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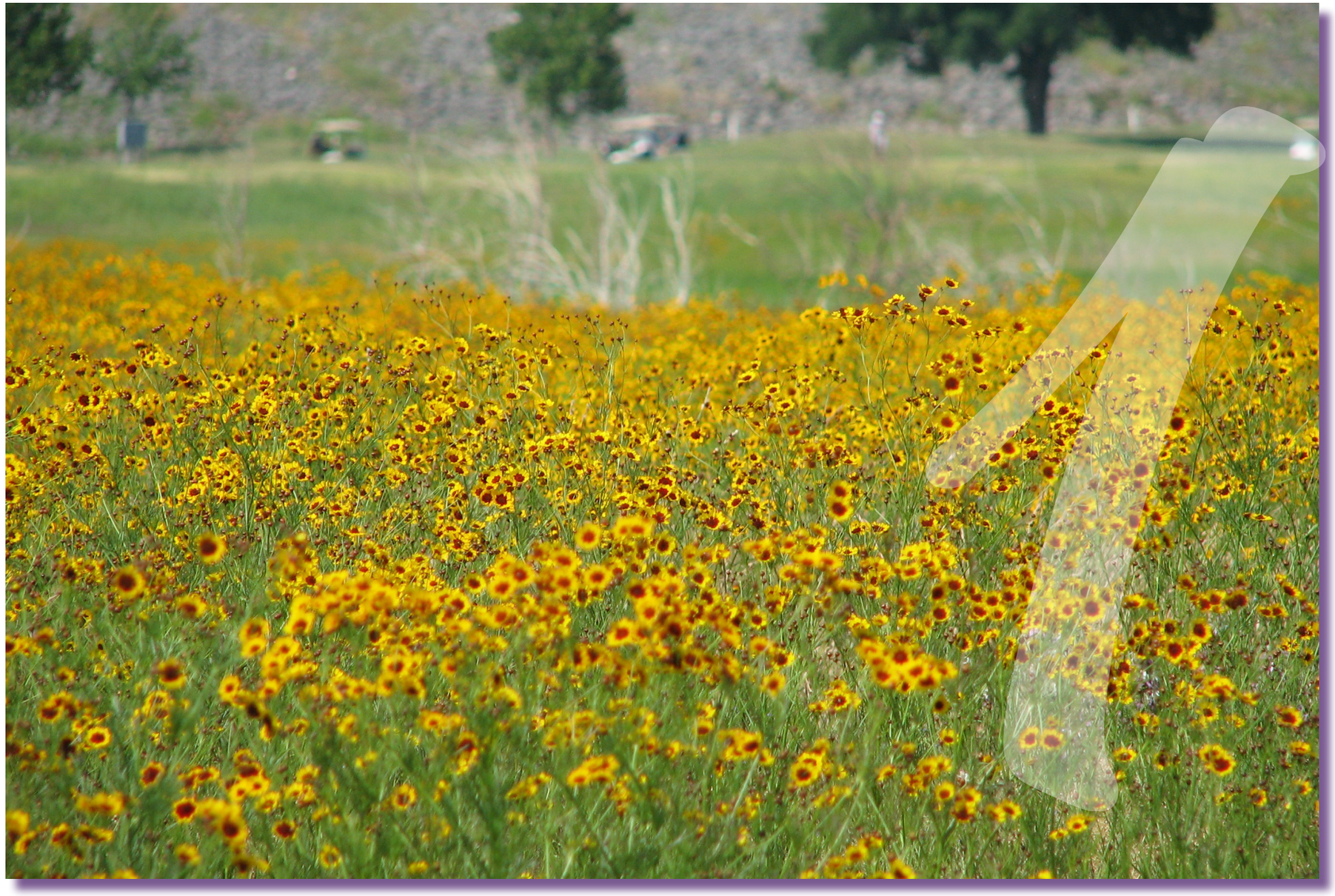

Chapter 1 - Introduction

Overview & Purpose of the Trails Master Plan

The 2011 Lewisville Trails Master Plan was developed through a joint effort between the citizens, City officials, and City staff in order to help Lewisville become a premier city for trails. This plan (developed with the assistance of Halff Associates, Inc.; hereafter referred to as "the Planning Team"), includes priorities, cost estimates, and standards that will help guide the City in making decisions about future trail development. Most importantly, this plan was developed with the input of Lewisville's citizens and this input has guided the development of every component of the plan.

The purpose of the Trails Master Plan is to provide a road map for the comprehensive development of trails, sidewalks, and bike routes throughout the city. This plan acts as a tool to help staff coordinate between City departments, with other planning efforts (such as the thoroughfare master plan, parks master plan, and the comprehensive plan), non-city agencies (such as utility companies and railroads), and other jurisdictions (such as adjacent cities, counties, the North Central Texas Council of Governments, the Texas Department of Transportation, the Denton County Transportation Authority, and the United States Army Corps of Engineers).

This plan will also help the City of Lewisville compete for grants from various regional, state, and federal sources, including the North Central Texas Council of Governments, the Texas Parks and Wildlife Department, and the Texas Department of Transportation.

The Master Plan Process

The Trails Master Plan has been developed based upon the following process, which comprehensively analyzes the existing and future trail system and identifies the most effective manner in which to achieve the best results for the City of Lewisville and its citizens.

Context (Chapter 2)

This portion of the Trails Master Plan examines the internal and external factors influencing the character, quality, and quantity of trails in Lewisville. Lewisville's background is explored, including a brief history of the City and a summary of existing trail user groups in the city. Next, the community's demographics are analyzed to understand how Lewisville compares to the Metroplex, the state, and the nation and how the city's unique demographic composition might influence trail use. Then, a review is performed of several of the City's relevant planning documents, including the comprehensive plan, to better understand the past, present, and future of Lewisville and how this Trails Master Plan might impact, and be influenced by, other planning efforts in the City. This chapter also includes an analysis of regional connections and opportunities to connect to surrounding cities and to larger regional trail networks. Finally, this portion concludes with a review of existing trails in Lewisville and a discussion of what opportunities might exist for the future.

Determining the Need for Trails (Chapter 3)

This chapter includes two primary components: public involvement and a trail benchmark analysis. The first portion of this chapter provides a review of the public involvement process that was used during the creation of the Trails Master Plan, as well as the results of that involvement. In the second portion of this chapter, benchmarks and standards from other communities are examined and a target "level of service" (LOS) is developed to help determine how many miles of trail per capita the community needs. Both the public input and the target level of service will help determine trail needs.

Creating a Premier Trails System (Chapter 4)

In Chapter 4, the information discussed in Chapter 2 and Chapter 3 is converted into concrete actions. The first component of this chapter contains an analysis of the unique needs, preferences, and challenges of each of the major trail user groups. The second main component provides descriptions of recommended facility types to be included in the Trails Master Plan. These facility types include trails (which are typically off-street, meaning they are along creeks or utility corridors, not roads), enhanced sidewalks (which are wider than standard sidewalks and include additional pedestrian amenities), bike routes (which can consist of a signed route, a shared lane, a striped bike lane, or a cycle track), and canoe/kayak trails along water bodies. Next, the opportunities and constraints present in Lewisville are identified; specifically, major destinations, attractors, and trip-generators (including multi-family residential areas, attractive natural areas, schools, major employment centers, parks, and transit areas) are mapped and analyzed. With these opportunities and constraints in mind, this chapter concludes with the development of overlapping networks of new trails, enhanced sidewalks, and bike routes.

Spine Corridor Analysis & Prioritization (Chapter 5)

In Chapter 5, the sixteen key spine trail segments, which serve as crucial connections within the system (and are identified in Chapter 4), are analyzed in detail. Each segment analysis includes a description of the alignment, a review of its opportunities and constraints, and a brief discussion of the key issues related to developing that segment. In addition, a planning-level cost estimate is provided for each segment, as is an evaluation score, which represents the overall connectivity, access, ease of implementation, and value to the community of the segment.

Trail Design Standards (Chapter 6)

As a tool to ensure that the trails that are built in Lewisville are high quality, attractive, and easy to use, trail design standards are presented in Chapter 6. While there are general state and national standards for the development of trails, these standards focus on the engineering and safety side of trail design. The design standards included in Chapter 6 focus on the aesthetic design of trails and should be considered in addition to applicable state and national standards. These design standards have been developed as part of this Trails Master Plan project and consider many aspects of trail design, including signs

and monuments, pavement patterns, rest area design, and so forth. They are included herein and are to be adopted by the City for all future trail construction.

Implementation (Chapter 7)

Chapter 7 provides a detailed plan for the implementation of the trail network as discussed in Chapter 4 and the spine segments analyzed in Chapter 5. This chapter provides a summary of the recommendations, including estimated total construction costs and annual maintenance costs. The chapter begins with an implementation plan that recommends phases of trail development in order to develop Lewisville's trail system in a cost-effective manner. Also included are cost estimates that have been developed for the key trail alignment priorities as identified in Chapter 5 and for the system as a whole. These estimates consider various cost-impacting items such as pavement width, signage, trail markers, creek crossings, and so forth. In conclusion, this chapter (and the report itself) is rounded out with a discussion of the overall strategies that should be utilized to develop the trail system, including the utilization of grants and coordinating trail development with other public works projects.

A Vision for Lewisville

Throughout this document, you will see the phrase *"Active Adventure...Creative Connections."* This phrase reflects the vision of the community to develop a high-quality trail system that provides miles of opportunities for recreation, exercise, and connections between homes, schools, parks, shops, and jobs. This phrase, repeated throughout this document, is a helpful reminder of this vision, as it is truly an integral part of every component of the Trails Master Plan. As a whole, this phrase simplifies the vision; however, each of the words within this phrase relate to a very specific and important component of the vision.

Active

People enjoy trails because they provide opportunities for low-cost, healthy activities. Regardless of age or demographics, trails can be used by citizens of all physical abilities. Providing opportunities for people to be active and healthy is paramount to the success of Lewisville's trail system.

Adventure

Besides simply providing a place to walk or bike, trails should be *exciting*. Using a trail should include some level of adventure or exploration for its users, whether that be coming in close contact with nature or learning something new. The trail system should be fun to use and enjoyable; simply said, trails should enhance the City's overall quality of life.

Creative

Lewisville is a mature community quickly approaching its build-out. Creating a premier trail system requires looking for creative options and opportunities. In addition to creating a network of paved trails and natural surface trails, options for enhanced sidewalks, bike routes, and even canoe/kayak trails along water bodies should be explored.

Connections

Finally, it is important that the trail system provide meaningful connections between where people are and where they want to go. With rising gas prices, increased traffic congestion, and the growing desire for people to be more active in their lives, it is important to consider that trails, sidewalks, and bike routes serve *transportation*, as well as recreation, roles.

Goals & Objectives

Broadening the vision set forth above, a series of goals and objectives for the Trails Master Plan and Lewisville's trail system have been developed. These goals were directly developed based upon the input that was received from the citizens that took part in the public involvement process. This set of goals should be applied comprehensively to all trail-related decisions made by the City in the future.

Be Multi-Functional

Create a trail system that is multi-functional and meets the needs of both recreation and transportation users, provides a multi-modal active/alternative transportation network, enhances recreation opportunities, and provides necessary end-of-route amenities in order to satisfy the needs of the community.

- Recognize that the trail system (including trails, sidewalks, and bike routes) serves both a recreation and a transportation function; create a system that effectively meets the needs of both functions
- Improve human mobility; enable active transportation; minimize traffic congestion; provide a multi-modal transportation system
- Enhance recreation opportunities and satisfy the needs of the community
- Provide necessary end-of-route amenities for recreation users (benches, water, etc.) and transportation users (bike racks, shade, etc. at transit stations, trailheads, and destinations)

Be Accessible

Provide an accessible trail system that is visible, easy to use, easy to understand, and easy to access. Construct trails and routes to meet the needs of the city's diverse population; provide maps, signs, and trailheads to help guide people along trails and routes; and ensure that trails and trail access points are distributed evenly across the city.

- Make the trail system a visible component of the city's recreation and transportation systems
- Make the trails easy to understand and use: provide mapping, signage, wayfinding, and accessible trail heads
- Evenly distribute trails and trail access points across the city so that all people have easy access to a trail

Enhance Quality of Life

Ensure that the trail system enhances quality of life by being attractive, enjoyable, high-quality, and reflective of the identity and history of Lewisville.

- Locate trails in scenic, natural areas whenever possible so people can experience nature and enjoy open space
- Utilize themes when the opportunity exists
- Provide quality trail amenities such as benches, overlooks, bike racks, shade, etc.
- Reflect the identity & history of Lewisville
- Enhance the physical beauty of the city through revealing natural areas, providing attractive facilities, landscaping, etc.

Be Context Sensitive

Develop trails and routes in a context sensitive manner, which is sensitive to the natural environment and neighborhoods and enhances the built environment.

- Be sensitive to the environment, wildlife, trees, and neighborhoods while still providing adequate facilities for the city
- The trail system should have a positive or neutral effect on the natural and built environment.

Provide Connections & Linkages

Form a trail system that is continuous and that provides connections and linkages east and west across IH-35E and between parks, schools, neighborhoods, shopping, jobs, and adjacent cities.

- Provide connections between east and west across IH-35E
- Create linkages between parks, neighborhoods, shopping areas, jobs, etc.
- Ensure that the trail system is continuous
- Connect with adjacent cities and tie into other regional planning efforts

Be Safe

Make trails, sidewalks, and bike routes safe by eliminating barriers for cycling, ensuring that trails are safe and secure for all users, and educate users on trail safety & etiquette.

- Eliminate barriers for cycling and improve existing streets through the provision of signage and striping and improving surface condition
- Encourage facility use and educate people on safety and etiquette
- Promote transportation use of the system
- Adopt design standards that dictate facility types, widths, construction methods, signage, and other facets of trail, sidewalk, and bicycle facility development
- Ensure adequate emergency access is provided for all trails so emergency personnel and vehicles can quickly and safely access all locations along the trail system

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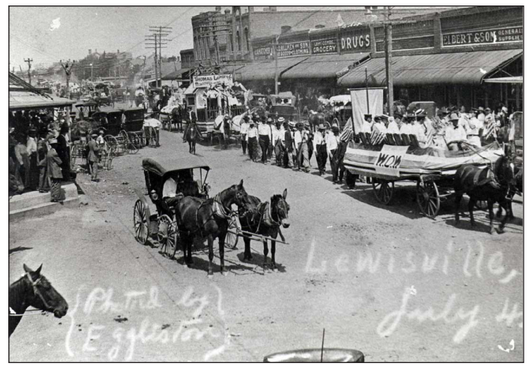
Chapter 2 - Context

Background

Lewisville is a diverse, well-established community in one of the most dynamic locations in the Dallas-Fort Worth Metroplex. It is the 14th largest city in (and a prominent gateway to) the Metroplex. Lewisville has a population of approximately 92,850 and is home to over 3,500 businesses. One of the more unique aspects of Lewisville is that while the City has experienced rapid growth over the last five years, it is a community with a rich history as well.

A Brief History of Lewisville



Lewisville's history dates back to 1841 when the Republic of Texas and the Texas Emigration and Land Company established a program to bring 600 families into present-day Denton County by deeding large tracts of land to the new settlers. Prior to this, much of the land in this part of Texas was inhabited by Native Americans from the Wichita Tribe (which were subsequently driven from this area into present-day Oklahoma). The first settlers arrived in present-day Lewisville in 1844; the settlement at the time was known as "Holford Prairie." Eleven years later, Basdeal Lewis purchased this land and changed the name of the settlement to "Lewisville." In 1881, the Wichita Railroad (now owned by Union Pacific) was extended, which drove the development of Lewisville's downtown area, known today as "Old Town."

Lewisville became an incorporated city in 1925 with a population of approximately 850. The city at the time had limited infrastructure, which included a low-capacity, privately-owned water utility corporation and very limited electricity. To generate electricity, many houses had their own wind turbines. The city's founders quickly began establishing ordinances (including a city-wide speed limit of 18 miles per hour) and developing public buildings. By 1927, Lake Dallas (a reservoir built north of Lewisville on the Elm Fork of the Trinity River) was completed and began providing a water source for Dallas. In the late 1940s and early 1950s (at which time the city had a population of about 1,500), the United States Army Corps of Engineers built the Garza-Little Elm Dam and demolished the dam containing Lake Dallas. This created the Garza-Little Elm Reservoir (now known as the Lewisville Dam and Lewisville Lake). This provided a much larger drinking water supply to Lewisville and other surrounding communities and also provides one of Texas' most popular recreational lakes.

Lewisville continued to grow steadily until 1970, when it had a population of 9,200. Between 1970 and 1990, the city grew very rapidly and quickly transformed from a rural community to a booming suburb, reaching a population of 46,500 in 1990. Perhaps foreshadowing this building boom, the Texas International Pop Festival was held in Lewisville in 1969. This festival, which included stars such as Janis Joplin and Led Zeplin, occurred two weeks after the famous Woodstock Festival and is claimed to be the largest concert ever held in Texas (with estimated attendance ranging between 120,000 and 150,000 – many times greater than Lewisville's population). Lewisville continued to grow after 1990 (reaching a 2000 population of over 77,737) but at a more stable pace than in the previous decades.

Walking, Running & Biking in Lewisville

As with many cities in Texas, walking was at one point a major form of travel in Lewisville. In fact, it was 1913 before the first cars arrived in the city. Old Town was originally built before cars were prevalent and was laid out in such a way that was conducive to walking; this included having short blocks, sidewalks, and easy access between residential areas and commercial areas. With the increased presence of cars, the construction of IH-35E in the 1950s, and rapid construction of subdivisions, walking became less common. However, in the 1990s and 2000s, walking (along with running and biking) began growing in popularity in Lewisville and across the nation as an enjoyable recreational activity that is healthy, fun, and inexpensive.

Today, many of Lewisville's citizens enjoy these activities and often cite trails as one of the most important types of recreational facility in the City. Besides trails, people often prefer to walk, run, and bike along streets because of the different experience this affords, the ease of navigation (because they have likely driven these streets before), and the ability to travel longer distances than is possible on the current trails system. While most of Lewisville's pedestrians, runners, and cyclists participate as individuals, there are also several clubs that are either based in Lewisville or have Lewisville residents constituting a considerable portion of their membership. There is also a handful of running shops and bicycle shops in and around Lewisville, which often sponsor clubs and/or hold regular runs/rides for their customers.

Finally, it is a growing trend across the country to walk and bike as a means of alternative transportation. While the current number of people in Lewisville that utilize alternative transportation is relatively small, many people say that they would like to be able to access jobs, shops, parks, schools, the lake and river, and other destinations by means of trails, sidewalks, bike routes, and kayak/canoe routes. Many factors influence this trend including the cost of fuel, increased traffic congestion, the ability to fit a work-out into ones commute, and simply the desire to better enjoy traveling from one place to another. In addition, tourism drives the need for alternative transportation options. When people travel to the nation's most popular tourism destinations, they find (and often expect) high-quality trails and bike routes that connect important tourism spots within the city.

Demographics

Understanding demographics is an integral part of the development of any planning document, including this Trails Master Plan. In this section, Lewisville's population growth, median age, ethnicity, and travel characteristics are analyzed and compared to those of the Dallas-Fort Worth Metroplex, the State of Texas, and the United States. Drawing such parallels helps to identify unique attributes within Lewisville and identify current and future trends.

Population Growth

As discussed earlier, Lewisville experienced rapid population growth in the 1980s and 1990s and then stabilized to a more even-paced rate of growth. Since 2000, Lewisville has continued to grow, but at a slower rate than the Metroplex and the State of Texas. However, between 2007 and 2008 Lewisville's rate of growth once again exceeded that of the Metroplex and the State as a whole. The table below compares Lewisville's population levels over time with those of the Metroplex, the State of Texas, and the United States.

Table 2.1
Population: 1990 - 2009

	Lewisville	Metroplex	Texas	United States
1990	46,521	--	16,986,510	248,709,873
2000	77,737	5,221,801	20,851,820	281,421,906
2005 (est)	81,484	5,727,391	22,270,165	288,378,137
2008 (est)	88,212	6,150,828	23,845,989	301,237,703
2009 (est)	92,850	6,637,230	--	--

Source: U.S. Census Bureau, 2006-2008 American Community Survey; North Central Texas Council of Governments 2009 Population Estimates

It is difficult to compare population growth between Lewisville and much larger areas when only considering total population numbers. Figures 2.1 and 2.2 compare population growth between the four geographies considered in Table 2.1 (Lewisville, the Metroplex, Texas, and the United States) by comparing each year's total population as a percentage of a starting year population.

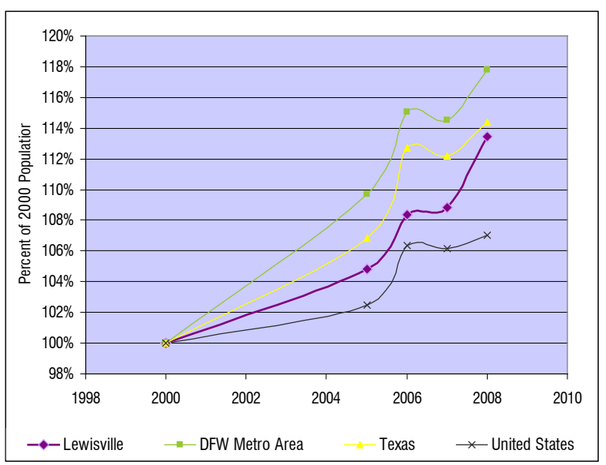


Figure 2.1 – Population Growth: 2000 to 2008

In this figure, each geography's population is compared to its population in the year 2000 (which is a base of 100%). As an explanation of how to interpret this figure, consider the line for Lewisville – it is at approximately 113% for 2008, which means that it's 2008 population is 13% greater than its 2000 population.

What can be seen in this figure is that while Lewisville grew in population from 2000 to 2008, it grew at a slower rate than that of the Metroplex and Texas. However, it can also be seen that Lewisville's rate of growth from 2007 to 2008 increased more dramatically than the rates of the other three geographies.

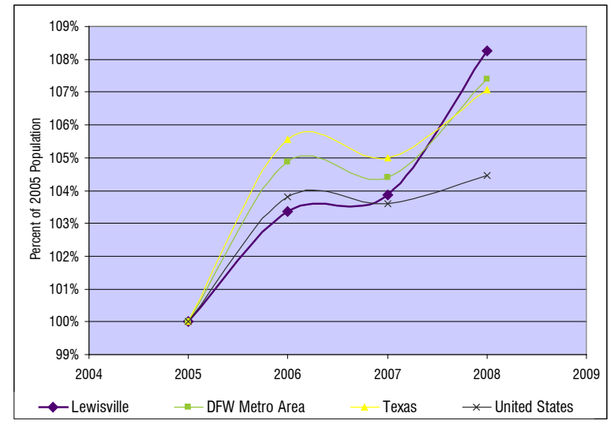


Figure 2.2 – Population Growth: 2005 to 2008

When comparing population growth with a starting year of 2005, Lewisville's 2007 to 2008 population growth becomes even more apparent. This figure illustrates that Lewisville's 2008 population is 8% greater than its 2005 population and that Lewisville had a higher rate of growth between 2005 and 2008 than the Metroplex, Texas, or the United States.

Median Age

Compared to the three other geographies, Lewisville is a relatively young city with a median age of only 31. The median age in the Metroplex and Texas is 33.2 for both while the median age in the United States is 36.7. While not a direct reflection of citizens' propensity to walk, run, or bike, a low median age could indicate a larger percentage of the population able to participate in these activities.

Race & Ethnicity

Lewisville's racial composition generally reflects that of the Metroplex with four significant differences. First, Lewisville has a lower percentage of Black/African American residents; second, there is a lower percentage of people claiming "other" as their race; third, Lewisville has a higher percentage of Asian residents; and fourth, Lewisville has a much higher percentage of people identifying with two or more racial groups. Table 2.2 below illustrates the racial compositions of Lewisville, the Metroplex, Texas, and the United States.

Table 2.2
Race

	Lewisville	Metroplex	Texas	United States
White	69.0%	69.2%	71.4%	74.3%
Black/African American	11.4%	14.0%	11.5%	12.3%
American Indian or Alaska Native	0.2%	0.5%	0.5%	0.8%
Asian	7.0%	4.8%	3.4%	4.4%
Native Hawaiian or Other Pacific Islander	0.0%	0.1%	0.1%	0.1%
Other	6.1%	9.5%	11.3%	5.8%
Two or More	6.2%	2.0%	1.9%	2.2%

Source: U.S. Census Bureau, 2006-2008 American Community Survey

The United States Census Bureau does not consider Hispanic/Latino a race; rather, it is considered an ethnicity and is therefore not included in the racial composition categories as illustrated above. Table 2.3 illustrates the percentage of the population that is Hispanic/Latino and that which is not Hispanic/Latino.

Table 2.3
Hispanic/Latino Ethnicity

	Lewisville	Metroplex	Texas	United States
Not Hispanic/Latino	76.5%	73.2%	64.1%	84.9%
Hispanic/Latino	23.5%	26.8%	35.9%	15.1%

Source: U.S. Census Bureau, 2006-2008 American Community Survey

Travel Characteristics

The U.S. Census Bureau records information on how people travel to work and the time it takes people to get to their job. This information does not correspond with the inclination to walk, run, or bike for recreational purposes, but does reflect their inclination to walk, run, or bike as a form of transportation. One can argue that the number of people using alternative modes of transportation in Lewisville might be higher than is reflected in the Census data because this data only considers trips to work, not trips to a store, to school, or to other non-work related destinations.

Travel Mode

The word "mode" is used to describe the type of transportation utilized and includes automobile (either driving alone or carpooling), public transportation (bus, light rail, and commuter rail), bicycle, walking, and other (including taxicab and motorcycle). While people use various modes of transportation, the Census Bureau only records the mode used for trips to and from work. The Census Bureau also records how many people work at home and therefore do not use a defined mode of transportation to arrive at work. Table 2.4 depicts the percentages of the population using each of the modes defined above for their trips to and from work. It can be seen that a higher percentage of Lewisville's population drives alone to work when compared to the Metroplex, Texas, and the United States. However, Lewisville's percentage of people that bike to work is higher than the average for the Metroplex and for Texas.

Table 2.4
Work Trip Travel Mode

	Lewisville	Metroplex	Texas	United States
Drove Alone	84.4%	79.9%	78.6%	75.8%
Carpooled	9.4%	11.5%	12.4%	10.6%
Public Transportation	0.8%	1.6%	1.7%	4.9%
Bicycle	0.5%	0.2%	0.2%	0.5%
Walked	0.9%	1.3%	1.8%	2.8%
Other (including taxi & motorcycle)	0.7%	1.3%	1.6%	1.3%
Work at home	3.2%	4.1%	3.6%	4.0%

Source: U.S. Census Bureau, 2006-2008 American Community Survey; North Central Texas Council of Governments 2009 Population Estimates

Travel Time

In addition to recording how people get to work, the Census also records commute time. Table 2.5 shows the time that Lewisville residents spend traveling to work.

Table 2.5
Work Trip Travel Time

	Lewisville	Metroplex	Texas	United States
Less than 10 Minutes	11.5%	10.4%	13.9%	14.3%
10 to 19 Minutes	24.7%	26.8%	30.1%	29.8%
20 to 29 Minutes	20.2%	21.4%	20.4%	20.6%
30 to 44 Minutes	29.4%	23.9%	20.6%	19.6%
45 Minutes or more	14.2%	17.5%	15.0%	15.6%

Source: U.S. Census Bureau, 2006-2008 American Community Survey; North Central Texas Council of Governments 2009 Population Estimates

It can be seen that close to half of Lewisville residents spend over 30 minutes traveling to or from work, which is disproportionately higher than the Metroplex, Texas, and United States residents. However, the percentage of Lewisville residents traveling less than 10 minutes to work is higher than the average for Metroplex residents. This figure is important because it means that the 11.5% of Lewisville's population that have travel times of less than 10 minutes likely live within five to ten miles of their jobs (assuming travel speeds of between 30 and 60 miles per hour). It is this portion of the population that is most capable of walking or biking to work if safe, convenient, and adequate facilities (such as trails, sidewalks, and bike routes) were made available.

Other Relevant City Plans

While this Trails Master Plan is the first of such plans in Lewisville, it is strongly influenced by past planning efforts and policies. Each of the plans discussed below has informed and shaped the analysis, recommendations, and priorities set forth in this Trails Master Plan in varying ways.

Comprehensive Neighborhood and City-wide Planning Program (2010 Plan)

This plan (also known as the 2010 Plan) has served as Lewisville's comprehensive plan since its adoption in 1994. The 2010 Plan identifies six major action items and outcomes, which are: strengthen neighborhoods and housing, enhance economic development, revitalize Old Town Lewisville, ensure quality development, plan the future of east Lewisville, and create strong community image. While the 2010 Plan does not provide direct guidance for the development of trails, its comprehensive guidance for Lewisville's future growth informs the Trails Master Plan about future conditions and development patterns within the city.

East Lewisville Land Use Plan

Completed in 2000, the East Lewisville Land Use Plan was a direct result of the aforementioned "2010 Plan" and was developed to identify land use and development potential in the area of Lewisville that is east of the Denton County Transit Authority railroad (formerly a Missouri-Kansas-Texas Railroad line). In the plan, areas suitable for develop-

ment were identified and specific land use development concepts were created for three primary areas. In total, this plan identifies the potential for 1,919.6 acres in East Lewisville to be developed as light industrial, commercial, multi-family residential, and single-family townhouses. This plan informs the Trails Master Plan as to how east Lewisville will grow in the future.

Thoroughfare Master Plan

Lewisville, as with most cities, maintains a Thoroughfare Master Plan that is updated regularly and indicates the general alignment and configuration of current and future streets. Lewisville's current iteration of the Thoroughfare Master Plan was adopted in 2003 and includes alignments for new roadways in the southern and eastern parts of the city. These new roadways are considered during the development of the Trails Master Plan and opportunities are sought after to plan for bike routes, sidewalks, and trails along these new streets so that they may be implemented concurrently with new street construction. Related to the Thoroughfare Master Plan, the Texas Department of Transportation is currently in the design phase of a project to expand IH-35E. Coordination between the City and TxDOT is of great necessity to ensure that adequate bicycle and pedestrian crossing over and under the newly-expanded IH-35E are provided.

Old Town Master Plan

This plan was adopted in 2003 and focuses on the revitalization of Old Town Lewisville (the area along Main Street, east of IH-35E). In addition to recommending zoning revisions, infrastructure improvements, and other area enhancements, the Old Town Master Plan recognizes the area's lack of sidewalks. Recommendations are made therein to develop a sidewalk system to build community cohesion and to provide an alternative to driving for short trips. Two key recommendations related to sidewalks include acquiring additional right-or-way and requiring sidewalk construction as individual parcels are redeveloped within the district. Because of its attraction as a destination for shopping, dining, and government services, connecting to Old Town via a city-wide trails system is of crucial importance.

2006 Land Use Assumption Report

This report was developed as an update to the aforementioned "2010 Plan" to reflect changing growth trends and to provide a basis for updating the City's future land use map, zoning districts, and impact fees. The key result of this report is the identification of areas for future low- and high-density residential, mixed-use, commercial, and office development. At the time of its writing, this report projected a population growth of an additional 30,151 by the year 2015. As with the Old Town Master Plan, the Land Use Assumption Report recognizes that Lewisville is quickly approaching build-out and must shift its focus toward infill development and redevelopment of existing areas.

Parks, Recreation & Open Space Plan

Under development at the time of writing, Lewisville's upcoming 2011 Parks, Recreation & Open Space Master Plan will take a comprehensive look at current parks, recreation facilities, and open spaces and make recommendations for the improvement, expansion, and operation of the City's parks and recreation system. Because trails provide ample recreation opportunities, this Trails Master Plan has been developed concurrently with the Parks, Recreation & Open Space Master Plan.

Economic Development

Though Lewisville does not have a comprehensive plan for economic development (rather, it has multiple smaller plans oriented toward specific issues or locations), the actions of the City's Economic Development Corporation (EDC) is instrumental in implementing each of the aforementioned plans. The EDC is or has been involved in many projects across the City that support walking and bicycling, including the Levee Improvement District Master Plan (which is currently being developed). Several of these projects, specifically those near future transit stations, will benefit greatly from trail and bike route connections. Finally, the City's economic development activities also directly support trails and other quality of life enhancements through economic and community development (4A and 4B) sales tax funds.

Regional Connections

The Regional Veloweb

The Regional Veloweb is a network of planned off-street bicycle paths designated by the North Central Texas Council of Governments (NCTCOG). The Veloweb includes 644 linear miles of planned paths stretching across Denton, Collin, Tarrant, and Dallas Counties. Of these 644 miles, 119 have been constructed and another 34 have been funded. The identification of alignments for the Veloweb is a result of cooperative planning between the NCTCOG and local jurisdictions. While the NCTCOG provides varying levels of assistance in constructing Veloweb route segments, it is in effect the responsibility of each city to construct the Veloweb. There are two unbuilt, unfunded Veloweb routes that pass through Lewisville. These routes, once constructed, will connect Lewisville to the surrounding region, allowing people to travel to other cities by bicycle along safe, car-free paths. This Trails Master Plan reflects the recommended routes of the Veloweb and makes minor modifications to some of their general alignments.

Denton County Transportation Authority Bicycle and Pedestrian Trail

The Denton County Transportation Authority (DCTA) is in the process of constructing its first commuter rail line (the "A-Train"). The A-Train line will be 21 miles in length and will connect downtown Denton with the Dallas Area Rapid Transit (DART) Green Line in north Carrollton. The Dart Green Line became operational toward the end of 2010; construction began on the A-Train line in early 2009. The A-Train line will pass through Lewisville (east of IH-35E) and will have three stations in Lewisville. The planned locations of these three stations include one at Garden Ridge on the east side of IH-35E, one east of Old Town between College and Main Streets, and one at Hebron Parkway. The A-Train is being constructed to accommodate a hike-and-bike trail along its entire length, which provides an extraordinary opportunity for Lewisville to connect with surrounding cities. Such a trail would provide connections with the Trinity Trail System, a much larger regional trail system. This Trails Master Plan includes a trail along the A-Train line and plans for connections with other planned trails and bike routes.

Surrounding Cities

Each of the major cities surrounding Lewisville has an existing trails system and many have adopted planned trails for the future. Making connections with the trails in surrounding cities is one of the most essential characteristics of providing regional connections; just as the city's street network makes connections with the street networks of surrounding cities. This section discusses what opportunities exist to connect to each of these cities.

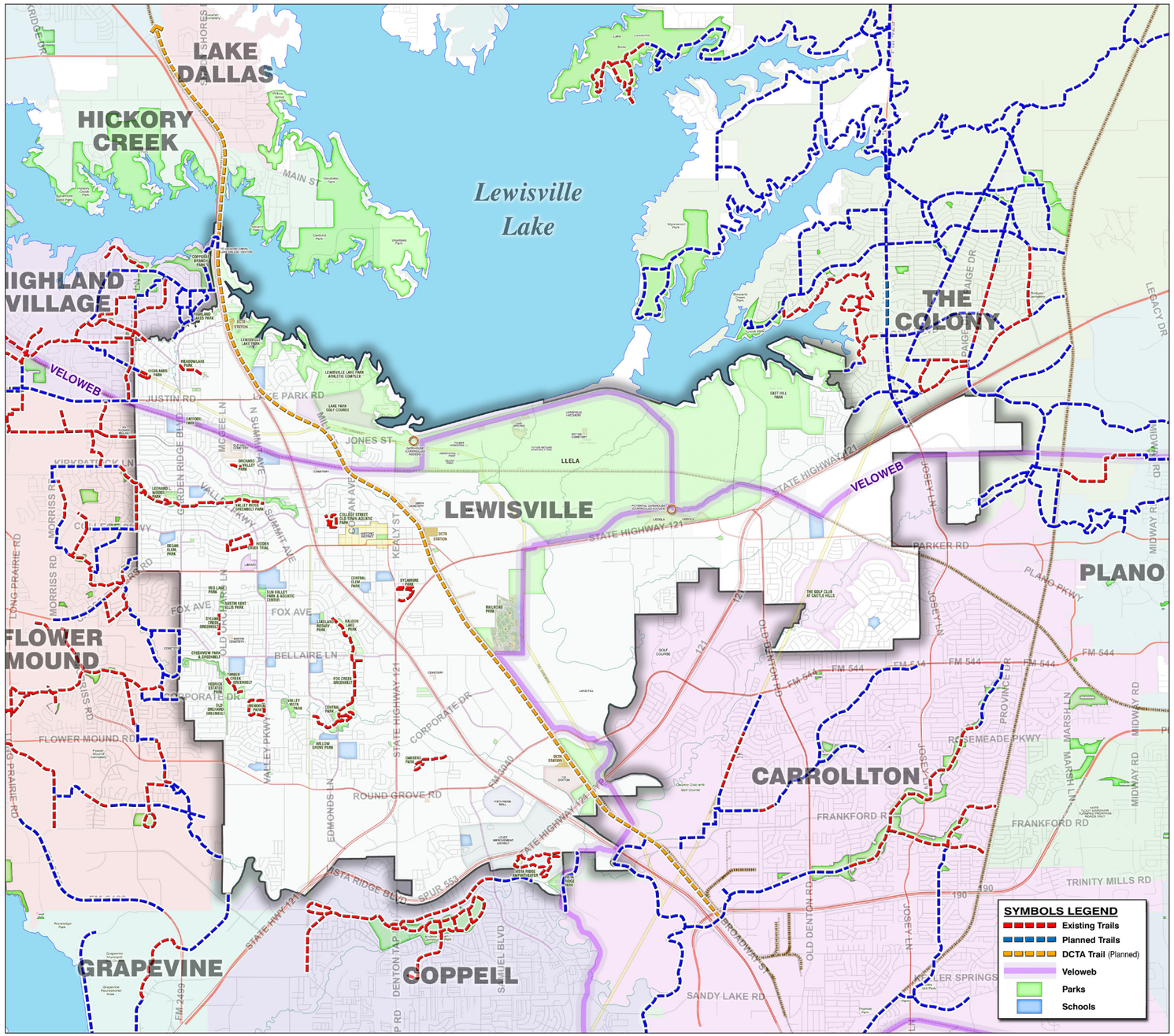


Figure 2.3 – Regional Connections and Existing Trails

This figure illustrates current and potential trail connections with surrounding cities and the region as a whole. Shown on this map are the Regional Veloweb, the DCTA "A-Train" Bicycle and Pedestrian Trail (alignment shown as planned by DCTA), and the existing and planned trails of each of the cities surrounding Lewisville. One can see that there are ample opportunities to provide trail connections to Lewisville's western and southern neighbors (Highland Village, Flower Mound, Grapevine, and Coppell) as well as a few opportunities to connect to its eastern neighbors (Carrollton and The Colony). Additional nearby cities (Plano, Lake Dallas, and Hickory Creek) should also be considered in the analysis, though there is much less of an opportunity to provide direct connections to these cities other than through the aforementioned Veloweb and DCTA Trail.

Also shown on this map are Lewisville's existing trails. There are currently 14.02 miles of paved trail in Lewisville; many of these miles are located within four primary linear trail corridors. These four corridors include Prairie Creek, Old Orchard Lane, Timber Creek, and Fox Creek. In addition, there are several loop trails dispersed throughout the city such as at Meadowlake Park, Highlands Park, College Street / Old Town Aquatic Park, Orchard Valley Park, Memorial Park, Oakbend Park, Sycamore Park, and the lakes in the Levee Improvement District (which is south of Vista Ridge Mall).

Highland Village

Highland Village currently has 2.8 miles of paved trails, as well as a trails system master plan which plans for future paved trails, sidewalks, nature trails, bike routes, and equestrian trails. There are several opportunities for connecting to Highland Village's trails. One such opportunity is to connect along the Texas-New Mexico Power Company's transmission easement (which runs through Lewisville's Highlands Park). Another such opportunity is to connect with Highland Village's planned trail along the north shore of Copperas Branch Lake by constructing a trail along Copperas Branch Creek, which flows north from the intersection of Garden Ridge Boulevard and Brazos Boulevard. There is also an opportunity to create a trail connection along the Kansas City Southern railroad line which would also connect to Flower Mound. Finally, there are opportunities to provide connections along thoroughfares, specifically along Brazos Boulevard and along IH-35E (which is slated to be expanded in the near future and will allow for the construction of a pedestrian bridge that will cross Lewisville Lake and provide connections to Highland Village and other cities to the north).

Flower Mound

Lewisville is arguably more physically connected to Flower Mound than to any of the other surrounding cities because of the dozens of roads and several creek corridors that cross the border between the two cities. Flower Mound has a well-developed trail system with several miles of existing trails and multiple planned trail corridors. There are many opportunities to provide sidewalk and bike route connections along existing and future

roads. Specifically, Valley Ridge Boulevard, College Avenue, and Corporate Drive all provide opportunities for on-street connections based upon Flower Mound's adopted trails master plan. There are also three creek and greenbelt corridors which provide trail connection opportunities. The City of Lewisville has already built trails along two of these corridors (Prairie Creek, which flows through Valley Ridge Greenbelt Park and Lenard L. Woods Park, and along Timber Creek, which flows through many parks in Lewisville including Creekview Park & Greenbelt). The third creek and greenbelt corridor opportunity is along Bakers Branch, which flows through the very southern portion of Lewisville where it merges with Denton Creek. Out of these three creek corridors, the City of Flower Mound has only, to date, built trails along Prairie Creek though the City has planned trails for the other two corridors. Finally, there is also an opportunity to connect with Flower Mound through the Kansas City Southern railroad line as mentioned earlier.

Grapevine

The City of Grapevine has a well-developed trails system which will eventually include nearly 34 miles of hard and soft surface trails. Of this, 22 miles of trails have already been constructed across the city. Most of these trails are located in the core of Grapevine and along the southern shore of Grapevine Lake, but there is one existing trail in the Grapevine Mills area. That trail is about one mile in length and could possibly be extended northeast along Denton Creek to its confluence with Bakers Branch Creek to connect with planned and existing trails in Flower Mound and Coppell and affords an opportunity for Lewisville to connect to this area as well.

Coppell

The City of Coppell is currently in the process of developing its trails master plan. Currently, Coppell has three main trails that are spread across the city. Most relevant to Lewisville are Coppell's existing trails along Denton Creek, which pass through Andrew Brown Jr. Community Park. These trails come to within one half of a mile of Lewisville's Vista Ridge Park and the trails which run through the Levee Improvement District (the area roughly bounded by IH-35E on the east, Vista Ridge Mall Drive on the north, Rockbrook Drive on the west, and Denton Creek on the south). Connecting to Coppell through this corridor would require less than 3,000 linear feet of trail.

Carrollton

The City of Carrollton has an adopted trails master plan which focuses trails primarily along creeks and utility easements. The City does not have any existing or planned trails that provide connections to Lewisville, but there are two primary opportunities for connection. The first is along Indian Creek and the TXU Easement that roughly parallels the creek, which would connect Carrollton to the Castle Hills area. The second opportunity is to connect to Carrollton with a hike and bike trail and/or a canoe and kayak trail along the Elm Fork of the Trinity River. An additional connection opportunity already discussed is the future trail along the DCTA A-Train line, which would connect Lewisville to Carrollton as well if a trail bridge is provided across the Trinity River.

The Colony

The City of The Colony has a long-range trail master plan which includes over 51 miles of existing, planned, and proposed routes. Of these 51 miles, just over five miles of trails exist currently in The Colony. The most relevant trail segment is the recently-completed Shoreline Trail, which is an approximately four mile long natural surface trail that stretches from Stewart Creek Park in the north, along the shoreline of Lewisville Lake (through U.S. Army Corps of Engineers Wildlife Management Areas), and currently terminates at Ridgepointe Park. The terminus of this trail is located approximately a half of a mile from Lewisville's city limits near the recently developed residential area known as "Meridian," which is adjacent to East Hill Park, west of the Lewisville Lake Environmental Learning Area (LLELA). Providing a connection to this trail would be very valuable, but might require one or more pedestrian bridges in order to create the connection.

Existing Trails

Lewisville currently has approximately 14.02 miles of trails. Some of these trails are linear in form (such as the 1.8 mile long trail that runs through LL Woods Park and the Valley Ridge Greenbelt) while some are loop trails (such as the three-quarter mile long loop trail at Hidden Creek Trail). This section discusses Lewisville's existing trails for these two categories.

Linear Trails

As mentioned in the caption for Figure 2.3, many of Lewisville's existing trails are linear in nature—following creeks, utility lines, and roadways—and fall within one of four linear corridors. Some of these corridors are more complete than others, proportionately having more linear miles of trails than their counterparts. These four linear trail corridors provide the foundation and backbone for Lewisville's trail system.

Trails along Prairie Creek

Prairie Creek flows from Flower Mound east into Lewisville and eventually merges with the Elm Fork of the Trinity River just south of the Lewisville Dam (in LLELA). In some locations, this is a highly-urbanized creek with engineered banks and concrete channels. In other locations it has been left in a more natural state. Before entering LLELA and merging with the Elm Fork, Prairie Creek flows through LL Woods Park and Valley Ridge Greenbelt Park. There are currently about 1.8 miles of trail along this corridor, which connects these two parks with each other, the surrounding neighborhoods, and Flower Mound's trail system. Figure 2.4 shows the location of this corridor and the existing trails located therein. The existing trails in Orchard Valley Park and College Street / Old Town Aquatic Park are not considered part of this corridor because they are considered to be loop trails. The opportunity exists to extend these trails to the east to connect with historic Old Town and the planned trail along the DCTA "A-Train" line. This is currently the most developed trail corridor in Lewisville.

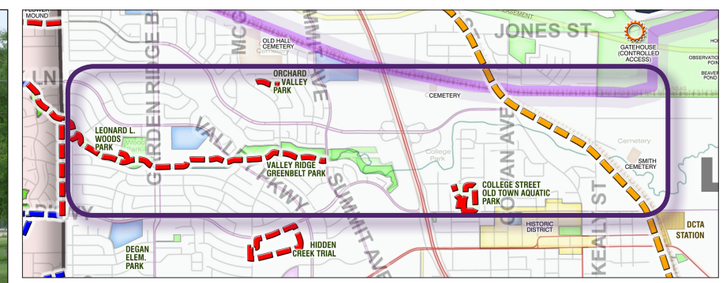


Figure 2.4 – Trails along Prairie Creek

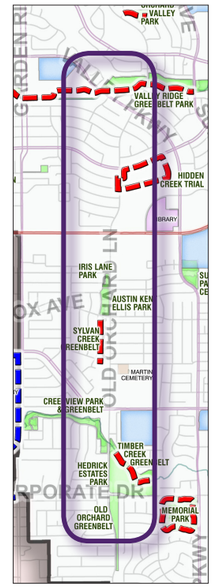
This figure illustrates the 1.8 miles of existing trails along Prairie Creek. These trails run from Lewisville's western city limit (and into Flower Mound) to Summit Avenue on the east. The dashed orange line represents the planned DCTA Trail which crosses Prairie Creek between Mill Street and Kealy Street.

Trails along Old Orchard Lane

Unlike the other three linear trail corridors discussed in this section, these trails follow a man-made feature rather than a natural feature. While a portion of the existing trails in this corridor run along Old Orchard Lane, some of the trail passes through off-street utility easements and City-owned right-of-way. Old Orchard Lane presents an opportunity to connect the trails along Prairie Creek with the trails along Timber Creek. While the distance between these two creeks is about 2.1 miles, there is only approximately 0.74 miles of trail existing in this corridor (and a considerable portion of this is south of Timber Creek). In addition to the desirability of connecting the trails along the two creeks, it is also desirable to continue the trails along this corridor in order to connect the many parks located therein.

Figure 2.5 – Trails along Old Orchard Lane

The figure to the right shows the existing trails along the Old Orchard Lane corridor. These trails pass through the Sylvan Creek, Old Orchard, and Timber Creek Greenbelts. Also, while not actually a linear trail, the Hidden Creek Trail is within this corridor, which can serve as a needed connection between the trails along Prairie Creek and Timber Creek.

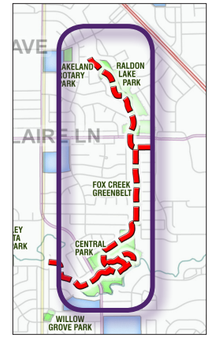


Trails along Fox Creek

The fourth corridor in which there are existing trails is along Fox Creek from Ralden Lake Park to Central Park, where the creek merges with Timber Creek. The creek is channelized and very urban as it flows through Ralden Lake Park, but remains more natural in the Fox Creek Greenbelt and Central Park. This is the shortest of the four corridors listed in this section, but one of the more complete (there are about 1.4 miles of existing trail in this 1.6 mile long corridor). One area of concern is the crossing of Bellaire Boulevard. The crossing is not adjacent to a controlled intersection and includes some narrow sidewalk segments.

Figure 2.7 – Trails along Fox Creek

This figure shows the extent of existing trails along Fox Creek, which connect multiple parks. These trails tie into trails along the Timber Creek corridor at Central Park. The primary issue in this corridor is the trail crossing at Bellaire Boulevard.

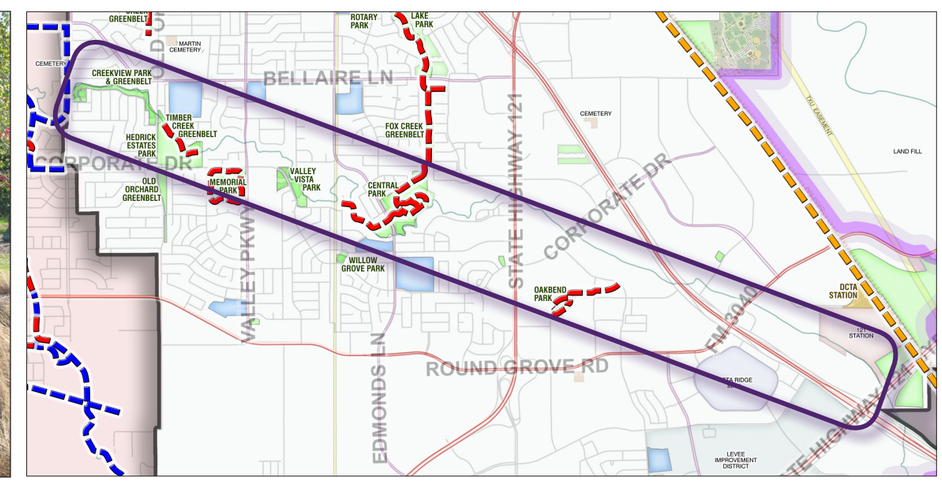


Trails along Timber Creek

Timber Creek is one of Lewisville's most valuable creek corridors because it is one of the city's most pristine. The creek is south of Prairie Creek and flows east from Flower Mound, through several of Lewisville's parks, and merges with the Elm Fork of the Trinity River near the IH-35E/SH-121 interchange. There are a number of existing trail segments along Timber Creek (totaling about 1.5 miles; 0.5 of these miles is along Corporate Drive, which parallels Timber Creek), including Lewisville's newest trail, aptly named "Timber Creek Trail." One of the major destinations along this trail is Central Park, at which point the Timber Creek Trail intersects with a trail that runs north along Fox Creek. This corridor provides a great opportunity to connect west Lewisville with the area around Vista Ridge Mall, the Levee Improvement District, the future DCTA Trail and a future DCTA transit station.

