An Ordinance of the City of Plano, Texas, adopting the Street Design Standards, which are minimum standards to be followed in the design and development of streets, thoroughfares, sidewalks, and appurtenances within the city, and providing a penalty clause, a repealer clause, a savings clause, a severability clause, a publication clause, and an effective date.

WHEREAS, the Thoroughfare Standards Rules and Regulations provides the minimum standards for the development and design of streets, thoroughfares, sidewalks, and appurtenances within the city; and

WHEREAS, in 2021, the City of Plano initiated an update of the Thoroughfare Standards Rules and Regulations to incorporate best practices in roadway design and implement recommendations consistent with the Transportation Component of the Comprehensive Plan; and

WHEREAS, the update of the Thoroughfare Standards Rules and Regulations includes renaming of the document to the Street Design Standards; and

WHEREAS, the Planning & Zoning Commission was presented an overview of major changes proposed in the Street Design Standards at its meetings on October 3, 2022, October 17, 2022, November 21, 2022, December 5, 2022, January 3, 2023, January 17, 2023, February 20, 2023, and March 1, 2023; and

WHEREAS, at its meeting on the August 21, 2023, the Planning & Zoning Commission recommended adoption of Street Design Standards; and

WHEREAS, the City Council is of the opinion and finds that such change should be adopted, would not be detrimental to the public health, safety, or general welfare, and will promote the best and most orderly development of the properties affected thereby, and to be affected thereby, in the City of Plano, and as well, the owners and occupants thereof, and the City generally.

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF PLANO, TEXAS, THAT:

Section I. The findings set forth above are incorporated into the body of this Ordinance as if fully set forth herein.

Section II. The Street Design Standards attached as Exhibit A, is hereby approved and adopted in its entirety.

Section III. All provisions of the ordinances of the City of Plano in conflict with the provisions of this Ordinance are hereby repealed, and all other provisions of the Ordinances of the City of Plano not in conflict with the provisions of this Ordinance shall remain in full force and effect.

Section IV. The repeal of any ordinance or part of ordinances effectuated by the enactment of this Ordinance shall not be construed as abandoning any action now pending under or by virtue of such ordinance or as discontinuing, abating, modifying or altering any penalty accruing or to accrue, or as affecting any rights of the municipality under any section or provisions of any ordinance at the time of passage of this Ordinance.

Section V. Any violation of the provisions or terms of this ordinance by any person, firm or corporation shall be a misdemeanor offense and shall be subject to a fine in accordance with Section 1-4(a) of the City Code of Ordinances for each offense. Every day a violation continues shall constitute a separate offense.

Section VI. It is the intention of the City Council that this Ordinance, and every provision hereof, shall be considered severable and the invalidity or partial invalidity of any section, clause or provision of this Ordinance shall not affect the validity of any other portion of this Ordinance.

Section VII. This Ordinance shall become effective immediately upon its passage and publication as required by law.

PASSED AND APPROVED on the 11th day of September, 2023.

____
John B. Muns, MAYOR

ATTEST:

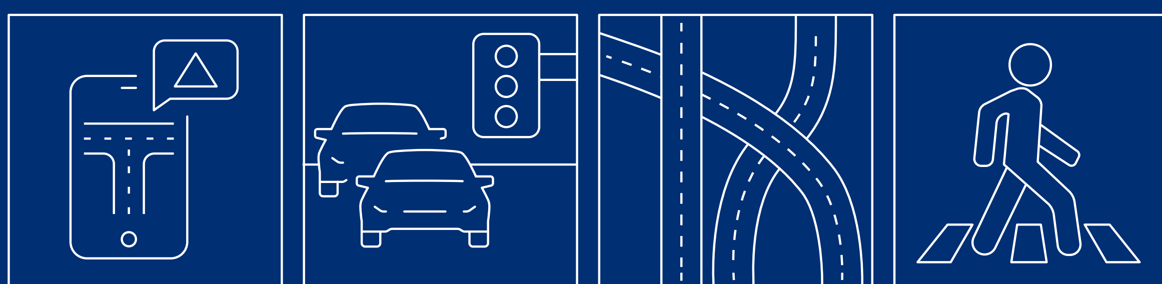
____
Lisa C. Henderson, CITY SECRETARY

APPROVED AS TO FORM:

____
Paige Mims, CITY ATTORNEY

Exhibit A

Street Design Standards



City of Plano

SEPTEMBER 2023

Table of Contents

SECTION 1
Introduction

1.1 What are the Street Design Standards?

The City of Plano Street Design Standards (Standards) provide the design requirements for transportation infrastructure, including streets, sidewalks, traffic calming, and other appurtenances. The design requirements outlined in these Standards are minimum requirements for design scenarios that frequently arise in transportation planning, traffic operations, street design, and site development. The Standards provide standardized traffic and transportation design requirements for existing and future site development in the City, including technical requirements for Traffic Impact Analysis (TIA). In addition, these Standards provide design requirements for street elements called for in the *Thoroughfare Plan Map* and *Bicycle Transportation Plan Map* of the City's *Comprehensive Plan*.

These Standards are a professional design resource for the City, the professional development community, and any individuals or groups involved in the planning and designing of the city's street network, public and private. It is adopted by ordinance by the City Council of the City of Plano, Texas. The Standards are intended to work in conjunction with the City of Plano Subdivision Ordinance.

Design standards for city streets are defined through these documents:

- **The Street Design Standards** – the document contained herein - which is part of the *Development Regulations Manual,* covering the technical details of street and transportation system design; and
- **Thoroughfare Plan Map** – a map that establishes the general alignment, size, and function of significant city streets - which is a part of the *Comprehensive Plan*.
- **Subdivision Ordinance** – a document designed to prepare land for development.
- **Standard Construction Details** – the detailed specifications for the construction techniques and materials used for streets and other thoroughfares.
- **Traffic Studies** – The Traffic Impact Analysis (TIA) guidelines are used to analyze site development. Refer to **Section 12 (Traffic Studies)** for additional information and requirements.
- All street designs within the City of Plano's public right-of-way (ROW) shall meet the guidelines in *AASHTO's A Policy on Geometric Design of Highways and Streets*.

1.2 Purpose of the Street Design Standards

The purpose of the Street Design Standards (Standards) is to provide design regulations to be applied when development or redevelopment occurs. In addition, these standards incorporate changes based on national best practices and recent city-initiated planning efforts. Updated design requirements in these Standards are intended to shift the street network into a multimodal transportation system that promotes the safety and efficiency of the roadways for all users, in keeping with the goals of the Comprehensive Plan.

1.3 Section Descriptions

- **Section 1 – Introduction**

  This section includes general minimum requirements applicable to all projects, including submittal requirements to the City. This section also includes an overview of the references and national best practices used in the Standards.

- **Section 2 – Street Framework**

  This section includes requirements associated with the City's functional classifications, typologies, mode integration, thoroughfare design, and cross-sections.

- **Section 3 – Special Streets and Accessways**

  This section provides requirements and standards to address requirements for alleys, mews, paseos and shared streets.

- **Section 4 – Downtown Streets**

  This section includes requirements associated with the City's Downtown Streets inset of the Thoroughfare Plan Map.

- **Section 5 – Street Design**

  This section includes requirements associated with the City's thoroughfares, including roadway geometry, minimum horizontal and vertical radius, roundabouts, street lengths, etc.

- **Section 6 – Intersection Design**

  This section includes requirements associated with the City's intersection design guidelines.

- **Section 7 – Medians, Left Turns and Right Turns**

  This section includes requirements associated with the city's medians, left turn, and right turn lanes.

- **Section 8 –Driveways**

  This section provides requirements and standards to address the procedure allowing access to streets and driveway design requirements within roadway right-of-way.

- **Section 9 – Multimodal Facilities**

  This section provides requirements and standards to address multimodal facilities design requirements, which include pedestrian, sidewalk, and bikeway designs.

- **Section 10 – Public Right-of-Way Visibility**

  This section includes requirements for corner visibility triangles, sight line triangles, traffic control devices, street trees, and fire lanes.

- **Section 11 – Street Lighting**

  This section includes minimum design requirements for street lighting and photometric analysis.

- **Section 12 – Traffic Studies**

  This section includes requirements associated with the city's traffic impact analysis and mitigation.

- **Section 13 – Neighborhood Traffic Management**

  This section includes requirements associated with the city's neighborhood traffic management.

- **Section 14 – Curb Management**

  This section includes requirements associated with the city's curbside management and parking.

- **Section 15 – Appendix**

  This section includes definitions, abbreviations, and acronyms used in the Standards.

1.4 Reference Standards and Superseding Law

If there is a contradiction between the Standards and the most recent and up-to-date standard listed below, the language of the Standards will control. If the Standards are superseded by state or federal law, then the City shall apply the required legal standard imposed by state or federal law. The Director of Engineering, in consultation with the City attorney, is empowered to determine whether the Standards are superseded and to require compliance with the correct standard imposed by law.

The national standards and guidelines are:

- **Roadway:**
  - *American Association of State Highway and Transportation Officials (AASHTO): A Policy on Geometric Design of Highways and Streets (The Green Book)*
  - *Texas Department of Transportation (TxDOT): Access Management Manual*
  - *Texas Manual on Uniform Traffic Control Devices (TMUTCD)*
  - *Highway Capacity Manual*
  - *Federal Highway Administration (FHWA) Roundabouts: An Informational Guide*
  - *FHWA: Flexibility in Highway Design*
  - *National Association of City Transportation Officials (NACTO): Urban Street Design Guide*
  - *NACTO: Global Street Design Guide*
  - *Congress for the New Urbanism (CNU) / Institute of Transportation Engineers (ITE): Manual Designing Walkable Urban Thoroughfares*

- *CNU/ITE Implementing Context-Sensitive Design on Multimodal Corridors: A Practitioner's Handbook*
- *American Planning Association (APA) Complete Streets: Best Policies and Implementation Practices*

- **Bicycle and Pedestrian Design:**
  - *NACTO Urban Bikeway Design Guide*
  - *NACTO Urban Street Design Guide*
  - *AASHTO Guide for the Development of Bicycle Facilities*
  - *FHWA Separated Bike Lane Planning and Design Guide*
  - *Texas Manual on Uniform Traffic Control Devices (TMUTCD)*
  - *Association of Pedestrian and Bicycle Professionals (APBP) Essentials of Bike Parking*
  - *Americans with Disabilities Act (ADA) Standards*
  - *Texas Accessibility Standards*
  - *United States Access Board's Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG)*
  - *NACTO Urban Street Design Guide*
  - *ITE Implementing Context Sensitive Design on Multimodal Thoroughfares*
  - *United States Department of Transportation (USDOT) Federal Railroad Administration (FRA) Rails with Trails: Best Practices and Lessons Learned*
- **Transit Design:**
  - *NACTO Transit Street Design Guide*
  - *Capital Metropolitan Transportation Authority (CMTA) Service Guidelines & Standards*
  - *CMTA Transit Design Guide: Standards & Best Practices, A Resource Manual for Transit System Design*
  - *Transit Cooperative Research Program (TCRP) Report 183, A Guidebook on Transit-Supportive Roadway Strategies*
  - *Federal Highway Administration Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts*
- **Complete Streets:**
  - *CNU/ITE Manual Designing Walkable Urban Thoroughfares*
  - *CNU/ITE Implementing Context-Sensitive Design on Multimodal Corridors: A Practitioner's Handbook*

  - *APA Complete Streets: Best Policies and Implementation Practices*
  - *NACTO Urban Street Design Guide*
  - *NACTO Urban Street Stormwater Guide*
- **Roadside Design (Offsets & Rails):**
  - *AASHTO's A Policy on Geometric Design of Highways and Streets (The Green Book)*
  - *AASHTO Roadside Design Guide*
  - *NACTO Urban Street Stormwater Guide*

1.5 Texas Accessibility Standards (TAS)

All plans and specifications for the construction or alteration of public buildings and facilities, privately owned buildings and facilities leased or occupied by state agencies, places of public accommodation, and pedestrian facilities within public right-of-way must be in compliance with the Texas Accessibility Standards (TAS) for individuals with disabilities and must conform to the standards required by regulations issued by the *Texas Department of Licensing and Regulation (TDLR)*, under the *Elimination of Architectural Barriers Act*, codified as *Chapter 469, Texas Civil Statutes*.

Projects with a total estimated construction cost of $50,000 or more are required to submit a full set of construction documents in accordance with Administrative Rule 68.20 to TDLR for registration and review of all transportation projects within Public Right-of-Way. For Public Right-of-Way projects, the estimated cost for the project shall be based on pedestrian elements only in accordance with Administrative Rule 68.102. An architect, engineer, interior designer, or landscape architect with overall responsibility for the design of a building or facility subject to subsection 5(j) of the Architectural Barriers Act shall mail, ship, or hand-deliver the project registration form, review and inspection fees, and construction documents to the TDLR, a registered accessibility specialist, or a contract provider not later than thirty (30) business days after the design professional seals and signs the construction documents. An Architectural Barriers Project Registration Form must be completed for each subject building or facility.

1.6 Interpretation

The Director of Engineering is responsible for interpretation of the provisions of the Standards. Such interpretations shall be in compliance with the intent and purposes of the Standards. Interpretations shall not have the effect of waiving requirements specifically provided for in the Standards. The Director of Engineering is not required to give advisory opinions regarding the interpretation of the Standards.

The request for interpretation of the Standards must be submitted in writing to the Director of Engineering for consideration. The request must contain the requestors' proposed interpretation, reason for appeal, and any applicable fees. Requests shall be evaluated by the Director of Engineering and his/her interpretation shall be provided in writing to the requestor. The Director's interpretation may be appealed to the City Manager's Office. The City Manager's decision on interpretation is final.

The City has adopted additional ordinances, which address various requirements not explicitly included in the Standards. Generally, such ordinances are to be read together and harmonized, giving effect to all language. If, however, these Standards and other such ordinances cannot be reconciled, the Director of Engineering is responsible for determining whether these Standards or the documents listed below take precedence in the context of imposing the design standards. Such ordinances, codes, and details include, but are not limited to:

- Zoning Ordinance
- Subdivision Ordinance
- Right-of-Way Ordinance
- International Building Codes
- International Fire Code
- Flood Damage Prevention Ordinance
- Standard Construction Details

1.7 Amendments

The City may amend the Street Design Standards by ordinance with the review and approval of the Planning & Zoning Commission. The City Secretary may administratively correct the scrivener's errors at any time.

1.8 Enforcement

The City may withhold related permits or approvals including but not limited to certificates of occupancy and acceptance of final plat for failure to meet applicable requirements in these Standards. It shall be an offense for any owner or agent of any owner to violate any term or provision of these Standards. Any violation of the provisions or terms of this ordinance by any person, firm, or corporation shall be a misdemeanor offense and shall be subject to a fine in accordance with Section 1-4(b) of the Code of Ordinances. Each day a violation continues shall constitute a separate offense.

Appropriate civil actions and proceedings may be maintained in law or in equity for any lawful purpose, including but not limited to preventing unlawful construction, recovering damages, imposing additional penalties, restraining, correcting, or abating a violation of these Standards when such violation occurs with respect to lands within the corporate boundaries of the City. These remedies are in addition to the penalties described above.

1.9 Exceptions, Deviations, and Additions

1.9.1 Exceptions

An Engineer of Record may make a formal request for an exception to these Standards or a mitigation measure required as the result of a Traffic Study in Section 12. The request must be submitted in writing to the Director of Engineering for consideration. The request must explain the reasoning for such exception (such as physical constraints of the Project, existing conditions limiting proposed improvements, etc.). Requests shall be evaluated by the Director on a case-by-case basis and shall in no way establish a precedent for approval of such exceptions for other projects. Any approved exception shall not be constructed to relieve the Engineer of Record of the ultimate responsibility for the engineering design of the project. The Director of Engineering shall consider the following when determining whether an exception should be granted:

- It is not detrimental to public safety and traffic efficiency: and
- It does not adversely impact the public facility in question; and
- It is supported by a signed and sealed engineering analysis performed by a Professional Engineer licensed in the State of Texas; and,

- It is not based solely on financial interests.

If the purpose of the request is to challenge the nexus or proportionality of a mitigation required by a traffic study, the proper procedure is to seek relief by the Waivers from Development Exactions procedure listed in the Subdivision Ordinance. If it is unclear whether relief from a mitigation measure should follow the exception process of these Standards or the process in the Subdivision Ordinance, the City Attorney shall determine which is proper.

1.9.2 Deviations

A deviation is a grant of an alternative material or method of construction. All deviations from the requirements included in the Manual must be approved by the Director of Engineering prior to implementation. A deviation shall not affect nor relieve the Engineer of the obligation, liability, and responsibility for such material or method of construction as meeting the intended purposes.

1.9.3 Additions

The Director of Engineering may impose additional requirements based on national standards and guidelines when, in the Director's professional engineering judgment, they are necessary to ensure the proper function of the City's street system for the safety and welfare of the public.

It shall be the responsibility of the Engineer to meet the additional requirements or provide information in writing explaining why such additional requirements are not necessary for review by the Director of Engineering. The Director's decision as to the necessity of the additional requirements is final.

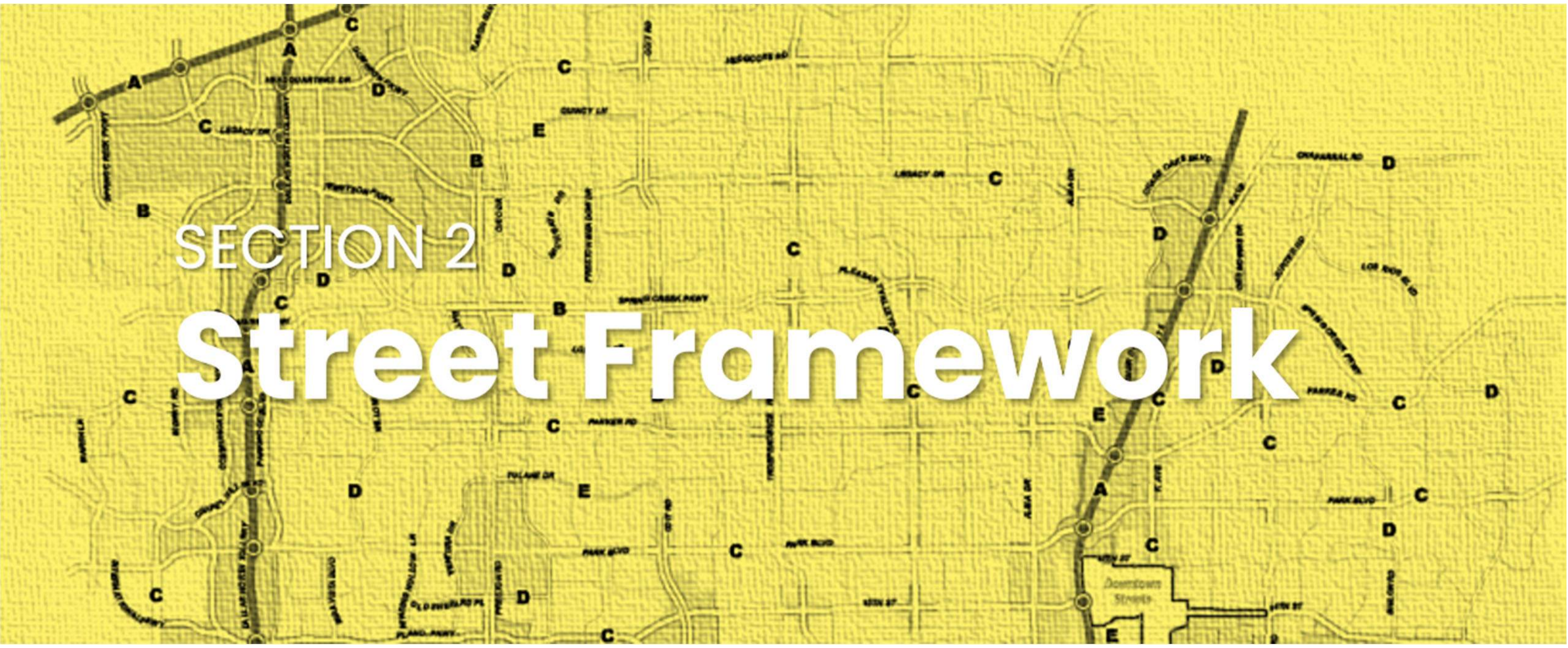
1.9.4 Standards

The State and National references listed above in **Section 1.4** can be used in considering an exception, deviation, or addition.

1.9.5 Responsibility of Engineer and Applicability of these Standards

- **Responsibility of Engineer.** The Engineer shall be responsible for the applicability of the information contained in the Standards to the design of his/her project. The Engineer shall also be responsible for the applicability and accuracy of the information furnished in his/her design. Acceptance by the City of the study or plans for construction shall not be construed to relieve the Engineer of any responsibility. When designing a facility, the Engineer shall bear the sole responsibility for meeting the engineering standard of care for all aspects of the design and providing a design that is required by the site-specific conditions and intended use of the facilities while at a minimum meeting the City's design and construction requirements.

- **Applicability.** The Standards shall be in full force and effect after adoption by City Council. Projects will be required to comply with all requirements unless vested under prior regulations as required by Chapter 245 of the Local Government Code. The Standards apply to all new construction, reconstruction, modifications, alterations, and improvements, whether public or private.



SECTION 2 Street Framework

2.1 Introduction

The purpose of this section is to provide city staff and private sector design professionals with a consistent approach to transportation facilities and streetscape. The Street Design Standards are intended to apply to new streets and the reconstruction of existing streets.

2.2 Street Typology

The City's *Thoroughfare Plan Map* displays thoroughfares within the city based on functional classification and land use context. Each roadway considers the function of the street in two ways:

- The efficiency of moving various volumes of traffic within the network with capacity, speed, and trip length
- To provide safe and effective connections for multiple modes through multimodal access

The City of Plano's thoroughfare network is characterized by seven Functional Classification types (Type A-G), a set of Special Street and Accessway types, and Downtown Streets. The seven functional classifications of roadways categorize streets by their purpose, projected traffic volumes, speeds, and property access, and include Type A Expressways (Freeways/Tollways), Type B Regional Arterials, Type C Major Arterials, Type D Minor Arterials, Type E Major Collectors, Type F Minor Collectors, and Type G Local/Residential streets. Each class provides a certain degree of continuity, capacity, and accessibility to adjacent land uses. Local/Residential Streets (Type G) are not indicated on the City's *Thoroughfare Plan*.

The design of streets requires the balancing of functional classification and the consideration of the adjacent land use context. The *Thoroughfare Plan Map* categorizes all thoroughfares as one of four land use contexts used in the Manual: Neighborhood, Commercial, Corner, and Mixed-Use. These context designations provide direction for determining necessary variations in street design to serve adjacent land uses best.

The Corner Context is unique in that it does not have its own specified cross-sections and may utilize either the Neighborhood (Option 1) or Mixed-Use context (Option 2) depending on the type of development proposed for the area. Option 1 should be utilized for streets where residential uses are proposed as an extension of the surrounding Neighborhood Context (as described in the Neighborhood Corners Future

Land Use Designation of the Comprehensive Plan). Option 2 should be used for compact single-family or mixed-use development.

Refer to **Table 2-1** for street types, functional classification, minimum right-of-way, median width, and number of lanes. The street characteristics provided below in **Table 2-1** (right-of-way, median width, and number of lanes) are the essential elements of a roadway. Depending upon the street type, as well as land use context, they will vary from one another to meet the desired roadway function and character.

This manual supplements the functional classification with a set of Special Street and Accessway types as defined in **Section 3 (Special Streets and Accessways)**. This includes alternative accessway types for vehicles and/or pedestrians (Alleys, Mews, Paseos, and Shared Streets) which are not indicated on the City's Thoroughfare Plan Map. Additionally, a set of Downtown Street types are identified as an inset to the *Thoroughfare Plan Map*. These streets have design standards and considerations unique to the Downtown context defined in **Section 4 (Downtown Streets)**.

2.2.1 Summary of Functional Classes

- **Type A Thoroughfares (Expressways/Tollways)** focus strictly on ultimate automobile movement on the City's major expressways. The design of these thoroughfares is coordinated with appropriate external agencies such as the Texas Department of Transportation (TxDOT) and North Texas Tollway Authority (NTTA).

- **Type B Thoroughfares (Regional Arterials)** prioritize considerable automobile movement throughout the city with consideration to decorative green zones and sidepaths. Special sections will be given to Spring Creek Parkway and Preston Road, large roadways with high-volume traffic.

- **Type C Thoroughfares (Major Arterials)** prioritize considerable automobile movement throughout the city with consideration to decorative green zones, pedestrian mobility, and sidepaths.

- **Type D Thoroughfares (Minor Arterials)** prioritize a mix of automobile movement, decorative green zones, pedestrian mobility, on-street parking where applicable, on-street bike paths, and sidepaths.

- **Type E Thoroughfares (Major Collectors)** prioritize a mix of limited automobile movement, pedestrian mobility, on-street bike paths, and sidepaths.

- **Type F Thoroughfares (Minor Collectors)** prioritize a mix of limited automobile movement, pedestrian mobility, on-street bike lanes, and sidepaths.

- **Type G Thoroughfares (Local Streets)** prioritize direct access to abutting land and provide local access and connectivity to higher level streets. Through traffic should be discouraged on local residential streets.

- **Special Streets and Accessways (Alleys, Mews, Paseos, and Shared Streets)** focus on prioritizing access for service vehicles and/or residential access.

- **Downtown Streets** are those located in the Downtown Streets inset map of the Thoroughfare Plan Map. Due to the historic character of the area and its unique design challenges, Downtown streets do not operate on the city's standard functional classification system.

The context-based cross-sections consist of street type cross-section alternatives that incorporate additional right-of-way needs or re-design of street elements based upon the combination of land use context and specific modal integration, such as vehicle travelway priority or sidepaths as identified on Plano's *Bicycle Transportation Plan Map*.

Table 2-1: Thoroughfare Design Specifications

Street Type	Functional Classification	Minimum ROW (feet)	Median Width (feet)	Number of Lanes
A	Expressways/Tollways	TxDOT/NTTA	2-24	8-10
B	Regional Arterials	130-160	20-24	6-8
C	Major Arterials	110	16-20	4-6
D	Minor Arterials	92-98	16-20	4
E	Major Collectors	68-73	11-20	2-4
F	Minor Collectors	60-62	N/A	2
G	Local/Residential Streets	50-63	N/A	2
Special Streets and Accessways	Alleys, Mews, Paseos, and Shared Streets	See Section 3 (Special Streets and Accessways)		
Downtown Streets	Downtown Couplet, Gateway Corridors, Local Streets	See Section 4 (Downtown Streets)		

2.2.2 Street Cross-Section Zones

A street can consist of five different zones as shown below. These five zones are illustrated in **Figure 2-1**. Refer to **Table 2-2** for the characteristics of Zones 1-4 based on specific land use contexts. Zone 5, ROW Zone, is applied to all street types across all land use contexts.

1. **Travelway Zone:** The portion of the street that is reserved for vehicular travel of all types, including motor vehicles, transit, and on-street bicycle facilities. Travelway consists of everything between the face of curbs including the median and curbside functions, such as on-street parking.

2. **Curbside/Flex Zone:** A subarea of the travelway that serves multiple uses along a street including on-street bicycles, transit stops, commercial deliveries, on-street parking, passenger loading, etc.

3. **Green Zone:** An area between the travelway zone and pedestrian zone that provides separation from moving vehicle traffic and provides space for appropriate landscaping or street furnishings. Street trees or shrubs may be required depending on the land use.

4. **Pedestrian Zone:** An area within the right-of-way reserved for pedestrian movement only and where motor vehicles are prohibited. This zone should be free of any physical obstructions to allow for continuous pedestrian movement. Facilities for pedestrian travel may include sidewalks or shared-use sidepaths that also accommodate bicycle travel. Sidepaths should be implemented in accordance with the City's *Bicycle Transportation Plan Map*.

5. **ROW Zone:** An area between the edge of the pedestrian zone and the limits of the Right-of-Way where appropriate spacing is provided. The ROW Zone provides a small buffer at the edge of city ownership, where applicable.

Figure 2-1: Typical Section with Cross-section Zones

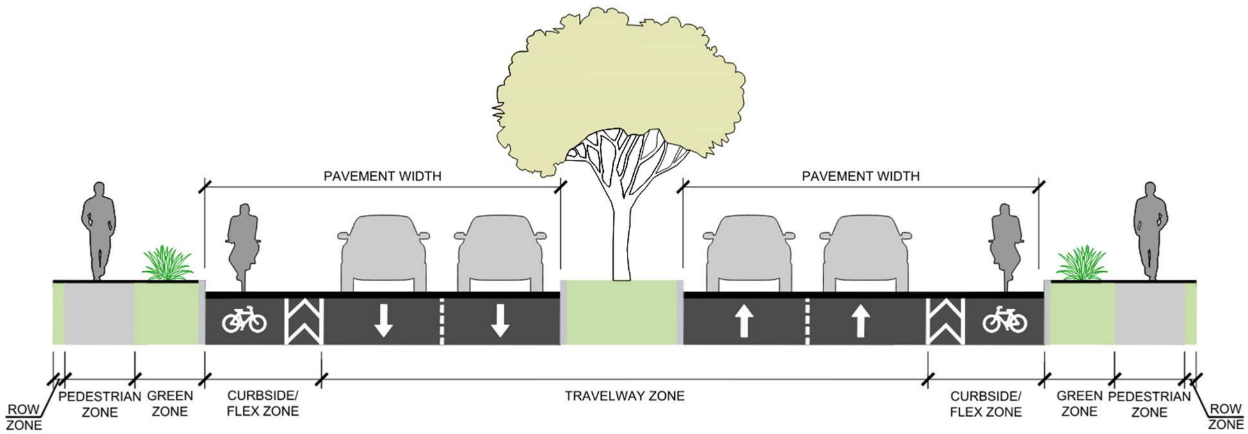


Table 2-2: Land Use Context

Modal Integration Zones	**Land Use Context**			
	Neighborhood	**Commercial**	**Corner**	**Mixed-Use**
Travelway Zone				
Motor Vehicles	Travel lanes have standard lane width and are designed for moderate to low speeds.	Travel lanes and turn lanes are designed to maintain traffic flow. Automobile access is prioritized.	Travel lanes are narrow and may require traffic calming. On-street parking is also recommended for Type E and below.	Travel lanes are narrower and may require traffic calming techniques. On-street parking is also recommended, where feasible.
Curbside/Flex Zone (Design for *Bicycles* is in accordance with City's *Bicycle Transportation Plan Map*)	Bicycles: Street Types B and C: Sidepath. Additional ROW may be necessary to accommodate a sidepath. On-Street Parking: Prohibited on Type B and Type C.			
	Bicycles: Street Types D and E: Sidepath or on-street bike lane On-Street Parking: Allowed where applicable (See **Section 14 (Curb Management)**)			
	Bicycles: Street Types F: Sidepath, shared facilities, or on-street bike lane On-Street Parking: Allowed where applicable (See **Section 14 (Curb Management)**)			
	Bicycles: Street Types G and Special Streets/Accessways: Shared facilities On-Street Parking: Allowed where applicable (See **Section 14 (Curb Management)**)			
Transit	Standard Amenities	Standard Amenities	Enhanced Amenities	Enhanced Amenities
Green Zone	An attractive landscape edge may be required on street types B and C. Street trees are encouraged on all street types.	A wide landscaped edge shall be required.	Street trees and planters may be required. Additional focus may be required on aesthetics to create destination.	Street trees may be required.
Pedestrian Zone	Standard sidewalks shall be required, buffered from traffic along street types B and C. Connections to sidepaths may also be required.	Buffered sidewalks from traffic may be required. A higher focus on pedestrian safety is required due to high automobile activity.	Pedestrian-oriented building frontage shall be required with wide sidewalks and associated amenities.	Pedestrian-oriented building frontage shall be required with wide sidewalks and associated amenities.

2.3 Cross-Sections

Cross-sections in the Standards illustrate the required physical dimensions of a thoroughfare, including the number of lanes, minimum right-of-way width, width of lanes, overall pavement width (face of curb to face of curb) and other elements on a roadway. These elements can include features such as medians, sidewalks, and sidepaths. The following cross-sections shall be applied when a street is designed for construction or reconstruction. Cross-section types include Typical Cross-sections, Minimum Cross-sections, and Modal Priority Cross-sections.

- **Typical Cross-section** should be used as the standard street design based on the functional classification and land use context.
- **Special Condition Cross-sections** should be used on a case-by-case basis when additional multimodal street elements or other alternative designs are included in the right-of-way. Circumstances warranting a special cross-section might include the use of sidepaths or on-street bike lanes where called for in the *Bicycle Transportation Plan Map*, or where underutilized right-of-way or travel lanes may be reconfigured for other design priorities.

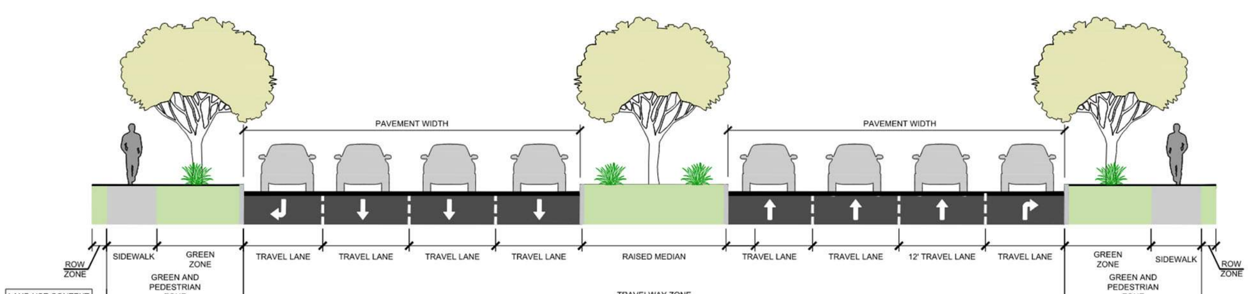
2.3.1 Type A Thoroughfare – Expressways

Within the City of Plano, there are four Expressway corridors: President George Bush Turnpike, Sam Rayburn Tollway, Dallas North Tollway, and U.S. Highway 75. These freeways/tollways are managed by external agencies with the City maintaining access control from service lanes. Refer to **Section 5 (Street Design)** for special access and design standards for certain Type A thoroughfares.

2.3.2 Type B Thoroughfare – Regional Arterials

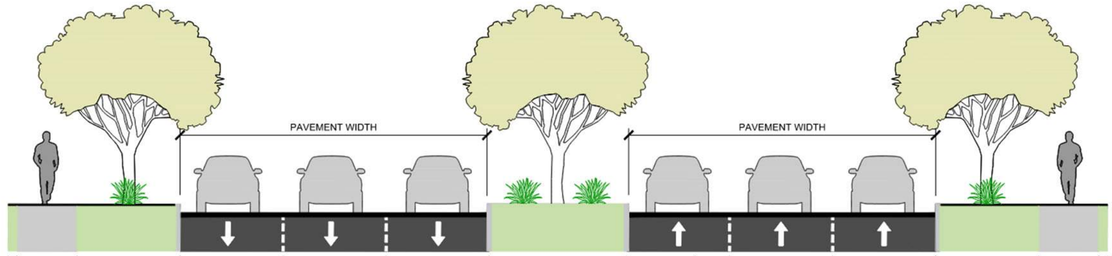
The following cross-sections in **Figures 2-2** and **2-3** represent typical Type B thoroughfares for all land use contexts. **Figure 2-3** is to be used where right-of-way is constrained. **Figure 2-4** represents a special condition section of a Type B thoroughfare where a sidepath is shown on the Bicycle Transportation Plan.

Figure 2-2: Type B Typical Section – 160' ROW



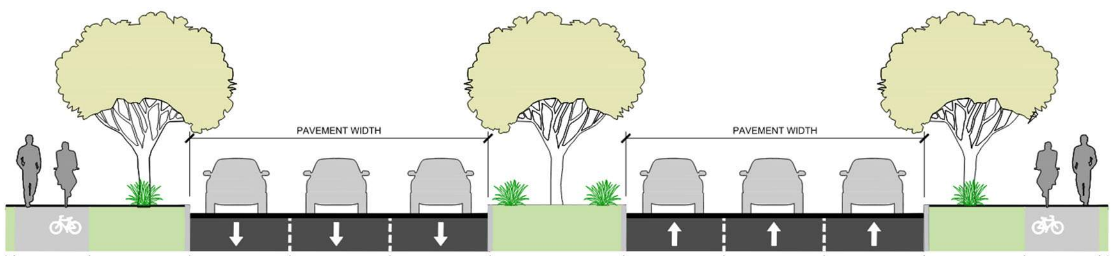
LAND USE CONTEXT	ROW ZONE	SIDEWALK	GREEN ZONE	TRAVEL LANE	TRAVEL LANE	TRAVEL LANE	TRAVEL LANE	RAISED MEDIAN	TRAVEL LANE	TRAVEL LANE	TRAVEL LANE	TRAVEL LANE	GREEN ZONE	SIDEWALK	ROW ZONE
NEIGHBORHOOD	2'	5'	15'	12'	12'	12'	12'	20'	12'	12'	12'	12'	15'	5'	2'
COMMERCIAL	2'	6'	14'	12'	12'	12'	12'	20'	12'	12'	12'	12'	14'	6'	2'
CORNER	2'	6'	14'	12'	12'	12'	12'	20'	12'	12'	12'	12'	14'	6'	2'
MIXED-USE	2'	7'	13'	12'	12'	12'	12'	20'	12'	12'	12'	12'	13'	7'	2'

Figure 2-3: Type B Minimum Section – 130' ROW



LAND USE CONTEXT	ROW ZONE	SIDEWALK (GREEN AND PEDESTRIAN ZONE)	GREEN ZONE (GREEN AND PEDESTRIAN ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	RAISED MEDIAN (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	GREEN ZONE (GREEN AND PEDESTRIAN ZONE)	SIDEWALK (GREEN AND PEDESTRIAN ZONE)	ROW ZONE
NEIGHBORHOOD	1'	5'	15'	12'	12'	12'	16'	12'	12'	12'	15'	5'	1'
COMMERCIAL	1'	6'	14'	12'	12'	12'	16'	12'	12'	12'	14'	6'	1'
CORNER	1'	6'	14'	12'	12'	12'	16'	12'	12'	12'	14'	6'	1'
MIXED-USE	2'	7'	12'	12'	12'	12'	16'	12'	12'	12'	12'	7'	2'

Figure 2-4: Type B Special Condition Section (Sidepath) – 130' ROW

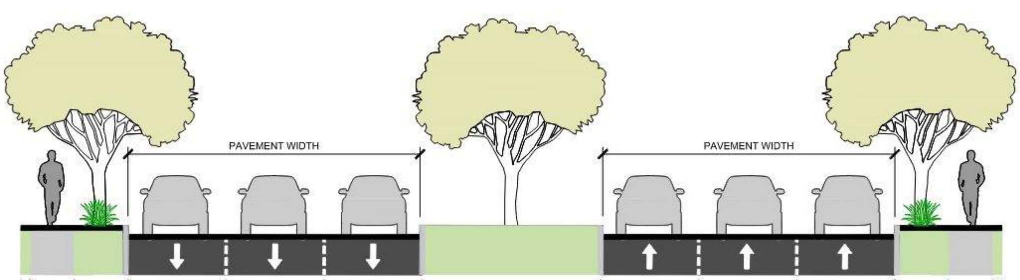


LAND USE CONTEXT	ROW ZONE	SIDEPATH (GREEN AND PEDESTRIAN ZONE)	GREEN ZONE (GREEN AND PEDESTRIAN ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	RAISED MEDIAN (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	GREEN ZONE (GREEN AND PEDESTRIAN ZONE)	SIDEPATH (GREEN AND PEDESTRIAN ZONE)	ROW ZONE
NEIGHBORHOOD	1'	10'	10'	12'	12'	12'	16'	12'	12'	12'	6'	10'	1'
COMMERCIAL	1'	10'	10'	12'	12'	12'	16'	12'	12'	12'	6'	10'	1'
CORNER	1'	10'	10'	12'	12'	12'	16'	12'	12'	12'	8'	10'	1'
MIXED-USE	1'	10'	10'	12'	12'	12'	16'	12'	12'	12'	8'	10'	1'

2.3.3 Type C Thoroughfare – Major Arterials

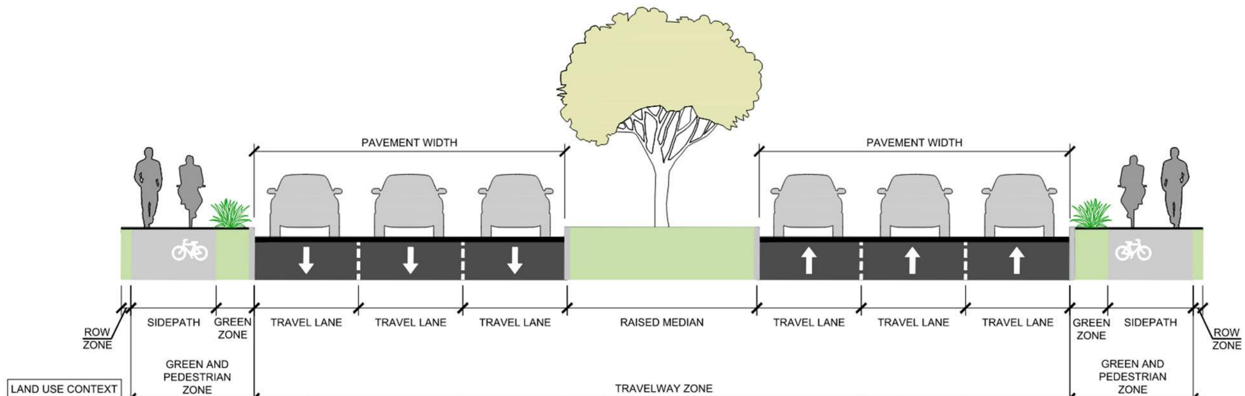
The following cross-section, **Figure 2-5**, represents the typical Type C thoroughfare through all land use contexts. **Figure 2-6** represents a special condition section where a sidepath is shown on the *Bicycle Transportation Plan Map* and **Figure 2-7** represent a special condition where on-street parking is desirable.

Figure 2-5: Type C Typical Section – 110' ROW



LAND USE CONTEXT	ROW ZONE	SIDEWALK (GRREN AND PEDESTRIAN ZONE)	GREEN ZONE (GRREN AND PEDESTRIAN ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	RAISED MEDIAN (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	TRAVEL LANE (TRAVELWAY ZONE)	GREEN ZONE (GREEN AND PEDESTRIAN ZONE)	SIDEWALK (GREEN AND PEDESTRIAN ZONE)	ROW ZONE
NEIGHBORHOOD	1'	5'	8'	11'	11'	11'	16'	11'	11'	11'	8'	5'	1'
COMMERCIAL	1'	6'	7'	11'	11'	11'	16'	11'	11'	11'	7'	6'	1'
CORNER	1'	6'	7'	11'	11'	11'	16'	11'	11'	11'	7'	6'	1'
MIXED-USE	1'	7'	6'	11'	11'	11'	16'	11'	11'	11'	6'	7'	1'

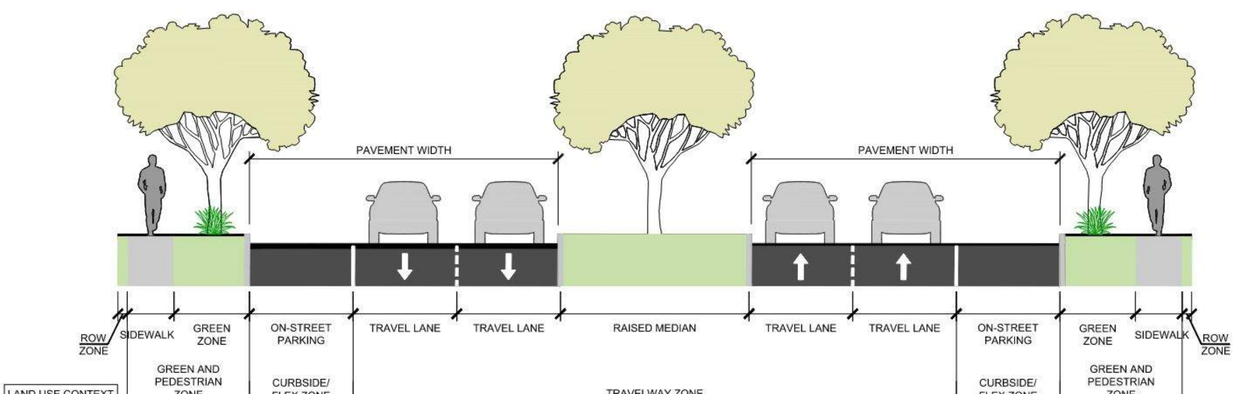
Figure 2-6: Type C Special Condition Section (Sidepath) – 110' ROW



LAND USE CONTEXT	ROW	SIDEPATH	GREEN ZONE	TRAVEL LANE	TRAVEL LANE	TRAVEL LANE	RAISED MEDIAN	TRAVEL LANE	TRAVEL LANE	TRAVEL LANE	GREEN ZONE	SIDEPATH	ROW
NEIGHBORHOOD	1'	10'	3'	11'	11'	11'	16'	11'	11'	11'	3'	10'	1'
COMMERCIAL	1'	10'	3'	11'	11'	11'	16'	11'	11'	11'	3'	10'	1'
CORNER	1'	10'	3'	11'	11'	11'	16'	11'	11'	11'	3'	10'	1'
MIXED-USE	1'	10'	3'	11'	11'	11'	16'	11'	11'	11'	3'	10'	1'

Figure 2-7: Type C Special Condition Section (On-Street Parking) – 110' ROW

This cross-section should be used where on-street parking is a priority and where lower traffic volumes permit a reconfiguration of travel lanes. When angled on-street parking is permitted, additional right-of-way must be granted to accommodate.



LAND USE CONTEXT	ROW	SIDEWALK	GREEN ZONE	ON-STREET PARKING	TRAVEL LANE	TRAVEL LANE	RAISED MEDIAN	TRAVEL LANE	TRAVEL LANE	ON-STREET PARKING	GREEN ZONE	SIDEWALK	ROW
NEIGHBORHOOD	1'	5'	8'	11'	11'	11'	16'	11'	11'	11'	8'	5'	1'
COMMERCIAL	1'	5'	8'	11'	11'	11'	16'	11'	11'	11'	8'	5'	1'
CORNER	1'	5'	8'	11'	11'	11'	16'	11'	11'	11'	8'	5'	1'
MIXED-USE	1'	5'	8'	11'	11'	11'	16'	11'	11'	11'	8'	5'	1'

2.3.4 Type D Thoroughfare – Minor Arterials

The following cross-sections in **Figures 2-8** and **2-10** represent typical Type D thoroughfares. **Figures 2-9** and **2-11** represent special condition sections in Type D thoroughfares.

Type D Streets in the Mixed-Use Context (previously referred to as Major Median Divided Streets in the Urban Mixed-Use and Residential Community Design zoning districts) have the following requirements:

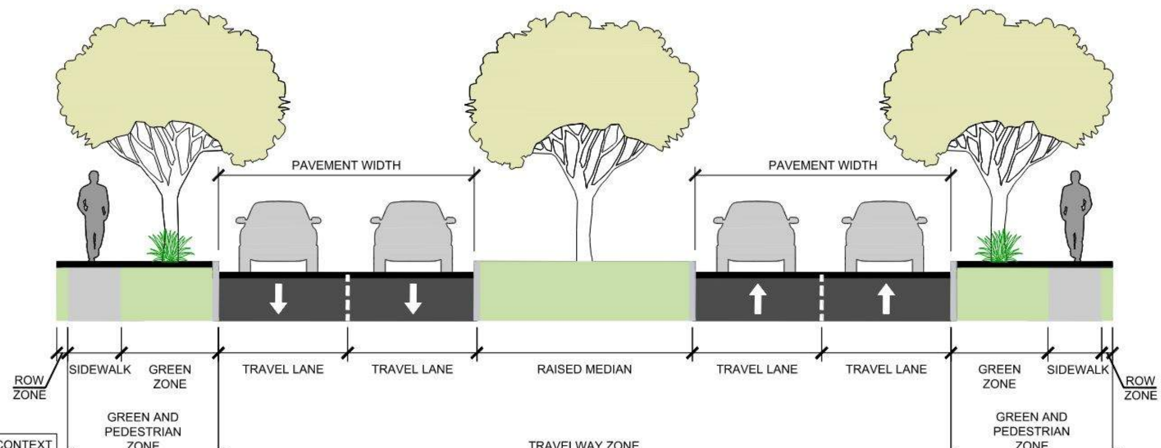
- Street trees are required at the rate of one tree per 40 linear feet of street frontage, except adjacent to retail uses the rate shall be one tree per 100 linear feet of street frontage.
- Street trees shall be in planting gates or tree grates within five feet of the back of the street curb.

- A clear pedestrian path of twelve feet shall be maintained. Trees, landscaping, outdoor dining areas, bicycle racks, and street furniture may be placed within the sidewalk but may not reduce the clear pedestrian path.

- On-street parking is required except in locations designated for loading, services, and pedestrian crossings. Perpendicular, angled/diagonal parking may be permitted in lieu of parallel parking where additional right-of-way is provided to cover the additional width of parking stalls and maintain the minimum Green Zone, Pedestrian Zones, and ROW zones. Right-of-way dedication shall extend to the outside edge of the ROW zone.

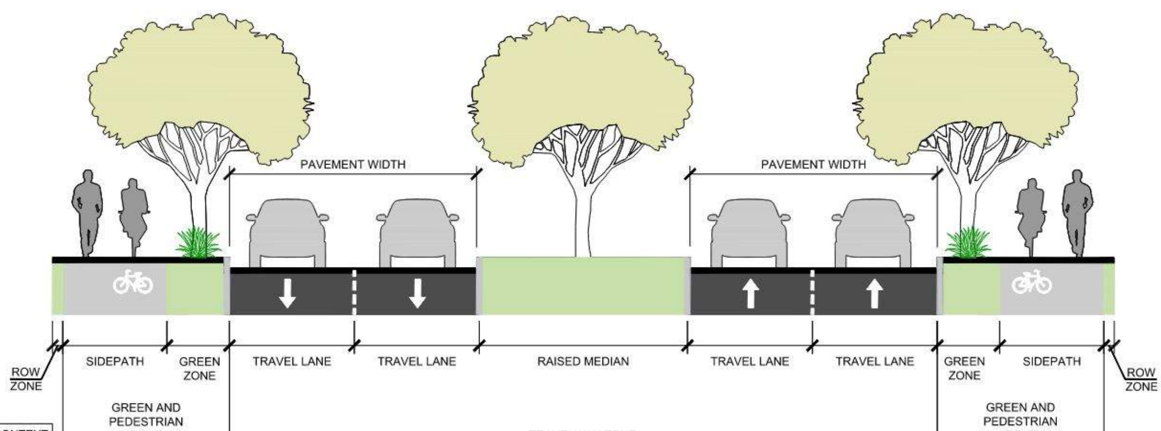
- The Director of Engineering may accept the dedication of a street easement, or street, sidewalk and utility easement, in lieu of requiring the dedication of a fee interest, where he determines the lesser property right to be sufficient for the city's purposes.

Figure 2-8: Type D Typical Section – 92' ROW
Land Use Context: Commercial, Neighborhood, Corner-Option-1



LAND USE CONTEXT	ROW ZONE	SIDEWALK	GREEN ZONE	TRAVEL LANE	TRAVEL LANE	RAISED MEDIAN	TRAVEL LANE	TRAVEL LANE	GREEN ZONE	SIDEWALK	ROW ZONE
NEIGHBORHOOD	1'	5'	8'	11'	11'	20'	11'	11'	8'	5'	1'
CORNER	1'	5'	8'	11'	11'	20'	11'	11'	8'	5'	1'
COMMERCIAL	1'	6'	9'	11'	11'	16'	11'	11'	9'	6'	1'

Figure 2-9: Type D Sidepath Option – 92' ROW
Land Use Context: Neighborhood, Commercial, and Corner-Option-1



LAND USE CONTEXT	ROW ZONE	SIDEPATH	GREEN ZONE	TRAVEL LANE	TRAVEL LANE	RAISED MEDIAN	TRAVEL LANE	TRAVEL LANE	GREEN ZONE	SIDEPATH	ROW ZONE
NEIGHBORHOOD	1'	10'	5'	11'	11'	16'	11'	11'	5'	10'	1'
COMMERCIAL	1'	10'	5'	11'	11'	16'	11'	11'	5'	10'	1'
CORNER	1'	10'	5'	11'	11'	16'	11'	11'	5'	10'	1'

Figure 2-10: Type D Typical Section – 92' ROW
Land Use Context: Mixed-Use and Corner-Option-2

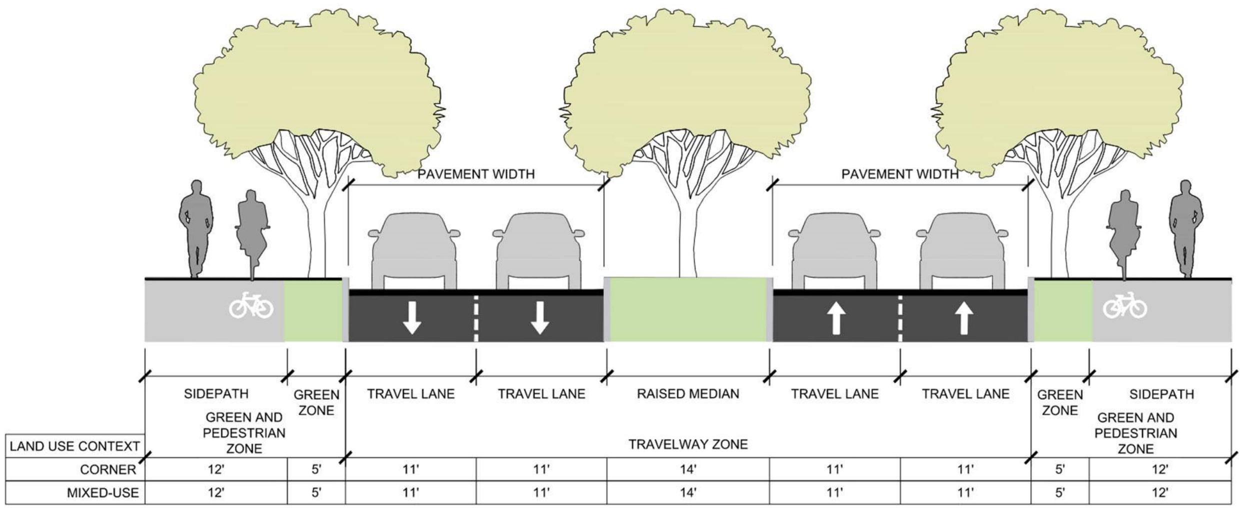
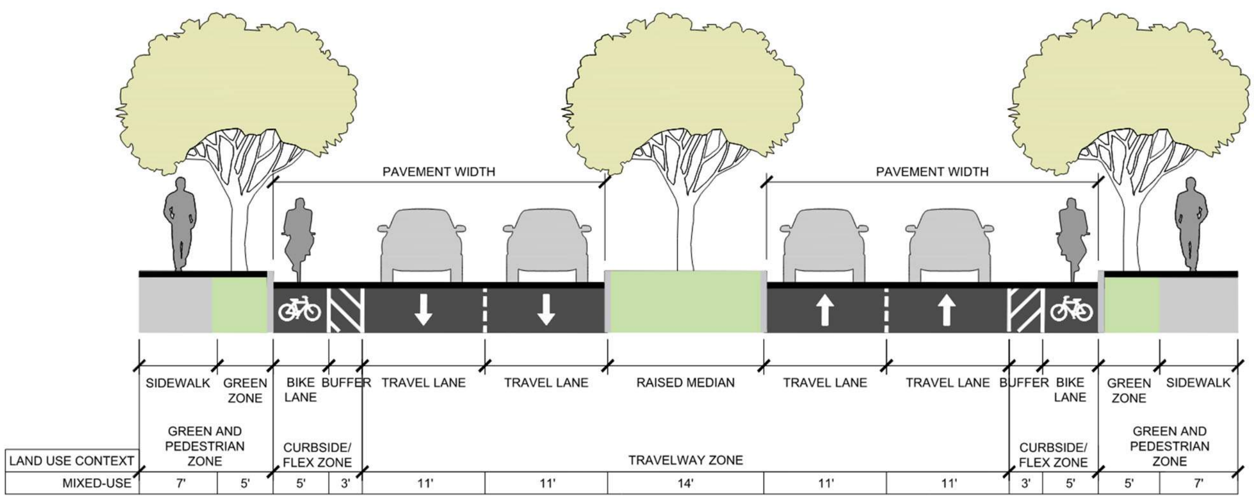


Figure 2-11: Type D Special Condition (Buffered Bike Lane) – 98' ROW
Land Use Context: Mixed-Use

This cross-section should be used for on-street bike routes identified on the Bicycle Transportation Plan Map, and where lower traffic volumes permit a reconfiguration of travel lanes.



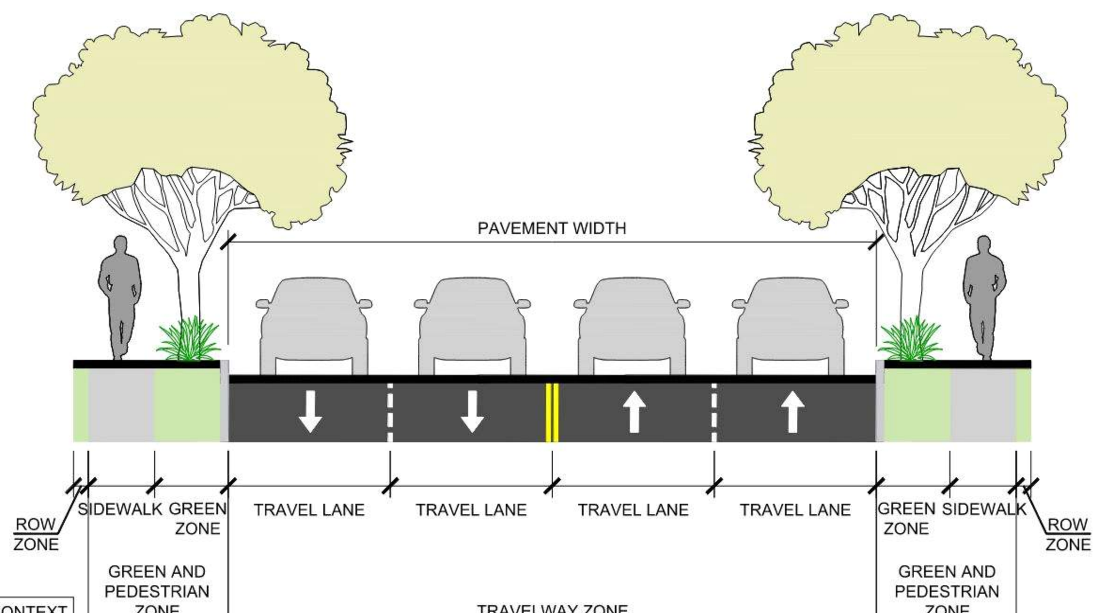
2.3.5 Type E Thoroughfare – Major Collectors

The following cross-sections represent Type E thoroughfares, which have the greatest amount of design flexibility. **Figures 2-12** and **2-13** represent typical Type E thoroughfares. This is applicable in situations where there is a higher traffic volume demand while **Figures 2-14**, **2-15**, and **2-16** represent special condition sections.

Type E Streets in the Mixed-Use Context have the following requirements:

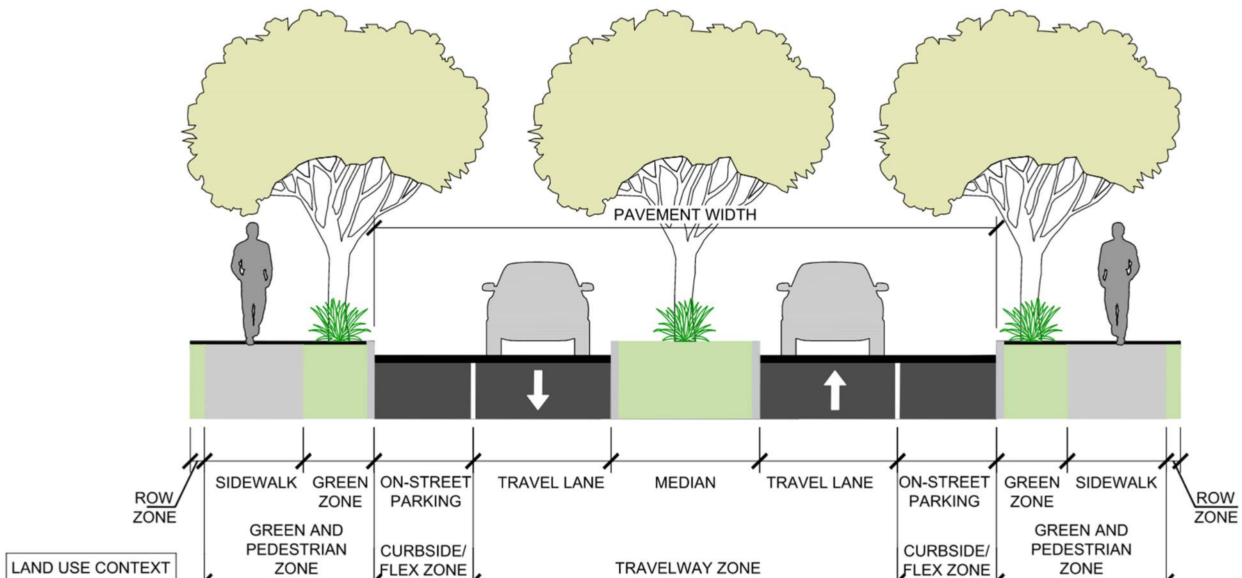
- Street trees are required at the rate of one tree per 40 linear feet of street frontage, except adjacent to retail uses the rate shall be one tree per 100 linear feet of street frontage.
- Street trees shall be in planting gates or tree grates within five feet of the back of the street curb.
- A clear pedestrian path of twelve feet shall be maintained. Trees, landscaping, outdoor dining areas, bicycle racks, and street furniture may be placed within the sidewalk but may not reduce the clear pedestrian path.
- On-street parking is required except in locations designated for loading, services, and pedestrian crossings. Perpendicular, angled/diagonal parking may be permitted in lieu of parallel parking where additional right-of-way is provided to cover the additional width of parking stalls and maintain the minimum Green Zone, Pedestrian Zones, and ROW zones. Right-of-way dedication shall extend to the outside edge of the ROW zone.
- The Director of Engineering may accept the dedication of a street easement, or street, sidewalk and utility easement, in lieu of requiring the dedication of a fee interest, where he determines the lesser property right to be sufficient for the city's purposes.

