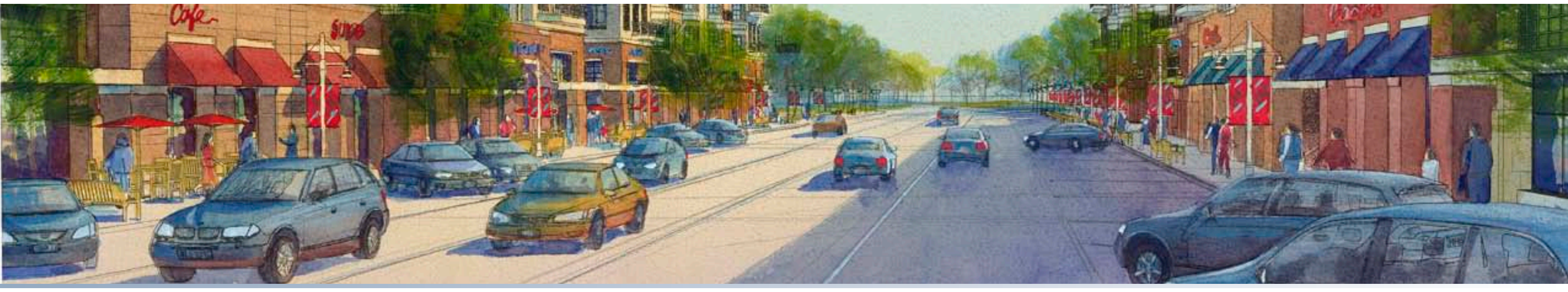
UNT - DALLAS AREA

CONTEXT SENSITIVE TRANSPORTATION STUDY



North Central Texas Council of Governments

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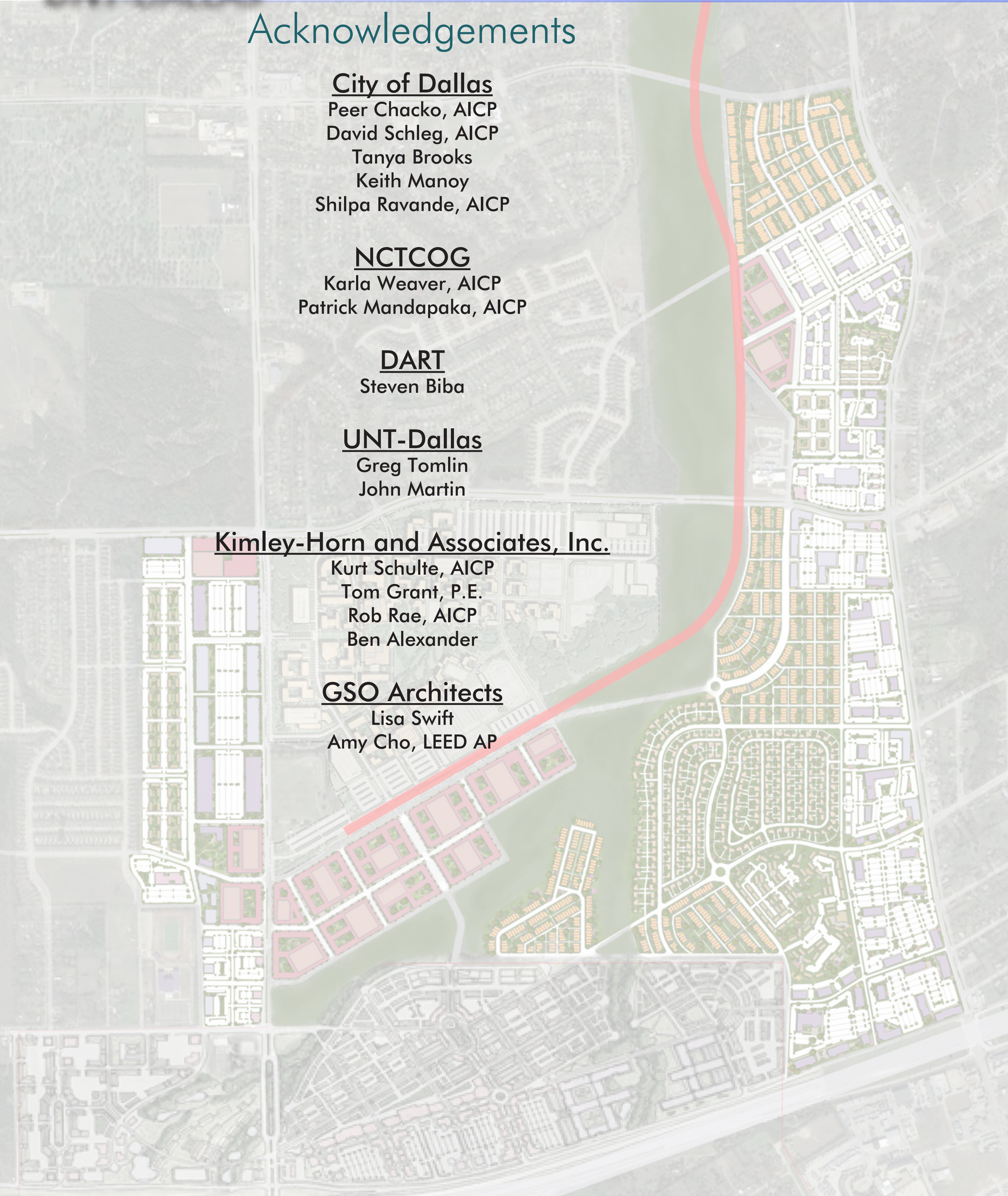

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Chapter 1 - Introduction

The University of North Texas at Dallas (UNT-Dallas) with its first major university campus within the City of Dallas, will have a positive effect on growth in the area. Economically, UNT-Dallas will attract key developments and new businesses, which will increase employment opportunities in the area. Additionally, Dallas Area Rapid Transit (DART) plans to implement rail service to the campus and the surrounding area. These new opportunities in the area present the need for a context sensitive transportation study to plan, prioritize, and implement projects that will help support the campus and the neighboring area. The study area is shown in *Figure 1.1*. The study area is bounded by IH 35 on the west; Laureland Road & Wagon Wheels Trail on the north; Tracy Road on the east; and, IH 20 and the Lancaster City Limits on the south.

Implementation of the City of Dallas' UNT-Dallas Area Plan, the University of North Texas at Dallas (UNT) Campus Master Plan, and neighboring master plans will place increasing demands on the transportation system. Community leaders, land-use planners, developers, and transportation agency administrators need ways to predict the number of net automobile, transit, bike, and pedestrian trips that may be generated by new transit-oriented developments.

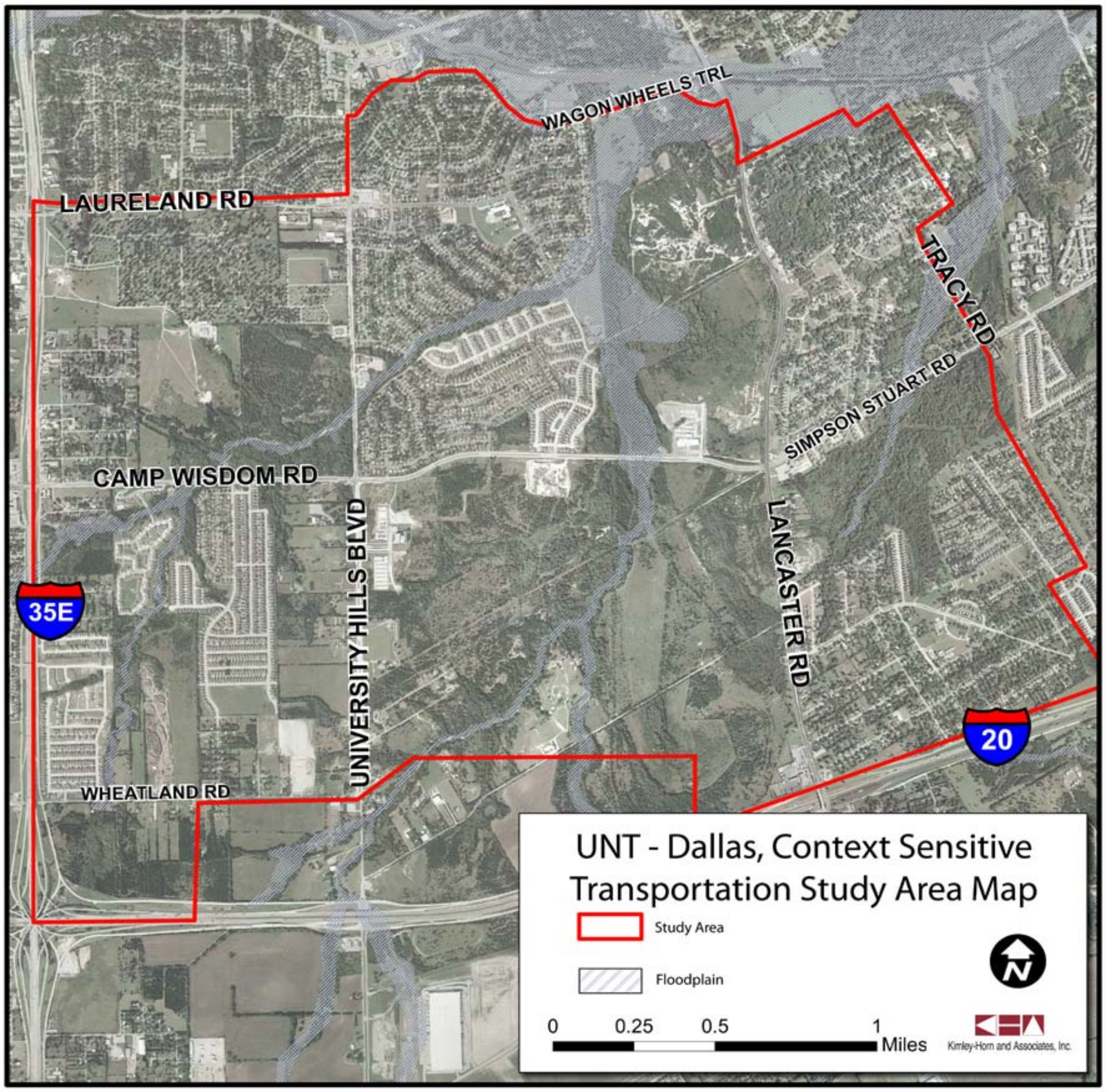


FIGURE 1.1 Study Area

1.1 Need for the Study

The UNT-Dallas Context Sensitive Transportation Study (CSTS) is a long-range planning analysis that incorporates consideration of flexibility in roadway standards to facilitate context sensitive design within its defined study area. The CSTS identifies the location and type of roadway facilities that are needed to meet projected long-term growth within the UNT-Dallas study area. This study serves as a tool to enable the City of Dallas to identify and preserve future corridors for transportation system development as the need arises. The objective of the CSTS is to conduct a comprehensive area-wide review of transportation needs within the context of the UNT-Dallas Area Plan and other existing plans in the study area. The goal of the CSTS is to develop a multi-modal transportation plan that facilitates a shift in travel behavior in response to a future land use and urban design vision that emphasizes a mixed-use, walkable community, as envisioned within the UNT-Dallas Area Plan. The CSTS includes detailed information related to roadway classification, right-of-way requirements, design criteria, and number of through travel lanes for each thoroughfare within the study area.

Development without proper planning and direction could lead to a built environment that doesn't meet the needs of a mixed-use and campus area location, making the area unfriendly to the users of non-motorized transportation options. This study provides the opportunity to accommodate all travel modes with greater efficiency, safety, and land development potential by creating a place that responds to the University and proposed transit context.

Like many cities in the country, Dallas' Thoroughfare Plan takes into account only the transportation element of the built environment. A thoroughfare may in fact have many context zones making one roadway design not suitable to serve different land uses. Recent trends in development, locally and across the nation, have changed the approach to roadway planning, allowing for greater flexibility in thoroughfare design which better compliments surrounding land uses. The *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach* (CSS), written by the Institute of Transportation Engineers and the Congress for New Urbanism (2010), provides a guide on how this emerging practice can be implemented during the thoroughfare planning process. The context-sensitive approach has been adopted by the Texas Department of Transportation (TxDOT) and is being planned and implemented by the City of Dallas.

The CSTS is based on a sound technical foundation combined with emerging practices in innovative roadway design, all of which are discussed in detail in Chapters 2 through 5.

Chapter 2 describes the planning process, the process of defining the alternatives, relevant plans taken into account, and a brief description of the technical foundation used.

Chapter 3 gives an overview of the CSS and flexible design strategies to create unique and corridor-specific design characteristics for thoroughfares.

Chapter 4 describes the CSTS and its four options, and includes the pros and cons for each option. This chapter also explains the specific street context of the UNT-Dallas study area and includes detailed design elements and example renderings.

Chapter 5 details a prioritization process used to determine the most effective timing for mobility investments. It also discusses additional steps necessary for successful implementation of the CSTS.

The appendix includes a glossary of terms, the technical foundation, and a summary of the preliminary scenarios.

Chapter 2 - Planning Process

To successfully develop the CSTS, the project team used a thorough planning, alternative analyses, and a design process based on input from planners, engineers, designers, and agency representatives. After months of discussions and analyses, the end result is a series of options or alternatives with their respective pros and cons. The study will assist the City of Dallas, DART and UNT-Dallas, in successfully being able to meet the future needs of the UNT-Dallas area. The following description summarizes the process.

2.1 Project Management

The UNT-Dallas Area CSTS was funded through North Central Texas Council of Governments (NCTCOG) Sustainable Development Funding Program and the City of Dallas. Kimley-Horn & Associates was selected as a consultant to conduct the study. A project management team (PMT) was created to oversee the planning process, including the representatives from the City of Dallas, NCTCOG, DART, and UNT-Dallas.

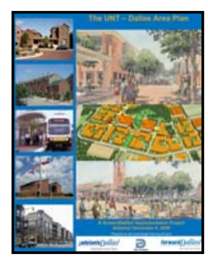
2.2 Stakeholder Involvement

The stakeholder involvement from the *UNT-Dallas Area Plan* provided the basis for this study. Major stakeholders included UNT-Dallas, City of Dallas, DART, property owners and citizens. Coordination with relevant stakeholders was important during this stage of the planning process to ensure a community-supported and easily implementable design. Common questions revolved around pedestrian and bicycle activity and accessibility, commercial development, residential development, parking, and transit options. The City's Office of Economic Development in collaboration with UNT-Dallas have been proactive in keeping residents and stakeholders involved and informed while conducting area promotion and outreach in order to attract development to the area. (UNT-Dallas Area Plan, 2009)

2.3 Relevant Plans

Relevant plans taken into account in shaping this transportation study include the following:

UNT-Dallas Area Plan, created by the City of Dallas, approved by the City Council in 2009, sets a long-term development vision for the area, with recommended implementation efforts related to public utility needs assessment, area promotion, and appropriate land uses and rezoning. It proposes a vision that maximizes multi-modal access and connectivity within the area, including sharing of Right-of-Way (R.O.W.) between proposed light rail lines and thoroughfares within the UNT-Dallas Campus Area and Camp Wisdom Strategic Opportunity Areas.



The UNT – Dallas Area Plan

City of Dallas Bike 2011 Plan, the Bike Plan includes public input along with assistance from expert bicycle planning consultants as well as three City-sponsored committees. This Plan makes possible the implementation of a consistent network of on-street and off-street bicycle facilities that will provide better bicycle connectivity to schools, employment centers, transit, and many other destinations.

City of Dallas Thoroughfare Plan, provides a roadway classification system with the type, functional class and number of lanes that guides R.O.W. acquisition, construction, and maintenance of the thoroughfares. Currently, thoroughfares are defined as either arterial or collector, divided or undivided.

Dallas Thoroughfare Plan

Mobility 2030, The Metropolitan Transportation Plan for the Dallas-Fort Worth Area - 2009 Amendment by the North Central Texas Council of Governments (NCTCOG). Approved by the Regional Transportation Council (RTC), Mobility 2030 is a comprehensive, multi-modal plan for transportation systems and services aimed at meeting the mobility and financial needs of the Dallas-Fort Worth (DFW) Metropolitan Area. This plan defines the vision for transportation systems and services within DFW through outlining the expenditure of nearly $71 billion of federal, state, and local funds through the year 2030. As of May 2011, the NCTCOG has developed Mobility 2035 Plan. Federal review of this plan is currently pending, to be completed the end of Summer 2011.

forwardDallas! is the comprehensive plan for the city of Dallas adopted in 2006. It is a long-term plan developed through extensive public outreach and discusses Dallas' economic, land use, housing, environment, urban design, neighborhood and transportation vision, goals, and objectives. The plan emphasizes transit oriented development, thriving urban downtown, a mix of housing choices, preserving neighborhoods, and a bountiful array of employment opportunities.

City of Dallas Trail Master Plan, adopted by the City of Dallas in 2005, guides the implementation of proposed trails within the City. This plan took into account the broadly focused Dallas County Trail Plan and the NCTCOG's Veloweb to suggest a preliminary network of trails throughout the city.

DART 2030 System Plan, identifies, schedules, and budgets system improvement projects that will more precisely respond to changing regional land uses and development patterns. This plan extends DART's reach with rail service to the outlying areas of the current DART Service Area, which could potentially add new member cities.

Lancaster Campus District, planned by the City of Lancaster as a mixed-use village within walking distance of the UNT-Dallas campus. This development is planned for numerous retail shopping stops, a research park and a resort hotel. The campus district will also include high rise residential development.


Lancaster Campus District

UNT-Dallas Campus Master Plan, prepared by UNT in 2005, establishes a future development vision and strategies for implementation with the goal of creating a vibrant and walkable university campus.


UNT-Dallas Campus Plan

2.4 The Alternatives

The consultant team conducted a site analysis and from this the team outlined the technical foundation needed to forecast future traffic scenarios. The resulting data was used to aid in the formulation of several conceptual alternatives that best fit the transportation needs of the campus and the surrounding area in the context of the UNT-Dallas Area Plan.

Using the data collected through field visits and a thorough site analysis, the consultant team analyzed the current conditions, including traffic volumes and environmental factors. The team also reviewed and discussed existing plans that would shape the direction of the planned approach. Based on this information, the team created an initial set of conceptual alternatives to illustrate alignments and interactions of existing and proposed roadways, light rail lines, and trails.

In the end, the currently-approved City of Dallas proposed alignment (identified as the "Base Alternative") and three additional conceptual alternatives were chosen through a *fatal flaw analysis* and input from the PMT. Using a strong technical foundation, the base map and three alternative maps proposed practical solutions that advance a mixed use, and walkable future for the community. The base map and three alternative maps are illustrated in *Appendix C*.

2.5 Technical Foundation

The CSTS was developed using a strong technical foundation of travel demand modeling that incorporated data and analysis at a regional and local level. The NCTCOG's Regional Travel Demand Model was used to forecast trips that people take on a daily basis within the study area. This model provided a comprehensive look at the study area's capacity needs and congestion levels in the year 2030 (Base and Alternative B with NCTCOG's 2030 Demographic Forecast and the UNT-Dallas Area Plan demographics, for a total of four model runs) as part of a growing region.

The project team completed model-based analysis through the following steps during the development of the CSTS:

- Ensure model is up-to-date
- Analyze existing street network (capacity, LOS, etc)
- Analyze existing Thoroughfare Plan (provided baseline data for update)
- Generate and test transportation network alternatives
- Finalize recommended system

Four Step Modeling Process

The NCTCOG Regional Travel Demand Model is comprised of a series of mathematical models that simulate travel on the transportation system. The model divides the region into Traffic Survey Zones (TSZs) which have specific demographic and land use data associated with them and are used to determine trip demand and travel patterns. The modeling process encompasses the following four primary steps (Figure 2.1):

Trip Generation – the number of trips produced and attracted to a destination or zone.

Trip Distribution – the estimation of the number of trips between each TSZ, i.e., where the trips are going.

Modal Split – the prediction of the number of trips made by each mode of transportation between each TSZ.

Traffic Assignment – the amount of travel (number of trips) that is loaded onto the transportation network through path-building and is used to determine network performance.

The model provides the study area with a tool to predict what the thoroughfare system will need to look like to accommodate future transportation needs. Although a primary use for the regional model is determining roadway capacity, it can also be used for other technical analysis such as:

- Evaluating development impacts and mitigation measures (Traffic impact analyses are often limited to their immediate area. This allows for a citywide snapshot.)
- Determination and prioritization of capital expenditures
- Land use / transportation scenario planning
- Emergency evacuation planning
- Special event planning

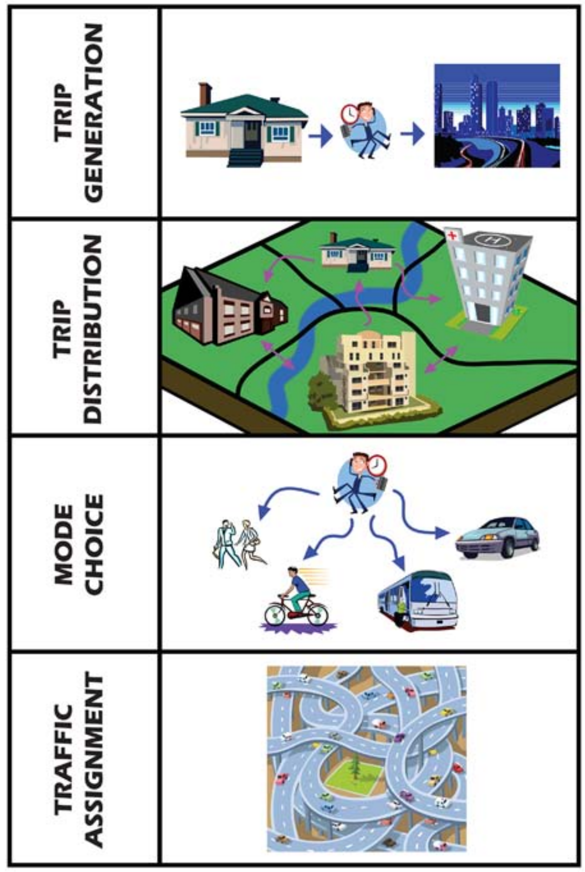


FIGURE 2.1 4-Step Modeling Process

Mesoscopic and Microscopic Process:

- The project team used the output from the four-step model, including the percentage of trips coming into and out of the study area to calibrate the mesoscopic model. This model was also utilized to assist with locating complete streets, trail connections, intersection design needs, and mid-block crossing needs.
- The Project Management Team then reviewed road capacity needs, sizing, and pedestrian connection recommendations.
- Based on the feedback from the Project Management Team, intersection and micro-simulation analysis was performed for the AM and PM peak hours.

Mesoscopic and Microscopic Product:

Micro-simulation analysis for the AM and PM peak hours was performed at study intersections to assist in identifying the need for mid-block crossings. The steps in the technical analysis produced regional auto travel demand and bicycle/pedestrian flows for the year 2030. Forecasting travel demand informed the next step of the CSTS, which was to select a preferred transportation network, sizing of transportation facilities and context sensitive design standards.

Results:

The modeling analysis was used to determine the traffic demand of the study area roadways. The NCTCOG Model provides an indicator for future traffic demand. The two sets of demographics (NCTCOG and the UNT-Dallas Area Plan) produced similar capacity needs and transit capture rates. In the end, the two demographic scenarios and three street alternatives requires similar auto capacity. However, the model with the UNT-Dallas Area Plan demographics generates higher internal capture, requires more pedestrian linkages and generates more transit demand. Figure 2.2 and Table 2.1 provides the model volume output for the Base and three alternative scenarios. In Table 2.1, COG volumes are output volumes using NCTCOG's 2030 Forecast demographics, while CSTS volumes are output volumes that use the UNT-Dallas Area Plan demographics. *Appendix B* provides a thorough description of the technical process used to complete this study. Appendix D illustrates how the base model and alternatives are configured.

