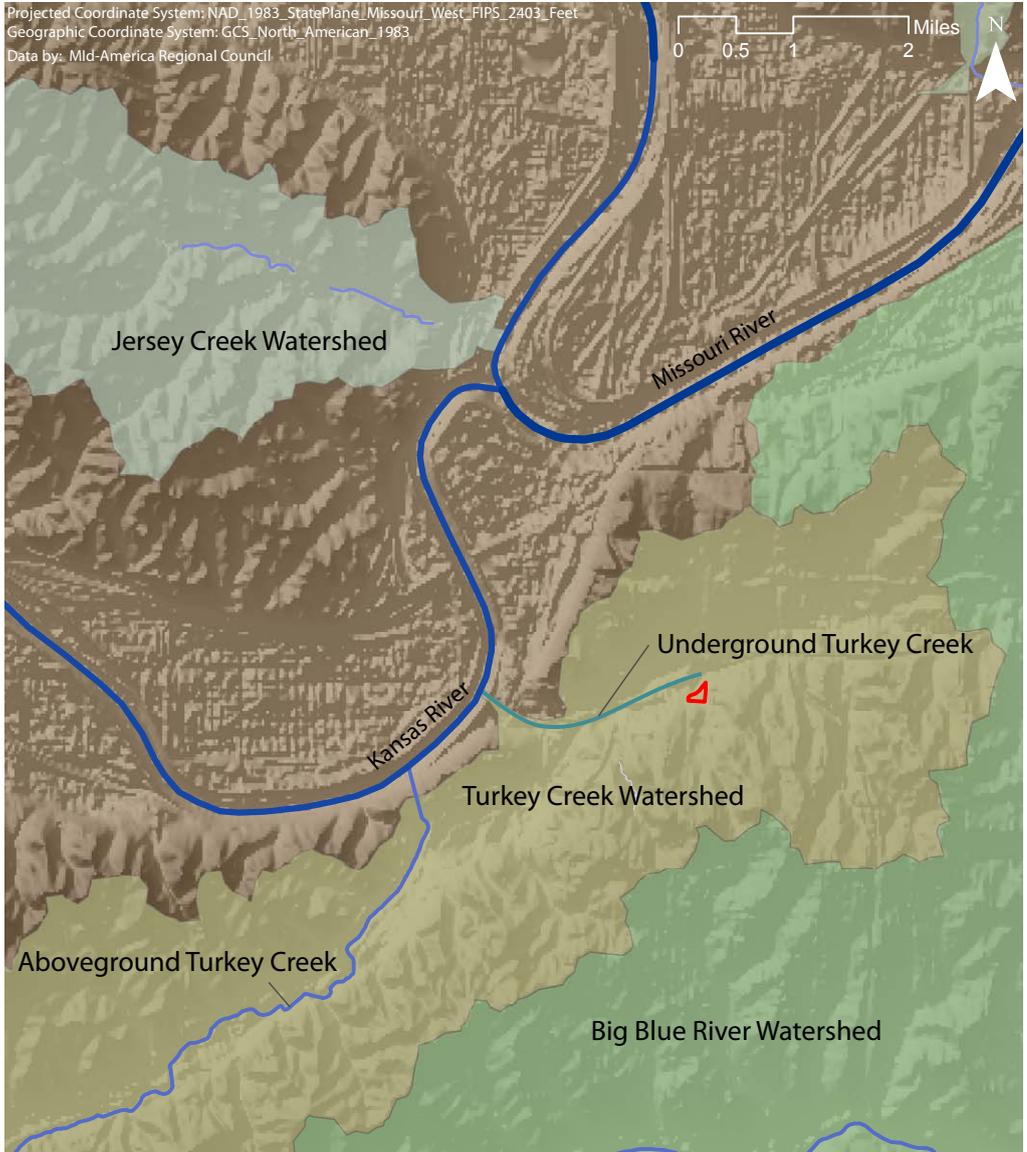


Figure 5.1.4: Stormwater from Washington Square Park Flows into Turkey Creek

The Turkey Creek watershed has been identified as a critical area to implement green stormwater solutions. The watershed drains runoff from Washington Square Park as well as a large area of dense downtown development.

Figure 5.1.5: Direction of Stormwater Runoff in Washington Square Park

Three stormwater drains control runoff in Washington Square Park. Stormwater flows from the park into Turkey Creek and then into the Kansas River. An irrigation system also exists in the park which is not connected to the stormwater system and is not currently operating.

Data by: United States Department of Agriculture

- Stormwater Drain
- ➔ Direction of Runoff

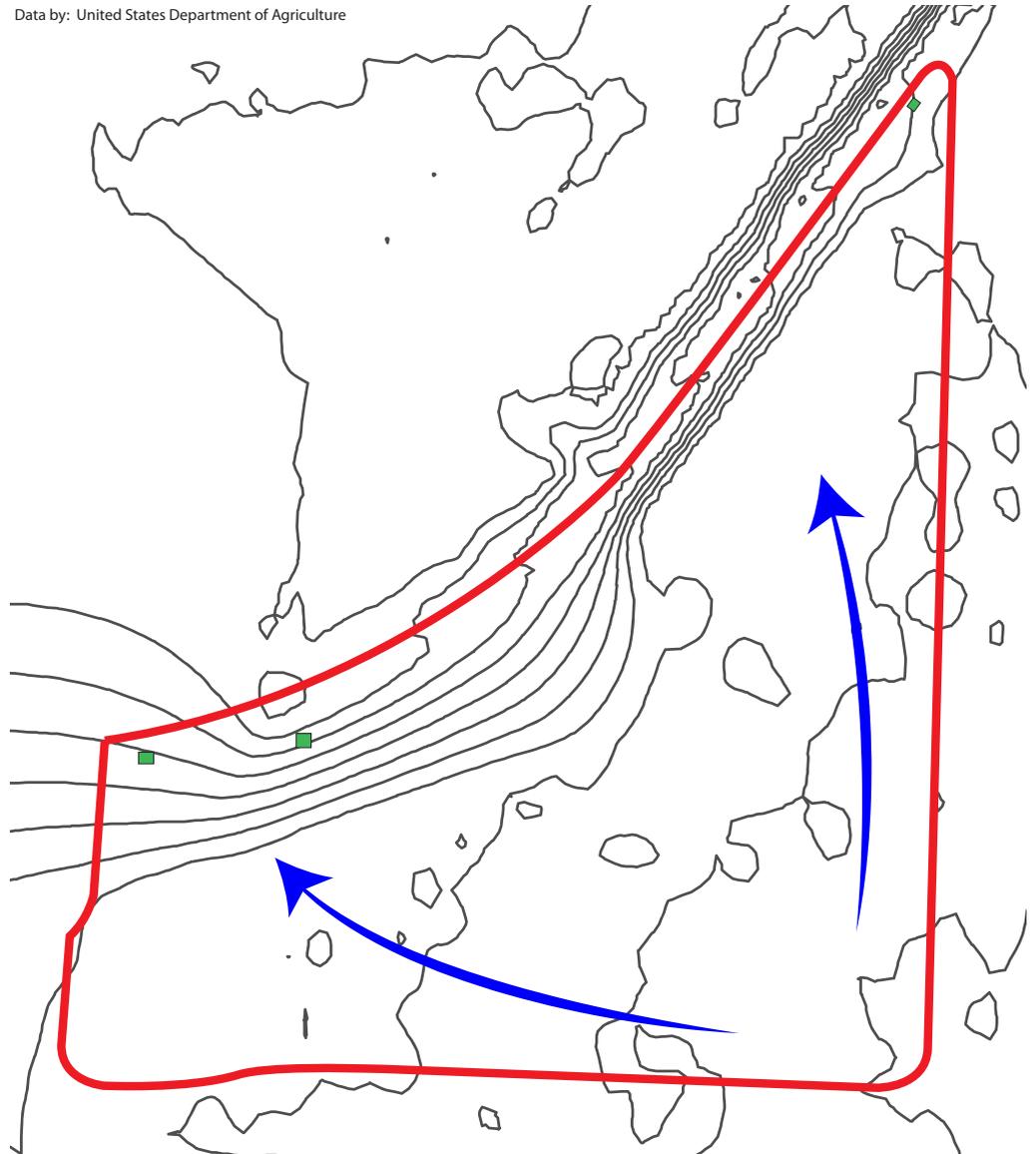




Figure 5.1.6: Tree Cover in Washington Square Park

Trees and grass areas in Washington Square Park intercept stormwater and help sequester carbon. Trees and grass absorb stormwater runoff and mitigate runoff with foliage. Vegetation also sequesters carbon from the atmosphere. I have estimated the amount of carbon sequestered in Washington Square Park by the amount of tree cover in the park. The estimation is based on Rowntree's and Nowak's research in *Quantifying the Role of Urban Forests in Removing Atmospheric Carbon Dioxide* (1991).

- Tree Cover**
 131,715.4 square feet of tree cover
 44.7% of Washington Square Park and the Pershing Road median contains tree cover
 1.01 tons of carbon is sequestered by the park's trees each year
- Turf Grass Areas**

Dioxide (1991). The high number of mature trees in the park results in a high amount of carbon being sequestered in the park.

The number and types of tree species located in Washington Square Park demonstrate redundancy in the vegetation system (Figure 5.1.7). Several tree species are currently repeated within the park. The existing Honey Locust trees demonstrate redundancy and contribute to the park's resilience because these trees are located along streets where there is an increased chance of disturbances. The Sugar Maple, Hackberry, and Crabapple trees, however, are non-repetitive trees which reduce the park's ecological resilience. The Sugar Maple is especially vulnerable to disturbances because it is a singular species located in a high-risk area for disturbances.

Native species in Washington Square Park help mitigate the need for irrigation and have an increased chance of surviving in the Kansas City climate with little maintenance. Native species also provide habitats for animal species in the area. The majority of trees located in the

park are native with the exception of the Littleleaf Linden, River Birch, and Crabapple trees which are exotic, but non-invasive species (Figure 5.1.8).

Tree species within Washington Square Park contribute to different types of habitats for animal species. Migratory species, such as birds, butterflies, and bees, can be found in the park. The existing tree species within the park attract different fauna species (Figure 5.1.9).

Habitats within the park help contribute to migration and pollination throughout the region. Two ecosystem corridors which run through the Kansas City area are located along the Big Blue and Little Blue Rivers (Figure 5.1.10). Movement of species through these corridors are critical to migration throughout the continent.

Washington Square Park was originally part of the Kessler park system designed by George E. Kessler (KCDC 2013). The Kessler system was implemented in Kansas City beginning in 1893 as a product of the City Beautiful movement (Kessler Society

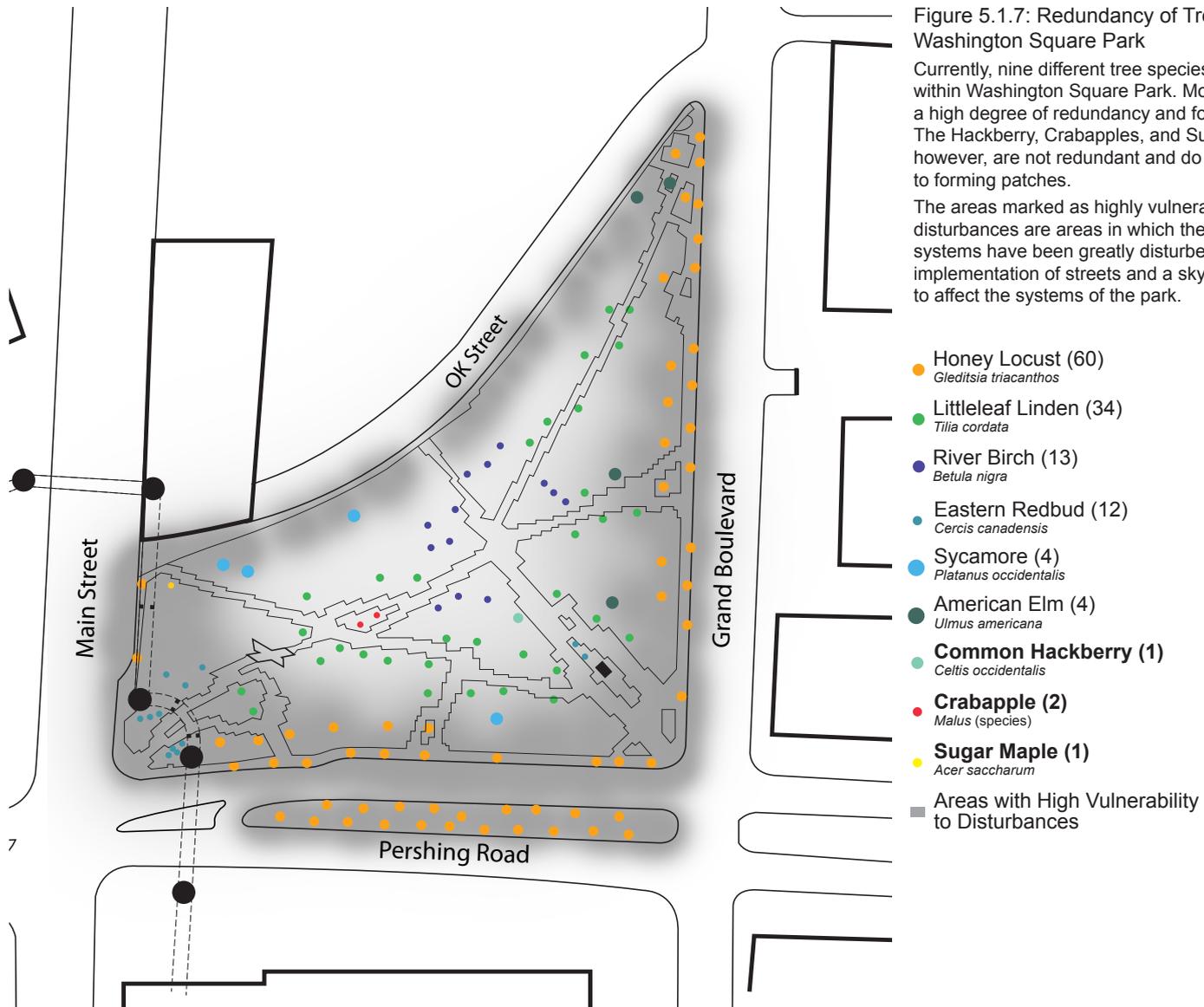


Figure 5.1.7: Redundancy of Tree Species in Washington Square Park

Currently, nine different tree species are located within Washington Square Park. Most demonstrate a high degree of redundancy and form patches. The Hackberry, Crabapples, and Sugar Maple, however, are not redundant and do not contribute to forming patches.

The areas marked as highly vulnerable to disturbances are areas in which the ecological systems have been greatly disturbed. The implementation of streets and a skywalk continue to affect the systems of the park.

- Honey Locust (60)
Gleditsia triacanthos
- Littleleaf Linden (34)
Tilia cordata
- River Birch (13)
Betula nigra
- Eastern Redbud (12)
Cercis canadensis
- Sycamore (4)
Platanus occidentalis
- American Elm (4)
Ulmus americana
- **Common Hackberry (1)**
Celtis occidentalis
- **Crabapple (2)**
Malus (species)
- **Sugar Maple (1)**
Acer saccharum
- Areas with High Vulnerability to Disturbances

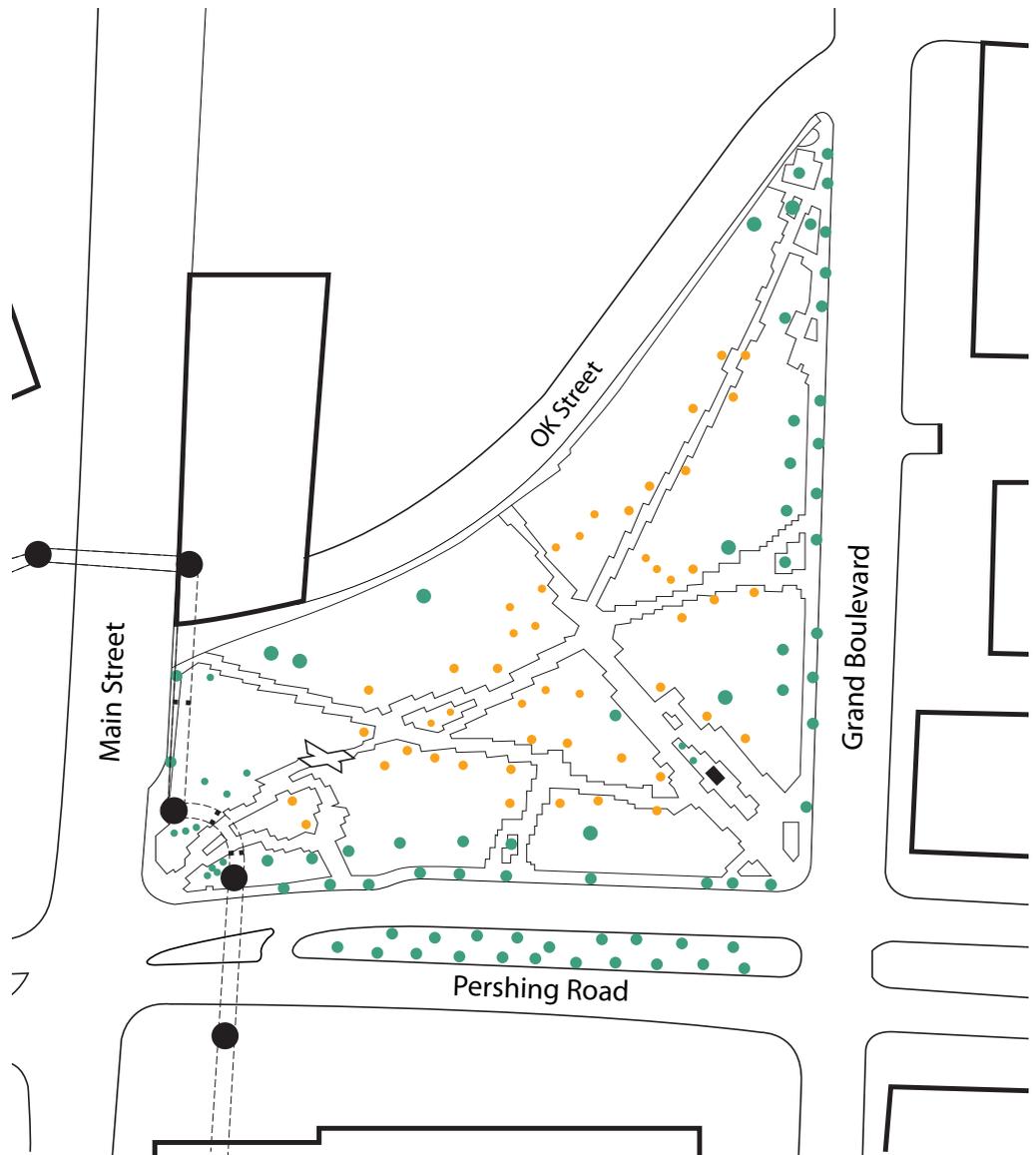
Figure 5.1.8: Native and Non-native Tree Species in Washington Square Park

Native species help mitigate the need for irrigation and maintenance and contribute to native habitats. Six tree species within Washington Square Park are native and three species, the Littleleaf Linden, River Birch, and Crabapple are exotic, but non-aggressive species.

Hightshoe (1988), Hightshoe and Groe (1998)

- Native Species**
 - Honey Locust (60)
Gleditsia triacanthos
 - Eastern Redbud (12)
Cercis canadensis
 - Sycamore (4)
Platanus occidentalis
 - American Elm (4)
Ulmus americana
 - Common Hackberry (1)
Celtis occidentalis
 - Sugar Maple (1)
Acer saccharum

- Non-native Species**
 - Littleleaf Linden (34)
Tilia cordata
 - River Birch (13)
Betula nigra
 - Crabapple (2)
Malus (species)





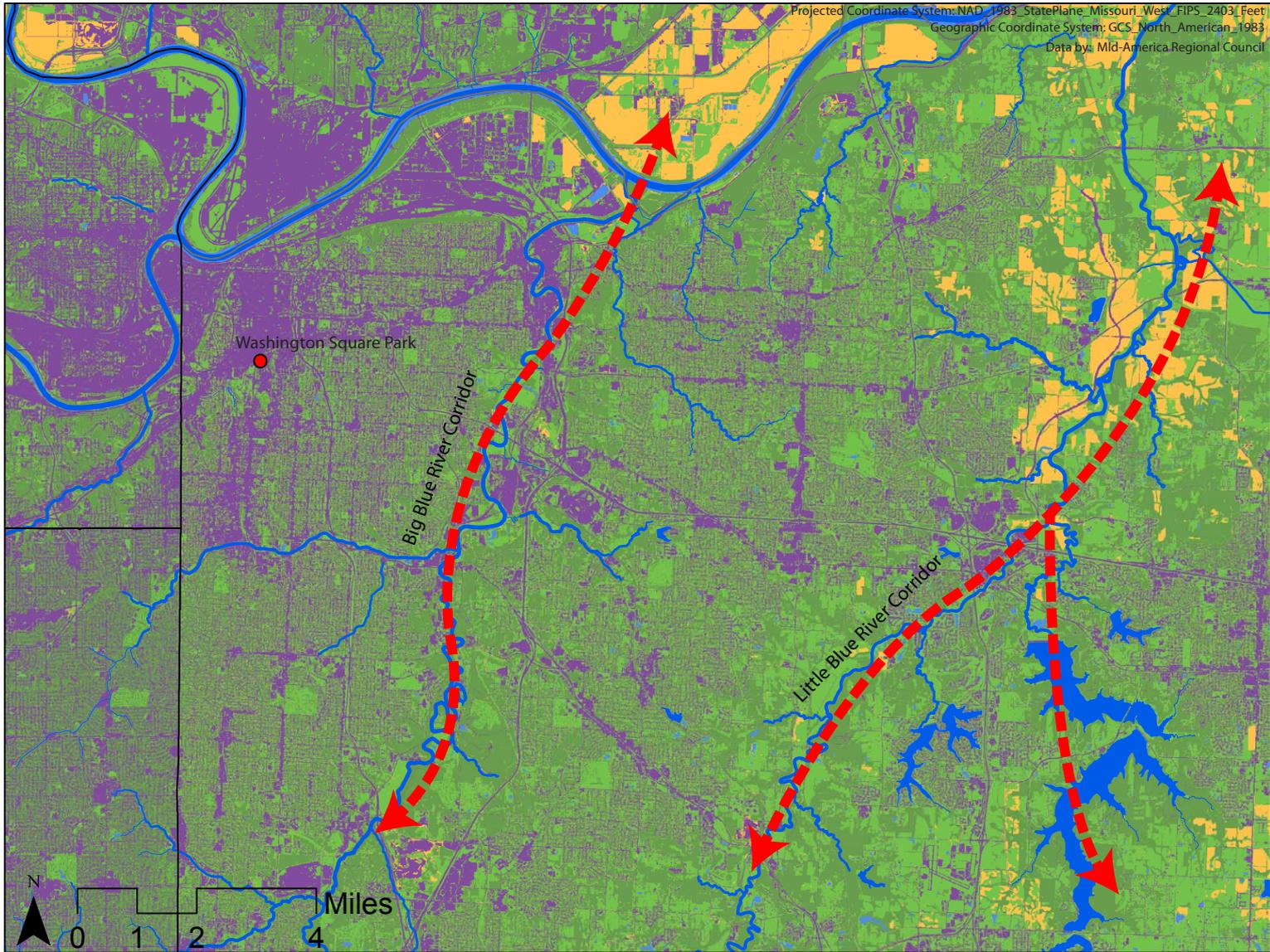
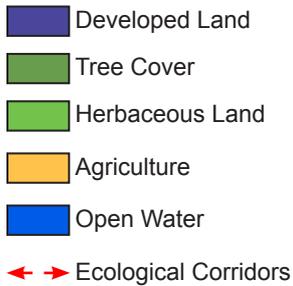


Figure 5.1.10: Kansas City Area Ecological Corridors

The Big Blue and Little Blue Rivers are major water ways in the Kansas City area. Both rivers run south from the Missouri River and create an ecological corridor for species movement. Green spaces along the rivers help species movement while urban and agricultural areas restrict animal movement.



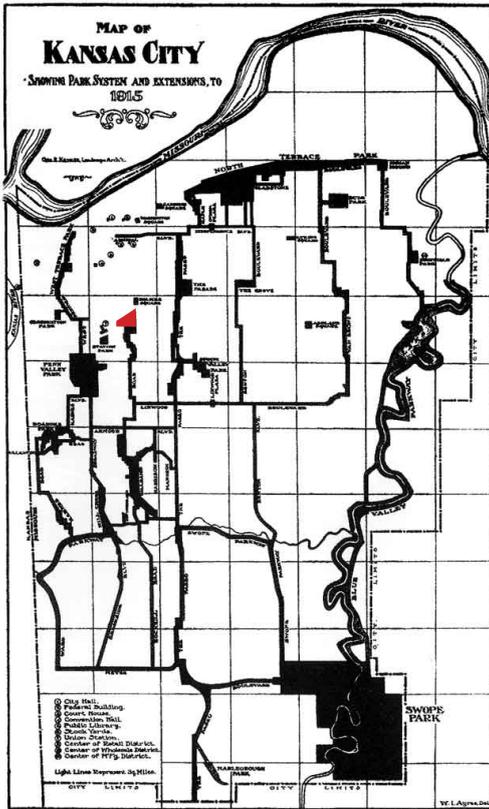
of Kansas City 2013). However, new development and the implementation of highways and major streets throughout the 1900's disrupted the Kessler system. Today, many parks remain from the City Beautiful movement, however, Kessler's original plan for parkways and systems does not remain intact (Figure 5.1.11).

