Dallas-Fort Worth Core Express Service

Alternatives Analysis Final Report

Prepared for:
Federal Railroad Administration

Prepared by:
Urban Engineers, Inc.

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List of Acronyms

ARRA	American Recovery and Reinvestment Act of 2009
BNSF	Burlington Northern Santa Fe Railway
DAL	Dallas Love Field
DART	Dallas Area Rapid Transit
DFW	Dallas – Fort Worth International Airport
DFX	Expanded Travel Demand Model
EIS	Environmental Impact Statement
FRA	Federal Railroad Administration
GDP	Gross Domestic Product
HSR	High Speed Rail
I	Interstate Highway
ITC	Fort Worth Intermodal Transportation Center
mph	Miles Per Hour
NCTCOG	North Central Texas Council of Governments
NEPA	National Environmental Policy Act
SAM	Texas Statewide Analysis Model
SH	State Highway
TCR	Texas Central High Speed Railway (Dallas to Houston High-Speed Rail Project)
TOPRS	Texas-Oklahoma Passenger Rail Study
T&P	Fort Worth Texas & Pacific Station
TRE	Trinity Railway Express
TxDOT	Texas Department of Transportation
UPRR	Union Pacific Railroad

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Executive Summary

Analysis Process, Purpose and Need

The Texas Department of Transportation (TxDOT), in coordination with the Federal Railroad Administration (FRA) and other stakeholders, initiated the preparation of a project-level (Tier 2) Environmental Impact Statement (EIS) pursuant to the National Environmental Policy Act (NEPA) (42 United States Code. § 4321 et seq.) and other federal, state and local laws, regulations, policies, and guidelines, for the Dallas – Fort Worth Core Express Service Project (Project). This alternatives analysis represents a key step in the NEPA process, progressing service-level findings from the Oklahoma City – South Texas Corridor Investment Plan (TOPRS) project described further in Section 1.2.1. TOPRS is examining opportunities for creating a connected and modern intercity passenger rail system for the State of Texas that will extend through Fort Worth from Oklahoma City, south to Laredo and the Rio Grande Valley, with a connection through Dallas that may be co-located with a high-speed rail service between Dallas and Houston. This project-level effort examines the service from Dallas to Fort Worth, connecting to the proposed TOPRS project.

The alternatives analysis process objectively defines those opportunities or alternatives that are anticipated for subsequent evaluation in the project-level EIS which will follow. Thus, the alternatives analysis serves as an evaluation tool that develops the information and technical analyses needed to inform decision-makers and the public on the costs, benefits and impacts associated with each alternative under consideration. This alternatives analysis synthesizes a great deal of information, far greater than a typical alternatives analysis, regarding the description of alternatives and their evaluation. This was done in order for the differences among the alternatives to be clearly understood and to inform the analysis of costs, benefits, and impacts; this information is intended for future use in the project-level EIS. The Project alternatives, including corridors, alignments and stations have been identified and shaped through extensive outreach and coordination with cooperating agencies, Project stakeholders and resource agencies, including the North Central Texas Council of Governments (NCTCOG), and the public.

TxDOT is the recipient of a $15 million grant under the American Recovery and Reinvestment Act of 2009. An amount of $8 million from that grant has been dedicated to conduct the project-level EIS. The FRA is the lead federal agency providing oversight and having responsibility for the final decision on the alternative(s) recommended for further development and is leading the preparation of the alternatives analysis in close coordination with TxDOT.

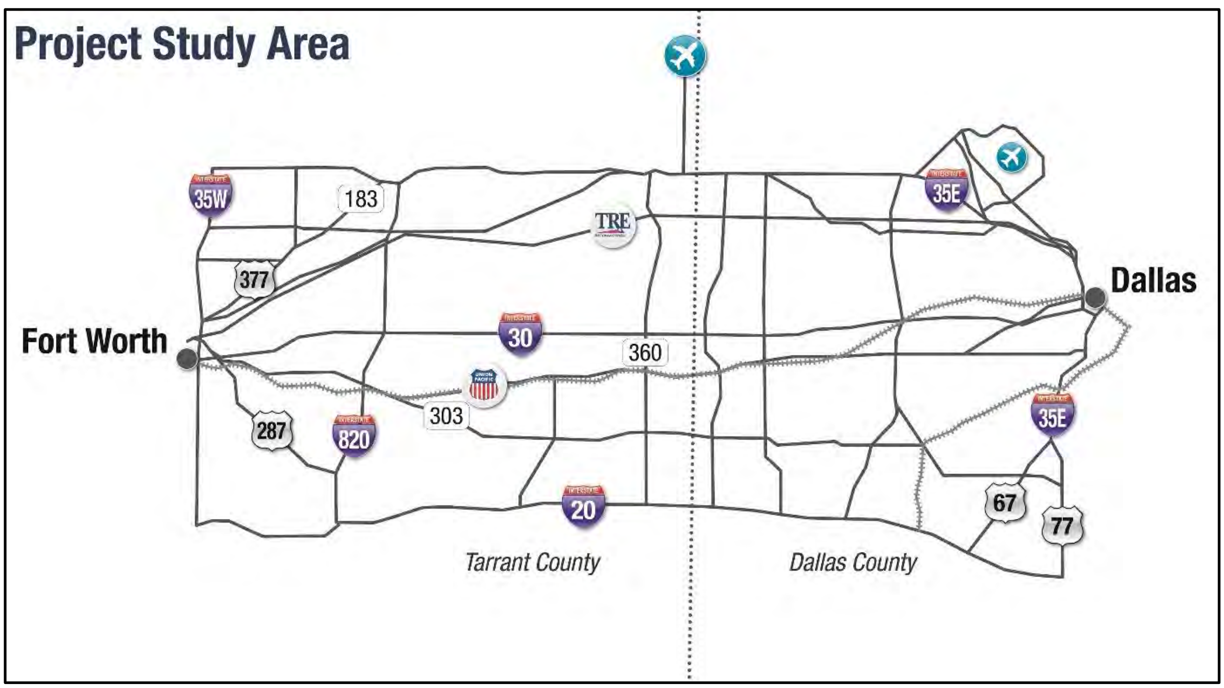
Project Background

The Project is a direct outcome of a number of key State and regional planning efforts. These efforts demonstrate the state's and region's goals to provide improved intercity travel time and efficient connections to other transportation providers with modern trainsets and facilities, and include:

- Texas Oklahoma Passenger Rail Study (TOPRS);
- Texas Rail Plans (2010, 2011, 2016);
- Adopted Regional Transportation Plan (Mobility 2040, March 2016); and
- Dallas to Houston High-Speed Rail Project (Texas Central Railway).

Project Study Area

Shown below is the Project's immediate study area, bounded to the east by the City of Dallas, and to the west by the City of Fort Worth, extending through both Dallas and Tarrant Counties. The Dallas - Fort Worth Metropolitan Statistical Area (MSA) is the official title assigned to the project area by the United States Office of Management and Budget and the project area falls completely within the MSA. The study area is also known as the Dallas – Fort Worth Metroplex, or the Metroplex. The Metroplex is rich in roadway infrastructure and is served by both freight and passenger operators.



Source: WSP/Parsons Brinckerhoff Inc. 2015

Project Purpose and Need – Problem Definition and Challenges

The Purpose and Need Statement prepared for the Project defined its need and established the fundamental framework for evaluating alternatives in order to inform decision-makers, stakeholders and the public in ultimately selecting a Preferred Alternative at the conclusion of the EIS.

The genesis for the Project reflects the robust growth of population and employment throughout the region, which has outgrown the existing transportation network. This has resulted in increased travel times for the movement of people and freight, decreased reliability and safety, and in some cases, reduced air quality. By the year 2040, the Dallas - Fort Worth region is forecast to grow from 6.3 million (2010) to 10.7 million residents, further taxing the existing transportation network. The Project presents an innovative opportunity for the State of Texas to implement the vision of an interconnected, multimodal, statewide and interstate transportation system.

Project Purpose

The overall purpose of the Project is to enhance inter- and intra-city mobility by providing a financially viable, safe, reliable and environmentally sustainable transportation alternative connecting Dallas and Fort Worth that could also provide a key link between existing and potential Texas high-performance passenger rail systems and other regional transit service.

Project Need

The overall need for the Project results from capacity constraints and lack of mobility alternatives in the existing passenger rail and roadway transportation systems, which fail to meet current and future needs. If nothing is done to remedy these issues, the region will continue to experience greater levels of traffic congestion and long trip times for travellers to, from and within the Dallas – Fort Worth Metroplex.

Alternatives Considered

A number of alternative corridors connecting Dallas and Fort Worth are considered in this alternatives analysis, in addition to the No Build Alternative, as described below.

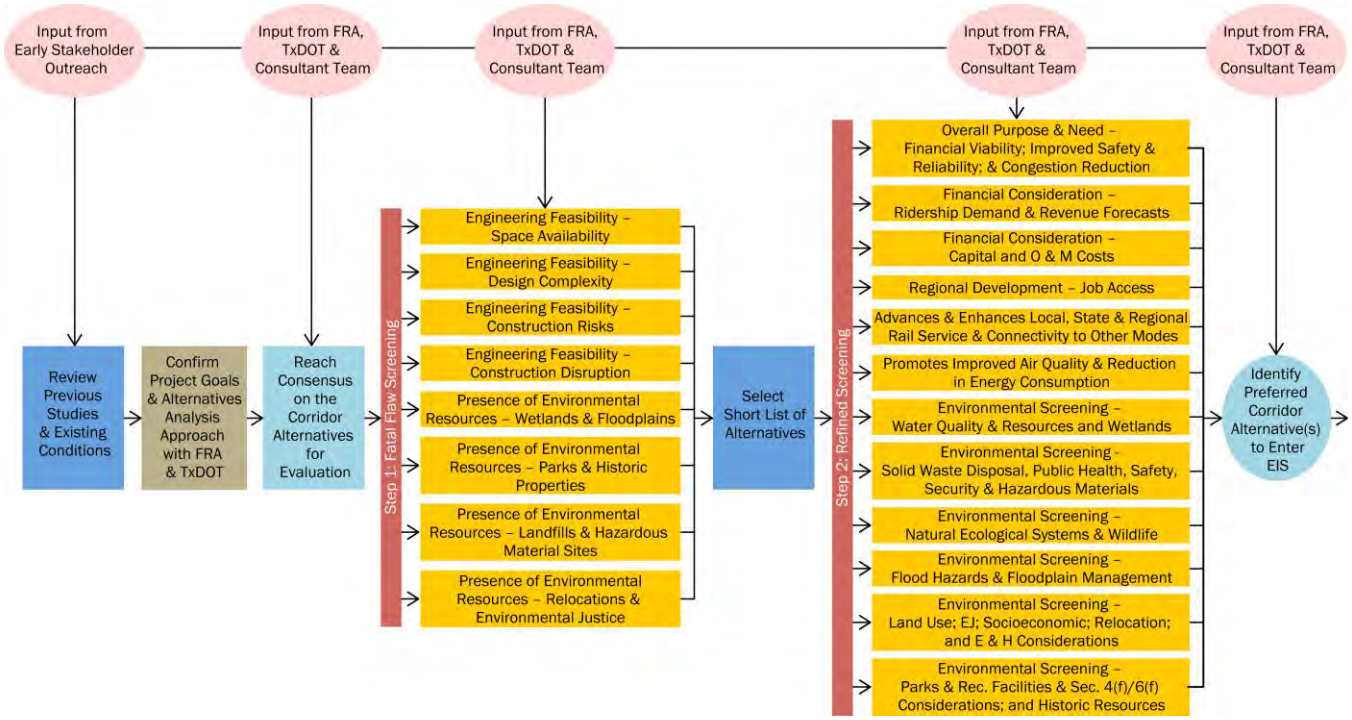
Study Corridors

The TOPRS identified three potential existing transportation corridors for implementing improved passenger service between Fort Worth and Dallas: Union Pacific (UP), I-30, and TRE (Study Corridors). The UP corridor was dropped from consideration after UP indicated it would not consider adding passenger trains in its corridor, potential serious environmental impacts were identified and the need for property acquisition was considered. The two remaining corridors, I-30 and TRE, as well as an alternative corridor consisting of a combination of the west end of the I-30 corridor and the east end of the TRE corridor connected by the state route 360 (SH360) corridor, are shown in the figure on the next page.

Within the three Study Corridors that were evaluated, there are various options for specific alignments associated with three operating speeds (90 mph, 125 mph and 220 mph), various land use and physical constraints, the potential for one or more intermediate stations between Fort Worth and Dallas, and options for entry to and from station locations in Fort Worth and Dallas; the detailed description of each of the three alternatives is provided in Chapter 3. In addition, a No Build Alternative was considered, assuming the implementation of all projects identified in the Metropolitan Transportation Plan, Mobility 2040, except for the Project (refer to Table 3-1). The No Build Alternative provides a baseline against which other alternatives will be compared in the EIS.

Screening Methodology and Results

The two-step screening process developed for the alternatives analysis includes the purpose and need criteria developed early in the study outreach efforts, the engineering feasibility criteria for the speed and alignment options within each Study Corridor and the environmental considerations identified in the alternatives analysis. This process is illustrated in the flow diagram below.



Step 1 provides the Project's fatal flaw review of the three initial Study Corridor alternatives, including an examination of the overall purpose and need, engineering feasibility and environmental considerations of the speed and alignment options. The engineering criteria include measures of alignment space, complexity and risk. Environmental considerations focus on the potential for significant impacts and/or require measurable mitigation efforts. Step 2 of the process examines the alternatives that passed the fatal flaw analysis from Step 1 and employs a greater degree of quantitative and qualitative analysis to measure their effectiveness in fulfilling the regional priorities for high speed rail service.

The presentation of results for the evaluation of alternatives used both qualitative and quantitative values, presented in a graphical format referred to as Consumer Reports' product review charts, or "Harvey Balls." This presentation format provides a clear structure to highlight the comparative benefits of alternatives for each evaluation measure, as shown below.

○	Little or no contribution
◔	0-25% are the first quadrant
◑	25-50% the half full quadrant
◕	50-75% the three quarters full
●	75-100% full circle

Summary of Evaluation Results and Recommendations

The results from the analysis of the three study corridors evaluated in the Step 1 Fatal Flaw Review show that the I-30 Corridor possesses considerable obstacles to implementation, including having the greatest engineering challenges, the highest design and construction complexity and construction risks, and the highest capital cost. For these reasons, the I-30 Corridor was dropped from further consideration and did not proceed into the Step 2 Refined Screening.

The evaluation results of the two alternatives (TRE and Hybrid corridors) that progressed from the Step 1 to Step 2 evaluation are summarized in Table ES-1 on the next page. Table ES-1 shows that both the TRE and Hybrid corridors are viable at the 90 mph and 125 mph operating scenarios. Operation in either corridor at 220 mph is not considered to be viable due to higher costs, corridor lengths and physical constraints and safety requirements for passenger equipment (rolling stock) that have not been issued by the FRA.

The Step 2 results show that the Hybrid Corridor performs slightly better, mainly due to higher ridership from the ability to serve the Arlington Station connection with TOPRS service and lower overall environmental impacts. However, the TRE Corridor offers the best financial viability, with the lower capital costs. It is therefore recommended that both corridors proceed into the EIS process. In addition to the traditional analysis of environmental impact areas included in the EIS process, there are a number of topics that will need future consideration, as discussed in Chapter 6.

Table ES-1: Summary Step 2 Evaluation Results

Identity	Objectives	Criterion	Measure	Quantity	Source	TRE 220	TRE 125E	TRE 125D	TRE 90D	Hybrid 220	Hybrid 125E	Hybrid 125D	Hybrid 90D
Overall Purpose	Financially viable, safe, reliable, and environmentally sustainable	Financial Viability, Safety and Reliability	Additional Funding Requirement	$ Subsidy	NCTCOG Mobility 2040 Plan	◕	◕	◕	●	◔	◔	◑	◕
Overall Need	Improve capacity constraints in transportation system	Reduce Congestion	Travel time increase due to congestion	Regional Travel Time	NCTCOG Mobility 2040 Plan	◑	◑	◑	◔	●	●	●	◕
Summary 1	Financial/ Economic Considerations	Ridership Demand	Average Daily Ridership	Trips	DFWCES	◑	◑	◑	◔	●	●	●	◕
Summary 2		Capital Cost	$ Capital Cost per Alignment Mile	$ Cap Cost/ Mile	DFWCES	◑	◑	◕	●	◔	◔	◑	◕
Summary 3		Operating Cost	$ Operating Cost per Annual Passenger	$ Ops Cost / Psgr	DFWCES	◑	◑	◑	◔	●	●	●	◕
Summary 4	Environmental Impacts	Screening Results	Viable Options	Potential Environmental Impacts	DFWCES	◑	◑	◑	◑	◕	◕	◕	◕
Summary 5	Engineering Feasibility	Integration within infrastructure	Impact on Infrastructure	$ Construction Planned	DFWCES	◔	◔	◑	◑	◑	◑	◕	◕
Summary 6	Development Facilitation	Improved Accessibility	Jobs accessibility	Jobs in 30 Minutes	DFWCES	◑	◑	◑	◑	◕	◕	◕	◕

Notes to table: "DFWCES" refers to the alternatives analysis study team evaluation results. "D" refers to diesel locomotive power. "E" refers to electric locomotive power.

