SIGHT DISTANCE POLICY



City of Charlotte Department of Transportation

> 600 East Fourth Street Charlotte, NC 28202-2858

> > May 2003

I. <u>DEFINITIONS</u>

AASHTO: American Association of State Highway and Transportation Officials

<u>Arterial Street</u>: Controlled-access, major-, and minor <u>Thoroughfares</u> as identified in the Mecklenburg-Union MPO's Thoroughfare Plan.

CDOT: City of Charlotte Department of Transportation

City: City of Charlotte, North Carolina

City Code: Code of the City of Charlotte, North Carolina, latest revision

<u>Collector Street</u>: A street that collects and distributes traffic between local streets and arterial streets as identified by the City of Charlotte. Generally speaking, collector streets funnel local traffic onto thoroughfares and provide conveyance for through traffic.

<u>Cross Street</u>: A street intersecting the one on which a driver is presently on. No inference of right-of-way should be made from the term "cross street," and the term should just be a synonym for "intersecting street." A cross street may be a <u>Major Street</u> or a <u>Minor Street</u> (q.v.).

<u>Design speed</u>: The *maximum* safe speed that can be maintained over a specified section of roadway when conditions are so favorable that the design features of the roadway govern. For posted speeds of 30 MPH or less, the design speed shall be no less than the posted speed plus 10%; for posted speeds of 35 MPH or more, the design speed shall be no less than the posted speed plus 5 MPH.

<u>Director</u>, <u>Department of Transportation</u>: The Director of the Charlotte, North Carolina Department of Transportation or his designee.

Director of Transportation: See Director, Department of Transportation

Driver: Operator of a motor vehicle

Driver's Eye Height: The distance from the pavement surface to the driver's eye.

<u>ETJ</u>: Extraterritorial jurisdiction. Land outside the city limits of Charlotte that falls under City zoning and regulatory control.

Existing Features: Any existing objects that are not built or installed by a given project.

Green Book: A Policy on Geometric Design of Highways and Streets, AASHTO, latest edition.

<u>Horizontal Alignment</u>: Tangents and curves in the horizontal plane that define the location of the street.

<u>Intersection</u>: The location of a public street, private street, or driveway where it crosses or meets a public street.

<u>Landscaping</u>: Roadside and median improvements involving trees, bushes, shrubs, and other plants; grading and mounding; and signs, fences, and decorative walls.

<u>Local Street</u>: A street that serves the primary function of access to residential, industrial, or commercial property. The object is to provide access to abutting properties and not be a conveyance for through traffic. Subordinate to all other street classifications.

<u>Major Street</u>: Relative to a given street, one that is more important, has a higher volume, functional classification, design speed, right-of-way, or any combination of these. A major street is typically an unimpeded through movement in an unsignalized intersection or a movement that receives a majority of the green time at a signalized intersection.

<u>Minor Street</u>: The street in a given intersection that is required to yield the right-of-way, indicated by signs or traffic signals, to a second street. See <u>Major Street</u>.

NCDOT: The North Carolina Department of Transportation.

<u>New Facility</u>: A proposed roadway, bridge, culvert, or landscape project; major reconstruction or major widening project.

Object Height: The distance from the roadway surface to the top of an object in the roadway.

Operating Speed: The 85th percentile speed or the posted speed limit, whichever is higher.

<u>Private Street</u>: A street that is located on private property and that is not maintained by a government agency. Also, streets with rights-of-ways that have been dedicated to the public but have not been accepted for maintenance.

<u>Public Street</u>: A street that is located on right-of-way dedicated to the public and that has been accepted by the City of Charlotte or NCDOT for maintenance.

<u>Right-of-way</u>: (1) The legal authority to construct a transportation conveyance across property. (2) The precedence of who yields to whom in a given circumstance, such as at an intersection.

Side Street: See Cross Street.

<u>Sight Distance</u>: The length of roadway visible to the driver who is traveling along the roadway or waiting to enter or cross the roadway.

Sight Obstruction: Any object that limits the view of the driver.

<u>Sight Triangle</u>: (1) An area formed by the curb lines or edges of the roadway and a straight line from the driver's eye on one street to an object on the other street. (2) An area formed by measuring along the right-of-way or curb lines from their projected point of intersection back a certain distance from the intersection along two legs of the intersection and a straight line between the end points thus established.

<u>State System Street</u>: Any street, road, or highway that is maintained by the North Carolina Department of Transportation.

