D. Transportation Plan

The North Richland Hills' (NRH) roadway system is largely built-out with most right-of-way acquired and facilities in place. Versatility is important in the future of this system as this policy document gives decisionmakers flexibility to address unforeseen issues that may arise during continued implementation phase.

Design Decision Process

A context-sensitive approach was developed to provide flexibility in the thoroughfare network with defined movement-based functional classifications and place-based land use contexts. This duality in characterizing a roadway type allows evolution of the roadway sections and geometry with the continued maturation of the community. This is a change from the previous thoroughfare plan, which recommended specific right-of-way designations for each functional classification.

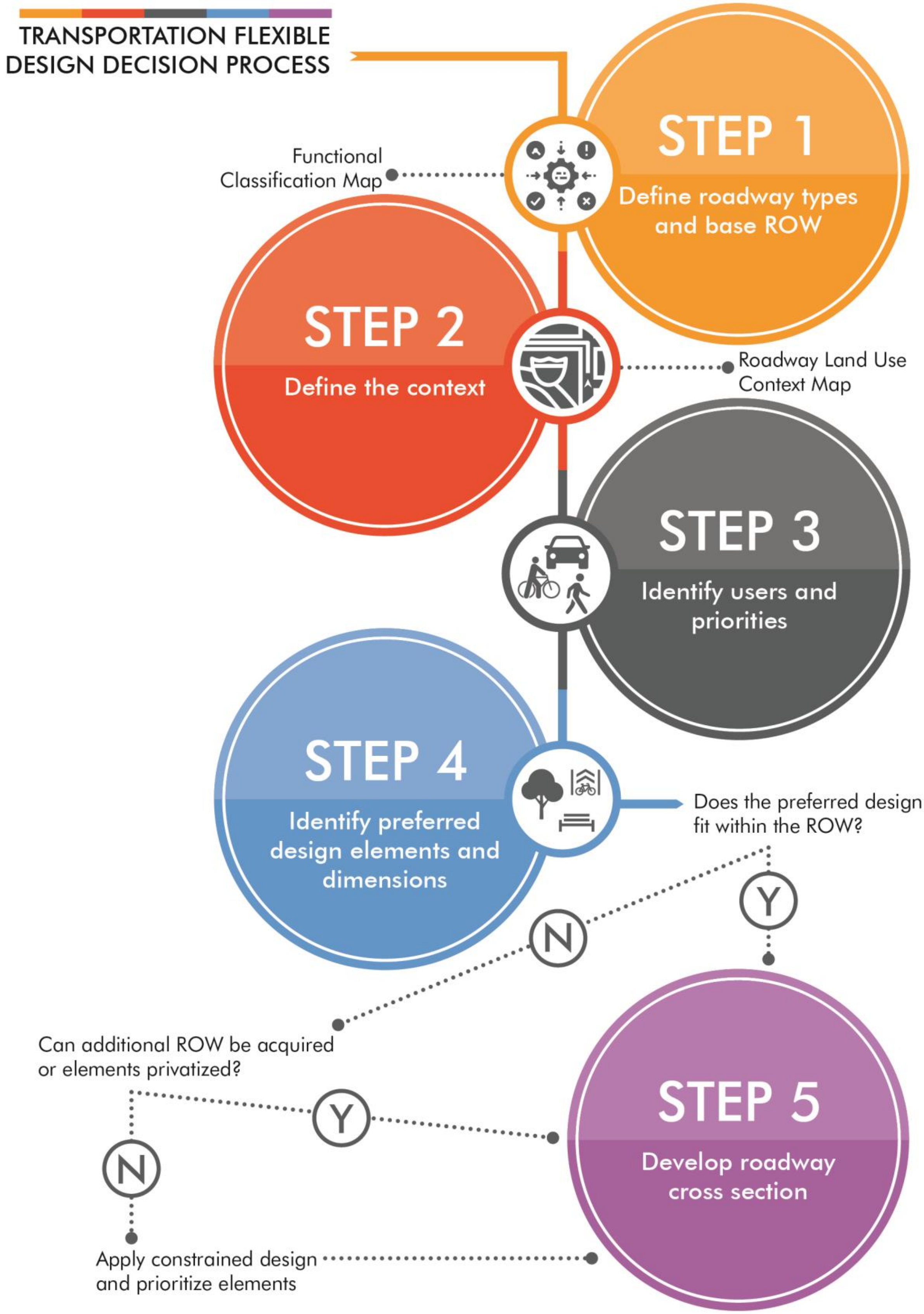
The Transportation Plan consists of foundational mapping elements, including:

- Functional Classification Map
- Land Use Context Map

Modal components, such as plans for bicycling, walking, and transit, then integrate into the design decision process for the complete multimodal implementation of transportation facilities. This plan only addresses the bicycle mode with the other modes to be evaluated in a future study.

Understanding transportation facility design as a process, the development of a street design and cross section entails the multiple elements of this Plan, including the functional classification mapping, with associated right-of-way envelope, land use context mapping, modal plans, and any additional specific design considerations. This process includes flexibility in the process, understanding that there are many demands within the right-of-way but limited space, so multiple elements must be considered and, if necessary, prioritized.

Figure D-1. Design Decision Process



As discussed in previous sections, intersection improvements and controls are vital in the optimal operation of roadway facilities. These are impactful to both vehicular capacity as well as continuity of comfortable facilities for active transportation users. Additional right-of-way may be necessary at intersections. A discussion of right-of-way and traffic control devices is found under the Design Guidelines section of this chapter.

A summary of the Design Decision Process and key maps is included in **Appendix A**.

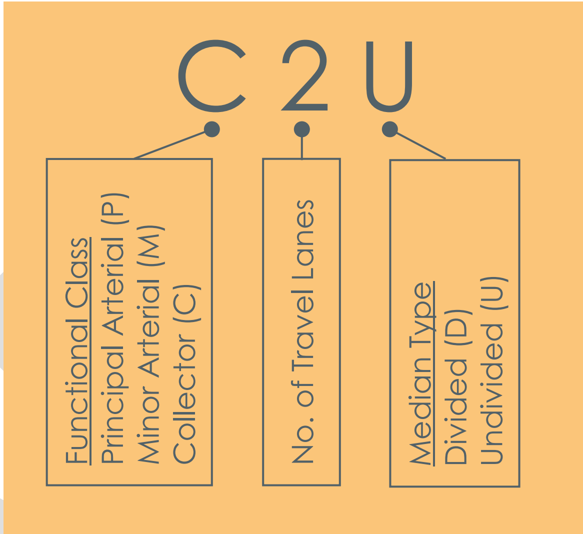
STEP 1

Define Roadway Types and Base ROW

Functional Classifications

Seven thoroughfare types are proposed for the Transportation Plan. The functional classification defines the right-of-way (ROW) envelope required for the roadway. It also defines the mobility characteristics and function associated with the specific corridor in the context of the greater transportation network. This includes design speeds as well as parking permissions.

The functional classification map, **Figure D-2**, depicts both the functional classification as well as the link-level lane configuration. Labeled throughout the map, lane configurations, such as P6D, M4U, and C2U, identify the number of travel lanes and median type expected for the roadway. The type of medians, whether raised or two-way left turn lanes (TWLTL), are discretionary to the designer under the appropriate context sensitivity and traffic operation's needs.



The look and feel of corridors within a specific functional classification can vary to best serve the land use context of their surroundings. A roadway typical section may change from block to block, though the functional classification continues. These characteristics are associated with the land use context, described in the next section.

Freeways are high-speed, limited access facilities that serve major regional movement. The freeway network includes the interstate, US, and State Highway roadways controlled by the state DOT, including IH-820, SH 183, and SH 121.

Principal Arterials serve as the primary route between key destinations within and the City and adjacent cities. Principal Arterials carry traffic across major segments of the city, with a primary function of throughput, rather than access. Examples include Boulevard 26, Mid-Cities Boulevard, and Davis Boulevard.

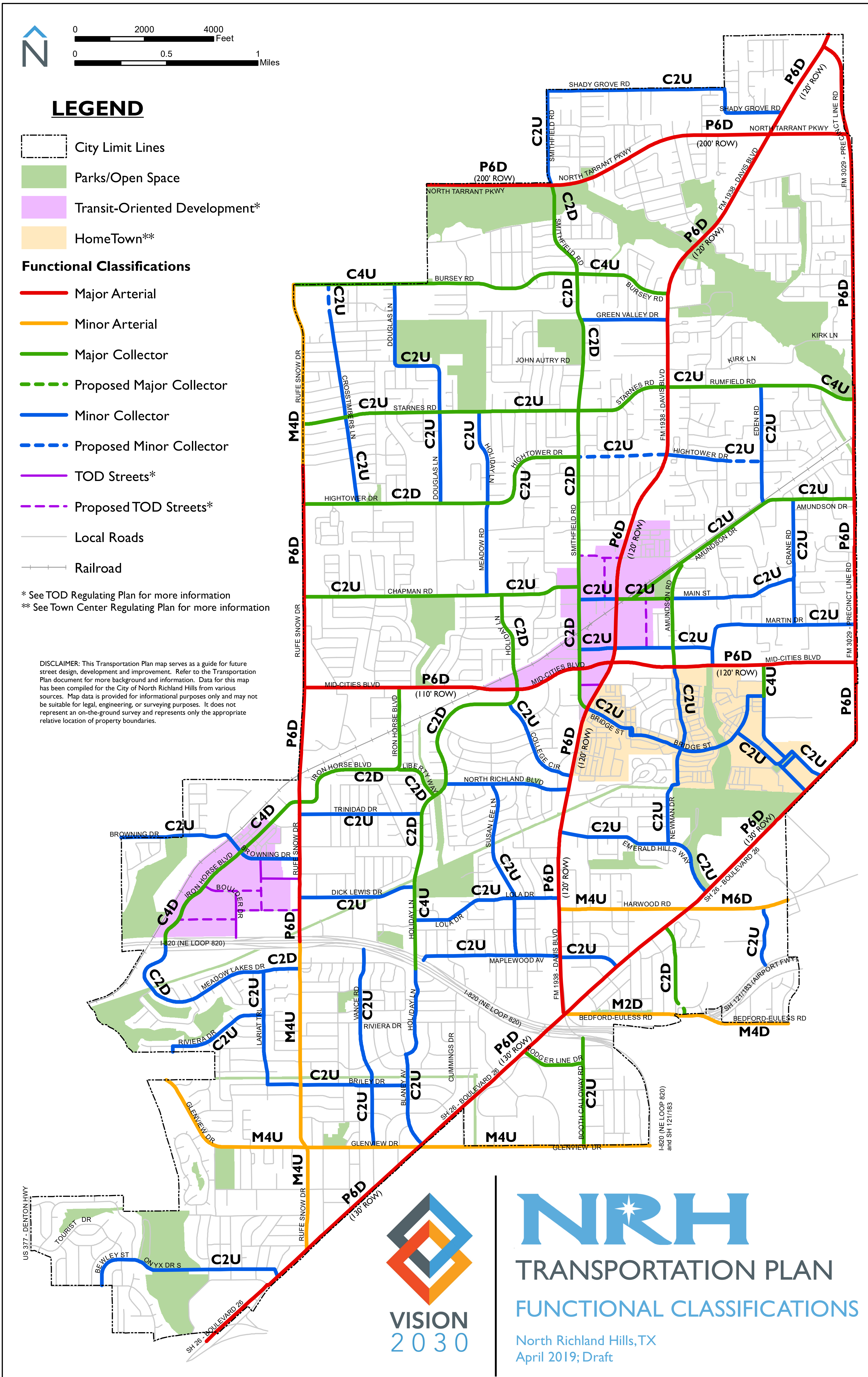
Minor Arterials also carry traffic across major segments of the city, with a primary function of throughput, rather than access. Minor Arterials serve lower traffic than Principal Arterials and have a more limited influence segment. Examples include Harwood Road and Glenview Drive.