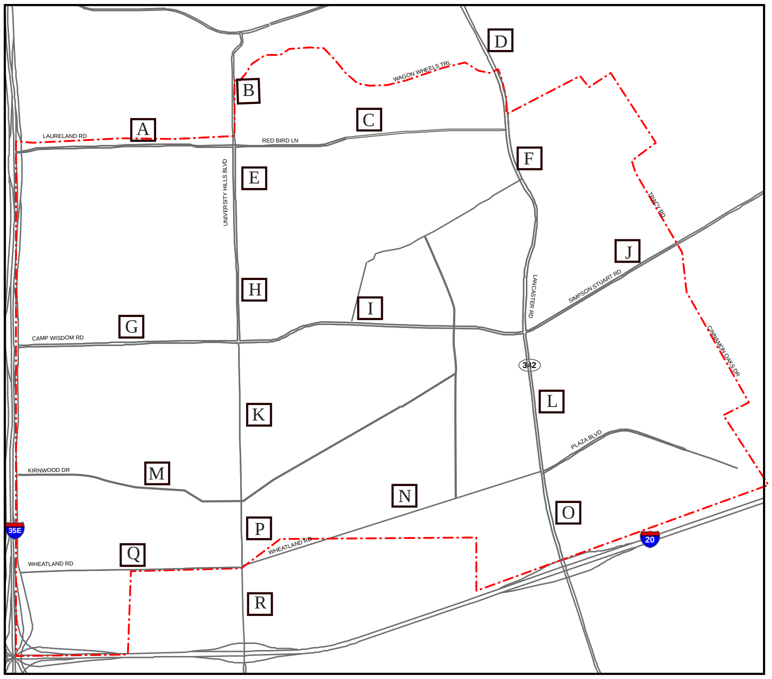


FIGURE 2.2 Locations of Model Output Values

Segment	Base		Alternative A		Alternative B		Alternative C	
	COG Volume	CSTS Volume	COG Volume	CSTS Volume	COG Volume	CSTS Volume	COG Volume	CSTS Volume
A	12,000	9,000	12,000	10,000	12,000	10,000	8,000	10,000
B	15,000	15,000	14,000	15,000	16,000	17,000	15,000	15,000
C	9,000	5,000	10,000	8,000	12,000	9,000	10,000	8,000
D	30,000	21,000	32,000	24,000	31,000	22,000	32,000	23,000
E	10,000	10,000	10,000	10,000	11,000	10,000	11,000	10,000
F	31,000	20,000	32,000	21,000	29,000	28,000	32,000	20,000
G	29,000	28,000	29,000	28,000	30,000	20,000	31,000	27,000
H	12,000	11,000	13,000	11,000	13,000	12,000	13,000	12,000
I	33,000	25,000	30,000	28,000	27,000	26,000	30,000	28,000
J	30,000	23,000	28,000	23,000	28,000	23,000	26,000	23,000
K	19,000	17,000	21,000	19,000	21,000	19,000	20,000	18,000
L	37,000	23,000	36,000	23,000	34,000	32,000	34,000	22,000
M	2,000	1,000	7,000	7,000	11,000	11,000	14,000	14,000
N	22,000	22,000	17,000	17,000	26,000	23,000	17,000	17,000
O	36,000	23,000	38,000	25,000	37,000	35,000	36,000	24,000
P	23,000	22,000	26,000	22,000	23,000	20,000	22,000	17,000
Q	29,000	21,000	30,000	20,000	26,000	28,000	30,000	21,000
R	21,000	20,000	25,000	22,000	23,000	22,000	22,000	19,000

Table 2.1 Model Output Values (Daily-Traffic Volumes)

Chapter 3 - Context Sensitive Design

3.1 Overview

Context Sensitive Design (CSD) is becoming embraced across the country as a more innovative approach to integrating different travel modes within the same mobility corridors by utilizing elements complementing the surrounding built environment. CSD can be defined as: designing the roadway based on the existing or anticipated context that is surrounding the roadway.

In the past, street classification standards were laid out across urban areas in a manner that did not reflect the differing context types across different geographies. Roadway capacity was based primarily on anticipated traffic volumes. This created a very limited "menu" of roadway design options when planning a future roadway or even a roadway reconstruction. The purpose of Context Sensitive Design is to allow a higher degree of flexibility to be implemented in the street cross section based on two primary elements, 1) the functional classification of the existing or future street, and 2) the context surrounding the existing or future street.

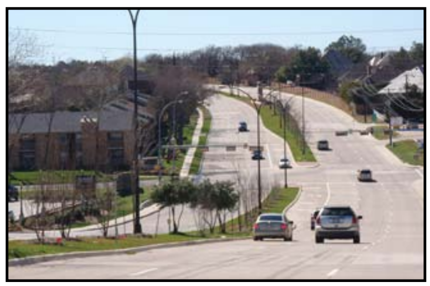
Context Sensitive Design (CSD) makes the connection between the demands of the transportation network with the form of the surrounding land uses.

3.2 Existing Functional Classification

The UNT-Dallas area consists of both existing development with businesses and residences as well as areas that anticipate future growth in the next 20 years. By using both the existing functional classification system and the street standards developed through the *forwardDallas!* Comprehensive Plan, the project team identified five different functional class types within the UNT-Dallas Study Area. These street classification types specify three main components of the street: the scale and volume capacity, number of lanes and whether there is a median. The five functional class types are:

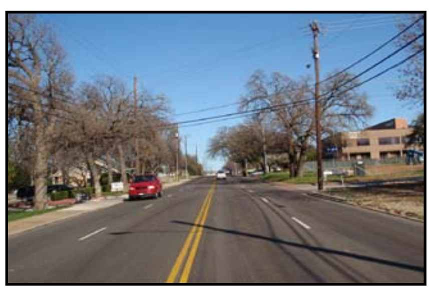
- Principal Arterial, 6 Lanes Divided
- Principal Arterial, 4 Lanes Divided
- Collector, 4 Lanes Undivided
- Collector, 2 Lanes Undivided
- Local Street, 2 Lanes Undivided

Each of these functional class types help to define the vehicle characteristics of the roadway. From these descriptions we can get a sense of the right-of-way needed for the corridor, volume capacity and the typical design speed range that would be used.



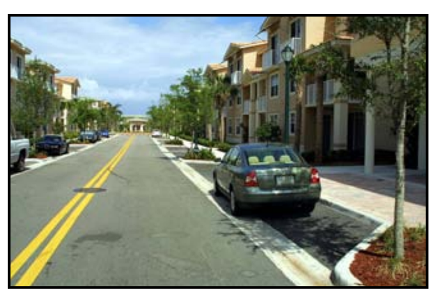
Principal Arterial,
6 Lanes Divided

Principal Arterial,
4 Lanes Divided



Collector,
4 Lanes Undivided

Collector,
2 Lanes Undivided



Local Street,
2 Lanes Undivided

3.3 Context Zones

Three broad types of future land development patterns are identified in the UNT-Dallas Area Plan (2009):

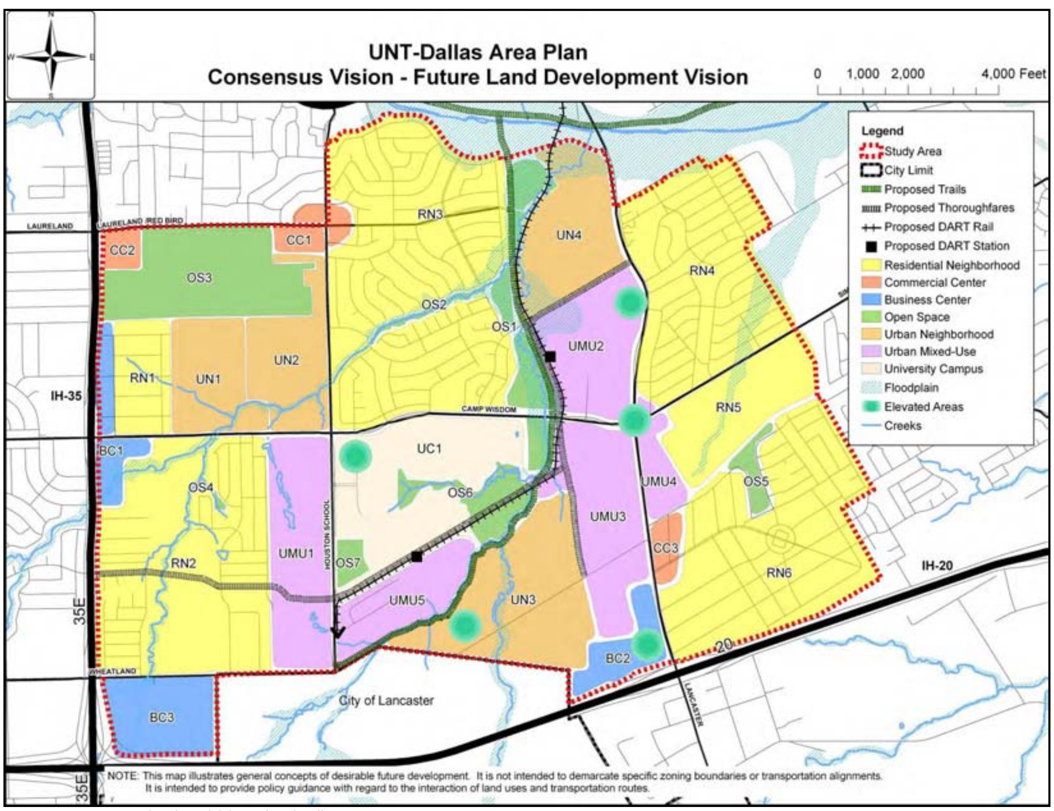
- "Walkable Mixed-Use Areas" will accommodate a range of housing choices, jobs, shopping and entertainment within easy access of each other in a pedestrian-friendly and transit-oriented environment.
- "Open Space" will provide aesthetic, leisure and recreational opportunities for the area.
- "Drivable Separate-Use Areas" will follow an already prevalent development pattern of distinct sites for housing, jobs and shopping in a manner that is inherently more dependent on vehicular transportation.

Each of these areas includes a variety of development blocks that are shown on the Future Land Development Vision Map (see figure 3.1) and described later in this section. The development blocks within each type of area share certain characteristics based on the predominant building types and transportation modes.

Walkable Mixed-Use Areas

Walkable Mixed-Use areas are urban places that allow people to live, work, shop and play in the same neighborhood. These areas accommodate a balanced mix of jobs, shopping, entertainment, and a range of housing types including affordable housing options, within convenient pedestrian access of each other. Walkable Mixed-Use areas will develop in a manner that reduces automobile dependency by enabling residents, employees and visitors to exercise other transportation choices such as public transit, bicycling and walking.

Walkable Mixed-Use Buildings



Source: Long Range Planning Division, City of Dallas

MAP 3.2

FIGURE 3.1 UNT-Dallas Area Plan, Future Land Development Vision

Urban Neighborhood

The Urban Neighborhood development blocks are portions of Walkable Mixed-Use Areas that are primarily residential with small concentrations of offices, retail, and civic uses located at key intersections or corridors. Urban neighborhoods promote a diverse choice of housing types ranging from small lot single family to townhouses, to apartments and condominiums at moderate densities (1 to 3 stories). These areas will ensure appropriate height and density transitions between existing single family neighborhoods and activity centers like the UNT-Dallas Campus and transit stations.

Urban Neighborhood Townhomes

Urban Mixed-Use

The Urban Mixed-Use development block includes low to moderate density developments, located around transit stations, placing emphasis on walking, biking and transit. There is a good mix of retail, office and residential uses. Buildings may range from mid-rise residential or commercial buildings to townhouses and small corner shops. People on foot or bike can enjoy interesting storefronts at ground level. Mixed-use buildings that allow restaurants and shopping on the lower floors and office or residential uses on the upper floors should be encouraged. The intent of the Urban Mixed-Use development block is to allow for a mix of land uses and building types. Residential uses include denser and compact development and also include live-work units. Low-density, automobile-oriented development is discouraged in these areas.

Urban Mixed-Use Buildings

University Campus

This development block is generally intended to meet the needs of universities, schools and college campuses in an urban setting. In this context, the University Campus development block applies specifically to the UNT-Dallas campus.

Urban Campus Rendering, *source: UNT-Dallas*

Open Space

The UNT-Dallas area is rich in natural beauty with an expansive canopy of mature trees, rolling hills, and creeks. Preservation of natural creeks, topography and tree coverage are a high priority. The design of future development, including roadways, light rail lines and trails, should respect these natural features in a manner that enhances economic benefits, minimizes environmental impacts and promotes public enjoyment of natural amenities. The development envisioned for the area will encourage clustered and denser development patterns that will provide opportunities to preserve and enhance tree canopy, creeks, and biodiversity and minimize impact to environmentally sensitive areas. Open spaces within the UNT-Dallas area should be accessible to the public and provide recreational and leisure opportunities. The park and trail system should be well connected to local pedestrian pathways and to transit. Parks should include amenities like benches, playground equipment, and trash receptacles.

Open Space

Drivable Separate-Use Areas

These areas follow a development pattern focusing on distinct areas for housing, jobs and shopping. They are characterized by a prevalence of parking lots and streets designed to accommodate faster-moving vehicular traffic. Opportunities for walking and bicycling are limited and mostly are confined to quieter residential streets. The auto-centric design is the common feature in these areas, but specific land use, building types, circulation and street design criterion distinguish the following Drivable Separate-Use development blocks:

Residential Neighborhoods

Residential Neighborhoods place emphasis on preserving the character of existing neighborhoods in the area. This development block focuses on promoting strong and healthy neighborhoods, a key focus of the *forwardDallas!* Plan.

Commercial Center

The primary intent of this development block is to provide retail and service destinations for the surrounding single family areas. These areas are easily accessible by car, with sufficient parking provided and are generally developed as strip commercial centers that will include service oriented businesses, restaurants, shops and smaller offices.

Business Center

The Business Center development block is intended to provide major employment and shopping destinations located at the intersection of major freeways or major arterials and are generally visible and easily accessible from the freeways. They are similar to Commercial Center development block, but are at a higher intensity. These areas allow for taller office towers, mid to high rise apartments or condominium buildings, and regional shopping malls. Generally these areas generate significant traffic, parking demand and expansive paved areas. Future development should minimize negative impacts like run-off and contribute to environmental sustainability through landscaping and energy efficient design.

Residential Neighborhood

Commercial Center

Business Center

Chapter 4 - The Plan

Two transportation plan scenarios are evaluated on the following pages (pages 16-23). These options are:

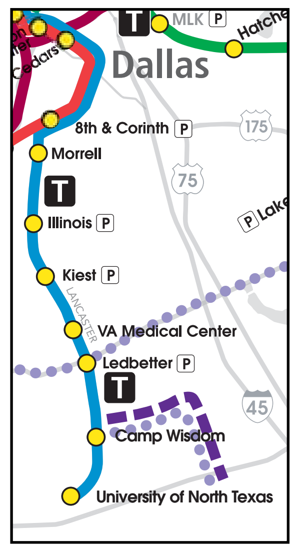
- The Shared right-of-way (R.O.W.) Option (Figure 4.1 on page 16), where transit shares the R.O.W. with DART.
- The Separated R.O.W. Option (Figures 4.2, 4.3, and 4.4 on pages 18-23), where the DART rail system uses its own separated R.O.W. from vehicular traffic. This option has three alternatives that are based on the roadway alignment south of the UNT-Dallas campus.

Transit Oriented Development

Each of the options begin with a general summarized description that differentiates it from the other options. Pros and cons are discussed for each of the options (on each of the facing pages). Lastly, each of the four options take into account all of the comments each stakeholder had in this project.

DART's Blue Line

According to DART's *2030 Transit System Plan*, the Blue Line light rail transit (LRT) will extend south from Ledbetter Station to provide transit service to the UNT-Dallas campus. It is possible that the Blue Line could continue south of the campus to service the City of Lancaster although Lancaster is not yet a DART member city. An additional spur has been considered by DART in their long range plans to accommodate transit users accessing Paul Quinn College and the International Inland Port of Dallas. There will be a suitable buffer between the Line and established single-family neighborhoods.



The Consensus Vision of *forwardDallas!* is to increase transit accessibility and to maximize opportunities for Transit-Oriented Development (TOD) around the two planned stations that will service the area. The Blue Line should successfully integrate with planned roadway and trail circulation in order to promote multi-modal accessibility and to maximize the potential for TODs.

Efforts should be made to accommodate all proposed streets and trails within the LRT R.O.W. with a goal of improving multi-modal connectivity and sharing R.O.W. Any existing bus routes servicing the area should be modified to provide accessibility to the proposed DART stations. As per the *UNT-Dallas Area Plan* (2009) and the *DART 2030 Transit System Plan*, two transit stations are in both options:

- UNT-Dallas Station - offers convenient pedestrian access to campus facilities, provides opportunities for transit-oriented development (TOD) south of the campus, and ensures vehicular access from University Hills Boulevard. Shared parking opportunities should be considered between the campus, station and other surrounding developments.
- The Camp Wisdom Station - maximizes TOD opportunities around the station while providing linkage to the trail network and open space, and vehicular access from Camp Wisdom Road. The proposed parking at the station should be shared within the TOD. The Consensus Vision also emphasizes multi-modal accessibility within the area.

Utility / Infrastructure Considerations & Impacts

Knowing where current utilities are located and where future utilities will be located may alter the transportation framework within the area.

Looking north on University Hills Blvd

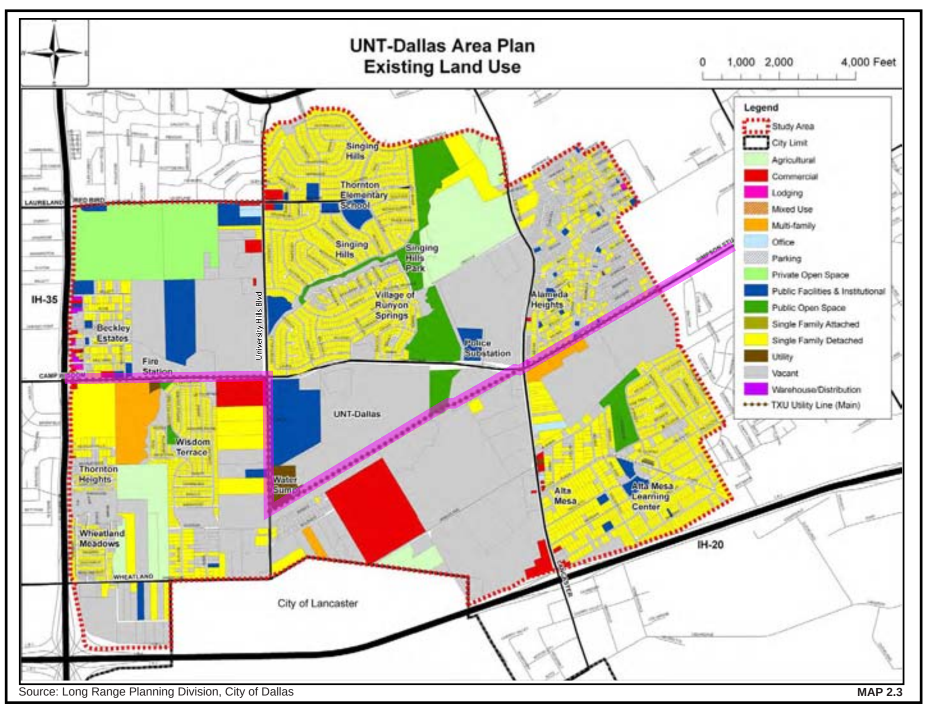
University Hills Boulevard (Houston School Road) and Camp Wisdom Road have existing utility alignments. This study proposes no R.O.W. changes on the roadways that currently have utilities located on them. There is a TXU main line (see map below) that dissects the study area from southwest to northeast, however nothing is proposed in this plan to interrupt that alignment especially since the majority of it is located within the UNT-Dallas property.

With regards to water and wastewater, Dallas Water Utilities (DWU) often crosses DART's R.O.W. to service a specific area. DWU prefers the crossing to be at a 90 degree angle and the pipe to be encased in a steel carrier pipe. In addition, DWU prefers that the centerline of the rail be 25 feet from the centerline of the pipe. The only issues will be attaining a DART permit and also meeting DART standards for construction.

In cases where the TXU/Oncor Utilities are in the vicinity of water lines, it is not common practice to run water lines parallel or inside a TXU R.O.W. because of the size and use of the lines, plus DWU's need to access the area. Also, it is rare where DWU installs new water and wastewater mains parallel to buried electric lines within TXU/Oncor easements due to limited accessibility for maintenance and potential hazardous conditions during main breaks, if any, as electrolytic corrosion may occur in the metal water pipe. In rare cases, DWU may have replaced some existing water/wastewater mains running parallel to buried electric while maintaining sufficient separation distance (minimum of five feet) within street or TxDOT R.O.W.

Another planning issue and consideration includes the placement of the LRT adjacent to the TXU/Oncor utility R.O.W., where it is contingent upon whether the R.O.W. is a designated easement (edge of the R.O.W. line) on a plat or a fee simple ownership (set back requirements from the edge of the R.O.W. line due to zoning).

Generally, in greenfield situations like the UNT-Dallas area, the rail alignment generally drives the project and the streets and utilities adapt to the rail alignment. The engineering constraints for rail guideway design (turn radii, required straight segments for stations, and grade), noise, and environmental impact are less flexible than engineering constraints on street and utility design.



TXU Main Line (Highlighted)

Transit Options and Alternative Alignments

A modern streetcar or BRT system are also viable alternatives to extending the LRT system in this area, and will be explored by DART. Table 4.1 shows general differences between each mode type, from LRT to bus.

Light Rail Transit

Streetcars

Streetcars are different than LRT systems in that they typically share existing right-of-ways, where light rail and commuter rail typically operate in designated rights of way separate from other forms of transportation. Streetcars can more easily be mixed with cars, bikes, buses, and pedestrians in a multi-modal street. Streetcars provide attractive short-trip urban circulation and help establish street life and public spaces. Similar to LRT, streetcars attract "choice" riders (those who have ready access to a car and are not transit dependent), a significant advantage over rubber-tired alternatives. Stops are spaced relatively close together, and the streetcar serves as a "pedestrian accelerator", facilitating trips that are part walking, part streetcar. Streetcars are highly visible, have easily understood routes and the vehicles add to the area's vibrancy.

Street Car

Streetcar systems are less expensive to build and operate than LRT systems. Infrastructure can be more simple to introduce than it's light rail counterpart, consistent with the lower speeds that it experiences and circulator function. Because it is easily integrated into the built environment, streetcars cost significantly less per mile than LRT.

Bus Rapid Transit

Bus Rapid Transit (BRT)

BRT combines some aspects of rail transit systems with the flexibility of buses. It can operate on exclusive transit ways, high occupancy vehicle (HOV) lanes, expressways, or ordinary streets. Compared to typical diesel bus transit systems, a BRT system offers potential advantages by combining priority transit lanes, alternative fuel technology, cleaner and quieter operation, rapid and convenient fare collection, and integration with land-use policy. BRT is also significantly less per mile than LRT.

	Mode			
	LRT	Street Car	BRT	Bus
Travel Function	Local/Regional	Local	Local/Regional	Local
Market Urban	Urban/suburban	Urban/District	Urban/Suburban	Urban/Suburban
Power System	Overhead Electric	Overhead Electric	Diesel or Electric	Diesel or Electric
Station Spacing	.5 to 1.5 miles	500'-1000'	.5 to 1.5 miles	500'-1000'
Development Incentive	Significant	Significant	Minimal	Minimal
Passenger Capacity	120 to 150	105 to 110	60 to 90	60 to 90
Capital $/mile	$90m-$300m	$45m-$90m	< $500k	< $500k
Operating $/ hour	$167	$122	$80-$90	$80-$90

Table 4.1 Typical Mode Comparisons

4.1 Shared R.O.W. Option

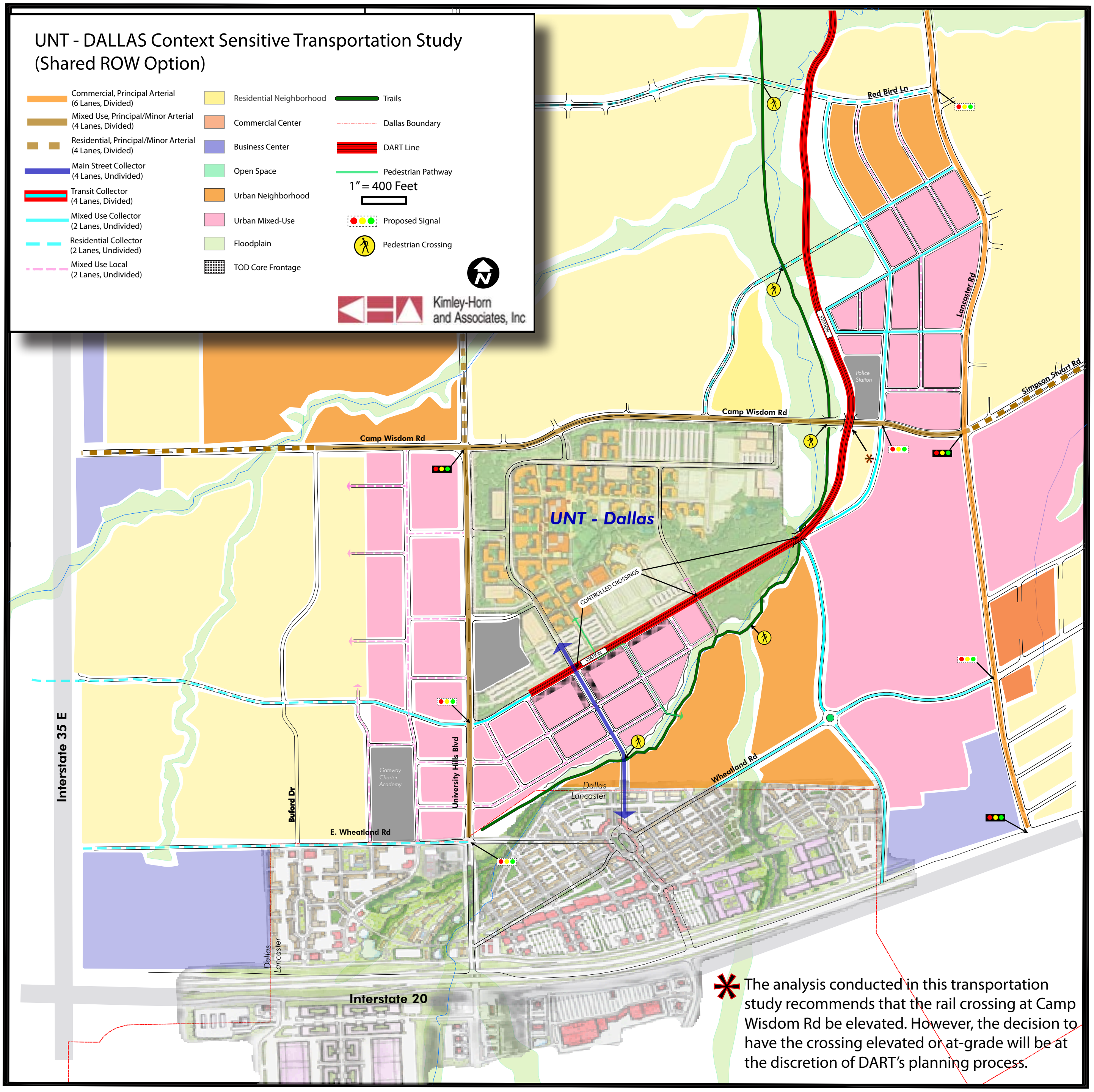


FIGURE 4.1 Shared R.O.W. Option (Transit Shares Roadway with Vehicles)

Summary:

- Transit shares the R.O.W. with vehicles in two segments containing the transit stations near the UNT-Dallas campus and the Camp Wisdom TOD.
- Camp Wisdom rail alignment and station location shares the R.O.W. with the mixed use collector for a short distance opposed to the entire length of the Camp Wisdom TOD.
- UNT-Dallas TOD development frontage is on the transit collector opposed to backing onto the collector.
- The mixed use collector is aligned on both sides of University Hills Blvd south of the UNT-Dallas TOD.
- In cases where the transit line crosses floodplains, these transit line sections will be elevated, while roads run underneath.

