RIGHT-SIZING SIDEWALKS

A Framework for Establishing Requirements of the Width and Treatment of Public Realm Improvements in Raleigh, North Carolina

January 1, 2011
Research & Report Prepared by the Raleigh Urban Design Center and Rachel Mukai Stark
Commissioned by the City of Raleigh

Abstract

Sidewalks are vital to the health of the city. They provide a sustainable and equitable transportation mode and allow for a unique experience of place. They also promote health at a time when Americans are lacking in daily exercise. The City of Raleigh also understands the value of urban sidewalks is about more than just transportation - they are used for cafes, signage, bus stops and bike racks, and other amenities.

In 2010, the City of Raleigh commissioned a study of its urban sidewalks to determine where sidewalks are too narrow and how to alleviate the pedestrian traffic congestion while preserving the sense of place that makes Raleigh unique. The study also provides a methodology to help other areas in Raleigh that are looking to develop a more urban network.

The key study findings are:

- The current required pedestrian clearance of five feet is insufficient in an urban setting because of pedestrian traffic volume. The clearance requirement should be increased to eight feet.
- New sidewalk corridors should be fourteen feet in most places downtown and the sidewalks in areas with the highest intensity of urban development (with sidewalk seating, nightclubs, and retail) should be twenty feet wide.
- Most urban areas should have sidewalk treatments with grated street trees to allow for both the shade and street buffer of trees while leaving space for amenities and pedestrian passing in crowded conditions. In a few places open tree pits, planted verges, or paved to the back of curb would be appropriate to preserve the character of the place.
- These suggestions can be implemented through redevelopment, or through a combination of city-initiated sidewalk improvements/widening and restrictions on encroachments such as outdoor dining.

Acknowledgements

This study was made possible through close collaboration between the consultant and the City of Raleigh Planning Department, in particular a special thank you goes to:
Mitchell Silver, AICP, Director of Planning & Development
Ken Bowers, AICP, Deputy Director of Planning & Development
For their overview, vision, and feedback in this study and its results.

Gratitude is also due to:
Grant Meacci, ASLA, Manager of the Urban Design Center
Elizabeth Alley, Urban Planner in the Urban Design Center
For their guidance, assistance, information, and for acting as a sounding board for ideas and testing the concepts found in this study.
Sharon Felton, Communications Group Manager for Planning & Development
Jorge Gao, Graphic Designer for Planning & Development
For their assistance in this documents web publication and creation of the report cover design.

To the rest of the group at the Urban Design Center:
Roberta Fox, AIA, Assistant Project Manager
Trisha Hasch, Urban Planner
Carter Pettibone, AICP Planner
Who provided information, assistance, and feedback throughout this study.

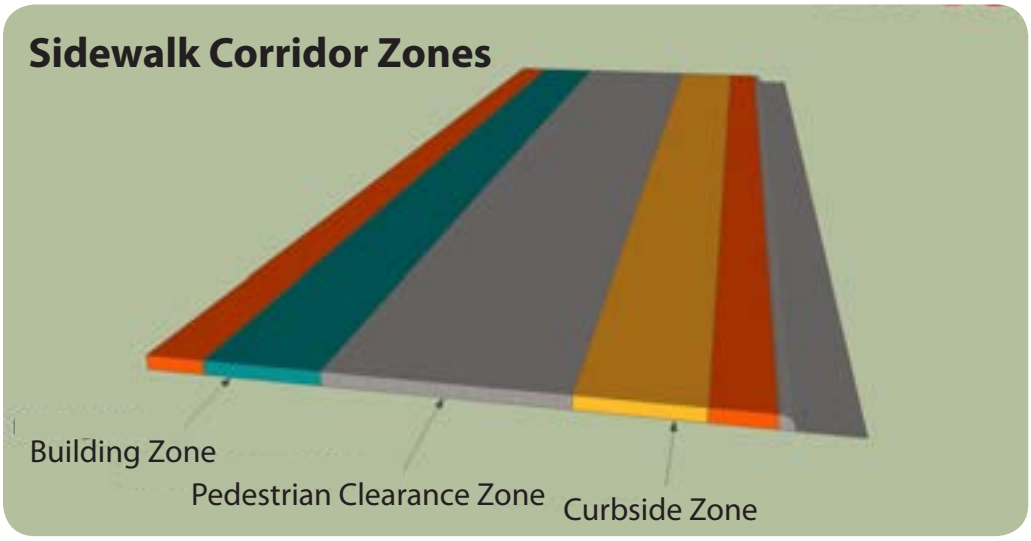
Table of Contents

List of Tables

List of Figures

Anatomy of the Sidewalk

An urban sidewalk is not only a walkway for pedestrians, it becomes the very pulse of a city.



A sidewalk is a "usually paved walk for pedestrians at the side of a street" according to the Merriam-Webster Dictionary. This sums up the main features of any given sidewalk. Note that it is identified for use by pedestrians which clarifies the fact that whatever the specific design features including width and treatment, a sidewalk is made first of all for pedestrian travel along a street.

Technically speaking, a sidewalk is located with the public right-of-way which spans between property lines. This is where the street, curb, public utilities, and sidewalk lie. In some cases the right-of-way is wider than is initially needed and the extra space is granted to private property owners through an encroachment permit. At other times, the right-of-way becomes insufficient when there is rapid growth and a municipality must seek a public easement from private property owners to make enough space for all the needed uses.

A sidewalk is intended to keep pedestrians safe from vehicular traffic, this is why there is typically a vertical curb separation and often a horizontal separation through the use of a planted verge which runs between the back of curb and the sidewalk. United States law also requires that sidewalks be accessible which dictates slope grade, clearance from obstacles, and use of curb cuts.

In urban situations a sidewalk takes on additional uses. The intensity of development and programming of these urban areas increase the demand on the sidewalk space to include other pedestrian-related activity like window shopping, queuing at a store or restaurant, standing outside to talk or smoke with others, dining outside, sitting and watching people, and so on. An urban sidewalk is not only a walkway for pedestrians, it becomes the very pulse of a city. In order to allow for this life, a sidewalk corridor is established with a pedestrian clearance zone for unobstructed movement, plus the additional space of curbside and building zones where other uses and obstacles are permitted. Together these three zones make up the urban sidewalk corridor and the intensity of use will dictate width and treatment of this space.

Glossary of Terms

- Districts = portions of a city that are distinct from other areas and share similar characteristics internally with structures and features that work in conjunction with each other
- Downtown Overlay District (DOD) = City-designated urban core
- Encroachment = privately-owned objects or uses located on any public space such as a sidewalk
- Grated street trees = street tree planters covered with an ADA-compliant tree grate
- Non-traveling pedestrian behavior = activities of a pedestrian on a sidewalk other than walking; this includes sitting, standing, mingling, and queuing
- Open space = an area such as a public park or plaza
- Open tree pit = open tree planters with grass, other plantings, or mulch in the area between the back of curb and the sidewalk pavement, evenly spaced with paving returning to the back of curb between each tree pit
- Paved to the back of curb = sidewalk pavement extends to the back of curb without street trees or planted verge
- Pedestrian Business Overlay District (PBOD) = City-designated areas for the preservation and enhancement of pedestrian-oriented retail districts
- Pedestrian generator = place with programming that influences pedestrian volume by acting as a source or destination of pedestrians
- Planted verge = a continuous buffer area between the back of curb and the sidewalk with grass, shrubs, trees, and other plants
- Public easement = privately owned land at the edge of a right-of-way where the City is allowed access for public uses such as sidewalks
- Public realm = land owned by the city
- Right-of-way = the publicly owned land between property lines that allows for streets, utilities, and sidewalks
- Shy distance = area within 18 inches from a wall, building, or other obstruction where most people will not walk, for the purpose of this study this industry standard was rounded to 2 feet, which is observed in Raleigh
- Sidewalk cafe = an establishment which provides outdoor dining or seating on the sidewalk
- Sidewalk corridor treatment = how the area between the curb and building is composed
- Street furniture = objects such as benches or planters located within or along the right-of-way
- Street performer = a person who provides visual or audio entertainment within the public right-of-way
- Street vendor = a person who offers food or articles for sale
- Use-base district = areas of the city defined by typical uses

Open tree pit

Paved to the back of curb

Planted verge

Right-of-way diagram

Street furniture on South Glenwood

CHAPTER 1: Introduction

Figure 1.01 Examples of Raleigh's cramped downtown sidewalks

South Glenwood by the Hibernian

South Glenwood by Bogart's Grill

Wilmington Street by Dos Taquitos

Blount Street by Tir Na Nog

Why the sidewalk study was commissioned

Downtown Raleigh has experienced a boom of reinvestment, which has resulted in an increase of pedestrian traffic. Public-sector planning and regulation need to be updated to accommodate these changing use patterns. While a City Code text change to address sidewalk width was passed relatively recently, it uses a one-size-fits-all approach, and only remedies inadequate sidewalk width when there is private redevelopment. Regulation alternations need to acknowledge the following:

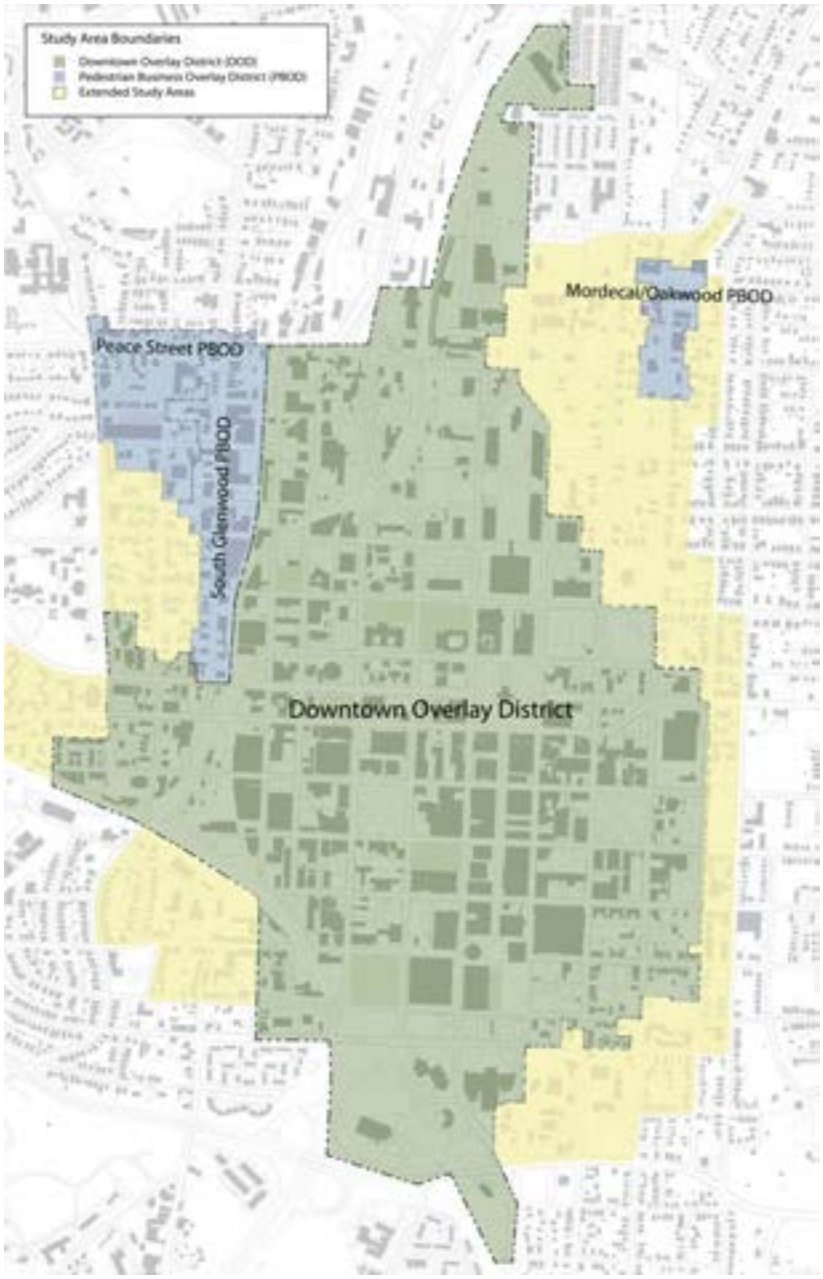
- Sidewalks are generally undersized
- One-size-fits-all regulations do not allow for site-specific solutions
- The document regulating sidewalk treatment is outdated and does not apply to some portions of downtown
- Current regulatory boundaries may not take into account future downtown expansion
- Current regulations do not acknowledge the important role sidewalks can play in developing district identity
- There is little Capital Improvement Plan (CIP) funding available for downtown sidewalks, in part due to a lack of data proving need

The City's current codes call for a widening of public sidewalks within the Downtown Overlay District (DOD) and Pedestrian Business Overlay Districts (PBOD) by the property owner at the time of property redevelopment where a site plan is issued. This requirement was adjusted in 2006 after amendments were made to the open space requirements in the DOD.

Current code requirements for sidewalks within the DOD and PBOD are listed within the required open space sections and are separate from the basic sidewalk width requirements that apply to the rest of the city. See **Appendix A** for code excerpts. Sidewalks that are initially less than fourteen feet wide are to be widened to fourteen feet; those that are already fourteen feet wide are to be widened to eighteen feet. While these rules are simple, they have a more complex logic that is not revealed in the codes. This study was conducted to make the rationale for sidewalk requirements more transparent as well as assess the validity of using the one-size-fits-all approach and to consider more site-specific responses to the issue of sidewalk widths in Raleigh's urban areas.

Study Area

While the exact study area is the Downtown Overlay District (DOD), Glenwood South Pedestrian Overlay District (PBOD), Peace Street PBOD, and Mordecai-Oakwood PBOD and the immediate surroundings of these areas (see Figure 1.02), the research did bear in mind the five other PBODs existing in Raleigh: University Village, Stanhope Center, Cameron Village, Glenlake, and Crabtree Place and is considered applicable to these other areas. See **Appendix B** for a map of all PBOD and DOD areas existing in 2010 in Raleigh.



Perspective on what observations to make, what to take inventory of, and source of reference for analysis and interpretation came from a short literature review.

Figure 1.02 Map of Study Area Boundaries

Approach

In order to gain a better understanding of the various urban elements that influence the width of a sidewalk, research was conducted in the form of observations, inventory, analysis, and interpretation. Perspective on what observations to make, what to take inventory of, and source of reference for analysis and interpretation came from a short literature review regarding sidewalks, pathway design, and urban functions. The observations that were made included pedestrian behaviors, elements within the public realm utilized by pedestrians, and the overall sense of place within downtown Raleigh.

The results of this approach led to the mapping of elements, behaviors, and patterns throughout the study area. Comparison of these maps led to a more complete understanding of the public realm and the identification of certain problems regarding sidewalks and the assumptions made about them as well as creating means to address the difficulties of the current regulations. The final result of this study was a keyed map illustrating appropriate sidewalk corridor widths and treatment.

Literature Sources

A brief examination of literature on the subject of design and planning of pedestrian spaces in the urban environment provided a basic foundation of what elements to particularly take note of and analyze. These influenced the perspective and approach to the observations that were made and how the results were reported. The most influential excerpts from this research are provided below. A full bibliography is provided at the end of this document.

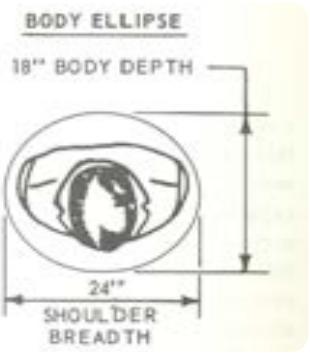


Figure 1.03 Diagram of the body ellipse used in design dimensioning
Source: Fruin, 20

Figure 1.04 Busy downtown sidewalk

Figure 1.05 Objects found on sidewalk

<u>Determining Pedestrian Clearance Width</u>

- The pedestrian & its behavior – Fruin, 19-24, 47-50, 66-69; Dines & Brown, 33; Alexander, 585-588

  In order to produce an appropriately designed pedestrian environment, one must know some of the fundamentals of human characteristics including physical dimensions of the body, locomotion patterns, and psychological preferences of the pedestrian.

- Traveling pedestrian volume - Fruin, 37-39, 71-78; Dines & Brown, 35

  Pedestrian flow volume is the most important traffic consideration because it determines the width of the pedestrian pathway. Adequate pathway widths are needed to prevent overcrowding and pedestrian inconvenience.

- Pedestrian generators – Fruin, 74-78, 147-152

  Pedestrian spaces that are well designed must meet traffic demands which are determined by estimated pedestrian volume, patterns, and composition. Land use typology, building programming, and building square footage contribute to this expected generation of pedestrian traffic.

- Pedestrian circulation patterns - Lynch, 54-57, 95-99; Fruin, 175-176

  On any given street, pedestrian volume will vary according to circulation patterns. These circulation patterns are dictated by the location of pedestrian destinations, location of transportation mode transitions, and ease of pedestrian movement. Areas dense with destinations will have busier circulation patterns and therefore require wider sidewalks.

<u>Determining Sidewalk Corridor Width and Treatment</u>

- Objects found on urban sidewalks - Fruin, 72-73, 171; Lewis, 19

  The effective width of sidewalk corridors must take into account the dimensions of stationary objects, standing pedestrians, and shy distances that pedestrians tend to observe in passing these objects.

- Frontage typology - Fruin, 71-72; Lynch, 50-51

  Different uses of the environment along a pedestrian pathway will result in varying patterns and need different solutions, standards, and treatment.

Figure 1.06 Street trees act as a vertical buffer between vehicular traffic and pedestrians

- Neighborhood and district character - Lynch, 66-72; Alexander, 87

  Districts and neighborhoods have thematic features that typify the area and make them distinct from other areas of the city. These features, whether historic or newly designed, will dictate sidewalk corridor treatment and width.

- Transportation patterns & street buffer zones – Alexander, 271; Fruin, 115-120; ITE, 124; Lewis, 19-20

  Where there is heavy vehicular traffic, pedestrian's safety and sense of security is threatened and there is a need to provide a horizontal and vertical buffer through the use of trees, landscaping, or on-street parking. Where there are bus stops there must be paved access to the back of curb, signage, and potentially a bench or bus shelter. These will increase the demand for sidewalk corridor width as well as influence what treatment the corridor may require.

- Building mass and setbacks - Lynch, 52; Alexander, 593-595

  Street trees, benches, shop front windows, awnings, and planting beds provide the needed sense of human scale to the streetscape next to tall buildings. The urban character of a downtown environment is enhanced by reduced setbacks because it encourages interaction between people, adds to the sense of density, and allows for the vitality of places that rely on people passing shop fronts and restaurants. This influences what elements are found in the sidewalk and how wide the corridor must be to accommodate these uses.

Assumptions & Limitations

The research conducted in this study primarily considers general observations of pedestrian behaviors, urban elements, and development frontages only as they influence sidewalk width and treatment and should not be taken as an exhaustive examination of these subjects. The study was conducted in Raleigh, North Carolina, a mid-sized American city that hosts multiple levels of government, various universities, and a large research-based industry and the accuracy of data may vary slightly if applied to other types of municipalities.

Pedestrian clearance widths were based on the assumption of a two-foot width for an individual, four feet and eight inches for a couple, and a comfortable passing distance of two feet were adequate and appropriate (Dines and Brown, 33). Sites identified for redevelopment only look at approved plans and development patterns over the next twenty years and are based on assumptions that the current data and plans of the City of Raleigh hold true despite economic pressures. The existing street tree inventory does not reveal exact location, species, or maturity and should not be used as a basis for understanding street trees beyond general patterns and character as it relates to sidewalk width and typology. Sidewalk widths where there were street trees were based on the assumption that a four-by-six-foot tree pit is sufficient for the health and vitality of a street tree. The inventory of frontages as related to pedestrian behavior only addresses types of sidewalk use that influence the flow of pedestrian traffic; it should not be mistaken as a complete inventory of all usage types and frontages. The vehicular pattern inventory is not a vehicular count, nor does it take into account the time of day and exact location of on street parking. Categories in the various maps look at averages and ranges rather than precise numbers unless otherwise indicated. Pedestrian and vehicular counts and user surveys were not included in this study though they could enhance the solidity of the outcomes produced here.*

* In 2011 the City of Raleigh and the Downtown Raleigh Alliance conducted and published a downtown Pedestrian County Study which can be found online at http://www.godowntownraleigh.com/do-business/reports-and-plans

Summary of findings

During the course of the study, five-foot pedestrian clearances were determined to be inadequate to handle the load of pedestrian traffic and their travel patterns in and around Raleigh's urban environments. A method for determining appropriate pedestrian clearance was created to be site-specific and is presented in Chapter 2 of this report.

While assessing the issues of site specificity and appropriateness of sidewalk width assumptions, it was discovered that the current City Code requirements of creating fourteen-foot wide sidewalk corridors is inappropriate in some locations and that a standard for the treatment of the corridor needs to be created. At times the width is too wide and at others it is too narrow, and often there are conflicts between site design, context, character, and general City policy regarding the treatment of sidewalk corridors. To address this problem, a methodology and recommended strategies were developed in the course of this study and are presented in Chapters 3 and 4 of this report. Implementation strategies and a means for incorporating the findings into City policy are given in Chapter 5.

CHAPTER 2: The Five-Foot Sidewalk Clearance Standard

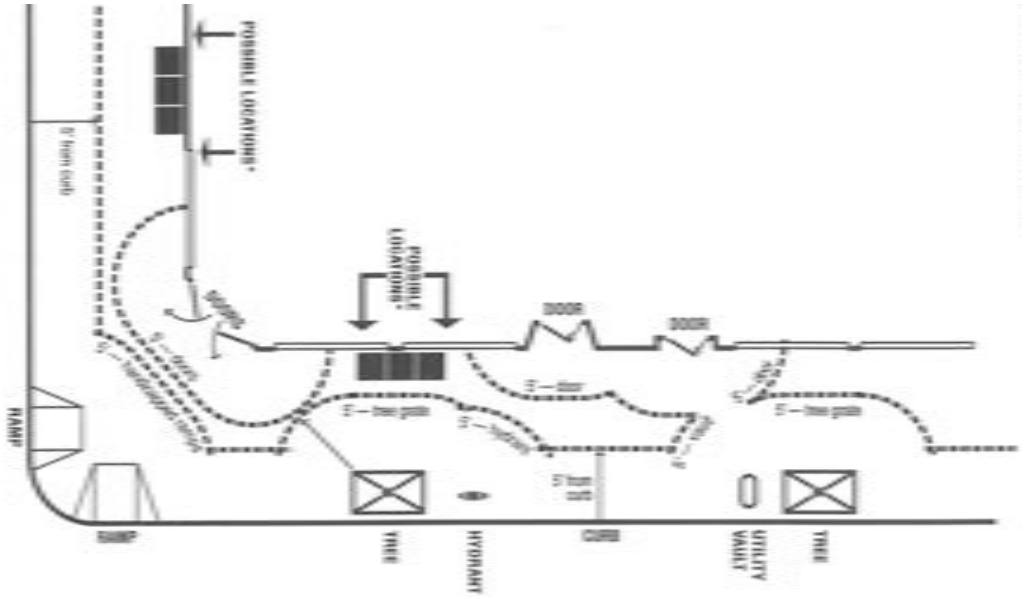


Figure 2.01 Sample of City guidelines illustrating their five-foot minimum sidewalk clearance
Source: City of Raleigh, Standards for Private Use of Public Spaces Design Handbook

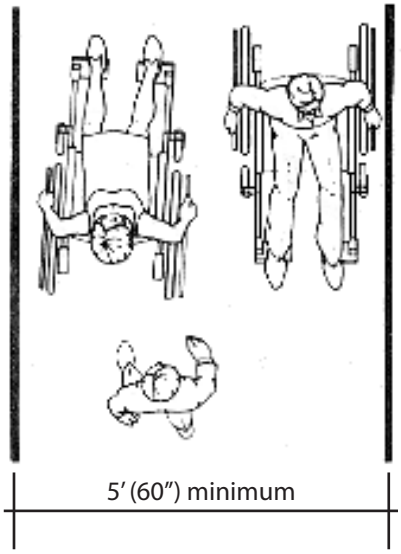


Figure 2.02 Diagram of the minimum clearance width for two wheelchairs
Source: www.access-board.gov

Figure 2.03 Diagram illustrating the space restriction between two pedestrians on a five-foot path

Many planning and development policies abide by a five-foot minimum pedestrian clearance standard and use it when calculating possible placement of obstacles on sidewalks (see Figure 2.01). This standard arises from the American Disabilities Act (ADA) requirement for providing accessible routes to individuals who may utilize wheelchairs, canes, crutches, and other assisted modes of mobilization. The five-foot accessible and clear pathway is the minimum width for two wheelchairs to pass each other according to the ADA standards (see Figure 2.02). While this meets the minimum accessibility requirement for a pathway, it is not necessarily an appropriate width for pedestrians in an urban situation.