Figure 2.6 – Trails along Timber Creek

This figure shows the scale of this almost 6 mile long corridor. Current trail segments exist in the Timber Creek Greenbelt and Central Park, where this corridor intersects with the Fox Creek Corridor. Opportunities exist to connect parks, schools, neighborhoods, businesses, and transit.



Loop Trails

Loop trails are often contained wholly within a park, do not typically provide a connection within a larger linear corridor, and are quite often "destination trails" to which people travel to in order to exercise. There are many benefits of loop trails – they allow people to walk a little more or a little less during their exercises by simply taking more or less laps around the trail, they allow parents to exercise while still being able to supervise their children playing in the park, they are often lower in cost than linear trails because there is generally less land to acquire, and they enhance the park within which they are located. While loop trails often do not provide connections within larger linear corridors, they can in fact play this role. The obvious example in Lewisville is the loop trail in Central Park. While it is itself a loop trail, it provides a connection between the trails along Fox Creek and the trails along Timber Creek.

Summary of Existing Trails

There is a total 14.02 miles of existing trails in Lewisville; 5.41 of these miles consist of trails along linear corridors while 8.61 of these miles consist of loop trails. Table 2.6 lists all of the existing trail segments in Lewisville along with their approximate lengths. While loop trails have many benefits for the community, one of the primary goals for this Trails Master Plan is to provide ample linear trails across Lewisville in order to provide connections within the community.

Table 2.6
Existing Trails in Lewisville

Linear Trail Corridors	Miles of Existing Trail
Trails along Prairie Creek	1.77
Trails along Old Orchard Lane	0.74
Trails along Timber Creek	1.55
Trails along Fox Creek	1.35
Loop Trails	**Miles of Existing Trail**
Highlands Park	0.38
Meadowlake Park	0.31
Orchard Valley Park	0.16
Hidden Creek Trail	0.75
College Street / Old Town Aquatic Park	0.61
Sycamore Park	0.81
Memorial Park	0.86
Central Park	1.01
Oakbend Park	0.62
Levee Improvement District	1.60
Railroad Park	1.50
Total Miles of Existing Trail	**14.02**

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LEWISVILLE

Deep Roots. Broad Wings. Bright Future.

The 2011 Lewisville Trails Master Plan

"Active Adventure... Creative Connections"

Chapter 3 - Determining the Need for Trails

Introduction

Before the Planning Team can begin determining the quantity, location, and characteristics of future trails, it must first determine the overall need for trails in Lewisville. There are many methods by which the need for trails, sidewalks, bike routes, and other pedestrian- or bicycle-oriented facilities are determined. The three primary methods used in this Trails Master Plan to assess needs are 1) citizen demand as expressed through the public involvement process, 2) a benchmark analysis, which compares Lewisville with other cities, and 3) a latent demand analysis, which considers the potential demand for pedestrian and bicycle facilities based upon proximity to key trip generators and attractors. None of these methods alone can substantiate a comprehensive assessment of the need for bicycle and pedestrian facilities and each of these methods has its own advantages and disadvantages. Therefore, each of these methods is utilized to determine trail needs in Lewisville. In this chapter, the results of the public involvement process are analyzed and a benchmark analysis is performed. Latent demand is analyzed in a hybridized method in Chapter 4 – "Creating a Premier Trails System" and in Chapter 5 - "Spine Corridor Analysis & Prioritization."

Public Involvement

Meeting with and gaining the input of the citizens of Lewisville was a crucial part of the Trails Master Plan. This input, gained through a series of focus group and public meetings, guided the development of each component of this plan. The goals of the public involvement process were to:

- Understand the "culture of use" of bicycle and pedestrian facilities in the community
- Gain citizen input on a draft set of trail alignments, including identifying potential additional or alternative facility alignments
- Understand user preference for facility variables such as surface material, width, character, and end-of-route facilities
- Identify key destinations, obstacles, and hazards

The purpose of establishing these goals was to ensure that adequate levels and types of information were gathered during the process in order to successfully meet the needs of the community and to complete the analysis performed in Chapter 5 – Trail Network Development & Corridor Analysis. Each of these goals was achieved at various points during the public involvement process.

The Public Involvement Process

The public involvement process for this Trails Master Plan included a focus group meeting, a public workshop, a booth at Lewisville's annual Western Day Festival, and a final public review meeting. At each of these events, a questionnaire was distributed to each participant. These questionnaires supplemented the verbal comments made during the meetings and allowed each person to share their thoughts and opinions on trails in Lewisville.

Focus Group Meeting – July 8, 2009

The first portion of the public involvement process was to hold a focus group meeting, which included representatives from the Parks and Recreation Board and members of the running and cycling community. The specific outcomes sought during this meeting were to understand the goals of various user groups, gain input on amenities and end-of-route facilities, and to discuss the limiting factors of the City's current trail system. This meeting utilized a nominal group process in which three questions were asked and each person was invited to respond to each question:

1. What are your goals for the Trails Master Plan?

- Improve the flow of human traffic; people need to be more mobile
- Enhance recreation opportunities
- Involve the community and satisfy their needs
- Plan for the future (10 to 30 years from now)
- Provide better connectivity and access to destinations, including jobs, and to adjacent cities
- Be sustainable and preserve/protect the environment
- Be safe and be accessible for emergency vehicles
- Minimize traffic congestion and provide a multi-modal/alternative transportation system
- Apply themes to trails to connect them with the identity of the community
- Be easily maintained
- Be easy to navigate by including maps and signs

2. What facilities and amenities are important at trailheads, along trails/routes, and at destinations?

- Wayfinding aids (maps, directional signs, mile markers)
- Drinking fountains and showers
- Emergency response aids (911 call boxes, ID trail markers, etc.)
- Bike racks, bike lockers, and air stations (to inflate tires)
- Exercise stations, benches, and shade along trails
- Parking
- Trash and dog waste receptacles
- Lighting along trails and at trailheads
- Art

3. What are the limiting factors of the existing trail system?

- Lack of variety
- Lack of visibility of the system
- No direct path / lack of continuity
- Lack of trailhead facilities
- Maintenance conditions
- Safety at intersections
- Narrow and limited right-of-way
- Lack of wayfinding aids
- Poor or misunderstood trail etiquette
- Lack of education for motorists and pedestrians/cyclists

Public Workshop – August 12, 2009

A public workshop was the second major component of the public involvement process. The purpose of this meeting was to present the preliminary trail and route alignments to the public and receive comments. While there were attendees from the general public, many of the people in attendance at this meeting were from home-owners associations and running and cycling clubs. After a brief large-group discussion, during which the planning team asked a series of questions to the attendees, the formal meeting was ended and attendees were invited to move about the room to view and comment (verbally and with pens and stickers) on a series of maps.

Three questions were asked during the formal portion of the meeting: "What do you like about Lewisville's existing trails?"; "What would you like to see in the future?"; and "How do trails function as part of a broader vision for the future of the city?" While this portion of the meeting was intended to develop ideas and strategies for trail development in Lewisville, discussion of these questions was very limited because many of the attendees were focused on discussing specific trail alignments in one portion of the city. However, the results of the limited discussion align with the results of the focus group meeting and show that citizens are interested in variety; connectivity with transit, schools, shops, and other cities; and amenities along trails (such as mile markers, dog waste stations, directional signs, and trailhead parking).

During the map-based portion of the meeting, citizens were given the opportunity to comment on specific trail or route alignments, make suggestions why a specific alignment was or was not a good idea, recommend alternative alignments, and recommend priority between various alignments. Additionally, citizens were given multi-color dot stickers and asked to place blue dots on the map to represent important destinations and red dots to represent hazards or barriers for trail users. The result of this portion of the meeting included modifying a few recommended trail and bike route alignments in order to reduce impact on surrounding home owners and the addition of some key destinations and hazards/obstacles previously unknown to the Planning Team.

Western Day – September 26, 2009

Lewisville's Annual Western Day Festival is one of the City's biggest special events and draws crowds from across the region, as well as large portions of Lewisville residents. The City of Lewisville Parks and Leisure Services Department (PALS) hosted a booth at the festival in order to gain citizen input on the Trails Master Plan. A large five-foot by six-foot map of existing and proposed bicycle and pedestrian facilities was on display. Members of the Parks and Recreation Board, City Staff, and the Planning Team were on hand during the event to discuss the plan with citizens, answer questions, and record comments. Additionally, a two-page questionnaire was provided to and completed by 68 people. This helped raise awareness of existing trails in Lewisville and of future plans.

Summary of Questionnaire Results

As mentioned previously, one of the major components of the public involvement process was a two-page questionnaire, which was distributed at each meeting and at the Western Day Festival. In total, 102 people completed the questionnaire. This section illustrates the results of the questionnaire and serves as an overall summary of the results of the public involvement process. It was identified early on in the development of this Trails Master Plan that, in addition to traditional trails, it would be important to consider other facility types – specifically, sidewalks and bike routes. Therefore, the questionnaire was divided into two sets of questions. The first set focused on trails and sidewalks while the second set focused on bike routes.

Trails & Sidewalks

Throughout the public input process, citizens commented that they enjoy Lewisville's existing trails but there needs to be more trails that are better connected to each other. In order to better understand how to move forward in developing additional trails in the city, the questionnaire sought to determine why people enjoy Lewisville's current trails. In general, the things that people most enjoy about current trails are their proximity to nature and the attractive scenery along trails, the fact that trails are located close to where people live (or are otherwise convenient to use), the peaceful and quiet nature of the trails, and the cleanliness and safety of Lewisville's trails.

In addition to asking about their perception of current trails, respondents were asked to give their opinions on what they would like to see in the future. In terms of the most important amenities on trails, they are natural areas (64% think this is important), shade (58%), hard surface trails (50%), and neighborhood access (45%). Besides amenities, many people have strong preferences as to where they think future trails should be located. Most people would like to see new trails in natural areas (78%), neighborhoods (62%), and utility corridors (59%). Just over half of the respondents like trails along railroad corridors (53%) and only about one third like trails that run along streets (34%).

Finally, people were asked to rank a series of potential priorities for Lewisville's trail system. Overall, the respondents ranked these priorities as follows:

Priority 1 *– Feeling safe on trails*

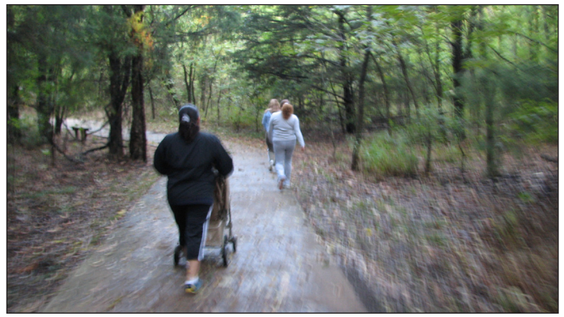
Priority 2 *– Trails located in scenic areas*

Priority 3 *– Trails close to where I live*

Priority 4 *– Trails wide enough for all types of users*

Priority 5 *– Convenient parking or access to trails*

Priority 6 *– Bike lanes along roadways*



The first three of these priorities (safety, scenic, and convenience) rated much more strongly than the other three. This implies that these three priorities are significantly more important to most people than the others. However, it is important to recognize that every one of these priorities was ranked as number one for some of the questionnaire respondents. In fact, almost 20% of the respondents said that "bike lanes along roadways" should be Lewisville's number one trail priority, even though this priority ranked lowest when considering all of the questionnaire responses.

It should be noted that 56% of the respondents stated that if Lewisville had safe pedestrian/bicycle routes connecting neighborhoods, schools, recreation, and civic uses, that they would use them to access these areas instead of driving. While it could be debated that Lewisville already has safe pedestrian routes (e.g., sidewalks) that connect these areas, this statistic illustrates a latent demand for additional alternative transportation facilities within the city.

Bike Routes

Bike routes are an important component of alternative transportation and can also serve recreation and fitness needs within the community. The questionnaire therefore asked for input on a potential future system of bike routes within Lewisville. The initial question asked was for what all purposes does the respondent ride a bicycle (respondents were allowed to indicate multiple purposes so the following results total well over 100%). A somewhat surprisingly large

percentage of the questionnaire respondents (22%) said that they use their bicycle for transportation purposes (primarily to commute to work or school or for trips within their neighborhood). Additionally, 58% cycle for recreation and 42% cycle for fitness. Approximately 30% of questionnaire respondents do not ride a bicycle at all.

In order to better understand the preferences of the public in terms of bicycle facility development, respondents were asked to rank a series of six priorities. The ranking of these priorities helps to determine preferences on items such as whether the City should focus on developing a small number of long-distance, highly-developed, major routes or provide smaller-scale bicycle facilities throughout the community. The result of these priorities are below.

Priority 1 *(tie) – Add to current standards so that superior bicycle facilities are planned into new development from the beginning*

Priority 1 *(tie) – Provide bicycle facilities throughout the city*

Priority 3 *– Focus on improvement of existing streets (provide route signs, improve surface condition, add striping, etc.)*

Priority 4 *– Focus on improvements to reduce or eliminate key existing barriers*

Priority 5 *– Development of one or two long-distance, major routes that have a high ease of use for the average user*

Priority 6 *– Focus on end of trip facilities (showers and changing areas, bicycle racks, parking facilities, etc.)*

Even though the top two items tied for first, the first four items (the two number 1 priorities as well as priority 3 and 4) were all within a few percentage points of each other in terms of overall importance. The inferred implication of these results is that the average citizen prefers moderate bicycle facility improvements on a city-wide basis rather than major facility improvements in one or two corridors. This reflects a desire to have a network of bike routes rather than one or two "bicycle boulevards" (or some other sort of major bicycle route) in Lewisville.

Trail Benchmark Analysis

In determining the overall need for trails, it is important to compare Lewisville's trail system with those of other cities. The following section includes an analysis of the trail systems of several cities similar or close to Lewisville, an assessment of Lewisville's current trail system in meeting the community's needs, and a target level of service for the amount of trails in the city.

Benchmark Cities

Seven benchmark cities were chosen for comparison to Lewisville's existing trail system. Each of these cities are either adjacent to Lewisville or are comparable to Lewisville in terms of the cities' development status (that is, they are close to build-out, as is Lewisville). The following comparison considers only existing, hard-surface trails (many of these cities have additional miles of soft-surface trails, which have not been considered for comparison purposes as the results of the public involvement process and discussions with City leadership indicate that Lewisville should focus its trail system on hard-surface, rather than soft-surface, trails). In Table 3.1, the number of existing miles of trails is compared to each city's current population. This results in a population-per-mile benchmark by which each city can be compared. A lower population-per-mile benchmark figure means that there are more miles of trail per capita in that city; this indicates a *higher* level of service. In simple terms, a lower population-per-mile benchmark figure is better (note that these figures consider only the quantity of each city's trails, not the quality).

Table 3.1
Benchmark City Comparison

	Existing Miles of Trails	2009 Population (est.)	Population per Mile (LOS)
Carrollton	6	120,950	20,150
Coppell	6	39,550	6,600
Grapevine	22	47,950	2,200
Flower Mound	32	62,800	2,000
The Colony	5	40,100	8,000
Plano	56	263,800	4,700
Richardson	40	99,700	2,500
Average	--	--	***6,600***
Average (minus Carrollton)	--	--	***4,300***

Source: North Central Texas Council of Governments 2009 Population Estimates; Various City Trail Maps and Master Plans

This information reveals that Grapevine, Flower Mound, and Richardson, which provide one mile for every 2,000 to 2,500 people, have a higher level of service for their citizens than do the other benchmark cities. In addition, Carrollton stands out has having a much lower level of service than these other cities as over 20,000 citizens share each mile of trail. Finally, an average population-per-mile benchmark figure of one mile per 6,600 people is identified when averaging the benchmark figures of each of these cities. Without Carrollton (which has a large population and very few miles of trails), this average decreases to one mile per 4,300 people.

Lewisville's Current Level of Service

As discussed earlier in this section, a level of service indicates how many miles of trails a city has in comparison with its total population. This LOS is reflected on a population-per-mile basis, with a lower population-per-mile figure indicating a higher (or better) level of service for the community. In 2009, Lewisville had a population of 92,850 and 14.02 miles of existing trails. This results in a population-per-mile figure of 1 mile per 6,600 people. Comparing Lewisville's current population-per-mile figure with the average population-per-mile figure of the benchmark cities shows that Lewisville is effectively on-par with its neighbors (see Table 3.2). However, when considering the average level of service not including Carrollton, it becomes apparent that Lewisville is not providing the same LOS as the majority of the benchmark cities. Again, this lower-than-average level of service does not imply that Lewisville's existing trails are subpar in terms of quality, it simply indicates that Lewisville has less trails per capita (on average) than its neighbors.

Table 3.2 Current Level of Service			
	Existing Miles of Trails	2009 Population (est.)	Population per Mile (LOS)
Lewisville	14.02	92,850	6,600
Benchmark City Average	--	--	6,600
Benchmark City Average (minus Carrollton)	--	--	4,300

Lewisville's Target Level of Service

In order to provide a premier system of trails in Lewisville, it is crucial to establish a target level of service, which will help guide the development of the City's system as Lewisville grows. This target level of service should not simply be high enough to match the benchmark city average level of service, but should aim beyond the average. Three of the cities analyzed in this section (Grapevine, Flower Mound, and Richardson) have excellent levels of service and these cities are therefore known for their extensive trail systems. In order for Lewisville to develop a trail system on par with these cities, it is recommended that the City adopt a target level of service of one mile per 2,500 people.

As can be seen in Table 3.3, adopting a target level of service of one mile per 2,500 people would require that a total of 44.5 miles of trails be provided by the year 2030. This includes Lewisville's 14.02 miles of existing trails and translates into a need to develop 30.5 additional miles of trails.

Table 3.3 Level of Service-Based Trail Needs				
Existing Miles of Trails	Current Level of Service*	Target Level of Service	2009 Trail Needs*	2030 Trail Needs**
14.02	1 mile per 6,600 people	1 mile per 2,500 people	37.1 miles (deficit of 23 miles)	44.5 miles (deficit of 30.5 miles)

**Based on a 2009 estimated population of 92,850*
***Based on a forecasted population of 111,168*
Source: North Central Texas Council of Governments 2009 Population Estimates and 2030 Population Forecasts

Immediately adopting such an aggressive target level of service would indicate that the City needs to immediately construct 23 miles of trails this year. Doing such would likely cost tens of millions of dollars in design and construction fees. Though the City may achieve a windfall (and the rapid implementation of this plan is definitely encouraged), it is more likely that this Trails Master Plan will be implemented over a period of 10 to 20 years. As such, it is recommended that the City of Lewisville sets an initial goal of achieving a level of service of one mile per 3,500 people by 2015. Then, in order to further achieve the goal of providing a premier trail system in Lewisville, this target level of service should be adjusted to a goal of achieving one mile of trail per 2,500 people by the year 2020. Table 3.4 describes this system of sliding level of service targets and illustrates the resulting miles of trails which should be built during various timeframes.

Table 3.4 Sliding Level of Service Targets				
Year	Population	Target Level of Service	Current Year Trail Needs	Miles of Trail to Build
2009	92,850	1 mile per 6,600 people (current)	14.02 miles	--
2015	95,554	1 mile per 3,500 people	27.3 miles	13.3 miles (between 2010 & 2015)
2020	96,844	1 mile per 2,500 people	38.7 miles	11.4 miles (between 2015 & 2020)
2025	105,444	1 mile per 2,500 people	42.2 miles	3.4 miles (between 2020 & 2025)
2030	111,168	1 mile per 2,500 people	44.5 miles	2.3 miles (between 2025 & 2030)

Source: North Central Texas Council of Governments 2009 Population Estimates and 2030 Population Forecasts

With all of this in mind, it is important to understand that a population-per-mile LOS target should not be the sole determinant in the amount of trails planned for the future of Lewisville. Rather, this figure must be considered alongside public demand, opportunities for recreation, and sound planning principles (including connectivity and the establishment of a network of trails that spans the entire city).

Summary of Needs

Many needs have been identified through this process; these needs can be summarized by saying that Lewisville's trail system should be enjoyable, functional, and forward-thinking.

Enjoyable

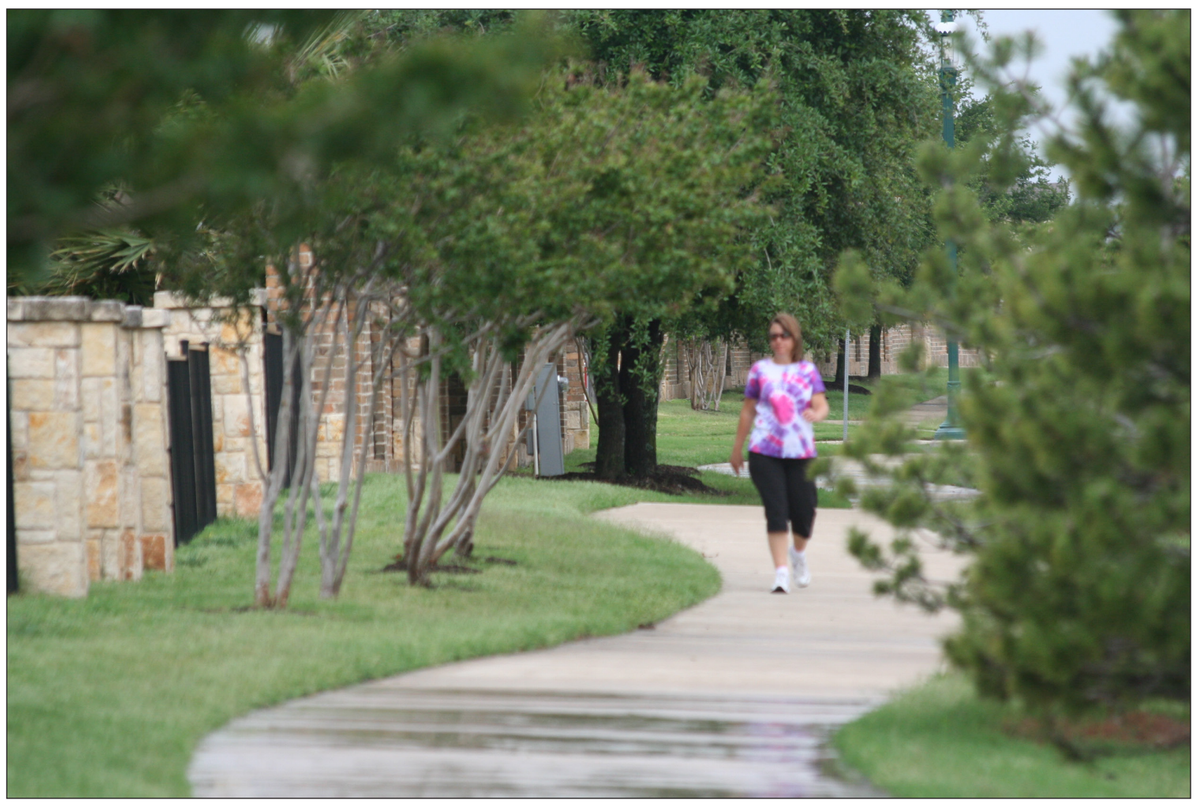
One of the primary reasons people use trails is because they provide an enjoyable source of recreation. As such, many of the needs expressed throughout the public involvement process are related to the importance of Lewisville's trails being enjoyable to use. Specifically, there is a need to enhance Lewisville's recreation opportunities through enjoyable trails that are scenic, have variety (such as various surface materials, locations, views, and amenities), and provide fun alternatives to driving.

Functional

In addition to being enjoyable, trails must be functional. One of the most important needs is for trails to be safe (that is, accident-free) and secure (crime-free). Trails need to be conveniently located within easy access of where people live so that they are usable. It is also important that there are amenities (such as benches, trash receptacles, and bike racks) along trails and at trailheads. Finally, trails should be made visible (through the use of trailheads and signage) so that people can understand the trail system and be aware of its presence.

Forward-Thinking

Lastly, there is the need and public desire for the development of the trail system to performed in a manner that is forward-thinking. The preparation of this Trails Master Plan is seen as a necessary first step in planning for the future in that it provides a road map for the development of continuous trail and bike route networks that span the entire City and provide abundant connections between key destinations. In order to ensure the development of a premier trail system, Lewisville needs to improve its level of service (the miles per capita of trails provided) over the next five to ten years. Finally, it is important to plan bicycle and pedestrian facilities early so that they may be implemented along with future development actions. Specifically, there is a strong need to modify current standards so that bicycle facilities are included as development occurs.

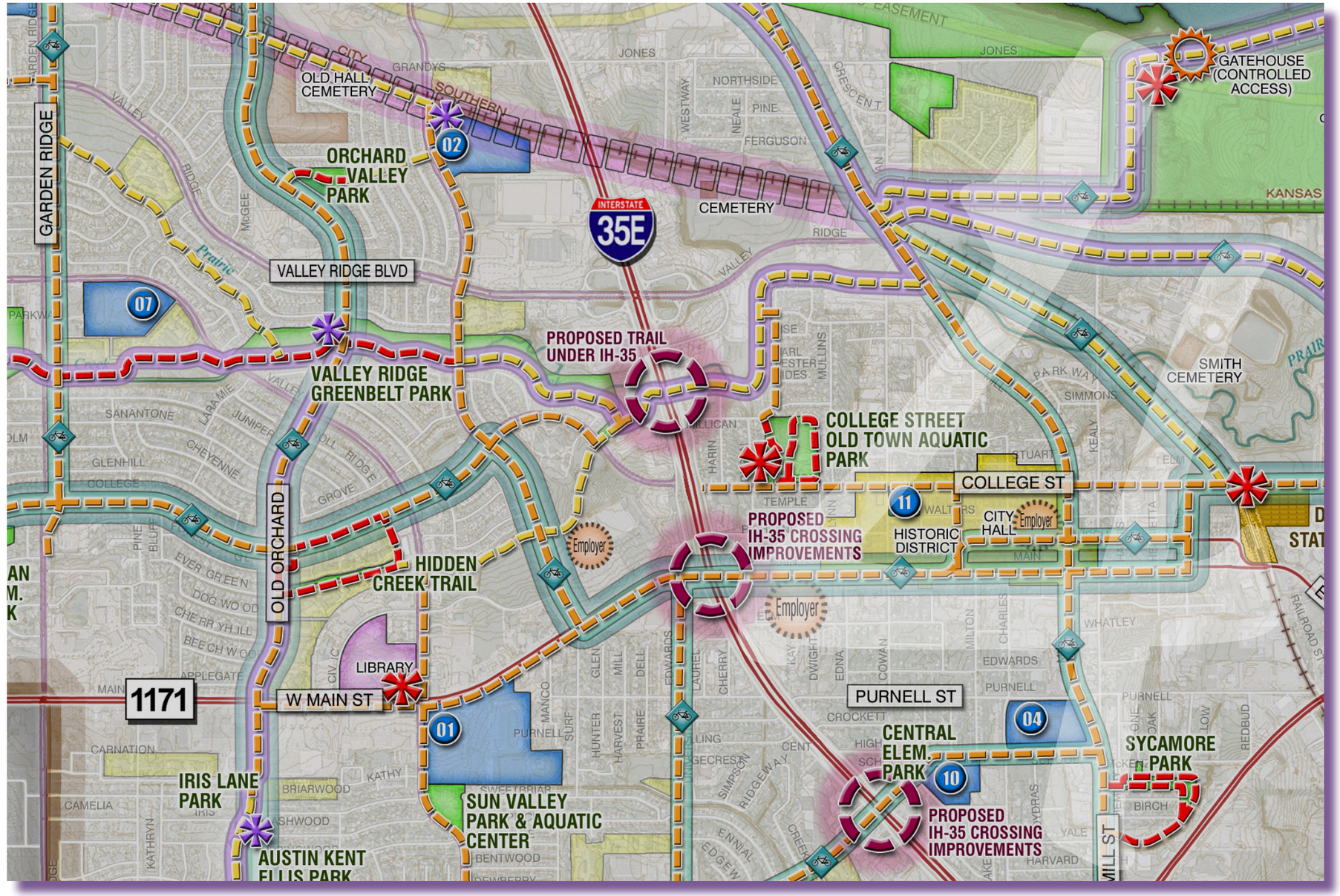


LEWISVILLE

Deep Roots. Broad Wings. Bright Future.

The 2011 Lewisville Trails Master Plan

"Active Adventure... Creative Connections"



Chapter 4 - Creating a Premier Trails System

Introduction

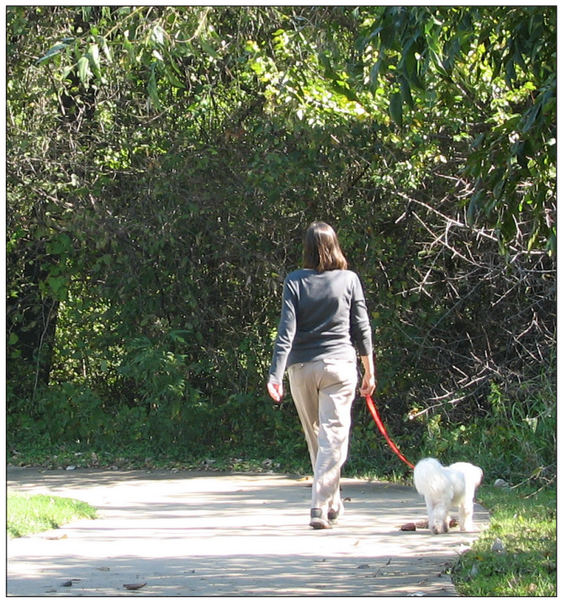
In this chapter, the needs of trail user groups are analyzed, opportunities and constraints across Lewisville are identified and studied, and the alignments of the various facility types that constitute the Trails Master Plan are explained. Planning a trail system that is comprehensive in nature and meets the needs of multiple user groups requires more than simply drawing lines on a map. It requires carefully considering the diverse needs of various types of users and the challenges associated with each, analyzing the unique opportunities and constraints present in Lewisville to identify the latent (or potential) demand for facilities, and developing creative solutions that go beyond the traditional opportunity-based method of planning trails. In essence, trails, sidewalks, and bike routes should be seen as "essential infrastructure" (just as streets, water, sewer, and electricity are) and should be planned accordingly.

Meeting the Needs of Multiple User Groups

One of the primary challenges in developing a system of trails that meets the needs of the entire community is understanding the characteristics, preferences, and challenges presented by the multiple user groups that will utilize the system. In addition to the traditional recreational walking and recreational cycling groups (these two groups represent the "hike" and "bike" in "hike and bike trail"), the spectrum of current and potential trail users in Lewisville also includes runners and joggers, advanced and novice cyclists, and canoers and kayakers. While it is truly important to consider and attempt to meet the unique needs of each of these groups, the City's primary goal should be to identify the shared or overlapping needs of these groups and build a trails system that most efficiently meets these various needs. The following section describes the various characteristics, preferences, and challenges of these trail user group types.

Pedestrians

As referenced above, multi-use trails are often called "hike and bike trails," with the word "hike" referring to various types of pedestrian activities, including walking, running, jogging, or otherwise enjoying the trail on foot. Because these types of activities are decidedly not "hiking" in the traditional sense, the term "pedestrian" is used in this Trails Master Plan instead. Due to the affordability, accessibility, health benefits, and relative ease of these types of activities, the majority of trail users typically fall within this broad category. Overall, pedestrians generally utilize trails because of the recreational experience that they provide. It is important to provide connectivity between neighborhoods and destinations so people can walk to places instead of driving. However, the primary consideration when developing trails for pedestrians is that the trail is enjoyable, attractive, and comfortable. Because pedestrians move at a very slow speed, generally between three to six miles per hour, they "see more" (or notice more visual detail) when using a trail and therefore the aesthetics of both the corridor and the facility itself are more important to this group than to cyclists. As such, these users desire trails which meander through the woods, along a creek, or through some other attractive area and appreciate well-designed amenities (such as scenic overlooks, benches, and trail markers).



Comfort and accessibility are typically the pedestrian's primary determinants when judging the quality of a trail. Therefore, shade along trails; well-distributed amenities like benches, mile markers and wayfinding signage; and access points spaced no more than one mile apart are all essential considerations when designing a trail. It is also important to consider how pedestrian users access trails; some will walk to the trail but many will drive, which requires the provision of adequate parking space at trailheads. The needs of people with physical disabilities and people pushing strollers also need to be considered. The maneuverability requirements of these two groups are similar and can be met by designing trails to meet the requirements of the Americans with Disabilities Act and the Texas Accessibility Standards. Finally, while it is the goal of this Trails Master Plan to develop a continuous network of trails in Lewisville, most pedestrian users are satisfied with trail segments of between one and three miles as such lengths allow two to six mile "out-and-back" trips. This should be considered when developing trail segments in multiple phases.

Walkers

While all of the pedestrian characteristics, preferences, and challenges mentioned above apply to walkers, this subgroup also has some unique needs which deserve consideration. One of the major characteristics of walkers is they generally are more focused on the experience of using a trail, the aesthetics and how scenic it is, and amenities located along the trail than any other user group. Destinations along the trail are also very important to walkers. Examples include on-trail destinations like scenic overlooks and off-trail destinations like schools or shops.

Challenges presented by this group include the fact that many people walk with dogs or small children, walkers typically walk in pairs or groups, which can cause congestion in certain parts of a trail, walkers often change direction or stop abruptly along trails, which can cause conflicts with cyclists, and finally, walkers are more likely than other groups to venture off of the trail, which could result in environmental damage, safety issues, and/or intrusion on private property.

Runners & Joggers

The characteristics, preferences, and challenges of runners and joggers are largely similar to those of walkers, though there are some significant differences. Since high-intensity exercise is the primary purpose or goal of running and jogging, the preferences of these users deal more with the physical characteristics of a trail or sidewalk than they do with aesthetics. Specifically, surface conditions and materials are often of great concern to many runners and joggers. One will often notice a person jogging in the street rather than on the sidewalk; this is often because asphalt is a "softer" material than concrete and induces less fatigue on the runner's joints. Many runners and joggers prefer asphalt, rubberized surfaces, or natural surfaces over concrete because of this. Runners and joggers are often not as concerned with connectivity to destinations as they are with simply having a convenient facility of adequate length to accommodate their exercise routines. In addition, many runners and joggers prefer trails that include hills as this adds an additional challenge and allows for a more strenuous work out. Finally, these users often run or jog alone, but may also run or jog in large groups if they are part of a club or training program.

Cyclists

Cyclists comprise the second primary user group and, as with pedestrians, have much variability between individual users. As opposed to pedestrians, cyclists move at a much faster speed which means that they see much less detail in the landscape and present different design challenges for multi-use trails and other bicycle facilities. Designing facilities for bicycle use requires an approach similar to that used by transportation engineers when designing streets and

highways; specifically, trail alignments must be developed according to predetermined "design speeds," which dictates sightlines, slopes, the radii of curves, etc. Other specifics include the requirement to provide improved shoulders on trails and a detailed regulatory/warning signage system. An important consideration for multi-use trails is that pedestrians and cyclists travel at much different speeds which creates the potential for traffic conflicts between these two groups. Beyond these requirements, cyclists also need facilities with surfaces that are smooth while still providing good traction. Quite often asphalt provides the best surface for cycling. Because of the speed at which they travel, cyclists typically do not accept transitions between facility types as easily as pedestrians do. As an example, pedestrians generally can transition from a trail to a sidewalk without any issues; transitioning from a trail to an on-street bicycle facility, however, is challenging for cyclists. Careful consideration must be given when designing such transitions.

Finally, it is very important to consider the bicycle's place in American society. On the one hand, bicycles are ridden by people of all ages (including very young children) purely for recreational purposes; on the other hand, bicycles are also ridden by skilled adults as a mode of transportation. The bicycle exists in a challenging paradigm as being seen as anything from a "toy" to a "vehicle," depending on the user. Planning for bicycles as part of a city-wide system of trails and routes, therefore, requires recognizing differences in abilities and perceptions amongst cyclists and motorists.

By Type (Transportation or Recreation)

As with all trail activities, cycling is simultaneously a recreational activity while also serving as a form of transportation; as such, cyclists ride bikes both of these reasons. However, most cyclists are decidedly either more recreation-oriented or more transportation-oriented and each type has different preferences.

Specifically, recreation cyclists generally prefer trails/routes that form loops and provide long distances (over five miles). This group is more interested in scenery and varying terrain that transportation cyclists usually are. On this last point, it is interesting to note that many of the accessibility design requirements for trails– as defined by the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and the Texas Accessibility Standards (TAS) – are at odds with the preferences of recreational cyclists. As an example, it is easier for cyclists to navigate a straight slope with a grade of over 8% than it is for them to navigate a series of flatter switchbacks (which is required by ADAAG/TAS).

Transportation cyclists, on the other hand, prefer the flattest, most direct route in most cases as they are often trying to get to their destination in the shortest amount of time possible. They also need clear visibility of destinations and most often prefer routes that do not limit access to adjacent businesses, neighborhoods, etc. For this reason, many transportation cyclists prefer on-street bike routes over off-street trails because on-street routes are inherently more easily accessible to adjacent developments. End-of-route facilities (such as bike racks, drinking fountains, and places to change clothes) are more important than scenery. Finally, access to transit (including bus stops and future train stations) is very important to transportation cyclists as cycling is often only one part of their daily commute.

By Skill Level (A, B, and C Cyclists)

In addition to differences between recreation and transportation cycling, cyclists can also be differentiated by skill level, each of which has different preferences and presents unique challenges to the Trails Master Plan. In 1992, the Federal Highway Administration (FHWA) classified cyclists as falling into one of three categories: A (advanced), B (basic), and C (children). While the definitions used to define these categories are arguably obsolete today, the general theory that cyclists fall within one of three skill levels is still applicable. A modern interpretation of this three-tiered classification is:

- Advanced - These are cyclists that are very experienced in riding with motor traffic and generally prefer to ride on streets. These cyclists will often use on-street bicycle facilities (if they are provided), but will usually choose their own routes and feel comfortable riding in many places that do not have any bicycle facilities. People within this group often see their bike as a replacement for an automobile.
- Basic - Most people, whether they consider themselves a "cyclist" or not, fall within this group when they straddle a bicycle. This group can be easily (and somewhat stereotypically) defined as anyone that does NOT wear spandex when they ride a bike. Basic cyclists might feel comfortable riding on-street in neighborhoods with low traffic or in areas with adequate on-street bicycle facilities, but they often prefer grade-separated paths (i.e., trails). While this group makes up the majority of current or would-be cyclists, it is also historically the least-served in the United States. In many European countries, which enjoy extensive bicycle infrastructure and implement pro-bicycle policies, cycling is often an integral part of the daily lives of most people and basic cyclists make up the majority of users. This group has the most potential for growth in Lewisville and across the country.
- Children and Seniors - While many seniors (and some children) fall into one of the two above categories, they generally fall into a third category based on their experience levels and physical abilities. Generally slower and less quick to react, children and seniors often only ride their bikes on grade-separated paths or on very low traffic streets.

Mountain Bikers

Often cited as destructive and dangerous, the mountain biking community actually spends more volunteer time maintaining trails than hikers and equestrians combined. Environmental stewardship and courtesy are core tenets of mountain biking and groups like the Dallas Off-Road Bicycle Association (DORBA) and the International Mountain Biking Association (IMBA) regularly provide training and education about ecosystems and trail maintenance to its members. That said, mountain biking trails are best suited to large natural areas, very few of which remain in Lewisville. In the future, once they have been closed, the landfills east of IH-35E might be desirable mountain biking areas.

Other Users

Though far less common than pedestrians and cyclists, there are other types of trail users that should be considered. Inline skaters constitute one such user group. The characteristics and preferences of inline skaters fall somewhere between those of pedestrians and cyclists and are generally well-served by shared-use trails built with these other two groups in mind. Similarly, skateboarders and BMX riders are becoming increasingly more prevalent as a user group. While most interested in skate parks and BMX tracks, these users will often use trails and sidewalks to access these facilities. With Lewisville's recently-open skate park at Railroad Park, it is likely that skaters will utilize future trail connections.

Equestrians users constitute yet another group; however, because of Lewisville's mostly urban setting and the sensitive nature of its rural areas (specifically, the Lewisville Lake Environmental Learning Area), there are not adequate locations in the city to provide equestrian trails at this point.

Paddlers

A final user group to consider is "paddlers" - people who canoe and/or kayak. As Lewisville is blessed to have the Elm Fork of the Trinity River flowing through its city limits, there is a great opportunity to develop a "paddling trail" in the city. Compared to other user groups, paddlers have very few needs. The primary need of this group include put-ins and take-outs (locations up-river where people can put their canoe or kayak in the water and locations down-river where people can end their trip). These put-ins and take-outs must be located in areas with fairly flat banks and with shallow water near the shoreline. They need to be easily accessible from paved roads and should have adequate car parking for the volume of river traffic present. Other needs include mile markers along the river to aid emergency responders and drinking fountains and litter receptacles at the put-ins/take-outs. Little maintenance along the river itself is necessary as canoers and kayakers generally prefer for there to be trees, rocks, and other obstacles within the river.

Finding Common Ground

As it can be seen, not all trail users are the same; rather trail user groups have unique sets of characteristics that present unique challenges. Providing a trail system that caters to each of the preferences of each of these groups is both unrealistic and inefficient. Rather, it is important to identify the common ground between these trail users as well as each group's essential needs and develop the trails system based on these aspects. The common ground between pedestrians, cyclists, and other users is that each group needs and desires a comprehensive, interconnected system of facilities (including traditional off-street trails as well as other facility types such as sidewalks and on-street routes) that is:

- enjoyable to use yet also provides connectivity and access to key destinations (that is, serves recreation as well as transportation needs);
- safe and secure;
- understandable and easy to navigate (through trail markers, mile markers, maps, and directional signage); and
- diverse and interesting, yet also familiar (that is, provides multiple facility types and trail environments yet is tied together as a unified system through signage, materials, etc.).

Facility Types

Basing Lewisville's trail system on the common ground between pedestrians, cyclists, and other trail users requires building a pedestrian and bicycle system that is based on a network of off-street trails, but also provides additional facility types to provide access to the system and "close the gap" in areas where off-street trails are not feasible. Most of the facility types recommended in this Trails Master Plan meet some or all of the needs of each user group. Variations between (and even within) these groups and physical limitations (e.g., lack of right-of-way) present the need to provide more than just traditional off-street trails. In order to create a comprehensive, city-wide system for pedestrians, cyclists, and other users, the four following facility types are recommended for Lewisville.

Off-Street Trails

This facility type is the most common component of any city's trail system and is utilized for jogging, walking, recreational cycling, and general relaxation. Primarily designed to provide recreation opportunities, off-street trails are typically located along creeks, through forests, and in other scenic areas. Quite often, these types of facilities are provided along railroad tracks and utility corridors. These facilities are typically two-way, striped concrete pathways, but are sometimes built utilizing other materials such as asphalt or crushed granite. Typically, trails are between 8' and 12' wide (depending on the anticipated type and volume of users; trails that will likely have a large amount of bicycle traffic should be at least 10' wide), constructed of either 4" thick or 5" thick concrete (depending on whether maintenance and emergency vehicles will cross the trail) and must have at least 3' of soft shoulder free of obstructions on either side of the trail (per American Association of State Highway and Transportation officials (AASHTO) guidelines). If land must be acquired for developing an off-street trail, it is recommended that the City acquire a corridor at least 32' wide. A corridor of this width accommodates the width of the trail and its shoulders and provides space for grading, tree protection, trail meandering, overlooks and rest areas. Wider trail corridors also help to maintain the visual integrity of the trail experience. In many cases, additional width may be required to accommodate drainage or other utilities. Table 4.1 illustrates the general guidelines for the development of off-street trails.

Table 4.1 Off-Street Trail Guidelines	
Facility Width	8' to 12' width (depending on anticipated volume)
Surface	Provide 4" thick reinforced concrete and/or brick with City approved sub-base preparation, 3' soft shoulders with prepared sub-base. Increase concrete depth to 5" where heavy maintenance vehicles are expected to cross the trail. Alternatively, the use of natural surface (i.e., crushed granite) is acceptable for lower-traffic trails and/or trails in environmentally sensitive areas.
Access Points	Access shall be no greater than one mile apart, no more than ½ mile walk or ride to an access point.
Minimum Corridor Width	Provide 32' trail and shoulder corridor
Other Facilities	Off-street trails benefit from the provision of parking at trailheads, banners, lighting, directional and informational signage, kiosks, locator maps, mile and ½ mile markers, water fountains, bicycle racks, benches, litter receptacles and interpretive/historic signage. It is recommended that electrical conduit for lighting be installed at key access points, trail heads and along trails which might be near heavily visited retail/restaurant/entertainment areas for potential future lighting. Key access points and trail heads shall be located in accordance to the Trails Master Plan.
Note: These guidelines are in addition to AASHTO standards.	

Sidewalks & Enhanced Sidewalks

While off-street trails are typically the most visible and exciting component of a city's trail system, sidewalks along public right-of-ways are also an essential component of any comprehensive system. Sidewalks provide connections where off-street trails are not possible and serve to link trails to neighborhoods, schools, and businesses. If a trail is a "highway," a sidewalk is the local street that connects people to that highway. It is recommended that the City of Lewisville adopt a 5' width as the minimum for all sidewalks because this width allows two adults to comfortably walk side-by-side. In addition to regular sidewalks, this Trails Master Plan also makes recommendations for "enhanced sidewalks." The difference between a regular sidewalk and an enhanced sidewalk is the latter is intended to be utilized in areas where increased pedestrian traffic is anticipated (such as connectors between two off-street trails and near retail/restaurant/entertainment areas) and should be wider (6' to 8' depending on anticipated volume). In addition, an enhanced sidewalk will often include pedestrian-scaled lighting, mile markers, directional signage, and other amenities not found along typical sidewalks. In locations where an enhanced sidewalk is recommended, these wider facilities should generally be provided on both sides of the street unless special circumstances negate the need.

One important consideration is that sidewalks are intended for pedestrians and generally are not appropriate facilities for bicycle use (other than for young children). The primary reasons for this are that sidewalks are narrower than trails (potentially causing conflicts with pedestrians that would not exist on an off-street trail) and they are typically parallel to a roadway. In most cases, sidewalks have many driveway crossings, which increases the potential for bicycle/automobile collisions. Table 4.2 illustrates the general guidelines for the development of sidewalks.

Table 4.2
Sidewalk Guidelines

Facility Width	5' minimum (city-wide); 6' to 8' for enhanced sidewalks (depending on anticipated volume)
Surface	Provide 4" thick reinforced concrete and/or brick with City approved sub-base preparation and 2' soft shoulders with prepared sub-base. Increase concrete depth to 6" at driveways and anywhere heavy maintenance vehicles are expected to cross.
Minimum Corridor Width	Provide a 10' corridor width for a 5' wide sidewalk, a 16' corridor width for a 6' wide sidewalk, and an 18' corridor width for an 8' wide sidewalk. In urban areas, these corridors can be narrower.
Other Facilities	Provide lighting where appropriate, directional and informational signage, mile and ½ mile markers. Provide kiosks, locator maps, water fountains, and interpretive/historic signage at key locations.

Note: These guidelines are in addition to AASHTO standards.

Bike Routes

Just as sidewalks are intended to specifically meet the needs of pedestrians that are not met by off-street trails, bike routes are intended to supplement off-street trails by providing connectivity where trails are not possible. There are several different types of facilities that fall within this bike route facility type – these include signed routes, shared lanes, bike lanes, and cycle tracks. Each of these facility types are described in more detail below.

Determining which facility type to use must be done on a case-by-case basis for each individual bike route corridor and requires in-depth study of right-of-way availability, traffic volumes and patterns, and other details beyond the scope of this Trails Master Plan. However, as bike routes (along with trails) make up a crucial part of the city-wide system for cyclists, analysis of and recommendations for this facility type have been included herein in order to "pave the way" for future bicycle planning in Lewisville. See Chapter 6 for more information on each of the facility types discussed below.

Signed Routes

The most simple of bike route facilities and the least expensive to construct, signed routes are simply an identified route with "bike route" signage. Signs used along bike routes typically include a route number and are placed every 1/4 to 1/2 mile and at all turns in the route. These facilities typically do not have any sort of pavement markings or striping and do not delineate space for bicycles from space for automobiles. As such, this type of facility is most appropriate along low-traffic two-lane streets and is often the first type of bike route facility provided in most cities. While this is the only type of facility with the word "sign" in its name, all bike route facilities should include bike route signage.

Shared Lanes

One step up from a signed route is a shared lane. This type of facility is similar to a signed route in that it does not include striping to delineate space for bicycles from space for automobiles. However, a shared lane bike route includes wider lanes (14.5' minimum, which gives room for a normal-sized automobile to safely pass a bicycle), pavement markings, and is most appropriate along lower- to moderate-traffic streets. The pavement markings used in shared lane facilities are referred to as "Sharrows" and consist of a double-chevron above an outline of a bicycle, which alerts motorists of the possibility of cyclists on the road. On four lane roads, only the outside lanes should be of increased width and have the Sharrow pavement markings. This facility type is a good compromise between the signed routes (which is the most cost-effective facility type and does not require additional right-of-way) and bike lanes (which provide increased delineation between space for bicycles and space for automobiles).

Bike Lanes

Besides signed routes, the bike lane is the most common type of bicycle facility in Texas. The benefits of this type of facility, which is most appropriate along moderate- to higher-traffic streets, include the fact that they provide clear delineation between space for bicycles and space for automobiles and that they are highly visible to cyclists and motorists alike (which can improve safety as well as wayfinding). Bike lanes should be a minimum 4' wide from the edge of pavement (not including the gutter) and ideally 5' wide whenever possible. Parking alongside a bicycle lane is strongly discouraged; however, if parking must be provided, it should stand separately from the bike lane. That is, the parking aisle should not encroach upon and should be in addition to the 4' to 5' wide bike lane. On one-way streets where a bike lane is only provided on one side of the road, parking should be located on the opposite side to minimize potential conflicts between cars and bicycles.

On moderate- to higher-traffic streets (where bike lanes are typically located), special consideration should be given to intersections, which should be laid out in a way that makes motorists aware of the cyclists' intentions well in advance. Additional improvements to consider include:

- specific pavement markings such as "bike boxes" (also referred to as "blue boxes" or "green boxes") at intersections and solid-color bike lanes (where the entire bike lane is painted with a noticeable color, such as green, in order to be more visible);
- warning signs wherever motorists will have to cross over an on-street bike lane (such as to enter a right-turn lane); and
- bicycle-oriented traffic signals (which give cyclists a head-start through the intersection).

There are many nuances and details associated with providing bike lanes which are well beyond the scope of this Trails Master Plan. A future bicycle master plan or alternative transportation master plan could be developed by the City of Lewisville to further analyze these issues.

Cycle Tracks

Also called a "side path," this is a highly-specialized facility type which is relatively new in the United States (though very common in European cities such as Copenhagen, Amsterdam, Vancouver, and Muenster, Germany). These types of facilities are typically used in one of two instances. The first instance is along high-traffic roadways where it is unsafe or uncomfortable to use a bike lane. The second instance is along major bike route corridors which are anticipated to have a very high volume of bicycle traffic or where the City wants to encourage bicycle traffic. Sometimes these two instances overlap.

As far as the specific design considerations of cycle tracks, they generally parallel roadways yet are separated from automobiles through a curb, parking aisle, median, bollard, or similar and are separated from pedestrians through a painted stripe, grade separation, or landscaped area. These facilities can be one-way or two-way; however, two-way versions are much more difficult to design and require more signage and traffic control measures than one-way versions. A typical cycle track will be 7.5' wide, which allows for one bicycle travel lane and one bicycle passing lane and has special bicycle-oriented traffic signals. In most cases, cycle tracks transition to traditional on-street bike lanes at intersections, which simplifies traffic control. If a cycle track is determined to be an appropriate facility type for Lewisville, it is essential that it be provided along a continuous corridor (without gaps) and, because of its complexity, be designed through the consultation of professionals that have experience with this facility type. Table 4.3 illustrates the general guidelines for the development of on-street bike route facilities.

