RESILIENCE BY DESIGN: A FRAMEWORK FOR EVALUATING AND PRIORITIZING SOCIAL-ECOLOGICAL SYSTEMS

by

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A REPORT

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ABSTRACT

Resilience theory provides an approach for landscape architects to analyze systems and design adaptive environments. C.S. Holling created the theory in response to changing social-ecological systems (Holling 1973). Resilience is the ability of a system to adapt to disturbances and remain in the same state (Walker and Salt 2006). This report proposes a framework that applies resilience to site analysis. The goal of the Resilience Analysis Framework is to help designers address expected and unexpected threats to human well being on a global and local scale. The framework was created by synthesizing findings from a literature review and expert interviews. A literature review based the framework in theory. Interviews with professionals working on the Rebuild by Design (2013) competition grounded the framework in professional practice. The goal of the Rebuild by Design competition was to develop resilient solutions to the changing environment. Synthesizing findings from the literature review and expert interviews resulted in a five part framework. The five parts are: Stakeholder Engagement, System Description & Goal Establishment, System Analysis, System Report, and Prioritization. Stakeholder Engagement is a process that occurs throughout each part of the framework. It includes education, data collection, reporting, and feedback. The System Description & Goal Establishment part describes the basic properties of a system and establishes goals for the future of those properties. System Analysis is an in depth evaluation of the factors determining a system's level of resilience. The System Report synthesizes the important information from the System Description & Goal Establishment and System Analysis parts. Prioritization performs the essential task of focusing a project by identifying high priority systems. The goals (from the System Description & Goal Establishment and System Analysis parts) for the high priority systems determine the primary goals for the project. These goals inform decisions during the site analysis/strategic planning phase of the design process. The framework was applied to Washington Square Park in Kansas City, Missouri. This application provided an example of how to apply the framework to a park analysis. This report's main finding was a framework for building evidence to make resilient design decisions.

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A report submitted in partial fulfillment of the requirements for the degree:
Master of Landscape Architecture

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Resilience theory provides an approach for landscape architects to analyze systems and design adaptive environments. C.S. Holling created the theory in response to changing social-ecological systems (Holling 1973). Resilience is the ability of a system to adapt to disturbances and remain in the same state (Walker and Salt 2006). This report proposes a framework that applies resilience to site analysis. The goal of the Resilience Analysis Framework is to help designers address expected and unexpected threats to human well being on a global and local scale. The framework was created by synthesizing findings from a literature review and expert interviews. A literature review based the framework in theory. Interviews with professionals working on the Rebuild by Design (2013) competition grounded the framework in professional practice. The goal of the Rebuild by Design competition was to develop resilient solutions to the changing environment. Synthesizing findings from the literature review and expert interviews resulted in a five part framework. The five parts are: Stakeholder Engagement, System Description & Goal Establishment, System Analysis, System Report, and Prioritization. Stakeholder Engagement is a process that occurs throughout each part of the framework. It includes education, data collection, reporting, and feedback. The System Description & Goal Establishment part describes the basic properties of a system and establishes goals for the future of those properties. System Analysis is an in depth evaluation of the factors determining a system's level of resilience. The System Report synthesizes the important information from the System Description & Goal Establishment and System Analysis parts. Prioritization performs the essential task of focusing a project by identifying high priority systems. The goals (from the System Description & Goal Establishment and System Analysis parts) for the high priority systems determine the primary goals for the project. These goals inform decisions during the site analysis/strategic planning phase of the design process. The framework was applied to Washington Square Park in Kansas City, Missouri. This application provided an example of how to apply the framework to a park analysis. This report's main finding was a framework for building evidence to make resilient design decisions.

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RECOGNITION

Thank you Blake Belanger, my major advisor, for providing guidance throughout the report process. This report would not have been possible without his advising. Thank you to my committee members Brent Chamberlain and Gary Stith. Their critiques and feedback were crucial to the development of this report.

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INTRODUCTION

Chapter 1

Over the next hundred years, climate change will challenge the way humans live. People will have to adapt to increased storm events, sea level rise, and change in local climates (Steffen et al. 2005). Resilience theory as first defined by C.S. Holling provides a systems thinking approach to adapting to climate change (Gunderson and Holling 2002). Understanding the behavior of systems is essential to designing adaptive environments. Resilience theory is valuable because it provides a way to understand system behavior. Therefore, an analysis of systems' resilience would create evidence for adaptive design decisions. This report addresses the need for an analysis of systems' resilience.

The seven sections of this report are: background, methodology, literature review, expert interviews, resilience analysis framework, Washington Square Park, and conclusion. In the background section the rationale for the selection of resilience theory and resilience theory are explained and the rationale for focusing on application of resilience to site analysis is explained. Resilience theory addresses four dilemmas facing designers which will be discussed in the background chapter. Dilemmas identified include climate change, the need to combine ideas from design and ecology, the need for a comprehensive approach, and the misuse of sustainability. Resilience theory is also gaining traction in professional practice. In addition to explaining resilience theory, the background section of this report outlines the reasoning behind the focus on the site analysis phase of the design process. The site analysis section explains current approaches to resilience analysis and their inadequacies.

The methodology for this report is a mixed-methods approach. Methods utilized include a literature review, expert interviews, framework development, and a case study. The mixed-methods approach results in a "top-down" (current understanding of the theory of resilience) and "bottom-up" (current application in the field) approach. A "top-down" approach is achieved through a review of literature. Expert interviews ground this report in professional practice. The author synthesized findings from the literature review and expert interviews to create the Resilience Analysis Framework. Last, the case study provides an example of how to apply the analysis framework.

The literature review overviews the creation and development of resilience theory. Then the review is narrowed to this report's topic and areas for future research are identified. Sources in the literature review provide the theoretical basis for this project. It is a top down, academic approach to the creation of the framework. Interviews of experts in the field provides information on how professionals define resilience, how it is assessed and what analysis methods are used in professional practice.

The expert interviews provide insight into the analysis of a resilience project in professional practice. The interviewees are members of teams participating in the Rebuild by Design (RBD) competition. The RBD competition is the interview selection criteria because it calls for replicable, resilient solutions to problems in the Hurricane Sandy affected region (Rebuild By Design 2013).

The Resilience Analysis Framework is a resilient approach to the site analysis phase of the design process. It provides a way to assess the resilience of social-ecological systems. A synthesis of findings from the literature review and expert interviews created the basis for the framework. The overall organization is a modification of the Ecological Planning Model by Frederick R. Steiner (Steiner 1991). The tailored model includes five parts: Stakeholder Engagement, System Description & Goal Establishment, System Analysis, System Report, and Prioritization. Potential users of the framework include professionals in ecology, landscape architecture, urban design, and land planning.

Finally, The Washington Square Park (WSP) case study provides an example of how to apply the framework. WSP is a park within the downtown area of Kansas City. The author was required to utilize WSP as part of the requirements for this master's report. This report analyzes WSP in the scenario of a professional hired by the Kansas City Department of Parks and Recreation for the design and implementation of the park.

BACKGROUND

Chapter 2

The background section of this report contains the rationale for the focus on resilience theory and the benefits of applying the theory to a site analysis. Two main sections included in this chapter are: Resilience Theory and Site Analysis. Resilience Theory explains the value of resilience thinking as applied to landscape architecture. This section also explains the principals of resilience theory. The Site Analysis section describes the value of site analysis in landscape architecture and the need for an approach to resilience analysis. The need is explained by analyzing existing approaches to resilience analysis.

Resilience Theory

This proposal explains the importance of resilience theory in three parts. First, this section addresses four dilemmas facing landscape architects. They include: climate change, shortcomings of theories integrating design and ecology, the need for a comprehensive design approach, and the misuse of sustainability. Resilience Theory also overviews what resilience theory is and how it addresses the four dilemmas facing landscape architects. Finally, this section explains the use of resilience in practice.

Current Dilemmas

Resilience theory is valuable because it addresses four major dilemmas. Global climate change has emerged as a major dilemma for humanity. Landscape architects must design for the changing climate to reduce possible negative consequences (Steffen et al. 2005). There is also a need for a successful combination of ideas from design and ecology. Landscape Urbanism, Ecological Urbanism, and Landscape Ecology attempt to combine design and ecology, but these theories are not as effective as resilience theory (Rees 2009). The third dilemma is the need for a comprehensive approach to design. A comprehensive approach is important to minimizing negative changes caused by overlooking possible outcomes. Last, "sustainability" is a dilemma because there is no unified definition. Sustainability lacks meaning in mainstream society and the most common definition is not sustainable (Rees 2009; Walker and Salt 2006). Climate change, a combination of design and ecology, a comprehensive approach, and the misuse of sustainability are dilemmas that resilience theory addresses.

Climate Change

A major dilemma facing humanity is global climate change. The earth is warming and local climates are changing at an unprecedented rate since industrialization. The dramatic impact humans have on the planet result in a need for designers to be responsible for mitigating the negative consequences (Steffen et al. 2005). Two examples of the consequences of climate change are increased severe storm events that threaten safety and reduced crop yields due to changes in local climate. To address global and local changes the *United Nations Millennium Ecosystem Assessment* (2005) calls for a better process for design decision making. Processes for design decisions can help designers produce and implement the best strategies for mitigating climate change (MA 2005). In order to ensure humanity's long-term well being, action must be taken to ensure that the environment will be livable for generations to come.

Design + Ecology

Landscape Urbanism, Landscape Ecology, and Ecological Urbanism try to synthesize ideas from design and ecology. The main goal of landscape urbanism is to establish the landscape as an essential part of the urban fabric (Cuff and Sherman 2011). The theory integrates landscape, ecology, and urbanity (Waldheim 2006). Projects are designed to approach time open-endedly with conditions to shape changes over time (Corner 1999a). Landscape Ecology has an emphasis on the sciences and is a cross-disciplinary approach to design (Dramstad 1996). An important idea that was pulled from ecology into this theory is a non-equilibrium view of systems (Ahern 2011). This view emphasizes designing the environment to adapt to dynamic systems (Lister, Nina-Marie 2007). The third theory, Ecological Urbanism, also tries to combine ideas from ecology and urban environments (Steiner 2011). Ecological Urbanism builds on ideas from Landscape Urbanism creating a theory that is more holistic. Ecological Urbanism looks at the reach of systems outside of the city to the surrounding rural environments (Mostafavi et al. 2011). All three theories have two linked dilemmas they: focus on large scale thinking, and lack strategies for application. Focusing on large scale thinking emphasizes planning and causes small sites to be insignificant. The lack of application methods increases the difficulty of implementing plans at all scales.

Comprehensive Approach

There is a need for a comprehensive approach to the design and management of landscapes. An important part of comprehensive thinking is to balance short and long term processes. For example, if the perennial grass-cover drops below 60 percent in the savannas of northern Australia the land will degrade (Walker and Salt 2012, 30). This land is used for cattle grazing. Another process happening in the savannas relates to the economics of ranchers. In order to remain financially profitable ranchers must graze the land beyond 60 percent grass cover (Walker and Salt 2012, 30). Therefore, the current state of the savanna system will result in a failure (Walker and Salt 2012, 30). What is yet to be determined is whether this failure will occur in either the near or far future. A comprehensive approach incorporating ecology, economics, design, slow processes, and fast processes must be used to solve the overgrazing problem. This is just one problem people are facing around the globe. Each situation has unique variables, so there is a need for a comprehensive approach that is applicable to any scenario. An essential part of a comprehensive approach is the balancing of different types and scales of systems.

Misused Sustainability

Mainstream society considers efficiency an important aspect of sustainability. However, W. Stanley Jevons in 1865 recognized that "It is a confusion of ideas to suppose that the economical use of fuel is equivalent to diminished consumption. The very contrary is the truth" (Rees 2009). Often people will not change the amount budgeted, so efficiency only equates to increased consumption (Rees 2009). Thus, efficiency is often found to be counterproductive and frequently leads to a less sustainable lifestyle. Another problem with efficiency is the manner in which systems are managed. In order to maximize efficiency people often attempt to keep systems in an "optimal" state even though a sustainable "optimal" state of systems does not exist. Trying to achieve the "optimal" state is unattainable and even counterproductive (Walker and Salt 2006). Attempting to keep systems in a fixed state almost always results in a waste of resources because it is inevitable that systems will change. Efficiency alone is not the solution to sustainability because it

[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)

causes a waste and an increased consumption of resources. Because efficiency does not lead to sustainability, there is a need for a new perspective on the definition of sustainability.

Resilience Overview

Resilience theory is explored by reviewing the initial research that first defined the concept of resilience theory, next the key concepts of resilience theory will be identified, and last the results that have been observed since the origin of resilience theory will be described. The Discussion summarizes the conclusions from the review of research and identifies how resilience theory can address the four dilemmas referenced above.

Origin of Resilience

Resilience theory originated with ecologists who were trying to understand and address problems presented by the changing environment. In response to the changing systems, C. S. Holling, an ecologist, wrote *Resilience and Stability of Ecological Systems* (1973). In this article, Holling proposes a new view defining systems as complex, dynamic, and adaptive. These systems link humans (social) and nature (ecologic) and are referred to as social-ecological systems (Holling 1973). To address the changing social-ecologic systems, Holling proposes a resilient approach. He defines resilience by stating that it “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). In other terms, resilience is the ability of a system to adapt to a disturbance and retain the same state (structure and functions). This was the first definition of resilience and initiated the development of resilience theory.

In another article, *Resilience and Adaptive Cycles* (2002) Holling and Gunderson clarify their definition of resilience by stating how it is varies from other interpretations. They describe the traditional approach to resilience as "engineering resilience," and they refer to their approach as "ecosystem resilience." Engineering resilience focuses on responding to a disturbance of a system by bringing it back to its "optimal state" as quickly as possible. Ecosystem resilience disregards the idea of trying to sustain an "optimal state" and rather embraces change. Instead of fighting system change, ecosystem resilience embraces change and manages the system with the goal of retaining the same state (structure and functions) (Holling and Gunderson 2002). Embracing change applies a concept from ecology to design and helps designers acknowledge that it is unrealistic to expect any system to reach and sustain an "optimal state."

Holling's definition of resilience in 1973 can provide a frame of reference for a problem that emerged years later: climate change. Resilience theory can provide designers with a methodology to identify the potential effects of climate change. Then, designers can utilize this knowledge of changing systems to create solutions capable of adapting to change. By understanding how to adapt to change designers become responsible for managing possible consequences of climate change (Holling and Gunderson 2002).

Main Concepts

Resilience theory understands changes occurring around the world through social-ecological systems. A social-ecological system is a "linked system of people and nature" (Walker and Salt 2012). Holling categorized social-ecological systems and into three parts: social, ecologic, and economic. An important property of social-ecological systems is that they are self-organizing. When a system is self-organizing it arranges its components in a purposeful manner without external influences (Holling 2001). In addition to self-organization, Resilience Theory breaks down the behavior of social-ecological systems into three core elements: the adaptive cycle, panarchy, and basins of attraction. These three elements describe the behavior of social-ecological systems (Walker and Salt 2006).

The adaptive cycle is the progression of movement across the four phases of a social-ecological system. The four phases are growth, conservation, release, and reorganization. This is the typical order of the four phases but "the adaptive cycle is not an absolute; it is not a fixed cycle, and many variations exist in human and natural systems"(Walker and Salt 2006). The growth phase is characterized by the use of readily available resources. In the conservation phase resources are inaccessible and as a result, the system becomes less adaptable. Release occurs when a disturbance results in the availability of resources. Finally, reorganization is a phase where new actors and ideas take hold (Walker and Salt 2012). Figure 2.1 shows a graphic representation of the adaptive cycle.

Panarchy is described as "the hierarchal structure in social-ecological systems are interlinked in never ending adaptive cycles of growth, accumulation, restructuring, and renewal" (Holling 2001). This term explains how systems affect each other and are arranged in a hierarchy of interacting adaptive cycles operating at different spatial and time scales. Each adaptive cycle is linked and impacts other systems (Walker et al. 2004). Figure 2.2 shows an example of the interactions of adaptive cycles within a panarchy. The feedback arrows indicate the interaction between the systems.

Basins of attraction describe the behavior of the state of systems. The basins "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" (Walker and Salt 2012). A common way to visualize basins of attraction is as a ball in a field of basins. The ball is the social-ecological system, and its location in the field determines its behavior. If it is in a basin, it tends to roll towards the bottom of the basin, also referred to as equilibrium. Disturbances are forces on the ball that cause it to roll in an unexpected way. In between two basins of attraction is a threshold. When a system crosses the threshold, it enters a new basin and the

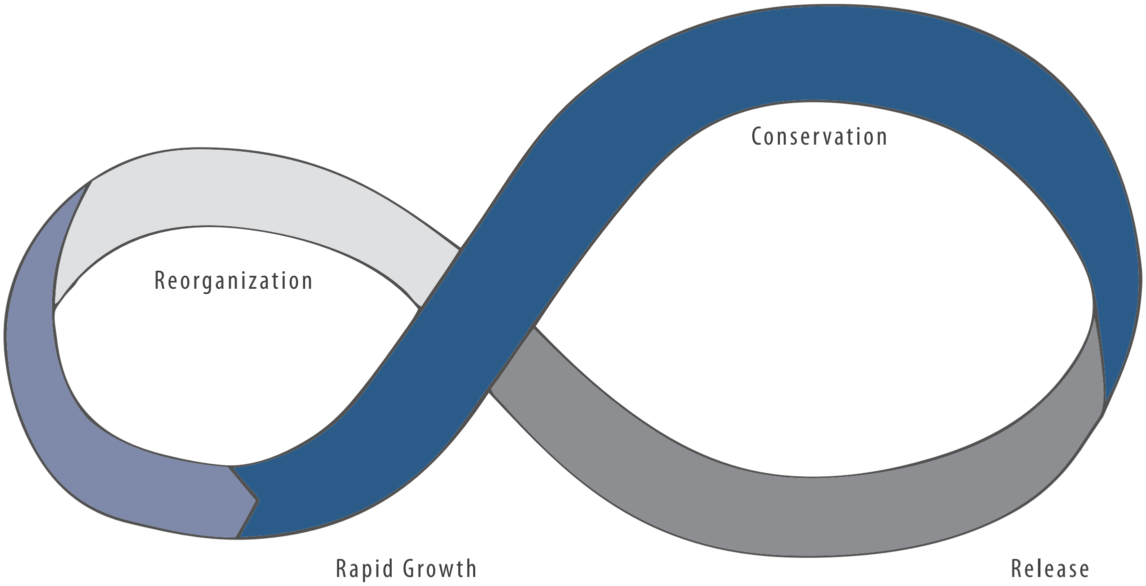


Figure 2.1. Adaptive Cycle (adapted from Walker and Salt 2006)

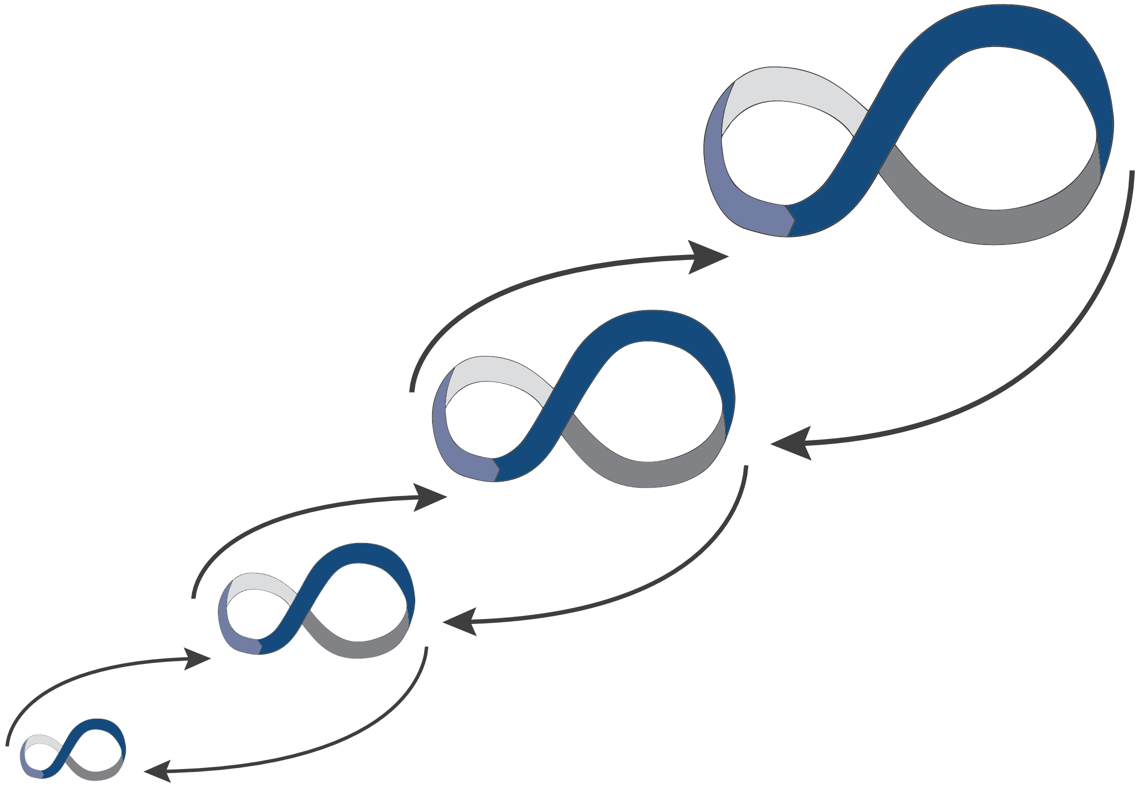


Figure 2.2. Panarchy (adapted from Walker and Salt 2012)

system's functions, feedbacks, and structure change. When a system crosses a threshold into a new basin it has gone through a regime shift (Walker et al. 2004). Figure 2.3 shows two basins of attraction and a system approaching the threshold.

Designers can use resilience to shape the difficulty level of a system's movement between basins. When high resilience is present it makes it difficult for disturbances to move the ball (system) into a new basin (Walker et al. 2004). This means that resilience is determined by a basin's width and depth in addition to the location of the ball. High resilience may not always be desired, for instance if a system is in an undesirable basin it may be the goal of designers to lower resilience to guide the system into a desired basin (Walker and Salt 2006).

General and specified resilience are important considerations for designers. General resilience focuses on maintaining the general capabilities of a system in order to adapt to change from an unforeseen disturbance. The five main factors for general resilience are diversity, modularity, tightness of feedback

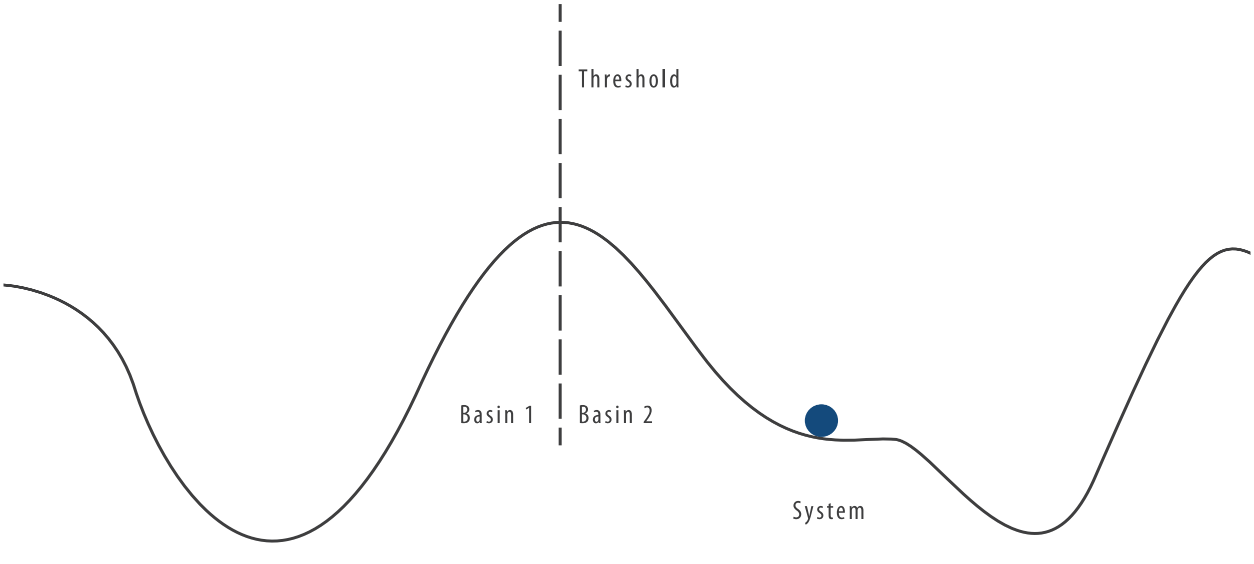


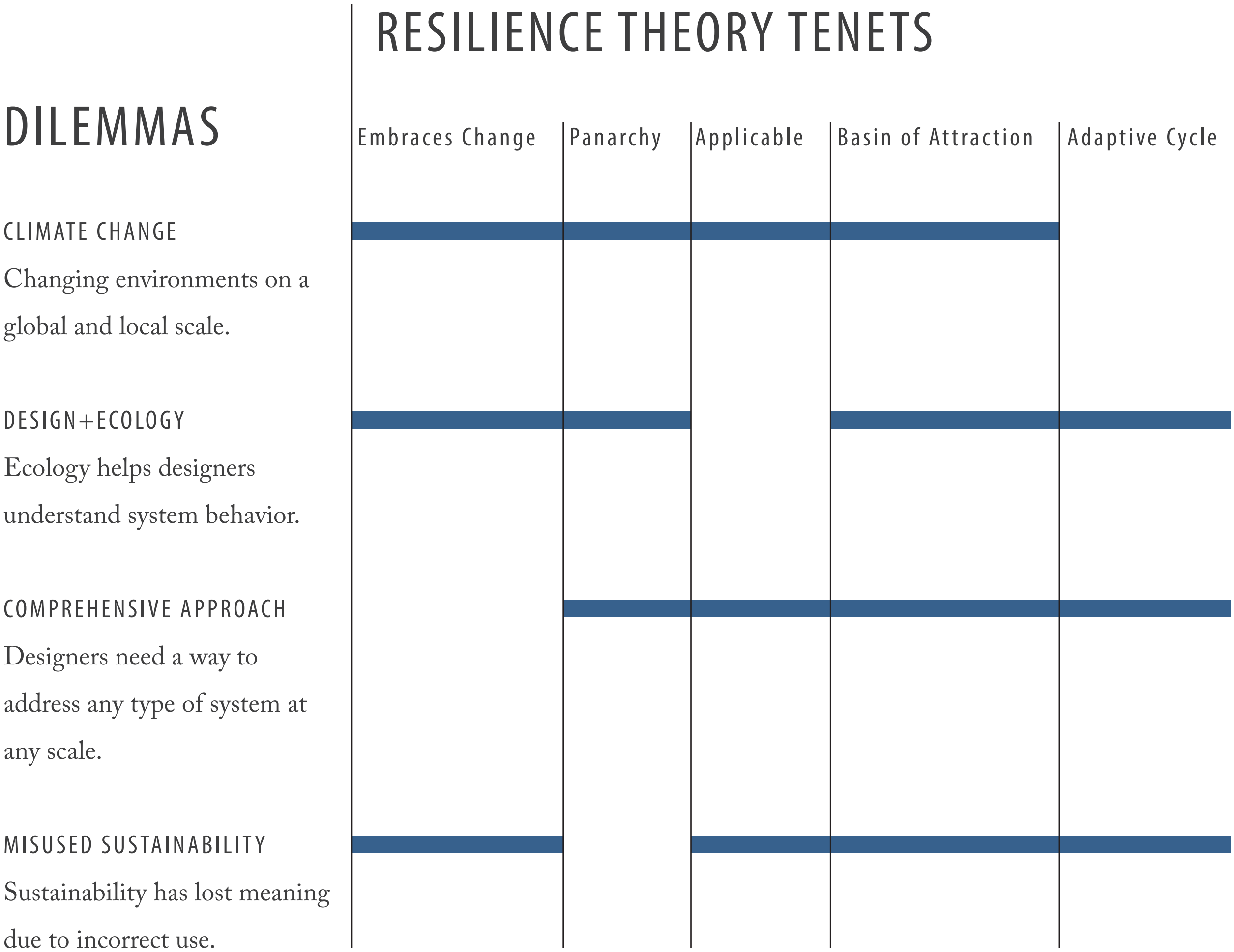
Figure 2.3. Basin of Attraction adapted from (Walker and Salt 2006)

loops, total capital, and openness. Specific resilience is the resilience of a system to an identified disturbance. Designers identify disturbances and thresholds when analyzing specific resilience (Ahern 2011; Gunderson et al. 2010; Walker and Salt 2012).

Discussion

Resilience theory is comprehensive because it considers all scales and systems. It also is applicable, and synthesizes design with ecology. Panarchy, one of the tenets of resilience theory, considers all scales. This includes geographic and time scales. By accounting for all scales from global to a small site resilience theory encompasses geographically far reaching impacts. Additionally, panarchy accounts for future and past impacts on systems by analyzing time scales of seconds up to billions of years (Gunderson and Holling 2002). Resilience theory achieves a comprehensive view of systems not only by considering all time and geographic scales, but also by considering all types of systems. Social, ecological, and economic are the three categories for systems identified by C. S. Holling (Holling 2001). Considering all types of systems enables designers to address all the systems impacting a site (Walker et al. 2004). A systems thinking approach allows resilience theory to be applied to the design of any project scale (Walker and Salt 2012). The result of considering all scales, systems, an applicable approach, and combining ideas from design and ecology is a comprehensive approach to design.