Although the Kessler system no longer fully remains, surrounding green spaces can still contribute to modules or patches which can serve to increase the resilience of ecological systems in Washington Square Park (Figure 5.1.12). Several small-sized parks are located in the immediate surrounding area of the park, except for Penn Valley Park which is relatively large at 164.7 acres. The park is also near the center of Kansas City in a highly developed area. This opens the park up to possible disturbances caused by urban system feedbacks. Larger parks with conservation areas are located outside the developed city.

Creating a resilient sense of place is critical to Washington Square Park because the park is surrounded by a variety of uses (Figure 5.1.13). A parking

lot is directly north of the site at a lower elevation than the park. High-rise office buildings are adjacent to the park on the east and the Blue Cross and Blue Shield of Kansas City high-rise building is located just northwest of the park. Other developments in the area include the Creative Crossroads district, Union Station, Crown Center mall, Hospital Hill where several hospitals are located, and Penn Valley Park.

Currently, a barrier exists with connections between Washington Square Park and its surrounding uses (Figure 5.1.14). Major streets surround the park and block easy pedestrian movement between the districts. In addition, "The Link" is a skywalk which runs from Union Station, to the Blue Cross and Blue Shield building, across Washington Square Park, through Crown Center, and terminates in the Hyatt hotel. This skywalk prevents pedestrians from interacting on the street level and with Washington Square Park. Other barriers prevent connections north to the Crossroads district. One major barrier is the railroad which runs north of the parking lot. Several tracks leading to Union Station remain in this right of way and are still utilized.



Kessler Society of Kansas City

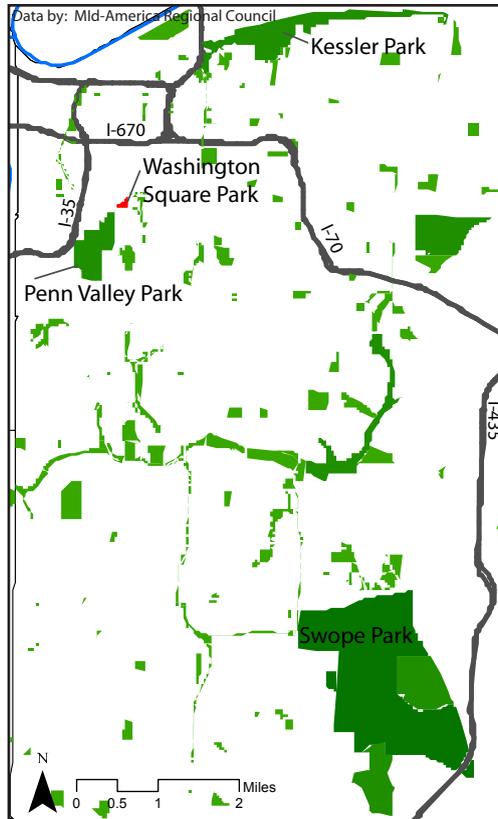


Figure 5.1.11: Kessler System in Kansas City has been Disrupted

This 1915 plan of the Kessler System demonstrates a series of connected green spaces and boulevards. Today, highways have fragmented the system, so only defragmented pieces remain.

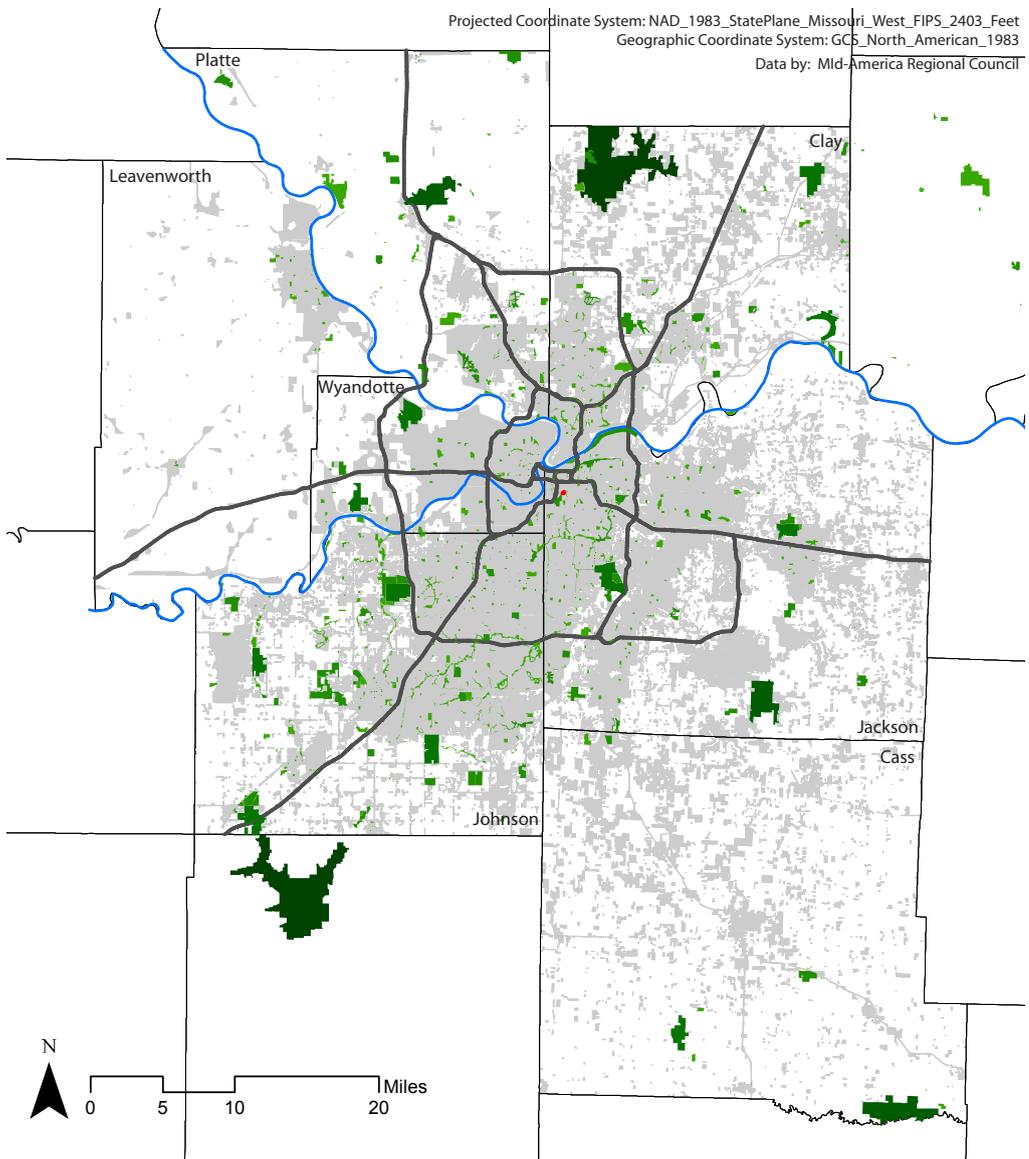


Figure 5.1.12: Regional Green Spaces Provide Opportunities for Modularity

The Kansas City area has greatly sprawled over the past century. The sizes of parks greatly increase the farther away from the city center. Several parks have been preserved in the dense downtown area, including Washington Square Park. Parks located within developed areas offer the best chance to create modules or patches for ecological systems.

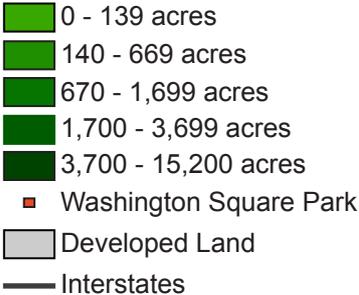
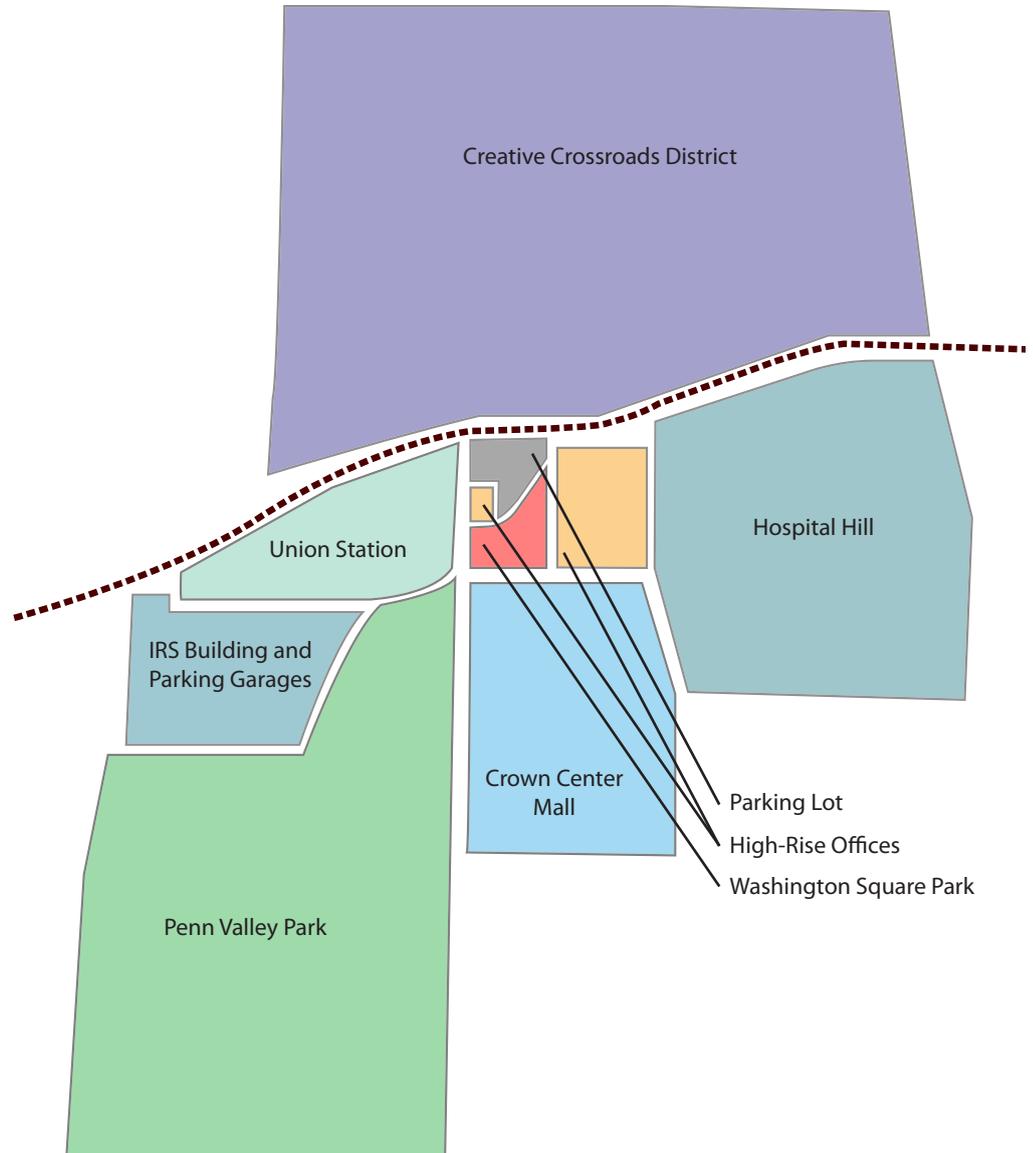


Figure 5.1.13: Washington Square Park is Surrounded by Varying Uses

Washington Square Park could become a vital civic space serving the variety of uses surrounding the park. Creating a space which links these uses and creates connections will improve the sense of place of the area and therefore improve the resilience of the park.



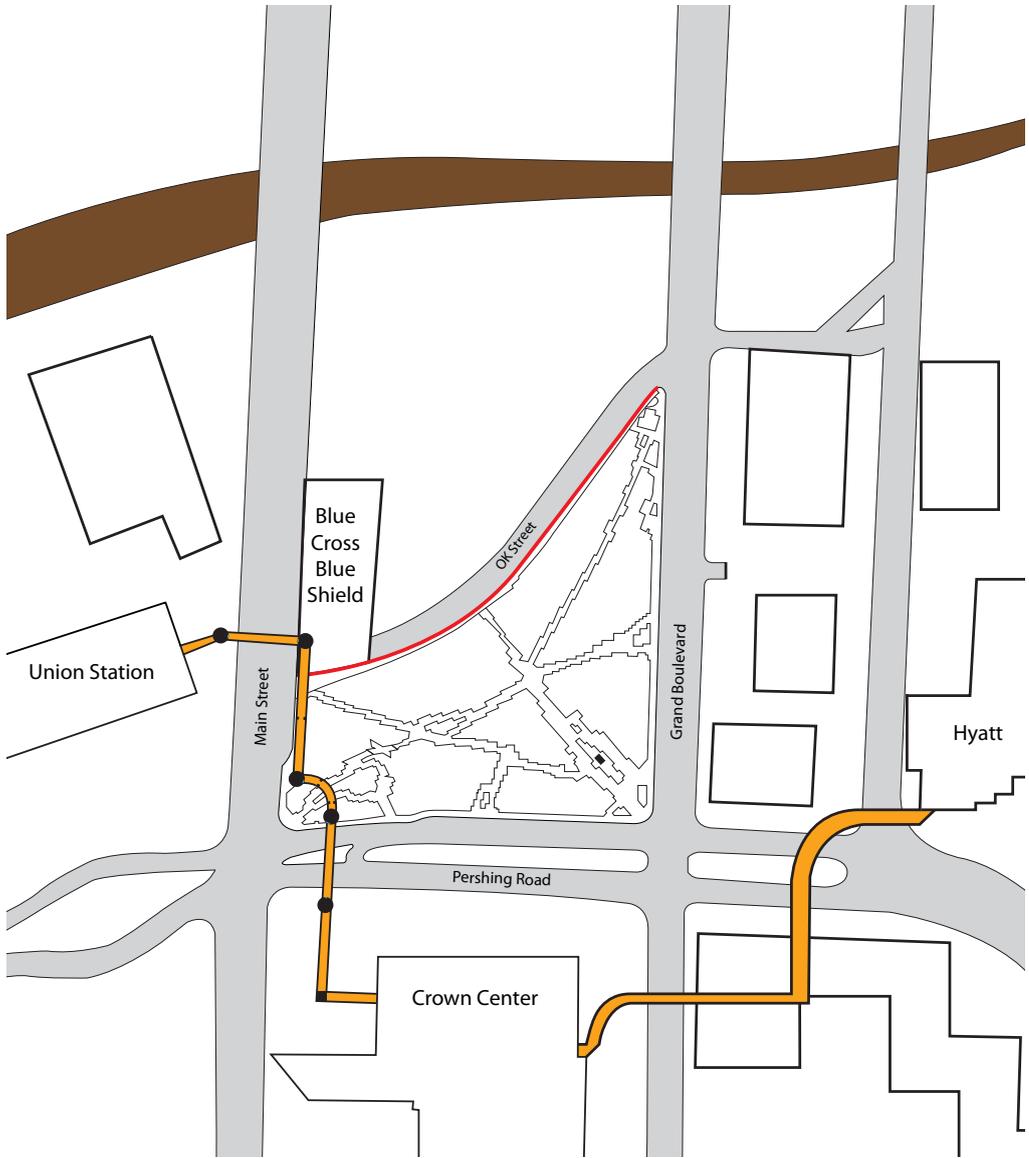


Figure 5.1.14: Connection Barriers
 The major arterial streets surrounding Washington Square Park and “The Link” prevent pedestrian interaction with the park. In addition, the elevation change north of the park and the railroad prevent connections north of the site to the Crossroads district.

- “The Link”
- Streets
- Railroad Tracks
- Retaining Wall

Recent efforts to connect pedestrians to downtown amenities has resulted in the proposal of a streetcar (Figure 5.1.15). The streetcar in downtown Kansas City will run from Union Station, near Washington Square Park, through the Crossroads and Power and Light District, to River Market in north downtown. The streetcar will further enhance pedestrian activity in downtown and connect the greater downtown area.

Several pedestrian amenities currently exist in Washington Square Park (Figure 5.1.16). Sidewalks run through the park and are lined with light posts. Benches with trash cans are scattered along the pathways and three picnic benches are located on grass in various locations. Two covered bus stops exist on the site, one on the east side by Grand Boulevard and the other on the west side by Main Street. Some planting beds containing perennial shrubs are located near entrances to the park. Additional amenities, newspaper stands, flagpoles, and a water fountain, also exist on the site.

One amenity provided by the multiple mature trees in the park is shade. I have analyzed areas covered by shade from

trees during morning and afternoon times in Spring (Figure 5.1.17). Trees provide the majority of shade for the park except for some cover from the skywalk on the western side of the park.

Current elements of interest on the site include two monuments and a gateway entrance on the southeast corner of the park (Figure 5.1.18). The gateway includes placards inscribed with the park's name and frames the statue of George Washington on a horse at that corner. The Washington statue has existed on this site since nearly the implementation of the park in 1921, but the Missouri Korean War Veterans Memorial, located on the west side of the park, was built recently in 2011. Another element is a name placard in the sidewalk at the southwest entrance of the park.

In addition, views to the surrounding landscape are major elements of interest of the park. Views north of the site look to downtown Kansas City and include the Kauffman Center for the Performing Arts. The vast parking lot located north of the park, however, fronts this view. A view also exists at the



Figure 5.1.15: Downtown Kansas City Streetcar

The proposed streetcar for Kansas City will provide access through the River Market, Central Business District, Power and Light district, and Crossroads district. The streetcar will provide pedestrian access to the Sprint Center, Convention Center, Kauffman Center for the Performing Arts, Union Station, and Crown Center, as well as Washington Square Park.

- Downtown Amenities
- Parks
- Streetcar Line
- Stops
- Interstates

Figure 5.1.16: Existing Amenities

Amenities have been added to Washington Square Park including sidewalks, benches, trash cans, and lighting. Two bus stops currently exist in the park and on-street parking surrounds the site. The park is mainly covered in turf grass, but some ornamental vegetation does exist.

-  Turf Grass
-  Sidewalks
-  Ornamental Plantings
-  On-street Parking
-  Covered Bus Stop
-  Newspaper Stands
-  Seating
-  Trash Can
-  Flagpole
-  Water Fountain
-  Light Post





Morning Shade



Afternoon Shade

Figure 5.1.17: Morning and Afternoon Shade Provided by Trees in the Spring

Currently Washington Square Park is heavily shaded by the high number of large trees. This is one ecosystem service trees can provide in the park. The abundance of shade can lead to increased enjoyment and use of the park.

Figure 5.1.18: Views and Monuments are Elements of Interest Currently in Washington Square Park

Two monuments, a George Washington statue and the Missouri Korean War Veterans Memorial, add interest to the park. Additionally, a gateway fronts the southeastern entrance to the park and a placard with the park name exists in the sidewalk at the southwest entrance. Significant views to downtown Kansas City, Liberty Memorial, and Union Station are also existing features of the site.

- Existing Features
- Views

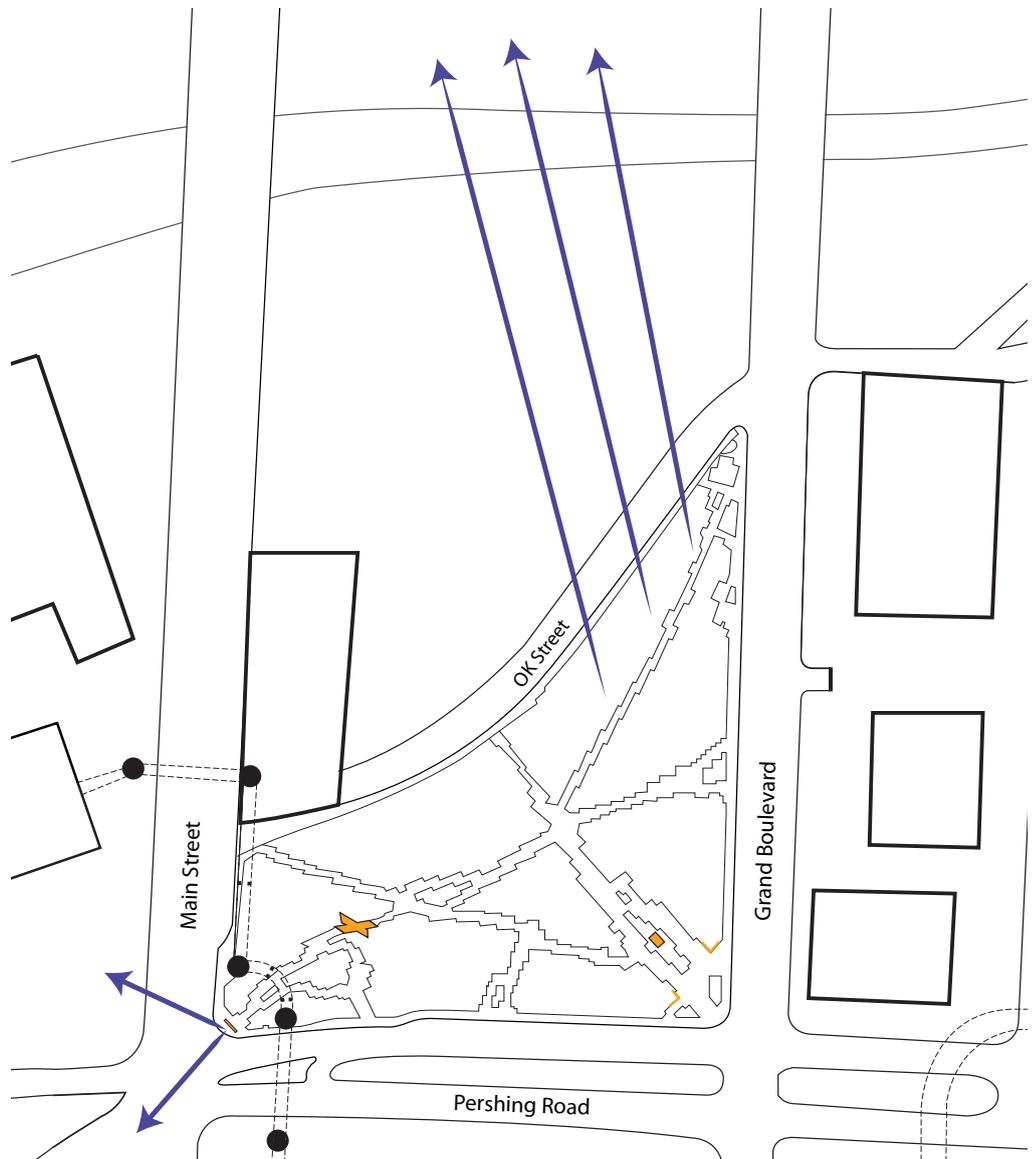


Figure 5.1.19: Goals for the Redesign of Washington Square Park determined from the Site Analysis

Goals determined from the site analysis focus on connecting pedestrians, preserving the current interests of the park, and implementing native plants to accommodate animal species. These goals contribute to creating a list of overall goals for the park's redesign.

Goals for Washington Square Park determined by the Site Analysis

Restore connections to surrounding parks (Kessler System)

Connect pedestrians to surrounding uses

Preserve and utilize views

Preserve statues and monuments within the park area

Add amenities suitable for everyday use and special events

Remove invasive and singular species

Use native species to absorb stormwater runoff

Accommodate streetcar stop at Union Station

Maintain permeable surfaces and reduce impermeable surfaces

Collect and cleanse stormwater

Implement additional ecosystem services

Accommodate existing animal species

southwest corner of the site looking towards Penn Valley Park and Liberty Memorial. A view from this corner also exists towards historic Union Station.

Goals discovered from the site analysis for Washington Square Park include connecting pedestrians to surrounding parks and uses, accommodating the streetcar stop,

and preserving existing interests in the park (Figure 5.1.19). The site analysis also reveals the park redesign should use native species to collect and cleanse stormwater and provide habitats. In addition, the site analysis goals reveal permeable surfaces and ecosystem services should be implemented in the park.

