CHAPTER THREE
BEST PRACTICES, DESIGN STANDARDS AND RALEIGH'S SIDEWALK PROGRAM

This chapter identifies best practices in pedestrian facility design that should be considered for Raleigh's pedestrian network. The recommendations are consistent with the Raleigh 2030 Comprehensive Plan with respect to establishing Complete Street standards, accommodating multiple users, considering pedestrian level of service, establishing pedestrian-friendly roadway design, and improving safety for all roadway users.

Pedestrian network recommendations presented in this chapter address three of the four key issues identified in the Chapter 2, Existing Conditions: (1) install sidewalks where missing, (2) make it easier for pedestrians to cross the street, and (3) change motorists' behavior with respect to pedestrians. Improvement strategies that address pedestrian needs described in other sections of this plan are reflected in the information in this chapter. These strategies include: make pedestrians more visible; install sidewalks where needed; shorten crossing distances; ensure sufficient crossing time; slow motor vehicle speeds at potential points of conflicts with pedestrians; improve transit access.

This chapter is comprised of three sections:

- An overview of best practices and information on their effectiveness
- Twelve new templates for designing intersection elements in Raleigh
- A new system to prioritize sidewalk projects in Raleigh.

Best Practices Overview

Pedestrian best practices are design treatments that have been shown to improve pedestrian travel and safety. The increased focus on multi-modal transportation by citizens, policy makers, planners, and engineers in communities throughout the country has resulted in a number of new design treatments and a re-examination of existing treatments to determine how well they serve pedestrian mobility.

The following three tools address different factors regarding the transportation system's effectiveness with particular emphasis on pedestrian safety and mobility. Together, these tools provide a comprehensive evaluation of the impact of a design treatment.

Measure of Effectiveness (MOE). MOEs relate to the impact of a design treatment on pedestrian and motorist behavior. MOEs include vehicle speed, percentage of motorists braking, percentage of pedestrians trapped in the crosswalk, percentage of pedestrian-vehicle conflicts, percentage of drivers stopping or yielding, pedestrian crossing time, pedestrian delay, and percentage of pedestrians making illegal crossings.[1] These measures can estimate a countermeasure's effects on pedestrian safety when crash data is not yet available, but also provide useful insight into other factors affecting pedestrian safety and comfort.

Crash Reduction Factor (CRF). Many design treatments specifically target safety improvements, i.e., reducing crashes. Over time and with careful assessment, the effectiveness of design treatments in reducing crashes can be determined, resulting in the assignment of a "Crash Reduction Modification Factor (CMF)." These modification factors are an index applied to determine the anticipated change, positive or negative, in crashes based on a design or operational modification along roadways or at intersections.[2] Crash Reduction and Crash Modification Factors take time to determine, and are based on the analysis of several years' experience. CRFs and CMFs do not currently exist for all design treatments; however, over time these factors are expected to be developed for more treatments.

The following table shows Measures of Effectiveness, and Crash Reduction Factors for some popular pedestrian safety countermeasures. Many of these countermeasures are more fully described in the section that follows, "Best Practices in Raleigh," or included in the "Intersection Templates" section of this chapter.

1 "FHWA Concludes Pedestrian Countermeasures Study in Three Cities," ITE Journal, August 2011, pp 39-43.

2 AASHTO Highway Safety Manual 1st Edition 2010.

Countermeasure	Measure of Effectiveness (MOE)	Crash Reduction Factor (CRF)
Leading Pedestrian Interval (LPI)	High	5%
Pedestrian countdown signals	High	25%
In-street pedestrian signs *(CRF is for pedestrian crossing warning signs.)*	High	15%
Activated flashing beacons *(AASHTO Highway Safety Manual 1st Edition 2010.)*	High	15%
Rectangular rapid flash beacons	High	80-88%
Danish-offset medians + high visibility crosswalk	High	46% (with crosswalk) to 60% (without crosswalk)
Advance yield markings	High	NA
"Yield Here to Pedestrians" signs *(CRF is for pedestrian crossing warning signs.)*	High	15%
"No Turn on Red" signs	Moderate	10%
Prohibitions on permissive left turn *(CRF is for protected left turn.)*	Moderate	70-80%
Portable speed trailers	Moderate	NA
Automated pedestrian detection	Moderate	NA
High visibility crosswalks	Low	20 to 29%
"Look" pavement stencils	Low	NA
"Turning Traffic Yield to Pedestrians" signs	Low	NA
"Pedestrian Zone" signs *(CRF is for pedestrian crossing warning signs.)*	Low	15%
Sidewalks	High	88%
Paved shoulders	High	70%

Best Practices in Raleigh

This plan recommends several best practices to be adopted by the City. These best practices are described in the following section and grouped into several categories: Along the Roadway Basics, Across the Roadway Basics, Bus Stops and Schools, and Emerging Practices. Practices that are emerging practices in communities throughout the country may be appropriate to consider as Raleigh improves and expands its pedestrian network. The communities that either developed or use these emerging treatments found they are appropriate for a limited number of locations requiring a site-specific solution.

Along the Roadway Basics

Pedestrian facilities and operations create safe and comfortable walking conditions along the roadway, and satisfy ADA compliance requirements. Nearly all of these best practices require adequate public right-of-way, which may or may not exist where development has already occurred. In areas planned for future increases in residential density or development, adequate right-of-way should be secured or preserved to accommodate future sidewalks and road enhancements that improve the pedestrian network.

Sidewalks. Sidewalks and walkways provide pedestrians with a space to travel separated from motor vehicles, typically within the public right-of- way. Sidewalks are associated with significant reductions in pedestrian collisions with motor vehicles. The recommended minimum clear width (free from obstructions) for a sidewalk or walkway is 5 feet, which allows two people to pass comfortably or to walk side-by-side. Wider sidewalks should be installed near schools, at transit stops, in downtown areas, or anywhere high concentrations of pedestrians exist. Sidewalks should be continuous along both sides of a street and sidewalks should be fully accessible to all pedestrians, including those in wheelchairs. A buffer zone of 4 to 6 feet is desirable and should be provided to separate pedestrians from the street.

A subset of this best practice is converting "social trails" to sidewalks or paved trails. Pedestrians often walk where there are no sidewalks either because it is the most direct route or because other options are unavailable. The presence of these "social trails" indicates an existing level of pedestrian activity and where possible, should be converted to formal trails or paved sidewalks.

Photo 27. A sidewalk comprised of three zones iis typical in urban areas.

Sidewalk Buffers. Buffers between pedestrians and motor vehicle traffic create greater levels of comfort, security, and safety for pedestrians. A buffer zone of 4 to 6 ft is desirable and should be provided to separate pedestrians from the street. The buffer zone width will vary according to the street type; in downtown or commercial districts, a street furniture zone (street signs, trees, benches, newspaper boxes, trash receptacles, etc.) is usually appropriate. See Figure 1.In more suburban or rural areas, a landscape strip is generally most suitable. Where sidewalk buffers cannot be provided due to right-of-way constraints, parked cars and/or bicycle lanes can provide an acceptable buffer zone. In addition to buffering pedestrians from traffic, sidewalk buffers provide a space for poles, signs, and other objects that may otherwise be obstructions within the sidewalk; and they protect pedestrians from splashing caused by vehicles driving through puddles. With a landscaped buffer between the sidewalk and the street, care must be taken to ensure that bus stops are fully accessible to wheelchair users and have connections to the sidewalk.

Paved Shoulders. The shoulder is the portion of the roadway to the right of the fog line (rightmost white stripe) of a travel lane or edge of the paved area. Providing a paved shoulder has safety benefits for all roadway users. For pedestrians and bicyclists, paved shoulders provide a level and smooth surface for traveling along the roadway. For motorists, paved shoulders provide extra room in which to maneuver to avoid crashes. The width of this paved shoulder area should be a minimum of three feet on rural highways with average daily traffic counts (ADTs) less than 400 vehicles per day; a minimum of four feet on rural highways where ADTs are between 400 and 1,200; or six feet on rural/suburban highways with ADT greater than 2,000. While sidewalks are preferred, wider shoulders can be a suitable treatment to maximize pedestrian comfort and safety where sidewalks are infeasible in order to maximize comfort and safety of pedestrians. Paved shoulders may be accomplished through a lane or road diet or by widening the road pavement surface and striping a fog line. Lane diets may also have speed management benefits: *reduced lane widths have been shown to reduce vehicle speeds while maintaining vehicle capacity*.[3]

Clearance (from Obstructions). A sidewalk with a clear width of at least five feet and a clear height of at least 8 feet ensures access for all sidewalk travelers, including those using wheelchairs, walkers and other assistive devices. The clear width area of a sidewalk (sometimes referred to as the pedestrian zone) should be clear of obstructions, such as poles, fire hydrants, street furniture, signposts, newspaper racks and other obstacles that could block the path, obscure a driver's view or pedestrian visibility, or become a tripping hazard. Where it is cost prohibitive to remove obstructions at spot locations, such as utility poles, the ADA minimum standard of three foot clearance should be provided only to the extent needed to pass the obstruction. Temporary construction materials and other portable signs should never obstruct a sidewalk. Where sidewalks must be temporarily obstructed due to construction activity or other reasons, a clearly marked alternative route that does not take pedestrians too far out of direction should be established.

Driveway Consolidation (also known as Access Management). Research over the past several decades has consistently shown that crash rates increase as driveway density increases on a roadway (i.e., number of driveways per mile). Multi-lane roadways without medians present particular challenges to both pedestrians and motorists, as motorists turning left into a driveway are focused on finding gaps in oncoming traffic. While focusing on gaps in traffic, the motorist's ability to see pedestrians may be blocked by the approaching vehicles. Motorists often accelerate rapidly towards the driveway to clear a gap, particularly on multi-

Photo 28. Shrubbery can reduce the space for pedestrians to travel along a sidewalk.

Photo 29. Regular maintenance will keep sidewalks clear of vegetative obstructions.

3 Several sources speak to this relationship, including: http://safety.fhwa.dot.gov/geometric/pubs/mitigation-strategies/chapter3/3_lanewidth.htm, http://www.arlingtonva.us/Departments/CPHD/forums/columbia/pdf/lane_width.pdf , and http://issuu.com/bostontransportationdepartment/docs/3_3_reducing_speed.

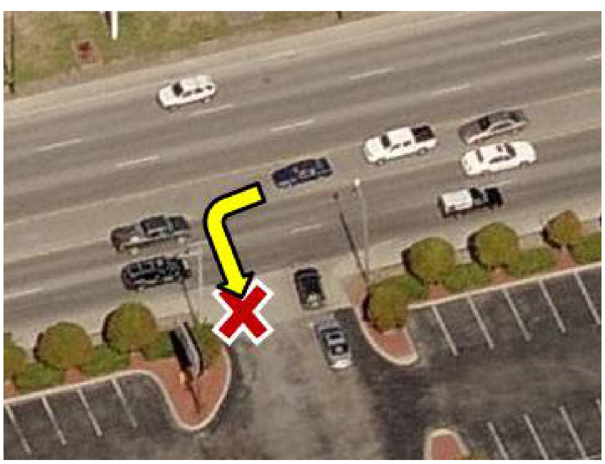
lane roadways, which can put a pedestrian crossing the driveway at risk. Limiting and consolidating vehicle access points (also known as access management), benefits pedestrians and bicyclists by reducing conflict points, and can also improve traffic operations by redirecting motor vehicles to intersections with appropriate traffic control devices. Access management strategies should be considered where numerous driveways or excessively wide driveways impede pedestrian travel or create unnecessary potential conflicts between vehicles, bicycles and pedestrians. Access management strategies include restricting turning movements, particularly left-turns into and out of a property, through median installation, interconnecting parcels with service roads or other internal connections, and reducing the number and size of driveways, particularly near intersections.

Across the Roadway Basics

Pedestrian facilities and operations that accommodate crossing the roadway, i.e., create the time and space for pedestrians to cross the roadway safely and comfortably, and satisfy ADA compliance requirements.

Rectangular Rapid Flash Beacon (RRFB). Rectangular rapid flash beacons (RRFBs) have proven to be effective devices at uncontrolled intersections for increasing motorist yielding rates and reducing pedestrian-vehicle crashes at crosswalk locations, especially when compared to standard flashing beacons.

The rapid flash beacon device consists of a pair of rectangular, yellow LED beacons that employ a stutter-flash pattern similar to that used on emergency vehicles. The beacons are often mounted below a standard pedestrian crossing warning sign and above the arrow plaque. The beacons are pedestrian-activated via pushbutton or passive detection and placed on both sides of the street. If a median exists at the crossing location, a third beacon may be placed in the median, which, studies show, significantly increases motorist yield rates. Advanced pedestrian warning signs can also be used with the rapid flash beacon. These devices have been granted interim approval

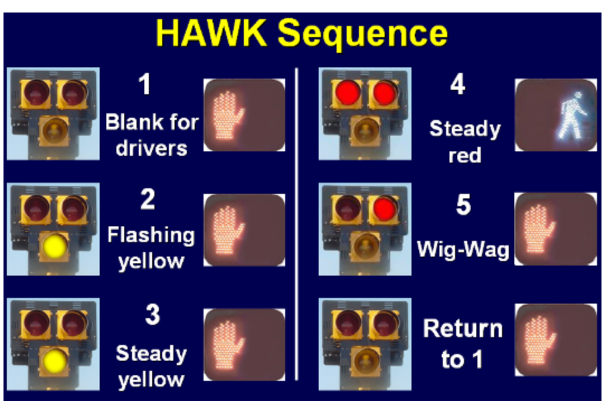


by FHWA. The City of Wilmington, NC has installed an RRFB at a busy pedestrian and bicycle crossing in their downtown area.