Figure 2-12: Type E Typical Section – 68' ROW
Land Use Context: Neighborhood, Commercial, and Corner-Option-1



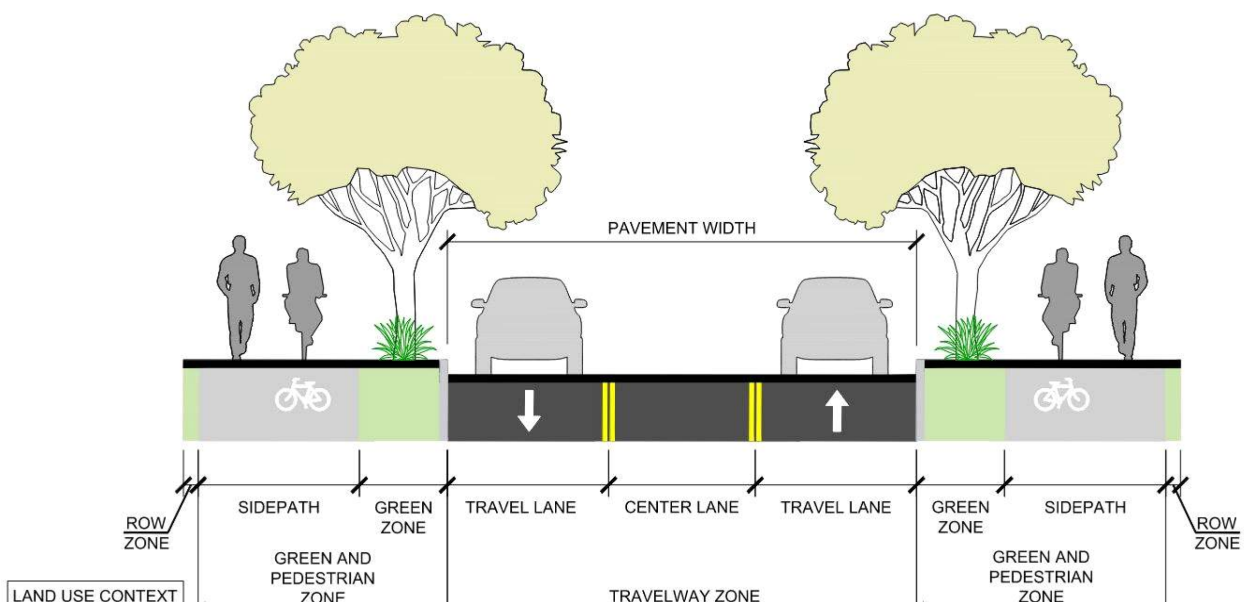
LAND USE CONTEXT	ROW ZONE	SIDEWALK	GREEN ZONE	TRAVEL LANE	TRAVEL LANE	TRAVEL LANE	TRAVEL LANE	GREEN ZONE	SIDEWALK	ROW ZONE
NEIGHBORHOOD	1'	5'	6'	11'	11'	11'	11'	6'	5'	1'
COMMERCIAL	1'	6'	5'	11'	11'	11'	11'	5'	6'	1'
CORNER	1'	5'	6'	11'	11'	11'	11'	5'	6'	1'

Figure 2-13: Type E Typical Section – 73’ ROW
Land Use Context: Mixed Use and Corner-Option-2



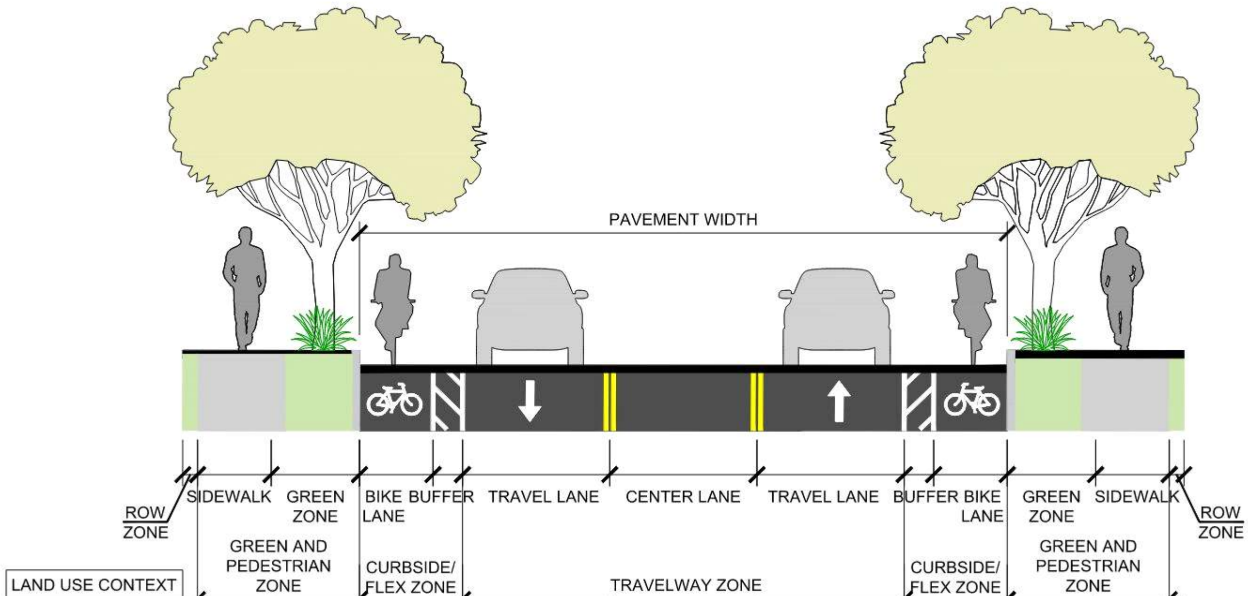
LAND USE CONTEXT	ROW Zone	Sidewalk	Green Zone	On-Street Parking	Travel Lane	Median	Travel Lane	On-Street Parking	Green Zone	Sidewalk	ROW Zone
CORNER	0'	7'	5'	8'	11'	11'	11'	8'	5'	7'	0'
MIXED-USE	0'	7'	5'	8'	11'	11'	11'	8'	5'	7'	0'

Figure 2-14: Type E Special Condition Section (Sidepath with Center Turn Lane) – 68’ ROW
Land Use Context: Neighborhood, Commercial, and Corner-Option-1



LAND USE CONTEXT	ROW Zone	Sidepath	Green Zone	Travel Lane	Center Lane	Travel Lane	Green Zone	Sidepath	ROW Zone
NEIGHBORHOOD	3'	10'	5'	11'	10'	11'	5'	10'	3'
COMMERCIAL	3'	10'	5'	11'	10'	11'	5'	10'	3'
CORNER	3'	10'	5'	11'	10'	11'	5'	10'	3'

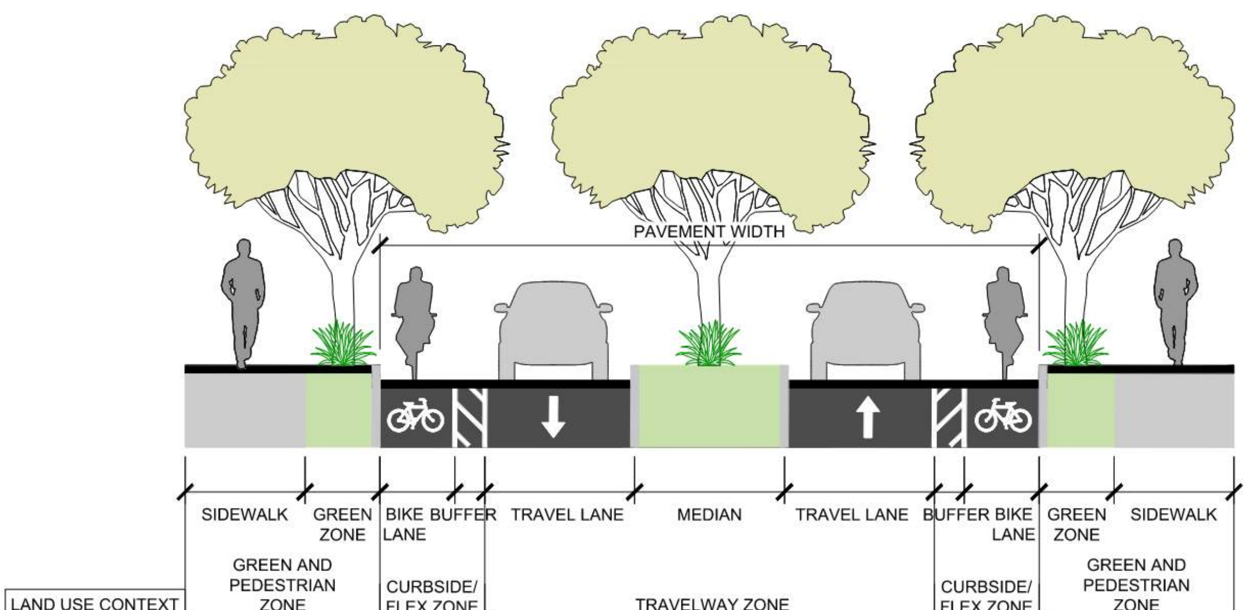
Figure 2-15: Type E Special Condition Section (Buffered Bike Lane with Center Turn Lane) – 68' ROW
Land Use Context: Neighborhood, Commercial, and Corner-Option-1



LAND USE CONTEXT	ROW ZONE	SIDEWALK	GREEN ZONE	BIKE LANE	BUFFER	TRAVEL LANE	CENTER LANE	TRAVEL LANE	BUFFER	BIKE LANE	GREEN ZONE	SIDEWALK	ROW ZONE
NEIGHBORHOOD	1'	5'	6'	5'	2'	10'	10'	10'	2'	5'	6'	5'	1'
COMMERCIAL	1'	6'	5'	5'	2'	10'	10'	10'	2'	5'	5'	6'	1'
CORNER	1'	6'	5'	5'	2'	10'	10'	10'	2'	5'	5'	6'	1'

Figure 2-16: Type E Special Condition Section (Buffered Bike Lane with Median) – 73' ROW
Land Use Context: Mixed-Use

This cross-section should be used where on-street bike routes are identified on the Bicycle Transportation Plan Map and where lower traffic volumes permit a reconfiguration of travel lanes.



LAND USE CONTEXT	SIDEWALK	GREEN ZONE	BIKE LANE	BUFFER	TRAVEL LANE	MEDIAN	TRAVEL LANE	BUFFER	BIKE LANE	GREEN ZONE	SIDEWALK
MIXED-USE	7'	5'	5'	3'	11'	11'	11'	3'	5'	5'	7'

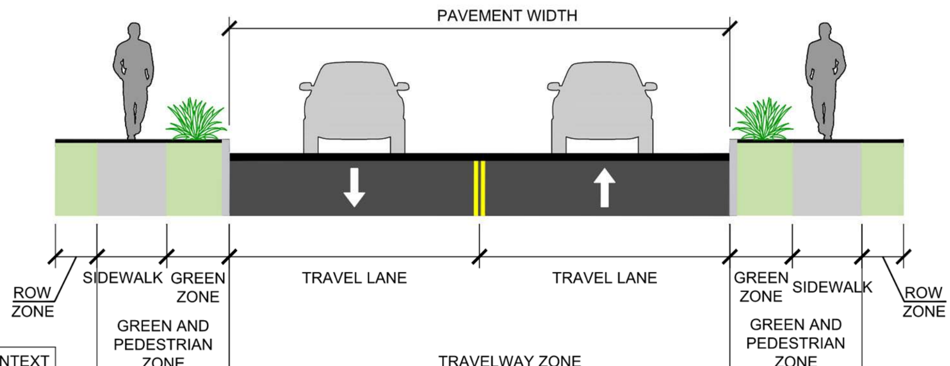
2.3.6 Type F Thoroughfare – Minor Collectors

The following cross-sections in **Figures 2-17** and **2-18** represent the typical Type F thoroughfares. **Figures 2-19** and **2-20** represent special conditions sections of Type F thoroughfares.

Type F streets in the Mixed-Use Context (previously referred to as Major Streets in the Urban Mixed-use and Residential Community Design zoning districts) have the following requirements:

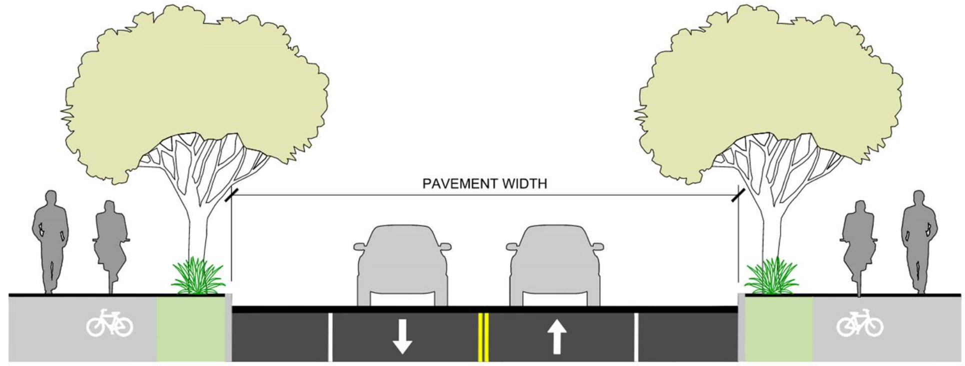
- Street trees are required at the rate of one tree per 40 linear feet of street frontage, except adjacent to retail uses the rate shall be one tree per 100 linear feet of street frontage.
- Street trees shall be in planting gates or tree grates within five feet of the back of the street curb.
- A clear pedestrian path of twelve feet shall be maintained. Trees, landscaping, outdoor dining areas, bicycle racks, and street furniture may be placed within the sidewalk but may not reduce the clear pedestrian path.
- On-street parking is required except in locations designated for loading, services, and pedestrian crossings. Perpendicular, angled/diagonal parking may be permitted in lieu of parallel parking where additional right-of-way is provided to cover the additional width of parking stalls and maintain the minimum Green Zone, Pedestrian Zones, and ROW zones. Right-of-way dedication shall extend to the outside edge of the ROW zone.
- The Director of Engineering may accept the dedication of a street easement, or street, sidewalk and utility easement, in lieu of requiring the dedication of a fee interest, where he determines the lesser property right to be sufficient for the city's purposes.

Figure 2-17: Type F Typical Section – 60' ROW
Land Use Context: Neighborhood, Commercial, and Corner-Option-1



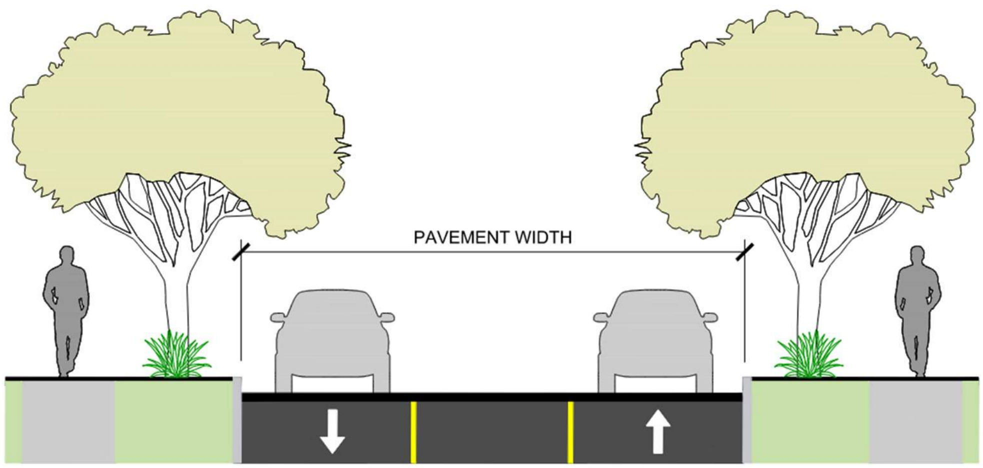
LAND USE CONTEXT	ROW ZONE	SIDEWALK	GREEN ZONE	TRAVEL LANE	TRAVEL LANE	GREEN ZONE	SIDEWALK	ROW ZONE
NEIGHBORHOOD	3'	5'	4'	18'	18'	4'	5'	3'
COMMERCIAL	1'	6'	5'	18'	18'	5'	6'	1'
CORNER	3'	5'	4'	18'	18'	4'	5'	3'

Figure 2-18: Type F Typical Section – 72' ROW
Land Use Context: Corner Activity and Mixed-Use



LAND USE CONTEXT	SIDEPATH	GREEN ZONE	ON-STREET PARKING	TRAVEL LANE	TRAVEL LANE	ON-STREET PARKING	GREEN ZONE	SIDEPATH
	GREEN AND PEDESTRIAN ZONE		CURBSIDE/ FLEX ZONE	TRAVELWAY ZONE		CURBSIDE/ FLEX ZONE	GREEN AND PEDESTRIAN ZONE	
CORNER	12'	6'	8'	11'	11'	8'	6'	12'
MIXED-USE	12'	6'	8'	11'	11'	8'	6'	12'

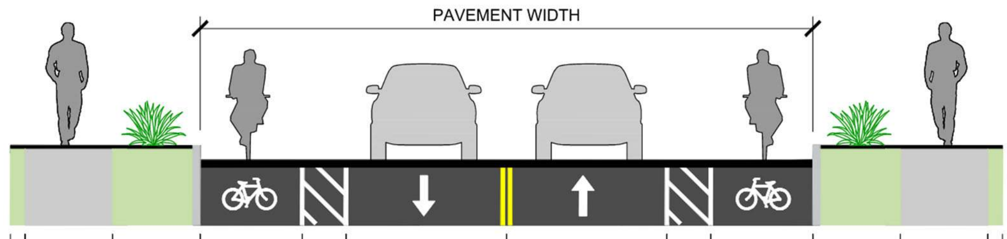
Figure 2-19: Type F Special Condition (Center Turn Lane) – 60' ROW



LAND USE CONTEXT	ROW ZONE	SIDEWALK	GREEN ZONE	TRAVEL LANE	CENTER LANE	TRAVEL LANE	GREEN ZONE	SIDEWALK	ROW ZONE
		GREEN AND PEDESTRIAN ZONE		TRAVELWAY ZONE			GREEN AND PEDESTRIAN ZONE		
NEIGHBORHOOD	1'	5'	8'	11'	10'	11'	8'	5'	1'
COMMERCIAL	1'	6'	7'	11'	10'	11'	7'	6'	1'
CORNER	1'	6'	7'	11'	10'	11'	7'	6'	1'
MIXED-USE	1'	7'	6'	11'	10'	11'	6'	7'	1'

Figure 2-20: Type F Special Condition (Buffered Bike Lane) – 60' ROW

This cross-section should be used for on-street bike routes identified on the Bicycle Transportation Plan Map.



LAND USE CONTEXT	ROW ZONE	SIDEWALK	GREEN ZONE	BIKE LANE	BUFFER	TRAVEL LANE	TRAVEL LANE	BUFFER	BIKE LANE	GREEN ZONE	SIDEWALK	ROW ZONE
		GREEN AND PEDESTRIAN ZONE		CURBSIDE/ FLEX ZONE		TRAVELWAY ZONE		CURBSIDE/ FLEX ZONE		GREEN AND PEDESTRIAN ZONE		
NEIGHBORHOOD	1'	5'	6'	5'	2'	11'	11'	2'	5'	6'	5'	1'
COMMERCIAL	1'	6'	5'	5'	2'	11'	11'	2'	5'	5'	6'	1'
CORNER	1'	6'	5'	5'	2'	11'	11'	2'	5'	5'	6'	1'
MIXED-USE	1'	7'	4'	5'	2'	11'	11'	2'	5'	4'	7'	1'

2.3.7 Type G Thoroughfare – Local Streets

The following cross-sections in **Figure 2-21** and **Figure 2-22** represent typical Type G thoroughfares. Type F streets will be utilized as a minimum standard for non-residential developments.

Type G Streets in the Mixed-Use Context (previously referred to as Minor Streets in the Urban Mixed-Use and Residential Community Design zoning districts) have the following requirements:

- Street trees are required at the rate of one tree per 40 linear feet of street frontage, except adjacent to retail uses the rate shall be one tree per 100 linear feet of street frontage.

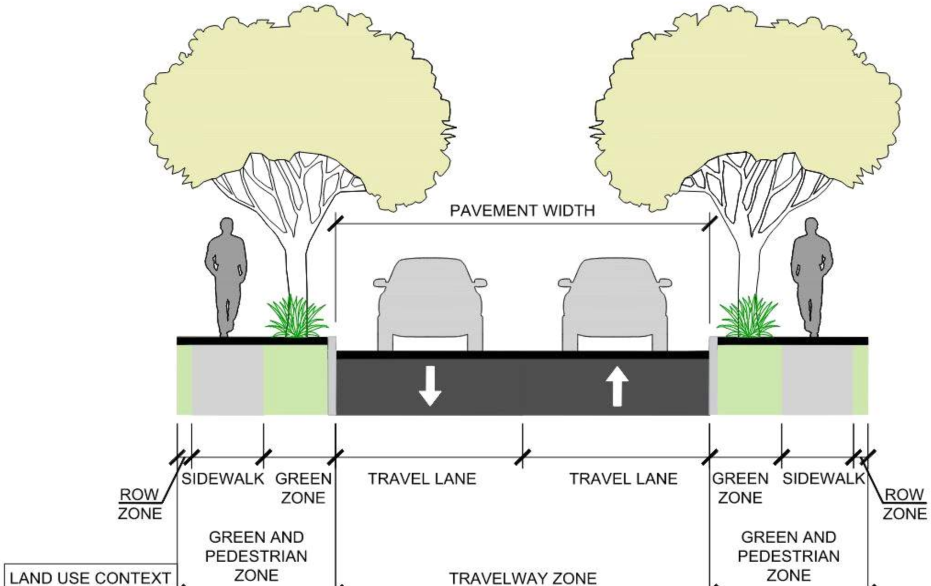
- Street trees shall be in planting gates or tree grates within five feet of the back of the street curb.

- A clear pedestrian path of seven feet shall be maintained. Trees, landscaping, outdoor dining areas, bicycle racks and street furniture may be placed within the sidewalk but may not reduce the clear pedestrian path.

- On-street parking is required except in locations designated for loading, services, and pedestrian crossings. Perpendicular, angled/diagonal parking may be permitted in lieu of parallel parking where additional right-of-way is provided to cover the additional width of parking stalls and maintain the minimum Green Zone, Pedestrian Zones, and ROW zones. Right-of-way dedication shall extend to the outside edge of the ROW zone.

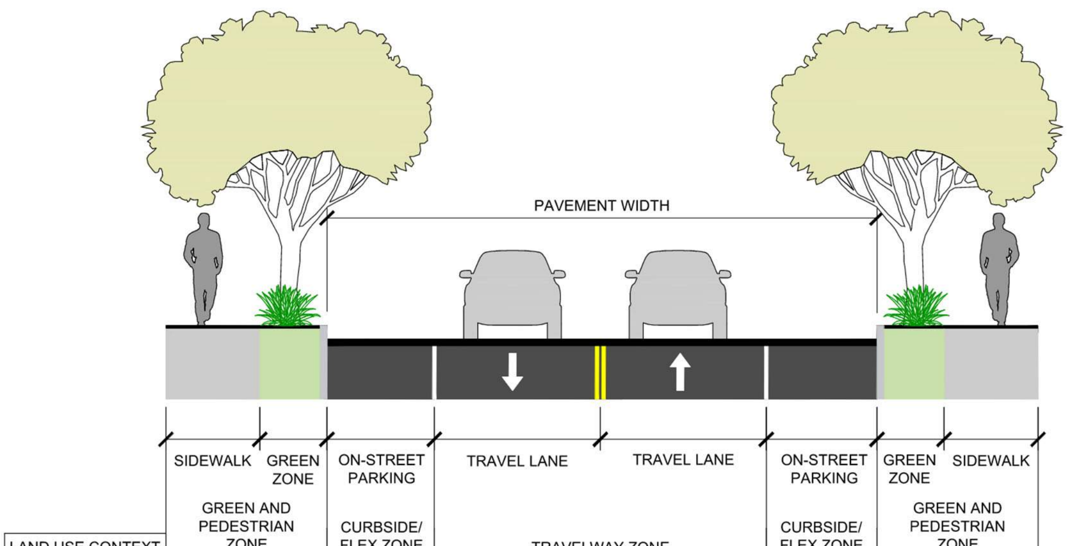
- The Director of Engineering may accept the dedication of a street easement, or street, sidewalk and utility easement, in lieu of requiring the dedication of a fee interest, where he determines the lesser property right to be sufficient for the city's purposes.

Figure 2-21: Type G Typical Section – 50' ROW
Land Use Context: Neighborhood and Corner-Option-1



LAND USE CONTEXT	ROW ZONE	SIDEWALK	GREEN ZONE	TRAVEL LANE	TRAVEL LANE	GREEN ZONE	SIDEWALK	ROW ZONE
NEIGHBORHOOD	1'	5'	6'	13'	13'	6'	5'	1'
CORNER	1'	5'	6'	13'	13'	6'	5'	1'

Figure 2-22: Type G Typical Section – 62' ROW
Land Use Context: Mixed-Use and Corner-Option-2



LAND USE CONTEXT	SIDEWALK	GREEN ZONE	ON-STREET PARKING	TRAVEL LANE	TRAVEL LANE	ON-STREET PARKING	GREEN ZONE	SIDEWALK
CORNER	7'	5'	8'	11'	11'	8'	5'	7'
MIXED-USE	7'	5'	8'	11'	11'	8'	5'	7'

SECTION 3
Special Streets and Accessways

3.1 General

The primary purpose of Special Streets and Accessways is for local access for vehicles, pedestrians, or service/delivery, and include Alleys, Mews, Paseos, and Shared Streets. These streets or accessways may be public or private and may range in size and use. This section provides information to design these facilities and relevant features. As described in Section 2 - Street Framework, land use context of the Thoroughfare Plan Map should be used to determine the appropriateness of Special Streets and Accessways. The Corner Context may utilize standards of the Mixed-Use Context for small-lot infill or redevelopment or as part of mixed-use developments.

3.2 Alleys

An alley is a narrow accessway that is typically provided at the rear of residential lots and commercial areas providing necessary vehicular access to garages or other parking areas. Alleys also support service accommodations, such as utilities, drainage, and trash pick-up. Alley widths vary with differing land use contexts. Alleys shall have the following requirements:

3.2.1 Cross-Sections

a. Single-Family – For single-family development in the Neighborhood context, alleys shall be constructed with a minimum of 10 feet of pavement width within a minimum 15-foot right-of-way (**Figure 3-1)**.

b. Commercial and Multifamily – For commercial and multifamily development in the Neighborhood or Commercial context, alleys shall be constructed with a minimum of 20 feet of pavement width within a minimum 20-foot right-of-way.

c. Mixed-use Development – For all development in the Mixed-Use Context, alleys shall be constructed with a minimum of 24 feet of pavement within a minimum 24-foot right-of-way (see **Figure 3-2**). See **Mews Streets** in **Section 3.3** for alley alternatives in the Mixed-Use Context.

Figure 3-1: Alley Typical Section
Land Use Context: Neighborhood

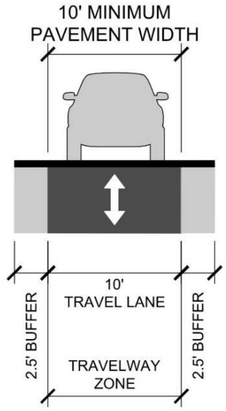
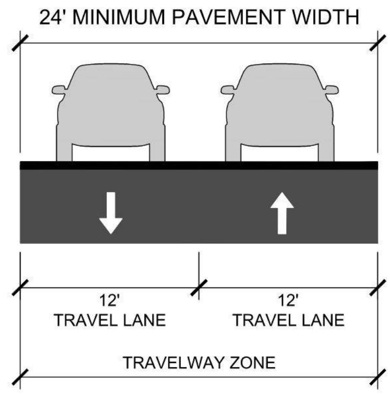


Figure 3-2: Alley Typical Section
Land Use Context: Mixed-Use



d. Wider alleys – When required for drainage, screening walls, or other purposes, shall be constructed in rights-of-way approved by the Director of Engineering. Alley turnouts shall be a minimum of 12 feet in width at the street right-of-way line or the width of the alley, whichever is greater. Paving in alleys adjacent to masonry screening walls shall be constructed a minimum of 12.5 feet in width and shall abut the screening wall.

e. When the alley designs from the above typical sections are not applicable, refer to *Plano Construction Standard Details* for other acceptable design options.

3.2.2 Design Requirements

a. Alley Length – Alleys shall not exceed 1,200 feet in length, except in the Mixed-Use Context alleys shall not exceed 600 feet in length.

b. Alley as Fire Lane – An alley that also serves the purpose of a fire lane shall be constructed to the standards of a fire lane as required by Plano Fire-Rescue. These standards include but are not limited to, a minimum pavement width of 24 feet, a minimum pavement thickness of 6 inches, fire lane striping painted on its edges, and a minimum pavement edge radius of 20 feet at street intersections. The pavement design for an alley that also serves as a fire lane is shown in the City's *Construction Standard Detail*.

c. Alley Visibility Obstructions – No fence, wall, screen, sign, structure, or foliage of hedges, trees, bushes, or shrubs shall be erected, planted, or maintained in any alley ROW. However, the City may place traffic control devices as necessary. The foliage of hedges, trees, bushes, and shrubs planted adjacent to the alleys ROW which are not otherwise governed by the following triangles or Section 20.100 of the Comprehensive Zoning Ordinance of the City, shall be maintained such that the minimum overhang above the ground 1 foot outside the edge of the pavement shall be 14 feet. A minimum 12 feet overhang above the entire width of the alley shall be provided in every case.

d. Alley Grade – Alleys shall have a maximum grade of 6%. Steeper grades may be permitted where required by topographical and/or natural features, as approved by the Director of Engineering or his/her designee. Alleys shall maintain a maximum cross-slope of 2% at the intersection of the adjacent sidewalk.

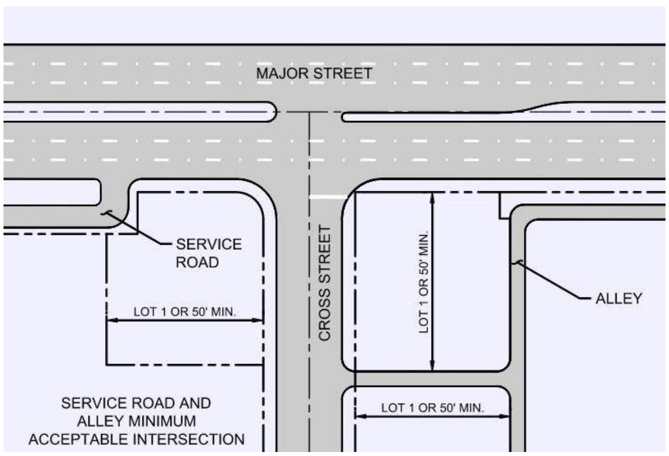
e. Vertical Curves in Alleys – Vertical curves in alleys shall be used in order to provide a design that is safe, comfortable in operation, pleasing in appearance and adequate for drainage. Vertical curve alignment shall also provide stopping sight distance in all cases based on a design speed of 20 mph.

f. Alley Screening Walls – The area between screening walls and alley pavement shall be paved and graded to drain to the invert.

3.2.3 Intersections

a. Alleys shall not form junctions with Type D and larger streets. If an alley runs parallel to and shares a common ROW line with a major street, then its alignment shall curve away from the major street and connect with another area alleyway, thus avoiding the formation of a junction. This curved alignment of a parallel alley shall occur not less than one subdivision lot width or a minimum of 50 feet (whichever is greater) from a cross-street intersection formed by another street that is Type F or greater as indicated in **Figure 3-3**.

Figure 3-3: Parallel Service Road/Alley Minimum intersection at a Major Road



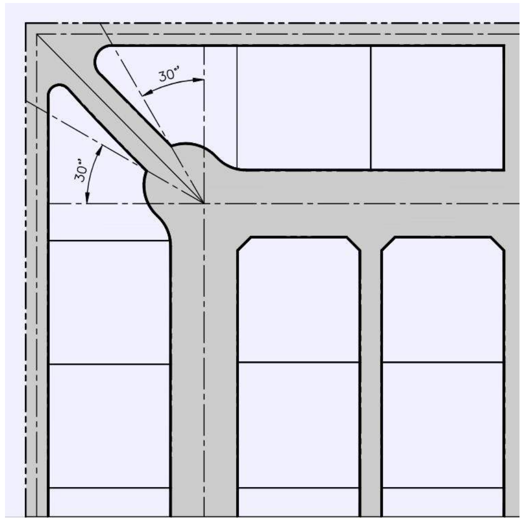
b. All alley intersections with streets shall be perpendicular or radial, within a 5° tolerance, at the intersection of the ROW lines.

c. The distance between alleys on opposite sides of an undivided street shall be less than 15 feet or greater than 75 feet as measured between the closest point between the edge of pavement of one alley and the edge of pavement of the other alley.

d. Alleys shall not align with existing or future streets or driveways on the opposite side of a street. Alleys shall be offset from such a street or driveway by a minimum of 75 feet measured from the edge of the alley to the edge of the street or driveway.

e. Alleys that intersect at “elbow” street intersections shall not intersect within 30° of the centerline of the adjacent streets. See **Figure 3-4**.

Figure 3-4: Alley Intersecting an Elbow



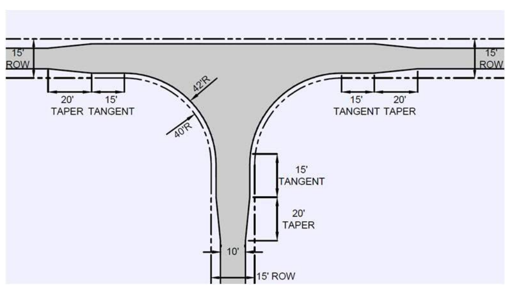
f. Alleys shall not intersect with a roundabout.

g. Internal alley intersections shall consist of no more than three alley approaches.

h. The offset between alleys on the opposite side of an intersecting alley shall be a minimum of 75 feet measured from centerline to centerline.

i. As an alley approaches an intersection with another alley, the pavement width shall increase using a taper 20 feet long. The wider pavement shall be maintained for a distance of 15 feet prior to the radius of the intersection. 2 feet of parkway shall always be maintained between the pavement and the ROW line. See **Figure 3-5**.

Figure 3-5: Alley-to-Alley Intersection



j. No permanent dead-end alley shall be permitted in new subdivisions. Alleys shall connect and/or be aligned with alleys in adjacent subdivisions.

k. The radius of alley pavement at street intersections shall not be less than 20 feet. At the intersection of two alleys, the radius of the alley ROW is dependent upon the alley ROW intersection angle as listed in **Table 3-1**. At the intersection of two alleys, the radius of the alley pavement shall be 2 feet greater than the radius of the alley ROW.

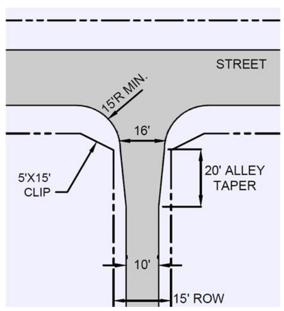
Table 3-1: Alley Intersecting Alley Radius

Alley ROW Intersection Angle	Minimum Required ROW Radius (Feet)
1°-40°	70
41° -70°	50
71° -90°	40
> 90°	50

l. At the junction of alleys with city streets, if fencing or foliage is provided near or at the property line, it shall be placed in a configuration that creates a triangular clear zone whereby the sides of the resulting triangle are 8 feet in length.

m. A taper length of 20 feet is required while approaching alley intersections. Refer to **Figure 3-5** for alley-to-alley intersection and **Figure 3-6** for alley-to-street intersection requirements. Parking is prohibited within the pavement of an alley.

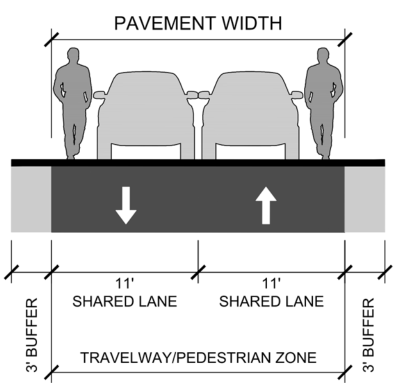
Figure 3-6: Alley-to-Street Intersection



3.3 Mews Streets

A mews is a narrow, curbless street that serves small-lot subdivisions in infill/redevelopment, mixed-use development, or functions similarly to alleys for residential lots that front onto open space areas, such as courtyards and paseos (see **Figure 3-7** for cross-section).

Figure 3-7: Mews Typical Section
Land Use Context: Mixed-Use



3.3.1 Design Requirements

a. Minimum Right-of-Way – A mews shall have a minimum ROW width of 28 feet.

b. Minimum Pavement Width – A mews shall have a minimum pavement width of 22 feet.

c. Buffer Zone – A buffer of 3 feet in width shall be provided on either side of the 22 feet travelway. A contrasting paving material shall be used for the buffer zone. Landscaping may be used in lieu of contrasting paving materials where single-family lots have additional frontage abutting a paseo.

d. Maximum Length – The maximum length of a mews shall be 600 feet, with a typical desired length of 400 feet.

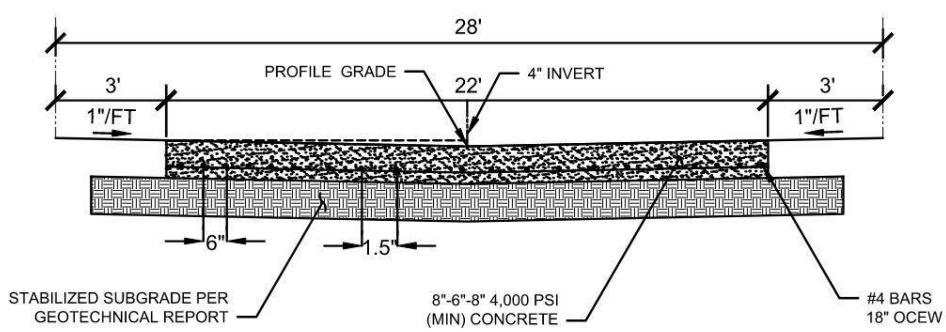
e. Parking – Mews parking may be provided for residential development but is not required. If provided, a parallel parking space shall be a minimum of 8 feet in width along the outside edge of the right-of-way.

f. Garage Access – Where individual garages take access from a mews, the face of the garage shall be setback either 8 feet (to allow a parallel parking space) or 20 feet (to allow a perpendicular parking space) from the outside edge of the right-of-way. Each space must be a minimum of 8 feet by 20 feet.

g. Mews as Fire Lane – A mews shall have fire lane striping in accordance with the City of Plano Fire Code. Striping shall be marked by painted lines of red traffic paint 6 inches in width to show the boundary of the fire lane. The words “NO PARKING FIRE LANE” or “FIRE LANE NO PARKING” shall appear in 4-inch white letters at 25-foot intervals on the red border markings along both sides of the fire lanes.

h. Pavement Thickness – The pavement of a mews shall be built in a similar manner as a typical alley, including having an invert and no curbs. The pavement design for a mews is shown in **Figure 3-8**.

Figure 3-8: Mews Pavement Design



3.3.2 Intersections

a. Every intersection along a mews for all land use contexts shall have a radius of 20 feet.

b. Each end of a mews shall connect to a Type F Street, Type G Street, or another mews. A mews shall not connect directly to a Type B, C, D, or E street. A mews shall not terminate into an alley and no dead-end mews shall be allowed.

c. Where a mews intersects with a street, Right-of-Way corner clips shall be provided. The corner clip on the inbound side of the mews shall be a triangle with one side measuring 15 feet along the street and the other side 5 feet along the alley. The corner clip on the outbound side of the mews shall be a triangle with one side measuring 10 feet along the street and the other 10 feet along the alley.

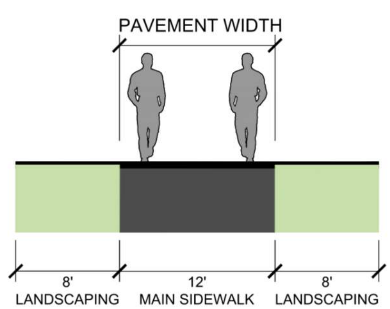
d. Where a mews intersects with a street or another mews, the mews shall have a stop sign with street name signs. No fence, wall, screen, sign, structure, or foliage of hedges, trees, bushes, or shrubs shall be erected, planted, or maintained in or adjacent to the mews ROW in a way that obstructs the visibility of the stop sign for motorists traveling on the mews. At a minimum, no obstruction shall be placed within 35 feet of the face of the stop sign.

e. Where a mews intersects with another mews, ROW corner clips and sight visibility triangles shall be provided. The ROW corner clip on each corner of the intersection shall be a triangle with a 20-foot side along each mews (see **Section 10 (Public Right-of-Way Visibility**). Sight visibility triangles shall be dedicated as easements according to the procedure described in Section 10.3 using a 20-mph design speed. These visibility requirements will preclude a home or a fenced yard from being located directly adjacent to the corner of two mews alleys.

3.4 Paseos

A paseo is a pedestrian-only pathway that may be used in conjunction with mews streets or small-lot residential subdivisions or for pedestrian connections through mixed-use developments (see **Figure 3-9** for cross-section). Paseo should include additional amenities, such as enhanced landscaping or gathering areas, that create unique public spaces, enhance overall architectural quality, and expand retail storefront opportunities.

Figure 3-9: Paseo Typical Section



3.4.1 Design Requirements

a. Vehicle Traffic Prohibited – Vehicle traffic and on-street parking are not permitted on paseos. No vehicles are allowed to travel on a paseo, except for emergency service access if the paseo is built to fire lane standards. In limited cases where vehicle access or bike facilities are included, items such as paver textures, landscaping, or pavement markings can be used to designate where pedestrians should be.

b. Minimum Right-of-Way – A paseo shall have a minimum right of way of 28 feet.

c. Minimum Pavement Width – A paseo shall be paved with a single sidewalk with a minimum width of 12 feet or multiple sidewalks with a minimum width of 7 feet each. Sidewalk connections from the main sidewalk(s) to adjacent lots shall be a minimum width of 4 feet.

d. Paving – Paseos should consider enriched paving materials. Surface materials like pavers, decorative concrete, or crushed stone should match local vernacular and design standards. These would comprise of slip resistance, ADA-compliant materials with little to no maintenance, the ability to handle long-term wear, and the ability to patch/replace if needed.

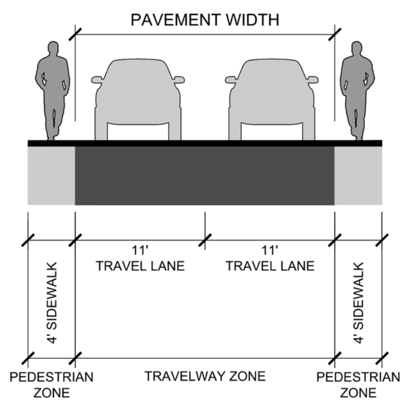
e. Landscaping – A minimum of 40% of the paseo shall be landscaped for those serving single-family neighborhoods and 15% for multifamily and non-residential areas. Landscaping for paseos can include the following but is not limited to street trees, planters, stormwater control measures, and site furnishings. Fixed vertical elements like benches and trash receptacles shall be placed outside of the minimum sidewalk and pathways widths. When possible, a consistent tree canopy along paseos should be considered. Common site furnishings can include pots, public art, pocket parks, benches, tables and chairs, trash receptacles, bollards, and bicycle racks. With the addition of planting, there needs to be consideration of visibility in the area.

f. Lighting – Paseos should be well-lit using a combination of accent lighting in landscape features and pedestrian lighting, either pole or surface mounted. Fixture design and material should reflect local vernacular and architectural standards. Lighting intensity and concentration shall meet city code. Decorative lighting accommodations, such as electrical outlets and mounting points for holiday lighting, should be considered.

3.5 Shared Streets

A shared street (or woonerf street) is an alternative type of curbless local street designed to be shared among various modes of travel to minimize segregation between road users in a commercial or residential setting (see **Figure 3-10** for cross-section). Shared streets blend the borders, surfaces, or zones used by drivers, pedestrians, bicyclists, and other road users. They require traffic calming, very low-speed limits, and signage. When a street is too narrow to provide comfortable sidewalks that comply with accessibility standards, converting it into a shared street saves space. It is also a good way to facilitate access to shops and services for people with reduced mobility. A wider section may be desired to accommodate additional design elements, such as street furnishings or on-street parking.

Figure 3-10: Shared Street Typical Section



3.5.1 Design Requirements

a. Minimum Right-of-way – A shared street shall have a minimum ROW width of 30 feet.

b. Minimum Paving Width – A shared street shall have a minimum pavement width of 22 feet for travel lanes. No curbs are allowed on a shared street.

c. Pedestrian Zone – A clear pedestrian path of a minimum of 4 feet wide shall be used on either side of the Travelway. Pedestrian zones should be defined using alternate paving materials, planters, bollards, or street furniture.

d. Tactile Warning Strips – Tactile warning strips should be provided at the entrance to all shared pedestrian spaces. Tactile warning strips must be placed where the pedestrian path of travel intersects with the motor vehicle travel path.

e. Signage – An advisory reduced speed of 5 mph – 15 mph may be used. Proper signage at entries shall be used to discourage through traffic, indicate a change in the street environment, and slow entering vehicles. The installation of “Shared Street” or “Share Road” signs at any entry/exit of the shared street/road should be provided.

f. Paving Materials – Non-standard paving materials such as brick, pavers, or stamped concrete can be used to alert drivers and emphasize the pedestrian orientation of the space, subject to permits, maintenance agreements, or revocable consents as required.

g. Shared Streets as Fire Lanes – If used as a fire lane, the fire lane shall comply with the standards applicable to mews streets. No furnishings, bollards, street trees, or other obstructions shall be located in the fire lane.

h. Traffic Calming Facilities – The facilities present in a shared street should also encourage pedestrians to appropriate space and discourage drivers from approaching the street as a typical roadway. These facilities include but are not limited to:

- Creating chicanes, raised crossings, and textured paving to calm traffic speed.
- Installing seats and benches.
- Introducing street trees, planters, and vegetation.
- Designing a lighting system homogeneous over the entire area.

SECTION 4
Downtown Streets

4.1 General

The purpose of this section is to establish a consistent approach to street design in the Downtown area. The City's *Thoroughfare Plan Map* includes an inset Downtown Streets Plan that indicates proposed street types within the Downtown area with the corresponding typical planned right-of-way, number of lanes, and location of bicycle facilities. The cross sections and design standards in this manual correspond to the various street types in the Downtown Streets Plan and are intended to apply to any new or existing street within the plan boundary that is designed for construction or reconstruction.

The following cross sections illustrate the required physical dimensions of each Downtown Street type, including the minimum right-of-way width, number of lanes, width of lanes (face of curb to face of curb), and other elements. These elements can include features such as medians, sidewalks, and bicycle facilities.

Downtown streets can be redesigned to accommodate multimodal and character-defining priorities using lane reconfigurations within the planned right-of-way. These lane reconfigurations would reduce the number of travel lanes or travel lane widths on a roadway and utilize the added space for multimodal or streetscape elements such as expanded sidewalks, plantings, street furnishings, or bicycle facilities. Any changes to existing travel lanes shall be based on an engineering study. Where wider right-of-way is available compared to the typical cross-section, the additional width should be used for enhanced Green and Pedestrian Zone design. Where street trees are not feasible within the Green Zone width, the Curbside/Flex Zone should be utilized for landscaped curb extensions.

4.2 Design Flexibility

Due to the unique design challenges in the Downtown area, it may be necessary for the Director of Engineering to grant exceptions to the standards in this section. **Section 1.9.1** of these Standards set forth the process and the criteria for exceptions.

4.3 Implementation

These cross-sections downtown will be implemented through a combination of private redevelopment and the city's Community Investment Program (CIP). Additional right-of-way dedication shall be required where necessary at the time of development so that long-term improvements can be completed through the CIP, as permitted by law. Construction of improvements to the Downtown Couplet and Gateway Corridors will be negotiated at the time of development on a case-by-case basis to allow practical short-term improvements. The developer must construct improvements to local streets at the time of development/redevelopment, consistent with the Zoning and Subdivision Ordinances.

4.4 Downtown Couplet

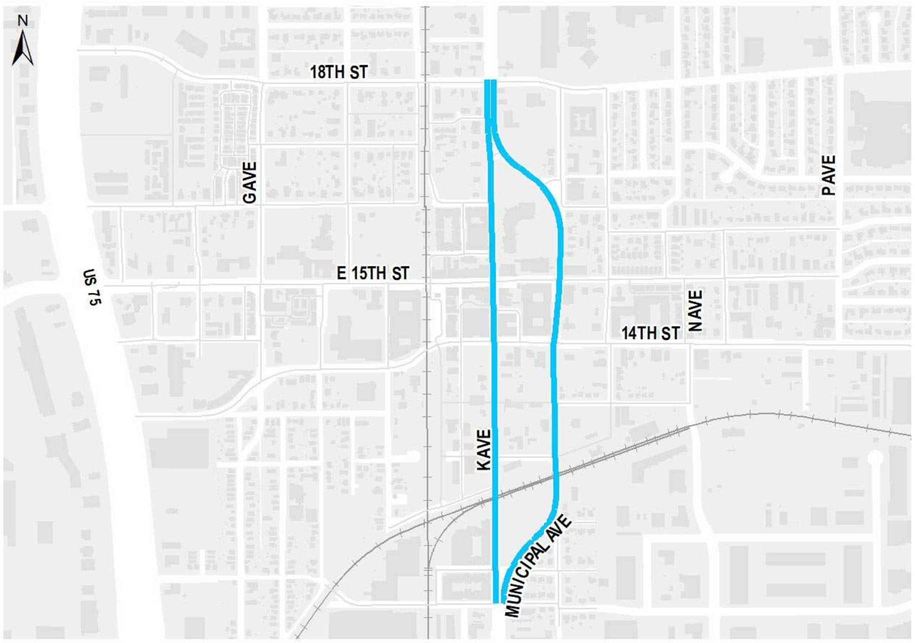
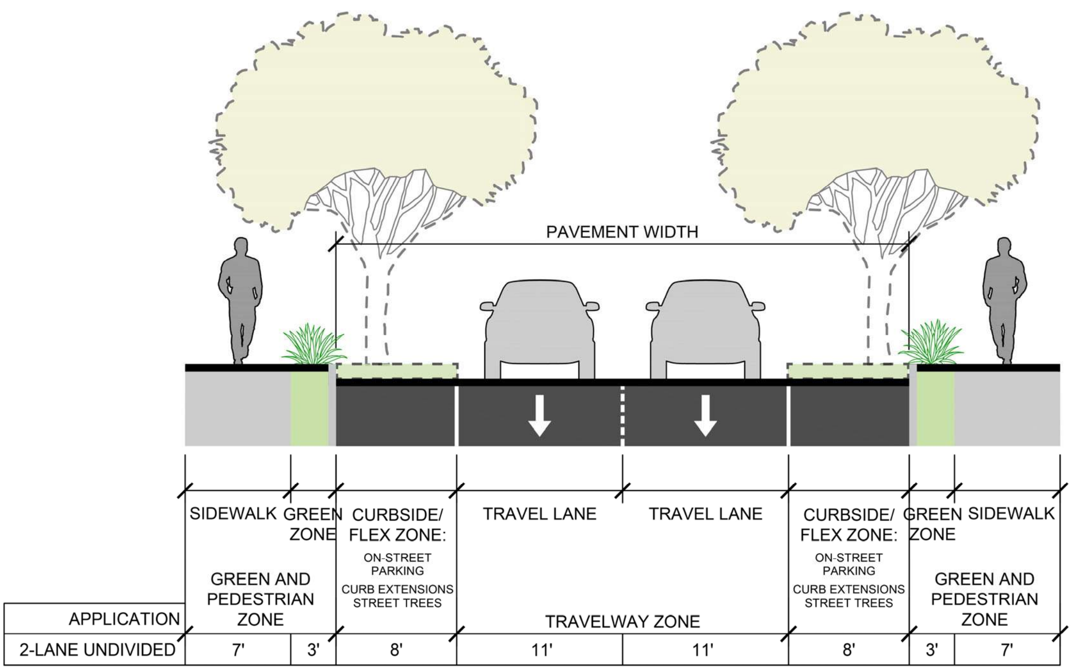
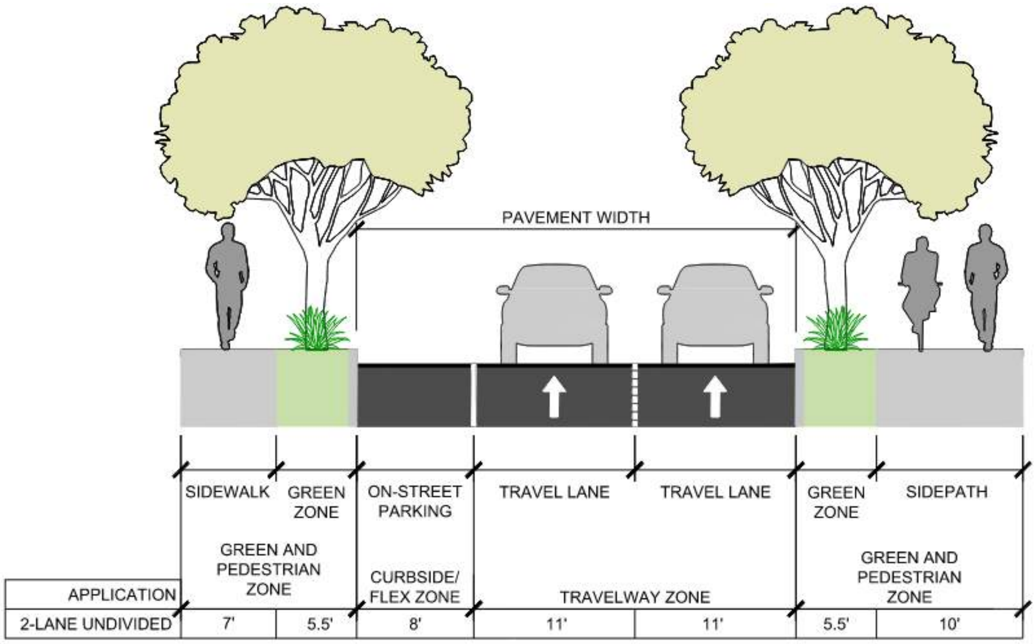


Figure 4-1: K Avenue – 10th to 17th Streets (58' ROW)



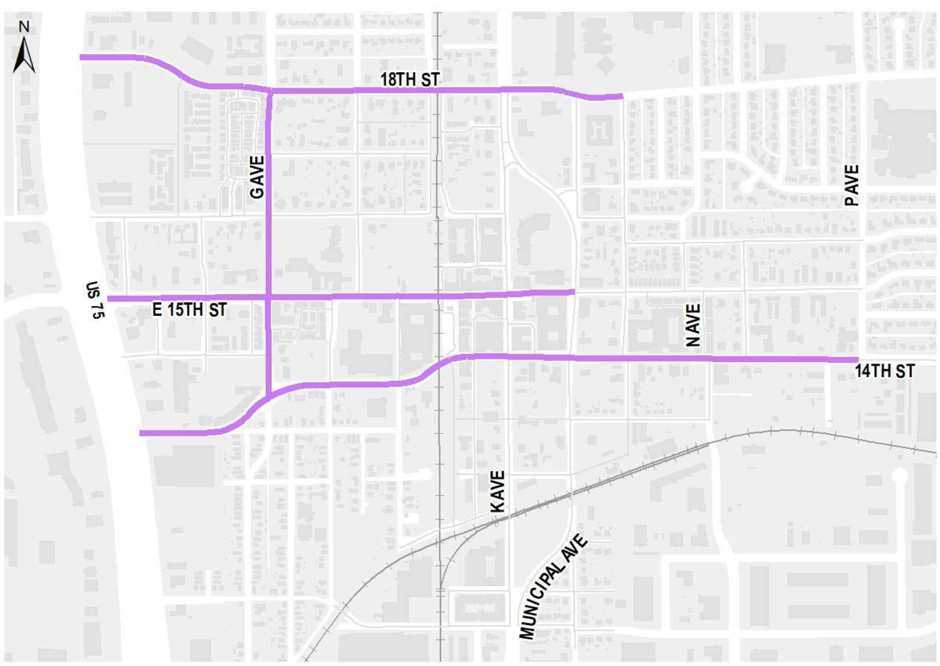
Where street trees are not feasible within the Green Zone width, the Curbside/Flex Zone should be utilized for landscaped curb extensions.

Figure 4-2: Municipal Avenue – 17th to 10th Streets (58' ROW)



4.5 Gateway Corridors

Gateway Corridors include portions of 14th Street, E. 15th Street, 18th Street, and G Avenue. Cross-sections for these streets are customized by individual sections.



4.5.1 E. 15th Street – US 75 to Municipal Avenue:

Where wider right-of-way is available compared to the typical cross-section, the additional width should be used for enhanced Green and Pedestrian Zone design. Where street trees are not feasible within the Green Zone width, the Curbside/Flex Zone should be utilized for landscaped curb extensions.

Figure 4-3: E. 15th Street – US 75 to G Avenue (100' ROW)

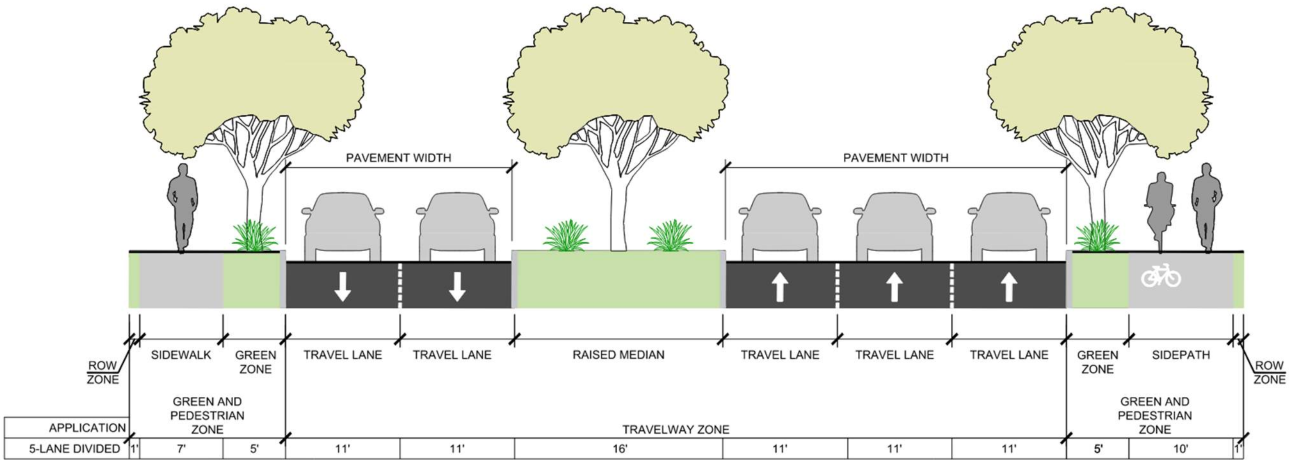


Figure 4-4: E. 15th Street – G Avenue to H Avenue (65' ROW)

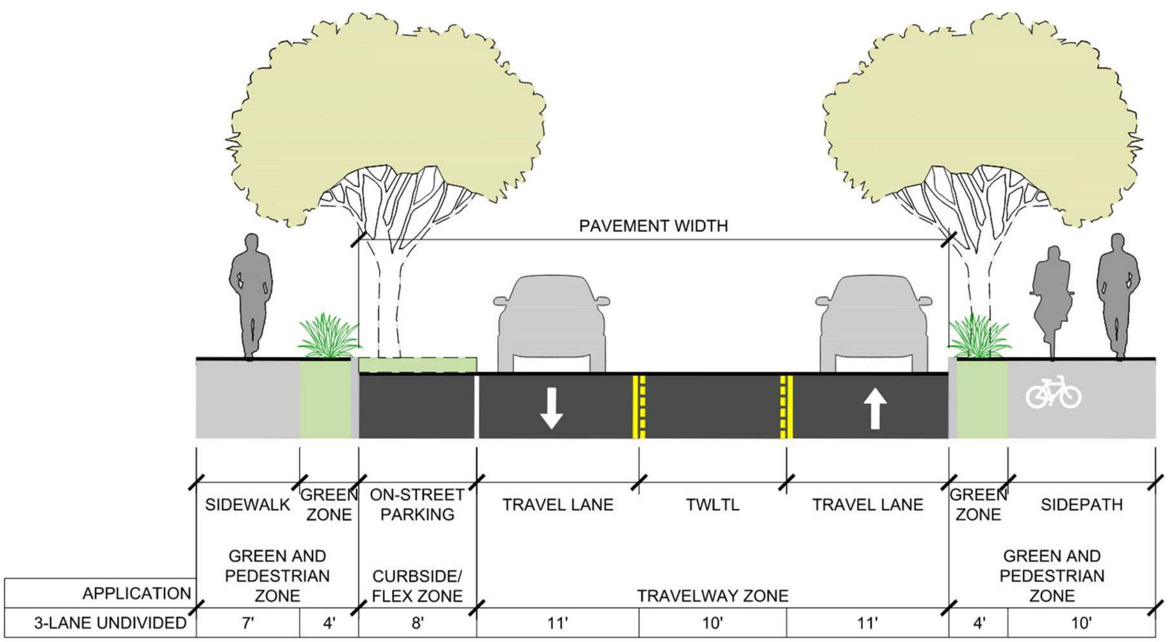


Figure 4-5: E. 15th Street – H Avenue to I Avenue (75' ROW)

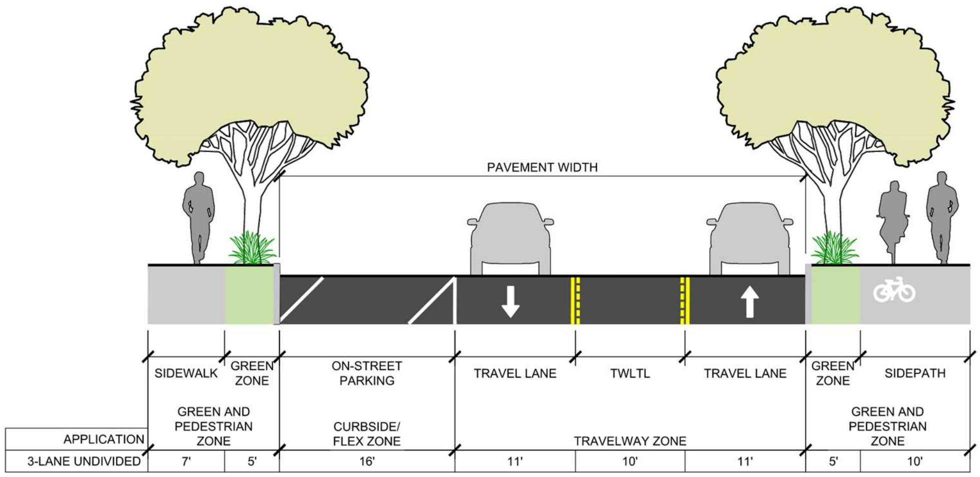


Figure 4-6: E. 15th Street – I Avenue to DART (80' ROW)

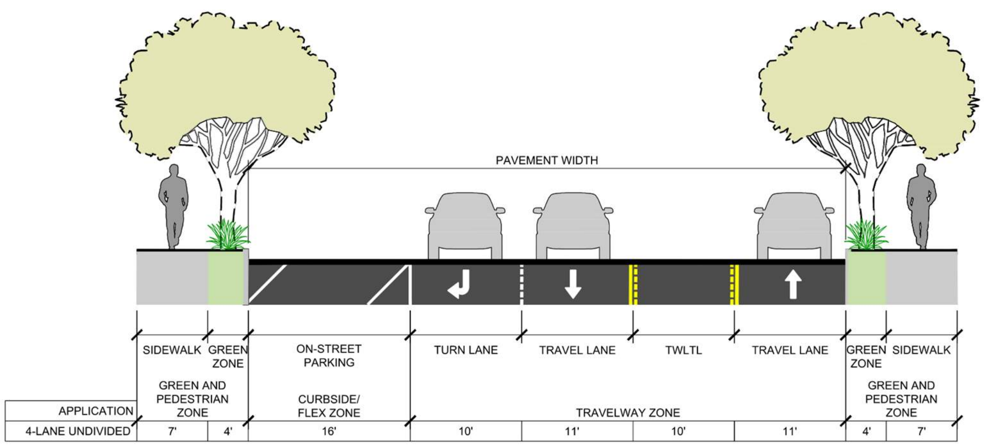


Figure 4-7: E. 15th Street – DART Rail to K Avenue (68' ROW)

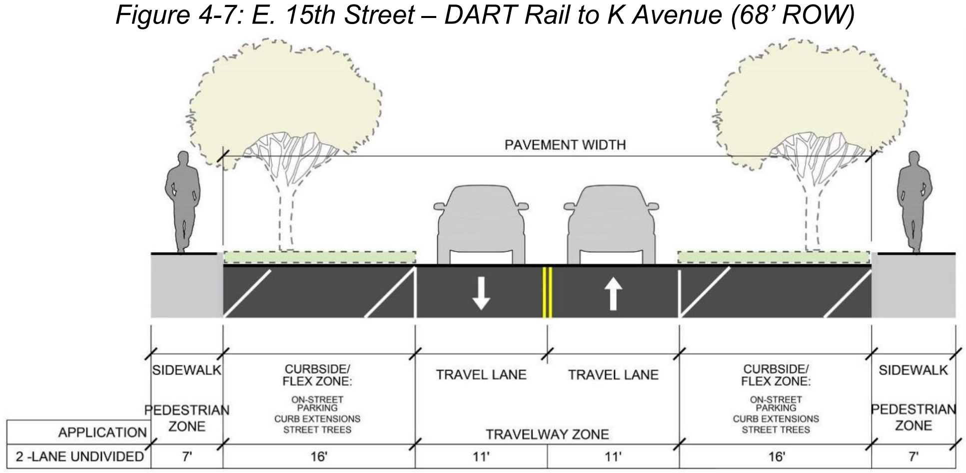
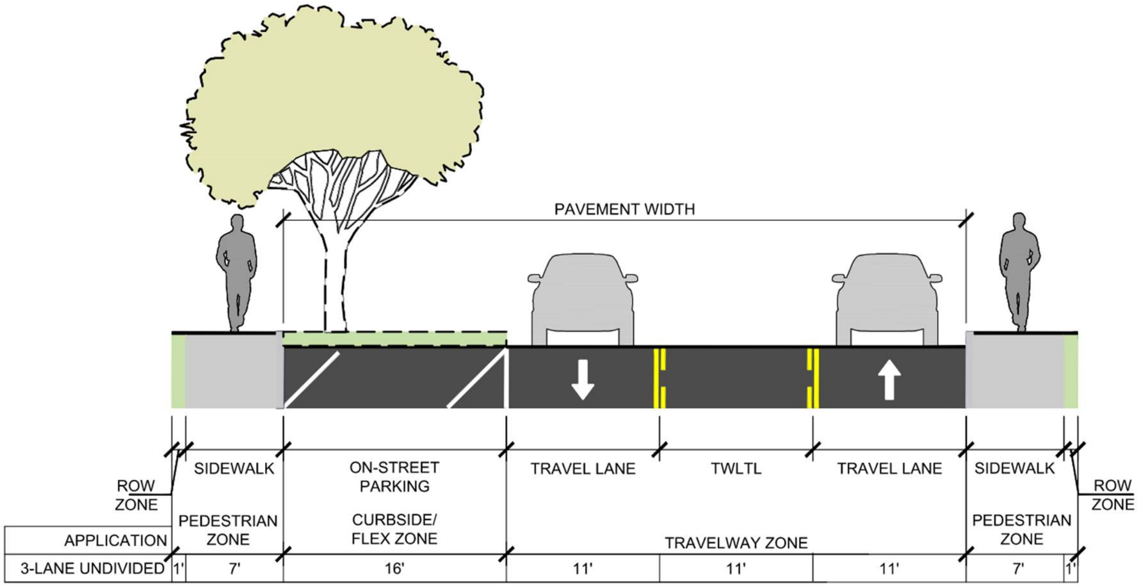


Figure 4-8: E. 15th Street – K Avenue to Municipal (65' ROW)



4.5.2 14th Street – 13th/14th Connector to P Avenue

Figure 4-9: 13th/14th Connector and 14th Street – Portion West of G Avenue (80' ROW)

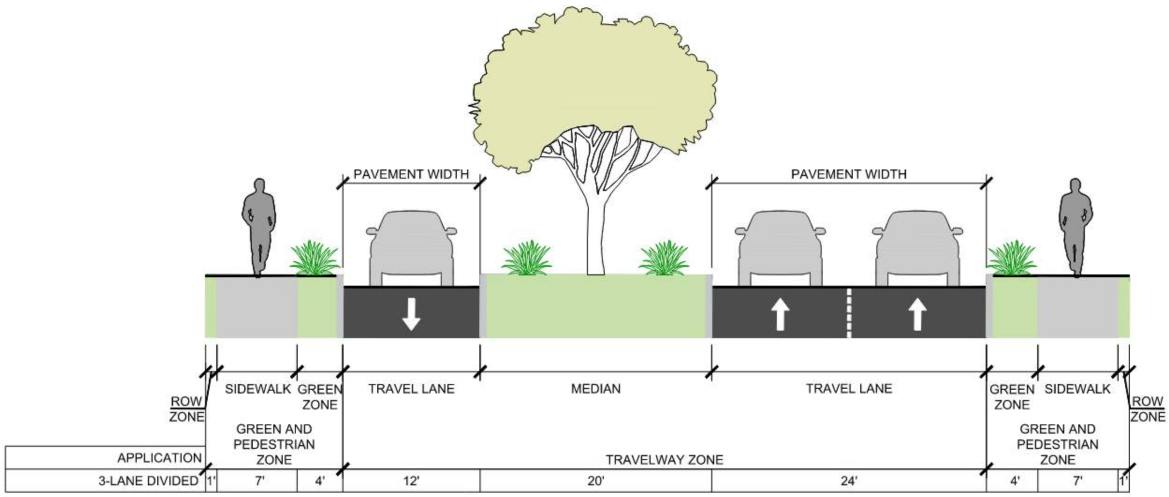


Figure 4-10: 14th Street – G Avenue to DART Rail (70' ROW)