Document	Greater Downtown Area Plan (2010)	Kansas City Downtown Corridor Strategy (2005)	Request for Qualifications/Proposals (2013)
Downtown Goals	<p>Prepared for: The City of Kansas City, Missouri Prepared by: City Planning and Development Department, BNIM, El Dorado Inc., Taliaferro & Browne Inc., HDR, KC Consulting, ETC Institute, and Architectural & Historical Research</p> <p>Create a Walkable Downtown</p> <ul style="list-style-type: none"> Elevate walking as the most important mode of transportation Support alternative transportation Connect all districts with walkable pathways <p>Double the Downtown Population</p> <ul style="list-style-type: none"> Promote diversity Track housing Provide diverse housing options Provide a dynamic urban environment <p>Increase Employment Downtown</p> <ul style="list-style-type: none"> Attract new businesses Pursue focused and targeted approaches Create new tools, policies, and procedures <p>Retain and Promote Safe, Authentic Neighborhoods</p> <ul style="list-style-type: none"> Maintain unique characters Promote compatible infill Repair infrastructure and develop maintenance programs Keep residents and visitors safe <p>Promote Sustainability</p> <ul style="list-style-type: none"> Use sustainable practices to guide policies and development decisions Improve air and water quality, manage stormwater, mitigate heat island effect 	<p>Prepared for: The Civic Council of Greater Kansas City Prepared by: Sasaki Associates and ERA</p> <p>Create centers of activity</p> <ul style="list-style-type: none"> Areas of intensity and diversity Specialty areas for arts, dining, and entertainment <p>Create “walkable urbanity”</p> <ul style="list-style-type: none"> Improve streetscapes Create pedestrian-friendly streets with a balance between vehicles and people Buildings should engage the street <p>Provide alternative transportation</p> <ul style="list-style-type: none"> Bring visitors in by commuter rail centered at Union Station System of alternative transportation including bus rapid transit, trolleys, streetcars, and commuter rail <p>Create a district identity</p> <ul style="list-style-type: none"> Create downtown gateways Use streets to connect places and districts Preserve and adapt to uses for historic buildings <p>Increase downtown population</p> <ul style="list-style-type: none"> Increase housing and office markets downtown <p>Improve park programming</p> <ul style="list-style-type: none"> Activate urban parks by providing surrounding uses Provide diverse and adaptable programs Add programs which reflect the needs of downtown 	
Washington Square Park Goals	<p>Connect activity centers around the park Add diverse programs Evaluate development potential around the park Improve security Encourage low maintenance native plants Use urban forestry to improve air quality and mitigate heat island effect</p>	<p>Develop stronger connections and a cohesive identity for the area around the park Transform highway-like streets around the park to city streets Create broad sidewalks Implement better wayfinding Tame the automobile and ensure pedestrians can stroll comfortably Infill development on the north edge Activate the ground floor of buildings Create a civic gathering space for the area</p>	<p>Create gathering space and civic hub serving surrounding development Reinforce the park’s relationship with the Park and Boulevard Plan Compliment plans for Grand Boulevard and Pershing Road Welcomes people of all ages and abilities Can be used everyday and for special events Areas for recreation Connections to multi-modal transit Should build on existing assets and past plans and community engagement</p>

Washington Square Park Goals

The goals discovered in the site analysis are combined with goals discovered in an analysis of Washington Square Park documents to create overall goals for the park. These overall goals set objectives for the redesign of the park as well as help create the guidelines for designing resilient urban civic spaces.

The three park documents I analyzed to determine the overall goals for Washington Square Park are the Greater Downtown Area Plan (2010), the Kansas City Downtown Corridor Strategy (2005), and the Request for Qualifications/Proposals (RFQ/P) (2013). The Greater Downtown Area Plan and Kansas City Downtown Corridor Strategy also provide goals for creating a better downtown in Kansas City. The RFQ/P for the redesign of Washington Square Park only focuses on the goals of the park (Figure 5.2.1).

The Greater Downtown Area Plan was prepared by a group of designers, city planners, and developers for the City of Kansas City, Missouri. The plan addresses the goals for creating a

more vibrant downtown and has specific goals for Washington Square Park, so the park can contribute to creating vibrancy in downtown. The Kansas City Downtown Corridor Strategy, prepared by Sasaki Associates and ERA, is similar to the Greater Downtown Area Plan, but focuses on centers for activity within downtown which are connected by walkable corridors. The plan identifies the Washington Square Park area as one of these activity centers and focuses on the park's lack of connections and poor walkability. The RFQ/P highlights Kansas City Parks and Recreation Department's goals and objectives for Washington Square Park's redesign.

Common goals for downtown shared between the Greater Downtown Area Plan and the Kansas City Downtown Corridor Strategy include creating better walkability, connecting districts with walkable pathways, increasing the downtown population, and providing alternative transportation. A major difference between the two plans is the Greater Downtown Area Plan focuses on sustainability and safety as goals for downtown while the Kansas City Downtown Corridor Strategy does not.

Figure 5.2.1: Goals for Washington Square Park determined from the Park Documents

The Greater Downtown Area Plan, Kansas City Downtown Corridor Strategy, and Request for Qualification/Proposals for the redesign of Washington Square Park outlines goals for the park and for downtown Kansas City. The goals in these documents contribute to the overall goals of the redesign of the park, along with the goals determined from the site analysis.

The goals for Washington Square Park between the three documents are all similar. A major goal is connecting the park to its surrounding uses and using the park to create a central gathering space. In addition, all three documents address the need for development infill around the park, especially the north side. Third, a major goal is to make the area more walkable which is a major goal for all of downtown Kansas City. Last, the RFQ/P specifically has a goal for the park to be welcoming to a variety of people everyday and for special events.

The overall goals for Washington Square Park are: create an identity for the park, increase connectivity, and promote sustainability and implement ecosystem services (Figure 5.2.2). The park documents and the site analysis reveal the park's lack of identity and the need to implement programs while maintaining elements of interest in the park. The analysis also reveals the lack of connections to and from the park for pedestrians. The Kansas City Downtown Corridor Strategy specifically calls for a reduction in automobile dominance around the park and for activated building groundfloors to contribute to pedestrian

Goals for Washington Square Park determined by Park Documents and Site Analysis Goals

Create an identity for the park

- Create a gathering space for surrounding development
- Add diverse programs for everyday use and special events
- Preserve statues and monuments within the park
- Preserve and utilize views

Increase connectivity

- Connect pedestrians to surrounding activities
- Reduce automobile dominance around the park
- Connect the park to other parks and parkways (restore Kessler System)
- Accommodate future streetcar stop at Union Station
- Activate building groundfloors and infill the parking lot north of the park

Promote sustainability and implement ecosystem services

- Remove invasive and singular plants
- Plant native vegetation
- Maintain permeable surfaces and reduce impermeable surfaces
- Use vegetation to improve air quality, mitigate heat island effect, and absorb stormwater
- Collect and cleanse stormwater
- Accommodate habitats of existing animal species

connectivity. The Greater Downtown Area Plan is the only document to address sustainability in downtown Kansas City, but the site analysis reveals there is a need to add native vegetation and permeable surfaces as well as collect and cleanse stormwater and facilitate animal habitats.

Case Study and Strategy Analyses

Analyses of case studies and suggested sets of strategies provide design implementations which create resilient landscapes. The set of strategies analyzed are by Kevin Cunningham from his thesis *Resilience Theory/A Framework for Engaging Urban Design* (2013). The case studies analyzed are design proposals which have strived to create resilience in urban civic spaces or urban areas. The case studies are James Corner's and Stan Allen's and OMA's proposals for Downsview Park in Toronto, Field Operation's proposal for Fresh Kills Park in Staten Island, Joan Hirschman Woodward's studio in Los Angeles, and Stoss's design proposal of the Lower Don Lands in Toronto.

Suggested Strategies

The suggested strategies I have analyzed are the concluding strategies in Kevin Cunningham's thesis, *Resilience Theory/A Framework for Engaging Urban Design* (2013). Cunningham lists goals for resilient landscapes and potential strategies for achieving these goals as the findings of his thesis. Cunningham determined these goals and strategies from a series of case studies using a framework. Cunningham developed his framework by analyzing the previous work of Jack Ahern (2011) and Walker and Salt (2006). The framework allowed Cunningham to evaluate case studies for thresholds, diversity, redundancy, connectivity, and planning of social, ecological, and economic systems at the regional, metro, and site scales. Therefore, Cunningham's goals and strategies address each element with each system at each scale. Many strategies, however, overlap and contribute to creating resilience in multiple aspects.

The analysis reveals Cunningham's strategies focus mainly on the fauna and people systems (Figure 5.3.1). Stormwater collection is also addressed

Figure 5.2.2: Goals for the Redesign of Washington Square Park

The overall goals for the redesign of Washington Square Park consist of goals determined from the site analysis and of goals outlined in park documents. These overall goals are combined with the strategies for designing resilient systems discovered in the case study and strategy analyses to create the design guidelines.

Social-Ecological Systems

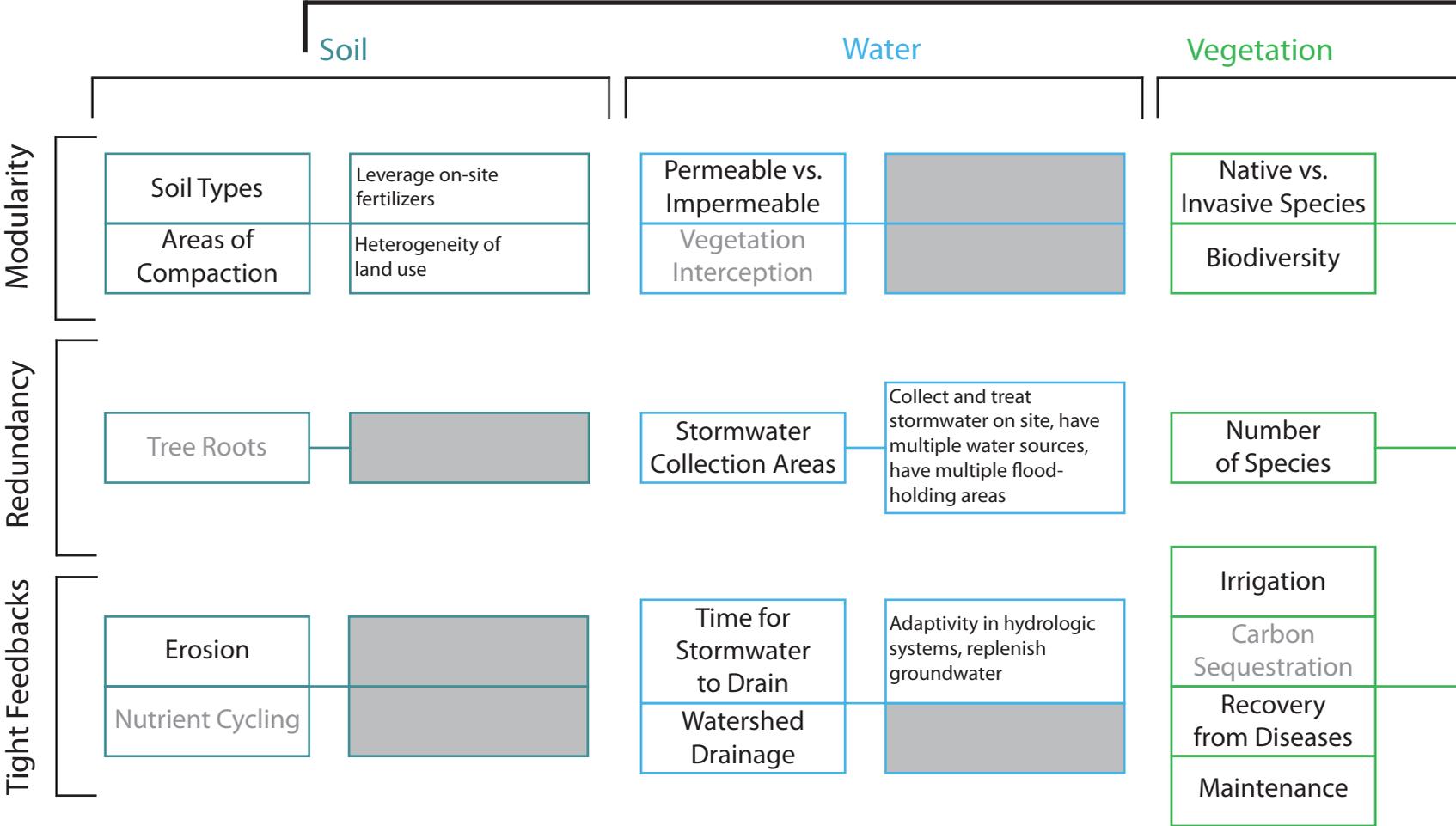


Figure 5.3.1: Strategy Analysis - Kevin Cunningham, *Resilience Theory/A Framework for Engaging Urban Design* (2013)

Fauna

People

Create diverse edge conditions, brown roofs, bioswale networks, diverse planting palette

No strategy addressed

Use planting and maintenance strategies that use less water

No strategy addressed

No strategy addressed

Reuse existing materials, use safe-to-fail management strategies

Species Movement

Expand habitat corridors, create buffers between land uses to facilitate flow of species

Habitats

Link critical habitat patches, habitat diversity, small-scale habitat patches

Number of Habitats/Habitat Elements

Create critical habitats, increase tree canopies, multiple habitat connectivity points

Pollination

Create small-scale habitats for insects

Migration

Provide connectivity for migratory species

Park System

Heterogeneous pattern of development

Connectivity

Connect to neighborhoods and learning institutions, create walkable loop to relevant destinations

Amenities

Alternative transportation modes, accommodate all demographic groups, diversity in fuel sources, housing typologies, services and accessibility

Elements of Interest

Engage natural site features

Programs

Community-managed food networks, diverse edge conditions, recreation, natural/cultural experiences, open space typologies, multiple gathering locations

Government

Create partnerships with local groups, studies promote knowledge to governing bodies

Visitation

Flow information through meetings and social networking

No strategy addressed

in the strategies as well as the need for vegetation diversity. Cunningham's strategies are one of the only strategies studied in this report which addresses pollination and migration. Many of the case studies address species movement, but migration involves larger continental and global movement of a variety of species. These strategies also address the need for heterogeneity. Cunningham determines heterogeneous land use and pattern of development are necessary to creating resilience.

Downsview Park

This first case study I have analyzed is of Downsview Park in Toronto. I analyzed two design proposals for this park, one by James Corner and Stan Allen and the other by the firm OMA. These two proposals were entered into a design competition for Downsview Park in 1999. The OMA proposal won the competition and has progressed further into a preliminary site design.

Corner and Allen developed a proposal for the park entitled "Emergent Ecologies." This proposal weaves people systems and ecological systems into two bands which merge on the site (Czerniak 2001,

58). Corner's and Allen's design focuses on fauna and creating habitats which mesh with the drainage system on the site (Figure 5.3.2). A ridge and furrow drainage system collects water in basins where wetter plants can be planted and support a type of habitat. On the edges of the basins, drier plants can be planted and a different habitat type can exist (Czerniak 2001, 61). Corner's and Allen's strengths with this proposal are providing amenities for people, creating many redundant and diverse habitats, creating multiple stormwater collection areas, and connecting to larger woodland systems for the movement of species. A weakness is that there is no intention to address the resilience of soils on the site.

On the other hand, OMA's proposal for Downsview Park, "Tree City," fully details a soil preparation plan as the first step to redesigning the park (Czerniak 2001, 79). However, OMA's design does not facilitate many of the components in the matrix (Figure 5.3.3). The proposal is designed as a series of clusters which are loosely assigned program elements. OMA's intent with this concept is that the clusters will be assigned programs over time and will be able to change over

time. Therefore, laying the foundations for the park to sustain itself is more important in this proposal than a specific site plan. The foundations of the park creation include soil preparation, laying pathways, and then adding vegetation clusters (Czerniak 2001, 74). The overall concept for this park is the main strategy for creating resilience, so specific strategies are not revealed.

Fresh Kills Park

Another case study by James Corner and Field Operations is of Fresh Kills Park in Staten Island. Field Operations's proposal for the park, "Lifescape," was also entered into a design competition for the park in 2001 and won the competition. Fresh Kills Park is a large area in Staten Island which is on top of a formerly operating landfill. Therefore, Field Operation's proposal involves large mounds and incorporates many topography changes (Field Operations 2014). For this reason, the proposal addresses soil remediation and erosion, unlike Corner's proposal for Downsview Park (Figure 5.3.4).

This case study is the only one studied to address resiliency for erosion. The

proposal stabilizes slopes and covers slopes with vegetation to create tight feedbacks when erosion occurs. In addition, this case study addresses vegetation absorption and creates berms for holding stormwater runoff for woody materials (Field Operations 2014).

The Lifescape design is also unique because the proposal takes initiative to make and distribute logos and posters around the community (Czerniak 2007, 228). This method is intended to increase awareness of the goals of the park's redesign and to increase visitation. However, like most of the case studies, the proposal does not address pollinating species or migration. Field Operation's narrative for this proposal actually addresses Staten Island's importance for many migratory species, but the design does not address any specific attention to migration other than the park being a large vegetated area.

Los Angeles

The next case study by Joan Hirschman Woodward is her studio's work on designing resilient landscapes within Los Angeles. Woodward explains the strategies her studio discovered for

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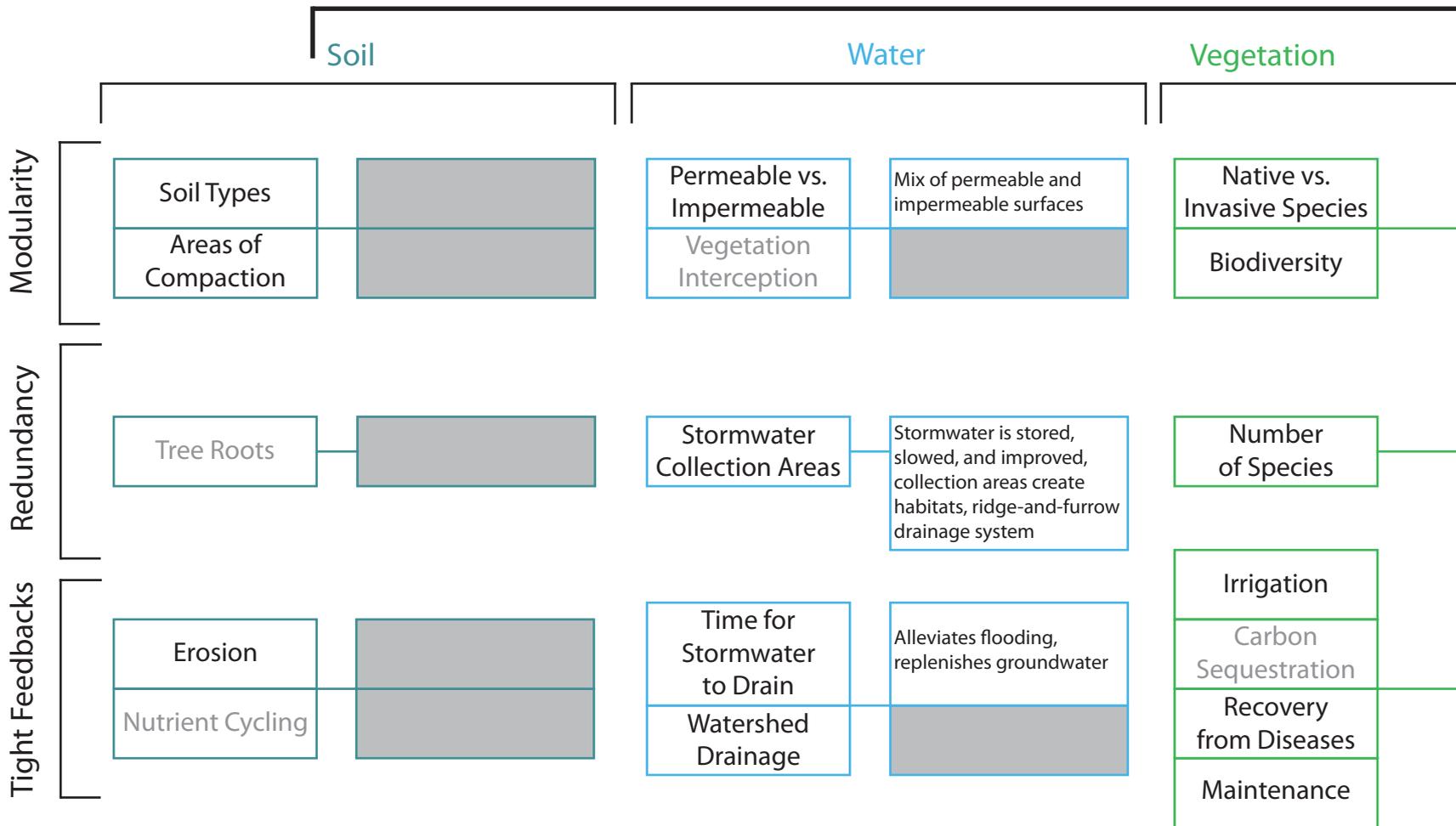


Figure 5.3.2: Case Study Analysis - James Corner and Stan Allan, Downsview Park, Toronto

Fauna

People

Clumps of conifer patches

Mix of vegetated groves and meadows

Tree lines create a windbreak, deciduous tree rows

Use vegetation for movement of people, water, and wildlife

Species Movement

Habitats

Linked to larger woodland systems, meadow corridors connect to adjacent ravines, dispersal corridor for wildlife
Habitats created with drainage system, difference in habitats

Number of Habitats/Habitat Elements

Redundant habitats across the site

Pollination

Migration

Park System

Connectivity

Amenities

Elements of Interest

Programs

Government

Visitation

Connects to adjacent ravine parks

Circuits of paths and services link territories, circulation corridors link activities

Services and elements varying in intensity based on need, windmills generate energy, lighting

Frame large open spaces and horizons

Areas for environmental education, interactive landscapes, diversified activities

Ecological test sites

No strategy addressed

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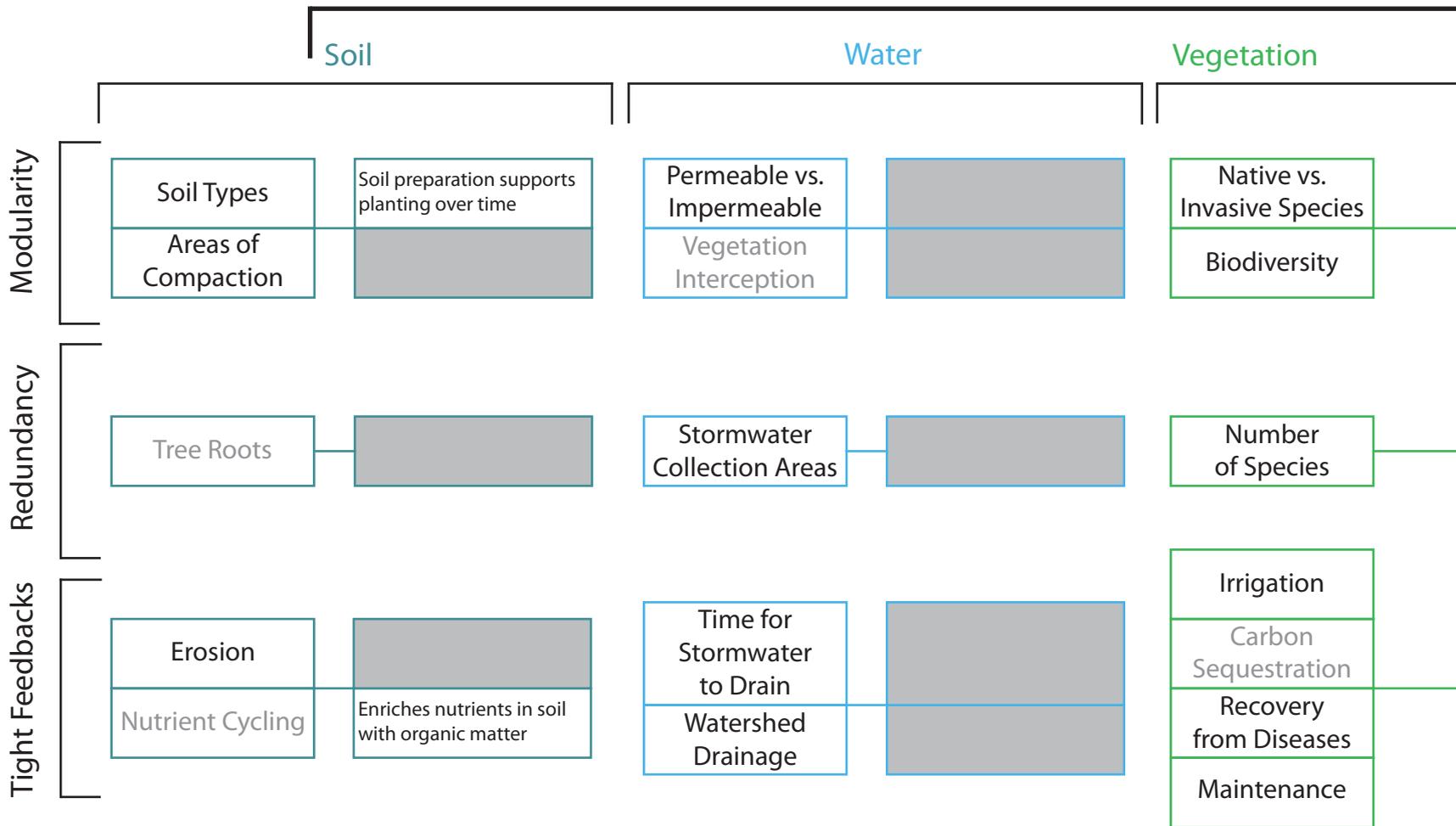
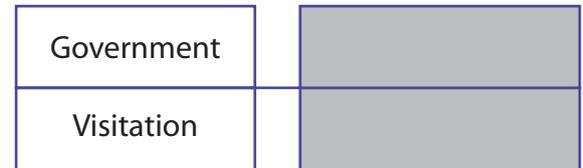
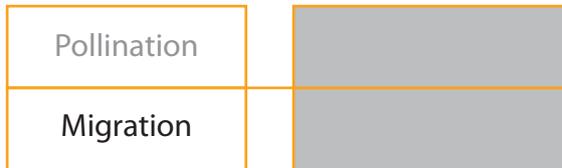
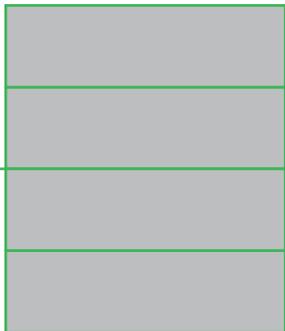
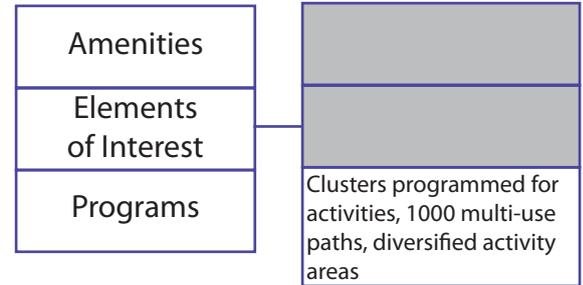
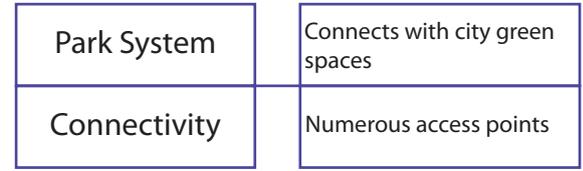
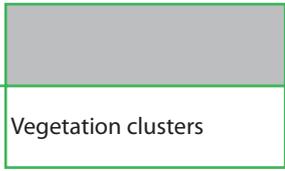


