CHAPTER III

ROADS, STREETS AND TRAFFICWAYS

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ANNE ARUNDEL COUNTY DESIGN MANUAL

CHAPTER III

ROADS, STREETS & TRAFFICWAYS

I. GENERAL

A. Introduction

This Chapter of the Manual outlines the Department of Public Works (DPW) policies, design criteria, and other essential design methodology for the design of roads, streets, and trafficways. It is the intent that the criteria presented herein represents the minimum requirements essential to the preparation of engineering reports, traffic studies, and construction documents. The requirements set forth herein shall apply to the design of new or proposed trafficways, as well as rehabilitative design and/or retrofitting of existing trafficways, whether they are to be constructed as capital projects, as part of a subdivision development or for a site development plan.

All engineering documents for facilities to be maintained by the County shall be prepared in strict accordance with the criteria presented herein, and shall not be deviated from without explicit approval, in writing, by the DPW Director of or Chief Engineer, or, in the case of development projects, through an approved Modification application.

The criteria contained in this manual are generally compatible with that of the American Association of State Highway and Transportation Officials (AASHTO), and the Maryland Department of Transportation State Highway Administration (MDOT SHA). References are made to documents published by these and other agencies where appropriate. All designs shall meet AASHTO minimums when not addressed within the standards mentioned in this manual.

Final determination relative to road classification will be made by the Anne Arundel County Office of Transportation. Reference the Functional Classification Map in the General Development Plan to determine the functional classification of existing trafficways requiring rehabilitation and for any types not defined herein.

B. Definitions

For the purposes of this Manual, the below listed terms shall be defined as follows:

Trafficway: The term "Trafficway" identifies any highway, road, street, cul-de-sac, alley, or trail that is within Public Right of Way. The term "State Road" identifies trafficways under the jurisdiction of the Maryland Department of Transportation (MDOT State Highway Administration).

Public Right of Way: Right of Way owned by Anne Arundel County or MDOT SHA.

Public Road: The pavement area within a public right-of-way.

Highway: More heavily traveled trafficways (usually under the jurisdiction of the Maryland Department of Transportation, (SHA) with large daily rates of vehicular traffic, serving both local and through traffic.

Street or Road: Either term applies to lower classification trafficways.

Freeway: Freeways are high-speed, multi-lane facilities with a high degree of access control. These facilities provide for efficient and uninterrupted travel over long distances serving interstate and commuter needs. They should provide a high level of traffic service for travelers making longer distance trips at high speeds. Freeways provide no direct access to abutting properties.

Principal Arterial: Principal Arterials serve the needs of through traffic for moderately long trips, the major activity centers in the County and major portions of the trips entering or leaving urban areas. They are the primary travel route for commercial, commuter and recreational travel in rural areas and also provide secondary linkages between large urban centers and suburban population/employment centers. Access may be controlled through medians or by the limitation of curb cuts through the orientation of access for new developments. Typically, they intersect minor arterials, collector or major activity locations.

Minor Arterial: Minor Arterials connect higher functional class facilities, activity centers, regions of the area, and major County roads. Traffic is composed predominantly of trips across and within regions of the County. They provide service to traffic at a somewhat lower level of travel mobility than principal arterials with minimal control of access to abutting commercial, industrial and residential properties. Direct access to individual properties and neighborhoods is discouraged.

Collector: Collectors provide traffic circulation within neighborhoods, commercial and industrial areas. These roads collect traffic from local streets in neighborhoods and channel it into the arterial system. Connections between arterials should be indirect or should not be allowed in order to discourage use by traffic from outside the neighborhood.

Local: Local Roads are designed specifically to have high accessibility to abutting land and access to the higher classification facilities. They offer the lowest level of mobility and service to through traffic usually is deliberately discouraged

Cul-de-sac: A local street with one outlet, having a paved, circular turn-around area at the closed end. Collectors and Arterial may also terminate in a cul-de-sac in Commercial, Industrial, and Multi-family developments, or where topographic features make it necessary. Cul-de-sacs shall meet Fire Marshal design standards.

T-Turnaround: A T-Turnaround is a local street with one outlet that does not have sufficient right-of-way for a full circular turn around area but allows a vehicle to make a three-point turn. T-Turnarounds shall meet Fire Marshal design standards.

Alley: A trafficway, which provides secondary service access for vehicles and pedestrians to the side or rear of abutting properties.

Minimum Stopping Sight Distance: Sight distance is the length of roadway ahead visible to the driver. The minimum stopping sight distance available on a roadway should be sufficiently long to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path. Minimum stopping sight distance is the sum of two (2) distances: the distance traveled by the vehicle from the instant the driver sights an object necessitating a stop to the instant the brakes are applied, and the distance required to stop the vehicle from the instant the brakes are applied. These are referred to as brake reaction distance and braking distance, respectively. The minimum stopping sight distance (SSD) is based on the longest distance at which a driver, whose eyes are three feet-six inches (3'- 6") above the pavement, can see the top of an object 2.00 ft high on the trafficway along an over-vertical (crest) curve.

Minimum Headlight Sight Distance: The headlight sight distance conforms to the minimum stopping distance definition. The headlight sight distance is based on latest AASHTO determination where the length of roadway along an under vertical (sag) curve illuminated by headlights 2'-0" above the trafficway with a one-degree (1°) divergence of the light beam from the vehicle's longitudinal axis.

Passing Sight Distance: Many roads in rural areas are two-lane, two-way highways which vehicles frequently overtake and pass slower moving vehicles using the lane regularly used by opposing traffic. If passing is to be accomplished without interfering with an opposing vehicle the passing driver should be able to see a sufficient distance ahead, clear of traffic, so the passing driver can decide whether to initiate and complete the passing maneuver without cutting off the passed vehicle before meeting an opposing vehicle that appears during the maneuver. When appropriate, the driver can return to the right lane without completing the pass if he or she sees opposing traffic is too close when the maneuver is only partially completed.

Intersection Sight Distance: The sight distance at a crossroad or street should be sufficient along the predominant highway to avoid the hazard of collision between a vehicle starting to cross the highway or turning into the intersecting highway from a stop position and a vehicle on the through road operating at design speed and appearing after the crossing or turning movement has begun.

C. Authorization, Permits

Where intersections occur with trafficways under the jurisdiction of Maryland State Highway Administration, or other political districts, a permit from the agency involved authorizing the proposed construction must be provided to DPW before plans will be approved.

Depending on project location, funding program, and environmental, or other specific characteristics, projects may be required to be reviewed and approved by a combination of one or more of the following agencies:

- Anne Arundel County DPW Bureau of Highways
- DPW Bureau of Watershed Protection
- DPW Bureau of Engineering
- DPW Bureau of Utilities
- Dept. of Inspections and Permits
- Office of Transportation
- Office of Planning and Zoning
- Office of the Fire Marshal
- Anne Arundel County Soil Conservation District (AASCD)
- Maryland Department of Transportation State Highway Administration (MDOT SHA) (for construction within SHA right-of-way or State and Federally funded projects)
- Maryland Department of Natural Resources (DNR)
- Maryland Department of the Environment (MDE)
- Water Resources Administration (WRA)
- Federal Highway Administration (FHWA) for Federally funded projects
- Environmental Protection Agency (EPA) for Federally funded projects
- Maryland Forest Service, Department of Natural Resources
- U.S. Corps of Engineers (COE)

D. Abbreviations

AASHTO:	American Association of State Highway and Transportation Officials
ADT:	Average Daily Traffic
CBR:	California Bearing Ratio
DPW:	Anne Arundel County Department of Public Works
MDOT SHA:	Maryland Department of Transportation, State Highway Administration
MUTCD:	Manual on Uniform Traffic Control Devices
P.C.:	Point of Curve
P.C.C.:	Point of Compound Curve
P.R.C.:	Point of Reverse Curve
P.T.:	Point of Tangent
P.V.C.:	Point of Vertical Curve
P.V.I.:	Point of Vertical Intersection
P.V.T.:	Point of Vertical Tangent
P.V.C.C.:	Point of Vertical Compound Curve
P.V.R.C.:	Point of Vertical Reverse Curve
P.S.D.:	Passing Sight Distance
S.S.D.:	Stopping Sight Distance
I.S.D.:	Intersection Sight Distance
T.C.:	Top of Curb

II. DESIGN CRITERIA

A. Preliminary Considerations

1. Factors to be Considered in Trafficway Design

The design of trafficways include general layout, alignment, grades, subsurface conditions, grading, paving widths, paving thickness, paving material, and drainage facilities. Sufficient right-of-way shall be established in the early stages of planning and preliminary layout to allow for future phase increases in pavement widths, the addition of sidewalks, and other roadside improvements that may be in projected planning needs of the community. The road right of way provided shall be sufficient to include all required elements of the cross-section for that classification (see Appendix G). Proposed right-of-way widths shall be determined by the design requirements (number and width of traffic lanes, median, turn lanes, by-pass lanes, shoulder width, sidewalks, bike lanes, drainage ditches, roadway classification etc.) and be consistent with the Updated Road Sections unless there is an adopted master plan. Proposed right-of-way widths should be consistent with adopted master plans. When determining alignments and grades of trafficways the design professional must consider the requirements for future or existing utilities and any relocations required, including providing adequate storm drainage facilities. Any unusual aspects of the design such as railroad and commuter rail crossings, and similar rights-of-way shall be taken into account. The design professional must also endeavor to select alignments which fit the existing site topography to the greatest extent possible, provide public safety, and are aesthetically pleasing, as well as economically feasible, and will not have detrimental impacts on the environment. To ensure public safety within project's limits, a ten-year view of crash data should be considered for projects along existing county roads, or at the intersection of any proposed road within a county roadway. Local, State, and Federal environmental regulations must be considered throughout the design process.

2. Survey Requirements

a. Horizontal control for all projects shall be coordinated with Chapter 2 of this design manual.

b. Vertical control for all projects shall coordinated with Chapter 2 of this design manual.

c. Survey baselines shall be extended for the full length of the project and extended a minimum of 400 linear feet beyond anticipated limits of work. Baseline stationing shall be shown at every 50 linear feet, at control points, and all intersecting points. Station equalities shall be shown for all common intersecting control points.

d. Spur lines shall be run on all intersecting roads, railroads, streams, and natural drainage courses, and shall be tied into the main baseline.

e. Topography (existing physical and/or natural features) to be shown on the Contract Drawings shall include but not be limited to all buildings and structures; utility poles, conduits, structures, overhead lines; manholes, water mains, valves, hydrants and meters; wells, springs, septic systems, fences, paving and curb, trees, hedges, shrubs, flower beds, storm drain pipes; and all other topography necessary for the design and construction of the proposed project.

   The method of locating topography shall be by field surveys using electronic data collection system or alternate method approved by DPW. If approved by DPW, aerial photogrammetry may be used and supplemented with field surveys as described above for topography only.

f. Topographic requirements (contour lines) may be provided by aerial photogrammetry for engineering studies and drainage area maps. All vertical survey requirements for preliminary and final design shall be acquired by actual, field surveys.

   If approved by the County, developer projects such as subdivisions, and site developments located substantially within undeveloped areas, may be designed utilizing aerial photogrammetry.

g. Contour lines shall be shown on the Contract Drawings as required by the Soil Conservation Service and as needed for Sediment and Erosion Control Plans. Traffic signalization plans do not require baseline contour lines.

h. Cross-sections shall be taken at fifty-foot stations, and at intersecting roads, driveways, entrances, rivers, streams, and railroads. Cross-sections shall be at right angles or radial to the proposed alignment and extend a minimum of 10 feet beyond the proposed right-of-way line each side or 10 feet beyond the limit of disturbance and a minimum of 100 feet beyond anticipated project limits. The minimum distances shown herein should be extended accordingly in order to provide sufficient information to establish profile grade lines beyond the actual project limits or to locate other topography or photographic relief, relative to the design or construction of the proposed improvements. Cross-sections shall be plotted on standard County plan border sheets of a quality that will provide acceptable prints.

i. Property corners shall be thoroughly referenced such that they may be reset after construction.

j. Anne Arundel County monuments that will be affected by the proposed construction shall be noted on the Contract Drawings as being protected or to be relocated accordingly.

3. General Development Plan

   All road or street planning shall use the current General Development Plan of Anne Arundel County as a guide for future development of a road or street, which is available online from the Office of Planning and Zoning. New roads or streets shall be on the current functional classification map before they can be proposed.

4. Preliminary Studies

   The first phase of a project shall be a preliminary study. The extent of a preliminary study will be as directed by DPW or by OPZ, in the case of developer projects. Preliminary studies will require coordination with I&P, OPZ and OOT in order to comply with the General Development Plan (GDP) and applicable Zoning and Environmental Regulations. Generally, the preliminary study will formulate multiple alternate alignments, and for each, evaluate all economic considerations, social or political impacts, safety, esthetics, environmental impacts, public access points, and any other relevant elements directed. The preliminary study shall arrive at a recommended alternate with justifications provided in detail through sound engineering principles.

5. Design Speed

   Design speed is the maximum safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design features of the highway govern. Running speed is the speed of a vehicle over a specified section of highway, being the distance traveled in the running time (the time the vehicle is in motion). Posted speed is usually based on the 85-percentile speed value determined by observation of a suitable sample of vehicles. For complete discussion on the relationship of design speed, running speed and posted speed see latest AASHTO "A Policy on Geometric Design of Highways and Streets." The chosen design speed must be a logical one with respect to the topography, the adjacent land use, and the type of highway. Once the design speed has been selected, all pertinent features of the highway must be related to it to obtain a balanced design.

   The design speed chosen should be consistent with the speed a driver is likely to expect. A highway or highway functional classification may justify a higher design speed than a lower classification facility in similar topography. A low design speed, however, should not be assumed for a secondary road where the topography is such that drivers are likely to travel at high speeds. Drivers do not adjust their speeds to the importance of the highway but to their perception of the physical limitations and traffic thereon.

   After determining the functional classification of the trafficway under design, the design professional shall determine the appropriate design speed based on the criteria presented herein.

   Roads and streets in residential areas should not be designed to encourage speeds beyond the design speeds. For streets with posted speeds of 30 mph and less, the design speed should be the same as the posted speed. For posted speeds above 30 mph, the design speed should only be 5 to 10 mph above the posted speed. The design parameters (horizontal alignment, vertical alignment, etc.) should be in accordance with the design speed.

DPW approval of the selected design speed is required.

B. Traffic Studies

1. Necessity of Study

Per County Codes, level of service studies shall be performed for those proposed development projects, which are likely to generate sufficient traffic to have a significant impact on existing facilities. Level of service studies shall be conducted in accordance with the County's "Guidelines for Traffic Impact Studies" in Appendix E and the Adequate Public Facilities Ordinance.

a. A level of service analysis is required at locations per the Adequate Facilities Ordinance.

b. The level of service analysis is the responsibility of the developer or design professional.

1) Roadway (uninterrupted flow): All existing County and State roads per the County's Adequate Facility Ordinance in all directions from each point of entrance to and exit from the proposed subdivision, through the intersection with the first arterial or major highway, and along the arterial or major highway in both directions, to the next intersecting arterial or major highway shall have a roadway analysis performed in accordance with the County's road rating system. In some specific cases, roadway level of service analysis may also be required (per County) to be performed using procedures from the latest edition of Transportation Research Board's Highway Capacity Manual.

2) At-Grade Intersection (interrupted flow): At-grade intersections can be controlled by several means, such as basic right-of-way rule, yield, two-way stop, four-way stop, roundabouts and signalization. The level of service analysis assumes signalization, but is also applicable to intersections controlled by other means.

If an intersection analysis is required, a simple critical lane analysis shall be performed in accordance with the County's Traffic Impact Study Guidelines. When the critical lane volume exceeds 1,300 vph, supplemental analysis using the TRB's Highway Capacity Manual is required.

Two factors used in the level of service analysis are the Peak Hour Factor for volume adjustment and the area type. The Peak Hour Factor and area type categories shall be established by DPW.

The "critical lane analysis" also may be used for assessing intersection level of service. If the Critical Lane Volume is less than 1300 vph, the intersection can be assumed to be operating satisfactorily. If, however, the critical lane volume exceeds 1300 vph, the intersection shall be further analyzed using the Transportation Research Board's Highway Capacity Manual procedures. The critical lane analysis procedures and an example are included in the TIS Guidelines. Level of Service analysis shall also include an Anne Arundel County Road Rating System Analysis as described in the County's "Road Rating System User Manual".

C. Roundabouts

1. Roundabouts are a safe and efficient form of traffic control which can be used at many locations where traffic signals or stop controls. Based on US and international studies, roundabouts reduce accidents for motor vehicles and pedestrians and, due to the slower speeds and the reduced angles, the severity of accidents are less, with fewer injuries. Roundabouts are allowed on local streets, minor and major collectors, minor and principal arterials, but are limited to no more than two approach lanes.

2. When designing roundabouts, there are several characteristics that can be standardized, such as signing and marking; while others must be adapted within the design guidelines to fit the demands of the location, such as approach angles and right of way restrictions. This design guide has been created to allow engineers the flexibility to design a roundabout to fit a particular site, while still maintaining consistency with other roundabouts countywide and statewide to enhance driver expectancy.

3. All roundabout designs will require a two-step process: a preliminary design initially submitted that meets design criteria listed under both general design criteria and specific / geometric design elements as noted, and upon approval of the overall preliminary design, a final design showing all construction details and any phased construction that might be needed.

4. The current Maryland State Highway Administration Roundabout Design Guidelines (See Appendix H) shall be used, along with engineering judgment and information from other sources, for the design of all roundabouts within Anne Arundel County, and for the review and preparations of design by county staff and private consultants.

5. Roundabouts shall be designed to accommodate Fire Department Emergency Vehicle turning radius - 47' outside, 38' inside.

D. Horizontal Alignment

1. Selection of General Alignment

Horizontal and vertical alignments cannot be designed independently as they complement each other. Horizontal alignment and vertical profile are the most important of the permanent design elements of the highway, for which thorough study is warranted. Curvature and grades must be in proper balance. Vertical curvature superimposed on horizontal curvature, or vice versa, generally results in a more pleasing facility, but it should be analyzed for effect on traffic. Horizontal curvature should not be introduced at or near the top of a vertical curve. This condition is hazardous in that the driver cannot perceive the horizontal change in alignment, especially at night when the headlight beams go straight ahead into space. The hazard of this arrangement is avoided if the horizontal curvature leads the vertical curvature, i.e., the horizontal curve is made longer than the vertical curve. Suitable design can also be made by using design values well above the minimum requirements for the design speed. However, roads and streets in residential areas should not be over designed to encourage speeds beyond the intended design speeds. Sharp horizontal curvature should not be introduced at or near the low point of a sag vertical curve. Because the road ahead is foreshortened, any curve but flat horizontal curvature assumes an undesirably distorted appearance. Additionally, vehicular speeds, particularly of trucks, often are high at the bottom of grades, and erratic operation may result, especially at night.

On two-lane roads and streets, the need for safe passing sections at frequent intervals and for an appreciable percentage of the length of the roadway often supersedes the general desirability for combination of horizontal and vertical alignment. In these cases, it is necessary to work toward long tangent sections to secure sufficient passing sight distance in design, however the designing for sufficient passing sight distance in residential communities is not required, since passing in residential communities is undesirable.

Horizontal curvature and profile should be made as flat as feasible at intersections where sight distance along both roads or streets is important and vehicles may have to slow up or stop. On divided highways and streets, variation in width of median and the use of separate profiles and horizontal alignments should be considered to derive design and operational advantages of one-way roadways. Where traffic justifies provision of four lanes, a superior design without additional cost generally results from the concept and logical design basis of one-way roadways.

The alignment should be designed with considerations given to aesthetics to enhance attractive scenic views of the natural and manmade environment.

2. Horizontal Curves

Horizontal curves are used to change direction at a safe rate of speed and shall be used wherever the roadway centerline changes direction. The horizontal curvature and superelevation rates for the roadway should follow the guidelines in Chapter 3 of the latest AASHTO. Superelevation method should follow Method 5 for determining rates for higher speed roadways (design speed equal to or more than 45 mph) and reference Table 3-8 with maximum superelevation rate of 4 %. For lower speed / urban areas, Method 2 can be used to determine whether superelevation is warranted. The relationship of design speed, curvature and superelevation shall be established to provide a balanced design.

Maximum superelevation rates are dependent upon the type of roadway, the effect of the superelevation upon vehicles operating at less than the design speed and drainage considerations. Vehicles operating at low speeds may have to steer against the curve to overcome the effect of superelevation, and erratic operation can result. On ice and snow, slow moving vehicles may slide to the inside of the curve if the superelevation rate is too great. In urban areas, the close spacing of intersections and driveways limit the superelevation. In these situations, Method 2 superelevation may be used and AASHTO Table 3-13 used to determine what rate to be used or if superelevation is warranted. The means of transitioning from a normal crown section to a fully superelevated section and then back to normal crown section is the tangent and superelevation runoff. The runoff must be sufficiently long to provide a smooth transition and not appear distorted to the driver. The length of tangent run out shall be such that the outside edge of pavement has the same slope relative to the centerline as that through the superelevation runoff. For appearance and comfort, the rate of superelevation runoff should not exceed a longitudinal slope (edge compared to centerline of a two-lane highway) of 1:200. In other words, when considering a two-lane pavement with plane sections, the difference in longitudinal gradient between the edge of pavement profile and its centerline profile should not exceed 0.5 percent. Two-thirds of the superelevation runoff shall be placed on the tangent and one-third on the curve.

Though the means of changing cross slopes are presented in terms of straight lines, the angular breaks shall be rounded in final design to produce smooth pavement edge profiles.

3. Superelevation and Warping

Horizontal curves of residential streets shall not be superelevated or warped. Horizontal curves of arterial joining or within major developments may warrant superelevation. Horizontal curves of arterial, commercial and industrial trafficways shall normally be superelevated or warped, in accordance with latest AASHTO "A Policy on Geometric Design of Highways and Streets" criteria and the material presented in Paragraph 2 above. Superelevation of rural collector highways shall not exceed 0.06 ft./ft.

4. Sight Distance

a. Passing: Passing sight distance (PSD) is the distance required for a vehicle to pass another before meeting an opposing vehicle which might appear after the pass began. It is applicable only to two-lane, two-way rural major collectors and minor arterial.

Passing sight distance is measured between an eye height of 3.5 feet and an object height of 4.25 feet.

The minimum passing sight distance should be provided at least once per mile.

See Table III-2 for minimum passing sight distance.

b. Stopping: Stopping sight distance (SSD) is the distance required for a vehicle to stop before reaching an object in its path. It is the sum of the distance traveled from the moment the object is first visible to the driver to the moment the brakes are applied, plus the distance required to stop after the brakes are applied. The equation for stopping sight distance is:

$$SSD = \text{Reaction time } x\ (V) + \frac{V^2}{30(f \pm G)}$$

Where: V = initial speed (mph)
f = coefficient of friction for wet pavement
G = percent of algebraic grade divided by 100 (G is positive for upgrade and negative for downgrade)

Stopping sight distance is measured between an eye height of 3.5 feet and an object height of 2.0 feet.

Stopping sight distance for various combinations of design speeds and grades are shown Table III-3 and Table III-4.

E. Vertical Alignment

1. Allowable Grades of Trafficways

The minimum grade for all roads and streets shall be 1.0 percent unless otherwise approved by the County. Where a curbed section is used, the spacing of inlets must be carefully studied when utilizing the minimum grade to avoid the excessive spreading of storm water across the pavement. Criteria limiting drainage encroachment upon the roadway are given in Chapter V, Storm Drains.

The maximum allowable grade varies with both the road classification and design speed. The maximum road grades shall be in accordance with the Table III-1:

TABLE III-1

Maximum Allowable Road Grade for Sub-Division Collector, Local, & Cul-de-Sac Streets

Zoning District	Local Streets/Road and Collector Streets/Roads	Cul-de-Sac Streets
RA, R-1, R-2, R-5, R-15, R-22 Commercial & Industrial Districts, Parks & Recreational Areas	10% 10% 8%	10%* 10%* 10%*

Maximum Allowable Road Grade for Principal Arterial and Minor Arterial		
Design Speed MPH	Maximum Grade Desirable	Absolute
40	6%	8%
50	5%	7%
60	4%	6%

It is necessary to consider, in addition to maximum grade, the effect of length of grade upon vehicle operation. Though most passenger cars can climb fairly steep long grades with little difficulty, trucks generally undergo a substantial reduction in speed, which can result in a reduced level of service and increased accident potential. The maximum length of designated upgrade that a loaded truck can travel without an unreasonable reduction in speed is termed the "critical length of grade." Major collectors in commercial or industrial areas and all arterial shall be checked for critical length of grade.

The maximum permissible speed reduction shall normally be 15 mph. Where the upgrade is preceded by a substantial downgrade, vehicle speeds are likely to be higher at the bottom of the upgrade, and the maximum permissible speed reduction may then be as great as 20 mph. Whenever a design exceeds the critical length of grade, the grade shall be reduced, the length reduced, or a climbing lane added. In no case shall the climbing lane be ended prior to a point at which the truck can attain a speed of at least 30 mph.

The design criteria presented herein regarding vertical curve lengths shall be carefully evaluated for the various conditions to ensure minimum requirements are designed for. An example of this is that intersection sight distance may govern crest vertical curve length.

2. Vertical Curves

   The vertical curve, which is a parabola, is the means by which transitions are made between vertical tangents. A typical curve with the major elements identified is shown in AASHTO Section 3.4.6.

3. Sight Distance

   a. Passing Sight Distance (PSD): Appreciable grades increase the sight distance required for safe passing. Passing is easier for the vehicle traveling downgrade because the overtaking vehicle can accelerate more rapidly than on the level and thus can reduce the time of passing, but the overtaken vehicle can also accelerate easily and increase the passing distance.

      The passing sight distance required to permit vehicles traveling upgrade to pass with safety is greater than those required on level roads because of reduced acceleration of the passing vehicle, which increases the time and distance of passing, and the likelihood of opposing traffic speeding up.

      Design values for crest vertical curves to provide sufficient length for passing sight distance differ from those for stopping sight distance because of the different height criterion. The general formulas apply, but the 3.5 feet height of object results in the following specific formulas:

When S is less than L

$$L = \frac{AS^2}{3093}$$

When S is greater than L

$$L = 2S - \frac{3093}{A}$$

L = Length of Vertical Curve, ft.
S = Stopping Sight Distance, ft.
A = Algebraic difference in grades (G), percent (%)

(Height of eye and object are 3.5 ft. and 3.5 ft. respectively.)

The passing sight distance on upgrades shall be greater than the derived minimum.

Table III-2
Minimum Passing Sight Distance
(See 2018 AASHTO Table 3-4)

b. Stopping Sight Distance (SSD): When a highway is on a grade, the standard formula for braking distance is the following:

$$D = \frac{V^2}{30(f \pm G)}$$

Stopping sight and distance = Reaction time *x (V)* + $\frac{V^2}{30(f \pm G)}$

$$= 3.675(V) + \frac{V^2}{30(f \pm G)}$$

The terms are as previously stated. The safe stopping sight distances on upgrades are shorter; those on downgrades are longer. The effect of grade on stopping sight distance is shown in Table III-3. These corrections are computed for wet conditions and the assumed design criteria is the same as that presented in the Stopping Sight Distance Table (2018 AASHTO Tables 3-1, 3-2).

Crest vertical curves must be sufficiently long to provide the required stopping sight distance. The formulas for minimum length of crest vertical curves are:

When S is less than L

$$L = \frac{AS^2}{1{,}329}$$

When S is greater than L

$$L = 2S - \frac{1{,}329}{A}$$

L = Length of Vertical Curve, ft.
S = Stopping Sight Distance, ft.
A = Algebraic difference in grades (G), in Percent (%)

(Height of eye and objects are 3.5 ft. and 2.0 feet, respectively.)

Minimum lengths of sag vertical curves shall be based upon headlight sight distance, which shall be equal to the stopping sight distance.

Table III-3
Effect of Grade on Stopping Sight Distance
(See 2018 AASHTO Tables 3-1, 3-2)

Table III-4
Stopping Sight Distance
(See 2018 AASHTO Tables 3-1, 3-2)

c. Headlight Sight Distance: The headlight sight distance shall not exceed the stopping sight distance. When a vehicle traverses a sag vertical curve at night, the portion of highway lighted ahead is dependent on the position of headlights and the direction of the light beam. It is to be assumed that the headlight has a height of 2.0 feet above the road surface, and a 1-degree upward divergence of the light beam from the longitudinal axis of the vehicle. The upward spread of the light beam provides some additional visible length, but this is to be ignored. The following formulas show the S, L, and A relation, using S as the distance between the vehicle and point where the 1-degree angle of light ray intersects the surface of the roadway:

When S is less than L:

$$L = \frac{AS^2}{400 + 3.5S}$$

When S is greater than L:

$$L = 2S - \frac{400 + 3.5S}{A}$$

Where L = length of sag vertical curve, ft. (minimum)
S = light beam distance, ft. (Stopping Sight Distance)
A = algebraic difference in grades, percent (%)

For overall safety on highways, a sag vertical curve length should be long enough so that the light beam distance is nearly the same as the stopping sight distance. Accordingly, it is pertinent to use stopping sight distances for different design speeds as the S value in the above formulas. See AASHTO Section 3.4.6.3 and Table 3-37 for design controls for sag vertical curves based on stopping sight distance.

Table III-5
Design Controls for Sag Vertical Curves Based on Stopping Distance
(See 2018 AASHTO Table 3-37)

F. Cross-Section Elements

1. Use of Typical Sections in Standard Details

Unless otherwise approved by the County, typical sections for the various functional classifications shall be as shown in the Standard Details. If the project roadway has been the subject of a completed Master Plan or corridor plan, the recommended typical sections of the Master Plan or corridor plan shall be considered for the roadway.

2. Pavement Criteria

   a. Typical Sections: Pavement thickness shall conform with the typical sections shown in the Section VI Paving Standard Road and Street Details when it has been proven through soil boring tests (as described below) that existing sub grade soil is California Bearing Ratio (CBR) of 5 or greater. The pavement structures for these typical sections require a minimum subgrade CBR of 5. The design professional shall perform soil borings as described in General Instructions, Chapter I of this Manual or perform laboratory CBR tests (AASHTO T193) to determine if the roadway sub base material will satisfy a minimum CBR of 5. If the soils on the project site do not satisfy the minimum CBR value, the design professional shall create a design that corrects the deficient sub base conditions. A Geotechnical Report should be submitted to the County detailing soil conditions and be approved prior to any paving.

   b. CBR Improvement: Testing of subgrade soils must be performed to assure the necessary data is provided for design of the pavement structure.

      Should the existing soils on site not have the required minimum CBR value of 5, the design professional may require the soil to be scarified and recompacted or removed to an appropriate depth and replaced with suitable material to increase CBR values to meet the minimum specified.

   c. Geotextiles: In cases where poor load bearing soils are encountered after two feet of unsuitable material have been undercut and removed below pavement subgrade, a geotextile / suitable soil stabilization fabric may be used to separate the poor load bearing soils from the suitable backfill material. In no case will the use of the geotextile be allowed in lieu of undercutting unsuitable material and replacing it with compacted suitable material.

3. Shoulders

   Where shoulders and open drainage sections are applicable, the shoulder typical section shall be the same as the adjacent trafficway typical section material as shown in the Standard Details. Where there is a prior approval by DPW, other shoulder materials may be specified in large lot residential subdivisions (one-acre lots or larger with 150-foot minimum frontage).

4. Curb & Gutters

   Curb & Gutters shall be used in accordance with Standard Cross-section Requirements within the updated Road Sections.

5. Valley Gutters

   Valley gutters, as shown in the Standard Details, shall be used only where approved by DPW but will normally be permitted where the approach road is a cul-de-sac or local street, providing that no more than 2 cfs are carried across an intersection.

6. Sidewalks

   Those areas normally requiring sidewalks are so indicated on the Standard Cross-section Requirements within the updated Road Sections or as indicated in project scoping. Sidewalks shall be a minimum of five (5) feet wide unless specific approval is given to reduce the width for existing conflicting facilities, Where there will be a large number of pedestrians, such as near schools and in some commercial areas, the sidewalks shall be made sufficiently wide to accommodate the anticipated pedestrian demand. The selection of a sidewalk width in such areas is subject to review and approval by DPW or OPZ in the case of development projects. Full accessibility shall be provided in accordance with all adopted County and Federal guidelines and standards.

7. Bikeways

   Bikeways shall be constructed where required by the Standard Typical Sections. . Residential areas, school and open space areas and short routes connecting residential and employment centers typically warrant provisions for bicyclists.

   Bikeways may be located within the roadway pavement, separated from the roadway but within the street right-of-way or within their own right-of-way such as through open areas. Locations shall conform with latest guidelines within the updated Road Sections and the County Pedestrian and Bicycle Master Plan.

   Unless otherwise approved by the County, bikeways shall conform with latest guidelines within the County Pedestrian and Bicycle Master Plan, and adopted regional plan. For bikeways on state roads, the MD SHA 2015 Bicycle Policy and Design Guidelines shall be followed.

8. Guardrail

   Guardrail is needed at certain roadside obstacles and along some embankments to reduce the severity of run-off-the-road type accidents. It should only be installed where the severity of a collision with the guardrail will be less than that which would occur were the guardrail not present.

   For placement and warrants for guardrail (w-beam traffic barrier), see the latest SHA Guidelines for Traffic Barrier & End Treatment Design. Wherever feasible, the embankment should be adjusted to eliminate the need for guardrail. Where guardrail is warranted, it shall be placed as shown on the typical sections and Standard Details.

   Factors to be considered when determining the need for guardrail at fixed roadside objects include design speed, roadway functional classification, type of obstacle and distance from pavement edge to the obstacle. Fixed roadside objects include (but are not limited to) street light poles, utility poles, retaining walls, etc.. The determination of the need for guardrail is subject to review and approval by DPW.

Guardrail shall normally be extended from the fill into the cut. Where a long low fill not requiring guardrail is adjacent to a fill that does warrant guardrail, the guardrail may be started or ended on the low fill.

9. Underdrains

To drain free water from sub grades, under drains shall be incorporated into the design of trafficways (See Standard Details). Underdrains are required in all new construction projects unless proven not to be needed. The design professional shall evaluate acquired soils/geotechnical data relative to groundwater conditions and provide a recommendation for the need, feasibility and design of under drains.

10. Gutters and Ditches

The minimum and maximum grades for gutters and ditches shall be designed in accordance with Chapter V, Storm Drains, and incorporated into the road design accordingly.

11. Bus Stop Widening

If provided, the deceleration lane, standing, or loading area, and acceleration lanes for buses shall be designed to be separated from the through traffic lanes. The design of bus turnouts shall include, but not be limited to, passenger platforms, ramps, stairs, railings, signs, and markings. Design of bus stop widening areas shall follow MDOT / MTA guidelines with review and approval through DPW and OOT. Speed-change lanes shall be long enough to enable the bus to leave and enter the through traffic lanes at approximately the average running speed of normal traffic without undue inertial discomfort to passengers. The length of acceleration lanes from bus turnouts shall be well above the normal minimum values for passenger cars, to allow a loaded bus to attain acceptable speed prior to reentering the through travel lane. The bus standing or loading area and transition lanes, which include the shoulders, shall be a minimum of 20 feet wide to permit passing a stalled bus. The pavement areas of turnouts should contrast in color and texture with the through traffic lanes to discourage through traffic from encroaching on or entering the bus stop.

The dividing area between the outer edge of the trafficway shoulder and the edge of the bus turnout lane should be as wide as feasible, but in no instance shall it be less than 20 feet wide. A barrier is required in the dividing area, and fencing shall be designed to keep pedestrians from entering the trafficway unless otherwise directed by DPW. Pedestrian loading platforms shall be designed a minimum of 10 feet wide unless otherwise approved by DPW and conform to ADA requirements.

The deceleration lane shall be tapered at a 5:1 transition.

The loading area shall provide a minimum of 50 feet of length for each bus. The width shall be a minimum of 12 feet wide unless otherwise approved by DPW.

The re-entry acceleration lane taper shall be a maximum of 3:1 transition.

The minimum length of turnout for a two-bus loading area shall be a minimum of 195 feet for a mid-block location, 165 feet for a nearside location, and 145 feet for a far-side location. These dimensions are based on a loading area width of 12 feet. Greater lengths of bus turnouts expedite bus maneuvers, encourage full compliance on the part of bus drivers, and lessen interference with through traffic.

12. Street Lighting

    a. When directed by DPW to provide street lighting as part of a capital improvement project or a developer project, requirements shall follow Appendix F
    b. The determination of need for lighting, as well as the design of a lighting system, shall be subject to review and approval by DPW.
    c. Direct bury fiberglass poles shall be used along all roadways if the pole is within the clear zone and not protected. Clear zone requirements shall conform to AASHTO's latest "Roadside Design Guide".
    d. The lighting system should be designed in conjunction with the roadway so that the result will be a coordinated facility in which each element complements the other. The relation between lighting and signs and potential obstacles must be carefully considered. Roadside obstacles can often be reduced by the utilization of "joint use" poles, which can, for example, support both a luminaire and a traffic signal.