A five-foot pedestrian clearance may account for the dimensions of two wheelchairs, but it does not consider pedestrian behaviors such as the tendency to maintain personal space (Fruin, 20) (see Figure 2.03). The reality of the average American's comfortable proximity to a stranger in a commuter situation is a minimum separation of two feet (Fruin, 22-24, 68-69) (see Figure 2.04). The two-foot spacing between two individuals also provides room for swinging arms, shoulder bags and other such projections which might collide with another person. This spacing can be observed throughout the City of Raleigh (see Figure 2.05). Using this spacing guideline coupled with expected types of pedestrian traffic patterns, one can determine an appropriate cleared pathway width for a sidewalk. This data was collected through observations that were mapped, analyzed and compared to the liturature-based assumptions.

General Observations of Pedestrian Behavior Patterns in Downtown Raleigh

Observations from patterns at various times of the day (mornings, lunch hour, afternoon, evening, and night) revealed that there are general behavior

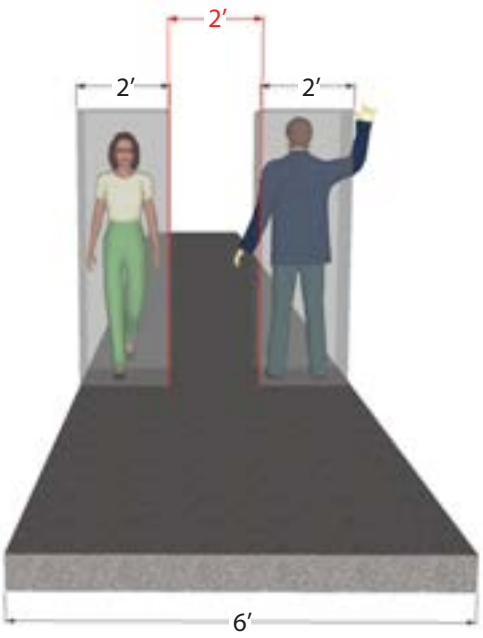


Figure 2.04 Illustration of the minimal width for two pedestrians passing at a comfortable distance

Figure 2.05 The behaviors of traveling pedestrians in downtown Raleigh illustrating the minimum two-foot buffer space

patterns among pedestrians in the City of Raleigh. These are listed here:

- Pedestrians walking together rarely walk in a group wider than four individuals, regardless of sidewalk width (see Figure 2.06)
- If there are individuals walking in the same direction and are not in the same group, they will generally assume different speeds; it is uncommon for unrelated groups to walk side by side at the same pace
- While groups are less likely to take notice of a group or individuals trying to pass from behind, they tend to walk closer together when approaching someone walking in the opposite direction to allow for space to pass
- In narrow areas, the group adjusts its width appropriately, but it does slow traffic (see Figure 2.07)
- In incidences of high-density crowds, such as following a concert or at a city-wide event people will walk closer to each other and at the same pace as unrelated individuals around them
- Pedestrians will take the shortest routes to their destination, often regardless of difficulty of path, dangers such as vehicular traffic, and likelihood of obstacles
- In areas of free-flowing traffic, people tend to spread out away from other people and inanimate objects and move more quickly

Similar observations have been made regarding pedestrian behavior patterns and more in-depth studies have been done on the subject and are available for further reading. To see a listing of useful resources, please see **Appendix C**.

Figure 2.06 Typical group width observed in downtown Raleigh

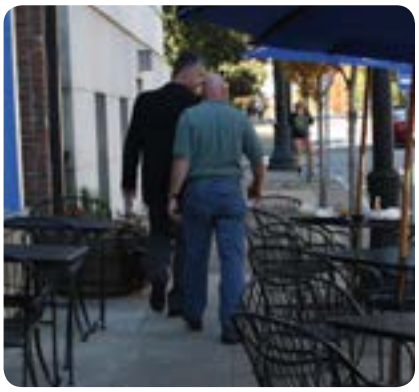


Figure 2.07 In narrow areas, people walk in a single file

Determining Appropriate Sidewalk Clearance Widths

In order to determine context-appropriate pedestrian clearance widths, a series of observations were made and mapped throughout downtown Raleigh. An inventory was taken of traveling pedestrian volumes and pedestrian generators. These were then analyzed to identify ranges of pedestrian use intensity which coincide with appropriate pedestrian clearance widths.

Figure 2.08 – Map of Existing Traveling Pedestrian Volumes

Observations were made of general pedestrian volumes along sidewalks on each block face. Only pedestrians moving along a street and not engaged in other types of pedestrian activities on the sidewalks were considered in developing a map of ranges throughout the study area.

Areas of light pedestrian volume are areas where it is infrequent to see more than a few pedestrians and rarely do they pass each other, in these instances a five- to six- foot sidewalk is adequate. Where there is moderate flow, there are several pedestrians and occasionally they pass each other. Areas of heavy pedestrian volume are where there are many pedestrians who are traveling in multiple directions. Places where there are many pedestrians constantly in the sidewalk and nearly always passing other individuals are places of very heavy pedestrian volume.

As the map reveals, Fayetteville Street and its immediately adjacent streets, the Moore Square area, and Glenwood South have the highest amounts of pedestrian traffic. This volume gradually lessens as a path moves out from these areas into more residential neighborhoods.

An inventory was taken of traveling pedestrian volumes and pedestrian generators. These were then analyzed to identify ranges of pedestrian use intensity which coincide with appropriate sidewalk clearance widths.

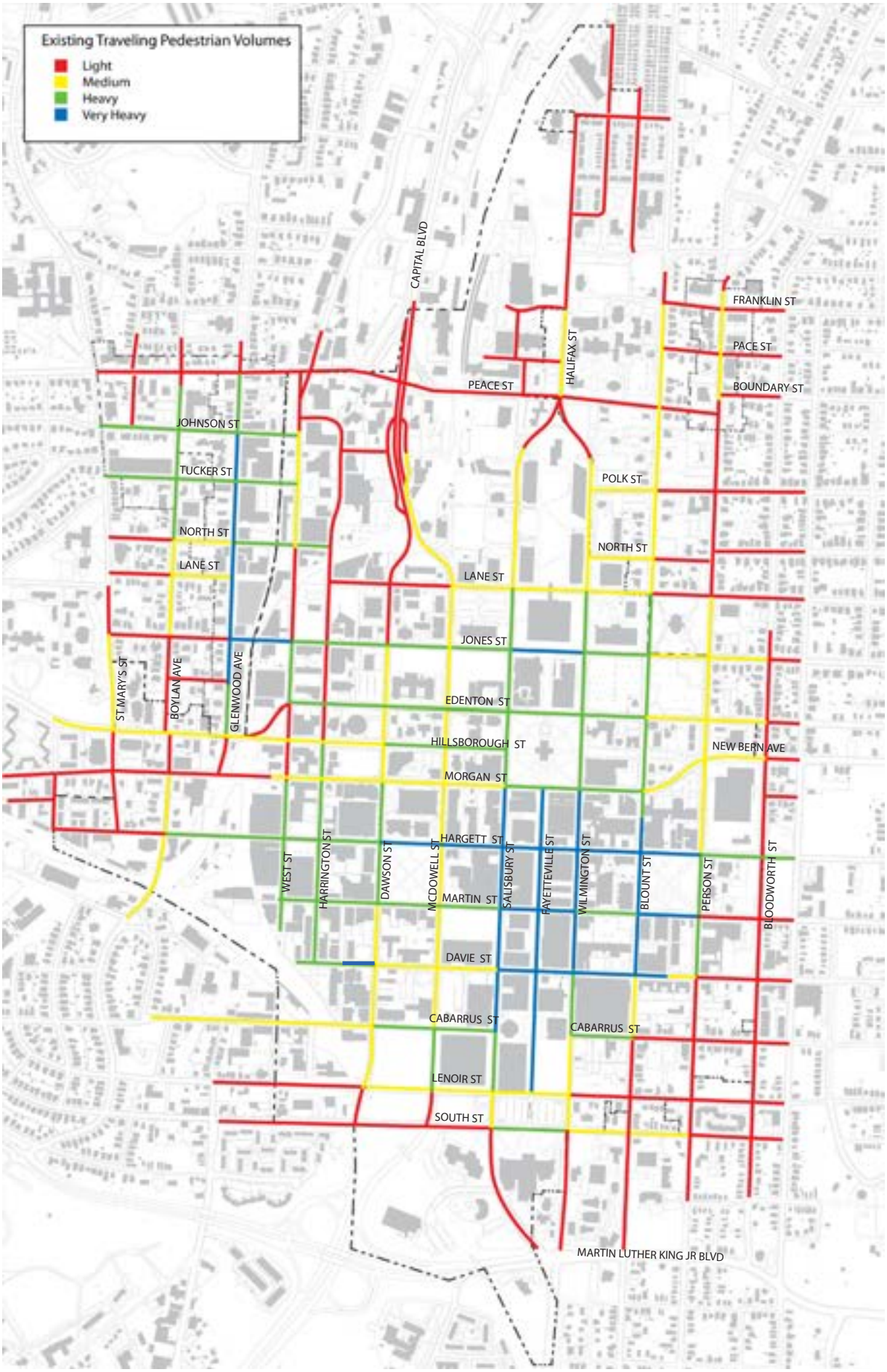


Figure 2.08 Map of Existing Traveling Pedestrian Volumes

Figure 2.10 – Map of Existing Pedestrian Generators

Figure 2.09 Downtown offices with first floor retail or restaurant use are major pedestrian generators

Pedestrian generators are places where the activity occurring in a place attracts pedestrian traffic. These were determined by observing general pedestrian movement in and out of block faces throughout the study area noting volume and frequency. This assumes that the people entering and exiting buildings and other areas become pedestrians for more than a block face and are not walking directly out to their car or other mode of transportation. These generators are destinations as well as sources of pedestrians and come in many different forms including: offices, parks, museums, post offices, parking decks, transit stations, restaurants and bars. By mapping pedestrian flow in and out of buildings or spaces and noting the times of days and time of week flows occur, it is possible to deduct where sidewalks may be in more demand than in other places.

Pedestrian generators that produce an occasionally moderate volume of pedestrians are places where there is reliable pedestrian input onto the sidewalk but traffic is neither consistent nor heavy; these areas certainly need sidewalks, but they do not have to be exceptionally wide.

Pedestrian generators that produce consistent moderate pedestrian volume are areas where there is regular pedestrian input onto the sidewalks but the traffic is not heavy, such as small office buildings. Sidewalks for these areas should be wide enough for people to pass each other with ease.

Generators that produce an occasionally high volume of pedestrians are places where there is heavy traffic on the sidewalk, but only on certain days or at certain times such as churches, night clubs, convention centers, theaters, and concert halls. Sidewalks around these types of generators will need to be wide, but if there is little additional pedestrian traffic, it will not be of the widest category and it is acceptable for it to be quite crowded occasionally.

Finally, pedestrian generators that consistently produce high volume pedestrian inputs create a need for very wide sidewalks to handle the dependable high amounts of pedestrian traffic. Major pedestrian generators are concentrated between Salisbury and Wilmington Streets. This spans the Fayetteville Street banking, business, county, and city government offices up to the State Government Complex. Other high volume generators can be found along South Glenwood Avenue. Most of the pedestrian generators found in the rest of downtown Raleigh are consistent but not high volume.

Figure 2.10 Map of Existing Pedestrian Generators

Figure 2.11 – Map of Existing Pedestrian Use Intensity

In order to determine the needed pedestrian clearance widths to accommodate existing pedestrian traffic, the previously discussed observation and inventory maps were analyzed by overlay and critical thought on how each sidewalk along a block face functioned. The result of this analysis is this map of pedestrian intensity which is then correlated into actual ranges of pedestrian clearance widths needed throughout downtown Raleigh.

In overlaying the maps, streets along block faces with all blues or a blue & green combination required the widest pedestrian clearance. It is assumed that these are heavily trafficked sidewalks. In places where there were all greens or a green and yellow combination, pedestrian clearance width needs were based on the idea that these are busy areas needing relatively wide sidewalks. Where there were all yellow or yellow and red in the overlaying of the maps, most sidewalks need to accommodate moderate traffic. Finally, there were only red in places where sidewalks only needed to meet the basic requirement of five to six feet.

Once pedestrian intensity was determined, pedestrian clearance widths were derived from the information. These widths were divided into the following four categories: five to six feet (space for two people to pass each other within a close distance, best for a sidewalk with little traffic), seven to nine feet (this allows two or three people to pass each other with a comfortable passing distance of two feet), ten to twelve feet (allow two couples or three individuals to pass with a comfortable passing distance, a good width for most busy places), and greater than twelve feet (best for places with very heavy pedestrian traffic). The final pedestrian clearance width typology details are listed in Table 2.1 and illustrated in Figure 2.12.

Table 2.1 Correlation between pedestrian use intensity and pedestrian clearance widths

Pedestrian Use Intensity	Appropriate Pedestrian Clearance Width	Maximum Individual Capacity Along Horizontal Plane	Tolerable Frequency at Capacity	Maximum number of Individuals with Comfortable Proximity	Likely locations of such sidewalks
Low	5-6'	3	Infrequent	2	Outer urban fringes, single family residential neighborhoods
Moderate	7-9'	4	Moderate Frequency	3*	Outer urban fringes, small businesses, residential areas
High	10-12'	5	Moderate Frequency	4*	Urban areas, high density residential neighborhoods, downtown office buildings, retail, some mixed-use areas
Very High	> 12'	6	Frequent	5*	Urban areas, dense mixed-use development with heavy pedestrian use

* The more urban an area, the more tolerant pedestrians tend to be of closer proximity to other individuals

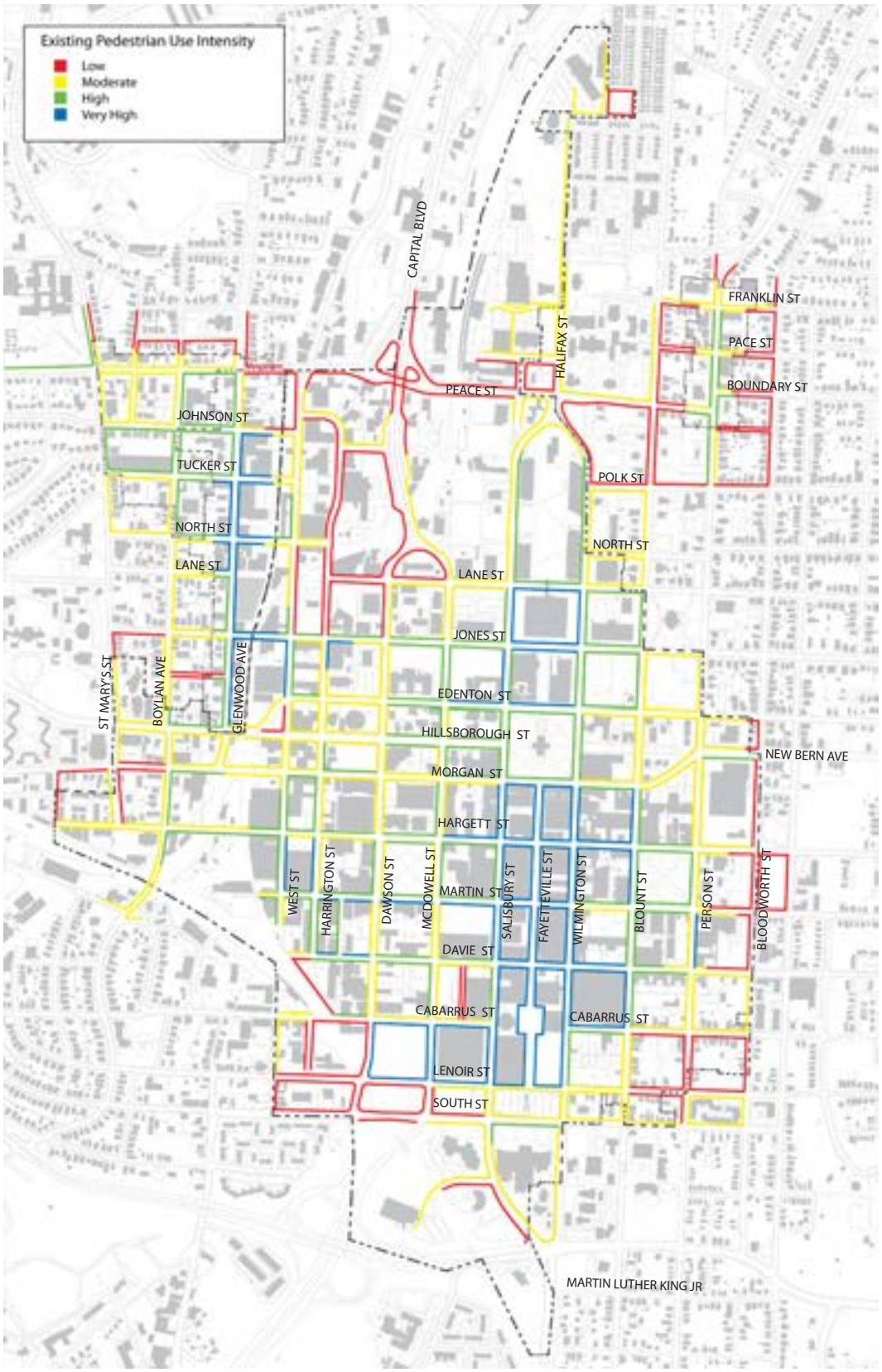


Figure 2.11 Map of Existing Pedestrian Use Intensity

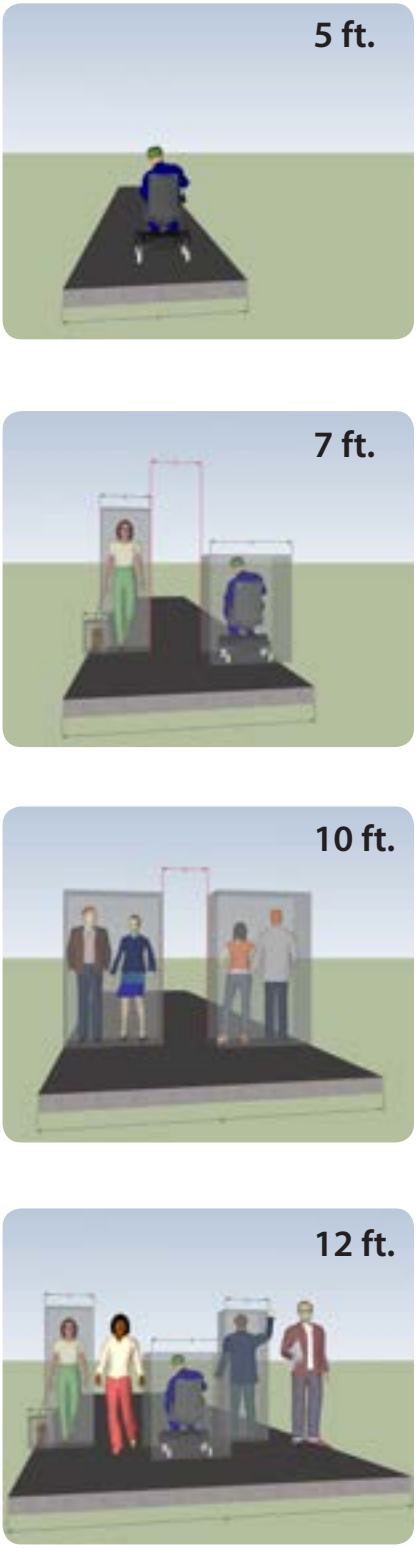


Figure 2.12 Sidewalk clearance typology of five, seven, ten, and twelve feet

Need for Wider Pedestrian Clearance

The Pedestrian Use Intensity Map identifies areas where various-sized pedestrian clearances should be located, but in order to illustrate areas where there is a need for clearance widening, the Pedestrian Use Intensity Map must be compared to existing pedestrian clearances in downtown Raleigh. This information was gathered through both manual field measurements and digital measurement via information available on the most recent AutoCAD data of the City's Planimetric (Figure 2.13).

This inventory revealed a great number of sidewalks that actually have a less than the required minimum clearance of five feet due to various obstructions, and in a few cases, the actual sidewalk is less than five feet in width. The widest clearance can be found along Fayetteville Street, some areas around the State Government Complex, and around the new convention center.

By overlaying the Pedestrian Use Intensity Map and the Existing Pedestrian Clearance Widths Map, one can determine areas where clearance needs to be addressed based on existing conditions. This is illustrated in Figure 2.14, Map of Areas of Insufficient Pedestrian Clearance. In order to determine how City development plans would affect clearance widths, it is essential to create maps based on possible outcomes as they relate to pedestrian clearance.

This inventory revealed a great number of sidewalks that actually have less than the required minimum clearance of five feet.

Figure 2.13 Map of Existing Pedestrian Clearance Widths

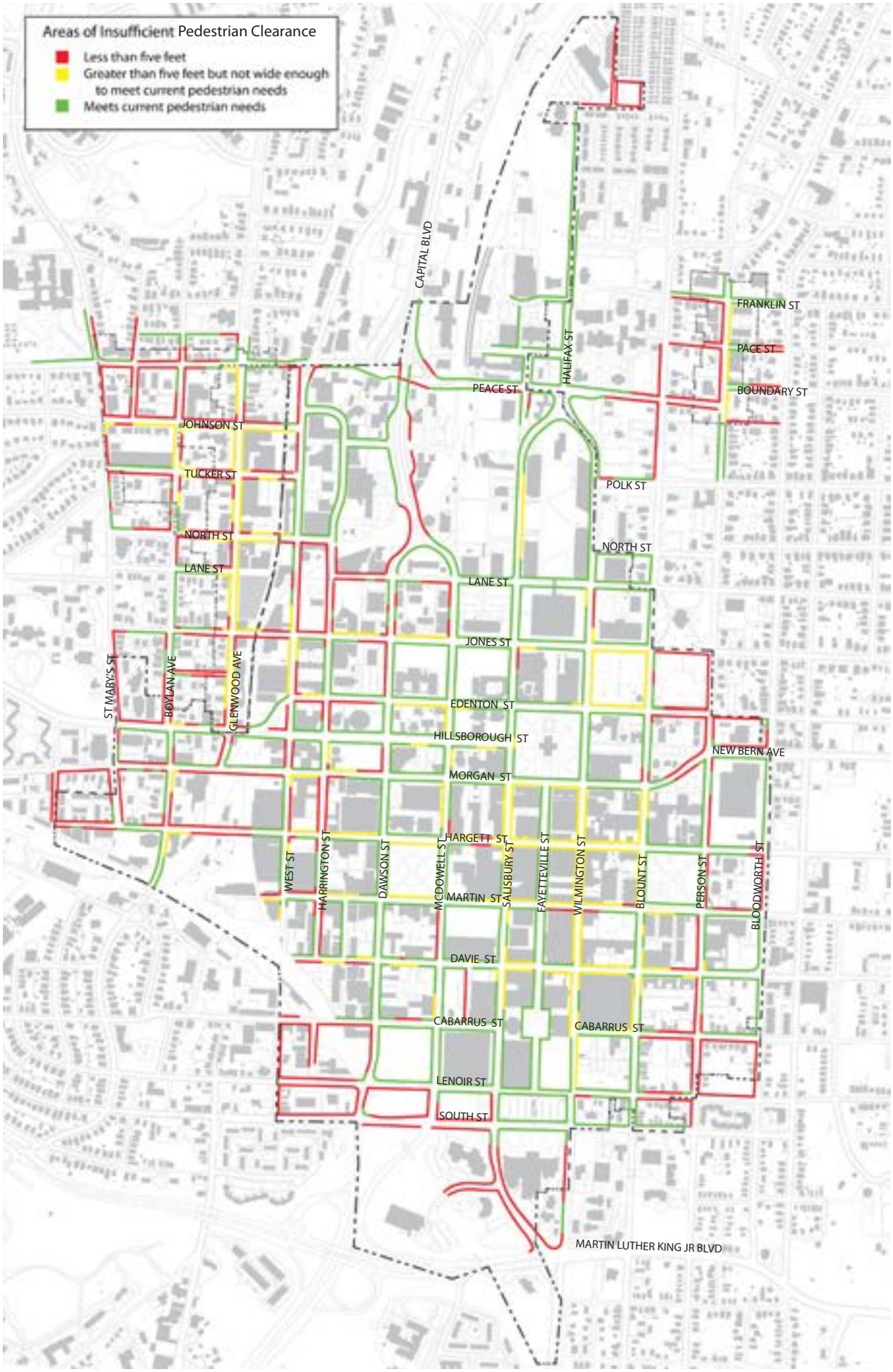


Figure 2.14 Map of Areas of Insufficient Pedestrian Clearance

Projected Outcomes

In order to create a pedestrian use intensity map that reflects future growth of the City, it was necessary to assemble and analyze City plans as they related to pedestrian intensity.

