URBAN STREET DESIGN GUIDELINES

CHARLOTTE.

Adopted by Charlotte City Council
October 22, 2007

URBAN STREET DESIGN GUIDELINES

Adopted October 22, 2007

This document was prepared by City of Charlotte staff from the following departments:

Charlotte Department of Transportation
Charlotte-Mecklenburg Planning Department
Charlotte Area Transit System
Engineering and Property Management

Additional technical input was provided by HNTB, Reid Ewing, and Kenneth Voigt.

CONTACT INFORMATION:

For more information about this document,
please visit *www.charmeck.org/departments/transportation* or contact:
Tracy Newsome
Charlotte Department of Transportation
600 East Fourth Street
Charlotte, NC 28202

TABLE OF CONTENTS

URBAN STREET DESIGN GUIDELINES

POLICY SUMMARY

Adopted October 22, 2007

Relationship to the Transportation Action Plan and the Centers, Corridors and Wedges Growth Framework

The Urban Street Design Guidelines (USDG) are a vital supporting component of the **Transportation Action Plan (TAP)**, because the USDG describe how the planning and design of Charlotte's streets and intersections will support livability and economic development objectives and create more travel choices. The USDG include methodologies and recommendations for implementing key aspects of the TAP - increasing the quantity and quality of streets, enhancing the integration of land use and transportation decisions (sometimes on a block-by-block basis), and providing "complete" streets for residents, property owners, and all types of travelers.

The USDG support Charlotte's **Centers, Corridors and Wedges Growth Framework** by providing a diverse set of street types and flexible designs to be applied to varying types and intensities of land uses in different areas of Charlotte. The USDG define a process to ensure that appropriate street types and street design elements will be used to support specific land development and transportation objectives. Additionally, the USDG describe the land uses and urban design elements that can best complement each type of street, with the intention that street design and land use/urban design decisions will reinforce each other.

Guiding Principles of the USDG: Achieving a "Complete Street" Network

1) Streets are a critical component of public space.
2) Streets play a major role in establishing the image and identity of a city.
3) Streets provide the critical framework for current and future development.
4) Charlotte's streets will be designed to provide mobility and support livability and economic development goals.
5) The safety, convenience, and comfort of motorists, cyclists, pedestrians, transit riders, and neighborhood residents will be considered when planning and designing Charlotte's streets.

6) Planning and designing streets must be a collaborative process, to ensure that a variety of perspectives are considered.

Key Policies of the USDG

By adopting the document entitled the USDG, the City Council declares that it is the policy of the City of Charlotte to:

1. Apply the USDG to the planning and design of new and modified streets in Charlotte and its Sphere, including State-maintained surface streets.

2. Apply the USDG street classifications (Main Streets, Avenues, Boulevards, Parkways, and Local Streets), and related recommendations for cross-sections, speeds, and functional and aesthetic design elements, to the planning and design of streets in Charlotte and its Sphere. The reasons for providing a variety of street classifications are described in Chapter 1 of the USDG and the specific components of the different types of street segments and intersections are described in Chapters 4 and 5 of the USDG, respectively.

3. Apply the "six-step" process, described in Chapter 3 of the USDG, to create a network of context-based, "complete streets". The "six-step" process will be used to select the correct street classifications, cross-sections, and design components for non-local street types. The "six-step" process consists of:

a. defining the existing and future land use and urban design context;
b. defining the existing and future transportation context;
c. identifying deficiencies;
d. describing future objectives;
e. recommending street classification and testing initial cross-section;
f. describing tradeoffs and selecting cross-section.

4. Apply the USDG "six-step" process to plans, programs, and projects that will potentially change the physical features of existing non-local streets or result in the construction of new, non-local streets. Planning processes that will incorporate the results of the "six-step" process for planning and designing streets include area plans, streetscape or pedscape plans, neighborhood improvement plans, development proposal reviews, and preparation of the Capital Investment Plan.

5. Apply the appropriate USDG street classifications and cross-sections, as described in Chapter 4 of the USDG, to new local and non-local streets built through the land development process by either the private sector or public agencies.

6. Implement processes to ensure that the USDG street classifications and designs derived through the "six-step" process result in mutually reinforcing land use and transportation decisions. Implementation will include: amending the TAP Street Classification Map to reflect the specific recommendations defined during area or neighborhood plans, and establishing priorities for adopting new or updating existing land use plans to reflect the most up-to-date land use objectives for streets classified according to the USDG.

7. Require that the following block lengths and creek crossing intervals (see table on this page) be created with new public or private land development projects, to ensure the continued development of a dense, well-connected network of streets and traffic-calmed route choices for all travel modes:

Land Use/Location	Block Lengths	
	Preferred or Typical Block Length for Local Streets	*Maximum Block Length for Local Streets*
Transit Station Areas[1]	400'	600'
Centers[1]	500'	650'
Corridors[1]	600'	650'
Non-Residential Uses[1,2]	500'	650'
Industrial	600'	1,000'
Residential ≥ 5 dua (gross) in Wedges	600'	650'
Residential < 5 dua (gross) in Wedges	600'	800'

[1] Parks, schools, and cemeteries would be excluded.
[2] These would include commercial centers, office buildings, or mixed-use sites.

Land Use/Location	Creek Crossings
	Intervals Between Creek Crossings
Transit Station Areas[1]	650' - 1300'
Centers[1]	650' - 1300'
Corridors[1]	650' - 1300'
Non-Residential Uses[1,2]	650' - 1300'
Residential ≥ 5 dua (gross) in Wedges	600' - 2600'
Residential < 5 dua (gross) in Wedges	1300' - 2600'

[1] Parks, schools, and cemeteries would be excluded.
[2] These would include commercial centers, office buildings, or mixed-use sites.

While the expectation is that Local Streets will be built at the preferred or typical block lengths described above, it may not always be feasible or desirable to construct all streets or block lengths exactly as described above. The process for defining the factors that would affect or influence the construction of stub streets or creek crossings, or the provision of dedicated rights-of-way is described in the next section of this preamble.

8. Expand Charlotte's street tree canopy by providing planting strips wide enough for healthy, large-maturing street trees. Details (and guidelines for flexible applications) are described in Chapter 4, but generally:

a. on retrofits to existing streets, whether built by the City or by developers, create 8' planting strips, planted with large-maturing trees;

b. for newly-constructed streets, whether built by the City or by developers, create 8' planting strips, planted with large-maturing trees, except in the case of new, Medium Local Streets. For this category of streets, developers could choose between 8' planting strips and large-maturing street trees or 6' planting strips and small or medium-maturing trees, but the site developer and staff would be expected to justify why they are not implementing 8' planting strips.

9. Apply the bicycle, pedestrian, and motorist Level-of-Service (LOS) comparisons (including a 2-hour AM or PM peak period congestion analysis), as described in Chapter 5 and Appendices A and B of the USDG, to the planning and design of signalized intersections, to ensure that the physical designs of intersections reflect their street classifications and surrounding context.

10. Apply the design recommendations described in Chapter 5 and Appendices A-C of the USDG to all (signalized or unsignalized) intersections, whether constructed or modified by the City or by private developers. The design recommendations will affect the number and width of travel lanes, inclusion of bicycle facilities, treatments for pedestrian crossings, traffic control devices and operation, pavement markings, and curb radii.

11. Apply the USDG sidewalk recommendations. These are described in detail in Chapter 4 of the USDG, but in general:

a. the minimum sidewalk width in the City will be 5',
b. the minimum sidewalk width

along Avenues and Boulevards will be 6',

c. a separate pathway outside the right-of-way of Parkways will be a design priority, and

d. minimum sidewalk widths of 8'-10' will be created in areas where there likely would be higher pedestrian volumes, due to the existing or planned land uses.

12. Continue to expand Charlotte's bicycle network by, in general, providing bike lanes on the higher-volume, higher-speed streets and signed bike routes on low-volume, low-speed streets. As described in greater detail in Chapter 4 of the USDG:

a. Bike lanes will typically be incorporated into new or existing Avenues and Boulevards.

b. Main Streets and Local Streets will not typically include bike lanes.

c. Parkways will incorporate bike pathways outside of the Parkway right-of-way or in one or more nearby, connected Local Streets.

d. The bicycle travel network will include signed bike routes on Local Streets connecting to bike lanes on Avenues, Boulevards, or Parkways.

e. Design teams will justify why bike lanes would not be included for any street segment where bike lanes would generally be expected.

13. Incorporate traffic calming components or treatments (as described in CDOT's Traffic Calming Report) into the design of new or retrofitted streets. Require "slow points" on new Local Streets.

14. Update all necessary and appropriate codes, standards, and ordinances to ensure that design components for all new or retrofitted streets meet the USDG recommendations.

15. By 2008, prepare supplements to the USDG for "special streets" (including, but not limited to, green streets, culs-de-sac, one-way streets, alleys, and private streets).

16. By 2008, update CDOT's Driveway Regulations and Sight Distance Policy, and revise the City's pavement standards, with structural components linked to the USDG classifications.

17. By 2008, evaluate and define feasible changes to horizontal and vertical curvature requirements, to support traffic calming, reduce the impacts of mass grading, and minimize negative impacts of stream crossings.

1. REDEFINING CHARLOTTE'S STREETS

The Urban Street Design Guidelines described in this document present a comprehensive approach to designing new and modified streets within Charlotte's designated Sphere of Influence. The Guidelines will allow us to provide better streets throughout Charlotte – streets that reflect the best aspects of the streets built in the past, and that will provide more capacity and safe and comfortable travel for motorists, pedestrians, bicyclists, and transit riders.

Why Do We Need New Urban Street Design Guidelines?

Charlotte's tree-lined streets have long symbolized our City's beauty and quality of life. However, many streets have also come to symbolize the growing pains that can accompany growth and prosperity, with increased congestion in some portions of the City and streets that have become increasingly hostile to anyone but motorists. Therefore, these Urban Street Design Guidelines have been developed in response to two basic issues:

1) Charlotte needs to better plan for continued growth and development, and
2) Charlotteans want better streets.

1) <u>Growth and Its Consequences:</u> Charlotte grew very rapidly over the course of the last three or four decades. The City is expected to continue to grow rapidly, with an additional 350,000 people projected to be living here over the next 25 years, along with 360,000 additional employees working here, many of whom will be commuters from other towns and counties. Our ability to accommodate this growth using the same development and transportation approaches as were used during previous decades is questionable at best. Our ability to do so *while also maintaining our high quality of life* is even less likely. Quality of life is one key to Charlotte's continued economic development.

The Urban Street Design Guidelines are intended to help the City accommodate growth in several ways. They support a variety of City policies, including the Centers, Corridors and Wedges growth framework and the recently adopted Transportation Action Plan, which describes the transportation-related policies and programs needed to help Charlotte maintain its many advantages as it continues to grow.

The Guidelines will help achieve the emerging vision for Charlotte (summarized in the box on the right) by supporting the goal of more compact and focused growth, and by offering more transportation choices. These are complementary intentions because compact development makes providing transportation choices easier and providing transportation choices makes compact development more liveable and viable.

"Transportation choices" are created both by providing more connections - more route choices for all travelers - and by building streets that are easier to use by more types of travelers – by people who want to walk, ride transit, or ride bicycles. Generally, more connections and better provision for all modes will help increase our transportation system's capacity, further sustaining growth. Providing transportation choices also helps address an important environmental consequence of growth – poor air quality. In Charlotte, like many cities, our major air pollution problem is ozone, which is created when nitrogen oxides and volatile organic compounds combine in sunlight and stagnant air. In Mecklenburg County, nitrogen oxides are emitted mostly by motor vehicles. Therefore, the sheer number of cars and the miles they travel have a great impact on our air quality. In addition to the health effects of poor air quality, this also rep-

Vision for Charlotte

"To be an urban community of choice for living, working and leisure"

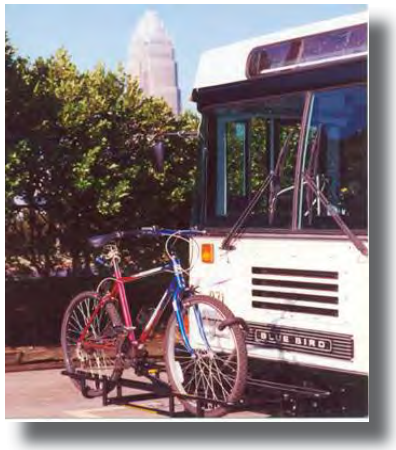
- More compact and focused growth
- Protection of environmentally sensitive areas
- Expanded travel choices
- Mix of uses/integration of live, work, shop and play
- Viable and healthy economy
- Maintenance of quality, livable neighborhoods
- Revitalization and infill in older areas
- Variety of housing choices and costs
- High quality urban design
- Infrastructure needed to support development
- Empowered, informed and engaged citizenry

resents a significant potential cost, since our region must remain in compliance with federal standards on certain pollutants, including ozone. Failure to comply can result in withholding of federal funding for transportation projects, which can further impact our city's ability to sustain development. Air quality, therefore, is an important component of both quality of life and continued economic development.

One way to affect air quality is by reducing three aspects of motor vehicle use - the vehicle miles traveled (VMT) and the number and duration of engine starts. VMT refers to the total number of daily miles traveled by motor vehicles within or through a geographic area. It is virtually impossible to reduce total VMT in a growing city, but it is possible to reduce *VMT per capita*, so that each additional person doesn't increase VMT by the same amount as each person does today. We can help do this by offering viable transportation choices for people as they travel between land uses, an important goal of these Urban Street Design Guidelines.

The Urban Street Design Guidelines will also help Charlotte plan for growth by better matching the transportation network to the land uses that lie along that network. Better integration of land uses and transportation, through context-based design, will ensure that mutually reinforcing decisions are made and that peoples' ability to take advantage of more transportation choices is enhanced.

The disconnected, cul-de-sac development style shown above reduces the street network's ability to handle traffic, because it forces all traffic onto a few streets. It also makes it more difficult for people to walk or bicycle between land uses, because of the lack of direct (shorter) routes.



2) <u>Better Streets:</u> Building streets to provide more choices will help Charlotte meet the challenges of growth, but it also means that we will be building better streets overall – the types of streets that Charlotteans have said they want. Stakeholder interviews held early in the development of the Guidelines resulted in a list of "most favorite" and "least favorite" Charlotte streets. The "most favorite" streets are typically located in the older, central neighborhoods of Charlotte. These streets include an abundant tree canopy and pedestrian amenities and were built before the dominance of the automobile.

Queens Road West

Colony Road

Tryon Street, Uptown

East Boulevard

The Plaza

Among the "least favorite" streets are those that reflect the prevailing approach to street design since WWII – the approach used throughout the outlying areas beyond Route 4. This approach is intended to move cars safely and swiftly through the City by adding lanes and otherwise increasing capacity…with little regard for the less positive impacts on others using the streets. These "least favorite streets" typically lack pedestrian amenities. Driveways, parking lots, and utility poles are more abundant than trees. They often consist of wide expanses of pavement for moving traffic. Even accounting for the different design and orientation of the land uses along the streets, motorists are clearly the dominant "users" of the least favorite streets.


Independence Boulevard


Harris Boulevard


Highway 51


Sharon & Fairview Roads


South Boulevard

The stakeholder interviews revealed that, across a broad spectrum of stakeholder groups, Charlotteans want streets that are:

- aesthetically pleasing (including street trees), and
- comfortable and safe for pedestrians and cyclists (specific design treatments and speed reduction were mentioned by several groups).

A follow-up internet-based survey of almost 1,000 people substantiated that the streets people most "prefer" do not look or function like many of the streets that we have been building in recent years. Some progress has been made - our ordinances and standards for local streets have been updated to provide better streets (to build sidewalks on both sides of the street and to reduce the use of culs-de-sac, e.g.). However, those standards still are not creating the quality of streets that people have said they prefer or that were built in previous eras – walkable, well-connected streets with street tree canopies. Further, our current street designs make retrofitting many of the streets built over the last 50 years (to include street trees, wider sidewalks, or more connections, e.g.) very difficult.

Since streets provide the framework for both current and future development, their long-term usefulness for all modes must be enhanced.

What Are the Guidelines Trying to Achieve?

Providing the best possible streets to accommodate growth, provide transportation choices, and help keep Charlotte liveable requires a different approach to and philosophy of planning and designing streets. Cities across the country are seeing the need to plan for and design "complete" streets – streets that better serve all users, rather than focusing only on one set of users. The Urban Street Design Guidelines are essentially Charlotte's complete street guidelines.

Through the years, we have become very good at designing auto-oriented streets, which has had unintended consequences. We are now getting better at providing design elements such as sidewalks, planting strips, and bike lanes on thoroughfares, but we do not have a consistent, clear method to decide which types of streets to build where. The Urban Street Design Guidelines will help us to get better at designing complete streets for all users. To accomplish this, City staff developed these Guidelines based on the following principles:

- Streets are a critical component of public space.
- Streets play a major role in establishing the image of a community. Therefore, they affect the health, vitality, quality of life, and economic welfare of a city.
- Streets provide the critical framework for current and future development. The locations and types of streets will affect the land development pattern, as well as how much development can be supported by the street network.
- The design of a street is only one aspect of its effectiveness. How the street fits within the surrounding transportation network and supports adjacent land uses will also be important to its effectiveness.
- Charlotte's streets will be designed to provide mobility and support livability and economic development goals.
- The safety, convenience, and comfort of motorists, cyclists,

pedestrians, transit users, and members of the surrounding community will be considered when planning and designing Charlotte's streets.

- Streets should be designed to encourage Charlotteans to make trips by means other than cars, thereby positively impacting congestion, air quality, and the health of our citizens.

- Planning and designing streets must be a collaborative process, because it is necessary that decisions about the street be made with a variety of interests and perspectives represented.

Based on these principles, the recommendations contained within these Urban Street Design Guidelines reflect the following basic goals:

1) ***Support economic development and quality of life*** – *by providing more transportation capacity, while creating more user-friendly streets overall.*

2) ***Provide more and safer transportation choices*** – *by creating a better-connected network (route choices) and building streets for a variety of users (mode choices).*

3) ***Better integrate land use and transportation*** – *by avoiding "mismatches" between land uses and streets and by creating the right combination of land uses and streets to facilitate planned growth.*

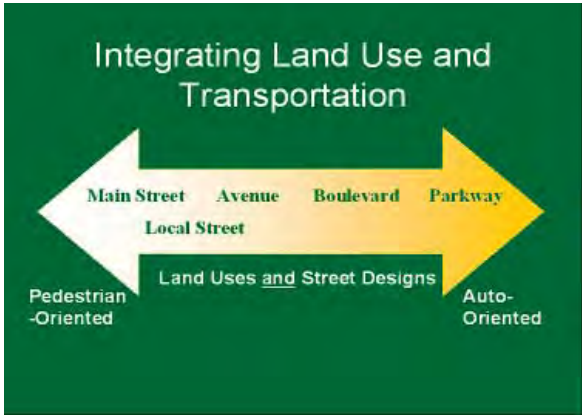


Figure 1.1

The New Street Types: Creating an Urban Street Network

To meet the goals described above, Charlotte's streets will be classified according to the following five street types:

- Main Streets
- Avenues
- Boulevards
- Parkways
- Local Streets

These street types fall along a continuum (Figure 1.1), with the Main Street being the most pedestrian-oriented street type and the Parkway being the most auto-oriented street type. "Pedestrian- and auto-oriented" refer both to the design of the street itself and to the characteristics of the land uses located along the street.

Even though each street type emphasizes different mixes of modes, all of these streets will be designed with all potential travelers and stakeholders in mind. By creating a variety of street types, the street network can better provide appropriate choices for those travelers and stakeholders, including Charlotte's current and future residents, commuters and visitors. Once a street (or portion of a street) is classified as a certain street type, the street design should reflect that classification and future land use decisions

along the street should also reflect that classification. Street design decisions and land use decisions should be mutually reinforcing, to create effective synergy between streets and land uses.

While a complete description of these street types and land use characteristics is provided in Chapter 4, the following are brief descriptions of each street type:

- ***Main Streets*** are "destination streets". They provide access to and function as centers of civic, social, and commercial activity. Main Streets are designed to provide the highest level of comfort, security and access for pedestrians. Development along Main Streets is dense and focused toward the pedestrian realm.

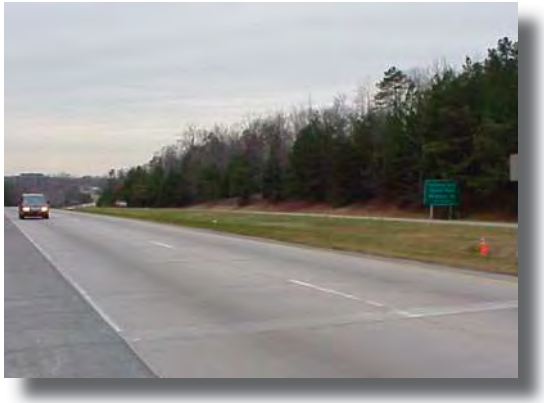
Land uses on Main Streets are typically mixed and are generators and attractors of pedestrian activity. Because of their specialized function and context, Main Streets will represent a relatively small portion of Charlotte's overall street network.

- ***Avenues*** can serve a diverse set of functions in a wide variety of land use contexts. Therefore, they are the most common (non-local) street type in our city. They provide access from neighborhoods to commercial areas, between major intercity destinations and, in some cases, through neighborhoods. Avenues serve an important function in providing transportation choices, because they are designed to provide a balance of service for all modes of transport. They provide for high quality pedestrian access, high levels of transit accessibility, bicycle accommodations such as bike lanes, yet they may also carry significant automobile traffic. Most *thoroughfares* in our street network would be classified as Avenues. The *collector/connector* function can also be served by some Avenue cross-sections.

- ***Boulevards*** are designed to move larger numbers of vehicles (as through traffic) from one part of the city to another and to other lower level streets in the network.

Therefore, maintaining vehicular movement is a higher priority than with an Avenue, but pedestrians and cyclists are still provided for in the design. In fact, the higher speeds and traffic volumes increase the need for safe pedestrian and bicycle treatments, such as providing adequate buffers from the traffic. Land uses along Boulevards can vary, but development will usually be set back further from the street than on Avenues.

- ***Parkways*** are the most auto-oriented of the street types. A Parkway's primary function is to move motor vehicle traffic efficiently from one part of the metropolitan area to another and to provide access to major destinations. Therefore, design decisions will typically favor the automobile mode over other modes. As with the Main Street, relatively few streets in Charlotte will be classified as Parkways.



- ***Local Streets*** provide access to residential, industrial, or commercial districts, as well as to mixed-use areas. They represent the majority of the lane miles of Charlotte's street network. Speeds and motor vehicle traffic volumes are low, providing a safe and comfortable environment for pedestrians and bicyclists. Since Local Streets are built through the land development process, specific cross-sections for a variety of different Local Street types are available. For residential streets, three alternative cross-sections are defined (narrow, medium, and wide), based on the expected need for on-street parking. For office/commercial Local Streets, two alternative cross-sections are provided (narrow and wide), based on the

expected need for on-street parking. The general intent is to keep the pavement on these streets as narrow as possible.

How Do these Guidelines Relate to Other Transportation Planning Activities?

With the 2006 adoption of the Transportation Action Plan (TAP), the City of Charlotte established a comprehensive plan for providing the necessary transportation elements to sustain Charlotte's growth and quality of life. The TAP describes the policies, programs, and projects that will be implemented over the next twenty-five years to ensure that Charlotteans have the most travel choices available to them as the City grows. The Urban Street Design Guidelines, by describing how Charlotte's streets should be designed, is a fundamental component for implementing the TAP and providing the necessary street network for decades to come.

In addition to the TAP, the Urban Street Design Guidelines will relate to other planning processes, including the existing State-required Thoroughfare Plan and emerging Comprehensive Transportation Plan. Both of these planning approaches are based on the functional classification of streets. The new street types described in the Guidelines are intended to work as "overlays" to existing street classifications. This means that, while a street might be identified, for example, as a major thoroughfare from a functional standpoint, it might be labeled an Avenue from the Urban Street Design standpoint. The Urban Street Design Guidelines classification will then affect the planning and ultimate design of the street. An important point is that a given street may be classified differently on different segments, for example, as an Avenue for one portion of its length and as a Boulevard for another. Since most thoroughfares traverse more than one land use context, the Urban Street Design classifications will allow the ultimate design of the street to reflect those various contexts.

The use of this "overlay" approach will likely need to be refined somewhat, as NCDOT moves away from its traditional thoroughfare planning process. Recent attempts to make state road planning better reflect multi-modal and context-based design have resulted in a new type of plan to replace the Thoroughfare Plan – the Comprehensive Transportation Plan (CTP). The CTP will use some different classification schemes than the Thoroughfare Plan. The Urban Street Design Guidelines classification system should work in tandem with the CTP, with the major difference being the street function anticipated by NCDOT or the city.

By having a set of street types that better reflect and complement a variety of land use contexts, Charlotteans and visitors can expect to find viable transportation choices as they travel through the City, something that has become increasingly difficult in recent decades. Further, by defining and implementing street designs to meet the intent of the different street types, we have the best chance of meeting

the multiple and sometimes conflicting objectives of the different users of our streets. ***Charlotte's Urban Street Design Guidelines will, over time, result in a well-connected network of "complete" streets that function well for all users and that complement and preserve the communities and neighborhoods they connect.***

Content of the Guidelines

The following chapters are intended to provide a comprehensive treatment of Charlotte's approach to street design. Each chapter provides a separate, stand-alone piece of information pertaining to street design, but each chapter also relates to the others. In this fashion, the Guidelines provide both the "big picture" of developing Charlotte's desired street network *and* the detailed guidelines necessary to design individual street segments and intersections. The remaining chapters include:

- **Chapter 2: Designing Streets for Multiple Users.** This chapter presents a thorough treatment of the need for and approaches to evaluating the tradeoffs among competing users and uses of the street right-of-way.

- **Chapter 3: Applying the Guidelines.** This chapter defines a recommended approach to applying the Guidelines, particularly in the case of non-local streets.

- **Chapter 4: Segments.** This chapter contains detailed information (text and diagrams) describing how to design the portions of the streets between the intersections.

- **Chapter 5: Intersections.** This chapter contains detailed information (text and diagrams) describing how to design various types of intersections.

- **Chapter 6: Glossary.** This chapter includes definitions or descriptions of different design elements, their intended purposes, and how they are best applied.

- **Appendices.** Appendices A-C provide additional details about the application of the new approaches outlined in the Guidelines.

Related Content Items to be Developed

Although the current document includes comprehensive coverage of planning and designing Charlotte's street network, there are some additional, related items that will be developed over the coming months and treated as supplements to the Urban Street Design Guidelines. Some of these are items that will require additional stakeholder comment or will be treated as part of the implementation of the Transportation Action Plan or the adopted Urban Street Design Guidelines. These additional items include:

- a section on designing "special" street types, such as green streets, alleys, culs-de-sac, one-way streets and private streets;

- more details on “connector” streets, including development of a connector map;
- a section describing access control, including driveway designs;
- updates to the City’s Sight Distance Policy and pavement standards; and
- an appendix describing horizontal and vertical curvature allowances on Local Streets.

2. DESIGNING STREETS FOR MULTIPLE USERS

These Urban Street Design Guidelines are intended to ensure that the best aspects of Charlotte's transportation network are re-created as the City and its street network continue to evolve. This means that the various street design elements (described in Chapters 4 and 5) must be applied in the right mixes and in the right places. The process for planning and designing streets must also be sensitive to both the land use context and to the needs of the various users of a street. This chapter provides information about how different travelers may expect different things from a street. Equally important, the following chapter (Chapter 3) describes a method for applying the Guidelines so that any tradeoffs are evaluated fairly for all stakeholders.

Assessing Tradeoffs: Who is Using the Street?

The first step towards designing streets that provide viable transportation options is to understand that different users of the street will likely have different expectations of what makes a "good" street. A street design solution that works well for a motorist, for example, may or may not work well for a pedestrian or a bicyclist. This is one reason many American cities are becoming more concerned about providing "complete streets." Further, even if every "ideal" design element for all of the *travelers* on a street were provided, then the resulting street might not satisfy the expectations of the people who live or work along it. These different stakeholders and their expectations for a street can complicate the design process, which is one reason Charlotte has developed these Guidelines.

Prior to the 1990s, street design was treated as a relatively straightforward task, with a pre-set menu of (often auto-oriented) cross-sections for streets with pre-defined functional classifications. That approach is changing in many cities, for a variety of reasons. One reason is that right-of-way becomes constrained as cities develop, and "standard" cross-sections are less likely to fit within the available right-of-way, particularly for retrofit projects. Another reason is that there is increasing concern about providing facilities that can be used by people other than motorists. In these cases, designing the street has had to become a more analytic process - one that considers the various user perspectives and the surrounding land use context, *in addition to* the street function.

These Guidelines are intended to ensure a process that clearly, consistently, and comprehensively considers the needs of motorists, pedestrians, and bicyclists when planning and designing streets. All streets should be evaluated in terms of how they affect many different groups, including:

- motorists,
- pedestrians (including transit riders),
- transit operators,
- bicyclists, and
- people living, working, or otherwise using the adjacent land uses.

Each of these groups has expectations about how a given street should function and, therefore, how it should be designed. The following examples describe various street users' perspectives and how they might be addressed in the design process.

What Do Motorists Want From Streets?

When a motorist expresses a concern or makes a request related to streets, it often stems from congestion or safety concerns. Motorists might expect streets to be widened and signalized intersections to be timed to enhance their own travel times, for example. They may also ask that the number of stop-controlled intersections on local streets be reduced, so that they can maintain free flow through neighborhoods. This interest in design features that motorists feel provide them "safe and efficient" travel has also long been the primary concern of highway designers.

To meet motorists' expectations for safe and efficient travel, perfect conditions over the street network would include:

- minimal travel delays,
- minimal conflicts (affecting both delay and safety), and
- consistently designed facilities.

For the most part, though, urban streets cannot provide this combination of conditions except perhaps on freeways or other access-controlled roadways. Even then, travel delay and potential for conflicts with other vehicles will vary by time of day. Furthermore, consistent design is not only difficult to provide on urban streets, but probably not even desirable for other reasons (it is at odds with the concept of context-sensitive design).

Although providing all of the favorable conditions for motorists described above is difficult, there are ways to achieve some of the motorists' preferences, either through construction or operational changes. These approaches include:

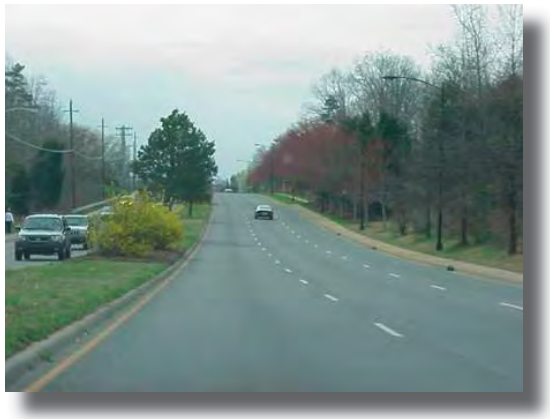
- adding through or turn lanes to increase capacity, which can help reduce delay, at least temporarily;
- making operational changes, such as providing more green-signal time to the street with the higher traffic volumes, which can reduce the wait time at signalized intersections *for those motorists on the higher volume street* while increasing the wait time for motorists entering from the lower volume side street;
- constructing grade-separated intersections and roundabouts, rather than signal or stop controlled intersections, which can also limit delay and increase capacity; and
- using bus pullouts to separate stopping transit vehicles from the travel lane and, therefore, to help reduce delay.

A roundabout can slow traffic without making the motorist actually stop.

Motorists not only want to travel quickly, but they also want to arrive safely. A variety of design features have been used through the years to enhance motorists' safety. For example:

- wide travel lanes are generally considered more forgiving to the motorist than are narrow travel lanes;
- turn lanes separate turning vehicles from the through traffic, potentially reducing rear-end collisions;
- medians separate opposing traffic streams;
- greater sight distances generally improve a motorist's ability to "see and be seen", thereby providing greater opportunity to avoid collisions;
- street lighting improves overall visibility; and
- a clear zone adjacent to the outside travel lane provides an extra measure of "forgiveness", should a vehicle actually leave the travel lanes.

In addition to these traditional, auto-oriented engineering designs, there are also design features that are desirable for other travelers, but which also have safety benefits for motorists. For example, bike lanes and planting strips, which buffer



A median can increase motorist safety and provide a refuge for pedestrians. However, it might also encourage higher speeds than desired.

pedestrians from traffic, also improve motorists' safety by increasing sight distance and by reducing the potential for conflicts between autos, bicycles, and pedestrians. Minimizing conflicts provides the motorist potential travel time savings and increased safety. Many of the "safety features" described on the previous page are, in fact, ways to minimize conflicts for the motorist.

As described, there are many ways to meet motorists' expectations for safe and efficient travel. However, doing so can have unintended and paradoxical results - many of the design elements listed above also tend to encourage higher speeds, thereby potentially *reducing the safety of not only motorists, but also bicyclists and pedestrians.* Design features that can encourage higher speeds include:

- wide travel lanes (particularly if the overall street cross-section is wide),
- a large clear zone (including a lack of street trees),
- medians,
- large (wide) curb radii at intersections and driveways, and
- straight, flat sections of streets with long blocks and widely spaced intersections.

Some drivers drive fast to reduce their travel times. Some drivers simply like to drive fast. Besides the safety paradox just described, this "need for speed" usually translates into rapid acceleration and deceleration between intersections, often with minimal impact on a driver's total travel time, but with significant impacts on pedestrians, bicyclists, and others using the street. These types of interrelationships and tradeoffs need to be considered when attempting to address motorists' expectations, particularly if that involves physical changes to streets and intersections.

What Do Pedestrians Want From Streets?

A traditional approach to street design might define pedestrian needs as simply 1) a sidewalk and 2) the ability to safely cross the street. These are, indeed, crucial to creating a safe walking environment. However, pedestrians expect and need more than just "walking space" to feel safe and comfortable, and these Guidelines consider many factors as important to pedestrians. If we are to support and encourage walking as an attractive and viable travel mode, our street designs should reflect that pedestrians also value features that:

- help shorten walking distances,
- separate (or buffer) pedestrians from moving traffic,
- create aesthetically pleasing surroundings and amenities,
- protect pedestrians from the elements, and
- let them walk as safely as possible.

In addition, some special pedestrian populations may have other, specific concerns and their needs must also be considered. For example, safe crossings for blind pedestrians may require a different set of design features than those for pedestrians in general.

Many individual design elements can provide for any one of the general

categories of pedestrian expectations described above. However, effectively encouraging more pedestrian travel typically requires a combination of several design elements, since the pedestrian is reacting to the overall walking environment. For example, the combination of

Many design elements combine to make this a functional pedestrian environment.

safe crossings, security lighting, and wide sidewalks may not encourage walking if people feel *they have nowhere to walk to.* For walking trips other than for pure recreation, this means that a walkable environment includes a mix of land uses in close enough proximity to walk comfortably between them.

People are much more likely to walk to a given destination if walking distance is minimized or if they perceive that the distances are not too long. In business districts, for example, typical acceptable walking distances may be longer than in an office park, since people are more likely to have stores, windows, and ground floor features to look at while they're walking in the business district. Conversely, walking in an office park often means traversing large parking lots with little visual stimulation, all of which makes the walk seem longer. Perceived distance, therefore, can be influenced by providing the right types of land uses and design characteristics. Distance can also be minimized by creating direct connections between land uses. Design elements that create better connections include:

- short blocks with marked intersections,
- safe mid-block crossings on longer blocks, and
- continuous walkway systems that connect door fronts with transit stops or other destinations.

Buffering pedestrians from passing cars also increases their comfort, even if they already have their own "walking space". Pedestrians generally find sidewalks with some sort of buffer more attractive than sidewalks built right next to moving traf-

fic. Several design elements can help to create suitable buffers between pedestrians and traffic, including:

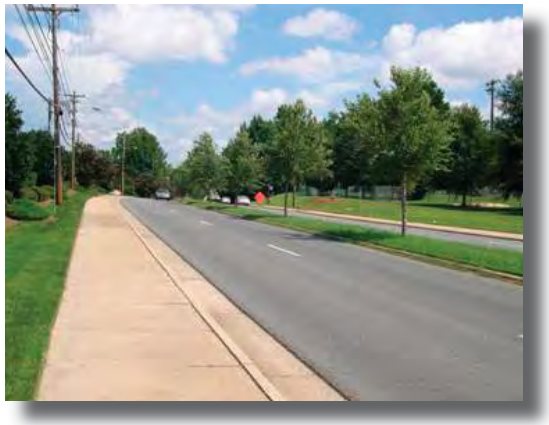
- planting strips,
- bicycle lanes,
- landscaping, and
- on-street parking.

These elements may be used alone or in combination. The dimensions of any one of these elements might vary, depending on how and whether it is combined with others. For example, an 8' planting strip will allow large maturing trees, which creates two types of buffer. That type of additional buffering is particularly important on a high-speed, high-volume street. By the same token, a 4' planting strip will still allow landscaping, but might require some additional form of buffering to increase the comfort level, even for those traveling on a lower-volume street. In that case, a bike lane or designated on-street parking could provide the extra buffer. The "correct" combination of these elements will depend on the space available, the various stakeholders' expectations, the land use context, and the objectives for the street.

The planting strip and trees combine for both vertical and horizontal buffering between pedestrians and motor vehicles.

Security is also an important consideration, since pedestrians will feel more vulnerable than motorists in many circumstances. A pedestrian's sense of security is improved by:

- providing street lighting and pedestrian scale lighting, and
- increasing pedestrian visibility from adjacent land uses (by placing windows/doors/"eyes on the street").



This "back-of-curb" sidewalk provides no buffer between pedestrians and vehicles.

Urban design can go a long way toward enhancing or hurting a pedestrian's sense of security - blank walls and facades, lack of windows and doors facing onto the street, and very large setbacks, for example, will isolate pedestrians from other activities and people.

Personal safety is also affected by the numbers and types of traffic conflicts to which pedestrians are exposed. The number of conflicts faced by a pedestrian can be reduced by:

- managing driveway access to minimize and control the locations of turning cars, and
- providing median or corner pedestrian refuge islands, which help to break up a crossing into more easily manageable parts.

This route would not seem secure to most pedestrians.

These design elements basically allow a pedestrian to only have to consider the various traffic movements one at a time. The overall distance (or time) over which the pedestrian must deal with potential conflicts can also be minimized by:

- reducing the number of travel lanes,
- providing curb extensions,
- designing smaller curb radii, and
- providing sufficient signal timing so that pedestrians do not feel "trapped" in an intersection.

In a less obvious fashion, a robust street network, with many connections, can make it easier to provide the pedestrian-friendly design treatments just described. **For a thorough discussion of how various intersection design elements, in combination, affect pedestrians at signalized intersections, see Appendix B.**

Conflicts between pedestrians and vehicles are not limited to motor vehicles,

The design elements on this route enhance the perception of personal safety and security.

but also occur with bicycles. Cyclists traveling the wrong way in mixed traffic or on the sidewalk are particularly dangerous, because they are traveling faster than pedestrians, but they are less visible and make less noise than motor vehicles. That is why bike lanes serve an important function for pedestrians that goes above and beyond the extra buffering described earlier.

A daunting intersection, from a pedestrian's perspective.

Aesthetics can also have a major impact on enhancing pedestrian comfort. Streetscape elements that impact aesthetics include:

- pedestrian scale lighting,
- benches,
- trash receptacles,
- landscaping,
- urban design treatments for adjacent development, and
- walking surface texture.

These design treatments can enhance aesthetics, but are also important functional elements. For example, trees and other forms of landscaping are not just "pretty" to look at, but also provide shade and buffering. Likewise, awnings along major pedestrian routes provide shade and shelter to make the walking environment more comfortable.

What Does Transit Want From Streets?

The "transit perspective" really needs to be discussed in terms of two different types of perspectives – that of the transit driver and that of the transit rider. Transit drivers are generally interested in and prefer the same street design elements as those who drive other large vehicles. Transit riders are essentially pedestrians, but pedestrians who are also interested in the placement and/or design features of bus stops and shelters. The street design team should consider both to help ensure transit's viability as an attractive mode of transportation.

Transit drivers have expectations specific to their need to operate very large vehicles along sometimes very busy streets. Transit drivers basically want:

- enough space to operate and maneuver their vehicles,
- minimal conflicts with other

travelers and with features along the sides of the street, and
- minimal delays, to help keep their route operating on time.

Design elements that help provide the space for buses to operate include:

- wide travel lanes,
- wide corner turning radii,
- street signs, utility poles, and on-street parking located to maximize clearance for side mirrors, and
- adequate merging distances.

Transit drivers also want to reduce the potential for conflict between transit vehicles and other travelers. In addition to minimizing driver fatigue, reducing such conflicts can also help minimize schedule delays, which harm transit operations and performance. Conflicts can be minimized by:

- selecting safe locations for bus stops, and
- providing signal priority for transit vehicles.

Just as delay will affect transit operations, so can the ability to provide more route coverage and travel efficiency. Coverage and efficiency are impacted by the extent of the street network. Short blocks providing multiple route options can increase pedestrians' access to transit as well as transit's access to more land uses (and potential riders).

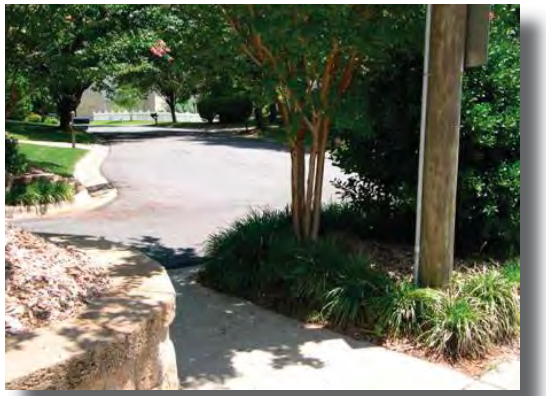
Transit riders have the same types of interests as do other pedestrians, with some additional, specific expectations. Transit riders also want:

- accessible bus stops,
- easy connections, and
- personal comfort and security while waiting for the bus.

Generally speaking, accessibility comes from having well-located transit stops on a well-connected network. The spacing

of bus stops and their locations relative to pedestrian-oriented or clustered land uses will affect peoples' ability or willingness to use transit. Transit stops should be located so that walk distances are not excessive. In addition, those land uses located near transit stops should be designed with entrances and sidewalks connecting buildings directly to the stop or to the nearest public sidewalk.

Accessibility is further improved by having a dense, well-connected network for pedestrians. Such a network can be achieved by including short blocks on the street network or bike-pedestrian



A pedestrian connection between a neighborhood street and a thoroughfare enhances pedestrians' route options.

pathways. Either way, the connections should include paved surfaces. The unpaved pedestrian path that might be adequate for joggers will be inadequate for commuters using transit, for example.

Closely related to their need for accessibility, transit riders also want to be able to change modes as easily as possible. Intermodal accessibility is provided through an extensive pedestrian sidewalk network with easy street crossings (defined earlier for all pedestrians), direct vehicle connections to park and ride facilities, and bike racks at stations and bus stops.

Unlike most other pedestrians, transit riders must occasionally be stationary. At transit stops, transit riders will be concerned about their own comfort and personal security. Riders' security concerns may be more pronounced than those of other pedestrians, because transit riders may perceive that they are more vulnerable once they stop walking and start waiting. Perceived or actual security can be enhanced by a variety of design features, including:

- street and pedestrian-scale lighting.
- transit stop locations that are not isolated from land uses and other people, and
- increased visibility through urban design (windows and doorways that face onto the street, for example).

Basic comfort for waiting riders can be achieved by buffering them from through traffic lanes (see "pedestrian needs" for a list of elements that achieve this), and by transit shelters, bus pads, benches, trashcans, and other amenities.

Here, amenities from a bygone era have been updated.

Finally, some design elements have positive impacts on both the transit driver and the rider, while others can have unintended negative consequences for one or the other of these two groups. For example, the quality of the vehicle ride

A transit shelter located on Randolph Road.

affects both drivers and riders. The ride quality can be improved by minimizing vertical grade variations along curb lanes at cross-streets and drainage grate areas, and by providing smooth, well-maintained street surfaces. Conversely, the wider lanes and curb radii that provide more maneuvering space for the transit vehicles can create less comfortable streets for transit riders. Bus pullouts may *reduce* delays to motorists who would otherwise have to wait behind the stopped bus, but may *cause* delays for transit riders when the driver has to wait for a gap in traffic to merge back into the travel lane. The point is that there are tradeoffs inherent in many of the decisions that must be made as part of the street design process – and what works well for one type of traveler may or may not work well for another type of traveler.

What Do Bicyclists Want From Streets?

Different types of bicyclists have different perspectives or expectations related to their trips. Those expectations will vary according to the type of cyclist and the type of trip - experienced vs. casual cyclists and transportation vs. recreational trips. Experienced cyclists typically feel more comfortable traveling in the traffic lanes than do casual cyclists. Casual cyclists will often avoid mixing with traffic and will feel more secure riding in separate, dedicated bike lanes. Experienced cyclists who are commuting to work will typically take the shortest, most direct route, while recreational cyclists and/or less experienced cyclists may seek out indirect routes, either to enhance their recreational experience or because they are avoiding higher-volume, higher-speed streets.

Either way, bicyclists of all kinds generally want:

- a well-connected network of bicycling facilities,
- safe travel routes, and
- direct travel routes, particularly when bicycling for purposes other than strictly exercise or recreation.

A dedicated bicycle network that connects neighborhoods, schools, parks, and other activity centers must be developed for bicycling to become a viable travel mode in Charlotte. That bicycle network should include direct routes, multiple

Dedicated space for bicyclists is one way to create a good bicycle network on higher speed, high volume streets.

route options, and dedicated cycling space. Direct routes can be provided through both a continuous network of local streets and through bike lanes on higher-volume streets. Short blocks help to create the dense network necessary for direct routes and lower-volume route options. Signed bike routes and other wayfinding treatments can make it easier for casual cyclists to travel on the local street network for short trips that might otherwise be made by car.

On higher-volume, higher-speed streets, a bike lane is necessary for cyclists' safety and comfort. The width of the bike lane is very important:

- the minimum width for a designated bike lane is 4' of usable asphalt surface, with 5' preferred;
- where the bike lane is next to parked cars or on steep, uphill grades, 6' may be necessary, since the cyclist may need room to avoid opening car doors or to pedal uphill (which can cause "wobbling").

In cases where space is insufficient for an official bike lane, edge striping should be used to keep motor vehicles within 10' of the center line or next travel lane.

Cyclists also need to be visible to motorized traffic. There are a variety of design elements that help improve bicyclists' visibility, including:

Signed bike routes on the local street network also contribute to a good bicycle network.

- designated bike lanes,
- pavement markings,
- street lighting,
- bike boxes and bike signals at intersections, and
- buffers from travel lanes and parked cars.

Conflicts with cars, buses, and pedestrians can also be minimized through reducing driveway frequency in commercial areas and providing bike lanes.

For bicyclists to operate their vehicles safely, they also need smooth, continuous surfaces. These surfaces are affected both by paving and by drainage grate design and/or maintenance. Grates should never run parallel to the direction of travel and pavement markings should be carefully assessed for potential slickness.

These images show the importance of well-designed drainage grates.

Bicyclists have special types of problems traveling through intersections, since they must operate their bikes as vehicles, but they are smaller and more vulnerable than the other vehicles. At intersections, it is particularly important that bicyclists be visible to both motorists and pedestrians. Design elements that improve cyclists' visibility at intersections include:

- bike lanes that are located appropriately in relation to the vehicle turn lanes,
- lead signal indicators (which provide a headstart and allow bicycles to clear the intersection ahead of motor vehicle traffic),
- bicycle stop bars (which provide similar advantages as the lead signal indicators), and
- bike boxes, which require a bike lane leading to the intersection (see photo).

A bike box at an intersection.

Roundabouts allow vehicles, including bicycles, to continue moving, although at reduced speeds.

Bicyclists also benefit from any design element that allows them to avoid stopping or that reduces their delay once they do stop. Cyclists generally want to avoid stopping, since starting back up is not easy, particularly if it must be done quickly and in mixed traffic. Reducing delay can be achieved by the use of roundabouts, lead signal indicators, and bike sensitive signal detectors. **For a thorough discussion of signalized intersection features and their effects on cyclists, see Appendix B.**

What Do the Adjacent Land Uses Want From Streets?

Thus far, the discussion has focused on those who travel along streets, but these are not the only stakeholders who have an interest in streets. Other people who have an interest in how streets are designed include residents, business owners, property managers, employees,

and other occupants of buildings along a street or in adjacent neighborhoods. These types of stakeholders often consider themselves most impacted by designs or design changes intended to meet the needs of other stakeholders, particularly those of motorists. These "stationary" stakeholders' perspectives are an important consideration when deciding which street design elements should be included.

People who occupy neighboring land uses may have different perspectives on street design, depending on whether these are residential or commercial land uses. Either way, these stakeholders will all want to feel safe and secure, to have access to their property, and to enjoy an aesthetically pleasing environment. Therefore, they will likely see the following design elements as beneficial:

- lighting,
- safe and contained travelways,
- driveways (for access to their properties), and
- trees and landscaping.

These stakeholders will typically not want to lose portions of their property, so minimizing the overall right-of-way width may be seen as beneficial to most of these stakeholders, as well.

Owners, inhabitants, or managers of residential, institutional, commercial or any pedestrian-oriented properties typically are very concerned about safety. These stakeholders want slower traffic speeds and, in some cases, lower traffic volumes. The types of street design elements that can help achieve this include:

- traffic calming devices,
- low design speeds,
- safe and convenient pedestrian crossings, and
- reduced street widths.

A "choker" on a local street.

Speed tables or "humps" are widely used for traffic calming.

In residential and institutional zones, reducing the noise from motor vehicles may also be important. Some forms of traffic calming can help achieve some level of noise reduction, but for major thoroughfares, the best way to achieve this may be to provide more separation between apartments or condominiums and the travel lanes. People who live or work in residential or institutional zones may also express concern about pedestrian and/or bicycle pathways located "too close" to their properties, due to (typically unsubstantiated) security concerns.

Owners or operators of commercial uses, particularly lower-density, less pedestrian-oriented commercial uses, will want automobile access and visibility. Therefore, these stakeholders might:

- oppose access controls (limiting-driveways), and
- oppose medians, but
- want turn lanes, and
- want median breaks allowing access to their commercial properties.

In addition to automobile access, owners or operators of higher-density commercial uses are also interested in good access to pedestrian traffic. To achieve this, good site design will typically include:

- operating front doors and windows,
- direct sidewalks to the street,
- sidewalks between buildings, and
- sidewalks to parking areas.

To further improve access to both pedestrians and to those in automobiles, these land uses may also require:

A wide amenity zone is useful in pedestrian-oriented developments.

- wider sidewalks (8' minimum in high activity areas),
- sidewalk amenity zones,
- higher quality street furnishings, and
- on-street parking.

These land uses also can benefit from access to transit riders and bicyclists. Even so, property owners or managers may express concern about the appropriate locations and maintenance of bus stops and bike racks, if they feel that these design elements are unsightly or are blocking their building entrances.

A wide sidewalk, awnings and pedestrian-scale lighting enhance the pedestrian environment. The planting strip provides a buffer from traffic, since on-street parking is not feasible.

Assessing Tradeoffs: Complementary and Competing Stakeholder Perspectives

Clearly, some design elements will be deemed beneficial to all adjacent "neighbors" and even to the various types of travelers along the street. Sidewalks, bike lanes, and planting strips may fall into this category, for example. More often than not, however, different stakeholders will express different interests or perspectives related to "good" street design. This means that some design elements will benefit some users more than others and that some design elements that benefit one user group may actually work to the detriment of other users. That, along with the likelihood of right-of-way constraints, heightens the need to thoroughly assess tradeoffs between different perspectives during the design process.