<u>Thoroughfare</u>: A street whose main function is to provide mobility to the traveling public, i.e., through traffic. Providing access to abutting properties is a secondary concern. All thoroughfares are identified on the Mecklenburg-Union MPO's Thoroughfare Plan.

Through Street: See Major Street.

Type I & II Driveways: A ramp-type driveway. (See City of Charlotte Driveway Regulations.)

<u>Type III Driveway</u>: A street-type driveway. (See City of Charlotte Driveway Regulations.)

<u>Vertical Profile</u>: Tangents and curves in the vertical plane that define the elevations and alignment of the roadway.

II. SIGHT DISTANCE PRINCIPLES

"The ability to see ahead is of the utmost importance in the safe and efficient operation of a vehicle on a street.... For safety on streets the designer must provide sight distance of sufficient length that drivers can control the operation of their vehicles to avoid striking an unexpected object on the traveled way. "¹ "The operator of a vehicle approaching an intersection at-grade should have an unobstructed view of the entire intersection and sufficient lengths of the intersecting street to permit control of the vehicle to avoid collisions.... After a vehicle has stopped at an intersection, the driver must have sufficient sight distance to make a safe departure through the intersection area".²

III. <u>APPLICATION</u>

Sight distance is the length of roadway visible to the driver who is traveling along the roadway or who is waiting to enter or cross the roadway. Types of sight distance include, but are not limited to, stopping sight distance, intersection sight distance, and passing sight distance. The horizontal alignment and vertical profile of a roadway affect sight distance. Objects such as buildings, walls, parked cars, cut or fill slopes, trees, bushes, hedges, tall crops, signs, and other objects within and outside of the right-of-way can also affect sight distance. Some objects may be located within sight-distance areas and not significantly obstruct the required visibility of the driver. The driver may be able to see over, under, or around some objects within sight distance areas. Objects that may be required within sight distance areas, such as fire hydrants, utility poles, and traffic control devices, shall be located so that they minimize visual obstruction. Other objects 12 inches in diameter and smaller (including tree trunks and sign posts) may be allowed within sight distance areas if located individually or in combination so as not to substantially restrict the driver's view. The Director of Transportation shall determine what objects, if any, are allowed within sight-distance triangles.

The Director of Transportation has the overall responsibility for the improvement, operation, and maintenance of Charlotte's street system. Included in this responsibility are the evaluation, prevention, and abatement of obstructions to the view of motorists using any street or approach to any street intersection that may constitute a traffic hazard or a condition dangerous to the public safety. The AASHTO Green Book provides guidelines for designing sight distance for new facilities and reconstruction projects. These guidelines may also be used to evaluate sight distance obstructions along existing roadways. Existing conditions that obstruct sight distance at intersection can also be abated through section 19-245 of City Code.

The Director of Transportation has developed this Sight Distance Policy to aid in the evaluation of public safety in and adjacent to the public right-of-way within the City of Charlotte and its ETJ. This policy regulates design of new roadways and reconstruction of existing roadways. The policy also applies to roadway designs within Charlotte or its ETJ constructed by private developers who intend to dedicate roadways and roadway improvements to the City or State for public maintenance. It also applies to landscape improvements adjacent to new and existing roadways.

This policy should not be applied without qualification to existing conditions. To the extent deemed possible by the City, existing facilities will be required to match these requirements. The sight distance requirements presented in this policy are minimum requirements and should be increased where social, economic, and environmental considerations allow.

It is recognized that certain improvements financed partially or wholly with State or Federal funds or on facilities that fall under the jurisdiction of other governmental agencies are subject to the standards prescribed by those agencies. Such standards may be more stringent than the City of Charlotte standards, and may take priority over City standards. In all cases, the more restrictive of any two conflicting standards shall apply.

IV. INTERSECTION-APPROACH SIGHT TRIANGLES

Section 19-245 of City Code establishes two sight triangles that must be preserved at each public or private street intersection with another public street, or at a Type III driveway connection to a public street. These triangles measure 35' x 35', measured along the intersection of the rights-of-way, or 50' x 50', measured from the midpoint of the curb return along the face of curb. The more restrictive of the two sight triangles shall be shown. These sight triangles shall be preserved and reserved at all intersections as described above and are required to be shown on all applicable plans. Smaller sight triangles, to allow drivers to see pedestrians on sidewalks, measure 10' x 10' and are required at all driveways regardless of type or intersecting street classification. They are oriented similarly to the 35' x 35' triangles.