ISSUE	SHARED R.O.W.	
	PROS	CONS
Consistency with Existing Plans	Compatible with UNT-Dallas Area Plan vision Compatible with City's Strategic Opportunity Area goals of encouraging a vibrant mixed use within easy walking distance of the UNT DART transit station	Not consistent with UNT-Dallas Campus Master Plan 2005, which displays the DART rail in a separate R.O.W. from the adjacent street
Development Potential	**UNT Station:** Provides TOD focus to be right at the location of the transit station opposed to a block away	**UNT Station:** Of the focus area, half of the land area within the ¼ mile walking radius will be on the UNT – Dallas side of the rail line Allowing for half of the most prime TOD land to be on the UNT-Dallas Campus reduces the ability for the city to gather the highest value in property tax revenue. (20% decrease in prime frontage when the collector is within the same R.O.W. as the transit corridor)
Land Use Impacts	**UNT Station:** Potential to reduce the barrier between the TOD and the UNT-Dallas Campus to provide a vibrant university district that promotes the goals of the UNT-Dallas Area Plan	**UNT Station:** See Development Potential
Parking	Allows for on-street parallel parking along transit collector.	None Identified
Pedestrian and Bike Connections	**UNT Station:** Distance between the TOD south of the campus and the UNT-Dallas Campus is much shorter in the Shared R.O.W. than in the Separated R.O.W. option. Pedestrian need to cross only one roadway 82' - 118' curb face to curb face, opposed to two roadways and a transit guideway in the separated options.	None Identified
Rail Transit Issues	Having the rail alignment in the center of the roadway makes it more simple to provide right-turning movements at each of the intersections (Rail alignment and station location moved 500' west allow for the transit to be separated between the UNT-Dallas and Camp Wisdom areas while maintaining Shared R.O.W. at the station locations)	Left turn movements can only be allowed at signalized intersections to eliminate possible conflicts with rail traffic.
ROW Access Issues and Costs	Less R.O.W. required to be purchased by City if collector shares the same R.O.W. as the rail allowing for more efficient use of space. The Camp Wisdom TOD requires the same amount of ROW in both alternatives	None Identified
Street Connectivity	The well-connected network assists in both the traffic operations and the pedestrian and bicycle flow throughout the study area. Improved vehicle connectivity between the UNT TOD and the UNT Campus. Kirnwood extension will be continous all the way to I-35. Good access to the neighborhoods west of University Hills Blvd.	None Identified
Traffic Operations	Signal spacing between the transit collector and Wheatland is 1800' which is sufficient (greater than 1320') to promote efficient signal timing on University Hills Blvd.	Left turn lanes may need to be separate from the main through lanes on the transit collector requiring additional ROW at intersections for left turn movements
Utilities	No R.O.W. is proposed to be acquired on existing thoroughfares for expansion. The current alignment of utilities both overhead and underground will have to be analyzed when future development occurs both on University Hills Blvd and Camp Wisdom Rd.	Difficulties in placing transit utilities in the Shared R.O.W. option is based on limited R.O.W. on the corridor and potential setback requirements that are entended to maintain an urban environment. DART maintains that a shared R.O.W. option will be more costly to provide transit utilities as discussed in the PMT meetings

4.2 Separated R.O.W. Option

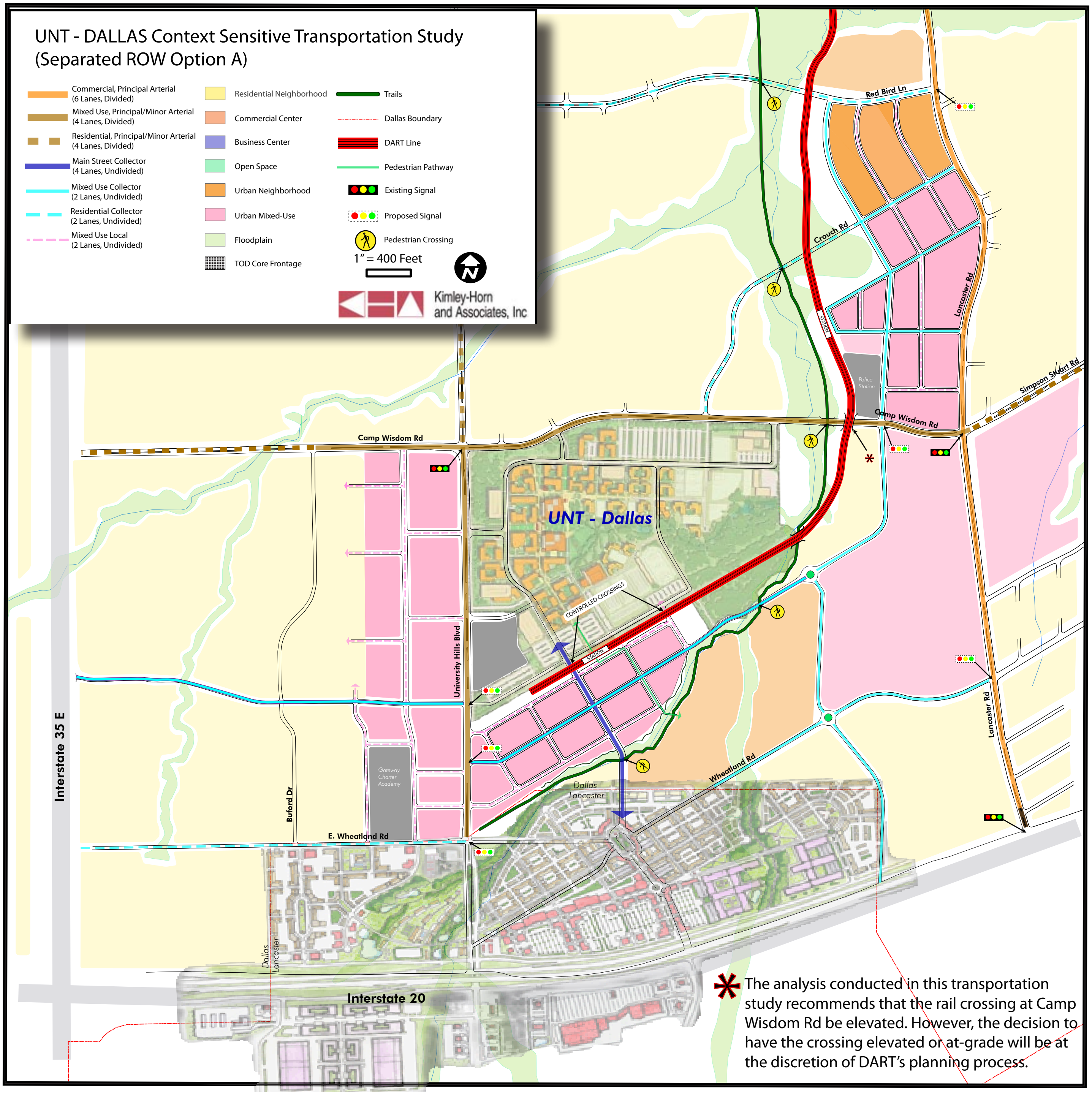


FIGURE 4.2 Separated R.O.W. Option A (Transit is Separated Throughout)

Summary:

- Transit R.O.W. is separated from vehicular trafficт throughout.
- Although the primary intersection of the UNT-Dallas TOD is 500' south of the rail alignment, the development adjacent to the alignment still fronts the local road it may just have less value to private developers as a result of the lack of traffic volume that is present as compared to the traffic on the mixed use collector.
- The mixed use collector south of the UNT-Dallas campus is not aligned and therefore creates additional turning movements on University Hills Blvd.
- The mixed use collector south of the UNT-Dallas campus is aligned 500' parallel to the DART R.O.W.

ISSUE	*SEPARATED R.O.W.OPTION 'A'*	
	PROS	**CONS**
Consistency with Existing Plans	Compatible with DART stated objectives.	Not compatible with City's adopted UNT-Dallas Area Plan 2009.
Development Potential	**UNT Station:** Development potential is higher in the area where the main street collector intersects with the mixed use collector. All four-corners are developable and provide increased tax revenue. (25% increase in prime frontage when collector is not abutting the transit corridor). The TOD intersection is only 500' away from UNT-Dallas Station which is inside of the ¼ mile walking shed.	**UNT Station:** Retail and services are located further from campus boundary.
Land Use Impacts	**UNT Station:** Provides a collector separated from the campus which allows increased private development potential along the mixed use collector.	None Identified
Parking	Due to the separation of the road and the rail alignment, parking and parking access will be simplified on the UNT TOD side of the rail R.O.W. This is due to the lack of median as a result of the transit alignment in the Shared R.O.W. option.	None Identified
Pedestrian and Bike Connections	Reduces bike and pedestrian conflicts with rail vehicles in mixed-flow. Rail R.O.W. in the separated alternative provides an opportunity to have an adjacent hike and bike trail paralleling within the rail R.O.W.	**UNT Station:** Pedestrians need to cross two roads and one double-track rail line to travel from the TOD to the Campus. This can add up to a distance of at least 300' including the rail R.O.W. and the two roadways.
Rail Transit Issues	Can accommodate larger numbers of pedestrians at the stations during peak times as a result of not being in situations of limited R.O.W. There is much more room for platform expansion when the rail alignment is in a separated function. Lack of vehicle and traffic interruptions, as can be found in the Shared R.O.W. option, can increase the efficiency and travel time for transit users.	The Camp Wisdom station is separated from the center of the TOD which allows for fewer TOD residences and businesses to be located within the ¼ mile walking shed. This can result in fewer ridership numbers as opposed to the station being more centrally located.
ROW Access Issues and Costs	None Identified	At least an additional 100' of R.O.W. required paralleling the UNT-Dallas TOD to provide for the mixed use collector.
Street Connectivity	The well-connected network assists in both the traffic operations and the pedestrian and bicycle flow throughout the study area.	Poor connectivity of the mixed use collector between the UNT-Dallas TOD and the neighborhoods west of University Hills Blvd. It does not provide clear through road on Kirnwood from the TOD to IH 35.
Traffic Operations	Signalized intersection at University Hills Blvd and the mixed use collector provides the best access for buses to access the north side of the UNT station.	Signal spacing on University Hills Blvd is not preferable to maintain efficient signal timing. The distance between Wheatland Rd and eastbound mixed use collector is 1200' and the distance between eastbound mixed use collector and westboun kirnwood is 900'. Ideal spacing is 1320' and less than 800' is not feasible. Disconnected collector requires a right turn and left turn at University Hills Blvd to access the TOD from the neighborhoods west of University Hills Blvd. Potential for cut-through traffic on the north side of the station to access the TOD south of the UNT-Dallas Campus.
Utilities	Available R.O.W. to place necessary transit utility infrastructure along the transit corridor.	None Identified

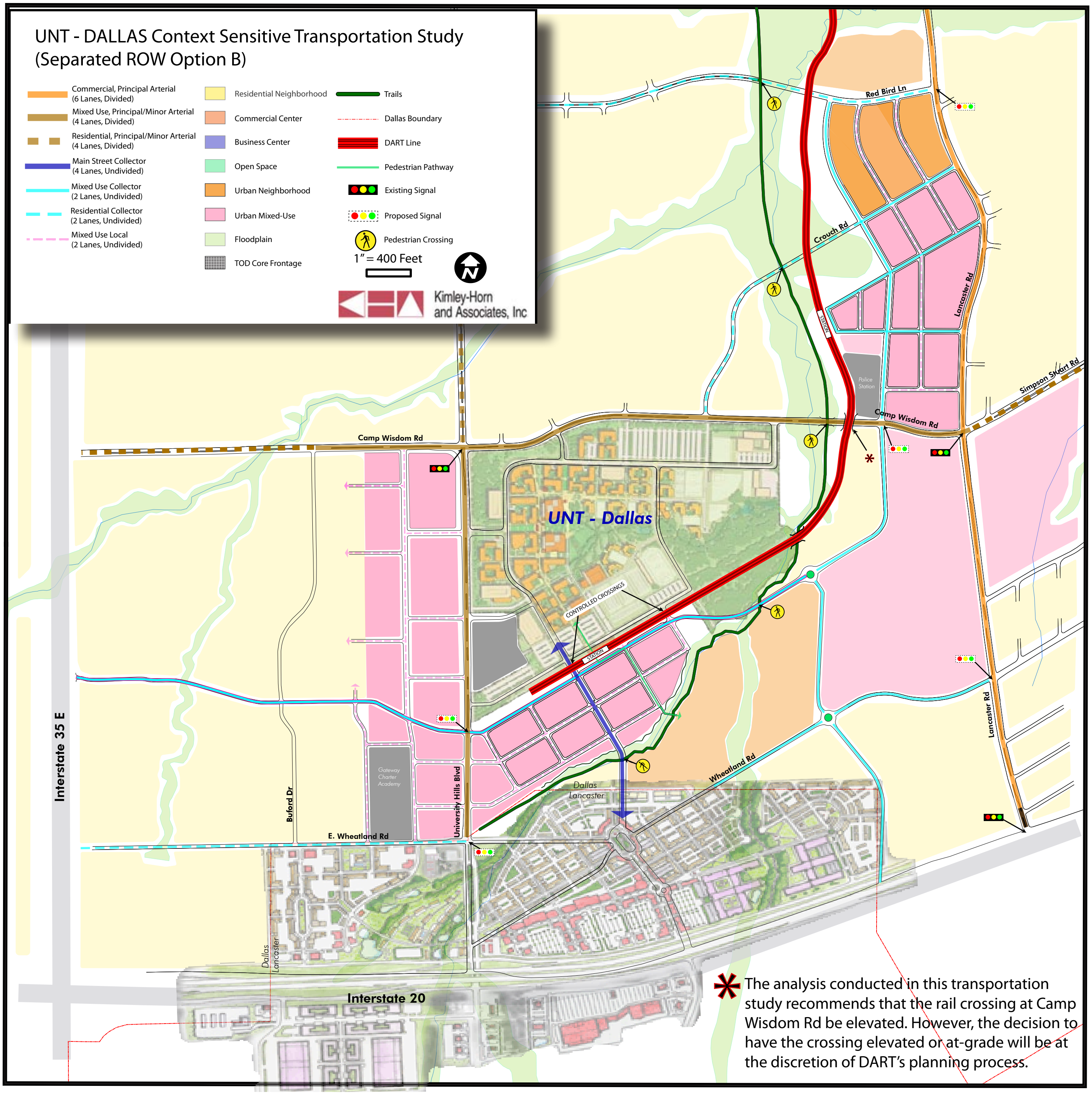


FIGURE 4.3 Separated R.O.W. Option B (Transit is Separated Throughout)

Summary:

- Transit R.O.W. is separated from vehicular trafficт throughout.
- The mixed use collector is aligned on both sides of University Hills Blvd south of the UNT-Dallas TOD.
- The mixed use collector south of the UNT-Dallas Campus parallels the DART R.O.W.
- UNT-Dallas TOD development frontage is on the transit collector opposed to backing onto the collector.

ISSUE	*SEPARATED R.O.W.OPTION 'B'*	
	PROS	**CONS**
Consistency with Existing Plans	Compatible with DART stated objectives.	Not compatible with City's adopted UNT-Dallas Area Plan 2009.
Development Potential	**UNT Station:** Provides TOD focus to be at the location of the transit station opposed to a block away. This can increase the value of the properties fronting the mixed use collector adjacent to the rail corridor.	**UNT Station:** In the focus area, half of the land area within the ¼ mile walking radius will be on the UNT – Dallas side of the rail line (20% decrease in prime frontage when the collector is abutting the transit corridor) resulting in the potential of capturing less tax revenue.
Land Use Impacts	**UNT Station:** See Development Potential	None Identified
Parking	More simplified access to on-street parking as a result of the separation of the road and the rail.	None Identified
Pedestrian and Bike Connections	R.O.W. for the separated alternative provides an opportunity to have an adjacent hike and bike trail. Reduces bike and pedestrian conflicts with rail vehicles in mixed-flow. Increased R.O.W. available for Bike Lanes.	**UNT Station:** Pedestrians need to cross two roads and one double-track rail line to travel from the TOD to the Campus.
Rail Transit Issues	Can accommodate larger numbers of pedestrians at the stations during peak times as a result of not being in situations of limited R.O.W. There is much more room for platform expansion when the rail alignment is in a separated function. Lack of vehicle and traffic interruptions, as can be found in the Shared R.O.W. option, can increase the efficiency and travel time for transit users.	The Camp Wisdom station is separated from the center of the TOD which allows for fewer TOD residences and businesses to be located within the ¼ mile walking shed. This can result in fewer ridership numbers as opposed to the station being more centrally located.
ROW Access Issues and Costs		At least an additional 100' of ROW required adjacent to the UNT TOD or on a parallel facility.
Street Connectivity	The well-connected network assists in both the traffic operations and the pedestrian and bicycle flow throughout the study area. Good connectivity to the neighborhoods west of University Hills Blvd and to IH 35	None Identified
Traffic Operations	None Identified	Eliminates signal access on the north side of the UNT-Dallas station area which makes it difficult for buses to make left-turns onto University Hills Blvd to travel southbound.
Utilities	Available R.O.W. to place necessary transit utility infrastructure along the transit corridor.	None Identified

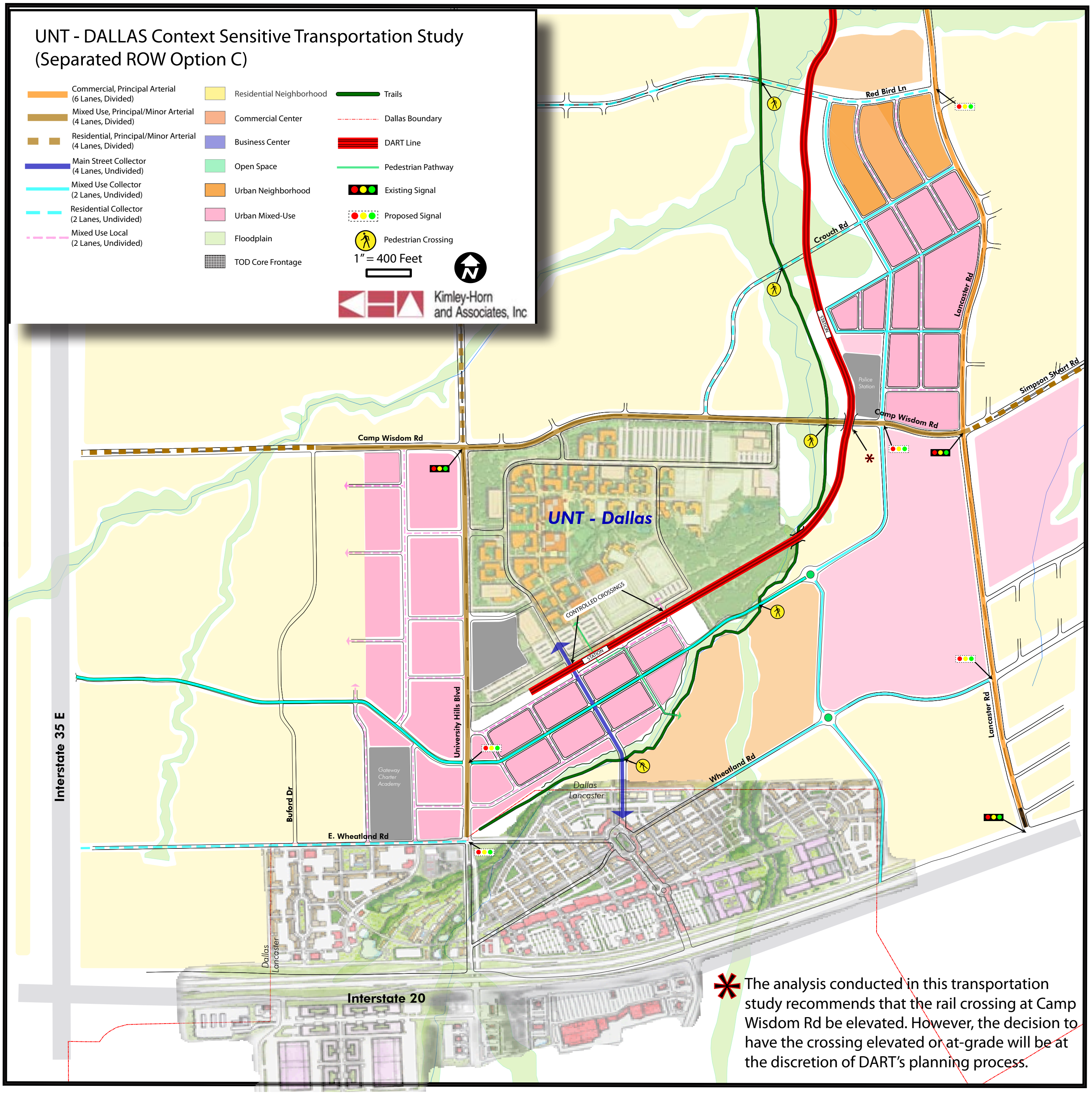


FIGURE 4.4 Separated R.O.W. Option C (Transit is Separated Throughout)

Summary:

- Transit R.O.W. is separated from vehicular traffict throughout.
- The mixed use collector is aligned on both sides of University Hills Blvd south of the UNT-Dallas TOD.
- The mixed use collector south of the UNT-Dallas Campus is aligned 500' parallel to the DART R.O.W. allowing for an additional development block between the rail and the mixed use collector.

ISSUE	*SEPARATED R.O.W.OPTION 'C'*	
	PROS	**CONS**
Consistency with Existing Plans	Compatible with DART stated objectives	Not compatible with City's adopted UNT-Dallas Area Plan 2009.
Development Potential	**UNT Station:** Development potential is high in the area where the Main Street Collector intersects with the Mixed Use Collector. All four-corners are developable and provide increased tax revenue (25% increase in prime frontage when collector is not abutting the transit corridor) The TOD intersection is only 500' away from UNT Station.	**UNT Station:** Retail and services placed further from campus boundary
Land Use Impacts	**UNT Station:** Provides a collector separated from the campus which allows increased private development potential along the mixed use collector.	**UNT Station:** Land uses not served in one corridor by all modes – may become an auto-dependent TOD.
Parking	More simplified access to on-street parking as a result of the separation of the road and the rail.	None Identified
Pedestrian and Bike Connections	Reduces bike and pedestrian conflicts with rail vehicles in mixed-flow. Rail R.O.W. in the separated alternative provides an opportunity to have an adjacent hike and bike trail paralleling within the rail R.O.W.	**UNT Station:** Pedestrians need to cross two roads and one double-track rail line to travel from the TOD to the Campus.
Rail Transit Issues	Can accommodate larger numbers of pedestrians at the stations during peak times as a result of not being in situations of limited R.O.W. There is much more room for platform expansion when the rail alignment is in a separated function. Lack of vehicle and traffic interruptions, as can be found in the Shared R.O.W. option, can increase the efficiency and travel time for transit users.	The Camp Wisdom station is separated from the center of the TOD which allows for fewer TOD residences and businesses to be located within the ¼ mile walking shed. This can result in fewer ridership numbers as opposed to the station being more centrally located.
ROW Access Issues and Costs	None Identified	At least an additional 100' of R.O.W. required paralleling the UNT-Dallas TOD to provide for the mixed use collector.
Street Connectivity	The well-connected network assists in both the traffic operations and the pedestrian and bicycle flow throughout the study area. Good connectivity to the neighborhoods west of University Hills Blvd.	None Identified
Traffic Operations	None Identified	Eliminates signal access on the north side of the UNT-Dallas station area which makes it difficult for buses to make left-turns onto University Hills Blvd to travel southbound.
Utilities	Available R.O.W. to place necessary transit utility infrastructure along the transit corridor.	None Identified

4.3 Bike and Pedestrian Recommendations

Figure 4.5 illustrates a combination of both the Draft Dallas Bike Plan as well as this study's recommendations. The 2011 Dallas Bike Plan will provide substantial connectivity for bicyclists [and pedestrians] a variety of bicycle facilities including: bike lanes, cycle tracks and buffered bike lanes, shared lane markings (aka "sharrows") and shared use paths (accessible to all non-motorized forms of transportation). Descriptions for each type of facility are given on the following page.

The City of Dallas Trail Network plan includes the Five Mile Creek Trail, which is being recommended for expansion to provide convenient access to destinations in the UNT-Dallas area for pedestrians and bicyclists. The trail network expansion proposed is consistent with the *City of Dallas Trail Master Plan*. The trail network for the area should be contiguous and provide connectivity to significant destinations in the area including the Regional Veloweb trail system. Overall, this network will promote non-motorized transportation modes throughout the UNT-Dallas area, and offers and opportunity to effectively reduce the amount of motorized vehicular traffic in the area.