Major Collectors serve as a conduit between local roadways and the network of arterials. Major Collector streets are differentiated from arterials by their length and degree of access to adjacent development. They are typically contiguous across one or more arterial roadways, but seldom more than one or two miles in length. Examples include Holiday Lane, Iron Horse Boulevard, and Smithfield Road.

Minor Collectors also serve as a conduit between local roadways and the network of arterial streets. Minor Collector serve lower traffic volumes than Major Collectors and have more limited contiguous connections to arterials. Examples include Meadow Lakes Drive, Lola Drive, and Main Street.

TOD or HomeTown Streets are roadways designated in the Regulating Plan serving a balance of all forms of mobility while maximizing convenience for residents and visitors. Roadway ROW, geometry, and amenities are defined in the Regulating Plan.

Local Streets are low-speed, low-volume facilities fronting residential or commercial uses. These streets serve primarily for access to properties, rather than mobility.



3/15/2019; Vision 2030_Transportation Plan_Functional Classification

Right-of-Way

Right-of-way (ROW) is a key component in determining the feasible mobility and placemaking elements for a street design. A predictable ROW is necessary in order to require dedications from new development and determine the optimum locations for multimodal elements, like bikes, trails, and transit.

As a significant portion of the community is developed, the existing ROW along most corridors affects the possible elements of design. When limited ROW exists for the recommended modal elements and geometry, there are three options to proceed:

- **Acquire Additional ROW**
  In areas of large setbacks or redeveloping properties, this option allows a wider envelope to fit all the recommended elements
- **Apply Compact Design**:
  Recommended and constrained geometric dimensions for design elements allow lane widths, sidewalks, and buffers to be minimized to fit the constrained ROW.
- **Prioritize Design Elements**:
  If neither additional ROW nor compact design accommodates the full multimodal demands of the corridor, then design elements can be prioritized (as discussed later in this chapter) through the project development process.

Conventional Highway Design:

Operating Speed ≠ Design Speed ≠ Posted Speed

Proactive Urban Street Design:

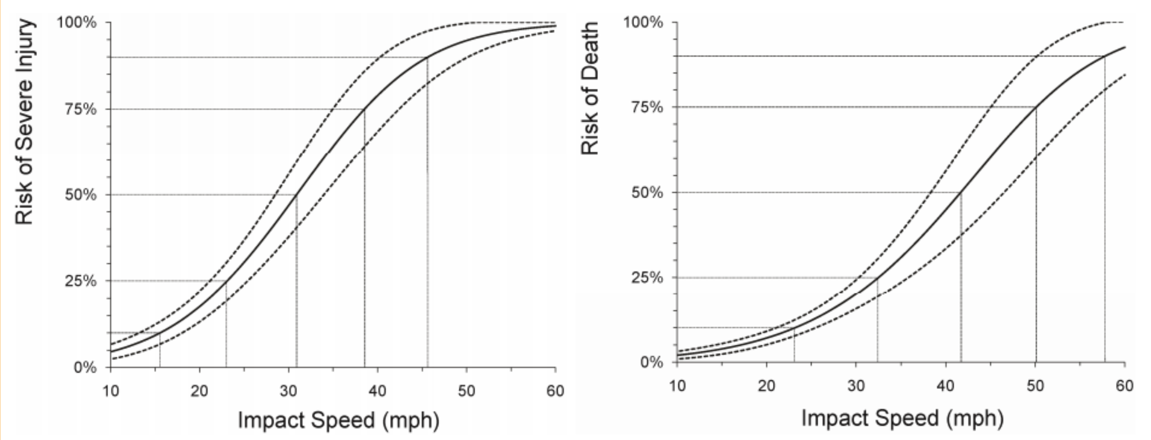
Target Speed = Design Speed = Posted Speed

Design Speed

The City of NRH supports best management practices for safety. Embracing a proactive design approach, design speed and multimodal components are enforced through speed control mechanisms and physical separation of modes. **Table D-1** depicts the range of design speeds as well as the minimum bicycle facility type allowable for the various functional classifications.

Speed plays a critical role in the cause and severity of crashes. According to research, risk of pedestrian death is 10% at an impact speed of 23 mph. At 32 mph, the risk of death increases to 25% and doubles to 50% at just 42 mph. Pedestrians struck by vehicles traveling at 58 mph have a 90% risk of death. Risks vary also by age. For example, the average risk of severe injury or death for a 70-year old pedestrian struck by a car traveling at 25 mph is similar to the risk for a 30-year-old pedestrian struck at 35 mph. (AAA Foundation for Traffic Safety, 2011)

Design streets using target speed, the speed drivers are intended to go, rather than operating speed. This proactive design approach creates an



Impact Speed and a Pedestrian's Risk of Severe Injury or Death, September 2011
Source: AAA Foundation for Traffic Safety

environment where drivers respond to the street design and behave accordingly with slower speeds that are safer for vulnerable users. According to the National Association of City Transportation Officials' (NACTO) Urban Street Design Guide, "The maximum target speed for urban arterial streets is 35 mph. Some urban arterials may fall outside of built-up areas where people are likely or permitted to walk or bicycle. In these highway-like conditions, a higher target speed may be appropriate." In residential neighborhoods, designers should consider slower speeds as well to reduce to those safe for interaction with children at play and other unpredictable behavior.

Design speeds also feed into the minimum standard of protection needed for people on a bicycle to maintain safety for these users. Speed and volume best practices are discussed further in the Bicycle Facilities Plan section.

> *"[H]uman behavior, which governs traffic engineering, is fundamentally adaptable, not fixed.* ***People adapt to their conditions****. Changing streets change behavior, meaning that a street designed for the fastest and worst driver may very well create more drivers who feel comfortable at faster and more unsafe speeds. A* ***proactive approach*** *uses design to affect desired outcomes,* ***guiding user behavior through physical and environmental cues****."*
>
> NACTO Urban Street Design Guide

Table D-1. Functional Classification Design Elements

FUNCTIONAL CLASSIFICATION			NO. OF TRAVEL LANES	ROW WIDTH (FEET)	DESIGN SPEED (MPH)	MEDIAN TYPE	ON-STREET BIKE FACILITY MINIMUM STANDARD	PARKING PERMITTED
ARTERIAL	MAJOR	P6D	6	VARIABLE	40-55	RAISED/TWLTL*	PROTECTED	NO
ARTERIAL	MINOR	M6D	6	110	40-45	RAISED/TWLTL*	PROTECTED	NO
		M4D	4	80	35-45	RAISED/TWLTL*	BUFFERED	NO
		M4U	4	70	35-45	NONE	BUFFERED	NO
		M2D	2	70	30-35	RAISED/TWLTL*	BUFFERED	SOME
COLLECTOR	MAJOR	C4U	4	68	30-35	NONE	BUFFERED	NO
		C2D	2	68	30-35	RAISED/TWLTL*	SIGNED ROUTE	SOME
		C2U	2	68	30-35	NONE	SIGNED ROUTE	SOME
COLLECTOR	MINOR	C2U	2	60	30-35	NONE	BICYCLE BOULEVARD	SOME
LOCAL		R2U	2	50	30	NONE	BICYCLE BOULEVARD	YES

Typical Roadway Capacities

NCTCOG has established planning guidelines for threshold values of traffic carrying capacity by facility type. For general planning purposes, the capacities for roadway configurations are shown in **Table D-2**. These values can be used when considering roadways for the need for widening. They also can be used for initial assessments of the potential for lane reductions of existing roadways to add bike lanes or to rightsize a roadway during a reconstruction project.

Table D-2. Roadway Hourly Capacities

Roadway Hourly Capacities (Suburban Residential Context)	
Functional Class	Hourly Capacity per Lane Divided (Undivided)
Freeway	2,225 (N/A)
Principal Arterial	925 (875)
Minor Arterial	900 (825)
Collector	575 (525)

Source: NCTCOG Travel Demand Model description
Note: LOS for D/E threshold

STEP 2

Define the Context

Land Use Context

Transportation investments are not constrained to impacts or influence within the right-of-way. While it primarily affects mobility, connectivity, and accessibility, roadways also impact the community character and design. Pairing with the functional classifications of roadways, land use contexts are assigned to each major facility. These contexts help define the local environment surrounding a corridor so street design can be sensitive to these community characteristics, known as context sensitive design.

Right-of-Way Zones

As NRH continues to mature as a community, essential functions within the right-of-way become more diverse to serve existing and emerging activity. The modal elements of the Transportation Plan define investment networks that add activity to certain corridors. Since every function cannot be accommodated within the right-of-way, a framework for integration and prioritization of functions must be developed.

Three (3) basic zones are embedded in the right-of-way:

Travelway: Primarily used for mobility purposes. Travel lanes can serve all modes or be dedicated to serve specific modes, such as bicycles or transit.

Pedestrian Realm: Comprised of sub-zones, including frontage, clear walk, and buffer zones, this area lies between the property line and the flex or travelway zones. This space includes the sidewalk, planting areas, street furniture, lighting, and other pedestrian and business amenities.

Flex Zone: A transition area between the travelway and pedestrian realm, this area provides space for people and goods to transition between moving vehicles and people in the pedestrian realm. This zone can contain multiple uses along a street including: on-street parking, passenger loading, commercial deliveries, and parklets, which are street-side miniature parks that provide a place for people to sit while enjoying the activity of the street.

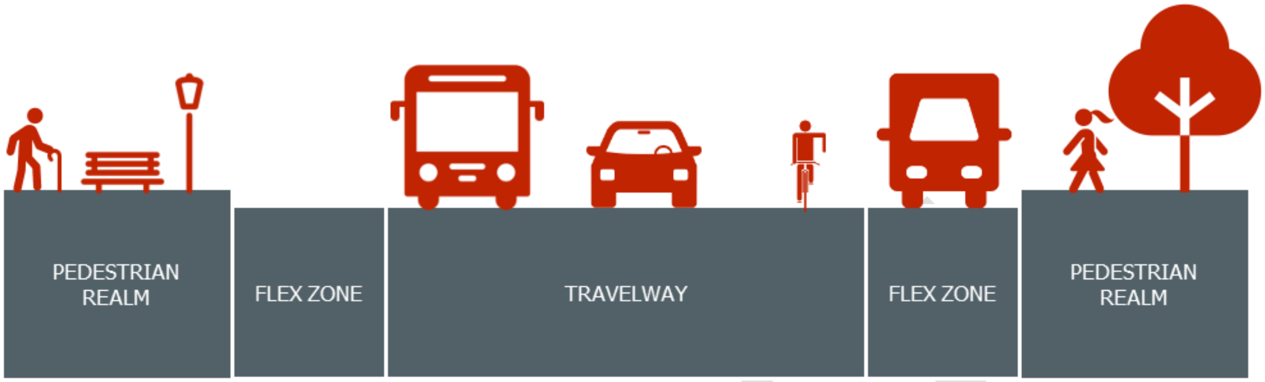
Right-of-Way Functions

The right-of-way has functions which are not mode-specific and can be achieved through various uses and treatments for different modes and spaces along a corridor. There are six core functions of the ROW, as shown on the right.