The High Intensity Activated Crosswalk (HAWK). Based on engineering judgement, the HAWK signal can be used in circumstances where volumes of traffic or roadway width suggests that motor vehicles should be stopped when pedestrians need to cross the roadway. The HAWK signal uses traditional traffic and pedestrian signal heads but in a different configuration. It includes a sign instructing motorists to “stop on red” and a “pedestrian crossing” overhead sign. When not activated, the signal is blanked out. The HAWK signal is activated by a pedestrian push button or passive pedestrian sensor. The overhead signal begins flashing yellow and then solid yellow, advising drivers to prepare to stop. The signal then displays a solid red and shows the pedestrian a “Walk” indication. Finally, an alternating flashing red signal indicates that motorists may proceed when safe, after coming to a full stop. The pedestrian is shown a flashing “Don’t Walk” with a countdown indicating the time left to cross. The City of Raleigh will install two HAWK signals as part of the Falls of Neuse Road widening project.

Leading Pedestrian Interval (LPI). The Leading Pedestrian Interval (LPI) is a traffic signal phasing strategy to improve pedestrian visibility in locations with heavy volumes of turning traffic and frequent pedestrian crossings. A LPI gives pedestrians the WALK indication four to seven seconds before concurrent vehicular traffic gets the green indication. This technique allows pedestrians to establish themselves in the intersection in front of turning vehicles, increasing visibility between all modes. In many cases, an LPI is a simple, inexpensive treatment because the signal controller can be retimed relatively easily. To reduce motorist delay, LPIs can be programmed to operate only during peak pedestrian demand times. LPIs can be complemented by NO TURN ON RED signs and shorter crossing distances. LPIs have been used successfully for decades in the United States. Cities with successful LIPs in North Carolina include Asheville, Charlotte, Chapel Hill, and Cary.

High Visibility Crosswalks. High visibility crosswalk markings aid both drivers and pedestrians in seeing the crosswalk. Two parallel lines indicating a marked crosswalk are less visible to motorists. High visibility (also known as ladder style or piano keys) markings should be used at locations without signals or stop signs, and are also advised at locations where these traffic controls are present. The crosswalk striping is placed outside of the wheel path, to reduce maintenance costs from wear caused by



motor vehicle tires. Crosswalks should not be slippery, create tripping hazards, or be difficult to traverse by those with diminished mobility or visual capabilities. Although initially more costly than paint, thermoplastic and is a more cost-effective material to use for crosswalk striping when considering all costs such as the initial installation and on-going maintenace. Thermoplastic material is also more visible and less slippery than paint when wet.

Crossing Islands. Crossing islands (also known as center islands, refuge islands, or pedestrian islands) are raised islands placed in the center of the street at intersections or midblock. Crossing islands allow pedestrians to cross only one direction of traffic at a time by enabling them to stop partway across the street and wait for an adequate gap in traffic before crossing the second half of the street. They are especially effective at reducing crashes at uncontrolled locations on busy multi-lane roadways where gaps are difficult to find, particularly for slower pedestrians, e.g. disabled, older pedestrians, and children. Where midblock or intersection crosswalks are installed at uncontrolled locations (i.e., where no traffic signals or stop signs exist), crossing islands should be considered as a supplement to the crosswalk, and should be designed with a stagger (also called Danish-offset medians in the table in the chapter overview section) forcing pedestrians to face oncoming traffic before progressing through second phase of crossing. They are also appropriate at signalized crossings, and may improve safety for vehicles by dividing traffic streams. If there is enough width, center crossing islands and curb extensions can be used together to create a highly visible pedestrian crossing and effective traffic calming. Crossing islands should be a minimum of six feet wide to accommodate the typical length of a bicycle; however, the recommended width is ten feet. Crossing islands should be aligned directly with marked crosswalks and provide an accessible route of travel (per current accessibility guidelines).

Channelization or Directional Islands. Installing channelization or directional islands (also known as pork chops) in right-turn slip lanes can shorten crossing distances, reduce pedestrian exposure, and improve overall coordination of the intersection. The island enables pedestrians and drivers to negotiate one conflict point separately from others. The island should have the longer tail pointing upstream to the approaching right-turn driver, and be designed so drivers approach the pedestrian crossing at a nearly 90-degree angle. The crosswalk is placed one car length back from the intersecting roadway so the driver can move forward and wait for a gap in

Photo 30. Parallel bar crosswalk along Martin Luther King Jr Boulevard.

Photo 31. High visibility crosswalk with parallel bar.

oncoming traffic once the pedestrian conflict has been resolved. This design puts the crosswalk in an area where the driver is still looking ahead. This design also ensures that motorists approach the crosswalk while still looking ahead, rather than while looking left for a gap in traffic. Since traffic signal timing is frequently based on the shorter crossing, the pedestrian crossing phase has a much smaller influence on the overall timing of the signal. See the next section, Intersection Templates, Figure 9, Slip Lane Design for Improved Pedestrian Safety.

Bus Stops

Infrastructure features at bus stops along the roadway create safe and comfortable accommodations for transit rider and satisfy ADA compliance requirements. These best practices also apply to school bus stops. As with along the roadway best practices, bus stop best practices require adequate public right-of-way.

Bus Stops. All public transit bus stop locations should be safe, convenient, well-lit, clearly visible, and accessible. Bus stops should be located at intersections wherever possible because intersections are generally more convenient for passengers intercepting other transit connections, accessing crosswalks, and connecting to pedestrian routes and building entrances. Selecting a bus stop site depends on a variety of factors, including the available curbside space, conditions of sidewalks, width of sidewalks, ADT (Average Daily Traffic), the number and width of travels lanes, turning movements, sight distances, parking, bicycle facilities, and the presence of or need for crosswalks. At signalized intersections, far-side placement is generally recommended; however, location selection should be done on a site-by-site basis. Advantages of locating stops on the far-side of an intersection include reduced delay for buses, encouraging pedestrians to cross the street behind the bus where they are more visible to passing traffic, minimizing conflicts between buses and right turning vehicles, and allowing buses to take advantage of gaps in traffic flow (especially with signal prioritization). This placement also enables the bus driver to pull away without endangering pedestrians. Bus stops should be setback a minimum of five feet from crosswalks. Where feasible, a ten foot setback is preferred. The City's current bus stop standards are detailed in the Passenger Amenitiy Guidelines & Transit Design Standards Final Report (March 2011).[4]

Sidewalk Connections to Public Transit Bus Stops. Bus stops should be highly visible locations that pedestrians can reach easily. Access to the bus stop via sidewalk connections from an adjacent intersection, sidewalk, or nearest land use should be as direct as possible. To accommodate wheelchairs, sidewalk connections should be a minimum of four feet wide (preferably five to six feet wide) and equipped with wheelchair ramps at all street crossings. Other improvements near transit stops include marked crosswalks and signals at intersections. When possible, sidewalks and bus stops should be coordinated with existing street lights to provide an adequate level of lighting and improve security. Installation of a continuous sidewalk from the adjacent intersection to the bus stop is one way to achieve greater patron access to the bus stop in areas with limited or no sidewalk coverage.

4 http://www.raleighnc.gov/services/content/PWksTransit/Articles/CapitalAreaTransit.html

Crossing Near Public Transit Bus Stop. It is often necessary for pedestrians to cross roadways when traveling to and from transit stops. A formal mid-block crossing may be needed for bus stops located mid-block on a long block (greater than 1,000 feet long). North Carolina code prohibits pedestrians from crossing mid-block between signalized intersections, except where there is a marked crosswalk. SS20-174(c) . Crossing improvemetns should be prioritized at locations with higher transit usage to increase the visibility of transit-riding pedestrians. Crosswalks at mid-block transit stops should be placed behind the bus stop so pedestrians cross behind the bus where they can see oncoming traffic. Signalized pedestrian crossings near transit stops where a full signal is not warranted should incorporate other treatments such as crossing islands, rapid flash beacons, and warning signage.

Sidewalk/Landing Pad Capacity at Transit Stops. Sidewalks at transit stops should extend to the curb so that passengers may access the sidewalk directly from the bus doors. It is desirable to provide a continuous eight foot wide area (either a dedicated pad attached to the sidewalk or a continuous sidewalk) to match the length of a bus or at least the distance between the front and rear bus doors. A larger pad area or sidewalk capacity should be considered in areas with higher pedestrian volumes on the sidewalk and high transit use. Where it is not possible to provide a pad or sidewalk of sufficient width, curb extensions can provide additional space for passengers to board and alight without interfering with sidewalk flow. The width of the curb extension should generally be six to eight feet, but should not be wider than the adjacent parking lane; the curb extension should be long enough to allow passengers to board and alight at all doors of the bus.

Photo 32. Well-equipped bus stop on Capital Boulevard include sidewalks, landing pads, shelter, light, trash can, and bench.

Emerging Practices

Practices that are emerging in communities throughout the country that create new or re-look at existing practices which may offer workable solutions to pedestrian network needs. As these practies continue to be used, additional guidance or lessons learned may become available on their effectiveness.

Slip Lane Raised Crosswalk. A variation of slip lane design to improve pedestrian conditions is to install a raised crosswalk across the turning lane. This treatment can increase pedestrian visibility; slow motor vehicle speeds, and improve yielding compliance by drivers. The crash reduction factor for raised crosswalks across travel lanes may be a useful indicator for the positive effect of a raised crosswalk in a slip lane.

Photo 33. Raised crosswalk in slip lane in Arlington, Virginia.

Pedestrian Shoulder Walking Lanes. Pedestrians may walk in the roadway on low volume, low speed roads with limited right-of-way for sidewalks. As shown in the photos from Carrboro, North Carolina, pavement markings and signage can be used for this type of facility. The pedestrian walking lanes in Carrboro work well based on several criteria:

» Narrow streets with no right of way for sidewalks

» Level of pedestrian traffic warrants designating pedestrian space on the roadway

» Low volume traditional grid streets with stop signs at each corner to slow traffic

» Better suited for one-way streets

» When partnered with a public education and enforcement program these types of shared roads can be a workable option for both pedestrians and motorists.

Photo 34. View of crushed stone sidewalk with timber curb.

Photo 35. Close-up of timber curb raised to allow for drainage.

Photo 36. Close-up of vertical drainage pipes in crushed stone.

Crushed Stone Sidewalks. Pedestrian travel along streets where storm water management is a concern or where existing right-of-way for sidewalks with standard curb and gutter may be limited can accommodate sidewalks constructed of crushed stone. The treatment is also suitable for areas where there is a desire to keep to a minimum disturbance to the mature trees within the park. A crushed stone sidewalk in Chevy Chase, Maryland is shown on the following previous page. Modified curbs with drainage can also be installed using raised beams. The honeycomb or "vertical pipes" are used to stabilize the crushed stone to prevent it from washing out, to enable infiltration to minimize runoff, and to provide bearing support for bicycles, pedestrians and motor vehicles (if desired). This type of sidewalk is suitable where traffic volume and speeds are high enough to make shared streets unsafe for pedestrians. The treatment is also suitable for areas where there is a desire to keep to a minimum disturbance to the mature trees within the park. A crushed stone sidewalk in Chevy Chase, Maryland is shown on the following page.

Multi-use Paths. In some instances asphalt multi-use paths are installed in lieu of standard concrete sidewalks. Multi-use paths are typically constructed 8-10 feet in width which generally provide sufficient space to accommodate pedestrians and cyclists. Depending on site conditions multi-use paths can typically be installed along streets with or without existing curb and gutter.

Small Footprint Bus Shelter. Streets with limited right-of-way for bus shelters at stops may be suitable for a small footprint bus shelter. The shelter canopy is supported by a single pole; the smaller canopy provides some weather protection. The shelter may also include a leaning rail to provide some support for waiting passengers.

Photo 37. Shelter in Alexandria, Virginia

Photo 38. Shelter in Raleigh, .

In-street Yield to Pedestrian Signs. Flexible in-street pedestrian crossing signs may be used to remind road users of the laws regarding right-of-way at unsignalized pedestrian crossings and increase motorists' awareness of pedestrian crossings. They are often used at school crossing and other locations with vulnerable populations or where high pedestrian volumes occur. They may also be used at greenway or trail crossing, and other locations where pedestrians not be expected, such as between a parking facility and a major destination (e.g.,

Photo 39. Apex, NC placed this in-street pedestrian sign at Baucom Elementary School (400 Hunter Street)

employer or college campus). In-street signs are usually used on two-lane streets with lower traffic speeds and volumes due to potential impacts. They can be used in conjunction with advanced warning at crosswalk signs, as well as with curb extensions. Photo 13 shows an in-street Yield to Pedestrian sign in Apex, NC.