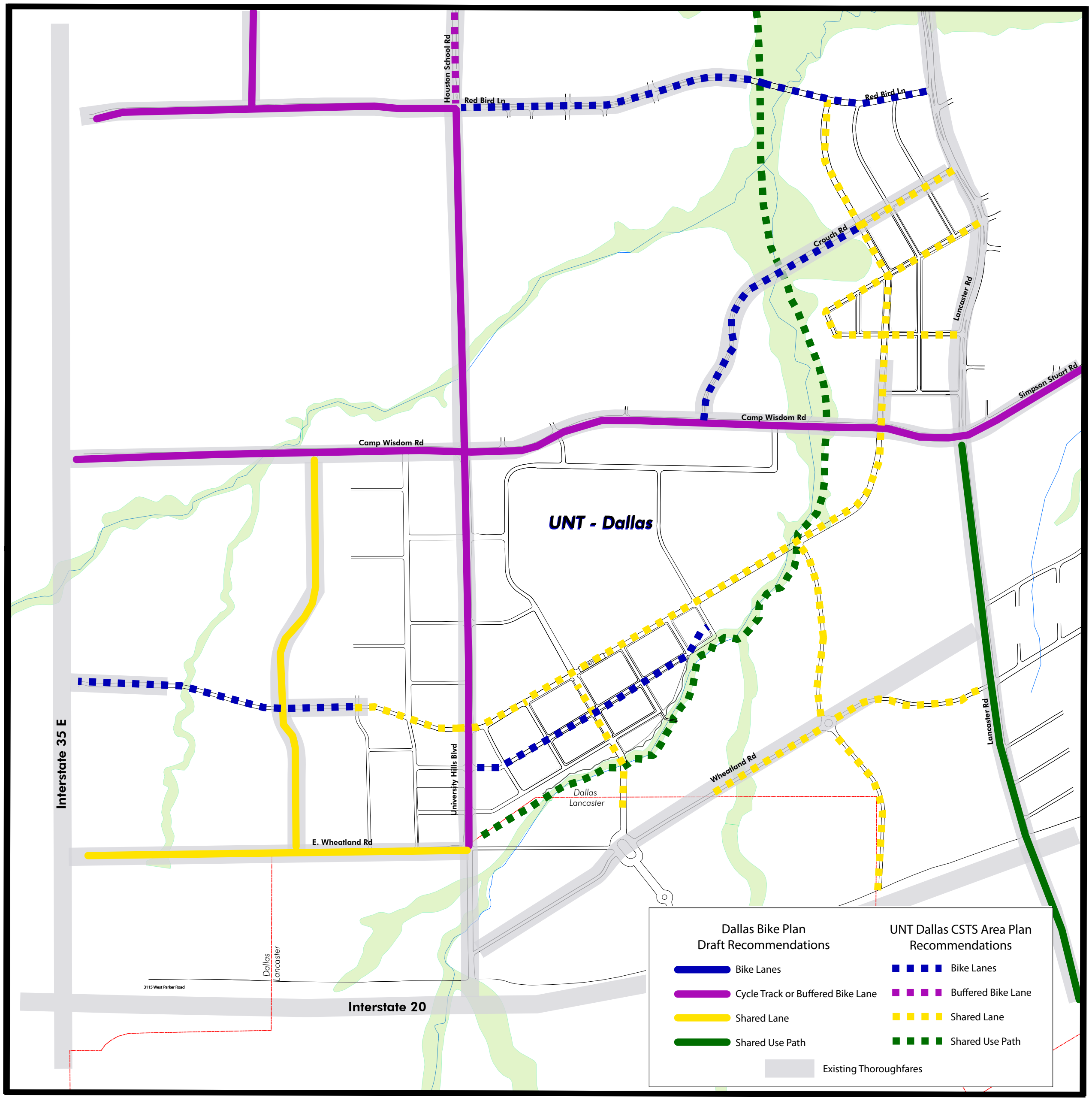


FIGURE 4.5 2011 Dallas Bike Plan and UNT Dallas CSTS Recommendations

Bike Lanes

A portion of a roadway which has been designated by pavement markings and, if used, signs, for the preferential or exclusive use of bicyclists. (AASHTO Guide for the Development of Bicycle Facilities)

Buffered Bike Lane

A bike lane that is separated from a travel lane or parking lane by a space of two or more feet (typically up to five feet). It is always one way and is buffered by cross-hatched pavement marking, and if used, a sign for the exlusive use of bicyclists. (2011 Dallas Bike Plan Addendum)

Shared Use Path

A bikeway physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way. Shared use paths may also be used by pedestrians, skaters, wheelchair users, joggers and other non-motorized users. (AASHTO Guide for the Development of Bicycle Facilities)

Shared Lane/Markings

Shared Lane: A lane of a traveled way that is open to bicycle travel and vehicular use. Shared Lane Marking: A pavement symbol that indicates an appropriate bicycle positioning in a shared lane. (AASHTO Guide for the Development of Bicycle Facilities)

4.4 Design Elements

The design elements of the CSTS are based on the design standards within the transportation element of '*forwardDallas!*'. As previously mentioned, street design has historically focused only on the area located between curbs and centering design criteria around automobile usage. However, the emerging practice emphasizes other aspects of the street in addition to the traveled way. It is important to note that there should be flexibility of ROW width in both the streetside (pedestrian) and context realms to allow for development/construction of these elements on private property, therefore limiting direct public acquisition of ROW for new or redeveloped travel way (thoroughfares). For example, pedestrian and bicycle infrastructure is beginning to be implemented more frequently in neighborhoods to encourage a healthy lifestyle, as well as in more commercial locations to spur increased economic development in a pedestrian-friendly environment. A number of examples exist in Dallas where important commercial streets place a high value on pedestrian travel, such as Knox-Henderson, Bishop Arts District, and West Village.

When planning future thoroughfares, it is essential to identify all aspects of the corridor in order to maximize multi-modal efficiency of the roadway system and the value of the surrounding property. Three separate realms are identified within the CSTS that should be taken into consideration when planning for roadways. These realms are the travel way realm, the streetside (pedestrian) realm and the context realm as shown in Figure 4.6.

Each of the realms are also identified in Figure 5.1 (page 37). Flexibility is enabled in the design matrix to allow developers and roadway designers to adapt their vision of the focus corridor to the UNT-Dallas Area Plan.

Intersection design examples are illustrated in figures 4.20, 4.21, and 4.22 on pages 41-42. Information on roundabouts is provided by the Federal Highway Administration (FHWA) Appendix E.

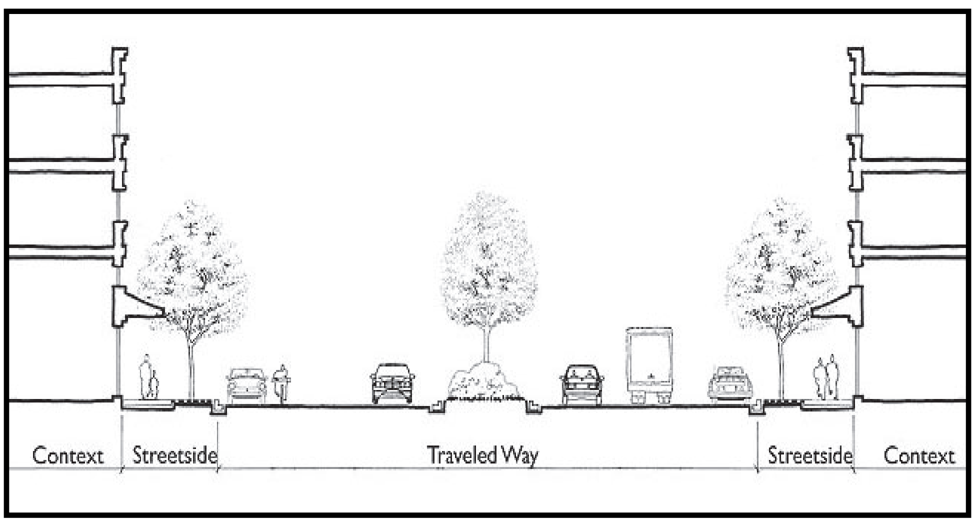


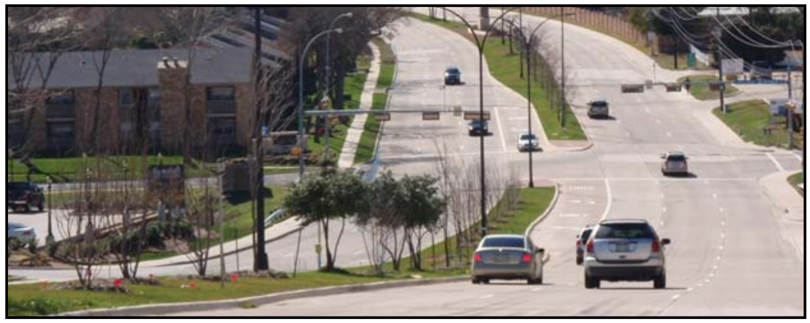
FIGURE 4.6. Anatomy of the Street. Source: Community, Design + Architecture

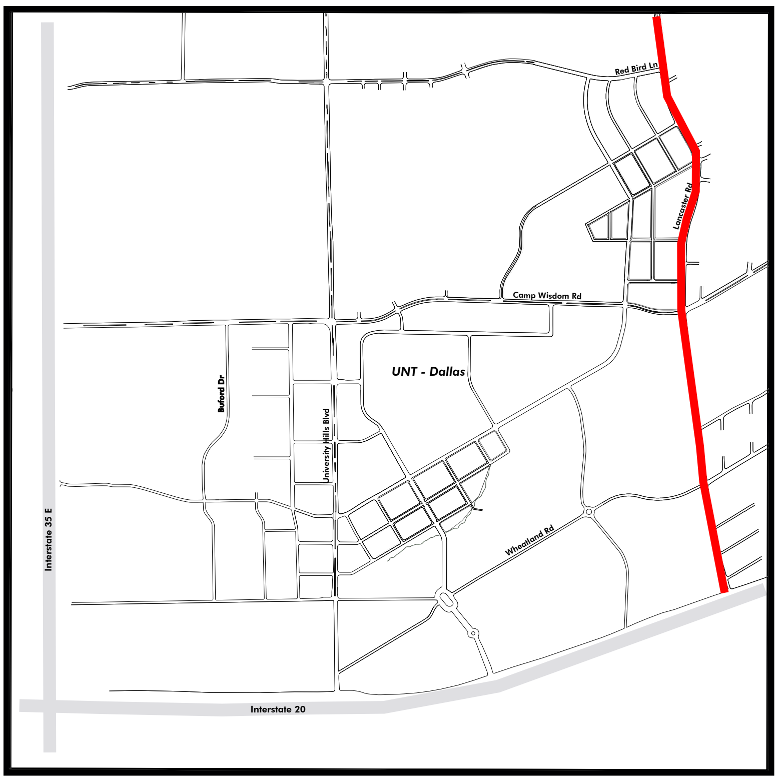
Commercial Principal Arterials

Commercial principal arterials as illustrated in Figure 4.7, serve the UNT-Dallas area with the highest capacity thoroughfares (excluding freeways). They are designed to accommodate six lanes of traffic, wide enough to support personal vehicles and commuter vehicles through commercial corridors. These roadways are always divided and speed limits tend to be higher than collectors and local roadways.

Priority elements:

- Number of travel lanes and travel lane width
- *Medians (preferably landscaped)*
- Wide sidewalks





Recommendation

R.O.W.: 107'

Operating Speed: 45 MPH

Parking: N/A

Number of Vehicular Lanes: 6

Number of Bike Lanes: N/A

Curb Radius: 20'

Landscape Type: Street Trees

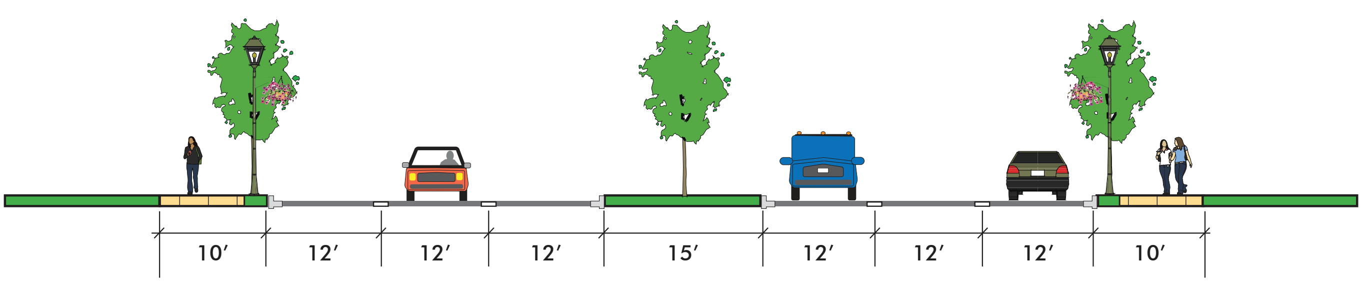


*FIGURE 4.7 Commercial Principal Arterial Example**

**Note that flexibility is encouraged for allowing elements such as wide sidewalks and on-street or street-adjacent parking to be placed on private property. A range of ROW is accordingly recommended.*

Mixed-Use and Residential, Principal / Minor Arterial

Mixed-use and residential, principal/minor arterials (Figures 4.8 and 4.9, respectively), are versatile in accommodating many travel choices including personal vehicles, pedestrians, bus and bicycle travel. Mixed-use streets are located in high intensity mixed-use commercial, retail and residential areas with substantial pedestrian activity. These streets are attractive for bicyclists and pedestrians alike due to their aesthetic attractiveness such as manicured medians, trees, lawns, and/or façades, while increasing safety of travelers due to reduced speeds.

Additionally, mixed-use and residential, principal/minor arterials can have on-street parking and wide sidewalks. Bike lanes, landscaping and sidewalks are higher priorities than the number of travel lanes of this street-type. Frontages may provide comfortable and safe refuge for pedestrians while accommodating vehicles with efficient circulation and consolidated-shared parking.

Priority elements:

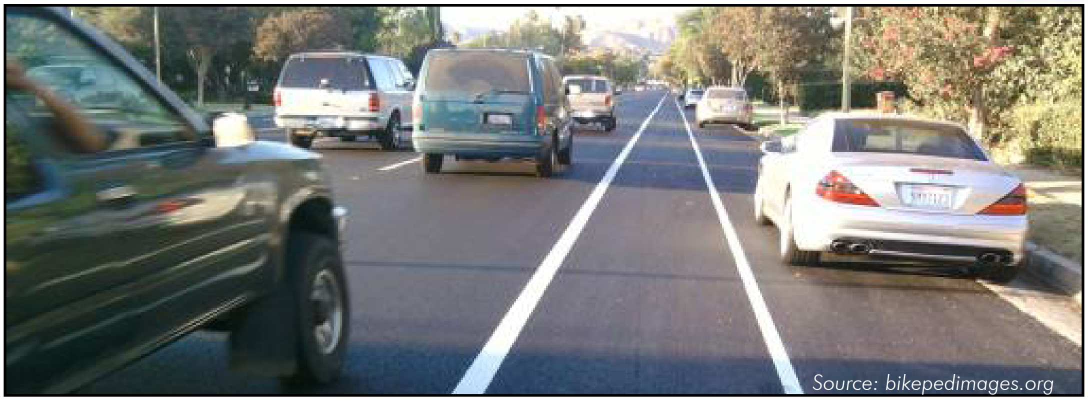
- Transit priority at intersections
- Wide sidewalks with access to transit service
- Bicycle lanes and cycle tracks on designated bike routes
- Bicycle facilities
- Tree Lawns
- On-street parking

Secondary elements:

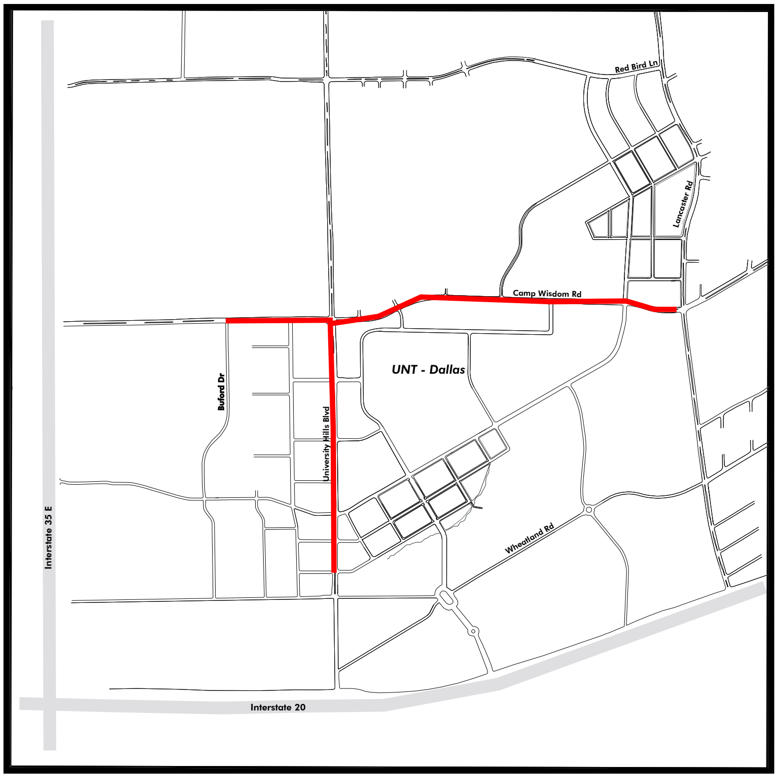
- Number of travel lanes and travel lane width
- Medians for residential streets

Examples of traffic management features:

- *Landscaped medians*
- *On-street parking*
- *Street trees*
- *Traffic circles and roundabouts*
- *Reduced pedestrian crossing distances at intersections, using curb extensions, traffic islands, and other measures*



Example Mixed-Use Principal/Minor Arterial



Recommendation

R.O.W.: 107′

Operating Speed: 30-35 MPH

Parking: Parallel (7′)

Number of Vehicular Lanes: 4

Number of Bike Lanes: 2 (5′)

Curb Radius: 20′

Landscape Type: Tree Wells

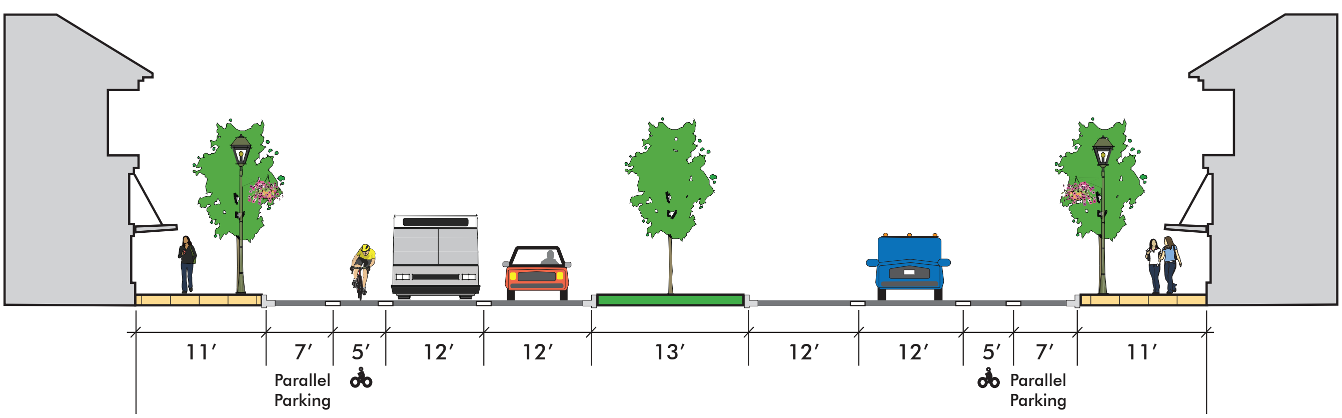


*FIGURE 4.8 Mixed-Use Principal/Minor Arterial Example**

**Note that flexibility is encouraged for allowing elements such as wide sidewalks and on-street or street-adjacent parking to be placed on private property. A range of ROW is accordingly recommended.*

Example Residential Principal/Minor Arterial

Recommendation

R.O.W.: 107′

Operating Speed: 30-35 MPH

Parking: N/A

Number of Vehicular Lanes: 4

Number of Bike Lanes: 2 Buffered (6′)

Curb Radius: 20′

Landscape Type: Grass Strip

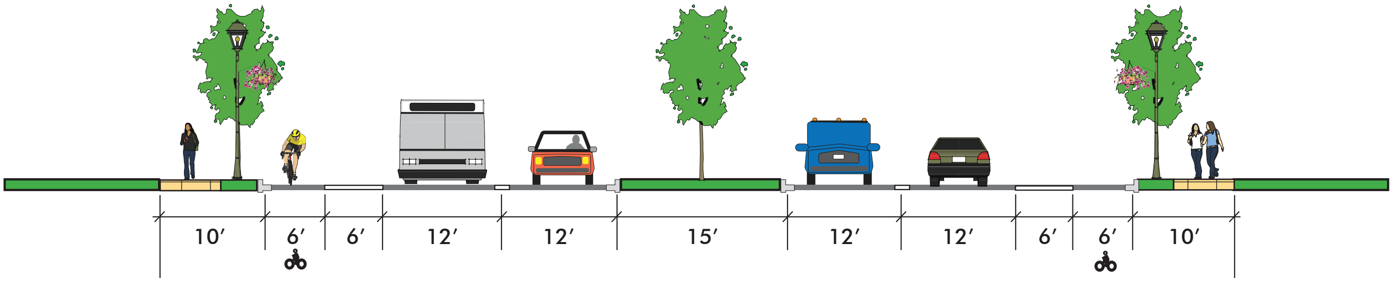


*FIGURE 4.9 Residential Principal Minor Arterial Example**

**Note that flexibility is encouraged for allowing elements such as wide sidewalks and on-street or street-adjacent parking to be placed on private property. A range of ROW is accordingly recommended.*

Main Street Collector

Main street collectors, illustrated in Figure 4.10, serve the highest intensity retail centers and mixed land uses. Like mixed-use streets, main streets are designed to promote walking, bicycling, and transit within an attractive landscaped corridor. In general, a main street may encompass two to eight blocks, but may extend further, depending on the type of adjacent land uses and the area served.

Main streets pertaining to the UNT-Dallas study area are designed with four travel lanes. On-street parking is usually provided to serve adjacent land uses. Unlike typical strip commercial developments, main streets offer the ability to park-once and walk among various destinations, thus reducing arterial trip making. Convenient on-street parking is key for main streets.

Within the parking lane, tree wells may be used to create a double row of street trees in combination with a tree lawn. To further create a pedestrian-friendly atmosphere, main streets have wide sidewalks, street furniture, outdoor cafes, plazas, and other public spaces.

Priority elements:

- Wide sidewalks
- Bicycle facilities
- Curb extensions
- Tree lawns
- On-street parking

Secondary elements:

- Medians
- Number of travel lanes and travel lane width

Examples of traffic management features:

- *Tree planters in parking lane*
- *On-street parking*
- *Narrower travel lanes*
- *Alternative paving material*
- *Reduced pedestrian crossing distances at intersections, using curb extensions, traffic islands, and other measures*
- *Raised intersections*
- *High-visibility crosswalks*

Example Main Street Collectors

<u>Recommendation</u>

R.O.W.: 44' - 110'

Operating Speed: 25 MPH

Parking: Angled (18')

Number of Vehicular Lanes: 4

Number of Bike Lanes: N/A

Curb Radius: 20'

Landscape Type: Street Trees

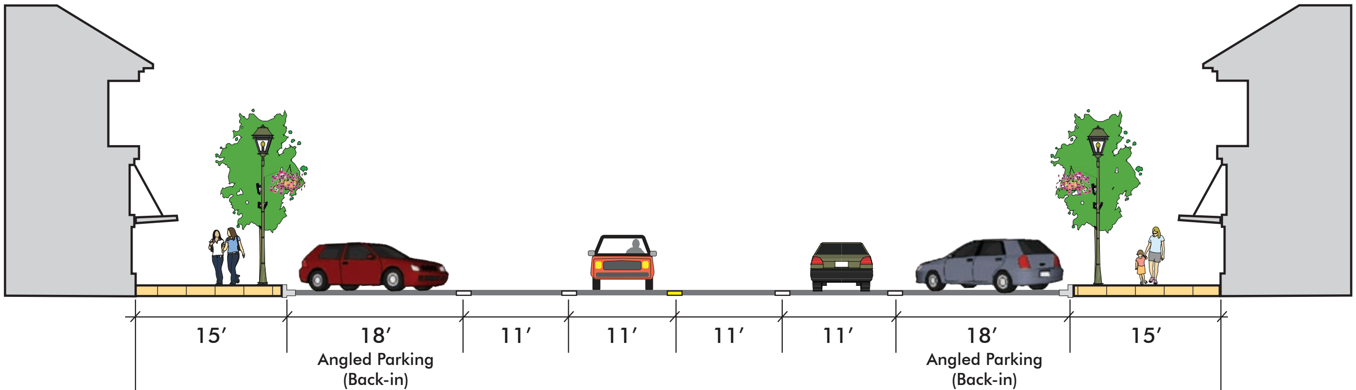


*FIGURE 4.10 Main Street Collector Example**

Residential/Mixed-Use Collectors

Residential and mixed-use collector streets (Figures 4.11, 4.12, respectively) go a long way in strengthening neighborhood cohesion, promoting alternative transportation, calming traffic, and connecting recreational destinations. These streets are typically applied in two instances: in new residential neighborhoods, or as a retrofit in existing residential or downtown street.

Residential and mixed-use collectors tend to be more pedestrian-oriented than commuter streets, utilizing landscaped medians, tree lawns, sidewalks, on-street parking, and bicycle lanes when possible.

