Walking, Transit Use, and
Urban Morphology in Walkable Urban Neighborhoods:
An Examination of Behaviors and
Attitudes in Seattle

by

Devon Scott McAslan

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Doctoral Committee:

Associate Professor Scott D. Campbell, Chair
Professor Robert L. Fishman
Professor Linda N. Groat
Assistant Professor Ana Paula Pimentel Walker

Devon Scott McAslan

dmcaslan@umich.edu

ORCID iD: 0000-0003-4333-3991

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Abstract

Creating walkable and transit oriented cities is an important planning objective. Cities are actively promoting walkability and are investing billions of dollars in public transit in an effort to reduce automobile dependence. This dissertation investigates the relationship between transit use and walking in walkable urban neighborhoods – neighborhoods that are dense; have mixed land uses; connected street networks; numerous destinations; and high transit accessibility. This research examines the different purposes that walking and transit serve in different parts of the city. I focus on walkable urban neighborhoods to push walkability research beyond its current emphasis on identifying the characteristics of walkable environments compared to less walkable neighborhoods. I instead examine how walkability varies in highly walkable places that are outwardly more similar than not.

I use a nested case study research design with mixed methods. Seattle and its urban core neighborhoods serve as my cases. Neighborhood mapping, pedestrian observations, a travel behavior survey, and interviews provide both quantitative and qualitative data to answer my research questions. The project emphasizes the role that different types of infrastructure play in facilitating walking and transit use: pedestrian-oriented infrastructure, transit infrastructure, and automobile infrastructure. The emphasis on infrastructure helps to bridge the gap between urban planning and urban design research and more accurately reflects the way that urban residents experience and talk about the urban environment.

The urban core of Seattle is a predominantly pedestrian environment, and there is significant variation in the levels of walking between the seven neighborhoods studied. Neighborhoods with more pedestrian infrastructure and less automobile infrastructure have higher levels of walking. Similar patterns are evident at the block scale, where pedestrian infrastructure positively influences walking and more automobile infrastructure correlates to less walking. The availability of transit positively correlates with higher walking activity. Higher

quality transit, such as light rail (rather than bus), encourages people to walk greater distances to use transit. Additionally, even though there is frequent and abundant transit in the urban core, a majority of people walk to destinations within the urban core because walking is often the most efficient mode of transportation available. Next to walking, driving is the second most common mode of transportation among residents in the urban core.

These findings contradict mainstream planning conceptions of transportation and urban form. We would expect transit to be a heavily utilized mode of transportation in the urban core, but walking and driving are the most common. Outside the urban core, driving is most common, despite frequent transit service throughout Seattle. This is because the transit that exists primarily serves commuting to Downtown. The findings of this dissertation suggest that planners need a new approach to transportation planning that prioritizes walking and transit at different geographic scales throughout the city based on where they are the most efficient. The urban core neighborhoods need to prioritize walking. Instead, the city over-emphasizes transit and continues to accommodate the automobile in the urban core. Planners over-emphasize transit in both the urban core and in suburban and rural areas and not in the places where transit is most effective – in the area up to 12.5 miles away from the urban center. Planners can create sustainable and livable cities by rebuilding a vibrant pedestrian realm and by connecting neighborhoods with efficient and reliable transit, which meets the needs of all people.

Chapter 1

Introduction

The pedestrian and walking are vital components of urban life. They are important for the social, economic and environmental well-being of cities and their residents (Jacobs 1961; Mumford 1981; Whyte 2009; Speck 2012; Appleyard 1981). Until the 20th century, a majority of travel within cities was on foot. The street has traditionally been a place for commerce, socializing, recreation and transportation – a place as diverse as the city itself. A place where children, adults and elderly mix. A place where different social classes and cultures encounter each other on a daily basis. As Jane Jacobs said in *The Death and Life of Great American Cities* "the street and its sidewalks, the main public spaces of the city, are its most vital organs (Jacobs 1961, 29)."

The introduction of the automobile into urban life changed the way people interacted with the city and with each other. Increasing regulation of the street in the late nineteenth century and throughout the twentieth century resulted in urban forms that promoted the segregation of street users from one another (Southworth and Ben-Joseph 2003). At first, these regulations aimed to protect people from the automobile. As the modernist school of thought became prominent, regulations increasingly provided a way to facilitate a transition to an efficient street network for the automobile, which the modernists regarded as a cornerstone of the modern city.

This automobile centered transportation system still dominates our cities today and ignores the fact that different modes of transportation are suitable in different parts of the city for different reasons. As early as 1958, Lewis Mumford recognized this tension between the automobile and city dwellers. He argued that the pedestrian was the most efficient and flexible mode of transportation within a city, but that mass transportation and automobile had their place (Mumford 1981). Mumford envisioned a transportation system in which the automobile was a small component and where the pedestrian had priority. Instead, urban transportation policy since the 1950s has placed the automobile first and as a result, an automobile centered urban landscape became dominant.

In the last couple of decades rising concern over automobile-dominated urban forms and automobile dependent cities and their negative aspects have given rise to a new vision for cities and for urban planning – one where the city is reshaped to put people first. Urban planners generally accept that excessive automobile use, automobile dependence and sprawling urban forms are detrimental to urban social life and damaging to the environment. The existing automobile-based transportation system in the US is responsible for a large percent of our greenhouse gas emissions, while sprawling urban development consumes farmland, wilderness and other ecologically important areas (P. Newman and Kenworthy 1999; Andres Duany, Plater-Zyberk, and Speck 2000; Rome 2001; Beatley 2004). As an alternative to automobile dominated urban forms, a sustainable urban form is one that prioritizes walking and non-motorized forms of transportation, mass transit, and compact and mixed use urban forms (UNCED 1992).

Since the 1990s, cities around the world have increasingly invested in providing alternatives to driving as a way to create more livable cities and to reduce the ecological footprint of the transportation sector. Many cities have expanded public bus systems and increased service, developed bus rapid transit, and constructed or expanded light rail and subway systems. Additionally, cities have developed bicycle and pedestrian plans, built networks of bike lanes, and improved pedestrian spaces. All of these investments work to achieve the goal of improving the urban environment for modes of transportation other than the automobile and providing urban residents more sustainable mobility options.

Alongside these investments, the concept of walkability – what social and environmental factors contribute to walking behavior – has become a central planning issue, both within academia and among professionals, and increasingly among urban residents. While urban planners have promoted walkable urban forms and new models of land use and transportation since the early 1990s, there is also now mounting evidence to suggest that a majority of the general public would prefer living in urban environments that are walkable and where driving is not a necessity (National Association of Realtors 2013). Additionally, millennials (people ages 18-35) prefer walking as a mode of transportation over driving (National Association of Realtors 2015). With this rising demand for walkable neighborhoods and a range of transit options, central city neighborhoods that many once considered on the decline are now a commodity, as evidenced by rapidly rising rents and construction booms in many cities. Metrics such as Walk Score, which allow current and future residents to consider how walkable a specific address is, or even a whole neighborhood, and to assess its transit options, reflect this growing demand for walkability and walkable urban environments. Metrics such as this serve as a sort of index of walkability based on a number of characteristics of the built environment that correlate with increased walking activity. These metrics also highlight the connection between walking and transit, which transportation planning practice often over-simplifies.

As cities plan new transit systems, build bicycle infrastructure and seek to improve the pedestrian environment, the automobile remains an ever-present reminder of the unbalanced nature of transportation planning. The development of multimodal transportation networks has become a primary goal of planners, which seeks to negotiate this unbalanced and automobile focused planning. This approach to multimodal planning has taken many shapes – from the installation of dedicated bus lanes, protected bike lanes, wider sidewalks, or grade separated light rail or modern streetcars. Urban planners apply these multimodal plans universally across an entire city or region with little consideration for how people in different types of communities and neighborhoods travel or the scale at which different modes of transportation are most efficient. This type of universal thinking is a holdover from the modernist automobile-centric planning era in which planners transformed, or attempted to transform, the city in order to achieve the singular task of incorporating the automobile into urban life. It is the contention of this research that planning practice, while accepting multimodality as a main principle of transportation planning, has failed to recognize that each mode of transportation is distinct or that each mode, whether walking, bicycling, bus, rail transit, or driving, has a specific purpose and works best in a specific type of urban environment.

While recent changes in practice are no doubt positive, do they go far enough to facilitate the use of sustainable modes of transportation? How do different modes of transportation relate to one another and how do people utilize them in their daily lives? Does multimodal transportation planning reflect this reality or is there a better approach to transportation planning that would yield greater results?

To address these questions, this project studies walking behavior in walkable urban neighborhoods of central Seattle. It necessarily touches upon issues of travel mode choice, focusing on why people walk and why they use transit. The project emphasizes the relationship between walking and transit use by exploring how both macro-scale and micro-scale neighborhood characteristics influence both walking and transit use. In urban planning literature, this relationship is often summed up as "every transit user is a pedestrian." However, this is tantamount to arguing that every tree is a plant and the inverse of such a statement is obviously not true, since not every plant is a tree. Likewise, not every pedestrian is a transit user, given the rise of commuter park-and-ride or bike-and-ride facilities. While it may seem absurd to have to make this statement, I believe it is an important point to make. In planners' preoccupation to get people out of their cars and using transit, often in the name of climate change, they have overlooked the most important and fundamentally human mode of transportation: walking.

As such, the main subject of this research is walking behavior. In discussions on sustainable transportation, planners often view walking, biking and transit use as a package deal and as a combined alternative to our automobile focused transportation systems. Researchers and practitioners should instead view each of these as distinct modes of travel, each with their own functions and purposes, and each with a range of possible interactions with any other mode of transportation. This dissertation highlights the link between two of these modes – transit and walking. There is no doubt that by default, every transit user is at some point in their journey a pedestrian, and this simple reality often leads to the argument that a more walkable urban environment will encourage more transit use. Instead of using this as a starting point, I reverse this assumption and start with neighborhoods that are highly walkable and then examine how the availability of different types of transit within each neighborhood affects walking. In doing so, I am able to highlight the differences between modes of transportation and the interplay between walking, transit and driving. Urban planning scholarship has progressed to the point where we know that a more compact urban environment results in more walking and transit use than sprawl, and it is time to refine our thinking about walkability and explore how walkable environments vary in terms of both walking and transit use.

Transit is no doubt a vital part of the modern metropolis and is a key component of a sustainable transportation system. The current framing of transit investment is to use transit as a way to get people out of their cars. However, I argue that a shift to thinking about transit as a way to link walkable neighborhoods, improve mobility and enhance the quality of urban life would go a long way to changing the way plan and build public transportation. There is little doubt that transit is both good for the environment and for people, and planners have been staunch advocates, but it is now in demand from the public in many communities. In November 2016, over $200 billion of transit investment was included in ballot initiatives in cities around the US (Schaper 2016), a majority of which passed. The largest of these proposals in Los Angeles ($120 billion) and Seattle ($52 billion) represent huge investments, most of it in rail transit. With these new rail systems likely to remain in service for the next century and beyond, it is vitally important that they be built in the most effective way they can that will help transform cities in more sustainable ways. This means recognizing that walkable urban forms are the cornerstone of a sustainable city and this is the main reason why walking is the focus of this research project. It also means building a transit system that is efficient, functional, and reliable and not building a transit system that attempts to duplicate and mirror automobile infrastructure, which all too often is what these new transit proposals do. Public transportation arose out of a need to expand the walkable area of a city, but this is not the purpose of transit today. Instead, planners expand transit in an effort to make people drive less – a fundamental shift that I argue is resulting in overall less effective public transport networks in US cities.

As cities develop new land use and transportation policies to move themselves in more sustainable directions, walking sometimes remains a missing component, although there are certainly many examples of innovative pedestrian planning schemes. The research in this dissertation comes out of an acknowledgement that urban designers and planners do not have as complete an understanding of walking behavior as they need to and rely on outdated studies that do not consider walking specifically within the context of planning for a sustainable and livable city. As a result, planners do not fully understand the range of reasons that people choose to walk and how different characteristics of the built environment influence walking and street life activities, which are important for creating both environmentally and socially sustainable places. As Manville (2017) suggests, land use and transportation planning and research focusses too much on the places where transportation does not occur. Instead, he proposes that transportation-based land uses need to be incorporated into transportation and land use planning (Manville 2017). In other words, he argues that planning should focus less on land use, density, and building typologies to influence travel and more on road use, parking policies, and traffic calming techniques. Towards this end, this dissertation not only emphasizes walking, but the design and use of streets within the broader context of urban planning.

Increasingly over the previous decade, the role and function of streets has been defined in new ways, many times in order to promote walking, cycling, and transit, as well as to address broader concerns over traffic and safety, and to provide new public spaces to attract new residents and investment in the built form of the city. Planners and residents alike no longer see streets as only a conduit for automobiles, but also as a public space – albeit a contested public space. The street is a fundamental component of the built environment and is the primary way in which people experience the city, whether walking, riding the bus or driving. As more people choose to live in walkable places, priorities have shifted to provide a better urban space to accommodate pedestrians and modes of travel other than driving. The practice of street reclaiming aims to do just this (European Commission 2009; Engwicht 1999; City Repair 2003). In many cities around the world, the practice of reclaiming streets for uses other than automobile traffic have been common since the 1960s, and is increasingly common in the US context. There are several distinct ways that cities implement the practice of street reclaiming, ranging from streetscape upgrades at the low end of the spectrum to completely car free pedestrian streets at the opposite extreme. In the US, the complete streets movement is one of the mainstream approaches towards this, which also promotes the development of multimodal streets and corridors (Schlossberg et al. 2013; McCann and Runne 2010; Smart Growth America 2015). As I will show throughout this dissertation, the physical design and configuration of the street is an important factor that determines how the street will function and how residents will utilize it regardless of its adjacent land uses, density or proximity to destinations.

This dissertation explores the relationship between walking and transit use, and through doing so, examines the broader roles of and relationships between all modes of transportation. The emphasis is on neighborhoods that are characteristically walkable by urban planning standards – they are dense, they have well connected street networks, they have a diversity of land uses, are in close proximity to destinations and are transit rich. Many studies include such neighborhoods alongside other less dense urban centers and suburban areas, but few studies examine at a finer grain the differences between walkable neighborhoods or how these differences and impact mobility and accessibility. Existing urban planning literature provides little in the way of understanding how walking varies between neighborhoods that are inherently walkable by planning definitions. This is an important dimension of walkability, which planners need in order to push the practice of building walkable neighborhoods and cities beyond what cities currently do. I offer a way of understanding variations between walkable urban environments by incorporating both urban planning and urban design approaches to studying walkability and the urban environment into a single study. While part of this dissertation emphasizes many of the more traditional urban planning traits of walkable neighborhoods, I also incorporate micro-scale infrastructure elements that comprise the street level experience of individuals and their effect on walkability. Throughout this project, I use the street and its physical characteristics as a way to understand walkability in a way that traditional urban planning scholarship is not able to do. Understanding walkability within the context of the street more directly reflects the way people interact with the city. Planners can understand variations in neighborhood walkability by looking beyond the traditional metrics of the compact city. Pedestrians are the cornerstone of a sustainable transportation system and this dissertation provides a possible approach to refining our understanding of walkable neighborhoods and offers a new way to promote walkability at the street, neighborhood, city and regional scales.

Structure of the Dissertation

In Chapter 2, I conduct a literature review of research regarding the street, sustainable urban form, and walkability, which is in two main parts. In the first part, I explore the relationship between the street, urban form and the rise of sustainability as a planning paradigm. This literature review explores how the modernist era started with an emphasis on planning for the protection of pedestrians, but ultimately resulted in an urban form based around the automobile. It explores the numerous concerns that began to arise out of an automobile dominated society that we created. I discuss sustainable development in terms of how it suggests the built environment should evolve to create urban forms that are less environmentally and socially harmful than automobile dominated landscapes. I explore how the street is a fundamental component of the built environment and discuss the numerous ways in which cities are exploring ways to transform their streets in order to promote sustainable modes of transportation and increased livability. In the second part of the literature, I discuss the rise of the concept of walkability and its emergence as a central planning issue and a subset of broader literature on how the built environment influences travel, which is among the most prolific threads in urban planning research. Walkability, however, is not always about travel, as I demonstrate through literature from public health and urban design. I explore walkability in three key ways – in its relationship to the built environment, the social dimensions of walkability, and the economic impacts of walkability. The multiple literatures examined here point to four weaknesses in existing research that this dissertation addresses in several ways.

In Chapter 3, I discuss the research design for this project. I detail the case study approach used in this project, which is a nested case study, and the criteria used in selecting the multiple layers of cases, from the city, to the neighborhoods, and the block scale. I examine the research questions in depth and the methods I use to answer my questions. As a preliminary summary, the project is a nested case study that uses mixed methods (Creswell 2009). I combine correlational strategies common to urban planning scholarship with qualitative and quantitative data from surveys and interviews with residents and workers in the compact walkable neighborhoods of the Seattle urban core. Combining these multiple approaches offers a more complete picture of walking and transit use (and driving) behavior in central urban neighborhoods from the perspective of the people to whom these issues really matter. This methodology aims to be relatable to mainstream urban planning and design literature, as well as contest the modernist paradigm still evident in planning.

In Chapter 4, I discuss the case study of Seattle. I provide a brief history of its urban form, detailing its transportation planning, land uses, and demographic changes over time. Seattle has a long history of developing grand transportation plans, a majority of which have remained unrealized. The city/region is currently building an extensive light rail system that will link central Seattle and its suburbs and it has been expanding local and express bus service throughout the city and region. The city has a number of innovative programs aimed at creating a more walkable and transit oriented city. However, even with these important steps, the city remains beholden to the interests of the automobile, which has resulted in a cautious and reserved approach to adopting more sustainable modes of transportation. I argue that a confluence of events have create a transportation crisis in Seattle and that transportation planning in Seattle needs to find a new approach in order to move the city forward.

In Chapter 5, 6 and 7, I discuss the results of the research, which I group by the research sub-questions presented in the research design. Each chapter presents the results of the research broken down into three thematic areas. Chapter 5 explores how the physical characteristics of the neighborhoods vary and what general travel behaviors exist in each neighborhood. Chapter 6 explores how pedestrian, transit and automobile infrastructure influences walking and what the role of transit is in these walkable neighborhoods. It examines how transit has changed behavior and how people anticipate changing behavior with new transit options. Chapter 7 offers a more evaluative analysis of the study area, including an examination of the enablers and barriers to walking and transit use, and an exploration of neighborhood satisfaction as it relates to walkability, transit use, and urban form characteristics.

In the final chapter, I conclude the dissertation by synthesizing my research findings and exploring the implications of my research on walkability and public transit planning practice. I revisit some of the innovative programs in Seattle, which I introduce in Chapter 4, and focus on transportation projects in the urban core completed over the last few years, as well as several projects in various stages of development. I provide analysis of how well walkability programs and transit investments are working within the context of my research findings and explore the extent to which they enhance walkability, promote transit use, or maintain the status quo of automobile dependence. I find that in the Seattle urban core, various projects prioritize different modes of transportation, and as a result, no mode comes out as a clear winner. Additionally, at the city and regional scale, planners over-emphasize public transit investments in both the urban core and in outlying suburban areas. Finally, I end by arguing that urban planners should develop new approaches to walkability and public transit planning in a way that is different from the status quo in many cities and in a way that prioritizes different modes of transportation at the geographical scale where they are most effective. Urban planners cannot effectively continue to fight automobile dependence without reevaluating the way we plan for walking and transit in cities. Pedestrians are at the core of a sustainable transportation system and public transit is vital for the future sustainability if cities and regions, but must not simply duplicate automobile infrastructure but connect walkable neighborhoods and be an extension of the walkable city.

Chapter 2

Literature Review: Streets, Urban Form, and Walkability

This chapter provides an overview of the literature that frames this dissertation research. There are three main components. First, is an understanding of how streets have evolved over the course of the 20^{th} century, from vital public spaces that served a wide array of functions, to being designed entirely for automobile, and most recently ideas about how to redesign them to incorporate sustainable transportation into an otherwise automobile-centric planning model. This discussion of streets is vital to the dissertation because I use streets and the different types of infrastructure that are dominant on them as a way to understand variations in walkability in walkable urban neighborhoods. The second component is on urban form and sustainability. Specifically, I review the literature on urban form and the rise of the compact city as a model of urban planning practice. The third component is a review of the literature on walkability, which draws on urban planning, urban design, and public health scholarship. I explore walkability research in relation to the built environment, the social dimensions of walkability, and the economic impacts of walkability. I conclude the literature review by considering several issues that emerge from this literature that I seek to address throughout this dissertation.

Streets and the Built Environment

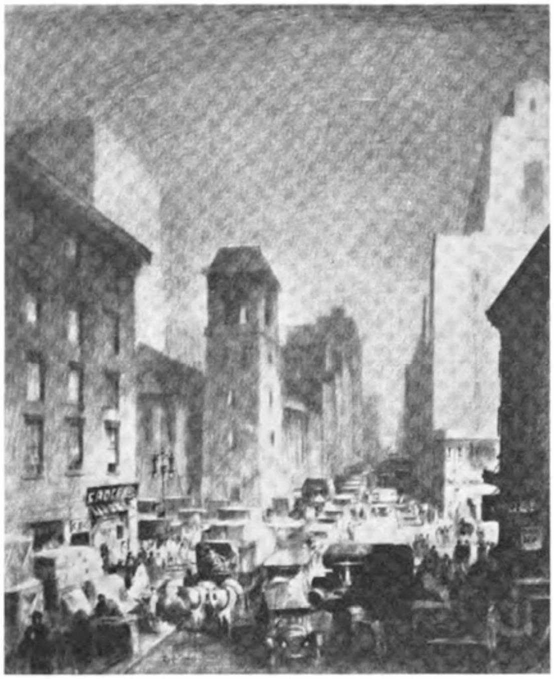
The pedestrian and the automobile have been at odds throughout the 20th century – a tension that remains today. Throw into the mix an array of public transit options and urban streets are more congested and increasingly contested as urban spaces with multiple users vying for use of a finite space. Only a century ago, walking was the primary mode of transportation in cities, but this quickly changed as the automobile flooded into urban areas and provided urban residents with an unprecedented level of freedom and mobility. The automobile forced planners to develop new ways to plan and build cities. Protection of the pedestrian realm was a primary objective when the automobile first arrived on the urban scene, and planners and designers created new urban forms to both accommodate the automobile and to protect pedestrians. Eventually, planning for the automobile became the primary objective, which resulted in a half century of continually increasing the number and width of roads, building freeways, cutting public transit service, and eroding the walkability of cities. Only at the start of the 21st century, have planners realized that the pedestrian is the most important part of the urban experience, not the automobile. Just as new urban forms emerged to accommodate the automobile, new urban forms, such as new urbanism, smart growth, and transit-oriented development, emerged in the late 20th century and they are now hallmarks of good urban planning. A goal of these new urban forms is to reorient cities around the pedestrian and walking – a process that will likely take as long as it did to plan cities for the automobile.

Streets are a quintessential part of the built environment. For much of urban history, they have served as the main public spaces within cities. Streets are places where people interact with one another, socialize, a traditionally, where merchants would sell goods and where children could play. In the latter half of the 19th century, pedestrians and numerous forms of horse-drawn transportation, from carts and carriages to omnibuses and streetcars, dominated urban transportation. By the end of the 19th century, streetcars had been electrified, which reduced the need for horses, but they remained an important part of private and commercial transportation. Starting in the early 20th century, this began to change, and the technology responsible was the automobile, or the horseless carriage. For the early decades of the 20th century, pedestrians coexisted in a tenuous relationship with numerous forms of private and public transportation, making the city a chaotic and dangerous environment.

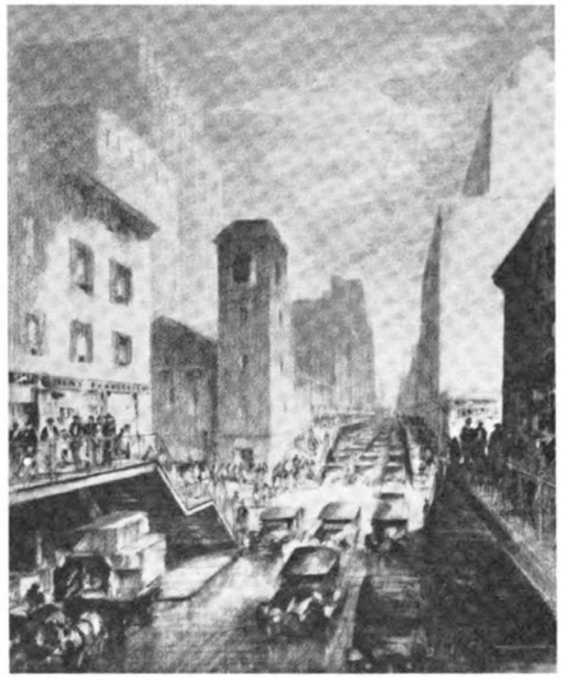
Lewis Mumford wrote in 1958 that "the purpose of transportation is to bring people and goods to where they are needed and to concentrate the greatest variety of goods and people in a limited area, in order to widen the possibility of choice without making it necessary to travel (Mumford 1981)." Pre-automobile cities did just this. All social and economic activity took place on the city streets and in public spaces defined by the buildings that surrounded them. These streets were accessible to nearly everyone. Important public spaces, usually plazas or squares, tended to have cultural meaning to the people who used them (Low 1997). Streets, unlike more formal public spaces, served to connect the various parts of the city and in doing so are both places with fixed characteristics, but also characteristics of movement.

During the early 20th century, cities in the US and Europe tried to adapt to the rapid introduction of the new technology of the automobile. During these early decades, policy makers and urban planners believed that people would primarily use the automobile for leisure activity and would still rely on transit as a means to travel within the city (Southworth and Ben-Joseph 2003). Throughout the 1920s and 1930s, car ownership in the US skyrocketed as people who could afford to move out of the city did so and thus began a long period of urban decentralization. Coinciding with this rise in car ownership, streets became deadly for pedestrians. In New York City, for example, the number of pedestrians killed more than tripled in a 20 year span, from just under 300 fatalities per year in 1910 to over 1000 per year in 1930 (New York City Department of Transportation 2010). This precarious situation prompted planners to evaluate and address the relationship between the pedestrian and the automobile and as a result, urban planners, architects, and engineers devised several new strategies for building cities and neighborhoods that addressed concerns over automobile traffic and pedestrian safety. One approach was to embrace the automobile as the technology of the future as the modernists did. An alternative was to attempt to mitigate the negative impacts of the automobile, primarily pedestrian safety and the loss of public space.

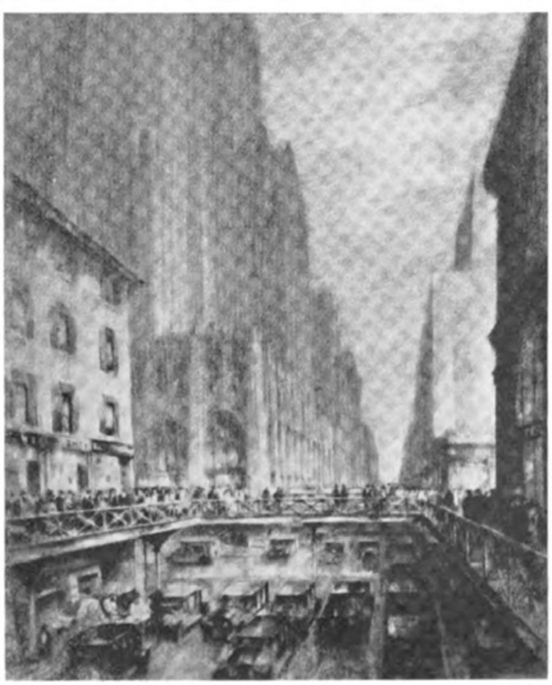
Figure 2.1. Transition from 1920s street chaos to a network of elevated walkways above busy streets. Source: Regional Survey of New York and its Environs, Vol. 4 (H. M. Lewis 1925).



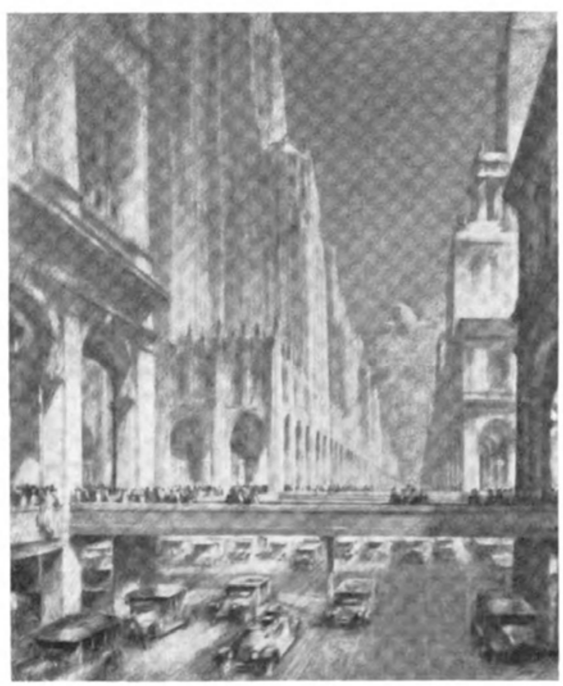
Typical conditions in a commercial district.



First step—an elevated sidewalk of temporary construction.



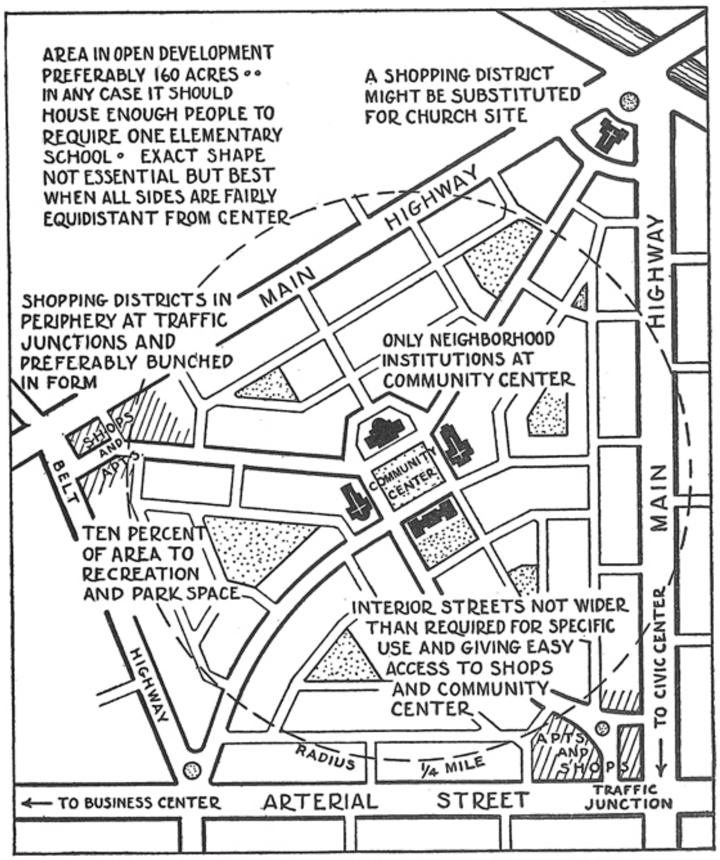
Second step—arcades on the ground level for standing vehicles.



Third step—pedestrian arcades provided on the upper level as a feature of permanent construction.

Figure 2.2. Plan of Radburn, NJ.

Figure 2.3. Neighborhood unit, circa 1929. Source: Regional Survey of New York and its Environs, Vol.7 (Perry, Heydecker, and Adams 1929).



In the 1920s, three models appeared that influenced urban development, essentially for the rest of the 20th century. The early modernist approach was to completely separate pedestrians from the street (Figure 2.1). This allowed for both the efficient movement of automobile traffic and protected pedestrians from the chaos of the street. By the 1950s and 1960s, the modernist approach sought ways to disrupt the chaotic nature of the city (Holston 1989), something critics of this approach recognized as vitally important to urban life (Jacobs 1961). This type of planning culminated in the creation of new cities, such as Brasilia and Chandigarh, which planners designed entirely around the automobile and which almost entirely lacked any regard for pedestrian movement or street activity.

The garden city concept, realized in Radburn, NJ, was an explicit response to the state of the American city in the 1920s where the automobile was a ‘disturbing menace’ (Southworth and Ben-Joseph 2003). Stein and Wright designed Radburn in such a way that pedestrians and automobiles did not interact on the street through a series of sidewalks and paths that ran throughout green spaces dispersed throughout the neighborhood, a practice that was common in German planning of new towns (Hass-Klau 2015). The streets themselves provided a circulation hierarchy in which houses have access with narrow streets, which feed into wider collector streets. Like the modernist approach, the garden city model sought to remove pedestrians from the street.

While the garden city was an independent unit, the neighborhood unit was a self-sustaining part of a larger whole. Six characteristics comprise the neighborhood unit: a limited size, clear boundaries, an internal hierarchical street system, open spaces, institutional sites at a central location, and local shops on the edges (Southworth and Ben-Joseph 2003). The main purpose of the neighborhood unit was to protect neighborhood living by not allowing automobiles use neighborhood streets as through streets. Less traffic made the area safer for children and adults alike and still provided all the necessary uses within a walkable distance. Although initially intended for dense urban areas, this model served as the basis for much of the post WWII suburban development.

In each of these models for urban growth, policies and regulations eroded the public space function of the street the street (Southworth and Ben-Joseph 2003). In the post-WWII period, the separation of people from the street increased as mass suburbanization and auto-dependent landscapes came to dominate metropolitan urban form of US cities (Warner and Whittemore 2012; Southworth and Ben-Joseph 2003). Ultimately, the form of post WWII development stems from regulations and standards developed in the 1930s and 1940s as well as a number of policies that advocated homeownership of single family homes in the post war period (Rome 2001). Suburbs, sprawl and the automobile changed the way people interacted the city and with the street. In just a few decades, metropolitan areas transitioned from walking and transit based to automobile based, which has had dramatic impacts on the environment and on society

Streets, while still an important part of the built environment, suffered greatly during this period, as did the traditional way in which humans interacted with the built environment –

walking. While suburbs and sprawl expanded around central cities, the cities themselves changed as they widened streets, narrowed sidewalks, razed entire neighborhoods and built freeways and provided as abundance of parking. The way that buildings interacted with the street also evolved over this same period, contributing to an erosion of street life and an increasing disregard for the needs of pedestrians (Kickert 2014). Only in the last few decades have urban planners and designers recognized the flaws in this single-minded approach to city building in which the automobile is the primary mode of transportation and the primary consideration. Two ideas drive this change: new attitudes and perspectives about the city and urban life and ideas of sustainable urban form.

Urban Sprawl and Sustainability

Until the years directly following WWII, most Americans who lived in cities walked. Once mass suburbanization and the ideal of the single family home took hold, the level of walking decreased rapidly. Post WW II patterns of urban development – suburbanization, highway development, urban renewal, and urban decentralization – resulted in metropolitan landscapes in which sprawl and automobile dependence are among its most notable features. There have been critics of this type of development going as far back as the 1960s (Jacobs 1961; Mumford 1961; McHarg 1969). As more urban residents owned cars, traffic, noise and congestion rose to never before seen levels, which reinforced the drive towards mass suburbanization. Mass suburbanization in turn, reinforced the need to own an automobile since the automobile facilitated the creation of new urban forms. The result has been more than a half century of increasing automobile dependence. The environmental movement of the 1970s emerged from the realization that sprawling suburban development was detrimental to the environment in many ways. However, urban development practices did not begin to change in any meaningful way until the 1980s and 1990s, which coincided with international recognition that urban areas played a major role in both local and global ecosystem degradation and unequal patterns of urban development contributed to increased social inequity.

In the US, issues of urban form became major concerns as the negative side effects of suburban development and urban decline mounted. Urban sprawl is characterized by low density development, single use zones, commercial strip development, and leapfrog development (Ewing 1997). Fragmented development due to inefficient land markets increases driving distances between one place and another (Gillham 2002). Within sprawling urban areas, there is poor accessibility and a lack of functional open space (Ewing 1997). New urbanists similarly identify several key characteristics of sprawl, though the emphasis is on the types of buildings. For them, sprawl's main characteristics are housing subdivisions that are entirely single family homes, shopping centers or strip malls along arterial roads, office parks surrounded by plentiful parking and open space, haphazardly placed civic institutions and an abundance of roadways (Andres Duany, Plater-Zyberk, and Speck 2000). Other scholars characterize sprawl by its low density and lack of land use mix and low connectivity with the result of this being automobile dependence (Frumkin, Frank, and Jackson 2004). These various definitions are useful in that they help urban planners and designers identify the components of the built environment that they can alter to create more sustainable cities that are walkable and transit friendly.

Many scholars write about the negative effects of sprawl. These include environmental impacts such as increased flooding from runoff (Rome 2001), loss of biodiversity, loss of open space and agricultural land (Cronon 1991), energy consumption and pollution (Ewing 1997; P. Newman and Kenworthy 1999). Increasingly through the 1990s and 2000s, scholars turned more to the social aspects of sprawl, including the loss of community life and social cohesion (Putnam 2000), public health concerns such as obesity (Corburn 2009; Frumkin, Frank, and Jackson 2004), and various mental health problems (Sullivan and Chang 2011; Frumkin, Frank, and Jackson 2004). Many scholars point out that cultural preferences for single-family homes and a more rural lifestyle are responsible for the continued prevalence of sprawling development (Bruegmann 2005). This however, ignores the fact that while cultural preferences do seem to tend to favor this in the US, pre-WWII suburbs built with transit were highly walkable, based around the single family home, and often incorporated abundant green space (Warner 1978; Condon 2010). Additionally, this cultural preference argument ignores the numerous ways in which the federal government promoted and subsidized mass suburbanization in the postwar period (Rome 2001). While there are definitely positive and negative aspects of suburbs, scholars usually considered sprawl harmful and it entirely possibly to have one without the other, a point that critics often overlook.

Automobile dependence, like sprawl, is largely the result of a specific type of development. However, low-density urban environments are not necessarily required for increased automobile use, and in fact, automobile dependence is as much as result of social and cultural attitudes as it is about the physical environment. Newman and Kenworthy (1999) acknowledge this social dimension in their work on automobile dependence which they argue is a result of interrelated transportation, economic and cultural priorities that shape cities (P. Newman and Kenworthy 1999). Wells (2012) argues that changes in the landscape have been the main factor in automobile dependence and as a result, new geographies specific to the automobile age now exist (Wells 2012). The cultural dimensions of automobile dependence, although much less explored, help explain why even in New York City automobile ownership is increasing (Kazis 2011) even though it is still the only city in the US with ownership rates below fifty percent.

The recognition that urban sprawl and automobile dependence are detrimental to the environmental and to the social fabric of cities has been one of the urban planning profession's most notable contributions to the sustainable development movement. Starting in the late 1990s, debates began about what a sustainable urban form would look like (Beatley 2000; Jabareen 2006; Miller 2012; Frey 1999; Guy and Marvin 2000). The alternative urban development pathways proposed a variety of forms all aimed at promoting environmental sustainability and social equity and the acceptance that existing forms of urban development in the US, and increasingly in other countries, were unsustainable. One of the most commonly discussed within planning scholarship has been the concept of a compact city.

Compact Cities

The concept of a compact city as a model of sustainability comes directly from the UN formulation of a sustainable city in *Agenda 21* which stated that a sustainable urban area should promote walking and non-motorized transportation, transit, and compact mixed use development (UNCED 1992). The problem with this formulation was that it did not provide any insight or specific guidelines as to what a compact city should (or could) look like. Much of the world took for granted that compact urban form was more environmentally and socially sustainable, and looked to the traditional urban cores of Europe as models of compact development as they sought to prevent further decentralization. In the US however, scholarship concerned itself with the simple question of whether the compact city was a meaningful planning objective (Gordon and Richardson 1997). This line of inquiry cites that density is not something most Americans prefer and that existing urban forms reflect the market choices of households. In contrast to this, those who promote compact cities cite that density as a singular measure of compactness is deeply flawed (Ewing 1997) and that real estate markets are highly inefficient and regulated, making them a poor judge of actual preferences. Since this initial debate, a huge effort has gone into showing the benefits of compact development. These include, but are not limited to, more efficient land use, reduced energy demands, less pollution and waste per capita, better ability to promote walking and sustainable transportation modes, fewer GHG emissions per capita, higher economic productivity, more social mixing, increased diversity, and lower costs of infrastructure (Beatley 2000; D. Owen 2004; Campoli 2012; Ewing and Hamidi 2015).

Numerous studies have shown the relationship between the built environment and travel behavior (Lawrence D Frank and Pivo 1994; Greenwald and Boarnet 2001; M. Alfonzo et al. 2008; Ewing and Cervero 2017; Cervero 2002; Ewing and Cervero 2010). Currently, the mainstream literature regarding compact cities recognizes that planning sustainable communities is not just an issue of densifying existing urban areas. Density, as well as diversity of land uses, the design of the street network, access to destinations, and distance to transit are all factors that influence travel in the built environment (Ewing and Cervero 2010; Campoli

2012). These measures, the five Ds, provide an integrated approach to urban development and allow researchers to consider a full range of variables when assessing the built environment.

In their seminal 2010 meta-analysis of literature addressing travel and the built environment, Ewing and Cervero show how various elements of the built environment influence different types of travel (Ewing and Cervero 2010). They conclude that accessibility to destinations and the street network design are most influential for reducing vehicle miles traveled (VMT), a common measure of automobile use within a metropolitan region. They found that land use diversity, intersection density and the number of destinations within walking distance had the most impact on walking. They conclude that proximity to transit and the street network design influences transit use the greatest. Additionally, they found that population and job density are weak predictors of travel behavior. These findings presented synthesize 38 different studies that analyze the built environment's influence on travel. Although none of the elasticities are particularly high, the authors note that the combined effect of built environment variables could be quite large (Ewing and Cervero 2010).

Stevens (2017) updated this earlier meta-analysis with seven years of additional studies. In addressing the questions of whether compact development makes people drive less, Stevens concludes that "planners should not rely on compact development as their only strategy for reducing driving unless their goals are very modest and can be achieved at a low cost (Stevens 2017)." Stevens' motives for conducting this research are valid in that he argues that policy makers have conflicting research, which does not address how they should develop policies to reduce automobile use. However, in addressing this, Stevens himself offers contradictory conclusions when his own research is very similar to the earlier Ewing and Cervero (2010) analysis. He characterizes the findings of his analysis (elasticity measures) as small and that driving is not very sensitive to changes in D-variables (Stevens 2017). I would argue, as do several critiques of his analysis, that the elasticities presented are not necessarily small. In fact, an elasticity of -0.63 for the distance to downtown and -0.22 for population density indicate that if a person moved 50% closer to downtown, they would drive 32% less and if they lived in a neighborhood twice as dense, they would drive 11% less. While arguably not huge, these values do indicate that compact cities do reduce driving and Stevens neglects the potential for compounding effects of combining multiple D-variables, such as moving closer to downtown and to a higher density neighborhood, which Ewing and Cervero (2010) point to as potentially very high.

This latest publication in this vein of research highlights the problems of looking at compact cities from such a narrow lens, in this case, VMT. In their critique of Stevens' article, Ewing and Cervero (2017) note that compact cities contribute to increased walking and transit use, reduced energy consumption, reduced pedestrian fatalities, increased physical activity, reduced household transportation costs, decreased crime, increased sense of community, increased social interaction and increased social capitol (Ewing and Cervero 2017). Numerous others offered critiques of this meta-analysis, arguing numerous points. Handy (2017) argues that while the direct benefits of compact development on driving might be small, compact development is a precondition for getting people to drive less. In essence, we as urban planners must provide the urban environment needed for people to drive less and help them understand how to do so (Handy 2017). Nelson (2017) furthers this critique essentially arguing that if cities do not invest in compact development now, then future conditions are likely to be worse when compared to a scenario where all new development is infill. He additionally argues that market forces currently favor a more compact model of growth, and that even if all new development in the US was in walkable neighborhoods, the demand for such housing may still be unmet (Nelson 2017). At the end of the day, these numerous critiques of Stevens' research confirms the fact that the compact city is a nearly universal planning ideal and that planners need to find new outlets in research and practice to advance the realization of the compact city.

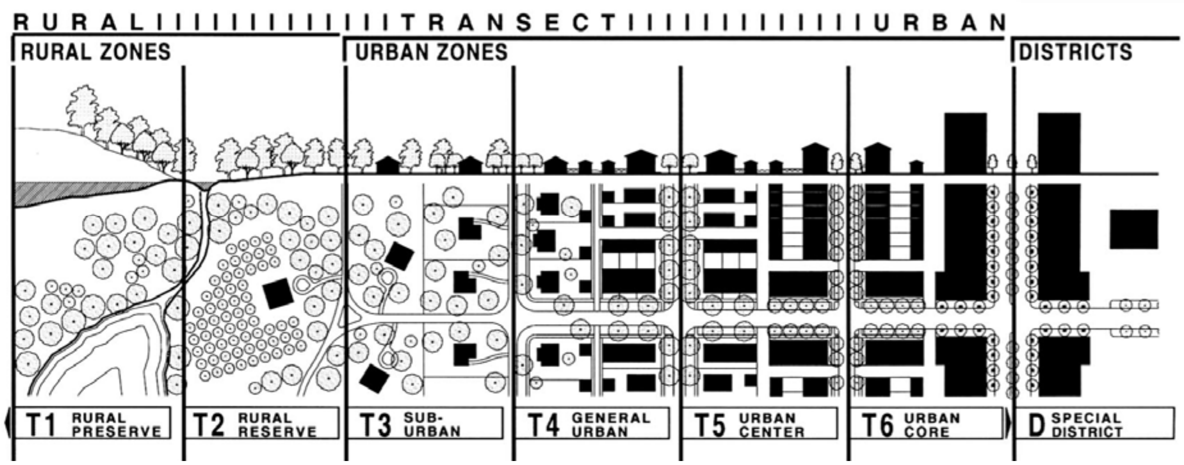
Theories and Models for Planning Compact Cities

The planning community has several models of what compact communities with reduced automobile dependence and increased walkability might look. These communities are human scale, planned around transit and are denser than post WWII suburban development. Generally, planners have developed policies to promote the ideal of walkability in two ways – through transportation policies aimed at reducing automobile use and through urban design and physical planning schemes aimed at making walking a viable alternative to driving. The transportation and land use approach contributes an emphasis on improving quality and access to public transportation, congestion pricing schemes, increased gasoline taxes, reducing the amount of parking available and/or increasing its cost, and making drivers pay the true cost of road infrastructure, which remains highly subsidized. On the design and physical side, researchers consider various aspects of the urban environment that are most likely to facilitate walking, such as density, mixed uses, proximity to destinations, width of sidewalks, proximity to fast moving traffic and other features. The logic is that if walking is as convenient as and more pleasurable than driving, people will walk more. Instead of working cohesively, these two approaches often do not accomplish as much as they purport and behavior changes little with these new policies and design paradigms. The fact is that the trends we are seeing in cities – increased desirability of urban living, less desire to drive and own cars, more positive attitudes of public transit – are major demographic shifts that are occurring for many reasons. Just as automobile dependence is the result of specific individual, social, institutional and environmental interactions, so is the walkable city. Recent evidence points to the walkable city as the planning paradigm of the 21st century, so what does a walkable city look like, and how are planners altering the urban environment to create more walkable places? The types of urban planning practices that have emerged as a result, discussed below, reflect this shift.

New Urbanism and Sprawl Retrofit

Several pathways towards compact cities exist. New urbanism is among the most commonly cited design approaches towards creating livable communities and combatting urban sprawl of the last two decades, and elements of it are now commonplace in planning practice. Part of its design approach is that it is explicit about several neighborhood elements. These include: every neighborhood should have a center, a five minute walking radius defines the neighborhood, the street network is interconnected, streets are narrow and versatile, development contains mixed uses and a diversity of housing types, and special sites provide space for special buildings (Andres Duany, Plater-Zyberk, and Speck 2000). The logic in these rules is clear. If streets are narrower, cars drive slower. Combined with well-connected street networks and sidewalks and a five-minute walk to commercial and daily needs, these features promote walkability. While residents tend to respond favorably to the design of the neighborhoods, they tend to remain insular and lack integration into the larger urban region. There is also little evidence to support any claims that new urbanism reduces automobile dependency in any meaningful way. For these reasons and others, new urbanist developments are the subject of much critique.

Figure 2.4. Transect diagram. (Source: Duany and Talen 2007).



Transect planning (Andrés Duany and Talen 2002; Bohl and Plater-Zyberk 2006; Brain 2006) is an extension of new urbanist planning. Transect planning operates within six zones ranging from rural to urban. One of the key principles of this approach is the creation of immersive urban environments – essentially ensuring that the context of each transect zone is consistent in terms of building typologies, density, and other characteristics. To achieve this, the transect supports the idea that different housing and building types are best suited to different transect zones and in specific places across and urban region. This planning approach ensures that rural areas maintain the characteristics that are rural, suburban communities maintain those traits that are typical of suburban areas, and that urban zones have the characteristics of urban zones. Additionally, each zone exists on a continuum, so that the densest zones are in the urban core, with rural zones on the outskirts (Figure 2.4). The idea that there is a proper balance between natural and manmade environments forms the basis of the transect and it provides for this balance differently in each of the different zones.

Sprawl retrofit, a similar but separate idea from new urbanism, seeks to densify existing suburban neighborhoods to create more urban environments. This approach accepts inevitable metropolitan growth and seeks ways to redesign and rebuild existing sprawling areas into more dense, walkable and mixed use centers (Talen 2011; Dunham-Jones and Williamson 2009; Lukez 2007). While these retrofit strategies promote infill development over green field development, there is a reliance on increased densities to promote walkable environments and transit without the explicit inclusion of transportation considerations in the development plans.

Transit Oriented Development

Transit oriented development is the practice of building urban centers around transit stops which include mixed use, walkable neighborhoods (Mees 2010; Dittmar and Ohland 2004). In many ways, TOD builds on both new urbanism and sprawl retrofit by providing not only the design features for reduced automobile use and walkability, but also a practical means by which to achieve it – a link to transit and the rest of the urban region. Even so, researchers do not fully understand the impact of transit proximity on actual transit use or VMT reduction, let alone its impact on walkability. Evidence has shown that due to the increased rents charged in TOD, they attract higher income individuals who choose to live in such places for the amenities and not necessarily the transit (Chatman 2013). Other research has shown that the impacts of TOD on gentrification is not as common as previously a though that that the extent to which transit induces gentrification is based more on local policies (Baker and Lee 2017). The reasons why people choose to live in compact, walkable, and transit-oriented neighborhoods is not well understood. In order to justify the investment of public dollars in transit, studies continue to rely on quantitative measures of transportation and the built environment and arguments showing how transit use results in reductions in VMT and GHG emissions.

Car Free Suburbs and Cities

In places outside the US, it is much more common to plan development in around transit and to plan development around issues of quality of life and livability. Throughout much of Europe, development is not planned around the automobile and instead on walking, biking and transit (Beatley 2000; Beatley 2012). European planning also tends to treat the automobile with hostility and is much more comfortable making it difficult and expensive to own a car and drive (Rosenthal 2011). The pedestrianization of central city areas has been common practice in major cities like Copenhagen, Amsterdam, and Vienna. Similarly, many cities restrict where automobiles can go. London provides the best example with its congestion charge for entering the central city. Also, the mayor of Paris recently proposed banning all diesel cars from the central city to alleviate air pollution levels which have reached all-time highs (Penketh 2014).

In addition to limiting automobile use, there are also many examples that seek to remove the automobile from the urban fabric. Vauban in Freiburg Germany is one example of a suburban area designed to be car free. Residents are required to sign a document saying they will not own an automobile or alternatively buy a parking spot for approximately 20,000 euros. Light rail and bus connect the neighborhood to the central city and most residents find they have no need for a car and do not own them or give them up after relocating here.

Entirely car free cities, although a mainly theoretical concept (Crawford 2000; Crawford 2009), are in the planning and development stages. Masdar City outside Abu Dhabi is one example currently under construction and expected to provide housing and jobs for 50,000 people in a single square mile. Great City outside Chengdu, China is another example of a planned car free city. This approach provides a striking alternative to modern auto-centric urban forms and the fact that planners and developers even discuss them shows that there is recognition of the benefit of urban landscapes without so many automobiles. The main question is will there simply be fewer cars, will they be heavily restricted or designed entirely out of the urban landscape? Just over a century ago, there were no automobiles and if given the opportunity, our urban environments could change just as radically in the next century as they did in the previous one.

Theory of Urban Fabrics

Planners in general have recognized the pitfalls of automobile dependence for decades, and several authors have begun to argue that we have entered a new era in transportation and land use planning that is post-automobile dependence (Condon 2010; P. Newman and Kenworthy 2015; Kushner 2004). To this end, the theory of urban fabrics (P. Newman, Kosonen, and Kenworthy 2016; P. Newman and Kenworthy 2015) argues that we need a new approach to transportation (P. Newman and Kenworthy 2015). Because of decreased demand for automobile-centric planning, the authors of this theory argue that transportation planning theory must also become non-automobile centric. To this end, the theory of urban fabrics is meant as a replacement for the still dominant modernist city framework, which they argue does not distinguish between these different fabrics and is the basis for current transportation planning theory (P. Newman, Kosonen, and Kenworthy 2016). By not recognizing that each urban fabric has distinct features and needs different planning approaches, the modernist city planning framework undermines efforts to revitalize the walking and public transport fabrics.

Figure 2.5. Three urban fabrics (Newman, Kosonen and Kenworthy 2016).

The theory of urban fabrics argues that each city is a combination of a walking city, a transit city and an automobile city and that each of these three urban fabrics is distinct and requires different planning approaches. The theory of urban fabrics acknowledges that each mode of transportation serves particular needs and functions within different parts of the city. Each of the urban fabrics has its own set of land use and transportation categories and once recognized, planners can optimize the different urban fabrics to best suit its function (P. Newman, Kosonen, and Kenworthy 2016). The theory of urban fabrics is useful in that it helps refine current transportation practices by providing planners with a framework for targeting investments into the places where they will be most effective. It also suggests that the universal ideas promoted by pedestrian master plans and numerous transportation plans, developed within a modernist city framework, may not be the best use of public money to create a sustainable and livable city. In other words, it makes little sense to make an entire city or metropolitan area as walkable as possible, as this does not reflect the reality or preferences of a city's residents. Instead, the theory of urban fabrics can help us to understand how to best target investment and develop programs aimed at revitalizing each urban fabric and optimizing them to make walking, transit (and even driving) most efficient in different parts of the city. Most importantly, from a sustainability perspective, the theory of urban fabrics can help inform urban planning practice about how to transform the automobile urban fabric into a more walkable and transit based urban fabric in a way that will be effective. Current planning practices, such as transit-oriented development, transit villages, street reclaiming, traffic calming and many others I have discussed in this chapter and the previous one, are examples of interventions into the built environment to improve transit accessibility and create more walkable urban environments. However, such projects often do not reach their fullest potential for the simple reason they often do not acknowledge that planners should develop different types of projects in different parts of the city. The theory of urban fabrics reminds planners of the geographic scales in which different modes of transportation function and the types of physical infrastructure that are supportive or disruptive to each one.

Streets and Sustainability

The approach towards compact cities in the US has always been from an environmental standpoint – how much energy do they save, how much land can we protect, how much lower are VMT or greenhouse gas emissions (GHG)? This approach often ignores issues of livability and quality of life that are more common in European urban policy pertaining to sustainable cities – that compact walkable cities improve social aspects of the city that are as important as the environmental aspects. However, this is a recent shift in their priorities. The modernist era of planning created a fragmentation of professions that dealt with the street (S. Marshall 2005). In essence, the street was no longer a cohesive subject and instead planned, managed and constructed in different ways by traffic engineers, landscape architects and urban planners. In order to build and rebuild compact cities that address both social and ecological concerns, a reintegration of these dimensions is necessary, and in fact can be seen happening in several new ways that streets are used in cities – not only as spaces for automobiles, but also for people.

The street is a logical way to examine how compact urban forms encourage social activity and street life. Several planning, design and engineering practices have emerged that have begun to reshape how cities use streets. By doing this, cities are more able to have control over the fate of their transportation system and plan it in such a way that it is most effective for all users. Essentially, there is a new emphasis on altering transportation based land uses to improve the urban environment. Indeed, Manville's (2017) critique of Stevens' meta-analysis highlights this point. He argues that per capita VMT is not something planners should worry about as it has very little policy relevance to urban residents – urban residents usually only care about the result of increased total VMT, otherwise known as congestion. Manville argues that in order to address transportation related issues, they need to shift their focus from land uses, which are slow to change, to focusing on transportation based land uses (Manville 2017). Below I discuss some of the common approaches used to reshape how streets function and how we use urban space for transportation.

Traffic Calming and Road Diets

Traffic calming aims to slow traffic in neighborhood streets, which are prone to high speeds due to their excessive widths required by numerous codes and standards. Design measures such as bump outs, chicanes, speed bumps or tables are a few examples aimed at slowing traffic and making streets safer for pedestrians. Likewise, road diets seek to create safer streets for all users through design and engineering changes. Road diets typically reduce the number of travel lanes for cars and the width of travel lanes, providing new opportunities for other infrastructure. This newly freed up road width allows for new or wider sidewalks, bike lanes, additional roadside parking, or even landscape buffers. These actions are an effort to make the pedestrian experience more friendly and this promote walkability by slowing traffic, making the streets safer by making street crossings safer, and providing a more attractive pedestrian realm through landscaping and seating amenities.

Street Reclaiming

Street reclaiming is the process by which street space is reused for uses other than the automobile (Engwicht 1999). Just as many streets were widened after 1920 and the introduction into urban life, some cities are seeing benefits to the opposite: narrowing streets and giving space back to pedestrians. Early examples of this practice come from northern European countries, such as Denmark and The Netherlands. It was in cities here that planners promoted building extensive bicycle networks, which resulted in induced demand for this mode of transportation and a much-reduced rate of automobile ownership and use. As public transit service was expanded and bike lanes added, planners turned space previously used for cars into public spaces. Pedestrian only streets, zones and city centers are now common in many European cities as a way to improve quality of life. Living streets are another example of street reclaiming that provide shared spaces for people, bikes, and cars, where traditional delineations between sidewalk and motorway are removed in favor of alternatives.

In some cities, planners have been able to turn underutilized street space into new public spaces. New York City is perhaps the pioneer in this with both high profile projects, such as the pedestrianization of Broadway in Times Square, as well as the creation of a number of small neighborhood plazas. In cities dominated by the automobile, a surge in temporary events provide opportunities for reclaiming streets, if even for a day. These include street festivals, farmers markets, cultural events, play streets, and many other types of events now common in many US cities. In US cities dominated by the automobile and a planning culture that continues to accommodate and even prioritize the automobile, these temporary events and small-scale street reclaiming projects help to slowly shift public opinion towards larger scale projects.

Complete Streets

Complete streets have become a popular model for planners, designers and traffic engineers to use in many cities in the US (Smart Growth America 2015; McCann and Runne 2010; Schlossberg et al. 2013). Complete streets is a strategy currently used in US planning which seeks to reverse the traditional hierarchy of street users, making the pedestrian the most important, followed by bikes, transit and then automobiles (Schlossberg et al. 2013). The complete street incorporates various traffic calming techniques and road diets, and divides the road and sidewalk space into specific functional zones: sidewalk, bike lane, bus lane, parking, and car lane. As multi-modal transportation has become commonplace, the complete streets model reflects this trend. In essence, complete streets seek to reorient, and in some cases reverse, the priority of users within the street space so that pedestrians and bikes have priority, followed by transit, then automobiles. Complete streets projects vary greatly from place to place, but often include reducing the number of general traffic lanes, widening sidewalks, building bike lanes, installing dedicated transit lanes, and making pedestrian crossings safer. Aesthetic elements often include street trees and landscaping, or even street medians. When done properly, these streets function better for all modes of transportation and in many cases they are justified as important projects to improve traffic safety, not necessarily pedestrian safety. While some advocates compare these complete streets to models of shared streets in

European cities, the two types of streets are very different configurations. Shared streets remove barriers between different modes of transportation allowing them to coexist. Complete streets on the other hand divide the street space up into even smaller more controlled portions for different modes of transportation.

Shared Streets

Shared streets, like complete streets, are an approach that puts the pedestrian as the main user of the street. Unlike complete streets, this concept allows all users to use the entire width of the street, providing plenty of space for pedestrians, bikes, and even room for children to play (Southworth and Ben-Joseph 2003). The concept has several forms, depending on what country you are in, but the most common is the woonerf, a Dutch term that translates roughly to 'living street'. Some US cities have experimented with the concept of woonerfs and shared streets, although they remain predominantly automobile oriented.

Super-Block Planning

Reminiscent of super-block planning of the modernist era, multiple cities are exploring ways to adapt the super-block idea to traffic calming and taming the automobile. In Barcelona, the city is moving forward with a plan to transform the city into super-block grids 3-blocks by 3-blocks (Bausells 2016). Every three streets will accommodate automobile traffic and buses, while the interior streets be traffic clamed for local access. They will be narrower to provide additional public space and parking will relocate underground. Although the plan has been met with some resident opposition (O'Sullivan 2017), the city is moving ahead with pilot projects. The city will apply this super-block scheme to the entire 19th century Eixample district famous for its gridded structure designed by Cerdá.

In New York City, Slow Zones create a super-block where streets within a certain area have reduced speed limits of 20 mph instead of the typical 25 mph and new speed bumps (America Walks 2017). The Slow Zones, started in 2011, are specifically designed to increase pedestrian safety and reduce the severity of crashes (NYCDOT 2017), which is in contrast to the Barcelona plan which aims to provide more public space for people.

Pedestrian Malls and Pedestrianization

Pedestrian malls are pedestrian only urban environments and are a frequent element in central city areas where mixed uses dominate, particularly throughout Europe. In the US, pedestrian malls have an overall bad reputation due to their ineffectiveness to revitalize deteriorating downtown areas in cities around the US in the 1970s and 1980s. However, in many cities, renewed interest in urban living has made pedestrian malls a viable option once again. Pedestrian malls work well in places that already have vibrant street life. Throughout Europe, planners use pedestrian malls to enhance the public realm and many cities have expanded their pedestrian street networks. Few cities in the US are building new pedestrian malls, although several cities have succeeded in maintaining their original pedestrian malls, such as Denver and Boulder CO, Santa Monica and Fresno, CA and Miami Beach, FL. New York has shown exceptional innovation in creating new pedestrian spaces by reclaiming street space for sidewalks and plazas, a program that other US cities are beginning to duplicate.

There is also an increasing prevalence of many major cities, primarily in Europe, to make their city centers pedestrian zones. Copenhagen was one of the first cities to do this on a large scale, starting with the Strøget in the 1960s and incremental additions since then, to today where a majority of the streets in the center are pedestrian only. Other cities have followed suit, transforming main shopping streets, or entire districts into car free zones in the city center, which is typically the historic medieval core of the city. Some of the largest cities doing this include Vienna, Austria; Bordeaux, France; Freiburg, Germany; Bristol, UK; and others. Oslo currently has a plan under way to pedestrianize their city center by 2019 (Bliss 2017). The desire to create public space, provide a safer pedestrian environment, and reduce automobile use often motivate these projects. Often improved public transit is a main component in the success of these pedestrianization projects.

Walkability and Urban Planning

Walkability has become a major planning subject over the last decade and cities around the world increasingly plan ways to create a more walkable urban environment. This has become necessary because the walking and transit cities of the early 20^{th} century radically transformed into automobile dominated metropolises. During the second half of the 20^{th} century, the act of walking in many ways became alien and even obsolete as a result of the way cities designed the urban environment (Jacks 2004). Now, after a century of increasing automobile dependence, the public is recognizing that an urban fabric built entirely on the automobile is not sustainable and does not necessarily increase quality of life, and in some cases, offers a lower quality of life. Recent research shows that both millennials (18-35 year olds) and retiring baby boomers (60 years and older) would prefer to live in neighborhoods where walking is a viable means of transportation (National Association of Realtors 2013) and that millennials prefer walking as a mode of transportation when given the choice (National Association of Realtors 2015). This is a huge shift in paradigms for urban planning – one that has slowly developed over the course of two decades, and with it a vast amount of research.

Walking is a key feature of a compact city and of a sustainable transportation system. This second half of the literature review focuses its attention on walkability – how various physical and social characteristics influence walking behavior. This literature comes from numerous travel behavior studies and public health, as well as urban design, which more than not emphasizes the physical and urban design qualities of the street as they pertain to walking. This review of the literature also covers research that examines the relationship between walking and transit use, which is the primary focus of this dissertation. I also explore the social and economic dimensions of walkability in addition to the built environment aspect.

Defining Walkability

In the simplest of terms, walkability is a measure of how friendly a particular area is to walking. Researchers have developed numerous measures that estimate walkability. Forsyth

(2015), however, argues that there is no simple definition of walkability. Forsyth (2015) argues that out of the many definitions of walkability, they all fall into three main categories: (1) the means or conditions for creating walkability; (2) the outcomes of walkability; and (3) walkability as a proxy for better design (Forsyth 2015). While this is not a hierarchy of definitions, the first set is typically a precondition for the second and the third combines both. Similarly to Canter's purposive use of place (Canter 1983), walking is done for a wide range of purposes and motivations and each purpose or motivation may be served by a different type of walkable place (Forsyth 2015; Wunderlich 2008). Places vary quite drastically and mainstream walkability literature deals primarily with city blocks and districts, streets, and trails. While the type of urban environment is important, Forsyth points out that many urban design theories emphasize physical features as a means to achieving a walkable environment. Evidence supports the fact that personal characteristics, individual behaviors, social contexts, cultural values, and various policies also affect the walkability of a place and that walkability varies from person to person even in the same place (Forsyth 2015). The article concludes with three ideas as to how to better define walkability: (1) a minimal definition, (2) a definition using specific terms related to features or outcomes, or (3) a comprehensive definition that moves beyond physical descriptions of places and also considers policies, programs, pricing, people, preferences and perceptions (Forsyth 2015).

Walkability and the Built Environment

A significant amount of research has shown the many ways in which the built environment influences walking activity. Ewing and Cervero (2010), who conducted a meta-analysis of 62 studies on travel and the built environment, show that walking is most strongly associated with design and diversity dimensions. Intersection density, jobs-housing balance, and distance to stores have the greatest impact on walking, with elasticities of 0.39, 0.25 and 0.19 respectively, as shown in Table 2.1. They also argue that having transit stops close by may stimulate walking, as it has an elasticity of 0.15. When looking at transit use, shown in Table 2.2, the distance to transit is the most influential, which has an elasticity of 0.29. This means that the closer someone lives to transit, the more likely they are to use it, which Ewing and Cervero argue supports the transit industry standard of having stops spaced a quarter mile apart. The next most influential factors are design elements, intersection density and percent of four-way intersections. Since intersection density is highly important for walking as well, this supports the mainstream planning argument that a walkable environment encourages transit use. To a lesser extent, transit may encourage more walking. It is, however, important to remember that this meta-analysis analyzes studies that examine travel and walkability across a wide range of neighborhood types that are compact. To this end, it does not distinguish between walkable neighborhoods in TODs, in downtown areas, or older traditional streetcar suburban areas now served by bus and rail.

Table 2.1. Walking elasticities, from Ewing and Cervero (2010).

		Total number of studies	Number of studies with controls for self-selection	Weighted average elasticity of walking (*e*)
Density	Household/population density	10	0	0.07
	Job density	6	0	0.04
	Commercial floor area ratio	3	0	0.07
Diversity	Land use mix (entropy index)	8	1	0.15
	Jobs-housing balance	4	0	0.19
	Distance to a store	5	3	0.25
Design	Intersection/street density	7	2	0.39
	% 4-way intersections	5	1	−0.06
Destination accessibility	Job within one mile	3	0	0.15
Distance to transit	Distance to nearest transit stop	3	2	0.15

Table 2.2. Transit use elasticities, from Ewing and Cervero (2010).

		Total number of studies	Number of studies with controls for self-selection	Weighted average elasticity of transit use
Density	Household/population density	10	0	0.07
	Job density	6	0	0.01
Diversity	Land use mix (entropy index)	6	0	0.12
Design	Intersection/street density	4	0	0.23
	% 4-way intersections	5	2	0.29
Distance to transit	Distance to nearest transit stop	3	1	0.29

Studies examining urban compactness and travel similarly show how the built environment influence walking. Hamidi et al (2015) develop four multidimensional factors of the built environment, which they use to measure transportation outcomes. Their development density factor includes gross density of census tracts, percentage of population at low, medium and high densities, urban density from the National Land Cover Database, employment density, and weighted population and employment density. Their land use mix factor includes jobs and population balance, diversity of land uses, job mixing, and walk score (which measures proximity to amenities). The third factor is activity centering, which includes percentage of population and employment in CBD and subcenters, density gradient, and variation in block group population and employment densities. The final factor is street connectivity includes measures of average block size and block length, intersection density, percentage of four-way intersections, and percentage of small urban blocks (blocks smaller than 1/100 of a square mile). The density factor and centering factor are the most important correlates of walking, followed by the mix factor and street factor. Ewing et al comment that the street factor outcome is unexpected, since planners often assume that small blocks, frequent intersections and high street connectivity translate into greater walkability (Hamidi et al. 2015). Planners should take caution with this conclusion, however, because while walkability may not result from an urban form with high connectivity, it is likely that this type of urban form enables walkability when combined with other elements. In other words, small blocks in a residential only zone are not likely to increase walkability if there are no destinations in walking distance.

In examining transit use, Hamidi et al (2015) find that the centering factor is the most important correlate, followed by the density factor, street factor and mix factor. This finding is as expected since cities with concentrated residential and job centers can easily connect them with effective public transit. Sprawling cities that have decentralized populations and jobs scattered across a region will find it difficult to encourage public transportation over automobile use.

Beyond the traditional D-variables of the built environment utilized in urban planning, urban design offers a rich analysis in the ways in which the built environment influences walking. Ewing and Handy (2009) analyze how urban design features influence walking behavior. These urban design qualities are the result of the interaction between different physical features of the built environment. Figure 2.5 diagrams their conceptual framework for the relationship between physical features and walking. They operationalize five urban design qualities: imageability, enclosure, human scale, transparency, and complexity (Ewing and Handy 2009). They tested over 130 physical characteristics and found 38 to be statistically significant. Imageability is a composite of number of people, proportion of historic buildings, numbers of courtyards and squares, presence of outdoor dining, number of buildings with non-rectangular silhouettes, noise, number of major landscape features, and number of buildings with identifiers. Features that contribute to enclosure are proportion of street wall, proportion of sky across the street, number of long sight lines, and proportion of sky straight ahead. Human scale determinants are number of long sight lines, street furniture, proportion of first floor with windows, building height, number of small planters. Transparency determinants are the proportion of the first floor with windows, proportion of active uses, and proportion street wall. Features of complexity are number of people, number of dominant building colors, number of buildings, presence of outdoor dining, number of accent colors, and pieces of public art.

Figure 2.6. Conceptual framework of physical features, urban design qualities, walkability and walking behavior (Ewing and Handy 2009).

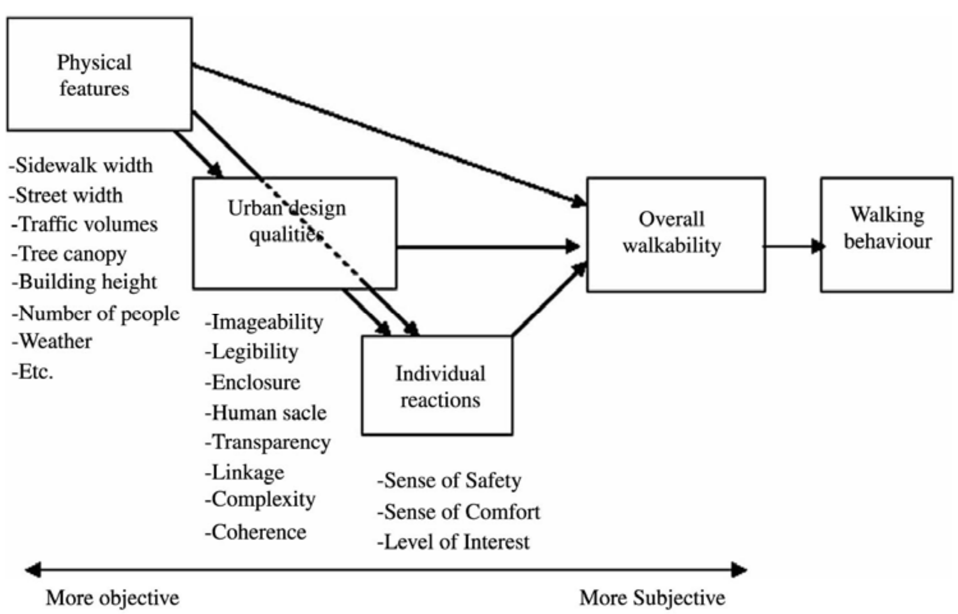
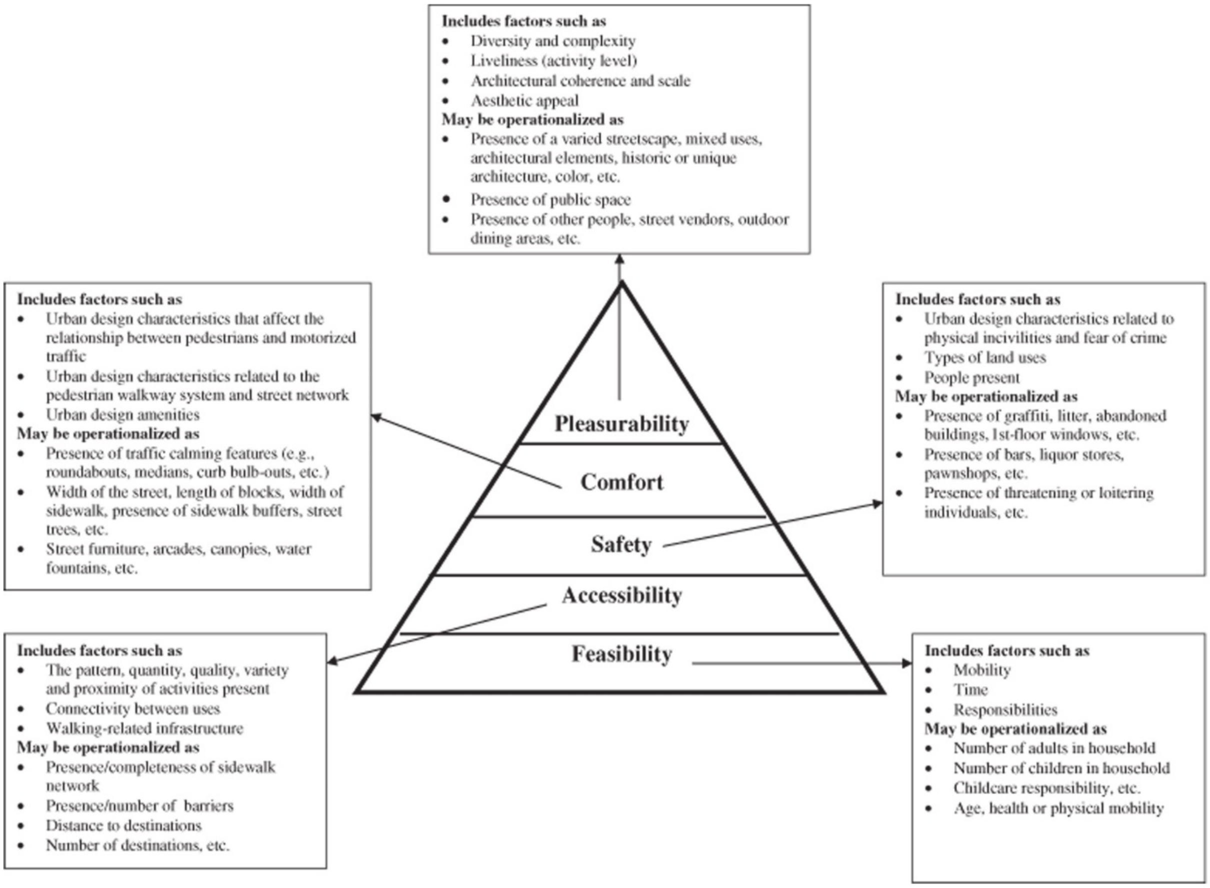


Figure 2.7. Hierarchy of walking needs (Alfonzo 2005).



From this analysis, we can see that both large-scale components of the built environment, such as density and land uses, and small-scale components, such as building sizes, plants, seating, building colors, and ornamentation, influence walkability. Although many researchers seek to quantify the built environment, it is important to remember that walkability has a necessarily subjective component. The hierarchy of walking needs (Figure 2.6) demonstrates the relationship between objective and subjective dimensions of the built environment (M. A. Alfonzo 2005). Each level further up the pyramid becomes feasible only after the levels below it have been satisfied. Researchers can operationalize each need with objective and subjective measures, although objectives measures are much more common as they do not require extensive surveys or questionnaires. Additionally, while the needs of comfort and pleasurability may seem inherently more subjective, many urban designers argue that a there is a certain universality of good design based on human physiological and psychological needs. Others, however, argue that planners and designers cannot, and perhaps should not, quantify walkability (Riggs 2015). Riggs (2015) makes the argument that we cannot quantify the psychological and emotional components of walking, and that a focus on the quantitative glosses over socio-economic and demographics issues.

A 2003 study examines differences in walking and neighboring (planned and unplanned interaction among residents of a neighborhood) in typical suburban developments and new urbanist developments (Lund 2003). The design of new urbanist neighborhoods adheres to elements of the compact city – they are walkable, have neighborhood centers, buildings that line the street, and mixed housing types – and seek to encourage social interaction that is not typical of automobile dependent development. Lund uses a household survey to collect data on walking and neighboring behavior, personal attitudes, sociodemographic characteristics, and perceptions of the local environment (Lund 2003). Lund finds that access to local retail shops is the most important objective environmental factor, and that walking is indeed higher in new urbanist neighborhoods. More important than this, however, Lund finds that attitudinal factors have a significant impact on walking, which other research has also found (Humpel et al. 2004). In other words, if a resident places importance on walking, they are more likely to walk to local stores and other destinations. This makes it very likely that residential self-selection influences walkability. Essentially, people who prefer to walk or use transit are more likely to want to live in neighborhoods where they can do this. Evidence, however, does indicate that there is a mismatch between the supply of housing in these types of neighborhoods and residential preference (Levine 2006). In other words, more people prefer to live in places where walking to local destinations is an option, but for a number of reasons, they are unable to.

In a survey of 328 pedestrians walking to rail stations, Agrawal et al (2008) find that minimizing the distance walked was most important factor influencing route choice. They found that a concern for safety was also important in route selection (Agrawal, Schlossberg, and Irvin 2008). Less important for these types of walking trips were sidewalk condition, attractiveness of buildings, presence of trees and landscaping, benches and shops, and the presence of other people (Agrawal, Schlossberg, and Irvin 2008). The findings of this study showing less importance on aesthetic elements of the built environment likely relates to the fact that the survey respondents were traveling to the rail station as part of their morning commute. This study highlights the reality of the hierarchy of walking needs mentioned above. The main concerns of pedestrians walking to transit would fall into the first three levels of the pyramid: feasibility, accessibility, and safety. Less important, though still considered, is comfort and pleasurability.

In a 2004 meta-analysis of 18 walkability studies, Owen et al (2004) examine both objectively measured and perceived environmental attributes and how they influence walking, for both exercise and for travel to destinations. They find that aesthetic perceptions are significant when walking is for recreation or exercise but not when walking to destinations. They find that access to open spaces and having a "highly walkable" neighborhood are associated with walking to and from places. Here, the researchers define a highly walkable neighborhood as having higher residential densities, more mixed land use, and greater street connectivity (N. Owen et al. 2004). Lastly, perceptions about traffic influence walking for both exercise and to destinations. As we can see from this, and the other studies discussed here, walkability is a complex phenomenon that many aspects of the built environment influence, both on an objective level and on a subjective level as measured by peoples' perceptions of the built environment. Understanding both aspects is important for planning and designing walkable cities.

Walkability and the Social Environment

Walkability has many important social benefits, which researchers have studied. These include neighborhood safety, pedestrian safety, social interaction and sense of community. I also include public health benefits of walkability in this category. Jane Jacobs (1961) was among the first to make connections between walking and neighborhood safety. She observed that safe street had three qualities. First, there is a clear boundary between public and private space. Second, there were "eyes on the street" acting as natural surveillance. And third, the presence of continual street users (Jacobs 1961). Newman (1972) developed the theory of defensible space, which suggests that crime can be prevented or reduced with an environment that allows residents a certain degree of control and which they can defend (O. Newman 1972). This facilitated the development of Crime Prevention through Environment Design (CPTED), which remains an active component of urban design practice in cities today.

Numerous studies have shown that the characteristics of walkable neighborhoods are also associated with higher crime rates (Wilcox et al. 2004; Groff et al. 2014; Kinney et al. 2008; Dong 2017). Residential areas with non-residential uses, i.e. mixed use areas, have a higher risk of crime (Wilcox et al. 2004; Groff et al. 2014). Kinney et al (2008) also find that certain types of non-residential uses are more associated with crime than not. These include retail shops, restaurants and bars, high schools, public transit stops (Kinney et al. 2008). In an examination of burglary and robbery in relation to walkable neighborhood, Dong (2017) finds mixed results. The study finds that walkability has a statistically significant association with burglary, but not with robbery. However, when controlling for street walkability and other variables, Dong (2017) finds that neighborhoods that are more compact tend to have lower burglary rates. Additionally, concentrations of retail space, restaurants and hotels are associated with high robbery rates, but when a more general measure of mixed use is used, the relationship with robbery is not significant. Dong (2017) also finds that high transit use is associated with high robbery rates, which echoes the findings of previous research (Loukaitou-Sideris 1999; Loukaitou-Sideris, Liggett, and Iseki 2002). These findings regarding walkability and crime are likely a by-product of the fact that walkable urban areas tend to be located in more dense urban centers, which also tend to have more crime overall, but not necessarily more crime per capita. The crime that happens is simply more visible because it happens in a more compact space and more people who see or experience it.