G. Intersection Design

1. Horizontal Alignment and Spacing:

Trafficways shall be so designed by functional classification that sufficient length is provided between intersections for the maneuvering of traffic volume, storage and support of adjacent land uses. The minimum intersection spacing, as measured along the through roadway between centerlines of intersecting roadways, shall be as indicated in the Table III-7. Centerlines of trafficways shall continue through intersections without breaks or offsets, and shall intersect as nearly as possible at right angles. The layout of intersections with State Highways shall be subject to final approval by the State Highway Administration. County trafficways shall not intersect State Highways at intervals less than 750 ft. between centerlines unless otherwise approved by DPW and SHA. This requirement supersedes the Minimum Intersection Spacing Table III-7 when the functioning classification of a State Road requires less than 750 feet.

Table III-7

Minimum Intersection Spacing

Functional Classification of Through Road	Minimum Intersection Spacing (Centerline to Centerline)
Freeway	1 mile (interchange)
Expressway	Median Crossover: 1,500'
Divided	Tee Intersections: 750'
Divided	750'
Undivided	500'
Principal Arterial	750'
Minor Arterial	500'
Collector	250'
Local Street/Road	150'
Cul-de-Sac	NA

2. Layout of Curbs, Pavement Edges and Property Lines at Intersections

   a. Curb/Pavement Edge Radius

   The design radii of traffic curbs and pavement edges at intersections shall be in accordance with Table III-8.

Table III-8

Minimum Curb Fillet Radius

Functional Classification of Intersection Streets	Residential or Town Center Area (ft.)	Industrial or Commercial Area (ft.)
Cul-de-Sac Streets -Any Classification	20	30
Local-Local		
Local-Collector	20	30
Local - Minor Arterial	20	30
Collector-Collector	20	30
Collector - Minor Arterial	20	40
Minor Arterial- Minor Arterial	25	40
	30	50
Major Highway- Arterial	30	60

The above radii are based on a 90-degree turning angle. A design vehicle or control vehicle should be determined in lesser traffic areas to consider if radii could be minimized on a case by case basis. Urban areas with higher volumes of pedestrian traffic and less truck traffic may consider reducing the curb radii. Reductions should consider following context sensitive guidance from ITE- Designing Walkable Urban Thoroughfares. Within urban areas containing high ped volumes and requiring curb management, road signing shall be addressed in regard to parking/no parking, bus / ride share pickup, drop-off zones, etc.

All curbs, sidewalks, and paving configurations at intersections shall be designed for accessibility in strict accordance with Federal accessibility codes and regulations, and all applicable State and County Codes and regulations.

3. Right of Way

At an intersection of trafficways (excluding alleys), the cutback of the property line shall be a line connecting two points on intersecting right-of-way lines and a minimum of 25 feet from their point of intersection, and shall be large enough to include all required traffic signal equipment.. At an intersection of alleys, the property line shall conform with the pavement fillet.

4. Roundabouts:

DPW or the County Traffic Engineering Department may request or approve the addition of a Roundabout intersection or the reconstruction of an existing intersection to a Roundabout. The number of lanes and design of the roundabout shall be determined by the results of traffic analysis submitted to and spproved by DPW. The design of the roundabout shall follow “AACo Roundabout Design Guidelines” or MD SHA Roundabout Design Guidelines

5. Intersections With State Highway

Criteria and permits related to intersections of private or County roads with State Highways shall be designed in accordance with SHA standards and subject to its approval.

6. Vertical Alignment

a. Pavement slopes of through streets or streets with the higher functional classification shall be carried through the intersection without deviation. The pavement slopes of the street with the lower classification shall be warped to meet the pavement edge of the through street. Where two roads of the same classification intersect, they may be connected by considering one the more important and transitioning the other or by transitioning both roadways. Proposed paving elevations at all points of intersection of curb line shall be clearly shown and identified on the plan and profile, as well as other points required to adequately construct the proposed facility. A top of curb or edge of pavement profile shall be shown on the contract drawings for radii 50' or greater.

b. Curb or Edge of Pavement Grades at Intersections: As discussed above, one of the intersecting roads shall be determined to be the more important and its grade carried through the intersection without interruption. Gutter or edge of pavement grades around fillets shall be intersected with a smooth transition that promotes complete positive drainage. Other grades at the intersection shall be such that complete runoff of drainage will occur, and water will not pond across or in any portion of the two intersecting trafficways. Proposed top of curb grades shall be clearly shown and identified at each fillet on the P.C., P.T., and midpoint. The grade of the minor intersecting road shall not exceed that indicated in Table III-9.

Table III-9

Pavement Grades at Intersections

Functional Classification	Maximum Approach Pavement Grade Through Intersection	Distance from Intersection[1]
Expressway	3.0%	200'
Principal Arterial	3.0%	200'
Minor Arterial/Collectors	3.0%	175'
Local/Cul-de-sacs	4.0%	100'

[1] Distance measured from pavement edge of intersecting road to the P.V.C. of the vertical curve. Intersections with State Highways shall be designed in accordance with SHA criteria, and subject to its approval.

7. Sight Distance

The maneuvers occurring at an intersection are different from those occurring at other points along a highway and the sight distance needed to ensure safety at intersections is consequently different. There are conditions where the intersection sight distance will prevail over other data to establish minimum crest vertical curve lengths, and this must be thoroughly investigated by the design professional. At signalized intersections, the movements are controlled and provisions for the stopping sight distance are given in AASHTO Chapter 9.. However, at unsignalized intersections, the driver on the cross street must be able to see enough of the highway to enable him to turn left, right, or proceed straight through the intersection without causing undue delay to traffic on the major road.

The following criteria have been established for the determination of unsignalized intersection sight distance:

a. Cross Movement: Sufficient distance, both left and right, to enable a stopped vehicle to cross the intersection before a vehicle on the major highway reaches the intersection, even though this vehicle appears just as the crossing maneuver begins, without the through vehicle having to decelerate.

b. Left Turn Movement: Sufficient distance on the left to enable a stopped vehicle to turn left onto the major road before a vehicle approaching from the left reaches the intersection even though this vehicle appears just as the left turn begins, without the through vehicle having to decelerate. Also, sufficient distance on the right to enable a stopped vehicle to turn left onto the major road without a vehicle on the major road approaching from the right, having to decelerate more than 10 mph, even though the approaching vehicle appears just as the turn begins.

c. Right Turn Movement: Sufficient distance on the left to enable a stopped vehicle to turn right onto the major road without a vehicle on the major road, approaching from the left, having to decelerate more than 10 mph, even though the approaching vehicle appears just as the turn begins.

Reference is made to latest AASHTO Section 9.5.3 regarding sight distances.

8. Turning/Storage and Merge Lane Design

The design professional shall use the Standard Cross-Section Requirements in Appendix G to inspect the necessity of providing auxiliary lanes to at grade intersections preceding and following right turning movements and to other purposes supplementary to through traffic movements.

Auxiliary lanes shall be a maximum of 12 feet wide and a minimum of 10 feet wide. The length of the auxiliary lanes for turning vehicles consists of three components: (1) deceleration length, (2) storage length, and (3) entering transition taper. The total length of the auxiliary lane shall be the sum of the length for these three components. Where intersections occur as frequently as four per mile, the auxiliary lane length shall be the sum of the storage length plus transition taper.

The deceleration length required is that needed for a comfortable stop from a speed that is typical of the average running speed on the main facility. On the basis of design speeds of 30, 40, and 50 mph, deceleration lengths for flat grades are 170, 275, and 410 feet respectively according to the latest Updated Road Section Requirements In urban areas where the design professional determines that it would not be feasible to provide the full length for deceleration the design professional shall present the recommendations to DPW with justification. In such cases it shall be demonstrated that a partial deceleration must be accomplished before entering the auxiliary lane. Deceleration lengths shown are applicable to both left and right turning lanes. The auxiliary lane shall be sufficiently long to store the number of vehicles during a critical period. The storage length shall be liberal to avoid the possibility of left turning vehicles stopping in the through lanes. The storage length shall be sufficiently long so that the entrance to the auxiliary lane is not blocked by vehicles standing in the through lanes waiting for a signal change or for a gap in the opposing traffic flow.

At unsignalized intersections the storage length, exclusive of taper, shall be based on the number of turning vehicles in an average 2-minute period during the peak hour. As a minimum requirement, space for at least three passenger cars shall be provided. Where truck traffic exceeds 10 percent of total traffic volume, provision shall be made for at least two cars and one truck. The design professional shall evaluate traffic patterns of opposing traffic volumes and provide recommendations on whether another appropriate time interval should be used or confirm that the 2-minute interval is satisfactory.

At signalized intersections the required storage length depends on the signal cycle length, the signal phasing arrangement, and the rate of arrivals and departures of left-turning vehicles. The storage length is a function of the probability of occurrence of events and shall be based on one and one-half to two times the average number of vehicles that would be stored per cycle, which is predicated on the design volume. This length will be sufficient to serve heavy surges that occur from time to time. As in the case of unsignalized intersections, provision shall be made for storing at least three vehicles.

The longitudinal location along the highway, where a vehicle will move from the through lane to a full width deceleration lane, will vary depending on several factors. These factors include the type of vehicle, the driving characteristics of the vehicle operator, the speed of the vehicle, weather conditions, and lighting conditions. Straight line tapers are frequently used. The taper rate shall be between 8:1 (for operating speeds of 30 mph and less) and 15:1 for operating speeds greater than 30 mph. The tapered section of deceleration auxiliary lanes shall be designed to be constructed in a "squared-off" section at full paving width and depth. This design requires a painted delineation of the taper and is only applicable to non-curbed sections. The design also requires transition of the outer or median shoulders around the squared-off beginning of the deceleration lane. A squared-off design principle can be applied to median deceleration lanes, and it may also be used at the beginning of deceleration right-turn exit terminals when there is a single exit lane.

Acceleration lanes are advantageous on roads without stop control, particularly those with higher operating speeds and / or higher volumes. Acceleration lanes are not desirable at all-way stop-controlled or signalized intersections where entering drivers can wait for an opportunity to merge without disrupting through traffic. For additional guidelines related to lengths of acceleration auxiliary lanes, refer to AASHTO (A Policy on Geometric Design of Highways and Streets) Section 10.9.

9. Signalization Warrants

Based on the results of a signalization warrants analysis, DPW will determine whether signalization is appropriate and required at a particular intersection.

It is essential that intersection design be accomplished simultaneously with the development of traffic control plans to ensure that sufficient space is provided for proper installation of traffic control devices. Geometric design should not be considered complete nor should it be implemented until it has been determined that needed traffic control devices will have the desired effect in controlling traffic.

Most intersections are adaptable to either signing control, signal control, or a combination of both. At intersections not requiring signal control, the normal pavement widths of the approach highways shall be carried through the intersection with the possible addition of speed change lanes, median lanes, auxiliary lanes, or pavement transition tapers. Where traffic is sufficient to require signal control, the number of lanes for through movements may require analysis to consider the need for additional lanes at the intersection. Where the traffic volume approaches the uninterrupted flow capacity of the intersection leg, the number of lanes in each direction may have to be increased (based on the design professional's recommendations to the County) at the intersection to accommodate the traffic volume under stop and go traffic control. Other geometric features that shall be investigated by the design professional that may be affected by signalization are, length and width of storage areas, location and position of turning roadways, spacing of other subsidiary intersections, access connections, and the possible location and size of islands to accommodate signal poles or signing.

10. Traffic Signal Design

The design of traffic signals and associated traffic control devices shall be conducted in accordance with Maryland State Highway Administration's "Traffic Signal Design Guidelines for State/Local Agencies and Private Developers". However, Anne Arundel County Signalization Standards differ slightly from the State's, both in the way the drawings are laid out and in some of the design details. For development projects refer to Appendix G.

Neighborhood Traffic Control Neighborhood traffic control devices such as traffic circles, islands, Chokers, Bulb outs, and speed humps shall be used only where approved by DPW. Details of speed control devices are shown in the AA County Neighborhood Traffic Control Guidelines.

H. Private Entrances

1. Location of Driveways - General

Driveways shall be designed and located in accordance with all County Codes, ordinances, and regulations. Driveways shall be designed such that they will not interfere with or be a hazard to the free movement of normal highway traffic and traffic congestion will not be created due to the entrance. In accordance with this principle, driveways shall be located where the roadway alignment and profile are favorable; i.e., where there are no sharp curves, or steep grades, and where driveway sight distance will be in accordance with criteria established herein for safe traffic operation. Driveways at locations that would interfere with the placement and proper functioning of highway signs, signals, lighting, or other devices that affect traffic operation shall be avoided. No driveway shall be located within 50 feet from the P.C. of the intersection curb radius.

Driveway location and design is essential in assuring that a road will be capable of performing its intended role through and even beyond the design year. Driveways shall be located to minimize impact on traffic flow, and provide access consistent with the road's classification. Driveway design must be such that vehicles can safely and quickly enter and leave the roadway without excessively impeding through traffic.

The control of access shall be in accordance with the functional classification of the road and approved by DPW.

There are two types of driveways: residential and non-residential. Residential driveways are those serving single-family houses or apartment buildings with no more than five dwelling units. Non-residential driveways serve employment and shopping areas, schools, recreational areas, multifamily residential, and apartment buildings with more than five dwelling units, and are consequently used by more trucks and a larger number of vehicles than residential driveways. High volume driveways are those with anticipated volumes exceeding 100 vehicles per hour.

All driveways regardless of type shall be shown on the Contract Drawings in plan view including spot elevations. Spur line profiles shall be shown for all commercial/industrial entrances clearly indicating intersection of proposed and existing grades as applicable. A section of all entrances shall be shown on the cross-sections indicating centerline road station and tie-in to existing grades.

Driveways shall have a minimum grade of 1% and a maximum grade of 14% except for high volume driveways shall have a maximum grade of 8%. Any part of the driveway that goes through a walking area shall have a 2% maximum cross slope in accordance with ADA regulations. Widened roadways that intersects a pedestrian access road shall have driveways tie-in within a maximum of 50' from the new edge of roadway and address all ADA sidewalk/ crossway requirements. Further guidelines for driveways can be acquired through the MDSHA Book of Standards and through SHA Pedestrian Design Guidelines.

Entrances which will have gatehouses, walls, fences and/or signs shall be designed in accordance with the "Anne Arundel County Standards for Gatehouses, Fences and Community Signs Within County Right-of-Way,.", Appendix F.

2. Non-Residential Entrances

   a. Entrance Location: The number and location of entrances that may be permitted will be based on other criteria presented herein, the usage, interior and exterior traffic patterns and the requirements of OPZ, I&P, OOT and DPW. A maximum of two entrances will be allowed in the first 200 feet of frontage. For each additional 100 feet of frontage a maximum of one entrance may be permitted, subject to the County's approval. All entrance drives shall be shown on the plan and profile of trafficway construction drawings. Profile of the entrance spur shall be shown clearly to the intersection of grades where necessary, together with spot elevation on the plan view.

The minimum frontages for two-way driveways are as follows:

Urban - Interior location - 75 feet

Urban - Corner location - 110 feet

Rural - Interior location - 90 feet

Rural - Corner Location - 125 feet

b. Entrance Width: The maximum width for two-way entrances at 60 to 90 degrees shall be 40 foot unless otherwise approved by DPW. The 40 feet width shall be divided into two 12-foot outbound lanes and one 16-foot inbound lane. If the design professional recommends a wider entrance width, the design professional shall submit justification to DPW for review. The maximum width for a one-way entrance shall be 35 feet. The design professional shall provide turning templates from Autoturn (or similar program) to display how design vehicle trucks can turn in or out of entrance.

Minimum allowable width for one-way access is 16 feet, minimum width for a two-way entrance is 24 feet.

c. Curbing: All islands must be curbed with standard concrete curb or concrete curb and gutter, as shown in the Standard Details. Refer to Section XII Pedestrian Facilities of the Standard Details for requirements regarding accessible curb ramps. The required landing area at the bottom of curb ramps should be located along the pedestrian route and the slope of curb ramps shall be parallel to travel lanes.

d. Curb Length: Minimum curb island length on tangent shall be as shown on the Standard Details. Minimum curb tangent length between entrances and property lines shall be 5 feet.

e. Median Openings: No new openings shall be permitted in existing County divided highway medians unless approved by DPW. Median openings designed for new construction shall be subject to the approval of DPW.

f. Drive-In Island Location: Drive-in islands shall include but not be limited to, gasoline pump islands, self-service banks, drive-in banks, drive-in restaurant, and drive-in photo service. Drive-in islands shall conform to the set-back requirements of Zoning Ordinance unless stopping sight distance or zoning ordinance dictate a greater distance for a particular usage. In all cases drive-in islands shall be located to provide sufficient queuing space so as to prevent vehicles from standing in public right-of-way.

g. Building Setback: Minimum building setback shall be as specified in the Zoning Ordinance. However, intersection sight distance shall prevail as a minimum if building setback meets the zoning requirements but interferes with proper sight distance at an intersection. Therefore, the more stringent requirement will control building setbacks at intersections. The design professional will investigate and provide the appropriate recommendations regarding building setbacks at each intersection. Recommendations shall address existing structures or buildings, as well as establish requirements for future structures or buildings.

h. Angular Entrances: Angular entrances and exits are advantageous for driveway connections that are for a right-in, right out movements. Angular entrances shall not extend beyond property line when paving driveway to highway, or beyond access control limits. The point of control will be the extension of the property line from its intersection County right-of-way line normal or radial to the edge of pavement.

i. Parking Lot Design: Non-residential uses shall provide sufficient parking or storage space off the right-of-way to prevent the storage of vehicles on driveway areas or backing up of traffic on the public right-of-way. Where there are one or more driveways to a corner establishment at a roadway intersection, parking will be restricted on each roadway between the intersection and the nearest driveway. Parking shall be in strict accordance with the requirements of the appropriate sections of County Code .

j. Sight Distance: To the extent feasible within frontage limits, all driveways shall be located at the point of optimum sight distance along trafficways.

   Where a driveway is provided to a non-residential use, the buffer area and adjacent border area shall be reasonably cleared so that either the establishment itself or any appropriate sign located outside the right-of-way can be seen at sufficient distance to enable proper and safe maneuvers on the part of drivers desiring to enter the establishment.

   The profile of a driveway and the grading of the buffer area shall be such that the driver of a vehicle that is standing on the driveway outside the edge of the trafficway has proper sight distance in both directions along the trafficway to enable the vehicle to enter without creating a hazardous situation. Driveway sight distance shall be the same as intersection sight distance or as approved by DPW. Attention is also directed to the A.A. County Zoning Ordinance regarding permissible height of objects adjacent to driveway areas, including slopes.

k. Signing: All commercial signs in conjunction with roadside establishments shall be placed outside the roadway right-of-way, and in accordance with the A.A. County Zoning Ordinance. Necessary official and standard signs located within the right-of-way shall be so positioned and mounted as not to obstruct the view along the trafficway on the part of driveway users. Traffic control devices, and regulatory and warning signs located on private property shall conform to MUTCD and the State's supplement thereto. For development projects, refer to the criteria in Appendix E.

3. New Residential Entrances for New Development

   a. Single-Family: All proposed entrances for single-family residences shall be located to allow safe stopping distance for the design speed of vehicles traveling on the public trafficway and allow minimum intersection sight distance for a vehicle exiting the driveway.

   b. Entrance of single-family residences on a corner lot shall be located off of the road with the lower ADT.

   c. Multi-Family: For multi-family residences the driveway(s) shall be located as to not affect the flow of traffic. A turning lane shall be provided at the discretion of the DPW. Entrance shall be located to allow minimum stopping distance for vehicles traveling along the road and minimum intersection sight distance for vehicles exiting the driveways.

   d. Median Openings: Median openings will not be permitted for residential driveway entrances. Median openings for multi-family residential areas will be permitted if approved by DPW. Where approval is given for median openings, turning lanes shall be provided unless waived by DPW.

I. Special Trafficways

1. Alleys

   The maximum permissible grade on alleys shall be the same as private entrances and stipulated in Paragraph II.H. herein. Minimum vertical sight distance allowable for alleys shall be 100 feet. Alleys shall follow the general pattern of the adjoining streets. Tangents may be used up to a deflection angle of 20 degrees, curves shall be used with a minimum radius of 100 feet, or the curve can be made with a series of short chords. At the intersection of an alley and a street, the angle shall be 90 degrees. The elevation of the outside edges of the alley shall be two inches lower than that of the finished grade of the adjoining property.

   Drainage design for alleys shall conform with, Chapter V, Storm Drains, of this Manual.

2. Cul-de-Sac, Alley Entrances, Driveways

   Permanent dead-end streets or roads with a circular turnaround (at the closed end shall be no longer than 600 feet. However, if approved by the County DPW, lengths up to 1000 feet are permitted where the topography or shape of the parcel make longer extensions necessary. The minimum radius of paving and right-of-way shall be in accordance with the Standard Details. Positive drainage shall be provided in cul-de-sacs and the gutter line shall be shown in a linear profile. Spot elevations shall be shown on the plan view of the contract drawings at a minimum every 45-degree interval indicating proposed top of curb or edge of paving elevations. Vertical profiles of the top of curb or edge of pavement will be required for radii 40 feet and greater. Cul-de-sacs shall be designed to accommodate Fire Department Emergency Vehicle turning radius - 47’ outside, 38’ inside.

Cul-de-sacs shall be consistent with local Fire Dept. regulations regarding whether parallel parking can be permitted. Off street parking must be provided in all cul-de-sacs. In the case of multi-family developments, the design professional must design off street parking areas. Traffic circulation provisions in parking area designs shall be reviewed and approved by OPZ and I&P. The Bureau of Highways, DPW, shall review and approve entrances onto County roadways.

3. Tee Turn-Arounds

If a street or road designed as a temporary dead-end street is to be extended into a through street at a future date, a tee turnaround shall be used in place of a cul-de-sac. The length and width of the turn-around (of "T" portion) shall equal the width of the right-of-way, to be no less than 46’ in length and no less than 20’ clear width. See the Standard Details for other pertinent dimensions.

J. Construction Affecting Existing Roadways

1. Utility Location and Trench Repair

The normal locations for the placement of utilities within an existing road right-of-way are shown in the Chapter 1. Where conditions are such that the use of normal location arrangement would be impractical an alternate arrangement shall be developed by the design professional and appropriate recommendations submitted to DPW for review and approval. All utility owners shall have their utility installation plans approved by DPW before any construction work is commenced. Utilities installed in existing roadways shall be permanently patched in strict accordance with the trench repair detail shown in the Standard Details and Section 2 below (Restoration of Roadways Affected by Excavations.

Utilities within existing or proposed trafficways shall be clearly shown and identified on the Contract Drawings in plan and profile. The design professional shall thoroughly investigate the relationship between the existing utility locations and the proposed design improvements. Utilities to be relocated, protected, etc. shall be so indicated on the Contract Drawings. These relocations shall be coordinated with the Utility Owner by the design professional and appropriate schedules and construction cost provided to the County.

2. Restoration of Roadways Affected by Excavations

a. If any individual, company, government agency or property owner within a two year period makes three excavations within a 500 foot length of right-of-way pavement with a condition rating of 90 or above, they, at the time specified in subsection (e) of this section, shall mill to a depth of 1.5 inches and resurface the travel lane or lanes for a minimum length of 100 feet and a maximum length of 500 feet.

b. If any individual, company, government agency, or property owner makes a longitudinal excavation of 20 feet or more in right-of-way pavement with a condition rating of 90 or above, they, at the time specified in subsection (e) of this section, shall mill to a depth of 1.5 inches and resurface the travel lane or lanes for a minimum length of 100 feet and a maximum length equal to the length of the excavation.

c. If any individual, company, government agency, or property owner within a two year period makes three excavations within a 100 foot length of right-of-way pavement with a condition rating of greater than 70 but less than 90, they, at the time specified in subsection (e) of this section, shall mill to a depth of 1.5 inches and resurface the travel lane or lanes for the 100 foot area.

d. If any individual, company, government agency, or property owner makes a longitudinal excavation of 100 feet or more in right-of-way pavement with a condition rating of greater than 70 but less than 90, they, at the time specified in subsection (e) of this section, shall mill to a depth of 1.5 inches and resurface the travel lane or lanes for a minimum length of 100 feet and a maximum length equal to the length of the excavation.

e. All milling and resurfacing required by this section shall be accomplished within 90 days following completion of the permanent patches, unless this time is extended by the department.

f. This section applies to any excavation of any size for any reason. Pavement restoration shall be performed for any pavement cut or hole in accordance with the Standard Details. If procedures and specifications for manhole repair, valve adjustment, utility test pit or small repair are not listed under County specifications, then the MDOT SHA specifications shall apply.

3. Maintenance of Traffic in Construction Areas

a. DPW Consultation: The design professional shall consult with DPW Traffic Engineering Division to ensure compliance with the existing requirements on the location; type and size of traffic control devices in place or to be installed, work restrictions including working hours and lane or shoulder closures.

b. Manual of Uniform Traffic Control Devices (MUTCD): Reference shall be made to the MUTCD for the location and type of device best suited to aid in the safe and efficient flow and control of traffic. Traffic shall include both motorized and non-motorized traffic.

c. Traffic Control Plan: A traffic control plan shall be prepared by the design professional and included as part of the Contract Documents for each project, unless otherwise directed by DPW. The traffic control plans shall designate traffic controls required during the various phases of construction indicating signage, detours, temporary trafficways, and other such devices to ensure existing traffic (vehicular and pedestrian) is maintained and is carefully and safely directed and controlled during construction. The traffic control plan shall designate work restrictions and working hours. For developer projects, traffic control plans will be required where the proposed construction of new facilities are tied into existing trafficways.

d. Detours: Any proposed road closure that requires a detour shall be approved by the Director of DPW.

III. CONTRACT DRAWINGS AND DOCUMENTS

A. Reports

When required by DPW, the design professional shall prepare a report which shall address the need for a new or improved trafficway. This report shall include impacts, both social and economic, for a built and non-built improvement and provide recommendations with justifications of the action that should be implemented.

B. Design Calculations

The design professional shall submit all design calculations prepared in connection with the project to DPW for review and approval. The calculations shall be submitted along with the Contract Drawings and shall be as specified in the General Instructions, Chapter I of this Manual. Any deviation from the criteria of this manual shall be so noted at the time of submittal. The design professional shall also submit survey information with the plans on the permanent control marker, which were required to be established.

C. Contract Drawings

Contract Drawings shall be submitted to DPW for review and approval at each required design phase.

1. Street Names

The names of all trafficways shall be clearly identified and lettered in bold heavy letters along the right-of-way such that it does not interfere with other pertinent information on the drawing.

All road or trafficway names on each drawing shall be placed in the same relative position and be of the same size lettering.

2. Widths of Rights-of-Way, Pavement and Easements

Widths of existing and proposed rights-of-way and pavements for each trafficway shall be shown by dimensioning. Slope easements, utility easements, and rights-of-way which intersect proposed or improved trafficway rights-of-way shall be clearly identified and dimensioned accordingly.

3. Topography

The location of all structures and topographic features shall be accurately shown, including poles, wells, septic systems, shrubs, trees, hedges, utilities, property markers, walls, buildings and other structures. This topography shall be obtained and shown on the drawings a minimum of 100 feet beyond right-of-way lines, 200 feet beyond the ends of trafficways or beyond approved limits of work, and 200 feet in each direction from an intersection. Standard symbols are shown in General Instructions, Chapter I. These indicated distances are the minimum requirements. Actual site conditions will determine if additional topography is warranted beyond the above minimum distances. The design professional is responsible to ensure adequate design information is shown on the drawings.

4. Coordinates, Bearing and Ties

All horizontal survey control (traverse) shall be identified at each control point by station and coordinates. Traverse lines between the control points shall be stationed and bearings shall be shown on each traverse line. All traverse control points shall be referenced to permanent objects not affected by the proposed construction, and shall be shown by reference diagrams on the Contract Drawings.

Bearings of trafficway centerlines and coordinates of centerline P.C.'s, and P.T.'s and of intersecting trafficway centerline P.I.'s shall be shown along the respective centerlines.

In addition to the above requirements, all P.I.'s, P.C.'s, P.T.'s and other points that are needed to re-establish the centerline of the trafficway shall be referenced to permanent features or guarded hub stakes that will not be disturbed by construction prior to the completion of all work.

The location and description of all reference points and the distance or angles to the centerline control points shall be shown on the Contract Drawings.

5. Horizontal Curve Information

Centerline curve information for each horizontal curve shall be tabulated on the plan sheet and the curve data is shown in the following order:

Δ = ______°______'______" (External Angle)
DC = ______°______'______" (Degree of Curve)
CR = ________ ft. (Centerline Radius)
T = ________ ft. (Tangent Length)
L = ________ ft. (Length of Curve)
E = ________ ft. (External)

Should a spiral curve be incorporated into the proposed facilities the same relative data shall be shown on the drawings, and shall be labeled and identified as shown in latest AASHTO's "A Policy on Geometric Design of Highways and Streets".

6. Stationing

Stationing along the surveyed horizontal control traverse and trafficway centerlines shall be in even 50-foot stations, indicated by a small circle and the station number. Stationing along horizontal curves shall be indicated in like manner.

P.C.'s and P.T.'s of horizontal curves shall be indicated by a small double circle on the centerline, and their stations shown to the nearest hundredth of a foot. Drainage structures and pipes with pipe diameters and direction of flow shall be shown. Flood plain and wetland areas shall be shown and identified.

7. Vertical Profiles

Vertical profile plans shall be provided within the contract documents in a scale matching the horizontal scale plans for each new baseline and any reconstructed trafficways. Vertical curve information shall be calculated and provide the following: PVIs, PVCs, and PVTs of parabolic curves, length of curve (L), vertical offset (E), stopping sight distance (SSD), K value, high point and/or low point.

D. Contract Specifications

Proposed work not covered by Anne Arundel County Standard Specifications for Construction of Water Mains, Sanitary Sewers, Storm Drains, Streets and Roads, dated 2024 or latest edition, and subsequent revisions thereof, shall be covered by Special Provisions in the contract specifications.

E. Estimates of Quantities and Costs

The design professional shall furnish detail construction cost estimates including all quantities and costs to complete all proposed work shown on Contract Drawings including fixed price contingent items with every design phase submission. The design professional shall, throughout the duration of the capital project, notify the County of any significant additions that would require additional funds for construction so that adequate funding may be appropriated prior to the bidding process, or the project scope revised accordingly.

F. Cross-Sections

The design professional shall prepare cross-sections for all proposed road construction or widening of County owned roads. Cross-sections shall be plotted at a natural scale of not greater than 1 inch = 5 feet. Cross-section sheets shall be kept neat and legible and shall be a part of the Contract Documents. Cross-sections shall be plotted at 50-foot station intervals and at intersecting roads, drives, or entrances.

Cross-sections shall show at a minimum existing ground, proposed ground, tie-in points, right-of-way lines and easements. Cross-sections, where shown, shall take precedence over typical sections.

G. Parking Restrictions

The design professional shall prepare plans for all proposed roadways under the following parking restrictions:

1. Roadway width greater than 36’ shall allow for 2 sided parallel parking.
2. Roadway widths between 28’ - 36’ shall allow for 1 sided parallel parking.
3. Roadway width less than 28’ - NO PARKING on either side of the roadway.
4. The design professional shall mark NO PARKING on plans and add statement to proposal and plans.

IV. APPENDIX

A. References

B. Road and Street Contract Drawing Check List

C. Sight Distance at Intersections

D. Guidelines for Traffic Impact Studies

E. Anne Arundel County Standards for Gatehouses, Fences and Community Signs within County Right-of-Way

F. Anne Arundel County Guidelines for Traffic Control Devices, Street Lights and Street Trees for New Development Projects

G. Anne Arundel County Standard Cross-Section Requirements.

REFERENCES

(1) Highway Capacity Manual, Transportation Research Board.

(2) "A Policy on Geometric Design of Highway and Streets", AASHTO (2018-Latest Edition).

(3) "Manual on Uniform Traffic Control Devices for Streets and Highways", Federal Highway Administration.

(4) "Transportation Planning Handbook", Traffic Engineering Handbook, Institute of Transportation Engineers.

(5) "Manual of Traffic Engineering Studies", Institute of Transportation Engineers.

(6) "Traffic Trends," Bureau of Traffic Engineering, State Highway Administration, Maryland Department of Transportation.

(7) "Trip Generation" Informational Report, Institute of Transportation Engineers.

(8) "Guidelines for Driveway Design and Location," Institute of Traffic Engineers.

(9) Anne Arundel County Zoning Ordinance. (this is part of the Code - below)

(10) Anne Arundel County Code.

(11) "Americans With Disabilities Act, Accessibility Guidelines Checklist for Buildings and Facilities," U.S. Architectural and Transportation Barriers Compliance Board.

(12) "Roadside Design Guide", AASHTO (Latest Edition)

(13) "Road Rating System User Manual", Anne Arundel County Department of Planning and Code Enforcement.

(14) "Traffic Signal Design Guidelines for State/Local Agencies and Private Developers", Maryland State Highway Administration.

(15) “Maryland State Highway Administration Guidelines for Traffic Barrier Placement and End Treatment Design”

(16) “AA County Traffic Engineering Draft Roundabout Design Guidelines”

(17) MD SHA Roundabout Design Guidelines

CHECK LIST

ROADS AND STREETS CONTRACT DRAWINGS

LOCATION:

DATE:

CHECKED BY:

– PLAN –

A. SUPPLEMENTARY INFORMATION.

1. PROPERTY -- ALL LINES ABUTTING TRAFFIC WAY RIGHT-OF-WAY SHOWN IN PROPER SYMBOLS.
2. PROPERTY -- EXISTING RIGHT-OF-WAY SHOWN AND DIMENSIONED.
3. PROPERTY -- SUBDIVISION PLAT BOOK AND FOLIO NUMBERS WHEN AVAILABLE.
4. PROPERTY -- SUBDIVISION LAYOUT CHECKED WITH FINAL SUBDIVISION PLAT.
5. PROPERTY -- SUBDIVISION NAME, SECTION, BLOCK LETTER WHEN AVAILABLE.
6. TOPOGRAPHY -- FIELD RUN CHECKED FOR POLES, FENCES, BUILDINGS, DRIVEWAYS. HYDRANTS. SHRUBS. TREES. PAVEMENT WALKS, SYMBOLS. ETC.
7. TOPOGRAPHY -- CARRIED 100' BEYOND RIGHT-OF-WAY LINES AND 200' BEYOND ENDS OF TRAFFIC WAYS OR BEYOND APPROVAL LIMITS.
8. TOPOGRAPHY -- SHOW EXISTING PAVEMENT AND LABEL TYPE OF SURFACE.
9. UTILITIES -- SHOW STORM DRAIN FACILITIES BEING PREPARED: WITH PROPER SYMBOL.
10. UTILITIES -- EXISTING UTILITIES SHOWN AND LABELED.
11. LIGHTING – EXISTING STREET LIGHTING SHOWN AND LABELED.
12. SCALES -- SHOWN IN PROPER LOCATION.

B. PROPOSED ROAD AND STREETS (TRAFFICWAYS)

13. TRAFFICWAYS -- NAMES OF ALL TRAFFICWAYS IN PROPER POSITIONS.
14. TRAFFICWAYS -- LIMITS OF CONTRACT CLEARLY DEFINED.
15. TRAFFICWAYS -- LIMITS OF NEW RIGHT-OF-WAY SHOWN AND DIMENSIONED.
16. TRAFFICWAYS -- LIMITS OF NECESSARY EASEMENT SHOWN AND DIMENSIONED.
17. TRAFFICWAYS -- WIDTHS OF PROPOSED PAVEMENT PROPERLY SHOWN AND DIMENSIONED.
18. TRAFFICWAYS -- CENTERLINES CORRECTLY SHOWN AND STATIONED.
19. TRAFFICWAYS -- COMPLETE BEARING INFORMATION.
20. TRAFFICWAYS -- CURVE DATA IN PROPER ORDER; CHECK COMPUTATIONS.
21. TRAFFICWAYS -- PROPER RADII RETURNS TO FACE OF CURB OR EDGE OF PAVEMENT.
22. TRAFFICWAYS -- P.I.s OF CURB LINES LOCATED AND LABELED.
23. TRAFFICWAYS -- DIRECTION OF FLOW ARROWS AT CURB RETURNS AND CRITICAL DRAINAGE POINTS.
24. TRAFFICWAYS -- SLOPES OF NON-STANDARD GUTTERS NOTED ON PLAN.
25. TRAFFICWAYS -- LOCATIONS OF CURB, GUTTER. INLETS, SIDE DITCHES, OUTLET DITCHES, SWALES OR MOUNTABLE CURB AND GUTTER SHOWN AND LABELED WHERE NECESSARY.
26. TRAFFICWAYS -- TYPICAL SECTIONS PROPERLY DRAWN AND LABELED.
27. TRAFFICWAYS -- GUARD FENCE OR BARRICADE POST LOCATIONS NOTED.
28. TRAFFICWAYS -- CUL-DE-SACS OR TEE STREETS CORRECTLY DRAWN: DIMENSIONED.
29. TRAFFICWAYS -- HORIZONTAL CURVES MEET REQUIREMENTS FOR DESIGN SPEED.