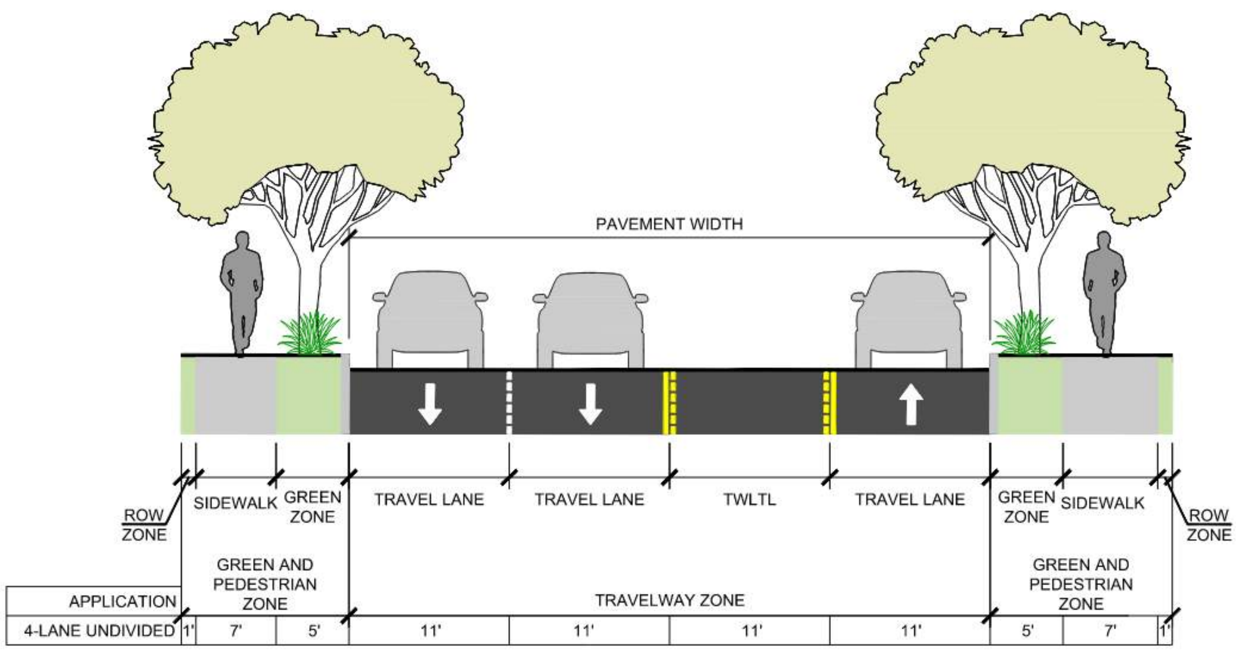


Figure 4-11: 14th Street – DART Rail to Municipal Avenue (65’ ROW)

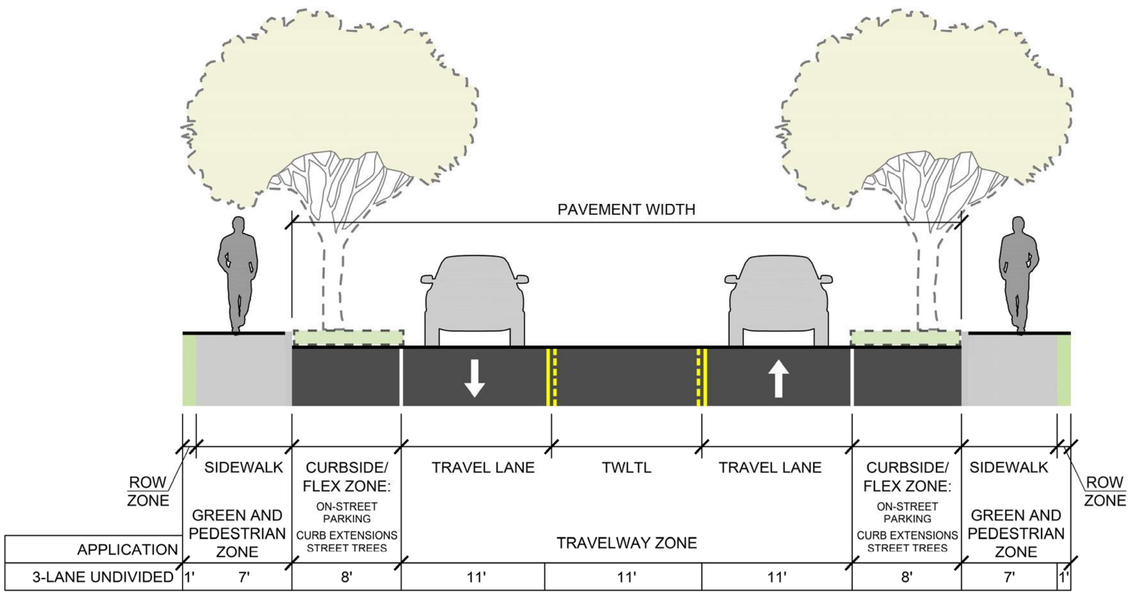


Figure 4-12: 14th Street – Municipal Avenue to P Avenue (75’ ROW) Option A

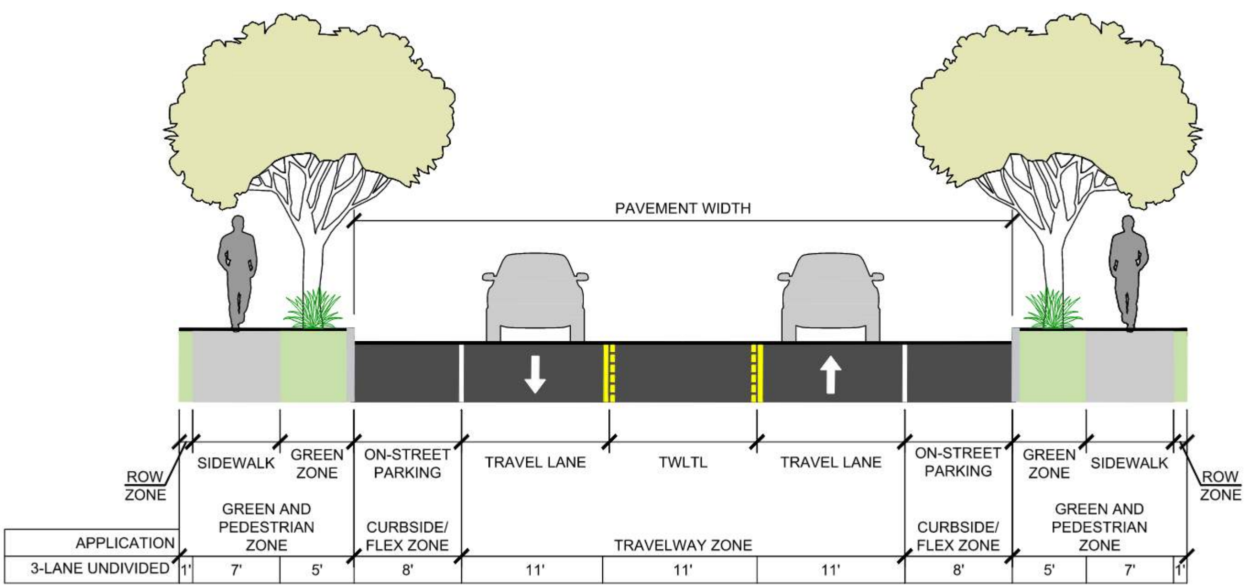


Figure 4-13: 14th Street – Municipal Avenue to P Avenue (75' ROW) Option B

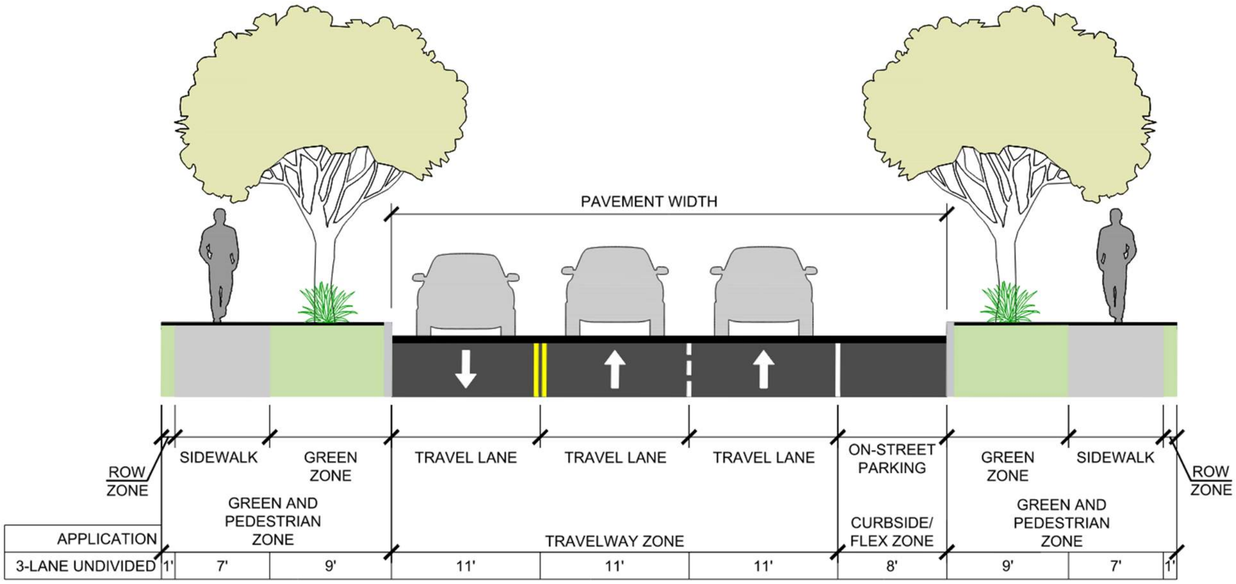
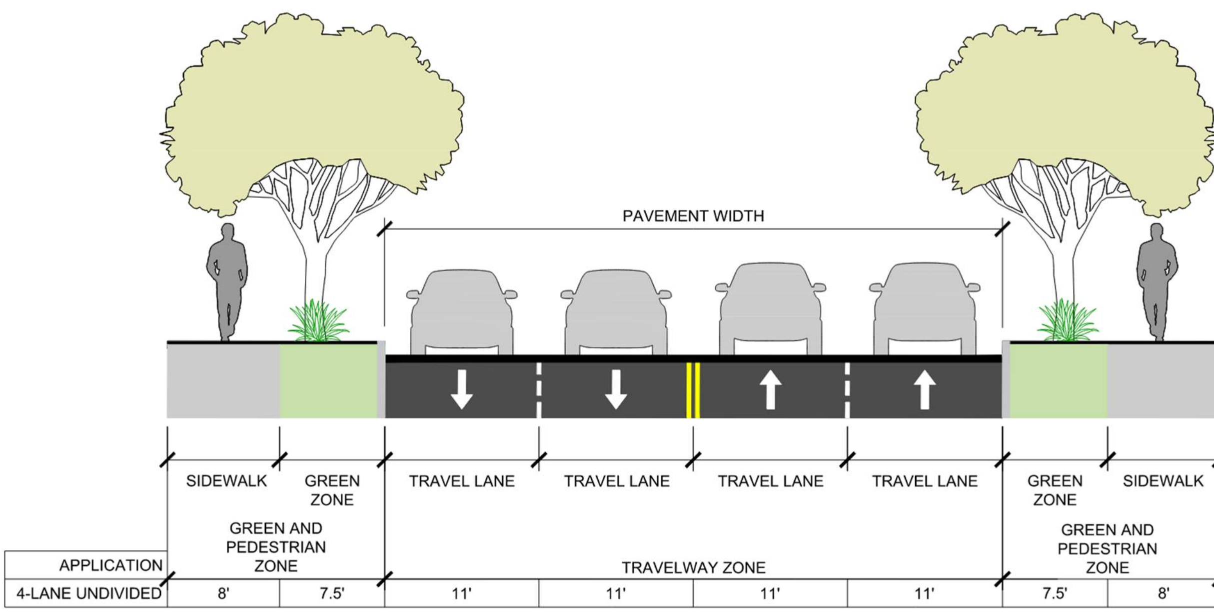


Figure 4-14: 14th Street – Municipal Avenue to P Avenue (75' ROW) Option C



Note: Determination of the appropriate cross-section option for 14th Street – Municipal Avenue to P Avenue will be based on engineering evaluation of traffic conditions.

4.5.3 18th Street - US 75 to L Avenue:

Figure 4-15: 18th Street – US 75 to G Avenue (80' ROW)

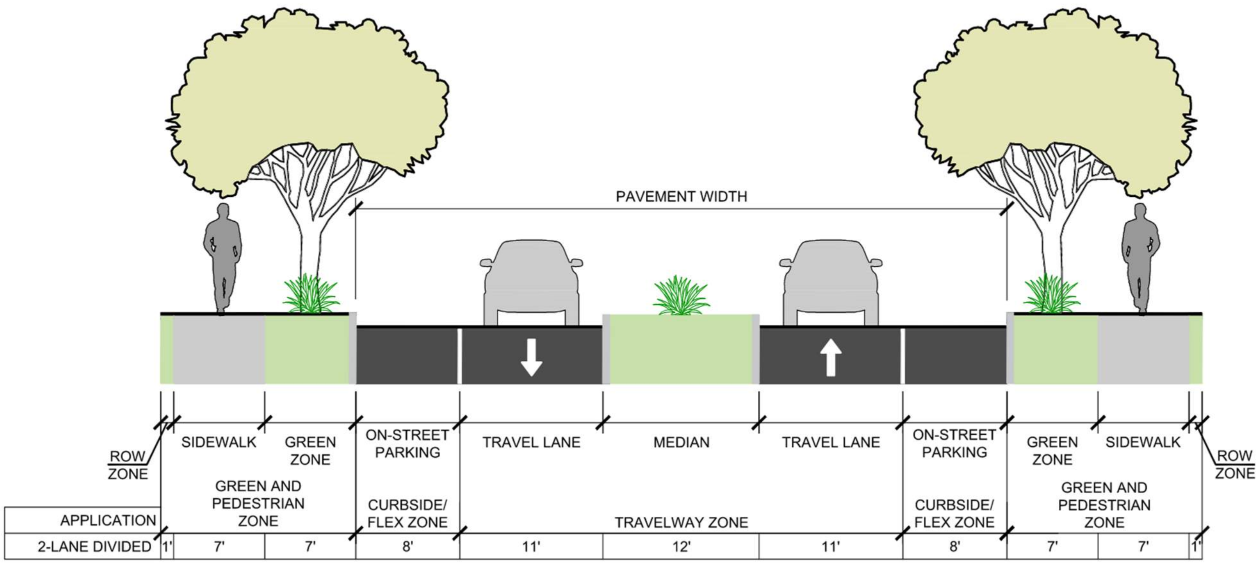
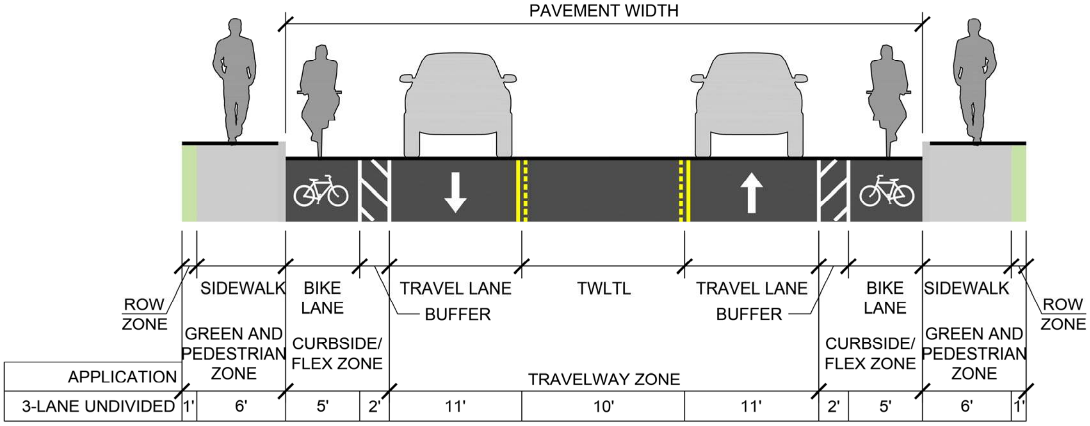
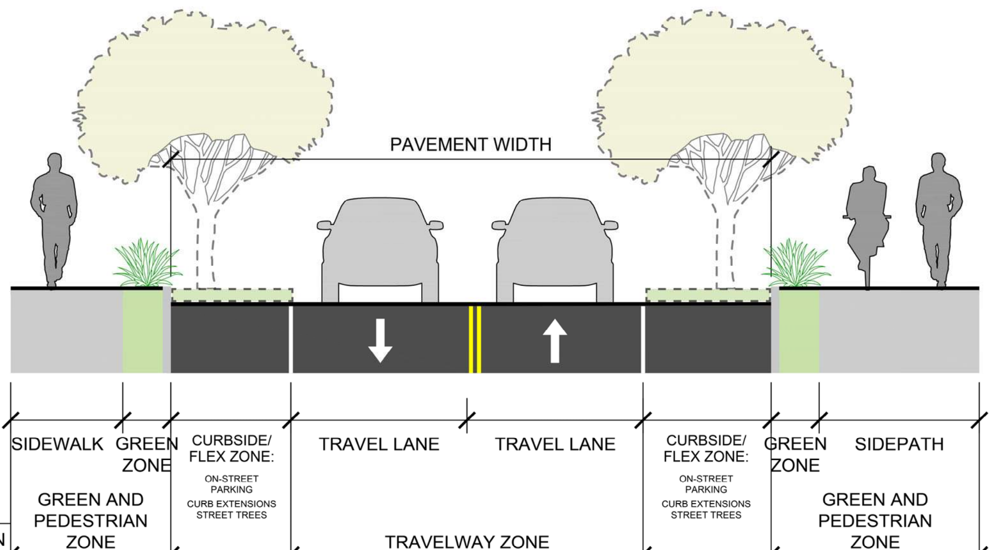


Figure 4-16: 18th Street – G Avenue to L Avenue (60' ROW)



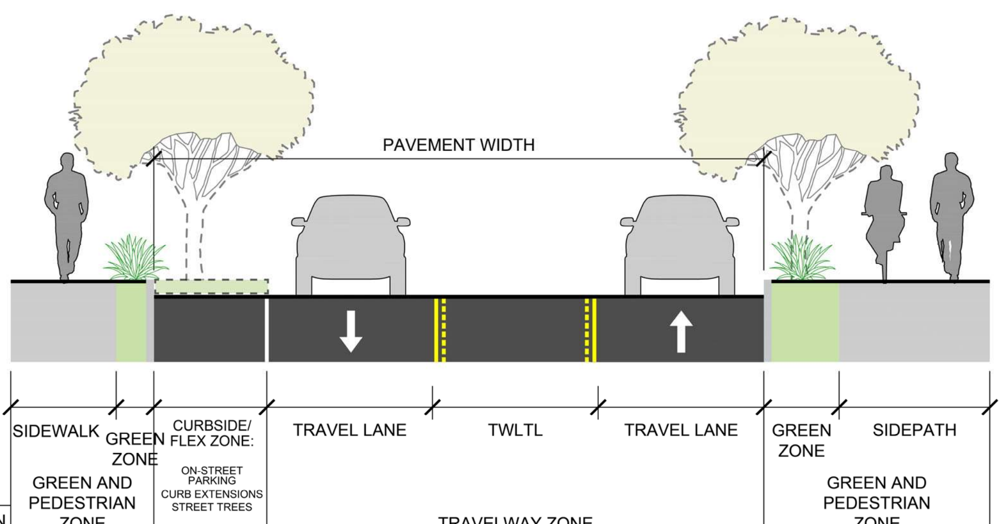
4.5.4 G Avenue – 14th Street to 18th Street:

Figure 4-17: G Avenue – E. 15th Street to 18th Street (61' ROW)



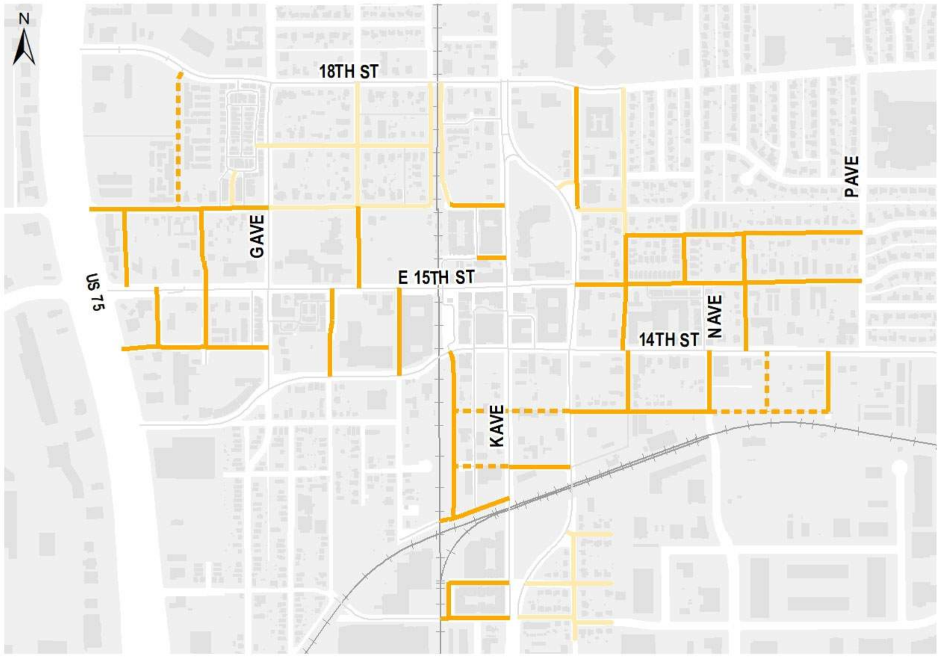
APPLICATION									
2-LANE UNDIVIDED	7'	3'	8'	11'	11'	8'	3'	10'

Figure 4-18: G Avenue – 14th Street to E. 15th Street (65' ROW)



APPLICATION								
3-LANE UNDIVIDED	7'	2'	8'	11'	11'	11'	5'	10'

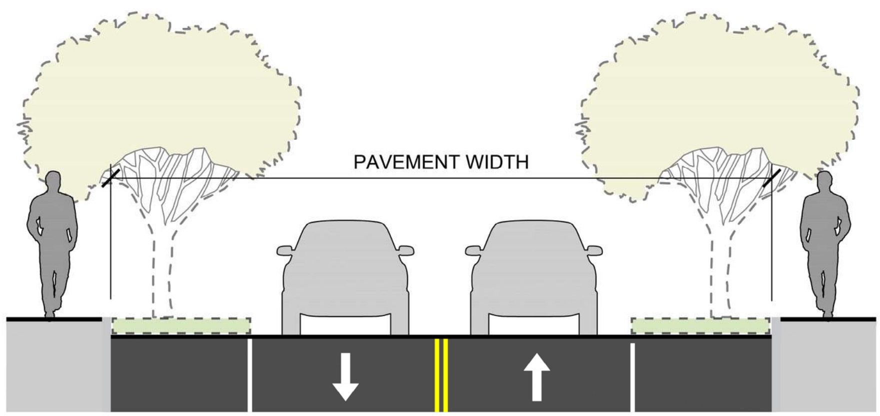
4.6 Local Streets



4.6.1 Mixed-Use Local Streets

Where street trees are not feasible within the Green Zone width, the Curbside/Flex Zone should be utilized for landscaped curb extensions.

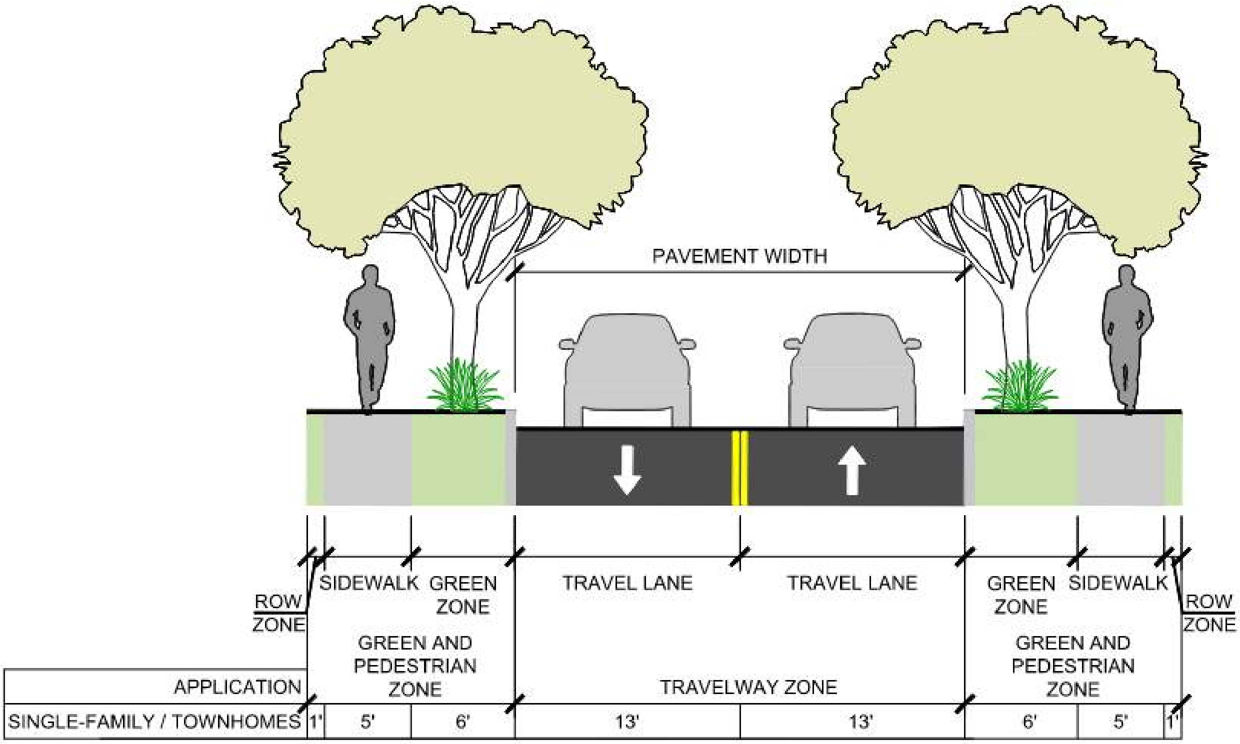
Figure 4-19: Mixed-Use Local Street (50' ROW)



	SIDEWALK	CURBSIDE/ FLEX ZONE: ON-STREET PARKING CURB EXTENSIONS STREET TREES	TRAVEL LANE	TRAVEL LANE	CURBSIDE/ FLEX ZONE: ON-STREET PARKING CURB EXTENSIONS STREET TREES	SIDEWALK
APPLICATION	PEDESTRIAN ZONE		TRAVELWAY ZONE			PEDESTRIAN ZONE
2-LANE UNDIVIDED	6'	8'	11'	11'	8'	6'

4.6.2 Residential Local Streets

Figure 4-20: Residential Local Street (50' ROW)



4.6.3 Alley/Mews/Shared Streets

Refer to **Section 3 (Special Streets and Accessways)** for typical section design for Alleys, Mews and Shared Streets.

4.7 Downtown Street Design Standards and Considerations

4.7.1 Sidewalks

a. Pedestrian Clear Zones – A pedestrian clear zone is the area of the sidewalk that is specifically reserved for pedestrian travel. This zone should be clear of any obstructions including utilities, traffic control devices, trees, planters, and street furniture.

b. Encroachments – Streetscape and architectural building features shall not encroach into the pedestrian clear zone and must be located within an adjacent shy zone, setback, or green/furnishing zone. These features may include sidewalk cafes, building entrances, retail displays, landscaping, or other features that activate and enhance the pedestrian environment. Please note that before placing anything in the City's right-of-way (including the sidewalk) permission must be obtained from the City.

c. Crosswalk Markings – At a minimum, typical marked crosswalk treatments should be provided at all intersections. Special intersection paving treatments may be used to highlight crossings at key locations, such as entries into special districts, key civic locations, and at mid-block crossings. Special intersection paving treatments include integrated colors, textures, and scoring patterns.

They may be instituted within crosswalk markings or across an entire intersection. Standard transverse or longitudinal high-visibility crosswalk markings are still required.

4.7.2 On-Street Parking

On-street parking should be included on Downtown mixed-use streets and residential streets where possible. Refer to **Section 5 (Street Design)** for on-street parking design standards.

a. Parallel Parking Preferred – Parallel parking spaces are preferred on most streets, in accordance with the Downtown Street Cross Sections.

b. Parallel and Diagonal Parking – The City may permit perpendicular or angle/diagonal parking in lieu of parallel parking. Where provided, the additional right-of-way shall be required so as to cover the additional width of the parking stalls and maintain the minimum Green Zone, Pedestrian Zone, and ROW zones as prescribed in the applicable cross-section. Right-of-way dedication shall extend to the outside edge of the ROW zone. The Director of Engineering may accept the dedication of an appropriate easement in lieu of right-of-way dedication where the street easement does not inhibit the provision of utilities, landscaped edges, or other design features required for the development.

c. Parking at Intersections – Where warranted, on-street parking space may be utilized for intersection turn lanes. At least 100 feet of storage for vehicles should be provided, and the Director of Engineering may prohibit parking near intersections to accommodate turn movements.

4.7.3 Green/Furnishing Zone

Street Trees

a. Street trees are required at a rate of one tree per 40 linear feet for all streets except mews and shared streets. Trees shall be placed in planting beds or tree grates within 5 feet of the back of the street curb.

b. All shrub pits shall be a minimum of 6 inches larger in diameter and 3 inches deeper than the shrub ball or root spread. All tree pits shall be a minimum of 12 inches larger in diameter and 2-3 inches less deep than the rootball. If water does not drain within 24 hours, drainage or a more suitable species or location shall be provided.

c. The design shall consider the width of the walkway and ensure that a minimum walking zone width of 5 feet (excludes off-street trail minimums) is maintained at tree pit locations. The minimum tree pit area is 4x4 feet.

d. Tree pits shall be placed at least 2 feet from the face of the curb for roadways with on-street parking to allow for a step-out area.

e. The design shall consider the width of the walkway and ensure that a minimum walking zone width of five feet is maintained at tree pit locations. In addition, the design shall account for periodic access from the street. The minimum planter width is 4 feet and the maximum planter length is 40 feet, with a minimum of 4 feet clear space between two adjacent planter systems.

Street Furniture (Benches, Bollards, Bike Racks, etc.)

a. The desired placement of street furniture shall be a minimum of 18 inches from the back of the curb, 2 feet from any driveway or wheelchair ramp, 4 feet at the landings of any ramp, and 5 feet from major utilities such as a fire hydrant.

b. Street furniture may be placed within curb extensions where the green/furnishing zone is extended into the parking lane.

Lighting

a. Lighting should be spaced to provide uniform illumination throughout the design. Refer to **Section 11 (Street Lighting)** for more lighting design information.

b. Minimum clearance from the back of the curb is 2 feet. Refer to the *TxDOT Roadway Design Manual Section 7.3.9* for more design information.

c. Lighting for the Downtown Streets is operated and maintained by Oncor Electric. All lighting appurtenances used downtown must be in adherence with Oncor standards.

d. Any requested deviation from standard lighting spacing shall require a photometric study to be performed and submitted to the city.

Curb Extensions

a. Curb extensions are recommended on block corners and mid-blocks of streets where on-street parking exists. The minimum width of curb extensions is 6 feet or the width of the on-street parking space.

b. At intersections or midblock crossings, the minimum length of a curb extension should be the width of the crosswalk.

c. On streets with limited space in the Green/Furnishing Zone, street trees, landscaped planters, or other street furnishings may be placed within curb extensions between parking spaces at regular intervals or at specific locations.

d. On streets with on-street parking, a midblock curb extension should be used every 100 feet spacing (up to 5 spaces for parallel, up to 8 spaces for angled).

Hardscape Guidelines

a. Sidewalks should use standard concrete paving at a minimum.

b. Special paving may be included as a component of portions of the street outside of the sidewalk clear zone, including curb extensions, green/furnishing zone, driveways, gateways, and other specific locations to define the edges or visually enhance the streetscape.

c. Special paving treatments can be selected from a range of options including unit concrete pavers, bricks, textured and colored concrete, natural stone pavers, and concrete with exposed or special aggregate or other finish treatments. The maintenance cost of special pavers should be considered during the selection process.

d. When special paving materials are used, they should extend at least a complete block for design consistency and maintenance efficiency.

e. All special paving materials, beyond standard concrete, must be approved by the Director of Engineering.

Utilities

a. Typical utility placement should be located within the Green Zone.

b. Street lighting should be placed at a minimum of 2 feet off the back of the curb.

c. Electrical, telephone, cable, and gas are placed at a minimum of 4 feet off the back of the curb.

d. Water and wastewater placed within Green Zone without impacting the Travelway Zone or Pedestrian Zone.

e. Utilities should be placed to minimize disruption to pedestrian through travel, potential planting and street furnishing locations. Utility locations may include:

- Edge of right-of-way
- Green zone (planter strip)
- Alley (behind private property)
- Underground in right-of-way

Driveway Separation/Consolidation

a. Driveways should be designed to minimize impact on through travel or pedestrian use of the sidewalk.

b. Curb cuts are discouraged in pedestrian-intensive areas. Reducing driveways reduces the number of conflict points between pedestrians and vehicles and can dramatically improve safety. Wherever possible, properties should consolidate driveways by interconnecting parking lots, loading area entries and by sharing parking among users.

4.8 Other Design Considerations

For other design requirements not specifically listed in this section, the street design shall comply with other sections in accordance with the following table:

Table 4-1: Street Types and Locations in Downtown

Street Type	Location
Type C Streets	E. 15th Street (US 75 to G Avenue) K Avenue (18th Street to 10th Street) Municipal Avenue (18th Street to 10th Street)
Type E Streets	G Avenue (14th Street to 18th Street) 14th Street (G Avenue to P Avenue) 18th Street (US 75 to Municipal Avenue)
Type F Streets	14th Street (US 75 to G Avenue) E. 15th Street (G Avenue to L Avenue) 16th Street (US 75 to G Avenue) 18th Street (Municipal Avenue to L Avenue)
Type G Streets	Local Streets
Special Streets	Special Streets
Land Use Context	Mixed-Use Context

5.1 Design Parameters

5.1.1 Design Speed and Target Speed

Table 5-1 summarizes the design and target speeds based on street type. Both the target speed range and the default target speed shown below are based on the City's *Thoroughfare Plan Map* and **Section 2 (Street Framework).**

Table 5-1: Design and Target Speeds (mph)

Street Types	Land Use Context	Design Speed (mph)	Target Speed (mph)
B,C	Commercial	45	40-45
	Mixed-Use		35-45
	Corner		
	Neighborhood		
D,E	Commercial	40	35-40
	Mixed-Use		30-40
	Corner		
	Neighborhood		
F	Commercial	35	30-35
	Mixed-Use		25-35
	Corner		
	Neighborhood		
G	Commercial	30	25-30
	Mixed-Use		20-30
	Corner		
	Neighborhood		
Special Streets	Commercial	30	<20
	Mixed-Use		
	Corner		
	Neighborhood		

The design speed is a primary factor in the horizontal and vertical alignment of streets. Design features such as curvature, super-elevation, turning movement radii, and sight distance affects street lane width, pavement width, pavement cross-slope, pavement crown, and clearances. Refer to **Table 5-4** for minimum horizontal centerline radius based on design speed. Refer to **Section 5.3** for more information on roadway geometrics.

5.1.2 Design Volume

Traffic volumes are important for the design of a street facility. Facilities should have enough capacity to accommodate anticipated traffic volumes. These design volumes are usually projected into the future for a designated design year. Refer to **Section 12 (Traffic Studies)**.

The *Thoroughfare Plan Map* categorizes street types design volume to assign ROW, number of lanes, median types, and bicycle facilities. Additional information on medians can be found in **Section 7 (Median, Left Turns and Right Turns)** and refer to **Section 8 (Multimodal Facilities Design Requirements)** for more information on bicycle treatments.

5.1.3 Design Vehicle

Choosing the appropriate design vehicle is critical for a safe design. The design vehicle shall be consistent with street functional classification and land use. Designing for a vehicle larger than necessary may increase cost for the project. This may sometimes cause unsafe conditions for bicyclists and pedestrians while accommodating occasional larger vehicles due to increased crossing distances. The turning movements of vehicles larger than the design vehicle should be evaluated if there is a likelihood that a larger vehicle may need infrequent access. In those instances, encroachment onto opposing traffic lanes or sides of streets, as well as multiple-point turns are permissible if sight distance and cross-sectional features are appropriate for safety.

- The design vehicle shall be able to make required turning movements to and from the street and at intersections without encroaching into opposing traffic lanes.

- Emergency vehicle turning movements must be verified during the design process for street design. Emergency vehicles shall not be required to encroach into opposing traffic lanes on thoroughfares and at thoroughfare intersections. Emergency Vehicle Encroachment into opposing traffic lanes in residential areas is permitted.

- *Design Vehicle Criteria* – **Table 5-2** includes requirements on the appropriate design vehicle based on street type.

Table 5-2: Required Design Vehicle Based on Land Use

Land Use Context	Required Design Vehicle
Commercial	WB-62
Mixed-Use	WB-50
Corner	Bus-40*/Emergency Vehicle**
Neighborhood	Bus-40*/Emergency Vehicle**

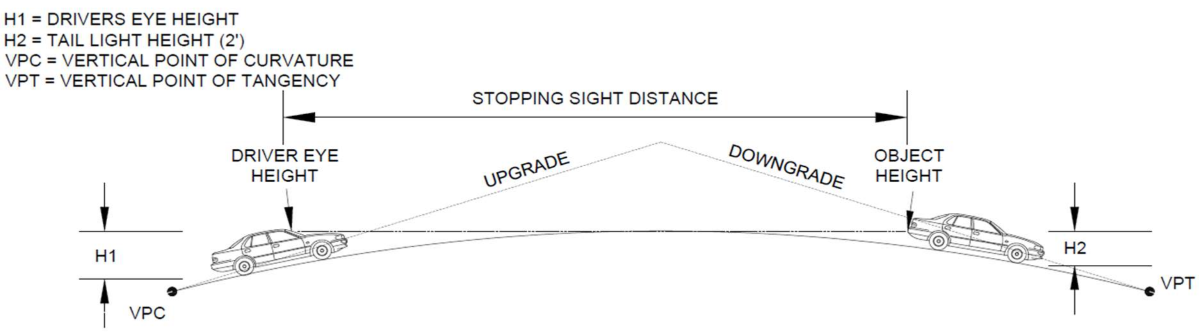
*If transit is expected to travel on the street, a city transit bus should also be accommodated for in the design.
**The design of emergency vehicles shall be obtained from Plano Fire-Rescue.

5.1.4 Stopping Sight Distance

Stopping sight distance is the minimum distance needed for a driver to be able to react and stop to an object or person on the roadway to avoid collision. It is the sum of two distances: (1) brake reaction distance and (2) braking distance. Brake reaction distance is the distance a vehicle travels from the time the driver sights an object to the time the brakes are applied, whereas braking distance is the distance required for the vehicle to stop after the brakes are applied. Stopping sight distance should be adequate at every point along a street for drivers to come to a safe stop before reaching an object.

Based on the latest edition of the *AASHTO's A Policy on Geometric Design of Highways and Streets* for stopping sight distances, the height of the driver's eye is 3.5 feet, and the object height is 2.0 feet, which is equivalent to the taillight height of a passenger car. **Figure 5-1** shows an overview of stopping sight distance.

Figure 5-1: Stopping Sight Distance



STOPPING SIGHT DISTANCE (SSD) IN FEET IS DETERMINED FROM THE FORMULA:

$$SSD = \frac{(1.47PV + V^2)}{30\ (F + G)}$$

WHERE:
V = TARGET SPEED, MPH
P = PERCEPTION REACTION TIME, 2.5s
F = FRICTION COEFFICIENT
G = GRADE, RISE/RUN, FT./FT.

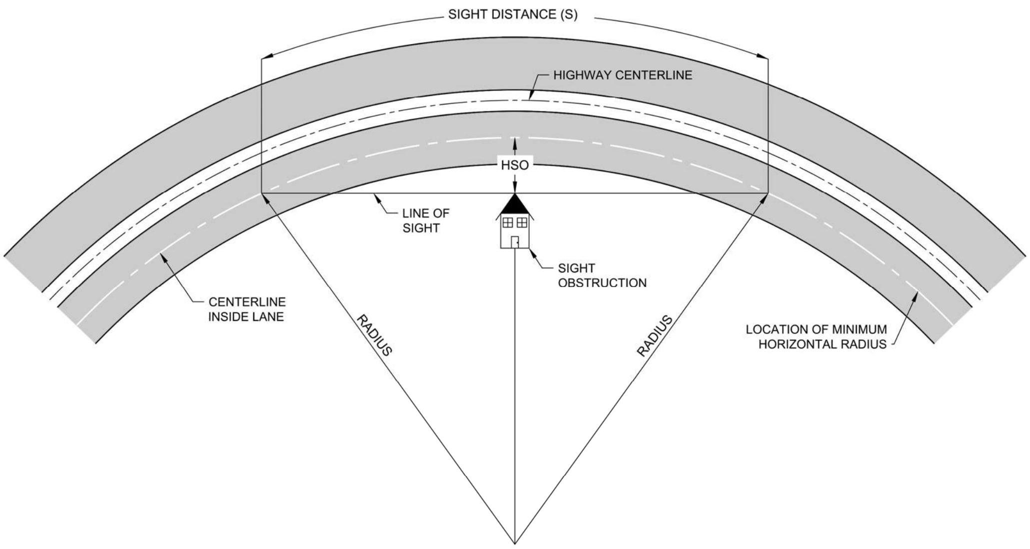
5.1.5 Horizontal Sight Distance

Horizontal Sight Distance is the distance across the inside of a horizontal curve that a driver can see before an obstruction (such as walls, cut slopes, buildings, and longitudinal barriers). For undivided highways, this is measured from the highway centerline whereas on divided highways, horizontal sight distance is measured from the centerline of the inside lane.

Based on the latest edition of the *AASHTO's A Policy on Geometric Design of Highways and Streets*, the Horizontal Sight Line Offset (HSO) is determined by setting the value S equal to the stopping sign distance (SSD). **Figure 5-2** shows an overview of horizontal sight distance.

For Intersection Sight Distance and right-of-way corner clips, refer to **Section 10 (Public Right-of-Way Visibility)**.

Figure 5-2: Horizontal Sight Distance



HORINZONTAL SIGHT DISTANCE, OR HORIZONTAL SIGHT LINE OFFSET (HSO), IN FEET IS DETERMINED FROM THE FORMULA:

$$HSO = R[1-\cos(\frac{28.65S}{R})]^*$$

WHERE:
HSO = HORIZONTAL SIGHT LINE OFFSET, FT.
S = SIGHT DISTANCE, FT.
R = RADIUS OF CURVE, FT.
*THIS EQUATION ONLY APPLIES TO CIRCULAR CURVES LONGER THAN THE SIGHT DISTANCE OF THE PERTINENT DESIGN SPEED.
REFER TO SECTION 9 FOR PUBLIC RIGHT-OF-WAY VISIBILITY REQUIREMENTS.

5.2 Roadway Geometrics

Geometrics of city streets shall be defined as the geometry of the pavement and curb areas that govern the movement of traffic within the confines of the right-of-way (ROW). Included in the geometrics are pavement width, horizontal curvature, width of traffic lanes, median nose radii, curb radii at street intersections, pavement cross-slope, crown height, pavement thickness, and geometric shapes of islands separating traffic movements and other features.

5.2.1 Grades

Street grades should preferably be a maximum of 6% and a minimum of 0.5% in order to ensure positive drainage. Steeper grades are allowed on certain local streets, up to a maximum of 10% as approved by the Director of Engineering. Grades steeper than 6% may be permitted on Type B, or C where necessitated by topographical and/or natural features, and as approved by the Director of Engineering.

Except at intersections, the use of grade breaks, in lieu of vertical curves, is not encouraged. However, if a grade break is necessary and the algebraic difference in grade does not exceed 1%, the grade break will be considered by the Engineer.

5.2.2 Street Centerline

a. Streets shall be placed in the center of the ROW. The centerline of curves shall be tangent to the centerline of a street at each end of curve.

b. If offset abuts an intersecting roadway, street centerlines for Type C, D, E, and F streets shall be offset a minimum of 125 feet. If a roundabout is located on one or both sides of the offset, the offset shall be measured from the closest edge of the circulatory street rather than the centerline of the roundabout.

c. If offset, turn lanes and median openings along the intersecting roadway shall be in accordance with the requirements of **Section 7.3**.

5.2.3 Cross-Slope/Side-Slope/Crown Height

See *City of Plano Standard Construction Details* for cross-sectional design requirements.

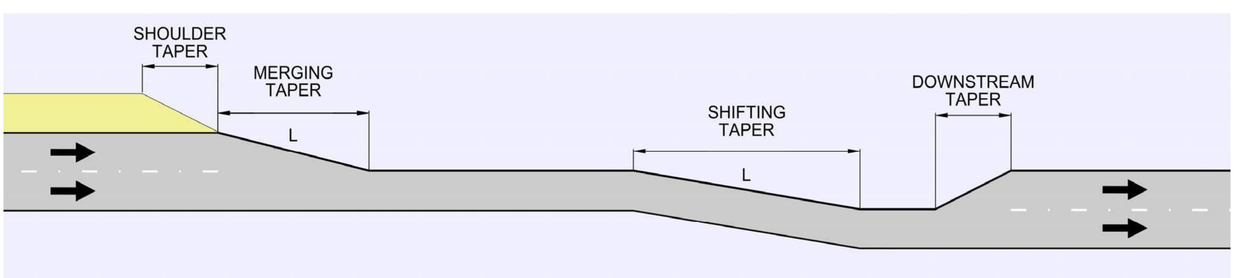
5.2.4 Pavement Transitions

Pavement transitions, or tapers, are generally provided for widening and narrowing street cross-sections to help guide users between changes in their normal driving path along a street. They are often used to transition from divided to undivided sections of streets which are referred to as street cross-overs. Tapers are used in the narrowing or shifting of streets. Drivers follow these tapers with the use of channelizing devices and/or pavement markings.

a. **Types of Tapers:** The main types of tapers are defined below, shown in **Figure 5-3**.

- Merging Transition Taper – The distance required for drivers to merge into an adjacent lane of traffic at the prevailing speed.
- Shifting Transition Taper – A transition taper is used when a lateral shift is needed.
- Shoulder Taper – Is used to direct traffic off the shoulder.
- Downstream Taper – A taper used to transition from a narrow street segment to a wider street segment.

Figure 5-3: Pavement Transition Tapers



b. **Design Criteria** – Pavement transition design for permanent conditions shall be done in accordance with procedures outlined in the latest edition of the *AASHTO's A Policy on Geometric Design of Highways and Streets*. For a temporary condition, pavement transition shall be done in accordance with the *Texas Manual on Uniform Traffic Control Devices (TMUTCD)* or the latest guidelines. The appropriate posted speed should be used to design the transition. The following equations are used to calculate the transition length. Refer to **Table 5-3** for taper length criteria.

When posted speed ≤ 40 mph:

$$L = \frac{WS^2}{60} \quad \text{(when posted speed ≤ 40 mph)}$$

$$L = WS \quad \text{(when posted speed > 40 mph)}$$

Where:
L = taper length in feet
W = width of offset in feet
S = posted speed in mph

Table 5-3: Taper Length Criteria

Type of Transition	Length of Transition
Merging Taper	at least L
Shifting Taper	at least L
Shoulder Taper	at least 0.33 L
Downstream Taper	50 feet minimum (turn lanes)
Turn Lane Taper	Refer to City of Plano Standard Construction Details for reverse curve tapers

Longer tapers, especially in mixed-use areas with short block lengths or driveways, can encourage drivers to delay lane changes, so they are not necessarily safer than shorter tapers. Multiple merging tapers should have a tangent length of at least 2 taper lengths between them. Adjoining merging and shifting tapers should have a tangent length of at least 0.5 taper lengths between them. If a shoulder is used as a travel lane, a normal merging or shifting taper should be used.

5.2.5 Dead-End Streets/Cul-de-Sacs/Stub Streets

a. **Cul-de-sacs (Turnarounds):**

i. All dead-end streets shall have a cul-de-sac (turnaround) unless otherwise allowed below. Cul-de-sacs (turnarounds) at the end of dead-end streets shall have a circular driving surface that has a minimum radius of 38 feet and a street right-of-way that has a minimum radius of 50 feet.

ii. All cul-de-sacs (turnarounds) shall be constructed at the end of a street with one of the standard pavement widths defined in **Section 2 (Street Framework)**. No cul-de-sac (turnaround) shall be constructed on the side of a street or in a way that creates a wider than normal intersection with a street.

iii. The maximum length of a dead-end street with a cul-de-sac (turnaround) shall be 600 feet, measured from the center of the intersecting street to the center point of the turnaround. If a dead-end street has another dead-end street branching off of it, the total combined length of the main dead-end street and its branch(es) cannot exceed the maximum length described above and the total number of lots fronting onto the combined dead-end streets cannot exceed 20.

b. **Temporary Dead End Streets (Stub Streets)** – A temporary dead-end street, or stub street, is an undivided dead-end street that will be extended in the future that does not have a turnaround, which is only allowed under the following conditions:

i. No residential lots shall front onto a stub street.

ii. Non-residential lots adjacent to a stub street shall have access to another street.

iii. If the length of a residential stub street exceeds the depth of the adjacent residential lots, it shall be temporarily blocked at the rear edge of the lots (or alley) with an approved barricade.

iv. If a non-residential stub street extends more than 100 feet beyond the last driveway on the street, it shall be temporarily blocked at the last driveway with an approved barricade.

v. If any residential lot fronts onto the dead-end portion of a street that will be extended in the future, that lot shall not be developed until the street is properly extended or a temporary turnaround that meets the standards described above is constructed at the end of the dead-end street within a temporary street easement. If no temporary turnaround is provided, the following note shall be placed on the plat: “Block X Lot Y shall not be developed until (name of street) is extended (give direction) with future development of abutting property. A revised plat shall be required to remove the condition of this note.” If a temporary turnaround is provided on Lot Z to allow Lot Y to develop, the following note shall be placed on the plat: “Temporary street easement on Block X Lot Z is for a temporary turnaround which shall remain in place until (name of street) is extended (give direction) with future development of abutting property. Block X Lot Z shall not be developed until the street is extended and the temporary street easement is removed by a revised plat.”

5.3 Minimum Horizontal Radius

The minimum centerline radius is defined by the design speed of the respective street. The minimum design speed of each street category in the City of Plano, as defined by the *Thoroughfare Plan Map*, is listed in **Table 5-4.**

The resulting minimum acceptable horizontal centerline radius for each respective street is determined by considering the speed (V), superelevation (e), and friction (f) as shown in **Table 5-4**, and as calculated by the following formula:

$$R = \frac{V^2}{15(e+f)}$$

The maximum allowable deflection angle without a horizontal curve along a roadway segment is 1°. The maximum allowable deflection angle without a horizontal curve at an intersection is 3°. Refer to **Section 6 (Intersection Design)** for pavements markings of an intersection with deflection.

The maximum length of a horizontal curve on Type E, F, or G roadways shall not exceed 1.6 times the centerline radius (i.e., shall not encompass an angle greater than 90° for a radii of 250 feet). Also, the minimum arc length of a centerline radius design shall be 100 feet. The minimum centerline radius for residential streets shall be 250 feet. However, for corners of 90° to 100° on residential streets, the centerline radius may be 33 feet.

Table 5-4: Minimum Horizontal Centerline Radius

V (mph)	f	e (feet/feet)	(e+f)	R (Calculated) (feet)	R (Rounded) (feet)
20	0.16	-0.02	0.14	222.22	250
25	0.16	-0.02	0.14	347.22	350
30	0.16	-0.02	0.14	428.57	450
35	0.16	-0.02	0.14	583.33	600
40	0.15	-0.02	0.13	820.51	850
45	0.15	-0.02	0.13	1,038.46	1,050

5.4 Minimum Vertical Curvature

Roadway profiles should be designed using vertical curves at vertical points of intersection and intersecting streets where practical. Designing a sag or crest vertical point of an intersection without a vertical curve is generally acceptable where the grade difference is 1% or less.

Vertical Alignment is a function of stopping sight distance (SSD) which is given by the equation:

$$SSD = \frac{(1.47PV + V^2)}{30\ (f + g)}$$

Stopping sight distances herein are calculated for g=0 and a perception/reaction time of 2.5 seconds (P). The minimum vertical curve length considers the algebraic difference in grades (A) of the two street segments to be joined by a curve, the rate of curvature (K), the speed, and other factors to derive the crest curve length listed in **Table 5-5**, or sag curve lengths as shown in **Table 5-6**. The minimum length of a crest or sag curve is 100 feet.

Table 5-5: Minimum Acceptable Crest Curve Given Speed and Difference in Grade of Road

V (mph)	SSD (feet)	K	A=1	A=2	A=3	A=4	A=5	A=6	A=7	A=8	A=9	A=10
30	200	19	100	100	100	100	100	114	133	152	171	190
35	250	29	100	100	100	116	145	174	203	232	261	290
40	325	44	100	100	132	176	220	264	308	352	396	440
45	400	61	100	122	183	244	305	366	427	488	549	610
50	475	84	100	168	252	336	420	504	588	672	756	840

***100 feet minimum**

Table 5-6: Minimum Acceptable Sag Curve Given Speed and Difference in Grade of Road

V (MPH)	SSD (feet)	K	L=KA*									
			A=1	A=2	A=3	A=4	A=5	A=6	A=7	A=8	A=9	A=10
30	200	37	100	100	111	148	185	222	259	296	333	370
35	250	49	100	100	147	196	245	294	343	392	441	490
40	325	64	100	128	192	256	320	384	448	512	576	640
45	400	79	100	158	237	316	395	474	553	632	711	790
50	475	96	100	192	288	384	480	576	672	768	864	960

***100 feet minimum**

5.5 Street/Block Lengths

All street length restrictions shall be measured from the right-of-way line of the intersecting street on each end of the street being measured.

Table 5-7: Street/Block Lengths

Functional Class	Neighborhood	Commercial	Corner	Mixed-use
Type A	None	None	Shall Follow Neighborhood or Mixed-Use	None
Type B	None	None		None
Type C	None	None		None
Type D	1,200 feet	1,200 feet		600 feet
Type E	1,200 feet	1,200 feet		600 feet
Type F	1,200 feet	1,200 feet		600 feet
Type G	1,200 feet	1,200 feet		600 feet
Alleys, Mews, Paseos, and Shared Streets	1,200 feet	1,200 feet		600 feet
Downtown Local or Mixed-Use	600 feet	600 feet	600 feet	600 feet
Cul-de-sac* (Turnaround)	600 feet	600 feet	600 feet	600 feet

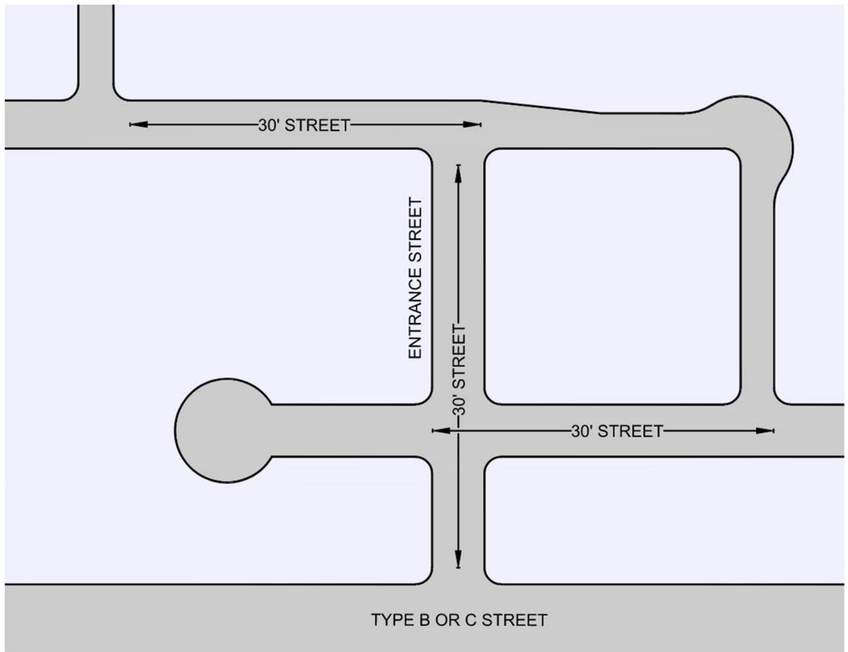
**Cul-de-sacs are measured from the intersecting street centerline to the center of cul-de-sac*

A Type G that intersects with a Type B Street and has residential lots fronting onto any portion of the street shall not exceed a maximum length of 600 feet measured from the Type B right-of-way line. Such an entrance street shall also meet the requirements of **Section 5.6** below.

5.6 Entrance Streets

An entrance street shall be a minimum of 30 feet wide, face to face, or be divided according to and then transition to a 30 feet wide street. On each side of the entrance street, at least one cross street shall have a minimum width of 30 feet, face to face, between the entrance street and the first intersection that provides access deeper into the subdivision. The entrance street shall remain 30 feet wide at least until it has reached a 30 feet wide side street on both sides. See **Figure 5-4** for an example.

Figure 5-4: Example of 30' Entrance Street Requirements



An entrance street that is a potential location for a traffic signal shall be a minimum of 36 feet wide, face to face, or be divided according to **Section 7.7**, for a minimum distance of 125 feet in advance of the curb return. It also shall align with the street on the other side of the Type B street so that the through lanes align across the intersection. In addition, if the entrance street serves a residential collector, the pavement on the outbound side of the street shall be 36 feet wide (or the right-of-way shall be dedicated in a way so that a right-turn lane can be added to the entrance street when the traffic signal is constructed) unless the approach will never have a through movement.

Refer to **Section 7.3.9** for requirements regarding medians on public street entrances to developments.

5.6.1 Primary Entrance Streets

A primary entrance street shall meet the following requirements:

a. A primary entrance street shall be located so that it is likely to serve more traffic than a secondary entrance street.

b. A primary entrance street shall have a minimum street length of 200 feet or twice the depth of the nearby residential lots, whichever is greater. The maximum street length is described in **Section 3.11.2** above.

A primary entrance street shall have an enhanced appearance by incorporating one or more of the following design features: a boulevard street or an entry roundabout.

a. If a primary entrance street does not incorporate a curvilinear street or a roundabout, it shall be a boulevard street and shall be divided for a minimum distance of 200 feet or twice the depth of the nearby residential lots, whichever is greater.

b. If a primary entrance street incorporates a roundabout or a curvilinear street, the entrance street is not required to be divided. However, it can be divided if the developer so chooses. If so, the divided portion only needs to meet the minimum length described in **Section 5.3**.

c. A primary entrance street shall not terminate at a "T" intersection unless the lot adjacent to the intersection contains open space, an amenity center, or the side of a home with proper screening as required by the *Subdivision Ordinance*. A primary entrance street shall not lead to the front of a home.

d. An entry roundabout shall be located a minimum of 120 feet from the Type B street, measured from the curb of the Type B street to the yield line of the roundabout.

5.6.2 Secondary Entrance Streets

A secondary entrance street not at a median opening shall, at a minimum, meet the following requirements:

a. A secondary entrance street shall have a minimum street length equal to the depth of a residential lot. The maximum street length is described in **Section 5.11.2**.

b. A secondary entrance street is not required to be divided. If it is divided, it must meet the standards described in **Section 5.4**.

c. A secondary entrance street shall not terminate at a "T" intersection unless the lot adjacent to the intersection contains open space, an amenity center, or the side of a home with proper screening as required by the *Subdivision Ordinance*. The secondary entrance street shall not lead to the front of a home.

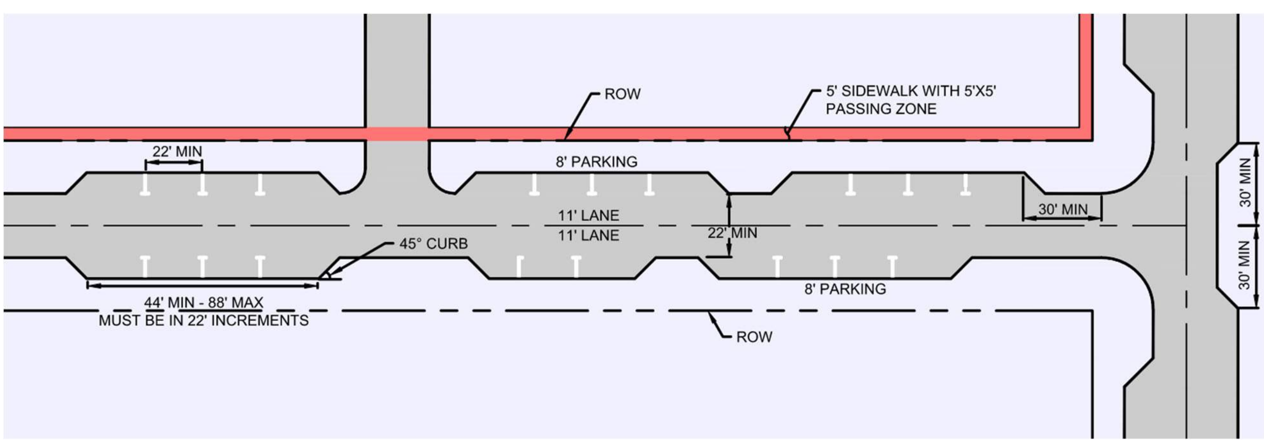
5.7 On-Street Parking

5.7.1 Parallel Parking

a. Minimum parking lane widths shall be 8 feet.

b. No Parking signs, for intersection daylighting, should be placed within 20 feet of an unsignalized intersection and 30 feet of a signalized intersection. See **Figure 5-5** below.

Figure 5-5: Parallel Parking



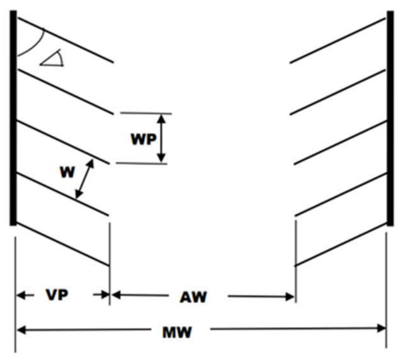
5.7.2 Angle/Diagonal Parking

a. In Mixed-Use, Downtown, and other special designation areas, the City may permit perpendicular or angle/diagonal parking in lieu of parallel parking. Where provided, the additional right-of-way shall be required so as to cover the additional width of the parking stall and maintain the minimum Green Zone, Pedestrian Zone, and ROW zones as prescribed in the applicable cross-section. Right-of-way dedication shall extend to the outside edge of the ROW zone. The Director of Engineering may accept dedication of a street easement in lieu of dedication of a fee interest where the street easement does not inhibit the provision of utilities, landscaped edges, or other design features required for the development.

b. All diagonal parking areas shall be designed at an angle of forty-five, sixty, or seventy degrees with a user comfort factor of 4 (9 feet wide). See **Figure 5-6** below.

c. Angle parking should not be used on streets with more than one automobile through lane per direction.

Figure 5-6: Angled Parking Dimensions



Parking Angle	Stall Width Projection (WP)	Module Width (MV)	Vehicle Projection (VP)	Aisle Width (AW)
User Comfort Factor 4				
45	12’-9”	49’-10”	17’-7”	14’-8”
60	10’-5”	54’-6”	19’-0”	16’-6”
70	9’-7”	57’-0”	19’-3”	18-6”

5.7.3 Accessible Parking Requirements

a. Streets within commercial areas that include parking may be required to provide at least two spaces per block (one on each side) specifically designated for accessible parking.

b. Designated accessible parking and loading spaces provide additional space adjacent to signed parking for vans with ramps to allow passenger boarding and alighting and ensure an accessible route from the landing area to the sidewalk. When designating accessible parking and loading that is not adjacent to the sidewalk, the designer is still required to provide boarding and alighting space and an accessible route to the sidewalk.

c. One accessible parking space should be provided for every 25 spaces on a block perimeter, for block perimeters with 100 spaces or fewer.

d. Provide a 5 feet access aisle adjacent to accessible spaces

On-street parking spaces shall be used for vehicular parking only. No sales, rental, storage, repair, servicing of vehicles, equipment or materials, dismantling, or other activities shall be conducted or located in such areas. On-street spaces cannot be designated as private or reserved for adjacent use. On-street parking spaces can be in a Parallel or Non-Parallel orientation and shall accommodate ADA and PROWAG requirements. Dedicated loading/drop-off zones, bulb-outs, or other uses may interrupt on-street parking in Corner or Mixed-Use land use contexts.

5.8 Other Street Design Requirements

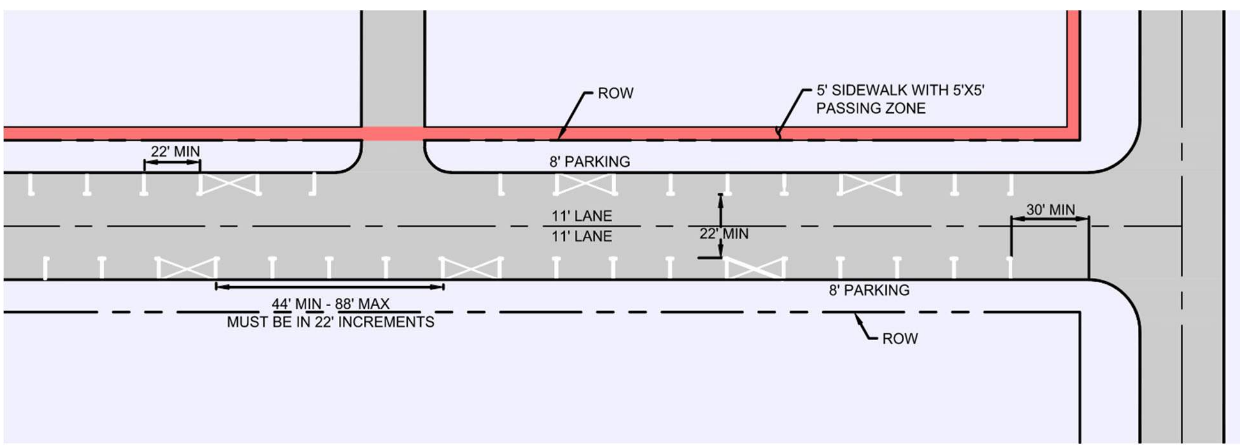
5.8.1 Encroachments

Encroachments are subject to the Right-of-Way Ordinance and Zoning Ordinance. Prior to placing any infrastructure in the City's right-of-way (including a sidewalk) you must obtain permission from the City.