Aside from crime, safety also applies here to traffic accidents and safety from traffic for pedestrians. Stoker et al (2015) review a number of studies on this topic and demonstrate the interplay between individual socio-demographic factors and the built environment (Figure 2.7). Overall, they find that measures to improve pedestrian safety include reducing vehicle speed, reducing pedestrian exposure to traffic, and improving visibility between pedestrians and traffic

(Stoker et al. 2015). A 2010 study of street network design (W. E. Marshall and Garrick 2010) finds that street network density correlates with pedestrian safety. Areas with low intersections densities have the highest risk of fatal crashes and as intersection density increases, safety outcomes improve (W. E. Marshall and Garrick 2010). The studies show that the layout of the built environment and the design of the streets does influence pedestrian safety. Although the absolute number of accidents and fatalities may be higher in denser urban areas, the injury and fatality rates are lower in dense urban areas, making them generally safer than their rural, or even suburban, counterparts. Changes in street design can reduce pedestrian injuries and fatalities, which serves to improve the walkability of a neighborhood or city.

Figure 2.8. Conceptual framework linking the built environment to pedestrian safety (Stoker et al 2015).

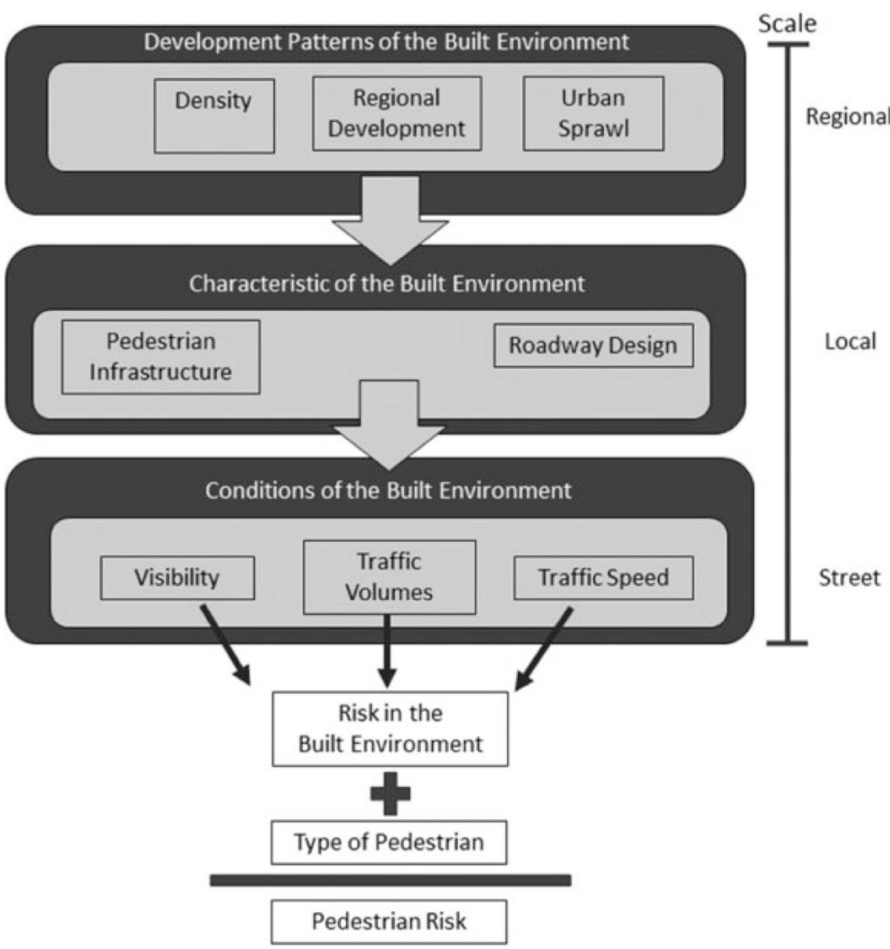
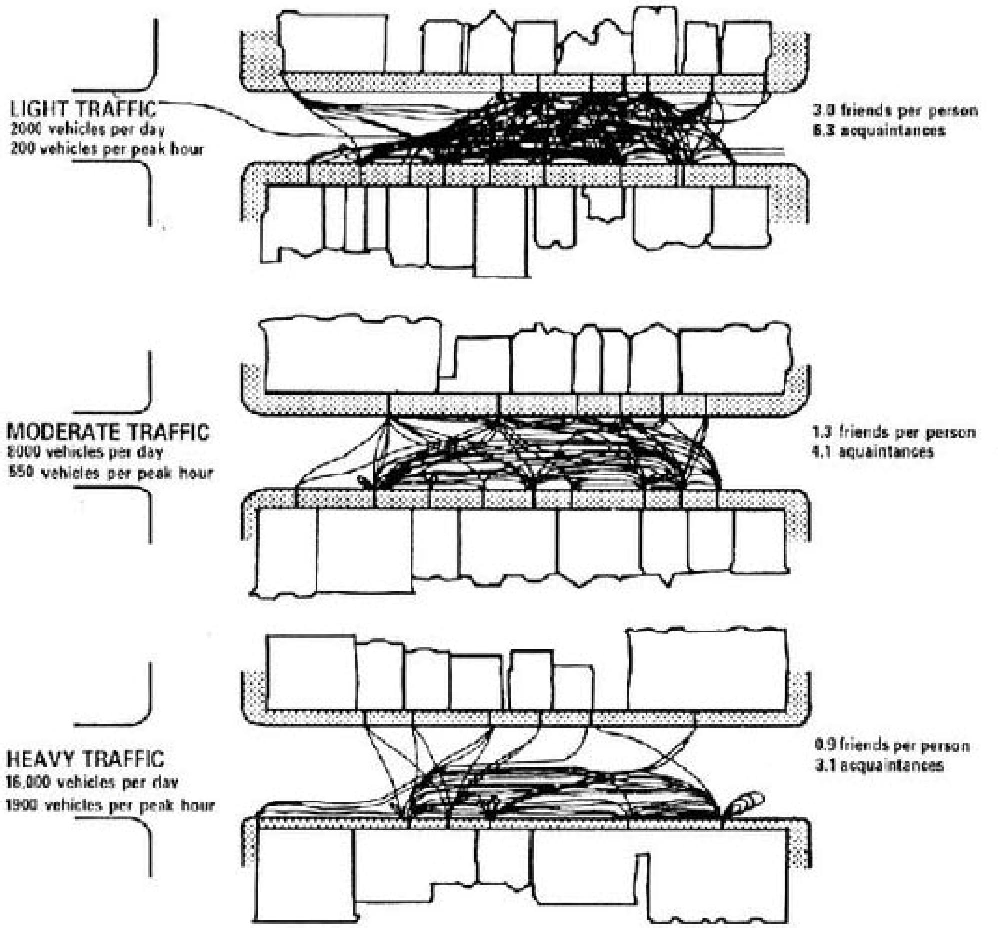


Figure 2.9. Social interactions and street traffic, (Appleyard 1981).



Social interaction and creating a sense of community are two very important aspects of a walkable community. Appleyard (1981) shows how traffic on a street affects the social connections on those streets. In his examination of three residential streets in San Francisco, Appleyard finds that on streets with light traffic (2,000 vehicles per day), versus those with high traffic (16,000 vehicles per day), residents have three times more friends and acquaintances (Figure 2.8). This type of social interaction is one component of creating a sense of community, alongside community attachment, community identity, and pedestrianism (Kim 2007). Kim (2007) finds that design characteristics of a new urbanist community influence the sense of community residents feel. New urbanism is premised on building more compact neighborhoods with a mix of housing types, retail within the neighborhood, and encourages walking as a mode of transportation through a number of design interventions (Andres Duany, Plater-Zyberk, and Speck 2000; Lund 2003). In general, this research concludes that locating parks and retail shops a neighborhood combined with pedestrian friendly street design increases walking and that people who walk around their neighborhood, whether to destinations or leisurely, are more likely to know their neighbors and form relationships within the neighborhood (Kim 2007; Lund 2003; L. Wood, Frank, and Giles-Corti 2010).

A major subfield in walkability research has examined how the built environment influences physical activity and its impact on a range of health outcomes. Numerous studies have shown that the built environment is a factor in physical activity (Lee and Moudon 2004; Lawrence D Frank 2000; Saelens, Sallis, and Frank 2003), of which walking is a major contribution to increased physical activity. People who live in more walkable environments are likely to drive less and have lower levels of obesity, especially when they prefer walking over other modes of transportation (Lawrence Douglas Frank et al. 2007). Lee and Moudon (2008) identify numerous barriers to walking that are attributable to neighborhood design, such as high traffic volumes, poor lighting, and a lack of utilitarian destinations like grocery stores, restaurants, retail and convenience stores. Simple interventions, such as adequate street lighting, sidewalks, street trees, benches, and traffic calming, are likely to enable a larger number of people to walk (Lee and Moudon 2008).

Van der Westhuizen (2010) studies neighborhood form and pedestrian activity in Detroit neighborhoods in relation to health outcomes. This research investigates how both place and space factors work together or inhibit human activity and travel, and concludes that the two reinforce each other to affect pedestrian movement and physical activity outcomes (Van der Westhuizen 2010). Several key findings emerge. Built environment measures correlate more strongly with pedestrian movement than with the combination of pedestrian movement and sedentary activities, such as sitting or standing. Destinations play a strong role in pedestrian movement, and the more destinations within a quarter mile of a sample block, the more pedestrian activity there is. However, the number of destinations does not have a significant correlation to physical activity or waist circumference (the two measures of health included in this study). The study highlights a key relationship between public health and the built environment. The built environment had a more direct relationship with walking and pedestrian movement, but this does not necessarily equate to better health outcomes, since health outcomes are a results of not only a person's physical environment, but also their socio-economic status, social networks, and an individual's basic biological characteristics.

The Economics of Walkability

Walkability also has important economic benefits. As the US economy has shifted towards the knowledge economy, many businesses are coming to realize the benefits of walkable places. This is for two reasons. First, there is benefit in the face-to-face interactions that walkable urban places provide. Second, highly educated individuals tend to prefer living and working in walkable places. In a study of the 30 largest metropolitan areas in the US, Leinberger and Lynch (2014) argue that wealth-creating development is shifting away from drivable suburban to walkable urban development. They find that walkable urbanism is highly correlated to educational attainment and metropolitan per capita GDP (Leinberger and Lynch 2014). They admit that they are unsure of the causality of this relationship, specifically whether walkable urban places attract highly educated workers, or whether metropolitan areas become more walkable because of highly educated workers. Walkability, however, acts as a magnet for highly educated workers (Florida 2002), making it likely that metropolitan areas that are more walkable attract more educated knowledge economy workers, which in turn increases metropolitan GDP. Walkable urban areas, while also attracting greater economic opportunities, are shown to reduce a number of costs, ranging from household transportation costs, public infrastructure costs, and provision of public services (D. Owen 2009).

Walkability has also been research for its possible implications on housing affordability and gentrification. Housing affordability is a key component of a sustainable city (Gilderbloom 2016). A study of Vancouver, BC, densification and associated increases in walkability, was found to be entangled with gentrification (Quastel, Moos, and Lynch 2012). They conclude that "rising housing prices in central areas and a cultural and policy turn that connect urbanity with environmental ideals have reinforced relationships between walkability, density, proximity to transit, and increasing social status (Quastel, Moos, and Lynch 2012).” Kotkin, in a recent book, argues that walkable neighborhoods are not for middle-class families because they are unaffordable to the vast majority of urban residents (Kotkin 2016). Likewise, a 2016 report by the Urban Land Institute called walkability a luxury that many households will not be able to afford (Urban Land Institute 2016). A study conducted by Redfin shows that a one point increase in Walk Score is associated with a one percent increase in the sale price of a house (Bokhari 2016). Likewise, academic research finds that the market shifts in favor of walkable and transit oriented neighborhoods results in higher real estate prices (Bartholomew and Ewing 2011) All this is to say that higher levels of walkability tend to be associated with higher housing and real estate costs.

A critique of this approach to walkability and its relationship with higher housing costs is that is overlooks the fact that total housing and transportation costs are fundamentally linked. In fact, an analysis combining total household expenditures on housing and transportation shows that in traditional cities, these total costs are about 40 percent of a household’s income, while residents in sprawling cities spend 50 percent of their income on housing and transportation (Steuteville 2017). The main reason for this difference is access to public transportation, which can drastically lower a household’s transportation costs. While some research has shown that new public transit also induces gentrification, this has been shown to be context specific and policies to mitigate displacement can be successfully used (Baker and Lee 2017). The reason why this issue of gentrification is important is because until walkability became mainstream, walkable neighborhoods and those with access to transit were often low income, minority, or immigrant communities. These communities, for a number of reasons, often rely on public transportation and walking as a primary means of transportation. However, as walkability has become mainstream, there seems to be a worry that forces in favor of development will ultimately displace these vulnerable populations. However, proponents of densification of existing neighborhoods often cite the fact that cities have numerous levels of restrictive zoning ordinances that are the reasons for the high costs of new development (Steuteville 2017), which is the most common reason for displacement. In the short term, a shortage of housing availability in walkable neighborhoods and a lack of policies to protect long-term residents, will likely continue the debate over walkability and affordability, but proponents of true urbanism maintain that walkability will ultimately promote affordability.

Conclusion

This chapter has explored the literature on urban form – how the automobile transformed the city and how cities approach re-emphasizing the role of walking in the city. At the beginning of the 20th century, most travel in urban areas was on foot. Mass transportation was emerging as a way to connect the city and to grow it outward into greener suburban areas. As urban residents increasingly saw value in automobile ownership, urban planners sought ways to modify our cities to accommodate the automobile. In multiple cases, the only viable way forward was to separate the two modes of transportation from one another, as they were inherently at odds with each other. Over time, cities adopted land use regulations, zoning codes, and engineering and design standards that made automobile use easy. Additionally, federal programs such as the Federal Highways Act and federally backed home mortgages, encouraged and allowed for urban decentralization and mass suburbanization.

There were early critics that warned of the ills of this new type of urban development, like Lewis Mumford who wrote in 1958 that, "we must re-plan the inner city for pedestrian circulation, and we must rebuild and extend our public forms of mass transportation. In our entrancement with the motorcar, we have forgotten how much more efficient and how much more flexible the footwalker is (Mumford 1981, 185–86)." This remained an accurate assessment of transportation planning, as the planning profession did not catch on to the negative impacts of automobile dependent development until the 1970s, with the environmental movement, and later in the 1990s, with the sustainable development movement. Now, the urban planning profession promotes the compact city as a model of urban sustainability. While it can take many forms, based on local contexts, a compact city is generally one that is dense, has mixed land uses, and is human scaled, where walking and transit are the primary modes of transportation. Research has shown repeatedly that compact urban forms have many social, economic and environmental benefits.

The extensive research on walkability in the urban planning, public health and urban design professions highlight many of these benefits of compact walkable urban forms. Walkability is a complex topic that has both physical, social, and economic implications that planners need to understand in order to plan walkable cities. The automobile dependent city evolved over the course of the 20th century and planners' continuous attempts to integrate and accommodate the automobile into urban life and mitigate its numerous impacts on urban residents is a key feature of post WWII planning. Despite attempts to the contrary, the accommodation of the automobile continues today in planning for walkable cities.

In this new era of the compact city, streets are no longer only spaces for cars, but also spaces for a wide range of transportation modes and for a wide range of activities. New planning approaches for designing streets for people to promote walkability and transit use have emerged, ranging from road diets and traffic calming to complete pedestrianization of a street or urban district. These emerging practices make the compact city a more viable way forward and remind us that creating a compact walkable urban form will take nearly as long, if not longer, than it took to create the sprawling automobile dependent metropolitan areas that marked the 20th century. However, the way we measure the compact city has not been greatly refined to understand how behavior varies within walkable neighborhoods. Urban design has the most to offer in this regard, but this literature often addresses more subjective qualities of the built environment and not the hard quantifiable qualities that urban planners like.

This literature review has examined an extensive body of literature within the fields of urban planning, design, public health and travel behavior, and while extensive, there are still areas in which the literature is lacking. The multiple literatures examined in this chapter point to four weaknesses in existing research that this dissertation addresses in several ways. Specifically, in this dissertation, I address four broad questions that this literature opens up. First, is whether the current approaches to developing walkable and transit oriented cities effective. Many of the practices used to promote walkability are now decades old, and even the golden standard for street design in the US, complete streets, has been utilized for 15 years. Additionally, the way we build transit still over-emphasizes the commute to work and fails to address broader issues of sustainability, livability and accessibility. Second, is regarding how the physical street environment reflects the transportation priorities cities have. This issue stems from the recognition that street space scarce and the fact that the way we design streets influences how we use them. Third is the issue of defining walkability. The literature defines walkability in numerous ways, but whether there are ways we can define and measure walkability in a way that better reflects the way urban residents talk about and experience the urban environment remains an ongoing point of research. Lastly, is the issue of understanding variability between walkable urban neighborhoods. Much of the existing literature focuses on understanding walkable versus non-walkable neighborhoods through various ways of understanding the built environment. What this walkability research has failed to address this far is any nuanced understanding of how walkability varies in neighborhoods that are inherently walkable. In the following chapter, I detail the research design used in this dissertation, which in one way or another, addresses these four issues raised here in order to advance our understanding of walkable neighborhoods and how people utilize walking and transit in their daily lives.

Chapter 3

Research Design

This dissertation is about the relationship between walking and transit use. I ask the following:

How does access to different types of transit affect quantity and quality of walking and street activity within and between different types of walkable urban neighborhoods?

By studying this relationship in detail, I aim to examine broader connections between all modes of transportation and the built environment. The project is an case study research design (Yin 2009) at multiple geographic scales, with mixed methods (Groat and Wang 2013). The methodology described in this chapter combines quantitative measures common to urban planning scholarship with qualitative data from surveys and interviews with residents and workers who utilize walking and transit in a variety of ways. Combining these two approaches offers a more complete picture of walking and transit use (and to a lesser extent, driving) from the perspective of the people to whom these issues really matter. The methodology presented in this chapter aims to be relatable to mainstream urban planning and design literature, as well as contest the modernist paradigm in urban planning, by examining the potential of the theory of urban fabrics (P. Newman, Kosonen, and Kenworthy 2016; P. Newman and Kenworthy 2015).

The research question first emphasizes walkability as a set of conditions – both physical and social – that influence walking behavior. The relationship between walkability and public transit is a contested one. More often than not, the research examines transit use as a dependent variable, or an outcome, of a walkable urban environment. Since access to transit is associated with transit use, and generally, this access is by foot, this relationship makes sense. However, the research also suggests that walking is associated with access to transit. So which is it? Does a walkable neighborhood result in transit use, or does the presence of transit in a neighborhood encourage people to walk? The simple answer is both. And neither.

These two different perspective of transit and walking could be explained by the fact a majority of planning research often compares neighborhoods of different types – urban, suburban, exurban, residential, mixed-use, new urbanist, transit oriented developments, and so on. The relationship between walking and transit use is necessarily different in each of these neighborhoods because of the urban fabric that is dominant in each one. The theory of urban fabrics (P. Newman, Kosonen, and Kenworthy 2016) supports this conclusion in that is suggests that different urban fabrics emphasize different types of transportation. Transit does not have the same function in a downtown neighborhood as it does in a suburban subdivision or commercial street. Likewise, walking does not serve the same functions in a downtown neighborhood as it does in an urban sub-center or suburban area. That is what this dissertation aims to tease out – the use and function of walking and transit in a single type of neighborhood: dense walkable center city neighborhoods. Existing research does not have any good methodology for understanding how walking varies within neighborhoods that are walkable and only distinguishes between walkable and non-walkable neighborhoods.

Selecting the Case City and Case Neighborhoods

The case study approach in this dissertation is a nested approach – first I select a city, and then neighborhoods within that city, and ultimately blocks within those neighborhoods. The multiple geographic scales of the cases serve different purposes within the research design in terms of determining the scale at which the different tactics are applied. An earlier iteration of this project utilized a comparative case study approach at the city scale. Instead, I settled on a single city case study methodology because it would allow me to gain an in depth understanding of the ways in which transit affects walkability that I would not have gained from a more cursory examination of walking and transit use in multiple cities. The nested case study approach, although not named, is common in urban planning research, which often applies a tiered approach, first selecting a city to study and then areas within that city (or region) to study specific phenomenon. This dissertation project creates a third level to common urban planning case study selection by also selecting blocks within each case neighborhood. In the following sections, I detail how I selected the city, the neighborhoods and the blocks included in this nested case study.

A number of criteria were determined to assist in selecting the case city. First, it had to be the central city in a large metropolitan area in the US. Second, it had to be more representative of a broad range of US cities, and not necessarily an exceptional case. Third, it needed to be a very walkable city. For this, I looked to two sources: Walk Score (Walk Score 2017) and the 2014 report on walkable urbanism, *Foot Traffic Ahead* (Leinberger and Lynch 2014). Table 3.1 shows these 30 largest metropolitan areas and their rankings for Walk Score and walkable urbanism (aka Walk UPS). Walk Score acts as a proxy for walkability by using several walkability measures to calculate a score, including the proximity to destinations, the density of the neighborhood, and the street network, including block length and intersection density ("Walk Score," n.d.). Walk Score ratings fall between 0 and 100, where 90-100 is a 'walker's paradise', 70-89 is 'very walkable', 50-69 is 'somewhat walkable', and 0-49 is 'car dependent' ("Walk Score," n.d.). The report on walkable urbanism ranks metropolitan areas on walkable urban places, of which there are six neighborhood typologies – downtown, downtown adjacent, urban commercial, suburban town center, strip commercial redevelopment, and greenfield (Leinberger 2012). These walkable urban places have a high proportion of office, retail, and residential, and are often major employment centers within a region. The report ranks each metropolitan area and then identifies four categories of walkable urbanism: high walkable urbanism, moderate walkable urbanism, tentative walkable urbanism, and low walkable urbanism.

Among these thirty largest metropolitan areas, the median size of the core city is approximately 640,000 residents. Eight cities are within range of this figure: Washington, DC; Boston, Detroit, Seattle, Baltimore, Denver, Portland and Las Vegas. Of these, only Washington DC, Boston and Seattle have a very walkable urban fabric (Walk Score between 70 and 89) and high walkable urbanism. Three cities are somewhat walkable (Walk Score between 50 and 69) and have moderate walkable urbanism: Baltimore, Denver and Portland. Miami and Detroit were excluded because they are very walkable and somewhat walkable respectively and they both have low walkable urbanism. Las Vegas is excluded because it is car-dependent (Walk Score under 50) and has low walkable urbanism.

Table 3.1. Largest US metropolitan areas with city Walk Score and regional walkable urbanism rankings.

	2014 Metro Population	2014 City Population	2015 Walk Score	Walk Score Category	Walk-UP Category	Walk-UP Rank
New York	20,092,883	8,491,079	87.6	**Very Walkable**	**High**	2
Los Angeles	13,262,220	3,928,864	63.9	Somewhat Walkable	Tentative	18
Chicago	9,554,598	2,722,389	74.8	**Very Walkable**	**High**	5
Dallas	6,954,330	1,281,047	43.6	Car-Dependent	Low	25
Houston	6,490,180	2,236,558	44.2	Car-Dependent	Tentative	15
Philadelphia	6,051,170	1,560,297	76.5	**Very Walkable**	Moderate	13
Washington, DC	6,033,737	**658,893**	74.1	**Very Walkable**	**High**	1
Miami	5,929,819	430,332	75.6	**Very Walkable**	Low	23
Atlanta	5,614,323	456,002	45.9	Car-Dependent	Moderate	8
Boston	4,732,161	**655,861**	79.5	**Very Walkable**	**High**	3
San Francisco	4,594,060	852,469	83.9	**Very Walkable**	**High**	4
Phoenix	4,489,109	1,537,058	38.3	Car-Dependent	Low	29
Detroit	4,296,611	**680,250**	52.2	**Somewhat Walkable**	Low	22
Seattle	3,671,478	**668,342**	70.8	**Very Walkable**	**High**	6
Minneapolis	3,495,176	407,207	65.4	Somewhat Walkable	Moderate	12
San Diego	3,263,431	1,381,069	48.5	Car-Dependent	Low	24
Tampa	2,915,582	358,699	46.3	Car-Dependent	Low	28
St Louis	2,806,207	317,419	59.8	Somewhat Walkable	Tentative	19
Baltimore	2,785,874	**622,793**	66.2	**Somewhat Walkable**	**Moderate**	11
Denver	2,754,258	**663,862**	55.7	**Somewhat Walkable**	**Moderate**	14
Pittsburgh	2,355,968	305,412	59.8	Somewhat Walkable	Moderate	9
Portland	2,348,247	**619,360**	62.8	**Somewhat Walkable**	**Moderate**	7
San Antonio	2,328,652	1,436,697	33.7	Car-Dependent	Low	27
Orlando	2,321,418	262,372	39.3	Car-Dependent	Low	30
Sacramento	2,244,397	485,199	43.4	Car-Dependent	Low	21
Cincinnati	2,149,449	298,165	50.1	Somewhat Walkable	Tentative	20
Kansas City	2,071,133	470,800	32.1	Car-Dependent	Tentative	17
Las Vegas	2,069,681	**613,599**	38.6	Car-Dependent	Low	26
Cleveland	2,063,598	389,521	56.8	Somewhat Walkable	Moderate	10
Columbus	1,994,536	200,887	40	Car-Dependent	Tentative	16

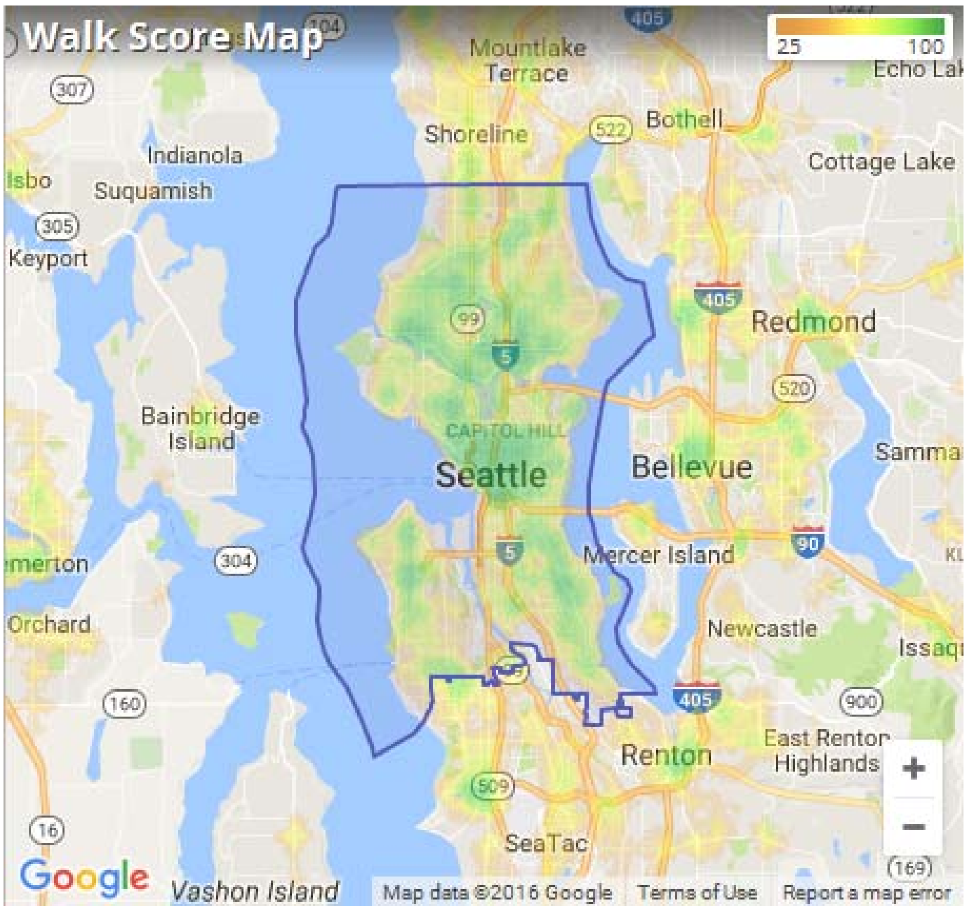
Table 3.2. Commute to work mode share among case study finalist cities (Source: American Community Survey, 2015 5-year estimates).

	Drive	Walk	Transit	Bike
Washington, DC	39.5%	12.9%	37.4%	4.0%
Boston	44.8%	15.0%	33.7%	1.9%
Seattle	58.4%	9.6%	12.9%	3.8%
Baltimore	69.5%	6.7%	18.6%	0.8%
Denver	78.8%	4.5%	6.8%	2.3%
Portland	66.9%	5.9%	12.1%	6.4%

The final criteria for selecting a case city is that they be actively building and investing in public transit on a city and regional scale. For ease, I look only at rail transit investment. Boston has a legacy subway system, and while they are investing in transit, much of the growth of Boston has been based on it having a subway system for over 100 years. The Washington, DC Metro began service in 1976, with a new ling currently being added to five existing ones. The Baltimore light rail began operation in 1992, and current plans only include infill stations on existing routes. Portland MAX began operation in 1986, currently has five lines, and there will be a new line opening in 2025. Denver opened its first light rail line in 1994, and currently has nine routes, three of them having opened in the last two years under the 2005 voter-approved FasTracks initiative which was slated to add 122 miles of rail transit. And lastly, Seattle opened its first light rail line in 2009, with extensions opening in 2016, 2021, and a second lines opening in 2023 and further extensions of both of these over the next 25 years.

In the final analysis, Seattle is the city selected for study. It's 2014 population is 670,000. It is very walkable with a Walk Score of 70.2 in 2015 (increased to 72.9 in 2016) and has a high level of walkable urbanism at the regional level. This combined with the relatively young age of its rail-based transit system and its anticipated future growth make it an ideal case study. Additionally, the level of walking to work is closest to the average of the six finalist cities, which is 9.1% of residents walking to work, while transit use is moderate compared to some of the other cities, such as Washington, DC or Baltimore, which have much higher transit use (Table 3.2). Seattle is a city in transition, moving from highly car-dependent to one that is based more on transit. This means that the findings in Seattle have wider applicability as more cities move to developing more extensive transit systems in the coming decades and transition away from automobile dependence. Additionally, the selection of Seattle as a case study allows for first-hand observation of the impacts of a new light rail extension opening, connecting Downtown Seattle to the University of Washington campus.

Figure 3.1. Seattle Walk Score map.



The next step in the case study selection is selecting neighborhoods within Seattle to study, specifically for neighborhood mapping and pedestrian observations. Seattle offers a number of walkable neighborhoods to choose from, each with a variety of urban forms and public transit options – both of which are important to consider for this study. Overall, Seattle is the 8th most walkable city in the US according to Walk Score (Walk Score 2017). The overall score of Seattle, 72.9, makes it very walkable, which on the Walk Score map is green (Figure 3.1). The city has a very walkable urban core along with many very walkable neighborhoods in North, South and West Seattle. Table 3.3 shows the 20 most walkable neighborhoods in Seattle based on their Walk Score. Ten of these neighborhoods have a Walk Score of over 90, making them 'walker's paradise'. The first nine of them are a contiguous area, and in addition to being highly walkable, these neighborhoods also have very high Transit Scores.

Table 3.3. 20 most walkable neighborhoods in Seattle by Walk Score (2016 rankings).

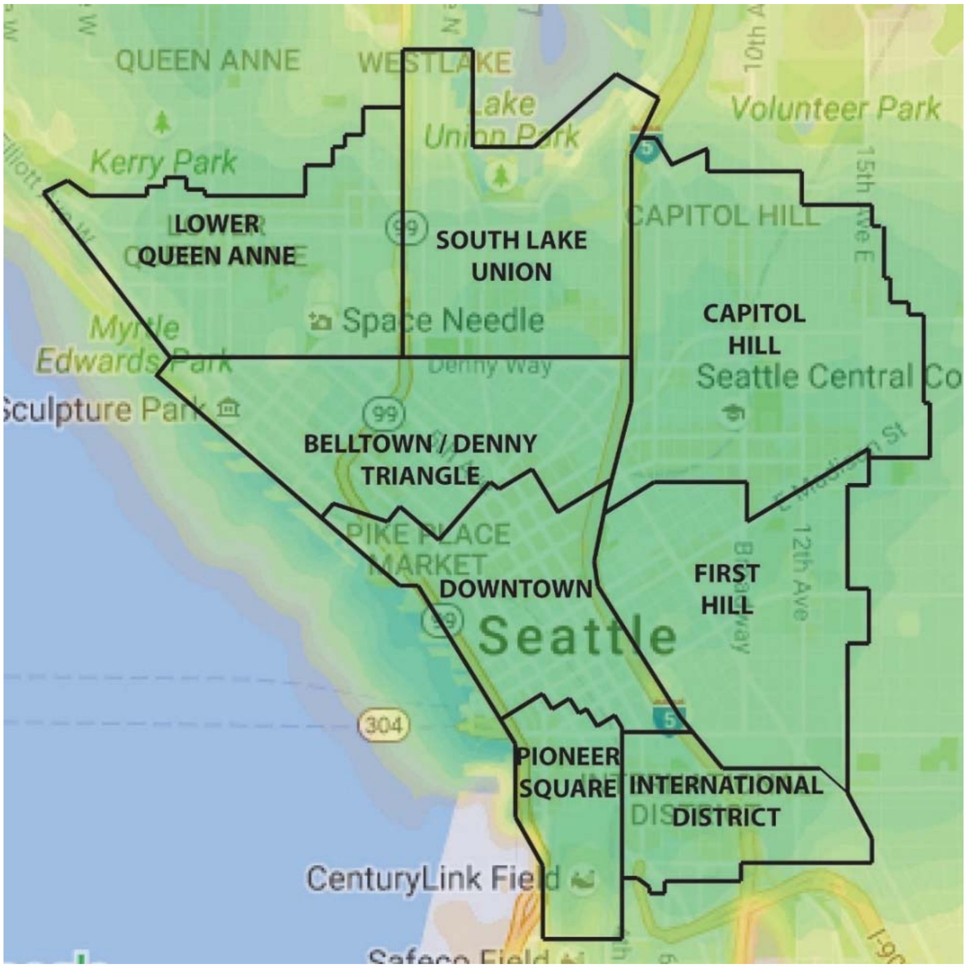
Neighborhood	Walk Score	Transit Score	Bike Score
Downtown	99	100	67
Pioneer Square	98	100	62
First Hill	97	98	74
Belltown	97	98	77
International District	97	100	69
Yesler Terrace	94	98	72
Lower Queen Anne	92	69	56
South Lake Union	92	86	72
Capitol Hill	91	73	69
University District	91	71	85
Central District	88	67	80
Ballard	87	51	80
Greenwood	85	52	72
Fremont	84	58	77
Columbia City	84	59	55
Hillman City	84	54	53
Wallingford	83	59	81
West Queen Anne	82	58	50
Green Lake	81	53	84
Genesee (West Seattle Junction)	81	50	49

An earlier iteration of this project considered comparing neighborhoods in the Downtown core to Columbia City, a neighborhood on the initial segment of the light rail line in South Seattle, Capitol Hill where the new light rail station opened in March 2016, and the Northgate neighborhood in North Seattle that will be getting light rail by 2021. Other neighborhoods considered were Wallingford, North Beacon Hill, and West Seattle. I settled on using the urban core neighborhoods for four reasons. First, these neighborhoods are the most walkable and have high transit accessibility. Second, was that after initial observations, these neighborhoods were found to have the most promise in terms of measuring walking activity. In other words, they had the most numbers of pedestrians compared to other neighborhoods outside the urban core. Third, these neighborhoods make up the urban core, which is an official City of Seattle planning designation. Fourth, was ease of collecting data. The urban core neighborhoods are contiguous, which provided an easier area for doing on the ground mapping and observation of pedestrian activity. In both instances the selection of case neighborhood utilizes a theoretical case replication approach (Yin 2009). This means that because each of the neighborhoods varies in one key way – the types of transit available – I expect to find different results in each neighborhood. The purpose of this is to understand how the availability of transit options in each neighborhood influences travel behavior and walkability.

Table 3.4. Neighborhood populations, densities, and Walk Scores.

Neighborhood	Population	Density (per square mile)	Neighborhood Walk Score
Downtown			
Downtown	4,852	10,832	98
Pioneer Square	1,984	13,023	98
International District	4,259	25,960	97
Belltown	14,326	43,488	98
Denny Triangle	6,740	29,749	98
Capitol Hill & First Hill			
Capitol Hill	20,469	32,839	95
Pike/Pine Corridor	6,491	32,455	95
First Hill	10,701	31,130	95
12th Street	5,354	20,979	95
South Lake Union	8,296	18,684	92
Lower Queen Anne	9,101	24,354	92
Seattle Urban Core	92,962	24,705	96 +/-
City of Seattle (2015)	684,451	8,161	73

Figure 3.2. Seattle urban core Walk Score map with neighborhood boundaries.



The final neighborhoods selected for this study are shown in Figure 3.2. The area encompasses the top nine most walkable neighborhoods by Walk Score and the study area corresponds to the Seattle urban core. The Seattle urban core is a designation the City of Seattle developed in 1994 as part of its comprehensive planning process that created a village planning model for the city (City of Seattle 1994). The urban core is an agglomeration of four of the six urban cores of the city. Within these urban cores, there are several distinct neighborhoods, each with their own character and identity. Each of them is dense, connected, mixed use, and packed with destinations – the hallmarks of a walkable neighborhood. Table 3.4 shows the specific characteristics of each of the urban core neighborhoods. Each neighborhoods also has multiple transportation options, as see in Table 3.5. This makes the urban core an ideal place to study the relationship between walkability and transit use. The next chapter discusses in depth the evolving transportation systems that have shaped the urban form of the urban core and the rest of Seattle.

Table 3.5. Neighborhood transit options.

Neighborhood	Transit Options
Downtown:	
Downtown	Bus, RapidRide, Light Rail, (Ferry)
Pioneer Square	Bus, Streetcar, Light Rail
International District	Bus, Streetcar, Light Rail
Belltown	Bus, RapidRide
Denny Triangle	Bus, RapidRide, Streetcar
Capitol Hill & First Hill:	
Capitol Hill	Bus, Streetcar, Light Rail
Pike/Pine Corridor	Bus, Streetcar
First Hill	Bus, Streetcar
12^{th} Street	Bus, Streetcar
South Lake Union	Bus, RapidRide, Streetcar
Lower Queen Anne	Bus, RapidRide

Methodology

The methodology used in this project is a mixed methods approach, in which multiple tactics are used throughout the study to complement one another and to focus on different aspects of the research question and sub-questions (Groat and Wang 2013). Table 3.6 provides a matrix detailing the research sub-questions, the tactics used to collect the data and the type of analysis used. The sub-questions are in three main categories, which are useful to understand each of the case study neighborhoods and the various ways that people travel in them. The sub-questions focus on identifying the basic characteristics of each neighborhood, the role of transit in each neighborhood and user evaluations of neighborhood and transit characteristics. The specific tactics used include: (1) neighborhood mapping; (2) non-participant observation of pedestrian activity; (3) a survey questionnaire of Seattle residents who live and/or work in the urban core; and (4) in-depth interviews with Seattle residents.

Table 3.6. Research Question Matrix.

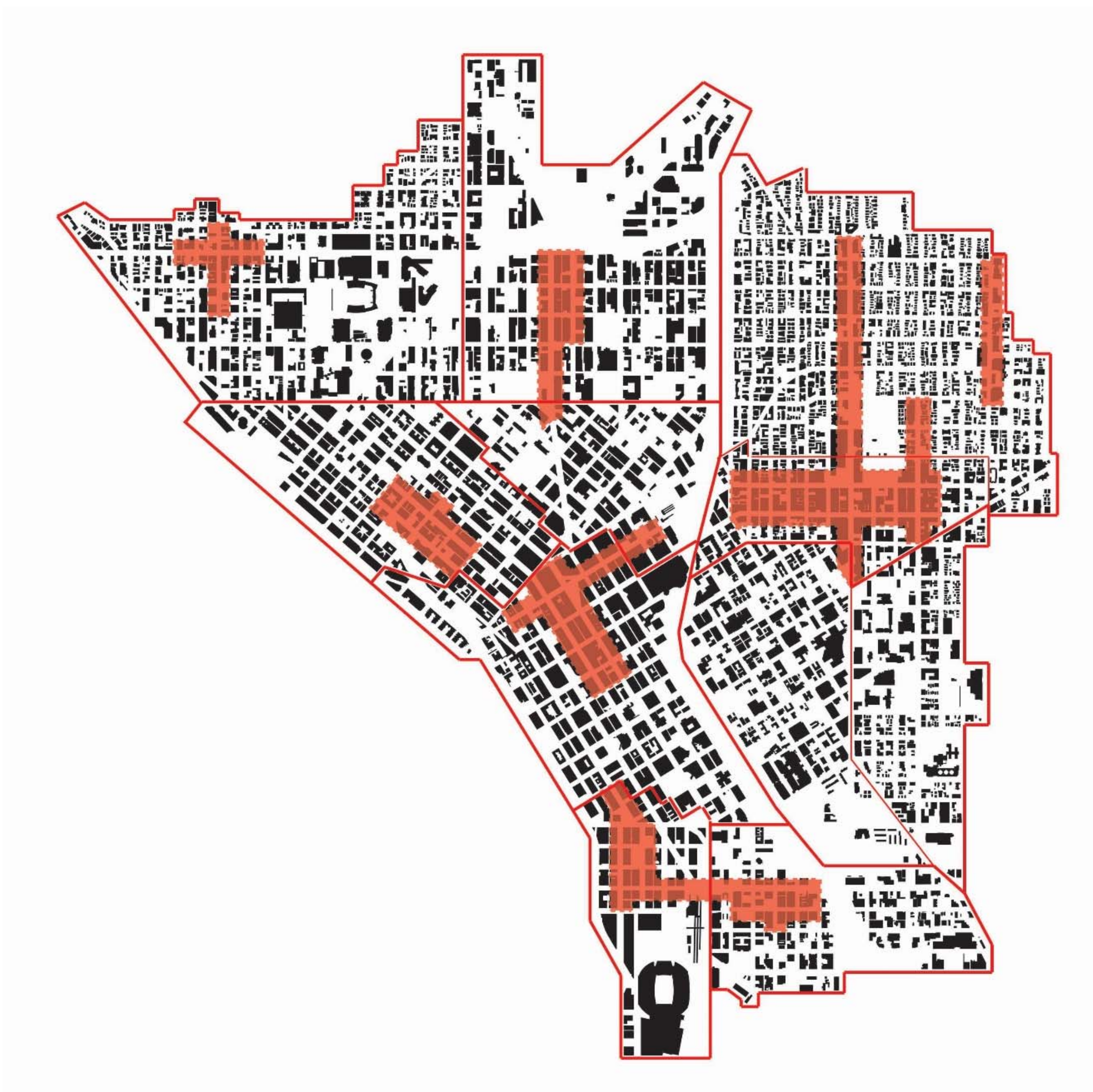
Research Sub-Question	Tactic	Analysis
1. Basic Characteristics of the Neighborhood:		
a. How does each neighborhood vary in terms of quantity and quality of walking and street life? Where in each neighborhood do these activities occur?	Observation Interviews	Descriptive Analysis
b. What are the morphological characteristics of each case neighborhood?	Neighborhood Mapping Observations	Morphological Analysis Descriptive Analysis
2. The Role of Transit and Walking in Each Neighborhood:		
a. **How do pedestrian, transit and automobile infrastructures influence walking and transit use?** To what extent does the location of bus and/or rail affect walking within each neighborhood?	Observation Interviews Surveys	Descriptive Analysis Correlational (?) Content Analysis
b. To what extent have people changed and/or anticipate changing their walking and other travel behaviors based on the availability of transit?	Survey Interviews	Correlational (?) Content Analysis
3. User Evaluation of Neighborhood Walkability and Transit Characteristics:		
a. What are the perceived enablers or barriers to transit use and walking?	Surveys Interviews	Descriptive Analysis Content Analysis
b. How do users evaluate the physical and social aspects of each neighborhood; and what specific qualities are most important to their satisfaction?	Survey Interviews	Descriptive Analysis Correlational (?) Content Analysis

Identifying the characteristics of each neighborhood is essential for understanding how the form of the neighborhoods vary in order to determine differences between walkable neighborhoods. Second, the physical characteristics are need in order to assess the extent to which they affect travel behavior. The sub-questions addressing this area deal with the morphological characteristics of the neighborhoods and walking activity in each. The second group of sub-questions deal specifically with transit in each neighborhood. The study's main emphasis is on the link between transit and walking and so understanding the circumstances under which people use transit is essential. The third set of sub-questions provide data on the evaluative understanding of walking and transit in each neighborhood. This includes perceptual aspects of the built environment, such as enablers and barriers to different modes of transport, as well as resident and user evaluation of the built environment and social characteristics of each neighborhood in terms of how they influence walking and transit use.

Neighborhood Mapping

Mapping is a well-established tactic within environment and behavior research that seeks to show how different aspects of the built environment relate to human behavior (Whyte 1980). The main objective of the neighborhood mapping is to complete a morphological analysis. Several studies serve as a model for this part of the mapping. A study of creative clusters in Sydney and Melbourne serves as a model for this morphological mapping in which the researchers looked at ground floor functional mix, lot size, building age, building height, and street interfaces (S. Wood and Dovey 2015). Jan Gehl's methods for assessing the pedestrian realm and public space are also useful as they focus on the infrastructure of walking as well as various urban design qualities (Gehl and Svarre 2013; Gehl 2010). I also draw on the theory of urban fabrics (P. Newman, Kosonen, and Kenworthy 2016; P. Newman and Kenworthy 2015) to determine what I mapped. In their work, the authors provide detailed characteristics of each urban fabric – pedestrian, transit and automobile – which they argue are distinct and need different planning approached. Another methodology used to developed the mapping variables comes from *The Urban Section* (Mantho 2015), which proposes using sectional diagrams of streets in order to examine the relationships between several urban design characteristics. Some of the elements included in this method include orientation, proportion, scale, horizontal and vertical layers, public/private character, the spatial definition, enclosure and exposure, base of the street wall, façade articulation, transparency, and volumetric interaction.

Figure 3.3. Seattle urban core with neighborhood boundaries and 110 blocks chosen for detailed mapping and observation.



In this study, three full-scale maps of the study detail key morphological features: land use, building age, and building height. These three characteristics provide important information for analyzing overall morphological patterns as well as identifying key parts of each neighborhood for more detailed block mapping and observation. These maps are used to identify activity centers, levels of interactivity between buildings and public space (i.e. the street), and complexity. Through these maps and personal observation and verification of the study area, I identified 110 blocks for more detailed mapping and later observation (Figure 3.3).

The blocks identified for detailed mapping and observation are located in seven neighborhoods: Capitol Hill (including the Pike/Pine Corridor), South Lake Union, Lower Queen Anne (also Uptown), Belltown, Downtown (the commercial core), Pioneer Square, and the International District. After careful consideration, I decided not to include the First Hill neighborhood (including the 12th Street sub-neighborhood) in the detailed mapping analysis. Although it meets many of the requirements of the study – being a dense walkable neighborhood – it is highly institutional, with three large regional hospitals, a university, and a large swath of vacant land where the city is currently redeveloping its largest low-income housing project. These uses account for over half of the area of the neighborhood. Additionally, after verification, I determined that pedestrian levels were not high enough to add significantly to the study.

For each of the 110 blocks selected, I mapped and analyzed a number of physical characteristics. These are broken into three main categories: pedestrian oriented infrastructure, public transit infrastructure, and automobile oriented infrastructure. Each neighborhood, while being outwardly walkable, offers very different characters in the degree to which they emphasize pedestrians, transit or the automobile. By distinguishing between infrastructures associated with each mode of transportation, I am able to analyze the impact on walking, and thus the extent to which the modes of transportation work together or conflict with one another. The emphasis on the different types of infrastructure that support different modes of transportation comes, in part, out of the theory of urban fabrics (P. Newman, Kosonen, and Kenworthy 2016; P. Newman and Kenworthy 2015), which I discussed briefly in Chapter 2. The measurement and analysis of the components of the physical street environment is not new and numerous research projects, often on urban design topics, have explored a range of phenomenon by studying similar variables. What is different in this project is that I am using these variables to assess travel behavior and not urban design characteristics of the urban environment.

Table 3.7. Sources of data for neighborhood mapping.

Source	Purpose
King County Assessor GIS maps	Land Use, Building Function, Building Age
City of Seattle Zoning Map	Land Use, Function
City of Seattle Land Use Maps	Land Use
Google maps and Google Earth	Land Use, Function, Building Height
Personal Observation	Function, Building Height

Table 3.8. Block mapping physical characteristics

Number of Buildings
Number of Destinations, ground floor
Number of Destinations, total
Public Seating
Other Seating
Number of Trees
Width of Sidewalk, average functional width
Transit Stops, types
Transit Stops, amenities (i.e. seats and shelters)
Number of Driveways
Number of Parking Lots
Amount of Street Parking

Observation

Observation is the primary method by which I will document behavior and activities in the neighborhoods selected for mapping. Nonparticipant observation is a commonly used method in the social and behavioral sciences (Zeisel 2006) which differs from participant observation due to the level of interaction with the people whose behavior and activities are being documented. The behavioral mapping used in this project provides observations of pedestrians and transit users on each of the 110 blocks selected. A secondary observation includes mapping other types of street life other than walking or transit use.

I conducted the observations between September 3, 2016 and November 13, 2016. I selected four times of day for observation and each had three separate observations, for 12 total observations per block. The times of day included three weekday observations: morning (7am to 10am), afternoon (Noon to 3pm), and evening (4pm to 7pm); and one weekend observation (2pm to 6pm). I conducted each of the three separate observations for each block at different times during each observation window in order to average pedestrian and transit usage over the entire morning, afternoon, evening or weekend window. I observed each block for either 4 minutes or 6 minutes, depending on whether it was a “short” or “long” block. Short blocks are 240 feet long, while long blocks are 360 feet long. A small number of blocks are slightly different sizes than these and I adjusted observation times accordingly. For the analysis, pedestrian counts were standardized to “pedestrians per hour” in order to account for the different block sizes throughout the neighborhoods. I counted pedestrians by standing at the midpoint of each block and tallied as they crossed the midpoint of the block. Direction of movement (north/south or east/west) and what side of the street was included in the observations. For transit users, I counted those waiting, getting on or off, and the mode of transit they were using.

The neighborhood mapping and pedestrian and transit user observations are analyzed both descriptively and statistically. *R Studio* serves as the analysis software for OLS regression and multiple regression in the quantitative portion of the analysis discussed in the following chapters.

Table 3.9. Demographic details of survey respondents.

Gender	Number of Respondents	Percent of Respondents
Male	123	49.4%
Female	124	49.8%
Other	2	0.1%
Age		
18-25	20	8.0%
26-35	82	32.9%
36-45	50	20.0%
46-55	47	18.9%
56-65	21	8.4%
Over 65	29	11.6%
Race		
Caucasian/White	215	86.4%
African American/Black	7	2.8%
Asian/Asian American	5	2.0%
Latino/Hispanic	7	2.8%
Other	15	6.0%
Marital Status		
Single	94	37.8%
Married or Living with Partner	155	62.2%
Work Status		
Full time	170	68.3%
Part time	27	10.8%
Self employed	22	8.8%
Unemployed	6	2.4%
Student	21	8.4%
Stay at home parent	6	2.4%
Retired	33	13.3%
Education		
Less than high school	0	0.0%
High school graduate	1	0.01%
Some college	30	12.0%
College graduate	99	37.8%
Graduate or professional degree	119	47.8%
Income		
Less than $10k	7	2.8%
$10k to $25k	8	3.2%
$25k to $50k	31	12.5%
$50k to $75k	40	16.1%
$75k to $100k	43	17.3%
$100k to 150k	56	22.4%
Over $150k	64	25.7%

Survey

The survey tactic has several goals: to identify travel behaviors among Seattle residents, specific habits for walking and transit use; and attitudes about transit use. I initially intended to conduct the survey with pedestrians walking on the street and keep it under 5 minutes in length. I conducted a pilot of this paper-based survey in early August 2016 in order to test the questionnaire itself and my approach to soliciting responses. After the pilot, which only included 25 respondents, I decided this approach would not work well in Seattle or within my timeline for completing my fieldwork if I had to both conduct surveys in person and conduct my observations. I altered the survey to be internet based, using *Survey Monkey*. During the conversion to an online survey, I decided to lengthen the survey, which I justified because respondents could now answer at their leisure at home and not on the sidewalk. I also decided upon this approach since the paper-based version would take a significant amount of time that I would otherwise spend conducting observations.

The final survey questionnaire, included in Appendix 1, has 59 total questions. Using the *Survey Monkey* logic feature, I was able to have respondents answer follow-up questions depending on their answers to certain questions. When accounting for this, the survey includes between 45 questions and 55 questions. The questionnaire design follows well-established rules discussed in literature (Fife-Schaw 2006; Zeisel 2006). The survey contains multiple choice questions, Likert scale questions and open-ended questions. It took most respondents between 15 and 20 minutes to complete. I developed the survey questions myself, using previous research as a guide as to the types of questions to ask and the appropriate phrasing. No single research study served as the basis of the questions I developed for this project. Demographic questions and available answers mirror those of the US Census so that I could compare them to other surveys that tend to do this as well.

I recruited survey participants from three separate avenues. First, I distributed flyers to pedestrians, transit users waiting at bus and rail stops, and put flyers on cars in each neighborhood. In total, I distributed approximately 2,000 flyers. I also distributed a link to the survey through the Seattle Neighborhood Greenways (SNG) email listserv. Seattle

Neighborhood Greenways is a community organization that advocates for bicycle and pedestrian safety. The City of Seattle formed the group as a way to share responsibility and gain community input into developing a citywide bicycle network of community greenways. Each neighborhood in Seattle has its own SNG group and each shared the link for the survey. The third method I utilized was *Next Door*, an online community that links neighbors together and allows them to share safety concerns, post events, and other classified ads. The website only allows you to post to neighbors in your own neighborhood and nearby neighborhoods, which in my case was access to roughly 4,000 residents. I was able to persuade several members of the Central Seattle Greenways group to repost the survey link to their own neighborhoods and nearby neighborhoods, which extended the reach of this. I attempted several times to contact groups that have the ability to send messages to all the neighborhoods in the City, such as the Seattle Police Department, Seattle Public Utilities, Seattle Department of Neighborhoods and City of Seattle. Unfortunately, these public organizations have policies against sharing messages, such as for this survey. In total, 363 people started the survey between September 1, 2016 and November 30, 2016 and 249 people completed the survey.

Interviews

The final tactic used in this project is an in depth interview of residents and users of the urban core neighborhoods. The emphasis of the interviews is on how people engage in walking and street life activities and their transit use. I solicited Interview participants through the survey. The final question provided a short summary of the interview and asked for the participant's contact information if they were interested in doing an interview. Out of the 249 people who completed the survey, 87 people indicated interest in the interview. After three rounds of emails seeking interview participants, I was able to conduct 43 interviews. Each interview took between 30 minutes and one hour. I had each interview transcribed. To assist in analysis of the interview data, I used *Dedoose*, a web based qualitative data analysis program.

The interview itself is a semi-structured format (Bernard 2011; Roulston 2010) comprised of two mapping exercises and questions targeted at three thematic areas. The semistructured format of the interviews means that there is a general script or themes that I address (Bernard 2011; Roulston 2010). The interviewing approach utilized in this project is predominantly phenomenological (Roulston 2010). This type of interview is used "to generate detailed and in-depth descriptions of human experiences (Roulston 2010, 16–18)." Within this project, the interviews emphasize residents' experiences of the urban environment as they relate to their travel behavior. Questions where primarily open-ended, which allows for the respondents to answer questions in their own words (Roulston 2010). I engage interviewees in a conversation about their walking experiences, experiences of using public transit, and of driving and how and where in the urban fabric these experiences have occurred. Additionally, mapping as an interview technique to understand a phenomenon has been widely used by urban designers, architects and planners (Lynch 1960; Lusk 2001). The first mapping exercise focuses on travel in the urban core area of Seattle, with an emphasis on walking. In this part, I ask participants about their frequently used walking routes, the things they like on these routes, what they like and do not like, the types of places they go out of their way to see or avoid and places that are either safe or unsafe. Participants used different color markers on the maps to indicate the topics we discussed. Interviewees used green for areas they enjoy walking in, red for areas they dislike, yellow for frequent destinations, blue for transit, and orange for biking. If alternate colors were used, the interview transcripts indicate the colors used.

The second mapping exercise emphasizes transit use by allowing participants to map an ideal transit system in Seattle that meets their needs and to talk about it characteristics, such as mode of transit, routes, stop spacing and the like. By talking about transit in these terms, I am able to understand what works about the existing transit system and what does not. The final segment of the interview is about driving. This segment is the most flexible of the three depending on each participants overall travel behaviors. Several participants do not drive at all, or have given up driving, so we discuss that. In general, I ask about places that participants have a difficult time getting to on transit, places they drive to frequently, why they choose to drive over another mode of transportation, and what transit might have to look like for them to give up driving. For those who bike regularly, I spend more time talking about cycling, since it is a distinct mode of transportation and has important implications for transit use and walkability.

Table 3.10. Interview respondents' demographic statistics.

	Gender	Age	Race	Income	Car	Neighborhood (Zip Code)
1	Male	46-55	White	over 150k	Yes	98101 / core
2	Male	over 65	White	50k-75k	No	98102 / core
3	Female	over 65	White	100k-150k	No	98102 / core
4	Male	46-55	White	over 150k	Yes	98112 / core
5	Female	over 65	White	100k-150k	Yes	98101 / core
6	Female	over 65	White	100k-150k	Yes	98102 / core
7	Male	36-45	White	50k-75k	No	98177
8	Female	26-35	Mixed	100k-150k	No	98103
9	Male	26-35	White	over 150k	Yes	98144
10	Male	46-55	White	100k-150k	Yes	98106
11	Male	26-35	White	100k-150k	Yes	98109
12	Male	36-45	White	100k-150k	Yes	98126
13	Male	46-55	White	25k-50k	No	98121 / core
14	Male	56-65	White	25k-50k	No	98104 / core
15	Male	46-55	Black	50k-75k	No	98122 / core
16	Female	35-49	White	25k-50k	No	98122 / core
17	Female	Over 65	White	NA	Yes	98122 / core
18	Female	26-35	Latina	50k-75k	No	98102 / core
19	Male	40ish	White	over 150k	Yes	98122 / core
20	Male	56-65	White	less 10k	No	98115
21	Female	46-55	White	10k-25k	No	98104 / core
22	Male	46-55	Black	50k-75k	No	98122 / core
23	Female	36-45	White	over 150k	Yes	98101 / core
24	Female	over 65	White	75k-100k	No	98102 / core
25	Female	46-55	White	100k-150k	Yes	98122 / core
26	Female	56-65	White	25k-50k	Yes	98103
27	Male	35-49	White	75k-100k	No	98122 /core
28	Female	over 65	White	75k-100k	Yes	98122 / core
29	Female	46-55	White	75k-100k	Yes	98199
30	Male	46-55	Latino	75k-100k	Yes	98104
31	Male	36-45	White	100k-150k	Yes	98118
32	Male	26-35	White	75k-100k	No	98102 / core
33	Male	36-45	White	over 150k	Yes	98112 / core
34	Female	36-45	Black	25k-50k	Yes	98122 / core
35	Female	36-45	White	over 150k	Yes	98122 / core
36	Male	26-35	White	100k-150k	No	98101 / core
37	Other	36-45	White	over 150k	Yes	98122 / core
38	Male	26-35	White	less 10k	No	98122 / core
39	Female	26-35	White	over 150k	No	98117
40	Male	26-35	White	over 150k	Yes	98126
41	Female	over 65	White	100k-150k	Yes	98112 / core
42	Male	18-25	White	50k-75k	Yes	98122 / core
43	Male	18-25	Asian	50k-75k	No	98115

Conclusion

The research design for this dissertation project is a nested case study examining walking and transit use in Seattle and urban core within the city, a cluster of dense walkable urban neighborhoods. The methodology employs several tactics common in urban planning and design research, and environment and behavior research – research that explores how the built environment influence behavior. In this study, the behaviors studied are walking and transit use, and the relationship between them. The study uses neighborhood mapping, observations of pedestrians and transit users, a household survey, and interviews. The goals of these tactics is to address the main research question: *How does access to different types of transit affect quantity and quality of walking and street activity within and between different types of walkable urban neighborhoods?* This question is broken into several sub-questions, each of which address separate components of the project: the built environment characteristics of the neighborhoods, variations in walkability, the role of transit, and an evaluative understanding of the walkability of each neighborhood and their transit options. The theory of urban fabrics provides a framework for operationalizing the built environment, which results in an analysis of different types of infrastructure – pedestrian infrastructure, transit infrastructure, and automobile infrastructure. The next chapter explores the case of Seattle, detailing its transportation, land use and urban form history as well as an introduction to policies currently used to promote walkability and transit use in the urban core and throughout the city.

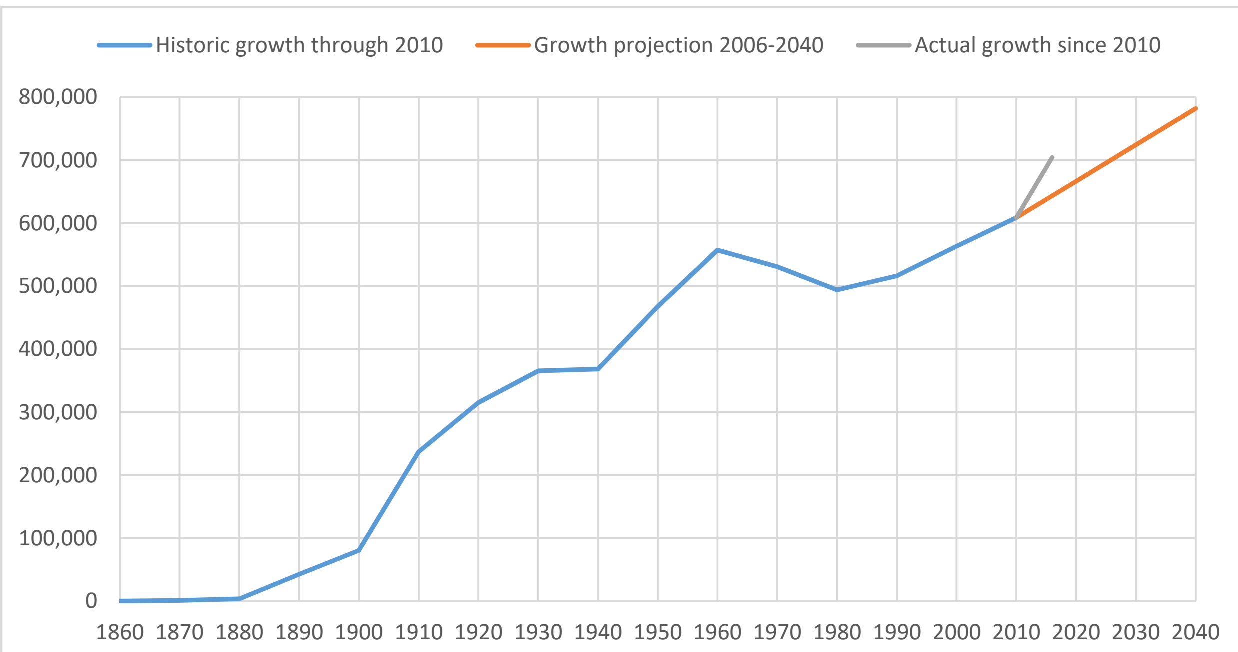
Chapter 4

Case Study: Transport Planning and Urban Form in Seattle

Nestled between the Puget Sound and Lake Washington in the Pacific Northwest state of Washington, circled by snowcapped mountains and pine forests, is the City of Seattle. Settled in the early 1850s and incorporated in 1869, much of the early history of Seattle is as a timber town, which fueled periods of economic boom and bust, a pattern of economic growth and development that continued throughout the 20th century as the economy evolved. Both the built environment and the city's investments in transportation infrastructure reflect this. The first part of this chapter traces the history of transportation planning in Seattle and the evolution of its urban form. Over the 20th century, Seattle has proposed many innovative transportation plans, but each successive plan failed to be realized, leaving present-day Seattleites in the midst of a *transportation crisis*. This transportation crisis stems from three related factors. First from the city's inability to adequately plan for alternative modes of transportation in the second half of the 20th century. Second, the crisis stems from rapid population growth since 2010, at nearly twice the projected rate anticipated in 2006, which has put pressure on roads, transit and housing, and showing no signs of slowing down. Third, the crisis is the result of the city's continuing inability to effectively plan for new transportation infrastructure within a short span of time and in places where it is needed. The consequence of this is a disjointed approach to transportation planning that emphasizes prioritizing sustainable modes of transportation, but has little to show for it in the built environment.

The second part of this chapter discusses the present state of transport planning in the City of Seattle and its relationship with other elements of city building, including land use, housing, environmental concerns, and open space, as well as social equity concerns present in the city today. The case of Seattle is one of a city in the middle of a transportation crisis and unsure of what to do. It shows a city that is both innovative and attempting to forge a new way forward, but also one that is bound by entrenched planning practices in its transport sector. It is a city full of contradictory planning and transportation policies. It is a city that is willing to experiment on a small scale with new and innovative transport policies, a practice that I conclude has come out of a long history of failed plans that would have drastically altered the historical development of Seattle. Residents of Seattle have long denied the fact that their city is growing and changing around them, and the slow incremental approach to transportation that has evolved as a result is no longer adequate if the city is to remain a vibrant and livable city for current and future residents.

Figure 4.1. Seattle historic population growth, 2006-2040 population projection, and actual growth. Source: US Census, City of Seattle.



Early Seattle: A Timber Town Thrives, 1850-1890

Present-day Seattle was first settled in the early 1850s with a series of encampments, eventually resulting in the permanent settlement on Elliot Bay in what is now Pioneer Square. The Denny Party relocated from their original site at Alki Point in 1851 to what became downtown Seattle in spring 1852. The first plats for the city were filed in 1853, with three key figures owning title to the townsite: Arthur Denny, Carson Boren, and David Swinson "Doc" Maynard. Maynard's land encompassed the land south of Yesler Way in what became Pioneer Square and Chinatown and the streets were laid out following the cardinal directions. The land north of Yesler Way, owned by Denny and Boren was laid out in a grid that followed the coastline: 32 degrees west of north and 49 degrees west of north from Stewart Street to Denny Way. As the city grew beyond these confines towards the end of the 19th century, the rest of the city was laid out of a grid oriented north to south. Maynard, Denny and Boren all competed to have the new city's downtown built on their land. Eventually, Denny would prevail in this, with the business district being built just north of Yesler Way along the waterfront.

Figure 4.2. Seattle in 1878.

Between 1880 and 1890, the population of Seattle boomed from only 3,500 residents to nearly 43,000 people. This boom saw the rapid construction of new buildings, which can be seen in the differences between Figure 4.2 and figure 4.3. Seattle in 1889 was a thriving city with a bustling downtown commercial center. The growth of Seattle in these early decades was driven by the timber industry. The timber milled here was used in the building of Seattle itself and imported to San Francisco, Hawaii and Australia (Caldbick 2014). At the waterfront at the end of present day Yesler Way, Henry Yesler built a steam powered lumber mill in the 1853 (Caldbick 2014). In order to operate the mill, Yesler built the city's first water supply system, a rudimentary system of flumes, which would later be replaced with underground log pipes.

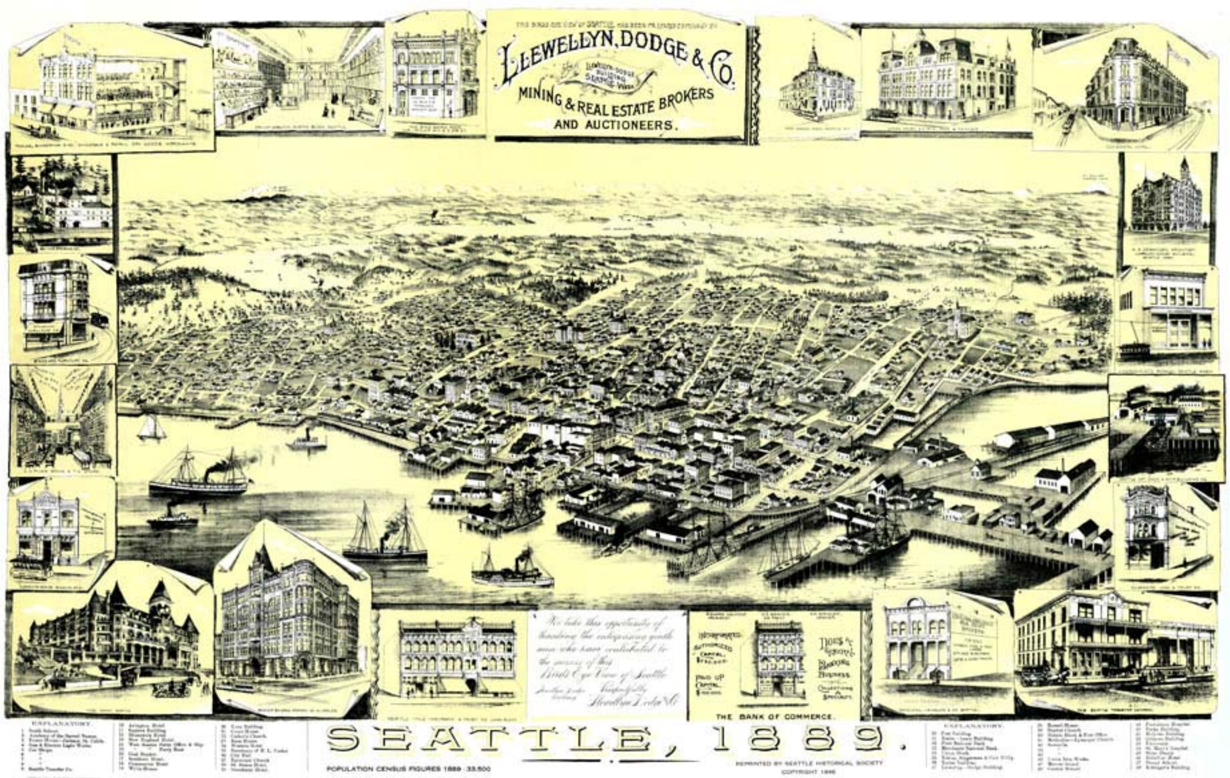


Figure 4.3. Seattle in 1989.

During the booming 1880s, the City saw its first public transportation system. In 1884, Frank Osgood began operating a horse-drawn trolley with tracks laid in the muddle streets and fares costing five cents (*The Seattle Times* 2007). The hilly topography of Seattle proved challenging for the horses, which led to the development of two cable car lines connecting Pioneer Square to Lake Washington via Yesler Way and Madison Street (*The Seattle Times* 2007). Osgood's Lake Washington Cable Railway, which began operation in 1887 ran alongside the horse-drawn trolleys which were still able to operate on the mostly flat north to south streets. In 1889, Osgood began operation of the City's first electric streetcar and within days the horse-drawn trolleys were retired, making Seattle the first US city on the West Coast to offer a fully electric streetcar system (*The Seattle Times* 2007).

Figure 4.4. Seattle's first horse-drawn streetcar, circa 1884.

On June 6, 1889, disaster struck the young city as a fire broke out in a cabinet shop in the middle of the central business district (G. Lange 1999). The fire quickly spread to surrounding buildings as the entire business district was built of wood. Even the streets had wooden sidewalks and layers of wood shavings and sawdust to make the streets less muddy (a nearly impossible feat in Seattle). As firemen attempted to put out the blaze, the water pressure in the fire hydrants and hoses dropped, leaving firefighters without sufficient water to fight the fire ("The Great Seattle Fire," n.d.). Within a couple hours the fire had engulfed the core of the central business district and by the evening, the wharves, commercial areas south of Yesler, and the railroad stations. In all, 120 acres had been destroyed and no one had been killed ("The Great Seattle Fire," n.d.). As was the case with other cities that had suffered fires such as this, the city was reshaped in its aftermath, and many credit the Great Fire for transforming Seattle from a small town into a city.

Reshaping the City: A Booming City Grows, 1890-1940

In the wake of the Great Fire, the landscape of Seattle was forever transformed. As was the case in other cities, Seattle banned the construction of wood buildings in the area destroyed by the fire – only brick or stone would be allowed ("The Great Seattle Fire," n.d.). The city also took the opportunity to solve two long standing problems in the central business district – a hilly topography and poor streets due to the low-lying tidelands this part of the city was originally built on. As a result, city officials decided to raise the level of the streets, between one and two stories above their previous levels ("The Great Seattle Fire," n.d.). Within a year, 465 buildings had been built, seen in figure 4.5. However, the raising of the street was going to take longer, so building owners were told to include entrances at the new street level, as well as the old. Engineers created concrete walls to raise the road levels, meaning that people had to climb up and down ladders to cross the street. Eventually, the lower sidewalk was sealed over with new sidewalks on the new street level, but the underground spaces remained to be used until 1907 when they were condemned after a scare with bubonic plague.

Figure 4.5. Seattle in 1891, only two years after the Great Fire of Seattle.

In 1896, gold was discovered in the Klondike region of Canada, and Seattle would become a main starting point for a significant number of the 100,000 prospectors who wanted to travel north. The new central business district rebuilt after the fire was well equipped to handle the huge flow of people and goods to the Klondike, as each person was required to bring with them a year's supply of food. During the three years of the gold rush, many Seattleites struck it rich, not from gold, but from selling supplies to those travelling north to find their fortune. Additionally, many of those returning from the north ended up settling in Seattle permanently, adding to the growth of the city. During the first decades of the 20th century, Seattle used this newfound wealth to become a world class city, going so far as to host a World's Fair in 1909 alongside London, New York and San Francisco. The changes seen in the city are reflected in its urban form – its streets, its topography, its public spaces and its transportation.

The City of Seattle had its first park in 1884 when it converted its then cemetery into a park and added to this with land acquired in 1887 on Queen Anne Hill and Capitol Hill (Williams, n.d.). At the turn of the 20th century, many city residents saw the need to develop a more extensive park system throughout the city. The Seattle Board of Park Commissioners hired the Olmsted Brothers in 1903 to design a world class park system which would bring an air of distinction to the growing city (Williams, n.d.). The plan developed by Charles Olmsted (figure 4.6) included not only the placement of parks but also a system of parkways to link them together. The plan encouraged the city to acquire new land for parks, which was done over the next several years after voters approved a $3.5 million bond (Williams, n.d.). The plan aimed to protect many natural areas, hillsides, and areas with mountain and water views. One of the centerpieces of the plan was a 20-mile parkway that would link parks on Lake Washington to the Puget Sound, winding its way through many existing and new natural areas and parks (Williams 1999). Much of this parkway was built along Lake Washington, as were pieces of other parkways, but the full network was never completed. . Among their many parks and parkways, the Olmsted Brothers also designed the grounds for the Alaska-Yukon-Pacific Exposition in 1909, which would later become the University of Washington campus. The plan developed in 1903 was never fully realized, even though the Olmsted Brothers continued working in Seattle until 1941 (Williams 1999). But many components were built that have left Seattle with one of the most extensive collections of parks and parkways designed by the Olmsted Brothers and much of the work done by the Olmsted Brothers has had a lasting impact on the urban form of Seattle.

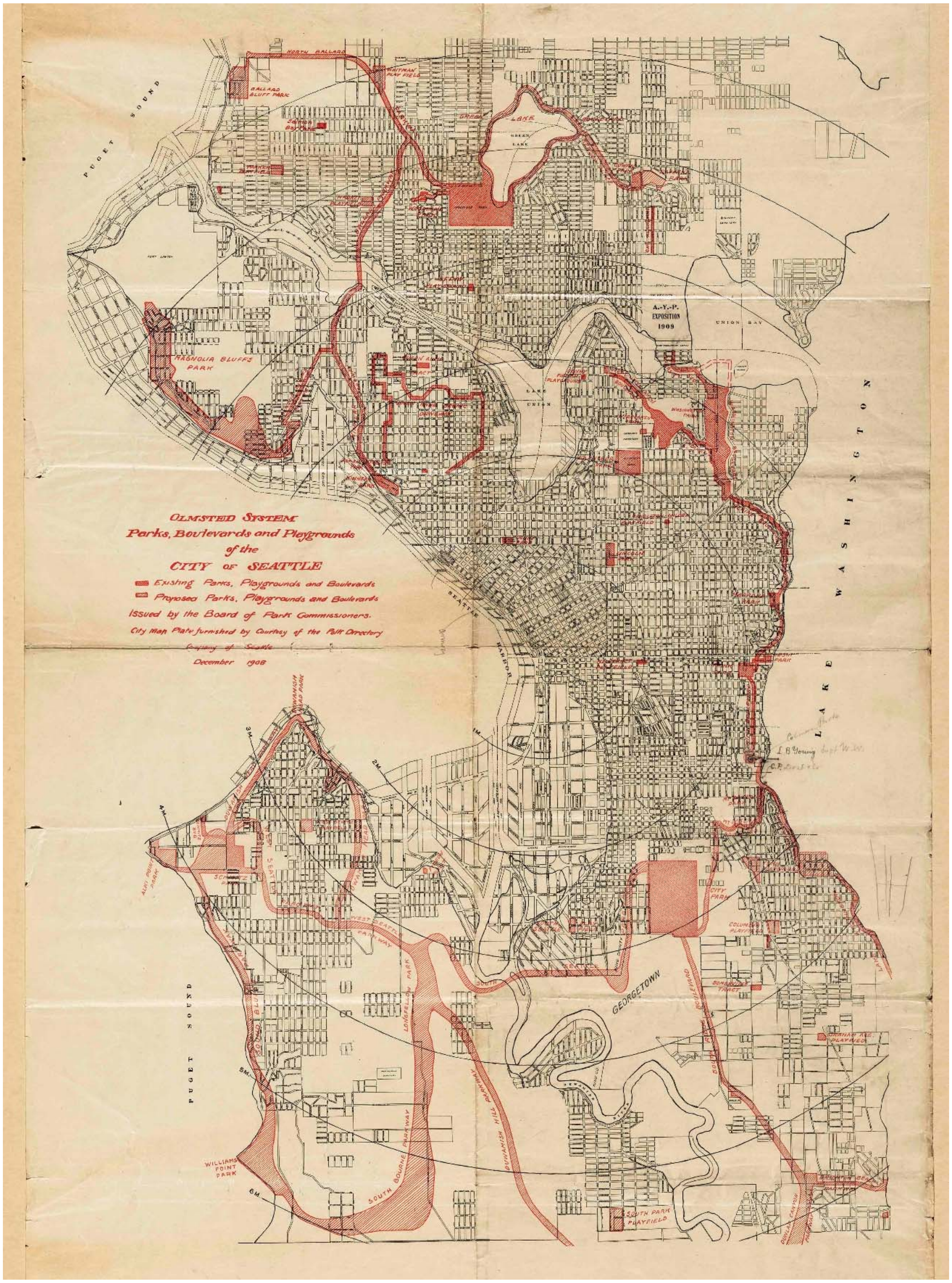


Figure 4.6. Map of proposed Olmsted Brothers parks and parkways.

In the first decade of the 20th century, city engineer R.H. Thomson wanted to facilitate the northward expansion of downtown. Denny Hill lay in his way. His solution was to convince city leaders to level the hill, which commenced in 1902. The hill, which rose gradually from the east to 5th Avenue and then more steeply to 2nd and ending in a steep cliff between 1st and 2nd Avenues. This cliff effectively isolated the small neighborhood of Belltown to a two-block area along the water and, in R.H. Thomson's view, limited the potential of the city to expand north (Crowley 1999). First Avenue was regraded between 1897 and 1899 providing a more workable commercial area for the neighborhood. Then between 1902 and 1911, the first phase of the regrade project was responsible for demolishing numerous buildings as the hill was sluiced into Elliot Bay (Crowley 1999). Property owners who did not want to relocate or sell their property had the hill removed around their property and in some cases even removed beneath their buildings (*Seattle Post Intelligencer* 2011). Between 1929 and 1930, the rest of the hill east of 5th Avenue was also removed. Although these regrade projects provided a blank slate of real estate ready for the expansion of Downtown several factors prevented this from happening (Crowley 1999). The automobile facilitated the development of land further away from the city center and negated the need for having regraded the hill in the first place (Crowley 1999). Secondly, the development of skyscrapers allowed businesses to remain concentrated in the original confines of Downtown, negating the need to expand northward (Crowley 1999). The area became populated with car dealerships, hotels, cheap apartments and parking lots to service downtown.

In 1911, at the completion of the first regrade project, municipal planning director Virgil Bogue proposed a new plan for the land cleared: a civic center (figure 4.9). This proposal was part of Bogue's 1911 *Plan of Seattle*. The plan was one of the many city beautiful plans completed in US cities in the first decades of the 20th century. In addition to the civic center, the plan proposed improvements to the city's parks, highways and streets, harbors and ports, and the transportation network (Bogue 1911). The plan included what would have been a 90-mile network of subway rail running on 21 different routes (Englehardt 2017), which would have supplement then existing and proposed streetcars and interurban rail service. For a city of less than a quarter million and a region of just under half a million people in 1910, this plan was extremely ambitious. Ultimately the plan was rejected by voters in 1912 over confusion about costs and a campaign by Downtown business owners who feared the plan would devalue their land in the existing central business district with the relocation of municipal buildings and a new central train station on South Lake Union (McRoberts 1998). Certain elements of the plan reappeared in later civic works projects, including several street widening projects, new bridges, and the placement of highways throughout the region.