DRAFT
Dallas – Fort Worth New Core Express
Alternatives Analysis Report

1.0 Introduction

1.1 Overview of Alternatives Analysis Process

The Texas Department of Transportation (TxDOT), in coordination with the Federal Railroad Administration (FRA) and other stakeholders, initiated the preparation of a project level (Tier 2) Environmental Impact Statement (EIS) pursuant to the National Environmental Policy Act (NEPA) (42 United States Code. § 4321 et seq.) and other federal, state and local laws, regulations, policies, and guidelines, for the Dallas – Fort Worth Core Express Service Project (Project). This alternatives analysis represents a key step in the NEPA process, progressing service-level findings from the Oklahoma City – South Texas Corridor Investment Plan (TOPRS) project described further in Section 1.2.1. TOPRS examines opportunities for creating a connected and modern intercity passenger rail system for the State of Texas that will extend through Fort Worth from Oklahoma City, south to Laredo and the Rio Grande Valley, with a connection through Dallas that may be co-located with a high-speed rail service between Dallas and Houston. This project-level effort examines the service from Dallas to Fort Worth, connecting to the proposed TOPRS project.

The alternatives analysis process objectively defines those opportunities or alternatives that are anticipated for subsequent evaluation in the project-level EIS which will follow. Thus, the alternatives analysis serves as an evaluation tool that develops the information and technical analyses needed to inform decision-makers and the public on the costs, benefits and impacts associated with each alternative under consideration. This alternatives analysis synthesizes a great deal of information, far greater than a typical alternatives analysis, regarding the description of alternatives and their evaluation; this information is intended for future use in the project-level EIS. This was done in order for the differences among the alternatives to be clearly understood and to inform the analysis of costs, benefits, and impacts. The document focuses on NEPA's intent to ensure that environmental factors are considered equally when compared to other factors (i.e., capital costs, development benefits, etc.) and that this consideration is applied equally and uniformly across all alternatives under consideration.

The identification of the Project alternatives, including corridors, alignments and stations have been shaped through outreach and coordination with cooperating agencies, project stakeholders and resource agencies, including the North Central Texas Council of Governments (NCTCOG), and the public. This is documented in the Project's Scoping Summary Report (June 2015) and the definition of the Project's Purpose and Need (Appendix A). They have also been shaped by other studies and regional and state-wide priorities and initiatives, discussed further, below.

TxDOT is the recipient of a $15 million grant under the American Recovery and Reinvestment Act of 2009 (ARRA) to conduct this work. An amount of $8 million from this grant has been dedicated to conduct the project-level EIS. The FRA is the lead federal agency providing oversight and having responsibility for the final decision on the alternative(s) recommended for further development and is leading the preparation of the alternatives analysis in close coordination with TxDOT.

1.2 Project Background

The Project is a direct outcome of a number of key State and regional planning efforts described below. These efforts demonstrate the State's and region's goals to provide improved intercity travel time and efficient connections to other transportation providers with modern trainsets and facilities.

1.2.1 Texas Oklahoma Passenger Rail Study (TOPRS)

As previously noted, TOPRS is the effort that has influenced the Project most directly since it identified corridor alternatives between Dallas and Fort Worth, as well as potential station locations. FRA, in coordination with TxDOT, issued the Record of Decision (ROD) for the TOPRS service-level (Tier 1) EIS, studying new and/or higher-speed intercity passenger rail services along an 850-mile corridor extending from Oklahoma City to the Fort Worth area (with the connecting corridor to Dallas) and further south to Laredo and the Rio Grande Valley. In addition to the service-level EIS, TOPRS includes a service development plan for the overall length of the corridor to guide further development and capital investment in passenger rail improvements. The EIS identifies the service type of passenger rail service within the overall length of the corridor including higher speed rail service (speeds of 125+ miles per hour [mph] or higher) between Fort Worth and Laredo and the Rio Grande Valley and traditional intercity passenger rail service (speeds of 90 mph or lower) between Oklahoma City and Fort Worth.

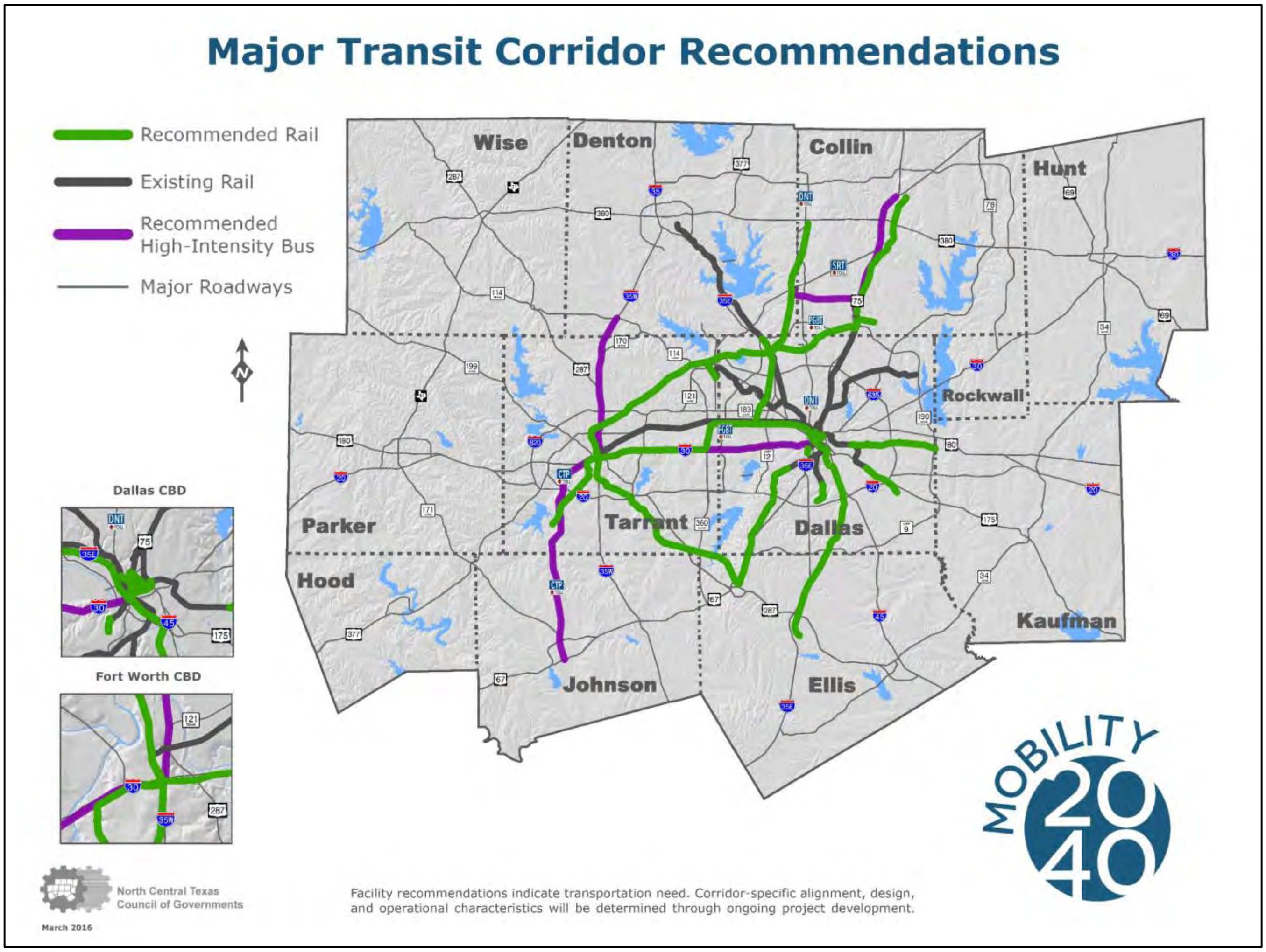
1.2.2 Texas Rail Plans

In 2016, TxDOT published the Texas Rail Plan, which establishes the vision, goals, and objectives for the passenger and freight rail system in the state (TxDOT 2010). The Plan envisions "cost-effective, energy-efficient, sustainable personal mobility and goods movement that connects Texas communities and links Texas businesses with domestic and international markets, minimizing environmental impacts, reducing road congestion, improving air quality, and promoting economic growth" (TxDOT 2010). In 2011, TxDOT published the Statewide Long-Range Transportation Plan, which emphasizes delivering a modern, interconnected, and multimodal transportation system in the state.

1.2.3 Adopted Regional Transportation Plan

The North Central Texas Council of Governments (NCTCOG), the metropolitan planning organization for the Dallas-Fort Worth Region, adopted its long-range regional transportation plan (Mobility 2040) in March 2016. The development of Mobility 2040 reflects detailed analysis and extensive coordination conducted by NCTCOG, and includes both freight and passenger transportation improvements. More specifically, the plan identifies the major transit corridor projects identified for the region, as shown on Figure 1-1 below. Germaine to this alternatives analysis, Mobility 2040 identifies a potential high-speed rail line connecting Dallas and Fort Worth, though the plan does not specify an exact route.

Figure 1-1: Mobility 2040 Major Transit Corridor Projects

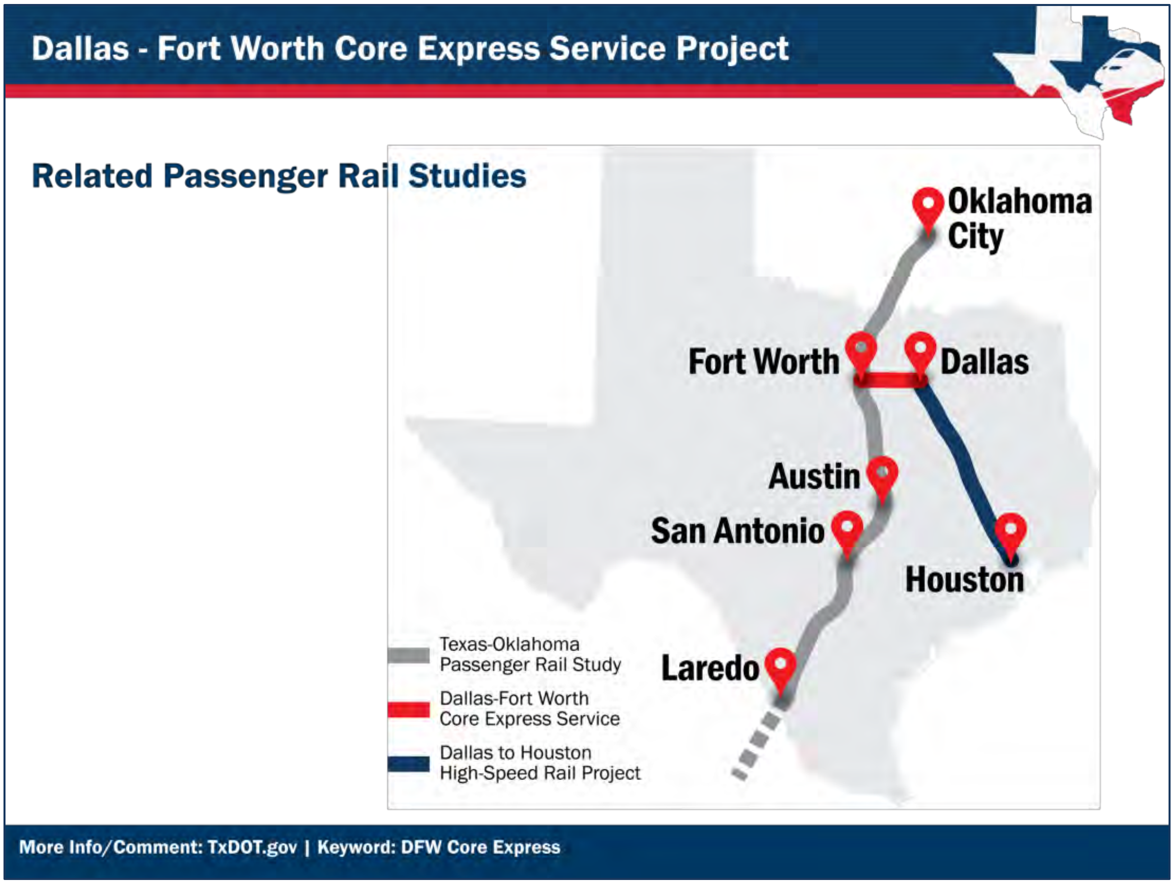


1.2.4 Dallas to Houston High-Speed Rail Project

FRA initiated a NEPA evaluation of the proposal by a private enterprise, the Texas Central Railway (TCR) to construct and operate a private, for profit, high-speed passenger rail system connecting Dallas and Houston with dedicated alignment and stations, thus providing the ability to coordinate service in a potential shared Dallas terminus of the Project. TCR proposes to use Japanese N700-1 Tokaido Shinkansen high-speed rail technology along the approximately 240-mile long corridor between the two cities. TCR's proposed high-speed rail system requires a fully sealed corridor with grade separated crossings and dedicated right-of-way that is approximately 125-feet wide in order to accommodate a two-track railroad and an access road. It requires a "closed system," meaning that the train must run on dedicated, high-speed rail tracks for passenger rail service only and cannot travel on existing or planned freight rail lines or share tracks with any other passenger rail service.

In summary, Figure 1-2 below shows a map that identifies the related passenger rail studies that influenced the Project and were discussed above.

Figure 1-2: Related Passenger Rail Studies



Source: WSP/Parsons Brinckerhoff 2015

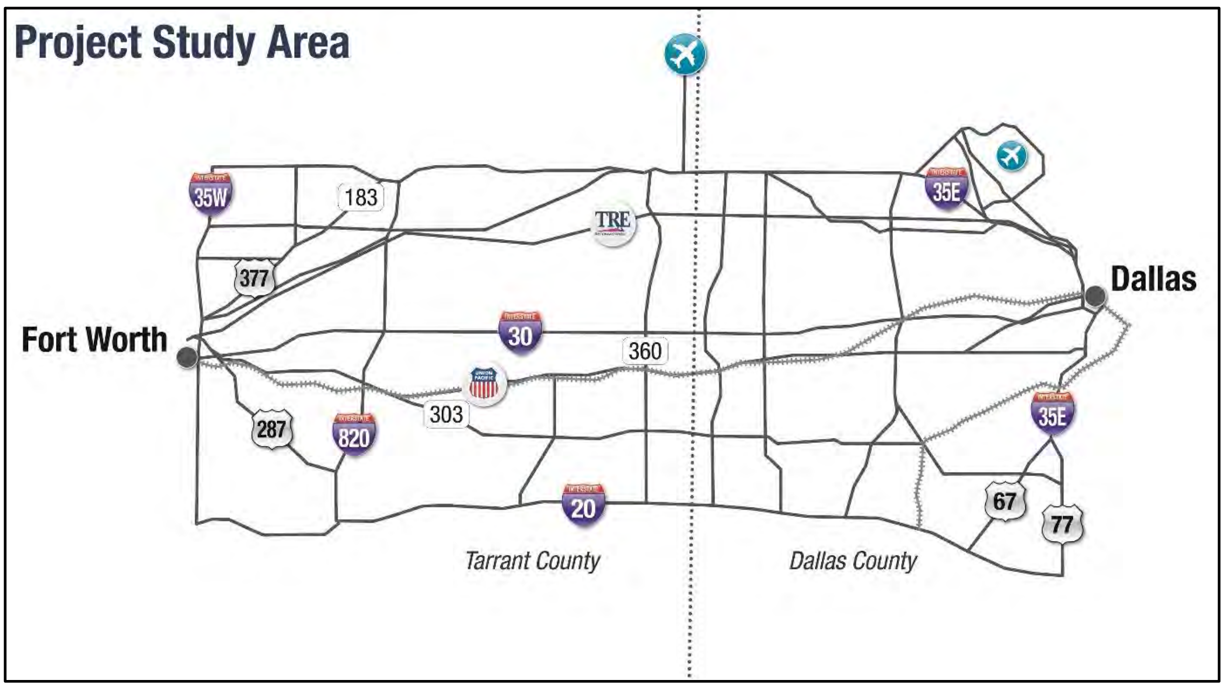
1.3 Project Study Area

Figure 1-3 illustrates the Project's immediate study area, bounded to the east by the City of Dallas, and to the west by the City of Fort Worth, extending through both Dallas and Tarrant Counties. The Dallas - Fort Worth Metropolitan Statistical Area (MSA) is the official title assigned to the project area by the United States Office of Management and Budget, and the project area falls completely within the MSA. The study area is also known as the Dallas – Fort Worth Metroplex, or the Metroplex, which also serves as an economic and cultural hub. However, as noted in Sections 1.2.1 and 1.2.4, the provision of passenger rail service through the study area extends well beyond its immediate borders to Oklahoma City to the north and to Laredo and points south; the proposed

TCR service to the study area would also provide a connection to Houston. Thus, the study area's geographic location serves as an important connection to a much broader passenger rail network envisioned for the State of Texas and beyond.

The study area is rich in roadway infrastructure, served by Interstate roadways, as well as a number of state highways. TxDOT is currently or has planned to invest significant resources to improve and expand the roadway network, including major interchanges in the City of Dallas. The Project study area is also presently served by both freight and passenger rail operators. The Class 1 freight operators include the BNSF Railway and the Union Pacific Railroad (UP). The Trinity Railway Express (TRE) provides daily commuter rail service in the study area, serving both Dallas and Fort Worth and connecting to 10 local stations. The Dallas Union Station is also served by Amtrak's Texas Eagle trains.

Figure 1-3: Project Study Area



Source: WSP/Parsons Brinckerhoff Inc. 2015

2.0 Project Purpose and Need – Problem Definition and Challenges

2.1 Overview

The Purpose and Need Statement prepared for the Project established the fundamental framework for evaluating alternatives in order to inform decision-makers, stakeholders and the public in ultimately selecting a Preferred Alternative at the conclusion of the EIS.