In addition to a comprehensive approach, resilience theory provides new ideas on the definition of sustainability. Discarding the notion of "efficiency as sustainability" dispels a misunderstanding of the term. Currently command-and-control is a common management practice (Holling and Meffe 1996). It is based on the idea of "efficiency as sustainability." Therefore, command and control management is not sustainable because it attempts to fight constantly changing systems to reach an "optimal" state (Holling and Meffe 1996). Sustaining an optimal state is impossible because systems are constantly changing. In order to be sustainable, it is necessary to embrace change by allowing systems to self-organize after a disturbance. Resilience theory provides a way to design systems to change while sustaining their state. Design solutions can achieve a stable state by increasing resilience after the system is in a desired basin (Walker and Salt 2006). Once a system is in a desired basin, a resilient, not command-and-control, approach sustains the system's state by making it difficult for the system to leave its basin (Holling and Meffe 1996). In addition to sustaining system states, resilience theory provides a strategy for defining sustainability based on stakeholder values. Defining sustainability based on stakeholders' goals enables application of the term to any project.



DILEMMAS	RESILIENCE THEORY TENETS Embraces Change	Panarchy	Applicable	Basin of Attraction	Adaptive Cycle
CLIMATE CHANGE Changing environments on a global and local scale.	●	●	●	●	
DESIGN+ECOLOGY Ecology helps designers understand system behavior.	●	●		●	●
COMPREHENSIVE APPROACH Designers need a way to address any type of system at any scale.		●	●	●	●
MISUSED SUSTAINABILITY Sustainability has lost meaning due to incorrect use.	●		●	●	●

Figure 2.4. Resilience Tenents Address Dilemmas

Theory Conclusions

Climate change, a synthesis of ideas from design and ecology, a comprehensive approach, and the misuse of sustainability are the three major design dilemmas resilience theory addresses. Figure 2.4 shows which resilience theory tenets address each of the current dilemmas. Resilience theory responds to climate change by embracing the fact that systems change instead of trying to fight the inevitable (Holling 1973). Embracing change is achieved in part by combining ideas from design and ecology. Disregarding the possibility of "optimal" states and accepting a non-equilibrium view of systems draws key concepts from ecological theory. The definition of social-ecological systems (linked systems of humans and nature) is another important idea taken from ecology. Resilience concepts are framed in a way that allows designers to apply them to practice (Walker and Salt 2006). The theory analyzes systems on both time and geographic scales. Combining the scales of systems with the types of systems (ecologic, economic, social) designers consider every aspect of a site. The consideration of all aspects of a site results in a comprehensive approach. Resilience theory adds to the discussion of sustainability's definition by accepting that efficiency does not equal sustainability. Instead, a system's state can be sustained by guiding the system into a desired basin and then increasing its resilience (Holling and Meffe 1996). It is important to note "the debate on sustainability has come a long way in recent decades. But if we examine it through a resilience lens, it's clear that we still have a way to go" (Walker and Salt 2006).

Currency

In addition to the dilemmas addressed by resilience theory, this report uses resilience theory because it is emerging in professional practice. Recently resilience has been identified as a judging criteria in competitions. After Hurricane Sandy , New York City held a design competition called For A Resilient Rockaway (FAR ROC). Resilience was on the list of five goals in the judging criteria. The devastating effects of Hurricane Sandy caused city officials to realize the importance of resilience to disturbances in urban environments (FARROC 2013). Rebuild by Design is another competition that calls for the application of resilience theory. The Rebuild by Design competition brief identifies five strategies for creating resilience that are within the body of literature reviewed for this report. The strategies in the Rebuild by Design brief are a modification of the strategies identified by Ahern in the article *From Fail-Safe to Safe-to-Fail: Sustainability and Resilience in the New Urban World* (2011). Another competition is The Rockefeller Foundation 100 Resilient Cities Centennial Challenge. The foundation selected cities from a pool of global applicants to be a part of their effort to make the world more resilient to disturbance events (The Rockefeller Foundation 2014). The Rebuild by Design, FAR ROC, and 100 Resilient Cities competitions are examples of the potential importance resilience theory could have to professional practice. These competitions result in the need for practitioners to understand resilience theory because it is essential for firms to remain current in order to win competitions and be able to compete in the current and the future market place.

Site Analysis

This report focuses on the site analysis phase of the design process. Site analysis is essential to development of quality designs. A growing approach in landscape architecture is evidence based design. The site analysis and research phase of the design process creates evidence for design decisions. The goal of evidence based design is to produce higher quality work (Kopec et al. 2011). As applied to resilience theory, a resilience analysis is required to make design decisions. A resilience analysis identifies the systems acting on a site and the current state of resilience of those systems (Gunderson et al. 2010). Approaches to resilience analysis have been created but they are inadequate because they do not provide a comprehensive approach to site analysis.

Current Approaches

An approach for analyzing a site's resilience was created by the Resilience Alliance in their documents *Assessing Resilience in Social-Ecological Systems: Workbook for Practitioners* (2010) and *Workbook for Scientists* (2007). The Resilience Alliance is an institution dedicated to the body of research of resilience theory. The workbooks identify steps for completing site analysis (Gunderson et al. 2010; Resilience Alliance and Collaborators 2007). Supplementing the workbooks is *Applying a Social-Ecological Inventory: A workbook for finding the key actors and engaging them* (2011). *Applying a Social-Ecological Inventory* focuses on engaging stakeholders and government officials in the process for analyzing systems' resilience (Schultz, Plummer, and Purdy 2011). Similar to the steps created by the Resilience Alliance, *Resilience Practice* (2012) by Brian Walker and David Salt is a guide for analyzing the resilience of social-ecological systems. Both the Resilience Alliance and Walker and Salt propose a process that begins with identifying important factors for a focal time and geographic scale. Then the analysis continues by describing the systems in the scales above and below the focal scale, and last analyzing the resilience of different aspects of the system (Gunderson et al. 2010; Walker and Salt 2012). *Resilience Practice* contains case studies to supplement the proposed approach to site analysis (Walker and Salt 2012).

Problems With Current Approaches

Resilience Alliance's documents and *Resilience Practice* (2012) by Walker and Salt use a step-by-step process to analyze resilience. A step-by-step process is inadequate because it does not follow the principles of resilience theory. One principal the step-by-step processes violate is iterative behavior. A core element of resilience theory, the adaptive cycle, is an iterative loop that is constantly cycling back to the same phases. Additionally, comprehensive thinking is an important part of resilience theory (Walker and Salt 2006). Therefore, it is important for designers to be comprehensive in their use of resilience theory. An iterative process that replicates the adaptive cycle is required for the comprehensive use of resilience. The step-by-step processes created by the Resilience Alliance, Walker and Salt are not iterative, and therefore are inadequate approaches to resilience analysis. Additionally, a step-by-step process is difficult to use because the design process is iterative in nature. A framework is a better alternative because it allows designers to be iterative in their approach to site analysis. Another problem with the approaches created by the Resilience Alliance, Walker and Salt is a lack of methods for carrying out site analysis. My report will take on the dilemma of the lack of a comprehensive approach to site analysis by creating a framework for resilience evaluation and prioritization.

METHODOLOGY

Chapter 3

The three primary methods for this report are a literature review, expert interviews, and a case study. This mixed methods approach was top down through a literature review and bottom up through expert interviews (see Figure 3.1). The literature review provided an overview of the literature on resilience theory and divides sources into four categories. These categories were: Humanity's Problems and the Origins of Resilience, Conceptualizing Resilience Theory, Applying Resilience Theory, and Methods for Resilience Analysis. This report organized the literature review to start with the general concept of resilience theory and then narrowed to this report's focus. The information in the literature review provided a theoretical base for this report. Phone interviews of professionals working on a resilience project provided information on using resilience in practice. The interviews revealed definitions of resilience and methods for analyzing resilience. Collecting data from a real project grounded this report in professional practice. Findings were synthesized from the literature review and interviews to create the framework for resilience analysis. The framework is an approach to evaluating the resilience of systems and prioritizing changes to systems. There are two reasons for application of the framework to WSP. First, for framework refinement and second, to explain how to use the framework.

Literature Review

The purpose of the literature review was to provide an overview of the existing resilience literature and then apply this information to the focus of this report. The literature review for this report was confined to sources relating to resilience theory as originally defined by C.S. Holling. Information from the literature provided the theoretical base for the creation of the framework. The sources are categorized into four groups: Humanity's Problems and the Origins of Resilience, Conceptualizing Resilience Theory, Applying Resilience Theory, and Methods for Resilience Analysis.

The first group, Humanity's Problems and the Origins of Resilience discussed issues related to changing social-ecological systems that drove the creation of resilience theory (Steffen et al. 2005). Literature in this group began to identify core concepts of resilience theory that explain the behavior of systems. Concepts in Origins of Resilience set up sources in the next group, Conceptualizing Resilience Theory, to develop resilience theory into a codified theory.

Sources in Conceptualizing Resilience Theory developed core concepts, defined terminology, and solidified the relevance of resilience. Literature in this group defined the three main elements of resilience theory: the adaptive cycle, panarchy, and basins of attraction (Walker et al. 2004; Gunderson and Holling 2001). Ideas in Conceptualizing Resilience Theory literature provided a base for the development of approaches to application. Conceptualizing Resilience Theory and the first group, Humanity's Problems and the Origins of Resilience, provide a background on this report's general topic of study.

The Applying Resilience Theory section is comprised of sources that used the ideas from Conceptualizing Resilience as a foundation and developed strategies for application (Walker and Salt 2012). In addition to strategies, sources in Applying Resilience Theory contained frameworks and guides for applying resilience theory (Allan and Bryant 2011; Cunningham 2013). The strategies, guides, and frameworks provided approaches to the site analysis and design phases of the design process. A study of the literature in Applying Resilience Theory revealed that the approaches to site analysis were inadequate. The absence of an adequate approach to site analysis is the main dilemma this report addressed. In addition to identifying the main dilemma, literature in this group provided information for the creation of the Resilience Analysis Framework. The existing approaches to

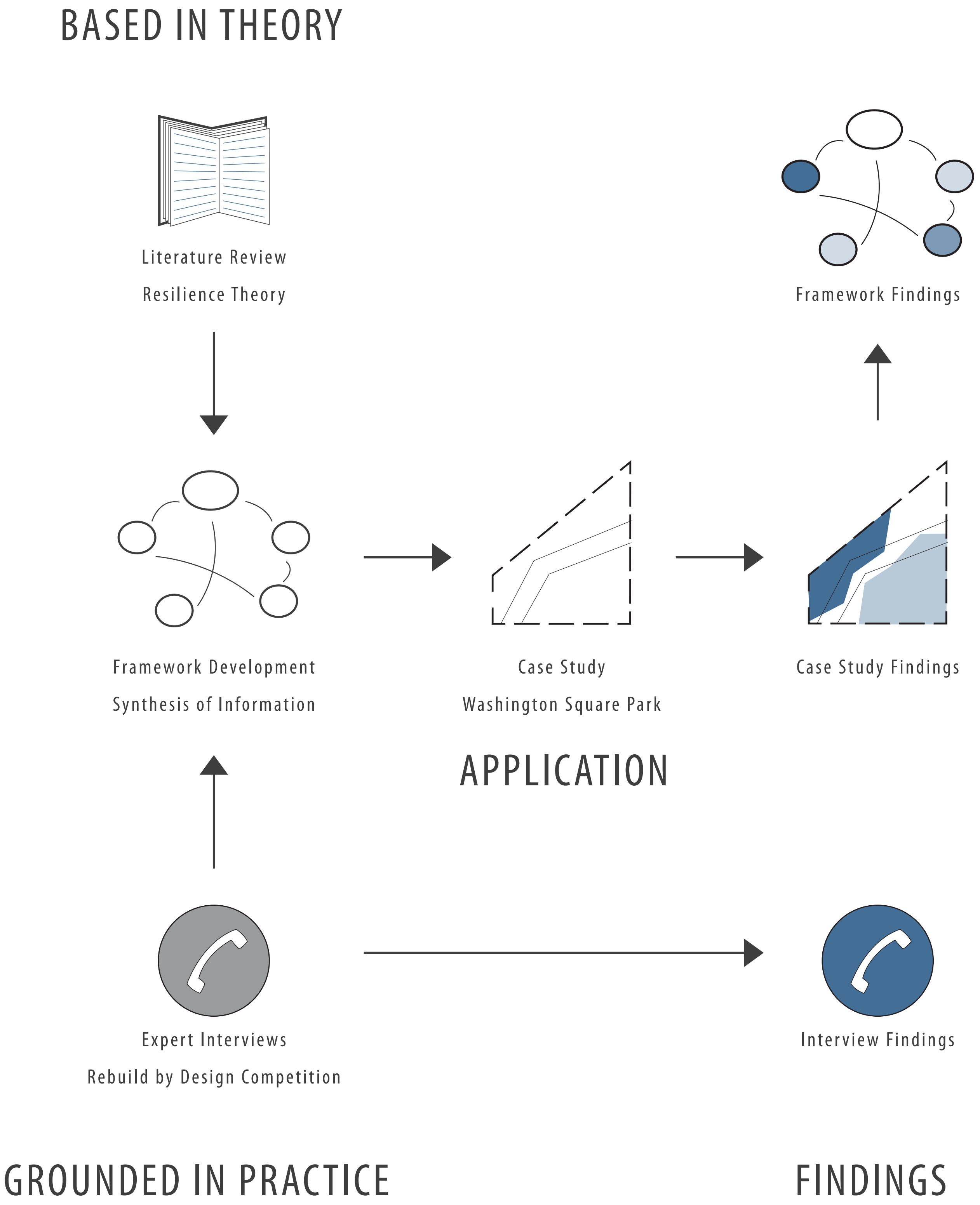


Figure 3.1. Top Down and Bottom Up Methodology

resilience analysis were the theoretical basis for creation of this report's framework (Ahern 2011; Walker and Salt 2012).

Methods for Resilience Analysis provided information on approaches for analyzing resilience. Content in this group provided methods to carry out the frameworks, strategies, and guides in the Applying Resilience Theory literature. Not all of the sources in Methods for Resilience Analysis mentioned resilience theory. Suggested methods within the body of resilience literature pertain to interactions with stakeholders and communities. Additional sources were included on general methods for site analysis because methods in the resilience literature were limited to stakeholder involvement (Walker and Salt 2012). Critical mapping and historical analysis are examples of two methods identified from literature outside the realm of resilience theory (Corner 1999; Kopec et al. 2011). Analysis of literature in this group revealed a gap in the identification of methods for analyzing resilience. Additionally, Methods for Resilience Analysis literature provided information on suggested methods for applying this report's framework.

Expert Interviews

Expert interviews conducted with professionals working on a resilience project grounded this report in practice. The professionals were members of teams that participated in the Rebuild by Design (RBD) competition. The author selected the RBD competition because it called for innovate approaches to creating resilience.

The US Department of Housing and Urban Development initiated the RBD competition in response to the destruction of hurricane Sandy. The competition participants were selected as interview subjects for this report because the RBD brief outlined strategies for resilience that are a part of this report's literature review (Rebuild By Design 2013). Jack Ahern's essay *From Fail-Safe to Safe-to-Fail: Sustainability and Resilience in the New Urban World* identifies five strategies for building urban resilience (Ahern 2011). Ahern's five strategies overlapped with the strategies in the RBD brief. This report documents interviews with members from eight of the ten teams that participated in the competition. The remaining two teams were not available for an interview. Each team was comprised of multiple disciplines, and the range of professionals interviewed reflects the range of expertise involved in the RBD project. The professions of the interviewees included architecture, landscape architecture, planning, and economic consultancy.

There were four phases to the Rebuild by Design competition. The first phase was a request for proposal. The administrators of the competition, the U.S. Department of Housing and Urban Development (HUD), selected ten teams to participate in RBD. Phase two was a research and analysis phase with a goal of understanding the challenges in the Sandy affected region and identification of four to five design opportunities per team. During phase three teams develop one design opportunity (selected by HUD) from their four or five design opportunities. An expert jury will evaluate the proposals at the end of phase three. The jury will select winning design solutions to receive funding from disaster recovery grants as well as other sources to move forward with the project (Rebuild By Design 2013).

The first step for conducting the phone interviews was receiving approval from the International Review Board (IRB). Approval from the IRB is required when human subjects participate in a research project. The IRB approval process requires the completion of an approval form and providing a sample Informed Consent Form. The author received an accepted approval form two weeks after the form was submitted. The interviews took place between December 16th, 2013 and January 21st, 2014. Each conversation ranged from 50 and 90 minutes. Notes were taken during the interviews and each conversation was recorded. Table 3.1 lists the participants.

The author conducted the interviews according to principals of grounded theory. "Grounded theory is a general method of comparative analysis" (Glaser and Strauss 2012). It provided a methodology for conducting and analyzing qualitative research. The main idea behind grounded theory is

HR&A Advisors
Olivia Moss

OLIN
Richard Roark

OMA
Daniel Pittman

Sasaki
Rhiannon Sinclair

SCAPE
Gena Wirth

Unabridged Architecture
Allison Anderson

Undisclosed
Undisclosed Team

Undisclosed
Undisclosed Team

Table 3.1. Interview Participants

> Findings from the three [interview] analyses informed the creation of the framework, determined how the professionals' use of resilience relates to this report, and revealed other properties of resilience.

to start with the data and work upwards, a "ground up" approach (Glaser and Strauss 2012). When applied to interviews, grounded theory outlined a technique that was casual and conversational. The technique begins with asking broad questions to allow the interviewees the freedom to talk as they saw fit. Broad questions covered the following topics: the definition of resilience, methods for analyzing resilience, and the interviewee's personal role on the project. Later in the interviews the questions became more focused to reveal further detail about something said during the interview (Dey 1999).

The first step of the analysis process was transcribing the interviews into a script. Then the author reviewed the transcripts multiple times and identified ideas. The list of ideas includes a combination of stated terms and ideas implemented as part of the analysis and/or design. Ideas were then analyzed in the three following ways: Categorization, Resilience Definition Comparison, and Importance of Ideas.

Categorization divided the ideas into three groups: methods, concepts, and resilience in practice. The methods category included ideas relating to geographic representation, community engagement, and on site data gathering and analysis. The concepts category included definitions of resilience, factors for analyzing resilience, and design strategies for achieving resilience. Resilience in practice included other ideas related to tips for successful projects.

This report compared the literature's definition of resilience to the definitions provided by the professionals that were interviewed (e.g. panarchy, basin of attraction). There are two parts to this analysis. First, the author analyzed the similarities between the literature review findings and the interviewees' ideas. Second, the interviewees' responses to the question "How did your team define resilience?" were analyzed for similarities.

The importance of the concepts was determined through quantitative and qualitative analyses. The quantitative analysis tallied the number interviewees that mentioned an idea and the number of times an idea was mentioned. The qualitative analysis determined the emphasis the professionals placed on an idea. Findings from the three analyses determined how the professionals' use of resilience relates to the literature, revealed other properties of resilience, and evaluated the importance of an idea to the RBD competition. This report used the findings from the interviews during creation of the framework.

Framework Development

The primary goal of the framework was to create an approach to site analysis using resilience theory. The author created the framework by synthesizing findings from the literature review and expert interviews. The resulting framework is replicable to projects across all scales. Findings from the framework provide evidence to inform design decisions.

Five sources were synthesized to create the framework. The five sources are *Resilience Practice* by David Salt and Brian Walker, *Assessing Resilience: A workbook for practitioners* by the Resilience Alliance, *From Fail-Safe to Safe-to-Fail: Sustainability and Resilience in the New Urban World* by Jack Ahern, *The Living Landscape* by Frederick Steiner and the expert interviews. *Resilience Practice* and *Assessing Resilience: A workbook for practitioners* provided a theoretical base for the Resilience Analysis Framework. A modification of the Ecological

Stakeholder Engagement	Interaction with stakeholders for education, data collection, reporting, and feedback (Woodle 2014).
Problem Description & Goal Establishment	Determining the base properties of a system: current conditions and future vision (Woodle 2014).
System Analysis	In depth analysis of the factors determining resilience: current trends and desired change (Woodle 2014).
System Report	A synthesis of the important information from the System Description & Goal Establishment and System Analysis parts of the framework (Woodle 2014).
Prioritization	Determining the systems' level of priority (Woodle 2014).
Problem Identification	”Problems or opportunities leading to specific planning issues” (Steiner 2008).
Goal Establishment	”Goals articulate an idealized future situation” (Steiner 2008).
Regional Inventory & Analysis	”Collection and analysis of information at a regional level” (Steiner 2008).
Local Inventory & Analysis	”Collection and analysis of information at a local level” (Steiner 2008).
Detailed Studies	”Detailed studies link the inventory and analysis information to the problems and goals” (Steiner 2008).
Planning Concepts	”The development of concepts for the planning area” (Steiner 2008).
Landscape Plan	”A strategy for development at the local scale” (Steiner 2008).
Detailed Design	”To give form and to arrange elements spatially” (Steiner 2008).
Plan and Design Implementation	”The employment of various strategies, tactics, and procedures to realize the goals” (Steiner 2008).
Administration	”Administration involves monitoring and evaluating how the plan is implemented on an ongoing basis” (Steiner 2008).
Community Engagement	”Community engagement includes interacting with citizens for education, explanation, and data collection” (Steiner 2008).

Table 3.2. **Ecological Planning Model Definitions** (Steiner 2008; Woodle 2014)

Planning Model from *The Living Landscape* shaped the overall organization of the framework. The expert interviews contributed to the framework by adding real world, “need to know” data (e.g. cost/benefit analysis). The Ecological Planning Model (EPM) by Steiner was the basis for the framework's overall organization. The author combined some parts of the EPM and omitted others. The excluded parts were found to be irrelevant to the site analysis phase of the design process. The Problem/Opportunity Identification and Goal Establishment steps from the EPM were combined into the

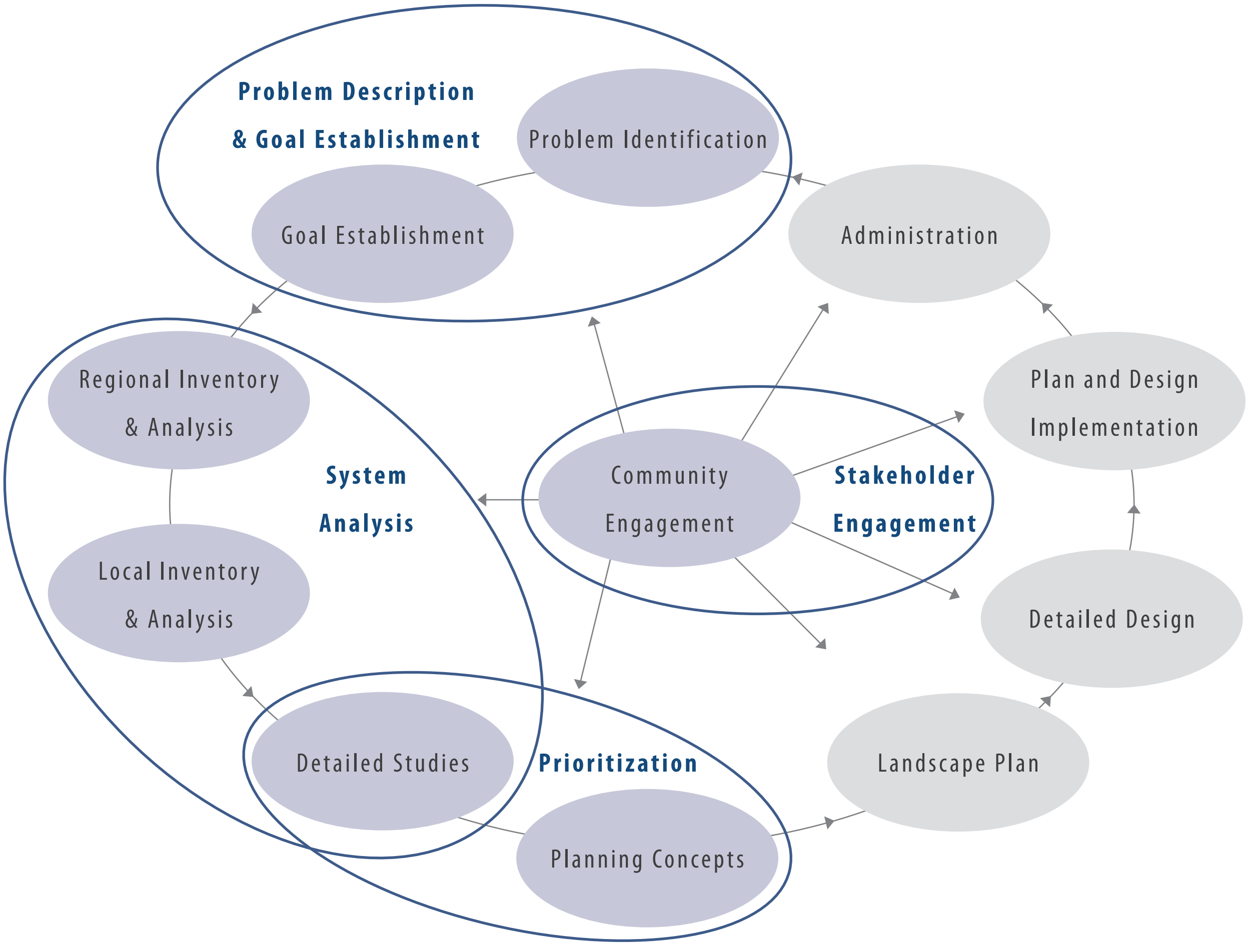


Figure 3.2. Ecological Planning Model Adaptation (Steiner 2008)

System Description & Goal Establishment. The System Analysis part of the resilience framework synthesized Regional Inventory & Analysis, Local Inventory & Analysis, and Detailed Studies from the EPM. Prioritization was a combination of the Detailed Studies and Planning Concepts steps of the EPM. Last, the a System Report step was added and placed before Prioritization. The author changed Community Engagement to Stakeholder Engagement and left in the center because it is essential to resilience evaluation. Figure 3.2 shows the Ecological Planning Model synthesis and Table 3.2 provides definitions for the EPM and resilience framework steps.

In addition to synthesizing steps of the Ecological Planning Model, the author rearranged the direction and locations of the steps. The overall framework according to the model being presented moves in a

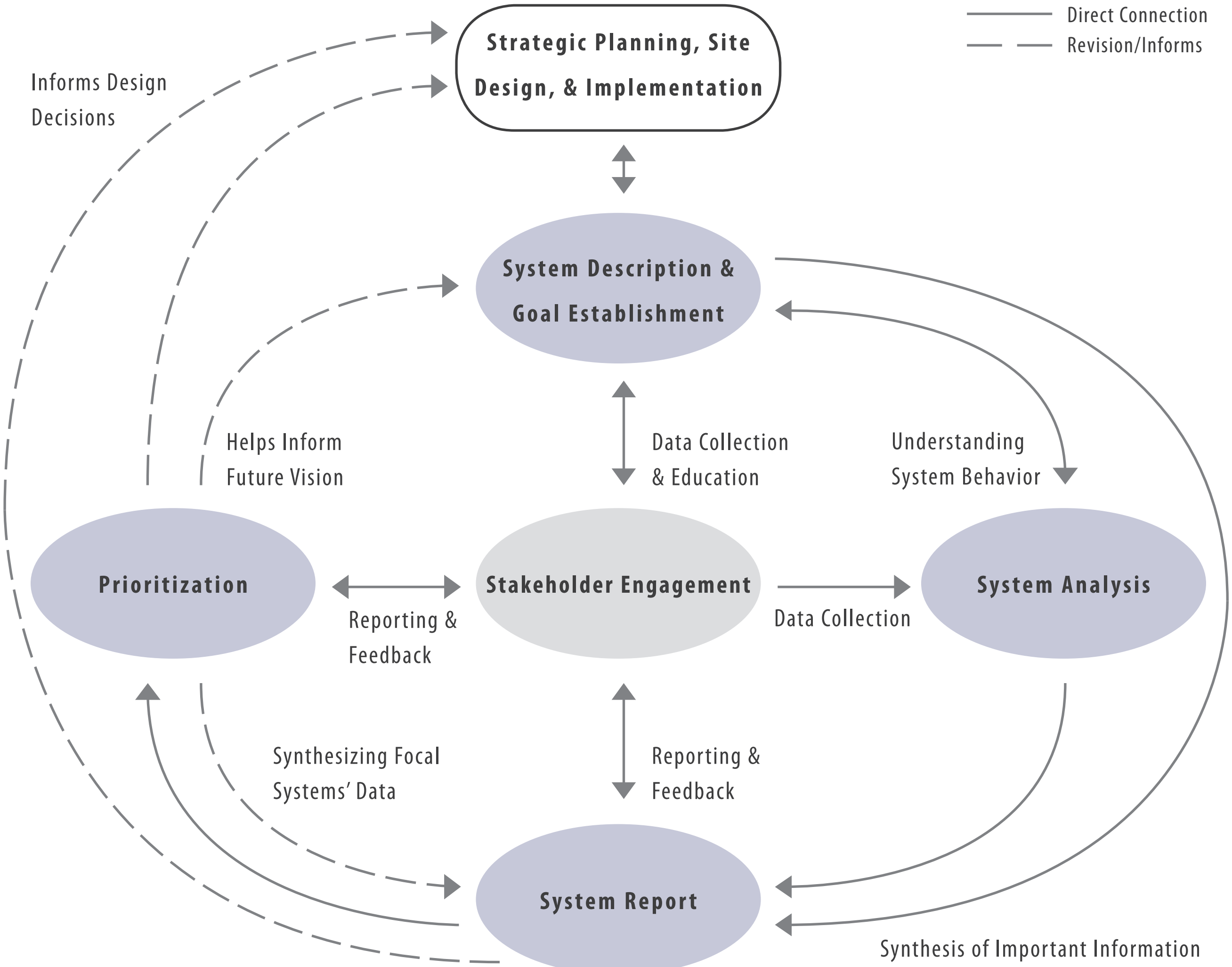


Figure 3.3. Resilience Analysis Framework

clockwise pattern verses counterclockwise. The author changed the direction because the counterclockwise motion was found to be counterintuitive. The System Report (Administration) part moved position and is placed before Prioritization (Detailed Studies + Planning Concepts). The System Report's location was changed because reporting out only pertinent information from the Problem Description & Goal Establishment and System Analysis parts informs the analysis in the Prioritization part. Last, the author moved the steps in the EPM relating to Strategic Planning, Site Design, and Implementation to be located as a branch off the Prioritization and System Report parts. The Prioritization informs designers and planners of the focal systems leading to Strategic Planning, Site Design, & Implementation. This last part was placed above the System Description &

STAKEHOLDER ENGAGEMENT

This part is integrated into every phase of the process.