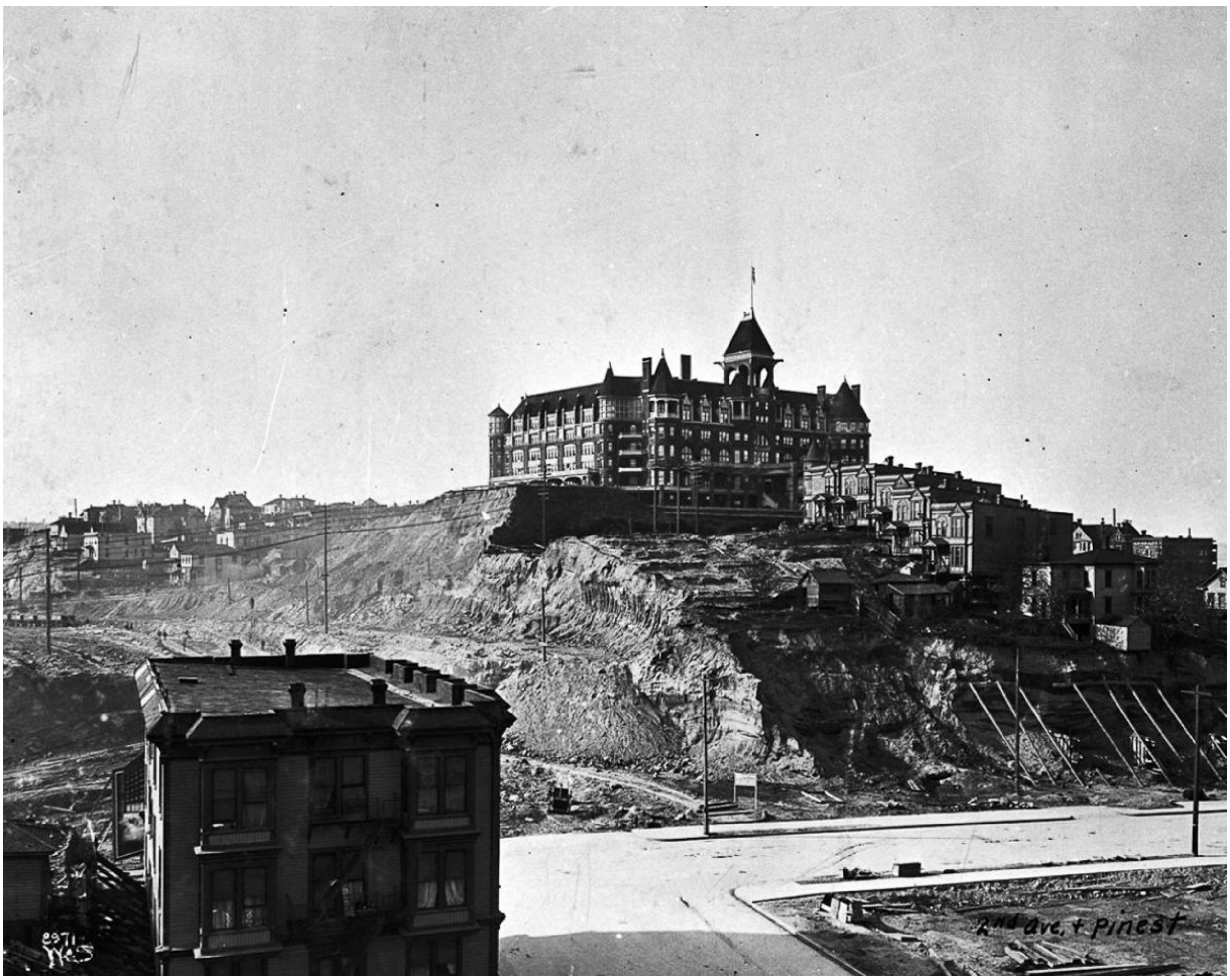
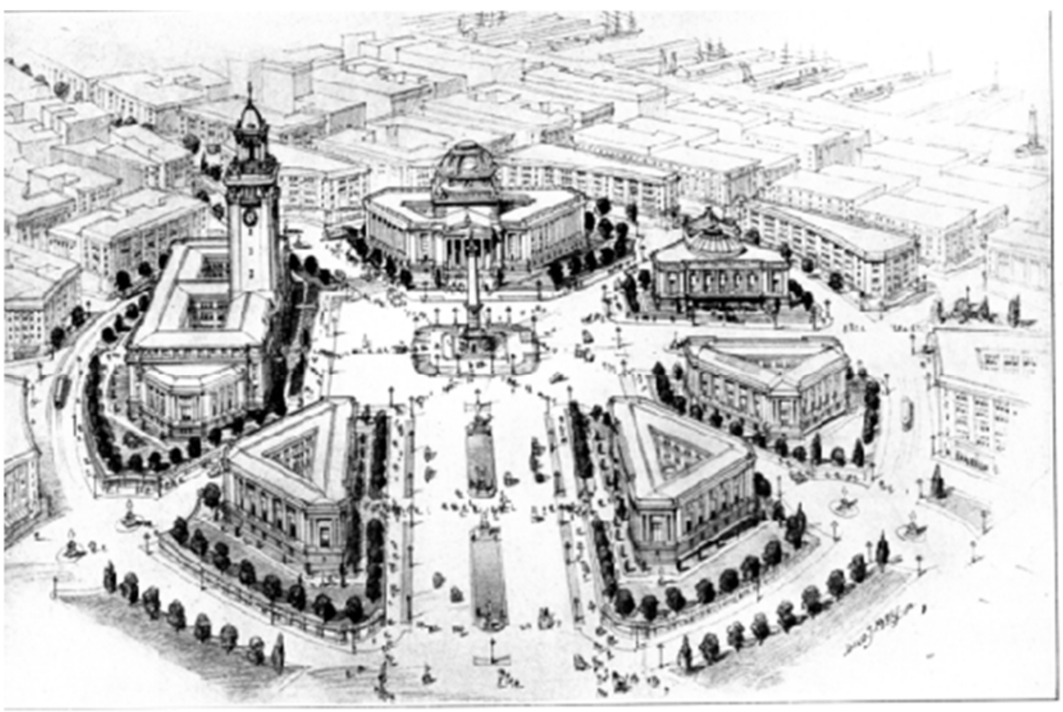


Figure 4.7. The Denny Hotel seen from 2nd Avenue and Pine St, on top of part of Denny Hill during the first phase of the Denny Regrade project.

Figure 4.8. Property owners who refused to sell their land or relocate their property had Denny Hill removed from underneath them during the Denny Regrade Project.



Civic Center Group, looking South on Central Avenue

Figure 4.9. Civic center proposed by Bougue Plan in 1911.

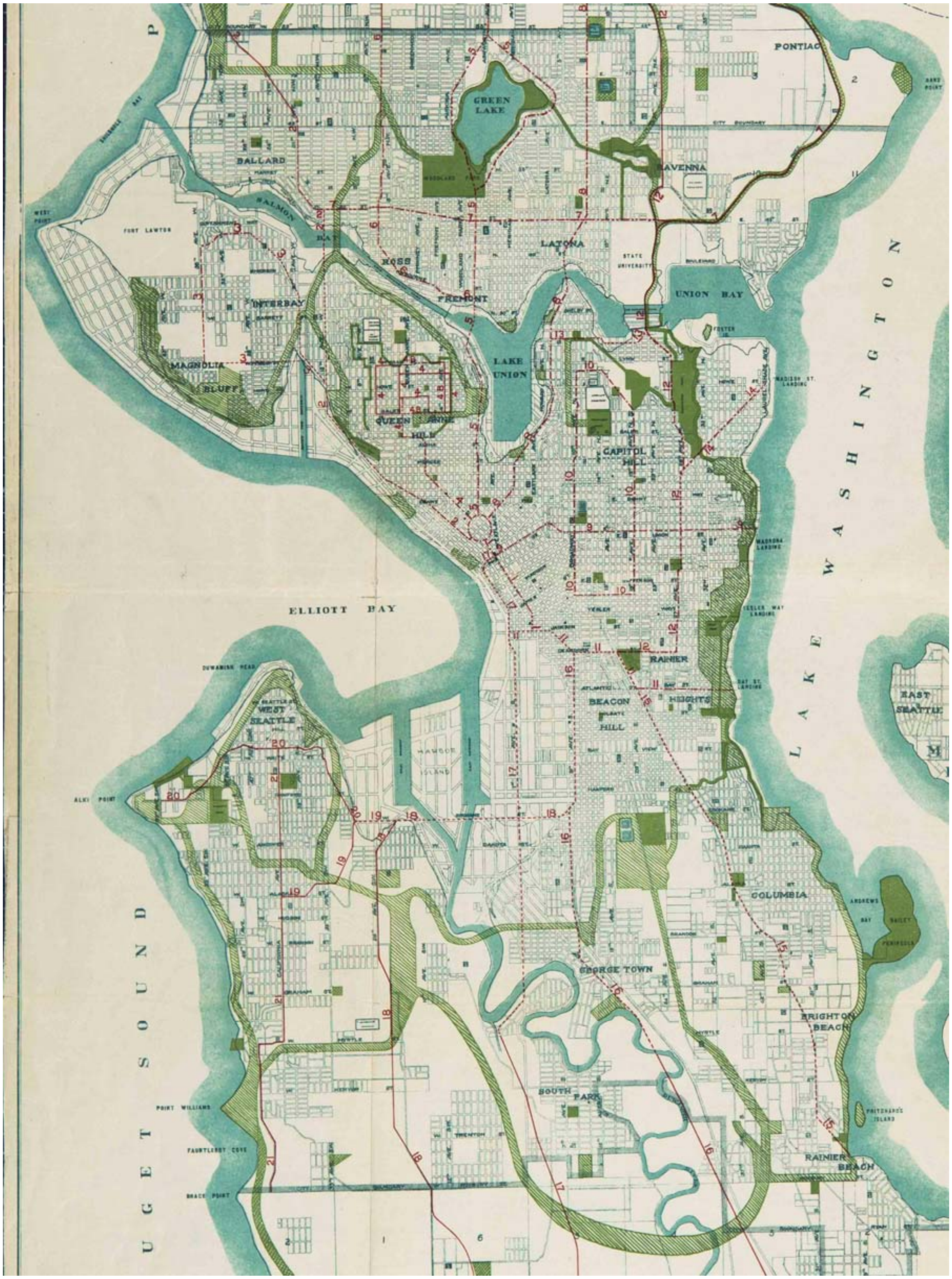


Figure 4.10. Mass transit subway system proposed by *Plan of Seattle*, 1911.

After the gold rush era boom of the 1890s, Seattle grew quickly, doubling in size between 1980 and 1900 and nearly tripling its population between 1900 and 1910. As the city grew, the transportation system grew with it and in the first decades of the 20th century, Seattle had an extensive streetcar network that serviced nearly every household in the city. By 1900, Stone and Webster, a national utility company that owned Seattle's electrical grid, had bought most of the streetcar lines from individual operators (*The Seattle Times* 2007; *Seattle Post Intelligencer* 2007). The city granted Stone and Webster a 40-year franchise to operate streetcars in Seattle with the stipulation that fare had to remain at 5-cents (*Seattle Post Intelligencer* 2007). The streetcar, as the city's only form of public transportation, was highly popular and in 1914, the city begins operation of its own streetcar line connecting Downtown to Ballard, which had been annexed in 1907 (King County Metro, n.d.).

In 1918, Stone and Webster offered to lease the City the streetcar system because it was losing money due to the rising use of personal automobiles and competition from jitneys, which offered 5-cent automobile rides along the streetcar routes (*Seattle Post Intelligencer* 2007). Instead of leasing the system, the City offered to purchase it, and Seattle voters approved of the purchase of the entire streetcar system from Stone and Webster for $15 million (King County Metro, n.d.), roughly three times its market value (*Seattle Post Intelligencer* 2007). As a city owned and operated venture, the streetcar system continued to operate in the red. Ever rising automobile ownership, increasing maintenance costs for the aging track system, and the 5-cent fare mandate were the main causes. Adding to the problem, the Washington Supreme Court ruled in 1922 that the City could not use money from its general revenue fund to pay for the streetcar system (*Seattle Post Intelligencer* 2007). By the early 1930s, political forces were shifting in favor of the automobile – work on State Highway 99 forced several interurban rail services to cease, and in 1932 the Aurora Bridge was completed without streetcar tracks (*The Seattle Times* 2007). The system peaked in 1936 with the Seattle Municipal Railway having 231 miles of streetcar tracks (Diltz 2016b). In 1937, voters rejected a plan to replace streetcars with buses, but ultimately the upkeep of the system was too much of a financial strain for the City. In 1939, the City was given a $10.2 million loan from the Federal Government to pay off streetcar debts and purchase diesel buses and electric trackless trolleys (Wilma 2000). All remaining interurban rail service stopped in 1939, cable car service on Madison, James and Yesler Streets stopped in 1940, and the final streetcar ceased operation in 1941 (King County Metro, n.d.). As in many other cities, the streetcar encouraged a compact urban form and encouraged the development of commercial and retail areas along arterial streets in both mixed-use and residential neighborhoods that were highly walkable. Through 1940, nearly half of the region's population lived in the City and had access to the streetcar system. Streetcars serviced Seattle for 57 years and had a profound impact on shaping the city.

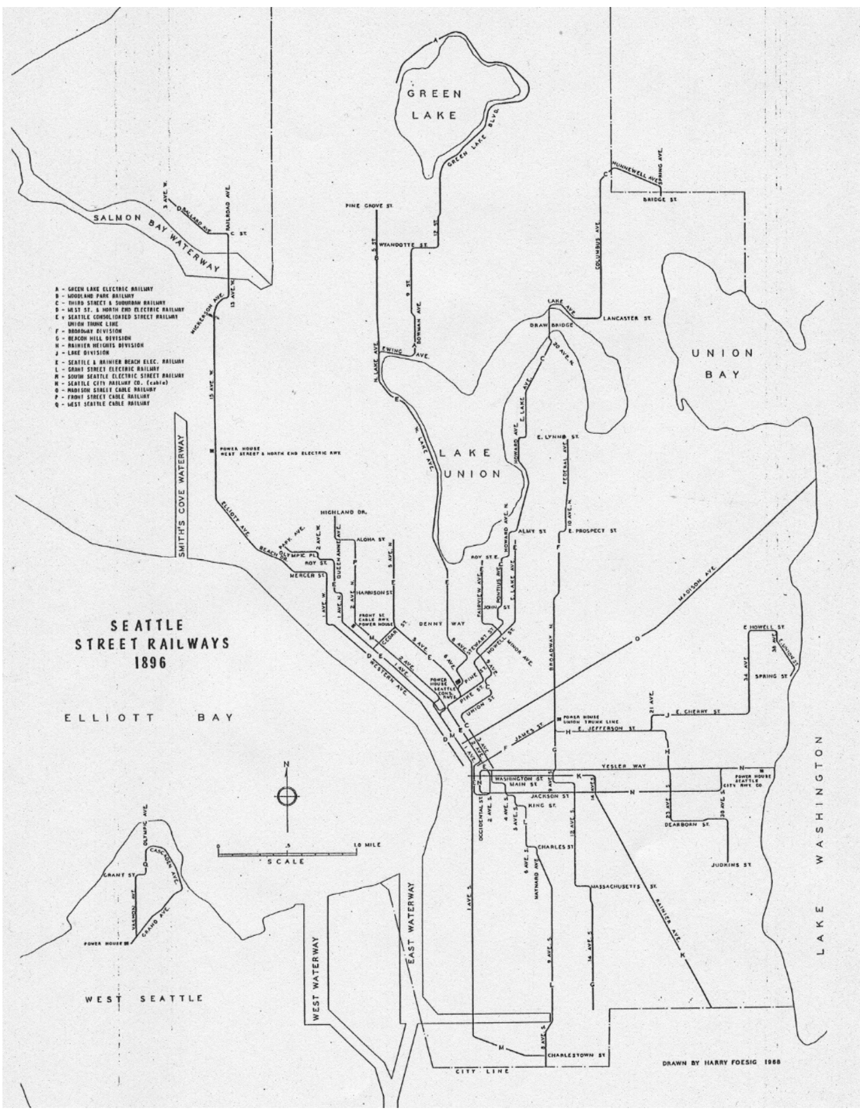


Figure 4.11. Streetcar lines in Seattle in 1896.

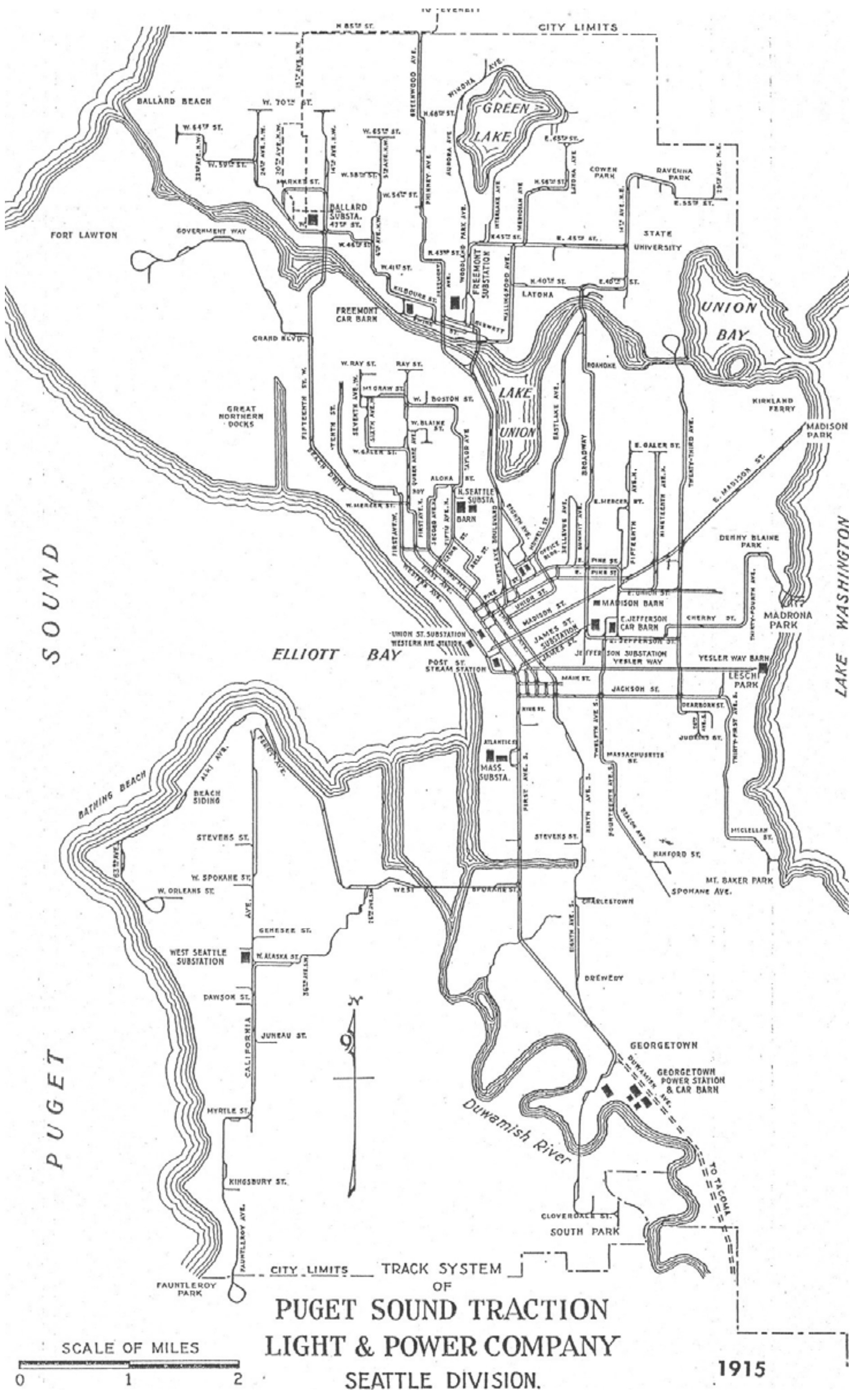


Figure 4.12. Streetcar lines in Seattle in 1915.

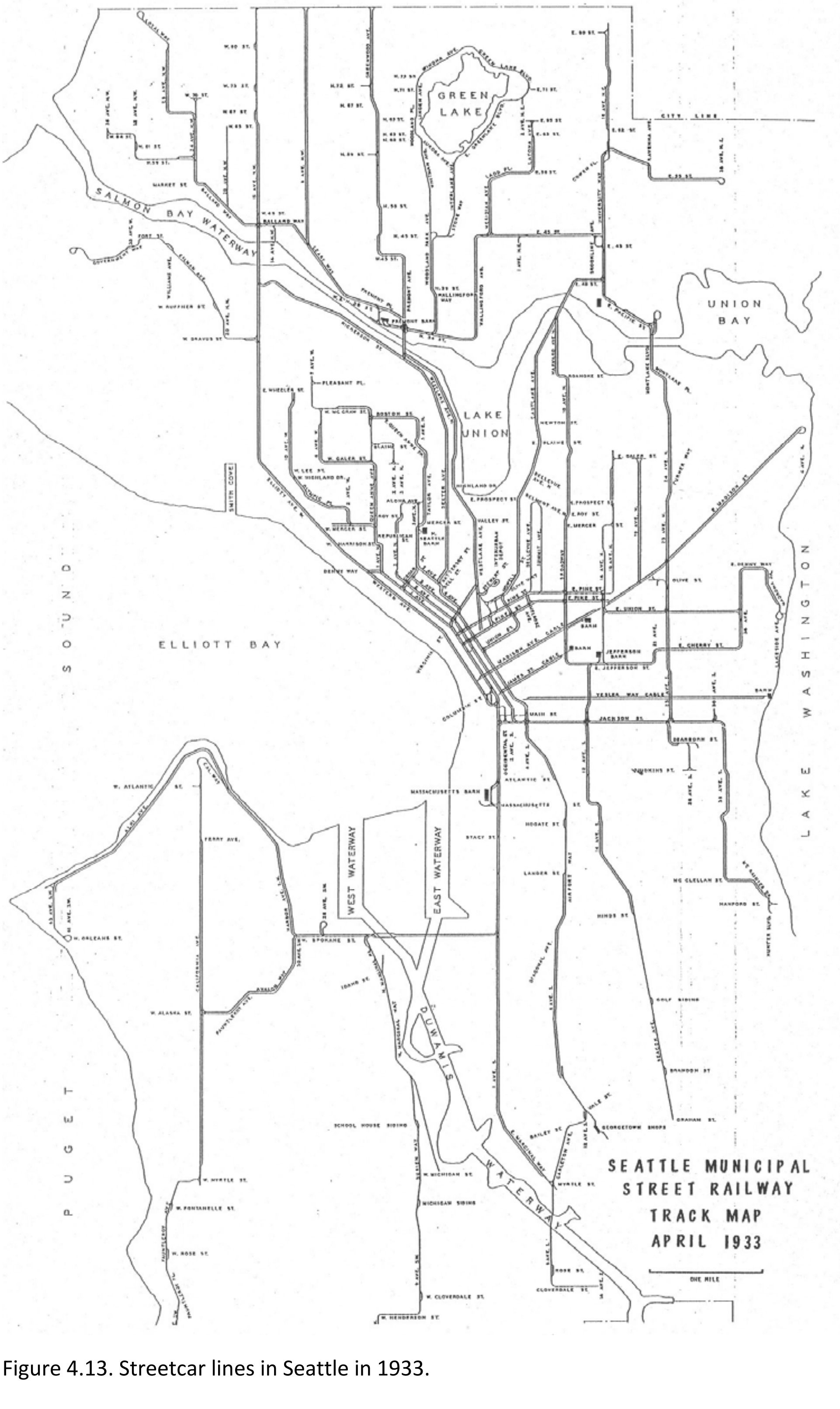


Figure 4.13. Streetcar lines in Seattle in 1933.

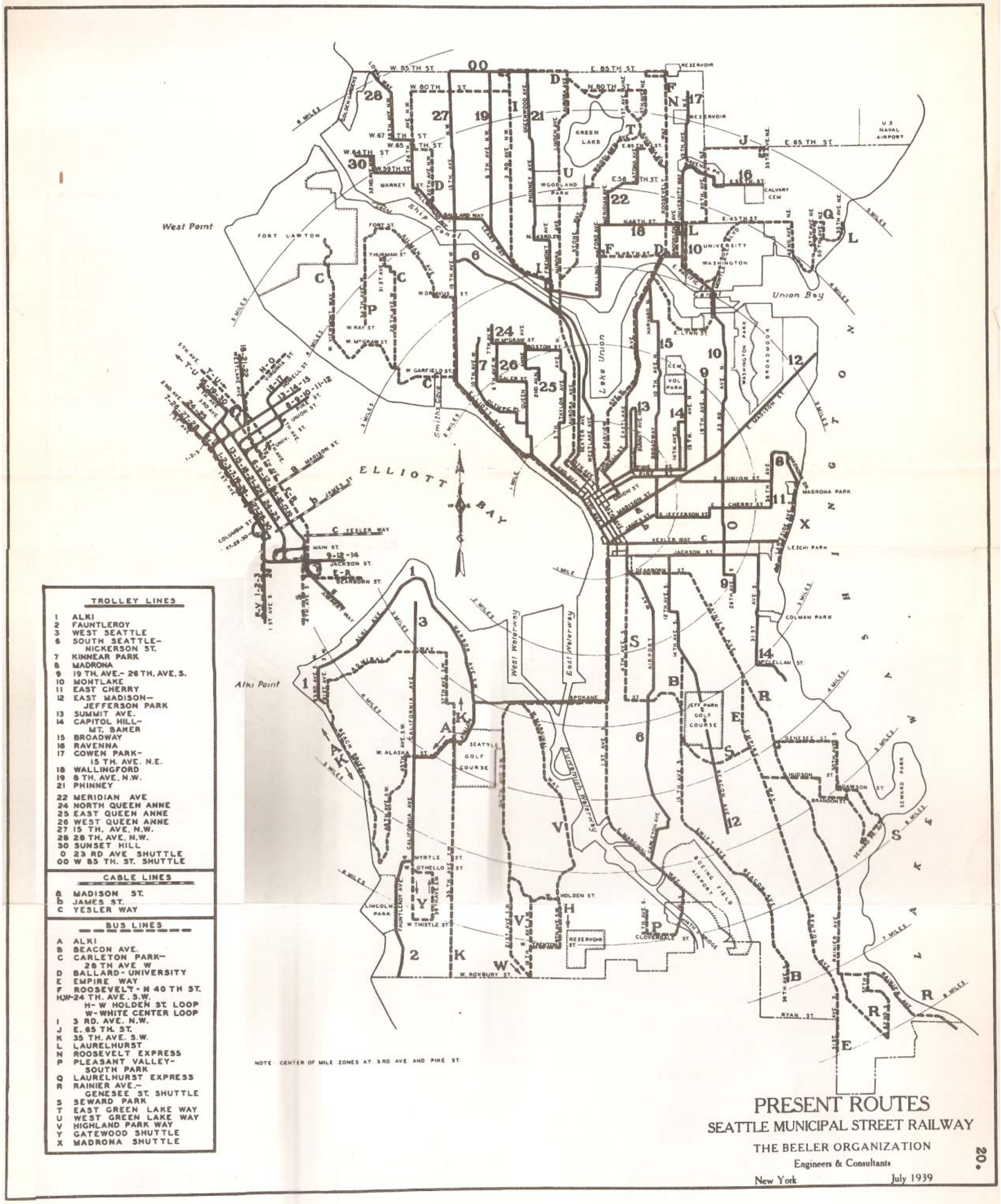


Figure 4.14. Streetcar and bus lines in Seattle in 1939.

An Automobile Metropolis is Born, 1940-1990

With the end of streetcar service in 1941, a new type of urban form emerged that was based on the automobile as the primary mode of transportation for Seattle residents. Through the 1940s, a large proportion of the region's population lived in Seattle, possibly attributable to its extensive public transportation network that residents fought to keep. The streetcar network encouraged people to live in the City as this was their primary means of transportation. As the automobile became more popular among working and middle class families, people began to live further outside the city center. Starting in the 1940s, a long period of mass-suburbanization took place in Seattle, evidenced by the shrinking proportion of the population in Seattle as compared to the region, reaching a low of only 17.7% in 2010.. This new era saw the urban form of Seattle adapt to meet the needs of the automobile. However, reminders of an earlier time remained, as seen in a 1958 public transit map of the City, showing bus routes essentially running the same routes as the streetcars before them since many routes utilized the same overhead electric cables.

Table 11. Population of Seattle and the metropolitan area 1860-2016. Source: US Census.

Year	Population, City of Seattle	Population, Seattle Metro	Percent of Regional Population in Seattle
1860	188		
1870	1,107	4,128	26.8%
1880	3,533	11,616	30.4%
1890	42,837	123,443	34.7%
1900	80,671	189,518	42.6%
1910	237,194	464,659	51.1%
1920	315,312	601,090	52.5%
1930	365,583	706,220	51.8%
1940	368,302	775,815	47.5%
1950	467,591	1,120,448	41.7%
1960	557,087	1,428,803	39.0%
1970	530,831	1,832,896	29.0%
1980	493,846	2,093,112	23.6%
1990	516,259	2,559,164	20.2%
2000	563,374	3,043,878	18.5%
2010	608,660	3,439,809	17.7%
2016 estimate	704,352	3,798,902	18.5%

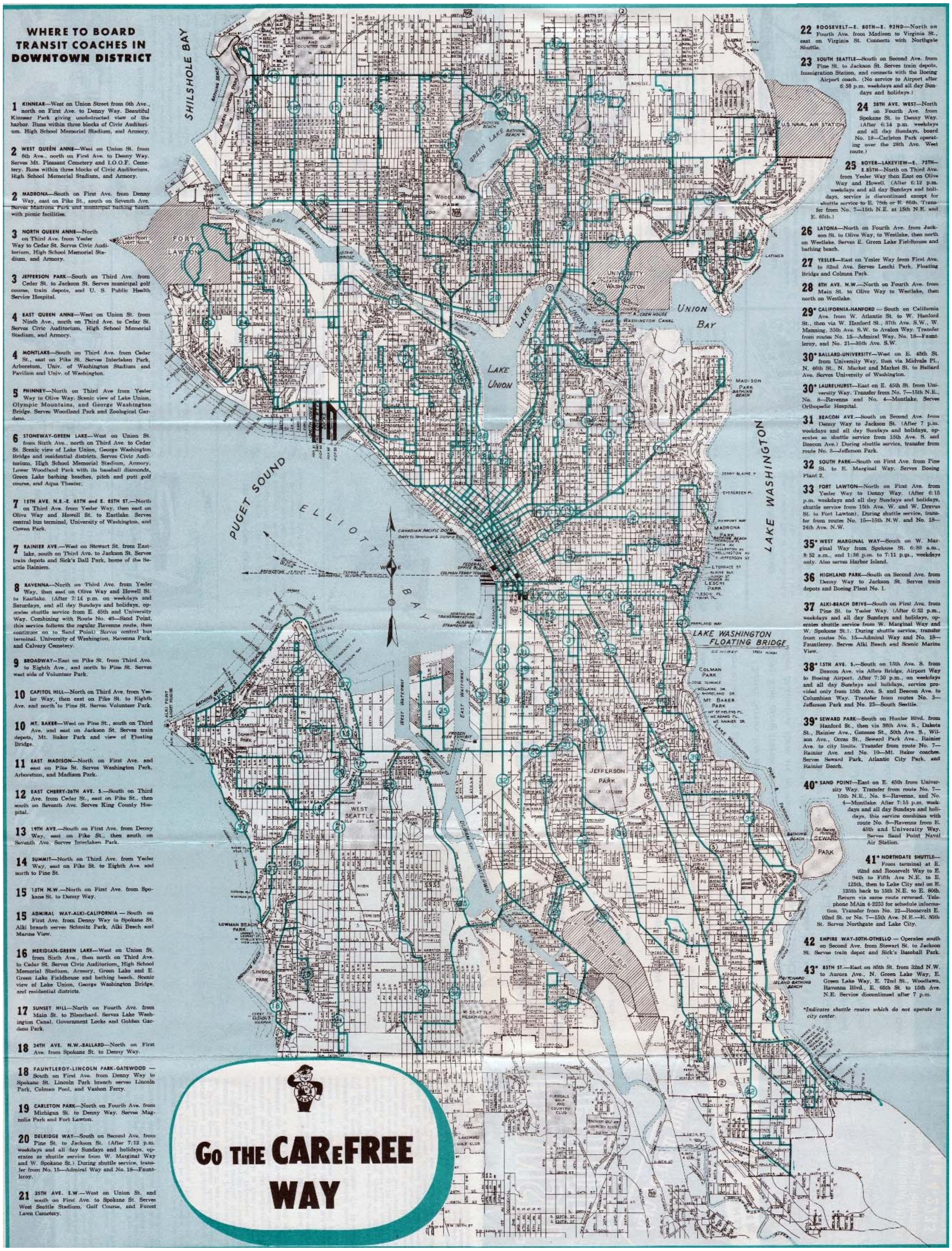


Figure 4.15. Seattle transit map, 1958.

Figure 4.16. I-5 construction through central Seattle looking north from Downtown, 1963.

Figure 4.17. Pine and Boren intersection during I-5 construction, 1965.

The State of Washington and City of Seattle wasted no time in beginning work on the planned interstate highway through the region and ushering in the automobile age. The Federal Aid Highway Act was passed in 1956, and by April 1957, the State of Washington had established an office for the purpose of acquiring land upon which to build the freeway (Becker 2002). In total, a 20.5 mile stretch of land containing 4,500 parcels was cleared for the freeway, many of which had homes, apartment buildings and businesses (Becker 2002). The first concrete was poured in 1960, and the freeway through Seattle was completed in January 1967 (Diltz 2016a). Since its initial construction, I-5 has served as one of only two north-south highway connections through Seattle, the other being the older State Highway 99. Like many Interstates in cities across the US, I-5 cut through once vibrant neighborhoods and tore apart the original fabric of the city center. Through central Seattle, the freeway runs along the western base of Capitol Hill and First Hill cutting them off from Downtown, then continues south, cutting the International District in half.

Critics and opponents of the freeway have always been present in Seattle. Some residents resisted the pressure to sell their property that lay in the path of the freeway only to have their property condemned, which accounted for roughly 10 percent of the land acquired by the state (Becker 2002). There were also attempts to save buildings with historical significance dating to the 1880s and 1890s, all of which were eventually demolished (Diltz 2016a). After the completion of I-5, work began to plan and build a number of other freeways around Seattle. By the late 1960s and early 1970s, anti-freeway sentiment came to the region, just as it had in many other cities around the country. Not only did the freeway revolt here halt plans to build new freeways, voters also successfully halted the construction of the R.H. Thompson Expressway, which was already under way (Westneat 2014; King County Metro, n.d.). The R.H. Thompson Expressway, which would have run parallel to I-5 on the east side of Seattle, and the Bay Freeway, which would have connected I-5 to US 99 along Mercer Street, are the most notable freeways stopped by citizen activism, but many others never came to be. The exit ramps for the R.H. Thompson Expressway, the only parts built before it was halted, stood for many decades in the Washington Park Arboretum as a reminder of the power of community activism (Westneat 2014).

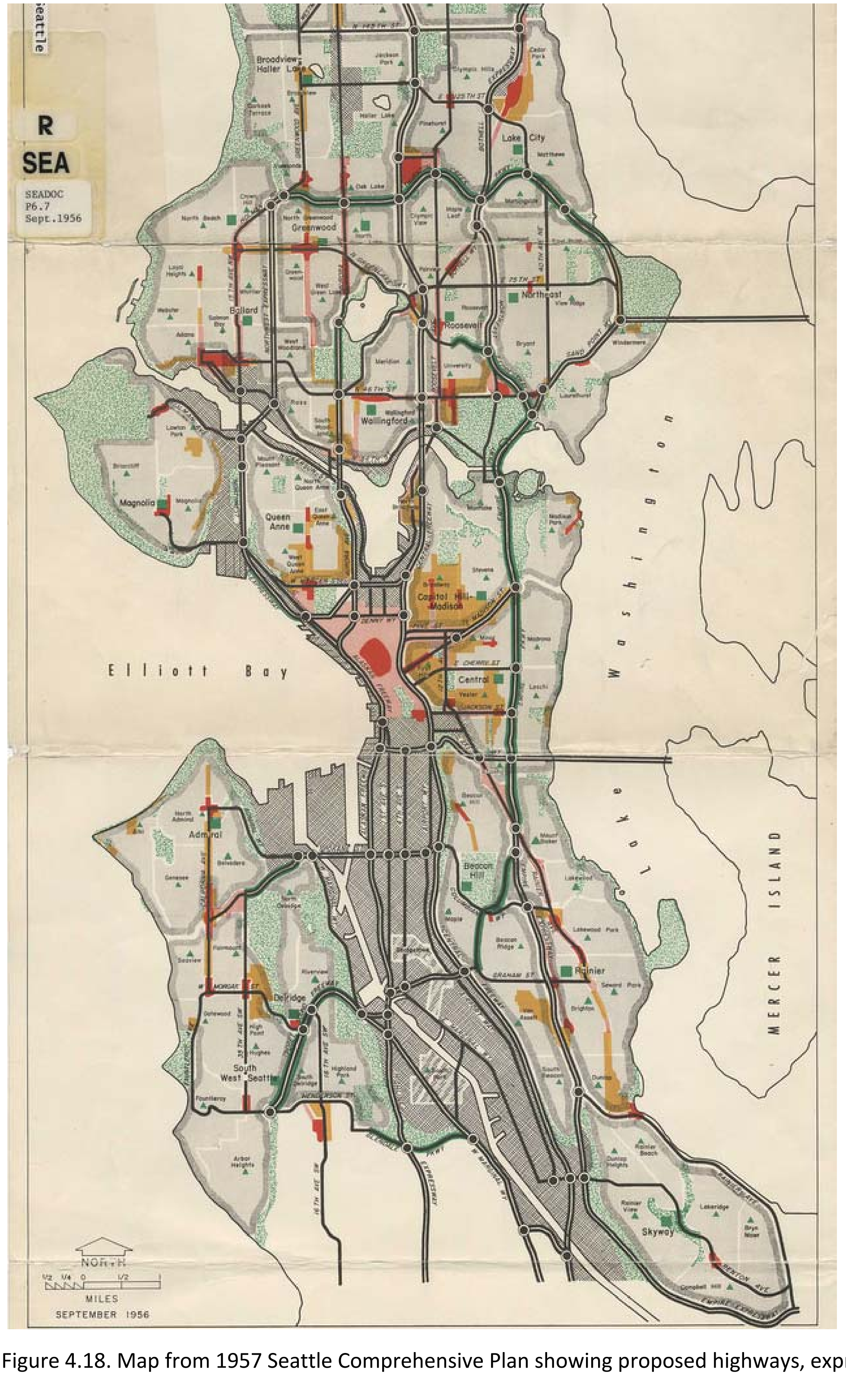


Figure 4.18. Map from 1957 Seattle Comprehensive Plan showing proposed highways, expressways and parkways.

At the same time that citizens were rallying around the anti-freeway movement, a group of civic leaders, organized by James Ellis, began a campaign to modernize Seattle (Mullins 2014). *Forward Thrust*, as this campaign was known, was a series of ballot initiatives in 1968 and 1970 to upgrade the region's infrastructure and provide new public facilities (McRoberts 1999). One of the 1968 initiatives was a $385 million bond proposal for rapid transit, which would have been matched with $765 million in federal funding (Cohen 2016). The *Forward Thrust* proposal included 47 miles of rail rapid transit running on four lines, 90 miles of express bus service, and 500 miles of local bus service to feed into the rail system (Cohen 2016). The rapid transit proposal was not approved by 60 percent of voters, the amount required to pass a ballot initiative, even though over half of voters were in favor of the transit proposal (McRoberts 1999). A strong opposition formed in the weeks leading up to Election Day, bankrolled by companies like General Motors, that had a vested interest in not seeing rail projects built. Among initiative that were approved in 1968 were those for a multi-purpose stadium, a youth center, highways, parks and recreation improvements, sewers, and fire protection (McRoberts 1999). The *Forward Thrust* committee attempted two years later to get rapid transit approved, again securing federal funding for almost $900 million, but voters again rejected the plan. In the 1970 vote, all four *Forward Thrust* initiatives failed, leading to the end of the campaign. In the end, the federal money that had been earmarked for Seattle went instead to Atlanta and their MARTA system (Cohen 2016). Although *Forward Thrust* failed in getting mass rapid transit, they did succeed in putting public transit back on the political map, but as a result of their failure, the approach became much more incremental, a trend which continues even today.

In 1972, the same year that voters halted the R.H. Thompson Expressway, King County voters approved the creation of Metro Transit and a 0.3% sales tax for transit (King County Metro, n.d.). The new transit agency would operate under Metro (Municipality of Metropolitan Seattle), an organization created by voters in 1958 to manage regional wastewater treatment, although its original intended function was to manage a range of regional issues (Oldham 2006). In starting the regional transit agency, Metro purchased the public Seattle Transit System, which served Seattle, for $6.5 million and the private Metropolitan Transit Corporation, which served the suburbs, for $1.2 million (King County Metro, n.d.). Employees at Metro had only 100 days to begin the first regional transit service, which began on January 1, 1973, and adopted an innovative approach to bus transit (Oldham 2006). Later in 1973, the implemented a “ride free” zone in Downtown Seattle, HOV lanes, a ridematch program for commuters to share carpools or vanpools, the first articulated buses in the US. During its first year of operation, ridership exceeded expectations with ridership increasing by 16.9 percent (Diltz 2016b). Ridership during the 1970s increased from a record low of about 30 million passengers in 1972 to 58 million in 1979 (King County Metro, n.d.). Much of this increase came as a result of the oil embargo and energy crises of the 1970s, which fueled the region’s need for alternative modes of transportation.

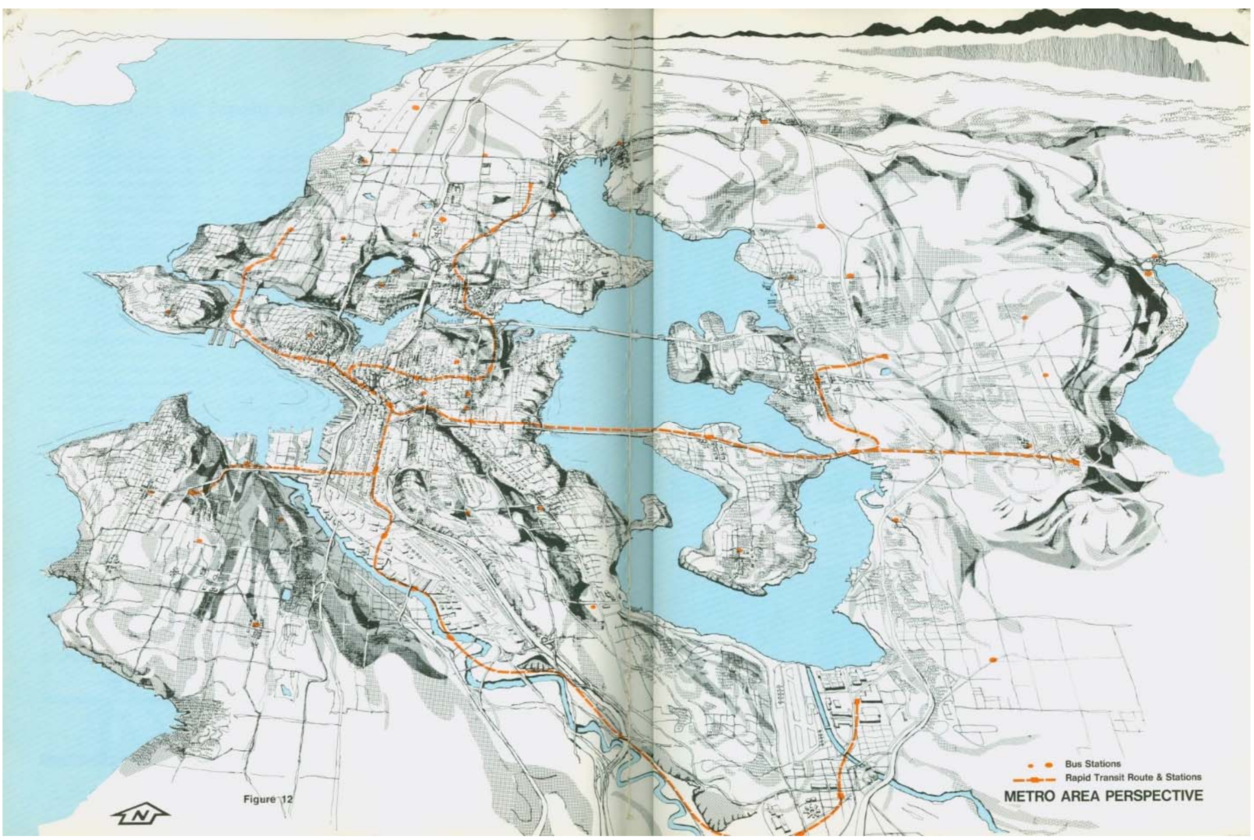


Figure 4.19. Rapid transit proposal from Forward Thrust Initiative, 1968-1970.

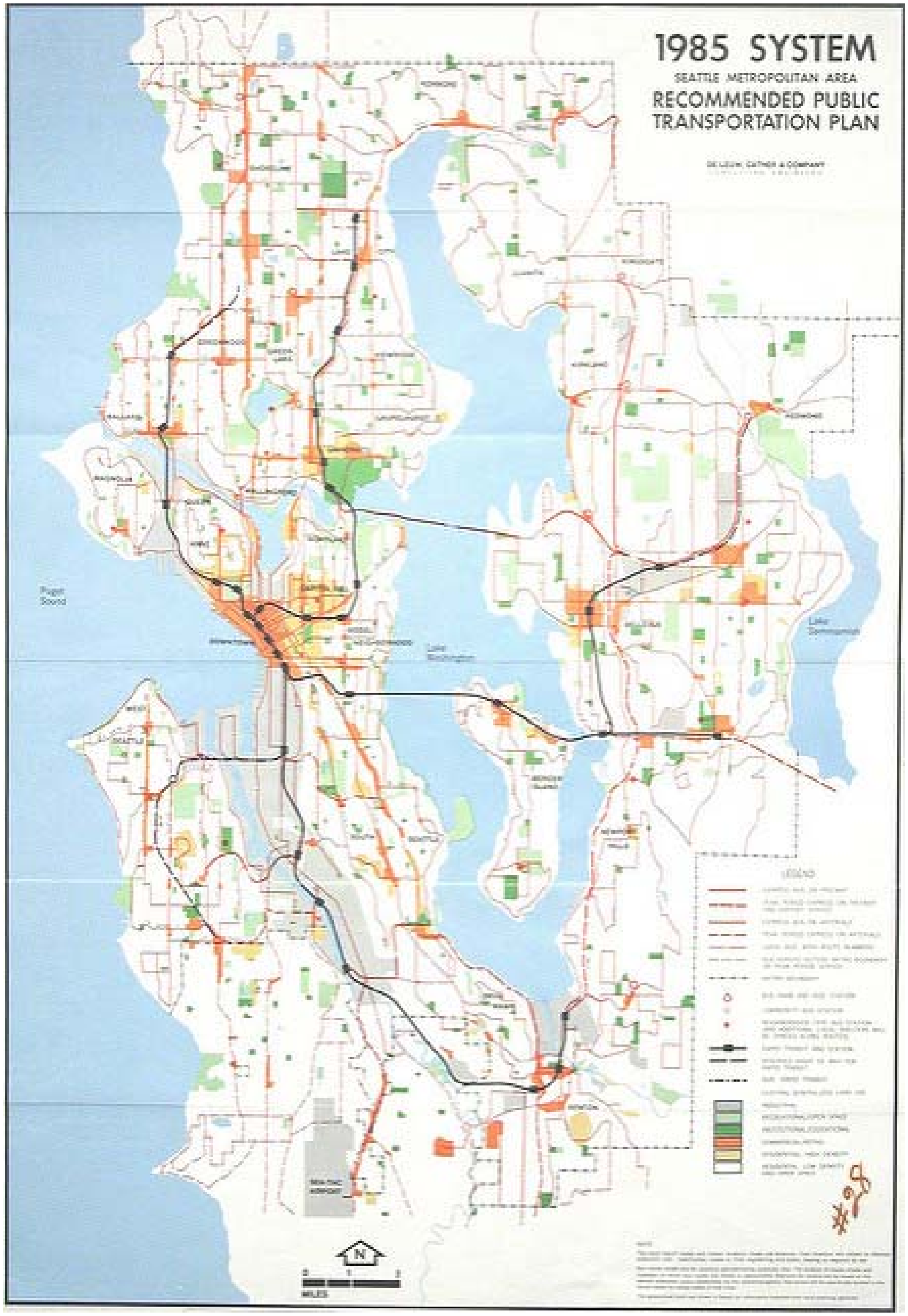


Figure 4.20. Rapid transit proposal in 1986.

Given this need, Metro proposed new rapid transit in 1976 under the federal Urban Mass Transportation Act, which was rejected (King County Metro, n.d.). By the early 1980s, congestion on Seattle's streets increased to such a degree that bus service began to suffer. In 1983, the Metro Council approved the construction of the Downtown Transit Tunnel (King County Metro, n.d.), which was an innovative solution allowing buses to avoid street level traffic congestion through Downtown Seattle. This same year, Metro bus service reaches 85 percent of the population of King County (within a quarter mile of a transit stop) and the agency is named the best major public transit system in the US (King County Metro, n.d.). While buses remain the only mode of transit in the regional system, Metro Transit continues to push for rail rapid transit, seen in a 1985 transportation plan proposal by Metro and the Puget Sound Council of Governments (figure 4.20). In 1989, Metro became the subject of a lawsuit which found it to be unconstitutional and required reform. As a result, Metro and King County merged in 1992 (Oldham 2006), which coincided with a series of other changes that would impact the future of transportation and urban growth in the region.

A Regional Approach: On the Path towards a Sustainable Future, 1990-Present

In 1987, the Brundtland Commission published the *Our Common Future*, which introduced the concept of sustainable development into the lexicon of urban planning. The Seattle region was among one of the first cities in the US to openly embrace sustainability as a guiding principle in its future growth. Both citizen groups and governments began thinking about long-term environmental sustainability. The State of Washington legislature passed the *Growth Management Act* (1990) and the *Commute Trip Reduction* law (1991). In 1993, the three counties of the Seattle metropolitan area (King, Pierce and Snohomish Counties) voted to join the Regional Transit Authority, which later became Sound Transit (King County Metro, n.d.). These two state laws and the creation of a regional transit authority have had significant impacts on the transportation and land use decisions made in Seattle over the last three decades.

The Washington State Growth Management Act (GMA) (1990) was comprehensive reform of local land use process for cities throughout the state. The primary goal was to prevent unplanned and uncoordinated growth by requiring counties and the cities within them to adopt comprehensive plans (State of Washington 2017). These comprehensive plans are guided by 14 goals which include transportation, housing, economic development, natural resource industries, property rights, and the environment (State of Washington 2017). One of the key features of the law is the requirement of counties to adopt county-wide planning policies that address urban growth areas, the promotion of contiguous development, siting of public capital and transportation facilities, county-wide economic development, affordable housing, and joint planning within urban growth areas (Laschever 1998). The law requires cities and counties to coordinate their efforts on these county-wide planning policies. The law also authorized local governments to create regional transportation planning organizations that could develop plans and ensure that local transportation plans were consistent with regional goals (Laschever 1998).

The City of Seattle adopted its first comprehensive plan, *Toward a Sustainable Seattle*, in 1994 and was a direct result of the GMA legislation. One of the key features of the GMA was the need to identify growth areas. These areas were intended to accommodate growth for a 20-year time frame. In Seattle, a land-locked and fully built-out city, planners and residents opted for an urban village planning model and created a series of urban centers, hub urban villages, and residential urban villages (City of Seattle 1994). These urban centers and villages would be the targeted areas for new growth in the city in accordance with the GMA. Urban centers and villages were identified based on existing residential and job densities, with urban centers being areas of regional significance (Kreis 2002). The urban centers include: Downtown (made up of the CBD, Pioneer Square, the International District, Belltown and Denny Triangle), Capitol Hill/First Hill, South Lake Union, Lower Queen Anne, the University District and Northgate. The village planning approach has helped facilitate the re-urbanization of the urban core, the area encompassing the Downtown, South Lake Union, Lower Queen Anne (Uptown), and Capitol Hill/First Hill urban centers. (A more in depth discussion of the urban core will be in Chapter 5). The village planning approach was seen as a way to direct growth in a logical way, meeting growth targets for new residential buildings and employment, and as a way to protect single family residential areas from increasing densities. The urban centers and villages were also intended to serve as hubs to guide the creation of a truly regional public transportation network.

The State of Washington passed the *Commuter Trip Reduction Law* in 1991 to address three main issues in the State's metropolitan areas: traffic congestion, air pollution, and petroleum fuel consumption (WSDOT 2017). To achieve this, the law requires state and local governments, transit agencies and regional transportation planning organizations and employers to coordinate efforts to reduce the number of people who drive to work alone (WSDOT 2017). While the law does not require employers to participate, it targets those with over 100 employees, and many companies see it as being in their best interest to participate in the program. In the City of Seattle, efforts to reduce the number of drive alone commuters has been quite successful. The City is divided into eight regions with different drive alone targets for each, ranging from between 20 percent in Downtown to 69 percent in north Seattle (City of Seattle 2016c). As part of the program, employers must report progress to the City every two years, complete a commuter survey, and incorporate at least two strategies for encouraging alternative modes of transportation, such as offering vanpools, subsidized transit passes, bike parking and locker rooms, or free parking for carpool vehicles (City of Seattle 2016a). Throughout Seattle, an estimated 66 percent of employees at participating employers now use alternative modes of transportation (City of Seattle 2016a). The City adopted a municipal ordinance that requires employers with over 100 employees to have a CTR program. In the urban core, the number of all commuters (not just those participating in commute trip reduction programs) who drive alone to work has dropped from 35 percent in 2010 to 30 percent in 2016, even while the number of jobs increased by 45,000 (Commute Seattle 2017). A majority of employers in this urban core region participate in the CTR program, with 63 percent of employers in Downtown, 80 percent in South Lake Union and Lower Queen Anne, and 89 percent in Capitol Hill/First Hill (City of Seattle 2016a). The State CTR law and the City of Seattle ordinance have been influential in shaping the transportation choices of the region's commuters and has likely been a factor in the huge increases in transit ridership since the early

1990s. In King County alone, transit ridership since 1990 has increased from 74.6 million in 1991 (King County Metro, n.d.) to 121.5 million in 2016 (King County Metro 2017a). The CTR law is also likely one of the contributing factors leading to increased support for public transit investment.

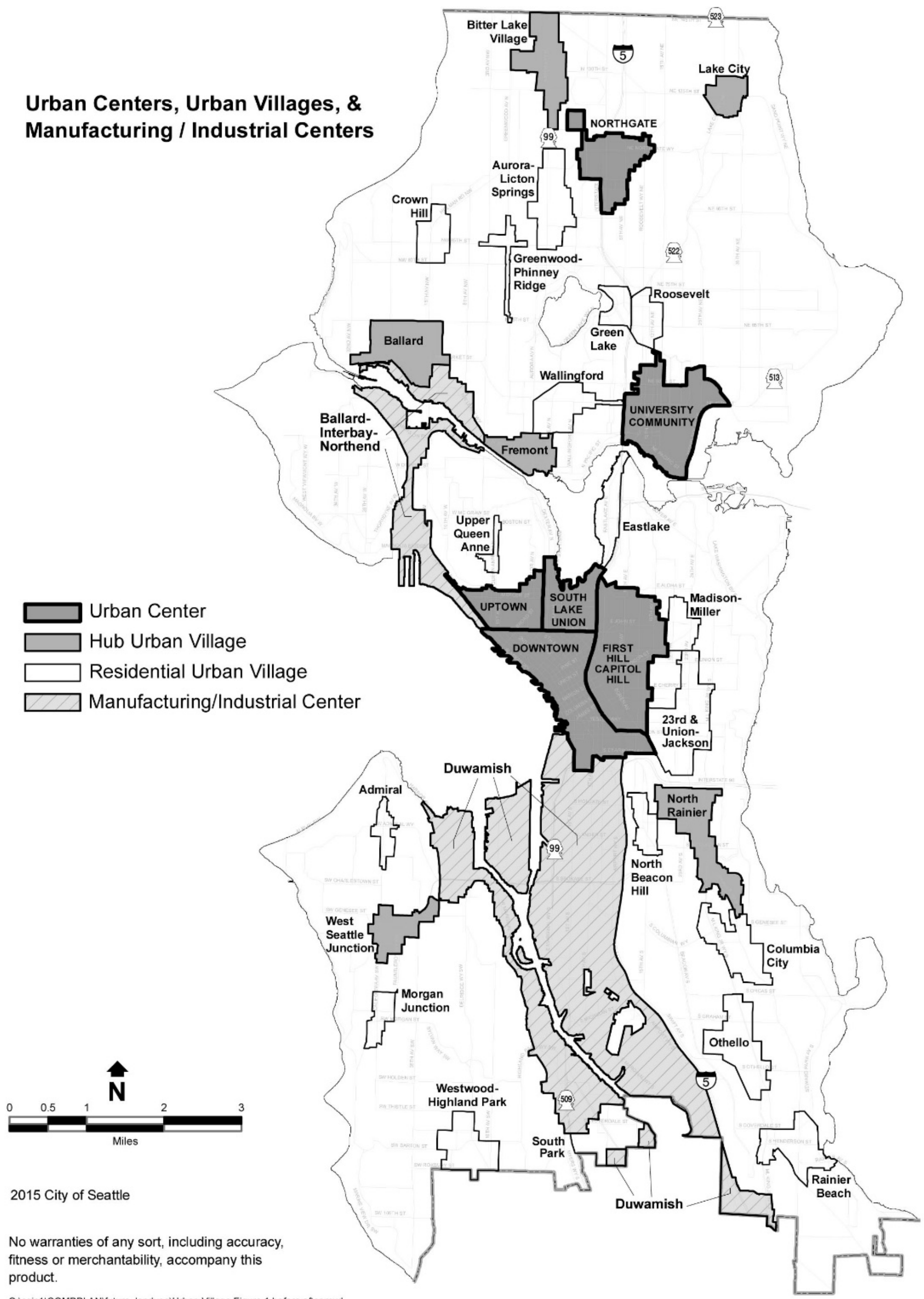


Figure 4.21. Seattle urban centers (green hatched) and urban villages (green) from Seattle comprehensive plan.

Figure 4.22. Sound Transit District.

In 1993, the three counties that make up the Seattle Metropolitan area (King, Pierce and Snohomish) each voted to join the Regional Transit Authority (King County Metro, n.d.), the creation of which was facilitated by the GMA of 1990. This Regional Transit Authority soon became known as Sound Transit. Since 1993, Sound Transit has been responsible for planning and constructing the region's rail transit systems (expanding heavy commuter rail and building light rail) and regional express bus service. In total there have been three successful regional transportation votes, Sound Move, ST2 and ST3.

In 1995, Sound Transit proposed a $6.7 billion 10-year transit plan that would have constructed light rail from Tacoma to Seattle to Mill Creek and to Bellevue and Redmond each of Lake Washington (the eastside), as well as expanded heavy commuter rail, express bus, and HOV lanes (Crowley 2000). This plan was defeated by voters, largely from opposition on the Eastside and in Pierce and Snohomish Counties; a majority approved of the plan in Seattle, Mercer Island and Shoreline (Crowley 2000). The following year, Sound Transit proposed a smaller $3.9 billion transit plan proposed a much less extensive 25-mile light rail line from SeaTac Airport to Northgate in Seattle running through Downtown, the University of Washington, and other major employment areas (Regional Transit Authority 1996). The area from the University of Washington to Northgate was included in this initial plan, but did not have dedicated funding. It also proposed commuter rail service, regional express bus service and expanded HOV express lanes as the previous plan did (Regional Transit Authority 1996). Voters approved this smaller plan in November 1996, but Sound Transit quickly ran into a number of political and financial issues. As a result, the route of the light rail through Seattle took longer to plan and costs quickly rose beyond what voters approved, resulting in the line being shorter than originally planned and taking three years longer than scheduled, terminating Downtown instead of at the University of Washington (Seattle Times Staff 2000).

Among rising costs and debates about the light rail route, voters in the City of Seattle approved the creation of the Elevated Transportation Company (ETC) in 1997 (Carr 2000). The ETC proposed building a 40 mile monorail system (Carr 2000), the Seattle Monorail Project, capitalizing on the existence of the monorail running from Westlake Center in Downtown to the Seattle Center (Space Needle) built for the 1962 World's Fair. The ETC eventually morphed into the Seattle Monorail Authority, which had the authority to design, build and operate a monorail system (Carr 2000). Voters approved the project four times at the ballot, even approving a motor vehicle tax to fund the project, but the cost of the project increased and revenue was lower than anticipated, which eventually led to the mayor withdrawing their support for the project in 2005 (Jamieson 2005). The Seattle Monorail Project went to voters one last time in 2005 on a shorter monorail line and was ultimately defeated, resulting in the dissolution of the Seattle Monorail Authority, ultimately costing Seattle taxpayers $125 million for a failed transit project (Murakami 2008).

During the failed Seattle Monorail Project, the regional Link Light Rail (Link) moved ahead, albeit behind schedule and over cost. It opened in mid-2009 between Downtown Seattle and Tukwila and by December 2009 extended to SeaTac Airport, a 17-mile route. In 2007, before the first stretch of light rail opened, Sound Transit and a number of partners developed Proposition 1, a 15-year regional plan to expand transit and highway capacity. The plan included adding 50 miles of light rail costing $30.8 billion and building 186 miles of new highway lanes and ramps costing $16.4 billion (L. Lange 2007). Voters rejected the proposition, in part because many were not sold on the high cost of light rail and were weary of voting 'yes' before the first line opened. However, this failure did not prevent Sound Transit from trying again in 2008, proposing a smaller expansion of the light rail system, this time adding only 36 miles to the line currently under construction and costing an anticipated $13.4 billion (Sound Transit 2008). The plan included funding for extending Link to Northgate (the terminus of the Sound Move proposition in 1996), light rail to the Eastside cities, and an extension south to Federal Way and north from Northgate to Lynnwood (Sound Transit 2008).

The extension from Downtown to the University of Washington began construction this same year (2008) after grant funding from the Federal Transit Administration was approved. This extension included two additional stations – Capitol Hill and the University of Washington. A third station was planned for First Hill, but soil conditions were found to be insufficient for an underground tunnel and station. In lieu of a light rail station, Sound Transit built the Frist Hill Street Car, which connects Capitol Hill, First Hill, the International District and Pioneer Square. The two stop extension from Downtown opened in March 2016, ahead of schedule and under budget, a significant improvement over the earlier phase (Lindblom 2016b). Within only a few weeks, ridership increased dramatically, causing Sound Transit to add more cars to the light rail trains (Yardley 2016; Lindblom 2016c). Travel time between Downtown reduced from an average commute peak of around 30 to 40 minutes to only eight minutes. The new extension was transformative and dramatically altered how many people moved around the city.

Building on the successful launch of the University Link extension, Sound Transit brought to voters a third transit initiative in November 2016. This plan, ST3, proposed a $53.85 billion plan that more than doubles the existing and under construction light rail lines, extends commuter rail lines and adds new service, expands express bus service, and creates two regional bus rapid transit corridors (Sound Transit 2016c). The plan adds 62 miles of light rail to the existing and under construction parts of ST2, bringing the future total system to 116 miles (Sound Transit 2016a). The plan extends light rail in the north from Lynnwood to Everett, connects Tacoma to SeaTac Airport, extends the existing line in Tacoma, extends the East Link line to Redmond, adds a line on the Eastside from Kirkland to Issaquah, and in Seattle adds new lines from West Seattle and Ballard to Downtown (Sound Transit 2016c). The timeline for completion is 25 years, meaning the full ST3 proposed system would not be complete until 2041, with projects completed in several phases. The initial 2041 completion date was highly criticized and in June 2016, Sound Transit revised their completion dates of light rail projects, with projects being completed anywhere from 2-5 years sooner than their first proposal (Sound Transit 2016b). Voters in the region approved ST3 with 54 percent of the vote (Mayo and Lindblom 2016). In general, voters in areas near where future light rail would be supported the plan more than cities and neighborhoods that would not be getting light rail service (Mayo and Lindblom 2016), even if those places were where light rail is already being planned or built as part of ST2. In Seattle, where 70 percent of voters supported ST3 (Mayo and Lindblom 2016), residents are clamoring for better transit sooner than their anticipated dates to have new light rail connections to West Seattle (in 2030) and Ballard (in 2035). In Summer 2017, many of the mayoral candidates in Seattle proposed finding ways to speed up planning and building new transit (Gutman 2017b). Regardless of when the system is complete, ST3 is among the largest public transit spending bills ever and will change the way the Seattle region travels.

ST3 Draft Plan Map – PROPOSED

Figure 4.23. Map of Sound Transit 3 regional transit proposal.

Transportation, Walkability, Transit and Streets in the Urban Core

Turning focus now to the City of Seattle and its urban core, there are a number of policies, programs and projects that are important to introduce as they are changing the way people move around the city, whether they walk, bike, use transit or drive. The City of Seattle is ranked as the 8th most walkable large US city, with a Walk Score of 73, making it a 'very walkable' city (Walk Score 2017). The city is currently the fastest growing US city with its population having grown from 563,374 to 608,660 in 2010 and to 704,352 in 2016. Much of this growth has been focused in specific parts of the city, based on the village planning model adopted in the early 1990s because of the Growth Management Act. The urban core has an area of about 3.75 square miles and nearly 93,000 residents, and growing at a rate much faster than the rest of the city, even while the City of Seattle is growing faster than the region as a whole. The urban core is the largest continuous walkable area of the city with Walk Scores between 90 and 100, has the highest concentration of access to public transportation in the region, and has access to the most variety of modes of public transportation, all reasons why this dissertation is exploring the connection between walking and transit in this area. The City of Seattle is actively seeking ways to make its urban environment more walkable, encourage street life, building out a multimodal transit system, and working to create a safe urban environment for users of all modes of transportation. This section provides an overview of many of the most important Seattle specific programs that exist that are influencing transportation in the urban core and around the city, promoting alternative modes of transportation, and shaping new development in the City.

Complete Streets

Like many cities in the US, Seattle has developed a complete streets program (City of Seattle 2016b). The complete streets strategy currently being developed seeks to reverse the traditional hierarchy of street users, making the pedestrian the most important, followed by bikes, transit and then automobiles (Schlossberg et al. 2013). The complete street incorporates various traffic calming techniques and road diets, and divides the road and sidewalk space into specific functional zones: sidewalk, bike lane, bus lane, parking, and car lane. Since 2007, the Seattle Department of Transportation (SDOT) has pursued a complete streets policies and puts safety for all road users, including pedestrians, as its top priority, followed by mobility. The City's complete street ordinance requires the Seattle Department of Transportation (SDOT) to "design streets for pedestrians, bicyclists, transit riders, and persons of all abilities, while promoting safe operation for all users, including freight (SDOT 2016b)." The top priority of SDOT is safety, followed by mobility. Under this complete streets program, SDOT evaluates the needs of all users and takes into account the unique characteristics of different streets to determine how to best balance different modes of transportation when completing major maintenance and construction. The complete streets policy supports many of the city's other longstanding goals, including providing a range of transportation alternatives (to the automobile) and make the best use of the City's limited street capacity and seeking to balance competing uses (SDOT 2016b). Complete streets are achieved through a comprehensive checklist process that allows planners and project managers to see how a single transportation/street project related to broader city goals, particularly those in the city's pedestrian and bicycle master plans.

Public Space Management Program

In 2013, SDOT organized the Seattle Public Space Management Program (SDOT 2016e). The group was developed to address growing interest in using streets for a variety of activities driven in part by the growing recognition that city street in Seattle make up 27 percent of the city's land area (SDOT 2016d). The group works to streamline the permitting and approval for projects that use street space for uses other than driving and/or parking. This includes both temporary and permanent projects.

Temporary projects (one-day or multiple-day events) include: play streets and summer parkways, neighborhood block parties, street vending, a-frame sign management, newsstand management, street use permits for special events (i.e. parades), farmers markets, pike people street, and park(ing) day (SDOT 2016e). Projects that are more permanent in nature and are designed to enhance both businesses and neighborhood. alley activation, gardening in the right of way, curbside rain gardens, street murals, signal box artwork, pole banners, festival streets, sidewalk cafes, parklets and streateries, shoreline street ends (to provide better access to water), pavement to parks, and tactical urbanism projects (SDOT 2016e). A majority of these projects simply involve a permitting process that planners in the work group work with residents and businesses to approve. Others, like the pavement to parks and alley activation programs, are a type of street reclaiming, a practice that utilizes underused street space once dedicated to automobile for public spaces for people (Engwicht 1999). SDOT launched the pavement to parks program in 2015 with two spaces in the First Hill neighborhood adjacent to Downtown and one in Phinney Ridge in north Seattle. The program aims to provide short-term, low-cost, adaptable and community-oriented public spaces in the city (SDOT 2016a). The pavement to parks program currently has planners identifying projects and working with the community only on design aspects of each new space. Several new pavement to parks projects are currently being planned and will be built in 2018 (SDOT 2016e). The 'alley activation' program is an SDOT supported program in conjunction with several neighborhood organizations that have been working to turn the traditional utilitarian spaces of alleys into public spaces. The most notable examples include Post and Nord Alleys in Pioneer Square (Alliance for Pioneer Square 2013), and the University District Alley (U District Square 2017).

Vision Zero

In 2015, the City adopted an ambitious *Vision Zero* goal to eliminate pedestrian, cyclist and motorist fatalities by 2030. The program utilizes a three-pronged approach to promote safety and prevent injuries and fatalities including "smarter street design, targeted enforcement, and thoughtful public engagement (City of Seattle 2017)." SDOT has carried a number of small 'spot improvements' to make specific intersections safer for pedestrians, installed new curb ramps. SDOT has also worked to make the city's most dangerous corridor, Rainier Avenue, safer – implementing a road diet and calming traffic. In the urban core, SDOT has installed new painted crosswalks, rapid flashing beacons (RFBs), and signaled crossings to make the urban environment safer. On a larger City-wide and State-wide scale, the City had two successes in 2016 in their work to promote street safety. In Seattle, a number of neighborhood organizations partnered with SDOT to advance a ’20 is plenty’ campaign to lower speed limits around the city. The city council approved the plan in late 2016, lowering speed limits in residential areas from 25 mph to 20 mph and on arterial streets (including in Downtown) speeds reduced from 30 mph to 25 mph (City of Seattle 2017). At the state level, the City of Seattle lobbied hard to have a state-wide distracted driving law enacted, which the City estimates is responsible for 30 percent of crashes (City of Seattle 2017). The law went into effect July 2017.

Move Seattle, Pedestrian Master Plan and Bicycle Master Plan

In 2015, Seattle mayor Ed Murray introduced *Move Seattle*, a 10-year strategic plan to integrate the City’s four transportation master plans: transit, bike, pedestrian, and freight. Voters approved a $930 million levy to fund this initiative in order to increase funding for streets, bridges, sidewalks, and other vital infrastructure (SDOT 2016c). The plan is built around five core values that work towards creating (1) a safe city, (2) an interconnected city, (3) a vibrant city, (4) an affordable city, and (5) an innovative city (SDOT 2015).

The City adopted the first *Pedestrian Master Plan* in 2009 and updated it in 2017. The plan is a 20-year blueprint to make Seattle the most walkable city in the US (SDOT 2017a). The plan adopts four goals in fostering a walkable city: safety, equity, vibrancy and health (SDOT 2009). Safety involves reducing the number of pedestrian crashes; equity includes ensuring that everyone has access to the city and that investments are distributed evenly and by need; vibrancy includes creating a pedestrian environment that supports healthy communities and a vibrant economy; and health includes raising awareness of the role of walking for health and disease prevention (SDOT 2009). The plan identifies high priority areas for investment (figure 4.24), which incorporates spatial analysis of the vibrancy of the city-wide pedestrian network, city-wide equity, and the corridor function (or the role of each street in the transportation network) (SDOT 2009). This approach has facilitated investment in the city’s urban centers, urban villages, and in the City’s most dangerous street corridors.

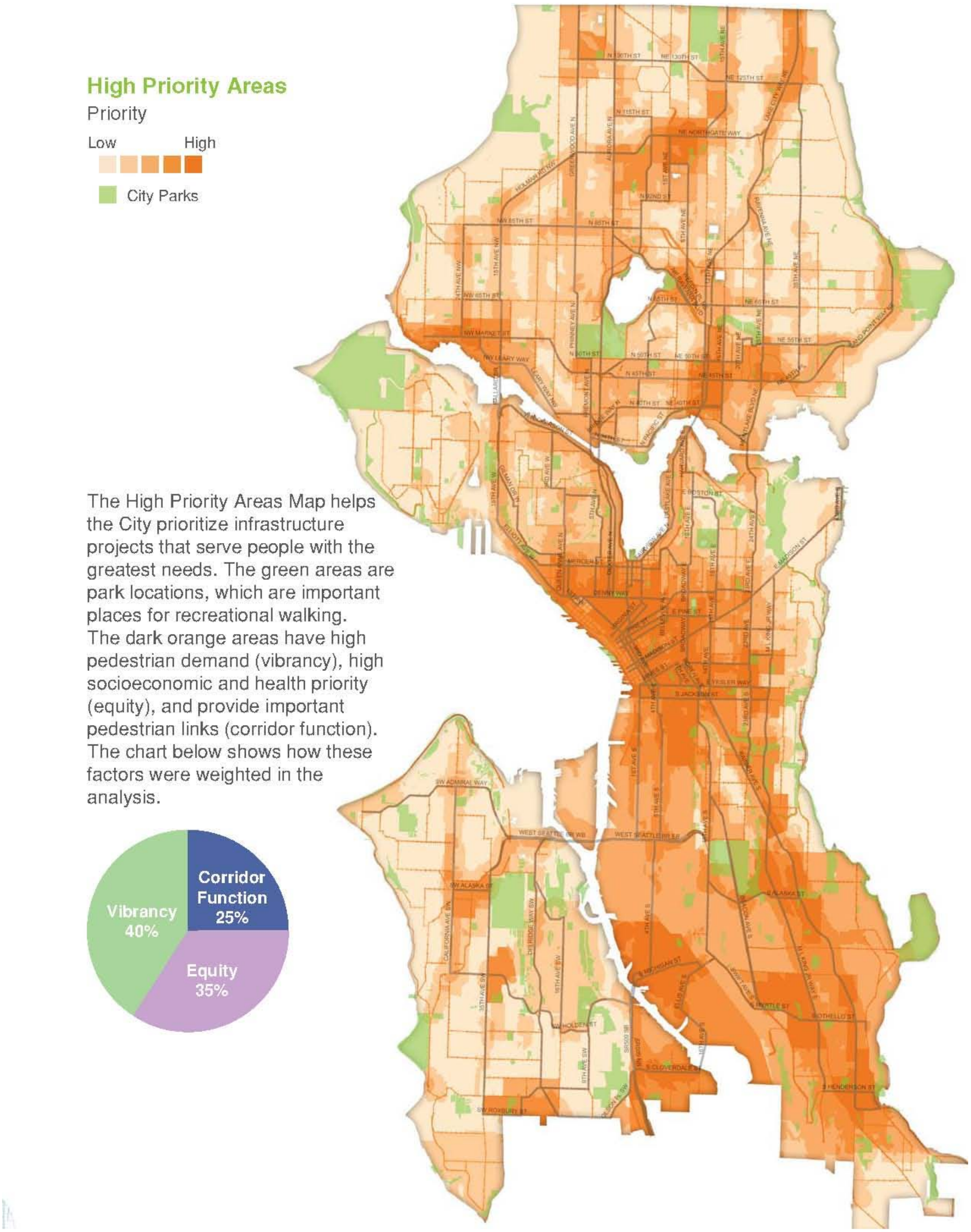


Figure 4.24. High priority pedestrian areas, City of Seattle Pedestrian Master Plan, 2009.

Figure 4.25. City-wide and local bicycle network, Bicycle Master Plan, 2014.

The City adopted the *Bicycle Master Plan* in 2014, which, like the *Pedestrian Master Plan*, provides a 20-year vision to build a network of bicycle infrastructure throughout Seattle. The plan advances a network of on street protected bike lanes, neighborhood greenways and off-road trails that seeks to make bicycling a “comfortable and integral part of daily life in Seattle for people of all ages and abilities (SDOT 2017d).” The strategy to develop a network of protected bikeways and neighborhood greenways stems from two challenges: difficult topography and limited street space on arterial streets. Arterial streets often provide the most direct and flattest route, but are also corridors that presently prioritize cars and transit. The neighborhood greenways help to mitigate this by developing a network of safe and relatively flat bicycle routes off the city’s main arterial streets.

One Center City and Pike Pine Renaissance

With the tremendous amount of growth happening in the urban core, in both jobs and residents, ensuring that the transportation network remains functional is a top priority. In recognition of a number of changes coming to the urban core, the City of Seattle, Sound Transit, King County and the Downtown Seattle Association have partnered to form the *One Center City* initiative and advisory board (One Center City 2017a). One of the most pressing concerns that this initiative is tackling is the pending closure of the bus tunnel running under Downtown. With new Link light rail lines opening in 2019, 2021 and 2023, the tunnel will become exclusively for light rail. How to accommodate hundreds of more buses on Downtown streets, how to ensure transit remains reliable, is a key objective of *One Center City*. The goal is to create a near-term plan as well as a 20-year vision about how to integrate new transportation options in the urban core and to accommodate as much as 25,000 new households and 55,000 new jobs (One Center City 2017b).

The *Pike Pine Renaissance*, like *One Center City*, is a project seeking to improve the pedestrian experience in the urban core, specifically by making improvements to Pike and Pike Streets, the city’s main commercial, entertainment and dining streets in Downtown (Waterfront Seattle 2017). The project will develop a streetscape design along Pike and Pine Streets to create a vibrant public space corridor through Downtown connecting the waterfront to Capitol

Hill. The Pike Pine Renaissance is part of a larger project under development by the City's Waterfront Seattle Program, which is working to revitalize the Seattle waterfront the length of Downtown in anticipation of the Alaska Way Viaduct being removed when the US99 tunnel is complete.

Public Space and Public Life

In 2008-9 the City of Seattle worked with Gehl Architects to develop a plan for improving public spaces and public life in Downtown Seattle (Gehl Architects 2009). The plan builds on decades of work by urbanist Jan Gehl whose approach to design has been influential in reshaping the idea of public space and public life in many cities around the world. This plan highlights the fact that the City of Seattle recognizes that walking and vibrant public spaces play an important role in the health of urban residents, communities and the environment (Gehl Architects 2009). The final plan and its recommendations are specific to the context of Seattle, but the main principles of public space and public life that are now being implemented have also been put into practice in cities such as Copenhagen, London, Milan, New York, Melbourne, and Sydney. Many of these cities have become home to some of the most walkable and livable neighborhoods. Seattle, as a case study, allows me to observe the results of the implementation of this plan and how it impacts walkability and the perception of walking within the city.

Public Transit and the Urban Core

In 2012, the City of Seattle adopted the *Transit Master Plan*, a 20-year vision for transit improvements throughout Seattle. The City updated the plan in 2016 to reflect the *Move Seattle* initiative (SDOT 2016f; SDOT 2016g). The Seattle *Transit Master Plan* covers issues such as prioritizing transit corridors, how to accommodate increasing transit in downtown, equity in service and accessibility, as well as plans to develop different modes of transit, including bus rapid transit and a modern streetcar. The plan also discusses the City's frequent transit network, and integrating transit capital projects with walking and bicycling infrastructure (SDOT 2016f).

- Seattle Streetcar

In 2007, the City of Seattle began operation of a modern streetcar line from Westlake Center in Downtown Seattle through South Lake Union, a major employment center and home of the Amazon headquarters campus (Seattle Streetcar, n.d.). The streetcar opened in anticipation of the Link light rail beginning service to provide a rail-based transit link from the light rail to South Lake Union. The total cost was approximately $52 million for a 1.3-mile streetcar, with $25 million of this coming from property taxes paid by property owners in the South Lake Union neighborhood (Lindblom 2009). In 2008, the city council approved an unfunded plan to develop a five-route streetcar system (Lindblom 2016a; SDOT 2008). In 2009, Sound Transit dedicated $132 million to build a second streetcar line, the First Hill Streetcar, connecting the planned Capitol Hill Link light rail station to First Hill, the International District and ending in Pioneer Square. This streetcar was developed because of promises made by Sound Transit to provide rail transit to First Hill, which was ultimately found to prohibitively expensive due to the soil conditions along the route, which caused them to cancel the First Hill stop. Construction of the First Hill Streetcar finished in Fall 2014 (Lindblom 2014), but service began in January 2016, only two months before the Link light rail opening in Capitol Hill, due to delays in getting the trains and testing the tracks. The city is now beginning construction of a streetcar expansion through Downtown, the Center City Connector, which will link the First Hill Streetcar to the South Lake Union Streetcar and unlike the existing lines, operate in a dedicated lane (Seattle Streetcar 2017). An extension of the streetcar to the Broadway commercial area in Capitol Hill is on hold after serious opposition from neighborhood businesses in the Broadway corridor (Osowski 2016).

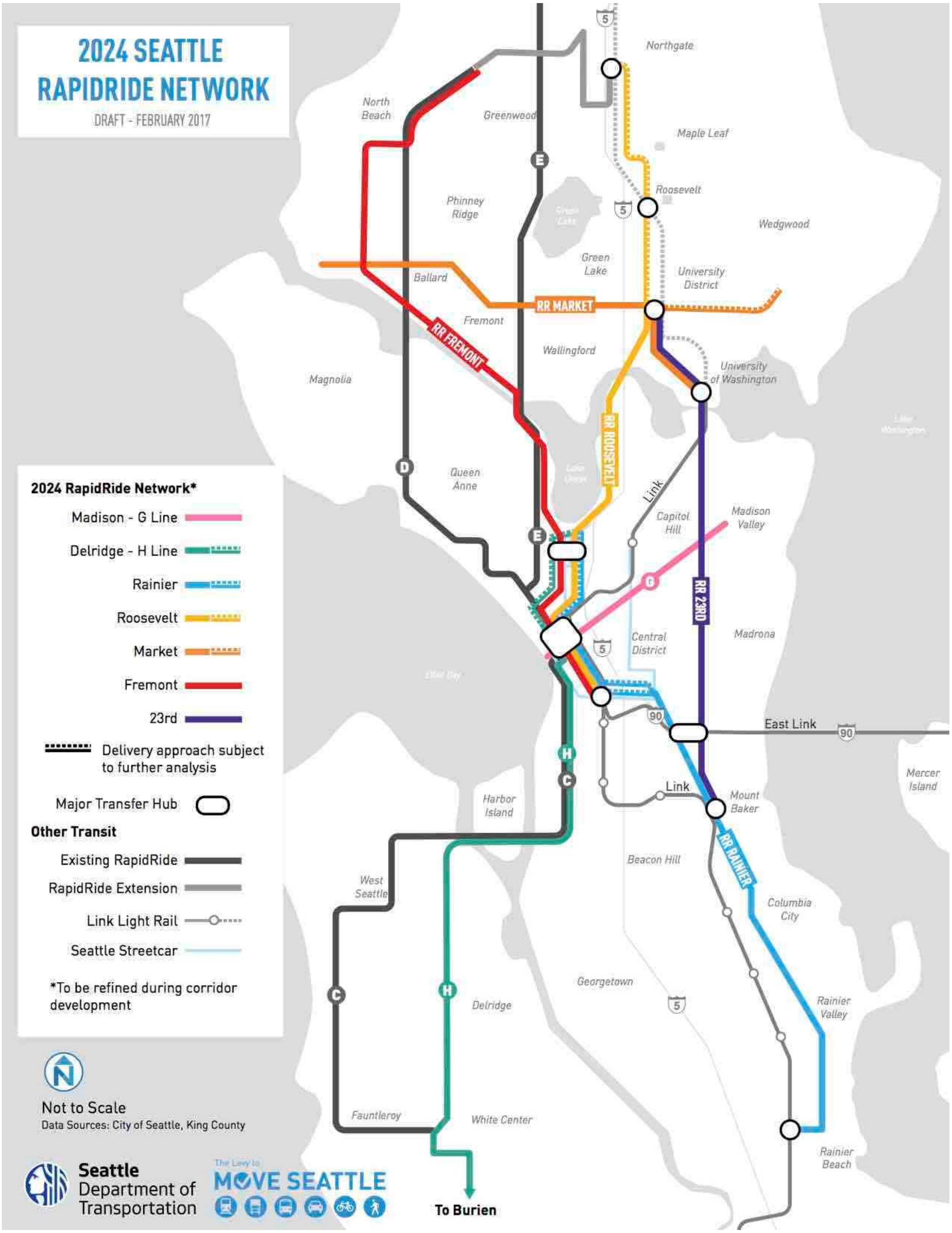


Figure 4.26. Proposed 2024 Seattle Rapid Ride network.