5.8.2 On-Street Parking and Bulb-Outs

In Mixed-Use and Corner land use contexts, on-street parking and bulb-outs are preferred to be used to reduce vehicular speeds and create a pedestrian-friendly environment. This street, based on a variation of a Type F cross-section, has a 22 feet-wide travel section with parking cutouts on each side that are 8 feet wide. See **Figure 5-7**. Refer to **Section 2 (Street Framework)** for cross-sections.

Figure 5-7: Mixed-Use/Corner Land Use Context - Type F Variation



In certain instances, bulb-outs with on-street parking are also appropriate as a neighborhood management technique in the Neighborhood land use context, per **Section 14 (Neighborhood Traffic Management)**. This is not the default design and will be determined applicable on a case-by-case basis.

5.9 Tollway and Access-Controlled Highway Corridors

- *Dallas North Tollway (DNT)* – The DNT Corridor as defined by Plano is bounded on the north by State Highway 121 (SH 121) and on the south by the City limits. The DNT main lanes are under the jurisdiction of the North Texas Tollway Authority. The frontage roads (Dallas Parkway) are City streets fully under the jurisdiction of the City of Plano. The east boundary of the DNT Corridor is defined by Parkwood Boulevard and the west boundary is defined by Communications Parkway.

- *President George Bush Turnpike (PGBT)* – The PGBT main lanes are under the jurisdiction of the North Texas Tollway Authority. The frontage roads along the Corridor are designated as State Highway 190 (SH 190) and are under the jurisdiction of TxDOT (Texas Department of Transportation). PGBT Corridor's east and west boundaries are the respective city limits.

- *Sam Rayburn Tollway (SRT)* – The SRT main lanes are under the jurisdiction of the North Texas Tollway Authority. The frontage roads along the Corridor are designated as State Highway 121 (SH 121) and are under the jurisdiction of TxDOT. The SRT Corridor is bounded by the city limits at Spring Creek Parkway on the west, and Custer Road to the east.

- *Central Expressway (US Highway 75)* – Both the main lanes and frontage roads are under the jurisdiction of TxDOT. The US 75 Corridor is bounded by PGBT to the south and the city limits to the north. The special standards outlined within this section do not apply to US 75 as it was developed under legacy design requirements, and redevelopment would not be feasible under the current design standards. Access/drive design along the US 75 service roads should be designed to Type C street standards as well as the *TXDOT Access Management Manual.* It is noted that modifications to the US 75 service roads may require design waivers and/or exceptions from TxDOT.

5.9.1 Design Standards

Design standards for select elements of said corridors are detailed in the following sections.

- *Highway and Tollway Service Roads (one-way), except U.S.75*
    - For driveway spacing relative to ramp gores, see **Figure 5-10** and **Figure 5-11** below.
    - For driveway-to-driveway spacing, and all other service road design elements under City jurisdiction, see **Figure 5-8**, **Figure 5-9**, and **Figure 5-12** below.
- Highway and Tollway Service Roads
    - Provide minimum spacing of 325 feet between individual driveways, except where two drives are served by one deceleration lane – where the minimum driveway spacing within the lane is 120 feet. See **Figure 5-8**.
    - Provide a deceleration lane with at least 60 feet of storage (120 feet transition, 12 feet wide) into all driveways or multiple driveways off the service road. One deceleration lane may serve multiple driveways. See **Figure 5-8**.
    - Provide a minimum spacing of 400 feet from the intersection of a crossing thoroughfare to the first downstream driveway and provide a minimum of 160 feet to the first upstream driveway. See **Figure 5-9**.
    - No driveway shall be placed less than 460 feet in advance of the painted gore tip, or less than 50 feet beyond the concrete curb gore of an entrance ramp. See **Figure 5-10**.
    - No driveway shall be placed less than 50 feet in advance of the concrete curb gore, or less than 460 feet beyond the painted gore tip of an exit ramp. See **Figure 5-11**.

- Refer to TXDOT Access Management Manual for further design standards.

- Thoroughfares Intersecting the DNT Tollway

  Crossing thoroughfares are those streets that form an intersection, interchange, or otherwise cross the right-of-way of the DNT tollway to carry through traffic. At these right-of-way crossings, the following standards shall apply:

  a. Provide minimum spacing of 160 feet along the crossing street, from its intersection with the tollway to the first driveway. Refer to **Figure 5-12**.

  b. Starting with the second driveway, provide a minimum spacing of 150 feet between all driveways on a crossing street.

  c. On divided thoroughfares within the DNT Corridor, mid-block full-movement median openings are not allowed.

  d. In the DNT Corridor, if only one mid-block turn lane is possible, priority will be given to the south side east of the tollway, and to the north side west of the tollway.

Figure 5-8: DNT Driveway to Driveway Spacing Along Service Road (Applicable to other Tollways)

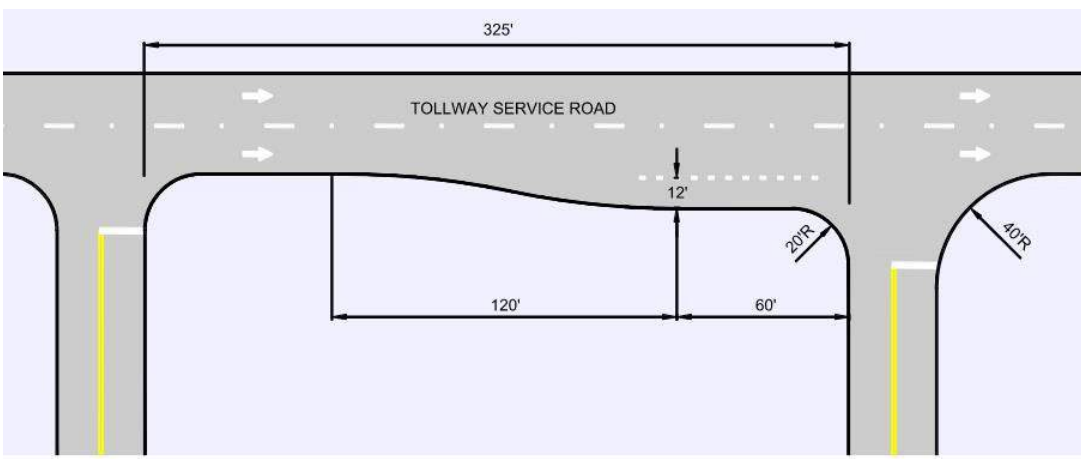


Figure 5-9: DNT Driveway to Thoroughfare Intersection Spacing Along Service Road (Applicable to other Tollways)

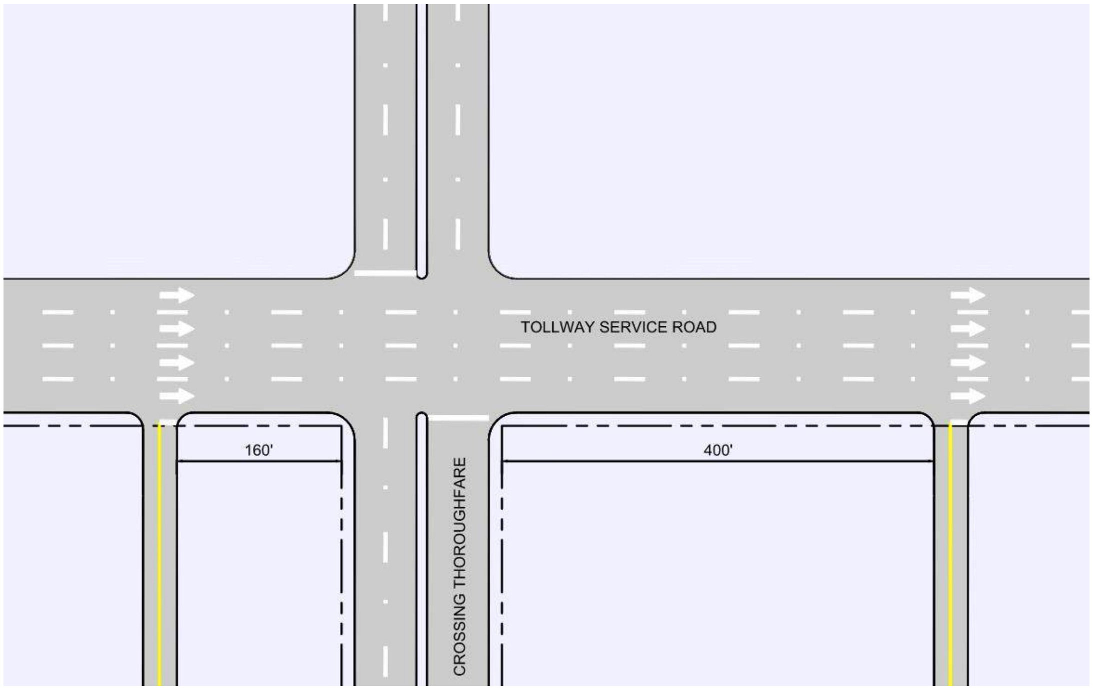


Figure 5-10: DNT Driveway to On-Ramp Spacing Along Service Road

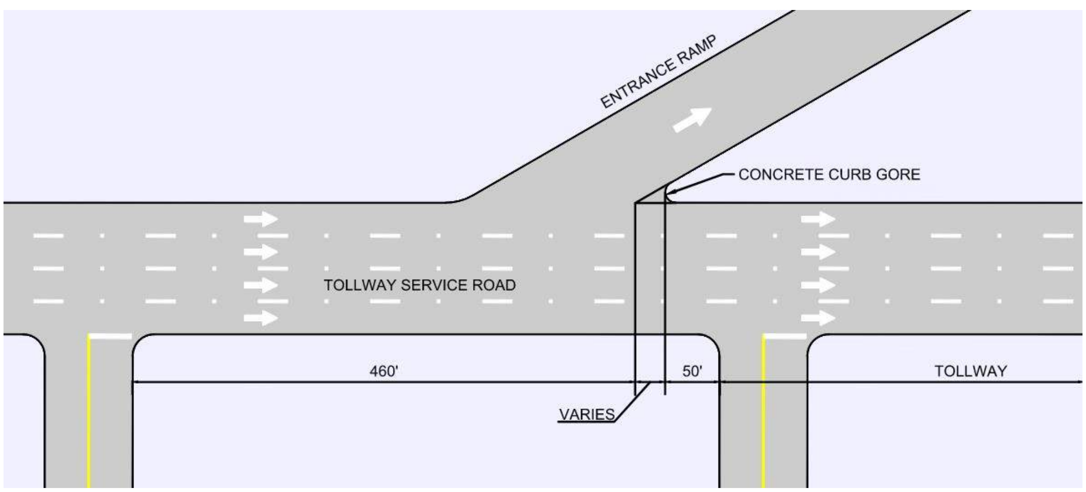


Figure 5-11: DNT/SH-121 Access Standards
(Driveway to Off-Ramp Spacing Along Service Road - applicable to other Tollways)

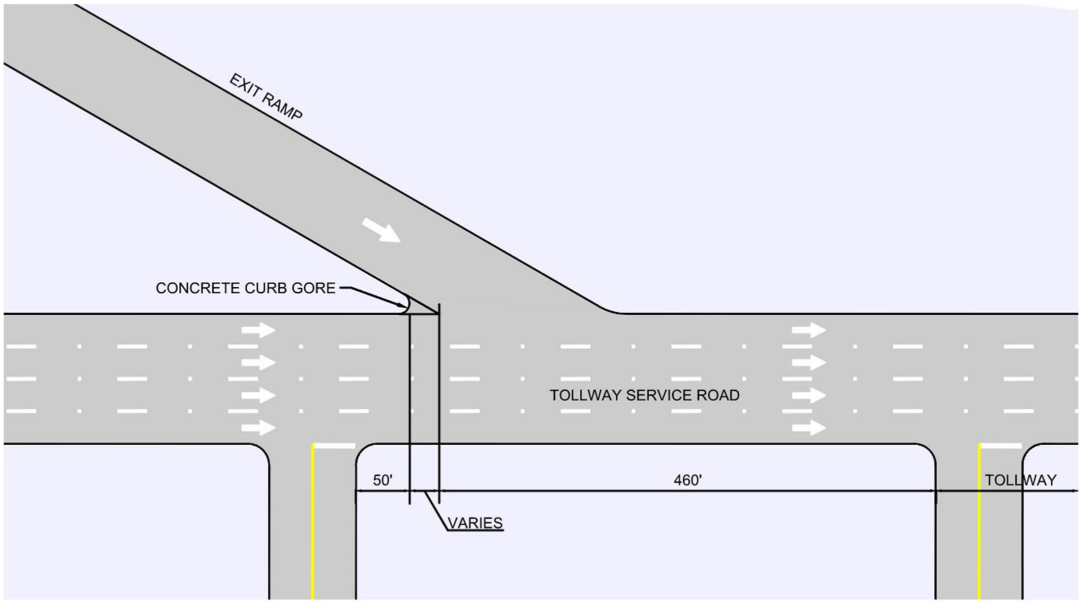
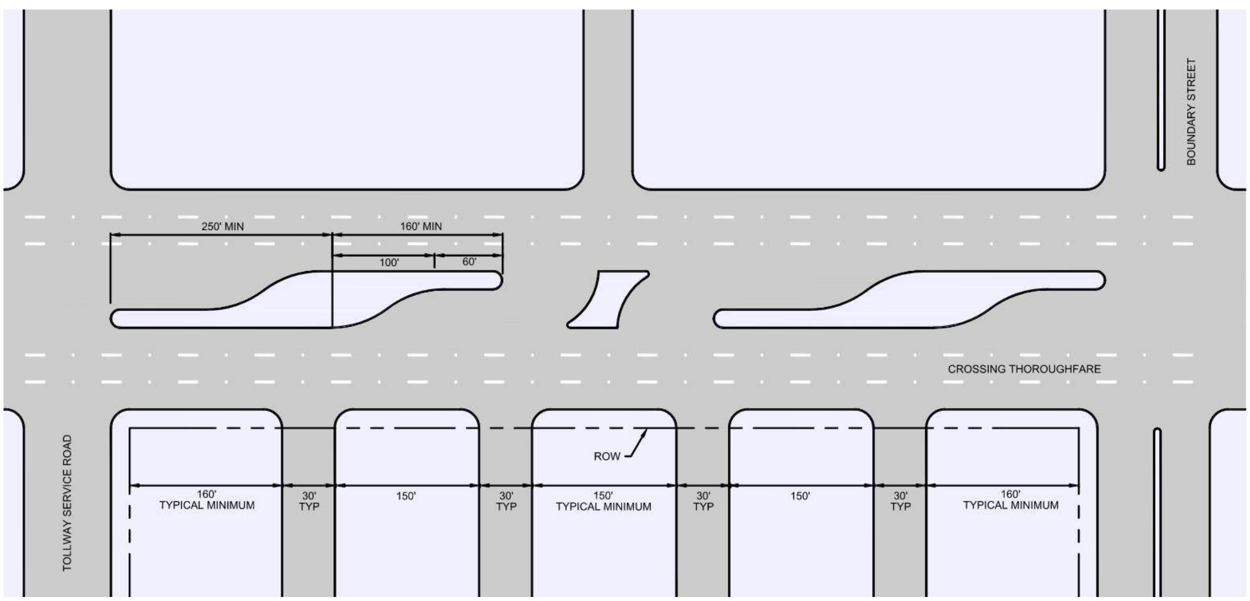


Figure 5-12: Dallas North Tollway Access Standards
(Crossing Thoroughfare Drive Spacing, applicable to other Tollways)



6.1 General

An intersection is defined as the area within the roadway segment where two or more roadways join or cross. There are two types of intersections: at-grade intersections and grade-separated intersections. This section primarily focuses on at-grade intersections. Intersections have more conflict points than other parts of the thoroughfare and can experience operational and safety issues. Intersections should accommodate all types and sizes of anticipated movements of various road users safely and efficiently, including motorized vehicles, bicyclists, and pedestrians. This section provides information on designing an intersection and its relevant features for the effective movement of each intersection user.

6.2 Intersection Type Selection

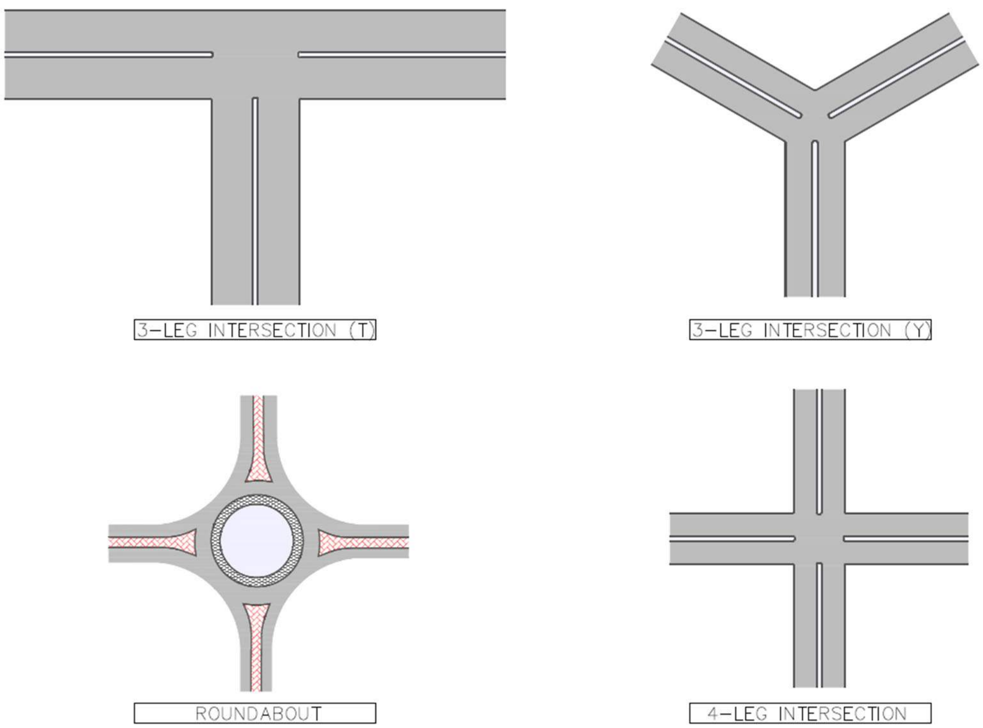
The design of intersection features is largely based on the following factors:

- Design parameters: design vehicle and design speed which are both based upon land use context. Refer to **Section 5 (Street Design)**.
- Intersection approach geometry based upon typical sections, land use contexts, and future land uses. Refer to **Section 2 (Street Framework)**.
- Traffic volumes including turning movement volumes, AADT, traffic composition, and pedestrian and bicycle movements.
- Intersection control type (i.e., stop control, signal control, uncontrolled, roundabout).
- Intersection profiles, grades, and available sight distance on each approach.
- Overall network, block dimensions, and available right-of-way (ROW).
- Adjacent land uses including driveway access, sidewalks, on-street parking, and land use context.
- Potential to reduce the severity of conflicts.
- Reported crash experience.

6.3 Basic Intersection Forms

There are four basic forms of intersections, three-leg T, three-leg Y, four-leg, and roundabouts. **Figure 6-1** shows various types of these different forms of intersections. Each of these types of intersections can be further categorized into different variations such as channelized, flared, or unchannelized. Intersecting streets ideally intersect at 90° angles, but at times more complex geometries are encountered. Roundabouts can be further classified into mini-roundabouts, single-lane roundabouts, and multi-lane roundabouts.

Figure 6-1: Common Intersection Types



6.4 Intersection Control Evaluation

The types of traffic control implemented at an intersection are a key element for its operations. Types of intersection control include the following:

6.4.1 Uncontrolled Intersections

Uncontrolled intersections are intersections without any traffic control devices. By State law, vehicles arriving at the same time to the intersection yield to the vehicle on the right. These intersection types are typical at low-volume roads and driveway intersections.

6.4.2 Yield-Controlled Intersections

Yield-controlled intersections assign right-of-way without requiring a stop. They are typically found at a merge condition such as channelized right-turn lanes of an intersection, three-way intersections, and ramps. Roundabouts are a special type of yield-controlled intersection with special design considerations and requirements (see **Section 6.8**). By State law vehicles are still required to stop for pedestrian traffic at yield-controlled intersections. Yield control shall not be used to control speed.

6.4.3 Stop-Controlled Intersections

Stop-controlled intersections may be categorized into T-intersections, two-way stop-controlled or all-way stop-controlled. Two-way stop-controlled or T-intersections require traffic on the minor street to stop and yield the right-of-way to major street traffic. Two-way stop control shall be installed per the guidance in the *Texas Manual on Uniform Traffic Control Devices* (*TMUTCD)*

a. All intersections comprised of crossing street types D and E shall be stop-controlled unless a traffic signal is warranted and recommended by the Director of Engineering or his/her designee (see **Section 6.4.4** for signal warrants).

b. State law *(TTC Section 545.151)* requires drivers on the minor approach to an uncontrolled T-intersection to stop, yield, and grant immediate use of the intersection to another vehicle on the major roadway. Stop signs are not required on the minor approach at T-intersections unless the intersection is under all-way stop control.

c. All-way stop-controlled intersections require traffic from all directions to stop before entering the intersection. All-way stop-controlled intersections shall be warranted according to *TMUTCD Section 2B.07* and recommended by the Director of Engineering or his/her designee.

d. All-way stop control at intersections shall not be used on a coordinated arterial nor used to control speed.

6.4.4. Signalized Intersections

Per the *TMUTCD Chapter 4C*, an engineering study of traffic conditions, pedestrian characteristics, and physical characteristics of the location shall be performed to determine whether the installation of a traffic control signal is justified at a particular location.

a. **Signalized Intersections Required** – Signalized intersections are required for the following:

- All intersections comprised of crossing street Type B or C shall be signalized.
- All intersections comprised of crossing street Types F and G shall be uncontrolled or two-way stop controlled unless an enhanced traffic control type is warranted and recommended by the Director of Engineering or his/her designee. Traffic circles may be used as traffic calming devices in Type F and Type G streets when there are no warrants met.

b. **Warrants** – Candidate intersections for signalization shall be analyzed according to *TMUTCD Chapter 4C*, including evaluation of the following warrants:

- Warrant 1 – Eight-Hour Vehicular Volume
- Warrant 2 – Four-Hour Vehicular Volume
- Warrant 3 – Peak Hour

- Warrant 4 – Pedestrian Volume
- Warrant 5 – School Crossing
- Warrant 6 – Coordinated Signal system
- Warrant 7 – Crash Experience
- Warrant 8 – Roadway Network
- Warrant 9 – Intersection Near a Grade Crossing

The satisfaction of a warrant or warrants shall not in itself require the installation of a traffic control signal.

c. **Engineering Study Required** – Installation of new traffic signals requires a full engineering study as outlined above and a recommendation for installation by the Director of Engineering or his/her designee.

6.5 Intersection Design Guidelines

The geometric design of an intersection directly influences the safety, convenience, and operational efficiency of an intersection. The basic intersection design elements are discussed in this section. Detailed information on accommodating and designing for bicyclists at intersections can be found in **Section 9 (Multimodal Facilities)**. The design of intersections shall consider the following factors:

a. Through lanes should ideally align across intersections without offset. The maximum allowed deflection of a through lane across an intersection shall not exceed half the receiving lane width. Puppy track pavement markings should be placed to guide drivers across the intersection in cases where deflection exceeds one-third of the receiving lane width.

b. Intersection design shall align with the natural paths and operating characteristics of drivers and vehicles. Turning movements at an intersection must be checked by the design engineer by the use of turning templates or CAD software to confirm that design vehicles are provided with adequate widths and turning radii to prevent off-tracking and conflicting paths. Design vehicle requirements can be found in **Section 5 (Street Design)**. The engineer of record shall provide documentation in the form of engineering sketches showing turning paths for all intersections and median openings.

c. Curvature of a roadway through an intersection shall be accommodated by radii that meet or exceed the value required for the given design speed. Refer to **Section 3.4**.

d. Grades shall be less than 4.0% slope in any direction within an intersection unless topography limits the ability to provide less than 4.0%.

e. Vertical deflection without a vertical curve within an intersection should have an algebraic difference not to exceed 1%.

f. The design shall provide sufficient horizontal and vertical sight distance based on current *AASHTO U.S. customary parameters*. Sight distance requirements can be found in **Section 5 (Street Design)**. Turning restrictions, movement-specific control types, and pedestrian considerations should be reviewed for all movements at an intersection.

g. Design shall utilize directional pedestrian ramps to the greatest extent feasible within the right-of-way. If directional ramps are not feasible, blended transition ramps are acceptable (see *City of*

Plano Standard Construction Details for Type B ramp). Diagonal ramps into the middle of the intersection shall be avoided.

h. Design of pedestrian facilities at arterial intersections should accommodate future traffic signal infrastructure such as signal poles, pedestrian poles, and push buttons per the *TMUTCD*.

- The centerline of the approaches or “legs” of street and driveway intersections should intersect perpendicular with each other, or “radially” in the case of curved street alignment. Where new street or driveway intersections are proposed, the intersection angle should not vary more than 5° in either direction from a 90° angle.

6.6 Type C Intersection ROW

For intersections of a Type C with a Type B, or C, the “legs” of the Type C ROW shall be expanded to 130 feet for a distance of 200 feet from the ROW line of the cross-street, and then transition back for 150 feet to the standard ROW width of 110 feet. This flare will allow auxiliary turn lanes to be added to the intersection as needed. In general, right-turn lanes are required at all such intersections of Type C with Type B or C, as shown in **Figure 6-2**.

For intersections of a Type C with a tollway service road, the approach intersection width of the Type C ROW shall be expanded to 140 feet for a distance of 200 feet from the ROW line of the cross-street, and then transition back for 150 feet to the standard ROW width of 110 feet, as shown in **Figure 6-3**. This flare will allow auxiliary turn lanes to be added to the intersection as needed.

Figure 6-2: Intersection of Type C with Type C and Above, ROW Requirements

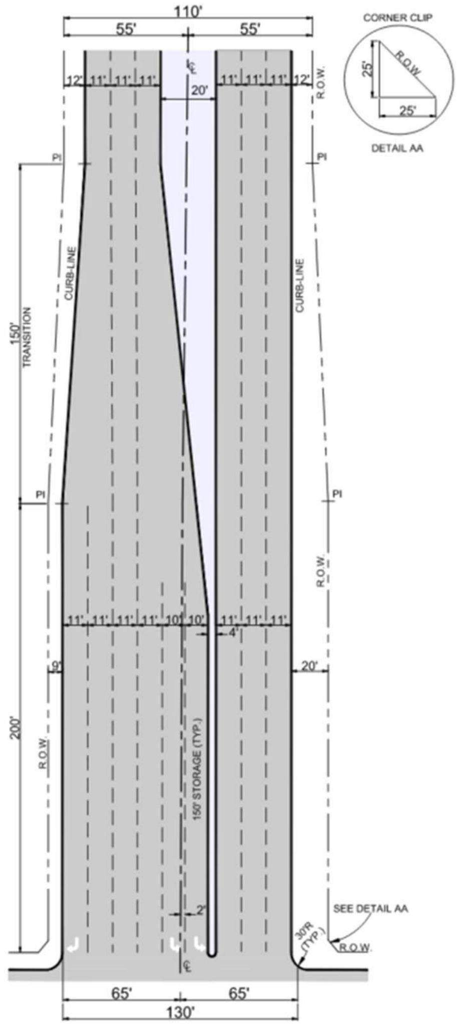
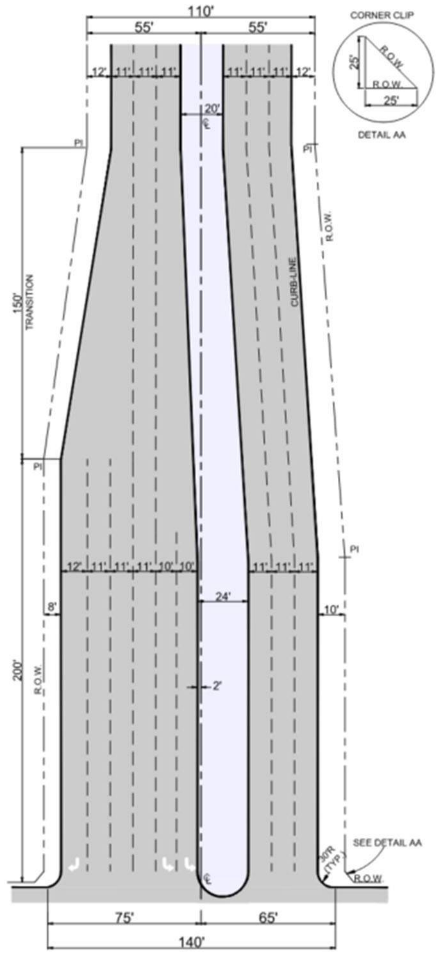


Figure 6-3: Intersection of Type C with Tollway Service Road, ROW Requirements

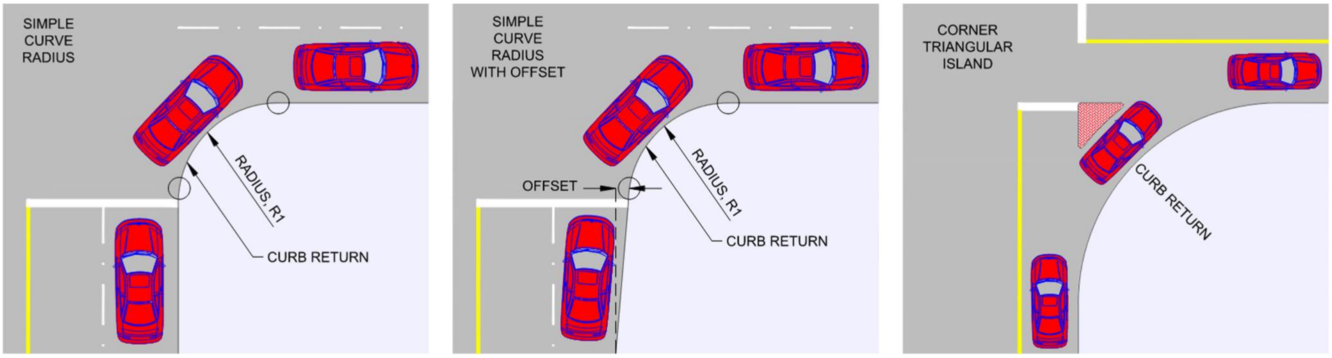


6.7 Intersection Curb Radii

The curb radii at an intersection depend on the design vehicle, pedestrian, and bicycle usage, intersecting roadway geometry, lane configuration, and operational characteristics of the roadways. Smaller curb radii are desirable on lower-speed urban streets with more pedestrian activity as they encourage lower turning speeds and shortened pedestrian crossing distances. Larger curb radii are desirable on higher volume roadways and thoroughfares as larger vehicles are expected to use these facilities and higher entry speeds are desirable to reduce the slowing of through traffic caused by right-turning vehicles. The curb radius may be designed with a simple curve as shown in **Figure 6-4**. Compound curve radii shall not be used at intersecting streets. The corner radius can be different from the effective turning radius. The corner radius depends on the intersection geometry while the effective turning radius is based on the path vehicles take when turning onto the intersecting street. If the corner radius is not designed properly, drivers may be encouraged to take wider turns and maneuver into the opposing lane of traffic.

In the design of the curb radii based on the turning path of the design vehicle, the design vehicle must be positioned on the outside lane line when starting and completing a turn. If the design vehicle requires a larger turning radius than the minimum curb radius and is not able to utilize additional lanes without encroaching on opposing vehicle lanes, then the corner radii shall be increased based on the minimum turning radius of the design vehicles.

Figure 6-4: Intersection Curb Radii



The *AASHTO's A Policy on Geometric Design of Highways and Streets* provides the recommended curb radii for various design scenarios. The selection of curb return radii must be evaluated with CAD software to determine its compatibility with the turns of specific design vehicles. The minimum curb radii for various street types should comply with values shown in **Table 6-1**.

Table 6-1: Minimum Curb Radii based on Land Use Contexts

Type of Street on	Type of Street at	Land Use Context	Recommended Radius (feet)
B, C, D	B, C, D	Commercial	40
		Mixed-Use	30
		Corner	
		Neighborhood	
B, C, D	E, F, G	Commercial	40
		Mixed-Use	30
		Corner	
		Neighborhood	
E, F, G	E, F, G	Commercial	20
		Mixed-Use	
		Corner	
		Neighborhood	
Alleys*	E, F, G	Commercial	15
		Mixed-Use	
		Corner	
		Neighborhood	
Mews, Paseos, Shared Streets	F, G	Commercial	20
		Mixed-Use	
		Corner	
		Neighborhood	

*Service alleys should be 20' minimum

6.8 Intersection Radii and Right-of-Way Corner Clips

Requirements for intersection corner clips can be found in **Section 10 (Public Right-of-Way Visibility).** Right-of-way requirements for intersections along thoroughfares should accommodate potential future traffic infrastructure, such as traffic signals, ITS camera poles, etc.

6.9 Roundabouts

Roundabouts are considered on a case-by-case basis. If designing a roundabout, refer to the following most recent guidelines or current state of practice:

1. Current edition of the *National Cooperative Highway Research Program (NCHRP) Report 672, Roundabouts: An Informational Guide.*

2. Current edition of *NCHRP Report 674, Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities*; and,

3. Current edition of *Texas Manual of Uniform Traffic Control Devices* (*TMUTCD*).

6.10 Bicycles and Pedestrians at Intersection

Requirements for bicycles and pedestrians at intersections can be found **in Section 9 (Multimodal Facilities)**.

SECTION 7 Medians, Left Turns and Right Turns

7.1 Medians

Medians are the portion of a divided street used to separate opposing lanes of traffic. Medians can be raised, depressed, or flush (pavement markings). Medians facilitate access management by limiting vehicle turning movements across the traveled way, thereby increasing safety by reducing the number of conflict points and providing an extra buffer between opposing lanes of traffic. Some medians also provide refuge for pedestrians crossing the street and offer additional space for landscaping, lighting, and the placement of utilities. Refer to **Section 2 (Street Framework)** for varying median widths based on land use context.

7.2 Median Openings

7.2.1 General Requirements

Median openings on divided streets are generally required at all public street intersections for all Type B, C, D, E, F, and G streets. Median openings at private streets and driveways must conform to the spacing and other design requirements herein, and the overall geometrics of the street must accommodate a median opening. The design of median openings and associated left-turn lanes shall accommodate both existing and potential future turning movements both to and from the arterial roadway.

Median openings shall be designed to accommodate turning paths and pedestrian movements (as applicable). Channelized median openings shall be designed using turning templates of the applicable design vehicle as stated in **Section 5 (Street Design)**.

The width of mid-block full median openings shall not be less than 60 feet measured nose to nose. Median openings may be greater than 60 feet where necessary to accommodate turning paths and crosswalks but should not exceed 75 feet. Refer to **Section 5 (Street Design)** for driveway design requirements.

Median openings without left-turn lanes in both directions shall be designed in a manner to accommodate left-turn movements in opposing directions with proper left-turn lanes, pedestrian accommodations (as applicable), and median opening width. Median openings may be constructed in this partial condition as necessary for development.

Channelized median openings may be provided at locations where limited access to and or from the arterial is intended. Channelization islands must conform to the median design requirements described herein. Channelizing islands shall be constructed using standard curb and or median nose treatments.

The minimum distance to an adjacent median opening along a Type B or C street is listed in **Table 7-1** and illustrated in **Figure 7-1**. This distance varies from 220 feet to 650 feet, measured nose to nose, depending on the street type and the type of mid-block opening. If the first median opening is downstream of a roundabout, the median opening shall be located so that the taper for its left-turn lane begins no less than 50 feet downstream from the crosswalk on the roundabout's departure.

The minimum distance between median openings on a Type B or C street where left-turn storage is provided in both directions for Types C, D, E, F and G intersecting streets and driveways is listed in **Table 7-1** and can be applied to **Figure 7-1**. The distances shown are measured nose to nose.

Figure 7-1: Typical Median Spacing based on Functional Classification

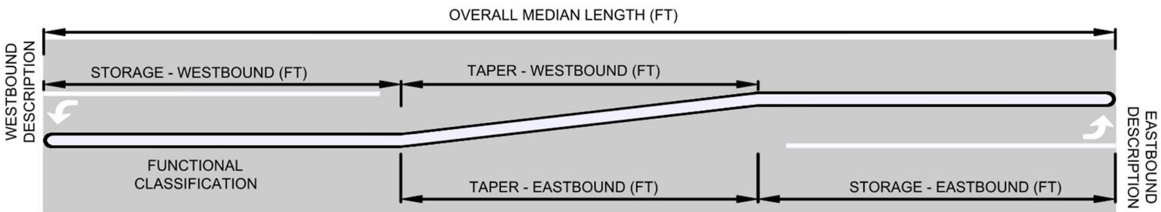


Table 7-1: Typical Median Spacing based on Functional Classification

Functional Classification	Design Speed (mph)	Overall Median Length (feet)
Type B and Type C	45	555-650
Type C and Type D	40	400-650

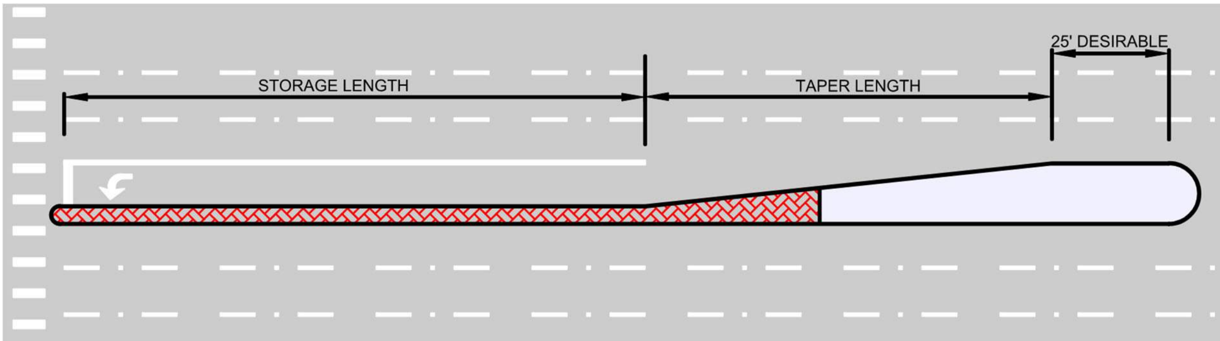
7.2.2 Median segments with Back-to-Back Turn Lanes

Median segments with back-to-back turn lanes shall meet design requirements for each pair of turn lanes, respectively. If the median does not accommodate proper storage and deceleration lengths for both turn lanes, then only a single turn lane will be allowed for that median segment.

7.2.3 Median Segments Without Left-Turn Lanes in Both Directions

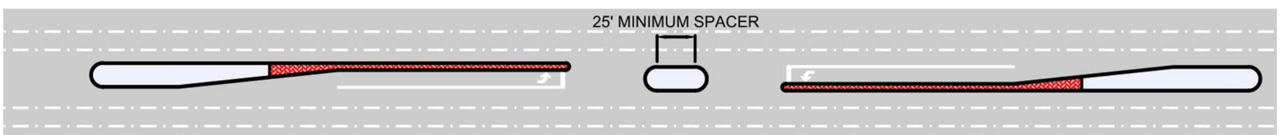
a. If a left-turn lane is only in one direction, the minimum length of the median shall be the sum of the required left-turn storage, taper length, 25 feet tangent and length of the median nose. This requirement is reflected in **Figure 7-2**. This median design is only allowed if access is not compromised for the property on the opposite side of the street. The length of the upstream tangent may be reduced or eliminated based on the recommendations of a traffic study.

Figure 7-2: Length of Median Where a Left-Turn Lane is Needed in Only One Direction



b. If left-turn storage is not required in either direction and the median is simply a spacer between two median openings, the minimum length of the spacer measured tangent to tangent shall be 25 feet (see **Figure 7-3**). The width of a median spacer shall be defined by the curb lines of the adjacent through lanes. Median spacers should have a constant width. Note that a median spacer differs fundamentally from a channelizing island in a way that the spacer allows access from the cross street.

Figure 7-3: Minimum Spacer Length



c. If a median opening does not serve a driveway, the nearest driveway should be placed in accordance with the driveway spacing requirements in **Section 8 (Driveways)**. However, a minimum of 100 feet of separation shall be provided between the edge of the driveway and the nearest nose of the median opening.

7.2.4 Medians on Public Street Entrances to Developments

a. Medians installed on undivided streets at entrances to subdivisions for aesthetics or any other purpose shall be a minimum of 4 feet wide and 100 feet long. The median shall have a maximum width of 10 feet at the intersection with a Type B or C street. Pedestrian movements shall be accommodated through the median when required. The pavement on either side of the median shall be a minimum of 22 feet wide, face-to-face. Median islands, where used, shall be aligned such that the opposing approach lanes operate freely.

b. A divided residential subdivision entrance shall transition to the normal residential street width within the subdivision. No part of the transition shall occur within an intersection.

c. If an entrance street is designated as a primary entrance, additional design standards may be required as described in **Section 8.12**.

7.3 Left-Turn Lanes

a. Left-turn lanes shall be provided for all:

- Median openings and intersections on divided roadways, except at T-intersections where insufficient pavement width is present for U-turns from the major approach turning against the minor street.

- Undivided minor arterial and collector roadways with a single vehicular lane in each direction and with a pavement width of greater than 30 feet at their intersection with arterial roadways.

b. All left-turn lanes constructed on divided streets should conform to the typical sections shown in **Section 2 (Street Framework)**.

c. Where right-of-way (ROW) or other physical constraints dictate, single or dual left-turn lanes constructed on divided streets shall be 11 feet wide nominal with a minimum of 10 feet wide.

d. Left-turn lanes constructed which may serve as future through lanes on divided streets shall be constructed to the through lane width for the entire length of both storage and taper per the applicable future cross-section.

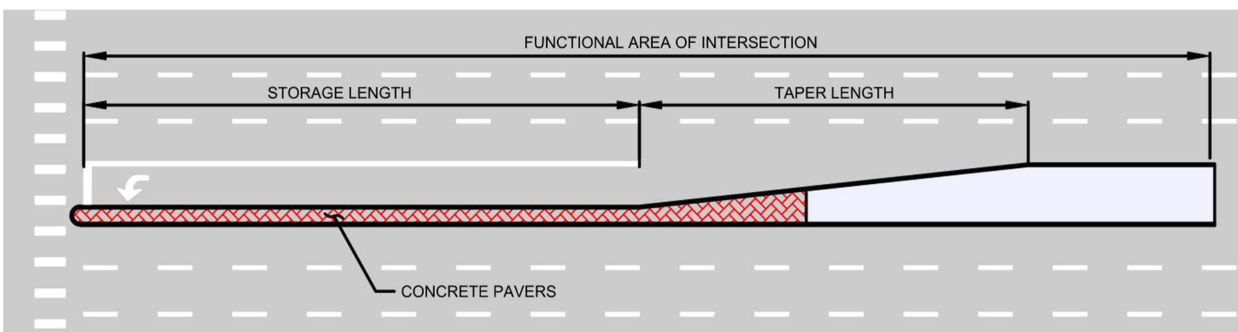
e. Minimum storage requirements are listed in **Table 7-3** and illustrated in **Figure 7-4**. Storage requirements may be increased based on the findings of a Traffic Impact Analysis or other traffic study based on the traffic safety and/or projected traffic demands of the properties that will be served by the left-turn lane.

f. Left-turn lanes on City facilities shall be delineated using the City's current *Standard Construction Details*. Left-turn lanes on State facilities shall be delineated using *TXDOT Design Standards*.

g. Concrete pavers shall be required in the median where the median width is 6 feet or less, back of curb to back of curb (see **Figure 7-4**). If the median width is greater than 6 feet, concrete pavers shall be required for a minimum distance of 10 feet from the median nose. See City's current *Standard Construction Details* for median nose treatments.

h. Design requirements for left-turn lanes are shown in **Table 7-2**. The variables used in these tables are illustrated in **Figure 7-4**. Straight tapers are used for turn lane design.

Figure 7-4: Typical Left-Turn Lane Dimensions



*Additional storage may be required based on queuing analysis

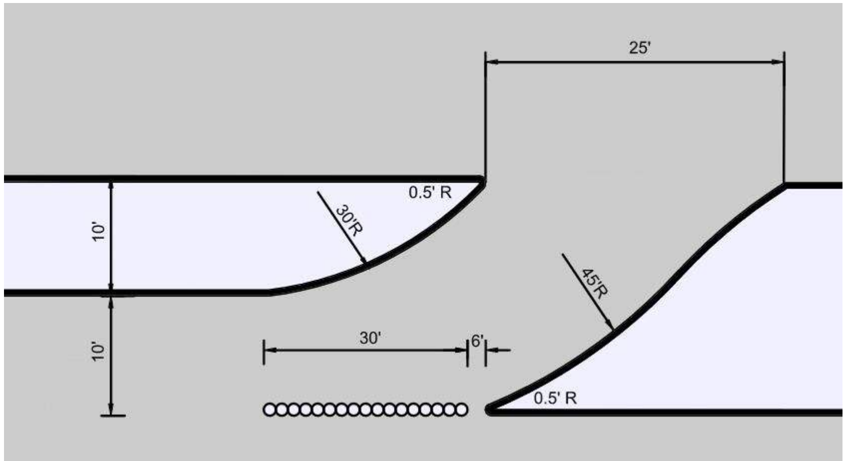
Table 7-2: Minimum Left-Turn Lane Design Requirements

Design Speed (mph)	Storage Length* (feet)		Taper Length (feet)		Lane Width (feet)	
	Single	Dual	Single	Dual	Single	Dual
45	200	250	50	100	11	10
40	200	250	50	100	11	10
35	100	N/A	50	100	11	10
30	100	N/A	50	100	11	10

*Storage length requirements at signalized intersections should be calculated based on a queuing analysis

i. Hooded left-turn median openings shall be designed with a barrier island that blocks all traffic movements from the adjacent driveways or cross-street but allows left-turn movements originating from a divided roadway to turn at the median as shown in **Figure 7-5**.

Figure 7-5: Hooded Median Opening Detail



7.4 Right-Turn Lanes

Right-turn lanes shall be provided based on street types or volume thresholds as listed below:

a. Type B streets shall require right-turn lanes for every driveway and street for all land use contexts.

b. Along Type C streets, a right-turn lane will be required based on the findings of a traffic study (Refer to **Section 12 Traffic Studies**).

c. Right-turn lanes are required at all intersections of Type D or higher with Type B or Type C streets for all land use contexts.

d. Type D streets and lower shall require a right-turn lane based on the findings of a traffic study (Refer to **Section 12 Traffic Studies**).

e. Right-turn lanes shall be required on Type D and higher for gated entries where the gates are closer than 75 feet from the outside travel lane. (Refer to **Section 8 Driveway Design**).

f. Right-turn lane requirements on State highway facilities are governed by the Texas Department of Transportation (TXDOT).

7.4.1 Right-Turn Lane Design Criteria

a. All right turn lanes constructed on divided streets should conform to the typical sections shown in **Section 2 (Street Framework)**. Additional right-of-way dedication and/or easements may be necessary to accommodate the required cross-sectional elements from the back of the curb to the right-of-way or easement line. In no case shall the parkway be less than 10 feet.

b. Where right-of-way or other physical constraints dictate, right-turn lanes constructed on divided streets shall be 11 feet wide nominal with a minimum of 10 feet wide.

c. Right-turn lanes constructed which may serve as future through lanes on divided streets shall be constructed to the through lane width for the entire length of both storage and taper per the applicable future cross-section.

d. Minimum storage requirements are listed in **Table 7-4** and illustrated in **Figure 7-6**. Storage requirements may be increased based on the findings of a Traffic Impact Analysis or other traffic study based on traffic safety and/or projected traffic demands of the properties that will be served by the left-turn lane.

e. Right-turn lanes on City facilities shall be delineated using the City's current *Standard Construction Details*. Right-turn lanes on State facilities shall be delineated using the *Texas Department of Transportation Design Standards*.

f. A minimum tangent section of 50 feet should be provided between the radius of the preceding driveway or cross-street curb return and the taper of a right-turn lane.

g. Driveways will not be permitted in the taper of a right turn lane.

h. In the case of two driveways that are back-to-back along a right-turn lane, the storage length can be extended to accommodate the needs of both driveways.

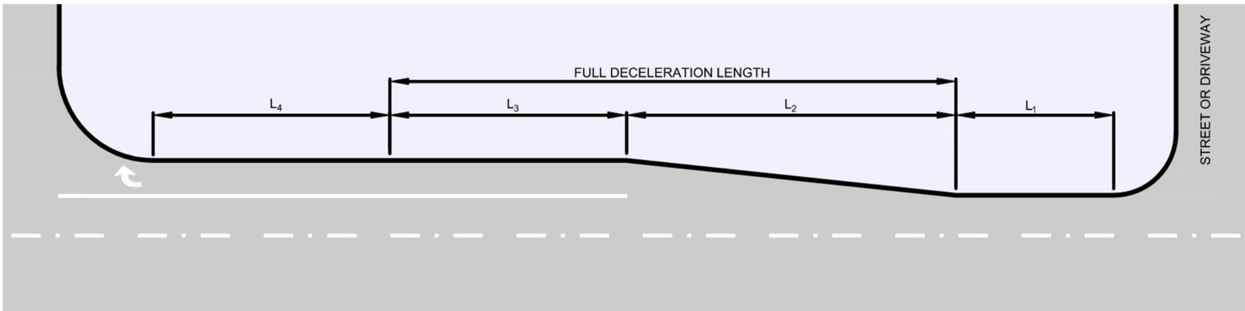
i. Design requirements for right-turn lanes based on design speed are listed in **Table 7-3**. The variables used in this table are illustrated in **Figure 7-6**. Straight tapers are used for right-turn lane design.

Table 7-3: Minimum Right-Turn Lane Design Requirements

Design Speed (mph)	Storage Length* (feet)	Taper Length (feet)	Lane Width (feet)
40+	200	50	11
35	150	50	11
30	100	50	11

*Storage length requirements at signalized intersections should be calculated based on a queuing analysis

Figure 7-6: Typical Right-Turn / Deceleration Lane Dimensions



Notes: L_1 = Distance traveled during the perception-reaction time.
L_2 = Taper distance to begin deceleration and complete lateral movement.
L_3 = Distance traveled to complete deceleration to a stop.
L_4 = Storage Length

8.1 General

Access points for properties shall be developed consistent with the technical criteria in this section in conjunction with the ***Thoroughfare Plan*** and the City's ***Subdivision Ordinance***. The City of Plano seeks to achieve balance among the following major factors: the safety needs of general vehicular and pedestrian traffic; the design parameters and operations of adjacent highway elements (State and Federal); the mobility needs of the adjacent roadway; and the access needs of the property. Access Management projects will be handled on a case-by-case basis involving City Engineering, Legal, and Real Estate Teams. Access Management for driveways varies and depends on the location, frequency, spacing, and design of driveways along various roadways.

8.2 Driveway Types

8.2.1 Residential Driveways

a. A residential driveway provides access to a single-family residence, duplex, or multi-family residence with ten or fewer units.

b. Residential driveways shall be allowed to intersect Type F thoroughfares and smaller, except a circular driveway may intersect a Type E thoroughfare if the lot meets the size and setback requirements of the ***Subdivision Ordinance***.

8.2.2 Commercial Driveways

a. A commercial driveway provides access to an office, retail, institutional, or multi-family building with more than ten units. Minor truck traffic is anticipated for incidental service or delivery. A driveway serving a mixed-use building shall be considered a commercial driveway.

b. Centralized retail development, such as a community or regional shopping center, may have one or more driveways specially designed, signed, and located to provide access to trucks. Such driveways shall be considered industrial driveways.

c. Commercial Driveways shall be allowed to intersect Type A – Type F thoroughfares in most contexts. Commercial driveways in the Mixed-Use context shall be allowed to intersect all street types.

d. The Director of Engineering, in consultation with the Director of Planning, may allow driveways serving commercial properties in historically residential areas to meet residential driveway standards where necessary to maintain the viability (or use) of the property.

8.2.3 Industrial Driveways

a. An industrial driveway serves truck movements to and from loading areas of an industrial facility, warehouse, distribution center, truck terminal, etc. An industrial facility, a driveway whose principal function is to serve administrative or employee parking lots shall be considered a commercial driveway.

b. Industrial driveways shall be allowed to intersect Type A – Type F thoroughfares.

8.3 Driveway Intersection Angle

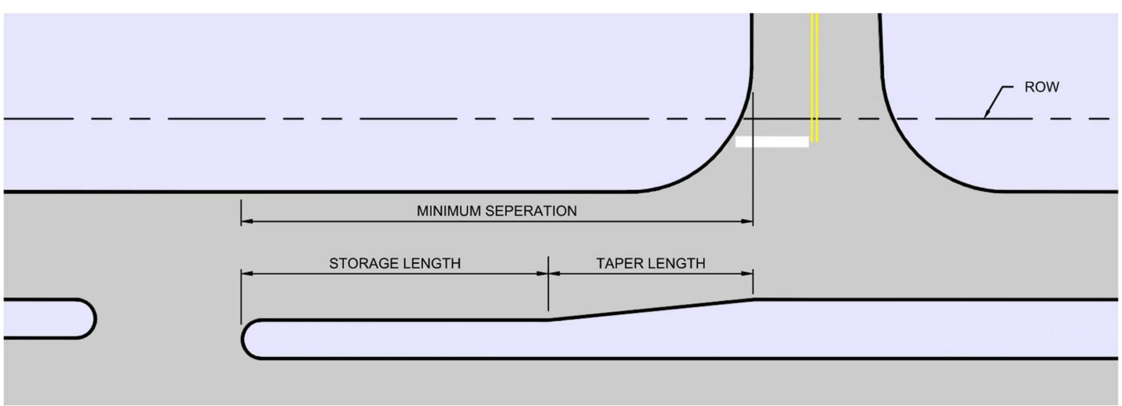
For all driveway types, two-way driveways shall always be designed to intersect the adjacent street at an approximate 90° angle. One-way driveways may be designed to intersect a street at an angle of either 90° or 45°.

8.4 Driveway Widths

As the term is used herein, the width of a driveway refers to the width of pavement measured orthogonally between the two curb-lines of the same driveway that define the functional traffic lanes of the driveway, and that have a point-of-intersection with the curb radii that connect the driveway curb-lines to the adjacent street curb-lines.

a. If a driveway is not served by a median opening, the sum of left-turn lane storage and taper length shall be provided between the edge of the driveway and the edge of the median opening as minimum separation (see **Figure 8-1**).

Figure 8-1: Driveway Separation at Median Openings



b. Residential driveways onto streets shall have a minimum width of 12 feet and a maximum width of 24 feet (see **Figure 8-2**).

c. Joint access residential drives shall have no less than 9 feet on each property. Joint access commercial/industrial drives shall have no less than 10 feet on each property, with the full drive width and access pavement to the property built for the development at the same time.

d. Commercial/Industrial drives, two-way, two-lane operation - These types of driveways shall have their width determined as follows:

   i. Commercial driveways shall have a minimum of 24 feet and a maximum of 30 feet of width. However, up to 40 feet wide drives may be used for vehicle-fueling service stations (see **Figure 8-3**).

   ii. Industrial driveways shall have a minimum width of 30 feet and a maximum width of 40 feet (see **Figure 8-3**).

e. Commercial/Industrial, two-way, three-lane operation - These types of driveways shall have their width determined as follows:

   i. Commercial driveways with two-way, three-lane operation shall have a minimum width of 36 feet and a maximum width of 40 feet.

   ii. All commercial and industrial drives will have an unbroken curb length of not less than 20 feet from the right-of-way, or 30 feet from the roadway curb, whichever is greater, extending into the site on each side of the drive (see **Figures 8-3** and **8-4**).

   iii. The radius for the inbound direction shall be 30 feet. The radius for the outbound direction shall be a minimum of 20 feet and a maximum of 30 feet where a right-turn lane is not present.

   iv. Pavement markings shall be installed to define the centerline between the opposing directions of travel and between the two lanes operating in the same direction.

   v. Pavement markings and signs to indicate the permitted or required exiting movements shall be installed and maintained by the property owner.

   vi. The pavement markings shall be consistent with the *Texas Manual on Uniform Traffic Control Devices (TMUTCD)*, and/or with city standards (see **Figure 8-5**).

f. Commercial/Industrial, two-way, divided, two-lane operation - These types of driveways shall have their width determined as follows:

   i. 90° drives shall have a width of 22 feet with a 30 feet radius for the inbound direction and 22 feet of width for the outbound direction, with a separation or barrier median with a minimum width of 4 feet and a maximum of 10 feet (see **Figure 8-4**). Narrower driveway widths must be approved by the Director of Engineering or his/her designee.

   ii. Joint access commercial/industrial drives shall have no less than 10 feet on each property, with the full drive width and access pavement to the property built for the development at the same time.

A summary of driveway widths, radii and angle requirements are provided in **Table 8-2**.

Figure 8-2: Driveway Width, Radius, and Spacing for Residential Driveways

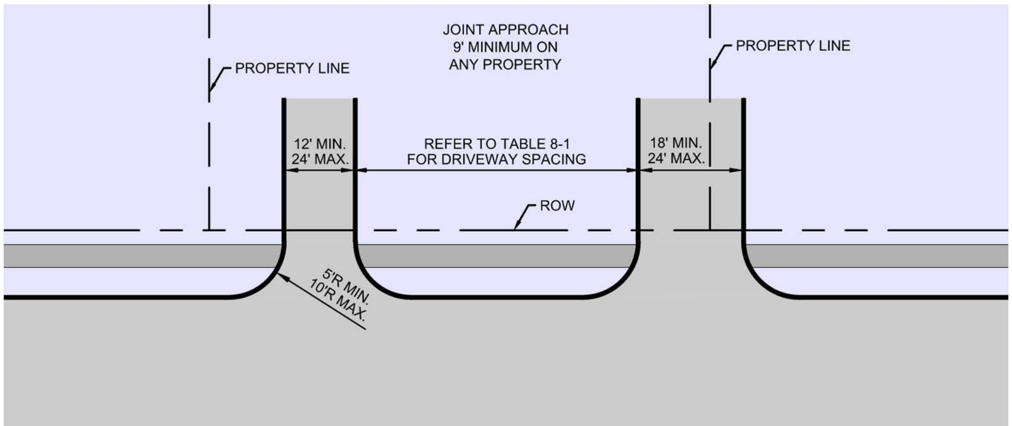


Figure 8-3: Driveway Width, Radius and Spacing for Undivided, Two-Lane Commercial and Industrial Driveway

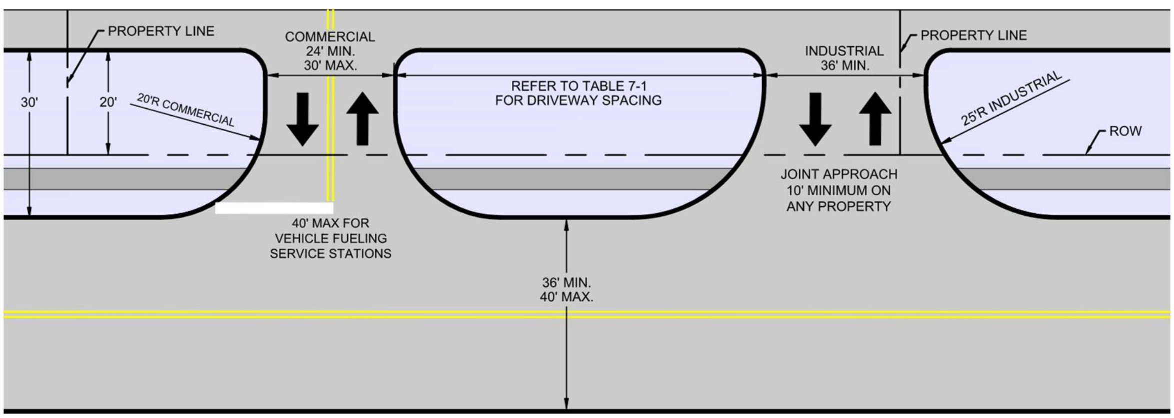


Figure 8-4: Driveway Width, Radius, and Spacing for Divided Commercial and Industrial Driveways

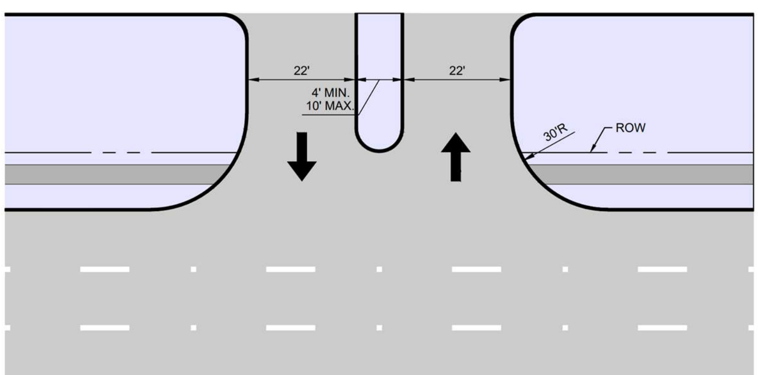


Figure 8-5: Driveway Layout for Undivided, Three-lane Commercial Driveways

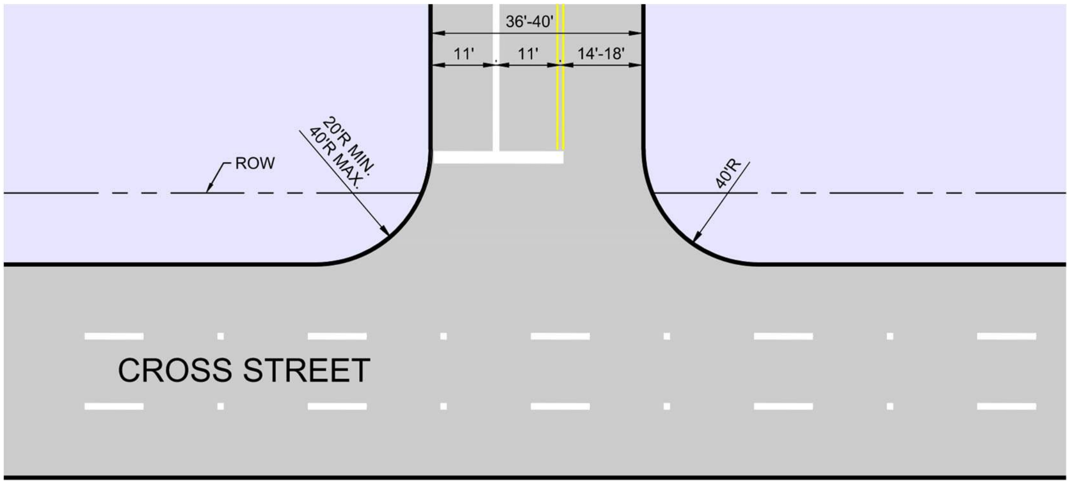


Figure 8-6: Driveway Layout for Undivided, Three-lane Commercial Driveways with Right-Turn Lanes

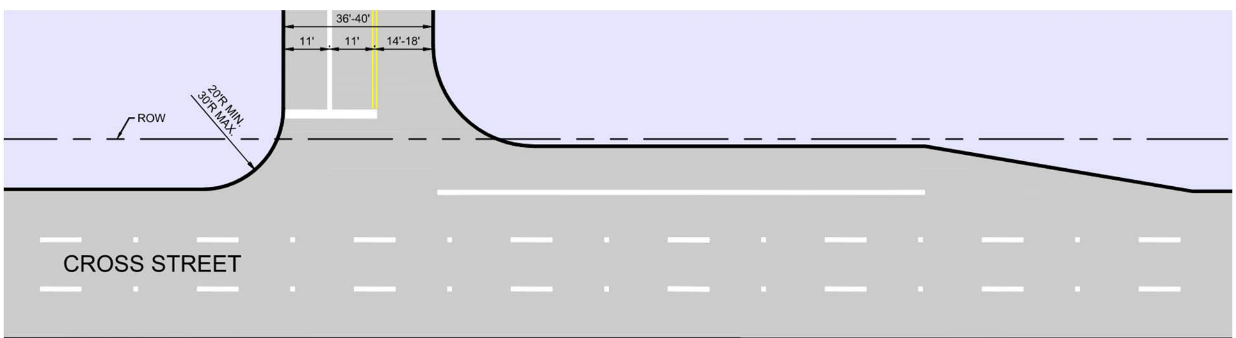


Table 8-1: Driveway Spacing in Relation to Other Drives Given the Posted Speed of the Street

Design Speed (mph)	Minimum Driveway Spacing (feet) (Projected Curb Lines)
25-30	100
35	135
40	180
45	235
50	300
55	375

Table 8-2: Summary of Drive Requirements

	Residential[3]	Commercial	Industrial	Commercial/Industrial-Divided	
				In	Out
Minimum Width	12 feet (including circular)	24 feet (two-lane) 36 feet (three-lane and if signalized)	30 feet[2]	22 feet[2]	22 feet[2]
Maximum Width	16 feet (one-way driveway) 24 feet to the street 32 feet to an alley	30 feet (two-lane) 40 feet (three-lane) 48 feet (if signalized)	25-30 feet	22 feet	22 feet
Curb Radii	5–10 feet	20–30 feet[1]	25-30 feet[1]	30 feet	20-30 feet Commercial 25-30 feet Industrial
Intersecting Angle	90°, 45°	90°, 45°	90°, 45°	90°, 45°	90°, 45°

(1)30 feet radius is required for inbound direction on a two-way three-lane drive.
(2)A one-way commercial/industrial driveway shall be 24 feet wide.
(3)A residential driveway connecting to an alley may have a width up to a maximum of 32 feet if the garage faces the alley; otherwise, its width is limited to 24 feet.