– PROFILE –

A. SUPPLEMENTARY INFORMATION

1. PROPERTY -- EXISTING GROUND ALONG PROPERTY LINES SHOWN WITH PROPER SYMBOL AND LABELED WITH SURVEY DATE.
2. TOPOGRAPHY -- EXISTING GROUND ALONG PROPOSED CENTERLINE SHOWN WITH PROPER SYMBOL AND LABELED WITH SURVEY DATE.
3. TOPOGRAPHY -- PREVIOUSLY ESTABLISHED GRADES LABELED WITH DATE OF ESTABLISHMENT AND ORIGINAL DRAWING NUMBER WHEN AVAILABLE.
4. TRAFFICWAYS -- EXISTING TRAFFICWAYS SHOWN AND LABELED.
5. TOPOGRAPHY -- EXISTING GROUND LINES OR TOP CURB LINES EXTENDED 200' AT TIE-INS OR BREAKS. HEIGHT OF EXISTING CURB FACES NOTED.

B. PROPOSED ROAD AND STREETS (TRAFFICWAYS)

6. TRAFFICWAYS -- NAMES OF ALL TRAFFICWAYS IN PROPER POSITION.
7. TRAFFICWAYS -- CENTERLINES OF INTERSECTING TRAFFICWAYS SHOWN AND LABELED.
8. TRAFFICWAYS -- TOP CURB GRADE OR CENTERLINE GRADE PROPERLY SHOWN AND LABELED.
9. TRAFFICWAYS -- PROFILES OF WARPED CURBS SHOWN WITH PROPER SYMBOL (ONE SOLID LINE: THE OTHER A DASHED LINE).
10. TRAFFICWAYS -- P.V.C.s, P.V.T.s INDICATED, AND P.I.s OF INTERSECTING CURB LINES INDICATED AND LABELED.
11. TRAFFICWAYS -- GRADE MEET MINIMUM AND MAXIMUM GRADIENT REQUIREMENTS.
12. TRAFFICWAYS -- TANGENT PERCENTS OF GRADE SHOWN TO TWO DECIMAL PLACES.
13. TRAFFICWAYS -- VERTICAL CURVES MEET SIGHT DISTANCE AND MINIMUM LENGTH REQUIREMENTS.
14. TRAFFICWAYS -- COMPLETE STATIONING AT 50' MINIMUM INTERVALS AND WHEREVER ELSE REQUIRED.
15. TRAFFICWAYS -- ELEVATIONS SHOWN AT 50' MINIMUM INTERVALS AND WHEREVER ELSE REQUIRED.
16. TRAFFICWAYS -- LINEAR PROFILE AROUND CUL-DE-SACS.
17. TRAFFICWAYS -- PROFILES CARRIED 200' BEYOND PROFILE LIMITS.
18. TRAFFICWAYS -- 200' MINIMUM OF PROFILE REPEATED AT BREAKS.
19. TRAFFICWAYS -- FINISHED CENTERLINE GRADE PROFILES SHOWN FOR ALLEYS AND ENTRANCES TO PARKING AREAS AS REQUIRED.
20. TRAFFICWAYS -- CHECK ALL COMPUTATIONS.

CROSS-SECTIONS

1. TRAFFIC WAYS -- NAMES OF ALL TRAFFICWAYS IN PROPER POSITIONS, WITH SCALE SHOWN. PREFERABLY 10:1 HORIZONTAL AND VERTICAL SCALE
2. TRAFFICWAYS – CROSS-SECTIONS TAKEN AT 50’ INTERVALS
3. TRAFFICWAYS – EXISTING GROUND AND PROPOSED GROUND SHOWN
4. TRAFFICWAYS -- AT A MINIMUM, THE FOLLOWING SHOULD BE SHOWN: PROPOSED CURB, SIDEWALK, SHARED USE PATH, AND RIGHT-OF-WAY LINES
5. TRAFFICWAYS – ELEVATIONS AND OFFSET GRIDS SHALL BE CLEARLY LABELLED.

– GENERAL –

1. CHECK RECOMMENDATI0NS OF PRELIMINARY SUBDIVISION SUBMISSION.
2. TITLE BLOCK --DRAFTER'S INITIALS, DESIGNER'S INITIALS, CHECKER'S INITIALS
3. GENERAL NOTES
4. TITLE OF DRAWING -- SUBDIVISION NAME AND SECTION, ELECTION DISTRICT, TRAFFICWAY NAME.
5. ENGINEER'S SEAL. OR ENGINEER'S SIGNATURE AND LICENSE NUMBER.
6. BENCH MARK REFERENCE AND DESCRIPTION. -
7. LOCATION PLAN -- SCALE I" = 1,000' PLUS SMALL SCALE WHEN REQUIRED; SITE OF PROPOSED WORK SHADED.
8. LOCATION PLAN -- NAMES OF PROPOSED AND ADJACENT TRAFFICWAYS.
9. LOCATION PLAN -- ARTERIAL STREETS LEADING TO SITES SHOWN.
10. PERMITS -- SERIAL NUMBERS OF PERMITS AS REQUIRED FROM STATE HIGHWAY ADMINISTRATION, MDE OR OTHERS.
11. NORTH ARROW PROPERLY ORIENTED.
12. THREE COORDINATE "TICS" LABELED AT MULTIPLES OF 100' OR 250’.
13. ADDITIONAL REVISIONS AS NOTED ON CHECK PRINT.

SIGHT DISTANCE AT INTERSECTIONS

MAJOR ROAD (2 LANES)									
Design Speed	Cross			Left Turn			Right Turn		
	P	SU	WB	P	SU	WB	P	SU	WB
30	290	380	470	335	430	520	290	380	470
40	385	510	625	445	570	690	385	510	625
50	480	630	780	555	710	855	480	630	780
60	575	755	930	665	850	1020	575	755	930
MAJOR ROAD (4 LANES)									
30	345	455	545	390	500	585	290	380	470
40	460	605	725	520	665	780	385	510	625
50	570	755	905	650	830	975	480	630	780
60	685	905	1085	780	995	1170	575	755	930
MAJOR ROAD (6 LANES)									
30	370	490	580	410	530	620	290	380	470
40	490	650	770	545	705	825	385	510	625
50	610	810	960	680	880	1030	480	630	780
60	730	970	1150	820	1060	1235	575	755	930

SIGHT DISTANCE AT INTERSECTIONS

See Figure 9-17 from AASHTO (2018) for sight triangles

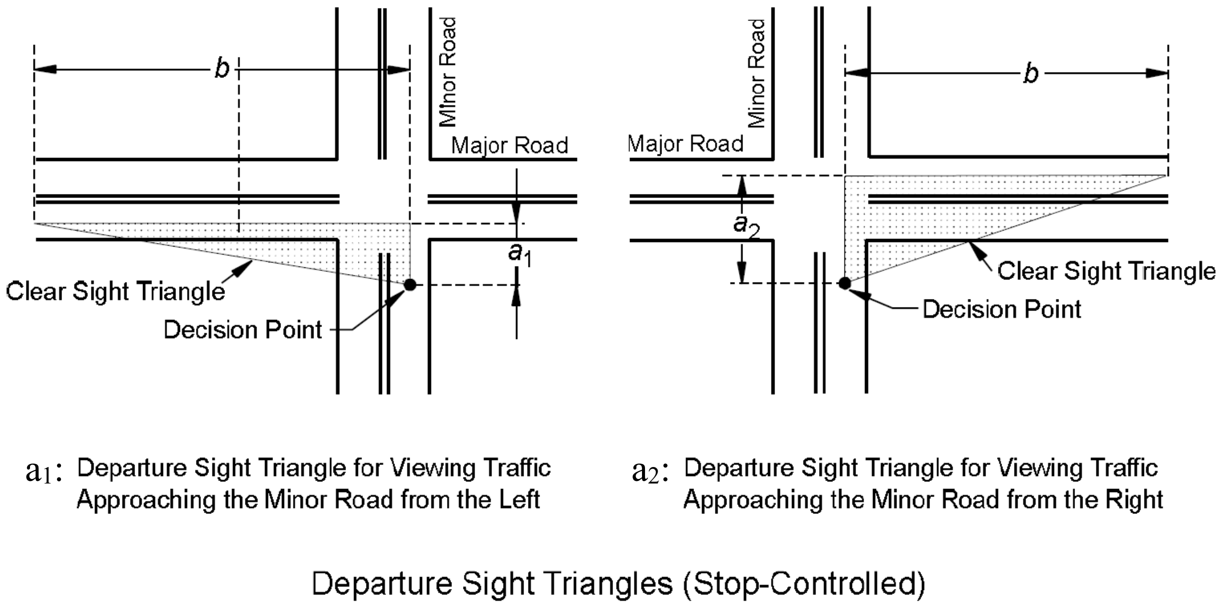

Figure 9-17. Departure Sight Triangles for Intersections

MULTI LANE SECTIONS INCLUDE MEDIAN OF 18 FEET WIDTH OR LESS. FOR WIDER MEDIANS, ANALYZE LEFT TURNS AND CROSSINGS AS TWO-STEP MANUEVERS

NOTES:
1. HEIGHT OF EYE: P = 3.50’, SU BUS AND WB = 6.0’
2. HEIGHT OF OBJECT: 3.50’
3. CHART IS BASED ON DESIGN SPEED OF MAJOR ROAD, PROPOSED OR EXISTING.
4. DISTANCES BASED OFF AASHTO (2018) SIGHT TRIANGLES (DISTANCE ‘b’ MEASURED IN FEET) AND EQUATION 9-1.
5. WHEN TRAFFIC TURNS ONTO AN UPGRADE OR DOWNGRADE, MULTIPLY THE SIGHT DISTANCES BY THE FOLLOWING:

GRADE	MULTIPLY BY
-6 % to -5%	1.2
-4 % to -3%	1.1
-3 % to 3 %	1.0
+3 % to + 6%	0.9

ANNE ARUNDEL COUNTY

DEPARTMENT OF PUBLIC WORKS

Traffic Engineering Division

GUIDELINES FOR TRAFFIC IMPACT STUDIES

1. When is a traffic impact study required?

   a. At final stage for any major subdivision.

   b. At building permit stage for planned commercial complexes.

   c. With any application for rezoning.

   d. At formal development plan stage for any development (major or minor subdivision, building permit, planned commercial complex) within either the Odenton or Parole Town Center Growth Management Areas.

   e. Before the hearing date for certain Special Exceptions (see Question 12).

2. What roads and intersections must be studied?

   a. In Town Center Growth Management Areas:

      - Intersections from the site access(es) out to and including the intersection with the first arterial, major highway, or State roadway in each direction.

      - Key intersections as identified by the County during the informal concept plan review.

   b. Elsewhere in the County:

      - Existing roads from the site out to and including the intersection with the first arterial, major highway, or State roadway in each direction.

      - Each of the first arterials, major highways, or State roadways in each direction to and including the intersection with the next arterial, major highway, or State roadway (in both directions).

      - Any intervening intersections designated by the County.

   c. Notes:

      - If a site enters directly onto an arterial, major highway, or State roadway, that road qualifies as the first arterial, major highway, or state highway. Note that if there is also an entrance onto a local or collector roadway, the analysis of that entrance route is as above.

      - Analyses need not be carried past the County's exterior boundary or into the City of Annapolis (except on County maintained roadways, such as Forest Drive).

- Arterial roadways built within a subdivision will be considered as internal subdivision streets, not as the first arterial to be studied.

- A continuous arterial route consisting of more than one road name (New Cut Road to Gambrills Road, for example) shall be considered as one arterial if so shown on the County's road network and classification plan.

- At the request of the developer (with justification submitted by the developer), The Permit Center may reduce or eliminate roadways from the study based on minimal impact or excessive distance. Distance is considered relative to the impact (size) of the development. The Permit Center will not eliminate the Traffic Impact Study requirement for any development parcel expected to generate 100 or more trips per day.

- In the Odenton and Parole Town Center Areas, the County may relieve the developer of the need to conduct a formal traffic study where it can be demonstrated that the proposed development will have a minimal impact on roadways. The Permit Center will not eliminate the need to conduct a traffic study for any development expected to generate 100 or more trips per day.

3. What traffic must be included in the study?

   a. For developments within Town Center Growth Management Areas:

      - Existing Traffic;

      - Traffic to be generated within the Town Center Growth Management Area as a result of:

         i. Building permits that have been issued and are expected to generate more than 250 vehicle trips per day;

         ii. Pending building permits expected to generate more than 250 vehicle trips per day that have had a Traffic Impact Analysis approved by PACE; and

         iii. Approved Subdivisions.

   b. Traffic to be generated outside the Town Center Growth Management Area that will impact intersections that are required to be studied and that is the result of:

      - The issuance of all building permits expected to generate more than 250 vehicle trips per day; and

      - Approved Subdivisions; and

      - Traffic projected to be generated from the proposed development.

   c. For developments elsewhere in the County:

- Existing traffic volumes.

- Traffic projected to be generated from building permits which will generate more than 250 trips per day.

- Traffic projected to be generated from subdivisions for which final plats have been approved.

- Traffic projected to be generated from subdivisions for which sketch plans have been approved.

- Traffic projected to be generated from the proposed development. Studies for rezoning cases must consider the maximum trip generation possible for the proposed rezoning, regardless of any suggested development plan. Studies for industrial/business parks must consider the maximum trip generation allowed based on buildable acres within the park.

- Alternately, studies can determine an acceptable mix of uses. The design professional will be required to submit backup data to support any assumptions. Field surveys of existing developments in the area and information as to business types from the Permit Application Center will be required to support these assumptions. Once DPW has this information, they will meet with The Permit Center to determine if these assumptions are acceptable.

- While all the preceding traffic must be included in the study, the determination of the need for road improvement will not include traffic projected to be generated from subdivisions for which only sketch plans have been approved. This may require analyses of several alternate scenarios assuming nearby sketch subdivisions proceed before or after the proposed development.

d. Traffic from other proposed developments must be considered if it can reasonably be expected to impact the roads and intersections under study. At a minimum, this will include all other developments whose traffic impact study area would overlap or abut the proposed development's traffic impact study area. It may also include other development farther away.

4. How should the study be organized and presented?

a. In an organized, logical, and neat fashion.

b. With the project name and number clearly identified on the cover.

c. With all assumptions clearly stated and documented.

d. With all backup material provided.

e. Required form:

- Description of existing conditions, roads, and traffic volumes

- Location map

- Description of proposed development: scope, size, type of development, schematic map

- Other nearby developments

- Traffic generated by other development (amount, distribution, splits)

- Traffic generated by proposed development (amount, distribution, splits)

- Total traffic volumes (Note: It is helpful to provide a series of maps/diagrams showing (a) Existing traffic, (b) Other development traffic, (c) Total background (a+b) traffic, (d) Site traffic, (e) Total (c+d) traffic for both AM and PM peaks).

f. Required analyses:

- "Simplified" critical lane analysis (per Mcinerney/ Petersen article) of all intersections (see also Question 2, "What roads and intersection must be studied?").

- Highway Capacity Manual (HCM) intersection analysis for any intersection with a total critical volume (see paragraph a. above) of 1300 or more.

- Signalization studies for intersections designated by the County. Such studies shall compare projected traffic volumes to signalization warrants contained in the Manual on Uniform Traffic Control Devices (MUTCD).

- For developments not within a Town Center Growth Management Area, the following analyses will also be undertaken:

- HCM capacity analysis for all roadway segments (must use HCM worksheets or FHWA software).

- AA County Road Rating analysis for all roadway segments.

- Analyses will normally be required for morning and evening peak hours (based on the adjacent roadway peak). Where the development's peak occurs at significantly different times than the adjacent roadways, other analyses may be required (midday, weekend, etc.).

- Description of improvements required to bring roads/intersections up to applicable standards (Note: Study may assume all State or County projects with 30% construction funding appropriated, not programmed - and all private developer projects covered by a PWA as being in place. However, the study must address the capability of these improvements to carry projected traffic.).

g. Acceptable assumptions

- The County will generally accept trip generation rates found in the latest edition of the Institute of Transportation Engineers' (ITE) Trip Generation Report. This report provides three methods to determine average trip generation for proposed developments: a weighted trip generation rate, a plot of actual trip ends versus an independent variable, and a regression equation.

- Design professionals will be required to use whichever method provides the best fit for the data. For example, if the regression equation for a particular use has a high correlation factor and the averaged trip rate for that use has a large standard deviation, the regression equation should be used. This will require a careful analysis of data for each use. Again, the design professional should determine which method provides the best fit for the type and size of the proposed development. Questions of interpretation should be directed to PACE, which will make the final determination of what method will be used.

- Other sources for trip generation rates will be considered if sufficient documentation is provided. This will generally apply only to uses not covered by the ITE report.

- Trip distributions for new traffic should be based on the proximity of trip generators and attractions and on existing travel patterns.

- Existing traffic volumes should be based on current count information. Three to seven day machine counts should be used to determine daily and peak volumes along roadway segments, and peak hour turning movement counts should be used to determine peak intersection volumes. Counts from one to three years old must be increased by 4% per year. Counts older than three years may not be used (see also Question 11, "What information is available to assist in the preparation of a traffic impact study?").

- Where peak hour counts are not available, the County will consider the use of an assumption that the peak volume equals 15% of the average daily traffic volume.

- Peak hour counts should generally not be used to determine average daily traffic. In unusual cases, the County will consider the use of an assumption that the ADT equals 20 times the peak hour volume.

- The County will allow the assumption of intercepted pass-by trips for certain retail and service uses. General guidelines include:

    i. Service Stations - up to 60% interception

    ii. Convenience stores - up to 60% interception

    iii. Retail (less than 100,000 s.f.) - up-to 50% interception

iv. Retail (over 100,000 s.f.) - up to 25% interception

- These guidelines may be altered (by the County) for specific sites. If intercepted pass-by trips are assumed, care must be taken to properly route all trips through all affected intersections and roadways.

- Please note that the County will allow consideration only of intercepted pass-by trips; that is, trips that would already be on the adjacent roadway(s). Trips that would be diverted from other roadways must be considered as new trips.

5. What standards will apply?

a. Intersections must operate at Level of Service (LOS) D or better as determined by the critical lane method (critical lane volume of 1450 or less). Intersections with a total "simplified" critical lane volume of more than 1300 must also be analyzed using the 1994 HCM. This analysis is to determine if any approaches have individual unacceptable levels of service (E or F). If an approach does fail, the study must address what the development's impact is and what actions are required to improve the service level to D or better. The Permit Center will review these analyses and make a recommendation regarding what improvements, if any, should be required of the developer.

With the approval of The Permit Center, intersections in the core of the Parole Town Center Growth Management Area may operate with a critical lane volume of less than 1600.

b. For developments not within a Town Center Growth Management Area, the following standards will also apply:

- Roadway segments must operate at LOS D or better as determined by the 1994 HCM.

- Roadway segments must have a County Road Rating system score of 70 or greater.

6. What if standards are not met?

a. For developments within a Town Center Growth Management Area:

- If the traffic generated to or from a site fails to meet the standards, a site may not be developed unless an applicant agrees to make improvements to each substandard intersection that bring the intersection's critical lane movements to an acceptable level or undertakes one or more of the actions listed below in the following order of preference, as directed by The Permit Center:

i. Construction of one or more roads that will have a positive effect on the substandard intersection and will bring the intersection's critical lane movements to an acceptable level;

ii. Contributions to a County Capital Project for road improvements and construction in the Town Center Growth Management Area;

iii. A significant Capital Improvement that will improve the County's ability to provide public transportation in the Town Center Growth Management Area; or

iv. An acceptable paratransit operation or ride-sharing program to mitigate traffic impact.

b. For developments elsewhere in the County:

- In most cases, failure to meet standards will result in a recommendation against the proposed development unless:

  i. The developer agrees to make those improvements necessary to meet standards, or

  ii. A waiver to meeting Adequate Public Facilities (APF) standards is requested and granted through The Permit Center.

- In those cases where a roadway segment or intersection is failing due to regional traffic, the developer will only be required to provide improvements sufficient to offset the proposed development's impact. At intersections, this mitigation will be measured in terms of critical lane volumes. Along roadway segments, actual per lane volumes will be measured. Mitigation will be measured assuming background traffic including existing traffic and traffic from all subdivisions with final approval and traffic from approved major building permits. (Note: The waiver process is also available in this case.)

7. What is regional traffic?

a. Traffic will be considered to be "primarily attributable to regional development and traffic patterns" only if the developer shows that all of the following conditions are met:

- The roadway (or one roadway at an intersection) is a County arterial or State highway, and

- At least 70% of the peak hour traffic volumes are not bound to or from sites in the near (within three miles) vicinity, and

- The roadway, or connecting County arterial or State highways, continue for at least five miles in each direction.

8. When will The Permit Center support a waiver of APF requirements?

a. The Permit Center will support waiver requests only if one or both of the following conditions is met:

- The Permit Center (and State Highway Administration, if applicable) believe the required numerical analyses do not accurately reflect operating conditions based on their field observations and professional judgment. It is anticipated that this condition will be met only in very rare instances.

- The improvements proposed by the developer will result in overall improvement in traffic operations even if some locations still fall short of standards. This will normally involve the provision of some improvements not required to meet standards in return for waiving of other improvements, which would be required. Examples might include providing 4-foot wide shoulders along an entire roadway instead of 8-foot shoulders in only one section, or elimination of a reverse curve with adverse cross-slopes instead of widening an entire roadway from 22 to 24 feet.

b. In order for a waiver to be considered, the developer must address the following questions:

- What are the existing conditions?

- What improvements are required to meet standards (include cost estimate)?

- What, if any, improvements are proposed (include cost estimate)?

- What level of service will result?

c. PACE is specifically prohibited from supporting waivers solely on the grounds of economic hardship.

9. When should the traffic impact study be submitted?

a. For developments within a Town Center Growth Management Area, the traffic impact study must be submitted with the formal development plan submittal.

b. For subdivisions outside of Town Center Growth Management Areas, the traffic impact study must be submitted with the final review submittal. PACE will not accept a final submittal that does not include a traffic impact study. The developer may submit the traffic impact study earlier, if desired, to identify any problem that need to be addressed. Early submittals may be made with the sketch submittal or directly to the Traffic

c. Engineering Division (with a copy of the cover letter to The Permit Center). Traffic Engineering will review and comment on early submittals, but will withhold approval of the traffic impact study until final stage in case changes occur.

d. For planned commercial complexes outside of Town Center Growth Management Areas, the traffic impact study must be submitted not later than building permit submittal. In order to avoid problems and delays, it is preferable to submit the study directly to The Permit Center before the building permit application is submitted. The Permit Center will review and comment on the study, but withhold approval until the building permit application is reviewed. A copy of the study should be resubmitted with the permit application.

e. For rezoning cases, the traffic impact study should be submitted as early as possible—preferably with the application. In any event, the study must be submitted four weeks in advance of the hearing date to assure adequate time for review, comments, and revisions.

10. For developments outside of Town Center Growth Management Areas, what is required at sketch stage?

    a. At sketch stage, the developer must submit an estimate of the trips to be generated by the subdivision and a list of roadways and intersections to be studied. PACE will review and comment on the acceptability of this information. The developer is required to also submit a list of other nearby developments to be included in the study. This will help assure that the final study is not done without including required developments.

    b. The submission of a full traffic impact study at sketch stage will satisfy these requirements.

11. What information is available to assist in the preparation of a traffic impact study?

    a. Developers should contact The Permit Center to review their subdivision activity map. This will identify other nearby subdivisions which may need to be included in the study.

    b. Developers may request information from the DPW's Traffic Engineering Division. Traffic Engineering will provide copies of available turning movement and volume counts, as well as information from other approved traffic studies. If nearby developments do not yet have an approved study, the Traffic Engineering Division will supply information on anticipated traffic generation to the best of its ability. Traffic Engineering will also supply copies of Road Rating information. All requests for information from the Traffic Engineering Division should be made in writing. Every effort will be made to respond within one week. Developers and design professionals should not expect that they will be able to pick up information from the Traffic Engineering Division without advance notice.

    c. Inspections and Permits should be contacted for information about nearby major building permits.

12. What is required for Special Exceptions?

a. Special Exceptions require (among other conditions) the recommendation of The Permit Center and a finding that the proposed use will not conflict with an existing or proposed road (County Code, Article 28, Section 12-104). A traffic impact study may be required for particular proposed uses. In no case will the study requirements be more rigorous than those for studies required under the Adequate Facilities Ordinance. Applicants should discuss their proposed use with PACE well before the hearing date to determine what level of study is required. Any required study must be submitted at least four weeks prior to the hearing to assure that comments and recommendations are available at the hearing.

Intersection Capacity Measurement Through Critical Movement Summations: A Planning Tool

by Henry B. McInerney and Stephen G. Petersen

The critical movement technique discussed in this article, was improvised not to replace the analysis techniques in the Highway Capacity Manual, but to meet the need for presenting a picture to the layman of how an intersection operates without losing him in a discussion of peak-hour factors and G/C ratios. The method was valuable in examining a group of intersections to determine those most able to absorb the load from a new employment center. The evaluation of the most favorable routes from a capacity standpoint led, in turn, to the provision of routing maps to employees based on the parking lot to which they were assigned. Because the technique dissects the various turns and through movements, it is possible to quickly determine which intersection improvement will do the most for improving capacity.

Another use of the technique is to determine the increment of development which can be added as a result of each change in intersection configuration. Caution has to be exercised in this application because one is dealing in differences rather than comparing totals against a standard.

Use of the technique to date has been related principally to site planning, but two other diverse applications have been suggested. One is as an algorithm for capacity restraint traffic assignments. In a network for an urbanized area, intersections are much more likely to determine capacity than links, yet present programs state capacity as a function of link volume.

At the opposite end of the spectrum, the technique can be useful as a quick check on the level of service at the intersections in a street network and possibly even as a rough warrant for signalization. It could be applied in reverse to a congested intersection to determine if it is operating as efficiently as possible. In a large traffic operations study, early identification of potential problem areas can be done with limited data through use of this tool. This makes the data collection effort a more productive process.

The traffic engineer engaged in planning frequently must evaluate the impact on traffic of proposed changes in land use. Estimates of generated traffic distributed over a new or expanded street system often must be made without the refinements available when an existing condition is being observed. Capacities must be determined, and this generally concerns intersection capacity since, at least in urban considerations, intersection conditions usually fix the capacity of the street system. By means of what can be called a critical movement method, intersection capacities can be developed easily.

While the Highway Capacity Manual (1965) and Public Roads[1] (Nos. 9 and 10, Vol. 34, 1967) cover the procedure for making

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This Traffic Engineering article results from the joint effort of the authors when Mr. McInerney was with AMV.

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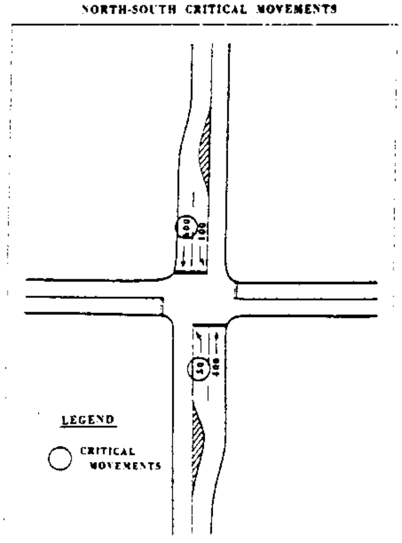
capacity determinations of at-grade intersections, when dealing with future conditions overly conscientious involvement with estimates of street widths, G/C ratios, peak-hour factor adjustments, and percentages of turns and trucks is often beyond the accuracy of the base data. The critical movement method, on the other hand, provides results which are reasonably consistent with those which could be obtained through conventional capacity analysis if it were possible to count the traffic which will be using an intersection in some future year.

the technique

Basically, the critical movement method applies a technique similar to that used in the analysis of diamond interchanges to a simple intersection. Early works[2,3] on capacity analysis of diamond interchanges define a "critical volume" above which a diamond interchange will fail unless additional lanes are added. This "critical volume" was determined by field work to be the sum of the volumes on a per lane basis of the four extreme approaches to the two at-grade intersections, taken as a system, created by a diamond interchange.

This same technique can be used on a simple intersection. At a simple intersection, the "critical movements" are the highest total of the through plus its opposing left in one direction on an hourly per lane basis (Figure 1). This total determines the green time requirement for that direction. For example, in Figure 1, 600 + 50 is greater than 400 + 100—assuming single lane flows—and therefore establishes the portion of an hour required for the N-S movement. Similarly, in Figure 2, the total of E-W critical movements is 450.

FIGURE 1
NORTH-SOUTH CRITICAL MOVEMENTS

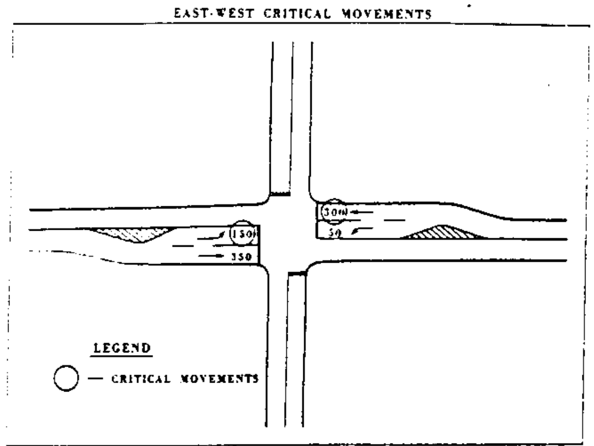


If the two directions are superimposed at an intersection, the total of the critical movements is 1,100.

The next problem is what to measure this number against. Several possibilities exist. A theoretical analysis in Matson, Smith & Hurd[4] set the maximum value of vehicles per hour passing over a given conflict point at 1,500, with 1,200 vehicles per hour set as the limit to avoid excessive cycle lengths.

A second possibility can be derived from a statement on page 126 of the **Highway Capacity Manual**: "Rarely can traffic move away (from a stop) at a rate greater than 1,500 vehicles per hour of green." If 50 percent of the traffic approaching a signal is stopped and has a departure capacity of 1,500 vehicles/hour/lane, and 50 percent is free flow at 2,000 vehicles/hour/lane, it is possible to cross 1,470 vehicles per hour over a given conflict point using a 50/50 split on the signal cycle and allocating 15 percent of the cycle to clearance intervals.

FIGURE 2
EAST-WEST CRITICAL MOVEMENTS



In addition to these, there are "rules of thumb" derived from experience. In one it is assumed each vehicle takes three seconds to clear the intersection—thus arriving at a capacity of 1,200 vehicles per hour. In another, through movements are estimated at 2.4 seconds per vehicle and turns at 3.6 seconds per vehicle. By multiplying vehicle volumes by these clearance values and comparing the total with 3,600, a measure is obtained.

The problem with these techniques is that they provide no measure against the **Highway Capacity Manual** and its "levels of service." The critical movement method, however, does.

correlating data

Data for this method were gathered at four heavily traveled intersections in the Virginia suburbs of Washington, D.C. Critical movement totals were developed for each intersection for levels of service "C" and "E" as shown below:

Intersection	Level of Service C (VPH)	Level of Service E (VPH)
I	1,225	1,475
II	1,205	1,445
III	1,185	1,455
IV	1,215	1,465

The average values for each condition are about 1,200 for level of service "C" and about 1,460 for level "E." In other words, if the volumes at an intersection are tabulated according to the rules set forth below, and the total of conflicting movements is around 1,200, it is reasonably safe to assume that the operation is at a "C" level of service or "design" capacity as defined by the American Association of State Highway Officials. If the total is in the 1,450 to 1,500 range, "E" level of service or "possible" capacity conditions can be expected. Between these two points, a value of 1,350 is a good indication of a "D" level of service. Over 1,500 there is little question of severe congestion and breakdown conditions.

Exclusive pedestrian phases, though, are one area for caution. These values are based on a full hour of movement through the intersection, assuming ambers are part of green time. A pedestrian phase reduces movement time available for vehicles, and the standard values should be reduced by an amount equal to the percentage the pedestrian phase is of the total cycle. The same is true for an all red phase in the signal cycle.

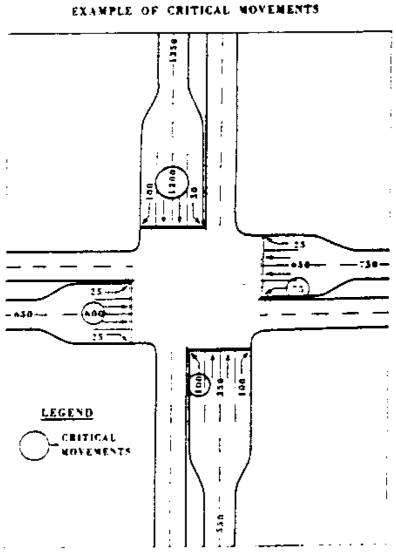
general rules of procedure

The engineer must know two things in order to proceed with a capacity analysis using this method: Turning volumes at the intersection under study and the number of lanes on each approach. Most important are the values for each critical movement, since these will give a good approximation of the level of service which can be expected with the given volumes and intersection configuration, assuming the signal controller and phasing will be efficient and result in minimum delay to all movements. It is best, in fact, not to think in terms of a specific signal phasing during the critical movement analysis, because it tends to restrict thinking about all the combinations of possible movements which will lead to a critical movement total. There is also no need to consider amber time since it is usually used to clear left turns. General rules for selecting conflicts, based on the sample volumes and intersection configurations in Figure 3, follow:

For north-south flow, (1) determine the volumes of through traffic (1,200 and 350 in this case); (2) compute the volume per lane for the through movement (600 and 175 for the two lane approaches shown); (3) determine opposite direction left turn volumes (100 and 50); and (4) add the through volume per lane and its opposing left turn (600 + 100 = 700, 175 + 50 = 225). The critical movements are the two which produce the largest sum —in this case, the southbound through and northbound left.

For east-west flow, the same procedure is followed. For Figure 3, volumes of through traffic are 600 and 650; volume per lane for through movement of the two approaches shown is 300 and 325; opposite direction left turn volumes are 75 and 25. The sum of the through volume per lane and its opposing left turn are 300 + 75 = 375 and 325 + 25 = 350. Therefore, the critical movements are the eastbound through and westbound left.

FIGURE 3
EXAMPLE OF CRITICAL MOVEMENTS



For the intersection, add the north-south and east-west critical movements (700 + 375 = 1,075), and compare with the standards for level of service. Since 1,075 is less than 1,200, the intersection in Figure 3 is operating at approximately level of service "B."

rules of procedure: other configurations

Intersections with turn lanes are the easiest to analyze by the critical movement technique, but other configurations also can be evaluated. Where the turn volumes are as light as those shown in Figure 3, and there are no turn lanes, the total approach volume is used. For example, if Figure 3 were a simple intersection of two 4-lane roads, the analysis would be as follows:

	N-S Flow		E-W Flow	
(1) Approach Volumes	1350	550	650	750
(2) Divide by Number of Lanes (2)	675	275	325	375
(3) Opposing Lefts	100	50	75	25
(4) Totals (2 + 3)	775	325	400	400
(5) Critical Movements (Larger value on line 4)	775		400	
(6) Intersection Total (sum of 5)	1175			
Level of Service	1175 < 1200; approximately "C"			

Another complication occurs when there are heavy left turns on multi-lane approaches without turn lanes. If one left is heavy enough to be considered a lane by itself, while the opposing left is light, the sum of critical movements is computed as described under the general rules except the approach with the heavy left is considered on a lane basis rather than dividing the total approach volume by the number of lanes. For example:

	East (2 lanes)	West (2 lanes)
L—	230	35
T—	365	235
R—	20	40
Total	615	310

Even though the left turn volume on the east approach is less than the through plus right, it is assumed that only lefts use the left lane because of the heavy through from the opposite direction. Thus, we compare

$(365 + 20) + (35) = 420$ with $\frac{310}{2} + 230 = 385$, and

select 420 as the sum of critical movements as shown.

However, if both left turns are heavy, the best method is to divide by the number of lanes and select the most critical combination:

	East (3 lanes)	West (2 lanes)
L—	200	230
R—	180	190
T—	430	360
Total	810	780

Since $\frac{810}{3} + 230 = 500$ is less than $\frac{780}{2} + 200 = 590$,

the latter is the critical movement total (see Figure 4).