Figure 4.27. Seattle transit map, updated 2016.

Figure 4.28. Seattle transit map, urban core detail.

- Rapid Ride and Bus Rapid Transit (BRT)

King County Metro proposed RapidRide in 2006 as a low cost form of bus rapid transit (BRT), and began operation in 2012. While RapidRide is not true BRT, it shares many characteristics including more frequent service (every 7 to 10 minutes), transit signal priority, queue jumping, improved bus shelters, real-time arrival information, on-bus Wi-FI pre-board payments, and longer space-stopping (roughly every half mile instead of every quarter mile). However, RapidRide buses share arterials with general purpose traffic just as local buses do, and are prone to delays caused by traffic congestion, even with priority at lights, queue jumping and bus only lanes in some parts of the city. Compounding this, the RapidRide buses operates without a schedule, so even while buses should arrive every 7 to 10 minutes, this is not always the case (Lindblom 2012). Currently, there are six RapidRide routes throughout King County, three of which serve Seattle: the West Seattle, Ballard and Aurora Avenue routes (King County Metro 2017b).

Presently, SDOT is planning seven additional high capacity transit corridors to be completed by 2024 as part of the *Move Seattle* initiative. These include the Madision BRT and the Delridge RapidRide which should begin operating by 2020 as well as five additional lines throughout Seattle (Shaner 2017). The Madison Street BRT, a 2.2-mile route (only 1.8-miles of which will be true BRT), project is now in the final planning phases and is more like traditional BRT than other RapidRide routes (SDOT 2017b). It is a sort of pilot project for making other RapidRide routes more like true BRT in the future, with center lane boarding platforms and bus only lanes the whole length of the route, as well as the above mentioned features. The Madison Street BRT began planning in 2013 and is expected to being service in 2020 (SDOT 2017b). When complete, these high capacity transit lines are expected to put 75 percent of Seattle residents within a 10-minute walk of a 10-minute or less transit service (Shaner 2017).

- Frequent Transit Network

The frequent transit network evolved during the 2000s as the City and King County Metro sought to increase transit service in higher density neighborhoods. Frequent transit is defined as every 15 min or less for 12 hours per day and every 30 min for 18 hours per day

(Staton 2015). In 2011, Oran Viriyincy developed a new transit map for Seattle showing the frequent transit routes (Viriyincy 2016). The most recent King County transit map now incorporates this element of transit in the official regional transit map (King County Metro 2017c). As of 2016, frequent transit includes routes with headways of every 10-12 minutes, headways of 15 minutes, and regular routes that combine to create frequent service through the urban core. The effect is that throughout the urban core, transit typically runs every 5-7 minutes during peak times, and every 10-15 minutes the rest of the day. Revising the transit network in terms of both coverage and frequency has allowed SDOT and the Seattle Department of Planning and Development to reduce parking requirements for new development. Between 2006 and 2011, the City eliminated parking requirements in many of the urban centers and urban village areas, and presently does not require parking if the development is within a quarter miles of a frequent transit stop (Madrid 2012; Barnett 2015). Over the next 20 to 25 years, the amount of frequent transit service will increase significantly as SDOT, King County Metro and Sound Transit build new transit infrastructure and expand service throughout the city and region.

Conclusion

Seattle is in the midst of a transportation crisis. This crisis is the result of three things: a failure to plan adequate transit during the 20th century, rapid population growth, and a continuing inability to plan and build new transportation infrastructure when and where it is needed. While Seattle is often ranked as having one of the best public transportation systems in the US (Wallace 2017; M. Lewis 2017), it also has some of the worst traffic congestion (Muoio 2017; Dicker 2016), on par with traffic in cities like New York and Los Angeles. One could look at this and simply say that cities with good transit have bad congestion, but in Seattle, this is not necessarily the case. Seattle is a fraction the size and much less dense than these other metropolitan areas, but its traffic is on par with them, meaning that while the region has great transit service, a lot of people in Seattle still drive, and question remains, why? I attribute this to the transportation crisis.

We have seen in this chapter that Seattle essentially grew up as a streetcar city, which resulted in a relatively compact urban form until about 1940. Since that time, the Seattle region has sprawled significantly. Transportation in the 1940s shifted towards the automobile and the transit system reflects this, with the replacement of the streetcars with trolley buses and decreasing ridership until the 1970s. Multiple times during the 20th century, civic leaders proposed grand transit plans and each time these plans were voted against, including the Bogue Plan and Forward Thrust. Even into the 1990s, after the region began to embrace the need for transit, it was piecemeal in that the first Sound Transit proposal was rejected in 1995, but the full system approved by voters in 2016 for completion in 2041 is the essentially the same system voters rejected in 1995. The inability of civic leaders to adequately convince residents of the need and benefit for investing in transit has been one of the major contributors to the present transportation crisis.

Growth of the region in recent years has been a major contribution to this transportation crisis. In 2016, the City of Seattle surpassed 700,000, a figure planners did not anticipate reaching until 2025 or later. This has put strain on existing roads and transit services. There is no sign that growth will slow down, but SDOT, King County Metro and Sound Transit are not adequately addressing the fact that growth in the city and region are happening much faster than what their plans are meant for. The lack of foresight to plan transit in the past has led to a situation where the City of Seattle is attempting to pick up the slack and build its own high capacity transit network by 2024, but even when this is finished, it will likely be inadequate to meet demand.

In the following chapters, I present the findings of this dissertation research about transit use, travel behavior and the relationship between transit use and walkability in the urban core. The objective of this is to explore how people utilize different modes of transportation in an effort to better understand how Seattle and its numerous transportation and transit authorities can more effectively plan and build a transit system that people will utilize. The city is so engaged in a number of innovative programs, and working to build a better transit system, but without fully understanding the possible implications of their work, or envisioning a different way forward. In Chapter 5-7, I present the findings from the dissertation research, and in Chapter 8, return to many of the current planning activities discussed in this chapter and analyze them in light of the results presented in Chapter 5-7 to determine if they are effective, how they can be more effective, and what would be more effective. I argue that many of the City and the Region's efforts in regard to transportation remain entrenched in a 20th century planning paradigm that addresses how to build for future growth, and as a consequence misses the mark on how to improve livability in Seattle today. As we have seen, Seattle has developed a slow and steady approach to public projects, an approach that is somewhat warranted given its past failures in promoting good planning, but this slow, steady, and cautious approach is not necessarily what the city needs not to address its current transportation crisis. Seattle has become one of the largest hotspots for technological innovation and the knowledge economy, but the City and transportation system are anything but innovative, even when more and more citizens acknowledge the fact that they need to do more. Not only do many transportation projects not do enough, many of them seem to contradict each other, especially within the urban core, something that will become more apparent in the following chapters.

Chapter 5

Results Part I: Neighborhood Morphology and Travel Behavior

The Seattle urban core is a vibrant urban center in one of the fastest growing large cities in the United States (Balk 2017). The urban core is a 3.75 square mile area comprised of the Downtown office and commercial core and seven mixed-use and residential neighborhoods – eight neighborhoods in total, seven of which are included in the following analysis. This chapter explores the basic characteristics of the urban core. First, I examine the urban form of the urban core and the morphological features that make each of the seven neighborhoods unique. I examine both macro scale features, such as density and land use, as well as micro scale features relating to pedestrian, transit and automobile infrastructure. Second, I examine the travel behavior within the urban core compared to the rest of Seattle.

Neighborhood Morphologies

Relevant Research Question: *What are the morphological characteristics of each case neighborhood?*

The urban core is 3.75 square miles and is a agglomeration of four urban centers: Downtown, Capitol Hill/First Hill, Lower Queen Anne (or Uptown), and South Lake Union (City of Seattle 1994). Within these four urban centers, there are anywhere between seven and 10 distinct neighborhoods, depending on different definitions. The Downtown urban center contains the Downtown commercial core, Pioneer Square, the International District, Belltown and Denny Triangle. The Capitol Hill/First Hill urban center contains the Capitol Hill, Pike/Pine, and First Hill neighborhoods. While the urban core functions as a cohesive unit, each neighborhood has its own unique character and morphology, which is a result of its historical development. Urban morphology is most often a consideration of the relationship between a city's buildings and its open spaces – parks, plazas, or even parking lots. First, I look at broad characteristics of the urban core as a whole. This includes looking at building typologies, streets and block patterns, building ages, building heights, open space and parking. Then I look at each of the neighborhoods included in this study in more detail, looking at land use patterns and other morphological characteristics. This study includes seven neighborhoods in its analysis: Downtown, Pioneer Square, International District (ID), Capitol Hill, Belltown, Lower Queen Anne (LQA) and South Lake Union (SLU).

Figure 5.1. Seattle urban core map, showing neighborhood borders.

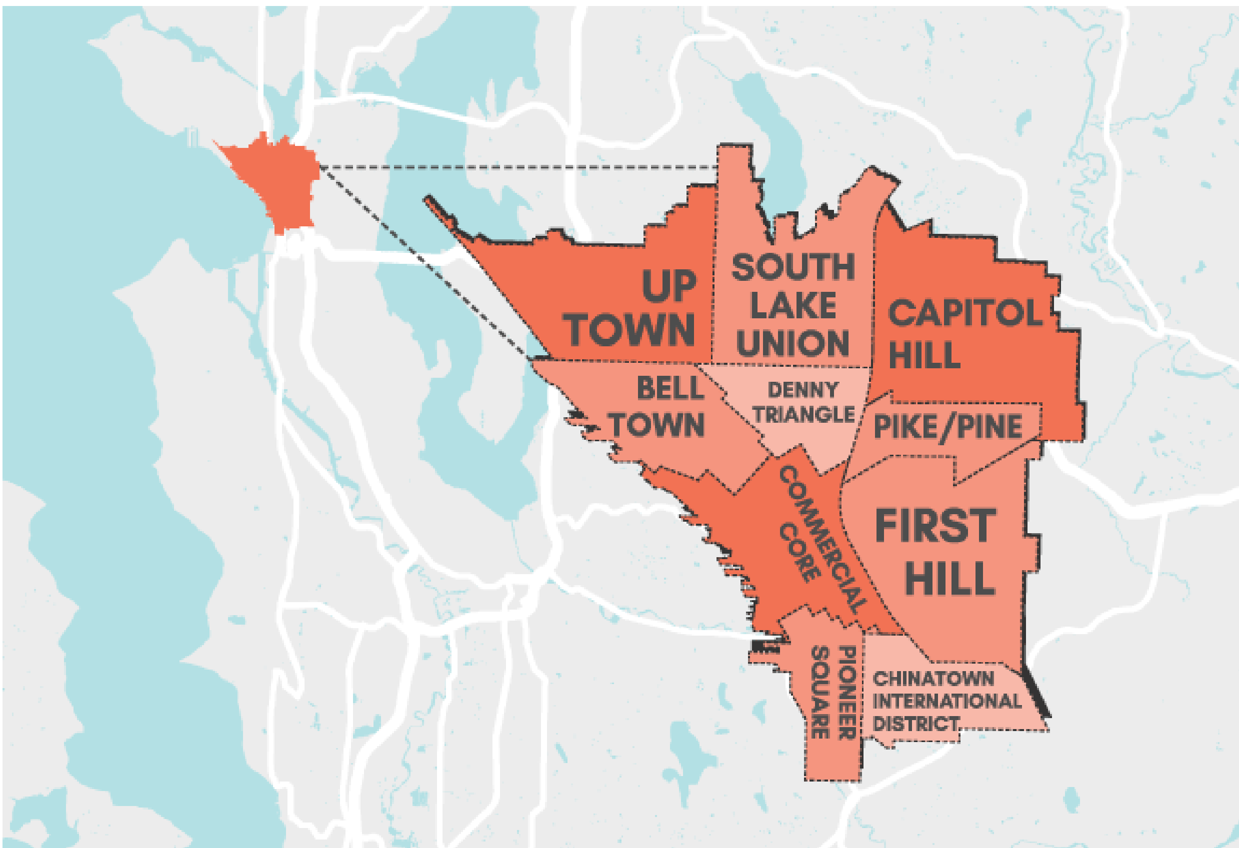


Figure 5.2. Seattle urban core figure ground.

The Seattle urban core is a compact urban area, which can be seen in the figure ground in Figure 5.2. It is the densest residential area in the Seattle metropolitan area and is the region's largest employment center. The total residential population in 2016 was roughly 93,000 (Table 5.1) (King County Assessor 2016), and total employment in the urban core is approximately 250,000 (One Center City 2017b). The average density of the urban core is nearly 25,000 people per square mile, although this varies from just under 11,000 people per square mile in the Downtown commercial core to 43,500 in Belltown. The urban core is the center of government, home to the Seattle city hall and municipal offices, King County offices, and numerous federal government offices. The urban core has many cultural and entertainment venues, including the Seattle Center (Space Needle, Pacific Science Center, Seattle Opera, Seattle Balley, Key Arena and others), the Seattle Art Museum, Seattle Aquarium, the Pioneer Square historic district, and Chinatown. First Hill is home to many of the region's largest health care providers, Swedish Medical Center, Harborview, and Virginia Mason, as well as home to Seattle University. The urban core is also home to the Amazon Inc headquarters, Seattle's largest employer and driver of much of the growth the city has seen in the previous decade.

Table 5.1. Neighborhood populations, density and Walk Score.

Neighborhood	**Population**	**Density (per square mile)**	**Neighborhood Walk Score**
Downtown:			
Downtown	4,852	10,832	98
Pioneer Square	1,984	13,023	98
International District	4,259	25,960	97
Belltown	14,326	43,488	98
Denny Triangle	6,740	29,749	98
Capitol Hill & First Hill:			
Capitol Hill	20,469	32,839	95
Pike/Pine Corridor	6,491	32,455	95
First Hill	10,701	31,130	95
12th Street	5,354	20,979	95
South Lake Union	8,296	18,684	92
Lower Queen Anne	9,101	24,354	92
Seattle Urban Core	92,962	24,705	96 +/-
City of Seattle (2015)	684,451	8,161	73

The urban core is the part of the city that is most walkable, as discussed in the previous chapters, and is the core of the walking urban fabric, as discussed by the theory of urban fabrics (P. Newman, Kosonen, and Kenworthy 2016). The analysis in much of this chapter is based on various elements of the theory of urban fabrics, which argues that each city is a combination of a pedestrian, transit and automobile urban fabric. The question of what urban fabric is most evident in the urban core neighborhoods is of prime importance to understanding walkability in the urban core. Being the city center and the oldest part of the city, we would expect this to be dominated by pedestrian oriented features, or at least the pedestrian fabric should be very prominent in all the neighborhoods. In many parts of the urban core, this is true, but in certain neighborhoods, the pedestrian fabric has been heavily eroded by the intrusion of the automobile urban fabric. The extent to which the pedestrian fabric has been preserved over the course of the 20th century is largely reflected in current types of infrastructure in each neighborhood. Table 5.2 and 5.3 show the elements of the pedestrian fabric as they exist in each of the seven neighborhoods within the urban core. Column 1 comes from Newman, Kosonen and Kenworth (2016) and their descriptions of the different types of urban fabrics. The remaining columns show what each neighborhood has in terms of that characteristic. Included in this table are both neighborhood wide elements, as well as elements present only in the observed case streets. The streets in this study all include main commercial areas in each area and as such are designated as arterials. They all tend to be wider than the most other streets (66 foot ROW is the de facto standard in most of Seattle) and range from 66 feet to 90 feet wide. Capitol Hill has some of the narrowest streets in the city at only 59 feet. Blocks in the Seattle urban core are either square or rectangular being either 240’ x 256’ or 360’ x 256’. Blocks identified as ideal for walkability are often cited as being between 300’ and 400’ long, so the block sizes in Seattle are well suited to a walkable urban fabric. The street network in all the neighborhoods is gridded and highly permeable, also contributing to its high degree of walkability. In many parts of the urban core, buildings front directly onto the street with little or no setbacks. In the Downtown proper, many large office buildings have street level plazas, but the hilly nature of Downtown Seattle means that even parts of these block sized buildings front onto the street. The commercial areas in all the neighborhoods are dominated by buildings fronting onto the street and broken up by the occasional parking lot. In Capitol Hill, residential areas are predominantly apartment buildings, duplexes and triplexes, and the rare single family home. Most of these have side setbacks and varying front setbacks.

The urban core contains some of the oldest buildings in Seattle as well as a huge amount of new construction and infill development. Figure 5.3 shows building ages across the urban core – the darker the color, the older the building. Many of the oldest buildings in Seattle are in Pioneer Square, which was rebuilt after the Great Fire of 1889. Most of the buildings in this part of the city are 5 to 7 story brick buildings. Other concentrations of older buildings are found on the northern edge of Downtown in the retail core section of the CBD, centered around Pike Place Market. Belltown has a small cluster of older buildings, many 2-3 stories along 1st and 2nd Avenue and also has a number of newer luxury condos. Much of the area east of here in Belltown and Denny Triangle is relatively new construction. This is much of the area of the Denny Regrade, which became parking lots, service shops and motels to service Downtown that have been redeveloped since 2000, with a number of new buildings planned. Capitol Hill has a high concentration of older buildings, although the distribution is more spread out with older and new buildings mixed together.

In looking at building heights, we see an almost inverse relationship between building age and building height. Figure 5.4 shows building heights, which dark colors being taller buildings. Areas with high concentrations of older buildings – Pioneer Square, the Downtown retail area, Belltown and Capitol Hill – have a low concentration of taller buildings. Downtown has a large concentration of mid- and high-rise buildings – mostly offices, but with a few residential condominium buildings. Denny Triangle has a lot of newer high rise buildings built within the last 5-10 years, as well as several currently under construction, seen in Figure 5.5. This is a result of the City up-zoning the area and essentially making it an extension of the Downtown commercial core. First Hill has a number of mid-rise buildings which contain the three major hospitals in Seattle, as well as number of mid-rise residential buildings. South Lake Union has a small number of buildings in the 9-12 story range, a number that is likely to increase in the coming years after the Seattle City Council recently approved an up-zone of the neighborhood to allow taller buildings and to increase the amount of affordable housing (Beekman 2017). SLU has the highest concentration of construction of any neighborhood in the study area, a result of its transition from a light industrial and warehousing to a hub of high-tech firms.

Figure 5.3. Seattle urban core building age.

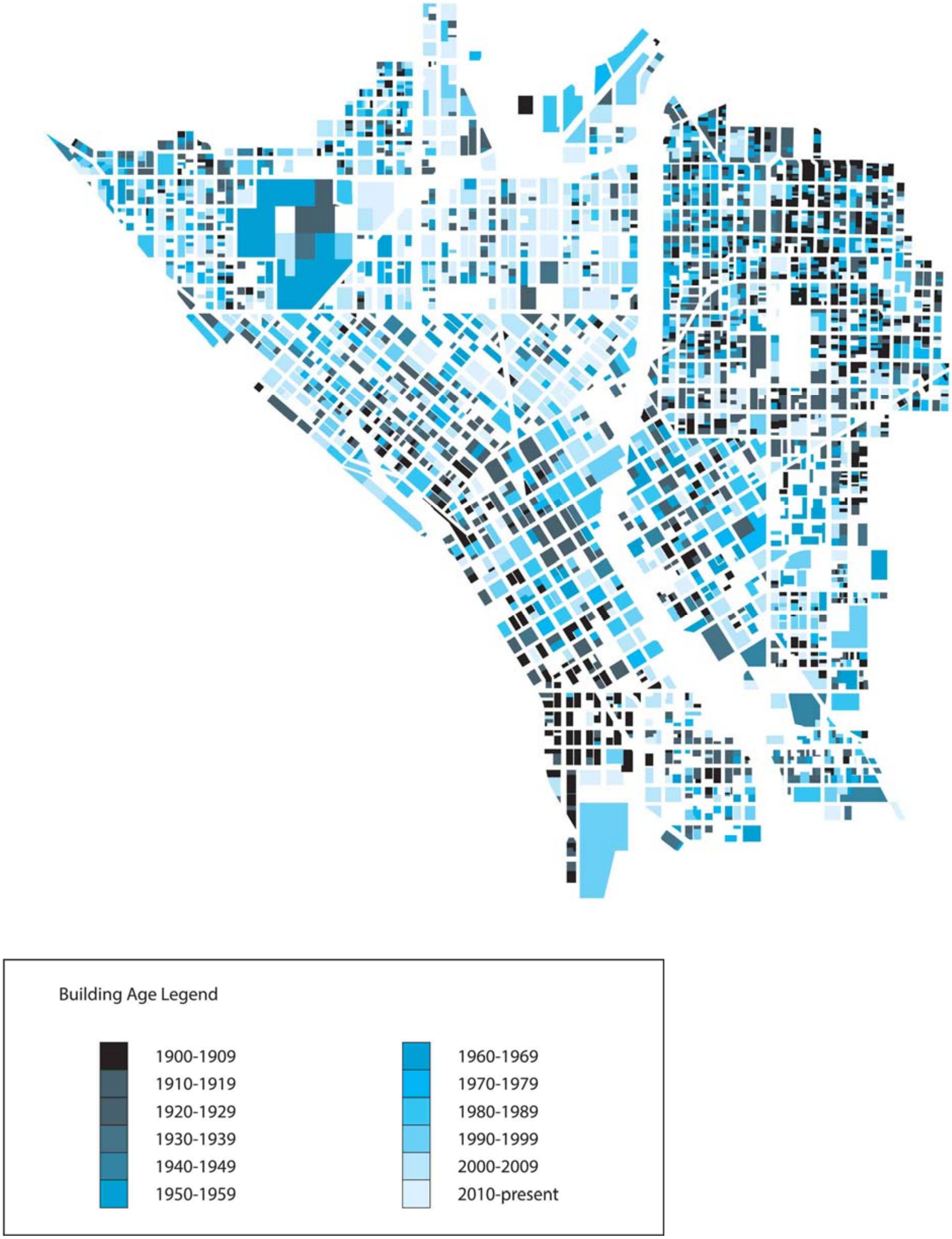


Figure 5.4. Seattle urban core building height.

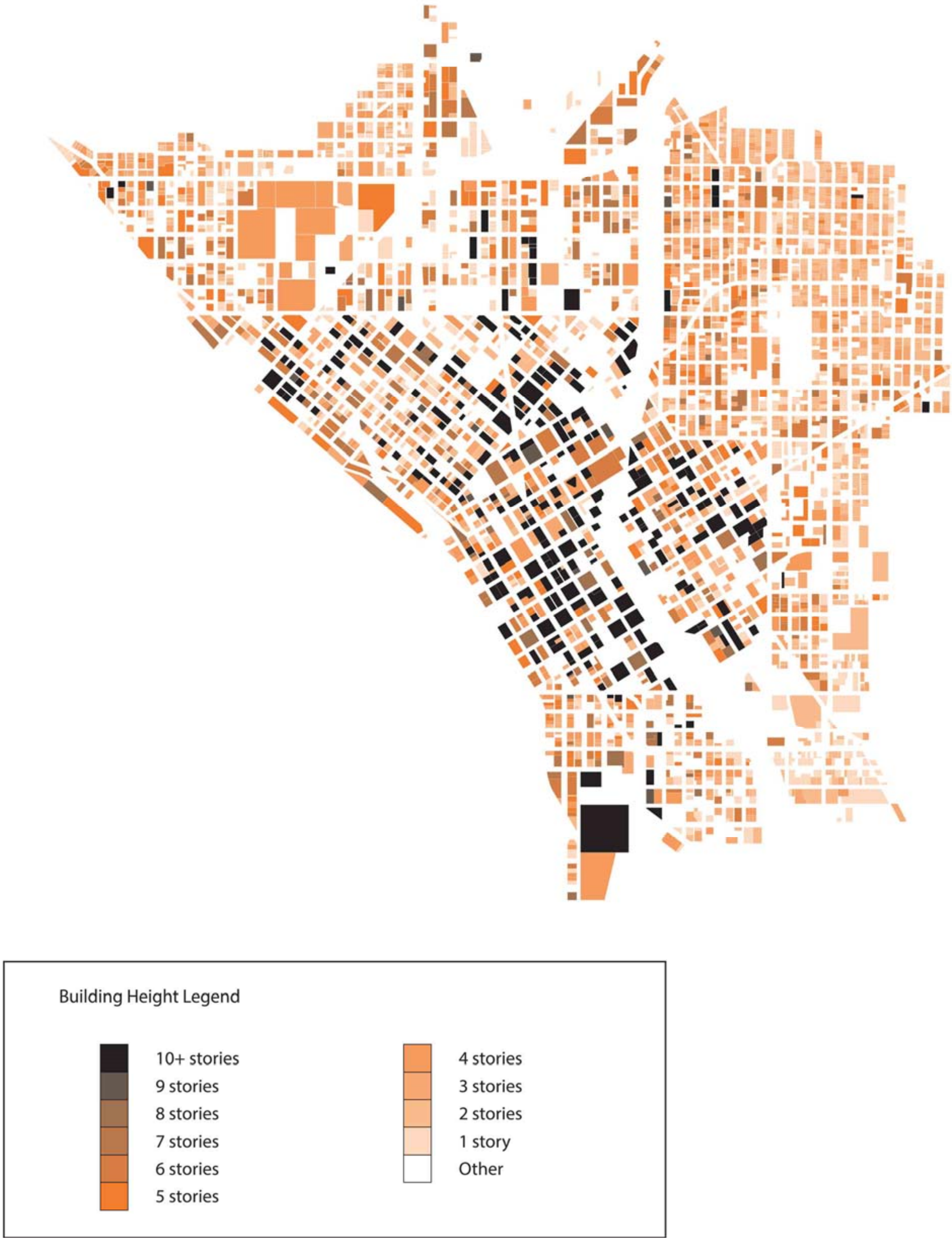
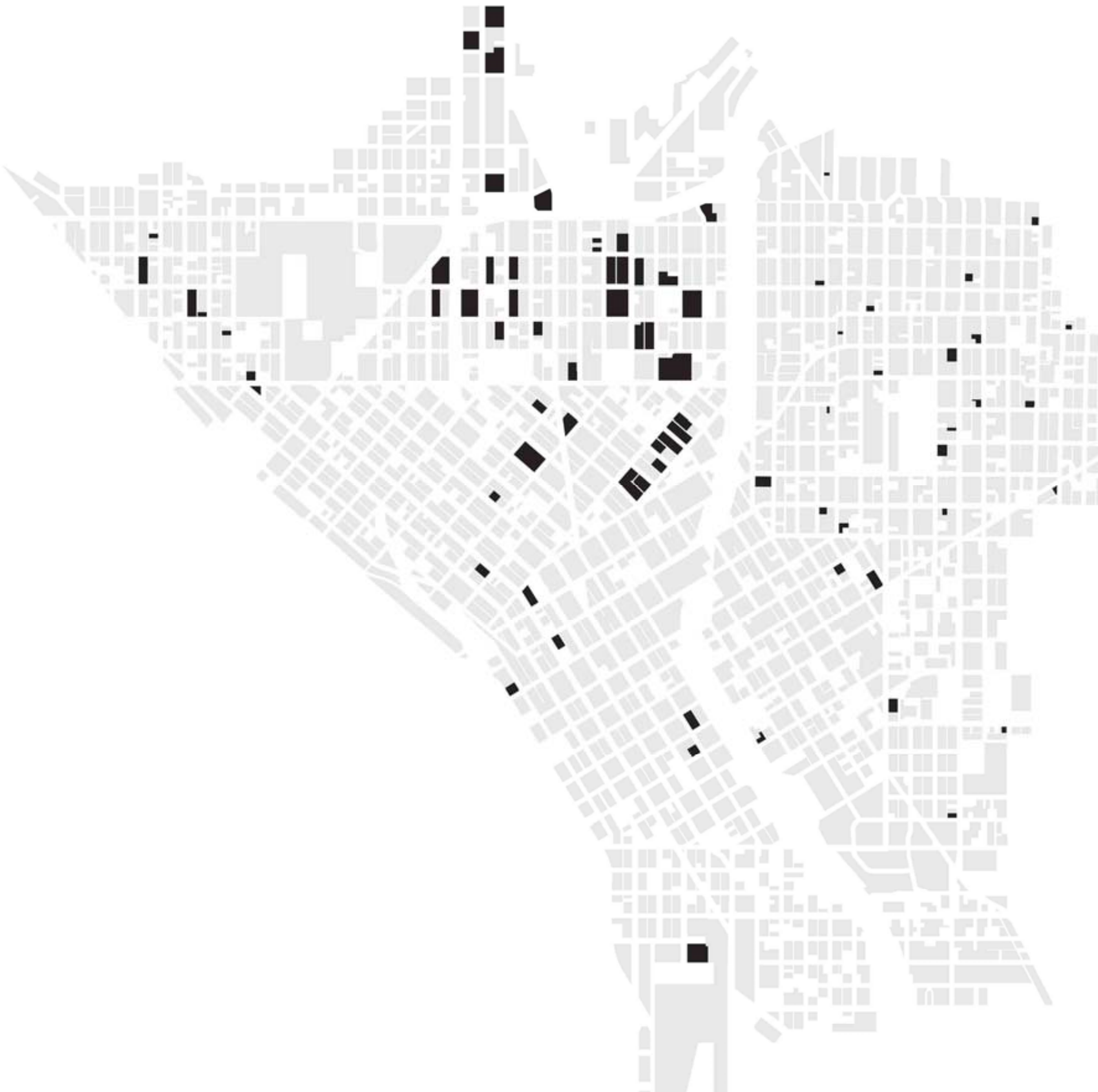


Figure 5.5. Seattle urban core construction (black) in Fall 2016.



Also included in the full area wide analysis is parking and open space, which along with buildings and their uses, are key components of urban morphology. The urban core has numerous parking garages, and surface parking lots that take up a full lot or more. A typical lot in Seattle is 60’ wide and 120’ deep and covers either 1/8 or 1/12 of a block, depending on the block size. There is no real identifiable pattern to the location of parking. Stand-alone parking garages are located mostly in the Downtown commercial core and First Hill, or by major institutions, like the Seattle Center in LQA or Seattle Central College in Capitol Hill. Surface parking is present in all the neighborhoods and varies greatly across the neighborhoods, showing how the pedestrian urban fabric in some parts of the urban core has been more heavily eroded than in others. For example, in LQA and Belltown/Denny Triangle, over 12 percent of their area is surface parking or stand-alone garages. These two neighborhoods also have the highest number of parking lots per block within the observed commercial areas. The International District has close to 15% of its area as parking lots and garages, but the commercial blocks do not have many parking lots. Capitol Hill and Downtown have the lowest area of parking lots and garages, with 5.4 percent and 7.2 percent respectively. They also have the lowest numbers of parking lots per block (just over 0.5 per block). The parking included in this analysis does not include all parking in the urban core. Not included in this is parking built into other buildings or below ground, or surface parking that takes up only a small portion of a lot, as is the case with many of the multi-family apartment buildings in Capitol Hill or LQA.

Public space and seating is highly varied throughout the urban core. In Downtown and Pioneer Square, there are a number of small public spaces, such as Pioneer Square, Occidental Park, and Westlake Park, as well as Freeway Park, a large urban park built on top of I-5 in the 1970s. LQA is home to the Seattle Center and the Space Needle, and has an abundant amount of open space connecting the many museums and entertainment venues found here. SLU is home to Denny Park, the city's first public park (and formerly a cemetery) and has a number of new plazas that provide numerous public spaces among the numerous Amazon buildings and were built as part of a public benefit requirement by the City in exchange for vacating an alley or allowing zoning variances. Capitol Hill has several small parks or p-patches (neighborhood community garden) and one larger neighborhood park (Cal Anderson Park) as well as a handful of streateries and parklets built by businesses in the area to provide outdoor seating to customers. Looking at seating, Downtown and Capitol Hill have the lowest amount of public seating per block. SLU has the most public seating per block, a result of same public benefits program leveraged against large developments in the neighborhood. Pioneer Square also has a high amount of public seating, but is isolated to areas around two of the plazas in the neighborhood, Pioneer Square and Occidental Park. SLU and Belltown have the highest amount of other seating, which mostly includes restaurant and coffee shop seating. Seating, while not necessarily a morphological feature, is often an important component of open space, and is often contributes to making an urban environment walkable.

Figure 5.6. Seattle urban core parking lots (grey) and parking garages (black) in Fall 2016.

Figure 5.7. Seattle urban core parks, plaza and open space (green) in Fall 2016.

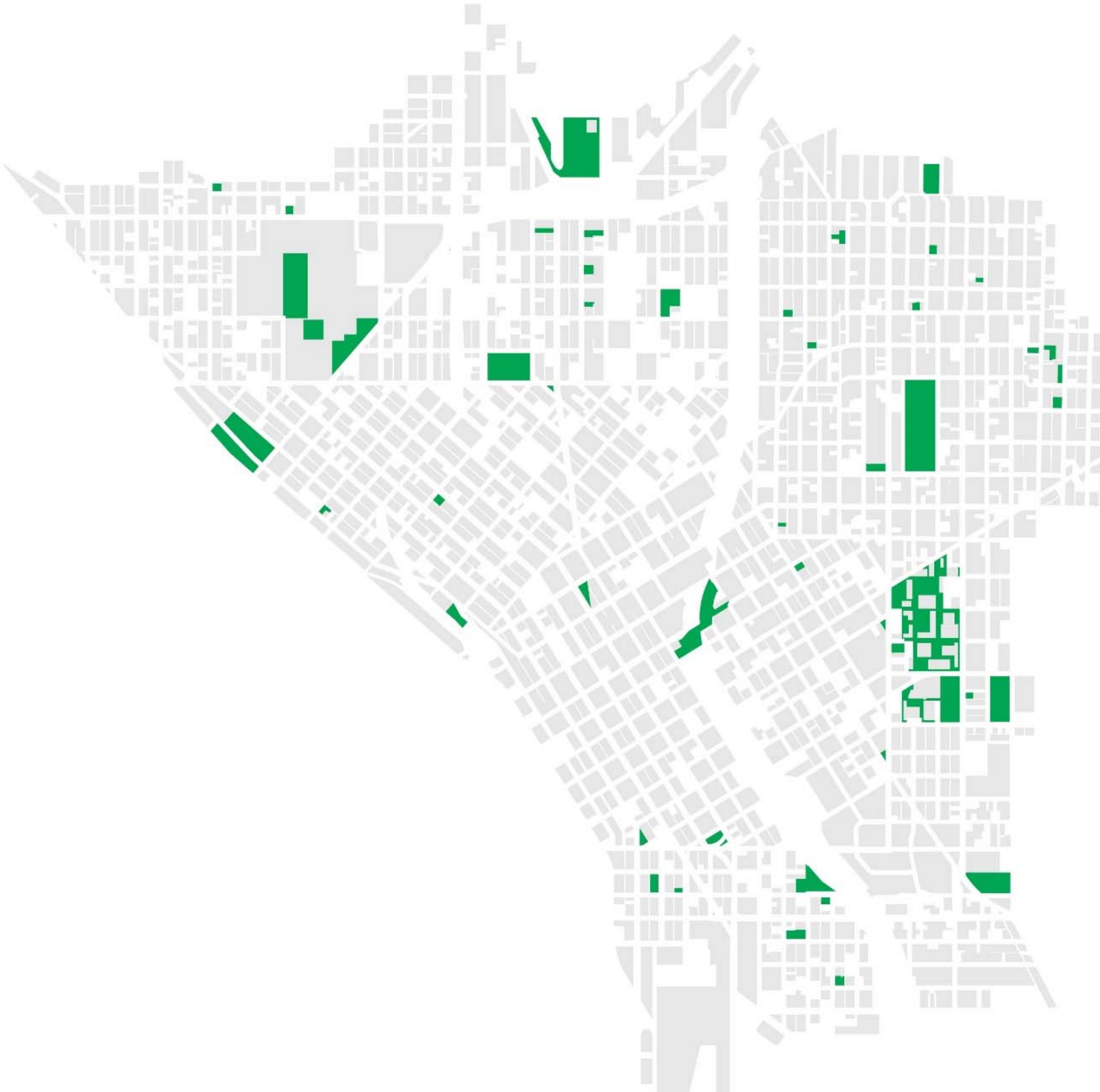


Table 5.2. Pedestrian urban fabric elements by Seattle neighborhood. Walking fabric elements (column 2) come from Newman, Kosonen and Kenworth, 2016.

	Walking Fabric	Downtown	Pioneer Square	International District
Street widths	Narrow	Pine St: 80’ 3rd Ave: 84’-90’ 4th Ave: 84’-90’ Widest: 90’ Narrowest: 66’	1st Ave: 84’ Occidental: 84’ Jackson St: 66’ Widest: 90’ Narrowest: 60’	Jackson St: 96’ King St: 66’ Maynard Ave: 66’ Widest: 96’ Narrowest: 66’
Squares and public spaces	Frequent as very little private open space	Parks: 2 Plazas: 4 P-Patch: 0 Parklets: 1 Streateries: 0 Other: Numerous small plazas in office building complexes	Parks: 1 Plazas: 5 P-Patch: 0 Parklets: 0 Streateries: 0	Parks: 2 Plazas: 2 P-Patch: 1 Parklets: 1 Streateries: 0
Street furniture	High level for pedestrian activity	Public Seating per block (*): 0.67 Other seating per block (*): 2.9	Public seating per block (*): 15.4 Other seating per block (*): 9.1	Public seating per block (*): 1.6 Other seating per block (*): 0.36
Street Networks	Permeable for easy access; enables good level of service for pedestrians	Very permeable Intersections per square mile:	Very permeable Intersections per square mile:	Very permeable Intersections per square mile:
Block scale	Short blocks	240’ x 256’ 360’ x 256’ (half of each)	240’ x 256’	240’ x 256’
Building typologies	High density min. 100/ha or 25,900 per square mile	10,832 per square mile	13,023 per square mile	15,656 per square mile
Building setbacks	Zero setbacks	No setbacks; large office buildings with plazas/podiums, some setbacks	No setbacks; historic neighborhood	No setbacks; historic neighborhood with new development
Building parking	Minimal for cars; seats for pedestrians; bike racks	On street parking; 40+ large parking garages in offices/residences; 7.2% blocks parking; 0.61 parking lots per observed block	On street parking plentiful; 14.1% blocks of parking; 0.85 parking lots per observed block	On street parking plentiful; some off street parking; 15.6% blocks parking; 0.55 parking lots per observed block
Level of service for transport mode	Pedestrian services allow large flows of pedestrians	Avg. Sidewalk Width (*): 10.6’ Avg. Destinations (*): 7.55	Avg. Sidewalk Width (*): 8.6’ Avg. Destinations (*): 6.85	Avg. Sidewalk Width (*): 9’ Avg. Destinations (*): 8.9

Table 5.3. Pedestrian urban fabric elements by Seattle neighborhood.

	Capitol Hill	South Lake Union	Lower Queen Anne	Belltown/Denny Triangle
Street widths	Broadway: 80' Pike St: 76' Pine St: 76' 12th Ave: 80' 15th Ave: 60' Widest: 80' Narrowest: 59'	Westlake Ave: 90' Terry Ave: 76' Widest: 140' Narrowest: 66'	Mercer St: 79' Queen Anne: 66' Widest: 79' Narrowest: 66'	1st Ave: 82' 2nd Ave: 90' Bell St: 66' Widest: 90' Narrowest: 66'
Squares and public spaces	Parks: 5 Plazas: 1 P-Patch: 2 Parklets: 1 Streateries: 2 (plus 3 in planning)	Parks: 3 Plazas: 3+ P-Patch: 1 Parklets: 0 Streateries: 0 Other: New offices with plazas	Parks: 0 Plazas: 1 P-Patch: 0 Parklets: 1 Streateries: 0 Other: Seattle Center	Parks: 1 Plazas: 1 P-Patch: 1 Parklets: 1 Streateries: 1 Other: Bell Street
Street furniture	Public seating per block (*): 1.6 Other seating per block (*): 11.4	Public seating per block (*): 12.5 Other seating per block (*): 35.9	Public seating per block (*): 0 Other seating per block (*): 6.85	Public seating per block (*): 6.9 Other seating per block (*): 40.7
Street Networks	Very permeable Intersections per square mile:	Very permeable Intersections per square mile:	Very permeable Intersections per square mile:	Very permeable Intersections per square mile:
Block scale	360' x 256' 360' x 200' (half of each)	240' x 256' 360' x 256' (majority)	240' x 256' 360' x 256' (majority)	240' x 256' 360' x 256' (majority)
Building typologies	32,839 per square mile	18,684 per square mile	17,344 per square mile	43,488 per square mile
Building setbacks	Zero setbacks in commercial areas; apartment buildings with 5' setbacks, single family, duplex, triplex with 10' setbacks; 5' side setbacks	Zero setbacks in commercial areas; new offices and apartments with minimal setbacks	Zero setbacks in commercial areas; minimal setbacks in residential areas, side setbacks 5'	Zero setbacks in commercial areas; minimal setbacks in whole neighborhood
Building parking	On street parking plentiful; off street parking; 5.43% blocks parking; 0.875 parking lots per block (north bway); 1.6 parking lots per block (15th ave); 0.52 parking lots per block (Pike/Pine)	On street parking plentiful; some off street parking; 11.9% blocks parking; 0.67 parking lots per observed block	On street parking plentiful; off street parking plentiful; 12.2% blocks parking; 1.29 parking lots per observed block	On street parking plentiful; off street parking; parking garages; 12.3% blocks parking; 0.9 parking lots per observed block
Level of service for transport mode	Avg. Sidewalk Width (*): 6.8' Avg. Destinations (*): 8.2	Avg. Sidewalk Width (*): 8.6' Avg. Destinations (*): 6.33	Avg. Sidewalk Width (*): 6.4' Avg. Destinations (*): 6.57	Avg. Sidewalk Width (*): 6.9' Avg. Destinations (*): 9.7

A final way to understand the form of the urban core and each of its composite neighborhoods is to look at its land uses. Figures 5.8 to 5.15 show the land uses in the urban core and each neighborhood in detail. Unlike more typical land use plans, the categories of land use are tailored here to highlight subtle differences between uses. There are three residential categories: single-family homes, single family attached (i.e. townhomes or row houses) and duplexes, and multifamily apartments and condominiums. There is also a category for mixed-use residential, which is any residential building with ground floor retail or commercial uses. Likewise, there is a mixed-use office category to identify office buildings with ground floor retail or commercial uses, as well as a category for stand-alone office uses. Having street level retail uses makes a difference in the walkability of a neighborhood, so differentiating between these is important. Other uses include: parks; educational (which includes grade schools, community colleges and universities); civic, cultural, or religious uses; government uses; vacant land; construction; parking; and industrial or warehouse uses.

For the most part, the urban core is shades of red, meaning that commercial, office and mixed use residential and office buildings dominate the area. A couple civic areas stand out, the Seattle Center in SLU, Century Link Field in Pioneer Square, and the Washington State Convention Center in the center. We can also see a north-south gap in the middle of the urban core splitting Capitol Hill and First Hill from Downtown – this is Interstate 5. More than dividing the neighborhoods, it also represents a change in land use patterns. On the west side of I-5, commercial, office and mixed use buildings dominate, and on the east side, there is more distinction between residential and commercial areas.

The northern part of the Downtown core is the retail center of Seattle, with department stores and high-end retailers. The southern half of the Downtown core is predominantly high-rise office buildings, some of which have ground floor uses catering to daytime employment – small restaurants, banks, and some high-end restaurants. Pioneer Square is predominantly mixed-use office and residential, with small ground floor retail shops and restaurants. The International District, which I-5 runs through on an elevated portion, has a commercial core on Jackson and King Streets, which is predominantly mixed-use residential buildings. On the other side of I-5, land uses consist of light industrial, warehousing, and retail strip mall centers.

Belltown has a mix of high density multi-family housing as well as mixed-use residential. The commercial areas along 1st and 2nd Avenues are dominated by bars, restaurants, cafes, and small retail shops. As we move east, the neighborhood transitions into more office uses centered around Westlake Avenue. This eastern part of the neighborhood has a large amount of new mid- and high- rise construction and a number of new projects in the planning and design phases. Lower Queen Anne is a mixture of smaller office buildings, multi-family residential and a small mixed use center along Queen Anne Avenue North and West Mercer Street. Scattered among the office buildings and apartments, there is also a large amount of parking. South Lake Union is centered along Westlake Avenue and is predominantly offices with ground floor commercial uses – many restaurants, fast food eateries and coffee shops. These uses primarily cater to the daytime workers who flood into the neighborhood each day. Many of the buildings in the neighborhood are less than a decade old and a lot of new construction is under way – both new offices and new housing.

On the east side of the I-5 divide are Capitol Hill and First Hill. These two neighborhoods are still considered mixed-use by most standards, but with more distinct commercial and residential areas. Capitol Hill itself has three primary commercial areas – Pike/Pine corridor, Broadway and 15th Avenue – and each one has a different character. Pike/Pine is primarily mixed-use residential which has undergone a tremendous amount of redevelopment in the last decade. This part of the neighborhood is predominantly restaurants and bars and is the center of nightlife in Seattle. The Broadway commercial area is predominantly restaurants and retail stores catering to residents in the neighborhood and has a mix of newer mixed-use buildings. The 15th Avenue commercial area is predominantly restaurants and locally serving stores. Residential uses in the neighborhood vary from 3-7 story apartments, townhomes, row houses, duplexes and triplexes in converted single-family homes, and a handful of single family homes. First Hill has three of Seattle's largest hospitals and complementary medical offices and is home to Seattle University. On the northern edge of the neighborhood, there are high density apartments, and in the south end of the neighborhood, a mixture of apartments and single family homes. The large vacant area in the south end of the neighborhood is Yesler Terrace, the city's largest low-income housing complex, which is currently being completely rebuilt.

Figure 5.8. Seattle urban core land use map, Fall 2016.

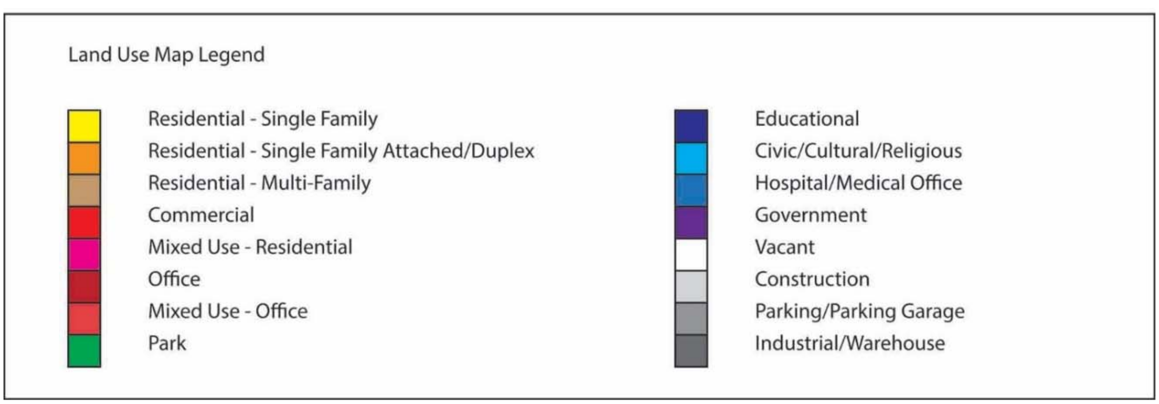


Figure 5.9. Capitol Hill land use map, Fall 2016.

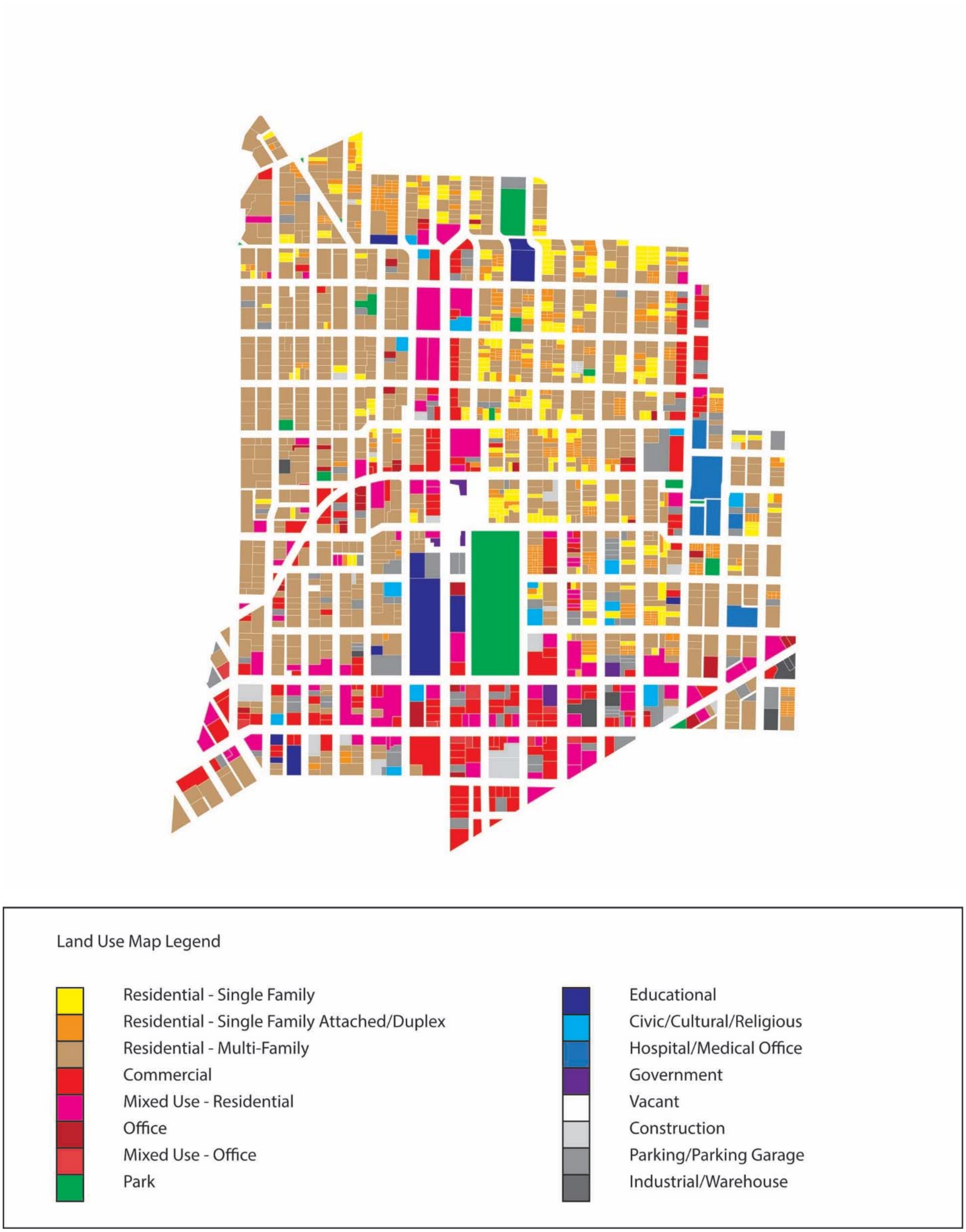


Figure 5.10. South Lake Union land use map, Fall 2016.

Figure 5.11. Lower Queen Anne land use map, Fall 2016.

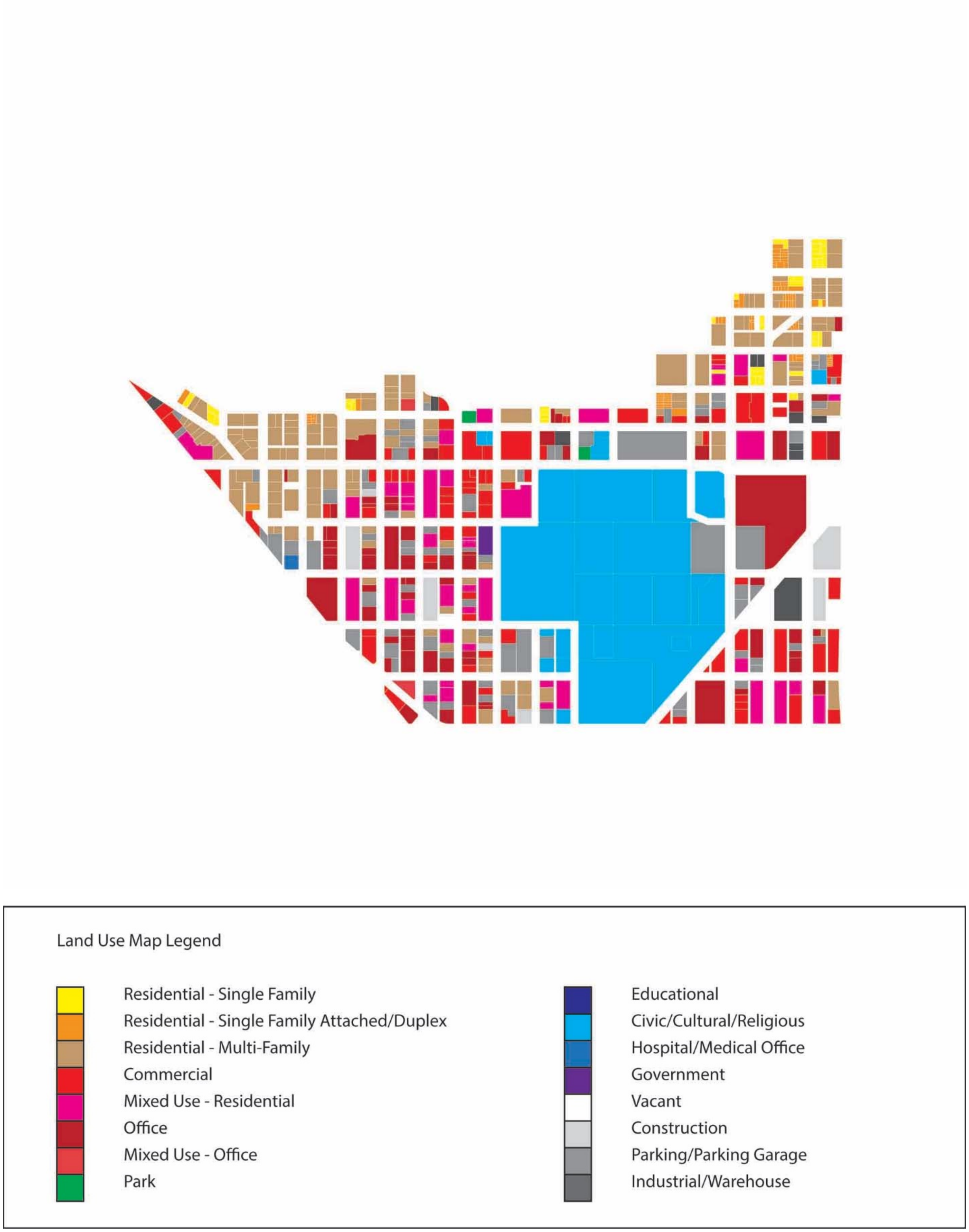
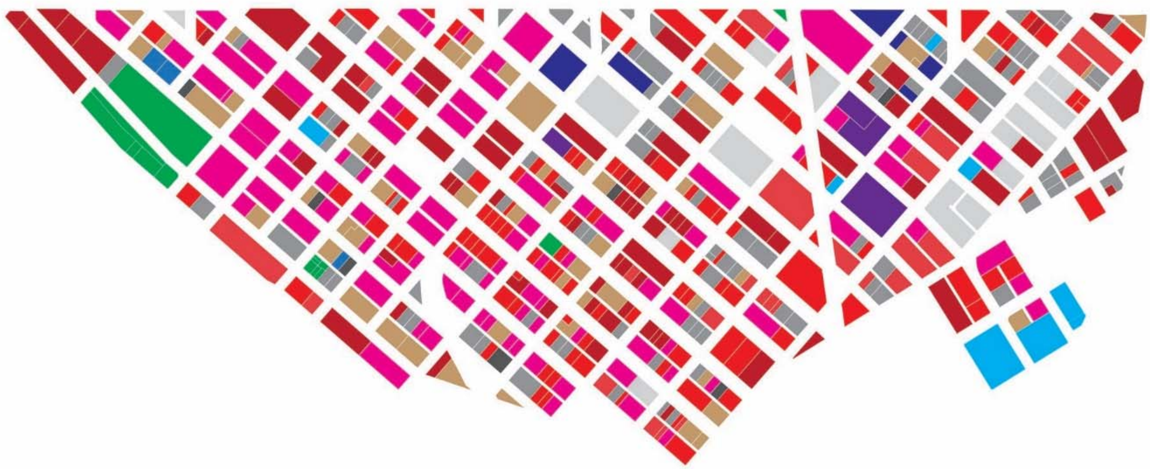


Figure 5.12. Belltown/Denny Triangle land use, Fall 2016.



Land Use Map Legend

	Residential - Single Family		Educational
	Residential - Single Family Attached/Duplex		Civic/Cultural/Religious
	Residential - Multi-Family		Hospital/Medical Office
	Commercial		Government
	Mixed Use - Residential		Vacant
	Office		Construction
	Mixed Use - Office		Parking/Parking Garage
	Park		Industrial/Warehouse

Figure 5.13. Downtown Commercial core land use map, Fall 2016.

Figure 5.14. Pioneer Square and International District land use map, Fall 2016.

Land Use Map Legend

- Residential - Single Family
- Residential - Single Family Attached/Duplex
- Residential - Multi-Family
- Commercial
- Mixed Use - Residential
- Office
- Mixed Use - Office
- Park
- Educational
- Civic/Cultural/Religious
- Hospital/Medical Office
- Government
- Vacant
- Construction
- Parking/Parking Garage
- Industrial/Warehouse

Figure 5.15. First Hill land use map, Fall 2016.

The morphology and urban form of the urban core of Seattle is representative of the type of urban environment idealized by planners. It is compact, dense, walkable, and full of mixed land uses. It has a variety of buildings styles that represent the history of Seattle itself. Over time, each of the neighborhoods in the urban core has developed its own character and feel.

Neighborhood Walkability

Relevant Research Question: What travel behaviors exist within the urban core? How does each neighborhood vary in terms of quantity and quality of walking? Where in each neighborhood do these activities occur?

As we have seen, each of the seven case neighborhoods has a distinct character. Not only is this distinct character evident in their built form, but also by the activities that take place in each neighborhood. This question examines what travel behaviors and walkability of the urban core neighborhoods. First I examine what travel behaviors exist within the urban core and if they are distinct from the rest of the Seattle. Second, I examine the extent to which walking and transit use vary between the seven case neighborhoods. Here I use the theory of urban fabrics (P. Newman, Kosonen, and Kenworthy 2016) as a starting point. The analysis considered different types of infrastructures – pedestrian, transit, or automobile – to help explain how each neighborhood is different and where in each neighborhood walking activities are focused.

Seattle residents utilize walking and transit more than the average American for their commute to work – 20.1 percent versus 5.1 for commute by transit and 9.6 percent versus 2.8 percent for commute by walking (American Fact Finder 2015). While commuting by walking and transit has stayed the same in the US since 2009, Seattle has seen an increase in transit use from 18.6 percent and an increase in walking from 8.3 percent. Table 5.4 shows commute mode share for Seattle from the US Census, commute modes from the travel survey. I identified survey respondents as either in the urban core or out of the urban core based on their zip code, even though some of the zip code boundaries go beyond the urban core limits. In the right column, commute modes to Downtown as reported by *Commute Seattle* (Commute Seattle 2017). I include these survey results here since a larger proportion of survey respondents reside in the urban core.

Between these three surveys, we can see quite a difference in results. For walking, 9.6 percent of residents commute to work according to the census, 19.25 percent according to the travel survey, and 6 percent of those who work in Downtown Seattle. Biking is similarly skewed in the travel survey, with 20.3 percent commuting to work by bike, while the census puts this at only 3.8 percent and 3 percent of Downtown workers. Transit use is highest among those who work Downtown, while the Census puts this figure at 20.1 percent and the travel survey at 33.1 percent. Driving is by far the most common commute mode according to the Census at 58.4 percent, while only 20.9 percent of survey respondents drive alone to work and 30 percent of Downtown workers. Values for carpooling and ridesharing are the most similar among all three surveys.

There are a several reasons that can help explain why the travel survey I conducted varies from the Census and from the Commute Seattle survey. First is the issue of sampling for the travel survey, which was done with flyers, promoted on social media and through organization listservs, namely Seattle Neighborhood Greenways, a bicycle and safe streets advocacy group. This alone accounts for the high percentage of respondents commuting to work by bicycle and walking. As for differences in transit use, it is plausible that city-wide commuting by transit is around 30 percent, higher than that reported by the Census. Transit use has risen steadily in the city as access to transit and transit services improve, especially the two station light rail extension that opened in Capitol Hill and at the University of Washington in 2016, which dramatically altered the way people got to work. Another factor contributing to higher transit use is overall regional growth, which has added congestion to the highways, dramatically increasing commute times by car. Additionally, re-urbanization in the urban core has decreased the supply of parking, making it more expensive. This combination of push and pull factors encouraging people to switch from driving to transit for their commute has likely increased commute by transit above the 20 percent indicated by the US Census. The higher share of transit commuting is also possibly a function of where survey respondents live, with 105 living in the urban core and 82 living throughout the rest of Seattle. The urban core, by its very nature, is transit rich, allowing people to travel easily within the urban core, as well as to neighborhoods outside the urban core for work.

Table 5.4. Commute share of Seattle residents from US Census, travel survey, and Commute Seattle.

Commute Mode	**Seattle (US Census, 2015) (%)**	**Seattle (Dissertation Travel Survey) (%, N=187)**	**Seattle (Commute Seattle) (%)**
Walk	9.6	19.3	6.0
Bike	3.8	20.3	3.0
Public Transportation	20.1	33.1	47.0
Carpool	8.2	6.4	9.0
Drive Alone	58.4	20.9	30.0
Other			5.0

Table 5.5. Commute mode share of residents in the urban core compared to residents in the rest of Seattle.

Commute Mode	**Seattle (Travel Survey) (%, N=82)**	**Urban Core (Travel Survey) (%, N=105)**
Walk	4.9	30.5
Bike	29.3	13.3
Public Transportation	32.9	33.3
Carpool	8.5	4.8
Drive Alone	24.4	18.1

When looking at differences between survey respondents in the urban core and those outside the urban core, a couple interesting patterns emerge. First is the dramatically higher percent of people walking to work – 30.5 percent of those in the urban core, versus 4.9 percent outside. Commutes by bike are interestingly more than twice as high for people who live outside the urban core. Transit use is essentially the same – 33.3 percent in the urban core and 32.9 percent in the rest of the city. This indicates that where survey respondents live does not drastically change their likelihood of using transit. Driving and carpooling are lower in the urban core, with 4.8 percent carpooling and 18.1 driving alone compared to 8.5 percent carpooling and 24.4 percent driving along in the rest of the city. As we would expect, walking, biking and transit use account for over 75 percent of all commutes to work among those that live within the urban core. For those who live outside the urban core, biking, transit and driving make up over 85 percent of commutes. Interestingly, fewer people bike to work within the urban core as compared to the city. This is because cycling many times serves as a replacement for transit use. The reasons given for this in interviews are often the same as those given for why people walk instead of use transit between urban core neighborhoods. The most commonly cited reasons include inability of busses to navigate traffic, the unreliability of the busses being on time, and the benefit of getting exercise while getting to work. When the light rail is within walking distance, people are more likely to use it as a transit option due to it being a direct, frequent and reliable mode of transit that avoids street level traffic altogether.

Table 5.6. Primary mode of transportation for all trip types, from travel survey.

Transportation Mode	City Wide (%, N=249)	Urban Core (%, N=153)	Outside Urban Core (%, N=96)
Walking	35.7	49.7	13.5
Bike	15.3	7.2	28.1
Drive	24.5	20.3	31.3
Bus	16.9	13.7	21.9
Light Rail	2.4	3.3	1.0
Streetcar	0.4	0.7	0.0
Transit Total	19.7	17.6	22.9
Bike and Transit Total	34.9	24.8	51.0
Other	4.8	5.2	4.2

As planners, knowing how people get to work is important, but this is only two trips per day, and thus it should also be important to understand what modes of transportation people use to a range of destinations. When asked a simple question about what their primary mode of transportation is, we see some surprising results. Citywide, 36 percent indicated walking as their primary mode of transportation, followed by driving (24 percent), bus (17 percent), bike

(15 percent), light rail (2.5 percent) and streetcar (0.5 percent). For those living in the urban core, the main mode of transportation is also walking at 50 percent, followed by driving (20 percent), bus (14 percent), bike (7 percent), light rail (3.3 percent), and streetcar (0.7 percent). For those living outside the urban core, we see very different results, with driving being the most common mode of transportation (31 percent), followed by biking (28 percent), bus (22 percent), walking (14 percent), and light rail (1 percent). The most interesting thing is public transit versus driving. In all cases, the number of people who identify driving as their primary mode of transportation is higher than those identifying public transportation. This is particularly surprising among those who live in the urban core, since it has such high transit accessibility, but only 17.6 percent of people in the urban core identify transit as their primary mode compared to 20.3 percent who identify driving. Another surprising trend is the high number of people living outside the urban core who identify biking as their primary mode of transportation – 28.1 percent – which is almost as high as the number who identify driving.

When asked about specific destinations such as grocery stores, drug stores, coffee shops, entertainment and shopping, a majority of people indicated that their most common mode of transportation to each of these places was walking (60 percent), followed by driving (28.4 percent), bus (17 percent), biking (11.1 percent) and light rail (10 percent). When looking at the urban residents versus those not in the urban core, we see the same pattern as that noted above. Walking is the most common mode to all destinations for those in the urban core, followed in most cases by driving, when transit modes are counted as distinct modes. Total transit use is higher than driving – 29.8 percent versus 22 percent. For those outside the urban core, coffee shops and parks are the most walked to destinations, while driving is most common to grocery, restaurant and retail destinations. Transit use overall is about the same as in the urban core (27.9 percent versus 29.8 percent in the urban core). This indicates that while walking trips are common outside the urban core, the trips that are no longer done on foot are done by car, not by transit.

Table 5.7. Transportation mode to destinations among residents in the urban core. NOTE: Percentages are out of total respondents in the urban core (N=153) and were allowed to choose more than one mode to each destination.

	Walking	Bus	Light Rail	Streetcar	Driving	Bicycle	Other	NA
Grocery Store	74.5%	7.2%	0.0%	2.6%	37.3%	7.8%	2.0%	0.7%
Drug Store	79.7%	3.9%	0.0%	0.7%	21.6%	6.5%	0.0%	3.3%
Coffee Shop	89.5%	2.6%	0.7%	0.0%	7.2%	5.2%	0.0%	3.9%
Restaurant	90.8%	17.0%	11.8%	4.6%	32.0%	7.8%	5.2%	0.0%
Bar/Night Club	69.3%	13.7%	7.8%	3.3%	9.8%	4.6%	11.8%	17.6%
Entertainment Venue	66.0%	28.8%	16.3%	3.3%	24.8%	6.5%	13.7%	3.3%
Park	90.8%	10.5%	4.6%	2.0%	24.2%	10.5%	0.7%	1.3%
Sporting Event	26.8%	13.7%	39.2%	8.5%	6.5%	3.9%	4.6%	35.3%
Retail Shopping	59.5%	34.6%	27.5%	3.3%	34.6%	7.8%	3.9%	2.6%
Average	71.9%	14.7%	12.0%	3.1%	22.0%	6.8%	4.6%	7.6%

Table 5.8. Transportation mode to destinations among Seattle residents outside the urban core. NOTE: Percentages are out of total respondents in the urban core (N=96) and were allowed to choose more than one mode to each destination.

	Walking	Bus	Light Rail	Streetcar	Driving	Bicycle	Other	NA
Grocery Store	46.9%	8.3%	0.0%	0.0%	64.6%	19.8%	0.0%	0.0%
Drug Store	46.9%	7.3%	0.0%	0.0%	42.7%	17.7%	0.0%	9.4%
Coffee Shop	67.7%	7.3%	2.1%	0.0%	18.8%	17.7%	0.0%	12.5%
Restaurant	38.5%	24.0%	7.3%	0.0%	52.1%	19.8%	4.2%	4.2%
Bar/Night Club	30.2%	27.1%	10.4%	0.0%	24.0%	13.5%	17.7%	27.1%
Entertainment Venue	15.6%	33.3%	12.5%	0.0%	40.6%	12.5%	13.5%	14.6%
Park	67.7%	9.4%	1.0%	0.0%	27.1%	32.3%	2.1%	0.0%
Sporting Event	7.3%	33.3%	21.9%	0.0%	14.6%	7.3%	7.3%	36.5%
Retail Shopping	31.3%	37.5%	7.3%	1.0%	62.5%	21.9%	1.0%	3.1%
Average	39.1%	20.8%	6.9%	0.1%	38.5%	18.1%	5.1%	11.9%

Turning now to walking and transit use in the urban core, these results are based on observations conducted in Fall 2016. The observations took place on 110 blocks distributed among the seven case neighborhoods, as seen in Figure 5.16. Observations took place on weekday mornings (7am to 10am), weekday afternoons (Noon to 3pm), weekday evenings (4pm to 7pm), and weekends (2pm to 6pm). If we recall the Walk Score map from earlier (figure 5.2), we can see that the urban core is uniformly green, meaning it is a 'walker's paradise' by Walk Score standards. However, Table 5.9 tells a different story when we look at the number of people actually walking in each neighborhood. Based on observations, we can identify rather large differences in the level of walking in each neighborhood core area. These core areas are detailed in figures 5.17 to figure 5.50. These figures include three maps for each neighborhood: a detailed figure ground and streetscape plan for each of the neighborhood areas observed; a pedestrian count map; and a ground floor functional use map showing the variation in ground level space between each neighborhood. The second of each set shows the figure ground image with the average number of pedestrians per block in each neighborhood, highlighting (in blue) where pedestrian activity is clustered in each neighborhood center. The blue bars are to scale to each other across all the neighborhood maps, so when compared we can see visually how pedestrian activity varies not only between neighborhoods but also within them. These core areas represent the parts of each neighborhood where the most walking takes place, which I determined after preliminary observations of the neighborhoods. They are the main commercial areas of each neighborhood, with a diversity of uses, including small and large retail stores, restaurants, coffee shops, and mixed-use developments including residential and office uses, depending on the neighborhood. In the next section, I explore in more detail what micro scale elements of the built environment affect levels of pedestrian activity.

Figure 5.16. Seattle figure ground with case streets highlighted in red.

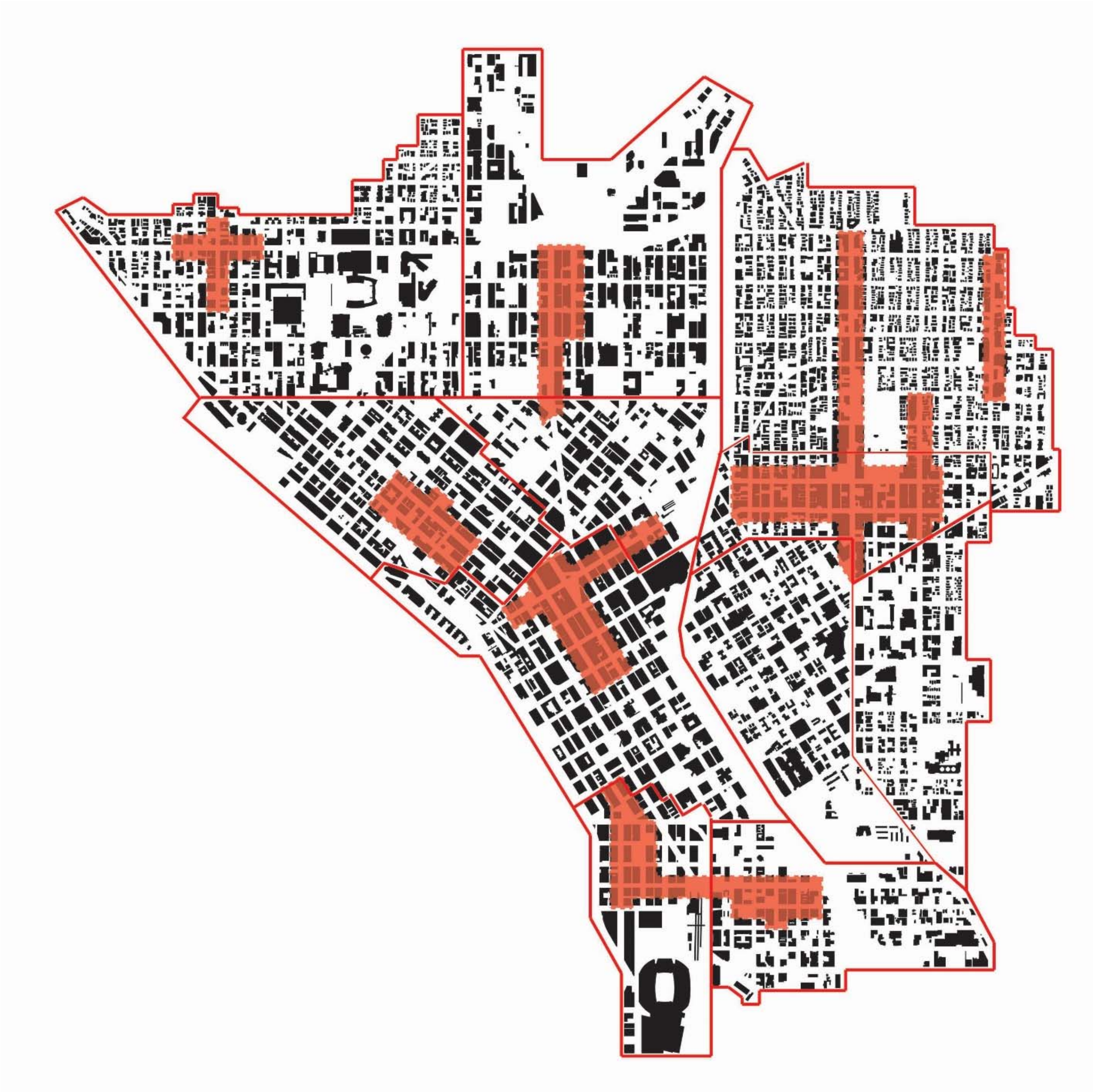


Table 5.9. Average number of pedestrians per block in each neighborhood in the morning, afternoon, evening and weekend observation periods.

Neighborhood	Morning	Afternoon	Evening	Weekend	*Average*
Capitol Hill (North Broadway)	416	953	1,286	1,284	***985***
Capitol Hill (15th Ave)	234	394	544	505	*419*
Capitol Hill (Pike-Pine Corridor)	284	463	705	629	*520*
South Lake Union	1,167	1,648	1,314	356	***1,121***
Lower Queen Anne	185	371	324	394	*318*
Belltown	374	497	815	793	*620*
Downtown	1,089	1,619	1,702	1,762	***1,543***
Pioneer Square	363	643	510	420	*484*
International District	267	424	409	334	*358*
Average	*487*	*779*	*845*	*720*	

Table 5.10. Average number of public transit users per transit stop per neighborhood, average of all modes of transit available in each neighborhood.

Neighborhood	Average transit users per stop (morning)	Average transit users per stop (afternoon)	Average transit users per stop (evening)	Average transit users per stop (weekend)	Average
Capitol Hill (North Broadway)	9.5	6.7	11.8	8.4	**9.1**
Capitol Hill (15th Ave)	1.6	0.6	1.5	1.0	1.2
Capitol Hill (Pike-Pine Corridor)	1.9	1.6	2.3	1.5	1.8
South Lake Union	4.9	2.3	7.4	0.9	3.9
Lower Queen Anne	12.0	8.3	15.8	9.3	**11.4**
Belltown	0	0.2	4.7	0.2	1.3
Downtown	25.7	14.9	30.7	21.8	**23.3**
Pioneer Square	1.1	1.2	2.3	1.1	1.4
International District	6.4	6.7	15.0	5.9	**8.5**

Table 5.11. Average pedestrian, transit and automobile infrastructures per block in each neighborhood.

Neighborhood	Average Pedestrians	Average Buildings per block	Average Destinations	Average Public Seating	Average Other Seating	Total Average Seats	Average Trees	Average Sidewalk Width
Capitol Hill (North Broadway)	**985**	**6**	**12.1**	0	9	9	**16.4**	**7.2**
Capitol Hill (15th Ave)	419	**7.2**	**11.6**	1.6	17.2	18.8	5.8	6.2
Capitol Hill (Pike-Pine Corridor)	520	5,2	6.55	2.1	11	13.1	10.8	6.8
South Lake Union	**1,121**	4.3	6.33	12.5	35.9	**48.4**	**14.7**	**8.6**
Lower Queen Anne	318	5.7	6.57	0	6.85	6.85	7	6.4
Belltown	620	**7.0**	**9.7**	6.9	40.7	**47.6**	**16.8**	6.9
Downtown	**1,543**	3.9	7.55	0.67	2.9	3.6	10.3	**10.6**
Pioneer Square	484	4.7	6.85	15.4	9.1	**24.5**	5.2	8.6
International District	358	3.7	**8.90**	1.6	0.36	2	4.2	7.6

Table 5.12. Average transit and automobile infrastructure per block in each neighborhood.

Neighborhood	Average Pedestrians	Average Transit Stops	Average Transit Seating	Average Transit Shelter	Average Driveways & Alleys	Average Parking Lots	Average Street Parking	Percent of Neighborhood Parking Lots
Capitol Hill (North Broadway)	**985**	**1.5**	**1.1**	0.13	1.37	0.875	17.5	5.4
Capitol Hill (15th Ave)	419	1.0	0	0	**2.6**	**1.6**	17.6	
Capitol Hill (Pike-Pine Corridor)	520	0.6	0.55	**0.34**	1.75	0.52	17.4	
South Lake Union	**1,121**	**1.1**	0.44	**0.56**	0.67	0.67	9.9	11.9
Lower Queen Anne	318	0.3	**1.71**	0.14	**2**	**1.29**	19.7	12.1
Belltown	620	0.3	0.4	0	1.3	0.9	19.2	**12.3**
Downtown	**1,543**	**1.0**	**1.67**	**0.22**	0.78	0.61	3.7	7.2
Pioneer Square	484	0.5	0	0.08	1.15	0.85	11.9	**14.1**
International District	358	0.8	0.9	0.09	**2**	0.55	14.5	**15.6**

Table 5.9 shows variations in the average levels of walking in each neighborhood across different times of day. Figures are presented as the average number of pedestrians per block in each observed neighborhood. Several patterns emerge from this. On average, downtown is the most walked neighborhood, followed by South Lake Union and the Broadway section of Capitol Hill. Lower Queen Anne and the International District are the least walked neighborhoods on average. Afternoons and evenings on average are the most walked time periods across all neighborhoods, although variations exist based on the dominant uses. Residential neighborhoods like Capitol Hill, LQA, and Belltown have more pedestrians in the evenings and on weekends. This makes sense since these are the times when people are not working and are shopping and visiting restaurants in their neighborhoods. Downtown, Pioneer Square and SLU have a much higher number of pedestrians in the afternoons, as these are major employment centers, busy with people eating lunch and going to meetings in the middle of the workday. Downtown on the weekends is the most busy, showing that the Downtown retail core is vibrant and attracts residents from all over the city. SLU on the other hand, is one of the least busy neighborhoods on the weekends, which shows it has not yet developed a balance of employment and residential uses which has been the goal for close to a decade – to create a live-work neighborhood for tech workers. But many of the establishments here close early in the evening and are not open on the weekends. In all but one neighborhood, the morning time period is the least busy, indicating perhaps that people are less likely to walk to work in the morning, but also that a lot of the walking taking place in the afternoons and evenings is not necessarily work related.

When looking at public transit use, Table 5.10 shows us the average number of transit users per transit stop in each neighborhood. Downtown is by far the most heavily used neighborhood for public transit, which corresponds to surveys showing that 47 percent of Downtown employees commute to work by transit (Commute Seattle 2017; SDOT Blog 2017a). The next most heavily transit used neighborhoods are Capitol Hill, Lower Queen Anne, and the International District. High transit in Capitol Hill is mostly light rail users with a quick direct link to downtown and beyond, as opposed to bus or streetcar. Likewise, in the International District, the light rail station is the most heavily used, although here it shares a tunnel with busses so the mode split between bus and light rail once in the tunnel is undetermined. Regardless, the station is positioned between the International District and Pioneer Square, and close to offices in Downtown. Transit use is also highest in both the morning and evening in almost every neighborhood, likely indicating that it is used for commuting, but little else, which is supported by survey results showing higher or nearly equal levels of walking and driving compared to transit for all types of trips and not just commuting to work.

Tables 5.11 and 5.12 show the per block averages of pedestrian, transit and automobile infrastructures measured. Within each neighborhood, the number of pedestrians is related pretty closely to what we expect to see based on the theory of urban fabrics. The theory suggests that neighborhoods with more pedestrian infrastructure will have higher levels of walking, while neighborhoods with higher levels of automobile infrastructure will have higher levels of driving. Transit use, since it necessarily requires a neighborhood to be walkable, will be higher where both pedestrian and transit infrastructure is dominant. There is quite a bit of variation in each neighborhood, but some clear patterns emerge. Capitol Hill-Broadway, 15th Ave and Belltown have the most destinations per block. South lake union and Pioneer Square have the most public seating per block, while South Lake Union, Belltown, 15th Ave in Capitol Hill, and Pioneer Square have the most overall seating per block, which includes public seating and seating at restaurants and cafes. Capitol Hill Broadway, South Lake Union, and Belltown have the most street trees per block. Capitol Hill, South Lake Union, Downtown, and Pioneer Square have the widest sidewalks. Capitol Hill, 15th Ave, South Lake Union, and Downtown have the most transit stops per block. And Lower Queen Anne, 15th Ave, and Belltown all have high numbers of driveways or alleys and parking lots.