The right-of-way zones and associated functions integrating transportation and land use components together are shown in **Figure D-3**.

Mobility
Accommodates the movement of people and goods towards their destinations.
Access for people
Allows for people to get on or off the mobility system en-route to or from a destination. Access for people can be provided in many ways: short-term on-street parking, a bus stop, or a bike rack.
Access for commerce
Accommodates deliveries of goods and site services. Ensuring adequate access for commerce facilitates the delivery of goods and materials while aiding service providers' access in and out of buildings.
Storage
Provides for on-street parking for vehicles and temporary accommodation of construction activities that intrude in the ROW.
Greening
Enhances environmental sustainability by planting and/or installing street trees, planter boxes, and vegetated curb extensions, adding to aesthetic conditions and the environmental health of the built environment.
Activation
Recognizes that placemaking is an important function of the public ROW. It creates vibrant streetscapes and serves an essential placemaking function. This can include street cafes, parklets, and food trucks.

Figure D-3. ROW Zones and Functions



	Definition	Travelway	Flex Zone	Pedestrian Realm
Mobility	Moves people and goods	✓	✓	✓
Access for People	People arrive at their destination or transfer between different travel modes		✓	✓
Access for Commerce	Goods and services reach their customers and markets		✓	✓
Storage	Provides temporary parking and/or storage of vehicles or equipment		✓	
Greening	Enhances aesthetics and environmental health		✓	✓
Activation	Offers vibrant social spaces		✓	✓

Context Zones

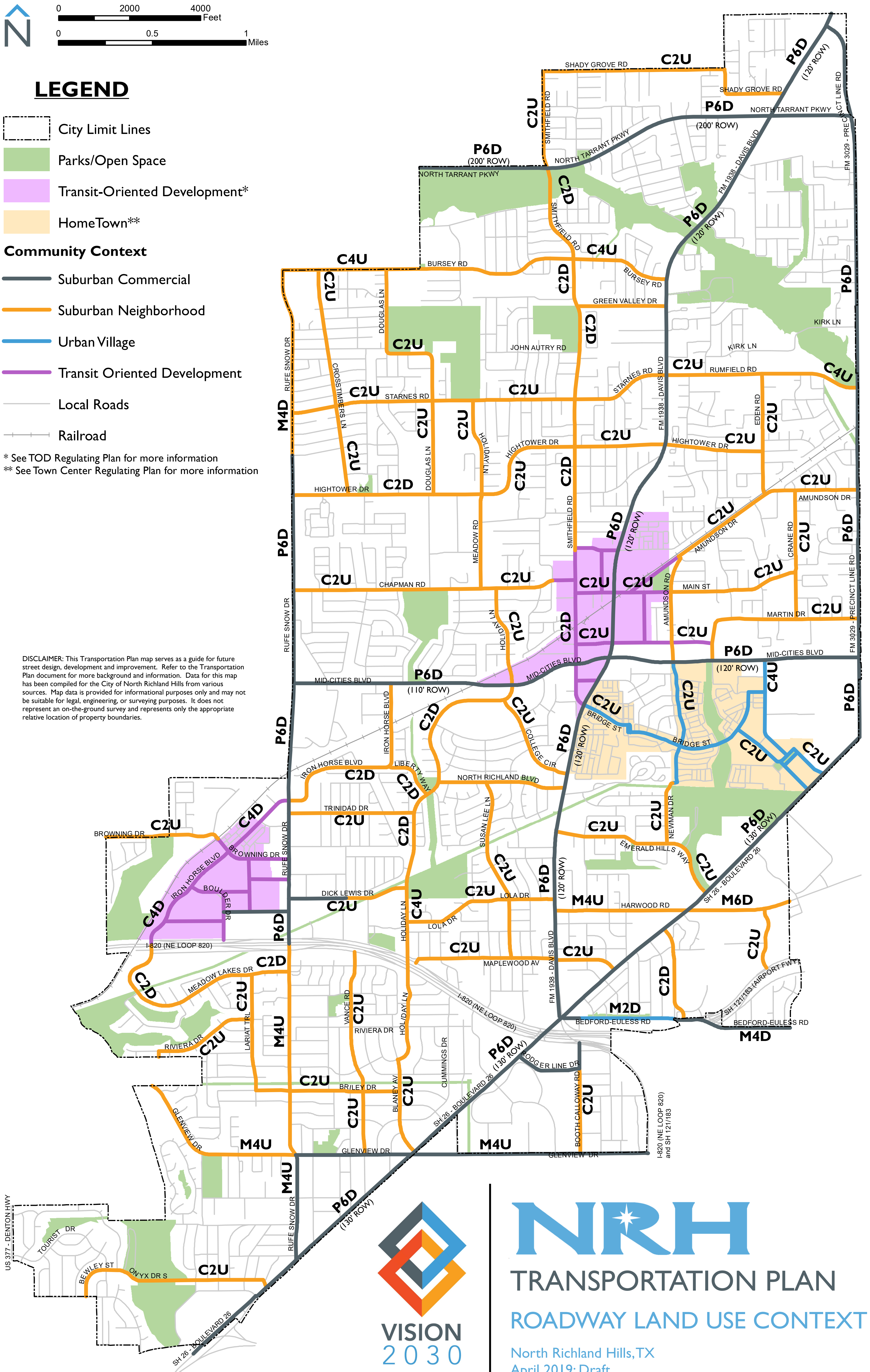
Contexts were divided into four (4) categories that outline characteristics of the roadway related to land use, travelway, flex zone, pedestrian realm, and the modal user hierarchy. The four contexts are defined in **Table D-3**, and include:

Suburban Commercial
A mix of commercial, retail, and office land uses with larger suburban building setbacks.
Suburban Residential
Primarily residential development with occasional neighborhood commercial or retail uses. On low volume facilities, homes may front the roadway.
Transit-Oriented Development (TOD)
Higher density mixed use environment with minimal building setbacks. These areas are defined by the Transit-Oriented Development Regulating Plan.
Urban Village
Similar to TOD areas, this context includes a mixed use of residential, commercial, retail, and office with minimal building setbacks. This includes defined areas like HomeTown as well as emerging urban centers.

Land use contexts are defined in **Figure D-4** but are meant to be revised and updated as development continues. As development intensifies in key areas, like the NRH City Hall district, Boulevard 26 urban villages, or Bedford-Euless Road corridor, land use contexts should be re-evaluated in the implementation of corridors to ensure a context sensitivity.

Table D-3. Land Use Context Definitions

	Suburban Commercial	Suburban Neighborhood	Transit Oriented Development	Urban Village
Land Use	Mix of uses: office, retail, restaurant, commercial Larger suburban building setbacks	Primarily residential Occasional neighborhood retail, restaurant, commercial Home frontages on low volume facilities	Mix of uses: residential, office, retail, restaurant, commercial Higher densities Minimal building setbacks	Mix of uses: residential, neighborhood office, retail, restaurant Minimal building setbacks
Travelway	Mobility focus Higher speeds and volumes Access management Raised medians desirable Transit routes Freight routes	Local resident access and circulation Low to moderate speeds and volumes Transit routes On-street bicycle facilities	Low speeds and volumes Transit routes On-street bicycle facilities	Low speeds and low to moderate volumes Transit routes On-street bicycle facilities
Flex Zone	No on-street parking Dedicated turn lanes Transit stops	On-street parking for home frontages Occasional transit stops	On-street parking common Freight delivery zones Pick-up/drop-off zones Activation spaces (food trucks, festivals)	On-street parking common Pick-up/drop-off zones Activation spaces (food trucks, festivals)
Pedestrian Realm	Sidewalks Off-street bicycle facilities Transit stops	Sidewalks Off-street bicycle facilities (if ROW is available) Transit stops Plantings (street trees, rain gardens)	Sidewalks Activation spaces (parklets, outdoor dining, public art) Bicycle parking Transit stops Plantings (street trees, rain gardens)	Sidewalks Activation spaces (parklets, outdoor dining, public art) Bicycle parking Transit stops Plantings (street trees, rain gardens)



NRH
TRANSPORTATION PLAN
ROADWAY LAND USE CONTEXT

North Richland Hills, TX
April 2019; Draft

VISION 2030

3/15/2019: Vision 2030_Transportation Plan_Roadway Contexts

STEP 3

Identify Users and Priorities

User Hierarchy

Within each combination of functional classification and land use context, there must be a balance between users. As the roadway function transitions from high-speed mobility to local access and from suburban to urban, travel mode considerations shift from vehicular travel to walking and biking. For each combination of functional classification and land use context, a modal hierarchy is defined and is designated as either low-, mid-, or high-priority.

The prioritization of multiple travel modes and users is also dependent upon the modal plans set forth by the City. A later section in this chapter details the Bicycle Facilities Plan with major routes and facilities identified. Future planning in pedestrian or transit master plans in NRH should also serve as an input into the design process for each road. These modal plans inform the design decisions needed to balance the range of demands on the limited right-of-way for each corridor. As the community continues to mature, these modals plans can be developed and updated to enhance the design decision process.

The specific modal priorities for consideration are identified in Step 5: Cross Section Development.

STEP 4

Identify Preferred Design Elements and Dimensions

ROW Zone Design Elements

Specific design elements in the right-of-way zones impact the design of the roadway. With multimodal corridors, each mode requires special consideration of facility type and dimensions, typically defined in the modal plan. For example, bike facilities have a range of options for separation type, lane width, and even on-street versus off-street location within the right-of-way. Other design elements like intersection treatments, street lighting, street furniture, driveways, and medians all also impact the design process. These elements are discussed later chapter under Design Guidelines and Special Considerations.

STEP 5

Develop Roadway Cross Section

Cross Section Development

The development of cross sections follows the design decision process (**Figure D-1**) which precludes standard typical sections by functional classification. Rather, the development of cross sections and associated dimensions builds from a matrix of functional classification and land use context.

The following tables, organized by land use context, provide the necessary information to build cross sections flexible to the community context.

- Suburban Commercial (**Table D-4**)
- Suburban Neighborhood (**Table D-5**)
- Urban Village (**Table D-6**)
- Transit-Oriented Development (see TOD Regulating Plan)

Note that dimensions for the Transit-Oriented Development context is not provided as it is determined by the TOD Regulating Plan. Also, streets within the HomeTown district are regulated by the Town Center Regulating Plan.

By finding the appropriate context table, columns of associated functional classifications provide the designer with a list of dimensions for key roadway features within each of the three ROW zones (**Figure D-3**). These dimensions are split into two categories:

- Preferred
- Constrained

In the development of a roadway cross section, the designer should begin with the preferred dimensions. Rather than beginning with minimums, especially for bike and pedestrian infrastructure, the designer can begin from a preferred design then narrow roadway elements as necessary.