8.5 Driveway Radius

a. All driveways intersecting dedicated streets should be built with a circular curb radius connecting the raised curb line of the roadway to the curb line or pavement edge of the driveway. Driveway radii shall have a point-of-curvature on the adjacent street curb-line (typically established along the back-of-curb line) so that that the rest of the driveway falls entirely within the subject property line. This does not apply to alleys.

b. 90° Driveway Curb Radii

- The curb radii for a residential drive shall be a minimum of 5 feet and a maximum of 10 feet (see **Figure 8-2**).
- The curb radii for a commercial drive shall be a minimum of 20 feet and a maximum of 30 feet, except as otherwise noted in this document.
- The curb radii of an industrial driveway shall be a minimum of 25 feet and a maximum of 30 feet (see **Figures 8-3** and **8-4**) except as otherwise noted in this document.

8.6 Residential Driveways Along Alleys

a. A residential lot shall be allowed a maximum of one driveway onto a public street, except in the case of a circular driveway approved by the Director of Engineering.

b. A residential lot ¼ acre or bigger may have a circular driveway that shall connect to the same street.

c. A residential driveway that provides access to a garage shall connect to an alley or shall connect to a residential street.

d. A residential lot bordered by an alley and a residential street shall provide a driveway to the alley if trash pick-up services cannot be easily provided on the residential street, as determined by the Public Works Department. Factors that will be considered include but are not limited to, trash truck routing and whether existing or planned homes on the block already connect to the alley.

e. A residential lot shall be prohibited from having multiple driveway connections in a configuration that would create the possibility of a cut-through route between a public street and an alley that does not intersect or between two public streets that do not intersect, as determined by the Director of Engineering or his/her designee.

f. If a residential driveway is shared between two properties, the driveway shall be centered on the common property line unless otherwise approved by the Director of Engineering.

g. A residential driveway connecting to an alley shall not be located within 20 feet of the ROW line of a public street so as to prevent the driveway from being located in the alley taper.

h. A residential driveway connecting to a mews street or private alley shall not be located within 20 feet of the curb line of a public street.

i. A residential driveway connecting to a public street shall be located so its upstream edge is no closer than 15 feet from the curb return of an upstream intersection and its downstream edge is no closer than 5 feet from the curb return of a downstream intersection.

j. A residential driveway that changes in width as it extends onto the property shall do so with an angled transition that does not exceed a taper of 1:1 within 10 feet of the property line.

k. Sidewalk section through the driveway shall be poured with the same thickness as the driveway approach (existing sidewalk if any shall be removed). The cross slope of the sidewalk crossing the driveway shall meet all ADA and PROWAG standards.

l. Driveway thickness shall match street pavement thickness of 6 inches minimum.

8.7 Driveway Spacing and Location in Relation to Other Drives

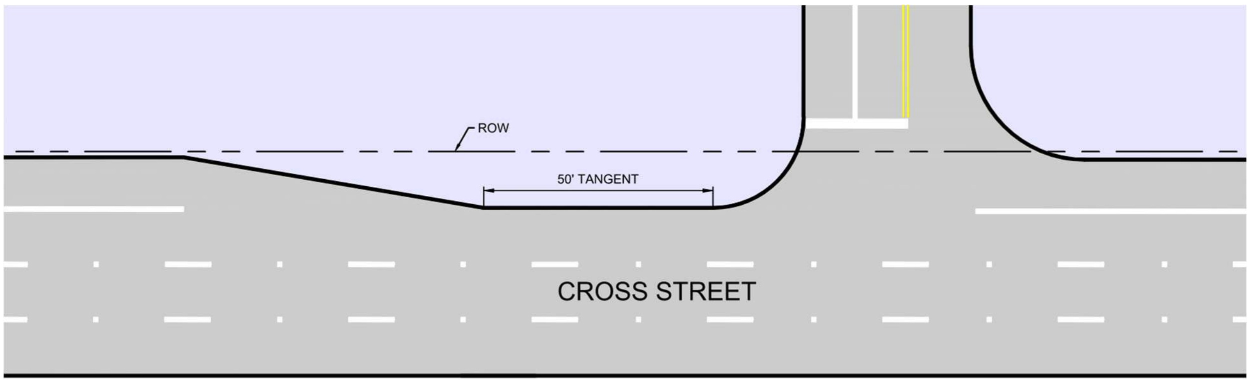
a. Residential – Driveways or access points on a given lot of land devoted to a single land use shall not occupy more than 70% of the linear frontage of one side of the lot adjacent to a roadway. No more than two driveways or access points per adjacent street shall be permitted on any lot.

b. Commercial and Industrial – For a given tract of land or development, the spacing and location of driveways shall be a function of both existing adjacent driveways and proposed driveways on other approved plans. The spacing between driveways shall depend upon the posted speed limit of the Major or Secondary Arterial as shown in **Table 8-1**. Driveways shall not be permitted in the transition or storage area of any deceleration lane or right-turn lane.

c. The minimum driveway spacing shall be measured parallel to the projected curb line between every two successive driveways (both existing and proposed). The distance being measured will be from the beginning of the closest tangent curb-line of one driveway to the closest tangent curb-line of the next driveway. Please note that the measurement is not taken from the centerline or radius of any driveway (see **Figure 8-3**).

d. In the case of back-to-back (successive) right turn lanes in proximity to a roadway, see **Figure 8-7** below for minimum tangent spacing required, 50 feet, between the turn lanes.

Figure 8-7: Tangent Spacing for Back-to-Back Right Turn Lanes



8.8 Driveway Spacing in Relation to a Cross Street

8.8.1 90° Drive Distance to Cross Street

a. Driveways along the curb line of Type F, Type G and/or Special Street shall be located a minimum distance equal to the driveway radius from the end of the street radius of the closest intersection of a Type F or smaller street (see **Figure 8-8**).

b. Driveways along the curb line of a Type D or Type E shall be located a minimum of 30 feet from the end of the street radius of the closest Type B, Type C, or Type D (see **Figure 8-9**).

c. Driveways along the curb line of a Regional or Major Arterial (Type B and C) shall be located a minimum of 100 feet from the closest ROW line or street easement of the closest intersection (any street type) along the Regional or Major Arterial (see **Figure 8-10**). If the property frontage being served by the said driveway is such that both the drive and the drive's curb radius cannot be totally within the proposed development, the drive shall be situated so as to create a joint access drive.

Figure 8-8: Driveway Spacing in Relation to a Cross Street - Driveway at 90° on a Minor Collector or Local/Residential Street

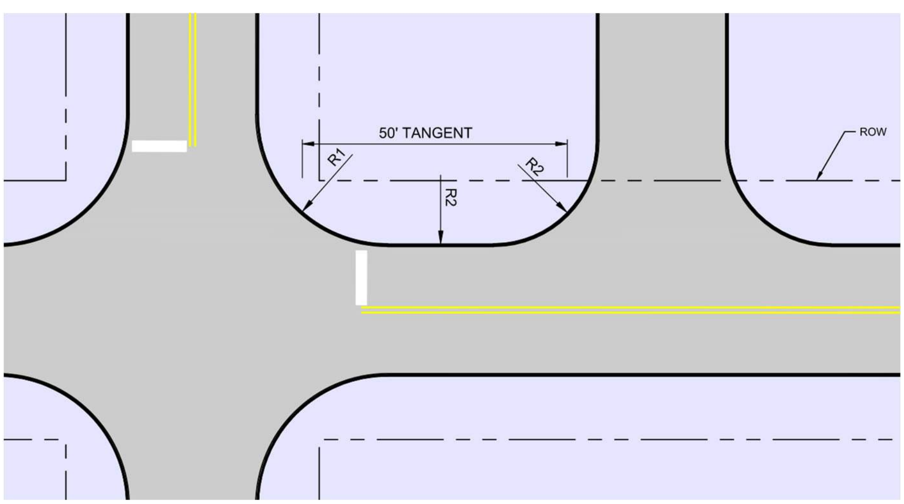


Figure 8-9: Driveway Spacing in Relation to a Cross Street - Driveway at 90° on a Minor Arterial or Major Collector

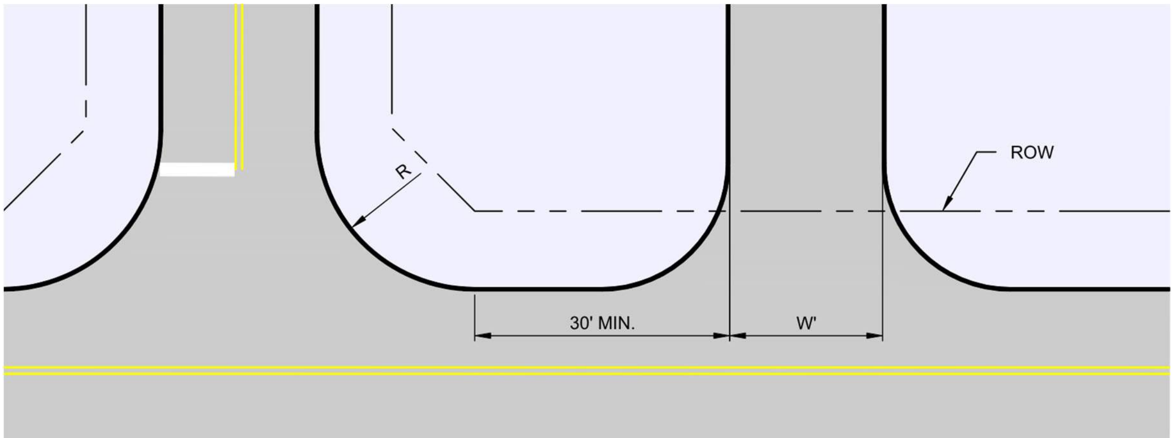


Figure 8-10: Driveway Spacing in Relation to a Cross Street - Driveway at 90° on a Regional or Major Arterial

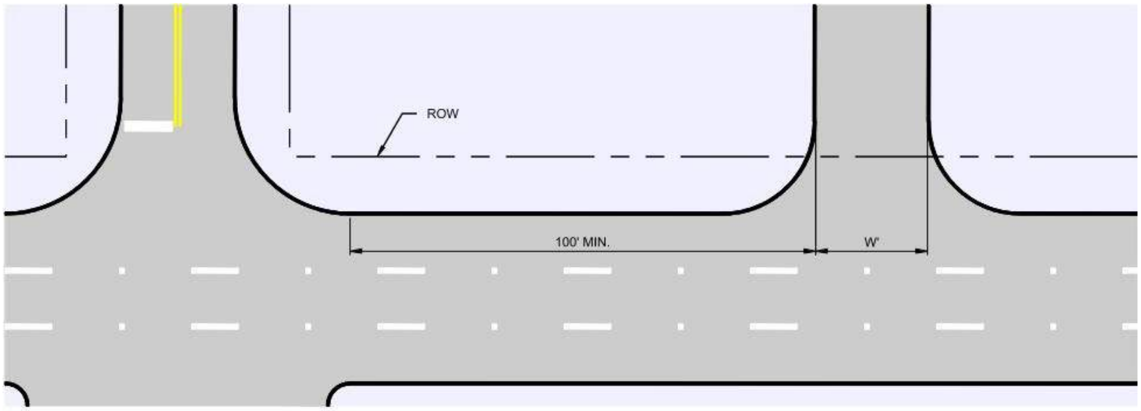
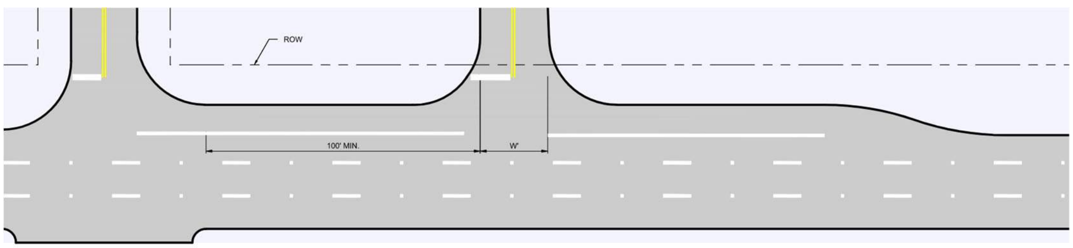


Figure 8-11: Driveway Spacing in Relation to a Cross Street - Driveway at 90° on a Regional or Major Arterial with Right-Turn Lane



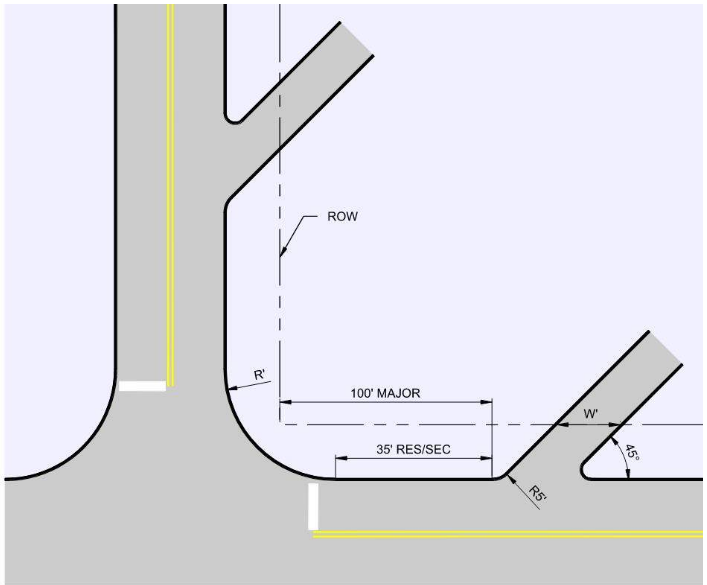
8.8.2 45° Drive Distance to Cross Street

If one-way angle drives are used, the radius for the driveway on a Local/Residential Street or Minor Collector shall be a minimum of 35 feet from an intersecting street's end of curb radius. On a Regional or Major Arterial, the drive shall be located a minimum of 100 feet from the closest ROW line or street easement of the closest street intersection (any street Type) along the Arterial. If the property frontage being served by the said driveway is such that both the drive and the drive's curb radius cannot be totally within the proposed development, the drive shall be situated so as to create a joint access drive (see **Figure 8-12**).

8.8.3 Driveways at 90° Corners

Commercial and industrial driveways and driveways serving other than a single-family residence shall not be located within the limits of the radius at approximately 90° corners or turns. Driveways located near approximately 90° corners or turns should be at least as far away from the corner as the spacing requirements established in **Subsections 8.8.1** and **8.8.2** above.

Figure 8-12: Angle Driveway Spacing in Relation to a Cross Street



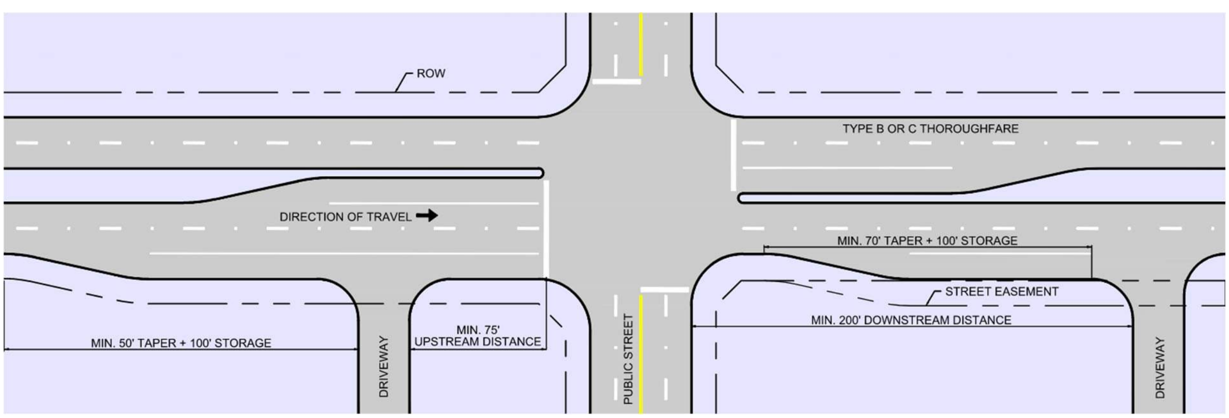
8.9 Driveways Located in Right-Turn Lanes

a. A driveway located upstream within the right-turn lane of a public street intersection shall be spaced so that its closest edge will be a minimum of 100 feet in advance of the stop bar. (see **Figure 8-13**).

b. If a driveway is located within the right-turn lane of a public street intersection, the storage length of the right-turn lane shall extend a minimum of 100 feet beyond the upstream edge of the driveway (see **Figure 8-13**). No driveway shall be permitted within the taper area of a right-turn or deceleration lane.

c. A driveway located downstream of a public street intersection shall be spaced so that its closest edge will be a minimum of 200 feet after the ROW line of the intersecting street. The downstream driveway shall have a minimum of 100 feet of storage and 50 feet of taper. (see **Figure 8-13**).

Figure 8-13: Distance Between Driveway and Intersection



8.10 Driveway Deceleration Lanes

Deceleration lanes are required on Type B Regional Arterials at all non-residential and multi-family driveways and shall meet the requirements of **Section 8.4** and **Section 8.5**. Deceleration lanes are also required for new developments meeting the right-turn volume criteria identified in **Section 12.4**.

8.11 Driveway Storage Lengths (Throat Lengths)

- On-site internal storage shall be provided at all non-residential and multi-family driveways for queuing of vehicles off-street to minimize congestion and increase safety both on the public street and within the driveway.
- Internal storage (throat length) requirements shall be based on the number of parking spaces accessible by the affected driveway. Divide the total number of parking spaces by the number of driveways and then use **Table 8-3** to determine the amount of internal storage required. This calculation shall be based on the preliminary site plan for an overall development or the site plan for a specific lot, whichever produces the largest ratio of parking spaces per driveway.
- Internal storage length shall be measured from the more restrictive of 11 feet from the projected curb line, 4 feet from the back of the sidewalk, or the ROW line or street easement to the first intersecting aisle, internal driveway, or parking stall.
- A circulation study will be required for all parking garages with a driveway that connects directly to a public street. Driveway storage requirements will be determined as a result of the study.
- No crossing drive aisles shall be within 100 feet of the stop bar at signalized driveways. A raised curb median shall be required at these locations.

Table 8-3: Minimum Driveway Storage Lengths (Throat Lengths)

Parking Spaces per Driveway	Storage Required (feet)			
	Multi-family or Commercial Uses		Industrial Land Uses	
	No Median Opening[1]	Median Opening[2]	No Median Opening[1]	Median Opening[2]
Less than 25	25	25	25	25
25-50	25	40	25	40
51-100	25	40	40	40
101-200	40	80	40	60
More than 200	100	150	40	100

[1]Includes driveways that connect to one-way frontage roads.
[2]Includes any driveway where a left-turn exit can be made, including driveways that connect to undivided roadways.

8.12 Entrance Streets and Driveways for Gated Developments

To ensure that the minimum dimensions are adequate, a traffic study, analyzing queue and storage lengths for both gate approaches and inbound turning movements, is required with the submission of a Specific Use Permit application for all gated communities.

8.12.1 Residential/Multifamily Developments

a. Gated developments shall have a median-divided street or driveway that will allow for a vehicular turnaround prior to the gate in the event that access is denied. A turnaround is not required on the public side of an exit-only gate provided that the exit is designed to prevent traffic from approaching it. If minimum distances cannot be met for exiting traffic, a right turn lane shall be required.

b. The turnaround shall be a minimum of 18 feet in width.

c. Entry gates shall be set back from the ROW line a minimum of 135 feet or as indicated in the traffic study. The card reader, or first stop, shall be set back from the ROW line a minimum of 100 feet, or as indicated in the traffic study, to provide storage for the longest queue of vehicles expected to access the gate (see **Figure 8-14**).

d. If a signal is added in the future, the distance from the gate to a major roadway must be long enough to accommodate the stacking of outbound traffic for signalization purposes.

e. Each direction of the divided street or driveway shall be a minimum of 24 feet in width with curb radii of 30 feet (see **Figure 8-14**).

f. The hinge point of the gate shall be a minimum of 18 inches behind the back of the curb. The gate shall open 24 inches behind the back of the curb.

g. Gates shall open sideways or swing open in the direction of travel on each side of the divided street.

h. Guard shacks may be located within the median before the gate entrance ensuring the location does not impede on the required queuing distance indicated in the traffic study.

i. Gates shall be equipped with emergency access devices as required by the Fire-Rescue Department.

j. Separate pedestrian gates shall be provided. The movement of the vehicular gates shall not encroach on sidewalks.

k. For alternative designs and deviations, see **Section 1.9, Introduction**.

l. Individual gated single-family residences shall have a minimum setback of 20 feet from the property line. The movement of the gate(s) shall not encroach on a sidewalk, alley, or street.

8.12.2 Non-Residential Developments

a. Gated developments shall have a median separating ingress and egress traffic flow allowing for a vehicular turnaround prior to the gate in the event that access is denied. A turnaround is not required on the public side of an exit-only gate provided that the exit is designed to prevent traffic from approaching it. If minimum distances cannot be met for exiting traffic, a right turn lane shall be required. An engineering study and queueing analysis shall determine the stacking distance required for each gated development. Vehicles will not be allowed to queue on the adjacent street.

b. The turnaround shall be a minimum of 18 feet in width and shall accommodate the turning movement of a City of Plano fire truck.

c. Entry gates shall be set back from the ROW line, or fire lane, a minimum of 75 feet, or as indicated in the traffic study. The card reader, or first stop, shall be set back from the ROW line a minimum of 40 feet, or as indicated in the traffic study, to provide storage for the longest queue of vehicles expected to access the gate.

d. Guard shacks may be located within the median before the gate entrance ensuring the location does not impede on the required queuing distance indicated in the traffic study.

e. Each direction of the driveway shall be a minimum of 22 feet in width with minimum curb radii of 30 feet (see **Figure 8-14**).

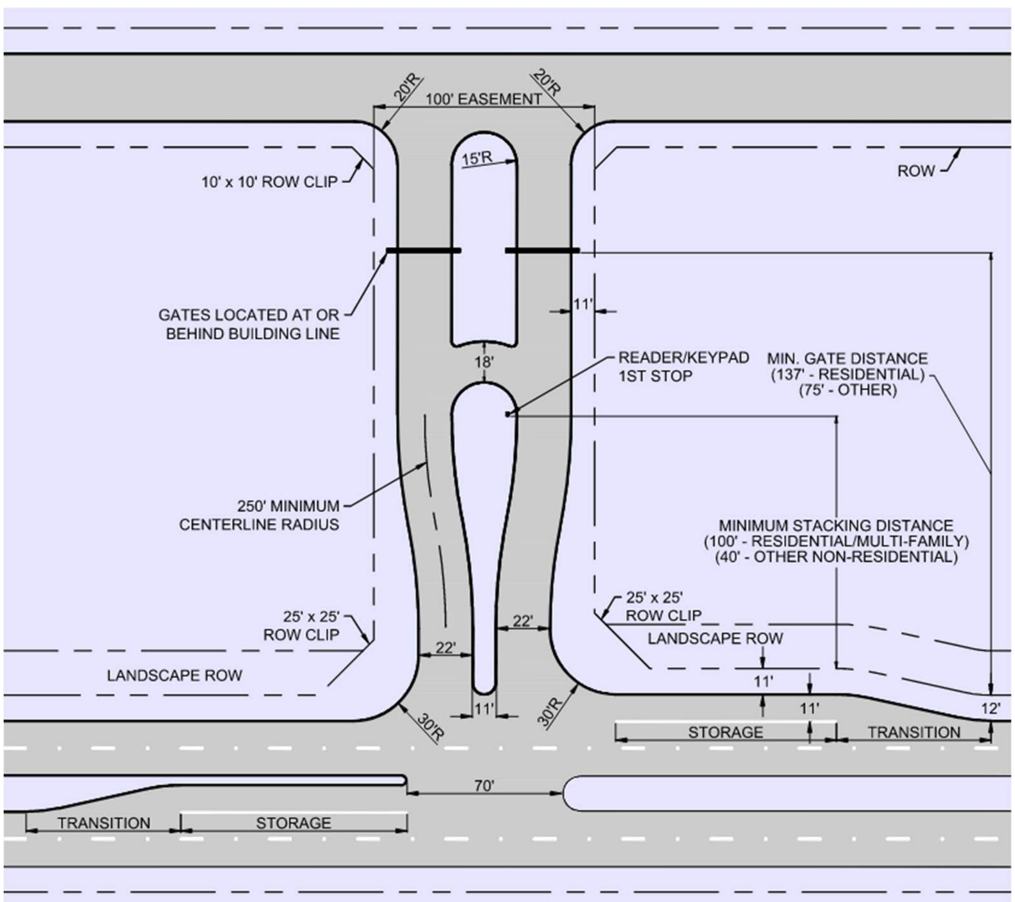
f. The hinge point of the gate shall be a minimum of 18 inches behind the back of the curb. The gate shall open 18 inches behind the back of the curb.

g. Gates shall open sideways or swing open in the direction of travel on each side of the divided entrance.

h. Gates shall be equipped with emergency access devices as required by the Fire Department.

i. All gates shall provide separate pedestrian gate access when pedestrian facilities are provided. The pedestrian gates can be locked during non-business hours. Pedestrian access shall not be taken from the same access as vehicles. The movement of the vehicular gates shall not encroach on sidewalks.

Figure 8-14: Gated Entrance Detail



8.13 Non-Conforming Driveways

a. All nonconforming driveways on a lot, tract, parcel, or site shall be allowed to remain in use until the occurrence of one or more of the following events:

- A change in use, or an increase in the intensity of use, occurs such that the site requires a 10% increase in required parking spaces.
- Addition or expansion of required queuing space of the driveway due to the increase of traffic volume of the driveway.
- Addition of a traffic signal.
- Any modification that changes the design or function of the existing driveway (including, but not limited to, any change to the internal circulation of the site that would increase the amount of traffic using the driveway).
- The addition of, or modification to, a median opening and/or turn lane(s) on the public street by a developer or city. All driveways that are served by the new and/or modified median opening shall comply with the requirements of these standards.

b. Upon the occurrence of the events described above, the nonconforming driveway shall either be reconstructed in accordance with these design requirements or eliminated.

9.1 General

This section covers the creation and implementation of facilities to improve multimodal transportation access and mobility for users of all ages and abilities. Users include, but are not limited to, pedestrians, bicyclists, and transit-riders. Pedestrian and bicycle facilities include sidewalks, barrier-free ramps, and bikeways. This section also discusses design guidelines for midblock crossing as well as the basics of transit design.

- The intent of the implementation of pedestrian facilities and sidewalks is to design streets and right-of-way (ROW) to promote safe, comfortable, and convenient access and travel for people of all ages and abilities. It is also the intent of this section to provide guidance to developers and development reviewers on the facility and design requirements of pedestrian facilities.

- The preferred placement of pedestrian facilities is away from the curb and near or next to the right-of-way line or easement line.

- Traffic signal cabinets shall be constructed in locations where maintenance personnel have unhindered line-of-sight to the signalized intersection controlled by the subject cabinet.

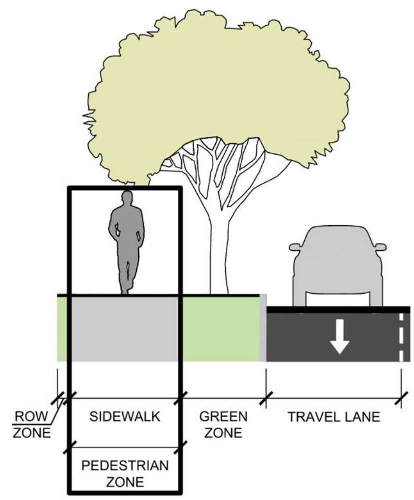
- The intent of the implementation of the bikeways is to provide a network of safe and comfortable bicycle facilities for people of all ages and abilities to encourage bicycling as a sustainable mode of transportation. To achieve this, bicycle facilities that are physically separated from vehicles shall be designed and constructed in accordance with **Section 2 (Street Framework)**.

- Transit is a critical aspect of transportation that helps in matching the mobility needs of customers and travel demands of a corridor while having significant cost savings. This section also provides an overview of guidelines on what to consider when designing transit facilities.

9.2 Pedestrian Facilities and Sidewalks

Sidewalks are located within the pedestrian zone, between the curb line or the edge of the pavement of the roadway and the adjacent property lines for the use of pedestrians that is separated from motor vehicles (see **Figure 9-1**). Sidewalks may vary in width depending on the land use context, available ROW, and street types (See **Section 2 (Street Framework Requirements)** for cross-sections with context-based sidewalk widths).

Figure 9-1: Sidewalk and Pedestrian Zone



9.2.1 Sidewalk Design Guidelines

Sidewalks shall conform to the most current federal, state and local Americans with Disabilities Act (ADA) and Public Right-of-Way Accessibility Guidelines (PROWAG) requirements. In situations where ADA and PROWAG standards conflict, the strictest requirements shall apply. In addition to the federal, state and local regulations, sidewalks shall conform to the following standards:

General Requirement

Concrete sidewalks designed and located according to city standards shall be constructed along all streets (except alleys and mews) in all zoning classifications except the agricultural zoning. Sidewalks shall be built at the time of site development.

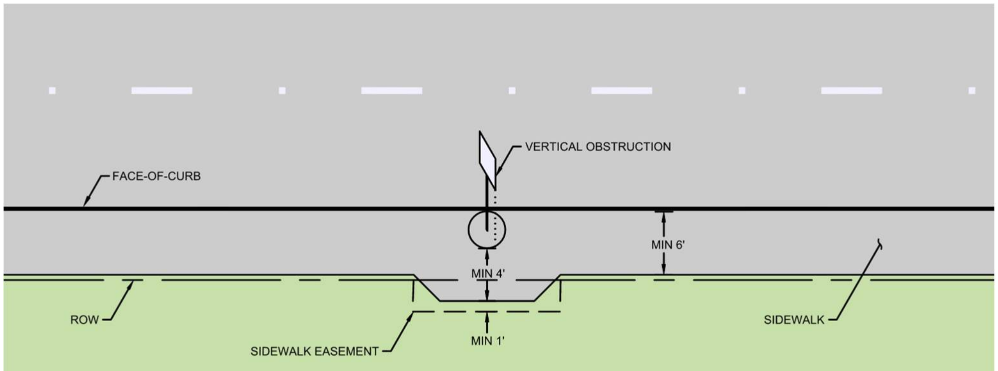
Sidewalk Width

Refer to **Section 2 (Street Framework)** for minimum width requirements of sidewalks to be met based on street type and land use context. The minimum clear width shall be unobstructed by any permanent or nonpermanent elements for accessible pedestrian travel. The sidewalk should typically be located within the street ROW but may extend into a sidewalk easement. The location of the sidewalk may vary within the pedestrian zone depending on other street elements or obstructions such as utilities, screening walls, or street trees. The inside edge of the sidewalk shall be no closer than 3 feet from the back-of-curb if approved by the Director of Engineering. Refer to **Section 2 (Street Framework)** and **Section 14 (Curb Management)** for parking locations and requirements.

a. If sidewalks are less than 5 feet wide, an adequate passing zone as defined in the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and PROWAG should be provided at intervals of 200 feet or where appropriate along the sidewalk.

b. If it should be necessary to construct the sidewalk adjacent to the curb line, the sidewalk shall be a minimum of 6 feet in width from the back-of-curb.

Figure 9-2: Sidewalk Placed Outside Roadway ROW



Sidewalk Grade

a. The maximum grade of the sidewalk shall be 5% or the grade of the adjacent street, whichever is greater. The maximum cross-slope of the sidewalk shall be 2%. However, the sidewalks shall also be designed in accordance with ADA and PROWAG requirements and regulations where applicable.

b. Sidewalks must be constructed between the curb line and the right-of-way line in the pedestrian zone or in an easement that creates a continuous path in front of adjacent properties.

c. Sidewalks and streetscape furnishings shall be constructed in accordance with the *City of Plano Construction Standard Details, Standard Park and Trail Construction Details,* and in accordance with the current edition of PROWAG and TAS. Whenever these standards are in conflict, the strictest requirements shall apply.

Sidewalk Easements

a. If the required sidewalk is to be placed outside of the roadway ROW, it must be placed in a sidewalk easement. Refer to **Figure 9-2** for a sidewalk placed outside the roadway ROW due to a vertical obstruction.

b. A minimum of 1 foot of ROW or sidewalk easement or consistent with typical cross-sections in **Section 2 (Street Framework)** shall be provided adjacent to the outside edge of the sidewalk for maintenance purposes. Any portion of the sidewalk extending outside the ROW shall be contained within a sidewalk easement, the inside edge of which extends to the ROW line and the outside edge of which extends a minimum of 1 foot beyond the outside edge of the sidewalk. No fence, wall, building, or other type of structure shall be located within the sidewalk easement. Approval of planned exceptions and sidewalk easements shall be made at the time of site plan or plat approval.

Areas Without Screening Walls

In areas on Type B, C, and D streets where screening is not required or a type of screening other than a wall is used, (e.g., a berm, foliage, etc.) a 5 feet sidewalk will be constructed not more than 2.5 feet from the ROW line.

Areas with Screening Walls

In areas where a screening wall is provided, a concrete sidewalk shall be constructed contiguous with the screening wall. The street side of the sidewalk shall run parallel to the street curb. The sidewalk shall be a minimum of 5 feet wide (or consistent with typical sections in **Section 2 (Street Framework)** and the measurement shall be made from the street side of the sidewalk to the face of the screening wall columns.

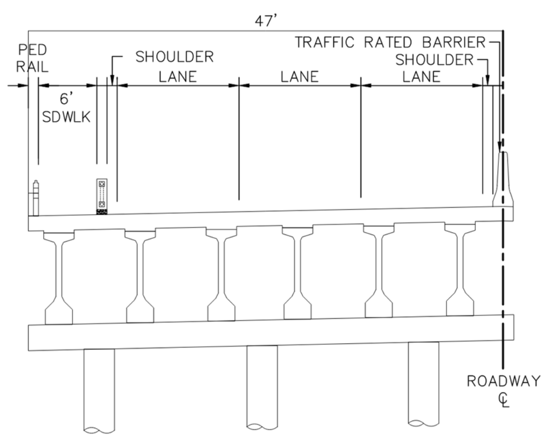
Sidewalk on Bridges

Bridges on all thoroughfares shall have a sidewalk constructed on each side of the bridge. The sidewalk should be constructed from the back-of-curb without a buffer for Types B and C thoroughfares, whereas Types C, D, E, F and G thoroughfares may have a buffer between the back-of-curb and sidewalk. If the sidewalk is part of a designated or planned bike route, the minimum width of the sidewalk shall be 10 feet to accommodate two-way bike traffic. If the sidewalk is not part of a bike route, the minimum width of the sidewalk shall be 6 feet. In both cases, a traffic-rated barrier shall be provided adjacent to the curb of the thoroughfare, with a standard pedestrian bridge rail protecting the sidewalk on the outside edge of the bridge. A pedestrian-rated bridge rail protecting the sidewalk shall be provided on the outside edge of the bridge (see **Figure 9-3**).

Sidewalks Under Bridges

When a pedestrian pathway is needed along the embankment of a roadway that traverses under the bridge of another roadway new or reconstructed, the minimum width of the sidewalk shall be 10 feet to accommodate two-way bike traffic. Pedestrian facilities under bridges should be designed in accordance to *Standard Park and Trail Construction Standards* with adequate physical space for pedestrians, proper lighting, clear sight lines, and architectural treatments that create an inviting pedestrian environment.

Figure 9-3: Typical Sidewalk on Bridge Section



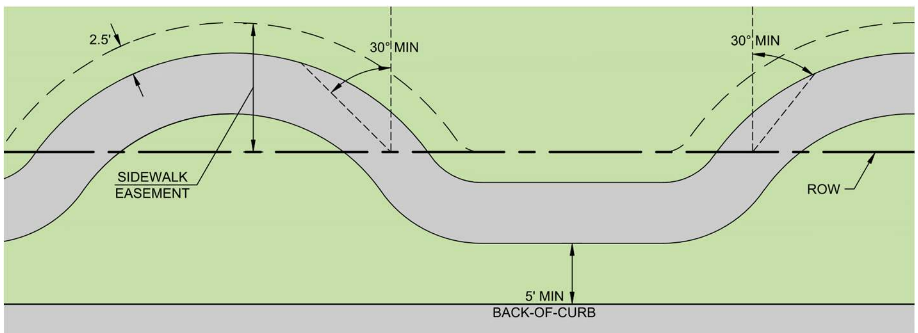
Sidewalks on Culverts

All culvert crossings shall have a sidewalk, a minimum of 6 feet wide, constructed on each side of the culvert. A pedestrian-rated handrail with a minimum height of 42 inches shall be provided at the back of the sidewalk or on the culvert headwall. A traffic-rated barrier between the travel lanes and sidewalk shall be required where the posted traffic speed is greater than 35 mph. For low-speed facilities, a traffic-rated barrier at the back of the sidewalk or beyond may be required based on *AASHTO's Roadside Design Guide*.

9.2.2 Meandering Sidewalks

Sidewalks along Types B, C, D, and E streets may meander to avoid pre-existing physical obstacles or encroachments. Meandering should be minimal and not along a whole block. Between street intersections, these sidewalks shall meander with smooth undulation and shall have no sharp angles or abrupt changes in direction. Sidewalk easements adjacent to the standard ROW line will be required to contain any portion of the meandering sidewalk that extends beyond the ROW. Sidewalk easements shall provide a minimum clearance of 2.5 feet beyond the outside edge of the sidewalk. The inside edge of a meandering sidewalk shall never be less than 3 feet from the back-of-curb but desired to be 5 feet. A tangent calculated at any point along the centerline of a meandering sidewalk shall not be less than 30° from perpendicular to the street. These requirements are shown in **Figure 9-4**.

Figure 9-4: Meandering Sidewalk



9.2.3 Barrier-Free Ramps

Barrier-free ADA access ramps shall be provided at all street intersection corners, all crosswalks, and across any non-residential or multi-family driveway, irrespective of the land use context in accordance with federal guidelines. The side of a residential T-intersection that has no corner shall have a minimum of one access ramp leading to one of the two corners. The number and location of ADA crossings across Type B, C, D, and E streets shall be determined by the Director of Engineering. Access ramps on each side of a crossing shall align with each other.

- Pedestrian crossings of Type D and greater roadways shall utilize enhanced crossing treatments including enhanced signs and markings, rectangular rapid flashing beacons, pedestrian hybrid beacons, or full traffic signals as determined by an engineering study.
- Existing pedestrian facilities including receiving ramps on opposing corners shall be made compliant when barrier-free ramps are added or removed.
- Median modifications or cut-thru ramps shall be constructed as necessary to provide unobstructed pedestrian crossings.

9.2.4 Pedestrian Handrails

Pedestrian handrail of a height not less than 42 inches and shall be required when any of the following conditions are located within 2 feet of an existing or planned public sidewalk, or as directed by the Director of Engineering:

- A permanent or intermittent body of water;
- Side slope steeper than 4H:1V with drop-off ending at a body of water;

- Side slope steeper than 3H:1V with drop-off greater than 2.5 feet; or,
- Vertical surface with drop-off greater than 0.5 feet.

Exemptions to this requirement may be considered by the Director of Engineering or his/her designee when:

- The depth of a body of water is less than 1 foot;
- The sidewalk provides recreational access to a body of water; or
- Alternative means of protection are approved.

Pedestrian handrails located on public sidewalks shall typically be TxDOT Type E rails or constructed in accordance with the *City of Plano Standard Construction Details*. Alternative pedestrian rail designs may be considered with signed and sealed details. Any required concrete foundation shall be in addition to the minimum sidewalk width.

All rail surfaces shall be galvanized steel or brushed aluminum. Fasteners and hardware shall be corrosion-resistant. Weathering steel and wrought iron are not acceptable materials for pedestrian rails for public sidewalks. Painted rails may be considered by the Director of Engineering or his/her designee. Coating for rails, if approved, shall be powder-coated or industrial-grade exterior paint. A maintenance agreement may be required for non-standard rails.

9.3 Midblock Crossings

A midblock crossing is a pedestrian crossing that is not located at a roadway intersection. Recommended locations for midblock crossings include midblock transit stops, parks, plazas, and high pedestrian volume building entrances. Midblock crossings of Type D and greater roadways shall utilize enhanced crossing treatments including enhanced signs and markings, rectangular rapid flashing beacons, pedestrian hybrid beacons, or full traffic signals as determined by an engineering study. Midblock crossings of Type E and lesser roadways shall conform to the following:

9.3.1 Midblock Design Guidelines

- Midblock crosswalks should be provided at locations where pedestrians are expected to cross. The midblock crosswalk location should give maximum visibility to both pedestrians and drivers.
- Midblock crossings may be marked with signing and high visibility pavement markings to improve the visibility of crossing pedestrians to drivers, especially at night. Signing and pavement marking design should reference the latest city standards and *Texas Manual on Uniform Traffic Control Devices* (TMUTCD) guidelines.
- Midblock crossings with raised crosswalks may be considered for improved visibility, detection, and recognition to the driver and pedestrian.
- Lighting may be provided at approved midblock crossings in accordance with **Section 11 (Street Lighting)**. Lighting may be considered by either luminaires, light poles, in-roadway lights, or backlit overhead signs.
- Midblock Crossings Through Medians – Adding a raised median is beneficial at midblock crossing locations as it provides pedestrians with a refuge. Crossings through short, raised medians are called

crossing islands (also known as center islands, refuge islands, pedestrian islands, pork chops or median slow points).

Considerations

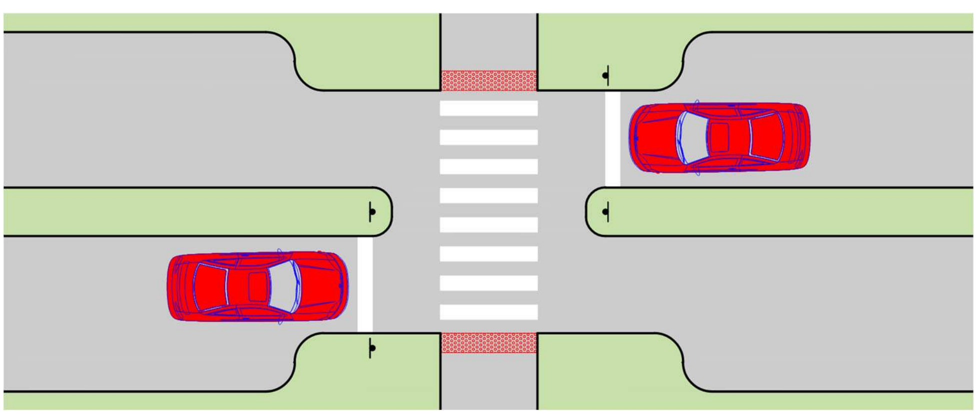
Medians allow pedestrians to cross two-way roadways one direction at a time, minimizing crossing delays. Children, seniors, and persons with disabilities often require larger gaps and time for crossing roadways. By introducing a median to a street, there are more opportunities for gaps since pedestrians only need to look for a safe one-way gap instead of a two-way gap. By reducing the time, a pedestrian must wait for an acceptable gap, pedestrians are encouraged to cross at the recommended crossing location.

Guidance

- Medians should ideally be at least 6 feet wide to allow a pedestrian to take refuge comfortably, to meet *TAS* and *PROWAG* standards, and to accommodate the typical width of a bicycle. It should be noted that even narrower medians can be used to provide at least some buffer to pedestrians, but it is not recommended for pedestrians to use these medians as a refuge because of the proximity to travel lanes. Considerations should be given to narrowing travel lanes to create a wider median to provide pedestrian refuge at midblock crossing locations.
- The median refuge as well as any narrow median cut through shall be provided to comply with TAS and PROWAG.
- The median refuge should be aligned directly with marked crosswalks and provide an accessible route of travel.
- Where midblock crosswalks are installed at uncontrolled locations across an undivided street or street with a flush median, crossing islands should be considered as a supplement to the crosswalk.
- Crossings through medians can be designed with a slight stagger, forcing pedestrians to face oncoming traffic before progressing through the second phase of the crossing.
- If there is enough width, midblock crossings through medians can be accompanied by curb extensions to create a highly visible pedestrian crossing and provide effective traffic calming.

Figure 9-5 shows an example of a midblock crossing location through a median with lighting, curb ramps, a cut-through ramp, curb extensions, and a marked crosswalk.

Figure 9-5: Midblock Crossing Example



9.3.2 Types of Midblock Crossing Control

Depending on the type of pedestrian control provided at the midblock crossing locations, midblock crossings can be broadly classified as non-actuated and actuated midblock crossings.

Non-Actuated Midblock Crossings

Non-actuated midblock crossings are midblock crossings where there is no pedestrian actuation or detection installed at the crossings. For these types of crossings, ADA-compliant curb ramps and marked crosswalks shall be provided, at a minimum, depending on the types of roadways being crossed. The crosswalks should be supplemented with necessary signage and pavement markings. At uncontrolled multilane crossings, the yield or stop bars should be placed 20 to 50 feet in advance of the nearest crosswalk with parking prohibited within that space to provide drivers with a better visibility of the crosswalk. Curb extensions may be considered as a replacement for parking spaces to reduce pedestrian crossing distance and visually alert drivers of the crossing ahead. If a non-actuated crossing is located near a transit stop, it should be placed upstream of the transit stop location so pedestrians can cross behind the bus or transit vehicle. Pavement markings and signage for crossings should be provided in accordance with the *TMUTCD* and the *City of Plano Standard Construction Details*.

Actuated Midblock Crossings

Actuated midblock crossings are the midblock crossing where pedestrian actuation or detection is installed at the crossings. These detections are typically provided through push button detection.

According to *Federal Highway Administration (FHWA)*, actuated midblock crossings should be considered under the following conditions:

- On high traffic volume and/or high-speed traffic roadways.
- Where there are infrequent gaps in traffic.
- In a school zone or within an area with a high number of young pedestrians.
- Where seniors and persons with disabilities frequently cross.

The main types of actuated midblock crossing devices are HAWK (High-Intensity Activated Crosswalk) signals, more commonly known as Pedestrian Hybrid Beacons (PHB), and flashing LED signs.

Rectangular Rapid Flashing Beacons (RRFB)

RRFBs are pedestrian-activated beacons which supplement the midblock crossings by providing an additional warning to the drivers. RRFBs can be activated by either passive (by a pedestrian detection system) or active (by physically pushing a push button) pedestrian detection. The most common type of detection is the push button detection. They usually supplement warning signs, operate similarly to emergency flashers, and remain flashing to provide adequate pedestrian crossing time in accordance with *TMUTCD* when activated. Compliance is likely to increase when installing RRFBs on either side of the crosswalk facing oncoming traffic. RRFBs can be installed on two-lane and multilane roadways.

All curb ramps, push buttons and crosswalks installed should be compliant with the *TAS* and *PROWAG*. These devices shall be installed in accordance with the latest edition of *TMUTCD* and city standards.

Pedestrian Hybrid Beacons (PHB)

A PHB is a signalized traffic control device designed to help pedestrians cross the street by stopping traffic. It is made up of two red lenses and a yellow lens. A PHB should be considered on roadways above 35 mph where recommended in the *TMUTCD*.

According to the *TMUTCD*, midblock crossings should not be signalized if they are located within 300 feet of the nearest traffic signal unless the proposed signalization will not restrict the progression of traffic. The crossing should also not be signalized if located within 100 feet of a stop or yield-controlled intersection with a street or driveway.

It is recommended that midblock signals have an immediate response when actuated by pushing the pedestrian call button. The immediate response of the PHB signal should only be installed if nearby signals are not in progression or if only used during off-peak hours. If the PHB signal is close to other signals, it should be part of an overall coordinated system to maintain progression. If there is a median refuge at the PHB signal, push buttons shall be at the median refuge to reactivate the PHB signal. The *TMUTCD* provides further guidelines and warrant criteria for the installation of PHB signals.

Flashing LED Signs

Flashing Light Emitting Diodes (LED) signs are the preferred actuated control at midblock crossings for the city. By embedding LED units in the warning signs, there are benefits of improved driver compliance and enhanced visibility in low light conditions. Due to the low power requirements of LEDs, flashing LED signs can be powered with stand-alone solar panel units. When installed at midblock crossings, the pedestrian warning sign (W11-2) is embedded with flashing LEDs. The signs are set to flash with active or passive pedestrian detection. One double-sided flashing LED sign or two single-sided flashing LED signs should be installed at each side of the crosswalk. When used, the LED-embedded signs must conform to the requirements set in the *TMUTCD*.

9.4 Bicycle Facilities

A Bicycle network is an assortment of interconnected bicycle facilities that together allow people to travel by bicycle safely and conveniently. Bicycle networks may comprise different types of bicycle facilities that serve different types of users and vary in their degrees of separation from motor vehicle traffic. The following section describes the different types of bicycle facilities found in the City of Plano's *Bicycle Transportation Plan Map*.

9.4.1 Types of Bicycle Facilities

Bicycle facilities are provisions to accommodate or encourage bicycling, including bikeways, shared lanes and shared lane markings, and other associated design elements such as crossings, bicycle detection, wayfinding, and bicycle parking.

Shared lanes are lanes that allow compatibility of operation for both motorized vehicles and bicycles. Bicycle facility types within the City can be classified into these three categories:

- **Sidepath (or Off-Street Bikeway)** – located within the Green and Pedestrian Zone where both pedestrians and bicyclists operate.
- **On-Street Dedicated Bike Lanes** – exclusive lanes for bicycle travel separated from general traffic lanes, located within the Curbside/Flex Zone, where both transit and bicyclists operate.

- **On-Street Shared Lanes** – non-exclusive lanes that allow compatibility of operation for both motorized vehicles and bicycles, located within the Travelway Zone, where both motorists and bicyclists operate.

- Bikeways are any road, path, or facility intended for bicycle travel that designates space for bicyclists distinct from motor vehicle traffic, such as bike lanes, buffered bike lanes, bike-accessible shoulders, sidepaths, and separated bike lanes. This type of bikeway does not include shared lanes, sidewalks, signed routes, or shared lanes with shared lane markings.

Bikeway design differs with varying street types. As a result, bikeways must be designed in a way that gives bikes a clear ROW along streets. Refer to **Section 2 (Street Framework)** for typical bikeway widths for different street types.

9.4.2 Bikeway Design Guidelines

This section discusses the design guidelines for the three types of bikeways - sidepath, on-street dedicated bike lanes, and shared lanes, as well as the required pavement markings for these facilities.

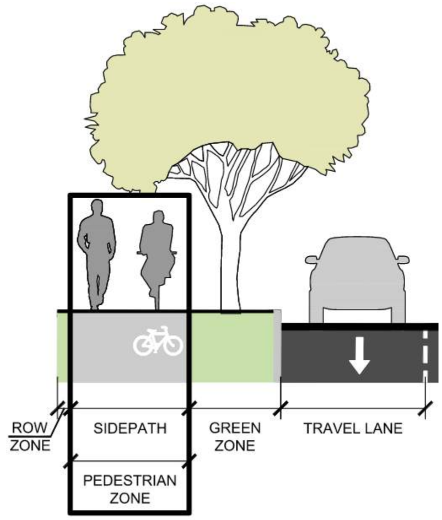
Sidepath

A sidepath is a bikeway facility physically separated from motor vehicle traffic and used by bicyclists, pedestrians, and other non-motorized users. Sidepaths maximize separation from motor vehicle traffic and are designed with minimal conflicts, although bicyclists and pedestrians will have increased interactions with motor vehicles at driveways and intersections on a sidepath (Refer to **Section 9.3.3** for crossing treatments and conflict markings). Sidepaths may be provided on both sides of the roadway to facilitate bicycle mobility and connectivity. Refer to **Table 2-3** in **Section 2 (Street Framework)** for the recommended locations of sidepaths based on street types and land use contexts.

The minimum width for a sidepath within the Green and Pedestrian Zone and adjacent to a roadway is 10 feet. In locations with higher volumes of users or when designated as an NCTCOG Regional Veloweb connection, a minimum of 12 feet should be used. Widths as narrow as 8 feet are only acceptable for short distances under physical constraints, as approved by the Director of Engineering or his/her designee. Warning signs should be considered at these locations (Refer to **Table 2-3** in **Section 2 (Street Framework)** for desired and minimum sidepath widths). Buffer width for a two-way sidepath shall be a minimum of 4 feet from the back-of-curb for curbed low-speed streets (45 mph or less). For a curbed high-speed street (50 mph or greater), a minimum of 6 feet buffer width shall be used. See **Figure 9-6** for the typical section with a sidepath.

Sidepaths must be designed according to state and national standards. This includes establishing a design speed (typically 18 mph) and designing path geometry accordingly. Consult the *AASHTO Guide for the Development of Bicycle Facilities* for guidance on geometry, clearances, traffic control, railings, drainage, and pavement design. Sidepaths must also conform to *Public Rights-of-way Accessibility Guidelines (PROWAG)* if in a public right-of-way or *Advance Notice of Proposed Rulemaking (AN-PRM) on Accessibility Guidelines* for sidepaths if in private streets.

Figure 9-6: Sidepath Typical Section

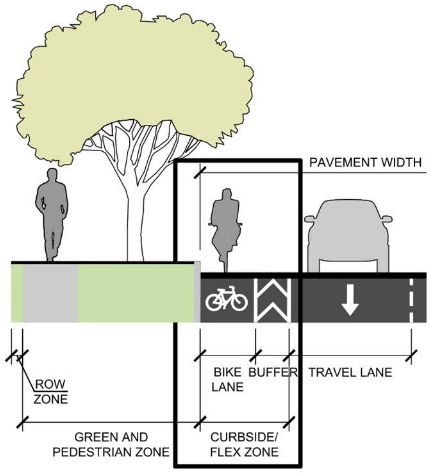


On-Street Dedicated Bike Lane

On-street dedicated bike lanes are located within the Curbside/Flex zone and are typically designated by a combination of striping, signage, and pavement markings.

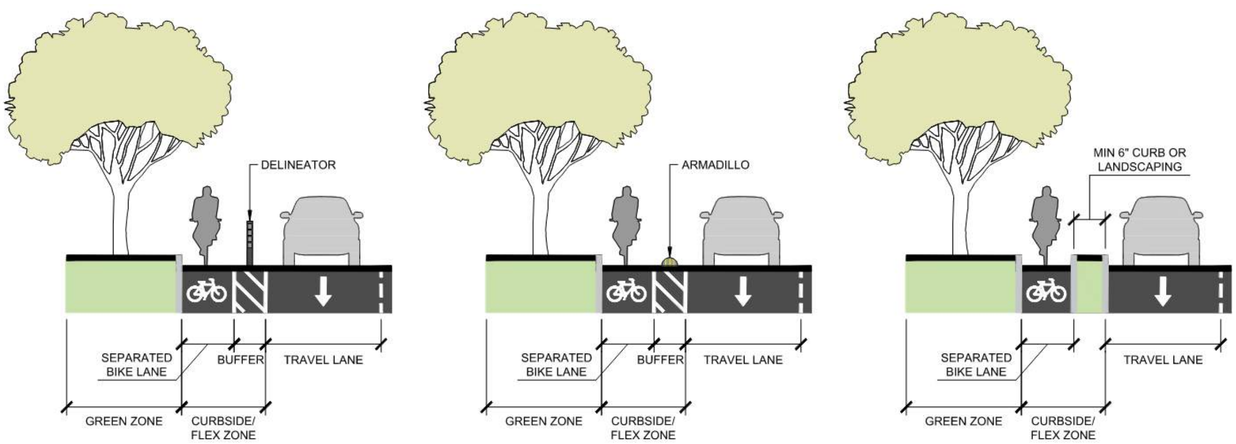
- Dedicated bike lanes must be a minimum of 5 feet and a preferred width of 6 feet excluding gutter (if present).
- A buffer is recommended in between a bike lane and the travel lane where speeds are 30 mph or greater or when traffic volume exceeds 6,000 vehicles per day. Refer to **Table 9-1** for the recommended locations of buffered bike lanes based on street types and land use contexts.
- When provided, typical buffer widths are 3 to 5 feet, with a minimum buffer width of 2 feet. Buffers are used between bicycle lanes and motor vehicle travel lanes to increase bicyclists' comfort and will also allow bicyclists to pass slower-moving bicyclists. Refer to **Figure 9-7** for the typical section with a buffered bike lane. Buffers may include pavement markings, physical barriers, raised markers, etc. or as approved by the Director of Engineering
- Chevron striping shall be used for buffers wider than 4 feet.

Figure 9-7: Buffered Bike Lane



- Separated bicycle lanes may be protected using physical barriers such as delineators, armadillos, minimum 6-inch curbs or landscaping. These are recommended where bicycle ridership is high, adjacent traffic volumes or speeds are high, and at intersections to provide visible barriers for motorists. Refer to **Figure 9-8** for a separated bike lane typical section with a physical barrier.

Figure 9-8: Separated Bike Lane with Physical Barrier



Shared Lane and Markings

A through travel lane on the far right side of the travel way zone can be shared with bicyclists (see design constraints below), denoted by a shared lane sign or pavement marking. The markings are two chevrons positioned above a bicycle symbol, placed where the bicyclist is anticipated to operate. Shared lanes should only be used in Type D through G streets, where low traffic speeds and volumes are part of a signed route or bicycle boulevard (see **Section 9.4.3**). Refer to **Figure 9-9** for the typical section with a shared bike lane marking. See below for design guidelines:

- Shared lanes can be used for downhill bicycle travel in conjunction with climbing lanes intended for uphill travel.
- Typical signage may include a “BICYCLES MAY USE FULL LANE” (R4-11).

- Custom signage may include language instructing drivers to change lanes to pass or use a 3 feet passing distance.

- Shared lanes are intended for use only on streets with posted speeds of up to 30 mph and traffic volumes of less than 3,000 vpd.

- Shared lane markings are sometimes used as a temporary solution on constrained, higher-traffic streets (up to 10,000 vpd) until additional ROW or street easements can be acquired but should not be considered a permanent solution in these contexts.

- The marking's centerline must be at least 4 feet from the curb or edge of the pavement (excluding the gutter, if present) where parking is prohibited.

- The marking's centerline must be at least 11 feet from the curb (excluding the gutter, if present) where parking is permitted so that it is outside the door zone of parked vehicles.

- For lanes 12 feet or less, it may be desirable to center shared lane markings along the centerline of the outside travel lane.

Figure 9-9: Shared Lane

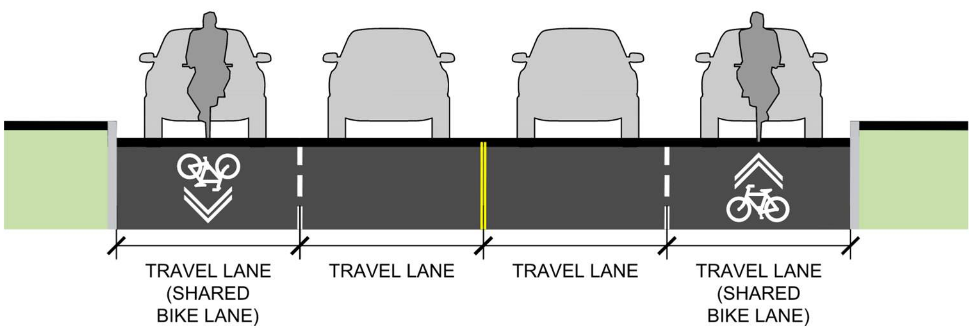


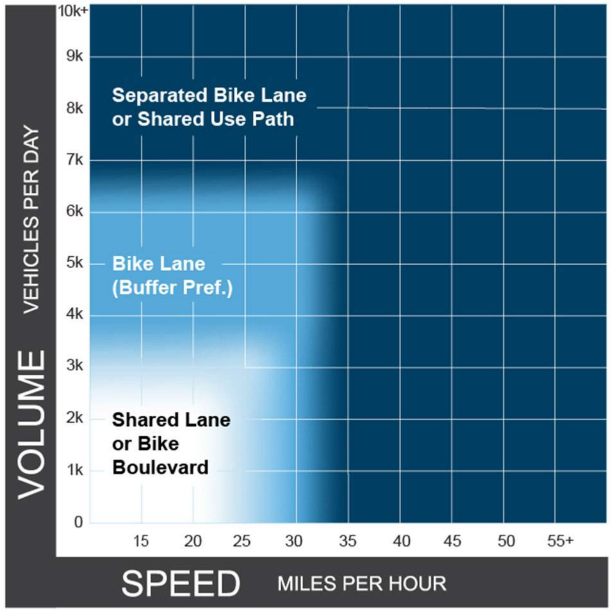
Table 9-1: Allowable Bikeway Locations

Street Types	Land Use Context	Sidepath	Buffered/ Separated Bike Lane	Shared Lane
Type B	Neighborhood	☒	☐	☐
	Commercial	☒	☐	☐
	Corner	☒	☐	☐
	Mixed-Use	☒	☐	☐
Type C	Neighborhood	☒	☒	☐
	Commercial	☒	☒	☐
	Corner	☒	☒	☐
	Mixed-Use	☒	☒	☐
Type D	Neighborhood	☒	☒	☒
	Commercial	☒	☒	☒
	Corner	☒	☒	☒
	Mixed-Use	☒	☒	☒
Type E	Neighborhood	☒	☒	☒
	Commercial	☒	☒	☒
	Corner	☒	☒	☒
	Mixed-Use	☒	☒	☒
Type F	Neighborhood*	☒	☒	☒
	Commercial	☐	☒	☒
	Corner	☐	☒	☒
	Mixed-Use	☐	☒	☒
Type G	Neighborhood	☐	☐	☒
	Commercial	☐	☐	☒
	Corner	☐	☐	☒
	Mixed-Use	☐	☐	☒

*Sidepaths may be allowed along a Type F Neighborhood street in limited situations upon approval from the Director of Engineering.

Refer to **Figure 9-10** for allowable bikeway locations based on posted speed and traffic volume. Shared lanes and/or bike boulevards should be used in areas with the lowest levels of traffic and speed, while shared-use paths and separated bike facilities should be used in areas with the highest levels of traffic and speed to increase safety for users.

Figure 9-10: Allowable Bikeway Locations based on Posted Speed and Traffic Volume (Source: TxDOT Bike Facility Selection Guide)



Notes: *Chart assumes operating speeds are similar to posted speeds. If they differ, use operating speed rather than posted speed.
**Advisory bike lanes may be an option where traffic volume is less than 3,000 ADT.

9.4.3 Enhancements and Supporting Treatments for Bicycle Crossings

Crossing Treatments

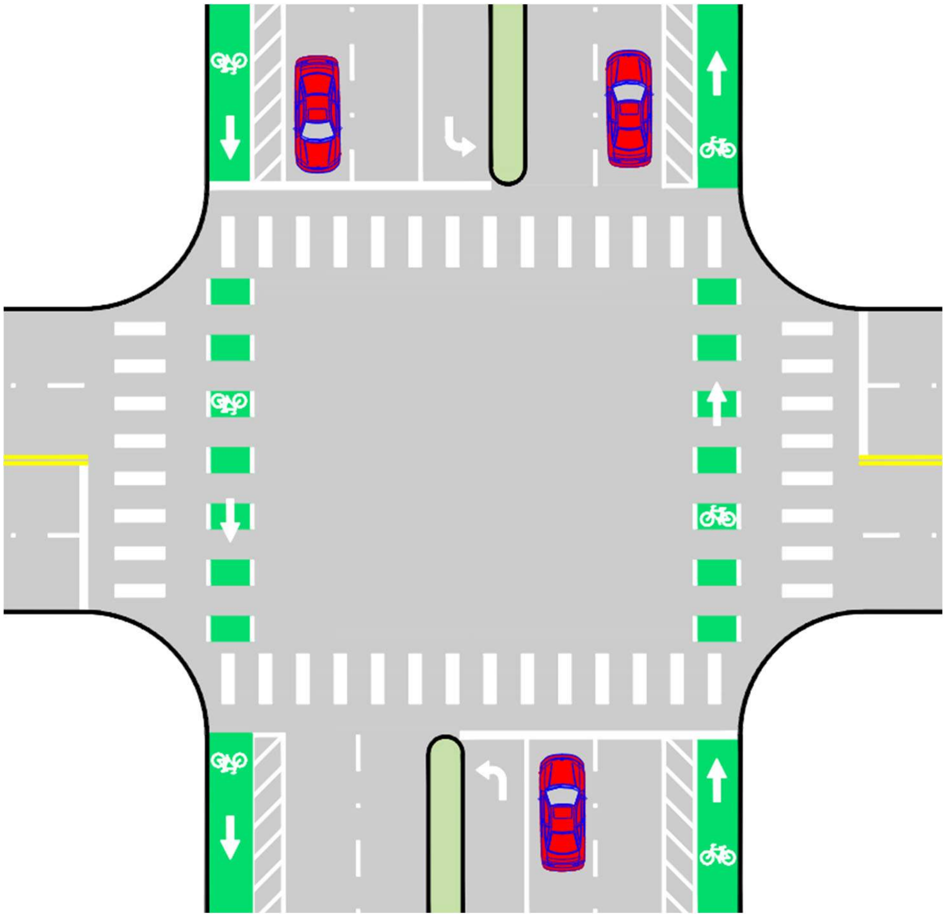
While the street segments of a traffic-calmed street may be comfortable for bicyclists without significant improvement, major street crossings must be addressed to provide safe, convenient, and comfortable travel along the entire route. This same crossing treatment is also applied at smaller instances such as driveways, yield-controlled cross-streets, and conflict areas such as vehicle right turn lanes. Treatments provide waiting space for bicyclists, control cross traffic, or ease bicyclist use by removing traffic control for travel along the bicycle boulevard route. See crossing treatments design guidelines below:

- Across intersections, the intended path of travel of dedicated lanes may be indicated using dashed white lines, at a minimum. Additionally, dashed white lines may be used with solid green pavement coloring for the lane, dashed green coloring, or elephant's feet markings instead of dashed white lines. Refer to **Figure 9-11** for recommended bicycle crossing on a Type D or E street with high traffic volumes. Typical applications of dashed markings and/or colored pavement also include across turning conflict areas such as vehicle right turn lanes, across driveways, and at a stop or yield-controlled cross-streets.

- For left-turning bicyclists, the intended path of travel typically occurs outside of the dedicated lane. However, a designated area, such as a bike queue box, at the head of the right-most left-turning traffic lane may be used to provide bicyclists with visibility and priority positioning ahead of queuing traffic. Bike boxes may be indicated using white lines, bike pavement markings, and stop lines behind the box to indicate the point where motor vehicles are required to stop. Additionally, solid green pavement coloring may be used to indicate the bike box.

- Corner islands reduce the common right-turn conflict between bikes and motor vehicles. A corner island provides separation between bikes continuing straight in their path of travel and motor vehicles turning right by preventing motor vehicles from encroaching into the bikeway and creates a protected queuing area for people on bikes waiting to turn. The separation may be indicated with modular speed bumps, raised elements such as a mountable curb or a pair of flexible delineator posts, or a marked, painted, or raised buffer.