The genesis for the Project reflects the robust growth of population and employment throughout the Dallas – Fort Worth Metroplex, which has outgrown the existing transportation network. This has resulted in increased travel times for the movement of people and freight, decreased reliability and safety, and reduced air quality. Furthermore, recently constructed and planned roadway and transit improvements may be insufficient to meet current and projected demand. In addition, other planned high speed rail service(s) will further impact the transportation system, and will require enhanced regional connectivity to fully leverage the multi-billion dollar investments.

By the year 2040, the Dallas – Fort Worth region is forecast to grow from approximately 7 million (2016) to 10.7 million residents, an increase of more than 65 percent. This continued rapid growth will further increase traffic congestion and may impact air quality, depending on the pollutant. A high speed, reliable passenger transportation option is needed that will both improve local mobility and provide connections to alternative modes for traveling between major cities in Texas and surrounding states. The Project presents an innovative opportunity for the State of Texas to implement the vision of an interconnected, multimodal, statewide and interstate transportation system.

2.2 Project Purpose

As stated in the August 2015 Project Purpose and Need, the TOPRS EIS defined the purpose of the Project as introducing a new, limited service transportation option in the Metroplex. The Project will increase intercity mobility to, from, and within the Metroplex by providing enhanced passenger rail service as a transportation option that is competitive with automobile, bus, and other travel modes. The Metroplex is an integral part of the larger Northern and Central Sections evaluated in the TOPRS EIS. The connection to other high- performance intercity passenger rail services in Texas, as well as regional transit service is critical to facilitate improved travel to, from, and within the Metroplex.

Building upon the TOPRS program rationale, the purpose of the Project is to enhance inter- and intra-city mobility by providing a financially viable, safe, reliable and environmentally sustainable transportation alternative connecting Dallas and Fort Worth that could also provide a key link between existing and potential Texas high-performance passenger rail systems and other regional transit service. The overall Project purpose can be more specifically defined to:

- P-1 Advance the local, state and regional high-performance rail network in accordance with the State Rail Plan described in Section 1.2.2;

- P-2 Enhance connectivity to existing and planned passenger rail services, airports, roadways, bicycle and pedestrian facilities, and be competitive with private automobile and air travel;
- P-3 Promote improved air quality and reduced energy consumption; coordinate with and do not negatively affect freight rail operations or facilities; and
- P-4 Augment economic development opportunities and enhance environmental sustainability, while facilitating regional land use and transit-oriented development plans, within the Metroplex by providing improved access to employment, entertainment, recreation, health and shopping opportunities for existing and future residents and visitors in the study area.

2.3 Project Need

The need for the Project results from capacity constraints in the existing transportation system. If nothing is done to address these constraints, the region will experience greater levels of traffic congestion and travelers to and from the Metroplex will continue to have limited mobility options. Expected growth in both population and economic development opportunities will further strain the congested transportation system.

2.3.1 Population and Economy

The Dallas-Fort Worth Metroplex is one of the fastest growing urban areas within the state. The Metroplex has continued to sustain an unprecedented level of population and economic growth as a result of factors such as a favorable business climate, attractive tax policies and an abundance of available land (TxDOT 2014). In 2016, the Metroplex had a population of approximately 7 million. As noted above, by the year 2040, NCTCOG forecasts that the Metroplex will grow to 10.7 million residents, an increase of almost 4 million people. This growth represents a 53 percent increase in the population of North Central Texas. The Metroplex is the second fastest growing area in the US (behind Houston). The Metroplex is also the most populous area in the State and the 4th most populous in the US. Growth trends are forecast to continue through 2040.

According to the NCTCOG, "The transportation system is central to this growth because it allows for the efficient movement of people and goods. Understanding not only population but also employment growth is critical to the transportation planning process and to providing the best system to move people to and from jobs."

North Central Texas is responsible for 30 percent of the State's Gross Domestic Product (GDP), is home to 18 Fortune 500 companies, and is the 12th largest metropolitan economy in the world. According to the Dallas Chamber of Commerce, the Metroplex is the Number 1 visitor and leisure destination in the State of Texas, attracting over 44 million visitors annually. Activity centers/employment areas are seeing strong employment demand, including downtown Dallas, the Southwestern Medical District, Stemmons Corridor, Las Colinas, Galleria/Tollway Corridor, DFW Airport, the Telecom Corridor and Legacy. Additionally, NCTCOG is projecting continued high employment growth in the Beach Street, North Richland Hills-Iron Horse, North Richland Hills-Smithfield, and Summer Creek areas (TEX Rail 2014). The dispersal of employment and entertainment centers results in complex travel patterns in the Metroplex that affect residents, business travelers and tourists.

In addition to being the Number 1 visitor and leisure destination in the State, the Metroplex is a major economic, social and political center which supports a diverse economy. Jobs within the Metroplex are projected to increase 46 percent from 4,584,235 in 2017 to 6,691,459 in 2040. According to NCTCOG's 2040 Demographic forecasts, the highest increase in the number of jobs is projected to occur in Dallas County at 1,312,672, a growth rate of 70 percent. Dallas County is followed by Tarrant County, which is expected to have 702,772 additional jobs or a 68 percent increase.

An increase in freight volumes also contributes to rising congestion on the transportation system within the Metroplex and statewide. According to the Texas Transportation Plan 2040, Texas truck tonnage is expected to increase by 78% between 2011 and 2040. Furthermore, the Texas Freight Mobility Plan notes that between 2014 and 2040, total freight tonnage (truck and rail) moved in Texas is projected to increase by 88%. Both congestion and the intensity of freight movement affect travel times and safety to, from and within the Metroplex.

2.3.2 Traffic Congestion

The Metroplex has the second largest number of freeway miles per capita in the nation, behind only the Kansas City Metropolitan area. Yet, due primarily to the enormous growth of area suburbs, the region experiences an ever-increasing problem with traffic congestion. The adopted Metropolitan Transportation Plan for North Texas, Mobility 2040 Plan notes that the Metroplex's population is expected to grow by more than 50 percent in size over the next 25 years, and that the region faces a tremendous challenge to provide a roadway system that meets the future needs and travel demands of its residents.

Daily commuting patterns have historically been characterized by suburb-to-central business district trips, with the average commute in the Dallas – Fort Worth area being 20 miles. Recently however, daily trip patterns have become increasingly more complex. The growth of employment centers outside of the central cities—the Alliance area for example—has become more common and has led to increased congestion along multiple travel corridors. This situation is further complicated by pass-through traffic using the Metroplex's interstate highway system.

The demand for truck freight services in the region has created additional congestion problems on the roadway network. Vehicular mobility is also reduced at highway-rail grade crossings that experience long blockage times as a result of increasing train frequencies and lengths, and congestion-induced reduction in train speeds. The total vehicle delay in the Study Area described in Section 1.3 is projected to significantly increase by 2040. The Federal Highway Administration defines Vehicle Delay as the time difference between ideal travel time and actual travel time.

2.3.3 *Air Quality*

Dallas and Tarrant counties do not currently meet the federal air quality standard for ozone. Under the most recent Environmental Protection Agency (EPA) Ozone Standard, ten of the twelve Metroplex counties are classified as moderate nonattainment for the 2008 8-hour ozone standard (0.070 parts per million (ppm) averaged over 8 hours). In addition, vehicle miles traveled are expected to increase from 206 million miles annually in 2017 to 320 million miles annually by 2040. As congestion levels rise, air quality in the region can decline, although there have been recent improvements to air quality in the Metroplex. Meeting regional air quality standards should be considered while continuing to secure future federal highway funding, as well as in promoting future economic growth.

Thus, the needs and corresponding issues to be addressed by the Project include:

- N-1 Planning for rapid population and economic growth between now and 2040 that will generate increased travel demand, additional congestion and reduce automobile and public transportation reliability;
- N-2 Enhancing transportation connectivity to, from and within the Metroplex;
- N-3 Facing access constraints to the DFW Airport and other major activity centers.; and
- N-4 Continuing to improve air quality within the Metroplex while also mitigating the effects that increased truck and rail freight traffic have on the transportation system.

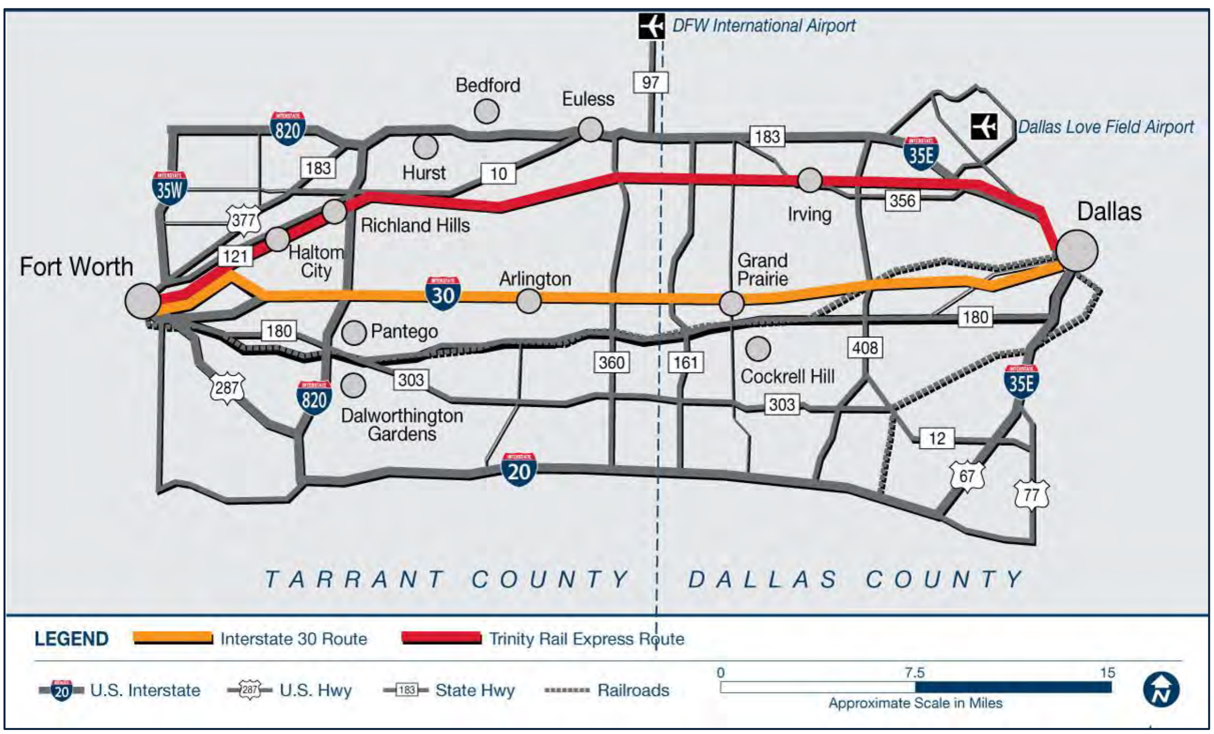
3.0 Definition of Alternatives

This section defines the key physical characteristics, service attributes and operating plans for the alternative corridors connecting Dallas and Fort Worth considered in TOPRS (I-30 and Trinity Railway Express (TRE)) and the combination I-30/SH 360/TRE (Hybrid) Corridor, in addition to the No Build Alternative. Detailed descriptions of each of the three corridors, their attributes and travel demand are provided below.

3.1 Study Corridors

The TOPRS identified three potential existing transportation corridors for implementing improved passenger service between Fort Worth and Dallas: Union Pacific (UP), I-30, and TRE. The UP corridor was dropped from consideration early in the alternatives analysis after UP indicated it would not consider adding passenger trains in its corridor, potential serious environmental impacts were identified and the need for property acquisition was considered. The two remaining corridors, I-30 and TRE are shown in Figure 3-1 below.

Figure 3-1: Potential Corridors Defined in TOPRS Study



Source: WSP/Parsons Brinckerhoff 2015

As a result of the Project's ongoing public outreach and stakeholder and agency coordination, an alternative corridor consisting of a combination of the west end of the I-30 Corridor, the east end of the TRE Corridor, and the State Route 360 (SH360) corridor connecting the approximate midpoints was added for consideration. These three corridors are the subject of this alternatives analysis, and are shown in Figure 3-2.

Figure 3-2: Corridors Considered in Alternatives Analysis

Within the three study corridors (I-30, TRE and I-30/SH 360/TRE (Hybrid)) there are various options for specific alignments associated with the maximum operating speeds, various land use and physical constraints, the potential for one or more intermediate stations between Fort Worth and Dallas, and options for entry to and from station locations in Fort Worth and Dallas. In the TRE corridor, sharing of TRE track could only be an option for the lower speed service alternatives.

As described in Chapter 4, an initial "fatal flaw" screening has been applied to each of the corridors to identify obstacles or constraints that would prevent an alternative from serving the Project's purpose and need, or would entail extraordinary, impractical and/or unacceptable measures, impacts, and costs to overcome. Following the initial screening, subsequent levels of more detailed analysis have been applied to a short list of alternatives. The analysis also includes a No Build Alternative throughout the evaluation as a baseline for comparison of the build alternatives. Under the No Build Alternative, high-performance intercity passenger rail service between Dallas and Fort Worth would not be constructed or implemented.

3.1.1 No Build Alternative

The No Build Alternative assumes the implementation of all projects in the Metropolitan Transportation Plan, Mobility 2040, except for the Project. The No Build Alternative provides a baseline against which other alternatives will be compared in the EIS. It assumes implementation of infrastructure, transit facilities and passenger rail projects identified on the following table, with the exception of the Project, which is identified as project Number 20, the West/East Line.

Table 3-1: Transit Project Listings – NCTCOG Draft Mobility 2040 Plan

Corridor ID	Corridor	From	To	Estimated Length (miles)	Region	Agency	Mode	Status	Conformity Range	Recommendation	Project Type	Segment ID	Capital Cost ($M) (YOE)
1	Blue Line – UNT Extension	Ledbetter	UNT South Campus	3	East	DART	Light Rail	Under Construction	Present - 2017	DART 2030 System Plan	Extension of Line	TR1- 10303.2	$266
2	Cotton Belt	DFWIA Terminal A/B	Shiloh	28	East	DART	Regional Rail	Programmed	2018 - 2027	DART 2030 System Plan	New Corridor	TR1- 10314.0	$2,900
3	Downtown Dallas 2nd Alignment (D2)	Victory Station	Deep Ellum	2.4	East	DART	Light Rail	Programmed	2018 - 2027	DART	New Corridor	TR1- 10333.0	$650
3	Downtown Dallas 2nd Alignment (D2) - Convention Center Extension	Metro Center Station	Dallas Convention Center	0.5	East	DART	Light Rail	Future	2018 - 2027	DART	New Corridor	TR1- 10333.1	$349
4	Dallas Streetcar (Central Link)	Urban Circulator/McKinney Avenue Trolley	Union Station	1.5	East	East-Other	Streetcar	Programmed	2018 - 2027	DART	New Corridor	TR1- 10351.2	$92
4	Dallas Streetcar	Oak Cliff	Bishop Arts	1	East	East-Other	Streetcar	Under Construction	Present - 2017	City of Dallas	New Corridor	TR1- 10351.1	$26
5	A-train	Trinity Mills	Belt Line (Carrollton)	2	East	DCTA	Regional Rail	Future	2028 - 2037	DCTA	Extension of Line	TR1- 10306.2	$96
6	Frisco Line	South Irving Transit Center	Frisco	29	East	East-Other	Regional Rail	Future	2028 - 2037	RRCS	New Corridor	TR1- 10318.0	$1,392
7	Mansfield Line	Midlothian	Fort Worth ITC	30	West	West-Other	Regional Rail	Future	2028 - 2037	NCTCOG	New Corridor	TR1- 10328.0	$1,440
8	McKinney Line	Parker Road Station (Plano)	McKinney North	18	East	East-Other	Regional Rail	Future	2028 - 2037	RRCS	New Corridor	TR1- 10300.2	$864
9	Midlothian Line	Westmoreland	Midlothian Central	18	East	East-Other	Regional Rail	Future	2028 - 2037	RRCS	New Corridor	TR1- 10336.0	$864
10	Green Line – Southeast Extension	Buckner Blvd.	South Belt Line Road	6	East	East-Other	Regional Rail	Future	2028 - 2037	NCTCOG	Extension of Line	TR1- 10302.2	$288
11	TEX Rail	T&P Terminal	DFWIA Terminal A/B	27	West	FWTA	Regional Rail	Programmed	2018 - 2027	FWTA	New Corridor	TR1- 10315.1	$996
12	Southwest TEX Rail	Sycamore School Road/McPhearson	T&P Terminal	11	West	FWTA	Regional Rail	Future	2028 - 2037	FWTA	Extension of Line		$528

Corridor ID	Corridor	From	To	Estimated Length (miles)	Region	Agency	Mode	Status	Conformity Range	Recommendation	Project Type	Segment ID	Capital Cost ($M) (YOE)
13	Scyene Line	Lawnview	Masters	4	East	East-Other	Regional Rail	Future	2028 - 2037	NCTCOG	New Corridor	TR1- 10345.1	$192
13	Scyene Line	Masters	Lawson Road	8	East	East-Other	Regional Rail	Future	2028 - 2037	NCTCOG	New Corridor	TR1- 10345.2	$384
14	Waxahachie Line	Downtown Dallas	City of Waxahachie	31	East	East-Other	Regional Rail	Future	2028 - 2037	RRCS	New Corridor	TR1- 10335.0	$1,488
15	IH 35W Express	T&P Terminal	TX 114	21	West	West-Other	High- Intensity Bus	Future	2018 -2027	NCTCOG	New Corridor		$10
16	Chisholm Trail Express	Fort Worth ITC	Cleburne Amtrak Station	33	West	West-Other	High- Intensity Bus	Future	2018 -2027	NCTCOG	New Corridor		$18
17	US 75 Express	Parker Road Station (Plano)	North McKinney	13	East	East-Other	High- Intensity Bus	Future	2018 - 2027	NCTCOG	New Corridor		$10
18	IH 30 Express East	Managed Lane Western Terminus	Downtown Dallas East Transfer Center	21	West/East	Other	High- Intensity Bus	Programmed	Present - 2017	NCTCOG	New Corridor		$11
19	Spring Creek Parkway Express	Sam Rayburn Tollway	US 75	15	East	East-Other	High- Intensity Bus	Future	2018 - 2027	NCTCOG	New Corridor		$16
20	West/East Line*	Downtown Fort Worth	Downtown Dallas	32	West/East	Other	High-Speed Rail	Future	2018 – 2027	FRA/TxDOT	New Corridor		$2,900

Source: Draft Appendix E: Mobility Options, The Metropolitan Transportation Plan for North Texas, Mobility 2040, NCTCOG, http://www.nctcog.org/trans/mtp/2040/documents/EMobilityOptions.pdf

*Project 20, West/East Line is the Dallas – Fort Worth Core Express Service; it is excluded from the No-Build Alternative.