When constrained right-of-way conditions are present, the design decision process (**Figure D-1**) guides the designer in problem solving by

- Acquiring more right-of-way,
- Applying compact design, or
- Prioritizing modal elements.

When a larger ROW is not feasible, the designer can consider narrower element dimensions than the preferred widths with the constrained dimensions in the tables serving as the minimum allowable.

If a constrained design containing the full multimodal elements continues to exceed the available ROW, the modal elements can then be prioritized. At the top of each table, prioritization categories are provided for walking, biking, and driving. These are rated as low, mid, or high priority modes within the land use and mobility context of each facility type.

Table D-4. Suburban Commercial Context Design Table

Suburban Commercial	MAJOR ARTERIAL		MINOR ARTERIAL		COLLECTOR		LOCAL	
	MODAL PRIORITY		MODAL PRIORITY		MODAL PRIORITY		MODAL PRIORITY	
	Walk	LOW	**Walk**	MID	**Walk**	MID	**Walk**	HIGH
	Bike	LOW	**Bike**	MID	**Bike**	HIGH	**Bike**	HIGH
	Drive	HIGH	**Drive**	HIGH	**Drive**	HIGH	**Drive**	MID
Right-of-Way	120' to 130'		70' to 80'		68'		50'	
Travelway								
Total Pavement Width[1] (FOC-FOC, Excluding Parking)	64' to 86'		33' to 60'		30' to 60'		30'	
No. of Travel Lanes	6		2-4		2-4		2	
	PREFERRED	CONSTRAINED	PREFERRED	CONSTRAINED	PREFERRED	CONSTRAINED	PREFERRED	CONSTRAINED
Outside Travel Land Width[1]	12'	12'	12'	11'	12'	11'	15'	N/A
Travel Lanes Width	12'	10'	11'	10'	11'	10'	N/A	N/A
Center Turn Lane Width	14'	11'	14'	11'	14'	11'	N/A	N/A
Raised Median	18'	14'	18'	14'	18'	14'	N/A	N/A
Flex Zone								
	PREFERRED	CONSTRAINED	PREFERRED	CONSTRAINED	PREFERRED	CONSTRAINED	PREFERRED	CONSTRAINED
On-Street Bicycle Facilities[2]								
Separated Bike Lanes *(Preferred)*	7' (Clear) 6' (Barrier)	5' (Clear) 2' (Barrier)	7' (Clear) 6' (Barrier)	5' (Clear) 2' (Barrier)	7' (Clear) 6' (Barrier)	5' (Clear) 2' (Barrier)	N/A	N/A
Buffered Bike Lanes	N/A	N/A	6' (Clear) 3' (Buffer)	5' (Clear) 2' (Buffer)	6' (Clear) 3' (Buffer)	5' (Clear) 2' (Buffer)	N/A	N/A
Conventional Bike Lanes	N/A	N/A	N/A	N/A	6'	5'	6'	5'
Bicycle Boulevard/Signed Route	N/A	N/A	N/A	N/A	Optional	Optional	Optional	Optional
Parking (Parallel)	N/A	N/A	N/A	N/A	8'	7'	8'	7'
Pedestrian Realm								
Amenity Zone[3]	10'	6'	8'	4'	6'	4'	4'	0'
Clear Sidewalk (Shared Use Path)	7' (12')	5' (8')	7' (12')	5' (8')	6'	5'	5'	4'
Setback/Shy Distance[4]	4'	2'	1'	0'	1'	0'	1'	0'

[1]Two-lane undivided collector facilities shall maintain a minimum pavement width of: 30' if no parking; 36' if parking on only one side; and 40' if parking on both sides.

[2]See Pattern Book for further details on bicycle facility design

[3]Includes up to face-of-curb

[4]Space between edge of vehicle lane and sidewalk

Table D-5. Suburban Neighborhood Context Design Table

Suburban Neighborhood	MINOR ARTERIAL		COLLECTOR		LOCAL	
	MODAL PRIORITY		MODAL PRIORITY		MODAL PRIORITY	
	Walk	MID	**Walk**	MID	**Walk**	HIGH
	Bike	MID	**Bike**	HIGH	**Bike**	HIGH
	Drive	HIGH	**Drive**	HIGH	**Drive**	MID
Right-of-Way	70' to 110'		60' to 68'		50'	
Travelway						
Total Pavement Width[1] (FOC-FOC, Excluding Parking)	42' to 82'		30' to 60'		30'	
No. of Travel Lanes	4-6		2-4		2	
	PREFERRED	CONSTRAINED	PREFERRED	CONSTRAINED	PREFERRED	CONSTRAINED
Outside Travel Land Width[1]	12'	11'	11'	11'	15'	N/A
Travel Lanes Width	11'	10'	11'	10'	N/A	N/A
Center Turn Lane Width	12'	10'	12'	10'	N/A	N/A
Raised Median	18'	14'	18'	14'	N/A	N/A
Flex Zone						
	PREFERRED	CONSTRAINED	PREFERRED	CONSTRAINED	PREFERRED	CONSTRAINED
On-Street Bicycle Facilities[2]						
Separated Bike Lanes (*Preferred*)	7' (Clear) 6' (Barrier)	5' (Clear) 2' (Barrier)	7' (Clear) 6' (Barrier)	5' (Clear) 2' (Barrier)	N/A	N/A
Buffered Bike Lanes	6' (Clear) 3' (Buffer)	5' (Clear) 2' (Buffer)	6' (Clear) 3' (Buffer)	5' (Clear) 2' (Buffer)	N/A	N/A
Conventional Bike Lanes	N/A	N/A	6'	5'	6'	5'
Bicycle Boulevard/Signed Route	N/A	N/A	Optional	Optional	Optional	Optional
Parking (Parallel)	8'	7'	8'	7'	8'	7'
Pedestrian Realm						
Amenity Zone[3]	8'	4'	6'	4'	4'	0'
Clear Sidewalk (Shared Use Path)	7' (12')	5' (8')	6' (10')	5' (8')	5'	4'
Setback/Shy Distance[4]	1'	0'	1'	0'	1'	0'

[1] Two-lane undivided collector facilities shall maintain a minimum pavement width of: 30' if no parking; 36' if parking on only one side; and 40' if parking on both sides.

[2] See Pattern Book for further details on bicycle facility design

[3] Includes up to face-of-curb

[4] Space between edge of vehicle lane and sidewalk

Table D-6. Urban Village Context Design Table

Urban Village	MINOR ARTERIAL		COLLECTOR		LOCAL	
	MODAL PRIORITY		MODAL PRIORITY		MODAL PRIORITY	
	Walk	HIGH	**Walk**	HIGH	**Walk**	HIGH
	Bike	HIGH	**Bike**	HIGH	**Bike**	HIGH
	Drive	HIGH	**Drive**	MID	**Drive**	LOW
Right-of-Way	70' to 110'		60' to 68'		50'	
Travelway						
Total Pavement Width[1] (FOC-FOC, Excluding Parking)	42' to 82'		30' to 60'		30'	
No. of Travel Lanes	4-6		2-4		2	
	PREFERRED	CONSTRAINED	PREFERRED	CONSTRAINED	PREFERRED	CONSTRAINED
Outside Travel Land Width[1]	12'	11'	11'	11'	15'	N/A
Travel Lanes Width	11'	10'	11'	10'	N/A	N/A
Center Turn Lane Width	12'	10'	12'	10'	N/A	N/A
Raised Median	18'	14'	18'	14'	N/A	N/A
Flex Zone						
	PREFERRED	CONSTRAINED	PREFERRED	CONSTRAINED	PREFERRED	CONSTRAINED
On-Street Bicycle Facilities[2]						
Separated Bike Lanes *(Preferred)*	7' (Clear) 6' (Barrier)	5' (Clear) 2' (Barrier)	7' (Clear) 6' (Barrier)	5' (Clear) 2' (Barrier)	N/A	N/A
Buffered Bike Lanes	6' (Clear) 3' (Buffer)	5' (Clear) 2' (Buffer)	6' (Clear) 3' (Buffer)	5' (Clear) 2' (Buffer)	N/A	N/A
Conventional Bike Lanes	N/A	N/A	6'	5'	6'	5'
Bicycle Boulevard/Signed Route	N/A	N/A	Optional	Optional	Optional	Optional
Parking (Parallel)	8'	7'	8'	7'	8'	7'
Pedestrian Realm						
Amenity Zone[3]	8'	4'	6'	4'	4'	0'
Clear Sidewalk (Shared Use Path)	7' (12')	5' (8')	6'	5'	5'	4'
Setback/Shy Distance[4]	1'	0'	1'	0'	1'	0'

[1]Two-lane undivided collector facilities shall maintain a minimum pavement width of: 30' if no parking; 36' if parking on only one side; and 40' if parking on both sides.