Chapter 3 describes a process for planning and designing streets that incorporates an assessment of those tradeoffs. The matrix shown in Figure 2.1 (beginning on page 30) offers additional information for assessing tradeoffs among street design elements that various stakeholders may prefer. The matrix shows which design elements may enhance certain stakeholders' experiences and relates those design elements to other stakeholders' expectations. **The matrix is not intended to be a comprehensive treatment of all aspects of street design and the tradeoffs inherent in them. Rather, it offers examples that a design team can consider to solve a variety of design issues in constrained environments. The design team should use this matrix to help document their discussions of the decisions made during Step 6 of the design process described in Chapter 3. For intersection projects, the design team should follow the guidelines described in Chapter 5 and Appendices A and B for assessing level-of-service (LOS) for pedestrians and bicyclists for different intersection types.**

Note that the matrix treats "transit" from the Transit Drivers' perspective. since riders share the characteristics and expectations discussed for other pedestrians.

Figure 2:1

Design Element Matrix – Different User Perspectives

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Pedestrians Want Buffering from Cars						
Consider some mix of the following elements to create a buffer:						
Planting Strip	The wider the better, since wider strips allow trees to grow	◆	◆	◆	◇	◆
Amenity Zone	Use where high pedestrian volumes are likely, particularly in combination with on-street parking	◆	◇	◆	◆	◆
Wide Sidewalk	Back-of-curb (6' min.) may be allowable in retrofits, if combined with bike lane or on-street parking	◆	◇	◇	◇	◆
Bike Lanes	Provide "extra" buffering, in combination with other elements	◆	◆	◆	◆	◆
On-Street Parking	Helps shield pedestrians from moving traffic	◆	◆	◆	◆	◆
Trees	Need a 6'-8' minimum planting strip or treewells in amenity zone; 8' is the minimum for large maturing trees	◆	◆	◆	◆	◆

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2.1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Pedestrians Want Safe and Comfortable Walkways						
The following elements impact pedestrians' comfort and safety:						
Adequate Sidewalk Width	5' is minimal width for two people to pass comfortably; ADA also supports 5' minimum; in higher volume locations, provide wider sidewalks	◆	◇	◇	◇	◆
Solid Surfaces	Minimize grates and other uneven surfaces	◆	◇	◇	◆	◆
No Sidewalk Obstructions	Utility poles and street furnishings should never be in the sidewalk; sidewalk width should be unobstructed	◆	◇	◇	◇	◇
Few Driveways	Reduce potential conflicts between pedestrians and turning vehicles; particularly important in Main Street settings or on "commercial/ retail" blocks	◆	◆	◆	◆	◆
Vertical Curbs	Separate the vehicle zone from pedestrian zone; mountable (valley) curbs increase the likelihood that cars will park on all or a portion of the sidewalk	◆	◆	◇	◇	◇

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2:1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Pedestrians Want Personal Security						
Consider the following elements to reduce pedestrians' vulnerability:						
Pedestrian Scale Lighting	More than just aesthetics, this identifies a "pedestrian area" and can fill gaps between street lights	◆	◆	◆	◆	◆
Street Lighting	If pedestrian scale lighting not provided, this becomes more important	◆	◆	◆	◆	◆
Other Pedestrians	Having other pedestrians around increases the number of "eyes on the street"; not a design element, but good streets and the right land uses tend to encourage more pedestrians	◆	◆	◇	◇	◆
Buildings Oriented onto Street	Must include windows and doors facing street for more "eyes on the street"	◆	◆	◆	◆	◆
Planting Strip	Provides extra separation between pedestrians and cars	◆	◆	◆	◇	◆

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2.1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Pedestrians Want Aesthetics and "Things to Look At"						
The following are examples of ways to enhance the walking environment; they also can help with security issues:						
Trees and Landscaping	Provide a more attractive walking environment; 8' minimum planting strip for large maturing trees	◆	◆	◆	◇	◆
Street Furnishings (not blocking sidewalk)	Benches, fountains, kiosks, etc. reduce monotony, as well as serving specific functions	◆	◆	◇	◆	◇
Buildings Oriented onto Street	Reduce the "blank wall" effect and provide stopping opportunities	◆	◆	◇	◆	◇
Variable Building Facades	Reduce the "blank wall" effect	◆	◆	◇	◇	◇
Ground Floor Activity	Arrange buildings to encourage a high level of activity for the pedestrian to observe or participate in; also enhances security	◆	◆	◇	◇	◇

◆ - Positive Impact ◆ - Negative Impact ◇- Mixed Impact or Use With Caution ◇- Neutral

Figure 2:1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Pedestrians Want Protection from the Elements						
The following can provide some protection against the elements:						
Trees	Can serve as windbreak, if evergreen; deciduous trees provide shade in summer. Must have 8' minimum planting strip for large maturing trees	◆	◆	◆	◇	◆
Awnings	Clusters of awnings can combine with trees to create shade, as well as opportunities for shelter	◆	◇	◇	◇	◆
Bus Shelters	Provide pedestrians opportunities for shelter	◆	◇	◇	◆	◇
Arcades	Ground floor "promenades" can create a totally sheltered outdoor area	◆	◇	◇	◇	◆
Pedestrians Want Direct Connections						
The following can provide more direct connections and potentially shorter routes, which is particularly important for pedestrians:						
Complementary Land Uses	Providing more pockets of complementary uses makes walking more likely for more people	◆	◆	◆	◆	◇

◆ - Positive Impact ◆ - Negative Impact ◇ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2.1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Short Blocks	Provide more route options, shorter routes, and more opportunities for safe crossings	◆	◆	◆	◆	◆
Mid-Block Crossings	Where blocks are very long, people need safer crossings between signals; must be appropriately applied - shorter blocks are generally preferable	◆	◆	◆	◆	◆
Pedestrians Want Safer Crossings						
Safer crossings can be achieved through combinations of the following: (See also CDOT's Pedestrian LOS in Appendix B and Mid-Block Crossing Policies for a more comprehensive discussion)						
Mid-Block Crossings	Must be carefully applied to be safe; should be combined with other features	◆	◆	◆	◆	◆
Refuge Islands	Should be 6' minimum to provide sufficient space and separation from traffic lanes	◆	◆	◆	◆	◆
Medians	Provide a pedestrian refuge, if wide enough; consider hardscape at likely crossing spot; may also increase vehicle speeds, though	◆	◆	◆	◆	◆

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2:1
Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Curb Extensions	Reduce crossing distances and may also serve to reduce vehicular speeds	◆	◆	◆	◆	◆
Pedestrian Countdown Signals	Let pedestrians know how much "crossing time" is available; use in combination with enhanced crosswalks and other features	◆	◇	◆	◇	◇
Neckdowns or Street Narrowing	The less pavement to cross at one time, the better	◆	◆	◆	◆	◆
Small Curb Radii at Intersections	Reduce the crossing distance and vehicle turning speeds by creating tighter turns	◆	◆	◆	◆	◆
Cyclists Want Designated Space						
The following can help create designated space for cyclists (note that designated space is typically more important for casual cyclists than for experienced cyclists):						
Bike Lanes	Particularly needed by casual cyclists on higher-volume, higher-speed streets; 4' minimum, 5' preferred	◆	◆	◆	◆	◆
Bike Boxes at Intersections	Should only be used in conjunction with a bike lane; even if absent from rest of segment, add bike lane on the intersection approach	◆	◆	◆	◆	◇

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2.1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Wide Outside Lanes (wosl)	Use as last resort, because generally inappropriate; extra wide lanes might increase traffic speeds; may be allowable if no space for full bike lane; better with edge line	◆	◆	◆	◆	◆
Edge Line	Can better define bike space, if wosl must be used; may also help better confine traffic, though calming benefits unproven	◆	◆	◆	◇	◇
Pavement Markings	Can be particularly useful with wosl's; consider, e.g., the "Denver Arrow" or "Sharrow"	◇	◆	◆	◆	◇
Traffic Calming	Both casual and experienced cyclists may feel more comfortable operating in mixed traffic on lower volume, lower speed streets; for specific calming tools, see CDOT's Traffic Calming Report	◆	◆	◆	◆	◆
Cyclists Want Safer Riding Environment						
To encourage cycling, consider the following to enhance safety:						
Smooth Surfaces	Provide smooth seams between asphalt and gutter; drainage grates should be bike friendly (no parallel-running grates)	◆	◆	◆	◆	◆

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2:1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Street Lighting	Bike lights more useful for visibility to drivers than for lighting the way	◆	◆	◆	◆	◆
No On-Street Parking	Opening car doors create potential hazard; however, wide bikes lanes alleviate this hazard	◆	◆	◆	◆	◆
Separation from On-Street Parking	If on-street parking is used, either parking lane or bike lane should be wider than minimum	◆	◆	◆	◆	◆
No Front-In Angle Parking	Seriously limits cyclists' visibility to drivers; however, reverse angle parking alleviates this hazard	◇	◆	◆	◇	◆
Reverse Angle Parking	Puts cyclist in drivers' sightline, but also requires more space and buffering than parallel parking	◇	◆	◆	◇	◆

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2.1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Cyclists Want Safer Crossings						
Consider the following elements to increase cyclists' visibility:						
Bike Boxes	Brings cyclists into drivers' sight; allows cyclists a headstart through an intersection; should provide bike lane approaching intersection	◆	◆	◆	◆	◇
Drop Bike Lane at Intersection	Achieves same as bike box, but without designated space; casual cyclists may feel less comfortable, although it is considered safer to drop the lane and have cyclists merge earlier for left-turns if there is no bike box	◆	◆	◆	◆	◇
Leading Bike Signal	Allows cyclists a headstart through the intersection; requires driver and cyclist education	◆	◆	◆	◆	◇
Short Blocks	Create more intersections, but potentially smaller intersections; more opportunities to avoid high volume routes; can potentially calm traffic and allow more opportunities for safe crossing treatments	◆	◆	◆	◆	◆

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2:1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Bike-Sensitive Signals at Intersections	If cyclists can't trip the signal, they're more likely to make unsafe movements	◆	◆	◆	◆	◇
Roundabouts	Slow down motor vehicles at intersections; "equalize" speed of bikes and cars; multiple lane roundabouts more difficult to traverse than single lane roundabouts	◆	◆	◆	◆	◇
Pedestrian Refuges	For casual cyclists, the ability to cross partway and wait may enhance perception of safety; should be 6-8' minimum width to shelter cyclists	◆	◆	◆	◆	◆
Cyclists Want Direct Connections						
The following elements can affect the cyclists' ability to find direct, easy connections:						
Short Blocks	Provide more route options, shorter routes, and more opportunities for safe crossings	◆	◆	◆	◆	◆
Bike/Ped Travelways	When local street connections (preferred) aren't possible	◆	◆	◇	◇	◆

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2.1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Cyclists Want Security						
Cyclists are more likely to be or feel vulnerable than are motorists; consider the following elements to enhance cyclists' security:						
Roundabouts	Help reduce the number of stops a cyclist must make	◇	◆	◆	◇	◇
Bike-Sensitive Signals at Intersections	If cyclists can't trip the signal, they're more likely to make unsafe movements	◇	◆	◇	◇	◇
Pedestrian Scale Lighting	Helps identify an area as pedestrian and cyclist friendly; provides additional lighting	◆	◆	◆	◆	◇
Street Lighting	Cyclists can more easily see potential dangers in and along the street	◆	◆	◆	◆	◇
Bike Lockers	Providing storage options at appropriate locations can make the difference between whether a cyclist is able to use this mode; not strictly a street design feature	◇	◆	◇	◆	◇
Bike Racks	Provides similar advantages as, though more exposed than, lockers; either treatment needs to be readily accessible to surrounding land uses; not strictly a street design feature	◇	◆	◇	◆	◇

◆ - Positive Impact ◆ - Negative Impact ◇ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2:1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Motorists Want Reduced Delays/Increased Capacity						
The following elements can increase a street's capacity and/or potentially reduce motorists' delay:						
More Travel Lanes	Each additional travel lane increases the street's capacity, especially at intersections; the mix of through and turn lanes can, up to a point, allow an intersection to process more traffic	◆	◆	◆	◆	◆
Design Consistency	By providing a consistent design (number of travel lanes, i.e.), motorists don't have to unexpectedly stop or merge; however, this may be difficult to achieve	◆	◆	◆	◆	◆
Grade Separated Intersections	Allows uninterrupted flow; particularly useful for high volume intersections, but destroys urban context for other users	◆	◆	◆	◆	◆
Unsignalized Intersections	May mean less delay for the higher-volume leg, but more delay for the lower-volume leg; in general, fewer signals means less delay on thoroughfares, but may also mean less connectivity	◆	◆	◆	◆	◆

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2.1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Signal Timing & Phasing, Progression	Signals can be phased and timed to reduce vehicular delay overall or by approach; progression may help reduce delay along higher-volume streets	◆	◆	◆	◆	◆
Roundabouts	Allow more traffic to flow through an intersection in a given period of time than with either unsignalized or signalized intersections; for all users, dual lane roundabouts less easy to navigate than single lane roundabouts	◆	◆	◆	◆	◇
Turn Lanes	Left turn lanes, in particular, allow through traffic to continue to move; at signalized intersections, creating separate phases along with turn lanes may increase overall delay	◆	◆	◆	◆	◆
Dual Left Turn Lanes	Can increase intersection's capacity to process traffic; creates wider intersections, but can also allow more efficient signal timing for other traffic movements	◆	◆	◆	◆	◆
Bus Pullouts	Remove stopped buses from travel lanes; bus drivers may find it difficult to re-merge into traffic	◆	◆	◆	◆	◆

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2:1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Motorists Want Safety						
The following elements are traditionally assumed to increase motorists' safety:						
Wider Lanes	May provide drivers more room for error; however, in combination with other features, may also increase speeds, because drivers feel more comfortable driving faster	◆	◆	◆	◆	◆
Clear Zone	Removing objects for some distance from the travel lanes improves sight distance and leaves room for error; but this may also increase speeds	◆	◆	◆	◆	◆
Increased Sight Distance	Increasing sight distance can improve overall visibility; appropriate sight distance depends on type of traffic control at intersections, speeds, and context; application should vary by intersection type	◇	◆	◆	◆	◆
Medians	Separate opposing traffic streams and minimize vehicle/vehicle and vehicle/pedestrian conflicts; but may increase traffic speeds	◆	◆	◆	◆	◆
Turn Lanes	Turn lanes, particularly for left turns and on higher-speed streets, reduce the potential for rear-end collisions	◆	◆	◆	◆	◆

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2.1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Street Lighting	Increases visibility and potentially reduces conflicts	◆	◆	◆	◆	◆
Motorists Want Speed						
The following elements may allow motorists to travel at higher speeds:						
Wide Travel Lanes	Combined with total cross-section width and straightness of street, may make drivers feel more comfortable driving at higher speeds	◆	◆	◆	◆	◆
Clear Zone	Removing objects for some distance from the travel lanes improves sight distance and may make drivers feel more comfortable driving at higher speeds	◆	◆	◆	◆	◆
Lack of Street Trees	In combination with other elements listed above, may make drivers more comfortable driving at higher speeds because of increased sight distance;	◆	◆	◆	◆	◆
Wide Overall Cross-section	A wide street, with few visible obstructions, tends to make drivers feel comfortable driving at higher speeds	◆	◆	◆	◆	◆

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2:1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Medians	Separating opposing traffic streams may make drivers feel more comfortable driving at hgher speeds	◇	◇	◆	◆	◇
Consistent Vertical and Horizontal Alignment	Straighter and flatter streets typically encourage motorists to drive faster	◇	◇	◆	◆	◇
Large Curb Radii at Intersections	Allow motorists to make sweeping turns, meaning they can turn at a higher rate of speed	◆	◇	◆	◆	◇
Motorists Want to Minimize Conflicts						
Minimizing conflicts is related to both safety and speed; the following elements can help minimize conflicts:						
Medians	Provide a buffer between opposing traffic streams; can help create higher speeds; requires more right-of-way and can limit access to adjacent land	◇	◇	◆	◆	◇
Grade Separated Intersections	Allow traffic to continue with little delay and exposure to conflicting traffic movements, but destroys urban context for other users	◆	◇	◆	◇	◆
Bike Lanes	Take cyclists out of travel lanes, easing motorists' confusion	◆	◆	◆	◆	◆

◆ - Positive Impact ◆ - Negative Impact ◇ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2.1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Sidewalks	Provide a separate space for pedestrians; keep them away from travel lanes, particularly when combined with other buffers	◆	◆	◆	◆	◆
Access Controls	Reduce the incidence of vehicles slowing and turning into/out of driveways; however, can limit direct access to land uses	◆	◆	◆	◆	◇
Signalization	Signal controlled intersections help limit direct vehicle/vehicle and vehicle/pedestrian conflicts	◆	◇	◇	◇	○
The requirements of transit drivers differ from those of transit riders; riders have basically the same perspective as other pedestrians; drivers have basically the same perspective as drivers of other large vehicles						
Transit Drivers Want Space to Maneuver						
The following elements can provide the space for buses (and other large vehicles):						
Wide Travel Lanes	12' feet preferred by transit operators	◇	◇	◆	◆	◇
Large Curb Radii at Intersections	Allow buses to turn more easily, by creating space for "sweeping" turns	◆	◇	◆	◆	◇

◆ - Positive Impact ◆ - Negative Impact ◇- Mixed Impact or Use With Caution ○- Neutral

Figure 2:1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Clear Zone	A clear zone between the travel lane and parked cars, utility poles, and trees reduces the likelihood of side mirrors hitting objects	◆	◆	◆	◆	◆
Mountable Curbs on Medians or Corners	Allow bus drivers to maneuver around corners, if curb radius is too tight	◆	◆	◇	◆	◆
Transit Drivers or Passengers Want Access to Loading/Unloading Passengers						
Some of the following elements refer to the drivers' perspective, others to the passengers' perspective:						
Waiting Pads	Provide a hard surface and designated waiting and loading area for passengers, if there is no sidewalk and/or amenity zone	◇	◇	◇	◆	◇
Curb Extensions	Allow passengers direct access off of curb and onto bus; bus doesn't have to leave travel lane	◆	◆	◆	◆	◆
Amenity Zone	Bus passengers don't have to wait or walk on grass	◆	◇	◆	◆	◆
Bus Shelters	Create a designated, comfortable waiting space for passengers	◆	◇	◇	◆	◆

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

Figure 2.1

Design Element Matrix – Different User Perspectives (cont'd)

		Pedestrians	Cyclists	Motorists	Transit*	Neighbors
Street Furniture	Benches, trash cans, etc. can make waiting for the bus more comfortable	◆	◆	◇	◆	◆
Transit Riders Want Safety/Security						
The elements that provide security for transit riders and drivers are the same as those for pedestrians and motorists, respectively, with a few exceptions; waiting riders may feel more vulnerable than other pedestrians because they are stationary; the following can help:						
Appropriately Located Stops	Transit stops should generally be located in well-traveled, visible areas	◇	◇	◇	◆	◆
Pedestrian Lighting at Bus Stops	Clearly identifies the space and provides added visibility to and of the passengers; particularly important in less traveled areas	◆	◆	◆	◆	◆

◆ - Positive Impact ◆ - Negative Impact ◆ - Mixed Impact or Use With Caution ◇ - Neutral

* **Transit** — the matrix treats "transit" from the Transit Drivers' perspective, since riders share the characteristics and expectations discussed for other pedestrians.

3. APPLYING THE GUIDELINES

The previous chapter explained that various stakeholders have different expectations of what makes streets "good" or even "great". To appropriately apply the Urban Street Design Guidelines (USDG), the plan/design team must assess the expectations of a variety of stakeholders in order for streets to best reflect their contexts and intended functions. This assessment is also intended to ensure that the resulting streets are "complete" streets – streets that provide for the safety and comfort of all users to the best extent possible.

The purpose of this chapter is to explain how the perspectives of all stakeholders interested in or affected by existing or future streets will be incorporated into a new process for planning and designing streets in Charlotte's Sphere of Influence. The new process described in this chapter consolidates traditional city planning, urban design, and transportation planning activities into a sequence of fact-finding and decision-making steps.

The application of the new process for planning and designing streets is intended to support the creation of "more streets for more people." This overriding goal of the USDG will require achieving the following changes:

1. Ensuring that the perspectives of all stakeholders interested or affected by streets are seriously considered during the planning and design process for existing or future streets;
2. Defining a clear sequence of activities to be undertaken by staff, consultants and stakeholders;
3. Remembering that this will be a process that is much more geared toward what we want to happen in the future than just accepting what happened in the past or exists now;
4. Verifying that the inevitable tradeoffs affecting objectives, benefits, costs, and impacts are well documented so that the recommendations made by staff, consultants or stakeholders are based on understanding the direct effects on specific modes of travel and/or land use intentions; and
5. Always striving to create not only more streets, but also more complete streets that are good for all modes of travel, and even some great streets that are remarkable because of the very effective and favorable ways that the adjacent land uses and transportation functions of those streets support each other.

The process described in this chapter provides a great deal of flexibility to those involved in the decision-making process, to ensure that the resulting streets are appropriately based on the existing and proposed land use and transportation contexts. This flexibility

is intended to foster creative solutions by ensuring that land use planners, engineers, transportation planners and others work together to think through the implications of alternative street designs.

The six-step process shown in figure 3.1 and described below will primarily be applied to planning and designing the "non-local" street types – Main Streets, Avenues, Boulevards, and Parkways. In some cases, public projects that retrofit existing Local Streets may require the use of the six-step process and, when area plans are being prepared, both non-local and Local Streets will need to be specified.

The area planning process provides one of the best opportunities to integrate the planned land use and transportation characteristics on an area-wide basis, and the six-step process gives the framework for that integration. Even in the case of area plans, though, the level of specification will vary between Non-Local and Local Streets. Assuming that there is enough information available

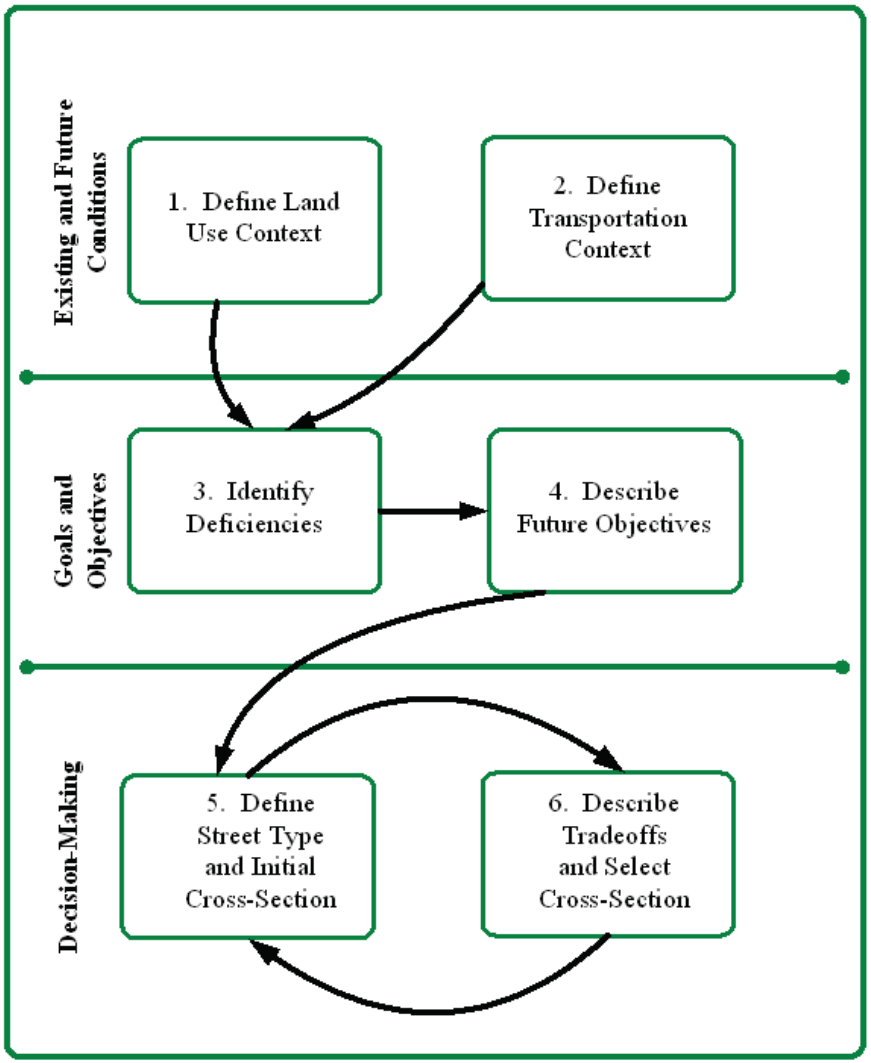


Figure 3.1. The Six-Step process for Applying Charlotte's Urban Street Design Guidelines.

about future land use context and future transportation context, the planning team would specify the actual cross-sections for all non-local streets in the area plan. For the Local Streets, the planning team would specify the spacing of the emerging Local Street network, and the specific cross-sections would be applied based on the adjacent land uses, as the streets are constructed.

For the most part, however, new Local Streets will be built through the land development process and the major design decision will be to select the appropriate pre-defined cross-section, as described in Chapter 4,rather than to apply the six-step process. Conversely, retrofitting a non-local street with limited right-of-way through an existing neighborhood will be more complicated and require more of a tradeoff analysis.

Applying the Guidelines: Six Steps

The remainder of this chapter defines a six-step process for developing the most appropriate design for streets in a variety of contexts. The following three assumptions are built into the six-step process:

1. The process will involve a variety of stakeholders. The number of stakeholders and discussions will vary, depending on the magnitude and consequences of the street(s) to be designed.

2. The resulting street will be as "complete" a street as possible, in order to meet the multi-modal objectives defined in the Transportation Action Plan.

3. The steps in the decision-making process will be well-documented. The documentation will clearly describe the major tradeoffs made among competing design elements, how those were discussed and weighed against each other, and the preliminary and final outcomes. Thorough documentation will ensure that all stakeholders' perspectives are adequately considered in the final design.

Figure 3.1 (previous page) shows the assessment steps to be included in applying the USDG. Each of the six steps is defined in more detail in the remainder of the chapter. **It is important to note that the steps described below can be applied either to a single street or to a collection of streets in an area (such as when an area plan is being developed).** In either case, the first four steps should take an area-wide approach to gathering and assessing the information required for each step, since even individual street segments do not exist or function in isolation from the surrounding street network and land uses.

Step 1: Define the Existing and Future Land Use and Urban Design Context

The classification and ultimate design of any street should reflect both the existing and expected future land use contexts. These existing and future contexts should be considered from the broadest, area-wide perspective down to the details of the immediately adjacent land uses. A street is likely to be classified and/or

designed differently if it is in an area slated for higher density development, such as a transit station area, versus in a neighborhood of single family houses, where very limited development changes are anticipated.

The following questions regarding the intensity and arrangement of existing and future land uses in the area surrounding the street to be designed should be addressed by the plan/design team:

- What does the area look like today?
- What are today's land use mixtures and densities?
- What are the typical building types, their scale, setbacks, urban design characteristics, relation to street, any special amenities, etc.?
- Are there any particular development pressures on the area (the nature of this may vary according to whether the area is a "greenfield" versus an infill area and this type of information is particularly important in the absence of an area plan)? What, if anything, can be gleaned from permit data, for example, about the nature of the emerging land use context?
- What are the "functions" and the general circulation framework of the neighborhood and adjacent areas?
- Is there a detailed plan for the area?
- If so, what does the adopted, detailed plan envision for the future of the area?
- Does the plan make specific recommendations regarding densities, setbacks, urban design, etc.?

The existing, auto-oriented transportation context surrounding the intersection of South Boulevard and Scaleybark Road. The future transportation context will change to include light rail transit and more pedestrian features to support a transit-oriented environment.

- Are there any other adopted development policies for the area?
- If so, what do those policies imply for the area?

Step 2: Define the Existing and Future Transportation Context

The transportation assessment should consider both the existing and expected future conditions of the transportation network adjacent to or affecting the street to be designed. The recommended design should reflect the entire transportation context (function, multimodal features, form), rather than that related strictly to capacity on a given segment.

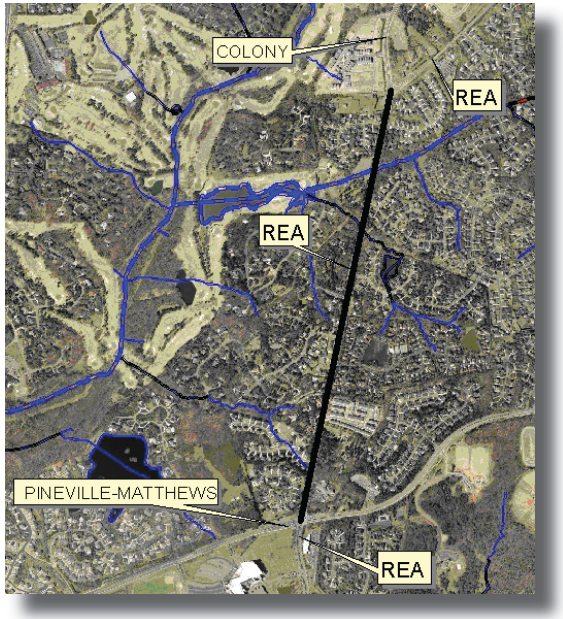
The following questions regarding existing and future transportation conditions should be addressed by the plan/design team:

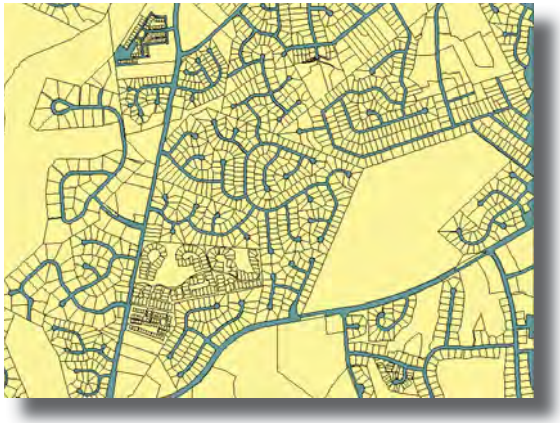
- What is the character of the existing street? How does the street currently relate to the adjacent land uses?
- How does the street currently function? What are the daily and hourly traffic volumes? Operating and posted speeds? What is the level-of-service (LOS) for pedestrians? Cyclists? Motorists?
- What are the current design features, including number of lanes, sidewalk availability, bicycle facilities, traffic control features, street trees, etc.?
- What, if any, transit services are provided? Where are the transit stops?
- What is the relationship between the street segment being analyzed and the surrounding network (streets, sidewalks, transit, and bicycle connections)?
- Are there any programmed or planned transportation projects in the area that would affect the street segment?
- Are there any other adopted transportation policies that would affect the classification of the street segment?

Step 3: Identify Deficiencies

Once the existing and future land use and transportation contexts are clearly

In these examples, there are significant gaps in the network along these streets. Note the worn footpaths and the fact that the bus stop on the right has no sidewalk to provide easy pedestrian access.





Left and Above: The street network surrounding this segment of Rea Road, in south Charlotte, is very disconnected, which has ramifications for motorists, bicyclists, and pedestrians.

defined and understood from an area-wide perspective, the plan/design team should be able to identify and describe any deficiencies that could/should be addressed by the new or modified street. This step should consider all modes and the relationship between the transportation and the land use contexts.

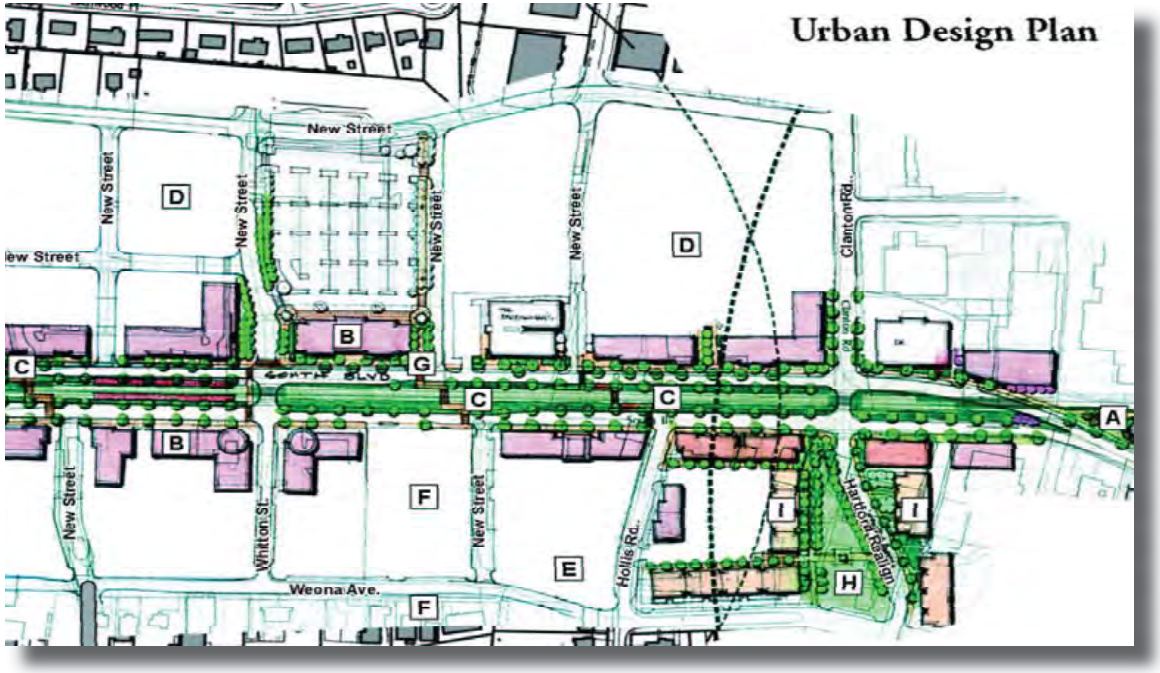
From the information provided in the first two steps, "deficiencies" might include, but are not limited to:

- Gaps in the bicycle or pedestrian network near or along the street segment;
- Gaps in the bicycle or pedestrian network in the area (which may increase the need for facilities on the segment, because of the lack of alternative routes);
- Insufficient pedestrian or bicycle facilities (in poor repair, poorly lighted, or not well buffered from traffic, e.g.);
- Gaps in the overall street network (this includes the amount of connectivity in the area, as well as any obvious capacity issues on other segments in the area);
- Inconsistencies between the amount or type of transit service provided along the street segment and the types of facilities and/or land uses adjacent to the street;
- Inconsistencies between the existing land uses and the features of the existing or planned street network.

Step 4: Describe Future Objectives

This step synthesizes the information from the previous steps into defined objectives for the street project. The objectives could be derived from the plans and/or policies for the area around the street, as well as from the previously identified list of deficiencies. The objectives will form the basis for the street classification and design.

In addition to the general intent of providing complete streets, the following



Above: A future plan for the Scaleybark Station Area incorporates the light rail transit line, the street network configuration, pedestrian connections, and land use and urban design into a transit-oriented area.

Above and Below: More detailed portions of the station area plan help to define the overall objectives for the area and its transportation network.

issues should be considered in defining the specific objectives:

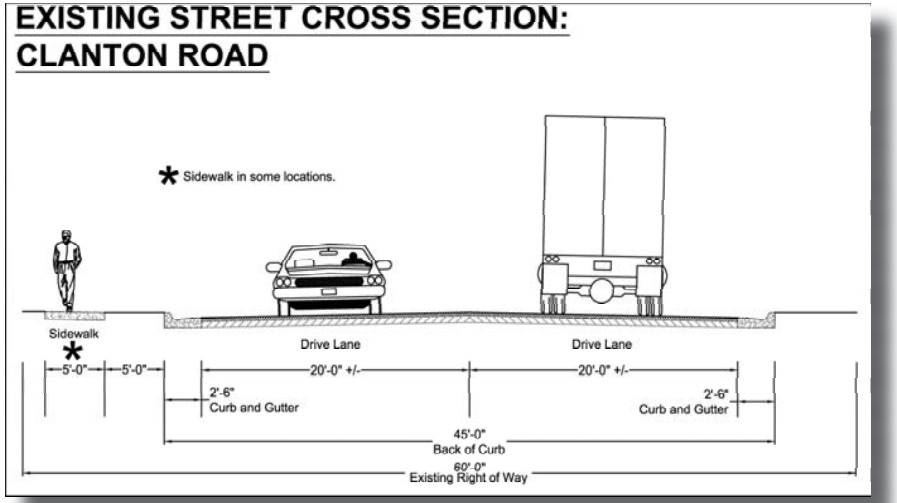
- What existing policies might or should influence the specific objectives for the street?

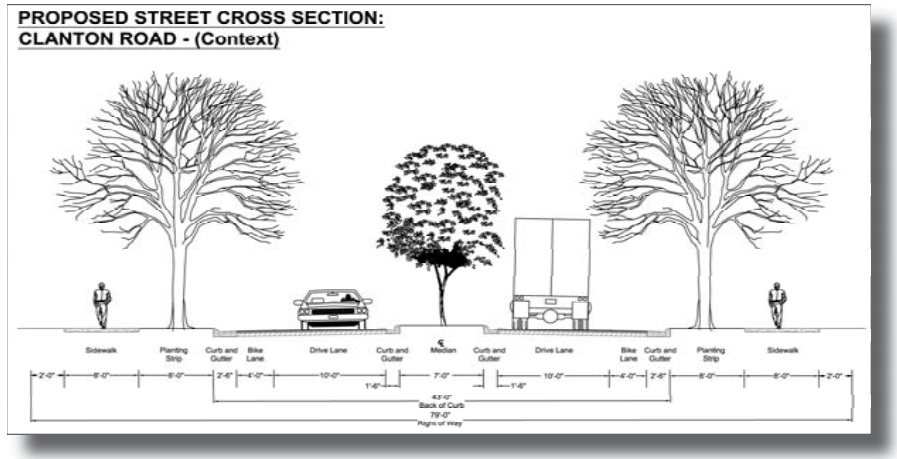
Station Area Pedestrian Mall &Park-and-Ride / LRT wayfinding kiosk

- What conditions are expected to stay the same (or, more importantly, what conditions <u>should</u> stay the same)?
- Would the community and the stakeholders like the street and the neighborhood to stay the same or to change?
- Why and how would the community and the stakeholders like the street and the neighborhood to change?
- Given this, what conditions are likely to change as a result of classifying the street (exactly how will the street classification and design support the stakeholders' expectations)?

Step 5: Recommend Street Classification and Test Initial Cross-Section

At this point, the plan/design team recommends the appropriate USDG street typology (or typologies, if several streets are being analyzed), based on the previous steps. The rationale behind the classification should be



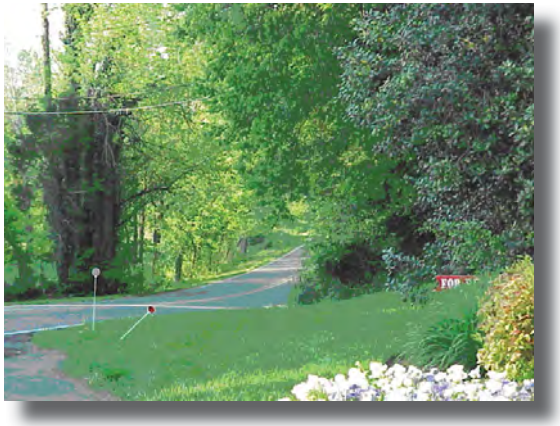


The bottom drawing shows a possible cross-section for a portion of a street in a station area. The cross-section is significantly different from the existing cross-section shown at the top, and is intended to reflect the emerging context of transit and pedestrian-oriented areas along light rail lines.

documented. **This step should also include a recommendation for any necessary adjustments to the land use plan/policy and/or transportation plan for that area.** Since the street type and the ultimate design are defined, in part, according to the land use context, subsequent land use decisions should reflect and support the agreed-upon street type and design.

The initial cross-section should be defined based on the recommended street typology, keeping in mind that some typologies allow more than one option. Once the preferred option is identified, the ideal cross-section will typically include the design features with their preferred dimensions specified for that street type.

The initial cross-section should then be tested against the land use and transportation contexts and the defined objectives for the street project. At this point, any constraints to the provision of the initial, preferred cross-section should also be identified, including:



Here, the rolling hills, existing stands of mature trees, and creek crossings will all have an impact on the final cross-section chosen.

- Lack of right-of way,
- Existing structures,
- Existing trees or other environmental features,
- Topography, and
- Location and number of driveways.

This step should clearly identify which constraints may prohibit the use or require refinement of the initially defined cross-section.

Step 6: Describe Tradeoffs and Select Cross-Section

If the initial, "preferred" cross-section can be applied, then this step is easy: the initial cross-section is the recommended cross-section. In many cases, though, the initial cross-section will need to be refined to better address the land use and transportation objectives, given the constraints identified in Step 5. Sometimes, the technical team will develop more than one alternative design. **In that case, these multiple alternatives should be presented to the stakeholders.**

Any refinements to the initial cross-section (or alternatives) should result from a thoughtful consideration of tradeoffs among competing uses of the existing or future public right-of-way. The tradeoffs should be related to the requirements of each group of stakeholders and the variety of design elements that can best accommodate those requirements. The matrix at the end of Chapter 2 provides a listing of the general expectations of

various stakeholders about streets and the elements that might achieve those expectations. *At the least,* the requirements and elements listed in that matrix should be considered in any tradeoff discussion, though that list should not be considered comprehensive.

The specific method of evaluating the tradeoffs is left open to the plan/design team, as long as the method/discussion/analysis is documented. All perspectives should receive equal consideration and accountability in the plan/design process. Proper documentation will also generate information useful for future street design projects that might have similar characteristics, objectives, or constraints.

Once the tradeoffs are evaluated, the team should be able to develop a refined cross-section and suggested design treatments. The culmination of all of the previous steps, including any additional stakeholder comments, should provide sufficient rationale to select the design alternative that best matches the context and future expectations for the street project.

Final Comments on the Six Steps

The steps outlined in this chapter suggest that there is a linear process leading to an ideal solution. Realistically, in some instances the process may not follow the exact sequence described above. Some information may not be available or even be applicable for some conditions. **The intent, though, is to ensure that the existing and future contexts are given adequate consideration, that any related plans are modified to reflect the outcome, and that all perspectives are given equal consideration in the process.**

The same approach described here for large-scale street projects can be applied to smaller-scale or short-term projects or processes. In those cases, an "abbreviated" version of the six steps can be used to reach decisions that will necessarily involve a shorter timeframe or fewer stakeholders, but for which it is still important to consider all perspectives and document any necessary tradeoffs. The intent is to apply this thought process to the design of our emerging complete street network, whether through the full six-step process, or through the abbreviated version.

4. SEGMENTS

The previous chapters of this document have focused on the need for, objectives of, and methods for applying Charlotte's new Urban Street Design Guidelines. This chapter contains the detailed guidelines for the street segments or blocks: *those portions of the street between intersections* (Chapter 5 provides guidelines for the intersections).

The following sections describe, for each of the street types, the design elements that should be included, with the preferred dimensions of those elements along the segment portions of a street. Each of the detailed descriptions included in this chapter is intended to accomplish the overall objective of providing safe, functional, multi-modal streets that serve all users - i.e., complete streets.

While the sections in this chapter describe how to design various types of street segments, it is important to remember that any given street, particularly if it is a thoroughfare, will traverse several types of land uses. Therefore, this chapter contains information about how to match relevant street elements to the existing or desired land uses along the street. This chapter *does not*, however, provide specific information about designing the transitions between different street types. These transitions will most likely occur at intersections, which are described in detail in the next chapter. The reader should refer to both chapters when designing a segment or an intersection that transitions between street types.

Sections 4.1 - 4.4: *Non-Local Streets*

Sections 4.1-4.4 describe the guidelines for segments on non-local streets (Main Streets, Avenues, Boulevards, and Parkways). The information in these sections is detailed, but not entirely prescriptive. The design team should use this detailed information about dimensions in conjunction with the design method and tradeoff analyses outlined in Chapter 3.

The cross-section diagrams do not show dimensions for these non-local street types, since the focus is on understanding and evaluating the tradeoffs among the various (possibly competing) uses of the right-of-way.

Many of the design element dimensions described in this chapter refer to evaluating tradeoffs in a "constrained" environment. Design teams should take care to consider what constitutes a "constraint." For example, when a streetscape is being designed with existing buildings, those buildings might constitute a constraint. However, when a street is built "from scratch" or when new buildings are being constructed along an existing street, these buildings would not typically be considered a constraint. In those cases, the preferred dimensions should generally be provided, or the design team should justify why they are not.

Block Lengths for Non-Local Streets

One of the design elements described in Sections 4.1 – 4.4 is block length, which refers to the expected spacing of cross-streets along a given street type. The relationship between block length and street network density, as well as the many advantages of a dense network are described in more detail in the section below titled "Block Lengths for Local Streets."

It is important, however, to note that the spacing of non-local streets (Main Streets, Avenues, Boulevards, and Parkways) is not described in this chapter. That is to say, there are no expected distances defined between streets that are likely to function as thoroughfares. In most areas of Charlotte, Avenues, Boulevards, or Parkways would not be spaced within one or several blocks of each other. Unless specifically defined in an area plan, these types of streets would typically be ½ mile or further from each other.

Sections 4.5 – 4.7:
Local Streets

Sections 4.5-4.7 describe the guidelines for segments of local streets (Residential, Office/Commercial, and Industrial). The elements and dimensions described for these local streets are more prescriptive than those for the non-local streets, since local streets are typically designed and built through the land development process. Although most of the design elements for Local Streets are described in Sections 4.5 – 4.7, the recommendations for block lengths are described here, because block length is critical to creating the street network that will meet the many objectives defined for Charlotte's streets.

Block Lengths for Local Streets

Block length is a critical component of the street network. In general, the shorter the block length, the denser the street network. A dense street network provides:

- capacity for vehicle traffic,
- multiple route options,
- shorter trip options,
- future development flexibility,
- more dispersed traffic flows, and
- more opportunities for traffic calming.

Shorter blocks create a high degree of connectivity to help ensure that vehicular traffic does not become focused on only one or two streets. Shorter blocks also create a better walking environment, by providing numerous direct and indirect routes throughout neighborhoods and between land uses. In the Local Street network, frequently spaced intersections created by shorter blocks can also serve as a form of traffic calming.

The general intent of the block lengths recommended here is to ensure that the density of the Local Street network appropriately reflects development density/intensity and provides the type of network structure that has stood the test of time elsewhere in the City. To integrate the street network with development density/intensity, the block lengths are organized by their geographic location relative to Charlotte's Centers, Corridors and Wedges growth framework,

and by land uses. Defining typical and maximum lengths for block faces does not always imply a "grid", but allows the possibility of different block and lot configurations. This adds flexibility for mixing housing and lot sizes, as well as for working with constrained or oddly-shaped parcels. Finally, the block lengths described here also include the spacing for external connections, including creek crossings, to ensure that neighborhoods and complementary land-uses are well-connected and that, over time, the street network over larger areas is as well-developed as possible.

For Local Streets, the block lengths shown in Table 4.1 and Creek Crossings described in Table 4.2 should be applied **(recommended block lengths for Main Streets, Avenues, Boulevards, and Parkways are described in sections 4.1-4.4).** Connections to surrounding land uses (external connections) that do not cross creeks should follow the recommended block lengths shown in Table 4.1 and connections to non-local streets (thoroughfares) should meet the block length recommendations described in Sections 4.1-4.4 for those street types.

Table 4.1 **Block Lengths for Local Streets**

Land Use/Location	Preferred or Typical Block Lengths for Local Streets	Maximum Block Length for Local Streets
Transit Station Areas[1]	400′	600′
Centers[1]	500′	650′
Corridors[1]	600′	650′
Non-Residential Uses[1,2]	500′	650′
Industrial	600′	1,000′
Residential ≥ 5 dua (gross) in Wedges	600′	650′
Residential < 5 dua (gross) in Wedges	600′	800′

Notes:

1. Parks, schools, cemeteries, and places of worship would not typically be expected to include these types of blocks, but would have appropriate external connections.

2. Includes mainly commercial and office land uses.

Table 4.2 **Spacing for Creek Crossings**

Land Use/Location	Creek Crossing Spacing[3]
Transit Station Areas[1]	650´ - 1300´ spacing
Centers[1]	650´ - 1300´ spacing
Corridors[1]	650´ - 1300´ spacing
Non-Residential Uses[1,2]	650´ - 1300´ spacing
Residential ≥ 5 dua (gross)	650´ - 2600´ spacing
Residential < 5 dua (gross)	1300´ - 2600´ spacing

Notes:

1. Parks, schools, cemeteries, and places of worship would not typically be expected to include these types of crossings, except to provide appropriate external connections.
2. Includes mainly commercial and office land uses.
3. Site developer and staff will justify why the preferred crossing spacing (described in more detail below) could not be implemented.

Table 4.2 shows the ranges of expected intervals between creek crossings. In general, creek crossings should occur approximately every 1300', with bike/pedestrian crossings in between (650' from street crossings). In high-density areas, such as transit station areas, activity centers, or areas with similar development intensities (> 20 dua and/or concentrated, mixed-use development), more frequent creek crossings should be provided – generally in the range of every 650'. In areas deemed to be particularly environmentally-sensitive, the crossings could occur as infrequently as every 2600'.

Exclusions and Allowances

While the expectation is that the preferred or typical block lengths in Table 4.1 will be provided on Local Streets, it may not always be possible to construct all external connections or all block lengths exactly as described. With the adoption of the Urban Street Design Guidelines, the City Code and Subdivision and Zoning Ordinances will be updated to reflect the Guidelines and appropriate exceptions will be defined. The process for defining these code and ordinance changes is described in more detail in the preamble to this document.

Section 4.1 Main Streets

Overview

Main Streets are, most importantly, destination locations that provide access to and function as centers of civic, social, and commercial activity. Main Streets may currently exist as older neighborhood centers or potentially refurbished business areas. New Main Streets may be developed in mixed-use developments or as part of pedestrian-oriented developments. There will be relatively few Main Streets in our street network, and they will likely be minor thoroughfares or connector/collectors.

Downtown Davidson's "Main Street".

Main Streets are designed to be pedestrian-oriented to complement the development next to the street. Main Street development is people-intensive and pedestrian-scaled, both in terms of design and land use. Main Street land uses should be generators and attractors of pedestrian activity. These uses may include institutional, (libraries or government buildings, e.g.); retail (especially store-front retail, cafés, and restaurants); offices; public gathering spaces (squares and plazas, e.g.); and, especially on upper stories, multi-family residential uses (apartments, condos, and townhouses). Mixed uses are particularly effective for enhancing the pedestrian nature and around the clock use of Main Streets.

Building design also complements the Main Street's pedestrian orientation. Good pedestrian-oriented design, as outlined in the 2003 General Development Policies, requires that buildings be placed close to the street, with doors and transparent windows fronting onto the sidewalk. Buildings should not have blank or similarly unappealing walls along the sidewalk. Pedestrian-level ornamentation and architectural details may be used to make the pedestrian environment more attractive. Parking areas should be located behind buildings to minimize conflicts between pedestrians and motor vehicles and also to avoid separating the pedestrians from the building entrances.

A Main Street intersection in California.

Main Streets

Because Main Streets serve as pedestrian-oriented activity centers, walking receives the highest priority of all the transport modes. Although they also serve transit, bicyclists, and automobiles, Main Streets are designed to provide the highest level of pedestrian comfort, access, and security of all of Charlotte's (non-local) street types. For example, Main Streets are kept relatively narrow to provide easy and safe pedestrian crossings, and priority is given to pedestrians' safety and convenience instead of motor vehicles' speeds and volumes. Traffic speeds are maintained at no more than 25 mph, to ensure that vehicle speeds are compatible with the pedestrian environment. They are typically 2 lanes with on-street parking, but Main Streets may also include a 3rd, center turn lane. Roadway capacity for vehicles is not expanded to maintain free flows and congestion is accepted as a positive, traffic calming aspect of the Main Street environment.