Engagement includes: data collection, education, reporting, and feedback.

ANALYSIS FACTORS: SYSTEM DESCRIPTION & GOAL ESTABLISHMENT

Factors to be analyzed for their Current Conditions and Future Vision.

Factors include: Scales (Time and Spatial), Stable State, Phase, Other System Interaction

ANALYSIS FACTORS: SYSTEM ANALYSIS

Below are the factors for the two sections of the System Analysis part.

General Resilience: Diversity, Redundancy, Openness, Tightness of Feedbacks, Total Capital

Specific Resilience: Disturbance, Thresholds of Concern, Interacting Thresholds

SYSTEM REPORT

A synthesis of only the important information from the other parts including maps and sources for analysis.

ANALYSIS FACTORS: PRIORITIZATION

Factors include: Benefit, Consequence, Importance of Vision, Budget/Funding Sources, Decision Makers

Goal Establishment because it is the phase related to achieving the goals. Additionally, the placement of the Strategic Planning, Site Design, & Implementation part mimics the spiraling nature of the design process. Figure 3.3 shows the Resilience Analysis Framework.

Steiner's Ecological Planning Model provided the overall organization of the framework. The author of this report devised the properties within each step of the framework through a synthesis of findings from the resilience literature and expert interviews.

In the middle of the framework is Stakeholder Involvement. This part is not a specific step but a part of each phase of the process. During the System Description & Goal Establishment phase stakeholders are educated and a source for information on

System Description	The current state of the basic properties of a system (Woodle 2014).
Future Vision	The goal for the state of the basic properties of a system (Woodle 2014).
Scales	Geographic and time extents of a system. Scale is dynamic and subject to change (adapted from Walker and Salt 2012).
Stable State (basin of attraction)	Stable state of a system. The system's identity as defined by its structures, functions, and feedbacks (adapted from Walker and Salt 2012).
Phase (adaptive cycle)	Phases of social-ecological systems (growth, conservation, release, and reorganization) (adapted from Walker and Salt 2012).
Other System Interaction (panarchy)	Effects on the state of a system due to the state of another system. A set of hierarchical adaptive cycles at different scales (adapted from Walker and Salt 2012).

Table 3.3. System Description & Goal Establishment Adapted Definitions adapted from (Walker and Salt 2012)

systems. Stakeholders also provide data during the System Analysis phase. Reporting and feedback from stakeholders occurs during System Reporting and Prioritization.

System Description & Goal Establishment

The System Description & Goal Establishment (SD&GE) part identifies the basic properties of systems. It is broken in two parts, System Description and Future Vision. The SD&GE part analyzes the following factors: Scales, Stable State, Phase, and Other System Interaction. These properties are repeated under the System Description and Future Vision to allow for documenting current conditions and future goals. The author synthesized information from *Resilience Practice* by David Salt and Brian Walker with *Assessing Resilience: A workbook* by the Resilience Alliance to create the SD&GE part of the framework.

The factors for analysis in the System Description & Goal Establishment include Scales, Stable State, Phase, and Other System Interaction. For Scales, it is important to analyze geographic and time scales. The scales of a system are subject to flux, and it may be important to determine potential change. Identifying a scale helps set the analysis scope and amount of detail to analyze. The Stable State determines the current basin of attraction, or the identity of a system. Phase is a modification of the adaptive cycle. The four phases of the adaptive cycle are growth, conservation, release, and reorganization. Analyzing the Phase determines ongoing changes to the system. Other System Interaction is modified from the term panarchy. This factor accounts for the influence of other systems. See Table 3.3 for a list of definitions.

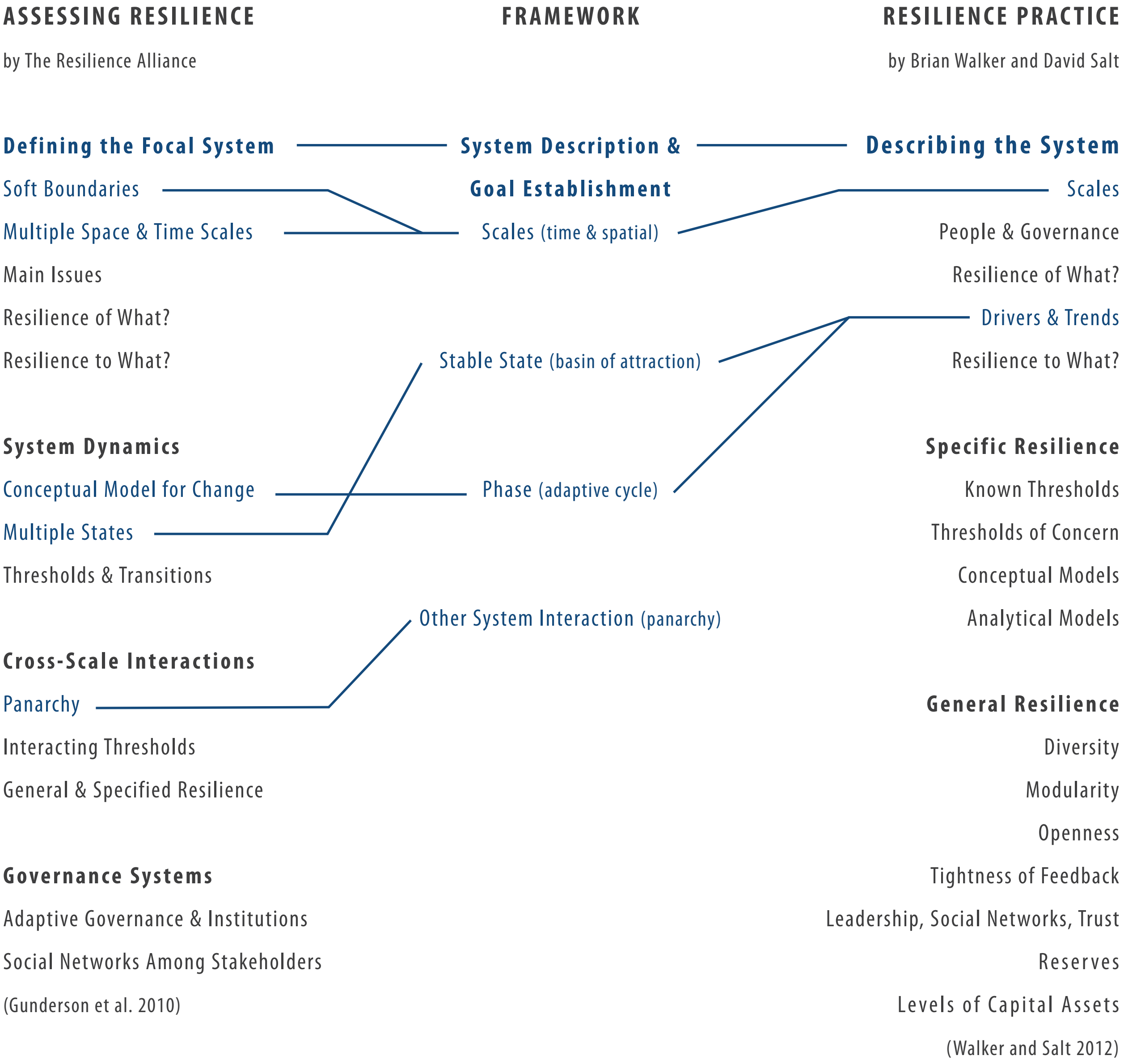


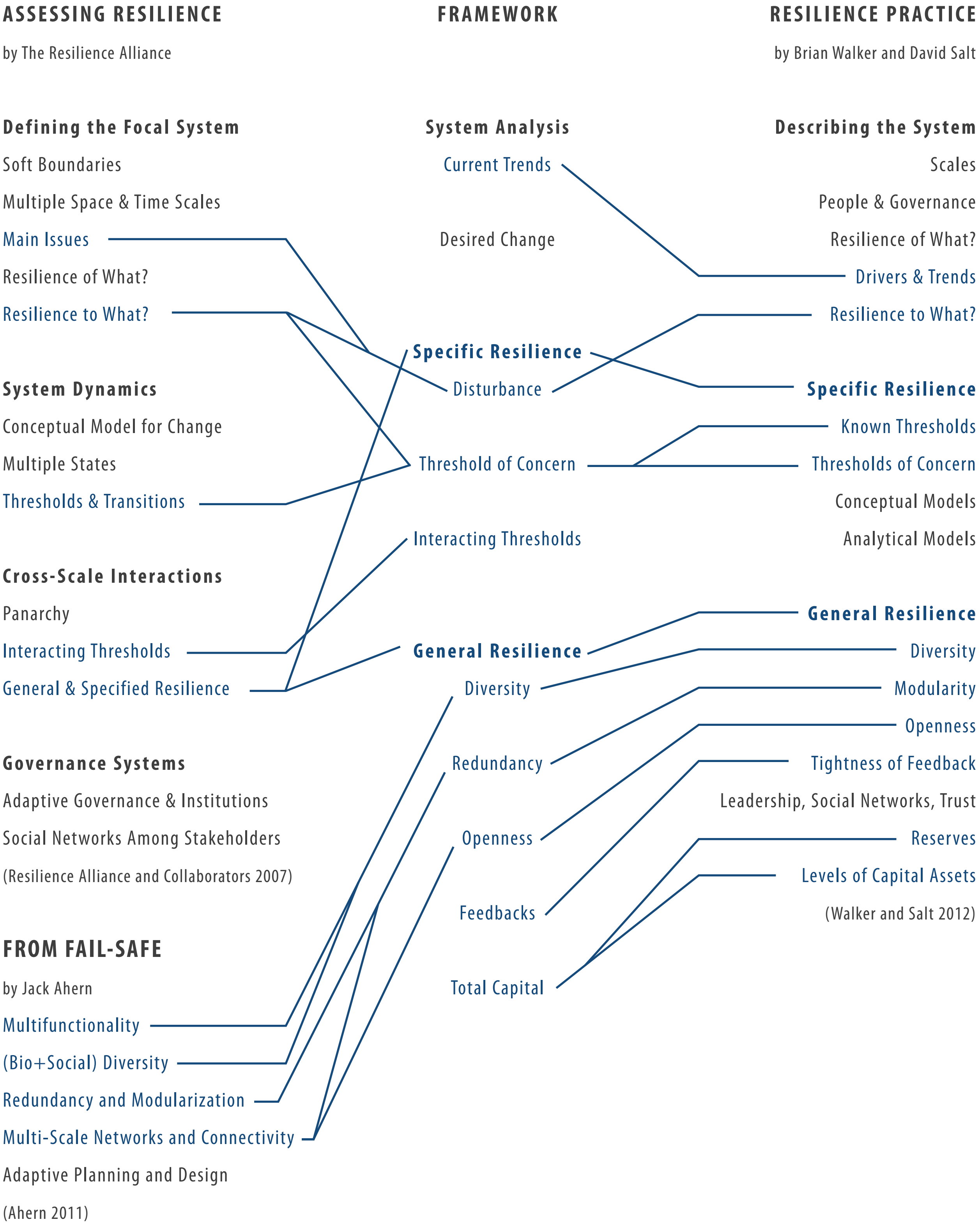
Figure 3.4. Literature Synthesis: System Description & Goal Establishment

Current Trends	State and change to the factors determining systems' resilience (Woodle 2014).
Desired Change	The goal for change to the factors determining systems' resilience (Woodle 2014).
Specific Resilience	"The resilience to particular kinds of disturbance" (Walker and Salt 2012).
Disturbance	"Actual change of a system triggered by an agent" (Holling 2001).
Threshold of Concern	A level that will cause change if a system surpasses (Walker and Salt 2012).
Interacting Threshold	The impact of a system crossing a threshold on other linked systems (adapted from Walker and Salt 2012).
General Resilience	"the capacity of a system to absorb disturbances of all kinds, so that all parts of the system keep functioning as they were" (Walker and Salt 2012).
Diversity	"The different kinds of components that make up a system, both functional and response" (Walker and Salt 2012).
Redundancy	Multiple nodes performing the same function to ensure that failure of one component does not result in total system failure (adapted from Walker and Salt 2012).
Openness	"The ease with which things like people, ideas, and species can move into and out of a system" (Walker and Salt 2012).
Feedbacks	The cause and effect occurrences in a system in terms of magnitude and response time (adapted from Holling 2001).
Total Capital	The sum of system reserves and capital assets (adapted from Walker and Salt 2012).

Table 3.4. System Analysis Definitions adapted from (Walker and Salt 2012; Holling 2001).

System Analysis

The System Analysis part analyzes factors determining the resilience of a system. This analysis is divided into two sections: Current Trends and Desired Change. The Current Trends section identifies how systems are currently behaving. The Desired Change section identifies how designers and stakeholders want the systems to behave. The Current Trends and Desired Change sections analyze systems in terms of specific and general resilience. Specific Resilience analyzes resilience to an identified threat. General Resilience determines the ability of a system to adapt to change. Factors for Specific Resilience include Disturbance, Thresholds of Concern, and Interacting Thresholds. General Resilience factors include Diversity, Redundancy, Openness, Tightness of Feedbacks, and Total Capital. The System Analysis part of the framework is a synthesis of ideas from: *Resilience Practice*, *Assessing Resilience: A workbook*, and *From Fail-Safe to Safe-to-Fail: Sustainability and Resilience in the New Urban World*. Figure 3.5 shows the synthesis of information.



ASSESSING RESILIENCE

by The Resilience Alliance

Defining the Focal System

Soft Boundaries

Multiple Space & Time Scales

Main Issues

Resilience of What?

Resilience to What?

System Dynamics

Conceptual Model for Change

Multiple States

Thresholds & Transitions

Cross-Scale Interactions

Panarchy

Interacting Thresholds

General & Specified Resilience

Governance Systems

Adaptive Governance & Institutions

Social Networks Among Stakeholders

(Resilience Alliance and Collaborators 2007)

FROM FAIL-SAFE

by Jack Ahern

Multifunctionality

(Bio+Social) Diversity

Redundancy and Modularization

Multi-Scale Networks and Connectivity

Adaptive Planning and Design

(Ahern 2011)

FRAMEWORK

System Analysis

Current Trends

Desired Change

Specific Resilience

Disturbance

Threshold of Concern

Interacting Thresholds

General Resilience

Diversity

Redundancy

Openness

Feedbacks

Total Capital

RESILIENCE PRACTICE

by Brian Walker and David Salt

Describing the System

Scales

People & Governance

Resilience of What?

Drivers & Trends

Resilience to What?

Specific Resilience

Known Thresholds

Thresholds of Concern

Conceptual Models

Analytical Models

General Resilience

Diversity

Modularity

Openness

Tightness of Feedback

Leadership, Social Networks, Trust

Reserves

Levels of Capital Assets

(Walker and Salt 2012)

Figure 3.5. Literature Synthesis: System Analysis

The intention of the System Reports is to discard all unnecessary information in order to focus on the data that provides evidence for informed design decisions.

Factors for Specific Resilience include Disturbance, Thresholds of Concern, and Interacting Thresholds. Disturbance accounts for agents of change. This factor identifies possible agents of disturbance, resulting change, and the potential magnitude of change. Thresholds of Concern identifies levels that breaching results in significant change to the system. A similar idea is a "tipping point" of a system. Interacting Thresholds are thresholds of a linked system. When a linked system crosses the threshold, the resulting change affects the linked system and the system being analyzed.

Analysis factors for General Resilience include Diversity, Redundancy, Openness, Feedbacks, and Total Capital. Diversity accounts for the different kinds of components that make up a system. The value of diversity is that it allows the system to continue functioning in the event of one failed component. Redundancy is the quantity of nodes performing the same function. Redundancy allows for the failure of a single node because another node performing the same function prevents the system from failing. Openness is the ease of which things, people, and ideas can enter and leave the system. A high amount of openness can result in resilience or vulnerability depending on the input and the system. Positive inputs can increase resilience and negative inputs reduce resilience. Feedbacks are the effects of a "cause" in a system. They are analyzed for magnitude of effect and response time. Typically tight and positive feedbacks increase resilience because it allows the system to quickly respond to a change. Total Capital is the sum of system reserves and capital assets. In times of failure, a system can use reserves or capital assets to prevent complete failure.

Systems Report

The next part of the framework is the Systems Report. This part is a synthesis of the important information from the System Description & Goal Establishment and Systems Analysis parts. The intention of the Systems Report is to discard all unnecessary information and focus on the information that helps make informed design decisions. The Systems Report part is a information synthesis process. In addition to analysis findings, information sources such as maps may be included in a system report.

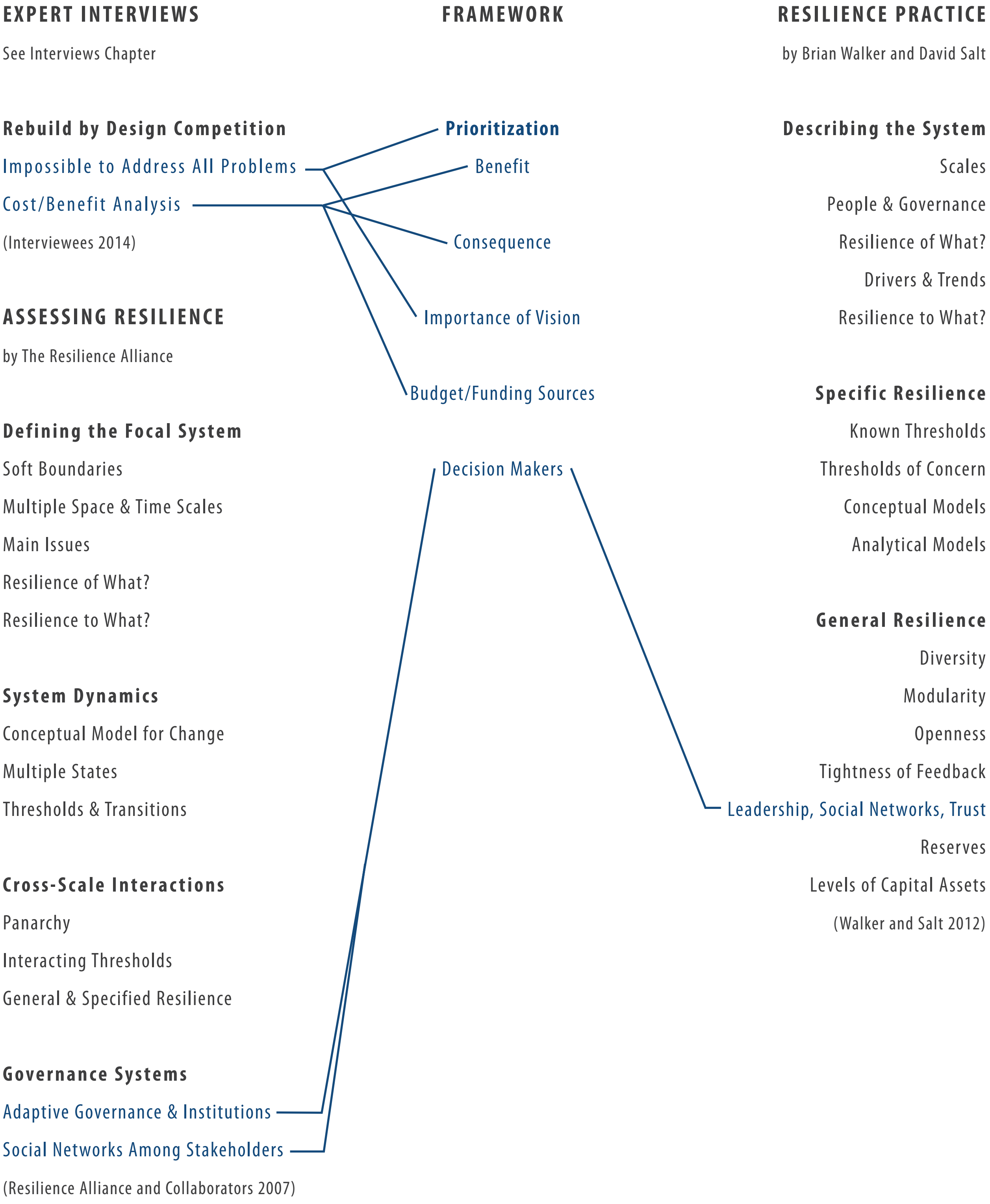
Prioritization	
Benefit	The positive impacts of a change in terms of finances, health, safety, and welfare.
Consequences	Negative impacts on people and other systems.
Importance of Vision	The value of proposed changes. Considerations include community and stakeholder values.
Budget/Funding sources	Possible budget for system changes and sources of funding.
Decision Makers	The people with administrative and implementation power.

Table 3.5. Prioritization Adapted Definitions adapted from (Interviews 2014)

Prioritization

The last part of the framework is Prioritization. The Prioritization part aids in determining on which systems to focus. There are five considerations in the Prioritization part: Benefit, Consequences, Importance of Vision, Budget/Funding Sources, and Decision Makers. The purpose of the Prioritization is to determine the focus of a project. The prioritization in turn helps inform the future visions in the System Description & Goal Establishment part. Additionally, Prioritization leads into the Strategic Planning, Site Design, and Implementation phase of the design process. Prioritization is a synthesis of interview findings, *Resilience Practice*, and *Assessing Resilience*. Figure 3.6 shows the findings influencing the creation of the Prioritization part of the framework.

There are five considerations for Prioritization. They are Benefit, Consequence, Importance of Vision, Budget/Funding Sources, and Decision Makers. Benefit accounts for financial and nonfinancial outcomes from the proposed changes to the system. Possible beneficiaries include the community, stakeholders, government officials, and businesses. Benefit accounts for improvements to the health, safety, and welfare of citizens. Consequence determines negative impacts of the proposed changes. This factor accounts for the negative result, the affected people, and the magnitude of the outcome. Importance of Vision determines the value of the proposed changes. This factor considers the values of stakeholders and communities. Budget/Funding Sources provides information on the financial cost of the changes and who might pay for the change. Decision Makers are the people that have the authority to implement the proposed system changes.



EXPERT INTERVIEWS

See Interviews Chapter

Rebuild by Design Competition

Impossible to Address All Problems

Cost/Benefit Analysis

(Interviewees 2014)

ASSESSING RESILIENCE

by The Resilience Alliance

Defining the Focal System

Soft Boundaries

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Resilience to What?

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Conceptual Model for Change

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Social Networks Among Stakeholders

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FRAMEWORK

Prioritization

Benefit

Consequence

Importance of Vision

Budget/Funding Sources

Decision Makers

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General Resilience

Diversity

Modularity

Openness

Tightness of Feedback

Leadership, Social Networks, Trust

Reserves

Levels of Capital Assets

(Walker and Salt 2012)

Figure 3.6. Literature and Interview Synthesis: Prioritization

Washington Square Park

After creation of the framework, it was applied to a case study. The analysis of Washington Square Park shows one way to apply the Resilience Analysis Framework. There are multiple application methods for the framework and the case study shows one example. A factor determining the application method is the scope of the project. The author analyzed Washington Square Park from the perspective of a practitioner hired by the Kansas City Parks and Recreation Department to redesign the park.

Washington Square Park balances this report because it contrasts the large scale project from the interviews with a small scale site design. Located in the middle of downtown Kansas City, Washington Square Park has diverse social-ecological systems influencing its state. Surrounding uses are diverse and attract many people to the area. The nearby uses include hotels, businesses, shops, and transit nodes. As it exists today, Washington Square Park is not an important public space even though it is in the middle of an active district. The current derelict state sets up this case study to analyze the resilience of Washington Square Park and identify changes for a resilient future (Parks and Recreation 2013a). Figures 3.7, 3.8, 3.9 show the location of Washington Square Park.

Washington Square Park is a central part to the future vision of downtown Kansas City. There have been numerous plans for the downtown area including the future of Washington Square Park. "The Downtown Corridor Development Strategy" (2005) plan done by Sasaki and the "Downtown Area Plan" (2010) both identify Washington Square Park as a part of an activity center for downtown Kansas City. The plans call for increased walkability and connectivity to the surrounding area. Another part of the activity center will be a streetcar along Main Street that borders Washington Square Park (Sasaki 2005; "Greater Downtown Area Plan" 2010). "The KC Forging Our Comprehensive Urban Strategy" (FOCUS) plan also discusses the future of Washington Square Park. All three plans identify the parking lot north of the site as an opportunity for a development (Sasaki 2005; "Greater Downtown Area Plan" 2010; Kansas City Urban Core Work Team 1998).

The groups involved in shaping Washington Square Park's future include the Public Improvements Advisory Committee (PIAC), Downtown Council, KC Parks and Recreation, Kansas City Design Center (KCDC), and Coen Partners. PIAC is a government committee that primarily "solicits resident input and makes recommendations regarding both citywide and neighborhood portions of the capital budget" (PIAC 2013). The Downtown Council is a non-profit organization dedicated to the revitalization and resurgence of downtown KC (Downtown Council 2013). KCDC is a satellite studio that is a collaboration between Kansas State University and the University of Kansas. Students enrolled in landscape architecture, architecture, and planning programs can elect to study at KCDC.

Figure 3.7. Washington Square Park Small Context Map (KCDC 2014)

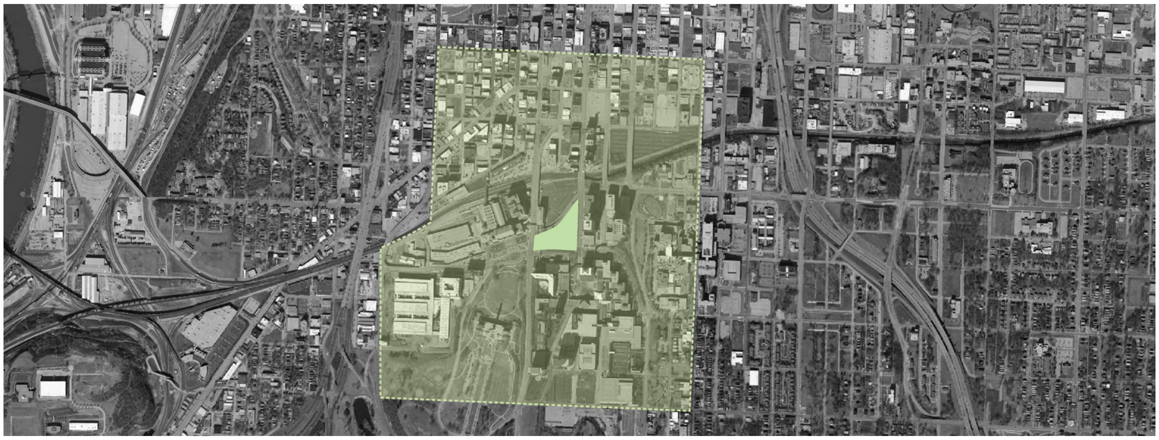


Figure 3.8. Washington Square Park Medium Context Map (KCDC 2014)

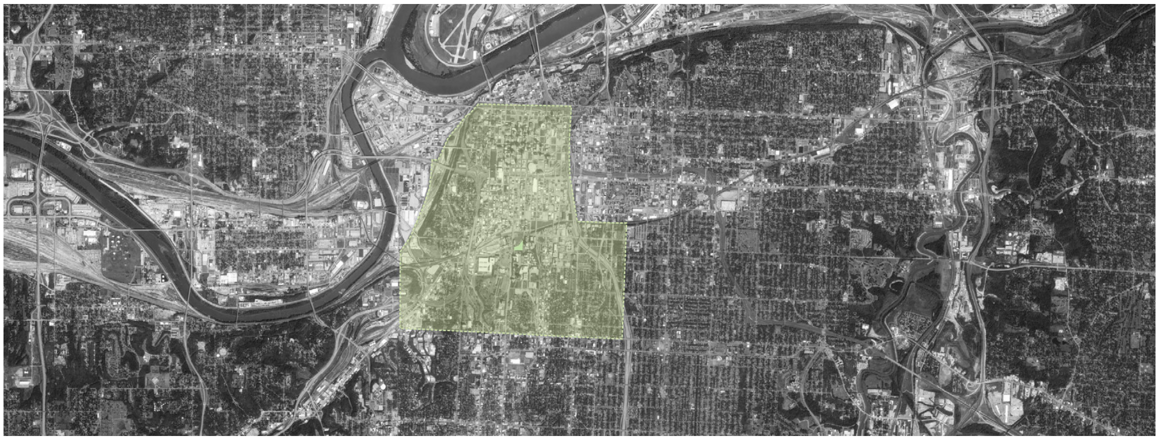


Figure 3.9. Washington Square Park Large Context Map (KCDC 2014)

Currently, there are only architecture students at KCDC (KCDC 2013). KC Parks and Recreation is a government department that manages "facilities, programs and recreational opportunities for the community that contributes to an aesthetically pleasing environment and enhanced quality of life" (Parks and Recreation 2013b).

The project for Washington Square Park began when the Downtown Council applied for a grant to PIAC. The grant requested funds for research and idea generation for the future of Washington Square Park. KC Parks and Recreation was in charge of the administration of the project. Their administration included managing KCDC and overseeing Coen Partners. A selection committee composed of people from the Downtown Council, KC Parks and Recreation, PIAC, and other professionals and government officials hired Coen Partners. The main deliverable for Coen Parners was an analysis of Washington Square Park and a possible site design (pending funding). KCDC was responsible for aiding in the research and development of ideas for the future of Washington Square Park. Coen Partners was providing critiques to KCDC's work and used their ideas as inspiration. Kansas State students became involved in the project through KCDC. Students from Kansas State and KCDC shared their research and projects, however their projects were separate. The goal was for the students to propose a variety of ideas to help shape the future of Washington Square Park (Parks and Recreation 2013a). Figure 3.10 shows the relationships of the stakeholders and partners on the project.