Figure 9-11: Recommended Bicycle Crossing Markings



a. Crosswalk refuge is recommended on high volume or wide roadways (preferably Type B and C Corner and Mixed-Use streets), especially with existing medians, or where pedestrian refuge exists.

b. Crosswalk refuge may be constructed to require right-in/right-out turns by motor vehicles while still allowing left turns by bicyclists at offset intersections.

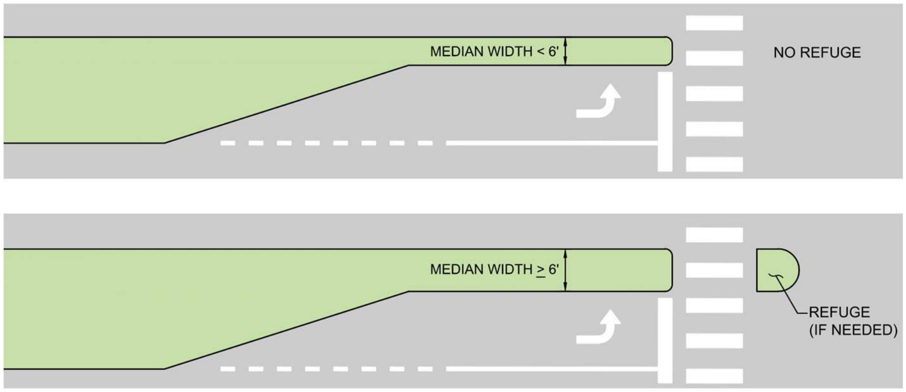
c. Medians should be a minimum of 6 feet in width, although 8 feet is desirable to allow adequate space for a bicycle. Refer to **Figure 9-12** for crosswalk refuge adoption based on median width.

d. Raised curb shall be outlined in reflective white or yellow paint.

e. Adjustments to traffic control, such as a PHB signal, bike signal, or stop sign adjustments may require a traffic study.

f. Refer to *NACTO's Urban Bikeway Design Guide* and *Don't Give Up at the Intersection* as well as *TMUTCD* for more detailed guidance on application and treatment at intersections.

Figure 9-12: Crosswalk Refuge



Midblock Sidepath Crossings

Crossings at an intersection are generally preferable whenever possible to reduce conflicts with motorists. However, when an intersection crossing is not readily accessible, it is important to make midblock crossings as safe as possible due to users being more likely to cross at that specific location regardless of signs and pavement markings that indicate otherwise. This is particularly true for sidepaths. See midblock crossing design guidelines below:

- Median crossing islands are protected spaces placed in the median of the street to facilitate bicycle and pedestrian crossings. These crossings can be particularly beneficial in locations where a bikeway crosses two-way traffic and roadways with moderate to high traffic volumes because they enable users to navigate one direction of traffic at a time. A crossing island shall be a minimum of 6 feet wide and indicated in accordance to *City of Plano Details for Construction Standards*. The approach edge of a raised median may be outlined in retroreflective white or yellow markings for better visibility.

- It is preferable for crossings to be as close to 90° as possible to minimize the crossing distance and maximize sight lines. Retrofitting skewed sidepath crossings can reduce roadway exposure for path users as well as reduce the approaching speeds of path users. **Figure 9-14** shows a midblock sidepath crossing and **Figure 9-13** shows a midblock off-street trail crossing realignment to achieve a 90° crossing. A minimum 60° crossing may be acceptable to minimize ROW needs.

Figure 9-13: Midblock Sidepath Crossing

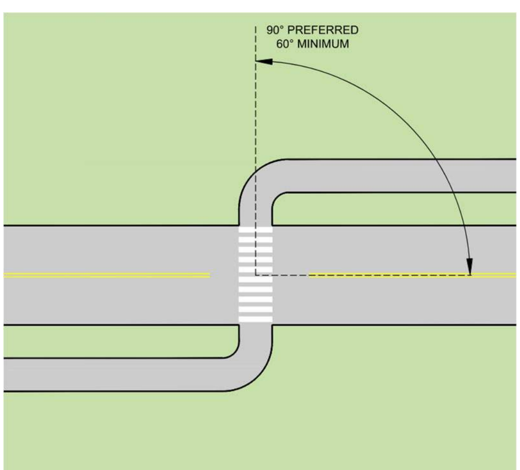
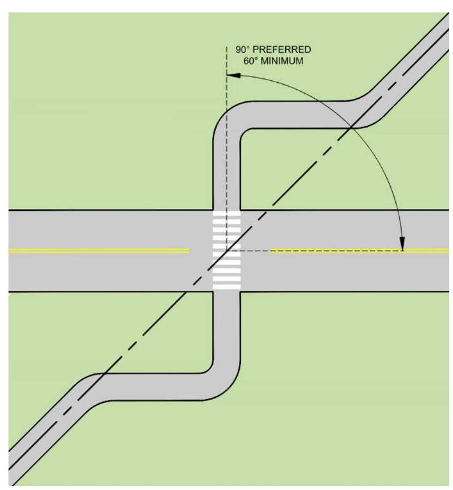


Figure 9-14: Midblock Off-Street Trail Crossing



Bicycle Boulevards

Bicycle boulevards incorporate traffic calming treatments, signs, and pavement markings with the primary goal of creating a shared, slow street that prioritizes bicycle through travel, while discouraging excessive motor vehicle traffic and maintaining relatively low motor vehicle speed. These treatments are applied on quiet, well-connected streets, often through residential neighborhoods. Refer to **Section 13 (Neighborhood Traffic Management)** for the impact on shared lanes from traffic calming devices. **Table 9-2** shows the threshold traffic volumes for bicycle boulevard treatments.

Table 9-2: Traffic Volume Thresholds for Bicycle Boulevard Treatments

Minimize Motorized Through Traffic Volumes and Speed Differential			
	Hourly Traffic Volume	**Daily Traffic Volume**	**Speed**
Preferred	50 vph	1,000 ADT	15 mph
Acceptable	75 vph	2,000 ADT	20 mph
Maximum	100 vph	3,000 ADT	25 mph

- Stop signs or traffic signals should be placed along the bicycle boulevard in a way that prioritizes bicycle movement and minimizes stops for bicyclists whenever possible. To discourage motorist use of the bicycle boulevard, they are diverted out of the street every 4th or 5th block using the tools described in the paragraph below.

- Bicycle boulevard treatments include traffic calming measures such as street trees, traffic circles, chicanes, and other horizontal speed controls. Traffic management devices such as diverters or semi-diverters can redirect cut-through vehicle traffic and reduce traffic volume while still enabling local access to the street.

- Additional treatments for major street crossings may be needed, such as median refuge islands, bicycle signals, and PHB or half signals. Refer to **Section 13 (Neighborhood Traffic Management)** for more traffic calming devices that support bicycle boulevards.

- For bicycle facility design, refer to **Section 1 (Introduction)** for national standards and guidelines.

9.5 Transit Design

An effective transit system helps reduce the number of vehicles on roadways and can have significant cost savings. To provide optimal service, transit routes and stops should be conveniently located and easily accessed. This section provides an overview of guidelines to consider when designing transit facilities, which fall within the Curbside/Flex zone that is managed by the City of Plano. Transit operations in the city are managed by Dallas Area Rapid Transit (DART). The primary modes of public transit in Plano consist of light rail, buses, and on-demand mobility options. Light rail requires infrastructural design and implementation which is led by DART. Bus lanes and properly sized and placed transit facilities make bus travel faster, more reliable and simplify conflicts and traffic flow. Bus lanes may be permanent or peak-only dedicated lanes if a critical mass of bus traffic volume is present, or they may be shared with other modes of transportation. Successful implementation of safe, convenient, and cost-effective bus facilities creates more demand for buses, increasing bus volumes. Specific design guidelines for facilities are outlined in this section. For more detailed guidelines, refer to *NACTO's Transit Street Design Guide*.

Principles to consider when designing streets for transit include:

- Designated bus lanes should be provided for the busiest transit lines.

- Transit stops should be easily accessible through safe and convenient crossing locations and provide shade or shelter to improve visibility and protect riders during adverse weather conditions.
- Transit shelters should not obstruct sight distance.
- Streets that connect neighborhoods to transit facilities should be safe and inviting for pedestrians and bicyclists.
- Zoning codes and development standards should encourage walking and a mix of land uses near transit stations and stops.

9.5.1 Transit Operations

Transit can be provided through a variety of services to match mobility needs. Transit operators address these differing needs by strategically deploying specific transit modes, vehicles, and service patterns on each travel corridor. Pedestrians should have safe, accessible, and convenient access to all transit stops. Improvements to provide access should be coordinated with DART. Impediments to access include, but are not limited to the following:

- Poor visibility or non-existent crosswalks.
- High speed/volume traffic.
- Non-existent or non-compliant curb ramps.
- Missing sidewalks or sidewalks in poor condition.
- Large distances between crosswalk locations.

Every transit trip should be accommodated with safe, accessible, and convenient street crossings. Existing midblock crossings should be evaluated at every transit stop. If a crossing is inappropriate, mitigation should be provided to either improve the existing crossing or, in cooperation with DART, move the transit stop to a safer crossing location. There should not be transit stops without means to cross the street safely and conveniently.

9.5.2 Bus Lanes

Bus lanes are usually used exclusively by buses; however, in some instances, carpools, taxis, or turning vehicles may share the lane. Bus lanes may be located along curbs or in medians and may operate with, or counter to automobile flow. Bus lanes fall within the Curbside/Flex Zone and shall be designed as follows. Coordination with DART shall occur in the design of bus lanes, the location of pedestrian boarding and alighting accommodations, and the placement of transit signage. At a minimum, standards include:

- Pavement sections where buses stop for passengers or dwell for schedule purposes shall be assessed to determine if a heavier pavement section is required to meet an expected 30-year life.
- Curbside bus lanes shall be marked by colored paving, “BUS ONLY” pavement markings and other roadside signage. Refer to *TMUTCD* for markings and signage.
- Curbside bus lanes should be placed to the right of travel lanes on one-way or two-way streets adjacent to curbs and preferably on streets without parking lanes.

- If curbside lanes are only dedicated bus lanes during peak times, provide regulatory signage that states the time periods of dedicated use by buses.
- Curbside bus lanes create the least conflict with turning vehicles on streets with few driveways and curb cuts. Where turn volumes are high, bus stops shall be on the far side and the parking lane between the bus lane and curb can be used as a turn lane at intersections.
- If parking lanes are present, vehicles may cross bus lanes to park but may not use the bus lanes for travel.
- Stops and shelters in the pedestrian zone require sufficient width in the green zone, usually 8 to 10 feet wide.
- Bus lanes shall be a minimum of 11 feet in width (12 feet preferred).
- Bus lanes may be shared with bike lanes. In such cases, the minimum lane width shall be 12 feet; 13 to 15 feet wide is preferable.
- When retrofitting streets, space can be dedicated to bus lanes by removing a median, a travel lane or a parking lane.
- Dedicated bus lanes should be a minimum of 11 feet in width and not be shared with bicycles or other modes of transportation.

Shared bus lanes are shared with cars and other modes of transportation. These are most common for streets with low bus traffic volumes, less than 10 buses per hour, as they are the least expensive method to accommodate buses. They shall be designed as follows:

- Shared lanes should be marked by pavement markings and roadside signage. Other pavement design may be used to signify shared lanes to make a more pleasant street for pedestrians. Refer to *TMUTCD* for markings and signage.
- Shared lanes are recommended on both one-way and two-way streets with bus stops on the right side of the travel lanes.

9.5.3 Transit Control Guidance

Any on-street accommodations for transit shall be coordinated with DART and shall meet DART's design standards for their proposed equipment. The following requirements shall be considered as guidance and minimum acceptable standards, where applicable and feasible to incorporate into the street. Turn restrictions should be strategically applied at intersections to reduce conflict as needed. Options for turning controls include:

- Right turns may use a shared right-turn lane for trucks, cars and buses with transit signal prioritization discussed in **Section 9.4.6**.
- Right turns may use a right turn pocket for trucks, cars and buses in the parking lane where parking is present.
- Left turns for buses from curbside lanes may be made by entering adjacent travel lanes.
- Right turns for buses from center lanes may be made by entering adjacent travel lanes as long as the lane to the right of the lane the bus occupies is a right-turn-only lane.

9.5.4 Geometric Design

At street intersections where all modes of transportation intersect, pavement treatments should prioritize pedestrians, bicycles, transit and cars in that order. Pedestrian pavement markings and other treatments should be continued across the vehicle and transit lanes. Treatments and geometries may be as follows:

Curb Radii

Buses require an effective radius of 20 to 30 feet depending on lane widths and target speeds. Curb radii should be designed to be as small as possible for pedestrian safety and comfort. Where curb extensions are desired for pedestrian crossings, a bus must be allowed to encroach into the oncoming travel lane or the middle lanes.

Shared right turn lane

- Colored transit lanes can be dashed 50 to 100 feet prior to the intersection to indicate where cars may enter the transit lane to make a turn. Alternatively, the color may be removed entirely where the turn lane is used by buses and vehicles.
- Pavement markings should indicate “RIGHT TURN ONLY” and “EXCEPT BUSES” so cars may only enter to turn. Refer to *TMUTCD R3-7R* and *R3-1B*.
- The rest of the transit lane, where the color is solid, should have “BUS ONLY” pavement markings.

Right turn pocket

- Recommended where right-side transit lanes are followed by a parking lane before the pedestrian zone.
- Parking zone may be used as a turn pocket for 120 to 160 feet ahead of an intersection.
- 115 to 160 feet of the transit lane may be dashed ahead of an intersection to permit cars to cross the transit lane into the right turn pocket
- The right turn pocket should be a minimum of 11 feet wide to accommodate turning buses and trucks. If the right turn pocket is primarily used by vehicles other than buses, it can be a minimum of 10 feet wide; 11 feet is preferred.

9.5.5 Transit Signal Priority

Transit signal priority extends or initiates the green indication earlier when a bus is detected approaching the intersection. This allows buses to pass through the intersection before the signal indication turns red. For near-side pull-out stops, the bus should complete loading before being detected by the signal. At far-side stops, the bus receives the priority signal before entering the stop.

9.5.6 Non-dedicated Guideway

Allocation of space in the ROW shall consider existing and future transit services in coordination with DART. Transit routes spend a significant amount of each trip navigating mixed-flow travel lanes, in which transit vehicles share the lane with private automobiles, trucks, and possibly non-motorized users. Mixed-traffic lanes do not give priority to any roadway user and may be adequate for transit operations if travel conditions do not impede transit vehicle movements or reduce transit performance.

Transit Priority Lanes

Transit Priority Lanes are street segments designated by signs and markings for the use of transit vehicles, sometimes limited use by other vehicles. Transit Priority Lanes are recommended in Corner and Mixed-Use context streets where transit volumes are higher. Transit priority lanes may also be incorporated when deemed necessary by the Director of Engineering.

Transit Priority Lanes can be flexible, operating either full time or during limited hours, and may be dedicated to transit use only, allow designated users (e.g., bicycles) to share the lane, or allow other vehicles to enter the lane exclusively to make local access turning movements.

Section 9.4.5 specifies markings and color treatment, and signage for transit priority lanes.

Transit Queue Jump/Bypass Lanes

- Transit queue jumps or bypass lanes may be used in coordination with shared right-turn, short bus lanes, and shoulder bus lanes to allow buses to preemptively bypass intersection queues in adjacent mixed-flow travel lanes. **Figure 9-15** illustrates each of these three applications of transit queue jump/bypass lanes as well as the associated transit signal heads.

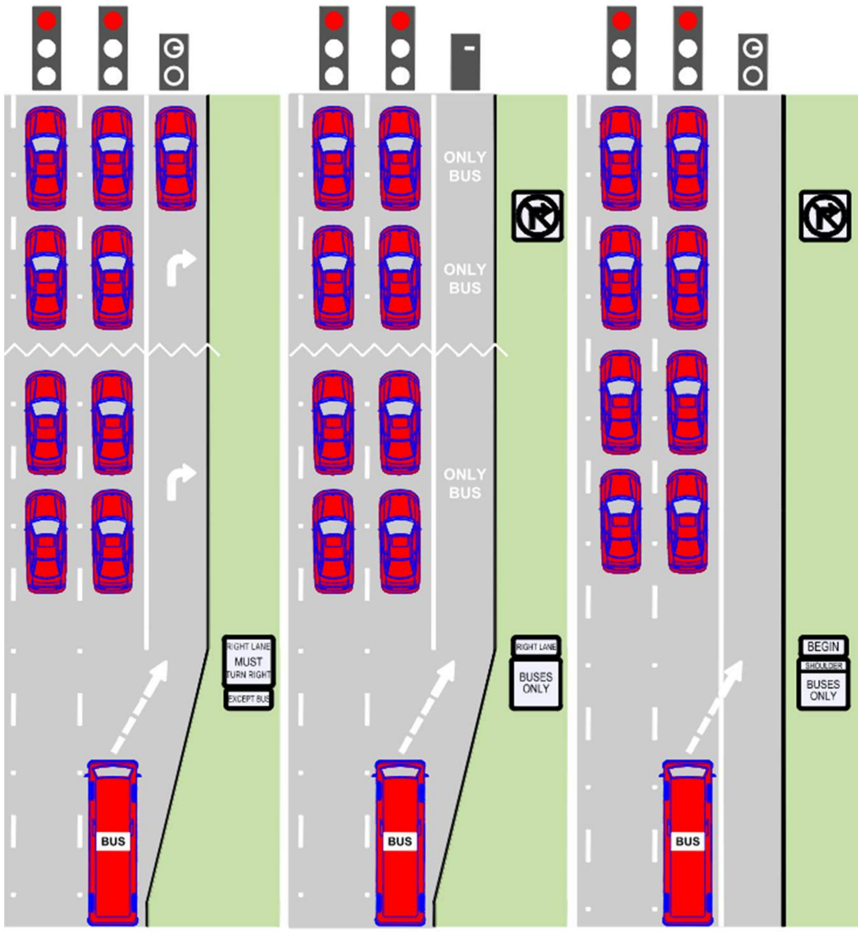
- Transit signal heads shall comply with the latest edition of *TMUTCD* for Light Rail Transit (LRT) signal heads found in Part 8 of the *TMUTCD*.

- *AASHTO Green Book* recommends that "1.5 to 2 times the average peak-period queue length be used in designing turn lane storage lengths, which approximate 85th and 95th percentile queues, respectively."

- The queue jump/bypass lane shall be designed so that an arriving bus would be able to access the queue jump lane unimpeded by queue spillback 95% of the time.

- A traffic analysis is required to determine the 95^{th} percentile queue length for lanes adjacent to a transit queue jump lane and therefore the length of the transit queue jump lane.

Figure 9-15: Queue Jump Treatment Options



(A) RIGHT-TURN LANE (B) SHORT BUS LANE (C) BUS SHOULDER USE

9.5.7 Dedicated Guideway

The purpose of dedicated guideways is to separate transit vehicles from mixed-flow traffic to improve the operational efficiency of transit services. This strategy is often employed in congested corridors with high traffic volumes and substantial existing or potential transit demand. Dedicated guideways may include at-grade facilities, which have some interface with street-level traffic, or aerial or underground structures that offer complete grade separation between transit vehicles and other roadway users. This Manual is limited to at-grade facilities for bus vehicle applications, and any additional criteria that may supersede this Manual are subject to final approval of the Director of Engineering.

Transit-Only Lane Requirements

When a City Capital Improvement Plan (CIP) project is being designed, transit-only lane conversions on existing streets and inclusion of transit-only lanes on new streets or widened streets, especially within Mixed-Use and Corner land use types, shall be considered as part of the project development process. Conversion of existing travel lanes with a mix of automobile and transit vehicle use shall be evaluated when the person-carrying capacity of the lane exceeds that of the person-carrying capacity of vehicles using the lane. Conversion of parking lanes to transit-only lanes or addition of transit-only lanes outside of existing vehicular travel lanes shall be approved by the Director of Engineering.

- Capacity will be evaluated for the peak hour and is based on the capacity of each transit vehicle multiplied by the number of vehicles arriving in 1 hour for each route.

- To determine the person carrying capacity of a lane, the sum of all capacities of transit routes using the street in a single direction shall be calculated.

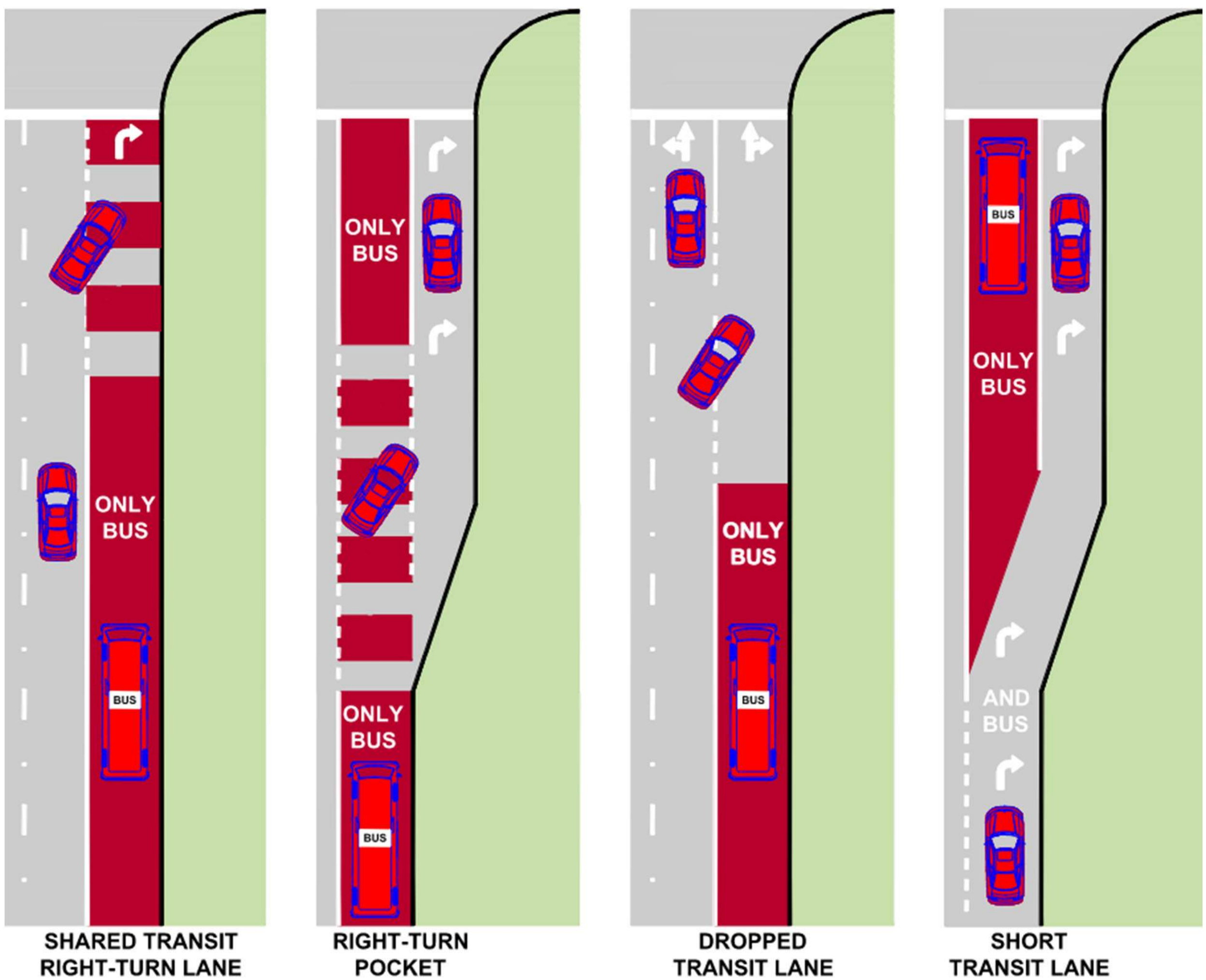
- Transit routes may be existing routes or in an approved plan by DART or the City of Plano. For routes in an approved plan, consideration in the calculation shall be given to whether the planned service route will replace an existing route, for which the existing route should be removed from the calculation.

- **Section 9.4.5** specifies markings and color treatment, and signage for transit-only lanes. Signage must be used for each block adjacent to the designated lane to convey restricted use to different classes of road users. All signage should be compliant with the *TMUTCD*.

- Manage or prohibit turns across transit facilities to reduce transit delays and minimize conflicts with pedestrians, bicyclists, and other traffic per example configurations in **Figure 9-16**.

- Transit-only lanes should be designated using a single or double white line and a stenciled "BUS ONLY" marking in the lane being used, per *TMUTCD*.

Figure 9-16: Intersection Approach Bus Lane Transitions

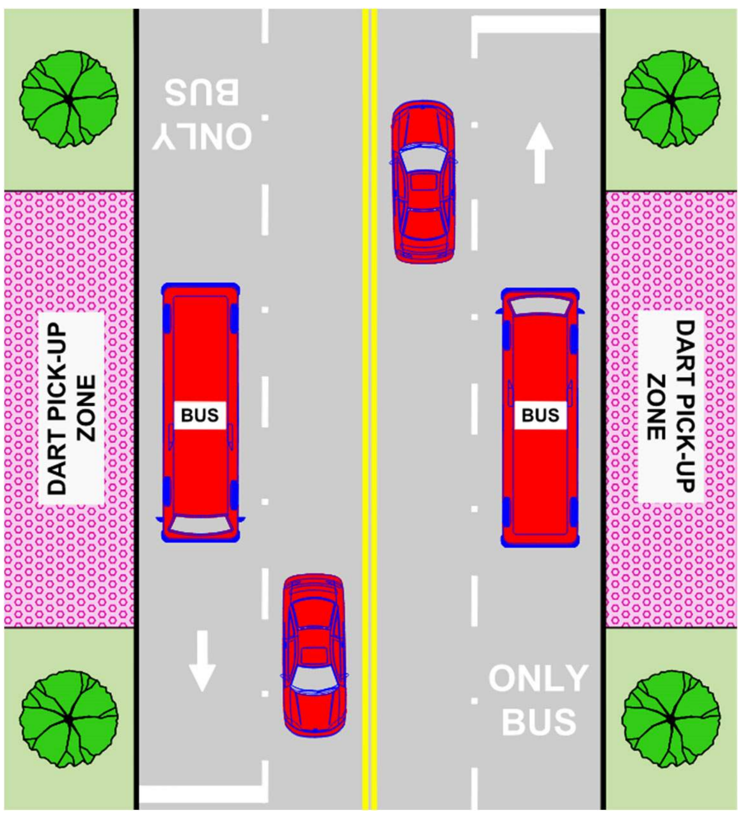


At-Grade

At-grade dedicated guideways offer enhanced transit capacity on existing thoroughfares by providing exclusive use of lanes to transit vehicles. Although these transit-only lanes promote the separation of transit vehicles from mixed-flow traffic, the design of these facilities must consider different points of conflict between modes at intersections.

- Side-Running
  - Side-running dedicated guideways offer the enhanced capacity and flow of fully separated transit lanes while enabling pedestrians to board directly from the sidewalk.
  - All intersections with pedestrian, bicycle, or motor vehicle traffic must be signalized.
  - To avoid conflicts with transit vehicles, left- and right-turning traffic across the transit lane must be either prohibited or accommodated using turn lanes with dedicated signal phases.
  - If parking is located next to a transit lane, 4 feet of clear width must be available adjacent to the parking lane to accommodate loading.

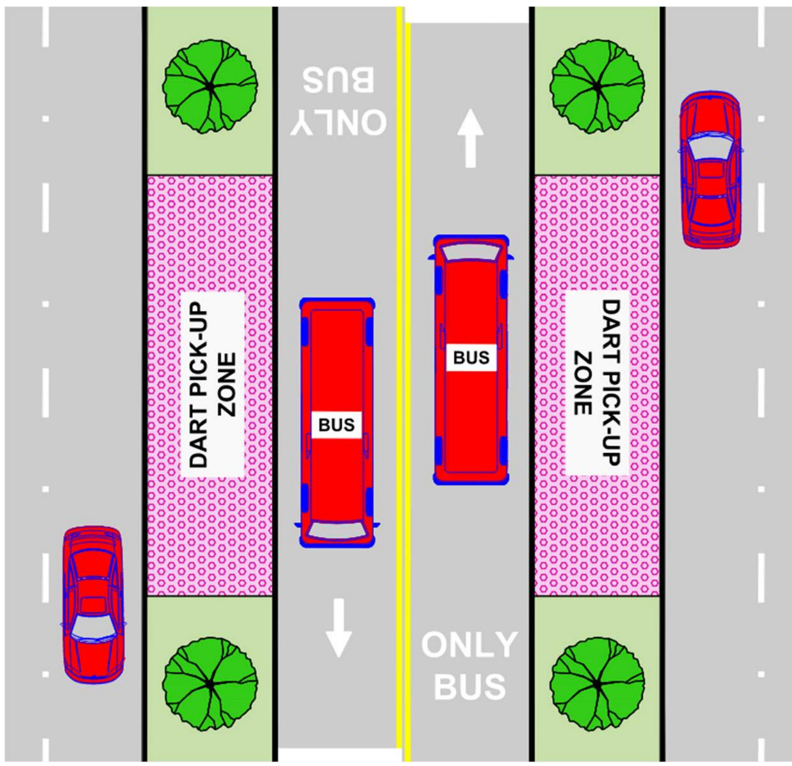
Figure 9-17: Side-Running Guideway Typical Application



- Center-Running
  - Center-running guideways are located in the roadway median. This alignment is advantageous in Type B and C thoroughfares with high-quality, frequent bus or rail service on very large streets. They provide strong protection from traffic-related delays and offer the highest running speeds for at-grade facilities.

- Median boarding islands must be fully accessible and lead to safe, controlled crosswalks or other crossings.
- Right-boarding stations (**Figure 9-17**) permit the use of typical rolling stock, while center platforms require transit vehicles with left-boarding. Center platforms (**Figure 9-18**) are advantageous in constrained corridors because they require less width.
- To avoid conflicts with center-running transit vehicles, left turns must be either prohibited or accommodated using left-turn lanes and dedicated signal phases.
- Transit signal heads shall be used at signalized intersections to give transit vehicles priority and avoid driver confusion with general traffic signals.

Figure 9-18: Center-Running, Side Platform Guideway Typical Application



9.5.8 Bus Stops

Bus stop facilities shall be designed to comply with DART's standards. Where a bus stop pad or bus shelter is provided, it shall comply with *ADAAG Section 10.2.1(1).* or *Section 10.2.1(2)* respectively. All bus stop upgrades should be coordinated with DART. Stops should be visible, providing a clear sight line between bus operators and users of the system. Simple stops without shelters are appropriate for lower-volume routes. Amenities may include benches, trash and recycling receptacles, shelters, lighting, bicycle racks, bus schedules, maps, real-time next-bus arrival information, newspaper boxes, and public art.

- DART buses are up to 40 feet in length. In general, bus stops should be a minimum of 60 feet in length (80 feet long if midblock).
- The Pedestrian Zone should extend to the curb at stops so that passengers may access the sidewalk directly from the bus doors.

- Area lighting shall be assessed at bus stop locations so that an adequate level of lighting is provided on the adjacent sidewalk, at the shelter, and on the roadway in front of the stop. Refer to **Section 10 (Street Lighting)** for required light levels at bus stops.

- The area on the sidewalk where passengers load and unload (board and alight) at bus doors is called the landing pad. The landing pad at the front of the bus stop must provide a clear zone 5 feet long, parallel to the curb, and a minimum of 8 feet deep. The landing pad should consist of ADA-accessible surface materials such as concrete.

- Trees shall not be planted within the landing pad and front and back door zones of a bus stop. When street trees are desired near or within bus stops, DART should be consulted.

- Bus stops should be set back a minimum of 5 feet from crosswalks. Where feasible, a 10-foot setback is preferred.

- Where possible, trash and recycling receptacles should be placed at the front of the bus stop, at a minimum of 18 inches from the landing pad, a minimum of 3 feet away from benches, and in the shade. They should also be anchored to the pavement to deter theft.

9.5.9 Stop Location

Transit stop frequency, size, and configuration shall be designed to accommodate all users in an accessible manner and service the demand and vehicle type using the stop or station. Specific considerations that factor into stop/station placement and design include:

- Center vs. side-running operations
- Intersection configurations; and
- Curb access (including right or left-boarding configurations).

Stop Spacing

Stop spacing is determined based on several factors including customer convenience, ridership demand, and land use context. Customer convenience involves a trade-off between proximity to stops and travel time. Closely spaced stops reduce customer walking distance but result in slower transit speeds, reducing operating efficiency and cost-effectiveness. Few stops spaced further apart increase walking distance but result in faster, more reliable service. **Table 9-3** defines recommended stop spacing ranges.

Table 9-3: Recommended Minimum Distance Between Bus Stops

Area Type	Stop Spacing Range (Min/Max) (feet)*
All Corner and Mixed-Use streets and Type C and D thoroughfares	800 - 1600
Other land use contexts and Type B thoroughfare	1200 - 2500

*Shorter spacing distances are permitted with approval from the Director of Engineering

Far-side Stop

Far-side stops occur when the bus stops after proceeding through the intersection. These stops are preferred at most intersections, including at intersections where buses make left turns and intersections with a high volume of right-turning vehicles. Far-side stops are also preferred on corridors with transit signal priority (TSP) and encourage pedestrians to cross behind the bus. Refer to **Figure 9-19** for a far-side stop.

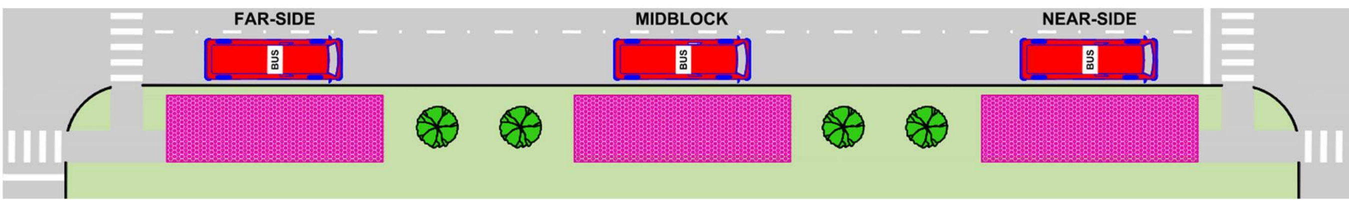
Near-side Stop

Near-side stops occur when the bus stops before the intersection. Near-side stops are discouraged where they have an impact on the ability of an intersection to process traffic and cause noticeable drops in intersection capacity. Near-side stops should be set back at least 10 feet from the edge of the intersection crosswalk, or at the end of the turn radius, whichever is further from the intersection. Refer to **Figure 9-19** for a near-side stop.

Midblock Stop

Midblock stops occur when the bus stops in between intersections, usually in a well-defined area. Midblock stops should be placed where a controlled, midblock pedestrian crossing can be installed in tandem with the transit stop. If pedestrian crossings are not present, options for the installation of a pedestrian hybrid beacon (PHB), pedestrian crossing islands, or other pedestrian crossings must be installed with transit stop design. Refer to **Figure 9-19** for a midblock stop.

Figure 9-19: Bus Stop Placement



Off-street Transit Facilities

Generally, transit facilities and supporting infrastructure located outside the public ROW are expected to adhere to the same requirements and guidelines as they would if located within the public ROW.

- Transit infrastructure located outside the public ROW shall be configured and sited in close proximity to adjacent transit services.
- Amenities provided for the transit service shall be located on the site in such a way that accessible pedestrian paths are provided between the transit stop or station and the amenities.
- Bicycle facilities shall be extended onto the site to locations for bicycle parking associated with the transit stop or station.
- Transit infrastructure provided on-site shall connect to open space with accessible pedestrian paths and bicycle facility extensions.
- Transit stops provided outside the ROW shall conform to the applicable provisions of this Section as it relates to connectivity, access, and handling of multimodal conflicts.

9.5.10 Curb Access

Curb access refers to the horizontal and vertical alignment of the curb space at transit stations in relation to transit vehicle use. This section summarizes options and corresponding design implications for curb access.

In-lane Stop

In-lane bus stops are the most common type of bus stop that has the least impact on bus operations and should be used in most contexts. **Table 9-4** specifies platform lengths based on location on a street block and the expected largest transit vehicle serving the stop.

Table 9-4: In lane Stops: Minimum Platform Length by Bus Length

	Length of Bus			
	40 feet Bus	60 feet Bus	2 x 40 feet Bus	2 x 60 feet Bus
Platform Length	35 feet	55 feet	80 feet	115 feet

Bulb-out In-lane Stop

A bulb-out (or "bus bulb") is a modification of the curb and sidewalk to extend the bus loading/waiting area out to the edge of the parking lane, allowing the bus to stop in the travel lane. The desired location for a bulb-out in-lane bus stop platform in relation to an intersection or pedestrian midblock crossing is illustrated in **Figure 9-20**.

Figure 9-20: In-lane Bus Stop Platform

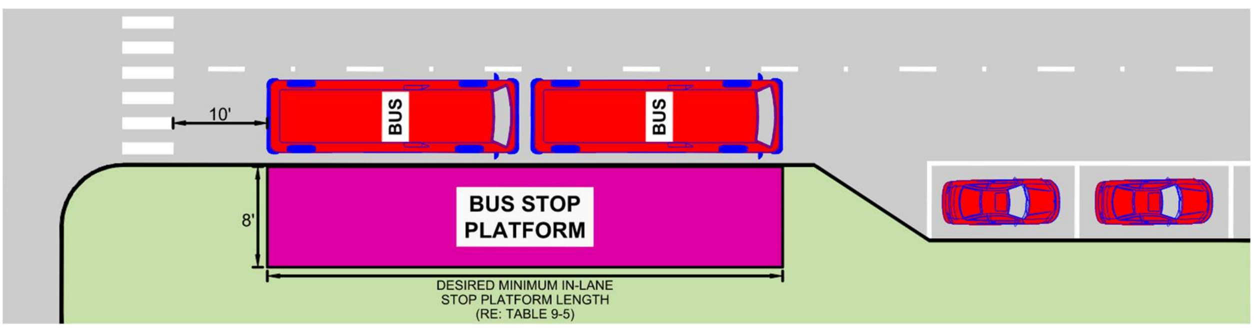


Table 9-5: Bus Bulb-Out Dimensions

Vehicle	Vehicle Length (feet)	Doors Served	Bulb Length (feet)*	On-Street Parking Displaced**
Standard Bus	40	2	30	2 spaces
Articulated Bus	60	2-3	50	3 spaces

*Additional 10 feet intersection buffer from the crosswalk.
**Assuming 20 feet length per parking stall, rounded up to the next stall.
Source: DVRPC, 2012

- Bus bulbs serving 40 feet buses shall be a minimum of 25 feet in length (in constrained environments).
- On-street parking is a prerequisite for bus bulbs, as bulb-outs are constructed within the area used by the parking lane.
- Bulb-out stops are applicable in both dedicated and mixed-traffic conditions.
- The bus bulb-out shall be designed to accommodate the largest vehicle using a specific bus stop.

Pull-out Stop

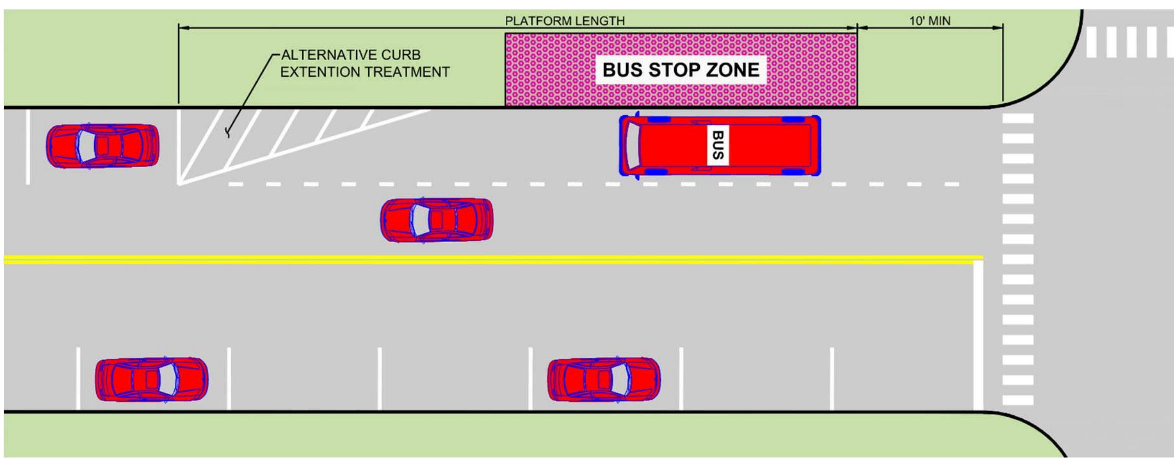
Pull-out stops require different spacing requirements to accommodate the maneuvering of a bus into and out of the pullout. In calculating the total curb space required for bus access to pull-out stops, both the length of the bus and the pull-out entering speed must be considered. The length of the bus pull-out taper and deceleration and acceleration zone is dependent on the bus speeds, as shown in **Table 9-6**. **Figure 9-21** illustrates a typical layout of a far-side and near-side bus pull-out stop.

Table 9-6: Bus Pull-Out Dimensions

Design Speed	Entering Speed	Suggested Taper Length (feet)	Minimum Deceleration Length (feet)	Minimum Acceleration Length (feet)
30 mph	20 mph	150	120	50
35 mph	25 mph	170	185	250
40 mph	30 mph	190	265	400
45 mph	35 mph	210	360	700
50 mph	40 mph	230	470	975

Source: Pace Transit, 2013

Figure 9-21: Far Side Pull-Out Stop



Near-level or Level Boarding

The curbside boarding level affects the ease of boarding, with implications for both vehicle access and route efficiency. Typical sidewalk/curb heights in an "unimproved" condition are approximately 4 to 6 inches, whereas the bottom step of the bus is over 12 inches, in an upright position and 9 inches, in a kneeling, lowered position. Adjusting curb heights to allow near-level or level boarding can provide seamless vehicle entry/exits and save stop times by not requiring a bus ramp or the bus itself to be lowered.

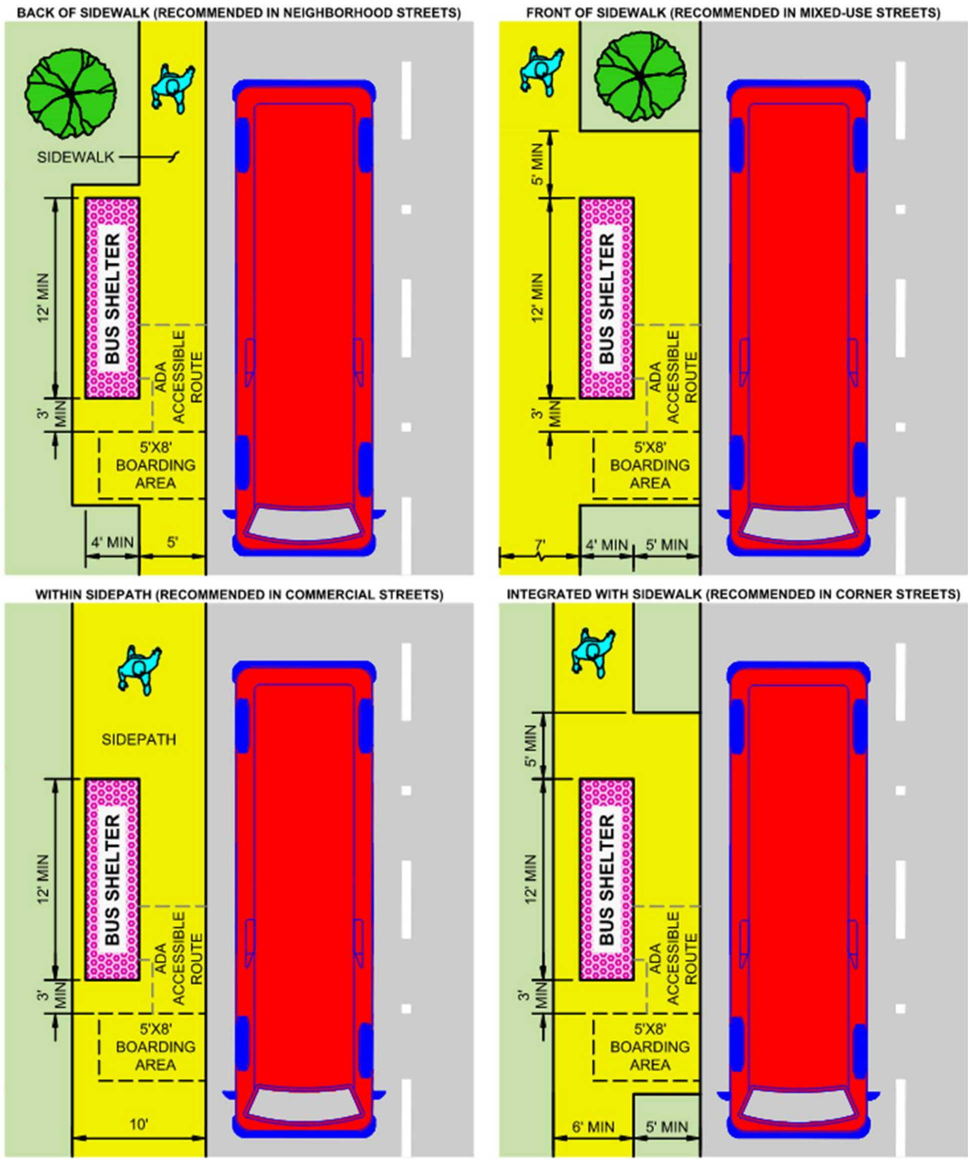
- Level boarding requires that the height of the curb aligns vertically with the typical 12 to 14-inch floor height of transit vehicles. Near-level boarding requires platform heights of approximately 8 to 11 inches, within the range of the vehicle floor height when in a lower position.
- Detectable warning strips with widths of at least 24 inches must be placed along the full length of the platform edge.
- Access to raised boarding platforms and curb space shall adhere to ADA and PROWAG accessibility requirements, including ramp design and slope.

9.5.11 Bus Shelters

Transit shelters should be provided on all key bus routes if sidewalk space allows. When providing a bus/transit shelter, the bus/transit stop must comply with *ADA Section 10.2.1* and *PROWAG Section R309.1*. Bus shelters shall meet DART's design and construction standards. Coordinate with DART in the selection and siting of new bus shelters or modification or replacement of existing shelters. Shelter placement must allow for unobstructed loading, unloading and unimpeded pedestrian through movements on the sidewalk. See **Figure 9-22** for the possible arrangement of bus shelter placement at a stop with varying land use contexts. The following minimum clear widths for shelter placement must be maintained:

- 1 foot from the building face
- 4 feet from the back-of-curb
- 15 feet from crosswalks at nearside bus stops for visibility.
- 1 foot from any ground obstruction (i.e., manhole, tree pit, sign)
- 10 feet from fire hydrants
- 3 feet from the landing pad (maximum 25 feet to the right of the landing pad)

Figure 9-22. Bus Shelters



9.5.12 Station Design

The size and scale of a stop/station will vary depending on the level of service that is provided at that location. The platform design process shall consider the location of intersections, shelters, points of public access, and parking areas.

- Platforms shall provide a clear path to direct commuters to and from the platform and shall be designed to provide accessible routes into train cars.
- In developing platform dimensions for each mode, it is necessary that the length of the platform adequately supports the boarding/alighting of transit vehicles.
- Depending on station activity and transit vehicle frequencies, the curb length may require the accommodation of multiple vehicles at one time.

- Bus transit stops shall meet the size and placement requirements of **Section 9.4.9**. Refer to DART's design and construction standards for bus transit station design.

9.5.13 Transit-Specific Streetscape Elements

The most important streetscape elements for transit include signs, shelters, seating, trash receptacles, and transit information such as a route map and schedule. All streetscape elements must comply with *TAS* and *PROWAG*. Impacts to the Pedestrian Zone should also be considered. Incorporating green zone into the transit street design can help improve water quality, manage stormwater runoff, improve aesthetics, calm traffic, and enhance comfort.

SECTION 10

Public Right-of-Way Visibility

10.1 Visibility Triangles

This section outlines the importance and implementation of adequate visibility at intersecting and collision points within the city. Visibility and sight distance are vital parameters central to the safety of intersections, driveways, and other potential conflict places of interest. This section discusses guidelines and requirements for providing a safe environment at major and minor crossings for pedestrians, bicyclists, transit vehicles, and motorists.

Adequate sight distance at the intersection of an existing street and a proposed street, driveway, or alley must be ensured. This sight distance is provided through the use of Sight Visibility Triangles. Sight Visibility Triangles are also known as Visibility, Access, and Maintenance (VAM) Easements. All intersection visibility requirements shall meet the guidelines for sight triangles in *AASHTO's A Policy on Geometric Design of Highways and Streets*.

Sight Line Triangles shall be provided on any signalized intersection approach where a right turn on red operation is permitted or where a driveway, an alley, or a stop-controlled street intersects an uncontrolled street.

In the case where the street contains existing horizontal curvature, the distances L and R must be measured along the horizontal curve.

Sight Visibility Triangles that extend outside of the right-of-way shall be dedicated as Visibility, Access and Maintenance (VAM) Easements on the plat using City-approved VAM language.

10.1.1 Visibility Triangle Obstructions

Obstructions within a visibility triangle include fences, walls, screens, signs, structures, foliage, hedges, trees, bushes, shrubs, berms, parked vehicles, or any other item or element, either man-made or natural that are erected, built, planted, or maintained. However, traffic control devices, streetlights, and other utility elements that cannot reasonably be placed elsewhere, may be placed within a given visibility triangle.

10.1.2 Sight Visibility Triangle

The field of vision at intersections and access points shall have a clear zone free of obstructions between the elevation of 2.5 feet and 9 feet above the average gutter elevation, within a sight visibility triangle area as detailed further in this section. The sight visibility triangle is not intended for residential driveways on Type F or Type G Streets

The criteria for the minimum triangle apply to intersections and access points that are controlled by a Yield sign, Stop sign, traffic signal light, and those with no traffic control devices. Furthermore, the desirable visibility triangle shall be used when considering intersections that are exiting, proposed, under construction, and existing intersections with proposed modifications.

In previous years, the visibility triangle was based in part on the stopping sight distance of the opposing vehicles, a distance that can vary with road speed. However, the year 2011 edition of *AASHTO's A Policy on Geometric Design of Highways and Streets* presents a method based on "gap acceptance" which is adopted herein.

The "gap acceptance" method is based on research that shows the driver on the minor street requires a small time period when there is no oncoming traffic near the intersection to execute a maneuver. This "gap" in the traffic stream, as measured in seconds, tends to remain constant for a variety of speeds and conditions.

The standard, minimum case for the desirable triangle requirement herein includes an 8.0 second time gap to accommodate left, right, or through movements of a passenger vehicle from a cross-street to a major, multilane street (6-lane divided street). The cross-street centerline grade can vary between a 3% upgrade (uphill), to a 3% downgrade (downhill) value for the standard case. **Table 10-1** summarizes the length of the triangle leg along the major street, which uses the same value for a left-turn or right-turn triangle. The through movement is automatically covered by these two triangles.

In the event that the posted speed limit and the design speed are not the same, the higher of the two speeds shall be used to determine the visibility triangle. **Figure 10-2** depicts the typical geometric construction of a visibility triangle for a given cross-street. Note that significant portions of the median may be encompassed by these triangles.

The desirable visibility triangle at intersections and access points where the minor street or driveway grades are greater than 3% (up or down), the triangle dimensions may be increased or modified by authorized city staff to maintain or improve the driver's field of vision based on the *AASHTO Manual*.

The desirable visibility triangle at intersections and access points with a slight skew angle will result in an acute or obtuse triangle, rather than a right triangle (90°). The desirable visibility triangle at intersections and access points with significant skew angles (greater than 30°) may be increased or modified by authorized city staff to maintain or improve the field of vision of drivers. Additional analysis based on the AASHTO Manual may be required by authorized city staff to determine an adequate visibility clear zone.

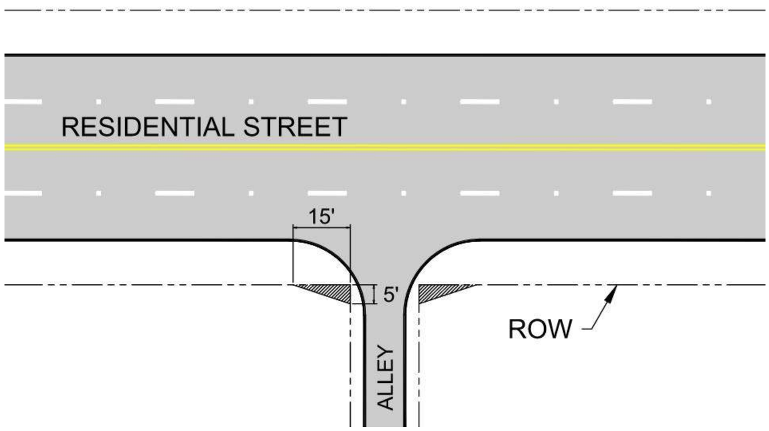
The desirable visibility triangle at an intersection or access point where the street alignment has slight curvature should be drawn to approximate a street with a linear alignment. The desirable visibility triangle at intersections and access points on streets with significant curvature (centerline alignment with a degree of curvature of 7 or sharper) may be increased or modified by authorized city staff to maintain or improve the field of vision of drivers. In these cases, the visibility triangle technique may not be adequate to define a clear zone in the driver's field of vision, and additional analysis based on the *AASHTO Manual* may be required by authorized city staff to determine an adequate clear zone. In general, intersections and access points along a sharp curve on a major street should be avoided in design.

For intersections that are constructed in phases and put into operation during or between construction phases, the desirable visibility triangle shall be established at the initial phase to cover the geometric condition that requires the largest or most restrictive visibility triangle for any of the foreseeable phases or planned, final street intersection geometry.

For example, in some cases the largest visibility triangle may be required for the final geometric condition of the intersection, but the sight triangle shall be established with the initial phase of construction.

Where alleys intersect residential Type E, F, and G streets, the sight visibility triangle is measured as 15 feet along the residential street right-of-way and 5 feet along the alley right-of-way from the point of intersection. These two points are then connected with an imaginary line to form the sight visibility triangle as shown in **Figure 10-1**.

Figure 10-1: Sight Visibility Triangle for an Alley



Geometric Construction for Sight Visibility Triangle for a Typical Intersection

In the plan view, the horizontal clear area at the intersection of a proposed street/drive shall be defined as being within a triangular area formed by the following imaginary lines (see **Figure 10-2**).

Beginning at the assumed point of the driver's eye on the minor street approach, 15 feet back-of-curb for all street types except Type F and Type G streets; and 10 feet back-of-curb for Type F and Type G streets, and running parallel to the centerline of the left most minor street approach lane to a point 5 feet into the nearest lane approaching from the left or to a point 5 feet into the nearest lane approaching from the right for a vertex. Proceeding along the major street parallel to the centerline of the street at a distance of "T" to a point for a vertex; and proceeding back to the assumed point of the driver's eye to complete the visibility triangle (see **Figure 10-3**).

Figure 10-2: Arterials, Expressways, and Tollways Intersection Sight Visibility Triangle

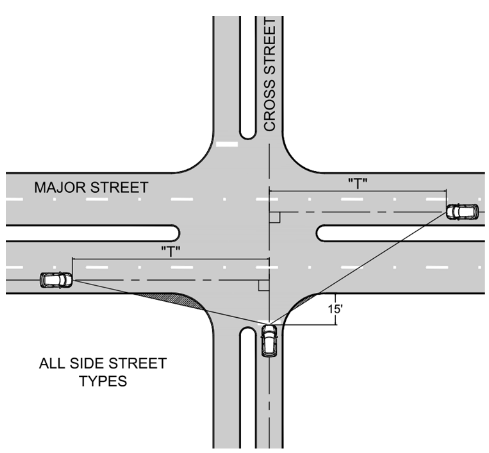


Figure 10-3: Street Intersection Desirable Visibility Triangle for Street Types F and G and Special Streets

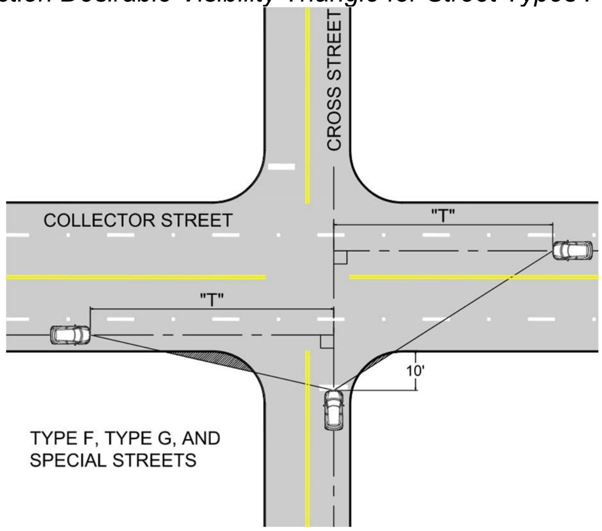


Table 10-1: Minimum Sight Distance at an Intersection

Street Type	Speed Limit (mph)	T (feet)
Special Streets*	20	240
F, G	30	355
D, E	35	415
B, C	40	475
B (Auto Modal Priority)	45	535

*Special Streets as defined in (**Section 3: Special Streets and Accessways**)

10.1.3 Right-of-way Obstructions Outside the Visibility Triangles

No fence, wall, screen, sign, structure, utility box, foliage, hedge, tree, bush, shrub, berm, driveways, parking, drive aisles, or any other item, either man-made or natural shall be erected, planted, or maintained in a position that will obstruct or interfere with a driver's clear line of sight within a sight visibility triangle (i.e., a VAM easement). Tree foliage within the sight visibility triangle shall be trimmed to the level specified below:

Tree foliage shall be trimmed to a minimum of 7 feet above any sidewalk and a minimum of 14 feet above any roadway, alley, or mews.

10.2 Right-of-Way Corner Clips

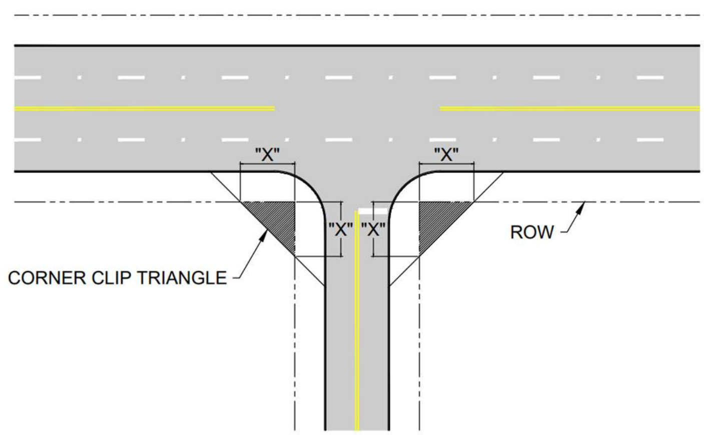
The Right-of-Way corner clip is defined at an intersection of two streets by extending the two right-of-way lines (or street easement) from their point of intersection to a distance as shown on **Table 10-2**. These two points are then connected with an imaginary line to form the corner clip triangle as shown in **Figure 10-4**. Corner clips shall be dedicated as right-of-way.

Table 10-2: Corner Clip Minimum Dimensions

Type of Street On	Type of Street At	Distance(1) (X)
B,C	B,C,D, or any residential street that potentially will be signalized	40'
B,C	E,F,G that will remain unsignalized	25'
D,E	D,E,F,G	25’
F,G	F,G	10'
TxDOT Road, Frontage Road	Use the specifications for a Type B Street	
Unimproved Road	D,E,F,G	30'

(1)The corner visibility triangle shall have the same dimension on all corners of the intersection

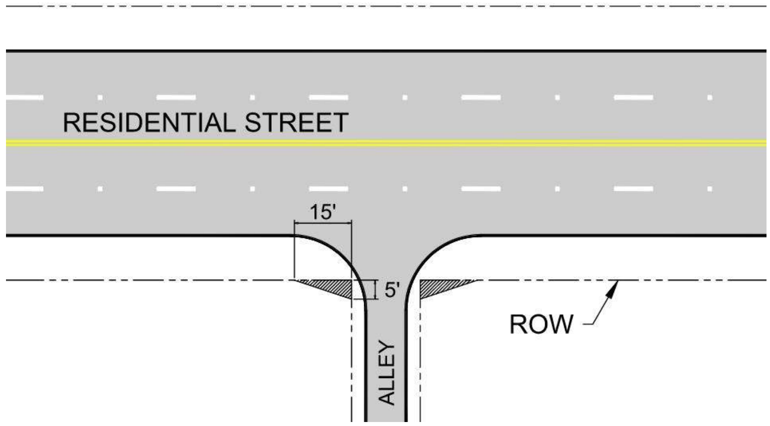
Figure 10-4: Corner Clip Triangle for an Intersection



Vision at all intersections of streets shall be clear at elevations between 2.5 feet and 9 feet above the average gutter elevation within the corner visibility triangle and meet *AASHTO’s* current minimum requirements.

Where alleys intersect residential Type E, F, and G streets, the sight visibility triangle is measured as 15 feet along the residential street right-of-way and 5 feet along the alley right-of-way from the point of intersection. These two points are then connected with an imaginary line to form the corner visibility triangle as shown in **Figure 10-5**. The alley corner clip shall be dedicated as right-of-way.

Figure 10-5: Corner Visibility Triangle for an Alley



10.3 Street Trees

Street trees that are planted between the curb and the sidewalk shall be restricted so they will not interfere with the visibility of traffic control devices or pedestrians preparing to cross a street:

a. At a minimum, a street tree shall be planted no closer than 35 feet upstream from the curb return of an intersection and no closer than 20 feet downstream from the curb return of an intersection.

b. If a curb return is not present on an approach to an intersection, a street tree shall be planted no closer than 35 feet upstream from a stop sign installation or the location that a stop sign might be installed in the future.

c. At a minimum, a street tree shall be planted no closer than 35 feet upstream from a pedestrian crossing, measured from the upstream edge of the ADA ramp. This restriction applies regardless of whether or not there is a striped crosswalk.

d. At a minimum, a street tree shall be planted no closer than 35 feet upstream from any traffic control device on a Type D, E, F, or G street and no closer than 50 feet upstream from any traffic control device on a Type B or C street.

SECTION 11
Street Lighting

11.1 General Requirements

The following requirements shall govern all street lighting installations within the city. As used in this Section, the term lighting includes street lights, pedestrian lights, and decorative lighting, whether maintained by the city or other approved electric service providers.

a. The Director of Engineering shall approve the design, equipment, and material that will be acceptable for all city maintained lighting installations within the city.

b. Lighting systems maintained by electric service providers shall comply with the requirements of such providers.

c. All lighting located in the city right-of-way and maintained by the city shall use city standard lighting. Any waivers to the city lighting policy would be under the guidance outlined in **Section 1.9.1, Introduction.**

d. It is the designer's responsibility to determine if the city or other electric service providers will maintain the proposed lights.

e. Lighting proposed within the Downtown and Haggard Park Heritage Districts shall comply with the lighting requirements for those special districts.

f. All lighting shall be designed to meet the lighting criteria in the latest version of the *Illuminating Engineering Society (IES) Roadway Lighting Report* and the latest version of the *National Electric Code (NEC),* which are both adopted and incorporated herein by reference.

g. When designing lighting circuits, the maximum allowable voltage drop is 5%.

h. When lights are installed in the parkway, they shall typically be installed between the back of the curb and the sidewalk. Designer shall prepare photometrics upon request by the city.

i. A minimum distance of 5 feet separation is required for light pole foundations from all surrounding existing and proposed infrastructure, including but not limited to curb inlets, water, sewer and storm lines and other appurtenances.

j. A minimum median width of 6 feet, measured from the back of the curb is required for median lighting. Foundations shall be centered within the median unless the foundation conflicts with an underground utility. For roadways with median widths less than 6 feet, light poles shall be placed as coordinated and approved by the city.

k. Light poles that are not protected by the curb or other protective barrier shall have a breakaway base.

l. Light poles shall be placed to avoid blocking the visibility of traffic control devices.

m. Light pole arms shall be angled perpendicular to the adjacent roadway.

n. No signage shall be installed on light poles.

o. A minimum of 10 feet shall be maintained between light poles, tree canopies, and new street trees

p. All conduit shall be schedule 80, placed at a 36-inch top depth, correctly sized, and be on TxDOT's material producer list.

q. All private lighting shall be maintained outside of city right-of-way, street easements, or other public easements.

r. All lighting system components shall be new and comply with city standards, ordinances, and specifications.

11.2 Photometrics

a. Photometric analysis is required to set pole spacing. A photometric analysis is not required for residential areas.

b. Light coverage of the roadway and/or sidewalk shall be prepared, reviewed, and approved by the city through a photometric study. The lighting designer shall use specific fixture information, including lumens, distribution, mounting height, and light loss factor (LLF) to properly model the photometrics to set pole spacing. Requirements are based on roadway classification, location, and design as well as the light type. Refer to the latest IES manual for required light levels for roadways, intersections, and sidewalks.

c. LLF – Designer shall use the manufacturer's recommended LLF. If no recommendation is available, the designer shall use 0.9 for LED fixtures and 0.65 for high-pressure sodium (HPS) fixtures.

d. Either illuminance or luminance methods may be used.

e. The photometric design grid should be placed between the travel lanes in each direction of travel with a minimum of two grid lines per lane and a maximum of 5 feet between longitudinal points. Travel lanes of the street and associated locations of each photometric calculation point within the design grid are needed to cover different street lighting improvement areas within the project, each grid should be provided with a unique name within the submitted document.

f. Photometric exhibits with calculation tables showing proposed values and the IES required values shall be submitted to the Director of Engineering for approval before proceeding to 60% design plans. The values that must be shown are minimum, average/minimum, and average.