Figure 5.3.3: Case Study Analysis - OMA, Downsview Park, Toronto

Fauna

People



No strategy addressed

Social-Ecological Systems

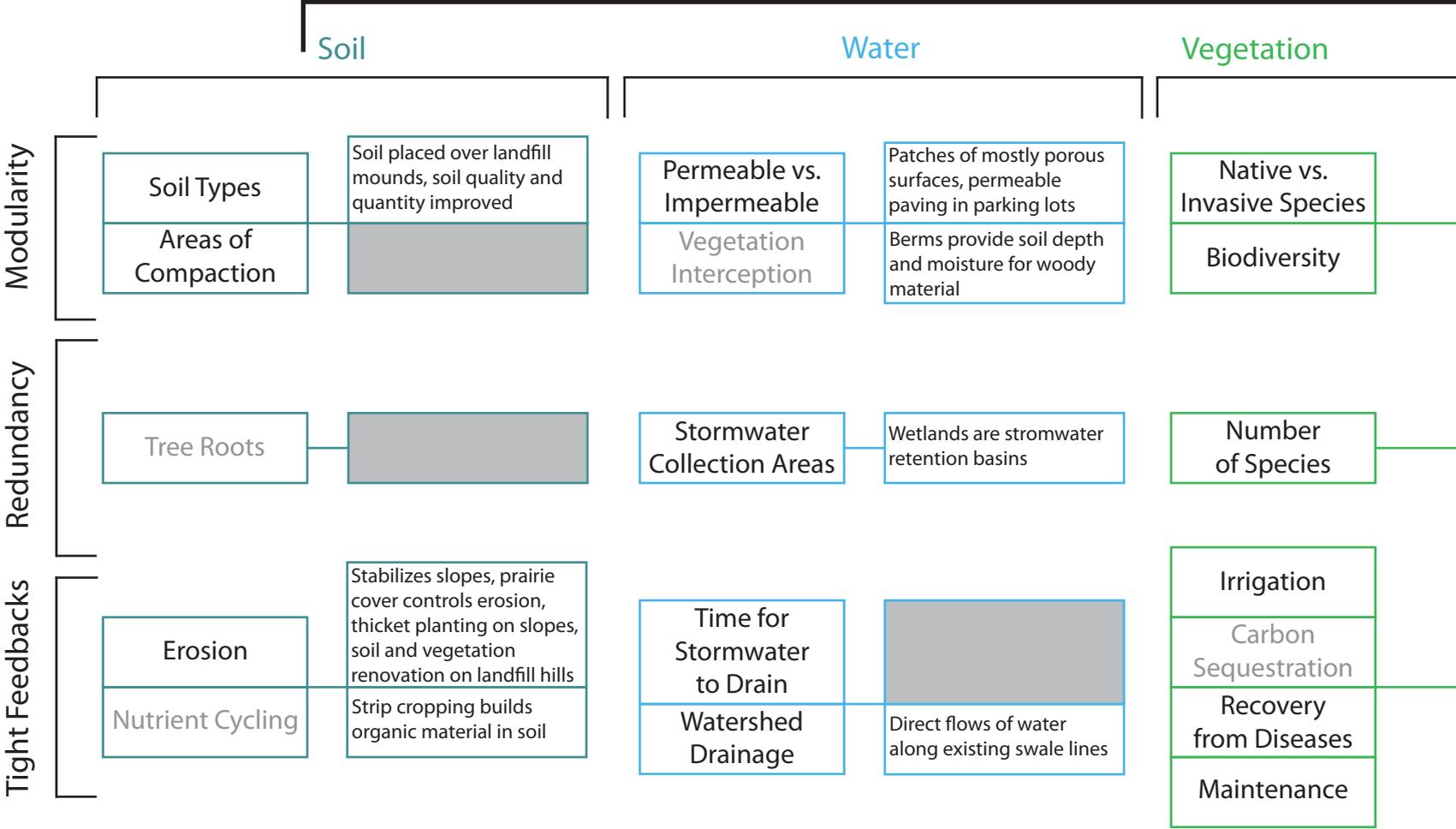


Figure 5.3.4: Case Study Analysis - Field Operations, Fresh Kills Park, Staten Island, New York

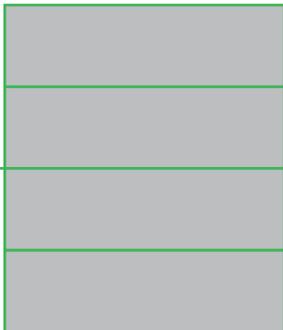
Fauna

People

Removes invasive species, native species form habitats, naturalized plantings

Introduces woody materials, diverse mix of species

Multiple native woodland communities



Species Movement

Dense woodland rim creates an ecological corridor

Habitats

Establishes grassland, habitats based on slopes and types of plants, habitat restoration, utilizes existing natural resources

Number of Habitats/Habitat Elements

Dense nests of protected habitats

Pollination



Migration



Park System

Four parks created within larger area

Connectivity

Weaves the parts of Staten Island together, defragmentation strategies

Amenities

Circulation paths, mesh screens, light beacons, gas facility incorporates solar and wind power

Elements of Interest

Prominent external views, memorial

Programs

Education areas

Government



Visitation

Designed advertisements, logos, and posters for public meetings

No strategy addressed

Social-Ecological Systems

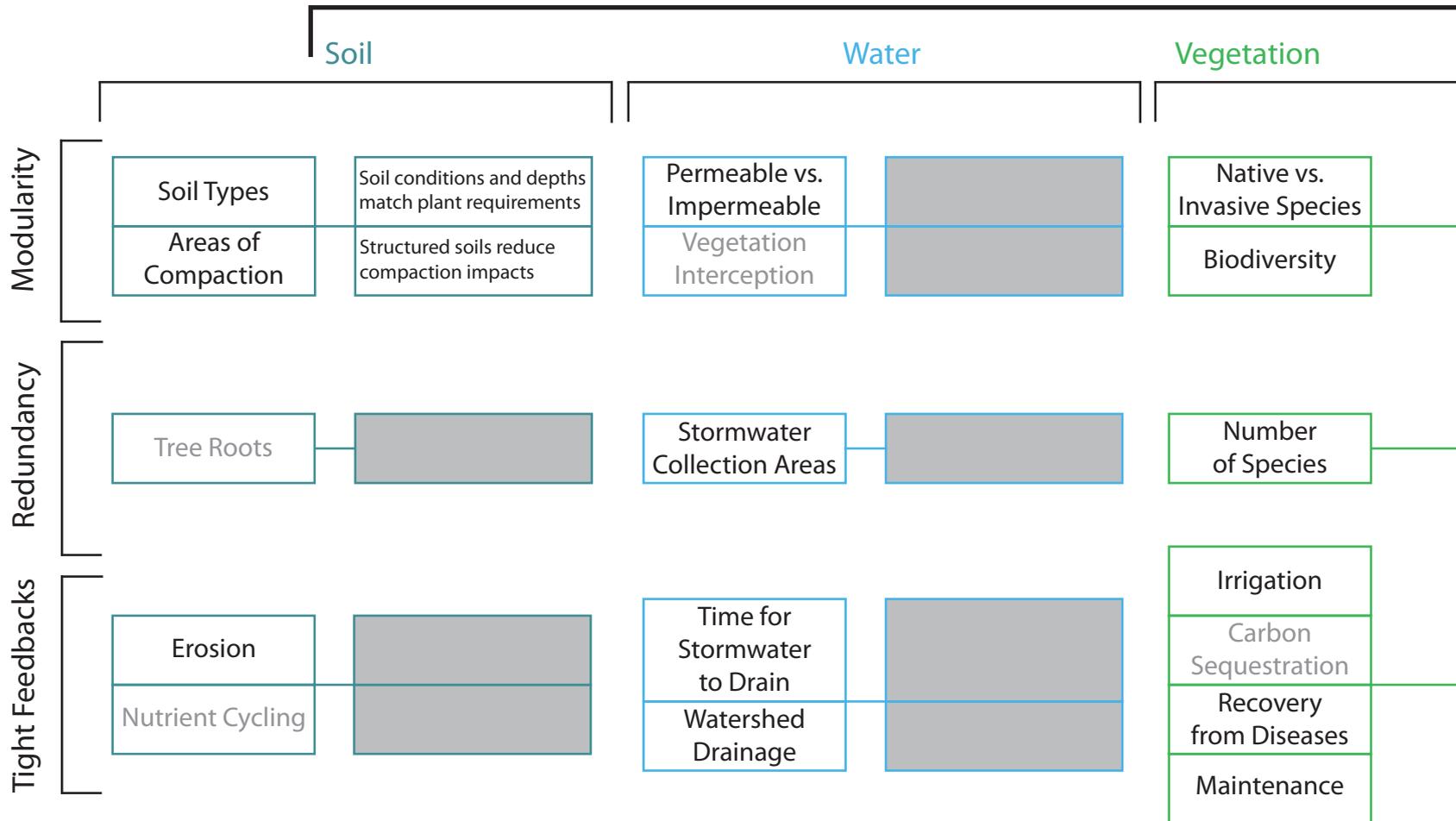


Figure 5.3.5: Case Study Analysis - Joan Hirschman Woodward, Los Angeles

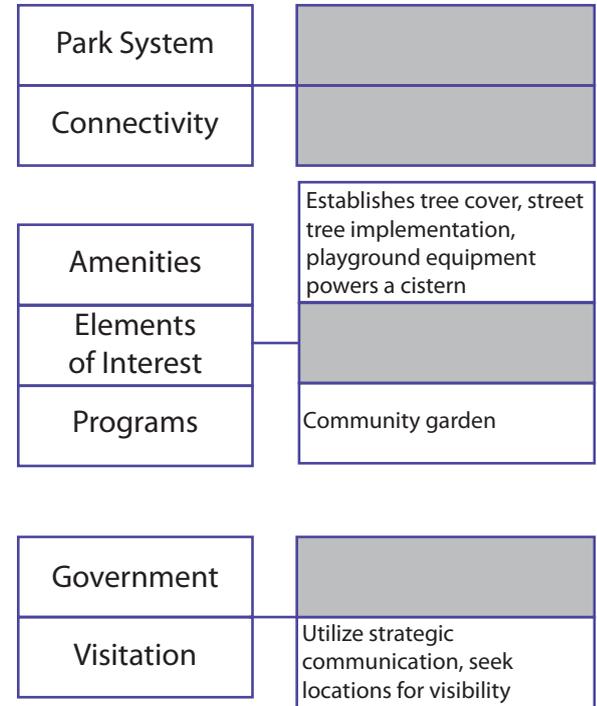
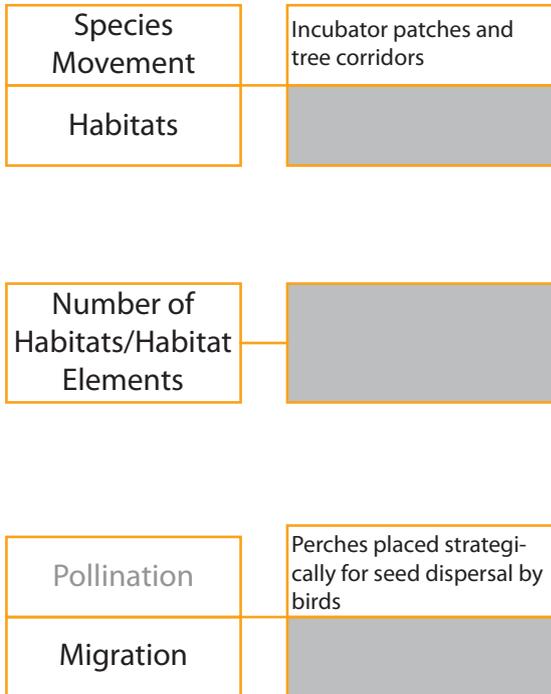
Fauna

People

- Only native and non-aggressive invasive species
- Creation of vegetation adaptation zones

- More field-grown plants to provide structure

- Craft water schedules to match plant requirements
-
-
- Appropriately-sized plants, ephemeral seed germination, self-reseeding plants, weed-suppressing plants, recycled mulch, or goats, well-located sites can have maintenance issues reported and responded to sooner



No strategy addressed

creating resilient landscapes in her article in *Landscape Journal* (Woodward 2008, 102). She then further describes one case study and the methods used to create a resilient landscape in the West Adams-Normandie district of Los Angeles.

The design strategies for Woodward's case study focus on vegetation (Figure 5.3.5). The design only incorporates native plants or non-aggressive invasive plants. The design also addresses maintenance for vegetation. Woodward explains vegetation should be appropriately sized and given enough room so pruning is not necessary. She also explains the importance of self-germinating plants and weed-suppressing plants to create resilience. In addition, Woodward describes the importance of a well-located area so maintenance issues can be reported sooner and create tighter feedbacks (Woodward 2008, 106).

This case study focuses on making landscapes resilient with self-maintaining vegetation, however, stormwater collection is not addressed. Although the implementation of vegetation can alleviate runoff, stormwater is a critical issue that needs to be addressed in resilient landscapes, especially in urban areas.

Lower Don Lands

The final case study is Stoss Landscape Urbanism's design of the Lower Don Lands in Toronto. Stoss's design, "RIVER+CITY+LIFE," was also a part of a design competition in 2007. The focus for the competition was to redesign the Lower Don Lands so the Don River can flow freely through the area into the surrounding bay (Burga 2008, 20). Stoss's proposal makes the river the focus for the area and provides development on berms integrated with the river (Stoss Landscape Urbanism n.d.).

The wetland habitat is the focus for this proposal (Figure 5.3.6). Stoss's design is a mesh of wetlands and uplands, so the designers selected vegetation which can survive in these varying habitats. Existing fauna, specifically fish, are accommodated for depending on the water locations where the different species reside. Recreation is then provided around and within the river. These programs are designed to be able to flood with the river (Stoss Landscape Urbanism n.d.).

Stoss's proposal also addresses a major housing need in this dense area of Toronto. The proposal accommodates

housing for 20,000 people. The housing plan consists of different densities which creates distinct neighborhood identities on the site (Stoss Landscape Urbanism n.d.).

Synthesis

A synthesis of the case study and strategy analyses reveals the overall methods for creating resilient social-ecological systems in urban areas (Figure 5.3.7). A common method shared by the case studies is the use of stormwater collection areas to create habitats. Vegetation is planted according to the amount of stormwater the collection area receives. The vegetation can be irrigated by the stormwater which reduces stormwater runoff. The vegetation then helps create habitats to facilitate different animal species. This is a major method to designing self-sustaining vegetation and habitats in landscapes.

Another common theme in the analyses is providing diverse programs for people with connections to alternative transportation. Diverse programs will attract people of varying ages and backgrounds to the area which will

help the area remain active. Alternative transportation will facilitate visitation and increase walkability.

Other common methods in this study include connecting to surrounding uses, providing ecological corridors, alleviating flooding and replenishing groundwater, enriching nutrients in soil, and reusing existing materials. Overall, the case studies and set of strategies address amenities and programming for people the most out of any other element.

Other systems addressed frequently are the water and vegetation systems. Fauna systems were not addressed frequently except for the habitats and species movement elements. Soil systems were addressed the least in every case study or set of strategies. The tree roots element within the soil system was not addressed in any of the analyzed projects along with carbon sequestration and recovery from diseases. Carbon sequestration and recovery from diseases are in the tight feedbacks category which overall had the least amount of strategies addressed. Modularity was the category most frequently addressed with the addition of redundant elements for the water and people systems.

Social-Ecological Systems

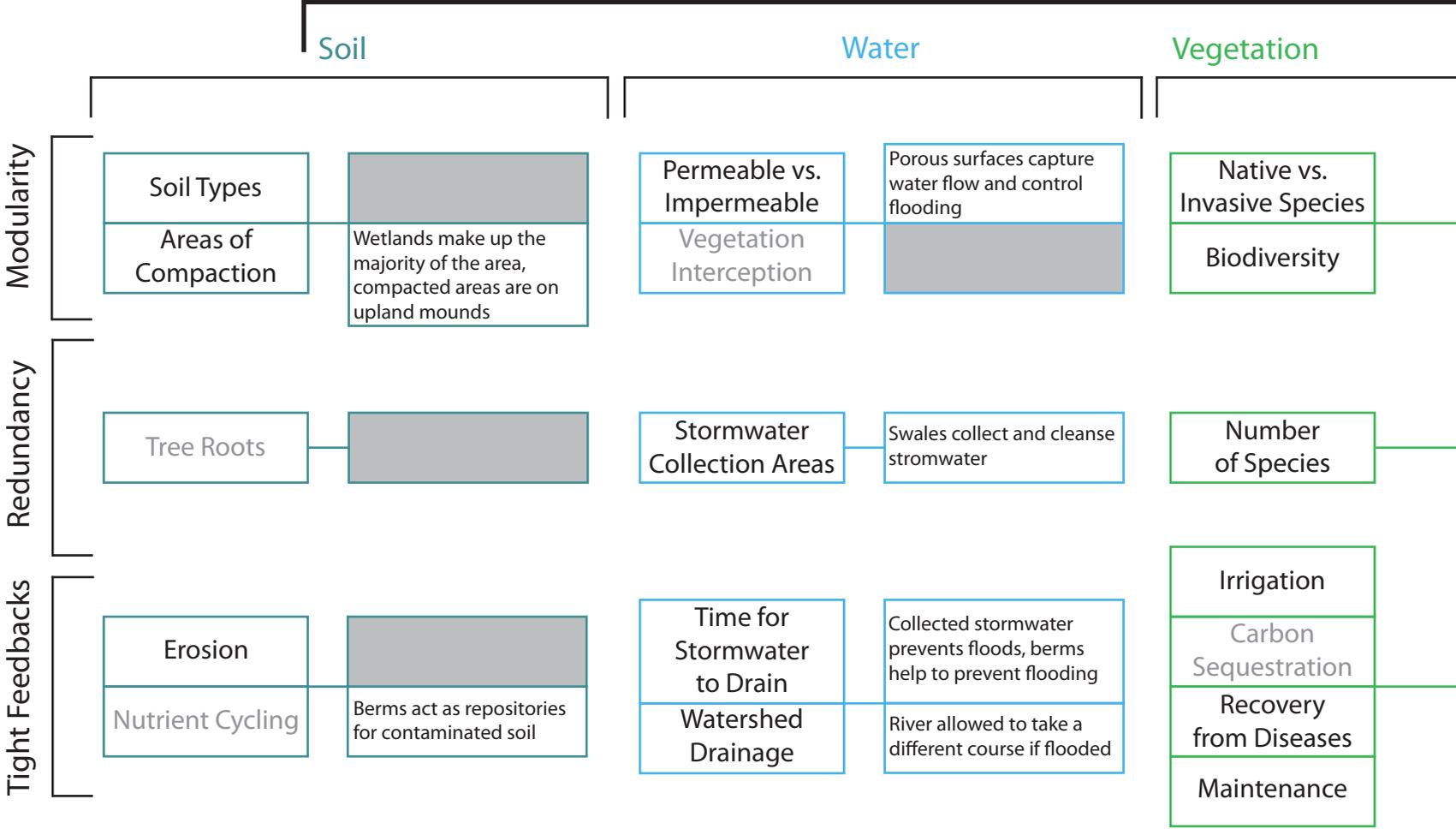


Figure 5.3.6: Case Study Analysis - Stoss
Landscape Urbanism, Lower Don Lands, Toronto

Fauna

People

Variety of vegetation makes up swamp, meadow, and forest land

Species Movement

Accommodate fish which move through the lake to the river

Habitats

Habitats created based on water level and vegetation

Park System

Connects to regional waterfront trails

Connectivity

Varying neighborhood densities

Plants are selected and placed based on their water need, plants receive adequate amounts of water from their location

Number of Habitats/Habitat Elements

Restores habitat elements, multiple green areas on building surfaces

Amenities

Provides alternative transportation, 11 housing typologies

Elements of Interest

Restores native wetlands

Programs

Series of destination open spaces

Pollination

Migration

Government

Visitation

Adds housing for twenty thousand people

No strategy addressed

Social-Ecological Systems

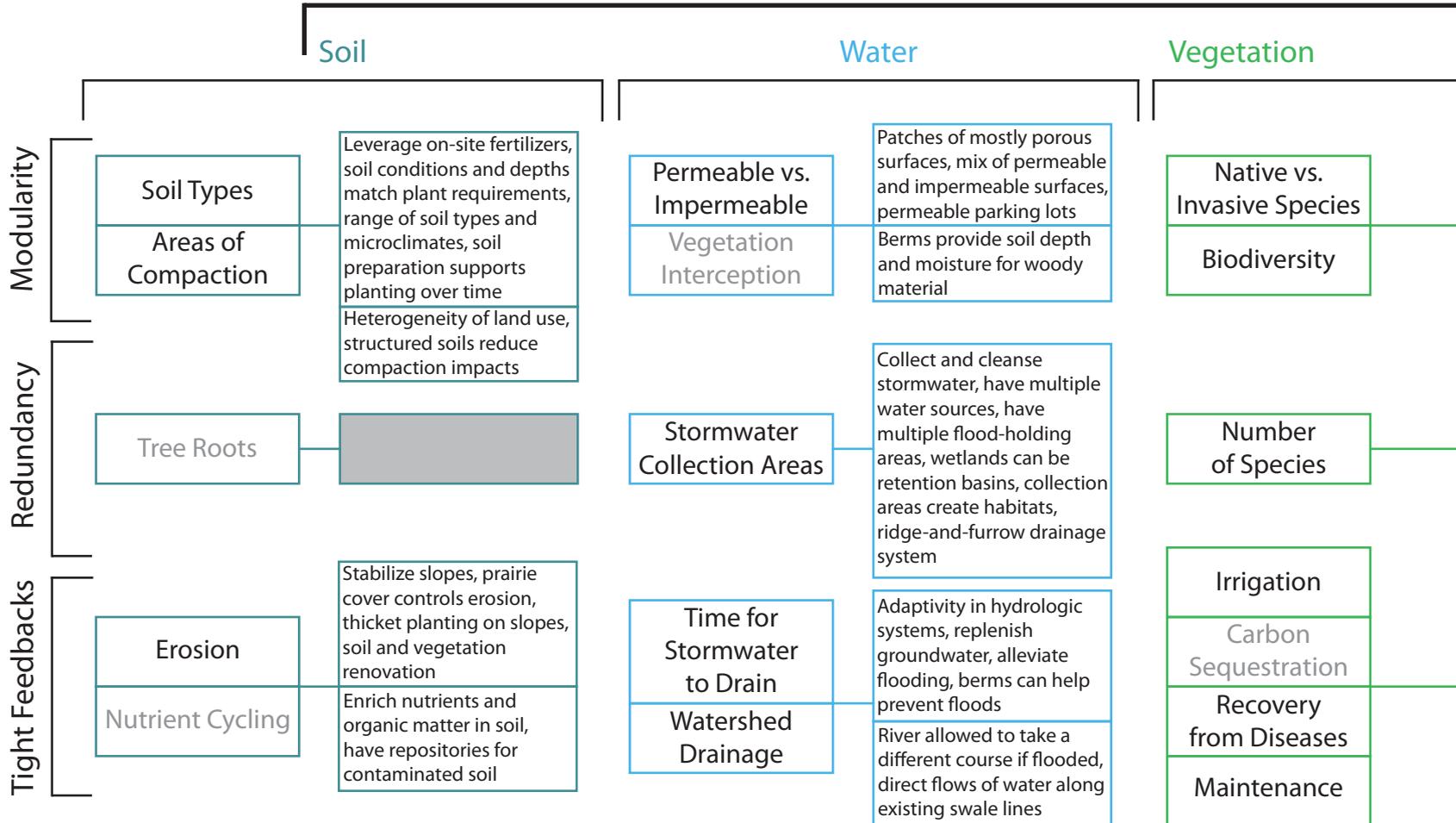


Figure 5.3.7: Case Study and Strategy Analysis - Synthesis

Fauna

People

Only native and possibly non-aggressive invasive species, native species form habitats, naturalized plantings, clumps of native species

Create diverse edge conditions, brown roofs, bioswale networks, diverse planting palette, creation of vegetation adaptation zones, vegetation clusters

More field-grown plants, multiple native communities, tree rows

Use planting and maintenance strategies that use less water, craft water schedules to match plant requirements

Reuse existing materials, appropriately-sized plants, self-reseeding plants, weed-suppressing plants, well-located sites can have faster maintenance, use vegetation for movement

Species Movement

Habitats

Expand habitat corridors, create buffers between land uses to facilitate flow, link habitat patches, link to larger woodland systems

Create habitat diversity, small-scale habitat patches, can be created based on water levels, slope, and vegetation, create mix of habitats

Number of Habitats/Habitat Elements

Redundant habitats, increase tree canopies, multiple habitat connectivity points, nests of protected habitats, green building surfaces

Pollination

Migration

Create small-scale habitats for insects, place perches strategically for seed dispersal by birds

Provide connectivity for migratory species

Park System

Connectivity

Heterogeneous development, small parks within larger area, connect with green spaces and trails

Connect to neighborhoods and learning institutions, create walkable loop, vary densities, numerous access points, circulation corridors

Amenities

Elements of Interest

Programs

Alternative transportation modes, accommodate all demographic groups, diversity in fuel sources, housing typologies, services and accessibility, tree cover, street trees, paths, mesh screens, lighting

Engage natural site features, prominent external views, memorials, frame large open spaces and horizons

Community gardens, diverse edge conditions, recreation, natural/cultural experiences, series of open spaces, multiple gathering locations, education areas, activity clusters, interactive landscapes, diversified activities

Government

Visitation

Create partnerships with local groups, studies promote knowledge to governing bodies

Utilize strategic communication, meetings, social networking, seek locations for visibility, add housing

No strategy addressed

Guidelines

I have combined the synthesis from the case study and strategy analyses with the goals for Washington Square Park to create guidelines for designing resilient urban civic spaces. This combination took place by evaluating the goals of the park and the strategies in the synthesis and finding similarities. For example, a goal for Washington Square Park is to connect the park to other parks and parkways. A strategy in the synthesis for the system component “Park System” is to connect with green spaces and trails. Therefore, the goal and strategy combined create the guideline “connect with area parks, parkways, and trails.”