This report contributed to the Washington Square Park project by analyzing the park using the Resilience Analysis Framework. Matrices organize the data and ensure the consideration of all parts of the framework. Sources for data collection include government websites, non-profit organization websites, Kansas City Design Center student work, on site observation, Google maps, and weather reporting websites. Methods for analysis includes GIS mapping, direct observation, and photograph analysis. Figure 3.11 shows maps utilized for the analysis, and a complete compilation can be found in Appendix B (p. 112). Stakeholder engagement is an important part of resilience analysis and is a limitation of the Washington Square Park analysis. The author analyzed the following systems: activity nodes, events, housing, sun/shade, storm water, views into WSP, views on approach to WSP, and pedestrian, bicycle, vehicular, and public transit. Another limitation of this case study is it did not analyze all of the systems influencing WSP.

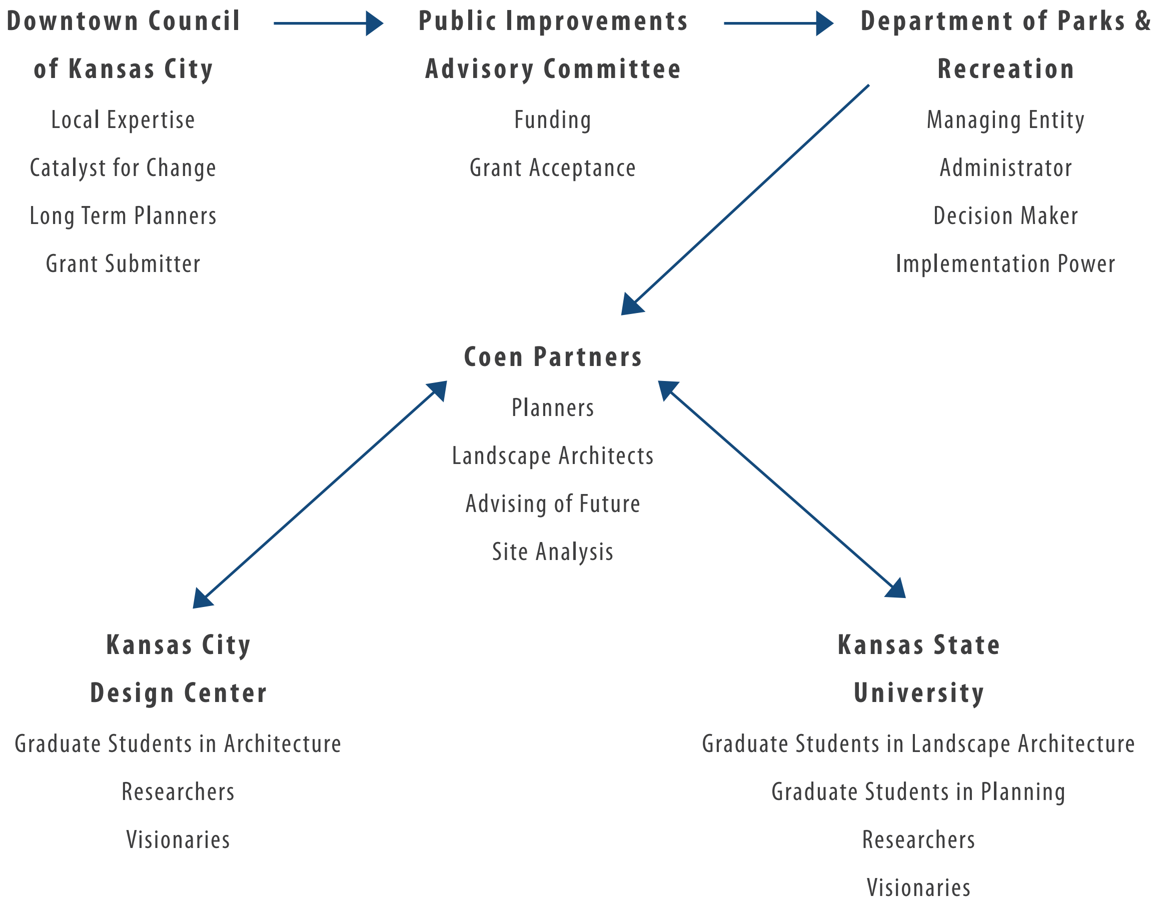
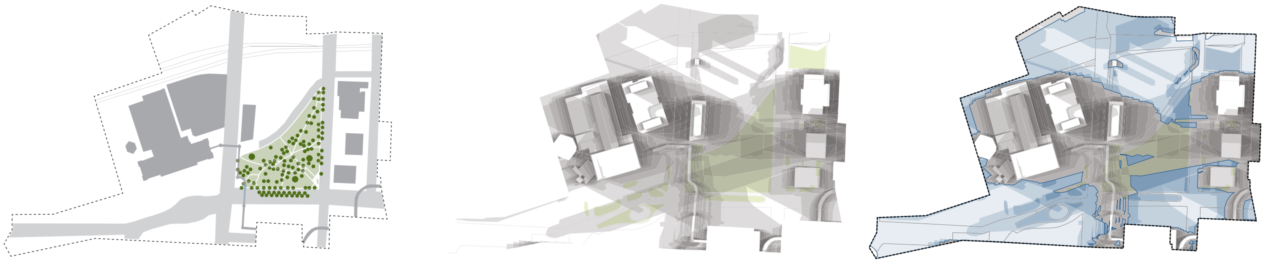


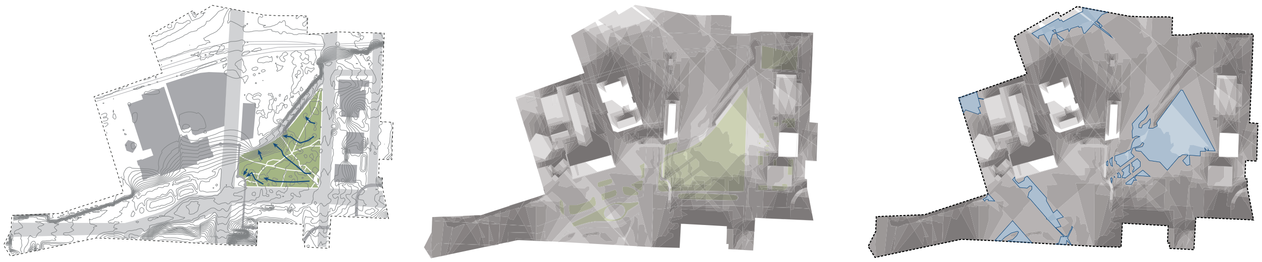
Figure 3.10. Washington Square Park Relationships



Site Plan (p. 117)

Summer Shadows (p. 125)

Less than Two Hours of Shade: Summer (p. 125)



Site Stormwater (p. 126)

Winter Sun (p. 125)

Less than Two Hours of Shade: Winter (p. 125)

Number of Households: 1980, 1990, 2000, 2010 (p. 116)

Views from WSP to City (p. 119)

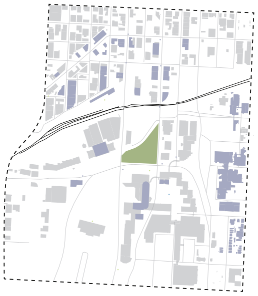
Views from WSP to City (p. 119)

Figure 3.11. Washington Square Park Analysis Maps and Diagrams (Adapted from KCDC 2014)

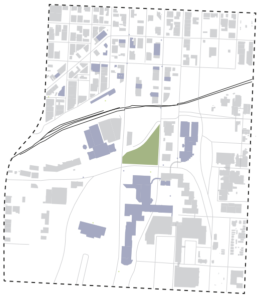
Vehicular Traffic (p. 120)

Main St. Approach (p. 124)

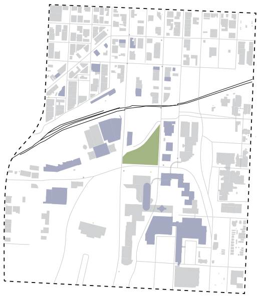
Grand Blvd. Approach (p. 124)



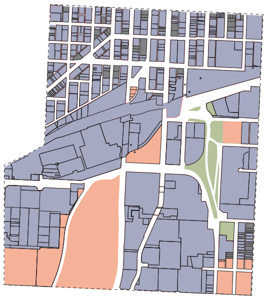
Residential Activity Nodes (p. 118)



Visitor Activity Nodes (p. 118)

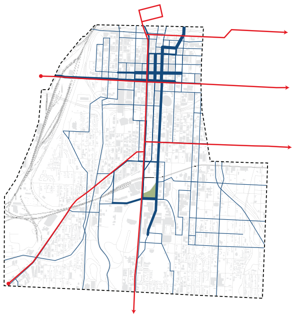


Office Activity Nodes (p. 118)

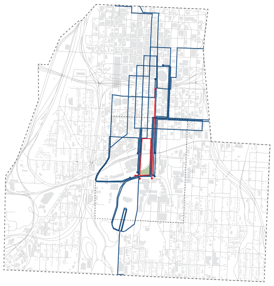


Parcel Ownership (p. 114)

Bike Routes (p. 122)



Public Transit (p. 119)



Parade and Race Routes (p. 115)

Pedestrian Traffic (p. 121)

Tree Canopy (p. 125)

LITERATURE REVIEW

Chapter 4

This literature review synthesizes sources to show the development of resilience theory and then narrows its focus to this report's goals. Sources were categorized into four groups: Humanity's Problems & the Origins of Resilience, Conceptualizing Resilience Theory, Applying Resilience Theory, and Methods for Resilience Analysis. The groups are not absolute divisions, but a way to frame the main points for each piece of literature. Some sources overlap into multiple groups, showing connections of ideas and progression of the theory. The first group, Humanity's Problems & the Origins of Resilience discusses issues related to changing social-ecological systems that drove the creation of resilience theory. The literature in this group begins to develop some of the core concepts of resilience theory, but the theory is not fully developed.

The sources in the Origins of Resilience group provide a base for the sources in Conceptualizing Resilience Theory to develop resilience theory into a codified theory. Key authors include Lance Gunderson, C.S. Holling, David Salt, and Brian Walker. The sources in this group clearly develop core concepts, define terminology, and solidify relevance. Ideas in the Conceptualizing Resilience Theory literature provide the basis for the development of ideas for application.

Applying Resilience Theory is comprised of sources that have taken the ideas from the Conceptualizing Resilience group and developed strategies for application to design practice. C.S. Holling and Brian Walker are key authors again in this group and are joined by Jack Ahern, David Salt, Kevin Cunningham, and the Resilience Alliance. In addition to strategies, this group contains frameworks, and guides for applying resilience theory to landscape architecture. The applications all contain methodologies to bridge ideas in the Conceptualizing Resilience Theory literature group to application. For the purposes of this report, the most important sources in Applying Resilience Theory describe ways to analyze resilience. The applications of resilience theory to site analysis are a process for analyzing resilience.

The Methods for Resilience Analysis group provides information on methods for carrying out the site analysis processes in the Applying Resilience Theory literature group. Not all of the sources in this group mention resilience theory. Literature on general landscape architecture methods for site analysis is included. Important authors include James Corner, DAK Kopec, David Salt, the United Nations Environmental Programme, and Brian Walker. This group contains sources that propose methods to use when analyzing the resilience of a site or system.

Humanity's Problems and the Origins of Resilience

Resilience theory began because ecologists were trying to address problems with the changing environment. *Global Change and the Earth System: A Planet Under Pressure* (2005) by Frank Oldfield, Katherine Richardson, H. J. Schellnuber, and Billie Lee Turner II explains problems humanity faces due to changes in systems. The main point Oldfield and Richardson make related to resilience theory is: people are not certain how ecosystems will change as human use increases. Often unexpected negative consequences arise, and there is a need for action to reduce undesirable phenomena (Steffen et al. 2005). In response to changing systems, C. S. Holling, an ecologist, wrote *Resilience and Stability of Ecological Systems* (1973). Holling explains the understanding of systems at that time was based on an equilibrium state. He argues the equilibrium view provides little insight into the behavior of systems because systems are constantly changing (Holling 1973). To address changing systems, Holling proposes viewing systems as complex, dynamic, and adaptive. These systems are a linked combination of humans (social) and nature (ecologic) called social-ecologic systems (Walker and Salt 2006). To address changing social-ecologic systems, Holling proposes a resilient approach. Holling

Humanity’s Problems and the Origins of Resilience

Global Change and the Earth System: A Planet Under Pressure, 2005, William L. Steffen et. al., 2005

Resilience and Stability of Ecological Systems, 1973, C. S. Holling

In A Quest of a Theory of Adaptive Change, 2002, C. S. Holling, Lance Gunderson, Donald Ludwig

Command and Control and the Pathology of Natural Resources Management, 2001, C. S. Holling, Gary Meffe

Resilience and Adaptive Cycles, 2002, C. S. Holling, Lance Gunderson

Conceptualizing Resilience Theory

Resilience and Stability of Ecological Systems, 1973, C. S. Holling

Resilience, Adaptability, and Transformability in Social-ecological Systems, 2004, C. S. Holling et. al.

Panarchy: Understanding Transformations in Human and Natural systems, 2001, C. S. Holling, Lance Gunderson

Regime Shifts, Resilience, and Biodiversity in Ecosystem Management, 2004, C. S. Holling et. al.

Resilience Thinking, 2006, Brian Walker, David Salt

Applying Resilience Theory

Resilience Thinking, 2006, Brian Walker, David Salt

From Fail-Safe To Safe-to-Fail, 2011, Jack Ahern

Resilience Theory /A Framework for Engaging Urban Design, 2013, Kevin Cunningham

Resilience as a Framework for Urbanism and Recovery, 2011, Penny Allan, Martin Bryant

From Metaphor to Measurement: Resilience of What to What, 2001, Steve Carpenter et. al.

Assessing Resilience in Social-Ecological Systems: A Workbook for Practitioners, 2010, Resilience Alliance

Assessing Resilience in Social-Ecological Systems: A Workbook for Scientists, 2007, Resilience Alliance

Applying a Social-Ecological Inventory: A workbook for finding the key actors and engaging them, 2011, Resilience Alliance

Resilience Practice, 2012, Brian Walker, David Salt

Methods for Resilience Analysis

Resilience Practice, 2012, Brian Walker, David Salt

Agency of Mapping, 1999, James Corner

Evidence Based Design, 2011, DAK Kopec, E. Sinclair, Bruce Mattes

The Millennium Ecosystem Assessment, 2005, United Nations

Figure 4.1. Literature Groups

defines resilience by stating it "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). In other terms, resilience is the ability of a system to adapt to disturbance and still remain in the same state. This was the first definition of resilience theory and began the development of the theory. Years later in the article, *In A Quest of a Theory of Adaptive Change* (2002) Holling explains his goal for resilience theory was "to develop an integrative theory to help us understand the changes occurring globally" (Holling, Gunderson, and Ludwig 2002).

C. S. Holling and Gary K. Meffe wrote *Command and Control and the Pathology of Natural Resource Management* (2001) in response to the need to address changing systems. Holling and Meffe apply resilience theory to management practices. They call for a change from command-and-control management of social-ecological systems to a resilient approach. Attempting to reach "optimal" production causes instability in social-ecological systems. To prevent undesired consequences Holling and Meffe argue people need to shift to a management based on resilience (Holling and Meffe 1996).

In another article, *Resilience and Adaptive Cycles* (2002) Holling and Gunderson clarify their definition of resilience by stating how it is different from other interpretations. They explain the traditional approach to resilience is "engineering resilience," and they call their approach "ecosystem resilience." Engineering resilience is focused on responding to the disturbance of a system by bringing it back to its "optimal state" as quickly as possible. Ecosystem resilience disregards the idea of trying to sustain an "optimal state" and embraces change. Instead of fighting systems, ecosystem resilience adapts to change with the goal of retaining the same system state (Holling and Gunderson 2002).

Conceptualizing Resilience Theory

The sources within the Conceptualizing Resilience Theory group explain and define the concepts of resilience theory. In addition to defining resilience, in *Resilience and Stability of Ecological Systems* (1973) Holling explains how stability and resilience are two separate aspects of systems. Holling argues a system can have a low amount of stability, while having a high resilience. Resilience is more important for designers because it does not try to stop small changes, which are inevitable. Managing resilience allows the system to change but retain its fundamental properties (Holling 1973). Brian Walker, C. S. Holling, Stephen Carpenter, and Ann Kinzig reinforce the importance of focusing on resilience in *Resilience, Adaptability, and Transformability in Social-ecological Systems* (2004). This article, written thirty one years after the initial article by Holling, argues a system's stability is determined by three elements: resilience, adaptability, and transformability. This departs from the idea Holling presented in *Resilience and Stability of Ecological Systems* (1973) that stability and resilience are two separate properties. The article by Walker, Holling, and others redefines resilience as one of three attributes of stability. The three attributes of stability presented in *Resilience, Adaptability, and Transformability in Social-ecological Systems* (2004) redefines stability by separating it from an "optimal state." A system's stability determines how easy it is for a disturbance to change its state (structure and functions). Changes in the system other than structure and function does not indicate instability (Walker et al. 2004).

Besides the attributes of stability, *Resilience, Adaptability, and Transformability in Social-ecological Systems* (2004) is one of many sources that explains the core concepts of resilience theory (Walker et al. 2004). Walker and others referenced the ideas from the book *Panarchy: Understanding Transformations in Human and Natural systems* (2001) edited by Gunderson and Holling. In the article *Understanding the Complexity of Economic, Ecological, and Social Systems* (2001) Holling promotes *Panarchy* by explaining it contains research from "a 5-year collaboration among an international group of ecologists, economists, social scientists, and mathematicians" (Holling 2001). The book was (at the time) the most complete source explaining the theory (Holling 2001). Holling and Gunderson explain the three main components of resilience theory: the adaptive cycle, panarchy, and basins of attraction (Gunderson and Holling 2001).

In addition to promoting *Panarchy* (2001), the article *Understanding the Complexity of Economic, Ecological, and Social Systems* (2001) by Holling overviews *Panarchy*. It explains the work done by Holling, Gunderson, Walker, and others for communication of resilience theory to other professionals. An important point in this article is the explanation of the three types of social-ecological systems (economic, ecological, social). Explaining the types of systems develops resilience theory into a comprehensive approach because it accounts for all systems (Holling 2001). *Regime Shifts, Resilience, and Biodiversity in Ecosystem Management* (2004) was written in collaboration with many of the founders of resilience including C.S. Holling, Brian Walker, Carl Folke, and Lance Gunderson. This article explains in depth one of the three main parts of resilience theory: basins of attraction. Basins of attraction are explained through examples of common ecosystems found around the world (Folke et al. 2004).

Brian Walker and David Salt create a synthesis of the previous literature on the core concepts of resilience in their book, *Resilience Thinking* (2006). This book provides a source with terminology, relevance, concepts, case studies, and validity. *Resilience*

Thinking is valuable because it contains all the necessary information for a comprehensive understanding of resilience theory. In addition to summarizing the concepts of resilience theory, *Resilience Thinking* (2006) begins to take the theory to the next step: application.

Applying Resilience Theory

Resilience Thinking (2006) by Brian Walker and David Salt outlines nine strategies for creating a resilient world. Similarly, *From Fail-Safe to Safe-to-Fail* (2011) by Jack Ahern identifies five strategies for building urban resilience. Both sets of strategies help designers to start determining programs for increasign a system's resilience. Kevin Cunningham in his thesis *Resilience Theory /A Framework for Engaging Urban Design* (2013) synthesizes the two sets of strategies into five categories to create a framework for engaging design (Cunningham 2013). Penny Allan and Martin Bryant created another resilience framework. Their article *Resilience as a Framework for Urbanism and Recovery* (2011) uses a framework for designing crisis landscapes however, their framework could be applied to non-crisis sites (Allan and Bryant 2011). The different strategies and frameworks determine how programs contribute to resilience, but they do not provide a way to determine if a site needs increased resilience.

The frameworks created by Cunningham, and Allan and Bryant do not determine a site's needs, and therefore are for use during the design phase and post-design case study analysis. *From Metaphor to Measurement: Resilience of What to What* (2001) by Steve Carpenter, Brian Walker, Marty Anderies, and Nick Abel begins to outline a strategy for determining a site's needs (Carpenter et al. 2001). Carpenter and others propose some key questions to ask when evaluating a site, but their ideas are an initial proposal that needs development. An approach for analyzing a site's resilience was created by the Resilience Alliance in their documents *Assessing Resilience in Social-Ecological Systems: A Workbook for Practitioners* (2010) and *A Workbook for Scientists* (2007). The Resilience Alliance is an institution dedicated to the body of research on resilience. The workbooks identify steps for completing site analysis (Gunderson et al. 2010; Resilience Alliance and Collaborators 2007). Supplementing the workbooks is *Applying a Social-Ecological Inventory: A workbook for finding the key actors and engaging them* (2011). This document focuses on engaging stakeholders and government officials in the resilience analysis process (Schultz, Plummer, and Purdy 2011). Similar to the steps created by the Resilience Alliance, *Resilience Practice* (2012) by Brian Walker and David Salt is also a guide for analyzing resilience. Both the Resilience Alliance and Walker and Salt propose a process that begins with identifying a focal time and geographic scale. Then the analysis describes the systems in the scales above and below the focal scale. Last is the analysis of the systems' resilience (Gunderson et al. 2010; Walker and Salt 2012). *Resilience Practice* (2012) contains case studies not found in *Assessing Resilience* (2010). These case studies provide supplemental information to aid in the development of the proposed approach to site analysis (Walker and Salt 2012). Additionally, *Resilience Practice* (2012) overlaps into the Methods for Resilience Analysis by proposing a limited list of methods for completing each step of the site analysis (Walker and Salt 2012).

Methods for Resilience Analysis

Within the resilience body of literature, there are processes for analyzing resilience, but few methods for carrying out an analysis. *Resilience Practice* (2012) begins to provide methods by proposing designers engage stakeholders in conversation to define a focal system (Walker and Salt 2012). No other literature discusses methods for analyzing resilience. This is an area of resilience theory that needs further development. Sources from the general body of landscape architecture site analysis can be applied to resilience theory analysis methods. General methods are not theory dependent, and therefore can be used to analyze resilience.

Evidence Based Design (2011) by DAK Kopec, E. Sinclair, and Bruce Matthes proposes numerous methods for research and analysis. These methods include: surveys, interviews, observation, historical analysis, photo analysis, experimentation, computer modeling, and a review of literature (Kopec et al. 2011). Another method used in landscape architecture is mapping. *The Agency of Mapping* (1999) by James Corner explains what mapping is and how it can be used to analyze complex systems (Corner 1999b). Mapping could be especially valuable to resilience theory because it can analyze systems at a wide range of geographic scales. *The Millennium Ecosystem Assessment* (2005) by the United Nations suggests scenario planning as a method for analyzing possible consequences of human action (MA 2005). Scenario planning is valuable because it allows designers to show consequences that can result from disregarding resilience.

Conclusion

Resilience theory was created in response to the problems with changing social-ecological systems (Holling, Gunderson, and Ludwig 2002). The theory provides a comprehensive approach enabling preservation systems' states (Holling and Gunderson 2002). Resilience theory understands the behavior of changing systems through the adaptive cycle, panarchy, and basins of attraction (Walker and Salt 2006). The theory is applied to urban design by using frameworks and strategies (Cunningham 2013). A resilience analysis creates evidence to inform design decisions (Gunderson et al. 2010). Methods for analyzing resilience are partially defined and need development (Walker and Salt 2012).

EXPERT INTERVIEWS

Chapter 5

The following interview analysis grounded this report in professional practice. The Rebuild by Design competition focused on creating resilience for the Hurricane Sandy affected region. A member from eight of the ten teams participated in the expert interviews. Table 5.1 on the following page lists the participants' names and their respective firms. Figure 5.1 indicates the participants' role on their team. The author guaranteed the interviewees that their conversations would remain confidential and that the findings would be untraceable.

The first step of the analysis was identifying ideas from the interviews. Ideas are a combination of stated terms and concepts described theoretically and/or described through explanation of the competition analysis. For example, a term a participant explicitly stated was "mapping". An example of a concept described theoretically was "social media". In this case, the participant discussed using twitter, Facebook, and other digital communication to interact with the local community. The author assigned terms to ideas described through explanation. An example of an assigned term is "starts with people." A participant described how social

HR&A Advisors	Olivia Moss
OLIN	Richard Roark
OMA	Daniel Pittman
Sasaki	Rhiannon Sinclair
SCAPE	Gena Wirth
Unabridged Architecture	Allison Anderson
Undisclosed	Undisclosed Team
Undisclosed	Undisclosed Team

Table 5.1. Interview Participants

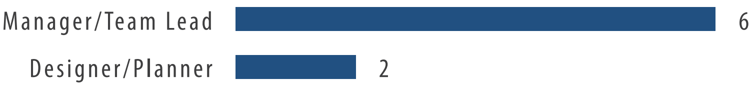


Figure 5.1. Participant Role in Rebuild by Design Competition

resilience is the most important system in urban environments because it results in an increase of resilience for other systems. For example, social resilience leads to physical resilience because people will band together to create barriers to protect their homes in the threat of a storm (Interviewees 2014).

After identifying ideas from the interviews, the author analyzed ideas in three ways: categorization, resilience definition comparison, and importance of ideas. The categorization section explains categories the author identified from analysis of the interviewees' ideas. Resilience definition comparison analyzes the participants definitions in comparison to each other and the definition found in the literature. The importance of concepts analysis determined the level of importance the participants placed on an idea.

Categorization

The categorization analysis revealed numerous categories and sub categories for the ideas. The three main categories are: Methods, Concepts, and Resilience in Practice. Method includes processes for gathering and conducting analyses. The author divided the Methods category into the three sub categories:

geographic representation, community engagement, and on site gathering. Geographic representation contains methods for analyzing systems through geographic means. Methods in the community engagement category are processed to collect data and receive feedback from local residents, stakeholders, and government officials. On site gathering methods are ways to assemble information during site visits.

Ideas in the Concepts category define resilience and propose strategies for analyzing and designing resilience. There are three sub categories in Concepts: defining resilience, factors for analyzing resilience, and design strategies. Defining resilience contains ideas about the properties of resilience. Factors for analyzing resilience are considerations that determine the level of resilience. Design strategies are approaches to creating resilience. The Resilience in Practice category contains ideas related to strategies for a smooth and successful design process. Table 5.2 shows the categories and provides a definition for each idea. The definitions created were based on the interviews. It is important to note that the definitions are a combination of ideas from numerous interviews and the author's interpretation of their ideas.

Methods			
	Geographic Representation		Analysis of data on a geographic scale.
		Critical Mapping	Layering and processing of geographic data.
		Modeling	Analytical modeling with a computer simulation and conceptual modeling of the structure of a system.
	Community Engagement		Methods for educating, gathering data, and analyzing data with community members.
		Focus Groups	A group of people guided through a discussion.
		Social Media	Digital technology communication systems.
		Forums	A public meeting for ideas to be shared.
		Workshops	Community gatherings for discussion and activities.
		Interviews	Impromptu or formal conversations with community members or local experts.
		Informal Meetings	A conversation with a small group of individuals.
	On Site Gathering		Data gathering and analysis during site visits.
		Direct Observation	Information gathered from on-site experience, often double checking digital findings.
		Photography	Use of photographs to document and analyze systems.
Concepts			
	Defining Resilience		Tenets of resilience.
		Vulnerability	The absence of resilience, low resilience.
		Starts with People	Resilience in urban areas starts with people. Social resilience results in people increasing the resilience of other urban systems.
		Adaptive	Systems must adapt to change.
		Multi-System Focus	Addressing multiple systems to increase the overall resilience of a region.
	Factors for Analyzing Resilience		Factors for determining a system's resilience.
		Redundancy	Numerous components serving the same function to protect against failure.
		Trends	Analyzing the way systems are changing is more valuable than analyzing just the current state because it indicates the future conditions.

Table 5.2. Interview Ideas, Categories, and Definitions derived from (Interviewees 2014)

Concepts (cont'd)	
Factors for Analyzing Resilience (cont'd)	
Impact Other Systems	Impact from changes to a system have on a linked system.
Thresholds	A level that will cause change if a system surpasses.
Critical Node	Important part of a system. If the critical node failed, the entire system would fail.
Disturbance	Change to a system away from it's stable state.
Design Strategies	Strategies for creating resilient design solutions.
Multi-Functional	Having several uses.
Multi-Layered	Having multiple layers or levels.
Creating Organizations	Forming groups of people to respond to change in order to keep systems functioning.
Disturbance Mitigation	Reducing the amount of change caused by disturbances.
Resilience is Everyday	Preparing people to adapt to change everyday, not just in the event of a natural disaster.
Resilience in Practice	
Cost/Benefit Analysis	Determining the positive and negative consequences in financial and non-financial terms.
Multi-Disciplinary Teams	Teams with a variety of experts result in a better understanding of system behavior.
Communication Between Experts	Clear communication between experts results in a better understanding of system behavior.
Matrices for Data Organization	Matrices are a beneficial tool for assembling and analyzing large amounts of data.
Impossible to Address Every Problem	There is not enough time or funding to address every problem in a study area.

▨ No linked idea

LITERATURE REVIEW	INTERVIEWS
Panarchy	
Time Scale	Trends
Spatial Scale	Multi-System Analysis
Multi-System Interaction	Multi-System Analysis, Impact Other Systems
Adaptive Cycle	
4 Stages	No linked idea
Cycling Behavior	Trends
Basin of Attraction	
Stable State	No linked idea
Social-Ecological Systems	
Adaptive/Changing	Adaptive
Self-Organization	Multi-System Analysis, Critical Nodes
Numerous Types	No linked idea
General Resilience	
Redundancy	Redundancy, Multi-Layered
Diversity	Multi-Functional
Openness	No linked idea
Feedbacks	Creating Organizations, Resilience is Everyday
Total Capital	No linked idea
Specific Resilience	
Thresholds	Thresholds
Disturbance	Disturbance, Disturbance Mitigation
Interacting Thresholds	No linked idea
	Interview Ideas Not Directly Associated with Literature
	Vulnerability, Starts with People

Figure 5.2. Link Between Literature's Definition of Resilience and Interview Ideas

Resilience Definition Comparison

There are two parts to the resilience definition comparison. First, the author of this report compared the ideas in the resilience concepts category to the properties identified in the literature review. The second part of the resilience definition comparison is a list and analysis of responses to the question: “How did your team define resilience?”