Intersection Templates

The City of Raleigh typically uses NCDOT design standards for infrastructure elements within the public right-of-way. As the City moves towards multi-modal roadway design, standards that modify those from NC DOT may be appropriate for some intersection and mid-block crossing elements. The 12 intersection templates included here reflect current best practices used by walkable communities. The list was generated from field work conducted for the example locations (See Chapter 4, Pedestrian Facility Recommendations). Design elements noted with an asterisk (*) are specifically mentioned in the Community Assessment Tool provided by the Pedestrian and Bicycle Information Center (PBIC)'s Walk Friendly Communities program.[5]

» Figure 1. Sidewalk Design: Sidewalk Around Obstruction

» Figure 2. Sidewalk Design: Sidewalks Across Driveway*

» Figure 3. Sidewalk Design: Sidewalk Mixing Zone

» Figure 4. Median Design: Median Nose Extension

» Figure 5. Median Design: Mid-block Crossing

» Figure 6. Curb Ramp: ADA-Compliant Curb Ramps*

» Figure 7. Curb Extension Design: Intersection*

» Figure 8. Curb Extension Design: Mid-block*

» Figure 9. Intersection Design: Slip Lane Design-Channelization Island

» Figure 10. Intersection Design: Superstreet

» Figure 11. Signal Design: Accessible Pedestrian Signal Placement*

» Figure 12. Intersection Design: Unsignalized Pedestrian Crossing at Free Flow Interchange Ramp

5 The City of Raleigh is considering applying for Walk Friendly Community status. The Community Assessment Tool document is available at http://www.walkfriendly.org/get_started.cfm.

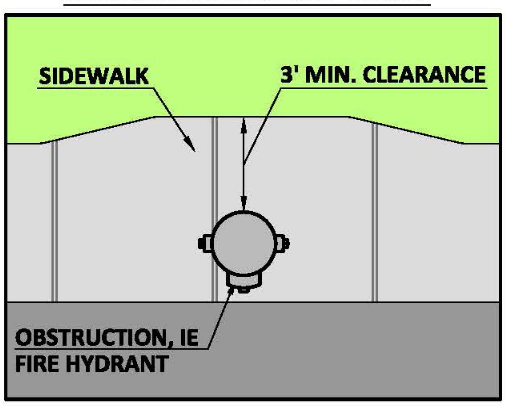
Figure 1 - Sidewalk Around Obstruction Design For Improved Pedestrian Safety

OVERVIEW:

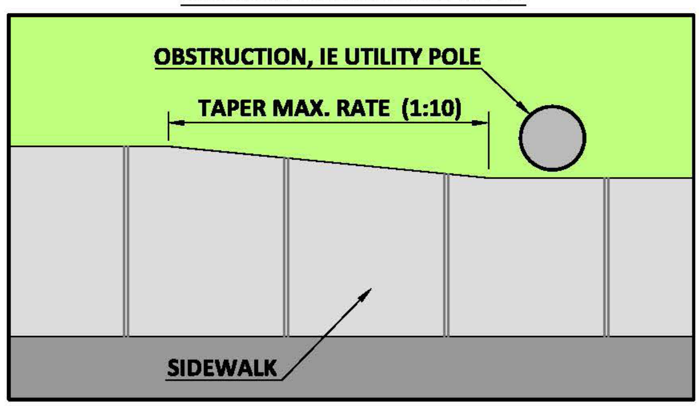
Proper sidewalk design around obstructions and vegetation can improve the safety and accessibility of the pedestrian and bicyclist environment. Sidewalks that are narrow (less than five feet) can create mobility issues at obstructions because the clearance space around the object may be too small for people in wheelchairs or with strollers to easily pass the obstruction, particularly if there is oncoming traffic to navigate around as well. Maintaining minimum passing widths in the sidewalk zone is not only recommended by the Americans with Disabilities Act (ADA), but it can also improve pedestrian comfort and perceived safety.

One design technique is to retrofit a sidewalk by providing access around an obstruction located within the sidewalk zone by widening the sidewalk at the point of obstruction (see *Sidewalk Obstruction - Utility*, below) to provide a clear path. The clear path should be a minimum of three feet at the point of obstruction to provide adequate space for pedestrians to maneuver around the obstruction. In some cases, the sidewalk may simply be narrowed for a short stretch to avoid an obstruction. The design of the transitional narrowing area should follow the design shown below in the *Sidewalk Transitional Taper* graphic. When the obstruction is a street tree or other major vegetation, it is preferred that the sidewalk be completely offset from the obstruction to allow for trunk and root growth. Most street trees are small to medium in size, and two feet is the desired minimum offset to preserve the health of the tree (see *Sidewalk Obstruction - Trees or Vegetation*, below), although smaller offsets may be used. However, large species trees may warrant additional offset space to provide adequate growing space. The vertical clear zone for the sidewalk should extend to 80" (approximately six-and-a-half feet) to protect pedestrians with visual disabilities.

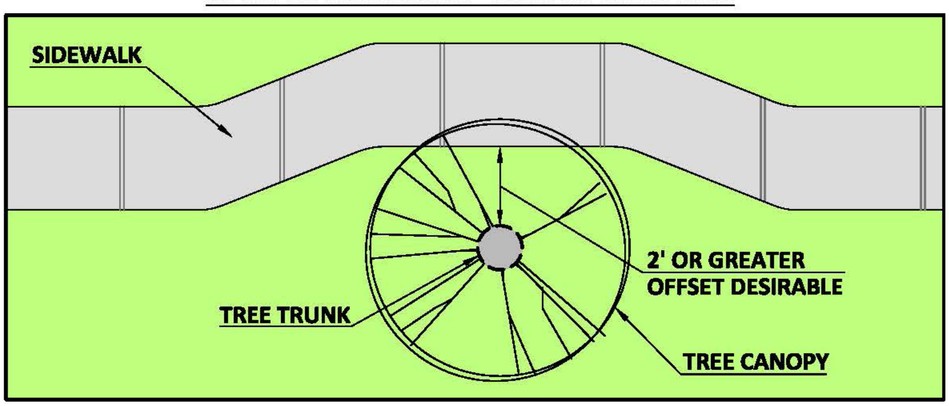
SIDEWALK OBSTRUCTION - UTILITY



SIDEWALK TRANSITIONAL TAPER



SIDEWALK OBSTRUCTION - TREES OR VEGETATION



BENEFITS:

- Improve pedestrian mobility
- Preserve the health of street trees and vegetation

SUITABLE LOCATIONS:

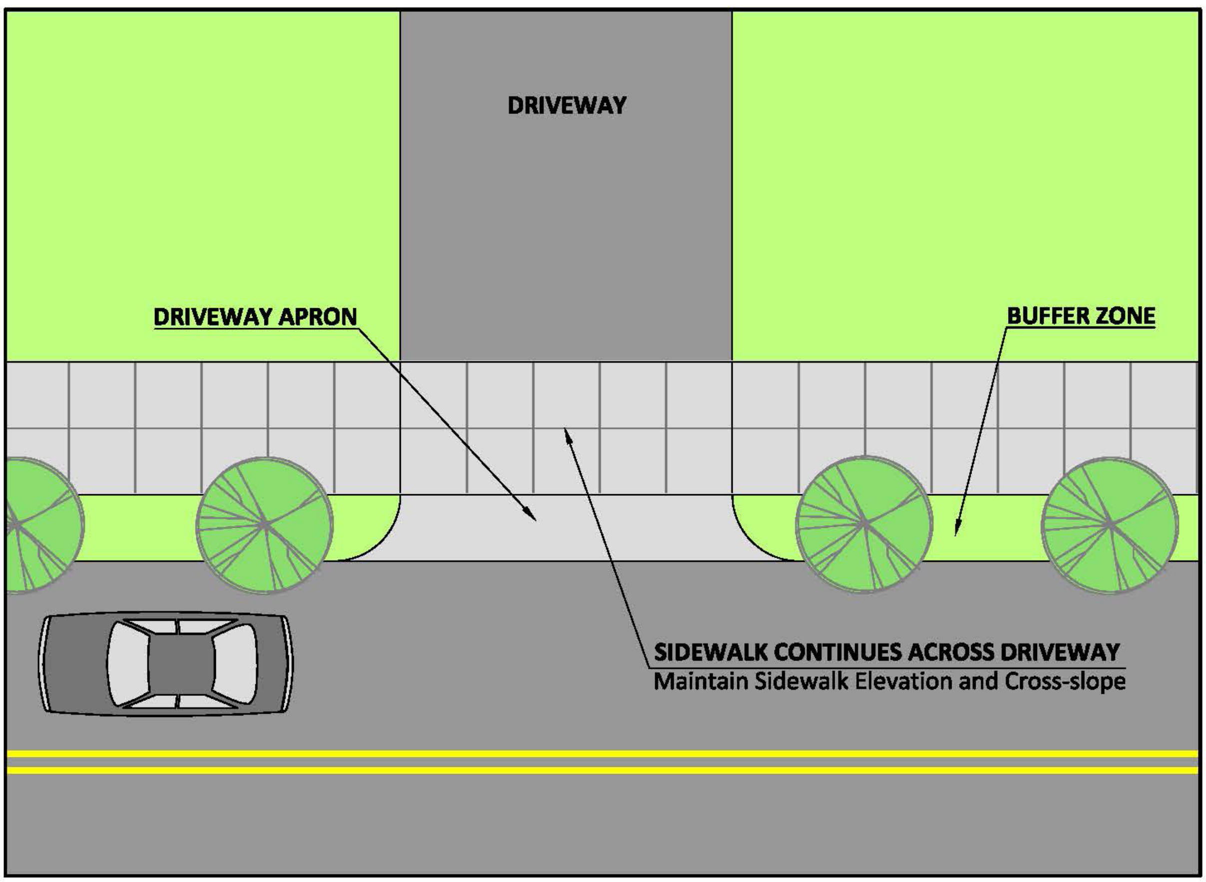
- Utility obstructions near or in the sidewalk zone
- Street trees and vegetation near the sidewalk zone
- Pinchpoints where the sidewalk must be narrowed for a short distance

Figure 2 - Sidewalk Across Driveway Design For Improved Pedestrian Safety

OVERVIEW:

Some driveway and sidewalk designs can improve the safety of the pedestrian and bicyclist environment. Traditional driveways are designed similarly to intersections,terminating the sidewalk at the edge of the driveway and providing curb ramps and marked crosswalks to allow pedestrians to cross the driveway. These designs can create conflicts between pedestrians and motorists, who may not be expecting a crossing on the driveway. Generally, vehicles are able to travel at faster speeds when driveways are designed as intersections.

One design technique is to eliminate the practice of designing driveways similar to intersections. Driveway designs similar to that shown below improve pedestrian safety by creating a continuous sidewalk with a constant cross-slope that pedestrians can more easily traverse. In addition, this improved design slows motor vehicle traffic, as motorists typically slow down to cross the sidewalk. The driveway apron is typically designed to accommodate the change in elevation between the roadway and sidewalk in order to preserve the gentle cross-slope of the sidewalk (two percent maximum). Roadways with wider buffers will have a wider driveway apron and can typically provide a more gentle driveway apron slope for motorists. Sidewalks without buffers from the roadway may need to be pulled back from the roadway edge in order to accommodate necessary slopes (see Figure 1 - *Sidewalk Around Obstruction Design for Improved Pedestrian Safety* for a typical design).