These plans were relayed primarily through the Urban Design Center's Safe Site Analysis and in discussion with City planners. This created an inventory of areas where change was planned within the next twenty years. Most redevelopment is planned for areas that are currently surface area parking lots and single-story buildings within downtown.

Figure 2.15 Examples of proposed redevelopment for downtown Raleigh
Source: City of Raleigh Urban Design Center

The L Building on McDowell Street & Davie Street (proposed)

This information, coupled with the extension of existing site-programming patterns and discussion over feasible frontages allowed for the interpolation of possible traveling pedestrian volumes and pedestrian generators. This information would then be processed to create a projected pedestrian use intensity map, a product that would dictate required sidewalk widths.

Figure 2.16 –Map of Massing Possibilities on Developable Land

This map looks at areas planned for redevelopment over the next two decades and illustrates building height possibilities. These heights are based upon context and discussion with City planners and the assumption that each story is ten to fifteen feet high. Developable land was determined by the Safe Site Analysis as previously mentioned.

Charter Square on Fayetteville Street (proposed)

This map reveals concentrated redevelopment along West and Harrington Streets, around the Warehouse District, and just outside of the Fayetteville Street District. This development will likely create new neighborhoods with their own distinct identity, a concept that is explored in Figure 2.18, Possible Use Based Districts. When coupling building mass possibilities with potential uses, it is possible to determine the potential for pedestrian generation (see Figure 2.19).

Building height will also influence the need for enhancing the sense of human scale along the sidewalks through setbacks, awnings, street trees, and landscaping features. These elements are variables in the equation for determining sidewalk width and treatment, topics of Chapters 3 and 4.

Green Square on Jones Street (under construction)

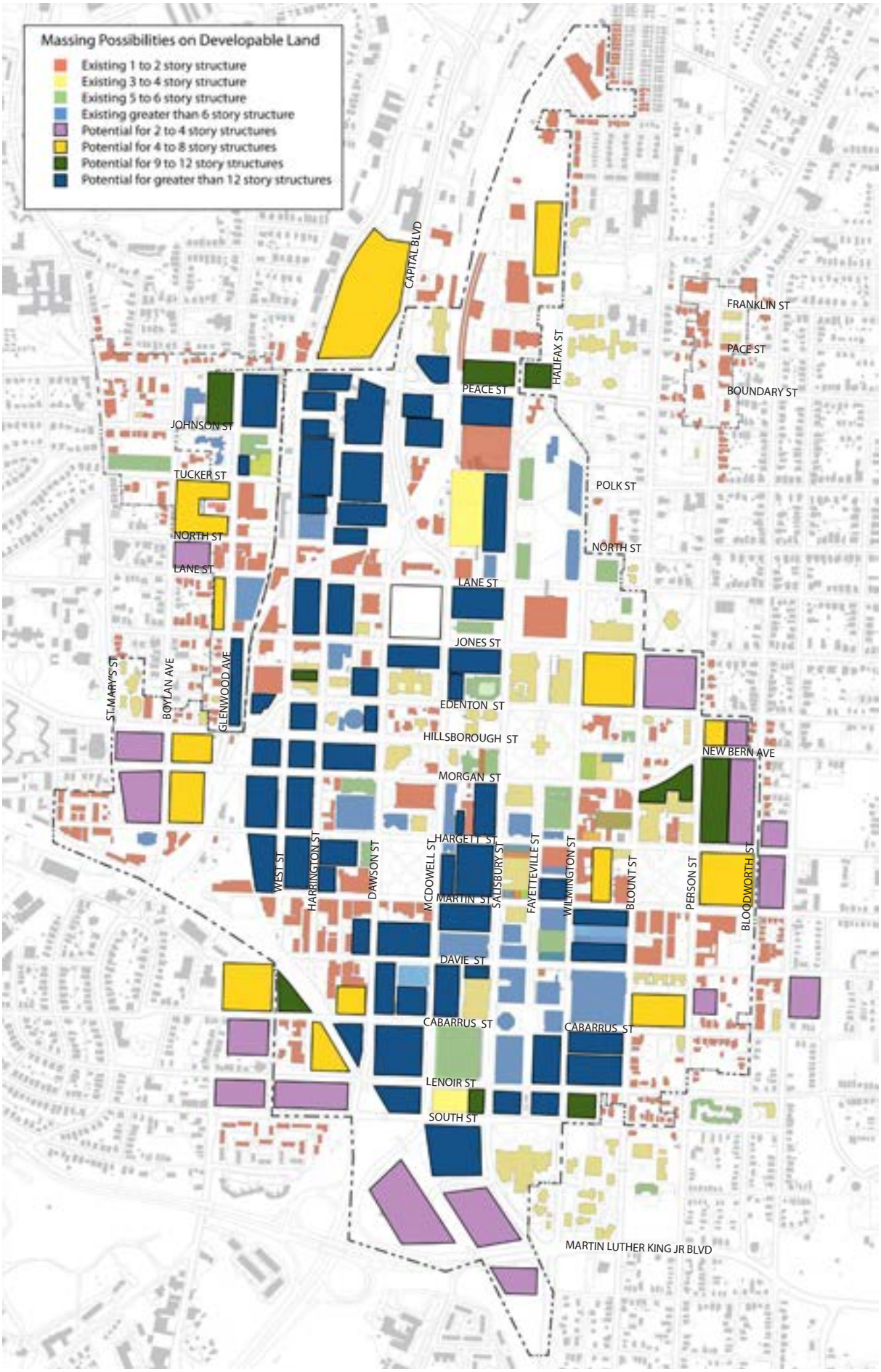


Figure 2.16 Map of Massing Possibilities on Developable Land

Figure 2.18 – Map of Possible Use-Based Districts

This map expounds upon the existing district definitions but looks more closely at use as a defining element. These districts were used to determine possible pedestrian generators and pedestrian volume. This map was also used to help determine projected frontages, sidewalk treatment, and needed sidewalk width which is explained in Chapter 3.

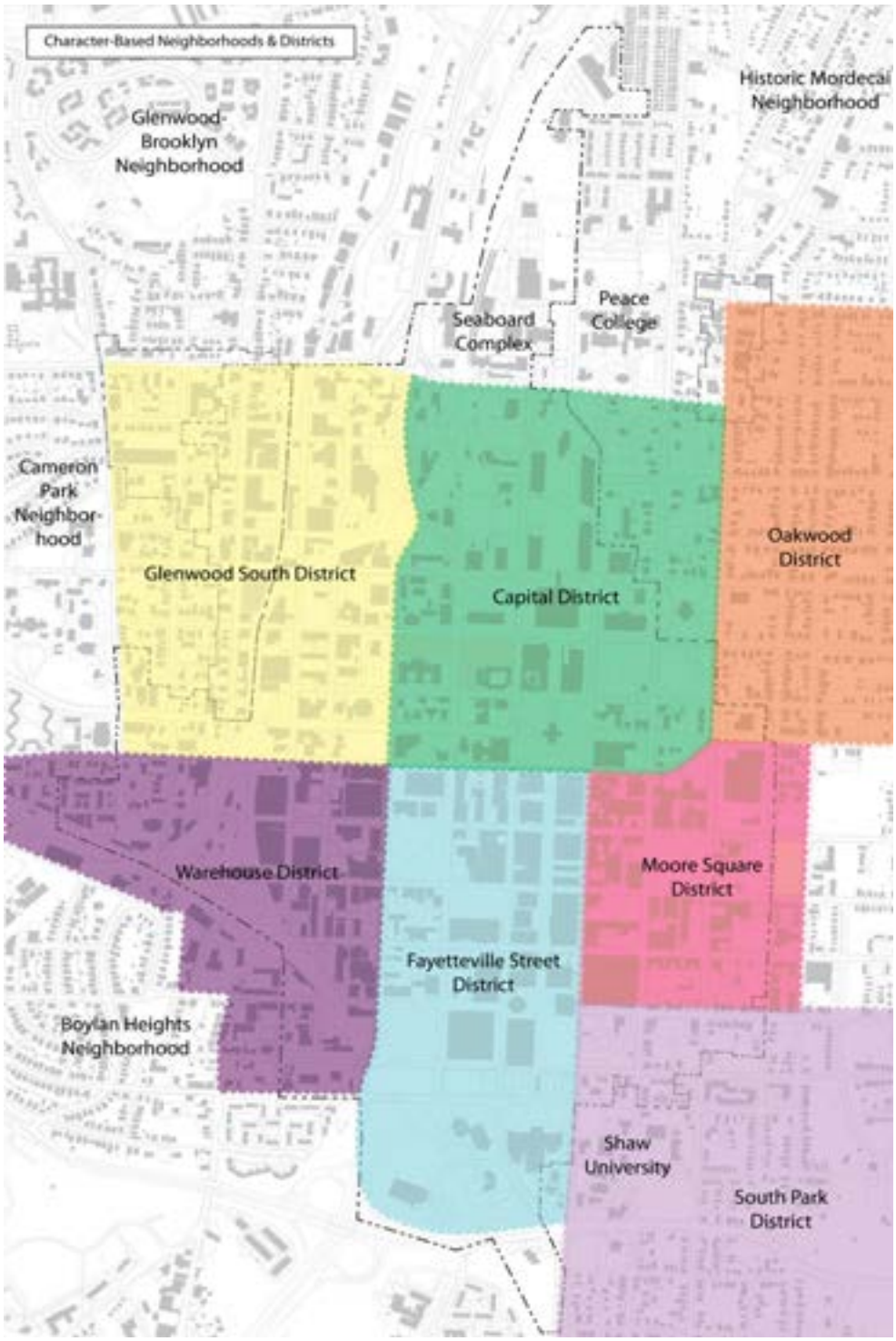


Figure 2.17 Current character-based neighborhood & district boundaries

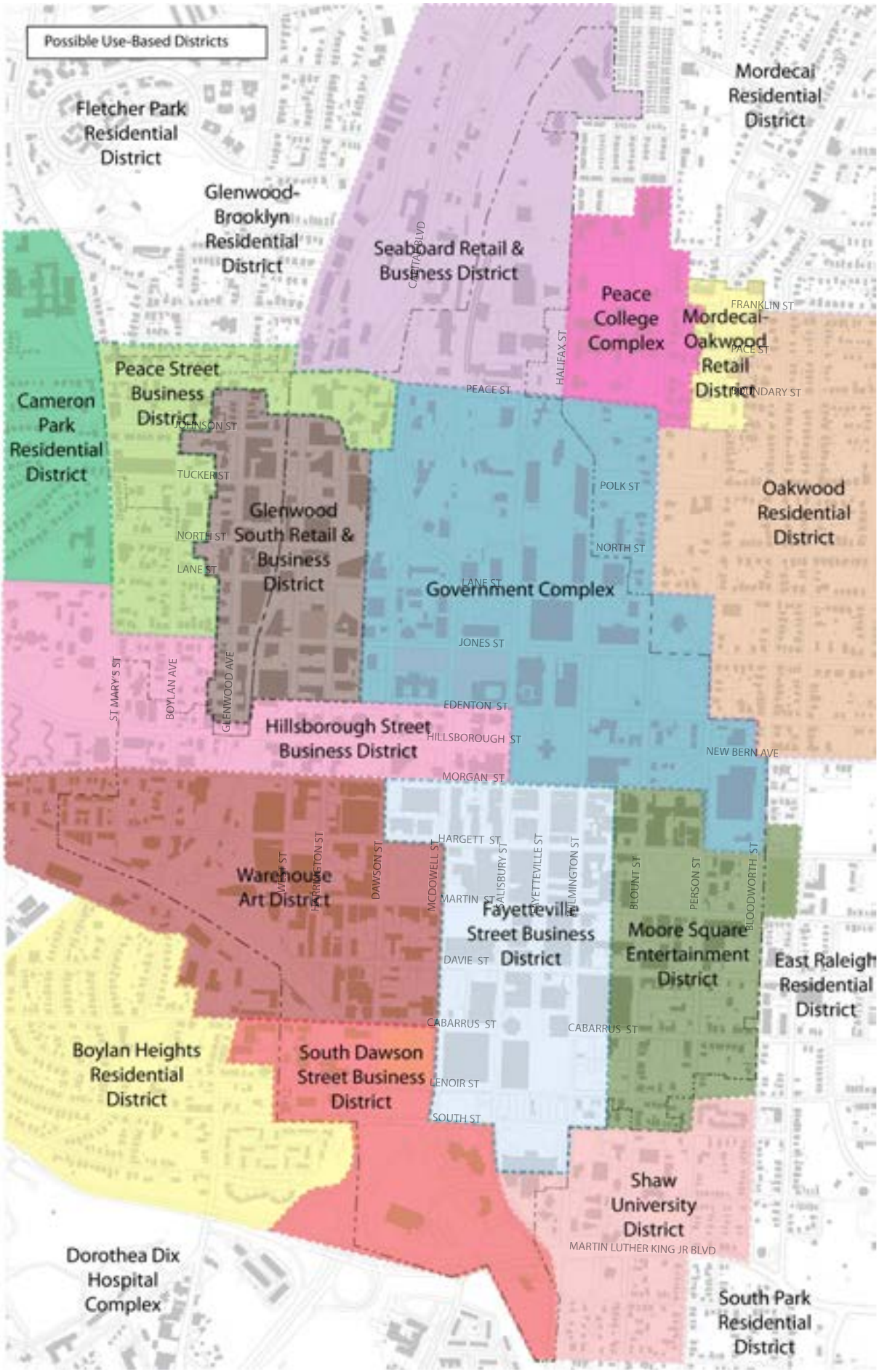


Figure 2.18 Map of Possible Use-Based Districts

Figure 2.19 – Map of Projected Pedestrian Generators

Combining massing possibilities, use-based districts, and existing pedestrian generators produces a map that illustrates the likely locations of pedestrian generators of various volume and consistency.

Pedestrian generators that produce an occasionally moderate volume of pedestrians are places where there is reliable pedestrian input onto the sidewalk but traffic is neither consistent nor heavy; these areas certainly need sidewalks, but they do not have to be exceptionally wide.

Pedestrian generators that produce consistent moderate pedestrian volume are areas where there is regular pedestrian input onto the sidewalks but the traffic is not heavy, such as small office buildings; sidewalks for these areas should be wide enough for people to pass each other with ease.

Generators that produce an occasionally high volume of pedestrians are places where there is heavy traffic on the sidewalk, but only on certain days or at certain times such as churches, night clubs, convention centers, theaters, and concert halls. Sidewalks around these types of generators will need to be wide, but if there is little additional pedestrian traffic, it will not be of the widest category and it is acceptable for it to be quite crowded occasionally.

Finally, pedestrian generators that consistently produce high volume pedestrian inputs create a need for very wide sidewalks to handle the dependable high amounts of pedestrian traffic.

According to this predicted data, the area around Moore Square, the Warehouse District, West and Harrington Streets will develop considerably and be the central sources of pedestrian traffic.

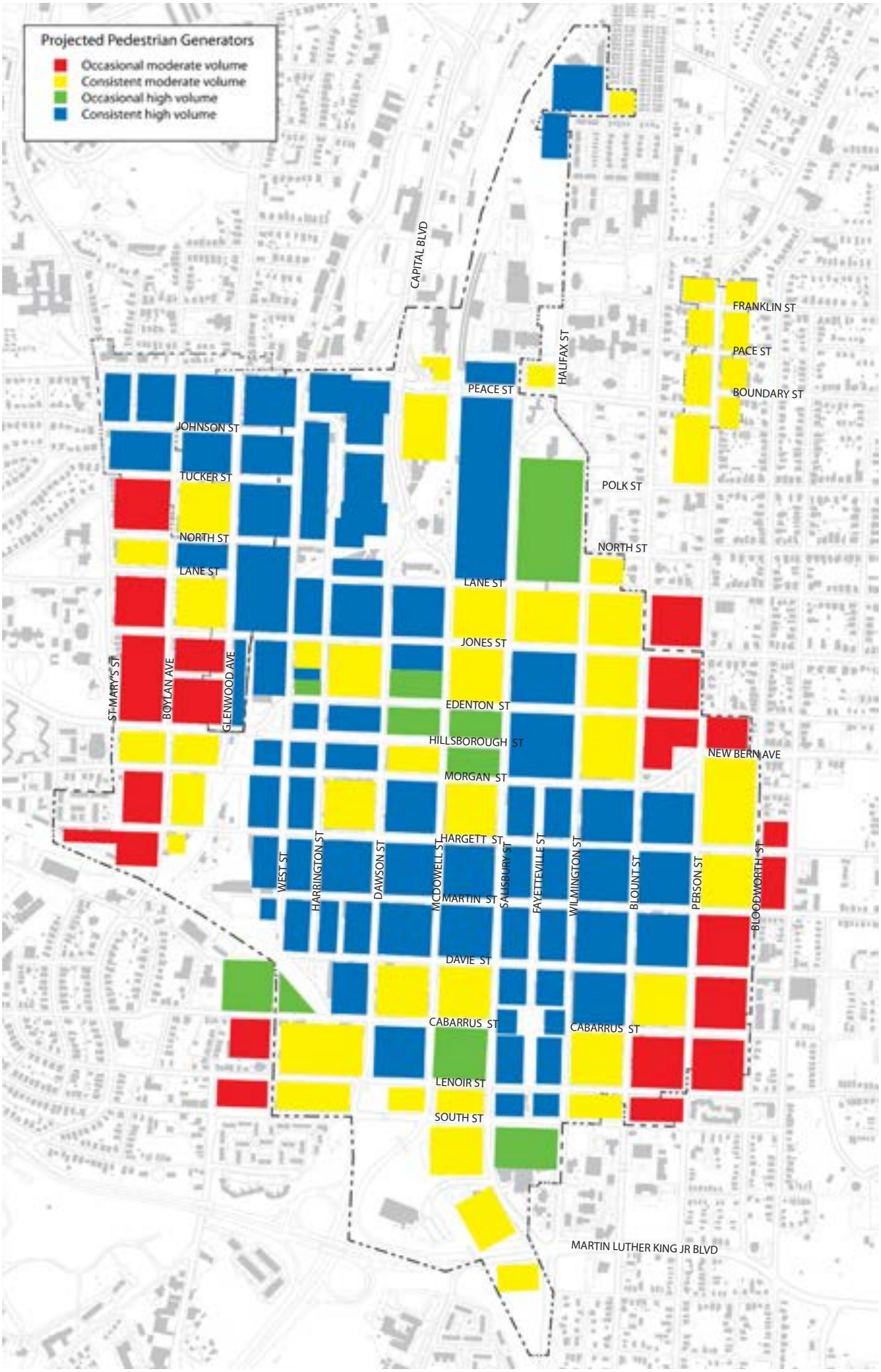


Figure 2.19 Map of Projected Pedestrian Generators

Figure 2.20 – Map of Projected Traveling Pedestrian Volumes

This map is based upon the locations of projected pedestrian generators, use-base districts, and patterns of the existing pedestrian flow throughout the study area.

Areas of light pedestrian volume will probably be areas where it is infrequent to see more than a few pedestrians and they rarely pass each other meaning a narrower sidewalk is appropriate. Where there would be medium flow, there could be several pedestrians and occasionally they pass each other. Areas of heavy pedestrian volume would be places where there are many pedestrians who are often passing each other but at comfortable distances. Places where there may be many pedestrians constantly in the sidewalk and nearly always passing other individuals are places predicted to have very heavy pedestrian traffic.

This map illustrates a general increase in pedestrian activity throughout downtown Raleigh. The only area with expected low pedestrian volume is in an area that is determined to remain as a single family residential neighborhood.

This series of maps were necessary to determine a reasonable projection of pedestrian use intensity in the City.

This map illustrates a general increase in pedestrian activity throughout downtown Raleigh.

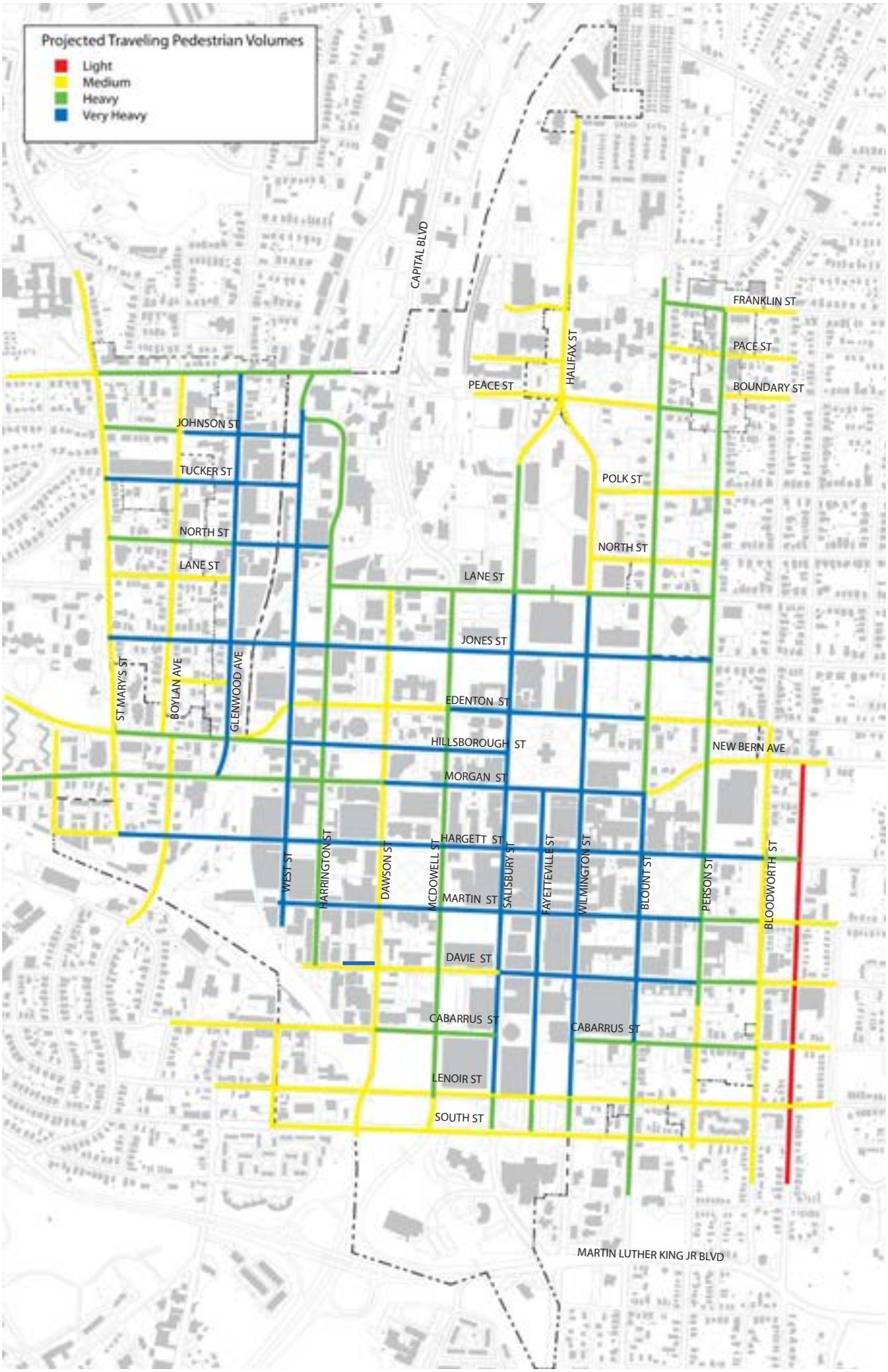


Figure 2.20 Map of Projected Traveling Pedestrian Volumes

Figure 2.21 - Map of Projected Pedestrian Use Intensity

This map was created based on information similar to that used for the Existing Pedestrian Use Intensity Map. However, this map utilized City plans and projected development patterns to provide a foundation for analysis and mapping. It is this map of pedestrian use and its related sidewalk clearance widths which are used as the basis for determining the ideal ranges of sidewalk corridor widths in Chapter 4.