These figures indicate that the neighborhoods with certain types of pedestrian oriented infrastructure tend to be the neighborhoods with the most amount of walking. In the following section, I explore this in more depth with a block-by-block analysis of walking compared to different types of infrastructure. The neighborhoods with the lowest levels of walking in Table 5.9 (LQA, Capitol Hill 15th Ave and International District) correspond to the highest amount of automobile oriented infrastructure (alleys, driveways and parking lots). Transit use does not seem all that related to how many transit stops there are in the neighborhood, since LQA and the International district have higher average transit use, but less than average transit stops per block.

The theory of urban fabrics tells us that the urban core should be a predominantly walking neighborhood, where a majority of people walk to all destinations, and in fact this is what I find. Much of the original walkable urban fabric, as described by Newman, Kosonen and Kenworthy (2016) is intact and still encourages a lot of walking activity. However, the uniformity of walking suggested by a metric like Walk Score does not show the more fine grain variation and differences between walkable neighborhoods. Levels of actual walking varies drastically between neighborhoods, with Downtown having almost five times more pedestrians on average per block. A broad look at the types of infrastructures in each neighborhood seems to relate to actual levels of walking, with neighborhoods with more pedestrian infrastructure having more people walking, and neighborhoods with more automobile infrastructure having fewer people walking. Certain neighborhoods within the urban core have maintained their pedestrian fabric better than others and some have been highly eaten away and transformed into more transit or automobile oriented neighborhoods. The next section provides a more fine grain analysis of the relationship between pedestrian, transit and automobile infrastructure and its impacts on levels of walking.

Conclusion

Walking is the dominant mode of transportation within the urban core. A majority of people who live in the urban core use walking as their primary mode of transportation for work and non-work travel. Those who live outside the urban core frequently walk, but do not use it as a primary means for all types of destinations. Second to walking, driving is the most common mode of transportation among those who live within the urban core. The theory of urban fabrics tells us the urban core should be predominantly a walking environment, which it is. It also tells us that residents should heavily utilize transit as well, but for a variety of reasons, they do not. Each of the neighborhoods within the urban core should have excellent access via transit to neighborhoods outside the urban core, making transit a viable mode of transportation. The fact that transit is not heavily used by those who live in the urban core indicates that there are deficiencies in the public transit network that do not meet the travel needs of these individuals. I explore why urban core residents do not utilize transit as much as they could and how transit would better serve them in the following chapters.

Beyond recognizing that the urban core is a predominantly walking environment, I find significant variation in the levels of walking that occur in each of the seven neighborhoods observed in the urban core. This variation has a strong relationship to the types of infrastructure most evident in the urban environment. Those neighborhoods with an urban fabric that is predominantly pedestrian oriented, such as the Downtown retail core, South Lake Union, or Broadway in Capitol Hill, have more pedestrians. Neighborhoods with a higher proportion of automobile oriented infrastructure, such as Lower Queen Anne, the International District, and 15th Avenue in Capitol Hill, have fewer pedestrians. Neighborhoods with a higher average number of transit stops also correspond to those with higher numbers of pedestrians. Transit infrastructure seems less related to the number of transit users in each neighborhood, which more closely corresponds to neighborhoods with access to light rail stations as having the most number of transit users. How infrastructure influences pedestrian and transit use activity on a block scale is explored in the following chapter.

Figure 5.17. Ground floor use legend

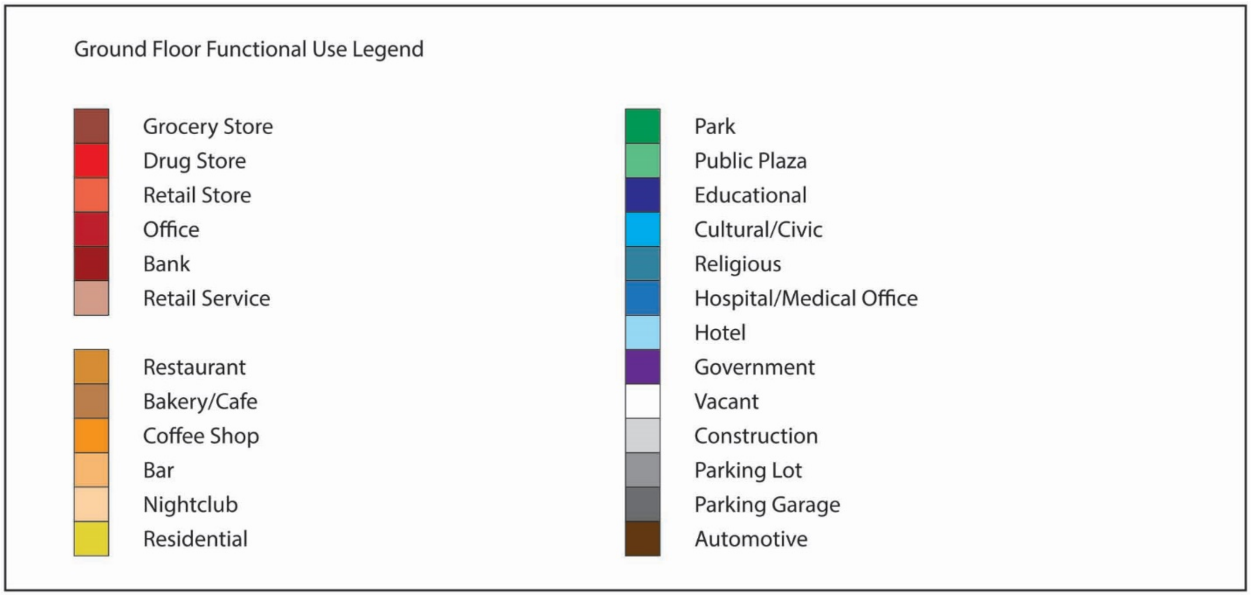


Figure 5.18. Capitol Hill Broadway figure ground and streetscape detail.

Figure 5.19. Capitol Hill Broadway average pedestrian counts per block.

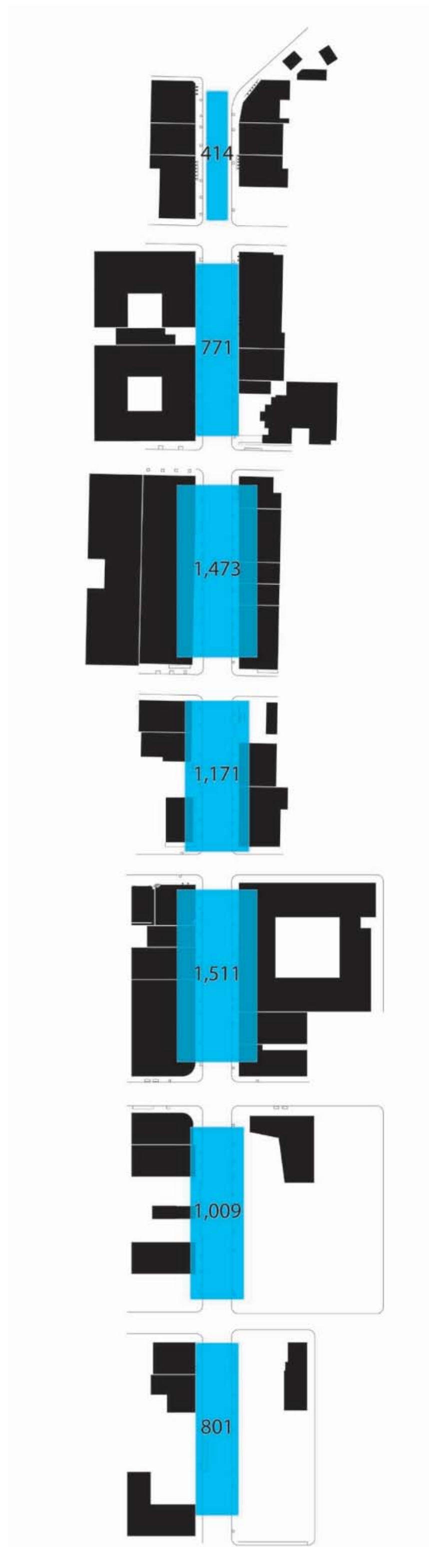


Figure 5.20. Capitol Hill Broadway ground floor uses.

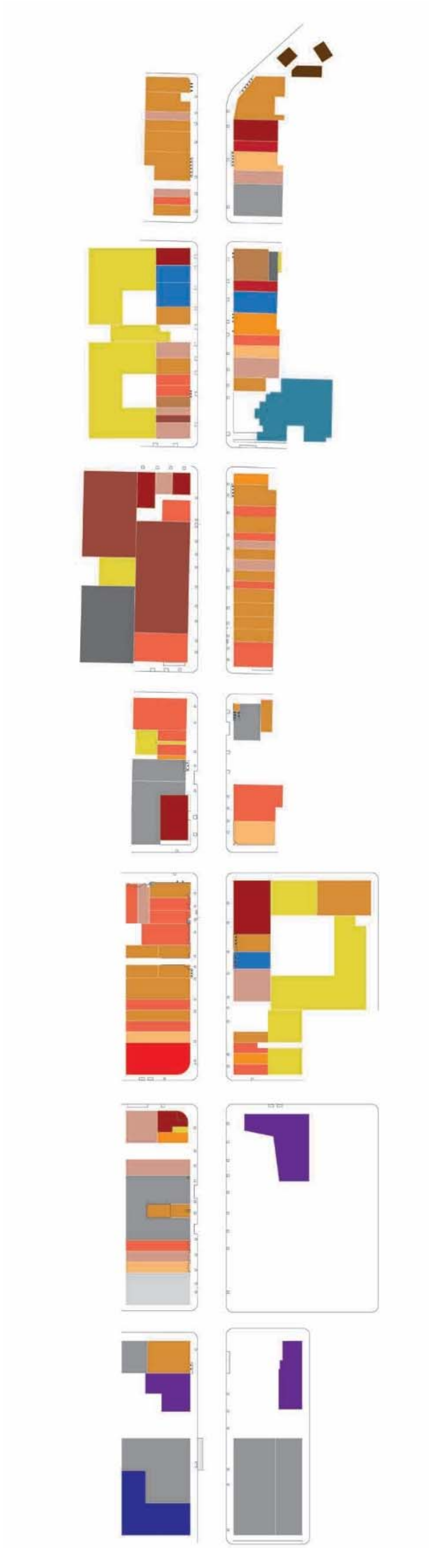


Figure 5.21. Capitol Hill 15th Avenue figure ground and streetscape detail.

Figure 5.22. Capitol Hill 15th Avenue average pedestrian counts per block.

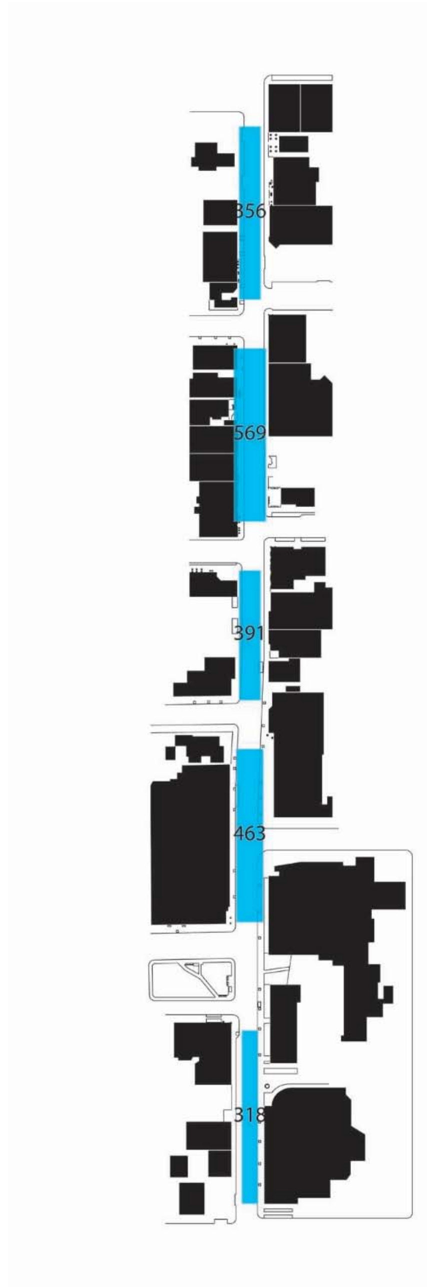


Figure 5.23. Capitol Hill 15th Avenue ground floor uses.

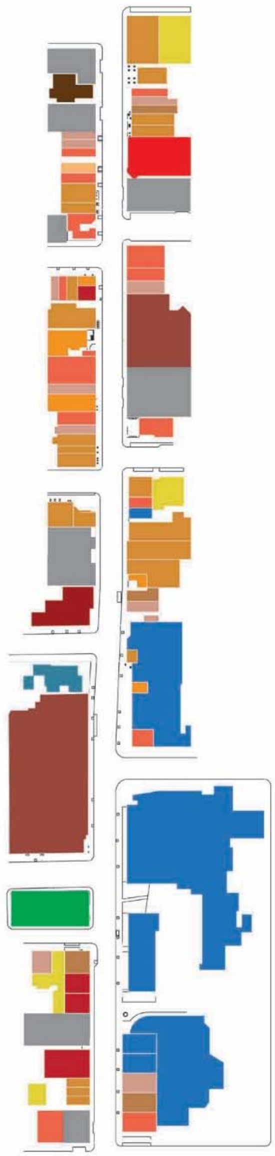


Figure 5.24. Pike and Pine Streets figure ground and streetscape detail.

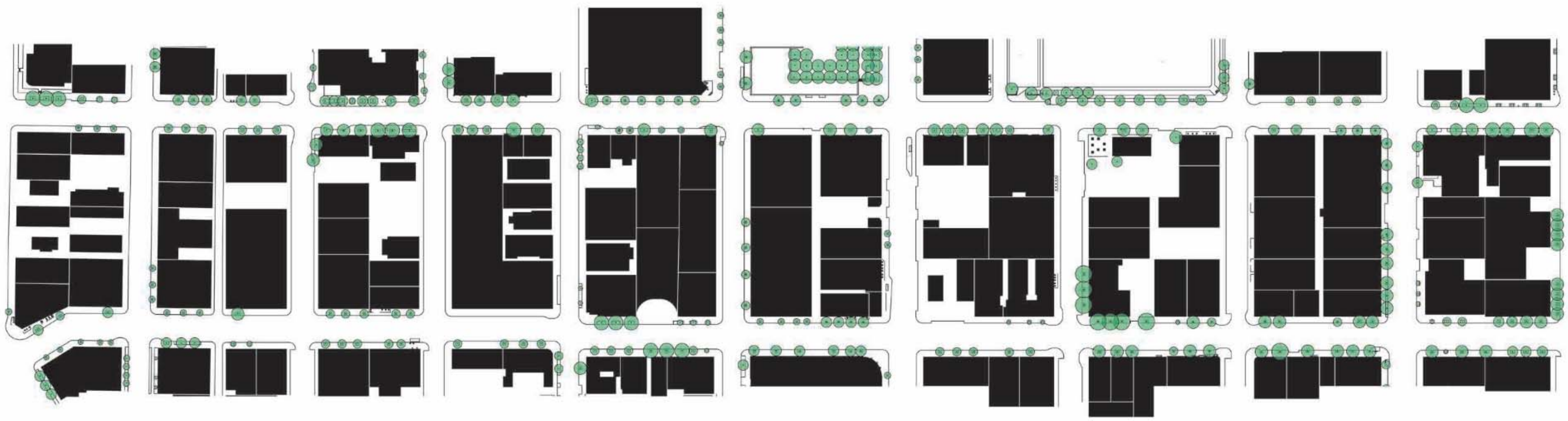


Figure 5.25. Pike and Pine Streets average pedestrian counts per block.

Figure 5.26. Pike and Pine Street ground floor uses.

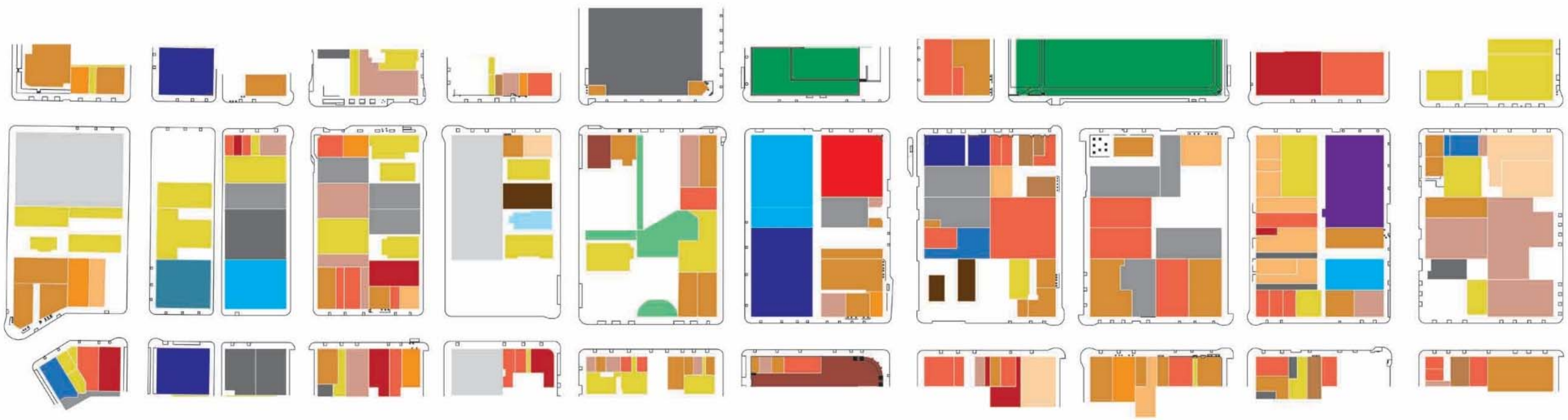


Figure 5.27. 12th Avenue figure ground and streetscape detail.

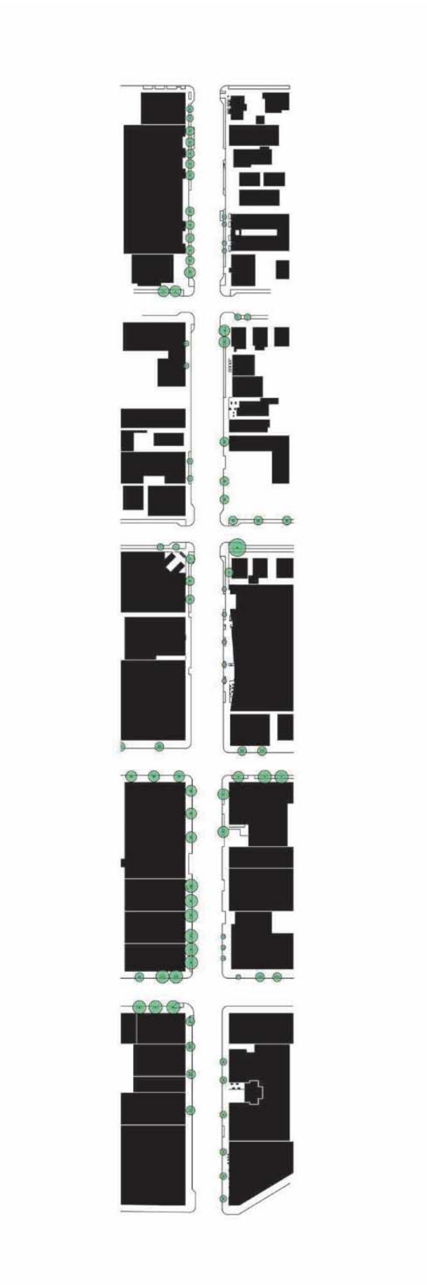


Figure 5.28. 12th Avenue average pedestrian counts per block.

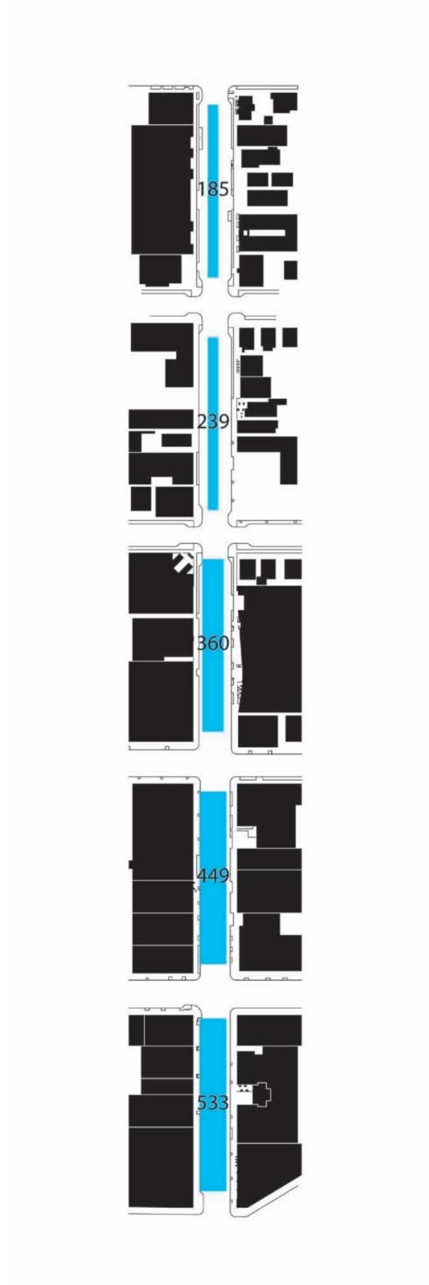


Figure 5.29. 12^{th} Avenue ground floor uses.

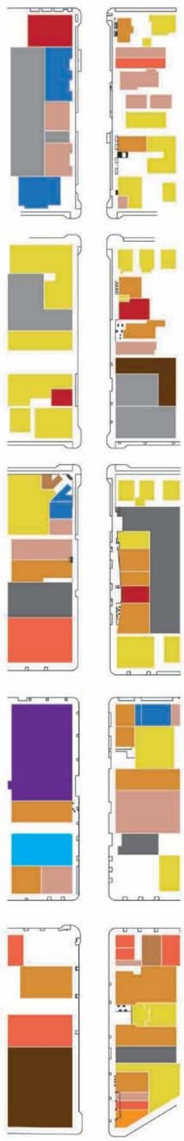


Figure 5.30. Broadway Pike-Pine corridor figure ground and streetscape detail

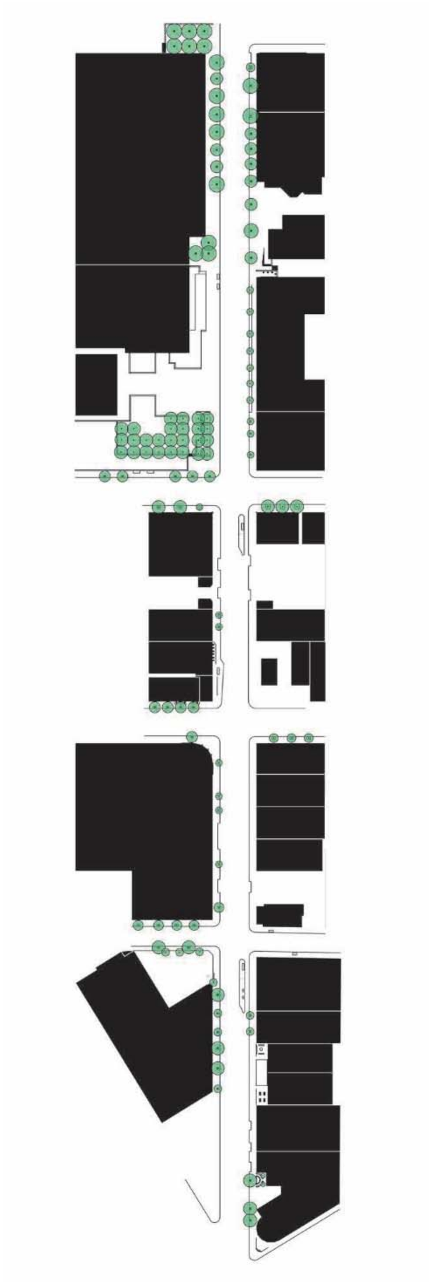


Figure 5.31. Capitol Hill Broadway Pike-Pine corridor average pedestrian counts per block.

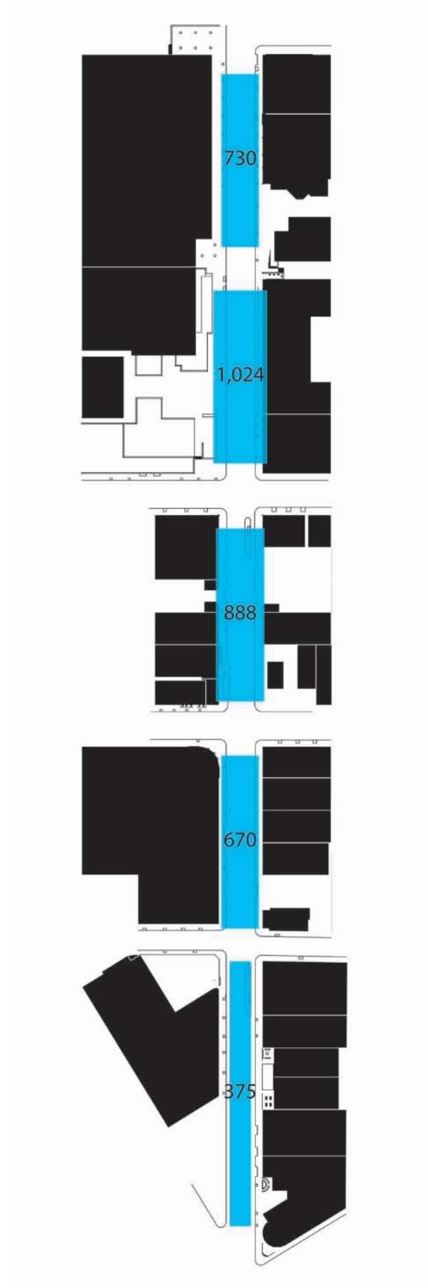


Figure 5.32. Broadway Pike-Pine corridor ground floor uses.

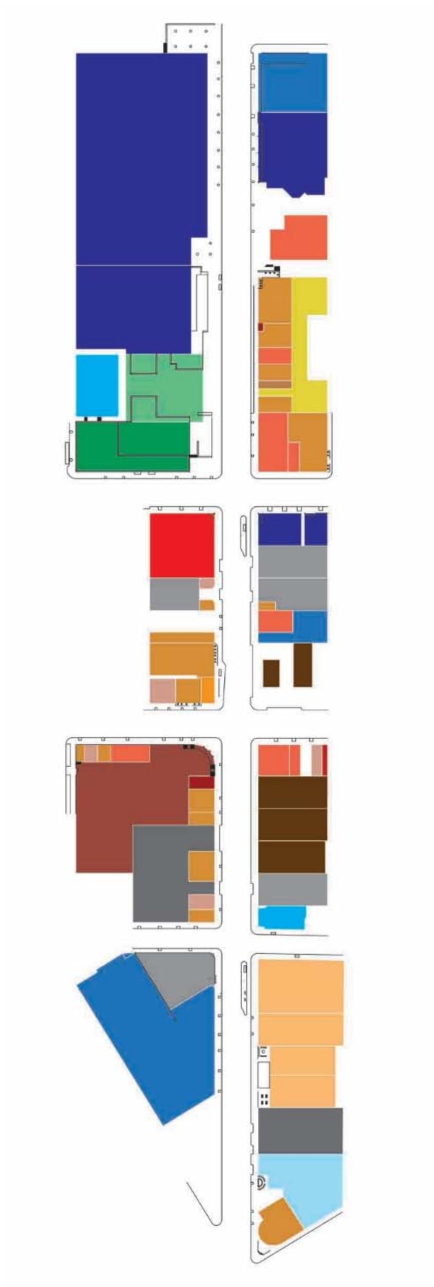


Figure 5.33. South Lake Union figure ground and streetscape detail.

Figure 5.34. South Lake Union average pedestrian counts per block.

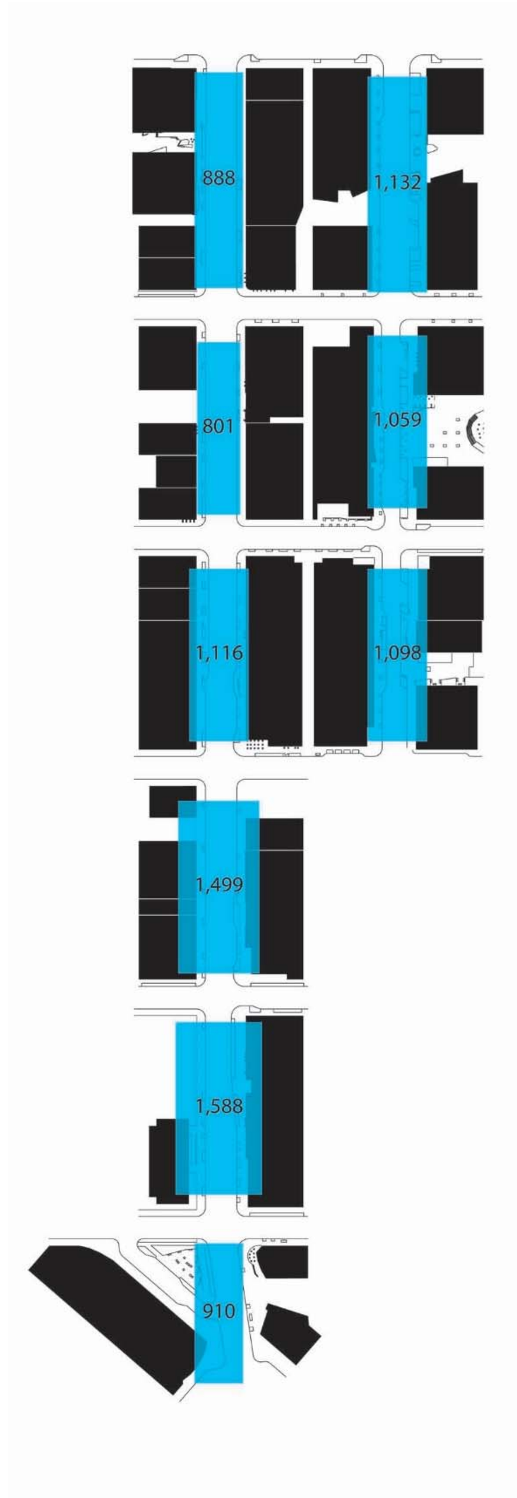


Figure 5.35. South Lake Union ground floor uses.

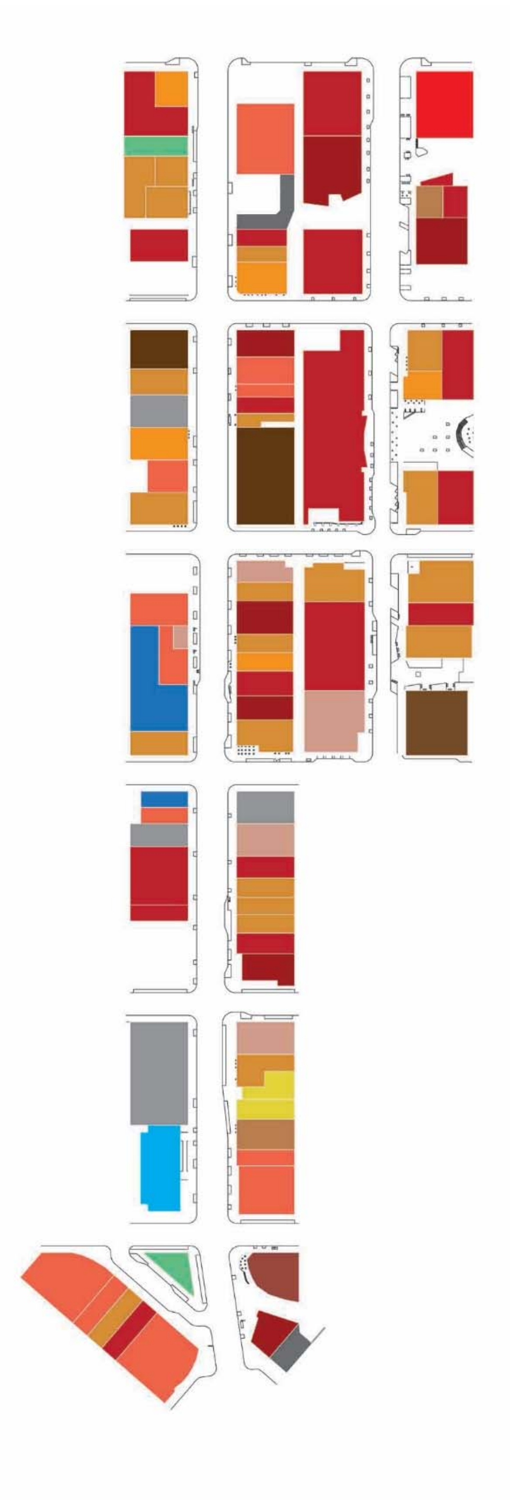


Figure 5.36. Lower Queen Anne figure ground and streetscape detail.

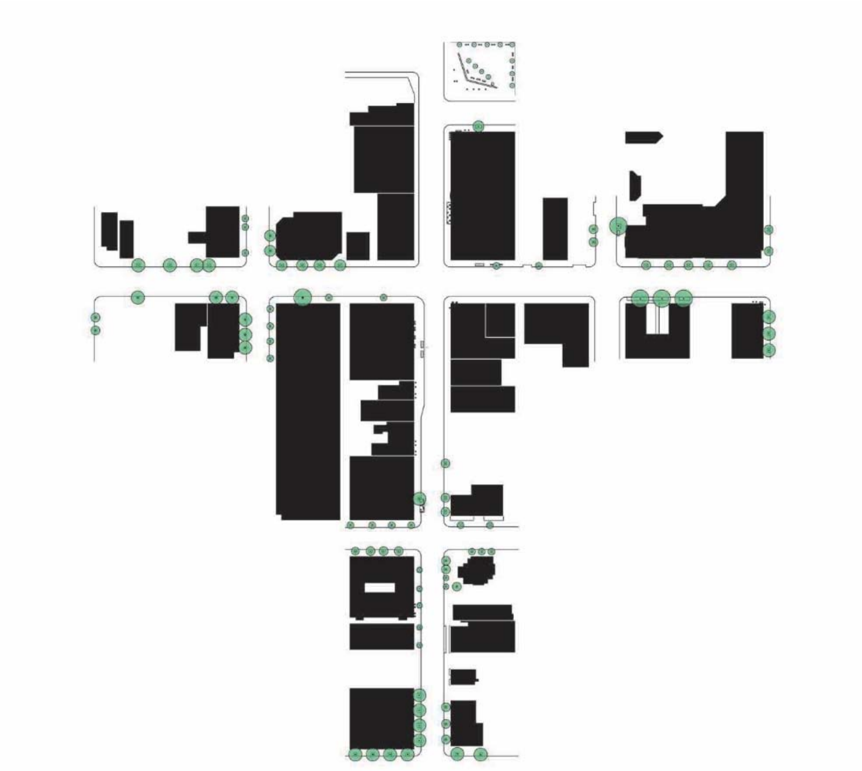


Figure 5.37. Lower Queen Anne average pedestrian counts per block.

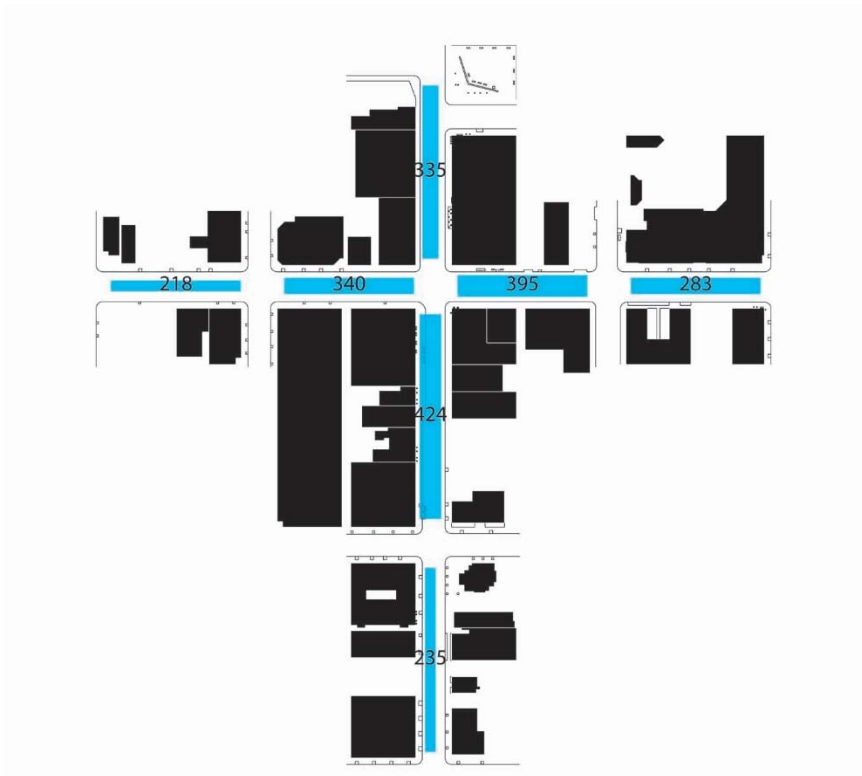


Figure 5.38. Lower Queen Anne ground floor uses.

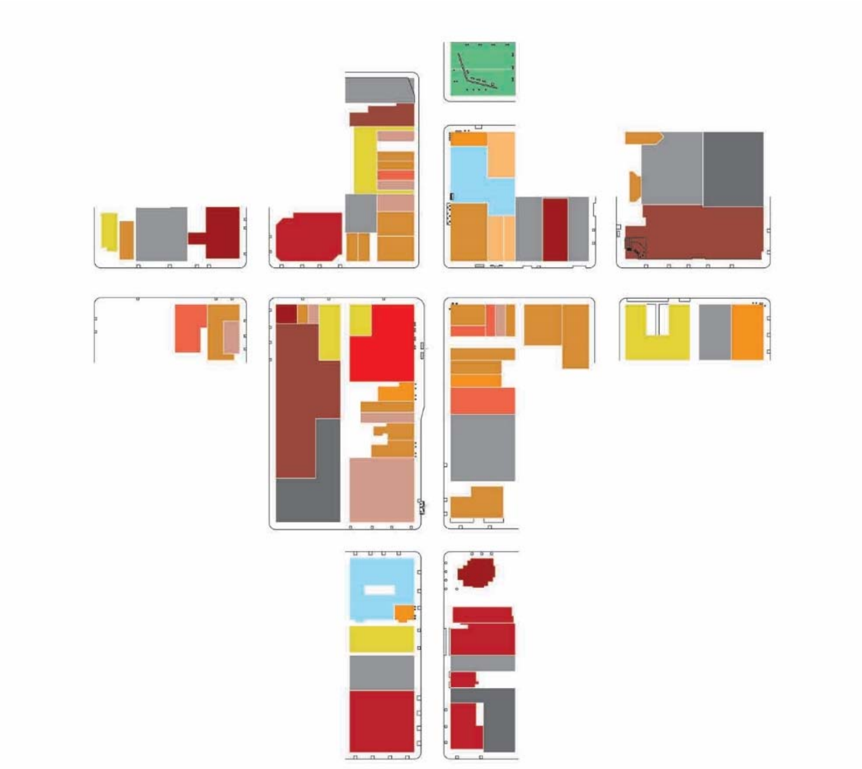


Figure 5.39. Belltown figure ground and streetscape detail.

Figure 5.40. Belltown average pedestrian counts per block.

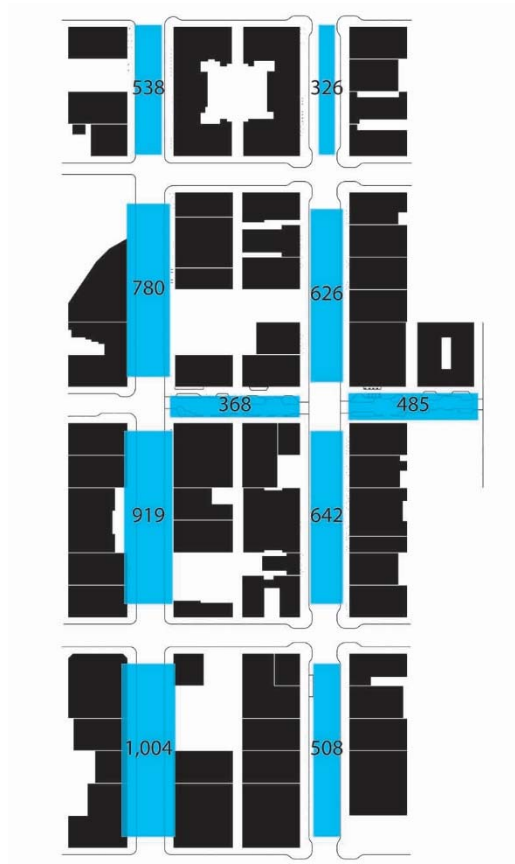


Figure 5.41. Belltown ground floor uses.

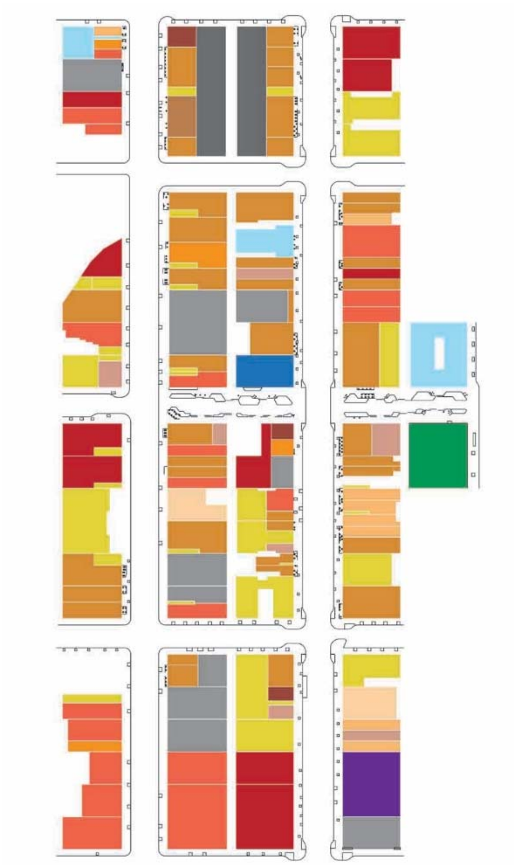


Figure 5.42. Downtown figure ground and streetscape detail.

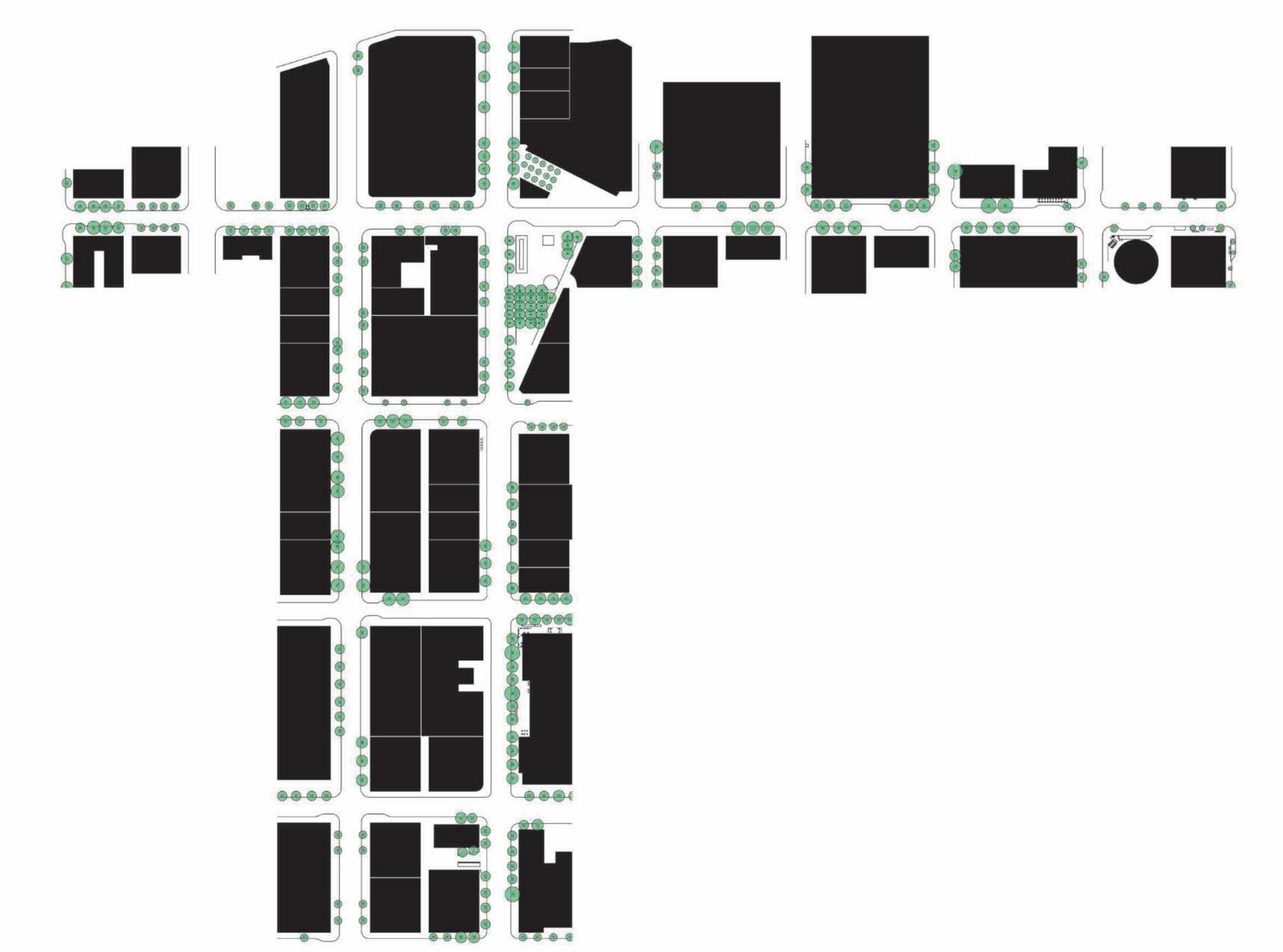


Figure 5.43. Downtown average pedestrian counts per block.

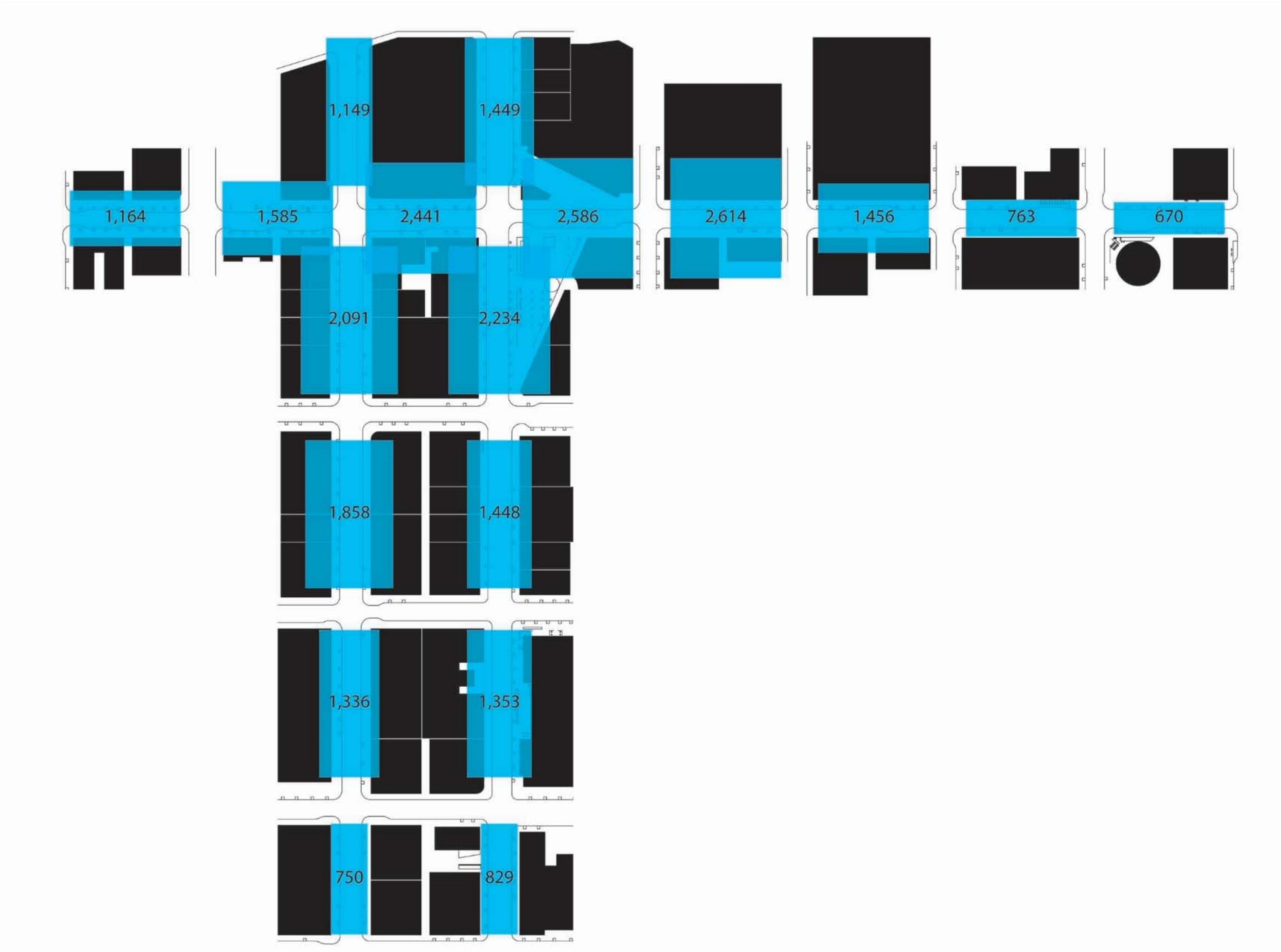


Figure 5.44. Downtown ground floor uses.

Figure 5.45. Pioneer Square figure ground and streetscape detail.

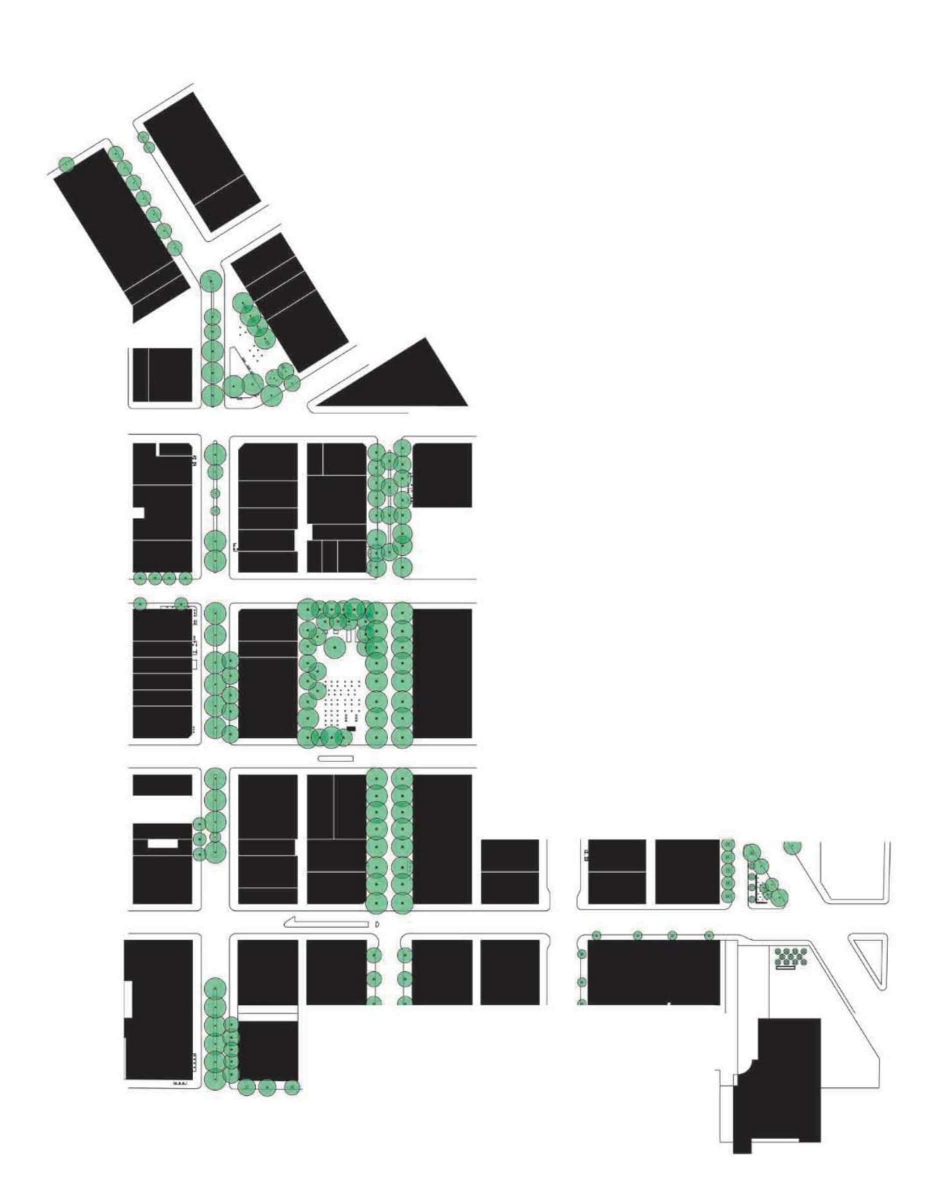


Figure 5.46. Pioneer Square average pedestrian counts per block.

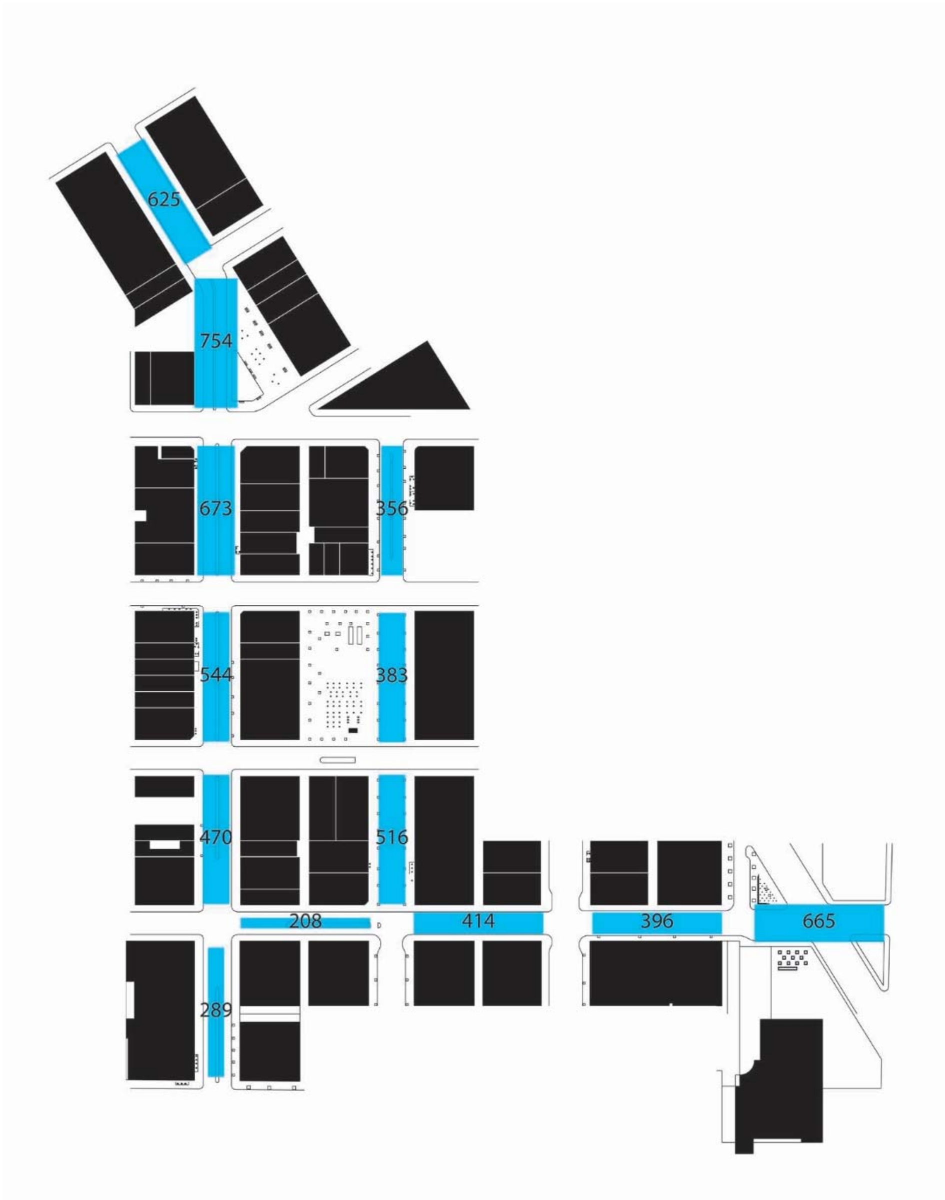


Figure 5.47. Pioneer Square ground floor uses.

Figure 5.48. International District figure ground and streetscape detail

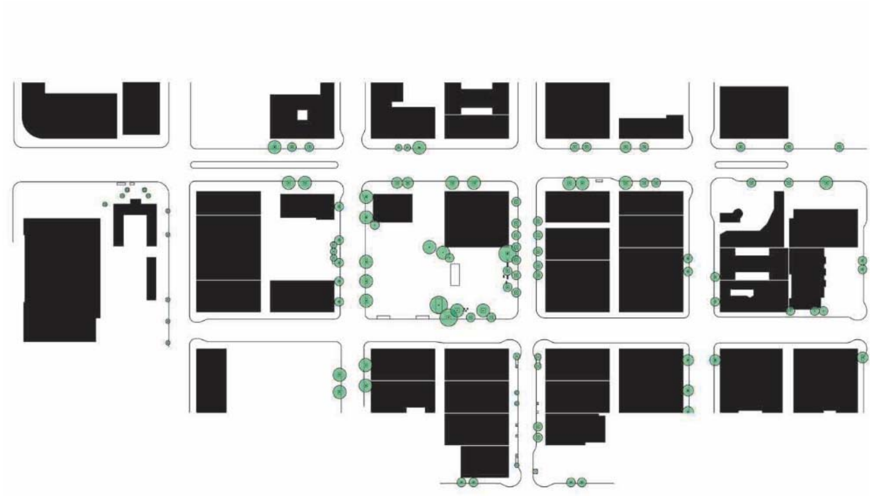


Figure 5.49. International District average pedestrian counts per block.

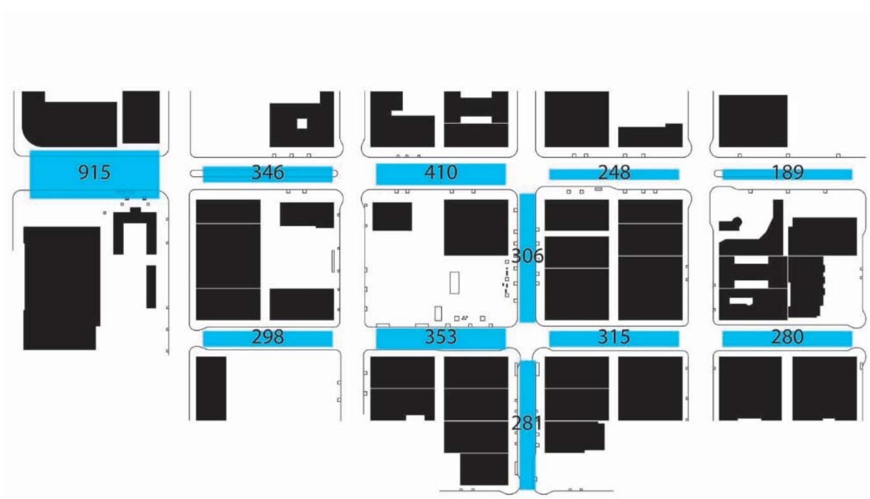
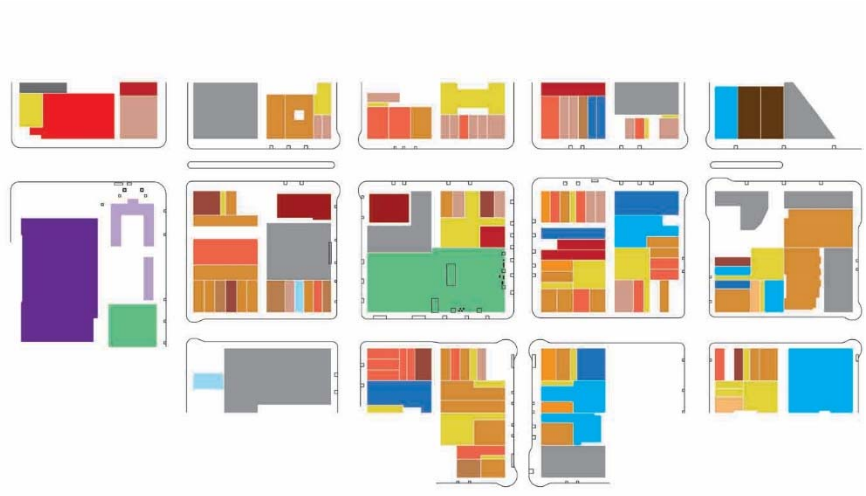


Figure 5.50. International District ground floor uses



Chapter 6

Results Part II: Transit and Walkability in the Urban Core

This chapter addresses the next two research sub-questions. These questions deal with the role of transit in each of the seven case study neighborhoods, looking at how pedestrian, transit and automobile infrastructure influence walking, as well as the location of transit and how it influences walking. This emphasis on infrastructure comes from the theory of urban fabrics (P. Newman, Kosonen, and Kenworthy 2016) and is based on characteristics of each urban fabric that can be measured at the block level and it serves as an empirical test of this theory. The second question explores how travel behaviors have changed due to new and planned transit services and infrastructure.

Neighborhood Transit and Walkability

Research Question: How do pedestrian, transit and automobile infrastructures influence walking and transit use? To what extent does the location of bus and/or rail affect walking in each neighborhood?

The theory of urban fabrics (P. Newman, Kosonen, and Kenworthy 2016) argues that different modes of transportation are dominant in different parts of the city. Furthermore, these three urban fabrics are based upon different types of infrastructure that support each different mode of transportation. Pedestrian infrastructure dominates the pedestrian urban fabric, which is typically about 2.5 miles in diameter and encompasses the present day central business district and neighboring central city neighborhoods. The transit urban fabric is up to 25 miles in diameter. Transit fabrics consist of early extensions of the walking city based around streetcars and subways, such as those in Los Angeles or New York, as well as suburban rail common in metropolitan areas such as New York or Boston. Seattle is also a good example of a streetcar-based transit city in its early layout. The automobile fabric can be 50 miles or more in diameter and is loosely defined as any area not in the walking or transit fabric (P. Newman, Kosonen, and Kenworthy 2016). Much of the automobile fabric dates to the post WWII era. In many cities, the encroachment of the automobile fabric into walking and transit fabrics has destroyed these fabrics, making present efforts at planning in urban core areas and in transit corridors more challenging. The urban core or central business district has a high degree of overlap between the different fabrics.

In the Seattle urban core, we saw in the previous section that walking is a dominant mode of transportation, which is what we would expect if the theory of urban fabrics is an accurate depiction of the city. But we also saw that walking varied from neighborhood to neighborhood and that neighborhoods with a larger amount of automobile infrastructure tended to have fewer pedestrians, such as 15th Avenue in Capitol Hill, Lower Queen Anne and the International District. This section explores this same idea, but on the block level, exploring how small scale variations in pedestrian, transit and automobile infrastructure on each of the 110 blocks observed influence both pedestrian activity and transit use.

As a first step in this analysis, it is useful to identify the availability of public transit within the urban core. Figure 6.1 shows all available public transit in the urban core. We can see that on the whole, the urban core is pretty saturated with public transit. And in terms of modes of transit, there are three different types of bus service, a monorail, light rail, and two modern streetcar lines. Figures 6.2 to 6.6 detail each individual mode and the stops throughout the urban core. We can see from these detailed maps that only the Downtown core has access to all five modes of transportation available in the urban core, with all the modes running on the 3rd Avenue transit corridor either at street level or below ground in the transit tunnel. And the SLU streetcar terminus is a block away from Westlake Center transit hub. Figures 6.7 to 6.17 show each of the 110 observed blocks with their availability of transit in each neighborhood and specific locations of the transit stops.

Figure 6.1. Seattle urban core complete transit network, combining bus, Rapid Ride (brt), monorail, streetcar and Link light rail.

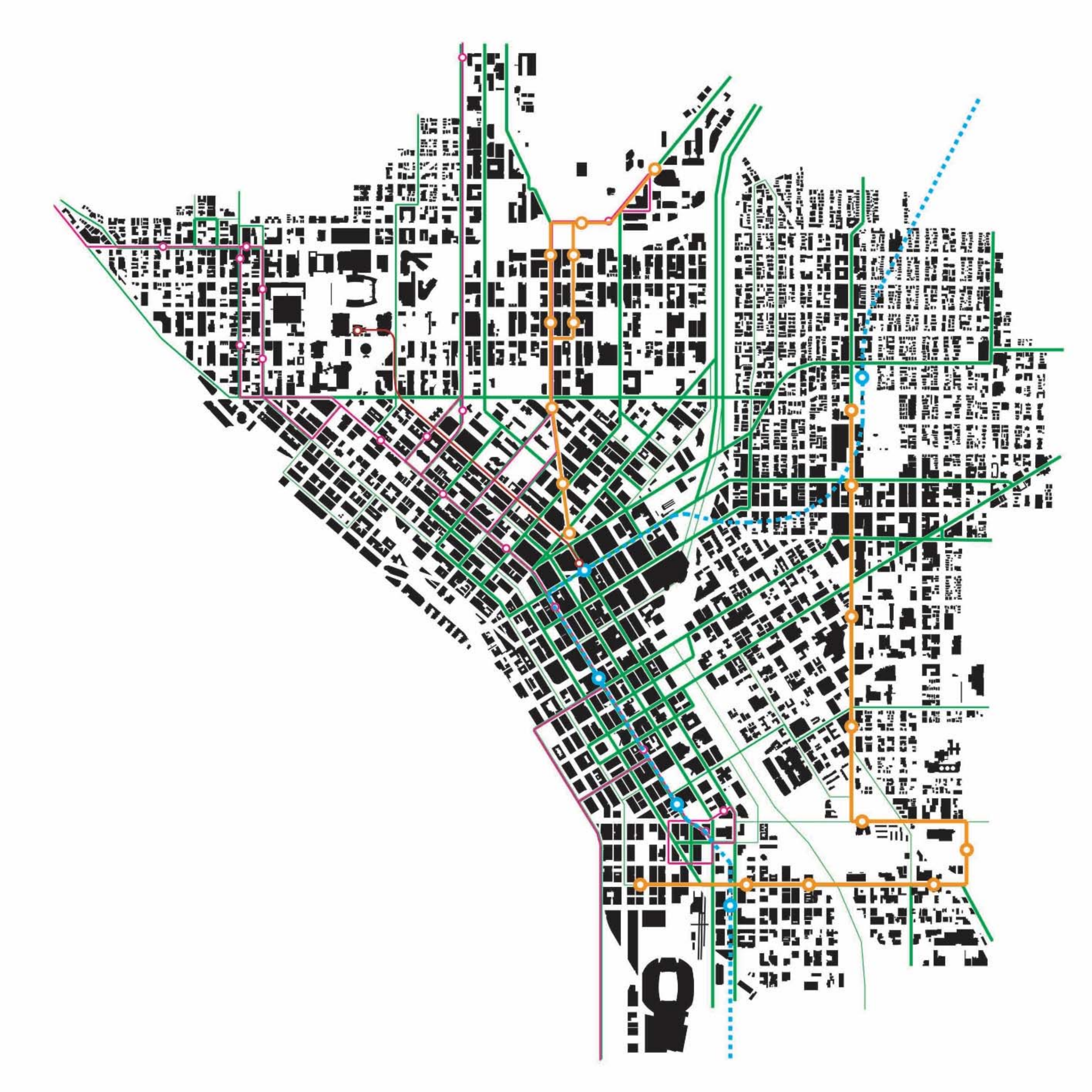


Figure 6.2. Seattle urban core bus routes and stops.

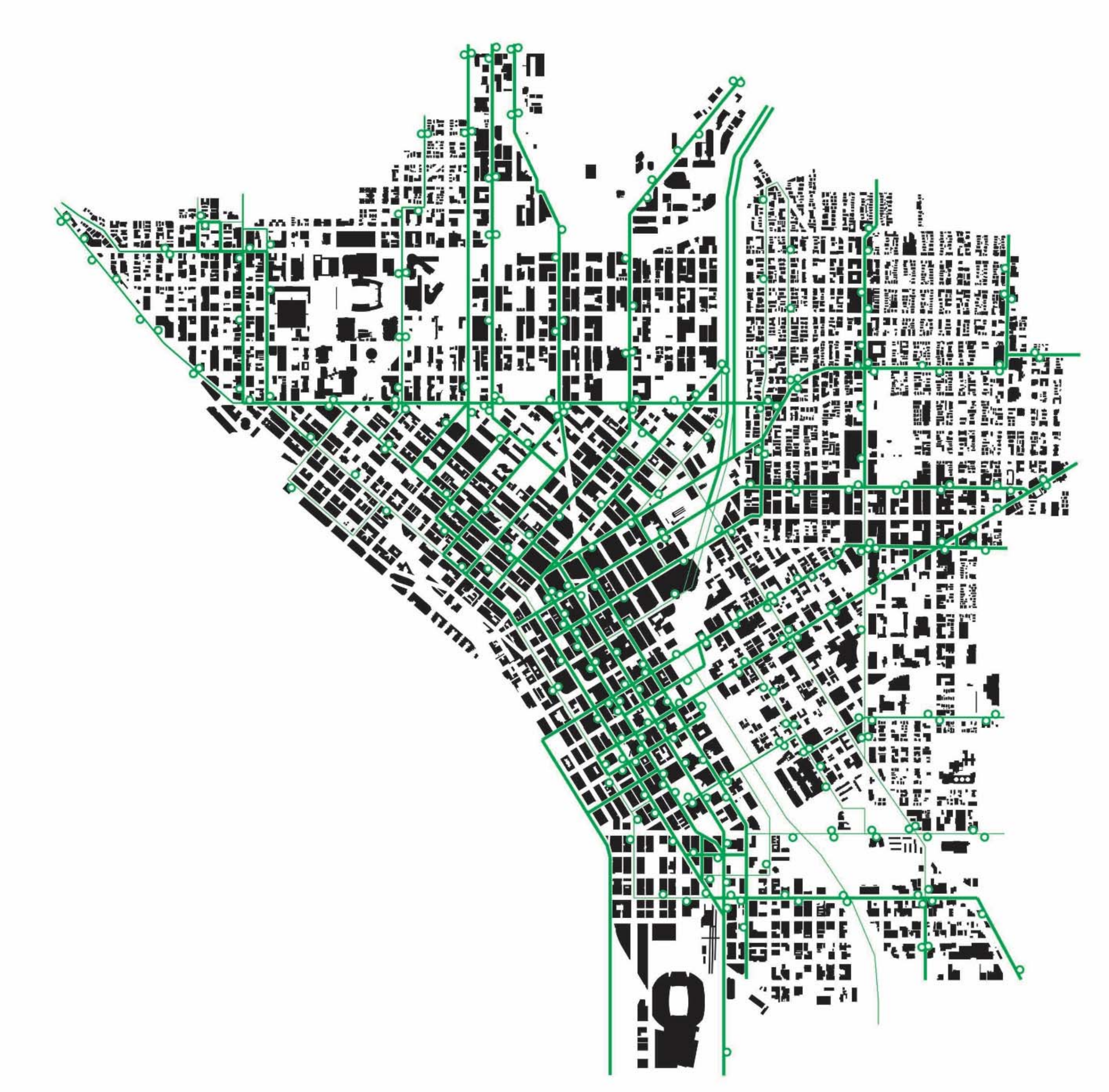


Figure 6.3. Seattle urban core rapid ride routes and stops.

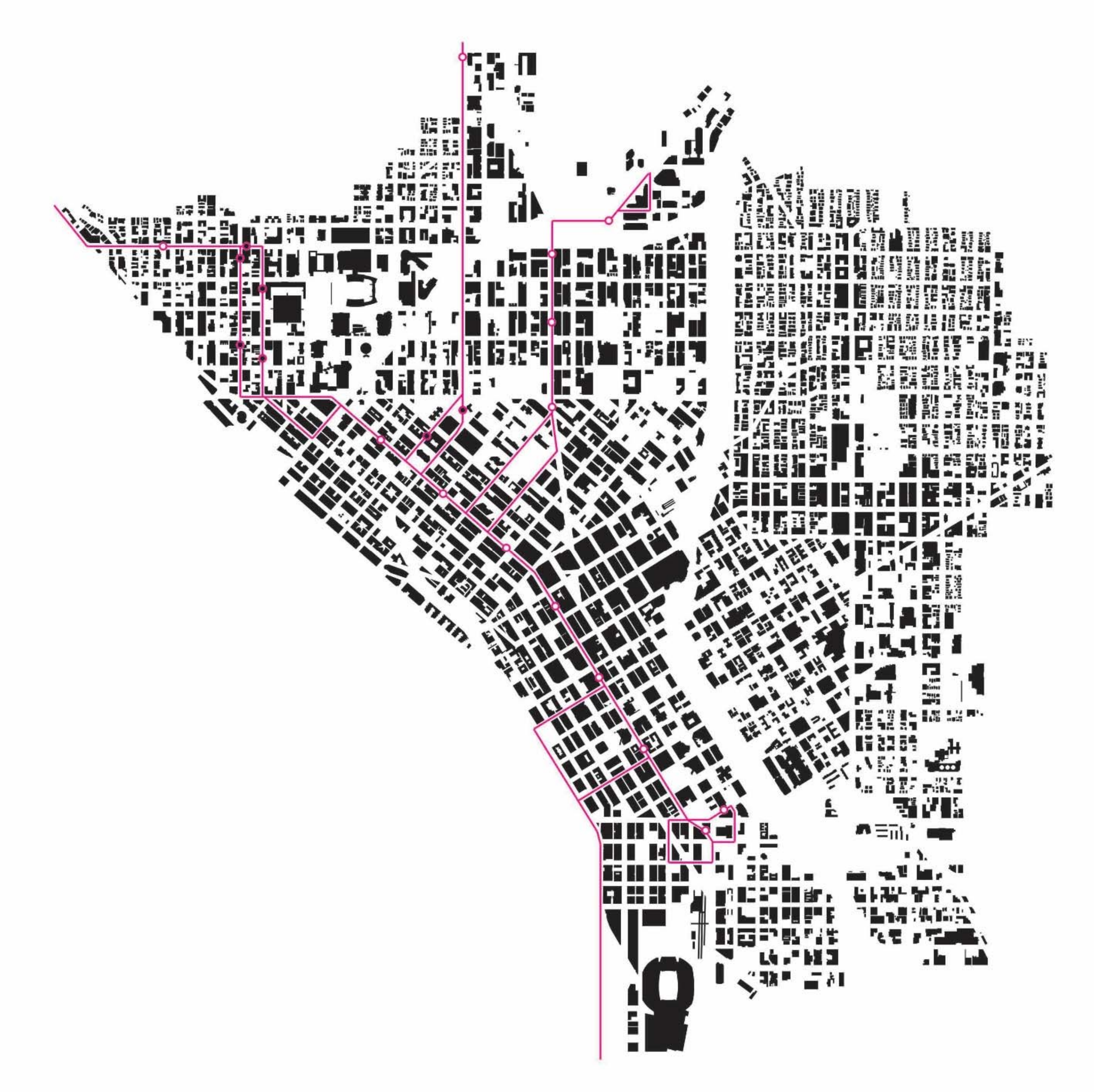


Figure 6.4. Seattle monorail route, from Westlake Center to Seattle Center.

Figure 6.5. Seattle urban core streetcar routes.

Figure 6.6. Seattle urban core Link light rail route, running underground through the urban core.

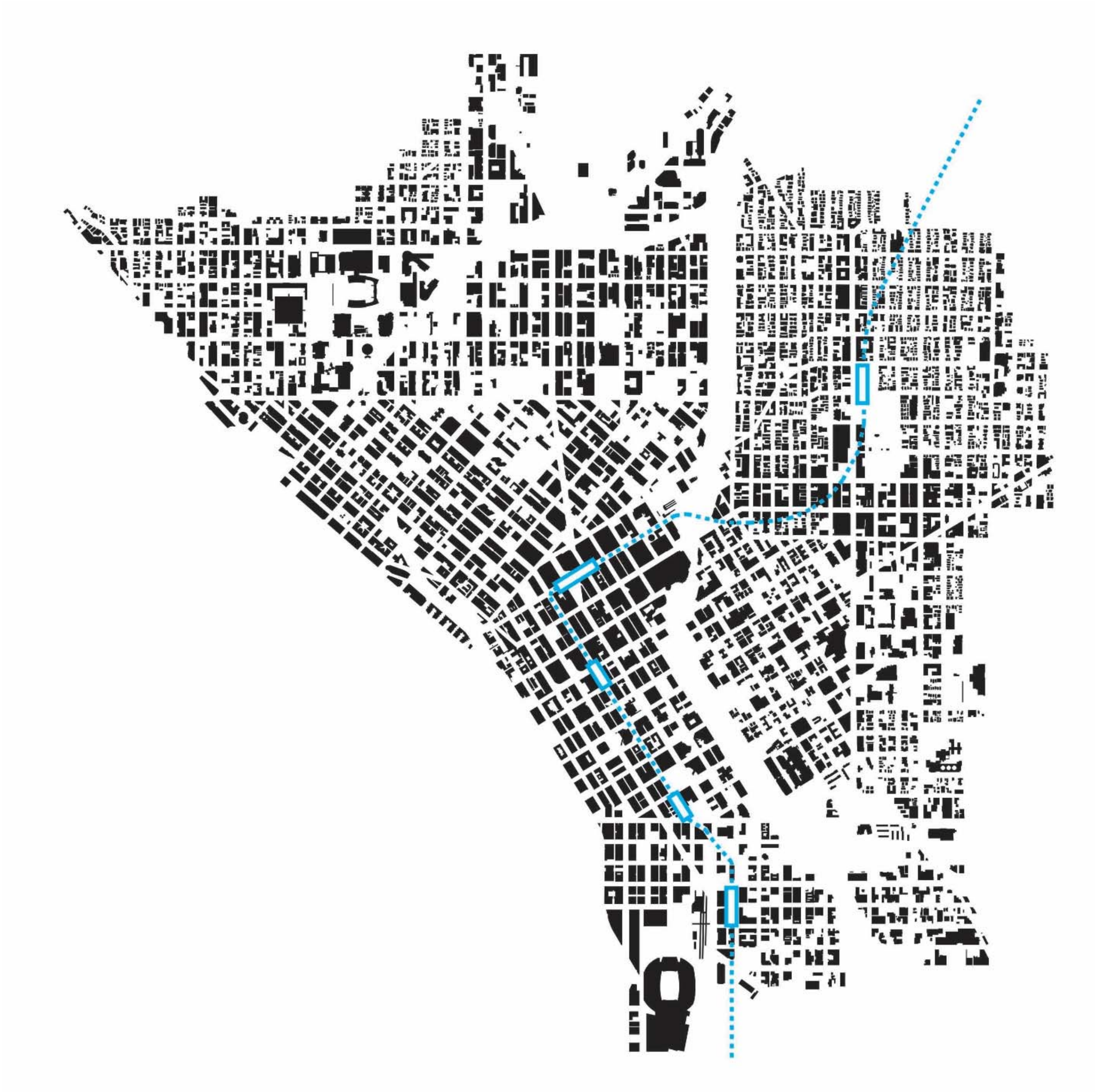


Figure 6.7. Capitol Hill Broadway (north) transit stops.

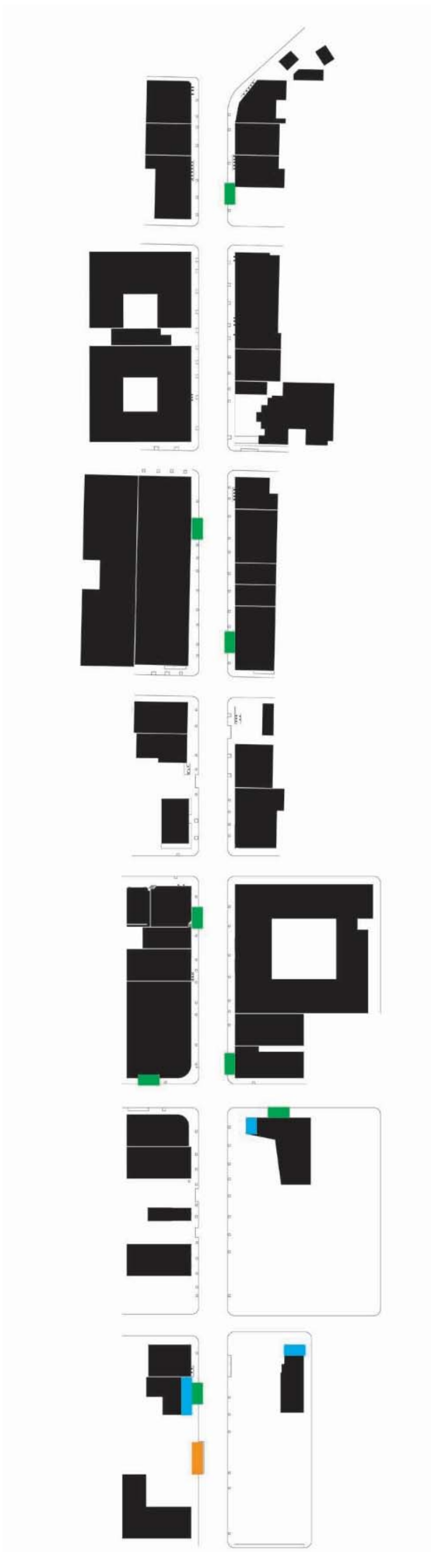


Figure 6.8. Capitol Hill Broadway (south) transit stops

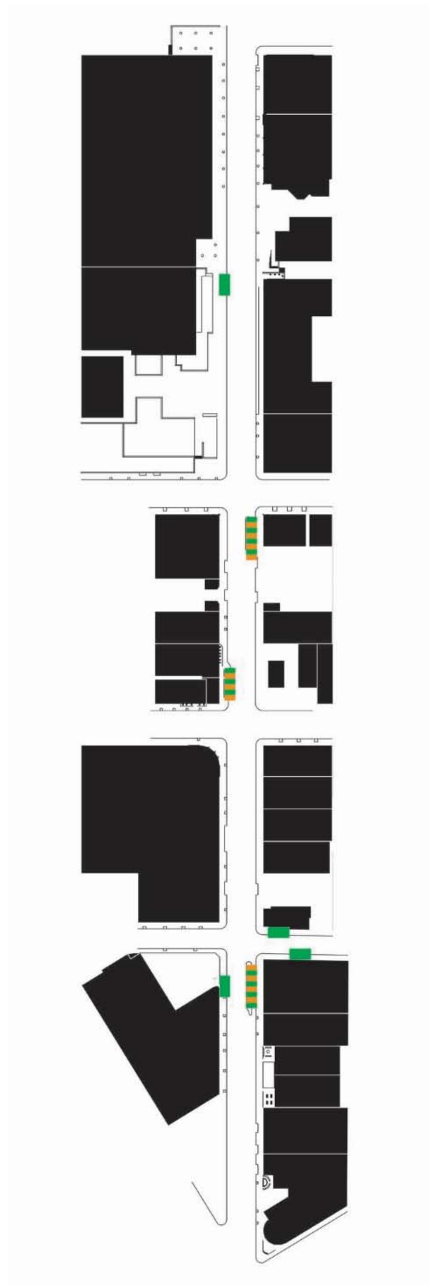


Figure 6.9. Capitol Hill 15th Avenue transit stops.