3.2 Build Alternatives

This section describes the conceptual alignments that were identified within each of the three corridors, shown in Figure 3-2. These descriptions represent concept-level engineering and field verification that has been performed. The descriptions present substantial detail in excess of what is typically included in an alternatives analysis. This was done in order for the differences among the alternatives to be clearly understood and to inform the analysis of costs, benefits, and impacts. As noted, each alignment is based on engineering factors and reducing or eliminating impacts to existing land uses, and includes curves with noted speed limitations. Where speed limitations are not noted, the alignment is suitable to accommodate maximum speeds up to 220 mph. However, the defined maximum speeds for the various alternatives of 90 mph, 125mph, and 220 mph are nominal. The actual maximum speeds that would be reached for each of those alternatives may be limited by the capabilities of the defined rolling stock for each maximum speed category operating within the limitations posed by the noted speed restricted curves of the selected alignment and station stops.

Although the FRA permits highway grade crossings with specified protections up to 125 mph, the TxDOT administration has established safety parameters and long range planning goals to avoid highway grade crossings where train speeds exceed 79 mph. In addition, the introduction of new grade crossings with frequent train movements at less than 79 mph will introduce traffic impacts and safety concerns, with the potential for accidents and service disruptions. Thus the conceptual alignment assumes full grade separation for the 125 mph and 220 mph alternatives, including in areas of speed-restricted curves, but does include some grade crossings for the 90 mph alternative in segments where an at-grade alignment was selected for 90 mph to reduce capital costs.

The figures in the following alignment descriptions are derived from the graphics that were initially prepared by the firms of HNTB and WSP/Parsons Brinckerhoff Inc., and subsequently modified by the FRA's Monitoring and Technical Assistance Contractor (MTAC), Urban Engineers, Inc.

3.2.1 The I-30 Corridor

The I-30 corridor runs for approximately 30 miles between Fort Worth and Dallas, and is a primary route for commuters and interstate travellers between these two metropolitan areas. Daily traffic levels average between 122,000 and 130,000 vehicles. The corridor runs through a heavily urbanized area with dense development adjacent to the existing interstate right-of-way, severely limiting further expansion of the highway and necessitating the use of multi-level interchanges to provide capacity and access.

TXDOT has invested more than $1 billion in recent improvements to I-30, nearly all of it (approximately $919 million) east of SH 360 between Arlington and Dallas. The Fort Worth District of TXDOT is in the early planning stages of developing projects to improve travel conditions in the western portion of the corridor between Fort Worth and Arlington, allowing opportunity for coordination with design of a new rail line in that portion of the corridor.

Construction investments scheduled or completed between Arlington and Dallas include three major interchanges with I-30:

- SH 360
- SH 161 (President George Bush Turnpike)
- I-35E (located in the City of Dallas)

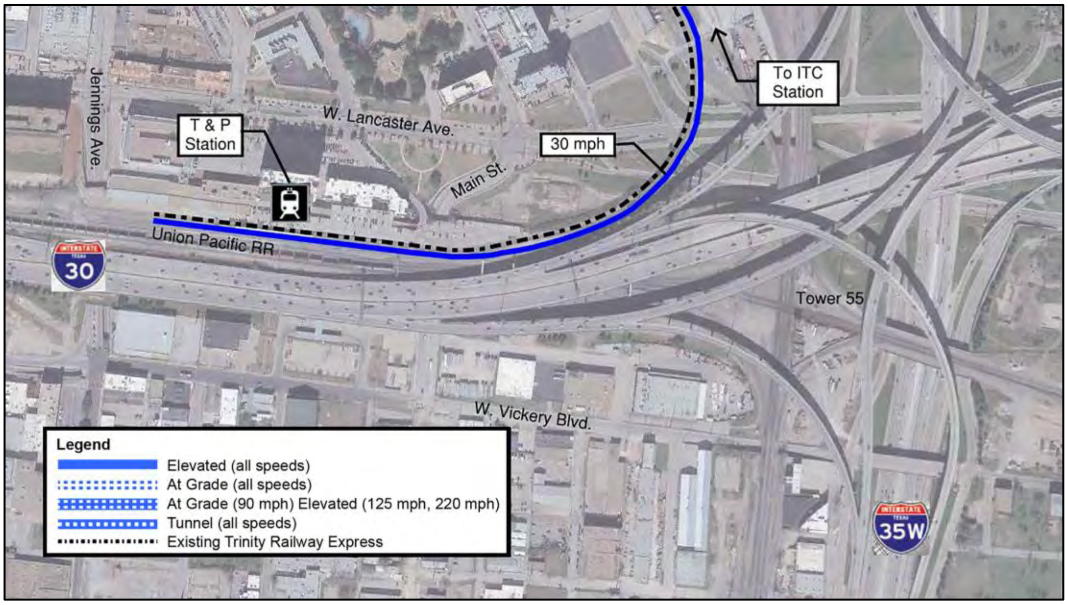
These are complex multi-level interchanges that are major obstacles for a new rail alignment.

As described below, the discussion of the alignment has been divided into segments due to the complexity of the entire route.

<u>Downtown Fort Worth</u>

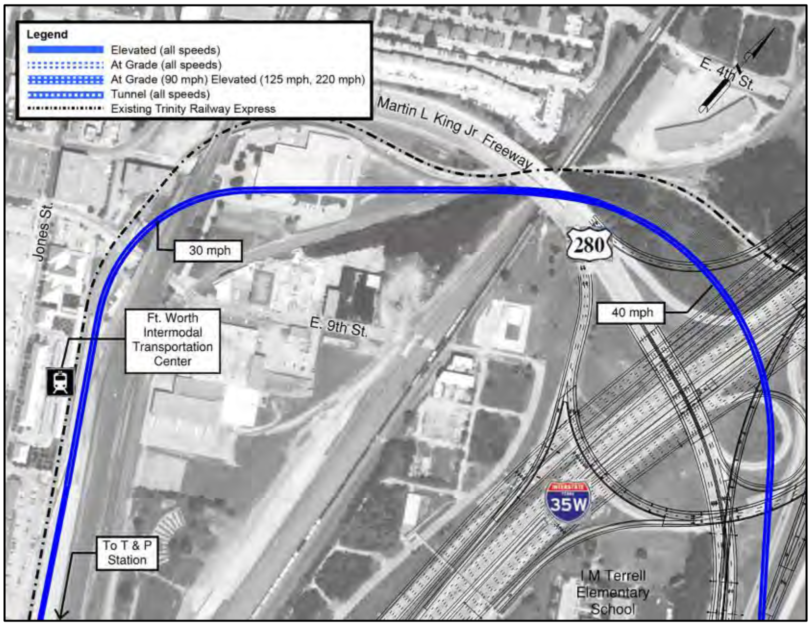
Station options in Fort Worth include the former T&P station, served by the TRE, and the Fort Worth Intermodal Transportation Center (ITC), served by TRE, Amtrak, and local bus routes. The T&P Station lies immediately west of the Tower 55 railroad junction and the multi-level I-30/I-35W interchange above the junction. Local streets pass beneath the railroad. The very heavy freight traffic through the junction precludes an at-grade route for a new passenger rail line, and the complex ramps and structures of the interchange and the streets below render both a viaduct and a tunnel unfeasible. The conceptual alignment beginning at the T&P station, shown in Figure 3-3 would parallel the existing TRE alignment leading to the ITC. The alignment would be on viaduct to avoid interference with TRE, Amtrak, and freight operations.

Figure 3-3: Fort Worth T&P Station



A route that bypasses Tower 55 and the I30/I35W interchange to the north would follow the existing TRE track passing adjacent to or through the ITC. Thus the ITC could serve as a terminal station, or an additional station if the proposed passenger service were to continue and terminate at the T&P station. Because of the need for a viaduct for the route between the station and the I-30 corridor, the new tracks would need to be elevated in the station area, which would also avoid conflicts with TRE, Amtrak, future TEX Rail commuter rail service, and freight movements.

Figure 3-4: Conceptual Alignment in Downtown Fort Worth

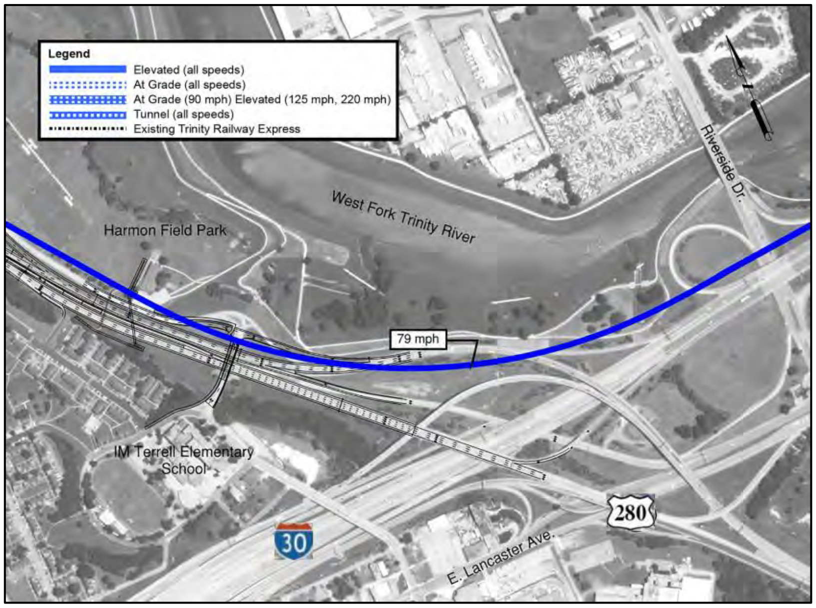


The proposed conceptual alignment through the ITC in downtown Fort Worth is shown in Figure 3-4.

Fort Worth to SH360

Leaving Downtown Fort Worth, the elevated alignment crosses above three rail lines and Martin Luther King Jr. Freeway. It then follows the east side of US 280 to avoid impacts to the Butler Learning Center and residential development as well as the IM Terrell Elementary School (on the southwest side of US 280), while also avoiding the US 280/I-30 interchange. The I-30 Conceptual Alignment curve in the northeast corner of the US 280/ I-30 interchange, as shown in Figure 3-5, intrudes into the west side of the Harmon Field Park, but is elevated to avoid direct impact to the park and the Fort Worth Branch trail (part of the Trinity Trail System).

Figure 3-5: Conceptual Alignment Adjacent to Harmon Field Park



The conceptual alignment connects to the I-30 corridor at the US 280 interchange and remains on the north side of I-30 (to avoid crossing I-30), where it continues to encroach slightly into the edge of the park and trail system.

In the section between Beach Street and Oakland Boulevard, as shown in Figure 3-6 and Figure 3-7, the alignment is located to minimize proximity to the West Fork Trinity River and the Trinity Trail System while avoiding a crossing of I-30. The maximum speed would be 90 mph.

Figure 3-6: Curve East of Beach St.

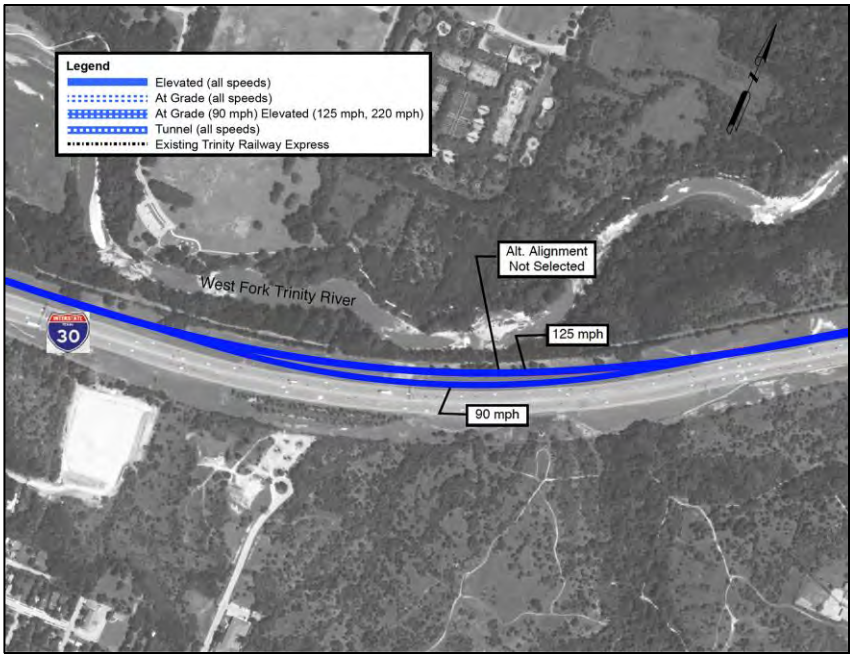
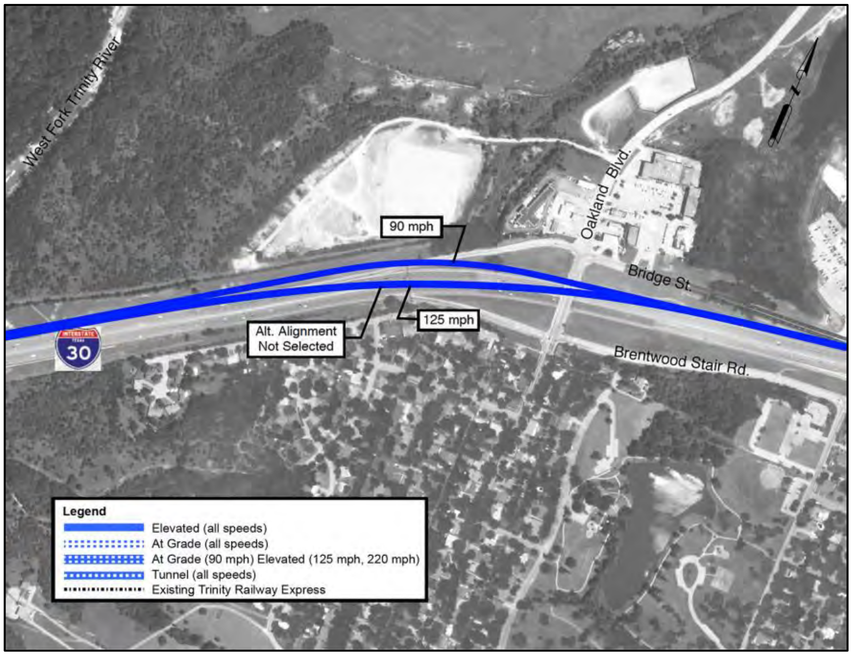


Figure 3-7: Curve at Oakland Blvd.



The conceptual alignment continues on the north side of I-30 and crosses above the I-820 interchange to avoid impacts to residential communities on the south side of I-30 as shown in Figure 3-8.

The conceptual alignment remains within the existing interstate right-of-way on the north side of I-30 and is elevated above crossing roadways and freeway ramps until it crosses to the south side of I-30 at N. Davis Drive, as shown in Figure 3-9. The conceptual alignment shifts to the south side of I-30 due to right-of-way restrictions on the north side, approaching Cooper Street.

Crossing I-30 requires straddle bents to span the I-30 lanes or reconstruction of I-30 in this area to provide for column locations for this alignment. The conceptual alignment on the south side of I-30 requires columns to be located between the main lanes and the frontage road between Cooper Street and SH 360 in Arlington. The conceptual alignment provides a tangent alignment to allow for a potential station location in Arlington.