11.3 Lighting in Residential Areas and Local Streets

Lighting guidelines for residential areas and local streets are designed to provide safety lighting at intersections, roadway hazards, and geometric changes in the roadway.

a. Lighting shall be installed at:

- All intersections, corners, curves, and cul-de-sac locations.
- The end of all dead-end streets that are 200 feet or longer.
- All neighborhood entrance/exit locations where thoroughfare lighting is not present. Street lighting may require adjustment when connecting to an existing thoroughfare.
- All significant horizontal and vertical changes in the direction of the roadway, defined as those where, when standing in the center of the roadway at one light, the next light cannot be seen due to centerline deflection and gradient changes in the roadway.

b. Light pole spacing in residential areas and local roads shall be between 500 feet and 600 feet except as defined in **Section 11.3.a**. Light poles shall be spaced uniformly within a block.

c. Locations for street lights shall be placed as directed by the city. The developer shall coordinate an electric service design with the electric service provider.

d. Decorative lighting is permitted, with prior approval of the Director of Engineering.

e. Photometric analysis is not required to be performed in residential areas.

f. Light poles shall be placed on lot lines and shall minimize impacts to existing trees.

g. All residential lighting shall be a minimum 100-watt High-Pressure Sodium or its wattage equivalent as approved by the Director of Engineering and electric service provider.

11.4 Lighting for Arterials

Lighting shall be installed on all divided arterial roadways. Lighting may be warranted on non-arterial roadways **(Section 11.5)** based on an engineering study.

a. Lighting shall be installed at:

- All intersections.
- All significant horizontal and vertical changes in the direction of the roadway, defined as those where, when standing in the center of the roadway at one light, the next light cannot be seen due to centerline deflection and gradient changes in the roadway.
- Signalized pedestrian crosswalks.

b. Photometric analysis shall be performed to determine light pole spacing to comply with the latest IES requirements. Illuminance or luminance methods may be used.

c. Light poles shall be placed in the median unless otherwise approved by the Director of Engineering and supported by an engineering study.

d. Light pole spacing shall not exceed 200 feet.

e. Decorative lighting is not permitted for these thoroughfare types.

f. Locations for street lights shall be placed as directed by the city and coordinated with the electric service provider.

g. Arterial lighting shall be a minimum 250-watt High-Pressure Sodium or its wattage equivalent as approved by the Director of Engineering and electric service provider.

11.5 Lighting for Non-Arterial and Non-Residential Areas

Lighting may be warranted based on an engineering study for non-arterial, non-residential roadways of Type D and below. If warranted, lighting should be designed to improve safety at intersections, roadway hazards, and geometric changes in the roadway.

b. Lighting should be installed at:

- All intersections, corners, and curves.
- All significant horizontal and vertical changes in the direction of the roadway, defined as those where, when standing in the center of the roadway at one light, the next light cannot be seen due to centerline deflection and gradient changes in the roadway.

c. Light pole spacing along non-arterial and non-residential local roads shall be between 500 feet and 600 feet except as defined in **Section 11.5.a**. Light poles shall be spaced uniformly within a block.

d. Locations for street lights shall be placed as directed by the city. The developer shall coordinate an electric service design with the electric service provider.

e. Photometric analysis is not required to be performed for this type of lighting.

f. Light poles shall minimize impacts to existing trees.

g. All non-arterial non-residential lighting shall be a minimum 150-watt High-Pressure Sodium or its wattage equivalent as approved by the Director of Engineering and electric service provider.

11.6 Lighting for Expressways

Lighting design on any frontage road, service road, or expressway maintained by TxDOT shall comply with the latest version of *TxDOT's Highway Illumination Manual*. TxDOT will review and approve the designs.

11.7 Design Plan Requirements

a. Design plan sheets and standard construction details of all proposed lighting shall be sealed by a licensed Texas Professional Engineer and included in the construction plans.

b. The demolition/removal plan must include the existing lighting system and any affected system (with callouts, symbols, and the like) detailing all information needed for a complete construction plan set, as well as all existing lighting system components adjacent to the project limits and construction.

c. All city lighting detail sheets required for the design must be included in the design plan set. The detail sheets must be current and not modified in any way. Only the details sheets relevant to the lighting system for the project are to be included in the design plan set.

d. Construction plan sheet requirements must include quantity and information table (filled with correct information and counts); conduit and cable table (filled with correct information and counts); eligible required notes; and any other requirements necessary for a complete design plan set. During plan review and construction, the design plans, including all tables, shall be updated to reflect current information, including change orders, field red-lines, and any other changes.

e. The quantity and information table for the lighting plan shall include all parts of the proposed lighting system as well as any parts of the existing lighting system to be modified.

f. Street names, block numbers, lot lines, and lot numbers are required for all visible locations on design plans.

g. A sheet legend must be included on the lighting design sheet of the design plans and shall contain all symbols and line types for both existing and proposed features within the lighting plan. The legend designations must match the plan scale and must be compatible in size between the plan and the legend.

h. All text, symbols, line work, and similar information shall be neat, clear, aligned, and sized appropriately in the lighting plan and legend.

i. The utility company name and the utility designer's current contact information must be shown on the design plan sheet(s).

j. Proposed lighting location and infrastructure information for the following is required in the design plans: conduit runs; ground boxes; contactor and type of service pedestal; service providers' transformers and type (service points); service providers' secondary boxes; pole riser; residential sign locations; all water system features (including water mains, hydrants, service lines, meter boxes, and storm drain inlets); all wastewater systems (including mains, manholes, clean-outs, metering stations, lift stations, etc.); location of overhead and underground utilities; utility easements and public access easements; utility poles, signals, curb line, curb ramps, sidewalks, drive approaches, bike lanes, trees, and the like; all street widths and dimensions (including medians); quantity table (by sheet and/or plan total); conduit and conductor table by run number and sheet.

SECTION 12
Traffic Studies

12.1 General

This section, in coordination with *Article 25* of the *Zoning Ordinance*, establishes requirements and procedures pertaining to the development of traffic studies, including Traffic Generation Reports, Traffic Engineering Assessments, Traffic Impact Analysis (TIA), and Regional Traffic Impact Analysis (RTIA). These requirements are intended to inform the applicant of the city's expectations, expedite the city staff's review process, provide standard criteria for evaluating development proposals, and establish equitable mitigation and cost-sharing policies.

12.2 Traffic Generation Report

a. **Applicability** – Refer to *Article 25* of the *Zoning Ordinance* for the applicability of traffic studies in the zoning and site plan review procedures. In addition to the trip generation threshold presented in **Table 12-1**, all schools and daycares will be required to submit a Traffic Impact Analysis regardless of anticipated trip generation.

b. **Pre-Application Meeting** – Pre-application consultation with the city traffic engineer and representatives from the Planning Department is required. Details of city expectations will be discussed at this meeting.

c. **Content -** Traffic Generation Reports shall include estimated traffic volumes for the existing and proposed conditions for the entire site. Trip generation information and details of the proposed development including project location, land use and the proposed development intensity (units, square footage, etc.) shall be based on a full-buildout site plan or provided Floor-to-Area Ratio (FAR). The report shall show estimated daily site volumes as well as volumes for the AM peak, PM peak, and Weekend peak. The latest edition of the *Institute of Transportation Engineers (ITE) Trip Generation Manual* must be used to determine the trips generated by a proposed development. Site-specific trip generation study or equivalent data based on business data related to the specific site use may be submitted in lieu of the ITE data, but the applicant's trip generation analysis must be pre-approved by the city traffic engineer prior to submittal of a traffic impact analysis.

d. **Review and Determination of Need for Further Study** – The Engineering Department will review the completed Traffic Generation Report to determine if further study is required. **Table 12-1** shows the type of study that will be required based on the total anticipated site traffic for the proposed development.

Table 12-1: Study Type Required for Anticipated Trip Generation

Section Reference	Anticipated Trip Generation/Condition	Study Type Required	Study Area
12.2	All projects as required by *Article 25* of the *Zoning Ordinance*	Traffic Generation Report	Trip generation must be based on the full build-out of the property.
12.3	Between 50 and 200 total peak-hour trips	Traffic Engineering Assessment	Site driveways for sight distance and right/left-turn lanes.
12.4	*If TIA or RTIA is required*	*TIA Kick-Off Meeting*	
12.5	For new (greenfield) development sites: Between 201 and 500 total peak hour trips or between 1,500 and 3,000 daily trips.	Traffic Impact Analysis (TIA)	All intersections of the proposed development with the adjacent roadway system and intersections within ½ mile from the site.
	For redevelopment sites: >100 additional peak hour trips or >1,000 daily trips from previous project submittal.		All intersections of the proposed development with the adjacent roadway system. Note: requirement for trip generation based on total redevelopment trips, not just the additional trips.
	All daycares and schools regardless of trip generation.		To be determined as part of a traffic management plan.
	>500 total peak hour trips or greater than 3,000 daily trips.	Regional Traffic Impact Analysis (RTIA)	All intersections of the proposed development with the adjacent roadway system and roadways and major intersections located outside the proposed development where site traffic is greater than 50 vehicles for a study area of up to a 1-mile radius.

12.3 Traffic Engineering Assessment

a. **Traffic Engineering Assessment** – When required, a Traffic Engineering Assessment shall include entering and exiting trip generation, trip distribution, traffic assignment and weekday peak hour volumes at all existing and proposed access points. In certain instances, traffic from other approved but not built developments may have to be included if cross-access is allowed or access point is shared between developments. The study may require that existing traffic volume data be collected to determine right-turn and left-turn storage needs based on volumes shown below in section **12.5.h Traffic Analysis** and **12.5.i Mitigation**. A Site Distance Assessment with an accompanying photo log will be required as directed during the pre-application meeting.

12.4 Traffic Impact Analysis (TIA) / Regional TIA Kick-Off Meeting

a. **Kick-Off Meeting** – A kick-off meeting between the traffic analysis engineer and city staff is required with every project requiring a TIA/RTIA. To provide consistency and to facilitate staff review of traffic studies, the following needs to be discussed in the meeting:

- Proposed project location
- Land use
- Proposed development intensity
- Proposed development's site access locations

b. **Phasing**

If the project is split into phases, the phasing breakout must be identified with corresponding build-out dates for each phase. If the development is broken into phases and only the first phase is being developed, the TIA/RTIA must be completed with separate results for each phase and for the ultimate build-out of the site. If site plans are not readily available for the future phases, analysis is to be performed based on anticipated land use and applicable FAR. Additionally, if a zoning change is requested, a description of the existing zoning and proposed zoning and/or use being requested must be included.

c. **Study Area**

The study area intersections and roadways to be analyzed, in addition to the site driveways, must be identified. The following outlines the study area requirements based on the above:

- All existing and planned thoroughfare and collector intersections per the City of Plano *Thoroughfare Plan Map* within the following designated study area of the proposed project location.
  - ½ mile study area from the property line for TIAs
  - 1-mile study area from the property line for RTIAs
  - When adjacent to a major highway, the study area shall terminate at the intersection of both frontage roads with the city thoroughfare.
- All existing and planned school sites, transit routes/stops, trails and bike lanes within the designated study area of the proposed project location.
- Additional intersections or analysis parameters may be added to the study area at the discretion of the city traffic engineer.

d. **Post Kick-off meeting approvals** – The following items must be submitted to city transportation engineering staff for approval before traffic analysis begins.

I. Trip Reduction Rates – Any trip reductions performed as part of trip generation must be approved by city transportation engineers.

II. Trip Distribution – The percent distribution of potential trip origins and destinations within the study area must be approved by city transportation engineers.

12.5 TIA/RTIA Report Format and Content

The TIA/RTIA report must be prepared under the direction and signed/sealed by a State of Texas licensed professional engineer with demonstrated experience in traffic/transportation engineering. The following outlines the typical format and sections to be included:

a. **Table of Contents**

A table of contents must be provided that identifies sections of the TIA, along with a list of tables and figures.

b. **Executive Summary**

This section must contain a brief overview of the purpose of the study, location of the site, site description, site access and land use. The study scenarios considered must be listed. The key results of the study must be presented, including principal findings, conclusions, identified study area recommendations and the scenario in which the recommendations are warranted. The recommendations figure must be provided showing all study area recommendations including its corresponding development phase.

c. **Introduction and Project Information**

The proposed project location, land use and proposed development intensity must be identified. The proposed development's site access locations and functionality are to be identified. If the project is split into phases, the phasing breakout is to be identified with corresponding build-out years for each phase. The study methodology should be summarized stating what analysis tools were used to complete the analysis (Synchro, HCS, etc.).

The approved study area boundary shall be identified. If an intersection within the study area is not intended to be analyzed, provide justification as to why it was excluded (ex: low amount of site traffic anticipated to route).

d. **Existing and Proposed Site Uses**

Describe the existing and proposed land uses/zoning. Provide a Vicinity Map figure which shows the location of the proposed development in relation to the defined study area. Describe any existing development in the vicinity of the site and how existing access may be impacted (e.g., additional access, restricting access, etc.) by the proposed development. A proposed site plan must be provided for reference.

e. **Transportation System**

Each roadway being considered in the analysis should be described in the existing condition. The cross-section, speed limits, number of access connections proposed, transit routes, bicycle facilities, pedestrian connections and ultimate classification per the *Thoroughfare Plan Map* should be included. If a TxDOT-designated roadway is part of the study area, then the study map needs to show TxDOT's control of access.

A figure showing the lane use, traffic control and lane assignments at each study area intersection is required. In addition, an existing volume figure must be provided along with a reference to the date of data collection for the study area intersections. Typically, the weekday AM and PM peak hours are analyzed. However, the city has the discretion to require a weekend peak hour based on the area or development planned.

Elements from the *Comprehensive Plan* shall be identified within the study area boundary. Any future adjacent projects and a brief description that will impact the study area network are to be included in this section as applicable.

f. **Site Traffic Characteristics**

The proposed development's daily and peak hour trip generation must be presented in a summary table that includes the calculation method. Trip generation values must be obtained from the latest version of the *Institute of Transportation Engineers (ITE) Trip Generation Manual*. A site-specific trip generation study or equivalent data based on business data related to the specific site use may be submitted in lieu of the ITE data but must be pre-approved by the city traffic engineer. If the development is anticipated to be phased, the phasing of the development should be outlined as well.

For certain lane uses, a reduction in external vehicle trips may be accounted for based on pass-by and the internal capture rates published in the *Institute of Transportation Engineers (ITE) Trip Generation Manual* and/or *NCHRP 684: Enhancing Internal Trip Capture Estimation for Mixed-Use Developments*. Given the wide interpretations of pass-by and internal capture rates, the use of trip reduction and the final reduction rates must be approved by the city traffic engineer. If other reductions are being requested, they are to be coordinated and approved by city staff. If a zoning change is requested, a comparison of the existing zoning trip generation versus the proposed zoning trip generation is required.

An estimate of the directional distribution of site traffic entering and exiting the proposed development must be presented and approved by city staff in advance of any analysis. The directional distribution of the development must be based on existing traffic patterns, proposed site layout and access locations, and the future study area roadway network. A directional distribution figure must be provided to clearly communicate distribution assumptions for the study area as a whole (global) and at each intersection and access drive (local). The figure must also distinguish between entering and exiting trips for all analyzed time periods. Multiple trip distributions shall be provided for phased developments to reflect changing traffic patterns resulting from additional land uses and access points in subsequent phases. A trip assignment figure shall be provided that illustrates the site-generated traffic at the study area intersections and site driveways.

g. **Analysis Scenarios and Traffic Volumes**

A typical TIA/RTIA will include an existing analysis to provide a baseline. No build (background growth only) and build (background plus site traffic) analyses will be required for each phase of a proposed development. Horizon analyses (no build and build) will be required assuming a study year 10 years after completion of the proposed development.

The city has established 1.5% per year as the standard background growth rate. If a different growth rate is necessary, data should be presented to support the assumed growth rate. The city is to provide the traffic study of any committed development that would impact the study area traffic volumes to incorporate the adjacent, committed development's site traffic into the no-build scenarios, as appropriate.

Traffic volume figures of estimated peak hour volumes are required for each phase (no build and build) of the proposed development.

h. **Traffic Analysis**

Intersection level of service (LOS) shall be completed for each scenario with the relevant peak hours being evaluated. The existing level of service shall be calibrated to field-verified conditions using appropriate peak-hour factors, signal timing, and other assumptions. A table that breaks out LOS for each intersection by approach as well as the overall LOS with the corresponding delays must be provided. For stop-controlled intersections, the LOS of the stop-controlled approaches are to be reported. When reporting LOS, the model shall account for overall intersection peak hour factors (PHF) observed in the field unless the traffic volumes in the future are anticipated to dramatically change. If this is the case, this must be noted along with the assumed PHF (ex: school sites). A separate table is required for each peak hour analysis. For all future scenarios, no build (background growth) and build (background plus site traffic) comparisons should be provided to help the city identify what the development's anticipated impact will be.

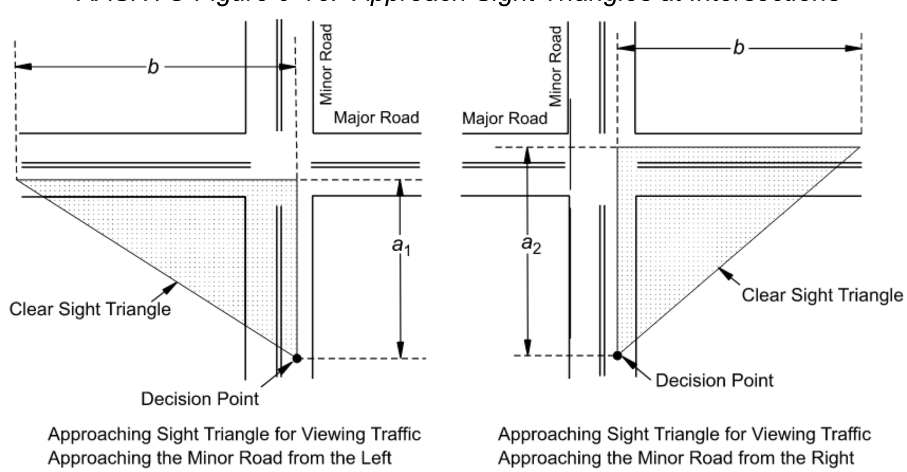
Each proposed project access drive or street must be evaluated for auxiliary lane needs at each phase anticipated of development. When analyzing for auxiliary lanes, existing traffic, background traffic and site traffic shall be considered. Criteria for determining the need for left-turn lanes is based on *AASHTO (American Association of State Highway and Transportation Officials)* recommendations while right-turn lanes are based on the *TxDOT Access Management Manual* Auxiliary Lane Threshold (Section 7) requirements. All median openings will require left-turn lanes. Per TxDOT standards, any right-turn movement on a TxDOT-designated roadway that is equal to or greater than 60 vehicles per hour (vph) requires a dedicated right-turn lane if the speed limit is posted at 40 mph or less; the threshold is reduced to 50 vph if the speed limit is posted at 45 mph or greater. Similarly, any turning movement on a city-designated roadway that is equal to or greater than 75 vph will require a dedicated right-turn lane or a left-turn lane (if at a median opening) if the speed limit is posted at 40 mph or less; the threshold is reduced to 60 vph if the speed limit is posted at 45 mph or greater. Site traffic that adds more than 150 vph to a left-turn movement requires mitigation such as an extended left-turn lane length or a dual-left turn lane.

Field observations must be made to confirm adequate sight distance at each proposed project access drive. A plan-level exhibit for the intersection sight distance of each project access location is required. Sight distance must also be evaluated based on the ultimate cross-section of the major street if future widening is anticipated. Adequate sight distance should be reviewed for the following conditions as identified by *AASHTO, 7th Edition*:

- *Case B1, Left Turn from Stop*
- *Case B2, Right Turn from Stop*
- *Case F, Left Turn from Major Road*

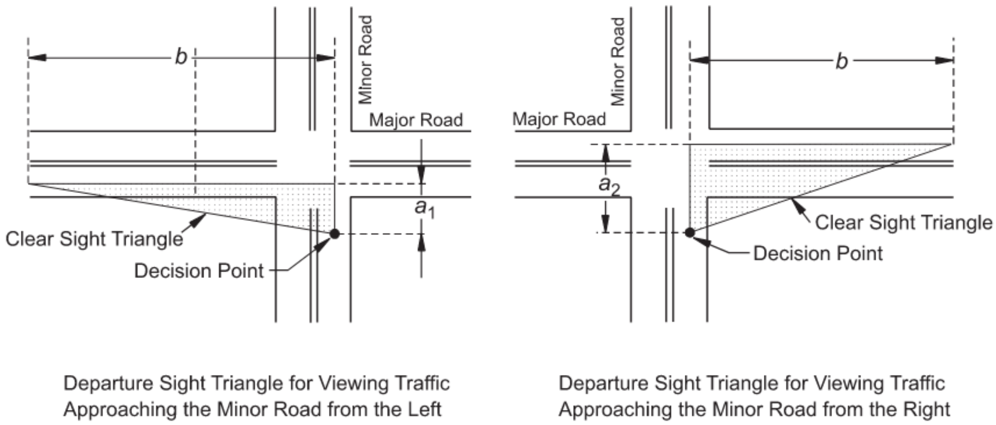
The following provides Figure 9-16 and Figure 9-17 from the *AASHTO Green Book, 7th Edition,* which shows the approach and departure sight triangles.

AASHTO Figure 9-16: Approach Sight Triangles at Intersections



Approach Sight Triangles (Uncontrolled or Yield-Controlled)

AASHTO Figure 9-17: Departure Sight Triangles for Intersections



Departure Sight Triangles (Stop-Controlled)

The following provides Tables (Table 9-7, Table 9-9, and Table 9-17) from the ***AASHTO Green Book, 7th Edition*** for the three sight distance conditions listed above.

AASHTO Table 9-7: Design Intersection Sight Distance – Case B1, Left Turn from Stop

Table 9-7. Design Intersection Sight Distance—Case B1, Left Turn from Stop

U.S. Customary			
Design Speed (mph)	Stopping Sight Distance (ft)	Intersection Sight Distance for Passenger Cars	
		Calculated (ft)	Design (ft)
15	80	165.4	170
20	115	220.5	225
25	155	275.6	280
30	200	330.8	335
35	250	385.9	390
40	305	441.0	445
45	360	496.1	500
50	425	551.3	555
55	495	606.4	610
60	570	661.5	665
65	645	716.6	720
70	730	771.8	775
75	820	826.9	830
80	910	882.0	885

Metric			
Design Speed (km/h)	Stopping Sight Distance (m)	Intersection Sight Distance for Passenger Cars	
		Calculated (m)	Design (m)
20	20	41.7	45
30	35	62.6	65
40	50	83.4	85
50	65	104.3	105
60	85	125.1	130
70	105	146.0	150
80	130	166.8	170
90	160	187.7	190
100	185	208.5	210
110	220	229.4	230
120	250	250.2	255
130	285	271.1	275

Note: Intersection sight distance shown is for a stopped passenger car to turn left onto a two-lane highway with no median and grades 3 percent or less. For other conditions, the time gap should be adjusted and the sight distance recalculated.

Source: AASHTO Green Book, 7th Edition

AASHTO Table 9-9: Design Intersection Sight Distance – Case B2, Right Turn from Stop

Table 9-9. Design Intersection Sight Distance—Case B2, Right Turn from Stop

U.S. Customary				Metric			
Design Speed (mph)	Stopping Sight Distance (ft)	Intersection Sight Distance for Passenger Cars		Design Speed (km/h)	Stopping Sight Distance (m)	Intersection Sight Distance for Passenger Cars	
		Calculated (ft)	Design (ft)			Calculated (m)	Design (m)
15	80	143.3	145	20	20	36.1	40
20	115	191.1	195	30	35	54.2	55
25	155	238.9	240	40	50	72.3	75
30	200	286.7	290	50	65	90.4	95
35	250	334.4	335	60	85	108.4	110
40	305	382.2	385	70	105	126.5	130
45	360	430.0	430	80	130	144.6	145
50	425	477.8	480	90	160	162.6	165
55	495	525.5	530	100	185	180.7	185
60	570	573.3	575	110	220	198.8	200
65	645	621.1	625	120	250	216.8	220
70	730	668.9	670	130	285	234.9	235
75	820	716.6	720				
80	910	764.4	765				

Note: Intersection sight distance shown is for a stopped passenger car to turn right onto or to cross a two-lane roadway with no median and with grades of 3 percent or less. For other conditions, the time gap should be adjusted and the sight distance recalculated.

Source: AASHTO Green Book, 7th Edition

AASHTO Table 9-17: Intersection Sight Distance – Case F, Left Turn from Major Road

Table 9-17. Intersection Sight Distance—Case F, Left Turn from the Major Road

U.S. Customary				Metric			
Design Speed (mph)	Stopping Sight Distance (ft)	Intersection Sight Distance		Design Speed (km/h)	Stopping Sight Distance (m)	Intersection Sight Distance	
		Passenger Cars				Passenger Cars	
		Calculated (ft)	Design (ft)			Calculated (m)	Design (m)
15	80	121.3	125	20	20	30.6	35
20	115	161.7	165	30	35	45.9	50
25	155	202.1	205	40	50	61.2	65
30	200	242.6	245	50	65	76.5	80
35	250	283.0	285	60	85	91.7	95
40	305	323.4	325	70	105	107.0	110
45	360	363.8	365	80	130	122.3	125
50	425	404.3	405	90	160	137.6	140
55	495	444.7	445	100	185	152.9	155
60	570	485.1	490	110	220	168.2	170
65	645	525.5	530	120	250	183.5	185
70	730	566.0	570	130	285	198.8	200
75	820	606.4	610				
80	910	646.8	650				

Note: Intersection sight distance shown is for a passenger car making a left turn from an undivided roadway. For other conditions and design vehicles, the time gap should be adjusted and the sight distance recalculated.

Source: AASHTO Green Book, 7th Edition

The proposed project access locations including driveways and median openings are subject to the spacing criteria from the Access Management Criteria in **Section 8 (Driveways)**.

Additional types of analysis (weaving, queueing, etc.) may be required by the city or TxDOT depending on existing conditions in the study area.

i. **Mitigation**

Improvements for each intersection shall be identified for each time period of analysis to:

- Either maintain a minimum intersection level of service (LOS) of D in future analysis scenarios, or
- When LOS is currently below D, and the site is anticipated to generate greater than 5% of the total traffic at the approach in question.

The TIA must provide a section detailing the mitigations required for the study area intersections and roadway links to operate at an acceptable level of service. This section must also indicate the timeframe when mitigations are needed and the responsible party. Mitigations may include but are not limited to the following improvements:

- Pedestrian Facilities;
- Right-of-way (ROW) Dedication;
- Adjacent Local or Collector Streets Improvements;
- Non-Adjacent Thoroughfare Improvements;
- Intersection Control Improvements; and
- Intersection Turn Lane Improvements
- Right-turn/Deceleration Lanes into Site
    - Any turning movement on a city designated roadway that is equal to or greater than 75 vph will require a dedicated right-turn/deceleration lane if the speed limit is posted at 40 mph or less; the threshold is reduced to 60 vph if the speed limit is posted at 45 mph or greater. Right-turn/deceleration lanes must have at least 60 feet of storage and appropriate tapers. Right-turn/deceleration lanes are not appropriate on arterial roadways (Type D and above) in the Mixed-Use Context or Downtown Streets where speed limits are posed at 40 miles per hour or above.

The system improvements ultimately required by the city will be determined in accordance with state law, federal law, and city policy based upon the information provided to the city concerning the development.

j. **Conclusions and Recommendations**

This section is to include all study area mitigation measures recommended in the report. Each measure should also reference the percent of site traffic impacted, the responsible party and the analysis scenario in which it was identified. Additional sections may be required and added by city staff including the findings of the auxiliary lane analysis, sight distance, access spacing, and any other transportation-related items.

12.6 Effect of Traffic Study

The results of the traffic study may be used for the following purposes:

- To be used by the Planning & Zoning Commission and City Council in consideration of a zoning change request;
- To condition approval of a zoning or site plan application;
- To determine onsite and/or offsite improvements, public or private, to be required from the applicant as part of the development;
- To determine city responsibility in cost sharing and construction of public improvements; and/or
- To establish a phasing plan whereupon identified mitigation measures are required prior to completion or initiation of subsequent phases.

SECTION 13 Neighborhood Traffic Management

13.1 Purpose

Plano aims to address residential safety and livability concerns through the collaboration of neighborhoods, public demands, and city staff while also supporting growth in a way that can protect civilians from the negative impacts of traffic. A concerned citizen may voice their opinion, concerning neighborhood traffic management, through the process laid out in this section. In residential and/or highly trafficked pedestrian areas, the City evaluates and implements an effective traffic management program to reduce traffic speeds and improve pedestrian safety for the City's street system. Plano's *Thoroughfare Plan Map* determines the City's street system. The *Thoroughfare Plan Map* is a component of Plano's *Comprehensive Plan*. The City of Plano aims to improve safety and efficiency for all road users.

The advantages of a neighborhood traffic management program include traffic calming elements which reduce traffic speed or volume, increase safety, and beautify city streets. The disadvantages include possible inconvenience to residents driving in the neighborhood, parking restrictions, unattractive devices, and increased noise for residents adjacent to the device.

Traffic calming elements shall be incorporated into the design of residential developments unless a Traffic Engineering Study concludes that traffic calming elements are not necessary. Traffic calming elements may alter standard city lane widths and cross sections as approved by the Director of Engineering. All traffic calming elements must be approved by the Director of Engineering and the Fire Marshal.

13.2 Policies

The following policies are established as part of the Neighborhood Traffic Management for neighborhood streets:

- Neighborhood traffic management projects should encourage slower speed to enhance safety for all road users within the neighborhood land use context.

- Neighborhood traffic management should be limited to streets with a neighborhood land use designation. This includes Type E, F, and G streets.

- Neighborhood traffic management techniques may be utilized in heavy pedestrian contexts such as Corner and Mixed-Use contexts. Refer to **Section 2 (Street Framework)** for land use context information.

- Neighborhood traffic management should be planned and designed to meet identified transportation engineering best practices, including those outlined in this Manual.

13.3 Selection of Project Areas

Request Period

A citizen or neighborhood association may request that a particular street or area be considered for neighborhood traffic management improvements. The requestor must complete a project request application including the specific location(s) and reasoning behind the request. Requests may be submitted throughout the year, and all requests received by August 1st will be considered during the following fiscal year, beginning October 1st. This August deadline provides adequate time for the City to collect data and rank each project area in time to begin the study process shortly after the start of the new fiscal year.

Project Eligibility Review and Notification

The City will review the eligibility of each request based on program purpose and policies. During the eligibility review, the City will consider requests and determine the study area. The study area will be based on the facility being analyzed; for instance, a collector (Type E and F) would likely have a larger study area than a local (Type G) street.

Evidence of Neighborhood Support

The applicant of a neighborhood traffic management request is responsible for collecting signatures of households or property owners within the proposed study area to determine the level of neighborhood support. A minimum of two-thirds of property representatives within the study area are required to sign the support petition in order for the location to move forward in the process. A property representative is defined as the legal owner of a property. Upon request, the city may provide forms, a map of the project area, and a list of affected property addresses to aid the applicant.

Data Collection and Scoring

The program coordinator facilitates the collection of project data including speed surveys, ball bank studies, traffic counts, crash analysis and photometric analysis of lighting conditions to establish project criteria score. The data collection method and *Neighborhood Traffic Management Program Prioritization Criteria* are included in Appendix A. The scoring criteria determines a projects priority order.

Application Retention

Eligible project applications that are not selected in the first year will remain eligible in the program for a period of two fiscal years. These project areas are reconsidered during the Data Collection and Scoring process beginning the following fiscal year. Rescored applications are not required to collect evidence of neighborhood support petition signatures in a subsequent year.

13.4 Neighborhood Engagement

The Neighborhood Engagement process is expected to include a minimum of two meetings. Additional meetings may be scheduled as necessary. Once a project location has been approved for neighborhood traffic management improvements, city staff will send a letter to each business, property owner, and resident in the project area. In addition, letters will also be sent to the president of the neighborhood association(s) within the project area. This letter outlines that a neighborhood traffic management project is being advanced to the design stage.

13.5 Meetings

The recommended public meeting schedule and action items are as follows:

- Introduction to Neighborhood Traffic Management and Identification of the Problem – Discuss existing neighborhood traffic issues, presentation of the traffic data and evaluation and discussion of potential neighborhood traffic management design concepts.

- Open House / Presentation of Design Concept – Present the final concept and discussion of feedback prior to voting.

Additional meetings may be held as the project progresses into and through the construction phase.

13.6 Menu of Traffic Management and Traffic Calming Techniques

There are many devices available to address neighborhood traffic concerns. Some devices are used to address vehicular speed, others to address cut-through traffic issues and still others to enhance pedestrian safety.

The City desires to implement devices that are aesthetically pleasing. Every attempt is made to ensure that only the necessary signs and markings are installed. Excessive clutter is not the intent, rather it is to adequately warn, guide and protect the users of the roadway.

13.7 Neighborhood Traffic Development

After reviewing the traffic data and the menu of devices available, city staff is responsible for developing possible solutions to address the given traffic problems which will be present at Meeting #2 – Open House/Presentation of Design Concept.

13.8 Plan Approval Process

1. After Meeting #2, the next step involves a vote by residents, businesses, and property owners in the project area. Instructions for voting are mailed by the City. These instructions will also contain details of the proposed neighborhood traffic management plan, maps showing where the proposed devices are located, written descriptions of each device, and a ballot or link to the ballot.

2. Each parcel within the project area is allowed one vote by the property owner. A minimum of two-thirds of ballots must be received and at least two-thirds of the ballots received must be in favor of implementing the plan.

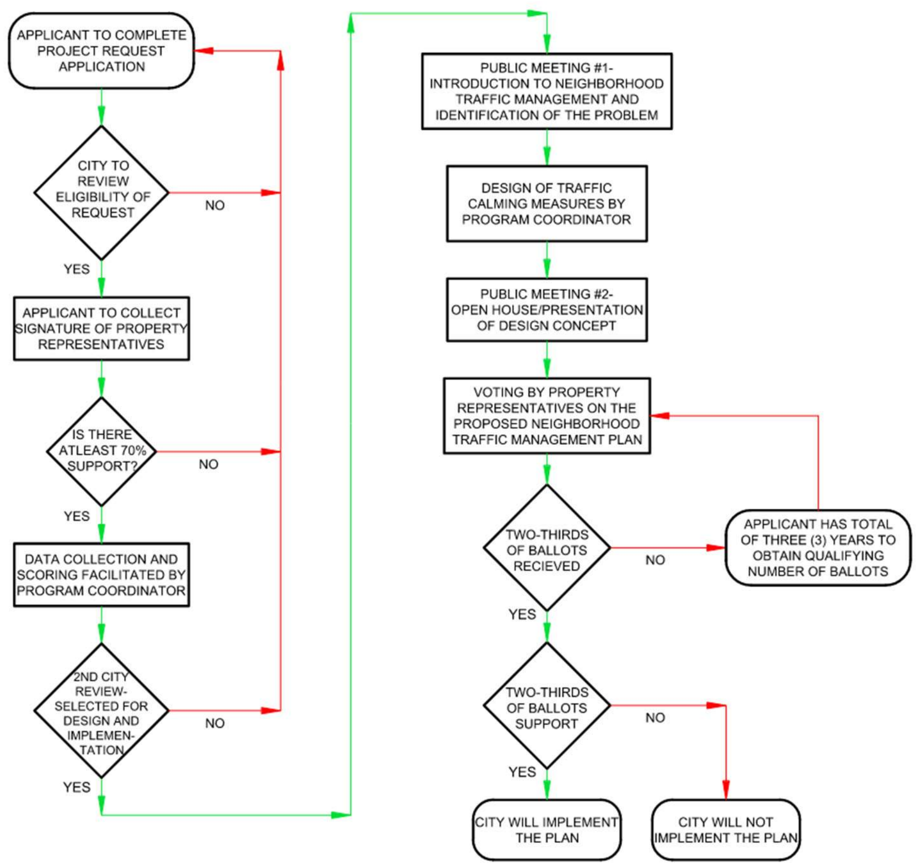
3. The notice is mailed at least 30 days prior to the deadline for receiving the ballots. This allows voters the opportunity to read through the material, return the ballot or ask city staff questions and still have time to fill out the ballot before the deadline. The ballots will be available at the open house and can be returned during that time. Ballots must be postmarked by the deadline given.

4. The neighborhood traffic management plan is voted on as a whole. Because the plan is a system of integrated calming devices, individual streets or devices cannot be taken out of the proposal as part of the vote. If one device or one street were removed from the plan, the comprehensive nature of the plan would be lost, and residents on that street may experience higher traffic speeds and/or increased traffic volumes. The vote is either yes or no. Comments are welcomed but will not change the result. This is the only opportunity to vote on the neighborhood traffic management plan, so every effort must be made in the planning stages to ensure that it is correct and complete.

5. If the two-thirds approval is obtained, then city staff completes the design of the devices, and the project is ranked in a prioritized list amongst other neighborhood traffic management projects. If two-thirds approval is not obtained, then the city does not implement the plan and the project area will be held for future analysis and remain for three years but is not eligible for evaluation during the next five years.

Refer below to **Figure 13-1** for complete neighborhood traffic calming implementation process flowchart.

Figure 13-1: Neighborhood Traffic Calming Implementation Process Flowchart



13.9 Device Location

It is understood that some residents may object to having a device immediately adjacent to their property. Since a neighborhood traffic management plan typically will include multiple devices across the neighborhood, the placement of individual devices must be consistent with the plan. Once a project has been approved by vote, the city will make every effort to work with property owners regarding device placement. However, the location of devices is based on engineering and necessity for the success of the program.

If deemed necessary, the City may modify the neighborhood traffic management plan to address problems discovered during the final design period. Factors that would lead to making a change in location may include but are not limited to mailbox access, drainage, and trash pickup.

13.10 Design for Speed Management

The operating speed of a street is a primary factor related to the safety of the roadway. Streets are designed to the design speed for the given classification of the roadway, however, the design speed may be greater than the desired target speed. Neighborhood traffic management plans are designed to reduce speeds such that the roadway operates at the target speed. This is made possible through the application of various speed management techniques. These techniques also greatly improve pedestrian crossing safety and may be used in conjunction with crossing locations as outlined further in **Section 9 (Multimodal Facilities)**.

This section outlines standardized speed management techniques for Type E, F, and G streets. Retrofits of existing streets with speed management devices shall be determined in consultation with applicable staff from the applicable department using the latest administrative guidelines.

- The following **Figure 13-2** illustrates a toolbox of some of the potential speed management design strategies on Type E, F, and G streets in the City of Plano. Refer to the *Institute of Transportation Engineers (ITE) Traffic Calming Measures* and *FHWA (Federal Highway Administration) Traffic Calming Modules* for an overview and typical application of traffic calming devices found below.

Figure 13-2: Speed Management Strategies

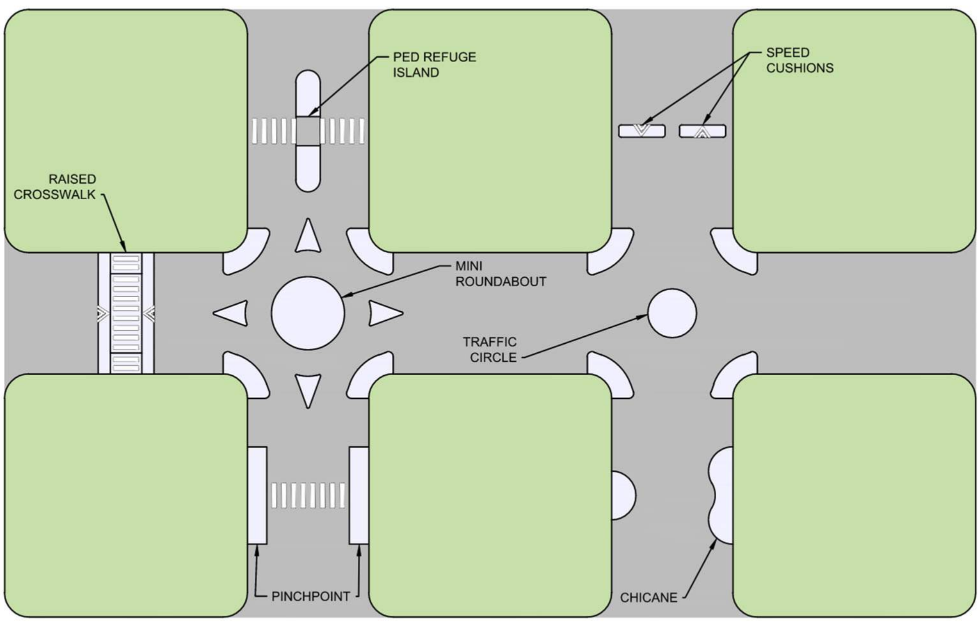


Table 13-1: Speed Management Spacing

Street Types	Maximum Spacing Between Treatments
Type G Streets	200 feet
Type E & F Streets	300 feet

- Speed management technique to be applied shall be approved prior to application by the applicable staff of the applicable department if deviating from the following:
  - The standard speed management device on Type G streets shall be a pinch-point with 12 feet. clear width. These shall be placed with spacing per **Table 13-1** from another mid-block device or the nearest intersection with a traffic circle, stop control, or raised intersection. Pinch-points will be strategically placed to avoid conflict with on-street parking, mailboxes, facility routes, etc.
  - The standard speed management device on Type E and F streets shall be a median island or painted median for horizontal deflection. These shall be placed with spacing per **Table 13-1** from another mid-block device or at the intersection approach in tandem with a crosswalk.
- Speed management devices should be placed at least 5 feet from any driveway, entrance, or curb cuts on Type E, F, and G streets except for median islands.
- Devices shall maintain a minimum spacing of two feet from manholes or mailboxes or utility poles or points of access.

13.11 Visually Narrowing Techniques

Visual narrowing techniques utilize either physical objects, vertical street elements, or pavement markings to communicate to the driver a perceived narrowing of their anticipated path of permissible travel to reduce operating speeds.

- Designed marked parking spaces can be used as an effective way to narrow a street by creating friction for moving vehicles. These parking spaces should be designed carefully if a street also has on-street bike facilities because of conflicts from the door zone of vehicles. In addition, they are particularly effective when coupled with pinch-points and bulb-outs.
- Street Trees, outlined in the cross sections in **Section 2 (Street Framework)** and required by Plano's Zoning and Land Development, help visually narrow the street. The visual narrowing effect is more pronounced the closer the trees are to the edge of the travel way for vehicles. Refer to **Section 10 (Public Right-of-Way Visibility)** for visibility requirements regarding street trees and additional guidance on street trees.

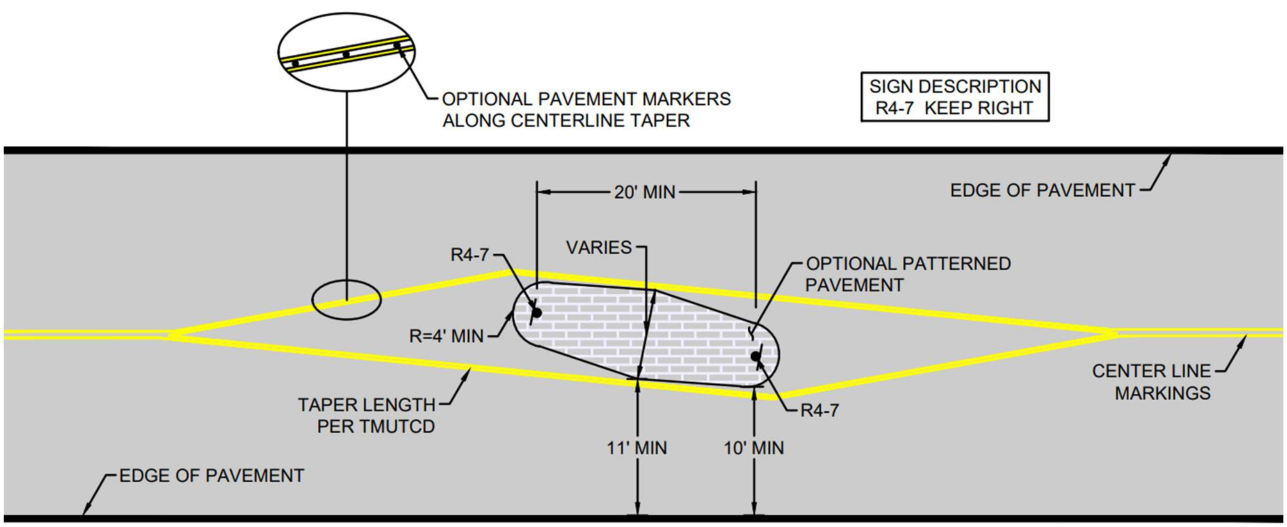
13.12 Horizontal Deflection

Horizontal deflection forces the driver to respond to a changing width or alignment of their anticipated travel path. This response typically results in a lowering of operating speed. Horizontal deflection can be implemented through the construction of physical barriers or through the application of pavement markings with supplemental vertical devices. Pinch-points and bulb-outs at pedestrian and bicycle crossings shall be used wherever possible in order to slow vehicle speeds at pedestrian and bicyclist conflict points.

13.12.1 Median Island

Median islands and raised central islands are the preferred speed management techniques to require vehicles to shift horizontally from their travel path which typically results in reduced speeds. Median Islands are typically landscaped with ground cover, bushes, and trees or paved with decorative pavers. They create narrowed lanes and encourage motorists to slow through the narrow section. Median islands of a sufficient width can also provide protected spaces in the center of the street to facilitate bicycle and pedestrian crossings comfortably.

Figure 13-3: Median Island



NOTE: ALL SIGNING AND STRIPING SHALL CONFORM TO THE LATEST EDITION OF THE TMUTCD

- A median island may simply be a painted area that is designated for non-automobile use but is most effective when it is defined by a raised curb and landscaped to further reduce the street width.
    - Often incorporate textured pavement on the island itself, particularly for a median island without a raised concrete curb.

- A median island can often double as a pedestrian refuge island if a cut in the island is provided along a marked crosswalk.
    - Where there is an existing crosswalk, it is desirable to locate the median island at the crosswalk.
- When placed at or near the entrance to a neighborhood, a median island provides a visual cue to the motorist and induces lower vehicle speed

Table 13-2: Median Island Pros and Cons

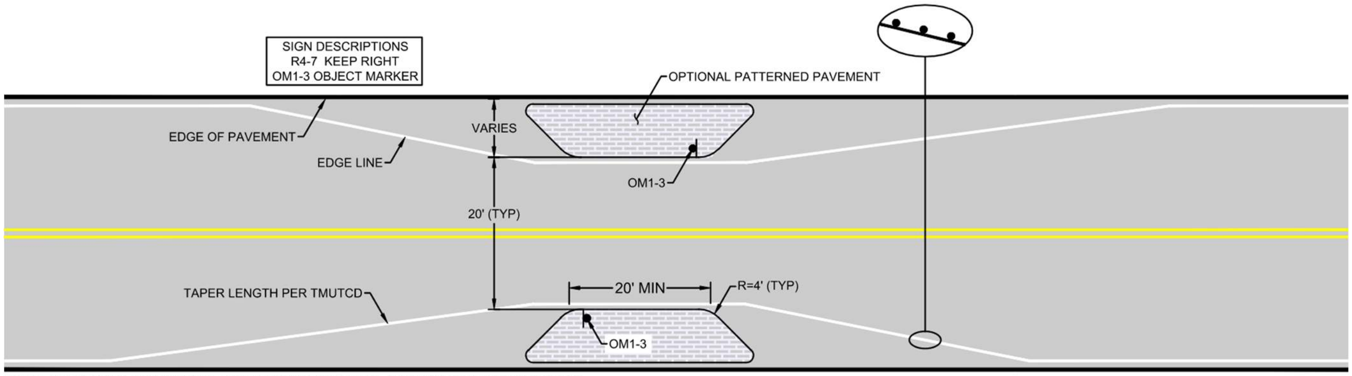
Pros	***Cons***	***Avoid***
Reduces lane width and vehicular speed.	Curbside parking must be prohibited.	Using along primary industrial route.
Provides aesthetic visual break up on long, straight streets.	Maintenance responsibility if landscaped.	Major relocation of drainage features or large utilities.
Provides a visual cue to motorists that they are entering a narrow section.	May have little or no impact on cut-through traffic.	Major reduction of accessibility of adjacent properties.

13.12.2 Pinch-point

A Pinch-point, also referred to as a “choker”, is a curb extension applied at the midblock of a street to slow traffic speeds and add public space. Pinch-points can facilitate midblock pedestrian crossings of low-volume streets by physically narrowing the street and expanding sidewalks at strategic areas. They provide shorter pedestrian crossing distances and protection at the beginning of a parking lane.

Figure 13-4: Pinch Point

(Legacy West, Plano, TX)



- Pinch-points are appropriate for Type E through Type G streets.
- Applied only at midblock crossings. If placed at an intersection, considered a "bulb-out."
- Appropriate at all levels of traffic volume.
- Appropriate along a primary emergency vehicle route and bus transit route.
- Installing a pinch-point may reduce travelway width for bicyclists and motor vehicles and force a shared travel lane. If traffic volume is high, the use of shared lane markings and signage could be necessary and appropriate.
- Bicycle racks can be combined with pinch-points, especially in areas where bicycle parking is insufficient or demand for bicycle parking is unmet.

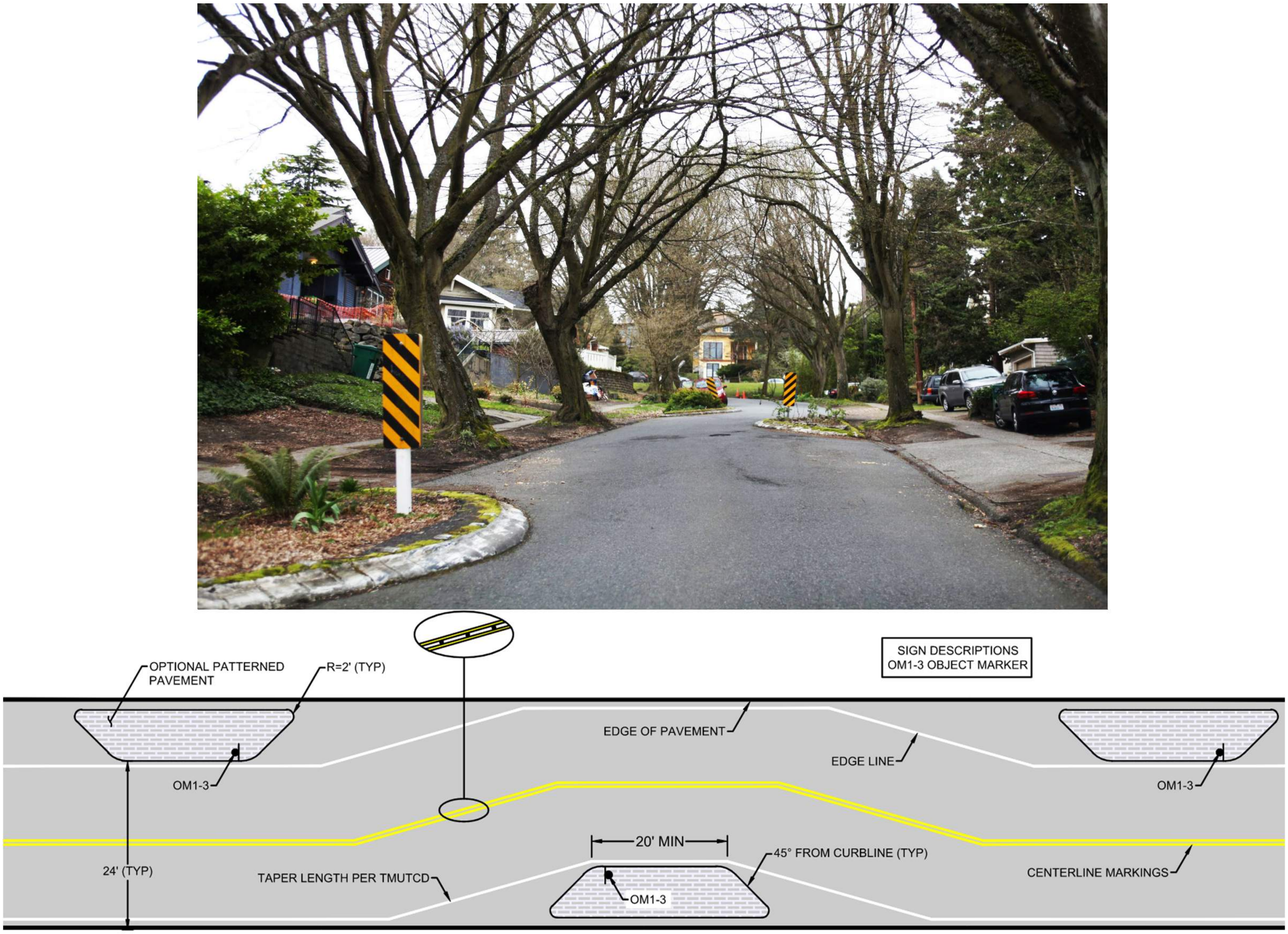
Table 13-3: Pinch-point Pros and Cons

Pros	***Cons***	***Avoid***
A minor inconvenience to drivers with minimal inconvenience to traffic.	Double lane narrowing is not very effective at reduced speeds.	Obstructing pedestrian visibility with landscaping.
Pedestrian friendly for crossing distance.	Only partially effective as a visual obstruction.	Major relocation of drainage features (including surface drainage and inlets) or large utilities.
Minimal impact on emergency services.	Unfriendly to cyclists.	
Effective when used in a series.		

13.12.3 Chicane

A chicane slows drivers by alternating parking, bulb-outs, or pavement markings along the street. Chicanes deflect the horizontal path of a vehicle and are designed at the posted speed or lower to induce reduced speeds. Chicanes also increase the amount of public space available on a corridor. They are usually landscaped with ground cover, bushes, and trees. Small, raised islands may be added.

Figure 13-5: Chicane



NOTE: ALL SIGNING AND STRIPING SHALL CONFORM TO THE LATEST EDITION OF THE TMUTCD

- With the proper degree of horizontal curvature, chicanes can be appropriate for a Type G street or low-volume Type E and F street.
- Chicanes can be used on a one-lane, one-way and two-lane, two-way road.
- Can be applied both with and without a bicycle facility.
- Appropriate with speed limits of 35 mph or less.
- Appropriate along a primary emergency vehicle route and bus transit route.
- Chicanes can be installed on a crest vertical curve only if there is adequate stopping sight distance or warning signs provided.

- Chicanes increase the amount of public space available on a corridor and can be activated using benches, bicycle parking, and other amenities.

Table 13-4: Chicanes Pros and Cons

Pros	Cons	Avoid
Reduces motorist speed.	Curbside parking is prohibited.	Location for a crosswalk.
Does not restrict access to residents.	Maintenance responsibility, if landscaped.	Relocation of drainage features unless re-design is completed.
Minimal impact on emergency services.	It may have little or no impact on cut-through traffic.	
Reduces cross distance for pedestrians.		

13.12.4 Striping

Striping as a traffic calming technique can help reduce the driver's perceived width of the roadway. The striping may be designed that deflects a vehicle's path. Striping is used when there is an ample amount of pavement width for lane configuration. Striping can also be used to provide on-site parking, on-street facilities for bicyclists, and/or buffer between vehicular travel and sidewalks/pedestrians. Color applications can be applied to some markings depending upon the application factors such as climate, use and stress, and age/condition of the pavement. Refer to *City of Plano Standard Construction Details* for striping details.

Figure 13-6: Striping

- Striping alternatives can consist of adding the following:
  - Centerline Stripe
  - Edge Lines
  - Striped Median
  - Striped Choker or Chicane
  - Psycho-perceptive striping

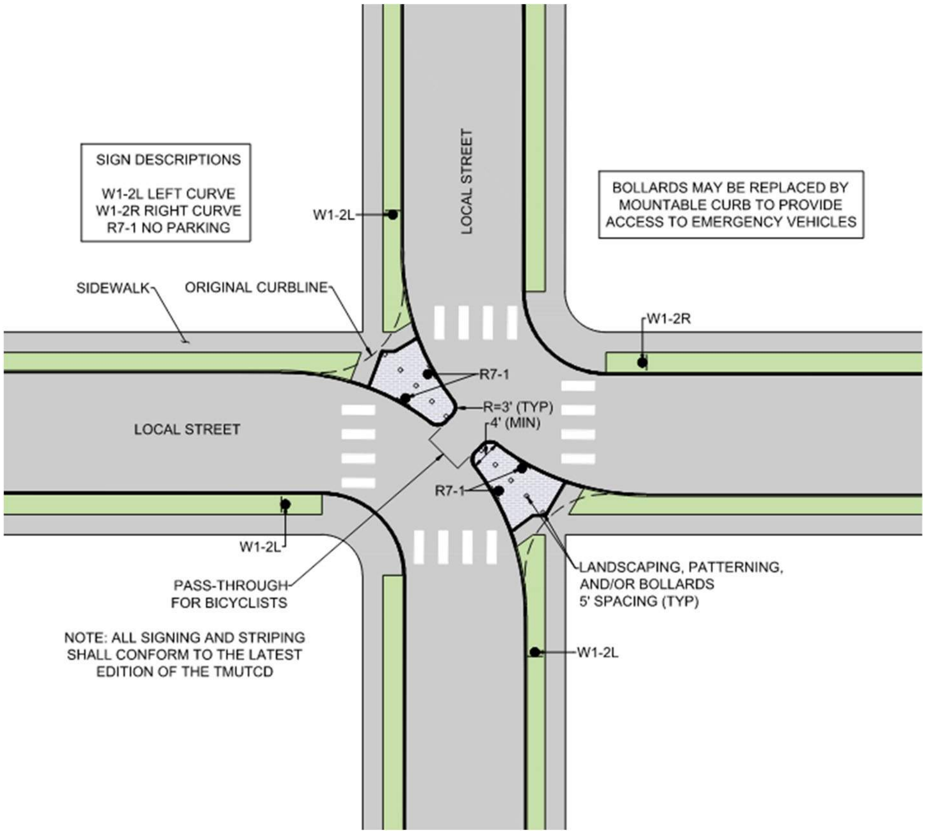
Table 13-5: Striping Pros and Cons

Pros	Cons	Avoid
Does not reduce emergency response times.	Some limitations in speed reduction.	When a physical barrier is more appropriate.
Allow for greater flexibility to meet future changes.	Less effective when speeds are already low.	Placing new striping/markings on old roads in poor condition.
Can be implemented quickly and are less costly to construct.	The paint of markings can fade over time.	
Provides an opportunity for multimodal street design.		

13.12.5 Diverter

A diverter is a device that limits through movements for motor vehicles in one or more directions. Some diverters cut across an existing intersection diagonally, while allowing passage for pedestrians and cyclists. Other diverter styles deny entry from a major street or only allow right-in, right-out movements. Diverters are appropriate for subdivisions, Type F or G streets. Diverters require slow vehicle speeds to negotiate the intersection's sharp curve; the typical maximum speed limit is 25 mph.

Figure 13-7: Diverter



- Diverters should only be used where the street network pattern is grid-like with a high connectivity index and nearby alternative routes.
- A cutout, gap, or channel can be provided in the diagonal diverter to allow at-grade bicyclist movement between all four legs of the intersection.
- Pedestrians can and should be accommodated by pass-throughs or walkways across or through the diverter.
- A cutout, gap, or channel can be provided in the diagonal diverter to allow at-grade bicyclist movement between all four legs of the intersection.

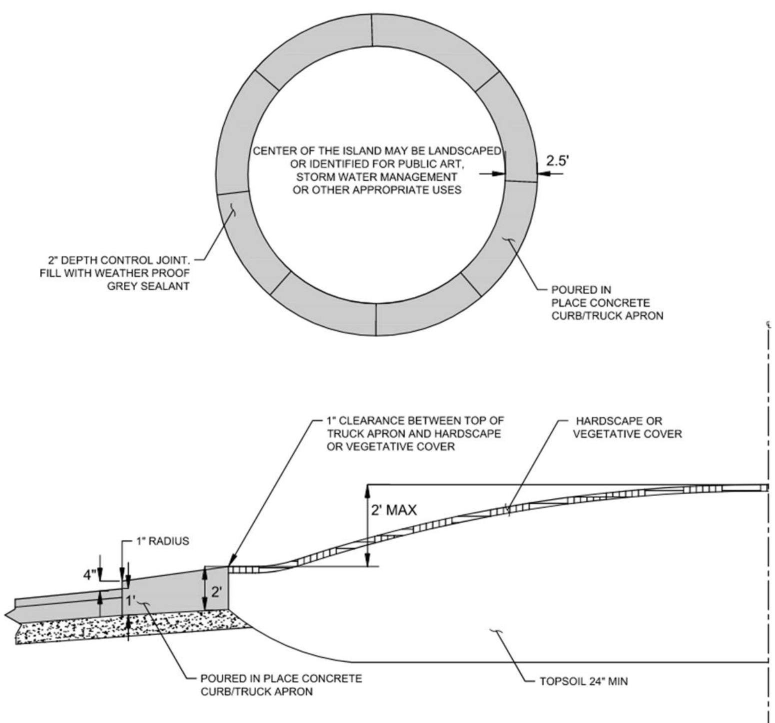
Table 13-6: Diverter Pros and Cons

Pros	***Cons***	***Avoid***
Reduces speed at intersection approach.	May not reduce cut-through traffic.	With on-street parking closer than 30 feet of intersection.
Reduces vehicle conflict.	Increases emergency response time.	Offset intersections
Provides equal access to the intersection for all users.	Can restrict access for trucks and large school buses.	Access for emergency services, commercial or industrial.
Does not restrict access to residents.	Requires maintenance responsibility, if landscaped.	Can create traffic flow issues.

13.12.6 Traffic Circle

A traffic circle is a central island, painted or raised with a vertical or mountable curb in the center of the intersection of two streets. Traffic circles are intended to be yield-operated intersections that cause a horizontal deflection in vehicle paths through the intersection.

Figure 13-8: Traffic Circle



- Traffic circles paired with a visual obstruction through the intersection, such as a tree, increase the effectiveness of reducing speed.
- A traffic circle can have stop signs or yield signs on the intersection approaches.
- A traffic circle is usually circular in shape but may be oval to fit a particular intersection.
- A traffic circle is typically designed to fit within the travel lanes of an existing intersection. Because of the infrequent large vehicle turning left on the near side of the circle, the intersection approaches do not have splitter islands.

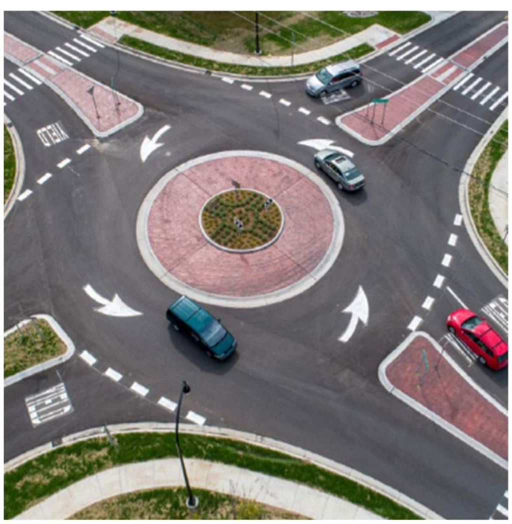
Table 13-7: Traffic Circles Pros and Cons

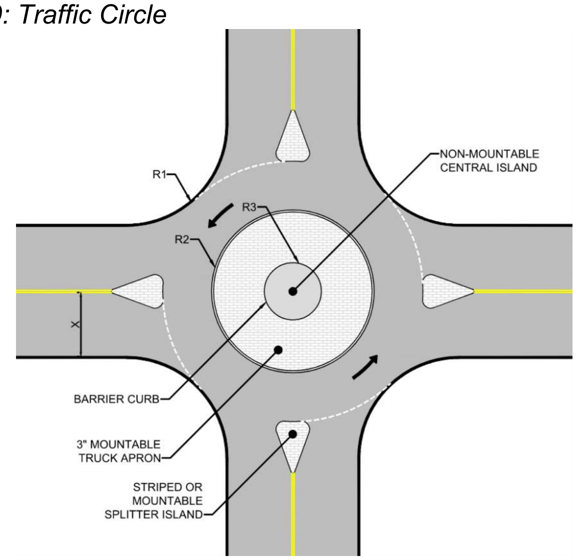
Pros	Cons	Avoid
Reduces speed at the intersection approach.	May not reduce cut-through traffic.	With on-street parking closer than 30 feet of intersection.
Reduces vehicle conflict.	Increases emergency response time.	Offset intersections
Provides equal access to the intersection for all users.	Can restrict access for trucks and large school buses.	Access for emergency services, commercial or industrial.
Does not restrict access to residents.	Requires maintenance responsibility, if landscaped.	

13.12.7 Mini-Roundabout

Mini-Roundabouts are intended to be used as an alternative traffic control device to a multi-way stop or a two-way stop. Mini-Roundabouts are intersections with circulating traffic that yield at entry. They are used to move traffic on neighborhood collector roads with higher volume. The main uses of Mini-Roundabouts are to increase the capacity of existing four-way stops and where approaching sight-distance is limited. Mini-Roundabouts differ from traffic circles in that they require deflection of vehicle paths prior to entry into the intersection, typically through the use of curbed or painted splitter islands.