Chapter Summary

A series of inventory and analysis maps coupled with observed and literature-supported knowledge of pedestrian behavior and dimensions revealed the need to consider an alternative to accepting the five-foot pedestrian clearance standard. The downtown environment has a high demand for pedestrian clearance due to the intensity of use. The research outlined acceptable ranges of clearance widths that would be site-specific in order to accommodate the expected amount of use. In addition to highlighting areas that are currently under pressure for widening, data was also provided to produce a plan-based projection of future pedestrian clearance needs.

Accommodating traveling pedestrians should be the primary goal of every sidewalk, therefore determining appropriate clearance widths is the first priority in addressing the width and treatment of a sidewalk corridor. This range is the foundation for all other additions that contribute to final urban sidewalk widths; the following chapter will discuss other considerations that are needed in concluding an appropriate sidewalk corridor width.

Table 2.2 Correlation between pedestrian use intensity and pedestrian clearance widths (repeat of Table 2.1)

Pedestrian Use Intensity	Appropriate Pedestrian Clearance Width	Maximum Individual Capacity Along Horizontal Plane	Tolerable Frequency at Capacity	Maximum number of Individuals with Comfortable Proximity	Likely locations of such sidewalks
Low	5-6'	3	Infrequent	2	Outer urban fringes, single family residential neighborhoods
Moderate	7-9'	4	Moderate Frequency	3*	Outer urban fringes, small businesses, residential areas
High	10-12'	5	Moderate Frequency	4*	Urban areas, high density residential neighborhoods, downtown office buildings, retail, some mixed-use areas
Very High	> 12'	6	Frequent	5*	Urban areas, dense mixed-use development with heavy pedestrian use

* The more urban an area, the more tolerant pedestrians tend to be of closer proximity to other individuals

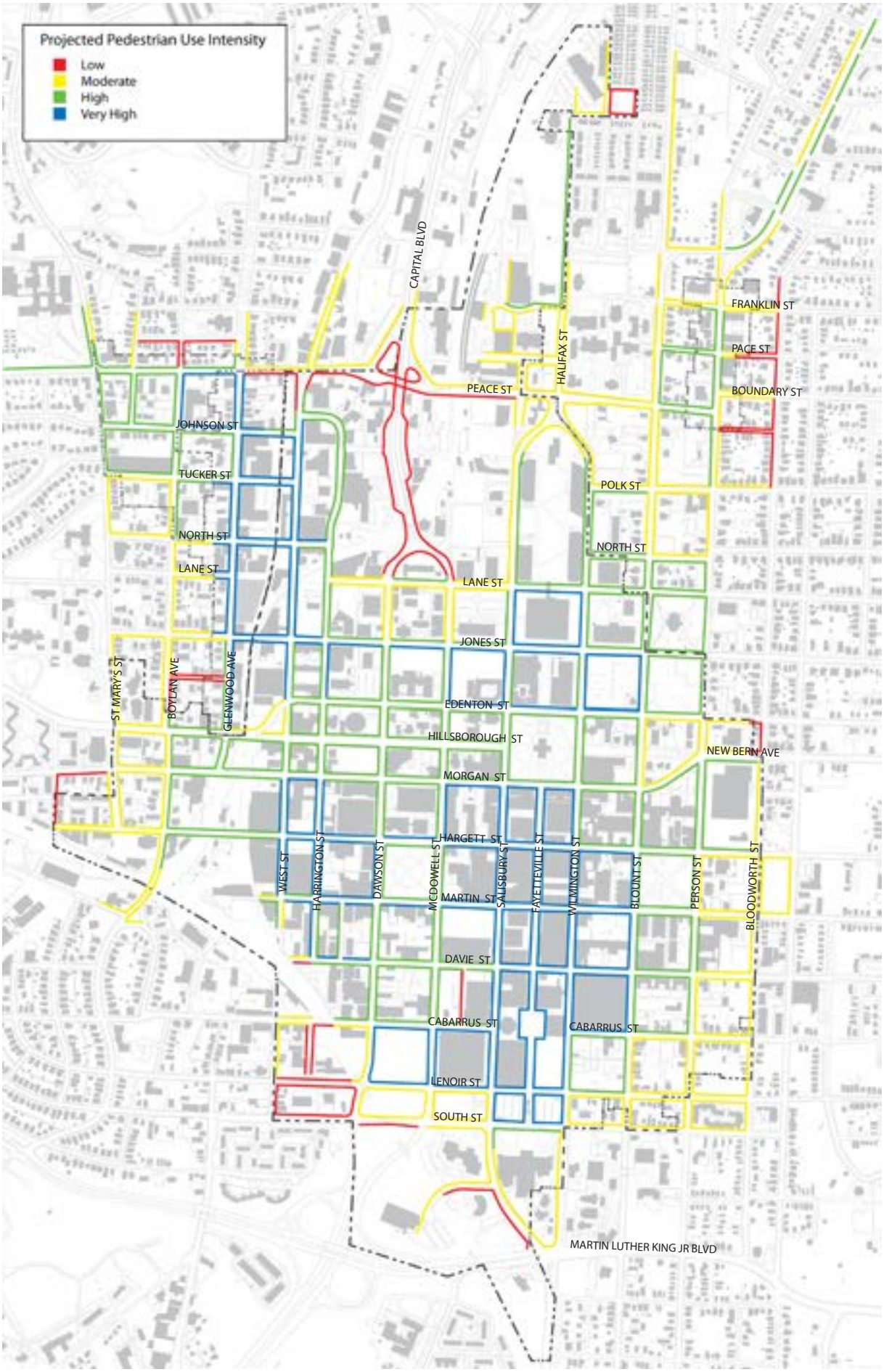


Figure 2.21 Map of Projected Pedestrian Use Intensity

CHAPTER 3: Framework for Sidewalk Corridor Treatment

Figure 3.02 Current sidewalk corridor treatment patterns

Paved to the back of curb

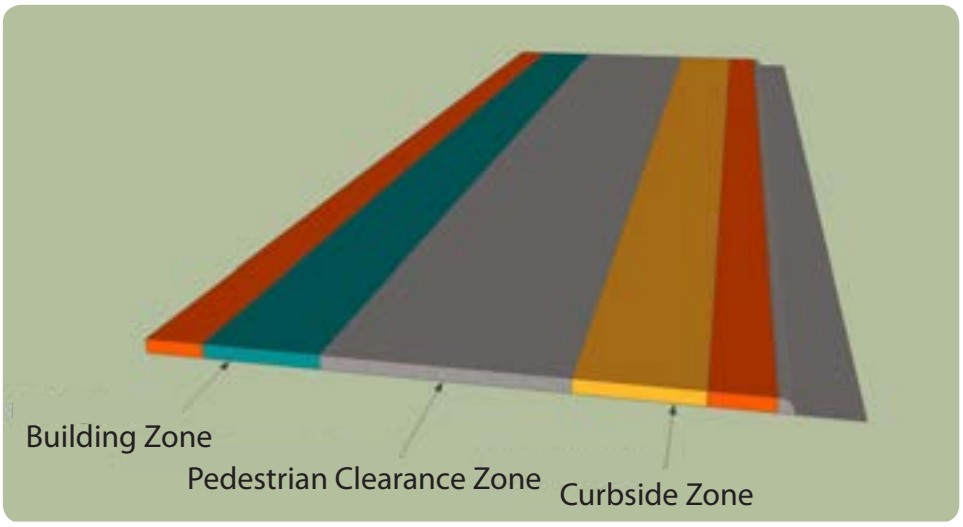
Grass verge

Open tree lawn

Paved to curb with grated street trees

Trees located behind sidewalk

Figure 3.01 Sidewalk corridor zones



In order to determine appropriate sidewalk corridor widths, it is important to first recognize that in an urban environment, the pedestrian clearance is not the entirety of a sidewalk corridor, but rather it is only the base. While the clearance preserves the walkway's primary goal, there are other pedestrian-related activities and elements surrounding that section of the sidewalk corridor. These non-traveling pedestrian activities and stationary elements are located in the building and curbside zones of a sidewalk (see Figure 3.01).

This chapter will explore the possible locations of some of the more permanent elements that would be found in these other zones. Current City standards require four-by-six-foot grated street trees throughout downtown Raleigh which does not allow for site-specific diversity which enhances the sense of place in downtown. This study will help establish a framework for possible sidewalk treatments that unify downtown Raleigh while being site-specific.

In order to formulate possible sidewalk treatment typologies, a thorough study was conducted of existing sidewalk corridor compositions; districts or areas that should maintain a distinguished character were identified; vehicular patterns were noted; and building mass and setback were recorded.

Figure 3.03 – Map of Existing Sidewalk Corridor Compositions

General corridor compositions were noted along each block face within the study area as this identifies the established sidewalk treatment. Typical compositions include the following:

- sidewalks paved to the back of curb lacking any vegetative buffer
- verge with grass or other plantings
- open tree pit that may or may not have grass or other vegetative features
- sidewalks with grated street trees

Some corridors had trees to provide shade for the pedestrian but were located on the backside of the sidewalk (not on the street side). (See Figure 3.02)

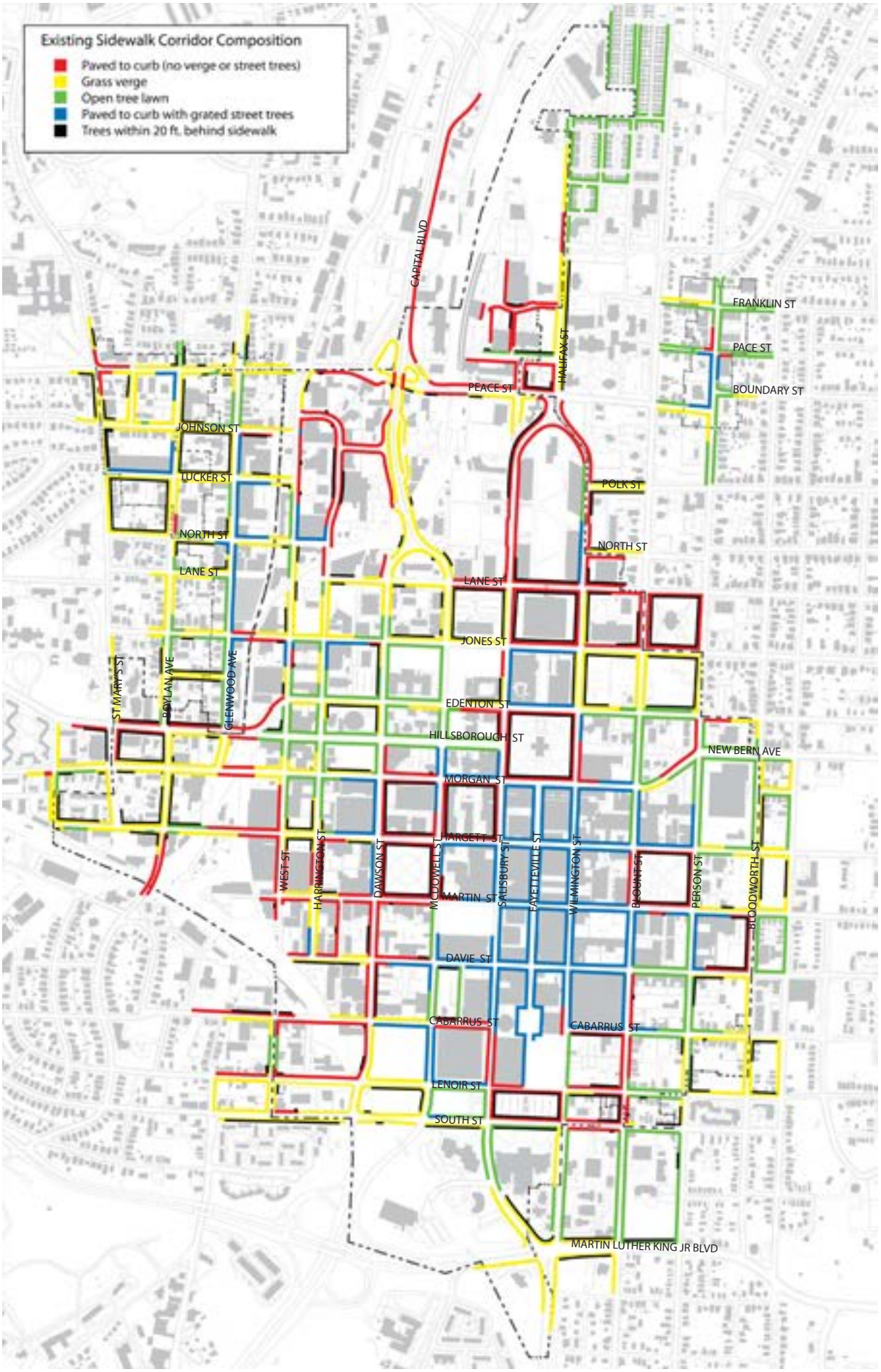


Figure 3.03 Map of Existing Sidewalk Corridor Compositions

Figure 3.06 – Map of Character-Based Neighborhoods & Districts

Based on existing district maps of the city (see Figure 3.05), boundaries are not well defined nor consistent. Those used here are generally accepted at the moment. These districts are named after their central feature. Each district contains certain characteristics found in its streetscape design that defines it from the rest of the city. These characteristics give pedestrians something to recognize and define the sense of place. Examples of these characteristics can be found in Figure 3.04.

This map can be compared to the Figure 2.18, Possible Use-Based District Map in order to get an idea of how the districts may evolve and what patterns might be associated with the various areas to create distinct but unified neighborhoods in downtown Raleigh.

Figure 3.04 Characteristic elements of various districts and neighborhoods

Glenwood South

Warehouse District

Fayetteville Street Corridor

Oakwood-Mordecai

Figure 3.05 Existing District Map

Source: www.raleighconvention.com

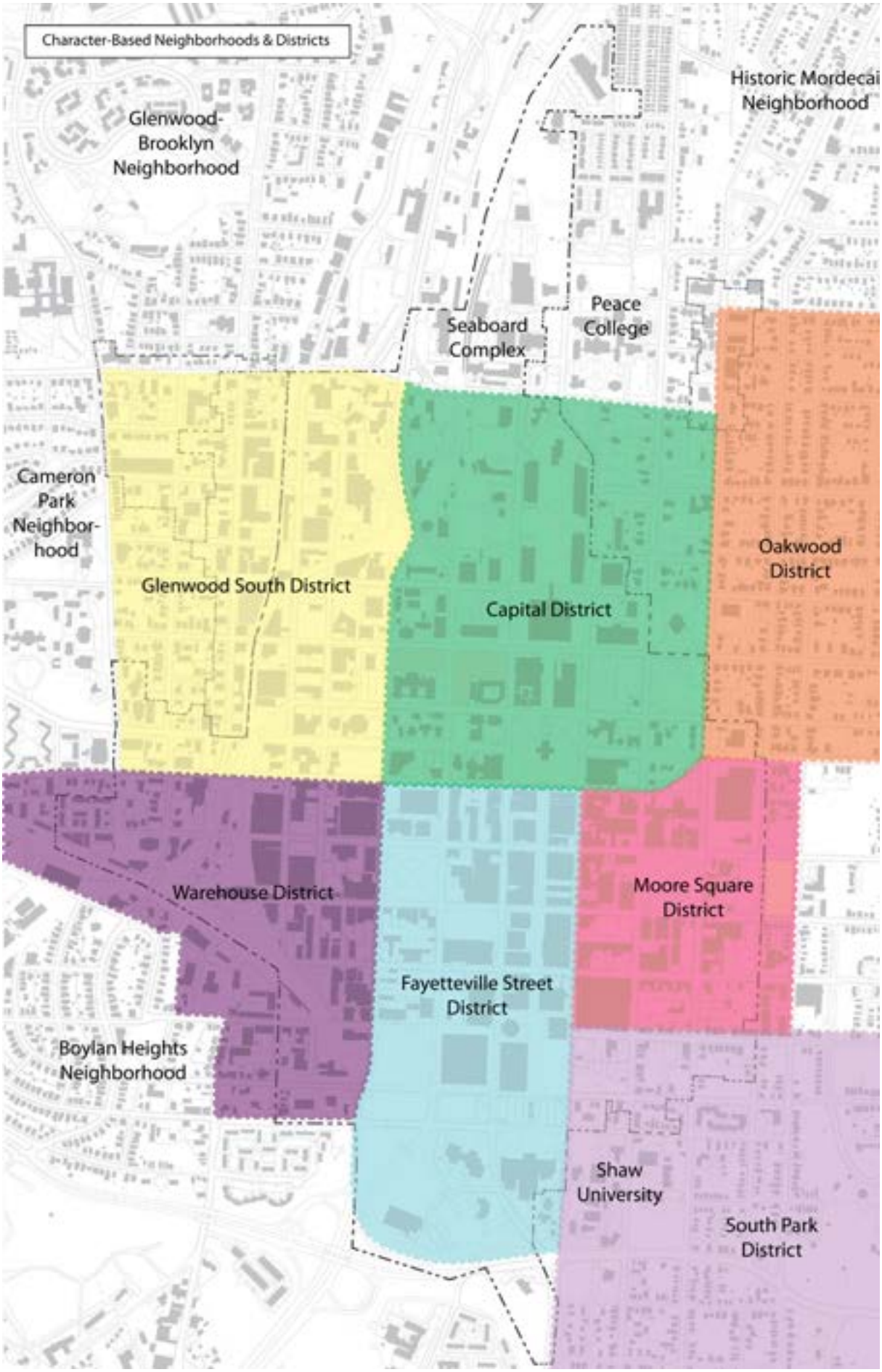


Figure 3.06 Map of Character-Based Neighborhoods & Districts

Figure 3.08 – Map of Areas of Preservation-Worthy Character

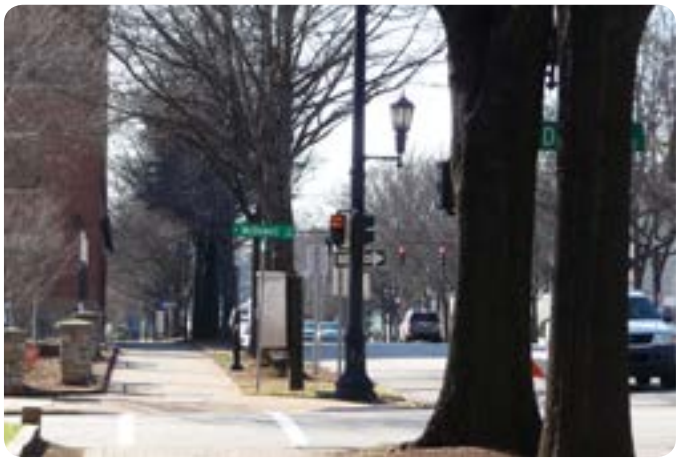
In some parts of Raleigh there are areas that offer a significant contribution to the local history. They are places that are unique because of the stories, features, and uses that are attributed to them; they are landmarks and play a role in keeping memories alive. This map identifies some of the areas with unique sidewalk elements recognized by locals as places that are worth preservation.

Figure 3.07 Examples of preservation-worthy streetscape and sidewalk elements

Union Square

Blount Street Corridor - Historic Brick Sidewalk

The Historic Warehouse District



Hillsborough Street Corridor - Mature Oak Trees

City Market

Fayetteville Street Corridor

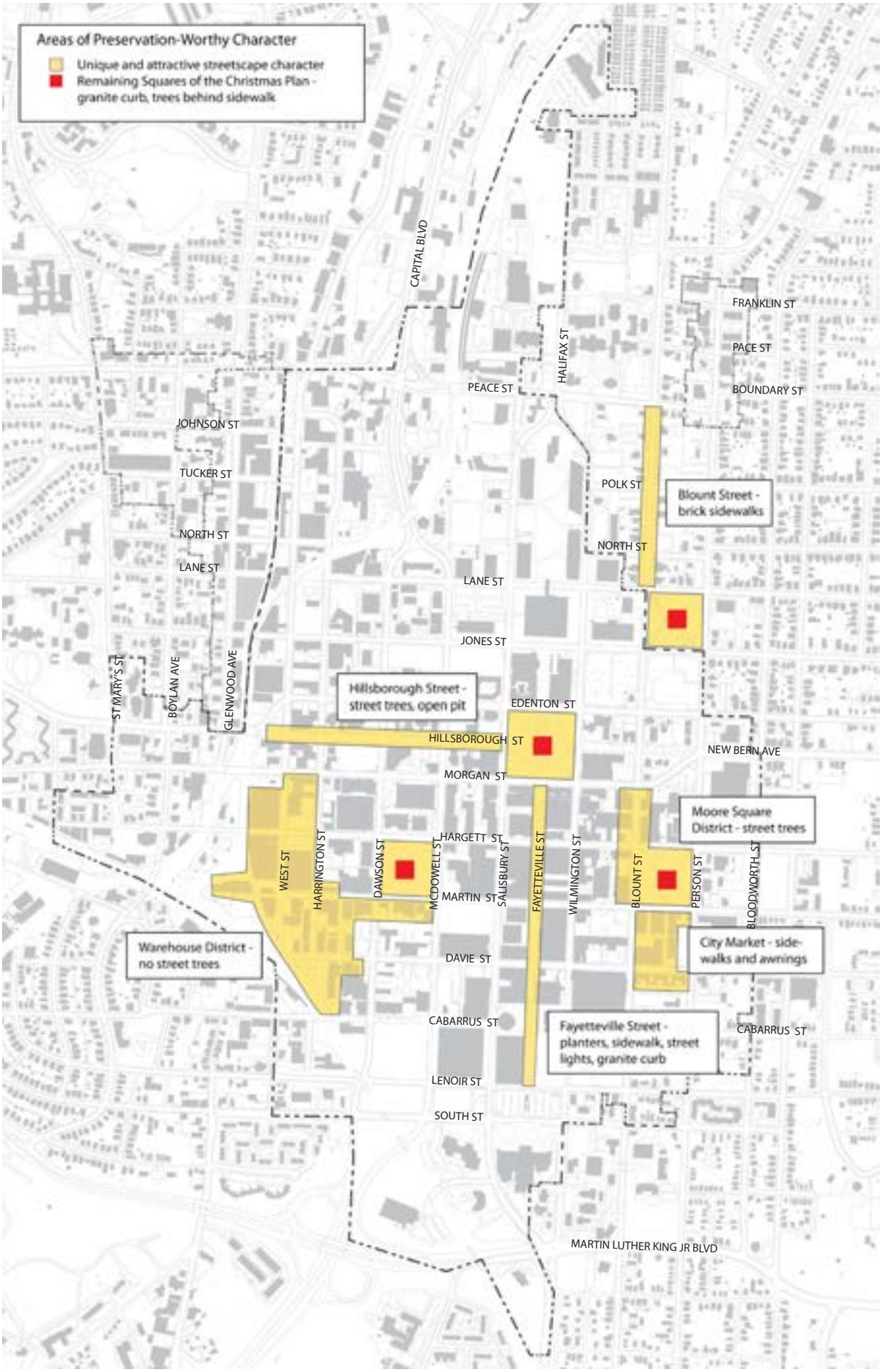


Figure 3.08 Map of Areas of Preservation-Worthy Character

Figure 3.11 – Map of Vehicular Traffic Patterns

On streets with higher concentrations of vehicular activity, a buffer of some sort is required between the street and sidewalk. This map shows on-street parking which functions as a buffer, but also requires its own special treatment and width. On-street parking requires an eighteen-inch to two-foot clearance for bumper overhangs or door swings, plus pavement should continue to the back of curb at regular intervals along to allow people to getting to and from their vehicle without being required to walk on uneven or muddy surfaces found in a planted verge. Entrances to parking decks will also change the sidewalk corridor treatment to allow for vehicles to cross the pedestrian pathway (see Figure 3.09). This map also reveals the location of bus stops which requires pavement to the edge of curb, space for signage clearance, and possibly an area for a bus shelter or bench (see Figure 3.10).