These sight triangles provide drivers the ability to perceive an upcoming intersection, see if there is any conflicting traffic, and take evasive action if necessary. These sight triangles are for approaches to intersections and are separate entities from departure sight triangles ("intersection sight distance") mentioned later in this document.

The NCDOT imposes a third sight triangle, measuring 10' x 70' in size along the intersecting rights-of-way, with the 70-foot dimension along the cross street. This sight triangle must be shown at all connections to a state-maintained roadway, regardless of street or driveway classification or dimension, and is located on each side of the approaching street or driveway.

No object that impedes sight distance between a height of 30 and 72 inches above the ground surface, subject to the exceptions established in Section III, shall be located within any of these three sight triangles.

The City of Charlotte Zoning Ordinance exempts certain zoning districts from mandatory use of the 35' x 35' or 50' x 50' sight triangles. In these areas, the Director of Transportation will establish any necessary sight triangle(s) on a case-by-case basis. NCDOT 10' x 70' triangles shall apply regardless of zoning district unless specifically exempted by NCDOT.

V. <u>STOPPING SIGHT DISTANCE</u>

Stopping sight distance is defined as the amount of distance required for a driver to perceive an approaching hazard, evaluate the hazard, apply the brakes, and comfortably bring his car to a complete stop without colliding with the hazard. The minimum stopping sight distance must be available to the driver at all locations on publicly-traveled ways. Stopping sight distance applies to horizontal as well as vertical alignments. Stopping sight distance on horizontal curves is measured along the centerline of the inside lane around the curve and the line of sight is a straight line between two points on the centerline of the lane. On vertical curves, stopping sight distance is measured on a straight line between the driver's eye and an object on the roadway surface. The height of the driver's eye traveling in a passenger car shall be measured at 3.5 feet above the roadway surface and the object shall be 2.0 feet above the roadway surface. Driver'seye heights for single-unit and tractor-trailer trucks shall be measured at 7.6 feet above the roadway surface. The object height has been increased in the 2001 Green Book from the 0.5 feet (6 inches) used in the 1990/1994 Green Books. Figures 1 and 2 illustrate that measurement of stopping sight distance horizontally and vertically, respectively. A more detailed explanation of the measurement of stopping sight distance is included in the Green Book. The minimum stopping sight distance required is based on wet pavements and depends on the design speed and the grade of the roadway. Table I presents the minimum stopping sight distances for various design speeds on level terrain. Table II presents stopping sight distance requirements that have been adjusted for grades; for grades not listed in the table, linear interpolation can be used to determine the appropriate value.

New streets or driveways that fail to provide adequate stopping sight distance will not be approved. Proposed subdivisions must provide full stopping sight distance on all internal streets.

Streets whose geometry causes the line-of-sight for stopping sight distance to extend outside the right-of-way will require sight-distance easements for the balance or their alignments must be revised to provide the sight distance.

TABLE I.

Minimum Stopping Sight Distance For Level Conditions <u>for passenger cars</u> (Exhibit 9-55, p.665, 2001 Green Book)

Design Speed (MPH)	Minimum Stopping Sight Distance (ft.)
15	80
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645

TABLE II. Stopping Sight Distance on Grades <u>for passenger cars</u> (Exhibit 3-2, p.115, 2001 Green Book)

Design	SSD:	SSD:	SSD:	SSD:	SSD:	SSD:
Speed	-3%	-6%	-9%	+3%	+6%	+9%
15	80	82	85	75	74	73
20	116	120	126	109	107	104
25	158	165	173	147	143	140
30	205	215	227	200	184	179
35	257	271	287	237	229	222
40	315	333	354	289	278	269
45	378	400	427	344	331	320
50	446	474	507	405	388	375
55	520	553	593	469	450	433
60	598	638	686	538	515	495
65	682	728	785	612	584	561

(Speeds are in MPH and distances are in feet.)

VI. INTERSECTION SIGHT DISTANCE

"Each intersection contains several potential vehicle conflicts. The possibility of these conflicts actually occurring can be greatly reduced through the provisions of proper sight distances..."³ Intersection sight distance allows a driver to observe a gap in traffic, evaluate its size and approach rate, and cross and/or merge into the gap, usually from a stopped condition.

Along the approaches and departures from an at-grade intersection, there must be sufficient sight distance for the operator of a vehicle to control the vehicle to avoid collisions. The amount of sight distance required depends on the type of traffic control at the intersection and the speeds of the vehicles.