The interviewees covered almost all of the elements of resilience identified by the literature review. Figure 5.2 shows the comparison between ideas from the interviews and literature review. Individually no single interviewee identified half of the resilience properties from the literature review.

The ideas from the interviews provided an incomplete overview of the core properties of resilience outlined in the background section. The core properties identified by the literature are Panarchy, the Adaptive Cycle, Basins of Attraction, and Social-Ecological Systems. Overall, the interviewees covered the concept of Panarchy. A mixture of terms including Trends, Multi-System Focus, and Impact to Other Systems combine to make up the idea of Panarchy. As for the Adaptive Cycle, interviewees discussed a similar concept: Trends. The main difference between the Adaptive Cycle and Trends is that the Adaptive Cycle identifies four phases whereas Trends is a general term. No participant discussed Basins of Attraction. Their analysis of a system state focused on conditions. The interviewees identified there are different types of Social-Ecological Systems. Additionally, the interviewees discussed the adaptive behavior of Social-Ecological Systems. A difference in understanding Social-Ecological Systems between the interviews and the literature review was identification of Critical Nodes. Interviewees discussed addressing Critical Nodes to increase resilience. Self-Organizing is a property of systems identified by the literature that was absent in the interviews. The literature identifies self-organization as an important part of understanding the behavior or systems. The interviews revealed a property of Social-Ecological Systems not present in the literature. Participants explained resilience “Starts with People”. The most important system is social because it causes people to band together to improve the resilience of their environment. For example, a group of residents came together before Sandy hit the coast and built a surge barrier to protect their houses (Interviewees 2014).

Properties of General Resilience found in the literature review and interviews include: Redundancy, Diversity, And Feedbacks. The literature and interviews discussed Redundancy directly. Interviewees discussed a term related to Diversity when identifying design strategies. The term, Multi-Functional, is linked to Diversity because it results in diverse functions for a single design element.

This Report: The capacity of a system to adapt to change and remain in the same state.

1 Preparing people everyday for events that will change the way they occupy their city. The capacity to adapt to events.

2 Adapting to flood risks to reduce insurance premiums.

3 Design physical, social, and ecological systems to work together.

4 Umbrella to hold all topics on the same table. Including vulnerability, system types, etc.

5 Flexibility and adaptability to known and unknown disturbance.

6 Immediate recovery from disaster events.

7 Multifunctional and a cause effect relationship.

8 A community that can weather storms economically, maintain demographic diversity, and are ecologically and environmentally healthy. The capacity to recover and keep employment centers open, and multiple opportunities for connection.

Table 5.3. Interviewees Definition of their Team's Use of Resilience (Interviewees 2014)

While discussing their project, participants identified ideas linked to Feedbacks. Two feedback loops identified by the interviewees were "Creating Organizations" and "Resilience is Everyday." People become a feedback loop after creating an organization to orchestrate responses to change. "Resilience is Everyday" creates a feedback loop for individual residents through education on strategies for adapting to change. Redundancy, Diversity, and Feedbacks are three properties of General Resilience covered by the literature review and interviews. Openness and Total Capital are two properties of General Resilience identified by the literature review that interviewees did not mention.

Specific Resilience is a part of the literature and interview findings. Both sources identified Disturbance and Thresholds as properties of Specific Resilience. Interviewees identified Sandy was a

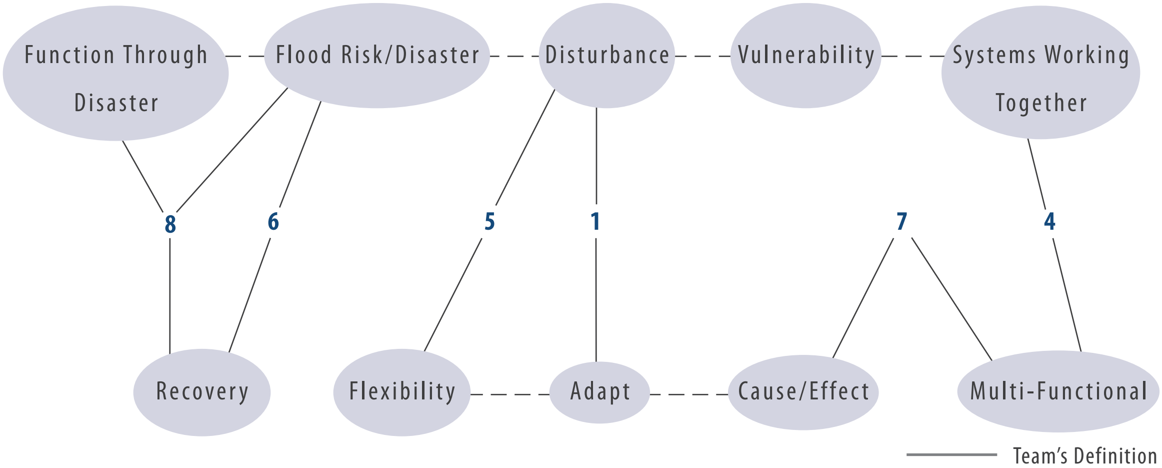


Figure 5.3. Connection Between Terms in the Stated Resilience Definitions

Figure 5.4. Familiarity with Resilience Prior to the Rebuild by Design Competition

significant disturbance. The interviewees mentioned analyzing critical Thresholds related to storm surge. Interacting Thresholds, however, was mentioned only in the literature. The interviews covered two (Thresholds, Disturbance) of the three properties (Interacting Thresholds) of Specific Resilience as identified by the resilience literature.

The second part of the resilience definition comparison analyzes the definitions interviewees explicitly stated. Table 5.3 indicates this report's definition of resilience and the interviewee's response to the question: "How did your team define resilience?" Figure 5.3 shows the connections between the different definitions of resilience. The connections were determined by identifying key concepts. Of the eight teams, two used similar definitions, and one team used a definition close to this report's definition of resilience. The diversity of responses is a result of the competition administrators telling teams to create their own definition. The definitions represent only a single team's use of resilience for the competition. Another finding from the interview was the teams' familiarity with resilience prior to RBD. Figure 5.4 shows the familiarity of the individual or team with resilience prior to the Rebuild by Design competition. The data is incomplete because the author did not discuss prior knowledge in every interview. The partial data indicates a diversity of knowledge bases. Two teams had familiarity with resilience prior to RBD, two did not, and one team's knowledge of resilience was limited to a single person.

Content Analysis: Importance of Ideas

Three analyses determine the importance of the ideas derived from the interviews. The first analysis tallies the number of interviewees who mentioned an idea. Second, the total number of times all interviewees mentioned an idea was tallied. The third analysis qualitatively determines the level of importance based on the emphasis interviewees placed on an idea. Emphasis was determined based upon the tone of voice and language used (ex: "is very important"). Figure 5.6 shows how many times the interviewees mentioned an idea and the average emphasis. Figure 5.7 shows how many interviewees mentioned an idea and the average emphasis.

Comparing the three analyses together reveals the most important ideas from each category (methods, concepts, resilience in practice). For Methods, the most important ideas were Community Engagement, Mapping, and Direct Observation. Community Engagement was mentioned the most out of any idea (eight times more than any other idea). Interviewees stressed the importance of engaging the community throughout the competition process. Mapping was another idea from the Methods category the interviewees designated as important. The interviewees explained the value of mapping was the organization and analysis of large amounts of geographic data. Direct Observation is the third most important idea in the Methods category. Site visits provided the teams a valuable perspective on the region (Interviewees 2014).

The most important ideas from the Concepts category include: Vulnerability, Disturbance, Disturbance Mitigation, and Creating Organizations. Vulnerability was important to the competition because it describes the problems the teams are addressing. The teams were searching for vulnerabilities. Disturbance and Disturbance Mitigation are linked ideas. It was important for teams to identify potential Disturbances (e.g. hurricanes) and develop strategies for mitigating the effects. Creating Organizations was also found to be important. Seven of the interviewees discussed creation of organizations to facilitate the collaboration necessary to implement projects across jurisdictional boundaries (Interviewees 2014).

The two most important ideas from the Resilience in Practice category were Multi-Disciplinary Teams and "Impossible to Address Every Problem." Interviewees identified Multi-Disciplinary Teams was essential to the research and analysis phase. "Impossible to Address Every Problem" was an idea expressed by every interviewee. Each team discovered many problems for the Sandy affected region and had to decide which problems to focus on because it is impossible to address every problem (Interviewees 2014).

Discussion

When reviewing the interview analyses as a whole, findings were identified from combining the Importance of Terms and the Resilience Definition Comparison analyses. Additionally, the interviews revealed properties of creating resilience in urban settings. The interviews also revealed ideas related to the application of resilience to practice (Interviewees 2014).

Reviewing the Importance of Terms and Resilience Definition Comparison analyses together revealed Redundancy and Thresholds were important in the literature but not important to the interviewees. Additionally, it was found that the idea of Trends from the interviews can supplement the terms found in the literature.

The literature explains Redundancy as an important aspect of resilience because if one part of a system fails, the redundant parts that serve the same function prevent a total system failure. Thresholds are important because they are identifiable tipping points to avoid. They are measurable points designers can strategize how to avoid. When conducting the analysis for the RBD competition, four of the interviewees discussed identifying Trends. For example, teams planned for six feet of sea level rise by 2080 and then another storm event like Sandy with those conditions (Interviewees 2014). The idea of analyzing for Trends is linked to the Adaptive Cycle and changing behavior Social-Ecological Systems. Determining the Trend is a beneficial way to analyze systems compared to the current state because it has an impact beyond the time scale of a single intervention. The goal of trend analysis is to enable designers to shape systems' trends so future change is beneficial.

There are two findings from the interviews related to resilience in urban areas: "Starts with People," and "Resilience is Everyday." Participants identified resilience "Starts with People" as the most important because social systems positively impact other types of resilience. Social system resilience leads to the creation of community organizations that shape the material and economic systems. Related to social resilience is "Resilience is Everyday". Three of the interviewees discussed creating resilience not only to single disturbance events like hurricanes, but also to every day events like job loss. Resilience in the everyday results in adaption to big, small, fast, and slow changes. The goal for adapting to changes in the everyday is to increase health, safety, and welfare (Interviewees 2014).

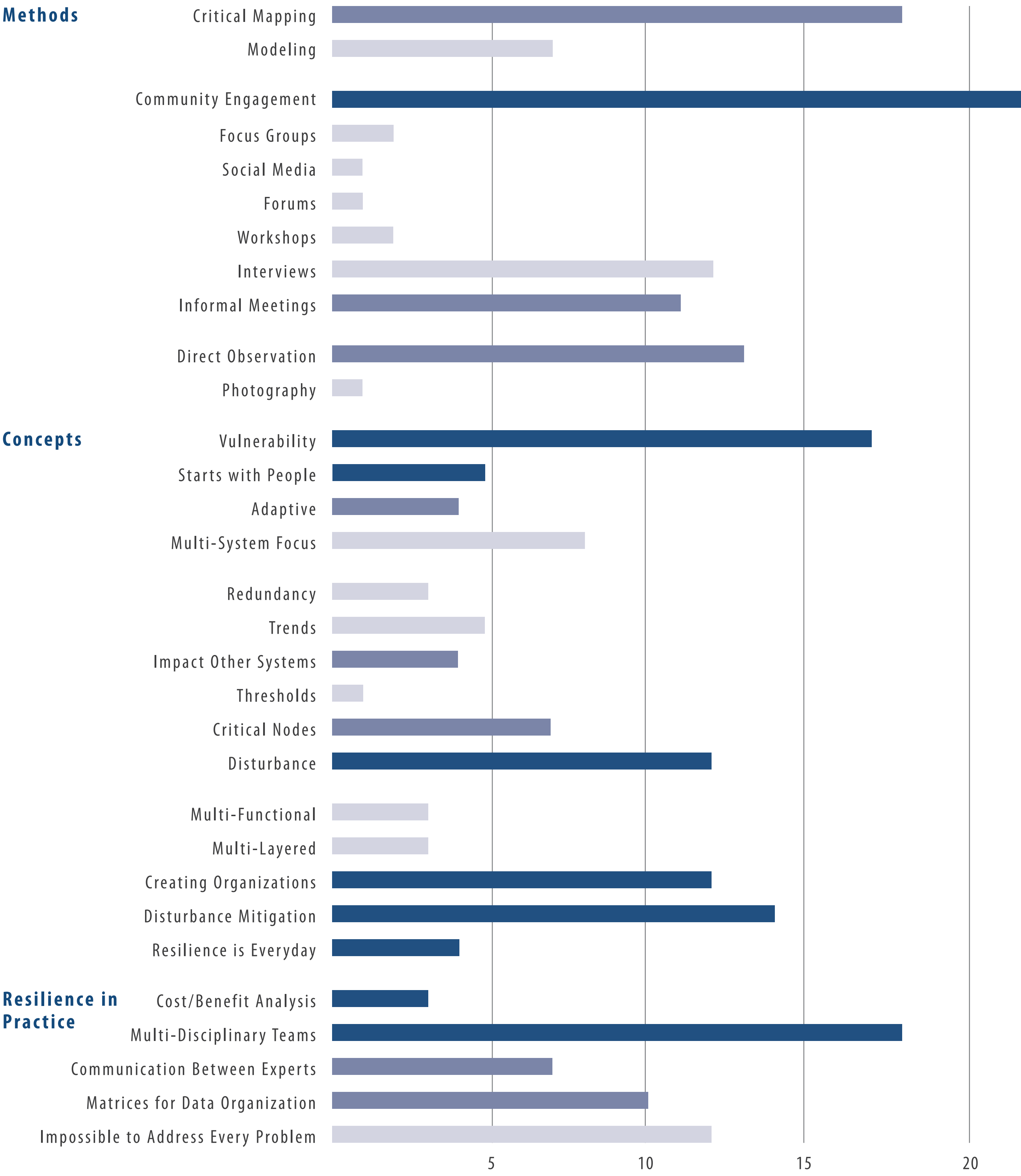


Figure 5.5. Number of Times the Ideas were Mentioned by Interviewees

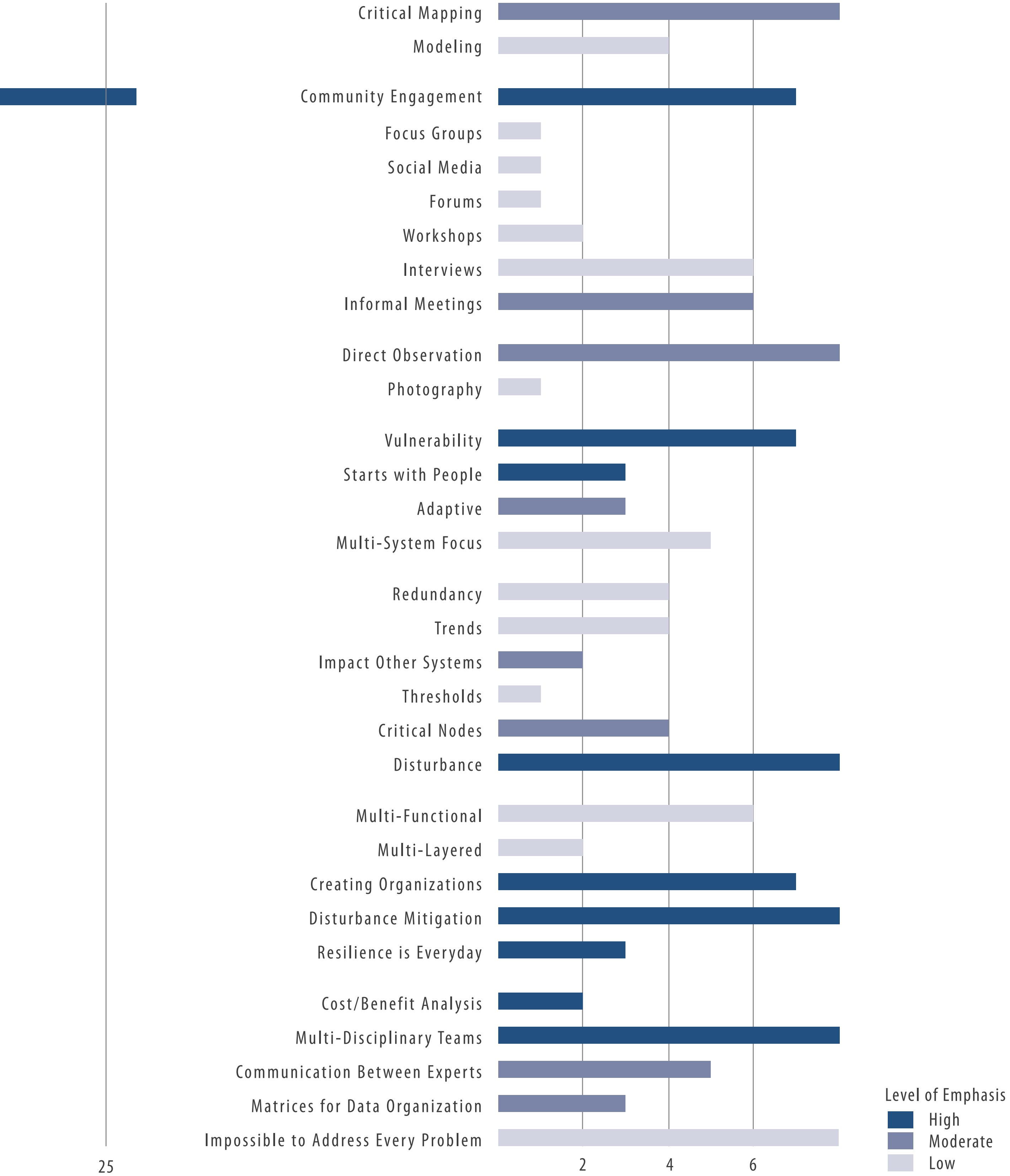


Figure 5.6. Number of Interviees that Mentioned the Ideas

The interviews revealed tips for applying resilience to practice. Two of the participants emphasized a Cost/Benefit Analysis. The purpose of a Cost/Benefit Analysis is to prove to stakeholders a project is worth implementing. Stakeholders will not want to spend five dollars to protect something worth one dollar (Interviewees 2014). Every interviewee discussed the importance of a Multi-Disciplinary Team. A single professional does not have the expertise to understand the behavior of all complex systems. The literature also supports this idea because it synthesizes ecology and design. All the interviewees mentioned Disturbance Mitigation as an important part of the competition. The Rebuild by Design competition used the disturbance Hurricane Sandy as a catalyst for increasing the resilience of multiple systems, not just a storm surge. Teams used Disturbance Mitigation to begin the conversation about the resilience of systems beyond a storm surge.

Limitations

There are limitations to the findings due to the analysis process, number of people interviewed, length of interviews, and competition phase. The analysis process involved the author's interpretation of the ideas interviewees discussed. The author's knowledge influenced the analysis and reporting of the ideas. There are ten teams participating in the Rebuild by Design competition and this analysis only accounts for eight of the teams. Additionally, only one member from each team was interviewed. The findings from this analysis are a blend of the team's use of resilience and the personal understanding of the interviewee. Another factor influencing the interviews was the timeframe. Participants were interviewed while the competition was ongoing. Interviews took place between December 16, 2013 and January 21, 2014. The first interview in December happened a short time after phase two, research and site analysis, of the competition. The last interview in January was during the middle of phase three, design solutions (Rebuild By Design 2013).

Findings Influencing the Framework

Findings from the interviews influenced the creation of the Resilience Analysis Framework. Specifically, the Impossibility of Addressing Every Problem, the necessity of a Cost/Benefit Analysis, analyzing Trends, and Community Engagement are four findings incorporated into the framework. The idea that it is "Impossible to Address Every Problem" came up in all eight interviews (Interviewees 2014). Some participants stated it, and others discussed their decision to focus on particular problems. The Impossibility of Addressing Every Problem creates the need for a prioritization process. Prioritization is therefore an essential part of the framework. The Rebuild by Design competition addressed the "Impossibility of Addressing Every Problem" issue by assigning different study areas for each of the ten teams. Overall, the sum of all the teams' work addresses a wider range of problems than would have been possible from a single effort. Part of prioritization is a Cost/Benefit Analysis. Stakeholders will not pay five dollars to protect something worth one dollar, and a Cost/Benefit Analysis shows the money holders the value in investment (Interviewees 2014). The interviews revealed Trends are important to consider during analysis. Determining how a system will change in the future causes designers to have a better understanding of the system's behavior than if they were to only consider the current state. The goal of analyzing Trends is for designers to devise strategies to change negative trends into positive trends. Lastly, the interviews provided insight into the value of methods for resilience analysis. All eight interviewees identified Community Engagement as the most important method. The importance of Community Engagement was demonstrated by the fact that the teams engaged the community at all stages of the analysis process. The Impossibility of Addressing Every Problem, a Cost/Benefit Analysis, identifying Trends, and Community Engagement are findings from the interviews incorporated into this report's Resilience Analysis Framework.

RESILIENCE ANALYSIS FRAMEWORK

Chapter 6

The Resilience Analysis Framework is an approach to site analysis that evaluates systems' resilience, identifies a future vision, and prioritizes goals. The framework's overall organization is based on the Ecological Planning Model by Frederick Steiner.
The framework is arranged to be iterative, following the nature of the site analysis process. There are four main parts to the framework: System Description & Goal Establishment, System Analysis, System Report, and Prioritization. A fifth part, Stakeholder Engagement is not an actual phase. It is integrated into the other parts.

The System Description & Goal Establishment part identifies current conditions and goals for the basic properties of systems. System Description establishes the current state of the basic properties of a system. Future Vision identifies goals for change to the basic properties. There are four properties: Scales, Stable State, Phase, and Other System Interaction. Table 3.3 (p. 30) in the Methodology section of this report explains the definitions for the System Description & Goal Establishment part. Table 6.1 and 6.3 on page 72 and 73 show the analysis properties.

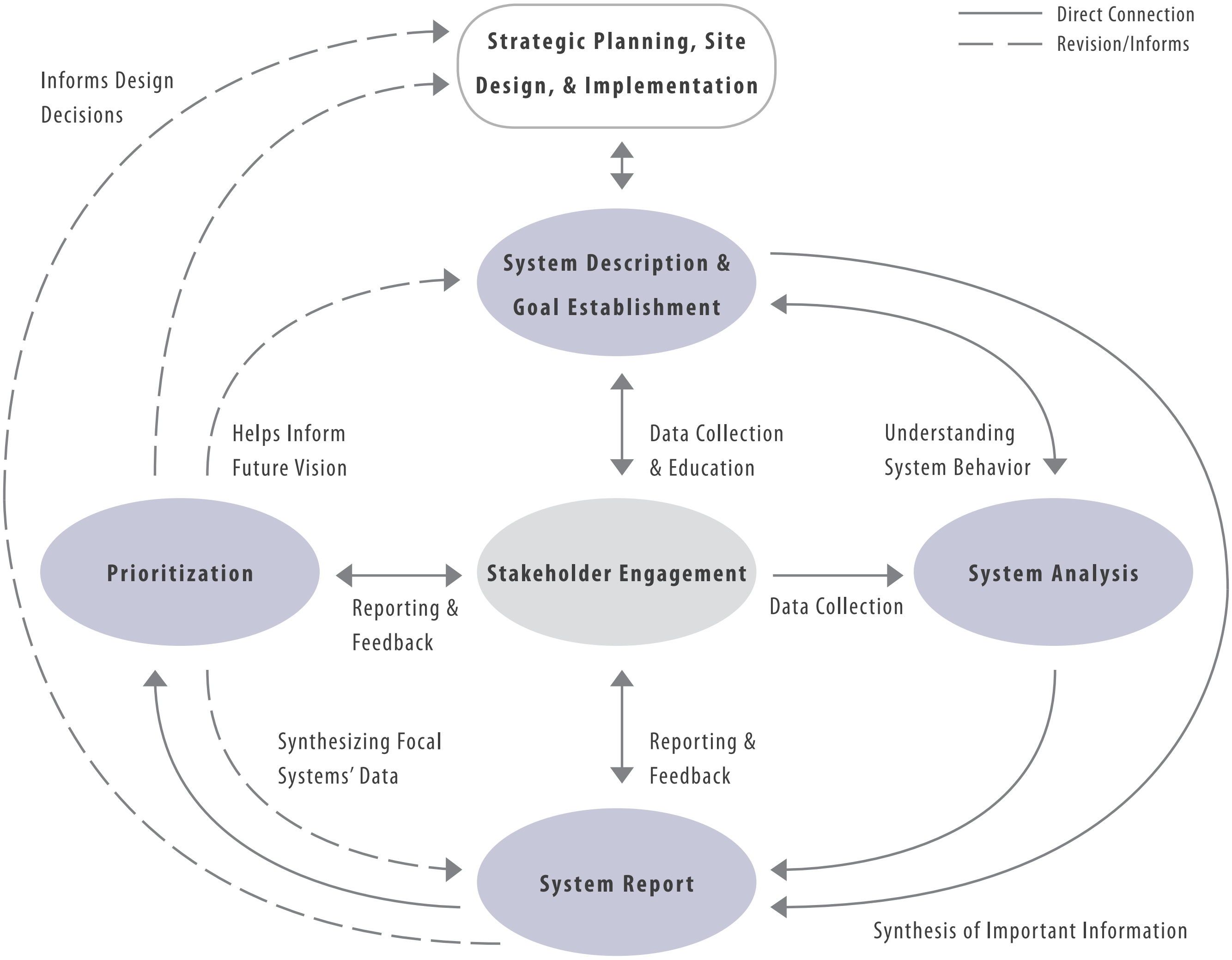


Figure 6.1. Resilience Analysis Framework

System Analysis evaluates factors determining the amount of resilience. The analysis determines Current Trends and the Desired Change to those trends. The factors are divided into two sections: Specific Resilience and General Resilience. Specific Resilience is the resilience to an identified disturbance and/or critical threshold. There are three factors for analyzing specific resilience. The factors are Disturbance, Thresholds of Concern, and Interacting Thresholds. General Resilience evaluates the capacity of a system to adapt to any change. There are five considerations for General Resilience: Diversity, Redundancy, Openness, Tightness of Feedbacks, and Total Capital. See Table 3.4 (p. 32) in the Methodology section of this report for definitions of the System Analysis part. Table 6.1 and 6.3 on the following spread show the breakdown of the System Analysis part.

System Report synthesizes the important information from the System Description & Goal Establishment and System Analysis parts. The purpose of the System Report is to discard irrelevant information. Synthesizing the important information provides a better understanding of the analyzed systems and is preparation for finalizing the next part of the Resilience Analysis Framework: Prioritization.

Prioritization determines which systems to focus on during site design and strategic planning. There are five properties to Prioritization. These properties are: Benefit, Consequences, Importance of Vision, Budget/Funding Sources, and Decision Makers. The Benefit and Consequences properties provide the opportunity to assess the potential positive and negative impact from the changes in the Future Vision. Importance of Vision takes the Benefit and Consequences into account in addition to stakeholder values to determine the importance of the proposed changes. Budget/Funding Sources determines the potential cost and sources of funding. Decision Makers determines the people with implementation power. See Table 3.5 (p. 36) in the Methodology section of this report for definitions. Table 6.2 on the following spread shows the Prioritization analysis factors.

Stakeholder Involvement is not a specific step but a part of each phase of the framework's process. During the System Description & Goal Establishment part stakeholders are educated and a source for information on systems. Stakeholders also provide data during the System Analysis phase. Reporting and feedback from stakeholders occurs during System Reporting and Prioritization.

Process

The process of the Resilience Analysis Framework is iterative and often multiple parts will occur simultaneously. To explain the overall process, I started with the System Description & Goal Establishment part and moved clockwise following the arrows.

The System Description & Goal Establishment (SD&GE) part provides a base understanding and vision for a system. This understanding and vision directly connect to the in depth analysis in the System Analysis part. The System Description is directly linked to the Current Trends section of the System Analysis part (Table 6.1 on the following page). Current Trends is an in depth analysis of the base properties in the System Description. Similarly, Future Vision in the SD&GE part is linked to the Desired Change section of the System Analysis part (Table 6.3 on the following page). In the framework (Figure 6.1), the line between the SD&GE and SA parts represents the relationship of the System Description-Current Trends and Future Vision-Desired Change. Stakeholder Engagement is a method for the first two parts. The stakeholders are a source of

SYSTEM DESCRIPTION

(System Description & Goal Establishment Part of Framework)

Scales		Stable State	Phase	Other System Interaction
Time	Spatial	(Basin of Attraction)	(Adaptive Cycle)	(Panarchy)

System Description Linked to Current Trends

CURRENT TRENDS

(System Analysis Part of Framework)

Specific Resilience			**General Resilience**				
Disturbance (Resilience to What?)	Thresholds of Concern	Interacting Thresholds	Diversity	Redundancy (Multiple sources of same function)	Openness (Ease of inputs into system)	Feedbacks (Effect of stimulants & response time)	Total Capital (Reserves + Capital Assets)

Table 6.1. Link Between System Description and Current Trends (System Analysis part)

PRIORITIZATION

Benefit	Consequence	Importance of Vision	Cost/Funding Sources	Decision Makers

Table 6.2. Considerations for Prioritization of Systems

information, and the designers have the opportunity to educate the stakeholder.

The first iteration of the Systems Report synthesizes findings from the SD&GE and System Analysis parts. Discarding unnecessary information begins to narrow the focus of the project. The report may contain maps, sources, key findings, important considerations, and goals. Reporting to the stakeholder after the systems report is an opportunity for

FUTURE VISION
(System Description & Goal Establishment Part of Framework)

Scales		Stable State (Basin of Attraction)	Phase (Adaptive Cycle)	Other System Interaction (Panarchy)
Time	Spatial			

↕ Future Vision Linked to Desired Change

DESIRED CHANGE
(System Analysis Part of Framework)

Specific Resilience			**General Resilience**				
Disturbance (Resilience to What?)	Thresholds of Concern	Interacting Thresholds	Diversity	Redundancy (Multiple sources of same function)	Openness (Ease of inputs into system)	Feedbacks (Effect of stimulants & response time)	Total Capital (Reserves + Capital Assets)

Table 6.3. Link Between Future Vision (Goal Establishment part) and Desired Change (Site Analysis part)

educating the stakeholders about systems' resilience and receive feedback based on the stakeholders' understanding of the systems.