Figure 3.09 Parking decks introduce points of pedestrian/vehicle conflict

Figure 3.10 Bus stops require a particular treatment which allows for waiting, loading, and unloading passengers

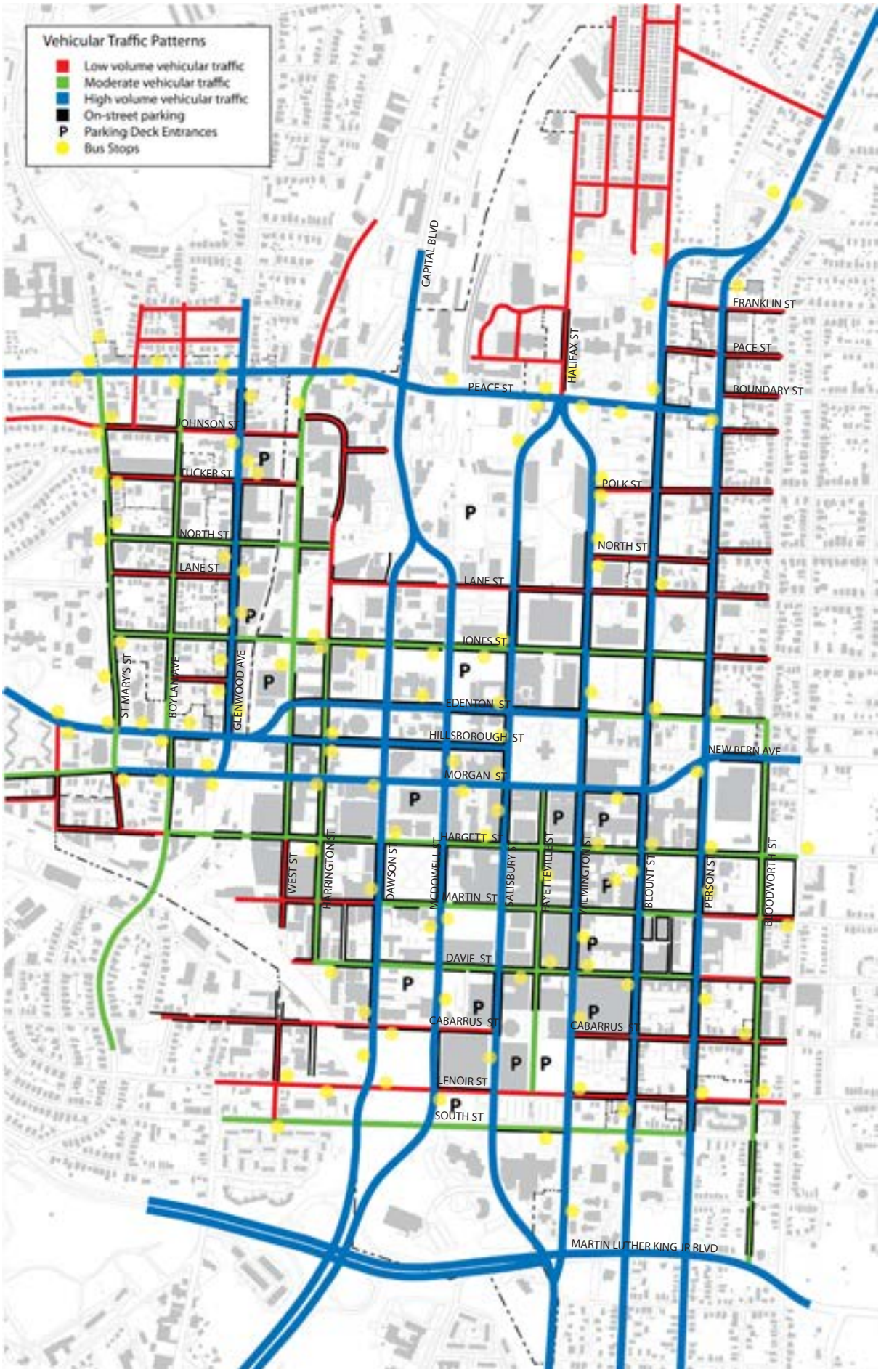


Figure 3.11 Map of Vehicular Traffic Patterns

Figure 3.14 – Map of Existing Building Massing & Setback

Building massing is identified by footprint and observed number of stories. Building height identified in ranges of one to two stories, three to four stories, five to six stories, and greater than six stories. These findings influence the identification of pedestrian generators and provides information on building setbacks. Both height and setback influence the potential composition of the sidewalk corridor because of a pedestrian's perception of comfort next to buildings of various heights and proximity. Also lack of a sufficient setback may limit the opportunity of an easement for widening the sidewalk and its corridor where it is near new or historic buildings that are unlikely to be redeveloped over the next twenty years.

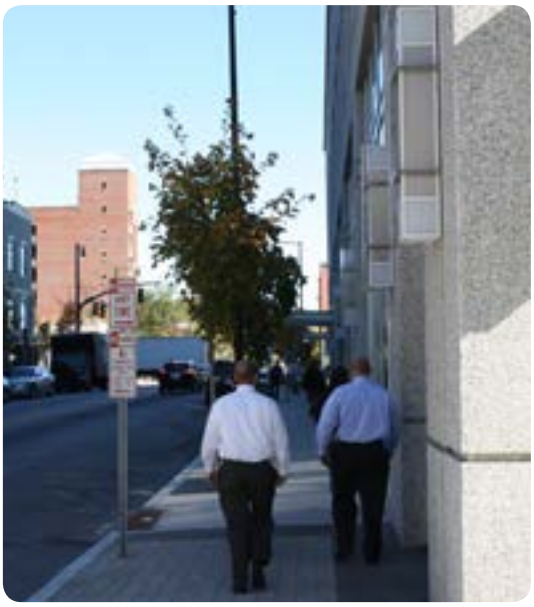


Figure 3.12 Example of an inappropriate sidewalk setback as it relates to building mass

Figure 3.13 Example of appropriate sidewalk setback and streetscape elements used to create a human scale for the pedestrian

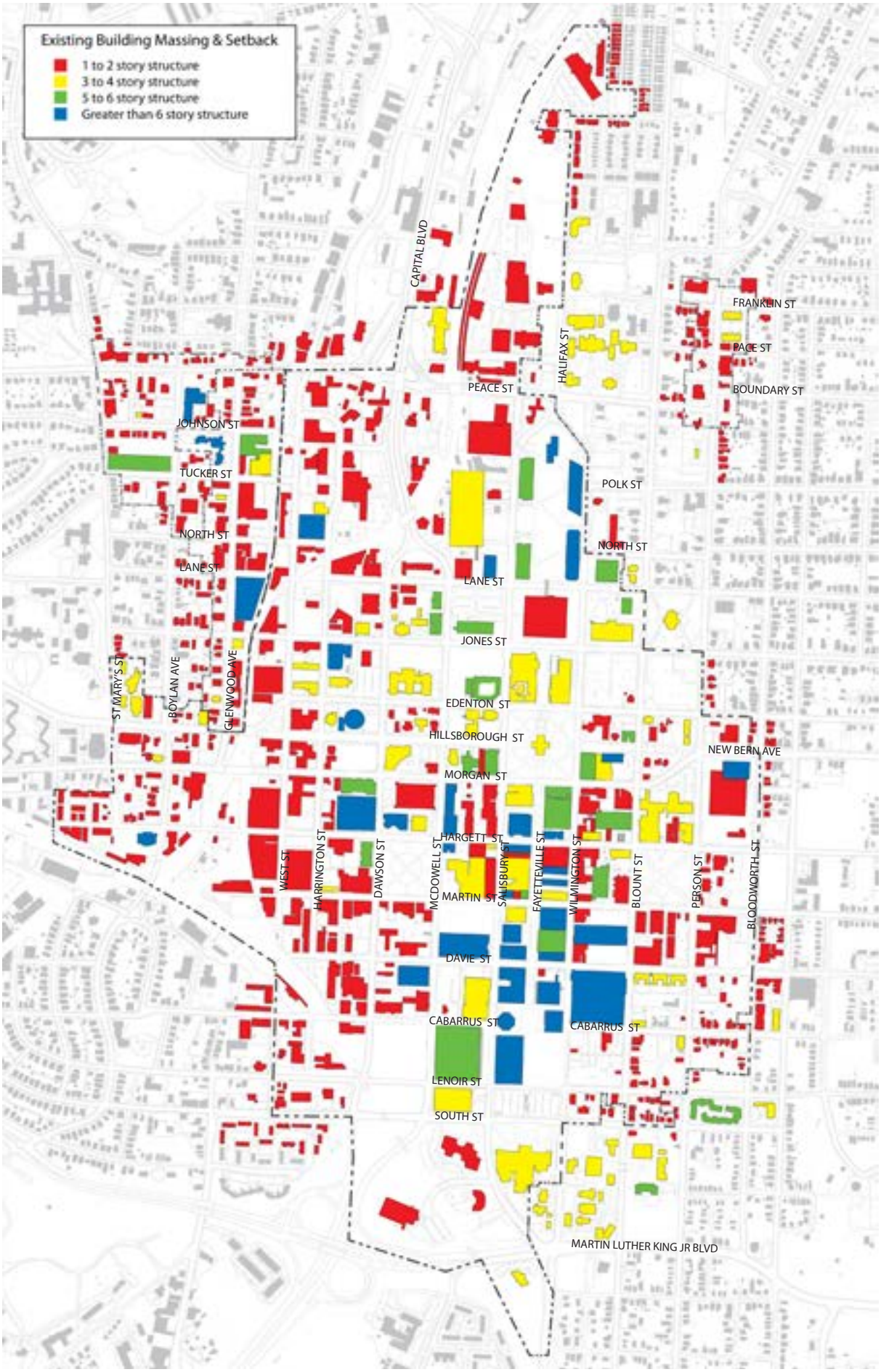


Figure 3.14 Map of Existing Building Massing & Setback

Figure 3.15 - Recommended Sidewalk Corridor Treatment Typology

Based upon existing corridor treatment typology, patterns of location, district and historic character, interaction with vehicular traffic, and relation to building mass, a new set of sidewalk corridor treatment typology was created. These treatments can be broken into four basic categories. These are illustrated in the images below.

Figure 3.15
Recommended
Sidewalk Corridor
Treatment Typology

Treatment A
Grated street trees
Brick band along curb
Scored concrete

Treatment B
Open Tree Pit
Brick band along curb
Scored concrete

Treatment A is the most common type of sidewalk corridor because the grated street tree allows for additional pedestrian traffic and works well in most dense urban areas. Treatment B is more common on the corridors between the urban edge and existing single family residences. Treatment C is rather uncommon and occurs only in residential neighborhoods that skirt downtown. Finally, Treatment D is found sporadically throughout the downtown core at areas of historic interest, such as the five squares and Warehouse District.

Treatment C
Planted Verge

Treatment D
No buffer vegetation
Paved to back of curb
Brick band along curb

Figure 3.16 – Map of Recommended Sidewalk Corridor Treatment

This map is based upon careful inventory and analysis aimed to understand existing sidewalk corridor treatment patterns as they relate to district character, historic character, vehicular traffic patterns, and building mass and setback. Using the sidewalk corridor treatment typology defined in Figure 3.15, each block or block face was mapped accordingly.

Chapter Summary

While unification is an important aspect of establishing the City's image, not every place should be treated the same, especially when looking at sidewalk and streetscape design. It is important to focus on districts and neighborhoods as a localized identifier which as a whole will make Raleigh distinct from other cities. It will give residents and visitors alike a sense of place through cohesive yet differentiated design solutions.

There are four main types of sidewalk corridor treatments that were identified for use throughout Raleigh:

- Paved to the back of curb with ADA accessible grated street trees
- Open tree pit which allows for the growth of grass other plants
- Continuous planted verge which may be planted with grass, trees, or other plants but functions as a continuous barrier to street traffic
- Paved to the back of curb without street trees or verge of any kind

These were observed as design themes already used in Raleigh and their proposed placement was identified through recognizing the context of each sidewalk including district and historic character, vehicular traffic, and building mass and setback.

By providing this basic framework of general types of sidewalk corridor treatments, the City, property owners, and designers are given freedom within these restrictions to create distinguishing elements that will stand out from surrounding neighborhoods. These may include different tree grates, street trees, lamp posts, or manhole covers. The basic framework provided here creates the structure for unique areas within a unified city design. The following chapter will discuss how these treatments are translated into sidewalk widths.

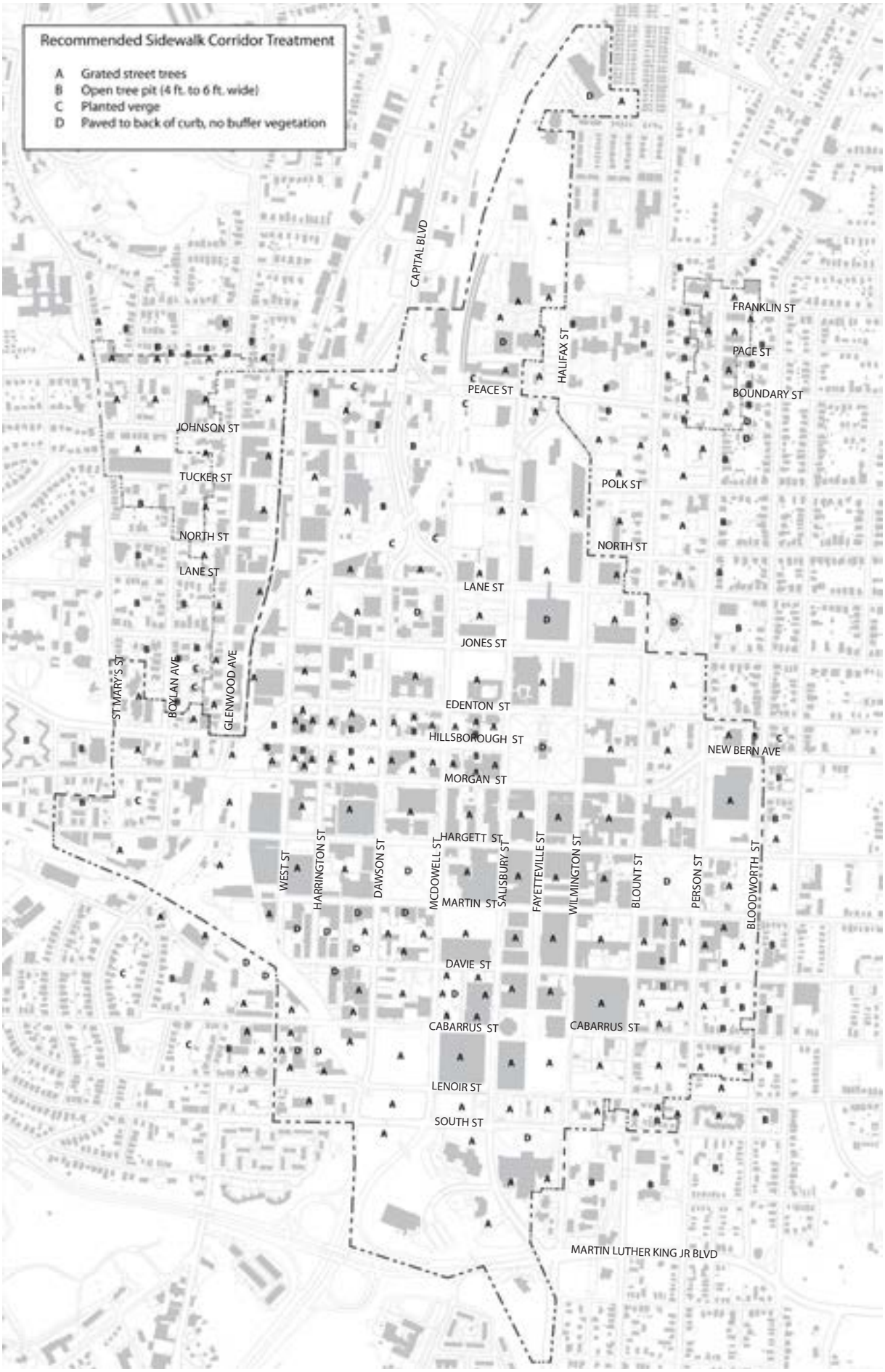


Figure 3.16 Map of Recommended Sidewalk Corridor Treatment

CHAPTER 4: The Fourteen-Foot Sidewalk Requirement

The previous chapter on sidewalk corridor treatments was beginning to approach the subject of various elements in the sidewalk that contribute to the total width of the sidewalk. In addition to these permanent objects including street trees, there are many other features that can be found in an urban sidewalk. These include everything from trash cans, to utility poles, to bus shelters. In addition to site features, there are also activities which encroach upon the public sidewalk. Each of these contribute to the total width needed on a sidewalk. By adding the expected amount of space used by these elements and activities to the base pedestrian clearance width defined in Chapter 2, it is possible to determine the final range of widths required.

A fourteen-foot sidewalk corridor is appropriate at times, but there are many instances where that standard is either too wide or too narrow. A typical sidewalk corridor composition should include street trees which automatically increase the sidewalk corridor by at least four feet. Where buildings are built to the sidewalk, a two-foot shy distance must be accounted for. In areas with high pedestrian use a minimum of a ten-foot sidewalk clearance is required, this already bumps the needed corridor width to sixteen feet.

Some of these non-traveling pedestrian activities and behaviors include stopping at shop front windows, standing, mingling, smoking, queuing, and sitting. It is possible to determine appropriate sidewalk widths needed to provide space for these activities based upon the dimensions of the associated objects. Some of these objects include outdoor dining tables and chairs, benches, trash cans and planters. Other obstacles which may not be associated with a pedestrian behavior but certainly affect the width of a sidewalk corridor and ease of pedestrian travel include utility boxes and poles, fire hydrants, parking meters, street trees, door swings, street vendors and performers, bus stops and shelters, signs, mail depository boxes, news racks, and bicycle racks. Each of these can be measured, thereby making it easier to determine a range of necessary widths of a sidewalk corridor. Table 4.1 is a matrix providing possible location and associated width for individual elements. Elements found in the curbside zone are illustrated in Figure 4.01 and those found in the building zone in Figure 4.02.

In order to determine context-appropriate sidewalk corridor widths, the Projected Pedestrian Use Intensity Map (Figure 2.21) was used as a base width and was added to the Projected Need for Non-Traveling Pedestrian Sidewalk Zone width in order to determine the ideal sidewalk corridor dimensions throughout downtown Raleigh.

Table 4.1 Required clearance width for various urban elements

	Door swing	Trash can	Fire Hydrant	Small Utility Box	Small Planter	Signage	Parking Meter	Residential Mailbox	Street Tree	Street Lamp	Traffic Light	Utility Pole	Small Bike Rack	Two-Top Table	Shrubs & Plantings	Mail Drop Box	News Rack	Bench	Street Performer	Large Utility Box	Queuing	Four-top Table	Large Bike Rack	Bus Shelter
Curbside																								
2 ft.	✓	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 ft.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-
6 ft.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	-	-	-
10 ft.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Building																								
2 ft	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 ft	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	-
8 ft.	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

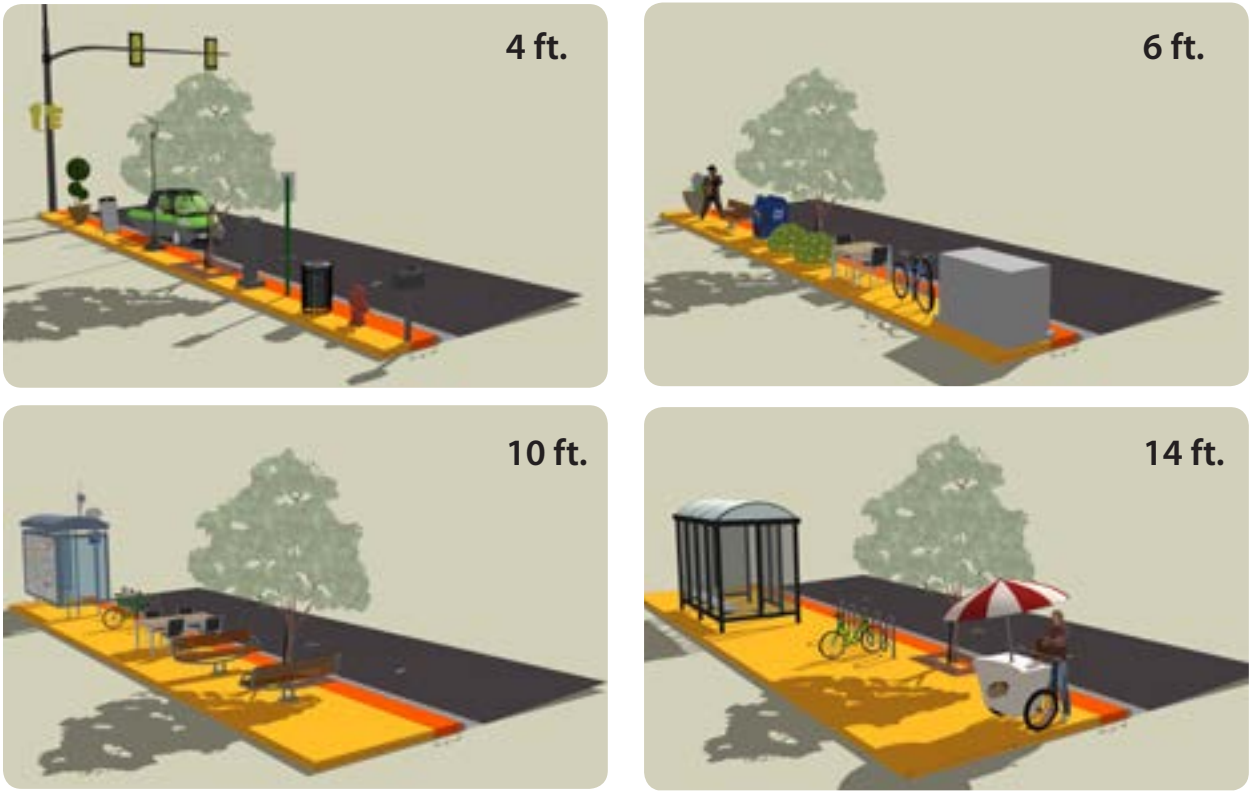


Figure 4.01 Curbside zone for urban elements

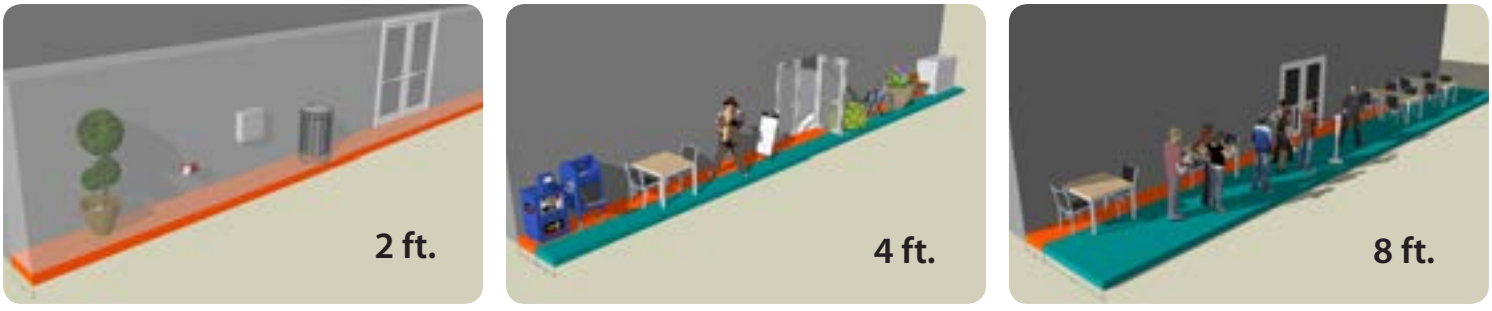


Figure 4.02 Building zone for urban elements

Figure 4.04 – Map of Projected Non-Traveling Pedestrian Behaviors

This map is based upon a study of existing non-traveling pedestrian behaviors as they related to frontages and overall first-floor use (see Figure 4.03). Projection of future frontage possibilities are based upon opportunities for redevelopment and an extension of current use patterns and districts.