Lastly, residential and mixed-use collectors consist of two to four travel lanes and place a much higher priority on pedestrian and bicycle-accessibility than on auto mobility. These streets can have local access to transit service to provide access to nearby transit facilities that connect to the entire metropolitan area.

Priority elements:

- Sidewalks
- Tree lawns
- On-street parking
- Bike lanes on designated bicycle routes
- Landscaped medians

Secondary elements:

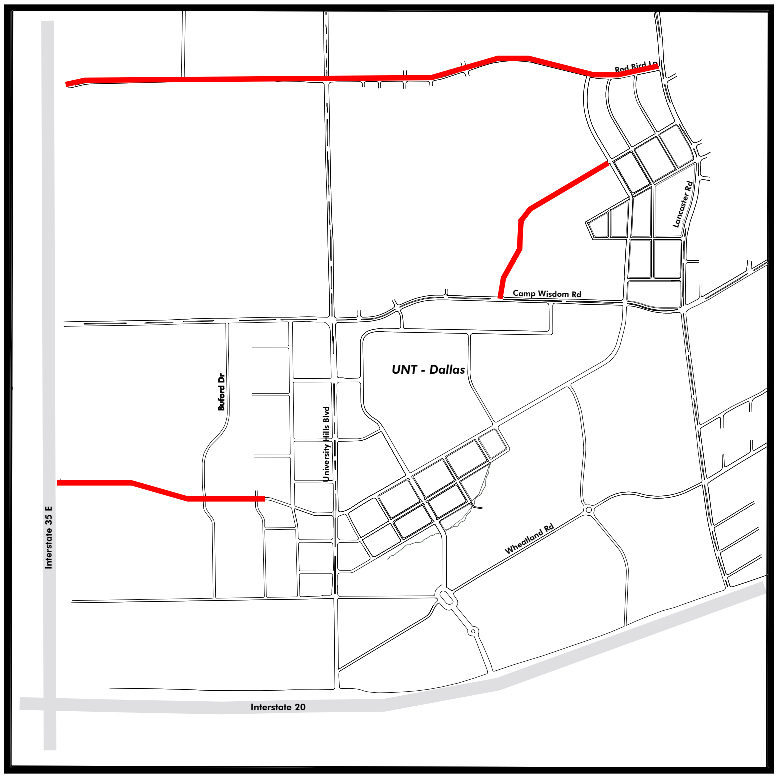
- Number of travel lanes and travel lane width

Examples of traffic management features:

- *On-street parking*
- *Street trees*
- *Pedestrian islands*
- *Narrower travel lanes*
- *Traffic circles and roundabouts*
- *Reduced pedestrian crossing distances at intersections, using curb extensions, traffic islands, and other measures*

**Note that flexibility is encouraged for allowing elements such as wide sidewalks and on-street or street-adjacent parking to be placed on private property. A range of ROW is accordingly recommended.*

Example Residential Collector, 2 Lanes, Undivided



Recommendation

R.O.W.: 54′

Operating Speed: 25 MPH

Parking: N/A

Number of Vehicular Lanes: 2

Number of Bike Lanes: 2 (6′)

Curb Radius: 20′

Landscape Type: Street Trees

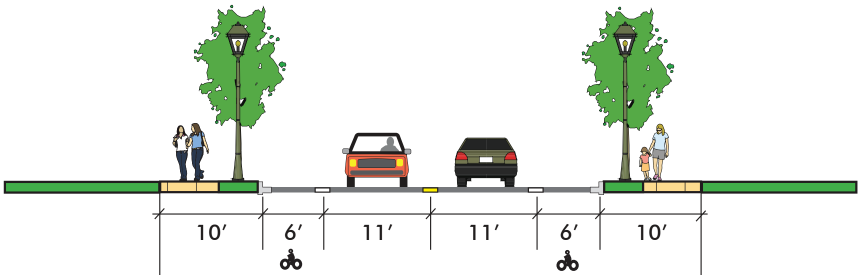


*FIGURE 4.11 Residential Collector, 2 Lanes, Undivided Example**

**Note that flexibility is encouraged for allowing elements such as wide sidewalks and on-street or street-adjacent parking to be placed on private property. A range of ROW is accordingly recommended.*

Example Mixed-Use Collector

Recommendation

R.O.W.: 42′ - 68′

Operating Speed: 25 MPH

Parking: (7′)

Number of Vehicular Lanes: 2

Number of Bike Lanes: Sharrow

Curb Radius: 20′

Landscape Type: Tree Wells

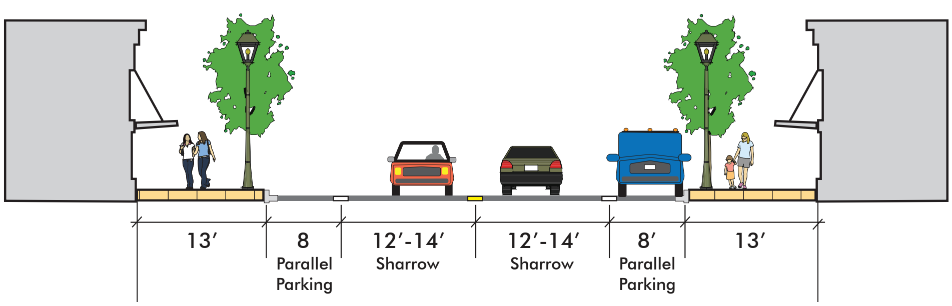


*FIGURE 4.12 Mixed-Use Collector Example**

**Note that flexibility is encouraged for allowing elements such as wide sidewalks and on-street or street-adjacent parking to be placed on private property. A range of ROW is accordingly recommended.*

Transit Collectors

Transit collectors are corridors designed to accommodate light rail and/or street cars. The Shared R.O.W. Option (Figures 4.13, 4.14, 4.15, and 4.16) should be used when developments call for mixing all modes of travel in a single corridor, while using the Separated R.O.W. Option (Figures 4.17 and 4.18) when wanting to separate vehicular traffic from transit. Commercial and mixed-use developments are the best choices when developing on these corridors, especially near transit stations. These corridors emphasize a pedestrian-friendly environment while offering many choices with regard to pedestrian activities.

Priority elements:

- Sidewalks
- Tree
- Landscaped medians

Secondary elements:

- Number of travel lanes and travel lane width
- Bike lanes on designated bicycle routes

Examples of traffic management features:

- *On-street parking*
- *Street trees*
- *Pedestrian islands*
- *Narrower travel lanes*
- *Traffic circles and roundabouts*
- *Reduced pedestrian crossing distances at intersections, using curb extensions, traffic islands, and other measures*

Example Transit Station (Middle Option)

**Note that flexibility is encouraged for allowing elements such as wide sidewalks and on-street or street-adjacent parking to be placed on private property. A range of ROW is accordingly recommended.*

Transit Collector (Shared R.O.W. Option)

Recommendation

R.O.W.: 66′ - 158′

Operating Speed: 25 MPH

Parking: (8′)

Number of Vehicular Lanes: 2

Number of Bike Lanes: 2 (5′-6′)

Curb Radius: 20′

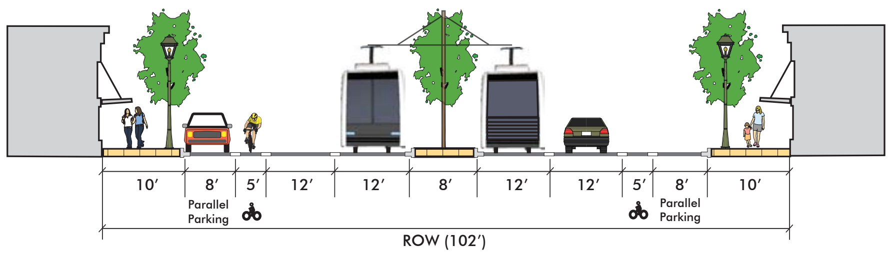


FIGURE 4.13 Transit Collector Example (Street Car Only)*

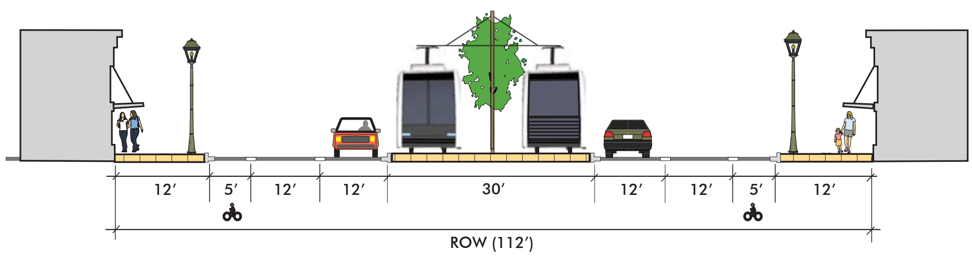


*FIGURE 4.14 Separated Transit Example**

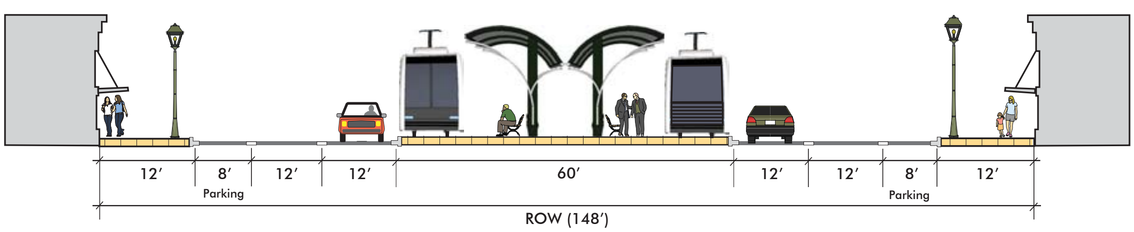


*FIGURE 4.15 Transit Station with Parking Example**

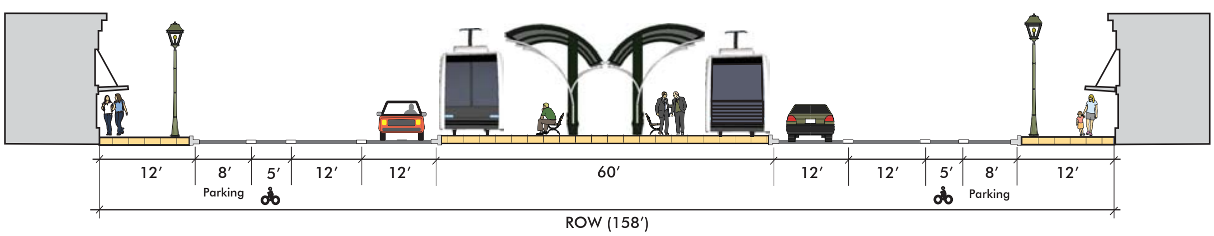


FIGURE 4.16 Transit Station with Parking and Bike Lanes Example (Shared ROW Option)*

Transit Collector (Separated R.O.W. Option)

Recommendation

R.O.W.: 71' - 100'

Operating Speed: 25 MPH

Parking: N/A

Number of Vehicular Lanes: 4

Number of Bike Lanes: N/A

Curb Radius: 20'

Landscape Type: Street Trees

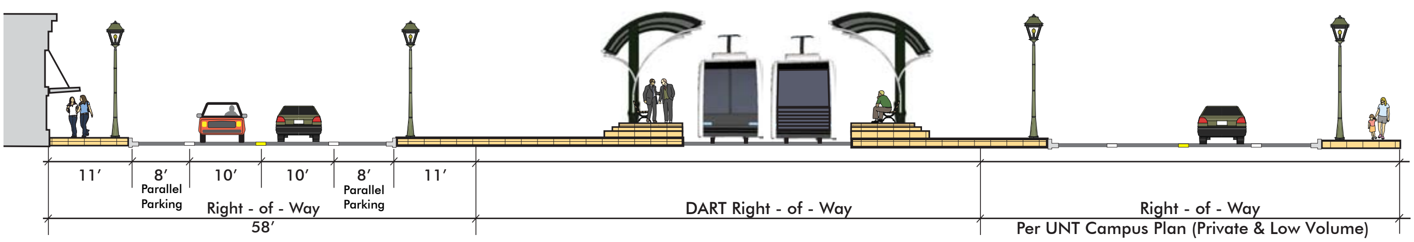


FIGURE 4.17 Parallel Mixed-Use Local Example (Separated R.O.W. Options A & C)*

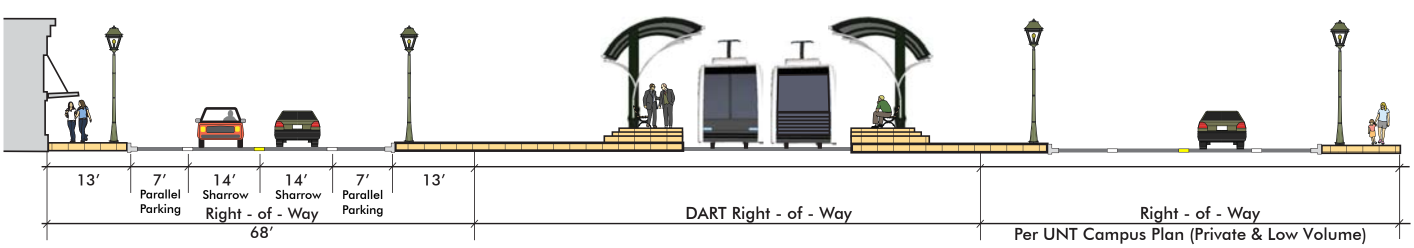


FIGURE 4.18 Parallel Mixed-Use Collector Example (Separated R.O.W. Option B)*

The intersections on both the public TOD side and the private UNT-Dallas side of the rail guideway needs to be far enough away to provide vehicle storage space for crossing vehicles.

**Note that flexibility is encouraged for allowing elements such as wide sidewalks and on-street or street-adjacent parking to be placed on private property. A range of ROW is accordingly recommended.*

Mixed-Use Local Streets

Mixed-use local streets (Figure 4.19) are designed to strongly encourage pedestrian movement through the corridor by providing a safe environment for them via narrow traffic lanes, two-lanes of traffic, and an overall narrow traveled R.O.W. (Note: City of Dallas will not take R.O.W. from existing residential land.)

Priority elements:

- Sidewalks
- On-street parking

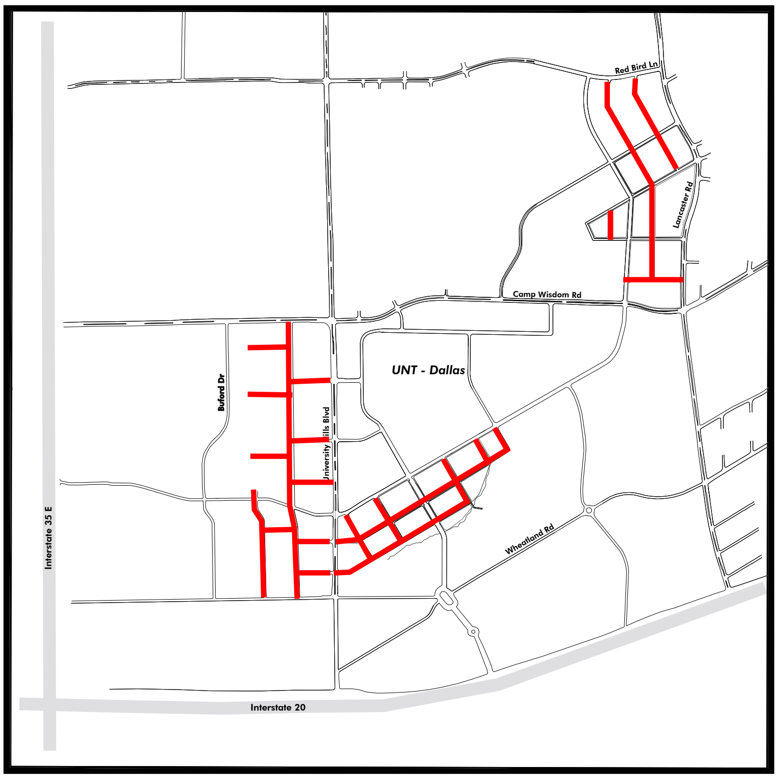
Secondary elements:

- Number of travel lanes and travel lane width

Examples of traffic management features:

- *On-street parking*
- *Narrower travel lanes*

Example Mixed-Use Local



Recommendation

R.O.W.: 20' - 60'

Operating Speed: 25 MPH

Parking: (8')

Number of Vehicular Lanes: 2

Number of Bike Lanes: N/A

Curb Radius: 20'

Landscape Type: Street Trees

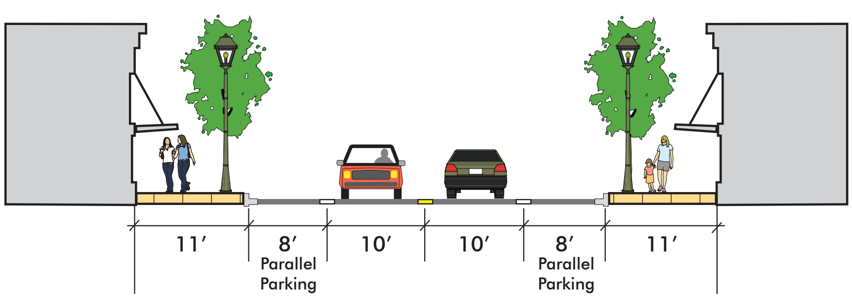


*FIGURE 4.19 Mixed-Use Local Example**

**Note that flexibility is encouraged for allowing elements such as wide sidewalks and on-street or street-adjacent parking to be placed on private property. A range of ROW is accordingly recommended.*

Intersection Design Examples

Three locations were selected within the study area to illustrate what the intersections could look like (in a plan view), if the CSTS is implemented (Figure 4.20)

Intersections are the areas along any particular corridor that have the greatest amounts of conflicting points between all the different modes. It is important when designing the intersections that priority is given to those modes such as pedestrians and bicyclist to maintain a exceptional level of safety. Slower speeds and design techniques should be implemented in areas that have high levels of bicycle and pedestrian uses.

Figure 4.21 illustrates a vibrant new main street, bustling with pedestrians and surrounded by urban mixed-use and residential developments. This TOD surrounds the DART station. The median will provide ample room for pedestrian movement, while vehicles will have four lanes of travel in all directions.

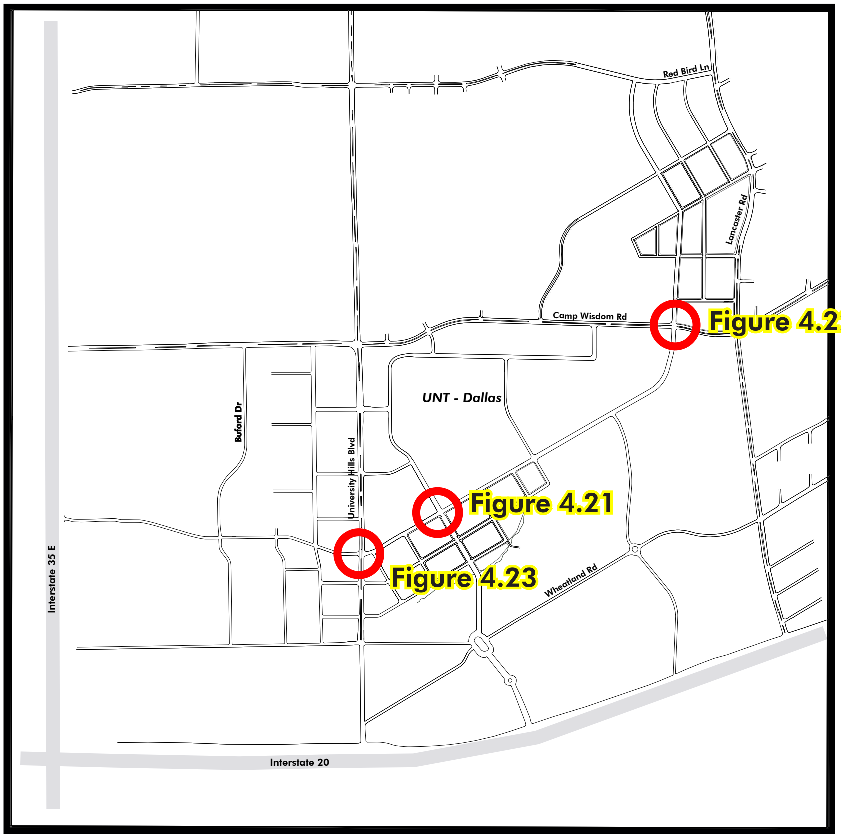


Figure 4.20 Locations of Intersection Design Examples

Figure 4.21 New Main Street South of UNT-Dallas

Figure 4.22 illustrates the intersection to the east of the police station on Camp Wisdom Road. The east-west and north-south movements will have left-turn bays. This intersection will be surrounded by mixed-use developments to the east and south.

Figure 4.23 illustrates the intersection of University Hills Boulevard and the proposed mixed-use collector. There will be four lanes of travel on University Hills Boulevard The proposed mixed-use collector will have two lanes to the west of the intersection, and lanes to the east.

Slower speeds, adequate signal timings and wide crosswalk markings are recommended through these intersections in order to accommodate any safety concerns that might arise by pedestrians and/or cyclists.

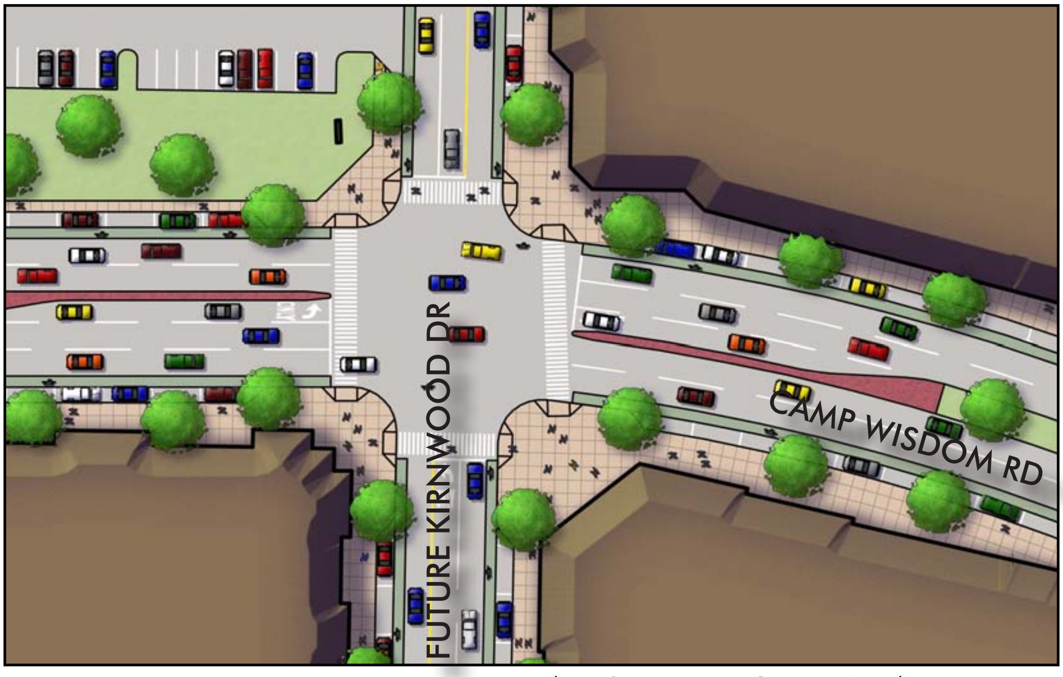


Figure 4.22 Intersection Near Police Station on Camp Wisdom

Figure 4.23 University Hills Blvd at Proposed Mixed-Use Collector

Chapter 5 - Summary

5.1 Planning Process

The UNT-Dallas Context Sensitive Transportation Study (CSTS) is a long-range planning analysis that incorporates consideration of flexibility in roadway standards to facilitate context sensitive design within its defined study area. The CSTS identifies the location and type of roadway facilities that are needed to meet projected long-term growth within the UNT-Dallas study area. This study serves as a tool to enable the City of Dallas to identify and preserve future corridors for transportation system development as the need arises.

To successfully develop the CSTS, the project team used a thorough planning, alternative analyses, and a design process based on input from planners, engineers, designers, and agency representatives. After months of discussions and analyses, the end result is a series of options or alternatives with their respective pros and cons.

5.2 Context Sensitive Design

Context Sensitive Design (CSD) is becoming embraced across the country as a more innovative approach to integrating different travel modes within the same mobility corridors by utilizing elements complementing the surrounding built environment. CSD can be defined as: designing the roadway based on the existing or anticipated context that is surrounding the roadway.