Intersection sight distance is measured from a driver's eye height of 3.5 feet to an object height of 3.5 feet as measured from the pavement surface. The object height has been decreased in the 2001 Green Book from the 4.25 feet used in the 1990/1994 Green Books. Driver's-eye heights for single-unit and tractor-trailer trucks shall be measured at 7.6 feet above the roadway surface.

Where proper sight distance cannot be achieved for the driver on the side street at the design speed of the intersecting roadway, CDOT shall determine an appropriate alternative, including, but not limited to, posting a speed reduction on the through street, landscape improvements, or altogether prohibiting the street- or driveway connection to the through street. All streets that are being designed as part of one contiguous development, such as a subdivision, shall provide appropriate intersection and stopping sight distances in all cases. Because the streets are being designed and are not already-existing streets, it is incumbent upon the developer and his consultant(s) to submit a development plan that satisfies all sight-distance requirements. Phasing a development such that only portions are built at any one given time does not eliminate the requirement to provide sight distance.

A. Yield Sign Control

This type of design requires that the minor street be posted with yield signs. The sight distance for the driver on the minor street must be sufficient for the driver to observe a vehicle on the through street approaching from either the left or the right and bring his vehicle to a stop prior to reaching the intersection as shown in Figure 3. The assumed design speed approaching the yield sign is 16.5 mph, resulting in a stopping sight distance of 80 feet and an intersection sight distance of 180 feet. For cases where the design speed is greater than 16.5 mph (i.e., a posted speed of 15 mph), see Exhibit 9-64 of the 2001 Green Book. The table in Exhibit 9-64 assumes certain conditions; for conditions that differ from these assumptions (see Condition VI.E, "General Case"), the sight distance must be evaluated per pp. 670-672 of the 2001 Green Book.

B. Stop Sign Control

At approaches to intersections that are controlled by stop signs or at driveways and alleys where the driver is required to stop before entering the street by the City Code, the driver must have an unobstructed view of the entire intersection and adequate sight distance for any of the various vehicular movements allowed upon departure of the intersection. These movements may include crossing the street, turning left, or turning right onto the street. Where the through street is either undivided or divided with a median narrower than 20 feet, the crossing or left-turn movements are treated as a single operation. Where the median can provide storage for the design vehicle (20 feet wide for a passenger car), the crossing or left-turn movement can be considered in two phases.

No obstruction to the driver's view shall be located within the sight triangles as defined in the City Code, Section 19-245 (a) through (d), to permit adequate view of the intersection (See Figures 4 and 5). In addition, there shall be no sight obstructions located in the triangular areas shown in Figures 6 through 8 to allow for safe departure through the intersection. The measurement of intersection sight distance is along the centerline of the appropriate lane of the roadway and is measured from an eye height of 3.5 feet above the surface of the roadway to an object 3.5 feet above the surface of the roadway. The location of the driver's eye (D_1) is dependent on the classification of the intersecting streets. For all intersections where the through street is a thoroughfare, the driver's eye location shall be assumed to be 15 feet back from the face of curb extended through the intersection, or the edge of pavement if there is no curb. At all intersections where the through street is a local or collector street, and for Type I and II driveways, the driver's eye shall be assumed to be located 10 feet behind the face of curb extended, or the edge of pavement if there is no curb. The sight distance lengths D_2 and D_3 shown in Figures 6 through 8 for left- or right-turns onto the through street are dependent an the design speed of the roadway and are presented in Table III. Figure 9 shows the measurement method for determining the sight distance-for left-turns from the through street. Table IV gives the minimum sight distance for this movement across one, two, or three lanes (D_1) .

For all-way stop-controlled intersections, only the required approach sight triangles must be provided. If, however, an all-way stop-controlled intersection may become signalized in the future, treat the intersection as if it were signalized (see next section).

C. Traffic Signal Control

Full intersection sight distance for the stop-sign-controlled condition shall be provided at all signal-controlled intersections as well. The sight distance shall be provided to accommodate (1) left- or right-turns on red, and (2) conditions when the signal is operating in flash mode.

TABLE III.

Intersection Sight Distance for stop-sign and signal-controlled intersections <u>for passenger cars</u> (Exhibits 9-55 and 9-58, 2001 Green Book)

Design Speed (MPH)	Minimum Intersection Sight Distance for Left-turn from Stop (ft.)	Minimum Intersection Sight Distance for Right Turns and Crossing (ft.)
15	170	145
20	225	195
25	280	240
30	335	290
35	390	335
40	445	385
45	500	430
50	555	480
55	610	530
60	665	575
65	720	625

It is recommended that the amount of Intersection Sight Distance necessary to permit a left turn from a stop condition also be the design sight distance for the right-turn and crossing conditions.