The following table is a list of design guidelines for creating resilience in social-ecological systems in urban civic spaces (Figure 5.4.1). The guidelines are divided into site, greater downtown, and metro scales. The system and resilience strategy each guideline pertains to is listed along with the guideline. In addition, the result of the guideline being implemented into a landscape is listed under the “Resilient Measures” column.

Site Scale		
System/ Resilience Strategy	Guideline	Resilient Measures
Soil/Modularity	Prepare heavily disturbed soils with organic matter	Restores nutrients in the soil and creates soil depth
Soil/Tight Feedbacks	Stabilize slopes with vegetation	Plants absorb runoff and reduce soil erosion
Water/Tight Feedbacks	Direct water runoff to existing swale lines	Contributes to the natural hydrology of the area which reduces flooding
Water/Redundancy	Collect stormwater at multiple locations	Ensures runoff drainage especially during large rain events
Water/Modularity	Implement mostly permeable surfaces, especially in parking lots	Reduces runoff and contributes to replenishing groundwater
Water/Redundancy Fauna/Modularity	Plant vegetation in stormwater collection areas	Absorbs and cleanses stormwater
Vegetation/Modularity	Remove invasive and singular plants and use native and non-aggressive exotic plant species	Reduces maintenance and irrigation, creates native habitats for animal species, improves air quality and mitigates heat island effect
Vegetation/Modularity Fauna/Modularity	Use a diverse planting palette	Contributes to biodiversity of plant and animal species

Figure 5.4.1: Design Guidelines for Designing Resilient Systems in Urban Civic Spaces

The design guidelines show strategies for creating resilience in systems in urban civic spaces. The guidelines are produced from a site analysis, goal analysis, and case study and strategy analyses.

Site Scale (continued)

System/ Resilience Strategy	Guideline	Resilient Measures
Vegetation/Redundancy	Implement more field grown plants and tree rows	Ensures survival of vegetation, tree rows provide a screen and wind protection
Vegetation/Tight Feedbacks	Use appropriately-sized, self-seeding, and wind-suppressing plants and give plants room to grow	Reduces the need for maintenance and irrigation
Vegetation/Tight Feedbacks	Reuse existing materials	Prevents materials from being discarded and lowers costs
Fauna/Redundancy	Create multiple habitat patches and habitat connectivity points	Contributes to species movement and animal diversity
Fauna/Modularity	Create diverse habitats based on water levels, slope, stormwater, and vegetation	These elements can help create habitats for diverse animal species
Fauna/Modularity Fauna/Tight Feedbacks	Create habitats for existing animal species, migratory species, and small-scale habitats for insects	Contributes to the survival of animal species and helps move migratory animals and insects across the area
Fauna/Redundancy	Create places for birds to disperse seeds	Contributes to pollination and self-seeding on the site
People/Redundancy	Implement tree cover, street trees, paths, mesh screens, and lighting	Provides amenities so people can enjoy the space and feel safe

Site Scale (continued)		
System/ Resilience Strategy	Guideline	Resilient Measures
People/Modularity People/Tight Feedbacks	Provide multiple access points	Ensures access to the area for all people
People/Redundancy	Provide services and accessibility	Ensures all people can enjoy and be comfortable in the site which creates high visitation
People/Redundancy	Implement community gardens, recreation, natural/cultural experiences, series of open spaces, education areas, activity clusters, interactive landscapes	Services and education contribute to use and visitation
People/Redundancy	Create multiple gathering locations with diverse qualities	Provides gathering spaces for surrounding commercial areas
People/Redundancy	Create diverse programs	Invites all demographic groups for everyday and for special events
People/Redundancy	Engage natural site features, memorials, monuments, and preserve views	Contributes to a unique identity and creating a sense of place
People/Modularity	Reduce automobile dominance and create a walkable area	Ensures pedestrian safety and increases connectivity for people
People/Modularity	Activate groundfloors and infill unnecessary surface parking lots	Ensures open space connections with dense building groundfloors

Greater Downtown Scale

System/ Resilience Strategy	Guideline	Resilient Measures
Fauna/Modularity	Create buffers between land uses	Facilitates species movement
Fauna/Redundancy	Increase tree canopies	Contributes to habitats, provides shade, mitigates heat island effect
Fauna/Redundancy	Implement vegetated surfaces on buildings	Creates habitats and mitigates heat island effect
People/Redundancy	Add housing	Ensure visitation, use, and longevity of the area
People/Redundancy	Vary building densities and housing typologies	Ensures housing can accommodate all people as well as the site design
People/Redundancy	Diversity in fuel sources	Ensures access to longevity of fuel sources
People/Tight Feedbacks	Create partnerships with local groups	Ensures maintenance and longevity of the area
People/Tight Feedbacks	Utilize strategic communication meetings	Spreads knowledge and ensures maintenance of the area
People/Redundancy	Program edge conditions	Creates a boundary for the district which contributes to creating a district identity

Greater Downtown Scale (continued)		
System/ Resilience Strategy	Guideline	Resilient Measures
People/Modularity	Connect pedestrians to surrounding activities and neighborhoods	Contributes to a district identity and to everyday use
People/Modularity	Connect with area parks, parkways, and trails	Creates a park network which contributes to visitation and species movement
People/Redundancy	Accommodate streetcar stop and other possible alternative transportation	Decreases automobile dominance and contributes to metro connectivity for pedestrians

Metro Scale		
System/ Resilience Strategy	Guideline	Resilient Measures
Fauna/Modularity	Expand and link habitat corridors and patches	Contributes to the movement of species and migration
People/Modularity	Develop heterogeneously	Provides varying land uses for species movement, provides permeable areas within impermeable areas
People/Tight Feedbacks	Social networking	Contributes to visitation of the site and knowledge about its resilience
People/Tight Feedbacks	Low maintenance designs should especially be created in less-visited areas	Maintenance issues are addressed less quickly in these areas





Design Proposal

The site-scale guidelines created in the previous chapter are used to create a design proposal for Washington Square Park. The downtown and metro guidelines are used to suggest design strategies for creating a more resilient downtown Kansas City and metro area.

By following the site-scale guidelines, the design for Washington Square Park focuses on creating resilient social-ecological systems in the landscape. In addition, the proposal implements strategies which create a legible identity for the urban civic space. Legibility, as mentioned earlier, is argued by Julia Czerniak to be necessary in a site in order to create resilience. Linear forms in the design evoke the urban context and are juxtaposed with organic and iconic

forms which give the park an identity and connect to program elements (Figure 6.1).

This design for Washington Square Park is unique because most of the mature trees existing within the site remain in the proposed design. Mature trees help improve the general resilience of the park by contributing to habitats, carbon sequestration, vegetation interception, and erosion control. Therefore, the park redesign can establish greater resilience by incorporating the existing trees. In addition, the existing tree species are mostly native, with the exception of Littleleaf Linden, River Birch, and Crabapple, which are non-aggressive exotic species. The Sugar Maple and Hackberry trees are the only two trees proposed for removal in the redesign because these trees are singular species

Railroad ROW

M

L

L

K

Blue Cross and Blue Shield

H

G

B

A

F

C

E

D

D

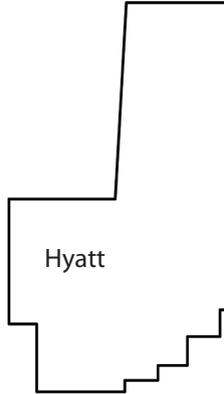
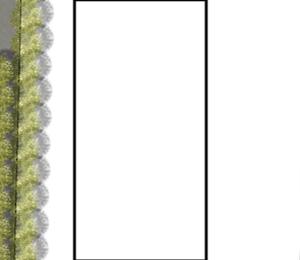
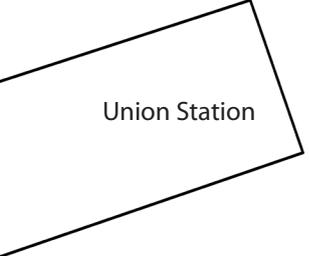
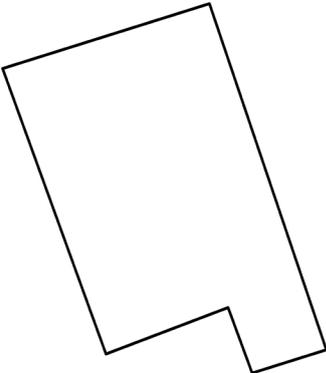
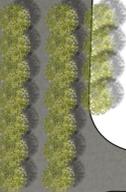
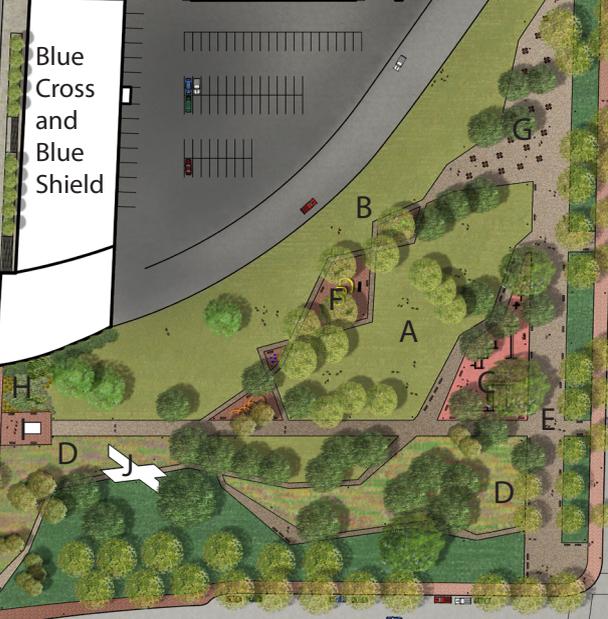
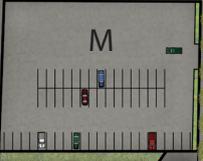
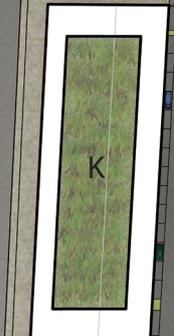
Main Street

Grand Boulevard

Pershing Road

Hyatt

Union Station



- A. Main Gathering Space
- B. Great Lawn
- C. Playground
- D. Wildflower Learning Gardens
- E. Promenade
- F. Art Walk
- G. Seating Area
- H. Rain Gardens
- I. Entry Plaza with Washington statue
- J. Missouri Korean War Veterans Memorial
- K. 10-story Infill Building
- L. 3-story Infill Buildings
- M. 3-story Parking Garage
- N. Existing Concrete Paver Pathway
- O. Proposed or Widened Medians

Figure 6.1: Design Proposal for Washington Square Park

The design proposal for the redesign of Washington Square Park incorporates forms and programs for a contemporary urban civic space while implementing design strategies to help the social-ecological systems operating within the park exhibit resilience.

within the site. As identified in the site analysis, singular, non-redundant species decrease the general resilience of the site.

The existing concrete paver pathways which border the park and run along the street curb will also remain in the redesign. This sidewalk is an important element to connecting the park and the street. In addition, the concrete paver material is permeable and reusing the material in the redesign will help lower costs. Besides remaining in the outer pathways, the concrete paver material is reused as ground material in other locations throughout the park.

The proposed design for Washington Square Park incorporates two main axes. The north-south axis serves as a promenade which can host vendors during special events in the park (Figure 6.2). Existing Honey Locust trees line the promenade on the east. Proposed Honey Locust trees further enhance tree allées which define the linear promenade. During special events, vendors, musicians, and food trucks can line the promenade on both sides to serve visitors. On non-event days,

special gatherings

festivals

crushed limestone

native grass

promenade



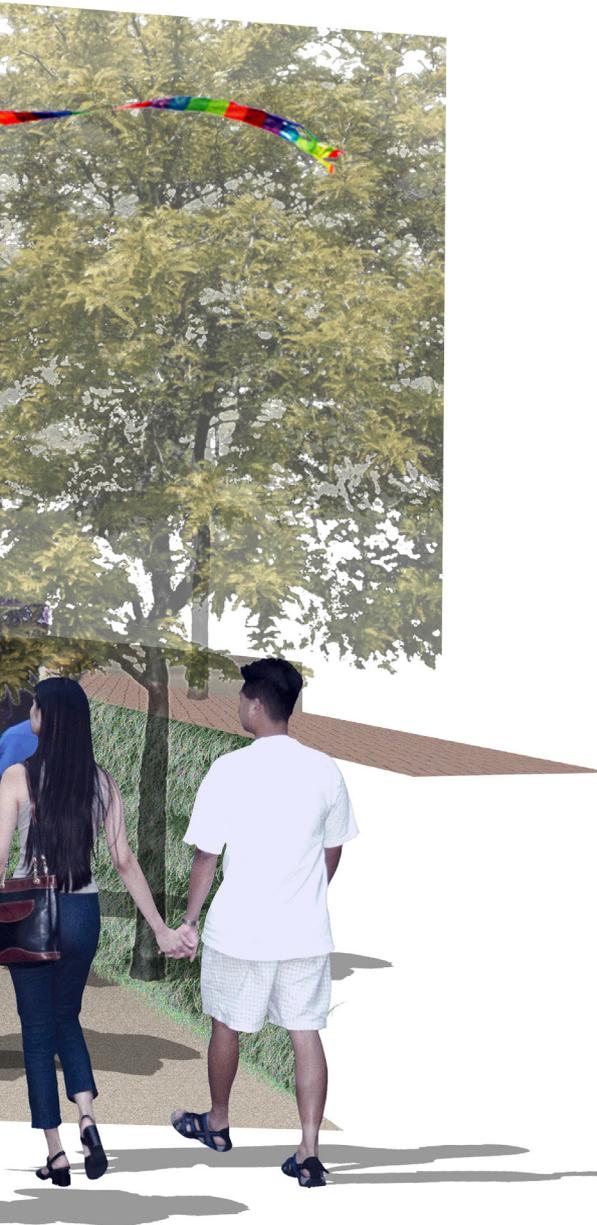


Figure 6.2: Promenade during a Special Event in Washington Square Park
The promenade acts as a linear space for vendors during special events or as a viewing and relaxing area during non-event days.

the promenade serves as a walking experience and resting place for visitors to view the surrounding buildings, watch other activities taking place in the park, and enjoy the tree-lined space.

The east-west axis creates the main entrance to the park. The statue of George Washington is moved from its existing location to a small plaza at the entry of the park (Figure 6.3). The entry plaza faces Main Street in the northwest corner of the site because the future downtown streetcar will stop across Main Street at Union Station. Visitors will then be able to ride the streetcar to Union Station, cross the street with a proposed crosswalk, and enter Washington Square Park.

The entry plaza reuses the concrete paver material while the two north-south and east-west pathways, as well as the majority of pathways in the design, use crushed limestone. This material is permeable and is an ADA accessible material. Limestone is also native to the region.

In order to improve the pedestrian connections of the area surrounding Washington Square Park, I have proposed the removal of “The Link.” The existing



culture

permeable paving

rain garden

streetcar

washington square park



Figure 6.3: Main Entrance to Washington Square Park

The main entrance to the park is adjacent to the future streetcar stop. The entrance contains a small plaza with the George Washington statue that leads visitors through to the main gathering space.

skywalk reduces people's connections with the park and with the street. It also causes heavily compacted soils and disrupts stormwater flows through the park. With the removal of "The Link," the area can better accommodate pedestrians and form into a walkable urban district.

In addition, to improve walkability for the area surrounding Washington Square Park, I have proposed a median be implemented in Main Street and the Pershing Road median be widened (Figure 6.4). The addition of a median in Main Street will reduce the vehicular dominance surrounding the park and force cars to slow down in the area. A wider median in Pershing Road will also reduce vehicular dominance and make drivers more aware of the pedestrians in the area. The medians will contain trees and native grasses which will help reduce the heat island effect created by the wide asphalt streets. In addition, the Main Street median has the opportunity to collect stormwater runoff from the street.

Additional Honey Locust and Kentucky Coffeetree trees proposed along Grand Boulevard are a part of the Grand Boulevard Streetscape Plan outlined in



Main Street

Pershing Road

Grand Boulevard

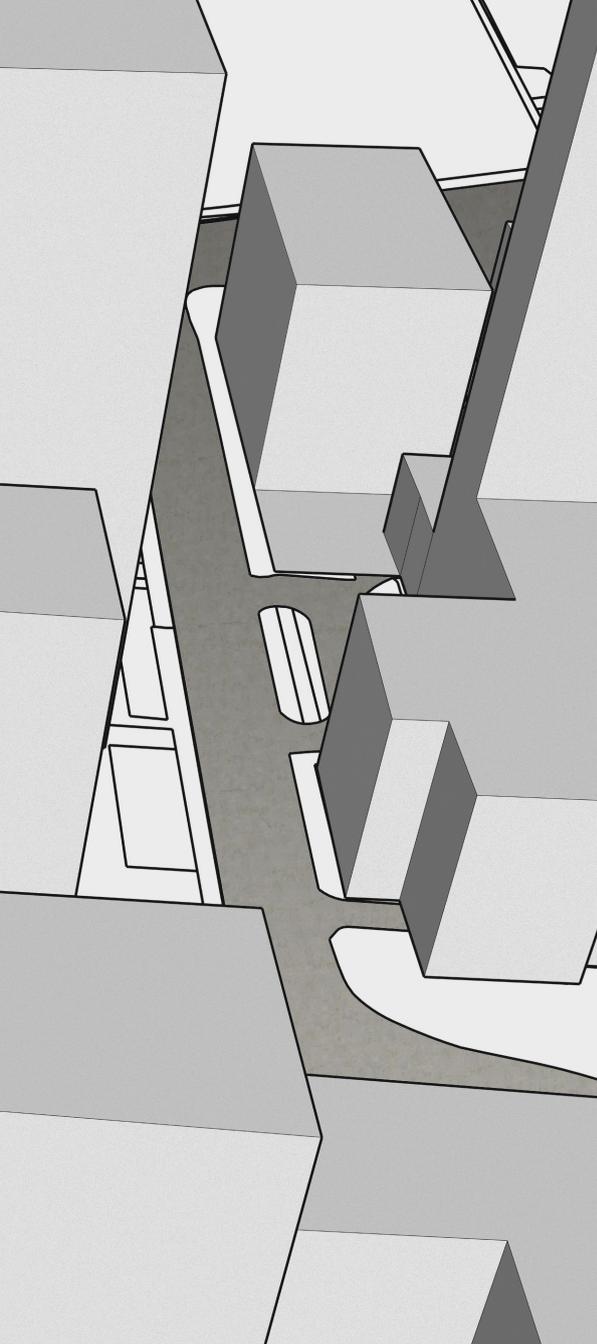


Figure 6.4: Aerial View of Washington Square Park Design Proposal

Tree cover is added along Main Street and Grand Boulevard while the existing Pershing Road tree cover remains. In this aerial view, the north-south and east-west axes can be seen with the organic pathways which flow between the axes to programs within the park.

the RFQ/P. This plan is a companion to the Greater Downtown Area Plan and works to improve the streetscape of Grand Boulevard for people and for natural systems. For the section of Grand near Washington Square Park, the plan incorporates trees, bike lanes, and on-street parking.

Within the proposed design of Washington Square Park, a series of organic pathways connect visitors from the main north-south and east-west axes to programs within the park (Figure 6.4). These connecting pathways create the iconic forms and identifiable elements for Washington Square Park. Intertwined paths connect the main entrance axis to the seating area in the north section of the park. The spaces created between the intertwined paths create places for temporary art displays. This art walk feature creates year-round interest in the park and gives the park a destination element for local and non-local visitors.

One organic pathway creates an experience for the existing Missouri Korean War Veterans Memorial. The existing memorial is well-liked by the community and the overhead planes can

create an intimate memorial experience for visitors. The pathways which help create this experience meander through tall grasses and wildflowers to further enhance this more intimate experience within Washington Square Park.

The pathways in the design are also used to define spaces. The large central space in the park is a main gathering space. I have designed this area to be used as one large gathering space or as several smaller gathering spaces divided by tree lines and pathways (Figure 6.5). These spaces can contain organized special events which can overlap with activities taking place in the promenade or can be used by the public for unorganized activities.

The great lawn adjacent to the main gathering space is an informal linear space. Similar to the main gathering space, organized or unorganized activities can occur in the lawn. The lawn's linear form is ideal for game activities or for viewing the distant vista of downtown Kansas City.

A playground also resides in the park adjacent to the main gathering space and the promenade. A playground provides activities for children and helps Washington

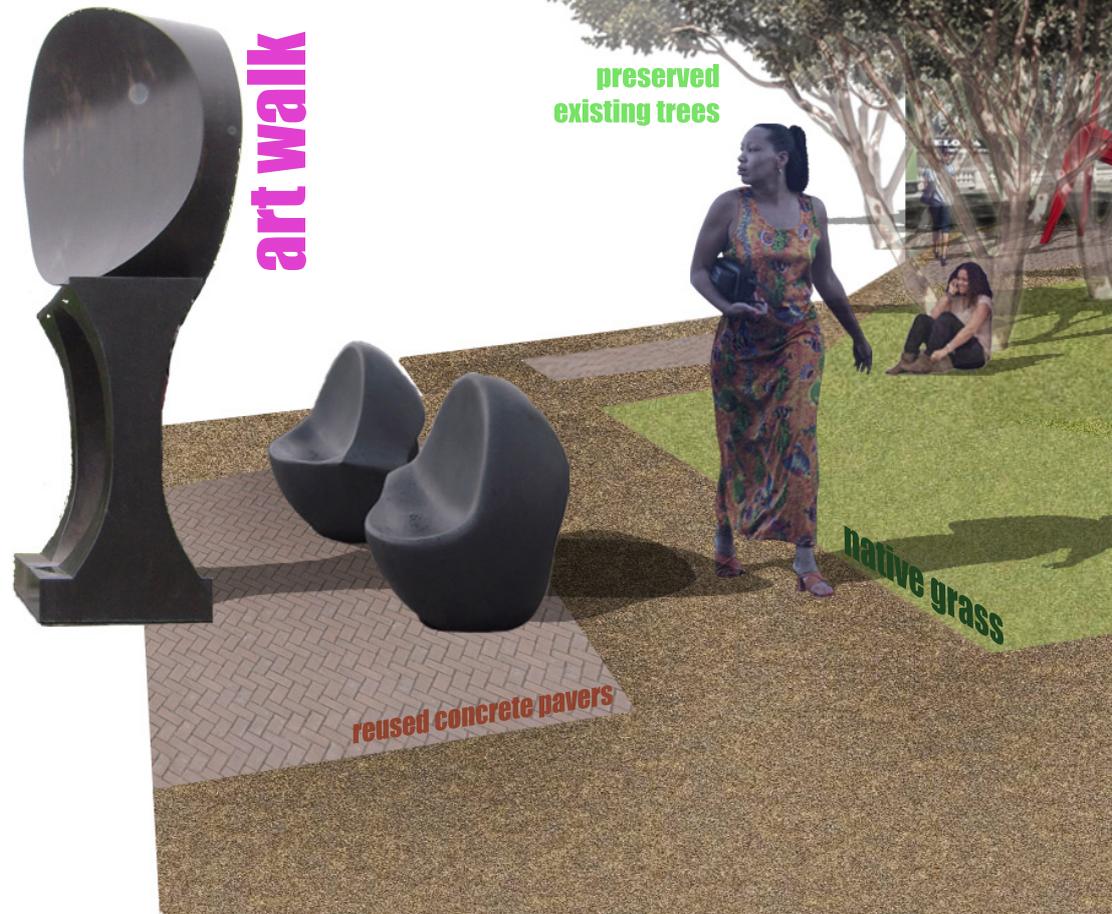




Figure 6.5: East-West Axis Introduces Visitors to the Activity Spaces in the Park

The entrance axis leads visitors to the main gathering space, playground, art walk, and terminates in the promenade. The program elements spatially overlap to create an activity center in the park.