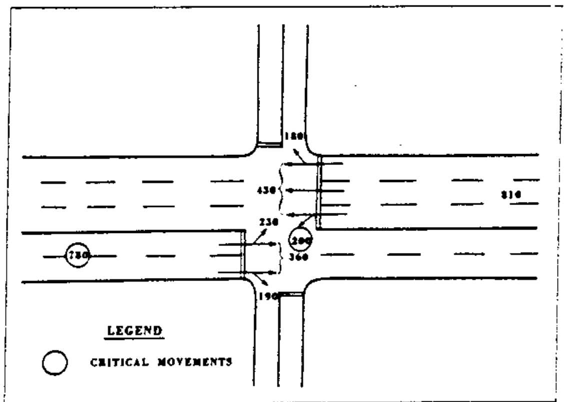
For situations where a double turn lane is needed, the 80 percent efficiency factor in the **Highway Capacity Manual** is applied. A turn volume of 360 vehicles in two lanes is divided by 1.8 and the heaviest lane volume of 200 is used in the critical movement analysis.

rules of procedure: one lane approaches

One lane approaches are the hardest to evaluate because the intersection operation becomes a function of whether or not through and right turn vehicles can "squeeze" by the left turner. On roads without curbs, the shoulder, whether paved or not, often becomes a lane. When curbs are present and only center line markings are used, streets less than 36 feet in width will usually not allow more than a single lane to pass. For planning purposes, it is rare that a single lane approach would be recommended for anything but a minor street, but there are occasions when such approaches must be evaluated and the following rules apply: For streets where the left can be bypassed, evaluate (through plus right)

FIGURE 4

EXAMPLE OF HEAVY OPPOSING LEFT TURN FLOWS



+ (opposing left) and select the pair of flows which give the highest total as the critical movement.

For streets where lefts cannot be bypassed, evaluate (through plus right plus left) + (opposing through plus right). Critical movements are the two flows with the highest total.

In addition, this technique can be applied to multi-legged intersections. In the case of a 3-legged intersection, right and left turns can often be phased together for more efficient utilization of the intersection and therefore a lower critical movement total. For more than 3 legs, a third set of critical movements is added to the total.

The critical movement method can be a useful tool in the traffic engineer's planning kit—one which provides results reasonably consistent with those that could be obtained through conventional capacity analysis if it were possible to measure the traffic that will be using an intersection at some future date.

A brief technical supplement describing the details of the field work used to develop the standards of comparison is available from the authors.

The authors acknowledge with appreciation the guidance provided by their AMV staff associates, particularly Dan Hoyt, a pioneer user of the critical movement technique for capacity analysis, and Steven Provost, for his review of several early drafts.

References:

[1]Journal of Highway Research, published by the U.S. Bureau of Public Roads.

[2]FREEWAY DESIGN AND OPERATIONS, HRB Bulletin 291 "Capacity Study of Signalized Diamond Interchanges," Capelle, D.G. and Pinnell, C. Highway Research Board, Washington, D.C. 1961 Pp. 1-25.

[3]FREEWAY OPERATIONS, HRB Bulletin 324, "Operational Study of Signalized Diamond Interchanges," Capelle, D.G., and Pinnell, C. Highway Research Board, Washington, D.C. 1963. Pp. 38-72.

[4]Traffic Engineering, McGraw-Hill, 1966. Pp. 336, 342.

Lane Use Factors for Traffic Impact Studies in Anne Arundel County

Number of lanes	Multiply total volumes in these lanes by:
1	1.0
2	0.55
3	0.4
4	0.3

NOTE: Exclusive turn lanes should be analyzed separately.

ANNE ARUNDEL COUNTY
STANDARDS FOR GATEHOUSES, FENCES AND COMMUNITY SIGNS WITHIN COUNTY RIGHT-OF-WAY
June 2, 1997

- In these standards, the term gatehouse includes any covered structure proposed as an entryway feature of a subdivision or development. The term community sign includes signs, fences, sculptures, and structures designed to identify the community.

- Gatehouses, fences and community signs are to be decorative only. They are not to be used to control access or for mail delivery. The only exception which will be considered is an open-sided bus shelter located outside of the roadway (not in the median).

- Gatehouses, fences and community signs are to be constructed and maintained by developer and/or community. Any gatehouse, fence or community sign within a County owned right-of-way will require an agreement with County which is to be recorded prior to plat approval and liability insurance in the amount of $500,000. The agreement shall specify:

  a) The County's right to approve the design, construction and location of the gatehouse, fence or community sign.

  b) The developer's/community's responsibility to maintain the structure in a manner acceptable to the County.

  c) A hold harmless agreement whereby the developer/community accepts full responsibility and liability for any claims arising from the construction, maintenance and/or presence of the structure.

  d) The County's right to require maintenance or removal of the structure.

  e) The County's right to maintain or remove the structure and to bill the developer/community to recover the cost of such action.

  f) That proof of insurance shall be submitted to the County yearly. If insurance is not maintained, the structure will be removed by the County at the developer's/community's expense.

- Preferred Location and Design

  a) Gatehouses - The preferred structure is open-sided and located outside the roadway (not in a median). Close-sided structures will be allowed outside the roadway or within a median subject to the conditions noted below under Construction Standards. No open-sided structures will be allowed within a median.

b) Fences - The preferred location is on private or community property, not within the public right-of-way. Fences will be allowed in the right-of-way only if they are within three feet of the right-of-way line and meet the conditions noted below under Construction Standards. Fences will not be allowed within medians.

c) Community signs - The preferred location is outside of the roadway near the edge of the County owned right-of-way. In addition, community signs must meet the requirements of Article 28, Section 8-115(b)(2 & 3) of the County Code, which notes that:

(2) "One sign giving the name of the subdivision or multifamily development may be placed at each roadway entry point. The sign may not exceed 36 square feet in area or a height of five feet above grade." Double sided signs with less than 18 inches of separation will be considered as a single sign.

(3) "Instead of the sign provided for in paragraph (2), one sign may be located at each side of the roadway entry point. Each sign may not exceed 20 square feet in area, the total area shall be 40 square feet or less and the height of each sign may not exceed five feet above grade".

The square footage of the actual sign and not the structure is considered in the measurement. Sculptures, statuary and other structures intended to identify the community will be reviewed on a case-by-case basis, but must at least meet the requirements for gatehouses as contained in these standards. No changeable messages will be permitted

Construction Standards - In this section, the term structure refers to any gatehouse, fence or community sign.

a) Structures are to be subject to all applicable building codes.

b) Structures are to be at least 25 feet behind the edge (curb or shoulder) of the cross road.

c) Structures are to be at least 2 feet behind curb or 6 feet behind the edge of the shoulder on roads with posted speed limit of 30 MPH or less. Distances are to be 6 and 8 feet respectively on roads with posted speed limit in excess of 30 MPH (except that no gatehouses or community signs shall be allowed in the median of a road with posted speed limit in excess of 30 MPH). These distances apply to structures located in medians. Structures in other locations shall not interfere with sidewalks or obstruct sight distance. The Department of Public Works will specify the appropriate speed limit. Speed limits will not be lowered to allow relaxation of these setbacks.

d) No utilities (except electricity when approved) will be allowed to serve the structure. Electricity shall be allowed only to provide lighting as approved by the Department of Public Works. Where electricity is allowed, the developer/community shall be responsible for all hook-up and on-going energy charges. All electrical work will require a County permit and shall be subject to all applicable codes. All circuits shall be protected by ground fault interrupters. Lighting shall illuminate only the intended gatehouse or community sign and shall not shine directly into motorists' lines of sight or beyond the right-of-way.

e) Closed-sided gatehouses will only be allowed if all windows are permanently closed (incapable of being opened) and the door is hinged to open into the structure and provided with a one inch throw deadbolt lock. The lock shall be keyed with a standard County specified key. The County shall be provided with a list of those developer/community officers (maximum of 4) holding keys. This list shall be updated and resubmitted to the County at least annually.

f) Maximum gatehouse footprint area is 100 square feet.

g) Maximum gatehouse height is 15 feet.

h) Plantings in the median are to be no higher than 24 inches above road surface.

I) All standards are subject to revision by the County on a case by case basis as needed to protect the health, safety and welfare of the general public.

Approved:

Steven R. Cover
Director of Planning and
Code Enforcement

John Brusnighan
Director of Public Works

Anne Arundel County Guidelines for Traffic Control Devices Street Lights and Street Trees for New Developments and Capital Projects

Traffic control devices (TCDs) include all signs, signals, lighting, and pavement markings placed on, over, or adjacent to a County roadway by the authority of the Director of Public Works to regulate, warn, and guide vehicular and pedestrian activity. The purpose of this policy is to provide guidance for the layout of signs, markings, signals, lighting, street trees, and pavement markings for inclusion in the Final Plan package.

Developers will prepare plans for traffic control devices, street lights, and street trees and submit them for approval once the roadway layout has been approved by the Office of Planning and Zoning. Developers will be responsible for the costs of signs and streetlights, but the County or its contractor will install them. The Developer's contractor under the supervision of Traffic Engineering will generally install signals and pavement markings.

A. General

1. Traffic signs, street lights (SL), and street trees (ST) shall be shown on a separate plan sheet (40 scale) included in the Final Plan package for all new development projects. This plan will include clear descriptions and locations of all required traffic control devices. Figure 1 provides a list of the standard symbols to be used in the plans. The sheets will also include locations of all driveways, utilities, intersections, edge of pavement, sidewalks, twin meters, required street trees and proposed and existing street lights so that conflicts can be avoided. All private roads should be labeled as such.

2. All costs associated with required TCDs for any new development will be paid for or bonded as appropriate under the Public Works Agreement for that project. Traffic Engineering will prepare a cost estimate once TCD/SL/ST plan is approved.

3. The developer will be required to include TCD/SL/ST plan sheet(s) with the Development Application. The Office of Planning and Zoning will forward the plans to Traffic Engineering Division for review and approval of signs and street light placement. Traffic Engineering will send their recommendations back to the Office of Planning and Zoning within 10 working days of receipt of the plan. The Office of Planning and Zoning will not approve any placement of signs or street lights unless they receive Traffic Engineering's agreement.

   Once the TCD/SL/ST plans have been approved, the developer will submit 5 copies to the Traffic Engineering Division. The Traffic Engineering Division will generate the cost estimate. The cost estimate and 2 copies of the TCD/SL/ST will be returned to the developer. The developer will include the approved TCD/ SL/ ST plans in their Public Works Agreement. The developer will notify the Traffic Engineering Division in writing once the new development is ready for street signs. The developer is responsible for the cost associated with replacement of any damaged street lights and sign until the county takes over the roadway. The Traffic Engineering Division will create necessary Notices of Traffic Control and work orders for the installation of signs and street lights.

4. All TCDs shall be in conformance with the Manual On Uniform Traffic Control Devices (MUTCD) and applicable State and County regulations. If there is a discrepancy between requirements, the Traffic Engineering Division shall be consulted for direction on what standards are to be followed. Developers are especially reminded that a State law adopted in 1998 requires all TCDs on private property to conform to the MUTCD.

B. Traffic Signs

1. The signing plan must be designed to provide the motorist with clear and concise regulatory, warning, and guidance information regarding the roadways within or adjacent to the development.

2. Traffic signs shall be located as close to property lines as possible in all new developments. Care must be taken to avoid placing signs at mid-lot locations.

3. The major exception to this is the acceptable practice of placing STREET NAME sign(s) and a STOP sign on the same channel. At times, a NO OUTLET or a DEAD END sign may also be added to this channel. Generally, only one traffic sign will be placed on a channel.

4. The Traffic Engineering Division may be consulted prior to TCD plan submittal to determine if additional signs are required due to unusual circumstances. Examples of this included the presence of schools, playgrounds, or sharp curves along a roadway. During the TCD plan review, it may be determined that additional signs will be required.

5. Refer to Figure 1 for a list of standard symbols that are to be used when developing TCD plans.

6. All traffic signs should be placed to provide adequate sight distances. Care must be taken to not obstruct the visibility of any traffic sign with street trees. Figure 2 illustrates the minimum clearances between street trees and signs/street lights. Figure 2 should also be included on the 40-scale street tree/street light/TCD plan.

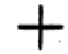
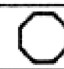
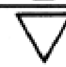
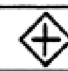
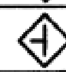
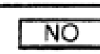
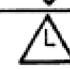
Traffic Control Device/Roadway Feature		Symbol
9" Street Name Sign (2 Blades)	SNS	
STOP Sign	R1-1	
YIELD Sign	R1-2	
Speed Limit Sign	R2-1	
Crossroad Warning Sign	W2-1	
T Intersection Warning Sign	W2-2	
Street Name Panel (Used with W2-1 or 2)	D3-2	
KEEP RIGHT Sign	R4-7	
DEAD END Sign (For SNS Assembly)	W14-1s	
NO OUTLET Sign (For SNS Assembly)	W14-2s	
Other Warning Signs	Wx-y	
Street Light		
Street Tree		

Figure 1 – Standard Symbols

Notes:
- Symbols to be ¼” – 3/8” in width
- Symbols to be centered on proposed location

7. STREET NAME Signs

   a. The standard designation for a STREET NAME sign is SNS.

   b. All SNS blades will be double-sided and nine inches in height with six inch lettering.

   c. One SNS installation will generally be required at new intersections. Two SNS installations will be required at each intersection along roadways that have medians or at those intersections where the street name changes from one side of the road to the other.

   d. If only one SNS is used at an intersection, it shall be installed on the higher volume cross-street leg.

   e. Refer to Figure 3 for additional information regarding SNS installations at the intersection of two County roadways.

   f. Refer to Figure 4 for additional information regarding SNS installations at the intersection of a County roadway and a State highway.

8. STOP Signs

   a. The standard designation for a STOP sign is R1-1.

   b. In general, the minor roadway(s) will be provided with a STOP sign at all County intersections. Refer to Figure 3 for additional information.

   c. When two residential roadways meet in a four-legged fashion, the road that intersects or is nearest to a collector or arterial roadway will typically be considered the major movement and the traffic on the other road will be required to stop. At a tee-intersection, the traffic on the base of the tee shall generally be required to stop.

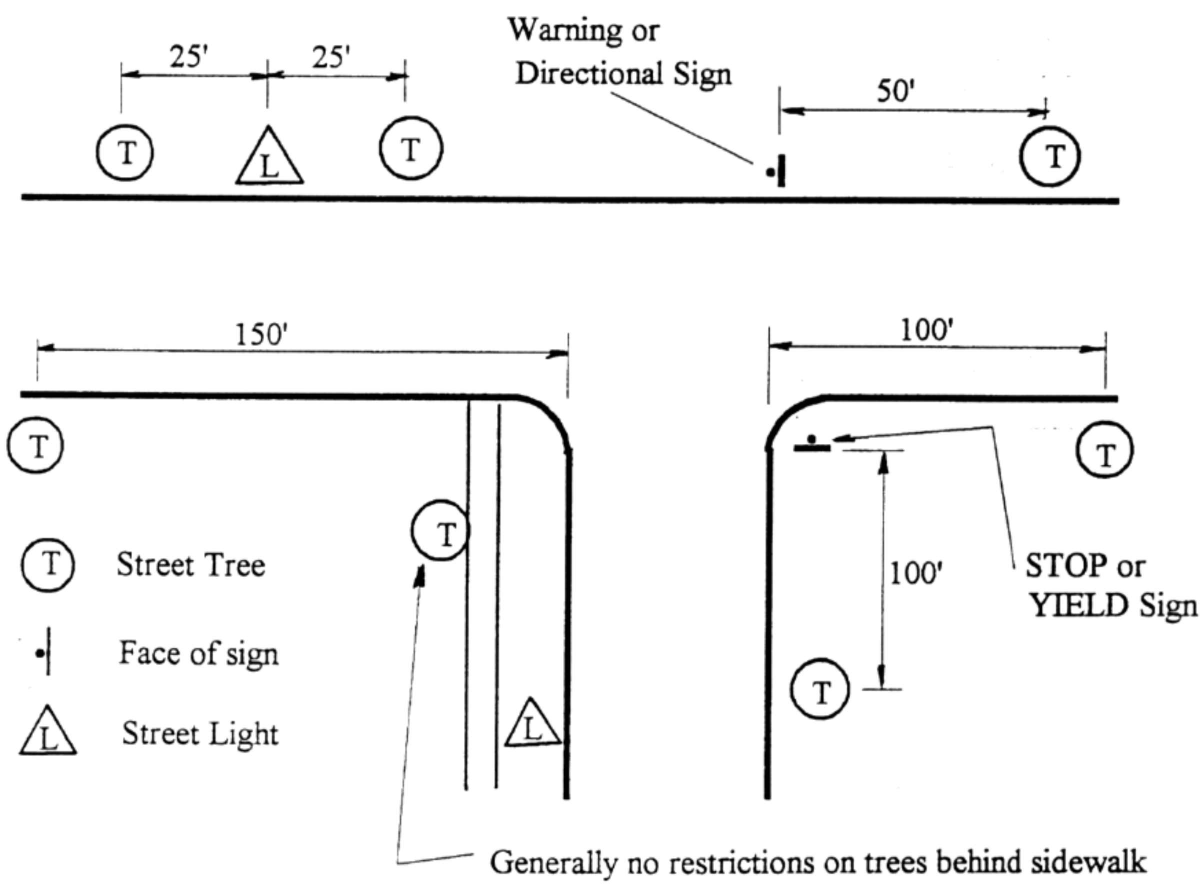
   d. The State Highway Administration is responsible for the installation and maintenance of STOP signs at the intersection of County roadways with State highways. The cost of a State maintained STOP sign will be included in the State's access permit, not the County's Public Works Agreement. Refer to Figure 4 for additional information.

Figure 2 – Street Tree Placement General Guidelines

Street trees which are placed behind sidewalk on closed section roads or at least 8 feet from the edge of paving on open roads usually do not obstruct sight distance and are generally not subject to these restrictions. However, a case by case review may be necessary depending on the species of tree used.

In order to assure adequate visibility of signs and vehicles, and to prevent the blocking of street lights, street trees shall not be placed:

- Within 100 feet of the face of a STOP or YIELD sign;
- Within 50 feet of the face of any other street sign;
- Within 25 feet of a street light, or
- Within 150 feet of the intersection to the left or within 100 feet of the intersections to the right along a cross street at an intersection controlled by a STOP or YIELD sign.



Note: All distances shown are minimum.

Figure 3 – Signing for County/County Intersections

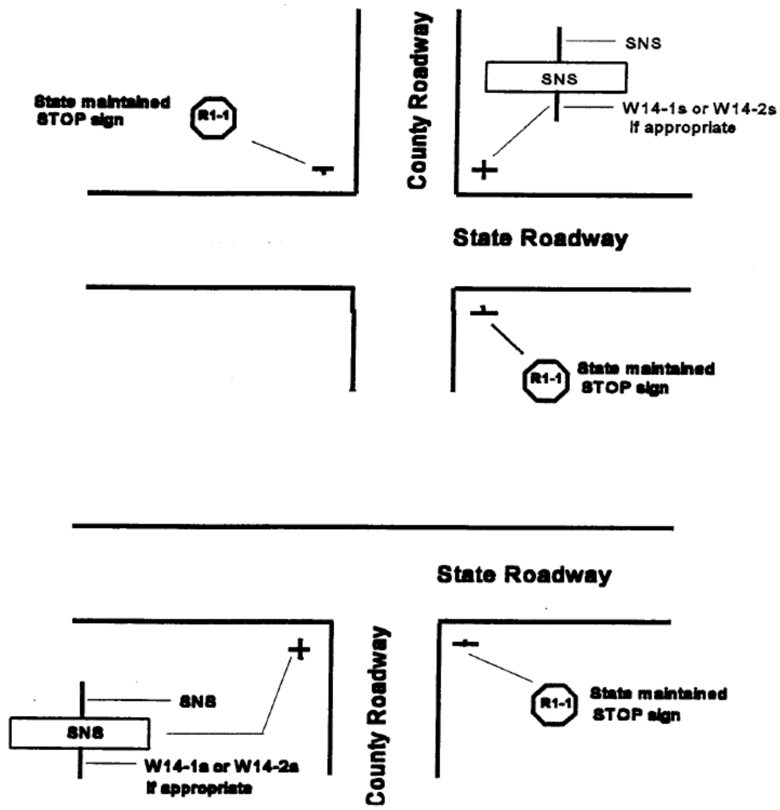
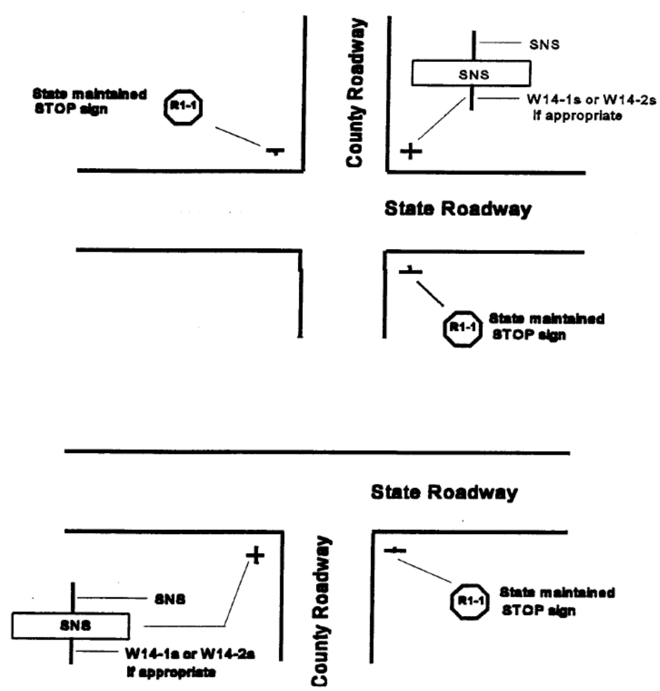


Figure 4 – Signing for State/County Intersections



9. DEAD END signs are appropriate for roads that end without intersecting another road.

   a. The standard designation for a street name sign assembly DEAD END sign is W14-1p.

   b. The standard designation for a diamond shaped DEAD END sign is W14-1.

   c. It is anticipated that the STREET NAME sign type DEAD END sign (W14-1p) will be used much more frequently than the diamond shaped DEAD END sign (W14-1). It shall be mounted between the STOP sign and the bottom STREET NAME sign. The diamond shaped variety shall only be used when the majority of the approach traffic is directly oncoming. A dead end sign shall be required if the end of the roadway can not be seen from the cross street.

10. NO OUTLET signs are required for roads that serve as the only access to a community.

   a. The standard designation for a STREET NAME sign assembly NO OUTLET sign is W14-2p.

   b. The standard designation for a diamond shaped NO OUTLET sign is W14-2.

   c. It is anticipated that the STREET NAME sign type NO OUTLET sign (W14-2p) will be used much more frequently than the diamond shaped NO OUTLET sign (W14-2). It shall be mounted between the STOP sign and the bottom STREET NAME sign. The diamond shaped variety shall only be used when the majority of the approach traffic is directly oncoming. No signs will be installed at the interior intersections of a closed area.

11. KEEP RIGHT Signs

   a. The standard designation for a KEEP RIGHT sign is R4-7.

   b. KEEP RIGHT signs will be required at both ends of the median for monumental type entrances.

   c. For those roadways with continuous medians that have breaks for driveways and roadway intersections, KEEP RIGHT signs will generally only be required at the beginning and end of the median.

12. SPEED LIMIT Signs

a. The standard designation for a SPEED LIMIT sign is R2-1(XX), where XX is the numeric value of the assigned speed limit.

b. A SPEED LIMIT sign will be installed along the inbound lane of all new residential roads which are at least 500 feet in length. The inbound sign shall be placed 200 feet of the beginning of the roadway and then beyond major intersections and/or at other locations where it is necessary to remind motorists of the posted speed limit. If the roadway is longer than 1000 feet, an outbound SPEED LIMIT sign will be installed approximately 500 feet from the far end of the roadway and then beyond major intersections and/or at other locations where it is necessary to remind motorists of the posted speed limit.

c. Collector and arterial roadways will have an inbound SPEED LIMIT sign placed within 500 feet of the beginning of the roadway as well as an outbound SPEED LIMIT sign placed within 500 feet of the far end of the roadway. Additional SPEED LIMIT signs will then be placed in pairs at one-half mile intervals or after intersecting side roads at close to the same intervals.

d. The Final Development Plan will show only the location of the SPEED LIMIT signs, not the actual speed limit(s). Speed limits will be established by the Traffic Engineering Division. In residential areas, the following guidelines will be used for setting speed limits:

- Local and collector roadways with R-2 or greater density zoning: 25 miles per hour.
- Local and collector roadways with less than R-2 density zoning: 30 miles per hour.
- Collector roadway with direct driveway access and R-2 or greater density zoning: 30 miles per hour.
- Collector roadway without direct driveway access but with less than R-2 density zoning: 35 miles per hour.

13. INTERSECTION WARNING Signs

a. INTERSECTION WARNING signs shall be placed on arterial roadways in advance of intersecting roadways which are not controlled by a signal.

b. The INTERSECTION WARNING signs will include supplementary STREET NAME panels.

c. The standard designation for a four-legged INTERSECTION WARNING sign is W2-1.

d. The standard designation for a three-legged INTERSECTION WARNING sign is W2-2 or W2.11 depending on the geometry.

e. The standard designation for a STREET NAME panel is D3-2 (black letters on a yellow background).

C. Street Lighting Design

1. The Final Development Plan will show the locations for the street lights.

2. The actual luminaires and poles will be ordered by Traffic Engineering using only those devices approved by Baltimore Gas and Electric for use under the Public Street Light rate schedule. 100/150 watt LED luminaires will typically be used. In residential areas, the luminaires will be mounted on fourteen foot black fiberglass poles. Thirty-foot fiberglass poles may be used on divided roadways, on major collector and arterial roadways in residential areas, and in commercial areas.

3. Refer to Figure 1 for a list of standard symbols that are to be used when developing TCD plans.

4. Other similar poles may be used if approved by the Baltimore Gas and Electric Company.

a. Generally, street lights are to be placed as close to intersections as possible and then spaced as follows (see Figure 5):

b. Roadways with medians: Street lights are to be installed on both sides of the road at approximately 160 feet spacing, on property lines or between lots.

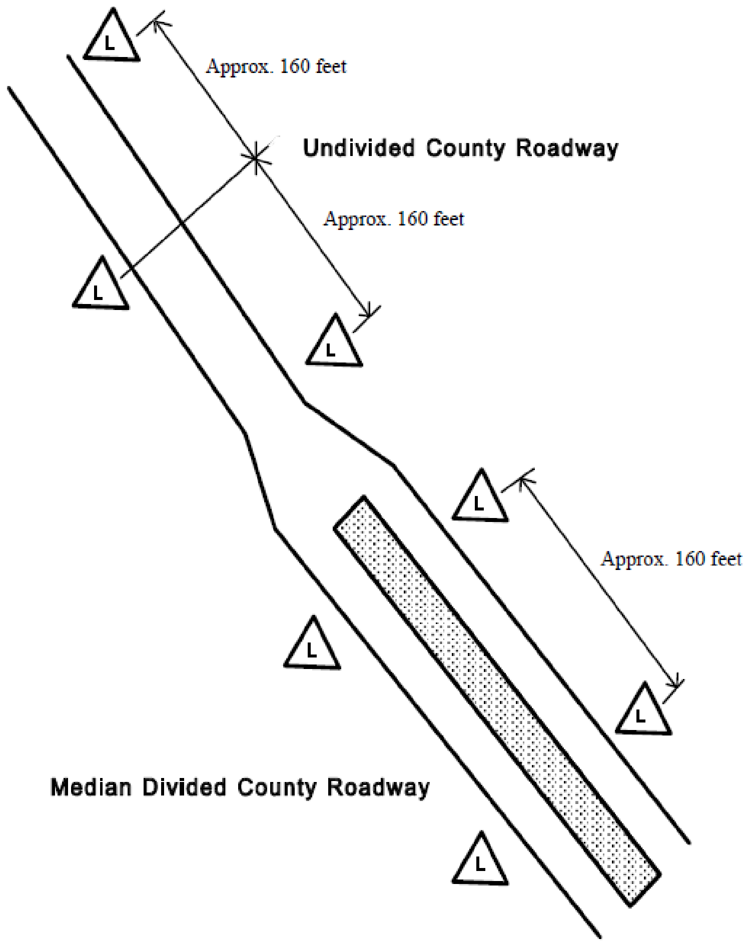
c. Roadways without medians: Street lights are to be installed on alternate sides of the road at approximately 160 feet spacing, as close to property lines as possible.

5. On closed section roadways, the street lights are to be placed in the grass area between the curb and the sidewalk.

6. On open section roadways, the street lights are to be placed adjacent to the shoulder, minimum 2 feet from the edge of shoulder. Where no paved shoulder exists, street lights will be placed at least six feet from the edge of the roadway. Street lights shall not be placed as to impede the flow of water in storm drain ditches.

7. Street trees shall be placed a minimum of twenty-five feet from street lights, except in those cases where a traffic sign is attached to a street light post. In these instances, street trees must be positioned such that the minimum clear sight distance to the sign, as described in Figure 2, is achieved.

Figure 5 – Street Light Placement



D. Street Trees

1. Street Trees shall be placed in accordance with the Landscaping Manual and to provide the minimum clearances from signs and street lights as noted below and as shown on Figure 2.

2. Street trees which are placed at least eight feet behind the curb (or edge of paving on open section roads) are not subject to the following restrictions. These restrictions apply only along the roadway frontage.

3. In order to assure adequate visibility of signs and vehicles, and to prevent the blocking of street lights, street trees shall not be placed:

- Within 100 feet of the face of a STOP or YIELD sign;
- Within 50 feet of the face of any other street sign;
- Within 25 feet of a street light; or
- Within 150 feet of the intersection to the left or within 100 feet of the intersection to the right along a cross-street at an intersection controlled by a STOP or YIELD sign.

4. Further restrictions may be applied on a case-by-case basis as necessary.

5. Care should be taken to avoid placing street trees directly under overhead utility lines.

E. Signal Design

Refer to Maryland Manual on Uniform Traffic Control Devices (MD MUTCD), 2011 Edition and SHA Signal Design Manual for signal design standards and plan requirements.

F. Pavement Marking Design

1. The pavement marking plan is to be included in the public roads plans submitted to OPZ. OPZ will forward the Traffic Engineering Division with a copy of the plan for review and approval of pavement markings. Traffic Engineering will send their recommendations back to OPZ and the developer within 10 working days of receipt of the plan. OPZ will not approve the placement of any pavement markings unless they receive Traffic Engineering's agreement.

2. The pavement marking plan must be designed to provide the motorist with clear driving guidance along County roadways.

3. The developer will be responsible for all pavement striping necessary for both roadway widening improvements as well as newly constructed subdivision roadways. The following are the most common types of roadway improvements:

   a. Collector and arterial roadway widening improvements. The pavement marking improvements will generally consist of the reconfiguration of the centerline, laneline, and edgeline markings so that the full pavement width can be utilized by motorists.

   b. Intersection improvements (new construction or widening). The pavement marking improvements will generally consist of striping bypass or turning lanes around or into the minor legs of the intersection, or the reconfiguration of the lane assignments of the major legs of the intersection. Pavement markings may also be required in the form of crosswalks, lane assignment arrows, and stop bars.

      - Lead Free Reflective Thermoplastic Pavement Markings are required.

- Specifications for materials must be submitted to Traffic Engineering for approval.
- Traffic Engineering Division reserves the right to make field changes as deemed necessary.

c. Residential roadway construction. Pavement markings are usually not required for these roadways.

4. It is recommended that the developer review MD MUTCD for further information regarding pavement markings.

5. The minimum transition rate of centerline and edgeline striping is as per the following table:

SPEED LIMIT (MPH)	TAPER RATIO (FT TO FT)
30	15 : 1
35	20 : 1
40	25 : 1
45	35 : 1
50	45 : 1

6. The minimum lane width for pavement striping purposes is ten feet.

7. Twenty-five feet of storage space is required per vehicle for the design of turning lanes. See Design Manual Chapter 3 for further requirements.

8. Traffic count data may be required at intersections where it is not clear whether a bypass lane arrangement or an exclusive left turn lane would be more appropriate.

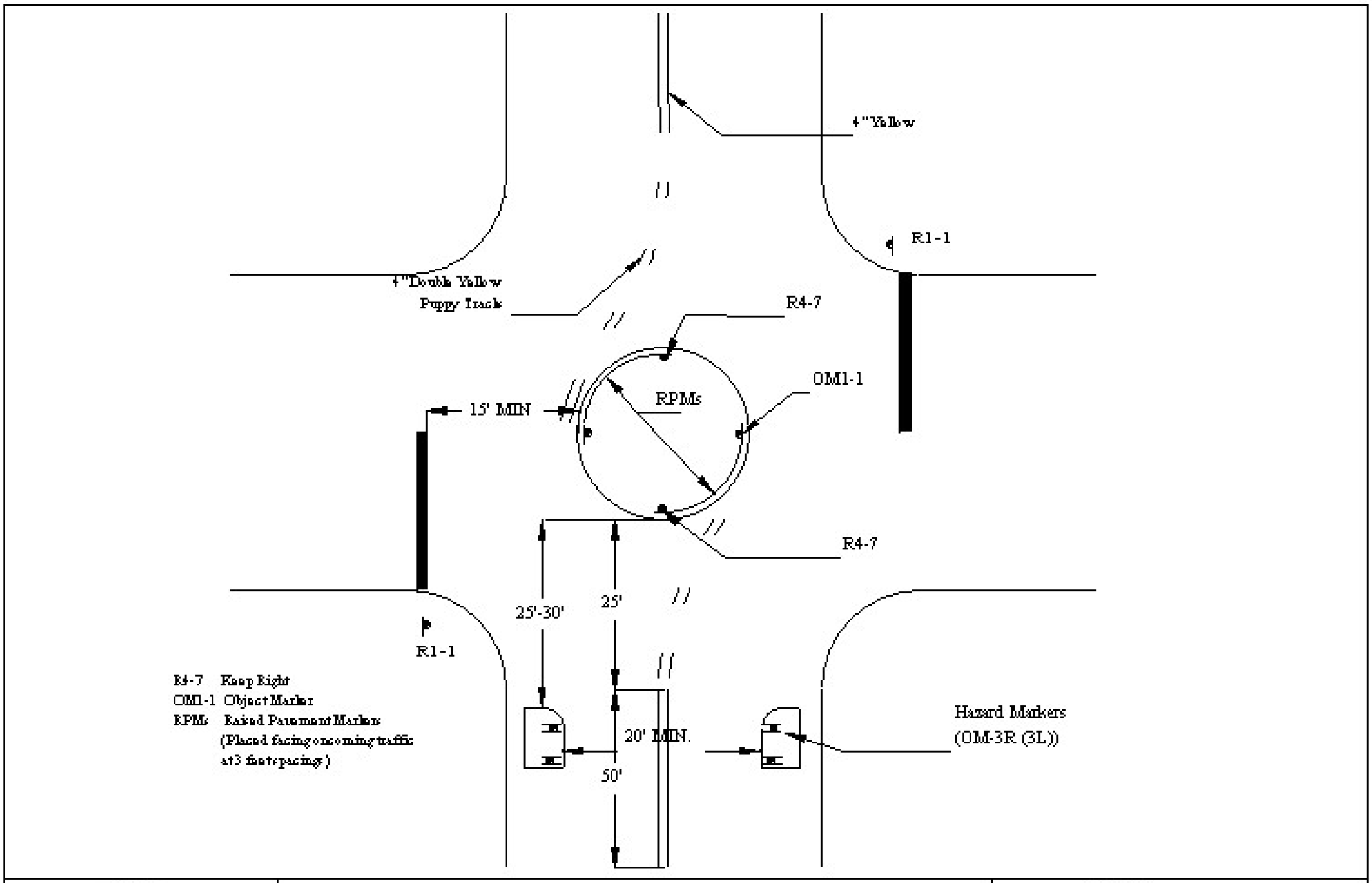
9. Any existing pavement markings that conflict with required new markings must be removed to the satisfaction of the Traffic Engineering Division. An asphalt overlay is appropriate and a grinding can only be used upon approval by the Traffic Engineering Division. Painting the existing striping with black paint is not acceptable. The costs associated for this work must be bonded under the subdivision's Public Works Agreement. The lines that are to be removed must be shown on the plans.