The UNT-Dallas area consists of both existing development with businesses and residences as well as areas that anticipate future growth in the next 20 years. By using both the existing functional classification system and the street standards developed through the *forwardDallas!* Comprehensive Plan, the project team identified six different functional class types within the UNT-Dallas Study Area. These street classification types specify three main components of the street: the scale and volume capacity, number of lanes and whether there is a median. The five functional class types are used through the travel demand modeling process to accommodate the 2030 traffic projections are:

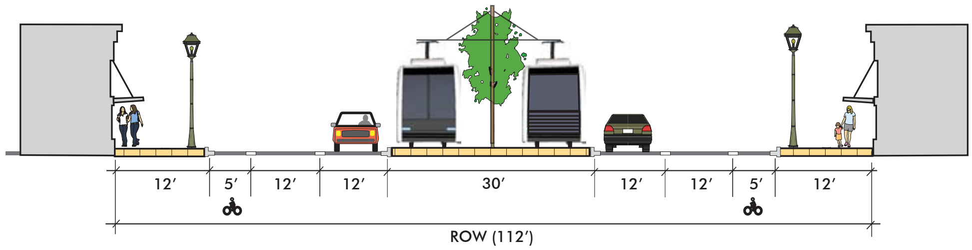
- Principal Arterial, 6 Lanes Divided
- Principal Arterial, 4 Lanes Divided
- Collector, 4 Lanes Undivided
- Collector, 2 Lanes Undivided
- Local Street, 2 Lanes Undivided

Along with the functional class types, this plan identified the context types to be used from the UNT-Dallas Area Plan developed by the City of Dallas in 2009. These context types were used to help characterize the streets based on the surrounding land uses. The context types for the UNT-Dallas Area are:

- Urban Neighborhood
- Urban Mixed-Use
- University Campus
- Residential Neighborhoods
- Commercial Center
- Business Center

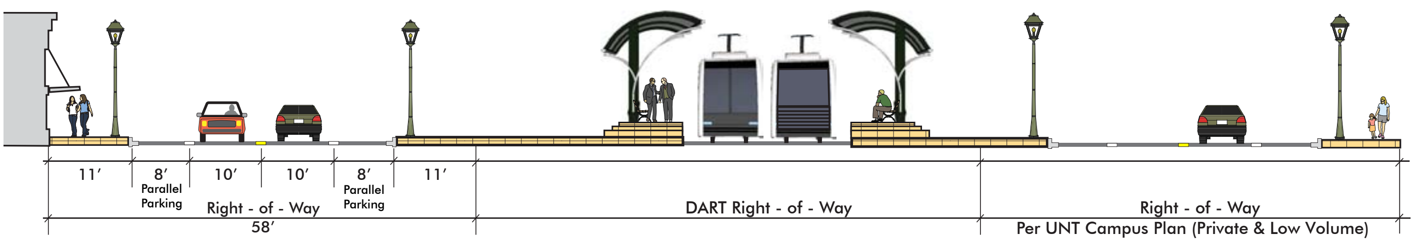
5.3 The Planning Alternatives

Through the CSTS, two primary transportation alternatives have been identified and evaluated. It is the purpose of the study not to recommend a preferred alternative but to weigh the alternatives and evaluate the pros and cons of each. The two alternatives are specified below:



The Shared R.O.W. Option (Figure 4.1 on page 16): The DART transit line shares the right-of-way (R.O.W.) with a collector thoroughfare that is aligned on the south side of the UNT-Dallas campus. Cross sections for this option show the transit service traveling in mixed-flow, much like a street car in figure 4.13, while also showing options of separated operation in figures 4.14, 4.15, & 4.16. Once the DART transit line travels past the UNT-Dallas campus to the north-east it leaves the shared R.O.W. and operates separately from any roads through the study area.

This alternative has been recommended by the City of Dallas Staff on the PMT due to the benefits of promoting a vibrant livable place adjacent to the UNT-Dallas campus and being more compatible with the goals and vision of the UNT-Dallas Area Plan. Similar rail alignments can be found within the DART system around the Good Latimer station as well as in the Las Colinas urban area in Irving. However, the alternative is not consistent with the UNT-Dallas Campus Master Plan and is cautioned by DART as potentially causing system-wide operational issues due to slower speeds in urban areas such as the UNT-Dallas TOD.



The Separated R.O.W. Option (Figures 4.2, 4.3, and 4.4 on pages 18-22): The DART rail system uses its own separated R.O.W. from vehicular traffic throughout the whole study area. This option has three sub alternatives that are based only on varying road alignments south of the UNT-Dallas campus.

This alternative is consistent with all of the stated objectives from DART through the planning preference with the Separated R.O.W. Option 'A' or 'C' as the preferred. Having the collector thoroughfare parallel the transit line south of the UNT-Dallas campus but not abutting the rail R.O.W. it is argued to have the least amount of conflict with the rail and other transportation modes.

This alternative, however, does not assist in promoting a more walkable, livable area of development. Pedestrians and bicyclists attempting to travel from the campus to the development south of campus could find it more difficult to cross two local/collector thoroughfares and one dedicated rail R.O.W.

5.4 Next Steps

This document has been created to provide additional insight and analysis into the transportation and development possibilities that can occur in the UNT-Dallas area. Additional planning will be conducted by DART as the rail extension is considered and coordination will need to continue between the agencies to allow for the best possible outcome for this area and the people of Dallas. This study is intended to serve as a guiding document as planning moves forward with DART, the City of Dallas, UNT-Dallas and future developers.

Appendix Sections

A Glossary of Terms

B Technical Foundation

C Alternative Scenarios (Preliminary Planning Process)

D Base and Alternative Volume Outputs

E Roundabouts

Appendix A - Glossary of Terms

Base Map

The Base Map in the context of this report illustrates current thoroughfare planning at the City of Dallas, current recommendations by City Staff for thoroughfare amendments (in red), City planned trails, UNT Dallas Campus internal streets and trails and DART's Blue Line preliminary alignment.

Complete Streets

In urban planning and highway engineering, complete streets are roadways designed and operated to enable safe, attractive, and comfortable access and travel for all users. All mode users of all ages and abilities are able to safely and comfortably move along and across a complete street.

Design Speed

The design speed is a tool used to determine geometric features of a new road during road design. The design speed may be higher than legislated speed limit caps. This is different than operating speed.

NCTCOG Model (demographics)

The NCTCOG Model estimated a demographic set based on build-out of the study area with a lower amount of development than the UNT-Dallas Area Plan. The NCTCOG demographics estimated 14,621 households and 15,346 jobs. This will be an input into the traffic generation element of the traffic model.

Fatal Flaw Analysis

The act of using professional judgement to evaluate the viability of a alternative as a potential solution for the UNT Dallas CSTS. A fatal flaw is something in or about the alternative that would keep it from being a realistic solution or recommendation in the final plan.

Internal Capture

Internal capture refers to the portion of person trips generated by the UNT Dallas Development Blocks that take place entirely within the UNT Dallas Study Area. These trips, which have both termini (origin and destination) within the Study Area, are known as internal trips. Internal trips are more likely to be captured when complimentary and interactive land uses are built on a transportation system that compliments walking, biking, convenient transit and shared strategic parking.

Internal Capture Rate

Internal capture rate estimates the percentage of trips that are likely to be captured between the UNT Development Blocks. These are rates between development types. Internal trip capture rates are defined for office, retail and residential land uses. The ITE Trip Generation Handbook, 2nd Edition (Chapter 7: Multi-Use Development) outlines one procedure that by using these internal capture rates (See APPENDIX) an overall percentage of internally captured trips can be calculated. ITE derived these internal trip capture rates from one early 1990s study of three mixed-use developments in Florida. The Trip Generation Handbook advises users to consider the limitations of the published data and that "local data may be given preference". Local research (FHWA/TX-10/5-9032-01-1) indicates rates of 50% to 60% are possible. The City of Dallas currently uses a 10% to 20% rate based on engineering judgment.

Local Network

This roadway network is made-up of municipal functionally classified collectors and locals, private streets and alleys and multi-use trails.

UNT-Dallas Area Plan Model (demographics)

The UNT Dallas Area Consensus Vision estimated a demographic set based on build-out of the study area with a larger amount of development than the NCTCOG model. The UNT-Dallas Area Plan demographics estimated 18,010 households and 18,357 jobs. This will be an input into the traffic generation element of the traffic model.

Manual Trip Generation

As the first step in a traffic impact analysis, trip generation determines the frequency of origins or destinations of trips in each zone by trip purpose, as a function of land uses and household demographics, and other socioeconomic factors. Manual Trip Generation refers to trip generation done without the aid of a computerized model and utilizes a reference source such as ITE's Trip Generation.

Mixed-Use Development

A land development that is characterized by different integrated, complementary, and interacting land uses such as office, retail, restaurants, entertainment, and/or hotels. The other key features of mixed-use developments are internal connectivity—walkways or internal streets or drives, convenient transit and the sharing of parking by using the same on-site parking lots by users of different buildings.

The Institute of Transportation Engineers' (ITE) Trip Generation Handbook defines a multi-use development as a "single real-estate project that consists of two or more ITE land use classifications between which trips can be made without using the off-site road system." In this handbook, ITE did not distinguish between mixed- and multi-use developments.

Mode Choice

Mode choice is the third step in the conventional four-step travel demand model, following trip generation and trip distribution but before route assignment. Trip distribution's zonal interchange analysis yields a set of origin-destination tables which tells where the trips will be made. Mode choice analysis allows the modeler to determine what mode of transport will be used, and what modal share results.

Mode Share, Mode Split

Mode share, Mode split or Modal split, is a traffic / transport term that describes the number of trips or (more common) percentage of travelers using a particular type of transportation. Mode share is an input into the travel demand model and is derived from U.S. Census Journey to Work Data.

Multi-Modal

A multi-modal transportation system is describes as a network of facilities designed for shared use with seamless linkages between at-least two or more modes of transportation. Multi-modal systems can be designed using shared right-of-way as found in a multi-modal boulevard where all modes share the same cross-section or as part of a network of roads, fixed transit guide ways and bicycle and pedestrian paths that when combined form a web of multi-use facilities.

NCTCOG Travel Demand Model

The North Central Texas Council of Governments travel demand model includes elements such as roadway and transit networks, and population and employment data to calculate the expected demand for transportation facilities. Within the model, mathematical equations are used to represent each individual's decision making process of: "Why", "When", "Where", and "How" to make the person trip, and "What" route to follow to complete the trip. The model results for these individual choices are combined so that the aggregate impacts of roadway vehicle volumes and transit route ridership on the average travel times can be determined. These volumes and riderships are typically used by member agencies to size roads, prepare transit service plans or for long-term planning of infrastructure needs. The current forecast year for the NCTCOG travel demand model is 2030.

Operating Speed

Speed at which drivers are observed operating their vehicles during free-flow conditions.

Regional Network

This roadway network is made up of municipal functionally classified arterials, county thoroughfares, state highways, interstate highways, private tollways, tunnels and bridges.

Regression Equation

Regression analysis is used to understand which among the independent variables are related to the dependent variable, and to explore the forms of these relationships. In restricted circumstances, regression analysis can be used to infer causal relationships between the independent and dependent variables. It was used in the context of this report by reference to TCRP 128 which compared two outcomes of the ITE trip generation formula. Regression is not an element of travel demand or traffic modeling.

Right-of-Way

A right-of-way is a strip of land that is granted, through an easement or other mechanism, for transportation purposes, such as for a trail, driveway, rail line or highway. A right-of-way is reserved for the purposes of maintenance or expansion of existing services with the right-of-way. In the case of an easement, it may revert to its original owners if the facility is abandoned.

Traffic Impact Analysis

Traffic impact refers to the effect a certain type or magnitude of development will have on the surrounding transportation system. A Traffic Impact Analysis (TIA) provides a way of assessing the adequacy of the existing or future transportation system to accommodate additional traffic generated by a proposed development, redevelopment or land rezoning. It will also assist in determining what improvements will be required to the roadway system in order to maintain a satisfactory level of service.

Traffic Models

Engineers use traffic models to predict traffic flow and report level of service, delay and speed, corresponding to the three main scales of observation in physics.

- Microscopic models typically simulate traffic systems on a vehicle-by-vehicle basis by updating position, speed, acceleration, lane position, and other state variables on time steps, such as on a seconds basis, as the vehicles interact with traffic signals, signs, other vehicles, and roadway geometrics. Microscopic simulations generally also include detailed modeling of traffic signal operations.

- Macroscopic models use aggregate equations and therefore provide only gross approximations of traffic volumes. Although they partially address the traffic modeling needs of roadway sizing, a greater level of detail is required for surface street networks, especially at intersections where heavy pedestrian activity is predicted.

- Mesoscopic models use macroscopic equations, but move vehicles in small-size packets. This affords the ability to test intersection interactions with vehicles or transit stops (see internal capture).

Transit-Oriented Development (TOD)

A transit-oriented development (TOD) is a mixed-use residential or commercial area designed to maximize access to public transport, and often incorporates features to encourage transit ridership.

Transportation Mitigation

In the context of this report transportation mitigation refers to the transportation improvements developers may be required to make in response to findings of a traffic impact analysis.

Transportation Mode

Transportation Mode is a general term for the different kinds of transport facilities that are often used to transport people or cargo.

Travel Demand Model

Travel demand models are used for transportation forecasting, which is the process of estimating the number of vehicles or travelers that will use a specific transportation facility in the future. Traffic forecasting begins with the collection of data on current traffic. Together with data on population, employment, trip rates, travel costs, etc., traffic data are used to develop a travel demand model. Feeding data on future population, employment, etc. into the model results in output for future traffic, typically estimated for each segment of the transportation infrastructure in question.

Traffic forecasts are used for several key purposes in transportation policy, planning, and engineering: to calculate the capacity of infrastructure, e.g., how many lanes a bridge should have; to estimate the financial and social viability of projects, e.g., using cost-benefit analysis and social impact assessment; and to calculate environmental impacts, e.g., air pollution and noise.

Trip Generation

As the first step in the four-step travel demand modeling process, trip generation determines the frequency of origins or destinations of trips in each zone by trip purpose, as a function of land uses and household demographics, and other socioeconomic factors.

Internal trips

Trips that are exclusive to the study. These are generally shorter trips that are often walking, bike, or transit trips.

External trips

These trips are often referred to as pass-through trips; they neither begin nor end in the study area, but will use the roadways within the study area.

Appendix B - Technical Foundation

Introduction

The City of Dallas *UNT-Dallas Area Plan*, the University of North Texas UNT *Campus Master Plan*, and neighboring master plans will place increasing demands on the transportation system. Community leaders, land-use planners, developers, and transportation agency administrators need techniques to enable them to reliably predict the number of net vehicle and person trips that may be generated by new or infill mixed-use and transit oriented developments.

This memorandum outlines the steps used in the UNT-Dallas Area Context Sensitive Transportation Study. The objective of the overall study is to conduct a comprehensive area-wide review of transportation needs within the context of the *UNT-Dallas Area Plan*. The goal of the study is to develop a multi-modal transportation plan that facilities a shift in travel behavior in response to a future land use and urban design vision that emphasizes a mixed-use walkable community.

This memorandum illustrates a procedure that quantifies the 2030 traffic demands on local and regional roadways within the study area. The results of the analyses were used to suggest proper sizing of the roadways for automobile traffic and to recommend locations for desirable connections for pedestrians, bicyclists, and transit riders within the study area.

Methodology

Early in the process, stakeholder involvement from DART, UNT, the City of Dallas and NCTCOG was an essential component to generate three alternative roadway/transit/bicycle and pedestrian scenarios. These alternative alignment scenarios were focused on identifying opportunities for promoting multi-modal accessibility within a mixed used walkable community. The three alternative alignment scenarios are illustrated in Figure B-2, Figure B-3, and Figure B-4. The scenarios and the existing City of Dallas current Master Thoroughfare Plan (Base Alternative – Figure B-1) will be compared to each other as part of the analysis. For each of the four roadway/transit/bicycle and pedestrian scenarios, two development assumptions/demographics will be used: "NCTCOG" and *UNT-Dallas Area Plan* from *forward Dallas!* NCTCOG demographics are developed for the six-county region and the UNT-Dallas Area Plan demographics were developed by the City of Dallas. The NCTCOG demographics assume a lower amount of development within the study area than assumed in the UNT-Dallas Area Plan.
In summary, eight separate evaluations were completed comparing the four alternative roadway/transit scenarios each with the NCTCOG and UNT-Dallas Area Plan demographic information.

Existing Conditions NCTCOG Regional Travel Demand Model

Prior to creating the alternative models, an existing conditions (2009 Model) run of the NCTCOG Regional Travel Demand Model was conducted.

Existing Conditions NCTCOG Regional Travel Demand Model Process:

- NCTCOG ran the NCTCOG Regional Travel Demand Model for existing conditions (2009 Model).

Existing Conditions Model Product:

- The daily model volume outputs within the study area were provided. These model volumes along with existing traffic data were utilized to understand the current traffic conditions within the study area.

Future Conditions NCTCOG Regional Travel Demand Model

The regional travel demand model was utilized to analyze regional trip distribution and regional impacts of the various scenarios.

Future Conditions NCTCOG Regional Travel Demand Model Process:

- Prior to any alternative NCTCOG model runs, the Consultant and Project Management team reviewed the future alternative roadway networks for accuracy. The NCTCOG provided a copy of road network to the Consultant prior to running the future conditions analyses.

- NCTCOG ran the 2030 NCTCOG Regional Travel Demand Model for two scenarios (Base and Alternative B with two sets of demographics), for a total of four model runs.

Future Conditions Model Product:

- The NCTCOG provided daily model volume outputs on roadways for the entire region which includes the study area based on AM, PM, and daily model outputs; these distributions were based on two roadway networks (Base and Alternative B) and both sets of demographics. The NCTCOG also provided the regional model mode split of auto and transit percentage in the campus study area TAZ in TransCAD format, though the pedestrian and bike numbers were not accounted for at the regional level.

Alternatives Evaluation

Each of the alternatives use the classic urban transportation modeling system (UTMS). This is a four-step transportation model to determine the demand on the facilities. The classic four-step model is listed and defined below:

1. Trip Generation – estimation of number of trips produced by and attracted to a study area.

2. Trip Distribution – prediction of where trips are coming from and where they are going.

3. Mode Choice – prediction of how travel will occur via different available modes. (e.g. auto, pedestrian, bicycle, transit, etc.)

4. Trip Assignment – defines the specific route of travel through the network.

A flow chart of how the UTMS four-step model was applied to this study is illustrated in Figure A-1.

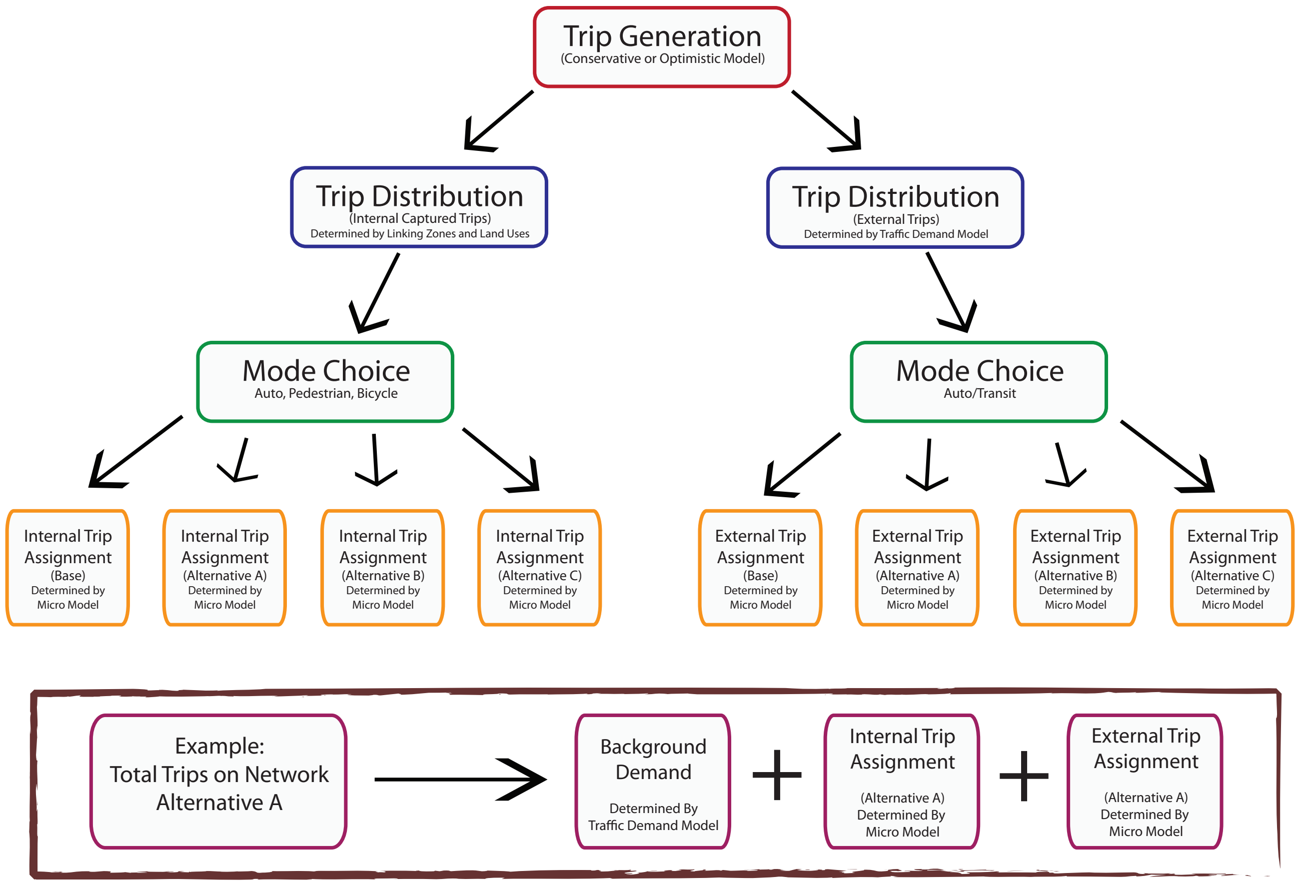


FIGURE A-1 Four-Step Model Flow Process

Detailed Step Descriptions

The completion of each step represents a major milestone in transportation modeling. Documentation was provided to the Project Management Team for review illustrating a detailed breakdown of the assumptions and results of each of the four steps. Due to the nature of the modeling process multiple steps were provided to the Project Management team and reviewed simultaneously.

1) Trip Generation

The trip generation process defined below is divided into two separate but connected processes:

NCTCOG Regional Model Process – This process involves running the NCTCOG trip generation model to convert persons/households and employment into auto and transit trips.

KHA-ITE Process – Standard trip generation was calculated using the most widely used national source for trip generation information: ITE's Trip Generation, 8th Edition, for each of the base planned and existing land uses within each development block as dictated by the UNT Dallas Area Consensus Vision. ITE's Trip Generation, 8th Edition is a three volume manual with multiple land use categories that is used to determine the trip generation of a site. Trip generation estimates were performed for both the NCTCOG and UNT-Dallas Area Plan demographic projections. For this analysis, the trip generation was aggregated into the eight "development zones," as shown in Figure A-2.

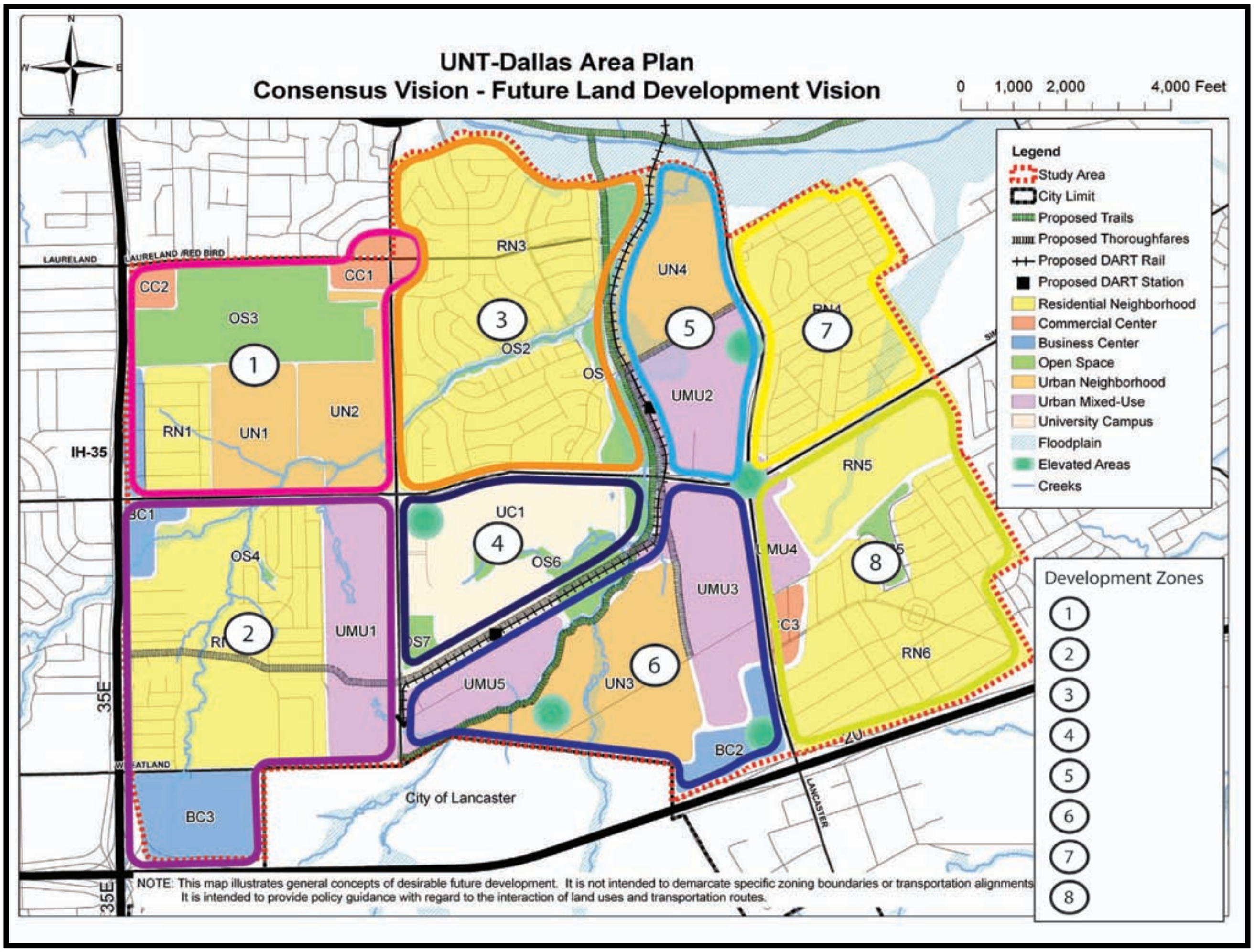


FIGURE A-2 UNT-Dallas Area Plan Development Zones

Internal Capture – Subset of Step 1: Trip Generation

Internal capture is defined as the portion of trips generated by the UNT Dallas Development Blocks that take place entirely within the UNT Dallas Study Area. In other words, these are short length trips that originate within the study area, but do not leave the study area. Internal capture trips are a part of the four-step process but because of the land use patterns and density, a home to work trip could simply be a walk or a short bike ride.