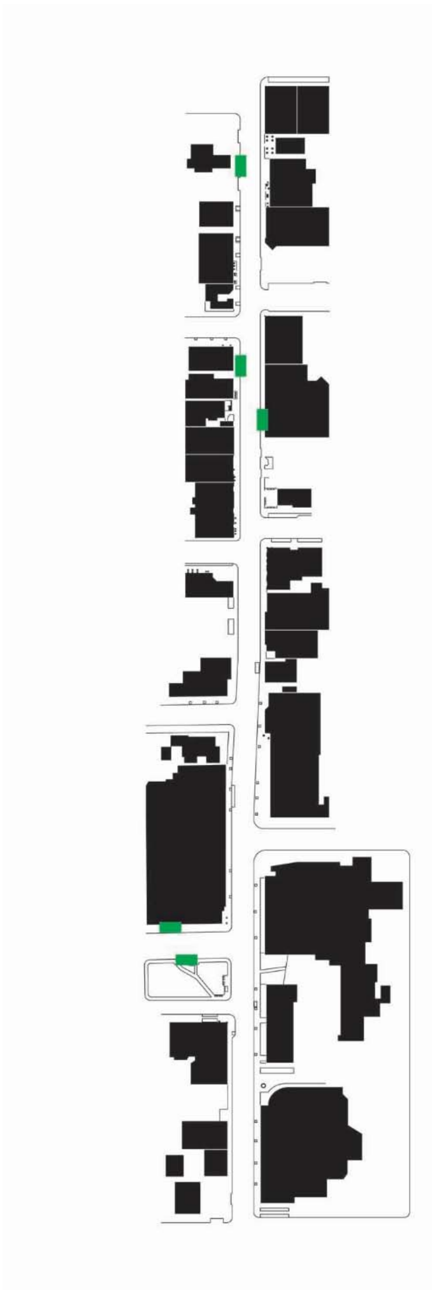


Figure 6.10. Capitol Hill 12th Avenue transit stops.

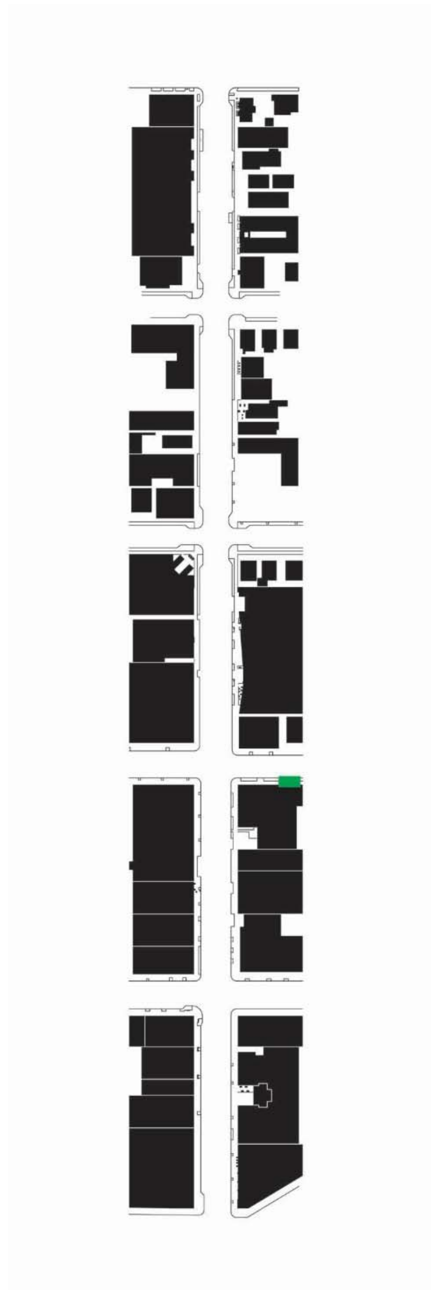


Figure 6.11. Capitol Hill Pike and Pine Streets transit stops.

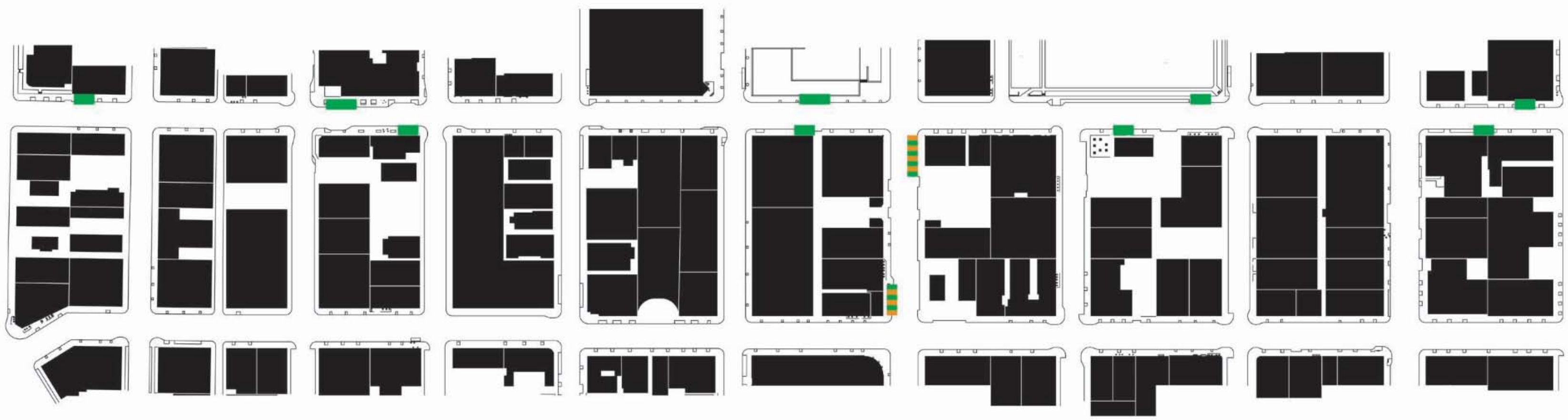


Figure 6.12. South Lake Union transit stops.

Figure 6.13. Lower Queen Anne transit stops.

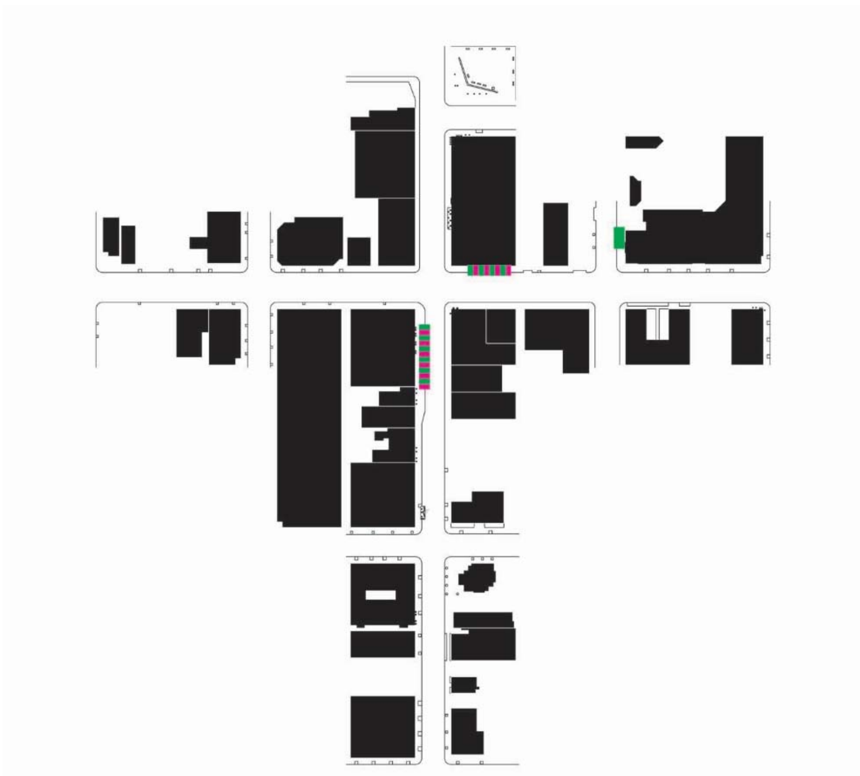


Figure 6.14. Belltown transit stops.

Figure 6.15. Downtown transit stops.

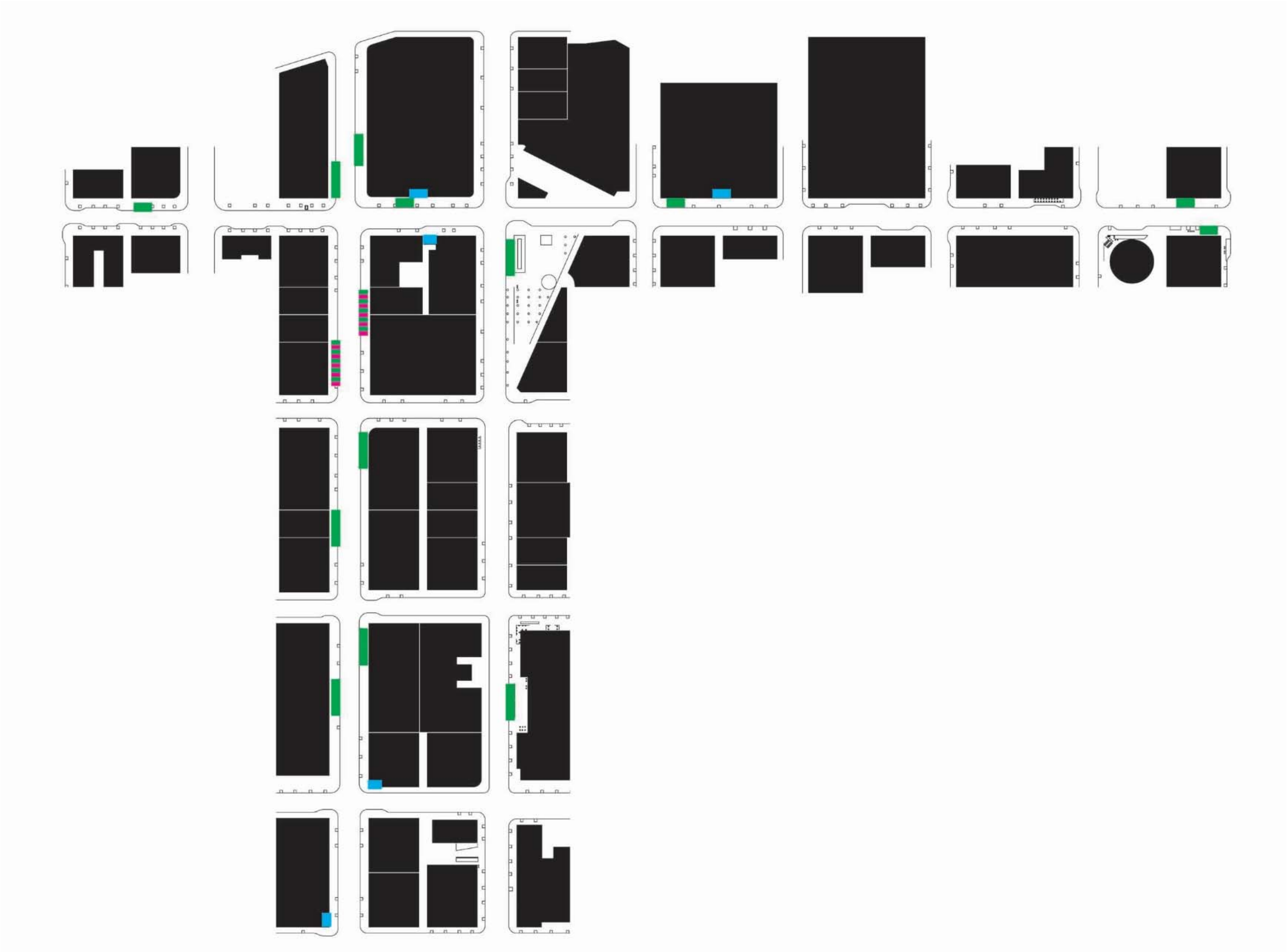


Figure 6.16. Pioneer Square transit stops.

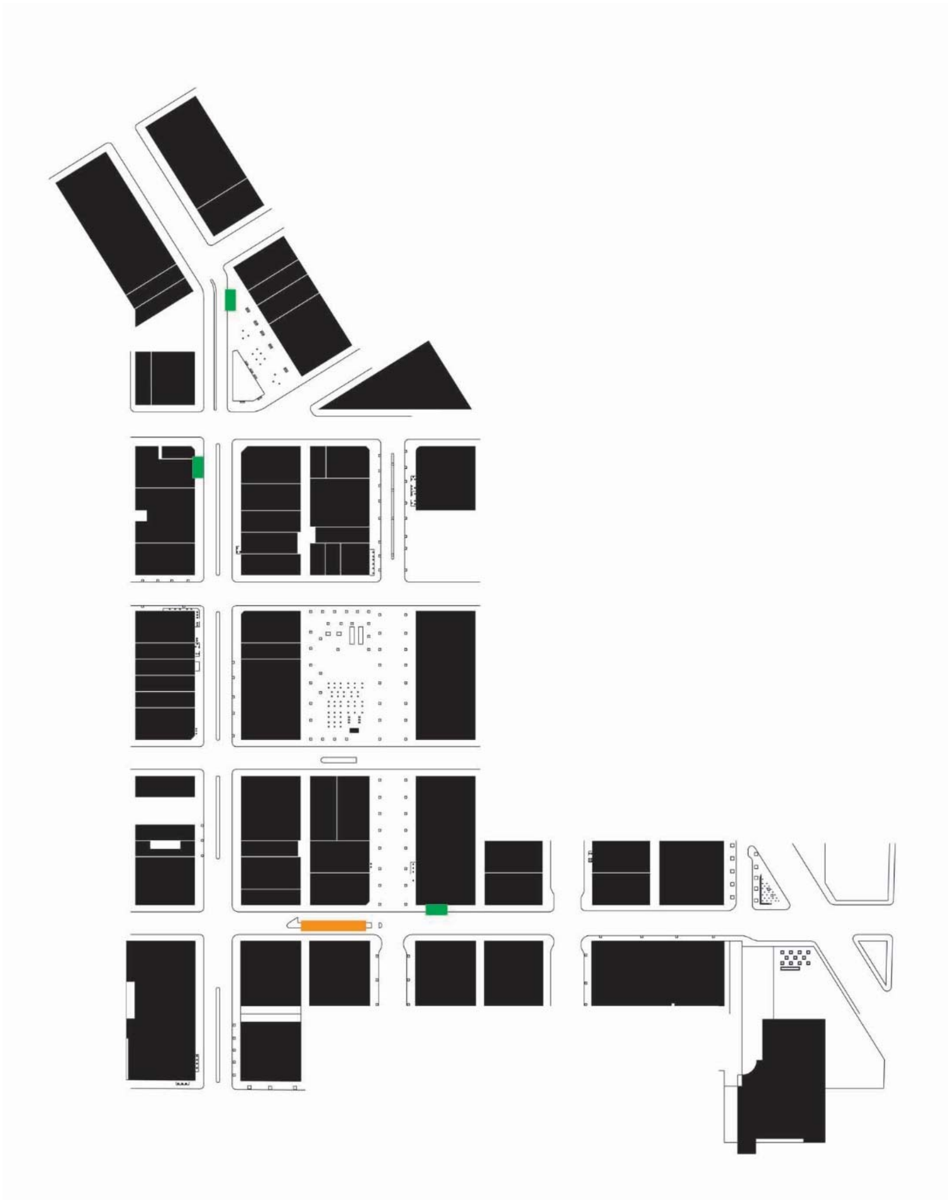


Figure 6.17. International District transit stops.

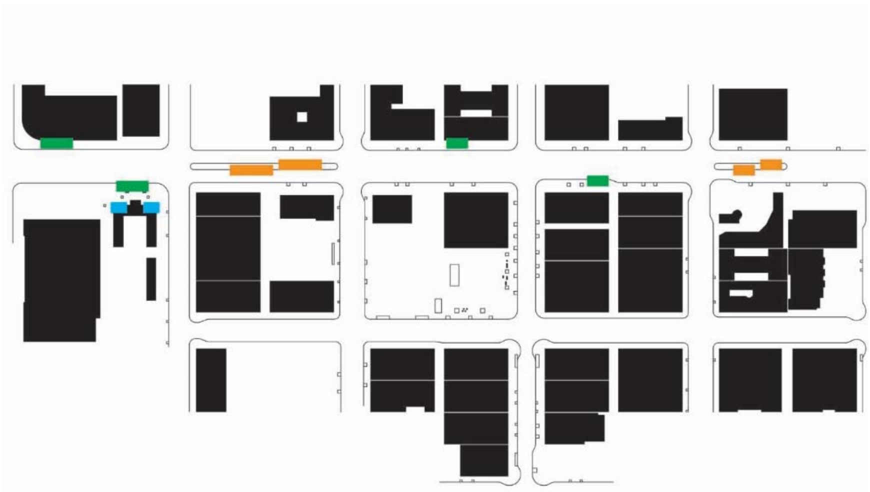


Figure 6.18. Average pedestrian counts in the urban core observed blocks (N=110).

Figure 6.19. Morning pedestrian counts in urban core.

Figure 6.20. Afternoon pedestrian counts in urban core.

Figure 6.21. Evening pedestrian counts in urban core.

Figure 6.22. Weekend pedestrian counts in urban core.

Table 6.1. Pearson's correlation coefficient for pedestrian counts in morning, afternoon, evening, weekend and average pedestrian counts.

	Average	Morning	Afternoon	Evening	Weekend
Buildings	-0.07	-0.19	-0.09	-0.05	0.02
GFDest	0.11	-0.03	0.09	0.11	0.18
TotDest	**0.23**	0.03	**0.17**	**0.25**	**0.34**
PubSeat	-0.06	0.06	0.01	-0.08	-0.16
OtherSeat	-0.06	0.02	-0.03	-0.02	-0.16
TotSeat	-0.08	0.05	-0.01	-0.06	-0.22
Trees	**0.20**	**0.16**	**0.20**	**0.21**	**0.15**
WalkWidth	**0.62**	**0.57**	**0.66**	**0.53**	**0.53**
TransitSeat	0.04	0.09	0.01	0.02	0.03
TransitShelter	0.07	0.11	0.10	0.10	-0.03
TransitStop	**0.45**	**0.37**	**0.39**	**0.45**	**0.40**
Driveway	**-0.31**	**-0.37**	**-0.33**	**-0.29**	**-0.19**
ParkingLot	-0.14	-0.13	-0.12	-0.14	-0.11
StreetParking	**-0.29**	**-0.33**	**-0.29**	**-0.27**	**-0.20**

Table 6.2. Pearson's correlation coefficient for transit user counts in morning, afternoon, evening, weekend and average transit users.

	Average	Morning	Afternoon	Evening	Weekend
Buildings	-0.13	-0.12	-0.12	-0.14	-0.10
GFDest	-0.03	-0.05	-0.03	-0.04	0.00
TotDest	-0.06	-0.07	-0.05	-0.07	-0.02
PubSeat	-0.10	-0.09	-0.12	-0.10	-0.10
OtherSeat	-0.19	-0.18	-0.20	-0.15	-0.20
TotSeat	**-0.20**	**-0.19**	**-0.23**	**-0.18**	**-0.22**
Trees	-0.02	0.01	-0.04	-0.03	-0.03
WalkWidth	**0.38**	**0.38**	**0.35**	**0.37**	**0.35**
TransitSeat	**0.41**	**0.44**	**0.43**	**0.37**	**0.37**
TransitShelter	0.03	0.00	0.04	0.06	-0.01
TransitStop	**0.68**	**0.66**	**0.70**	**0.70**	**0.58**
Driveway	-0.08	-0.09	-0.06	-0.07	-0.09
ParkingLot	0.06	0.04	0.07	0.03	0.10
StreetParking	**-0.30**	**-0.30**	**-0.32**	**-0.30**	**-0.26**

Stop spacing is an important characteristic of the different modes and worth mentioning here briefly. Local buses and streetcar stops tend to be every 2-3 blocks, or about 600 to 800 feet, or about one eighth of a mile. This is about half what the standard stop spacing is for local bus service, which is recommended to be roughly one quarter of a mile apart. Rapid Ride (BRT) stop spacing through the urban core is close to twice the distance between stops than the local bus service, at about 3 to 4 blocks or about 1320 or one-quarter mile. Stop spacing for the light rail is roughly 2000 feet between each of the Downtown stops (Westlake to University Street, University Street to Pioneer Square, and Pioneer Square to the International District). Going north from Westlake Center to Capitol Hill, the stop spacing is just over 1-mile, and south of the International District outside of the urban core, the stop spacing for the LINK light rail is about 1-mile between stops, with some stations being close to 2-miles apart.

Stop spacing is not necessarily an important factor in residents' use of transit within the urban core. There is a certain amount of convenience with having transit stops close together, but these seem to outweigh the downside of transit taking longer to get to where it is going. In general, people are more willing to walk to a transit stop only if it is fast and reliable. Reliable tends to mean that the mode of transit is not slowed down by traffic, accidents, or stop lights. For most interview respondents, this means that reliable transit is grade-separated. Or at the very least is in a dedicated lane on city streets. Only the light rail meets this criteria presently. Fast, often means the same as reliable, in that transit is not delayed and sticks to a schedule that people can count on. One of the biggest problems identified by residents in the urban core is the lateness of buses in the urban core and the lack of reliability knowing that a bus will show up when it is scheduled to. The Rapid Ride bus service runs without a schedule and has buses spaced at 5 to 7 minute intervals, but residents often note that this is not the case and that buses can sometimes be 15 to 20 minutes apart. When the service is unreliable, the distance between stops becomes somewhat of an afterthought. How this issue can be resolved is discusses in greater detail in the next chapter.

Before looking at how different types of infrastructure influence walking, it is first useful to note that walking varies greatly per block and by time of day. The images in the previous section show average levels of walking per block, but do not differentiate by time of day. Figure

6.18 shows the average number of pedestrian visually across the 110 blocks observed within the urban core. Figures 6.19 to 6.22 show the number of pedestrians on each block in the morning, afternoon, evening and weekend observation times. We can see that the mornings are least walked throughout the urban core, with Downtown and SLU having the most at this time. Afternoon shows significant peaks in Downtown and SLU. The evening is overall the busiest period in nearly all the neighborhoods. Weekends remain busy for many blocks in Capitol Hill, LQA, Belltown and Downtown.

Now that we have visually seen how pedestrian activity varies in each neighborhood and on each block within the observed parts of each neighborhood, the question remains, how do block-scale pedestrian, transit and automobile infrastructures impact pedestrian activity and transit use? For this part of the analysis, I conduct a regression analysis with number of pedestrians (PedCount) and transit users (TransitCount) as the dependent variables. I conducted each analysis using the morning, afternoon, evening and weekend pedestrian counts and transit user counts to look at how the independent variable influence walking and transit use. Independent variables fall into three categories – pedestrian oriented infrastructure, transit infrastructure and automobile infrastructure. Each variable is measured per block. Pedestrian infrastructure variables include the total number of buildings (Buildings); the number of ground floor destinations (GFDest); the total number of destinations (TotDest); the amount of public seating (PubSeat); other seating including restaurant and café seating (OtherSeating); the total number of seating, which combines public and other seating (TotSeat); the total number of trees per block (Trees); and the width of the sidewalk on each block (WalkWidth). Transit infrastructure variables include the amount of seating at a transit stop (TransitSeat); the number of bus shelters at a transit stop (TransitShelter); and a transit score for each block (TransitStop). The transit score was calculated using a point system: a bus or streetcar stop receives one point, a light rail stop receives 5 points, a block within a 5-minute walk of a light rail stop gets 2 points and a block within a 5-10 minute walk of a light rail station gets 1 point. The maximum possible score would be 11, although no block contains all transit modes, so no block has a score of 11 (the highest is an 8). Lastly, automobile infrastructure includes the number of driveways and alleys on a block (Driveways); the percent of each block frontage that is a surface parking lot or garage (ParkingLot); and the total number of street parking spaces per block (StreetParking).

Before beginning the regression, a test of multicollinearity for all independents variables was conducted. This yielded mostly expected results. The number of buildings has a high correlation to the number of ground floor destinations and the amount of street parking and less significant relationships with total destinations, other seating, and sidewalk width. Ground floor destinations was highly correlated with total destinations, as we would anticipate since total destinations is simply adding ground floor destinations and others on each block. Likewise, public seating and other seating are highly correlated to total seating, although not correlated with each other. Sidewalk width has a moderate correlation with the transit score variable that is positive and a negative correlation with street parking. This indicates that blocks with more transit on them have wider sidewalks, and that streets with more street parking have narrower sidewalks. Driveways have a moderate correlation with parking lots, since any parking lot on a block will increase the number of driveways. And lastly, street parking as a negative correlation on the transit score variable, which makes sense since most transit stops are bus stops which are curbside and there is no parking in the bus stop area, meaning less overall street parking on blocks with transit.

Table 6.1 and 6.2 show the Pearson's correlation coefficient for pedestrians and transit users for the average counts as well as at each observation period – morning, afternoon, evening and weekend. The Pearson's correlation coefficient tests each independent variable against the dependent variables (pedestrians or transit users) to see if there is any linear correlation. After running this analysis, I decided to exclude ground floor destinations, public seating, and other seating from the multiple regression models. Since there was a higher degree of multicollinearity with these variables, the Pearson's r showed that total destinations has a stronger correlation with both pedestrians and transit users than ground floor destinations. Likewise, total seating has a stronger correlation with pedestrians and transit users than either public seating or other seating. Both of these outcomes were anticipated.

Table 6.3. Linear regression results for the average number of pedestrians per block.

Independent Variable	R^2	p-value
Buildings	0.004	0.502
GFDest	0.011	0.260
TotDest	0.055	0.014 *
PubSeat	0.003	0.566
OtherSeat	0.004	0.538
TotSeat	0.006	0.421
Trees	0.038	0.040 *
WalkWidth	**0.389**	**<0.001** ***
TransitSeat	0.001	0.715
TransitShelter	0.005	0.485
TransitStop	0.199	**<0.001** ***
Driveway	0.099	**<0.001** ***
ParkingLot	0.019	0.155
StreetParking	0.088	0.002 **

Table 6.4. Linear regression results for the average number of transit users per block.

Independent Variable	R^2	p-value
Buildings	0.016	0.192
GFDest	0.001	0.736
TotDest	0.003	0.558
PubSeat	0.011	0.276
OtherSeat	0.034	0.052
TotSeat	0.042	0.032 *
Trees	0.001	0.813
WalkWidth	0.145	**<0.001** ***
TransitSeat	0.168	**<0.001** ***
TransitShelter	0.001	0.788
TransitStop	**0.468**	**<0.001** ***
Driveway	0.006	0.416
ParkingLot	0.003	0.541
StreetParking	0.092	0.001 **

Table 6.3 and 6.4 show the results from a simple linear regression analysis of each independent variable for both pedestrian activity and transit users. For pedestrian activity (Table 6.3), three variables are significant at the 0.001 level. These include sidewalk width (WalkWidth), the transit score variable (TransitStop) and the number of driveways (Driveways). Sidewalk width shows a positive correlation to pedestrian activity and has the highest R^2 of 0.389, meaning that this variable explains 38.9 percent of the variation of pedestrian activity. TransitStop explains 19.9 percent of the variation and shows a positive correlation. Driveways explains 9.9 percent with a negative correlation, meaning that the more driveways, the fewer pedestrians on the block. Beyond these three variables, a few others are significant at lower thresholds. StreetParking shows a negative correlation, is significant at the 0.01 level, and explains 8.8 percent of pedestrian activity. The number of trees per block and the total number of destinations both show a positive correlation and are significant at the 0.05 level and explain 3.8 percent and 5.5 percent of the variation in pedestrian activity.

Looking at Table 6.4, we can again see that three variables are significant at the 0.001 level. These include the transit score variable, with a positive correlation that explains 46.8 percent of the variation in transit users per block. TransitSeat and WalkWidth both show positive correlations, but have much lower r^2 values of 0.168 and 0.145, meaning that on their own, transit seating explains 16.8 percent of the variation in transit use, while sidewalk width explains 14.5 percent of the variation. Street parking shows a negative correlation with transit users, and is significant with a p-value of 0.0013 and explains 9.2 percent of the variation in transit use. Total seating has a negative correlation with transit use, is significant at the 0.05 level and explains 4.2 percent of the variation in transit use.

Between both tables, both sidewalk width and the transit stop variable are significant and have a positive correlation with pedestrian activity and transit users. In the case of average number of pedestrians per block, sidewalk width has a stronger correlation than transit stops, while transit stops have a stronger correlation to the average number of transit users per block than sidewalk width. Overall, three pedestrian infrastructure variables have a significant correlation with pedestrian activity, while only one transit infrastructure variable has a significant positive correlation with walking. Two automobile infrastructure variables have a significant negative correlation with walking activity. In looking at transit users, two transit infrastructure variables have a significant positive correlation. Two pedestrian infrastructure variables show significant relationships, one positive and one negative. And only one automobile infrastructure variable has a significant negative correlation to the average number of transit users. This indicates what is expected – that pedestrian infrastructure has a stronger influence on pedestrian activity and that transit infrastructure has a stronger influence on transit use. Automobile infrastructure has a negative influence on both pedestrian activity and transit use, which is expected since urban environments with more accommodations for cars are likely to have more cars and be less attractive and less safe for pedestrians.

Table 6.5. Regression R^2 and p-values for pedestrian activity.

	Pedestrian Infrastructure		**Transit Infrastructure**		**Automobile Infrastructure**		**All Variables**	
	R^2	p-value	R^2	p-value	R^2	p-value	R^2	p-value
Average	0.496	3.41E-14	0.223	6.16E-06	0.183	8.02E-05	0.603	2.35E-15
Morning	0.378	1.33E-09	0.144	0.0008895	0.247	1.22E-06	0.489	2.23E-10
Afternoon	0.516	4.41E-15	0.181	9.24E-05	0.197	3.50E-05	0.601	2.95E-15
Evening	0.399	2.30E-10	0.237	2.46E-06	0.155	0.0004489	0.528	6.29E-12
Weekend	0.456	1.70E-12	0.198	3.21E-05	0.079	0.03328	0.533	4.00E-12

Table 6.6. Regression R^2 and p-values for transit users.

	Pedestrian Infrastructure		**Transit Infrastructure**		**Automobile Infrastructure**		**All Variables**	
	R^2	p-value	R^2	p-value	R^2	p-value	R^2	p-value
Average	0.173	0.001237	0.508	2.82E-16	0.108	0.006704	0.560	2.55E-13
Morning	0.175	0.001083	0.498	8.46E-16	0.103	0.008932	0.563	1.95E-13
Afternoon	0.158	0.002727	0.531	< 2.2e-16	0.114	0.004806	0.573	6.63E-14
Evening	0.160	0.002437	0.505	3.78E-16	0.098	0.01151	0.549	8.21E-13
Weekend	0.156	0.003078	0.379	5.56E-11	0.100	0.01034	0.440	1.28E-08

To explore the relationship further between pedestrian, transit and automobile infrastructure and pedestrian activity and transit use, I conduct a series of multiple regression analyses. These are presented in Table 6.5 and 6.6, which show the results for the average number of pedestrians per block and transit users per block. Both tables show the results of four basic regression models that were run for average, morning, afternoon, evening, and weekend times. The first model is for pedestrian infrastructure, which combines the five pedestrian infrastructure variables: Buildings, TotDest, TotSeat, Trees, and WalkWidth. The second includes transit infrastructure only: TransitSeat, TransitShelter, and TransitStop. The third model includes the three automobile infrastructure variables: Driveway, ParkingLot, and StreetParking. The final model in the last column includes all the variables in the previous three models. First, I examine all the models for pedestrian activity, then those for transit use.

The first model with pedestrian infrastructure looking at average pedestrian activity has a R^2 of 0.496 and a p-value of <0.001. Within this model, three variables are significant: WalkWidth (p= <0.001), TotDest (p=0.0046), and Trees (p=0.003). Removing the two other variables from the regression model does not lower the R^2 value of 0.496, with a p-value of <0.001. The second model looking at morning pedestrian activity shows an R^2 of 0.378 and a p-value of <0.001. In this model, only WalkWidth (p= <0.001) and Trees (p=0.041) are significant. Removing non-significant variables reduces the R^2 to 0.366. The model looking at afternoon pedestrian activity has the highest R^2 of 0.516. Three variables are significant: WalkWidth (p= <0.001), Trees (p=0.006) and TotDest (p=0.034). The model looking at evening pedestrian activity has an R^2 of 0.399 and a p-value of <0.001. Three variables show significance: WalkWidth (p= <0.001), Trees (p=0.006), and TotDest (p=0.004). The model looking at weekend pedestrian activity has an R^2 of 0.456 and a p-value of <0.001. This model has four significant variables: WalkWidth (p= <0.001), TotDest (p= <0.001), Trees (p=0.009), and TotSeat (p=0.036). Across all time periods two variables stand out as being significant in all models: sidewalk width and the number of trees per block.

Looking at the impact of transit infrastructure on pedestrian activity, we can see that in general the three transit variables yield lower R^2 values at all observation times. The transit infrastructure model looking at average pedestrian counts has an R^2 of 0.223. The TransitStop variable is the only significant one with a p-value of p= <0.001. The second model with morning pedestrian counts has an R^2 of 0.144 and TransitStop is the only significant variable (p= <0.001). The third model with afternoon pedestrian counts has an R^2 of 0.181 and TransitStop is the only significant variable (p= <0.001). The fourth model with evening pedestrian counts has an R^2 of 0.237. This model has two significant variables: TransitStop (p= <0.001) and TransitSeat (p=0.039). The final model looking at weekend pedestrian counts has an R^2 of 0.198 and only TransitStop is the only significant variable (p= <0.001). The transit stop variable is the only one that is significant across all models at p= <0.001. This indicates that seating and transit shelters are not correlated to the number of pedestrians. The transit stop variable is significantly correlated with the number of pedestrians, but this variable doesn't explain as much of the variation in pedestrian activity as the pedestrian infrastructure variables.

The regression model looking at automobile infrastructure's influence on average pedestrian activity has an R^2 of 0.183 and a p-value of <0.001. This model has two significant variables: Driveway (p= 0.002) and StreetParking (p=0.001). When removing the ParkingLot variable, the Driveway variable becomes significant at p= <0.001 and the R^2 value remains unchanged at 0.183. The second model with morning pedestrian activity has an R^2 of 0.247 two significant variables: Driveway (p= <0.001) and StreetParking (p=0.002). The third model with afternoon pedestrian activity has a R^2 of 0.197. There are two significant variables: Driveway (p= <0.001) and StreetParking (p=0.002). The fourth model has an R^2 of 0.155 and two significant variables: Driveway (p=0.006) and StreetParking (p=0.004). The final model looking at weekend pedestrian activity has an R^2 of 0.079 and only one significant variable, StreetParking, with a p-value of 0.03.

A regression model with all the variables included looking at average pedestrian counts has an R^2 value of 0.603. There are five significant variables: TotDest (p=0.02), Trees (0.007), WalkWidth (p= <0.001), TransitStop (p= <0.001) and Driveway (p=0.0046). The second model with morning pedestrian counts has an R^2 of 0.489 and three significant variables: WalkWidth (p= <0.001), TransitStop (0.035), and Driveway (0.001). The third model with afternoon pedestrian counts has an R^2 of 0.601 and four significant variables: WalkWidth (p= <0.001), Trees (p=0.016), TransitStop (0.009), and Driveway (0.0014). The fourth model with evening pedestrian counts has an R^2 of 0.528 and five significant variables: WalkWidth (p= <0.001), TransitStop (p= <0.001), Trees (p=0.009), TotDest (p=0.02) and Driveway (p=0.017). The final model with weekend pedestrian counts has an R^2 of 0.533. This model has five significant variables: WalkWidth (p= <0.001), TotDest (p= <0.001), TransitStop (p=0.002), TotSeat (p=0.044), and Trees (0.015). Sidewalk width is the only variable that is significant in all five regression models at the 0.001 level in each. TransitStop is significant in each model, but at various significance levels. In each of the different observation times, the models with all variables have R^2 values of about 0.1 higher than the models with only pedestrian infrastructure. We can see from this analysis that pedestrian infrastructure is has the overall strongest correlation to pedestrian activity, with sidewalk width being significant in all models including only pedestrian infrastructure, as well as in the models combining all types of infrastructure. The number of destinations also has a strong correlation to pedestrian activity. The transit stop variable is a strong correlation in the models with transit infrastructure and in models including all variables, but with less significance than the other variables.

Turning now to look at how pedestrian infrastructure, transit infrastructure and automobile infrastructure impacts the number of transit users per block, we look at Table 6.17. Here we can see that overall, regression models with only the three transit infrastructure variables have R^2 values of around 0.5, meaning that these variables explain about 50 percent of the variation in the number of transit users per block. Look at models with all variables, we can see that when we add pedestrian and automobile infrastructure variables to the transit ones, the R^2 only increases by about 0.05.

Looking specifically at how pedestrian infrastructure impacts average transit use, we can see an R^2 of 0.173 and a $p<0.01$. Within this first model, only WalkWidth is significant with a p-value of <0.001. TotSeat is significant at $p<0.1$. The second model with morning transit use shows similar results, with an R^2 of 0.175 and with Walkwidth significant at $p<0.001$ and TotSeat significant at $p<0.1$. The third model looking at afternoon transit users has an R^2 of 0.158 with Walkwidth significant at $p<0.001$ and TotSeat significant at $p<0.1$. The fourth model looking at evening transit use has an R^2 of 0.16 and only WalkWidth is significant with a p-value of <0.001. In the final model looking at weekend transit use, we see an R^2 of 0.156 and again WalkWidth is significant at p<0.001 and TotSeat is significant at p<0.1.

In column 2 of table 6.17 we see the influence of transit infrastructure on transit activity. Looking at average transit use across all 110 blocks, we see an R^2 of 0.51 with a p-value of <0.001. All three variables are significant to some degree: TransitStop at p<0.001, TransitSeat at p<0.5 and TransitShelter at p<0.1. The second model has an R^2 of 0.498, again with three significant variables: TransitStop at p<0.001, TransitSeat and p<0.01 and TransitShelter at p<0.05. The third model looking at afternoon transit use has an R^2 of 0.531, with TransitStop significant at p<0.001, TransitSeat significant at p<0.05 and TransitShelter significant at p<0.1. The fourth model looking at evening transit use has an R^2 of 0.505 with only one significant variable: WalkWidth with a p-value of <0.001. And the final model looking at weekend transit use has an R^2 of 0.379, with TransitStop signigicant at p<0.001 and TransitShelter and TransitSeat significant at p<0.1. This lower R^2 on the weekend is likely the result of fewer transit users on the weekend since people are not using it to commute to and from work, which accounts for a majority of overall transit use.

In column 3 of table 6.17 we see the impact of automobile infrastructure on transit use. Each of the models presented here have R^2 values of about 0.1 and p-values of p<0.01 or p<.05, indicating that these three variables are generally not significant in explaining transit use. The only variable that is significant in the models is StreetParking, with a p-value of <0.001 in the afternoon and only p<0.01 in the morning, evening, weekend, and average models. As indicated earlier, this variable is highly correlated to TransitStop since a majority of the transit in the urban core is either bus or streetcar which requires curb-side space for stops, which in turn reduces the possibility of street parking on that block.

In the last column of table 6.17, I look at a model combining all 11 variables into one regression model. In the model looking at average transit use, we have an R^2 of 0.56 and four significant variables: TransitStop (p= <0.001), TransitSeat (p=0.013), TransitShelter (p=0.08) and WalkWidth (p=0.07). The second model looking at morning transit use has an R^2 of 0.563 and again four significant variables: TransitStop (p= <0.001), TransitSeat (p=0.002), TransitShelter (p=0.036) and WalkWidth (p=0.04). The third model looking at afternoon transit use has an R^2

of 0.573 and three significant variables: TransitStop (p= <0.001), TransitSeat (p=0.009), and TotSeat (p=0.06). The fourth model looking at evening transit use has an R^2 of 0.549 and has three significant variables: TransitStop (p= <0.001), TransitSeat (p=.075) and WalkWidth (p=0.097). The final model looking at weekend transit use has the lowest R^2 of 0.44 and four variables that show some level of significance: TransitStop (p= <0.001), Transit Seat (p=0.032), TotSeat (p=0.09) and Driveway (p=0.08). Overall, the only variable that is highly significant in all the models is TransitStop. This variable is a composite score of the number and types of transit stops, with a bus or streetcar stop contributing one point, a light rail station on the block equals 5 points, a light rail station within a 5 minute walk gets 2 points and within a 10 minute walk 1 point. The fact that this composite is the strongest correlate to the number of transit users on a block, it indicates, and corroborates my own observations, that blocks within walking distance of a light rail station are more heavily populated with people using transit. It also indicates that blocks with access to more types of transit have more transit users.

In conclusion, pedestrian, transit and automobile infrastructures does show a correlation to the level of pedestrian activity and to number of transit users in the urban core. The presence of pedestrian infrastructure, or lack thereof, is a moderately strong predictor of how many pedestrians will be present on any given block in the urban core. The most significant pedestrian infrastructure variables across all the regression models include the total number of destinations and the sidewalk width. The sidewalk width is a particularly important one since this is something that planners and engineers have control over when planning and designing streets. It indicates that sidewalk space possibly operates in much the same way that freeway capacity does for cars, with an induced demand. In other words, the more space there is for pedestrians, the more pedestrians there are likely to be. Obviously, surrounding uses contribute to this, as is indicated by the number of destinations also being a significant contributor. Additionally, the availability of transit (the TransitStop variable) is significant, but explains less of the variation in pedestrian levels. This indicates that while the availability of transit contributes to pedestrian activity, it is not solely responsible for pedestrian activity within the urban core. This is supported in the final models including all the variables, which shows TransitStop with less significant p-value than both destinations and sidewalk width. The number of driveways is also a significant predictor of pedestrian activity, although again to a lesser extent than the pedestrian infrastructure variables. The presence of driveways has an overall negative impact on pedestrian activity, meaning that the more driveways are on a block, the fewer pedestrians there are likely to be. This is corroborated by interviews and survey data that indicate people tend to avoid walking in places with a lot of car traffic. Driveways are one indicator that there will be more car traffic, especially car traffic that interferes with pedestrians walking on the sidewalk.

Transit use, like pedestrian activity, is most significantly influenced by its corresponding infrastructure. In these regression models, transit infrastructure – seating available at a transit stop, transit shelters, and the availability of different modes of transit – all have a positive correlation with the number of transit users on a block, explaining about 50 percent of the variation in transit users between blocks. The TransitStop variable is by far the most significant indicator of the number of transit users. In other words, the higher availability of transit there is on any given block, the more transit users on that block. In addition, the most transit users are on or near blocks with access to light rail transit, which is what the highest transit score values represent. The exception to this is along the 3rd Avenue transit corridor in Downtown, although even here, a high proportion of riders are waiting for Rapid Ride buses as opposed to local bus service, indicating that faster and more reliable transit service attracts more transit users. This indicates that while access to more transit is a variable, it is not only access to transit, but to a specific type of transit that makes the biggest impact on the number of transit users – transit that is fast and more reliable. Light rail definitely falls into this category, while Rapid Ride buses have mixed results in their speed and reliability compared to local bus service. Pedestrian and automobile infrastructure has low correlation to the number of transit users on a block. Sidewalk width is by far the most significant pedestrian infrastructure variable, but if we recall, there is a degree of multicollinearity between WalkWidth and TransitStop. Wider sidewalks are often present on blocks with transit stops, meaning a wider sidewalk is likely to have a transit stop. Likewise, street parking is the most significant automobile infrastructure variable that influences the number of transit users on a block, but again this variable is highly correlated with TransitStop. If there is a transit stop on a block, there is likely to be less street parking since any bus or streetcar transit requires curb space for a stop. We can more or less conclude that pedestrian and automobile infrastructures have little to no effect on transit users, especially since the p-values for these models are all more than p=0.001, meaning they are less significant. The conclusion that pedestrian infrastructure has little correlation on the number of transit users seems to go against mainstream planning literature that suggests a more walkable urban environment will encourage more transit use. These results, however, seem to indicate that people in the urban core use transit more out of necessity than choice. By this, I mean that they use transit despite the fact that the urban environment is not as pedestrian oriented as it could be.

Influence of New and Planned Transit on Travel Behavior

Relevant Research Question: To what extent have people changed and/or anticipate changing their walking and other travel behaviors based on the availability of transit?

We saw in the previous chapter that walking is the primary mode of transportation among residents in the urban core, followed by driving and transit. Outside the urban core, driving the most common primary mode of transportation, followed by bike, transit and walking. Non-urban core residents still utilize walking to a high degree to a number of neighborhood destinations even though driving is indicated as a primary mode. Trips to work, especially for those who work in the urban core, are predominantly transit. Understanding current travel behaviors only gets us so far in understanding the role of different modes of transportation in Seattle residents' daily travels. In order to understand the extent to which people have altered their travel behavior and why is important for planners to consider as they build new transit in the hopes of providing people with viable alternatives to driving and give people a wider range of choices in how they travel throughout the city.

Citywide, Seattle residents have shown a significant change in their travel behavior for both work and non-wok travel between 2015 and 2016. These results are self-reported in the survey questionnaire complete in Fall 2016 through a series of questions that had respondents indicate what their primary mode of transportation was for work and non-work travel 12 months ago, as well as what the reasons for changing their travel behaviors were. For work travel (Table 6.7), we see an increase in walking, express bus, streetcar, light rail, bike and carpooling. We see decreases in local bus use Rapid Ride, and driving alone. The amount of walking increased nearly 20 percent, light rail use increased 420 percent. Meanwhile, driving alone decreased nearly 20 percent, and local bus use decreased 40 percent.

Table 6.7. Changes in commute to work travel behavior for all Seattle residents between 2015 and 2016.

	12 Months Ago	**Fall 2016**	
Commute Mode	All Seattle (Travel Survey) (%, N=208)	All Seattle (Travel Survey) (%, N=187)	Percent change from 2015 to 2016
Walk	16.3	19.3	17.8
Local Bus	26.0	15.5	-40.3
Rapid Ride	1.9	1.6	-16.6
Express Bus	6.7	8.0	19.2
Seattle Streetcar	0.0	0.5	100.0*
LINK Light Rail	1.4	7.5	419.1
Bike	16.3	20.3	24.3
Drive Alone	25.5	20.9	-18.2
Carpool	5.8	6.4	11.2

Table 6.8. Changes in commute to work travel behavior for non-urban core residents between 2015 and 2016.

	12 Months Ago	**Fall 2016**	
Commute Mode	Non-urban core (Travel Survey) (%, N=87)	Non-urban core (Travel Survey) (%, N=82)	Percent change from 2015 to 2016
Walk	8.0	4.9	-39.4
Local Bus	23.0	18.3	-20.4
Rapid Ride	3.4	3.7	6.1
Express Bus	6.9	8.5	23.8
Seattle Streetcar	0.0	0.0	0.0
LINK Light Rail	1.1	2.4	112.2
Bike	28.7	29.3	1.9
Drive Alone	23.0	24.4	6.1
Carpool	5.7	8.5	48.5

Table 6.9. Changes in commute to work travel behavior for urban core residents between 2015 and 2016.

	12 Months Ago	Fall 2016	
Commute Mode	Urban Core (Travel Survey) (%, N=121)	Urban Core (Travel Survey) (%, N=105)	Percent change from 2015 to 2016
Walk	22.3	30.5	36.6
Local Bus	28.1	13.3	-52.5
Rapid Ride	0.8	0.0	-100.0
Express Bus	6.6	7.6	15.2
Seattle Streetcar	0.0	1.0	100.0*
LINK Light Rail	1.7	11.4	591.4
Bike	7.4	13.3	79.3
Drive Alone	27.3	18.1	-33.7
Carpool	5.8	4.8	-17.7

When we look at the urban core residents versus non-urban core residents (Table 6.8 and 6.9), we can see that the two groups had different changes in travel behavior. Those who live outside the urban core decreased walking nearly 40 percent and had lower local bus use. Meanwhile, they had a 50 percent increase in carpool rates, a 110 percent increase in light rail use, and a 24 percent increase in express bus use. Among residents in the urban core, there was a 37 percent increase in walking, a nearly 600 percent increase in light rail use, and an 80 percent increase in bike use. There was a 50 percent decrease in local bus use, a 34 percent decrease in driving alone, and a nearly 20 percent decrease in carpooling among urban core residents.

The increase in light rail use in both groups is directly attributable to the extension that opened in March 2016 and connected Downtown Seattle to Capitol Hill and the University of Washington. The larger increase in light rail use in the urban core group is the result of the light rail station opening in this neighborhood. The decrease in local bus use is likely a result of switching from local bus to light rail. This switch, which a handful of interview participants corroborate, as well as more general acknowledgment within the transportation planning profession (Walker 2011), happened because people are more willing to walk farther distances for a faster and more reliable form of transportation. For many who made the switch to light rail, a bus stop is likely closer, but with wait times of 10-15 minutes, it is faster to walk to the light rail station instead of the bus to work, or the bus to light rail transfer. During peak commute times, the light rail trains arrive every 6 minutes and get people to their destination faster than the bus. This resulting switch means that in general, people are walking more to use a superior form of transit, which by most measures is a good thing.

The other thing we see among urban core residents that we do not in the non-urban core group is a large increase in cycling to work. This is likely attributable to a number of factors. First is that in 2015 and 2016, the City installed a number of key bike safety improvements, such as the 2nd Avenue protected bike lane, and the Broadway protected bike lanes, as well as a number of painted bike lines on other major routes into and around the urban core. While avid cyclists will cycle to work with or without these infrastructure improvements, they are a vital component to getting more people to try biking to work and other places around the city. The second thing, which came out of a number of interviews with cyclists from around the city, is that cycling sometimes replaces transit trips, especially to and from work. The reason for this is that cycling provides a more reliable mode of transportation, in that it takes the same amount of time to get to a person's destination every time, in contrast to a majority of transit in Seattle, which is prone to delays from traffic, congestion, accidents and other unpredictable circumstances. Additionally, cycling typically takes the same amount of time that a bus ride generally would, and in some cases, residents even indicate that it is faster to bike than to ride the bus, even if there were no delays.

Decreases in driving among urban core residents, are attributable four factors. First, is the new light rail station providing access to jobs that were previously inconvenient to get to on transit from the Capitol Hill neighborhood, where one of the new light rail stations opened. Second, is the increasing levels of congestion across the city on the whole, which makes driving a less appealing option. Third, is the rising cost and decreasing availability of parking within the urban core. As new development continues to be built, parking lots are turned into apartments, and more people are vying for the same number of street parking spots, and some individuals decide to do without a car altogether. The fourth factor is the higher cost of housing in the urban core compared to the rest of the city. When people move to the urban core from outside the city or from other neighborhoods, they often realize they do not need to drive as much, and getting to work by other means is typically pretty easy from these centrally located neighborhoods.

Table 6.10. Changes in primary mode of transportation for non-work travel for all Seattle residents in 2015 and 2016.

	12 Months Ago	Fall 2016	
Commute Mode	All Seattle (Travel Survey) (%, N=249)	All Seattle (Travel Survey) (%, N=249)	Percent change from 2015 to 2016
Walk	37.3	45.8	22.6
Local Bus	12.9	8.8	-31.3
Rapid Ride	0.0	0.8	100.0*
Express Bus	0.8	0.0	-100.0
Seattle Streetcar	0.0	0.0	0.0
LINK Light Rail	0.0	1.6	160.0
Bike	10.0	10.8	8.0
Drive Alone	21.3	14.5	-32.1
Carpool	17.7	17.7	0.0

Table 6.11. Changes in primary mode of transportation for non-work travel for non-urban core residents between 2015 and 2016.

	12 Months Ago	Fall 2016	
Commute Mode	Non-Urban Core (Travel Survey) (%, N=96)	Non-Urban Core (Travel Survey) (%, N=96)	Percent change from 2015 to 2016
Walk	25.0	27.1	8.3
Local Bus	11.5	8.3	-27.3
Rapid Ride	0.0	2.1	210.0*
Express Bus	0.0	0.0	0.0
Seattle Streetcar	0.0	0.0	0.0
LINK Light Rail	0.0	0.0	0.0
Bike	15.6	17.7	13.3
Drive Alone	25.0	17.7	-29.2
Carpool	22.9	27.1	18.2

Table 6.12. Changes in primary mode of transportation for non-work travel for urban core residents between 2015 and 2016.

	12 Months Ago	Fall 2016	
Commute Mode	Urban Core (Travel Survey) (%, N=153)	Urban Core (Travel Survey) (%, N=153)	Percent change from 2015 to 2016
Walk	45.1	57.5	27.5
Local Bus	13.7	9.2	-33.3
Rapid Ride	0.0	0.0	0.0
Express Bus	1.3	0.0	-100.0
Seattle Streetcar	0.0	0.0	0.0
LINK Light Rail	0.0	2.6	260.0*
Bike	6.5	6.5	0.0
Drive Alone	19.0	12.4	-34.5
Carpool	14.4	11.8	-18.2

Looking at non-work related modes of transportation, we see similar patterns as for work travel – more walking, less local bus use, more express bus use, more light rail use, more cycling, less driving alone, and more carpooling (Table 6.10). Among non-urban core residents (Table 6.11), we see about a 10 percent increase in walking, a 30 percent decrease in local bus use, a 13 percent increase in cycling, a 30 percent decrease in driving, and an 18 percent increase in carpooling. In 2015, walking and driving alone were the most common modes of travel for non-work trips, but in 2016, walking and carpooling were the most common. Overall, fewer people are driving and walking or biking. This indicates that people are likely staying closer to their own neighborhoods for non-work trips as opposed to driving to neighborhoods that are farther away. Several interview respondents indicated this to be the case, and my own general observations and conversations with people from around Seattle indicate that increased traffic and congestion have caused people to travel less between neighborhoods. Although not included as a distinct mode of transportation in the survey, the use of ridesharing likely contributes to the increase in carpooling as a mode of transportation for non-work trips, especially when those trips are outside a person's neighborhood.

In the urban core, walking and light rail use have increased, while all types of bus use and driving have decreased (Table 6.12). Walking as a mode for non-work trips has increased nearly 30 percent, while driving alone has decreased 35 percent and carpooling has decreased nearly 20 percent. Light rail use has increased from zero percent of non-work trips to roughly 3 percent of non-work trips, indicating that it is not widely used as a mode of transportation for non-work trips. Walking and driving have increased and decreased respectively for the same reasons among urban core residents as non-urban core residents. It is likely that more people are staying in their own neighborhoods and choosing to walk, over driving to other neighborhoods. Likewise, parking within the urban core is more challenging, with more people in the neighborhoods, and expensive, which has made driving to a destination within your own neighborhood within the urban core less appealing. This still happens in the neighborhoods where parking is more readily available, such as 15th Avenue in Capitol Hill or Lower Queen Anne, but overall, less availability of parking, or at least a perceived lack of parking, has encouraged more people to choose walking over driving. Likewise, newcomers to the city who choose to live in the urban core, soon realize that driving on a daily basis is not necessary.

Table 6.13. Reasons for changes in travel behavior between 2015 and 2016 in Seattle, the urban core, and non-urban core residents.

	Seattle (N=89)	**Urban Core (N=61)**	**Non-Urban Core (N=28)**
Started a new job	**27**	18	**9**
Moved to a new neighborhood	**26**	16	**10**
New public transit options became available in my neighborhood	23	**19**	4
Moved to a new city	21	17	4
No longer wanted to drive	16	10	6
It is cheaper to use public transportation	10	6	4

Out of the 249 total survey respondents, 89 people indicated that they changed their primary mode of transportation for either work or non-work travel. Table 6.13 shows the most common reasons for changing their primary mode of transportation and respondents were able to choose more than one reason. Citywide, starting a new job and moving to a new neighborhood were the most common reasons for changing their primary mode of transportation. Respondents in the urban core indicated that new public transit options were the primary reason for their new travel behavior, and 61 out of the 89 total respondents who indicated that they changed their travel behavior live in the urban core. Starting a new job and moving to a new city closely follow as reasons for new travel behavior. Since the urban core is the fastest growing area of Seattle, this is where many new residents live when they first arrive to the city, and although many of these people have cars when they move to Seattle, they soon realize that they do not necessarily need their cars to get to work or for non-work travel.

Among those who live outside the urban core, 28 of the 89 respondents who indicated they changed their travel behavior, the most common reasons for new travel behavior were moving to a new neighborhood and starting a new job. Some of these people moved to neighborhoods that enabled them to more easily walk and utilize transit, while others moved to neighborhoods that were closer to where they work, even if this meant they could no longer walk or use transit as easily.

The fact that moving to a new neighborhood and starting a new job heavily influenced changes in travel behavior among both non-urban core and urban core residents, highlights three things. First, that neighborhood form makes a difference in travel behavior, which has been shown by copious amounts of research. Second, is the need to link neighborhoods with transit to each other and not just to an urban center. Seattle too often emphasizes linking outlying neighborhoods to the urban core, without as much consideration of connecting outlying neighborhoods to other neighborhoods. This results in the inability of people to get to work or other destinations effectively by walking or transit.

The third thing this highlights is the housing choices that people make based on a combination of priorities. In interviews, many urban core residents pointed to the importance of being able to walk and live in a place where they did not need to drive frequently as why they live in the urban core. In one extreme case, one interviewee moved from an exurban town where both he and his wife commuted over an hour by car each day to a condo in a Downtown high-rise, where his wife now walks five blocks to work and he uses the company shuttle to commute 30 to 45 minutes to work. Both now enjoy more free time and although they still have two cars, they have considered not replacing one when the time comes. Currently the interviewee often drives to work on Mondays, leaves the car at his place of employment curing the week to use in his suburban work location, and drives it home on. Other interview respondents indicated that while they would like to walk or use transit, other factors were limiting their ability to do so, such as cost of housing, having a family,

Looking at future travel behavior and transit's influence on travel behavior in the next 12 months, 53 of the 249 survey respondents indicated that they would like to or plan to change their travel behavior. Two things stand out. First is that for work travel, people generally would like to drive less. This is the most common reason for wanting to change work-related travel behavior among both urban core residents and non-urban core residents. Among those outside the urban core, wanting to bike more often is the second most common reason, while wanting to walk more and use the bus more are the second most common reasons for those who live in the urban core. The second thing that stands out is that for non-work travel, a majority of people would like to walk more. This is the most cited way that people want to change their travel behavior for both urban core and non-urban core residents. For those in the urban core, using the bus and riding LINK light rail are the next most common ways that people would like to change their non-work travel behavior. The increased desire to use LINK is a reflection of its new availability in the Capitol Hill neighborhood. Among those who live outside the urban core, biking more often is the second most common way people would like to change their travel behavior.

When we look at the reasons people want to change their travel behavior, for either work or non-work travel, we see a number of common answers. The three most common reasons given for planning to change travel behavior include health, traffic, and the environment. Overall, survey respondents would prefer to walk or bike because they feel healthier when they do. They are able to get exercise while commuting to work or going to the store, negating the need to set aside other time for exercising, which allows more time for other activities. Traffic congestion is the next most cited reason people would like to change their travel behavior. People would like to avoid the hassle and stress of sitting in traffic and increased traffic in Seattle has made other options much more appealing. The third most cited reason for wanting to change travel behavior is a concern for the environment. Driving less contributes to a lower carbon footprint, and this is something that many people in Seattle are aware of and are actively trying to reduce how much they drive, or want to even if they are currently unable to. Other commonly cited reasons for wanting to change travel behaviors include the high cost of driving, parking, and generally wanting to spend less time in a car.

In summary, the availability of transit through Seattle has had an impact on changing travel behaviors. Throughout the city, there has been an increase in walking as a primary mode of transportation for both work and non-work trips. This increase is particularly high among urban core residents. In the urban core, there has been a sharp increase in light rail use, which is a result of the large proportion of respondents in the Capitol Hill neighborhood where the new light rail station opened in March 2016. Along with this increase in light rail use, there has been a drop in local bus use among the same group. This indicates that many people have chosen to switch from local bus to light rail because it is a faster mode of transportation. It also has the added benefit of encouraging more people to walk farther distances to transit. Overall, Seattle residents are walking more, biking more, and using more rapid forms of transit over traditional local bus service and driving. These trends are likely to continue in the future as more rapid transit options become available in other neighborhoods in the city and around the region in the next several years. People in Seattle are aware of the health and environmental benefits of active transportation and many people have shown an interest in switching to walking and biking for just these reasons. However, there are also strong disincentives to driving that people are also very aware of – traffic congestion, cost and availability of parking, the cost of owning a car, and the stress associated with driving in traffic and dealing with other drivers. Each of these entices people to make the switch from driving, and as more people move to the Seattle region, traffic, parking and the associated hassles are going to get worse before they get better.

Conclusion

In this chapter, I have examined how pedestrian, transit and automobile infrastructure influences both walking behavior and transit use. Pedestrian infrastructure explains a significant proportion of walking behavior at the block scale, with sidewalk widths, the number of destinations and the number of trees on a block being significant variables. Transit infrastructure alone explains less than half of the variation in walking, as does automobile infrastructure. Altogether, these infrastructure variables explain about 60 percent of the variation in walking. The sidewalk width is a particularly important one since this is something that planners and engineers have control over when planning and designing streets. It indicates that sidewalk space possibly operates in much the same way that freeway capacity does for cars, or with protected bicycle infrastructure – with an induced demand. In other words, the more space there is for pedestrians, the more pedestrians there are likely to be. Obviously, surrounding uses contribute to this, as is indicated by the number of destinations also being a significant contributor. Broader neighborhood features, such as land use and density act as a pre-condition to walking. If these do not support walking, wider sidewalks, more trees and destinations will have little impact. Providing ample pedestrian infrastructure, while at the same time minimizing automobile infrastructure, and providing transit infrastructure in an appropriate and common sense manner is the key for a walkable urban environment.

Transit use, like pedestrian activity, is most significantly influenced by its corresponding infrastructure. The overall availability of transit is by far the most significant indicator of the number of transit users. This means that the higher availability of transit there is on any given block, the more transit users on that block. Although transit mode was not accounted for in this analysis, more transit users are present in locations where light rail is available. And in lieu of light rail, other modes of rapid transit, such as Rapid Ride, attract more transit users. This indicates that while access to more transit is a variable, it is not only access to transit, but to a specific type of transit that makes the biggest impact on the number of transit users – transit that is fast and more reliable. Supportive infrastructure, such as seating or shelters are significant indicators of transit users, but less so than the overall availability of transit. While these elements make using transit more attractive, people are likely not basing their use of transit on these factors. Likewise, they are likely not using transit because the urban environment in the urban core provide able pedestrian infrastructure. Pedestrian infrastructure contributes minimally to transit use – only sidewalk width has a significant and positive correlation to the number of transit users on a block. This shows that people in the urban core use transit despite the fact that the urban environment is not as pedestrian oriented as it could.

I have also examined the role of transit in changing travel behaviors between 2015 and 2016, as well as anticipated travel behavior changes in the future. In general, there has been a large increase in the amount of walking and biking that people around the city are doing, for both work and non-work related travel. In the urban core, this increase in walking is more striking. Urban core residents are also using local bus service less, in favor of new rapid transit options in the form of light rail in Capitol Hill, which opened in Spring 2016. This also means that urban core residents are likely walking farther distances to get to transit than they were before, accounting for some of the increase in walking. This is because light rail is a more reliable, convenient and faster mode of transit. In addition, several bus routes changed routes and no longer serve the same areas, a move by King County Metro to encourage more people to use Link light rail. These trends towards more walking, cycling and switching to more rapid modes of transit is likely to continue. People throughout Seattle recognize that active modes of transportation are better for their health, that driving less is better for the environment, and that exclusively driving is associated with high costs and high stress and frustration from dealing with traffic congestion and parking. These factors will lead Seattle residents to continue to make the switch to transit for work trips, and a range of other modes for non-work trips. As the city expands its network of rapid transit in the form of Link light rail, Rapid Ride, and new bus rapid transit, more residents will utilize these modes of transit and walk more.

Chapter 7

Results Part III: Resident Perspectives on Walking and Transit Use

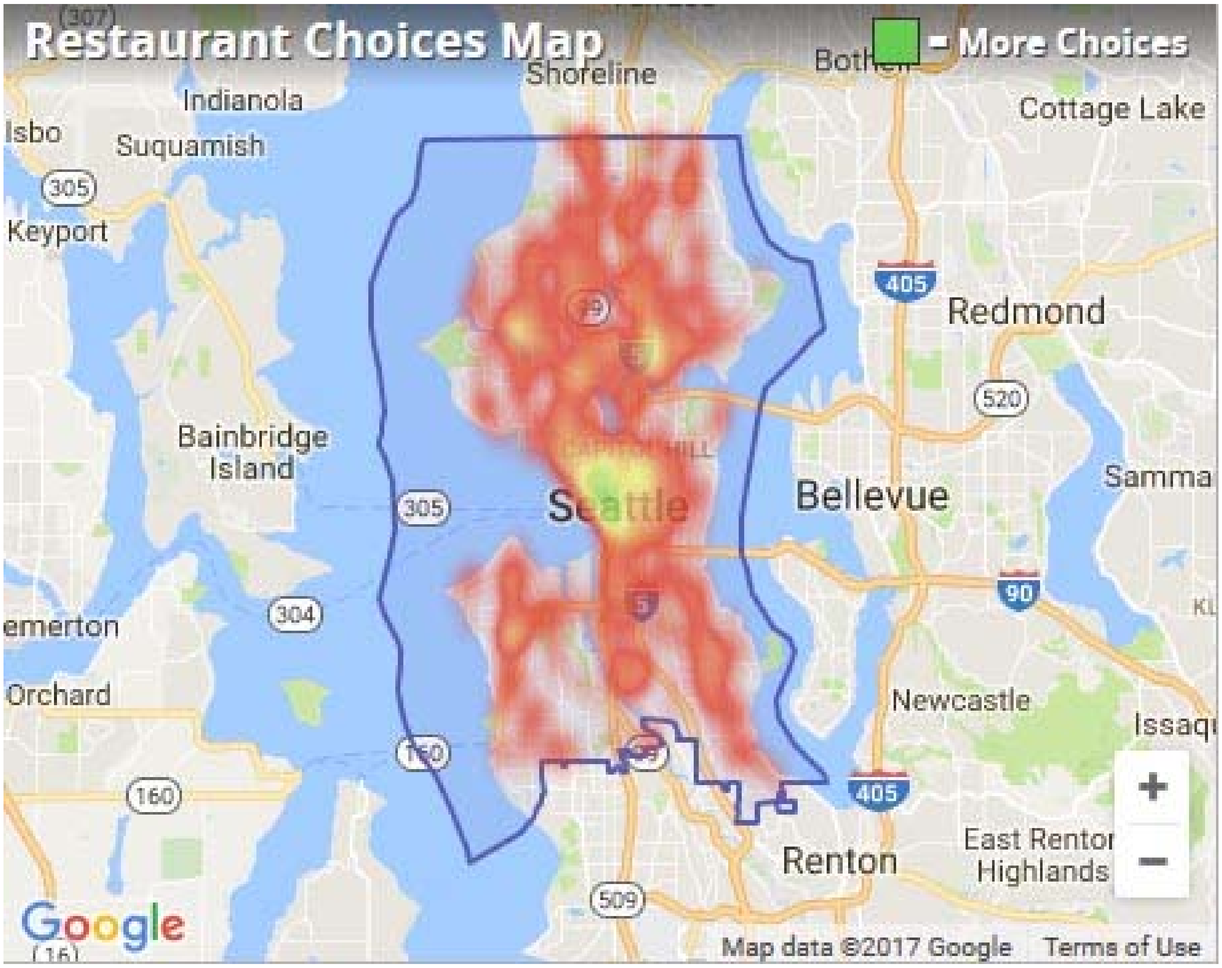
This chapter addresses the final two research sub-questions. These questions deal with how residents in Seattle evaluate the urban environment. First, I present findings about the perceived barriers and enablers for walking and transit use. Second, I look how residents rate the physical and social aspects of the urban core and its neighborhoods and what characteristics contribute to their satisfaction, especially in terms of walking and transit use. With these two questions, there is a fine line as to whether something acts as an enabler of walking or transit use, or whether it contributes to increased satisfaction. In many cases, there is quite a bit of overlap between the two.

Enablers and Barriers to Transit Use and Walking

Relevant Research Question: What are the perceived enablers or barriers to transit use and walking?

Destinations within walking distance are perhaps the most important enabler of walking behavior identified through the course of this research. Overall, 70 percent of survey respondents indicate that they “walk frequently because there are places in their neighborhoods to walk to”. Among those who live in the urban core, 81 percent strongly agree with this statement, while an additional 14 percent agree with it. Among those who live outside the urban core, this drops to 52 percent who strongly agree and 30 percent who agree. This indicates that a portion of the variation in walking between urban core and non-urban core residents is the mere presence of places to walk to.

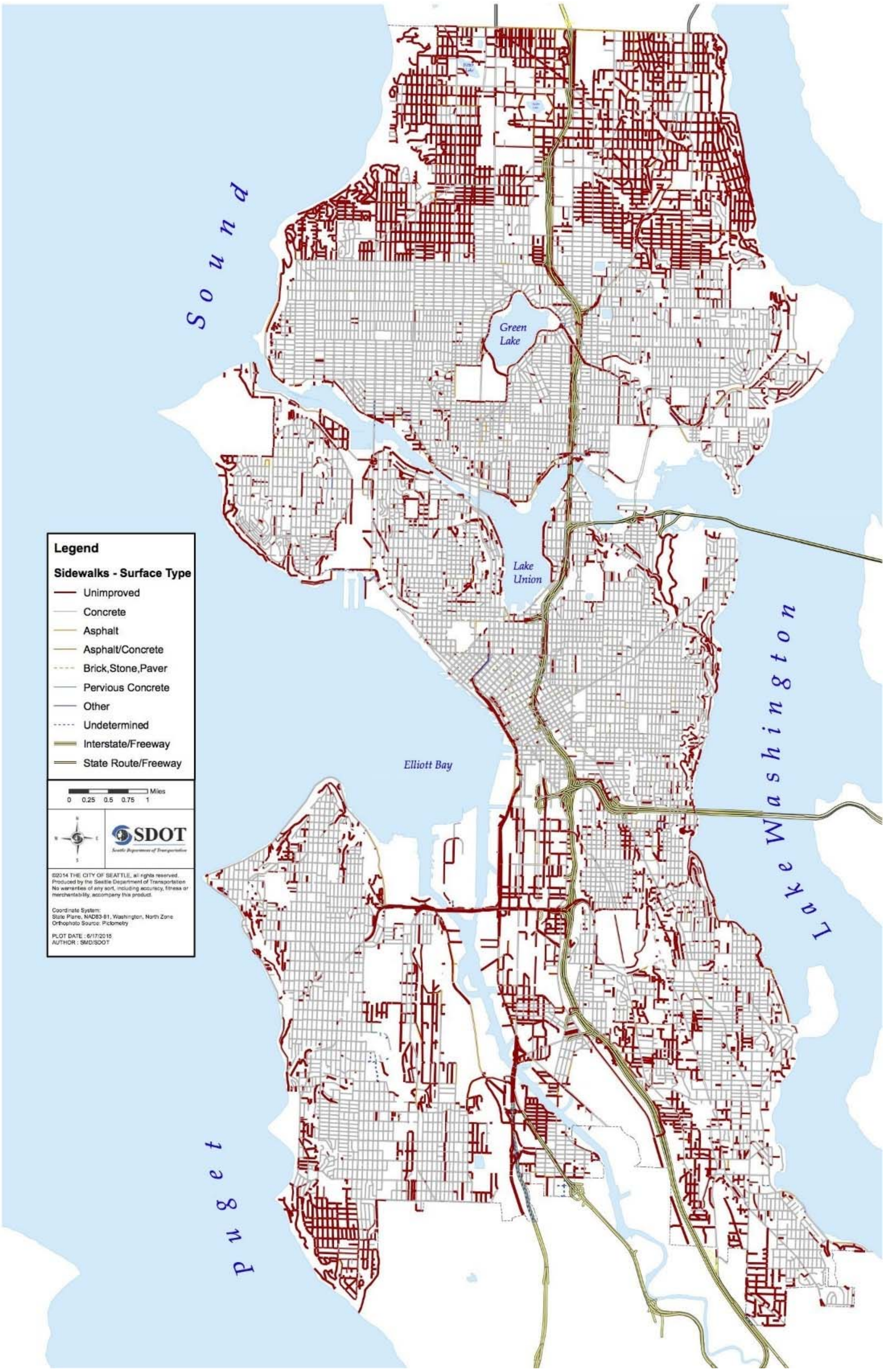
Figure 7.1. Restaurant choices map (Walk Score 2017).



In Chapter 6, an analysis of general travel behavior also shows that the role of destinations for walking is vitally important. In that chapter, I showed that urban core residents primarily reply on walking to all types of destinations, while non-urban core residents drive more than walk, even though there are a few types of destinations they primarily walk to, such as parks and coffee shops. Combined with knowing that people outside the urban core walk because there are destinations less than those in the urban core, indicates two things. First, destinations in these outlying neighborhoods are not necessarily within walking distance. Second, that these outlying neighborhoods have fewer destinations altogether. Figure 7.1 highlights this point by showing the number of restaurants throughout Seattle, which shows a high concentration in the urban core, and a few outlying neighborhoods, but overall, restaurant destinations are less available in outlying neighborhoods. When asked if they would walk more if everything they needed on a daily basis was within a 10-minute walk, residents generally agreed with this. Those outside the urban core agreed with this more, indicating that currently these neighborhoods do not provide everything people need on a daily basis within a 10-minute walk.

The physical environment is important as an enabler of walking. The presence of sidewalks and the condition are two factors that people frequently indicate as being important. Beyond these two basic criteria, survey and interview respondents rarely pointed to more aesthetic qualities of the street space or amenities as a barrier to walking, but these do play a huge role in the pleasurability of the pedestrian environment, which I discuss in the next section. An inventory of sidewalks in Seattle completed for the Pedestrian Master Plan shows that 28 percent of blocks in the city have no sidewalks (SDOT 2017a), shown in Figure 7.2. in 2016, SDOT also conducted a survey of all sidewalks in each urban center and urban village in order to assess where to prioritize investments in repairing sidewalks (SDOT 2017e). Both of these are important to improve walkability throughout the city, as many areas outside the urban core are missing sidewalks, and many areas within the urban core are in poor condition. Overall, 69 percent of urban core residents and 64 percent of non-urban core residents agree or strongly agree that sidewalks in their neighborhoods are well maintained. With these two factors, it is no wonder that the physical space of the sidewalk ranks high as an enabler to walking. However, it is also important to note, that people still walk despite less than ideal sidewalk conditions or absence of sidewalks altogether. Older age groups, 55 and over, typically see more need for an improved pedestrian environment, which is not a surprising finding. At the same time, however, older age groups do not necessarily think investments will make it more appealing to walk. This indicates that the physical environment is more of a barrier for older individuals than others, which makes sense given the potential for increased mobility issues as people age. This makes it all the more important to provide basic infrastructure that is well maintained and suitable for all age groups.

Figure 7.2. Missing sidewalks in Seattle, shown in red.



Transit is an enabler of walking in multiple ways. First, transit enables walking as a specific type of destination. At a basic level, every transit user is also a pedestrian. In general, Seattle residents use transit because it is within walking distance to where they live. For those who live outside the urban core, a lower percentage of respondents indicated that they use public transit because it is within walking distance – indicating that they either do not use it because it is not accessible on foot, or that they walk farther distances to access it than people in the urban core. The second way that transit enables walking is by its mode. Light rail transit encourages people to walk farther to it because it is a superior mode of transit. In general, 69 percent of Seattle residents indicate that they would walk farther distances to use light rail instead of bus. There is no discernible difference between urban core and non-urban core residents in this regard. This means that people are willing to walk farther in neighborhoods that already have light rail and those that do not. This points to the fact that when new light rail stations in Seattle open in 2021 and 2023, that more people will be walking farther to use it over buses. The third way that transit induces walking is by its absence and happens almost exclusively in the urban core. Most interview respondents indicates that when they are in the urban core, they typically only use transit "if it is coming". Because the walking distances are typically shorter, people often highlight the fact that they could walk to their destination faster than if they waited for the bus and rode it. This seems to hold true for nearly any trip under one mile, or about a 20 minute walk. It is true of urban core residents as well as those who only work in the core and frequently go to other places within the urban core throughout the workday. However, if a bus or streetcar happens to be pulling up when they are outside, the likelihood of not walking and using the transit increase because there is no wait time.

Automobile traffic is not a barrier to walking per se, nor is it an enabler. It is a much more aesthetic element of the built environment, which I discuss in the next section. However, it is worth mentioning here in conjunction with safety – particularly in relation street crossings. Street crossings were another aspect of the physical environment that were frequently mentioned in interviews that can act as an enabler or barrier of walking – and especially to safe walking. Crossings that provide a safe and comfortable way to cross the street enable people to walk with more ease and feel safer doing so. Many intersections throughout the urban core were identified by interviewees as being more unsafe than not and are places where people have encountered issues crossing. These tend to be busy intersections with the most amount of car traffic, particularly in the Downtown commercial core, South Lake Union, First Hill, and a few places in Capitol Hill. This does not mean that they avoid these place, but that they are more cautious when they do so. This is because even though they are less than ideal places to be walking, people walk in the most direct route possible when they have a specific destination in mind. Because of this, there often is not a significant effort to avoid places that are less safe, but merely an increased effort to be aware of ones surroundings.

This brings up the issue of conflicts between modes of transportation, which acts as a barrier to both walking and transit use. As mentioned above, people tend to feel less safe in places where automobile traffic is high. But they also avoid (or dislike) places where there is a lot of bus traffic, such as the 3rd Avenue transit corridor in Downtown and Belltown. The Seattle Streetcar was also cited numerous times as being a point of conflict between modes. More often cyclists avoid the places where the streetcar runs because there have been numerous incidents with bike tired getting caught in the tracks and causing an accident. A few interview respondents also indicated that they avoid walking in the places where the streetcar runs because it feels less safe now than before. This is particularly the case where the streetcar runs directly on the curb, removing nearly all barriers between people on the sidewalk and the traffic on the street. Cyclists also indicate that they avoid some of the city's protected bicycle infrastructure. Sometimes this is because there are better places to bike that have less car traffic and other times it is an issue with the topography of Seattle or the person's destination is not close to the protected bike lane. But often cyclists cited too much car traffic and inattentive or distracted drivers who turn in front of a bike lane and are not looking for cyclists. Pedestrians, more than not, see car traffic not so much as an enabler or barrier to walking, but rather as an aesthetic quality. Places with less traffic not only feel safer, but are also more pleasant.

Whereas walking is more a function of the physical environment and its qualities, transit use is more a function of the transit system as a whole. One of the things to point out right away is that while planners would look at Seattle's public transit system, comprised of bus, streetcars, and light rail, and call it a successful multimodal network, residents more often than not see this as three separate modes of transportation, each one serving different purposes. While some trips cannot be completed without switching between modes, this seems to be something that people tend to avoid. In some cases this is because transfers between modes are not easy or efficient, but more often than not, it is because transfers of any sort discourage people from using transit. Several key characteristics of the transit system act as both enablers and barriers to transit use, which I discuss below. These include the modes available, trip time, transfers, destination access, reliability, and ease of use.

As with walking, destinations are a key deciding factor in determining whether someone will use transit or not use transit. More often than not, a person is not deciding between walking and transit, but between transit and driving. As we have seen, even people who own cars and live in non-urban core neighborhoods frequently walk. But they use the bus much less often, especially for non-work trips. Work destinations are very likely to be accessible by transit because of the way the transit system has been developed over the last 25 years to encourage people to use transit instead of driving to work. And for this goal, it has worked. However, the transit system does not work so well for destinations that are not within walking distance and are not work related. And for this reason, people in all parts of the city still drive. This helps explains why, as we saw in Chapter 6, driving is the second most common mode of transportation next to walking among urban core residents. Some specific neighborhoods emerged as being particularly inaccessible by transit and places where people would use transit to get to if it was a better option, such as West Seattle and Ballard. Other destinations that were most cited as being inaccessible by transit were the city's numerous parks, often along Puget Sound or Lake Washington. These parks offer a refuge from the city for many residents, and yet they cannot get there without driving. In a couple cases, interview respondents cited this as being one of the only reasons they still had a car, and would gladly give it up if they could use transit to get to these parks.