As a designer moves from the Systems Report to Prioritization the project is further narrowed. The Systems Report provides the information indicating the possible benefits and consequences of the proposed changes. Prioritization takes the resilience analysis and applies it to practical matters necessary to convince a client the project is worth implementing. Reporting the prioritization information to the stakeholders educates the stakeholders on key findings and provides an opportunity for the values of the stakeholder to influence the project outcome.

After Prioritization, a revised System Report incorporating the Prioritization information creates one source with all the important information from the Resilience Analysis Framework. The report identifies focal systems, current system states, and goals. Additionally, the report includes a resilience analysis, maps, images, and other sources for informing design decisions.

Digital Processing	Data gathering and analysis using a computer.	(Woodle 2014)
Critical Mapping	Layering and processing of geographic data to reveal relationships not readily apparent.	(Interviewes 2014) (Corner 1999)
Analytical Modeling	Analytical modeling involves running a computer simulation to determine results.	(Interviewes 2014) (Walker and Salt 2012)
Scenario Planning	Forcasting future outcomes based on current and future decisions.	(MA 2005)
Community Engagement	Methods for educating, gathering data, and analyzing data with community members.	(Interviewes 2014) (Walker and Salt 2012)
Surveys	Asking people a list of questions for data gathering.	(Kopec et. al. 2011)
Focus Groups	A group of people guided through a discussion.	(Interviewes 2014)
Social Media	Digital technology communication systems.	(Interviewes 2014)
Forums	A public meeting for ideas to be shared.	(Interviewes 2014)
Workshops	Community gatherings for discussion and activities.	(Interviewes 2014)
Interviews	Impromptu or formal conversations with community members or local experts.	(Interviewes 2014)
Informal Meetings	A conversation with a small group of individuals.	(Interviewes 2014)
Conceptual Modeling	Conceptual understanding of a system's organization.	(Walker and Salt 2012)
Historical Analysis	Gathering and analysis of historical data to understand current conditions.	(Kopec et. al. 2011)
On Site Gathering	Collection and analysis of data on the site.	(Interviewees 2014)
Direct Observation	Information gathered from on-site experience, often double checking digital findings.	(Interviewes 2014) (Kopec et. al. 2011)
Photography	Use of photos to document and analyze systems.	(Interviewes 2014) (Kopec et. al. 2011)
Sketching	Drawing out ideas, observations, and interpretations by hand (pen, pencil, tablet pen).	(Kopec et. al. 2011)

Table 6.4. **Analysis Methods Definitions and Source** adapted from (Interviewees 2014: Walker and Salt 2012: Kopec et. al. 2011; MA 2005)

The next step is to move on to Strategic Planning, Site Design, & Implementation. Prioritization and Systems Report directly feed into the next step because they provide information on focal systems, goals, spatial data, and design strategies. Prioritization provides the information on the focal systems. Spatial data is a part of the Systems Report part and can inform placement of programing. The Systems Report also provides design strategies (ex: diversity, redundancy, disturbance mitigation) for creating resilience. Last, the primary goals of the project to guide overall design and planning decisions are included in the System Report.

Methods

The literature review and interviews revealed methods for resilience analysis. The methods were divided into the three groups: digital processing, community engagement, and on site gathering. Digital methods use computer technology to synthesize and analyze data. Examples of digital analysis include mapping, analytical modeling, and scenario planning. Community engagement contains methods for collecting and analyzing data from community members. Methods in this group include surveys, focus groups, public forums, interviews, workshops, meetings, social media, conceptual modeling, and historical analysis. On site methods collect information from site visits. Examples of on-site methods include photography, direct observation, and sketching. Table 6.4 provides definitions and sources for system analysis methods.

Limitations

The limitations of this framework include unfamiliarity of terminology, lack of a transformability analysis, and the focus on site analysis. The Resilience Analysis Framework uses terminology directly from resilience theory as originally defined by C.S. Holling. Without familiarity of the terms, it would be difficult to use and understand the framework. Another limitation is the lack of a transformability analysis. Transformability is "the capacity to create a fundamentally new system when ecological, economic, and/or social conditions make the existing system untenable" (Walker and Salt 2012). The Resilience Analysis Framework identifies the goals for changes to systems, but does not determine the difficulty of achieving the goals. The literature lacks development of transformability analysis resulting in a limitation for the Resilience Analysis Framework. Another limitation is the Resilience Analysis Framework covers only the site analysis phase of the design process. After prioritization, designers will have to identify a process for engaging design.

WASHINGTON SQUARE PARK

Chapter 7

Washington Square Park provides an example of an application of the Resilience Analysis Framework. The site balances this report's methods by focusing on a small site scale compared to the large scale analysis in the interviews. Additionally, WSP further grounds this report through application to a real site. The scope of the analysis was limited to a practitioner hired by the Department of Parks and Recreation to redesign WSP. This scope shaped the analysis to focus on systems influenced by WSP.

A matrix was the primary tool for application of the framework. The interviews identified matrices as a useful tool for the organization, synthesis, and analysis of data. Matrices allows for quick and easy comparison of large amounts of data. The author created a matrix for the analysis of the System Description & Goal Establishment, System Analysis, and Prioritization parts. On the x axis is the framework components. Along the y axis is the list of systems.

Site Focus: Washington Square Park			**SYSTEM DESCRIPTION**			
System Category	System	Sub-System	Scales		Stable State (Basin of Attraction)	Phase (Adaptive Cycle)
			Time	Spatial		
Institutional	Governance	Parcel Ownership	Varies depending on business relocation and selling of land	Adjacent properties to WSP	Mix of owners including public and private	Conservation, stable
Social	Gathering of People	Events	Temporary events	In parcel or adjacent to WSP	Used for over 7 events annually	Growth, as KC grows more events
	Demographics	Number of Households	Next 10 years	Metro scale around WSP	Numerous neighborhoods in local area	Growth, increase in households from 2000-2010

Table 7.1. System Description & Goal Establishment for Washington Square Park for sources see Appx. B, Systems Reports 1-3

The list of systems are organized in a three level categorization. The first and most general categorization is the System Category. Three system categories were identified: social, material, and institutional. Social systems pertain to the settlement and activities of people. Examples of social systems include demographics, housing, and events. Material systems are a combination of ecologic and infrastructural. Examples of material systems include stormwater, transit, and electric grids. Institutional systems cover governance and economic systems. Examples include parcel ownership, community organizations, and employment centers.

After the system category column, systems are broken down into two additional categories. The next column is the Systems column. This column contains systems within the system category. For example, in the material category a system is transit. The third column breaks the systems down into sub-systems. Continuing with the transit example, sub-systems for transit include public transit, pedestrian, bicycle, and vehicular. For this example, from system category to sub-system, the breakdown would list as:
material > transit > pedestrian transit.

Each cell contains an explanation of the analysis for that property of a system. The author designated cells in the System Description & Goal Establishment and System Analysis matrices with colors corresponding to the level of resilience and

FUTURE VISION

(System Description & Goal Establishment Part of Framework)

Other System Interaction (Panarchy)	Scales		Stable State (Basin of Attraction)	Phase (Adaptive Cycle)	Other System Interaction (Panarchy)
	Time	Spatial			
Depends on success of businesses and city plans with government owned land	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope
Dependant on citizens and city using WSP for location of events	Temporary Events	In parcel or adjacent to WSP	WSP is a destination used for many different events annually	Growth, as KC core grows amount of events increases	Dependant on businesses not relocating or closing
Dependant on jobs and economy, amount of housing and building of new units	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope

🟩 Resilient 🟧 Vulnerable

vulnerability. The color designations allow for quick understanding of the overall resilience of the systems. The Prioritization matrix used color to designate the level of importance. Darker colors signify a higher importance level. Color coding the matrices allows designers to look at the data as a whole and understand what systems have high vulnerability, resilience, and prioritization.

Analysis

This report analyzes twelve sub-systems influencing Washington Square Park. The author selected systems based on availability of data and diversity of system type. Within the institutional category, parcel ownership was analyzed. The social systems that were analyzed include events and number of households. Last, for the material category, stormwater, views out of WSP, views on approach to WSP, sun/shade, and pedestrian, bicycle, vehicular, and public transit were analyzed. This report analyzes more material systems than institutional and social systems because the project scope focuses on a physical design for WSP. Table 7.1 and 7.2 show the findings for the System Description & Goal Establishment part, Table 7.3 and 7.4 show the System Analysis part, and Table 7.5 is the Prioritization analysis. System reports are located in Appendix B (p. 108) and include a written data synthesis and analysis diagrams. Sources with the data in the matrices is located in the System Reports. Pages 86 and 87 contain examples from the System Reports.

Site Focus: Washington Square Park			SYSTEM DESCRIPTION			
System Category	System	Sub-System	Scales		Stable State (Basin of Attraction)	Phase (Adaptive Cycle)
			Time	Spatial		
Material	Places (Infrastructure)	Activity Nodes (destinations that draw people)	50 years	In parcel or adjacent to WSP	No draw except during temporary events	Growth, as KC core grows amount of people at activity nodes increases
			50 years	Walking distance to WSP	Mix of nodes including hotel, businesses, shopping, and transit	Growth, as KC core grows amount of people at activity nodes increases
	Transit (Infrastructure)	Public Transit	Varies depending on commute distance	Adjacent stops linking to metro region	Transitioning from bus system to streetcar & bus system	Early part of growth phase, more people and connectivity trending
		Vehicular Transit	Varies depending on commute distance	Adjacent parking & streets linking to metro region	High connectivity, high usage	Conservation, possibly towards the end as more public transit introduced
		Pedestrian Transit	Varies depending on distance	Local	Sidewalks along streets surrounding WSP connect to local region, most traffic around perimeter of WSP	Slowly growing as neighborhoods around WSP grow
		Bicycle Transit	Varies depending on distance	Metro	Designated adjacent bike route, biking in traffic lanes, bike share nearby, few amenities in WSP	KC has a growing bike infrastructure and usage
	User Experience (Infrstructure & Ecologic)	Views	50 years	From inside WSP	View of surrounding buildings, one view to city skyline	End of conservation, potential for future development blocking views
			50 years	On approach to site, surrounding streets	3/4 corners can view into park	End of conservation, potential for future development
		Sun/Shade	Change with the season	Surrounding buildings determine shade	Varies, mostly sunny except for southern side along street	No change
	Hydrologic (Ecologic)	Stormwater Drainage	No data on speed of discharge	Bound by parcel of WSP	Poor drainage with unintentional flooding during moderate rain events	Conservation, stable
		City Stormwater System	No data on speed of discharge	Metro, whole city	Combined sewer and stormwater system, violates EPA regulations	Reorganization, system is being redesigned per EPA requirements

Table 7.2. System Description & Goal Establishment (cont'd) for sources see Systems Reports 4-14

FUTURE VISION

(System Description & Goal Establishment Part of Framework)

Other System Interaction (Panarchy)	Scales		Stable State (Basin of Attraction)	Phase (Adaptive Cycle)	Other System Interaction (Panarchy)
	Time	Spatial			
Dependant on surrounding activity nodes, transit to WSP	50 years	In parcel of WSP	WSP is a destination with numerous attracting elements	Growth, as KC core grows amount of nodes and people grows	Dependant on businesses not relocating or closing; transit accommodating growth
Dependant on activity nodes in area continuing to draw people; transit to area	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope
Vehicular transit is the main form of transit to KC	Varies depending on commute distance	Adjacent stops linking to metro region	Strong connection between park and adjacent bus and streetcar transit stops	Stable in conservation phase	Vehicular transit
Public Transit	Varies depending on commute distance	Adjacent parking & streets linking to metro region	High connectivity, moderate usage, stagnant	Conservation, stable	Public transit expansion relieving dependence on vehicular transit
Impacted by other transit systems	Varies depending on distance	Local	Enhance existing conditions and supplement with paths drawing people through the park	Slowly growing as neighborhoods around WSP grow	Impacted by other transit systems like the streetcar, bike routes, and vehicular transit
Impacted by other transit systems	Varies depending on distance	Metro	Provision of bike amenities in WSP	Growth as KC bike culture grows	Dependant on government implementing infrastructure and people using bikes
Dependant on construction of buildings surrounding the site	50 years	In parcel of Washington Square Park	View to city skyline and interesting surrounding buildings	Conservation, stable with laws preventing blocked views	Future developments don't block views, enhance them
Dependant on developers and new projects' impact on views	50 years	On approach to site, surrounding streets	4/4 corners can view into park	Conservation, stable with laws preventing blocked views	No development to the north of WSP
Dependant on developing surrounding WSP, unlikely to change	Change with the season	Surrounding buildings determine shade	Only southern part shaded by buildings, other parts vary in shade/sun	No change	Dependent on development around WSP, unlikely to change conditions
City stormwater system drains site water	2 day discharge of heavy rain events	WSP parcel boundary	On site processing of heavy rain events with overflow to city system	Conservation, stable	City stormwater system only in severe situations or failure on site
WSP feeds into city stormwater system	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope

🟩 Resilient 🟥 Vulnerable

Site Focus: Washington Square Park

CURRENT TRENDS

Specific Resilience

System Category	System	Sub-System	Disturbance (Resilience to What?)	Thresholds of Concern	Interacting Thresholds
Institutional	Governance	Parcel Ownership	No significant disturbance	No data on thresholds	No data on interacting thresholds
Social	Gathering of People	Events	Inclement weather	For profit events: income must exceed cost of event	No data on interacting thresholds
	Demographics	Number of Households	No significant disturbance	No data on thresholds	No data on interacting thresholds
Material	Places (Infrastructure)	Activity Nodes (within WSP)	Changing cultural preferences	No data on thresholds	No data on interacting thresholds
		(Walking distance to WSP)	Relocation of current nodes	No data on thresholds	No data on interacting thresholds
	Transit (Infrastructure)	Public Transit	Extremely high ridership, most bus along Grand Blvd, Streetcar on Main st.	Number of riders exceeds occupancy of streetcar or bus	No data on interacting thresholds
		Vehicular Transit	High vehicular traffic volume, traffic jams, highest along Main St. and Grand Blvd.	Number of vehicles exceeds maximum street traffic capacity	High pedestrian or bicycle traffic impeding traffic flow
		Pedestrian Transit	Extremely high pedestrian numbers, highest along Main St. and Pershing Rd.	Amount of pedestrians exceeding sidewalk capacity	High traffic flow resulting in difficulty of crossing streets
		Bicycle Transit	Extremely high bike traffic, creating congestion	Higher bike traffic than storage prevents people from visiting the site. Current storage is minimal	High vehicular traffic causes reduction in bike safety
	User Experience (Infrastructure & Ecologic)	Views (from site looking out)	Construction of a building north of WSP	If a building north of WSP is constructed above ground level of WSP the view will be blocked	No data on interacting thresholds
		(on approach)	Construction of a building north of WSP	If a building north of WSP is constructed above ground level views into WSP will be blocked	No data on interacting thresholds
		Sun/Shade	Tree loss from storms and disease	No data on thresholds	No data on interacting thresholds
	Hydrologic (Ecologic)	Stormwater Drainage	Severe storm event	6.38" rainfall in one day, largely discharged into city system	Discharge into storm sewer with any size rain event
		City Stormwater System	Severe storm event	No data on thresholds	No data on exact thresholds, but 6.4 billion gallons of overflow a year, EPA requiring change

Table 7.3. System Analysis: Current Trends for Washington Square Park for sources see Appx. B, Systems Reports 1-14

General Resilience

Diversity	Redundancy (Multiple sources of same function)	Openness (Ease of inputs into system)	Feedbacks (Effect of stimulants & response time)	Total Capital (Reserves + Capital Assets)
Diverse ownership, different businesses and public	Multiple owners of each type	Low openness, no property for sale	Selling of parcel north of WSP	All land is purchased and being used
Parades, runs, festivales all take place in WSP	Numerous runs and festivals throughout the year	Events are public, anyone can attend	Annual events bring back people, social media	Potential for more events to take place in WSP
Numerous types of housing avaiable around WSP	Multiple neighborhoods around WSP	Easy for people to move to area with renting or buying	Amount of people in area impact WSP use	Moderate amount of housing around WSP, space for more
No activity nodes	No activity nodes	Public space is available for anyone's use	Social network communication	City events have potential to move or establish in WSP
High diversity including hotels, businesses, shopping, and transit	Moderate redundancy, especially with businesses	Highly open to people, high accessibility	Social network communication	People drawn to surrounding nodes, money from those institutions
Moderate, two types: streetcar and bus system	Moderate, bus and streetcar routes to and from WSP partially overlap	High, easy access for people to get on bus or streetcar from WSP	Ridership currently uncertain with introduction of streetcar	Low but growing usage, growing investment
High, interstates, highways, arterial, and local roads create variety of types	High, multiple routes to and from WSP	High, easy access to connector roads from WSP	Traffic count, change uncertain with introduction of streetcar	Extensive network already invested in
Moderate, sidewalks along street and cutting through WSP	Moderate, Both sides of the street have sidewalks and multiple paths through WSP	Moderate, No obtrusive barriers, overall easy to navigate	Safety, large sidewalks, pleasant experience result in continued usage	Many options for pathways through and around WSP
Two options: designated route and riding in traffic lanes	All local vehicular streets available for bikers creating multiple routes	Easy to access all vehicular streets	Bike share system results in continued bike transit	City & voters invested in improving bike infrastructure
Views to street, city skyline, and surrounding buildings	No redundancy of city skyline view	High open to city skyline	Repeated visiting of site to experience pleasant views	Current view to downtown brings value to WSP
	Numerous views to surrounding buildings	The link blocks a view to Central Station		
Surrounding streets provide multiple views into WSP	Many spots along each street corridor have visual access to WSP	Moderate visual access to WSP, partially blocked by street scale elements and trees	Visual access into WSP can create a desire to visit	High, many points along approach with views
Numerous types of trees and placement in park, no other shade structures	Trees around the park provide lots of opportunity for shade	Moderate range of shade from direct sun to dappled shade	Sun/Shade comfort encourages repeated use	Many mature trees providing shade in the park
Some ground absorption in lawn, most drains to drain inlets	No overlap in catchment basins, results in flooding	Water drips down from the link pooling on site	Water moves to drains, but also pools in undesired areas	WSP has the open space to incorporate stormwater management elements
None, combined sewer and stormwater system, all hard infrastructure management	None, reliant on hard infrastructure, frequent overflow to nearby rivers	High, regularly placed drain inlets provide inputs into the system	Slow, takes a lot of governmental legislation to make changes	Moderate, KC has the space and money to make changes

🟩 Resilient 🟥 Vulnerable

Site Focus: Washington Square Park			DESIRED CHANGE Specific Resilience		
System Category	System	Sub-System	Disturbance (Resilience to What?)	Thresholds of Concern	Interacting Thresholds
Institutional	Governance	Parcel Ownership	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope
Social	Gathering of People	Events	Weather shelter provides place for events	No data on thresholds	No data on interacting thresholds
	Demographics	Number of Households	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope
Material	Places (Infrastructure)	Activity Nodes (within WSP)	Flexibility to WSP programs allowing change with culture	No data on thresholds	No data on interacting thresholds
		(Walking distance to WSP)	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope
	Transit (Infrastructure)	Public Transit	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope
		Vehicular Transit	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope
		Pedestrian Transit	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope
		Bicycle Transit	N/A Outside of Scope	Provision of adequate bike storage/locking	N/A Outside of Scope
	User Experience (Infrastructure & Ecologic)	Views (from site looking out)	Zoning change prohibiting construction of a building that blocks views to skyline	Only underground structure allowed, or park extension over covered parking lot	No data on interacting thresholds
		(on approach)	Zoning change prohibiting construction of a building that blocks views into WSP	Only underground structure allowed, or park extension over covered parking lot	No data on interacting thresholds
		Sun/Shade	Tree loss from storms and disease minimized by selection and placement	No data on thresholds	No data on interacting thresholds
	Hydrologic (Ecologic)	Stormwater Drainage	Severe storm event	6.38" rainfall in one day, largely processed on site, no flooding	Minimal discharge to city system removes WSP stormwater overflow from system
		City Stormwater System	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope

Table 7.4. System Analysis: Desired Change for Washington Square Park for sources see Appx. B, Systems Reports 1-14

General Resilience

Diversity	Redundancy (Multiple sources of same function)	Openness (Ease of inputs into system)	Feedbacks (Effect of stimulants & response time)	Total Capital (Reserves + Capital Assets)
N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope
Continue existing events and draw more to WSP	Maintain existing events, add more	Events are public, anyone can attend	Annual and monthly events to draw people to site	Potential for more events as local population grows
N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope
Multiple types of activity nodes attracting variety of ages	Multiple nodes to draw people to WSP	Public space is available for anyone's use	Social network communication	WSP has space for multiple activity nodes
N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope
Ensure ease of access to bus and streetcar stops	No opportunity for change	Bus stops and streetcar stop as access point to WSP	Increased ridership to WSP	No opportunity for change
Ensure ease of access to drop-off and parking	Ensure numerous connection points to vehicular transit	Drop-off and connection to parking for access	Ease of travel to WSP encourages continued visits	No opportunity for change
Street side sidewalks and paths through WSP match circulation patterns	Multiple paths through WSP	Ease of circulation into and out of WSP to surrounding context	Safety, large sidewalks, pleasant experience result in continued use	Land is effectively used to ease circulation
Accommodates different types of bikes	Numerous places to lock up bike	Easy circulation and visual access to storage areas	Adequate accommodations encourages continued use	N/A Outside of Scope
Views to street, city skyline, and surrounding buildings preserved	No redundancy of city skyline view	High open to city skyline	Repeated visiting of site to experience pleasant views	Views to downtown, streetscape, Central Station brings value to WSP
	Numerous views to surrounding buildings	Link removed and view to Central Station		
Surrounding streets provide multiple views into WSP	Many spots along one street corridor have visual access to WSP	Deliberate design of views into WSP	Visual access into WSP can create a desire to visit	High, many points along approach with views
Many types of trees, shade structures, different types of shade	Trees and structures around park provide opportunities for shade or sun	Complete range of full shade to full sun	Sun/shade comfort accommodations encourages repeated use	Many mature trees providing shade in park
Multiple types of on site drainage: bioswales, rain gardens, bioretention ponds	When on site storage fails, overflows into city system to prevent flooding	Only input from water dripping off the link, accounted for in WSP	Water moves to storage areas/drains, discharged steadily into ground	WSP has the open space to incorporate stormwater management elements
N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope

🟩 Resilient 🟥 Vulnerable

System Report 3

Study Area: Washington Square Park

System: Number of Households

Scale: Local area around WSP

- State: currently numerous neighborhoods around WSP
- Trends: Neighborhoods have been growing in density since 2000

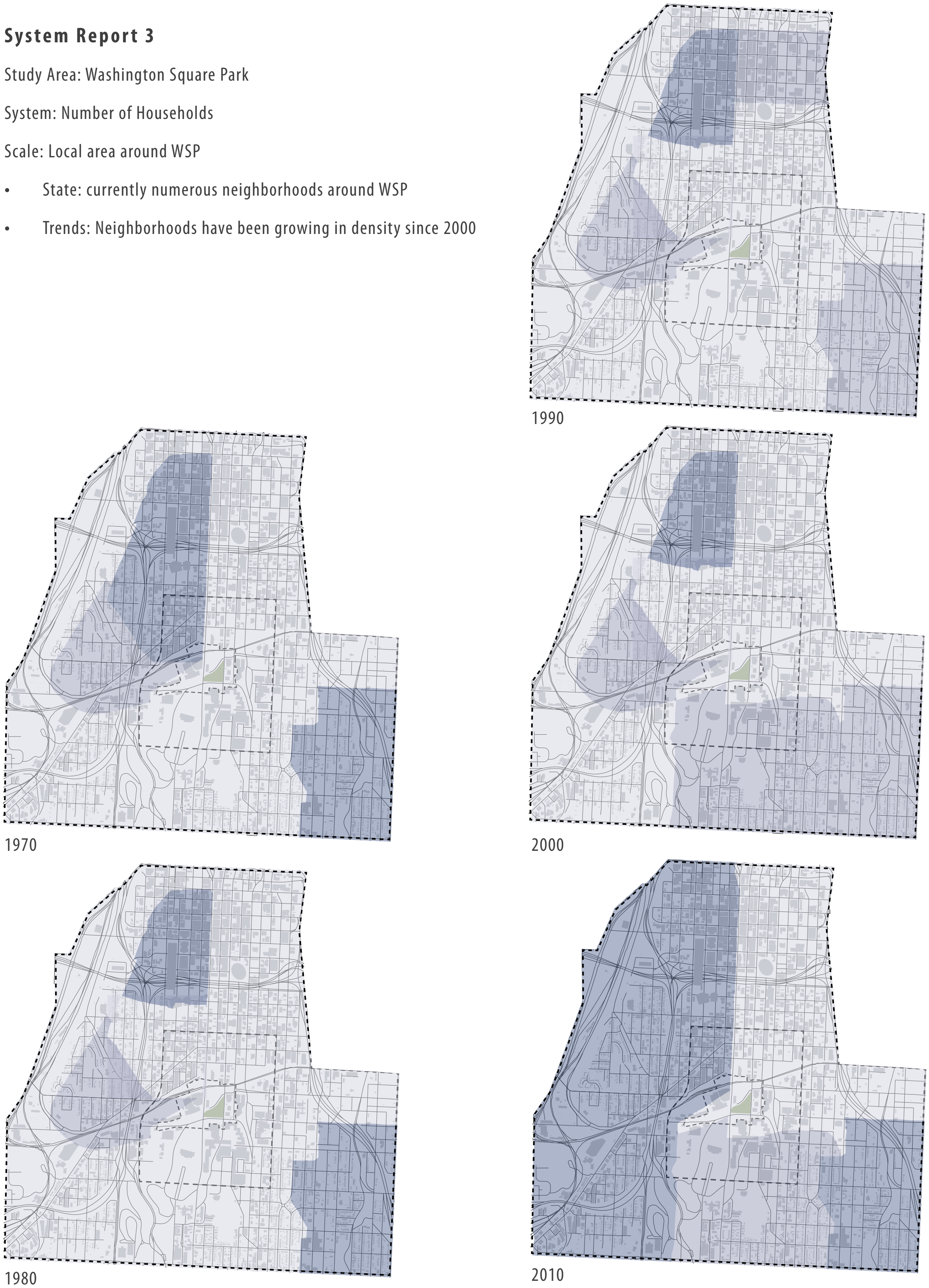


Figure 7.1. Number of Households: 1970, 1980, 1990, 2000, 2010 (KCDC 2014)

System Report 8

Study Area: Washington Square Park

System: Pedestrian Transit

Scale: Local

- State: Moderate pedestrian traffic along Main St. and Grand Blvd.
- Goal: pedestrian routes through the park would increase the resilience of the site, strong connection to street sidewalk to encourage entering the park
- Trend: possible increase as neighborhoods around WSP continue to grow and public transit ridership increases

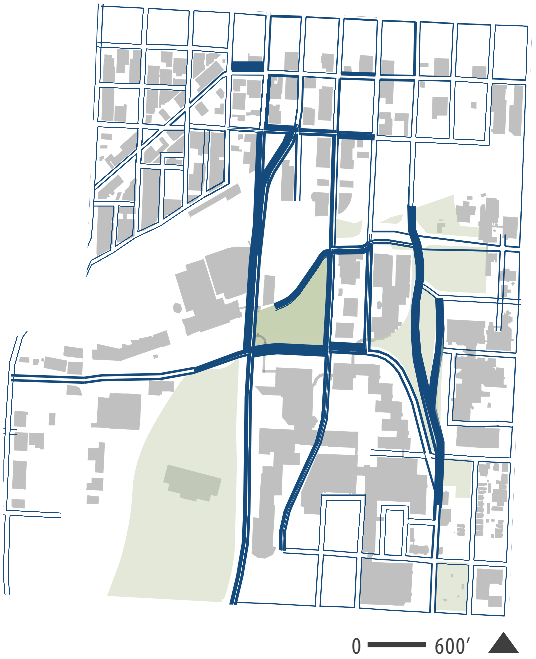
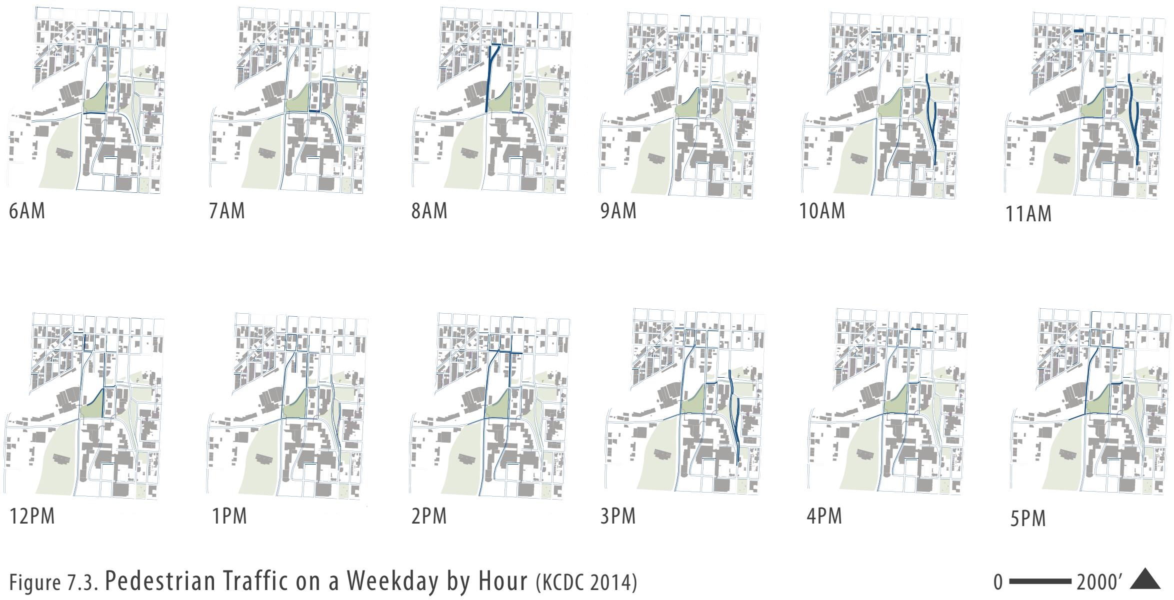