There are four categories of frontages that influence pedestrian behavior:

- Residential areas where pedestrians are likely to move fluidly along sidewalks.
- Retail and galleries, places with shop front windows are likely to slow traffic and create some stopping along the sidewalk.
- Bars, night clubs, theaters, restaurants, and churches tend to produce pedestrians who stand to talk, mingle, smoke or queue on sidewalks in front of such establishments.
- Sidewalk cafes and places with outdoor dining are a type of establishment that produces encroachments to the sidewalk not only due to site furniture but also non-traveling pedestrian behaviors on the sidewalk.

Figure 4.03 Map of Existing Non-Traveling Pedestrian Behaviors Based on Frontages

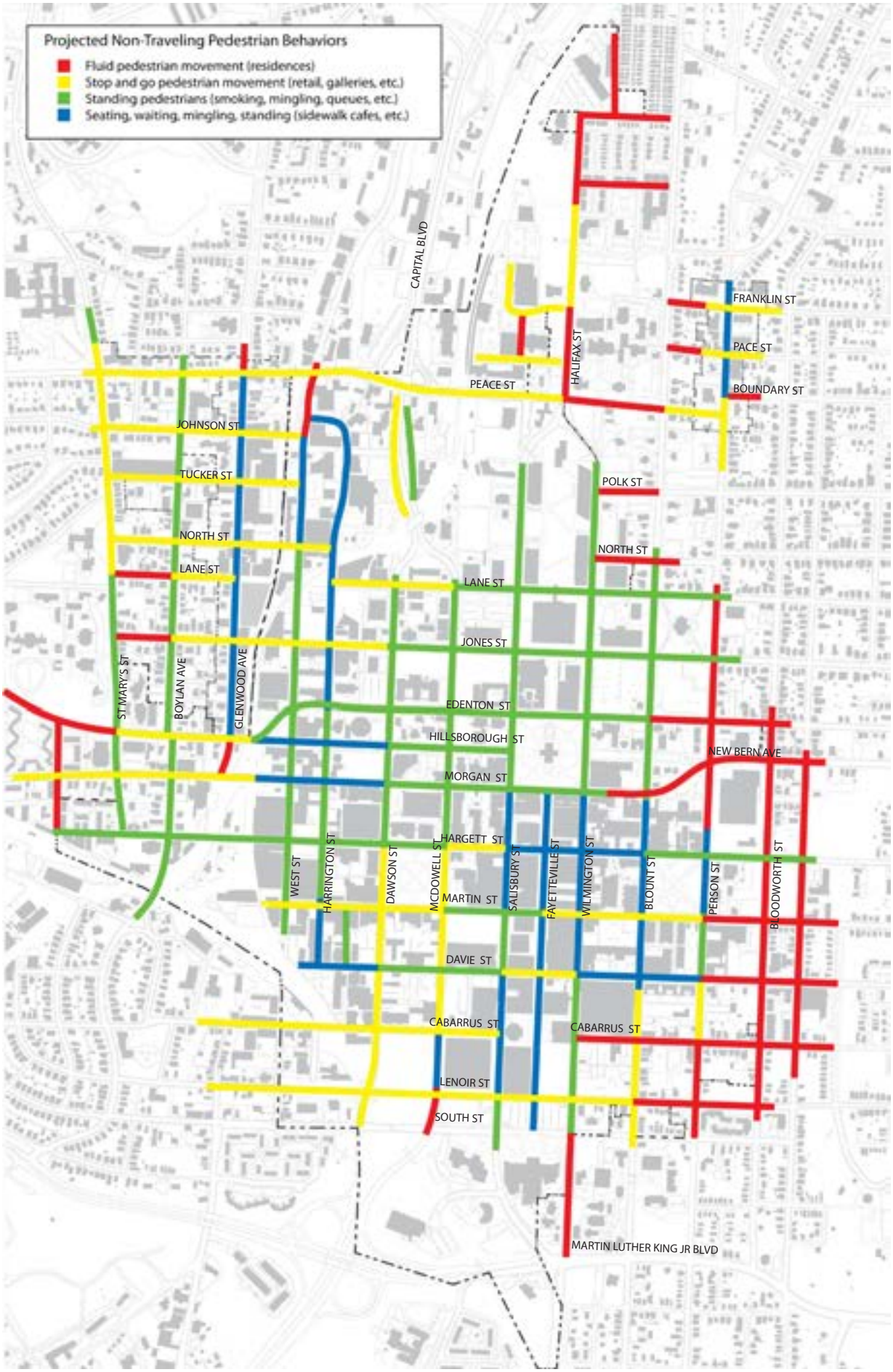


Figure 4.04 Map of Projected Non-Traveling Pedestrian Behaviors

Depending on the typology of frontage and programmed uses, various elements may be expected to appear on the sidewalk. These elements require various widths as is illustrated in Figures 4.01 and 4.02 as well as Table 4.1. By knowing what the expected typology is for a block face, it is possible to determine the expected range of widths that are necessary for non-traveling pedestrian zones on the sidewalk. This range, coupled with the pedestrian clearance needs will give the required width of the sidewalk corridor.

To further understand the different types of elements that may be placed on a sidewalk at any given frontage typology, a matrix was created to give a sample of probable elements found in various areas. This matrix is found in Table 4.2.

By knowing what the expected typology is for a block face, it is possible to determine the expected range of widths that are necessary for non-traveling pedestrian zones on the sidewalk.

Table 4.2 Commonly found elements in different frontage typologies

	Door swing	Trash can	Fire Hydrant	Small Utility Box	Planter	Signage	Parking Meter	Residential Mailbox	Street Tree	Street Lamp	Traffic Light	Utility Pole	Small Bike Rack	Two-Top Table	Shrubs & Plantings	Mail Drop Box	News Rack	Bench	Street Performer	Large Utility Box	Queuing	Four-top Table	Large Bike Rack	Bus Shelter
Small office	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	-	-	✓	✓	✓	-	-	-	-	✓	✓
Government	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	-	✓	-	✓	✓	✓	✓	✓	✓	-	-	✓	✓
High Rises	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	-	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dense Mix-Use	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	-	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓
Single-Family Residential	-	-	✓	✓	-	✓	-	✓	✓	✓	✓	✓	-	-	✓	-	-	✓	-	-	-	-	-	✓
Apartments	✓	✓	-	✓	✓	-	✓	-	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	-	✓	-	-	✓	✓
Retail	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	-	-	✓
Restaurants	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	-	-	✓
Sidewalk Café	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓
Bars, Clubs	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	✓	-	-	✓
School	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	-	✓	✓	-	✓	✓
Fitness Center	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	-	-	✓	-	✓	✓
Park	-	✓	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓	-	-	-	-	✓	✓	-	-	✓	✓	✓

Figure 4.05 Residential elements

Figure 4.06 Retail elements

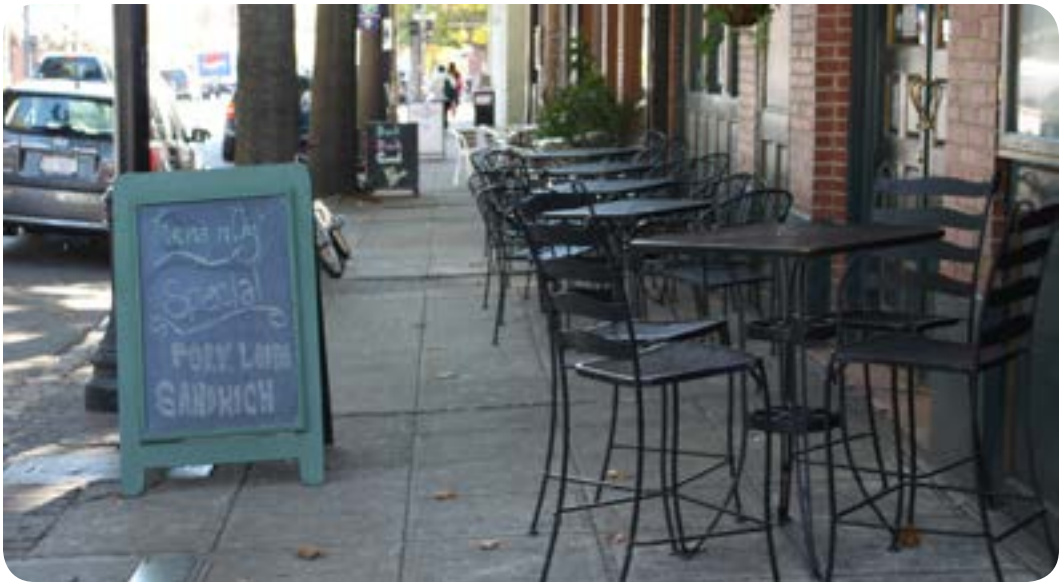


Figure 4.07 Sidewalk cafe elements

Figure 4.09 – Expected Non-Traveling Pedestrian Sidewalk Zone Widths

An overlay of the inventory and analysis map resulted in a range of expected widths of non-traveling pedestrian zones. These can be added to the required pedestrian clearance in order to identify the range of sidewalk corridors, which are mapped in Figure 4.10, Ideal Sidewalk Corridor Widths and Treatments.

This map was created from projected frontages as they relate to non-traveling pedestrian behavior which dictate which urban elements are likely to be used as well as the planned corridor treatment presented in the previous chapter. This again refers to the diagrams used to illustrate possible sidewalk elements and their required widths (see Figure 4.08).

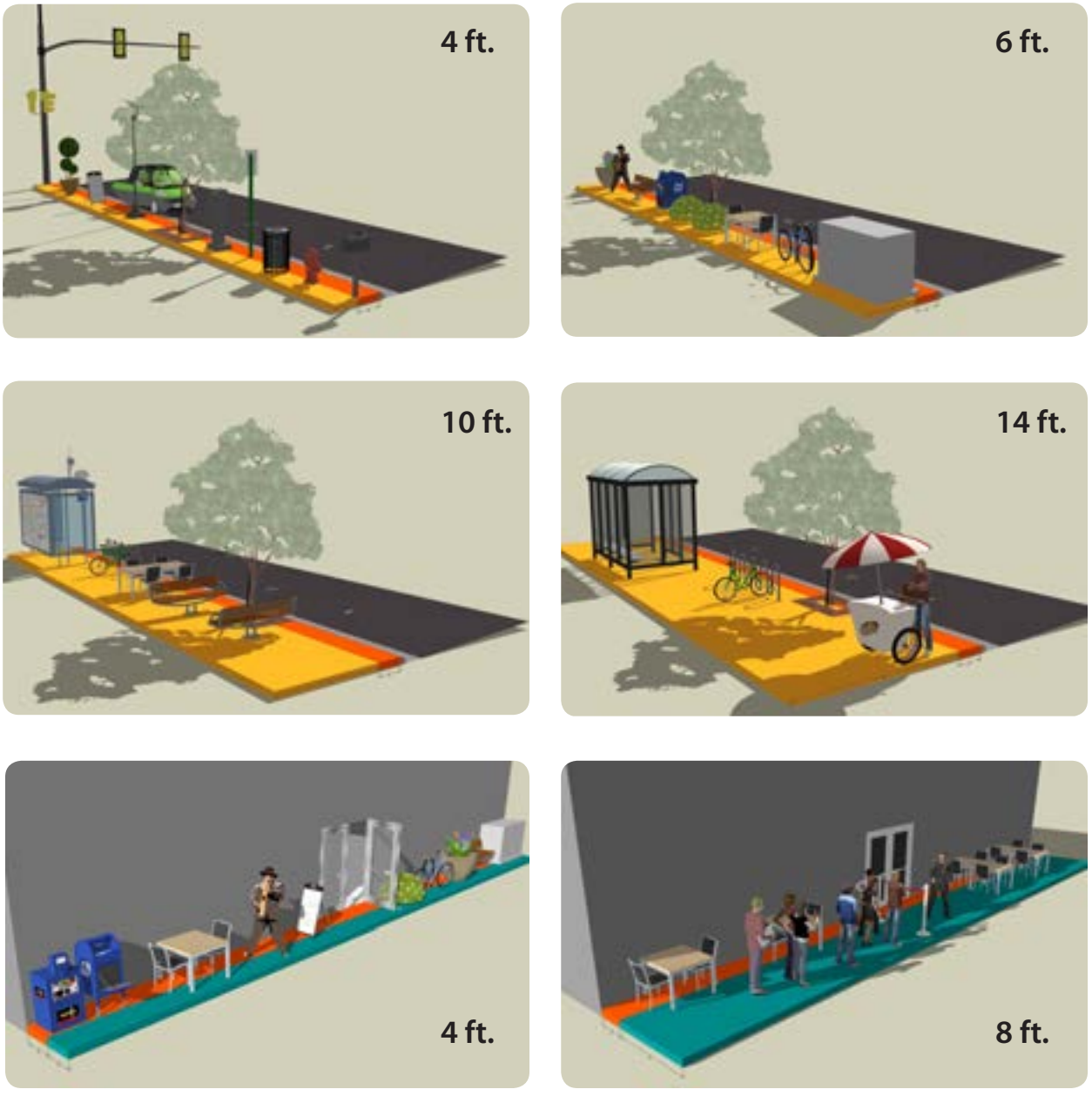


Figure 4.08 Non-traveling pedestrian zones provide space for urban elements

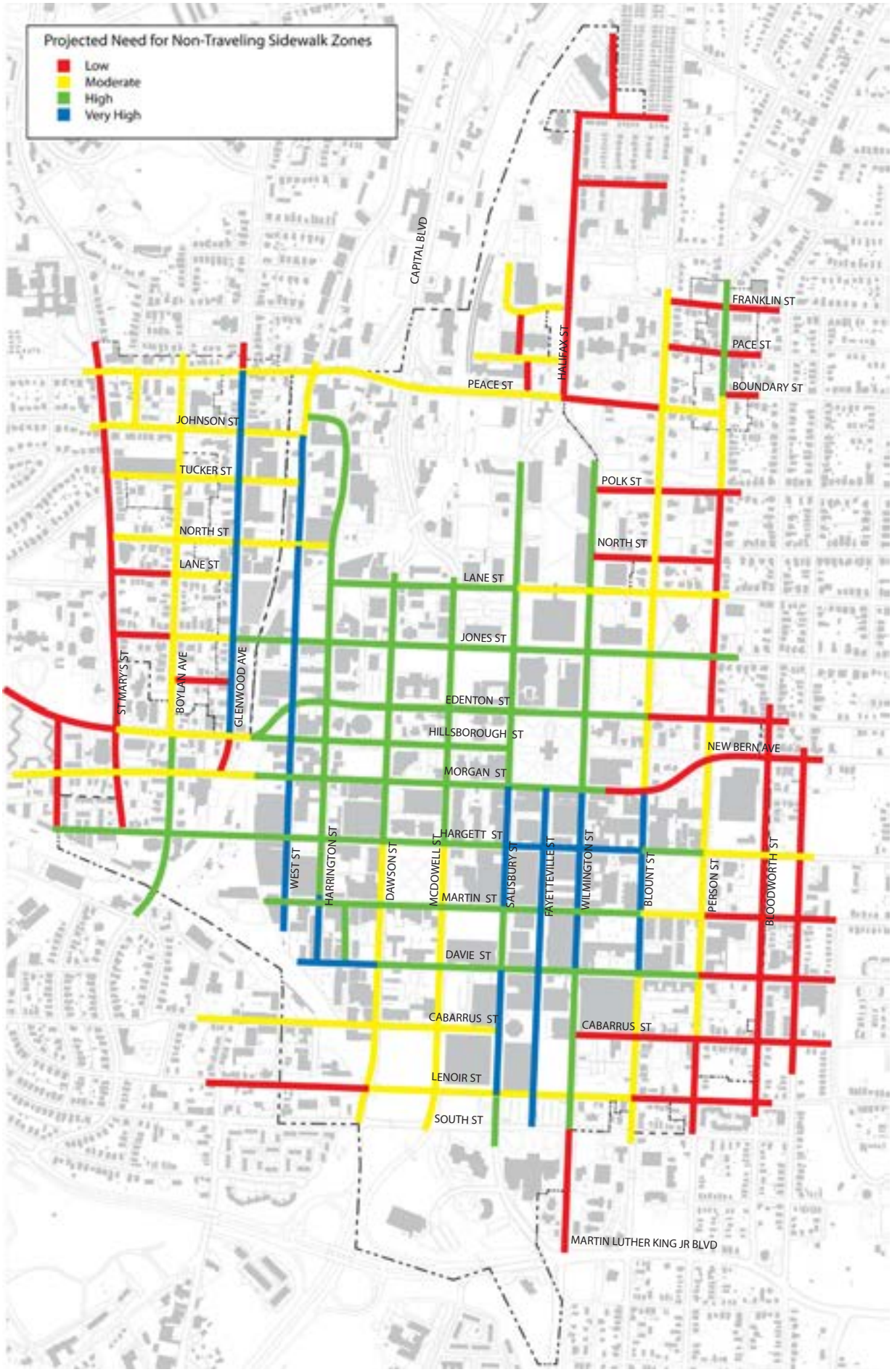


Figure 4.09 Map of Projected Need for Non-Traveling Pedestrian Zones on Sidewalks

Figure 4.10 - Map of Ideal Sidewalk Corridor Widths & Treatment

This map is based upon critical decision making of where the desired streetscape may occur and how wide of an area the city can expect to gain through easements during redevelopment. This is based on the study of the entire inventory, analysis, and projected maps as well as the final findings of the projected sidewalk width needs and available right-of-way.

Corridors of fourteen feet are not always appropriate even when taking into account the possibilities of future development. Rather, where there are places of historic streetscape character and in areas that around single family residential neighborhoods on the fringes of downtown Raleigh where there is a need for the preservation of narrow corridors and atypical treatment. There are also places where a fourteen-foot corridor is inadequate to manage the volume of projected use. This map details the various opportunities for sidewalk corridor widths and treatments.

Chapter Summary

A series of inventory and analysis maps coupled with observed knowledge revealed the need to consider an alternative to accepting the fourteen-foot sidewalk corridor throughout downtown Raleigh. While sidewalks are first intended to accommodate the traveling pedestrian, in an urban environment such as downtown Raleigh other activities occur on the sidewalk and make a demand on sidewalk corridor width. The range of urban element widths can be added to the required pedestrian clearance, in order to determine the appropriate sidewalk corridor width.

While sidewalks are first intended to accommodate the traveling pedestrian, in an urban environment such as downtown Raleigh other activities occur on the sidewalk and make a demand on the sidewalk corridor width.

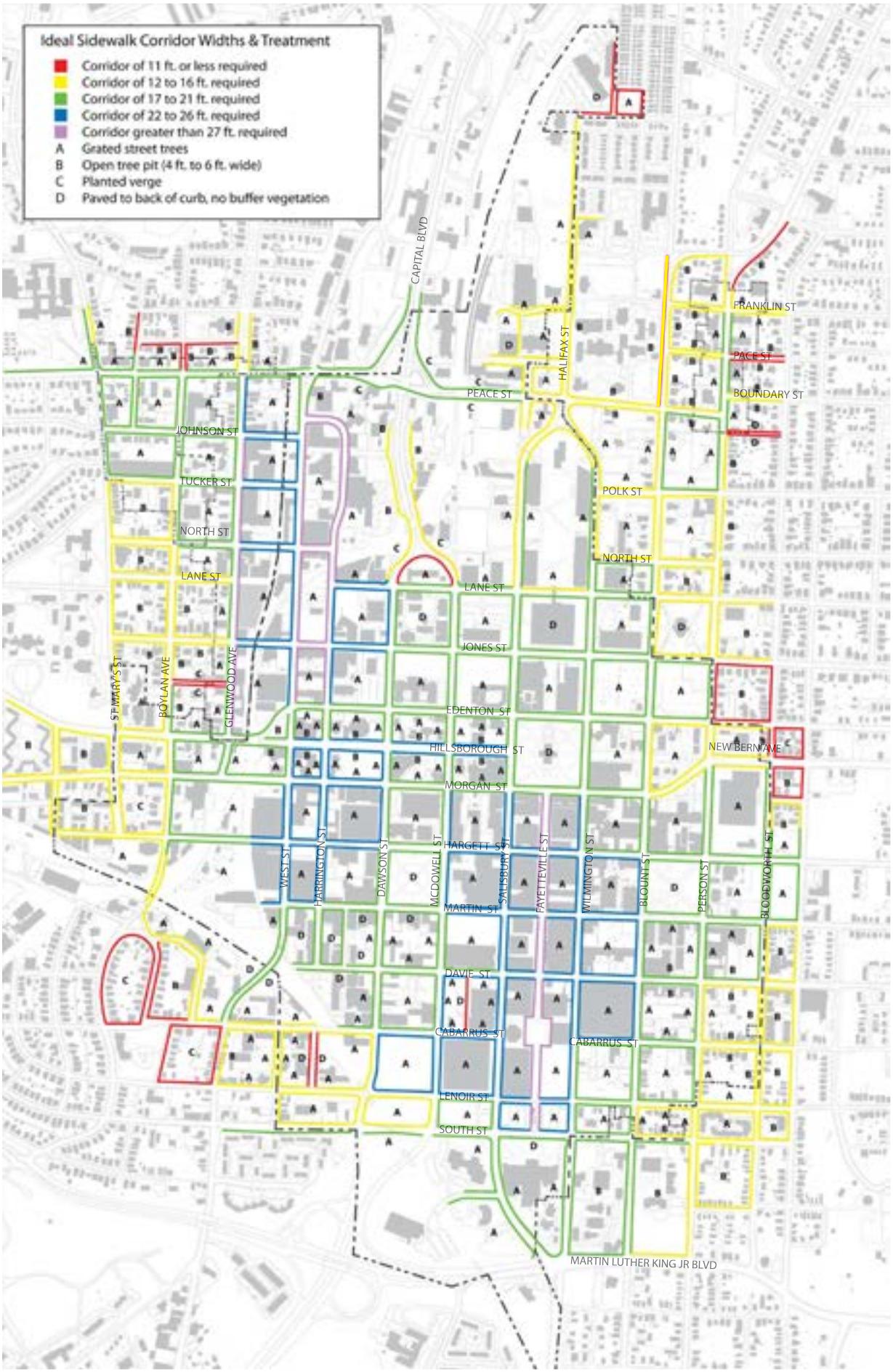


Figure 4.10 Map of Ideal Sidewalk Corridor Widths & Treatment

CHAPTER 5: Conclusions

Summary of Research Results

Sidewalks in downtown Raleigh are undersized; a problem that is primarily experienced by traveling pedestrians. The area in which they walk is considered the pedestrian clearance zone, which runs parallel to the street and is protected through City policy from encroachments. Current policy only calls for a five-foot sidewalk clearance and private users generally observe these restrictions. Yet, research shows that five feet is inadequate.

In order to determine the appropriate pedestrian clearance width, multiple observations and analyses were made regarding pedestrian volume and patterns. The result was a range of widths that were identified to match existing and projected pedestrian use intensity.

In addition to clearance for pedestrians, sidewalks in a downtown area have other uses and its final width must take into account the space needed for object encroachments and non-traveling pedestrian behaviors that are associated with the urban environment.