The mode of transit used is itself an enabler of transit use. Light rail is by far the more preferred mode of transit among all interview respondents. This is because it offers a more reliable service and is typically faster than bus transit since it does not get stuck in traffic. Car owners in Seattle are much more likely to use transit when light rail is an option over bus, and are more willing to walk farther distances to use it than people without cars are. While many interview respondents indicated that any transit system that provided a dedicated right of way would be ideal, they often acknowledged that light rail would be preferred over bus, even if both had dedicated lanes, especially if it was completely separated from street level either elevated or underground. In either case, light rail is more likely to get existing non-transit users to use transit over driving.

Time is a key characteristic of the transit network. In general, buses in Seattle operate as a speed of 9.7 miles per hour, compared to the average driving speed of 28 miles per hours (during non-peak times). This means that transit, on average takes 3.1 times longer than driving. Many interview respondents indicated that this was an acceptable ratio. This makes sense, since this ratio also varies greatly between peak and non-peak travel. With traffic congestion during peak times, the ratio of bus travel time versus driving is much closer. This likely explains the fact that among survey respondents 44 percent of people agree or strongly agree that they use transit because it takes the same time or less than driving. This compares to 36 percent who disagree or strongly disagree.

Time also plays a role in transit use in two additional ways: in transfers and in reliability, both of which are somewhat related. While many people indicate that they use transit because it is not significantly longer than driving, the issue of reliability was one of the most significant factors in transit use behavior. Most of the transit system in Seattle is bus-based, which means it is subject to and vulnerable to the same traffic that an automobile trip is. This can make travel by bus somewhat unreliable, in that if a bus is delayed, a person's arrival at their destination will be delayed, and when people need to be to work at a certain time, this uncertainty is a significant barrier to using transit. Add to this the quality of transfers and the reliability becomes even more questionable. If a person's first bus is delayed even a few minutes, they are likely to miss their connecting bus and need to way anywhere between 10 and 15 more minutes, assuming that bus is also not delayed. In average, to get from any neighborhood in Seattle to any other neighborhood, there are 1.6 transfers. For people going to downtown, there are often no transfers. This in and of itself helps explain why so many people do use transit when they work downtown – because they only need to get on one bus to get there. But when work (or non-work trips) are not downtown, the trip often requires a transfers (although almost never two transfers unless the destination is farther out in the suburbs).

Because of this unreliability in bus service, many people have switched from using transit to cycling – both to work, and for non-work travel. Many interview respondents indicated that by cycling, they were able to get to work in a certain amount of time without the potential for any delays, and that this often took as long as their previous transit trip. Many people commute to Downtown by bike from West Seattle, Ballard, the University District, and even North Seattle. Travel by bike is also common between the urban core and non-urban core neighborhoods. Biking figures prominently in the survey and interviews as a mode of transport because one of the email lists that it went to was for Seattle Neighborhood Greenways, an advocacy group for bike infrastructure and pedestrian improvements. This group comprised about 20 percent of survey respondents, but one of the only things that differentiates them from the rest of the sample is that cycling is the primary mode of 40 percent of them, versus only 8 percent for the rest of respondents. Among this group, cycling replaces walking, driving and bus trips. In many regards, they do not vary greatly from the rest of the survey respondents. Among interviewees who incorporate cycling into their regular travel, this same pattern of replacing transit with bike trips was very evident. Typically transit would only be used in inclement weather or one-off occasions. Several of these interviewees also indicated that they would likely bike less if public transit was better – in that it went the places they needed it to and did so in a reliable and efficient way. This indicates that while many people do bike for the sake of biking, an equal number bike because the existing transit system does not work well for them – its fundamental characteristics are a barrier to its use.

Ease of use of the transit system comes into play in two main ways. First is its ease of access for elderly and people with disabilities. Several older interview respondents talked about how transit just was not a feasible option for them. Many of the buses in Seattle (older buses) still have large steps to get on and off, as opposed to the newer walk-on buses. Additionally, the simple act of waiting for a bus, especially at bus stops with no seating or in the rain with no shelter, proved a challenge for older interview participants. With these reasons, it is not surprising to find that over 65 survey respondents have the highest rate of driving as their primary mode of transportation at 52 percent.

At the other extreme, interviews indicated that transit does not work well with families with small children. Using transit with children takes more planning and coordinating. For a couple interview participants, this was a significant barrier to using transit. They cited the unpredictable needs of children. And the fact that strollers on buses often do not work. In one unfortunate instance, an interviewee recounted how the bus driver made her hold her young son and fold up the stroller or he would not allow her on the bus at all. Encounters such as this often create a long-term deterrent from using transit. This plus the comparative ease of having a car available to cart around children, provides an ample barrier to transit use. Interviewees did concede that using the light rail was often easier, but even so, it was not often their first choice for making a trip when they also had a car available.

Neighborhood Satisfaction and Walkability

Relevant Research Question: How do users evaluate the physical and social aspects of each neighborhood; and what specific qualities are most important to their satisfaction in terms of walking and/or transit use?

In the same ways that traffic acts as a barrier to walking, or the absence of traffic an enabler of walking, it is one of the most widely cited factors that contribute to how much a neighborhood is liked as a pedestrian. Other elements of the built environment that contribute to a positive or negative walking experience include sidewalks, buildings and destinations, and greenery. Another element discussed frequently in the survey and interview is the presence of people, or lack of people. The types of people that are found in each neighborhood contribute to whether people like to dislike these neighborhoods.

Figure 7.3. Urban core map composite showing walking areas that are liked (green) and disliked (red). Darker shades indicate higher levels of like or dislike.

Table 7.1. Seattle neighborhoods and places most liked for walking.

Rank	Neighborhood	Vote	Rank	Neighborhood	Vote
1	**Capitol Hill**	171	**39**	Burke-Gilman Trail	2
2	**Downtown**	90	**40**	Discovery Park	2
3	Ballard	44	**41**	Hillman City	2
4	Fremont	42	**42**	Jackson Park	2
5	Green Lake	32	**43**	Linden Trail	2
6	**First Hill**	26	**44**	Madison Valley	2
7	Central District	25	**45**	Sand Point	2
8	Queen Anne	25	**46**	Squire Park	2
9	University District	24	**47**	The Arboretum	2
10	**Pioneer Square**	23	**48**	West Woodland	2
11	**Belltown**	21	**49**	Blue Ridge	1
12	**South Lake Union**	20	**50**	**Denny Triangle**	1
13	Wallingford	17	**51**	Gatewood	1
14	West Seattle	17	**52**	Golden Gardens	1
15	Greenwood	13	**53**	Hawthorne Hill	1
16	Columbia City	11	**54**	High Point	1
17	Madison Park	11	**55**	Interurban Trail	1
18	**International District**	10	**56**	Lake City	1
19	Ravenna	10	**57**	Laurelhurst	1
20	Magnolia	9	**58**	Lincoln Park	1
21	Phinney Ridge	9	**59**	Loyal Heights	1
22	**Lower Queen Anne**	7	**60**	Maple Leaf	1
23	Seward Park	7	**61**	Myrtle Edward	1
24	Alki	6	**62**	New Holly	1
25	Montlake	6	**63**	Pinehurst	1
26	Beacon Hill	5	**64**	Rainier Beach	1
27	Leschi	5	**65**	Seattle Center	1
28	Roosevelt	5	**66**	Seattle University	1
29	Eastlake	4	**67**	Shilshole	1
30	Madrona	4	**68**	SODO	1
31	Waterfront	4	**69**	South Park	1
32	Bryant	3	**70**	Sunrise Heights	1
33	Georgetown	3	**71**	View Ridge	1
34	Mount Baker	3	**72**	Windermere	1
35	Northgate	3			
36	Pike Place Market	3			
37	Wedgwood	3			
38	Broadview	2			

Table 7.2. Seattle neighborhoods and place least liked for walking.

Rank	Neighborhood	Vote	Rank	Neighborhood	Vote
1	**Downtown**	75	**39**	Yesler Terrace	2
2	SODO	54	**40**	Airport Way	1
3	Rainier Valley	32	**41**	Alki	1
4	**Capitol Hill**	31	**42**	Bitterlake	1
5	University District	25	**43**	Eastlake	1
6	**International District**	24	**44**	Fairmount	1
7	**South Lake Union**	24	**45**	Gatewood	1
8	**Pioneer Square**	23	**46**	Highland Park	1
9	**Belltown**	22	**47**	Judkins Park	1
10	Aurora Avenue N	18	**48**	Laurelhurst	1
11	Ballard	18	**49**	Licton Springs	1
12	West Seattle	17	**50**	Lincoln Park	1
13	Northgate	14	**51**	Maple Leaf	1
14	**First Hill**	13	**52**	Mount Baker	1
15	Lake City	13	**53**	Montlake Blvd	1
16	Beacon Hill	12	**54**	North Beach	1
17	Magnolia	12	**55**	Puget Ridge	1
18	Central District	10	**56**	Ravenna	1
19	**Denny Triangle**	9	**57**	Roosevelt	1
20	North Seattle	8	**58**	Seattle Center	1
21	Georgetown	6	**59**	South Park	1
22	Greenwood	6	**60**	Wedgewood	1
23	Queen Anne	6	**61**	Westlake	1
24	Fremont	5	**62**	Windermere	1
25	South Seattle	5			
26	Crown Hill	4			
27	Interbay	4			
28	North Delridge	3			
29	**Lower Queen Anne**	3			
30	Wallingford	3			
31	Broadview	2			
32	Columbia City	2			
33	Green Lake	2			
34	Haller Lake	2			
35	Madison Park	2			
36	Madrona	2			
37	Sand Point	2			
38	Waterfront	2			

In the urban core, several places emerge as places where people like walking, while others emerge as places people tend to dislike, shown in Figure 7.3. One of the key differences between the two types of places are the levels of car traffic and places where conflicts between pedestrians and other modes (cars, buses, and bikes) occur. Places that are particularly disliked for walking include areas of Downtown, especially on 2nd and 3rd Avenues, the I-5 overpasses and underpasses, Denny Way west of I-5, Mercer Street in South Lake Union, and Broadway in First Hill. These are all places with higher amounts of traffic and are more car oriented than pedestrian oriented. Survey and interview participants often cite the noise and fumes from the automobile traffic as a major factor in what makes these areas unpleasant. Throughout the city, the same holds true looking at how much people like or dislike walking in neighborhoods. While the absence of traffic is almost never explicitly listed as a reason for liking a neighborhood, the presence of traffic is often a key determinant of whether people dislike walking in any given neighborhoods. The neighborhoods that are disliked are cited as having many cars, being designed for cars, unsafe due to cars and traffic, noisy streets, and having 'crazy drivers'.

In terms of places in the urban core where people like walking, they have two main qualities: being retail shopping areas, or quiet residential streets with lots of greenery in the form of street trees, landscaping or parks. In survey responses, people indicated that they like neighborhoods with a variety of destinations for walking. Retail shopping and restaurants serve as one of the most cited destinations that make for an enjoyable walking environment. Parks are another. In the urban core, areas such as Pike Place Market, 1st Avenue in Pioneer Square and in Belltown, Broadway and 15th Avenue in Capitol Hill, Pike-Pine corridor in both Downtown and Capitol Hill were identified as some of the most liked areas for walking. Parks around the urban center also provide pleasant walking environments, such as Cal Anderson Park in Capitol Hill, Denny Park in South Lake Union, or the Olympic Sculpture Park and Myrtle Edwards Park along the Puget Sound near Belltown. Seattle University and the Seattle Center (Space Needle) also offer enjoyable places to walk and offer several blocks each where there are no cars. People enjoy these areas because there are small and interesting storefronts, a variety of types of destinations, and they are scaled more for walking.

The physical environment also places a role in the level of satisfaction gained from walking in different neighborhoods. This is evident in two ways: sidewalks and buildings. Sidewalks can both positively or negatively affect neighborhood satisfaction. Many people indicated that neighborhoods where they like to walk had clean and well maintained sidewalks, sidewalks that were wider than the standard six foot width, and provided landscaping and greenery. In neighborhoods that people disliked walking in, sidewalks were typically cited as being dirty, littered with garbage, and used needles. The lack of sidewalks and complete absence of sidewalks were also cited as being common in neighborhoods where people do not like walking.

Buildings also play an important role in neighborhood and walking satisfaction. Neighborhoods where people like to walk are cited as having interesting buildings, old homes, and architecture that is described as 'traditional', 'pretty', and 'beautiful'. A mix of buildings types and home types was also cited as a factors in neighborhoods where people like to walk. Architecture was not an important element of neighborhoods that people did not like walking in, and when it was cited, it was because it was 'bland', 'generic' and 'uninteresting'. In interviews, areas that were identified as places people liked walking because of their architecture where typically in Capitol Hill, with a few participants identifying places in Pioneer Square or Downtown. One of the most cited areas that people enjoyed leisurely walks in the urban core was the northeast part of Capitol Hill between Broadway and 15th Avenue. This area is a mostly residential area, with a mix of old and new buildings and architectural styles. It has a large proportion of old homes dating to the 1900-1920 period. These houses are almost all duplexes, three-plexes or four-plexes now, with a small number of single-family homes and newer townhomes mixed in. There are also a number of larger apartment buildings between three and four stories mixed in between smaller buildings. The streets are all lined with mature trees and many of the houses have well-maintained landscaping. It is interesting to note that this part of the neighborhood has the narrowest streets (59 foot right of ways versus the standard 66 feet), smaller blocks (200 feet wide versus the standard 256 feet), and smaller lots (25 and 50 foot frontages versus the standard 60 feet). These elements, along with interesting architecture, and greenery make it a well-liked area for walking.

People are another significant element in neighborhood satisfaction. The presence of people is generally something that people like in the neighborhoods they like to walk in. The presence of more people make the neighborhoods more enjoyable to be in. People watching is a commonly cited activity and reason why people like walking in certain neighborhoods. They also make people feel safer. More urban core residents indicated a greater sense of safety when walking in their neighborhoods (85 percent) compared to those who live in non-urban core neighborhoods (75 percent). This is interesting given the fact that the urban core is a higher crime area of Seattle compared to the rest of the city (Seattle Police Department 2017). But the fact that more people are in the urban core walking around at any given time contribute to an added sense of safety. Neighborhoods outside the urban core that people do not enjoy walking in were often cited as such because there are no people and no pedestrian presence on the streets. This, however, is in contrast to neighborhoods within the urban core that people dislike walking in. In the urban core neighborhoods that people dislike walking in, many survey and interview respondents cite the homeless population as a common element. Associated panhandling was identified my many as a deterrent to walking satisfaction in a neighborhood. Drug use among the homeless population was another deterrent in these neighborhoods, and is unfortunately a very visible problem within the urban core, evident in the people and in the litter found in many neighborhoods. Aside from the presence of a large homeless population, people also indicated that neighborhoods with noisy, unruly or rowdy groups were less pleasant to walk in, especially the Pike-Pine corridor in Capitol Hill on the weekend nights, and the University District. Both areas are nightlife centers that draw huge crowds on Friday and Saturday nights.

In looking at the rankings of the most liked and least liked neighborhoods for walking (Table 7.1 and 7.2), we see that many of the urban core neighborhoods fall into both categories. Capitol Hill is by far the most liked neighborhood for walking, but is also one of the least liked neighborhoods, though significantly fewer people dislike it than like it. Likewise, Pioneer Square is in the top ten on both lists, with an equal number of people liking the neighborhood as disliking it. Downtown tops the list as the least liked neighborhood for walking and is also the second most liked neighborhood for walking in. This highlights the highly subjective nature of neighborhood satisfaction and the characteristics that contribute to that. But in general, the most liked neighborhoods in Seattle are those that have a clear neighborhood feel to them, are more residential than not, and have a strong retail area within walking distance to a lot of people. The ten least liked neighborhoods tend to have a higher mix of uses, more commercial and office uses, and are much more oriented to car traffic than other neighborhoods throughout the city.

Conclusion

There is a lot of overlap between what is an enabler or barrier to walking and transit use with what makes a neighborhood pleasant or unpleasant to walk in. Destinations are most important for walking. The presence of places to walk to are a primary motivation for walking and walking for recreation or leisure in the city is much less common. Leisure walking is more specific to parks, on trails, in waterfront areas, or in natural areas. Having destinations within walking distance are therefore necessary for walkability. Likewise, people enjoy walking in places with a range of destinations – coffee shops, bars, restaurants, and a variety of retail stores.

Traffic is a significant factor in neighborhood satisfaction. Neighborhoods and specific streets within neighborhoods are typically disliked when they have too much traffic and emphasize automobile travel over pedestrian travel. While traffic is not a direct barrier to walking for most, the presence of traffic in many parts of the city, and especially in the urban core force pedestrians to be more aware of their surroundings. Interactions between a high volume of automobile traffic and pedestrians creates unsafe situations for both groups. Additionally, interactions between pedestrians, transit, and cyclists tend to be places that people dislike walking or avoid. And if not to avoid, the goal is often to minimize the number of interactions with other types of traffic.

The sidewalk and street space of a neighborhood are also enablers or barriers to walking as well as significant contributors to neighborhood and walking satisfaction. Poorly maintained sidewalks or the complete absence of sidewalks are a significant barrier to walking, especially for elderly individuals. Poorly maintained sidewalks also result in a less appealing walking environment, lowering overall neighborhood satisfaction. Sidewalks that are well maintained, lined with trees, incorporate greenery and nature, and safe enhance neighborhood satisfaction.

In terms of public transportation, it serves as an enabler of walking. All transit users typically walk to a transit stop, making them pedestrians by default. However, beyond this, light rail in Seattle, especially when grade separated, incentivizes people to walk farther to use it. It is a more reliable, faster and convenient mode of transportation, and thus people are willing to walk greater distances to use it. Likewise, in the urban core, the immediate absence of transit is an enabler of walking. If transit is not immediately available to use (with the exception of the light rail), a person in the urban core is much more likely to walk to their destination instead of waiting for transit. This is true whether buses are scheduled to arrive every 15 minutes or every 5 minutes. The distances between destinations in the urban core are short enough that transit between urban core destinations and between urban core neighborhoods is not necessarily the fastest way to get somewhere. This is directly a result of the fact that the urban core is a pedestrian oriented urban environment, even though it has a significant public transit presence and despite many parts of the urban core being more automobile oriented than not.

Chapter 8

Conclusion: Planning the Walking and Transit City in Seattle

Seattle is a city in transition – one that is automobile dependent to one that is transit oriented. This far in the dissertation, I have presented the specifics of my research findings in Chapters 5 to 7, but what are the implications of my research on current policy in Seattle? How do my findings relate to broader theories about urban form and transportation? In this chapter, I explore these questions in relationship to several of the projects in the Seattle urban core that affect walkability – some positively, some negatively – as well as a handful of transit projects currently under development. I begin the chapter with a summary of my key research findings.

Key Research Findings

This dissertation has explored the complex relationship between walking and transit by investigating the research question: *How does access to different types of transit affect quantity and quality of walking and street activity within and between different types of walkable urban neighborhoods?* Five key findings emerge from my research regarding the relationship between transit availability and its impact on walking in the Seattle urban core.

First is that transit is not a significant part of daily travel behavior among residents within the urban core. People who live in the urban core are predominantly pedestrians. Their next most common mode of transportation is driving, which they use more frequently than public transit. Additionally, despite frequently transit service in the urban core, residents will often walk rather than wait for a bus if their destinations are within the urban core, because it takes the same or less time to walk. In this way, despite its frequency, transit, or the perceived lack of transit, encourages people in the urban core to walk because it is the most efficient way to get somewhere. Likewise, transit service outside the urban core encourages people to drive rather than use transit. Transit service outside the core is more infrequent and less reliable due to delays from traffic and congestion, and outside non-peak times, it runs less frequently, making it a less appealing option. Additionally, the transit system heavily emphasizes travel into and out of the urban core and less on connecting neighborhood centers to one another outside the core, making driving a more viable option than transit.

The second finding is that public transit in the urban core primarily serves to facilitate commuting to work from throughout the Seattle region to jobs in the Downtown core and South Lake Union neighborhood just north of Downtown and home to several major tech companies, including Amazon. Nearly 50 percent of people who work in the urban core use transit to get to work. In this way, transit in the urban core facilitates a very large daytime population of people who are primarily pedestrians once they arrive here in the morning. However, it is important to note that driving to the urban core also facilitates this, as people who drive to work, generally park once and then walk between various destinations in the urban core throughout the workday.

Third, the levels of walking within the distinct urban core neighborhoods vary greatly. The D-variables common in planning research do not directly explain variations in walking levels between these neighborhoods. The D-variables include population and job density, diversity of land uses, design of the street network, destination accessibility, and distance to transit (Cervero and Kockelman 1997; Ewing and Cervero 2010; Campoli 2012). Each of the study neighborhoods has high densities, are served by transit, have well-connected street networks, have mixed-uses, and have destinations within close walking distances. The extent to which each neighborhoods maintains its traditional pedestrian urban fabric, or alternatively, the extent to which the automobile urban fabric has eroded the pedestrian urban fabric, explains a large amount of variation in walking. The elements specific to the transit urban fabric explain much less of the variation in walking than do the characteristics of the pedestrian urban fabric.

The fourth way that transit directly affects walking in the urban core is dependent on transit mode. Rail transit in the form of underground light rail has led to many people in the urban core walking greater distances to use this mode of transit over buses that are closer to where they live. This is because light rail offers a far superior transit service that is reliable, frequent, and comfortable. Another reason for this is that people tend to avoid transferring between different modes of transit, even if it means walking more. Residents in Seattle are very aware of the health benefits of walking, and see this as an opportunity for exercise during their daily travel routines.

Lastly, walking and neighborhood satisfaction in these urban core neighborhoods, and in fact around Seattle, are highly related to interactions with other types of transportation, especially automobiles. Streets with little car traffic and slower speeds tend to be more liked than busier streets. They are generally more pleasant and contribute to an added sense of safety. Additionally, streets that are tree lined, have a variety of destinations, and engaging architecture significantly increase walking satisfaction. These elements correspond to the pedestrian infrastructures that quantitatively show that streets with a more pedestrian focus have more pedestrians. This qualitative approach similarly revealed that these pedestrian oriented streets are preferred for walking on and contribute to neighborhood satisfaction. Public transit did not reveal itself as an important factor in overall neighborhood satisfaction within these walkable urban neighborhoods.

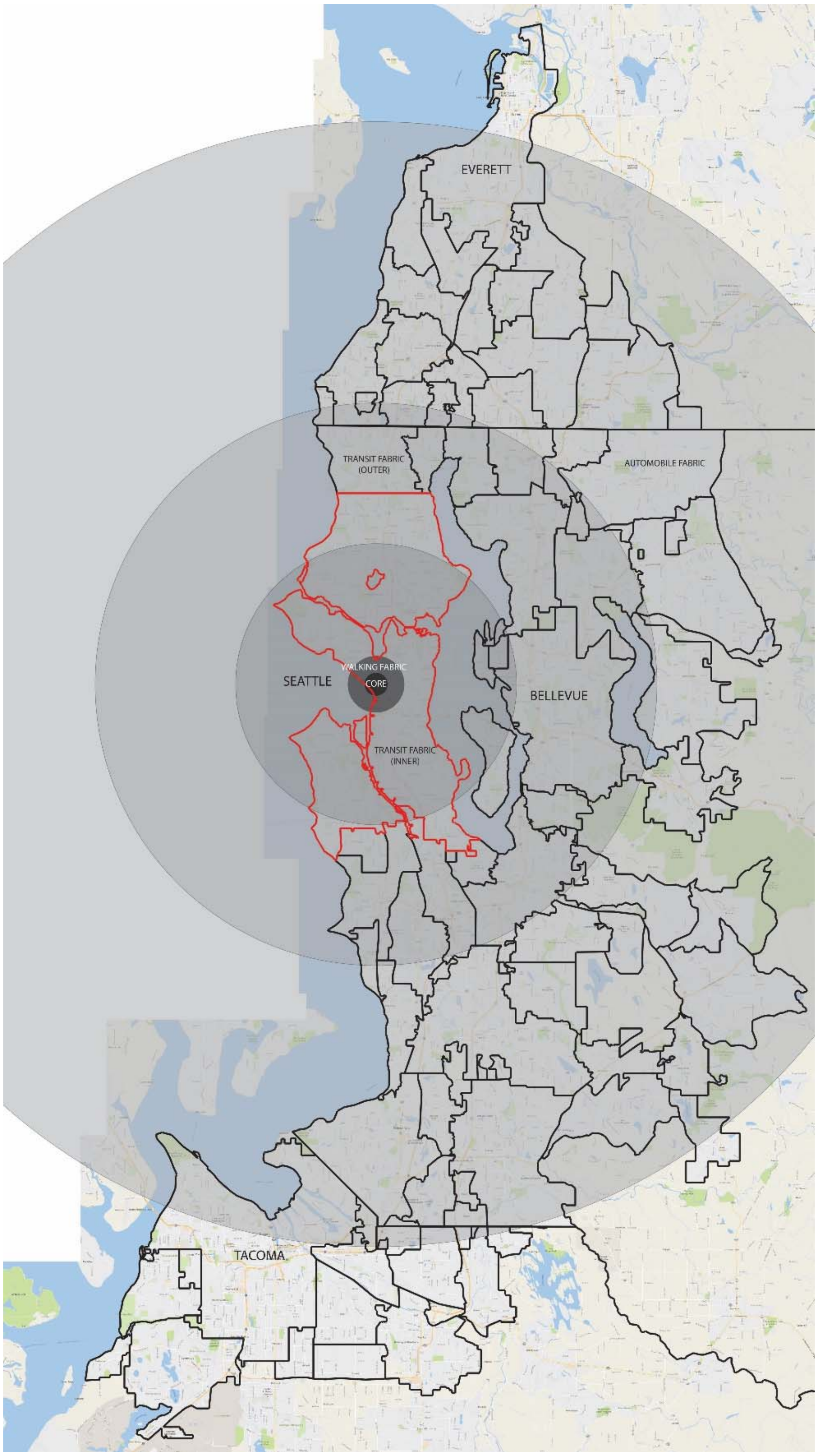
Building the Walking and Transit City in Seattle

The urban core is the fastest growing area of Seattle and this growth has no sign of slowing down, especially since currently policies target as much as three quarters of Seattle's growth to the urban core – an anticipated 25,000 new households in the next 20 years (One Center City 2017b). Transportation planning in the urban core remains highly fragmented, which include a variety of projects, some focusing on walkability, some on transit, and others on automobile access. The fragmented nature of transportation planning currently playing out in the urban core of Seattle is symptomatic of larger issues in transportation planning, of which three main issues emerge from my study of Seattle. The first issue is the inability to fully prioritize walking in areas of the city where walking is the primary mode of transportation, as is the case in the urban core. At a minimum, this means making the pedestrian environment inviting, ensuring that pedestrians always have the right of way and that they are safe. Second is the over-emphasis of public transit in the urban core and the use of complete streets to attempt to balance the modes when in reality we should prioritize walking in the urban core. Third, is the issue of investment in transit infrastructure in sprawling, low-density suburban areas where the density threshold is not high enough to encourage walking or transit use and where transit is not necessarily a practical mode of transportation. Despite claims by researchers that we have entered into an era in which transportation aims to plan for post-automobile dependence (P. Newman and Kenworthy 2015), my research in Seattle shows the contrary. I would argue that a majority of US cities are more like Seattle in this regard and have not fully transitioned into a transportation era that is post-automobile dependent.

This issue of scale is vitally important for transportation issues, as different geographic scales make different types of transportation more or less attractive. Figure 8.1 depicts one example of this based on the theory of urban fabrics (P. Newman, Kosonen, and Kenworthy 2016). Applying this theory to Seattle, we can see that a pedestrian urban fabric is up to 2.5 miles in diameter, or essentially the urban core, which I have studied in this dissertation. The transit fabric is up to 25 miles in diameter, with an inner and outer zone. These are the areas where mass transit is the most efficient mode of transportation. The automobile fabric is beyond this transit zone. This is not unlike the transect planning approach from new urbanism (Andrés Duany and Talen 2002; Bohl and Plater-Zyberk 2006) which proposes a gradient of urban development from very dense in the core to low density development and rural on the fringes. The transect utilizes different building typologies and housing types that are most suitable for each zone. This is the same way in which the theory of urban fabrics proposes that different modes of transportation should be prioritized at the scale at which each is most efficient.

In the remainder of this chapter, I conclude the dissertation by revisiting several of the programs used in the Seattle urban core to promote walkability and current transit projects in the urban core and around the city and region to highlight the issues I have raised. These numerous projects show that while transportation planning practice is moving in the right direction, it still has some way to go before walking and transit are fully prioritized at the scales at which they are the most effective mode of transportation as depicted in Figure 8.1.

Figure 8.1. Seattle region showing the theoretical extent of the pedestrian fabric (innermost), transit fabric (middle two zones) and automobile fabric (outer zone).



Walkability in the Seattle Urban Core

The pedestrian urban fabric in Seattle is among the most intact in among US cities, which makes walking a viable form of transportation for meeting the transportation needs of many residents. With the trends towards re-urbanization in the urban core, more and more pedestrians are using the streets, putting pressure on the city to improve pedestrian safety and revitalize the pedestrian urban fabric. This makes now an ideal time to address how to better plan for walkability in the urban core. Despite the heavy dependence on walking, and intact elements of the pedestrian urban fabric, the overall quality of the pedestrian fabric is quite poor, having been heavily eroded by the automobile fabric throughout the 20th century. The presence of abundant parking, one-way streets and narrow sidewalks throughout the urban core exemplifies this erosion. My research points to numerous ways that the pedestrian urban fabric can be enhanced. First and foremost, pedestrians must be at the center of any transportation strategy in the urban core – before transit and driving. This is supported by my research that indicates that pedestrians make up a majority of the transportation activity within the urban core. Although walking is the main way in which people interact with the urban core, it is not always prioritized over other modes. Several projects currently in the works and some recently completed highlight this point. In some cases, the city has made it more challenging to walk in parts of the urban core or they simply have not enhanced walkability. Pedestrian safety is a stated top priority of SDOT, but this priority often loses out to others in the urban core.

Complete Streets

Complete streets are perhaps one of the most evident ways in which current transportation planning addresses walkability, transit and street configuration in a holistic way and Seattle has had a complete streets program since 2007. In Seattle, we see mixed results in terms of its success in prioritizing pedestrians. The complete streets approach used by the SDOT is not up to the task of providing this enhanced pedestrian environment. In many instances, the Seattle complete streets program only addresses the road bed (the space between curbs), instead of the entire right of way. Therefore, while it might provide transit only lanes, or better transit stop infrastructure with seats and shelters, or build protected bike lanes, the program rarely provides any improvement to the sidewalk space – the space that really matters for the walkability. Sidewalks in many parts of the city where investments have been made in complete streets still have the same sidewalks as before the projects. Infrastructure and amenities such as public seating, wider functional sidewalks, new street trees for shade and protection from rain, and trashcans could all be incorporated to improve the pedestrian environment but were left out of such complete street projects. We therefore have to ask whether they are actually complete streets by the standard planning definition, since they do not improve the pedestrian environment. In some cases, the complete streets projects even work against walkability, as is the case with one of the Seattle Streetcar projects. Parking was removed from a stretch of Broadway in Capitol Hill and First Hill so that the streetcar could run alongside the curb. The problem with this is that without wider sidewalks to act as a buffer between pedestrians and traffic, the street now seems more unsafe and is certainly more unpleasant to walk along, as indicated by several interview participants. This is likely one of the reasons why there has been opposition to expanding this streetcar further north on Broadway in north Capitol Hill.

Street Reclaiming

Street reclaiming is another way in which cities can promote walkability as Seattle does through its Public Space Management Program (PSMP), introduced in Chapter 4, which has numerous programs that are relevant within the urban core in promoting walkability, improving the pedestrian environment and creating new public spaces. The first is *Pavement to Parks*. This program has developed three new public spaces in the urban core (two in First Hill and one in Capitol Hill) and is in the process of creating three new spaces in the next year (one in Pioneer Square, one in the International District and one in Lower Queen Anne). The program seeks to use underutilized street space, which are often out of the way and not in heavily walked areas. The exception is the public space in Capitol Hill, which is at the intersection of two busy arterials. This makes the space noisy and relatively unpleasant, and as such, not heavily used. A streateries (seating for restaurants and cafes in parking spaces) and parklets program allows businesses to sponsor these public spaces which occupy parking spaces outside their business. Currently there are three streateries and five parklets in the urban core, with three more being planned in the Capitol Hill neighborhood. These public spaces add outdoor seating to the neighborhoods they occupy since they attract patrons to restaurants, bars and cafes, and provide much needed public space.

Figure 8.2. Broadway complete street with streetcar, protected bike lanes and no sidewalk improvements.

Figure 8.3. Broadway in north Capitol Hill, with on-street parking and trees, represents a more traditional streetscape in Seattle.

Figure 8.4. First Pavement to Parks project in Seattle, located in the First Hill neighborhood.

Seattle Waterfront and the Viaduct

In 2002, an earthquake damaged the State Highway 99 viaduct and officials determined that it would need to be replaced within ten years. Three options emerged for replacing it: a new viaduct, a tunnel, or a street level boulevard. Ultimately voters approved a tunnel replacement because it offered an opportunity to reconnect the city to the waterfront after decades of being cut off from it by the viaduct. A proposal to create a linear waterfront park and multi-use trail was developed in anticipation of the new space opened up by the removal of the viaduct. In the most recent iteration of the project, the size and extent of the waterfront promenade have been greatly reduced, providing more space to the needs of transit, automobile traffic, and freight. A new four to eight lane roadway will continue to separate the city from the waterfront (Packer 2016), despite the main reason for building the SR-99 tunnel being to provide more space for people and less space for cars in the redesigned waterfront. While there will still be a multi-use trail, the fact that the final design suffered from a perceived need to give more space to transit, cars and freight, despite a new multi-billion dollar four lane highway with access on both the north and south ends of Downtown.

Pike Pine Renaissance

The Pike Pine Renaissance, which I introduced in Chapter 4, is a project seeking to improve the pedestrian experience along Pike and Pine through Downtown and provide a more welcoming urban environment that connects the Waterfront to Capitol Hill (Waterfront Seattle 2017). The plan utilizes primarily urban design improvements to provide a consistent pedestrian environment for the length of these streets. These include new pavement markings, crosswalk improvements, consistent lighting, and new street trees. On several blocks, a shared street concept is used, while other blocks benefit from wider sidewalks. The biggest improvements proposed are significant improvements to the Interstate-5 crossings, which are loud, have narrow sidewalks and offer little in the way of safety. The proposed design extends the 20-foot wide sidewalks of Downtown into Capitol Hill, along with improved facilities for bikes and buses. One of the only things lacking from this proposal is a lack of new seating, which from my own research and others, we know is an important component of a pleasant walking environment, especially one intended for all ages and abilities.

Figure 8.5. Existing (left) and proposed (right) pedestrian environment along Pike Street as part of the Pike Pine Renaissance project.

Mercer Street

The Mercer Street widening project presents perhaps the most stark case of anti-walkability planning in the urban core. Completed in 2014, the street improvement project restored two-way traffic on Mercer Street from the Interstate 5 interchange to the Seattle Center by widening the road from four lanes to between six and eight lanes. Sidewalks were also widened and a bike path built, but with the increased width of the road and high levels and speed of traffic, walking along Mercer is only done out of necessity. Mercer Street serves as the main link between I-5 and SR-99 through the urban core, making it a heavily trafficked arterial street. The reason for this street widening project was to relieve congestion on the I-5 on ramp into South Lake Union since heavy congestion has been an ongoing challenge for the city for over 40 years (SDOT 2017c), and was originally proposed to be a freeway corridor before the freeway revolts halted it. The arguments for improvements included creating an efficient and direct east/west corridor between I-5 and SR-99, reducing conflicts between cars, bikes and pedestrians, improved pedestrian and bicycle safety, strengthened connections between neighborhoods, and accommodating future transit investments (SDOT 2017c). Unfortunately, the reality is that travel times are not any faster for cars, congestion remains bad, and the pedestrian environment has been sabotaged (Keeley 2016; Packer 2017a). Additionally, recent attempts by SDOT to use Intelligent Traffic System (ITS) and adaptive traffic signals to improve traffic flow (SDOT Blog 2017b) have failed to improve travel times. The integration of this technological fix has also failed to adequately plan for the needs of pedestrians (Ostrow 2017). Despite overwhelming evidence that wider streets and more lanes of traffic do nothing to ease congestion, SDOT decided this was the only way to fix this street. A wider street only encourages more people to drive to this extremely congested part of the urban core, compounding the problem even further. Pedestrians are left with longer wait times, a roadway twice as wide to cross, and inconsistent signal cycles, which encourage jaywalking across an eight lane road. In what is one of the most heavily walked neighborhoods in the urban core, this street serves as a reminder how pedestrians fail to get priority in a neighborhood that is still growing its employment and residential populations.

Prioritizing Pedestrians in the Urban Core

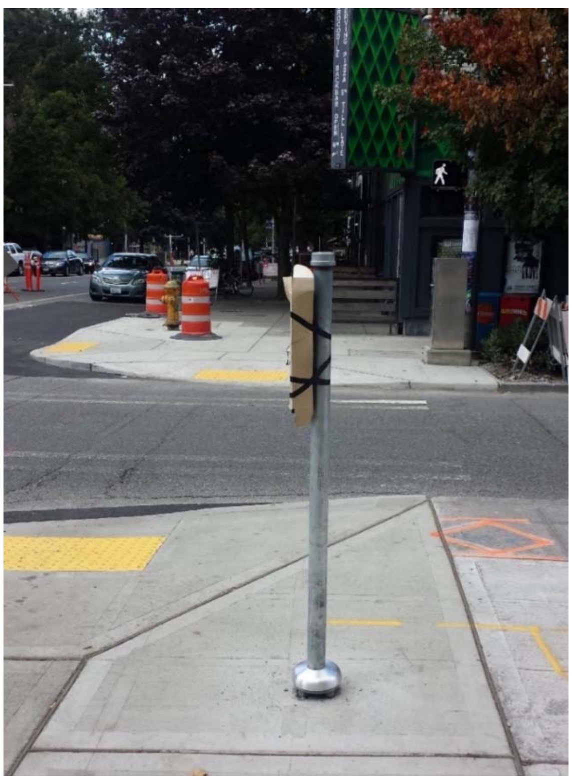
The projects discussed above all emphasize the somewhat schizophrenic nature of planning for pedestrians in the urban core of Seattle. Although pedestrian safety is a stated goal of the Seattle Department of Transportation, projects are often completed that contradict this. Furthermore, the city's complete streets program rarely addresses pedestrian concerns, and instead emphasizes bike and transit improvements, even though an emphasis on pedestrians is a main goal of complete street programs, including the one in Seattle. But other, community driven projects, such as the Pike Pine Renaissance, are moving in the right directions, providing more space for pedestrians in an area of the city where the number of pedestrians far out numbers the number of people in cars or on transit. So what can Seattle do to better prioritize pedestrians in the urban core?

A first step is providing a physical environment that allows people of all ages and abilities to walk. This means providing well-maintained sidewalks throughout the urban core. A step towards achieving this was the city's efforts in 2016 to map sidewalk conditions throughout the urban core and urban villages in order to prioritize maintenance.

Curb cuts and ramps are important and need to be at every intersection throughout the urban core. Earlier this year, the city settled a lawsuit regarding its application of ADA accessibility on its sidewalks – specifically its lack of curb ramps (Gutman 2017a). Renovating existing curb ramps and installing 22,500 new ones over the next 18 years will cost the city nearly $300 million (Gutman 2017a). As the city moves forward on this, they should follow the lead of other cities that have minimized the curb radius and installed 90 degree angle curb cuts, as opposed to two separate curb ramps. This larger curb-cut facilitates the movement of more people. As many of the curb-ramps in Seattle exist, they rarely line up with the sidewalk on the other side of the street, often there is only one narrow ramp, and often none at all. Crosswalks should also be well marked at both signalized and un-signalized crossings on main streets.

In order to prioritize pedestrians, the city should also remove beg-buttons, at a minimum in the urban core, and ideally within every urban center and village. In a recent blog post, SDOT went to great lengths to justify their continued use of pedestrian push buttons throughout the city (SDOT Blog 2017c). Push buttons, typically, require a person to push a button to activate the walk signal in order to cross the street. On wide roads where pedestrians are scarce, these buttons are used to activate a longer cycle to allow a pedestrian to cross the street, but when there is no pedestrian present, the signal timing prioritizes car use. In a dense urban center where there are pedestrians crossing the streets at every signal, the use of these buttons is unnecessary. In certain places in the urban core, the push button is used to extend the signal length or provide auditory assistance for those who need it. In other places, the button still needs to be pushed just to get a walk signal. This however misses the point that every walk signal in the urban core should allow enough time for even the slowest person to cross the street safely.

Figure 8.6. Newly installed pedestrian ‘beg-button’ in Belltown, directly in the path of pedestrian traffic.



An additional issue with the use of push buttons in the urban core is there placement. In order to meet ADA requirements, newly installed push buttons are installed in the path of foot traffic (Figure 8.6), so much so that people frequently bump into them. The solution is simple – provide a walking environment where the pedestrian is not required to do anything extra to cross the street. Push buttons should not be a physical obstacle for pedestrians to navigate. The presence of the push button sends a clear message to a pedestrian – that this street is meant for cars. On many of the streets that are both most walked and most enjoyed by residents, there are no beg buttons and walk signals are automatic. This practice needs to be extended throughout the urban core as a way of prioritizing pedestrians and providing a consistent treatment of traffic control signals. Another way to prioritize pedestrians would be to use all-walk signals that allow pedestrians to cross anyway while there is no automobile traffic moving. While these signals are longer between walk cycles, in some of the busiest intersections, they can be used to effectively manage the conflicts between pedestrians and cars, and in certain circumstances, improve the flow of car traffic by minimizing conflicts of turning traffic.

Providing safer crossings at heavily trafficked intersections is another way to prioritize pedestrians in this fabric. Crosswalks should provide enough time for the slowest pedestrians and should make pedestrians feel comfortable, not threatened. Unfortunately, many safe crossings only get put in after there is an accident or after citizen groups advocate for years for change. The city needs to realize that it cannot take a year to install a marked crosswalk with a painted island on what is a major pedestrian intersection. Additionally, it cannot leave projects half finished, as is the case on Broadway in Capitol Hill where the city recently installed an all-way-walk signal phase which now makes jay-walking and red light running more common due to extremely long wait times for both pedestrians and cars. Long wait times to cross the street, especially in a city known for its rainy weather, do not incentivize more walking. SDOT needs to be smart about providing a safe and welcoming pedestrian environment.

Another major change on urban core streets that would represent a shift towards prioritizing people and pedestrians over cars would be converting all one-way streets to two-way streets, which tend to be more pedestrian friendly (Riggs and Gilderbloom 2016; Gayah 2012; Appleyard 1981). The existing street network, shown in Figure 8.7, relies heavily on one-way streets in the Downtown, Belltown and Denny Triangle, with extensions into Pioneer Square, the International District and Lower Queen Anne. Current plans already have this network of one-way streets extending in to Capitol Hill as part of the Pike Pine Renaissance project. Additionally, the One Center City initiative has proposed extending these one-way streets on Pike and Pine Streets even further, primarily in an attempt to accommodate protected bicycle infrastructure that does not interfere with the location of bus stops on these streets. With two one-way streets, protected bike lanes could be installed on the left side of each street while buses remain to use the right lane.

The problem with this dependence on one-way streets, it that one-way streets are perhaps one of the most obvious ways that the automobile urban fabric disrupts the pedestrian and transit fabric. One-way streets typically encourage faster automobile traffic and drivers are less attentive (Gayah 2012). Additionally, they create a sense that the street is for traveling through the neighborhood and not a destination itself. Two-way streets slow traffic down, making streets safer for pedestrians. They also provide a more legible environment for transit users, who may not know where the return bus stop is when streets are one-way. Two-way streets also have numerous benefits to drivers. One-way streets require drivers to drive greater distances to get from one location to another, adding to traffic and congestion (Gayah 2012). Two-way streets also allow for greater business exposure (Gayah 2012). One of the only real benefits of one-way streets is increased vehicle flow (Gayah 2012), which in a Downtown that is primarily pedestrian oriented and by which 50 percent of workers get to by transit, prioritizing the flow of automobile traffic is not what the urban core street network needs to do. Additionally, taking into account the city's current plans to reduce general traffic lanes on urban center streets for bicycle infrastructure and bus lanes, converting streets in the Downtown maintains the same number of travel lanes in each direction. When combined with developing extended range for "transit only" streets, which SDOT already does on 3rd Avenue during peak times, the Downtown core would function significantly better for all modes of transportation, especially pedestrians if streets were converted to two-way traffic from their existing one-way configuration.

Figure 8.7. One-way streets (red) in the Seattle urban core.

Another approach that could be used to prioritize pedestrians in the urban core is to develop a network of shared streets. Shared streets are a form of traffic-calmed street that blur the lines between pedestrian space and automobile space. Numerous shared street designs exist and research has shown that the design of these spaces has an influence on how people ultimately use them (Ruiz-Apilánez et al. 2017). In general, pedestrians feel a greater sense of safety and are more comfortable on these shared streets (Ruiz-Apilánez et al. 2017). The only example of a shared street in Seattle can be found on four blocks of Bell Street in Belltown, shown in Figures 8.8 and 8.9. On the scale of least to most shared street configurations, this is perhaps on the lowest side, but has been an overall successful street improvement project in Seattle combining traffic calming and placemaking strategies. The newly redesigned street now provides only one lane of thru traffic (one-way), wider sidewalks, landscaping with street trees, parking, and public seating (both benches and tables and chairs). The street is frequented by neighborhood residents seeking outdoor public spaces for gathering and socializing and is a preferred route for pedestrians and cyclists due in part to the low volume and speed of cars. In general, it is a pleasant street to be on and a rare example of good street design in the urban core that people go out of their way to walk on. This type of street or similar designs that slows traffic and provide more space to pedestrians could be built on many of the streets throughout the Downtown core, Belltown and other neighborhoods to prioritize pedestrians.

Another way to better prioritize pedestrians in the urban core, as supported by my research findings, are to decrease the overall amount of automobile infrastructure. Much like the effect of widening a highway causing induced traffic, automobile infrastructure, especially parking, induces car use. Minimizing the amount of parking at in new developments should be a key strategy of the city, especially given the fact that the buildings constructed today will likely be a part of the urban fabric for 100 years or longer. With the potential for new developments in transportation, such as automated vehicles, the demand for parking will likely be much less in the future than it is today. In just the Denny Triangle area of Belltown, nearly 10,000 new housing units and 3.5 million square feet of office space are planned to be built in the next five years (Packer 2017a). With this new development, comes close to 10,000 parking spaces, half in residential buildings and half in office and mixed use buildings (Packer 2017a). In these developments, all this parking will be below grade, requiring extensive excavation, adding to the high cost of new development. The city already does not require developers in the urban core and other village centers with frequent transit service to build parking, but the choice is up to the developer. At the very least, in the urban core, the city should make no new parking a requirement. At an average cost of $34,000 per parking spot for underground parking (Shoup 2011), not building parking would save developers $340 million. Developers could pass these savings on to consumers, which could go a long way to alleviating some of the city's current problems of skyrocketing rents. Alternately, the city could find ways to capture these funds and use them to expand the transit infrastructure throughout the city. Keeping in mind that this is only in one part of the urban core, applying this throughout the area would raise significantly more money that could fund transit or pedestrian improvements in the urban core.

Figure 8.8. Bell Street shared street, incorporating traffic calming, wider sidewalks, seating and greenery.

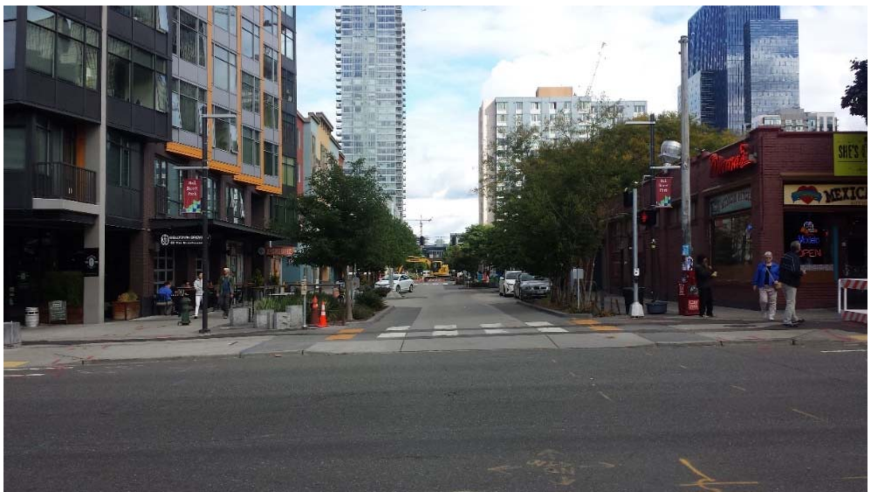


Figure 8.9. Bell Street shared street design with improved pedestrian environment.

Any attempt to lessen the impact of automobile traffic on pedestrian activity, whether through traditional traffic calming, one-way to two-way street conversions, with shared streets, or minimizing new parking, would go a long way to making streets safer and more pleasant. Safer streets, not only prioritize pedestrians, but they also work towards achieving the City's *Vision Zero* goals. Safer streets for pedestrians require minimizing the conflicts between pedestrians and other modes of transit – bikes, buses, and especially automobiles. The case of Seattle shows that even when planners know what things are good for prioritizing pedestrians in the urban core, this does not mean they get incorporated into new street designs. And worse yet, is when programs that are clearly intended to improve the pedestrian environment, do nothing to alter it and in some cases makes it worse off. Planners need to be more aware that the way the streets themselves and the sidewalks are designed influences not only pedestrian safety, but also comfort. The case of Seattle shows that a dense urban core within a vibrant city is still a place where walking is the main mode of transportation, even after decades of alterations to incorporate the automobile and more recently to increase transit accessibility. It shows how an entire city's transportation network can suffer when all modes are incorporated – walking becomes hazardous, using transit becomes tedious and time consuming, and driving becomes unbearably frustrating. Many cities across the US are experiencing growth in the number of pedestrians in urban core areas, places where a walking fabric naturally exists and the concerns raised in Seattle regarding how pedestrians and transit are not prioritized and the automobile overwhelms them are present in nearly every US city. In Seattle's urban core, slower traffic, safer street crossings, small public spaces and seating, wider sidewalks in commercial areas, more street trees and greenery, and less infrastructure that supports automobile use, such as narrower roads and less parking, are the things my research shows can significantly improve the pedestrian environment in the urban core.

Public Transit Policy in Seattle

One of the reasons why pedestrians are not prioritized to the extent they should be in the urban core, has been because of the over-emphasis on public transit in the urban core. In the last decade, the urban core has received new light rail transit, two modern streetcar routes, and significant changes in bus scheduling and routes to provide frequent bus service. While light rail and increased bus service make the urban core more accessible from neighborhoods outside the urban core, many of the changes only impact the urban core, such as frequent transit and the streetcar. The logic behind many of these projects is to provide multiple transportation options. Because the urban core is a walkable urban environment, urban planners assume that transit will benefit them, no matter the form it takes. This is not what my research has shown, however, since walking is the main mode of transportation within the urban core. Transit is not a significant mode for travel within the urban core because distances between destinations are short and transit is generally not the most efficient mode of transportation, even with frequent bus service and multiple modes. Numerous projects reinforce this over-emphasis of transit in the core. This continued emphasis on transit means that planners are less focused on emphasizing walking in the urban core. Additionally, a decades old emphasis of using transit to connect to Downtown for commuting, takes resources away from creating a transit urban fabric that connects walkable neighborhoods to each other. Two major transportation projects that SDOT is working on represent this over-emphasis of transit – the Center City Connector and the Madison BRT. The One Center City initiative, addressing mobility issues in the urban core, likewise shows an emphasis on transit.

Center City Connector

The Center City Connector broke ground in Summer 2017, and is the city's latest extension of its modern streetcar network. The new addition will link the existing South Lake Union and First Hill Streetcar routes to create a continuous route. The connector is a much improved version of the streetcar, with its own dedicated transit lane and priority at lights. Even with these improvements over the existing routes, the 1.1 mile extension exclusively runs in the urban core. When complete, there will be have 5-minute headways through the Downtown core, which are achieved by running two routes that overlap in the center section – no single route will run from one end to the other. SDOT, city officials and transit advocates tout the Center City Connector as a vital piece of infrastructure (Malott and Broesamle 2017), but this ignores the way people actually travel through the Downtown. My research has shown that transit is not a vital part of how people travel when destinations are within the urban core. That being said, the Center City Connector does have two primary benefits. First, it will decrease the dependence on bus travel on the Third Avenue transit corridor by shifting some of this to First Avenue. A dedicated transit lane and pre-boarding paying will make it more attractive for those going from one end of the Downtown to the other or to South Lake Union. Additionally, the new streetcar route will serve many of the city's most visited tourist destinations, and will likely be used heavily by tourists because it will have frequent service, will be relatively quick, and easily legible for those unfamiliar with the complicated bus system.

Madison BRT

The Madison BRT is the first planned bus rapid transit project in Seattle, running east/west on Madison Street from First Avenue in Downtown to MLK Boulevard in the Madison Valley. Madison Street is the only street that runs diagonally from Downtown at the same orientation of the Downtown grid, thus interrupting the north/south oriented grid in the eastern half of the urban core. The Madison BRT will run in the center of the street in a dedicated transit lane and have pre-boarding paying. SDOT anticipates that the travel times for transit will decrease five minutes going east and seven minutes going west, while automobile travel times will increase by four minutes (jseattle 2017). While this is a definitely improvement for transit, because of the inclusion of a dedicated bus lane, bikes will not be allowed on Madison, and new protected infrastructure will be built on a "parallel route". Additionally, sidewalks will not be widened anywhere in the corridor, and in some parts of this area, the sidewalks are perhaps some of the narrowest in the urban core – only six feet with no buffer between the sidewalk and traffic. In what is a heavily walked corridor, the lack of improvement in the pedestrian environment has been a continued issue among residents. Additionally, a number of very busy and somewhat dangerous intersections are being redesigned, but in order to prioritize transit and ensure improved transit travel times, efforts that could be made to make walking and biking safer are not necessarily being incorporated. The Madison BRT is a clear example of how prioritizing transit can be detrimental to prioritizing pedestrians.

One Center City

The One Center City initiative is a partnership between the City of Seattle, King County, Sound Transit and the Downtown Seattle Association to develop a 20-year strategy for transportation in the urban core (One Center City 2017a). One of the immediate short-term tasks that the task force has had to address is how to restructure public transportation when the Northgate and East Link light rail extensions open. When these new lines begin operation, increased train traffic through the Downtown transit tunnel will increase dramatically, and in order to ensure that trains run on time, the bus routes that currently use the tunnel will move to the street. The Third Avenue transit corridor already sees hundreds of buses an hour during peak times. The city is also currently expanding bicycle lanes in the urban core, constructing a two-way cycle track on Fourth Avenue, which parallels the existing cycle track on Second Avenue. As a result of this, buses on Fourth Avenue would be considerably delayed with the addition of more buses. However, the One Center City work group, after suggesting that bike infrastructure would not work on Fourth Avenue with increased bus transit, the transit agencies came to an agreement to reroute buses to Fifth and Sixth Avenues, which is ultimately projected to shorten transit trips by four minutes (Packer 2017b). While the stated goal of One Center City is to address all forms of transportation within the urban core, while also improving the quality of public spaces, there is a heavy emphasis on transit. While the City and the various transit agencies in the region must ensure that access to the Downtown core remains reliable and affordable, they must not overlook the role that walking plays in the urban core. After all, once people arrive to Downtown by transit, they are de facto pedestrians, and ensuring the pedestrian environment is safe, accommodating to all, and attractive should be a top priority.

Each of the projects I mention above highlight the fact that transit in the urban core is over-emphasized as a mode of transportation. Transit of course plays a vital role in the urban core and provides regional connectivity to the core for a large percent of the population. Increasingly, however, new transit projects only operate at the scale of the urban core and do not extend beyond it, which is the basis of this over-emphasis of transit. In addition to this over-emphasis in the urban core, the city is actively building a regional rail and bus rapid transit system. Seattle is one of the latest cities to develop light rail transit following the "rebirth of rail transit" (Altshuler and Luberoff 2003). Seattle opened its first light rail route in 2009 and completed an extension in 2016. It will add future extensions and a second route in 2021 and 2023. These extensions will turn a single light rail line into a fledgling light rail system and go a long way to building a transit-oriented city. However, plans to extend light rail further into suburban areas does not build on the existing infrastructure as well as it could. While it is important to provide high quality transit within the urban core and throughout the city, what could the city and the regional transit agencies do differently that would build a true transit city? In order to focus efforts to build a transit city, Seattle (and the region) must focus on four elements. First, planners must continue to reduce travel times and recognize that a major barrier to increased transit use is the travel time budget. Second, planners must prioritize transit that enhances quality and reliable service within the geographic area where transit is most efficient – the transit urban fabric. Third, transit needs to connect neighborhoods to each other and not just to Downtown. Fourth, planners must ensure that new transit infrastructure integrates into the pedestrian environment and not mirror automobile oriented landscapes.

One of the main reasons why transit is not used more heavily in the Seattle region is time. Time – and more specifically the travel time budget – is a key element of the theory of urban fabrics. Each of the fabric extents is based on the idea that a city will grow to be an hour wide based on whatever mode of transportation is dominant (Marchetti 1994; Zahavi and Talvitie 1980; P. Newman, Kosonen, and Kenworthy 2016). Therefore, the walking city is 2.5 to 3 miles in diameter because this is how far a person can walk in one hour. The transit fabric grows to be up to 25 miles in diameter because this is the farthest extent that transit could reasonably get you in one hour. The problem facing Seattle, and likely many other US cities, is that this implies an average speed of transit of about 25 mph. In Seattle, the average speed of transit is just under 10 mph hour when looking at the travel times between all urban centers and villages by transit. This however ranges from a low speed of 2.8 mph hour to a high of 40 mph. The difference in these speeds is explained by the presence of the light rail. Neighborhoods connections where light rail serves as the main link between them, nearly all travel times achieve speeds over 20 mph. In places were bus is the only way to get between neighborhoods by transit, the speeds are well under 10 mph.

The importance of time is also evident in an examination of the travel time ratio between transit and driving. The average ratio in Seattle is 3.1:1. This means that on average, travel between any urban center or village to any other urban center or village takes 3.1 times longer on transit than by driving (Table 8.1 and 8.2). This ratio ranges between a low of 0.6:1 to a high of 6:1. This travel time ratio is an important factor is why people switch to transit over driving because of the travel time budget (P. Newman and Kenworthy 2015). Minimizing travel time is a key factor in determining which modes people utilize and for what types of trips. This is why people walk to destinations that are near and drive to destinations farther away. The time it takes in Seattle on transit to get between neighborhoods is far enough outside an acceptable ratio for a majority of people to switch to transit. The exception of course is if they live within the range of the light rail, which as we can see drastically lowers the ratio.

This travel time ratio not only explains the dependence on driving over transit between neighborhoods, but it also explains the dependence on transit for commuting to Downtown. The ratios in Tables 8.1 and 8.2 are based on driving times at non-peak times. During commuting hours, travel times increase drastically, especially to Downtown – typically 2 to 3 times longer, but on occasion, as much as 4 to 5 times longer. With this added drive time during commuting hours due to traffic congestion, travel times by car become much closer to travel times by transit. Add to this the unpredictability of delays due to congestion or accidents, and transit becomes a more viable mode of transportation for a much larger population and, in some cases, becomes more reliable. This emphasis on transit for commuting is a remnant of the

1991 *Washington Commuter Trip Reduction Act* (See Chapter 5). Towards this end, the transit system is quite successful. However, beyond serving purpose of getting people to and from work in centrally located neighborhoods, the transit system remains underutilized.

The travel time savings from new light rail also go a long way to understanding why after only a couple weeks of service, additional trains needed to be added. When the light rail from Downtown Seattle to Capitol Hill and the University of Washington opened in 2016, ridership quickly jumped past their 1-year projections, prompting Sound Transit to add more cars to each train (Lindblom 2016c). Additionally, from 2016 to 2017, ridership again jumped beyond Sound Transit's projections, increasing 17 percent in only one year. This is because of the drastic decrease in peak travel time with the opening of the light rail extension. Prior to the new light rail line opening, driving between Downtown Seattle and the University of Washington stadium could take as long as 40 minutes. With light rail, this trip is now only 6 minutes.

The second reason why transit ridership in Seattle is not as high as it could because planners do not prioritize it at the right geographic scales. The integration of light rail into Seattle has been transformative and encouraged a surge in transit ridership. However, plans for the expansion of this initial segment are based on plans that are essentially unchanged from transit proposals made in the 1950s-1970s. The next phases of transit opening in 2021 and 2023 will have a profound impact on the region. Much of this expansion of the light rail system is situated within the outer transit urban fabric, as depicted in Figure 8.10. This map however, also shows the ST3 plan that was approved by voters in 2016 (in pink), which expands light rail into more suburban locations – places which are automobile dependent. While transit can and should serve these areas, this light rail based transit does not meet this need. The light rail operates at roughly 25 mph, meaning that beyond this diameter, the travel time increases over an hour, greatly reducing its effectiveness. When complete in 2041, the light rail will extend from north to south close to 70 miles. This means that at 25 to 30 mph, a trip from one end to the other will likely take between 2.5 and 3 hours – well exceeding the 1-hour travel time budget. For comparison, driving time is about 1 hour and 15 minutes.

Table 8.1. Ratio of Transit travel time to driving travel time between all Seattle urban centers and villages. Green indicates that transit is faster than driving, while red indicates a transit time more than three times that of driving (Source: Author).

	23rd & Union-Jackson	Admiral	Aurora-Licton Springs	Ballard	**Belltown**	Bitter Lake Village	**Capitol Hill**	Columbia City	Crown Hill	**Downtown**	Eastlake	**First Hill**	Fremont	Green Lake	Greenwood/Phinney Ridge	**International District**	Lake City
23rd & Union-Jackson																	
Admiral	4.1																
Aurora-Licton Springs	3.4	3.7															
Ballard	3.8	4.0	2.3														
Belltown	1.8	4.0	1.7	3.2													
Bitter Lake Village	3.4	4.2	2.8	2.9	2.0												
Capitol Hill	3.6	3.0	2.8	3.2	1.3	2.9											
Columbia City	2.7	3.0	2.9	2.8	2.2	2.6	2.2										
Crown Hill	3.2	3.8	3.3	2.2	2.1	3.6	3.5	3.3									
Downtown	2.4	4.3	2.3	2.2	1.3	2.2	0.7	2.2	2.7								
Eastlake	3.5	4.3	5.8	3.7	2.8	4.6	2.0	3.7	4.6	2.7							
First Hill	2.0	4.4	3.5	3.2	3.1	2.9	1.8	3.3	3.5	2.4	6.3						
Fremont	2.8	4.6	2.9	3.3	3.7	3.1	2.9	3.2	2.5	2.1	4.6	2.8					
Green Lake	3.4	3.4	3.7	3.9	2.4	3.8	3.1	2.6	2.6	1.7	2.9	2.1	3.1				
Greenwood/Phinney Ridge	3.4	3.9	2.7	6.0	1.9	2.9	2.8	3.2	4.0	2.3	4.7	3.5	2.2	5.3			
International District	3.3	3.1	3.6	2.9	2.1	3.2	1.0	2.2	3.5	3.3	5.1	4.4	2.4	3.0	2.8		
Lake City	3.0	2.5	3.6	3.9	2.7	6.4	2.7	3.1	3.3	2.4	4.2	3.0	3.9	3.7	4.3	2.6	
Lower Queen Anne	2.0	4.2	2.9	1.5	1.8	3.5	2.4	4.2	1.9	2.0	4.4	3.0	4.0	3.7	3.2	2.1	3.9
Madison Miller	5.0	3.6	3.5	3.2	2.1	3.2	2.0	2.5	3.8	2.3	3.4	3.0	2.8	3.9	2.7	3.5	2.9
Morgan Junction	2.7	1.7	2.9	2.9	2.2	3.0	2.6	3.3	3.3	2.8	3.4	3.1	3.1	3.6	3.2	2.3	3.1
Mt Baker	2.3	4.2	3.2	3.1	2.8	2.7	2.1	3.0	3.4	2.3	3.6	3.1	2.8	3.7	2.9	2.3	2.5
North Beacon Hill	4.0	4.3	3.0	2.8	1.9	3.3	1.6	1.7	3.5	1.7	4.0	2.9	3.0	4.1	3.3	2.4	3.6
Northgate	2.5	3.8	4.7	3.2	3.1	6.1	2.4	3.5	3.1	3.4	4.1	2.3	5.2	5.6	3.7	2.1	1.9
Othello	2.8	3.7	3.1	2.5	1.9	3.0	1.7	1.7	3.3	1.8	3.5	3.3	3.0	3.4	3.1	1.8	3.6
Pioneer Square	2.5	3.4	2.5	2.6	1.6	2.9	0.8	1.9	2.7	2.5	4.0	1.8	2.5	3.1	2.7	2.0	3.1
Rainier Beach	2.7	3.6	2.6	2.5	1.6	2.3	1.8	1.4	2.9	1.4	3.6	2.4	2.7	3.3	2.9	1.4	3.2
Roosevelt	3.2	4.1	4.4	3.7	2.8	4.6	2.8	3.6	3.3	2.6	4.7	5.4	3.4	3.0	4.6	3.2	3.8
South Lake Union	2.5	5.3	3.8	2.9	2.4	3.3	1.7	4.2	2.9	2.2	2.3	4.7	3.2	4.1	2.9	4.3	4.8
South Park	3.6	4.5	3.2	3.3	3.2	3.2	3.0	3.6	3.4	3.5	4.4	3.5	3.5	3.8	3.4	2.7	3.4
U-District	2.5	2.6	3.2	2.6	2.7	3.0	1.8	3.1	3.1	2.1	1.8	3.6	2.6	1.9	2.6	3.4	3.5
Upper Queen Anne	2.6	4.4	2.5	3.4	1.9	2.6	2.1	3.4	2.6	2.3	4.1	3.0	3.0	3.2	3.1	3.6	3.4
Wallingford	3.5	4.7	3.7	3.0	3.0	3.4	3.2	4.0	3.1	3.8	4.1	5.4	2.5	2.3	3.4	5.5	4.0
West Seattle Junction	3.3	1.8	3.6	3.2	2.8	3.2	2.8	2.3	3.3	2.4	3.4	3.4	3.7	3.5	3.3	2.7	2.4
Westwood-Highland Park	2.9	4.1	3.1	3.9	3.0	3.1	2.8	2.9	3.1	2.8	3.6	3.8	3.1	3.4	3.5	2.5	2.7

Table 8.2. (Continued) Ratio of Transit travel time to driving travel time between all Seattle urban centers and villages. Green indicates that transit is faster than driving, while red indicates a transit time more than three times that of driving (Source: Author).

	Lower Queen Anne	Madison Miller	Morgan Junction	Mt Baker	North Beacon Hill	Northgate	Othello	**Pioneer Square**	Rainier Beach	Roosevelt	**South Lake Union**	South Park	U-District	Upper Queen Anne	Wallingford	West Seattle Junction	Westwood-Highland Park
23rd & Union-Jackson																	
Admiral																	
Aurora-Licton Springs																	
Ballard																	
Belltown																	
Bitter Lake Village																	
Capitol Hill																	
Columbia City																	
Crown Hill																	
Downtown																	
Eastlake																	
First Hill																	
Fremont																	
Green Lake																	
Greenwood/Phinney Ridge																	
International District																	
Lake City																	
Lower Queen Anne																	
Madison Miller	2.4																
Morgan Junction	3.2	2.9															
Mt Baker	4.1	2.6	3.6														
North Beacon Hill	3.0	3.3	3.2	1.7													
Northgate	2.9	2.8	2.5	2.2	2.3												
Othello	3.0	2.4	3.1	1.5	0.9	3.3											
Pioneer Square	2.1	2.5	2.3	1.7	1.4	2.6	1.6										
Rainier Beach	2.8	1.9	2.9	1.1	0.9	3.5	0.6	1.6									
Roosevelt	4.8	4.1	3.3	4.2	3.5	2.1	4.1	3.4	3.4								
South Lake Union	4.4	2.4	2.9	4.0	4.3	5.5	3.8	3.3	3.2	4.9							
South Park	3.5	3.7	3.6	2.5	2.4	3.0	3.8	2.6	4.4	4.3	3.9						
U-District	4.4	2.7	3.7	3.0	2.9	1.9	2.6	2.6	2.6	2.0	2.0	2.8					
Upper Queen Anne	2.3	3.6	2.6	3.1	3.2	3.6	2.9	3.0	2.8	5.0	5.7	3.7	2.9				
Wallingford	4.1	3.6	3.8	5.5	4.1	3.3	3.6	3.9	3.4	4.0	3.7	3.8	2.8	3.6			
West Seattle Junction	3.3	3.1	1.7	3.3	1.9	2.8	2.5	2.8	1.8	2.8	2.8	2.8	3.5	1.9	4.1		
Westwood-Highland Park	3.5	3.1	3.6	3.6	3.0	2.5	3.0	2.5	3.0	4.0	2.9	4.0	3.6	3.1	3.4	3.0	

Figure 8.10. Existing and planned light rail overlaid on a regional urban fabric model. Many of the extensions under construction (green) and those of the ST3 initiative (pink) are outside the reach of the outer transit fabric.

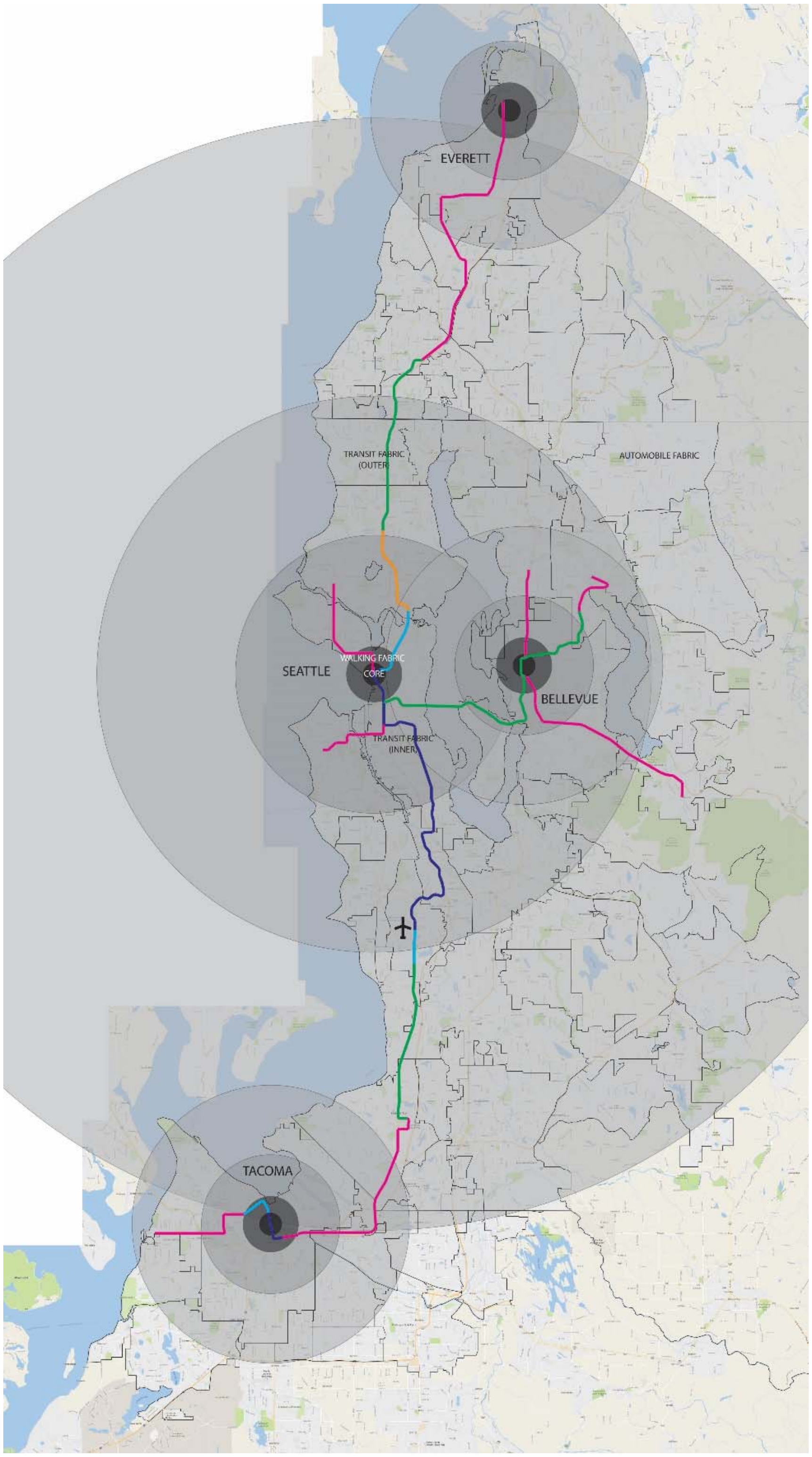
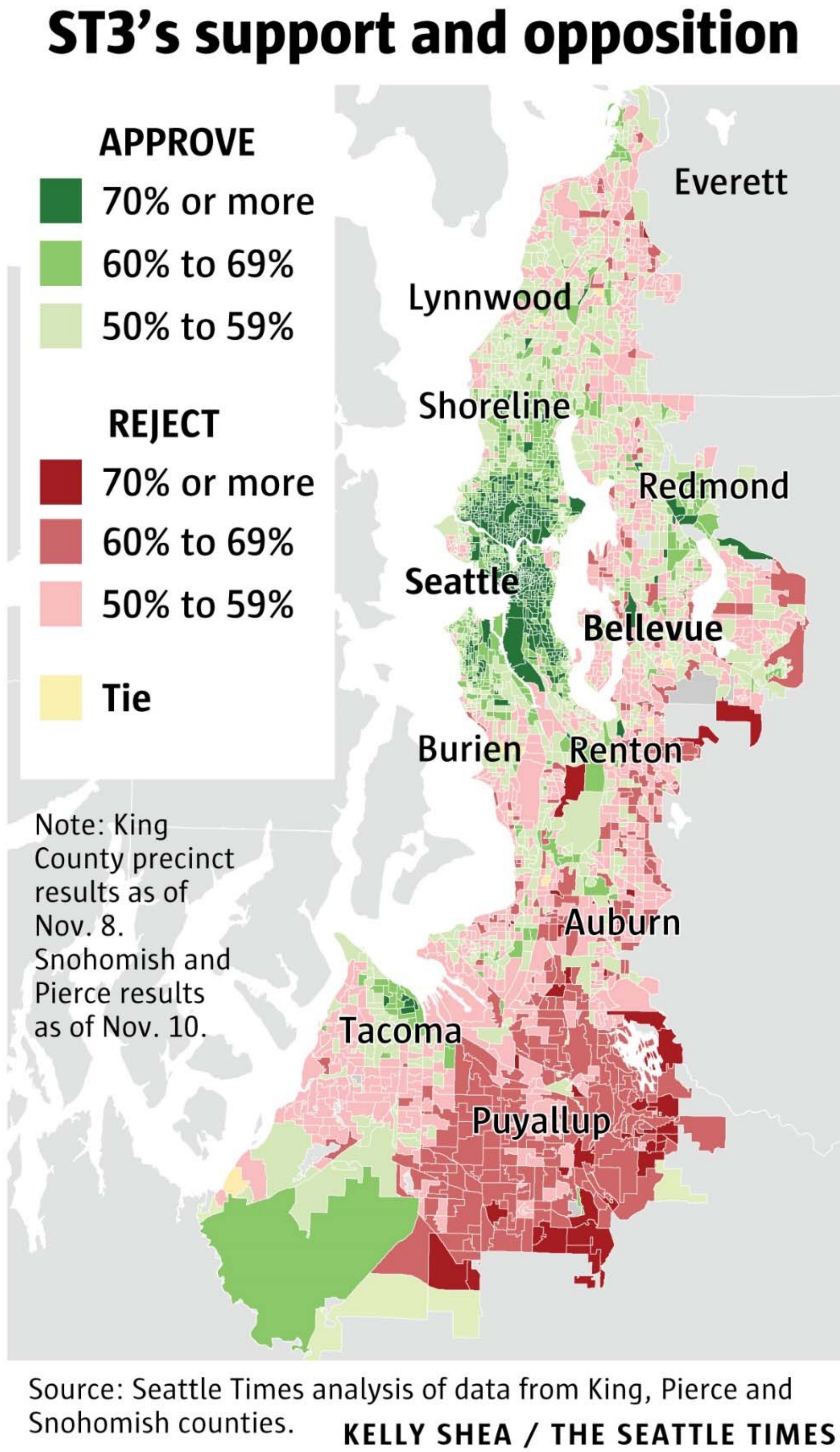


Figure 8.11. Sound Transit 3 vote results by precinct (Mayo and Lindblom 2016).



This new extension of transit highlights how planners overlook the geographical benefits of transit. Transit works well within a certain range. Even certain modes of transit work better at different scales. For example, effective commuter rail could serve the same 70-mile distance in much less than 3 hours, especially when combined with shorter distance rapid transit like the light rail already in operation. The greatest benefit from a light rail system such as the one in Seattle exists within the transit urban fabric, an area of 2.5 miles from the center to 12.5 miles from the center (or 25 miles in diameter). Figure 8.10 also shows a more realistic application of the theory of urban fabrics compared to Figure 8.1, since it recognizes the polycentric nature of the region. Each of these independent cities – Seattle, Bellevue, Tacoma, and Evertt – has their own urban core and a geographical area in which transit is the most efficient to get to the core. Between each of the transit-sheds for each city, the automobile reigns. It is also important to note that Figure 8.10 mirrors the latent demand for transit, which is evident in the polling results for ST3 shown in Figure 8.11 (Mayo and Lindblom 2016). The more centrally located areas, where transit is most effective, is where there is the highest demand.

Transit oriented development has become one of urban planning's favorite creations. And the great benefit of public transit when built within the extend of the transit urban fabric is ability to encourage densification on a large scale, not just in pockets as is the case with TOD. By providing high quality transit that is more ubiquitous, planners would help facilitate the densification of the already built up area, making it a more compact region. As the region becomes more compact, the accessibility of the region increases (Levine et al. 2012). A true walking and transit based city is much more uniformly dense than most cities in the US. And while TOD principles add density, they typically are in isolated pockets surrounded by single family homes. This is certainly the case in Seattle, although in Seattle the cause is its village planning growth strategy adopted in 1994. In many of these urban villages, there are new developments that are essentially TODs, only without the transit component. Additionally, because these new developments are mixed-use and offer amenities not available, they often attract higher income individuals who, even with the availability of transit, might not utilize it (Chatman 2013). When access to these amenities, including rail, are in isolated pockets, it creates a premium for this type of development.

Figure 8.12. Seattle Subway proposal for expanding rapid transit in the region (Source: Seattle Subway 2017).

Figure 8.13. Regional transit proposal, connecting the regional within a regional transit urban fabric framework.

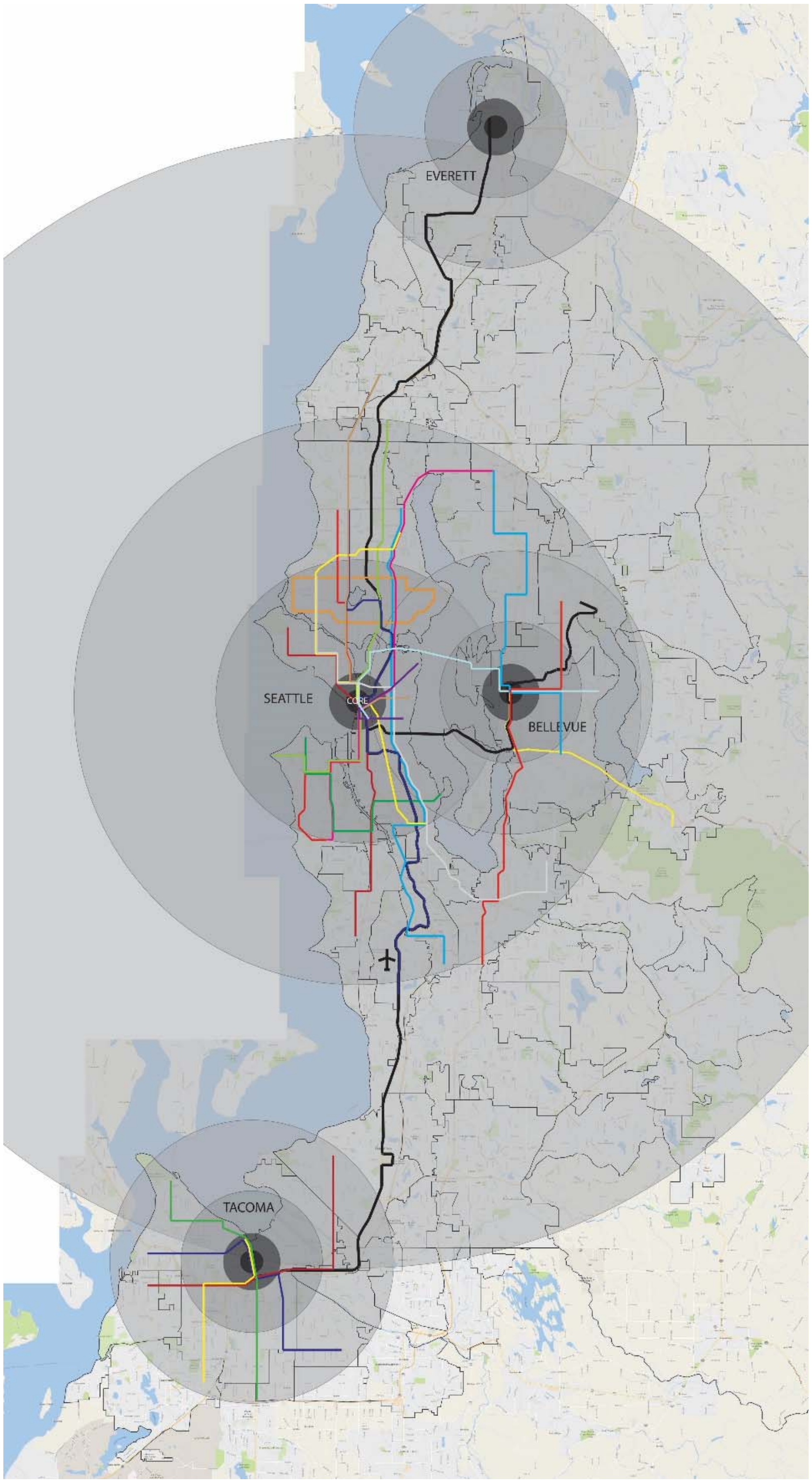
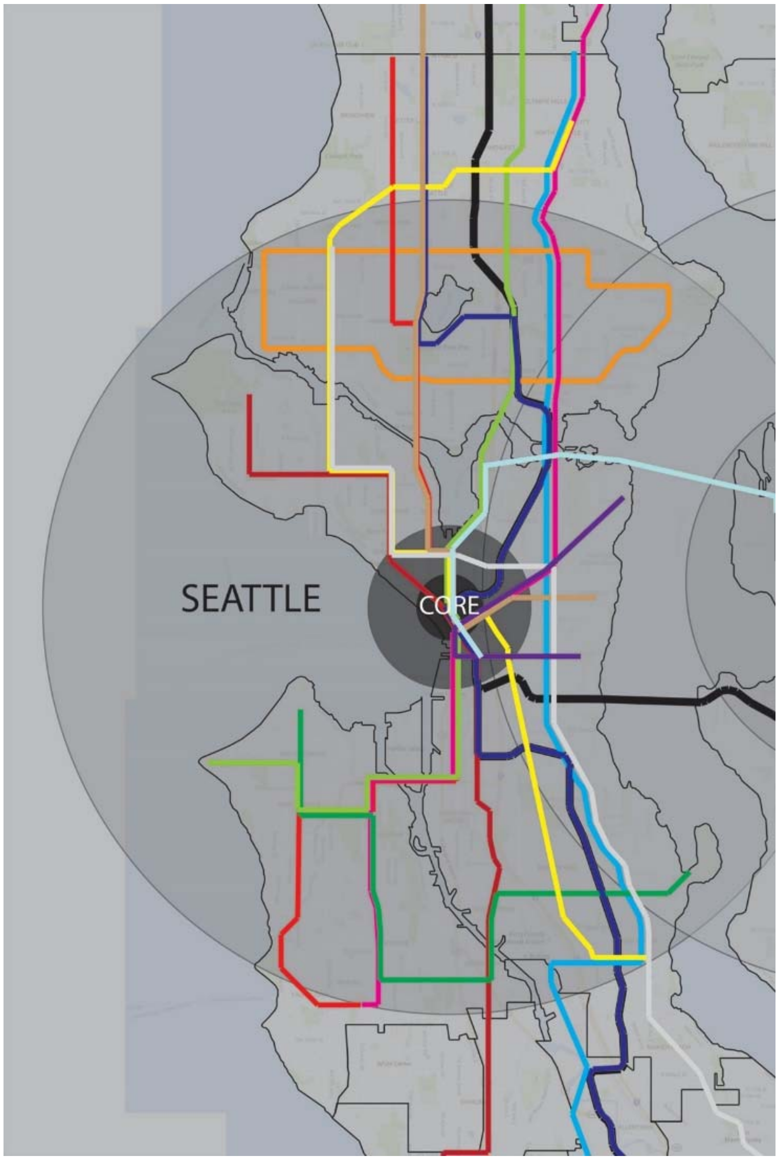


Figure 8.14. Seattle transit urban fabric close-up, detailing an extensive light rail network connecting neighborhoods throughout Seattle.