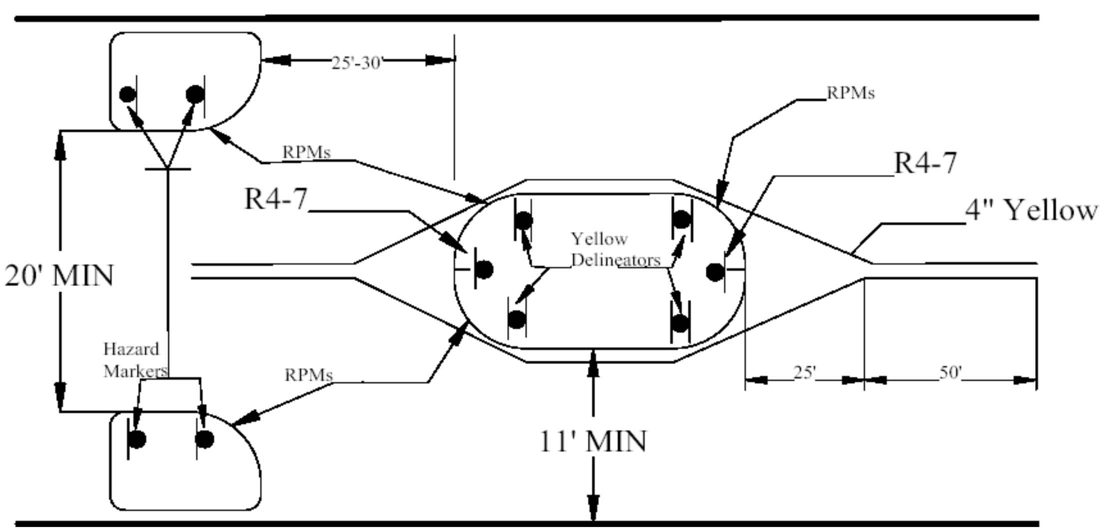
10. All pavement marking plans must include a note requiring the Contractor to notify the Traffic Engineering Division (410-222-7331) and arrange a field review before installing any pavement markings.

G. Traffic Calming Device Signing and Pavement Marking

Roadways should be designed to discourage speeds in excess of the posted speed limit. Speed humps should generally not be installed on new residential roadways. The design and layout of other speed control devices (such as islands, circles, chokers, edgelines, etc.) should be reviewed with the Traffic Engineering Division to assure appropriate designs for school buses, emergency vehicles, snow plows, and trash trucks. Plans for traffic calming devices will be included in the public roads plans. Signing and striping for islands, circles, and chokers shall be as shown on Figure 6.

Figure 6 – Signing and Markings for Speed Control (Circles, Islands, and Chokers)



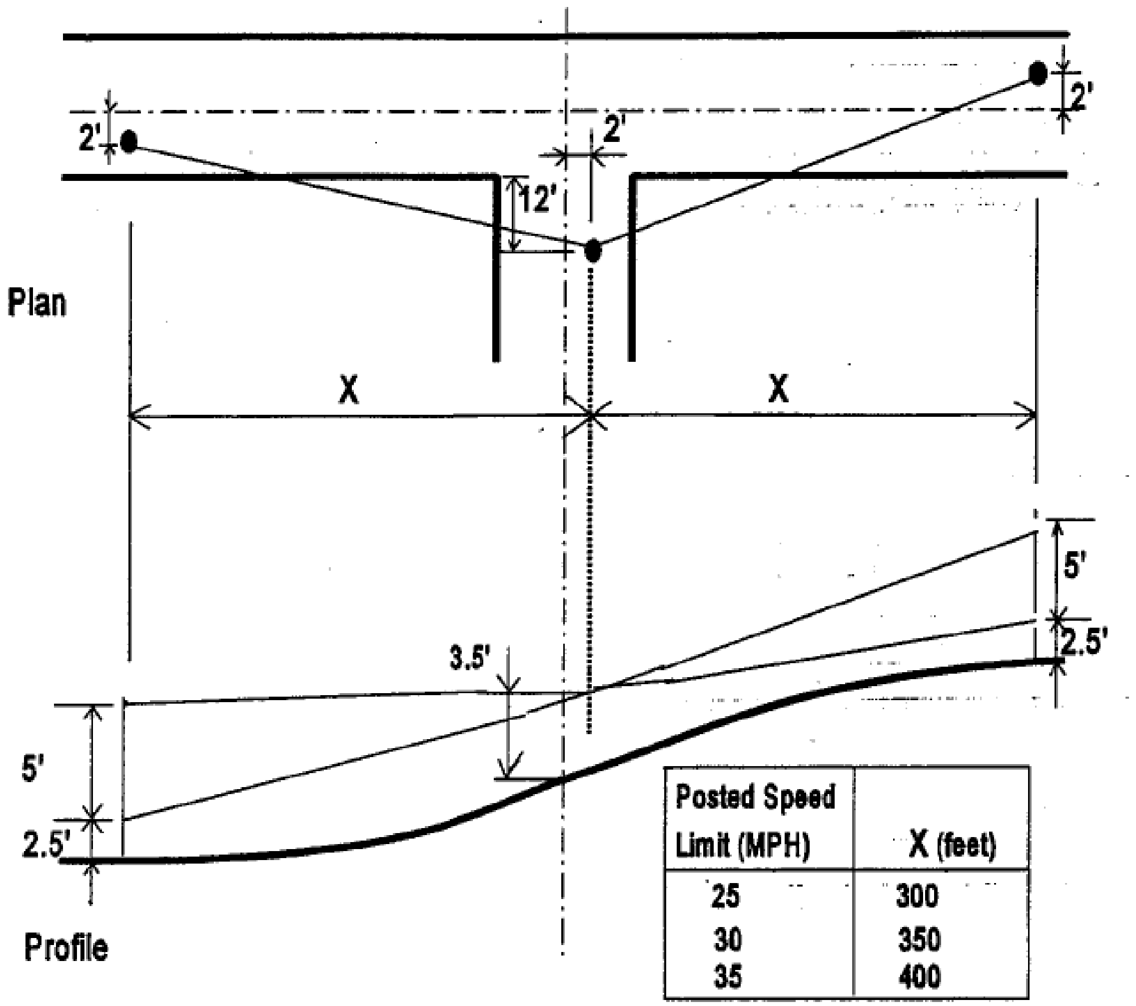


H. Sight Distance at Intersections

At intersections controlled by STOP or YIELD signs, care must be taken to provide adequate sight distance for vehicles exiting the minor road. In addition, vehicles turning left into the minor road must have adequate sight distance and must be visible to other vehicles approaching from the rear.

Figure 7 illustrates the minimum acceptable sight distance for vehicles entering local and collector roadways. For higher speed roadways, AASHTO Green Book guidelines should be followed.

Figure 7 – Sight Distance Requirements for Local and Collector Roads (See AASHTO for intersections with Arterial or higher roadways)



Posted Speed Limit (MPH)	X (feet)
25	300
30	350
35	400

The sight triangle must be free of obstructions in both the horizontal and vertical planes as defined above.

STANDARD CROSS-SECTION REQUIREMENTS

Updated April 2023

	Road Classification / Facility	Principal Arterial - Closed	Principal Arterial - Open	Minor Arterial - Closed	Minor Arterial - Open	Collector-Closed	Collector - Open	Local - Closed	Local - Open
A.	**Slope (outside R/W line)**	C1	C1	C1	C1	C1	C1	C1	C1
B.	**Stormwater Conveyance**	C2	C2	C2	Y; 9' min	C2	Y; 9' min	C2	Y; 9' min
C.	**Street Trees/Buffer (see C14)**	5' min	5' min	5' min	5' min	5' min	5' min	5' min	5' min
D.	**Sidewalk**	5' min	C3; 5' min	5' min	C3; 5' min	5' min	C3; 5' min	5' min	C3; 5' min
E.	**Shared Use Path**	C4; 10' min	C4; 10' min	C4; 10' min	C4; 10' min	C4; 10' min	C4; 10' min	N	N
F.	**Utility Strip**	C5; 4' min	C5; 4' min	C5; 4' min	C5; 4' min	C5; 4' min	C5; 4' min	C5; 4' min	C5; 4' min
G.	**Curb/Gutter**	2'	N	2'	N	2'	N	2'	N
H.	**Shoulder (see C15)**	12' min	10' min	8' min	8' min	N	N	N	N
I.	**Parking Lane**	N	N	N	N	C6; 8'	C6; 8'	C6; 8'	C6; 8'
J.	**Dedicated Bicycle Facilities**	C7; 6-10'	C7; 6-10'	C7; 6-10'	C7; 6-10'	C9; 4-6'	C9; 4-6'	N	N
K.	**Right Turn Lane**	C10; 10' min	C10; 10' min	C10; 10' min	C10; 10' min	C10; 10' min	C10; 10' min	N	N
L.	**Through Lane**	C11; 11-12'	C11; 11-12'	C11; 10-12'	C11; 10-12'	C11; 10-11'	C11; 10-11'	10'	10'
M.	**Left Turn Lane**	C12; 10' min	C12; 10' min	C12; 10' min	C12; 10' min	C12; 10' min	C12; 10' min	N	N
N.	**Median**	C13: 16'min	C13: 16'min	C13: 6'min	C13: 6'min	C13: 6'min	C13: 6'min	N	N

C - Conditional; see notes below
Y - Required
N - Not Required

C1: Slope to tie-in right-of-way(r/w) grade to existing grade, or retaining wall, MUST be located outside the public r/w; 2:1 max slope.

C2: Stormwater conveyance consists of roadside ditching. If provided, width shall be based on Design Manual requirements to handle design flow volume. Stormwater management facilities shall not be located in the public right-of-way unless approved by the DPW Bureau of Highways. R/W width shall be adjusted as necessary for facility to be completely in public r/w, and no utility structures located between top of banks of facility.

C3: Sidewalk required on all roads unless 25-year ADT < 400, AND average lot size is over 30,000 sf, AND entrance to development is not within 1.5 miles of any pedestrian generator when measured along the public right-of-way.

C4: Shared Use Paths shall be installed when required by the County, in lieu of sidewalk on that side, in accordance with adopted master plans, corridor studies, extension of existing paths, or other multimodal impact that may be identified.

C5: Utility Strip to be located between curb and sidewalk shall include Signage, Fire Hydrants, Street Lighting. Private utilities (i.e. BGE, Verison, CATV) shall be located under the sidewalk.

C6: Parking lane shall be required on all roads where average lot width is less than 80 feet as follows:
For lot widths between 30'-80', parking lane required on one side of road
If lot widths ≤30' and rear alley access provided, parking lane required on both sides of road
If lot widths ≤30' and no rear access, no on-street parking shall be provided. Instead, additional parking shall be provided in accordance with the requirements of the County Code (17-6-604(e)) when on-street parking is prohibited.

C7: The appropriate facilities will be determined by the County in accordance with current Federal, State, and Local standards, and may include separated bike lanes (characterized by a vertical barrier) of a width appropriate for the speed and volumes, shared use paths, or buffered bike lanes.

C9: Provide a striped and marked bicycle lane in accordance with the following:
Posted speed ≤35 mph - 4'
Posted speed >35 mph and ≤45 mph with ≤8% trucks - 5'
Posted speed >35 mph and ≤45 mph with >8% trucks - 6'
Posted speed >45 mph - 6'
If adjacent to parking or a physical barrier such as a guardrail or curb with no gutter pan, provide a 6' marked bicycle lane.

C10: Right Turn Lane required if volume warrants met - see Exhibit C10. R/W shall be widened as necessary for facilities to be completely in public r/w. Full width pavement is required along the total length of the lane. The taper is to be established via pavement markings.

C11: Lane width based on speed and volume - see Exhibit C11.

C12: Left Turn lane required if volume warrants met - see Exhibit C12(a-c). R/W shall be widened as necessary for facilities to be completely in public r/w. Full width pavement is required along the total length of the lane. The taper is to be established via pavement markings.

C13: If median is provided, minimum width provided shall be based on the ultimate road design for its classification, the characteristics of the area, and meet all ADA and other regulatory requirements.

C14: If credit for street trees is provided through existing trees preserved immediately abutting the right of way, 5' grass buffer must still be provided.

C15: Requirement for shoulder on multi-lane arterials shall be determined by the County during development plan review.

NOTES:

1. Unless otherwise shown/prescribed in an adopted plan, authorized corridor study, or active/completed CIP design, the above typical section requirements shall apply to the design of all public roads, including State roads subject to SHA approval of an Accesss Permit.
2. The right-of-way of any proposed road, or road impacted by required frontage improvements, shall be adjusted as necessary so that all required elements are within the delineated right-of-way.

STANDARD CROSS-SECTION REQUIREMENTS

EXHIBIT C10

RIGHT TURN LANE REQUIREMENTS

Collectors and Arterials

Right turn lanes are required under the following conditions:

1. If road DDHV < 400, and right turn DHV>60.
2. If road DDHV $\geq$ 400, and right turn DHV>30.

DDHV = Directional Design Hour Volume – peak hour volume in direction of travel of right-turns

DHV = Design Hour Volume – peak hour right turn volume

NOTE: Right turn lanes in designated Town Centers and other urban areas are subject to review to consider the impact to pedestrians and signal timings.

When required based on the above information, right turn lanes shall be provided as follows:

Design Speed	Taper Length (ft)	Deceleration Length (ft)	Total Length (ft)
30	80	170	250
35	100	250	350
40	150	275	425
45	150	340	490
50	150	410	560
55	150	485	635

STANDARD CROSS-SECTION REQUIREMENTS

EXHIBIT C11

MINIMUM THROUGH LANE WIDTH

Collectors

1. If road ADT <400, then:
   a. If Design Speed ≤50 mph, lane width = 10'
   b. If Design Speed >50 mph, lane width = 11'

2. If road ADT > 400 and <1500, then:
   a. If Design Speed ≤30 mph, lane width = 10'
   b. If Design Speed >30 mph, lane width = 11'

3. If road ADT > 1500, then lane width = 11'

Arterials

1. If road ADT <1500, then:
   a. If Design Speed ≤30 mph, lane width = 10'
   b. If Design Speed >30 mph, lane width = 11'

2. If road ADT > 1500 and <2000, then:
   a. If Design Speed ≤50 mph, lane width = 11'
   b. If Design Speed >50 mph, lane width = 12'

3. If road ADT > 2000, then lane width = 12'

Note: ADT for the purposes of determining the through lane width shall be calculated by adding any traffic from the proposed development under review to the existing traffic.

STANDARD CROSS-SECTION REQUIREMENTS

EXHIBIT C12

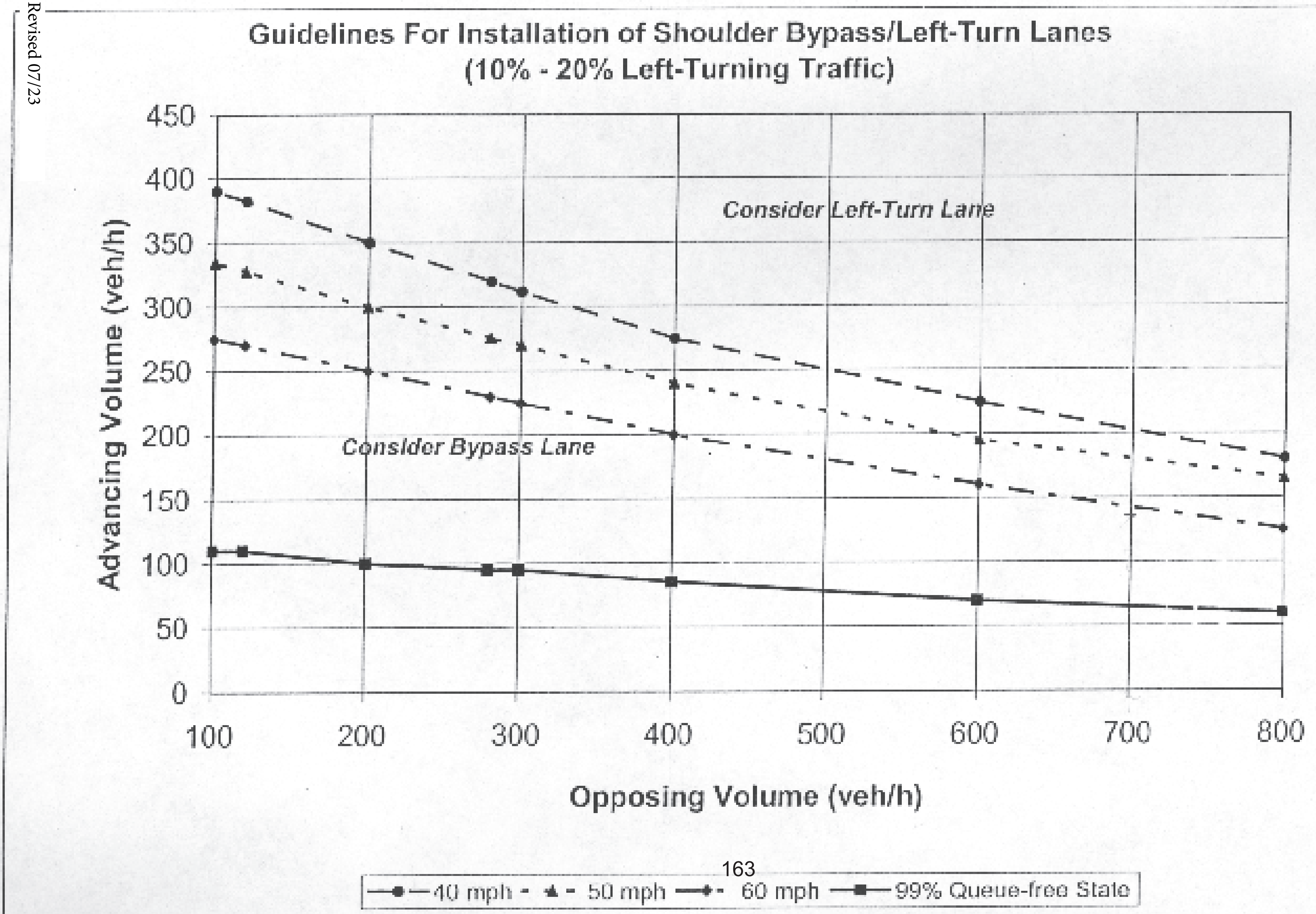
LEFT TURN LANE REQUIREMENTS

Collectors and Arterials

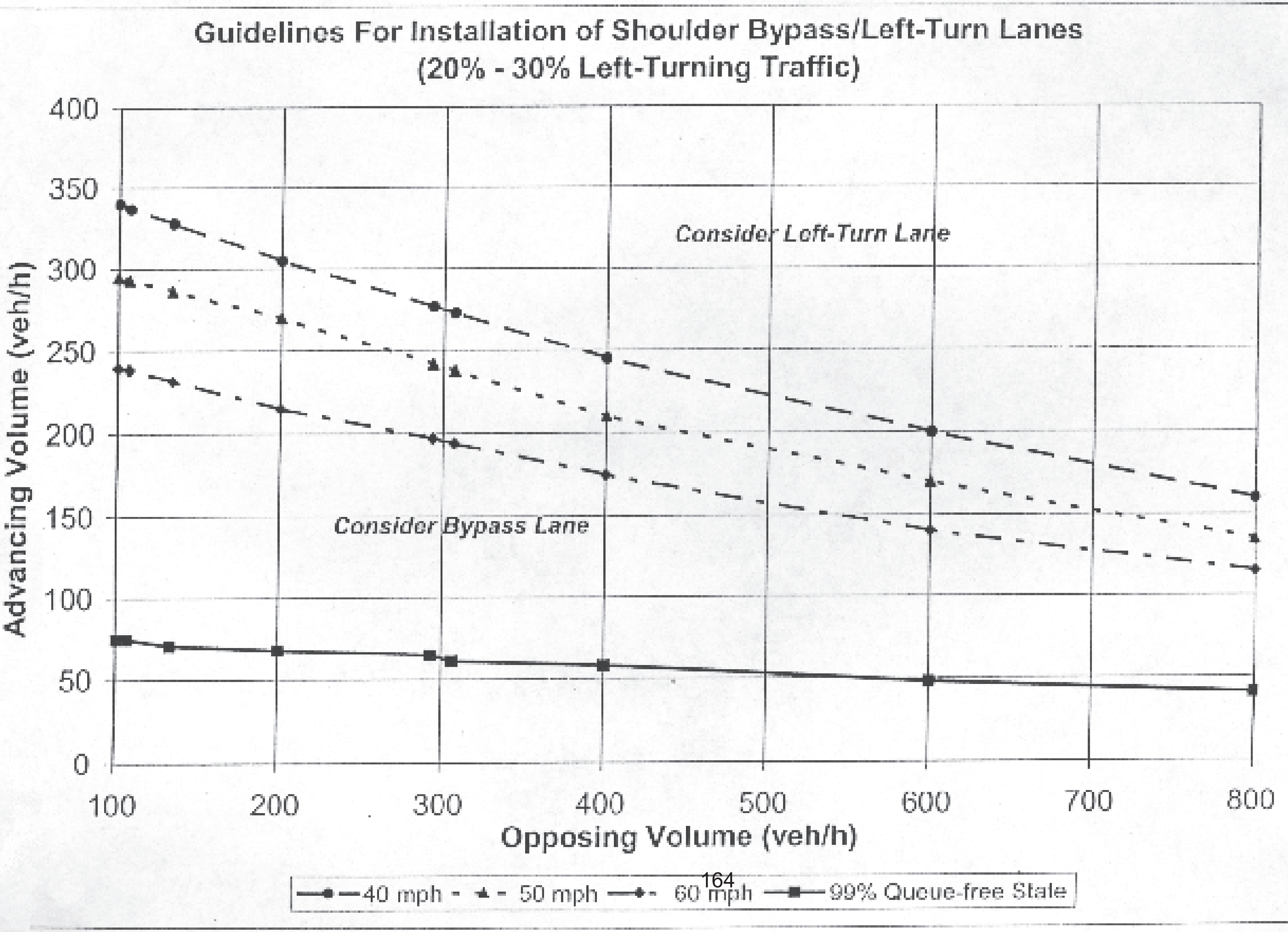
When required based on Exhibits 12a-c, left turn lanes shall be provided as follows:

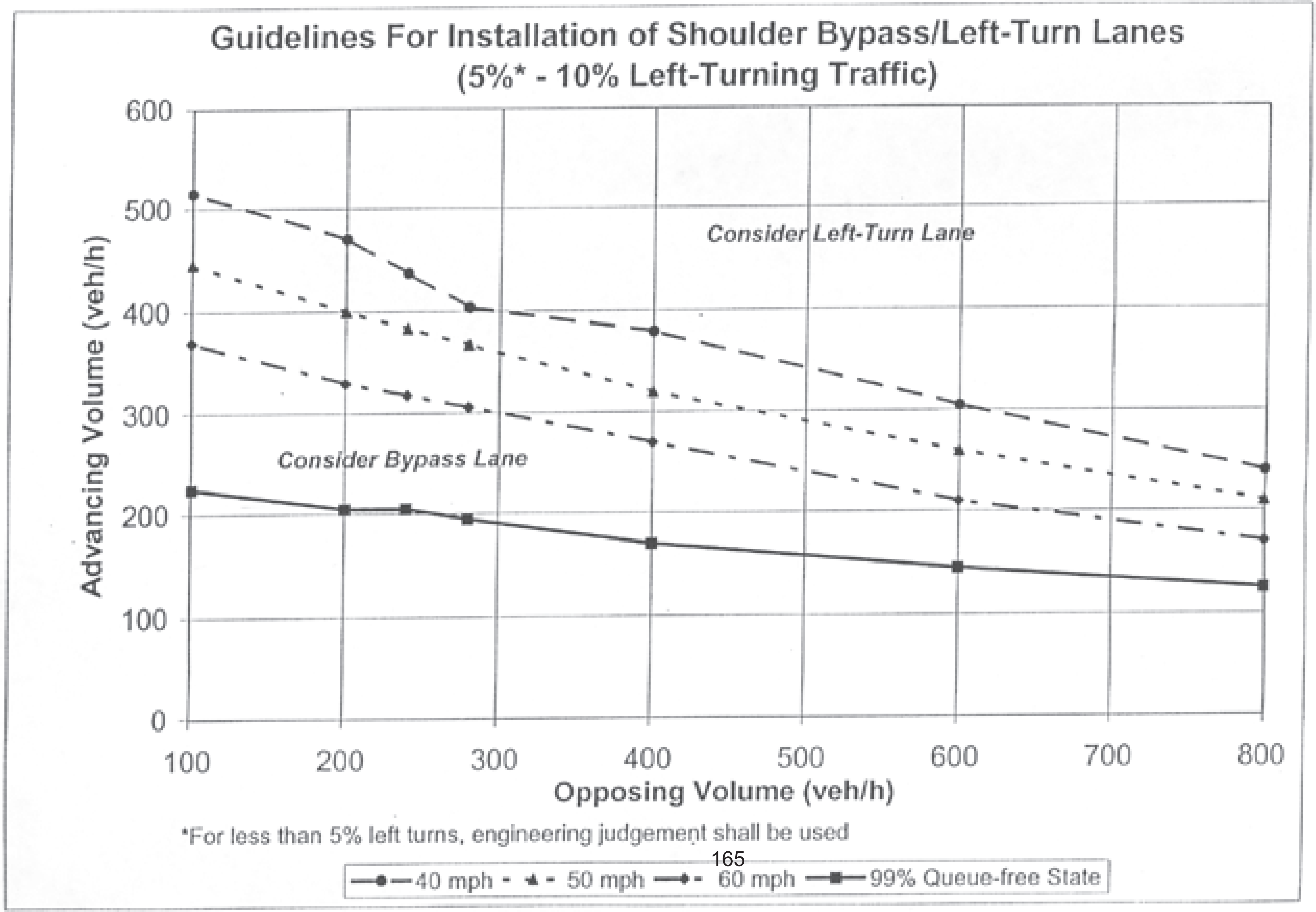
Design Speed	Taper Length (ft)	Deceleration Length (ft)	Total Length (ft)
30	80	170	250
35	100	250	350
40	150	275	425
45	150	340	490
50	150	410	560
55	150	485	635

Revised 07/23



Revised 04/24


Guidelines For Installation of Shoulder Bypass/Left-Turn Lanes
(20% - 30% Left-Turning Traffic)
Advancing Volume (veh/h)
Opposing Volume (veh/h)
Consider Left-Turn Lane
Consider Bypass Lane
0
50
100
150
200
250
300
350
400
100
200
300
400
500
600
700
800
40 mph
50 mph
60 mph
99% Queue-free State


Guidelines For Installation of Shoulder Bypass/Left-Turn Lanes
(5%* - 10% Left-Turning Traffic)
Consider Left-Turn Lane
Consider Bypass Lane
Advancing Volume (veh/h)
0
100
200
300
400
500
600
100
200
300
400
500
600
700
800
Opposing Volume (veh/h)
*For less than 5% left turns, engineering judgement shall be used
40 mph
50 mph
60 mph
99% Queue-free State

Odenton Town Center
Preliminary Draft of Code Revisions

Roadway and Streetscape Typical Sections for public roads in the Odenton Town Center [1, 2, 3, 4, 5, 6]

Street Name	Road Segment		Min. ROW Width	Min. # of Through Lanes	Min. Roadway Width	Median (Variable)	Parking Lanes [9] (7')	Dedicated Bike Lane [7]	Min. Planting Width [8]	Min. Sidewalk Width	Min. Hiker/ Biker Trail Width (10')
	From	To									
Principal Arterial											
Annapolis Rd. (MD 175)	Jackson Grove Rd.	MD 32	85'	4	60'	No	No	Yes	5'	5' (westbound)	Yes (eastbound)
Annapolis Rd. (MD 175)	MD 32	Town Center Blvd. (P)	73'	4	48'	No	No	No	5'	5' (westbound)	Yes (eastbound)
Annapolis Rd. (MD 175)	Town Center Blvd. (P)	MD 170	73'	4	48'	Yes	No	No	5'	5' (westbound)	Yes (eastbound)
Annapolis Rd. (MD 175)	MD 170	Harding Ave.	80'	4	60'	Yes	No	Yes	5'	5'	No
Annapolis Rd. (MD 175)	Harding Ave.	Oakton Rd.	80'	4	60'	No	No	Yes	5'	5'	No
Annapolis Rd. (MD 175)	Oakton Rd.	Sappington Station Rd.	80'	4	60'	No	No	Yes	5'	5'	No
Telegraph Rd. (MD 170)	Annapolis Rd. (MD 175)	MD 32	73'	4	48'	Yes	No	Yes	5'	5' (northbound)	Yes (southbound)

Street Name	Road Segment		Min. ROW Width	Min. # of Through Lanes	Min. Roadway Width	Median (Variable)	Parking Lanes [9] (7')	Dedicated Bike Lane [7]	Min. Planting Width [8]	Min. Sidewalk Width	Min. Hiker/ Biker Trail Width (10')
	From	To									
Typical Section	-	-	100'	4	60'	No	No	Yes	5'	5'	Yes (both sides)
Minor Arterial											
Blue Water Blvd.	Annapolis Rd. (MD 175)	Town Center Blvd. (P)	68'	4	48'	Yes	No	No	5'	5'	Yes (eastbound)
Charter Oaks Blvd.	Annapolis Rd. (MD 175)	Town Center Blvd. (P)	68'	4	48'	Yes	No	No	5'	5'	Yes (westbound)
Odenton Ave. (P)	Annapolis Rd. (MD 175)	Town Center Blvd. (P)	85'	4	60'	Yes	No	Yes	5'	5' (southbound)	Yes (northbound)
Odenton Rd.	Piney Orchard Pkwy. (MD 170)	Sappington Station Rd.	48'	2	24'	No	No	No	5'	5' (eastbound)	Yes (westbound)
Piney Orchard Pkwy. (MD 170)	Odenton Rd.	Annapolis Rd. (MD 175)	73'	4	48'	Yes	No	No	5'	5' (northbound)	Yes (southbound)
Town Center Blvd.	Annapolis Rd. (MD 175)	Blue Water Blvd.	68'	4	48'	Yes	No	No	5'	5' (southbound)	Yes (northbound)
Town Center Blvd. (P)	Odenton Rd.	Southern Terminus	94'	4	74'	Yes	Yes	Yes	5'	10'	No
Typical Section	-	-	94'	4	54'	No	No	Yes	5'	5'	Yes

Street Name	Road Segment		Min. ROW Width	Min. # of Through Lanes	Min. Roadway Width	Median (Variable)	Parking Lanes [9] (7')	Dedicated Bike Lane [7]	Min. Planting Width [8]	Min. Sidewalk Width	Min. Hiker/ Biker Trail Width (10')
	From	To									
Collector											
Baltimore Ave.	Annapolis Rd. (MD 175)	Northern Terminus	44'	2	24'	No	No	No	5'	5'	No
Berger St. (G)	Baldwin Rd.	Nevada Ave.	72'	2	38'	No	Yes	No	Sidewalk trees	10'	No
Berger St.	Odenton Ave. (P)	Baldwin Rd.	72'	2	38'	No	Yes	No	Sidewalk trees	10'	No
Betson Ave.	Lokus Rd.	Telegraph Rd. (MD 170)	48'	2	24'	No	No	No	5'	5'	No
Bucklina Ave.	Lokus Rd.	Telegraph Rd. (MD 170)	48'	2	24'	No	No	No	5'	5'	No
Crossroads Dr.	Telegraph Rd. (MD 170)	Eastern Terminus	58'	2	48'	No	No	No	5'	5' (westbound)	No
Duckens St. (G)	***Baldwin Rd.***	**Town Center Blvd.**	***72'***	***2***	***38'***	***No***	***Yes***	***No***	***Sidewalk trees***	***10'***	***No***
Hale St. (G)	Baldwin Rd.	Town Center Blvd.	72'	2	38'	No	Yes	No	Sidewalk trees	10'	No
Hale St.	Town Center Blvd.	Lokus Rd.	72'	2	38'	No	Yes	No	Sidewalk trees	10'	No

Street Name	Road Segment		Min. ROW Width	Min. # of Through Lanes	Min. Roadway Width	Median (Variable)	Parking Lanes [9] (7')	Dedicated Bike Lane [7]	Min. Planting Width [8]	Min. Sidewalk Width	Min. Hiker/ Biker Trail Width (10')
	From	To									
Hale St. Extended (P)	Odenton Ave. (P)	Baldwin Rd.	72'	2	38'	No	Yes	No	Sidewalk trees	10'	No
Lamonte Ave.	Lokus Rd.	Telegraph Rd. (MD 170)	48'	2	24'	No	No	No	5’	5'	No
Lokus Rd.	Lamonte Ave.	Mayfield Rd.	62'	2	38'	No	Yes	No	5’	5'	No
Mayfield Rd.	Lokus Rd.	Telegraph Rd. (MD 170)	48'	2	24'	No	No	No	5’	5'	No
Monterey Ave.	Odenton Rd.	Murray Rd.	44'	2	24'	No	No	No	5'	5'	No
Mt. Vernon Ave.	Southern Terminus	Telegraph Rd. (MD 170)	44'	2	24'	No	Yes (northbound)	No	5’	5'	No
Odenton Rd. (MD 677)	***Magazine Rd.***	***MARC Station (West)***	***51'***	***2***	***31'***	***No***	***Yes (eastbound)***	***No***	***5'***	***5'***	***No***
Odenton Rd.	***MARC Station (East)***	***Piney Orchard Pkwy. (MD 170)***	***44'***	***2***	***24'***	***No***	***No***	***No***	***5'***	***5'***	***No***
Nevada Ave.	Northern Terminus	Berger St.	110'	2-5	60'	Yes	Yes	No	Sidewalk trees	10'	No
Nevada Ave. (G)	Berger St.	Duckens St.	110'	2-5	60'	Yes	Yes	No	Sidewalk trees	10'	No
Patuxent Rd. N	***Old Waugh Chapel Rd.***	***Odenton Rd.***	***44'***	***2***	***24'***	***No***	***No***	***No***	***5'***	***5'***	***No***

Street Name	Road Segment		Min. ROW Width	Min. # of Through Lanes	Min. Roadway Width	Median (Variable)	Parking Lanes [9] (7')	Dedicated Bike Lane [7]	Min. Planting Width [8]	Min. Sidewalk Width	Min. Hiker/ Biker Trail Width (10')
	From	To									
Pine St.	Baltimore Ave.	Mt. Vernon Ave.	44'	2	24'	No	No	No	5'	5'	No
Pine St. (P)	Baltimore Ave.	Winmeyer Ave.		2		No	No	Yes	5'	5'	No
Town Center Blvd.	***Odenton Rd.***	***Annapolis Rd. (MD 175)***	***87'***	***4***	***67'***	***Yes***	***Yes (northbound)***	***Yes***	***5'***	***5'***	***No***
Winmeyer Ave.	Annapolis Rd. (MD 175)	Northern Terminus	68'	2	48'	No	No	Yes	5'	5'	No
Typical Section	-	-		2		No	No	Yes	5'	5'	No
Local											
Anderson Ct.	Crossroads Dr.	Northern Terminus		2		No	No	No	5'	5'	No
Baldwin Rd. (G)	Berger St.	Duckens St.	72'	2-4	48'	No	Yes	Yes	Sidewalk trees	10'	No
Baldwin Rd.	Duckens St.	Southern Terminus	72'	2-4	48'	No	Yes	Yes	Sidewalk trees	10'	No
Becknel Ave.	Western Terminus	Patuxent Rd. N	51'	2	31'	No	Yes (westbound)	No	5' (eastbound)	5' (eastbound)	Yes (westbound)
Becknel Ave.	***Patuxent Rd. N***	***Western Terminus***	***56'***	***2***	***36'***	***No***	***No***	***Yes***	***5'***	***5'***	***No***

Street Name	Road Segment		Min. ROW Width	Min. # of Through Lanes	Min. Roadway Width	Median (Variable)	Parking Lanes [9] (7')	Dedicated Bike Lane [7]	Min. Planting Width [8]	Min. Sidewalk Width	Min. Hiker/ Biker Trail Width (10')
	From	To									
Berger St.	Annapolis Rd. (MD 175)	Eastern Terminus	51'	2	31'	No	Yes (westbound)	No	5'	5'	No
Betson Ct.	Western Terminus	Lokus Rd.	44'	2	24'	No	No	No	5'	5'	No
Beverly Ave.	Murray Rd.	Monterey Ave.	44'	2	24'	No	No	No	5'	5'	No
Brietwert Ave.	Western Terminus	Eastern Terminus	44'	2	24'	No	No	No	5'	5'	No
Center St.	Western Terminus	Baltimore Ave.		2		No	No	No	5'	5'	No
Dare St. (G)	Annapolis Rd. (MD 175)	Hale St.	72'	2	38'	No	Yes	No	Sidewalk trees	10'	No
Duckens St.	***Odenton Rd.***	***Baldwin Rd.***	***72'***	***2***	***38'***	***No***	***Yes***	***No***	***Sidewalk trees***	***10'***	***No***
Harding Ave.	Murray Rd.	Brietwert Ave.	44'	2	24'	No	No	No	5'	5'	No
Higgins Dr.	Annapolis Rd. (MD 175)	Saint Barbara Ln.		2		No	No	No	5'	5'	No
Lokus Rd.	Annapolis Rd. (MD 175)	Northern Terminus	51'	2	31'	No	Yes (southbound)	No	Sidewalk trees	10'	No
Lokus Rd.	Southern Terminus	Lamonte Ave.	*44'*	2	24'	No	No	No	5'	5'	No
Lokus Rd.	Mayfield Rd.	Northern Terminus	*44'*	2	24'	No	Yes (northbound)	No	5'	5'	No

Street Name	Road Segment		Min. ROW Width	Min. # of Through Lanes	Min. Roadway Width	Median (Variable)	Parking Lanes [9] (7')	Dedicated Bike Lane [7]	Min. Planting Width [8]	Min. Sidewalk Width	Min. Hiker/ Biker Trail Width (10')
	From	To									
Murray Rd.	Beverly Ave.	Oakton Rd.	*44'*	2	24'	No	No	No	5'	5'	No
Oakton Rd.	Odenton Rd.	Brietwert Ave. (eastern intersection)	*44'*	2	24'	No	No	No	5'	5'	No
Odenton Rd.	Magazine Rd.	Northern Terminus	*44'*	2	24'	No	No	No	5'	5'	No
Railroad Ave.	Southern Terminus	Beverly Ave.	*44'*	2	24'	No	Yes (southbound)	No	5'	5'	No
Sarrento Ave.	Odenton Rd.	Beverly Ave.	*44'*	2	24'	No	No	No	5'	5'	No
Skyline Ave.	***Becknel Ave.***	***Odenton Rd.***	***44'***	***2***	**24'**	***No***	***No***	***No***	***5'***	***5'***	***No***
Urban St.	Lamonte Ave.	Mayfield Rd.	*44'*	2	24'	No	No	No	5'	5'	No
Waco Ave.	***Becknel Ave.***	***Odenton Rd.***	***44'***	***2***	**24'**	***No***	***No***	***No***	***5'***	***5'***	***No***
Typical Section	-	-		2		No	No	No	5'	5'	No

Note:

1. This chart is to provide general minimum guidelines for the construction of public roads. Requirements for new roads, including additional pedestrian facilities such as crosswalks and pedestrian refuges, will be confirmed by the County and the State Highway Administration at the time of the proposal.