BENEFITS:

- Improve visibility for motorists and pedestrians
- Improve pedestrian safety and mobility at crossing
- Emphasize pedestrian zone as primary space

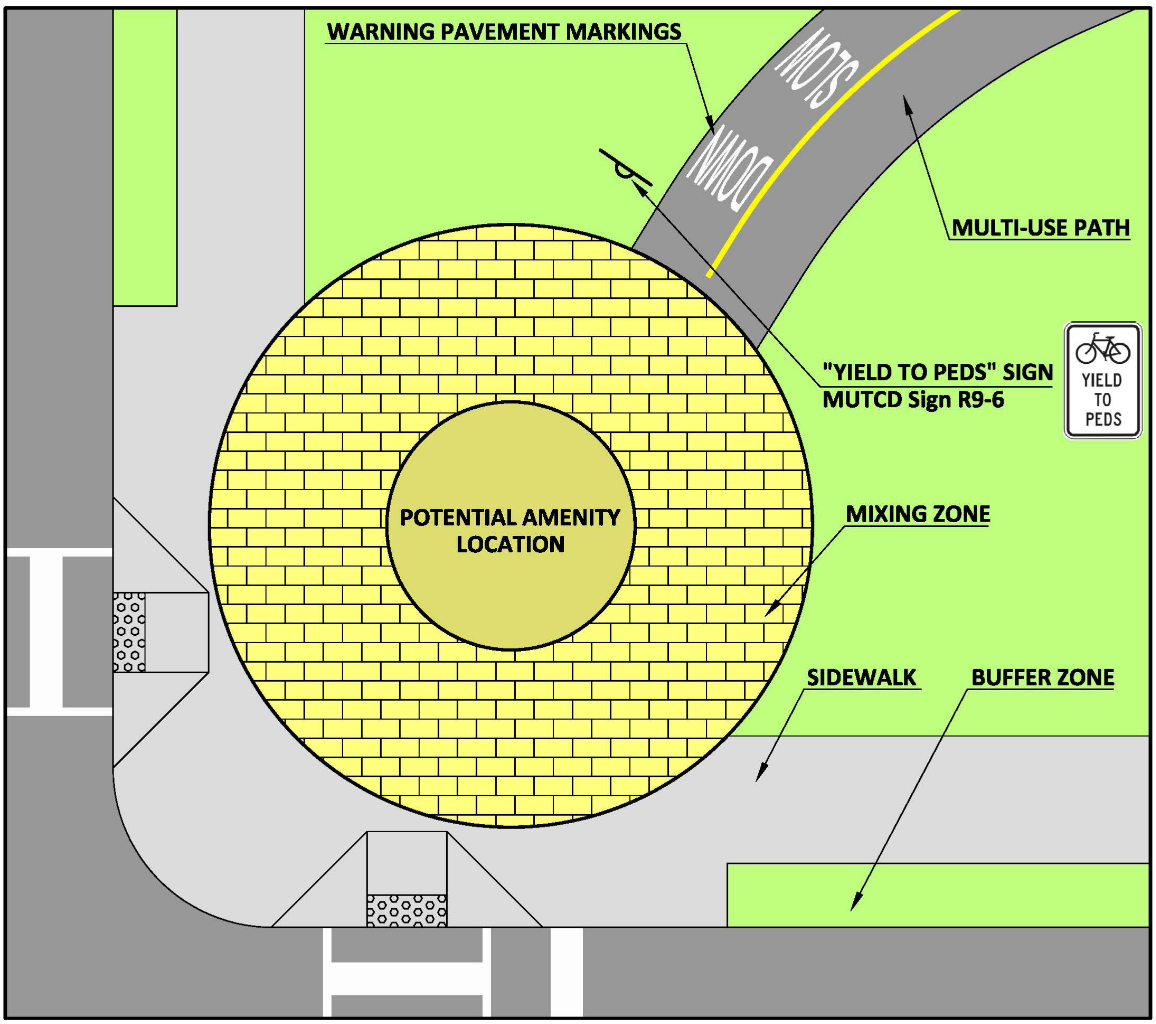
SUITABLE LOCATIONS:

- Commercial/Institutional driveways and alleys that are not formalized intersections

Figure 3 - Sidewalk Mixing Zone Design For Improved Pedestrian Safety

OVERVIEW:
Multi-use paths and trails, especially those located in urbanized areas, are often linked with sidewalks running parallel to roadways in order to provide connections for pedestrians and bicyclists. These connection points, know as mixing zones, if not carefully designed, may encourage conflicts between sidewalk users and path users. Faster moving traffic (such as bicyclists) traveling from a path to the sidewalk or roadway network may not adequately slo down when crossing through the mixing zone, increasing the potential for crashes. In addition, these connections are often made at roadway intersections, which can create further complications as pedestrians and bicyclists may also be entering the mixing zone from the adjacent crosswalks.

Mixing zones should be designed so that conflict areas are clearly defined from both the sidewalk and the multi-use path. This is typically achieved by installing distinctively colored or textured paving materials. Warning signs and pavement markings should be installed on the multi-use path approach. Amenities such as fountains or planters located in the mixing zone can further slow traffic by forcing traffic to navigate around the objects. The graphic below shows one example of mixing zone design. Mixing zone design can vary widely depending on site-specific configurations and constraints.



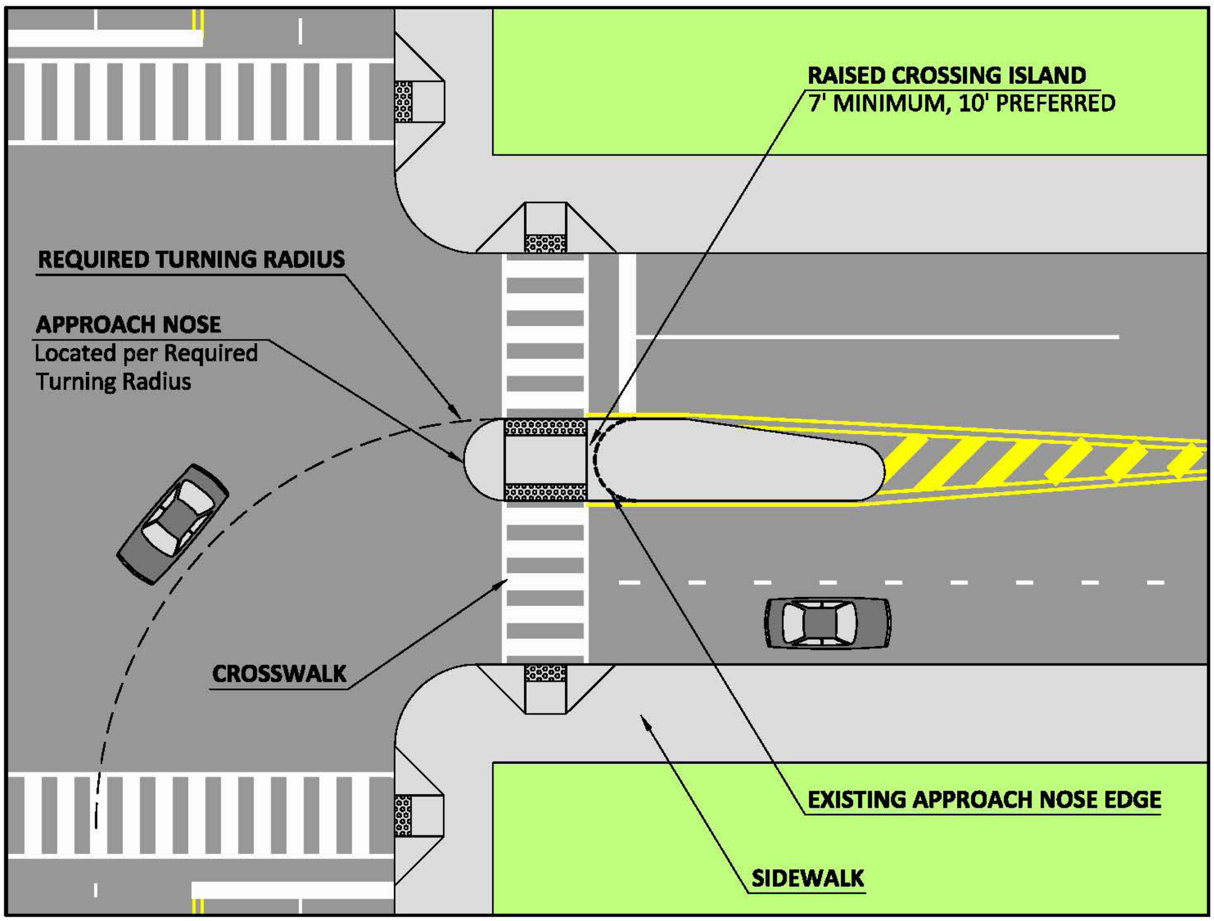
BENEFITS:
- Improve safety for sidewalk and shared-use path users
- Emphasize zone as a shared space for pedestrians and bicyclists

SUITABLE LOCATIONS:
- Connection or intersection between sidewalk and shared-use path

Figure 4 - Median Nose Extension Design For Improved Pedestrian Safety

OVERVIEW:
Center medians at intersections can be utilized or modified to provide a refuge for pedestrians crossing the roadway to reduce crossing distances and minimize exposure to motor vehicles. Existing medians that do not extend into an intersection where a formal pedestrian crossing is desired can be extended to provide a refuge for pedestrians.

Many intersection designs terminate the median before an intersection, creating additional motor vehicle maneuvering space. This design can be detrimental to pedestrians because crosswalks are typically installed directly at an intersection. Therefore, traditional center medians may not provide a refuge area for pedestrians to stop when crossing the roadway in stages. After considering necessary vehicle turning envelopes, a similar design to that shown below can be used to extend the median. Refuges in medians should include at-grade cut throughs or curb ramps to provide an accessible pedestrian path. An at-grade cut through is used when there is not adequate space to install curb ramps and a landing pad in the median zone. If the median is landscaped, the vegetation must not obstruct necessary clear sight lines or impede pedestrian movement and visibility.



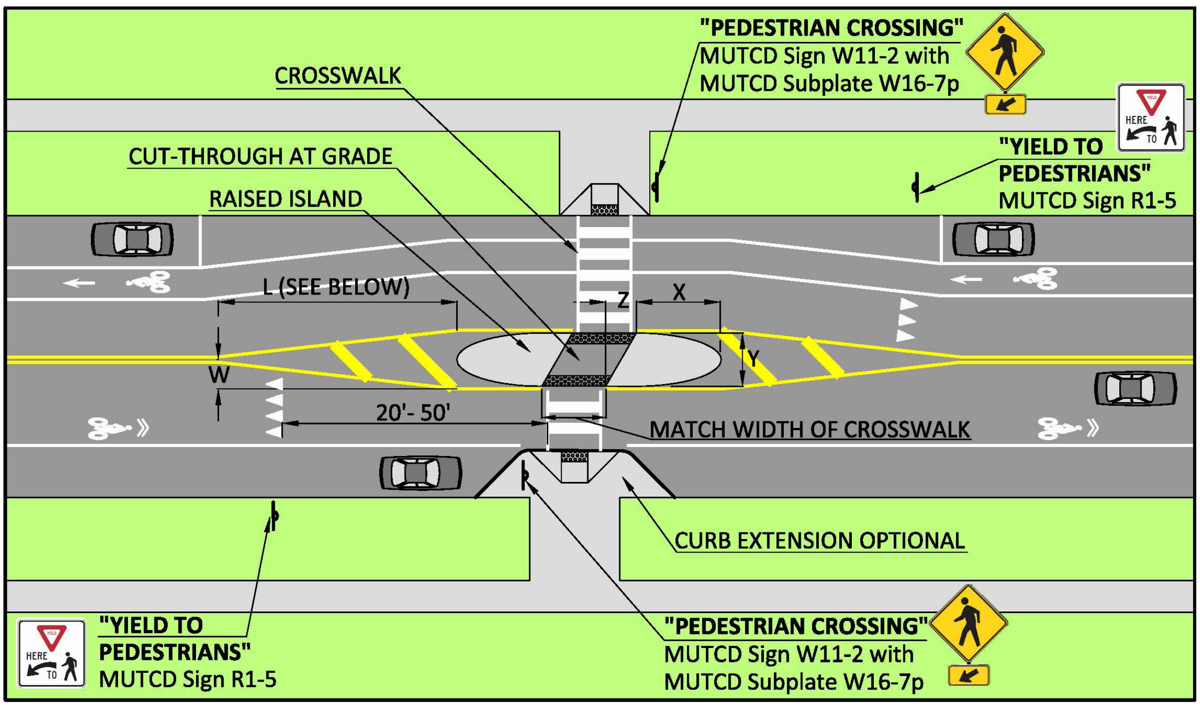
BENEFITS:
- Reduces the width of roadway that pedestrians must cross at one time
- Reduces pedestrian crashes at multi-lane sites

SUITABLE LOCATIONS:
- Particularly beneficial on multi-lane roadways
- Suitable at both controlled and uncontrolled locations

Figure 5 - Midblock Crossing Pedestrian Refuge Design For Improved Pedestrian Safety

OVERVIEW:
Midblock crossings on multi-lane or busy roadways provide important connections for pedestrians and bicyclists. Pedestrian refuge islands can improve the safety and comfort of pedestrians and bicyclists. This design can allow multi-staged crossings when adequate crossing time is not typically available due to the volume and speed of motor vehicles traveling along the roadway. In addition, midblock refuge islands also reduce the overall amount of time the pedestrians are exposed to motor vehicle traffic, reducing potential conflicts.

The design of midblock refuge islands should follow the recommeded dimensions shown below. Midblock refuge islands should be wide enough to provide adequate waiting space for the anticipated pedestrian volumes desiring to cross a particular roadway. Diagonal channelization of the pedestrian path through the median directs the pedestrian to face oncoming traffic and increases awareness for all roadway users (see design below). When lane narrowing is included with a pedestrian refuge, transitional markings should be included to alert and align motorists to both the crossing and the narrowing travel lane. Additional crossing signs may be installed on the refuge island on roadways with multiple travel lanes, or where motor vehicle, pedestrian, or bicycle counts are relatively high.



DESIGN OF REFUGE ISLAND

Z (offset)= $\frac{Y}{2}$

X = Length of island should be 6' or greater

Y = Width of refuge:
7' = minimum
10' = preferred

APPROACH MARKINGS FOR OBSTRUCTIONS IN ROADWAY

For English Units:

$L = \frac{WS^2}{60}$, where S < 45 mph

W= Offset in feet

See Section 3B.10 in the MUTCD for further information.