Figure 3-8: Conceptual Alignment at I-820

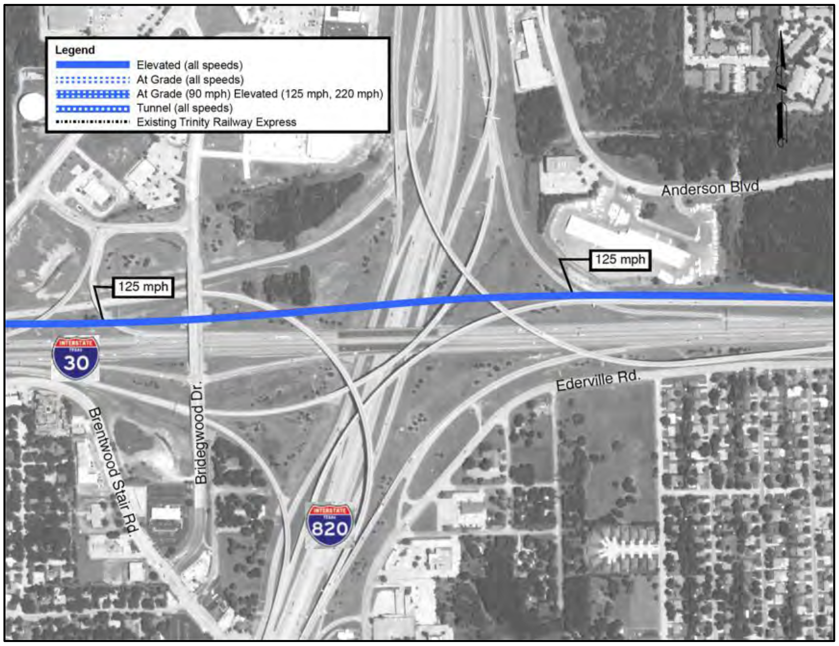
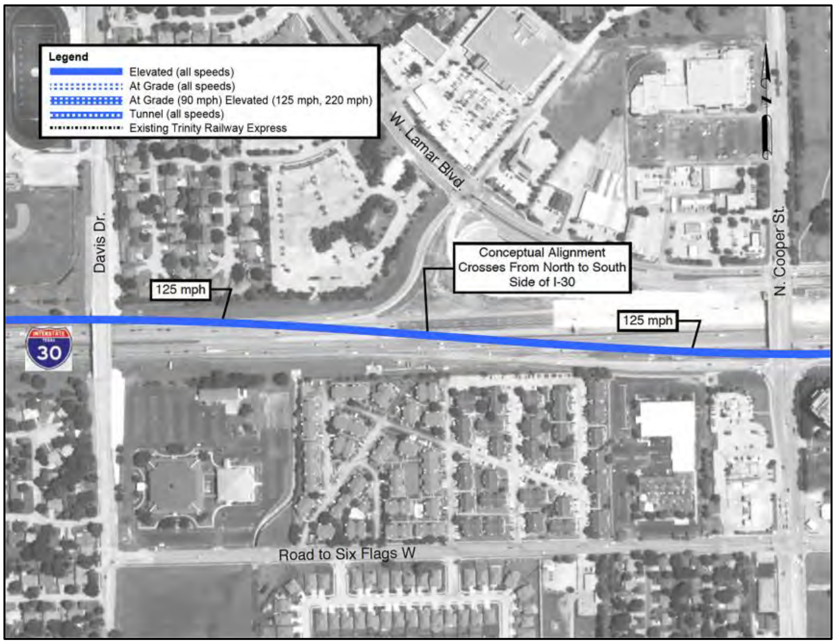


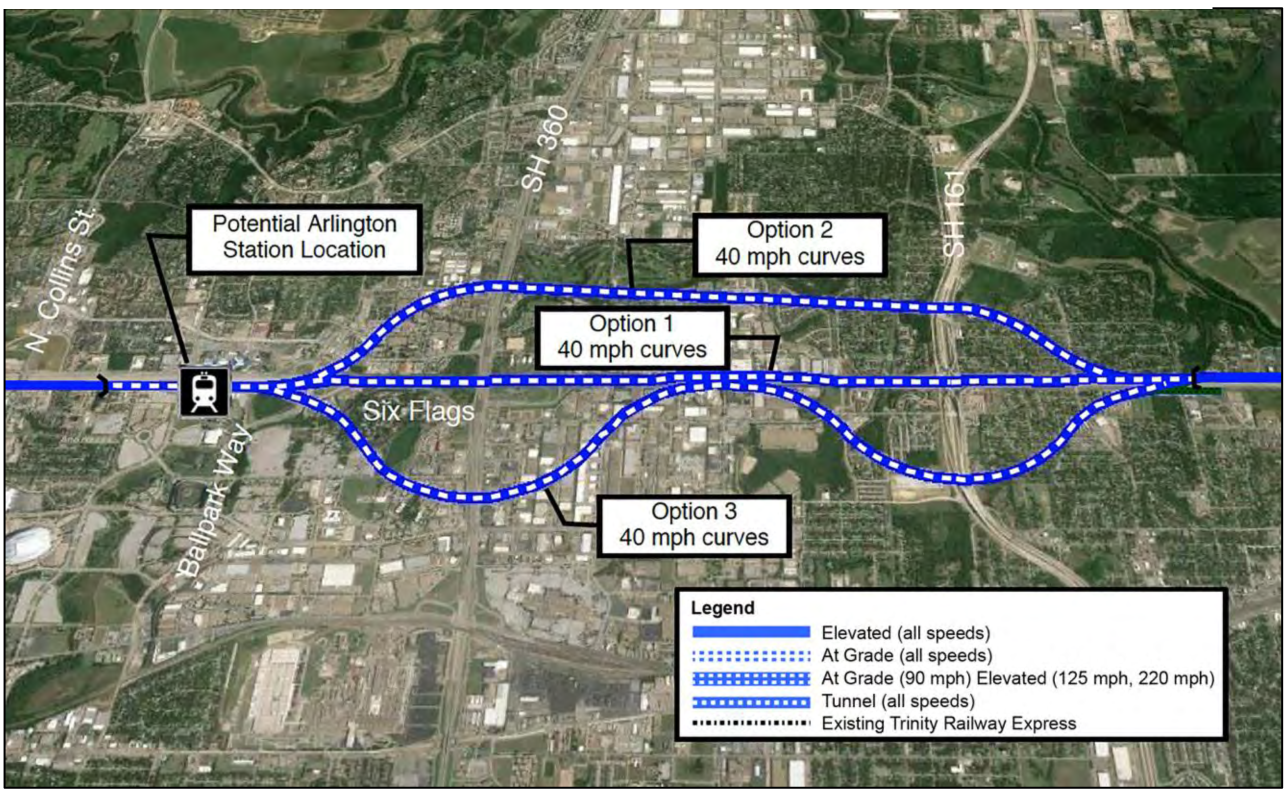
Figure 3-9: Conceptual Alignment at Davis Drive



Arlington

In Arlington the SH 161 interchange opened to traffic in 2009, and reconstruction of the SH 360 interchange got underway in March, 2016. When completed in 2020, the SH 360 interchange, similar to the SH 161 interchange, will be a large, multi-tiered junction with ramps on several levels. The current design for the SH 360 interchange does not provide the provision to accommodate rail service. Thus, the options at SH 360 include an alignment through the interchange, or more likely, a bypass alignment around the interchange since its current design does not accommodate a high-speed rail line. The alignment options are shown in Figure 3-10. Because the two interchanges are only about two miles apart, a combined or common solution is appropriate for both locations. Option 1 represents an alignment through the interchange. Options 2 and 3 represent bypass alignments to the north and south of the interchanges respectively.

Figure 3-10: Conceptual Alignments at Arlington



Option 1:

Due to the multi-level roadways within the SH 360 interchange, a viaduct would have to be more than 100 feet tall, and due to the long approaches, could impact the options at the nearby SH 161 interchange approximately two miles away. A viaduct of that height and scale would be a very high cost element with long approaches and significant visual impact. It would negatively impact the ability to place an intermediate station near the entertainment district in Arlington with the alignment on a very high structure at that location.

Tunnel construction methods include cut and cover or boring/mining and would have to occur beneath the main roadways to avoid the large number of ramp overpass foundations. Cut and cover construction would have severe impacts to the traveling public including lane closures and reduced speeds to accommodate excavation, support of existing foundations and earth, construction of an overhead causeway for construction traffic and material delivery, and protection for construction workers. The disruption to traffic could extend from one and one-half to two years. A bored tunnel method of construction could reduce, but not eliminate, the disruption to traffic. It would present significant engineering challenges and risks due to the nature of the subsurface geological conditions. The tunnel would penetrate alluvial soil near the surface and the Eagle Ford Shale formation as it goes deeper. The formation varies both vertically and laterally and is known for its methane gas production, in-situ clay, water content, and physical traits of becoming unstable after drying due to its pervasive clay/bentonite content. Potential settlement of structures immediately above the tunnel would be a major concern. The transition from tunnel to viaduct, depending on the specific alignment, could have significant traffic impacts. Both tunnel construction methods would be very costly. A station in Arlington near the entertainment district would need to be below ground.

Options 2 and 3:
A deviation that would swing around the interchanges with sweeping curves would be substantial due to the size of the interchanges and would vary in extent depending on the maximum design speed of 90, 125, or 125+ mph. The higher design speeds would require the greatest deviation unless permanent speed reductions were in effect. A deviation to either the north or south side of I-30 would take the alignment outside of the corridor and have major impacts due to the extensive commercial and residential development in the area. Figure 3-10 shows Option 2 on the north side of I-30 as a single bypass for both interchanges while Option 3 on the south side shows separate bypasses for each interchange. Either solution or a bypass alignment falling between the two shown could be implemented on either the north or south side of I-30 depending on detailed analysis to minimize impacts. Because of the extensive development on both sides of I-30, both a viaduct and surface alignment would have severe impacts. A surface deviation would have the greatest number of impacts due to the need to take many homes and businesses and the introduction of numerous grade crossings or street/road closures. Both a viaduct and a cut and cover tunnel would eliminate the need for permanent street closures or grade crossings, but would still require the taking of many homes and businesses. A deep bored tunnel would entail the fewest impacts, but would present similar engineering challenges and risks as noted in the Option 1 discussion above. A station near the entertainment district would have to be either elevated on viaduct or in tunnel below grade.

For the conceptual alignment, a tunnel and 40 mph curves as shown in Figure 3-10 are assumed for all of the Arlington options to minimize potential impacts through this area.

Arlington to Dallas

Continuing east from Arlington, the conceptual alignment would be elevated on the north side of I-30. At S. MacArthur Blvd., shown in Figure 3-11, a series of curves ranging from 90 to 160 mph would be required to minimize impacts.

After a 160 mph maximum curve west of Loop 12, the elevated alignment passes over Loop 12 and then transitions to tunnel east of Chalk Hill Rd. to minimize impacts to dense development along I-30. Curves could permit a maximum operating speed up to 160 mph in the tunnel alignment. The alignment at this location is shown in Figure 3-12.

Figure 3-11: Alignment at S. MacArthur Blvd.

Figure 3-12: Transition to Tunnel at Chalk Hill Rd

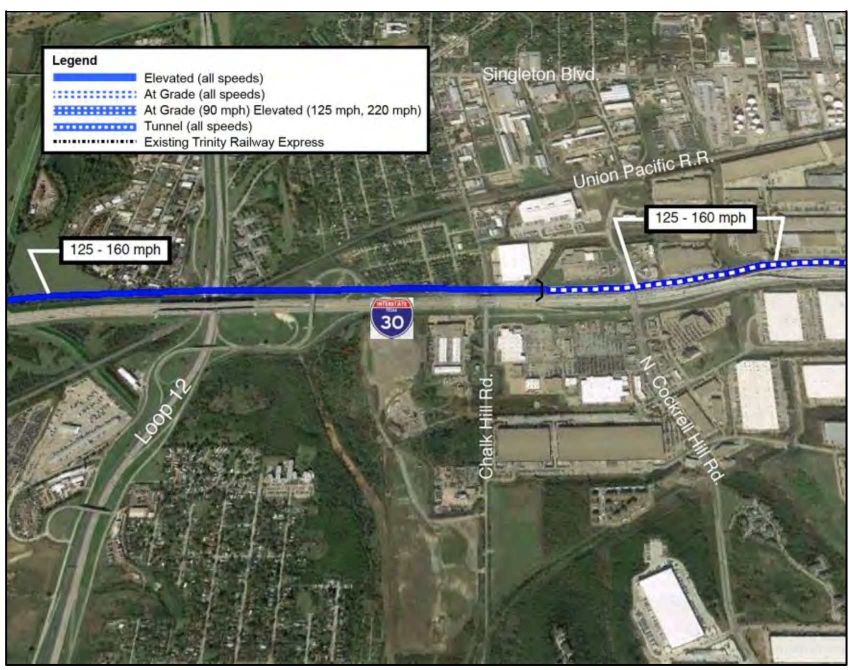
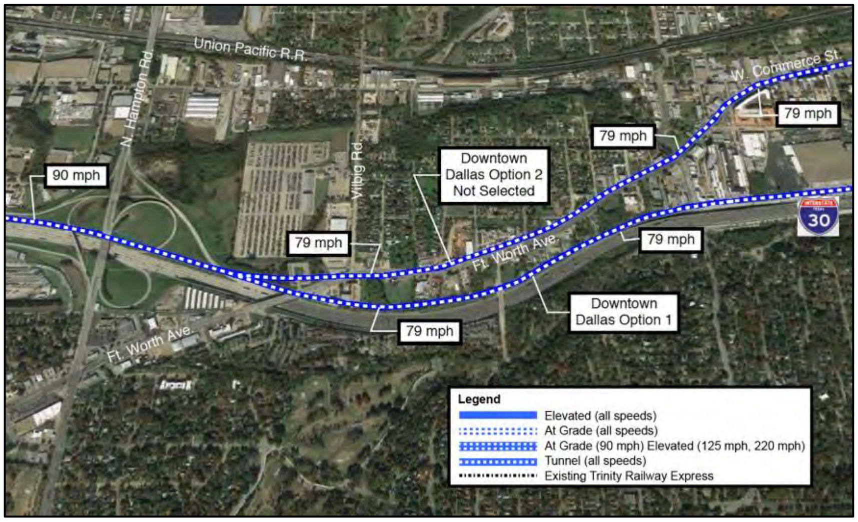


Figure 3-13: Alternative Options Approaching Downtown Dallas

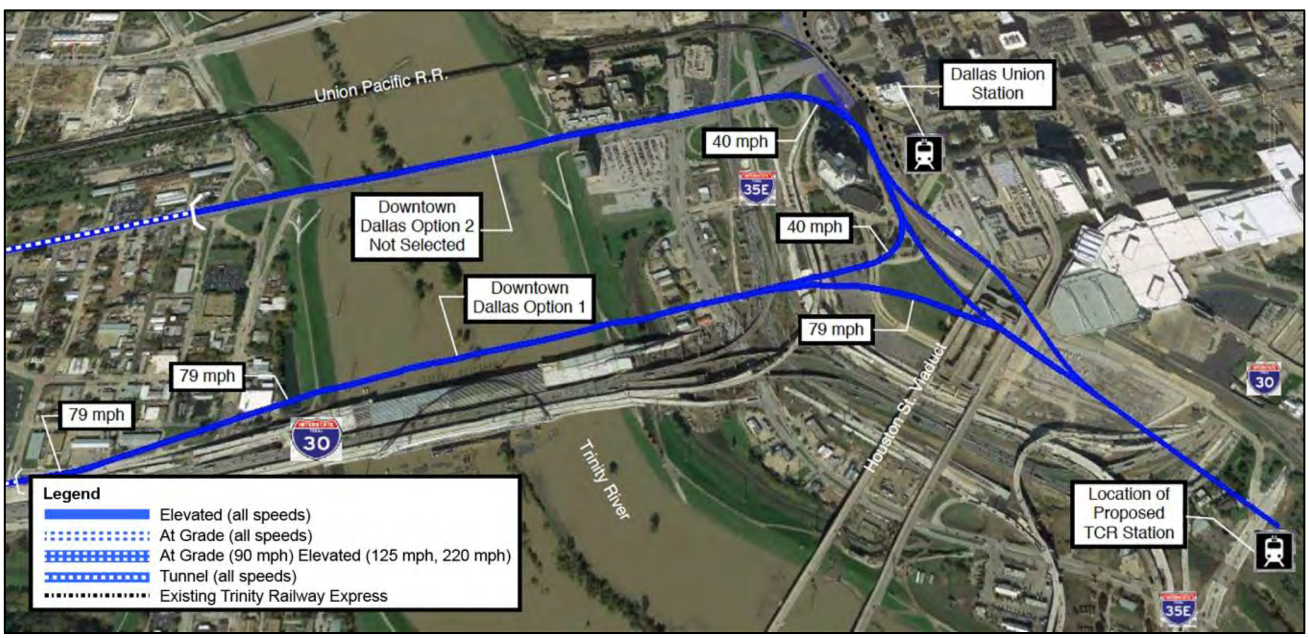


The tunnel alignment continues along the north side of I-30, passing beneath the N. Hampton Rd. interchange. Starting just west of Fort Worth Ave. two alternative alignments to reach downtown Dallas are considered. Option 1 remains on the north side of I-30, and Option 2 follows Fort Worth Ave. and, further east, W. Commerce St. Both options, as shown in Figure 3-13, remain in tunnel and entail 79 mph curves.

Downtown Dallas

Figure 3-14 shows the two optional alignments entering downtown Dallas. Both options emerge from tunnel to cross the Trinity River on viaduct and continue elevated to either of the proposed Dallas termini.

Figure 3-14: Downtown Dallas Alignments



Option 1 passes adjacent to and through portions of the I-30/I-35E interchange adjacent to downtown Dallas. This is a complex intersection with ongoing major roadway reconstruction projects including expansion and addition of several new bridges and roadways as well as the construction of a new signature bridge over the Trinity River. The number of support columns for ramps and limited vertical clearances preclude threading a surface rail alignment through the interchange into downtown Dallas. The only feasible options are a viaduct or a tunnel, both of which have significant challenges due to the density of highway structures and cost. A viaduct would have to be approximately 100 feet high, and finding room to place viaduct supports may prove to be impossible. A tunnel would face challenges due to subsurface conditions and the need to avoid or reliably underpin the dense array of highway structure foundations.

Figure 3-15, looking west toward Fort Worth, shows the interchange with some of the new bridge piers under construction.