Table 4.3
Bike Route Guidelines

Facility Width	Signed Routes: no specific width Shared Lanes: 14.5' minimum outside lane (not including gutter) Bike Lanes: 4' minimum (not including gutter); 5' preferred Cycle Tracks: 7.5' minimum
Surface	All Facilities: pavement surfaces should be smooth, uniform in width and free of utility covers/lids, wide cracks, or longitudinal joints. Utilize bicycle-safe grates without longitudinal openings. Concrete or asphalt preferred. Brick, pavers, or stamped concrete is not recommended.
Other Facilities	Provide "No Parking" signage where appropriate. Provide directional, informational signage and pavement markings in the rights-of-way.

Note: These guidelines are in addition to AASHTO standards.

Paddling Trails

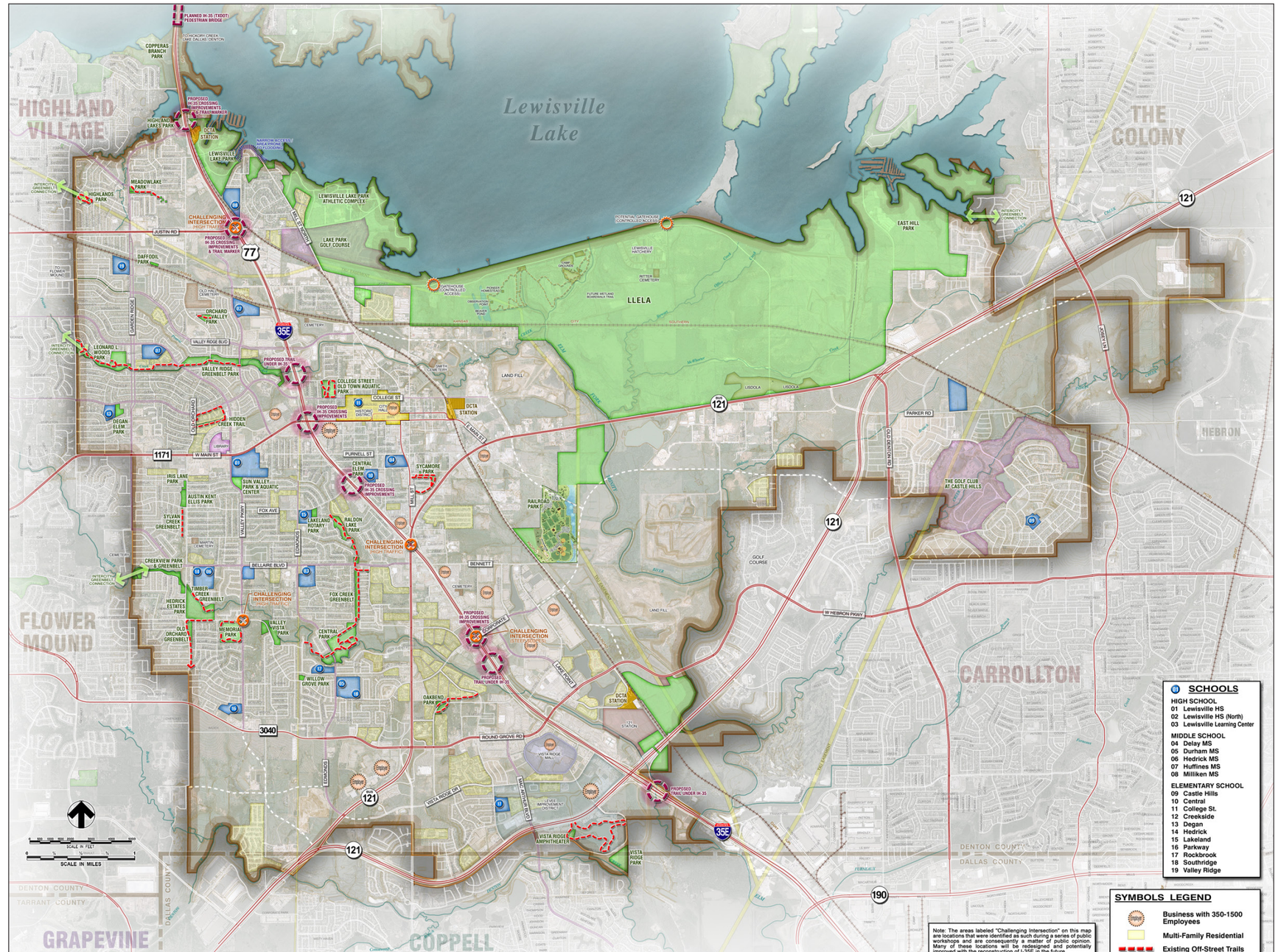
Paddling trails, the final facility type recommended in this Trails Master Plan, is a very specialized type of facility, yet is very cost-effective for the recreational opportunities it provides. As discussed throughout this document, the Elm Fork of the Trinity River provides great opportunities for canoers and kayakers because of its regular flow and scenic value. A paddling trail requires very little capital investment compared to other facility types and almost no operational costs. The facilities needed in order to turn the Elm Fork into a paddling trail include mile markers (which aid emergency responders) and put-ins/take-outs, which are the riparian version of a trailhead. There is little difference between a put-in and a take-out other than its position on the river relative to the segment the user will travel. These facilities should be located at areas with relatively flat river banks which extend into somewhat shallow water and must have easy access to a street. It is necessary for put-ins/take-outs to include parking areas (paved or unpaved, depending on anticipated traffic volume), drinking water sources, and informational kiosks to warn canoers and kayakers of potential hazards on the river. A put-in should be located at the upper end of the river (in this case, just south of the Lewisville Dam, where an existing make-shift put-in is located) and roughly every two to three miles thereafter.

Figure 4.1 – Opportunities & Constraints

This figure illustrates the location and spatial relationship between the various opportunities and constraints that were identified and analyzed for this Trails Master Plan.

Opportunities & Constraints

So far, this chapter has detailed the various needs of each of the major trail user groups in Lewisville and has defined a "toolbox" of facility types to use in developing Lewisville's trail system. However, in order for trail corridors to be determined and specific facility networks to be developed, the opportunities and constrains within the city must be identified and analyzed. The primary method of completing this task is to study latent demand by mapping these various features and analyzing their spatial relationships. As discussed in Chapter 3, true latent demand modeling is incredibly data-intensive and does not necessarily yield a comprehensive, interconnected system of facilities (it identifies "hot spots" of potential pedestrian and bicycle activity, but does not provide guidance as to how to connect these hot spots). Rather than using this process, the Planning Team utilized a streamlined version of analyzing latent demand which basically involved mapping key opportunities and constraints and using judgement, experience, and public input in order to determine hot spots of pedestrian and bicycle activity and potential alignments by which to connect these areas. Figure 4.1 illustrates the various opportunities and constraints identified and analyzed during this hybridized latent demand process. The following section examines these features in more detail and explains the impact each has on the development of the various facility networks and overall trail system.



Opportunities

There are many opportunities for the expansion of Lewisville's trail system. Each of these plays a large role in determining future facility alignments, the location of trailheads and access points, and the prioritization given to each facility segment.

Existing Trails

Perhaps the greatest opportunity in Lewisville is the City's existing trail network. These trails lay the groundwork for the expansion of the City's trail system. The off-street trail network should be based off of these existing trails and should build upon their successes.

Parks & Public Facilities

Research indicates that the majority of non-motorized trips taken by most Americans are for recreation purposes, so connecting parks and public facilities (such as the library, recreation center, and senior center) with a system of trails and other pedestrian and bicycle facilities is a sensible priority that will enhance the usability and enjoyment of the City's parks and facilities.

Lewisville Lake Environmental Learning Area

As one of the last remaining natural areas of significant size in the Metroplex, LLELA presents a great opportunity for connecting people with nature through trails. This area is also bisected by the Elm Fork (which includes a make-shift canoe/kayak put-in) and provides an open space connection between Lewisville and The Colony.

Schools

Though fewer and fewer children walk or bike to school these days, the provision of safe, accessible routes between neighborhoods and schools can help to encourage more children to use active transportation. In addition, there are grant programs which provide significant funding assistance for building such facilities near schools.

Employment Centers

As discussed in Chapter 2, only 1.5% of people in Lewisville walk or bicycle to work. However, the home-to-work travel time for 11.5% of Lewisville's residents is ten minutes or less (see Tables 2.4 and 2.5). As explained in detail in Chapter 2, on page 8, this means that over one tenth of residents live about five to ten miles from where they work, which is easy bicycling distance. Major employers (businesses that employ 350 to 1,500 employees) were mapped to help illustrate their proximity to trail corridors. While it is likely that a large portion of the employees of these companies do not live in Lewisville, the provision of good pedestrian and bicycle facilities linking neighborhoods with employers will encourage these employees to move to Lewisville.

Population Density

Population density is an important factor in determining trail alignments since people living in higher-density areas are more likely to walk or cycle as their primary mode of transportation.

Transit Stations

Though not yet in operation, the station locations for the DCTA A-Train have already been determined. These are key opportunity areas as they will generate significant bicycle and pedestrian traffic once the commuter rail line becomes operational.

Old Town

Centered in the heart of the city, Old Town is Lewisville's historic downtown area, the location of many festivals and special events, and the site of Lewisville's City Hall. In addition to the commercial and civic uses found in this district, there are also several historic residential neighborhoods, which have small block sizes and naturally encourage bicycle and pedestrian activity. Providing connections between this district and other parts of the city is essential.

Creek Corridors

Most of Lewisville's existing trails are located along creek corridors for a good reason – these are some of the most attractive and most pleasant parts of the city and provide natural routes across the city. This Trails Master Plan looks toward each of the creek corridors in the city as potential trail corridors for these reasons.

Utility & Railroad Corridors

Though often lacking the natural beauty of creek corridors, utility and railroad corridors often provide excellent opportunities for trails in many instances. Providing trails along these corridors requires the ability to gain access easements and the cooperation of the railroad or utility company. Electric transmission lines may sometimes be good trail corridors, but often they by easement rather than right-of-way and therefore cross private property lines.

Future Thoroughfares

Especially for bicycle facilities, it is important to look at future thoroughfares and thoroughfare widenings to identify opportunities to provide facilities. As it is easier to design a facility into a thoroughfare corridor before it is built than it is to retrofit a facility into an existing thoroughfare, planning a facility along one of these future corridors is often a good alternative to retrofitting.

Intercity Greenbelts

Being connected to surrounding communities and regional trail corridors is an essential quality of a premier trail system. There are several opportunities to provide trail connections along creek corridors and utility corridors. The primary challenge in this instance is enrolling the cooperation and shared commitment of the surrounding communities so that the intercity greenbelt provides a connection and not a dead end.

Constraints

While there are many opportunities for expanding the trail system in Lewisville, there are also many constraints or challenges which must be considered.

IH-35E

The most obvious constraint at the moment is IH-35E, which runs through the middle of the city geographically and separates east Lewisville (including Old Town) from west Lewisville. This freeway limits several potential trail corridors along creeks as many of its bridges are not of sufficient elevation for a trail to pass under. However, the Texas Department of Transportation is currently undergoing a planning process to expand IH-35E between the President George Bush Turnpike and the City of Denton. This gives the City of Lewisville the unprecedented opportunity to resolve these crossing issues and open up the Prairie Creek and Timber Creek corridors for cross-city trails.

Challenging Intersections

Though most of the opportunities and constraints were identified by the Planning Team, the challenging intersections shown on Map 4.1 were identified through the public involvement process. These are locations which members of the public have identified as being difficult to navigate either because of traffic volumes or steep slopes. These locations indicate areas that should either be avoided by the Trails Master Plan or should be improved to accommodate pedestrian and bicycle traffic. Even so, most of these intersections are located along IH-35E which, as mentioned above, will be reconstructed in the future eliminating many of these challenging intersections.

Limited Right-of-Way

Another significant constraint in Lewisville is the fact that many of the City's thoroughfares have very limited right-of-way, significantly limiting what improvements are possible. This constraint primarily impacts the enhanced sidewalk and bike route networks but may also impact the City's ability to provide off-street trails.

Topographic Constraints

It is impossible to identify all topographic constraints when planning on a city-wide basis. Rather, each corridor will need to be analyzed individually as its trails are being designed. However, major topographic constraints have been identified. In general, practically every creek corridor will present topographic constraints (excessive slopes, cross-slopes, and undulating land). Another specific major topographic constraint is around Eagle Point, which is prone to flooding and has a very narrow shoreline. Little would be possible along the shoreline in this area other than a natural surface trail.

Sensitive Environmental Areas

It is often the case that the most desirable place to have a trail is also a very environmentally sensitive area. Creek corridors, which provide the most ecologically diverse landscapes, are especially sensitive to erosion and pollution. Similarly, LLELA contains very sensitive animal habitat and grasslands.

Network & System Development

Considering all of these opportunities and constraints, the next step in developing a premier trail system for Lewisville is to utilize the "toolbox" of facility types detailed on previous pages by beginning to establish a system of overlapping and interconnected networks for pedestrians and cyclists based on latent demand "hot spots," the principles of connectivity and access, and the goal to provide facilities across the city. From these networks, "spine" systems of the highest-priority routes are then developed for pedestrians and for cyclists. The primary roles of identifying the spine systems are to help prioritize individual trail segments and to tie together the four facility networks.

Facility Networks

The four facility types described earlier in this chapter each represent a distinct component of a comprehensive trail system. The facility networks described in this section are essentially representations of the recommended alignments for each of these facility types. These networks were developed with the intended user in mind (i.e., sidewalks for pedestrians, bike routes for cyclists, paddling trails for canoers and kayakers, and off-street trails for all non-aquatic users). Each of these facility networks are described over the next two pages.

Off-Street Trails

Building upon the City's existing trails, the off-street trail system was the first network developed during this planning process as it is the intent of this Trails Master Plan to focus on this type of facility. Creek corridors, utility corridors, railroad corridors, and large publicly-owned open spaces are the primary locations in which these trails have been planned. This network, which recommends a total of 65.1 miles of trail (which includes the existing 14.02 miles), is closely tied to the enhanced sidewalk network and the bike route network (in fact, many of the proposed bike routes share alignments with proposed off-street trails). Notable proposed off-street trail alignments include continuations of the Prairie Creek and Timber Creek corridors, a trail along the DCTA A-Train line, trails through LLELA (including connecting to its existing 3.4 miles of trails), and trail connections to Coppell, Grapevine, and Flower Mound.

Enhanced Sidewalks

Though it is crucial to provide sidewalks on any street along which someone might walk, this Trails Master Plan only makes network recommendations for enhanced sidewalks (that is, high-priority and high-traffic sidewalks). The intent of the enhanced sidewalk network is to fill gaps in the off-street trail network in order to provide access between trail segments and to connect those trails with neighborhoods, schools, businesses, and transit. Other determinants for the alignment of enhanced sidewalks include the need to provide crossings across IH-35E (such as at Justin Road and Corporate Drive) and the need to provide facilities in the more urbanized parts of Lewisville where off-street trails are not feasible. This proposed network includes 50.4 miles of enhanced sidewalks.

Figure 4.2 – Off-Street Trails

The red lines on this figure indicate existing off-street trails while the yellow lines represent proposed off-street trails. The long alignment roughly paralleling IH-35E on the east side represents the proposed DCTA A-Train trail.

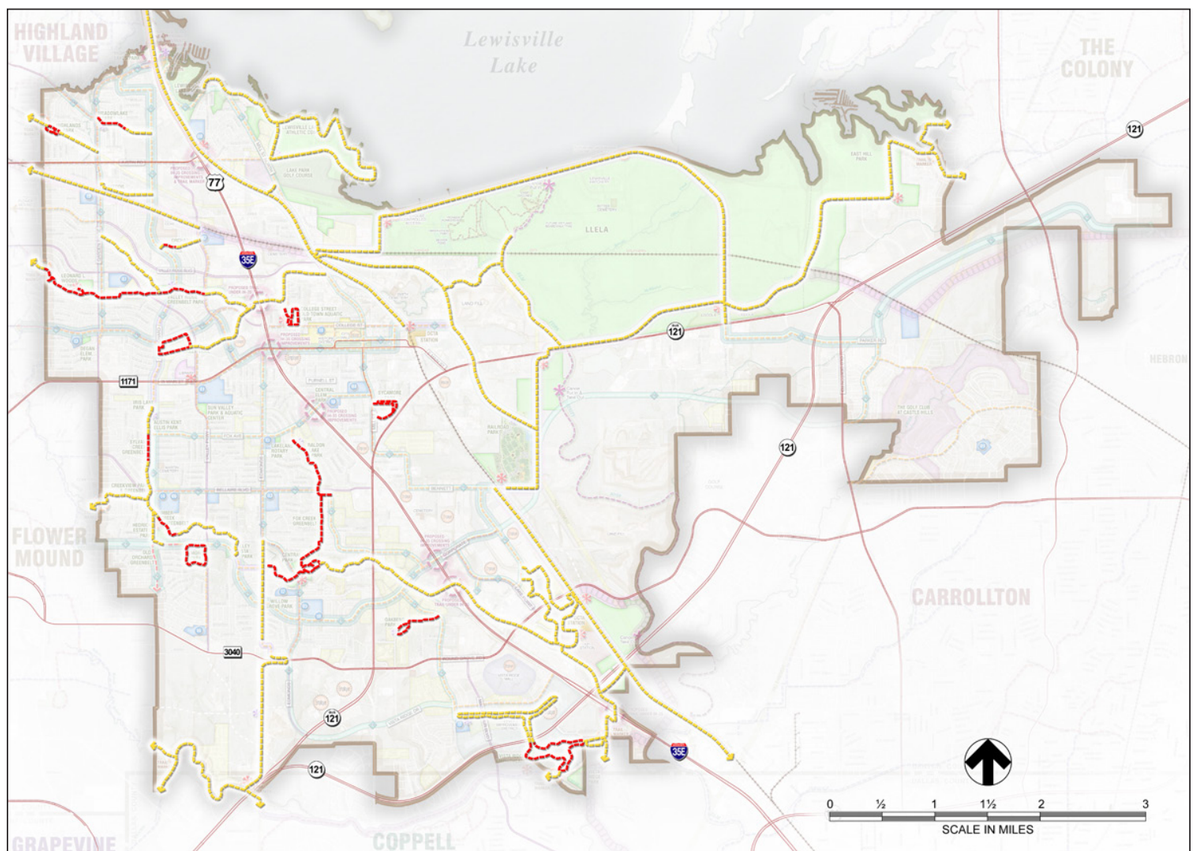
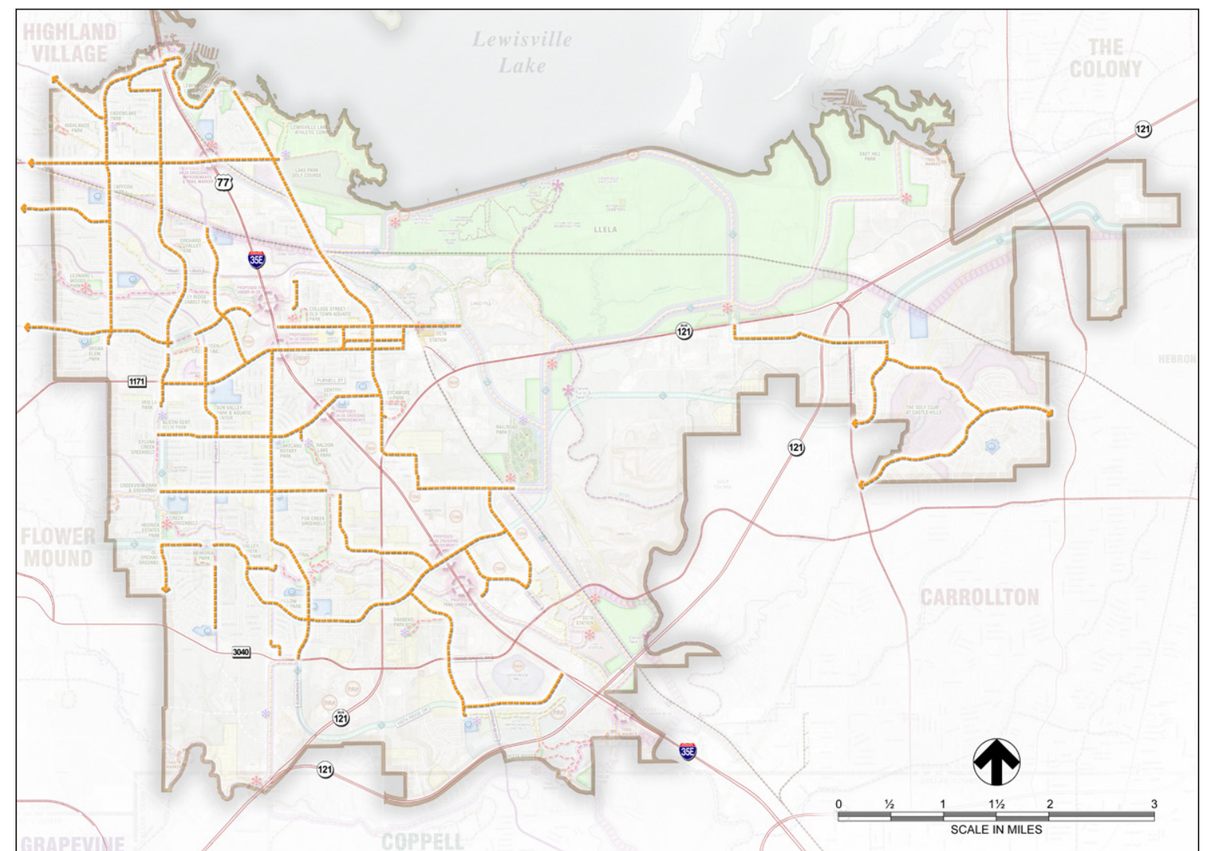


Figure 4.3 – Enhanced Sidewalks

The orange lines on the figure below illustrate the proposed alignments for enhanced sidewalks. While there are gaps in the enhanced sidewalk network, these gaps are filled by the proposed off-street trail network (see Figure 4.2).

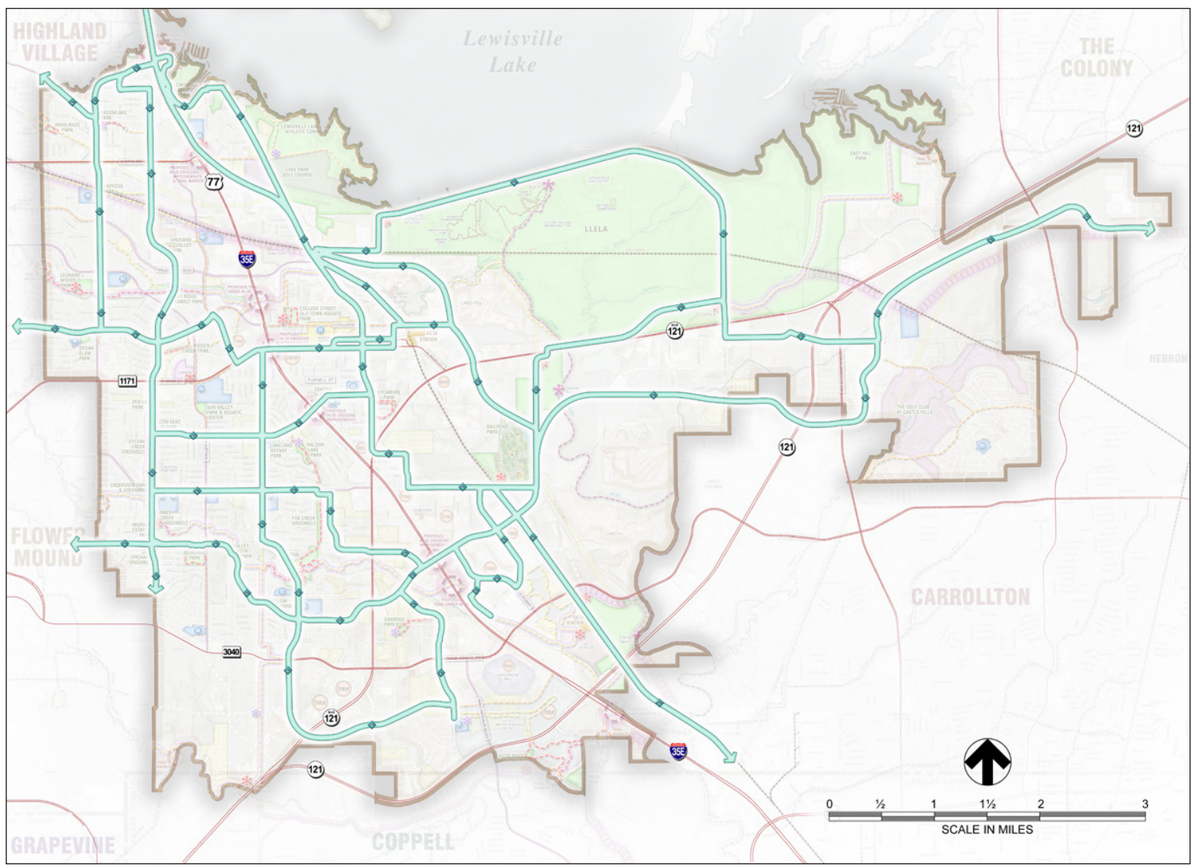


Bike Routes

Similar to the enhanced sidewalk network, the bike route network was developed to augment the off-street trail network by filling gaps where off-street trails are not feasible. However, the bike route network was also planned in such a way that it includes on-street routes paralleling several of the proposed off-street trail alignments in order to provide more direct and more accessible routes for transportation-oriented cyclists. In some instances, especially along the DCTA A-Train trail and through LLELA, the bike route network directly overlaps the off-street trail network; this indicates that in these locations, the off-street trail should be of such capacity and high-priority that it serves both recreational and transportation functions. In total, the proposed network includes 66.5 miles of bike routes.

Figure 4.4 – Bike Routes

The blue lines on the figure below indicate proposed bike route alignments for Lewisville. The Trails Master Plan does not dictate which specific facility (e.g., signed routes, shared lanes, bike lanes, or cycle tracks) should be constructed for each route. Rather, specific bike facilities should be determined based on case-by-case engineering studies.

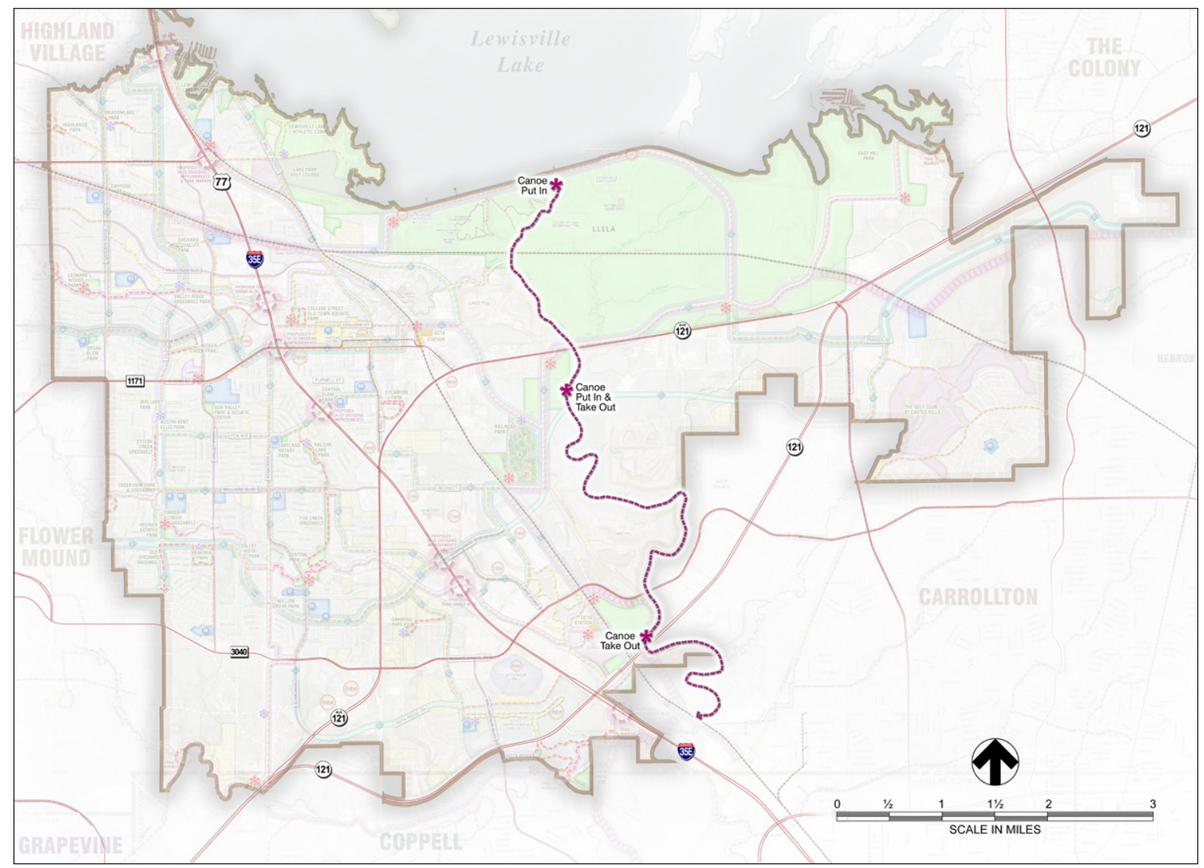


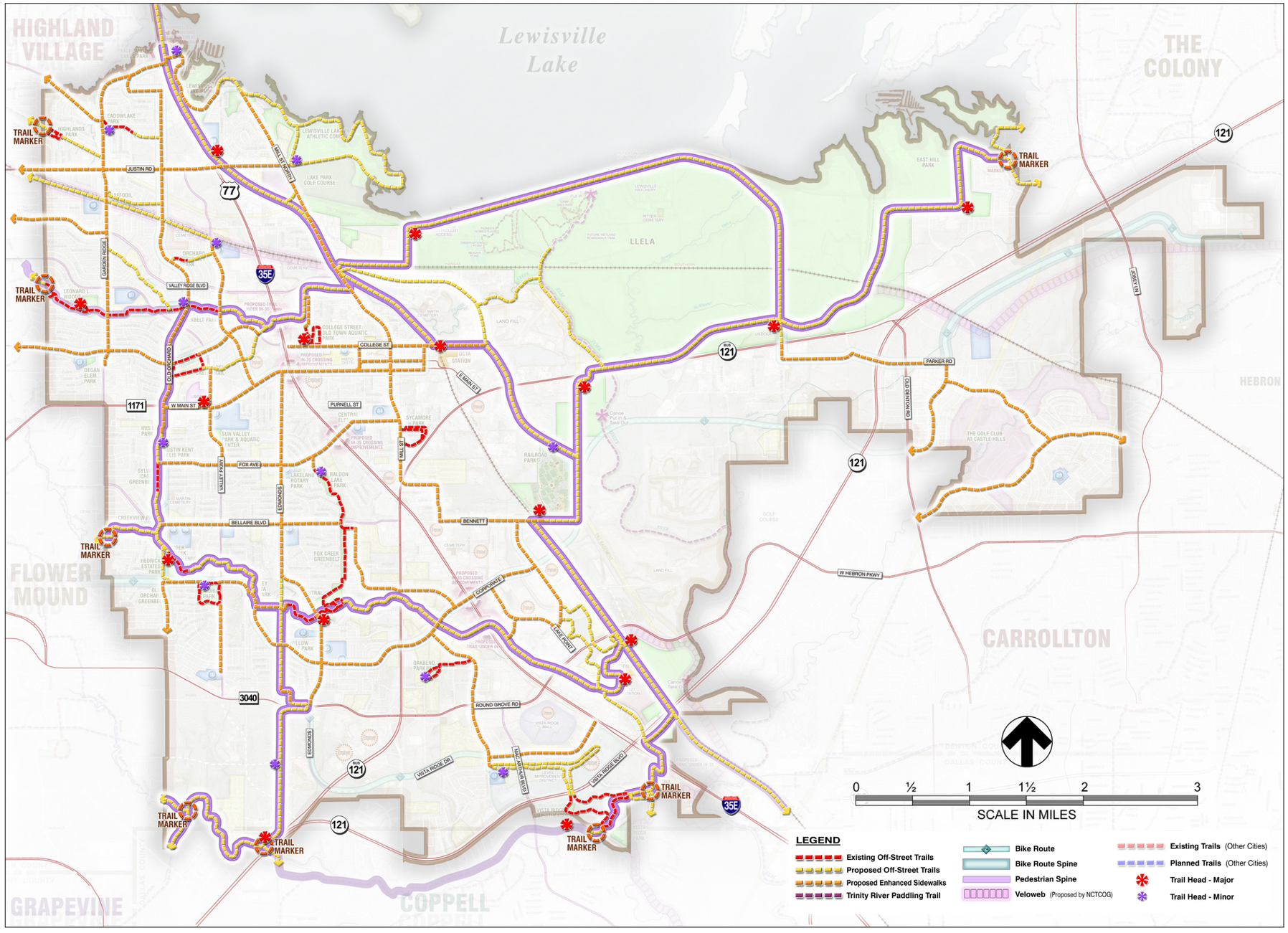
Paddling Trails

Though the possibility exists to develop additional paddling trails in the future (such as along Denton Creek), only one paddling trail alignment is identified as part of the Trails Master Plan. The paddling trail proposed for the Elm Fork of the Trinity River is approximately 7.4 miles in length and stretches from just south of the Lewisville Dam to the recently acquired City-owned land near where Vista Ridge Boulevard crosses the river. Three put-in/take-out locations have been identified (the northern location is at the current make-shift put-in in LLELA, the central location is on City-owned park land near Railroad Park, and the southern location is on City-owned park land near SH-121). Future opportunities to continue this paddling trail into Coppell, Carrollton, and Dallas should also be considered.

Figure 4.5 – Paddling Trail

The purple lines on this figure indicate the alignment of the proposed paddling trail along the Elm Fork of the Trinity River as well as three put-in/take-out locations. This alignment indicates the possibility to continue the paddling trail into Coppell, Carrollton, and Dallas.





Spine Systems

The networks developed and explained on the previous pages reflect a long-range plan for trails and other facilities in Lewisville. None of these networks by themselves constitute a comprehensive trail system. Rather, it is how these networks are linked together and overlap that determines the quality and comprehensiveness of the Lewisville's Trail system.

The following section examines two "spine" systems for Lewisville – one for pedestrians and one for cyclists. Each of these systems constitutes a combination of multiple facility networks in order to effectively meet the needs of the primary user groups.

The heart of each of these systems are the "spine" trails/routes which indicate the high-priority facility segments for each system. These segments are further analyzed and prioritized in later chapters of this Trails Master Plan.

Pedestrian Spine System

The overall pedestrian spine system is a combination of the off-street trail network and the enhanced sidewalk network. The combination of these two network yields multiple north-south and east-west routes as well as several loop routes. The spine route segments similarly combine off-street trails with enhanced sidewalks in order to create an interconnected network. These spine routes (which are highlighted in purple on the map), represent the highest priorities for future trail and sidewalk development and were determined based on the opportunities and constraints analysis. These are primarily aligned along Prairie Creek, Timber Creek, the DCTA A-Train, through LLELA, and along a utility transmission line running south toward Denton Creek.

These spine routes provide intercity and regional trail connections and will serve as the "highways" for pedestrian use in Lewisville.

Figure 4.6 – Pedestrian Spine System

The pedestrian system is a combination of the off-street trail and enhanced sidewalk networks. The purple highlights indicate the "spine" (high-priority) segments.

Bicycle Spine System

The bicycle spine system was developed in a manner similar to that used to develop the pedestrian spine system. This system is made up of a combination of the off-street trail network and the bike route network and similarly focuses on providing multiple north-south, east-west, and loop routes of varying priority. The network of bicycle spine segments (represented by thicker blue lines on the map) was developed with the intent of providing major cross-town routes that link major recreation, civic, transportation, employment, and residential areas.

As it can be seen, most of the bicycle spine segments located west of IH-35E are along on-street bike routes rather than off-street trails. This is a factor of several issues, including the fact that there are not many opportunities for a north-south off-street trail in this portion of the city and the importance of providing a direct connection for cyclists to Old Town (a similar connection is provided for pedestrians through the enhanced sidewalk network). In addition, some of these streets (such as Corporate Drive) can serve as excellent on-street routes for the more transportation-oriented cyclists and are far more direct than nearby off-street trails.

This of course does not mean that the off-street trails do not play a vital role in the bicycle network for Lewisville. To the contrary, the majority of bicycle spine segments on the east side of IH-35E are along proposed off-street trail alignments. In addition, the off-street trails in all parts of Lewisville will likely be preferable for many recreation-oriented cyclists.

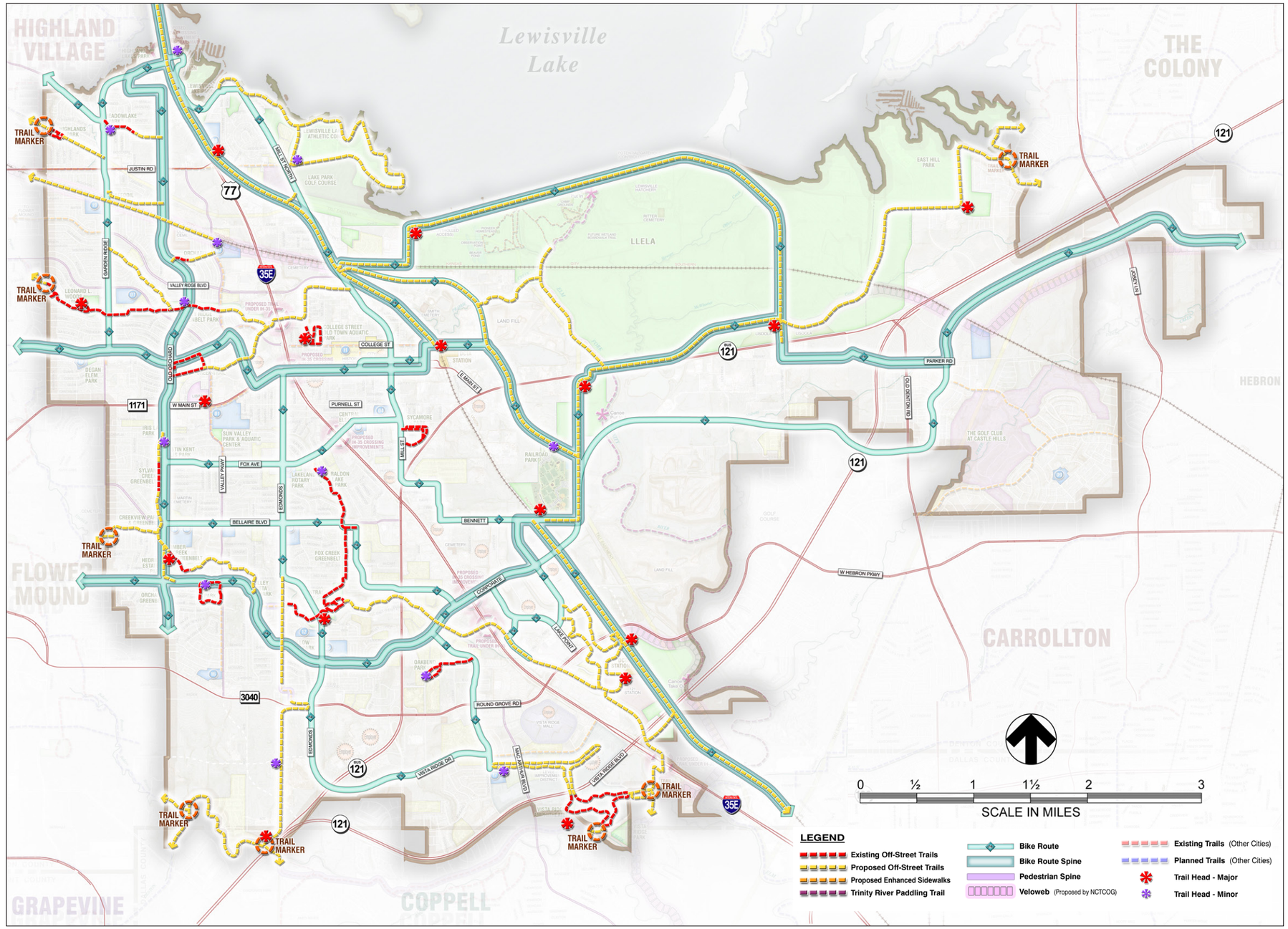
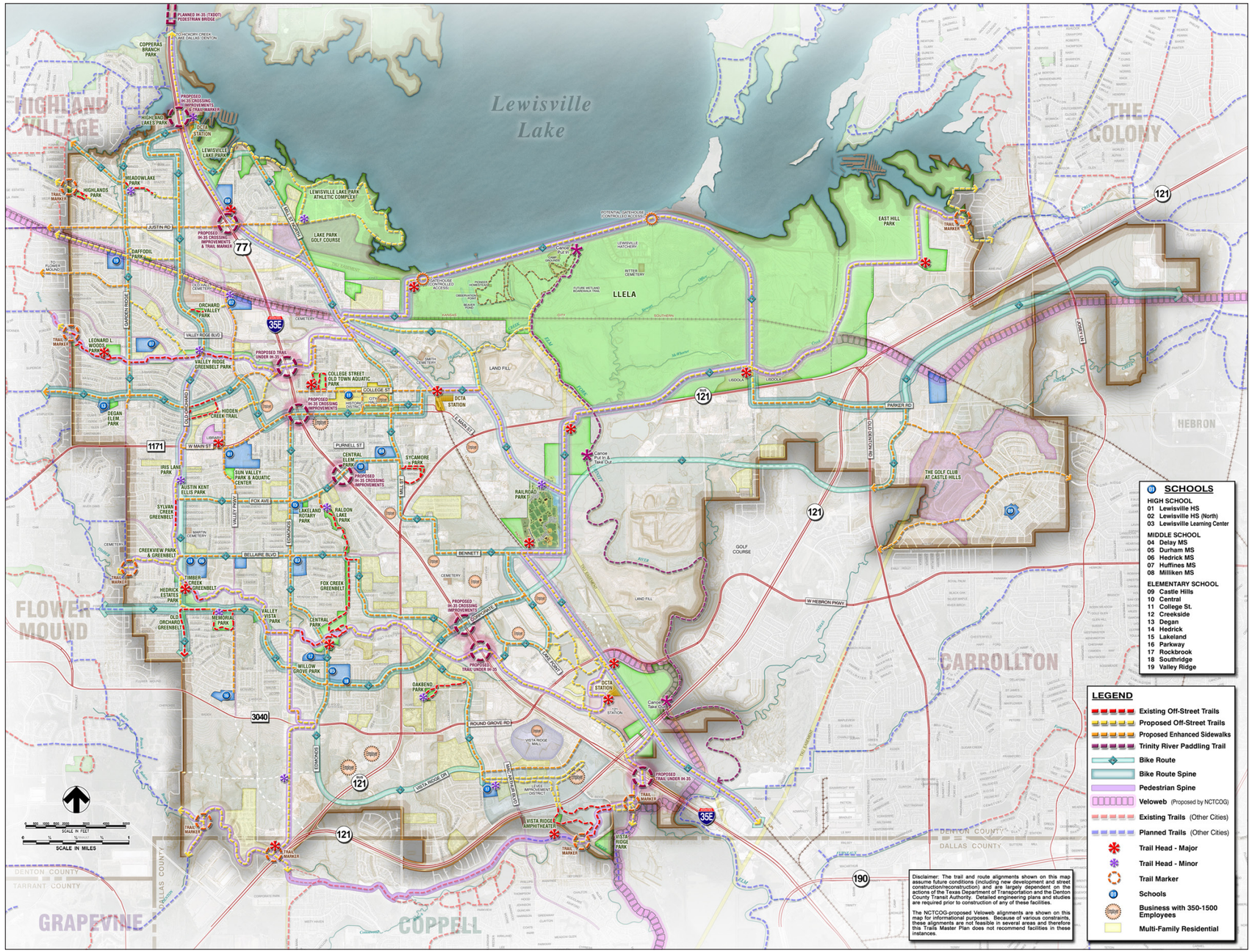


Figure 4.7 – Bicycle Spine System

The bicycle system is a combination of the off-street trail and bike route networks. The thicker blue highlights indicate the "spine" (high-priority) segments.



The Trails Master Plan

Finally, the overall result of the four facility networks, the two spine networks, and the identification of major and minor trail heads is the overall Trails Master Plan map shown here. This map represents the spatial orientation of the long-range recommendations contained in this document. In total, this plan contains approximately 187 miles of recommended facilities for pedestrians, cyclists, and canoers and kayakers. While this Trails Master Plan identifies these future possibilities, achieving the trail system recommended herein will require a dedicated, creative, and cooperative implementation strategy.

Trailheads

The recommended major and minor trailhead locations shown on this map (and in Figures 4.6 and 4.7) as red and purple asterisks, respectively, were chosen in order to provide an adequate distribution of access points across the city. Specific locations were determined based on potential land availability; proximity to parks, schools, transit stations, and other key destinations; and relation to the spine networks.

Major Trailheads

Proposed major trailheads are located approximately every two to three miles along the spine systems. A major trailhead should include at minimum the following: ten off-street parking spaces, a drinking fountain, bike racks, seating, lighting, trail markers, and a kiosk/map of the trails.

Minor Trailheads

Proposed major trailheads are located approximately halfway between major trailheads along the spine systems where necessary. A minor trailhead should include at minimum the following: five parking spaces, a drinking fountain, bike racks, seating, lighting, trail markers, and a kiosk/map of the trails.

Figure 4.8 – Trails Master Plan

This figure illustrates the four facility networks, the pedestrian spine system, the bicycle spine system, and the location of proposed major and minor trailheads.

LEWISVILLE

Deep Roots. Broad Wings. Bright Future.

The 2011 Lewisville Trails Master Plan

"Active Adventure... Creative Connections"

Chapter 5 - Spine Corridor Analysis & Priority Evaluation

Introduction

The four networks (off-street trails, enhanced sidewalks, bike routes, and paddling trail), the pedestrian system, and the bicycle system described in Chapter 4 – Creating a Premier Trails System provide guidance and a long-range vision for the future of Lewisville's trail system. However, continuing to develop the City's trail system effectively requires identifying key trail corridors, analyzing these corridors segment-by-segment to understand the issues associated with each, and prioritizing these segments for implementation.

The majority of this chapter focuses on analyzing individual segments of the pedestrian spine system (as identified in Chapter 4), which is predominately comprised of off-street trails. As discussed throughout this Trails Master Plan, off-street trails are suitable for pedestrians and cyclists of all abilities. While the stand-alone bicycle spine system is important in its own right, it is not analyzed in the same detail in this Trails Master Plan for two primary reasons:

- Many of the bicycle spine corridors exist as on-street bike routes. While these may effectively meet the needs of more advanced cyclists, they do not necessarily meet the needs of all cyclists. On the other hand, the off-street trail network (of which the pedestrian spine system is predominately comprised) can meet the needs of most pedestrians and most cyclists. Therefore, the approach has been taken in this chapter to analyze the pedestrian spine system and where a spine segment exists as enhanced sidewalks rather than off-street trails, consideration is given to potential costs and issues of on-street bike routes in those locations.
- While this Trails Master Plan attempts to provide a foundation for a future on-street bike route system by identifying a bike route network and providing a "tool box" of facility types (see Chapter 4), it is not intended to be a comprehensive master plan for on-street bike routes. As the City moves forward with developing its on-street bike route network, it will be necessary to analyze bike route corridors in a similar manner in which the spine segments are analyzed in this Chapter in order to understand associated costs and development issues between the multiple on-street bike route facility types (i.e., signed routes, shared lanes, bike lanes, and cycle tracks) available.

In addition to describing and analyzing the challenges along each spine corridor segment, this chapter also includes planning-level cost estimates and priority rankings for each of these segments. This chapter concludes with a summary of the spine corridor segment costs and prioritization.

Spine Corridor Analysis

For the purposes of this analysis, cost estimates, and prioritization, the pedestrian spine system has been broken into sixteen individual segments which average approximately two miles in length. The general approach taken while dividing the corridors into segments was to make each division at a current or future trailhead so that each segment would begin and end at a trailhead. However, this approach was not possible for every segment and in those instances, divisions were made at existing trails, city streets, or at the city limits where the trail would tie-in to an existing or planned trail in the adjacent city. In addition to providing a basis for the analysis, this ensures that as these segments are constructed, there are no "dead ends" – rather, any trail segment that terminates will, at a minimum, do so at a trailhead facility or at some other public access point.

Methodology

The following pages analyze the sixteen priority segments as shown on the map on the facing page. Each of these segments is analyzed using the methodology described below. For clarity, each segment is highlighted on a small map (which is shown at the same scale for each of the segments). These maps also show adjacencies and the location of trailheads. In addition, a locator map is provided to help the reader identify the location of each segment.

- Description – The first step in analyzing each corridor is to provide an overall description of the alignment including where it passes, what it crosses, and what it connects to.
- Type/Width – This section indicates the facility type recommended for each segment and its width.
- Length – The lengths of both the existing and planned portions of each corridor segment is displayed in miles.
- Land Ownership – Identifying the different land owners along each corridor segment is crucial to determining ease of implementation and land acquisition requirements.
- Key Land Uses / Destinations – This section provides an overview of what is adjacent or near the segment (such as schools, neighborhoods, businesses, etc.) and what connections the segment makes to other cities or other major trail corridors.
- Issues – The major issues associated with each corridor segment are identified in this section.
- Planning-Level Cost Estimate – A general estimation of the order of magnitude is given for each segment. This is based upon the length of each segment, facility type, number of street crossings, number of bridges, and required amenities.
- Evaluation Score – Finally, a priority score is given to each segment. These scores are based on proximity to key destinations, impact on nearby residential areas, land availability, and connectivity within the overall trail system. The scoring methodology is based on a hybridized latent demand score (LDS) which indicates potential demand for a facility segment. A traditional LDS system basically functions as a gravity model whereby segments are ranked based on the proximity of key trip generators and attractors. The fallacy with a traditional LDS is that it focuses only on proximity of generators and attractors and ignores overall connectivity. In contrast, this hybridized version considers the proximity of key destinations and the degree to which each segment enhances overall connectivity with the trail system. The evaluation score is shown in the title of each segment analysis.

General Considerations

While the individual issues of each segment are identified in the following pages, there are a few issues that relate to multiple segments and therefore deserve special consideration.

Segments Through LLELA

There are multiple segments (B, J, K, L, and M) that pass through the Lake Lewisville Environmental Learning Area. As this area includes one of the Metroplex's most significant dams and is also very ecologically sensitive, access into this site is currently limited. Providing trails through LLELA will require a committed partnership between the City of Lewisville, the US Army Corps of Engineers, and the staff that operates LLELA in order to determine how to maintain the level of security necessary in this area while still providing bicycle and pedestrian access.

Segments Crossing IH-35E

Perhaps the greatest barrier to bicycle and pedestrian traffic currently and the greatest future opportunity for providing cross-town trail connections is IH-35E. The Texas Department of Transportation is currently planning for a complete overhaul of this freeway from Carrollton to Denton. Carefully analyzing the preliminary schematics for the redesign of IH-35E and ensuring that provisions are made for trail crossings is of crucial importance to the future of the City of Lewisville's trail system. These schematics were reviewed and a detailed list of recommended changes was created. This review is included in the appendix.