These elements are designed to occur on either side of the pedestrian clearance zone and are located either along the curb or by the building. Together these three zones comprise the sidewalk corridor. The current City regulation of fourteen-foot sidewalks was found to be appropriate in some areas, but there are also many places where it is insufficient to accommodate current and projected urban uses.

This study identified a range of possible sidewalk corridor widths based upon existing and projected frontages, pedestrian behaviors, building uses, and other similar factors that would determine possible objects that would encroach the downtown sidewalk. This provided solutions that would be specific to the needs of each sidewalk.

Finally, there is a need to unify the City through its public realm treatment while allowing for distinct corridor and neighborhood character. To provide this structure with internal flexibility, four treatment typologies were identified throughout Raleigh that would act as a template for future sidewalk treatment.

Implementation Difficulties and Solutions

The greatest challenge to implementing the results of this research is that the needed sidewalk corridor widths is much greater than the actual available right-of-way. While these proposed widths are ideal to improve the pedestrian environment, the nature of downtown Raleigh will not allow for the full application of these ranges. Additionally, it would be difficult for City officials to implement such a wide range of sidewalk widths. A smaller range of width options will simplify the planning and design process.

To address these problems, it is necessary to prioritize needs and create a compromise between the available space, conflicting uses, and ideal widths.

The top priority of sidewalks in downtown Raleigh is to meet the needs of the volume of traveling pedestrians. The research determined that a five-foot pedestrian clearance is inadequate but in order to meet the limits of the space, it is most likely that the ideal clearance (maximum is over twelve feet) is unachievable in many cases. The existing pedestrian use map reveals that most areas require a six- to ten-foot pedestrian clearance. Eight feet falls in the center of that range; it would allow for three people to pass each other with relative comfort with a maximum capacity of four individuals. Additionally, the typical sidewalk corridor treatment has grated street trees, which would allow for nearly two extra feet of traversable space. Plus there is two feet of shy distance next to buildings which provides a little extra space. This means that while the official pedestrian clearance is eight feet where encroachments are not allowed, the usable width in most places will have a maximum of twelve feet total, or effective width of ten feet (see Figure 5.01). Therefore the eight-foot clearance works for most urban situations in downtown Raleigh and should be used as the new clearance standard where encroachments are prohibited.

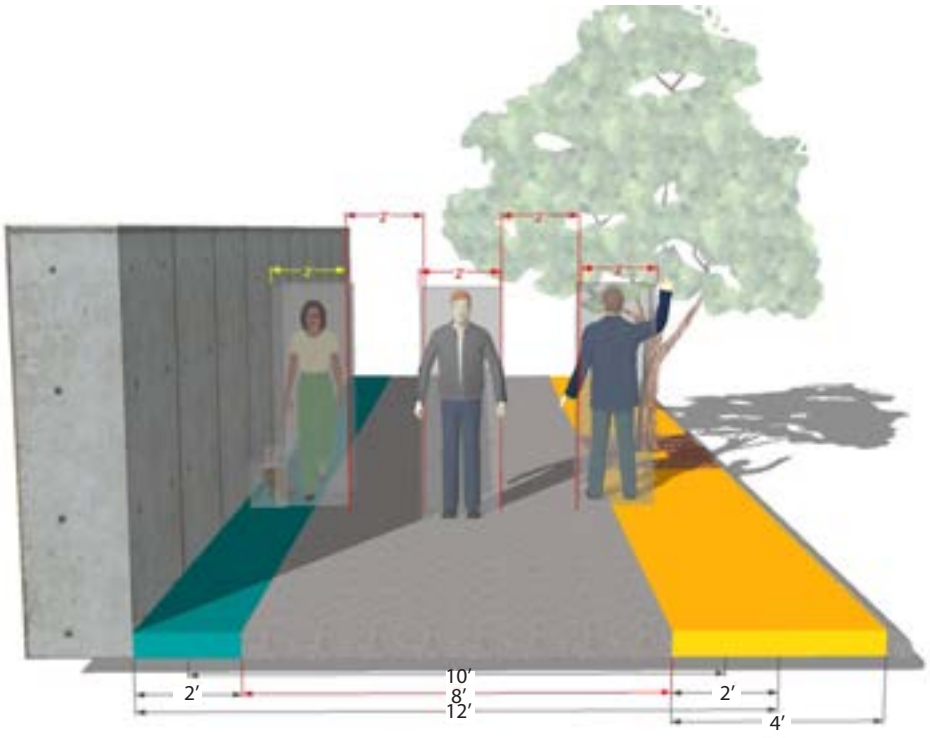


Figure 5.01 Reality of the eight-foot sidewalk clearance

The eight-foot sidewalk clearance standard effectively reduces the sidewalk corridor width requirements, but it is still necessary to simplify the range. Most of the downtown core will be treated with street trees, which require four feet of sidewalk width along the curb and by providing the minimum two-foot setback clearance for a building we reach a sidewalk width of fourteen feet. While this is the existing required width, the existing encroachment will need to be reduced to allow for pedestrian flow to continue on the sidewalk. This space would allow for a two-top table in the curbside zone, a small bike

rack, a news rack, a mail drop box and other such small urban elements. This works for many sidewalks downtown because of the limited right-of-way and also because these areas do not have an abundance of urban sidewalk life at the moment. However, in areas where there is more activity or such activity is planned, it is necessary to require a wider sidewalk corridor.

Adding six feet of space to be shared between the building and curbside zone will enable many more urban sidewalk activities. This would bring the total sidewalk width to twenty feet and would allow for four-top tables, bicycle racks, benches, small bus shelters, or queuing in the sidewalk corridor. This works well for areas with more intense urban use on the sidewalk, such as where there are sidewalk cafes, restaurants, bars, and shop fronts. This distinction of sidewalk use is mapped out in Figure 5.04.

Figure 5.02 Illustration of a fourteen-foot sidewalk corridor

Figure 5.03 Illustration of a twenty-foot sidewalk corridor

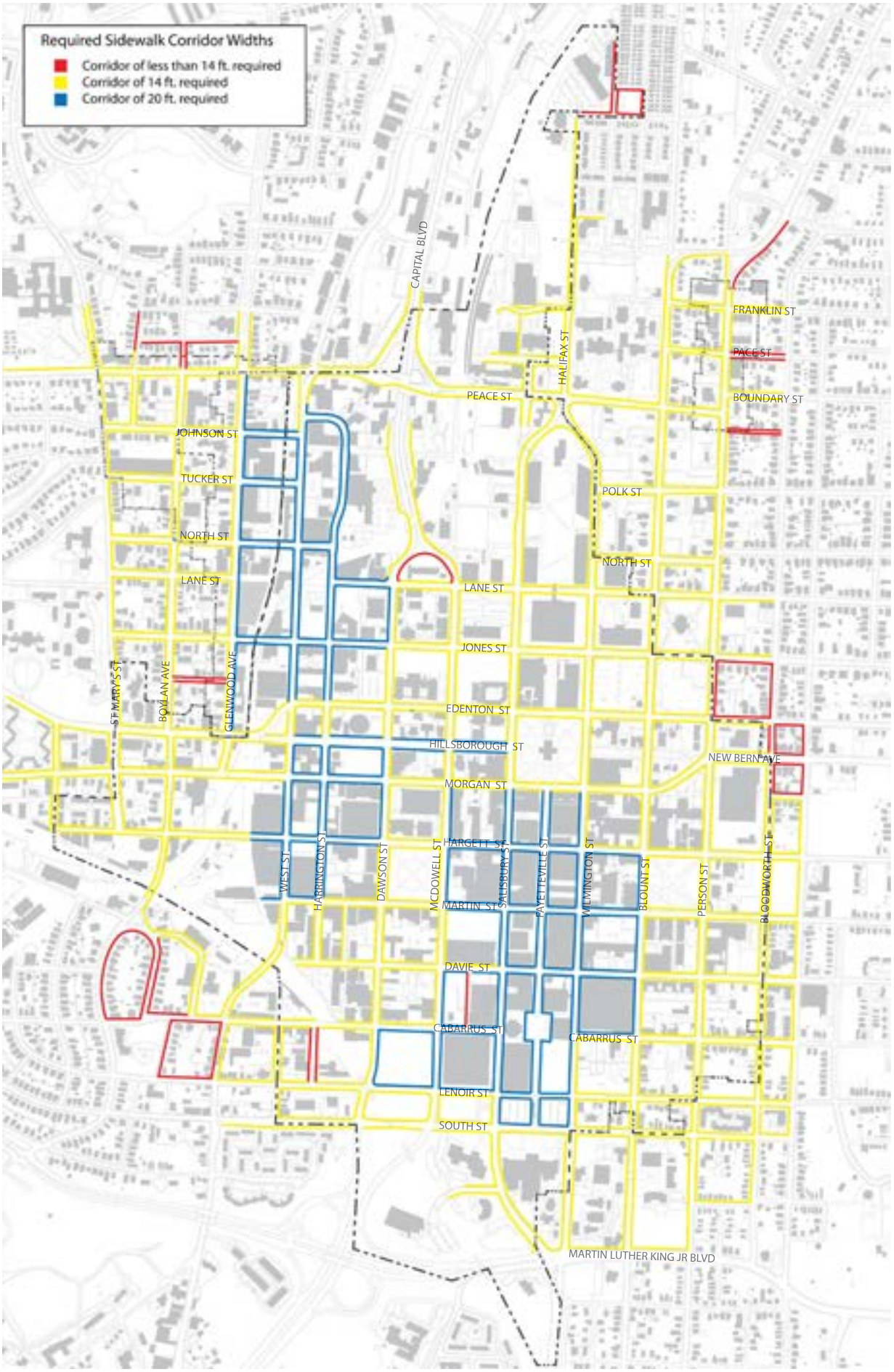


Figure 5.04 Final Map of Required Sidewalk Corridor Widths

This simplification of sidewalk corridor widths creates a new map that can be used by the City to evaluate development proposals for needed sidewalk width (see Figure 5.04 – Required Sidewalk Width Map on page 56). This map can be correlated to urban objects that are allowed to encroach the sidewalk, providing a means for the City to reevaluate encroachment permits (see Table 5.1 and Figures 5.07 and 5.08 on page 59). The map of widths can be coupled with the previously defined sidewalk corridor treatment plan for the evaluation of development proposals for appropriate design features (see Figure 5.05 – Illustrations of Sidewalk Treatment Typology and Figure 5.06 – Required Sidewalk Corridor Widths & Treatment Map). Lastly, another result of this study is the comparison of needed sidewalk corridor widths and available right-of-way. This highlights areas where there is opportunity for a Capital Improvement Plan (CIP) projects and when and how sidewalk widening may occur in downtown Raleigh (see Figure 5.09 on page 60).

Figure 5.05 Recommended sidewalk corridor treatment typology (repeat of Fig. 3.15)

Treatment A Grated street trees, brick band along curb, scored concrete

Treatment B Open tree pit, brick band along curb, scored concrete

Treatment C Planted verge

Treatment D No buffer vegetation, paved to back of curb, brick band along curb

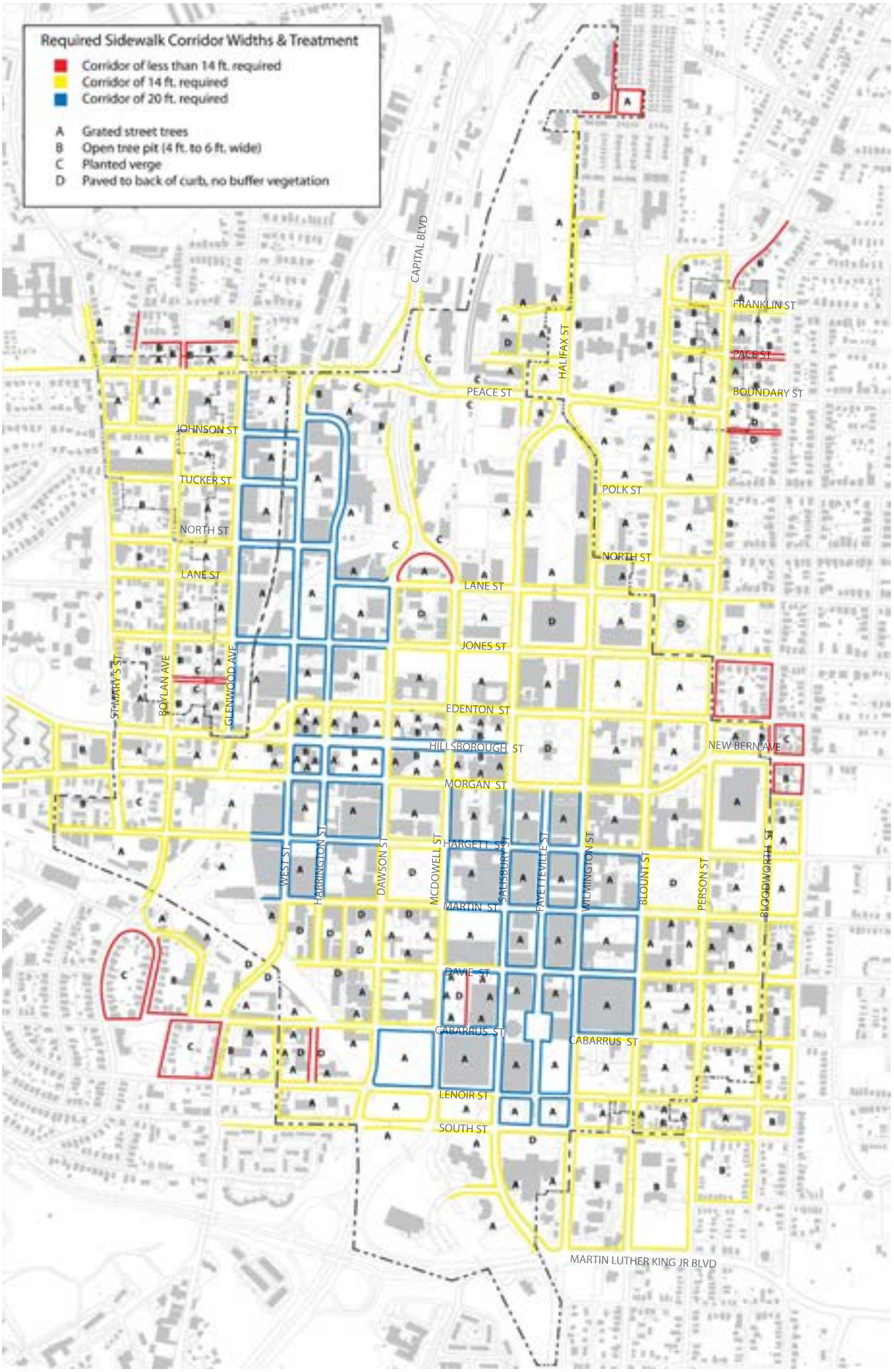
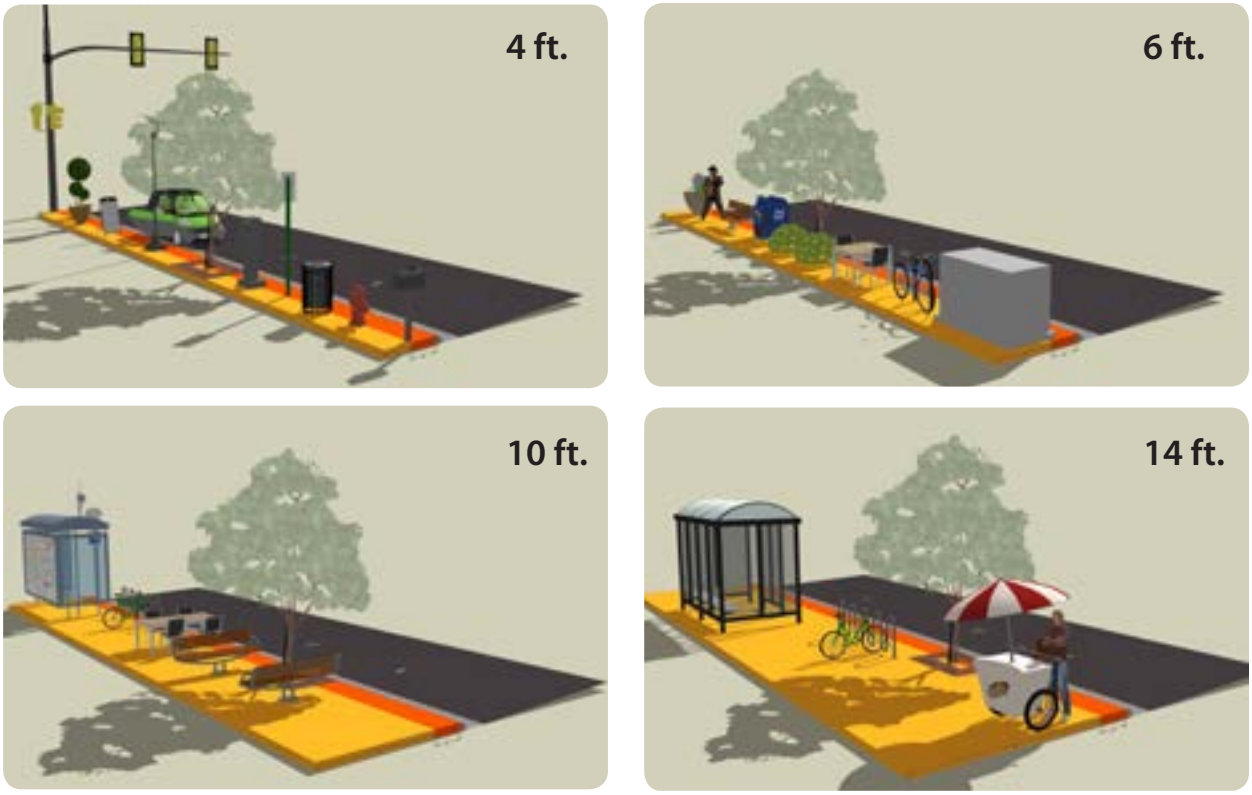


Figure 5.06 Final Map of Required Sidewalk Corridor Widths & Treatment

Table 5.1 Required clearance width for various urban elements (colors coordinate with colors in Figures 5.04 and 5.06)

	Door Swing	Trash Can	Fire Hydrant	Small Utility Box	Small Planter	Signage	Parking Meter	Street Tree	Street Lamp	Traffic Light	Utility Pole	Small Bike Rack	Two-Top Table	Shrubs & Plantings	Mail Drop Box	News Rack	Bench	Street Performer	Large Utility Box	Queuing	Four-Top Table	Large Bike Rack	Bus Shelter
Curbside																							
4 ft.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-
6 ft.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-
8 ft.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
10 ft.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Building																							
2 ft.	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 ft.	✓	✓	✓	✓	✓	✓	-	-	-	-	-	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-
6 ft.	✓	✓	✓	✓	✓	✓	-	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-
8 ft.	✓	✓	✓	✓	✓	✓	-	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Figure 5.07 Curbside zone for urban elements (repeat of Fig. 4.01)



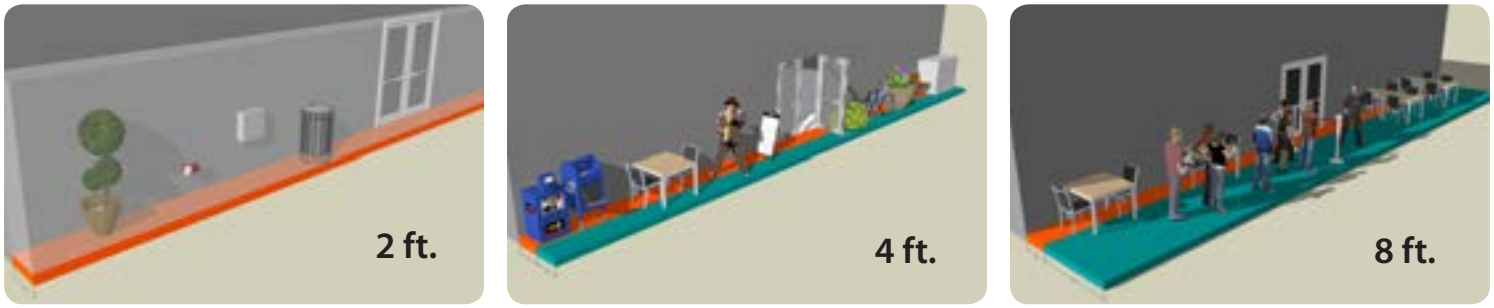


Figure 5.08 Building zone for urban elements (repeat of Fig. 4.02)

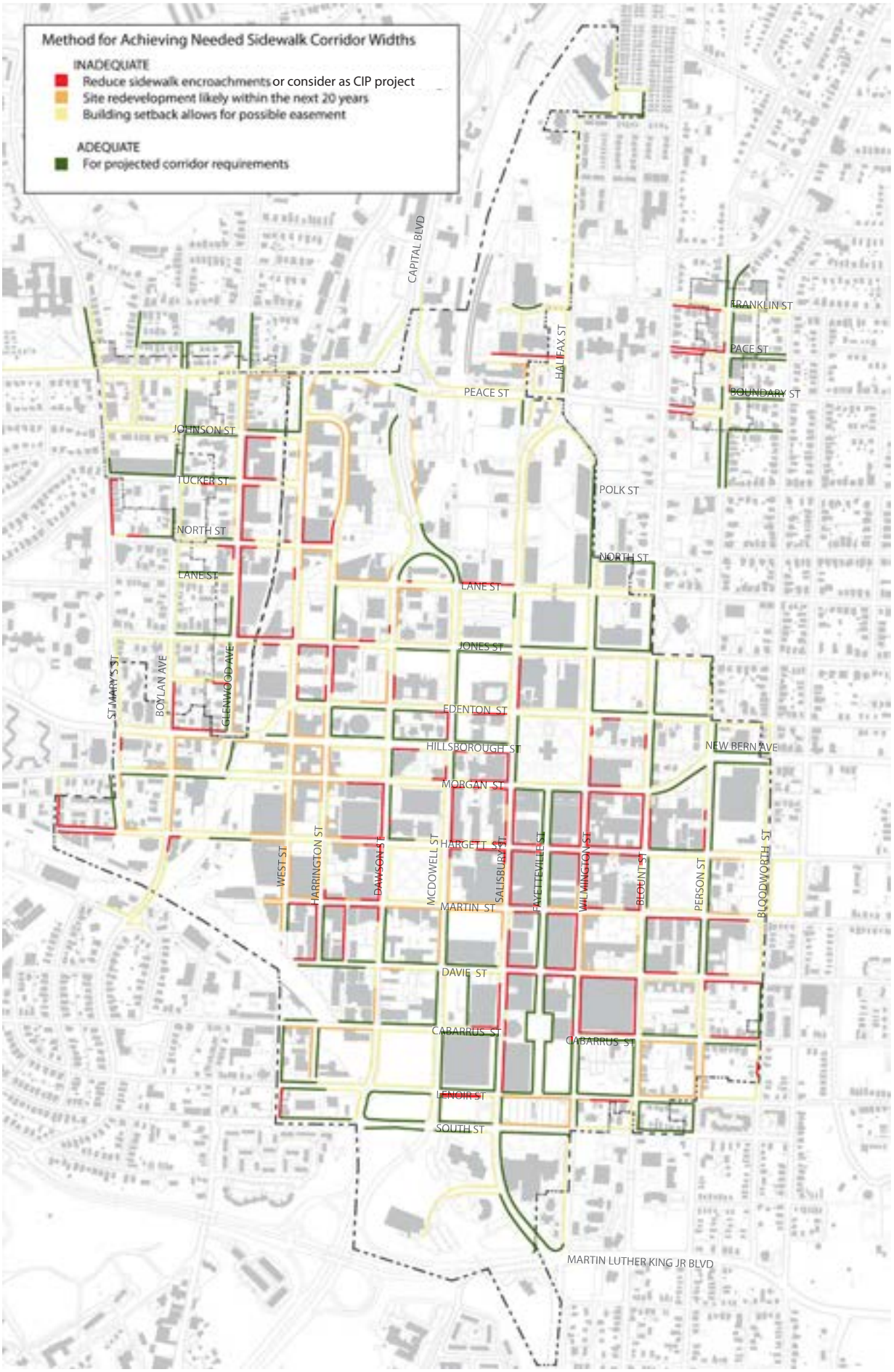


Figure 5.09 Map of Method for Achieving Needed Sidewalk Corridor Widths

Appendix A: Existing City of Raleigh Code Requirements Regarding Sidewalk Widths & Treatment

RALEIGH CITY CODE, PLANNING AND DEVELOPMENT, Section 10-2051. DOWNTOWN OVERLAY DISTRICT. (d)(5) 10/2/C-66.5

(5) Required open space.