Figure 13-9: Traffic Circle





- Mini-Roundabouts have relatively small, inscribed circle diameters and traversable central islands, allowing larger vehicles to cross over the island when turning. However, they are designed to accommodate passenger vehicles without requiring them to drive over the central island. **Table 13-8** for design radii is found below

Table 13-8: Radii Table

X	R1	R2	R3
16'	15', 20', 25'	12', 18', 20'	7', 7', 7'
14'	15', 20', 25'	10', 11', 12'	5', 5', 5'
12'	15', 20', 25'	6', 8', 9'	3', 3', 3'

Table 13-9: Mini-Roundabout Pros and Cons

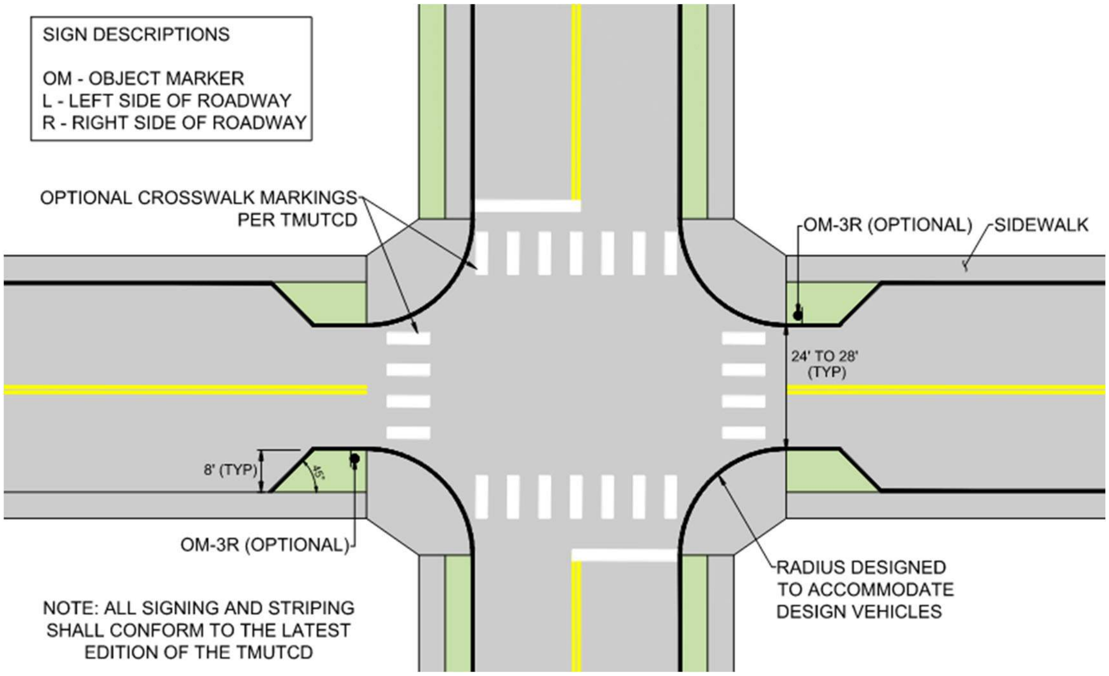
Pros	Cons	Avoid
Reduces speed at the intersection.	Can restrict access for trucks and longer school buses.	When posted speeds are higher than 35 mph.
Decreases severity and number of potential vehicle conflict points.	Requires maintenance responsibility, if landscaped.	If the slope of roadway is higher than 6%.
Provides equal access to the intersection for all users.	Higher installation costs.	To accommodate high volumes of truck traffic.
Visually appealing when landscaped or hardscaped.		With on-street parking closer than 30 feet of the intersection.

13.12.8 Pedestrian bulb-outs

Pedestrian bulb-outs are used at an intersection to narrow the street at the location where pedestrians cross the street. When bulb-outs are combined with on-street parking, the corner extension can create a protected street parking and prevent illegal parking near intersections. Bulb-outs are used to physically narrow the street and expand sidewalks and landscaped areas. They provide shorter pedestrian crossing distances and protection at the beginning of a parking lane. Bulb-outs shall contain landscaping or a sign to increase their visibility to motorists; however, trees shall not be planted in them.

Figure 13-10: Pedestrian Bulb-Out

(Legacy West, Plano, TX)



- The primary purpose of bulb-outs is to "pedestrianize" an intersection. The bulb-outs, typically containing a reduced corner radius, slow automobile speeds, shortens pedestrian crossing distance, and increases pedestrian visibility.

- Pedestrian bulb-outs have limited impact on vehicle speed because of the absence of either a pronounced vertical or horizontal deflection. If reducing vehicle speed is also a priority, the bulb-out can be combined with a vertical speed device such as a raised crosswalk.

- During the design, consideration is needed for the potential impacts on the existing drainage system and major utility relocation

Table 13-10: Pedestrian Bulb-Outs Pros and Cons

Pros	***Cons***	***Avoid***
Minimal impact on traffic.	Unfriendly to cyclists unless designed to accommodate.	When posted speeds are higher than 35 mph.
Safer for pedestrians due to shorter crossing distances.	Only partially effective as a visual obstruction.	Without taking drainage design into consideration.
Provides space for landscaping.	The conflict between passing opposing drivers could create problems.	
Slows traffic without affecting emergency response time.		

13.13 Vertical Deflection

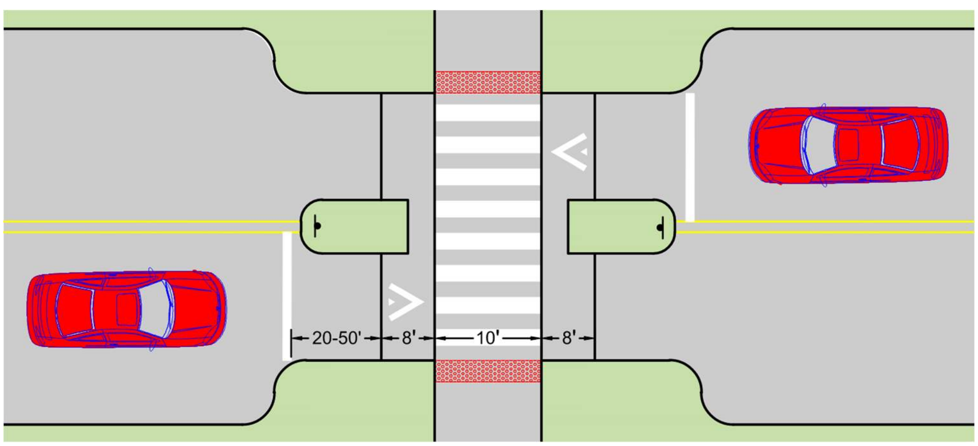
Vertical deflection is an isolated increase in the normal pavement elevation that encourages the driver to slow vehicle speed. Raised crosswalks are the preferred method of vertical deflection on Type E and F streets. The use of raised crosswalks encourages vehicle speeds to be slower at the point of conflict with pedestrians and bicyclists. When using vertical deflection, positive drainage shall be maintained to avoid ponding of water in the ROW. See **Section 5 (Street Design)** for guidance on tapers when transitional shifts are used with either pavement markings or physical curbs.

13.13.1 Raised Crosswalk

Raised crosswalks are constructed along an elongated mound in the roadway pavement surface extending across the travel way at a right angle to the traffic flow. They encourage motorists to travel at slow speeds while increasing sight distance to active pedestrians. Raised crosswalks should be installed where there is significant pedestrian desired movement and low traffic volume. Common positioning includes bus stops, plazas, parks, building entrances, waterfronts, and midblock passageways.

Figure 13-11: Raised Crosswalk

(Willow Bend Mall Rd, Plano, TX)



- The raised crosswalk shall be from the face of curb to the face of curb in the traveled way.
- Raised crosswalks shall be designed so that the design vehicle does not bottom out traversing the raised crosswalk operating at 5 mph.
- The crosswalk should be striped, regardless of the paving pattern or material, to bring attention to the drivers, especially at night.

- Stop bars at crossings should be set back 20-50 feet. This ensures that a person crossing the street is visible to all drivers in the stop queue.

- Daylighting in advance of a crosswalk makes pedestrians more visible to motorists and care more visible to pedestrians. This may be accomplished by restricting parking and/or installing a curb extension.

- If bicycles operate in the street where a raised crosswalk is planned, bicycles shall transition across the raised crosswalk location with grades appropriate for their design speed. The maximum slope shall be 10% for ramps across a raised crosswalk when bicycles operate in the street.

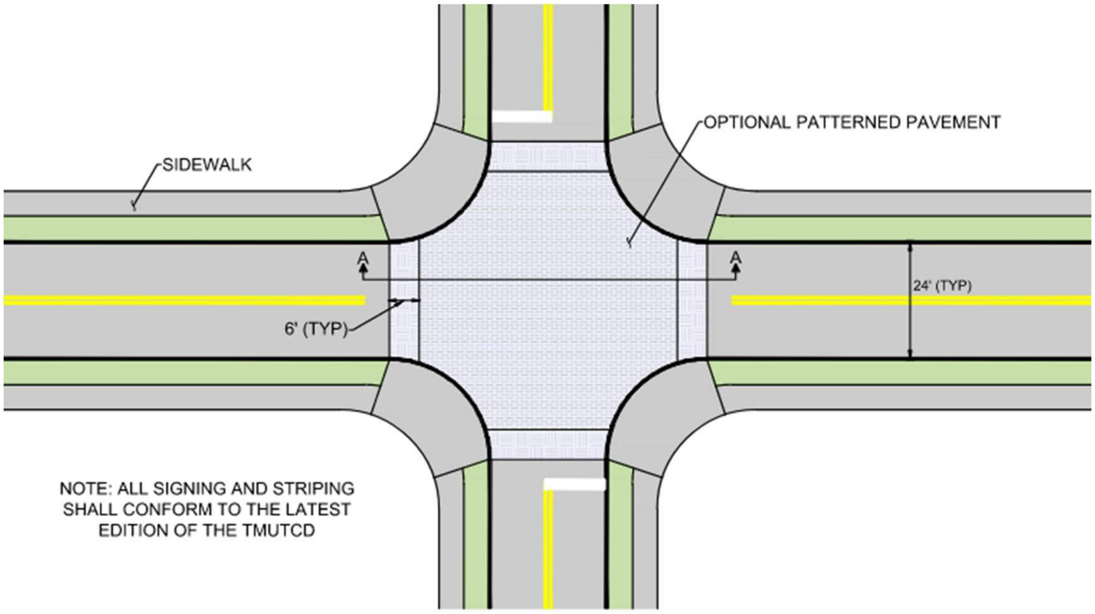
Table 13-11: Raised Crosswalks Pros and Cons

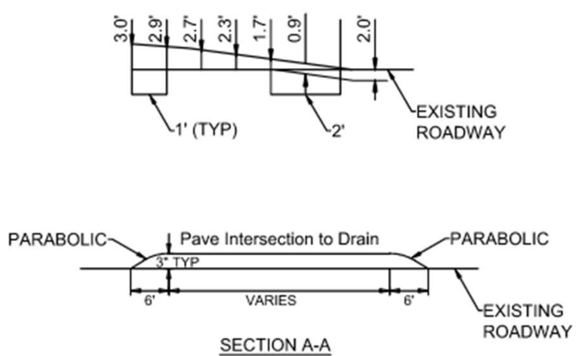
Pros	***Cons***	***Avoid***
Work well in combination with bulb-outs.	Impacts emergency vehicle response times.	Work well in combination with bulb-outs.
Elevated crossing pedestrians are more visible to drivers.	Appropriate only at mid-block sections and not at intersections.	Elevated crossing pedestrians are more visible to drivers.
Can be used on single or multi-lane roadways.	Impacts design for drainage.	Can be used on single or multi-lane roadways.
Reduces speeds by 20-25%.		Reduces speeds by 20-25%.

13.13.2 Raised Intersection

Raised intersections are a flat, raised area covering an entire intersection that creates a safe, slow-speed crossing and public space. Similar to other vertical speed control elements, they reinforce slow speeds and encourage motorists to yield to pedestrians. Raised intersections are flush with the sidewalk and ensure that drivers traverse the crossing slowly.

Figure 13-12: Raised Intersection





Raised Intersections are appropriate for the intersection of a Type E, F, or G street, and residential streets where traffic volumes are relatively low and if there are existing crosswalks on all four legs of the intersection or if crosswalks are warranted.

The *ITE Guidelines for the Design and Application of Speed Humps* recommends a few guidelines for the installation of raised intersections:

- Maximum speed limit of 30 mph and a maximum grade of 8%.
- Crosswalks do not need to be marked unless they are not at grade with the sidewalk. ADA-compliant ramps and detector strips are always required.
- Bollards along corners keep motorists from crossing into the pedestrian space and protect pedestrians from errant vehicles.
- Approach legs to a raised intersection can be either one-way or two-way. Where two one-way streets intersect, there will be two corners which no drivers will turn. This can be designed with the smallest constructible radius as long as a fire truck can make the turn without encroaching upon the sidewalk.

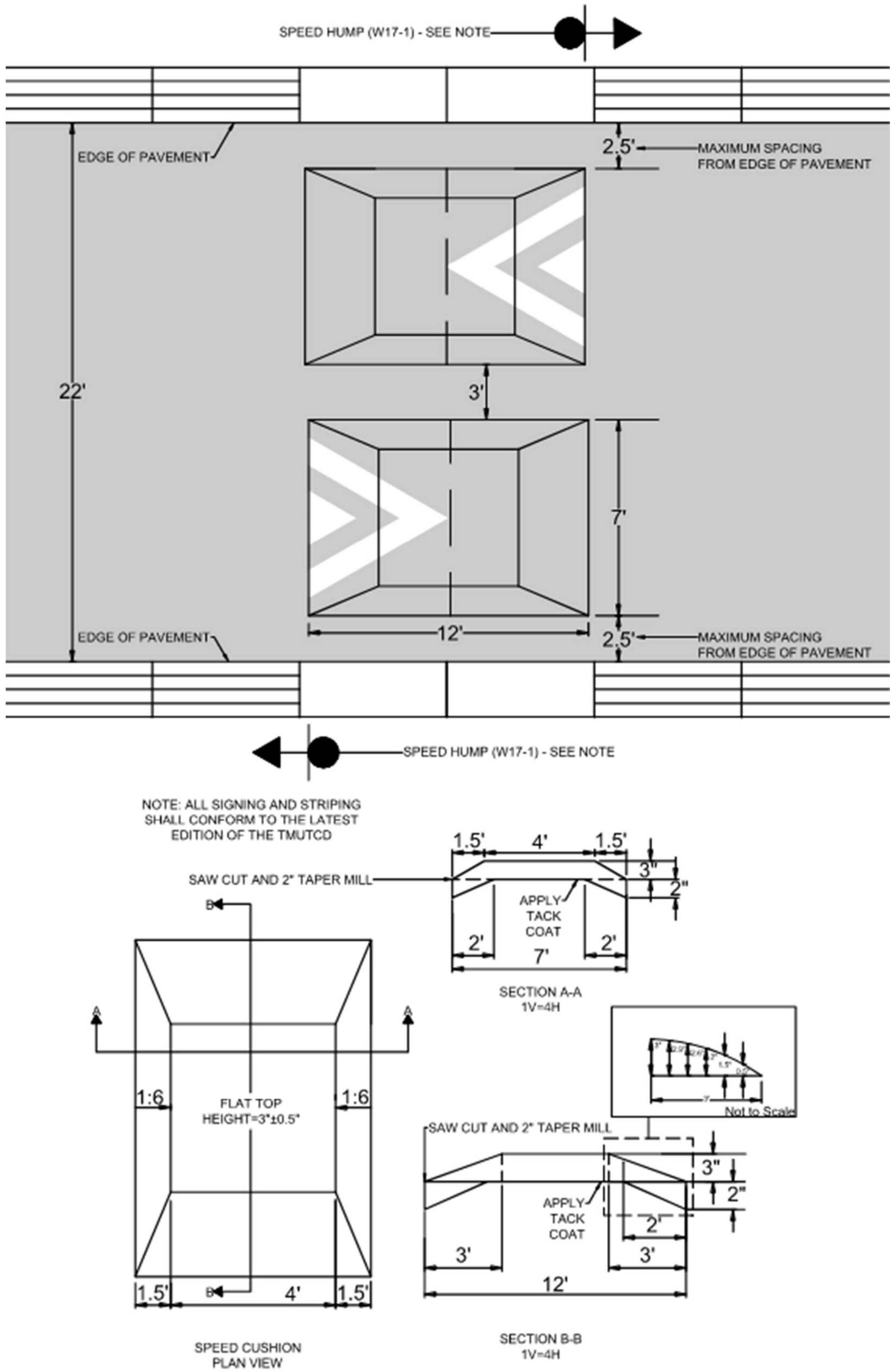
Table 13-12: Raised Intersections Pros and Cons

Pros	Cons	Avoid
Reduces speed at the intersection.	Traffic noise may increase from braking and acceleration at the intersection.	When posted speeds are higher than 30 mph.
Increases pedestrian visibility and safety.	Likely requires changes in access to below-ground utilities.	If slope of roadway is higher than 8%.
Compliments a mixed-use, high volume, pedestrian area.	Slower response times for emergency vehicles.	Any change in accessibility to the property along all legs of the intersection.

13.13.3 Speed Cushions

Speed cushions are parabolic calming devices intended to slow traffic speeds on low-volume, low-speed roads. They consist of two raised areas placed laterally across a roadway with gaps in between. They are seen as favorable over speed humps because these gaps allow for emergency vehicles to pass through at normal speeds. Speed cushions can be designed for a range of speeds based on length and height.

Figure 13-13: Speed Cushions


SPEED HUMP (W17-1) - SEE NOTE
EDGE OF PAVEMENT
2.5'
MAXIMUM SPACING
FROM EDGE OF PAVEMENT
22'
3'
7'
12'
EDGE OF PAVEMENT
2.5'
MAXIMUM SPACING
FROM EDGE OF PAVEMENT
SPEED HUMP (W17-1) - SEE NOTE
NOTE: ALL SIGNING AND STRIPING
SHALL CONFORM TO THE LATEST
EDITION OF THE TMUTCD
1.5'
4'
1.5'
3"
2"
SAW CUT AND 2" TAPER MILL
APPLY
TACK
COAT
2'
2'
7'
SECTION A-A
1V=4H
B
A
A
1:6
FLAT TOP
HEIGHT=3"±0.5"
1:6
B
1.5'
4'
1.5'
SPEED CUSHION
PLAN VIEW
Not to Scale
SAW CUT AND 2" TAPER MILL
3"
2"
APPLY
TACK
COAT
2'
3'
3'
12'
SECTION B-B
1V=4H

- Speed cushions should be used primarily on Type E, F, and G streets at midblock locations.
- Speed cushions should be spaced 260-500 feet apart with appropriate advance warning and striping to ensure users anticipate the speed cushions.
- Vertical speed control elements should be designed to the following criteria:
    - Slopes should not exceed 1:10 or be less than 1:25.
    - Side slopes on tapers should be no greater than 1:6.
- Location of speed cushions should be where there is sufficient visibility and available lighting.

Table 13-13: Speed Cushions Pros and Cons

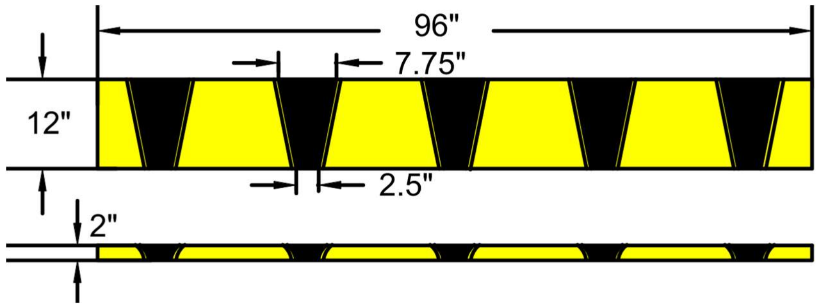
Pros	***Cons***	***Avoid***
Minimal impact on emergency response times.	Does not slow down large commercial vehicles or motorcycles.	On roads with a grade of greater than 8 percent.
Lowers traffic volumes by an average of 20%.	Passenger vehicles may try to steer around them.	On roads with speeds higher than 35 mph.
Low cost to construct.		Combining with pedestrian crossings.

13.13.4 Speed Bumps

Speed bumps are parabolic calming devices intended to greatly reduce vehicle speed and cause significant driver discomfort on low-volume, low-speed roads. These roads are typically alleys, mews, residential areas, commercial driveways, or parking lots. Speed bumps will not be found on a public roadway with a speed limit greater than 10 mph. Speed bumps do not tend to exhibit consistent design parameters from one installation to another, generally having a height of 2 to 6 inches with a travel length of 1 to 3 feet.

Figure 13-14: Speed Bumps

(Residential Development, Plano, TX)



- Speed bumps are a more aggressive traffic calming option than speed humps
    - Useful in places where pedestrians and vehicles share space closely.
    - Generally, slows traffic to 2-10 mph.
    - Much shorter travel distance than speed humps, between 6 inches to 2 feet.
- Can be placed at intervals to maintain speed reduction.
- When made of rubber or plastic, a vehicle hitting the speed bump too fast can expect less damage to the vehicle.
- Speed bumps can be the most adaptable tool for traffic management due to low costs and easy installation.

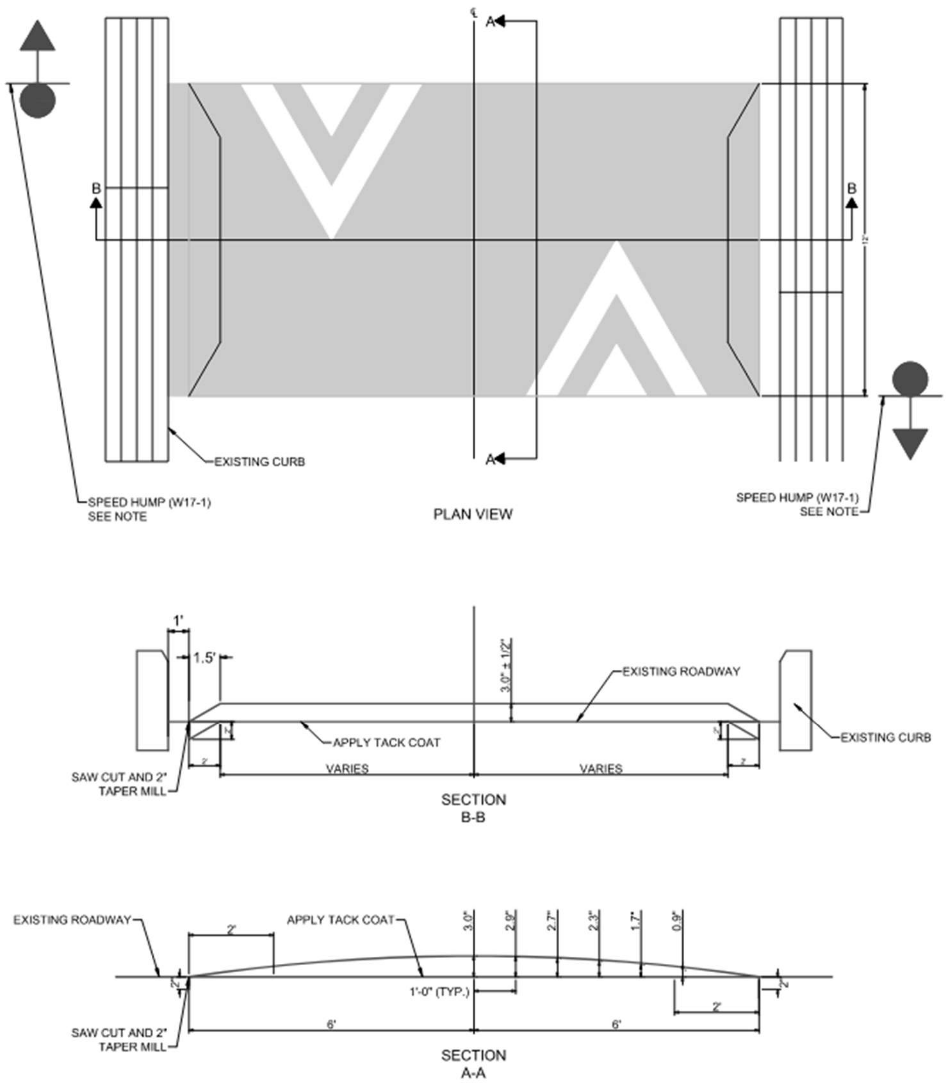
Table 13-14: Speed Bumps Pros and Cons

Pros	***Cons***	***Avoid***
Sharply reduces speed.	Creates extreme discomfort.	Placement on a public roadway.
No relocation of utilities.	Visibility can be an issue during heavy rains or snowfall.	Long curves or grade steeper than 8%.
One of the most effective speed-reducing traffic measures.	Can cause vehicle damage if the device is ignored or unseen.	Installation along emergency routes.

13.13.5 Speed Humps

Speed humps are parabolic calming devices intended to slow traffic speeds on a low-volume, low-speed roads, typically neighborhood, Type E, F, and G streets. Speed humps shall not be placed in front of driveways or other significant access areas. Speed humps are generally not appropriate for a primary emergency vehicle route or a street that provides access to a hospital or emergency medical services.

Figure 13-15: Speed Humps



- Speed humps are three-to-four inches high and 12-14 feet wide, with a ramp length of three-to-six feet, depending on target speed.
- The *ITE Guidelines for the Design and Application of Speed Humps* recommends a few guidelines for the installation of speed humps:
  - The appropriate speed for installation of speed humps is 30 mph or less. Speed humps reduce speeds to 15-20 mph and are often referred to as "bumps" on signage and by the public.
  - Only consider installation on a street with a grade of 8% or less.
  - Should not be placed on a sharp curve, with the minimum horizontal curve radius being 300 feet.
  - Should be placed at a midblock location and not near an intersection. Typically spaced 150 feet from an unsignalized intersection and 250 feet from a signalized intersection.
- Speed humps are recommended to be designed to the following criteria:
  - Slopes should not exceed 1:10 or be less steep than 1:25.
  - Side slopes on tapers should be no greater than 1:6.
  - The vertical lip should be no more than a quarter-inch high.

Table 13-15: Speed Humps Pros and Cons

Pros	***Cons***	***Avoid***
Typically, requires no removal of on-street parking or effect on adjacent properties.	Impacts emergency vehicle response times.	On routes with primary access for emergency, commercial, or industrial traffic.
No relocation of utilities.	Impacts design for drainage.	Close proximity to crosswalks.
One of the most effective speed reducing traffic measure.	Traffic noise may increase from braking and acceleration at speed hump.	If drainage gutter is in center of the roadway.

13.14 Landscaping

Vegetation is chosen which requires minimal attention, such as xeriscape. Devices that include raised curbs could contain 1-3 trees, low-lying shrubs, and ground cover, depending on the size of the device. The neighborhood association will have the responsibility of maintaining the landscaping. Adjacent residents could, in their routine lawn maintenance, water or trim the vegetation when the need arises. Failure to maintain the vegetation will result in its removal.

13.15 Conclusion

Neighborhood Traffic Management offers effective solutions to address residential traffic problems. The comprehensive nature of the program allows for the mitigation of potential impacts to all streets within the entire project area. It is a program in which all residents, businesses and property owners are allowed and encouraged to participate in the process. With technical assistance from the City of Plano, neighborhood traffic management plans can be developed and approved by those most affected.

Evaluating streets in an entire project area can be a worthwhile activity to foster a sense of community and develop solutions that not only address traffic problems but also offer attractive landscaping areas and textured pavement. These modifications can, in turn, result in increased safety and property values and improve the overall quality of life.

APPENDIX A

NEIGHBORHOOD TRAFFIC MANAGEMENT

PRIORITY POINT RANKING

STREET: ____

FROM ______________________ **TO** ______________________

STAFF NAME: ______________________________ **DATE:** ______________

CATEGORY :______________________________ **POINTS:** ______________

Draft Neighborhood traffic management Scoring Process Update

Category	Criteria	Points Allocated	Max Points
Traffic	Traffic Volume	Average daily traffic volume (ADT)/200	25
	Cut-Through Traffic	1 point per % of cut-through traffic based on Origin Destination Study or Traffic Study	25
	Speed (85th percentile speed)	Two (2) points for each mph over the posted speed limit up to 4 mph over Plus five (5) points for each mph in excess of 5 mph over the posted speed limit	No Max
Safety	Crashes	Three(3) points for each reported speed related crash in the past five years	No Max
	Road Geometry	Five (5) points for each element below the posted speed limit (i.e. sight distance, curves, etc.)	No Max
	Street Lighting	No points for lighting consistent with City of Plano standards Five (5) points for each non-compliant location	No Max
Multimodal Activity	*Sidewalks (Both Sides)	No points for detached sidewalks (Greater than 80%) Two (2) points for back-of-curb sidewalks less than 6 feet in width Five (5) points for no sidewalks (Greater than 50%)	5
	Bikeways	No points for buffered/protected bike lanes or for no bicycle facility designation Three (3) points for bike lanes Five (5) points for a designated bike route or shared lanes	5
	Activity Generators	Five (5) points for projects within one block of a school, park, neighborhood commercial/ mixed-use area (5 points for each generator)	No Max
Neighborhood Support	Evidence of Neighborhood Support Signatures	1 point for each % above two-thirds% support on the ballot process	No Max

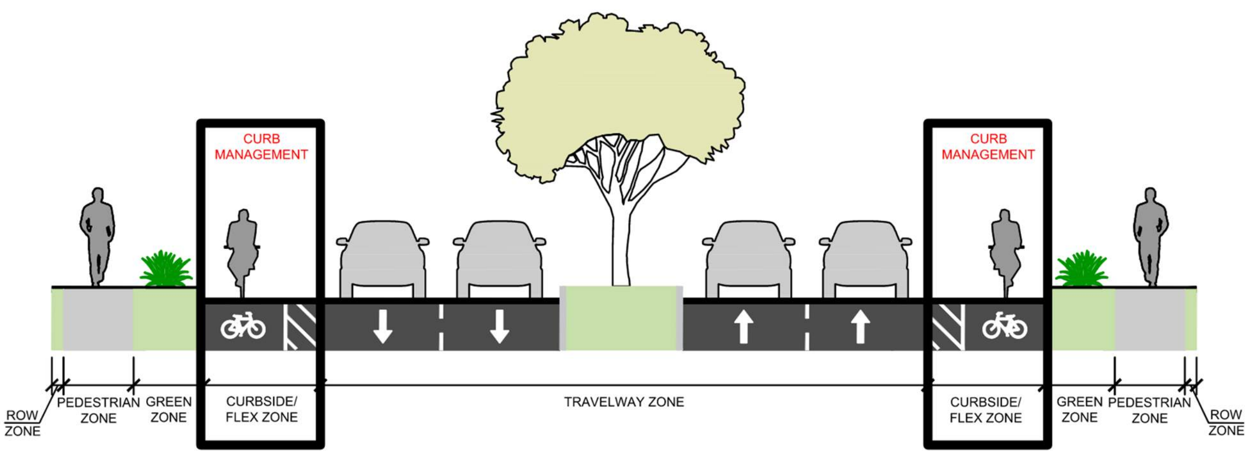
*****_Percentage of sidewalks as determined by the Engineering Department_

SECTION 14 Curb Management

14.1 General

The purpose of this section is to provide options and tools for addressing competition for short-term curbside access from rideshare, transit, public realm activation, and deliveries through curb management. Curb management is used to address multiple potential uses within the 'Curbside/Flex Zone,' see **Figure 14-1**, including on-street bicycles, transit stops, commercial deliveries, on-street parking, passenger loading, etc. Curb management is any intentional practice to bring order to the curb and determine specific priorities for space. It refers to a broad and varied suite of tools and treatments. It can range from simple signage or striping distinguishing the public right-of-way (ROW) from private property; to permanent changes to curb infrastructure like bus bulbs, queue jumps, or protected bike lanes; to computer-generated geofencing to designate pick-up and drop-off areas for rideshare. The physical manifestations of curb management are dependent upon the size, context, and priorities of the community.

Figure 14-1: Curb Management operates within the Curbside/Flex Zone (refer to Section 2.2)



14.2 Types of Curb Use

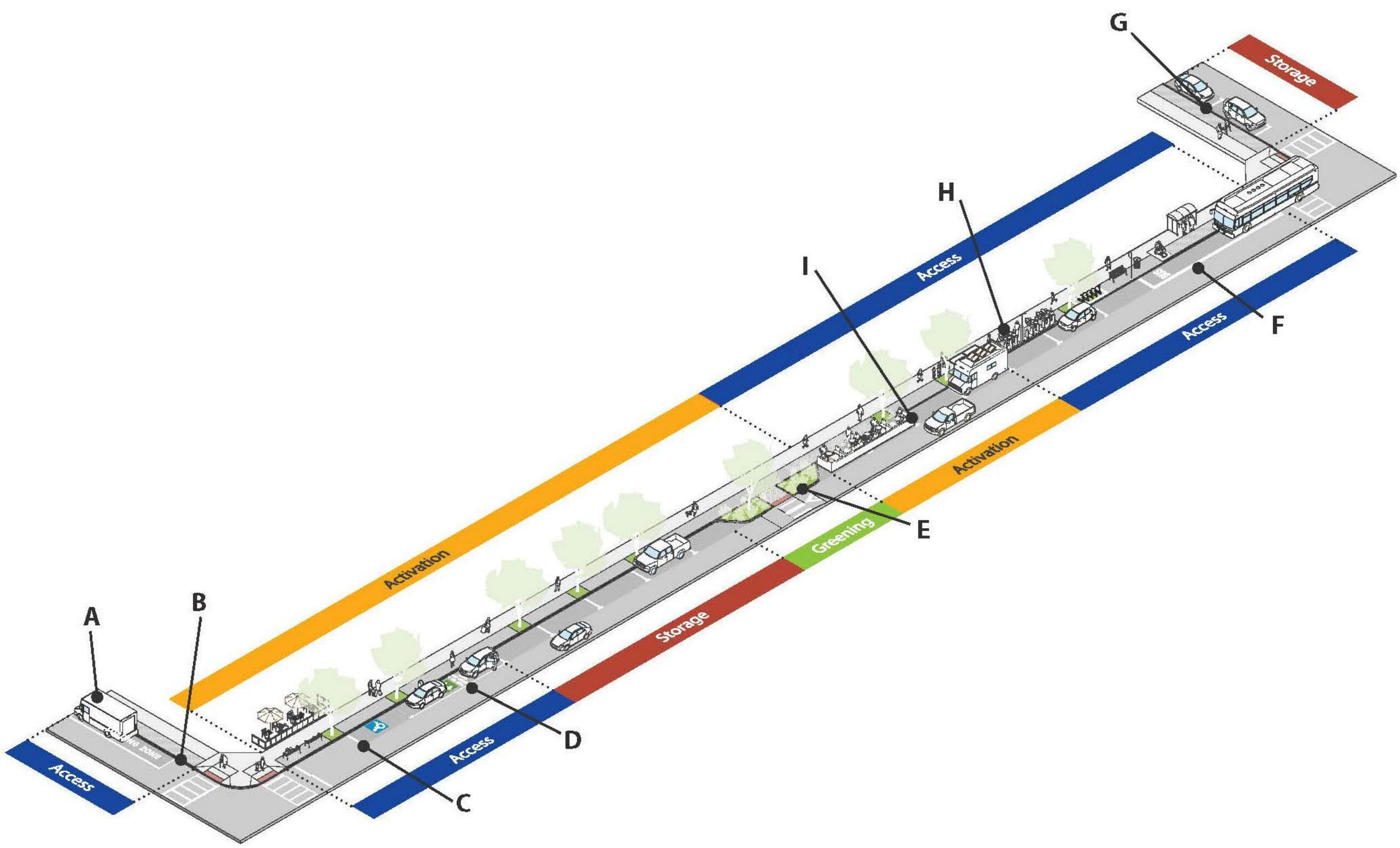
While historically, single occupancy vehicles (SOV) were the primary mode of transportation to dominate on the street and at the curb, in many places in the City of Plano, the curb has become a hub for a variety of modes. **Section 2 (Street Framework Requirements)** categorizes all thoroughfares as one of four land use contexts used in the Street Design Standards: Neighborhood, Commercial, Corner, and Mixed-Use. Each of these land use contexts are home to a spectrum of mode services and intensity. A few examples:

- Pickup/Drop-off at the Curb (rideshare)
- Dockless Vehicles (scooters)
- Pedestrians/Cyclists
- Transit
- Parking

Curb management may also allow for an extension of the ‘Green Zone’ into the ‘Curbside/Flex Zone’, creating additional space for landscaping and street furniture, as well as a social gathering and commercial endeavors such as parklets, food trucks, street vendors, and green infrastructure. All curb management shall adhere to the ADA and PROWAG accessibility requirements in combination with providing curb access to these various modes.

Curb uses on a typical block should support the land use and transportation context. Once street space has been allocated to ensure safety and achieve multimodal mobility, the space above and below the curb can be used to meet priorities related to access, activation, greening, and storage. **Figure 14-2** shows how different curb uses might be arranged along a block face in a mixed-use district and highlights some of the best practices for enhancing safety, comfort, and convenience for people in Mixed-Use, Commercial, and Neighborhood land use contexts.

Figure 14-2: Curb Management Diagram (Source Dallas, TX Parking Management 2023)



A Commercial loading with large trucks may be best suited on side streets.
B At intersections, provide daylighting and parking restrictions to maximize visibility.
C Accessible parking should be placed near a curb ramp, which may be provided at an access aisle, at the end of a block.

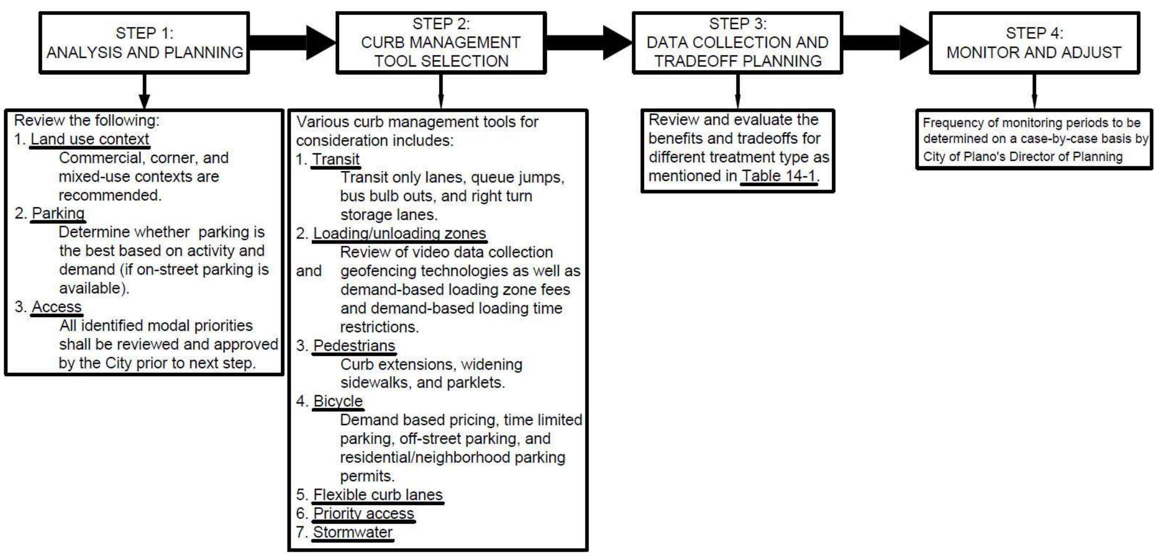
D General use loading / short stay zones can serve taxis, TNCs, passenger pick-up/drop-off, or people making a quick purchase. Place near activated spaces (i.e. restaurants, cafes, public open spaces), high-density residential buildings, or other key services.
E Where contextually possible/recommended, midblock curb extensions opportunities to safely cross the street. Designs may incorporate bike parking, landscaping, mobility hub elements, or street furniture while maintaining clear sightlines.
F Placement of the bus stop on the far side of the intersection increases the visibility of passengers boarding and exiting as they cross the street and allows the bus to depart promptly.
G Providing longer-stay on-street parking on side streets prioritizes more active curb uses on main corridors.
H Positioning micromobility hubs near transit stops supports first/last mile connections for transit riders.
I Parklets and vending such as food trucks may be placed adjacent to each other, providing space to eat, drink, and gather.

14.3 Planning Methodology

The planning methodology for the City of Plano's curb management is presented in this section and will follow a four-step process to ensure curb management tools are deployed where needed. The processes include:

1. Analysis and Planning
2. Curb Management Tool Selection
3. Data Collection and Trade-off Analysis
4. Monitor and Adjust

Figure 14-3: Planning Methodology Flow Chart



Curb management is best implemented in areas where different and competing activities occur. Commercial areas, central business districts, and mixed-use retail and restaurant corridors are good examples of areas likely to benefit from curb management. In the City of Plano, CBDs, downtowns, and entertainment districts also typically have the most convergence of multiple modes of travel and curb demands. Airports, college campuses, and hospitals may also benefit from curb management plans as these types of land uses typically require large volumes of people traveling into/out of the campus via a variety of modes.

In contrast, a single-family residential neighborhood with calm, quiet streets will likely not need a curb management plan or policies due to the limited activity occurring at the curb. Similarly, big box stores, such as Walmart, Costco, and Home Depot, provide large parking lots and people typically access these stores with cars in order to transport their purchased items. Therefore, most people accessing these types of stores will likely not be arriving via alternative modes, leading to very little activity at the curb.

Step 1: Analysis and Planning

To begin planning a curb management strategy, first, determine the functional classification and land use context (refer to **Section 2 (Street Framework)**) of the street. The adjacent land use and activity level will have a greater impact on curb management tools used, but the functional classification will determine the physical limits of curb management strategies. Curb management opportunities are limited to the curbside/flex zone. Refer to **Section 2 (Street Framework)** for details.

Streets serve a broad range of functions, from through-traffic routes to pedestrian thoroughfares. Practices to ensure safety and manage traffic flow will vary according to the principal purpose of each street section, which will need to be updated to include short-term passenger and goods loading zones.

The types of modes and activities that are prioritized in the subject location can be determined by reviewing the functional classifications and land use types, as shown in **Table 2-2** in **Section 2 (Street Framework)**. Some land use types align better with curb management tools than others as shown below in **Table 14-1**:

Table 14-1: Recommended Land Use for Curb Management

Recommended Land Use Context	Non-Recommended Land Use Context
Commercial	Neighborhood
Corner	
Mixed-Use	

Parking – If on-street parking is available, determine if parking is the best use based on observed activity during peak weekend and weekday periods or if parking/vehicle storage needs can be shifted to off-street locations. If demand exceeds functional capacity (80% utilization) during peak periods, identify adjacent off-street parking alternatives and provide a cost-benefit analysis for maintaining street parking versus moving off-street or eliminating some or all parking capacity. Note, if options beyond street parking are considered the curb has the potential to provide greater access to more people.

Access – All identified modal priorities shall be reviewed and approved by the City prior to moving to **Step 2**. The main objectives of the planning process are to identify and prioritize other related plans and policies that need to be coordinated to optimize curb management. Within district and small area plans, mobility hubs can be created that co-locate transit, ride-hailing, and package deliveries. These hubs can be strategically planned to serve multiple buildings in a space that does not impede traffic flow for pedestrians, bicyclists, and vehicles.

Step 2: Curb Management Tool Selection

This section provides an overview of various curb management tools and initiatives that may be considered. The tools provided are separated by the different types of user groups including transit, pickup/drop-off, pedestrian, and bicycle. These tools form a series of treatment options to be put into use to implement curbside management strategies. Each curbside management scenario requires that a combination of these treatments be used to address the curb's modal priorities and land uses documented in **Step 1**.

Bus/Transit Access

Bus lanes fall within the Curbside/Flex Zone. Coordination with DART shall occur in the design of bus lanes, location of pedestrian boarding and alighting accommodations, and placement of transit signage, refer to **Section 9 (Multimodal Facilities)**.

- Curbside bus lanes shall be marked by colored paving, "BUS ONLY" pavement markings and other roadside signage. Refer to *TMUTCD* for markings and signage.
- Curbside bus lanes should be placed to the right of travel lanes on one-way or two-way streets adjacent to curbs and preferably on streets without parking lanes.
- If curbside lanes are only dedicated bus lanes during peak times, provide regulatory signage that states the time periods of dedicated use by buses.
- Curbside bus lanes create the least conflict with turning vehicles on streets with few driveways and curb cuts. Where turn volumes are high, bus stops shall be on the far side and the parking lane between the bus lane and curb can be used as a turn lane at intersections.
- If parking lanes are present, vehicles may cross bus lanes to park but may not use the bus lanes for travel.
- Stops and shelters in the pedestrian zone require sufficient width in the green zone, usually 8 to 10 feet wide.
- Queue Jumps: Give buses a brief leading interval.
- Bulb outs: Extensions of the sidewalk could be used for active loading without leaving the travel lane.
- Storage Lanes: Reduce delays at intersections due to vehicles turning right.

Pros	Cons	Avoid
Provides convenient access to transit without the bus having to leave the travel lane.	Lose space for other multimodal uses like rideshare or bike lane.	In locations that would be better served by other uses or where space is constrained.

Loading/Unloading Zones

- Transportation Network Companies (TNCs) like Uber and Lyft provide on-demand travel with curbside pickup.

- Deliveries – Freight vehicles or app-based services like Grub Hub.

- Demand-Based Loading Zone Fees - Encourage commercial deliveries to occur in off-peak times by charging fees during peak traffic and parking congestion.

- Demand-Based Loading Time Restrictions - Restricting user types by the time of day, typically prioritizing active loading zones for commercial deliveries during business hours and passenger loading during evenings.

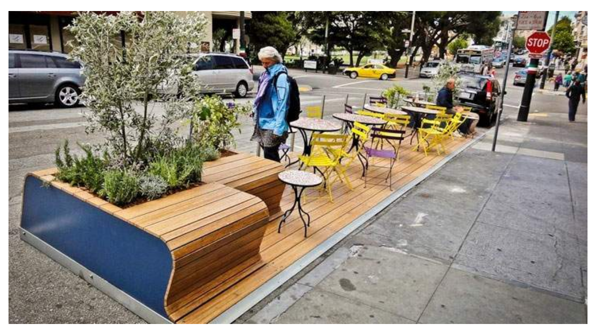
- Specific parking spaces for freight vehicles and app-based services that require less than 10 minutes of occupancy.

- Autonomous Vehicles (Future) – In the future, cities and towns may consider integrating their road and utility mapping with AV platforms to ensure AVs can appropriately navigate streets and account for road closures and other irregularities

Pros	Cons	Avoid
Flexibility in dense urban areas where space is limited reducing parking pressure.	May be confusing and require enforcement to maintain proper usage and availability.	In areas with less activity where long term (more than 30 minutes) parking is in demand.

Pedestrian Enhancements

- Bulb outs – Expansion of the 'green zone,' including pedestrian amenities like seating and planting, in place of parking spaces to improve the pedestrian experience.



- Widening Sidewalks – Increase pedestrian accessible areas to meet recommended minimums per functional classification and land use context, Refer to **Section 2-2**.

  Parklets – Temporary or permanent pedestrian-activated spaces within an existing parking lane. Parklets are confined to one or more spaces and can contain seating, lighting, signage, shade structures, etc. that benefit the pedestrian experience and activation of a street. Parklets can be used to increase available pedestrian space as temporary measures for events or be made into permanent facilities, outdoor dining is an example.

- Crosswalks - at intersections or mid-block.

Pros	Cons	Avoid
Increase overall quality of the public realm for pedestrians increasing activity and vibrancy.	Amenities like benches, planters, and lighting require annual and seasonal maintenance .	In areas where frontages and adjacent land use is unlikely to support additional public amenities (example: industrial or suburban).

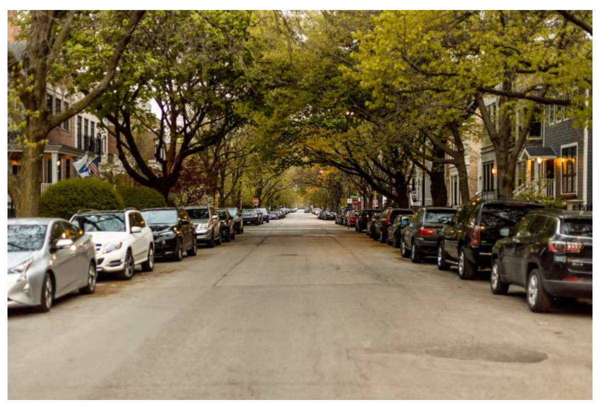
Bicycle and Micromobility

Refer to **Section 9 (Multimodal Facilities Design Requirements)** for widths and other multimodal requirements.

- Protected Bikeway – A separated facility from vehicular and pedestrian traffic. Dedicated bike lanes must be a minimum of 5 feet and a preferred width of 6 feet excluding gutter (if present).
- Shared, Motorized Mobility Options – Scooters and e-bikes.
- Designated Micromobility Parking - Specified stations for micromobility options, like e-scooters or e-bikes that improve first and last-mile connections to transit. Designated parking areas also discourage users from leaving e-vehicles in places that block access for others.

Pros	Cons	Avoid
Increased access to bike facilities and a more robust micromobility network. Increased adoption.	Increased maintenance	In areas where destinations and bicycle travel is unclear or unlikely.

Parking



- Demand-Based Pricing – Encourages parking turnover.
- Time Limited Parking – Vehicles are required to move after the preset time expires.
- Residential/Neighborhood Parking Permits – Vehicles may park for extended periods of time.
- Flexible Curb Lanes – Convert traffic lanes to on-street parking lanes during off-peak times. These are useful in areas with dense retail and/or weekend activities. Flexible curb lines are designated with signage.

Pros	Cons	Avoid
Provides easy access to commercial, residential, or retail frontage.	On-street parking limits other options for amenities that may provide more benefit in urban areas.	In areas where off street parking is available and curbside/flex zone could be better used for multimodal or activation purposes.

Green Infrastructure

Curbs are also critical infrastructure for stormwater management, hence new uses and hubs will need to take storm drains and manhole covers into account.

Pros	Cons	Avoid
Helps meet sustainability goals by reducing heat islands and providing water quality.	Requires additional landscape maintenance and can be costly to install.	In areas where drainage is not a significant challenge or where other uses would provide more benefit.

Prioritizing Curb Management Based on Context

Cities can most efficiently manage curb space by considering the overall functional needs and desired outcomes in a corridor or neighborhood rather than making ad-hoc decisions on a case-by-case basis. This policy recommends that the City follow a three-step process in allocating space above and below the curb.

Table 14-2: Land Use Context and Curb Management

		Functional Classification		
		Arterial Thoroughfare	**Collectors**	**Local Streets**
Land Use Context	**Mixed-Use**	Prioritize transit and balance pedestrian and green infrastructure.	Prioritize transit and balance pedestrian and green infrastructure.	Prioritize transit and balance pedestrian and green infrastructure.
	Commercial	Prioritize transit and balance pedestrian and green infrastructure.	Prioritize transit and balance pedestrian and green infrastructure.	
	Corner		Prioritize transit and balance pedestrian and green infrastructure.	Prioritize transit and balance pedestrian and green infrastructure.
	Neighborhood		Balance pedestrian, bicycle, and green infrastructure.	

Step 3: Trade-off Analysis

The final selection process will include evaluating trade-offs. When one mode or service is prioritized over another, another mode might be impacted. Additionally, if roadway characteristics may be altered, it could have an impact on the rest of the system.

Also, with most treatments, there will be costs associated with implementation. This may mean costs of infrastructure, loss of parking revenue, administrative costs, cost of enforcement of new rules and regulations, etc. It is important for communities to weigh these costs with the benefits that might be achieved from implementation.

In general, major benefits to consider despite trade-offs are the potential for various treatments to contribute to greater economic activity on the street, traffic calming (reduce speeding and improve safety for all modes), navigation, and order.

Trade-offs shall be evaluated in keeping with the modal priorities the City and community have set. For example, the installation of a protected bike lane might impede the speed of movement in the travel way among motorists, but if active modes have been prioritized in the focus area, this might be an appropriate and necessary trade-off. Conversely, a commercial loading zone would increase the ease of this business activity but may pose a challenge if parking revenues are an essential priority and no revenue is generated from loading zone usage.

Evaluating Trade-offs

Evaluating trade-offs is a required part of the tool selection process. When one mode or service is prioritized over another, another mode might be impacted. Additionally, if roadway characteristics may be altered, it could have an impact on the rest of the system. **Table 14-3,** shown below provides a summary of benefits and trade-offs to consider when selecting various curb management treatments for each mode. Note that this list is not exhaustive – coordinate with City of Plano staff to confirm appropriate treatment.

Table 14-3: Summary of Benefits and Trade-offs of various Curb Management Treatments

Treatment Type	Benefits	Trade-off
Transit • Transit lanes • Bus Bulbs • Right turn storage lanes	• Increased transit service • Economic activity • Safer boarding/unloading • Less congestion for both buses and vehicles	• Potential loss of throughput • Cost of infrastructure and operation • Potential bike lane conflicts
Loading/Unloading Zones • Dedicated pickup/drop-off spaces for TNCs • Dedicated pickup/drop-off spaces for deliveries • TNC and commercial delivery fees	• Greater compliance from delivery drivers. • Provide a safe space for TNC drivers/passengers to meet. • Potential revenue source if a pickup/drop-off fee is implemented. • Improve traffic flow by reducing queuing and loading/unloading vehicles	• Loss of on-street parking • Loss of parking revenue if spaces are paid
Pedestrian Enhancements • Bulb outs • Wider sidewalks • Parklets • Crosswalks	• Improved pedestrian safety • Encourages walking • Walkable communities • Economic activity (more people on the street accessing businesses) • Traffic calming	• Cost of infrastructure • Potential loss of travel lane and on-street parking (depending on treatment and available ROW).
Bicycle • Protected Bikeways • Shared Mobility devices and bicycle parking	• Increased bike access • Safer bicycle routes • Reduced vehicle/bike conflicts • Traffic calming	• Potential loss of parking/parking revenue if spaces are paid.
Parking • Demand-based pricing • Off-street parking • Residential Parking Permits • Time limits • Parking technology, mobile app wayfinding	• Greater parking turnover • More open spaces, reducing instances of circling/congestion searching for a space. • May encourage people to use alternatives instead of driving and parking.	• Cost of enforcement • Infrastructure costs, meters, etc. • Public feedback, negative • If space is dedicated to parking, less space may be available for curbside treatments benefiting other modes.

Step 4: Monitor and Adjust

Curb use and management are dynamic. The tools and treatments deployed today may need to be adjusted as needs change. Locations throughout the City of Plano where curb management has been implemented should continue to be monitored to ensure success in accordance with the issues identified and priorities set in **Step 1**.

The evaluation shall include quantitative data collection in the form of on-the-ground counts or video data collection as well as qualitative data in the form of a survey or other acceptable means of public outreach. The frequency of monitoring periods is to be determined on a case-by-case basis by the Director of Planning.

SECTION 15 APPENDIX

15.1 *Definitions*

The definitions within this section are intended to provide descriptions for terms used within the Standards. When words and terms are defined herein and in other City ordinances, they shall be read in harmony. If an irreconcilable conflict exists, the definition contained herein shall control in the construction and application of these Standards. Where no definition appears, the term should be interpreted according to its customary usage in the practice of municipal planning and engineering. The Director of Engineering or his/her designee has the final determination of interpretation.

Access – "Access" (or access point) is defined as the location, frequency, spacing, and design of driveways along the frontage, or perimeter of a given property that allows vehicular traffic to cross between the public right-of-way (ROW) to the private property, whether entering or exiting.

Alley – A minor public right-of-way, not intended to provide the primary means of access to abutting lots, which is used primarily for vehicular service access to the back or sides of properties otherwise abutting on a public way.

Arterial – A roadway designed to carry large volumes of traffic of a local nature to the freeway or expressway systems. Interchange of traffic from freeway systems to the local streets occurs via the arterial street.

Average Daily Traffic (ADT) – A volume that represents the total two-way traffic on a roadway for a period of less than a year, divided by the total number of days it represents, and that includes both weekday and weekend traffic. ADT is typically adjusted for the day of the week, seasonal variations, and/or vehicle classification.

Chicane – Offset curb extensions which slows drivers by alternating parking, bulb-outs, or pavement markings along the street.

City – City of Plano.

Collector – A roadway designed to pass through neighborhoods collecting traffic from local streets and distributing the traffic to arterial streets. These streets also serve neighborhood facilities.

Commercial driveway – A commercial driveway provides access to an office retail or institutional building or to a multiple-family building having more than five dwelling units. Commercial drives shall be allowed to intersect and access Major or Secondary Arterials only (Type B, C, D). It is anticipated that such buildings will have minor truck traffic for incidental service or delivery.

Corner Clip – Right-of-way dedication at intersection corners to provide sufficient room for intersection visibility, pedestrian access, and other street facilities.

Crown – Depending on the context, (a) the highest point on the inside of a closed conduit; or (b) the highest point of a roadway cross-section. Also known as a soffit.

Curbside/Flex Zone – A subarea of the travelway that serves multiple uses along a street including on-street bicycles, transit stops, commercial deliveries, on-street parking, passenger loading, etc.

Design Speed – The maximum speed at which the design vehicle can safely travel on a roadway and is a fundamental criterion for the design of horizontal and vertical geometry. Design speed shall not be lower than the posted speed.

Deceleration Lane – A speed-change lane, including tapered areas, which enables a vehicle exiting a roadway to leave the travel lanes and slow before making a turn***.***

Design Speed – A selected speed used to determine the various geometric design features of the roadway.

Design Vehicle – Governs several geometric features in street design from lane widths to curb radii.

Director – The Director of Engineering or his/her designee.

Diverter – A device that limits through movements for motor vehicles in one or more directions.

Engineer – The Professional Engineer (P.E.) licensed in the State of Texas through the Texas Board of Professional Engineers (TPBE) who is responsible for the signing and sealing of construction plans, studies, calculations, and/or any other engineering documents in accordance with TBPE's requirements for professional practice.

Frontage Road – A local roadway along an arterial highway governed by TxDOT allowing control of access and service to adjacent areas and property. Also known as a service road.

Green Zone – An area between the travelway zone and pedestrian zone that provides separation from moving vehicle traffic and provides space for appropriate landscaping or street furnishing.

Horizontal Sight Distance – The distance across the inside of a horizontal curve that a driver can see before an obstruction (such as walls, cut slopes, buildings, and longitudinal barriers).

Industrial Driveway

- An industrial driveway serves truck movements to and from loading areas of an industrial facility, warehouse, distribution center, truck terminal, etc. Industrial drives shall access Major or Secondary Arterials only (Type B, C, D).
- At an industrial facility, a driveway whose principal function is to serve administrative, or employee parking lots shall be considered a commercial driveway.
- Centralized retail development, such as a community or regional shopping center, may have one or more driveways specially designed, signed and located to provide access for trucks. Such driveways shall be considered industrial driveways.

Intersection – Any at-grade connection with a roadway. Includes the connection of two roadways or a driveway and a roadway. The junction of an alley with a roadway shall not constitute an intersection.

Intersection Daylighting – Pedestrian safety measure achieved by removing curb parking spaces around an intersection, increasing visibility for pedestrians and drivers, and minimizing conflicts.

Level of Service (LOS) – A measure of traffic flow and congestion. LOS is a qualitative measure describing operational conditions within a traffic stream, generally described in terms of speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety.

Local Street – A roadway designed to provide the basic function of serving private property with access to other streets.

Median – The portion of a divided roadway separating the opposing traffic flows. A median may be traversable or non-traversable.

Median Opening – An opening in a non-traversable median that allows accessing or crossing the opposing traffic lanes.

Mews – A narrow, curbless street that serves small-lot subdivisions in infill/redevelopment, mixed-use development, or to function similar to alleys for residential lots that front onto open space areas.

Midblock Crossing – A pedestrian crossing that is not located at a roadway intersection.

Owner – The person or entity financially responsible for developing a particular site or project. Also referred to as Developer.

Parkway – An area within the right-of-way but outside the edge of pavement which is typically reserved for public use other than vehicular traffic.

Paseo – A pedestrian-only pathway that may be used in conjunction with mews streets or small-lot residential subdivisions, or for pedestrian connections through mixed-use developments.

Pedestrian Zone – An area within the right-of-way reserved for pedestrian movement only where motor vehicles are prohibited.

Pinch-point – A curb extension applied at the midblock of a street to slow traffic speeds and add public space.

Post-development – The condition of the given site and drainage area after the anticipated development has taken place. Also known as proposed condition or post-project.

Pre-development – The existing condition of the given site and drainage area prior to development. Also known as existing condition or pre-project.

Residential driveway – A residential driveway provides access to a single-family residence, to a duplex, or to a multi-family building containing five or fewer dwelling units. These drives shall be allowed to intersect and access some collectors and smaller streets only (Type E and smaller). All other access to residential property abutting all other streets shall be off an alley or a service road, but not the street.

Right-of-Way (ROW) – A strip of land dedicated by a plat for the use of public roadways and/or related facilities. Other facilities include, but are not limited to, utilities, drainage systems, and other transportation uses. Unless otherwise specified, the term right-of-way shall refer to a public right-of-way.

Roundabouts – A form of circular intersection in which traffic travels counterclockwise around a central island. Features include yield control of all entering traffic, channelized approaches, and geometric feature to induce desirable vehicle speed.

ROW Width – The shortest horizontal distance between the lines which delineates the limits of right-of-way.

Schools – A public, private, or parochial institution for the education of students in any grade between pre-kindergarten through twelfth grade or any combination thereof. A public school includes an open-enrollment charter school as defined under the Texas Education Code. Includes elementary and secondary schools. Does not include trade, vocational, or commercial schools.

Shared Streets – An alternative type of curbless local street designed to be shared among various modes of travel to minimize segregation between road users in a commercial or residential setting.

Sidewalk – The clear unobstructed paved area within the pedestrian zone, between the curb line or the edge of pavement of the roadway and the adjacent property lines for the use of pedestrians that is separated from motor vehicles.

Standards – City of Plano Street Design Standards.

Stopping Sight Distance (SSD) – The minimum distance needed for a driver to be able to react and stop to an object or person on the roadway to avoid collision.

Storage Length – The portion of a turn lane required to store the number of vehicles expected to accumulate in the lane during an average peak period.

Target Speed – The ideal speed at which vehicles desirably operate on a street in a specific context, consistent with the level of multimodal activity generated by adjacent land uses to provide both mobility for motor vehicles and a safe environment for pedestrians and bicyclists. A slower target speed allows the use of features that enhance the pedestrian experience, such as reduced horizontal curve radii, narrower lane widths, on-street parking, curb extensions, and bicycle facilities. Additional design elements are applied to different contexts to achieve these target speeds. Advisory speed signage shall be utilized where design elements are utilities to achieve a target speed which is lower than the posted speed.

Tapers – Pavement transitions which are generally provided for widening and narrowing street cross sections to help guide users between changes in their normal driving path along a street.

Traffic Circle – A central island, painted or raised with a vertical or mountable curb in the center of the intersection of two streets.

Travelway Zone – The portion of the street that is reserved for vehicular travel of all types, including motor vehicles, transit, and on-street bicycle facilities. Travelway consists of everything between the outside face of curbs including the median and curbside functions.

15.2 *Design Review Process*

Step	WHAT:	WHO:	WHEN:
Step 1	Initiation & Validation	Engineering, Fire-Rescue, Parks & Recreation, Planning, and Public Works departments	Time Frame: Varies
Step 2	Scoping Approval Funding	Engineering, Planning, and Public Works departments moves the project closer to implementation	Time Frame: Varies
Step 3	Design Consultant	Widepsread notification of the City's intent to award contracts (by all departments)	Time Frame: Up to 3 months
Step 4	Scoping Fee Negotiations	All departments (except Procurement/Project Management)	Time Frame: 5 to 10 working days
Step 5	Project Kickoff	Varies per project type	Time Frame: 5 to 10 working days
Step 6	Preliminary Engineering Report	Produced by developer's engineers and reviewed by Engineering, Fire-Rescue and Planning department	Time Frame: May take weeks
Step 7	30% Design	Produced by developer's engineers and reviewed by Engineering, Planning & Public Works department	Time Frame: May take weeks or months
Step 8	60% Design	Produced by developer's engineers and reviewed by Engineering and Public Works department	Time Frame: May take weeks or months
Step 9	90% Design	Produced by developer's engineers and reviewed by Engineering, Fire-Resue, and Public Works department	Time Frame: May take weeks or months
Step 10	Bid Documents	Produced by developer's engineers and reviewed by Engineering and Public Works department	Time Frame: May take weeks or months

	WHAT:	WHO:	WHEN:
Step 11	Advertisement & Bidding	Engineering, Procurement/Project Management, and Public Works departments	Time Frame: May take weeks or months
Step 12	City Council Approval	City Council	Time Frame: May take weeks or months
Step 13	Award	Engineering department	Time Frame: May take weeks or months
Step 14	Construction	Contractors & City inspectors	Time Frame: Varies
Step 15	Closeout	City inspectors to do final inspection & approval	Time Frame: Varies

- (Blue) Project Initiation - Kickoff
- (Red) Engineering Design & Review Process
- (Green) Bidding - Closeout

15.3 *DEVELOPMENT PROCESS CHECKLIST*

1. *Initiation and Validation*

1.1 ☐ Determine which council district(s) the project is located.

1.2 ☐ Propose a preliminary scope of work (street, drainage, etc.) and preliminary project limits and boundaries.

1.3 ☐ Making a preliminary determination of whether the subject project is affected by or affects one or more other approved or potential projects.

1.4 ☐ Identify major problems that might be encountered (e.g., hazardous materials, managing traffic curing construction, utility complications, inadequate ROW, etc.

1.5 ☐ Identify potential sources of funds to design and build the project.

1.6 ☐ Establish a preliminary estimate of the cost to execute the project.

1.7 ☐ Document the month and year this information was assembled.

2. *Selection Process*

2.1 ☐ Widespread notification of the City's intent to award contracts to design consultants.

2.2 ☐ Design consultants respond by submitting statements of interest.

2.3 ☐ Select a design consultant for each project and begin the process of negotiating a Professional Services Contract.

3. *Initial scope meeting*

3.1 ☐ Utility coordination and subsurface utility engineering requirements.

3.2 ☐ Submit plans for joint bidding with utilities or other design consultants.

3.3 ☐ City preferences for traffic control, environmental responsibilities, project sequencing, complete streets, and public information efforts.

3.4 ☐ Identify expectations and submittal requirements for the preliminary engineering report (PER), 30 percent, 60 percent, 90 percent, and bid document phases.

3.5 ☐ Identify CAD standards, drawing standards, and file-management standards.

3.6 ☐ Identify standard specifications that will govern the construction of the project.

3.7 ☐ Propose desired overall project schedule and duration of time required by the City to review each milestone submittal.

3.8 ☐ Invoice requirements and normal turnaround time for payment.

3.9 ☐ Identify management change and communication procedures with the City.

4. ***Fee Negotiations***

4.1 ☐ Consider the scope of work, the estimated hours for various types of personnel to complete the tasks, and the billing rates.

4.2 ☐ City PM will review the fee proposal and determine whether the fee is acceptable or further negotiation is required.

5. ***Design Processes***

5.1 ☐ Preliminary engineering report submitted by design consultants.

5.2 ☐ 30 percent design submitted by design consultants, reviewed by City engineers, and send back for revision.

5.3 ☐ 60 percent design submitted by design consultants, reviewed by City engineers, and send back for revision.

5.4 ☐ 90 percent design submitted by design consultants, reviewed by City engineers, and send back for revision.

5.5 ☐ Bid documents submitted by design consultants and reviewed by City engineers.

6. ***Bidding***

6.1 ☐ The design consultant issues bid documents, including plans, specifications, and addenda.

6.2 ☐ The design consultant should evaluate each bidder's proposal, checking to ensure that all bidders used the same bid forms and quantities and verifying that unit prices were correctly extended and totaled.

6.3 ☐ City engineers determine the award.

7. ***Construction, Inspection, and Closeout***

7.1 ☐ Contractor to start the construction.

7.2 ☐ The design consultant evaluates and responds to requests for information, changed conditions, and proposed design changes, if any.

7.3 ☐ City engineers to do final inspection and closeout.