Immediately beyond the interchange area, the alignment sharply turns either northward to serve Dallas Union Station or southward to serve the proposed TCR Station. Serving both would require a backup movement.

Figure 3-15: Reconstruction of I-30/I-35E Interchange

Option 2 avoids most of the I-30/I-35W interchange and offers the potential advantage of serving both Union Station and the proposed TCR station without the need for a backup move. However, Option 2 includes substantial subway tunnel construction beneath major urban streets west of the Trinity River.

Both options include 40 mph curves. They are both shown as elevated in Figure 3-14 although detailed engineering would be required to determine whether a viaduct or tunnel would be feasible and which would be more cost effective. For purposes of the Alternatives Analysis, Option 1 is selected as it would avoid tunneling under Ft. Worth Avenue and West Commerce Street, which are more densely developed than the north side of I-30.

3.2.2 The Trinity Railway Express (TRE) Corridor

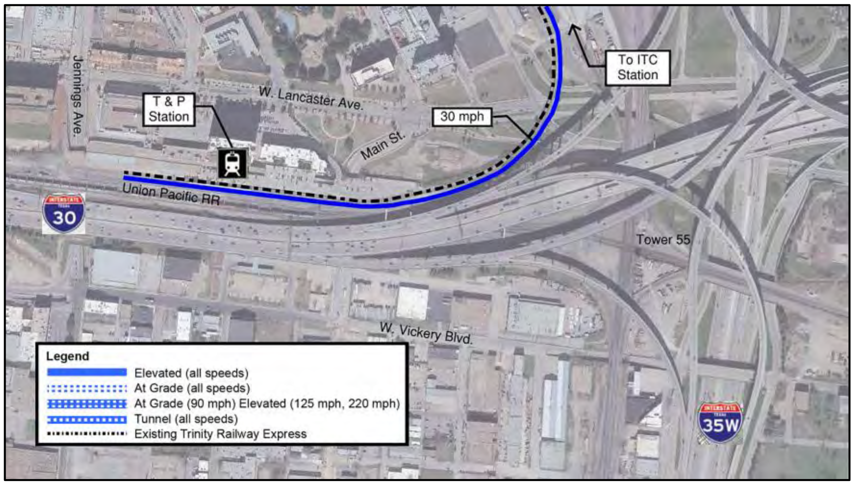
The TRE is a railway line extending approximately 34 miles between the T&P Station or the ITC in downtown Fort Worth to Union Station in downtown Dallas. The line is served by the TRE commuter rail service, a daily Amtrak train in each direction, and freight service. Located primarily at grade, the line is a mix of single and double track. Full double tracking and the addition of a future third track are under consideration.

Most of the TRE corridor consists of long stretches of tangent track connected by a few isolated curves making it possible, with the exception of the curves, for 90 mph, 125 mph, or 125+ mph maximum speed alignments to stay within or closely parallel to the existing corridor right-of-way. The existing corridor includes numerous highway grade crossings, industrial sidings, and TRE rail stations. The alignment for the three maximum speed alternatives is the same; however, the profile for the 90 mph alternative includes more at-grade segments than the 125 mph and 220 mph alternatives.

<u>Downtown Fort Worth</u>

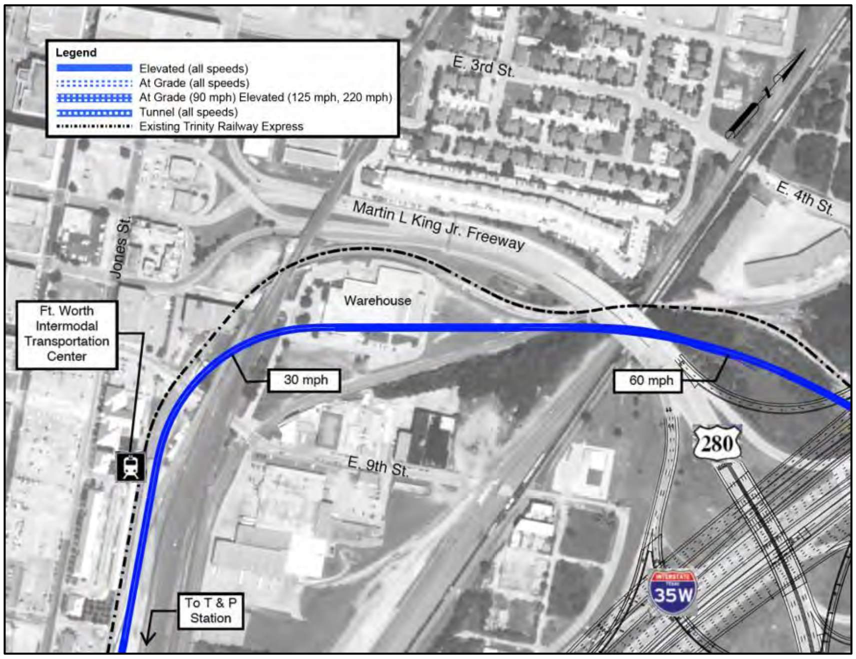
Either the T&P, the ITC, or both would be viable stations in Fort Worth as they are currently connected to the TRE corridor. The conceptual alignment beginning at the T&P station is shown in Figure 3-16. An elevated alignment and platform would be required due to expected capacity limitations at the station hosting existing and planned additional TRE service.

Figure 3-16: Fort Worth T&P Station



The alignment continues elevated through the ITC to avoid conflicts with existing and future TRE service as well as Amtrak and future TEX Rail service. From the Fort Worth ITC, the alignment continues east on elevated structure south of the existing TRE tracks to cross above freight lines, US 280, and the West Fork Trinity River. The alignment requires a slight shift away from the existing TRE tracks to minimize impacts to adjacent properties, although the alignment would impact a large wholesale distributor warehouse to the south of the TRE line. The alignment is shown in Figure 3-17.

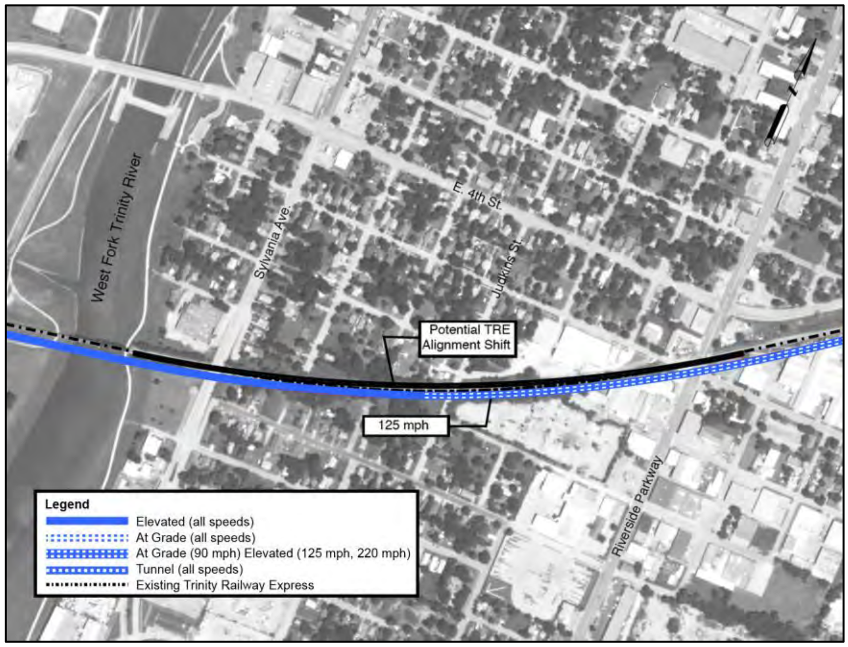
Figure 3-17: TRE Conceptual Alignment in Downtown Fort Worth



Fort Worth to TRE CentrePort Station

East of the West Fork Trinity River the alignment continues on the south side of the TRE tracks, on elevated structure for the 125 mph and 220 mph alternatives to avoid grade crossings of the numerous streets and roads, and at-grade for the 90 mph alternative. The curve immediately east of the West Fork Trinity River, shown in Figure 3-18, may require some shifting to accommodate higher speeds depending on what speeds could be realized given the need to accelerate from and brake for the speed restricted curves entering downtown Fort Worth.

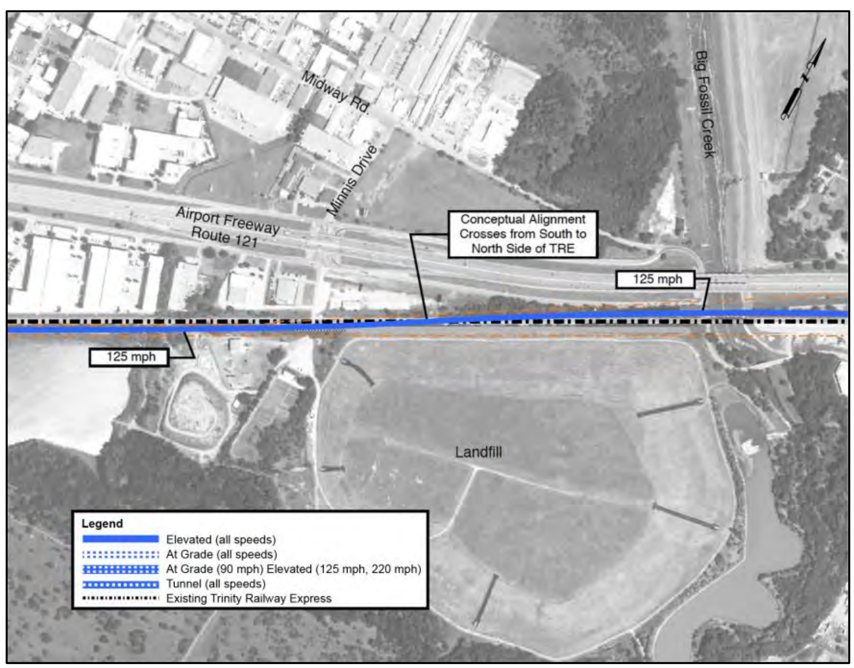
Figure 3-18: Curve East of West Fork Trinity River



The TRE alignment continues eastward south of the existing TRE track on elevated structure for the 125 mph and 220 mph alternatives to remain grade separated from the many roadway crossings, and at-grade as far as Elliot Reeder Rd. for the 90 mph alternative.

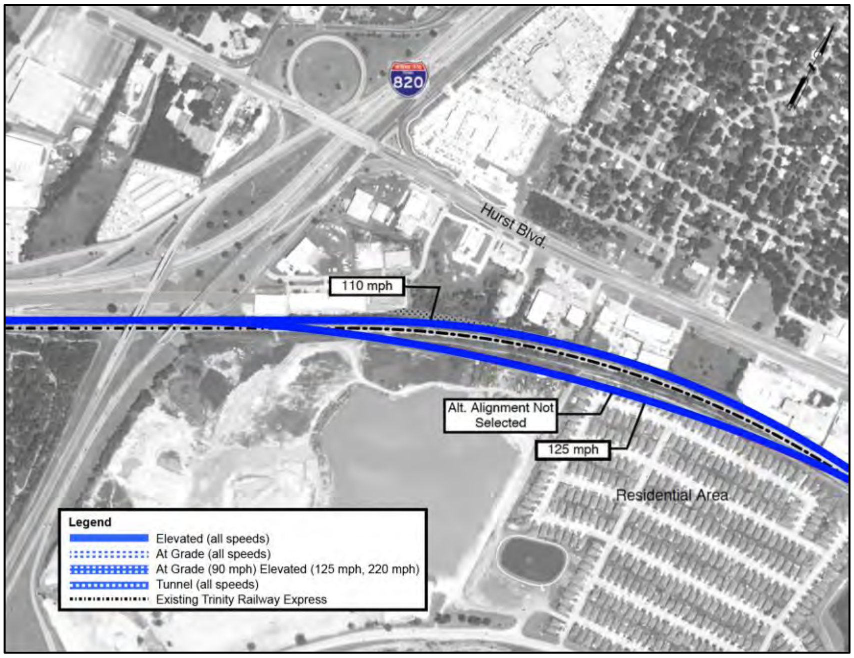
The segment from Minnis Drive, where the alignment crosses from the south to the north side of the TRE track, to Bell Helicopter includes a major curve, a landfill and residential area on the south side of the TRE track, and a crossing of I-820, for which improvements are planned on the north side of the TRE track. Transitioning to the north side of the TRE track at Minnis Drive would avoid impacts to the landfill, shown in Figure 3-19, and the residential area on the south side east of I-820, shown in Figure 3-20. This would entail a maximum speed of 125 mph on the curves at the transition location. A 110 mph alignment at the curve east of I-820 would minimize impacts,

Figure 3-19: Conceptual Alignment at Minnis Drive



while a 125 mph curve would require transitioning back to the south side of the TRE track and the taking of 20 homes in the northwest portion of the residential development, and then transitioning back to the north side. An alignment for speeds higher than 125 mph would have significantly more impact and the taking of additional homes. The 110 mph and 125 mph curves are shown in Figure 3-20, and it is assumed that the more conservative (110 mph) curve speed would be utilized.

Figure 3-20: Curve at I-820

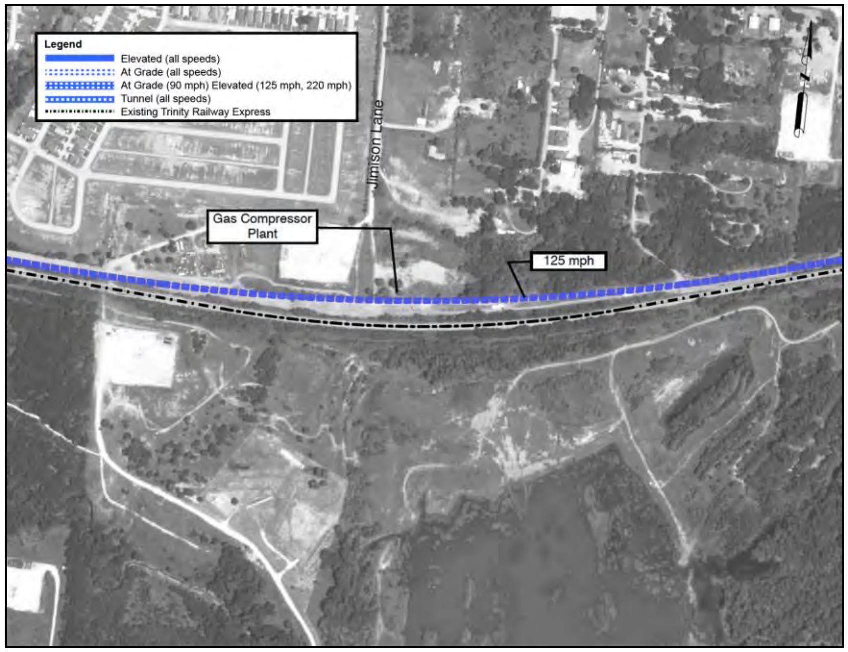


After the curve, the alignment continues east on the north side of the TRE on elevated structure except for two short at-grade segments for the 90 mph alternative, and transitions from elevated structure to at-grade just west of the Bell Helicopter property to avoid conflicts with helicopter flight and landing areas on the north side of the tracks. The alignment passes under the existing Bell Helicopter overpass and requires a grade separated roadway underpass at Bell Spur as shown in Figure 3-21.

Figure 3-21: Conceptual Alignment at Bell Helicopter

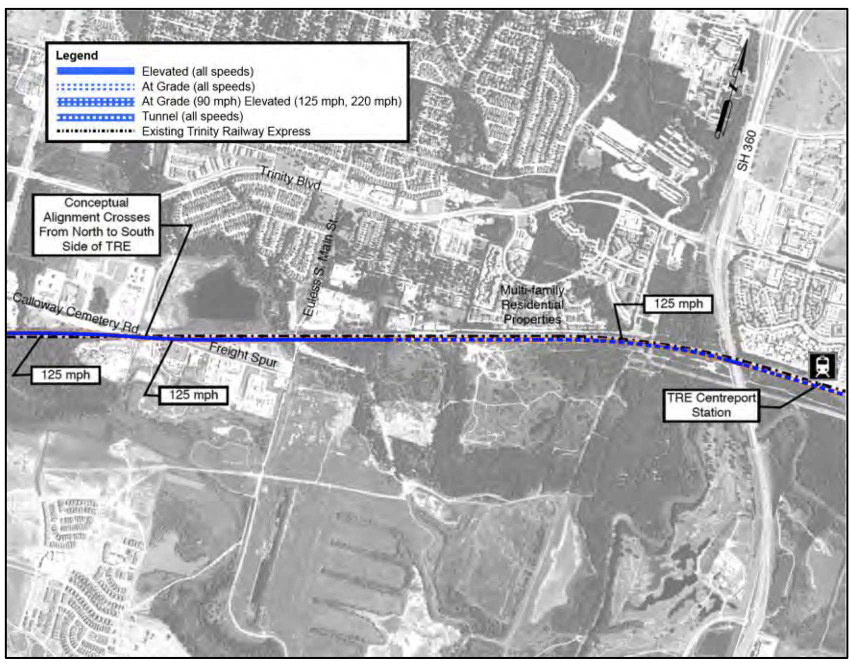
The conceptual alignment continues east mostly at grade on the north side of the TRE tracks, passing under Trinity Blvd., where the highway profile and bridge may require adjustment to provide adequate clearance to the rail line below. East of the Trinity Blvd. overpass, there is a major curve. Maintaining a 125 mph curve would impact a gas compressor plant on the north side of the TRE. The curve and plant are shown in Figure 3-22. Being on the north side, the alignment avoids a large landfill and quarry operation on the south side. The alignment requires a grade separated roadway overpass at Mosier Valley Road and a rail bridge above the depressed Hwy 157 (N. Collins Street).