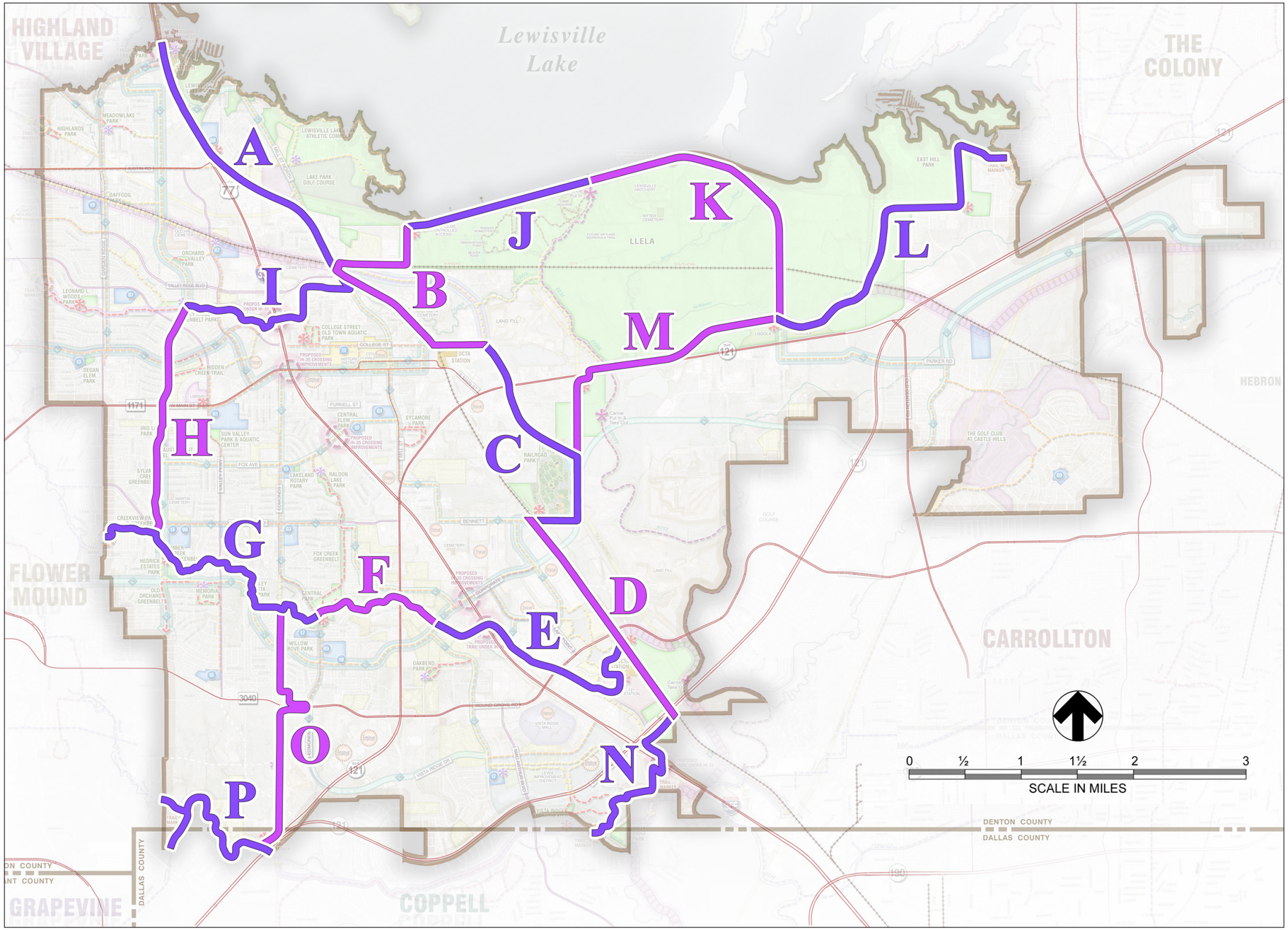
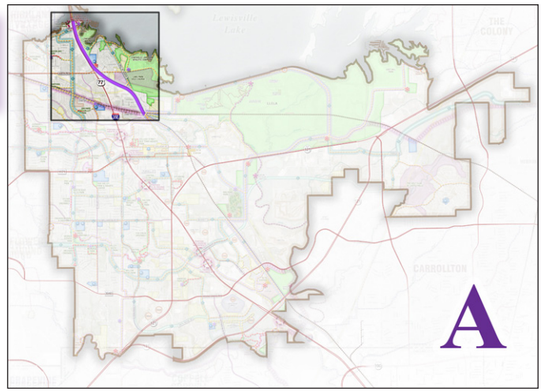


Figure 5.1 – Spine Corridor Segments

This figure illustrates the segments that make up the pedestrian spine system. The letters are intended merely as identifiers and do not indicate priority.

Segment A – Evaluation Score: 1

Northern DCTA Station to KCS Railroad



Description

Segment A is part of the planned DCTA trail, which will parallel the A-Train commuter rail. This segment runs south from the DCTA station at Garden Ridge on the east side of IH-35E, past Milliken Middle School (which is also the location of a proposed major trailhead), along Mill Street, and ties into other priority segments at the KCS Railroad.

Type/Width

12' wide concrete off-street trail

Length

Planned: 2.3 miles

Land Ownership

Denton County Transit Authority, Lewisville ISD

Key Land Uses / Destinations

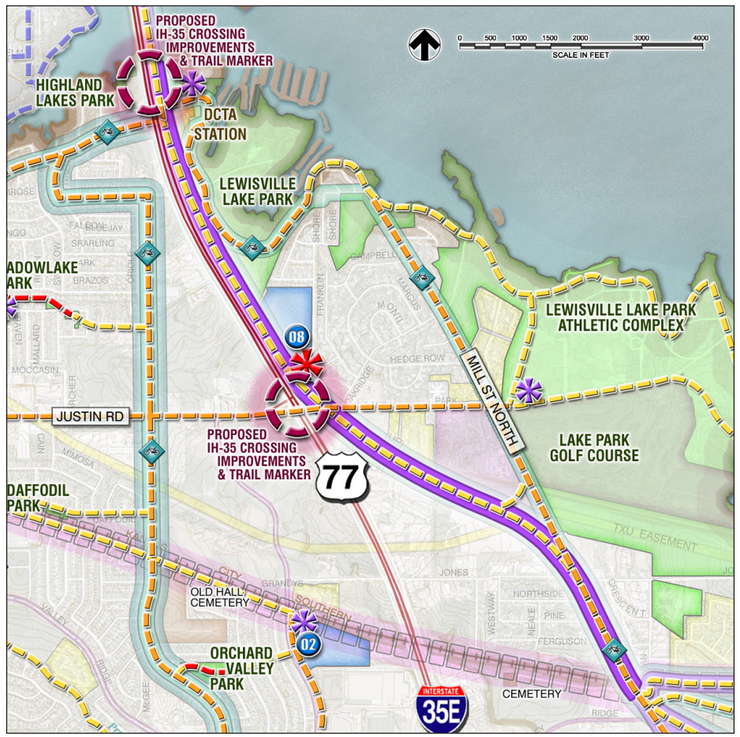
Provides access to future DCTA Station, Lake Park, Milliken Middle School, and Lake Park Golf Course. Intercity-connection to Highland Village.

Issues

- DCTA anticipated to fund and construct this segment within their right-of-way.
- Partnership with LISD needed in order to provide a trailhead at the middle school

Planning-Level Cost Estimate

$1,808,295 total / $342 per linear foot

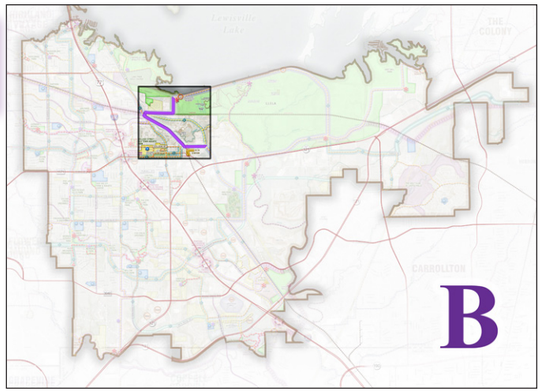


LEGEND

- Existing Off-Street Trails
- Proposed Off-Street Trails
- Proposed Enhanced Sidewalks
- Trinity River Paddling Trail
- Bike Route
- Bike Route Spine
- Pedestrian Spine
- Veloweb (Proposed by NCTCOG)
- Existing Trails (Other Cities)
- Planned Trails (Other Cities)
- Trail Head - Major
- Trail Head - Minor
- Trail Marker
- Schools
- Business with 350-1500 Employees
- Multi-Family Residential

Segment B – Evaluation Score: 1

LLELA Gate House to Old Town/DCTA Station



Description

The northern half of Segment B runs from the existing LLELA gate house, parallels Kealy Street on its east side, and runs parallel to the KCS Railroad on its southern side. From this point, the southern half is part of the planned DCTA trail and runs from the KCS Railroad to the future DCTA Station located at the intersection of Railroad Street and College Street. It then runs along the northern side of College Street to Valley Ridge Boulevard.

Type/Width

12' wide concrete off-street trail

Length

Planned: 2.3 miles

Land Ownership

Denton County Transit Authority, US Army Corps of Engineers, Kansas City Southern Railway, City of Lewisville

Key Land Uses / Destinations

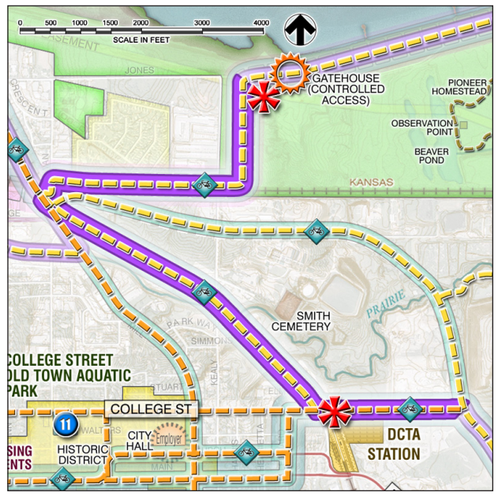
This is as an integral segment of the DCTA trail and provides a direct connection from this trail corridor to LLELA.

Issues

- The primary issue with this segment is enlisting the partnership and cooperation of the Kansas City Southern Railway to allow a trail to be placed parallel to their railroad facility. As the private property south of the railroad is currently undeveloped, it might be possible to place the trail at a considerable distance from the railroad if land is acquired from or made accessible by the property owner.
- The location of the two proposed trailheads will require the partnership and cooperation of the US Army Corps of Engineers, LLELA, and the Denton County Transit Authority.
- The DCTA-owned right-of-way between Kealy Street and College Street is very narrow in several locations.
- This segment requires a trail bridge over Prairie Creek.

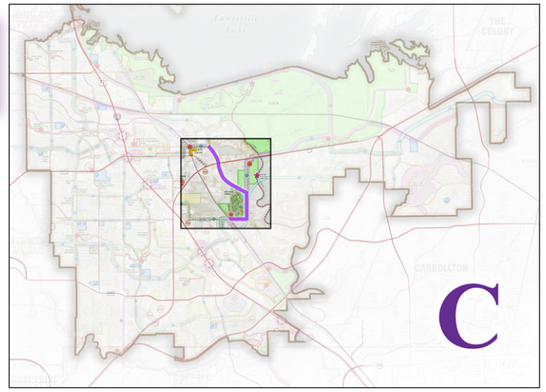
Planning-Level Cost Estimate

$1,565,370 total / $296 per linear foot



Segment C – Evaluation Score: 1

Old Town/DCTA Station to Railroad Park



Description

Segment C follows the new extension of Valley Ridge Boulevard south from College Street, across Business 121 (near the Universal Display and Fixtures manufacturing plant—one of Lewisville's major employers) to Railroad Park. The trail then runs along the eastern and southern edges of Railroad Park to the planned trail along the DCTA commuter rail line.

Type/Width

12' wide concrete trail (located on the east side of Valley Ridge Boulevard)

Length

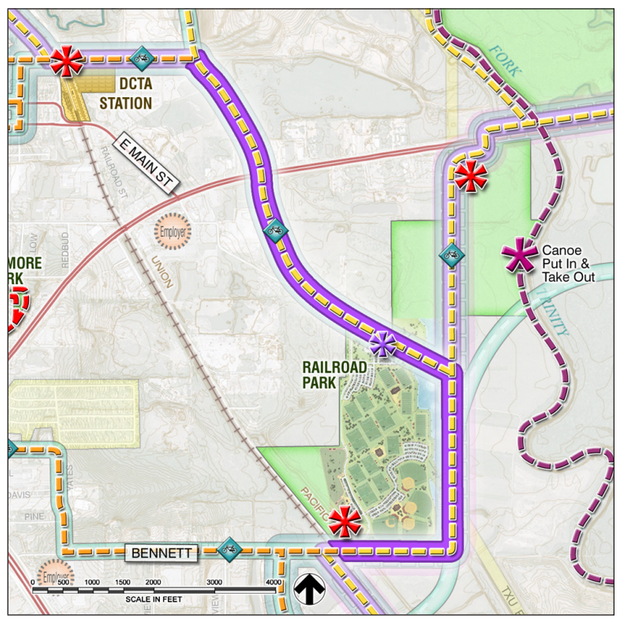
Planned: 2.2 miles

Land Ownership

Denton County Transit Authority, State of Texas (at Business 121 crossing), City of Lewisville

Key Land Uses / Destinations

Because of physical constraints along the DCTA corridor to the west, this alignment is proposed as an alternative for the DCTA trail in this area. It continues to provide access between Old Town and Railroad Park. This segment is located near one of Lewisville's major employment areas and wraps around the City's newest (and most popular) park. It also passes near a large City-owned forested area to the north and passes near the Trinity River.



Issues

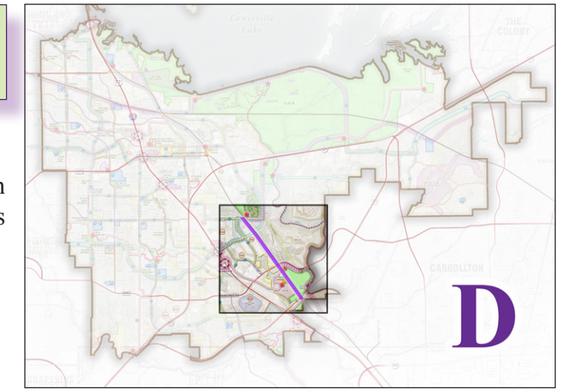
- The primary issue regarding this segment is ensuring that the continuation of Valley Ridge Boulevard and Corporate Drive are done in such a way that they accommodate parallel trails and trail crossings.
- An additional issue to consider is the need to work in partnership with the electric utility company so that a trail can be built that meets the requirements of the utility company while also being enjoyable to use (i.e., includes shade and landscaping).

Planning-Level Cost Estimate

$1,478,205 total / $280 per linear foot

Segment D – Evaluation Score: 1

Railroad Park to Southern DCTA Station/SH 121



Description

The final segment of the DCTA trail corridor as it passes through Lewisville, Segment D runs south from Railroad Park, across Hebron Parkway, past a future DCTA station, to SH 121.

Type/Width

12' wide concrete off-street trail

Length

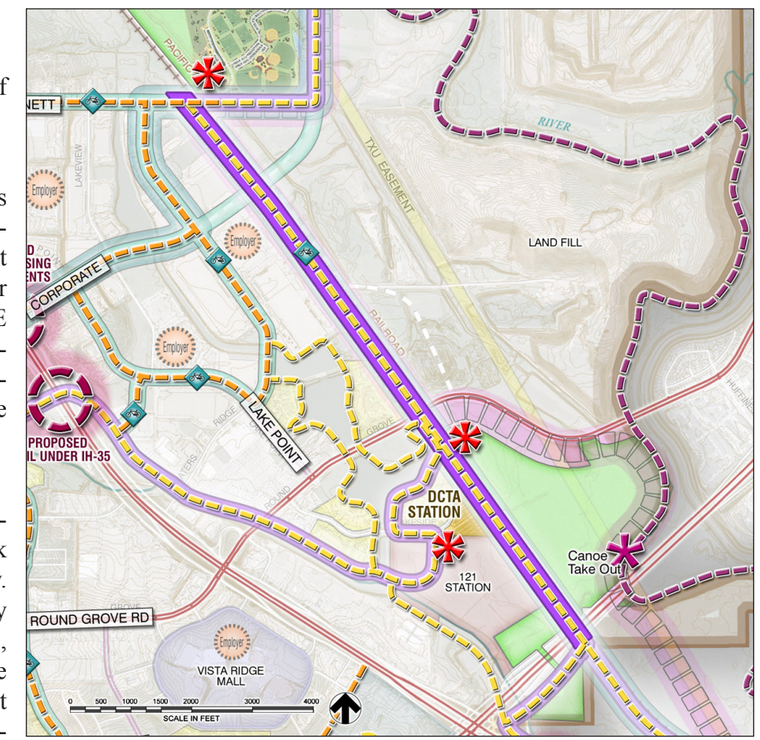
Planned: 2.0 miles

Land Ownership

Denton County Transit Authority, State of Texas (at SH 121), City of Lewisville

Key Land Uses / Destinations

Also along the DCTA trail corridor, this segment is essential in creating an inter-city connection with Carrollton. Adjacent land uses include Railroad Park, a major employment area (the area east of IH-35E between Corporate Drive and Hebron Parkway), several apartment complexes, the future "121 Station" development, and a large piece of newly-acquired park land.



Issues

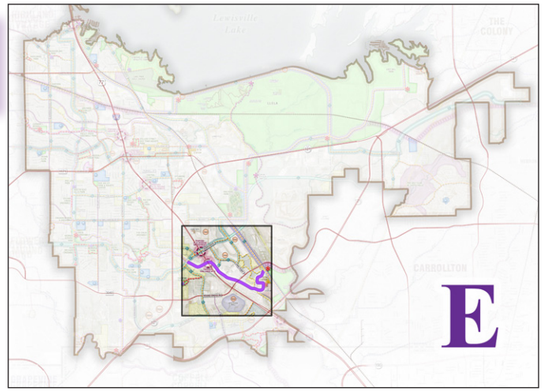
- The primary issue with this alignment is that it requires a mid-block trail crossing of Hebron Parkway. This location does not currently have traffic control devices in place, but as it is directly adjacent to the future DCTA commuter rail line, it is feasible to install bicycle/pedestrian crossing signals as the trail and rail line are constructed. Alternatively, the trail could instead be routed to the newly-constructed signalized intersection at Railroad Street.
- The location of the proposed trailhead will require the partnership and cooperation of the Denton County Transit Authority.

Planning-Level Cost Estimate

$1,634,625 total / $310 per linear foot

Segment E – Evaluation Score: 2

Corporate Drive to Southern DCTA Station



Description

This segment runs along Timber Creek from Corporate Drive, goes along the Timber Creek Reliever Channel, crosses under IH-35E, follows the reliever channel until it merges back into Timber Creek near Waters Ridge Drive, passes under Hebron Parkway, and connects to the future DCTA station and trail.

Type/Width

12' wide concrete off-street trail

Length

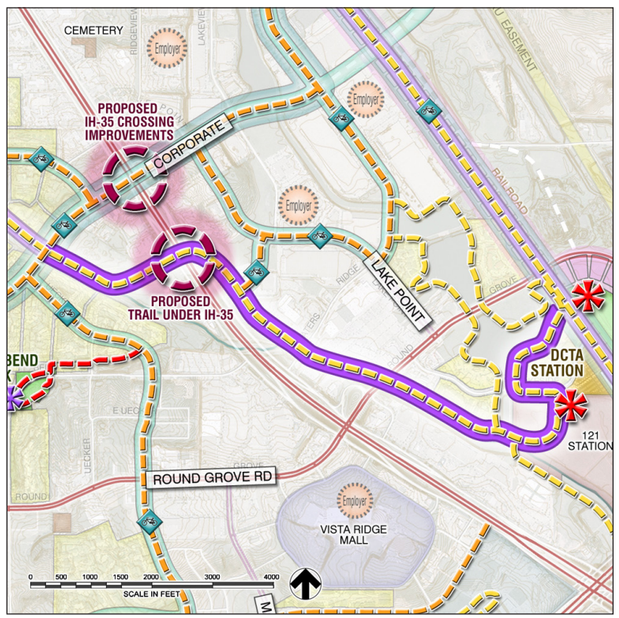
Planned: 2.5 miles

Land Ownership

City of Lewisville, Private Land Owners

Key Land Uses / Destinations

This segment serves as a crucial connection across IH-35E and passes through one of Lewisville's largest employment centers. There are also multiple apartment complexes and one of the future DCTA stations located along this segment.



Issues

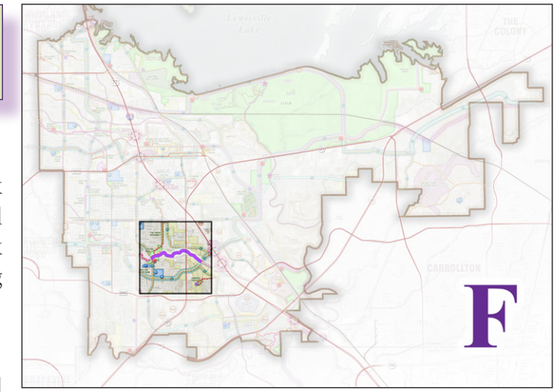
- One of the greatest challenges presented by the alignment of this segment is the fact that it crosses private land that is currently owned by three different land owners.
- It is crucial for the City to ensure that the reconstruction of IH-35E allows at least 10' of clearance under the bridge structure at the Timber Creek Reliever Channel in order to accommodate this trail segment.
- The Timber Creek corridor south of Hebron Parkway is very narrow as a result of the damming of the creek.

Planning-Level Cost Estimate

$1,671,525 total / $317 per linear foot

Segment F – Evaluation Score: 3

Central Park to Corporate Drive



Description

This segment begins at Edmonds Lane where the Timber Creek Trail enters Central Park. This segment runs through Central Park along existing trails and continues along Timber Creek through private land, crossing under Business 121, entering City-owned land, and ending at Corporate Drive.

Type/Width

12' wide concrete off-street trail (a portion of the existing trail is 10' wide)

Length

Existing: 0.25 miles

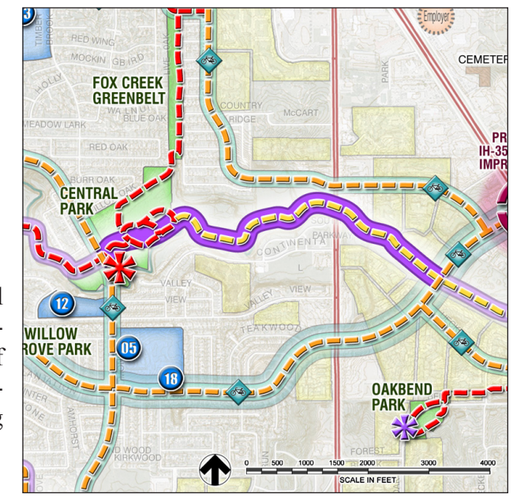
Planned: 1.0 mile

Land Ownership

Private Land Owners, City of Lewisville

Key Land Uses / Destinations

This segment is a continuation of the existing Timber Creek Trail and passes through a very attractive natural creek corridor. The primary surrounding land use is residential, much of which consists of townhouses and apartment complexes. There are a few small commercial complexes adjacent to this corridor, mostly oriented along Business 121.



Issues

- The main issue along this segment is that much of the land along Timber Creek is privately owned by real estate developers and investors. However, as it is generally undeveloped, the possibility exists to partner with these private land owners to provide easements for this trail corridor.
- The Business 121 and Corporate Drive bridges over Timber Creek appear to provide adequate clearance for a trail but modifications such as benching, retaining walls, etc. may be required in order to make these crossings possible.

Planning-Level Cost Estimate

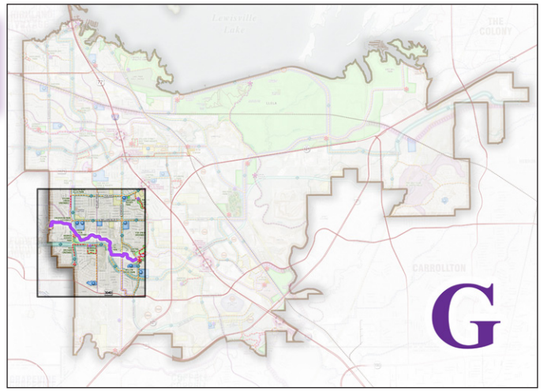
$1,175,778 total / $223 per linear foot

LEGEND

- Existing Off-Street Trails
- Proposed Off-Street Trails
- Proposed Enhanced Sidewalks
- Trinity River Paddling Trail
- Bike Route
- Bike Route Spine
- Pedestrian Spine
- Veloweb (Proposed by NCTCOG)
- Existing Trails (Other Cities)
- Planned Trails (Other Cities)
- Trail Head - Major
- Trail Head - Minor
- Trail Marker
- Schools
- Business with 350-1500 Employees
- Multi-Family Residential

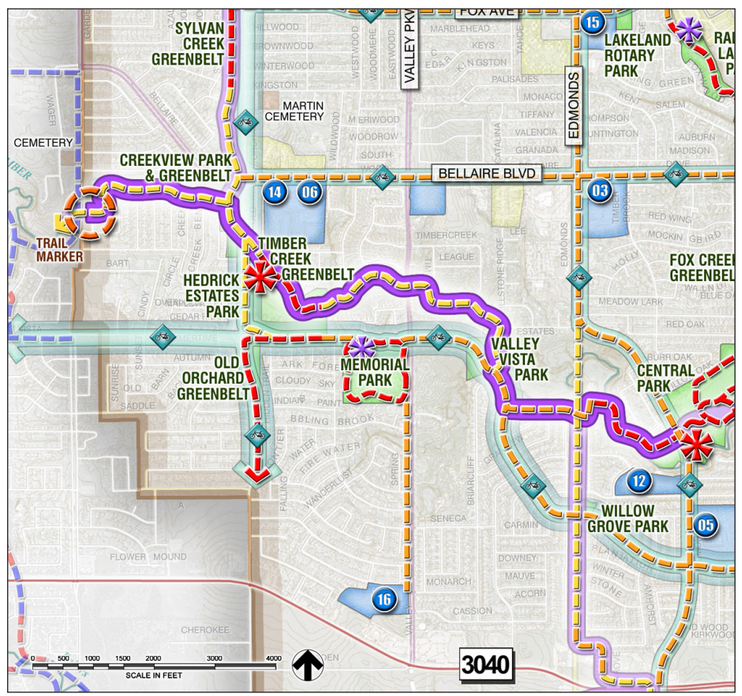
Segment G – Evaluation Score: 4

Western Border with Flower Mound to Central Park



Description

Segment G runs from the western border between Lewisville and Flower Mound along Timber Creek, passing through Creekview Park & Greenbelt, after which it crosses under Old Orchard Lane and passes through the Timber Creek Greenbelt following the existing trail. From there, this corridor passes under Valley Parkway and through privately-owned land before it links with the existing Timber Creek Trail near Valley Vista Park and carries on to Central Park.



Type/Width

12' wide concrete off-street trail (portions of the existing trail are 8' or 10' wide), existing 5' to 8' wide enhanced sidewalks, on-street bike route

Length

Existing: 1.6 miles

Planned: 1.0 mile

Land Ownership

City of Lewisville, Private Land Owners

Key Land Uses / Destinations

The segment connects many City of Lewisville parks and three Lewisville ISD schools to several neighborhoods. Also nearby is the Recreation Center and Senior Center (at Memorial Park).

Issues

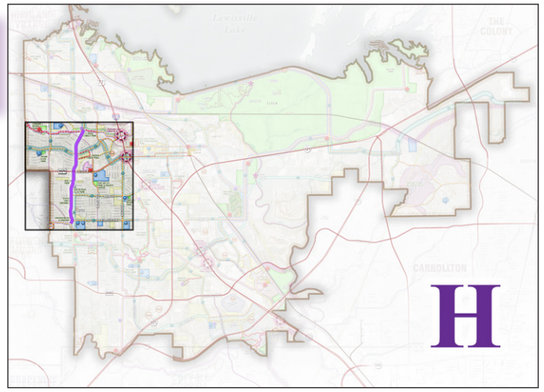
- Part of this segment (between Valley Parkway and Valley Vista Park) crosses through privately-owned land. As an alternative, this segment could exist as enhanced sidewalks along Valley Parkway and Corporate Drive rather than as an off-street trail as shown. While this would be an easier solution, it would not provide the same recreational and aesthetic value as this proposed alignment.

Planning-Level Cost Estimate

$1,596,184 total / $302 per linear foot

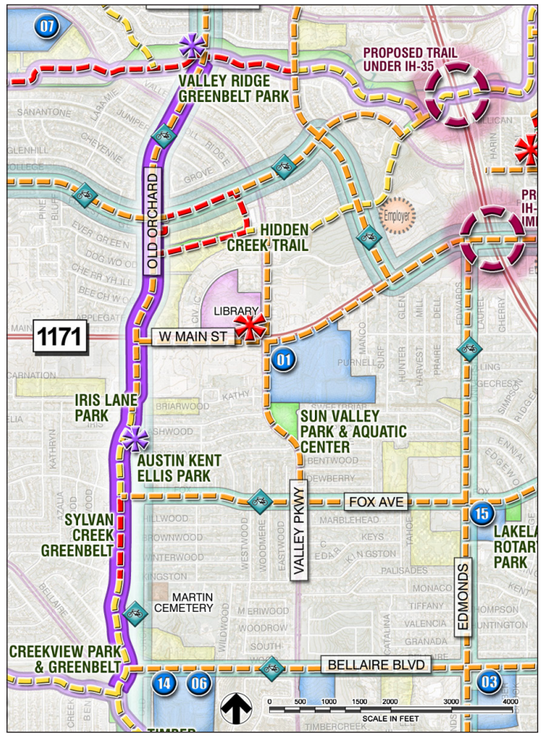
Segment H – Evaluation Score: 2

Valley Ridge Greenbelt Park to Creekview Park & Greenbelt



Description

This segment will serve as the main north-south corridor on the west side of Lewisville as it connects the existing and proposed trails along Prairie Creek to the existing and proposed trails along Timber Creek. This northern half of this corridor runs south from Valley Ridge Greenbelt Park along Old Orchard Lane, crosses Main Street, and connects to Iris Lane Park. The primary facility type for this half would be enhanced sidewalks. The southern half of this corridor would consist primarily of off-street trails and runs south from Iris lane Park, through Austin Kent Ellis Park and the Sylvan Creek Greenbelt (which has an existing trail) to Creekview Park & Greenbelt.



Type/Width

8' wide enhanced sidewalks and 12' wide concrete off-street trail (portions of the existing trail are 10' wide and existing sidewalks along Old Orchard Lane are generally 4' or 5' wide)

Length

Existing: 0.3 miles

Planned: 1.7 miles

Land Ownership

City of Lewisville, Private Land Owners

Key Land Uses / Destinations

This segment connects several parks and connects Lewisville's major residential areas north and south of West Main Street. This segment is near the library and the commercial areas along West Main Street.

Issues

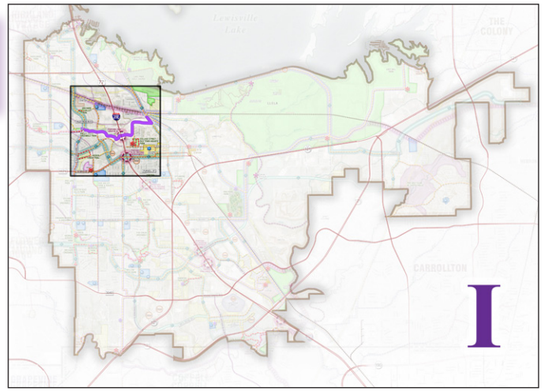
- The greatest limiting factor for this segment is the limited right-of-way along Old Orchard Lane. In its current configuration (four lane undivided), it will be very difficult to provide 8' wide sidewalks on both sides of the road without acquiring additional right-of-way.
- Because of its prominence as a major route, the northern half of this segment (Prairie Creek to Iris Lane Park) might be a good location for providing a cycle track (see page 26 for more information on cycle tracks).

Planning-Level Cost Estimate

$1,177,335 total / $223 per linear foot

Segment I – Evaluation Score: 2

Valley Ridge Greenbelt Park to KCS Railroad



Description

This segment ties in with the existing trails at Valley Ridge Greenbelt Park near Summit Avenue and continues along Prairie Creek, passes under IH-35E, and continues along Prairie Creek to Mill Street (near its intersection with Valley Ridge Boulevard) where it links with the future DCTA trail.

Type/Width

12' wide concrete off-street trail (portions of the existing trail are 8' or 10' wide), 8' wide enhanced sidewalks, on-street bike route

Length

Existing: 0.25 miles

Planned: 1.6 miles

Land Ownership

City of Lewisville, Private Land Owners

Key Land Uses / Destinations

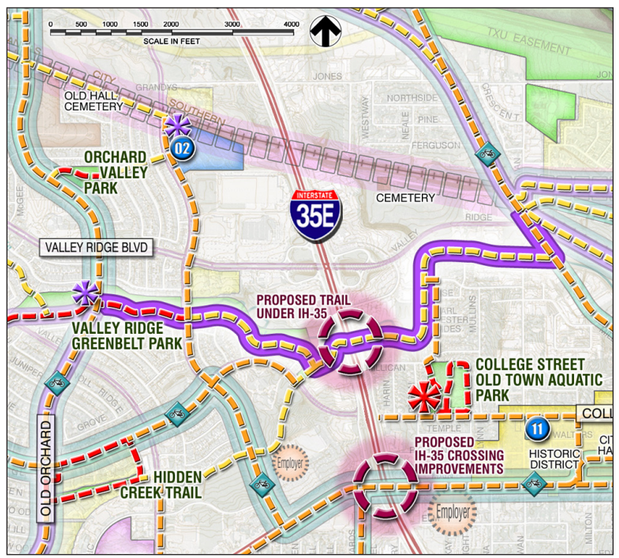
This segment would provide an important crossing under IH-35E and is primarily surrounded by neighborhoods, warehouses, and light industrial facilities.

Issues

- The crossing of IH-35E presents the greatest challenge for this segment. It is essential for the City of Lewisville to ensure that the future reconstruction of this freeway accommodates a trail crossing along Prairie Creek.
- An additional issue along this segment is the Mill Street / Valley Ridge Boulevard / Cowan Avenue intersection, which presents a significant design challenge.

Planning-Level Cost Estimate

$1,099,668 total / $208 per linear foot

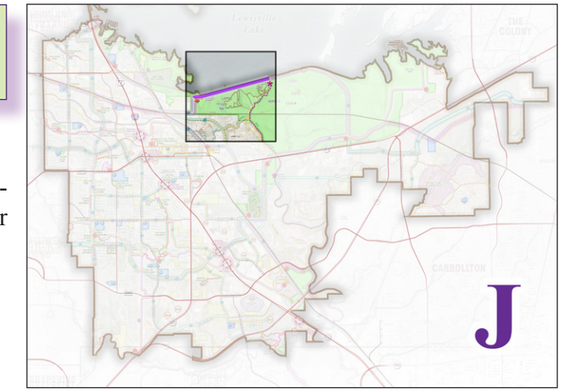


LEGEND

- Existing Off-Street Trails
- Proposed Off-Street Trails
- Proposed Enhanced Sidewalks
- Trinity River Paddling Trail
- Bike Route
- Bike Route Spine
- Pedestrian Spine
- Veloweb (Proposed by NCTCOG)
- Existing Trails (Other Cities)
- Planned Trails (Other Cities)
- Trail Head - Major
- Trail Head - Minor
- Trail Marker
- Schools
- Business with 350-1500 Employees
- Multi-Family Residential

Segment J – Evaluation Score: 3

LLELA Gate House to the Elm Fork of the Trinity River



Description

Segment J begins at the existing LLELA gate house and follows the Lewisville Dam to the Elm Fork of the Trinity River near the proposed paddle trail put-in.

Type/Width

12' wide concrete off-street trail

Length

Planned: 1.7 miles

Land Ownership

US Army Corps of Engineers

Key Land Uses / Destinations

This segment exists entirely within LLELA and therefore primarily provides access to its existing natural surface trails and the Trinity River.

Issues

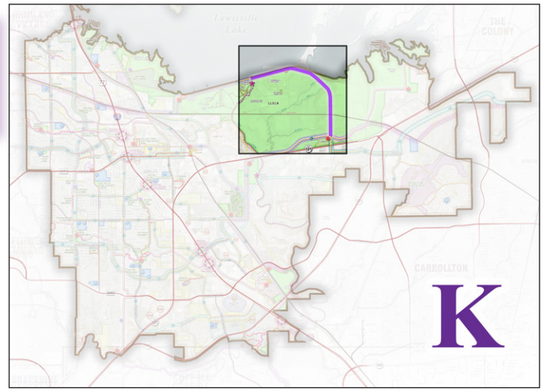
- This segment could be designed either on top of the dam (which would provide unequalled views of the lake and of LLELA) or along the existing road below the dam.

Planning-Level Cost Estimate

$1,126,080 total / $213 per linear foot

Segment K – Evaluation Score: 3

Elm Fork of the Trinity River to the Lewisville ISD Outdoor Learning Area (LISDOLA)



Description

This segment begins at the mouth of the Elm Fork of the Trinity River and follows the dam to Fish Hatchery Road. It then parallels Fish Hatchery Road, passing by LLELA's preserved grasslands, crosses over the KCS Railroad and McWhorter Creek, and enters the Lewisville ISD Outdoor Learning Area (LISDOLA).

Type/Width

12' wide concrete off-street trail

Length

Planned: 2.7 miles

Land Ownership

US Army Corps of Engineers

Key Land Uses / Destinations

This segment provides access to LLELA and LISDOLA and passes through some of the last preserved native landscapes in the area.

Issues

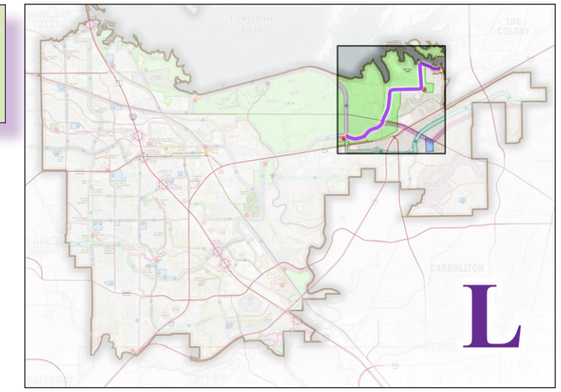
- As with Segment J, the western half of this segment could be designed either on top of the dam or along the existing road below the dam.
- This segment crosses over the KCS Railroad and McWhorter Creek. Both crossings would either require trail bridges (in addition to the existing road bridges) or would need to be designed in such a way that bicycles and pedestrians could use the road bridges. As low as the traffic is on this road, the latter option is very feasible.

Planning-Level Cost Estimate

$2,274,480 total / $431 per linear foot

Segment L – Evaluation Score: 3

Lewisville ISD Outdoor Learning Area (LISDOLA) to Eastern Border with The Colony



Description

Segment L begins near LISDOLA at Fish Hatchery Road and runs east along McWhorter Creek, crosses under the KCS Railroad and then parallels the Lewisville Dam spillway. From here, this segment turns east and passes through East Hill Park (soon to be developed), around a new subdivision, and along the lakeshore until it connects to The Colony's trail system.

Type/Width

12' wide concrete off-street trail

Length

Planned: 3.1 miles

Land Ownership

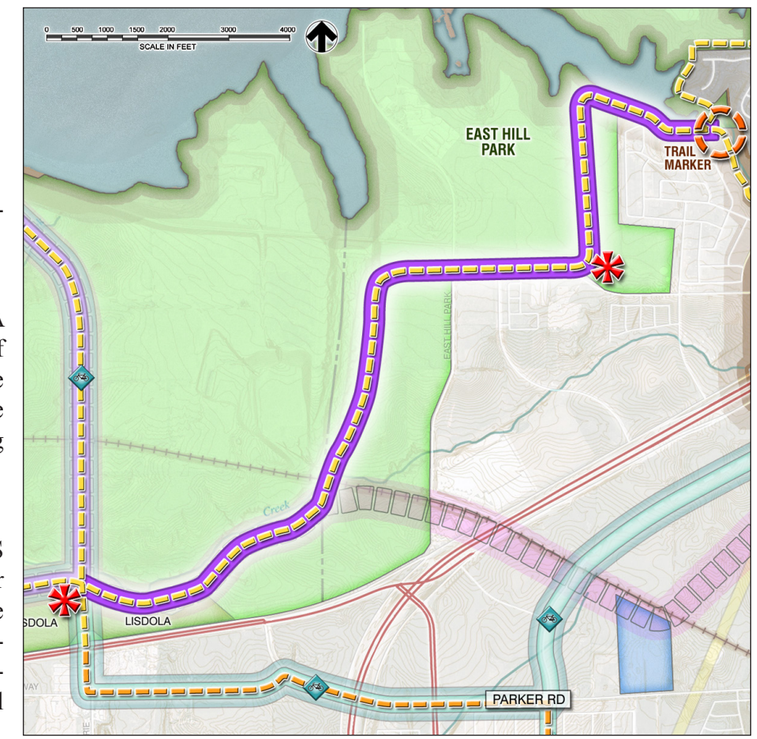
US Army Corps of Engineers, City of Lewisville

Key Land Uses / Destinations

This segment provides access to LLELA and LISDOLA and passes through some of the last preserved native landscapes in the area. Additionally, it connects to the future East Hill Park and the quickly-developing residential area east of LLELA.

Issues

- This segment crosses under the KCS Railroad. The existing bridge over McWhorter Creek appears to have ample clearance, but several tributaries enter the creek near this location, potentially requiring trail bridges as well.
- Because of the character of the lakeshore, this trail might require one or more bridges and/or boardwalks where it enters The Colony.

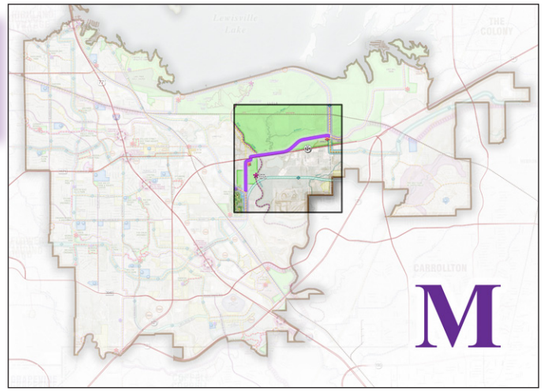


Planning-Level Cost Estimate

$3,283,965 total / $622 per linear foot

Segment M – Evaluation Score: 4

Business 121/Elm Fork of the Trinity River to the Lewisville ISD Outdoor Learning Area (LISDOLA)



Description

This segment begins in City-owned land at the northern end of Railroad Park, crosses under Business 121 at an existing bridge, parallels the highway on the north side (on the southern edge of LLELA), crosses the Trinity River, runs northeast between LLELA and LISDOLA, and terminates at Fish Hatchery Road.

Type/Width

12' wide concrete off-street trail

Length

Planned: 2.6 miles

Land Ownership

City of Lewisville, US Army Corps of Engineers

Key Land Uses / Destinations

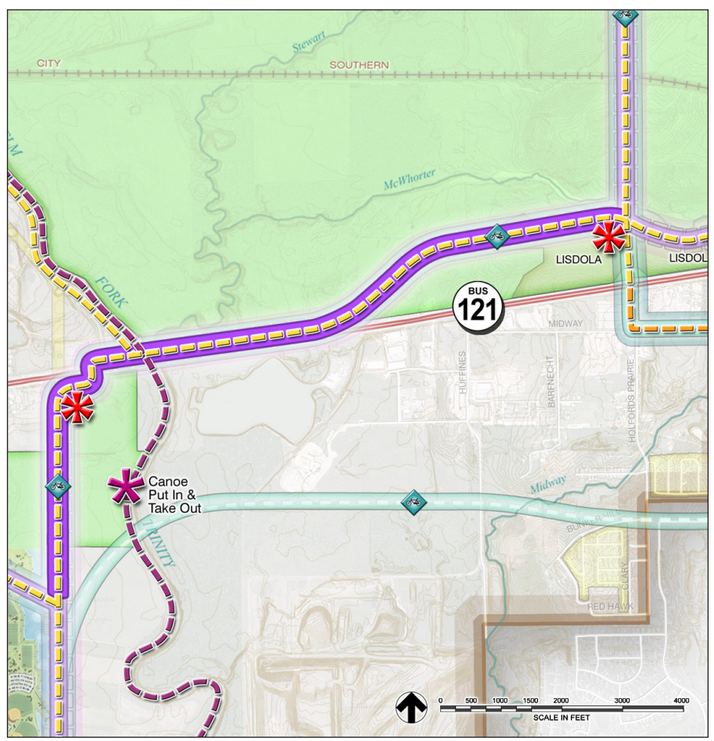
This segment provides access to Railroad Park, LLELA, and LISDOLA and serves as a crucial trail connection over the Trinity River.

Issues

- This segment requires a bridge over the Trinity River. Because of the depth of the river's channel, this would be a very large structure.
- There are multiple drainage areas on the north of Business 121, which would require boardwalks and/or bridges for a trail to be possible.

Planning-Level Cost Estimate

$2,223,765 total / $421 per linear foot

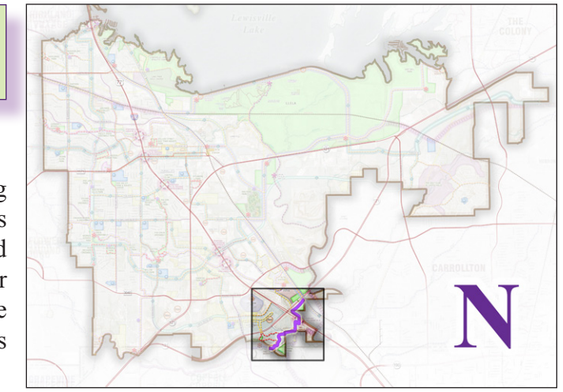


LEGEND

- Existing Off-Street Trails
- Proposed Off-Street Trails
- Proposed Enhanced Sidewalks
- Trinity River Paddling Trail
- Bike Route
- Bike Route Spine
- Pedestrian Spine
- Veloweb (Proposed by NCTCOG)
- Existing Trails (Other Cities)
- Planned Trails (Other Cities)
- Trail Head - Major
- Trail Head - Minor
- Trail Marker
- Schools
- Business with 350-1500 Employees
- Multi-Family Residential

Segment N – Evaluation Score: 2

Southern Border with Coppell to Southern DCTA Station/SH 121



Description

This segment begins at the City's border with Coppell along Denton Creek and continues along the existing off-street trails which run along the Levee Improvement District's sumps and pass through the Lake Vista business park. It then crosses over Lake Vista Drive, continues along another sump, runs along the levee, crosses under IH-35E, and parallels SH-121 until it ties in with the future DCTA trail.

Type/Width

12' wide concrete off-street trail

Length

Existing: 0.4 miles

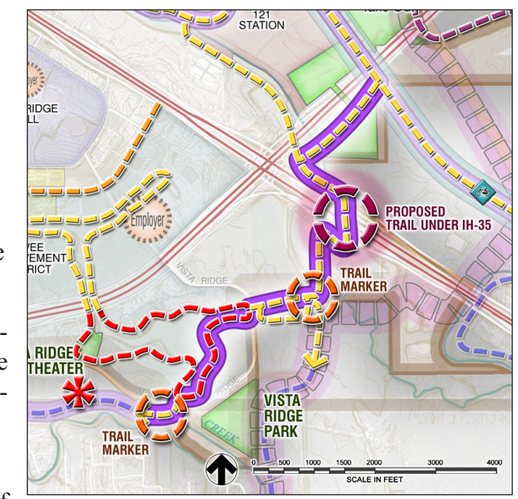
Planned: 1.4 miles

Land Ownership

Denton County Levee Improvement District #1, City of Lewisville

Key Land Uses / Destinations

Located near Lewisville's most major employment areas, this segment provides an important connection between Coppell and the future DCTA trail and provides access to a park, the future 121 Station development, and multiple major employers.



Issues

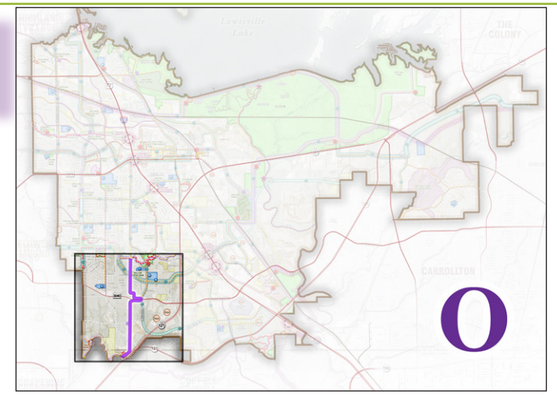
- This segment presents two mid-block, at-grade crossings of Lake Vista Drive. This would require trail crossing signage and traffic control.
- This segment would require trails that cross and/or run on top of the levee. This requires careful study of potential impacts of any construction on the structural integrity of the levee.
- A crossing under IH-35E at Timber Creek (at an existing bridge) is required for this segment. Though there is an existing bridge, as IH-35E is being redesigned it is essential that the City of Lewisville work with the Texas Department of Transportation to ensure that the schematics allow adequate clearance for a trail crossing.
- Timber Creek intersects this segment west of IH-35E and south of SH-121. This crossing would require a trail bridge. Because Timber Creek is quite wide in this area, the bridge might be a fairly significant structure.

Planning-Level Cost Estimate

$1,235,225 total / $234 per linear foot

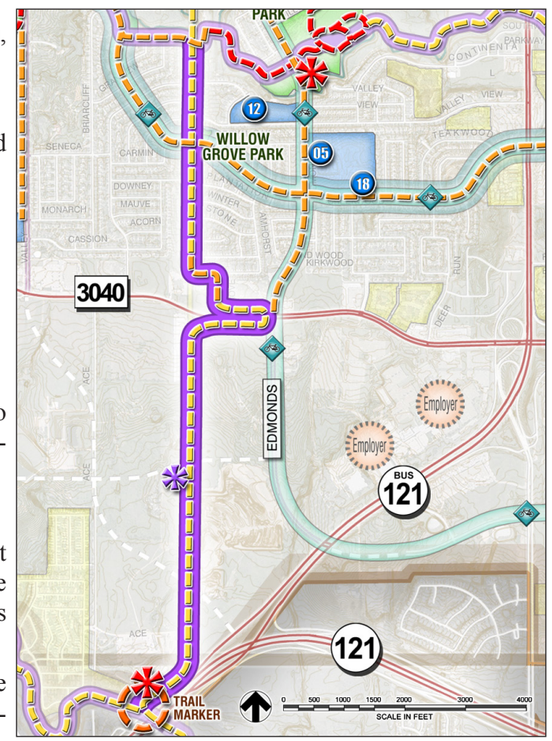
Segment O – Evaluation Score: 5

Timber Creek to Denton Creek



Description

Segment O begins at Timber Creek as an off-street trail and follows an electric utility easement south across Hillshire Drive and Corporate Drive. As it nears Round Grove Road, this segment transitions to a combination of enhanced sidewalks/bike route along Camelot Drive, Golden Grove Drive, and Willow Grove Drive, then transitions to a "side path," which will parallel Round Grove Drive and will cross the street at Edmonds Lane. The segment then parallels Round Grove Drive (on the south side) back to the electric utility corridor and continues on, through a generally undeveloped area south to Denton Creek.