The calculation to determine the portion of the total trips generated that are internally captured trips was performed using the procedure identified for multi-use developments in ITE's Trip Generation Handbook, 2nd Edition (pages 85-100) that can balance internal trip demand and supply for four different land uses or areas. Note that at the step of trip generation, the mode choice is undefined, but due to the nature of the area, it is likely that a large portion of these internal captured trips will be pedestrian or bicycle trips instead of automobile. The determination of mode choice will occur in Step 3.

Researchers around the country are starting to examine the transportation and economic impacts of the wide variety of transit-oriented development (TOD) centers which are now becoming mature developments. The research to date has been assembled in reports like TCRP 102 and TCRP 128, and will make its way into future editions of ITE's Trip Generation and Trip Generation Handbook.

While the results vary due to the individual nature of each TOD, typical observed reductions from the book values due to the combined internal capture were found to be in the 40-50% range. In light of these findings, it is likely that many of the ITE Internal Trip Capture Rates will increase with the next edition of the Trip Generation Handbook.

For this analysis, increased internal trip capture rates were developed based on engineering judgment. In addition, a new use – Institutional – was included that will be used to demonstrate the interaction between the UNT Dallas campus and the surrounding land uses. The modified Internal Trip Capture Rates for Trip Origins within a Multi-Use Development have been included as Tables A-1 and A-2.

Trip Generation Process:

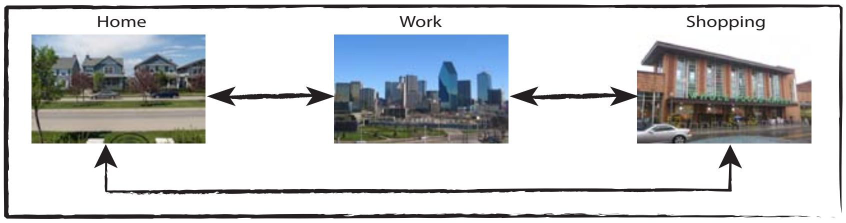
- Calculate daily trip generation for each development zone based on ITE's Trip Generation for both the NCTCOG and UNT-Dallas Area Plan future demographics.
- Calculate internal capture for each development zone based on modified Trip Capture Rates provided in this memorandum.
- Calculate internal capture between adjacent development zones based on modified Trip Capture Rates.
- The Project Management Team reviewed the trip generation and internal capture for each of the development zones for both development scenarios.

Trip Generation Product:

- Daily, AM peak hour and PM peak hour Trip Generation by each "development zone" was provided in the tabular format similar to that illustrated in Figure A-3. A trip generation table was provided for both the NCTCOG and UNT-Dallas Area Plan demographic projections.
- Internal Capture within and between the adjacent "development zones" was shown as a percentage of total trips. The percentage of internal capture calculated was provided as a supplement to table shown in Figure A-3. An internal capture percentage was provided for both the NCTCOG and UNT-Dallas Area Plan demographic projections.

Development Zone 1				AM Peak			PM Peak		
Land Use	*Intensity*	*Unit*	*Daily Trips*	*In*	*Out*	*Total*	*In*	*Out*	*Total*
Total Trips - Development Zone 1									
Development Zone 2				AM Peak			PM Peak		
Land Use	*Intensity*	*Unit*	*Daily Trips*	*In*	*Out*	*Total*	*In*	*Out*	*Total*
Development Zone 2									

FIGURE A-3 Trip Generation Table



2) Trip Distribution

The trip distribution is a prediction of where trips are coming from and where they are going.

Trip Distribution Process:

- Trip distribution was determined by the NCTCOG travel demand model (see Future Conditions NCTCOG Regional Travel Demand Model). This distribution determined where trips entering the Study Area are coming from (origin) and where trips leaving the Study area are going (destination). In other words, the model demonstrates if trips are coming to/from the north, south, east, or west, both internal and external to this site.
- The percentage of trips coming into and out of the study area was calculated at each point of entry.
- Once the percentages were established the trips generated using the ITE method was distributed using the percentages from the NCTCOG travel demand model. (Therefore, NCTCOG model trips destined to or generated from the study area are not included as site traffic, assuring no double counting of site trips).
- Site trip distribution was determined using the eight "development zones," shown in Figure A-2. For example, the analysis showed how Zone 1's internal trip generation was distributed among the eight different zones.
- Non-site trips were estimated from the NCTCOG model by quantifying the E-E (External-External) trips that pass through the study area without stopping.
- The Project Management Team had an opportunity to review the internal trip distribution that is based on the internal capture trips previously reviewed in Step 1.

Trip Distribution Product:

- Internal trip distribution was determined using the eight "development zones," shown in Figure A-2. The analysis showed how a zone's internal trip generation is distributed among the eight different zones. Internal trip distribution was provided in the tabular format similar to that illustrated in Figure A-4.

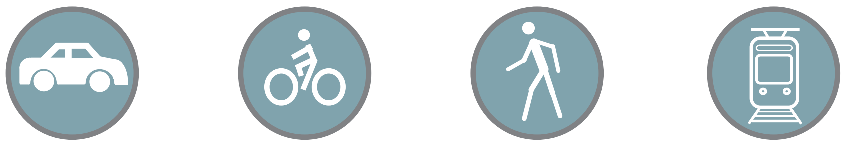
	Development Zone 1	Development Zone 2	Development Zone 3	Development Zone 4	Development Zone 5	Development Zone 6	Development Zone 7	Development Zone 8
Development Zone 1	%	%	%	%	%	%	%	%
Development Zone 2	%	%	%	%	%	%	%	%
Development Zone 3	%	%	%	%	%	%	%	%
Development Zone 4	%	%	%	%	%	%	%	%
Development Zone 5	%	%	%	%	%	%	%	%
Development Zone 6	%	%	%	%	%	%	%	%
Development Zone 7	%	%	%	%	%	%	%	%
Development Zone 8	%	%	%	%	%	%	%	%

FIGURE A-4 Example Internal Distribution/Capture Table

3) Mode Choice

Mode choice is the prediction of how travel will occur via different available modes. (e.g. auto, pedestrian, bicycle, transit, etc.). The mode choice depends on whether the trip is an internal trip or external trip.

For internal trips (trips exclusive to the study area), the mode choices are predominantly pedestrian, bicycle and automobile. For the type of mixed-use development being planned in *forwardDallas!*, it is likely a large portion of the internally captured trips will be pedestrians or bicyclists. Creating a walkable, live-work community will increase the pedestrian mode choice. Automobiles will be used for longer internal trips that exceed typical acceptable walking distances. A breakdown of internal trip mode choice was provided.



For external trips (trips not stopping but passing through the study area), the mode choices are predominantly automobile and transit, although a small number of long-distance bicycle or pedestrian trips may occur. For TODs, the transit mode share is typically 2-5 times greater than the typical rate in the region. According to Hank Dittmar's The New Transit Town (2004), TOD residents also tend to own fewer vehicles than is typical for their regions. Once vibrant TOD areas are established, people who have a predisposition to using transit or owning fewer vehicles tend to self-select to reside in or do business in the TOD due to its attractiveness, causing the vehicle trip reductions to slowly increase over time. With the acceptance of these new mode share factors, adjustments were made to the current NCTCOG mode share for external trips from the study site.

Mode Choice Process:

Internal mode choice was based on the interaction between the "development zones" illustrated in Figure A-4. The shorter the trip, the higher likelihood the trip is a non-automobile choice. Also, the type of development interacting between the zones (e.g. apartments with institutional) affect the mode choice.

External trips mode choice was based on the Future Conditions NCTCOG Regional Travel Demand Model. The team utilized national research on transit shares in mixed use TODs to calculate the transit mode split.

The Project Management Team had an opportunity to review the mode choice for internal and external trips. The mode choices were broken down into auto, pedestrian, bicycle, and transit.

Mode Choice Product:

- A breakdown of the total trips generated by mode was provided in tabular format.

4) Trip Assignment

Once the trip generation, trip distribution, and mode choice is established, the route can be determined. When the routes are determined, actual trips can be assigned to the network. The external trips will be routed to their destination outside the study area and the internal trips will be routed to their internal destinations within the site. Combining the two trip assignments gives the overall area's site demand on each route, whether roadway or pedestrian pathway. When the trip assignment is completed, a mesoscopic and microscopic model can be used to evaluate the roadway and pedestrian/bicycle system in further detail.

Trip Assignment Process:

- Trip Assignment for the study area traffic will be done for each of the base and alternative roadway scenarios.
- Non-site traffic will also be assigned to the roadway network by using the NCTCOG model. These external trips are separate from the trips generated by the study area demographics and make up the balance of the traffic on the roadways. This allows for no double counting of trips to or from the site.
- The Project Management Team will have an opportunity to review the trip assignment. It should be noted that trip assignment is largely dependent of the previously reviewed trip distribution.

Trip Assignment Product:

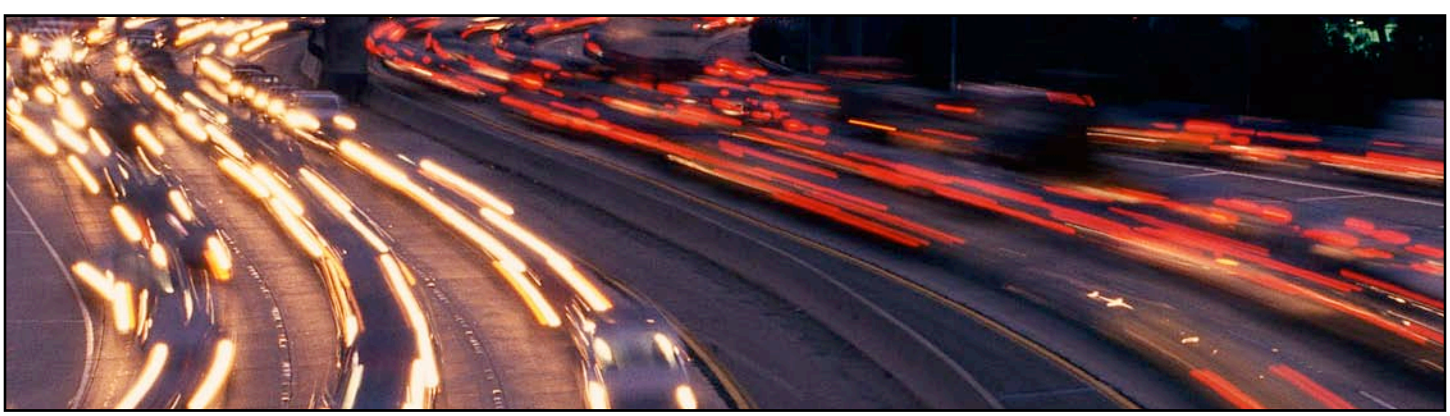
- Eight (8) Roadway Network Maps with traffic volumes will be provided (Base Roadway Network, Alternative A Roadway Network, Alternative B Roadway Network, Alternative C Roadway Network each with two sets of demographics).

Mesoscopic and Microscopic Model

Once the four-step model is completed, there will be a transfer of vehicular and transit network data to the mesoscopic and microscopic model.

Mesoscopic and Microscopic Process:

- Using the output from the four-step model, (see Trip Assignment) the percentage of trips coming into and out of the study area will be used to calibrate the mesoscopic model. This model can also be utilized to assist with locating complete streets, trail connections, intersection design needs and mid-block crossing needs.
- The Project Management Team will have an opportunity to review road capacity needs, sizing, and pedestrian connection recommendations.
- After feedback is received from the Project Management Team, intersection and microsimulation analysis will be performed for the AM and PM peak hours.



Mesoscopic and Microscopic Product:

- Microsimulation analysis for the AM and PM peak hours was performed at study intersections to assist in intersection design and need for mid-block crossings. Measure of effectiveness were used to evaluate each scenario. The measures of effectiveness for automobile, transit, pedestrian, and bicycles were summarized and compared to each other to describe the overall effectiveness for each scenario.

Conclusion

This memorandum outlines the technical analysis steps that were used to produce accurate auto travel demand and bicycle/pedestrian flows for the year 2030. Figure A-5 demonstrates steps in the process. This forecasting informed the next step of this plan, to select a preferred transportation network, sizing of transportation facilities and context sensitive design standards. Using this analysis builds a circulation plan for all modes of transportation and facilitation of future land use and urban design that relies upon a walkable environment.

Additionally, this memorandum and the analysis provides a model for other mixed-use or transit-oriented development sites to determine the internal trip capture procedure and potential for improving roadway, transit and pedestrian/bicycle facility design. Engineers and planners considering the traffic impact of mixed-use developments in Dallas may use this method and example of how to perform the analysis and translate the outputs into design guidance. The Glossary and modified ITE internal capture rates provide a common language and standard method for site development review. The final outcome is predictability in the development process of mixed-use and transit-oriented developments matched with complimentary roadways, transit and pedestrian/bicycle facilities.

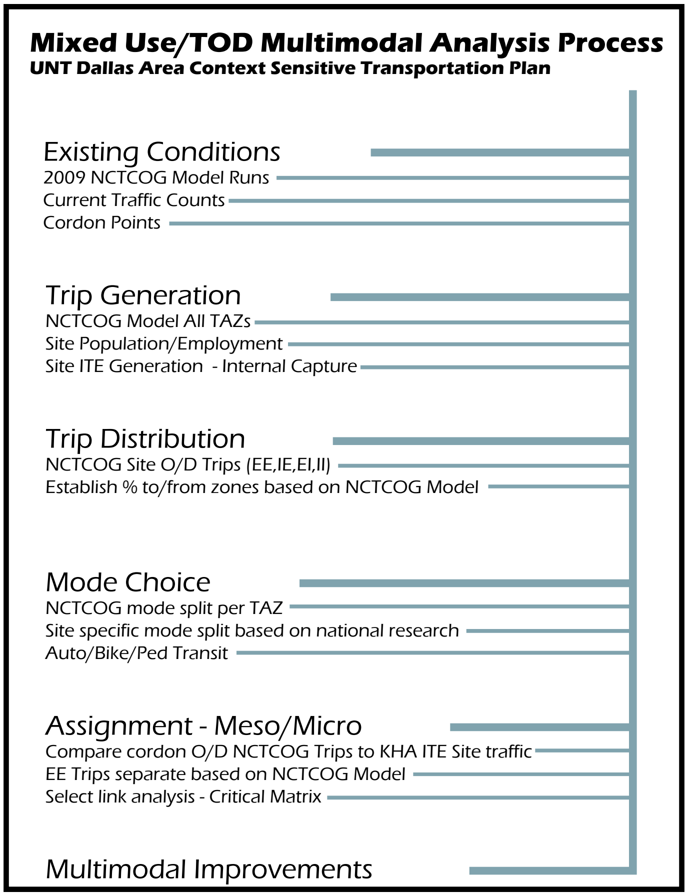


FIGURE A-5 Mixed Use/TOD Multimodal Analysis Process

MODIFIED ITE UNCONSTRAINED INTERNAL TRIP CAPTURE RATES

TABLE A-1: Modified ITE Unconstrained Internal Trip Capture Rates for Trip Origins within a Multi-Use Development

From Land Use	To Land Use	ITE Daily %	Proposed UNT Daily %
Office	Office	2%	4%
	Retail	22%	30%
	Residential	2%	6%
	Institutional	--	4%
Retail	Office	3%	4%
	Retail	30%	45%
	Residential	11%	16%
	Institutional	--	8%
Residential	Office	N/A	6%
	Retail	38%	44%
	Residential	N/A	3%
	Institutional	--	30%
Institutional	Office	--	3%
	Retail	--	8%
	Residential	--	8%
	Institutional	--	3%

TABLE A-2: Modified ITE Unconstrained Internal Trip Capture Rates for Trip Destinations within a Multi-Use Development.

To Land Use	From Land Use	ITE Daily %	Proposed UNT Daily %
Office	Office	2%	4%
	Retail	15%	23%
	Residential	N/A	6%
	Institutional	--	4%
Retail	Office	4%	7%
	Retail	28%	44%
	Residential	9%	15%
	Institutional	N/A	8%
Residential	Office	3%	5%
	Retail	33%	42%
	Residential	N/A	3%
	Institutional	--	3%
Institutional	Office	--	6%
	Retail	--	8%
	Residential	--	15%
	Institutional	--	4%

Appendix C - Alternative Scenarios (Preliminary Planning Process)