2. An example of the minimum typical road section is listed under each Functional Classification heading in the event of the construction of a new road within that Functional Classification.

3. Capital Improvement Programs or studies in progress at the time of this adoption of the Master Plan or conducted after the Master Plan shall take precedence over the requirements in this chart. (G): road is part of the Odenton Grid Streets capital improvements project (H563800).

4. Street names in bold italics indicate a road segment listed on the County's Scenic and Historic Roads inventory.

5. Improvements are assumed for both sides of the street unless otherwise noted for: Parking Lanes, Dedicated Bike Lane, Minimum Planting Width, Minimum Sidewalk Width, and Minimum Hiker/ Biker Trail Width.

6. (P): Planned road.

7. The appropriate facilities will be determined by the Office of Transportation in accordance with current Federal, State, and Local standards, and may include separated bike lanes (characterized by a vertical barrier) of a width appropriate for the speed and volumes, shared use paths, or buffered bike lanes.

8. Sidewalk trees are defined astrees within tree grates as part of the sidewalk system and as illustrated in Exhibit 5: Urban Streetscape Design in the Landscape Manual. The requirements of Landscape Manual V.A shall govern.

9. This column indicates where on-street parking lanes are required. On-street parking may be allowed after consultation with the County.

Parole Town Center

Typical Section Details

Street Name	Road Segment From	Road Segment To	Functional Classification	Posted Speed Limit (mph)	Existing AADT	Existing Peak Hour Directional Volumes	Ultimate Peak Hour Directional Volumes	# of Lanes	Min. ROW Width	Min. Roadway Width	Median (Y/N/TWLTL)	Parking Lanes	Min. Buffer	Min. Sidewalk Width[1]	Dedicated Bike Lane (Y/N) (recommended type)	Min. Bike Lane Width	Shared-use Path (Y/N)	Min. Shared-use Path Width	Shared-use Path Side of Road
Bestgate Road	MD (178) Generals Highway	N. Bestgate Road / Tidewater Colony Dr	Minor Arterial	35	26,000	Up to 1,100	Up to 1,350	4	75'	50'	Y	None	5'	5'	N	n/a	Y	10'	North
Admiral Drive	Bestgate Road	Jennifer Road	Collector	25	8,500	Up to 400	Up to 700	2	49'	24'	N	None	5'	5'	N	n/a	Y	10'	West
Admiral Drive	Jennifer Road	MD 450 (West Street)	Collector	25	8,500	Up to 400	Up to 800	2	49'	24'	N	None	5'	5'	N	n/a	Y	10'	West
Jennifer Road	MD 450 (West Street)	MD 2 (Solomons Island Road) / Medical Parkway	Collector	30 / 40	5,750	Up to 800	Up to 1,200	4	74'	44'	N	None	5'	10'	N	n/a	Y	10'	North
Jennifer Road	MD 2 (Solomons Island Road) / Medical Parkway	Admiral Drive	Collector	30 / 40	5,750	Up to 800	Up to 1,200	4	69'	44'	N	None	5'	5'	N	n/a	Y	10'	North
Medical Parkway	Bestgate Road	Jennifer Road	Collector	30	8,500	Up to 800	Up to 900	4	75'	50'	Y	None	5'	5'	N	n/a	Y	10'	West
MD 178 (Generals Highway)	Knollwood Drive	Bestgate Road	Minor Arterial	40	20,000	Up to 1,500	Up to 1,600	3	66'	46'	TWLTL	None	5'	5'	Y (marked)	6'	N	n/a	n/a
MD 178 (Generals Highway)	Bestgate Road	Defense Highway	Minor Arterial	35	23,500	Up to 1,200	Up to 1,250	5	79'	54'	TWLTL	None	5'	5'	N	n/a	Y	10'	East
Housley Road	MD 178 (Generals Highway)	MD 450 (Defense Highway)	Collector	30	5,000	Up to 450	Up to 600	4	75'	50'	Y	None	5'	5'	N	n/a	Y	10'	North/West
MD 450 (Defense Highway)	MD 178 (Generals Highway) / MD 450 (West Street)	Alton Lane	Minor Arterial	35	7,250	Up to 1,000	Up to 1,050	5	79'	54'	TWLTL	None	5'	5'	N	n/a	Y	10'	North
MD 450 (Defense Highway)	Alton Lane	Crownsville Road / S. Haven Road	Minor Arterial	40	7,250	Up to 800	Up to 900	2	56'	36'	N	None	5'	5'	Y (separated)	6'	N	n/a	n/a
MD 450 (West Street)	MD 178 (Generals Highway) / MD 450 (Defense Highway)	Jennifer Road	Minor Arterial	35	43,250	Up to 1,800	Up to 2,250	4	69'	44'	N	None	5'	5'	N	n/a	Y	10'	North
MD 450 (West Street)	Jennifer Road	Riva Road	Minor Arterial	35	43,250	Up to 1,800	Up to 2,250	4	74'	44'	N	None	5'	10'	N	n/a	Y	10'	North
MD 450 (West Street)	Riva Road	MD 2 (Solomons Island Road)	Minor Arterial	30 / 35	34,250	Up to 1,800	Up to 1,800	4	74'	44'	N	None	5'	10'	N	n/a	Y	10'	North
MD 450 (West Street)	MD 2 (Solomons Island Road)	Admiral Drive	Minor Arterial	30 / 35	34,250	Up to 1,800	Up to 1,800	4	69'	44'	N	None	5'	5'	N	n/a	Y	10'	North
Riva Road	MD 450 (West Street)	Forest Drive	Minor Arterial	35 / 40	26,250	Up to 2,000	Up to 2,400	5	84'	54'	TWLTL	None	5'	10'	N	n/a	Y	10'	South
Riva Road	Forest Drive	Harry S. Truman Parkway	Minor Arterial	35 / 40	26,250	Up to 2,000	Up to 2,400	5	79'	54'	TWLTL	None	5'	5'	N	n/a	Y	10'	South
Riva Road	Harry S. Truman Parkway	Speicher Drive	Minor Arterial	35 / 40	26,250	Up to 2,000	Up to 2,400	5	79'	54'	TWLTL	None	5'	5'	N	n/a	Y	10'	North
Harry S. Truman Parkway	S. Haven Road	Park & Ride Entrance	Collector	35	12,250	Up to 850	Up to 900	2	52'	32'	N	None	5'	5'	Y (separated)	4'	N	n/a	n/a
Harry S. Truman Parkway	Park & Ride Entrance	Riva Road	Collector	35	12,250	Up to 850	Up to 900	5	79'	54'	N	None	5'	5'	N	n/a	Y	10'	East
Harry S. Truman Parkway	Riva Road	Admiral Cochrane Drive	Collector	35	4,500	Up to 400	Up to 450	3	59'	34'	TWLTL	None	5'	5'	N	n/a	Y	10'	East
Admiral Cochrane Drive	Riva Road	MD 2 (Solomons Island Road)	Collector	30	7,250	Up to 650	Up to 900	4	75'	50'	Y	None	5'	5'	N	n/a	Y	10'	East
MD 2 (Solomons Island Road)	Jennifer Road	Forest Drive	Principal Arterial	40	57,000	Up to 2,950	Up to 3,300	6	116'	86'	Y	None	5'	10'	N	n/a	Y	10'	West
MD 2 (Solomons Island Road)	Forest Drive	Admiral Cochrane Drive	Principal Arterial	40	57,000	Up to 2,950	Up to 3,300	6	111'	86'	Y	None	5'	5'	N	n/a	Y	10'	West
Forest Drive	Riva Road	MD 2 (Solomons Island Road)	Collector (Urban)	35	10,000	Up to 875	Up to 1,025	4	96'	66'	Y	None	5'	10'	Y (separated)	8'	N	n/a	n/a
Forest Drive	MD 2 (Solomons Island Road)	Fairfax Road	Collector	30	10,000	Up to 650	Up to 700	2	52'	32'	N	None	5'	5'	Y (marked)	4'	N	n/a	n/a
Old Solomons Island Road	MD 2 (Solomons Island Road)	Forest Drive	Local	30	7,000	Up to 650	n/a	2	44'	24'	N	None	5'	5'	N	n/a	N	n/a	n/a
Old Solomons Island Road	Forest Drive	MD 450 (West Street)	Local	30	7,000	Up to 650	n/a	2	52'	32'	N	None	5'	5'	Y (separated)	4'	N	n/a	n/a
Somerville Road	MD 450 (West Street)	Old Solomons Island Road	Local (Urban)	25	3,000	Up to 250	n/a	2	70'	40'	N	None	5'	10'	Y (separated)	8'	N	n/a	n/a
Chinquapin Round Road	MD 450 (West Street)	MD 665/Forest Drive	Collector	30	21,750	Up to 1,250	Up to 1,425	3	62'	42'	TWLTL	None	5'	5'	Y (marked)	4'	N	n/a	n/a

Notes:

1.) In Town Center Core, sidewalks shall be 10-15 feet in width.

2.) In addition to those in the table above, all other local roadways in the Parole Town Center Core should follow the typical section set forth by the Local (Urban) cross-section. These roadways include Annapolis Exchange, Annapolis Mall Road, Annapolis Restaurant Park, Tower Place, Harker Place, and Towne Center Boulevard.

Typical Section Details - Continued

New Roads

Street Name	Road Segment		Functional Classification	Posted Speed Limit (mph)	Existing AADT	Existing Peak Hour Directional Volumes	Ultimate Peak Hour Directional Volumes	# of Lanes	Min. ROW Width	Min. Roadway Width	Median (Y/N/TWLTL)	Parking Lanes	Min. Buffer	Min. Sidewalk Width	Dedicated Bike Lane (Y/N) (recommended type)	Min. Bike Lane Width	Shared-use Path (Y/N)	Min. Shared-use Path Width	Shared-use Path Side of Road
	From	To																	
Gateway Village Drive Extension	Housley Road	MD 178 (Generals Highway)	Local (Urban)	25	n/a	n/a	n/a	2	68'	38'	N	Both Sides	5'	10'	N	n/a	N	n/a	n/a
Admiral Cochrane Drive Extension	Riva Road	Harry S. Truman Parkway	Collector	30	n/a	n/a	n/a	2	52'	32'	Y	None	5'	5'	Y (separated)	4'	N	n/a	n/a
US 50 Overpass	Admiral Cochrane	Housley Rd.	Collector	30	n/a	n/a	n/a	2	52'	32'	Y	None	5'	5'	Y (separated)	4'	N	n/a	n/a
MD 665 Overpass	Spruill Road	Riva Town Center Blvd	Local	25	n/a	n/a	n/a	2	52'	32'	Y	None	5'	5'	Y (separated)	4'	N	n/a	n/a
Parallel Road to Forest Drive	MD 665	Greenbriar Lane	Collector	30	n/a	n/a	n/a	2	49'	24'	N	None	5'	5'	N	n/a	Y	10'	North
Annapolis Corporate Park / Heritage Office Complex Connector	Harry S. Truman Parkway	Riva Road	Local	25	n/a	n/a	n/a	2	44'	24'	N	None	5'	5'	N	n/a	N	n/a	N/A

Maryland State Highway Administration

Roundabout Design Guidelines

Supplement to the NCHRP Report 672 "Roundabouts: An Informational Guide", Second Edition (2010)

The Maryland State Highway Administration (SHA) has adopted the NCHRP Report 672 "Roundabouts: An Informational Guide" Second Edition as our Roundabout Design Guideline. The information contained in this document is considered a Supplement to the NCHRP Report 672 and is intended to document SHA's approach to the design of roundabouts. Any reference to AASHTO, unless otherwise noted, should be considered a reference to the 2001 AASHTO "A Policy on Geometric Design of Highways and Streets" Unless otherwise noted, the references throughout this supplement are found in the NCHRP Report 672 "Roundabouts: An Informational Guide" Second Edition.

The NCHRP Report 672 is available for downloaded for free from the NCHRP website. The direct link is: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_672.pdf

<u>Introduction</u>

The Maryland State Highway Administration (SHA) began implementing modern roundabouts (RAB), circular at-grade intersections, in 1993. They are an effective intersection design which reduces the numbers of intersection conflict points while operating at slower speeds. This type of intersection has successfully replaced many traditional intersections that had exhibited recurring crash problems and/or operational problems. Roundabouts operate continuously, but at much slower speeds than traditional intersections and normally result in very little delay. Normal operating speeds within roundabouts are between 20 and 30 mph.

SHA has expanded the implementation of roundabouts and they are now routinely placed on facilities that typically operate at higher speeds. Crash reduction results in these environments have been positive as well (refer to *Maryland's Roundabouts; Accident Experience & Economic Evaluation, March 2007, Office of Traffic and Safety).* However, as consideration is given to placement of objects (landscaping or fixed objects) within the central island, special care must be taken to slow traffic down in advance of the roundabout entry. The best way to achieve this speed reduction is through the use of self-enforcing roadway.

This supplement is intended to document SHA's approach to the design and/or redesign of central island and approach alignments where approach speeds (design speed, prevailing speed or posted speed) are greater than 30 mph.

Every roundabout design is unique in that the engineer must seek a design and document the decisions that address the proper balance of approach alignment, approach speeds, operating speed, traffic volumes, pedestrian and bicyclist accommodations and site constraints. This guideline is formatted around and is to be utilized as an extension of the NCHRP Report 672.

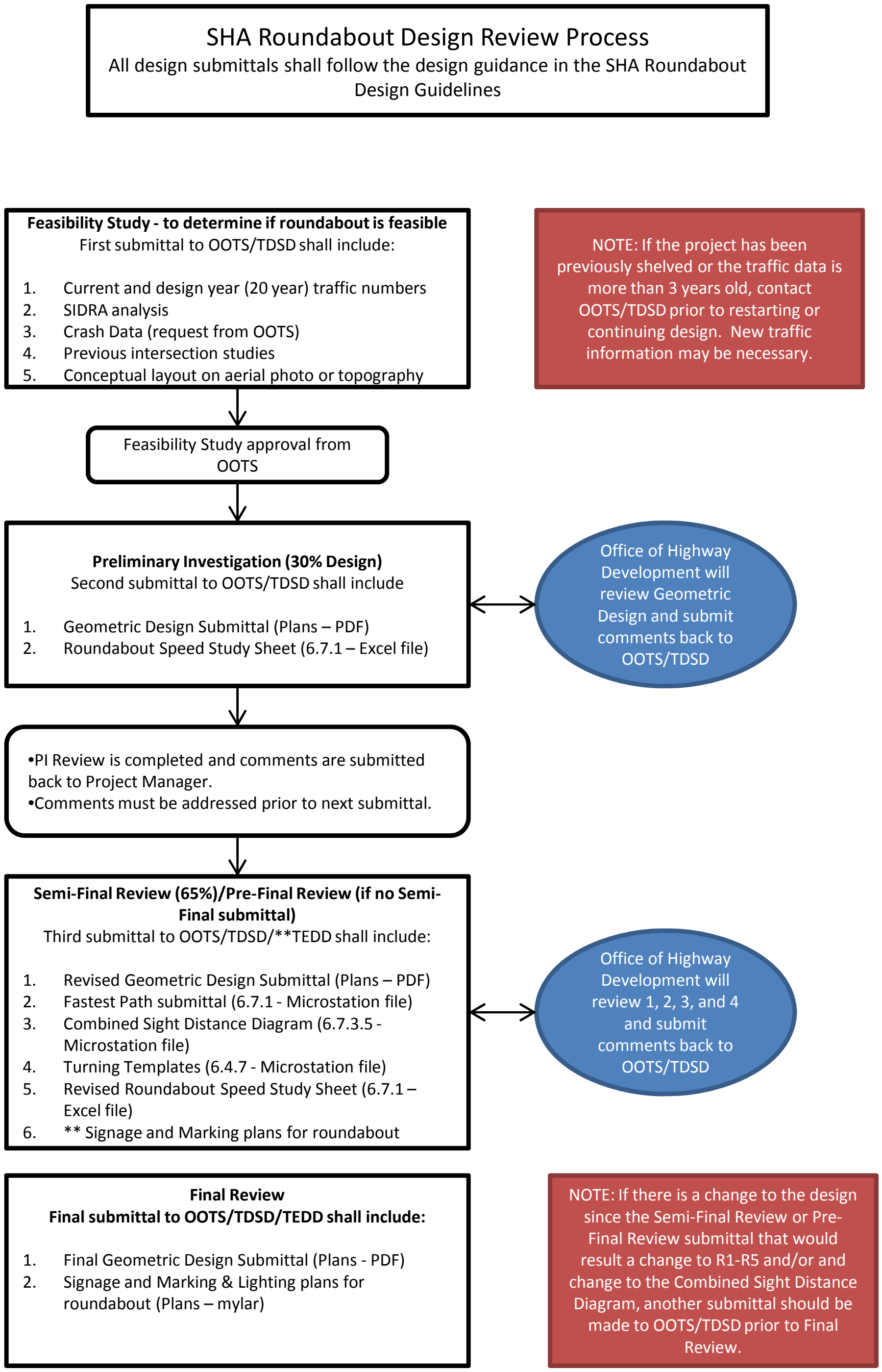
NOTE: The contents of this document are intended to serve as guidance, not as a standard or rule.

In addition to design precautions, and to ensure the intended outcomes (speed reduction, operations, and safety) have been achieved, SHA shall conduct post-construction speed studies to confirm that all constructed roundabouts with approach speeds of greater than 30 mph are exhibiting the desired deceleration characteristics. Appropriate adjustments shall be made to operating roundabouts where higher than desirable approach speeds are encountered. If adjustments are needed, please see Section 6.8.5.5 for adjustment strategies and coordinate with the Office of Traffic and Safety and District Traffic to ensure the proper adjustment strategies are considered.

Since the focus of this guidance is specific to the central island design of a roundabout and approach alignments, it is important to note that SHA, specifically District Offices, must refer to the design guidance provided in this supplement and the *Policy for Placing Fixed Objects in SHA Roundabouts* (see attached) before making any decisions on placement of a fixed object in a roundabout.

This document does not serve as a directive for providing funding sources for any improvements or betterments that are derived from this guidance. Funding sources should be identified through the appropriate fund managers or SHA senior management.

The SHA Roundabout Design Review Process flow chart has been developed to show the basic steps for roundabout design from concept development to final design. This flow chart is included on the next page and should be used for all new roundabout designs, including those designs that have been on hold and are being reconsidered.

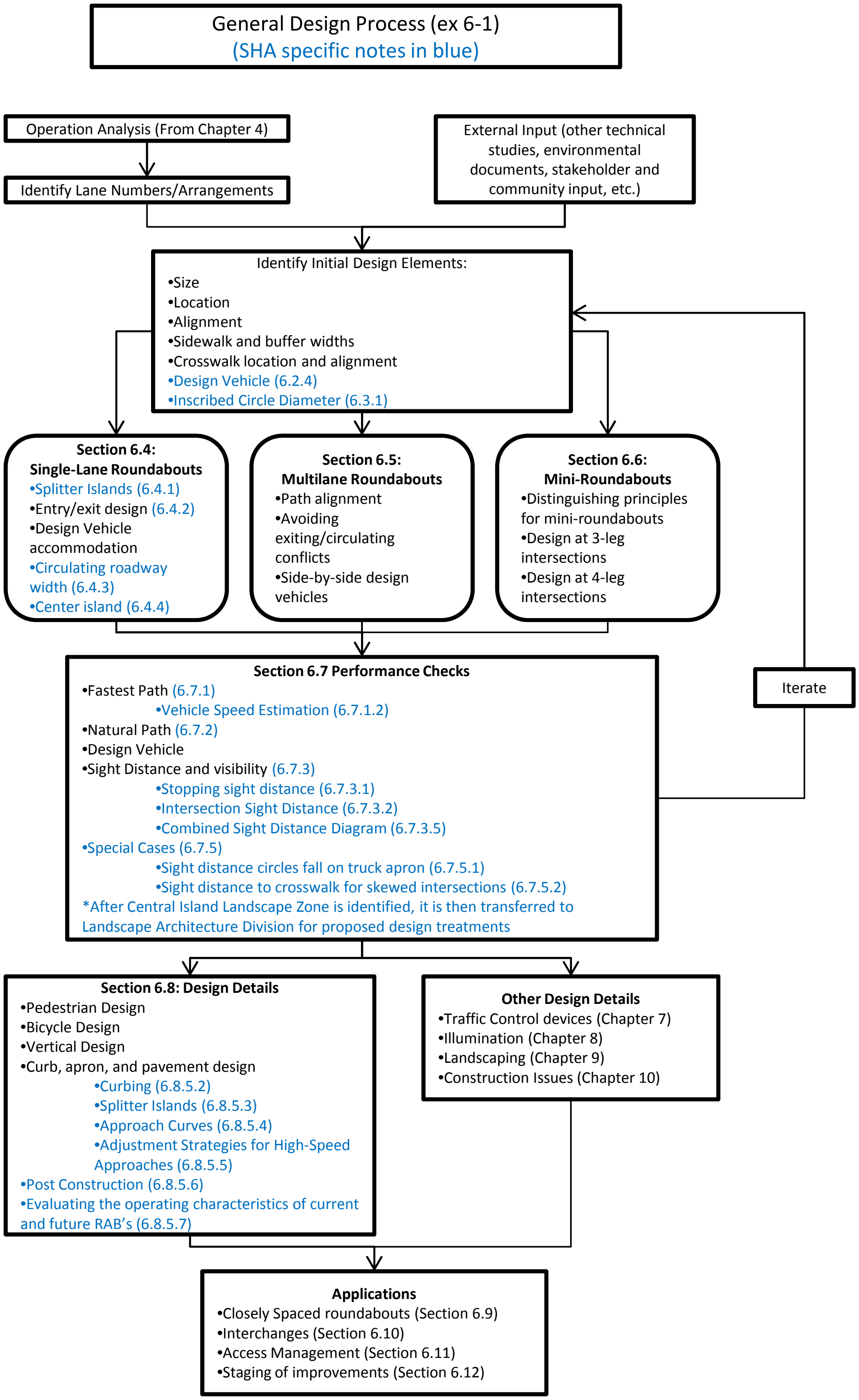

SHA Roundabout Design Review Process
All design submittals shall follow the design guidance in the SHA Roundabout Design Guidelines
Feasibility Study - to determine if roundabout is feasible
First submittal to OOTS/TDSD shall include:
1. Current and design year (20 year) traffic numbers
2. SIDRA analysis
3. Crash Data (request from OOTS)
4. Previous intersection studies
5. Conceptual layout on aerial photo or topography
NOTE: If the project has been previously shelved or the traffic data is more than 3 years old, contact OOTS/TDSD prior to restarting or continuing design. New traffic information may be necessary.
Feasibility Study approval from OOTS
Preliminary Investigation (30% Design)
Second submittal to OOTS/TDSD shall include
1. Geometric Design Submittal (Plans – PDF)
2. Roundabout Speed Study Sheet (6.7.1 – Excel file)
Office of Highway Development will review Geometric Design and submit comments back to OOTS/TDSD
•PI Review is completed and comments are submitted back to Project Manager.
•Comments must be addressed prior to next submittal.
Semi-Final Review (65%)/Pre-Final Review (if no Semi-Final submittal)
Third submittal to OOTS/TDSD/**TEDD shall include:
1. Revised Geometric Design Submittal (Plans – PDF)
2. Fastest Path submittal (6.7.1 - Microstation file)
3. Combined Sight Distance Diagram (6.7.3.5 - Microstation file)
4. Turning Templates (6.4.7 - Microstation file)
5. Revised Roundabout Speed Study Sheet (6.7.1 – Excel file)
6. ** Signage and Marking plans for roundabout
Office of Highway Development will review 1, 2, 3, and 4 and submit comments back to OOTS/TDSD
Final Review
Final submittal to OOTS/TDSD/TEDD shall include:
1. Final Geometric Design Submittal (Plans - PDF)
2. Signage and Marking & Lighting plans for roundabout (Plans – mylar)
NOTE: If there is a change to the design since the Semi-Final Review or Pre-Final Review submittal that would result a change to R1-R5 and/or and change to the Combined Sight Distance Diagram, another submittal should be made to OOTS/TDSD prior to Final Review.

6.1 INTRODUCTION

Exhibit 6-1 shows the general outline for the design process for new roundabout designs. This outline can also be used to analyze existing roundabouts.

If the existing roundabout is being analyzed because of operational issues, the engineer should coordinate with the District Traffic Office, the Office of Traffic and Safety (OOTS) and the Travel Forecasting and Analysis Division (TFAD). Before reviewing the geometry of the existing roundabout, it should be verified that the roundabout will function properly based on the traffic volumes.

When an engineer is reviewing an existing roundabout for geometric layout, it is important that all performance checks in section 6-7 are completed and documented. If survey and/or design information is not available, the engineer should research as-builts and aerial imagery information that can be found on eGIS. This information can then be referenced into Microstation to complete the performance checks.


General Design Process (ex 6-1)
(SHA specific notes in blue)
Operation Analysis (From Chapter 4)
Identify Lane Numbers/Arrangements
External Input (other technical studies, environmental documents, stakeholder and community input, etc.)
Identify Initial Design Elements:
•Size
•Location
•Alignment
•Sidewalk and buffer widths
•Crosswalk location and alignment
•Design Vehicle (6.2.4)
•Inscribed Circle Diameter (6.3.1)
Section 6.4: Single-Lane Roundabouts
•Splitter Islands (6.4.1)
•Entry/exit design (6.4.2)
•Design Vehicle accommodation
•Circulating roadway width (6.4.3)
•Center island (6.4.4)
Section 6.5: Multilane Roundabouts
•Path alignment
•Avoiding exiting/circulating conflicts
•Side-by-side design vehicles
Section 6.6: Mini-Roundabouts
•Distinguishing principles for mini-roundabouts
•Design at 3-leg intersections
•Design at 4-leg intersections
Section 6.7 Performance Checks
•Fastest Path (6.7.1)
•Vehicle Speed Estimation (6.7.1.2)
•Natural Path (6.7.2)
•Design Vehicle
•Sight Distance and visibility (6.7.3)
•Stopping sight distance (6.7.3.1)
•Intersection Sight Distance (6.7.3.2)
•Combined Sight Distance Diagram (6.7.3.5)
•Special Cases (6.7.5)
•Sight distance circles fall on truck apron (6.7.5.1)
•Sight distance to crosswalk for skewed intersections (6.7.5.2)
*After Central Island Landscape Zone is identified, it is then transferred to Landscape Architecture Division for proposed design treatments
Iterate
Section 6.8: Design Details
•Pedestrian Design
•Bicycle Design
•Vertical Design
•Curb, apron, and pavement design
•Curbing (6.8.5.2)
•Splitter Islands (6.8.5.3)
•Approach Curves (6.8.5.4)
•Adjustment Strategies for High-Speed Approaches (6.8.5.5)
•Post Construction (6.8.5.6)
•Evaluating the operating characteristics of current and future RAB's (6.8.5.7)
Other Design Details
•Traffic Control devices (Chapter 7)
•Illumination (Chapter 8)
•Landscaping (Chapter 9)
•Construction Issues (Chapter 10)
Applications
•Closely Spaced roundabouts (Section 6.9)
•Interchanges (Section 6.10)
•Access Management (Section 6.11)
•Staging of improvements (Section 6.12)

6.2 PRINCIPLES AND OBJECTIVES

6.2.4 DESIGN VEHICLE

Selection of the appropriate design vehicle is crucial when laying out and analyzing the geometrics of a roundabout. It is important that the designer should clearly document the design vehicle prior to progressing into final design. If the design vehicle changes once the design has started, it is likely that the designer will need to start the design over in order to address the geometrics to accommodate the design vehicle.

When considering a design vehicle, the designer will need to coordinate with District Traffic Offices and Travel Forecasting and Analysis Division to understand the need for special design vehicles that may dictate the geometrics of the roundabout. For instance, in eastern Maryland, there may be significant farm equipment that utilizes the corridor the roundabout is being designed for. If this is the case, the geometrics of the roundabout may need to be adjusted to accommodate the farm equipment. This is a local situation that will likely be known by District Traffic.

When documenting the decision for the design vehicle, it is important to understand the movement that the design vehicle will be making. For instance, if the design vehicle is a WB-67, and the side streets prohibit trucks, it may not be appropriate to design the roundabout to accommodate all movements of the design vehicle to all legs of the roundabout. This can have significant impacts on the design of the roundabout and the size of the inscribed diameter and mountable truck aprons.

For most situations throughout Maryland, the designer should consider a WB-67 as the preferred design vehicle for all roundabouts, unless the roundabout is in an urban setting which prohibits trucks along the side roads. In those cases, it is important that the designer coordinates with the District Traffic office and local jurisdictions to understand the design vehicle needed.

6.3 SIZE, POSITION, AND ALIGNMENT OF APPROACHES

6.3.1 INSCRIBED CIRCLE DIAMETER

SHA projects should be designed to accommodate the appropriate design vehicle. As stated in 6.2.4, the preferred design vehicle for SHA is a WB-67. In some cases, the design vehicle will be a WB-50. The minimum suggested inscribed diameter for a WB-50 (105 ft.) may be appropriate if there are design constraints that prohibit a larger diameter and if there are low-speed approaches to the roundabout. It is recommended that the designer should consider a diameter of at least 120 ft. when laying out the roundabout using a WB-50. If the design vehicle is larger than a WB-50, a larger inscribed diameter will be required.

Roundabouts with inscribed circle diameters less than 120 ft. but greater than 90 ft., although not considered mini-roundabouts, are not preferred by SHA. Inscribed circle diameters in this range can lead to very small to no area in the central island for landscaping. Little to no landscaping in the central islands leads to a greater visibility for approaching vehicles which is not considered favorable. The process to determine the appropriate sight distance can be found in section 6.7.

Roundabouts less than 90 ft. are considered mini-roundabouts. Mini-roundabouts should only be considered for existing low speed urban conditions where environmental and right-of-way impacts preclude the use of a larger roundabout. Central islands on mini-roundabouts are typically traversable and must remain free of landscaping and fixed objects in all cases.

6.4 SINGLE-LANE ROUNDABOUTS

6.4.1 SPLITTER ISLANDS

Splitter islands should be a minimum length of 100 ft. on SHA projects. See Section 6.8.5.3 for more details.

Preferably, splitter islands should be raised using Standard Type A Curb and Gutter (Standard No. MD-620.02). The corners of the splitter island should be nosed down as shown in Figure 6.4.1-1 below.

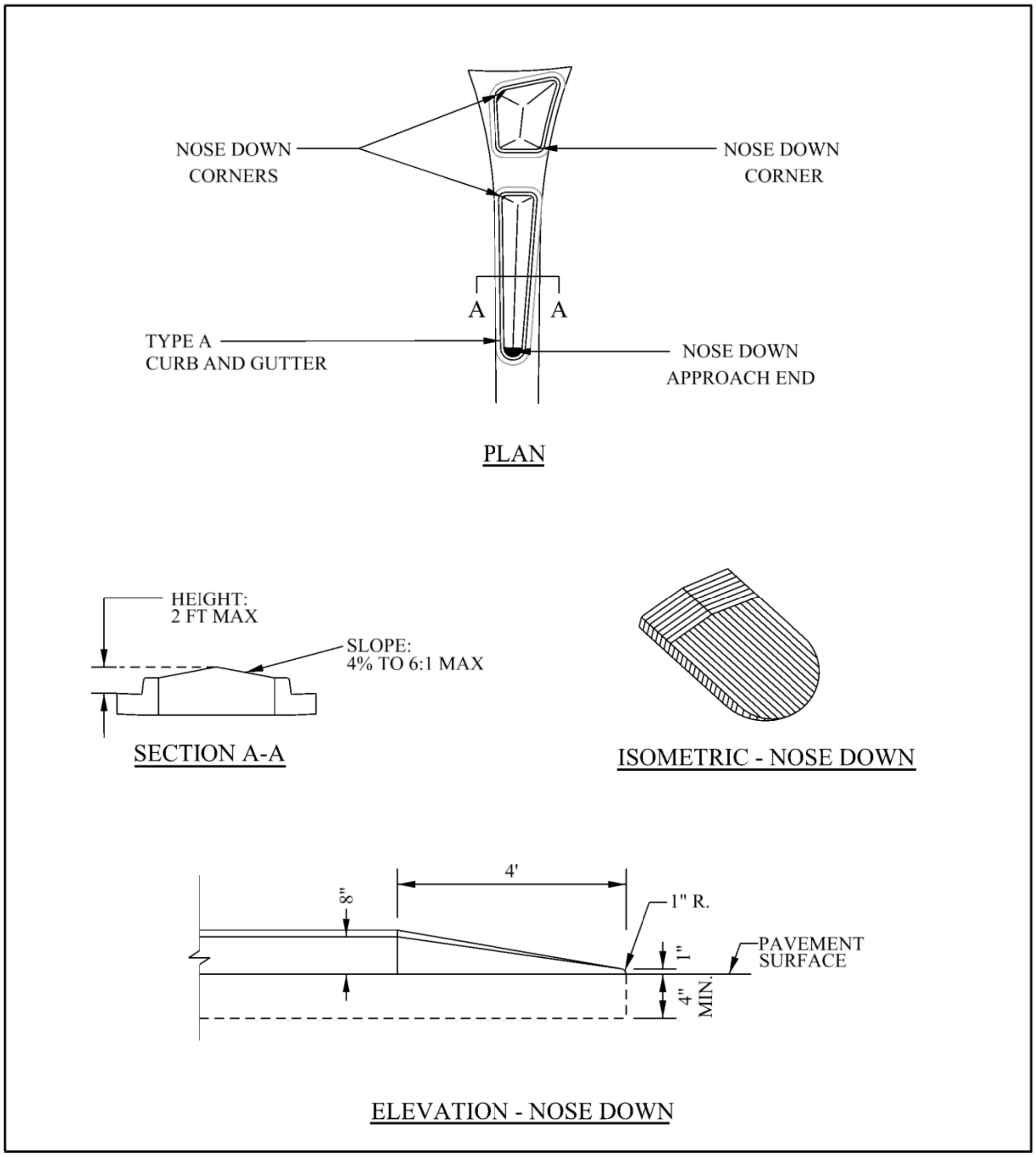


FIGURE 6.4.1-1

At intersections with restricted right-of-way, it may be necessary to use Type C Curb and Gutter when the design vehicle cannot pass through the entry or exits with at least 2 ft. of clearance to the face of vertical curb. In that case, use Figure 6.4.1-2 shown below for the splitter islands.