Type/Width

12' wide concrete off-street trail/side path, 6' wide enhanced sidewalks, on-street bike route

Length

Planned: 2.5 miles

Land Ownership

City of Lewisville, HOAs, Private Land Owners

Key Land Uses / Destinations

The northern portion of this segment is primarily adjacent to neighborhoods but also connects schools and parks. The southern portion is in a mostly undeveloped area.

Issues

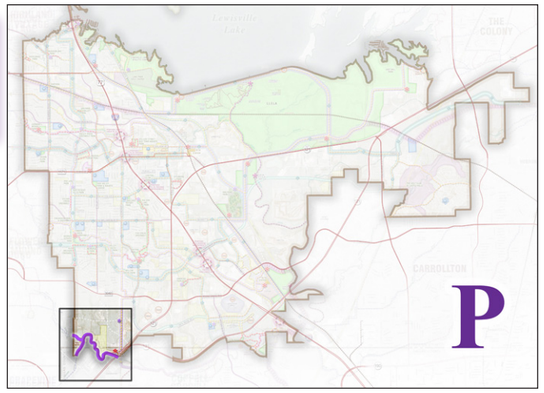
- The primary challenge in the northern half of this segment will be land assembly. Though the utility corridor is free of fences, it is divided among multiple property owners between Corporate Drive and Round Grove Road.
- Round Grove Road presents a challenge as it cannot be crossed mid-block and its traffic is too great for a combination of enhanced sidewalks/on-street bike routes. Instead, it will be necessary to provide shared use facilities along Round Grove for a short distance in order to utilize the traffic signal at Edmonds Lane (this type of facility is often referred to as a "side path").
- It is essential to plan this trail segment corridor into the future development plans south of Round Grove Road.

Planning-Level Cost Estimate

$1,716,281 total / $325 per linear foot

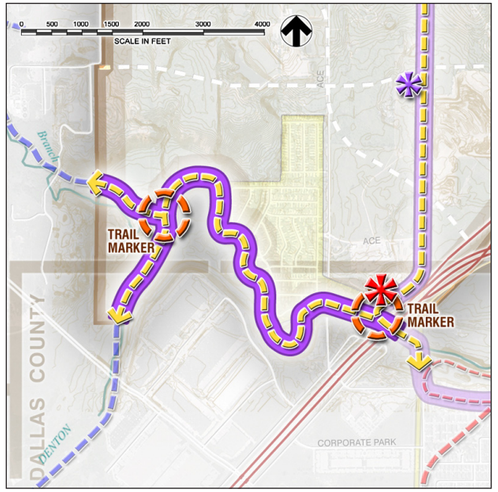
Segment P – Evaluation Score: 5

Western Border with Flower Mound/Grapevine to Southern Border with Coppell along Denton Creek



Description

Though this segment is in the far southwestern corner of Lewisville, it serves and an important connection along Denton Creek between Lewisville, Flower Mound, Grapevine, and Coppell. This segment follows Denton Creek and Bakers Branch from the border with Flower Mound and Grapevine (where it would tie into these cities' planned trail systems), carries south around an existing mobile home park, and crosses under SH-121 where it enters Coppell and would tie in with its existing trails.



Type/Width

12' wide concrete off-street trail

Length

Planned: 1.9 miles

Land Ownership

Private Land Owners

Key Land Uses / Destinations

This segment is in a generally undeveloped area though much of the surrounding area is currently zoned for light industrial, office, and residential (multi-family and townhouse). Existing adjacent land uses in Coppell include light industrial, office, and residential.

Issues

- The primary issues with this segment are that all of the land in this corridor is privately-owned and that the potential corridor is very narrow. These issues do not exist on the southern side of Denton Creek (which is within Grapevine and Coppell city limits) and therefore it might be more appropriate to provide this trail on the southern side of the creek through a partnership with these two cities.

Planning-Level Cost Estimate

$2,246,085 total / $425 per linear foot (for a trail on the northern side of the creek)

Spine Segment Priority Evaluation & Cost Estimate Summary

Table 5.1 summarizes the evaluation scores, length, and estimated costs for the seventeen spine corridor segments identified in this Trails Master Plan. The segments are ranked in the table based on their priority scores. Though these evaluation scores provide a good estimation of the overall importance of each segment relative to others, it is important to consider that while a segment might have a relatively low evaluation score for several reasons (such as it is not near existing schools or parks, it crosses privately-owned land, or it is in a topographically challenging area), it may be crucial to creating a connection between two or more higher-priority segments. For this reason, the order in which these segments are listed in Table 5.1 should be thought of as the relative importance of each individual segment, but not necessarily the order in which each segment should be constructed. Chapter 7 - Implementation provides in-depth recommendations for the phasing of these priority segments.

Table 5.1
Spine Segment Priority Evaluation & Cost Estimate Summary

Evaluation Score	Segment	Description	Length (miles)	Cost Estimate
1	C	Old Town/DCTA Station to Railroad Park	2.2	$1,478,205
1	D	Railroad Park to Southern DCTA Station/SH 121	2.0	$1,634,625
1	A	Northern DCTA Station to KCS Railroad	2.3	$1,808,295
1	B	LLELA Gate House to Old Town/DCTA Station	2.0	$1,565,370
2	I	Valley Ridge Greenbelt Park to KCS Railroad	1.85	$1,099,668
2	H	Valley Ridge Greenbelt Park to Creekview Park & Greenbelt	2.0	$1,177,335
2	P	Southern Border with Coppell to Southern DCTA Station/SH 121	1.8	$1,235,225
2	E	Corporate Drive to Southern DCTA Station	2.5	$1,671,525
3	F	Central Park to Corporate Drive	1.25	$1,175,778
3	L	Lewisville ISD Outdoor Learning Area (LISDOLA) to Eastern Border with The Colony	3.1	$3,283,965
3	J	LLELA Gate House to the Elm Fork of the Trinity River	1.7	$1,126,080
3	K	Elm Fork of the Trinity River to the Lewisville ISD Outdoor Learning Area (LISDOLA)	2.7	$2,274,480
4	G	Western Border with Flower Mound to Central Park	2.6	$1,596,184
4	M	Business 121/Elm Fork of the Trinity River to the Lewisville ISD Outdoor Learning Area (LISDOLA)	2.6	$2,223,765
5	O	Timber Creek to Denton Creek	2.5	$1,716,281
5	P	Western Border with Flower Mound/Grapevine to Southern Border with Coppell along Denton Creek	1.9	$2,246,085
		TOTAL	***35.0***	***$27,312,866***

Note: A low evaluation score indicates higher priority

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Deep Roots. Broad Wings. Bright Future.

The 2011 Lewisville Trails Master Plan

"Active Adventure... Creative Connections"

Chapter 6 - Trail Design Standards

Introduction

In order to ensure that Lewisville's trail system is developed in a consistent manner and is safe and easy to use, a set of design standards has been created as part of this Trails Master Plan. Building Lewisville's trail system based on design standards for trailheads, sidewalks, bridges, access points, pavement markings, etc. ensures that a high level of quality is maintained. These design standards also present an aesthetic or "brand" for the City's trail system, which will become recognizable to its users as a hallmark of excellence. The intent of these standards is not to preclude innovation or uniqueness within the trail system. Rather, these standards and guidelines are intended to provide a framework within which each piece of the trail system can be designed in a manner sensitive to its surrounding context while ensuring that certain aesthetic, safety, comfort, and quality features are present across the system.

Types of Standards

There are many different types of standards which apply to the development of bicycle and pedestrian infrastructure. The purpose of developing and adopting standards is to ensure public safety, the coherency of individual facilities and the overall system, and consistency of quality across the system. By definition, a standard is a set of minimum parameters within which each individual facility should be designed. Generally, standards fall within one of two categories:

National and State Standards

The primary national and state standards related to bicycle and pedestrian facilities are the American Association of State Highway and Transportation Officials (AASHTO) "Guide for the Development of Bicycle Facilities," the Americans with Disabilities Act Accessibility Guidelines (ADAAG/TAS), the Texas Accessibility Standards (TAS), and the Texas Manual on Uniform Traffic Control Devices (TMUTCD). These standards focus on safety and accessibility for the disabled and should serve as the foundation for the design of any trail facility. Generally, these standards provide guidelines and/or mandated requirements for the geometric (rather than the aesthetic) design of facilities and include requirements for slope, cross slope, vertical clearance, and a multitude of other dimensional aspects of trail facilities.

Local Standards

In contrast with the national and state standards, local standards generally focus more on capacity, quality, and aesthetic issues. As an example of a capacity standard, some cities have a standard trail width of eight feet (which allows two adults to comfortably walk side-by-side and a third adult to pass them) while others have a standard of ten feet (which better accommodates two-way bicycle traffic). An example of a quality standard is requiring certain pavement thicknesses and reinforcement patterns in order to ensure adequate structural performance in different conditions. Finally, an example of an aesthetic standard is requiring that all bridges be of the same character and include columns clad with a specific type of material.

Lewisville Trail Design Standards

The following set of design standards has been developed in order to ensure that Lewisville's trail system is developed with a high level of safety, quality, and comfort for trail users. These standards are in addition to mandated national and state standards (AASHTO, ADAAG/TAS, and MUTCD). In some cases, such as when a certain component of the trail system cannot be standardized (crosswalks, for example), the following recommendations are provided as guidelines rather than standards.

Off-Street Trails – Hard Surface

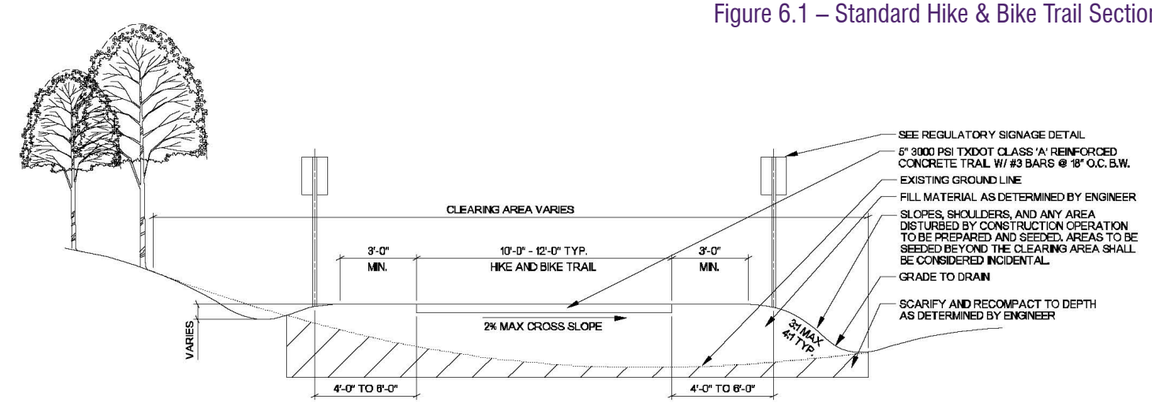
Design Objectives

- The alignment should follow the contours of the land and its natural drainage patterns. The trail should not appear to be carved out of the terrain.
- Trails should be gentle, curvilinear, and may include a combination of curving and straight segments. Serpentine or sinuous trail alignments are not desirable and should be limited to instances where tree preservation necessitates such alignments.
- Meanders in trails should appear to have a purpose and should not be haphazard or irregular.
- Create functional, efficient, trail alignments that present and preserve the natural terrain and vegetation to the greatest extent possible.
- Locate intersections at natural focal points such as scenic vistas and convenient access points.
- Where conditions apply, trails shall align with existing or future crosswalks at streets. These intersections shall incorporate handicap accessible ramps that meet the design criteria of ADAAG/TAS.

Design Standards

a. Prepared Sub-grade: Over excavate unstable subgrade soils where encountered and replace with city approved fill material. Compact all fill to 95% standard proctor @ 0% to +6% optimum. Remove all topsoil prior to subgrade preparation and use in finish grading work along trail edges after concrete has cured. Import additional soil backfill as needed for trail edges to provide a minimum 3' wide trail shoulder and an embankment blended

Figure 6.1 – Standard Hike & Bike Trail Section



with existing grade on both sides of the trail. All embankments must be constructed at mowable slopes with a grade of 3:1 or less. See Figure 6.1 – Standard Hike & Bike Trail Section.

b. Pavement Structure: The standard pavement shall be reinforced 4" to 5" thick Portland cement concrete with a transverse medium broom finish. Bituminous fiberboard board expansion joints shall be placed in the trail at an interval of 40' for 10' wide trails and 50' to 60' for 12' wide trails. Expansion joints shall be topped and sealed with a self-leveling elastomeric joint compound and shall be flush with the top surface of pavement on both sides of the joint. Control joints shall be placed at intervals equal to the trail width and shall be of a depth of one-fourth the pavement thickness. The joints shall be saw-cut and 1/4" wide. For optimum user comfort, the finished surface of trails should not vary more than 1/4" from the lower edge of an 8' long straight edge when laid on the surface in any direction. The concrete thickness of all trails and sidewalks shall be 4" minimum depth and 5" minimum depth on spine trail segments and where heavy maintenance vehicles are expected to cross over the trail. The reinforcement shall be #3 (minimum) deformed steel bar at a maximum of 12" on center both ways and shall be supported on plastic chairs placed 24" on center both ways. Welded wire mesh is not acceptable. See Figure 6.2 – Spine Trail Pavement Section, Figure 6.3 – Typical Trail Pavement Section, Figure 6.4 – Expansion Joint Section, and Figure 6.5 – Expansion Joint Spacing.

Figure 6.2 – Spine Trail Pavement Section

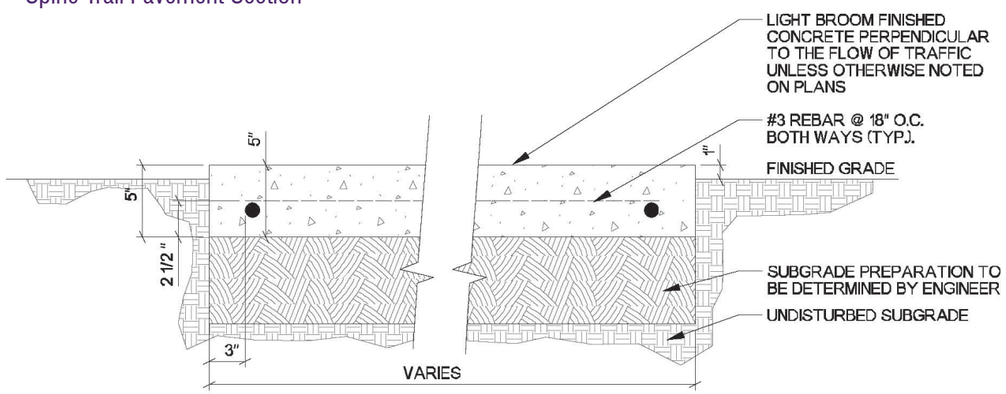


Figure 6.3 – Typical Trail Pavement Section

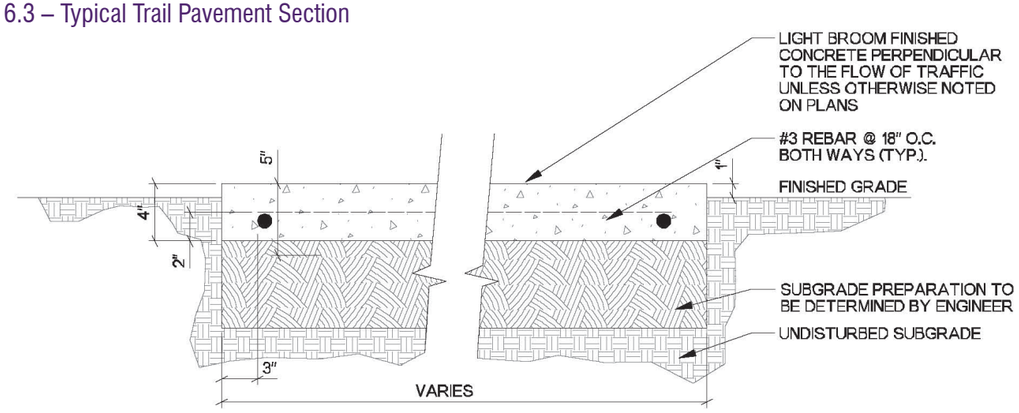


Figure 6.4 – Expansion Joint Section

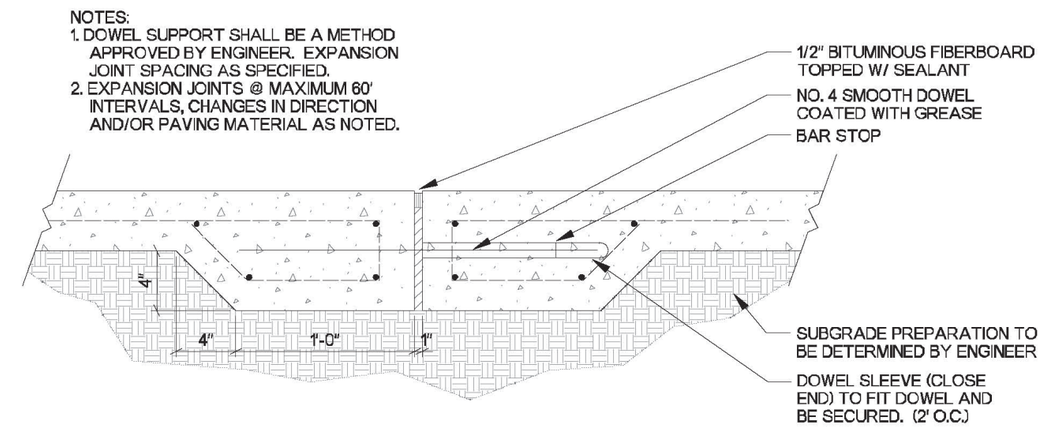
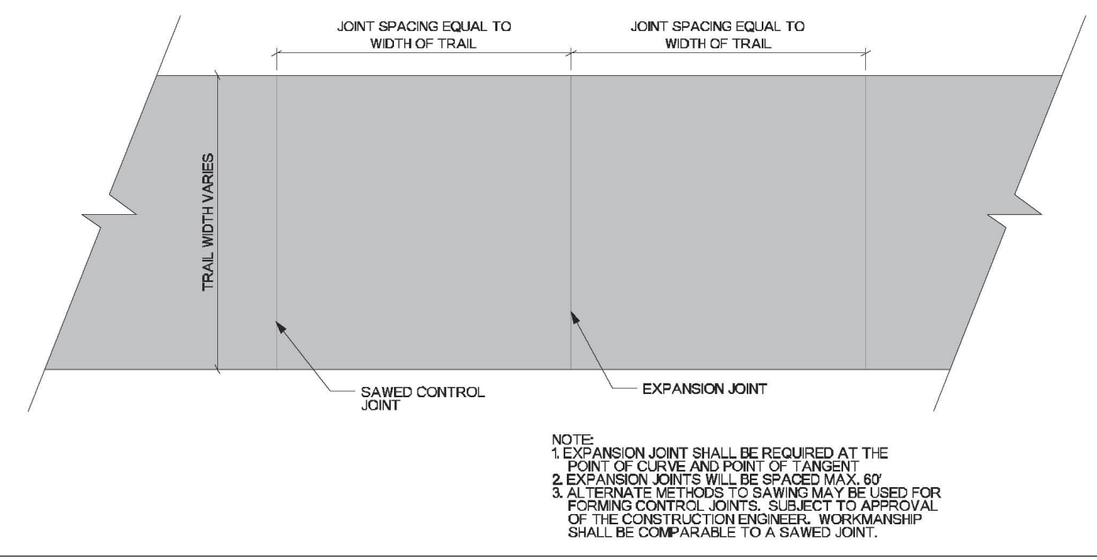


Figure 6.5 – Expansion Joint Spacing

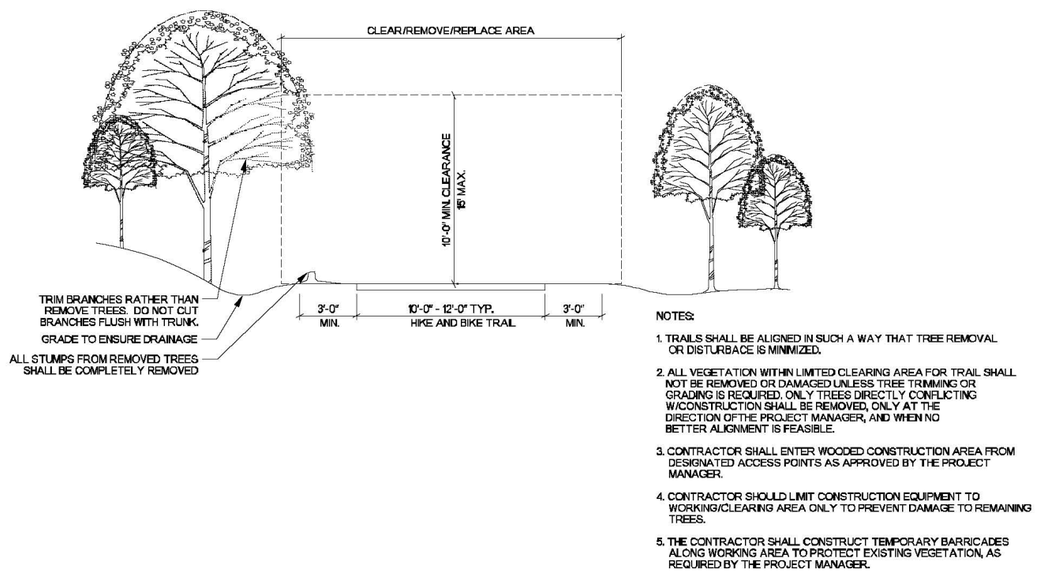


c. Width & Clearance: The spine trails within the City's system, which will include a mix of bicycle, pedestrian, other non-motorized transportation, and maintenance vehicles, shall be 12' in width. The minimum width of a multi-use trail shall be 10' to accommodate maintenance access and passing room for cyclists (if the maintenance vehicles will navigate steep grades, the minimum width shall be 12'). See Figure 6.1 – Standard Hike & Bike Trail Section.

The optimum vertical clearance of obstructions over a trail is 10' or higher, which accommodates maintenance, patrol, and emergency vehicle access. All underpasses and tunnels should be a minimum of 10' in height. If vertical clearances under bridges and other structures are less than 10', the clearance shall be clearly posted with warning signage to alert approaching trail users.

A minimum 3' wide graded soft shoulder should be constructed and maintained on both sides of the trail (in addition to any adjacent graded areas for steep inclines). Shoulders must be constructed with a constant grade (4:1 typical, 3:1 maximum). Shoulders should be clear of trees, stumps, drainage, poles, walls, fences, guardrails, and other vertical or lateral obstructions whenever possible. In instances where trees or other obstacles may encroach within this space, warning signage should be provided. A 5' lateral separation is necessary from any vertical embankment or drop-off. If this is not possible, safety railing, walls, or fencing shall be provided. All barrier material shall conform to City of Lewisville standards. See Figure 6.6 – General Construction Limits.

Figure 6.6 – General Construction Limits



d. Design Speed: In general, a minimum design speed of 20 mph should be used when trail grades do not exceed 5%. In those instances where strong prevailing tail winds exist or trail grades may exceed 5%, a design speed of 30 mph is advisable. Speed bumps or similar surface obstructions intended to slow down cyclists would pose a trip hazard for other trail users and should never be used. In instances where it is desirable to slow the speed of cyclists, chicanes should be used.

e. Alternate Routes: It is the intent of the plan to provide accessible routes linking all destinations and nodes within the city. It is at the discretion of the City to allow for the creation of alternate routes to destinations which do not meet standards established by ADAAG/TAS.

f. Horizontal Alignment & Super-Elevation: The use of super-elevated trails shall be limited to instances where they are needed in order to help alleviate drainage issues or in other special circumstances such as challenging topography. Trails shall not exceed a 2% cross-slope. The City may allow for the construction of additional and alternate routes that do not meet the standards established within ADAAG/TAS so long as the super-elevation does not exceed a 5% slope. Minimum radius varies depending on cross-slope.

When curves of lesser radii than those recommended must be used on multi-use trails because of limited right-of-way, topography, or other considerations, standard curve warning signs and supplemental pavement markings should be installed in accordance with the TMUTCD. It is advisable to widen the trail in order to increase the lateral space available to cyclists as they lean to the inside of the turn. The amount of widening should be limited to a maximum of 4'.

Cyclists frequently ride two abreast on trails. On narrow trails, cyclists have a tendency to ride near the middle of the path. For these reasons and because of the serious consequences of a head-on bicycle collisions, lateral clearances on horizontal curves should be widened through the curve, a non-skid yellow center stripe should be installed, and a "curve ahead" warning sign should be installed in accordance with the TMUTCD.

g. Grade: Longitudinal grades on trails shall not exceed 5% except in unusual circumstances. In cases where the minimum grade must be exceeded, an alternate route must be constructed to meet ADAAG/TAS standards. The absolute maximum grade for a trail intended for bike usage is 8%.

Grades between 2% and 5% are acceptable for trails where a leveling off at the base of the incline permits adequate recovery before an intersection or other conflict point. Bridges constructed with a wood surface shall not exceed a 2% slope with the exception of the camber on pre-fabricated bridges. Concrete surfaces on bridges can exceed 2% to a maximum of 5% if the exit off of the bridge has an adequate deceleration area prior to encountering an intersection of any kind or a curve in the alignment of the trail.

h. Drainage: The cross-slope of areas adjacent to trails should be a minimum of 2% to provide for drainage. Trail pavement surfaces shall meet but not exceed a cross slope of 2% in order to maintain compliance with ADAAG/TAS standards. See Figure 6.1 – Standard Hike & Bike Trail Section.

Sloping in one direction instead of crowning is preferred because it simplifies drainage, surface construction, and maintenance. An even surface is essential to prevent water ponding and ice formation. Culverts and other drainage and piping should be extended laterally at least 10' from the downhill side of a trail or path.

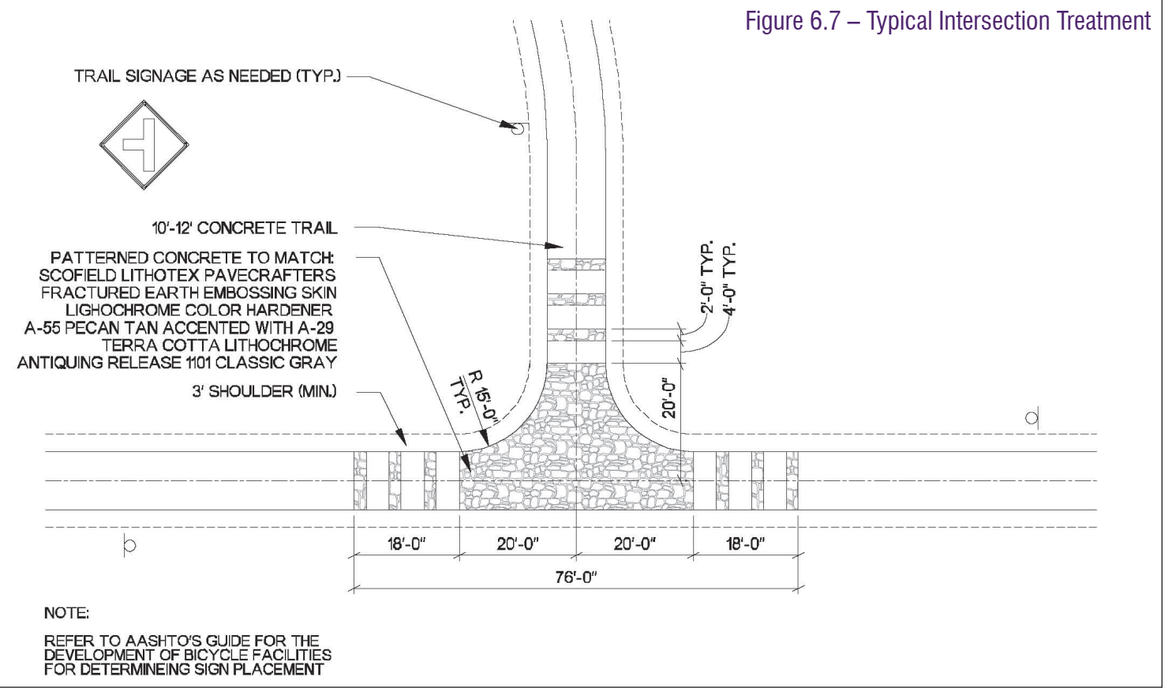
In floodplains, trail rights-of-way or easements shall be located on the highest elevation within the designated floodplain while maintaining a 3' soft shoulder on both sides.

Where a trail is constructed on the side of a hill, a ditch or sizable swale of dimensions suitable for the safety of cyclists and for the volume of water expected shall be constructed on the uphill side to intercept the hillside drainage. Where necessary, catch basins with cross culverts (pipe structures built underneath the trail) shall be provided to convey the intercepted water under the trail. The length of cross culverts should be extended to include the clear zone as well as the trail width and should be backfilled to provide an uninterrupted clear zone.

Drainage grates and manhole covers should be located outside of the travel path of bicyclists and wheelchair users. To assist in draining the area adjacent to the trail, the design should include considerations for preserving the natural ground cover. Seeding, mulching, and sodding of adjacent slopes, swales, and other erosion-prone areas shall accompany trail construction and shall be implemented by the trail builder. Where trails pass underneath highway bridges, existing deck drain discharges must be routed or reconstructed so that deck runoff will not discharge upon or flow across the trail (such drainage can create ice and algae on the pavement as well as erode the pavement surface).

i. Intersection Treatment: Intersections are important locations from a traffic flow and aesthetic point of view. The corner radius for 90 degree intersections should typically by 15' though larger or smaller radii (10' minimum) may be appropriate in special circumstances such as at non-right-angle intersections and when trails intersect at planting beds, signage or other focal points. "Stop" or "yield" signs should be utilized on trails with high traffic volumes and at intersections with limited sight lines to denote right-of-way. At a minimum, intersection warning signs shall be placed on each intersection approach per AASHTO and TMUTCD guidelines. Major intersections shall have patterned concrete as indicated in Figure 6.7 – Typical Intersection Treatment.

Figure 6.7 – Typical Intersection Treatment



Off-Street Trails – Soft Surface

Design Objectives

- Materials should provide a stable surface and be permeable.
- Color should be earth tone to blend with the natural environment and to minimize visual impact.
- Design for wheelchair accessibility wherever practical, with trail widths no less than 48". In cases where a 48" wide trail is designed, ensure that adequate wheelchair passing areas are provided per ADAAG/TAS requirements.
- Minimize erosion of surface material at side drainage locations to limit washing, i.e., provide concrete pans or other erosion mitigating devices as approved by the city.

Design Standards

a. Prepared Sub-grade: Compact on-site material where approved by the City Engineer. Over-excavate if unstable sub-soils are encountered and replace with City-approved fill material. Compact all fill areas to 95% standard proctor @ 0% to +6% optimum moisture content. Remove all topsoil prior to subgrade preparation. The use of a geotextile fabric under the aggregate fines where installed in wet or unstable areas is recommended.

b. Trail Surface: 3/8" diameter crushed and compacted aggregate fines, such as crushed or decomposed granite with adequate binder, minimum 4" depth.

c. Width & Clearance: Standard width for two-way trails is 6' with a minimum width of 3'.

d. Grade, Sight Distance, Drainage: Refer to hard-surface trail design guidelines.

e. Sensitive Areas: For natural surface trails that will be located in environmentally sensitive areas, several measures are recommended to lessen the impact of the trail and trail users on the area (see Figure 6.8 – Trails Near Creeks):

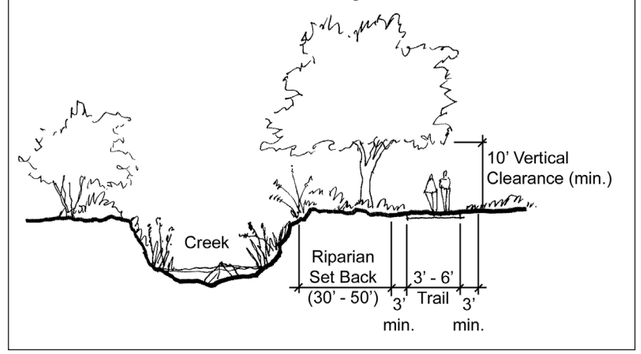
1. The riparian setback should be as wide as possible. 30' to 50' is recommended.

2. Slope the trail away from the waterway or pre-treat trail run-off with a trail-side swale.

3. Limit vegetation removal but remove invasive plant species.

4. Use the trail as an opportunity to restore and enhance the waterway or environmentally sensitive area.

Figure 6.8 – Trails Near Creeks

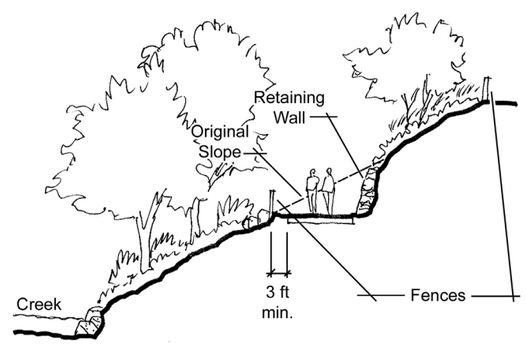


f. Other Considerations: Trails can vary in width and type depending on the existing topographic and environmental constraints. Soft surface trail design should take into account issues like drainage, erosion, slope/grade, presence of waterways, vegetation, riparian and habitat areas, and environmental requirements and regulations. In some cases the proposed trails will have to address slope concerns during design and construction (see Figure 6.9 – Trails Along Steep Slopes).

g. Accessibility: Areas with earthen walking trails (i.e., parks and natural areas) should also provide an alternate route that meets or exceeds ADAAG/TAS standards.

h. Steep Slopes: Figure 6.9 illustrates a typical earthen trail design that is appropriate for steep and inclined areas. This type of trail is typically 3' to 6' wide and is designed to accommodate walkers, hikers, and runners, depending on available space. The foot trail will be an earthen or other "soft" surface (rather than materials such as crushed granite), so it is not appropriate for most bicyclists, nor will it meet ADAAG/TAS requirements. The trails should be designed with adequate drainage to prevent channeling and erosion.

Figure 6.9 – Trails Along Steep Slopes



Enhanced Sidewalks

Design Objectives

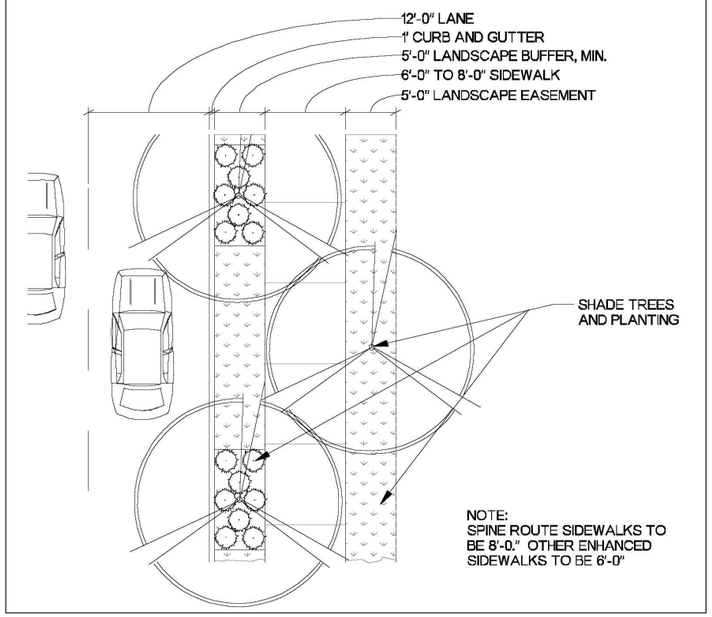
- Enhanced sidewalks are intended to provide pedestrian connections between off-street trail segments, to provide pedestrian routes where alternative off-street trail alignments are not feasible, and to provide pedestrian routes along streets which have a high density of pedestrian-oriented land uses.
- Enhanced sidewalks are generally not intended for use by cyclists except for young children. Cyclists should use alternative off-street trail routes or on-street bike routes.

Design Standards

a. Prepared Sub-grade, clearance, pavement structure, horizontal alignment, grade, and drainage: see City of Lewisville standard for sidewalk design.

b. Width: Where enhanced sidewalks overlap the pedestrian spine system as defined in the Trails Master Plan, the minimum width shall be 8' and shall be provided on both sides of the street. In all other locations the minimum width for enhanced sidewalks shall be 6' and shall be provided on both sides of the street. See Figure 6.10 – Typical Enhanced Sidewalk.

Figure 6.10 – Typical Enhanced Sidewalk



On-Street Bicycle Facilities

Design Objectives

- Provide safe, quick, and direct travel along corridors with high bicycle demand.
- Connect discontinuous segments of shared-use trails.
- Provide a common route for cyclists through a high demand corridor.
- Provide extensions along local neighborhood streets and collectors that lead to commercial areas, places of employment, educational facilities, parks and other community facilities.
- Provide striped bike lanes or cycle tracks where possible. Provide shared lanes where these other facility types are not possible due to limited right-of-way.

Design Standards

a. Signage: Bike route signs shall be used on streets with bike routes, shared lanes, bike lanes, and cycle tracks as well as on shared-use trails where applicable. Route signs should include route number and destination information, yet be legible to moving cyclists. Route signs shall be located at all intersections where the bike route changes direction. Additional route signs should be located in accordance with AASHTO and TMUTCD standards.

b. Pavement Surface: The pavement surface shall match the roadway surface; pavement seams should be minimized and placed outside of the bicycle facility where possible. Adjust utility covers to grade, install bicycle safe drainage grates, and fill potholes to provide a smooth surface.

c. Shared Lanes: Outside lanes for shared lane facilities shall meet or exceed a width of 14.5' (not including curb and gutter). Sharrow markings shall be used on all shared lanes, shall be of reflective, non-skid material, and shall be placed a minimum of 5' from the face of curb on roads without on-street parking and a minimum of 5' from the outside edge of the parking lane on roads with on-street parking (in both cases, placement at the lane centerline is recommended). A minimum of two Sharrow markings per block face shall be used and shall be located 50' toward midblock from the intersection at both ends of the block. If the block face is over 300' in length, an addi-

Figure 6.11 – Typical Shared Lane

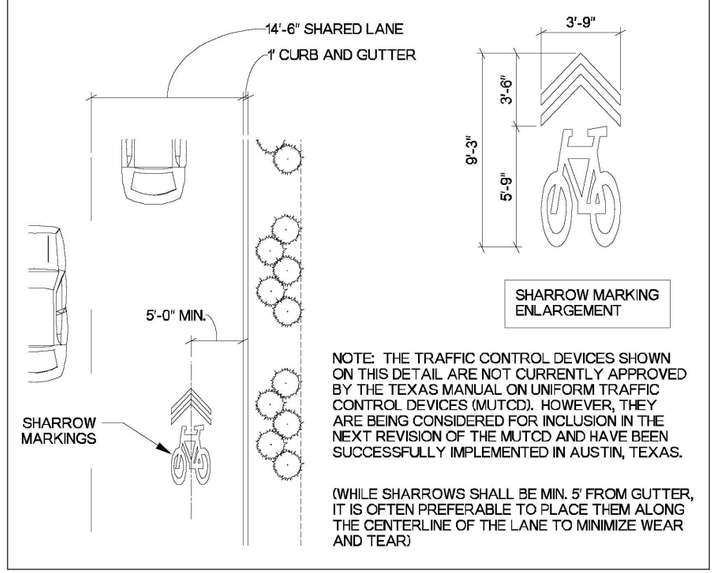


Figure 6.12 – Shared Lane with On-Street Parking

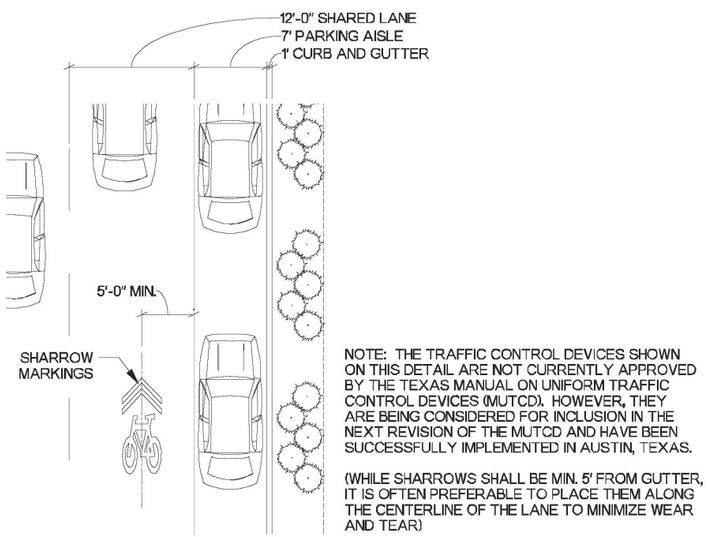
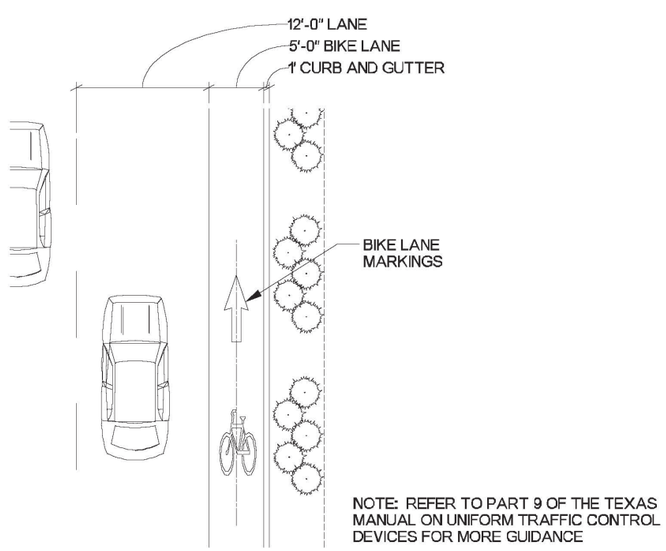


Figure 6.13 – Typical Bike Lane



tional Sharrow marking should be placed at midblock. See Figure 6.11 – Typical Shared Lane and Figure 6.12 – Shared Lane with On-Street Parking.

d. Bike Lanes: Bike lanes shall be at minimum 4' wide (5' is recommended) not including curb and gutter. Bike lanes are one-way and should be indicated as such through pavement markings per TMUTCD. Bike lane markings should be placed at the bike lane centerline and should be of reflective, non-skid material. A minimum of two sets of bike lane markings (which consists of a bicycle outline and directional arrow) per block face shall be used and shall be located 50' toward midblock from the intersection at both ends of the block. If the block face is over 300' in length, an additional set of bike lane markings should be placed at midblock.

Bike lanes should be continuous along a corridor and should not terminate at major intersections. On major roads, bike lanes should terminate into off-street trails, cycle tracks, or bike lanes on intersecting streets. On minor roads, bike lanes can terminate into shared lanes or signed routes.

Trail/Roadway Crossings

Trail/roadway crossings may be at-, below-, or above-grade. Designing safe crossings is crucial to the safety of a trail design. Trail/roadway crossings should comply with AASHTO, TxDOT, and TMUTCD standards. Evaluation of trail crossings involves analysis of vehicular and trail user traffic patterns, travel speeds, street width, traffic volumes (average daily traffic, peak hour traffic), and line of sight. The most appropriate trail/roadway crossing option should be based on the best available information and must be verified and/or refined through the actual engineering and construction document stages. Engineering studies should be done to determine the appropriate level of traffic control and design. There are four primary types of trail/roadway crossings:

- Type 1 – Unprotected/Marked: Unprotected/marked crossings include trail crossings of residential, collector, and sometimes major arterial streets or railroad tracks.
- Type 2 – Existing Intersections: Trails that emerge near existing intersections may be routed to these locations, provided that sufficient protection is provided at the existing intersection.
- Type 3 – Signalized/Controlled: These trail crossings include signals or other traffic control measures due to traffic volumes, speeds and trail usage.
- Type 4 – Grade-separated: Bridges or under-crossings provide the maximum level of safety but also generally are the most expensive and have rights-of-way, maintenance and other security considerations.

Design Guidelines – Unprotected/Marked Crossings (Type 1)

An unprotected crossing is a midblock crossing or a crossing at an intersection without traffic signals or stop signs that consists only of a crosswalk and signing. The approach to designing crossings at mid-block locations depends on an evaluation of vehicular traffic, line of sight, trail traffic, use patterns, vehicle speed, road type and width, and other safety issues such as the proximity of schools. Table 6.1 indicates where unprotected crossings (crossings without traffic signals or stop signs) may be acceptable. Figure 6.14 – Typical Unprotected/Marked Crossing illustrates the typical layout and signage scheme for this crossing type.

In addition to considering traffic volume and speed, it is important to consider line of sight. Per the Texas Department of Transportation Roadway Design Manual (March 2009), the minimum line of sight for unprotected crossings (on level grade) should be based on the speed at which vehicles travel as follows:

- 25 mph zone: 155 feet
- 35 mph zone: 250 feet
- 45 mph zone: 360 feet

Figure 6.14 – Typical Unprotected/Marked Crossing

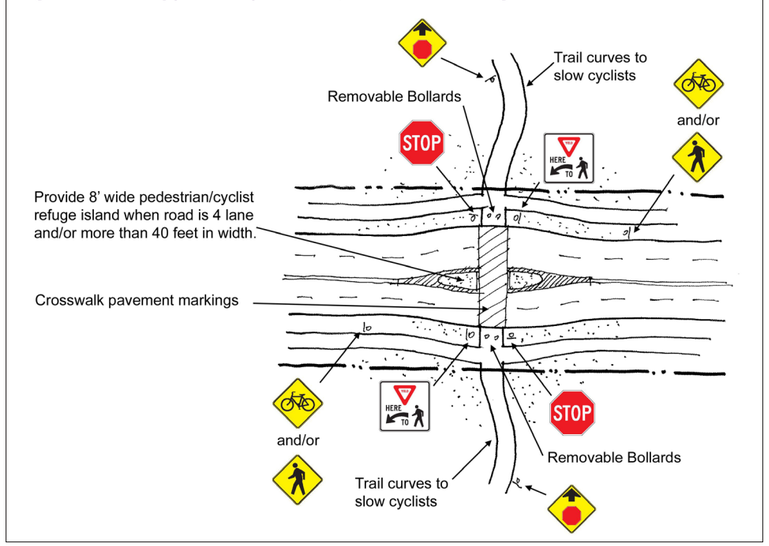


Table 6.1
Recommendations for Installing Marked Crosswalks and Other Needed Pedestrian Improvements at Uncontrolled Locations*

Roadway Type (Number of Travel Lanes and Median Type)	Vehicle ADT** <9,000			Vehicle ADT 9,000 to 12,000			Vehicle ADT 12,000 to 15,000			Vehicle ADT >15,000		
	Posted Speed Limit†			Posted Speed Limit			Posted Speed Limit			Posted Speed Limit		
	< 30 mph	35 mph	40 mph	< 30 mph	35 mph	40 mph	< 30 mph	35 mph	40 mph	< 30 mph	35 mph	40 mph
Two Lanes	C	C	P	C	C	P	C	C	N	C	P	N
Three Lanes	C	C	P	C	P	P	P	P	N	P	N	N
Multilane (four or more lanes) with raised median‡	C	C	P	C	P	N	P	P	N	N	N	N
Multilane (four or more lanes) without raised median	C	P	N	P	P	N	N	N	N	N	N	N

Source: modified from: Federal Highway Administration. Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations. FHWA Publication Number: HRT-04-100. September 2005.

* These guidelines include intersection and midblock locations with no traffic signals or stop signs on the approach to the crossing. They do not apply to school crossings. A two-way center turn lane is not considered a median.

** ADT = Average daily trips

† Where the speed limit exceeds 40 mph, marked crosswalks alone should not be used at un-signalized locations.

‡ The raised median or crossing island must be at least 1.2 m (4 ft) wide and 1.8 m (6 ft) long to serve adequately as a refuge area for pedestrians in accordance with TMUTCD and AASHTO guidelines.

C = Candidate sites for marked crosswalks. Marked crosswalks must be installed carefully and selectively. Before installing new marked crosswalks, an engineering study is needed to determine whether the location is suitable for a marked crosswalk.

P = Possible increase in pedestrian crash risk may occur if crosswalks are added without other pedestrian facility enhancements. These locations should be closely monitored and enhanced with other pedestrian crossing improvements, if necessary, before adding a marked crosswalk.

N = Marked crosswalks alone are insufficient, since pedestrian crash risk may be increased by providing marked crosswalks alone. Consider using other treatments, such as traffic-calming treatments, traffic signals with pedestrian signals where warranted, or other substantial crossing improvement to improve crossing safety for pedestrians.

Wherever unprotected crossings are necessary, crosswalks and warning signs ("Bike Xing") should be provided to warn motorists. Stop signs and slowing techniques (bollards/geometry) should be used on the trail as it approaches the crossing. Care should be taken to keep vegetation and other obstacles out of the sight line for motorists and trail users. Engineering studies should be performed to determine the appropriate level of traffic control and design for each individual crossing.

The top of the crosswalk should be flat and typically made of asphalt, patterned concrete, or brick pavers. Brick or unit pavers should be discouraged because of potential problems related to pedestrians, bicycles and ADAAG/TAS requirements for a continuous, smooth, vibration-free surface. Tactile treatments are needed at the sidewalk/street boundary so that visually impaired pedestrians can identify the edge of the street. Costs can range from $5,000 to $20,000 per crosswalk, depending on the width of the street, the drainage improvements required, and the materials used for construction.

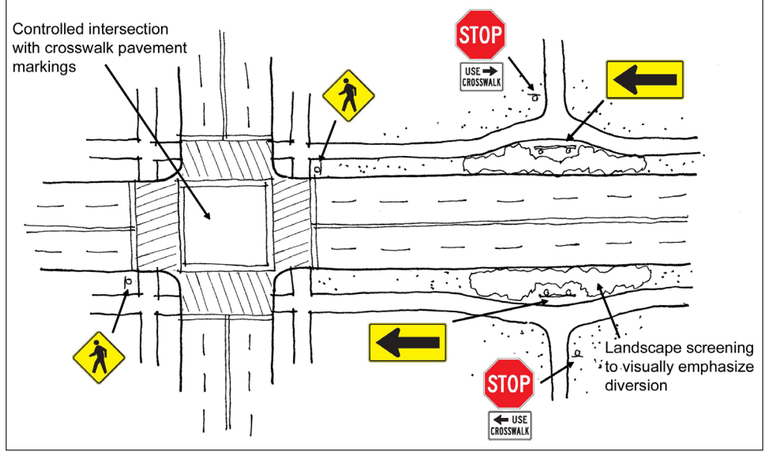
A flashing yellow beacon costing between $15,000 and $30,000 (preferably one that is activated by the trail user rather than operating continuously) may be used. Some cities have successfully used a flashing beacon activated by motion detectors on the trail, triggering the beacon as trail users approach the intersection. This equipment, while slightly more expensive, helps alert motorists to trail traffic (see Design Guidelines – Signalized/Controlled Crossings).