[2]See Pattern Book for further details on bicycle facility design

[3]Includes up to face-of-curb

[4]Space between edge of vehicle lane and sidewalk

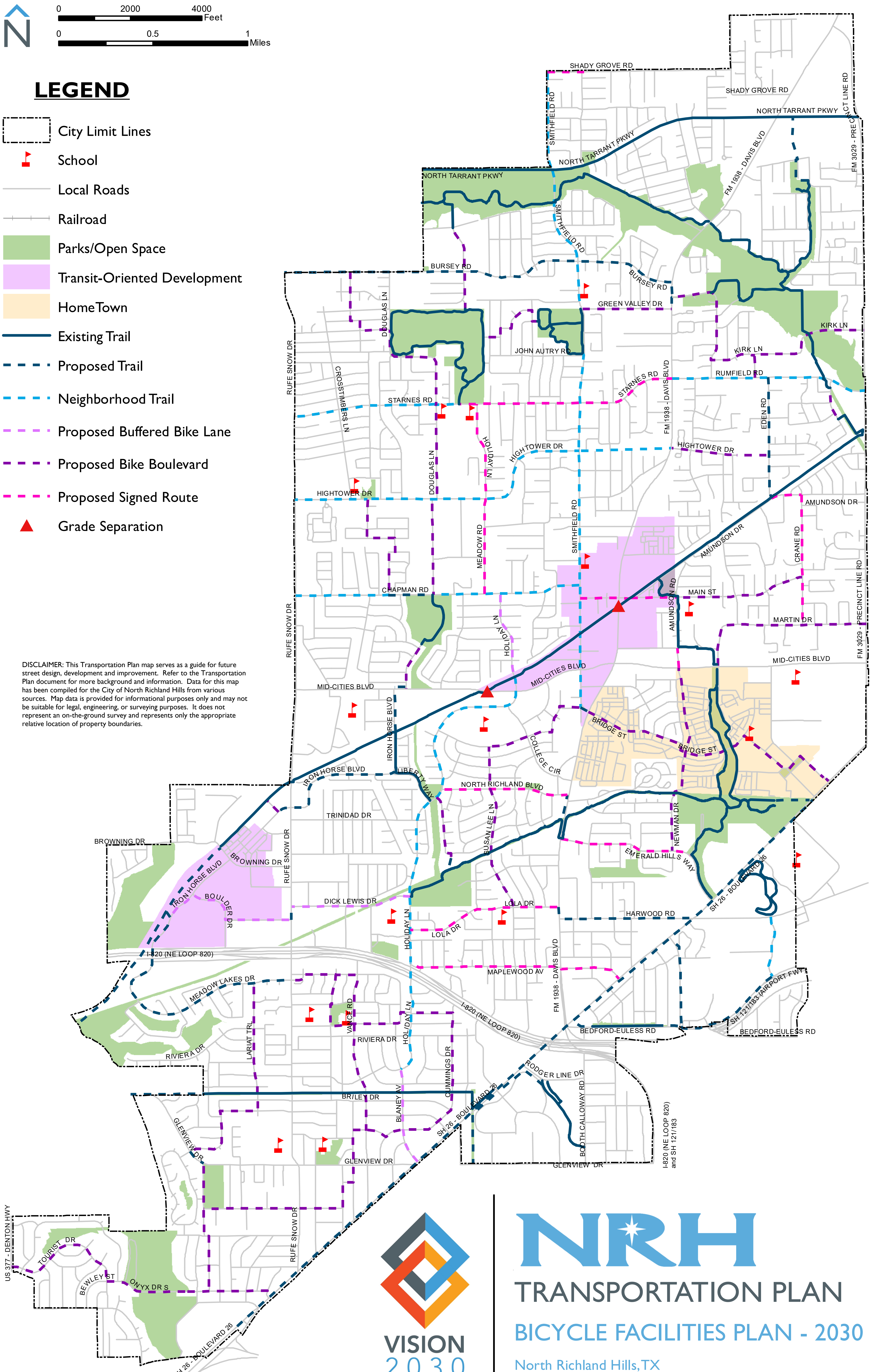
Bicycle Facilities Plan

The Bicycle Facilities Plan is built on the previous work by the City in the 2016 Trail and Route System Plan, which created a framework for investments in bicycle infrastructure. These routes and facilities were then evaluated for the roadway volumes and speeds as well as land use contexts to determine suitable facility recommendations. The Bicycle Facilities Plans are broken up into two different maps – a 2030 Plan (**Figure D-5**) and a Vision Plan (**Figure D-6**). The key difference in the two plans is that the 2030 Plan addressed recommendations that can be accomplished by the year 2030, and the Vision Plan provides a network of facilities that is still achievable and provides the most comfortable facility network possible with the current and predicted constraints. The 2030 Plan will help the City prioritize projects and see the bigger picture. It also provides the roadmap of facilities that can implement a network that can be improved over time through the identification of corridors and destinations that create a complete north-south and east-west network. The Vision Plan takes the 2030 network and raises the bar on the facility type to develop a network of trail types to separate users from vehicular traffic, increase user comfort, and increase ridership.

Both plans started with the existing network of trails and bicycle facilities, the proposed trails in the NCTCOG 2045 Veloweb, and the schools, parks, transit stations, community amenities, and other key destinations. North Richland Hills and the NCTCOG region is blessed with several world-class trail facilities. Connecting to these trails with additional network in the street right-of-way will not only bolster these existing trails, but also will provide multimodal access into NRH, the TODs, and destinations off the main trails. The Cotton Belt Trail, John Barfield Trail, North Electric Trail, JoAnn Johnson Trail, and Walker's Creek Trail were all key trail corridors that the maps strove to connect with neighborhoods and key destinations to enhance their use and accessibility. There were strong desire lines along existing roadways to complete the network, but many of these corridors are on busier streets, narrow available right-of-way, and the amount of investment to make them safe routes would not be feasible by the target year of 2030. The key north-south roadway corridors are Smithfield Road and Holiday Lane. The east-west network roadways are Starnes Road, Hightower Drive, and Chapman Road. The remainder of the network is connected by on-street and off-street facilities.

The 2030 Plan expands the Veloweb network locally with additional trails, on-street buffered bike lanes, bike boulevards and signed route networks. Some of the main trail extensions were on the west end of the Cotton Belt Trail and small trail segment connections through available park and easement property. Some of the main roadway corridors have existing sidewalks that can be signed and enhanced to become a neighborhood trail system. This type of network development that utilizes existing infrastructure will allow the City to focus on making intersections and crossings improvements and save funding for bigger projects that provide more impact to the system. It also looked at where to make grade separated crossings, and the main crossings were for the Cotton Belt Trail at Mid-Cities Boulevard and Davis Boulevard.

The Vision Plan took the network developed on the 2030 Plan and evaluated where it was possible to improve the 2030 recommendations to be trails and off-street facilities. This plan also looked at additional segments that could be used to close gaps and used the proper facility type to connect similar facilities. The desire was not for users to have to go from a trail, to bike boulevard, to a bike lane, and back to a trail. Rather the Vision Plan looked for corridors that could be of consistent facility type and be developed into a cohesive network. The Vision Plan also looked at other opportunities along the Cotton Belt Trail to add grade separation, and the intersections at Rufe Snow Drive and over IH 820 when the Cotton Belt trail is extended.



DISCLAIMER: This Transportation Plan map serves as a guide for future street design, development and improvement. Refer to the Transportation Plan document for more background and information. Data for this map has been compiled for the City of North Richland Hills from various sources. Map data is provided for informational purposes only and may not be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and represents only the appropriate relative location of property boundaries.

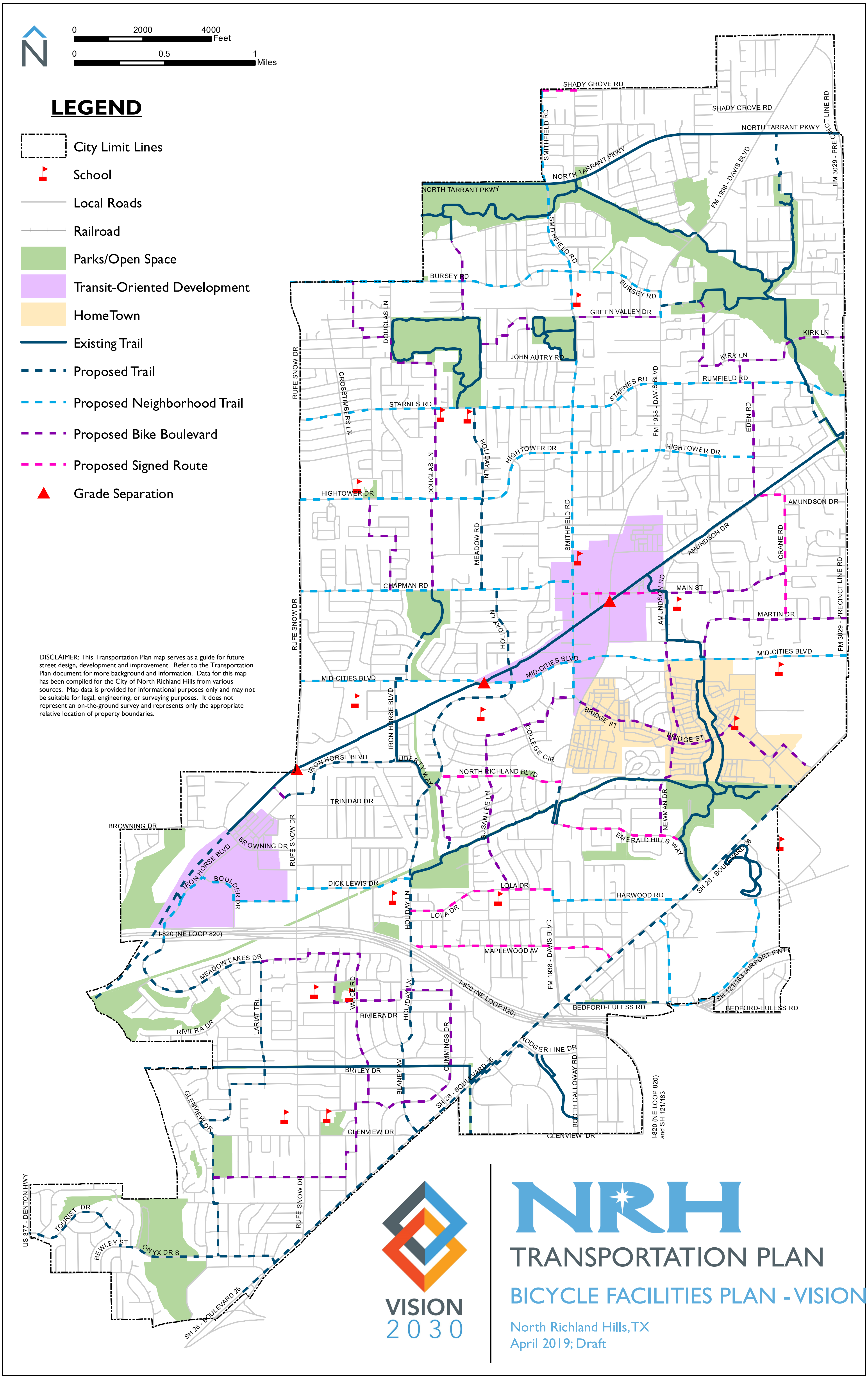
VISION 2030

NRH TRANSPORTATION PLAN

BICYCLE FACILITIES PLAN - 2030

North Richland Hills, TX
April 2019; Draft

3/28/2019; 5622_NRH_BikeFacilitiesPlan



VISION 2030

NRH

TRANSPORTATION PLAN

BICYCLE FACILITIES PLAN - VISION

North Richland Hills, TX
April 2019; Draft

Facility Types

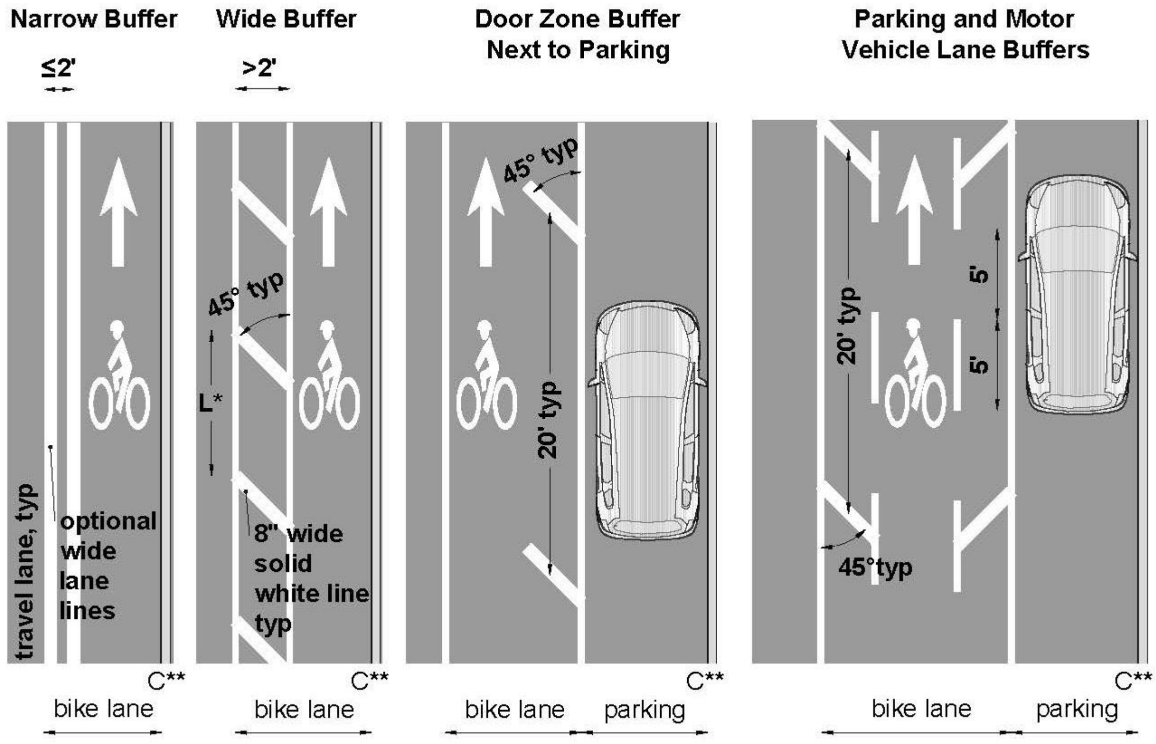
Buffered Bicycle Lanes

Buffered bicycle lanes are created by painting or otherwise creating a flush buffer zone between a bicycle lane and the adjacent travel lane. While buffers are typically used between bicycle lanes and motor vehicle travel lanes to increase bicyclists' comfort, they can also be provided between bicycle lanes and parking lanes in locations with high parking turnover to discourage bicyclists from riding too close to parked vehicles. Buffered bike lanes are typically installed by reallocating existing street space, and it is preferable to a conventional bicycle lane when used as a contra-flow bicycle lane on one-way streets.