Figure 3-22: Curve East of Trinity Blvd.



Farther east near Calloway Cemetery Road, the alignment includes a rail overpass to cross from the north to the south side of the TRE tracks and above a freight spur track on the south side. This avoids impacts on the north side of the TRE tracks such as the multi-family residential properties west and east of SH 360 on the north side and the TRE CentrePort Station on the north side east of SH 360. After the overpass the alignment continues at grade. The alignment in this area is shown in Figure 3-23.

Figure 3-23: Alignment at Calloway Cemetery Rd.



The alignment is grade separated on a rail bridge generally following existing ground elevations across the depressed SH 360 lanes.

TRE Proposed CentrePort Station to Dallas

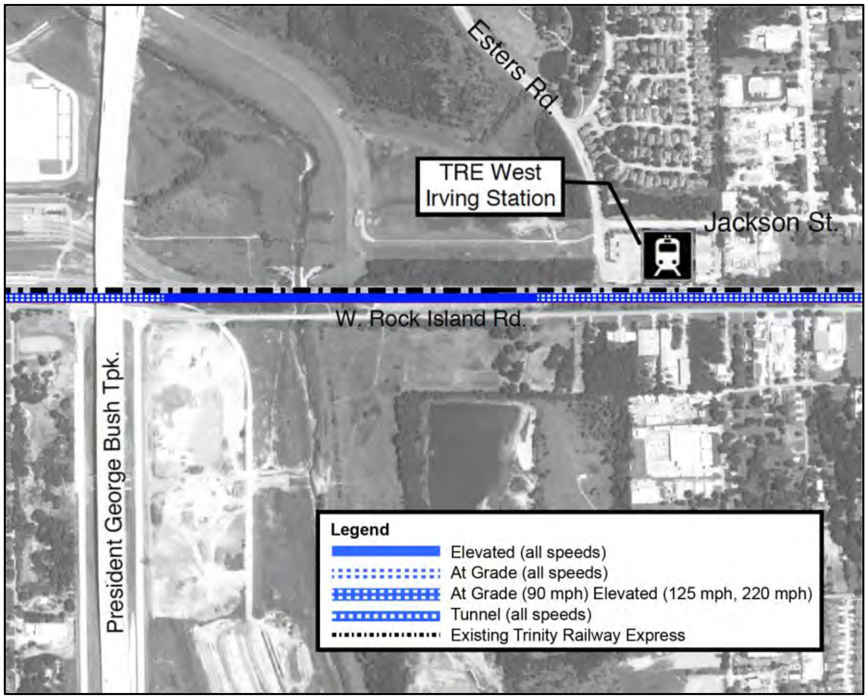
The TRE alignment continues east at grade and requires reconstruction of the existing Trinity Boulevard overpass east of CentrePort Station to maintain required vertical clearance above the alignment.

The alignment transitions to elevated structure again just west of Roy Orr Blvd. and continues on the south side of the TRE to avoid impacts to the TRE maintenance facility and storage tracks on the north side as shown in Figure 3-24. While the alignment for the 125 mph and 220 mph alternatives remains on elevated structure, the alignment for the 90 mph alternative returns to and remains at-grade after crossing Roy Orr Blvd.

Figure 3-24: Trinity Blvd. to President George Bush Tpk.

After passing over the President George Bush Tpk., the alignment continues on the south side of the TRE, passing the TRE West Irving Station located on the north side of the TRE as shown in Figure 3-25.

Figure 3-25: Alignment at Proposed TRE West Irving Station

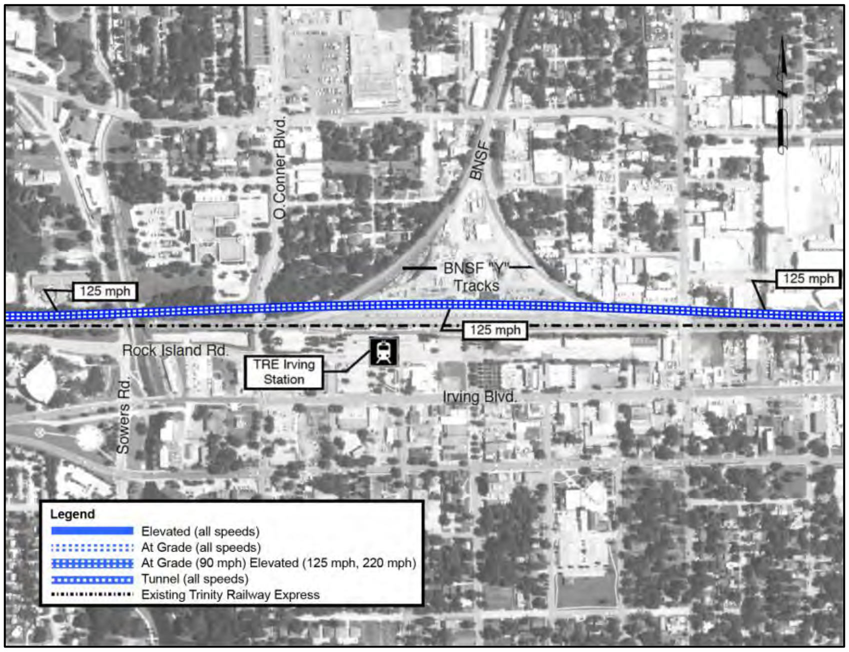


The TRE alignment continues eastward on elevated structure for the 125 mph and 220 mph alternatives and at grade for the 90 mph alternative to Belt Line Rd. where, for all alternatives, as shown in Figure 3-26, the alignment shifts on elevated structure from the south side to the north side of the TRE due to the proximity of Rock Island Road on the south side of the TRE tracks. An alignment remaining on the south side of the TRE utilizing straddle bents across Rock Island Road would have numerous direct and indirect impacts to the residential properties east of S. Briery Road.

Figure 3-26: Alignment at Belt Line Rd.

The TRE alignment continues on the north side of the TRE, on elevated structure for the 125 mph and 220 mph alternatives but transitioning west of Irving Blvd./Hwy 356 to at-grade for the 90 mph alternative. The 125 mph and 220 mph alternatives cross above the BNSF "wye" tracks near the TRE Irving Station while the 90 mph alternative crosses the "wye" tracks at grade, as shown in Figure 3-27. The alignment employs 125 mph curves to avoid impacting several side tracks parallel to the TRE within the "wye".

Figure 3-27: Alignment at Proposed West Irving TRE Station

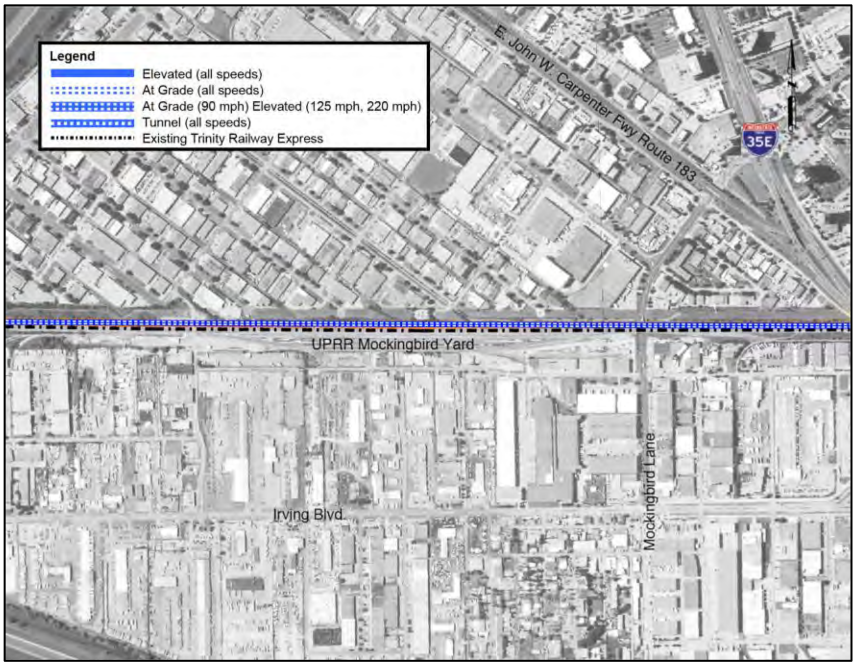


As shown in Figure 3-28 the alignment at Loop 12 employs 125 mph reverse curves to minimize impacts to the Loop 12 bridge structure. East of Loop 12 the 90 mph alternative transitions to elevated structure, but returns to at-grade after crossing the Elm Fork of the Trinity River.

Figure 3-28: Alignment at Loop 12

The alignment, elevated for the 125 mph and 220 mph alternatives and at-grade for the 90 mph alternative, remains on the north side of the TRE to I-35E to avoid the UPRR Mockingbird freight yard on the south side, though it does impact some businesses on the north side. The conceptual alignment at Mockingbird Yard is shown in Figure 3-29.

Figure 3-29: Alignment at Mockingbird Yard

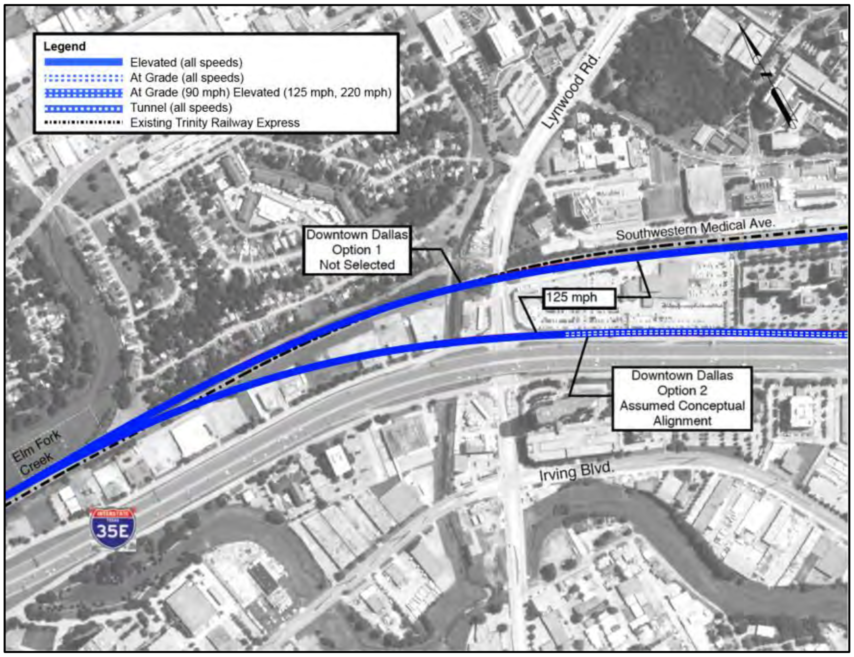


Downtown Dallas

Two potential alignment options between I-35E/North Stemmons Freeway and the Dallas North Tollway were considered: the TRE Downtown Dallas Option 1 and TRE Downtown Dallas Option 2 with reduced speed curves, as shown in Figure 3-30 through Figure 3-32. All 3 speed alternatives are elevated as they approach downtown.

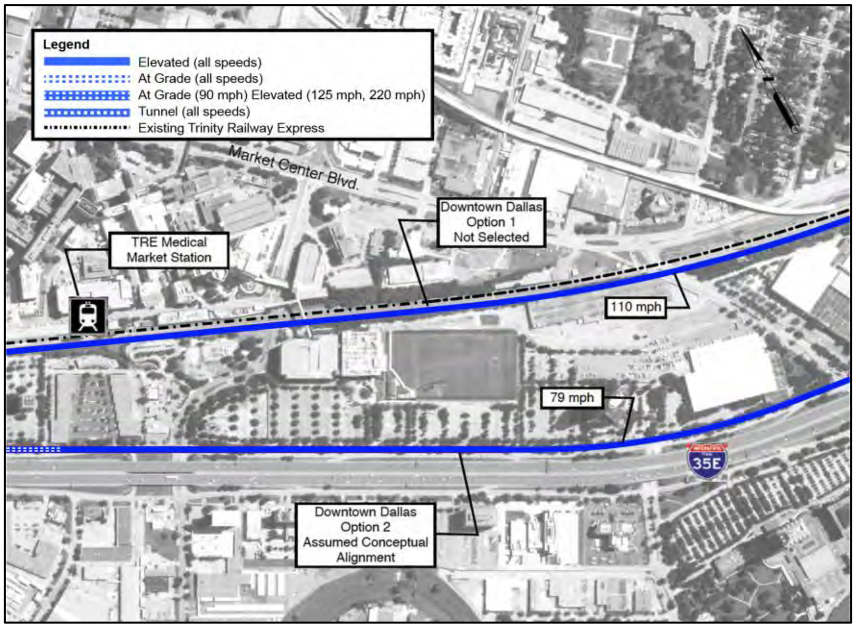
As shown in Figure 3-30, Option 1 transitions from the north to the south side of the TRE at Lynwood Road and remains elevated to avoid grade crossings. Option 2 transitions from the north to the south side of the TRE west of Lynwood Road and shifts away from the TRE to parallel the north/east side of the I-35E frontage road and, to avoid grade crossings, remains elevated except for a short segment immediately east of Lynwood Rd. that is at-grade for the 90 mph alternative.

Figure 3-30: Downtown Dallas Option 1 & 2 Near Lynwood Rd.



Both options have curves with reduced design speeds ranging from 60 mph to 110 mph due to the right-of-way and geometry restrictions through downtown Dallas. Option 1 affects more acres of commercial properties than Option 2 (12 and seven acres, respectively). Option 2 has more property access impacts to commercial properties located between the TRE and I-35E, since these commercial establishments face the frontage road rather than the TRE tracks at the rear of the property; however, the access impacts may be mitigated by careful placement of piers to retain ingress/egress and

Figure 3-31: Downtown Dallas Options 1 & 2 Near Market Center Blvd.



visibility for the properties. Because of its fewer impacts to commercial acreage and the ability to mitigate frontage road access impacts, Option 2 is assumed for the alignment.

Southeast of Oak Lawn Ave. the alignment is elevated over the Dallas North Tollway direct connectors and stays on the south side of the TRE to avoid impacts to the DART/TRE Victory Station. The alignment would require relocating existing electrical transmission lines underground to accommodate I-35E interstate improvements and to provide structural touchdowns for the viaduct that would be required. The alignment is also elevated over the Woodall Rodgers Freeway interchange and the UPRR "wye" tracks as shown in Figure 3-33, with reduced design speeds due to curvature along areas of restricted right-of-way.

Figure 3-32: Downtown Dallas Options 1 & 2 Near Oak Lawn Ave.

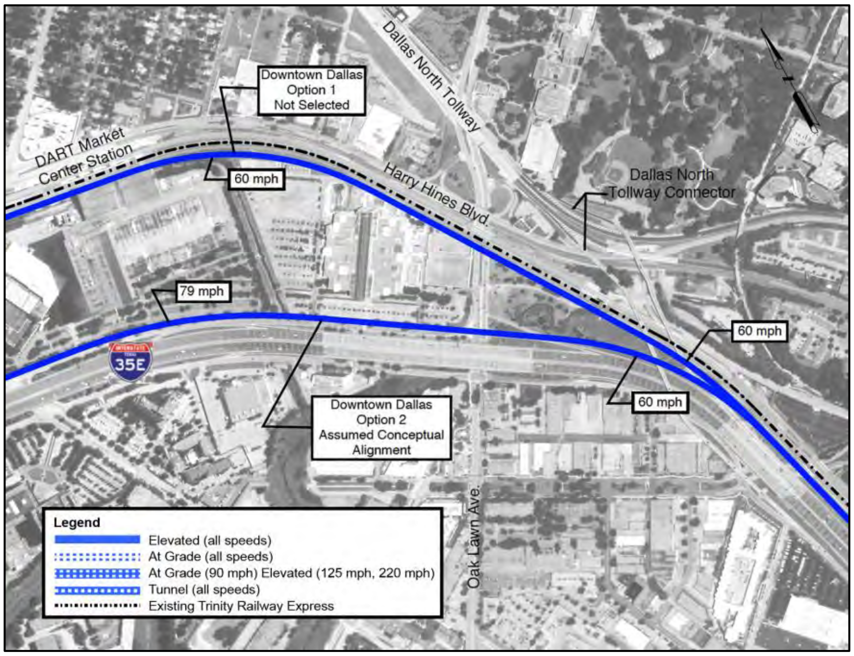


Figure 3-33: Alignment at Woodall Rogers Fwy. & UPRR

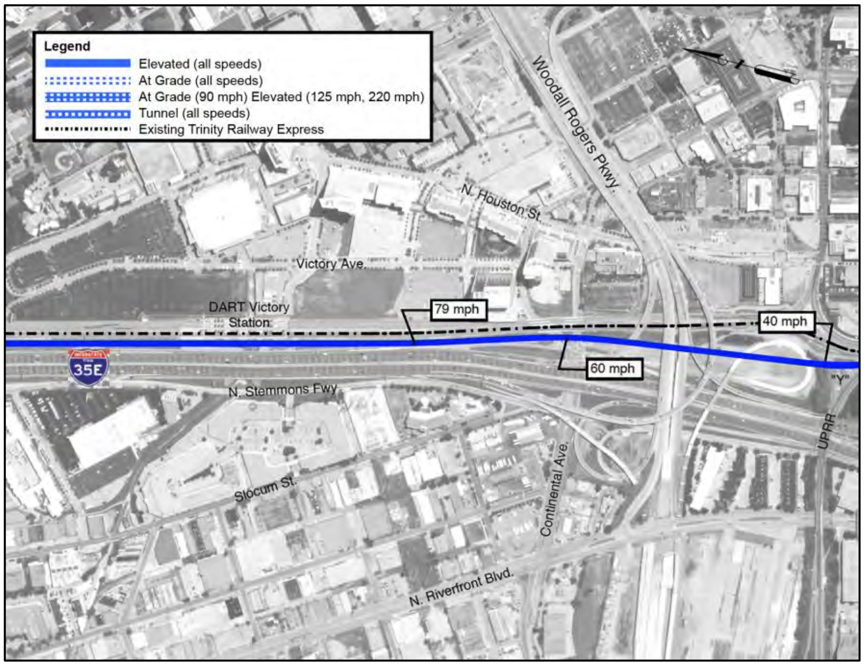
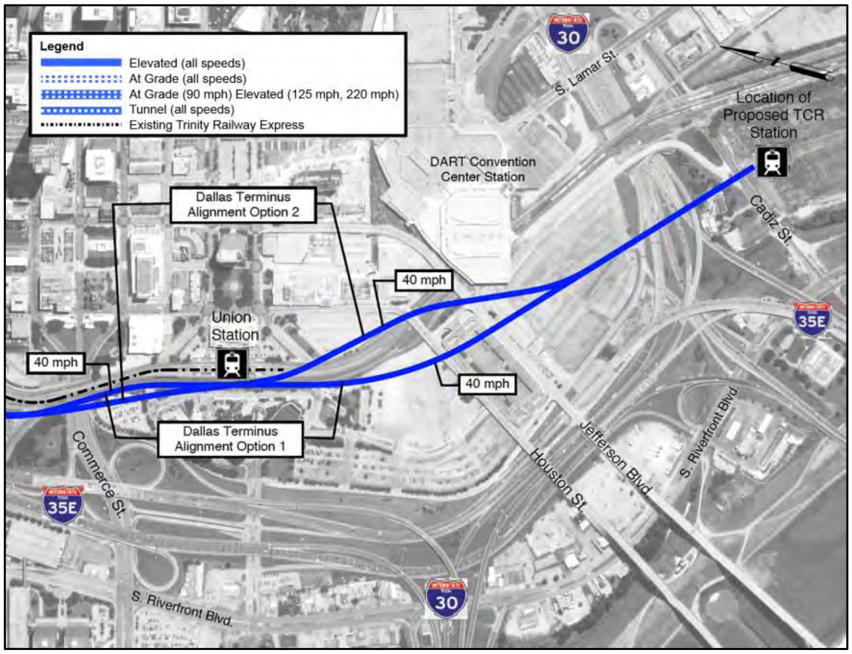