BENEFITS:
- Creates more direct pedestrian routes

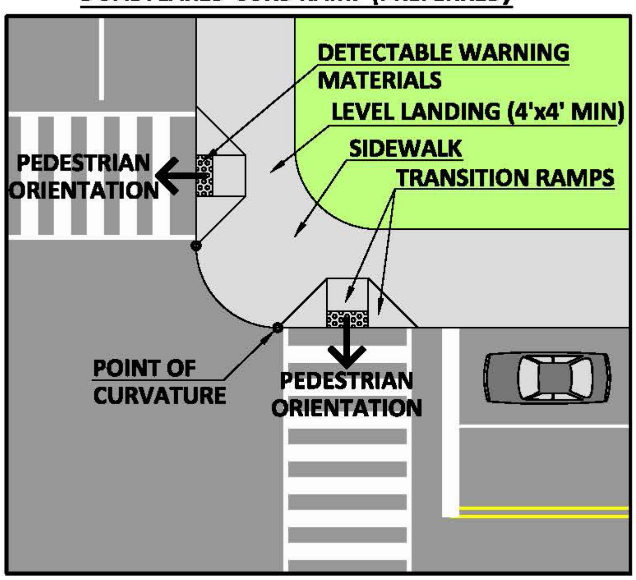
SUITABLE LOCATIONS:
- Long street blocks; particularly those streets with midblock destinations
- Midblock locations with companion bus stops on both sides of the road

Figure 6 - Curb Ramp Designs For Improved Pedestrian Safety

OVERVIEW:
Curb ramps are essential to providing access between sidewalks and the roadway for people with physical disabilities or limited mobility. Curb ramps create a smooth transition between the sidewalk zone and the surface of the roadway, which are typically separated vertically by a curb of at least four inches in height. Curb ramps should be designed to meet guidelines set forth by the Americans with Disabilities Act (ADA) and NC DOT. Curb ramps are recommended at all marked and unmarked pedestrian crossings, but may also be installed at facilities such as parallel parking areas or bus pull-off areas. It is important for curb ramps to align with the associated crosswalk, in order to guide pedestrians with visual disabilities to the enter the roadway at the correct angle. The correct orientation is reinforced by the detectable warning materials, which are installed in line with the curb ramp landing or crosswalk when the curb ramp is askew.

Curb ramps sometimes must be designed to fit within limited space. While the traditional flared curb ramp design is preferred for maximum accessibility and maneuverability, the space required is higher than other curb ramp design. Intersections with larger curb radii or other physical constraints may require the installation of other curb ramp designs to create access to the crosswalk. Curb ramps with returned or parallel curbs require less space along the roadway for installation; however, when the preferred flared curb ramp placement (see below, left) is not possible, a full apex curb ramp (see below, right) should be installed. See NC DOT's *Standard Drawings for Curb Ramps* (Sections 848.05 and 848.06) in the NC DOT Standard Roadway Drawings (2012 Edition) for additional information on curb ramp design and installation.

DUAL FLARED CURB RAMP (PREFERRED)



BENEFITS:
- Provides access from the sidewalk to the roadway

SUITABLE LOCATIONS FOR FLARED CURB RAMPS:
- Controlled or uncontrolled crossings with adequate sidewalk space
- Locations where access from the sidewalk to the roadway is required to reach parking or transit vehicles

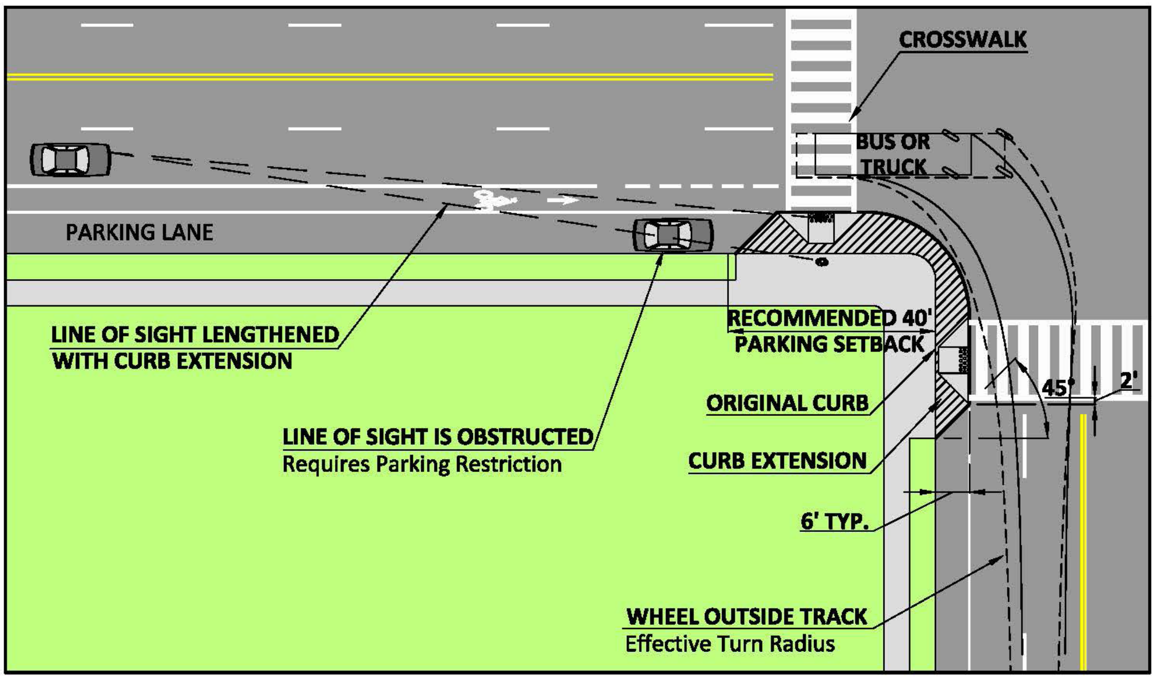
SUITABLE LOCATIONS FOR CONTINUOUS CORNER CURB RAMPS:
- Controlled or uncontrolled crossings where physical space is limited or obstructed by fixed objects
- Locations where access from the sidewalk to the roadway is required, but physical space is limited

Figure 7 - Intersection Curb Extension Design For Improved Pedestrian Safety

OVERVIEW:

Traditional intersection designs with relatively large curb radii and wide roadways, or parallel parking bays can create conflicts for pedestrians and bicyclists traveling through the intersection. Typical intersection designs such as these allow motorists to travel at higher speeds and reduces visibility for both pedestrians and motorists. In these cases, pedestrian and bicyclist safety at the intersection is improved through design techniques that reduce crossing distances of pedestrians, reduce motor vehicular speed, improve visibility for all users, and reduce the overall amount of time the pedestrians are exposed to motor vehicle traffic.

A technique for implementing curb extensions at the corners of intersections is to utilize unused roadway space created by restricting parallel parking at the intersection. Installing curb extensions in unused roadway space reduces the distances pedestrians must cross, improves visibility for both pedestrians and motorists, and reinforces parking restrictions at the intersection. Reducing the radius of corners further improves pedestrian and bicyclist safety by forcing motorists to slow down to complete a right turn at the intersection.



CURB EXTENSION BENEFITS:

- Enhanced visibility between pedestrians and drivers
- Greater space for pedestrians waiting to cross the intersection
- Less exposure for pedestrians due to shorter crossing distance
- Prevent cars from parking too close to the crossing

SUITABLE CURB EXTENSION LOCATIONS:

- Intersection locations on streets with on-street parking

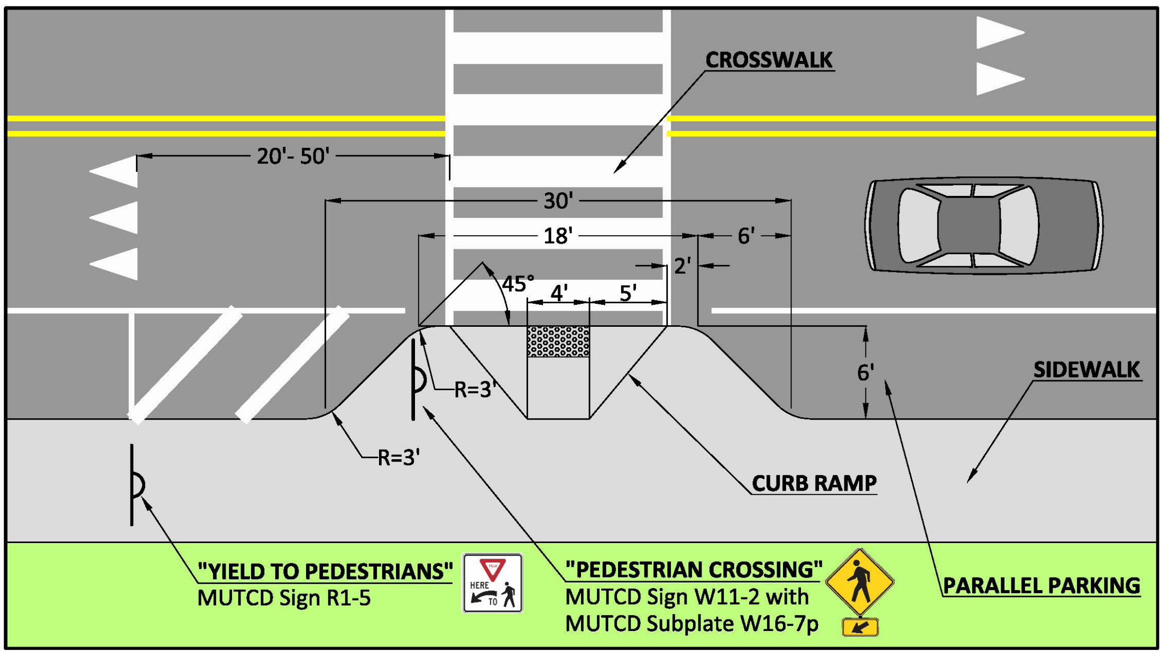
DESIGN AND PLACEMENT OF CURB EXTENSIONS:

- Curb extensions should not extend into travel lanes
- Typical curb extensions extend six feet from the curb (the approximate width of a parked car)
- The turning needs of larger vehicles should be considered in curb extension design, in locations where higher volumes of truck traffic are expected
- Each curb extension may extend into either one or two legs of the intersection, depending on parallel parking
- Consider allowing large vehicles (B-40, SU-30, and WB-50) to use more than one lane to turn (see design shown above)
- On local streets, consider allowing vehicles to use the entire paved surface of the street to turn and very large vehicles (WB-50) to back up to complete the turn

Figure 8 - Midblock Curb Extension Design For Improved Pedestrian Safety

OVERVIEW:
Traditional roadway designs with parallel parking or wide travel lanes increase the crossing distance for pedestrians at midblock locations. Improved safety for pedestrians may be accomplished through design techniques that reduce motor vehicular speed, improve visibility for all users, and reduce the overall amount of time the pedestrians are exposed to motor vehicle traffic, reducing potential conflicts.

One design technique to reduce crossing distance for pedestrians at midblock crossings is to install curb extensions on one or both sides of the roadway. Roadways with parallel parking can be difficult for pedestrians to cross at midblock locations, as parked cars reduce visibility for both pedestrians and motorists and extend crossing distances. A midblock curb extension can be most easily accommodated on the side of the road where there is parallel parking, allowing for one curb extension on a road with parking on one side and two curb extensions on a road with parking on both sides. Curb extensions may also be installed on roadways with wide lanes if adequate roadway space is available. If so, transitional markings should be included to alert and align motorist vehicles to the crossing and narrow the travel lane. See Section 3B.10 in the MUTCD for more information on the transition-required distances and marking design for narrowing travel lanes.