FIGURE C-1: Base Alternative – Existing Thoroughfare Plan

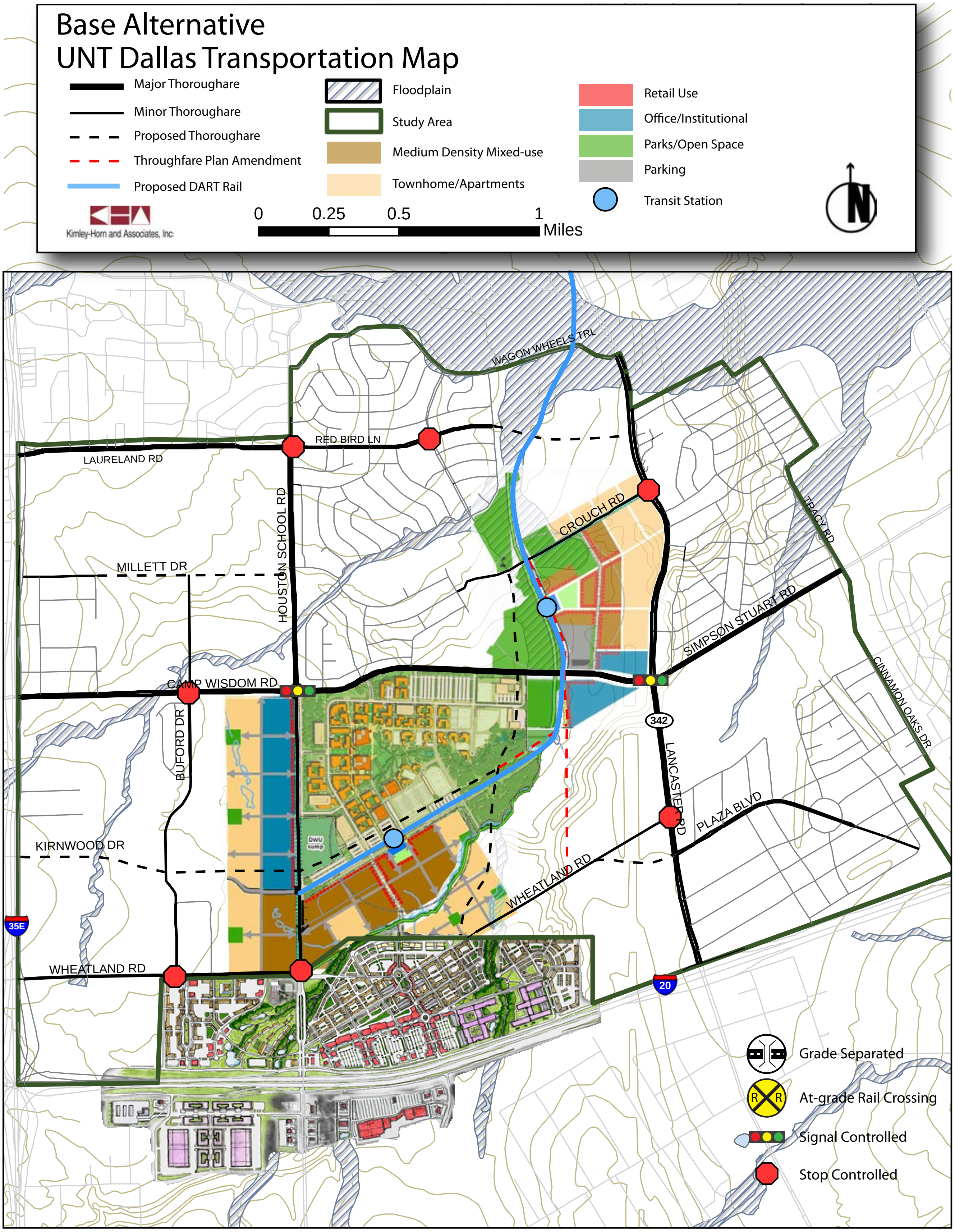


FIGURE C-2: Alternative A

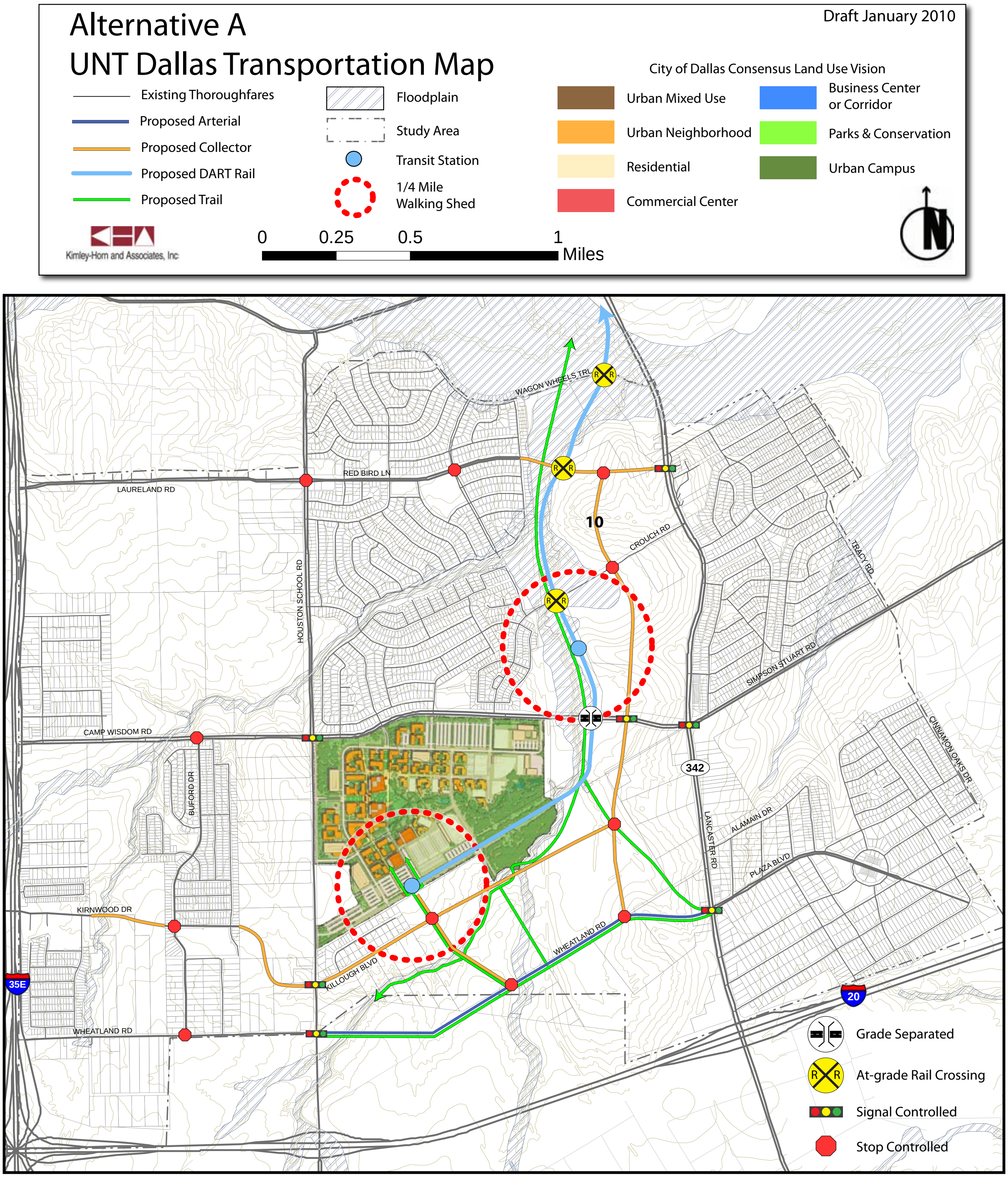


FIGURE C-3: Alternative B

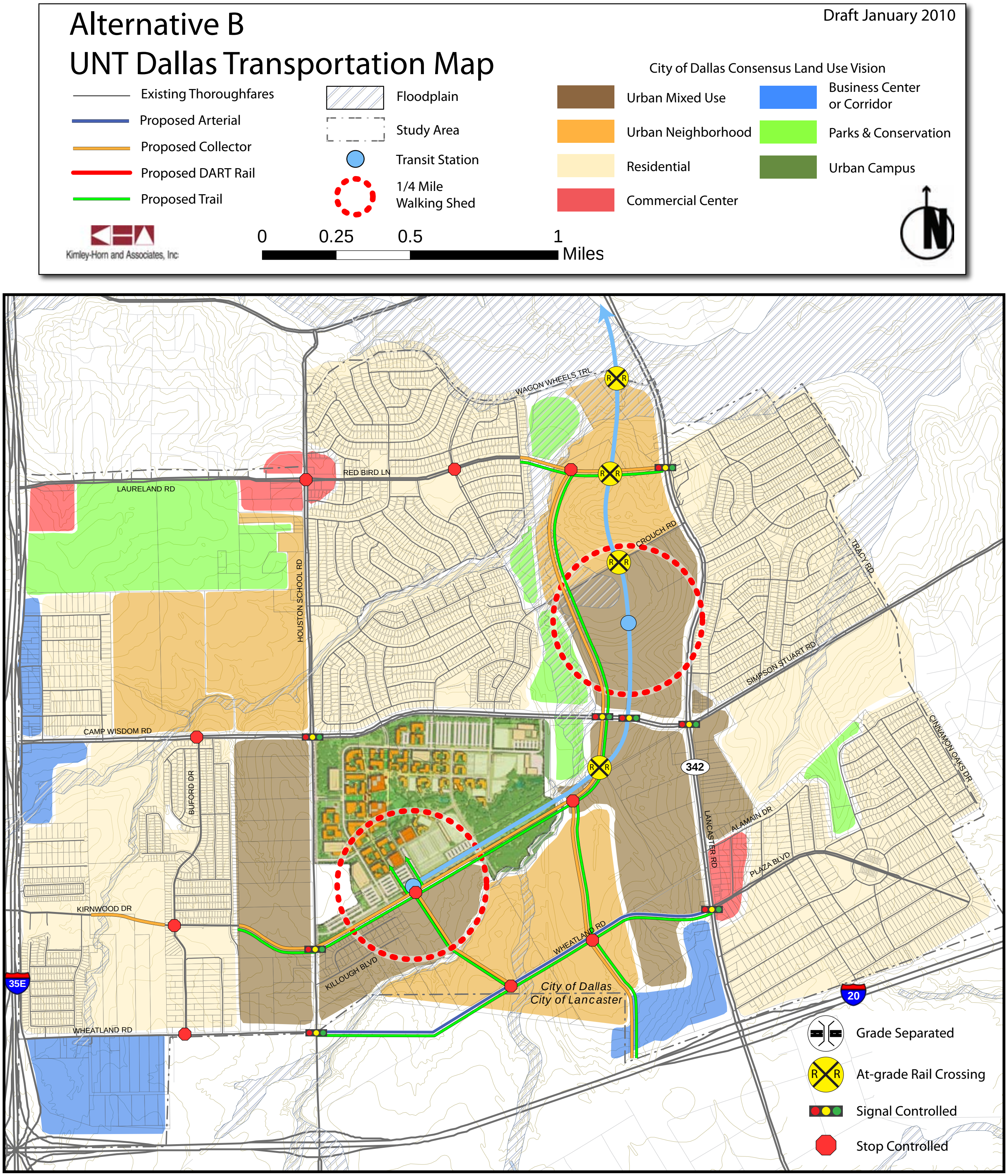
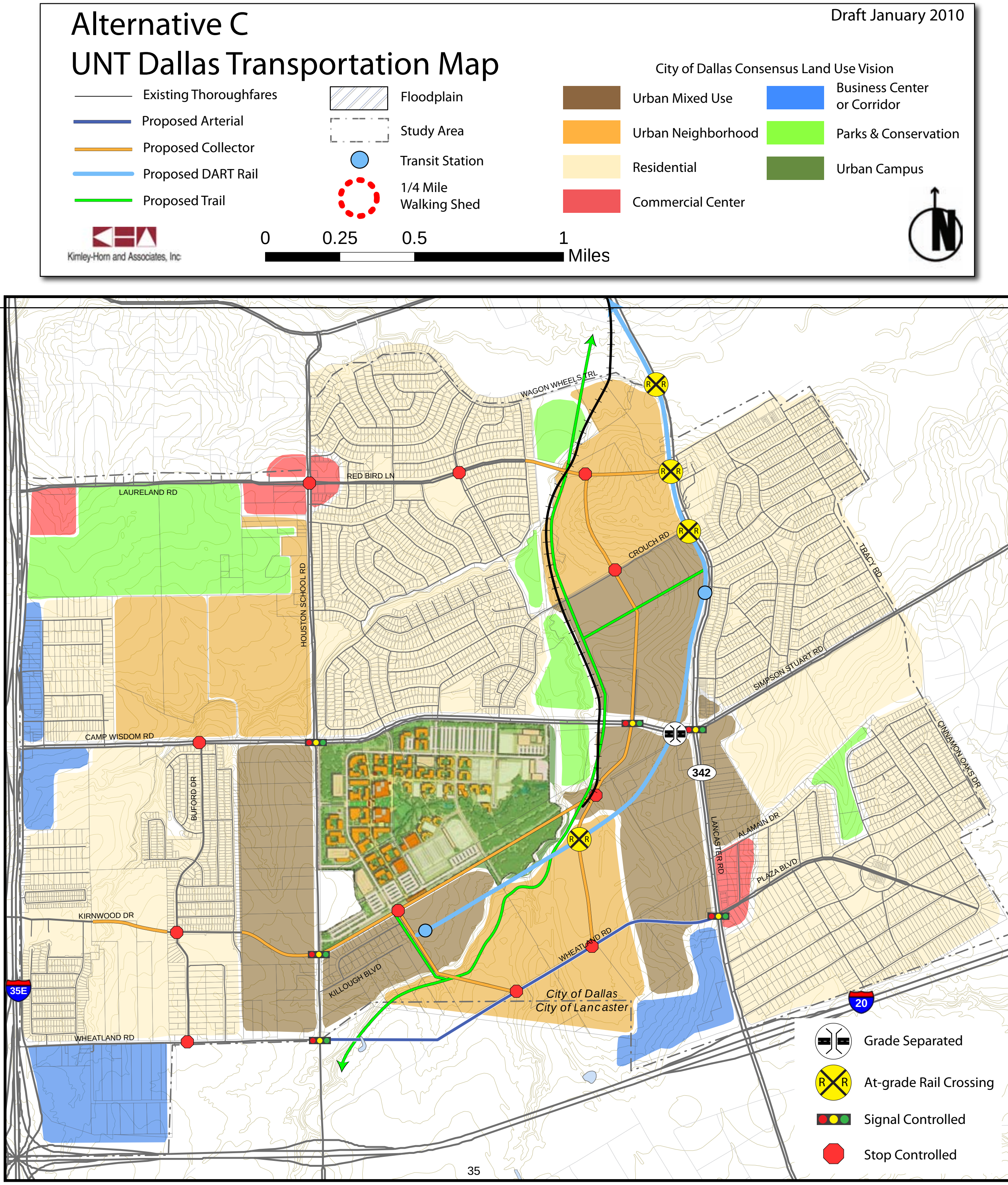


FIGURE C-4: Alternative C



Appendix D - Base and Alternative Volume Outputs

FIGURE D-1: Base Alternative

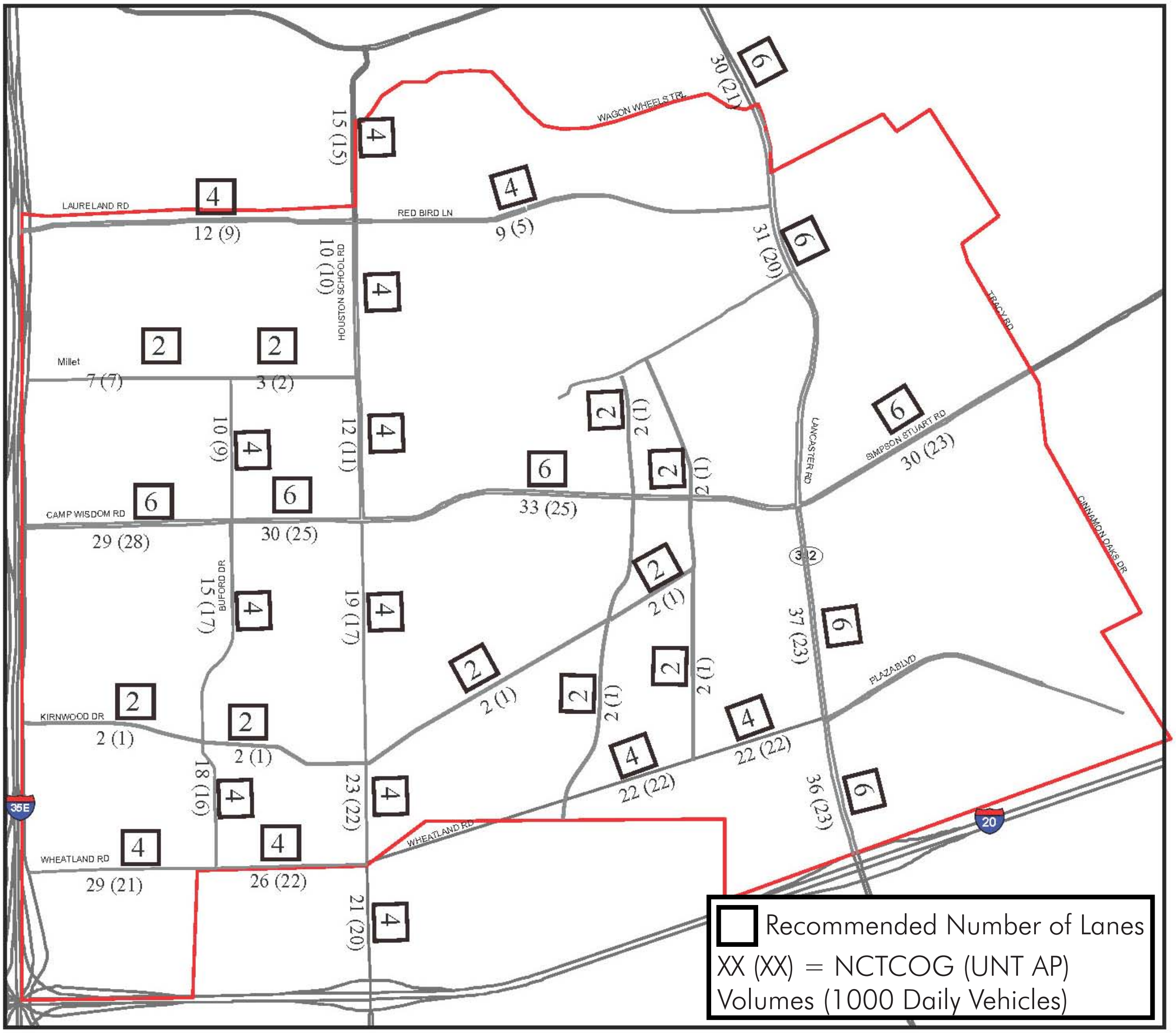


FIGURE D-2. Alternative A

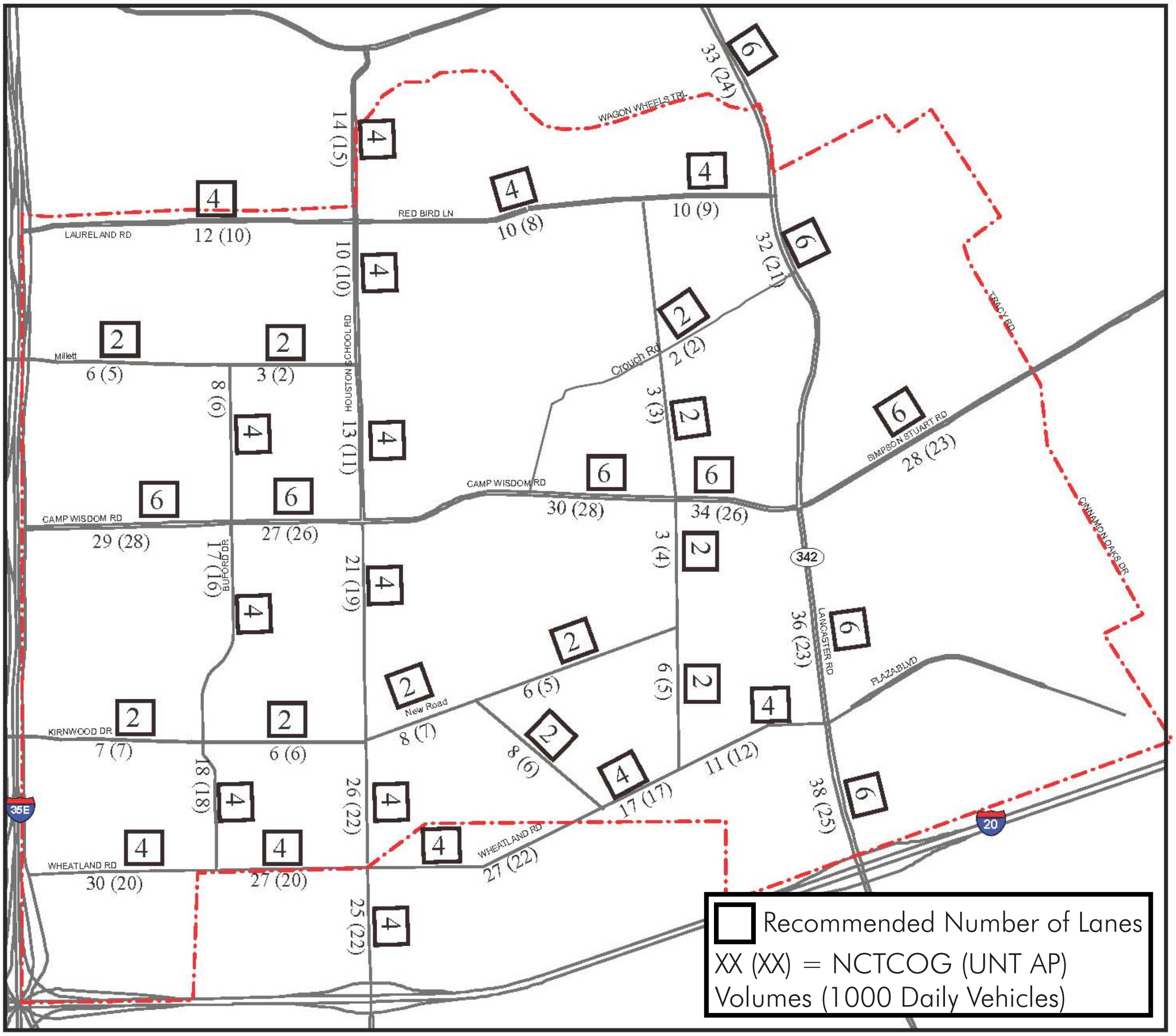


FIGURE D-3. Alternative B

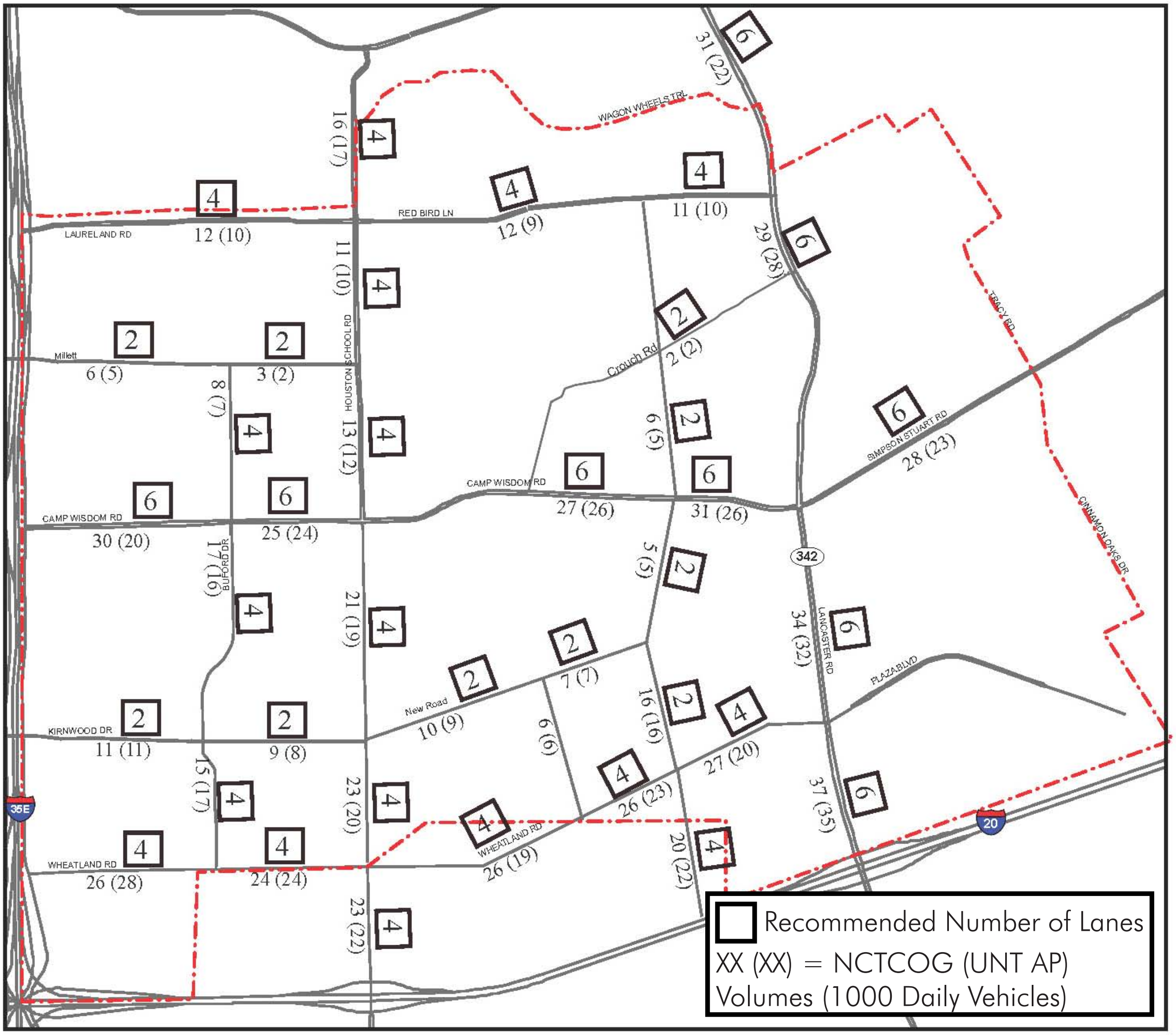
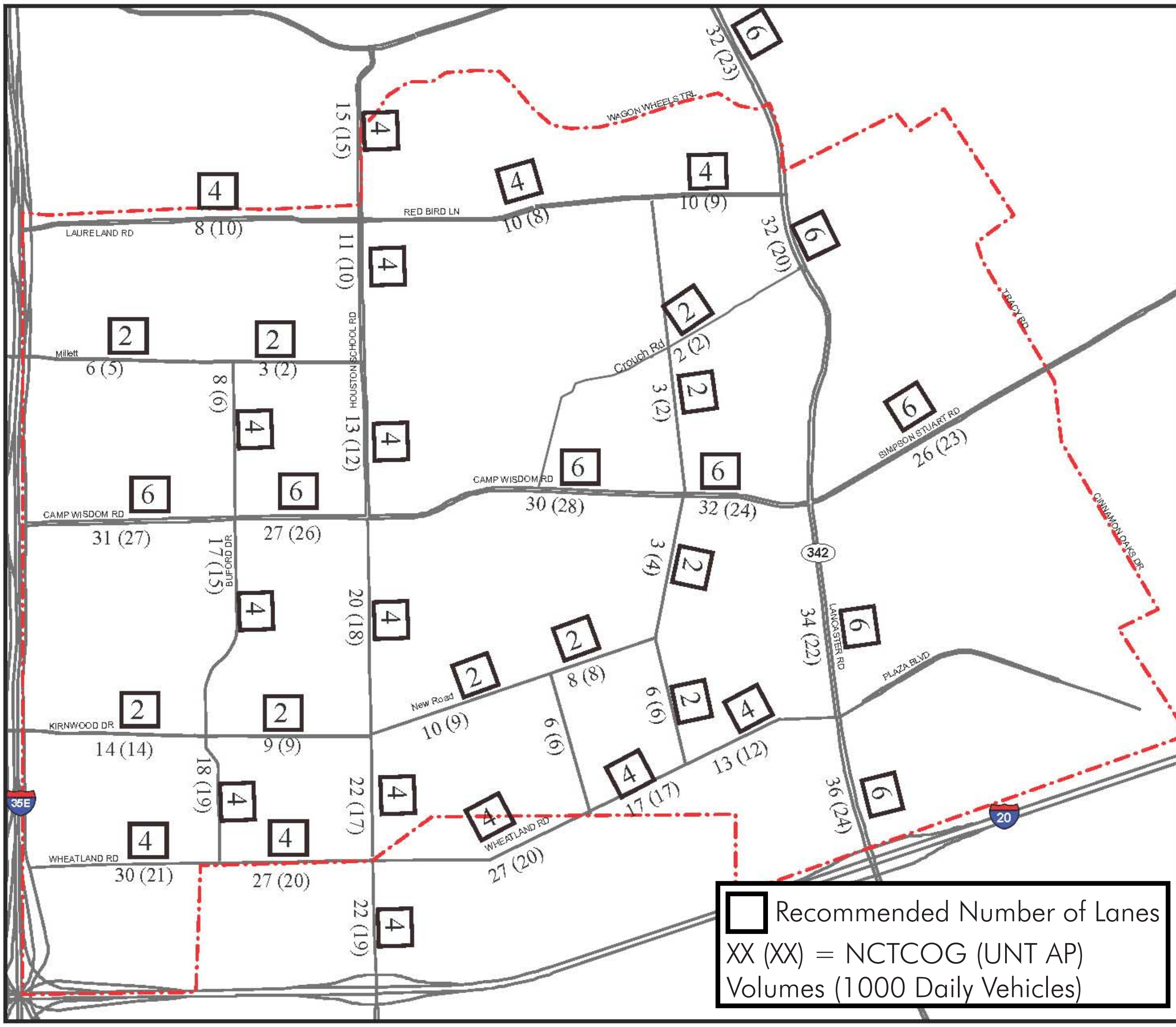


FIGURE D-2. Alternative C



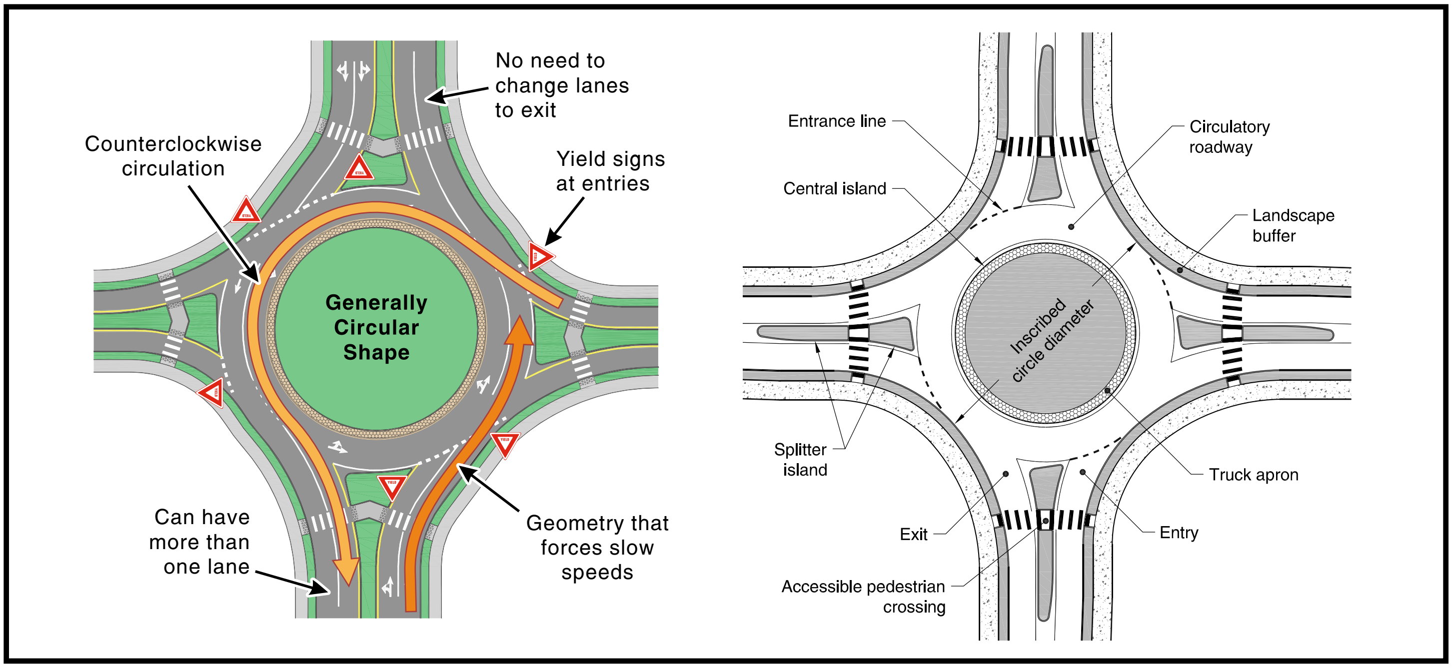
Appendix E - Roundabouts

Circular intersection forms have been part of the transportation system in the United States for over a century. Their widespread usage decreased after the mid-1950s, as rotary intersections began experiencing problems with congestion and safety. However, the advantages of the modern roundabout, including modified and improved design features, have now been recognized and put to the test in the United States. There are now estimated to be well over a thousand roundabouts in the United States and tens of thousands worldwide, with the number estimated to be increasing in the United States each year.

Example Roundabout

A modern roundabout has the following distinguishing characteristics and design features:

- Channelized approaches;
- Yield control on all entries;
- Counterclockwise circulation of all vehicles around the central island; and
- Appropriate geometric curvature to encourage slow travel speeds through the intersection.



Roundabout Characteristics (left) & Roundabout Design Features (right) [FHWA, 2010]