For the purposes of this subsection, "open space" *shall* include greenways and any common outdoor landscape and recreation spaces (excluding *vehicular surface areas*), outdoor decks, roof gardens and other similar outdoor community space accessible to and available for use by all residents, employees and/or visitors of their development.

The minimum "open space" provided on the site *shall* be five (5) per cent of the total land area of the development, excluding dedicated rights-of-way unless density transfer is allowed from the right-of-way.

The minimum required open space *shall* be required to conform to the following standards:

a. Sidewalk widening.

Where the property lies adjacent to a public *street* right-of-way with an existing sidewalk width of eighteen (18) or less feet, sidewalk widening *shall* be required based on the following:

Existing walkway condition	*Construction to a minimum of*
0 – 14 feet	14 feet
> 14 – 18 feet	18 feet
> 18 feet	No sidewalk construction required

Additional right-of-way dedication *shall* not be required to accommodate the sidewalk widening set forth herein. However, for any sidewalk widening provided to comply with these minimum requirements and located on private property, the property owner *shall* be required to grant to the *City* a public access easement. The newly constructed sidewalk *shall* be of compatible paving materials with the public sidewalk and *shall* conform to any applicable adopted streetscape plan. The sidewalk widening *shall* occur along the entirety of the public *street frontage* with no permanent obstructions, other than those that *may* be required by the *City* Code and structural columns supporting overhangs or upper-story structures creating an arcade or recessed covered area in which case the columns *shall* be spaced a minimum of five (5) feet from both the building façade and the individual columns;

RALEIGH CITY CODE, PLANNING AND DEVELOPMENT, Section 10-2055. PEDESTRIAN BUSINESS OVERLAY DISTRICT. (d)(4) 10/2/C-85

(4) Required open space.

For the purposes of this subsection, and the subsection 10-2051 (d)(1)c.6., above, "open space" *shall* include greenways and any common outdoor landscape and recreation spaces (excluding *vehicular surface areas*), outdoor decks, roof gardens and other similar outdoor community space accessible to and available for use by all residents, employees and/or visitors of their development.

The minimum "open space" provided on the site *shall* be five (5) per cent of the total land area of the development, excluding dedicated rights-of-way unless density transfer is allowed from the right-of-way.

The minimum required open space *shall* be required to conform to the following standards:

b. Sidewalk widening.

Where the property lies adjacent to a public *street* right-of-way with an existing sidewalk width of eighteen (18) or less feet, sidewalk widening *shall* be required based on the following:

Existing walkway condition	*Construction to a minimum of*
0 – 14 feet	14 feet
> 14 – 18 feet	18 feet
> 18 feet	No sidewalk construction required

Additional right-of-way dedication *shall* not be required to accommodate the sidewalk widening set forth herein. However, for any sidewalk widening provided to comply with these minimum requirements and located on private property, the property owner *shall* be required to grant to the *City* a public access easement. The newly constructed sidewalk *shall* be of compatible paving materials with the public sidewalk and *shall* conform to any applicable adopted streetscape plan. The sidewalk widening *shall* occur along the entirety of the public *street frontage* with no permanent obstructions, other than those that *may* be required by the *City* Code and structural columns supporting overhangs or upper-story structures creating an arcade or recessed covered area in which case the columns *shall* be spaced a minimum of five (5) feet from both the building façade and the individual columns;

RALEIGH CITY CODE, PLANNING AND DEVELOPMENT, Section 10-2055. PEDESTRIAN BUSINESS OVERLAY DISTRICT. (e)(3, 5, 6, 9)

(3) Landscape.

Landscaping shall be done in accordance with Section 10-2082, and all street tress shall be planted in accordance with the adopted Streetscape Plan or Streetscape and Parking Plan.

(5) Pedestrian Ways.

The minimum width of pedestrian ways from the curb to the building line for all new buildings and uses shall be eighteen (18) feet wide, unless the width of pedestrian ways for more than seventy-five (75) percent of the linear frontage of pedestrian ways on the same side of the street as the new development, within a single block, are less than fourteen (14) feet. In such instances, the minimum pedestrian way shall be in accordance with Section 10-2055(d)(4) above.

All improvements to pedestrian ways shall be made in accordance with the adopted Streetscape Plan or Streetscape and Parking Plan. Upon adoption of a Streetscape and parking Plan, alternatives to the aforementioned requirements for pedestrian ways may be established by the adopted Streetscape and Parking plan whenever the property is developed using any of the less stringent standards of the Overlay District.

(6) Bicycle parking.

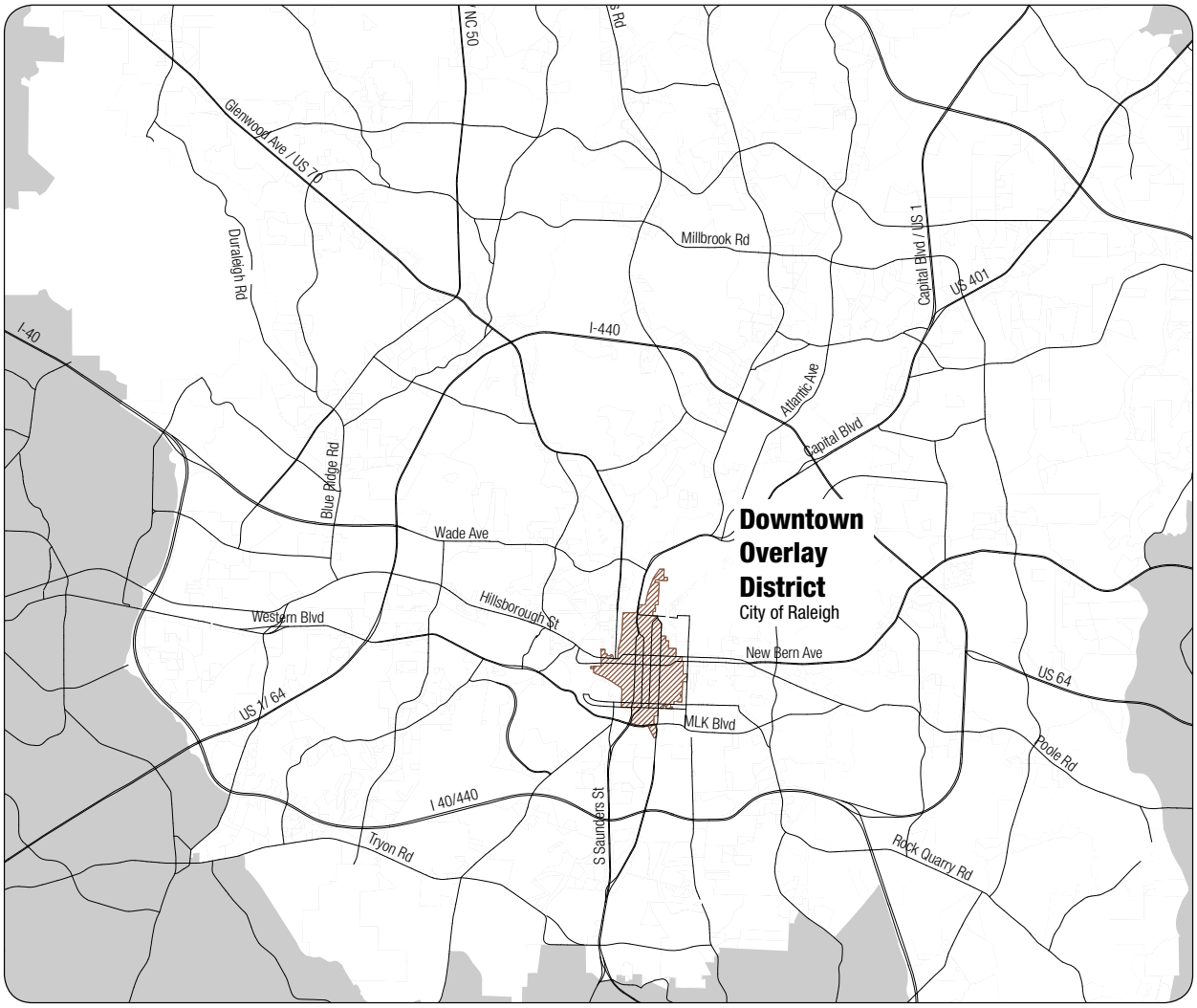
Bicycle parking spaces shall be provided for all new uses, new buildings, and for existing buildings and uses whenever those existing buildings and uses undergo any one (1) or more of the expansions, expenditures, or changes listed in subsections a. through c. of Section 10-2055 (e)(2) above. Bicycle spaces shall be provided at a rate of at least one (1) bicycle space for every twenty (20) automobile spaces provided for five thousand (5,000) square feet of nonresidential floor area gross, whichever is greater. Bicycle parking facilities shall be located within easy access from the street right-of-way, and shall be designed in accordance with the Streetscape plan or Streetscape and Parking Plan.

(9) "Streetscape Plan" and "Streetscape and Parking Plan"

No improvement of street right-of-way, to vehicular surface areas and to the sides of any building that face a thoroughfare or collector street shall be made within a Pedestrian Business Overlay District except in conformity with the adopted Streetscape Plan or Streetscape and Parking Plan. All additions, changes, expansions and alterations to such existing structures must comply with the regulations of the Streetscape Plan or Streetscape and Parking Plan unless the Board of Adjustment in accordance with Section 10-2146.3(a)(7) approves the addition, change, expansion, or alteration as if the structure were made nonconforming by the Overlay District. Improvements to thoroughfare rights-of-way that are part of the Streetscape Plan or Streetscape and Parking Plan shall be installed whenever the properties that adjoin said rights-of-way acquire new buildings, new uses, or undergo

Appendix B: Maps of Raleigh's Downtown Overlay District & Pedestrian Business Overlay Districts

DOD: Downtown Overlay District



Downtown Overlay District
(Code of Ordinances Section 10-2051)

The Downtown Overlay District is intended to promote the development of intensive residential and nonresidential uses within the downtown area so as to provide living areas in close proximity to high concentrations of employment, reduce peak hour commuter congestion, and support for downtown *commercial* development and redevelopment. Within the Downtown Overlay District, properties which are subject to different regulations by their underlying zoning district for purposes of density, setbacks, height, *floor area ratio* and *building lot coverage* may be more equitably developed through the application of *site plan* approval and these properties are developed in accordance with the general plans for the physical development of the City as embodied in the Raleigh Comprehensive Plan.

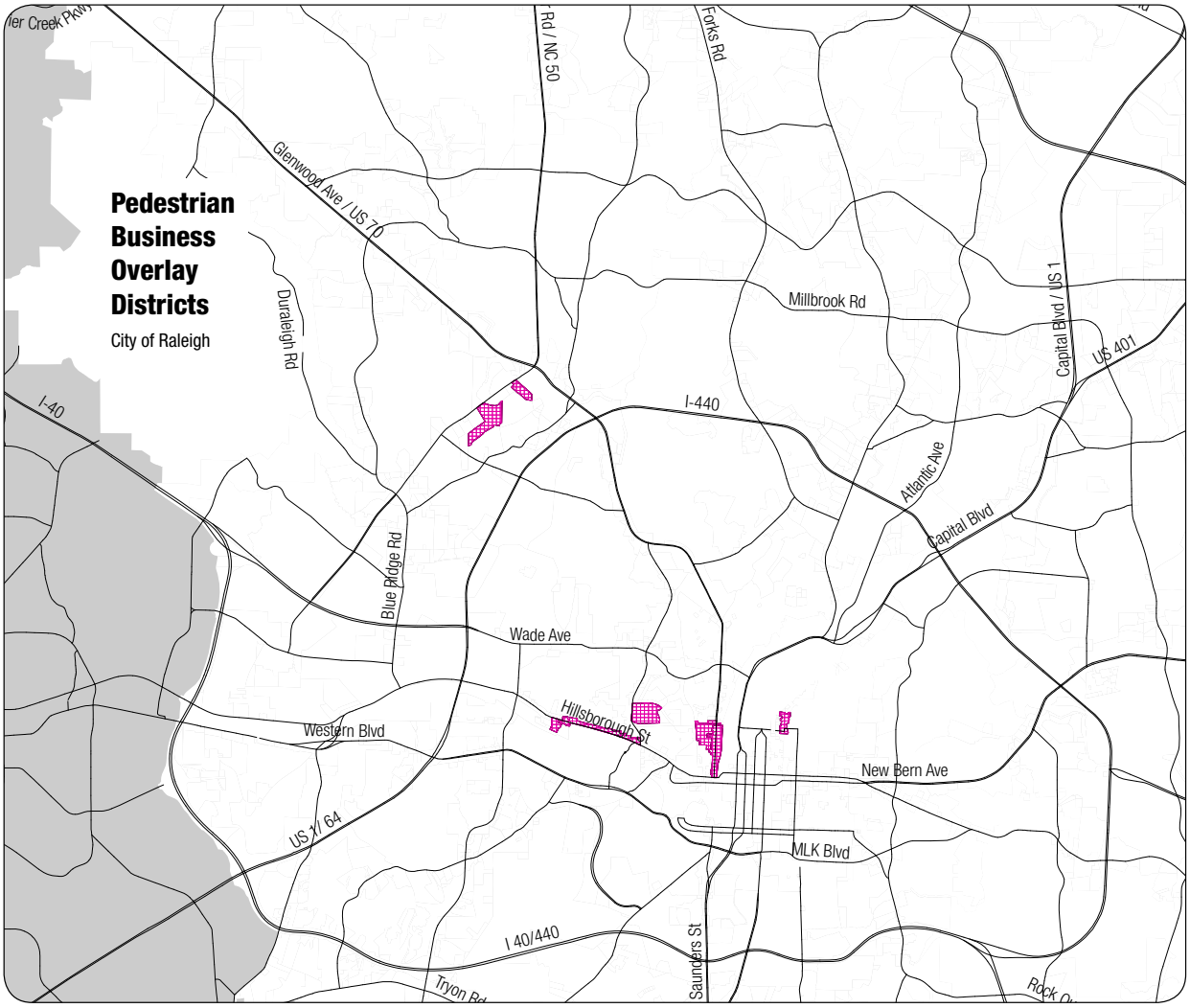
Permitted uses*:*

All uses permitted in the underlying zoning district.

With City Council site plan approval, residential uses within the Industrial zoning districts and additional density in other districts may be permitted (up to 320 units per acre) and retail uses on property zoned O&I-1 or O&I-2 when integrated into a high density development.

Subject to City Council site plan approval, exceptions to setbacks, height, parking, floor area ratio and building lot coverage may also be approved.

PBOD: Pedestrian Business Overlay District



Pedestrian Business Overlay District (Code of Ordinances Section 10-2055)

The Pedestrian Business Overlay District is intended to preserve and enhance the character of pedestrian-oriented retail districts. Through the application of design standards which encourage pedestrian activity, the Overlay District improves and protects the economic viability of the area. By respecting and improving the pedestrian environment, the Pedestrian Business Overlay District reduces the conflicts between pedestrian and vehicular traffic and it encourages compatible development.

The districts include:

Oakwood/Mordecai
Glenlake
Cameron Village
Glenwood South
Peace Street
Stanhope Center
University Village
Crabtree Place

Permitted uses*:*

All uses permitted in the underlying zoning district, except vehicular display areas.

Allows up to 320 dwelling units per acre through City Council site plan approval.

Reduces the off-street parking requirements for all uses.

Requires the planting of street trees and improvements of pedestrian space according to an adopted *streetscape plan.*

Setbacks, signage, pedestrian ways, height determined by *streetscape plan.*

Requires bicycle parking facilities.

Appendix C : Resources on Pedestrian Behavioral Studies

The following is a list of available resources that provide more information on streetscapes, sidewalks and their composition:

- Fruin, John J. Pedestrian Planning and Design. Mobile: Elevator World, Inc.,1971. *Print.*
- *Dines, Nic*holas and Kyle Brown. *Landscape Architect's Portable Handbook*. New York: McGraw-Hill, 2001. Print.
- Benepe, B. *The Pedestrian in the City*. Traffic Quarterly, Vol. 19, No 1 January 1965, pp. 28 – 42)
- Rudofsky, Bernard. *Streets for People, a Primer for Americans*. Doubleday and Co. Inc. 1970
- Hall, E.T. *The Hidden Dimension*. *New York*: Doubleday and Co. Inc. 1966
- Horowitz, M.S. et al. *The Body Buffer Zone, an Exploration of Personal Space*. Arch Gen Psychiat. 11 pp. 651-656, 1964
- Cavagna, G.A. et al. *Mechanics of Walking*. Journal of Applied Physiology, 21 (1): 271-278, 1966.
- Lynch, Kevin. *The Image of the City*. Cambridge: MIT Press,1960. Print
- Hoel, L.A. *Pedestrian Travel Rates in Central Business Districts*. Traffic Engineering, Jan 1968. pp 10-13
- Older, S.J. *Movement of Pedestrians on Footways in Shopping Streets*. Road Research Laboratory, Ministry of Transport, Traffic Engineering and Control. August 1968. pp 160-163
- Navin, P.D. R.J. Wheeler. *Pedestrian Flow Characteristics*. Traffic Engineering. June 1969. pp 38-43
- Stuart, D.G. *Planning for Pedestrians*. Journal of American Institute of Planners. Jan 1968. pp 37-41
- Morris, R. L. and S.F. Zisman. *The Pedestrian, Downtown and the Planner*. Journal of the American Institute of Planners. August 1962. Vol. XXVIII No. 3, pp 26 – 33
- Garbecht. D. *Distributions of Pedestrians in a Rectangular Grid*. Journal of Transportation Economics and Policy. Jan 1970 pp 66-88
- Stuart, D. *The Systems Approach in Urban Planning*, Special Report ASPO
- Trolley, Rodney. *Sustainable transport: planning for walking and cycling in urban environments*. Boca Raton: CRC Press
- Soderstrom, Mary. *The Walkable City: from Haussmann's boulevards to Jane Jacob's streets and beyond*. Montreal 2008

- Gehl, Jan. *Life Between Buildings: Using Public Space*. Copenhagen, 2006
- *Accessible Rights-of-Way: sidewalks, street crossings, other pedestrian facilities: A design guide*. 1999
- Rubenstein, Harvey M. *Pedestrian Malls, Streetscapes, and Urban Spaces*. 1992
- Garvin, Alexander. *The American City: What works and what doesn't*. 2002
- Jacobs, Allen. *Great Streets*. 1993

Appendix D : Possible Correlation to UDO-Defined Frontages

	Parkway	Detatched	Parking Limited*	Green	Urban Limited	Urban General	Shopfront
Sidewalk Typology							
Grated Street Trees		x	x	x	x	x	x
Open Tree Pit	x	x	x	x	x		
Planted Verge		x	x	x			
Paved to Back of Curb			x		x	x	

*place vegetated buffer between sidewalk and parking lot

Cleared Pedestrian Pathway							
Low Pedestrian Use	5'	5'	-	5'	-	-	-
Moderate Pedestrian Use	7'	7'	7'	7'	7'	7'	-
High Pedestrian Use	10'	-	10'	10'	10'	10'	10'
Very High Pedestrian Use	-	-	-	-	12'	12' or greater	12' or greater
Building Edge Spaces							
Building Clearance (min)	-		-		2'	2'	2'
Small Sidwalk Obsticles	-	4'	4'	4'	4'	4'	4'
Large Sidewalk Obsticles	-		8'	8'	8'	8'	8'
Curbside Spaces							
Minimal Sidewalk Setback	-	2'	4'	4'	4'	4'	4'
Moderatly Programmed	-	4'	6'	6'	6'	6'	6'
Heavily Programmed	-	-	10'	10'	10'	10'	10'
Large Sidewalk Obsticles	-	-	14'	-	-	14'	14'
Sidewalk Corridor Width							
Grated Street Trees	-	9' to 15'	11' to 30'	9' to 24'	11' to 30'	13' to 34'	16' to 34'
Open Tree Pit	-	10' to 15'	11' to 30'	11' to 24'	11' to 24'	-	-
Planted Verge	15' to 30'	8' to 15'	11' to 22'	9' to 18'	10' to 22'	-	-
Paved to Back of Curb	-	-	11' to 24'	-	11' to 28'	13' to 34'	-
Appropriate Streetscape Elements							
Planters	-	-	x	-	x	x	x
Trashcans	x	-	x	x	x	x	x
Fire Hydrants	-	x	x	x	x	x	x
Utlitity Boxes	-	x	x	x	x	x	
Newspaper Dispensers	-	-	x	-	x	x	x
Mail Dropbox	-	-	x	x	x	x	x
Two Top Table	-	-	-	-	x	x	x
Street Performer	-	-	-	-	x	x	x
A-Frame Sign	-	-	-	x	x	x	x
Shrubery & Flowers	x	x	x	x	x	x	x
Bike Rack	-	-	-	x	x	x	x
Bench	x	-	x	x	x	x	x
Five Top Table	-	-	-	-	x	x	x
Utlity Poles	-	x	-	x	x	-	-
Sign Posts	-	x	x	x	x	x	x
Residential Mailbox	-	x	-	x	-	-	-
Parking Meter	-	-	x	x	x	x	x
Street Tree (Grated)	-	x	x	x	x	x	x
Street Tree (Open)	x	x	x	x	x	-	-
Street Light Pole	x	x	x	x	x	x	x
Bus Stop Bench	x	x	x	x	x	x	x
Bus Stop Shelter	x	-	x	x	x	x	x
Street Vendor	-	-	-	-	-	x	x
Traffic Light Pole	-	-	x	x	x	x	x

Appendix E : Bibliography

Alexander, Christopher et al. *A Pattern Language*. New York: Oxford University Press, 1977. Print.

Dines, Nicholas and Kyle Brown. *Landscape Architect's Portable Handbook*. New York: McGraw-Hill, 2001. Print.

Fruin, John J. *Pedestrian Planning and Design*. Mobile: Elevator World, Inc., 1971. Print.

Institute of Transportation Engineers. *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*. Washington: Institute of Transportation Engineers, 2001. Print.

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

Lewis, Craig and David Walkters. *Urban Design Guidelines for Mixed-Use Neighborhood and Village Centers*. Raleigh: The Lawrence Group, 2002. Print.

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

Raleigh Convention Center. *Downtown Raleigh Map*. 2009. Web. 16 December 2010. <http://www.raleighconvention.com/Images/PDF/downtown-raleigh-map.pdf>

Raleigh (North Carolina). *City of Raleigh Development Regulations: City Code Part 10*. Raleigh: Raleigh Department of Planning, 2010. Print.

Raleigh (North Carolina). *Livable Streets: Downtown Raleigh Plan*. Raleigh: Raleigh City Council, 2003. Web. 1 January 2011 < http://www.raleighnc.gov/search/content/PlanUrbanDesign/Articles/LiveableStreetsPlan.html>

Raleigh (North Carolina). *Raleigh Zoning Handbook*. Raleigh: Raleigh Department of City Planning, 2009. Web. 1 January 2011. < http://www.raleighnc.gov/business/content/PlanLongRange/Articles/ZoningCode.html>

Raleigh (North Carolina). *Standards for Private use of Public Spaces: A downtown Raleigh urban design handbook*. Raleigh: Raleigh City Council, 2007. Print.

Raleigh (North Carolina). *Streetscape Plans*. 2010. Web. 1 January 2011 < http://www.raleighnc.gov/projects/content/PlanLongRange/Articles/StreetscapePlans.html> (individual plans as PDF links)

United States Access Board. *ADA Accessibility Guidelines for Buildings and Facilities*. Washington: United States Access Board, 2010. Web. 1 January 2011 <http://www.access-board.gov/adaag/html/>