CURB EXTENSION BENEFITS:
- Enhanced visibility between pedestrians and drivers
- Greater space for pedestrians waiting to cross the intersection
- Less exposure for pedestrians due to shorter crossing distance
- Prevent cars from parking too close to the crosswalk area

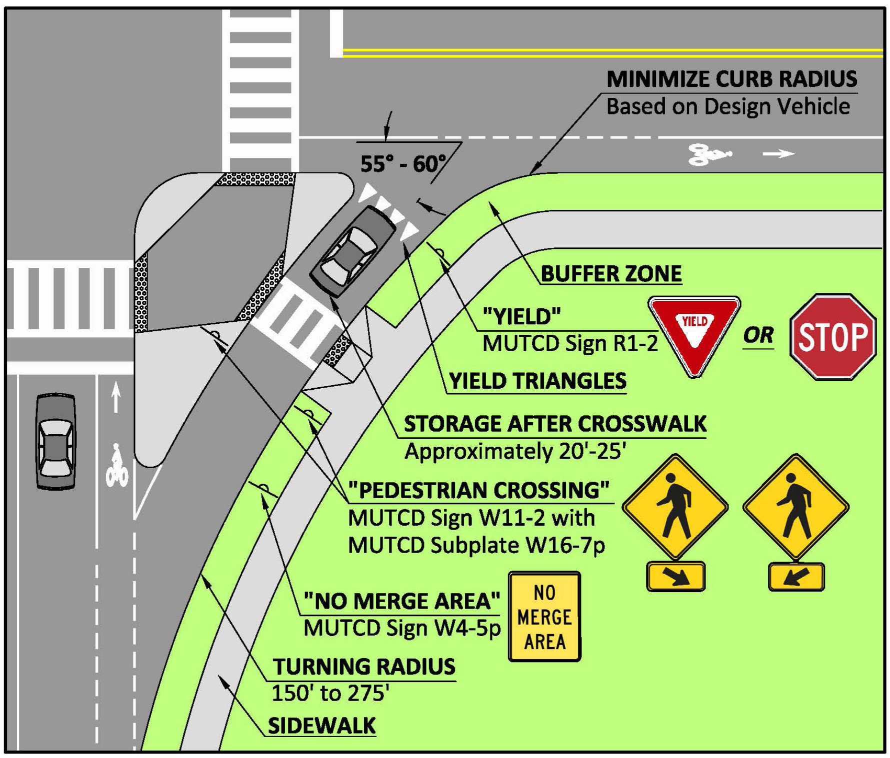
SUITABLE CURB EXTENSION LOCATIONS:
- Midblock locations on streets with on-street parking
- Midblock locations on streets with wide travel lanes or un-utilized roadway space

DESIGN AND PLACEMENT OF CURB EXTENSIONS:
- Curb extensions should not extend into travel lanes
- If used in parking lanes, curb extensions should extend a minimum of six feet from the curb (the approximate width of a parked car
- Curb extensions may be installed on one or both sides of the roadway, depending on the configuration of the roadway and roadway space available

Figure 9 - Slip Lane Design For Improved Pedestrian Safety

OVERVIEW:
A slip lane may be installed at an intersection to allow motorists to make a right turn without entering the main traffic pattern of the intersection. Typical slip lane designs can create conflicts for pedestrians and bicyclists traveling through the intersection. In these cases, pedestrian and bicyclist movement across the slip lane can be improved through design techniques that reduce motor vehicular speed, improve visibility for all users, and reduce the number of conflict points between pedestrians and motorists.

A design technique is to eliminate the practice of designing the slip lane to feed into an acceleration/speed change lane. The slip lane-acceleration lane combination is usually based on balancing multiple factors including traffic volume, speed and roadway classification, but not pedestrian activity and adjacent land use. As a result, the slip lane-acceleration lane combination is often detrimental to pedestrians because it is typically designed for higher turning speeds. Including the level of pedestrian activity and adjacent land use when determining the need for an acceleration/speed change lane with the slip turn lane is one way to accommodate pedestrian safety needs at the intersection. If deemed appropriate, a similar design to that shown below can be used to slow turning vehicles at the pedestrian crossing. A raised crosswalk may be considered at the crossing where motor vehicle speeds are relatively high, or the pedestrian environment is perceived to be unsafe.



BENEFITS:
- Approach angles between 55-60 degrees discourage high speed turns, thus reducing speeds in the ramp area
- Improve sight distances
- Improve pedestrian safety at crossing
- Reduce pedestrian crossing distances on multi-lane roadways

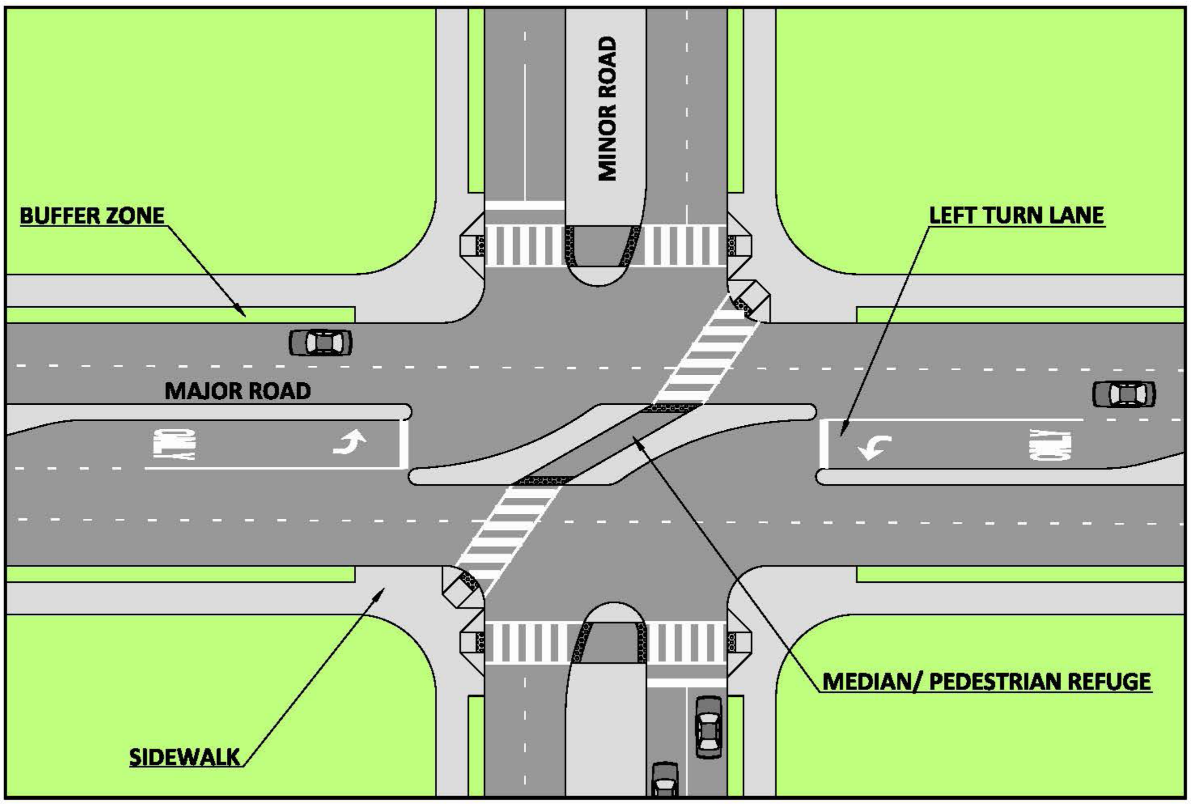
SUITABLE LOCATIONS:
- Multi-lane roadways with intersections requiring very large turning radii, or with heavy volumes of right-turning traffic

DIRECTIONAL ISLAND DESIGN:
- Island could include landscaping if adequate space and sight distances can be maintained.
- Pedestrian access on island could be accomplished by a street level cut-through in lieu of curb ramps.

Figure 10 - Super Street Intersection Design For Improved Pedestrian Safety

OVERVIEW:
Super street intersection designs improve motor vehicle movement by reducing delays and congestion associated with through and left-turn movements from minor streets. However, super street intersections often create challenges for pedestrians and bicyclists navigating the intersection. Improving pedestrian safety through super street design is accomplished by using design techniques that create waiting areas and reduce the number of conflict points between pedestrians and motorists.

Super street intersections restrict through and left-turn movements from minor streets by use of a median. Motorists wishing to travel through or turn left from a minor road must first turn right onto the major road, and then perform a U-turn at a designated location, typically 400 to 1,00 feet beyond the intersection (not shown below). Pedestrians crossing the major road may be routed diagonally across the intersection, as shown below. This allows for the pedestrian movement across the major road to not conflict with left-turn movements from the major road, minimizing delays. Super street intersections designed with signalization may be designed to include traditional, perpendicular pedestrian crossings on the major road.



BENEFITS:
- Improve pedestrian safety at crossing
- Reduce pedestrian crossing distances on multi-lane roadways
- Reduce conflict points between pedestrians and motorists

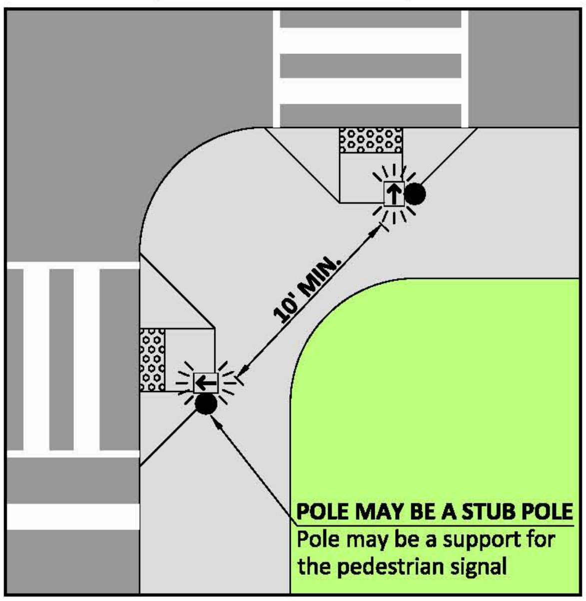
SUITABLE LOCATIONS:
- Multi-lane roadways with high motor vehicle volumes

Figure 11 - Accessible Pedestrian Signal Placement Design For Improved Pedestrian Safety

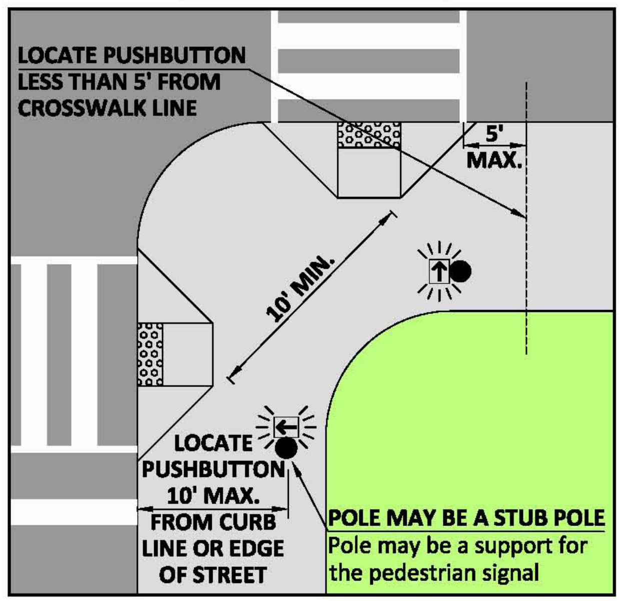
OVERVIEW:
While pre-timed (not actuated) pedestrians signals are increasingly common, factors such as surrounding land use or signal timing requirements may necessitate the use of pushbutton activation for pedestrian signals. Correct accessible pedestrian signal (APS) placement ensures both pedestrians with disabilities and bicyclists can easily access and operate pushbuttons for pedestrian signals at a designated crossing. Accessible pedestrian signals are recommended by the Americans with Disabilities Act (ADA) and improve the pedestrian environment for all users. Additional features such as audible messages accompanying pedestrian signal heads provide guidance for pedestrians with visual disabilities. The need for audible signals should be evaluated early in the design process for installation of pedestrian signals at an intersection.

The preferred placement of a pushbutton for an accessible pedestrian signal is between the edge of the crosswalk farthest from the intersection and the edge of the curb ramp. The signal should be between one and one-half feet and six feet from the edge of the curb or edge of street, but no more than 10 feet. The control face and tactile arrow should be carefully aligned with the direction of travel for the associated crosswalk. In order to ensure pedestrians with physical disabilities can access the pushbutton, accessible pedestrian signals should be located adjacent to the paved surface of the sidewalk. Signals with audible messages should be oriented so that speakers project sounds to the correct crosswalk. If audible signals are used, installations should include identifiable tones that differentiate between waiting time and walking time.

PREFERRED PLACEMENT



ACCEPTABLE PLACEMENT



BENEFITS:
- Improve pedestrian safety and mobility at crossing
- Improve perceived safety for pedestrians with physical and/or visual disabilities
- Create a consistent pedestrian environment at crossings throughout the city, improving comfort levels of all roadway users

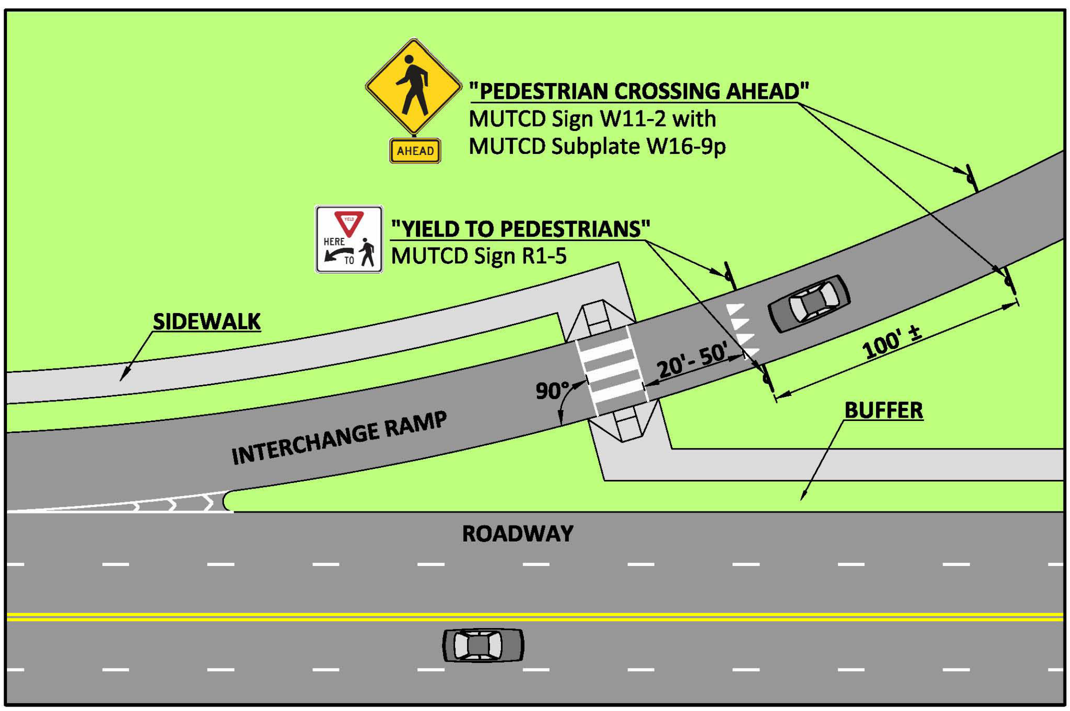
SYMBOL KEY
- Sound from Pushbutton Speaker
- Pushbutton-Integrated APS
- Pole

SUITABLE LOCATIONS:
- Signalized pedestrian crossings at intersections
- Midblock signalized pedestrian crossings

Figure 12 - Unsignalized Pedestrian Crossing at Free Flow Interchange Ramp Design For Improved Pedestrian Safety

OVERVIEW:
Interchanges ramps can be among the most difficult locations for pedestrians and bicyclists to navigate. Free Flow interchange designs can create conflicts for pedestrians and bicyclists due to relatively high motor vehicle speeds and merging traffic. In these cases, pedestrian and bicyclist safety across an interchange ramp can be improved through design techniques that reduce motor vehicular speed. If free flow motor vehicle movement is not needed, new interchange ramps should be designed similarly to a traditional right-angle intersections to slow motor vehicle traffic and improve pedestrian conditions.