Crossings of higher volume arterials over 15,000 average daily vehicle trips (ADT) may be unprotected in some circumstances. For example, if they have 85th percentile speeds of 30 mph or less and have only two lanes of traffic. Such crossings would not be appropriate if a significant number of school children used the trail.

Design Guidelines – Existing Intersections (Type 2)

When a trail approaches a street within 500' of an existing signalized intersection with pedestrian crosswalks, users are typically diverted to the signalized intersection for safety and traffic control purposes. For this option to be effective, barriers and signage are needed to direct trail users to the signalized crossings. In most cases, signal modifications would be made to add pedestrian detection and to comply with ADAAG/TAS. In many cases, pedestrian crossings are simply part of the existing intersection and are adequate for most trail users. However, it may be necessary to provide wider curb ramps and crosswalk striping depending on existing conditions and the volume of trail users anticipated. See Figure 6.15 – Typical Existing Intersection Treatment.

Figure 6.15 – Typical Existing Intersection Treatment



Design Guidelines – Signalized/Controlled Crossings (Type 3)

New signalized crossings are recommended for crossings more than 500' from an existing signalized intersection, where speed limits are 40 mph and above, and/or ADT exceeds 15,000 vehicles (see Table 6.1 for information regarding situations in which an unprotected crossing might be insufficient). Each crossing, regardless of traffic speed or volume, requires additional review by a registered Texas professional engineer to identify sight lines, potential impacts on traffic flow, timing with adjacent signals, capacity, and safety.

There are generally two types of signalized/controlled crossings: partially signalized (which include flashing yellow warning beacons for motorists and stop signs for trail users) and fully signalized (which include red/yellow/green signals for motorists and walk/don't walk signals for trail users). These two types are illustrated in Figure 6.16 and 6.17, respectively.

Trail signals are normally activated by push buttons, but may also be triggered by motion detectors. The maximum delay for activation of the signal should be one minute, with minimum crossing times determined by the width of the street. The signals may rest on flashing yellow or green for motorists when not activated and should be supplemented by standard advanced warning signs. Typical costs for a signalized crossing range from $150,000 to $250,000.

Figure 6.16
Partially Signalized
Trail Crossing

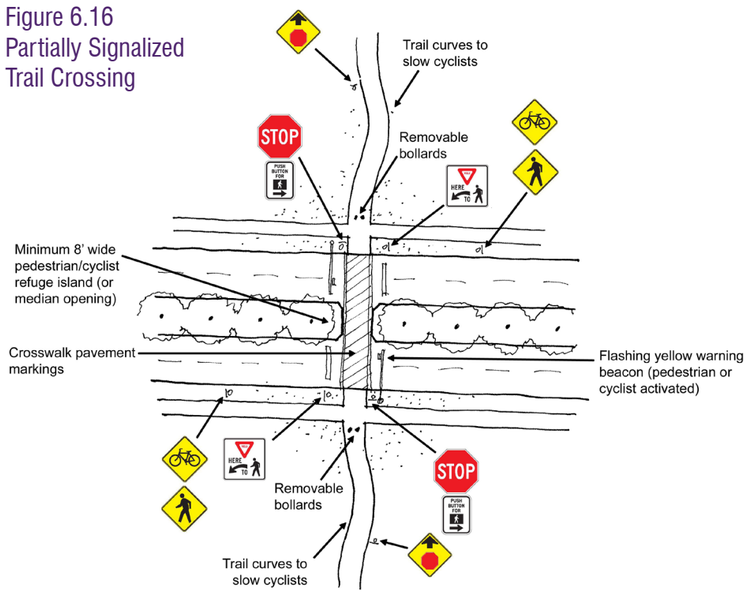
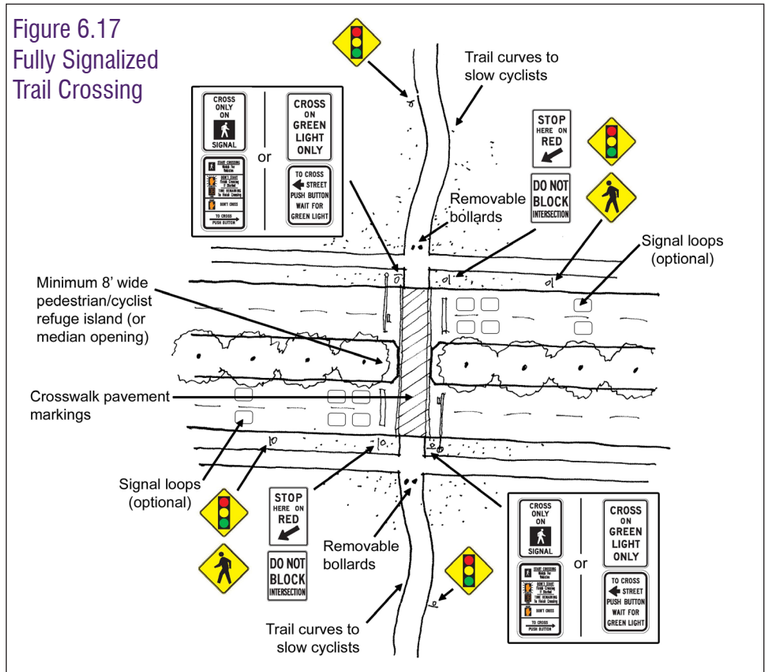


Figure 6.17
Fully Signalized
Trail Crossing



Design Guidelines – Grade-separated Crossings (Type 4)

Grade-separated crossings may be needed where ADT exceeds 25,000 vehicles and 85th percentile speeds exceed 45 mph. Security is a major concern with both over-crossings and under-crossings. In both cases, trail users may be temporarily out of sight from public view and may themselves have poor visibility. Under-crossings, like parking garages, have the reputation of being places where crimes occur. Most crime on trails, however, appears to have more in common with the general crime rate of the community and the overall usage of the trail than any specific design feature.

Design and operation measures are available which can address trail user concerns. For example, an under-crossing should be designed to be spacious, well lit, and completely visible for its entire length prior to entering. Emergency phones or call boxes located near grade-separated crossings are encouraged. Other potential problems with under-crossings include conflicts with utilities, drainage, flood control, and maintenance requirements. Over-crossings pose potential concerns about visual impact and functional appeal.

Trail Signing and Traffic Control

Design Objectives

Crossing features for all roadways include warning signs both for vehicles and trail users. Type, location, and other criteria are identified in the TMUTCD. Adequate warning distance is based on vehicle speeds and line of sight. Signage should be highly visible; catching the attention of motorists accustomed to roadway signs may require additional alerting devices such as flashing warning beacons, roadway striping, or changes in pavement texture. Signing for trail users must include a standard stop sign and pavement marking; these traffic control devices are sometimes combined with other features such as bollards (see Figure 6.18) or chicanes in the trail to slow cyclists. Care must be taken not to place too many signs and other traffic control devices at crossings as they tend to overwhelm the user and lose their impact.

Directional signing may be useful for trail users and motorists alike. For motorists, a sign reading "Bicycle Trail Xing" along with a Lewisville trail emblem or logo helps both warn motorists and promote use of the trail. For trail users, directional signs and street names at crossings help direct people to their destinations.

A number of striping patterns have emerged over the years to delineate trail crossings. A median stripe on the trail approach will help to organize and warn trail users. The actual crosswalk striping is a matter of local and State preference, and may be accompanied by pavement treatments to help warn and slow motorists. The effectiveness of crosswalk striping is highly related to local customs and regulations. In communities where motorists do not typically yield to pedestrians in crosswalks, additional measures may be required. Table 6.2 notes some of the most common signs that may be required on the Lewisville Trails system.

Figure 6.18 – Typical Bollard Placement

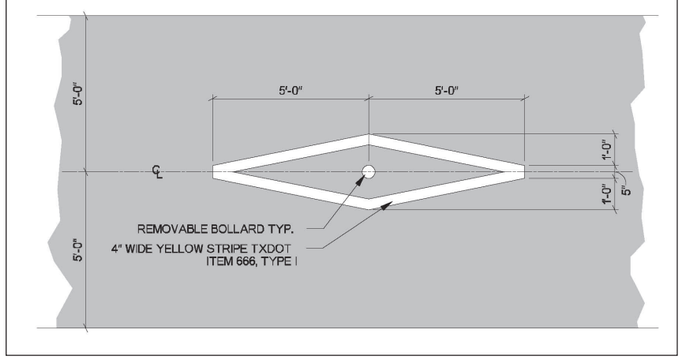
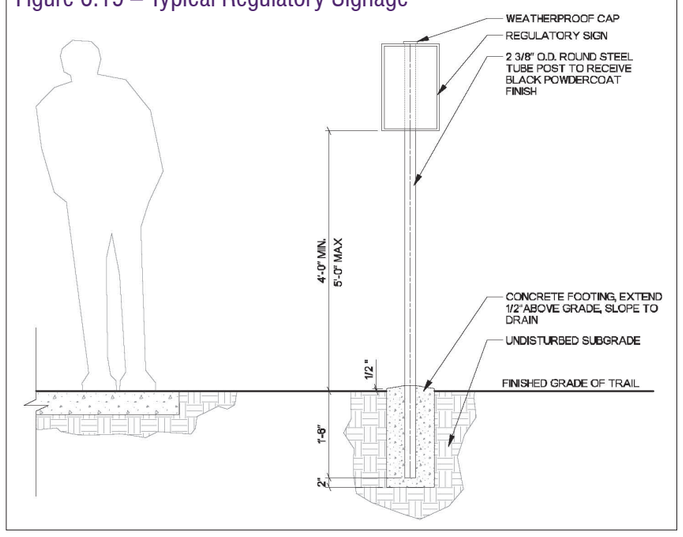


Figure 6.19 – Typical Regulatory Signage



Design Standards

a. Trail Regulatory Signs: All regulatory signs shall be mounted on a black powdercoat-finished 2-3/8" outside diameter round steel post mounted in a concrete footing placed between 4' and 6' on-center from the trail's edge of pavement. Signs shall be mounted such that the bottom edge of the sign is between 4' and 5' from finished trail grade. See Figure 6.19 – Typical Regulatory Signage and Figure 6.1 – Standard Hike & Bike Trail Section.

Table 6.2
Commonly Used Trail Signage

Item	Location	Color	TMUTCD Designation	Minimum Dimensions (for trails)
No Motor Vehicles	Entrances to trail	B on W	R5-3	24"x24"
Use Pedestrian Signal	At crosswalks	B on W	R9-5	12"x18"
Bicycle Yield to Pedestrians	At crosswalks	B on W	R9-6	12"x18"
Bike Route	At the beginning of each route and at intersections	W on G	D11-1	24"x18"
Bike Route Supplemental Plaques	Where bike lanes begin, end, or change direction	W on G	M4-11,12, 13 M7-1,2,3,4,5,6,7	12"x4" 12"x9"
Stop Yield	At trail intersections and crossings	W on R	R1-1 R1-2	18"x18" 18"x18"x18"
Bicycle Warning Pedestrian Warning	Oriented toward motorists at trail crossings	B on Y	W11-1 W11-2	18"x18"
Turn and Curve Warning	At turns and curves which exceed design speed criteria	B on Y	W1-1,2,3,4,5	18"x18"
Trail Intersection Warning	At trail intersections where no stop or yield sign is required; locations with limited sight lines	B on Y	W2-1,2,3,4,5	18"x18"
Stop Ahead Yield Ahead Signal Ahead	Where stop/yield sign or traffic signal visibility is obscured	B,R on Y B,R on Y B,R,G on Y	W3-1 W3-2 W3-3	18"x18"
Directional Signs	At intersections where access to destinations is available	W on G	D1-1b, D3-1	24"x6"
Trail Regulations / Rules of the Trail	Entrances to trail	varies	n/a	18"x18"
Multi-purpose Trail: Bikes Yield to Pedestrians	Entrances to trail	varies	n/a	18"x18"
Please Stay On Trail	In environmentally-sensitive areas or where the trail travels near private property	varies	n/a	12"x18"
Trail Closed: No Entry Until Made Accessible & Safe for Public Use	Where trail or access points closed due to hazardous conditions	varies	n/a	18"x18"

Note: B=black, W=white, G=green, R=red, Y=yellow

Underpass Structures

Design Objectives

- Underpasses provide safety and continuity by eliminating the need for users to interact with and/or cross busy streets.
- Design underpasses with security and comfort in mind by increasing site distances, providing lighting, and providing increased vertical clearance.

Design Guidelines

a. Underpasses shall be constructed according to minimum vertical and horizontal clearances per AASHTO and ADAAG/TAS standards. All modified underpasses should meet these requirements. In situations where the underpass is straight (allowing clear visibility) two-way traffic can be accommodated.

Bridges & Low Water Crossings

Design Objectives

- Trail crossings over creeks and drainage ways generally shall be by bridge.
- Design bridges that are sturdy, safe, vandal-resistant, and easily maintained.
- Deck surface shall have good skid resistance.
- Stabilize deck to minimize vibrations.
- Railing should be free of splinters and provide a smooth, clean surface to the touch.
- Railing design should allow views to creeks for persons of all heights, yet ensure user safety.
- Scale of bridge should be in keeping with its surroundings.
- Bridge color should blend with the natural environment or tie into the color scheme of adjacent development.
- Integrate design with other elements throughout the corridor.
- Low water crossings may be used at small stream crossings with the approval of the City Engineer.

Design Standards

a. General: All bridge designs to be sealed by a registered Texas professional engineer and approved by the City. Low water crossings shall not exceed 4' from path to flowline of the waterway or ravine unless approved by the City Engineer. Low water crossings shall have a widened shoulder to 5' on both sides of the trail. The headwall structure under the trail shall have gently sloping wingwalls constructed with the headwall no steeper than 8:1. The pipe ends shall be finished at the same repose of slope as the wingwalls. Any crossing exceeding this 4' separation to permit the construction of ADAAG/TAS-compliant trail approaches to the crossing shall require a bridge.

b. Bridge Type: Prefabricated bridges require approval by the City. Bridges shall be of an arched truss design and in compliance with ADAAG/TAS longitudinal slope criteria. The minimum width of clear deck shall equal the width of the widest approaching trail (all bridges should be at minimum 10' wide). All bridge foundation and abutment designs shall be sealed by a registered Texas professional engineer and approved by the City. Pre-fabricated arched truss bridges should generally be used unless the bridge's location requires a unique design because of physical constraints or aesthetic opportunity.

c. Bridge Approaches: Bridge approaches shall be designed in accordance with Figure 6.20 – Typical Trail Bridge Approach Section and Figure 6.21 – Typical Trail Bridge Approach Plan.

Figure 6.20 – Typical Trail Bridge Approach Section

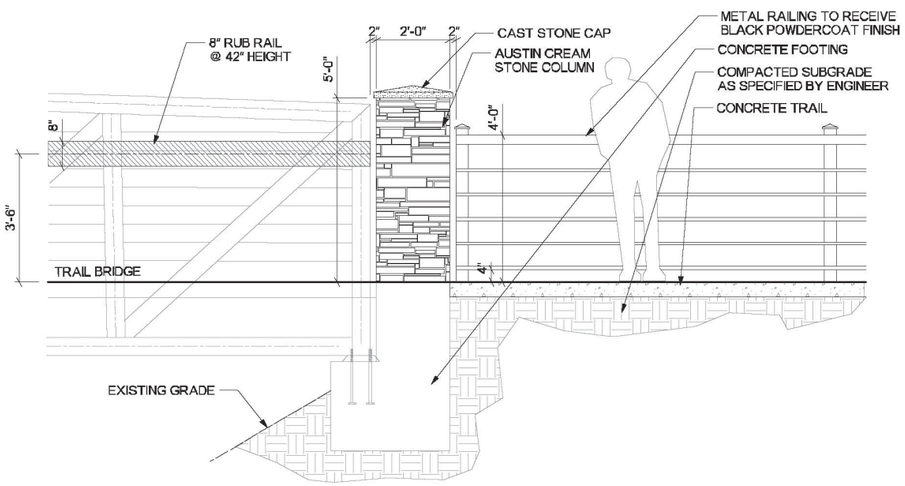
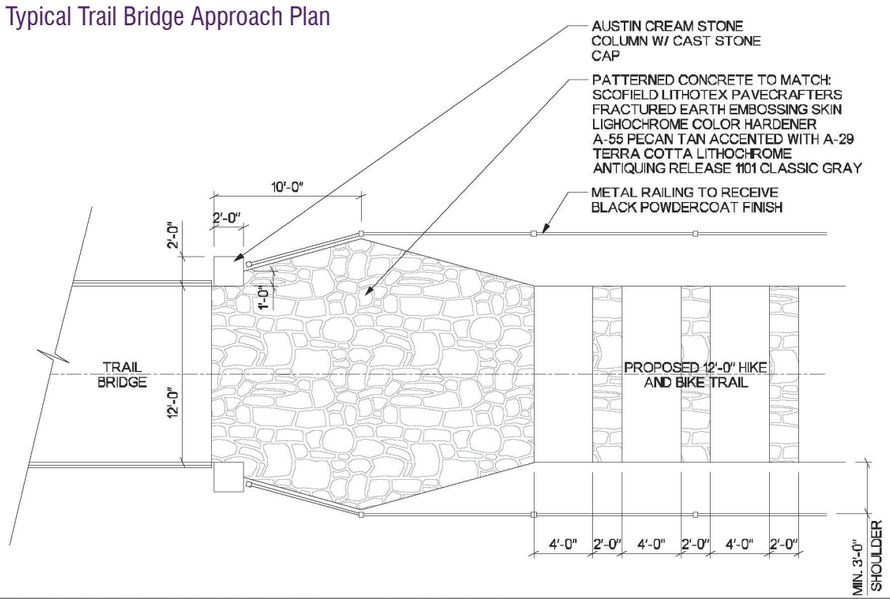


Figure 6.21 – Typical Trail Bridge Approach Plan



Culvert Outfall Structures

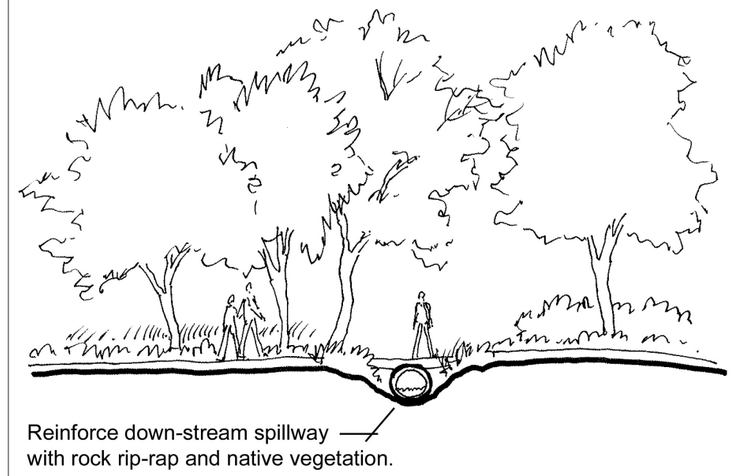
Design Objectives

- Existing culvert pipe structures may need modification to meet trail safety and aesthetic standards. Culvert outfalls shall occur on the downhill side of trails.
- Outfall structures shall feature stone veneer or concrete form liners to provide a more aesthetically pleasing appearance.

Design Guidelines

a. Design: A registered Texas professional engineer shall design and size all outfall pipes.

Figure 6.20 – Typical Culvert Outfall



Trail Safety Railing

Design Objectives

- Railings are should provide a safety barrier without being visually imposing or limiting visibility.
- Railings should be higher than the average cyclist's center of gravity but low enough to not feel imposing to pedestrians.

Design Guidelines

a. Railing Placement: Railings should be placed between the trail and embankments or other vertical displacements when such topographical features are within 5' of the trail shoulder.

b. Railing Design: The top of railings, fences, or barriers on either side of a trail structure shall be 4' higher than the trail surface. Railing ends shall be angled downward and flared away from the trail at both ends to prevent cyclist and pedestrian injury. Railing rungs should be horizontal in orientation so as not to catch bicycle handlebars. The bottom rung of a railing shall be 4" from the finished trail grade. See Figure 6.20 – Typical Trail Bridge Approach Section and Figure 6.21 – Typical Trail Bridge Approach Plan.

c. Rub Rails: On bridges, railing shall have 8" wide rub rails attached on-center at handlebar height (3'-6") made of smooth metal or similar material. See Figure 6.20 – Typical Trail Bridge Approach Section.

Trail Features & Amenities

Design Objectives

- Create and maintain a unique aesthetic and quality for Lewisville's trail system.
- Use aesthetic treatments and visual cues to provide an identity to the trail system and create familiarity for trail users.

Trail Marker Design Standards

a. Location: Trail markers shall be placed at each trailhead, trail access point, and major trail intersection. Trail markers should also be placed along trails where they are visible from major roadways in order to increase the visibility of Lewisville's trail system.

b. Type A Trail Markers: Shall be placed at major and minor trailheads in a location that is visible from the road and is adjacent to the trail entrance. Type A trail markers shall be constructed in accordance with Figure 6.21 – Type A Trail Marker Elevation and Figure 6.22 – Type A Trail Marker Plan.

c. Type B Trail Markers: Shall be placed at trail access points and at major trail intersections (Type A markers can alternatively be placed at these locations per the City's discretion) in a location that is visible from the road and is adjacent to the trail entrance. Type B trail markers shall be constructed in accordance with Figure 6.23 – Type B Trail Marker Elevation and Figure 6.24 – Type B Trail Marker Plan.

Figure 6.22 – Type A Trail Marker Plan

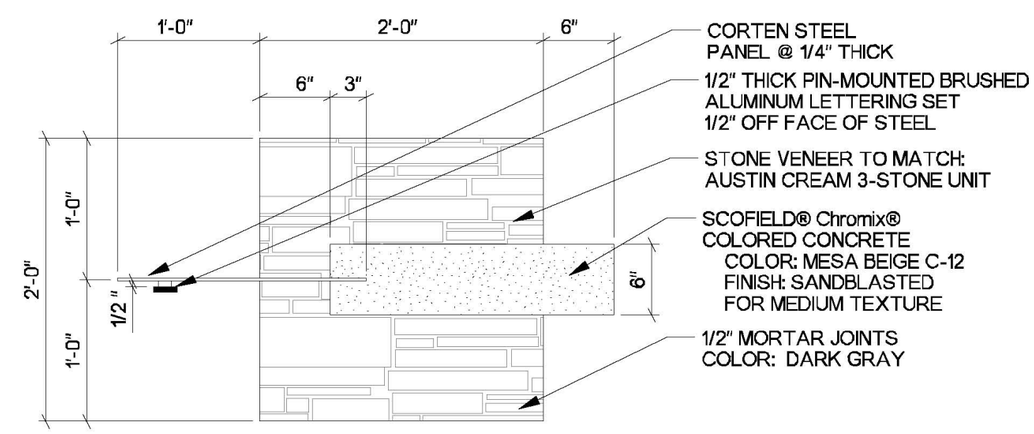


Figure 6.21 – Type A Trail Marker Elevation

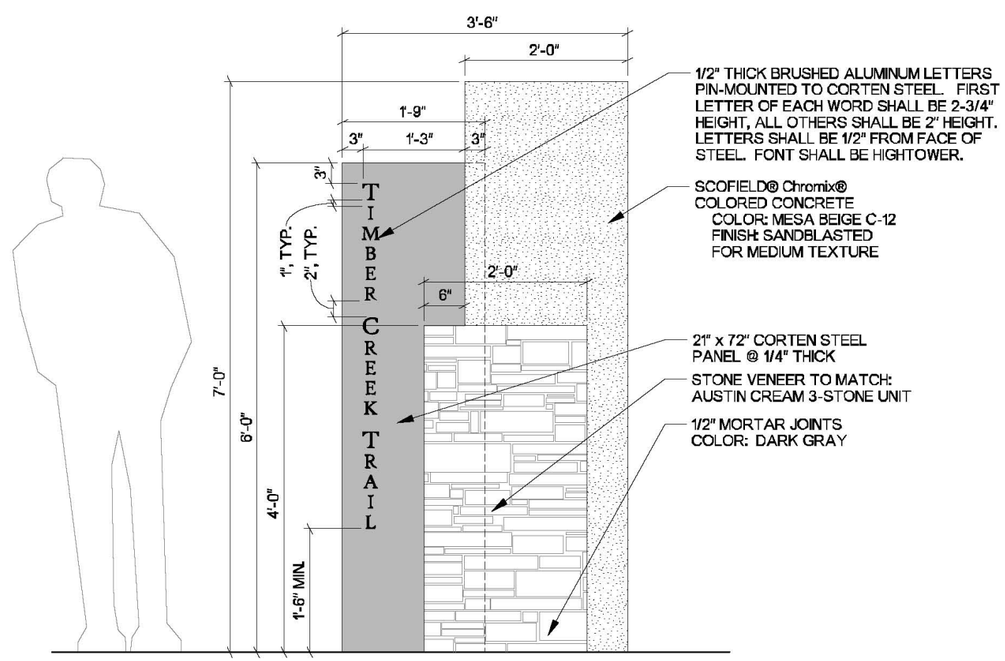


Figure 6.23 – Type B Trail Marker Elevation

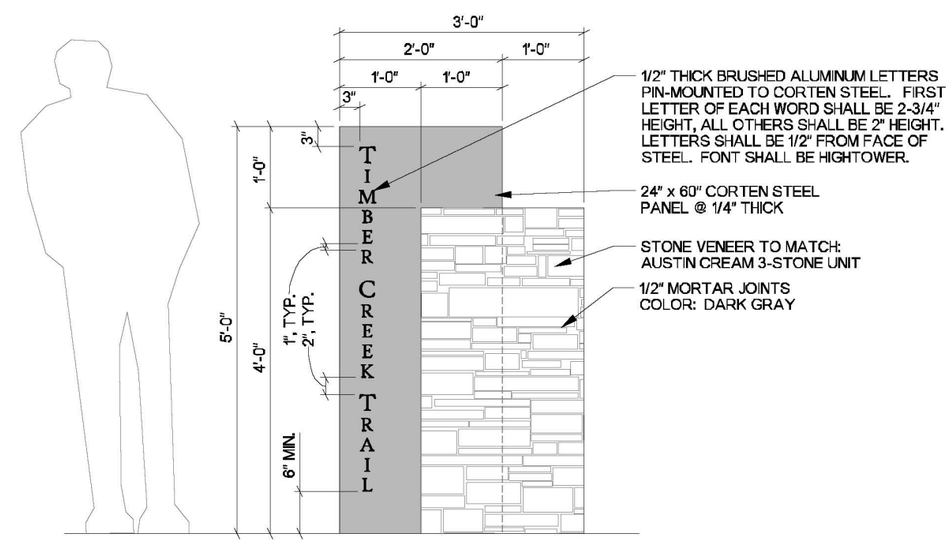


Figure 6.24 – Type B Trail Marker Plan

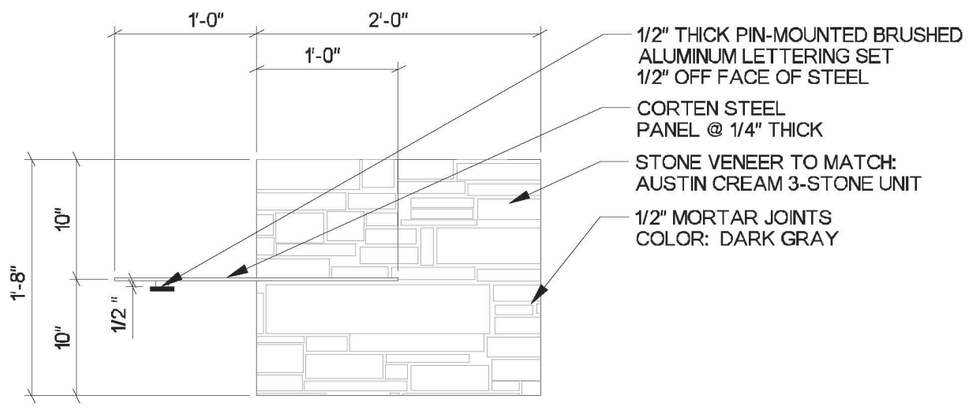
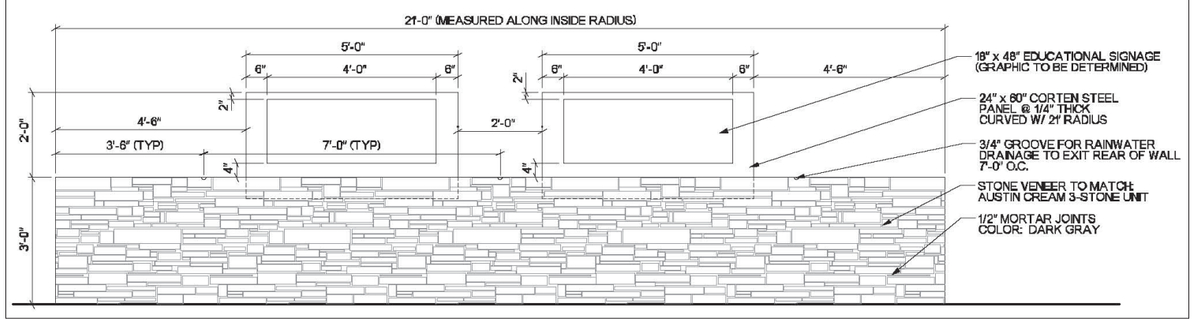


Figure 6.26 – Typical Overlook Elevation



Rest Area Design Standards

a. Placement: Rest areas should be placed every half to one mile and at major trail intersections. Ideally, locate rest areas overlooking attractive vistas or in other physically attractive locations.

b. Design: Rest areas shall be designed in accordance with Figure 6.27 – Typical Rest Area. Ideally, the bench and ADA space should not be located within 5' of a significant downward grade change; however, if such a location is chosen, railing must be provided at the grade change.

Overlook Design Standards

a. Placement: Overlooks should typically be placed at areas of scenic beauty and/or cultural or historical importance. It is preferable to place overlooks such that the removal of existing trees is not required. Ideally, overlooks should be provided every one to three miles along major trail corridors.

b. Design: Overlooks shall be designed in accordance with Figure 6.25 – Typical Overlook Plan and Figure 6.26 – Typical Overlook Elevation. The design of individual overlooks can vary based on unique site conditions such as topography and drainage.

c. Signage: Interpretive or educational signage provided at overlooks should contain information related to the surrounding landscape (such as information about local plant and animal species) or historical locations or events that occurred nearby.

Figure 6.25 – Typical Overlook Plan

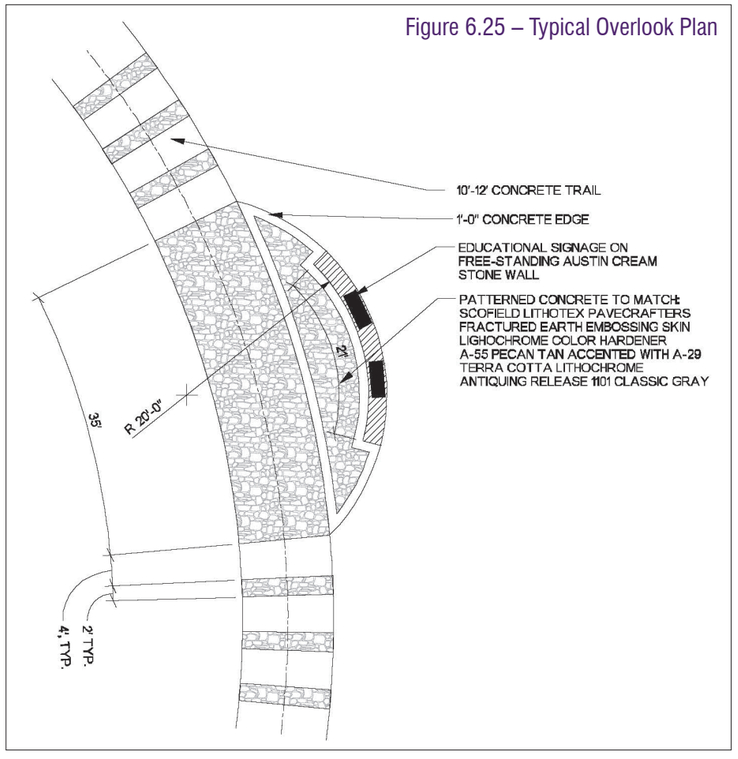
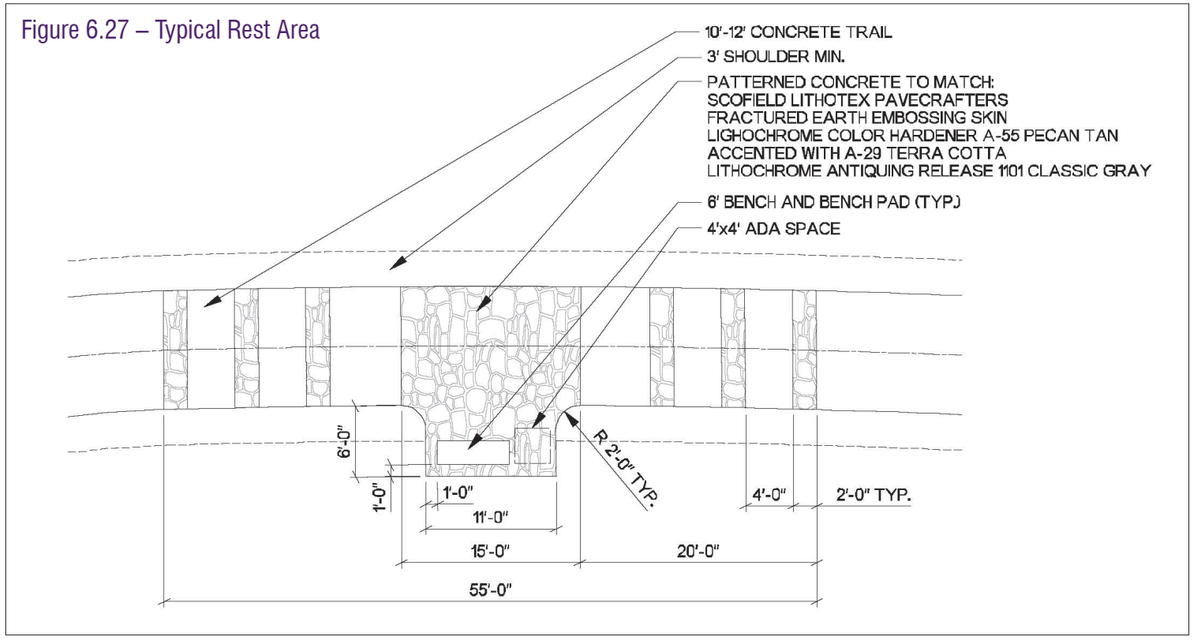


Figure 6.27 – Typical Rest Area



Trailheads & Access Points

Design Objectives

- Provide transition between motorized and non-motorized transportation and recreational systems.
- Create a unique entry to the trail system through hardscape and landscape features that support aesthetic guidelines established in these standards.
- Encourage utilization of trail and bicycle routes as alternative transportation paths within the city.
- Provide access to a variety of destinations, streets, and trails.
- Utilize existing facilities such as schools, civic facilities (library, city hall, etc.) and parks as trailheads.
- Establish a hierarchy of major trailheads, minor trailheads, and access points.
- Encourage shared use of parking when appropriate and when such shared use would not have a negative impact on the parking availability of the primary parking lot user.

Trailhead Design Standards

a. Trail Markers: A minimum of one (1) trail marker shall be provided at each major and minor trailhead located such that it indicates the primary trail access point.

b. Parking: A minimum of ten (10) parking spaces and one (1) handicap space shall be provided at major trailheads. A minimum five (5) spaces and one (1) handicap space shall be provided at minor trailheads. In both instances, the handicap parking space must be van accessible. Sidewalks shall connect handicap spaces to the trails and the parking lot shall be signed for trailhead usage.

c. Bike Racks: Bike racks approved by the City shall be provided at a ratio of one (1) bike space for every two (2) car parking spaces. No less than five (5) bike spaces shall be provided in a rack at any trailhead.

d. Drinking Fountains: One (1) drinking fountain approved by the City shall be provided within 30' of benches and bike racks. Drinking fountains shall be per the City of Lewisville's standard, or approved equal. Drinking fountains shall comply with City standard specifications.

e. Benches: One (1) bench approved by the City for every three (3) parking spaces shall be provided, with minimum four (4) benches provided at major trailheads and two (2) benches provided at minor trailheads.

f. Lighting: Parking lots and trail intersections shall be lighted to a minimum of ½ footcandle with appropriate commercial light fixtures and no spillover to adjacent property.

g. Trail Termination: Trails that terminate at trailheads shall receive landscape traffic control measures for buffering and guiding the direction of pedestrian and bicycle traffic.

h. Trees: Trailheads shall provide one (1) canopy tree per two (2) parking spaces with a minimum of five (5) trees required. Three (3) ornamental trees shall equal one (1) canopy tree. (See Landscape Ordinance for minimum sizes and specifications for shade and ornamental trees).

i. Identification: Trailheads shall be identified by trail markers.

j. Signage: Directional and wayfinding signage shall be provided at each major and minor trailhead and shall at a minimum include a map of the City's trail system.

Trail Access Point Design Standards

a. Trail Markers: One (1) trail marker shall be provided at each access point.

b. Parking: Off-street parking is not required at trail access points.

c. Bike Racks: One (1) bike rack (holding capacity of five bikes) shall be provided at any trail access points.

d. Drinking Fountains: No drinking fountains are required at access points.

e. Benches: One (1) bench approved by the City shall be provided.

f. Trail Termination: Trails that terminate at trail access points shall receive landscape traffic control measures for buffering and direction of pedestrian and bicycle traffic.

LEWISVILLE

Deep Roots. Broad Wings. Bright Future.

The 2011 Lewisville Trails Master Plan

"Active Adventure... Creative Connections"

Chapter 7 - Implementation

Introduction

This chapter provides guidance to the City for the effective implementation of the off-street trail, enhanced sidewalk, bike route, and paddling trail networks. The focus of this chapter is to prioritize the spine trail segments identified in Chapter 6; establish phasing; estimate system-wide costs; and provide guidance on funding strategies, maintenance issues, safety and security concerns, and policy actions.

Infrastructure Development

Priority Projects

The individual spine segments identified and analyzed in Chapter 5 represent the primary priority trail projects for the City of Lewisville. Due to their prominence and connectivity, only these spine segments have been prioritized. However, during the implementation of this Trails Master Plan, the City may identify minor facility segments in other locations that justify being given priority over certain spine segments based on their ease of implementation or degree of connectivity.

Prioritization Methodology

In Chapter 5, an evaluation score was developed for each of the spine segments. These evaluation scores reflect latent demand for each of the segments based on proximity to destinations. However, the evaluation scores must be balanced with connectivity needs and public demand in order to determine overall priority and ensure that the trail system is developed in a logical and efficient manner. While this results in some segments with high evaluation scores being prioritized above segments with low evaluation scores[1], it ensures that the City's trail system is developed contiguously. It is also important to consider that sometimes a segment might not be within close proximity of key destinations or may be difficult to implement, but is nevertheless important from a recreational or connectivity point of view. Segment F is a good example of how the prioritization of some spine segments differs from their evaluation score. Though Segment F has an evaluation score of 3, it has been ranked above other segments with priority scores of 1 and 2 because of its connectivity to the Timber Creek Trail, the Fox Creek Greenbelt trail, and Segment E (which is ranked above Segment F). Table 7.1 shows the ranking and proposed phasing of the sixteen spine trail segments.

Phasing

In addition to the priority rankings discussed above, the sixteen spine trail segments have been assigned to one of three phases. Each phase represents a set of segments, which—once fully implemented—will achieve a major milestone in the completion of the City's trail system. As such, it is recommended that the segments in each phase be implemented in rapid succession or simultaneously where possible.

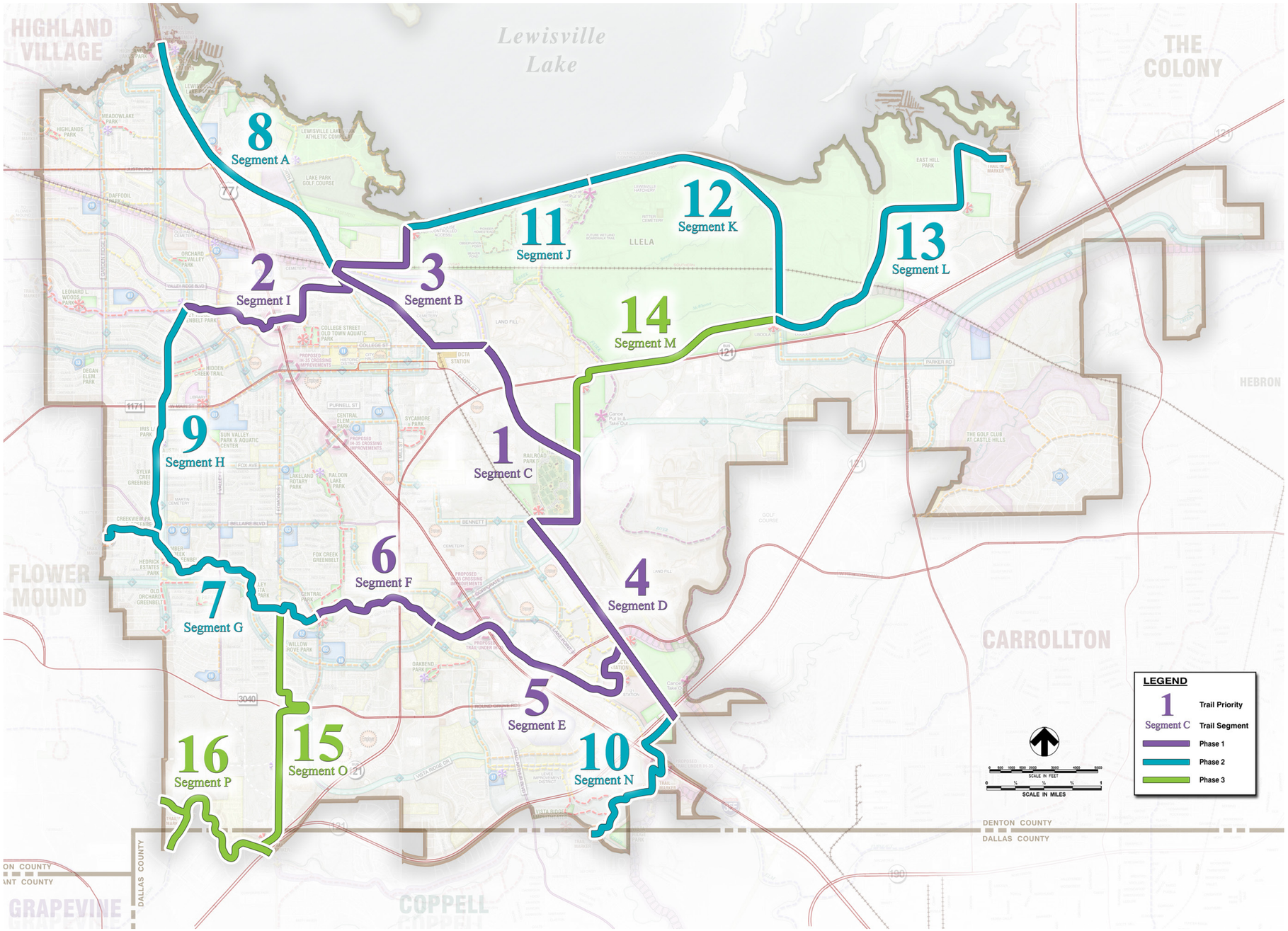
1. A low evaluation score indicates higher latent demand, greater ease of implementation, and lesser impact on residential areas.

Table 7.1
Spine Segment Priority Evaluation & Cost Estimate Summary

Priority Ranking	Evaluation Score	Trail Segment	Description	Length (miles)	Cost Estimate
Phase 1					
1	1	C*	Old Town/DCTA Station to Railroad Park	2.2	$1,478,205
2	2	I	Valley Ridge Greenbelt Park to KCS Railroad	1.85	$1,099,668
3	1	B*	LLELA Gate House to Old Town/DCTA Station	2.3	$1,565,370
4	1	D*	Railroad Park to Southern DCTA Station/SH 121	2.0	$1,634,625
5	2	E	Corporate Drive to Southern DCTA Station	2.5	$1,671,525
6	3	F	Central Park to Corporate Drive	1.25	$1,175,778
			Subtotal	***12.1***	***$8,625,171***
Phase 2					
7	4	G	Western Border with Flower Mound to Central Park	2.6	$1,596,184
8	1	A*	Northern DCTA Station to KCS Railroad	2.3	$1,808,295
9	2	H	Valley Ridge Greenbelt Park to Creekview Park & Greenbelt	2.0	$1,177,335
10	2	N	Southern Border with Coppell to Southern DCTA Station/SH 121	1.8	$1,235,225
11	3	J*	LLELA Gate House to the Elm Fork of the Trinity River	1.7	$1,126,080
12	3	K*	Elm Fork of the Trinity River to the Lewisville ISD Outdoor Learning Area (LISDOLA)	2.7	$2,274,480
13	3	L*	Lewisville ISD Outdoor Learning Area (LISDOLA) to Eastern Border with The Colony	3.1	$3,283,965
			Subtotal	***16.2***	***$12,501,564***
Phase 3					
14	4	M*	Railroad Park to the Lewisville ISD Outdoor Learning Area (LISDOLA)	2.6	$2,223,765
15	5	O	Timber Creek to Denton Creek	2.5	$1,716,281
16	5	P*	Western Border with Flower Mound/Grapevine to Southern Border with Coppell along Denton Creek	1.9	$2,246,085
			Subtotal	***7.0***	***$6,186,131***
			TOTAL	***35.3***	***$27,312,866***

Note: A low evaluation score indicates higher latent demand, greater ease of implementation, and lesser impact on residential areas.

**Segments for which funding partnerships with DCTA, LLELA, or adjacent cities might be possible.*



Phase 1

The first phase includes segments of the future DCTA trail (which will be partially funded by DCTA), segments along Timber Creek, and a segment along Prairie Creek. The completion of this phase would result in the completion of trails along the entire Prairie Creek corridor (from Flower Mound to the DCTA line), the provision of trails through about two thirds of the Timber Creek corridor (by linking to the existing Timber Creek Trail, which makes up the eastern half of Segment G), and the provision of trails along the DCTA line from Prairie Creek to Carrollton.

Phase 2

While the first phase establishes the foundation for the spine system, the second phase continues providing essential connections. Highlights of this phase include the completion of the Timber Creek corridor, a north-south connection between Prairie Creek and Timber Creek, the completion of the DCTA trail through Lewisville, a connection through LLELA to The Colony, and a connection between the DCTA trail, the Levee Improvement District, and existing trails in Coppell.

Phase 3

Finally, the third phase of implementation accomplishes two goals: it provides a connection between Railroad Park and LLELA (while also providing a loop through LLELA) and it connects Lewisville's trail system with Flower Mound's, Grapevine's, and Coppell's planned and existing trails along Denton Creek to the south.

Figure 7.1 – Spine Corridor Segment Priorities

This map illustrates the prioritization of the spine corridor segments. The purple segments comprise the first phase of implementation, the blue segments comprise the second phase, and the green segments comprise the third phase.

System-Wide Cost Estimates

The Trails Master Plan recommends over 173 linear miles of new bicycle, pedestrian, and paddling facilities in addition to the City's existing 14.02 miles of off-street trail. If fully implemented, Lewisville's trail system would total over 187 linear miles of facilities. Fully implementing the recommended trail system independent from other projects would cost an estimated $75.7 million. However, many of these facilities can and should be implemented in coordination with other capital projects. For example, enhanced sidewalks and on-street bike route facilities should be constructed in concert with road reconstruction/improvement projects, thereby reducing the cost per mile of these facilities.

Table 7.2
Overall Trail System Implementation Cost

Facility Type	Linear Miles / Units	Cost per Mile / Unit*	Total Cost*
Existing Off-Street Trails	14.02	--	--
Proposed Off-Street Trails	51.1	$800,000	$40,864,000
Enhanced Sidewalks**	50.4	$470,000	$23,688,000
On-Street Bike Routes†	50.4	$40,000	$2,016,000
Paddling Trail	7.4	$10,000	$74,000
Major Trailheads‡	19	$350,000	$6,650,000
Minor Trailheads	12	$200,000	$2,400,000
TOTAL	*173.3 miles*		*$75,692,000*

**Estimated costs include design, administration, and miscellaneous costs as well as a 20% contingency. The cost for the spine segments, as reflected in Table 7.1, are included in the totals shown on this table.*

***Estimated cost per mile for two 6' wide sidewalks (one on each side of the street).*

†Estimated average cost. Costs can range from $20,000 per mile for a signed route, $50,000 per mile for shared lanes, and up to $100,000 per mile for bike lanes. Cycle track costs vary too greatly based on site-specific conditions to provide an estimated cost per mile.

‡Includes three paddling trail put-ins/take-outs.

Possible funding assistance from other public agencies and non-profits will greatly reduce the overall funding burden placed on the City. Specifically, spine segments A, B, C, and D are to be funded and constructed by DCTA, thereby decreasing the total costs reflected in Table 7.2 by $6.5 million. If DCTA funds the trailheads recommended along this corridor, this could reduce the City's cost burden by an additional $1.6 million. Along a similar vein, it is possible that the U.S. Army Corps of Engineers and LLELA would partially or completely fund facilities located within LLELA (including spine segments J, K, L, and M). Finally, there is the opportunity to enlist the support of canoe and kayak organizations in funding the development of the paddling trail (and associated facilities) along the Trinity River.

In addition to the capital costs reflected in Tables 7.1 and 7.2, annual maintenance costs are an important consideration for the City. These annual costs, as well as maintenance guidelines and strategies, are discussed later in this chapter.

Development & Funding Strategies

Effectively and efficiently implementing the recommendations included in the Trails Master Plan is made easier by adopting strategies that streamline the development of trails and related facilities. The strategies included in this section provide guidance to the City by describing ways to seek additional funding sources and methods, identify opportunities in advance and ensure that they are not missed, and be prepared to take advantage of new opportunities as they arise. The strategies are divided into two groups: development strategies, which provide guidance on planning, design, and policy actions related to trails, and funding strategies, which provide strategic advice for implementing the Trails Master Plan in a cost-efficient manner.

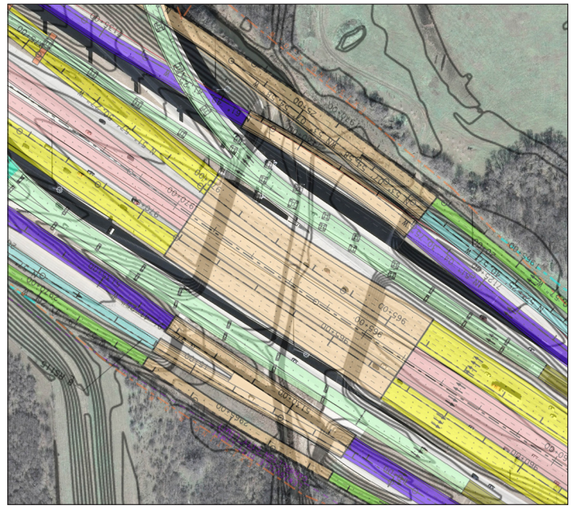
Development Strategies

Coordination Between City Departments

Achieving effective interdepartmental coordination with regard to the development of the trail system is an important objective for the City to achieve. It is generally more cost-effective to develop trails, on-street bike routes, enhanced sidewalks, and other facilities in conjunction with other capital projects. Coordinating the implementation of the trail system with projects from other departments (such as street construction/reconstruction, major water or wastewater projects, right-of-way acquisition, and drainage improvement projects) will reduce overall capital costs to the City and speed up the development of the trail system.