Square Park accommodate for people of all ages. Along with the playground, wildflower gardens provide an education area for children to learn about native species and the contributions wildflowers make to creating resilience in urban landscapes.

The seating area placed in the north area of the park takes advantage of the iconic vista towards downtown (Figure 6.6). The seating area also provides a place for viewing activities in the promenade, main gathering space, and lawn. The seating consists of moveable chairs and tables that people can move at their leisure. People can sit and eat in this area during special events or have a place to picnic during non-event days.

Many aspects of this Washington Square Park design take advantage of the view to downtown. The park is higher in elevation than the area directly north of the site which provides the park with an iconic view of downtown. The area immediately north of the park, however, is a large surface parking lot which does not contribute to the view. On the other hand, the parking lot provides an opportunity for mixed use and housing infill. The buildings

proposed for this infill are height-restrictive to avoid obstructing the vista. The buildings also have green roofs which provide an aesthetic foreground to the distant view of downtown (Figures 6.7 and 6.8).

In order to compensate for the loss of parking spaces, I have implemented parking garages in the infill structures. A parking garage is located in the very east infill building and in the first three stories of the very west, 10-story infill building. The parking garages and remaining surface parking will provide approximately 679 parking spaces which is comparable to the 719 spaces which currently exist. The garages also provide multiple access points for employees of Blue Cross and Blue Shield to arrive and depart from.

The 10-story infill building and the two center infill buildings contain mixed use on the ground floor. Mixed use will bring businesses to the area and will provide services for the residents of the area. Housing is placed in the second and third floors of the two center infill buildings and in the setback portion of the very west 10-story infill building. In

Figure 6.6: Seating Area looking to Iconic View of Downtown Kansas City Green roofs on the infill buildings provide a complementary foreground to the view from the lawn and seating area.

iconic view

rain garden

housing mix

green roofs

native grass

moveable seating

preserved existing trees

permeable paving



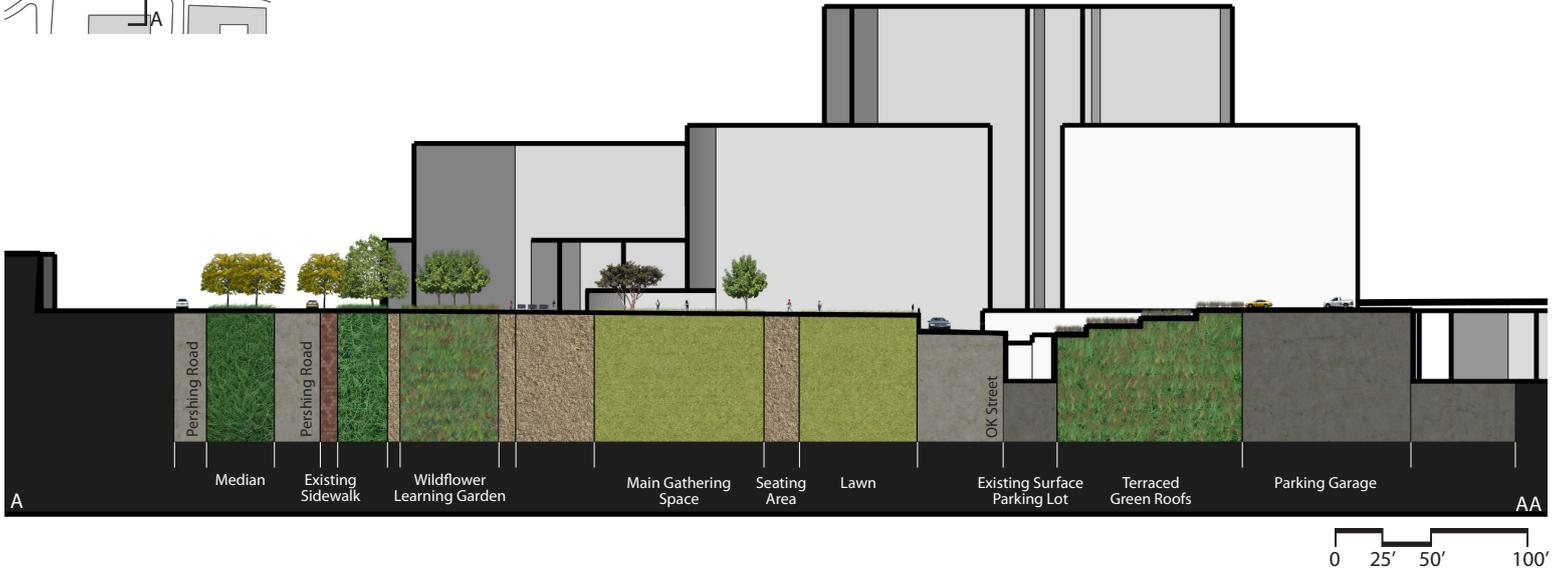
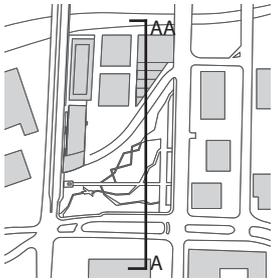


Figure 6.7: Section through Terraced Parking Garage Looking West

Infill buildings north of the park are height restrictive to allow for the preservation of downtown views. The parking garage is terraced with green roofs to create a foreground for the distant vista.

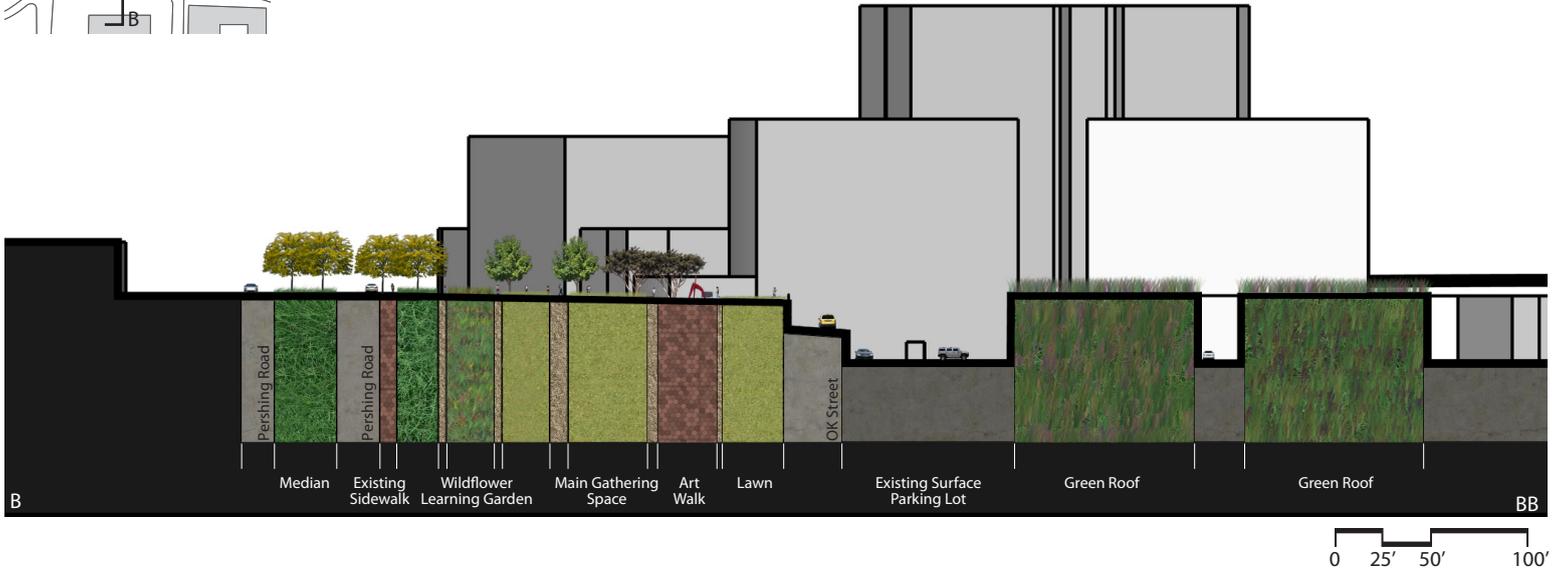
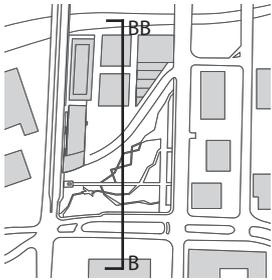


Figure 6.8: Section through Mixed Use Infill Buildings

The mixed use buildings are also height restrictive and contain green roofs. A parking lot for Blue Cross and Blue Shield is incorporated south of the mixed use buildings for the center's visitor and handicapped parking. Space for this parking lot is created by the curve in OK Street which defines the north edge of Washington Square Park. OK Street also uses the length of the north edge of the park to decline from the park's elevation to the entrance of Blue Cross and Blue Shield.

addition, the 10-story building extends the urban plaza along Main Street in front of the Blue Cross and Blue Shield building.

One main element to this design is the use of native and naturalized plant materials to be self-organizing and reduce the maintenance of the park. Figure 6.9 lists the plant species I have chosen for the park design along with the species' locations within the design and their aesthetic and habitat contributions. The plant species locations are determined based on sunlight and stormwater drainage amounts. One goal for each species type and location is to survive in the conditions of the area with little maintenance. Another goal is to contribute to biodiversity and the creation of habitats for local fauna within Washington Square Park.

In addition, vegetation helps absorb and cleanse stormwater runoff within the park through the establishment of rain gardens. I have placed two rain gardens in the northeast and northwest corners of the park. These locations have the two lowest elevations in the site, so stormwater runoff which flows through the site drains to these two areas. Using vegetation to absorb stormwater will reduce the amount of

runoff which flows from the site to city stormwater infrastructure and to the Kansas River. Cleansing stormwater is also important because vegetation can remove substances carried by runoff before the stormwater drains and is carried elsewhere.

Figure 6.10 shows how the strategies proposed in the redesign for Washington Square Park utilizes the site-scale guidelines. The table lists each guideline with its corresponding strategy and system and then explains how the guideline is used in the park with a diagram.

Figures 6.11 and 6.12 outline design suggestions I have made according to the greater downtown and metro-scale guidelines. These suggestions are intended to become part of a greater plan to create resilient social-ecological systems within downtown Kansas City and the metro area of Kansas City. These larger-scale suggestions consist of design interventions as well as improvements to government and social networks.

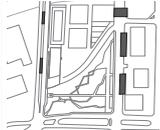
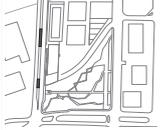
Figure 6.9: Species Used in Washington Square Park Proposal

The proposed plant species in the design include trees, grasses, forbs, shrubs, and sedges. Each species contributes to creating habitats for local fauna and to the aesthetics of the park. These species placed in appropriate locations will also help reduce stormwater runoff and the need for maintenance.

Hightshoe (1988), Hightshoe and Groe (1998), Lady Bird Johnson Wildflower Center (2014)

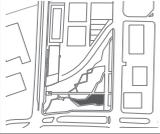
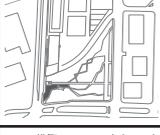
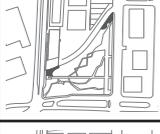
Proposed Species Plant List

Trees

Species	Location	Usage	Characteristics	Attractive Characteristics	Habitat Contributions
Kentucky Coffeetree <i>Gymnocladus dioica</i>		Street tree along Grand Boulevard and Main Street	Large canopy, resistant to urban conditions, prefers wet to average soils	Yellow-green flowers mid through late June, yellow Fall color	Larval host to the Bicolored Honey Locust moth
Swamp White Oak <i>Quercus bicolor</i>		Street tree along Main Street, habitat elements	Large canopy, resistant to urban conditions, prefers wet to moist soils	Golden yellow brown Fall color	Attracts songbirds, ground birds, water birds, and mammals

Grasses

Sideoats Grama <i>Bouteloua curtipendula</i>		Reflect native prairies on roof top gardens	Grows 2-3ft. tall, high drought tolerance, can be mowed, but rarely	Green or blue-green, turns purple or red in Fall, tan fruit	Bird food, nesting materials, cover, graze for mammals, attracts butterflies, larval host for Green and Dotted Skipper
Blue Grama <i>Bouteloua gracilis</i>		Mixed with Sideoats Grama on roof tops, wildflowers, and Buffalo Grass for turf	Grows 12-14in. tall, high drought tolerance, can be mowed, but rarely	Gray-green with bluish-green fruit	Provides graze and food for granivorous birds, attracts butterflies, larval host for Skippers
Buffalo Grass <i>Bouteloua dactyloides</i>		Mixed with Blue Grama to create turf grass, adds aesthetics to street medians	Grows 3-12in. tall, high drought tolerance, can be mowed	Gray-green, blue-green	Food and nesting materials for birds, food for mammals in winter, attracts butterflies, larval host for Green Skipper
Bluejoint <i>Calamagrostis canadensis</i>		Used in south native grass area with Wild Oats	Grows 3-5ft. tall, grows in moist soils, can grow in shade	Green grass with purple-brown ends	Cover
Wild Oats <i>Chasmanthium latifolium</i>		Used in south native grass area and with wildflowers, aesthetics	Grows 2-4ft. tall, grows in moist soils, grows in shade, no full sun	Blue-green grass with oat-like flowers June - September	Food and nesting materials for birds and mammals, attracts butterflies, larval host for skipper butterflies

Forbs					
Species	Location	Usage	Characteristics	Attractive Characteristics	Habitat Contributions
Prairie Coneflower <i>Ratibida pinnata</i>		Used in east wildflower garden with Wild Oats, aesthetics	Grows 3-5ft. tall, grows in moist to dry soils	Yellow flowers May - September	Attracts birds, butterflies, and native bees
Purple Coneflower <i>Echinacea purpurea</i>		Used in east wildflower garden with Wild Oats, aesthetics	Grows 2-3ft. tall, grows in dry soils, sun to part shade	Pink, purple flowers April - September	Attracts butterflies, native bees, and hummingbirds
Eastern Red Columbine <i>Aquilegia canadensis</i>		Used in east wildflower garden and south native grass area, aesthetics	Grows 2 ft. tall, grows in moist to dry soils, high drought tolerance	Red, pink, yellow flowers February - July	Seeds consumed by finches and buntings, attracts hummingbirds, bees, butterflies, and hawk moths
Pale Coneflower <i>Echinacea pallida</i>		Used in west wildflower garden with Blue Grama, aesthetics	Grows 2-4ft. tall, grows in moist to dry soils, high drought tolerance	Pink, purple flowers May - July	Attracts bees and butterflies
Butterfly Milkweed <i>Asclepias tuberosa</i>		Used in west wildflower garden, aesthetics, habitat elements	Grows 1-2ft. tall, grows in moist to dry soils, tolerates drought, full sun	Orange, yellow flowers May - September	Important food source for monarch butterflies, attracts butterflies, hummingbirds, and native bees
Swamp Milkweed <i>Asclepias incarnata</i>		Used in rain gardens to absorb stormwater and provide habitat elements	Grows 2-4ft. tall, grows in moist soils, may need to be sprayed for aphids	Pink, purple flower clusters June - October, fragrant	Important food source for monarch and queen butterflies, attracts butterflies, hummingbirds, and native bees
Orange Coneflower <i>Rudbeckia fulgida</i>		Used in west rain garden to absorb stormwater, aesthetics	Grows 1-3ft. tall, grows in moist soils, self-sows, full sun	Orange, yellow flowers July - October	Attracts birds and native bees

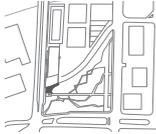
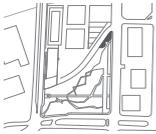
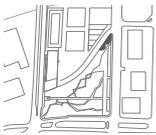
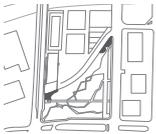
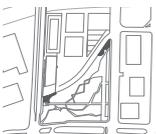
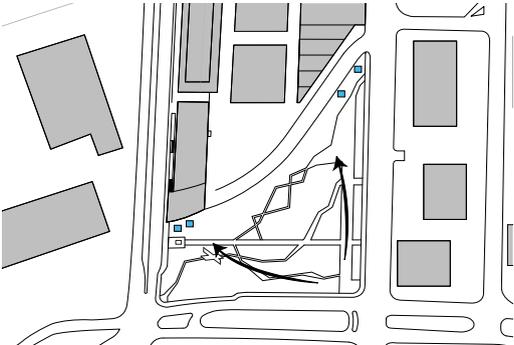
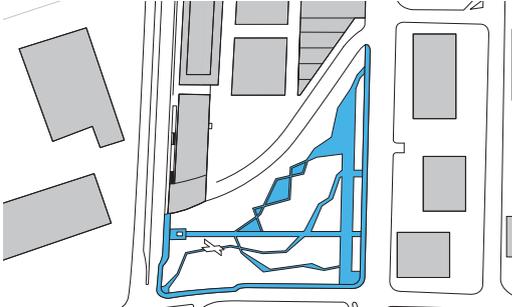
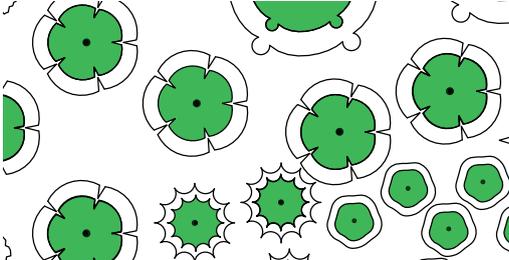
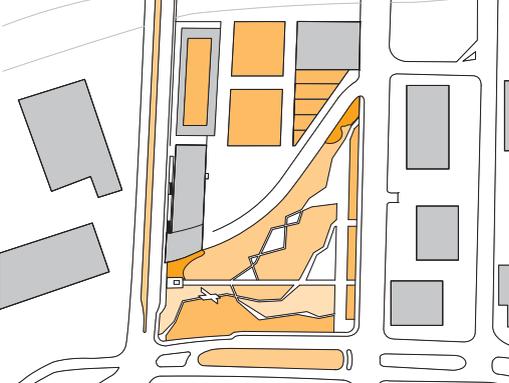
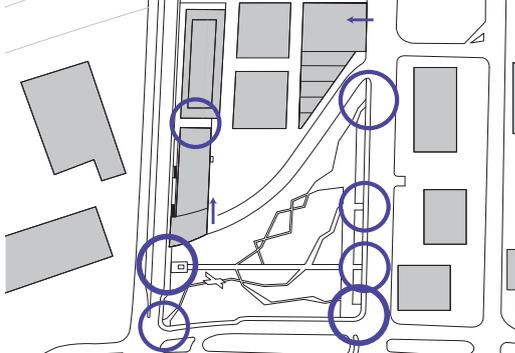
Forbs					
Species	Location	Usage	Characteristics	Attractive Characteristics	Habitat Contributions
False Aster <i>Boltonia asteroides</i>		Used in west rain garden to absorb stormwater, aesthetics, habitat	Grows 4-7ft. tall, grows in dry and moist soils, high drought tolerance	White flowers July - October	Attracts butterflies and provides nectar, attracts insects which prey on pest insects
Eastern Bluestar <i>Amsonia tabernaemontana</i>		Used in east rain garden to absorb stormwater, aesthetics	Grows 1-3ft. tall, grows in moist soils, cut back after flowering, shade	Blue, purple star-like flowers March - May, leaves turn yellow in Fall	Cover
New England Aster <i>Symphotrichum novae-angliae</i>		Used in east rain garden to absorb stormwater, aesthetics, habitats	Grows 3-4ft. tall, grows in moist soils, part shade, can be aggressive	Pink, purple flowers August - October	Attracts bees and butterflies, nectar source for monarchs, larval host to Pearl Crescent and Checkerspot butterflies
Shrubs					
Common Winterberry <i>Ilex verticillata</i>		Used in rain gardens to absorb stormwater, winter interest, habitat elements	Grows 6-10ft. tall, grows in moist, dry, and wet soils, sun, part shade, or shade	Red berries in late Fall, early Winter if male and female plants present	Attracts birds and butterflies, provides cover, nesting sites, nectar for insects, larval host for Henrys Elfin butterfly
False indigo <i>Amorpha fruticosa</i>		Used in rain gardens to absorb stormwater, aesthetics, habitat elements	Grows 6-10ft. tall, grows in moist to dry soils, fast-growing	Orange, blue, violet, or purple flowers April - June, fragrant	Attracts butterflies, provides nectar for bees, butterflies, and insects
Sedges					
Fescue sedge <i>Carex crus-corvi</i>		Used in rain gardens to absorb stormwater	Grows 1-2ft. tall, grows in moist soils	Green parallel leaves	Cover

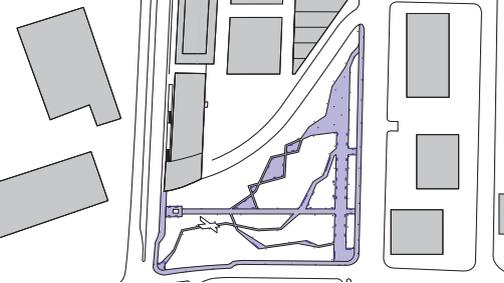
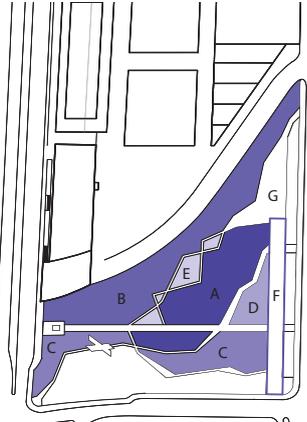
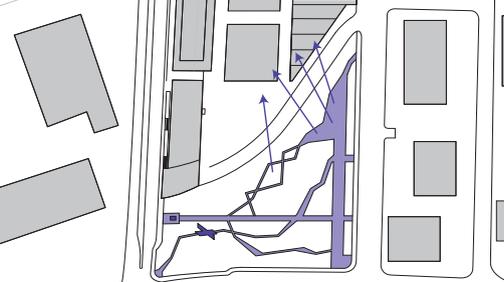
Figure 6.10: Site-Scale

System/ Resilience Strategy	Guideline	Usage in Washington Square Park	Diagram of Usage
Soil/Modularity	Prepare heavily disturbed soils with organic matter	Long history as a green space and the number of mature trees makes preparing the soil unnecessary	
Soil/Tight Feedbacks	Stabilize slopes with vegetation	No extreme slopes located on the site	
Water/Tight Feedbacks	Direct water runoff to existing swale lines	Direct stormwater to north and northwest of the site	
Water/Redundancy	Collect stormwater at multiple locations	Four drains located in rain gardens direct runoff to the Kansas River	

System/ Resilience Strategy	Guideline	Usage in Washington Square Park	Diagram of Usage
Water/Modularity	Implement mostly permeable surfaces, especially in parking lots	All sidewalks are permeable crushed limestone or concrete pavers	
Water/Redundancy Fauna/Modularity	Plant vegetation in stormwater collection areas	Species are native and can absorb water while tolerating drought	
Vegetation/Modularity	Remove invasive and singular plants and use native and non-aggressive exotic plant species	Sugar Maple and Hackberry trees are removed, all proposed plant species are native or non-aggressive exotic species which attract animal species	 
Vegetation/Modularity Fauna/Modularity	Use a diverse planting palette	13 new native shrubs and grasses are introduced in the park	 <p style="text-align: right; font-size: small;">See Figure 6.9</p>
Vegetation/ Redundancy	Implement more field grown plants and tree rows	Native grasses cover the park, existing and new trees create rows for sun and wind protection	

System/ Resilience Strategy	Guideline	Usage in Washington Square Park	Diagram of Usage
Vegetation/Tight Feedbacks	Use appropriately-sized, self-seeding, and wind-suppressing plants and give plants room to grow	All plants are self-seeding and are spaced to allow for growth, all plants can intermingle	
Vegetation/Tight Feedbacks	Reuse existing materials	Existing concrete pavers remain and are reused, light posts are reused	
Fauna/Redundancy	Create multiple habitat patches and habitat connectivity points	Plant species create multiple habitat patches in the park	

System/ Resilience Strategy	Guideline	Usage in Washington Square Park	Diagram of Usage
Fauna/Modularity	Create diverse habitats based on water levels, slope, stormwater, and vegetation	Rain garden species provide habitats or food for animal species	
Fauna/Modularity Fauna/Tight Feedbacks	Create habitats for existing animal species, migratory species, and small-scale habitats for insects	Grasses, shrubs, and trees create habitats for insects, migratory butterflies, bees, and birds	
Fauna/Redundancy	Create places for birds to disperse seeds	Tree cover is enhanced over seed-pollinating grasses	
People/Redundancy	Implement tree cover, street trees, paths, mesh screens, and lighting	Additional tree cover and street trees along Main Street and Grand Boulevard, reuse light posts	
People/Modularity People/Tight Feedbacks	Provide multiple access points	Five points provide surrounding programs access to the park, north infill provides another access point to Blue Cross Blue Shield, two vehicular points provide access to north infill, three proposed crosswalks provide additional access points along Grand and Main	