For pedestrian crossings on free flow ramps, design techniques include revising the ramp geometries or lane width to reduce motor vehicle speeds. A pedestrian crossing should be perpendicular to the interchange ramp to reduce the crossing distance for pedestrians and improve visibility for all roadway users. Treatments such as "yield" pavement markings and "yield to pedestrians" signs alert motorists to the crossing and encourage yielding behavior. Pedestrian warning signs (W11-2) with "AHEAD" subplates (W16-9p) may be installed up approximately 100 feet before the crossing (not shown). A raised crosswalk may be considered at crossings where motor vehicle speeds or traffic counts are relatively high, or the pedestrian environment is perceived to be unsafe.



BENEFITS:
- Improve sight distances
- Improve pedestrian safety at crossing
- Reduce pedestrian crossing distance

SUITABLE LOCATIONS:
- Interchange on-ramps
- Interchange off-ramps

Sidewalk Prioritization Program

This section describes a recommended sidewalk project prioritization method that the City may use in making sidewalk project funding decisions. The new method would replace Raleigh's existing method. Beginning with a re-scoring of Fiscal Year (FY) 2011 approved projects and for new projects identified through the development of this Plan (see Chapter 4, Sidewalk Recommendations). The new method uses GIS-based data to score sidewalk projects and does not consider cost and feasibility as part of the initial ranking system. Appendix A provides background information on how the new method was developed.

Raleigh's Current Sidewalk Program. The goal of Raleigh's current Sidewalk Priority Funding Program is to complete missing links in the pedestrian network and improve citywide sidewalk connectivity in a logical manner. New sidewalk projects typically come through city-initiation, a petition process initiated by property owners along a street, or as part of other roadway improvement projects. The 2011 Transportation Bond is a new funding source for sidewalk projects. It includes $4.75 million for new city initiated sidewalk projects, $3 million for petition sidewalk projects, and $4 million for sidewalk repairs.

> *City-initiated sidewalk projects* originate from a variety of sources, which include other departments, schools, and transit providers. City-initiated projects are generally focused on fixing gaps along streets with higher motor vehicular traffic and have existing curb and gutter infrastructure. City-initiated projects are currently evaluated and ranked according to the City's current technical evaluation criteria, including street classification, existing demand, special population needs, feasibility, and the proximity of places people want to walk to, like parks, schools, and shopping areas.*

Petition-initiated sidewalk projects typically originate through a petition process by the residents along a particular street. The petition program for a new sidewalk requires signatures from a majority of the property owners along the street frontage where the sidewalk project would be constructed. In the past, the cost of these sidewalks was borne by the property owner. However, beginning in early 2011, the City assumed all costs for these projects. In the past, property owners were assessed $6 per linear foot for petition-initiated sidewalks. Historically, these projects have not been included sidewalk program and ranking. The City recently adopted a new petition process with its own project ranking system. See Appendix A.

Other capital projects provide an opportunity to install sidewalks. The City partners with the North Carolina DOT through a cost-sharing agreement to fund and construct new sidewalks as part of non-freeway roadway improvement projects undertaken in Raleigh where the project owner is the NC DOT.

**The new method for scoring and ranking sidewalk projects will be used for City-initiated projects.*

Small Sidewalk Gap Program. In addition to the standard sidewalk petition process, the City of Raleigh plans to initiate a program to install short segments of missing sidewalks. This Small Sidewalk Gap Program will focus on missing sidewalk links that may not qualify for the petition program but and are too small in scope to be considered for the major streets City initiated sidewalk program. This program is geared toward filling in gaps along a single parcel, in between subdivisions, or other small sidewalk gap areas that were never connected for other reasons. City staff is developing a candidate list of this projects that will be available for review after adoption of the Pedestrian Plan.

Sidewalks along Non-Standard Streets. The construction of sidewalks in residential neighborhoods typically requires existing curb and gutter. While the new Unified Development Ordinance does allow sidewalks to be constructed in certain situations where curbs and gutters do not exist, such construction requires more right of way than is typically available in existing subdivisions. Construction of sidewalks without curb and gutter will be reviewed on a case by case basis and may require that property owners dedicate the right of way or easements required to install the sidewalk. In situations where construction of sidewalk without curb and gutter is not feasible, property owners may petition for street improvements. Such improvements would include the installation of curbs, gutters, storm drains and sidewalk. A portion of the cost of the street improvement costs would be

passed to the abutting property owners in the form of an assessment. More information on the Petition Program, including assessment rates is available at www.raleighnc.gov Search: "Petition Program."

Existing Sidewalk Project Evaluation Process. The existing method for determining sidewalk priorities uses a number of factors such as street classification, evidence of need, cost, and feasibility. Staff assembles information and data for each project, determining a score for each factor. Most factors allow for scoring within a range of zero to 10. The majority of the evaluation process is completed manually, with some project evaluation information generated from computerized geographic information systems (GIS). Criteria and values currently used are shown below.

Safety & Street Type (0-10 points)

» Primary Arterial	8-10 points
» Secondary Arterial	7-9 points
» Major Thoroughfare	6-8 points
» Minor Thoroughfare	5-7 points
» Collector Street	4-6 points
» Residential Street	3-5 points

⇒ Adjust points based upon traffic volumes, roadway cross-section and pedestrian safety

Demand & Use (0-10 points)

- » Measurable Demand
  - » Worn path (+5)
  - » Pedestrians observed in field (+2)
- » Special Needs
  - » Disabled citizens (+9)
- » Density of Development (+3)
- » Economic Development Focus Area (+3)

Fees-In-Lieu (1 point)

- » Check to see if any prior fees have been collected from private development

Improved Access (0-10 points)

- » Continuity of existing system
- » Location of adjacent trip generators
  - » Parks
  - » Greenways
  - » Schools
  - » Shopping Centers or Retail Areas
  - » Village Centers or Mixed-Use Developments
  - » Transit Facilities
  - » Other Public Facilities

Cost & Feasibility (0 or –2 points)

- » Topography
  - » Severe cut required
  - » Severe fill required
- » Narrow right-of-way
- » Structures
  - » Buildings
  - » Culverts
- » Landscaping Impacts

There are several weaknesses of the existing method. First, the method requires considerable effort to assemble data and information manually, adding time to the overall process. Second, the cost and feasibility factors are used to assess a numerical "penalty" for a project. This may lower the ranking of a much-needed project. Third, scoring for several of the factors is judgment-based, i.e., reviewers determine the score within a range. This can result in different scores for a project, depending on the reviewer.

A New Prioritization System for Raleigh. This plan recommends a change in the City's current system for evaluating and ranking City-initiated sidewalk projects in order to address the weaknesses described above. In addition, two trigger events precipitated the new method at this time: The City's decision to fund all petition sidewalk projects; and the availability of revenue designated for sidewalk projects from the successful October 2011 bond issue. The City has established a separate priorization and evaluation system for sidewalk petition projects, See Appendix A.

The approach recommended here has several benefits that make it easier to use and maintain over time:

Fewer discreet measures. The new method uses information bundled into single factors, instead of separately identifying and scoring multiple factors. The Demand Score is an example of this.

GIS-based factors. GIS layers generated as part of developing this Plan can be a good source of data that is easily "at hand." This will require some upfront work in order to be able to use the recommended process. It also means that regular updates to existing GIS data are needed. However, it will expedite the evaluation process.

Objective scoring. Assigning a specific score to each criterion removes judgment-based scoring.

The new method for ranking sidewalk projects uses two criteria: Demand and Need. Both criteria are built around the demand and needs analysis developed as part of this plan (See Chapter 2, Existing Conditions, "Demand and Needs Analysis").

Demand Criteria uses GIS-based demand analysis developed for the Comprehensive Pedestrian Plan. The sidewalk project receives a score that reflects the demand score of the area in which the sidewalk is located. For example, a sidewalk project in an area that had a demand score of 60 would received a score of 20.

Demand Criteria: Score from Demand Analysis	
Red (>= 90)	25
Dark Orange (72 to 89)	23
Orange (57 to71)	20
Yellow (44 to 56)	15
Light Green (32 to 43)	12
Medium Green (18 to 31)	9
Dark Green (0 to 17)	5
Minimum Score = 5; Maximum Score = 25	
Needs Criteria: Score from Needs Analysis	
Red (15 to 33)	20
Orange (8 to 14)	15
Light Green (4 to 7)	10
Gray (-5 to 3)	5
Need: Evidence of Need	
Evidence of worn path	10
ADA citizen sidewalk request	10
Non-ADA citizen sidewalk request	5
Minimum Score = 5; Maximum Score = 45	
Combined Minimum Score = 10 Combined Maximum Score = 70	

Needs Criteria uses three sub-criteria: the GIS-based needs analysis developed for the Comprehensive Pedestrian Plan; and evidence of need, such as "Evidence of worn path"; and citizen requests (ADA citizen request or non-ADA citizen request).

The table below shows specific demand and needs criteria and scores recommended. These scores are assigned for each criterion to each segment of the roadway, and then added up to get a total sidewalk score for that segment.[6] To make managing installing sidewalks easier and more cost efficient, sidewalk projects are usually comprised of several contiguous roadway segments. Thus, the score of a sidewalk project is the average score for all the segments from which it is comprised. For example, a sidewalk projects that is made of five roadway segments with sidewalk scores of 40, 45, 65, 50, and 52 will have an average score of 50.

A Comparison. This section provides a comparison of the current and new methods for prioritizing sidewalk projects: a comparison of criteria and a comparison of scoring. Many of the criteria used in the City's current evaluation system are part of the new system, but reflected or captured in a different way, i.e., using the GIS-based demand and need analysis. Criteria not included in the new method include density of development, continuity of existing system, cost and feasibility, and availability of funds from the city's fee-in-lieu program.

6 Segments are usually about one-block long, but can be longer depending on where the road is and how often there is a cross street.

Current Criteria	Captured in Recommended Criteria for
Safety & Street Type	
Roadway classification	Needs: Included in needs analysis
Adjust points based upon traffic volumes, roadway cross-section and pedestrian safety	Needs: Included in needs analysis
Demand & Use	
Measurable demand	Needs: Included as separate criteria
Special needs	Needs: Included in needs analysis
Density of development	Not included
Economic development focus area	Demand: Included in demand analysis as Growth Framework Plan
Improved Access	
Continuity of existing system	Not included
Location of adjacent trip generators: Parks, Greenways, Schools, Shopping Centers or Retail Areas, Village Centers or Mixed-Use Developments, Transit Facilities, and Other Public Facilities.	Demand: Included in demand analysis
Cost & Feasibility	
Topography (Severe cut required, Severe fill required) Narrow right-of-way Structures (Buildings, Culverts) Landscaping Impacts	No longer included in scoring system
Fees-In-Lieu	
Check for payment from private development	No longer included in scoring system

The table below tracks how existing criteria are treated in the new method.

A useful way to understand the differences between the current and new methods is to compare the scores for several sidewalk projects. In the list of approved FY 2011 sidewalk projects in, some projects remain in about the same position in the overall list and others change. The breakout of scores for individual projects displayed in Table 1 shows the new method affects sidewalk project ranking. Details of the scoring differences for three projects are provided below.

Sidewalk projects and rankings are included in Chapter 4, Pedestrian Facility Recommendations.