IH-35E Proposed Improvements

TxDOT is in the process of developing schematics for the expansion of IH-35E from US-380 in Denton to IH-635 in Farmer's Branch. This project would involve the complete reconstruction of the freeway, including reconfiguring overpasses, underpasses, frontage roads, and bridges over creeks. As discussed in Chapter 4, IH-35E is currently a major barrier to providing east-west trail connectivity in Lewisville. Therefore, coordinating with TxDOT to ensure that the redesign of IH-35E provides space for trail and on-street bike route crossings is of crucial importance. Specific locations where improved crossings are recommended are identified in the map on page 27 and are discussed in detail in Chapter 5. In addition, specific comments to be provided to TxDOT during the public comment period and schematics for specific trail crossings have been developed in conjunction with the Trails Master Plan. These comments and schematics can be found in the appendix of this document.



Trail Corridor Acquisition

Acquiring rights-of-way or easements for trail corridors is one of the most important and challenging tasks in developing a trail system. The task of securing land for trails can be aided by adopting a set of policies and ordinances that require or incentivize new development to dedicate land or easements to the City where a planned trail corridor passes through the property (see the map on page 34). Specifically, the City should consider the following when developing a greenway/trail ordinance or policy:

- Require the dedication of land or easements when land along a proposed trail corridor is developed or subdivided.
- Provide developer incentives (such as infrastructure provision, density bonuses, or reduced parkland fee requirements) to encourage the provision of a trail corridor or to offset the requirement to do so. It is important for the City to be flexible and work with the developer by allowing slight modifications to planned trail alignments as long as crucial connections are maintained. When a planned trail corridor passes through land slated

for commercial development, the requirement to provide a trail easement might be offset by reducing minimum parking requirements.

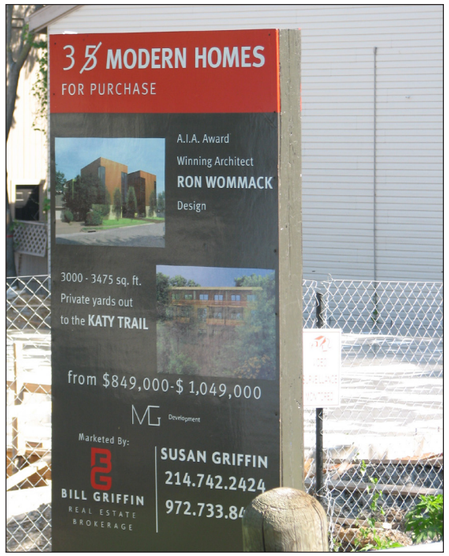
- Encourage and incentivize developers to construct the portion of trail that passes through their land and require that the trail be dedicated to the City. However, it is important to ensure that the trail is built to the minimum standards described in Chapter 6.

While strategies for acquiring trail corridors in new development are described above, the following describes strategies for acquiring land or easements for trails in already-developed areas:

- To provide trails through existing development, it will typically be necessary for the City to purchase land or easements. In these cases, it is usually easiest to acquire land from one or two large land owners rather than from many small land owners. For this reason, the City might need to consider minor realignments of planned trail corridors in order to streamline the right-of-way acquisition process. For example, consider acquiring land through nearby utility easements and commercial areas rather than through existing neighborhoods.
- In locations where a critical segment of a planned trail corridor passes through already-developed locations, the City might explore acquiring a *right of first refusal* or *right of first offer* on the properties needed (both of which would give the City the first opportunity to purchase the land when the landowner decides to sell; the difference between these two options is whether a sale price is pre-negotiated, as is the case with a *right of first refusal*). If these options are explored, a short-term trail bypass (such as sidewalks along a street) could be provided in the interim period.

Addressing Community Concerns

Quite often, the planning or construction of a trail causes community concerns about public safety and effects on property values. Specific community concerns often include loss of privacy, vandalism, burglary, robbery, and assault – all of which would negatively effect property values. However, several studies[2] have shown that crime rates associated with properly-designed trails (that include screening, lighting, and regular access points) generally reflect the existing crime rates within the neighborhood. In other words, trails have not been shown to substantially increase crime rates. In addition, these same studies show that real estate adjacent to or near a trail corridor sells for a premium and is on the market for a shorter period than other comparable houses. As far as how to use this information to address community concerns, it is recommended when neighborhood meetings are held to discuss a specific trail project, the City have a police officer and real estate agent in attendance to answer citizens' questions. Ideally, the police officer and real estate agent will both have experience working in neighborhoods with and without trails and will be capable of making comparisons between the two.



2 *Evaluation of the Burke-Gillman Trail's Effect on Property Value and Crime* – Seattle, WA Engineering Department
The Impact of Brush Creek Trail on Property Values and Crime – Michelle Miller Murphy, Sonoma State University
The Effect of Greenways on Property Values and Public Safety – Colorado State Parks

Trail Amenities

Trail amenities are very important components of the trail system. In order to complete the trail experience and make the trail more functional and comfortable, it is important to provide essential amenities at the time of trail construction (such as benches, bike racks, mile markers, litter receptacles, dog waste stations, kiosks, wayfinding signage, water fountains, and maps). However, there are often other amenities that are very valuable and enhance the overall quality and experience of the trail system but are cost prohibitive at the time of the trail's construction. Such amenities include interpretive signage, overlooks, restrooms, public art, gateways, and ornamentation. When it is not possible to provide these non-essential but very beneficial amenities as part of the initial project, it is important to save space for their future provision. Generally, it is possible to design the entire project at once and implement it in phases, such as building the trail and its essential amenities in the first phase and then adding gateways and overlooks a few years later. See Chapters 5 and 6 for examples of and standards for trail amenities.

Transit-Oriented Development

The construction of the DCTA's A-Train commuter rail will include three transit stations in Lewisville. The areas around two of these stations (one near Old Town and one near SH-121) have already begun to redevelop based on public and private sector actions. In both cases, it is likely that development in these areas will be more transit-oriented than typical development. The result being transit-oriented is that these areas are consequently very pedestrian- and bicycle-oriented due to their compact design and mix of land uses. Therefore, it is important to connect these areas of transit-oriented development to the trail, on-street bike route, and sidewalk systems. This will ensure the overall bicycle and pedestrian friendliness of these areas by requiring wider sidewalks, bike racks, and other improvements to address the increased demand for these facilities.

Trails along Utility Corridors

There are often excellent opportunities to provide trails, which are inherently linear in nature, along utility corridors (including water, wastewater, storm sewer, gas, and electric). Often, trail easements through such corridors are made available at little or no cost to the City and are consequently often the most cost-effective location for a trail. However, there are limitations presented by this type of corridor. Specifically, many electric utility corridors are themselves easements and do not necessarily present the same opportunity as utility corridors with dedicated rights-of-way. In addition, utility corridors of various types have restrictions with regard to trail design and construction. For example, many electric utilities will not allow the planting of trees within their rights-of-way (this greatly reduces shade and the overall comfort of the trail). Generally speaking, water, wastewater, and storm sewer utility corridors (which are typically City-owned) are the easiest corridor types to provide a trail along because they usually have fewer restrictions regarding trail construction.

Trails Along Active Railroads

The Trails Master Plan recommends several trail corridors that parallel active railroad lines. The implementation of

such trails can often prove to be difficult because of hesitancy on the part of the railroad operator and community concerns about safety. Regardless, several such "rail trails" have been implemented across the country including some in North Texas. Even so, the issues mentioned above will likely be of concern to the City and it is therefore important to demonstrate that properly-designed trails along active rail corridors are as safe for users as any other type of trail. Several resources to utilize when making the case for a rail trail are available, including the Rails to Trails Conservancy's *"Rails with Trails"* report, which includes a survey of 61 rail trails across the country and includes information on their design, management, and operating conditions.

Funding Strategies

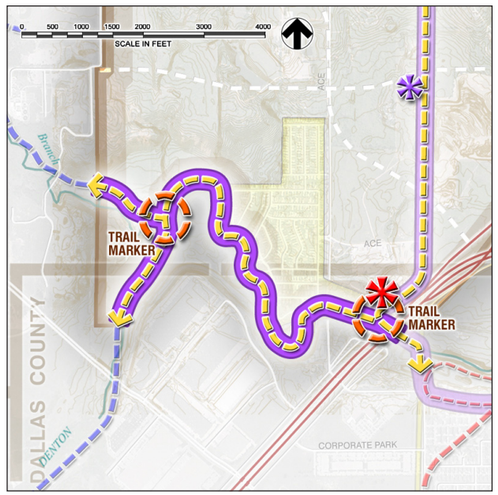
In addition to the development strategies discussed above, it is also valuable to consider strategies for more efficiently funding the development of the trails system. The following strategies should be considered in order to minimize the City's direct costs when acquiring land, designing a facility, and construction. Specific sources of funding are discussed in a later section.

New Development & Trails

As discussed above, one of the most cost-effective ways to provide trails is to require or otherwise incentivize developers to dedicate land and construct trails per City standards (see the Trail Corridor Acquisition section). It is recommended that the City modify its subdivision ordinances to either require the construction of trails in addition to other developer requirements or as partial fulfillment of parkland dedication requirements.

Partnering with Adjacent Cities

Partnering with adjacent cities can significantly reduce the City of Lewisville's cost burden when providing trails near its City limits. Many of the recommended trail segments in this Trails Master Plan connect to planned trail corridors in adjacent cities. When considering constructing these trails, costs can be reduced if the adjacent City is willing to construct the connecting trail in their City limits as part of the same project.



Spine segment P (discussed in detail on page 45 and shown in the image to the right) presents an interesting funding opportunity. This trail segment is located along Lewisville's southwestern border and connects with planned and existing trails in Coppell, Grapevine, and Flower Mound. As discussed on page 45, there might not be adequate land along the northern side of Denton Creek to construct this trail. However, there appears to be available room on the southern side of the creek (which lies within Grapevine's and Coppell's City limits). Because of these connections, the fact that the trail would mutually benefit each of the four Cities, and the potential necessity to locate a portion of the trail outside of Lewisville's City limits, the most realistic manner in which to fund this trail is by sharing the cost between the four cities.

Grants

Grants are the most sought-after source of funding for trail projects. When applying for grants, a City that has a shovel-ready project (consisting of completed plans, schematics, and/or a local funding match) will typically be more likely to be awarded funding. While there are many ongoing grant programs (several are described in the next section), it is often the case that there is a short time period between a grant program's call-for-projects and the proposal deadline. Sometimes this period is less than six weeks in length, which does not allow sufficient time to develop plans, schematics, and estimates. In order to successfully compete against the numerous other Cities in the region and state applying for the same grants, it is recommended that the City of Lewisville always have a shovel-ready project prepared in anticipation of a grant program call-for-projects. Specifically, the City should have both a trail project and an on-street bicycle facility project shovel-ready at all times (i.e., have fully-prepared plans, schematics, and estimates and have acquired or be in the process of acquiring rights-of-way and/or easements).

Funding Sources

Most often a trail project is funded from the City's capital budget; national, state, and local grant programs; or a combination thereof. This section details potential funding sources related to these two general categories.

City Funding

Municipal Bonds

Debt financing through the issuance of municipal bonds is one of the most common ways in which to fund trail projects. This type of funding is a strategy wherein a City issues a bond, receives an immediate cash payment to finance projects, and must repay the bond with interest over a set period of time ranging from a few years to several decades. The interest rates for municipal bonds are significantly lower than rates for corporate bonds or consumer loans (such as home mortgages). There are two main types of municipal bonds:

- ***General Obligation Bonds*** – This is the standard type of municipal bond and is repaid through property taxes. This is the most common form of bond for trails and other parks and open space purposes (as well as other infrastructure uses such as streets and storm sewers).
- ***Revenue Bonds*** – This type of bond is repaid through revenues generated by a facility, such as the user fees generated by a water utility. This type of bond is generally not appropriate for funding trail projects as trails do not directly generate revenue.

While bond issuance is common practice for most cities, the City of Lewisville is strongly encouraged to pursue external funding sources (including grant funding) for all of its trail projects. In addition, the cost of many trail projects can be included in other capital projects, which can reduce the overall cost to the City (as described previously in this chapter). However, in order to achieve the trail LOS figures shown on Table 3.4 (which necessitates building 24.7 miles of off-street trails by 2020; see page 19) the possibility exists that City of Lewisville may need to issue municipal bonds within the next five years.

Other Local Funding Sources

In addition to bond issuance, there are other local funding sources available for the implementation of the trail projects. The following provides a brief description of some of these sources.

- ***Developer Requirements*** – Requires the dedication of trail rights-of-way or easements for new development to offset the City's land acquisition costs. Require developers to construct trail segments to meet the City's new trail design standards. Implementing these requirements must be done through revisions to the City's subdivision ordinance.
- ***Tax Increment Financing / Public Improvement Districts*** – These related tools allow a development district to divert a portion of its property taxes to fund infrastructure improvements within its area. Where a planned trail passes through one of these districts, the City should encourage the district to fund all or a portion of the facility. Businesses within these districts will greatly benefit from the implementation of a new trail. The Levee Improvement District serves as an example of this type of financing tool in action.
- ***"Friends" Organizations*** – There are many organizations in the Metroplex that have helped fund trail systems and specific trail segments. A local example is the "Friends of the Katy Trail" organization, which is a non-profit organization that advocated for the construction of the Katy Trail in Dallas and raised a significant amount of private funding for the trail's construction ($2.72 million of the project's $5.7 million total cost). If community interest exists, the City of Lewisville should encourage the formation of this type of organization.
- ***Private Sponsorship Programs*** – Often referred to as an "adopt-a-trail" program, this tool can be used to organize groups of volunteers or businesses to help maintain and improve the City's trail system. These programs typically allow the organization's name to be placed on a "this trail adopted by..." sign at trailheads or access points and require the sponsoring organization to commit to a certain amount of volunteer hours or funding.

Grant Programs

There are many State and local grant opportunities for trail projects available to the City of Lewisville. In the past, many of these programs were funded through Federal transportation acts, the latest of which was the *Safe, Accountable, Flexible and Efficient Transportation Act: A Legacy for Users* (SAFETEA-LU). However, due to the current recession, Federal funding for grant programs is becoming less common and has lately been provided through stimulus acts versus traditional transportation acts. Regardless of this change, most available Federal grant money continues to be administered through State or local grant programs. The grant programs discussed in this section include the most common and significant trail-related grant programs available to the City.

Texas Department of Transportation Statewide Transportation Enhancement Program

Through the Statewide Transportation Enhancement Program (STEP), the Texas Department of Transportation (TxDOT) periodically makes funds available for the construction of bicycle routes, trails, pedestrian safety enhancements, and landscaping of transportation facilities. To date, there have been seven program calls (1993, 1994, 1996, 1999, 2001, 2005-cancelled, and 2009) totaling $533.4 million worth of grant dollars awarded. Grant selection and administration goes through the North Central Texas Council of Governments (NCTCOG), which reviews the projects within the Metropolitan Planning Area for eligibility, ranks the projects, and provides the State-required Letter of Transportation Improvement Program Placement.

STEP provides monetary support for transportation activities designed to strengthen the cultural, aesthetic, and environmental aspects of the transportation system. Funding is on a cost reimbursement basis and projects selected are eligible for reimbursement of up to 80%. The grant application window for the 2009 program call is closed, but there will likely be additional grant calls within the next five years. This is one of the most important grants for trail projects.

Additional information can be found at: http://www.txdot.gov/business/governments/te.htm

Texas Parks & Wildlife Recreational Trail Grants

The Texas Parks and Wildlife Department (TPWD) administers the National Recreational Trails Fund in Texas under the approval of the Federal Highway Administration (FHWA). This Federally-funded program receives its funding from a portion of Federal gas taxes paid on fuel used in non-highway recreational vehicles. The grants can be up to 80% of project costs with a maximum of $200,000 for non-motorized trail grants. Funds can be spent on both motorized and non-motorized recreational trail projects such as the construction of new recreational trails, to improve existing trails, to develop trailheads or trailside facilities, and to acquire trail corridors. The application deadline is May 1st each year.

Congestion Mitigation and Air Quality (CMAQ) Improvement Program / Regional Surface Transportation Program

The CMAQ Improvement Program directs funds to transportation projects in Clean Air Act non-attainment areas for ozone and carbon monoxide. These projects should contribute to meeting the attainment of national ambient air quality standards (NAAQS). CMAQ funds may be used for construction of pedestrian walkways and bicycle transportation facilities or non-construction projects such as brochures and route maps related to safe bicycle use. Bicycle projects must be primarily for transportation rather than recreation and must be included in a plan developed by each Metropolitan Planning Organization and the State. Projects that bring sidewalks into compliance with the Americans with Disabilities Act Accessibilities Guidelines (ADAAG) are eligible for these funds. Because CMAQ funds are managed by NCTCOG, their availability is subject to that organization's current funding initiatives. Additional information about CMAQ programs may be found at http://nctcog.org/.

Safe Routes to School Program

The Safe Routes to School (SRTS) Program in Texas is based upon Federal funding and is administered by TxDOT. The overall purpose of this program is to improve safety in and around school areas. Projects eligible for SRTS funding are those that reflect one or more of the "5 Es" (engineering, education, encouragement, enforcement, and evaluation). Funds are available for use around schools that enroll kindergarten through eight grade students and the amount of funding each State received from the Federal government is based on percentage of student enrollment. This grant program is a 100% Federally-funded cost reimbursement program, which means there is no required match from the local government.

The following guidelines determine what projects can be submitted:

- Projects may be located on or off the State highway system, but must be located on public property
- Projects must be located within a two mile radius of a school
- Projects can cover multiple school sites if similar work is performed at each site
- Infrastructure projects can be awarded a maximum of $500,000 per application
- Non-infrastructure projects can be awarded a maximum of $100,000 per application

Non-infrastructure project types eligible for funding include:

- Education on bicycle and pedestrian safety, health, and the environment
- Traffic education and enforcement in the vicinity of identified school(s)
- Creation and reproduction of promotional and educational materials
- Public awareness campaigns and outreach efforts to the news media and community leaders
- Modest incentives for SRTS contests and incentives that encourage more walking and bicycling over time
- Safety and educational tokens that also advertise the program
- Cost for additional law enforcement or equipment needed for enforcement activities

Infrastructure projects must fall within one of six categories to be eligible for funding:

- Sidewalk improvements
- Pedestrian and bicycle crossing improvements
- On-street bicycle facilities
- Off-Street bicycle and pedestrian facilities
- Traffic diversion improvements
- Traffic calming measures for off-system roads
- Secure bicycle parking facilities

Additional information may be found at http://www.txdot.gov/safety/safe_routes/default.htm

Maintenance

In order to ensure the long-term sustainability and continued enjoyment of Lewisville's trail system, it is imperative that the City's maintenance program be effective and thorough. In general, trail maintenance activities most often include pavement stabilization, landscape maintenance, facility upkeep, sign replacement, mowing, litter removal, and painting. A successful maintenance program requires vigilance, continuity, and the involvement of citizens in maintaining and informally policing the trails (such as a neighborhood watch program applied to a trail corridor). Routine maintenance on a year-round basis will not only improve trail safety, but will also prolong the life of the trail. Apart from its capacity to continually attract users, a good trail maintenance program has the following benefits:

- A high standard of maintenance is an effective advertisement to promote the trail as a city, regional, and state recreational resource
- Good maintenance deters vandalism, litter, and encroachments
- Good maintenance promotes positive public relations between the adjacent land owners and managing agency
- Good maintenance makes enforcement of regulations on the trail more efficient. Local clubs and interest groups will take pride and ownership of "their" trail and will be more apt to assist in its protection
- A proactive maintenance policy improves safety along the trail
- Good maintenance protects the tax payers' investments

The following section illustrates the framework of an effective maintenance program that the City of Lewisville should use as a model for its maintenance practices. The first section (General Considerations) describes common trail maintenance issues and strategies. After that, a typical trail maintenance schedule and list of anticipated annual maintenance costs are provided.

General Considerations

The following describes common trail maintenance issues and strategies to consider in order to address these issues.

Quality Control

Establishing a quality control program for the trail maintenance is an important responsibility of the City. The City must provide appropriate equipment, material, and labor to achieve good maintenance on a reoccurring basis.

Trail and Soil Stabilization

It is crucial to protect trail stability by maintaining proper levels of backfill, profile, and contours of the subgrade. Continually maintain soil surfaces suitable for turf establishment and repair and re-establish grades in settled, eroded, and damaged areas as necessary. The grade of the soil adjacent to the edge of the trail should be maintained no higher than flush to the surface of the trail and no lower than a half-inch from the surface of the trail. Soil levels and grades adjacent to trail surfaces shall comply with ADAAG standards. Maintenance should be performed periodically and often enough to assure safety of the trail user and to maximize the life of the trail (see Table 7.3).

Vegetation

Off-street trails require an unobstructed soft shoulder along both sides of the trail primarily to preclude any obstructions or hazards to cyclists (see Chapter 6 – Trail Design Standards). These soft shoulders also provide space for people to step off the trail if necessary. In order to maintain their effectiveness, shoulders must be unobstructed to maintain good visibility and to reduce hazards along the edges of trails. Vegetation is encouraged beyond the shoulder in order to provide visual interest and shade. Under-story vegetation within the shoulders of a trail should not be allowed to grow higher than 6". Vegetation along sidewalks can be allowed to grow up to 24" in height since these facilities are intended for pedestrians only.

Basic measures should be taken to protect the trail investment. This includes mowing along both sides of the trail to prevent invasion of plants into the pavement area. The standards for mowing shall be the same for like areas of similar public spaces. Tree species selection and placement should minimize vegetative litter on the trail and root uplifting of pavement. Vertical clearance along the trail should be checked on a reoccurring schedule, and any overhanging branches must be pruned to a minimum vertical clearance of 10'. Vegetation control should be accomplished by mechanical means or hand labor. Some species may require spot application of State-approved herbicide.

Surfacing

Concrete is the recommended surface material for paved off-street trails. Cracks, ruts, and water damage to the concrete surface shall be repaired periodically and often enough to maintain barrier-free access required by ADAAG. Where drainage problems exist along the trail, ditches and drainage structures shall be kept clear of debris to prevent washouts along the trail and maintain positive drainage flow. Inspections for erosion along the trail shall be made on a reoccurring schedule and immediately after any storm that brings flooding to the local area. Natural and soft surface trails, such as those constructed with decomposed granite or earth, should closed to users during wet conditions.

The trail surface shall be kept free of debris, broken glass and other sharp objects, loose gravel, leaves, and stray branches. Trail surfaces shall be swept on a routine basis and as soon as practical after a storm event. Soft shoulders should be well maintained to assure safety and maximize their usability.

Litter and Illegal Dumping

Staff or volunteers should remove litter along the trail. Litter receptacles and dog waste stations should be placed at access points such as trail heads, rest areas and picnic areas. Illegal dumping should be controlled by vehicle barriers, regulatory signage, and fines where applicable. When illegal dumping does occur, it shall be removed as soon as possible in order to prevent further dumping. Neighborhood volunteers, friends groups (i.e. "Friends of ____ Trail"), "Adopt a Trail" groups, alternative community service crews, and inmate labor should be considered in addition to paid maintenance staff.

Signage

Directional, informational, and safety signage shall be replaced along the trail as signs become damaged or missing. Missing, damaged, or vandalized signs serve as clear, obvious indicators of ineffective maintenance practices. Considering James Q. Wilson and George L. Kelling's "Broken Windows Theory," which basically states that a broken window left unrepaired encourages vandalism, creates a sense of abandonment, and gives an impression of apathy, it is important to replace these signs before they become symbolic "broken windows." As a related issue, it is important to immediately remove graffiti as it is discovered.

Recommended Maintenance Schedule

The following table summarizes a recommended maintenance schedule for the proposed trails in Lewisville. These guidelines address maintenance for off-street trails. On-street facilities, such as sidewalks and bike lanes, should be maintained per the City of Lewisville's current practices.

Table 7.3
Recommended Maintenance Schedule

Action	Frequency
Inspections	Scheduled on a routine basis
Sign replacement	Immediately upon damage, deterioration, or are missing
Pavement marking replacement	Immediately upon damage, deterioration, or are missing
Major damage response (fallen trees, washouts, or flooding)	Schedule as soon as practical
Pavement sealing and pothole repair	As needed to maintain ADA accessibility standards and a smooth surface
Introduce new tree / shrub plantings, tree trimming	Scheduled on a routine basis
Culvert inspection	Scheduled on a routine basis and after major storms
Cleaning ditches	As needed
Trash/litter pick-up	Weekly during high use; twice monthly during low use
Lighting luminary repair	Immediately upon damage, deterioration or are missing
Pavement sweeping/blowing	Scheduled on a routine basis and after major storms
Maintaining culvert inlets	Scheduled on a routine basis and after major storms
Shoulder plant trimming (weeds, trees, or brambles)	Scheduled on a routine basis
Water barrier maintenance (earthen trails)	Annually
Site furnishings, replace damaged components	Immediately upon damage, deterioration or are missing
Graffiti removal	Immediately upon notification
Fencing repair	Immediately upon damage, deterioration or are missing
Shrub/tree irrigation for introduced planting areas	Weekly during summer months until plants are established
Trail and soil stabilization	Scheduled on a routine basis.

Estimated Annual Maintenance Costs

Estimated annual maintenance costs for Lewisville's trail system are summarized in Table 7.4. These costs will vary based on facility design, location, and frequency of use. These estimates are based on regional averages and are in 2010 dollars.

Table 7.4
Estimated Annual Maintenance Costs

Facility Type	Miles	Cost per Mile	Total*
Spine Trails	35.3	$6,000	$211,800
Other Off-Street Trails**	29.8	$4,000	$119,200
Enhanced Sidewalks	50.4	$1,000	$50,400
On-Street Bike Routes†	50.4	--	--
Paddling Trail‡	7.4	--	--
TOTAL	*173.3*		*$381,400*

**Total costs will not apply until the trail system is completed.*

***Includes existing 14.02 miles of off-street trail.*

†Bike route maintenance cost per mile depends on facility type (signed route, shared lane with Sharrow markings, or bike lane). These facility types shall be determined in future engineering studies.

‡Maintenance of the paddling trail generally does not include any additional maintenance activities beyond those already used to maintain river flowage.

Safety & Security

According to the citizen questionnaire, which received 102 responses and is discussed in Chapter 3, the community's top priority for the trail system is "feeling safe on trails." As discussed earlier in this chapter, trails are often viewed as potentially unsafe or unsecure and though a properly-designed trail precludes many safety and security issues, it is still necessary to actively address these concerns. This section provides guidance for ensuring the safety (freedom from non-criminal dangers) and security (freedom from crime) of Lewisville's trail system.

Police, Fire & EMS

A primary safety and security concern is good access to trails for police patrols and emergency vehicles. Trails must accommodate this need by having regularly-spaced access points and being continuous and of sufficient width to accommodate emergency vehicles. Additional public safety measures appropriate for trail facilities include:

- ***Police Patrols*** – Schedule regular police patrols along each of the City's trail corridors. Bicycle-mounted officers on patrol at trailheads, access points, and along the trails themselves will provide the most reassuring deterrent to criminal activities.
- ***Emergency Response*** – Provide the Fire and Police Departments with a map of the trail system that shows access points and mile markers. Provide keys or combinations to locked gates and/or bollards to ensure quick emergency response. To shorten response times, consider developing an easily identifiable trail numbering system based on regular intervals (such as every 500 feet). The trail numbers would be embedded on the trail surface, be identifiable by GPS, and be tied to the City's emergency dispatch system.
- ***Public Safety Programs*** – Implement programs that educate and encourage citizens about public safety along the trail system. An example of such programs is a 'Cells on Trails' program, which could be provided by the Police Department and would encourage citizens to carry cell phones when they use the trail system

Infrastructure & Maintenance

As discussed in the previous section on maintenance, the overall design and condition of trail facilities can inherently preclude many safety and security concerns. The most effective and most visible deterrent to illegal activity in a trail corridor will be the presence of legitimate trail users. As a general pattern, introducing legitimate use into an area through the provision of comfortable, attractive, and easy-to-use facilities tends to drive out illegitimate use.

The following safety and security issues should be considered when developing a trail:

- ***Good Trail Access*** – Wherever feasible, public access to the trail system should be provided. Access ranges from providing conveniently located trail heads along trails to building sidewalks to accommodate access from private developments adjacent to trails. Access points should be inviting and signed in order to welcome the public onto the trails.
- ***High Level of Maintenance*** – A well-maintained trail system expresses the community's pride in its public spaces and encourages the citizens to care about trails in their neighborhoods. Again considering Wilson and Kelling's "Broken Windows Theory," a high level of maintenance will discourage undesirable activity along the trails.
- ***Infrastructure for Public Safety*** – As a general rule, infrastructure (such as emergency call boxes, lighting, and in some cases, remote video monitoring) may be considered as a final line of defense against criminal activity on a trail. Generally, this type of infrastructure is expensive and may involve 24-hour remote monitoring. In addition, these features may represent an additional liability hazard if they are not properly maintained and monitored.
- ***Public Safety Amenities*** – Provide bicycle racks at key destinations and at trail heads. Bicycle racks should allow for the frame and wheels of a bicycle to be secured. Post "Trail-User Ethics" signs at trail heads and in unobtrusive but visible areas to inform users of trail regulations and customs.

Community Involvement

Effective enforcement goes beyond public safety officers and should involve the entire community. There are several ways in which to accomplish this:

- ***Informal Surveillance*** – Neighbors adjacent to trails potentially provide 24-hour informal surveillance of the trails and can become the City's greatest ally. Though some screening and setback of any trail is needed for the privacy of adjacent neighbors, completely blocking out visual access of a trail from neighborhood view should

be discouraged. Good visual access allows the neighbors to have "eyes on the trail," which can improve the overall security of the facility.

- ***Programmed Events*** – Events along trails will increase public awareness of the trail system and thereby bring more people to the trails. A "friends" group that supports the development, maintenance, and use of the trail system should be formed. This group can then help initiate numerous public events along the trails in an effort to raise public awareness and increase support for the system. Events might include a trail clean-up day or a series of short interpretive walks led by the friends group. Friends groups can also assist the City with public support of future funding applications.

- ***Community Projects*** – The support generated through the friends group could be further capitalized on by involving neighbors in a community project along the trails. Ideas for community projects that have been successful in other cities include volunteer planting events, art projects (often associated with adjacent schools), interpretive research projects, or even bridge-building events. These community projects are the strongest means of creating a sense of ownership along the trails that are perhaps the strongest single deterrent to undesirable activity.

- ***Adopt-a-Trail Program*** – Businesses, educational institutions and residential communities will abut the trails. As neighbors to the trails, they often see the benefit of their involvement in trail development and maintenance. Developers view trails as an integral piece of their campus. Property owners adjacent to trails often become willing to take on some level of responsibility for the trail. Creation of an Adopt-A-Trail program (similar to the City's existing Adopt-a-Spot program) should be explored to capitalize on this opportunity and help build civic pride.

- ***Citizen Patrols*** – Volunteer citizen patrols, similar to neighborhood crime watch organizations, can serve as a valuable interface and support function for law enforcement officers. The City should develop a citizen patrol academy that educates citizens on trail regulations and how to identify and report criminal activity.

Conclusion

Striving to create a premier trail system in Lewisville that provides active adventure and creative connections for the community is no small task. Achieving this end-result will necessitate the commitment and dedication of City Officials, City Staff, and the citizens of Lewisville. The purpose of the Trails Master Plan is to provide a "road map" that provides direction in accomplishing this task. Specifically, through the Trails Master Plan process, the City of Lewisville has achieved the following:

- Established a vision and goals for the future of the City's trail system, which will aid decision-making;
- Involved the public and gained their input and opinions about various aspects of the trail system;
- Identified and analyzed the unique needs and preferences of various user groups (such as recreational cyclists and slow-paced pedestrians) and created a plan for a system that meets each group's needs;
- Developed a target level of service for trails that is based on regional trends and establishes a series of benchmarks for the City to achieve in the future in order to encourage the implementation of this plan;
- Identified key trail barriers (such as IH-35E, limited right-of-way, areas of difficult terrain, etc.), as well as opportunities for the provision of future trails and related facilities and the enhancement of existing facilities;
- Provided a toolbox of facility types (including off-street trails, enhanced sidewalks, on-street bike routes, and paddling trails) and provided guidance for the implementation and use of each;
- Created a set of detailed design standards for the trail system and its related amenities. These ensure that the City's trail system continues to be developed in a high-quality manner and that there are aesthetic elements present within all facilities that serve as a unifying theme for the system;
- Prioritized and phased key trail facility projects and provided a detailed opportunities and constraints analysis and cost estimate for each; and
- Provided strategies to streamline and improve the development of the trail system and enhance maintenance and safety operations.

Having a road map in place, the City and its citizens must now begin the task of implementing the Trails Master Plan. In order to do so effectively, the community must commit to fund and build facilities on a regular basis. The City should use the target level of service established in the Trails Master Plan as a continuous benchmark by which to judge the their progress in implementing this plan.

Finally, it is crucial to understand that this plan is not static. Rather, it must be continually updated to reflect the changing needs of the citizens and take advantage of new opportunities. With these tools in hand, the journey toward creating a premier trail system in Lewisville can now begin.

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LEWISVILLE

Deep Roots. Broad Wings. Bright Future.

The 2011 Lewisville Trails Master Plan

"Active Adventure... Creative Connections"

Appendix A- IH-35E Crossing Analysis

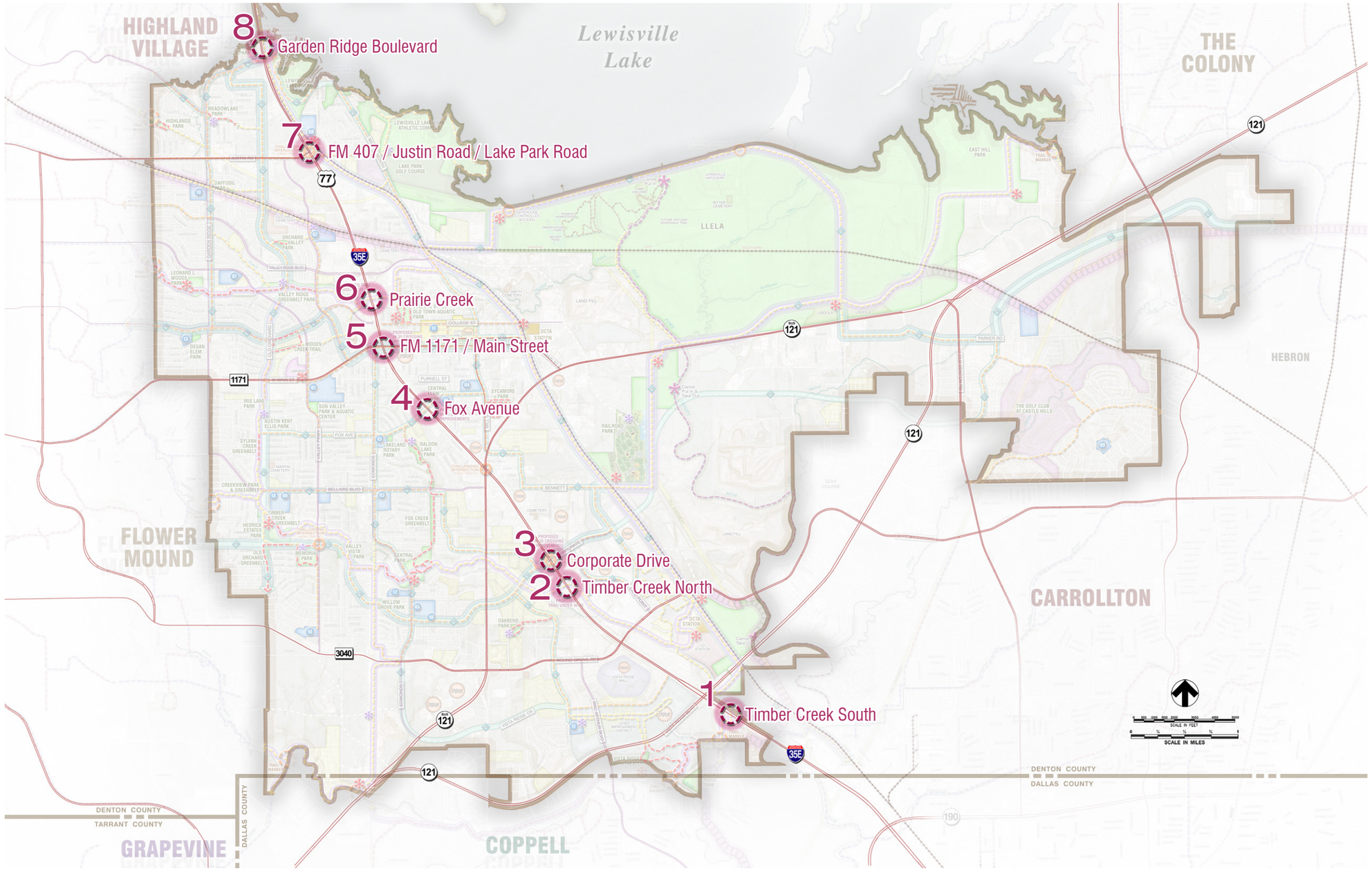


Figure A.1 – Key Map
The numbers on this figure indicate the location of the crossings described in the following pages.

Introduction

The 2010 Lewisville Trails Master Plan recommends eight locations for pedestrian and bicycle crossings of IH-35E. In order to ensure the viability of these recommendations, the Planning Team (led by Halff Associates, Inc.) reviewed the Texas Department of Transportation's (TxDOT's) preliminary roadway schematics for the redesign of IH-35E to identify potential constraints and opportunities for pedestrian and bicycle crossings. These schematics have been submitted to the FHWA for review, but will be made available for public comment in Fall 2010, after which time minor revisions may be made to the schematics. In order to enhance coordination between the City and TxDOT, the City of Lewisville and the Planning Team have prepared the following list of recommended modifications to the schematics.

General Overview

It is the intent of the 2010 Trails Master Plan to develop a system of trails, enhanced sidewalks, and bike routes that provides non-motorized connectivity across the city. One of the most significant barriers to such cross-town routes is IH-35E, which divides the city east to west and places Lewisville's "Old Town" area and future Denton County Transit Authority commuter rail stations on the east side and the majority of Lewisville's housing stock on the west side. The redesign of IH-35E provides an unprecedented opportunity to improve pedestrian and bicycle connectivity across the freeway.

Recommended Schematic Revisions

The Planning Team's recommended changes to the schematics for each of the eight crossing locations are described in the following pages. The recommendations for each of the crossings consist of a list of specific recommended modifications to the schematics. Each of the specific recommendations is associated with a particular alignment within the schematics as indicated by various codes, such as FRSB, CM35, or XCORP. The definitions, alignments, and sections for each of these coded alignments can be found in TxDOT's schematics. The position along each of these alignments is indicated by station number; these locations may be specific to one station or may cover a range of stations. In addition, these recommendations are illustrated through plan and section graphics. The various alignment codes referenced are defined below.

- CM35 – IH-35E Centerline (main lanes)
- GMNB & GMSB – General Purpose Northbound and Southbound lanes
- DMNB & DMSB – Collector Distributor Northbound and Southbound lanes
- FRNB & FRSB – Frontage Road Northbound and Southbound lanes
- RN & RS – The codes include three numerals afterwards and indicate northbound and southbound entrance and exit ramps
- XCORP, XFOX, XMAIN, XF 407 & XGARD – Corporate Drive, Fox Avenue, FM 1171 / Main Street, FM 407 / Justin Road, and Garden Ridge Boulevard

For example, "GMNB STA 967+00" indicates station 967+00 on the general purpose northbound plan and profile.

View atop the existing Garden Ridge Bridge, looking north

The existing Fox Avenue Bridge over IH-35E with fenced pedestrian crossing – one of the few existing bicycle and pedestrian crossings of IH-35E.

1. Timber Creek South

Two alternatives are presented for this crossing location. The preferred alternative is to provide a crossing underneath IH-35E along the western bank of Timber Creek. In order to provide a crossing in this location that meets AASHTO standards, the following revisions to the schematics would be required:

- FRSB STA 2965+00 to 2966+00 – Ensure 10' vertical clearance between bridge bottom and existing grade underneath.
- RS115 STA 14+00 to 14+50 – Reduce bridge depth from 7' to 6' and raise bridge elevation by +/-3.5' (ensure 10' vertical clearance between bridge bottom and existing grade underneath).
- DMSB01 STA 5132+00 – Raise bridge elevation by +/-3' (ensure 10' vertical clearance between bridge bottom and existing grade underneath).
- GMSB and GMNB STA 967+00 to 968+00 - Ensure 10' vertical clearance between bridge bottom and existing grade underneath.
- CM35 968+00 to 969+00– Ensure 10' vertical clearance between bridge bottom and existing grade underneath).
- DMNB01 STA 7130+00 to 7131+00 – Raise bridge elevation by +/-1' (ensure 10' vertical clearance between bridge bottom and existing grade underneath).
- FRNB STA 1975+00 to 1976+00 – Raise bridge elevation by +/-1' (ensure 10' vertical clearance between bridge bottom and existing grade underneath).

As an alternative, the trail alignment could follow the south-bound frontage road of IH-35E to the north and utilize the signalized intersections of the IH-35E and SH-121 frontage roads. This alternative may require widening the bridge for the east-bound frontage road of SH-121 in order to provide a minimum 10' wide trail along the roadway.

Figure A.2 – Planned CM35 Profile at Timber Creek South
(As per current TxDOT schematics)

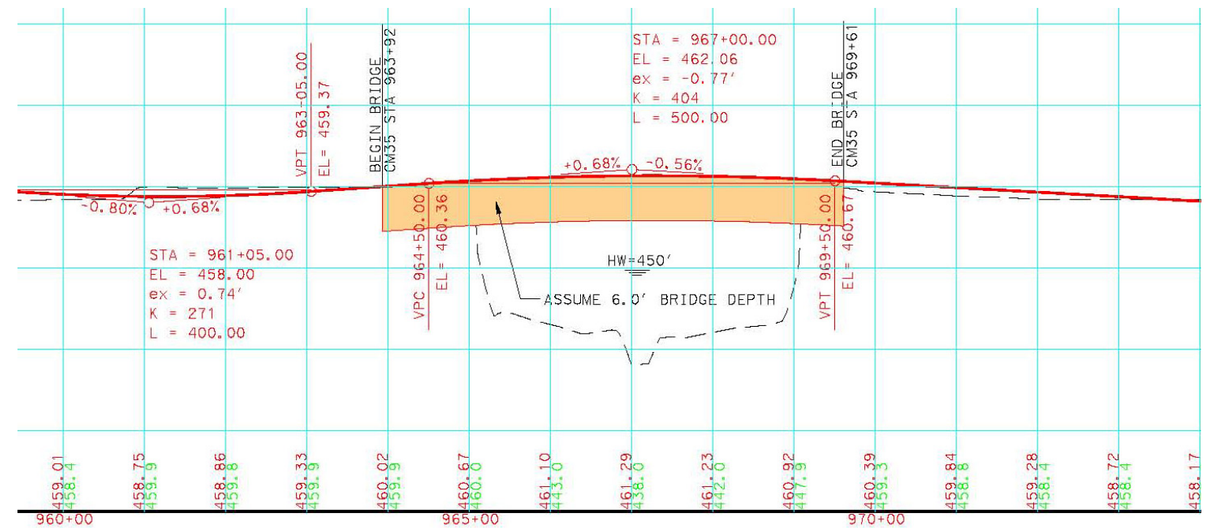


Figure A.3 – Proposed Section View of Timber Creek South Crossing

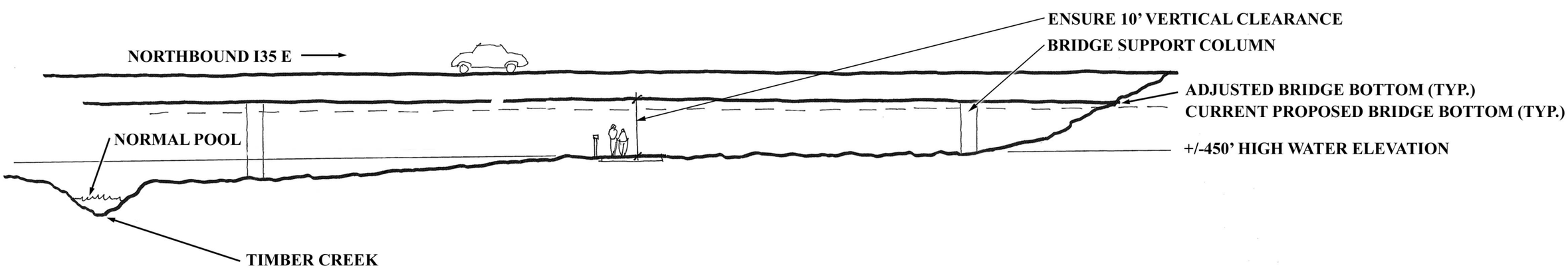
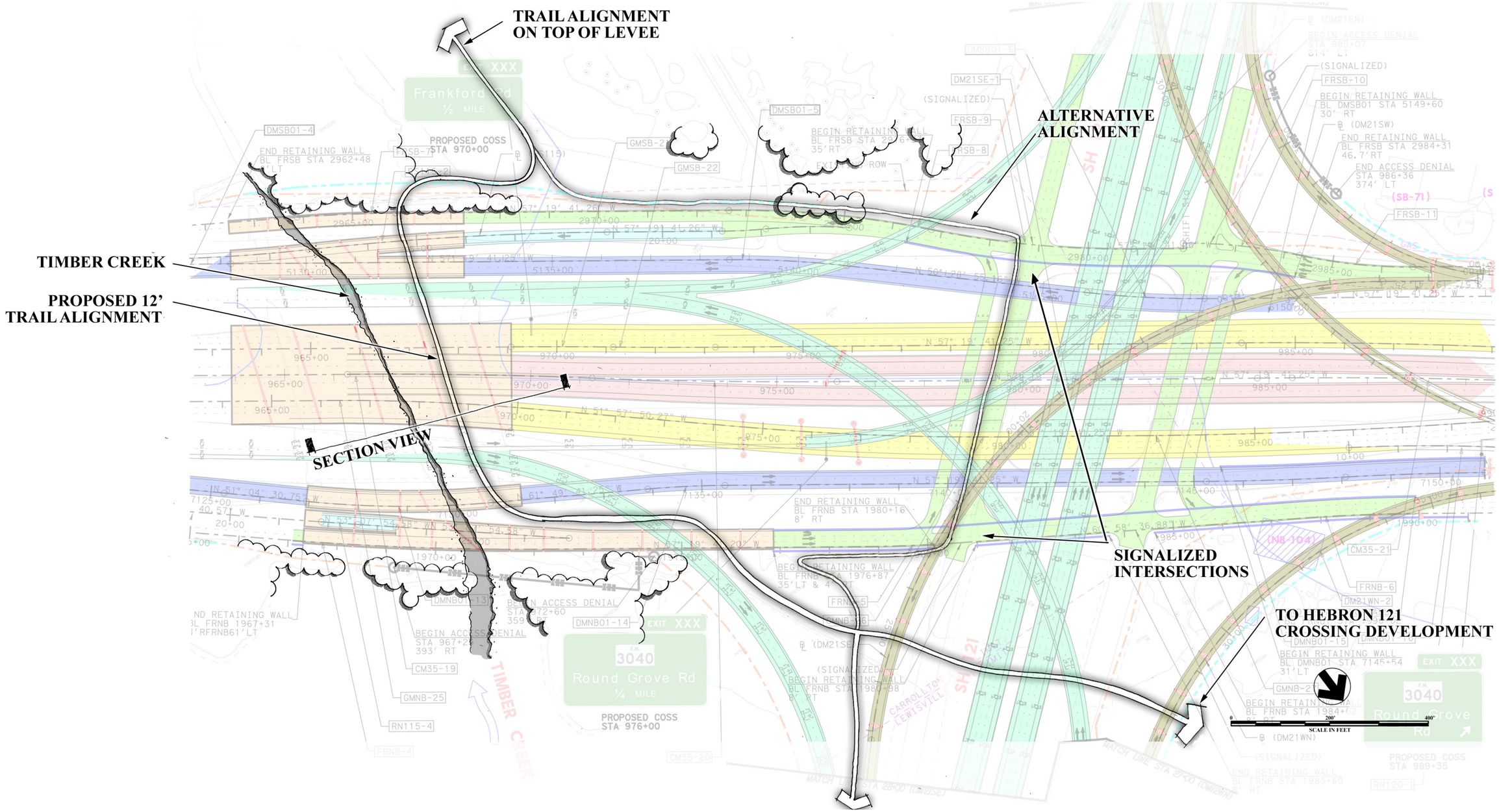


Figure A.4 – Proposed Plan View of Timber Creek South Crossing



2. Timber Creek North

- FRSB STA 3068+50 to 3069+50 – Raise bridge elevation by +/- 1.5' (ensure 10' vertical clearance between bridge bottom and existing grade underneath).
- GMSB STA 1068+00 to 1069+00 – Profile not available (ensure 10' vertical clearance between bridge bottom and existing grade underneath).
- CM35 STA 1067+00 – Raise bridge elevation by +/- 1.5' (ensure 10' vertical clearance between bridge bottom and existing grade underneath).
- CM35 STA 1068+00 – Raise bridge elevation by +/- 0.5' (ensure 10' vertical clearance between bridge bottom and existing grade underneath).
- GMNB STA 1067+00 – Raise bridge elevation by +/- 3' (ensure 10' vertical clearance between bridge bottom and existing grade underneath).
- GMNB STA 1068+00 – Raise bridge elevation by +/- 2' (ensure 10' vertical clearance between bridge bottom and existing grade underneath).
- RN135 STA 18+00 to 19+00 – Raise bridge elevation by +/- 5' (ensure 10' vertical clearance between bridge bottom and existing grade underneath).
- FRNB STA 2067+00 to 2068+00 - Raise bridge elevation by +/- 4' (ensure 10' vertical clearance between bridge bottom and existing grade underneath).