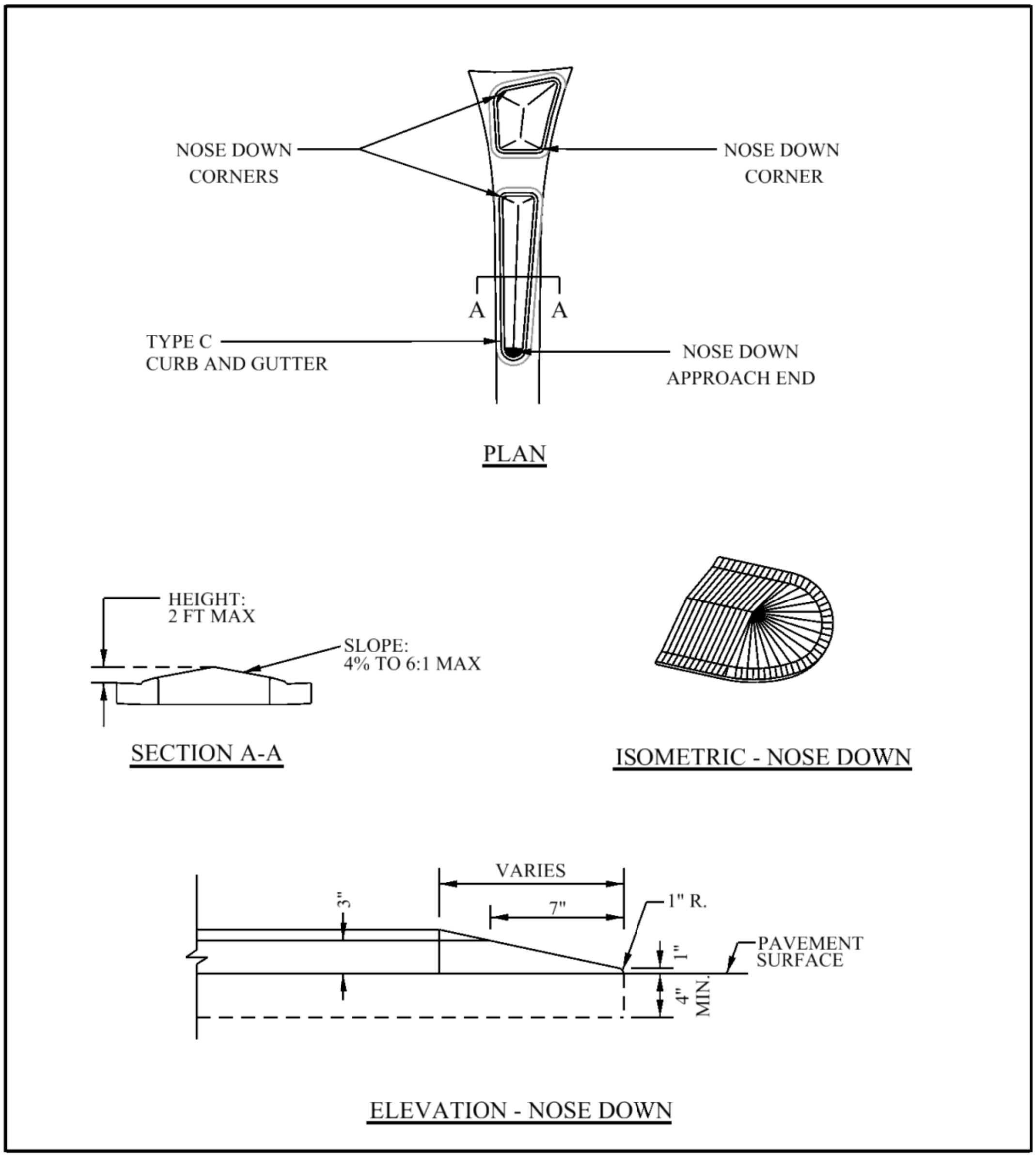


FIGURE 6.4.1-2

The portion of the splitter island that is narrower than 6 ft. wide should be hardscaped with traffic-bearing, context sensitive treatments. The area that is wider than 6 ft. may be landscaped with turfgrass or appropriate plantings in conformance with sight distance requirements and other safety considerations as approved by the Office of Environmental Design.

6.4.2 ENTRY WIDTH

Entry widths should range from 14-18 ft. and should not exceed the width of the circulatory roadway.

6.4.3 CIRCULATORY ROADWAY WIDTH

The circulatory roadway width should be as wide as the maximum entry width and up to 120% greater than the maximum entry width. The circulatory roadway should also be wide enough to accommodate a bus without the use of a truck apron. Where truck traffic is considered high (10% or greater), it is advised to have the circulatory roadway wide enough to accommodate a WB-50 without the use of a truck apron so capacity of the roundabout is not compromised. Increasing the inscribed circle diameter will also aid in this accommodation.

A truck apron is standard on all SHA projects to accommodate the turning movements of a WB-67 design vehicle.

6.4.4 CENTRAL ISLAND

The central island consists of 3 zones which are the truck apron, buffer zone, and landscape zone. Raised central islands are preferred over depressed central islands since depressed central islands are difficult for approaching drivers to recognize and drainage can become an issue. The central island grading and landscaping should be designed to provide the minimum required sight distance. Providing more than the minimum sight distance may result in excessive speeds within the roundabout and should not be considered. Follow the guidance set forth in Section 6.7.3 in order to obtain the limits of the Central Island Buffer and Landscape Zones.

The Central Island Buffer Zone should be a minimum 6 ft. wide behind the Type A Curb and Gutter to allow for vehicle overhang. The width of the zone may increase in accordance with Section 6.7.3 as necessary to provide the minimum required sight distance. Within this zone, the combined height of the grading and the landscaping should be less than 2 ft. in height from circle which the stopping sight distance along the circulatory roadway is measured. This circle is shown in Exhibit 6-56 and is offset 6 ft. from the flowline of the truck apron (See Figure 6.4.4-1). Preferred treatments for the Central Island Buffer Zone are turfgrass or hardscape.

The Central Island Landscape Zone should be graded and landscaped to obtain a combined height of 3.5 ft. or greater above the elevation of the circulatory roadway also from the circle which the stopping sight distance along the circulatory roadway is measured. When designing landscaped central islands within areas of existing pavement, consideration should be taken to remove paving and subbase material unsuitable for plant growth, scarify compacted subgrade, and place necessary subsoil and topsoil.

All landscaping treatments must be coordinated with the Office of Environmental Design.

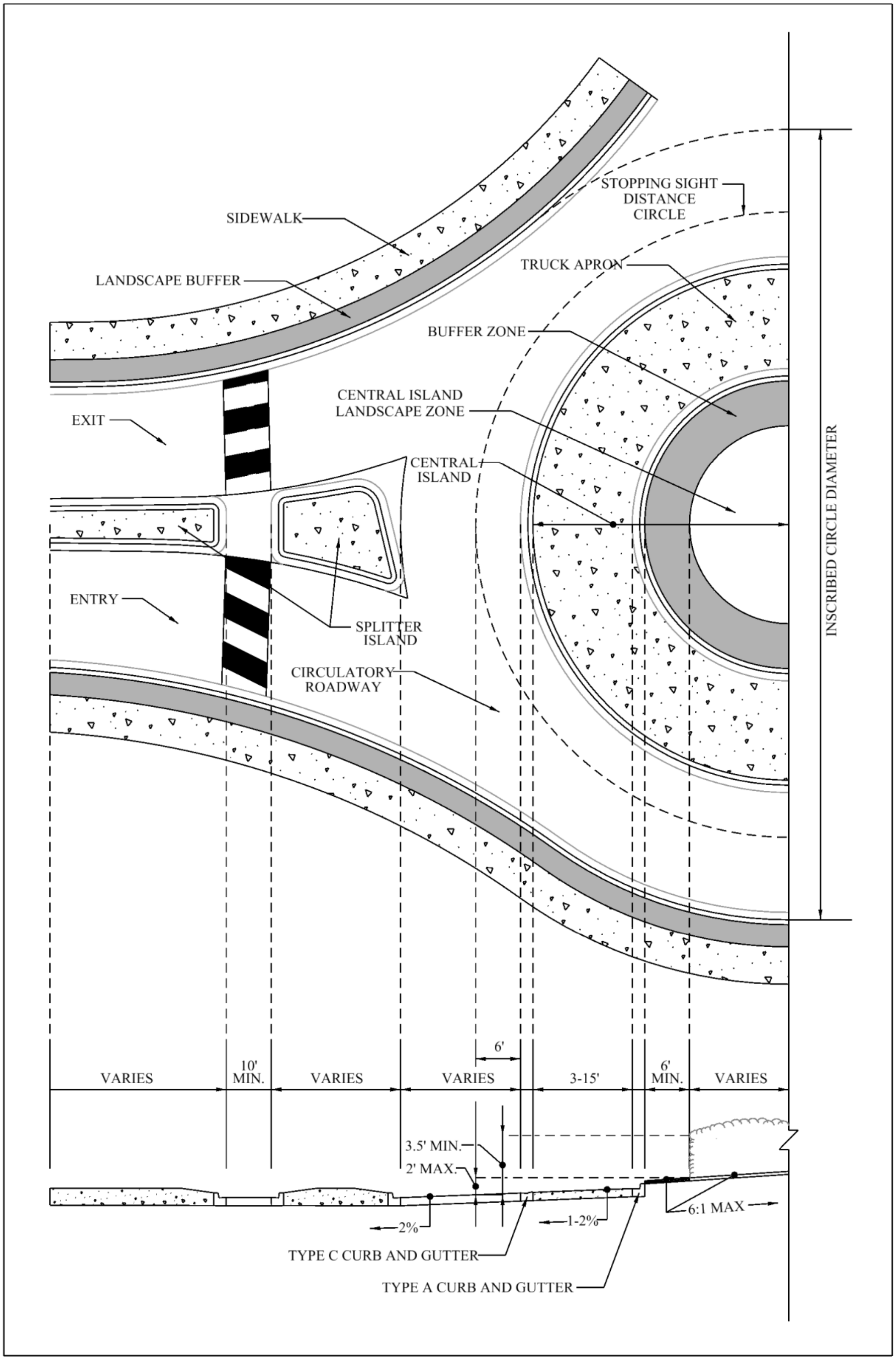

SIDEWALK
LANDSCAPE BUFFER
STOPPING SIGHT DISTANCE CIRCLE
TRUCK APRON
BUFFER ZONE
CENTRAL ISLAND LANDSCAPE ZONE
CENTRAL ISLAND
EXIT
ENTRY
SPLITTER ISLAND
CIRCULATORY ROADWAY
INSCRIBED CIRCLE DIAMETER
VARIES
10' MIN.
VARIES
VARIES
6'
3-15'
6' MIN.
VARIES
3.5' MIN.
2' MAX.
2%
1-2%
6:1 MAX
TYPE C CURB AND GUTTER
TYPE A CURB AND GUTTER

FIGURE 6.4.4-1

The central island should not contain features which are likely to attract pedestrians. Examples of such features are flagpoles, memorial plaques, pedestrian-scale statues or artwork, benches, etc. When requests are received for the placement of such features, SHA shall identify the appropriate locations in the vicinity of the roundabout that can be considered in lieu of the central island. The costs of installation, lighting and maintenance of such features shall be the responsibility of the municipality. Please refer to the latest SHA adopted *AASHTO Roadside Design Guide* when placing any fixed objects near the roadway.

Any requests be considered by SHA for the placement of features mentioned above or any fixed object within the central island of a roundabout shall be in compliance with the *SHA Policy for Placing Fixed Objects in SHA Roundabouts.* Before any final decision is made on whether or not fixed objects can be placed in the central island of the roundabout, coordination with the District Office and the Office of Traffic and Safety is required.

Identification of the Central Island Landscape Zone as described in 6.7.3.5 must be completed prior to a final decision on the location of any proposed fixed object within the central island of the roundabout.

6.4.5 ENTRY DESIGN

The outside curb line of the entry should be designed cuvilinearly tangential to the outside edge of the circulatory roadway. The inside roadway edge of entry should be curvilinearly tangential to the truck apron.

The minimum entry radii should be 65ft. so that capacity of the roundabout is not affected.

Entry angles (phi) should be between 20 and 40 degrees with 30 degrees desired. Figures 6.4.5-1 and 6.4.5-2 on the next page are derived from the WisDOT Roundabout Guide. Figure 6.4.5-1 is to be used to find phi when distance from the entry to the next exit is not more than 100 ft. Use Figure 6.4.5-2 to find phi when the distance from the entry to the next exit is greater than 100 ft. such as at 3 legged roundabouts.

Published: 01/01 Revised: 04/24

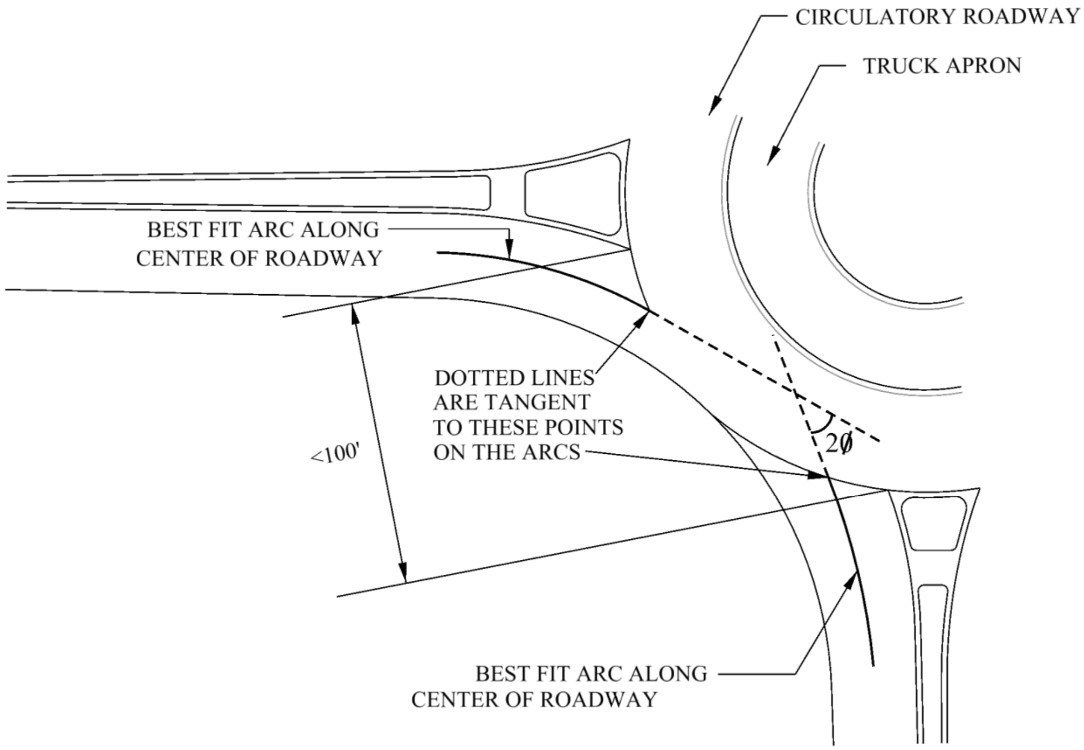


FIGURE 6.4.5-1

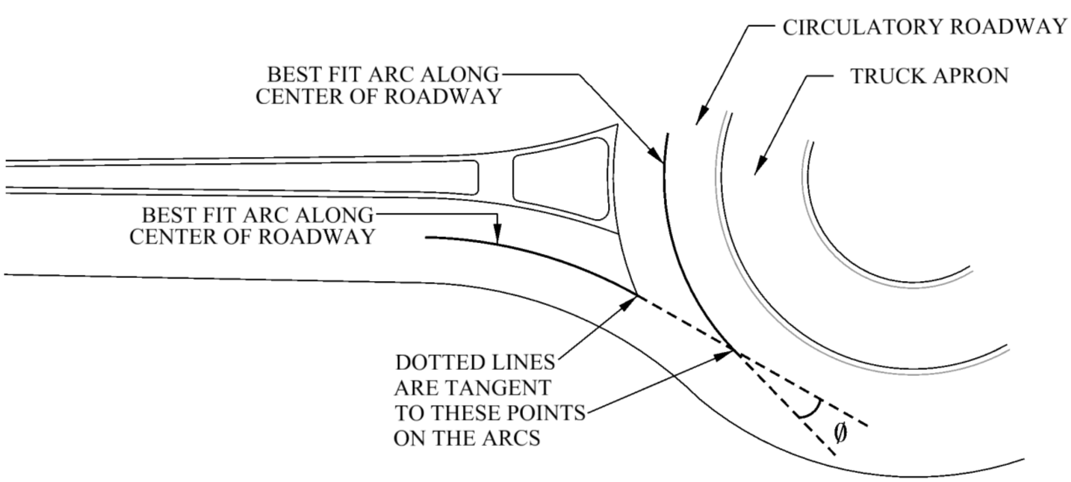


FIGURE 6.4.5-2

6.4.6 EXIT DESIGN

The outside curb line of the exit should be designed cuvilinearly tangential to the outside edge of the circulatory roadway. The inside roadway edge of the exit should be curvilinearly tangential to the truck apron.

A large-radius or tangential type exit design as illustrated in Exhibit 6-16 should only be used in rural environments where no pedestrian traffic is expected since it increases exit speeds.

6.4.7 DESIGN VEHICLE

The design vehicle for SHA projects is a WB-67. It may be occasionally appropriate to choose a smaller design vehicle for turning movements and a larger design vehicle for through movements. For example, if a roundabout is placed at the intersection of a state route and a county route, it may be reasonable to design so that a WB-50 can easily make left turns, right turns, and through movements, but a WB-67 vehicle can only travel straight through the roundabout along the state route. This technique can be used at the discretion of the engineer and should be discussed and approved by the Office of Traffic and Safety, District Traffic Office, and the Travel Forecasting and Analysis Division.

CAD-based vehicle-turning-path simulation software should be used to determine if the roundabout design appropriately accommodates the design vehicle. Roundabout design is iterative so the software should be used each time a design is changed or modified. The final circulating paths generated by the CAD-based vehicle-turning-path simulation software should be archived with the project documents.

6.4.7.1 TRUCK APRONS

Truck aprons should be designed so they are traversable to trucks but discourage use by passenger vehicles. To discourage use by passenger vehicles, truck aprons should be designed with Type C Curb and Gutter between the circulatory roadway and the truck apron. The apron should be constructed of reinforced concrete or other traffic bearing material as approved by the Office of Materials and Testing. The material used should differentiate it from both the circulatory roadway and sidewalk if present. To minimize damage by design vehicles to the central island signs and landscaping, truck aprons should be separated from the Central Island Buffer Zone by Type A Curb and Gutter.

Truck apron width is dictated by the tracking of the design vehicle using CAD-based vehicle-turning-path simulation software. They should generally be 3 to 15 ft. wide and have a cross slope of 1 to 2% away from the central island. When the minimum truck apron width is less than a typical shoulder width, the truck apron may be increased to provide a full shoulder for maintenance activities in the central island.

6.5 MULTILANE ROUNDABOUTS

6.5.1 LANE NUMBERS AND ARRANGEMENTS

Lane numbers and arrangements should be provided to the Office of Highway Development from Travel Forecasting and Analysis Division.

6.5.2 ENTRY WIDTH

A two lane entry should be 24 to 30 ft. wide and a three lane entry should be 36 to 45 ft. wide with individual lanes ranging from 12 to 15 ft. in both cases depending on the turning requirements of the design vehicle.

In cases where a single lane enters a multilane roundabout, the entry width should be flared from the upstream roadway width, but the flare length should not exceed 330 ft. as any length greater than that has no effect on capacity (WisDOT Roundabout Guide 11-26-30, pg 10). If additional capacity is required, a lane should be added as shown in Exhibit 6-24.

6.5.3 CIRCULATORY ROADWAY WIDTH

Circulatory roadway lane widths should range from 14 to 16 ft. Where truck traffic is high (greater than 10%), the roadway width may need to be increased to accommodate simultaneous passage of a truck and a car (See Section 6.5.7 for more information).

6.5.4 ENTRY GEOMETRY AND APPROACH ALIGNMENT

For multilane roundabouts, it is important to avoid vehicle path overlap between the lanes. One design aspect for avoiding vehicle path overlap is a compound curve entry design. The first entry curve radius should be 65 to 120 ft. followed by the larger curve with a radius greater than 150 ft. A tangent section instead of the large radius curve may be used if necessary. The first entry curve should be set back from the circulatory roadway by at least 20 ft. (6-40). See Exhibit 6-30 for more details.

Another important aspect for multilane roundabouts is providing sufficient deflection on the entry. This can be achieved by offsetting the approach to the left of the center of the roundabout typically by 20 to 30 ft.

Guidance for checking path overlap does not exist in NCHRP 672; however WisDOT provides a clear method. Figure 6.5.4-1 on the next page shows the desirable entry path tangent being 40 to 50 ft. and the desirable exit path tangent being greater than 40 ft. It is also important to note that providing 5 ft. between the face of the central island curb and the extension of the face of curb on the splitter island usually results in avoiding vehicle path overlap.

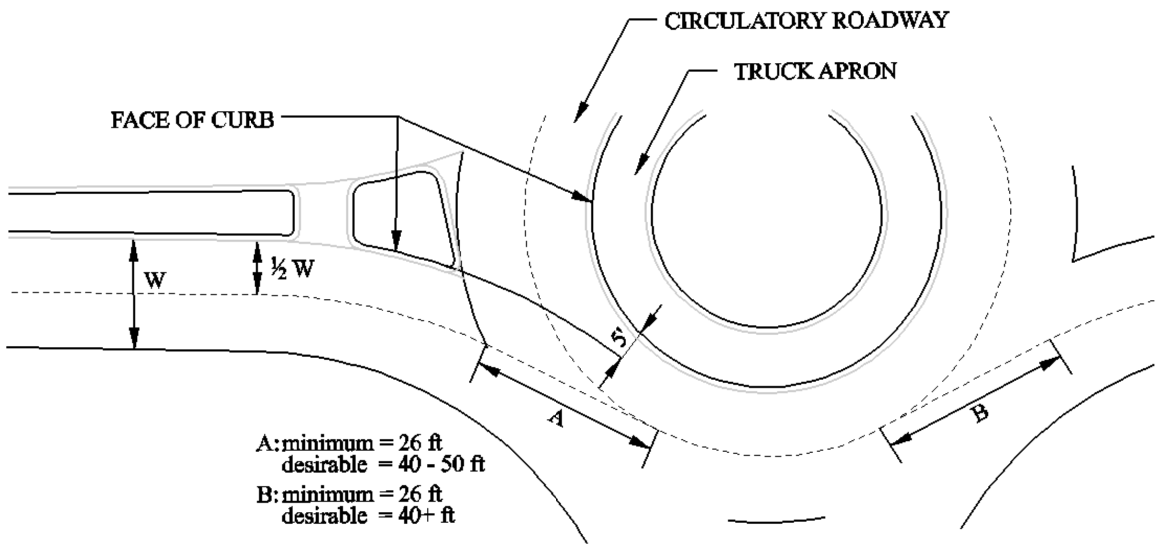


FIGURE 6.5.4-1

6.5.7 DESIGN VEHICLE CONSIDERATIONS

Side by side navigation through the roundabout must be considered for multilane roundabouts. In areas where truck traffic is low, a WB-67 can be allowed to claim both lanes to navigate through the roundabout. In this case, it may be appropriate to design for the side by side navigation of a single unit truck or bus and a passenger car. However, allowing a WB- 67 to claim both lanes in areas where truck traffic is high will result in reduced capacity. See page 6-44 of the NCHRP Guide for design techniques for accommodating large design vehicles.

6.7 PERFORMANCE CHECKS

It is necessary for the project engineer to properly document the design decisions along with the performance checks discussed in this section for every roundabout project. This information should be stored with the project files and included in the appropriate design milestone report.

6.7.1 FASTEST PATH

Every SHA project that contains a roundabout within the project limits ***MUST*** check the roundabout for entry speed and sight distance. This applies to new design as well as existing roundabouts. The method for checking a roundabout begins with drawing the fastest paths for each leg in order to obtain the R values (see Exhibits 6-46 thru 6-50). Once the R values are obtained, the corresponding speeds, V, for each R value can be calculated. Download the Roundabout Speed Study Sheet for the roundabout calculations from the Office of Highway Development Intranet site \Design Resources\eLibrary\roundabout speed study sheet\.

6.7.1.2 VEHICLE SPEED ESTIMATION

For normal approaches and normal roundabout cross slope calculate the corresponding speeds, V, as follows:

For R1, R3, and R5	use Equation 6-1
For R2 and R4	use Equation 6-2

If the approach and roundabout cross slopes are not 2%, please refer to Appendix D for information on how to derive the speed equation.

The speeds associated with the R1 values are considered entry speeds. The maximum entry speeds must be as follows:

25 mph	for single lane roundabouts
30 mph	for multilane roundabouts

If any one of the entry speeds exceeds the limit for that type of roundabout, the geometry should be modified so that the entry speed is reduced to meet the guidelines.

6.7.3.1 STOPPING SIGHT DISTANCE

When calculating the three types of stopping sight distances use Equation 6-5 and consider the following:

1. For ***approach sight distance***, V is equal to the design speed of the roadway prior to the roundabout. The distance, d, that is calculated is used to draw the sight triangles to both the yield line and the beginning of the crosswalk. Use Exhibit 6-55 for drawing the sight triangles to the yield line and use Figure 6.7.3.1-1 to draw the sight triangles to the crosswalk.

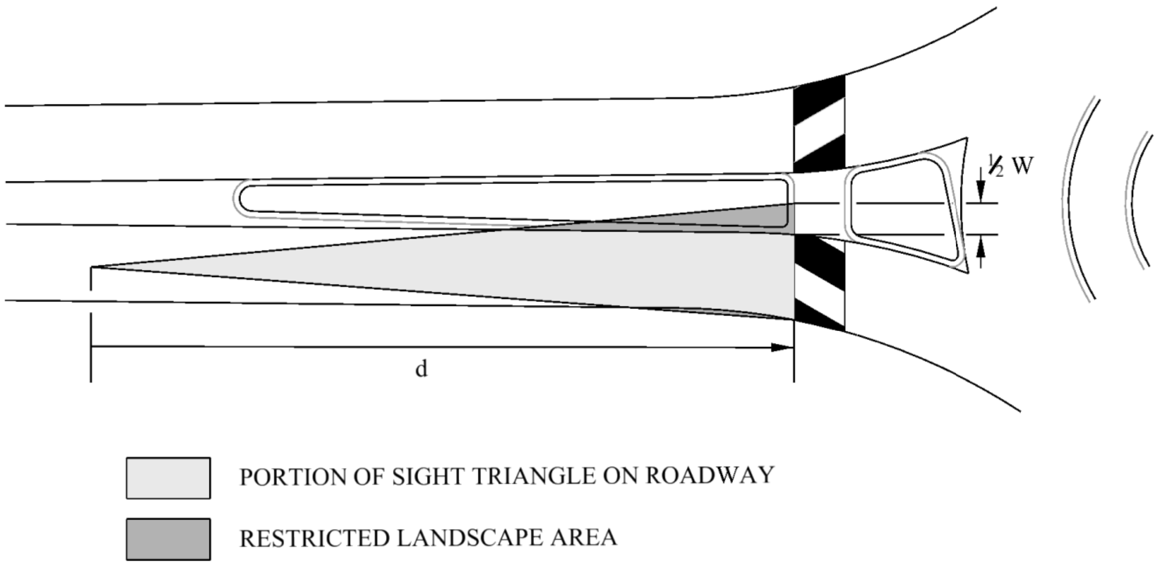


FIGURE 6.7.3.1-1

2. For ***sight distance on circulatory roadway***, use the V that corresponds to the largest of all R2 and R4 values. The distance, d, that is calculated is used to draw the stopping sight distance line as shown in Exhibit 6-56. d and the corresponding stopping sight distance line should be drawn for each leg and placed on the same diagram similar to Figure 6.7.3.1-2. The stopping sight distance lines will form a box in which the Stopping Sight Distance Landscape Buffer can then be drawn. The Stopping Sight Distance Landscape Buffer should be concentric to the central island and a minimum of 6 ft. from the back of the Type A Curb and Gutter.

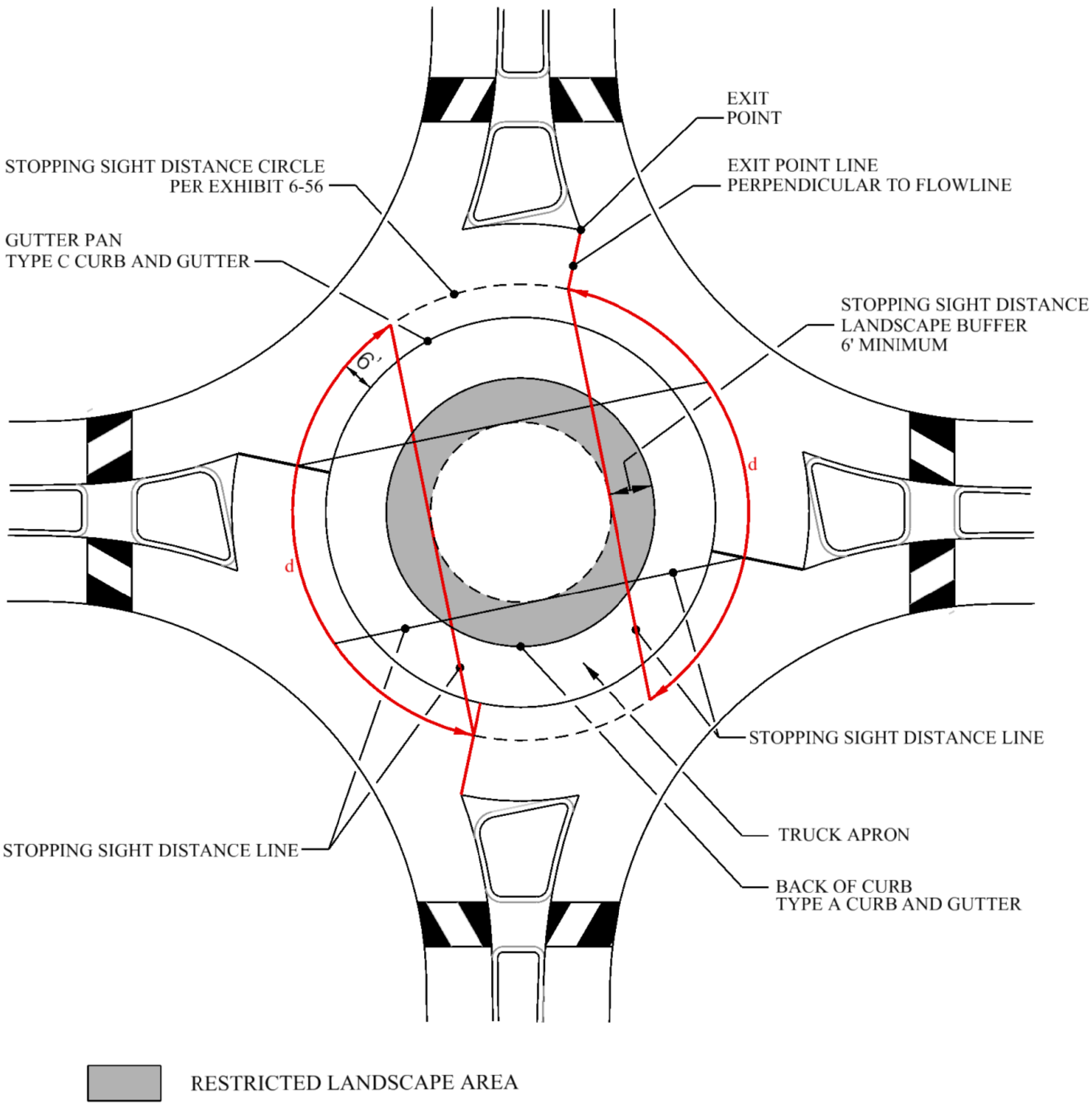


FIGURE 6.7.3.1-2

3. For ***sight distance to crosswalk on exit***, use the V that corresponds to the R5 value from the leg to the left of the crosswalk to calculate d. Draw the sight distance to crosswalk lines as shown in Figure 6.7.3.1-3.

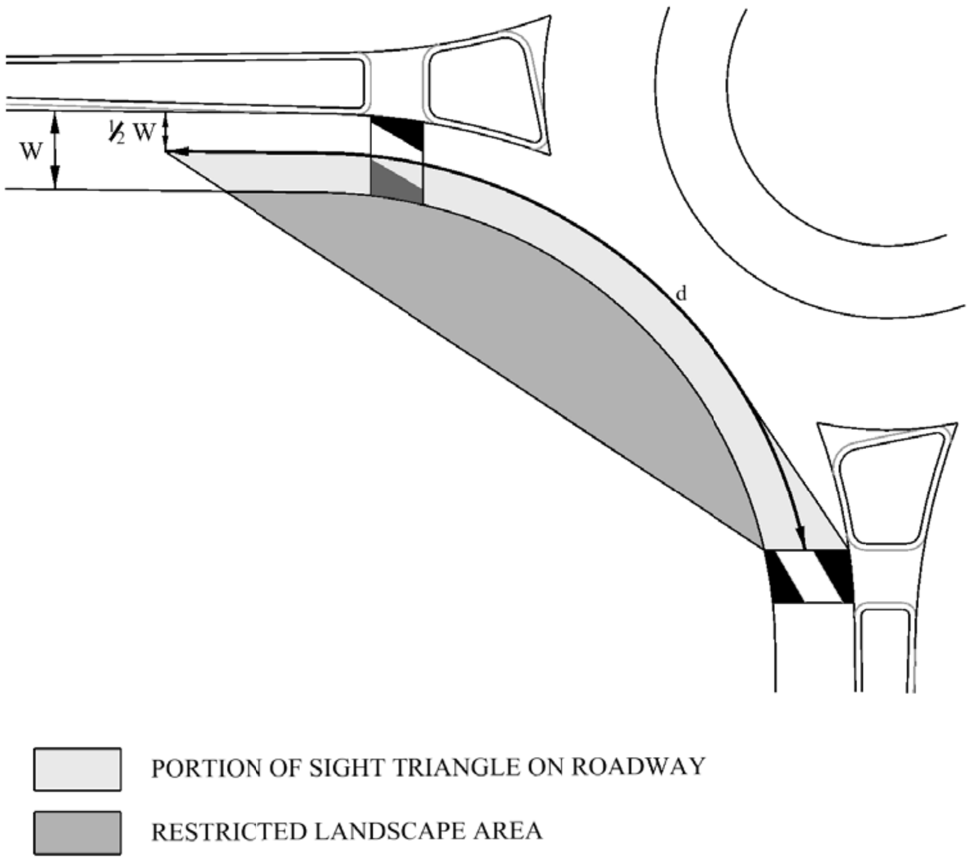


FIGURE 6.7.3.1-3

6.7.3.2 INTERSECTION SIGHT DISTANCE

Intersection sight distance requires calculating d_1 and d_2 for each leg by using Equations 6-6 and 6-7, respectively. When calculating d_1 for a specific leg of the roundabout, the V is based on an average of the R1 and R2 values from the leg to the left (see Exhibit 6-58). When calculating d_2, use the V that corresponds to the largest of all R2 and R4 values. The d_2 value is the same for all legs. All of the intersection sight lines for each leg should be put on a single diagram similar to Figure 6.7.3.2-1 below.