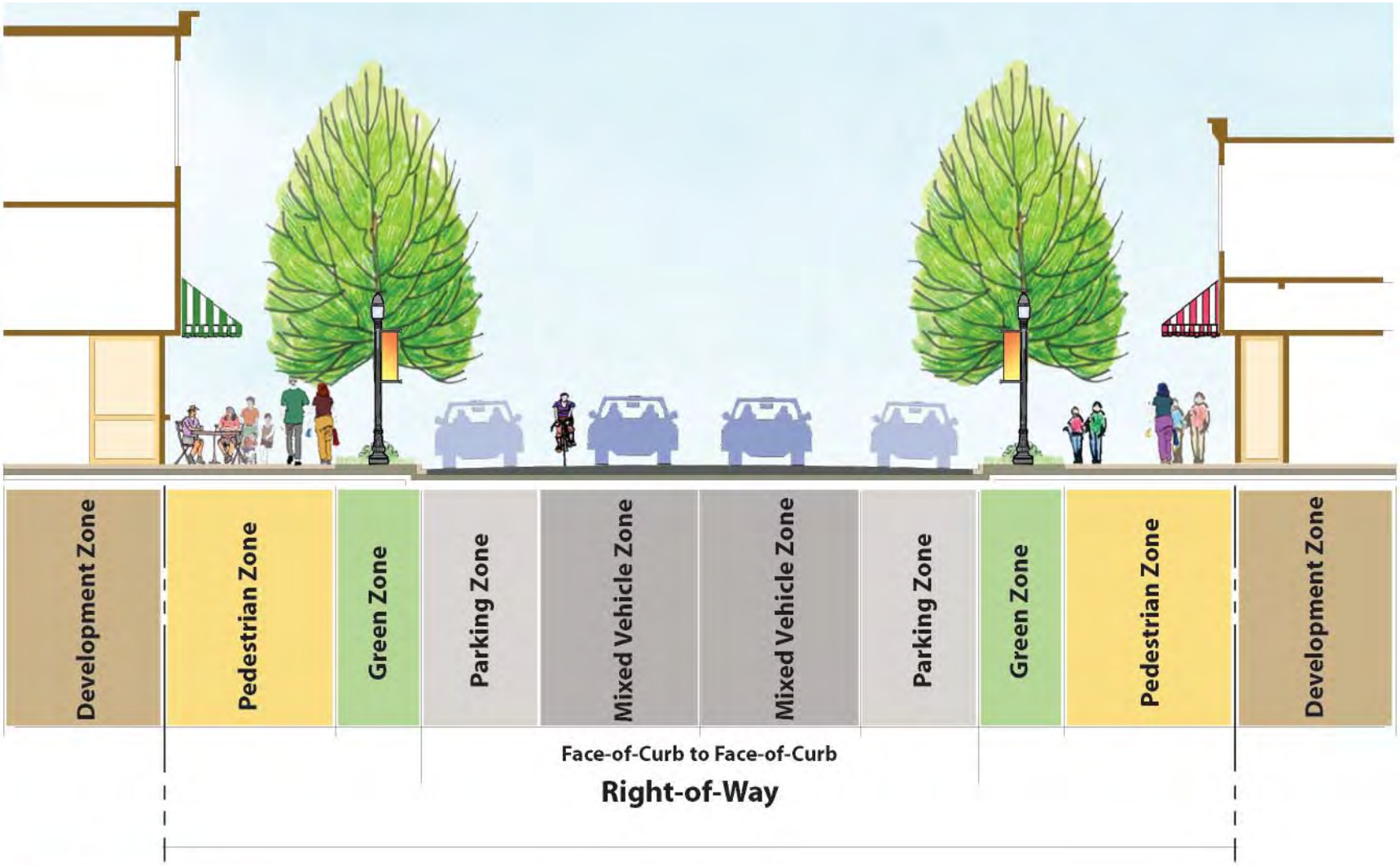
Pedestrian-oriented features on Main Streets include generous sidewalks and amenity zones. An amenity zone provides space for street furniture, trees, pedestrian-scale lighting and signs, public art, and last, but not least, maintains unobstructed sidewalk space for pedestrians. To minimize conflicts between pedestrians and vehicles, driveways on Main Streets are restricted or very limited – motor vehicle access is ideally provided behind the buildings.

Main Streets' block lengths are ideally no more than 400', to provide frequent locations for pedestrian crossings and numerous connections to adjacent streets. Main Streets will typically not be long streets. They function best at total lengths of 1000'-1500', which is considered a comfortable walking distance.

On-street parking is encouraged, to provide traffic calming and convenient parking for Main Street land uses. Special lanes for bicyclists are not typically provided, since bicyclists can travel in mixed traffic due to the low operating speeds.

Because of the nature of their land uses and pedestrian-oriented design, Main Streets are also ideal settings for transit service. The short block lengths and heavy pedestrian traffic suggest that transit stops can be closely spaced.

Main Streets



Main Street

For specific dimensional information refer to the guidelines in this section.

Main Streets

Development Zone:

Important to maintaining Main Street character and function, development should include pedestrian-oriented land use and design, with narrow setbacks, functioning doors and windows facing onto the sidewalk, no expanses of blank walls, and first floor active spaces.

Pedestrian Zone:

Crucial to Main Street purpose and function; because of expected high pedestrian volumes, this zone should include spacious, unobstructed sidewalks and pedestrian scale lighting.

Green Zone:

Very important for supporting the pedestrian character of the Main Street, this zone includes street trees and other landscaping in appropriately designed planters, as well as interspersed street furnishings in a hardscaped amenity zone. This zone also provides extra buffering between pedestrians and vehicles.

Parking Zone:

Important for supporting Main Street pedestrians and businesses, the parking zone calms traffic, provides parking for businesses, and buffers pedestrians from moving traffic.

Mixed Vehicle Zone:

Because the Main Street emphasis is on the pedestrian, this zone serves cars, trucks, buses, and bicycles as mixed traffic in a limited number of travel lanes. Main Streets are low-speed, relatively low-volume streets.

Main Streets

Priority Elements:

- Maximum Posted Speed – 25 mph - equal to design speed and comfortable for both bicyclists and pedestrians.

- Number of Through Lanes – Typically, 1 in each direction (2 total). Where short block lengths (400' or less) are maintained, an alternative "typical" design would provide 1 lane in each direction, with a center lane used as back-to-back turn lanes (3 total). Where longer blocks are necessary, the 3rd lane is still allowable, but should be intermittently broken with landscaped islands or, in rare cases, pedestrian refuges or a median. Four lanes are inappropriate. In cases where existing 4 lane sections are deemed to be Main Streets, the extra lane width can be used to accommodate parking or other elements, thereby "dieting" to an ideal Main Street cross-section.

- Lane Width – Should typically allow 13' for lanes next to parking to maintain the necessary clear distance for opening car doors and to accommodate commercial vehicles – in the 3 lane situation, 10' is suitable for the third lane. In constrained conditions, lanes next to parking should not be less than 12' wide. In the case of angled parking, the travel lane should be at least 13' wide.

- Sidewalks – Sidewalks are the most important element on a Main Street, because pedestrians are the priority - sidewalk width should be at least 10' , unobstructed. In constrained circumstances and where uses such as sidewalk dining are desirable, the unobstructed portion of the sidewalk can be reduced to 8', which allows for some intrusion into the sidewalk area by adjacent outdoor dining areas, while maintaining a comfortable walking space. Even in those cases, however, no railings or other permanent or semi-permanent fixtures should encroach into the 10' sidewalk width. Even in constrained conditions, sidewalks should not be less than 6' unobstructed width.

- Sidewalk Amenity Zone – This zone enhances the pedestrian environment along a Main Street. It should be 8' wide (not including the sidewalk). This width provides space for street trees, streetlights, benches, transit amenities, and trash receptacles. Even in constrained conditions, the minimum sidewalk amenity zone is 5' (without trees) or 6' (with small maturing trees).

- On-Street Parking Lanes – On-street parking supports businesses and provides a buffer between pedestrians and traffic – 7' from the face-of-curb is ideal to minimize street widths, to provide a small measure of clear width for opening doors, and to provide ad-

equate travel lane width for shared use by bicycles, transit, autos, and commercial vehicles. Even in constrained conditions, on-street parking lanes should not be less than 7' wide.

- Curb and Gutter – Main Streets will typically have 6" vertical curb, in keeping with the urban context.

- Curb Extensions – Should be provided at mid-block crossing points. The width should match the width of on-street parking lanes (7' typical). Curb extensions provide for reduced pedestrian crossing distances and increased pedestrian visibility when crossing the street – they also add space for trees, other landscaping, and street furniture.

- Lighting – Since pedestrian activity is expected and encouraged in Main Street locations, decorative pedestrian-scale lighting should be provided. Pedestrian lighting should be sufficient to illuminate the sidewalk, as well as to provide for pedestrian visibility and safety from crime. Pedestrian lighting should be placed so that light is not obscured by branches and leaves. In some cases, the pedestrian-scale lighting can also be sufficient for street lighting. Where street lighting is provided, sharp cut-off, ornamental fixtures should be used rather than Cobraheads.

- Block Length – Typically, should not exceed 400'. Short block lengths provide for traffic calming and more frequent and accessible crossing points for pedestrians, as well as improved connectivity for all travel modes.

Main Streets

Other Elements to Consider

- Utilities – To preserve sidewalk capacity for pedestrians, maintain a clear zone per ADA requirements, and allow larger trees and other aesthetic treatments (thereby enhancing the pedestrian nature of Main Streets), utilities should be placed underground, wherever feasible. If underground placement is not feasible, the next most preferable location is at the back of property. If poles must be located along the street frontage, they should be placed in the sidewalk amenity zone. Under no circumstances should they be placed in the sidewalk. Utility poles should be consolidated where possible, with redundant poles removed in retrofit situations.

- Traffic Calming – Typically not necessary if other elements are in place, but may be used to maintain desired speeds. See CDOT's Traffic Calming Report for more details on appropriate applications of traffic calming tools.

- Mid-Block Pedestrian Crossings - Should be considered on blocks of more than 600' to ensure accessible pedestrian crossing points. Curb extensions and high visibility markings should be provided at these mid-block crossing locations. See CDOT's Mid-Block Crossing Policy for more information on safe crossings.

- Angled Parking – Allowable in special cases where adequate right-of-way exists, parking demand exceeds the capacity of parallel parking, and traffic volumes and speeds are low enough for safe operation. Angled parking requires 20' for the parking, next to a 13' travel lane. Back-in angled parking may be used in situations where it is deemed necessary, due to increased visibility for the driver.

- Medians – Medians are typically inappropriate in a Main Street, because they increase the crossing distance required for pedestrians. However, they may be allowable in circumstances requiring special treatment for aesthetics, open space needs, pedestrian safety, or to provide intermittent breaks in the third lane on longer, 3 lane segments. If provided, should be a minimum of 6', and paved at appropriate locations to facilitate their use for mid-block crossing.

- Median Planting – If median is provided (see above), landscaping should be provided, except in portions of the median designated for pedestrian access. Where provided, plants should be no higher than 30 inches and tree limbs should fall no lower than 6' to provide a "visibility zone" for pedestrians and motorists.

Inappropriate Elements:

- Bus Stops/Bus Zones – Excluded in segments, because block lengths are short and stops will typically be located at the intersections. See Chapter 5 for details on bus stops at Main Street intersections.

- Bike Lanes – Excluded to minimize street widths and conflicts between bicyclists and parked cars – bicyclists can operate in mixed traffic due to the low operating speeds and wide lanes on Main Streets.

- Planting Strips – Excluded to maximize sidewalk space for pedestrians and to provide unrestricted access from parking to the sidewalk. Planting would typically be street trees in appropriately designed planters, located within the sidewalk amenity zone.

- Driveways – Excluded to eliminate conflicts between pedestrians and motor vehicles turning into businesses. Service access should be at the rear of the commercial properties. In constrained conditions where driveways cannot be excluded, shared driveways are encouraged.

- Pedestrian Refuge – Since Main Streets have short blocks (providing frequent crossing opportunities at intersections), pedestrian refuges are typically not recommended. However, refuges may be allowable under certain circumstances, as described in this section under "Number of Through Lanes", and "Medians", and also in Section 5.1: "Main Street Intersections".

Section 4.2 Avenues

Overview

Avenues can serve a diverse set of functions in a wide variety of land use contexts. Therefore, they are the most common (non-local) street type in our city. Avenues provide access from neighborhoods to commercial areas, between areas of the city and, in some cases, through neighborhoods.

Charlotte's East Boulevard, a re-configured commercial Avenue in a constrained environment.

Avenues serve an important function in providing transportation choices, because they are designed to provide a balance of service for all modes of transport. They include high-quality pedestrian access, high levels of transit accessibility, and bicycle accommodations such as bike lanes, yet they also may carry high volumes of traffic. Most thoroughfares in our street network would be classified as Avenues. Some collectors/connectors would also be classified as Avenues.

Avenues perform an important mobility function for motorists, but they are expected to provide a higher level of comfort and convenience for other users of the street than are Boulevards or Parkways. Therefore, posted speeds are limited to 25-35 miles per hour to allow safe and comfortable pedestrian travel along and across these streets. Since Avenues are expected to balance the interests of many types of travelers, property owners, and residents, roadway (vehicle) capacity will not necessarily be expanded to maintain free flows and some congestion is to be expected, especially during peak travel periods.

Development along Avenues may include a wide range of land uses, from single-family houses to multifamily development (townhouses, apartments, condos) to commercial (retail or office) to mixed-use to institutional (schools, churches) or industrial uses. Development patterns along Avenues may include a dense mix of uses in some locations and lower-density, single uses in others.

An Avenue in a mixed use area in another city.

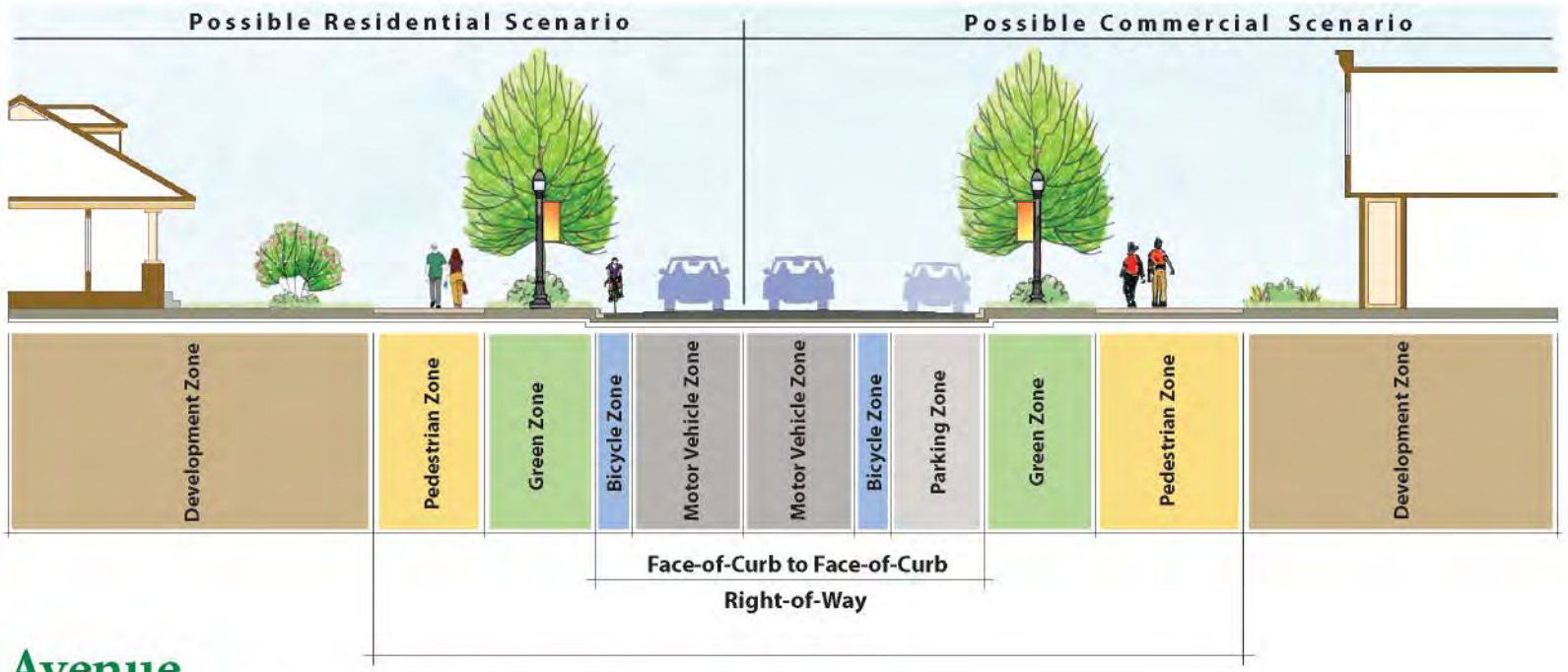
Avenues

Although land uses may vary greatly, certain design elements help to provide the best access for pedestrians and maintain the desired modal balance along Avenues. In keeping with good design practices and as outlined in the 2003 General Development Policies, non-residential buildings on Avenues should typically be oriented toward the street and located closer to the street than on Boulevards. Windows and doors should front onto the street, with direct pedestrian access to the streetfront sidewalk. Parking should generally be located to the rear or sides of buildings or, in some cases, on-street. If parking is located between the street and the building, it should generally be no more than one row, to avoid large expanses of parking that separate buildings from the sidewalks. Residential development, particularly single family, may be located further from (but should still face) the street, with direct pedestrian access to the streetfront sidewalk. For both residential and non-residential uses, blank walls and non-transparent windows should be avoided along pedestrian areas, to help provide for pedestrian comfort, security, and points of interest.

Since they serve so many functions and contexts, there are a number of alternative Avenue cross-sections and design teams should carefully review the information on design elements provided later in this section. Avenues can have two, three or four lanes. Continuous medians are allowed on Avenues, but are not typical. Avenue block lengths should be limited to 600' to provide frequent locations for safe pedestrian crossings, as well as frequent, convenient connections to adjacent neighborhoods. Signalized intersections are specially designed for pedestrian crossings, and refuge islands may also be provided between signalized intersections to allow pedestrian crossings. Common elements included in all Avenue cross-sections are sidewalks, planting strips or amenity zones with street trees, and bike lanes along both sides of the street.

Avenues provide an ideal transit environment, since they are well designed for pedestrians and provide many connections to adjacent neighborhoods. Transit stops are closely spaced, creating high levels of accessibility to service, and transit use is relatively heavy.

Avenues



Avenue

For specific dimensional information refer to the guidelines in this section.

Avenues

Development Zone:

Setbacks, design, and land uses will vary, but the basic intent for this zone is that development orients toward and has good functional and visual connections to the street.

Pedestrian Zone:

Very important for modal balance, pedestrian travel should be comfortable on Avenues; this zone should include unobstructed sidewalks, at appropriate widths for adjacent and surrounding land uses.

Green Zone:

To maintain comfortable pedestrian travel and serve an important buffer function, as well as enhancing the street for other users, this zone should include grass, landscaping, and shade trees in spacious planting strips or, in some cases, replaced by or interspersed with hardscaped amenity zones. **In some Avenue configurations, this zone will also include a median or intermittent "islands" with trees and landscaping.**

Parking Zone:

The need for this zone varies on Avenues, but the potential for traffic calming, buffering between vehicles and pedestrians, and access to adjacent land uses should be considered. **Some Avenues will have on-street parking and some will not.**

Exclusive Bicycle Zone:

Avenues are higher-speed and volume streets than Main Streets, so cyclists are less likely to feel comfortable in mixed traffic; this zone is important and should be considered for modal balance, safety, and additional buffering for other modes.

Motor Vehicle Zone:

This zone serves motor vehicles, in **a variety of possible lane configurations,** to accomodate higher volumes than Main Streets, while maintaining modal balance.

Avenues

The 3-lane cross-section with intermittent landscaped islands, not to be confused with 2-lanes and a median. This configuration can also be used for a 5-lane cross-section. The advantages of this configuration include: better access, while removing turning traffic from through lanes; opportunities for pedestrian refuge; lower right-of-way requirements; and an additional source for the "green zone".

Avenues

Priority Elements:

- Posted Speed – 25-30 mph preferred, with 35 mph allowable. This is higher than Main Street speeds, but lower than Boulevard speeds, reflecting the desire to provide reasonably safe and comfortable speeds for all modes.

- Design Speed – 30-40 mph. The design speed should be slightly higher than the posted speed, but not so high as to encourage speeding.

- Number of Through Lanes – 1 in each direction (2 total), 1 in each direction plus an intermittently landscaped or (on short blocks) back-to-back turning lane (3 total), 2 in each direction (4 total), or 2 in each direction plus an intermittently landscaped turning lane (5 total). The diagram on the preceding page shows the general configuration of the 3-lane cross-section with the intermittent landscaped islands. The 5-lane cross-section is similar and this configuration is generally preferable to using a continuous median on Avenues. In special circumstances, may have 1 lane in each direction with a median.

- Lane Width – Should typically provide 10' lanes, in addition to the gutter, where curb and gutter is present. 11' lanes are acceptable. Twelve foot outside lanes should be provided where there is vertical curb, but no bike lane or on-street parking (to allow adequate clearance from curb for vehicles). Fourteen foot outside lanes are appropriate where there is on-street parking but no bike lane. In the case of a median-divided Avenue with only 1 lane in each direction, lanes should be 14' wide.

- Bicycle Accommodations – Bicycle lanes are desirable on Avenues, to allow cyclists space to operate in a higher speed (though still urban) environment. They are especially important when needed to complete or continue a bicycle network or when there are few other options for network continuity. Bicycle lanes should be a minimum of 4' wide and striped, in the absence of on-street parking. Where on-street parking exists, the bicycle lane should be 6' wide and striped, to allow additional clear space between cyclists and opening car doors. Wide outside lanes may also be considered under constrained conditions.

- Sidewalks – Pedestrian activity is expected and encouraged along Avenues. Therefore, minimum 6' wide unobstructed sidewalks should be provided on an Avenue. In areas that are currently or are planned to be pedestrian-oriented retail or mixed-use development (which should face onto the sidewalk), minimum 8' wide unobstructed sidewalks should be provided. In this case, a sidewalk amenity zone would typically be provided, as well.

Avenues

- Planting Strips – Should be provided on Avenues to separate pedestrians from vehicles, provide a better walking environment, and enhance the streetscape. Planting strips should ideally be 8' minimum between curb and sidewalk to allow for grass and large maturing trees. Even in retrofit or constrained situations, the 8' planting strip and large-maturing street trees should be the design priority. The design team should justify and document any deviations from the preferred width. In that case, the guidelines described in Section 4.5 (Planting Strips) for City-built retrofits (item 2) and developer-built infill projects (item 3) on Local Residential Streets will also apply to Avenues.

  Where an 8' planting strip cannot be provided (as described in Section 4.5, items 2 and 3), the following guidelines apply. For planting strips between 6' and 8', small maturing trees may be acceptable. If the planting strip is less than 5', trees should not be planted in the planting strip, but shrubbery or ground cover may be acceptable, depending on maintenance needs. Even in constrained conditions, the planting strip should never be less than 3'. When trees cannot be planted in the planting strip, they should be planted in back of the sidewalk, if possible. Sight distance should also be considered in the location and spacing of trees within the planting strip. Depending on factors such as street curvature, locations of driveways, land use context, and planting strip width, a mix of species, tree sizes, or different spacing may be necessary to maintain minimal sight distances for vehicles entering the street. In highly urban conditions, a sidewalk amenity zone should replace the planting strip.

- Bus Stops – Most Avenues will have local and/or express bus service. Preferred locations for bus stops, particularly for higher-volume bus stops, include cross streets (see Chapter 5: Intersections) and at mid-block crossings. Where there is full-time, dedicated on-street parking, bus stops must include curb extensions. At other locations, particularly in commercial or mixed-use areas, a hardscape pad for boarding and alighting passengers should be considered.

- Curb and Gutter – Should always have curb and gutter. 2'6" curb and gutter is typical, although 2'0 curb and gutter or 6" vertical curb may be used in constrained situations or in more urban environments. If a median exists, 1'6" curb and gutter is allowable on inside, median lanes.

- Lighting – Street lighting is to be provided. Separate, decorative pedestrian-scale lighting should also be provided when necessitated by adjacent land uses or the existence of mid-block crossings, bus stops, or other facili-

ties where pedestrian activity is likely to occur. Where it is provided, pedestrian lighting should be sufficient to illuminate the sidewalk, as well as to provide for pedestrian visibility and safety from crime. Ideally, these fixtures should be located away from trees to maximize lighting.

- Block Length – Should not exceed 600', to provide more frequent and accessible opportunities for crossings and to enhance connectivity for all modes. In the case where a median is provided, median cuts should occur every 600'.

Other Elements to Consider

- Medians – Medians are typically not expected on Avenues, but they may be provided, primarily in residential areas. Where provided, medians should be at least 16' wide to provide continuity between the portions of median along the segment and at the intersection (where the 16' width allows a minimal 6' pedestrian refuge and a 10' left-turn lane, if necessary). If a median is provided in constrained conditions, it may be narrower along the segment, but never less than 6' wide.

- Median Treatment – If medians are at least 8' wide, they should be landscaped. Landscaping should include trees, where possible given sight distance. At specified mid-block crossing points, medians should be paved in a material that facilitates pedestrian use. If a median is located on a street with only two travel lanes, maintenance needs should be considered. Options to accommodate maintenance vehicles included mountable areas for the vehicles, no parking/loading zones reserved for maintenance vehicles, equipment turnout locations, frequent cross streets where vehicles can park, or wider lanes.

- Pedestrian Refuge – If there is a median, it provides a pedestrian refuge. Where a median serves as a pedestrian refuge at specified mid-block crossings, it should be paved in a material that facilitates pedestrian use. Absent a median, pedestrian refuges may be provided at mid-block pedestrian crossing points. Pedestrian refuges can also be used to break up the 3rd lane in a 3-lane cross-section (to create an "intermittent" 3rd lane).

- On-Street Parking – Desirable in areas with front facing development, especially retail development. Accompanying curb extensions are preferable when the on-street parking is full-time, dedicated. Off-peak, on-street parking is also allowable, depending on specific traffic and land development conditions. As a last resort, in very con strained circumstances, such as where historic buildings and narrow setbacks exist, cut-outs could be used for on-

Avenues

street parking. Parking lanes should be parallel lanes, marked 7' from the face-of-curb (e.g., 5' plus 2' of gutter).

- Curb Extensions – Must be provided at intersections, whenever full-time, dedicated on-street parking is provided in order to shorten the crossing distance for pedestrians. They are also desirable at other locations, such as mid-block crossings.

- Driveways – Avenues typically will have driveways to adjacent properties. However, driveways raise the potential for conflicts between pedestrians and turning vehicles. Therefore, in commercial or other areas with high pedestrian activity expected, efforts should be made to minimize the number of driveways and to maximize the distance between them. For example, in these types of pedestrian-oriented areas, access should be off of a side street rather than the Avenue. Shared driveways are also encouraged.

- Utilities - To preserve sidewalk capacity for pedestrians, maintain a clear zone per ADA requirements, and allow larger trees and other aesthetic treatments, utilities should be placed underground, wherever possible. Every attempt should be made, even with underground placement, to avoid or minimize conflicts with street trees. If underground placement is not possible, the next locations to consider for poles are at the back of the right-of-way or in the planting strip, depending on the land use context (e.g., it may be preferable to place poles in the planting strip rather than too close to buildings). In no circumstance should poles be placed in the sidewalk and, as with underground placement, every attempt should be made to avoid or minimize conflicts with street trees. Utility poles should be consolidated where possible, with redundant poles removed in retrofit situations.

- Mid-Block Pedestrian Crossings – Allowable. Should be considered when blocks are longer than 600', particularly in areas with land uses likely to create high pedestrian volumes. When provided, crossings should be striped (with high visibility markings) and combined with appropriate signage. Also consider pedestrian-actuated signals (consider Hawk signals when ADT exceeds 12,000), curb extensions, and a pedestrian refuge, depending on the circumstances. See CDOT's Mid-Block Crossing Policy for more information on safe crossings.

- Sidewalk Amenity Zone – Typically not necessary, because the planting strip provides aesthetic enhancement and separation between vehicles and pedestrians. However, in areas (blocks or portions of blocks) that are currently or are planned to be pedestrian-

oriented retail or mixed-use, a sidewalk amenity zone should be provided in conjunction with the wider sidewalk (see "sidewalks" above). In this circumstance, the amenity zone replaces the planting strip. This is particularly important if on-street parking is provided, to allow space for opening car doors and unloading passengers. Where provided, the ideal amenity zone width is 8' minimum.

- Traffic Calming – Many of the ideal elements on Avenues will provide a measure of traffic calming (e.g. on-street parking, short block lengths, closer signal spacing). However, some forms of traffic calming, such as street-side landscaping treatments, are allowable if necessary to maintain desired speeds (see CDOT's Traffic Calming Report for more information on appropriate application of traffic calming tools).

Inappropriate Elements:

- Shoulder – Inappropriate in an urban setting, such as would occur along an Avenue.

Section 4.3 Boulevards

Overview

Boulevards are intended to move large numbers of vehicles, often as "through traffic", from one part of the city to another and to other lower level streets in the network. As a result, the modal priority on Boulevards shifts (from the Main Street's pedestrian priority and the Avenue's modal balance) somewhat towards motor vehicles, while still accommodating pedestrians and cyclists as safely and comfortably as possible. Many major thoroughfares will be classified as Boulevards.

As with Avenues, a variety of land uses and development intensities will be found along Boulevards. However, given the nature of their vehicular mobility function (higher volumes and speeds than for Avenues), Boulevards are not suited for land uses that would foster high volumes of pedestrians crossing from one side of the street to the other.

Fairview Road is classified as a Boulevard, though it needs better separation between pedestrians and traffic.

Regardless of the actual land use, buildings along Boulevards will usually either be:

1) set farther back from the street than for Avenues,
2) located directly on a parallel frontage street, or
3) oriented to less highly traveled side streets.

In some cases, reverse frontage may be used, but it is generally preferable for buildings to be connected to and oriented towards the street, even with setbacks that are larger than on Avenues. In all cases, sites should allow easy pedestrian access from sidewalks, parking areas, and, if applicable, the frontage street. In cases 2 or 3 (listed above) the design recommendations offered for less vehicle-oriented streets (Local, Main, or Avenue) should be used. These include having sidewalks connecting parking and street sidewalks with entrances, functional windows and doors opening onto pedestrian areas, and avoidance of blank walls and empty space in pedestrian circulation areas.

Vehicle access to adjacent land uses along Boulevards must be managed carefully, with individual driveways permitted and shared driveways preferred. Driveways should be appropriately spaced and based on safety considerations along this

higher-speed, higher-volume street type. On-street parking should not be permitted on the Boulevard, but could be placed on a separate, parallel frontage street.

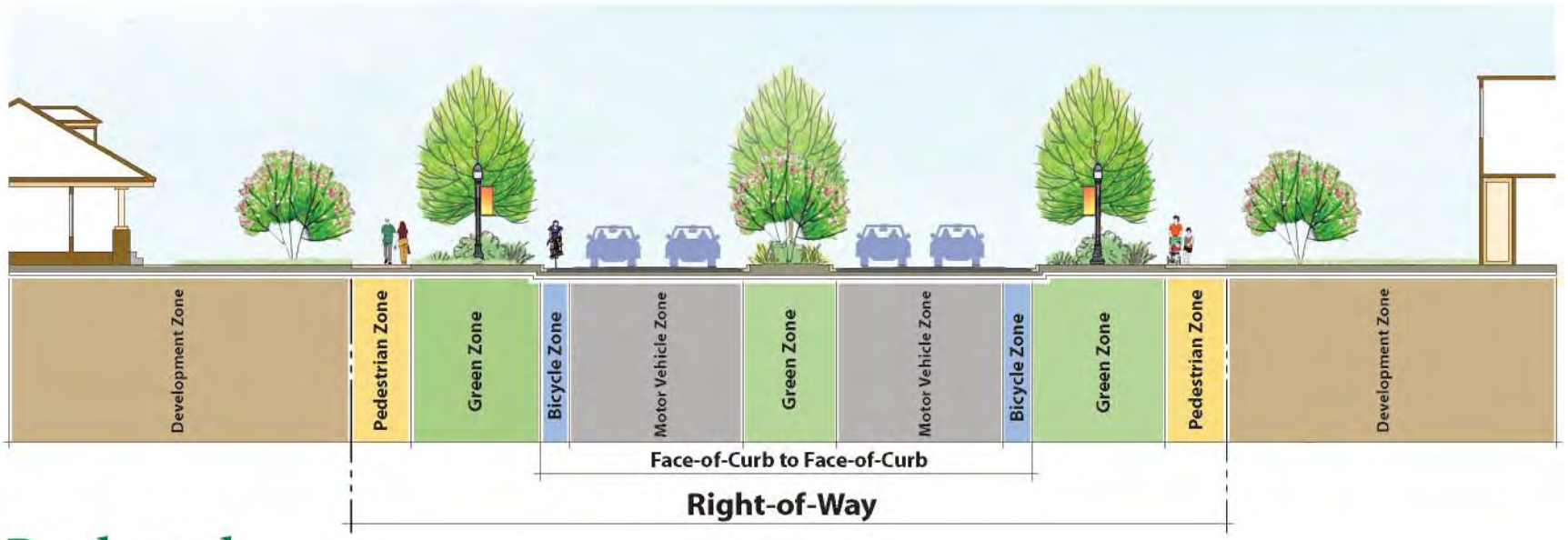
Boulevard in another city, with a narrow planting strip to buffer pedestrians from traffic.

Boulevard cross-sections typically include at least 2 lanes in each direction, but may include as many as 3 lanes in each direction, depending on the availability of alternate routes on the surrounding street network. The 4-lane (total) cross-section is generally preferable.

No matter how many lanes are included, Boulevards will always feature a wide, landscaped median. The median separates opposing traffic flows, provides additional green space (and trees), and, in some cases, allows for pedestrian refuge (since the typical distance between signalized intersections or median openings on Boulevards is 1000'-1200').

The Boulevard cross section also includes sidewalks, planting strips with street trees, bike lanes, and transit stops along both sides of the street. Transit stops on Boulevards are to be located near signalized intersections or other safe locations for pedestrians to cross. With the Boulevard's modal emphasis shifted towards motor vehicles, posted speeds on Boulevards are 35-40 mph with design speeds up to 45 mph. That is why the provision of the multi-modal elements becomes even more important for the safety and comfort of travelers other than motorists.

Boulevards



Boulevard

For specific dimensional information refer to the guidelines in this section.

Boulevards

Development Zone:

Land uses and design will vary, but setbacks will likely be deeper than on Avenues and frontage will not always be directly onto the street; in all cases, good physical connections to the street are still important.

Pedestrian Zone:

Although the balance shifts away from a pedestrian orientation, pedestrians need to be able to travel safely along the Boulevard. This zone should always include sidewalks of adequate width for the adjacent and surrounding land uses.

Green Zone:

Higher speeds and volumes on Boulevards require significant attention to this zone. To serve the important buffer function between pedestrians and vehicles, as well as enhancing the street for other users, this zone should include grass, landscaping, and shade trees in spacious planting strips and medians. Where a parking zone on a parallel access street is used, the Green Zone should also extend to the area between the parking and the pedestrian zones (back of sidewalk).

Parking Zone:

Given the emphasis on traffic flow and development characteristics, this zone should generally be removed from the main vehicle zone; it should either be non-existent or placed on an access street.

Exclusive Bicycle Zone:

Given the higher speeds and volumes on Boulevards, this zone should get strong consideration for treatment to increase cyclists' safety. Cyclists are generally not comfortable in mixed traffic on these types of streets.

Motor Vehicle Zone:

A very important zone since the Boulevard shifts more towards an auto-orientation; the number of travel lanes will vary by capacity needs, although the impact to other users should be considered in that decision.

Boulevards

Priority Elements:

- Posted Speed – 35-40 mph. Speeds are higher than on an Avenue, reflecting the Boulevard's function of serving longer distance, intra-city traffic flows.

- Design Speed – up to 45 mph. As with Avenues, design speed is slightly higher than posted speed, but not so high as to encourage speeding on these urban streets.

- Number of Through Lanes – Typically, 2 in each direction (4 total).

- Lane Width – 10 or 11' lanes, in addition to the concrete gutter where curb and gutter is present. 10' inside lanes are particularly appropriate where the posted speed is 35 mph. Can also use 14' wide outside lanes in some cases, as deemed by the *Bicycle Plan.*

- Medians – Should be provided on Boulevards. Typically, should be at least 17' wide to provide continuity between the portions of median along the segment and at the intersection (where the 17' width allows a minimal 6' pedestrian refuge and an 11' left-turn lane, if necessary). In constrained situations, the median can be narrower along a street segment, but never less than 6' wide, since it is also to be used for pedestrian refuge.

- Median Planting – All medians should be landscaped. Landscaping should include trees, where possible given sight distance. At specified mid-block crossing points, medians should be paved in a material that facilitates pedestrian use. Where pedestrian refuges are provided, plants should be no higher than 30 inches and tree limbs should fall no lower than 6' to provide a "visibility zone" for pedestrians and motorists.

- Bicycle Accommodations – Bike lanes are desirable to allow cyclists to operate in the higher speed Boulevard environment. They are especially important when needed to complete or continue a bicycle network or when there are few other options for network continuity. Bicycle lanes should be striped and a *minimum* of 4' wide. In most circumstances, 5' lanes are preferred and, under certain conditions, 6' lanes are preferred. Wide outside lanes (14') may also be considered under constrained conditions.

- Sidewalks – Although the characteristics of a Boulevard suggest that it is less pedestrian-oriented than either a Main Street or an Avenue, pedestrian activity is expected and encouraged along Boulevards. The higher speed, higher volume traffic characteristics make sidewalks a required element. Sidewalks should be a minimum of 6'

unobstructed width, except in highly constrained situations, where 5' unobstructed width may be allowed.

- Planting Strips – Since Boulevards typically will have higher speeds, higher volumes, and wider cross-sections, good separation between vehicular and pedestrian traffic is desirable. Planting strips should be at least 8' between curb and sidewalk, to allow for grass and large maturing trees. Sight distance should be considered in the location and spacing of trees within the planting strip. Depending on factors such as street curvature, locations of driveways, land use context, and planting strip width, a mix of species, tree sizes, or different spacing may be necessary to maintain minimal sight distances for vehicles entering the street.

- Curb and Gutter – Boulevards are urban locations, and should always have curb and gutter. A minimum 2'0" curb and gutter should be used on the outside lane, but 1'6" is allowable on inside, median lanes.

- Lighting – Street lighting is to be provided. Separate, decorative pedestrian-scale lighting should also be provided when necessitated by adjacent land uses or the existence of mid-block crossings, bus stops, or other facilities where pedestrian activity is likely to occur. Where it is provided, pedestrian lighting should be sufficient to illuminate the sidewalk, as well as to provide for pedestrian visibility and safety from crime. Pedestrian lighting should be placed so that light is not obscured by branches and leaves.

- Block Length – Typical distance between signalized intersections or median openings on Boulevards is 1000'-1200' (approximately ¼ mile). It may be allowable or even desirable to provide more closely spaced side streets (to ensure a well-connected grid of streets off of the Boulevard), but median openings should not typically be provided at these more closely spaced locations. In some cases, directional crossovers may be used to reduce the number or frequency of median openings and signalized intersections. These should be used sparingly and no more frequently spaced than 1000'-1200'.

Boulevards

Other Elements to Consider

- Pedestrian Refuge - The median will typically provide for pedestrian refuge. Where the median serves as a pedestrian refuge at specified focal points, such as mid-block crossings, it should be paved in a material that facilitates pedestrian use.

- On-Street Parking - Should be separated from the travel lanes and provided along a separate, parallel facility (frontage street). At those locations, curb extensions, matching the parking width, should be provided. Parallel parking lanes should ideally be 7' wide. Angled parking may also be allowable since the parking is removed to the frontage street.

- Double Tree Rows – Allowable, for aesthetics, if right-of-way is available.

- Driveways – Driveways are to be expected in typical Boulevard land uses, and are acceptable. In cases where adjacent land uses will result in high levels of ingress/egress, consider the use of frontage roads to minimize impact on through lanes.

- Bus Stops/Bus Zones – Preferred locations are generally at cross streets and high traffic generators, although other locations are allowable. Pedestrian enhancements should be included at all locations and may, in some cases, include mid-block crossings and pedestrian refuges.

- Utilities – To preserve sidewalk capacity for pedestrians, maintain a clear zone per ADA requirements, and allow larger trees and other aesthetic treatments, utilities should be placed underground, wherever possible. Every attempt should be made, even with underground placement, to avoid or minimize conflicts with street trees. If underground placement is not possible, the preferred locations to consider for poles are at the back of the right-of-way or in the planting strip. In no circumstance should poles be placed in the sidewalk and, as with underground placement, every attempt should be made to avoid or minimize conflicts with street trees. Utility poles should be consolidated where possible, with redundant poles removed in retrofit situations.

- Mid-Block Pedestrian Crossings – Should typically be avoided on Boulevards, due to the higher speeds. However, may be allowable in rare situations where the nearest signalized intersection is 600' or more from an adjacent land use that is likely to create high pedestrian demand or at very heavy volume bus stops. When provided, crossings should include high visibility markings and appropriate signage. Hawk signals, curb extensions, and a pedestrian refuge

should also be strongly considered. See CDOT's Mid-Block Crossing Policy for more information on safe crossings.

- Traffic Calming – Many traffic calming tools are inappropriate on Boulevards, given the Boulevard's higher volume, higher speed function. However, some forms of traffic calming, such as street-side landscaping treatments or changes in horizontal alignment, are allowable if necessary to maintain desired speeds (see CDOT's Traffic Calming Report for more information). Superelevation should be avoided or at least minimized.

Inappropriate Elements:

- Sidewalk Amenity Zone – Typically not necessary, because the planting strip provides aesthetic enhancement and separation between pedestrians and vehicles, which are operating at relatively high speeds.

- Shoulder – Inappropriate in an urban Boulevard setting.

- Curb Extensions – Inappropriate on Boulevards, because they present a safety issue on these higher speed and higher volume streets. Further, curb extensions are typically used with on-street parking, which is not allowed on Boulevards. In the case where a frontage street is provided, the frontage street should have curb extensions, with the width matching the parking lane (typically 7' wide).

Section 4.4 Parkways

Overview

Parkways are the most motor vehicle-oriented of Charlotte's street types. A Parkway's primary function is to move large volumes of motor vehicles efficiently from one part of the city to another. Therefore, these roadways are designed to serve high traffic volumes at relatively high speeds (posted speeds of 45-50 miles per hour and maximum design speeds of 55 miles per hour).

In keeping with their motor vehicle function and design orientation, there should not be pedestrian-oriented land uses located adjacent to Parkways. Parkway design is better matched to land uses that depend on vehicular accessibility from a nearby street and that do not foster large numbers of pedestrians crossing or walking along the Parkway. These types of uses may include regional or community malls, industrial or office parks, and some types of office/mixed-use/multi-use centers. While these types of sites should still be designed to encourage parking once and walking between land uses or buildings, the resulting pedestrian activity should be oriented away from the Parkway.

Harris Boulevard, a Parkway, with access to multi-family residential development along both sides of the street.

To accomplish this, development along Parkways includes stringent access control and include deep setbacks from the right-of-way, with buildings oriented towards intersecting or parallel roadways and away from the Parkway. Urban design features should be appropriate to the street type onto which the buildings actually front. Landscape treatments and buffers along Parkways should be extensive and serve to further separate adjacent land uses from the Parkway.

In keeping with the land use and development characteristics described above, as well as to facilitate traffic flow, access is controlled along Parkways. Parkways should include more shared entrances and larger "block lengths" than Charlotte's other street types. On Parkways, the desired distance between cross streets is ½ mile.

Parkways are designed to provide higher capacity than other street types and typically include 2 or 3 through lanes in each direction, as well as separate turn lanes. Wide landscaped medians and shoulders are important elements, in recognition of the high traffic volumes and speeds on

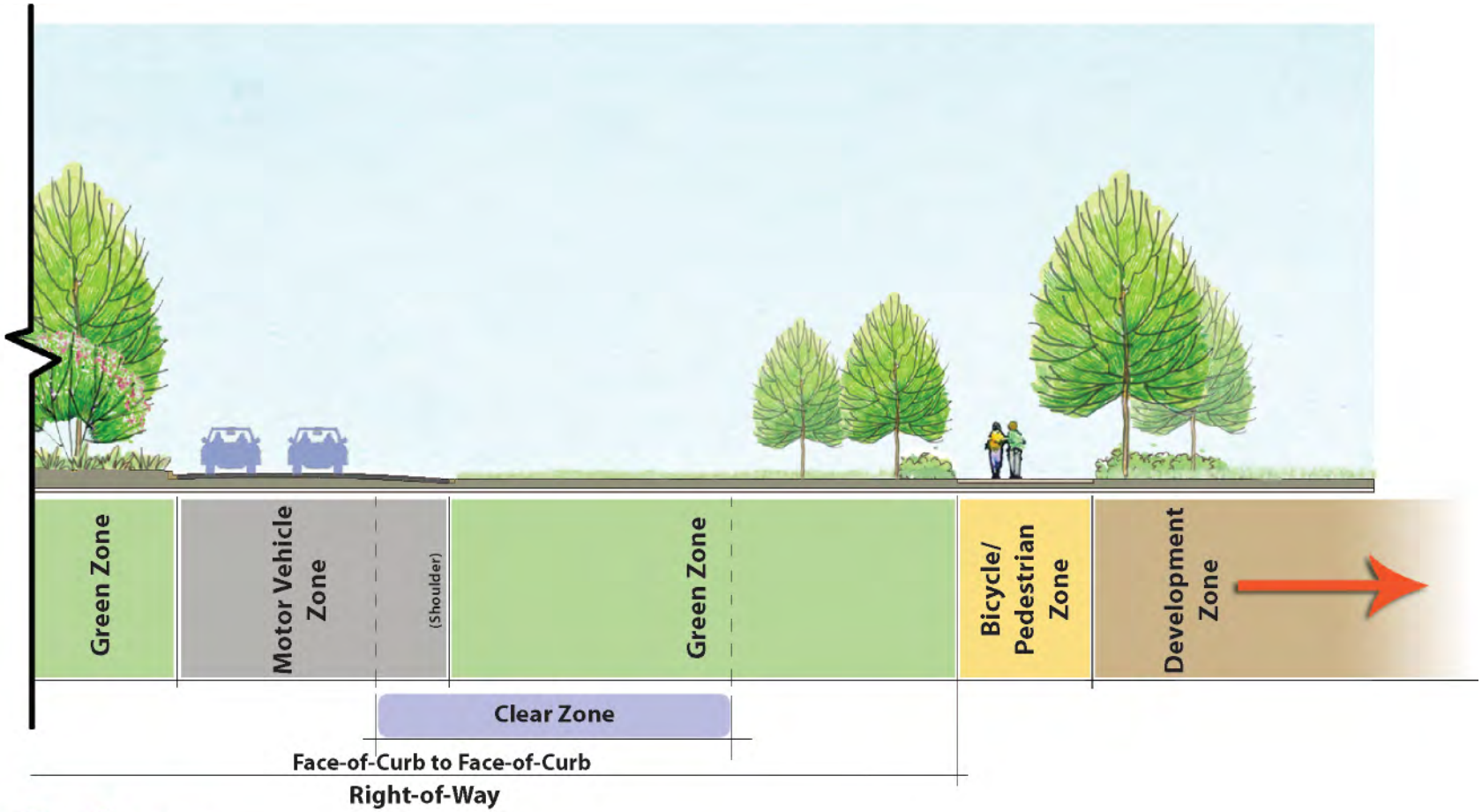
Parkways. In addition, this is the only street type for which a "clear zone" is explicitly specified to enhance motorist safety.

Another section of Harris Boulevard, approaching commercial land uses. This section has more access control.

Since the immediate Parkway environment is not well suited for pedestrian and bicycle traffic, pathways for these travelers should be provided on separate facilities. Ideally, bicycle and pedestrian facilities should be located on nearby, parallel streets. Those streets would provide most of the access to development adjacent to the Parkway, as well as a continual, connected network for cyclists and other travelers. If such routes are not available or feasible nearby, then provision should be made for cyclists and pedestrians to travel as far from the roadway and clear zone as possible.

Parkways are most appropriate for express bus or other limited-stop routes. When transit stops are provided, they should be located off the Parkway, either within adjacent developments or on cross-streets. If off-Parkway stops are not possible, bus pull-outs should be provided to remove buses from the high speed travel lanes.

Parkways



Parkway

For specific dimensional information refer to the guidelines in this section.

Parkways

Development Zone:

The land uses, along with building design and orientation to the street, are typically auto-oriented; access to this zone is limited or managed/controlled and setbacks are deep, with side or reverse frontage common; physical connections to the street are typically limited.

Bicycle/Pedestrian Zone:

This is a crucial zone for cyclist, pedestrian, and motorist safety, because it separates these modes; this zone should preferably be located beyond the right-of-way or on parallel streets.

Green Zone:

Important for buffering land uses from the high-speed, high-volume traffic, as well as enhancing the aesthetics of this auto-oriented street, the green zone should be wide, with large maturing trees. This zone also includes the median and the areas adjacent to the Bicycle/Pedestrian Zone, if one exists.

Clear Zone:

Unique to the Parkway, this zone is important for motorist safety due to high volumes and speeds.

Motor Vehicle Zone:

Reflecting the auto-orientation of the Parkway, the number of travel lanes (2 or 3 in each direction) will depend on travel demand.

Parkways

Priority Elements:

- Posted Speed – 45-50 mph, reflecting that this is a roadway used for high-speed, intra-city connectivity.

- Top Design Speed – Up to 55 mph.

- Number of Through Lanes – 2 in each direction (4 total) or 3 in each direction (6 total), as determined by capacity analysis.

- Lane Width – Typically 12' lanes (not including concrete gutter, if curb and gutter exists). In constrained situations, minimum 11' lanes are acceptable.

- Medians – Should be provided on Parkways. At least 20' wide is preferable, to provide continuity between the portions of median along the segment and at intersections (where the 20' width allows a minimal 9' pedestrian refuge and an 11' left-turn lane). If the right-of-way is severely constrained, the median can be narrower away from intersections (not less than 17' wide), but will need to transition to the wider dimension as it approaches an intersection.

- Median Planting – All medians should be landscaped. Landscaping should include trees, where possible given sight distance and an adequate clear zone.

- Shoulder – A shoulder should always be provided on a Parkway. The shoulder should ideally be 10' wide, but a minimum of 8' wide may be allowable in constrained situations.

- Sidewalks – The preferred pedestrian treatment along Parkways is a separate, parallel facility. This should be shared with bicycles if no preferred alternative for bicycle accommodations is possible (in which case, a 10' minimum unobstructed path is required and there must be very limited access along the Parkway). If it is not possible to construct a parallel facility and if right-of-way is available, sidewalks (minimum 5' wide unobstructed) may be provided for pedestrian network connectivity, particularly to connect transit stops to nearby pedestrian generating land uses. This sidewalk should be located as far as possible from travel lanes to provide a safer and more comfortable pedestrian environment.

- Planting Strips – If there is no sidewalk, the entire right-of-way should be treated as a planting strip. Trees are desirable, but should be located beyond the 25' clear zone (from the edge of the travel lane). In cases where a sidewalk is provided, a planting strip with grass and low ground cover should be included to separate pedestrians from the high-speed

vehicular traffic. To provide adequate separation, the planting strip should be a minimum of 15' between curb (if curb exists) or shoulder and the sidewalk.