System/ Resilience Strategy	Guideline	Usage in Washington Square Park	Diagram of Usage
People/Modularity	Provide services and accessibility	Materials and slopes allow for ADA access through the park, seating, water fountains, and lighting are placed throughout the park and away from direct walking paths	
People/Redundancy	Implement community gardens, recreation, natural/cultural experiences, series of open spaces, education areas, activity clusters, interactive landscapes	Native wildflower areas provide education with an interactive and cultural experience, open spaces throughout park cater to different programs	 <ul style="list-style-type: none"> A. Main Gathering Space B. Great Lawn C. Wildflower Education Gardens D. Playground E. Art Walk F. Festival Promenade G. Seating Area
People/Redundancy	Create multiple gathering locations with diverse qualities	Open spaces are programmed for many different activities	
People/Redundancy	Create diverse programs	Programs cater to all ages and are for special events as well as everyday	
People/Redundancy	Engage natural site features, memorials, monuments, and preserve views	Monuments are engaged and help create the experience of the park, seating areas capitalize on views	

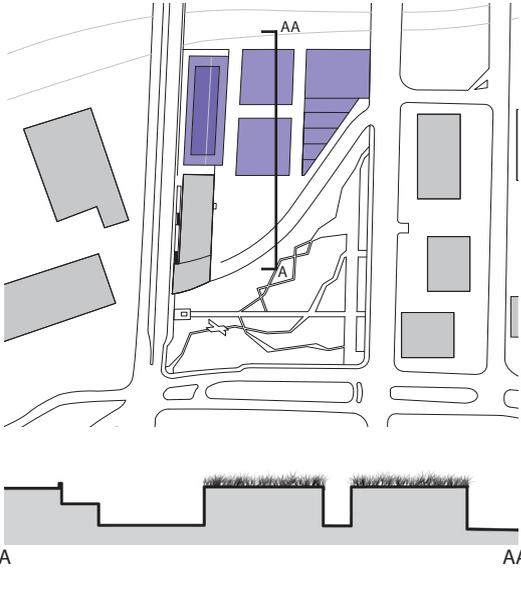
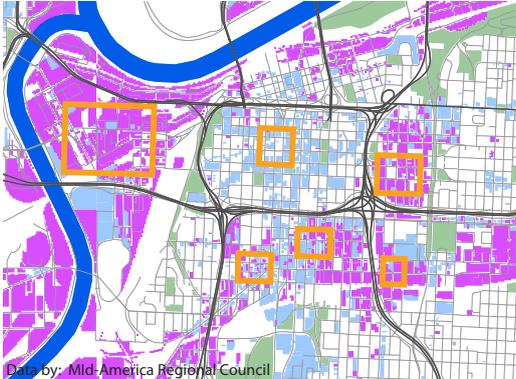
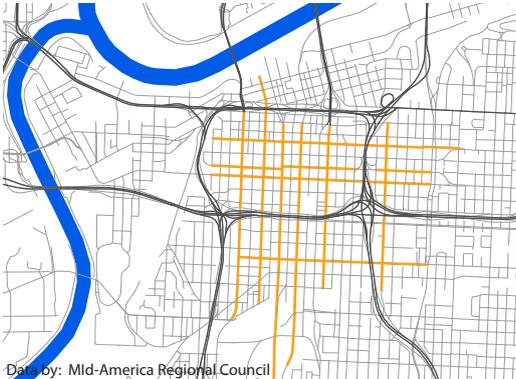
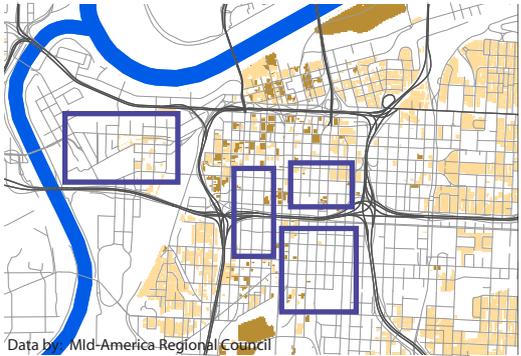
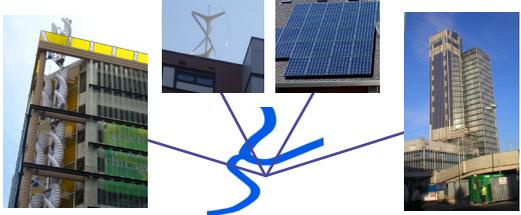
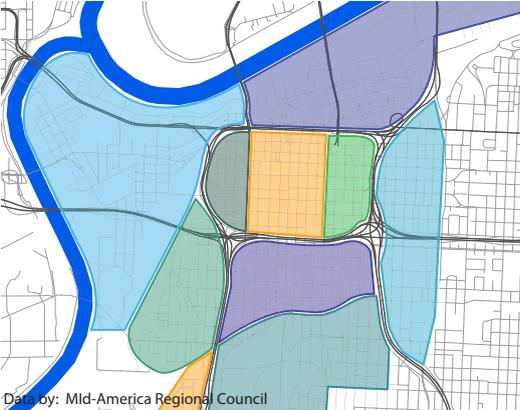
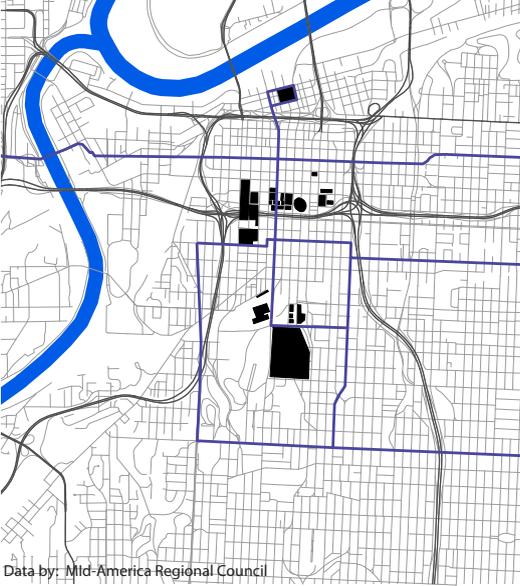
System/ Resilience Strategy	Guideline	Usage in Washington Square Park	Diagram of Usage
People/Modularity	Reduce automobile dominance and create a walkable area	Street lanes around the park are reduced and medians increased	
People/Modularity	Activate groundfloors and infill unnecessary surface parking lots	North parking lot is infilled with housing with green roofs which contribute to the view	

Figure 6.11: Greater Downtown Scale

System/ Resilience Strategy	Guideline	Usage in Washington Square Park	Diagram of Usage
Fauna/Modularity	Create buffers between land uses	Implement pocket parks and residential areas in dense commercial areas	 <p>Data by: Mid-America Regional Council</p>
Fauna/Redundancy	Increase tree canopies	Add street trees and increase canopies in pavement areas	 <p>Data by: Mid-America Regional Council</p>
Fauna/Redundancy	Implement vegetated surfaces on buildings	Create green roofs and green walls on urban buildings	 <p>Lower Don Lands, Stoss</p>

System/ Resilience Strategy	Guideline	Usage in Washington Square Park	Diagram of Usage
People/Redundancy	Add housing	Implement dense urban housing, create more mixed use buildings	 <p data-bbox="1102 537 1380 557">Data by Mid-America Regional Council</p>
People/Redundancy	Vary building densities and housing typologies	Accommodate housing for varying demographics	
People/Redundancy	Diversity in fuel sources	Use alternative, small-scale fuel sources to supply energy to downtown	
People/Tight Feedbacks	Create partnerships with local groups	Establish partnerships between KC Parks and downtown groups	
People/Tight Feedbacks	Utilize strategic communication meetings	Conduct meetings between governing bodies and citizens	

System/ Resilience Strategy	Guideline	Usage in Washington Square Park	Diagram of Usage
<p>People/Redundancy</p>	<p>Program edge conditions</p>	<p>Establish programs and art elements between districts in downtown to create district identities</p>	 <p>Data by: Mid-America Regional Council</p>
<p>People/Modularity</p>	<p>Connect pedestrians to surrounding activities and neighborhoods</p>	<p>Create a more walkable downtown, increase alternative transportation</p>	 <p>Data by: Mid-America Regional Council</p>

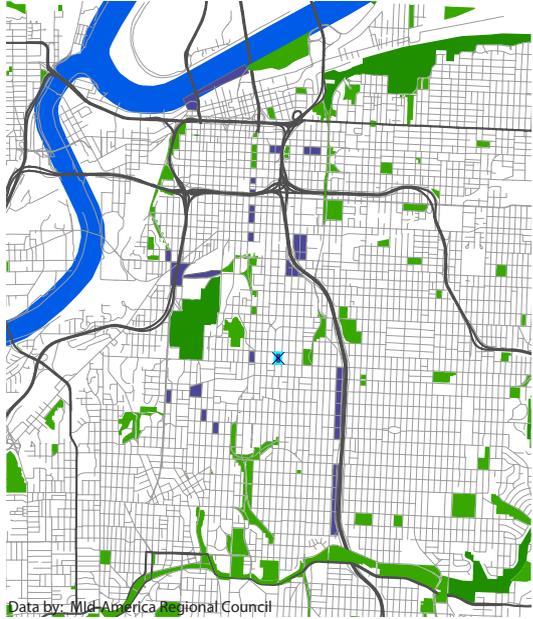
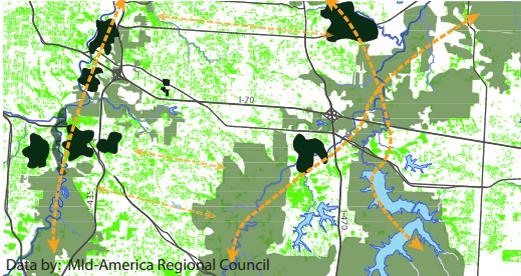
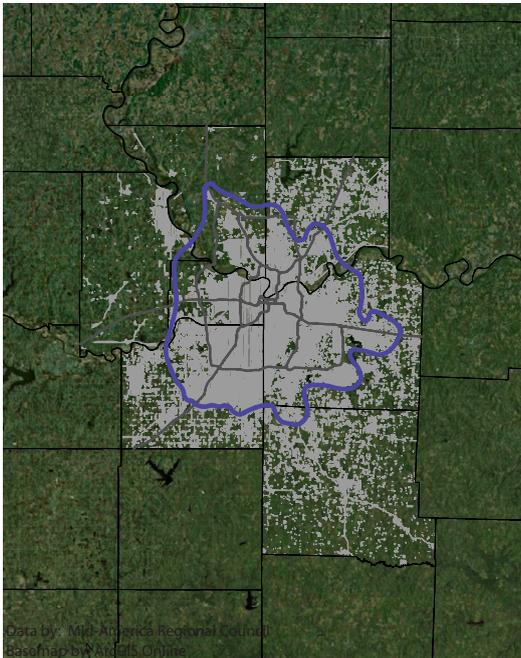
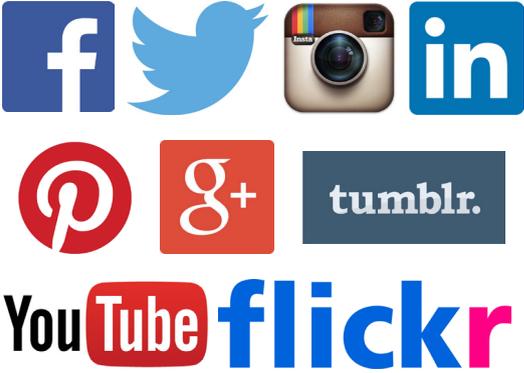
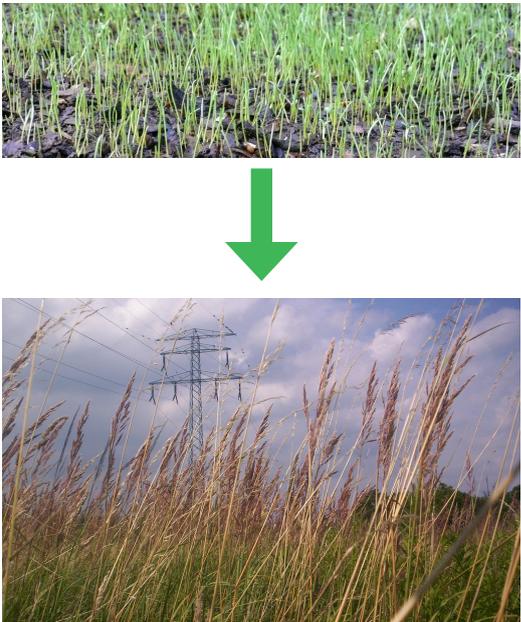
System/ Resilience Strategy	Guideline	Usage in Washington Square Park	Diagram of Usage
People/Modularity	Connect with area parks, parkways, and trails	Implement parks and parkways to reestablish the Kessler System	 <p data-bbox="1095 798 1367 817">Data by: Mid-America Regional Council</p>
People/Redundancy	Accommodate streetcar stop and other possible alternative transportation	Reduce automobile lanes for arterial streets and implement additional streetcar routes and bike lanes	 <p data-bbox="1095 1214 1367 1233">Data by: Mid-America Regional Council</p>

Figure 6.12: Metro-Scale

System/ Resilience Strategy	Guideline	Usage in Washington Square Park	Diagram of Usage
Fauna/Modularity	Expand and link habitat corridors and patches	Implement habitat patches to continue and link the Big Blue and Little Blue River corridors	 <p data-bbox="1050 530 1319 551">Data by: Mid-America Regional Council</p>
People/Modularity	Develop heterogeneously	Develop dense areas in cities and conserve areas outside of cities for habitats, reduce sprawl	 <p data-bbox="1050 1189 1319 1229">Data by: Mid-America Regional Council BaseMap by: ArcGIS Online</p>

System/ Resilience Strategy	Guideline	Usage in Washington Square Park	Diagram of Usage
<p>People/Tight Feedbacks</p>	<p>Social networking</p>	<p>Use social media and other modern networking methods to share events within Washington Square Park and downtown with people in the surrounding area</p>	
<p>Vegetation/Tight Feedbacks</p>	<p>Low maintenance designs should especially be created in less-visited areas</p>	<p>Less-used parks should be implemented with native, self-organizing materials to require less maintenance</p>	



A photograph of a park area. In the foreground, there is a fountain with several jets of water spraying upwards. Behind the fountain, there is a large, leafy green bush. In the background, there are several large, mature trees with dense green foliage. The ground appears to be a mix of grass and dirt. The overall scene is bright and sunny.

Conclusions and Findings

In order to determine if the general resilience of Washington Square Park has increased due to the guidelines, I have diagrammed and measured the system components according to the design proposal. These diagrams and metrics are similar to the diagrams and metrics of Washington Square Park's existing conditions discovered in the site analysis. Therefore, these diagrams show the change in resilience of the park's social-ecological systems. The social-ecological systems I focused on in this research are soil, water, vegetation, fauna, and people.

The soil system components operating in Washington Square Park that I examined are soil types, areas of compaction, and tree roots which create the feedbacks of erosion and nutrient

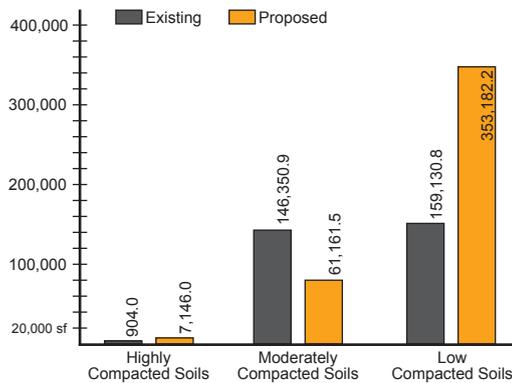
cycling. The soil types in the park are a mix of soils because of the park's highly urban location. Due to the number of mature trees in the site, implementing organic matter to increase the soil's nutrients, similar to the processes used in the examined case studies, would be impractical when trying to preserve the existing trees. The nutrients in the soil can instead be improved by reducing the amount of compacted soils and increasing the amount of vegetation in the site. Areas of low compaction are increased by 45% in the design proposal (Figure 7.1). Areas of high compaction, however, are also increased in the design proposal because of the increase in hardscape for the playground.

Tree roots as well as vegetation help mitigate erosion and create a tighter

Figure 7.1: Proposed Areas of Compaction

Increasing the amount of low compaction areas in the park can help increase nutrients and permeability of the soil. Planted areas and areas covered by crushed limestone are considered low compaction areas. Moderately compacted soils are areas covered by concrete pavers and are the planting areas in the urban area surrounding the park. Highly compacted soils are increased in the proposal because of the playground material.

- Highly Compacted Soils**
7,176.0 square feet of highly compacted soils proposed within Washington Square Park
- Moderately Compacted Soils**
61,161.5 square feet of moderately compacted soils proposed within Washington Square Park and the surrounding streets
- Low Compaction**
353,182.2 square feet of low compacted soils proposed within Washington Square Park



feedback for when soil starts to erode. The proposal increases the amount of trees in the area which increases the area of tree roots. The design proposal increases the area of tree roots by 73% (Figure 7.2).

The water system components I examined are permeable or impermeable surfaces, stormwater collection areas, and vegetation interception. Implementing permeable surfaces, increasing the number of stormwater drains, and increasing vegetation all contribute to creating tighter feedbacks for stormwater drainage. The design proposal decreases the amount of impermeable surfaces in Washington Square Park and increases the amount of permeable planting surfaces (Figure 7.3). The design also incorporates rain gardens which allow vegetation to absorb and cleanse stormwater. Two rain gardens collect stormwater in the proposal and stormwater drains located in each rain garden help prevent flooding during a heavy rain garden event.

Vegetation also reduces the amount of time it takes for stormwater to drain and helps cleanse stormwater. In addition,

the increased amount of vegetation will decrease stormwater runoff by intercepting precipitation with foliage. Components within the vegetation system are number of species, native or invasive species, and biodiversity. These components help create tighter feedbacks for irrigation, carbon sequestration, recovery from diseases, and maintenance.

The increase in redundant tree species increases the species' chance of self-organizing and recovering from disturbances. Many of the trees existing in Washington Square Park are redundant. The proposal increases redundancy by removing singular, non-redundant species and adding 108 Honey Locust, Kentucky Coffeetree, and Swamp White Oak trees to the park and surrounding streets (Figure 7.4).

The increase in vegetation increases the number of native plant species and the amount of biodiversity in the park (Figure 7.5). Native and naturalized vegetation reduce the need for irrigation because these species can tolerate the region's climate and the amount of rainfall in the area. Native vegetation can also

Figure 7.2: Proposed Tree Roots

Most of the existing trees remain in the design proposal. Therefore, tree roots in the redesign will remain mostly in the same locations in the park. Additional trees in the park and along Main Street and Grand Boulevard add to the amount of tree roots.

 Spread of Tree Roots
180,523.4 square feet of proposed tree roots within Washington Square Park and the surrounding streets

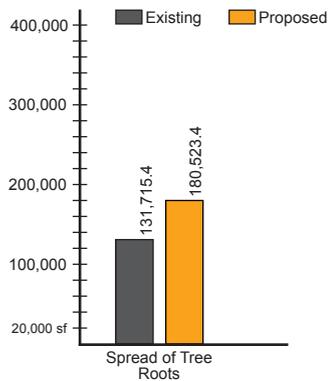




Figure 7.3: Proposed Permeable vs. Impermeable Surfaces

The area of permeable planting surfaces is greatly increased in the design proposal due to the addition of the Main Street median and the widening of the Pershing Road median. All planting and sidewalk surfaces are permeable within the park in the proposal except for the area covered by the George Washington statue, the Missouri Korean War Veterans Memorial, and the playground.

- Impermeable Surface**
8,245.7 square feet of impermeable surface proposed within Washington Square Park
- Permeable Paving Surface**
157,816.4 square feet of total permeable paving proposed within Washington Square Park
- Permeable Planting Surface**
202,480.2 square feet of permeable planting area proposed within Washington Square Park and the surrounding streets

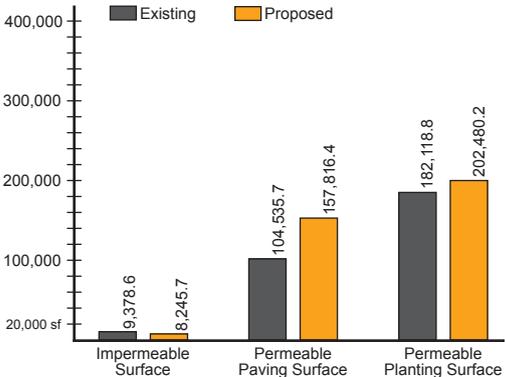


Figure 7.4: Proposed Trees

Trees existing within Washington Square Park exhibit redundancy. In the proposal, the singular Sugar Maple and Hackberry trees are removed from the site and 108 Honey Locust, Kentucky Coffeetree, and Swamp White Oak trees are added to the promenade and the surrounding streetscapes.

- Honey Locust (110)**
Gleditsia triacanthos
● 50 Proposed
● 60 Existing
- Kentucky Coffeetree (47)**
Gymnocladus dioica
● 47 Proposed
● 0 Existing
- Littleleaf Linden (34)**
Tilia cordata
● 0 Proposed
● 34 Existing
- River Birch (13)**
Betula nigra
● 0 Proposed
● 13 Existing
- Eastern Redbud (12)**
Cercis canadensis
● 0 Proposed
● 12 Existing
- Swamp White Oak (9)**
Quercus bicolor
● 9 Proposed
● 0 Existing
- Sycamore (4)**
Platanus occidentalis
● 0 Proposed
● 4 Existing
- American Elm (4)**
Ulmus americana
● 0 Proposed
● 4 Existing
- Crabapple (2)**
Malus (species)
● 0 Proposed
● 2 Existing
- Areas with High Vulnerability to Disturbances**





Figure 7.5: Proposed Native and Non-Native Tree Species

All proposed trees, shrubs, grasses, forbs, and sedges are species native to the Kansas City area or are non-aggressive exotic species.

Hightshoe (1988), Hightshoe and Groe (1998)

- | | |
|---|--|
| <p>Native Species</p> <p>Trees
 Honey Locust (110)
 <i>Gleditsia triacanthos</i>
 Kentucky Coffeetree (47)
 <i>Gymnocladus dioicus</i>
 Eastern Redbud (12)
 <i>Cercis canadensis</i>
 Sycamore (4)
 <i>Platanus occidentalis</i>
 American Elm (4)
 <i>Ulmus americana</i></p> <p>Grasses
 Sideoats Grama
 <i>Buteloua curtipendula</i>
 Blue Grama
 <i>Buteloua gracilis</i>
 Buffalo Grass
 <i>Buteloua dactyloides</i>
 Bluejoint
 <i>Calamagrostis canadensis</i></p> | <p>Shrubs
 False Indigo
 <i>Amorpha fruticosa</i></p> <p>Sedges
 Fescue Sedge
 <i>Carex crus-corvi</i></p> <p>Forbs
 Prairie Coneflower
 <i>Ratibida pinnata</i>
 Purple Coneflower
 <i>Ratibida purpurea</i>
 Pale Coneflower
 <i>Echinacea pallida</i>
 Butterfly Milkweed
 <i>Asclepias tuberosa</i>
 Swamp Milkweed
 <i>Asclepias incarnata</i>
 Eastern Bluestar
 <i>Amsonia tabernaemontana</i></p> |
| <p>Non-native Species</p> <p>Trees
 Littleleaf Linden (34)
 <i>Tilia cordata</i>
 River Birch (13)
 <i>Betula nigra</i>
 Swamp White Oak (9)
 <i>Quercus bicolor</i>
 Crabapple (2)
 <i>Malus</i> (species)</p> <p>Grasses
 Wild Oats
 <i>Chasmanthium latifolium</i></p> | <p>Forbs
 New England Aster
 <i>Symphotrichum novae-angliae</i>
 Orange Coneflower
 <i>Rudbeckia fulgida</i>
 False Aster
 <i>Boltonia asteroides</i></p> <p>Shrubs
 Common Winterberry
 <i>Ilex verticillata</i></p> |
| <p>Naturalized Species</p> <p>Eastern Red Columbine
 <i>Aquilegia canadensis</i></p> | |

self-organize which reduces the need for maintenance. Increased biodiversity and modularity of plant species also contributes to disease recovery. Having a modular plant structure reduces the spread of disease in a certain plant species.

In addition, an increased number in vegetation, besides contributing to absorbing and cleansing stormwater and adding nutrients to the soil, helps sequester carbon. Based on the increased amount of tree cover, the park and surrounding area can sequester 73% more carbon than the existing amount of tree cover (Figure 7.6). Carbon sequestration is especially important in urban areas where pollution decreases air quality.

The fauna system components are habitats, number of habitat elements, and species movement. These components are important to the survival of local fauna in the area. Increase in habitats for pollinators and migratory species also contribute to overall survival of the ecosystem. Existing tree species and proposed tree, grass, forb, shrub, and sedge species contribute to supplying habitat elements for local animal species in the park (Figure 7.7).