Considerations

- Can be used on one-way or two-way streets.
- Consider placing buffer next to parking lane where there is moderate to high turnover commercial or metered parking.
- Consider placing buffer next to travel lane where speeds are 30 mph or greater or when traffic volume exceeds 6,000 vehicles per day.
- Buffered bicycle lanes allow bicyclists to pass slower moving bicyclists.
- Research has documented buffered bicycle lanes increase the perception of safety.

Figure D-7. Buffered Bicycle Lane Options



Guidance

- The minimum width of a buffered bicycle lane adjacent to parking or a curb is 5 feet exclusive of gutter (if present); a desirable width is 6 feet.
- Where there is 7 feet of roadway width available for a bicycle lane, a buffered bicycle lane should be installed instead of a conventional bicycle lane. The preferred configuration is a 5-foot or wider bicycle lane and an 18-inch or wider buffer. Typical buffer widths are 3 to 5 feet, but even a 12-18" buffer is helpful.
- The preferred minimum buffer width is 18 inches. There is no maximum width. Diagonal cross hatching should be used for buffers less than 3 feet in width. Chevron cross-hatching should be used for buffers greater than 3 feet in width.
- Buffers are to be broken where curbside parking is present to allow cars to cross the bicycle lane.
- Add total minimum width of buffer, include use of reflectors on outside stripe to improve longevity

Bicycle Boulevard Treatments

Bicycle boulevards incorporate traffic calming treatments with the primary goal of prioritizing bicycle through-travel, while discouraging excess-ive motor vehicle traffic and maintaining relatively low motor vehicle speeds. These treatments are applied on quiet, well connected streets, often through residential neighborhoods. Treatments vary depending on context, but often include traffic diverters, speed attenuators such as speed humps or chicanes, pavement markings, and signs. Bicycle boulevards are also known as neighborhood greenways and neighborhood bikeways, among other locally-preferred terms.

Note that bicycle boulevards are not just signed bike routes. The following factors distinguish bicycle boulevards from typical local streets:

- Controlled motor vehicle volumes and speeds,
- Prioritized right-of-way for bicyclists and pedestrians at local street crossings, and
- Safe and convenient crossings at major streets.

To be considered a bicycle boulevard, traffic volumes and speeds must be low.

Considerations

Many cities already have signed bicycle routes along neighborhood streets that provide an alternative to traveling on high-volume, high-speed arterials. Applying bicycle boulevard treatments to these routes makes them more suitable for bicyclists of all abilities and can increase comfort and reduce crashes.

Stop signs or traffic signals should be placed along the bicycle boulevard in a way that prioritizes the bicycle movement, minimizing 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 traffic calming tools described below;

- 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.

Communities should begin by implementing bicycle boulevard treatments on one pilot corridor to measure the impacts and gain community support. The pilot program should include before-and-after crash studies, motor vehicle counts, and bicyclist counts on both the bicycle boulevard and parallel streets. Findings from the pilot program can be used to support bicycle boulevard treatments on other neighborhood streets.

Additional treatments for major street crossings may be needed, such as median refuge islands, bicycle signals, RRFBs and HAWK or half signals. For more information on treatments supporting bicycle boulevards, see **Appendix D**.

Guidance

- Maximum Average Daily Traffic (ADT): 3,000
- Preferred ADT: Up to 1,000
- Target speeds for motor vehicle traffic are typically around 20 mph; there should be a maximum 10 mph speed differential between bicyclists and vehicles.

When to Use Them

When the operating characteristics of a bicycle boulevard are achieved, i.e. low motor vehicle traffic speeds and volumes, this facility provides comfortable conditions for a wide range of bicyclists, including children.

Bicycle Boulevards are appropriate on local, neighborhood streets, and are often an appropriate alternative to a high-speed parallel bike lane.

Speed Management

Reducing motor vehicle speeds along a bicycle boulevard helps to improve the comfort and safety of bicyclists using the corridor. Reducing traffic speeds can be accomplished by creating a sense of enclosure with horizontal or vertical treatments that require motorists to reduce speeds.

Traffic Calming Strategies

Treatments vary depending on context, but often include traffic diverters, traffic circles, chicanes, pavement markings, and signage.

- Creating Enclosure
    - No Centerlines

- "Skinny Streets"/Narrow (Yield) Streets
- Bulb-Outs/Curb Extensions/ Neckdowns

» Horizontal Deflection

- One-Lane Pinch-Point
- Chicanes
- Mini-Traffic Circles

» Vertical Deflection

- Raised Crossings
- Raised Intersections

Signed Routes

Appropriate and helpful signage is essential to making users comfortable along signed roadway routes. The signs along the corridor or route is to affirm to users that they are on the correct path of travel and to remind vehicular drivers that bicyclists may be present. These routes are typically a part of a bicycle boulevard treatment, or along routes that have destinations along them or connects a gap in another bicycle network. The elements of a well-designed signage system include:

» Uniformity and Design,
» Legibility,
» Placement,
» Safety,
» Communication,
» And Advertisement.

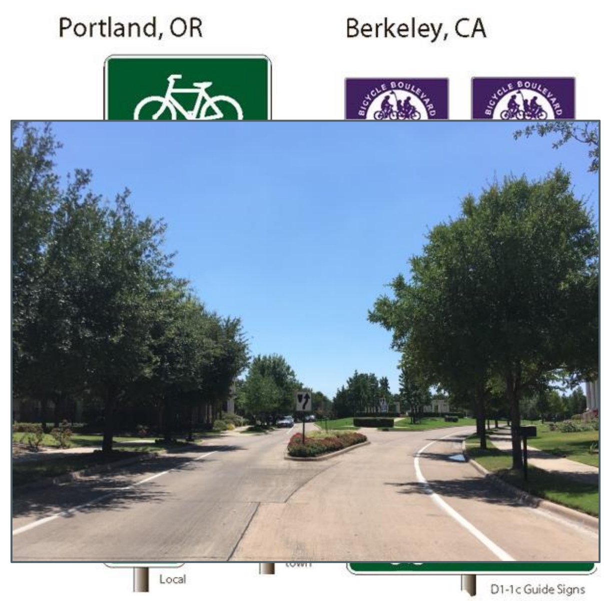
Design Factors

Uniformity and Design
City staff and stakeholders should work together to create a streamlined design of wayfinding signs that trail users can easily identify, understand and navigate the network.

Legibility
The shape, size, text, and icons on a sign should be legible for trail users of all ages, locals, and visitors. They should also be easy to understand for English and non-English speakers, as well as visually impaired persons. For important messages conveyed by text, consider including a Spanish translation.

Placement
Signs should be placed at entrances, intersections, and at forks in the trails to inform and guide trail users. Such signage aims to inform users of any and all directional options, nearby destinations, and attractions.

Figure D-8. Signed Route Wayfinding Examples



Safety
Reference location signs, or mile markers, represent an important safety measure for the trails system. They provide a simple, straightforward way of identifying locations in case of an emergency.

Communication
Signage should convey distance, direction, and destination. Trail etiquette signage conveys appropriate speed and "keep right pass left" messages.

Advertisement
For more people to use the trails, they need to know they exist, where they are located, and how to access them. Better wayfinding and signage can attract users and inform them of their off-street options.

Urban Trails

Description

Urban trails are the highest level of trail classification. They serve to make regional connections and accommodate for large volumes of users.

Design

The standard width of an urban trail should ideally be between 12 and 16 feet; the width may go down to 10 feet in constrained conditions. Since urban trails need to be able to serve large amounts of users, and potentially emergency vehicles, the recommended surface material is either concrete or asphalt.

The shoulder width, vertical clearance, maximum cross slope, and maximum grade for urban trails are determined according to AASHTO design recommendations.

Dual-Track Alternative

If a trail maintains heavy pathway volumes which dictate the need to separate wheeled users from pedestrians, an urban trail may be designed as a dual-track path. This design dedicates 10 feet of width to bicyclists and 5 feet to pedestrians.

Centerline striping, directional arrows, and mode symbols should be used on spines where directions and modes are separated. Centerlines can be painted-on or represented by a change in surface.

A shoulder path for pedestrians could also be built using decomposed granite or similar materials. This path would be beneficial for people running but would not be provide full separation of bikes and pedestrians as people using wheelchairs or other mobility devices would remain on the paved surface.

Trail Traffic Calming

If bicyclists are riding too fast along trails, traffic calming techniques can be applied: speed limit signs, slow zones, a center island, and chicanes.

Neighborhood Trails

Description

Neighborhood trails serve as the final connection to common destinations for bicyclists. This can be anything from a local neighborhood to downtown. A neighborhood trail is a two-way multi-use path, adjacent to the roadway, serving both pedestrians and cyclists – essentially, a wide sidewalk, or a "trail next to a road." They are typically separated from roadways and are 6-8 feet wide or greater, accommodating a variety of users. Typical users of neighborhood trails are bicyclists, walkers, and runners using the trail for recreation or transportation purposes.

Design considerations for these trails focus more on mobility instead of capacity to ensure that the network can be accessed by residents all over the City.

Design

Neighborhood Trails are preferred to be 8 feet wide but could vary based upon available right-of-way. The surface material of concrete can be either concrete, asphalt, or crushed limestone depending on location, natural conditions, and anticipated daily usage.

The shoulder width, vertical clearance, maximum cross slope, and maximum grade for neighborhood trails are all determined according to AASHTO design recommendations.

Method for Bikeways: Parking Removal

The removal of on-street parking provides space for bicyclists can reduce conflicts between bicyclists and motorists. Policies that may help reduce parking demand, provide more parking on side streets, or provide more shared off-street parking areas should be considered when parking is removed.

Benefits

- Reduces conflicts with bicyclists as drivers pull into and out of parking spaces and drivers and passengers open doors of parked vehicles.
- Provides additional roadway space for bicycle facilities.
- Improves sight distance for all roadway users.

Challenges

- Resurfacing projects that include parking removal are usually more challenging than Lane Diets due to resident or business community resistance to losing parking and potential impacts on loading and freight delivery.