D. Left turns from the through street

Drivers making left turns from through streets onto cross streets must be able to judge an adequate gap in oncoming traffic, accelerate from a complete stop, and exit the roadway. On tangent horizontal alignments with intersecting streets, the stop-controlled intersection sight distance parameter (See Condition V.B) will likely govern and provide sufficient sight distance to perform the left-turn from the major road maneuver. However, in curved horizontal alignments, especially on median-divided roadways, the left-turn from the major road condition can be a separate, and possibly more restrictive, requirement. The designer should not automatically assume that this requirement is superseded by a stop-controlled requirement and should evaluate this case separately. Exhibit 9-67 on page 679 of the 2001 Green Book lists minimum sight distances needed to make a left turn across one lane of traffic on an undivided road (this left turn could be made from a through lane or an exclusive left-turn lane). For conditions where having to cross a median or more lanes, and/or where grade is an issue, the sight distances must be adjusted per the instructions on page 678 of the 2001 Green Book.

E. General Case

In all cases, intersection sight distance is a multi-variable parameter. Intersection sight distance is a function of the intersecting-street cross-section, intersecting street approach grade, minor street approach grade, design vehicle, and intersecting street laneage. The Green Book lists default values of intersection sight distance but states that it must be calculated on a case-by-case basis if any of the parameters listed above does not fall within a default range. The necessary formulas and adjustment factors for non-default values may be found on pp. 660-670 of the 2001 Green Book for stop-controlled intersections, pp. 670-672 for yield-controlled intersections, and pp. 678-680 for left turns from through streets. The default/assumed values for these parameters are as follows:

- 1. -3.0% to +3.0% through street approach grade
- 2. 0.0% minor street (the street that stops/yields) approach grade
- 3. Two-lane through street
- 4. Undivided through street
- 5. Passenger car design vehicle

VII. <u>EXISTING CONDITIONS AT PUBLIC STREETS AND</u> <u>INTERSECTIONS</u>

The Director of Transportation has the responsibility to evaluate, prevent, and abate obstructions to the view of motorists using any street or approach to any street intersection so as to constitute a traffic hazard or a condition dangerous to the public safety according to Section 19-245(g) of the City Code. The Code sets forth restrictions on objects and combinations of objects that obstruct the view of motorists in the triangles of land shown in Figures 4 and 5 of this policy and in any other location on public or private property that constitutes a condition dangerous to the public safety. The Code further provides for notification and enforcement of violations.

The evaluation of adequate provision of sight distance shall generally conform to the requirements set forth in this policy. It is recognized that in some cases existing conditions may exist that prevent the attainment of desirable sight distance due to social, economic, or environmental considerations. In these cases, the maximum practical sight distance, up to the desirable values, shall be obtained. In addition, where desirable sight distance is not attained, additional measures such as warning signs, reduced speed zones, and other traffic controls may be imposed. In all cases, except those specifically exempted in City Code, the minimum provision of adequate stopping sight distance shall be required.

VIII. PASSING SIGHT DISTANCE

In general, crossing the centerline of the road to pass another vehicle is not allowed within the city limits. If passing zones are established on city streets, the Director of Transportation will establish the required amount of passing sight distance, which shall be no less than what is required in the Green Book. On State-maintained roadways, the Director of Transportation and the North Carolina Department of Transportation will establish the required passing sight distance.

IX. ON-STREET PARALLEL PARKING

Except where specifically authorized by the Director of Transportation, all on-street parallel parking shall recessed such that through lanes are unimpeded. No parallel parking can occur within 20 feet of intersections with driveways and local or collector streets, and 50 feet for thoroughfares. The amounts of sight distance necessary shall be evaluated on a case-by-case basis; a more restrictive condition than the 20- or 50-foot distance listed above may be imposed at CDOT's discretion.

On-street parallel parking should be located adjacent to and outside of a 35' x 35' or 50' x 50' sight triangle.

On-street parallel parking is prohibited on NCDOT-maintained roadways unless specifically authorized by NCDOT.

FOOTNOTES

1. A Policy on Geometric Design of Highways and Streets, Washington, DC, AASHTO, 1990, p. 117

- 2. Ibid, pp. 739, 740.
- 3. Ibid, p. 739.

