Figure A.5 – Planned CM35 Profile at Timber Creek North
(As per current TxDOT schematics)

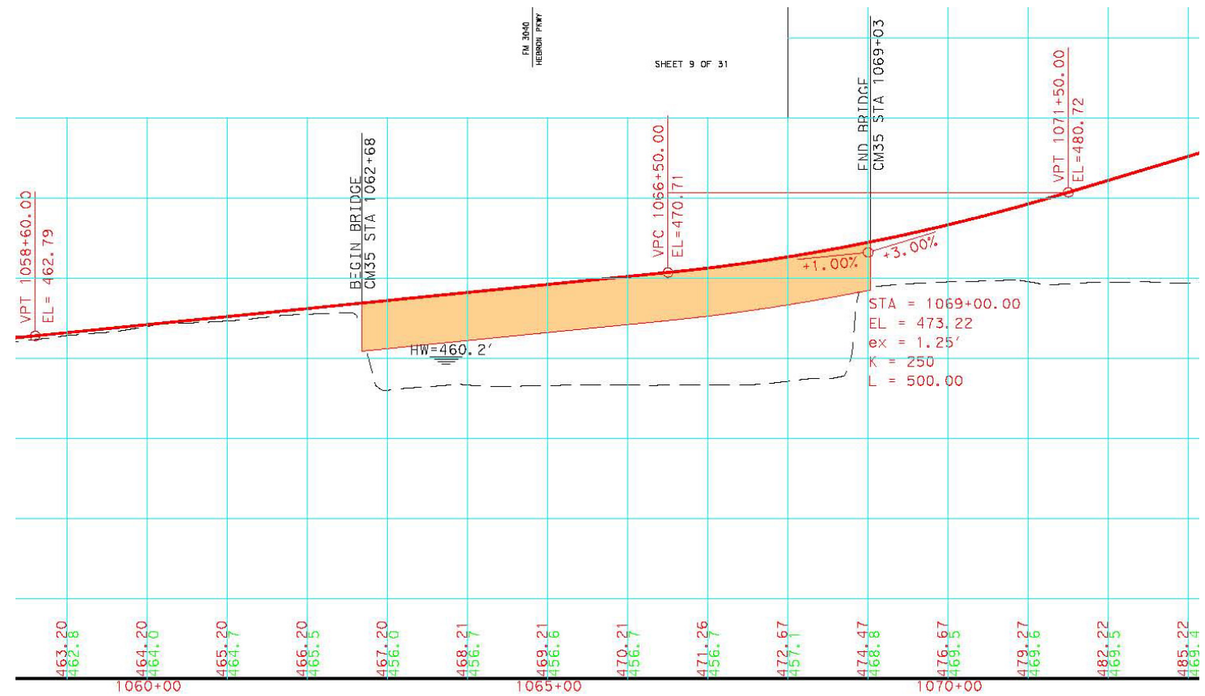


Figure A.6 – Proposed Section View of Timber Creek North Crossing

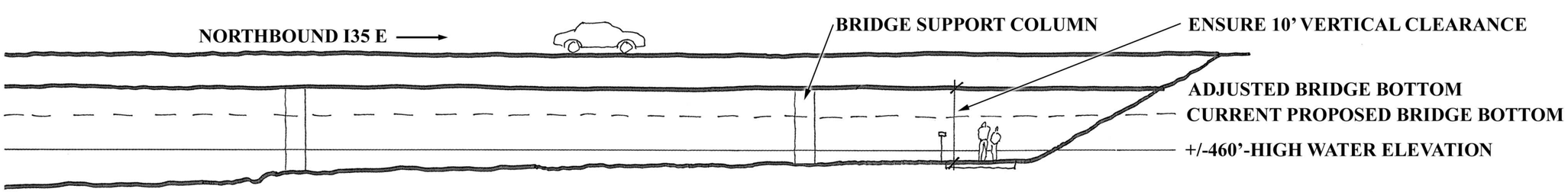
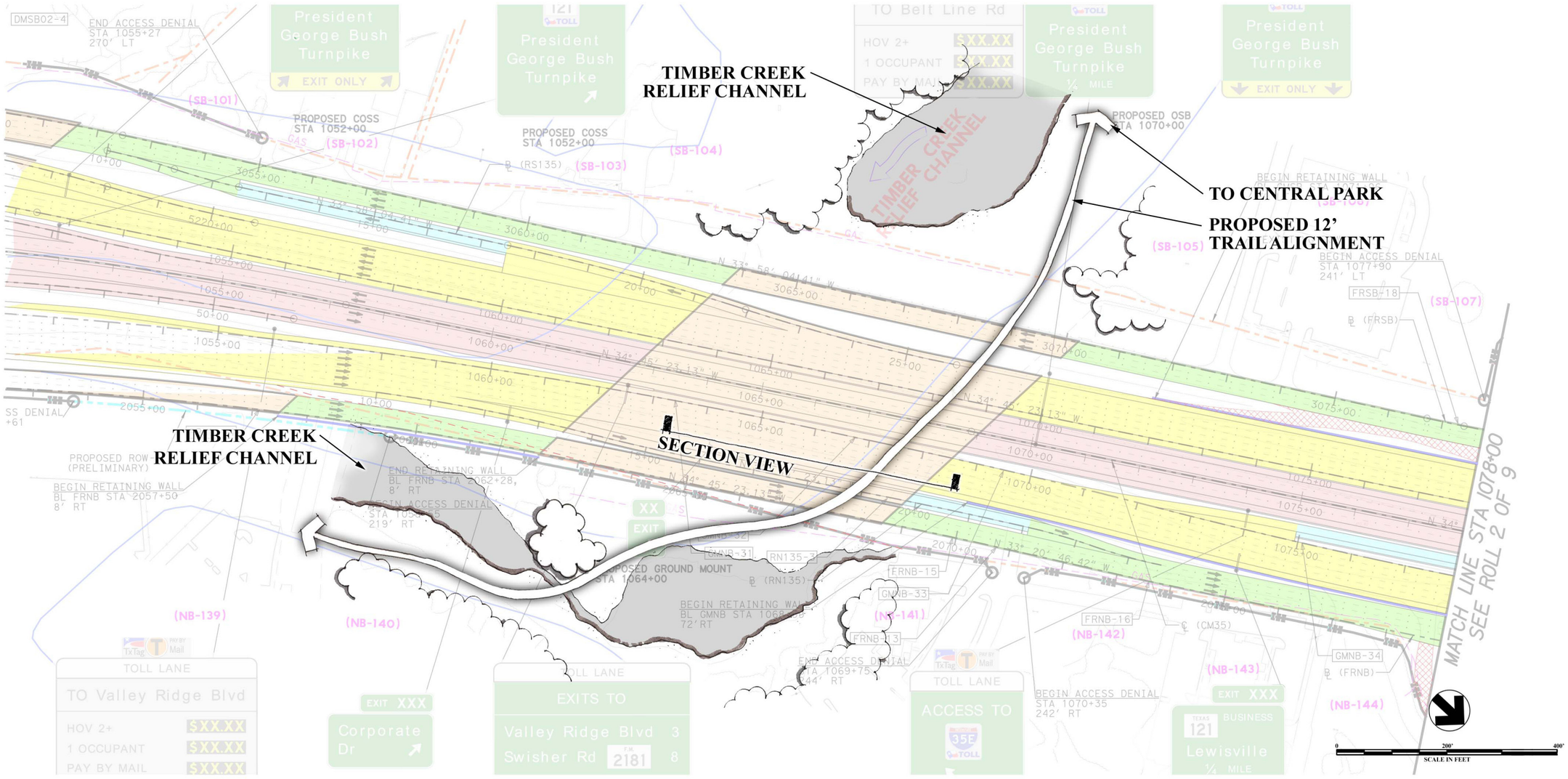


Figure A.7 – Proposed Plan View of Timber Creek North Crossing



3. Corporate Drive

- XCORP STA 100+00 to 111+85 – Provide 14' wide outside lanes and 2' curb offsets as shown in Figure A.8 and existing schematics.
- XCORP STA 104+60 to 107+60 – Modify underpass configuration to accommodate enhanced sidewalks as follows:
  - Increase column spacing by 2' from centerline for a total of an additional 4' of width between columns,
  - Provide a 6' wide sidewalk plus a 2' wide paved buffer between the sidewalk and through-lanes on each side of the street.

Figure A.8 – Planned Section of Corporate Drive
(As per current TxDOT schematics)

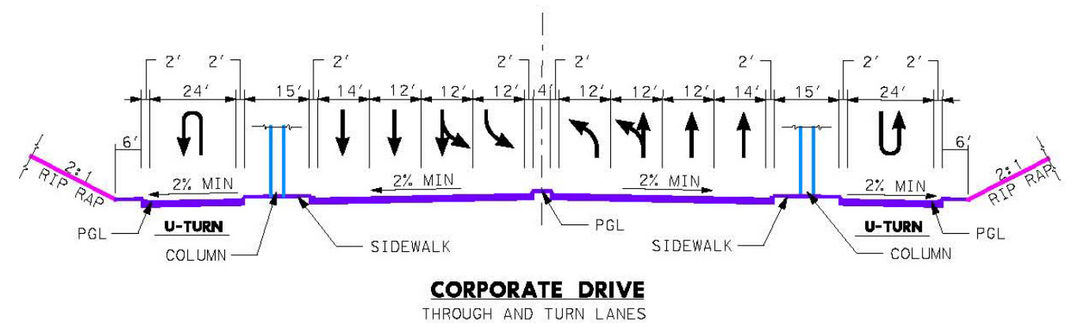


Figure A.9 – Proposed Section View of Corporate Drive

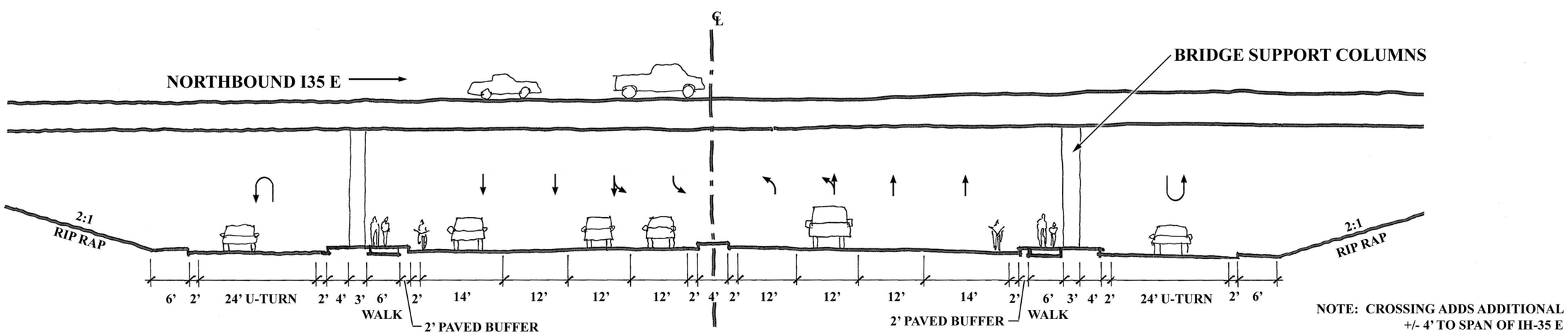
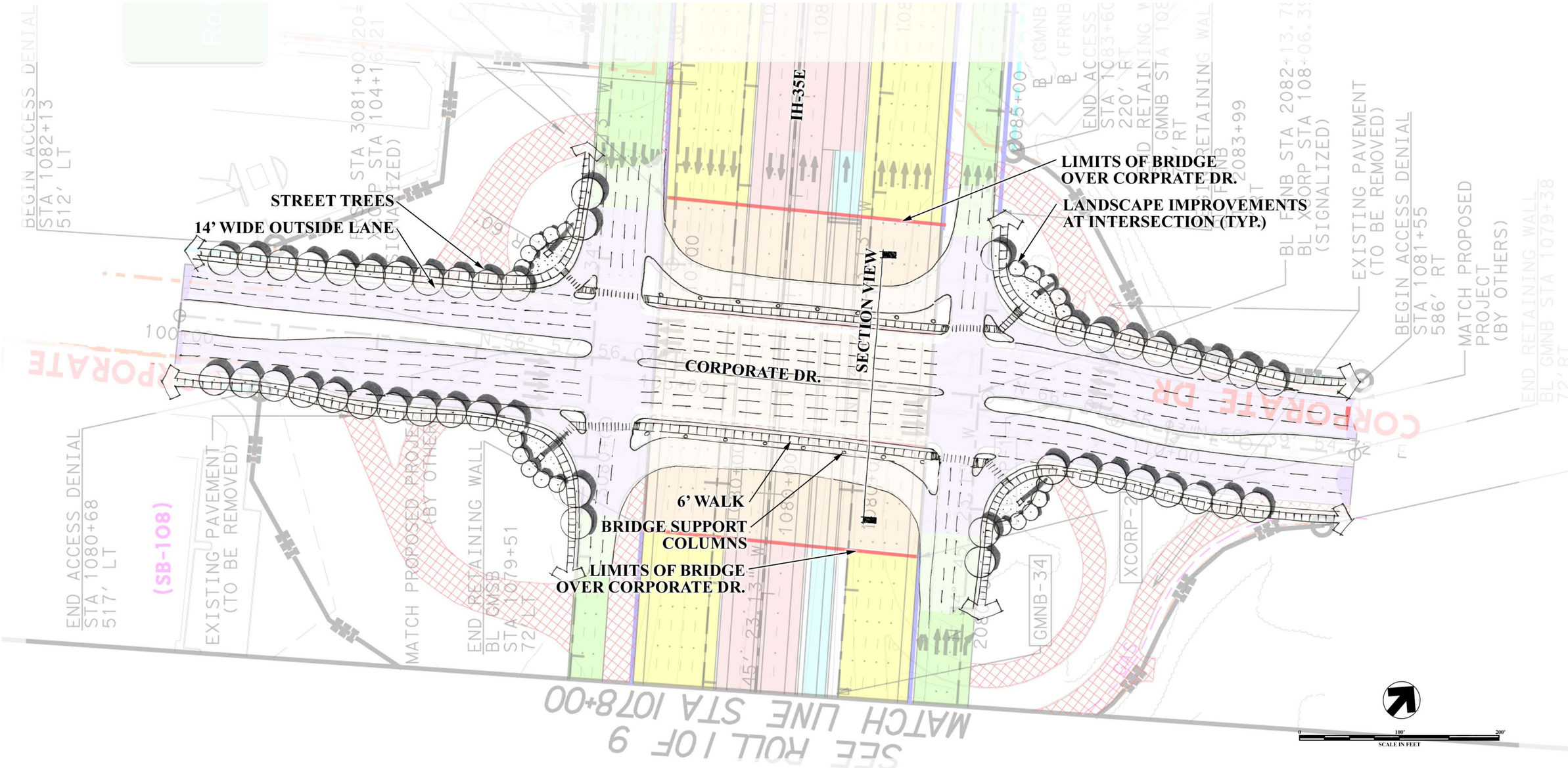


Figure A.10 – Proposed Plan View of Corporate Drive



4. Fox Avenue

- Because of the numerous turning conflicts between bicycles and automobiles at the "jughandle" intersections, it is recommended that bicycles be directed to use wide pathways along the sides of Fox Avenue rather than a wide outside lane. This approach will require an "entry ramp" and "exit ramp" on the far ends of each jug handle that connects the on-street bicycle route to the shared-use pathway adjacent to the street. Bicycles will then be directed to use crosswalks along with pedestrians.
- XFOX STA 100+00 to 113+50 – Widen the cross section of Fox Avenue by 24' to accommodate a 10' wide pathway on each side. Each pathway should consist of:
    - A crash-tested barrier with railing between travel lanes and the pathway,
    - A 10' wide pathway for pedestrians and cyclists, and
    - Decorative columns, railing, and lighting on the outside of the pathway.
- Provide 10' wide curb ramps and crosswalks, as well as warning and regulatory signage at the intersections between Fox Avenue and the access road connectors (TFOXSW, TFOXNW, TFOXSE, and TFOXNE).
- At the project extents (both ends of XFOX), provide "entry ramp" and "exit ramp" transitions between the 10' wide pathways and 14' wide outside lanes.
- XFOX STA 105+00 to 112+00 – The 14' wide outside lanes are unnecessary for bicycle use if the adjacent 10' wide pathways are provided. Therefore, the outside lanes could be narrowed to 12', based on TxDOT's discretion.

Figure A.11 – Planned Section of Fox Avenue
(As per current TxDOT schematics)

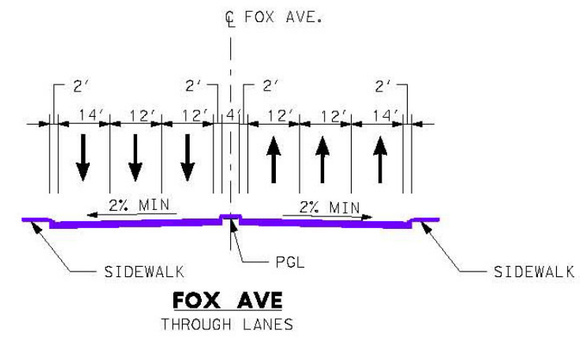
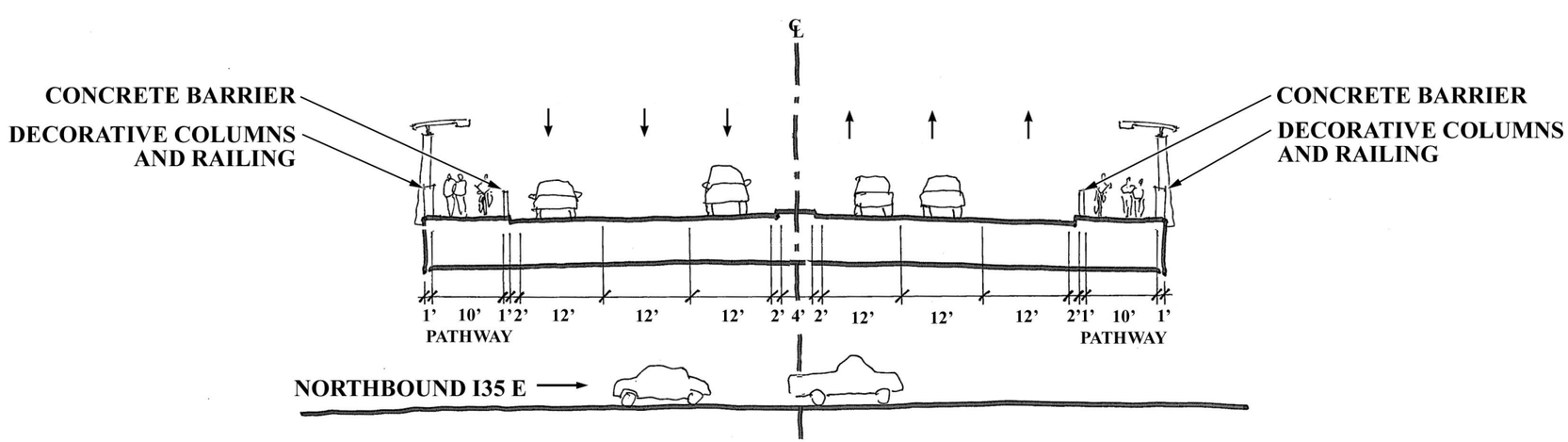
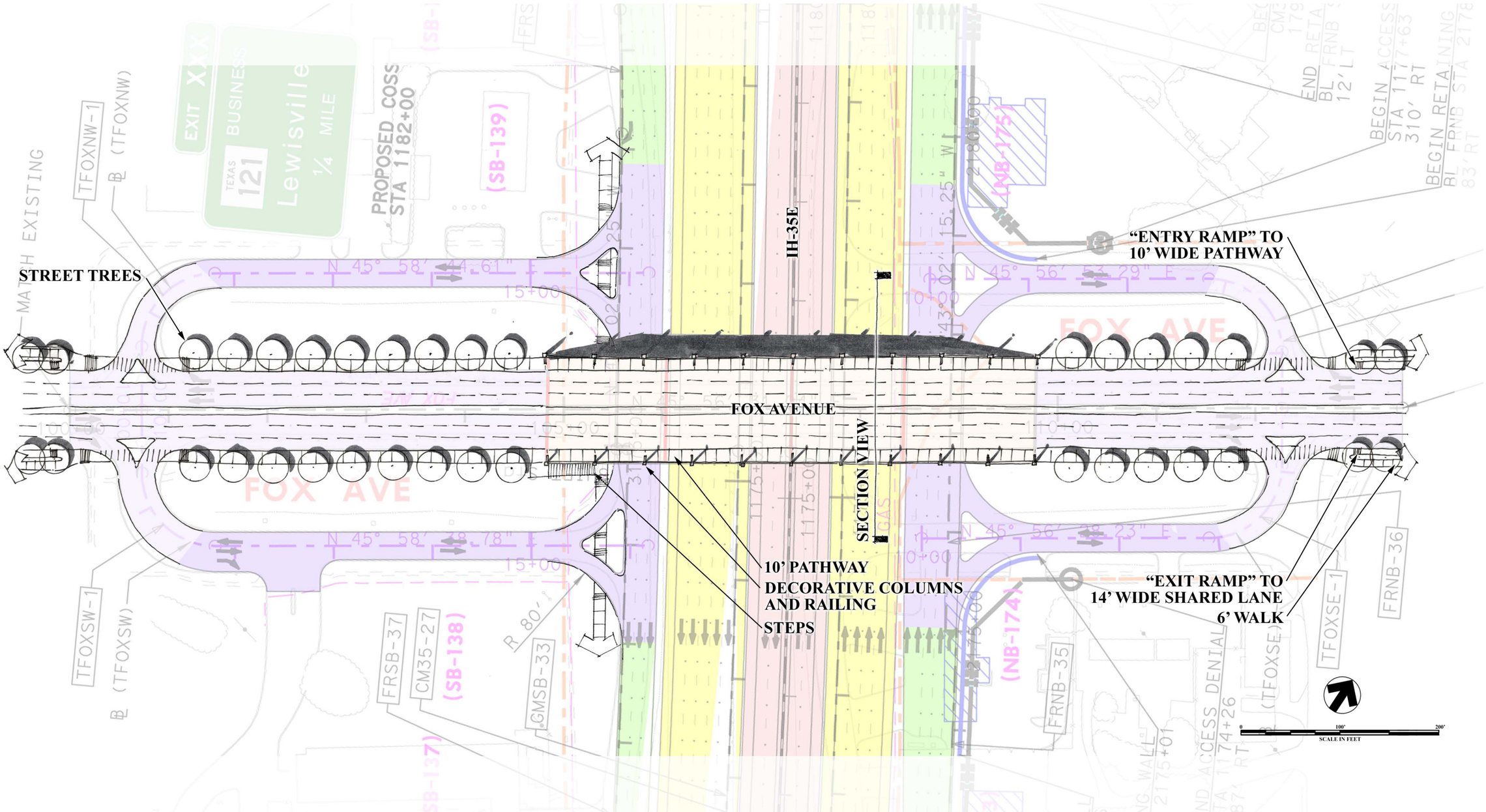


Figure A.12 – Proposed Section View of Fox Avenue



NOTE: CROSSING ADDS +/- 24' TO WIDTH OF BRIDGE

Figure A.13 – Proposed Plan View of Fox Avenue



5. FM 1171 / Main Street

- XMAIN STA 103+00 to 110+28 – Provide 14' wide outside lanes and 2' curb offsets as shown in Figure A.14 and existing schematics.
- XMAIN STA 105+10 to 108+10 – Widen bridge by 12' and modify configuration to accommodate enhanced sidewalks and streetscape elements as follows:
    - Widen the proposed medians/sidewalks on each side of the bridge by 6' (resulting in 12' total width for each) to accommodate 10' sidewalks and crash-tested barriers (place barriers between the median/ sidewalk and U-turn lanes).
    - Provide street trees in planters along the street-side edge of the 10' sidewalks. Trees should be spaced 30' on center and should be located no more than 4' on center from the back of curb.

Figure A.14 – Planned Section of FM 1171 / Main Street
(As per current TxDOT schematics)

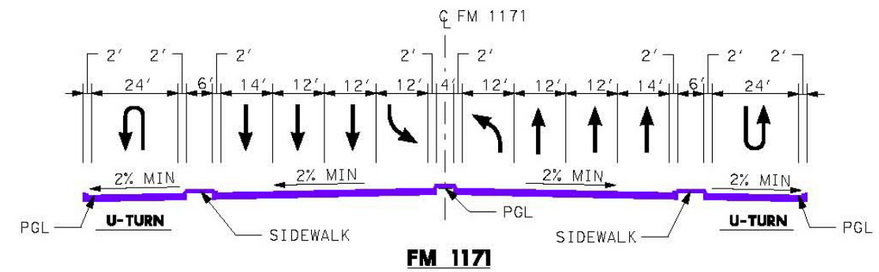
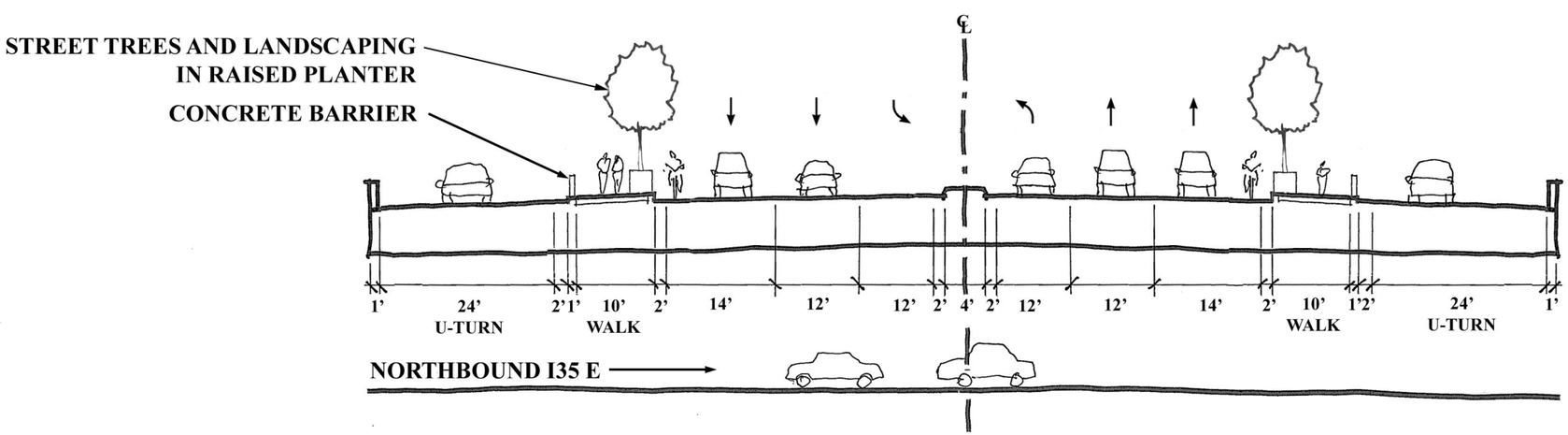
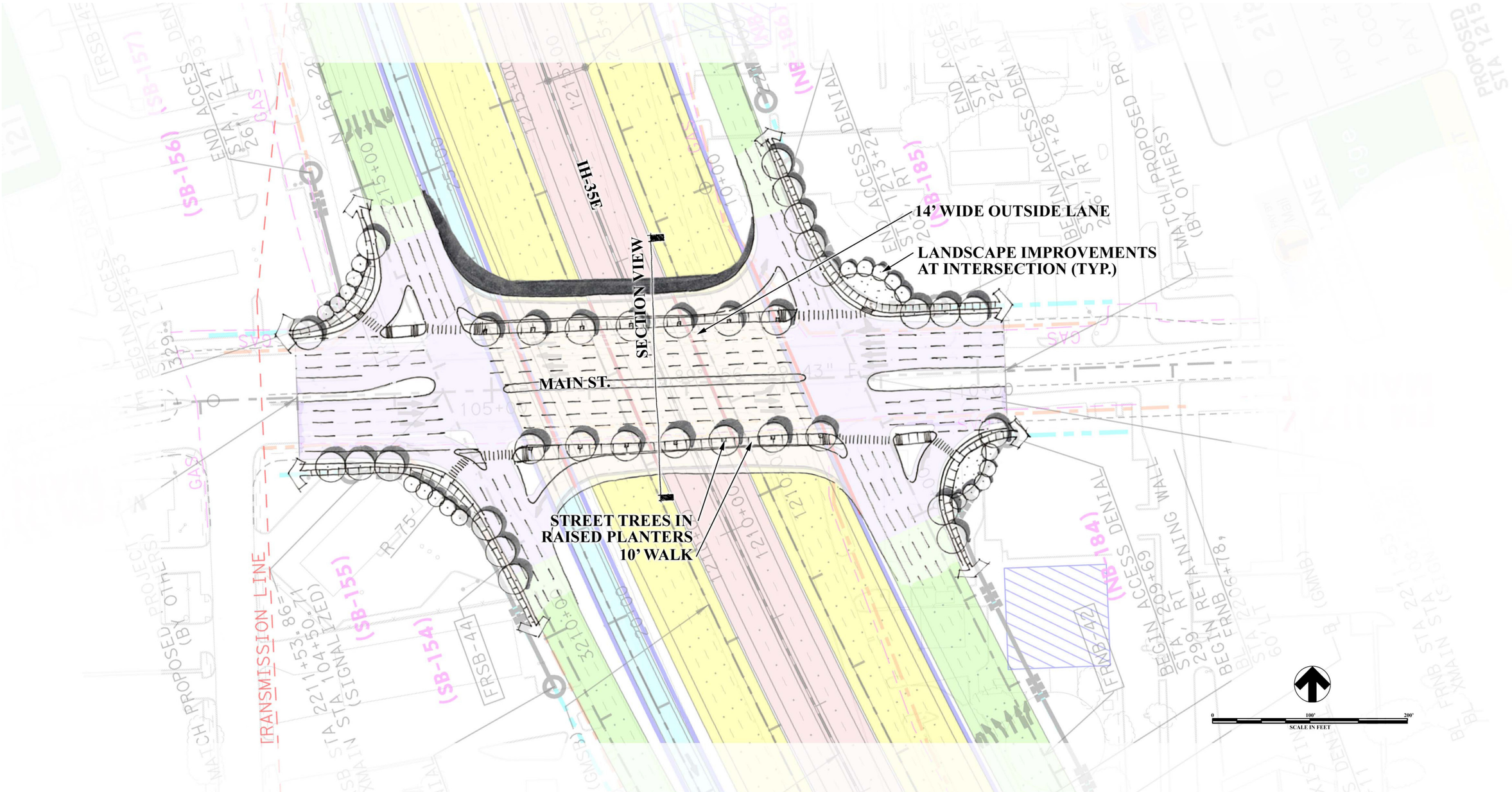


Figure A.15 – Proposed Section View of FM 1171 / Main Street



NOTE: CROSSING ADDS +/- 10'
TO WIDTH OF BRIDGE

Figure A.16 – Proposed Plan View of FM 1171 / Main Street



6. Prairie Creek

- FRSB STA 3234+00 to 3235+00 – Ensure 10' vertical clearance between bridge and existing grade underneath.
- GMSB STA 1233+50 to 1234+50 - Profile not available (ensure 10' vertical clearance between bridge and existing grade underneath).
- CM35 STA 1233+50 to 1234+50 – Raise bridge elevation by +/- 4.5' (ensure 10' vertical clearance between bridge and existing grade underneath).
- GMNB STA 1233+00 to 1234+00 - Profile not available (ensure 10' vertical clearance between bridge and existing grade underneath).
- FRNB STA 2234+00– Ensure 10' vertical clearance between bridge and existing grade underneath.
- FRNB STA 2235+00 – Raise bridge elevation by +/- 1' (ensure 10' vertical clearance between bridge and existing grade underneath).

View of northbound IH-35E at Prairie Creek existing conditions.

Figure A.17 – Proposed Section View of Prairie Creek Crossing

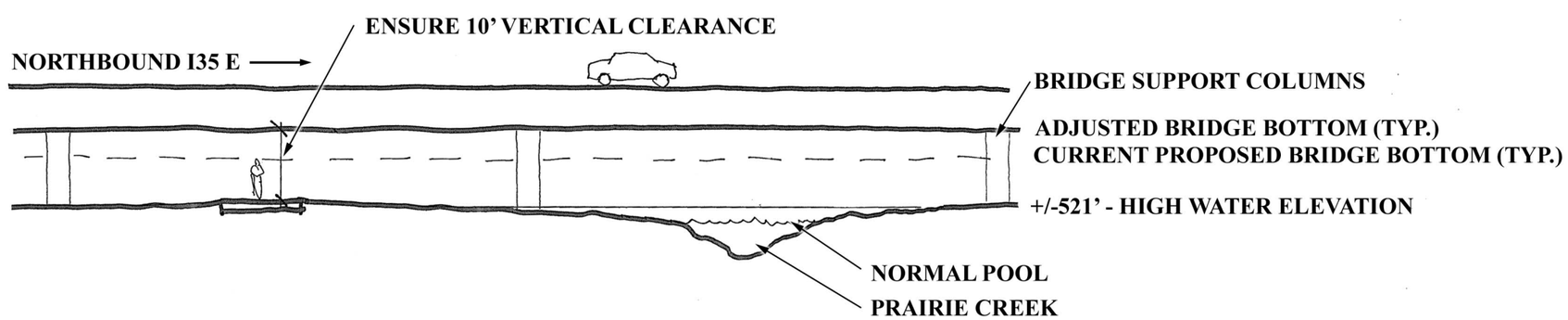
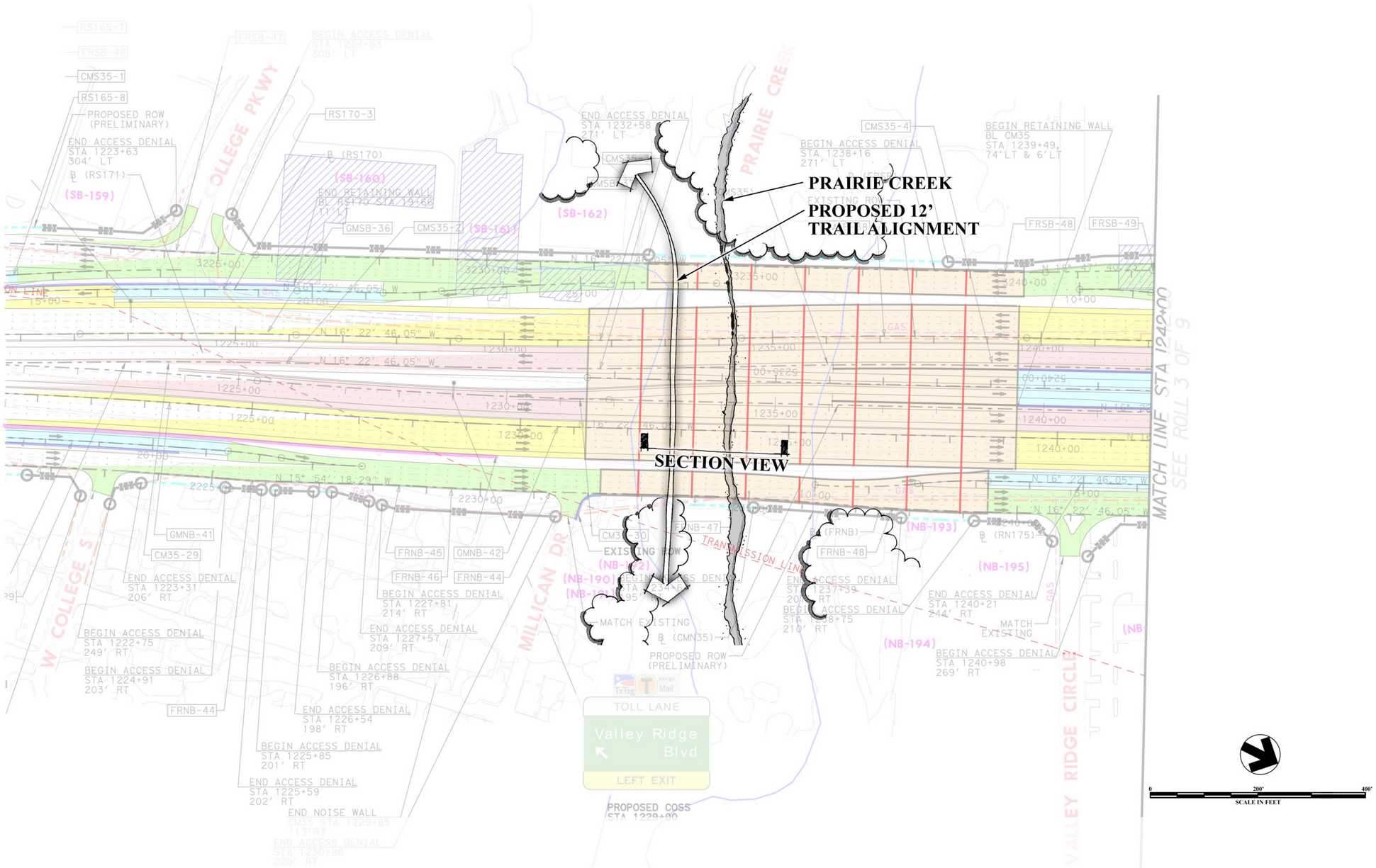


Figure A.18 – Proposed Plan View of Prairie Creek Crossing



7. FM 407 / Justin Road / Lake Park Road

- XF407 STA 100+00 to 113+00 – Provide 14' wide outside lanes and 2' curb offsets as shown in Figure A.19 and existing schematics.
- XF407 STA 106+25 to 109+25 – Modify underpass configuration to accommodate enhanced sidewalks as follows:
  - Increase column spacing by 2' from centerline for a total of an additional 4' of width between columns,
  - Provide a 6' wide sidewalk plus a 2' wide paved buffer between the sidewalk and through-lanes on each side of the street.

Figure A.19 – Planned Section of FM 407 / Justin Road / Lake Park Road
(As per current TxDOT schematics)

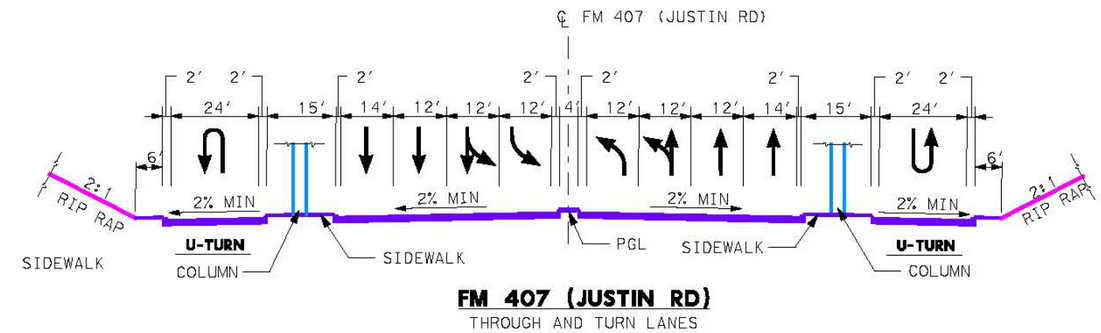


Figure A.20 – Proposed Section View of FM 407 / Justin Road / Lake Park Road

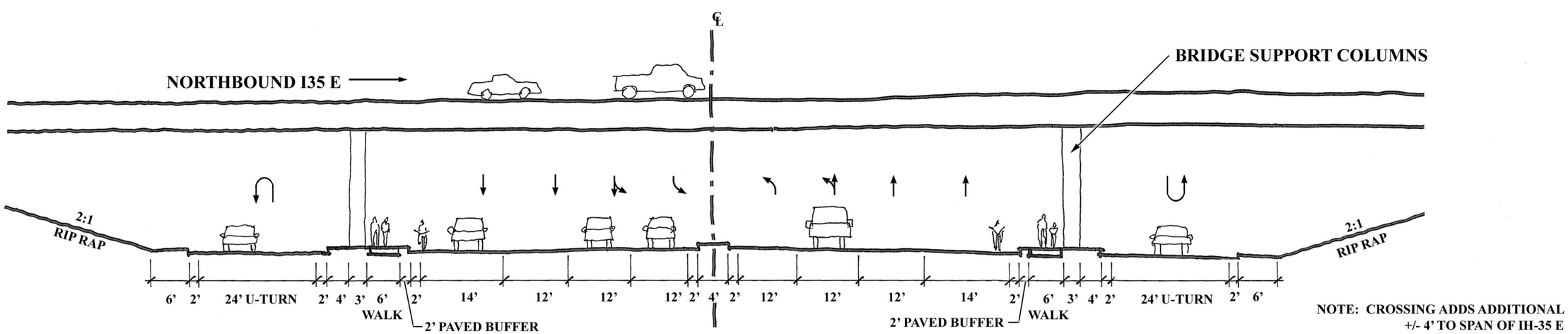
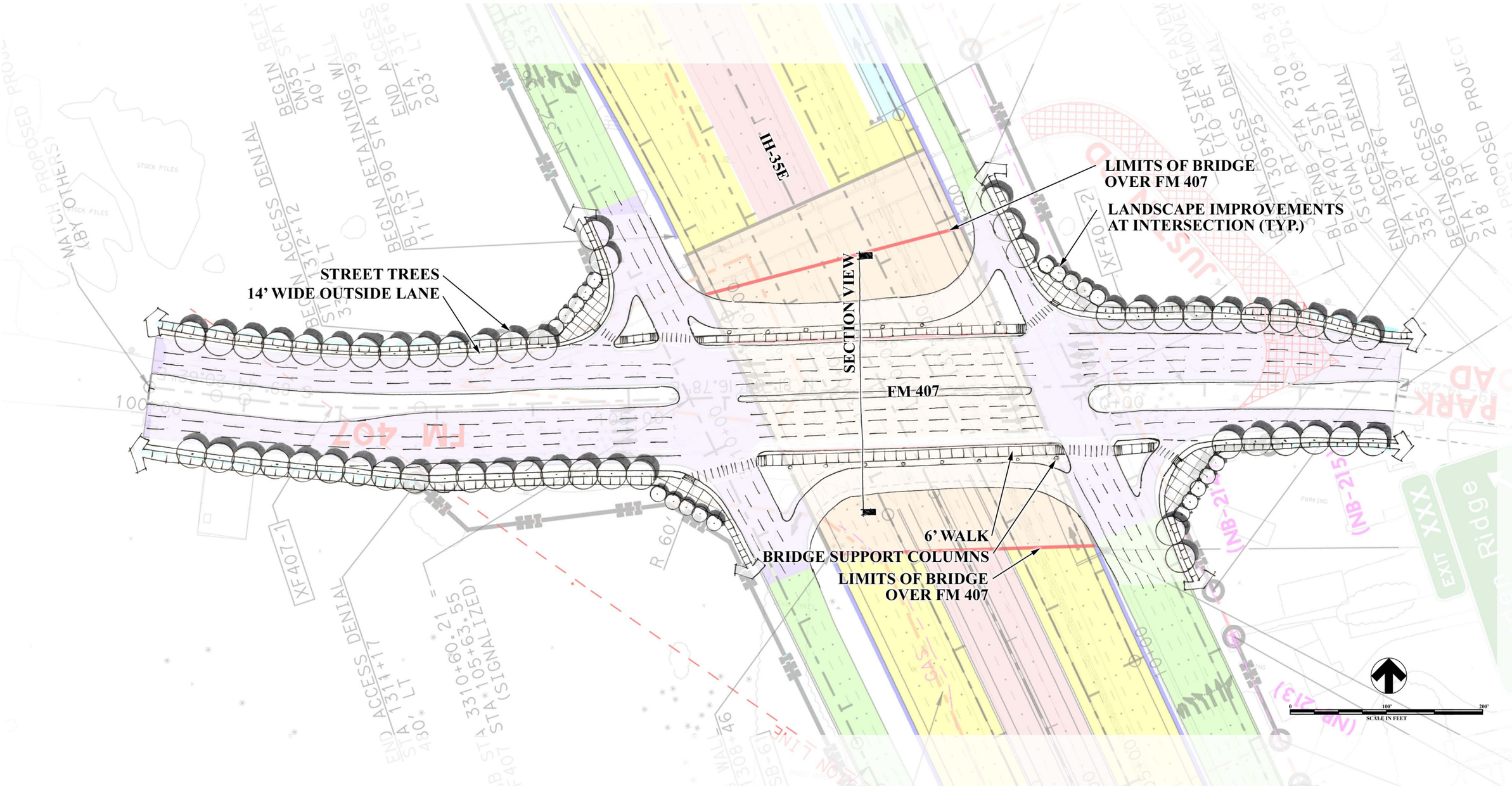


Figure A.21 – Proposed Plan View of FM 407 / Justin Road / Lake Park Road



8. Garden Ridge Boulevard

- XGARD STA 100+82.50 to 109+00 – Provide 14' wide outside lanes and 2' curb offsets as shown in Figure A.22 and existing schematics.
- XGARD STA 104+10 to 106+95 (Southern side of Garden Ridge Boulevard) – Modify underpass configuration to accommodate an enhanced sidewalk as follows:
  - Move southern columns 2' from centerline,
  - Provide a 6' wide sidewalk plus a 2' wide paved buffer between the sidewalk and through-lanes on the southern side of the street.
- XGARD STA 104+10 to 106+95 (Northern side of Garden Ridge Boulevard) – Modify underpass configuration to accommodate a 10' wide trail as follows:
  - Move northern columns 6' from centerline,
  - Widen median by 2',
  - Provide a 10' wide trail plus a 2' wide paved buffer between the trail and through-lanes on the northern side of the street,
  - Move northern U-TURN lanes and adjoining curb offsets 2' away from centerline to accommodate the resulting increased median width.

Figure A.22 – Planned Section of Garden Ridge Boulevard
(As per current TxDOT schematics)

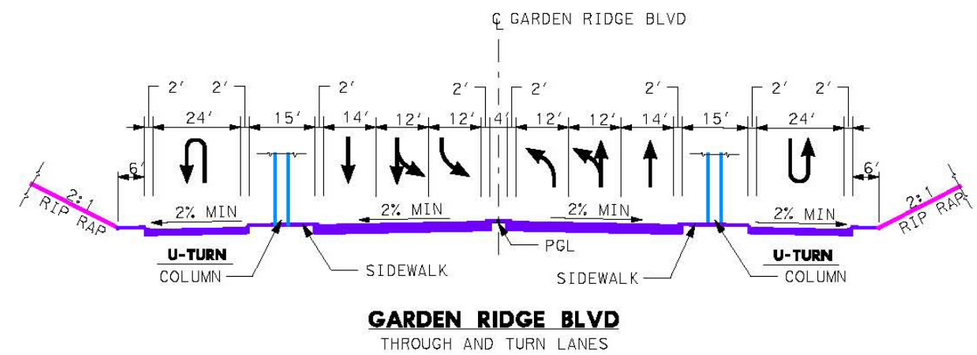


Figure A.23 – Proposed Section View of Garden Ridge Boulevard

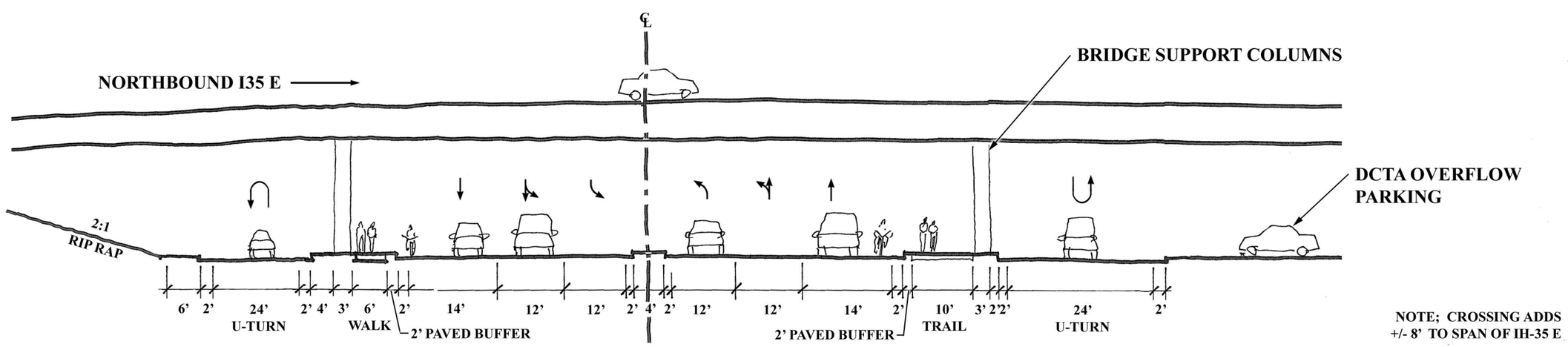
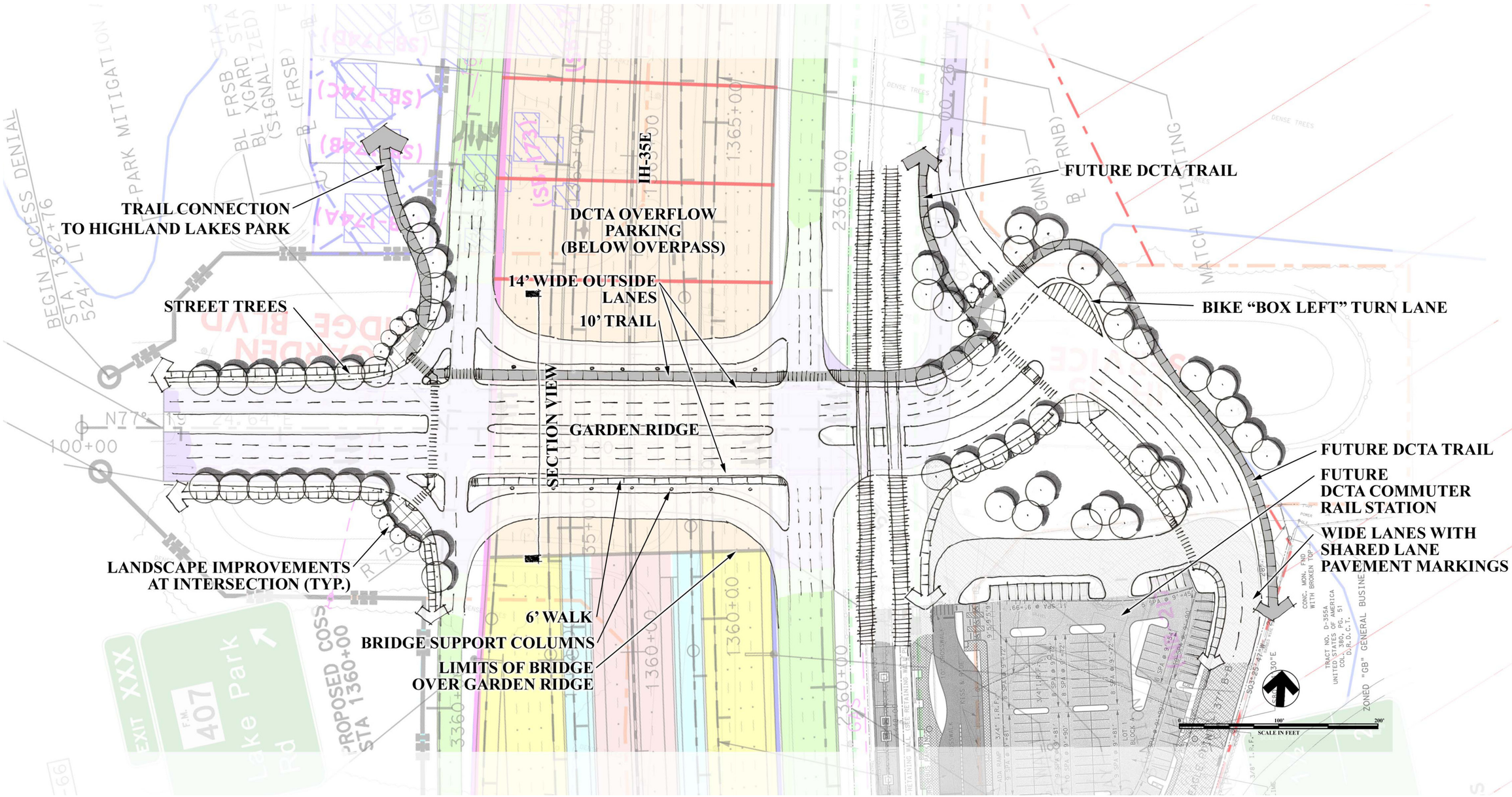


Figure A.24 – Proposed Plan View of Garden Ridge Boulevard

The grey highlight indicates major trail facilities; sidewalks are shown in white.



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