Figure 7.2. Pedestrian Traffic Count (KCDC 2014)

Other Sources

- Pedestrian and Bike Benefit from Streetcar: http://bikewalkkc.org/streetcar
- Bike Walk KC: http://bikewalkkc.org/
- Bike Share Program: https://kansascity.bcycle.com/
- BikeKC Public Works: http://kcmo.gov/publicworks/bikekc/


6AM 7AM 8AM 9AM 10AM 11AM

12PM 1PM 2PM 3PM 4PM 5PM

Figure 7.3. Pedestrian Traffic on a Weekday by Hour (KCDC 2014)

Site Focus: Washington Square Park			PRIORITIZATION	
System Category	System	Sub-System	Benfit	Consequence
Institutional	Governance	Parcel Ownership	N/A Outside of Scope	N/A Outside of Scope
Social	Gathering of People	Events	Improve social life of citizens in KC; bring businesses to surrounding area; increase land value for adjecent properties	Maintenance increase after events from trash and wear on vegetation
	Demographics	Number of Households	N/A Outside of Scope	N/A Outside of Scope
Material	Places (Infrastructure)	Activity Nodes (within WSP)	Draw people to WSP and create a lively open space in KC downtown; benefit surrounding businesses by increased local activity	Could reduce the usage of nearby open spaces
		(Walking distance to WSP)	N/A Outside of Scope	N/A Outside of Scope
	Transit (Infrastructure)	Public Transit	Increased access to WSP through bus and streetcar stops; creates desitnation for general park use and transit to festivals	High traffic flows increase maintenance costs
		Vehicular Transit	Maintaining connection to vehicular transit ensures the immediate use of the park with current dominant form of transit	Limited parking around park limits the amount of people that can travel to WSP
		Pedestrian Transit	Increased access to WSP; reduced vehicular traffic loads; healthier lifestyle; increase use by drawing people from surrounding high traffic areas	Weather and season dependant, more trash and maintenance costs
		Bicycle Transit	Increased use of WSP; more business for stores in surrounding area, healthier lifestyle for residents	Weather and season dependant, more trash and maintenance costs
	User Experience (Infrastructure & Ecologic)	Views (from site looking out)	Provide visual connection to downtown for spatial orientation; improve experience of park; visibility of surrounding businesses/shops	Prevents a feeling of an “escape” from the city
		(on approach)	Provide visual connection into park; encourage park use through enticing views	Privacy in the park is reduces, less isolation from the city
		Sun/Shade	Creates a comfortable, desirable place to use; shade decreases heat island; accounts for different weather conditions and seasons	No negative consequences
	Hydrologic (Ecologic)	Stormwater Drainage	Provide education on stormwater management, prevent flooding on site	Part of the park will be unusable by people, only for stormwater purposes
		City Stormwater System	N/A Outside of Scope	N/A Outside of Scope

Table 7.5. System Prioritization for Washington Square Park for sources see Appx. B, Systems Reports 1-14

Importance of Vision	Budget/Funding Sources	Decision Makers
N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope
Events help bring people to the park and bring life to the area outside of day to day usage	Continue existing events and draw more to WSP	Event organizers
N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope
Creating a destination is essential to the success of WSP	Sales tax, ticket price from events	Parks and Recreation, Voters
N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope
Need to connect transit stops to WSP in order for it to be an important open space in KC	Can be incorporated into general budget through design, no special funding required	Parks and Recreation, Voters, Kansas City Transportation Authority
In order to ensure immediate use, connection to vehicular transit is needed	Can be incorporated into general budget through design, no special funding required	Parks and Recreation, Voters, Kansas City Transportation Authority
Need people in order to be successful open space	Public-private partnerships, non-profit organizations, taxes, federal and state grants	Parks and Recreation, Voters
Moderately important to vision of a healthier, multimodal, vibrant KC	Can be incorporated into general budget through design, no special funding required	Parks and Recreation, Voters, Kansas City Transportation Authority
Important to make the park feel like it is an important park in KC; ties the park to local area	Public-private partnerships, non-profit organizations, taxes, federal and state grants	Parks and Recreation, Voters, Planning Board
A beneficial way to increase park awareness and use	Public-private partnerships, non-profit organizations, taxes, federal and state grants	Parks and Recreation, Voters, Planning Board
Key to creating a comfortable place people want to repeatedly use	Public-private partnerships, non-profit organizations, taxes, federal and state grants	Parks and Recreation, Voters
Important to voters and Parks and Recreation to reduce strain on city's system because of the EPA requirements	Public-private partnerships, non-profit organizations, taxes, federal and state grants	Parks and Recreation, Voters
N/A Outside of Scope	N/A Outside of Scope	N/A Outside of Scope

▨ Priority

Findings

The system reports are valuable to identify only the necessary information from each system. However, the individual reports lack an overall understanding of all systems. To better understand the systems as a whole the author compared the systems to each other. The System Reports Synthesis revealed four groups of systems. These groups are High Resilience & Preserve, High Vulnerability & Change, Moderate Change, and Other Considerations. High Resilience & Preserve systems are within a desirable basin, and have minimal Desired Change. Systems in the High Resilience & Preserve group are events, vehicular transit, views on approach, and sun/shade. An undesirable basin needing significant change characterizes systems in the High Vulnerability & Change group. Systems in this group are activity nodes within the park and stormwater management. Moderate Change systems are in a desired basin and require moderate change to strengthen resilience. The systems in this group are views from the park, and public, pedestrian, and bike transit. The last group, Other Considerations, contains systems beyond the scope of this project. These systems are important to consider, but are outside of the project's scope. Other Considerations systems include ownership, surrounding activity nodes, number of households, and city stormwater systems. Figure 7.4 shows the System Reports Synthesis groups.

High Resilience & Preserve
Events
Vehicular Transit
Views on approach
Sun/Shade

High Vulnerability & Change
Activity Nodes within WSP
Stormwater Management

Moderate Change
Views from the park
Public Transit
Pedestrian Transit
Bike Transit

Other Considerations
Parcel Ownership
Activity Nodes in 5 minute walking distance
Number of Households
City Stormwater System

Figure 7.4. Systems Report Synthesis Groups

The final matrix, Prioritization, is a valuable tool for identification of high priority systems. The author synthesized the Prioritization findings into one matrix and analyzed the systems as a whole. From the analysis, three priority classifications were created: High, Moderate, and Low. The High category contained two high cell color designations. Systems in this group include activity nodes within the park, views from the site,

High Priority

Activity Nodes within WSP
Views from the park
Sun/Shade
Stormwater Management

Moderate Priority

Events
Pedestrian Transit
Vehicular Transit

Low Priority

Views on approach
Public Transit
Bike Transit

Figure 7.5. System Prioritization Synthesis Groups

sun/shade, and stormwater management. Moderate Prioritization systems had one high or three low priority cells. The moderate priority systems are events, and pedestrian and vehicular transit. Low Prioritization included systems with two or less low priority cell designations. These systems are views on approach, public, and bicycle transit. The systems outside of the scope of this project are not included in this categorization

Limitations

The limitations of this analysis include a lack of stakeholder involvement, a limited number of systems, a lack of expert opinion, and minimal site access. The most significant limitation of this analysis is the lack of stakeholder involvement. It was not possible to engage the community or stakeholders. A lack of stakeholder and community values limits the Prioritization analysis. The absence of Stakeholder Engagement resulted in a reliance on digital analysis methods. Another limitation is the number of analyzed systems. Not every system was analyzed because of limited data availability and time constraints. Results from the prioritization synthesis and system analysis synthesis would possibly change if additional systems were analyzed. Another limitation to the analysis is the person conducting the analysis. The author's knowledge as a graduate student in landscape architecture influenced the analysis results. Additionally, the author's knowledge of resilience influenced the ideas that were identified from the interviews. The study could have further depth if experts in ecology, urban systems, or Kansas City contributed to the analysis. In addition to experts, site access was another limitation. The author of this report lived in Manhattan, KS while conducting the analysis. This limited travel to Kansas City to three site visits. A lack of stakeholder engagement, a limited number of systems, a lack of expert opinion, and minimal site access limited the analysis results for Washington Square Park.

CONCLUSION

Chapter 8

This report explored the application of resilience to site analysis. Methods included a literature review, expert interviews, framework creation, and a case study. Findings from the literature review and expert interviews were synthesized to create a Resilience Analysis Framework. Last, the author applied the framework to a case study. This report's primary finding is a framework for resilience analysis. The framework identifies the state of systems, analyzes factors determining resilience, establishes future goals, synthesizes findings, and prioritizes systems. The end result of the framework is the identification of focal systems and strategies for resilient design/planning. Findings derived from execution of the framework provide evidence to inform decisions during the site design and strategic planning phases.

Literature Review

The literature review established the value of resilience because it addresses the four dilemmas: climate change, a combination of ideas from design and ecology, a comprehensive approach, and sustainability. Climate change impacts environments on a global and local scale. Ecological theory is valuable because it helps designers understand system behavior. A comprehensive approach is needed to address all types of problems at of any scale. Sustainability has been misused and has lost meaning due to its incorrect application. There are five tenets of resilience theory that address the four dilemmas. The five tenets are: embracing change, panarchy, an applicable approach, basin of attraction, and the adaptive cycle. Embracing change accepts the fact that systems are going to change through an adaptive approach. Panarchy considers all scales of systems and the interaction between systems (Gunderson and Holling 2002). Resilience is applicable to all scales and types of projects. Basin of attraction is a concept that helps designers understand the behavior of systems. Last, the adaptive cycle describes the phases of systems providing insight into system change. The five tenets address the four problems by describing how designers can address systems' behavior.

Additionally, the literature review found site analysis is essential to informed design decisions. A site analysis builds information to help designers address critical issues. The growing importance of evidence based design in landscape architecture supports the importance of site analysis (Kopec et al. 2011). *Resilience Practice* by Brian Walker and David Salt and *Assessing Resilience: A Workbook for Practitioners* by the Resilience Alliance are approaches to site analysis using resilience theory. They are inadequate approaches because they lack methods for analysis, a prioritization process, and a strategy for synthesizing information to see the bigger picture. Additionally, *Resilience Practice* and *Assessing Resilience* are difficult to use because their step-by-step approach conflicts with the nature of the design process. The value of site analysis coupled with the existing inadequate approaches to analyzing resilience created the need for an approach to resilience analysis.

Another finding from the literature review was a lack of a resilient design/planning process. The goal of this report's framework was to create a resilience based process for the site analysis phase of the design process. To inform the organization of this report's framework, the author modified the Ecological Planning Model by Frederick Steiner. The Ecological Planning Model is an approach to the design/planning process using ecological theory. It outlines eleven steps to the planning process. For the purpose of this report the eleven steps were synthesized into six parts to create the organization for the Resilience Analysis Framework.

Expert Interviews

Eight interviews with professionals working on the Rebuild by Design competition grounded this report in practice. The Rebuild by Design competition was the selection criteria for interviewees because the main goal of the competition is to create solutions for increasing the resilience of the hurricane

Sandy affected region. This report analyzed the interviews in three ways: Categorization of Ideas, Resilience Definition Comparison, and Importance of Ideas. The Categorization divided the ideas mentioned during the interviews into the categories: analysis methods, resilience concepts, and resilience in practice. Analysis methods are techniques for conducting resilience analysis. Resilience concepts provide ideas on the theory of resilience. Resilience in practice identifies tips for applying resilience to professional practice.

The author used two approaches to the Resilience Definition Comparison analysis. First, the definition of resilience derived from the interviewees was compared to the definition found in the literature review. Second, the connections between the individual definitions of resilience were extracted from each interviewee. The interview-literature definition comparison revealed the interviewees discussed a majority of the ideas from the literature review. Ideas found in the literature that were not discussed during the interviews were: the stages of the adaptive cycle, basins of attraction, systems are self-organizing, openness and total capital are properties of general resilience, and interacting thresholds is a property of specific resilience.

The interviews identified ideas not found in the literature review. These ideas are: vulnerability and "resilience starts with people". Interviewees identified vulnerability as the opposite of resilience. "Resilience starts with people" describes the importance of social resilience. High social resilience increases the resilience of other systems because people will facilitate adapting to change (Interviewees 2014). The comparison of the interviewees' definitions to each other revealed a diversity of resilience definitions. Each team defined resilience in a different manner because HUD allowed teams to create their own definitions (Interviewees 2014). Different interpretations of resilience resulted in varied approaches to analyzing and creating resilience.

The Importance of Ideas analysis assessed the number of interviewees that mentioned an idea, the number of times an idea was mentioned, and the average emphasis. The author tallied the number of interviewees that mentioned an idea. Then, the total number of times an idea was mentioned was tallied. Last, the author determined the average emphasis of an idea by considering tone of voice, words of emphasis (very), and stated importance.

Synthesizing findings from all three Importance of Ideas considerations analyses revealed the overall most important ideas. Community engagement was mentioned and emphasized more than any other idea. Interviewees identified community engagement as the most important method and a crucial element of the competition process (Interviewees 2014). Determining vulnerabilities and multi-disciplinary teams were the next two important ideas. Identifying vulnerabilities provided focus to the competition and indicated the main problems the teams needed to address. The problems Sandy revealed were too complex for any single expert to address. Teams including architects, landscape architects, engineers, and ecologists were reported to be necessary by the interviewees in order to understand the systems' behavior.

The Rebuild by Design competition also provided insight on changes in the profession. Addressing resilience resulted in teams engaging in the design of non-material systems. Several teams planned to create organizations for administration of resilience projects. The organizations would facilitate collaboration between numerous governance bodies to implement projects that cross jurisdictional boundaries. This means some of the teams in the RBD competition are creating the organizations that would hire a firm to design a project.

The author of this report synthesized findings from the interviews into the Resilience Analysis Framework. Findings that were incorporated into framework include: analyze trends, a cost/benefit analysis, community engagement, and the impossibility of addressing all problems. The interviews revealed the importance of analyzing trends. Addressing trends allows designers to influence future change to a system. A cost/benefit analysis is crucial to implementation of a project. It communicates the value of investing in the proposed project to the stakeholders. Community engagement was the most important method during the research and analysis phase of the competition. Teams engaged the community throughout the process. The last idea from the interviews incorporated into the framework is the impossibility of addressing all problems. Hurricane Sandy revealed numerous challenges that forced the teams to prioritize what is realistic to address.

Resilience Analysis Framework

This report's primary finding is a framework for analyzing resilience. Designers can use the framework to create evidence for resilient design decisions. Following the spiraling nature of the design process, the author designed a framework to be an iterative approach to resilience analysis. The framework is valuable as a tool for analyzing systems, establishing goals, prioritizing, and synthesizing findings.

There are five main parts to the framework. The parts are Stakeholder Engagement, System Description & Goal Establishment, System Analysis, System Report, and Prioritization. Integrated throughout the resilience analysis process is Stakeholder Engagement. Possible interactions with stakeholders include: education, data collection, reporting, and feedback. System Description & Goal Establishment analyzes the core properties of a system, both their current condition and the future vision. System Analysis is an in depth evaluation of the factors determining a system's resilience. The System Analysis part identifies current trends and desired change. System Reports synthesize the important information from the System Description & Goal Establishment and System Analysis parts. The main goal of the Systems Report is to assemble all the important information about a system into one place. Prioritization determines a priority level for each system. The purpose of Prioritization is to identify the systems for the focus of design and planning efforts. The results of the Prioritization and System Report parts inform the next phase of the design process: strategic planning, site design, & implementation.

The framework does not limit application methods. Methods for resilience analysis include focus groups, social media, forums, workshops, interviews, meetings, modeling, mapping, direct observation, and photography. The framework excludes a specific application method. For example, designers could apply the framework in the form of a matrix or checklist. Allowing flexibility in application allows the framework to be applied to any project and utilized by any designer (if they understand resilience theory).

Washington Square Park

The Washington Square Park case study provides an application of the Resilience Analysis Framework. The author analyzed Washington Square Park under the scenario of a professional hired to redesign the park. Application of the framework to a site scale was valuable because it provided an understanding of the analysis, goals, and prioritization of systems. The author used matrices to organize the framework's analysis. Analysis considerations were listed along the x axis. The author placed the list of systems on the y axis. Each cell contained a brief summary of the analysis findings. The cells were then color coded to indicate the level of resilience (System Description & Goal Establishment and System Analysis analyses) or priority (Prioritization analysis). A review of the color coded matrices for the System Description & Goal Establishment analysis provided a quick identification of the variance in resilience between the current state and future vision based on color coding. The System Analysis matrices identified which systems had the highest and lowest resilience. Synthesizing the System Description & Goal Establishment and System Analysis into a report increased the author's understanding of the systems. Prioritization identified the systems to focus on during the site design phase (not in the scope of this report).

Findings from the framework application include a categorization of resilience analysis

This report's goal is to provide a starting point for the development of a Resilient Design/Planning Model (similar to the Ecological Planning Model by Frederick Steiner) that incorporates every stage of the design/planning process.

and a prioritization. The System Report synthesis revealed there are four categories for the analysis of systems' resilience. The categories are: High Resilience & Change, High Vulnerability & Preserve, Moderate Resilience & Change, and Other Considerations. Systems in the High Resilience & Change category include: events, vehicular transit, views on approach, and sun/shade. High Vulnerability & Change systems are: activity nodes within WSP and stormwater management. Moderate change includes: views from the park, public transit, pedestrian transit, and bike transit. Other Considerations are: parcel ownership, activity nodes within a 5 minute walking distance, the number of households, and the city stormwater system. The Prioritization analysis designated the systems' priority level. A system with a high priority indicates a system of focus for the design of WSP. Systems with a high priority include: activity nodes within WSP, views from the park, sun/shade, and stormwater management.

Future Research

A topic this report did not address is transformability (the ease or difficulty of transforming a system from one state to another) (Walker and Salt 2012). This report omits transformability because the literature does not provide an approach to transformability analysis. Transformability is an important part of understanding the feasibility of goals for future system states. Further research on analyzing transformability would increase designers understanding of system behavior. In addition to transformability, this report omitted phases for the strategic planning, site design, and implementation phases of the design process. The author excluded these phases because this report focused on site analysis. This report's goal is to provide a starting point for the development of a Resilient Design/Planning Model (like the Ecological Planning Model by Frederick Steiner) that incorporates every stage of the design process.

In addition to development of a Resilient Design/Planning Model, another area of future research is testing the success of resilience. The Rebuild by Design and For A Resilient Rockaway competitions are some of the earliest resilience projects. As resilience projects are built, there is an opportunity for analyzing the value of resilience thinking. Evaluating resilience projects also allows for refinement of the theory through monitoring projects and analyzing their success.

Resilience by Design

A concern for the future of resilience theory is the potential for "resilience washing." Without a proper understanding of the theory, designers may use the term incorrectly. The incorrect use of resilience would result remove all meaning from the word, similar to what has happened to the word sustainability. To prevent "resilience washing," ideas and terms from resilience theory need to become common knowledge in the environmental design professions. Additionally, strategies for application are essential to the proper use of resilience. This report aids in the effort to create application strategies by creating a framework for applying resilience theory to site analysis. The spread of resilience ideas and application strategies can help create world where people thrive by adapting to the changing environment.

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GLOSSARY

Appendix A

Adaptability – "The capacity of actors (people) in a system 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).

Adaptive Cycle – "A way of describing the progression of social-ecological system 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).

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

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).

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

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).

“The new r phase may be very similar to the previous r phase or may be fundamentally different. The r to K transition is referred to as the fore loop, and the release and reorganization phases are referred to as the back loop. Though most systems commonly move through this sequence of the phases, there are other possible transitions” (Walker and Salt 2012).

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 2013).

Disturbance - “actual change (of a system) is triggered by agents of disturbance, such as wind, fire, disease, insect outbreak, and drought” (Holling 2001).

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).

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).

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).

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).

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).

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).

Panarchy - "the term we use 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).

Redundancy - "Systems designed with multiple nodes to ensure that failure of one component does not cause the entire system to fail" (Fleischhauer).

Regime - (see basin of attraction) "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 2012).

Regime shift - "When a social-ecological system crosses a threshold into an alternate regime of that system" (Walker and Salt 2012).

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).

Self-organizing - "The internal, interactive processes that determine the dynamics of a system, independently of any external influences. A system possessing these processes is a self-organizing system" (B. H. Walker and Salt 2012).

Social-Ecological System - "Linked systems of people and nature" (Holling 2001).

"1. A social-ecological system is one integrated system that spans matter, life, and human social and cultural phenomena (or mind).
2. A social-ecological system consists of relationships between elements at a number of scales and within nested systems.
3. SESs are systems that are complex and adaptive, with properties of self-organization and emergence.
4. What differentiates SESs from other systems is the introduction of abstract thought and symbolic construction" (Du Plessis 2008).

State of a system - (see basin of attraction) "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).

Sustainability - "requires both change and persistence" (Holling 2001).

"Sustainability is the capacity to create, test, and maintain adaptive capability. Development is the process of creating, testing, and maintaining opportunity. The phrase that combines the two, "sustainable development," therefore refers to the goal of fostering adaptive capabilities while simultaneously creating opportunities. It is therefore not an oxymoron but a term that describes a logical partnership" (Holling 2001).

Stakeholder - "Any individual or organization that can affect or be affected by the management of the resources affected" (L. Gunderson et al. 2010).

Thresholds - “A point at which a system crosses over into another attraction basin” (Cunningham 2013). “Once a threshold has been crossed it is usually difficult (in some cases impossible) to cross back” (Walker and Salt 2006).

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)

SYSTEM REPORTS

Appendix B

The following pages contain the system reports from the Washington Square Park analysis. The system reports synthesize findings from the System Description & Goal Establishment and System Analysis parts of the Resilience Analysis Framework. Each report identifies the important findings and provides sources for the findings. There is a total of fourteen system reports.

System Report 1

Study Area: Washington Square Park

System: Parcel Ownership

Scale: Properties adjacent to WSP

- State currently a mix of private and public owners
- Main concern is the selling of the lot to the north of the park, potential for development

Figure B.1. Parcel Ownership (KCDC 2014)

System Report 2

Study Area: Washington Square Park

System: Events

Scale: Within or adjacent to WSP

- State: currently resilient, over 7 events annually
- Current conditions: diversity and redundancy to the events
- Goals: increase diversity and redundancy by drawing more to WSP by accommodating needs, space for tents, food trucks, etc
- Disturbance: Inclement weather on event days a disturbance

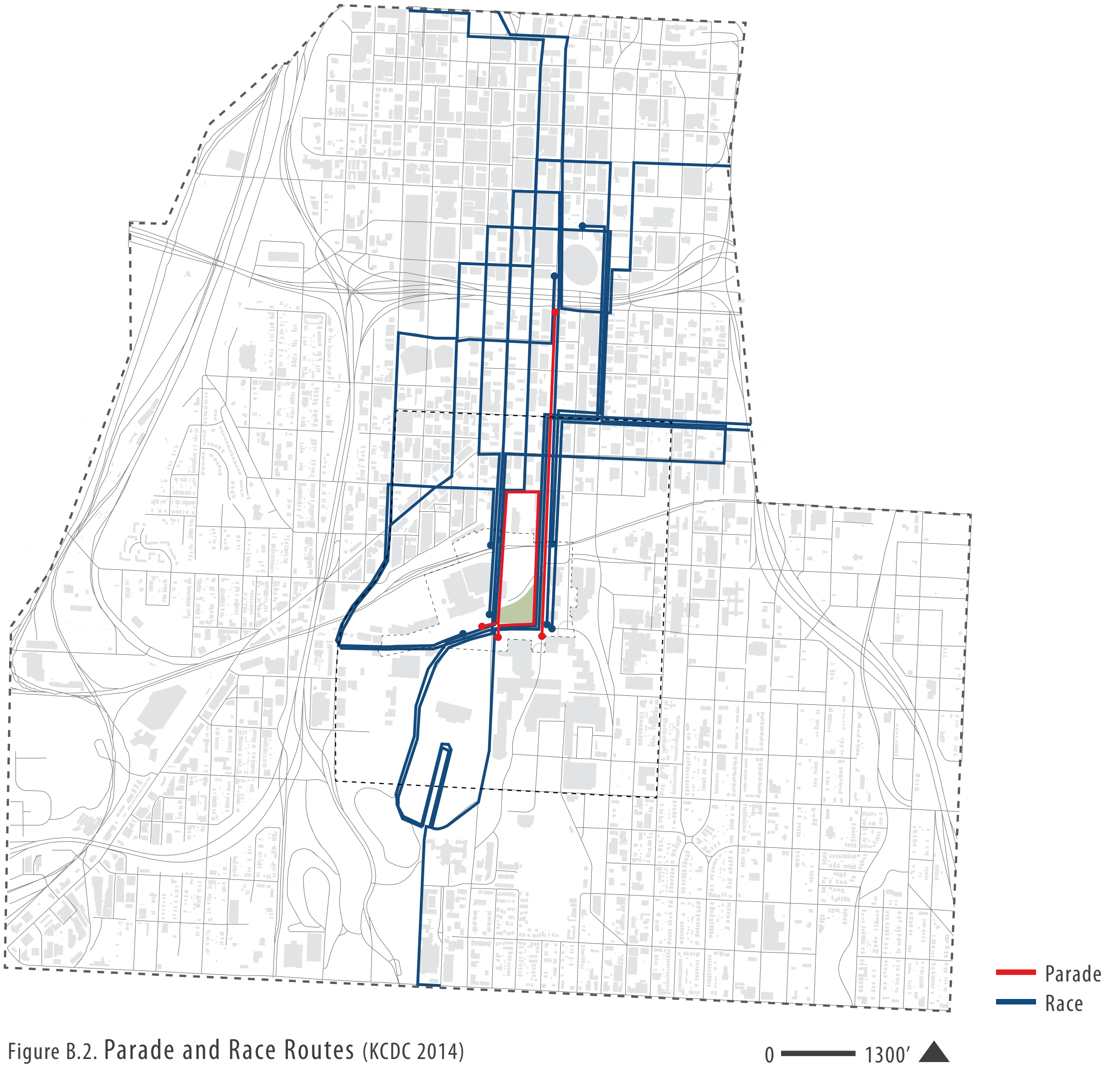


Figure B.2. Parade and Race Routes (KCDC 2014)

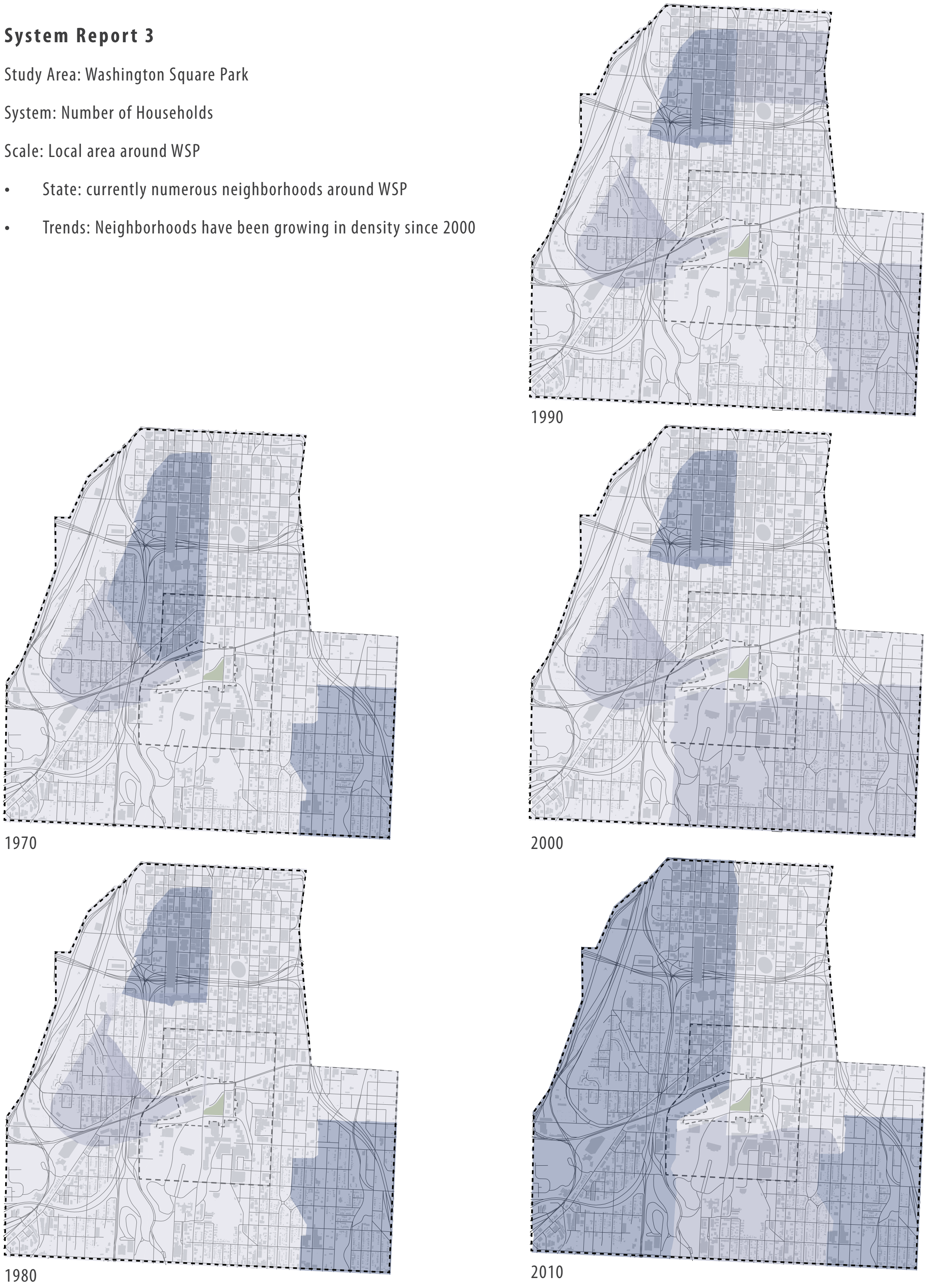
System Report 3

Study Area: Washington Square Park

System: Number of Households

Scale: Local area around WSP

- State: currently numerous neighborhoods around WSP
- Trends: Neighborhoods have been growing in density since 2000