Design Considerations

- On most streets with parking on both sides, removal of all on-street parking is not necessary to add bike lanes. If the street includes businesses, it is preferential to remove parking on the side of the street with fewer or no businesses.

- Parking may be alternated from one side of the street to the other with proper transitioning. This pattern may cause motorists to reduce their speed.
- For a roadway with two 10-foot parking lanes, the removal of one parking lane can provide space for a 4-foot bike lane next to a 2-foot gutter on one side of the street, and a 6-foot bike lane next to an 8-foot parking lane on the other side of the street.

Additional Considerations

When parking lanes are converted to bike lanes, ensure that drainage grates are compatible with bicycle use, that manhole or utility covers are flush with the pavement, and that gutter joints are smooth and not a hazard to bicyclists.

Figure D-9. Sample illustration of a street before parking removal

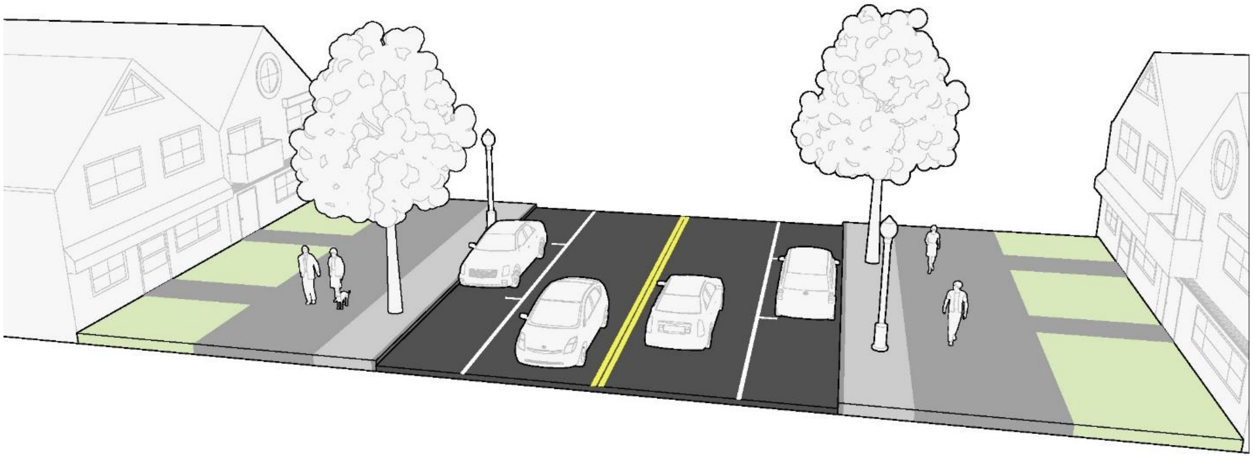


Figure D-10. Illustration of a street after parking removal on one side to include bike lanes

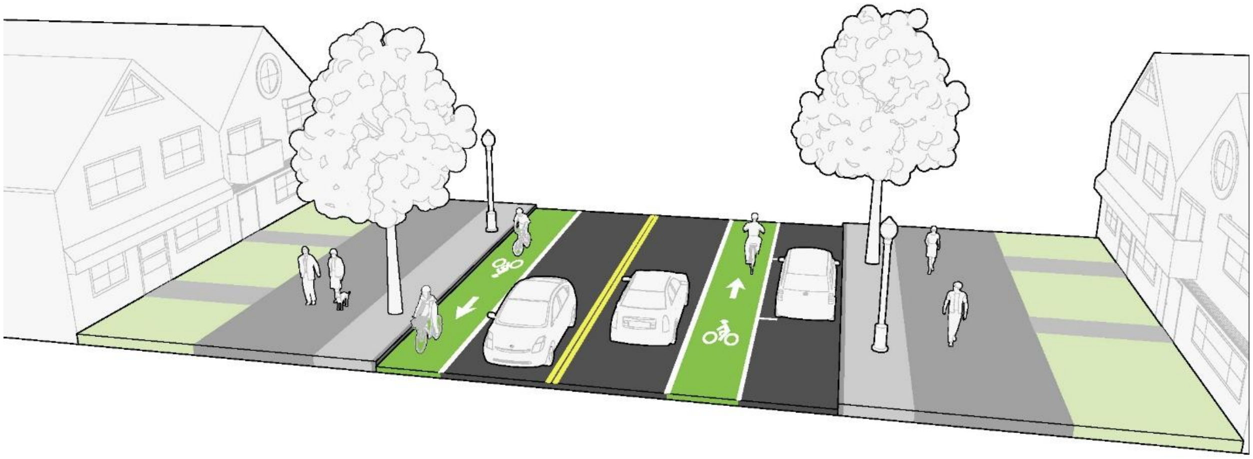
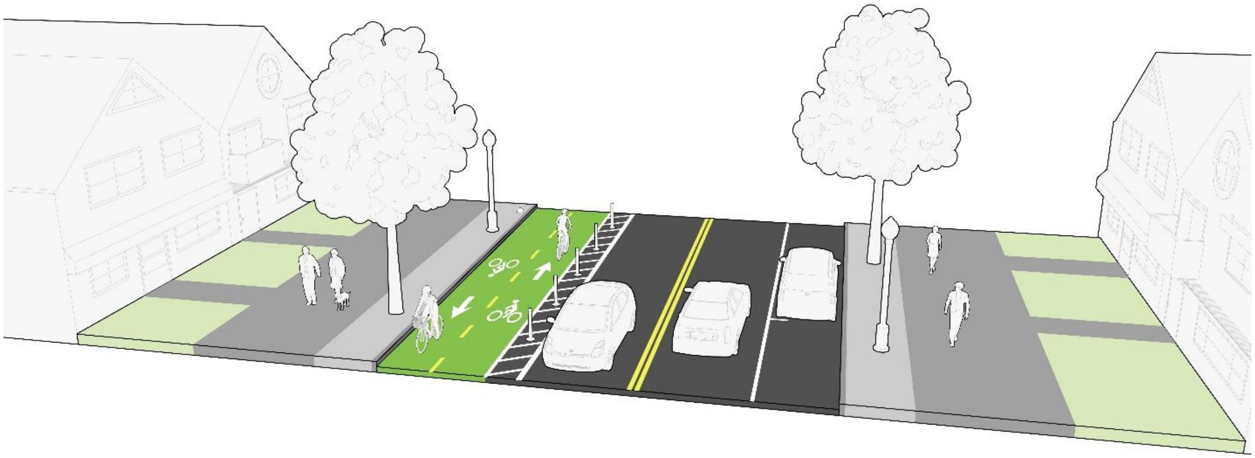


Figure D-11. Sample illustration of a street after parking removal on one side to include a two-way separated bike lane



Overall parking demand and space should be evaluated from the standpoint of the community's needs and values, including the value of using the street for mobility of all users, the desire to reduce single-occupancy vehicles, and the need to promote bicycling or transit.

Specific Successes

- The City of Austin removed on-street parking to add a two-way separated bike lane along Bluebonnet Lane.

Summary

The two Bicycle Facilities Plans – 2030 Plan (**Figure D-5**) and the Vision Plan (**Figure D-6**) address the near-term and long-term visions for NRH. The 2030 Plan recommends facilities that can be accomplished by the year 2030 with a focus on bicycle boulevards and re-striping existing roadways for buffered on-street bike lanes. The Vision Plan provides a network of facilities that builds on the 2030 Plan and recommends higher comfort facilities which can be implemented as roadways are reconstructed or additional right-of-way is acquired. Both plans build on the existing 20-plus miles of trails in NRH with a focus on on-street routes in low-volume, low-speed neighborhoods complemented by off-street trails which serve all ages and ability levels.

Table D-7. Proposed Bicycle Facilities Summary

	2030 Plan (miles)	Vision Plan (miles)
Signed Route	7.2	4.9
Bicycle Boulevard	20.9	17.1
Buffered Bike Lane	2.4	0
Neighborhood Trail	11.3	19.7
Trail	15.2	18.3

Design Guidelines and Special Considerations

There are standards for design that are utilized by communities across the United States and have been established based on research and local experience. These are the anticipated guidelines for implementation of the transportation system plan:

Roadway Design Guidelines

- AASHTO ***A Policy on Geometric Design of Highways and Streets***, latest edition
- NACTO ***Urban Street Design Guide***
- Transportation Research Board ***Highway Capacity Manual***, latest edition
- Texas ***Manual on Uniform Traffic Control Devices***, latest edition
- City of North Richland Hills ***Public Works Design Manual***

Bikeway Design Guidelines

- AASHTO ***Guide for the Design of Bicycle Facilities***, latest edition
- NACTO ***Urban Bikeway Design Guide***

Sidewalks and Pedestrian Design Guidelines

- AASHTO ***Guide for the Planning, Design and Operation of Pedestrian Facilities***, latest edition
- NACTO ***Urban Street Design Guide***
- City of North Richland Hills ***Public Works Design Manual***

In addition to these established design standards, there are additional guidelines for design applications to best suit the current and anticipated conditions along the roadway corridor.

Complete Streets

The focus of a Complete Streets initiative is to consider all modes during the planning, design, construction, operation and maintenance of the city's street network. Effective complete streets policies help communities routinely create safe and inviting road networks for everyone, including bicyclists, drivers, transit operators and users, and pedestrians of all ages and abilities. Instituting a Complete Streets policy ensures that transportation planners and engineers consistently design and operate the entire roadway with all users in mind. For the Complete Streets policy to be effective, a program of supporting policies and procedures need to be put in place in all City departments, including a program of land use planning guidelines, a series of project development checklists, established responsibilities for addressing modal issues, and design and operating standards for implementation and maintenance.

Special Context Sensitive Corridors

Every corridor should be designed with complete streets principles and context sensitive solutions in mind. **Appendix B** details the following corridors which were identified at the outset of the study for heightened attention to such special considerations. Special typical sections and implementation measures were evaluated for these corridors.

- Hightower Drive
  Smithfield Road to Davis Boulevard
- Hightower Drive
  Michael Drive to Eden Road
- Eden Road
  Rumfield Road to Amundson Drive
- Amundson Drive
  Main Street to Precinct Line Road
- Meadow Road
  Hightower Drive to Chapman Drive
- Iron Horse Boulevard
  Rufe Snow Drive to Mid-Cities Boulevard
- Bedford-Euless Road
  Boulevard 26 to Strummer Drive
- Holiday Lane
  IH 820 to Liberty Way

Key Intersections

The ability for the roadway network to operate effectively relies on the ability of intersections to efficiently process traffic. Operational conditions typically break down when insufficient turn-lane capacity is available to remove turn movements from the traffic stream. To ensure the ability to provide channelized turn movements, such as a second left-turn or right-turn lane, an additional 24 feet should be provided at key major and minor arterial intersections. To determine the exact dimensional requirements of specific intersections, a traffic analysis should be conducted at the time of facility implementation.

As currently defined, divided roadways have the ability to accommodate a separate left-turn lane. By adding 24 feet of width, a second left-turn and separate right-turn bay can be added as needed to an intersection. Travel lanes of 12’ provide sufficient roadway width for turn movements.

Table D-8 identifies necessary distances by roadway class for storage and transition requirements. The distances identified allow for minimum turn-lane storage and lane transitions. In high intensity development areas, a traffic analysis should be conducted to determine appropriate intersection requirements. **Figure D-12** illustrates intersection right-of-way requirements at critical locations.