- Lighting – Street lighting is desirable on Parkways. In cases where pedestrian facilities exist along Parkways, it is generally expected that the regular street lighting should also provide for adequate pedestrian lighting. However, where the pedestrian facility is removed from the Parkway (as a separate path, for example) and at bus stops, separate pedestrian lighting should be considered, depending on ambient light, location of street lighting, and visibility/safety. Pedestrian lighting should be placed so that illumination is not obscured by branches and leaves.

- Block Length (distance between cross-streets) – Due to the function of Parkways, it is generally desirable to limit access. Therefore, the distance between cross-streets should ideally be at least ½ mile. Shorter "block lengths" are allowable only when existing intermediate streets cannot be closed, or when required by land parcel configuration.

Parkways

Other Elements to Consider

- Curb and Gutter – Either curb and gutter or drainage swales are allowable, though curb and gutter is atypical, since a shoulder should always be provided. If curb and gutter is provided, mountable curbs should be used.

- Bus Stops – If there are bus routes operating on Parkways, bus stops should be located off the roadway. If this is not feasible, bus pull-outs should be provided, so that the bus is not stopping in mixed traffic. Bus stops should have sidewalks (minimum 5' wide unobstructed) connecting to surrounding land uses, as well as pedestrian scale lighting, if deemed necessary for safety.

- Utilities – Where they are necessary, poles should be located at back of right-of-way, beyond the 25' clear zone (from edge of travel lane). In no circumstance should utility poles be placed in sidewalks or bicycle paths.

Inappropriate Elements:

- Driveways – Inappropriate and unsafe on a Parkway. Should only be provided when no other access is possible to a property or when a driveway is pre-existing. Every effort should be made to provide alternate access in order to eliminate existing driveways.

- Bicycle Accommodations – Bicycle lanes are typically inappropriate on Parkways. In some cases, they may be allowable, but only when necessary for network connectivity. Bicycle routes on nearby, parallel streets (which are not Parkways) are preferable. In some cases, there could be a shared bicycle/pedestrian facility parallel to the Parkway (in which case, a 10' minimum unobstructed path is required and there must be very limited access along the Parkway).

- Sidewalk Amenity Zone – Although sidewalks may be provided in some cases (see above), a sidewalk amenity zone is inappropriate, due to the vehicular orientation of Parkways.

- On-Street Parking – Inappropriate, since the function of a Parkway is to move traffic at higher volumes and speeds than any other street type.

- Curb Extensions – Inappropriate, since the function of a Parkway is to move traffic at higher volumes and speeds than any other street type.

- Traffic Calming – Inappropriate, since the function of a Parkway is to move traffic at higher volumes and speeds than any other street type.

- Mid-block Pedestrian Crossings - Mid-block pedestrian crossings would be unsafe in the Parkway environment, since the function of a Parkway is to move traffic at higher volumes and speeds than any other street type. Further, the land use context of the Parkway is unlikely to create the need for mid-block crossings.

- Pedestrian Refuge – Pedestrians are typically not expected or encouraged on Parkways. Pedestrian refuges should not be provided along the segment, so as to not encourage mid-block pedestrian crossings.

Section 4.5 Local Residential Streets

Overview

The main function of Local Streets is to provide direct access to sites or land uses. There are several types of Local Streets, based on the predominant land uses found along the street, with Local Residential Streets serving the residential land uses.

Local Residential Streets are the most common street type and account for the most lane miles of all the City's streets. These streets are typically built during the land development process, rather than as a result of specific public projects. Further, Charlotteans consider Local Residential Streets (and their design) as particularly important to their quality of life, since they likely live along such streets. For all these reasons, the cross-sections and dimensions described in this section are less flexible than those described for non-local streets, to ensure high-quality neighborhood street design.

The predominant land use along Local Residential Streets will be either single family or multi-family housing, with a full range of possible densities. In keeping with the range of possible residential types found along these streets, there is also some variability in the development characteristics found along them. Building setbacks and lot sizes, for example, will vary by density and design, but in all cases building fronts should orient to the street. Related to both density and lot size is the location and amount of on-site parking, which is important in determining the appropriate street cross-section to use for a given development type. This is discussed in more detail below, under the heading "Alternative Cross-Sections".

A residential street where residents and visitors will park on the street.

Local Residential Streets

Regardless of the applicable cross-section, there are several common elements to all Local Residential Streets. These streets are designed for low traffic speeds and volumes since they are serving mostly neighborhood traffic, and a comfortable walking, cycling, and living environment is expected along them.

Local Residential Streets will have small blocks, which will provide both a high degree of connectivity for motorists, pedestrians, and cyclists, as well as a form of traffic calming for residents, through frequently spaced intersections. This is described in more detail in the Chapter 4 introduction, under the heading "Block Lengths for Local Streets." Local Residential Streets, therefore, will include built-in traffic calming features (such as intersections or other "slow points" every 300'-500') along with continuous sidewalks, planting strips, and street trees, to enhance safety, functionality, and aesthetic value for all users.

On this residential street in Myers Park, on-street parking has been limited to one side.

Because Local Residential Streets are intended to provide direct access to the residential land uses along them, individual driveways are the norm. However, in the case of higher-density, multi-family housing, shared driveways are encouraged to help reduce conflicts between pedestrians and turning vehicles, to reduce the number of and total space allotted to curb cuts (thereby allowing more space for on-street parking), and to increase potential green space.

Transit service is not typical on most local streets, but may be available, especially as feeder or neighborhood circulator service. The location and spacing of bus stops, therefore, is highly variable on these streets.

At these densities, on-street parking should be provided on both sides of the street.

Local Residential Streets

Cross-Section Alternatives

Local Residential Streets will reflect one of the following three cross-sections:

- Narrow **(<u>may</u> be used under conditions described below)**
- Medium **(the <u>default</u>)**
- Wide **(<u>must</u> be used under conditions described below)**

Selection of the appropriate cross-section depends primarily on the likely demand for on-street parking and the density of the street network. The general intent is to keep the curb-to-curb dimensions of Local Residential Streets as narrow as possible, while providing adequate width for emergency vehicles or for other vehicles to safely get around parked cars. In general, the more on-site parking provided, via longer driveways, rear or side loading garages, larger lots, shared parking, etc., the narrower the allowed cross-section.

The medium cross-section is used when it is likely that on-street parking will occur on both sides of the street with some frequency. The narrow cross-section is to be used only when it is likely that on-street parking will be relatively infrequent and likely to occur on only one side of the street at any given time, and the street network is well-connected. The wide cross-section applies where a high demand for on-street parking is likely. This cross-section includes a travel lane in each direction and parking on both sides of the street. This width will also allow emergency vehicle staging anywhere along the block.

The medium cross-section is the <u>default</u> cross-section for Local Residential Streets.

The "narrow" cross-section <u>may</u> be used if:

- net densities along the street are below 4 units per acre,
- lots are at least 80' wide,
- garages or parking areas are side loaded, rear loaded, recessed, or located behind the residence,
- there is more than one connection to the street (for redundant emergency access routes), and
- there are alternative, parallel routes available.

OR, if:

- net densities along the street are 4-7 units per acre,
- there is sufficient shared parking to allow for three vehicles per unit on-site,
- there is more than one connection to the street (for redundant emergency access routes),
- there are alternative, parallel routes available, and
- block length is a maximum of 650'.

Local Residential Streets

The "wide" cross-section must be used if:

- net densities along the street are at or above 8 units per acre, and
- there is insufficient on-site parking to allow for 2.5 vehicles per unit.

A medium residential street in Columbus, Ohio, with over-utilized on-street parking.
(photo courtesy of Dan Burden)

Both the medium and wide cross-sections may serve as collectors/connectors. This function will typically be served by creating a relatively direct connection to the thoroughfare network. However, the width of the cross-section should be related to the on-street parking demands (as discussed above), rather than the street's designation as a collector/connector. The narrow cross-section should not be used for a collector/connector street, except where there are many such connections to the thoroughfare in close proximity.

Infrequent parking on a narrow street.

Planting Strips

Planting strips, located between the curb and the sidewalk, improve the environment for pedestrians and neighborhood residents in two ways. First, by providing separation between pedestrian and vehicular traffic, and second, by providing shade and traffic calming when they are planted with large maturing street trees. In addition, citizen surveys and a broad variety of stakeholder discussions indicate that Charlotteans strongly support the provision of street trees. To achieve all of these goals, planting strips should be at least 8' wide. The cross-sections for Local Residential Streets included in this chapter show expected dimensions for planting strips, but the following describes the various ways in which planting strips will be provided on Local Residential Streets.

Local Residential Streets

1. New Local Residential Streets, built through the private development process in subdivisions or greenfields:

- The "Narrow" street includes an 8' planting strip planted with large maturing street trees.
- The "Medium" street includes an 8' planting strip (preferred) planted with large maturing street trees, or a 6' planting strip planted with medium maturing street trees*. The site developer and staff will be expected to justify why they are not providing the 8' planting strips. The 8' width is particularly recommended for entrance streets in new subdivisions and along any interior streets likely to carry the higher traffic volumes.

  *Approved species lists of appropriate street trees for 6' and 8' planting strips is provided by Landscape Management.

- The "Wide" street includes an 8' planting strip or an 8' amenity zone, either of which should be planted with large maturing trees.

It may sometimes be allowable to "meander" the sidewalk for short distances (affecting planting strip width) to preserve existing trees (specifically, where large lot development allows the potential for significant frontyard tree save and the existing trees are in the vicinity of the sidewalk location). Even in these cases, the planting strip must be a minimum of 4' wide (or the sidewalk must go behind the preserved trees), to maintain an adequate buffer between pedestrians and vehicles, and the distance of the "meander" should be as short as possible.

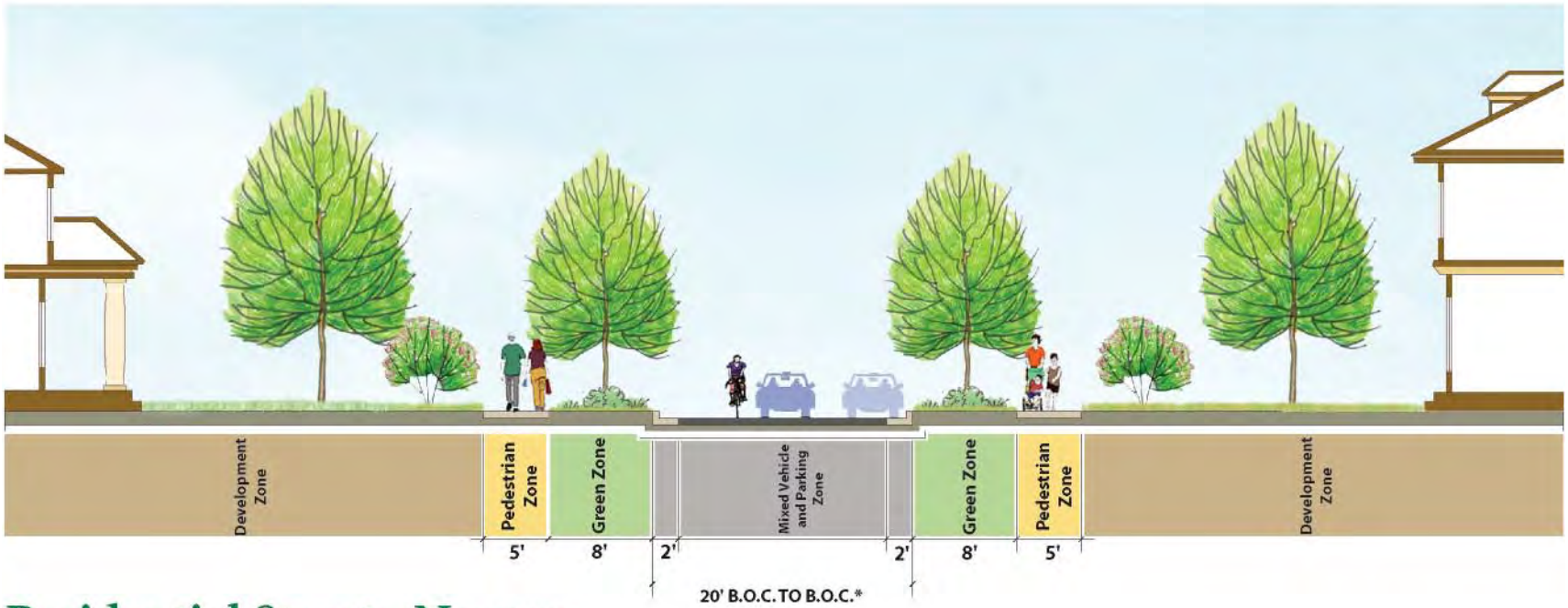
2. Retrofit projects built by the City on existing Local Streets: where deemed reasonable, the project design team is expected to provide an 8' planting strip and incorporate large maturing street trees (with trees to be planted at the time the project is completed). The team will document any reasons for deviating from the preferred width. Reasons might include:

a) avoiding interference with existing stands of mature trees,
b) steep slopes,
c) retaining walls,
d) location of existing houses,
e) location of existing utilities, or
f) other issues related to existing houses and yards.

3. Infill development projects fronting along existing Local Streets: as with #2 above, the expectation is to provide, where possible, an 8' planting strip and large maturing street trees (with trees to be planted at the time the project is completed). Any deviation should be documented in much the same way as for City projects, with the exception that items d and f would not apply for new construction (infill development projects would

typically be removing existing structures, allowing the appropriate planting strip and sidewalk widths to be constructed in most cases).

Local Residential Streets



Residential Street - Narrow

**B.O.C. - Back of Curb*

Local Residential Street - Narrow

Development Zone:

Crucial to maintaining the functionality of the Narrow Residential Street, this zone should typically include only lower-density, large-lot housing, with ample on-site parking.

Pedestrian Zone:

Crucial for safe, walkable neighborhoods, this zone includes sidewalks of adequate width for two adults to comfortably pass one another.

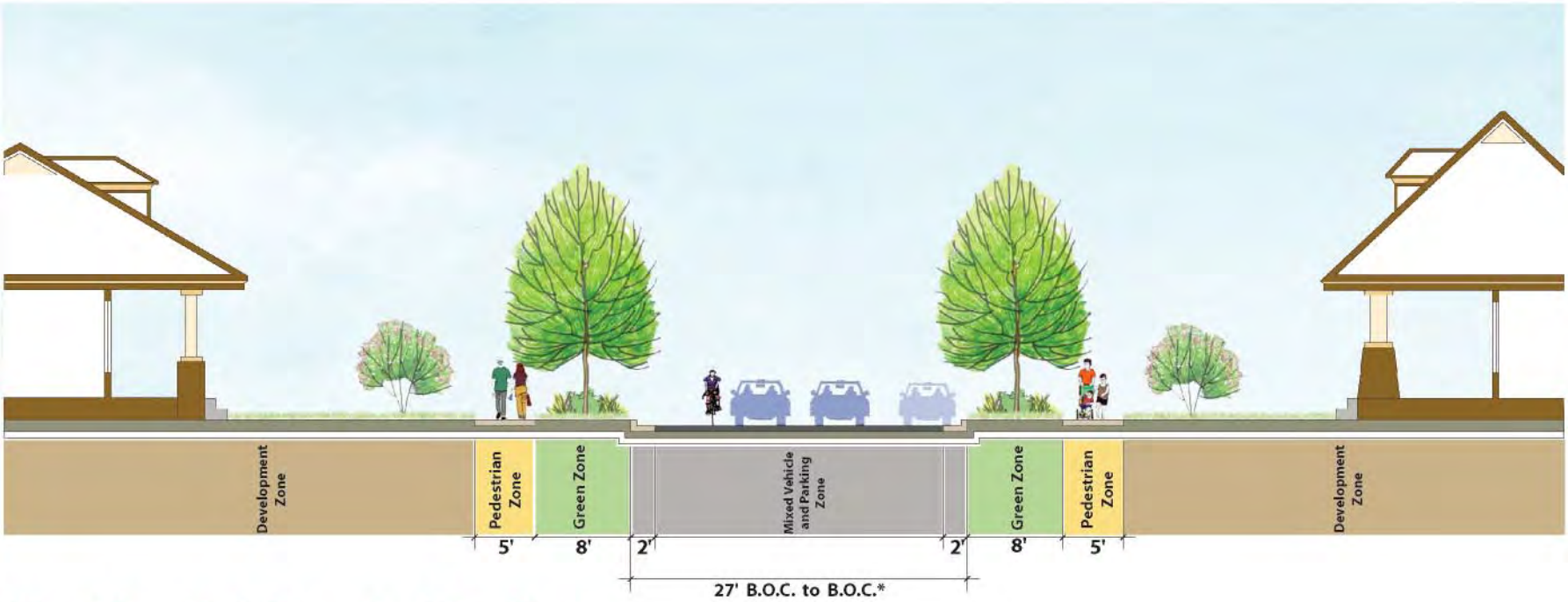
Green Zone:

Very important for pedestrian comfort and neighborhood livability, this zone should include grass, landscaping, and street trees in spacious planting strips. The tree canopy in neighborhoods can also help to calm traffic.

Mixed Vehicle and Parking Zone:

This zone sets the tone for the street's multiple objectives of allowing mobility and accessability for both motor vehicles and bicycles, while maintaining low volumes and speeds and, thereby, contributing to overall neighborhood livability. Parking will be infrequent, but can help to calm traffic.

Local Residential Streets



Residential Street - Medium

**B.O.C. - Back of Curb*

Local Residential Street - Medium

Development Zone:

This zone is characterized by low- to medium-density residential land uses, with direct access via driveways or alleys; on-site parking should be sufficient to allow most cars to be parked off of the street.

Pedestrian Zone:

Crucial for safe, walkable neighborhoods, this zone includes sidewalks of adequate width for two adults to comfortably pass one another.

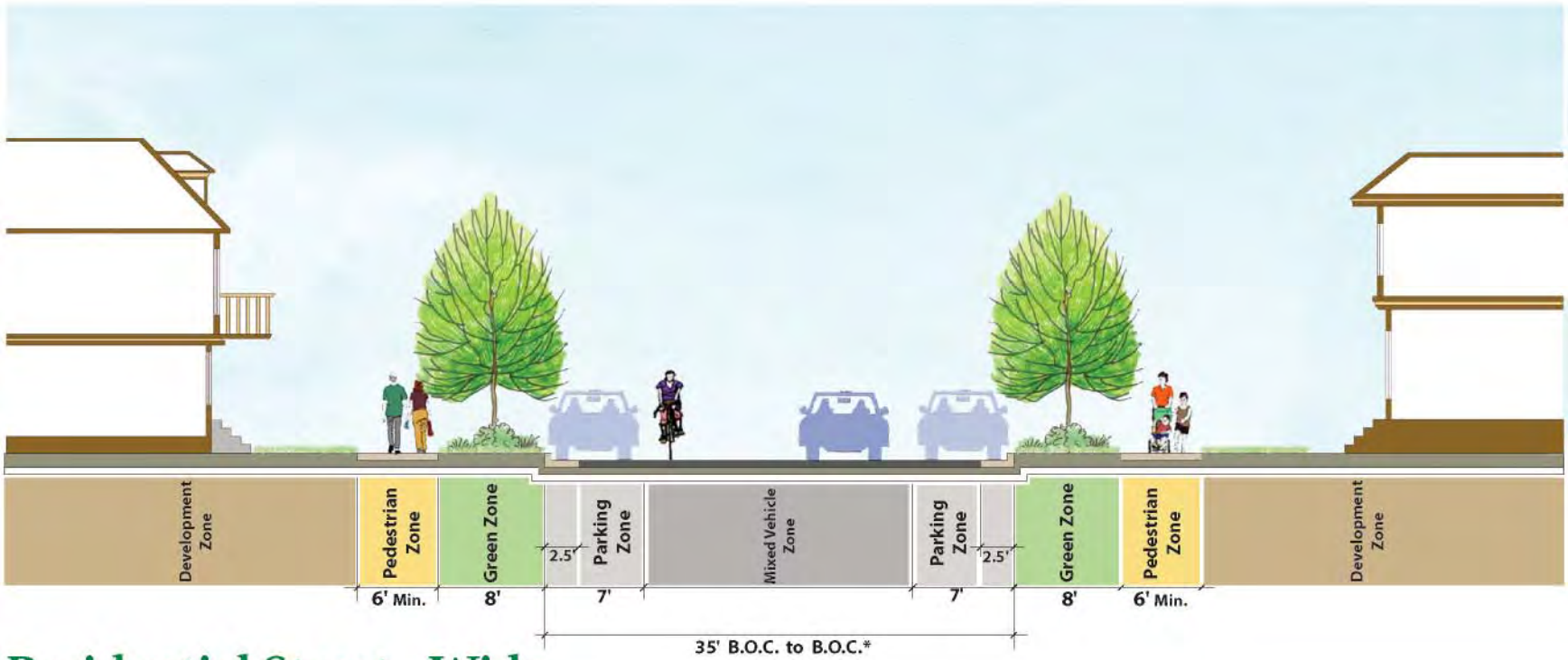
Green Zone:

Very important for pedestrian comfort and neighborhood livability, this zone should include grass, landscaping, and street trees in spacious planting strips. The tree canopy in neighborhoods can also help to calm traffic.

Mixed Vehicle and Parking Zone:

This zone sets the tone for the street's multiple objectives of allowing mobility and accessability for both motor vehicles and bicycles, while maintaining low volumes and speeds and, thereby, contributing to overall neighborhood livability. Parking on the street will occur more frequently than with the Narrow cross-section, helping to calm traffic, but most parking should be on-site.

Local Residential Streets



Residential Street - Wide

**B.O.C. - Back of Curb*

Local Residential Street - Wide

Development Zone:

This zone is characterized by medium- to high-density residential land uses, such as townhouses and other attached, multi-family uses. These land uses have small setbacks with strong functional and visual connections to the street, thereby reinforcing the pedestrian character of this street type.

Pedestrian Zone:

Crucial for safe and walkable neighborhoods and reflecting the higher density land uses characteristic of this street type, this zone includes wider sidewalks than do the other residential street types.

Green Zone:

Very important for pedestrian comfort and neighborhood livability, this zone should include grass, landscaping, and street trees in spacious planting strips or, alternatively, trees and landscaping in amenity zones.

Parking Zone:

Parking is offered in a separate zone for this residential street type, because it is expected that there will be much more demand for on-street parking in these higher-density areas.

Mixed Vehicle Zone:

Speeds and volumes are low enough on this street type for bicycles to operate in mixed traffic.

Local Residential Streets

Priority Elements

- Posted Speed – 25 mph, deemed a comfortable and safe speed allowing for residential neighborhood livability.

- Design Speed – 25 mph, set equal to the posted speed. Along with frequent "slow points", the low design speed is intended to discourage speeding.

- Number of Through Lanes – 1 in each direction (2 total).

- Lane Width – Where medians exist, the travel lanes should be 14' wide. Depending on the design context (described under "Cross-Section Alternatives"), the ideal cross-sections are:
  - The "narrow" dimension of 20' back-to-back, with parking allowed only on one side, and 12' left as open travel lane (21' back-to-back when using valley curb).
  - The "medium" dimension of 27' back-to-back, with parking allowed on both sides, and 12' left as open travel lane (28' back-to-back when using valley curb); or
  - The "wide" dimension of 35' back-to-back, with on-street parking on both sides and two 10' travel lanes left open.

- On-Street Parking – The need for on-street parking and its likely frequency of use is a major consideration in defining the appropriate cross-section for local residential streets. For the narrow cross-section, it is assumed that parking will only occur (and infrequently) on one side of the street. The medium cross-section assumes that on-street parking will sometimes occur along both sides of the street. In neither case does the parking need to be striped, but additional parking restrictions may be applied in cases where emergency vehicles are frequently or regularly blocked by on-street parking. The wide cross-section includes on-street parking (7' wide, from face-of-curb), which should preferably be striped, on both sides of the street. On-street parking will support the more urban, pedestrian nature of the higher density development adjacent to the "wide" street, help reduce on-site parking needs, and provide a degree of traffic calming.

- Curb and Gutter – The "narrow" and "medium" streets may have 2' curb and gutter or 2' mountable/valley curbs (2'). For projects in existing developments, curb and gutter should always be used instead of valley curb. The "wide" street should always have curb and gutter (2' minimum) or vertical curb. Valley curb should not be used for the "wide" street, to avoid parking/pedestrian conflicts and because it

is incompatible with the higher density land use context.

- Swales – This is not a typical urban treatment. However, swales (or other, more effective water quality bmps) may be used in some special circumstances. For example, if properly designed for water quality purposes, they may be used with the "narrow" cross-section, if densities are very low (less than 3 dua) and street frontage is at least 100'. When used, sidewalks must still be provided and there must still be sufficient drainage to keep sidewalks free from standing water. Other, similar treatments may also be considered in more urban or dense environments where there is little opportunity for adequate water quality bmps elsewhere on-site and where their design can be shown to meet not only water quality objectives, but the other objectives of the street such as adequate sidewalks, buffering from traffic, and provision of street trees. More research is needed on the applicability of these treatments in dense development, however, and these should not be considered typical for urban streets.

- Planting Strips – For appropriate planting strip dimensions, see the discussion on "Planting Strips" provided in the introduction to Section 4.5.

- Sidewalks – Sidewalks of a minimum 5' unobstructed width must be provided along the "narrow" and "medium" residential streets. For the "wide" residential street, sidewalks must be a minimum of 6' wide unobstructed at densities less than 12 dua and a minimum of 8' wide unobstructed at densities greater than 12 dua. Sidewalks may be provided in an easement.

- Driveways – Are appropriate, as direct access is allowed on local streets. For townhouse style or dense single family development, rear-accessed parking is encouraged, to minimize driveways.

- Lighting – Where ambient light is insufficient for pedestrian visibility, decorative pedestrian-scale lighting should be provided along "narrow" and "medium" segments. Decorative pedestrian-scale lighting should *always* be provided along the "wide" segments, since pedestrian activity is expected in this context. Pedestrian lighting should be sufficient to illuminate the sidewalk, as well as to provide for pedestrian visibility and safety from crime. Street lighting would typically not be provided mid-block on Local Residential Streets, except to address specific safety concerns. If absolutely necessary in a mid-block location, sharp cut-off ornamental fixtures should be used. In some cases, the pedestrian-scale lighting may also be sufficient for street lighting as determined by a lighting study.

Local Residential Streets

- Utilities – To preserve sidewalk capacity for pedestrians, maintain a clear zone per ADA requirements, and allow larger trees and other aesthetic treatments, utilities should be placed underground, wherever possible, taking care to minimize conflicts with street trees. If underground placement is not possible, the next locations to consider for poles are at the back of property (with an alley), behind the sidewalk (where greater setbacks allow) or, least preferred, in the planting strip (where lesser setbacks exist). Under no circumstances should poles be placed in the sidewalk and, as with underground placement, every attempt should be made to avoid or minimize conflicts with street trees. Utility poles should be consolidated where possible, with redundant poles removed in retrofit situations.

- Traffic Calming – Local Residential Streets are intended to be low-speed streets and traffic calming should be provided as part of the street design. In addition to design features that inherently provide traffic calming (on-street parking, for example), specific "slow points" should be incorporated into the design, every 300-500', to maintain the design speed. Given the short block length expected on these streets (see below), stop controlled intersections can serve as "slow points". See CDOT's Traffic Calming Report for other appropriate types of slow points.

- Block Length – Refer to Table 4.1 in the introduction to this chapter for block size dimensions for these streets. Whatever the block size and dimensions applied, the block face length should be related to the slow point spacing described above (under "Traffic Calming"). In other words, if a blockface is 600' long, then a mid-block slow point will be required. Conversely, a 400' blockface might not require a mid-block slow point, depending on whether the intersections at either end of the block can serve as slow points.

- Bus Stops – If there are bus routes on a Local Residential Street, mid-block stops are allowable, where necessary to maintain preferred spacing.

Other Elements to Consider

- Medians – Typically not appropriate, but may be allowable for aesthetic purposes, in which case they should be a minimum of 8' wide to provide enough space for trees.

- Median Planting – If medians exist, they should be landscaped, preferably with trees, since the purpose of the median in the local street context is for aesthetics.

- Sidewalk Amenity Zone – Inappropriate for lower density settings (with

the "narrow" and "medium" cross-section), because planting strips are the preferred treatment to provide separation between pedestrian and vehicular traffic. Where the "wide" cross-section is used, the amenity zone is still not required, but should be considered in locations where on-street parking parallels high pedestrian activity zones, especially if the residential land use includes ground floor retail (though these uses could be more appropriately categorized as Local Office/Commercial Streets). In such cases, the amenity zone could either substitute for or alternate with the planting strip. An amenity zone may also be appropriate in constrained situations where an 8' planting strip is impossible – as described under "Planting Strips" – and a narrower amenity zone will further enhance the sidewalk (by providing more space for pedestrians).

Inappropriate Elements:

- Pedestrian Refuge – Not necessary on a 2-lane local street, particularly when other traffic calming devices are provided to maintain the relatively low speeds.

- Curb Extensions – Typically inappropriate, except where used for traffic calming purposes. See Chapter 5 for a discussion of curb extensions at intersections.

- Shoulder – Inappropriate for a local street in an urban or suburban setting.

- Bicycle Lanes – Typically not necessary on local streets, because bicycles can share the lanes with low-volume, low-speed traffic. Local streets may be designated as bicycle routes, particularly in locations close to Parkways, where a nearby, alternative route is desirable.

- Mid-Block Pedestrian Crossings – Typically unnecessary on a 2 lane street with low volumes and speeds. May be considered under certain circumstances, as outlined in CDOT's Mid-Block Crossing Policy.

Section 4.6 Local Office/Commercial Streets

Overview

Local streets provide for direct access to specific land uses or sites, in this case to office, commercial, or mixed land uses. Local Office/Commercial Streets will apply to developments ranging from very pedestrian-oriented retail locations (similar to Main Streets) to business parks. Whatever the specific land use type or development style along these streets, the goal is to create a convenient and safe network of well-designed streets. The alternative cross-sections described in this section are intended to accommodate the variety of land uses served by Local Office/Commercial Streets, while also providing consistent, high-quality street design.

Land uses along Local Office/Commercial Streets include office, commercial, and/or mixed-use developments, which may be either pedestrian- or auto-oriented. Commercial uses could include restaurants and other convenience retail services, as well as concentrations of specialty shops or other, single retail uses. Office uses could be developed as mid or high-rise office buildings, or as a business park.

Camden Road in South End.

Although land uses on these streets may be pedestrian-oriented, auto-oriented, or somewhere in-between, the general intent is that these local streets (and the uses along them) will accommodate travel by a variety of modes. To maintain or foster a reasonably accessible pedestrian environment, buildings should have entrances that face the street and sidewalks connecting the buildings to the streetfront sidewalks, parking areas, and, where appropriate, adjacent buildings. Setbacks will vary, as will parcel size.

Even with the wide variety of land uses and two cross-section options (described below under "Cross-Section Alternatives"), there are several characteristics common to all Local Office/Commercial Streets. These characteristics recognize that the majority of the people traveling on these streets are searching for or visiting shops or businesses along them, or are either residents or visiting residents. Therefore, traffic speeds on these streets are lower than on Boulevards and most Avenues. Design and posted speeds are set equal to one another, with appropriate traffic calming built into the street design. Access to and from sites consists of individual driveways permitted in

Local Office/Commercial Streets

appropriate locations. However, along blocks with smaller setbacks and higher levels of concentrated pedestrian activity, shared driveways are highly encouraged.

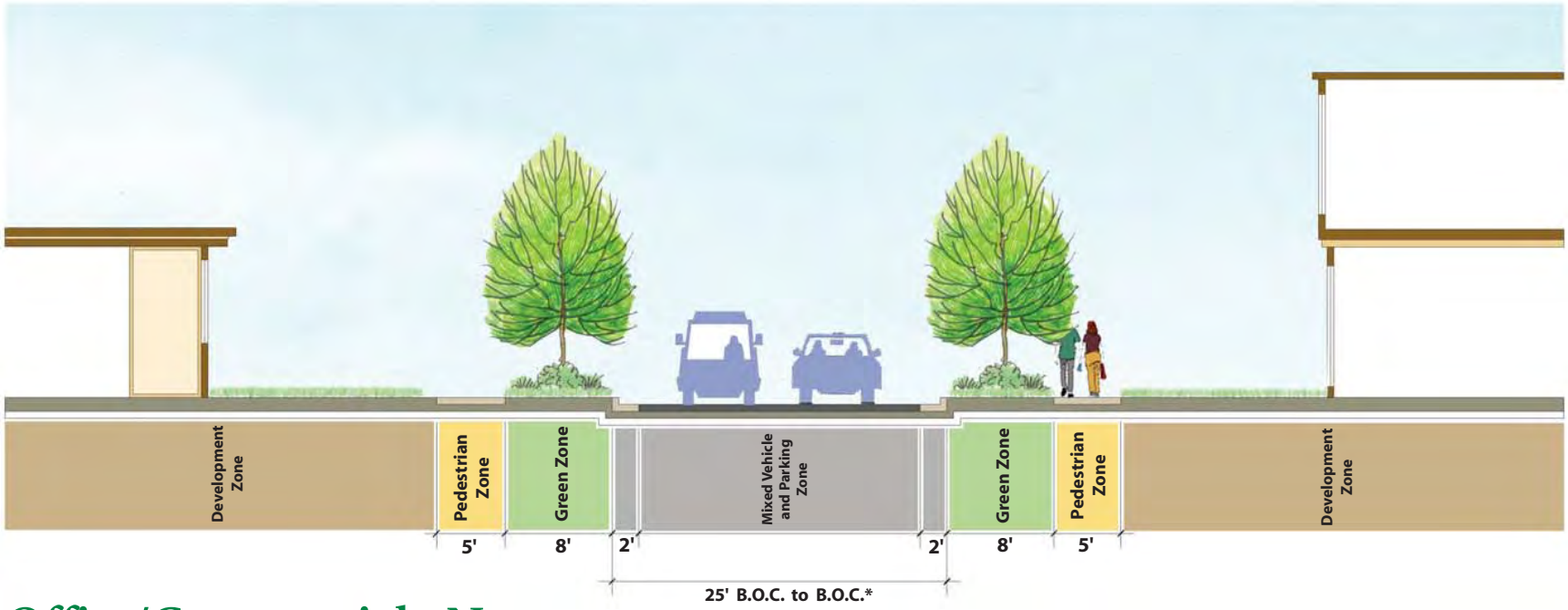
Birkdale Village. Higher density, mixed uses increase the need for spacious pedestrian areas.

Local Office/Commercial Streets are designed to safely accommodate pedestrians and cyclists, as people travel between land uses along the street or to and from nearby residential areas. Continuous sidewalks are required along all of these streets. Other treatments include trees, street furniture in pedestrian activity areas, and appropriately scaled signage. Cyclists are expected to operate in mixed traffic, since the traffic volumes and speeds are low. Transit stop spacing and locations will vary, depending on the intensity of land uses along the street.

Cross-Section Alternatives

As with Local Residential Streets, there is more than one cross-section option available for the design of Local Office/Commercial Streets: a "narrow" cross-section and a "wide" cross-section. Both options are intended to maintain the desired functionality of Local Office/Commercial Streets, where both traffic volumes and speeds are relatively low. The "wide" option is ideal in a more commercial or mixed-use type of environment, where there is limited off-street parking nearby, short-term visitors are likely, and there is, therefore, a high demand for on-street parking. In an office park environment, where surface parking is offered off-street in sufficient quantity and proximity, on-street parking is less likely to be used. In that case, the "wide" option would result in a street that is too wide, so the "narrow" option is the ideal, to help maintain low speeds.

Local Office/Commercial Streets



Office/Commercial - Narrow

**B.O.C. - Back of Curb*

Local Office/Commercial Street - Narrow

Development Zone:

Important to maintaining the functionality of the narrow street, this zone will typically include office park style development, with ample on-site parking.

Pedestrian Zone:

Crucial for creating a safer, walkable environment, this zone includes sidewalks of adequate width for two adults to comfortably pass one another.

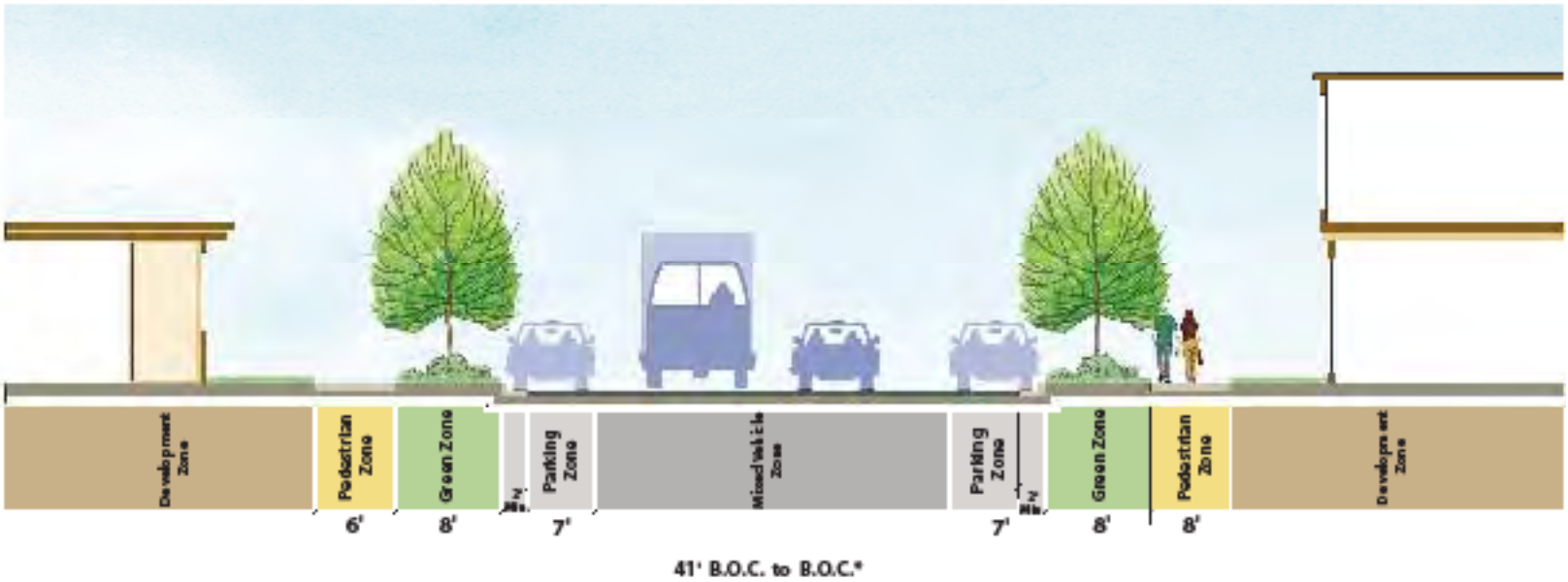
Green Zone:

Very important for pedestrian comfort, this zone should include grass, landscaping, and street trees in spacious planting strips. The tree canopy can also help to calm traffic.

Mixed Vehicle Zone:

This zone sets the tone for the street's multiple objectives of allowing mobility and accessibility for both motor vehicles and bicycles, while maintaining low volumes and speeds. Parking will be on-site, rather than on-street.

Local Office/Commercial Streets



Office/Commercial - Wide

*B.O.C. - Back of Curb

Local Office/Commercial Street - Wide

Development Zone:

Serving a variety of commercial land uses, this zone shares some characteristics with Main Street type development, including higher intensity development, buildings that front the street, and a greater likelihood of mixed uses than with the Narrow Office/Commercial Street.

Pedestrian Zone:

Important for reinforcing the pedestrian nature of this street type, this zone includes spacious sidewalks to complement the pedestrian-orientation of the buildings in the development zone.

Green Zone:

Very important for supporting the pedestrian character of the Wide Office/Commercial Street, this zone includes street trees and other landscaping in a planting strip or, alternatively, in appropriately designed planters in a hardscaped amenity zone. This zone also provides extra buffering between the pedestrian and vehicle zones.

Parking Zone:

Important for supporting the pedestrian character of this street type, the marked parking zone calms traffic, provides parking for businesses, and buffers pedestrians from moving traffic.

Mixed Vehicle Zone:

This zone sets the tone for the street's multiple objectives of allowing mobility and accessibility for both motor vehicles and bicycles, while maintaining low volumes and speeds. Motor vehicles and bicycles operate together in the travel lanes.

Local Office/Commercial Streets

Priority Elements:

- Posted Speed – 25 mph, deemed a comfortable and safe speed for local streets in urban environments.

- Design Speed – 25 mph, set equal to the posted speed. Along with frequent "slow points", the low design speed is intended to discourage speeding.

- Number of Through Lanes – 1 in each direction (2 total).

- Lane Width – Should provide at least 12' lanes to accommodate maneuvering delivery trucks and other large vehicles. The cross-section should reflect one of two options:

    - A "wide" dimension of 41' back-to-back, with two 13' travel lanes and on-street parking (7' wide) on both sides; or

    - A "narrow" dimension of 25' back-to-back, with two 12' travel lanes (including gutter) and no on-street parking.

- On-Street Parking – Parallel parking should typically be provided on both sides of the street (7' wide), preferably striped, where the wide cross-section is employed. In that case, on-street parking will help reduce off-street parking needs and provide a degree of traffic calming. On-street parking should not be provided where the narrow cross-section is employed.

- Curb and Gutter – Should always have curb and gutter or vertical curb. If curb and gutter is provided, 2'0" is the minimum.

- Planting Strips – Planting strips improve the pedestrian environment by providing separation between pedestrian and vehicular traffic, as well as shade when they are planted with large maturing trees. To achieve these goals, planting strips should be at least 8' wide. Where on-street parking is likely to be most intensely used (directly adjacent to commercial or mixed-use buildings, for example), consider alternating recessed on-street parking with the planting strip and paved amenity zones with trees in appropriately designed planters.

- Sidewalks – Pedestrian activity is to be expected, encouraged, and accommodated on these streets. In the higher density commercial or mixed-use context, where on-street parking and the wider cross-section are used, sidewalks should provide a minimum of 8' unobstructed width. In the lower density office setting, without on-street parking (and where the narrow cross-section is used), provide a 5' minimum unobstructed width.

Local Office/Commercial Streets

- Bus Stops – If there are bus routes on a Local Office/Commercial Street mid-block stops are allowable, where necessary to maintain preferred spacing.

- Driveways – Are appropriate, to allow frequent access to adjacent land uses. However, in higher density locations, shared driveways are encouraged.

- Lighting – Street lighting is to be provided. Separate pedestrian lighting should always be provided along the "wide" cross-section and should be considered anywhere higher levels of pedestrian activity are anticipated, either because of adjacent or surrounding commercial activity or because the area provides a major pedestrian route or pathway between land uses or to parking areas. Where provided, pedestrian lighting should be sufficient to illuminate the sidewalk, as well as to provide for pedestrian visibility and safety from crime. In some cases, the pedestrian-scale lighting may also be sufficient for street lighting, as determined through a lighting analysis.

- Utilities – To preserve sidewalk capacity for pedestrians, maintain a clear zone per ADA requirements, and allow larger trees and other aesthetic treatments, utilities should be placed underground, taking care to minimize conflicts with street trees. If underground placement is not possible, the next locations to consider for poles are at the back of property (with an alley), behind the sidewalk (where greater setbacks allow) or, least preferred, in the planting strip (where lesser setbacks exist). In no circumstance should poles be placed in the sidewalk and, as with underground placement, every attempt should be made to avoid or minimize conflicts with street trees. Utility poles should be consolidated where possible, with redundant poles removed in retrofit situations.

- Traffic Calming – Local Office/Commercial Streets are intended to be low speed streets and traffic calming should be provided as part of the street design. In addition to design features that inherently provide traffic calming (on-street parking, for example), specific "slow points" should be incorporated into the design, every 300'-500', to maintain the design speed. See CDOT's Traffic Calming Report for appropriate types of slow points.

- Block Length – To provide appropriate scale and connectivity options for all modes, the block lengths described in Table 4.1, located in the introduction to this chapter, should be applied.

Local Office/Commercial Streets

Other Elements to Consider

- Sidewalk Amenity Zone – Not required, but may be allowable in the higher density commercial or mixed-use context, where on-street parking and the wider cross-section are used. In such cases, the amenity zone could either substitute for or alternate with the planting strip (unless the planting strip is alternated with recessed on-street parking, in which case, the amenity zone is unnecessary).

- Medians – Typically not appropriate, but may be allowable for aesthetic purposes, in which case they should be a minimum of 8' wide. In addition, lane widths should be increased to 14', exclusive of parking lanes.

- Median Planting – If medians exist, they should be landscaped, preferably with trees, since the purpose of the median in the local street context is for aesthetics.

Local Office/Commercial Streets

Inappropriate Elements:

- Pedestrian Refuge – Not necessary on a 2-lane local street, particularly when other traffic calming devices are provided.

- Curb Extensions – Typically not provided on segments, unless they are to be used for traffic calming.

- Bicycle Lanes – Typically not necessary on local streets, because bicycles can share the lanes with lower-volume, low-speed traffic. Local streets may, however, be designated as bicycle routes, particularly in locations close to Parkways, where a nearby, alternative route is desirable.

- Shoulder – Inappropriate for a local street in an urban or suburban setting.

- Mid-Block Pedestrian Crossings – Typically unnecessary on a 2-lane street with low volumes and speeds.

May be considered under certain circumstances, as outlined in CDOT's Mid-Block Crossing Policy.

Section 4.7 Local Industrial Streets

Overview

Local Industrial Streets provide direct access to predominantly industrial or warehouse/distribution land uses. Their design is geared toward the operational requirements of large volumes of trucks serving these land uses, while also recognizing that other modes and complementary land uses should be accommodated. These streets balance design elements derived from the space and maneuverability characteristics of large trucks with the design elements that create an aesthetic and traffic calmed environment for safer and more comfortable travel by pedestrians, bicyclists, and motorists.

Land uses located along Local Industrial Streets typically include warehousing, distribution, and manufacturing sites, interspersed with restaurants and some convenience retail to serve nearby employees and businesses. Relatively large parcels are prevalent on Local Industrial Streets to accommodate industrial or warehouse uses, and building setbacks will vary. These types of land uses will have some functional requirements that can make orienting buildings to the street difficult or even infeasible. However, any opportunities to front buildings onto the street should be strongly considered, because one design objective is to ensure that pedestrians are well-separated from truck and auto traffic, and another objective is to create "eyes on the street", an important aspect of pedestrian safety and comfort.

Local Industrial Streets are wider than other local streets and may include larger curb radii, for maneuverability of larger trucks. Blocks may be longer (up to 1,000') than for other local streets, due to the likelihood of larger parcels, freeway or rail frontage, and more land extensive uses. These sites should be well-connected to the rest of the street network, with multiple connections wherever possible. Traffic volumes on Local Industrial Streets are low. Designed and posted speeds are also low and are set equal to one another. Direct access is typical, with individual driveways permitted.

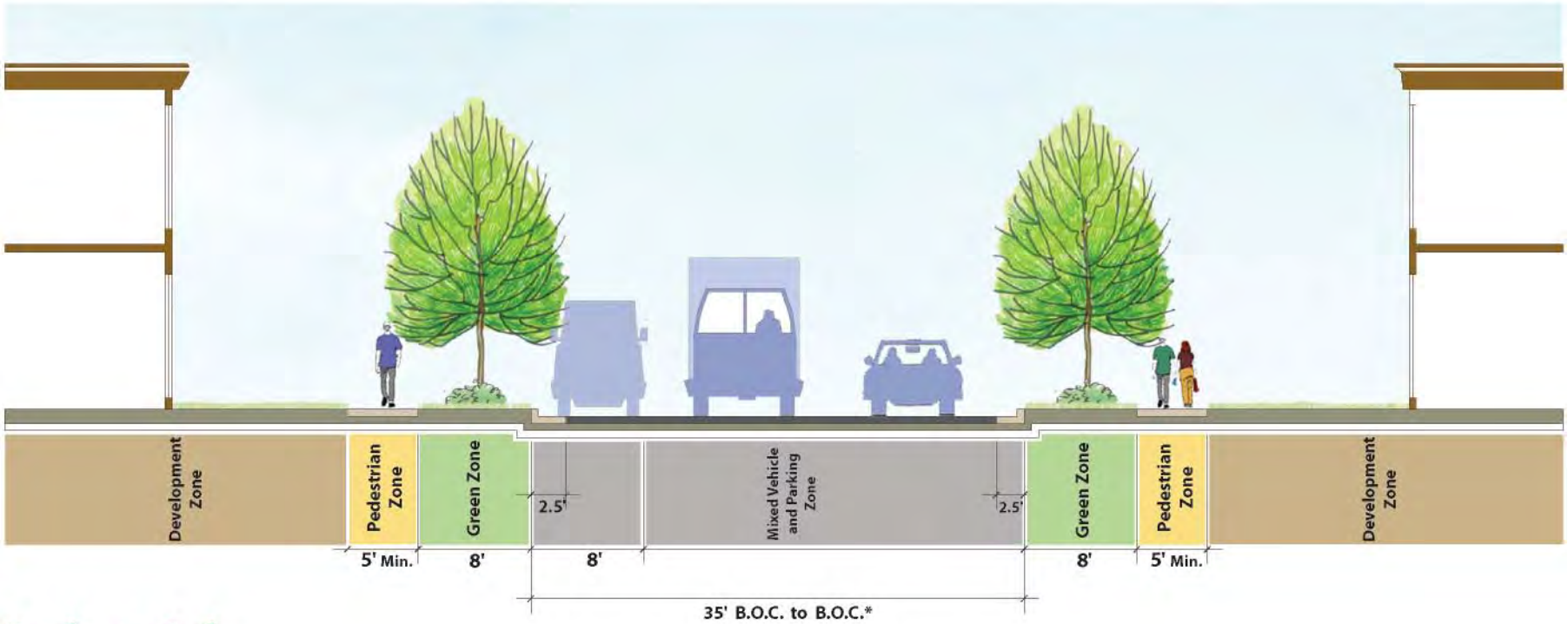
An Industrial Street where the buildings front the street, but the pedestrian pathway is non-existent or interrupted by driveways and parking lots.

Local Industrial Streets

Although Local Industrial Streets are assumed to have relatively low levels of pedestrian activity compared to other local streets, the higher volumes of truck traffic and the more auto- and truck-oriented street design do not eliminate the need to provide safe and comfortable pedestrian pathways. That is why continuous sidewalks are provided. These streets should also include the basic elements of other local streets, including planting strips with street trees, for shade and aesthetics. The frequency of bus stops along Local Industrial Streets will vary, depending on the locations of access points to individual sites or employment concentrations.

Buildings are likely to be set back from the street in industrial areas.

Local Industrial Streets



Industrial

**B.O.C. - Back of Curb*

Local Industrial Street

Development Zone:

The land uses in this zone are likely to be land extensive, with large parcels and varying setbacks.

Pedestrian Zone:

This zone is very important because of the auto/truck traffic found within this street type and the need to provide a separate pathway for pedestrians. This zone includes sidewalks of adequate width for two adults to comfortably pass one another.

Green Zone:

Very important for pedestrian comfort, this zone should include grass, landscaping, and street trees in spacious planting strips. The tree canopy can also help to calm traffic.

Mixed Vehicle/Parking Zone:

This zone sets the tone for the street's multiple objectives of allowing mobility and accessibility for both motor vehicles and bicycles, while maintaining low volumes and speeds. The demand for on-street parking will be influenced by the location of driveways and the layout of the industrial sites, but is generally expected to not require a separate zone within the right-of-way.