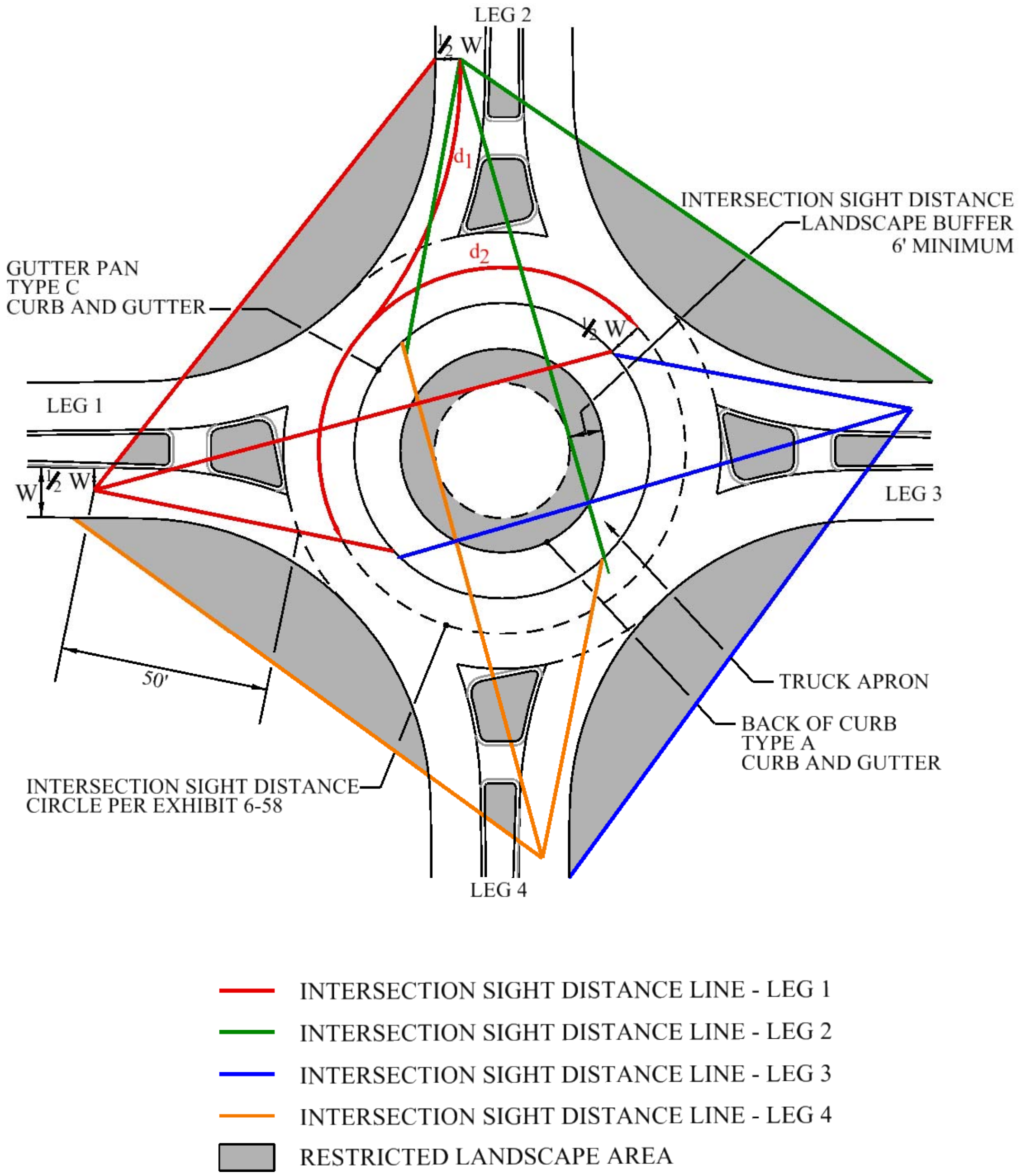


FIGURE 6.7.3.2-1

6.7.3.5 COMBINED SIGHT DISTANCE DIAGRAM

In order to create a Combined Sight Distance Diagram (CSDD), overlay all of the stopping sight distance and intersection sight distance lines on the roundabout drawing. See Figure 6.7.3.5-1.

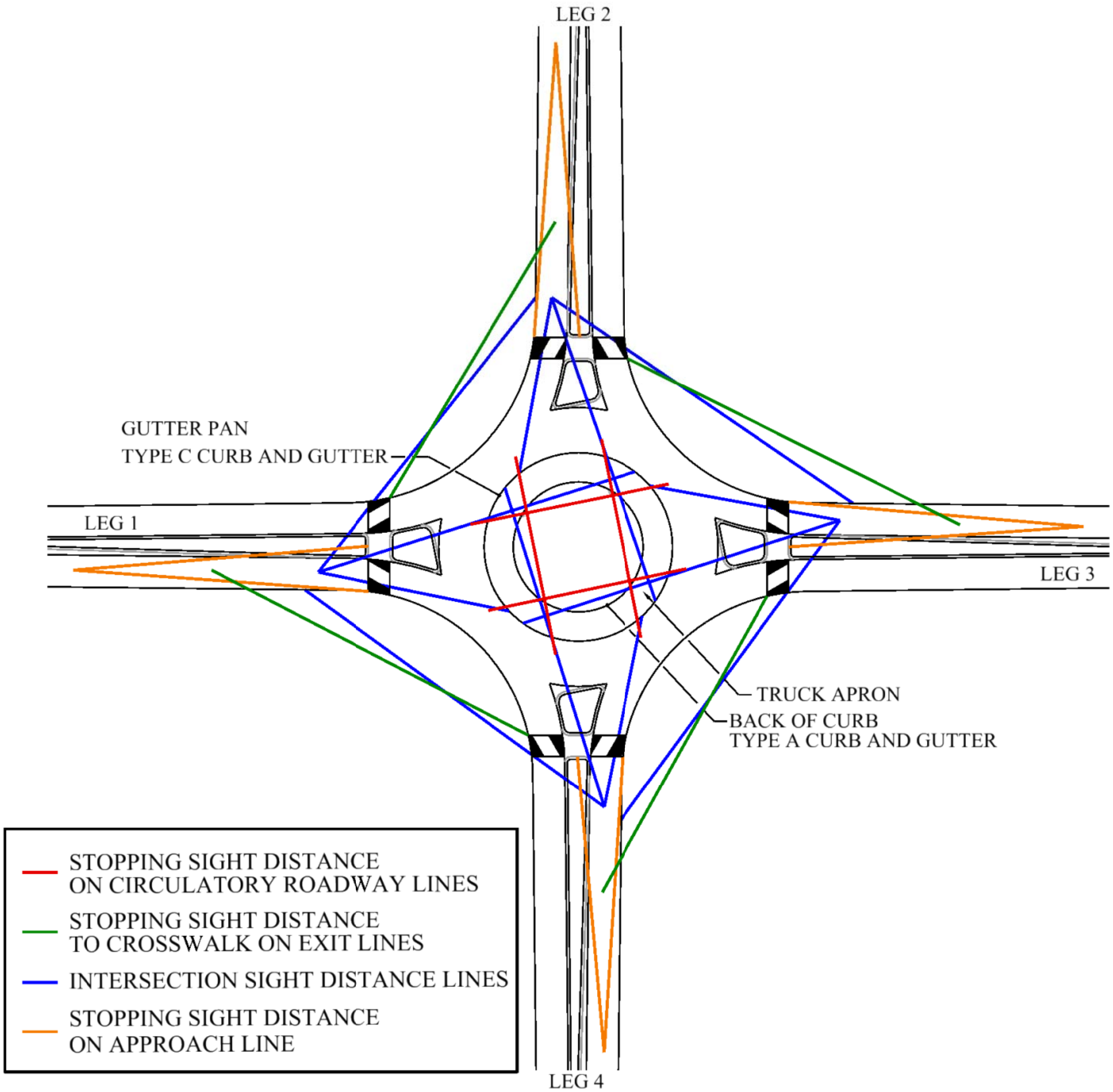


FIGURE 6.7.3.5-1

Keep the lines that provide the most conservative sight distance estimates in order to shade the areas that must remain clear of obstructions. See Figure 6.7.3.5-2.

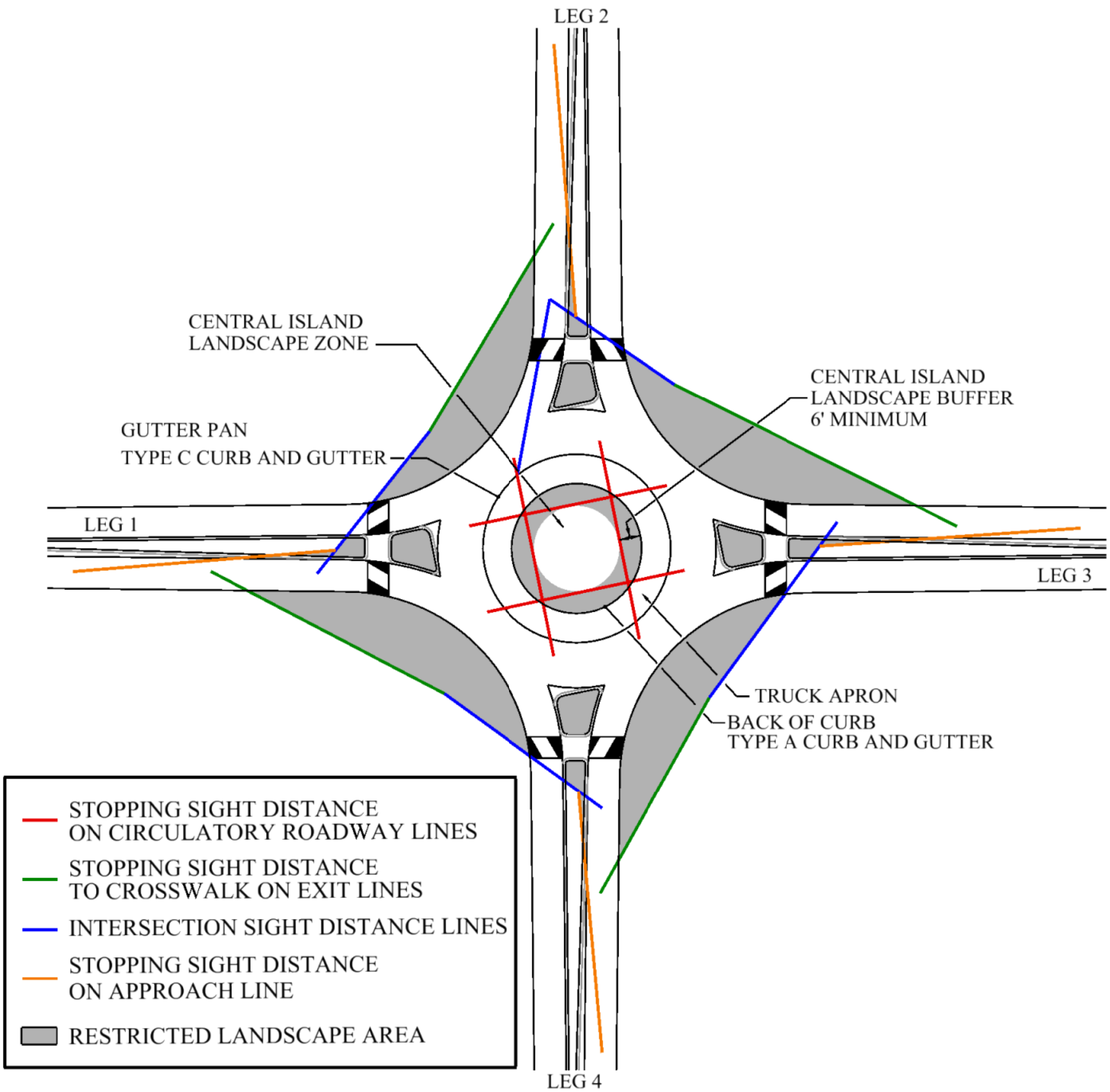


FIGURE 6.7.3.5-2

This diagram should be provided to the Landscape Architecture Division to ensure the roundabout landscaping and central island grading will be designed to maintain the required sight distance.

NOTE: providing more sight distance than shown in the diagram above may lead to higher vehicle speeds and reduce the safety of the intersection (NCHRP pg 6-64).

6.7.5 SPECIAL CASES

This section does not exist in the NCHRP manual; however there are a few special cases to clarify.

6.7.5.1 SIGHT DISTANCE CIRCLES FALL ON THE TRUCK APRON

Sometimes when the inscribed circle diameter of the roundabout is large and the speeds associated with the R values are low, the stopping sight distance and the intersection sight distance circles for the central island fall on the truck apron. This means that a Central Island Landscape Buffer is not necessary for sight distance; however, one should be provided at a 6 ft. minimum offset from the back of the Type A Curb and Gutter behind the truck apron. The Central Island Landscape Buffer is to remain free of obstructions and landscaping over 2 ft. in height above the circulatory roadway to minimize encroachment of larger landscaping into the truck apron, keep roundabout signs clear of vegetation, and simplify maintenance. See Figure 6.7.5.1-1.

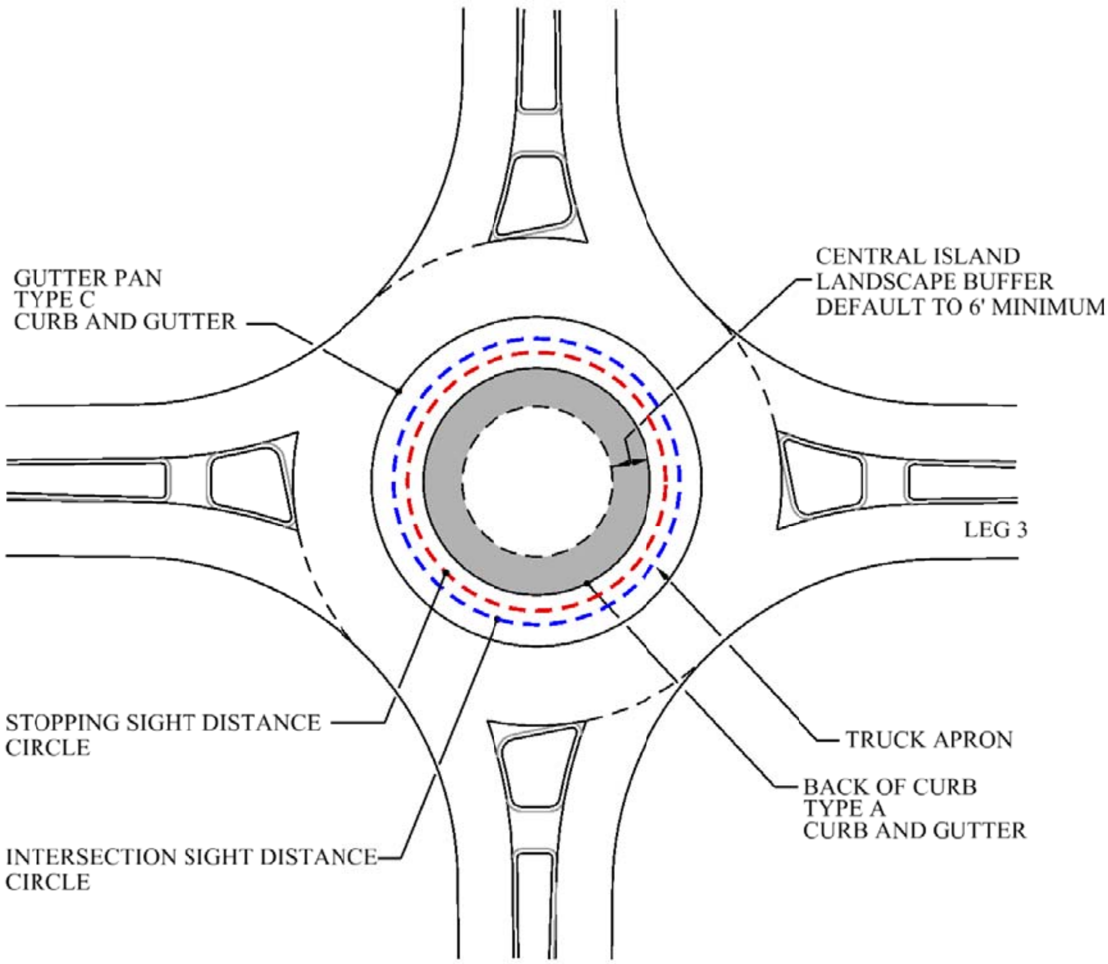


FIGURE 6.7.5.1-1

6.7.5.2 SIGHT DISTANCE TO CROSSWALK FOR SKEWED INTERSECTIONS

At skewed intersections, the right turn movement path is similar to a through movement path. Therefore, a single R5 value cannot be drawn. Instead the right turn path will consist of three R values: R5a, R5b, and R5c as shown in Figure 6.7.5.2-1.

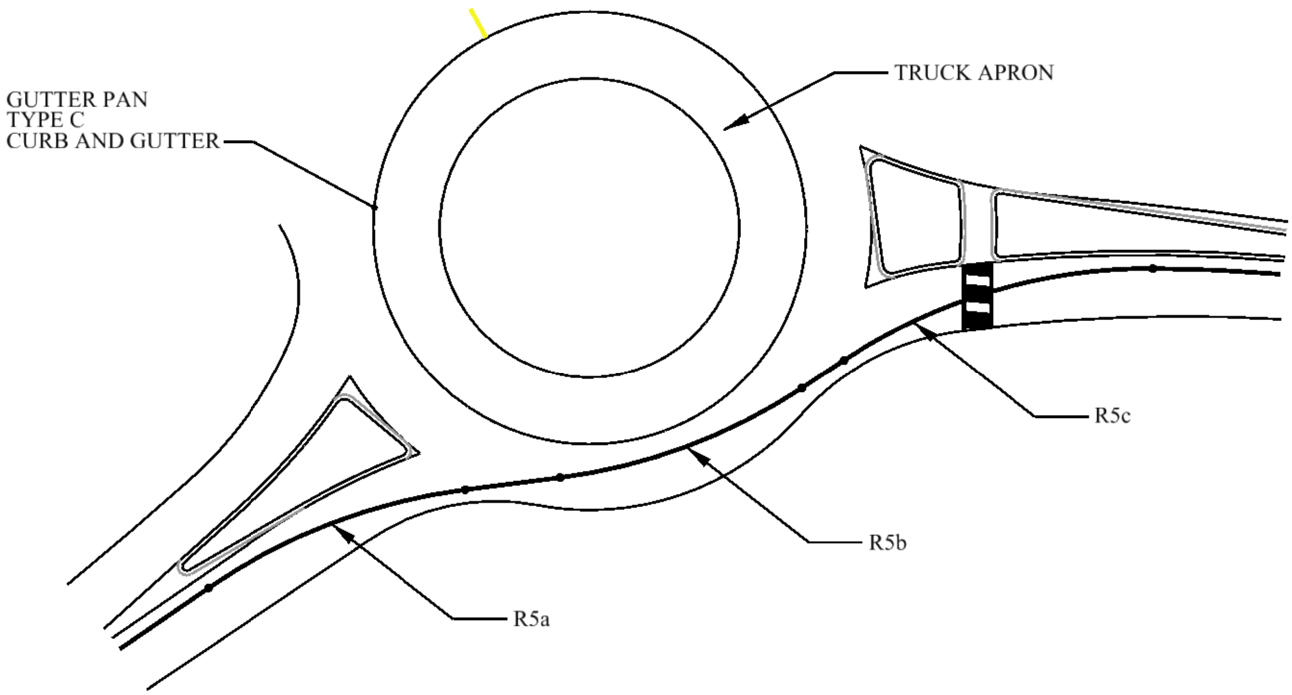


FIGURE 6.7.5.2-1

The speed, V, associated with the R5b value should be used to calculate the stopping sight distance, d, needed to the crosswalk. The stopping sight distance to the crosswalk should then be drawn according to Exhibit C in this report.

If the distance, d, from the crosswalk falls along the curve R5b, then the sight lines can be drawn from that point. If the distance, d, falls along the curve R5a, then the speed V must be recalculated using the average of the R5a and R5b values.

Published: 01/01 Revised: 04/24

6.8 DESIGN DETAILS

6.8.1 PEDESTRIAN DESIGN CONSIDERATIONS

6.8.1.1 SIDEWALKS

The minimum sidewalk width on SHA projects is 5 ft. This width should be as wide as 10 ft in high pedestrian areas. The preferred landscape buffer width between the curb and the sidewalk is 5 ft or greater although where right-of-way is restricted it may be less. When the buffer is 3 ft or greater, it should be turfgrass as other landscape plantings will likely block the required sight distance. Sidewalk buffer areas less than 3 ft. wide should be hardscaped.

On projects that have extra right-of-way at the roundabout corners and where sidewalk is part of the scope of work, the sidewalk design shown in Exhibit 6-64 should be taken into consideration.

Use SHA Standard No. MD 655.11 for the sidewalk ramps and place detectable warning surfaces on each ramp.

6.8.1.2 CROSSWALKS

Crosswalks at roundabouts should be marked and treatments provided according to Chapter 10 of the *SHA Pedestrian and Bicycle Design Guidelines*. Typically at roundabouts, the location of the crosswalk is 20 ft. from the edge of the circulatory roadway or yield line. If it is determined that the crosswalk should be placed further back, place it in even vehicle lengths of 20 ft. plus assume a 5 ft. gap between queued vehicles (20 ft., 45 ft., 70 ft.).

The minimum cut through for the splitter island should be no less than the dimensions shown in Exhibit 6-12. The cut through should not be ramped; however it should contain detectable warning surfaces along each side.

6.8.2 BICYCLE DESIGN CONSIDERATIONS

Since maximum entry speeds for roundabouts are between 25 and 30 mph, bicyclists should be able to navigate the roadway of a roundabout safely. If the engineer determines a roundabout to be unsafe for bicyclists such as in a large multilane roundabout, then a shared use path should take the place of a sidewalk. See Exhibit 6-67 and 6-68 for guidance.

6.8.3 PARKING CONSIDERATIONS

In urban conditions, parking lanes near roundabouts may be present. Special consideration should be taken to locate them far enough from the roundabout that drivers exiting the roundabout can come to a controlled stop. Considering the maximum roundabout entry speed is 30 mph and R2 is less than R1, the parking lane should be located at least 200 ft. from the midpoint of R2 on approach leg B. AASHTO Exhibit 10-73 was used to derive this distance. Also verify that the appropriate sight distance for leg A exists to the parking lane for R5 similar to the method used for crosswalks as discussed in Section 6.7.3.1. Lastly, a parking lane should not be located within a crosswalk. See the diagram below for more information.

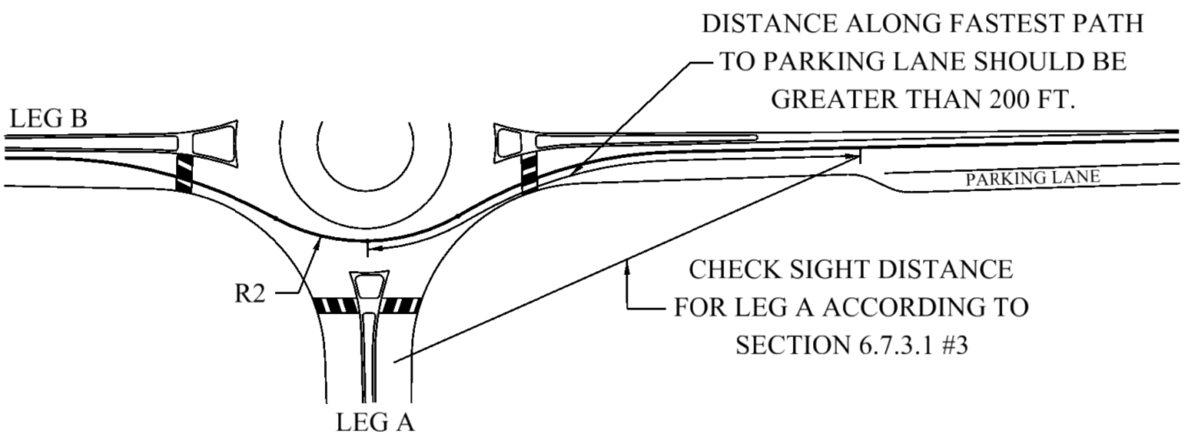


FIGURE 6.8.3-1

6.8.5 TREATMENTS FOR HIGH-SPEED APPROACHES

This section describes design elements that should be utilized on high speed approaches to increase visibility and driver awareness of a roundabout. Treatments for high speed approaches may also apply to low speed roadways as well.

6.8.5.1 VISIBILITY

Landscape the central island according to Section 6.4.4 and Chapter 9 to increase its visibility from the approach roadways. In addition to landscaping, advanced warning signs, pavement markings, and rumble strips may also be necessary to enhance visibility and driver awareness of the roundabout.

6.8.5.2 CURBING

Introducing curbing on otherwise open sections is desirable to reduce the approach speeds of vehicles on high speed rural roadways. Use the chart below to determine the suggested minimum length of curbing.

Design Speed of Approach (mph)	**Minimum Length of Curbing on Approach (ft) Based on Entry Speed R1 (mph)**			
	15	**20**	**25**	**30**
30	200	170	140	100
35	250	210	185	150
40	295	265	235	185
45	350	325	295	250
50	405	385	355	315

This chart is based on AASHTO Exhibit 10-73 for deceleration lengths on grades of 2% or less.

For approach speeds greater than or equal to 45 mph use Type C Curb and Gutter along the outside edge of roadway and transition it to Type A as the approach speed decreases below 45 mph.

6.8.5.3 SPLITTER ISLANDS

For approach design speeds from 30 to 50 mph, the splitter islands should be a minimum of 100 to 200 ft. respectively. Additionally, the splitter islands should extend beyond the end of the exit curve to prevent exiting traffic from crossing into the path of approaching traffic (pg 6-22). The splitter islands should be constructed as described in Section 6.4.1.

6.8.5.4 APPROACH CURVES

The maximum entry speed, R1, is 25 mph for single lane roundabouts and 30 mph for multilane roundabouts. NCHRP recommends limiting the approach speeds to 35 mph prior to the entry curve closest to the roundabout (pg 6-78). In order to accomplish this, successive curves can be used as shown in Exhibit 6-70. The change in speed on successive geometric curves should be limited to 12 mph.

It may be beneficial when designing a high speed approach using successive curves to work from the roundabout outward. For example, if the greatest entry speed is 25 mph and the change in speed on successive geometric curves should be limited to 12 mph, then the moderate radius curve should be designed for a speed of 35 mph. If the moderate radius is designed for 35 mph, then the broad radius should be designed for 45 mph. (Additional guidance for the successive curve treatment is being developed)

Additionally, it is necessary to reduce the approach speed prior to the broad radius from the approach design speed to the broad radius speed. This can be accomplished using rumble strips and warning signs and even warning beacons.

6.8.5.5 ADJUSTMENT STRATEGIES FOR HIGH-SPEED APPROACHES

Below is a list of strategies that may be used to help address high-speed approaches (speeds greater than 30 mph) observed in an existing condition or during a post construction survey, when geometric modifications may not be possible or feasible. Before implementing the strategies listed or if the strategies are not sufficient for your needs, please coordinate with the District Traffic Office and the Office of Traffic and Safety. Potential strategies for speed control include:

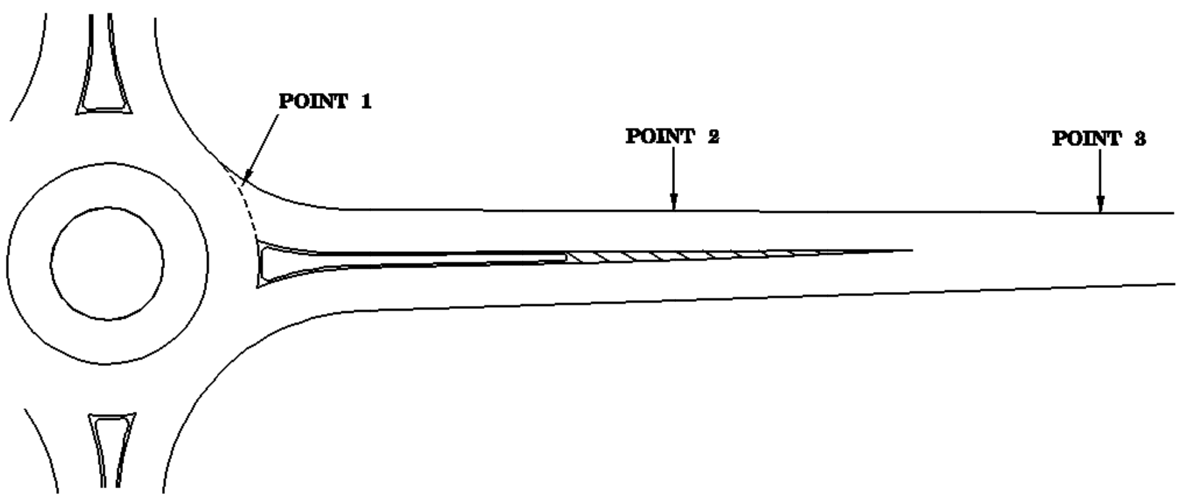
- Provide larger advance warning signs (RAB ahead)
- Provide larger yield signs
- Provide larger chevron signs in the central island
- Increase the length of the splitter island by installing a longer, hatched splitter island adjacent to the existing island
- Reduce width of approach lane
- Place rumble strips at the centerline and edgeline
- Provide flashing yellow beacons along high speed approaches
- Use transverse ‘bar’ markings on the high speed approaches
- Enhance lighting
- Provide a graduated or transition speed zone
- Provide 10 in. edgelines and center line/gore lines
- Place delineators at edgeline (D6)
- Place traverse rumbles in areas with high crash rate or significant safety issue

6.8.5.6 POST CONSTRUCTION

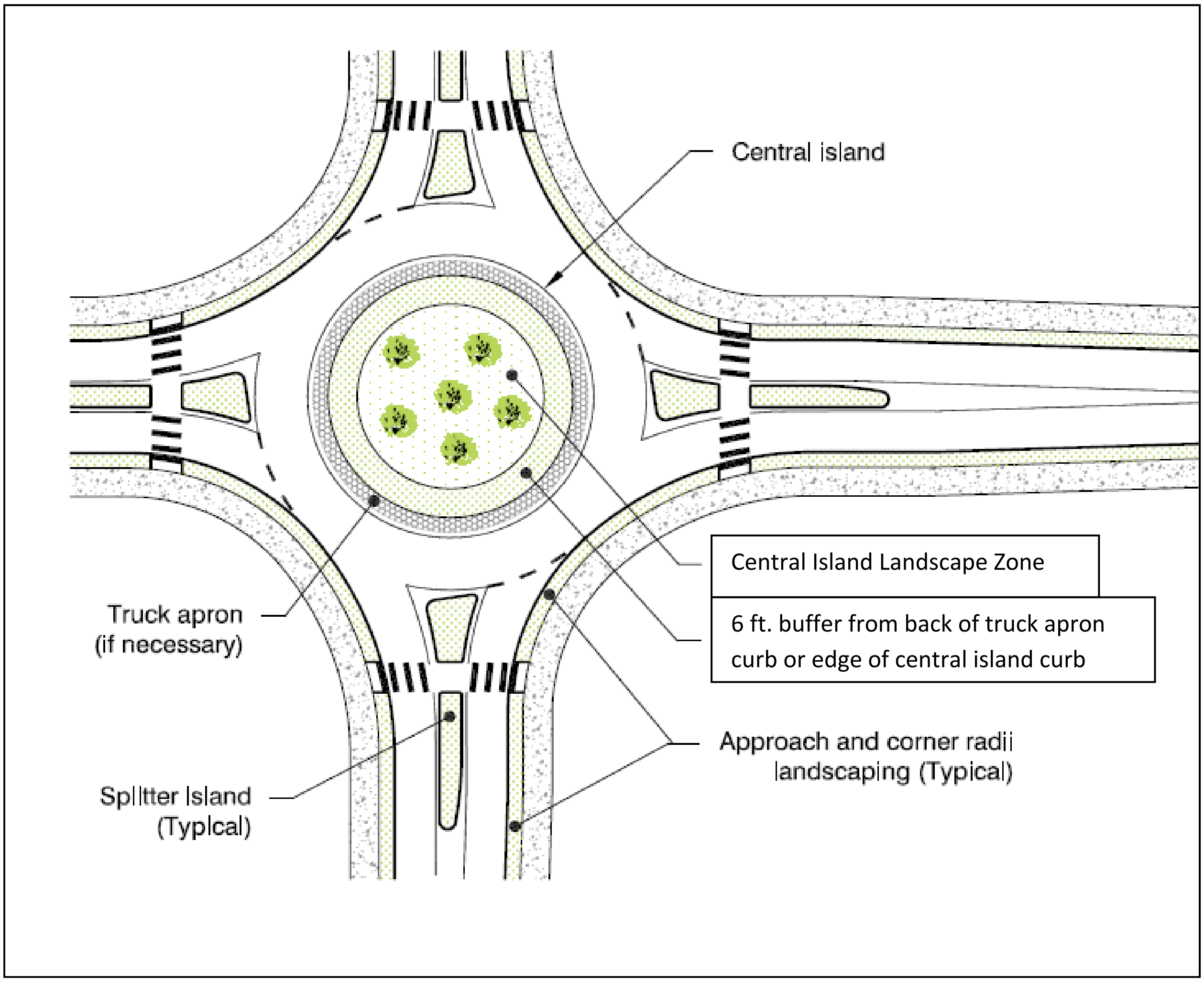
Each new roundabout placed on roadways with approach speed limits of 30 mph or more shall be evaluated for operational characteristics by a traffic engineer after a suitable phase-in period, but no later than the end of the first year of opening. The study shall be conducted according to the ITE Manual of Transportation Engineering Studies, Second Edition (2010) to assess the success of speed reduction strategies on the roundabout approaches. The 85th percentile entry speeds must be at or below 30 mph or further strategies shall be employed to control speed.

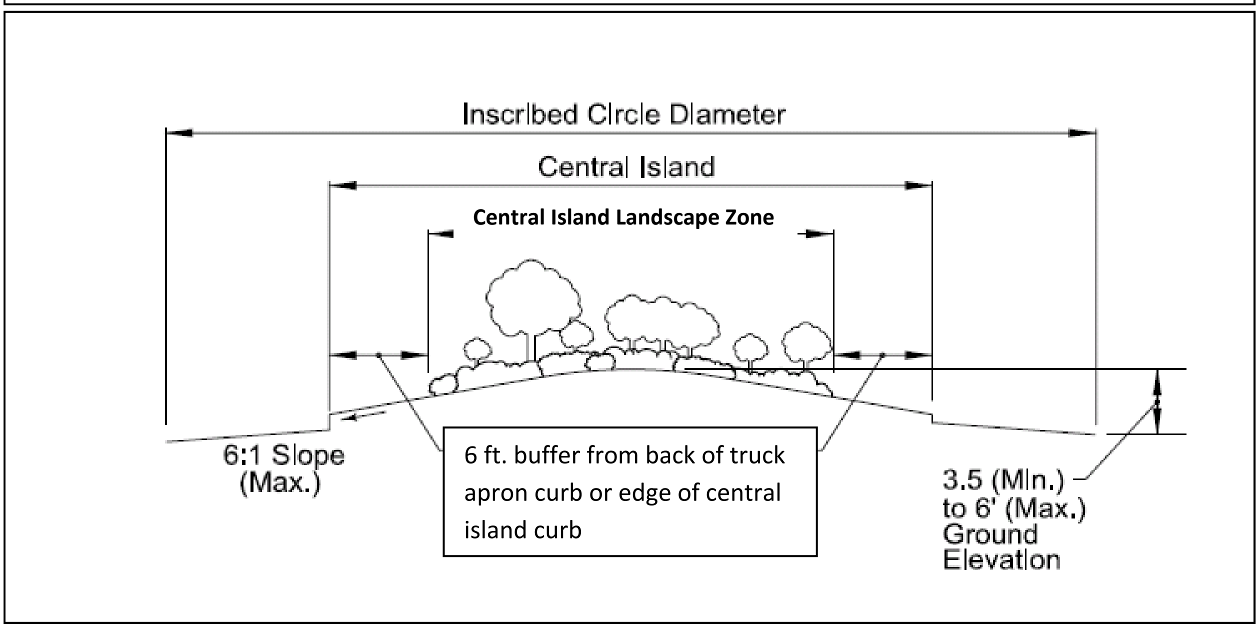
6.8.5.7 EVALUATING THE OPERATING CHARACTERISTICS OF CURRENT AND FUTURE RAB'S

1. Point #1 is at the stopping/yield point – at the RAB
2. Point #2 is x/2
3. Point #3 is a point (x) along the approach to the RAB where the first recognition of the RAB ahead is made, and the 85th %-tile speed of approaching traffic is obtained
4. Using an acceptable rate of deceleration, "spot" speeds are measured at Point #2 (x/2) and, if found to be unacceptable, driver behavior modification strategies/devices are considered
5. A graph of some sort can be prepared for the various approach speeds and values of "x"



9.2 PRINCIPLES





Policy for Placing Fixed Objects in SHA Roundabouts
October 9, 2012

Authority: Under § 8-646, Transportation Article, Md. Code Ann., the State Highway Administration (SHA) is authorized to issue a permit for certain work, which must be performed to the satisfaction and under the supervision of SHA. Such work includes placing any structure on any State highway right of way, changing or renewing any structure placed on any State highway right of way, digging within any State highway right of way for any purpose, planting or removing any vegetation on any State highway right of way, or placing any obstruction or improvement on any State highway right of way.

Background/ Analysis: SHA requires a permit issued by the appropriate District Engineer to place fixed objects in State highway roundabouts, in conformance to existing procedures allowing persons and entities to place objects in State rights-of-way under existing Maryland law. Placing of such objects in roundabouts can present safety and aesthetic benefits, but may also create safety hazards to roadway users. SHA tries to reasonably accommodate community requests to use the SHA right-of-way, but must, first and foremost, work to protect the safety of Maryland travelers.

Proposed Policy: Under certain circumstances provided in the Maryland SHA Roundabout Design Guidelines (2012) an SHA District Office may issue a permit to a governmental or nongovernmental person or entity that applies to the District Engineer to place a fixed object or fixed objects within a State Highway roundabout.

Approved:

______________________ 11-5-12
Melinda B. Peters Date
SHA Administrator