Example 1: Wilmington Street	
Existing Method	New Method
Score for Demand and Use = 5 of 10	Score for Demand = 9 of 25
Score for Safety & Street Type = 9 of 10	Score for Needs = 29 of 50 (19 from need analysis; 10 from worn path; 0 from ADA citizen request and non-ADA citizen request)
Score for Improved Access = 8 of 10	
Score for Cost & Feasibility = 0	
Score for Fees-In-Lieu = 0 of 1	
TOTAL = 22of 31	TOTAL = 38 of 70

Example 2: Millbrook Road	
Existing Method	New Method
Score for Demand and Use = 5 of 10	Score for Demand = 15 of 25
Score for Safety & Street Type = 7 of 10	Score for Needs = 20 0f 50 (10 from need analysis; 10 from worn path; 0 from ADA citizen request and non-ADA citizen request)
Score for Improved Access = 9 of 10	
Score for Cost & Feasibility = 0	
Score for Fees-In-Lieu = 0 of 1	
TOTAL = 21 of 31	TOTAL = 45 of 70

Example 3: Martin Luther King Jr Boulevard	
Existing Method	New Method
Score for Demand and Use = 5 of 10	Score for Demand = 20 of 25
Score for Safety & Street Type = 6 of 10	Score for Needs = 35 of 50 (20 from need analysis; 10 from worn path; 0 from ADA citizen request; 5 from non-ADA citizen request)
Score for Improved Access = 5 of 10	
Score for Cost & Feasibility = 0	
Score for Fees-In-Lieu = 1 of 1	
TOTAL = 17 of 31	TOTAL = 55 of 70

Implementation Needs. The recommended sidewalk evaluation program provides scores for proposed sidewalk projects in an efficient manner because it is GIS-based. A commitment to generating and maintaining the data current is needed to in order to sustain this level of efficiency. Two basic tasks are involved:

Collecting, Organizing and Updating the Data. This includes establishing GIS layers for evaluation criteria that may not be commonly used, such as the percentage of an area's population by age group, and regularly surveying conditions in the field and updating the GIS database on elements such as presence of worn paths.

Reviewing the Program Periodically. Periodic review of the program should be conducted regularly in order to evaluate whether the program is achieving the desired results. The program can be modified, if necessary. If all sidewalk projects are reviewed annually, a good time to review the prioritization program may be two or three months prior to its application by testing a few projects.

Chapter 4, Pedestrian Facility Recommendations, includes a map and table of all missing sidewalk projects scored and ranked according to the new system.

Intersection Improvements

Intersections in Raleigh were not specifically evaluated for pedestrian crossing conditions, other than those included in the six example locations. However, a process for identifying intersections needing pedestrian crossing improvements is described here and recommended for the City's use. The process uses a three-step approach that combines GIS- and web-based information querying with an in-the-field assessment.

Step 1: Determine combined demand and needs analysis scores for intersections or roads with classification of collector through principal arterial. Develop list of intersections with a combined score of X or greater for Step 2.

Step 2: Add 2 points each to the combined demand and needs score for missing curb ramps (at least 1 corner) and x crashes during the past 3 years.

Step 3: Conduct field visits to intersections scoring Y or greater to determine the presence of other issues. The list of issues and additional points is below:

Jurisdiction/Ownership	
NC DOT Jurisdiction/ownership of intersection.	0
City of Raleigh Jurisdiction/ownership of intersection.	1
Pedestrian Crossing Times	
Large volume of pedestrians crossing the street requires more time.	2
Larger number of student or senior pedestrians, or pedestrians with disabilities crossing.	2
Pedestrian crossing facilities	
Poor crosswalk placement with respect to the corner and curb ramps.	2
No or low lighting.[6]	3
Crossing incorporates more than one travel lane in each direction.	2
Signals and signs placement create line-of-sight problems.	2
Transit or school access	
Missing sidewalks within 50 feet of the intersection.	2
Missing signs alerting motorists of presence of school or pedestrian crossing.	2

Improvements should be identified to mitigate the issues at intersections with scores of Z or greater. This Plan provides information to guide improvements in Chapter 3, Best Practices.

Table 1. Comparison of existing and recommended sidewalk scoring system.

New System				Current System		
Street Name	Segment Description	Total Score	Ranking	Total Score	Street Name	Segment Description
Sunnybrook Road	Holston Lane to existing sidewalk on south side	63	1	28	Falls of Neuse Road/Wake	Hardimont Road to Bland Road / Pacific Drive
New Hope Church Road	Wake Forest Road to east of Atlantic Avenue	58	2	27	Wade Avenue	Hobson Court to Annapolis Drive
New Bern Avenue	Poole Road to Raleigh Blvd	56	3	26	Hillsborough Street	Beryl Road to east of Royal Street
Clark Avenue	Cameron Village Driveway to Bellwood Drive	55	4	26	Lake Boone Trail	I - 440 to Dixie Trail
Martin Luther King Jr. Blvd.	Peyton Street to Glenbrook Drive	55	5	26	Poole Road	Sunnybrook Road to Old Poole Road
New Hope Road	Capital Boulevard to Wallingford Drive	54	6	25	Calvary Drive	Capital Boulevard to Louisburg Road
Raleigh Boulevard	New Bern Avenue to Martin Luther King Jr Blvd	53	7	25	Creedmoor Road	Stonehenge Drive to Strickland Road
Poole Road	Donald Ross Drive to Sunnybrook Road	53	8	25	Creedmoor Road	Glenwood Avenue to Millbrook Road
Strickland Road	Across front of Harvest Plaza retention pond	53	9	25	New Bern Avenue	Poole Road to Raleigh Blvd
Poole Road	Sunnybrook Road to Old Poole Road	52	10	24	Beryl Road	Blue Ridge Road to Method Road
Rock Quarry Road	South of Martin Luther King Jr. Blvd to Bart Street	52	11	23	Calvary Drive	Green Road to Capital Boulevard
Crabtree Boulevard	Capital Blvd to Timber Drive	50	12	23	Clark Avenue	Cameron Village Driveway to Bellwood Drive
Green Road	New Hope Church Road to Spring Forest Road	48	13	23	Glenwood Avenue	Hilburn Drive to Millbrook Road
Maywood Avenue	Lake Wheeler Road to South Saunders Street	48	14	23	Sunnybrook Road	Holston Lane to existing sidewalk on south side
Bloodworth Street (South)	Martin Luther King Jr. Blvd. to Worth Street	48	15	23	Wade Avenue	Dogwood Lane to Hymettus Court
Falls of Neuse Road/Wake	Hardimont Road to Bland Road / Pacific Drive	48	16	22	Centennial Parkway	Avent Ferry Road to Nazareth Street
Creedmoor Road	Glenwood Avenue to Millbrook Road	47	17	22	Chapel Hill Road (NC 54)	Corporate Center Drive to Cary City Limits
Wade Avenue	Hobson Court to Annapolis Drive	47	18	22	New Hope Road	Capital Boulevard to Wallingford Drive
Capital Boulevard	Highwoods Ave to Brentwood Road	46	19	22	Wilmington Street	Tryon Road to south of Rush Street
Beryl Road	Blue Ridge Road to Method Road	45	20	21	Fox Road	Werribee Drive to I-540 Bridge
Millbrook Road	Atlantic Avenue to Capital Boulevard	45	21	21	Green Road	New Hope Church Road to Spring Forest Road
Glenwood Avenue	Hilburn Drive to Millbrook Road	45	22	21	Millbrook Road	Atlantic Avenue to Capital Boulevard
Glenwood Avenue	Oberlin Road to Argyle Drive	45	23	21	New Hope Church Road	Wake Forest Road to east of Atlantic Avenue
Lake Boone Trail	Blue Ridge Road to Rexwoods Office Driveway	45	24	20	Atlantic Avenue	Six Forks Road to Highwoods Boulevard
Fox Road	Werribee Drive to I-540 Bridge	45	25	20	Atlantic Avenue	Whitaker Mill Road to Six Forks Road
Westinghouse Boulevard	Capital Boulevard to existing sidewalk	45	26	20	Brookside Drive	Wake Forest Road to Vale Street
Spring Forest Road	Atlantic Springs Road to Capital Boulevard	44	27	20	Capital Boulevard	Highwoods Ave to Brentwood Road
Hillsborough Street	Beryl Road to east of Royal Street	44	28	20	Millbrook Road	Creedmoor Road to Lead Mine Road
Ileagnes Road	Cherry Street (w) to S. Saunders Street	44	29	20	Pleasant Valley Road	Glenwood Avenue to Millbrook Road
Lake Boone Trail	I - 440 to Dixie Trail	44	30	20	Poole Road	Donald Ross Drive to Sunnybrook Road
Trawick Road	Capital Boulevard to Broadland Drive	44	31	20	Raleigh Boulevard	New Bern Avenue to Martin Luther King Jr Blvd
Raleigh Boulevard	Crabtree Boulevard to Westinghouse Blvd	43	32	20	Rock Quarry Road	South of Martin Luther King Jr. Blvd to Bart Street
Millbrook Road	Creedmoor Road to Lead Mine Road	42	33	19	Glenwood Avenue	Oberlin Road to Argyle Drive
Van Dyke Avenue	Chamberlain Street to Oberlin Road	42	34	19	Ileagnes Road	S. Saunders Street to Wilmington Street
Wade Avenue	Dogwood Lane to Hymettus Court	42	35	19	Ileagnes Road	Cherry Street (w) to S. Saunders Street
Lynn Road	Pleasant Pines Drive to west of Ray Road	42	36	19	Maywood Avenue	Lake Wheeler Road to South Saunders Street
Louisburg Road (US 401)	Spring Forest Road to Perry Creek Road	41	37	19	Raleigh Boulevard	Crabtree Boulevard to Westinghouse Blvd
Creedmoor Road	Stonehenge Drive to Strickland Road	41	38	19	Spring Forest Road	Atlantic Springs Road to Capital Boulevard
Gardner Street	Van Dyke Ave to Wade Avenue	41	39	19	Strickland Road	Across front of Harvest Plaza retention pond
Brookside Drive	Wake Forest Road to Vale Street	40	40	18	Glen Eden Drive	Ridge Road to I - 440
Sawmill Road	Mine Shaft Road to Northway Court	40	41	18	Lake Boone Trail	Blue Ridge Road to Rexwoods Office Driveway
Millbrook Road	Still Pines Drive to east of Ponderosa Road	40	42	18	Louisburg Road (US 401)	Spring Forest Road to Perry Creek Road
Louisburg Road (US 401)	Perry Creek Road to Mitchell Mill Road	38	43	18	Millbrook Road	Still Pines Drive to east of Ponderosa Road
Tryon Road	Durham Drive to Garner Road	38	44	17	Ligon Street	Method Road to west of Atwater Street
Wilmington Street	Tryon Road to south of Rush Street	38	45	17	Lynn Road	Pleasant Pines Drive to west of Ray Road
Fairview Road	Canterbury Road to Oberlin Road	37	46	17	Martin Luther King Jr. Blvd.	Peyton Street to Glenbrook Drive
Pleasant Valley Road	Glenwood Avenue to Millbrook Road	37	47	17	Westinghouse Boulevard	Capital Boulevard to existing sidewalk
Glen Eden Drive	Ridge Road to I - 440	37	48	16	Bloodworth Street (South)	Martin Luther King Jr. Blvd. to Worth Street
Chapel Hill Road (NC 54)	Corporate Center Drive to Cary City Limits	35	49	16	Ridge Road	Wade Ave. to Ridge Road Shopping Center entrance
Deana Lane	New Hope Church Road to Capital Boulevard	35	50	16	Tryon Road	Durham Drive to Garner Road
Ligon Street	Method Road to west of Atwater Street	35	51	15	Chapanoke Road	Ileagnes St to Wilmington St Frontage Rd
Calvary Drive	Capital Boulevard to Louisburg Road	35	52	15	Crabtree Boulevard	Capital Blvd to Timber Drive
Chapanoke Road	Ileagnes Street to Wilmington Street Frontage Road	33	53	15	Louisburg Road (US 401)	Perry Creek Road to Mitchell Mill Road
Ridge Road	Wade Ave. to Ridge Road Shopping Center entrance	32	54	15	Sawmill Road	Mine Shaft Road to Northway Court
Atlantic Avenue	Whitaker Mill Road to Six Forks Road	32	55	15	Trawick Road	Capital Boulevard to Broadland Drive
Ileagnes Road	S. Saunders Street to Wilmington Street	32	56	14	Van Dyke Avenue	Chamberlain Street to Oberlin Road
Calvary Drive	Green Road to Capital Boulevard	31	57	13	Highwoods Boulevard	Altlantic Avenue to Capital Boulevard
Atlantic Avenue	Six Forks Road to Highwoods Boulevard	29	58	12	Deana Lane	New Hope Church Road to Capital Boulevard
Highwoods Boulevard	Altlantic Avenue to Capital Boulevard	27	59	12	Fairview Road	Canterbury Road to Oberlin Road
Centennial Parkway	Avent Ferry Road to Nazareth Street	25	60	11	Hilburn Road	Glenwood Avenue to Grove Barton Road
Hilburn Road	Glenwood Avenue to Grove Barton Road	20	61	11	Gardner Road	Van Dyke Avenue to Wade Avenue