1990

1970

2000

1980

2010

Figure B.3. Number of Households: 1970, 1980, 1990, 2000, 2010 (KCDC 2014)

0 — 1300′ ▲

▨ 0-500
▨ 501-1000
▨ 1001-2000

System Report 4

Study Area: Washington Square Park

System: Activity Nodes

Scale: 50 years, inside WSP boundary

- State: currently lacks any destination or draw factor
- Trends: main dilemma is lack of diversity and redundancy of activity nodes in WSP
- Goal: make WSP a destination to greatly increase resilience

Figure B.4. Site Plan (KCDC 2014)

System Report 5

Study Area: Washington Square Park

System: Activity Nodes

Scale: 50 years, walking distance to WSP

- State: currently resilient: a mix of nodes including hotels, businesses, and transit, services residents, visitors, and businesses
- Trends: has potential to increase use as surrounding neighborhoods grow, currently diverse, redundant, open, and has tight feedbacks
- Goal: opportunity to draw people from surrounding nodes to WSP

Figure B.5. Residential Activity Nodes (KCDC 2014)

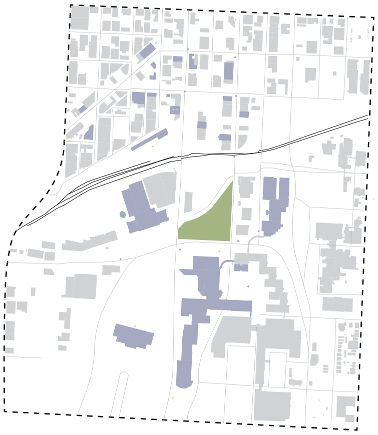


Figure B.6. Visitor Activity Nodes (KCDC 2014)

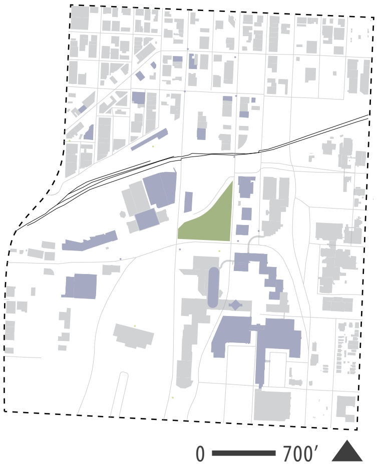


Figure B.7. Business Activity Nodes (KCDC 2014)

System Report 6

Study Area: Washington Square Park

System: Public Transit

Scale: Local to metro

- State: currently transitioning from bus only to bus and streetcar
- Trends: system is growing and gaining users and network connection, critical connection nodes surround WSP
- Goal: Create a strong connection to bus and streetcar stop to bring users to the site

Other Sources

- Streetcar Causing Invenstment: http://www.smartgrowthamerica.org/2013/11/14/more-than-a-year-from-operation-kansas-citys-streetcar-is-already-driving-investment-downtown/
- Bus Ridership: http://www.transitworksforus.org/transit-ridership-up-in-kansas-city-and-across-nation/

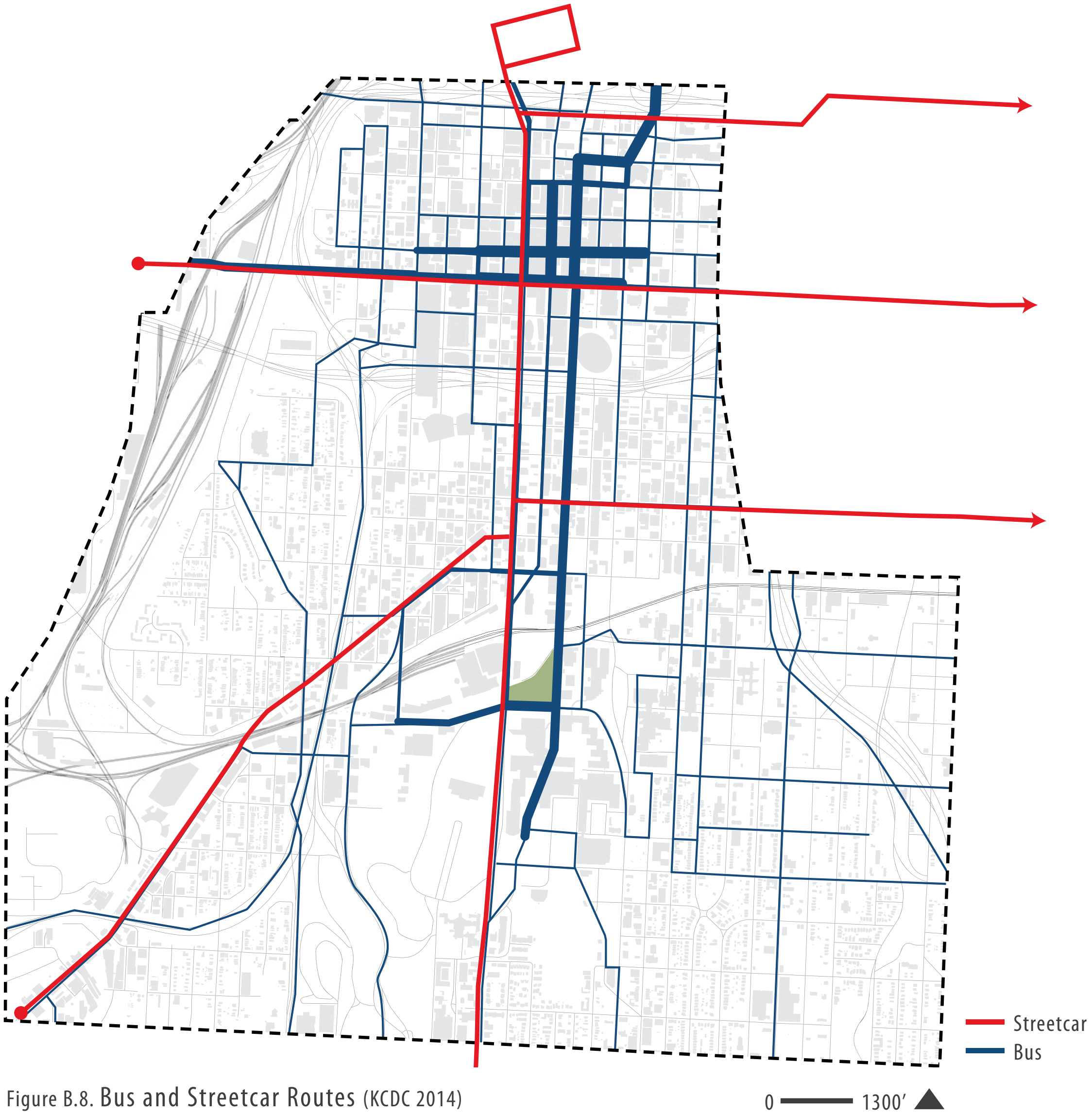


Figure B.8. Bus and Streetcar Routes (KCDC 2014)

System Report 7

Study Area: Washington Square Park

System: Vehicular Transit

Scale: Local, metro, and regional

- State: resilient, lots of connections to surrounding and regional area
- Trends: primary mode of transit for the KC region, potential to decrease as other transit forms increase in use
- Goal: extremely important for short term success of the park, establish connections to vehicular transit

Figure B.9. Adjacent Vehicular Traffic (KCDC 2014)

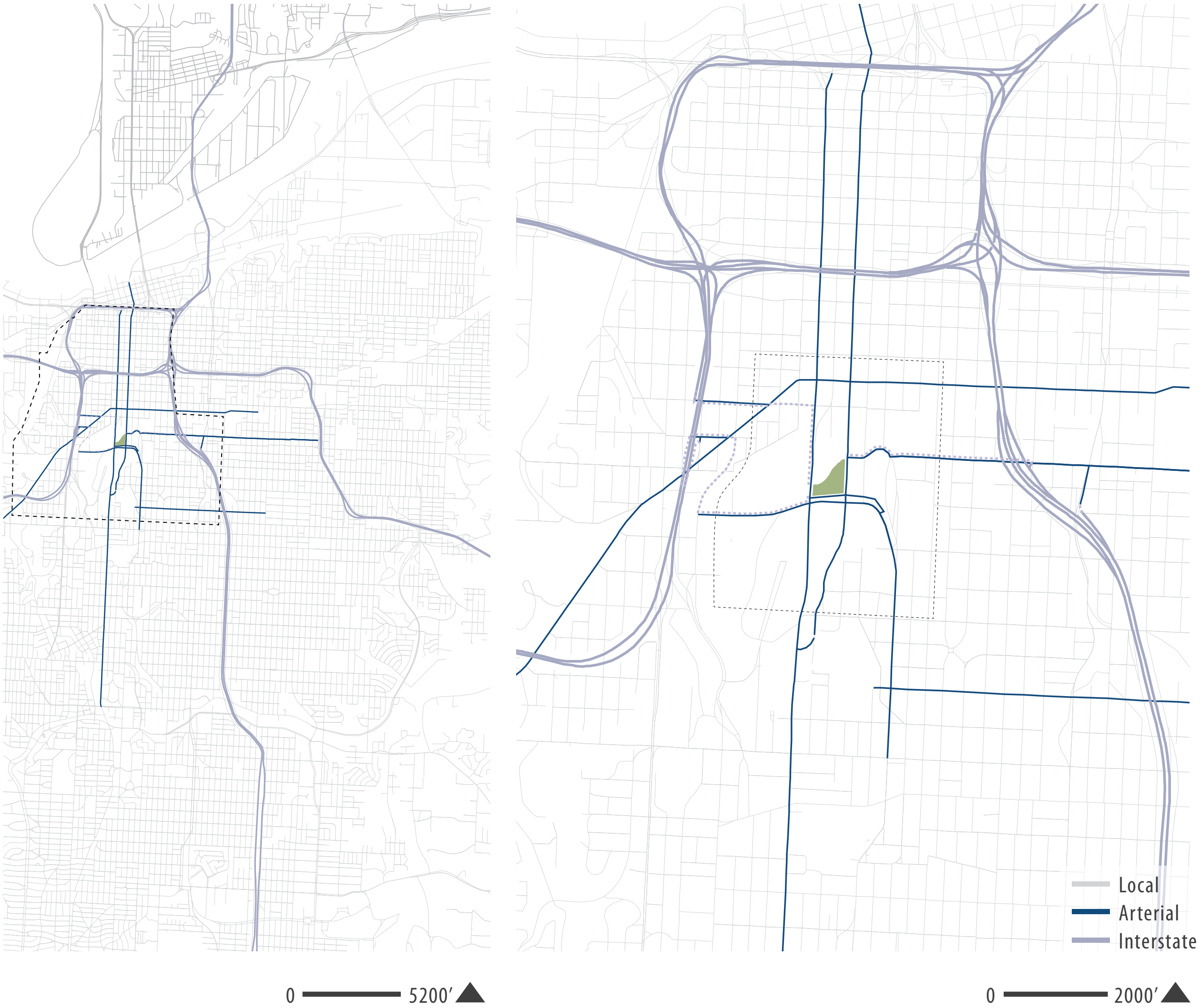


Figure B.10. Vehicular Connections: Regional and Local (KCDC 2014)

System Report 8

Study Area: Washington Square Park

System: Pedestrian Transit

Scale: Local

- State: Moderate pedestrian traffic along Main St. and Grand Blvd.
- Goal: pedestrian routes through the park would increase the resilience of the site, strong connection to street sidewalk to encourage entering the park
- Trend: possible increase as neighborhoods around WSP continue to grow and public transit ridership increases

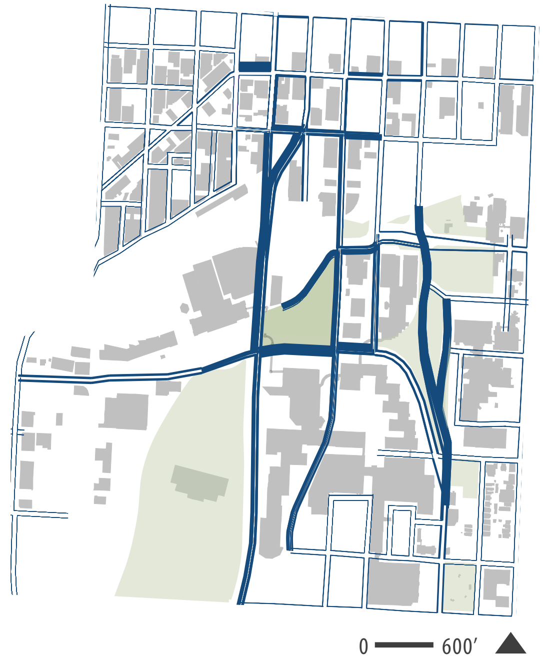


Figure B.11. Pedestrian Traffic Count (KCDC 2014)

Other Sources

- Pedestrian and Bike Benefit from Streetcar: http://bikewalkkc.org/streetcar
- Bike Walk KC: http://bikewalkkc.org/
- Bike Share Program: https://kansascity.bcycle.com/
- BikeKC Public Works: http://kcmo.gov/publicworks/bikekc/

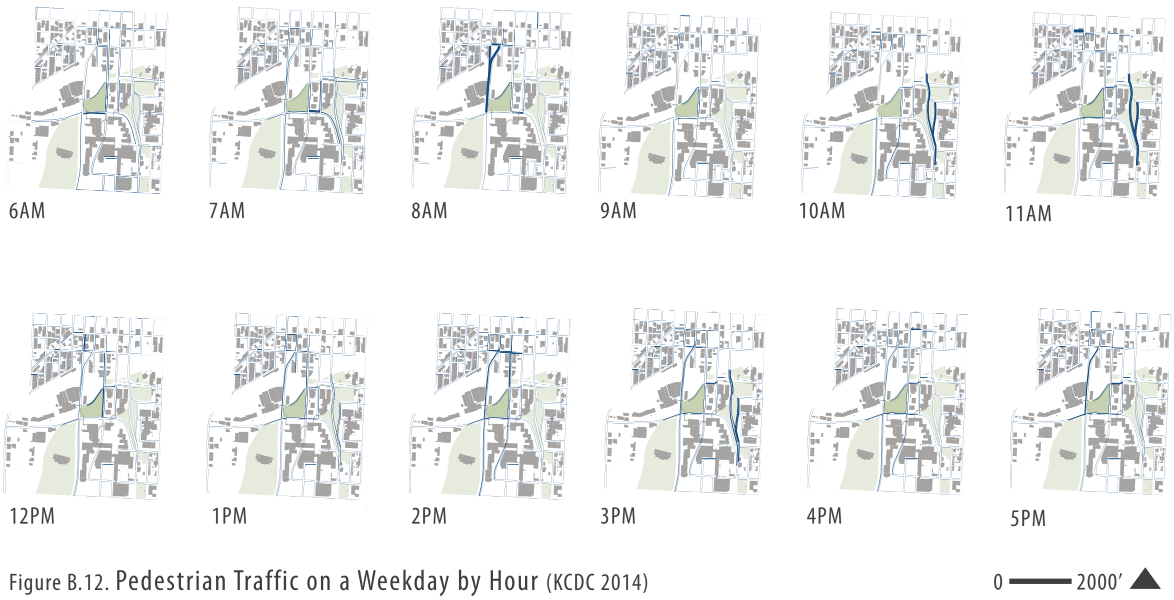


Figure B.12. Pedestrian Traffic on a Weekday by Hour (KCDC 2014)

System Report 9

Study Area: Washington Square Park

System: Bike Transit

Scale: Local

- State: Main bike routes are shared lanes in the street, within the park few amenities
- Trends: growing bike culture in KC, Bike Share program
- Goal: provision of amenities (racks, repair station) within WSP to allow people to bike to the park

Other Sources

- Pedestrian and Bike Benefit from Streetcar: http://bikewalkkc.org/streetcar
- Bike Walk KC: http://bikewalkkc.org/
- Bike Share Program: https://kansascity.bcycle.com/
- BikeKC Public Works: http://kcmo.gov/publicworks/bikekc/

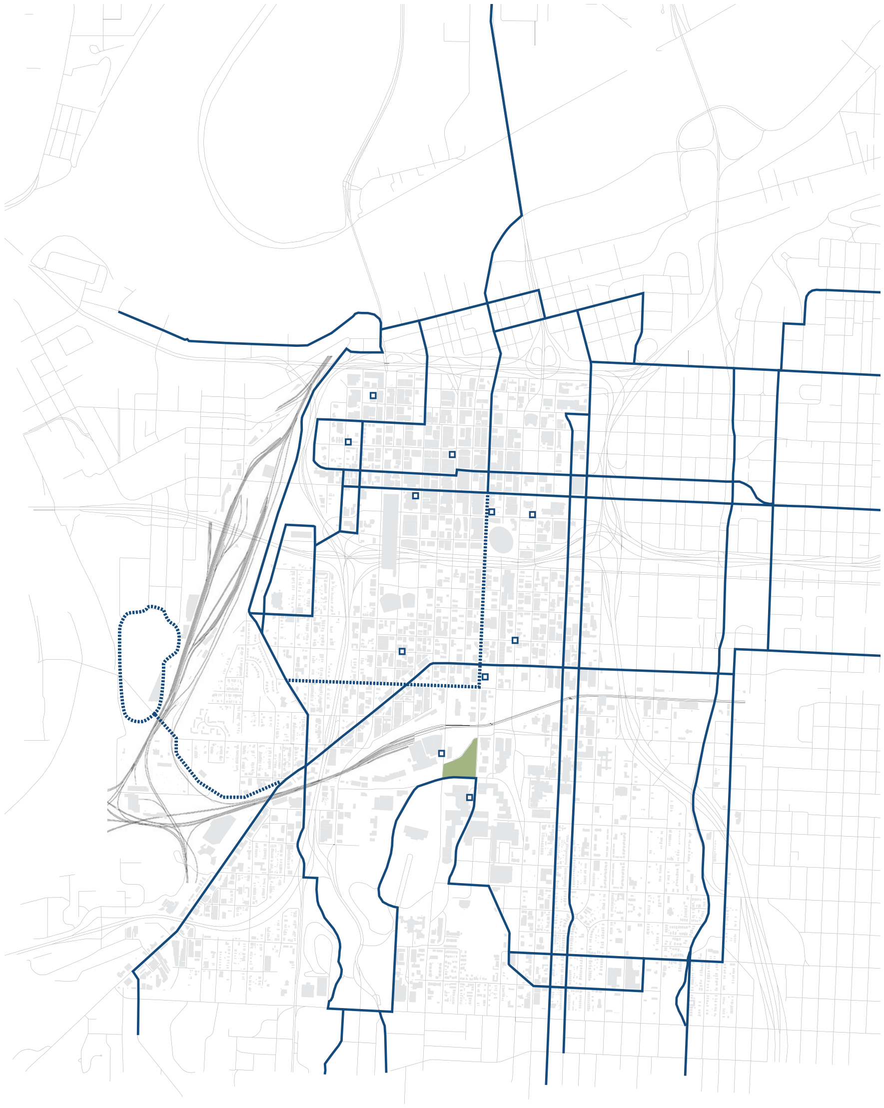


Figure B.13. Bike Routes (KCDC 2014)

System Report 10

Study Area: Washington Square Park

System: Views

Scale: Within WSP looking out

- State: currently moderately resilient with views to a city skyline, surrounding streets and buildings
- Vulnerabilities: the link blocks views to Central Station, possible disturbance of view to city skyline if a building is constructed north of WSP
- Goal: prevent construction of a building north of WSP, remove link to provide visual access to Central Station

Figure B.18. View to Union Station Blocked (KCDC 2014)

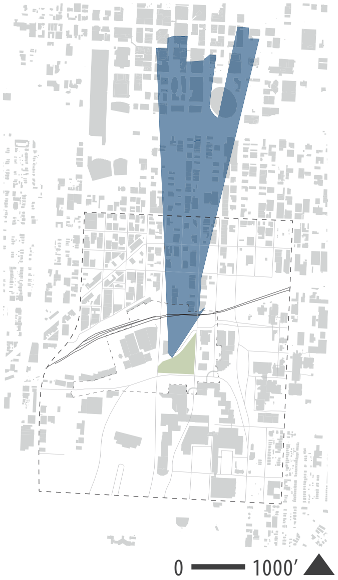


Figure B.15. View 1 to City Map (KCDC 2014)

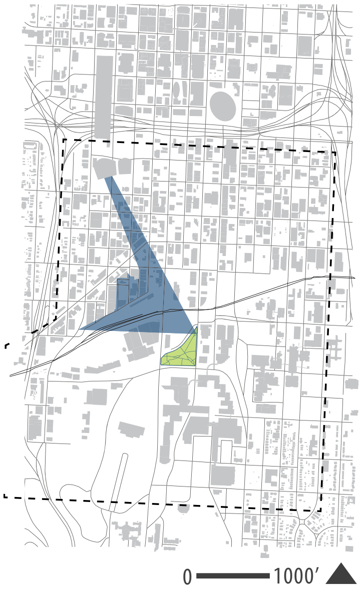


Figure B.16. View 2 to City Map (KCDC 2014)

Figure B.14. View 1 to City (KCDC 2014)

Figure B.17. View 2 to City (KCDC 2014)

System Report 11

Study Area: Washington Square Park

System: Views

Scale: On approach to WSP

- State: moderately resilient, 3/4 corners have views into WSP
- Vulnerabilities: the link blocks views into WSP, possible disturbance of view into WSP if a building is constructed north of WSP
- Goal: prevent construction of a builidng north of WSP, remove link to provide visual access into WSP

Figure B.19. View into WSP Blocked (KCDC 2014)

Figure B.20. Main St. Approach (KCDC 2014)

Figure B.21. Grand Blvd. Approach (KCDC 2014)

System Report 12

Study Area: Washington Square Park

System: Sun/Shade

- State: resilient, sun during the day for most of the year, trees scatted across site provide shade opportunities
- Goals: increase resilience through utilizing mature trees in park and supplementing with shade structures
- Sub-Goals: have diverse and redudandant shading in spaces to account for all weather conditions
- Minimal disturbance threat, it is unlikely a new building will be constructed that changes sun conditions

Figure B.24. Tree Canopy (KCDC 2014)

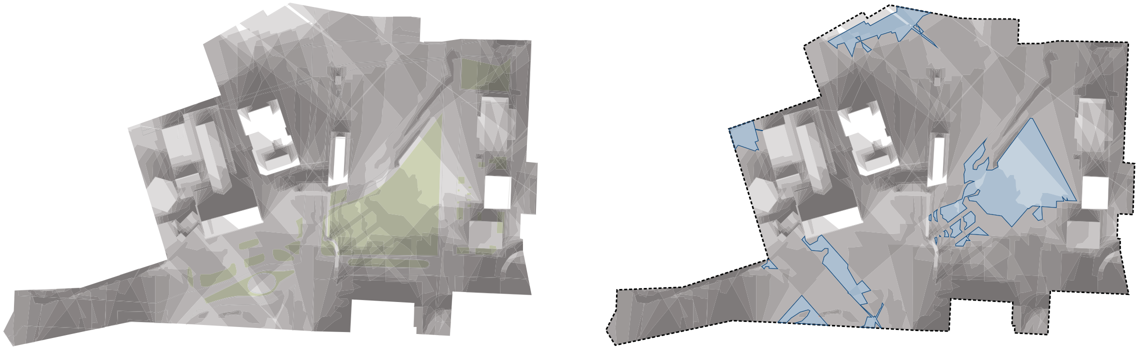


Figure B.22. Winter Shade: Total Overlay and Areas with Less Than Two Hours of Shade (KCDC 2014)

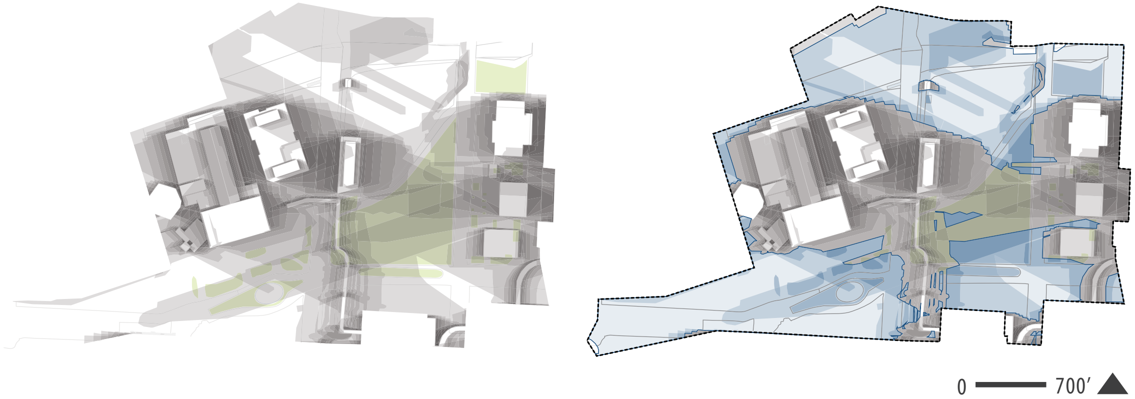


Figure B.23. Summer Shade: Total Overlay and Areas with Less Than Two Hours of Shade (KCDC 2014)

System Report 13

Study Area: Washington Square Park

System: Stormwater

- State: currently vulnerable: reliant on city's systems and there is localized flooding due to poor drainage
- Trends: lack of diversity, redundancy, tight feedbacks,
- Goals: Desire for on site processing of stormwater
- Disturbance/threshold: 6.38" is most rainfall in one day, storm in 2007
- Needs: Increased diversity, redundancy, openness, tighter feedbacks

Other Sources

- Highest Single Day Rainfall: http://average-rainfall.weatherdb.com/l/13311/Kansas-City-Kansas

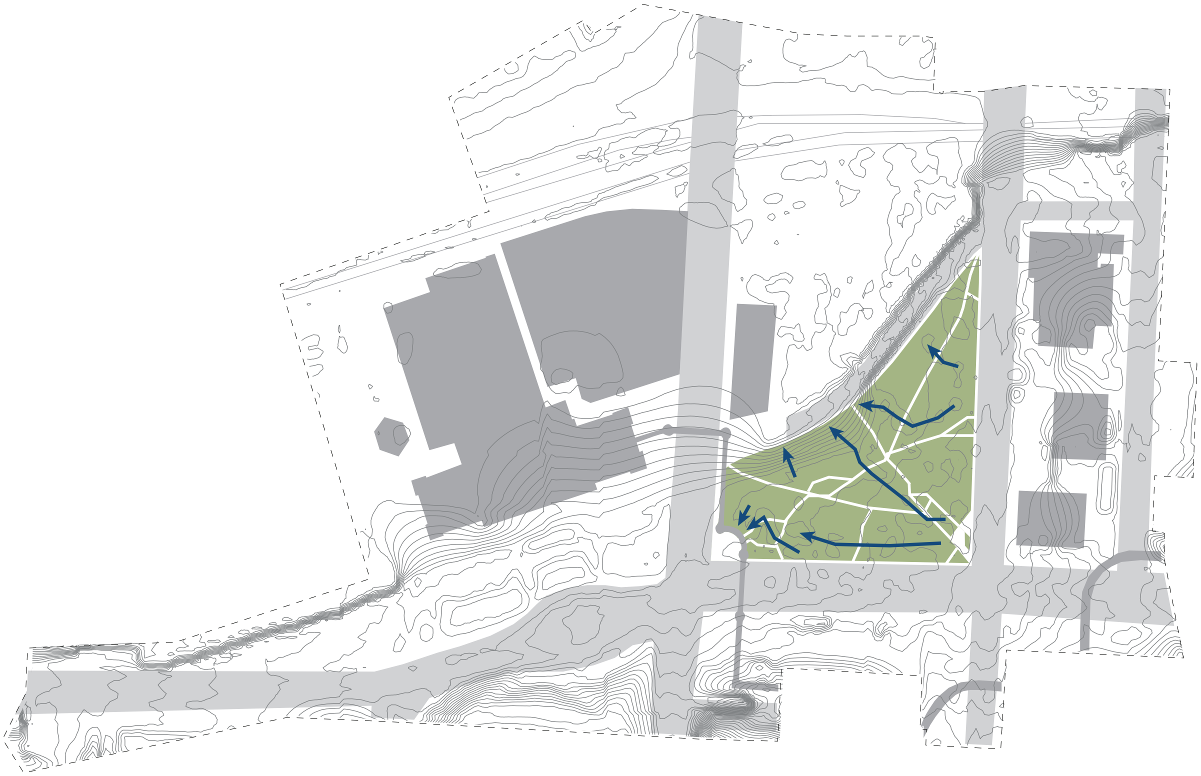


Figure B.25. Topography and Drainage (KCDC 2014)

System Report 14

Study Area: Washington Square Park

System: City Stormwater System

Scale: Kansas City

- State: currently in a combined sewer/stormwater system with frequent overflow to nearby rivers
- Trends: in process of updating, EPA requiring KC to fix current problems
- Goals: WSP has potential to aid in the process, reducing water from this site added to system during a storms

Other Sources

- Highest Single Day Rainfall: http://average-rainfall.weatherdb.com/l/13311/Kansas-City-Kansas
- KC Sewer Overflow: http://www.kcmo.org/idc/groups/water/documents/ckcmowebassets/plan_overview.pdf