Local Industrial Streets

Priority Elements

- Posted Speed - 25 mph, deemed a safe and comfortable speed in urban environments.
- Design Speed - 25 mph, set equal to the posted speed. Low design speed is intended to discourage speeding.
- Number of Through Lanes - 1 in each direction (2 total).
- Lane Width - Typically, 12 ft lanes. The cross section is 35' back-of-curb to back-of-curb, to allow two 12' travel lanes, 8' for parking (on one side), and 2' gutter (on the side not used for parking). These dimensions should provide for adequate maneuverability and potential staging of vehicles, if necessary.
- On-Street Parking - Parallel parking typically provided on one side of the street, 8' wide (including the gutter), to allow for truck parking when necessary.
- Curb and Gutter-Should always have 2'6" curb and gutter.
- Planting Strips - The planting strip provides separation between pedestrian and vehicular traffic and room for healthy tree growth, an important consideration in a low density, industrial environment. Should be a minimum of 8' to support large maturing trees.
- Sidewalks - Pedestrian traffic may be lighter in industrial locations than in other local street contexts, but pedestrians must still be accommodated, particularly given the truck traffic on the Local Industrial Street. Minimum 5' unobstructed width sidewalks must be provided.
- Driveways - Appropriate, as direct access is expected.
- Lighting - Street lighting typically provided along segments only where necessary for safety. Separate pedestrian lighting is typically not necessary.
- Utilities - To preserve sidewalk capacity for pedestrians, maintain a clear zone per ADA requirements, and allow larger trees and other aesthetic treatments, utilities should be placed underground, taking care to minimize conflicts with street trees. If underground placement is not possible, the next locations to consider for poles are behind the sidewalk or in the planting strip. In no circumstance should poles be placed in the sidewalk and, as with underground placement, every attempt should be made to avoid or minimize conflicts with street trees. Utility poles should be consolidated where possible, with redundant poles removed in retrofit situations.
- Block Length - As described in Table 4.1, in the introduction to this chapter, Local Industrial Streets' block lengths may be longer than other local street types, due to the land uses and typically larger building footprints, but should not exceed 1000', to help maintain connectivity.

Local Industrial Streets

Other Elements to Consider

- Bus Stops – If there are bus routes on a Local Industrial Street, mid-block stops are allowable, where necessary to maintain preferred spacing.

Inappropriate Elements

- Medians – Inappropriate for a Local Industrial Street, since direct access to land uses and maneuverability for large vehicles is expected.

- Median Planting – Not applicable, since medians are not provided for a Local Industrial Street.

- Pedestrian Refuge – Typically not necessary on a 2-lane street, since the speeds and volumes are relatively low.

- Curb Extensions – Inappropriate for a Local Industrial Street with low volumes and speeds, particularly given the potential for truck traffic.

- Bicycle Lanes – Typically not necessary on local streets, because bicycles can share the lanes with the lower-volume, lower-speed traffic. Local streets may be designated as bicycle routes, particularly in locations close to Parkways, where a nearby, alternative route is desirable.

- Shoulder – Inappropriate for a Local Industrial Street in an urban or suburban environment.

- Sidewalk Amenity Zone – Inappropriate for a Local Industrial Street, since pedestrian traffic will be relatively low and the planting strip will provide separation between the pedestrian and the vehicular traffic.

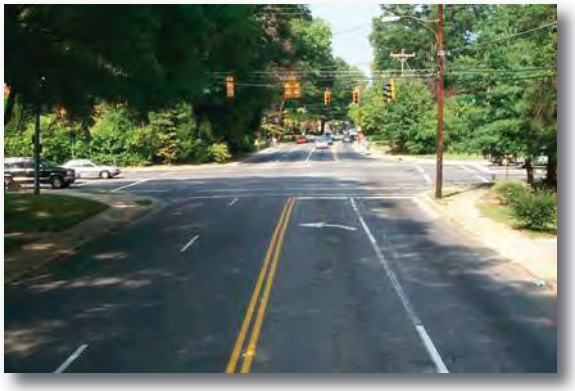
- Mid-Block Pedestrian Crossings – Typically inappropriate on a 2-lane street with low volumes and speeds, although they may be considered under certain circumstances, as outlined in CDOT's Mid-Block Crossing Policy.

- Traffic Calming – Inappropriate for a Local Industrial Street because of the prevalence of large vehicles.

5. INTERSECTIONS

Designing Intersections

This chapter includes the guideline recommendations with the most potential for conflicts and tradeoffs – the ones for designing intersections. In addition to Tables 5.1-5.5, which provide information about most design elements related to the various possible intersection types, this chapter also describes Charlotte's new approach to evaluating the level-of-service (LOS) at intersections for motorists, pedestrians, and bicyclists.



Designing street segments often involves tradeoffs (particularly when retrofitting

streets without ample right-of-way), but designing intersections is even more complicated, for the following reasons:

- There are a large number of possible intersection types, due to the many combinations of street types. Furthermore, each intersection will potentially vary from the "ideal" or "preferred" design, particularly when the requirements of specific land use contexts are also considered.
- Intersections are where the transitions between different street types are most likely to occur. These transitions can be problematic, as they present potential conflicts between those elements that might support one street type over another.
- Vehicular traffic delays occur most often at intersections, so engineers typically attempt to reduce travel delays by increasing capacity at intersections. However, intersections are also where pedestrians are expected to cross the street. Conflicts are therefore created, because capacity increases for motorists often lead to lower LOS for other travelers (pedestrians and cyclists). Simply put, each additional turn lane or through lane makes crossing that intersection by foot or bicycle more difficult and is also more likely to directly affect the adjacent land uses through loss of right-of-way. This means that working through design tradeoffs is both more difficult and potentially more important for intersections than for street segments.

- Given the importance of intersections for congestion relief, pedestrian crossings, and commercial interests, these locations are also often where mismatches between transportation and land uses occur.

All of the above issues combine to make intersection design the most likely point of contention between traffic engineers, land use planners, urban designers, the traveling public, and those people who live and work near an intersection. The information contained in this chapter and in Appendices A-C is intended to provide guidance through the myriad tradeoffs associated with intersection design and to support the Urban Street Design Guidelines' objective of providing safer and more convenient travel for all modes.

Level of Service at Signalized Intersections

A consistent definition of the *verb* "intersect" is to "cut or divide by passing through or across". A consistent definition of the *noun* "intersection" is "a place where two or more roads (or streets) meet" or "a junction of roads (or streets)." Common synonyms for the noun "intersection" include crossroads, crossing, or corner. However defined, an intersection is where motorists, pedestrians, and bicyclists come together in their travel, and they compete for the use of the same space or signal time.

A motorist's interest in maintaining a smooth flow through intersections – to not have to wait 1 to 3 minutes for the next green signal phase at a signalized intersection, or to find a safe gap between vehicles traveling on the street perpendicular to his or her approach – collides with the interests of pedestrians and bicyclists to travel across or through the intersection safely. Motor vehicles traveling through, or making right or left turns will be competing for the same roadway space or signal green time. Pedestrians will be looking for shorter crossing distances and, especially, to not find themselves in conflicts with turning vehicles. Bicyclists will be looking for separation from motor vehicles.

At this intersection, the competition between motorists and pedestrians for the same space is particularly pronounced. Vehicles making this right turn and pedestrians wanting to cross in the crosswalk are in obvious conflict, especially since right-turns-on-red are allowed.

As discussed earlier, intersections are also much more likely than segments to be the places where there are capacity deficiencies. This is why more through or turn lanes are added at intersections. A segment with only two travel lanes in one travel direction may widen to four lanes at an intersection, for example.

There is an ongoing, intense pressure for traffic engineers to add lanes at intersections, so as to reduce delays for motor vehicles traveling during peak travel periods. However, the decisions made about enhancing traffic LOS conditions during peak traffic periods will affect the cross-section of the intersection for all hours of every day and night. This is why, as part of these Guidelines, CDOT is changing the analytic process and the City will be changing the stakeholders' expectations about the physical and operational design of intersections.

To that end, CDOT has devised methodologies for determining LOS for bicycles and pedestrians at signalized intersections. The technical details of these methodologies can be found in Appendix B, and a more detailed description of their application is found in Appendix A.

Appendix A describes the analytic process and multi-modal assumptions that will be used for any evaluation of or construction project for a signalized intersection—anyone involved in such analyses should be familiar with and apply this approach.

The intersection of Sharon and Fairview Roads (above): capacity increases made for motor vehicles have made pedestrian crossings in this multi-use area much more difficult.

The intersection of Randolph and Wendover Roads (right), is an example where capacity increases for motor vehicles have affected pedestrian level-of-service, though the land uses and their orientation to the intersection make the issue less obvious.

The bicycle and pedestrian LOS methodologies, described in Appendix B, are used—in conjunction with existing traffic analysis methods—to evaluate how a signalized intersection performs for all travelers. Traditionally, the concept of LOS has only been applied to motor vehicles and then mostly related to traffic congestion or reduction of motorists' delay. The types of improvements that result from such a single mode approach, however, are not necessarily benign for other travelers or for the City. For that reason, these Guidelines introduce the approach wherein all users' interests are evaluated when making decisions about intersection design.

The Guidelines' multi-modal approach to intersection planning and design includes a "trigger" or threshold for considering an intersection for potential capacity increases. As outlined in the technical table in Appendix A, that threshold value varies according to the street type. Since Main Streets and some Avenues are intended to be much more pedestrian-oriented than are Boulevards and Parkways, it stands to reason that the threshold required to investigate potential vehicular capacity increases at these intersections should be set higher, to avoid unintended negative impacts on pedestrians, cyclists, and adjacent land uses. Therefore, the threshold volume/capacity (V/C) ratio for motor vehicles is not only higher, but it will also be measured for two hours, rather than for only the peak 60 minute period.

Using a higher threshold doesn't mean that congestion is ignored, only that its influence is tempered to meet other street design objectives. This approach allows careful consideration of the likely impacts of potential improvements on pedestrians, cyclists, and the adjacent land uses, *prior to making design decisions based solely on traffic congestion.*

Once the threshold for a *given intersection type is met* and an intersection is listed as "saturated", then the intersection will be evaluated as to the types of options that might be implemented and the potential impacts of those options. The pedestrian and bicycle LOS methodologies will be applied to meet the target pedestrian and bicycle LOS for that specific intersection type.

In some cases, meeting the pedestrian and bicycle LOS targets may prove very difficult if vehicular capacity increases are provided. The LOS measures for these modes are primarily determined by the number of lanes that must be crossed on foot or by bike and the physical and operational (signalization) elements included to aid in crossing. Depending on the land use context and other functional aspects of the surrounding street network, it may not be possible to both expand capacity and maintain or enhance other travelers' LOS. Where that occurs, the planning and design

team should thoroughly evaluate the overall objectives for the intersection in relation to the rest of the network and the City's goals for provision of multi-modal streets. In many parts of the City, the decision may well be that the capacity improvement cannot or should not occur.

Sight Distance at Corners

Once the decision to make changes at an intersection occurs, the tables found in this chapter are used to decide how, and in which combinations, various design elements should be provided in the design of that intersection. An important design consideration that is not, however, included in Tables 5.1-5.5, is corner sight distance, which impacts the relationship between the street and the buildings adjacent to it.

Sight distance refers to the ability of motorists to see other vehicles or objects in the street without obstructions. Sight distance is applicable where motorists need to decide whether to stop or whether to enter an intersection.

These Urban Street Design Guidelines have some objectives that will change the way that CDOT's current sight distance recommendations are applied. In general, CDOT's Sight Distance

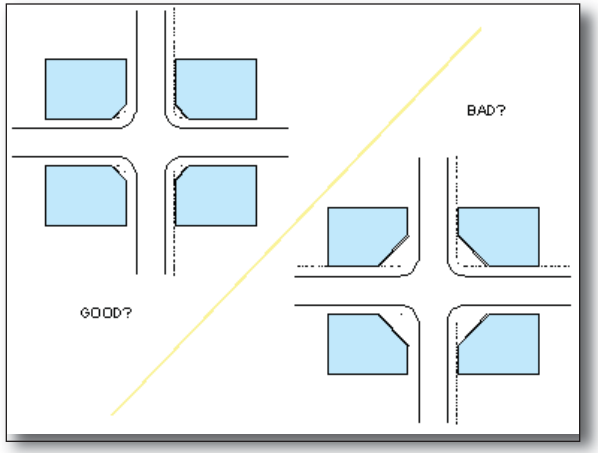


Figure 5.1. Sight Distance Triangles in Urban Locations: Potentially Conflicting Objectives?

Policy will be applied to all intersections, although there are some instances that will call for using the policy with the greatest possible flexibility. For example, in a very urban or pedestrian-oriented context, there may be a conflict between sight triangles (the space available for drivers to see each other as they approach an intersection) and the desire to have buildings situated close to the street or even directly behind the sidewalk (Figure

5.1). Even with the wider sidewalks and amenity zones found in these areas, meeting the requirement of a strictly applied sight triangle for an adjacent intersection may not be possible or desirable. Likewise, the requirements for departure sight triangles along streets (when pulling out of side streets or driveways), if applied strictly, may conflict with the desire to provide bus shelters, street furnishings, or enough street trees of sufficient size to create a canopy.

On the other hand, on streets designed for other contexts, where higher speeds and land uses with deeper setbacks are found, a stricter application of the sight distance recommendations is required. In those cases, the traditional viewpoint of maintaining adequate "room for error" by motorists is necessary for maintaining safety - a worthwhile objective and intended outcome for all streets and intersections defined within these Guidelines.

In summary, corner sight distance must be applied carefully, to avoid unintended and potentially negative consequences. As with many of the recommendations contained within these Guidelines, those designing a street should make an effort to best match the design outcome to the surrounding context.

Traffic Signal Timing

As described earlier in this chapter, designing the physical elements of an intersection to satisfy multiple objectives related to motorists, pedestrians, and cyclists can be challenging. Likewise, there are many tradeoffs to consider when timing traffic signals, because people traveling through one location and using different modes essentially "compete" for green signal time. Specific signal timing recommendations are not included in Tables 5.1 – 5.5, but signal timing is an important and complex component of meeting the multi-modal objectives of these Urban Street Design Guidelines.

Why is signal timing so complex? The following illustrates some of the difficulties of satisfying everyone who is impacted by signal timing at an intersection:

- Not surprisingly, most motorists do not like to be stopped by traffic signals.

Once they do stop, they typically want to move again as soon as possible.

- Traffic signal timing traditionally heavily favors (provides more "green time" to) the higher-volume street over the lower-volume street – sometimes creating noticeably higher delays for motorists waiting on the lower-volume street. Motorists on the higher-volume street are less likely to be stopped at any given side street, but motorists on the lower-volume street often feel that their wait is excessive.
- In addition to "fairly" allocating green time between competing motorists, it is also important to provide enough green time for safe pedestrian crossings – which can have the unintended consequence of increasing overall cycle lengths at the intersection. However, it is important to provide for pedestrians, particularly in pedestrian-oriented areas, and even where it might be more difficult, such as at very large or high-traffic-volume intersections, where pedestrians might otherwise have a difficult time traversing the intersection.
- Like motorists, pedestrians also do not like to wait a long time to cross an intersection and, when the wait is perceived as being "too long", are more likely than motorists to cross against the signal.
- Signalized intersections do not function solely as discrete locations – they are increasingly operated as part of a group of signals and, therefore, signal timing (and "green time" allocation) at any given intersection is typically not considered independent of other, nearby intersections.

Charlotte's signal timing practices are increasingly reflecting a corridor-level, system-oriented approach. This approach also is being refined to reflect our multi-modal objectives. Signal cycle length tradeoff decisions will help meet those objectives, in part through the following assumptions:

- In general, shorter cycle lengths and wait times are desirable, particularly when this can also accommodate pedestrian crossings.
- Signal timing decisions will consider the types of streets that intersect (the intersection "context"), in addition to the nearby (potentially synchronized) intersections that might be affected.

- Signal timing decisions will not always heavily favor the higher-volume streets or flows, although every attempt will be made to maintain satisfactory throughput.

- The objective of minimizing vehicular delay and/or maximizing vehicular throughput is a higher priority for Boulevards and Parkways than for Main Streets or Avenues.

Intersection Design Elements

Tables 5.1 – 5.4 describe the features of non-local intersection types (Main Streets, Avenues, Boulevards, and Parkways). The information in these sections is detailed, but not necessarily prescriptive. The detailed information on dimensions should be used by the design team in conjunction with the design method and tradeoff analyses outlined in Chapter 3 and the LOS guidelines discussed above and described in Appendix A. Note that the plan view diagrams do not show dimensions for these street types, as the focus is on understanding and evaluating the tradeoffs among the various uses and users of the right-of-way.

Table 5.5 describes the design elements for local intersections (Residential, Office/Commercial, and Industrial). The elements and dimensions described are more prescriptive than those for the non-local streets, since these streets are typically provided through the development process.

Some of the design elements described in the following tables represent the "ideal" for which the City is striving, but will require further refinement for an incremental approach to implementation. In many cases, there are specific programs that are responsible for providing such features and it will be necessary to update our approaches to reflect these new Guidelines. These program updates will include evaluating the timing required to meet the design goals for most intersections and developing priorities to ensure practical implementation. Elements that will be subject to such evaluation and prioritization include, for example, enhanced crosswalks, audible pedestrian signals, and bicycle detectors.

5.1 Main Street Intersections

This section describes the features of all (non-local street) intersections that include at least one Main Street approach to the intersection. Main Streets can intersect with all of the other street types, except for Parkways. With the proper application of these Guidelines, Main Street intersections will be located in a pedestrian-oriented context. This is why Main Streets and Parkways should not intersect – because they should exist in mutually exclusive contexts. The design of a Main Street intersection will typically favor the pedestrian orientation of the Main Street leg, whether the intersecting street is a Local Street, an Avenue, or a Boulevard. For example, although Avenues and Boulevards will have higher volumes, more lanes, and higher speeds than do Main Streets, their intersections with Main Streets should be carefully designed to maintain a relatively high pedestrian level-of-service, even with the potential for more through lanes.

General Intent:

(1) Pedestrian-oriented design and very good pedestrian level of service (LOS) should guide the design decision for all Main Street intersections (see Appendix A for a description of how to balance pedestrian and bicycle LOS with vehicular LOS).

(2) At Main Street intersections with Avenues and Boulevards, the physical and operational design should particularly provide very good pedestrian LOS if the Main Street extends across the intersecting street (see Appendix B for a description of the pedestrian LOS methodology).

(3) Some elements will remain constant for all Main Street intersections, such as the use of enhanced pavement markings, countdown signals, not allowing right-turns-on-red, and limiting the use of turn lanes onto and off of Main Streets.

The following table provides guidance in applying design elements to different types of Main Street intersections. The column headings refer to the various possible types of approach legs. The "Main Street Approach" column should be used to assess Main-to-Main intersections, as well as the Main Street approach to any of the other intersection types (Main-to-Avenue and Main-to-Boulevard). Note that the recommendations for Avenues and Boulevards are intended to maintain a relatively high pedestrian LOS at intersections with Main Streets. For a discussion of Main streets intersecting Local Streets, see "Local Street Intersections," Section 5.5.

Main Street Intersections 5.1

Main Street Intersections

Diagram reflects possible scenarios and intersection may vary slightly in design. For specific information refer to the guidelines shown on Table 4.1.

Table 5.1 Main Street Intersection Elements

Element:	*Main/Main Intersections or Main Approach to Other Intersection Types:*	*Avenue Approach to Main/Avenue Intersection:*	*Boulevard Approach to Main/Boulevard Intersection:*	*Parkway Approach to Main Street Intersection:*
Level of Service (LOS):				
• Pedestrian LOS Objective	LOS A for the entire Main/Main intersection.	LOS B for the entire Main/Ave intersection.	LOS B for the entire Main/Blvd intersection.	Not a valid intersection type.
• Bicycle LOS Objective	Not applicable (see Appendix A for details).	LOS B for the entire Main/Ave intersection, using the average LOS value of only the Avenue approaches (see Appendix A for details).	LOS B for the entire Main/Blvd intersection, using the average LOS value of only the Blvd approaches (see Appendix A for details).	Not a valid intersection type.
• Motor Vehicle V/C Threshold	1.0, for two consecutive AM or PM hours, for the entire Main/Main intersection.	1.0, for two consecutive AM or PM hours, for the entire Main/Avenue intersection.	.95, for two consecutive AM or PM hours, for the entire Main/Blvd intersection.	Not a valid intersection type.
Median	Atypical, but allowable under special circumstances (see Section 4.1).	Atypical. When provided, should be a minimum width of 6' (for pedestrian refuge) at intersections, 8' preferred.	Should be provided, with a minimum width of 8' (for adequate pedestrian refuge) at intersections.	Not a valid intersection type.

Main Street Intersection Elements (continued) Table 5.1

Element:	*Main/Main Intersections or Main Approach to Other Intersection Types:*	*Avenue Approach to Main/Avenue Intersection:*	*Boulevard Approach to Main/Boulevard Intersection:*	*Parkway Approach to Main Street Intersection:*
Pedestrian Refuge Island	Atypical, but allowable at signalized intersections, if necessary for traffic calming. Where provided, refuges should be a minimum of 6' wide, measured face-of-curb to face-of-curb.	Consider when there are 4 or more lanes on the approach. To be provided either by extending the median to the crosswalk or by providing a separate 6' minimum, pedestrian refuge (measured face-of-curb to face-of-curb).	Yes, typically created by extending the median through the crosswalk (8' minimum width at intersections with Main Streets, due to high speeds on Blvds).	Not a valid intersection type.
Number of Through Lanes	No more than 1 in each direction.	Typically, 1 to 2 lanes in each direction.	Typically, 2 lanes in each direction.	Not a valid intersection type.
Left-Turn Lane	Allowable only with the 3-lane Main Street cross-section. Typically, the turn lane will be 10' wide.	Will be provided with the 3-lane and the 5-lane cross-sections. Allowable on the 4-lane cross-section, if acceptable pedestrian LOS can be maintained. 10' turn lanes suitable.	Should be provided, ideally 11' wide. In constrained situations, may be 10' wide.	Not a valid intersection type.

Table 5.1 Main Street Intersection Elements (continued)

Element:	*Main/Main Intersections or Main Approach to Other Intersection Types:*	*Avenue Approach to Main/Avenue Intersection:*	*Boulevard Approach to Main/Boulevard Intersection:*	*Parkway Approach to Main Street Intersection:*
Dual Left-Turn Lanes	Inapplicable.	Inappropriate.	Inappropriate.	Not a valid intersection type.
Right-Turn Lanes	Inappropriate.	Inappropriate.	Inappropriate.	Not a valid intersection type.
Right-Turn Corner Islands	Inapplicable.	Inapplicable.	Inapplicable.	Not a valid intersection type.
Tapers	Inappropriate.	Inappropriate.	Inappropriate.	Not a valid intersection type.
Bicycle Lanes	Inapplicable. Bikes are expected to travel in mixed traffic.	Should be provided. 4' minimum. When on-street parking exists along the segment, bike lanes should be 5' minimum, with 6' preferred. There should be a "receiving" lane on the opposite side of the intersection. Otherwise, the bike lane should be dropped just prior to the actual intersection, to allow the cyclist to safely merge. The bike lane should never be located to	Should be provided. 5' minimum. 6' preferred. There should be a "receiving" lane on the opposite side of the intersection. Otherwise, the bike lane should be dropped just prior to the actual intersection, to allow the cyclist to safely merge. The bike lane should never be located to the right of an exclusive vehicle turning lane.	Not a valid intersection type.

Main Street Intersection Elements (continued) Table 5.1

Element:	*Main/Main Intersections or Main Approach to Other Intersection Types:*	*Avenue Approach to Main/Avenue Intersection:*	*Boulevard Approach to Main/Boulevard Intersection:*	*Parkway Approach to Main Street Intersection:*
		the right of an exclusive vehicle turning lane.		
Curb Extensions	Should be provided at all corners, at same width as the on-street parking, except at far-side bus stops with high service frequencies.	Should be provided (at the same width as the on-street parking) where full-time, on-street parking exists along the segment, except at far-side bus stops on 2-3 lane cross-sections.	Inappropriate.	Not a valid intersection type.
Bus Stops:	Typically located at far side of intersection.	Typically located at far side of intersection.	Typically located at far side of intersection.	Not a valid intersection type.
• Pullout	No.	No.	Consider for high frequency bus stop locations.	Not a valid intersection type.
• Curb Extension	Not allowable at far-side stops with high service frequencies. May be considered at other stop locations.	Yes, where full-time, on-street parking exists. Do not use at far-side on the 2-3 lane cross-sections.	No.	Not a valid intersection type.
Curb Radii	The intent in these pedestrian-oriented areas is to keep the curb radii small.	The intent in these pedestrian-oriented areas is to keep the curb radii small.	The intent in these pedestrian-oriented areas is to keep the curb radii	Not a valid intersection type.

Table 5.1 Main Street Intersection Elements (continued)

Element:	*Main/Main Intersections or Main Approach to Other Intersection Types:*	*Avenue Approach to Main/Avenue Intersection:*	*Boulevard Approach to Main/Boulevard Intersection:*	*Parkway Approach to Main Street Intersection:*
	(See Appendix C, "Curb Radii" for details)	(See Appendix C, "Curb Radii" for details)	small. (See Appendix C, "Curb Radii" for details)	
ADA Ramps:				
• Type 1	No.	No.	No.	Not a valid intersection type.
• Type 2	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying circumstances.	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying circumstances.	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying circumstances.	Not a valid intersection type.
Crosswalks:	Should be provided on all legs, unless there is a physical restriction or safety-related reason that requires otherwise.	Should be provided on all legs, unless there is a physical restriction or safety-related reason that requires otherwise.	Should be provided on all legs, unless there is a physical restriction or safety-related reason that requires otherwise.	Not a valid intersection type.
• Marked	Yes, always using enhanced marking or enhanced paving.	Yes, always using enhanced marking or enhanced paving.	Yes, always using enhanced marking, but not enhanced paving.	Not a valid intersection type.

Main Street Intersection Elements (continued) Table 5.1

Element:	*Main/Main Intersections or Main Approach to Other Intersection Types:*	*Avenue Approach to Main/Avenue Intersection:*	*Boulevard Approach to Main/Boulevard Intersection:*	*Parkway Approach to Main Street Intersection:*
• Location	Should not be located on the radius.	Should not be located on the radius.	Should not be located on the radius.	Not a valid intersection type.
Traffic Control:				
• Two-Way Stop	No. A Main/Main intersection, if stop-controlled, should be a four-way stop.	No.	No.	Not a valid intersection type.
• Four-Way Stop	Allowable if both streets are two-lane and established warrants are met.	Allowable if both streets are two-lane and signal warrants not met.	No.	Not a valid intersection type.
• Roundabout	Allowable, except at intersections with Boulevards.	Allowable, as a gateway transition.	No.	Not a valid intersection type.
• Signals	Yes, depending on warrants. Bus priority should be used where appropriate.	Yes, depending on warrants. Bus priority should be used where appropriate.	Yes. Bus priority should be used where appropriate.	Not a valid intersection type.
• Right-Turn on Red	No.	No.	No.	Not a valid intersection type.
• Pedestrian Signals	Yes, with countdown. Where possible, the countdown should show the total number of	Yes, with countdown. Where possible, the countdown should show the total number of seconds	Yes, with countdown. Where possible, the countdown should show the total number of	Not a valid intersection type.

Table 5.1 Main Street Intersection Elements (continued)

Element:	*Main/Main Intersections or Main Approach to Other Intersection Types:*	*Avenue Approach to Main/Avenue Intersection:*	*Boulevard Approach to Main/Boulevard Intersection:*	*Parkway Approach to Main Street Intersection:*
	seconds available for crossing. Also consider audible signals (where deemed appropriate) and leading pedestrian interval.	available for crossing. Also consider audible signals (where deemed appropriate) and leading pedestrian interval.	seconds available for crossing. Also consider audible signals (where deemed appropriate) and leading pedestrian interval.	
• Bicycle Detectors	Provide for all Main Street approaches to signalized intersections.	Provide for through lanes and left turns.	Provide for left turns.	Not a valid intersection type.
• Advance Stop Bars	Yes, at signalized intersections. Should be spaced to allow clear separation and visibility between cars and the crosswalk and, where necessary, far enough back to allow additional maneuvering space for vehicles turning off of the other street.	Yes, at signalized intersections. Should be spaced to allow clear separation and visibility between cars and the crosswalk and, where necessary, far enough back to allow additional maneuvering space for vehicles turning off of the other street.	Yes, should be spaced to allow clear separation and visibility between cars and the crosswalk.	Not a valid intersection type.
• Bike Box	Inapplicable, since bikes are expected to travel in mixed traffic.	Should be considered, but only if a bike lane approaches the intersection.	Should be considered, but only if a bike lane approaches the intersection.	Not a valid intersection type.

Main Street Intersection Elements (continued) Table 5.1

Element:	*Main/Main Intersections or Main Approach to Other Intersection Types:*	*Avenue Approach to Main/ Avenue Intersection:*	*Boulevard Approach to Main/Boulevard Intersection:*	*Parkway Approach to Main Street Intersection:*
		This bike lane approach need not run the entire length of the segment.	This bike lane approach need not run the entire length of the segment.	
• Bicycle Stop Bars	Inapplicable, since bikes are expected to travel in mixed traffic.	Should be provided if there is a bike lane, but no bike box.	Should be provided if there is a bike lane, but no bike box.	Not a valid intersection type.
• Grade Separation	No.	No.	No.	Not a valid intersection type.
Lighting:				
• Street	Yes.	Yes.	Yes.	Not a valid intersection type.
• Pedestrian	Yes.	Yes.	Yes.	Not a valid intersection type.
Traffic Calming	Typically not necessary, but may be used to maintain desired speeds.	Consider a combination of elements on intersection approach to slow traffic approaching intersection. At the intersection, curb extensions may be used, for example (see "curb extensions", above, and CDOT's Traffic Calming Report for more information).	May be appropriate, if necessary to maintain desired speeds. Lateral shifts and some forms of narrowing may be considered. See CDOT's Traffic Calming Report for more information.	Not a valid intersection type.

5.2 Avenue Intersections

This section describes the features of all (non-local street) intersections that include at least one Avenue approach to the intersection. Avenues serve a wide variety of land uses and transportation functions. They are expected to provide a safety and comfort balance among the various modes in all contexts. The majority of non-local street intersections will be with Avenues. There are also several potential cross-sections for Avenues. The mix of possible land uses, cross-sections, and intersection types, along with the desire to provide a balance among the modes, makes Avenue intersections the most complicated in many respects. At intersections with Parkways, in particular, providing the necessary modal balance may prove difficult and plan/design teams might consider transitioning the Parkway to a Boulevard prior to the approach. A pedestrian-oriented Avenue should typically not intersect with a Parkway, if at all possible.

General Intent:

(1) Design decisions will assess and compare the tradeoffs of safe and efficient travel for motorists, pedestrians, and cyclists.

(2) Capacity increases or delay reductions at Avenue intersections will be carefully evaluated against the impacts to all travelers and their level-of-service, as well as the impacts on adjacent land uses.

The following table provides guidance in applying design elements to different types of Avenue intersections. The column headings refer to the various possible types of approach legs. The "Avenue Approach" column should be used to assess Avenue-to-Avenue intersections, as well as the Avenue approach to any of the other intersection types (Avenue-to-Main and Avenue-to-Boulevard). For a discussion of Avenues intersecting Local Streets, see "Local Street Intersections", Section 5.5.

Avenue Intersections 5.2

Avenue Intersections

Diagram reflects possible scenarios and intersection may vary slightly in design.
For specific information refer to the guidelines on Table 4.2.

Table 5.2 Avenue Intersection Elements

Element:	*Main Street Approach to Avenue/Main Intersections:*	*Avenue/Avenue Intersections or Avenue Approach to Other Intersection Types:*	*Boulevard Approach Avenue/Boulevard Intersection:*	*Parkway Approach to Avenue/Parkway Intersections:*
Level of Service (LOS):				
• Pedestrian LOS Objective	LOS B for the entire Avenue/Main intersection.	LOS B for the entire Avenue/Avenue intersection.	LOS B for the entire Avenue/Blvd intersection.	LOS D for the entire Avenue/Parkway intersection.
• Bicycle LOS Objective	LOS B for the entire Avenue/Main intersection, using the average LOS value of only the Avenue approaches (see Appendix A for details).	LOS B for the entire Avenue/Avenue intersection.	LOS B for the entire Avenue/Blvd intersection.	LOS C/D for the entire Avenue/Parkway intersection.
• Motor Vehicle V/C Threshold	1.0, for two consecutive AM or PM hours, for the entire Avenue/Main intersection.	.95, for two consecutive AM or PM hours, for the entire Avenue/Avenue intersection.	.95, for two consecutive AM or PM hours, for the entire Avenue/Blvd intersection.	.95, for two consecutive AM or PM hours, for the entire Avenue/Parkway intersection.
Median	Atypical, but allowable under special circumstances (see Chapter 4, Section 4.1).	Atypical. When provided, should be a minimum width of 6' (for pedestrian refuge) at intersections (8' preferred if the Avenue has land uses likely to generate heavy pedestrian traffic).	Should be provided, with a minimum width of 6' (for pedestrian refuge) at the intersection (8' minimum if the Avenue approaches have land uses likely to generate pedestrian traffic across the Boulevard approaches).	Yes, preferably 9' wide at the intersection, 6' minimum (for pedestrian refuge). 8' minimum if Avenue approaches have land uses likely to generate pedestrian traffic across Parkway approaches.

Avenue Intersection Elements (continued) Table 5.2

Element:	*Main Street Approach to Avenue/Main Intersections:*	*Avenue/Avenue Intersections or Avenue Approach to Other Intersection Types:*	*Boulevard Approach Avenue/Boulevard Intersection:*	*Parkway Approach to Avenue/Parkway Intersections:*
Pedestrian Refuge Island	Atypical, but allowable at signalized intersections, if necessary for traffic calming. Where provided, refuges should be a minimum of 6' wide, measured face-of-curb to face-of-curb.	Consider when there are 4 or more lanes on the approach. To be provided either by extending the median to the crosswalk or by providing a separate, 6' minimum, pedestrian refuge (measured face-of-curb to face-of-curb).	Yes, created by extending the median through the crosswalk (6' minimum, face-of curb to face-of-curb; 8' if Avenue approaches have land uses likely to generate pedestrian traffic across the Boulevard approaches).	Yes, created by extending the median to the crosswalk (6' minimum, face-of-curb to face-of-curb; 9' preferred; 8' minimum if Avenue approaches have land uses likely to generate pedestrian traffic across the Parkway approaches).
Number of Through Lanes	No more than 1 in each direction.	Typically, 1 to 2 lanes in each direction.	Typically, 2 lanes in each direction.	2 or 3 lanes in each direction.
Left-Turn Lane	Allowable only with the 3-lane Main Street cross-section. Typically, the turn lane will be 10' wide.	Will be provided with the 3-lane and the 5-lane cross-sections. Allowable on 4 lane cross-section. 10' turn lanes suitable.	Should be provided, ideally 11' wide. In constrained situations, may be 10' wide.	Should be provided, ideally 11' wide. In constrained conditions, may be a minimum of 10' wide. Should preferably include a 4' offset and an edge line, if there is no curb on the median.

Table 5.2 Avenue Intersection Elements (continued)

Element:	*Main Street Approach to Avenue/Main Intersections:*	*Avenue/Avenue Intersections or Avenue Approach to Other Intersection Types:*	*Boulevard Approach Avenue/Boulevard Intersection:*	*Parkway Approach to Avenue/Parkway Intersections:*
Dual Left-Turn Lanes	Inapplicable.	Inappropriate onto Main Streets. Should be avoided at other Avenue intersections. The preferred option is to try the longest possible storage lane and green time for a single left-turn first and/or to provide additional connections in the surrounding street network. May be considered : 1) when turning movements are greater than through movements, thereby affording the possibility to eliminate a through lane in exchange for the dual left; 2) when turning movements are greater than 400 vehicles per hour;	Should be avoided. The preferred option is to try the longest possible storage lane and green time for a single left-turn first and/or to provide additional connections in the surrounding street network. May be considered: 1) when turning movements are greater than through movements, thereby affording the possibility to eliminate a through lane in exchange for the dual left; 2) when turning movements are greater than 400 vehicles per hour; 3) when it can be shown that dual lefts will still permit an acceptable	Even with the greater emphasis on vehicle capacity for Parkways, dual-lefts should be avoided onto Avenues, as the overall dimensions of the intersection can become detrimental to the Avenue environment. The preferred option is to try the longest possible storage lane and green time for a single left-turn first and/or to provide additional connections in the surrounding street network.

Avenue Intersection Elements (continued) Table 5.2

Element:	*Main Street Approach to Avenue/Main Intersections:*	*Avenue/Avenue Intersections or Avenue Approach to Other Intersection Types:*	*Boulevard Approach Avenue/Boulevard Intersection:*	*Parkway Approach to Avenue/Parkway Intersections:*
		3.) when it can be shown that dual lefts will still permit an acceptable pedestrian LOS to be maintained.	pedestrian LOS to be maintained.	
Right-Turn Lanes	Inappropriate.	Inappropriate at Main Street intersections. Discouraged at Avenue/Avenue intersections. The preferred option is to provide additional connections in the surrounding street network. May be considered: 1) when turning movements are greater than through movements, thereby affording the possibility to eliminate a through lane in exchange for right-turn lane; 2) when dropping a lane as the street cross-section changes;	Allowable. Where used, Florida slip-lane design, with corner islands, is the preferred treatment . The preferred option is to provide additional connections in the surrounding street network.	Although right-turn lanes are the ideal on Parkways, they should be very carefully considered and designed when they are allowing turns onto Avenues. Where used, Florida slip-lane design, with corner islands, is the preferred treatment.

Table 5.2 Avenue Intersection Elements (continued)

Element:	*Main Street Approach to Avenue/Main Intersections:*	*Avenue/Avenue Intersections or Avenue Approach to Other Intersection Types:*	*Boulevard Approach Avenue/Boulevard Intersection:*	*Parkway Approach to Avenue/Parkway Intersections:*
		3) when turning movements are greater than 300 vehicles per hour; 4) when acceptable pedestrian LOS can be maintained.		
Right-Turn Corner Islands	Inapplicable.	Inapplicable at Main Street intersections. Allowable at Avenue/Avenue and Avenue/Blvd, but only if necessary to maintain pedestrian LOS or as refuge on wide cross-sections. Where provided, should be a minimum of 50 sf., preferably landscaped.	Allowable, if necessary to maintain pedestrian LOS with the addition of a right-turn lane. Minimum of 50 sf.	Yes, in conjunction with Florida slip-lane design.
Tapers	Inappropriate.	Inappropriate.	Inappropriate.	Inappropriate.
Bicycle Lanes	Inapplicable. Bikes are expected to travel in mixed traffic.	Should be provided. 4' minimum. When on-street parking exists along the segment, bike lanes should be 5' minimum, with 6' preferred. There	Should be provided. 5' minimum. 6' preferred. May also be provided on a parallel frontage road, if that increases bicycle LOS.	Typically inappropriate, but may be allowable to maintain bicycle network connectivity (6' minimum for adequate

Avenue Intersection Elements (continued) Table 5.2

Element:	*Main Street Approach to Avenue/Main Intersections:*	*Avenue/Avenue Intersections or Avenue Approach to Other Intersection Types:*	*Boulevard Approach Avenue/Boulevard Intersection:*	*Parkway Approach to Avenue/Parkway Intersections:*
		should be a "receiving" lane on the opposite side of the intersection. Otherwise, the bike lane should be dropped just prior to the actual intersection, to allow the cyclist to safely merge. The bike lane should never be located to the right of an exclusive vehicle turning lane.	There should be a "receiving" lane on the opposite side of the intersection. Otherwise, the bike lane should be dropped just prior to the actual intersection, to allow the cyclist to safely merge. The bike lane should never be located to the right of an exclusive vehicle turning lane.	separation from high-speed traffic). Preferred option is to have separate facility outside of right-of-way or on parallel local streets.
Curb Extensions	Should be provided, at same width as the on-street parking, except at far-side bus stops with high service frequencies.	Should be provided (at the same width as the on-street parking) where full-time, on-street parking exists along the segment, except at far-side bus stops on 2-3 lane cross-sections.	Inappropriate.	Prohibited.
Bus Stops:	Typically located at far-side of intersections.	Typically located at far side of intersection.	Typically located at far side of intersection.	Typically located at off-street lots or stops. Far side stops preferred at intersections.

Table 5.2 Avenue Intersection Elements (continued)

Element:	*Main Street Approach to Avenue/Main Intersections:*	*Avenue/Avenue Intersections or Avenue Approach to Other Intersection Types:*	*Boulevard Approach Avenue/Boulevard Intersection:*	*Parkway Approach to Avenue/Parkway Intersections:*
• Pullout	No.	No.	Consider for high frequency bus stop locations.	Yes.
• Curb Extension	Not allowable at far-side stops with high service frequencies. May be considered at other stop locations.	Yes, where full-time, on-street parking exists. Do not use at far-side on the 2-3 lane cross-sections.	No.	No.
Curb Radii	The intent in these pedestrian-oriented areas is to keep the curb radii small. See Appendix C, "Curb Radii" for details.	The intent is to keep the curb radii as small as possible. See Appendix C, "Curb Radii" for details.	The intent is to keep the curb radii as small as possible. See Appendix C, "Curb Radii" for details.	The intent is to keep the curb radii as small as possible. See Appendix C, "Curb Radii" for details.
ADA Ramps:				
• Type 1	No.	No.	No.	No.
• Type 2	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying circumstances.	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying circumstances.	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying

Avenue Intersection Elements (continued) Table 5.2

Element:	*Main Street Approach to Avenue/Main Intersections:*	*Avenue/Avenue Intersections or Avenue Approach to Other Intersection Types:*	*Boulevard Approach Avenue/Boulevard Intersection:*	*Parkway Approach to Avenue/Parkway Intersections:*
	circumstances.			circumstances.
Crosswalks:	Should be provided on all legs, unless there is a physical restriction or safety-related reason that requires otherwise.	Should be provided on all legs, unless there is a physical restriction or safety-related reason that requires otherwise.	Should be provided on all legs, unless there is a physical restriction or safety-related reason that requires otherwise.	Should be provided on all legs, unless there is a physical restriction or safety-related reason that requires otherwise.
• Marked	Yes, always using enhanced marking or enhanced paving.	Yes, always using enhanced marking or enhanced paving.	Yes, always using enhanced marking, but not enhanced paving.	Yes, always using enhanced marking, but not enhanced paving.
• Location	Should not be located on the radius.	Should not be located on the radius.	Should not be located on the radius.	Should not be located on the radius.
Traffic Control:				
• Two-Way Stop	No.	No.	No.	No.
• Four-Way Stop	Allowable if both streets are two-lane and established warrants are met.	Allowable if both streets are two-lane and signal warrants not met.	No.	No.

Table 5.2 Avenue Intersection Elements (continued)

Element:	*Main Street Approach to Avenue/Main Intersections:*	*Avenue/Avenue Intersections or Avenue Approach to Other Intersection Types:*	*Boulevard Approach Avenue/Boulevard Intersection:*	*Parkway Approach to Avenue/Parkway Intersections:*
• Round-about	Allowable as a gateway transition.	Allowable as a gateway transition at Main Streets. Allowable elsewhere, when: 1) volumes are less than 35,000; 2) analysis shows that roundabouts provide higher vehicle LOS than signals; and 3) provision of roundabout does not degrade pedestrian and bicycle LOS.	Allowable, when: 1) volumes are less than 35,000; 2) analysis shows that roundabouts provide higher vehicle LOS than signals; and 3) provision of roundabout does not degrade pedestrian and bicycle LOS.	No.
• Signals	Yes, depending on warrants. Bus priority should be used where appropriate.	Yes. Bus priority should be used where appropriate.	Yes. Bus priority should be used where appropriate.	Yes. Bus priority should be used where appropriate.
• Right-Turn on Red	No.	Not at Main Street intersections. Allowable at other intersections, but should be avoided in locations with a high potential for pedestrian traffic (in areas that are currently or are planned to be	Allowable, but should be avoided in locations with a high potential for pedestrian traffic (in areas that are currently or are planned to be pedestrian-oriented or mixed-use).	Desirable, depending on sight distance and potential for higher volume pedestrian traffic at the intersection.

Avenue Intersection Elements (continued) Table 5.2

Element:	*Main Street Approach to Avenue/Main Intersections:*	*Avenue/Avenue Intersections or Avenue Approach to Other Intersection Types:*	*Boulevard Approach Avenue/Boulevard Intersection:*	*Parkway Approach to Avenue/Parkway Intersections:*
		pedestrian-oriented retail or mixed-use).		
• Pedestrian Signals	Yes, with countdown. Where possible, the countdown should show the total number of seconds available for crossing. Also consider audible signals (where deemed appropriate) and leading pedestrian interval.	Yes, with countdown. Where possible, the countdown should show the total number of seconds available for crossing. Also consider audible signals (where deemed appropriate) and leading pedestrian interval.	Yes, with countdown. Where possible, the countdown should show the total number of seconds available for crossing. Also consider audible signals (where deemed appropriate) and leading pedestrian interval.	Yes, with countdown. Where possible, the countdown should show the total number of seconds available for crossing. Also consider audible signals (where deemed appropriate).
• Bicycle Detectors	Provide for all Main Street approaches to signalized intersections.	Provide for through lanes and left-turns at Avenue/Main intersections. At Avenue/Avenue and Avenue/Blvd, provide for left-turns and on through lanes of the weaker approach legs.	Provide for left turns.	No.

Table 5.2 Avenue Intersection Elements (continued)

Element:	*Main Street Approach to Avenue/Main Intersections:*	*Avenue/Avenue Intersections or Avenue Approach to Other Intersection Types:*	*Boulevard Approach Avenue/Boulevard Intersection:*	*Parkway Approach to Avenue/Parkway Intersections:*
• Advance Stop Bars	Yes, at signalized intersections. Should be spaced to allow clear separation and visibility between cars and the crosswalk and, where necessary, far enough back to allow additional maneuvering space for vehicles turning off of the Avenue.	Yes. Should be spaced to allow clear separation and visibility between cars and the crosswalk and, where necessary, far enough back to allow maneuvering space for vehicles turning off of the other street. When right-turn-on-red is allowed with the four-lane cross-section, stagger the stop bars, so that the outside, turning lane's stop bar is closer to the crosswalk than is the inside lane's stop bar. This allows the turning driver to see approaching traffic without encroaching into the crosswalk.	Yes. Should be spaced to allow clear separation and visibility between cars and the crosswalk. When right-turn-on-red is allowed, stagger the stop bars, so that the outside, turning lane's stop bar is closer to the crosswalk than are any adjacent lanes' stop bars. This allows the turning driver to see approaching traffic without encroaching into the crosswalk.	Allowable. Should be spaced to allow clear separation and visibility between cars and the crosswalk. When right-turn-on-red is allowed, stagger the stop bars, so that the outside, turning lane's stop bar is closer to the crosswalk than are any adjacent lanes' stop bars. This allows the turning driver to see approaching traffic without encroaching into the crosswalk.
• Bike Box	Inapplicable, since bikes are expected to travel in mixed traffic.	Should be considered, but only if a bike lane approaches the intersection. This bike lane approach need not run	Should be considered, but only if a bike lane approaches the intersection. This bike lane approach	No. If a bike lane exists, use bicycle stop bars, rather than a bike box.

Avenue Intersection Elements (continued) Table 5.2

Element:	*Main Street Approach to Avenue/Main Intersections:*	*Avenue/Avenue Intersections or Avenue Approach to Other Intersection Types:*	*Boulevard Approach Avenue/Boulevard Intersection:*	*Parkway Approach to Avenue/Parkway Intersections:*
		the entire length of the segment.	need not run the entire length of the segment.	
• Bicycle Stop Bars	Inapplicable, since bikes are expected to travel in mixed traffic.	Should be provided if there is a bike lane, but no bike box.	Should be provided if there is a bike lane, but no bike box.	Provide in the rare circumstance that a bike lane exists.
• Grade Separation	No.	No.	No.	No.
Lighting				
• Street	Yes.	Yes.	Yes.	Yes.
• Pedestrian	Yes	Should be provided where adjacent land uses or facilities are likely to cause concentrations of pedestrians (at bus stops or in areas that are currently or are planned to be pedestrian-oriented retail or mixed-use, e.g.).	Should be provided where adjacent land uses or facilities are likely to cause concentrations of pedestrians (at bus stops or in areas that are currently or are planned to be pedestrian-oriented retail or mixed-use, e.g.).	Atypical, but should be provided in any circumstance where adjacent land uses or facilities are likely to cause concentrations of pedestrians.

Table 5.2 Avenue Intersection Elements (continued)

Element:	*Main Street Approach to Avenue/Main Intersections:*	*Avenue/Avenue Intersections or Avenue Approach to Other Intersection Types:*	*Boulevard Approach Avenue/Boulevard Intersection:*	*Parkway Approach to Avenue/Parkway Intersections:*
Traffic Calming	Typically not necessary, but may be used to maintain desired speeds.	Consider a combination of elements on intersection approach to slow traffic approaching intersection. At the intersection, curb extensions may be used, for example (see "curb extensions", above, and CDOT's Traffic Calming Report for more information).	May be appropriate, if necessary to maintain desired speeds. Lateral shifts and some forms of narrowing may be considered. See CDOT's Traffic Calming Report for more information.	No.

5.3 Boulevard Intersections

This section describes the features of all (non-local street) intersections that include at least one Boulevard approach to the intersection. Boulevards serve a wide variety of land uses, while providing important intra-city travel functions. Special care must be taken at Boulevard intersections with Main Streets and Avenues, because the higher speeds and volumes of the Boulevard must not overwhelm the pedestrian orientation of the Main Street and the desire for modal balance of the Avenue. This is an important point because the design solutions for the Boulevard approaches may be in conflict with the design requirements for the other approaches for these types of intersections.

General Intent:

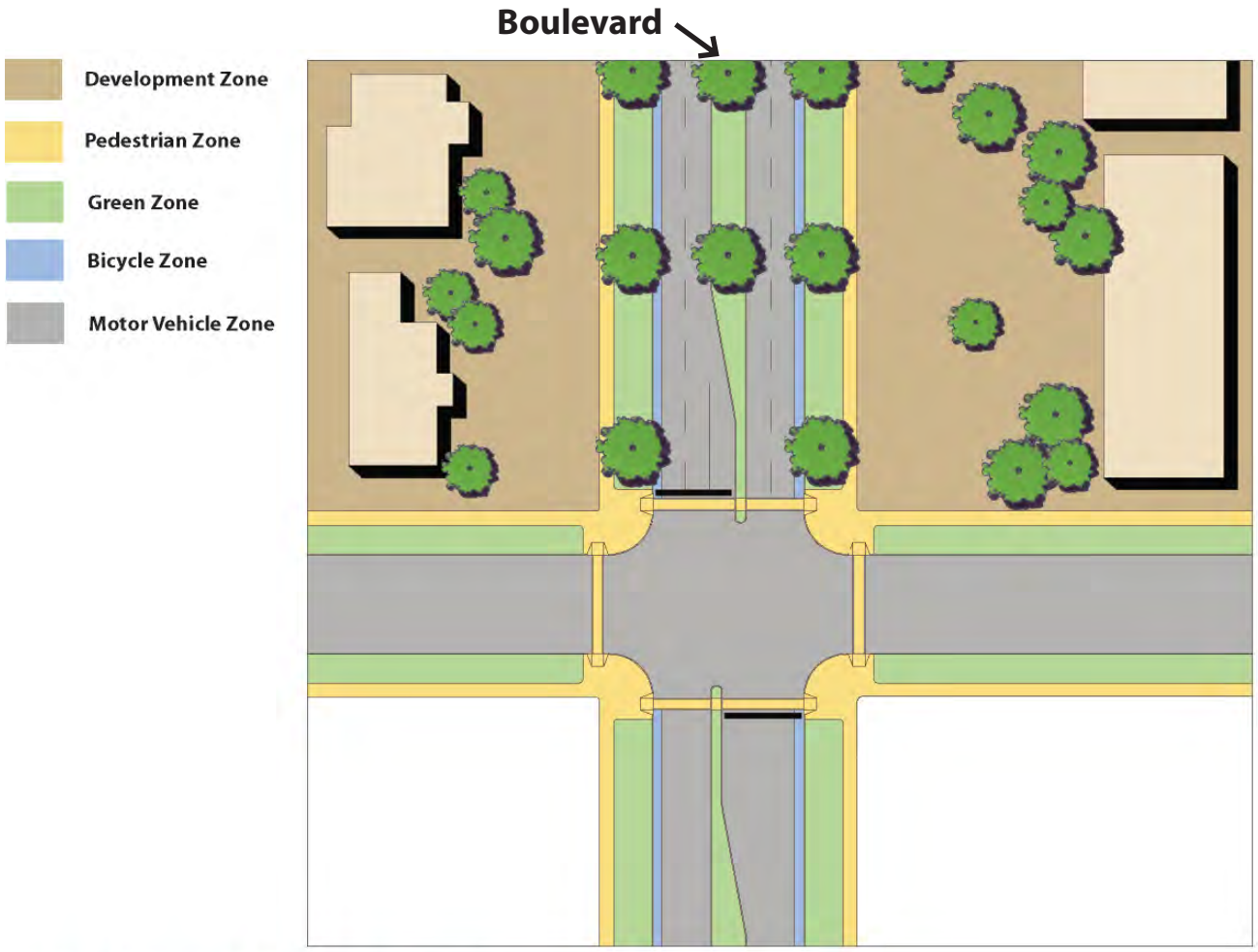
(1) Pedestrians and cyclists will be provided with a safe LOS at Boulevard intersections.