The third way to build a transit city, in addition to building an overall a more robust rail-based transit network within a 7 to 12.5 mile radius from the core, the Seattle region must prioritize connecting neighborhoods to each other rather than only to the Downtown core. Transit in the Seattle region has become really good at one thing – getting people into and out of Downtown for their commute to and from work, evidenced by the fact that 47 percent of people who work in Downtown Seattle use transit to get to work, with only 30 percent driving alone (Fucoloro 2017). Beyond the commute to work, people are less likely to use transit because it does not always go to the places they need to go, and when it does, the length of the trip in time, uncertainty about connections, and unreliability due to general traffic conditions, make it a less than ideal mode of transportation, especially for non-work trips. Emphasizing new light rail transit only in the ranges shown in Figure 8.10 is a first step towards rebuilding the transit city. My research shows that in order for transit to be effective for a large number of people for all types of trips other than just commuting to work, transit must effectively connect neighborhood centers to each other with reliable and high quality transit – essentially grade separated light rail. This approach is also much more likely to reduce automobile dependence both within the urban fore and around the city. The inability to access neighborhoods outside the urban core is the primary reason why driving remains a dominant mode of transportation. In addition to connecting neighborhoods to each other, transit for the 21st century must connect more residents to recreational opportunities and nature, which are currently very difficult for many people to access by transit.

Seattle Subway, a non-profit community organization, has been advocating for years for expanding light rail throughout the region, and they played a large role in the campaign to pass the ST3 initiative. Figure 8.12 shows their current plan for expanding light rail in Seattle beyond what ST3 will already do. This proposal, however, simply builds on the framework already provided by ST3, rather than proposing a different vision that provides a much more robust light rail system. Figures 8.13 and 8.14 show an alternative vision for a light rail network that takes into consideration the numerous findings from my research. This more robust (and perhaps unrealistic) vision connects each neighborhood in Seattle to each other neighborhood, with no more than one transfer. Additionally, it provides access to numerous places that the traditional public transit system does not, such as city and regional parks. Much of the reasons that the ST3 proposal is suburb heavy is due to equity issues in the distribution of infrastructure within the Sound Transit Service District. More extensive bus routes could continue to serve these more automobile oriented areas, while rail transit in the 12.5 mile radius area would likely induce a greater number of people to walk and use transit. Essentially the same investment in light rail closer to the core where population densities are higher would likely have an overall greater impact on reducing automobile dependence in the region than an equal investment in more suburban and rural areas.

A transit system such as this would help to densify the city within the transit urban fabric, which could have a greater impact in reducing sprawl than existing plans to expand transit. The existing plans to extend transit far into the suburbs encourages more development and associated density farther away from the existing urban centers. This approach would also have an impact on two other aspects of transit development that currently exist, in part, because rail transit is a commodity in the region – housing affordability and gentrification. A more robust and evenly distributed rail transit system would allow existing swaths of single-family homes to be redeveloped into townhomes and row houses (as well as inclusionary zoning regulations that are supportive of this increased density instead of in opposition to it). This missing middle housing stock has the potential to lower housing costs (Hurley 2016) as well as providing more owner occupied housing stock in the city. While the current model of targeting growth the village centers has been successful in Seattle, this approach relies predominantly on mid-rise apartments. This housing stock is primarily rental and occupied by young adults. As this millennial demographic becomes eager homebuyers, they often find the need to relocate far into the suburbs or "drive until they qualify". Since this demographic prefers walking and using transit over driving, many would prefer to stay in the city, but the lack of affordable housing options will increasingly prevent many from doing so, and thus they must make compromises. A more uniform densification of Seattle allowing single family detached homes to be up-zoned to attached single family homes, townhomes, and row houses, would allow current renters to transition into property owners and continue to live in walkable and transit rich neighborhoods. Additionally, because this new housing development would be more distributed throughout the city, it would mitigate many of the effects of gentrification. Gentrification of neighborhood centers with rapid transit is a result of the premium associated with that transit. If this transit is spread throughout the city so that 90 percent or more of residents are within a ten minute walk of a rail station, the premium associated with transit would be greatly reduced.

The final approach to building a transit city requires that planners integrate transit more fully with the pedestrian fabric. In the urban core, light rail transit has been well integrated into the pedestrian urban fabric, but once outside the city, rail transit lines often follow highways. While planning agencies do this to minimize the costs associated with acquiring land, it fails to build on the strengths of transit. Since transit users are also pedestrians, the urban environment must be walkable – especially around transit stations. In order to justify building transit farther into the suburbs, many of these more distant stations incorporate massive park-and-ride lots, so that suburban commuters can drive to the transit station. This emphasis on accommodating automobile commuters, however, can be self-defeating. Transit must first be built within a walkable environment. One of the reasons why transit was so successful in expanding cities was because the areas around train stations were built to be walkable town centers. This is what TOD policies aim to achieve today, but still incorporate automobile infrastructure, which increases the costs and reduces the overall amount of space that can be used for new housing. Transportation planners need to stop promoting transportation plans that simply put public transit in the same places where we have highways, which is essentially what the ST3 plan in Seattle does. People will no doubt use the transit, but its overall effectiveness will be greatly diminished and the urban environment in these outlying areas will be less likely to be transformed if large areas are dedicated to park-and-ride facilities.

Even within the urban core, transit must do a better job integrating into the pedestrian environment and not overwhelm it. Nearly every street in the Downtown commercial core and Belltown and numerous streets in each of the other neighborhoods has some form of transit on it, whether bus or streetcar. Much of this has to do with the dominance of one-way streets, but is also an attempt by transit agencies to ensure that transit routes remain efficient. If efforts were made to make transit rail-based, many of these routes would become redundant, and since the rail would run underground through the urban core, it could more seamlessly be integrated into the pedestrian realm. But even without this long-term transition to rail, a simplification of the bus network would benefit both transit and walkability. The city could develop transit malls – streets that are transit only – that would consolidate bus routes onto fewer streets and would help to prioritize transit over cars. It would help make the urban core more pedestrian friendly by minimizing pedestrian interactions with bus traffic. It could also make the bus system more legible. Currently, some 250 bus routes run through the urban core and the sheer number of buses make using the bus network a somewhat daunting task. Additionally, since walking is already the dominant mode of transportation within the urban core itself, there is less need to have a bus routes on every street.

Prioritizing transit in the right parts of the city/region and building a true transit city is no easy task for Seattle. In the short term, bus-only lanes should be provided wherever possible in order to increase travel times, which are a significant barrier to increased transit use. Beyond this, a long-term vision for transit in Seattle should emphasize the expansion of light rail. This will enable easy travel between neighborhoods, and not just to the Downtown core. In the urban core, SDOT has over-emphasized the development of transit and not fully prioritized pedestrians. Ultimately, this practice does not benefit the transit network, nor does it improve walkability in the urban core. Additionally, at the regional scale, Sound Transit is over-emphasizing light rail transit in low density suburban and rural areas that are automobile dependent. While TOD has been promoted as a way to develop around future light rail stations, Sound Transit will still be incorporating abundant parking in order to entice suburban commuters. By failing to prioritize transit at the appropriate scale, both the city and regional transit agencies are failing to capitalize on the benefits of transit. Additionally, these transit agencies continue to not fully use transit as a way to expand the walking city, and instead use it to replace the automobile city – a strategy that will ultimately prevent the city and region from building and utilizing a true transit urban fabric.

Conclusion

The pedestrian is the foundation of the sustainable city. Building cities that are based on walking – the most efficient mode of transportation that exists – has been the basis for city building for thousands of years. The 19th century saw the expansion of this walkable city through the invention of mass transportation. In the 20th century, the automobile completely transformed urban areas in ways that research has found to be detrimental to urban social life and the environment. Shifting transportation priorities away from the automobile to walking, cycling and public transit has been standard practice in the urban planning profession for 30 years. Together, they form the basis of sustainable transportation systems. However, automobile ownership continues to rise, VMT is on the rise after almost a decade of decline, and pedestrian fatalities have increased. This indicates that the status quo in planning for walkability and transit use is not working.

The European model for planning compact, walkable and transit based cities is based more on a quality of life and livability model, and in many ways is openly hostile to the automobile. For this reason, planners focus on walking and transit as the primary modes of transportation and let the automobile fend for itself. In the US, the automobile remains an integral component of the transportation network, even as planners, policy makers and urban residents make efforts to improve walking and transit infrastructure. This is broadly evident in the mainstream complete streets movement and specifically within many of the projects that the Seattle Department of Transportation has undertaken. This accommodation of the automobile is also reflected in the way planners talk about and promote transit – its sole purpose is to encourage people to not drive. However, public transit in the US remains unenticing for many when compared to the automobile. I believe that the problem is not that Americans are unique in their love affair with the car, but that the urban landscapes planners allow to be created and the way in which we design the built environment does not do enough to fully prioritize walking or transit over driving in a way that elevates it to the top.

This dissertation has explored the relationship between walkability and transit use in the urban core neighborhoods of Seattle. These neighborhoods are by definition walkable – they are dense, have a well connected street network, have destinations close to where people live, have varying degrees of mixed land use, and have good access to transit. The emphasis on walkable neighborhoods has been used to explore the variations that exist between them in terms of their urban form and in their levels of walking and to understand the ways in which walking and transit use are related in dense urban environments. This research finds that the relationship between the two are not always what planners expect (or would like) to find and this has numerous implications for planning practice. The way we design the public space of the street has a significant influence in the way people use the street and planners have significant control over this since the city owns the public right-of-way. Streets that are designed for people walking have more pedestrians, while streets designed for cars have fewer pedestrians. This research has made the argument that we need to prioritize walking in dense urban areas in US cities, even if this means being less accommodating of the automobile.

This research has also shown that there is an over-emphasis of transit development in urban core areas in Seattle, something that I would contend is common in many US cities. While the urban core is expectedly transit rich, this transit must serve to connect neighborhoods throughout the city and be built at a scale in which it is the most efficient mode of transportation. The over-emphasis of public transit in the urban core is detrimental to the development of a true transit city – one that enables a majority of people to travel throughout the city without additional time constraint or burden. The goal of public transit must shift from being a tool to get people out of their cars, to connecting walkable neighborhoods. This simple shift puts public transportation in the position of enabling mobility for all ages and all abilities and promoting accessibility. This is in contrast to the way that many people still view public transit, which is in a more negative light that attempts to decrease a person's freedom of mobility and choice that come with the automobile. It is time that transportation planning in the US actually plan for all people, and not for the needs of the lone automobile. Developing an extensive light rail network that is fast and reliable and is fully integrated into the pedestrian urban fabric would significantly alter the perception of public transit. No longer would it be a commodity, but a viable choice for everyone to get around the city and meet all their transportation needs.

A common criticism of current transportation planning is its active role in a 'war on cars'. In our age of all or nothing politics, there seem to be only two positions for the transportation planner to have – be entirely for cars or entirely against them in favor of walking, biking and transit. These two extremes, however, ignore the fact that different modes of transportation are most suitable to different parts of the city. This approach argues for the prioritization of modes based on a geographic scale, which is in contract to the existing approach in planning that seeks to balance the modes more evenly throughout the city or region. This perspective is reminiscent of Lewis Mumford in his 1958 essay "The Highway and the City", in which he argues that pedestrians are the most efficient mode of transportation in a city, but that both public transportation and the automobile have a role in the modern transportation system. What remains a challenge for planners today is to define those roles and plan the city accordingly. Ultimately, the case of Seattle shows the problems evident in current transportation practice and the way it attempts to simultaneously plan for walking, transit and driving through the city and not prioritize different modes in different parts of the city.

This dissertation has shown that planners need a new way to conceptualize the street, the neighborhood, the city, and the region in a way that more fully prioritizes walking and transit in a way that current practice does not do – by prioritizing walking, transit (and even driving) in the areas of the city where they are most efficient. My dissertation has shown how walking varies based on the type on infrastructure that is dominant at the block and neighborhood scale – whether pedestrian, transit or automobile infrastructure. Neighborhoods and blocks with more pedestrian infrastructure, access to reliable and convenient rapid transit, and minimal impacts from automobile related uses, have more pedestrians. This shows that the way we design our streets and the amount of space that we dedicate to each mode of transportation does have an impact on what mode of transportation that street prioritizes. In central city neighborhoods, like the Seattle urban core, streets must prioritize pedestrians. In the transit city, streets must prioritize transit and walking and ensure that transit is a part of the pedestrian environment. And in other parts, perhaps it is ok that streets prioritize automobile traffic, so long as pedestrian comfort and safety are a primary concern in the design of the street. Streets are a vital public space that planners must treat as such. Planners can create sustainable and livable cities by rebuilding a vibrant pedestrian realm, by connecting neighborhoods with efficient, reliable and comfortable transit, and defining a limited role for the automobile in the city. Only then will urban planners be free of the century-old burden of catering to the needs of the automobile before meeting the needs of people.

References

Agrawal, Asha Weinstein, Marc Schlossberg, and Katja Irvin. 2008. "How Far, by Which Route and Why? A Spatial Analysis of Pedestrian Preference." *Journal of Urban Design* 13 (1): 81–98. doi:10.1080/13574800701804074.

Alfonzo, Mariela A. 2005. "To Walk or Not to Walk? The Hierarchy of Walking Needs." *Environment and Behavior* 37 (6): 808–36. doi:10.1177/0013916504274016.

Alfonzo, Mariela, Marlon G Boarnet, Kristen Day, Tracy Mcmillan, and Craig L Anderson. 2008. "The Relationship of Neighbourhood Built Environment Features and Adult Parents' Walking." *Journal of Urban Design* 13 (1): 29–51. doi:10.1080/13574800701803456.

Alliance for Pioneer Square. 2013. "Alley Corridor Project in Pioneer Square." http://allianceforpioneersquare.org/2013/08/alley-corridor-project-in-pioneer-square/.

Altshuler, Alan A, and David E Luberoff. 2003. *Mega-Projects: The Changing Politics of Urban Public Investment*. Washington, DC: The Brookings Institute.

America Walks. 2017. "New York: Slow Zones." http://americawalks.org/new-york-slow-zones/.

Appleyard, Donald. 1981. *Livable Streets*. Berkeley, CA: University of California Press.

Baker, Dwayne Marshall, and Bumsoo Lee. 2017. "How Does Light Rail Transit (LRT) Impact Gentrification? Evidence from Fourteen US Urbanized Areas." *Journal of Planning Education and Research*, June, 1–15. doi:10.1177/0739456X17713619.

Balk, Gene. 2017. "Seattle Once Again Nation's Fastest-Growing Big City; Population Exceeds 700,000." *The Seattle Times*, May 25. http://www.seattletimes.com/seattle-news/data/seattle-once-again-nations-fastest-growing-big-city-population-exceeds-700000/.

Barnett, Erica C. 2015. "Seattle's Parking Proposals Are Reality-Size." *Seattle Transit Blog*, May 7. https://seattletransitblog.com/2015/05/07/seattles-parking-proposals-are-reality-size/.

Bartholomew, Keith, and Reid Ewing. 2011. "Hedonic Price Effects of Pedestrian- and Transit-Oriented Development." *Journal of Planning Literature* 26 (1): 18–34. doi:10.1177/0885412210386540.

Bausells, Marta. 2016. “Superblocks to the Rescue: Barcelona’s Plan to Give Streets back to Residents.” *The Guardian*, May 17. https://www.theguardian.com/cities/2016/may/17/superblocks-rescue-barcelona-spain-plan-give-streets-back-residents.

Beatley, Timothy. 2000. *Green Urbanism: Learning from European Cities*. Washington, DC: Island Press.

———. 2004. *Native to Nowhere*. Washington, DC: Island Press.

———. 2012. *Green Cities of Europe*. Washington, DC: Island Press.

Becker, Paula. 2002. “Washington Establishes an Office for Clearing the Route of Seattle Freeway (Interstate 5) on April 1, 1957.” *History Link*. http://www.historylink.org/File/4168.

Beekman, Daniel. 2017. “Taller Buildings Coming: Seattle Council Approves Upzone in Downtown, South Lake Union.” *The Seattle Times*, April 10. http://www.seattletimes.com/seattle-news/politics/taller-building-coming-seattle-council-approves-upzone-in-downtown-south-lake-union/.

Bernard, H Russell. 2011. “Interviewing I: Unstructured and Semistructured.” In *Research Methods in Anthropology: Qualitative and Quantitative Approaches*. New York, NY: AltaMira Press.

Bliss, Laura. 2017. “Oslo Is on Track for a Car-Free Future.” *CityLab*, April 13. https://www.citylab.com/transportation/2017/04/oslo-is-on-track-for-a-car-free-future/522882/.

Bogue, Virgil G. 1911. “Plan of Seattle.” https://ia801407.us.archive.org/29/items/planseattlerepo00bogugoog/planseattlerepo00bogugoog.pdf.

Bohl, Charles C, and Elizabeth Plater-Zyberk. 2006. “Building Community across the Rural-to-Urban Transect.” *Places* 18 (1): 4–17.

Bokhari, Sheharyar. 2016. “How Much Is a Point of Walk Score Worth?,” August 3. https://www.redfin.com/blog/2016/08/how-much-is-a-point-of-walk-score-worth.html.

Brain, David. 2006. “Democracy and Urban Design: The Transect as Civic Renewal.” *Places* 18 (1): 18–23.

Bruegmann, Robert. 2005. *Sprawl: A Compact History*. Chicago, IL: The University of Chicago Press.

Caldbick, John. 2014. “Yesler, Henry L (1810?-1892).” *History Link*. http://www.historylink.org/File/286.

Campoli, Julie. 2012. *Made for Walking: Density and Neighborhood Form*. Cambridge, MA: Lincoln Institute of Land Policy.

Canter, David. 1983. “The Purposive Evaluation of Places.” *Environment and Behavior* 15 (6): 659–98.

Carr, Tom. 2000. “Elevated Transportation Company: Extending the Monorail (Seattle).” *History Link*. http://www.historylink.org/File/2534.

Cervero, Robert. 2002. “Built Environments and Mode Choice: Toward a Normative Framework.” *Transportation Research Part D: Transport and Environment* 7 (4): 265–84. doi:10.1016/S1361-9209(01)00024-4.

Cervero, Robert, and Kara Kockelman. 1997. “Travel Demand and the 3Ds: Density, Diversity, and Design.” *Transportation Research Part D: Transport and Environment* 2 (3): 199–219. doi:10.1016/S1361-9209(97)00009-6.

Chatman, Daniel G. 2013. “Does TOD Need the T?” *Journal of the American Planning Association* 79 (1): 17–31. doi:10.1080/01944363.2013.791008.

City of Seattle. 1994. “Seattle Comprehensive Plan: Toward a Sustainable Seattle.” Seattle, WA.

———. 2016a. “Commute Trip Reduction Program.” http://www.seattle.gov/waytogo/ctr.htm.

———. 2016b. “Complete Streets in Seattle.” http://www.seattle.gov/transportation/completestreets.htm.

———. 2016c. “Your Neighborhood, Your CTR Goals!” http://www.seattle.gov/waytogo/goals.htm.

———. 2017. “Vision Zero.” http://www.seattle.gov/visionzero.

City Repair. 2003. “Placemaking Guidebook.” http://www.cityrepair.org/.

Cohen, Josh. 2016. “How Seattle Blew Its Chance at a Subway System: A Look Back at the Failed Forward Thrust Initiative.” *Crosscut*, October 14. http://features.crosscut.com/seattle-forward-thrust-sound-transit.

Commute Seattle. 2017. “How Do You Get There, Seattle?” https://commuteseattle.com/modesplit/.

Condon, Patrick M. 2010. *Seven Rules for Sustainable Communities: Design Strategies for the Post Carbon World*. Washington, DC: Island Press.

Corburn, Jason. 2009. *Toward the Healthy City: People, Places and the Politics of Urban Planning*. Cambridge, MA: MIT Press.

Crawford, J H. 2000. *Carfree Cities*. Utrecht: International Books.

———. 2009. *Carfree Design Manual*. Utrecht: International Books.

Creswell, John W. 2009. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Third. Thousand Oaks, CA: Sage Publications.

Cronon, William. 1991. *Nature's Metropolis: Chicago and the Great West*. New York, NY: W.W. Norton.

Crowley, Walt. 1999. "Seattle Neighborhoods: Belltown-Denny Regrade - Thumbnail History." *History Link*. http://www.historylink.org/File/1123.

———. 2000. "Voters in King, Snohomish, and Pierce Counties Reject Regional Transit Plan on March 14, 1995." *History Link*. http://www.historylink.org/File/2677.

Dicker, Rachel. 2016. "These 10 Cities Have the Worst Traffic in America." *U.S. News and World Report*, March 15. https://www.usnews.com/news/slideshows/worst-traffic-cities-in-america-ranked.

Diltz, Colin. 2016a. "These 7 Photos Reveal How I-5 Construction Tore through Old Seattle." *The Seattle Times*, January 27. http://www.seattletimes.com/seattle-news/transportation/these-7-photos-reveal-how-i-5-construction-tore-through-old-seattle/.

———. 2016b. "More than 100 Years Ago, Streetcars Ran throughout Seattle. Here's How They Met Their Demise." *The Seattle Times*, December 15. http://www.seattletimes.com/seattle-news/transportation/more-than-100-years-ago-streetcars-ran-throughout-seattle-heres-how-they-met-their-demise/.

Dittmar, Hank, and Gloria Ohland. 2004. *The New Transit Town: Best Practices in Transit-Oriented Development*. Washington, DC: Island Press.

Dong, Hongwei. 2017. "Does Walkability Undermine Neighbourhood Safety?" *Journal of Urban Design* 22 (1): 59–75. doi:10.1080/13574809.2016.1247644.

Duany, Andres, Elizabeth Plater-Zyberk, and Jeff Speck. 2000. *Suburban Nation: The Rise of Sprawl and the Decline of the American Dream*. New York, NY: North Point Press.

Duany, Andrés, and Emily Talen. 2002. "Transect Planning." *Journal of the American Planning Association* 68 (3): 245–66. doi:10.1080/01944360208976271.

Dunham-Jones, Ellen, and June Williamson. 2009. *Retrofitting Suburbia: Urban Design Solutions for Redesigning Suburbs*. Hoboken, NJ: John Wiley and Sons, Inc.

Englehardt, Bruce. 2017. "Our Subway Plan, Rejected 105 Years Ago." *Seattle Transit Blog*, March 7.

Engwicht, David. 1999. *Street Reclaiming: Creating Livable Streets and Vibrant Communities*. Gabriola Island, BC: New Society Publishers.

European Commission. 2009. "Reclaiming City Streets for People: Chaos or Quality of Life?" http://ec.europa.eu/environment/pubs/pdf/streets_people.pdf.

Ewing, Reid. 1997. "Is Los Angeles-Style Sprawl Desirable?" *American Planning Association. Journal of the American Planning Association* 63 (1): 107–26. doi:10.1080/01944369708975728.

Ewing, Reid, and Robert Cervero. 2010. "Travel and the Built Environment." *Journal of American Planning Asscociation* 76 (3): 265–94.

———. 2017. "'Does Compact Development Make People Drive Less?' The Answer Is Yes." *Journal of the American Planning Association* 83 (1): 19–25. doi:10.1080/01944363.2016.1245112.

Ewing, Reid, and Shima Hamidi. 2015. "Compactness versus Sprawl: A Review of Recent Evidence from the United States." *Journal of Planning Literature* 30 (4): 413–32. doi:10.1177/0885412215595439.

Ewing, Reid, and Susan Handy. 2009. "Measuring the Unmeasurable: Urban Design Qualities Related to Walkability." *Journal of Urban Design* 14 (1): 65–84.

Fife-Schaw, Chris. 2006. "Questionnaire Design." In *Research Methods in Psychology*, edited by Glynis M Breakwell, Sean Hammond, Chris Fife-Schaw, and Jonathan A Smith, 210–31. Thousand Oaks, CA: Sage Publications.

Florida, Richard. 2002. *The Rise of the Creative Class*. New York, NY: Basic Books.

Forsyth, Ann. 2015. "What Is a Walkable Place? The Walkability Debate in Urban Design." *Urban Design International* 20 (4): 274–92. doi:10.1057/udi.2015.22.

Frank, Lawrence D. 2000. "Land Use and Transportation Interaction - Implications on Public Health and Quality of Life." *Journal of Planning Education and Research* 20 (1): 6–22.

Frank, Lawrence D, and Gary Pivo. 1994. "Impacts of Mixed Use and Density on Utilization of Three Modes of Travel: Single-Occupant Vehicle, Transit and Walking." *Transportation Research Record* 1466: 44–52.

Frank, Lawrence Douglas, Brian E Saelens, Ken E Powell, and James E Chapman. 2007. "Stepping towards Causation: Do Built Environments or Neighborhood and Travel Preferences Explain Physical Activity, Driving, and Obesity?" *Social Science and Medicine* 65 (9): 1898–1914. doi:10.1016/j.socscimed.2007.05.053.

Frey, Hildebrand. 1999. *Designing the City: Towards a More Sustainable Urban Form*. Hoboken, NJ: John Wiley and Sons, Inc.

Frumkin, Howard, Lawrence Frank, and Richard Jackson. 2004. *Urban Sprawl and Public Health: Designing, Planning and Building for Healthy Communities*. Washington, DC: Island Press.

Fucoloro, Tom. 2017. "Only 5% of New Downtown Seattle Commute Trips Are Made by Driving Alone, but Biking Is Flat." *Seattle Transit Blog*, February 9. http://www.seattlebikeblog.com/2017/02/09/only-5-of-new-downtown-seattle-commute-trips-are-made-by-driving-alone-but-biking-is-flat/.

Gayah, Vikash V. 2012. "Two-Way Street Networks: More Efficient than Previously Thought?" *Access* 41 (Fall 2012).

Gehl, Jan. 2010. *Cities for People*. Washington, DC: Island Press.

Gehl, Jan, and Birgitte Svarre. 2013. *How to Study Public Life*. Washington, DC: Island Press.

Gehl Architects. 2009. "Downtown Seattle: Public Spaces and Public Life." http://www.seattle.gov/council/attachments/2010_publicspaces_publiclife.pdf.

Gilderbloom, John. 2016. "Ten Commandments of Urban Regeneration: Creating Healthy, Safe, Affordable, Sustainable, and Just Neighbourhoods." *Local Environment* 21 (5): 653–60. doi:10.1080/13549839.2015.1005467.

Gillham, Oliver. 2002. *The Limitless City: A Primer on the Urban Sprawl Debate*. Washington, DC: Island Press.

Gordon, Peter, and Harry Richardson. 1997. "Are Compact Cities a Desireable Planning Goal?" *Journal of the American Planning Association* 63 (1): 95–106.

Greenwald, Michael, and Marlon Boarnet. 2001. "Built Environment as Determinant of Walking Behavior: Analyzing Nonwork Pedestrian Travel in Portland, Oregon." *Transportation Research Record: Journal of the Transportation Research Board* 1780 (January): 33–41. doi:10.3141/1780-05.

Groat, Linda, and David Wang. 2013. *Architectural Research Methods*. Second. Hoboken, NJ: John Wiley and Sons, Inc.

Groff, Elizabeth R, Ralph B Taylor, David B Elesh, Jennifer McGovern, and Lallen Johnson. 2014. "Permeability across a Metropolitan Area: Conceptualizing and Operationalizing a Macrolevel Crime Pattern Theory." *Environment and Planning A* 46 (1): 129–52. doi:10.1068/a45702.

Gutman, David. 2017a. "Settlement: Seattle to Build Thousands of Sidewalk Curb Ramps over next 18 Years." *The Seattle Times*, July 17. https://www.seattletimes.com/seattle-news/transportation/settlement-seattle-to-build-thousands-of-sidewalk-curb-ramps-over-next-18-years/.

———. 2017b. "Here's Where Seattle Mayoral Candidates Stand on Big Transportation Issues." *The Seattle Times*, July 22. http://www.seattletimes.com/seattle-news/transportation/heres-where-seattle-mayoral-candidates-stand-on-big-transportation-issues/.

Guy, Simon, and Simon Marvin. 2000. "Models and Pathways: The Diversity of Sustainable Urban Futures." In *Acheiving Sustainable Urban Form*, edited by Katie Williams, Elizabeth Burton, and Mike Jenks. New York, NY: Spon Press.

Hamidi, Shima, Reid Ewing, Ilana Preuss, and Alex Dodds. 2015. "Measuring Sprawl and Its Impacts: An Update." *Journal of Planning Education and Research* 35 (1): 35–50. doi:10.1177/0739456X14565247.

Handy, Susan. 2017. "Thoughts on the Meaning of Mark Stevens's Meta-Analysis." *Journal of the American Planning Association* 83 (1): 26–28. doi:10.1080/01944363.2016.1246379.

Hass-Klau, Carmen. 2015. *The Pedestrian and the City*. New York, NY: Routledge.

Holston, James. 1989. *The Modernist City: An Anthropoligical Critique of Brasilia*. Chicago, IL: The University of Chicago Press.

Humpel, Nancy, Neville Owen, Don Iverson, Eva Leslie, and Adrian Bauman. 2004. "Perceived Environment Attributes, Residential Location, and Walking for Particular Purposes." *American Journal of Preventive Medicine* 26 (2): 119–25. doi:10.1016/j.amepre.2003.10.005.

Hurley, Amanda Kolson. 2016. "Will U.S. Cities Design Their Way Out of the Affordable Housing Crisis?" *Next City*, January 18. https://nextcity.org/features/view/cities-affordable-housing-design-solution-missing-middle.

Jabareen, Yosef Rafeq. 2006. "Sustainable Urban Forms: Their Typologies, Models, and Concepts." *Journal of Planning Education and Research*. doi:10.1177/0739456X05285119.

Jacks, Ben. 2004. "Reimagining Walking: Four Practices." *Journal of Architectural Education* 57 (3): 5–9. doi:10.1162/104648804772745193.

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

Jamieson, Robert L. 2005. "Time to Join the Mayor and Jump off Monorail." *Seattle Post Intelligencer*, September 16. http://www.seattlepi.com/default/article/Time-to-join-the-mayor-and-jump-off-monorail-1183156.php.

jseattle. 2017. "Madison BRT, Now RapidRide G, Rounding out Pedestrian, Bike Elements with Aim for 2019 Start of Service." *Capitol Hill Seattle Blog*, March 1. http://www.capitolhillseattle.com/2017/03/madison-brt-now-rapidride-g-rounding-out-pedestrian-bike-elements-with-aim-for-2019-start-of-service/.

Kazis, Noah. 2011. "New York's Car Ownership Is On the Rise." *Streets Blog*, April 6. http://www.streetsblog.org/2011/04/06/new-yorks-car-ownership-rate-is-on-the-rise/.

Keeley, Sean. 2016. "$74 Million Later, Mercer Mess Has Improved by Two Seconds." *Curbed Seattle*, October 17. https://seattle.curbed.com/2016/10/17/13307466/mercer-mess-two-seconds-traffic-street.

Kickert, Conrad Christiaan. 2014. "Active Centers - Interactive Edges." University of Michigan.

Kim, Joongsub. 2007. "Perceiving and Valuing Sense of Community in a New Urbanist Development: A Case Study of Kentlands." *Journal of Urban Design* 12 (2): 203–30.

King County Assessor. 2016. "King County Assessor Local Scape." http://localscape.property/#kingcountyassessor/.

King County Metro. n.d. "Milestones." http://metro.kingcounty.gov/am/history/history.html.

———. 2017a. "Key Data: 10-Year Summary." https://docs.google.com/spreadsheets/d/1Qyj31NiW1kc30GX9PCNrmnAn_EEmPn8WaUB_NMkYCQE/pubhtml.

———. 2017b. "RapidRide." http://metro.kingcounty.gov/travel-options/bus/rapidride/.

———. 2017c. "System Maps." http://kingcounty.gov/depts/transportation/metro/schedules-maps/maps/system.aspx.

Kinney, J. Bryan, Patricia L. Brantingham, Kathryn Wuschke, Michael G. Kirk, and Paul J. Brantingham. 2008. "Crime Attractors, Generators and Detractors: Land Use and Urban Crime Opportunities." *Built Environment* 34 (1): 62–74.

Kotkin, Joel. 2016. *The Human City: Urbanism for the Rest of Us*. Chicago, IL: Agate Publishing.

Kreis, Karen. 2002. "The Urban Centers and Urban Villages Strategy of Seattle."

Kushner, James A. 2004. *The Post-Automobile City: Legal Mechanism to Establish the Pedestrian-Friendly City*. Durham, NC: Carolina Academic Press.

Lange, Greg. 1999. "Seattle's Great Fire." *History Link*. http://www.historylink.org/File/715.

Lange, Larry. 2007. "Proposition 1: Voters Hit the Brakes." *Seattle Post Intelligencer*, November 6. http://www.seattlepi.com/local/transportation/article/Proposition-1-Voters-hit-the-brakes-1254869.php.

Laschever, Eric S. 1998. "An Overview of Washington's Growth Management Act." *Pacific Rim Law and Policy Journal* 7 (3): 657–77. https://digital.law.washington.edu/dspace-law/bitstream/handle/1773.1/872/7PacRimLPolyJ657.pdf?sequence=1.

Lee, Chanam, and Anne Vernez Moudon. 2004. "Physical Activity and Environment Research in the Health Field: Implications for Urban and Transportation Planning Practice and Research." *Journal of Planning Literature* 19 (2): 147–81. doi:10.1177/0885412204267680.

———. 2008. "Neighbourhood Design and Physical Activity." *Building Research & Information* 36 (5): 395–411. doi:10.1080/09613210802045547.

Leinberger, Christopher B. 2012. *The Walk UP Wake-Up Call: The Nation's Capital as a National Model for Walkable Urban Places*. Washington, DC: The George Washington University School of Business.

Leinberger, Christopher B, and Patrick Lynch. 2014. "Foot Traffic Ahead: Ranking Walkable Urbanism in America's Largest Metros." http://www.smartgrowthamerica.org/documents/foot-traffic-ahead.pdf.

Levine, Jonathan. 2006. *Zoned Out: Regulation, Markets and Choices in Transportation and Metropolitan Land Use*. Washington, DC: RFF Press.

Levine, Jonathan, Joe Grengs, Qingyun Shen, and Qing Shen. 2012. "Does Accessibility Require Density or Speed?" *Journal of the American Planning Association* 78 (2): 157–72. doi:10.1080/01944363.2012.677119.

Lewis, Harold M. 1925. *Highway Traffic in New York and Its Environs*. New York, NY: Regional Plan of New York and Its Environs.

Lewis, Marilyn. 2017. "The 30 U.S. Cities With the Best Public Transit." *MSN Money*, April 17. http://www.msn.com/en-us/money/realestate/the-30-us-cities-with-the-best-public-transit/ss-BBzWgyc#image=30.

Lindblom, Mike. 2009. "Streetcar Cost Overruns: What about the next Line?" *The Seattle Times*, December 23. http://www.seattletimes.com/seattle-news/streetcar-cost-overruns-what-about-the-next-line/.

———. 2012. “RapidRide Buses Not so Fast in Ballard, Speedy in West Seattle.” *The Seattle Times*, November 27. http://www.seattletimes.com/seattle-news/rapidride-buses-not-so-fast-in-ballard-speedy-in-west-seattle/.

———. 2014. “First Hill Streetcar Delayed: Line Is Ready, Streetcars Are Not.” *The Seattle Times*, September 23. http://www.seattletimes.com/seattle-news/first-hill-streetcar-delayed-line-is-ready-streetcars-are-not/.

———. 2016a. “Seattle’s First Hill Streetcar to Open Saturday with Free Rides.” *The Seattle Times*, January 22. http://www.seattletimes.com/seattle-news/transportation/seattles-first-hill-streetcar-to-open-saturday-with-free-rides/.

———. 2016b. “University Link Light-Rail Service Starts March 19.” *The Seattle Times*, January 26. http://www.seattletimes.com/seattle-news/transportation/university-link-light-rail-service-starts-march-19/.

———. 2016c. “Sound Transit to Add Longer Trains to Meet Unexpected Light-Rail Demand.” *The Seattle Times*, March 23. http://www.seattletimes.com/seattle-news/transportation/sound-transit-to-add-bigger-trains-to-meet-ridership-demands/.

Loukaitou-Sideris, Anastasia. 1999. “Hot Spots of Bus Stop Crime.” *Journal of the American Planning Association* 65 (4): 395–411. doi:10.1080/01944369908976070.

Loukaitou-Sideris, Anastasia, Robin Liggett, and Hiroyuki Iseki. 2002. “The Geography of Transit Crime.” *Journal of Planning Education and Research* 22 (2): 135–51. doi:10.1177/0739456X02238443.

Low, Setha M. 1997. “Urban Public Spaces as Representations of Culture: The Plaza in Costa Rica.” *Environment and Behavior* 29 (1): 3–33.

Lukez, Paul. 2007. *Suburban Transformations*. New York, NY: Princeton Architectural Press.

Lund, Hollie. 2003. “Testing the Claims of New Urbanism: Local Access, Pedestrian Travel, and Neighboring Behaviors.” *Journal of the American Planning Association* 69 (4): 414–29. doi:10.1080/01944360308976328.

Lusk, Anne. 2001. “Greenways’ Places of the Heart: Aesthetic Guidelines for Bicycle Paths.” University of Michigan.

Lynch, Kevin. 1960. *The Image of the City*. Cambridge, MA: MIT Press.

Madrid, Cienna. 2012. “The Old Parking Fight Is Over! (Let the New Parking Fight Begin...).” *The Stranger*, May 2. http://www.thestranger.com/seattle/the-old-parking-fight-is-over-let-the-new-parking-fight-begin/Content?oid=13534890.

Malott, Paige, and Ben Broesamle. 2017. “The Center City Connector Is A Critical, High Quality Transit Project.” *The Urbanist*, October 18. https://www.theurbanist.org/2017/10/18/center-city-connector-critical-high-quality-transit-project/.

Mantho, Robert. 2015. *The Urban Section: An Analytical Tool for Cities and Streets*. New York, NY: Routledge.

Manville, Michael. 2017. “Travel and the Built Environment: Time for Change.” *Journal of the American Planning Association* 83 (1): 29–32. doi:10.1080/01944363.2016.1249508.

Marchetti, Cesare. 1994. “Anthropological Invariants in Travel Behavior.” *Technical Forecasting and Social Change* 47 (1): 75–78.

Marshall, Stephen. 2005. *Streets and Patterns*. New York, NY: Spon Press.

Marshall, Wesley E, and Norman W Garrick. 2010. “Street Network Types and Road Safety: A Study of 24 California Cities.” *URBAN DESIGN International* 15 (3): 133–47. doi:10.1057/udi.2009.31.

Mayo, Justin, and Mike Lindblom. 2016. “See How the Sound Transit Vote Went in Your Neighborhood — and Everywhere Else.” *The Seattle Times*, November 12. http://www.seattletimes.com/seattle-news/transportation/planned-light-rail-areas-big-backers-of-sound-transit-3/.

McCann, Barbara A, and Suzanne Runne. 2010. *Complete Streets: Best Policy and Implementation Practices*. Chicago, IL: American Planning Association.

McHarg, Ian L. 1969. *Design with Nature*. Garden City, NY: The Natural History Press.

McRoberts, Patrick. 1998. “Seattle Defeats Bogue Improvement Plan on March 5, 1912.” *History Link*. http://www.historylink.org/File/160.

———. 1999. “King County Voters on Forward Thrust Bonds Approve Stadium and Aquarium and Nix Transit on February 13, 1968.” *History Link*.

Mees, Paul. 2010. *Transport for Suburbia: Beyond the Automobile Age*. Sterling, VA: Earthscan.

Miller, Jody. 2012. “Sustainable Urban Form.” In *Sustainable Urban Environments: An Ecosystem Approach*, edited by Ellen Van Buren, Hein Van Bohemen, Laure Itard, and Henk Visscher. New York, NY: Springer.

Mullins, William H. 2014. “The Persistence of Progresivism: James Ellis and the Forward Thrust Campaign.” Center for the Study of the Pacific Northwest. http://www.washington.edu/uwired/outreach/cspn/Website/Articles/Mullins/ForwardThrust.html.

Mumford, Lewis. 1961. *The City in History: Its Origins and Transformations*. New York, NY: Harcourt, Brace and World.

———. 1981. “The Highway and the City.” In *The Highway and the City*, 234–46. Westport, CT: Greenwood Press Publishers.

Muoio, Danielle. 2017. “The 13 US Cities with the Absolute Worst Traffic.” *Business Insider*, May 23. http://www.businessinsider.com/13-us-cities-worst-traffic-2017-5/#6-miami-received-a-score-of-30-a-2-increase-from-the-year-prior-8.

Murakami, Kery. 2008. “Monorail Agency Officially Dissolves; Cost Taxpayers $125 Million.” *Seattle Post Intelligencer*, January 17. http://www.seattlepi.com/local/transportation/article/Monorail-agency-officially-dissolves-cost-1262011.php.

National Association of Realtors. 2013. “Realtors Report Americans Prefer to Live in Mixed-Use, Walkable Communities.”

———. 2015. “Millenials Favor Walkable Commumities, Says New NAR Poll.”

Nelson, Arthur C. 2017. “Compact Development Reduces VMT: Evidence and Application for Planners—Comment on ‘Does Compact Development Make People Drive Less?’” *Journal of the American Planning Association* 83 (1): 36–41. doi:10.1080/01944363.2016.1246378.

New York City Department of Transportation. 2010. “The New York City Pedestrian Safety Study and Action Plan.” New York, NY. http://www.nyc.gov/html/dot/downloads/pdf/nyc_ped_safety_study_action_plan.pdf.

Newman, Oscar. 1972. *Defensible Space: Crime Prevention through Urban Design*. New York, NY: Macmillan.

Newman, Peter, and Jeffrey Kenworthy. 1999. *Sustainability and Cities: Overcoming Automobile Dependence*. Washington, DC: Island Press.

———. 2015. *The End of Automobile Dependence: How Cities Are Moving Beyond Car-Based Planning*. Washington, DC: Island Press.

Newman, Peter, Leo Kosonen, and Jeff Kenworthy. 2016. “Theory of Urban Fabrics: Planning the Walking, Transit/public Transport and Automobile/motor Car Cities for Reduced Car Dependency.” *Town Planning Review* 87 (4): 429–58. doi:10.3828/tpr.2016.28.

NYCDOT. 2017. “Neighborhood Slow Zones.” http://www.nyc.gov/html/dot/html/motorist/slowzones.shtml.

O'Sullivan, Feargus. 2017. "Barcelona's Car-Taming 'Superblocks' Meet Resistance." *CityLab*, January 20. https://www.citylab.com/transportation/2017/01/barcelonas-car-taming-superblocks-meet-resistance/513911/.

Oldham, Kit. 2006. "Metro: Municipality of Metropolitan Seattle." *History Link*. http://www.historylink.org/File/7813.

One Center City. 2017a. "One Center City." http://onecentercity.org/.

———. 2017b. "One Center City Fact Sheet." http://onecentercity.org/about.

Osowski, Kaylee. 2016. "Seattle City Hall Presses Pause on Broadway Streetcar Extension." *Capitol Hill Seattle Blog*, December 13. http://www.capitolhillseattle.com/2016/12/seattle-city-hall-presses-pause-on-broadway-streetcar-extension/.

Ostrow, Mark. 2017. "Adaptive Signal System Kicks Pedestrians To The Curb." *The Urbanist*, June 9. https://www.theurbanist.org/2017/06/09/adaptive-signal-system-kicks-pedestrians-curb/.

Owen, David. 2004. "Green Manhattan: Everywhere Should Be More Like New York." *The New Yorker*, October.

———. 2009. *Green Metropolis: Why Living Smaller, Living Closer, and Driving Less Are the Keys to Sustainability*. New York, NY: Riverhead Books.

Owen, Neville, Nancy Humpel, Eva Leslie, Adrian Bauman, and James F Sallis. 2004. "Understanding Environmental Influences on Walking." *American Journal of Preventive Medicine* 27 (1): 67–76. doi:10.1016/j.amepre.2004.03.006.

Packer, Ryan. 2016. "Waterfront Design Predictably Disappoints Seattle." *The Urbanist*, November 3. https://www.theurbanist.org/2016/11/03/waterfront-design-predictably-disappoints-seattle/.

———. 2017a. "South Lake Union Is For Cars." *The Urbanist*, April 27. https://www.theurbanist.org/2017/04/27/south-lake-union-cars/.

———. 2017b. "One Center City Finally Finds Mode Balance." *The Urbanist*, September 18. https://www.theurbanist.org/2017/09/18/one-center-city-finally-finds-mode-balance/.

Penketh, Anne. 2014. "Paris Mayor Announces Plans to Ban Diesel Cars from French Capital by 2020." *The Guardian*, December 7. http://www.theguardian.com/world/2014/dec/07/paris-mayor-hidalgo-plans-ban-diesel-cars-french-capital-2020.

Perry, Clarence, Wayne Heydecker, and Thomas Adams. 1929. "Regional Survey of New York and Its Environs Volume 7: Neighborhood and Community Planning, Comprising Three Monographs."

Putnam, Robert D. 2000. *Bowling Alone: The Collapse and Revivial of American Community*. New York, NY: Simon & Schuster Paperbacks.

Quastel, Noah, Markus Moos, and Nicholas Lynch. 2012. "Sustainability-As-Density and the Return of the Social: The Case of Vancouver, British Columbia." *Urban Geography*. doi:10.2747/0272-3638.33.7.1055.

Regional Transit Authority. 1996. "Sound Move: The Ten-Year Regional Transit System Plan." Seattle, WA. https://www.soundtransit.org/sites/default/files/documents/pdf/news/reports/soundmove/199605_soundmovethetenyearregionaltransitsystemplan.pdf.

Riggs, William. 2015. "Walkability: To Quantify or Not To Quantify." *Journal of Urbanism: International Research on Placemaking and Urban Sustainability*, November, 1–3. doi:10.1080/17549175.2015.1111926.

Riggs, William, and John Gilderbloom. 2016. "Two-Way Street Conversion." *Journal of Planning Education and Research* 36 (1): 105–18. doi:10.1177/0739456X15593147.

Rome, Adam. 2001. *The Bulldozer in the Countryside: Suburban Sprawl and the Rise of American Environmentalism*. Cambridge, UK: Cambridge University Press.

Rosenthal, Elisabeth. 2011. "Across Europe, Irking Drivers Is Urban Policy." *The New York Times*, June 26. http://www.nytimes.com/2011/06/27/science/earth/27traffic.html?_r=0.

Roulston, Kathryn. 2010. *Relective Interviewing: A Guide to Theory and Practice*. Thousand Oaks, CA: Sage Publications.

Ruiz-Apilánez, Borja, Kayvan Karimi, Irene García-Camacha, and Raúl Martín. 2017. "Shared Space Streets: Design, User Perception and Performance." *URBAN DESIGN International*, January. doi:10.1057/s41289-016-0036-2.

Saelens, Brian E, James F Sallis, and Lawrence D Frank. 2003. "Environmental Correlates of Walking and Cycling: Findings from the Transportation, Urban Design, and Planning Literatures." *Annals of Behavioral Medicine* 25 (2): 80–91. doi:10.1207/S15324796ABM2502_03.

Schaper, David. 2016. "No Free Rides: Voters Asked to Raise Taxes for Trains, Buses." *NPR*, September 21. http://www.npr.org/2016/09/21/494617390/november-voters-will-be-asked-to-raise-taxes-to-fund-transit-projects.

Schlossberg, Marc, John Rowell, Dave Amos, and Kelly Sanford. 2013. "Rethinking Streets: An Evidence-Based Guide to 25 Complete Street Transformations."

SDOT. 2008. "Seattle Streetcar Network Development Report." Seattle, WA. http://www.seattlestreetcar.org/about/docs/StreetcarNetworkReportMay2008rev.pdf.

———. 2009. "Seattle Pedestrian Master Plan Summary." Seattle, WA. http://www.seattle.gov/transportation/pedestrian_masterplan/docs/PMP Summary_Low Res.pdf.

———. 2015. "Move Seattle: Mayor Edward B. Murray's 10-Year Strategic Vision for Transportation." Seattle, WA. https://www.seattle.gov/transportation/docs/MoveSeatte-FinalDraft-2-25-Online.pdf.

———. 2016a. "Adaptive Streets Program." https://www.seattle.gov/transportation/AdaptiveStreets.htm.

———. 2016b. "Complete Streets in Seattle." https://www.seattle.gov/transportation/completestreets.htm.

———. 2016c. "Move Seattle: Mayor Murray's 10-Year Strategic Vision for Transportation." https://www.seattle.gov/transportation/moveSeattle.htm.

———. 2016d. "Play Street Program Handbook." Seattle, WA. https://www.seattle.gov/transportation/docs/PlayStreetHandbook.pdf.

———. 2016e. "Public Space Management Program." https://www.seattle.gov/transportation/publicspacemanagement.htm.

———. 2016f. "Transit Master Plan." https://www.seattle.gov/transportation/transitmasterplan.htm.

———. 2016g. "Transit Master Plan Final Summary Report." Seattle, WA. http://www.seattle.gov/transportation/docs/TMP/final/TMPSupplmtALL2-16FINAL-080417.pdf.

———. 2017a. "City of Seattle Pedestrian Master Plan." Seattle, WA. http://www.seattle.gov/transportation/docs/SeattlePedestrianMasterPlan.pdf.

———. 2017b. "Madison Street Bus Rapid Transit." http://www.seattle.gov/transportation/MadisonBRT.htm.

———. 2017c. "Mercer Corridor Project." https://www.seattle.gov/transportation/projects-and-programs/current-projects/mercer-corridor-project.

———. 2017d. “Seattle Bicycle Master Plan.” https://www.seattle.gov/transportation/bikemaster.htm.

———. 2017e. “Sidewalk Condition Assessment Project.” https://www.seattle.gov/transportation/about-sdot/asset-management/sidewalk-condition-assessment-project.

SDOT Blog. 2017a. “More than 70% of Downtown Seattle Commuters Choosing Not to Drive Alone,” February 9. http://sdotblog.seattle.gov/2017/02/09/more-than-70-of-downtown-seattle-commuters-choosing-not-to-drive-alone/.

———. 2017b. “City of Seattle Introduces Mercer Adaptive Signal System To Keep Traffic Moving.” *SDOT Blog*, April 24. http://sdotblog.seattle.gov/2017/04/24/city-of-seattle-introduces-mercer-adaptive-signal-system-to-keep-traffic-moving/.

———. 2017c. “Why We Need the Pedestrian Push Button,” October 16. http://sdotblog.seattle.gov/2017/10/16/why-we-need-the-pedestrian-push-button/.

Seattle Police Department. 2017. “Online Crime Maps.” https://www.seattle.gov/police/information-and-data/online-crime-maps.

Seattle Post Intelligencer. 2007. “Seattle Streetcar Timeline,” December 11.

———. 2011. “The Denny Regrade in Seattle,” November 2. http://www.seattlepi.com/local/seattle-history/slideshow/The-Denny-regrade-in-Seattle-31845/photo-1719577.php.

Seattle Streetcar. n.d. “Seattle Streetcar.” http://www.seattlestreetcar.org/default.htm.

———. 2017. “Center City Connector.” http://www.seattlestreetcar.org/centercity.htm.

Seattle Times Staff. 2000. “Light-Rail Cost Soars $1 Billion.” *The Seattle Times*, December 13. http://community.seattletimes.nwsource.com/archive/?date=20001213&slug=TTGI2KF2J.

Shaner, Zach. 2017. “Move Seattle’s Rapid Ride Corridor Planning Kicks Off.” *Seattle Transit Blog*, February 23. https://seattletransitblog.com/2017/02/23/move-seattles-rapid-ride-corridor-planning-kicks-off/.

Shoup, Donald C. 2011. *The High Cost of Free Parking*. New York, NY: Routledge.

Smart Growth America. 2015. “National Complete Streets Coalition.” http://www.smartgrowthamerica.org/complete-streets.

Sound Transit. 2008. “Sound Transit 2: A Mass Transit Guide.” https://www.soundtransit.org/sites/default/files/documents/pdf/st2/transitexapansion/st2_plan_web.pdf.

———. 2016a. “Sound Transit 3.” http://soundtransit3.org/overview.

———. 2016b. “Sound Transit 3: Projects and Amended Timelines.”

———. 2016c. “Sound Transit 3: The Regional Transit System Plan for Central Puget Sound.” https://www.soundtransit.org/sites/default/files/project-documents/st3-system-plan-2016.pdf.

Southworth, Michael, and Eran Ben-Joseph. 2003. *Streets and the Shaping of Towns and Cities*. Washington, DC: Island Press.

Speck, Jeff. 2012. *Walkable City: How Downtown Can Save American, One Step at a Time*. New York, NY: North Point Press.

State of Washington. 2017. “The Growth Management Act and the Growth Management Hearings Board.” http://www.gmhb.wa.gov/Reader.aspx?pg=About.htm.

Staton, Renee. 2015. “No ‘Average’ Transit.” *The Urbanist*, March 9. https://www.theurbanist.org/2015/03/09/no-average-transit/.

Steuteville, Robert. 2017. “Why Walkability Is Not a Luxury.” *Strong Towns*, October 4. https://www.strongtowns.org/journal/2017/10/3/why-walkability-is-not-a-luxury.

Stevens, Mark R. 2017. “Does Compact Development Make People Drive Less?” *Journal of the American Planning Association* 83 (1): 7–18. doi:10.1080/01944363.2016.1240044.

Stoker, Philip, Andrea Garfinkel-Castro, Meleckidzedeck Khayesi, Wilson Odero, Martin N Mwangi, Margie Peden, and Reid Ewing. 2015. “Pedestrian Safety and the Built Environment: A Review of the Risk Factors.” *Journal of Planning Literature* 30 (4): 377–92. doi:10.1177/0885412215595438.

Sullivan, William C, and Chun-Yen Chang. 2011. “Mental Health and the Built Environment.” In *Making Healthy Places: Designing and Building for Health, Well-Being and Sustainability*, edited by Andrew L Dannenberg, Howard Frumkin, and Richard J Jackson. Washington, DC: Island Press.

Talen, Emily. 2011. “Sprawl Retrofit: Sustainable Urban Form in Unsustainable Places.” *Environment and Planning B* 38 (6): 952–78.

“The Great Seattle Fire.” n.d. University of Washington Libraries. https://content.lib.washington.edu/extras/seattle-fire.html.

The Seattle Times. 2007. “Seattle’s Streetcar History,” December 10. http://www.seattletimes.com/seattle-news/seattles-streetcar-history/.

U District Square. 2017. “U District Alley.” https://www.udistrictsquare.org/alley.

UNCED. 1992. “Agenda 21.” New York, NY.

Urban Land Institute. 2016. “Housing in the Evolving American Suburb.” Washington, DC. https://uli.org/wp-content/uploads/ULI-Documents/Housing-in-the-Evolving-American-Suburb.pdf.

Van der Westhuizen, Diaan Louis. 2010. “Concepts of Space and Place: Neighborhood Access, Pedestrian Movement, and Physical Activity in Detroit: Implications for Urban Design and Research.” University of Michigan.

Viriyincy, Oran. 2016. “The Seattle Transit Map.” https://seattletransitmap.com/view/.

“Walk Score.” n.d. https://www.walkscore.com/.

———. 2017. “2017 City and Neighborhood Ranking.” https://www.walkscore.com/cities-and-neighborhoods/.

Walker, Jarrett. 2011. *Human Transit: How Clearer Thinking about Public Transit Can Enrich Our Communities and Our Lives*. Washington, DC: Island Press.

Wallace, Nick. 2017. “The Best Cities for Public Transportation.” *Smart Asset*, June 6. https://smartasset.com/mortgage/best-cities-for-public-transportation.

Warner, Sam Bass. 1978. *Streetcar Suburbs: The Process of Growth in Boston, 1870-1900*. Second Edi. Cambridge, MA: Harvard University Press.

Warner, Sam Bass, and Andrew H Whittemore. 2012. *American Urban Form: A Representative History*. Cambridge, MA: MIT Press.

Waterfront Seattle. 2017. “Pike Pine Renaissance: Act One.” https://waterfrontseattle.org/pike-pine.

Wells, Christopher. 2012. *Car Country: An Environmental History*. Seattle, WA: University of Washington Press.

Westneat, Danny. 2014. “Arboretum’s Ramps to Nowhere Mark Successful Freeway Revolt.” *The Seattle Times*, October 14. http://www.seattletimes.com/seattle-news/arboretumrsquos-ramps-to-nowhere-mark-successful-freeway-revolt/.

Whyte, William H. 1980. *The Social Life of Small Urban Spaces*. Washington, DC: The Conservation Foundation.

———. 2009. *City: Rediscovering the Center*. Philadelphia, PA: University of Pennsylvania Press.

Wilcox, Pamela, Neil Quisenberry, Debra T. Cabrera, and Shayne Jones. 2004. "Busy Places and Broken Windows? Toward Defining the Role of Physical Structure and Process in Community Crime Models." *The Sociological Quarterly* 45 (2): 185–207.

Williams, David B. n.d. "A Brief History of Seattle's Olmsted Legacy." City of Seattle. http://www.seattle.gov/friendsofolmstedparks/FSOP/history.htm.

———. 1999. "Olmsted Parks in Seattle." *History Link*. http://www.historylink.org/File/1124.

Wilma, David. 2000. "Trackless Trolleys and Busses Replace Streetcars in Seattle Transit System on April 13, 1941." *History Link*. http://www.historylink.org/File/2536.

Wood, Lisa, Lawrence D. Frank, and Billie Giles-Corti. 2010. "Sense of Community and Its Relationship with Walking and Neighborhood Design." *Social Science & Medicine* 70 (9): 1381–90. doi:10.1016/j.socscimed.2010.01.021.

Wood, Stephen, and Kim Dovey. 2015. "Creative Multiplicities: Urban Morphologies of Creative Clustering." *Journal of Urban Design* 20 (1): 52–74. doi:10.1080/13574809.2014.972346.

WSDOT. 2017. "CTR Overview." http://www.wsdot.wa.gov/Transit/CTR/overview.htm.

Wunderlich, Filipa Matos. 2008. "Walking and Rhythmicity: Sensing Urban Space." *Journal of Urban Design* 13 (1): 125–39. doi:10.1080/13574800701803472.

Yardley, William. 2016. "Seattle Continues Quest to Get Greener as It Grows with 'Transformative' Light-Rail Expansion." *Los Angeles Times*, April 4. http://www.latimes.com/nation/la-na-sej-seattle-light-rail-20160404-story.html.

Yin, Robert K. 2009. *Case Study Research: Design and Methods*. 4th Editio. Thousand Oaks, CA: Sage Publications.

Zahavi, Yacov, and Antti Talvitie. 1980. "Regularities in Travel Time and Money Expenditures." *Transportation Research Record*, no. 750: 13–19.

Zeisel, John. 2006. *Inquiry by Design: Environment / Behavior / Neuroscience in Architecture, Interiors, Landscape, and Planning*. Revised Ed. New York, NY: W.W. Norton & Company.

Appendix 1

IRB Approval Letter

UNIVERSITY OF MICHIGAN
eResearch.umich.edu

Health Sciences and Behavioral Sciences Institutional Review Board (IRB-HSBS) • 2800 Plymouth Rd., Building 520, Room 1170, Ann Arbor, MI 48109-2800 • phone (734) 936-0933 • fax (734) 998-9171 • irbhsbs@umich.edu

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To: Devon McAslan

From:
Thad Polk

Cc:
Scott Campbell
Linda Groat
Devon McAslan

Subject: Notice of Exemption for [HUM00117034]

SUBMISSION INFORMATION:
Title: Walking, Public Life and Transit Use in Walkable Urban Neighborhoods
Full Study Title (if applicable):
Study eResearch ID: HUM00117034
Date of this Notification from IRB: 8/2/2016
Date of IRB Exempt Determination: 8/2/2016
UM Federalwide Assurance: FWA00004969 (For the current FWA expiration date, please visit the UM HRPP Webpage)
OHRP IRB Registration Number(s): IRB00000246

IRB EXEMPTION STATUS:
The IRB HSBS has reviewed the study referenced above and determined that, as currently described, it is exempt from ongoing IRB review, per the following U-M demonstration exemption category:

> **EXEMPTION #2a:**
> Minimal risk research that involves a non-invasive intervention followed by data collection via survey, interview (including focus groups), or observation unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation. **The research is not federally sponsored or intended to collect pilot data to support proposals for federal funding.**

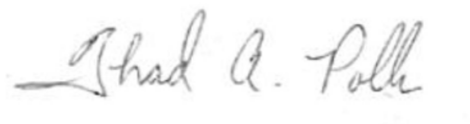
This exemption applies only to projects that are not federally-funded, regulated by the FDA, or conducted under a Certificate of Confidentiality. If you receive federal funding for the project, please notify the IRB immediately. U-M Exemption #2a cannot be applied to federally-funded projects.

Note that the study is considered exempt as long as any changes to the use of human subjects (including their data) remain within the scope of the exemption category above. Any proposed changes that may exceed the scope of this category, or the approval conditions of any other non-IRB reviewing committees, must be submitted as an amendment through eResearch.

Although an exemption determination eliminates the need for ongoing IRB review and approval, you still have an obligation to understand and abide by generally accepted principles of responsible and ethical conduct of research. Examples of these principles can be found in the Belmont Report as well as in guidance from professional societies and scientific organizations.

SUBMITTING AMENDMENTS VIA eRESEARCH:
You can access the online forms for amendments in the eResearch workspace for this exempt study, referenced above.

ACCESSING EXEMPT STUDIES IN eRESEARCH:
Click the "Exempt and Not Regulated" tab in your eResearch home workspace to access this exempt study.



Thad Polk
Chair, IRB HSBS

Appendix 2

Walkability Survey

Seattle Walkability

Introduction

This survey is part of a research study on walking, transit use, and travel behavior being conducted in Seattle through the University of Michigan. Your participation is greatly appreciated. The survey should take approximately 15 minutes to complete. Please provide accurate responses to each question to the best of your ability. Your submission of this online survey acknowledges your permission to participate in this survey. All survey responses are anonymous and any personal information you provide will remain confidential. This study is not affiliated with the City of Seattle or any other public agency. The findings of the study will be presented at academic conferences and to public officials in the area and may impact policies in Seattle and other cities. If you have any questions regarding the study, please email seattlewalkability2016@gmail.com.

Thank you for your assistance!

* 1. What do you consider your primary mode of transportation?

- ◯ Walking
- ◯ Bike
- ◯ Driving
- ◯ Bus
- ◯ LINK light rail
- ◯ Seattle Streetcar
- ◯ Other (please specify)

[ ]

Seattle Walkability

General Travel Behavior

* 2. How often do you use each of the following transportation modes?

	Daily	3-5 days per week	1-2 days per week	Less than once per week	Less than once per month	Rarely/Never
Walking	○	○	○	○	○	○
Local Bus	○	○	○	○	○	○
Rapid Ride bus	○	○	○	○	○	○
Express Bus	○	○	○	○	○	○
Seattle Streetcar	○	○	○	○	○	○
LINK light rail	○	○	○	○	○	○
Bicycle	○	○	○	○	○	○
Car Share service (Car2Go, Zipcar)	○	○	○	○	○	○
Ride Share service (Lyft, Uber)	○	○	○	○	○	○
Drive Alone	○	○	○	○	○	○
Drive with others	○	○	○	○	○	○
Other	○	○	○	○	○	○

Other (please specify)

* 3. What is your most frequently used mode of transportation to each of the following destinations? If you typically use more than one mode of transportation to get to a destination, please check all that apply.

	Walking	Bus	Light Rail	Streetcar	Driving	Bicycle	Other	Not Applicable
Grocery Store	☐	☐	☐	☐	☐	☐	☐	☐
Drug Store	☐	☐	☐	☐	☐	☐	☐	☐
Coffee Shop	☐	☐	☐	☐	☐	☐	☐	☐
Restaurant	☐	☐	☐	☐	☐	☐	☐	☐
Bar or Night Club	☐	☐	☐	☐	☐	☐	☐	☐
Entertainment Venue	☐	☐	☐	☐	☐	☐	☐	☐
Park	☐	☐	☐	☐	☐	☐	☐	☐
Sporting Event	☐	☐	☐	☐	☐	☐	☐	☐
Retail Shopping	☐	☐	☐	☐	☐	☐	☐	☐

4. When you use public transit, how long do you usually walk to reach each of these types of transit?

	Less than 5 minutes	5-10 minutes	10-15 minutes	15-20 minutes	more than 20 minutes	Do not use this type of transit
Local Bus	○	○	○	○	○	○
Rapid Ride Bus	○	○	○	○	○	○
Express Bus	○	○	○	○	○	○
Seattle Streetcar	○	○	○	○	○	○
LINK Light Rail	○	○	○	○	○	○

Seattle Walkability

Commute to and from Work

* 5. Are you currently employed full or part time in a job that requires you to commute two or more days per week? Or are you a student that commutes to school two or more days per week?

◯ Yes

◯ No

Seattle Walkability

Commute to and from Work

* 6. What do you consider to be your primary mode of transportation for your commute to and from work or school? If you often combine two or more modes, please choose 'other' and write which modes you combine.

- Walking
- Local Bus
- Rapid Ride bus
- Express Bus
- Seattle Streetcar
- LINK light rail
- Bicycle
- Drive alone
- Drive with others

Other (please specify)

* 7. How satisfied are with the transportation mode you most frequently use for your daily commute?

Very Satisfied	Somewhat Satisfied	Neutral	Somewhat Unsatisfied	Very Unsatisfied
○	○	○	○	○

* 8. About how long is your daily commute (one way) in both time and distance?

Time (minutes)

Distance (miles)

* 9. Overall, how satisfied are with the length of your daily commute?

Very Satisfied	Somewhat Satisfied	Neutral	Somewhat Unsatisfied	Very Unsatisfied
○	○	○	○	○

Seattle Walkability

Non-Work Travel

* 10. What do you consider to be your primary mode of transportation fo<u>non-work</u> related travel?

- ◯ Walking
- ◯ Local Bus
- ◯ Rapid Ride bus
- ◯ Express Bus
- ◯ Seattle Streetcar
- ◯ LINK light rail
- ◯ Bicycle
- ◯ Drive alone
- ◯ Drive with others

Other (please specify)

____

* 11. How satisfied are you with the transportation mode you most frequently use fornon-work related travel?

Very Satisfied	Somewhat Satisfied	Neutral	Somewhat Unsatisfied	Very Unsatisfied
◯	◯	◯	◯	◯

Seattle Walkability

Past Travel Behavior

* 12. What was your primary mode of transportation12 months ago for WORK related travel?

- ◯ Walking
- ◯ Local Bus
- ◯ Rapid Ride bus
- ◯ Express Bus
- ◯ Seattle Streetcar
- ◯ LINK light rail
- ◯ Bicycle
- ◯ Driving alone
- ◯ Drive with others
- ◯ Not Applicable

Other (please specify)

* 13. What was your primary mode of transportation12 months ago for NON-WORK related travel?

- ◯ Walking
- ◯ Local Bus
- ◯ Rapid Ride bus
- ◯ Express Bus
- ◯ Seattle Streetcar
- ◯ LINK light rail
- ◯ Bicycle
- ◯ Driving alone
- ◯ Drive with others

Other (please specify)

14. If you have changed your primary mode of transportation for work or non-work related travel in the previous 12 months, what were the reasons? Check any that apply.

- ☐ Moved to a new neighborhood
- ☐ Moved to a new city
- ☐ Moved to a new residence in the same neighborhood
- ☐ New public transit options became available in my neighborhood
- ☐ It is cheaper to use public transportation
- ☐ Started a new job
- ☐ No longer wanted to drive

Other (please specify)

Seattle Walkability

Travel Behavior in the Next 12 Months

* 15. In the next 12 months, do you plan to change, or would you like to change, your primary mode of transportation for WORK or NON-WORK related travel?

- ◯ Yes
- ◯ No

Seattle Walkability

Travel Behavior in the Next 12 Months

* 16. How do you plan to, or how would you like to change, your<u>WORK</u> related transportation behavior in the next 12 months?

- [ ] I plan/would like to drive fewer days per week
- [ ] I plan/would like to drive few miles per week
- [ ] I plan/would like to ride the LINK light rail
- [ ] I plan/would like to walk more often
- [ ] I plan/would like to live a car free lifestyle
- [ ] I plan/would like to use the bus
- [ ] I plan/would like to drive more
- [ ] I plan/would like to bike more often
- [ ] Not Applicable

Other (please specify)

* 17. How do you plan to or how would you like to change your<u>NON-WORK</u> related transportation behavior in the next 12 months?

- [ ] I plan/would like to drive fewer days per week
- [ ] I plan/would like to drive few miles per week
- [ ] I plan/would like to ride the LINK light rail
- [ ] I plan/would like to walk more often
- [ ] I plan/would like to live a car free lifestyle
- [ ] I plan/would like to use the bus
- [ ] I plan/would like to drive more
- [ ] I plan/would like to bike more often

Other (please specify)

* 18. What is/are your main reason(s) for wanting to change your transportation behavior for work or non-work related travel?

Seattle Walkability

Future Transit Options

* 19. In general, how likely would you be to use the following types of public transportation if they became available in your neighborhood? If it is already available, please check that option.

	Already Available	Very Likely	Somewhat Likely	Neutral	Somewhat Unlikely	Very Unlikely	Unsure/Don't Know
LINK light rail	◯	◯	◯	◯	◯	◯	◯
Seattle Streetcar	◯	◯	◯	◯	◯	◯	◯
Rapid Ride bus	◯	◯	◯	◯	◯	◯	◯
Bus Rapid Transit (BRT)	◯	◯	◯	◯	◯	◯	◯

* 20. If one of the rapid transit options in the above question became available in your neighborhood, what are your reason(s) for wanting to use it or not to use it?

Seattle Walkability

Walking Behavior

* 21. About how many minutes do you spend walking per day?

* 22. In a typical week, how many days do you walk at least 30 minutes or more throughout the day?

1	2	3	4	5	6	7
○	○	○	○	○	○	○

* 23. What Seattle neighborhoods, and/or streets, do you MOST enjoy walking in? List up to four.

Neighborhood 1

Neighborhood 2

Neighborhood 3

Neighborhood 4

* 24. What about these neighborhoods makes them enjoyable to walk in?

* 25. What Seattle neighborhoods, and/or streets, do you LEAST enjoy walking in? List up to four.

Neighborhood 1

Neighborhood 2

Neighborhood 3

Neighborhood 4

* 26. What about these neighborhoods makes then unenjoyable to walk in?

Seattle Walkability

* 27. Please indicate how much you agree or disagree with the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I use public transit because it is within walking distance to my house	○	○	○	○	○
I use public transit because it goes to the places I need to go even though they are in walking distance	○	○	○	○	○
I am more likely to walk a greater distance in order to use light rail than the bus	○	○	○	○	○
I use public transit because it comes frequently	○	○	○	○	○
I use public transit because it takes about the same time or less to get to my destination as driving	○	○	○	○	○
I use public transit because driving is too expensive	○	○	○	○	○

* 28. Please indicate how much you agree or disagree with the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I walk frequently because there are places in my neighborhood to walk to	◯	◯	◯	◯	◯
Sidewalks in my neighborhood are well maintained	◯	◯	◯	◯	◯
Car traffic is a major obstacle for walking in my neighborhood	◯	◯	◯	◯	◯
I generally feel safe walking in my neighborhood	◯	◯	◯	◯	◯
Improvements in pedestrian facilities make it more appealing to walk	◯	◯	◯	◯	◯
I would walk more if I lived in a neighborhood where everything I need on a daily basis was within a 10 minute walk	◯	◯	◯	◯	◯

Seattle Walkability

* 29. Please indicate how much you agree or disagree with the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I enjoy walking	○	○	○	○	○
I enjoy using public transportation	○	○	○	○	○
I enjoy driving	○	○	○	○	○
My overall quality of life is high	○	○	○	○	○
I am a generally happy person	○	○	○	○	○
I have a strong sense of community in my neighborhood	○	○	○	○	○

* 30. Please indicate how much you agree or disagree with the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Investment in public transportation is important	○	○	○	○	○
Investment in walking infrastructure is important	○	○	○	○	○
Having a large house and a yard is more important than being able to walk places	○	○	○	○	○
Investment in bicycle infrastructure is important	○	○	○	○	○
I would consider living in a city with no cars if everything I needed was within a 5-10 minute walking distance or a short transit ride	○	○	○	○	○
I would consider living in a city with no cars if I could still live in a single family house or townhome	○	○	○	○	○
Rail based rapid transit (such as LINK light rail) is a better alternative to driving than buses	○	○	○	○	○
Streets should be used to create more public spaces for pedestrians away from car traffic	○	○	○	○	○
It is important for me to have access to a car even if I don't use it everyday	○	○	○	○	○
A neighborhood with mixed housing types (single family homes, townhomes, apartments) is highly desirable	○	○	○	○	○

Seattle Walkability

Socio-Demograpic Information

* 31. Your gender:

- ◯ Male
- ◯ Female
- ◯ Other

[ ]

* 32. Your age:

- ◯ 18-25
- ◯ 26-35
- ◯ 36-45
- ◯ 46-55
- ◯ 56-65
- ◯ over 65

* 33. Your race:

- ◯ Caucasian/White
- ◯ African American/Black
- ◯ Asian/Asian American
- ◯ Latino/Hispanic
- ◯ Other (please specify)

[ ]

* 34. Marital status:

- ◯ Single
- ◯ Married or living with partner

* 35. Do you have children?

◯ Yes

◯ No

36. If yes, how many children?

* 37. How many people live in your household?

* 38. What is your current work status? Choose any that apply.

☐ Full time

☐ Part time

☐ Self employed

☐ Unemployed

☐ Student

☐ Stay at home parent

☐ Retired

* 39. What is your highest level of education?

◯ Less than high school

◯ High school graduate

◯ Some college

◯ College graduate

◯ Graduate or professional degree

* 40. What is your annual household income?

- Less than $10,000
- $10,000 to $25,000
- $25,000 to $50,000
- $50,000 to $75,000
- $75,000 to $100,000
- $100,00 to $150,000
- Over $150,000

* 41. Approximately how much money does your household spend each<u>MONTH</u> on transportation related expenses? Provide a rough estimate of your expenses, including car payments, insurance, gas/fuel, parking, transit passes and fares, car or ride sharing, and any other regular transportation expenses you have while traveling around Seattle.

- Less than $100
- $100 to $250
- $250 to $500
- $500 to $750
- $750 to $1,000
- Over $1,000

Seattle Walkability

Car Ownership

* 42. Do you own a car?

- ◯ Yes
- ◯ No

Seattle Walkability

Car Ownership

* 43. How many cars does your household have?

44. What type of car(s) does your household have?

- ☐ Electric car
- ☐ Hybrid
- ☐ Alternative Fuel vehicle
- ☐ Gasoline Engine

* 45. Would you ever consider living without a car?

- ○ Yes
- ○ No
- ○ Maybe

46. Under what conditions might you consider living without a car?

Seattle Walkability

Car Ownership

* 47. Have you previously owned a car?

- ◯ Yes
- ◯ No

48. If yes, why do you no longer own a car?

* 49. Do you anticipate buying a car at some point in the future?

- ◯ Yes
- ◯ No
- ◯ Maybe

50. If yes, why will you buy a car in the future?

Seattle Walkability

Residence and Neighborhood

* 51. What type of residence do you live in?

- ◯ Single family house on a large lot (greater than 0.25 acres)
- ◯ Single family house on a small lot (smaller than 0.25 acres)
- ◯ Single family attached house / townhouse
- ◯ Duplex
- ◯ Apartment or condo in small building (2 to 4 units)
- ◯ Apartment or condo in medium building (5 to 30 units)
- ◯ Apartment or condo in large building (30 or more units)
- ◯ Apartment or condo in complex (30 or more units in multiple buildings)

* 52. Do you rent or own your current place of residence?

- ◯ Rent
- ◯ Own

* 53. What is your current ZIP code?

____

* 54. What are the names of the two streets at the intersection closest to your current residence?

Street 1 ________________

Street 2 ________________

Seattle Walkability

* 55. How did you hear about this survey?

- Email
- Flyer
- Social Media
- In Person with survey taker

* 56. Are you affiliated with any community organizations that advocate for walking, bicycling, public transportation or other transportation related issues in Seattle?

- Yes
- No

Seattle Walkability

Advocacy Group Affiliation

* 57. What organization(s) are you affiliated with that advocate for walking, bicycling or public transit?

Organization 1 ______

Organization 2 ______

Organization 3 ______

* 58. What is your level of involvement in the organization(s) you indicated above?

	Very Involved	Somewhat involved	Moderately involved	Somewhat involved	Not very involved
Organization 1	◯	◯	◯	◯	◯
Organization 2	◯	◯	◯	◯	◯
Organization 3	◯	◯	◯	◯	◯

Seattle Walkability

Seeking Interview Participants

59. Thank you for your participation in this survey!

As part of the study, we are **seeking interview participants who live and work in Seattle** The interview will take approximately 60 minutes and have you discuss your walking behavior, experiences of walking, transit use and general travel around Seattle. These will take place in October and November 2016 and will be scheduled at your convenience.

If you are interested in participating, please provide your name and email address or phone number. Your personal information will not be affiliated with your survey responses. If you would like to participate but do not want to enter your personal information here, or have further questions before making your decision, please email seattlewalkability2016@gmail.com.

Name

City/Town

ZIP/Postal Code

Email Address

Phone Number

Appendix 3

Interview Consent Form

Consent to Participate in a Research Study
"Walking, Transit Use, and Urban Morphology in Walkable Urban Neighborhoods: An Examination of Behaviors and Attitudes in Seattle Neighborhoods"

Principal Investigator: Devon McAslan, PhD Candidate, University of Michigan
Faculty Advisor: Scott Campbell, Professor of Urban and Regional Planning, University of Michigan

I invite you to participate in a research study investigating individuals' walking and transit use behaviors, attitudes about walking and transit use and experiences of being a pedestrian in the city. The purpose of this research it to more completely understand the role of walkable urban environments in urban life and what this means for creating urban places that enhance quality of life.

If you agree to be part of the research study, I will ask you to map frequently walked routes in the course of your daily (or weekly) activities. I will ask you specific questions about these routes as well as questions about why you choose to walk certain places and not others, why you choose a specific mode of transportation over another, your experiences of being a pedestrian in Seattle and your satisfaction of different types of walkable neighborhoods with which you are familiar. The interview will last between 60 and 90 minutes and will be audiotaped. Afterwards, I will ask you to complete a short survey that provides basic socio-demographic information.

Talking about your own experiences of walking and transit use and urban walkability in general may be beneficial to you and others. This research will be published in academic journals and presented at academic and professional conferences to further the development of walkable urban environments and more sustainable and livable cities.

There are no risks associated with your participation in this study. Your name and personal information will not be associated with any of the answers you provide today.

If you have any questions about this study, you may contact:

Devon McAslan, Ph.D. Candidate, Taubman College of Architecture and Urban Planning, University of Michigan, 2000 Bonisteel Blvd, Ann Arbor, MI 48105. Email: dmcaslan@umich.edu

Participating in this study is completely voluntary. Even if you decide to participate now, you may change your mind and stop at any time. You may choose not to answer any questions for any reason. You will be given a copy of this document for your records and a signed copy will be kept on file with the study records.

I agree to participate in this study.

______________________________	____________
Signature	Date

I agree to be audiotaped for the duration of this study.

______________________________	____________
Signature	Date