For the people system components, I examined the Kansas City park system, connectivity of downtown, programs in the surrounding area, and amenities and elements of interest in Washington Square Park. These components contribute to the overall enjoyment of the area which creates a feedback of visitation and government operation. Connectivity and walkability in the area are increased by decreasing the automobile dominance of Main Street, Pershing Road, and Grand Boulevard (Figure 7.8). Connectivity is also increased with the removal of “The Link” and with the addition of crosswalks that allow visitors to enter the park in multiple locations.

Amenities provided in the park, such as seating and ornamental plantings, have also increased in the design proposal (Figure 7.9). Other amenities which currently exist in the park, such as bus stops, on-street parking, and turf grass, remain as amenities in the redesign.

Elements of interest currently in the park are a statue of George Washington, the Missouri Korean War Veterans Memorial, and the views to



Figure 7.6: Proposed Tree Cover and Vegetation

The tree cover in the design proposal is greatly increased in the streetscapes which helps sequester more carbon from the air. The carbon sequestration amount estimated is only from the proposed tree cover, but vegetation also helps sequester carbon. The area of vegetation is greatly increased in the proposal, partly due to the addition of green roofs on the infill buildings.

Rowntree and Nowak (1991)

Tree Cover

180,523.4 square feet of proposed tree cover
 52% of Washington Square Park and the surrounding streets is proposed to contain tree cover
 1.4 tons of carbon will be sequestered by the proposed park's and surrounding area's trees each year

Vegetated Areas

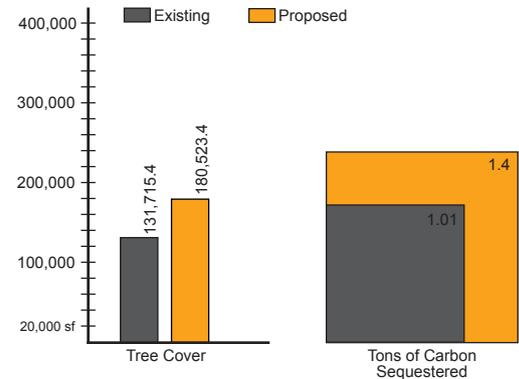


Figure 7.7: Fauna Species Attracted to Proposed Vegetation

Vegetation helps create habitats for local fauna, especially pollinators and migratory species.

Lady Bird Johnson Wildflower Center (2014)

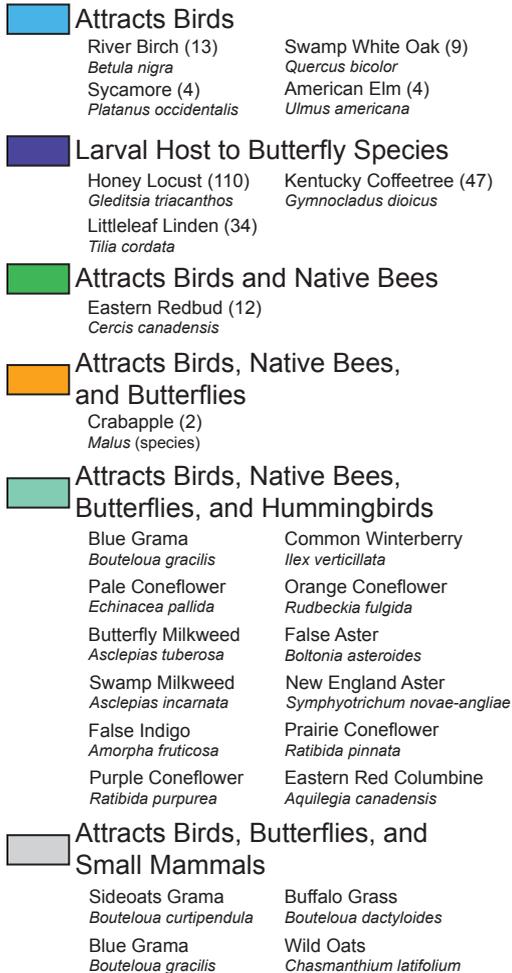
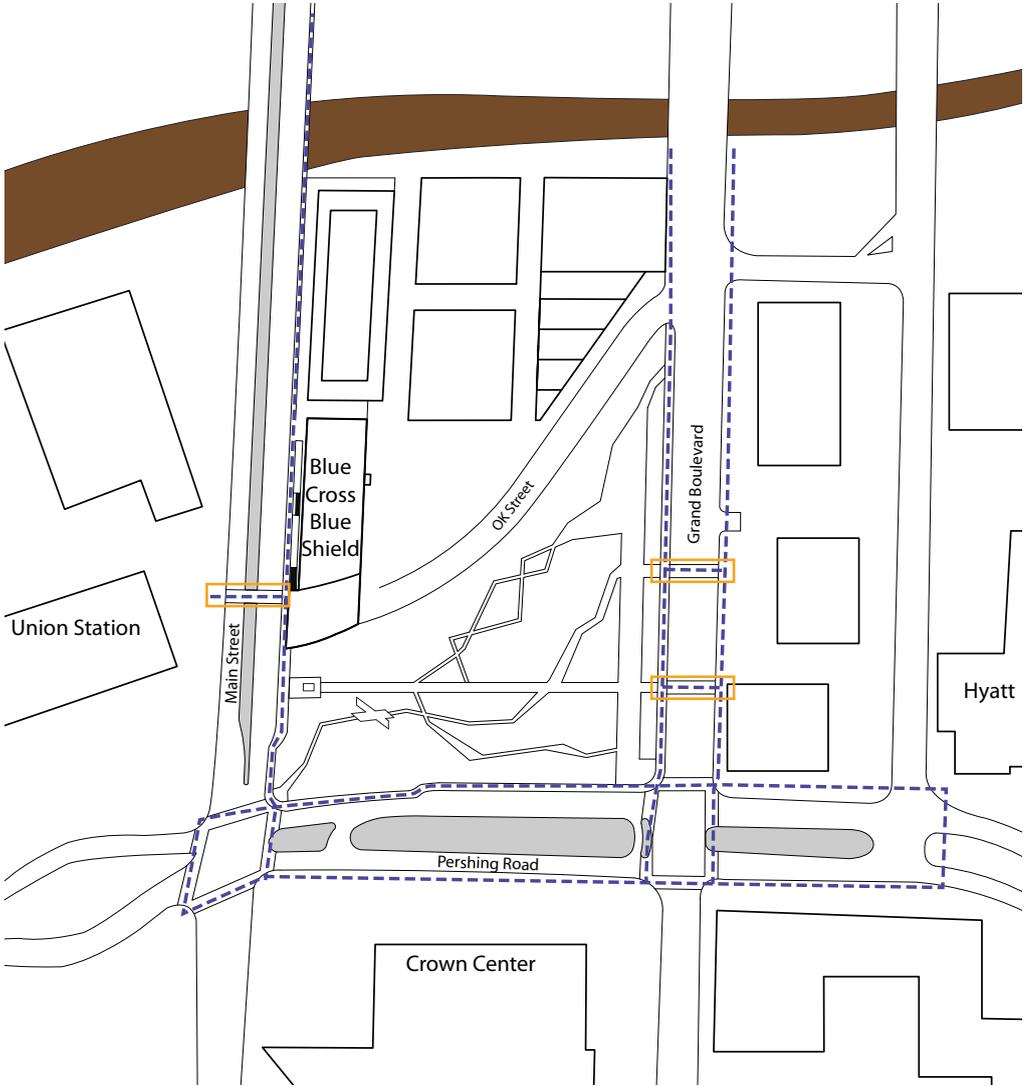


Figure 7.8: Pedestrian Connections Improved in the Proposal

The addition and widening of medians help reduce vehicular dominance in the area around Washington Square Park which improves walkability. Crosswalks also add to pedestrian connections to the park from surrounding programs. The infill and extended urban plaza helps to create connections north across the Main Street and Grand Boulevard bridges. In addition, the removal of "The Link" improves walkability at the street level and forms a connection between people and the street.



- — Pedestrian Connections
- ▭ Proposed Crosswalks
- ▭ Widened Medians
- ▭ Railroad Tracks

Figure 7.9: Proposed Amenities

Seating in the park greatly increases in the design proposal due to a seating area and designed spaces for seating throughout the site. Ornamental plantings, which are lacking in the existing park, have greatly increased due to the wildflower learning gardens and rain gardens. Existing amenities, such as on-street parking and bus stops, remain in the design proposal.

-  Turf Grass
-  Sidewalks
-  Ornamental Plantings
-  On-street Parking
-  Covered Bus Stop
-  Newspaper Stands
-  Seating
-  Trash Can
-  Flagpole
-  Water Fountain
-  Light Post



downtown, Liberty Memorial, and Union Station. These elements remain in the park redesign and the experience of each are further enhanced. The George Washington statue is moved to create a new entry plaza along Main Street and organic pathways create a more appropriate intimate experience for the Missouri Korean War Veterans Memorial (Figure 7.10). Seating areas are placed to take advantage of the views and green roofs add to the foreground of the view to downtown Kansas City. Other elements of interest added in the design proposal are a promenade, art walk, and rain gardens.

Based on these system components and feedbacks, the design proposal created from the guidelines will help improve the general resilience of Washington Square Park. If implemented, the design can give the park a better chance of being resilient to disturbances and self-organizing after the park enters the release phase of the Adaptive Cycle.

An understanding of the park's resilience, however, will not be possible until the resilience can be measured over time. Quantifying the degree of

resilience in landscapes is still a complex subject and further research is needed to determine specific measurable changes of resilience in Washington Square Park. However, the guidelines have provided a starting point for landscape architects to refer to when designing a resilient urban civic space.

Limitations

The perceptual model and system components I used in this research to evaluate for resilience were derived from the significant systems acting within Washington Square Park. These systems (soil, water, vegetation, fauna, and people) are not individual systems, but work together in urban ecosystems. Because of this complexity, I separated the systems and their components out in order to focus on how each component can help a system become more resilient. This separation helps evaluate for resilience in landscapes, however, it also allows for gaps to exist between functions operating in landscapes. Many social and ecological functions exist and influence urban landscapes, but evaluating all these functions for resilience is beyond current understanding.

Figure 7.10: Enhanced and Added Elements of Interest to Washington Square Park

The experience of existing cultural features in the park are enhanced with the redesign. In addition, new elements of interest are added to the park to improve visitation and enjoyment of the park.

- Cultural Features
 - Art Walk
 - Rain Gardens
 - Rooftop Gardens
 - Promenade
 - George Washington statue
 - Missouri Korean War Veterans Memorial
- Views to Crossroads district and Kansas City skyline
- View to Union Station
- View to Penn Valley Park and Liberty Memorial



In addition, although the guidelines account for site, downtown, and metro scales, the system components used to create the guidelines allow for little interaction between scales. In other words, it is unknown through this research how the design interventions proposed from the site-scale guidelines affect the resilience at other space and time scales. For example, adding rain gardens to Washington Square Park will affect the overall stormwater system operating in downtown Kansas City. Therefore, an understanding of the park's position within the entire Kansas City stormwater system will allow for increased understanding of how the entire system can be more resilient.

Further Research

Resilience is a complex and highly scientific theory which makes the theory difficult to apply to design. A methodology for quantifying resilience in landscapes currently does not exist, but recent research by the Resilience Alliance and by my peer, Brandon Woodle, have made strides in evaluating landscapes for resilience. The Resilience Alliance's *Assessing Resilience in Social-Ecological Systems: Workbook for Practitioners*

(2010) and Woodle's research *Resilience by Design: Evaluating and Prioritizing Social-Ecological Systems* (2014) both have created frameworks for assessing sites for resilience. These frameworks could be incorporated into my methodology as a way to further assess and identify the existing and proposed resilience conditions of an urban civic space.

In addition, applying a quantifiable methodology to my research could amend the guidelines to enhance their success of helping to design resilient landscapes. Methods of measuring resilience could also help further progress ideas on the characteristics of resilient systems. The research of Jack Ahern, Brian Walker and David Salt, and Kevin Cunningham begin to state characteristics systems should have in order to be resilient which guided the development of the guidelines in this research. However, more research could provide further understanding into how resilient systems operate and what strategies could help systems be resilient over time.

Further research is also necessary to help determine resilient strategies at the downtown and metro scales. A design

proposal at these scales for Kansas City was beyond the scope of this project, but resilience at a variety of scales, not just a project's focus scale, is important to consider. The design suggestions I made in this project for Kansas City's downtown and metro areas can be used as a basis for implementing resilient design improvements in Kansas City.

Project Application

The design proposal for Washington Square Park produced in this research creates an identity for the park and district as well as demonstrates resilient qualities. Implementing a resilient redesign in the park will increase the park's visitation and use over an extended period of time. Throughout the park's history, changing conditions have decreased use of the park, but a resilient design will allow for change. Therefore, the park can be suitable for use as time progresses without the Kansas City Parks and Recreation department having to make continued design interventions.

In addition, implementing a resilient design in Washington Square Park will contribute to the park becoming a catalyst. The park's resilient design can influence

other urban civic spaces to become more resilient and provide an example for these other designs. The park can also be a catalyst for downtown Kansas City and the Kansas City metro area to make resilient design improvements. Finally, Washington Square Park can be a catalyst for creating urban spaces which allow natural and human systems to coexist. Many design practitioners believe this coexistence is important, but many only implement minor ecosystem services in their urban designs.

The design proposal and methodology presented in this research can also benefit Coen+Partners who will conduct a site analysis and propose a design for Washington Square Park for Kansas City Parks and Recreation. The design proposal demonstrates that a design which benefits both natural and human systems can exist for the park. Therefore, natural systems should be a major consideration for the park's site analysis and redesign, in addition to human systems. Keeping existing features, as my design proposal shows, should also be a consideration of Coen+Partners as they continue with their site analysis and redesign. This research shows the

benefits of keeping the existing mature trees and viewsheds and reusing existing materials, but the research also shows the benefits of recreating the experiences of the existing memorials.

Coen+Partners should also consider a means of demonstrating the improvements to ecological systems their design will create, similar to the comparison method used in this research. This will show the City of Kansas City the value in making ecological improvements in the park.

In addition, through this research, the City of Kansas City can envision a resilient future for the downtown and metro area. The design suggestions proposed in this research begin to identify strategies which the city can work toward implementing to create a better downtown and metro area for people and natural systems. These suggestions, along with the design proposal for Washington Square Park, demonstrate that simple and cost-effective strategies can be used to create resilience. This allows for the implementation of resilient strategies to be easier, therefore, they are more realistic.

This research also provides a methodology for designers to design other urban civic spaces to exhibit resilience. The guidelines I created can help practitioners, however, designers will need to consider the specific conditions of an urban civic space before implementing the guidelines. Through Woodle's and my research, we have found that evaluating and applying resilience to sites involves a clear understanding of specific site conditions. Therefore, designers can still apply the guidelines to varying urban civic spaces, but they should use a similar methodology used for Washington Square Park in this report to ensure specific site conditions are being addressed. A site analysis and goal evaluation or an analysis of a site using Woodle's framework should be conducted for each urban civic space to ensure all goals of the spaces are met with a design proposal.

In addition to aiding with the design of resilient urban civic spaces, this research shows the importance for planners, landscape architects, and other practitioners to think about larger systems in all environmental designs.

Resilience theory shows interventions made at one scale influences all scales. Therefore, more understanding of larger regional systems and micro systems should take place when designing landscapes. This will improve areas' ecological and human systems while creating better sites.

This research also demonstrates a need for design theories to be further explored so their values can be integrated into practice. Many theories regarding urban design exist and have benefits that can be utilized. Therefore, research similar to this report, needs to be conducted to test theories and understand their benefits.

This research contributes to further research of resilience theory and how the theory applies to landscape architecture. The guidelines and the methodology presented begin to form current suggestions for designing for resilience into conclusions and design strategies. This is an initial step in trying to design resilient landscapes. This first step will benefit resilience theory as it is further researched and developed by practitioners and by organizations, such as the Resilience Alliance. This research

can also benefit and be influenced by projects practicing resilience, such as Rebuild by Design in New York City currently in progress.

Resilience should continue to be researched and a dialogue between resilience and design should continue. More research, like the work of Rockström et. al. (2009), is revealing that there are global thresholds anthropomorphic changes are causing systems to cross. Resilient landscapes, however, better accommodate for the simultaneous functioning of natural and social systems and the persistence of these systems over time. Resilient designs, especially in urban areas, can improve the functions of natural systems while creating a place for people to enhance quality of life.





Appendices

Appendix A: Argumentation Diagram

Enthymeme

Claim: Resilience theory can be applied to components of social-ecological systems in urban civic spaces through the implementation of modularity, redundancy, tight feedbacks, and ecosystem services.

Reason: because these elements exhibit qualities which create adaptive systems and allow landscapes to be designed holistically.

Grounds

- Landscape design case studies utilize these strategies to create adaptive systems.
- These strategies are professed in multiple literature works as strategies which create resilience.
- Many landscape architects already practice these strategies to create adaptive systems.



Conditions of Rebuttal

- Focusing on select social and ecological systems cannot create a resilient landscape.
- These elements do not encompass all strategies which can and should be implemented to create resilient systems.
- These elements cannot translate to all systems within a variety of urban civic spaces.

Warrant

1. Resilience theory provides a holistic approach to designing landscapes to be adaptive and sustaining.
2. Resilience theory should be implemented in landscapes.

Backing

Arguments showing why resilience theory leads to adaptive systems better than current sustainable practices.

- Identify relationships between resilience theory and adaptability.
- Resilience theory considers multiple space and time scales while sustainable practices tend to concentrate on the site scale.
- Case study analysis of systems which have been designed for enhanced resilience.
- Examples of increased adaptability in systems because of the implementation of resilient strategies.



Conditions of Rebuttal

- Sustainable practices are creating adaptability at multiple scales.
- Resilience cannot be achieved in already developed areas.
- Designers create their own methods for designing systems to be adaptable based on specific site conditions.
- Resilience theory relates more to landscape ecology than to landscape architecture.

Glossary

Adaptability – “The capacity of actors in a system (people) to manage resilience. This might be to avoid crossing into an undesirable system regime, or to succeed in crossing into a desirable one” (Walker and Salt 2006, 163).

Adaptive Cycle – “A way of describing the progression of social-ecological systems through various phases of organization and function. Four phases are identified: rapid growth, conservation, release, and reorganization. The manner in which the system behaves is different from one phase to the next, with changes in the strength of the system’s internal connections, its flexibility, and its resilience” (Walker and Salt 2012, 213).

Rapid Growth (r) - “A phase in which resources are readily available and entrepreneurial agents exploit niches and opportunities” (Walker and Salt 2012, 213).

Conservation (K) - “A phase in which resources become increasingly locked up and the system becomes progressively less flexible and responsive to disturbance” (Walker and Salt 2012, 213).

Release (omega) - “A phase in which a disturbance causes a chaotic unraveling and release of resources” (Walker and Salt 2012, 213).

Reorganization (alpha) - “A phase in which new actors (species, groups) and new ideas can take hold. It generally leads to another r phase” (Walker and Salt 2012, 213).

Basin of Attraction - “All the stable states of the system that tend to change toward the attractor. An attractor is a stable state of a system, an equilibrium state that does not change unless it is disturbed. The basin of attraction is often described using the ball-in-the-basin metaphor” (Walker and Salt 2012, 214).

Complex Adaptive Systems – Systems which “have the potential to exist in more than one kind of regime...in which their function, structure, and feedbacks are different. Shocks and disturbances to these systems...can drive them across a threshold into a different regime” (Walker and Salt 2006, 31).

Diversity - “The different kinds of components that make up a system. With respect to resilience there are two types of diversity that are particularly important” (Walker and Salt 2012, 214).

Functional diversity - “Diversity of the range of functional groups that a system depends on. For an ecological system this might include groups of different kinds of species such as trees, grasses, deer, wolves, and soil. Functional diversity underpins the performance of a system” (Walker and Salt 2012, 214).

Response diversity - “Diversity of the range of different response types existing within a functional group. Resilience is enhanced by increased response diversity within a functional group” (Walker and Salt 2012, 214).

Ecosystem Services - “The combined actions of the species in an ecosystem that perform functions of value to society (e.g., pollination, water purification, flood control)” (Walker and Salt 2012, 214).

Equilibrium - “A steady-state condition of a dynamic system where the interactions among all the variables (e.g., species) are such that all the forces are in balance and no variables are changing” (Walker and Salt 2012, 214).

Feedbacks - “The secondary effects of a direct effect of one variable on another that cause a change in the magnitude of that (first) effect. A positive feedback enhances the effect; a negative feedback dampens it” (Walker and Salt 2012, 214).

Focus scale – A scale, such as regional, metro, or site, which the study system resides in, is the focus of the resilience study, and determines what systems above and below will be studied for their influence on the focus scale (Gunderson and Holling 2001).

Kansas City Downtown Council - The downtown council is a non-profit organization who works with the city and business owners to make a more vibrant, healthy, and economically sustainable downtown (“About Us” 2013).

Kansas City Parks and Recreation - Kansas City Parks and Recreation, KC Parks, is a department within the city government who uses city funding to manage and improve public parks within the city (“About KC Parks” 2013).

Modularity - “The degree and pattern of connectedness in a system. A modular system consists of loosely interacting groups of tightly interacting individuals” (Walker and Salt 2012, 215).

Nonlinear – Systems and disturbances do not act on linear, cause-and-effect paths, but cycle through unexpected and lurching changes (Walker and Salt 2006).

Panarchy - “the term used to describe a concept that explains the evolving nature of complex adaptive systems. Panarchy is the hierarchal structure in which systems of nature (for example forests, grasslands, lakes, rivers, and seas), and humans (for example, structures of governance, settlements, and cultures), as well as combined human-nature systems (for

example, agencies that control natural resource use) (Gunderson and others 1995) and social-ecological systems (for instance, co-evolved systems of management) (Folke and others 1998), are interlinked in never-ending adaptive cycles of growth, accumulation, restructuring, and renewal. These transformational cycles take place in nested sets at scales ranging from a leaf to the biosphere over periods from days to geologic epochs, and from the scales of a family to a socio-political region over periods from years to centuries” (Holling 2001, 392).

PIAC - The Public Improvements Advisory Committee (PIAC) is a part of the Capital Improvements Program for the City of Kansas City, Missouri. The committee makes recommendations on how the capital budget is distributed for city and neighborhood improvement projects based on input from citizens.

Redundancy – “multiple elements or components provide the same, similar, or backup functions” (Ahern 2011, 5).

Regime - “A set of states that a system can exist in and still behave in the same way-still have the same identity (basic structure and function). Using the metaphor of the ball in a cup, a regime can be thought of as a system’s basin of attraction. Most social-ecological systems have more than one regime in which they can exist” (Walker and Salt 2013, 215).

Regime shift - “When a social-ecological system crosses a threshold into an alternate regime of that system” (Walker and Salt 2013, 215).

Request for Qualifications/Proposals (RFQ/P) - The Request for Qualifications/Proposals for Washington Square Park was distributed by KC Parks. It outlines the expectations of the park improvement project and lists qualifications necessary for teams interested in bidding on the project, the goals of the park improvement, and the products expected when working on the project (Parks and Recreation Kansas City 2013).

Resilience - “Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist” (Holling 1973, 17).

Specified resilience – Resilience of a known disturbance. Resilience “of what, to what” (Walker and Salt 2006, 120).

General resilience – “general capacities of a social-ecological system that allow it to absorb unforeseen disturbances” (Walker and Salt 2006, 121).

Self-organizing - The capacity for a system to organize its functions to regrow and sustain the functionality of the whole system after a disturbance.

Social-ecological systems - “Linked systems of people and nature” (Walker and Salt 2012, 215).

State of a system - “Defined by the values of the “state” variables that constitute a system. For example, if a rangeland system is defined by the amounts of grass, shrubs, and livestock, then the

state space is the three-dimensional space of all possible combinations of the amounts of these three variables. The dynamics of the system are reflected as its movement through this space” (Walker and Salt 2012, 215).

Stakeholder - “Any individual or organization that can affect or be affected by the management of the resources affected” (Gunderson et al. 2010, 52).

Sustainability - “The likelihood an existing system of resource use will persist indefinitely without a decline in the resource base or in the social welfare it delivers” (Walker and Salt 2006, 165).

System - “The set of state variables together with the interactions between them, and the processes and mechanisms that govern these interactions” (Walker and Salt 2006, 165)

Thresholds - “Levels in underlying controlling variables of a system in which feedbacks to the rest of the system change” (Walker and Salt 2006, 165).

Transformability - “The capacity to create a fundamentally new system (including new state variables, excluding one or more existing state variables, and usually operating at different scales) when ecological, economic, and/or social conditions make the existing system untenable” (Walker and Salt 2006, 165)

Variables

Controlling variables - “Variables in a system (such as nutrient levels in a lake, depth of the water table) that determine the levels of other variables (like algal density or soil fertility) (Walker and Salt 2006, 165).

Fast and slow variables - “Controlling ecological variables often tend to change slowly (sediment concentrations, population age structures), while controlling social variables may be fast (e.g., fads) or slow (culture). Slow variables determine the dynamics of the fast variables that are of direct interest to managers. The fast biophysical variables are those on which human use of systems is based, and the fast social variables are those involved in current management decisions or policies” (Walker and Salt 2006, 165).

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