(2) Designing for pedestrians will be particularly important where Boulevards intersect Main Streets and Avenues.

(3) Boulevard intersections are likely to be fairly large, increasing the importance of aesthetics in their design.

The following table provides guidance in applying design elements to different types of Boulevard intersections. The column headings refer to the various possible types of approach legs. The "Boulevard Approach" column should be used to assess Boulevard-to-Boulevard intersections, as well as the Boulevard approach to any of the other intersection types (Boulevard-to-Main, Boulevard-to-Avenue, and Boulevard-to-Parkway). For a discussion of Boulevards intersecting Local Streets, see "Local Street Intersections", Section 5.5.

Boulevard Intersections 5.3



Boulevard Intersections

Diagram reflects possible scenarios and intersection may vary slightly in design. For specific information refer to the guidelines on Table 4.3.

Table 5.3 Boulevard Intersection Elements

Element:	*Main Street Approach to Blvd/Main Intersections:*	*Avenue Approach to Blvd/Avenue Intersections:*	*Blvd/Blvd Intersections or Blvd. Approach to Other Intersection Types:*	*Parkway Approach to Blvd/ Parkway Intersections:*
Level of Service (LOS):				
• Pedestrian	LOS B for the entire Blvd/ Main intersection.	LOS B for the entire Blvd/ Avenue intersection.	LOS C for the entire Blvd/ Blvd intersection.	LOS D for the entire Blvd/ Parkway intersection.
• Bicycle	LOS B for the entire Blvd/ Main intersection, using the average LOS value of only the Blvd approaches (see Appendix A for details).	LOS B for the entire Blvd/ Ave intersection.	LOS C for the entire Blvd/ Blvd intersection.	LOS C/D for the entire Blvd/Parkway intersection.
• Motor Vehicle V/C Threshold	.95, for two consecutive AM or PM hours, for the entire Blvd/Main intersection.	.95, for two consecutive AM or PM hours, for the entire Blvd/Ave intersection.	.95, for BOTH one AM and one PM hour, for the entire Blvd/Blvd intersection.	.95, for BOTH one AM and one PM hour, for the entire Blvd/Parkway intersection.
Median	Atypical, but allowable under special circumstances. (Chapter 4, Section 4.1)	Atypical. When provided, should be a minimum width of 6' (for pedestrian refuge) at intersections (8' preferred if the Avenue approaches have land uses likely to generate heavy pedestrian traffic).	Should be provided, with a minimum width of 6' (for pedestrian refuge) at the intersection. 8' minimum at Main Streets and at Avenues if the Avenue approaches have land uses likely to generate pedestrian traffic across the Boulevard.	Yes, preferably 9' wide at the intersection, 6' minimum (for pedestrian refuge).

Boulevard Intersection Elements (continued) Table 5.3

Element:	*Main Street Approach to Blvd/Main Intersections:*	*Avenue Approach to Blvd/Avenue Intersections:*	*Blvd/Blvd Intersections or Blvd Approach to Other Intersection Types:*	*Parkway Approach to Blvd/ Parkway Intersections:*
Pedestrian Refuge Island	Atypical, but allowable at signalized intersections, if necessary for traffic calming. Where provided, refuges should be a minimum of 6' wide, measured face-of-curb to face-of-curb.	Consider when there are 4 or more lanes on the approach. To be provided either by extending the median to the crosswalk or by providing a separate, 6' minimum, pedestrian refuge (measured face-of-curb to face-of-curb).	Yes, created by extending the median through the crosswalk (6' min. width, face-of-curb to face-of-curb; 8' under conditions described above for "medians").	Yes, created by extending the median to the crosswalk (6' minimum, face-of-curb to face-of-curb; 9' preferred).
Number of Through Lanes	No more than 1 in each direction.	Typically, 1 to 2 lanes in each direction.	Typically, 2 lanes in each direction.	2 or 3 lanes in each direction.
Left-Turn Lane	Allowable only with the 3-lane Main Street cross-section. Typically, the turn lane will be 10' wide.	Will be provided with the 3-lane and the 5-lane cross-sections. Allowable on 4 lane cross-section. 10' turn lanes suitable.	Should be provided, ideally 11' wide. In constrained situations, may be 10' wide.	Should be provided, ideally 11' wide. In constrained conditions, may be a minimum of 10' wide. Should preferably include a 4' offset and an edge line, if there is no curb on the median.

Table 5.3 Boulevard Intersection Elements (continued)

Element:	*Main Street Approach to Blvd/Main Intersections:*	*Avenue Approach to Blvd/Avenue Intersections:*	*Blvd/Blvd Intersections or Blvd Approach to Other Intersection Types:*	*Parkway Approach to Blvd/ Parkway Intersections:*
Dual Left-Turn Lanes	Inapplicable.	Should be avoided. The preferred option is to try the longest possible storage lane and green time for a single left-turn first and/or to provide additional connections in the surrounding street network. May be considered: 1) when turning movements are greater than through movements, thereby affording the possibility to eliminate a through lane in exchange for the dual left; 2) when turning movements are greater than 400 vehicles per hour;	Inappropriate onto Main Streets. Allowable onto Parkways. Should be avoided onto Avenues and other Boulevards. The preferred option is to try the longest possible storage lane and green time for a single left-turn first and/or to provide additional connections in the surrounding street network. May be considered: 1) when turning movements are greater than through movements, thereby affording the possibility to eliminate a through lane in exchange for the dual left; 2) when turning movements are greater than 400 vehicles per hour;	Allowable, though the overall dimensions of the intersection can become detrimental to the Boulevard environment. The preferred option is to try the longest possible storage lane and green time for a single left-turn first and/or to provide additional connections in the surrounding street network.

Boulevard Intersection Elements (continued) Table 5.3

Element:	*Main Street Approach to Blvd/Main Intersections:*	*Avenue Approach to Blvd/Avenue Intersections:*	*Blvd/Blvd Intersections or Blvd Approach to Other Intersection Types:*	*Parkway Approach to Blvd/ Parkway Intersections:*
		3) when it can be shown that dual lefts will still permit an acceptable pedestrian LOS to be maintained.	3) when it can be shown that dual lefts will still permit an acceptable pedestrian LOS to be maintained.	
Right-Turn Lanes	Inappropriate.	To be avoided. The preferred option is to provide additional connections in the surrounding street network. May be considered: 1) when turning movements are greater than through movements, thereby affording the possibility to eliminate a through lane in exchange for right-turn lane; 2) when dropping a lane as the street cross-section changes;	Inappropriate onto Main Streets. Allowable onto Avenues, other Boulevards, and Parkways, when necessary to meet vehicle LOS. The preferred option is to provide additional connections in the surrounding street network. Where used, Florida slip-lane design, with corner islands, is the preferred treatment. Not to be used for entrances to commercial properties.	Yes. Where used, Florida slip-lane design, with corner islands, is the preferred treatment. In constrained conditions, provide right turn deceleration lanes at a minimum.

Table 5.3 Boulevard Intersection Elements (continued)

Element:	*Main Street Approach to Blvd/Main Intersections:*	*Avenue Approach to Blvd/Avenue Intersections:*	*Blvd/Blvd Intersections or Blvd Approach to Other Intersection Types:*	*Parkway Approach to Blvd/ Parkway Intersections:*
		3) when turning movements are greater than 300 vehicles per hour; 4) when acceptable pedestrian LOS can be maintained.		
Right-Turn Corner Islands	Inapplicable.	Allowable, if necessary to maintain pedestrian LOS with a turn lane or as refuge on wide cross-sections. Where provided, should be a minimum of 50 sf., preferably landscaped.	Allowable, if necessary to maintain pedestrian LOS, particularly in conjunction with Florida slip-lane design. Minimum of 50 sf.	Yes, in conjunction with Florida slip-lane design.
Tapers	Inappropriate.	Inappropriate.	Inappropriate onto Main Streets or Avenues. Inappropriate in most circumstances at other Boulevards. Allowable at Parkways.	Allowable.
Bicycle Lanes	Inapplicable. Bikes are expected to travel in mixed traffic.	Should be provided. 4' min. When on-street parking exists along the segment, bike lanes should be	Should be provided. 5' minimum. 6' preferred. May also be provided on a parallel frontage road, if	Typically inappropriate, but may be allowable to maintain bicycle network connectivity (6' minimum

Boulevard Intersection Elements (continued) Table 5.3

Element:	*Main Street Approach to Blvd/Main Intersections:*	*Avenue Approach to Blvd/Avenue Intersections:*	*Blvd/Blvd Intersections or Blvd Approach to Other Intersection Types:*	*Parkway Approach to Blvd/ Parkway Intersections:*
		5' minimum with 6' preferred. There should be a "receiving" lane on the opposite side of the intersection. Otherwise, the bike lane should be dropped just prior to the actual intersection, to allow the cyclist to safely merge. The bike lane should never be located to the right of an exclusive vehicle turning lane.	that increases bicycle LOS. There should be a "receiving" lane on the opposite side of the intersection. Otherwise, the bike lane should be dropped just prior to the actual intersection to allow the cyclist to safely merge. The bike lane should never be located to the right of an exclusive vehicle turning lane.	for adequate separation from high-speed traffic). Preferred option is to have separate facility outside of right-of-way or on parallel local streets.
Curb Extensions	Should be provided, at same width as the on-street parking, except at far-side bus stops with high service frequencies.	Should be provided (at the same width as the on-street parking) where full-time on-street parking exists along the segment, except at far-side bus stops on 2-3 lane cross-sections.	Inappropriate.	Prohibited.
Bus Stops:	Typically located at far side of intersection.	Typically located at far side of intersection.	Typically located at far side of intersection.	Typically located at off-street lots or stops. Far side stops preferred at intersections.

Table 5.3 Boulevard Intersection Elements (continued)

Element:	*Main Street Approach to Blvd/Main Intersections:*	*Avenue Approach to Blvd/Avenue Intersections:*	*Blvd/Blvd Intersections or Blvd Approach to Other Intersection Types:*	*Parkway Approach to Blvd/ Parkway Intersections:*
• Pullout	No.	No.	Consider for high frequency bus stop locations.	Yes.
• Curb Extension	Not allowable at far-side stops with high service frequencies. May be considered at other stop locations.	Yes, where full-time, on-street parking exists. Do not use at far-side on the 2-3 lane cross-sections.	No.	No.
Curb Radii	The intent in these pedestrian-oriented areas is to keep the curb radii as small as possible. See Appendix C, "Curb Radii" for details.	The intent is to keep the curb radii as small as possible. See Appendix C, "Curb Radii" for details.	The intent is to keep the curb radii as small as possible. See Appendix C, "Curb Radii" for details.	The intent is to keep the curb radii as small as possible. See Appendix C, "Curb Radii" for details.
ADA Ramps:				
• Type 1	No.	No.	No.	No.
• Type 2	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying

Boulevard Intersection Elements (continued) Table 5.3

Element:	*Main Street Approach to Blvd/Main Intersections:*	*Avenue Approach to Blvd/Avenue Intersections:*	*Blvd/Blvd Intersections or Blvd Approach to Other Intersection Types:*	*Parkway Approach to Blvd/ Parkway Intersections:*
• Type 2	under varying circumstances.	circumstances.	circumstances.	circumstances.
Crosswalks:	Should be provided on all legs, unless there is a physical restriction or safety-related reason that requires otherwise.	Should be provided on all legs, unless there is a physical restriction or safety-elated reason that requires otherwise.	Should be provided on all legs, unless there is a physical restriction or safety-related reason that requires otherwise.	Should be provided on all legs, unless there is a physical restriction or safety-related reason that requires otherwise.
• Marked	Yes, always using enhanced marking or enhanced paving.	Yes, always using enhanced marking or enhanced paving.	Yes, always using enhanced marking, but not enhanced paving.	Yes, always using enhanced marking, but not enhanced paving.
• Location	Should not be located on the radius.	Should not be located on the radius.	Should not be located on the radius.	Should not be located on the radius.
Traffic Control:				
• Two-Way Stop	No.	No.	No.	No.
• Four-Way Stop	Yes, if both streets are two-lane.	Allowable if both streets are two-lane and signal warrants not met.	No.	No.
• Round-about	No.	Allowable, when: 1) volumes are less than 35,000	Inappropriate at Main Streets and Parkways. Allowable at Avenues and	No.

Table 5.3 Boulevard Intersection Elements (continued)

Element:	*Main Street Approach to Blvd/Main Intersections:*	*Avenue Approach to Blvd/Avenue Intersections:*	*Blvd/Blvd Intersections or Blvd Approach to Other Intersection Types:*	*Parkway Approach to Blvd/ Parkway Intersections:*
	No.	2) analysis shows that roundabouts provide higher vehicle LOS than signals; and 3) provision of roundabout does not degrade pedestrian and bicycle LOS.	other Boulevards, when: 1) volumes are less than 35,000; 2) analysis shows that roundabouts provide higher vehicle LOS than signals; and 3) provision of roundabout does not degrade pedestrian and bicycle LOS.	No.
• Signals	Yes, depending on warrants. Bus priority should be used where appropriate.	Yes. Bus priority should be used where appropriate.	Yes. Bus priority should be used where appropriate.	Yes. Bus priority should be used where appropriate.
• Right-Turn on Red	No.	Allowable, but should be avoided in locations with a high potential for pedestrian traffic (in areas that are currently or are planned to be pedestrian-oriented retail or mixed-use).	Desirable at Blvd/Blvd and Blvd/Parkway intersections, depending on sight distance and pedestrian volumes. Avoid with opposite dual lefts. Allowable at Blvd/ Avenue intersections, but should be avoided in	Desirable, depending on sight distance and potential for higher volume pedestrian traffic at the intersection.

Boulevard Intersection Elements (continued) Table 5.3

Element:	*Main Street Approach to Blvd/Main Intersections:*	*Avenue Approach to Blvd/Avenue Intersections:*	*Blvd/Blvd Intersections or Blvd Approach to Other Intersection Types:*	*Parkway Approach to Blvd/ Parkway Intersections:*
			locations with a high potential for pedestrian traffic (in areas that are currently or are planned to be pedestrian-oriented or mixed-use). Inappropriate onto Main Streets.	
• Pedestrian Signals	Yes, with countdown. Where possible, the countdown should show the total number of seconds available for crossing. Also consider audible signals (where deemed appropriate) and leading pedestrian interval.	Yes, with countdown. Where possible, the countdown should show the total number of seconds available for crossing. Also consider audible signals (where deemed appropriate) and leading pedestrian interval.	Yes, with countdown. Where possible, the countdown should show the total number of seconds available for crossing. Also consider audible signals (where deemed appropriate) and leading pedestrian interval. Will typically be actuated.	Yes, with countdown. Where possible, the countdown should show the total number of seconds available for crossing. Also consider audible signals (where deemed appropriate).
• Bicycle Detectors	Provide for all Main Street approaches to signalized intersections.	Provide for left-turns and on through lanes of the weaker approach legs.	Provide for left-turns and on through lanes of the weaker approach legs.	No.

Table 5.3 Boulevard Intersection Elements (continued)

Element:	*Main Street Approach to Blvd/Main Intersections:*	*Avenue Approach to Blvd/Avenue Intersections:*	*Blvd/Blvd Intersections or Blvd Approach to Other Intersection Types:*	*Parkway Approach to Blvd/ Parkway Intersections:*
• Advance Stop Bars	Yes, at signalized intersections. Should be spaced to allow clear separation and visibility between cars and the crosswalk and, where necessary, far enough back to allow additional maneuvering space for vehicles turning off of the Boulevard.	Yes. Should be spaced to allow clear separation and visibility between cars and the crosswalk and, where necessary, far enough back to allow additional maneuvering space for vehicles turning off of the Boulevard. When right-turn-on-red is allowed with the four-lane cross-section, stagger the stop bars, so that the outside, turning lane's stop bar is closer to the crosswalk than is the inside lane's stop bar. This allows the turning driver to see approaching traffic without encroaching into the crosswalk.	Yes. Should be spaced to allow clear separation and visibility between cars and the crosswalk. When right-turn-on-red is allowed, stagger the stop bars, so that the outside, turning lane's stop bar is closer to the crosswalk than are any adjacent lanes' stop bars. This allows the turning driver to see approaching traffic without encroaching into the crosswalk.	Allowable. Should be spaced to allow clear separation and visibility between cars and the crosswalk. When right-turn-on-red is allowed, stagger the stop bars, so that the outside, turning lane's stop bar is closer to the crosswalk than are any adjacent lanes' stop bars. This allows the turning driver to see approaching traffic without encroaching into the crosswalk.

Boulevard Intersection Elements (continued) Table 5.3

Element:	*Main Street Approach to Blvd/Main Intersections:*	*Avenue Approach to Blvd/Avenue Intersections:*	*Blvd/Blvd Intersections or Blvd Approach to Other Intersection Types:*	*Parkway Approach to Blvd/ Parkway Intersections:*
• Bike Box	Inapplicable, since bikes are expected to travel in mixed traffic.	Should be considered, but only if a bike lane approaches the intersection. This bike lane approach need not run the entire length of the segment.	Should be considered, but only if a bike lane approaches the intersection. This bike lane approach need not run the entire length of the segment.	No. If a bike lane exists, use bicycle stop bars, rather than a bike box.
• Bicycle Stop Bars	Inapplicable, since bikes are expected to travel in mixed traffic.	Should be provided if there is a bike lane, but no bike box.	Should be provided if there is a bike lane, but no bike box.	Provide in the rare circumstance that a bike lane exists.
• Grade Separation	No.	No.	No.	No.
Lighting:				
• Street	Yes.	Yes.	Yes.	Yes.
• Pedestrian	Yes.	Should be provided where adjacent land uses or facilities are likely to cause concentrations of pedestrians (at bus stops or in areas that are currently or planned	Yes, at Main Streets. Optional at Blvd/Blvd, Blvd/ Ave. Atypical at Parkways. Should be provided where adjacent land uses or facilities are likely to cause	Atypical, but should be provided in any circumstance where adjacent land uses or facilities are likely to cause concentrations of pedestrians.

Table 5.3 Boulevard Intersection Elements (continued)

Element:	*Main Street Approach to Blvd/Main Intersections:*	*Avenue Approach to Blvd/Avenue Intersections:*	*Blvd/Blvd Intersections or Blvd Approach to Other Intersection Types:*	*Parkway Approach to Blvd/ Parkway Intersections:*
		to be pedestrian-oriented retail or mixed-use).	concentrations of pedestrians (at bus stops or in areas that are currently or are planned to be pedestrian-oriented retail or mixed-use).	
Traffic Calming	Typically not necessary, but may be used to maintain desired speeds.	Consider a combination of elements on intersection approach to slow traffic approaching intersection. At the intersection, curb extensions may be used, for example (see "Curb Extensions", above, and CDOT's Traffic Calming Report for more information).	May be appropriate, if necessary to maintain desired speeds. Lateral shifts and some forms of narrowing may be considered. See CDOT's Traffic Calming Report for more information.	No.

5.4 Parkway Intersections

This section describes the features of all (non-local street) intersections that include at least one Parkway approach to the intersection. Parkways serve as high-volume, relatively high-speed intra-urban thoroughfares. Adjacent land uses are assumed to be auto-oriented in both type and design, with access control much more prevalent than on any other street type. Parkways may intersect with all other street types, except Main Streets. While the basic design of a Parkway intersection is intended to serve high volumes of traffic, some design elements may be adjusted to reflect the type of street the Parkway is intersecting.

General Intent:

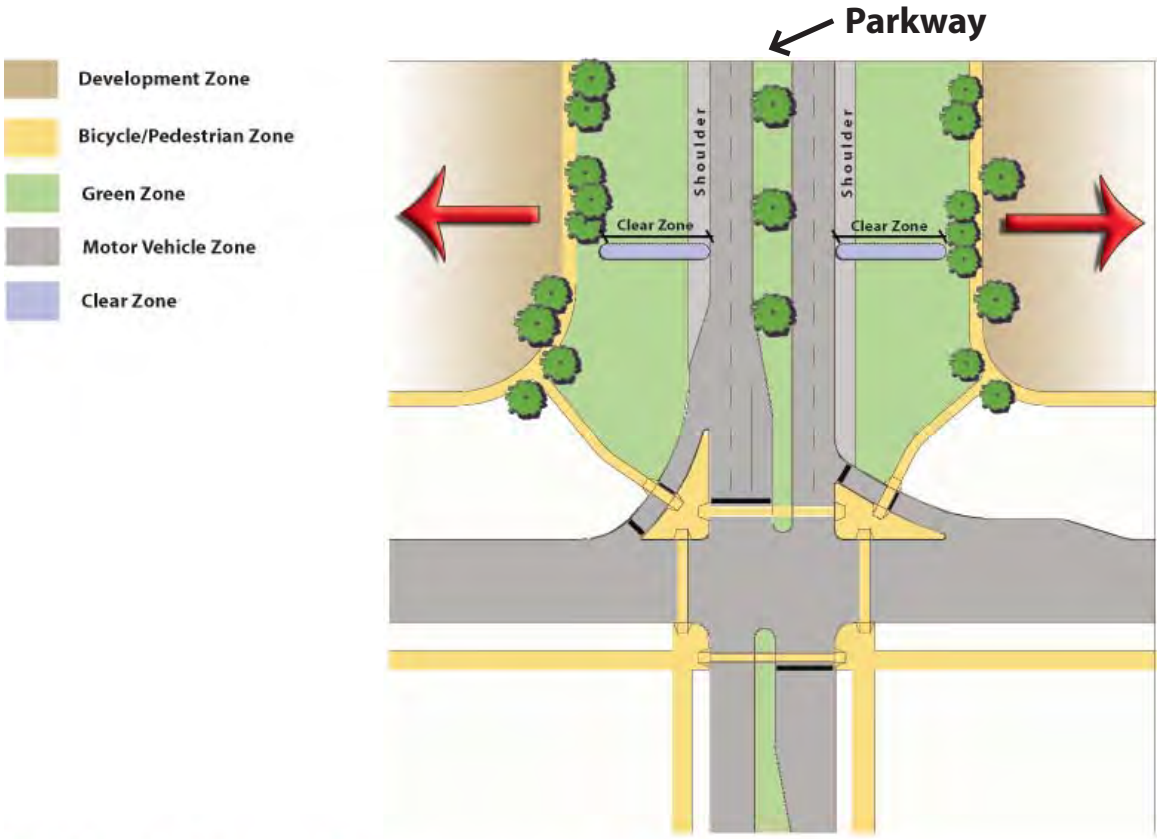
(1) Providing motor vehicle capacity and reducing travel delay is a major design goal for Parkway intersections.

(2) Safety for all users is another important goal, even though motor vehicle level-of-service is emphasized.

(3) Land uses that would generate large numbers of pedestrians wanting to cross the Parkway should be limited near Parkway intersections.

The following table provides guidance in applying design elements to different types of Parkway intersections. The column headings refer to the various possible types of approach legs. The "Parkway Approach" column should be used to assess Parkway-to-Parkway intersections, as well as the Parkway approach to any of the other intersection types (Parkway-to-Avenue, and Parkway-to-Boulevard). For a discussion of Parkways intersecting Local Streets, see "Local Street Intersections", Section 5.5.

Parkway Intersections 5.4



Parkway Intersections

Diagram reflects possible scenarios and intersection may vary slightly in design. For specific information refer to the guidelines on Table 4.4.

Table 5.4 Parkway Intersection Elements

Element:	*Main Street Approach:*	*Avenue Approach to Parkway/Avenue Intersection:*	*Boulevard Approach to Parkway/Boulevard Intersection:*	*Pkwy/Pkwy Intersection or Parkway Approach to Other Intersection Types :*
Level of Service (LOS):				
• Pedestrian LOS Objective	Not a valid intersection type.	LOS D for the entire Parkway/Avenue intersection.	LOS D for the entire Parkway/Boulevard intersection.	LOS D for the entire Parkway/Parkway intersection.
• Bicycle LOS Objective	Not a valid intersection type.	LOS C/D for the entire Parkway/Avenue intersection.	LOS C/D for the entire Parkway/Boulevard intersection.	LOS D for the entire Parkway/Parkway intersection.
• Motor Vehicle V/C Threshold	Not a valid intersection type.	.95, for two consecutive AM or PM hours, for the entire Parkway/Avenue intersection.	.95, for BOTH one AM and one PM hour, for the entire Parkway/Blvd intersection.	.90, for BOTH one AM and one PM hour, for the entire Parkway/Parkway intersection.
Median	Not a valid intersection type.	Atypical. When provided, should be a minimum width of 6' (for pedestrian refuge) at intersections (8' preferred if the Avenue approaches have land uses likely to generate heavy pedestrian traffic).	Should be provided, with a minimum width of 6' (for pedestrian refuge) at the intersection.	Yes, preferably 9' wide at the intersection, 6' minimum. 8' minimum at Avenues (for pedestrian refuge) if Avenue approaches have land uses likely to generate pedestrian traffic across the Parkway approaches.
Pedestrian Refuge Island	Not a valid intersection type.	Consider when there are 4 or more lanes on the approach. To be provided either by extending the	Yes, created by extending the median through the crosswalk (6' minimum	Yes, created by extending the median to the crosswalk (6'-8 minimum as described

Parkway Intersection Elements (continued) Table 5.4

Element:	*Main Street Approach:*	*Avenue Approach to Parkway/Avenue Intersection:*	*Boulevard Approach to Parkway/Boulevard Intersection:*	*Pkwy/Pkwy Intersection or Parkway Approach to Other Intersection Types :*
		median to the crosswalk or by providing a separate, 6' minimum, pedestrian refuge, measured face-of-curb to face-of-curb.	width, face-of-curb to face-of-curb).	above for medians, 9' preferred).
Number of Through Lanes	Not a valid intersection type.	Typically, 1 to 2 lanes in each direction.	Typically 2 lanes in each direction.	2 or 3 lanes in each direction.
Left-Turn Lane	Not a valid intersection type.	Will be provided with the 3-lane or the 5-lane cross-sections. Allowable on 4 lane cross-section. 10' turn lanes suitable.	Should be provided, ideally 11' wide. In constrained situations, may be 10' wide.	Should be provided, ideally 11' wide. In constrained conditions, may be a minimum of 10' wide. Should preferably include a 4' offset and an edge line, if there is no curb on the median.
Dual Left-Turn Lanes	Not a valid intersection type.	Should be avoided. The preferred option is to try the longest possible storage lane and green time for a single left-turn first and/or to provide additional connections in the surrounding street network. May be considered:	Allowable. The preferred option is to try the longest possible storage lane and green time for a single left-turn first and/or to provide additional connections in the surrounding street network.	Allowable, though the overall dimensions of the intersection can become detrimental to the Avenue or Boulevard environments. The preferred option is to try the longest possible storage lane and green time for

Table 5.4 Parkway Intersection Elements (continued)

Element:	*Main Street Approach:*	*Avenue Approach to Parkway/Avenue Intersection:*	*Boulevard Approach to Parkway/Boulevard Intersection:*	*Pkwy/Pkwy Intersection or Parkway Approach to Other Intersection Types :*
		1) when turning movements are greater than through movements, thereby affording the possibility to eliminate a through lane in exchange for the dual left; 2) when turning movements are greater than 400 vehicles per hour; 3) when it can be shown that dual lefts will still permit an acceptable pedestrian LOS to be maintained.		a single left-turn first and/or to provide additional connections in the surrounding street network.
Right-Turn Lanes	Not a valid intersection type.	To be avoided. The preferred option is to provide additional connections in the surrounding street network. May be considered: 1) when turning movements are greater than through movements, thereby affording the possibility to eliminate a	Allowable, when necessary to meet vehicle LOS. The preferred option is to provide additional connections in the surrounding street network. Where used, Florida slip-lane design, with corner islands, is the preferred	Yes, though they should be very carefully considered and designed when they are allowing turns onto Avenues. Where used, Florida slip-lane design, with corner islands, is the preferred treatment. In constrained conditions, provide

Parkway Intersection Elements (continued) Table 5.4

Element:	*Main Street Approach:*	*Avenue Approach to Parkway/Avenue Intersection:*	*Boulevard Approach to Parkway/Boulevard Intersection:*	*Pkwy/Pkwy Intersection or Parkway Approach to Other Intersection Types :*
		through lane in exchange for right-turn lane; 2) when dropping a lane as the street cross-section changes; 3) when turning movements are greater than 300 vehicles per hour; 4) when acceptable pedestrian LOS can be maintained.	treatment. Not to be used for entrances to commercial properties.	right turn deceleration lanes at a minimum.
Right-Turn Corner Islands	Not a valid intersection type.	Allowable, if necessary to maintain pedestrian LOS with a turn lane or as refuge on wide cross-sections. Where provided, should be a minimum of 50 sf., preferably landscaped.	Allowable, if necessary to maintain pedestrian LOS, particularly in conjunction with Florida slip-lane design. Minimum of 50 sf.	Yes, in conjunction with Florida slip-lane design.
Tapers	Not a valid intersection type.	Inappropriate.	Allowable.	Inappropriate onto Avenues. Allowable onto Boulevards or other Parkways.
Bicycle Lanes	Not a valid intersection type.	Should be provided. 4' minimum. When on-street parking exists along the segment, bike	Should be provided. 5' minimum. 6' preferred. May also be provided on	Typically inappropriate, but may be allowable to maintain bicycle network

Table 5.4 Parkway Intersection Elements (continued)

Element:	*Main Street Approach:*	*Avenue Approach to Parkway/Avenue Intersection:*	*Boulevard Approach to Parkway/Boulevard Intersection:*	*Pkwy/Pkwy Intersection or Parkway Approach to Other Intersection Types :*
		lanes should be 5' minimum, with 6' preferred. There should be a "receiving" lane on the opposite side of the intersection. Otherwise, the bike lane should be dropped just prior to the actual intersection, to allow the cyclist to safely merge. The bike lane should never be located to the right of an exclusive vehicle turning lane.	a parallel frontage road, if that increases bicycle LOS. There should be a "receiving" lane on the opposite side of the intersection. Otherwise, the bike lane should be dropped just prior to the actual intersection, to allow the cyclist to safely merge. The bike lane should never be located to the right of an exclusive vehicle turning lane.	connectivity (6' minimum, for adequate separation from high-speed traffic). Preferred option is to have separate facility outside of right-of-way or on parallel local streets.
Curb Extensions	Not a valid intersection type.	7' extensions should be provided where full-time, on-street parking exists along the segment, except at far-side bus stops on 2-3 lane cross-sections.	Inappropriate.	Prohibited.
Bus Stops:	Not a valid intersection type.	Typically located at far side of intersection.	Typically located at far side of intersection.	Typically located at off-street lots or stops. Far side stops preferred at intersections.

Parkway Intersection Elements (continued) Table 5.4

Element:	*Main Street Approach:*	*Avenue Approach to Parkway/Avenue Intersection:*	*Boulevard Approach to Parkway/Boulevard Intersection:*	*Pkwy/Pkwy Intersection or Parkway Approach to Other Intersection Types :*
• Pullout	Not a valid intersection type.	No.	Consider for high frequency bus stop locations.	Yes.
• Curb Extension	Not a valid intersection type.	Should be provided (at the same width as the on-street parking) where full-time, on-street parking exists. Do not use at far-side on the 2-3 lane cross-sections.	No.	No.
Curb Radii	Not a valid intersection type.	The intent is to keep the curb radii as small as possible. See Appendix C, "Curb Radii" for details.	The intent is to keep the curb radii as small as possible. See Appendix C, "Curb Radii" for details.	The intent is to keep the curb radii as small as possible. See Appendix C, "Curb Radii" for details.
ADA Ramps:				
• Type 1	Not a valid intersection type.	No.	No.	No.
• Type 2	Not a valid intersection type.	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying circumstances.	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying circumstances.	Yes, if crosswalks are provided. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying circumstances.

Table 5.4 Parkway Intersection Elements (continued)

Element:	*Main Street Approach:*	*Avenue Approach to Parkway/Avenue Intersection:*	*Boulevard Approach to Parkway/Boulevard Intersection:*	*Pkwy/Pkwy Intersection or Parkway Approach to Other Intersection Types :*
Crosswalks:	Not a valid intersection type.	Should be provided on all legs, unless there is a physical restriction or safety-related reason that requires otherwise.	Should be provided on all legs, unless there is a physical restriction or safety-related reason that requires otherwise.	Should be provided on all legs where there are sidewalks, unless there is a physical restriction or safety-related reason that requires otherwise.
• Marked	Not a valid intersection type.	Yes, always using enhanced marking or enhanced paving.	Yes, always using enhanced marking, but not enhanced paving.	Yes, always using enhanced marking, but not enhanced paving.
• Location	Not a valid intersection type.	Should not be located on the radius.	Should not be located on the radius.	Should not be located on the radius.
Traffic Control:				
• Two-Way Stop	Not a valid intersection type.	No.	No.	No.
• Four-Way Stop	Not a valid intersection type.	Allowable if both streets are two-lane and signal warrants not met.	No.	No.
• Round-about	Not a valid intersection type.	No.	No.	No.

Parkway Intersection Elements (continued) Table 5.4

Element:	*Main Street Approach:*	*Avenue Approach to Parkway/Avenue Intersection:*	*Boulevard Approach to Parkway/Boulevard Intersection:*	*Pkwy/Pkwy Intersection or Parkway Approach to Other Intersection Types :*
• Signals	Not a valid intersection type.	Yes. Bus priority should be used where appropriate.	Yes. Bus priority should be used where appropriate.	Yes. Bus priority should be used where appropriate.
• Right-Turn on Red	Not a valid intersection type.	Allowable, but should be avoided in locations with a high potential for pedestrian traffic (in areas that are currently or are planned to be pedestrian-oriented retail or mixed-use).	Desirable, depending on sight distance and pedestrian volumes. Avoid with opposite dual lefts.	Desirable, depending on sight distance and potential for higher volume pedestrian traffic at the intersection (apply carefully at Avenues).
• Pedestrian Signals	Not a valid intersection type.	Yes, with countdown. Where possible, the countdown should show the total number of seconds available for crossing. Also consider audible signals (where deemed appropriate) and leading pedestrian interval.	Yes, with countdown. Where possible, the countdown should show the total number of seconds available for crossing. Also consider audible signals (where deemed appropriate) and leading pedestrian interval. Will typically be actuated.	Yes, where crosswalks exist at the intersection, with countdown. Where possible, the countdown should show the total number of seconds available for crossing. Also consider audible signals (where deemed appropriate).
• Bicycle Detectors	Not a valid intersection type.	Provide on through lanes of the weaker approach legs.	Provide on through lanes of the weaker approach legs.	No.

Table 5.4 Parkway Intersection Elements (continued)

Element:	*Main Street Approach:*	*Avenue Approach to Parkway/Avenue Intersection:*	*Boulevard Approach to Parkway/Boulevard Intersection:*	*Pkwy/Pkwy Intersection or Parkway Approach to Other Intersection Types :*
• Advance Stop Bars	Not a valid intersection type.	Yes. Should be spaced to allow clear separation and visibility between cars and the crosswalk and, where necessary, far enough back to allow maneuvering space for vehicles turning off of the Parkway. When right-turn-on-red is allowed with the four-lane cross-section, stagger the stop bars, so that the outside, turning lane's stop bar is closer to the crosswalk than is the inside lane's stop bar. This allows the turning driver to see approaching traffic without encroaching into the crosswalk.	Yes. Should be spaced to allow clear separation and visibility between cars and the crosswalk. When right-turn-on-red is allowed, stagger the stop bars, so that the outside, turning lane's stop bar is closer to the crosswalk than are any adjacent lanes' stop bars. This allows the turning driver to see approaching traffic without encroaching into the crosswalk.	Allowable. Should be spaced to allow clear separation and visibility between cars and the crosswalk. When right-turn-on-red is allowed, stagger the stop bars, so that the outside, turning lane's stop bar is closer to the crosswalk than are any adjacent lanes' stop bars. This allows the turning driver to see approaching traffic without encroaching into the crosswalk.
• Bike Box	Not a valid intersection type.	Should be considered, but only if a bike lane approaches the intersection. This bike lane approach need not run the	Should be considered, but only if a bike lane approaches the intersection. This bike lane approach	No. If a bike lane exists, use bicycle stop bars, rather than a bike box.

Parkway Intersection Elements (continued) Table 5.4

Element:	*Main Street Approach:*	*Avenue Approach to Parkway/Avenue Intersection:*	*Boulevard Approach to Parkway/Boulevard Intersection:*	*Pkwy/Pkwy Intersection or Parkway Approach to Other Intersection Types :*
		entire length of the segment.	need not run the entire length of the segment.	
• Bicycle Stop Bars	Not a valid intersection type.	Should be provided if there is a bike lane, but no bike box.	Should be provided if there is a bike lane, but no bike box.	Provide in the rare circumstance that a bike lane exists.
• Grade Separation	Not a valid intersection type.	No.	No.	Allowable, for Parkway/Parkway. No for other intersections.
Lighting:				
• Street	Not a valid intersection type.	Yes.	Yes.	Yes.
• Pedestrian	Not a valid intersection type.	Optional. Should be provided where adjacent land uses or facilities are likely to cause concentrations of pedestrians (at bus stops or in areas that are currently or are planned to be pedestrian-oriented retail or mixed-use, e.g.).	Atypical. Should be provided where adjacent land uses or facilities are likely to cause concentrations of pedestrians (at bus stops or in areas that are currently or are planned to be pedestrian-oriented retail or mixed-use, e.g.).	Atypical, but should be provided in any circumstance where adjacent land uses or facilities are likely to cause concentrations of pedestrians.

Table 5.4 Parkway Intersection Elements (continued)

Element:	*Main Street Approach:*	*Avenue Approach to Parkway/Avenue Intersection:*	*Boulevard Approach to Parkway/Boulevard Intersection:*	*Pkwy/Pkwy Intersection or Parkway Approach to Other Intersection Types :*
Traffic Calming	Not a valid intersection type.	Consider a combination of elements on intersection approach to slow traffic approaching intersection. At the intersection, curb extensions may be used, for example (see "curb extensions", above, and CDOT's Traffic Calming Report for more information).	May be appropriate, if necessary to maintain desired speeds. Lateral shifts and some forms of narrowing may be considered. See CDOT's Traffic Calming Report for more information.	No.

5.5 Local Street Intersections

There are three different Local street types (residential, office/commercial, and industrial) and multiple cross-sections for two of those street types (residential and office/commercial). Any of these street types can intersect with any other street type. Intersections between two Local streets should be designed to reflect the primary function of Local streets - providing access to land uses. Intersections between Local streets and non-local streets should be designed to accommodate the lower volumes and modal balance of a Local street, balanced against the higher volumes and wide range of possible functions of the intersecting non-local street. The design recommendations for Local streets should be considered more prescriptive than those for non-local streets, particularly at Local/Local intersections.

Assumed Conditions:

(1) Local streets provide access to specific (existing or planned) land uses. Traffic volumes and speeds on Local streets will be low.

(2) Intersections of two Local streets should be designed to maintain low-speed, low-volume conditions similar to or lower than those for Main Streets.

(3) Local streets and their intersections should be designed toward more of a pedestrian orientation than an auto-orientation. This is less the case with local *industrial* streets, where higher volumes of truck traffic will require some design features that are not as pedestrian-oriented as those of other Local streets.

The following table provides guidance in applying design elements to different types of Local intersections. The column headings refer to the various possible types of approach legs. The "Local Approach" column should be used to assess all Local-to-Local intersections, as well as the Local approach to any of the other intersection types (Local-to-Main, Local-to-Avenue, Local-to-Boulevard, and Local-to-Parkway).

Local Street Intersections 5.5

Local Street Intersections

This example shows a Medium Residential Street intersection. For specific information on Local Street intersections, refer to the guidelines on Table 4.5.

Table 5.5 Local Street Intersection Elements

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
Level of Service (LOS) ***at signalized intersections***:					
• Pedestrian LOS Objective	LOS A for the entire Local/Local intersection.	LOS A for the entire Local/Main intersection.	LOS B for the entire Local/Avenue intersection.	LOS B for the entire Local/Boulevard intersection.	LOS D for the entire Local/Parkway intersection.
• Bicycle LOS Objective	Not applicable (see Appendix A for details).	Not applicable (see Appendix A for details).	LOS B for the entire Local/Avenue intersection, using the average LOS value of only the Avenue approaches (see Appendix A for details).	LOS B for the entire Local/Blvd intersection, using the average LOS value of only the Blvd approaches (see Appendix A for details).	LOS C for the entire Local/Parkway intersection, using the average LOS value of only the Parkway approaches (see Appendix A for details).
• Motor Vehicle V/C Threshold	1.0, for two consecutive AM or PM hours, for the entire Local/Local intersection.	1.0, for two consecutive AM or PM hours, for the entire Local/Main intersection.	.95, for two consecutive AM or PM hours, for the entire Local/Avenue intersection.	.95, for BOTH one AM and one PM hour, for the entire Local/Blvd intersection.	.90, for BOTH one AM and one PM hour, for the entire Local/Parkway intersection.
Median	Atypical, but allowable under special circumstances, as an aesthetic or	Atypical, but allowable under special circumstances (see Chapter	Atypical. When provided, should be a minimum width	Should be provided, with a minimum width of 6' at the	Yes, preferably 9' wide at the intersection, 6'

Local Street Intersection Elements (continued) Table 5.5

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
	gateway feature. When provided, should be a minimum width of 6' at intersections (measured face-of-curb to face-of-curb), for pedestrian refuge. Use mountable aprons at the intersection to allow tighter curb radii. Avoid on Local Industrial streets.	4, Section 4.1). When provided, should be a minimum width of 6' at intersections (face-of-curb to face-of-curb), for pedestrian refuge.	of 6' at intersections (face-of-curb to face-of-curb), for pedestrian refuge.	intersection (face-of-curb to face-of-curb), for pedestrian refuge.	minimum (face-of-curb to face-of-curb), for pedestrian refuge.
Pedestrian Refuge Island	Atypical, but, where a median exists, a paved portion may serve as pedestrian refuge at the crosswalk, particularly at intersections with higher volume Avenues or Boulevards. Where provided, refuges should be a minimum of 6' wide (measured face-of-curb	Atypical, but allowable at signalized intersections, if necessary for traffic calming. Where provided, refuges should be a minimum of 6' wide (measured face-of-curb to face-of-curb).	Consider when there are 4 or more lanes on the approach. To be provided either by extending the median to the crosswalk or by providing a separate, 6' minim um, pedestrian refuge (measured face-of-curb to face-of-curb).	Should be provided, by extending the median through through the crosswalk. 6' minimum width (measured face-of-curb to face-of-curb); 8' preferred if Local approaches have land uses likely to	Should be provided, by extending the median to the intersection. 9' preferred width, with 6' minimum (measured face-of-curb to face-of-curb). 8' minimum if Local approaches have

Table 5.5 Local Street Intersection Elements (continued)

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
	to face-of-curb).			generate pedestrian traffic across the Boulevard approaches.	land uses likely to generate pedestrian traffic across the Parkway approaches.
Number of Through Lanes	No more than 1 in each direction.	No more than 1 in each direction.	Typically, 1 to 2 lanes in each direction.	Typically, 2 lanes in each direction.	2 to 3 lanes in each direction.
Left-Turn Lane	Atypical. Local street entrances should not be wider than 3 lanes total, with 2 lanes total preferred.	Allowable only with the 3-lane Main Street cross-section. Typically, the turn lane will be 10' wide.	Will be provided with the 3-lane and the 5-lane cross-sections. Allowable on 4 lane cross-section. 10' turn lanes suitable.	Should be provided where there are median openings or left-overs, ideally 11' wide. In constrained situations, may be 10' wide.	Should be provided where there are median openings or left-overs, ideally 11' wide. In constrained conditions, may be a minimum of 10' wide. Should preferably include a 4' offset and an edge line, if there is no curb on the median.

Local Street Intersection Elements (continued) Table 5.5

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
Dual Left-Turn Lanes	Inappropriate.	Inappropriate.	Typically inappropriate. May be allowable onto "narrow" Local Commercial streets, which would be for access to campus-style office park settings. In that case, a short receiving lane leading into the site would be provided if dual lefts off of a busy thoroughfare are necessary. This solution should be applied only rarely. Dual lefts are inappropriate onto other Local streets.	Typically inappropriate. May be allowable onto "narrow" Local Commercial streets, which would be for access to campus-style office park settings. In that case, a short receiving lane leading into the site would be provided if dual lefts off of a busy thoroughfare are necessary. This solution should be applied only rarely. Dual lefts are inappropriate onto other Local streets.	Inappropriate.

Table 5.5 Local Street Intersection Elements (continued)

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
Right-Turn Lanes	Atypical. Local street approaches should not be wider than 3 lanes total, with 2 lanes preferred.	Inappropriate.	Discouraged. The preferred option is to provide additional connections in the surrounding street network.	Allowable. The preferred option is to provide additional connections in the surrounding street network.	Although right-turn lanes are the ideal on Parkways, they should be very carefully considered and designed when they are allowing turns onto Local Streets. The design of these lanes should discourage continuous flow and, where used, Florida slip-lane design with corner islands is the preferred treatment.

Local Street Intersection Elements (continued) Table 5.5

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
Right-Turn Corner Islands	Not applicable.	Not applicable.	Inappropriate.	Allowable, if necessary to maintain acceptable pedestrian LOS with the addition of a right-turn lane. Minimum of 50 sf, Florida Slip-Lane design preferred .	Yes, if used in conjunction with Florida slip-lane design, as discussed above under "Right-Turn Lanes".
Tapers	Inappropriate.	Inappropriate.	Inappropriate.	Typically inappropriate, but allowable onto Local Industrial streets.	Typically inappropriate, but allowable onto Local Industrial streets.
Bicycle Lanes	Not applicable.	Not applicable.	Should be provided. 4' minimum. 5' minimum and 6' preferred when on-street parking exists along the segment.	Should be provided. 5' minimum. 6' preferred. May also be provided on a parallel frontage road, if that creates the safest cycling treatment.	Typically inappropriate, but may be allowed, to maintain bicycle network connectivity (6' minimum). Preferred option is to have separate facility outside of

Table 5.5 Local Street Intersection Elements (continued)

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
					right-of-way or on parallel local streets.
Curb Extensions	Should be considered at Local/Local intersections (except for Industrial streets), particularly where there is the likelihood of high pedestrian volumes (such as on "wide" Commercial or Residential streets) and/or the need for traffic calming (as on "medium" or "wide" Residential streets). Should be provided at intersections with Main Streets and are allowed at Avenues.	Should be provided, at same width as on-street parking (7'), except at far-side bus stops with high service frequencies.	7' extensions should be provided where full-time, on-street parking exists along the segment, except at far-side bus stops on 2-3 lane cross-sections.	Inappropriate.	Inappropriate.

Local Street Intersection Elements (continued) Table 5.5

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
Bus Stops:	Allowable far side, near side, or mid-segment.	Typically located at far side of intersection.	Typically located at far side of intersection.	Typically located at far side of intersection.	Typically located at off-street lots or stops. Far side stops preferred at intersections.
• Pullout	Inappropriate in most circumstances, though might be considered at high volume bus stops on "narrow" Local Commercial streets.	No.	No.	Consider for high frequency bus stop locations.	Yes.
• Curb Extension	Typically unnecessary at bus stops, except as described above under the general topic of "curb extensions".	Not allowed at far-side stops with high service frequencies. May be considered at other stop locations.	Should be provided (at the same width as the on-street parking) where full-time, on-street parking exists. Do not use at far-side on the 2-3 lane cross-sections.	No.	No.

Table 5.5 Local Street Intersection Elements (continued)

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
Curb Radii	The intent on these low-volume and low-speed streets is to keep the curb radii small. See Appendix C, "Curb Radii" for details.	The intent in these pedestrian-oriented areas is to keep the curb radii small. See Appendix C, "Curb Radii" for details.	The intent is to keep the curb radii as small as possible. See Appendix C, "Curb Radii" for details.	The intent is to keep the curb radii as small as possible. See Appendix C, "Curb Radii" for details.	The intent is to keep the curb radii as small as possible. See Appendix C, "Curb Radii" for details.
ADA Ramps:					
• Type 1	No.	No.	No.	No.	No.
• Type 2	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying circumstances.	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying circumstances.	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying circumstances.	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying circumstances.	Yes. See CDOT's Guidelines for the Design and Location of Accessible Ramps for details and explanations regarding appropriate ramp designs under varying circumstances.

Local Street Intersection Elements (continued) Table 5.5

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
Crosswalks:	Should be provided on all legs at signalized intersections, unless there is a physical restriction or safety-related reason that requires otherwise. Should also be provided on the Local legs of unsignalized intersections with Non-Local streets. At Local/Local intersections, crosswalks should be provided at locations where there is likely to be a high level of pedestrian activity.	Should be provided on all legs at signalized intersections, unless there is a physical restriction or safety-related reason that requires otherwise. Typically would not provide on Main Street approach to unsignalized intersections with Local streets.	Should be provided on all legs at signalized intersections, unless there is a physical restriction or safety-related reason that requires otherwise. Typically would not provide on Avenue approach to unsignalized intersections with Local streets.	Should be provided on all legs at signalized intersections, unless there is a physical restriction or safety-related reason that requires otherwise. Typically would not provide on Blvd approach to unsignalized intersections with Local streets.	Should be provided on all legs at signalized intersections, unless there is a physical restriction or safety-related reason that requires otherwise. Typically would not provide on Parkway approach to unsignalized intersections with Local streets.
• Marked	Yes, always using enhanced marking or enhanced paving.	Yes, always using enhanced marking or enhanced paving.	Yes, always using enhanced marking or enhanced paving.	Yes, always using enhanced marking, but not enhanced paving.	Yes, always using enhanced marking, but not enhanced paving.
• Location	Should not be located on the radius.	Should not be located on the radius.	Should not be located on the radius.	Should not be located on the radius.	Should not be located on the radius.

Table 5.5 Local Street Intersection Elements (continued)

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
Traffic Control:					
• Two-Way Stop	Yes.	No.	No.	No.	No.
• Four-Way Stop	Yes, at other Locals and at Main Streets.	Yes, at other Locals and at Main Streets.	No.	No.	No.
• Round-about	Allowable at other Locals, Mains, and, in rare instances, at Avenues. Not at Boulevards or Parkways.	Allowable as a gateway transition.	Allowable for traffic calming when: 1) volumes are less than 35,000; 2) analysis shows that roundabouts provide higher vehicle LOS than signals; 3) provision of round-about does not de-grade pedestrian and bicycle LOS, and 4) movements are bal-anced enough to allow safe exit from the Lo-cal Street leg. Typical-ly want to avoid multi-lane roundabouts at these intersections.	No.	No.