Access Management

Complementing the roadway development concepts of Complete Streets and Context Sensitive Design is the management of access points to and from a roadway to facilitate traffic flow and safety. Access management addresses the classic trade-off between the two chief functions of major roadways: (1) accommodating higher speed and through traffic, and (2) providing access to abutting properties. Roads that are designed to move the most traffic also become almost immediately attractive for adjoining land development given the visibility and volume of passersby they offer to frontage properties. However, vehicles turning into and out of driveways – and slowing down and accelerating to do so – introduce “friction” into the system. As traffic volumes increase and more

Figure D-12. Critical Intersection Right-of-Way Requirements

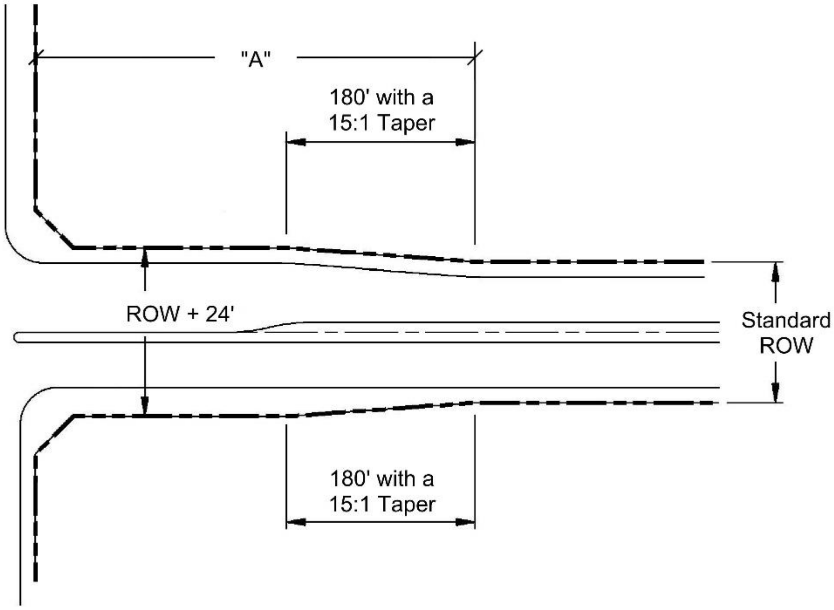


Table D-8. Critical Intersection Right-of-Way Requirements

Critical Intersection Right-of-Way Requirements (Distance "A")				
Roadway	Major Arterial	Minor Arterial	Major Collector	Minor Collector
Major Arterial	380'	380'	330'	280'
Minor Arterial	330'	330'	280'	280'

access points occur along a roadway, it becomes more challenging to prevent traffic congestion and reduced travel speeds. Once these trends set in, then the full traffic-carrying potential of a road goes to waste. Subsequently, efforts are expended to try to improve the capacity of the roadway and most often involve adding travel lanes.

Access management strategies have a broad reach, drawing principles from transportation, land use, urban design, and recreation planning to create functional and aesthetically pleasing streetscapes. The following illustration reflects the wide selection of access management policies and tools. These elements can be incorporated into plans, policies, and studies; land development regulations; and design standards and guidelines. Access management treatments predominantly include raised medians and driveway consolidation, but also can involve auxiliary lanes, pedestrian sidewalks and crossings, landscaping and signage, and bicycling and transit accommodations.

More details on access management elements are found in the Pattern Book in **Appendix D**.

Raised Medians

Raised medians limit cross-street movements and improve traffic flow. They have been proven in studies sponsored by the Federal Highway

Administration (FHWA) to reduce crashes by over 40 percent in urban areas and over 60 percent in rural areas. Medians also serve as a safe refuge for pedestrians and bicyclists crossing the street, especially compared to two-way left-turn lanes. The placement of the median opening depends on the type of thoroughfare system. Priority should be given to thoroughfares providing mobility and access throughout the entire community. Openings should only be provided for street intersections or major developed areas. Spacing between median openings must accommodate left-turn lanes with proper deceleration and storage lengths. Median treatments can take on many different forms, including full median openings and channelized openings.

Driveway Consolidation

Research sponsored by FHWA shows that the density and design of driveways have a direct impact on roadway safety – the more access connections, the more accidents. The purpose of driveway consolidation and spacing is to limit the number of conflict points while ensuring convenient and safe access to businesses. Driveway consolidation involves the removal of existing access connections, or driveways, for the primary purpose of improving safety. This technique will impact multiple stakeholders, typically requiring cooperative agreements between each property owner and governing agency attempting to consolidate the driveways. Each driveway presents a potential conflict point, thus a safer redesign would use an internal circulation system to funnel roadway traffic through one major access point. Driveway realignment involves the relocation of driveways, so they mirror or offset one another to minimize potential conflicts.

Auxiliary Lanes

Deceleration and acceleration lanes at major driveways are considered "auxiliary lanes" and can provide refuge for turning vehicles while maintaining travel speeds for traffic though lanes. Auxiliary turn lanes at intersections allow turning traffic to get out of the way of through traffic and wait to turn using gaps in opposing traffic. These treatments increase the capacity and average travel speed of the roadway, while enhancing driver safety.

Urban Design

Pedestrian Sidewalks and Crossings

Pedestrians are a critical user group of intra-city travel, especially in urban and mixed-use centers. Well-designed pedestrian environments not only encourage walking; they separate pedestrians from vehicular traffic to increase the safety and enjoyment of this experience. Well-designed, safe, convenient, and attractive pedestrian environments will increase the viability of walking as an alternative transportation mode. Intersections are the most dangerous pedestrian environments. The location and design of crosswalks, median rests, curb ramps, and pedestrian signals help to improve the safety and accessibility of pedestrian crossings.

Landscaping and Streetscaping

Landscaping provides functional and aesthetic benefits to the streetscape through the use of scale, shade, and color. Improvements may include shade trees, hanging flower baskets, flower boxes, decorative signage, and entry features. Planting amenities can require higher maintenance costs than streetscape and street furniture, but they offer natural beauty and a much grander scale. Landscaping is also used as a traffic calming device to reduce the speed of automobiles. When street trees are placed along the sidewalk edge or in the median, their presence creates the appearance of reduced area of the roadway available to vehicles. This influence has a "traffic calming" effect.

Signage

With regard to access management, roadway signs create order to traffic flow and thus improve its efficiency by:

- Regulating and channelizing motorists along streets and highways;
- Informing motorists of conflicting routes and speeds, such as driveways, intersections, and parking areas;
- Directing motorists to streets, highways, cities, towns, villages, or other significant destinations;
- Alerting motorists of changes or hazards within the roadway; and
- Providing other information of value to road users.

Bicycling Accommodations

Bikeway amenities alert motor vehicles and pedestrians of bicycle traffic, while also guiding cyclists to their proper location on the roadway. Bicyclists also benefit from the other access management treatments that reduce conflict points and create order and calming effects to traffic flow.

Roundabouts

Roundabout Elements

Roundabouts are a type of intersection characterized by a generally circular shape, yield control on entry, and geometric features that create a low-speed environment through the intersection. Modern roundabouts have been demonstrated to provide a number of safety, operational, and other benefits when compared to other types of intersections. On projects that construct new or improved intersections on collector or minor arterial roadways, the modern roundabout should be examined as an alternative to all-way stops or traffic signal control. The design principles and parameters for roundabouts are described in detail in the National Cooperative Highway Research Program (NCHRP) *Report 672: Roundabouts: An Informational Guide – Second Edition*.

Roundabout Size

The size of a roundabout, typically measured by its inscribed circle diameter (outside to outside of pavement) is determined by a number of design objectives, including: traffic movements through the intersection, design speed, path alignment, and design vehicle. Smaller size roundabouts can be used for some local street or collector street intersections where the design vehicle may be a fire truck or single-unit truck.

Table D-9 provides common ranges of inscribed circle diameters for various roundabout categories and typical design vehicles. Neighborhood traffic circles, often called mini-roundabouts, are typically built at the intersections of local streets for reasons of traffic calming and/or aesthetics. Needed right-of-way would include the roundabout pavement plus space for sidewalks, buffer and utilities.

Figure D-13. Illustration of Roundabout Elements, FHWA

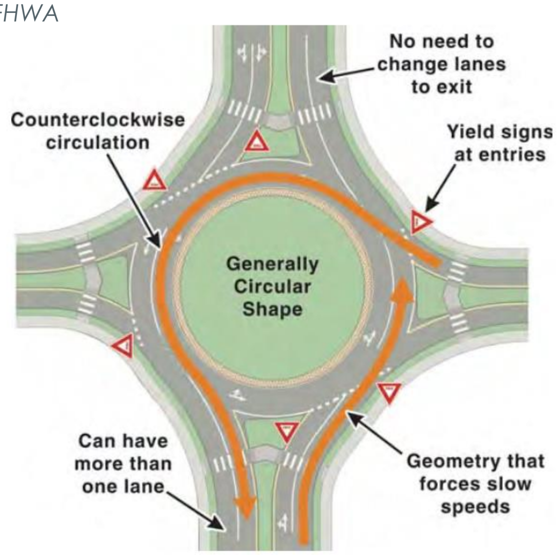


Table D-9. Comparison of Roundabout Types, AASHTO Green Book, 7th Ed.

Design Element	Mini-Roundabout	Single-Lane Roundabout	Multilane Roundabout
Desirable maximum entry design speed	15 to 20 mph	20 to 25 mph	25 to 30 mph
Maximum number of entering lanes per approach	1	1	2+
Typical inscribed circle diameter	45 to 90 ft	90 to 180 ft	150 to 300 ft
Central island treatment	Mountable	Raised	Raised
Typical daily service volumes for a four-leg roundabout below which the roundabout may be expected to operate without needing a detailed capacity analysis	0 to 15,000	0 to 20,000	0 to 45,000 (for a two-lane roundabout)

Demonstration Projects

Cities are constantly changing. Large scale urban transformations, such as museums, parks, and stadiums are high profile projects that typically generate attractive returns. However, such projects require a substantial investment of time and a considerable reserve of social and financial capital. Additionally, the long-term economic or social benefit of these projects is not always guaranteed. Therefore, cities around the world are embracing the incremental approach and grassroots energy of "tactical urbanism" to implement street safety and neighborhood improvement projects.

Tactical urbanism is a term used to describe a collection of low-cost, temporary changes to the built environment intended to improve local neighborhoods and public places. From plazas and parklets to open streets events and piloting complete streets designs, these initiatives are a deliberate, phased approach to instigating change in the public realm. Demonstration and pilot projects can prove concepts, shape design, and build momentum for

long-term action. Tactical urbanism efforts can occur through formalized strategies, such as New York's Pavement to Plazas program. Cities in Texas have also used this approach in reclaiming pavement space for other uses. In Dallas, Marilla Street lacked adequate pedestrian facilities but through a tactical urbanism approach, small-scale improvements were made and feedback taken from the community to move toward long-term construction projects to enhance walkability on the corridor. Other communities like Austin, San Marcos, and Houston have also taken this approach on projects to quickly test and implement design solutions and gain momentum for long-term goals. Taking this approach would allow the city to test new concepts before making major political and economic commitments.