Local Street Intersection Elements (continued) Table 5.5

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
• Signals	Yes, depending on warrants, though unlikely at Local/Local intersections.	Yes, depending on warrants, with bus signal priority, where appropriate.	Yes, depending on warrants, with bus signal priority, where appropriate.	Allowable, depending on warrants, with bus signal priority, where appropriate.	Rarely.
• Right-Turn on Red	Allowable in rare case where a Local/Local intersection is signalized, but should be avoided in locations with a high potential for pedestrian traffic. Not allowed at Main Street intersections. Allowable at other intersections, but should be avoided in locations with a high potential for pedestrian traffic (in areas that are currently or are planned to be pedestrian-oriented retail or mixed use.	Not allowed.	Allowable, but should be avoided in locations with a high potential for pedestrian traffic (in areas that are currently or are planned to be pedestrian-oriented retail or mixed-use).	Allowable, but should be avoided in locations with a high potential for pedestrian traffic (in areas that are currently or are planned to be pedestrian-oriented retail or mixed-use).	Desirable if signalized, depending on sight distance and potential for higher volume pedestrian traffic at the intersection.

Table 5.5 Local Street Intersection Elements (continued)

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
• Pedestrian Signals	Yes, where signal warrants are met, with countdown. Also consider audible signals (where deemed appropriate) and leading pedestrian interval.	Yes, with countdown. Also consider audible signals (where deemed appropriate) and leading pedestrian interval.	Yes, with countdown. Also consider audible signals (where deemed appropriate) and leading pedestrian interval.	Yes, with countdown. Also consider audible signals (where deemed appropriate) and leading pedestrian interval.	Yes, with countdown. Also consider audible signals (where deemed appropriate).
• Bicycle Detectors	Provide for all Local Street approaches to signalized intersections.	Provide for all Main Street approaches to signalized intersections.	Provide for through lanes and left turns.	Provide for left turns.	Typically, not applicable. Bicycle facilities should be provided as far as possible from the travel lanes on Parkways.
• Advance Stop Bars	Yes, at signalized intersections. Should be spaced to allow clear separation and visibility between cars and the crosswalk and, where necessary, far enough back to allow for vehicles	Yes, at signalized intersections. Should be spaced to allow clear separation and visibility between cars and the crosswalk and, where necessary, far enough back to allow	Yes. Should be spaced to allow clear separation and visibility between cars and the crosswalk and, where necessary, far enough back to allow for	Yes. Should be spaced to allow clear separation and visibility between cars and the crosswalk. Stagger the stop bars when right-turn on red is allowed. This	Allowable. Should be spaced to allow clear separation and visibility between cars and the crosswalk. Stagger the stop bars when right turn on red

Local Street Intersection Elements (continued) Table 5.5

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
	turning off of the cross street.	for vehicles turning off of the Local Street.	vehicles turning off of the other street. With the four-lane cross-section, stagger the stop bars when right-turn on red is allowed. This allows the turning vehicle to observe approaching traffic without encroaching into the crosswalk.	allows the turning vehicle to observe approaching traffic without encroaching into the crosswalk.	is allowed. This allows the turning vehicle to observe approaching traffic without encroaching into the crosswalk.
• Bike Box	Inapplicable, since bikes are expected to travel in mixed traffic.	Inapplicable, since bikes are expected to travel in mixed traffic.	Should be considered, but only if a bike lane approaches the intersection. This bike lane approach need not run the entire length of the segment.	Should be considered, but only if a bike lane approaches the intersection. This bike lane approach need not run the entire length of the segment.	No. If a bike lane exists, use bicycle stop bars, rather than a bike box.

Table 5.5 Local Street Intersection Elements (continued)

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
• Bicycle Stop Bars	Inapplicable, since bikes are expected to travel in mixed traffic.	Inapplicable, since bikes are expected to travel in mixed traffic.	Should be provided if there is a bike lane, but no bike box.	Should be provided if there is a bike lane, but no bike box.	Provide in the rare circumstance that a bike lane exists.
• Grade Separation	No.	No.	No.	No.	No.
Lighting					
• Street	Yes.	Yes.	Yes.	Yes.	Yes.
• Pedestrian	Should be provided where adjacent land uses or facilities are likely to cause concentrations of pedestrians (at bus stops or in areas that are currently or are planned to be pedestrian-oriented retail or mixed-use, e.g.).	Yes.	Should be provided where adjacent land uses or facilities are likely to cause concentrations of pedestrians (at bus stops or in areas that are currently or are planned to be pedestrian-oriented retail or mixed-use, e.g.).	Should be provided where adjacent land uses or facilities are likely to cause concentrations of pedestrians (at bus stops or in areas that are currently or are planned to be pedestrian-oriented retail or mixed-use, e.g.).	Atypical, but should be provided in any circumstance where adjacent land uses or facilities are likely to cause concentrations of pedestrians.

Local Street Intersection Elements (continued) Table 5.5

Element:	*Local/Local Intersections or Local Approach to Other Intersections:*	*Main Street Approach to Local/Main Intersections:*	*Avenue Approach to Local/Avenue Intersections:*	*Boulevard Approach to Local/ Blvd Intersections:*	*Parkway Approach to Local/Parkway Intersections:*
Traffic Calming	Slow points should be provided on Local streets every 300-500 feet. Stops at intersections can count as slow points. Curb extensions and other devices can also narrow the intersection and serve to calm traffic (see "curb extensions", above, and CDOT's Traffic Calming Report for more information)	Typically not necessary, but may be used to maintain desired speeds.	Consider a combination of elements on intersection approach to slow traffic approaching intersection. At the intersection, curb extensions may be used, for example (see "curb extensions", above, and CDOT's Traffic Calming Report for more information).	May be appropriate, if necessary to maintain desired speeds. Lateral shifts and some forms of narrowing may be considered. See CDOT's Traffic Calming Report for more information.	No.

6. GLOSSARY

AMENITY ZONE

A hardscaped extension of the sidewalk to the back-of-curb, typically used instead of, or alternating with, a planting strip.

Purpose/Benefits:

- Provides space for street furnishings (benches, trashcans, etc.) and street trees outside of the unobstructed walking space for pedestrians.
- In areas with on-street parking, provides a hard surface for passengers exiting parked cars.
- Street furnishings help to create a more active pedestrian environment in dense areas.

Design Considerations:

Inclusion of an amenity zone depends upon a variety of factors, including:

- Higher intensity pedestrian-oriented uses, such as retail, office, high-density residential, and mixed uses are more likely to require the amenity zone. This is a more "urban" treatment than is a planting strip.
- The amenity zone can help to extend the sidewalk area when there are right-of-way constraints to the preferred sidewalk width. In most cases, however, the amenity zone should **not** be considered part of the unobstructed pedestrian pathway.
- The amenity zone should include intermittent landscaping and street trees, using appropriate planting techniques (in grates or planters, e.g.).

Two examples of amenity zones. The amenity zone above is ample and, in conjunction with the wide sidewalk, provides a substantial pedestrian area. The amenity zone shown below is small, but helps to extend the pedestrian area in a very constrained environment. Benches, lighting, and shade are important components of the walking environment.

BICYCLE DETECTOR

A device at a signalized intersection used to detect bicycles for traffic actuated signals.

Purpose/Benefits:

- Activates the traffic signal in the absence of motor vehicle traffic, thereby keeping the cyclist from having to wait for another vehicle to "trip" the signal or, after a prolonged wait, to run the signal.

Design Considerations:

- Detectors should be located in the bicyclists' expected path, whether the intersection includes bike lanes, a bike box, or a wide outside lane.
- Bicycle detectors are most important on the less traveled leg of a signalized intersection, because the wait for another vehicle to "trip" the light will be longer. However, a strong case can be made for using detectors on all legs, as the time of day can make a difference even on the more traveled legs.
- Markings on the roadway surface can be used to indicate the optimum location for bicycle detection.

BICYCLE LANE

The portion of the street specifically designated for the use of bicyclists by pavement markings or other means of delineation on the street.

Purpose/Benefits:

- Provides a clearly marked area of the street for bicycle travel and separates cyclists from motor vehicles.
- Help reduce conflicts between motor vehicles and bicycles.
- Provides an additional buffer between pedestrians and motor vehicles.
- Gives motorists more confidence about passing cyclists, because they know where the cyclist's "space" is and *they know that the cyclist knows where his/her space is, as well.* The uncertainty about passing in the absence of bike lanes can create unnecessary backups or dangerous passing conditions.

Design Considerations:

Placement and width of bicycle lanes is dependent on:

- Right-of-way width, traffic speed and volume, signalization, turn lanes and parking.
- A marked bicycle lane should be a minimum of four feet wide (not including gutter), with 5' generally preferred.
- Wider lanes are preferred next to on-street parking (to avoid opening car doors) and on steep hills (to allow room for weaving caused by pedaling uphill).
- If there is a right turn lane at an intersection, the bicycle lane should be placed to the left of the right turn lane, to clearly separate the bicycle's through movement from the motor vehicles' turning movements.

A bike lane in a residential area. The back-of-curb sidewalk is not the preferred treatment, but the bike lane helps to provide a buffer between the pedestrians and motor vehicles.

Example of a bike box in Vancouver, B.C. Note the short bike lane, which allows cyclists to safely advance to the box.

BIKE BOX

A marked, designated area at a signalized intersection that places bicyclists at the front of the traffic queue when the signal is red.

Purpose/Benefits:

- Puts bicyclists at the head of the queue, allowing them to enter and clear an intersection before motor vehicles.
- Bicyclists are more visible to motorists at the front of the queue.
- Provides a storage area for bikes at an intersection where there is heavy bicycle traffic and left turn movements.
- Stores vehicles further back from the crosswalk, providing a better crossing environment for pedestrians.

Design Considerations:

- Should only be used at signalized intersections where there is no right turn on red.
- May require additional signage to inform motorists and cyclists how to correctly use the bike box.
- Must be accessed via a bike lane, which allows cyclists to safely move ahead of motor vehicles in the intersection.

BLOCK LENGTH

The longest dimension of a block, from intersection to intersection. Charlotte's Street Design Guidelines recommend relatively short block lengths for most street types.

Purpose/Benefits:

- Block lengths help determine the overall "density" of the street network, with shorter blocks generally creating a denser network.
- Shorter blocks (and a denser network) can help disperse traffic through the network, rather than focusing it on a few routes. The fewer route choices, the greater the likelihood that the routes will become congested.
- A denser network provides more route choices for all travelers by all modes.
- Shorter block lengths and a denser network can allow more direct (and therefore, shorter) routes, a particularly important factor for pedestrians and cyclists.
- Shorter blocks (and a denser network) allow for more flexibility as a city grows.

Design Considerations:

- Block length will vary according to street type and surrounding land uses. Charlotte's Urban Street Design Guidelines recommend that most street types have blocks no longer than 650'.
- Pedestrian, vehicular, and bicycle network connections should be considered when laying out the block structure.

The relatively flat, treeless area to the right of the travel lanes on Harris Boulevard (a Parkway) is an example of a clear zone.

CLEAR ZONE

A zone (adjacent to the street) that is kept clear of significant obstructions, such as trees. The clear zone is measured from the edge of the travel lane.

Purpose/Benefits:

- Provides a margin of error for vehicles that might run off the road, potentially allowing the driver to avoid a crash.
- Can reduce the severity of crashes for vehicles that do run off the road.

Design Considerations:

- Clear zones are typically used for high-speed streets and roadways. The Urban Street Design Guidelines only recommend a clear zone for the Parkway classification.
- The shoulder is included as part of the measured clear zone.

CORNER ISLAND

A raised triangular or semi-triangular island used to direct traffic in a particular direction, described herein to separate a right-turn lane from the through lanes at an intersection. Also referred to as a "Channelization Island".

Purpose/Benefits:

- Helps to separate the turning traffic from the through traffic, potentially enhancing flow.
- If properly designed, a corner island can be used for pedestrian refuge at large intersections.

Design Considerations:

- Consider the use of well-designed corner islands to "break up" the distance and conflicting turning movements that must be traversed by pedestrians at wide intersections.
- The safest design for pedestrians is when the corner island is designed to bring the turn lane into the receiving lane at an angle, rather than as a sweeping curve. Otherwise, the turning driver is likely to be looking over his/her left shoulder at oncoming traffic, rather than at pedestrians trying to cross the turn lane.
- The use of corner islands (and their design) should be based upon the intersection volume and the surrounding land use and design characteristics. The potential "pedestrian refuge" benefit should also be weighed against the additional right-of-way requirements and overall dimensions of the intersection.

Two views of the same landscaped corner island. Note, in top photo, that the crosswalk extends to and across the island to clearly delineate the safest pedestrian path. Below, the right-turn lane could approach the receiving lane at a sharper angle to ensure that turning cars actually look both directions. As it is, there is some tendency to treat it more as a merge than a turn. Pulling the crosswalk away from the receiving lane (toward the camera, in this picture) reduces the risk to pedestrians, but also makes for a less direct pedestrian connection.

Two types of crosswalks at signalized intersections. The crosswalk at the bottom, located in a higher-volume pedestrian location, includes enhanced paving.

CROSSWALKS

The crosswalk generally refers to the most direct pedestrian pathway across a given leg of an intersection, whether marked or unmarked. For the purposes of these Guidelines, however, "crosswalk" refers to the *marked* portion of the street that is specifically designated for pedestrian crossing, whether at an intersection or a mid-block crossing.

Purpose/Benefits:

- Crosswalks clearly define the pedestrian space, enhancing safety and comfort for all users.
- Crosswalks are an important part of the pedestrian network - they form a continuation of the pedestrian's travel path and enhance pedestrian connectivity.
- Crosswalks support the overall transportation system because other users, such as motorists, bicyclists and transit users will be pedestrians at some point during their trip and may need to cross the street.

Design Considerations:

- Can be installed at intersections or designated mid-block crossing locations (see CDOT's Mid-Block Crossing Policy for more information).
- The crosswalk location should be highly visible, so the pedestrian can see and be seen by traffic while crossing.
- Signalized intersections will typically have crosswalks on all approaches.
- Installation at unsignalized intersections and mid-block locations may be affected by a number of factors, including: street classification, width of street, traffic speed and volume, use of traffic control devices such as stop signs, and surrounding land uses.
- Pedestrian crossing distance should be minimized; on some streets this may require the use of other street design elements (see Curb Extension, Pedestrian Refuge).

CURB EXTENSION

A feature that extends from the sidewalk into the pavement at an intersection or at a mid-block crossing (also sometimes called a “curb bulb”, “neckdown” or “bulbout”). A curb extension can be hardscape, landscaped, or a mix of both.

Purpose/Benefits:

- Reduces street width both physically and visually, thereby shortening pedestrian crossing distance at crosswalks and potentially helping to reduce traffic speeds.
- Provides increased visibility for pedestrians and motorists.
- Moves parked vehicles away from street corners, improving visibility.

Design Considerations:

- Should be used whenever possible in pedestrian-oriented areas.
- Should also be used for transit stops, where full-time, on-street parking exists.
- Should only be used where there is a permanent parking lane.
- Should not encroach into the bike lane.
- Street furniture or plants on the curb extension should not impede motorist or pedestrian sightlines.
- Should be designed to accommodate both large and small vehicles; tight curb radii can accommodate low speed turning movements by large vehicles if the intersection is designed properly.

Curb extensions can be installed as a retro-fit, such as in the photo at the top, or, preferably, as part of the original design. They can also occur at intersections or mid-block, as shown below.

Two radically different curb radii. The radius at the top is very small (or "tight"), which helps to slow turning vehicles. The radius below is very large (or "wide"), allowing vehicles to turn more easily and quickly. Note the location of the crosswalk relative to the curve. The radius above is more conducive to pedestrian travel. Note also the different traffic characteristics - the intersection below must handle a much larger volume of traffic.

CURB RADIUS

The curved section of the curb connecting the curb lines of two intersecting streets. The curb radius measurement is taken from the back of the curb.

Purpose/Benefits:

- Defines the space for (and helps direct) vehicle turning movements at intersections.
- The curb radius dimension can affect ease and speeds of vehicular turning movements.

Design Considerations:

- Radii should be minimized, to allow the necessary dimension for traffic, while minimizing impacts on pedestrians, cyclists, and the adjacent land uses.
- Smaller curb radii narrow the overall dimensions of the intersection, shortening pedestrian crossing distance and reducing right-of-way requirements.
- A smaller curb radius provides a more visible pedestrian waiting space at the intersection.
- Smaller radii help reduce the turning speeds of vehicles.
- A smaller radius allows for more flexibility in placement of curb ramps. With a larger radius, the ramp(s) may need to be located in the radius or will be too far from the corner for good visibility.
- Larger radii may be required on streets that carry a high percentage of truck traffic, because they allow easier turning movements for large vehicles.
- The presence of a bike lane or parking lane creates an "effective radius" that allows a smaller curb radius than might otherwise be required for some motor vehicles, because they provide extra maneuvering space for the turning vehicles.

ENHANCED PAVEMENT

Refers to the installation of materials other than the typical smooth concrete or asphalt surface within the right-of-way.

Purpose/Benefits:

- Improves intersection and crosswalk visibility.
- Use of different paving materials can be used to better define pedestrian, bicycle and vehicular areas in the right-of-way.
- Materials can be used for aesthetic enhancement and for defining public space in general.

Design Considerations:

- Function is an important factor when utilizing different materials, including cobblestone, brick, stamped concrete, colored concrete, and pavers. Heavily traveled truck routes, for example, may require a different surface than a lightly traveled local street.
- When choosing the type, location, and design of enhanced pavement, be sure that all potential users are considered, including those with disabilities or pushing strollers.
- Visibility during the day, at night, and in inclement weather is important in selecting the design and location of enhanced pavement.
- Avoid the use of slippery surfaces such as smooth granite in primary pedestrian areas.
- Materials such as cobblestones and brick may increase construction and maintenance costs.

Stamped and painted asphalt is one type of enhanced pavement used to highlight a pedestrian area.

HIGH-INTENSITY ACTIVATED CROSSWALK (continued)

A traffic control beacon for pedestrians used to warn and control vehicular traffic at mid-block locations. Also referred to as a "pedestrian beacon." The design is unique because the device is dark until activated by a pedestrian. A yellow beacon flashes, turns to solid yellow, and then to a red indication. After a period of time, the red indication "wig-wags," to allow drivers to proceed if the pedestrian has cleared the crossing.

Note: The HAWK is currently approved for use on city-maintained streets as an experimental application. The new edition of the Manual on Uniform Traffic Control Devices (MUTCD) will include provisions for a pedestrian beacon.

Purpose/Benefits:

- Assists pedestrians in crossing a street or highway at a marked crosswalk.
- Assigns right-of-way to the pedestrians, with the use of red indications for vehicles and a walk indication for pedestrians.
- Useful in locations where pedestrians have a difficult time finding gaps to cross multi-lane roads.
- This type of beacon has been found to have higher compliance rates in some applications than other types of pedestrian signals.

Design Considerations:

- Typically pedestrian beacons are used on higher volume, higher speed streets.
- Signs and pavement marking must be used in conjunction with the pedestrian beacon.
- Installation will typically be mid-block, away from an intersection, to avoid confusion with side street traffic.
- Countdown pedestrian signals and APS devices should be used when possible.

HIGH-INTENSITY ACTIVATED CROSSWALK (continued)

- When possible, pedestrian beacon should be coordinated with adjacent traffic signals.
- The location should be highly visible, so the pedestrian can see and be seen while crossing the street.

photo courtesy of Richard Nassi, City of Tucson, AZ

LEADING PEDESTRIAN INTERVAL

Used at signalized intersections, the Leading Pedestrian Interval (LPI) is a signal phase that provides a pedestrian crossing signal a few seconds before the green signal for vehicles.

Purpose/Benefits:

- Allows pedestrians to enter the crosswalk ahead of turning vehicles, thereby establishing their right-of-way.
- Improves visibility of pedestrians by providing them with a "head start" before vehicles are allowed to move.
- Reduces potential conflicts with turning vehicles.

Design Considerations:

- LPI should typically have an equivalent audible signal for vision-impaired pedestrians.
- The Street Design Guidelines encourage the use of LPI at many different types of locations. They are often included where there are large numbers of pedestrians crossing the street, for example, but are also important where there are fewer pedestrians. This is because it is sometimes easier for large groups of pedestrians to "take" their right-of-way, than for a lone pedestrian to do so. Lone pedestrians are also less visible to motorists.

MEDIAN

A raised barrier that separates traffic flows. Generally used to control access and reduce vehicular turning movements.

Purpose/Benefits:

- Separates opposing traffic flows, reducing or eliminating vehicular conflicts.
- Can be used for access management, by restricting turning movements into driveways or side streets.
- If properly designed, can provide a pedestrian and bicycle refuge on wider streets.
- If properly designed, can provide a landscaped element to the streetscape.

Design Considerations:

- Design and installation of a median will vary according to street type and right-of-way width.
- The Street Design Guidelines generally recommend that, if a median is used, it should be wide enough for landscaping and pedestrian refuge.
- In the absence of other design elements such as landscaping, street trees, and on-street parking, a median may encourage higher traffic speeds. This unintended consequence should be carefully considered when designing streets in residential areas or where there are likely to be many pedestrians.
- Spacing between median openings depends on the street type and land use context. In general, spacing should be longer in areas with higher speeds, fewer driveways, and larger setbacks. Spacing should be more frequent in areas where smaller block lengths and more access are desired.

MEDIAN (continued)

There are a variety of median types. The medians shown above range from minimal to substantial. Functionally, they range from those that simply separate vehicular traffic movements to those that provide fully functional, aesthetic enhancements to the street. The Urban Street Design Guidelines generally discourage minimal, single-function medians.

ON-STREET PARKING

Generally refers to space for parking cars within the street right-of-way (between the curbs), as opposed to off-street parking areas accessed via driveways.

On-street parking on a commercial street.

Purpose/Benefits:

- Provides improved access to nearby land uses, especially in higher density neighborhoods and commercial areas.
- Reduces the need for large, off-street parking areas.
- Provides a buffer between moving vehicles and pedestrians on the sidewalk.
- On-street parking can narrow the perceived right-of-way width and help reduce traffic speed.

Design Considerations:

- On-street parking will be allowed on many local streets, but not necessarily designated with marked spaces. Most of the information here refers to marked on-street parking.
- High-speed street types are not suitable for on-street parking.
- Cars parked in on-street parking spaces should not impede visibility for pedestrians, bicyclists and other vehicles. This means that on-street parking spaces should be located carefully relative to intersections and crosswalks.
- The provision of on-street parking depends on street width as well as traffic speed. Angled or reverse angle parking requires more roadway space than parallel parking, but can accommodate more vehicles per block.
- On-street parking can be allowed at some times of the day and disallowed at peak traffic times. This can allow more efficient use of lane capacity when it is needed.
- Where dedicated, full time on-street parking is provided, curb extensions can make pedestrians more visible at crossing points.

The situation on the top shows why pedestrian refuges are sometimes needed on multi-lane streets. Below is an example of a simple pedestrian refuge at an intersection crosswalk (photo courtesy of Reid Ewing).

PEDESTRIAN REFUGE

A protected area between traffic lanes that separates a pedestrian crossing into segments and allows pedestrians to wait safely for gaps in traffic (also called a "median refuge", "refuge island" or "pedestrian refuge island").

Purpose/Benefits:

- Reduces pedestrian/vehicular conflict.
- Shortens the distance a pedestrian must cross at one time.
- Allows the pedestrian to consider traffic coming from only one direction at a time, potentially reducing confusion and increasing crossing opportunities.
- Can reduce the time a pedestrian must wait to cross by increasing the number of gaps in traffic, since the pedestrian need only cross traffic coming from one direction.

Design Considerations:

- Typically, would be provided on wider, multi-lane roads, to reduce the effective crossing width.
- Should be signed and illuminated to identify purpose.
- Should be a minimum of 6' wide to provide sufficient space for refuge. Wider is preferable, particularly on higher-speed streets or in areas where there may be many pedestrians crossing at one time.
- Might be used at signalized or unsignalized crosswalks, intersections, and mid-block crossings.
- Landscaping on pedestrian refuges should not impede visibility of pedestrians or drivers.
- The crosswalk should pass through the refuge at grade, for accessibility by all travelers.

PEDESTRIAN REFUGE (continued)

- Should typically include some sort of vertical element, such as landscaping or signs, so that drivers can clearly see and avoid running into the refuge.
- A key tradeoff when providing pedestrian refuge islands is the additional width required. The design team should carefully consider whether the pedestrian and the adjacent land uses are better served by a narrower crossing or by the addition of the refuge. For intersections that are already very wide, with multiple turning movements, the addition of pedestrian refuges may be the only way to improve the pedestrian crossing environment.

This image is an example of a pedestrian refuge without a crosswalk.

The image above is a minimal planting strip, providing little buffering from traffic.

Below, a more substantial planting strip, alternating with on-street parking and curb extensions.

PLANTING STRIP

An unpaved area within the right-of-way that separates the street from the sidewalk.

Purpose/Benefits:

- Serves as a buffer between vehicles and pedestrians.
- Trees in the planting strip provide shade and additional buffering for pedestrians.
- This unpaved area can enhance the stormwater drainage system by helping to reduce run-off.
- If properly designed, the planting strip can soften the appearance of the streetscape, enhance aesthetics, and contribute to an increased sense of safety and identity along the street.

Design Considerations:

- The width of the planting strip will dictate the size and type of landscape materials to be installed.
- Generally, the wider the planting strip, the better the functionality and aesthetic value.
- The planting strip might be replaced by, or alternated with, a hardscaped "amenity zone" in more urban, higher-density contexts.
- The planting strip and its width may need to be considered against the need for other design elements if the right-of-way is limited (in retrofit situations, for example).
- Landscaping and trees in the planting strip should be placed to assure an acceptable sight distance.
- Consider increasing the width of the planting strip as travel speeds increase.

ROAD DIET

A physical conversion of the street, wherein one or more travel lanes is converted to another use, often to support the use of other modes. A "narrowing" of the motor vehicle travelway.

Purpose/Benefits:

- Converts excess vehicle capacity on a street into useable space for other modes. For example, a four-lane street might be narrowed to two lanes, with bike lanes and a median.
- When a street is dieted to two lanes, this helps to calm traffic, in part by eliminating the opportunity for passing.
- Can enhance aesthetics and livability of adjacent land uses.

Design Considerations:

- Consider the street classification and function, along with traffic volumes. Very high-volume streets are not good candidates for road diets.
- Right-of-way width, adjacent land uses and the existing and planned street network should be considered. In some cases, benefits can be gained for other modes without the road diet. On the other hand, in a well-connected network, it may be possible to save right-of-way by using the road diet.
- Consider proper integration of pedestrian, transit and bicycle circulation and related facilities.
- The decision to use a road diet solution should carefully weigh the advantages and disadvantages to all stakeholders, including representatives of the adjacent land uses.

An example of a "road diet". This street was a four-lane street with a wide median. It was converted to a two-lane street, with bike lanes (and with the wide median remaining).

ROUNDABOUT

A circular island located at the convergence of two or more roadways that takes the place of traffic signals or stop signs. Traffic circulates around the island, rather than through the intersection.

A roundabout in a residential neighborhood, where five street segments converge. Note the "apron" that allows larger vehicles to negotiate the roundabout.

Purpose/Benefits:

- Can be used to improve traffic flow, by eliminating the need to come to a complete stop when the intersection is clear and/or reducing the delay if other vehicles are in the intersection.
- May be used as a gateway feature to a neighborhood or a commercial area. This usually entails the use of landscaping or public art in the island.
- Small roundabouts, known as traffic circles, mini circles or mini roundabouts, can also be used for traffic calming because, even though relatively free flow is maintained, the island deflects traffic, requiring that motorists slow before entering the traffic circle.

Design Considerations:

- While single-lane roundabouts are relatively pedestrian friendly, multi-lane roundabouts can be difficult for pedestrians and cyclists to traverse. Multi-lane roundabouts should typically be avoided where pedestrians are likely.
- Consider proper integration of pedestrian and bicycle facilities and emergency vehicle access in roundabout design. Special care should be taken with providing a safe entry and exit for cyclists, for example.
- Roundabouts should typically be landscaped. The landscaping can help make the roundabout more visible to motorists, as well as enhancing its role as a gateway feature.
- Roundabouts should be designed to be major focal point of a streetscape or area.
- Turning movements of larger vehicles can be accommodated by having a paved area with a mountable curb on the outside curb of the roundabout.

SIGHT DISTANCE

The length of roadway that is visible to the driver traveling on a street or approaching (or waiting to enter) an intersection. More generally, sight distance refers to the ability of motorists to see one another as they approach an intersection or enter a street.

An example of a potential sight distance problem – the bushes at the corner of these two streets may make it difficult for a driver to judge whether it is safe to enter the roadway.

Purpose/Benefits:

- Increased sight distance improves safety for motorists, by providing visibility and increasing the amount of time to respond to other vehicles on or entering the street.
- Increased sight distance for motorists entering the street allows the motorist to feel more comfortable and better judge "gaps" in the stream of approaching vehicles.
- Adequate sight distance improves safety for pedestrians and cyclists by making them more visible to drivers and by allowing them to see approaching vehicles, as well.

Design Considerations:

- Sight distance regulations for motor vehicles may conflict with pedestrian friendly objectives such as the desire to have buildings close to the street, especially on Main Streets.
- Sight distance does not need to be as great for motorists approaching a stop sign as it does for motorists approaching an uncontrolled intersection.
- Motorists tend to feel more comfortable traveling at higher speeds when sight distances are very long. Increased safety related to provision of sight distance might, in some circumstances, actually increase speeds. This needs to be considered when designing for streets in different contexts, particularly where there are many pedestrians.

The bus shelter with benches, information kiosks, and trashcan shown here on South Tryon Street are all examples of street furnishings located in an amenity zone.

STREET FURNISHINGS (STREET FURNITURE)

Physical features included as part of the streetscape, e.g. benches, bike racks, lighting, trash receptacles, and banners.

Purpose/Benefits:

- Can improve aesthetics and provide a sense of identity for a neighborhood or commercial area.
- Enhances the functionality of the street for users other than motorists.
- Can enhance safety and protection from vehicular traffic.
- Can provide focal points for street activities.
- Provides short-term parking for bikes.

Design Considerations:

- Street furnishings should be carefully placed so that they do not obstruct the sidewalk. In high pedestrian volume areas, they should be placed in an amenity zone. In no case should street furnishings be placed in the minimal "unobstructed" walking area, as described in Chapter 4 of the Guidelines.
- Placement should be strategic to each type of furnishing's purpose, with appropriate furnishings well-located relative to bus stops, major pedestrian focal points, etc.
- The design and placement of street furnishings should not contribute to visual clutter along the street.
- Street furnishings should be carefully located relative to other features such as street trees, landscaping, adjacent land uses, and signs.

STREET LIGHTING

Refers to the illumination of a street's travel lanes. Other portions of the street right-of-way may also be illuminated by the street lighting and/or by pedestrian-scale lighting, which specifically illuminates the sidewalk or other pedestrian areas.

Purpose/Benefits:

- Street lighting enhances safety for all travelers, by illuminating hazards, curves, and other travelers in the street.
- Lighting can also improve safety and security around buildings and in parking areas. This may best be accomplished by a mix of street and pedestrian-scale lighting, depending on the context.

Design Considerations:

- The optimal type and number of streetlights depends on street classification, configuration, and adjacent land uses.
- Street lighting that reduces glare or unnecessary uplighting should be considered, to ease localized light pollution. Cobraheads should be avoided.
- Consider whether pedestrian-scale lighting can be used to illuminate or define a curve or other feature and, therefore, reduce the need for streetlights in some spots (on portions of Local Streets or some residential Avenues, for example).
- Areas of high pedestrian activity or primary pedestrian routes should have pedestrian-scale lighting, which is specifically intended to illuminate the sidewalk, as opposed to the travelway. For proper illumination and to avoid glare, pedestrian-scale lighting should typically be no more than 12' in height. Even in parking areas, which may need street lighting, pedestrian-scale lighting can better define and enhance the pedestrian "space".

The lighting at the top is pedestrian-scale lighting, intended to illuminate the sidewalk and adjacent areas. The more conventional street lighting shown on the bottom can also help illuminate the pedestrian areas, but is generally intended to light the travel lanes.

STREETSCAPE

The combination of the physical elements installed within and along the street right-of-way that impact its usability, functionality, appearance and identity. The information contained in the Urban Street Design Guidelines (particularly Chapters 4 and 5) essentially describe how to develop the "streetscape".

Purpose/Benefits:

- Good streetscapes enhance a street's functionality and aesthetics.
- Good streetscapes enhance the community environment by providing access to land uses, locations for social interaction, and sites for locating and maintaining infrastructure and amenities.

Design Considerations:

- The appropriate combination of streetscape elements will vary according to street classification, right-of-way width, traffic volume, land use context, and multi-modal expectations. These variations are described in Chapters 4 and 5 of the Urban Street Design Guidelines.

TRAFFIC CALMING

One or a combination of physical measures installed within the street right-of-way to slow or discourage traffic along a street. Traffic calming tools include curb extensions, chicanes, traffic circles, speed humps (also called "speed tables"), raised crosswalks, landscaping, and paving treatments. See CDOT's Traffic Calming Report for a full discussion of the types and appropriate application of traffic calming devices.

Purpose/Benefits:

- Modifies traffic patterns to reduce traffic speeds.
- Some forms of traffic calming are used to reduce traffic volumes either by eliminating travel options entirely or by discouraging traffic through significant speed reductions. The intent of the tools and applications described in the Urban Street Design Guidelines and CDOT's Traffic Calming Report is to reduce speeds.
- Properly applied, can improve safety for all travelers by reducing speeds.
- Properly applied, can improve liveability for those in the adjacent land uses, by increasing safety and reducing noise, e.g..

Design Considerations:

- The appropriate application of traffic calming devices depends on street type, traffic volumes, current and desired speeds, street width, and existing traffic control facilities and amenities. See CDOT's Traffic Calming Report for more information about which traffic calming tools should be used under which circumstances.
- The placement of traffic calming items such as speed bumps and traffic circles may impact drainage inlets.

Speed "humps" (or tables), such as those shown here, have been the typical approach to traffic calming in Charlotte. The Urban Street Design Guidelines and related Traffic Calming Report include additional options and the conditions under which they would be applied.

Above, a wide-outside-lane in constrained right-of-way.

Below, a wide-outside-lane with sidewalk.

WIDE OUTSIDE LANE

An extra wide traffic lane that provides enough space for motor vehicles and bicycles to use the same lane (also called a shared lane). Typically used where there is not enough space for a separate, marked bicycle lane.

Purpose/Benefits:

- Provides some increase in safety and comfort for both cyclists and motorists, in the absence of a bicycle lane (which is the preferred treatment for bicycle safety).

Design Considerations:

- Should be wide enough to allow a motor vehicle to pass a cyclist without crossing into the next lane (minimum 14' width).
- Extra width is required if the wide-outside-lane is to be used with on-street parking (to reduce the risk to cyclists from opening car doors).
- Wide outside lanes can also make motorists feel more comfortable speeding, so they should be used carefully. Marked bicycle lanes are the preferred option.

URBAN STREET DESIGN GUIDELINES



CHARLOTTE.

Adopted by Charlotte City Council
October 22, 2007

APPENDICES

Appendix A

Planning and Designing Signalized Intersections Using Multi-Modal Level-of-Service Standards

Appendix A: Planning and Designing Signalized Intersections Using Multi-Modal Level-of-Service Standards

This Appendix includes information necessary for evaluating Charlotte‟s signalized intersections from a multi-modal perspective. It includes 1) a brief introduction to Charlotte‟s new approach to intersection design, 2) a table and related notes to be used for evaluating and designing specific intersections, and 3) a step-by-step process for planning and defining intersection improvement projects in Charlotte. The intent of this information is to ensure that intersection design reflects the goals inherent in Charlotte‟s Urban Street Design Guidelines, specifically the desire to increase transportation choices by making travel by pedestrians, cyclists, and transit users safer and more convenient. Major changes to the evaluation procedure, as outlined below, include a two-hour standard for evaluating motor vehicle "level-of-service" (LOS) at an intersection, and the inclusion of a pedestrian and a bicycle LOS standard.

As shown on Table 1, the volume/capacity (V/C) ratio of a signalized intersection is used as a surrogate for motor vehicle LOS and as a threshold or trigger to investigate any operational or physical capacity increases at the intersection. The "conditions" listed are directly related to the street classification(s) at the intersection, as defined by the Urban Street Design Guidelines. In general, the more pedestrian-oriented the intersection classification, the more stringent the V/C threshold condition. The inclusion of a two hour V/C threshold condition for most street types is a major departure from the previous method used by CDOT to evaluate intersections and is intended to ensure a context-sensitive, multi-modal approach to planning and designing intersection "improvements". Note that signalized driveways should be evaluated as if they are Local Streets.

The V/C ratio must also be balanced against the level-of-service (LOS) expected for pedestrians and cyclists for a given intersection type, which is another major departure from the traditional approach to intersection planning and design. Both LOS methodologies were developed by CDOT for use at all signalized intersections. The LOS ratings shown on Table 1 are objectives to strive for when designing or re-designing an intersection. A detailed description of the LOS methodology for pedestrians and bicyclists is provided in Appendix B.

Finally, there are several steps that should be taken before any physical capacity increases are provided. For the analysis of existing motor vehicle operating conditions, multiple year trends should be analyzed. Capacity increases would be considered when:

- the above thresholds are met for multiple years,
- operational solutions are analyzed and deemed unworkable, and
- additional connections/route options are also investigated.

Once these steps are taken, then physical capacity increases for motorists would be considered, in conjunction with whatever physical and design features would be necessary to maintain the pedestrian and bicycle LOS, as shown on Table 1.

Table 1. Thresholds for Analysis Based on Conditions of Motor Vehicle Travel and Level of Service Objectives for Pedestrian and Bicycle Travel at Signalized Intersections

Travelers / Street type	**Threshold Conditions for Motorists[1]**	**Level of Service Objectives for Pedestrians**	**Level of Service Objectives for Bicyclists**
Main Street	Local: Condition 1 Main: Condition 1 Avenue: Condition 1 Blvd: Condition 2	Local: A Main: A Avenue: B Blvd: B	Local: N/A[2] Main: N/A[2] Avenue: B[3] Blvd: B[3]
Avenue	Local: Condition 2 Main: Condition 1 Avenue: Condition 2 Blvd: Condition 2 Pkwy: Condition 2	Local: B Main: B Avenue: B Blvd: B Pkwy: D	Local: B[3] Main: B[3] Avenue: B Blvd: B Pkwy: C/D
Boulevard	Local: Condition 3 Main: Condition 2 Avenue: Condition 2 Blvd: Condition 3 Pkwy: Condition 3	Local: B Main: B Avenue: B Blvd: C Pkwy: D	Local: B[3] Main: B[3] Avenue: B Blvd: C Pkwy: C/D
Parkway	Local: Condition 4 Avenue: Condition 2 Blvd: Condition 3 Pkwy: Condition 4	Local: D Avenue: D Blvd: D Pkwy: D	Local: C[3] Avenue: C/D Blvd: C/D Pkwy: D
Local	Local: Condition 1 Main: Condition 1 Avenue: Condition 2 Blvd: Condition 3 Pkwy: Condition 4	Local: A Main: A Avenue: B Blvd: B Pkwy: D	Local: N/A[2] Main: N/A[2] Avenue: B[3] Blvd: B[3] Pkwy: C[3]

[1] These conditions (existing or projected) for vehicular travel at signalized intersections establish the thresholds for proceeding with the analysis of levels-of-service (LOS) for motor vehicle, pedestrian and bicycle travel.

[2] The application of the CDOT bicycle LOS methodology is not recommended for intersections of Local or Main streets. The methodology assigns high positive values to the separation of bicyclists from motor vehicles, specifically by bike lanes and/or bike boxes. Local and Main streets do not need bike lanes because they are generally comfortable and safe for most cyclists.

[3] Intersections of this type shall be analyzed based on the averages of only the Avenue, Boulevard, or Parkway approaches. For example, when analyzing the intersection of a Main street and a Boulevard, the two values obtained for the Boulevard approaches should be averaged.

Defined Threshold Conditions

- Condition 1: V/C (volume/capacity) >= 1.0, for two consecutive AM or PM hours
- Condition 2: V/C (volume/capacity) >= 0.95, for two consecutive AM or PM hours
- Condition 3: V/C (volume/capacity) >= 0.95, for **BOTH** one AM and PM hour
- Condition 4: V/C (volume/capacity) >= 0.90, for **BOTH** one AM and PM hour

Applying LOS Standards to Project Definition

The previous discussion describes the new philosophy of and standards for intersection design for the City of Charlotte. The following steps describe the appropriate application of that philosophy to planning and, specifically, to defining intersection projects based on the Street Design Guidelines" recommendations.

1. Analyze all signalized intersections for am and pm peak hour traffic operational conditions, and for accident trends and problems.

2. Based on the analysis of operational conditions and accident data, develop initial list of locations that could include traffic congestion and/or safety mitigation measures.

3. Calculate pedestrian and bicycle LOS for current operating and design conditions for the intersections that appear on the list in step two.

4. Define ways that those intersections can be improved for autos by operational changes alone and those that require roadway changes (i.e., widenings).

5. If two or more intersections in the vicinity are classified for possible changes that affect pedestrian and bicycle LOS, the scope of analysis will be expanded to include the arterial corridor or an area.

6. When operational changes alone can be made to improve auto level of service at signalized intersections, CDOT staff will proceed with implementing those changes – provided those changes do not worsen pedestrian and/or bicyclist level

of service for crossing those intersections. If operational changes will result in degradation to pedestrian and/or bicyclist level of service, then Systems Division personnel will meet with Planning Division personnel (e.g., pedestrian and bike planners) before implementing changes. Personnel responsible for phasing and/or signal timing modifications will identify and try to mitigate those conditions in the Pedestrian and Bicyclists Level of Service Methodology that worsen pedestrian and bicyclist level of service.

7. If it is determined that operational changes alone will not affect auto level of service, then additional capacity analyses will be performed based on an expanded time period - beyond the am and pm peak hours analyzed in step one. The number of hours to be analyzed will vary according to the level of service standards set forth in the street design guidelines. For locations that meet or exceed these standards, solutions that provide improved auto level of service may be developed, provided pedestrian and bicyclist level of service are not worsened. Staff from both the Planning Division and Systems Division will work together to develop possible project alternatives.

Appendix B

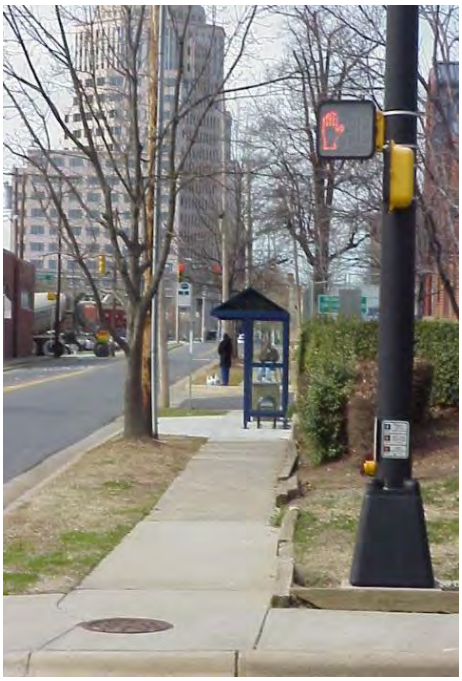
Method for Determining Pedestrian and Bicycle LOS at Signalized Intersections

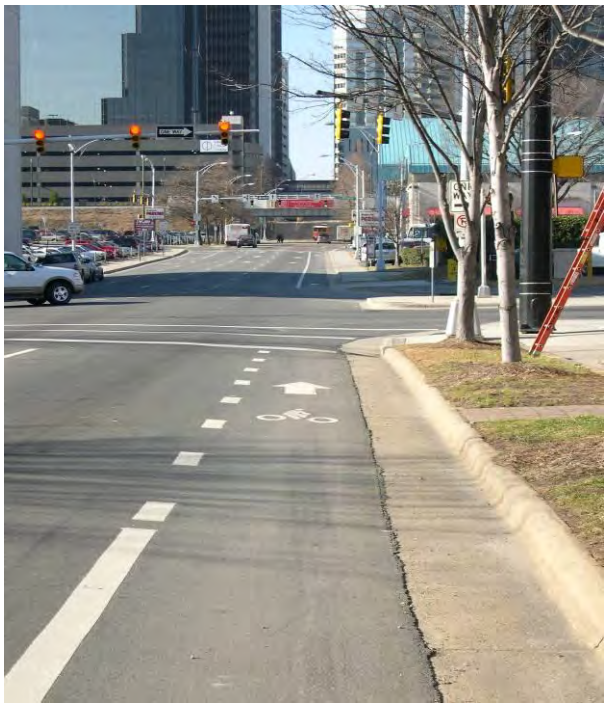
Connecting Charlotte

CHARLOTTE DEPARTMENT OF TRANSPORTATION

PEDESTRIAN & BICYCLE LEVEL OF SERVICE
METHODOLOGY FOR CROSSINGS AT SIGNALIZED INTERSECTIONS

Updated February 2007





CONTENTS

TABLES AND FIGURES

INTRODUCTION

The Charlotte Department of Transportation has developed the following methodology to assess the important design features that affect pedestrians and bicyclists crossing signalized intersections. Referred to as Level of Service (LOS), this methodology identifies and evaluates features according to their influence on the comfort and safety of pedestrians and bicyclists. Among the key features identified and rated are crossing distance, roadway space allocation (i.e., crosswalks, bike lanes), corner radius dimension and traffic signal characteristics.

This methodology can be used as a diagnostic tool to assess and improve pedestrian and bicyclist levels of comfort and safety by modifying design and operational features of intersections. The results can be compared with those for traffic levels of service of an intersection and weighed according to user priorities. This methodology is intended to be used to select design and operational features that can help achieve desired levels of service for pedestrians and bicyclists.

SIGNALIZED INTERSECTION FEATURES AND THEIR RELATIVE IMPORTANCE TO PEDESTRIAN LEVEL OF SERVICE (LOS)

The primary impediments to comfort and safety for pedestrians crossing at signalized intersections are crossing distance and conflicts with turning vehicles. Vehicle volumes and speeds are factors as well, but are tempered by the presence of the traffic signal, its phasing, and/or physical characteristics of the intersection. For example, tight corner radii can slow the speeds of right-turning vehicles, and right and left turn conflicts can be reduced or eliminated by signal phasing, all design factors affecting comfort and safety between pedestrians and vehicles. So although volumes and speeds are not explicitly addressed by this methodology, they are implicitly dealt with.

This approach for assessing pedestrian level of service, therefore, identifies those key elements or features of intersections that enhance or reduce comfort and safety, and then weighs them relative to one another by a point system. Points are assigned to physical and operational features of intersections according to how well they achieve these objectives. These important features are discussed below.

Rated Intersection Features

Crossing Distance (Table 1) – As previously mentioned, crossing distance is the primary crossing component or obstacle for pedestrians traveling across intersections and therefore receives the greatest weight in this methodology. The less distance one has to walk to cross a street, the easier and more comfortable it is perceived to be. A crossing equivalent to two or three lanes, for example, rates a minimum LOS of B, exclusive of any other features. By contrast, a crossing of eight lanes or more falls in the LOS F range, exclusive of other features. For wide street crossings, where there is a greater probability that pedestrians might fail to make it across the entire roadway during a signal phase, level of service can be improved noticeably if there is a median wide enough to

serve as a refuge. Slip lanes and raised corner islands can also enhance pedestrian crossings by breaking long continuous distances into shorter, more manageable crossings. Crossing distance is determined based on the number of motor vehicle travel lanes that must be crossed to reach the far side of the intersection. Travel lanes are assumed to be within the range of 10‟ to 14‟ in width. If a lane(s) is much wider, one might consider the street crossing as wider than simply the number of delineated travel lanes. For example, the departure leg of an intersection is 20‟ wide and unmarked. In this case, the departure leg can be considered as two travel lanes to be crossed instead of one.

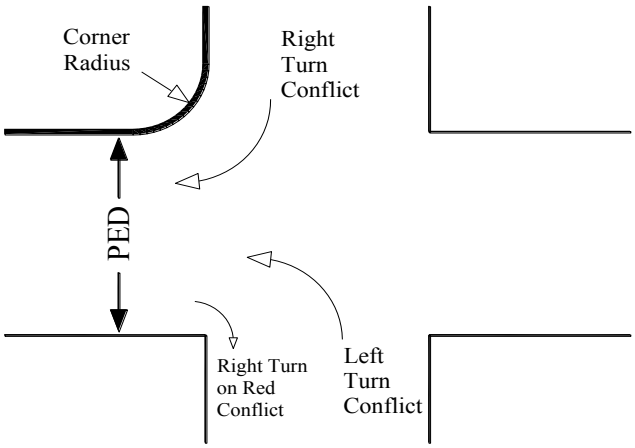
Signal Phasing & Timing (Table 2) – This is the most intricate of the design parameters and second most important in terms of points. It is rated according to the type and level of crossing information provided to the pedestrian and whether the signal phasing minimizes, eliminates or exacerbates conflicts between pedestrians and turning vehicles (Figure 1).

The signal phasing feature that rates best for reducing left turn conflicts across the pedestrian path is the Protected Only phase (when turns occur on a green arrow only), provided there are signals that inform pedestrians when they can cross without a conflict with left turning vehicles. Protected turn phases (e.g., green arrow only, green arrow/green ball) without accompanying pedestrian signals expose pedestrians to greater risks by adding an extra phase to the signal cycle that may not be perceptible to pedestrians. This condition, which may entice pedestrians into the street while motorist are turning on the arrow and not expecting to encounter pedestrians crossing, is viewed negatively. Also considered an increased risk, and rated accordingly, are lane arrangements that allow multiple lanes of traffic to turn across pedestrian paths, unless the signal phasing reduces or eliminates the conflict.

As with left turn conflicts, right turn conflicts are assessed according to lane configuration and signal phasing. Points can only be achieved in this category if the pedestrian conflict with turning traffic is eliminated by the signal phasing. Points are taken away if either the signal phasing creates a conflict similar to that discussed above for left turn phasing (overlap) or multiple lanes of traffic are allowed to turn concurrent with pedestrian crossings. Otherwise, no points are awarded or subtracted.

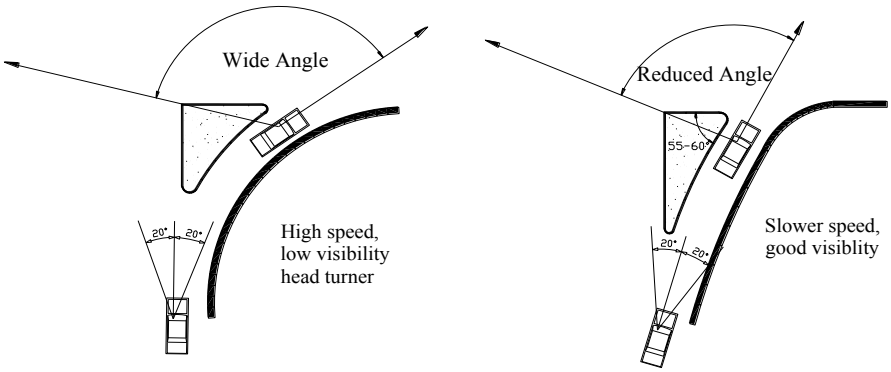
Points can also be attained by the use of pedestrian signals, provided vehicle conflicts are reduced and/or information is given by the signal that shows pedestrians how much time is available for them to cross the street (e.g., countdown signals). Additional points can be obtained within this subcategory by timing pedestrian phases for slower walk speeds, if countdown pedestrian signals are used. Pedestrian phase times based on slower walk speeds without countdown signals are not perceptible to pedestrians, and therefore do not receive extra points.

Figure 1. Pedestrian Crossing Conflicts



Corner Radius (Table 3) – Corner radius is rated according to its effect on right-turning vehicle speeds and any increased walking distance for pedestrians. The smaller the radius, the slower the turning speeds around it and the less additional distance to be walked. Radii of 20‟ or smaller rate best, while large radii (greater than 40‟) are considered detrimental enough to be assigned negative point values. If slip lanes or raised corner channel islands suitable in size to serve as pedestrian refuge are provided (Figure 2), then points are assigned according to the type of traffic control present (i.e., yield or signal control) and how this control manages the pedestrian-turning vehicle conflict. For simplicity, no distinction is made between corner radius and its effect on vehicle speeds for turns into a single lane or turns into multiple lanes. Also, the effect of intersection angle on vehicle speeds for a given radius is not directly incorporated. Corner radius ranks third for points among the rated intersection features.

Figure 2. Corner Channel Island Designs



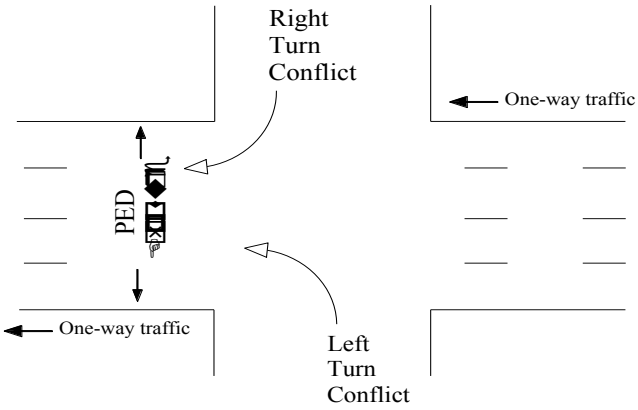
(A) Standard slip lane design (B) Modified slip lane design

Right Turns On Red (Table 4) – Prohibiting right-turns-on-red eliminates a possible conflict between pedestrians and motorists. The Right-Turns-On-Red and Crosswalk (below) features each account for about 5% of the possible points.

Crosswalk Treatment (Table 5) - The presence of and design features of crosswalks are both rated. Crosswalks help raise awareness to motorists of the possibility of pedestrians crossing the street. Enhanced crosswalks (e.g., textured/colored pavement or ladder style pavement markings) are more visible than simple transverse markings, and therefore are rated better.

Adjustment for One-Way Street Crossings (Table 6) – This parameter accounts for the increased risk to pedestrians caused by their exposure to left and right turning traffic while crossing the departure leg of a one-way street that intersects a two-way street. With this scenario, pedestrians are exposed to left and right turning traffic for the entire crossing distance of the road, instead of just a portion (such as is the case for crossing a two-way street with traffic stopped on the approach lanes by the signal).

Figure 3. Adjustment for One-Way Streets



SIGNALIZED INTERSECTION FEATURES AND THEIR RELATIVE IMPORTANCE TO BICYCLE LEVEL OF SERVICE (LOS)

The major impediments to the comfort and safety of bicyclists are somewhat different than those for pedestrians. Traffic signal features and potential conflicts with turning vehicles are still prominent issues, but crossing distance is less important and is surpassed by the desire for physical space in the roadway apart from automobile traffic. Because bicyclists share space with and travel alongside motor vehicles, the speed of traffic is also a significant factor.

As with the pedestrian level of service methodology, key elements or features of intersections that enhance or reduce comfort and safety are identified and assigned points according to how well they meet the objectives. These important features are discussed below.

Rated Intersection Features

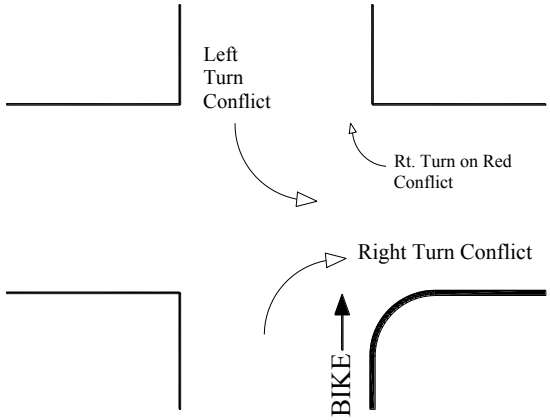
Bicycle Travel Way & Speed of Adjacent Traffic (Table 8) – Where bicyclists travel within the roadway and how fast motor vehicle traffic is moving next to them is the most important factor in accessing their comfort and safety.

For streets with moderate to high traffic speeds (30 mph or more), travel space beyond that provided for general traffic is highly desirable. This extra space may be in the form of separate bicycle lanes, or in the form of wide outside travel lanes (13‟ to 14‟). Bicycle lanes rate best and are the preferred treatment. Conditions requiring bicyclists to share travel lanes with motorists rate poorly.

Bike lanes and wide outside lanes, on the other hand, do not provide as much benefit on low speed streets (less than 30 mph) because cyclists can better match the speed of adjacent traffic. Also, low speed streets generally carry low traffic volumes, which many cyclists prefer.

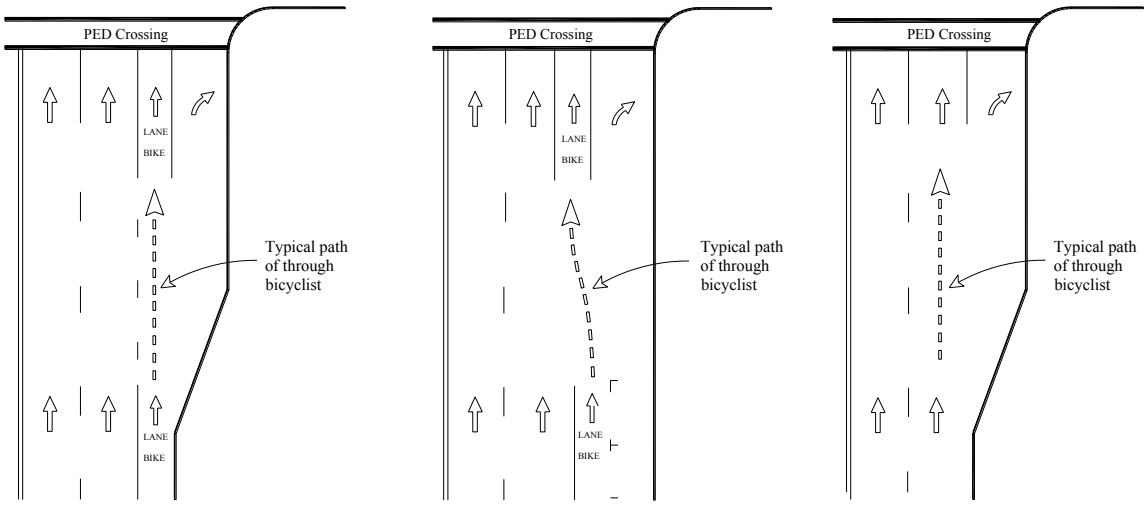
Signal Features – Left Turn Phasing & Stop Bar Location (Table 9) – Features that remove potential left turn conflicts from the path of bicyclists and features that place bicyclists before motorists (in space) are rated as desirable. Signal phasing and stop location rate as the second most important bicycle feature.

Figure 4. Bicycle Crossing Conflicts



Right Turn Traffic Conflict (Table 10) – This parameter addresses the potential conflict involving motorists turning right and bicyclists traveling straight ahead on an intersection approach. The preferred method of resolving this conflict is for bicyclists to „take‟ the traffic lane if it is shared with traffic, or if there is a separate right turn lane (Figure 5), motorists should merge right in advance of the intersection while bicyclists travel straight-ahead. Points are awarded if there is no right turn conflict with motorists or if there is a bicycle lane that places bicyclists left of a right turn lane. Otherwise, points are either not awarded at all or they are taken away, depending on whether the bicyclist or motorist is required to merge.

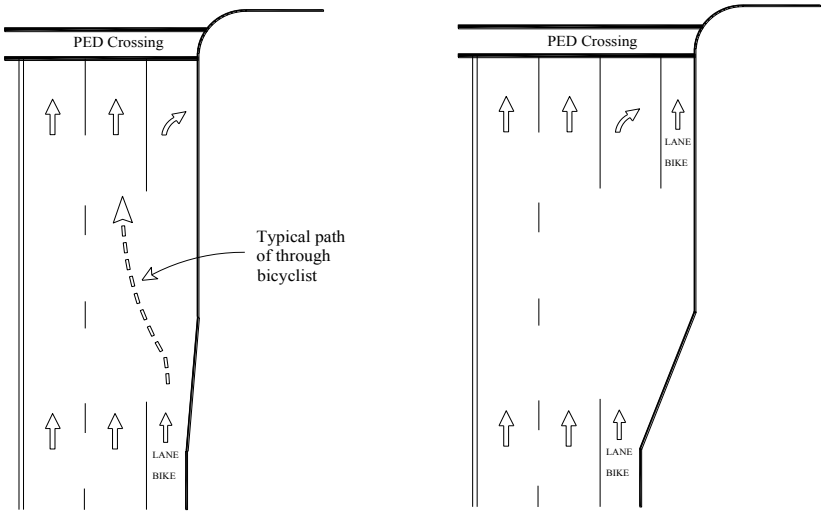
Figure 5. Bike Treatments at Exclusive Right Turn Lanes



(A) Straight alignment - Cyclists travel straight and turning motorists yield to cyclists (BEST CONDITION)

(B) Alignment shift - Cyclists merge left and turning motorists merge right

(C) No bike lane - Cyclists share lane with motorists



(D) Bike lane ends - cyclists shift into motor vehicle lane

(E) Bike lane right of turn lane (BAD CONDITION)

Right Turns On Red (Table 11) - This condition creates another conflict between bicyclists and motorists. Bicyclists can easily blend into the background when a motorist is looking to turn right on red because motorists are often looking for larger motor vehicles (Figure 4).

Crossing Distance (Table 12) – Wide street crossings increase the risk of exposure to bicyclists from motor vehicle traffic on cross-streets. Signal clearance times (the yellow and all-red signal phase portions) are timed for motor vehicle speeds and not the slower speeds of bicyclists; therefore, the wider the intersection, the greater the likelihood that cyclists will still be crossing when right-of-way changes to the cross-street.

Intersection Features Not Rated in the Pedestrian and Bicycle Methodologies

There are several other features not rated in these methodologies that also affect the comfort and safety of pedestrians and bicyclists and should be considered in intersection design. Among these features are sight lines, street lighting, pavement condition, signing, pedestrian and bike detection, curb extensions, and ADA features such as wheel chair ramps and accessible signals.

PEDESTRIAN AND BICYCLE LOS DETERMINATION

Level of service for an intersection crossing/approach is determined by adding points from Tables 1 through 6 (for Pedestrians) and points from Tables 8 through 12 (for Bicyclists). The accumulation of points is then compared to the points listed in Tables 7 (Pedestrians) and 13 (Bicyclists), which provides the threshold values for levels of service A through F. An overall intersection level of service for either pedestrian or bicycle features can also be determined by adding the total points from each crossing and dividing their sum by the number of intersection crossing legs (e. g., a three leg intersection‟s point totals would be divided by three). The higher the point total, the better the level of service.

SUMMARY

The level of service methodology is intended to be used to assess the most crucial, especially safety related, factors affecting pedestrians‟ and bicyclists‟ crossing signalized intersections. It attempts to identify and compare those design elements that help make intersection crossings safer and pedestrians and bicyclists feel more comfortable. The methodology is not concerned with the quality of the environment away from the intersection crossing, so those elements that make an area more inviting and attractive to pedestrians and bicyclists, such as visual stimuli, convenience, security, and noise are not considered. These other elements and their importance on creating a pedestrian and bicycle friendly environment are addressed through initiatives such as the Urban Street Design Guidelines

The focus of this methodology is on those intersection features that reduce traffic conflicts, minimize crossing distances, slow down traffic speeds and raise user awareness. The methodology assumes that all rated features are adequately designed and implemented (e.g., signals are timed adequately and pedestrian signals are well placed), so that equivalent comparisons can be made between features. While important to the overall sense of safety and comfort, elements of risk (e.g., traffic volumes) are not directly evaluated in the methodology since design features are the focus and design features can be used to mitigate the effects of risks. Furthermore, design features such as

cross-section distance, number and type of travel lanes, and signal-phasing schemes typically reflect varying traffic volumes.

This level of service methodology is expected to be applied in conjunction with the traditional level of service methodology for motor vehicles. The importance or relative weight given to each level of service (for motor vehicles, bicyclists or pedestrians) is expected to vary by intersection, depending on the planned function and context of each intersection.

The following pages provide additional detail of the pedestrian and bicycle level of service methodologies, along with example level of service calculations. As a companion piece to this document, Charlotte DOT has also developed an electronic spreadsheet that can be used to quickly calculate levels of service. The spreadsheet should be used when performing level of service calculations.

PEDESTRIAN LEVEL OF SERVICE CALCULATION

TABLE 1. PEDESTRIAN LOS: Crossing Distance

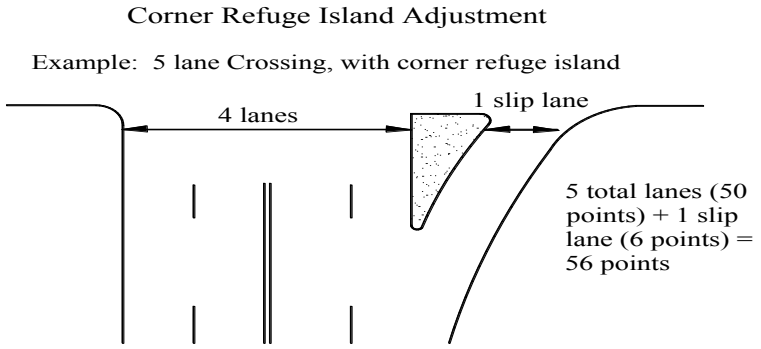
Crossing distance is determined based on the total number of motor vehicle travel lanes that must be crossed to reach the opposite side of the street. The added effect of corner radii on crossing distance is addressed in parameter number 3 (Corner Radius). When the number of travel lanes crossed includes the crossing of corner refuge island lane(s), an adjustment to the points in the table below should be made. This adjustment is described just below the table.

	Points		
Total Travel Lanes Crossed	**No Median Refuge (or less than 4')**	**Median Refuge (4' to 6')**	**Median Refuge (6' or more)**
2 Lanes	**80**	**80**	**80**
3 Lanes	**78**	**78**	**78**
4 Lanes	**65**	**65**	**68**
5 Lanes	**50**	**52**	**55**
6 Lanes	**37**	**40**	**44**
7 Lanes	**24**	**28**	**33**
8 Lanes	**8**	**12**	**20**
9 Lanes	**-5**	**0**	**10**
10 Lanes	**-15**	**-10**	**0**

Corner Refuge Island Adjustments:

- Crossing of corner refuge island lanes is not weighed as heavily as crossing other travel lanes, and therefore the points assigned based on crossing distance in the table above should be adjusted. Six points are assigned for each refuge island lane crossed. Refuge lane points are added to the points assigned for the total crossing distance from Table 1 above.

  Example: A crossing of 5 lanes (one of which is a refuge island lane) is adjusted as follows: 50 points (based on 5 lanes crossed) + 6 points (for refuge island lane) = 56 points.



- Adjustments are also made based on how slip lane traffic is controlled at the intersection. If slip lane traffic is under signal control then 5 points are added to the crossing total. If traffic is under Yield control then 3 points are subtracted from the crossing total, and if traffic is uncontrolled (i.e., free flow) then 20 points are subtracted.

TABLE 2. PEDESTRIAN LOS: Signal Phasing & Timing Features

Pedestrian Crossing Conflicts

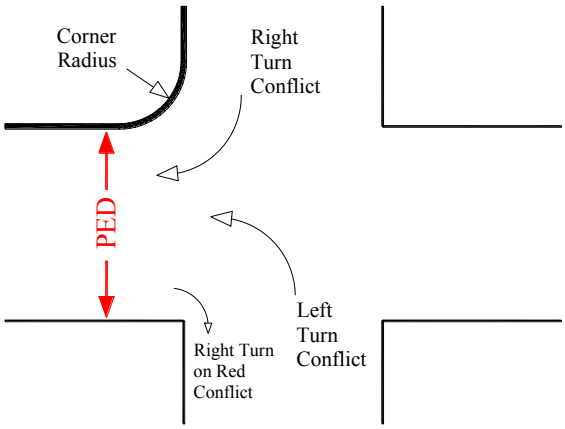


Table 2A
Left Turn Conflicts (Left Turns into Pedestrian Crossing Path) — **Points**

A1. Lefts on GREEN BALL Only (permissive phase - left turns unprotected)
- From SINGLE lane, no pedestrian phase on conflicting crossing: **-5**
- From SINGLE lane, with pedestrian phase on conflicting crossing: **0**
- From 2 or more lanes, no pedestrian phase on conflicting crossing: **-10**
- From 2 or more lanes, with pedestrian phase on conflicting crossing: **-5**

A2. Lefts on GREEN ARROW & GREEN BALL (protected/permissive phase)
- From SINGLE lane, no pedestrian phase on conflicting crossing: **-5**
- From SINGLE lane, with pedestrian phase on conflicting crossing: **0**

A3. Lefts on GREEN ARROW Only (protected only phase)
- From SINGLE lane, no pedestrian phase on conflicting crossing: **5**
- From SINGLE lane, with pedestrian phase on conflicting crossing: **15**
- From 2 or more lanes, no pedestrian phase on conflicting crossing: **0**
- From 2 or more lanes, with pedestrian phase on conflicting crossing: **15**

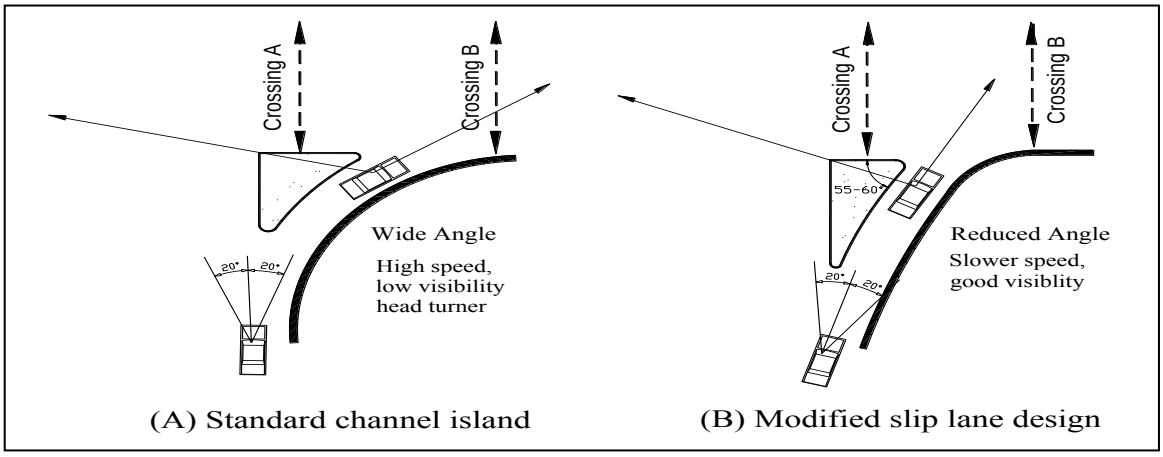
A4. No Left Turn Conflict (e.g., "T" intersections, one-way streets, exclusive pedestrian phase): **15**

Table 2B **Right Turn Conflicts (Right Turns into Pedestrian Crossing Path)**	**Points**
B1. Rights on GREEN BALL Only (permissive phase)	
• From SHARED Thru-Right lane, no pedestrian phase on conflicting crossing	**0**
• From SHARED Thru-Right lane, with pedestrian phase at crossing	**0**
• From SINGLE Right lane, no pedestrian phase on conflicting crossing	**0**
• From SINGLE Right lane, with pedestrian phase on conflicting crossing	**0**
• From 2 or more Right lanes, no pedestrian phase on conflicting crossing	**-10**
• From 2 or more Right lanes, with pedestrian phase on conflicting crossing	**-7**
B2. Rights on GREEN ARROW & GREEN BALL (overlap phase)	
• From RIGHT turn lane(s), no pedestrian phase on conflicting crossing	**-10**
• From RIGHT turn lane(s), with pedestrian phase (no conflict for duration of the Green Arrow)	**0**
B3. Rights on GREEN ARROW Only (protected phase)	
• From SINGLE Right lane, no pedestrian phase	**-10**
• From SINGLE Right lane, with pedestrian phase – turning traffic held for pedestrian movement, which eliminates turning/crossing conflict	**10**
• From 2 or more Right lanes, no pedestrian phase	**-15**
• From 2 or more Right lanes, with pedestrian phase – turning traffic held for pedestrian movement, which eliminates turning/crossing conflict	**10**
B4. No Right Turn Conflict (e.g., "T" intersections, one-way streets, exclusive pedestrian phase)	**15**

TABLE 2C **Pedestrian Phase Signal Display**	
C1. No Pedestrian Phase	**-5**
C2. UPRAISED HAND, WALKING PERSON display	**0**
C3. UPRAISED HAND, WALKING PERSON display – with LEADING pedestrian phase (pedestrians start crossing seconds before vehicles on the adjacent street)	**4**
C4. COUNTDOWN display (crossing time is shown) With pedestrian crossing time based on following walk speeds:	
> 3.5 ft/sec	**5**
≤ 3.5 ft/sec	**8**
C5. LEADING COUNTDOWN display (pedestrians start crossing seconds before vehicles on the adjacent street) With pedestrian crossing time based on following walk speeds:	
> 3.5 ft/sec	**8**
≤ 3.5 ft/sec	**12**

TABLE 3. PEDESTRIAN LOS: Corner Radius

Standard Radius	Points
A. Radius ≤ to 20‟	**10**
B. Radius > 20‟ and ≤ 30‟	**5**
C. Radius > 30‟ and ≤ 40‟	**0**
D. Radius > 40‟ and ≤ 60‟ (or Equivalent Compound Curve)	**-10**
E. Radius > 60‟ (or Equivalent Compound Curve)	**-15**



(A) Standard channel island (B) Modified slip lane design

CHANNEL ISLAND (in lieu of standard radius)	
F. Painted Channel Island (no curb)	
- Right turns are uncontrolled (free flow)	**-20**
- Right turns made on Yield or Signal Control	**-10**
G. Curbed Channel Island (Figure A)	
- Right turns are uncontrolled (free flow)	**-20**
- Right turns on Yield, Green Ball or Green Arrow/Green Ball	
(& Pedestrian crossing at location B)	**-10**
(& Pedestrian crossing at location A)	**0**
- Right turns on Green Arrow Only	
(& Pedestrian crossing at location B)	**0**
(& Pedestrian crossing at location A)	**5**
H. Curbed Low Speed Design Slip Lane (Figure B)	
- Right turns on Yield, Green Ball or Green Arrow/Green Ball	
(& Pedestrian crossing at location B)	**0**
(& Pedestrian crossing at location A)	**5**
- Right turns on Green Arrow Only	
(& Pedestrian crossing at location B)	**5**
(& Pedestrian crossing at location A)	**10**
I. No Corner Radius (e.g., “T” intersection)	**10**

TABLE 4. PEDESTRIAN LOS: Right Turns On Red

	Points
Allowed	**0**
Prohibited (or no conflict because right turns are not permitted/possible)	**5**

TABLE 5. PEDESTRIAN LOS: Crosswalk Treatment

No designated crosswalk	**-5**
Painted crosswalk	
- Transverse markings (Type A)	**0**
- LADDER type markings (Type B)	**5**
Textured/Colored Pavement	**5**

Crosswalk Types

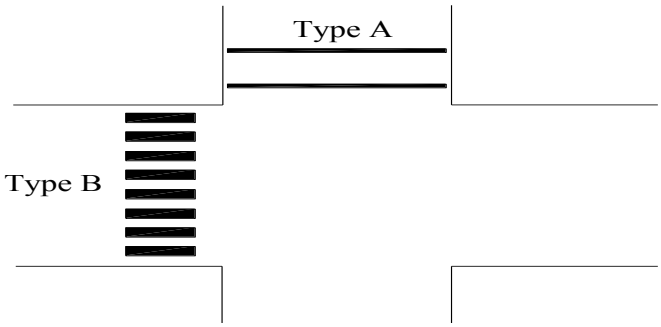


TABLE 6. PEDESTRIAN LOS: Adjustment for One-Way Street Crossings

Applies only to the departure leg of a one way street with 4 or more lanes that intersects a two-way street. (Figure 3, page 6)

Conflicting left turns made on:

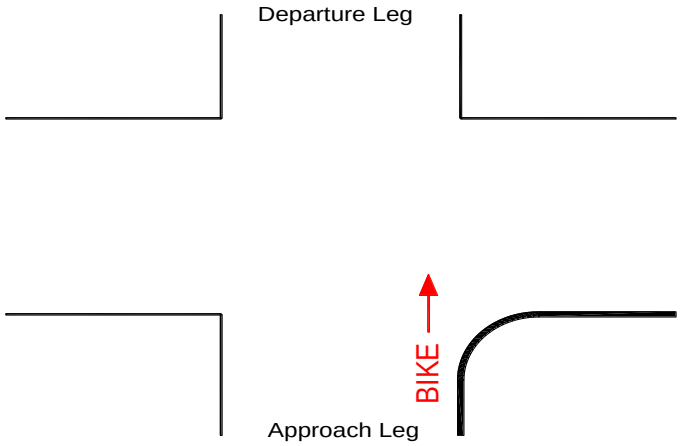
- Green Ball Only (with or without pedestrian phase) **-10**
- Green Arrow/Green Ball (with or without pedestrian phase) **-10**
- Green Arrow Only (without pedestrian phase) **-5**
- Green Arrow Only (with pedestrian phase) **-2**
- Condition does not apply **0**

TABLE 7. Point Totals and Corresponding PEDESTRIAN Level of Service

Points	LOS
93+	A
74 - 92	B
55 - 73	C
37 - 54	D
19 - 36	E
0 - 18	F

BICYCLE LEVEL OF SERVICE CALCULATION

TABLE 8. BICYCLE LOS*:* Bicycle Travel Way & Speed of Adjacent Traffic



Bike Travels in: (Approach/Departure Legs)	Speed Limit	Points
• **Shared Auto Lane to Shared Auto Lane** (lanes ≤ 12‟ wide)	≥ 40 mph	5
	30 to 35 mph	30
	‹ 30 mph	50
• **Shared Auto Lane to Wide Curb Lane** (13‟ to 14‟ wide)	≥ 40 mph	20
	30 to 35 mph	40
	‹ 30 mph	55
• **Shared Auto Lane to Bike Lane**	≥ 40 mph	35
	30 to 35 mph	50
	‹ 30 mph	60
• **Shared Wide Curb Lane To Shared Auto Lane**	≥ 40 mph	15
	30 to 35 mph	35
	‹ 30 mph	50
• **Shared Wide Curb Lane to Wide Curb Lane** (13‟ to 14‟ wide)	≥ 40 mph	30
	30 to 35 mph	50
	‹ 30 mph	60
• **Shared Wide Curb Lane to Bike Lane**	≥ 40 mph	45
	30 to 35 mph	60
	‹ 30 mph	70

TABLE 8 (continued)

Bike Travels in: (Approach/Departure Legs)	Speed Limit	Points
• **Bike Lane to Shared Auto Lane** (lanes ≤ 12‟ wide)	≥ 40 mph	30
	30 to 35 mph	45
	‹ 30 mph	55
• **Bike Lane to Wide Curb Lane** (13‟ to 14‟ wide)	≥ 40 mph	40
	30 to 35 mph	55
	‹ 30 mph	65
• **Bike Lane to Bike Lane**	≥ 40 mph	60
	30 to 35 mph	70
	‹ 30 mph	80

TABLE 9. BICYCLE LOS: Signal Features – Left Turn Phasing & Stop Bar Location

Vehicular Left Turn Phase – turns opposing cyclists (Figure 4, page 7)	**Points**
Made on Green Ball Only	**0**
Made on Green Ball/Green Arrow	**5**
Made on Green Arrow Only	**15**
No Left Turn Conflict (e.g., “T” intersection, one-way streets)	**15**
Stop Bar Location	
Shared stop bar - automobiles & bikes stop at common point	**0**
Advanced stop bar – bikes stop closer to intersection than automobiles	**10**

Bicycle Crossing Conflicts

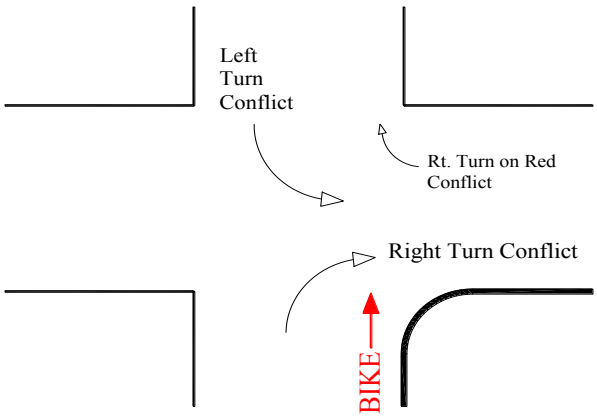


TABLE 10. BICYCLE LOS: Right Turn Traffic Conflict

	Points
No Right Turn Conflict (e.g., "T" intersection, one-way street)	**15**
No Separate Right Turn Lane (Bike in Shared Lane)	**0**
Separate Right Turn Lane (Figure 5, page 8)	
Bike lane LEFT of right turn lane (cyclist travels straight ahead and motorist merges right) – see Figure 5A	**10**
Curb lane drops as right turn lane, with bike lane left of turn lane (cyclist merges left, motorist merges right) – see Figure 5B	**5**
No bike lane (cyclist travels straight ahead and motorist merges right) – see Figure 5C	**0**
Curb lane drops as right turn lane, no bike lane at intersection (cyclist merges left, motorist merges right) – see Figure 5D	**0**
Bike lane RIGHT of right turn lane – see Figure 5E	**-20**

TABLE 11. BICYCLE LOS: Right Turns On Red

Allowed	**0**
Prohibited (or no conflict because right turns are not permitted/possible)	**5**

TABLE 12. BICYCLE LOS: Intersection Crossing Distance

	≤ 3 motor vehicle travel lanes	**0**
	4 to 5 motor vehicle travel lanes	**-5**
	≥ 6 travel motor vehicle lanes	**-10**

TABLE 13. Point Totals and Corresponding BICYCLE Level of Service

Points	LOS
93+	A
74 - 92	B
55 - 73	C
37 - 54	D
19 - 36	E
0 - 18	F

Intersection Example # 1

Application of the pedestrian and bicycle level of service methodologies for an example intersection is presented in Figures 6 and 7. The intersection evaluated is that of a one-way street (4th Street) and a two-way street (McDowell Street) in downtown Charlotte. The sample worksheets in figures 6 and 7 provide information on features relevant to the intersection.

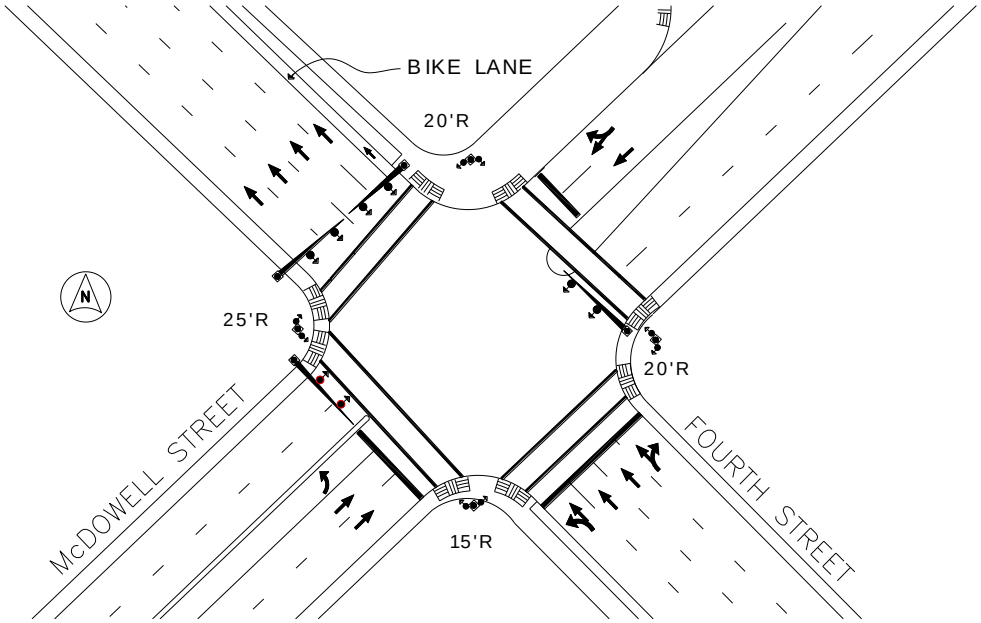


Figure 6. Example Intersection #1: Pedestrian LOS Calculation

Location: 4th Street & McDowell Street

	Crossing of Northbound Approach (McDowell St.)	Crossing of Southbound Approach (McDowell St.)	Crossing of Eastbound Approach (4th St.)	Crossing of Westbound Approach (4th St.)
Pedestrian Crossing Distance	5 Lanes (2" median)	4 Lanes (10" median refuge)	4 Lanes	4 Lanes
Score	**50**	**68**	**65**	**65**
Signal Features				
Left Turn Conflict (left turns into pedestrian path)	Lefts on Green Ball Only, from a single lane – with pedestrian phase	No Left Turn Conflict - (4th St. one-way)	Lefts on Green Arrow/Green Ball - with pedestrian phasing	No Left Turn Conflict - (4th St. one-way)
Score	**0**	**15**	**0**	**15**
Right Turn Conflict (right turns into pedestrian path)	No Right Turn Conflict (4th St. one-way)	Right Turns on Green Ball, from a shared thru-right lane - with pedestrian phase	Right Turns on Green Ball, from a shared thru-right lane - with pedestrian phase	No Right Turn Conflict (4th St. one-way)
Score	**15**	**0**	**0**	**15**
Pedestrian Signal Display	Countdown Display (4 ft/sec)	Countdown Display (4 ft/sec)	Countdown Display (4 ft/sec)	Countdown Display (4 ft/sec)
Score	**5**	**5**	**5**	**5**
Corner Radius	25'	20"	20'	15'
Score	**5**	**10**	**10**	**10**
Right Turns on Red	No Conflict (4th St. one-way)	Prohibited	No Conflict (4th St. one-way)	Allowed
Score	**5**	**5**	**5**	**0**
Crosswalks	Textured/Colored	Textured/Colored	Textured/Colored	Textured/Colored
Score	**5**	**5**	**5**	**5**
Adjustment for One-Way Street Crossings	Two-Way Street (Not Applicable)	Two-Way Street (Not Applicable)	Departure Leg 4 Lanes Wide, with left and right turn conflicts	Multilane One-Way street, no left and right turn conflicts (Not Applicable)
Score	**--**	**--**	**-10**	**--**
Approach Total	**85**	**108**	**80**	**115**
Approach LOS	**B**	**A**	**B**	**A**
Intersection AVG.	**97**			
Intersection LOS	**A**			

Figure 7. Example Intersection #1: Bicycle LOS Calculation

Location: 4th Street & McDowell Street

	Northbound Approach (McDowell St.)	Southbound Approach (McDowell St.)	Eastbound Approach (4th St.)	Westbound Approach (4th St.)
Bike Travel Way & Speed of Adjacent Traffic	Shared 12" Lane with Motor Vehicles 35 mph	Shared 12" Lane with Motor Vehicles 35 mph	Does not Apply	Shared 12" Lane Transitions to 4" Bike Lane 35 mph
Score	**30**	**30**		**50**
Signal Features				
Opposing Vehicular Left Turn Phase	No Left Turn Conflict	Green Arrow & Green Ball		No Left Turn Conflict
Score	**15**	**5**		**15**
Stop Bar Location	Vehicles & Bikes Stop at Same Point	Vehicles & Bikes Stop at Same Point		Vehicles & Bikes Stop at Same Point
Score	**0**	**0**		**0**
Right Turning Traffic Conflict Shared Traffic Lane/Separate Right Turn Traffic Lane	No Right Turn Conflict	Shared Thru-Right lane - no bike lane		Shared Thru-Right Lane - no bike lane on approach
Score	**15**	**0**		**0**
Right Turns On Red	Allowed	No Conflict		Prohibited
Score	**0**	**5**		**5**
Intersection Crossing Distance	4 Travel Lanes	4 Travel Lanes		5 Travel Lanes
Score	**-5**	**-5**		**-5**
Approach Total	**55**	**35**		**65**
Approach LOS	**C-**	**E+**		**C**
Intersection AVG.	**52**			
Intersection LOS	**D+**			

Intersection Example # 2

A second application of the pedestrian level of service methodology is presented in Figure 8. This example illustrates how the methodology should be applied for slip lane or channel island designs. The sample worksheet in figure 8 provides information on features relevant to the intersection.

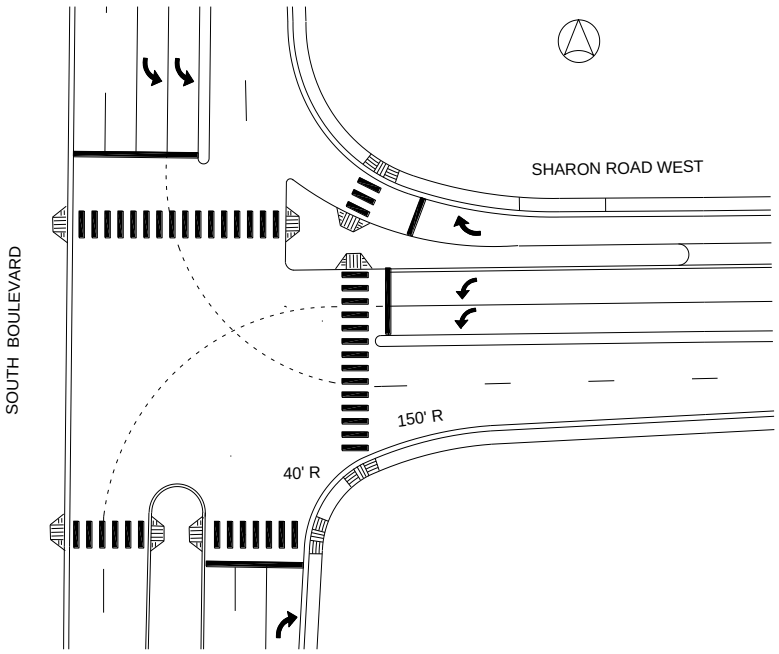


Figure 8. Example Intersection #2: Pedestrian LOS Calculation

Location: South Boulevard & Sharon Road West

	Crossing of Northbound Approach (South Blvd..)	Crossing of Southbound Approach (South Blvd.)		Crossing of Westbound Approach (Sharon Rd. West)
Pedestrian Crossing Distance	5 Lanes (12˝ median refuge)	7 Lanes 6+1 slip lane – under yield control (no median refuge)		5 Lanes 4+1 slip lane – under yield control (no median refuge)
Score	**55**	**27**		**53**
Signal Features				
Left Turn Conflict (left turns into pedestrian path)	Lefts on Green Arrow Only, from 2 lanes – with pedestrian phase	No Left Turn Conflict		Lefts on Green Arrow Only, from 2 lanes – with pedestrian phase
Score	**15**	**15**		**15**
Right Turn Conflict (right turns into pedestrian path)	No Right Turn Conflict	Cross to Corner Channel Island		Right Turns on Green Arrow/Green Ball, from single right turn lane
Score	**15**	**7**		**0**
Pedestrian Signal Display	Countdown Display (4 ft/sec)	Countdown Display (4 ft/sec)		Countdown Display (4 ft/sec)
Score	**5**	**5**		**5**
Corner Radius	None (T intersection)	Corner Slip Island (crossing point A)		Compound Curve (55˝ equivalent)
Score	**10**	**5**		**-10**
Right Turns on Red	Allowed	No Conflict		Slip Lane, right turns yield controlled
Score	**0**	**5**		**0**
Crosswalks	Ladder Style	Ladder Style		Ladder Style
Score	**5**	**5**		**5**
Adjustment for One-Way Street Crossings	Not Applicable	Not Applicable		Not Applicable
Score	**--**	**--**		**--**
Approach Total	**105**	**69**		**68**
Approach LOS	**A**	**C**		**C**
Intersection AVG.	**81**			
Intersection LOS	**B**			

Appendix C

Guidelines for Designing Curb Return Radii

July, 2007

Appendix C: Curb Return Radii Design Guidelines

I. Overview and Purpose

The intent of the curb return radii design guidelines is to establish a procedure that allows flexibility in designing curb radii to reflect conditions of specific locations, while assuring that the *result will yield the smallest radii that are feasible* to accommodate the specified design vehicle.

The primary reason for minimizing curb radii is to help provide shorter crossings for pedestrians. In general, the distance a pedestrian must cross to reach the opposite curb will decrease as the curb radius decreases. Similarly, the larger the radius, the greater the distance the pedestrian has to traverse and the more the pedestrian is potentially out of the line-of-sight of the driver. Smaller radii can also serve as a traffic calming design feature, requiring vehicles to turn at slower speeds, depending on the width of the street.

Smaller curb radii, therefore, serve to:

- Minimize the (unprotected) distance pedestrians need to cross,
- Allow for better alignment of the crosswalk with the connecting sidewalks (i.e., provide a continuous path of travel),
- Assure adequate space at the corner for proper placement and alignment of ADA-compliant curb ramps (typically, one per each direction of travel is desired),
- Moderate the speeds of turning vehicles,
- Improve visibility of drivers and pedestrians,
- Result in improved compliance with "No Turn On Red" regulations.

While the overall intent is to keep radii small and improve pedestrian crossings, curb radii will be designed to accommodate the expected type and volume of vehicle turning at the intersection. Properly designed curb radii will provide sufficient space for the expected vehicles to maneuver through their turns safely, while minimizing conflicts between cars, trucks, buses, bicyclists and pedestrians. The design should also take into account the typology of the two intersecting streets, the level of pedestrian activity expected, the location of crosswalks, curb ramps, presence or absence of bike lanes, pedestrian refuge islands, curb extensions, bus stops and on-street parking, and whether the intersection is signalized or unsignalized.

II. Design Criteria

The following guidelines are to be used to determine the curb radii at any given intersection. For the purposes of this process, the AASHTO Green Book"s "crawl speeds" are assumed for the turning speeds of vehicles.

It is important to note that, as with any document of this nature, these guidelines are intended to provide guidance and direction when designing streets and should be flexible to account for the specific traffic, vehicle and roadway conditions at any given location, and be sensitive to any unique or unusual situations. Sound engineering and planning judgment shall be used to produce designs in keeping with the context of the adjacent land uses and surrounding street network.

Approach

The approach outlined in this section is different for ***Local*** and ***Non-Local*** streets, given the different nature and context of each of these typologies. The discussion on *Non-Local* streets is presented first as this is typically the more complex of the two street types.

a) Non-Local Streets

Determination of Appropriate Design Vehicle

The appropriate curb radii to be used at the intersection of two non-local streets is initially based on the type and frequency of vehicle (the "design vehicle") expected to traverse the intersection under normal conditions. While often not readily available, this information can be determined by a variety of methods, such as field observations, vehicle classification counts, and assumptions and projections based on future land uses.

In the absence of specific information regarding the types and numbers of vehicles expected, Table 1 shall be used to select the appropriate design vehicle:

Table 1 – Design Vehicle for Non-Local Street Intersections

	Local	Main	Avenue	Boulevard	Parkway
Local	See Table4	Pass. Veh.	School Bus	SU-30	B-40
Main	-	SU-30	SU-30	B-40	B-40
Avenue	-	-	B-40	B-40	WB-50
Boulevard	-	-	-	WB-50	WB-50
Parkway	-	-	-	-	WB-62

Potential Encroachment for Turning Vehicles

Once a design vehicle is selected, the designer must make assumptions regarding the potential encroachment into various travel lanes on the receiving street. These assumptions relate to the ability of the design vehicle to turn from one street into the available traffic lanes on the receiving street. The possible encroachment is based on a number of factors, including the street typology, the number and width of traffic lanes, available sight distance, the speed and volume of vehicles on each

street and the presence or absence of onstreet parking. As a result, different curb radii may be designed for each corner of an intersection.

While it is acknowledged that occasional encroachment by larger vehicles into adjacent or opposing lanes of traffic will occur, the goal is to minimize as much as possible conflicts between vehicles, pedestrians, bicyclists, and other users of the street, while providing the minimum curb radii appropriate for the given situation.

Tables 2 and **3** are to be used as a guide to determine the potential/possible encroachment for vehicles turning at signalized and unsignalized intersections, given the factors described above. **Figure 1** graphically illustrates the various encroachment scenarios ("cases" shown in **Tables 2** and **3**) that may be used for the design vehicle in determining the appropriate curb radii.

Table 2 – Allowable Encroachment for Signalized Intersections

From\To*	Local	Main	Avenue	Boulevard	Parkway
Local	Table 4	Case B	Case B	Case B	Case B
Main	Case D	Case C	Case B**	Case B	Case B
Avenue	Case D	Case C	Case B**	Case B	Case B
Boulevard	Case C	Case C	Case B**	Case B	Case B
Parkway	Case C	Case C	Case B**	Case B	Case B

Table 3 – Allowable Encroachment for Unsignalized Intersections

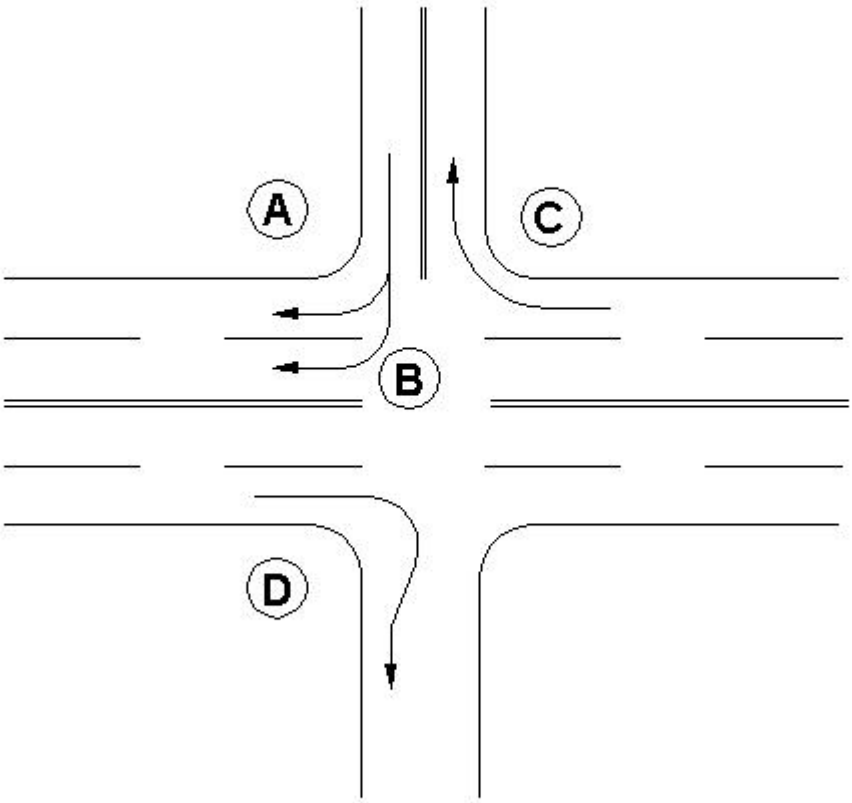
From\To*	Local	Main	Avenue	Boulevard	Parkway
Local	Table 4	Case C	Case A	Case A	-
Main	Case D	Case C	-	-	-
Avenue	Case D	-	-	-	-
Boulevard	Case D	-	-	-	-
Parkway	-	-	-	-	-

*The column along the left side of the table indicates the street ***from*** which the vehicle is turning; the headings indicate the ***receiving*** street.

**Case B should be assumed, unless the Avenue only has one receiving lane, whereupon Case A should be assumed.

The possible encroachment is intended to be more flexible at signalized intersections (i.e., resulting in smaller radii), since it is assumed that a) larger vehicles can wait for a green signal to assure adequate space to safely complete their turn, and b) a higher level of pedestrian activity is expected or desired.

FIGURE 1
ENCROACHMENT FOR INTERSECTIONS
USE IN CONJUNCTION WITH TABLES 2 AND 3
(NOT TO SCALE)



LETTER CORRESPONDS TO CASE LISTED IN TABLES 2 AND 3

NOTE: LANE WIDTHS ARE NOT CONSIDERED

b) Local Streets

As stated previously, determination of the appropriate curb radii is based on many factors. In the case of *Local Streets*, curb-to-curb width must also be considered. In most cases, the width of the street is the critical factor in determining the necessary curb radii for *Local Streets*.

While *Local Streets* are typically narrower than *Non-Local Streets*, there is also more flexibility in applying the design vehicle encroachment guidelines, since it is generally assumed that the full width of available pavement can be used to "receive" the turning vehicle. This, of course, must take into account the traffic volumes, function, adjacent land uses and specific conditions of the street being designed.

Table 4 indicates the curb radii to be used for the intersections of *Local Streets*. Again, while the goal is to provide the smallest radii possible, the design should be tested to be sure it can adequately accommodate the *expected* typical design vehicle, based on the specific traffic and roadway conditions of the project area.

Table 4 - Curb Radii for Local Street Intersections

From\To	R/Narrow	R/Medium	R/Wide	C/Narrow	C/Wide	Industrial
R/Narrow	35					
R/Medium	20	15				
R/Wide	15	15	10			
C/Narrow	20	15	25	35		
C/Wide	15	15	15	30	10	
Industrial	30	25	15	40	25	50

R = Residential
C = Commercial

III. Other Factors Affecting Curb Radii

As previously stated, the determination of the appropriate curb radii for any given location is influenced by many different and varied factors. For the purpose of achieving the goals of Charlotte's *Urban Street Design Guidelines*, the overwhelming consideration for most street types is for safety, including providing safer and shorter pedestrian crossings.

While minimizing the curb radii is the desired outcome, other factors must be evaluated to assure that the design is adequate before a final determination can be made.

Additional factors to consider include:

- *The overall street pattern* – depending on the size and layout of the adjacent street system, it may be appropriate to design smaller radii at most intersections (e.g. along a *Main Street*), while accommodating larger vehicles at fewer select locations along designated routes.
- *The presence of a bike lane* – the additional width created by a bike lane makes the effective curb radius larger. Therefore, the actual curb radius can usually be smaller when a bike lane exists.
- *The presence of a raised median or pedestrian refuge island* - may require larger radii to prevent vehicles from encroaching onto the median. Alternatively, particularly for "gateway" medians on Local Streets, medians may have aprons to allow larger vehicles to turn without damaging landscaping or curbs.
- *Skewed or oddly shaped intersections* - may dictate larger or smaller radii than the guidelines would otherwise indicate.
- *Lane configuration or traffic flow* – intersections of one-way streets, locations where certain movements are prohibited (left or right turns), or streets with uneven numbers of lanes (two in one direction, one in the other) will also affect the design of curb radii.
- *Onstreet Parking* – the presence or absence of onstreet parking will directly affect the curb radii required to accommodate the design vehicle. **Table 5** may be used where *permanent full-time* onstreet parking is allowed and accommodated on *both streets* at an intersection.

Table 5 – Curb Radii with Permanent Full-time Onstreet Parking*

From\To	Local	Main	Avenue	Boulevard	Parkway
Local	15	20	25	30	-
Main	20	20	25	30	-
Avenue	25	25	25	30	-
Boulevard	30	30	30	35	-
Parkway	-	-	-	-	-

** This table should not be used where parking is either part-time only or occurs infrequently.*