Figure 3-34: Dallas Terminus Alignment Options



The alignment at Union Station would likely need to be elevated to minimize impacts to UPRR tracks and existing station tracks and platforms. If the service terminates at Union Station, a tangent alignment parallel to the existing station tracks is optimal. For the service to extend to and terminate at the proposed TCR station on the east side of I-30, two options were considered as shown in Figure 3-34.

Option 1 would be tangent and parallel to the existing tracks and platforms at Union Station. Option 2 would be curved and at an angle to the Union Station tracks and platforms. Both options would entail 40 mph curves and be elevated to cross streets and I-30, and remain elevated east of I-30 as the proposed TCR station would also be elevated.

Option 1 -Tangent alignment at Dallas Union Station impacts the DART Convention Center parking garage, one park, two National Register Historic Districts, and 3.4 commercial acres.

Option 2 – Curved and angled alignment at Union Station Impacts UPRR and DART tracks, two parks, two National Register Historic Districts, and 3.7 commercial acres.

If the proposed service were to serve both Union Station and the TCR Station, Option 1 would provide a better alignment at Union Station as it would be parallel to the existing station tracks and platform layout rather than crossing at an angle, which would likely require more complicated structures and platform access.

3.2.3 I-30/SH 360/TRE Corridor

This Corridor, also referred to throughout this document as the Hybrid Corridor, combines the west end of the I-30 Corridor and the east end of the TRE corridor by using the SH 360 Corridor as a connecting link between them.

<u>Fort Worth to SH 360</u>

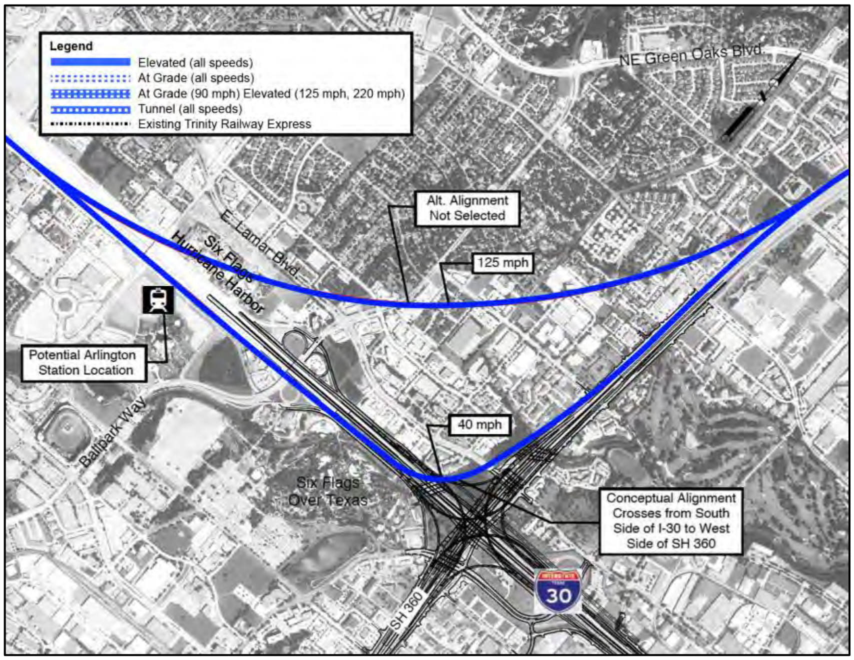
The conceptual alignment between Fort Worth and SH360 would be the same as described in the I-30 Corridor option. Approaching the I-30/SH360 interchange from the west, the alignment would be elevated on the south side of I-30. This option takes advantage of the less densely developed portion of the I-30 corridor west of SH 360 and the ability to coordinate rail planning with proposed

I-30 improvements west of SH 360, which are currently in the planning stage. It also avoids the high costs, engineering challenges and impacts presented by the I-30 interchanges at SH360, SH161, and I-35E.

I-30 Corridor to SH360 Corridor Connection

Two alignment options for transitioning from the I-30 corridor to the SH 360 corridor were evaluated: a 125 mph design speed option and a 40 mph design speed option, both shown in Figure 3-35. Both options stay on the west side of the I-30/SH 360 interchange taking into account the current reconstruction, which is scheduled for completion in 2020.The 125 mph design speed option results in about 15 acres of right-of-way impacts, including residential and commercial properties. This option bisects the Six Flags Hurricane Harbor Waterpark and affects one acre of wetlands. It also traverses several neighborhoods, resulting in three single-family relocations and 123 multifamily unit relocations.

Figure 3-35: I-30 to SH 360 Corridor Connection



The 40 mph design speed option hugs the west side of the interchange and has right-of-way impacts to two acres of commercial properties and four acres of residential properties, but results in no residential relocations. The 40 mph option also affects five acres of floodplains.

Both options are on viaduct to cross over from the south side of I-30 and to cross over the numerous streets, frontage roads, and access ramps.

Based on the issues described above, the 40 mph design speed option was found to be more desirable to minimize property impacts to the waterpark and residences.

SH 360 Corridor

The conceptual alignment remains on viaduct on the west side of SH 360 within the right-of-way between the roadway and frontage roads until it reaches Post and Paddock Street, thus minimizing property impacts.

SH 360 Corridor to TRE Corridor Connection

For a transition from the SH 360 Corridor to the TRE Corridor, multiple alignment options with design speeds ranging from 40 mph to 125 mph as shown in Figure 3-36 were considered.

Each option requires a new crossing of the West Fork Trinity River, and has floodplain and wetland impacts.

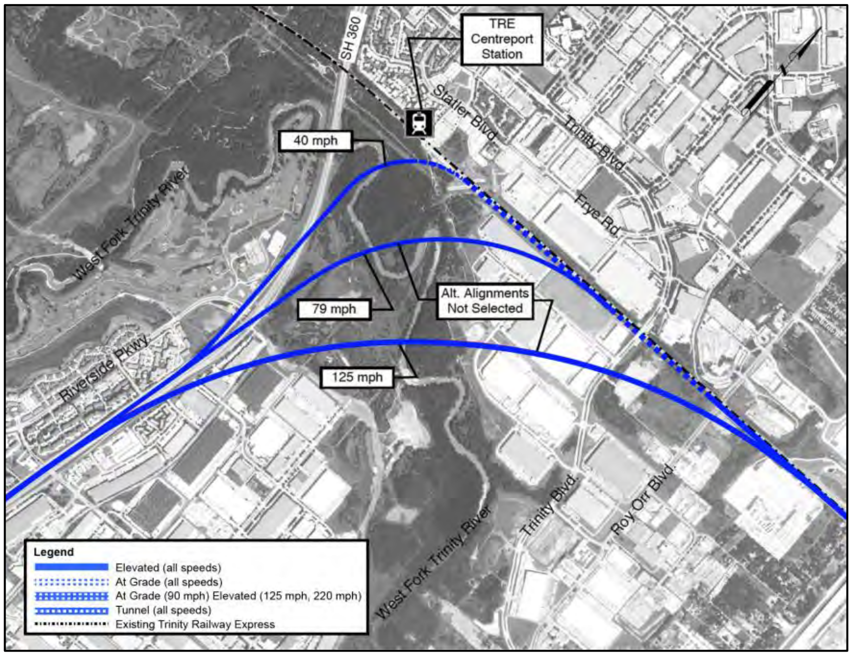
The 125 mph design speed option requires the largest radius curve and impacts at least eight warehouses along the curve (11 acres of commercial/industrial property), six acres of residential property (no relocations) and six acres of floodplains.

The 79 mph design speed option impacts one warehouse property (two acres of commercial land), seven acres of residential property (no relocations), and nine acres of floodplains.

The 40 mph design speed option has the smallest radius curve, impacts two acres of commercial land including right-of-way of a private golf course west of SH 360, six acres of residential property (no relocations), and 10 acres of floodplains.

Based on the discussion above, the alignment incorporates the 40 mph design speed option to minimize property impacts. The 40 mph option also merges with the TRE alignment closest to the TRE CentrePort station allowing the possibility of an expanded station serving both rail services.

Figure 3-36: SH 360 to TRE Corridor Connection



SH 360 to Dallas

East of SH 360 the alignment is the same as described in the TRE Corridor Description in Section 3.2.2.

3.3 Stations

Seven station locations were evaluated, two each in downtown Fort Worth and downtown Dallas, and in three intermediate locations approximately half way between Fort Worth and Dallas. These station locations are shown in Figure 3-2. In Fort Worth and Dallas the stations could be served by all three of the corridor alignments. Intermediate stations that could be served depend on the particular corridor.

Fort Worth

There are two existing stations in Fort Worth, the T&P and the ITC. Both stations are served by the TRE and will also be served by the planned TexRail commuter service. The ITC, served by Amtrak, is a hub for local bus routes, and is considered a potential station location by the TOPRS. The two stations are less than one mile apart.

The T&P is the westernmost station. The Project's proposed service could stop at the ITC and then continue to the T&P, terminating at that station, or it could terminate at the ITC with no service to the T&P.

The three corridor alignments are the same for both stations and would need to be elevated to avoid conflicts with TRE, Amtrak, and future TexRail trains as well as the heavy freight traffic that moves through the area.

Dallas

There is one existing station in downtown Dallas, Union Station, which is the eastern terminal for TRE service and is also served by Amtrak and by DART light rail trains. A new station to serve the proposed TCR high speed service between Dallas and Houston is anticipated to be constructed on the south edge of downtown, approximately ¾ miles from Union Station.

The proposed service on the TRE and Hybrid corridor alignments could terminate at Union Station, or could stop at Union Station and then continue to a terminal at the TCR location. Because the I-30 corridor alignment enters downtown Dallas between the two station locations, the proposed service could turn north to terminate at Union Station or south to terminate at the TCR station. To serve both stations it would need to directly proceed to one and then reverse direction to terminate at the other.

The selected alignment for all three corridors in downtown Dallas would need to be elevated to avoid conflicts with TRE, DART light rail, and freight trains as well as numerous city streets, and interstate highways and ramps.

Arlington

An intermediate station located in the entertainment district at Arlington could serve the proposed service on either the I-30 or the Hybrid corridor alignments. The station would be located on the west side of the I-30/SHA 360 interchange. For the I-30 corridor alignment, it is anticipated that the station would be below grade to enable the alignment to tunnel through the interchange area. For the Hybrid alignment the station would be elevated to allow the alignment to turn northward and cross over I-30.

CentrePort

The CenterPort station is an existing TRE station and could serve as an intermediate stop for Project trains operating on the TRE corridor alignment. By modifying and expanding the station it could also serve the selected Hybrid alignment, which would join the TRE corridor at the east end of the station. The CentrePort station could provide for transfers between the existing TRE commuter rail service and the proposed Project service.

County Line

A new intermediate station was considered near the Tarrant/Dallas County line at a location approximately one mile east of the CentrePort Station. Although trains on the TRE corridor alignment could serve this station, it was primarily useful to be served by trains on a higher speed Hybrid alignment, which would join the TRE corridor east of the CentrePort Station. Since a slower 40 mph connecting alignment was selected for the Hybrid alignment allowing service to an expanded CentrePort station, a County Line station was dropped from further consideration.

3.4 Maintenance Facilities

Seven potential locations for a maintenance facility were identified. The locations are shown in Figure 3-2. All seven locations are located along the existing TRE alignment, three in the western half of the corridor and four in the eastern half. For the I-30 corridor option, trains would need to travel without passengers (deadhead) over the TRE from Dallas or Fort Worth to reach any of the seven locations. For the Hybrid corridor option, deadhead movements over the TRE would be required for access to any of the three locations in the western half of the existing TRE corridor. All of the locations would have impacts on primarily commercial and industrial properties, most likely requiring displacement depending on the design of the maintenance facility.

Location M-FW1

This location in the western half of the TRE corridor is on the south side of the existing TRE tracks immediately west of the TRE Richland Hills station and Handley Ederville Rd. The site is occupied by a mix of one story commercial and light industrial facilities; up to 14 properties would be impacted.

Location M-FW2

Also in the western half of the TRE corridor, this location is on the north side of the TRE track, between the track and W. Hurst Blvd. The site is occupied by two commercial and three industrial properties that would be impacted.

Location M-FW3

Less than ½ mile further east of the M-FW2 site, this location is also on the north side of the TRE corridor between the track and W. Hurst Blvd. The western portion of the site is undeveloped; the eastern portion is occupied by three commercial and one industrial properties, which would be impacted.

Location M-DAL1

Located in the eastern half of the TRE corridor, this site is less than a mile east of the TRE Irving Station near S. Britain Rd. on the north side of the TRE tracks. The site is occupied by one residential, one commercial, and one industrial property, which would be impacted.

Location M-DAL2

This site is located on the west side of Dallas on the north side of the TRE tracks. It is near the west end of the Mockingbird freight yard. The site centers on the alignment of a removed rail spur surrounded by commercial and industrial properties. Three industrial and 25 commercial properties would be impacted.

Location M-DAL3

This site is immediately east of and adjacent to M-DAL2 on the north side of the TRE tracks. One industrial property and up to 34 commercial properties would be impacted.

Location M-DAL4

Located about 1/2 mile east of M-DAL3, this site is also located on the north side of the TRE tracks and near the east end of the Mockingbird freight yard. Similar to M-DAL 2, the site centers on the alignment of a removed rail spur with commercial and industrial properties on each side. One industrial and up to 26 commercial properties would be impacted.

3.5 Alternative Speed Considerations

Three operating speeds, consistent with the TOPRS, were considered for each of the corridor alternatives described in Section 3.3. The three operating speeds are: 90 mph; 125 mph; and 220 mph. The corridor alignment design concepts described in Section 3.3 reflect the alignment requirements for each of these speed categories.

3.5.1 90 mph Operation

In order to operate at 90 mph, the alignments would require separation of freight service from the passenger service. In addition, a number of other improvements would be required, including: implementation of curvature and profile improvements; modification of the train control system; and procurement of diesel powered train sets that meet the 90 mph speed requirements. These rolling stock improvements focus on the acceleration/deceleration rates and maximum operating speed, plus premium passenger accommodations to meet the comfort and technology expectations of today's intercity rail passengers.

3.5.2 125 mph Operation

Operation at 125 mph can be accomplished with the use of either diesel or electric locomotives, although the latter provides faster acceleration and deceleration characteristics. It is assumed that the service would be fully grade-separated with no shared track with freight or commuter rail service, and no at-grade crossings with roadways.

The track alignments would be designed for a maximum allowable speed of at least 125 mph and up to 160 mph (Class 7 track according to the FRA's Track Safety Standards in 49 CFR Part 213, Subpart G). Curves would be designed to the highest speeds possible based on design criteria, train performance models, and local conditions and are not typically held to the maximum allowable operating speeds. In some locations the minimum allowable speed of 125 mph may not be feasible due to constraints related to the urban environment of the Metroplex; in these areas the speeds may be reduced to less than 125 mph as detailed in the screening and reflected in the travel times and ridership estimates.

3.5.3 220 mph Operation

The 220 mph operating speed, as defined by TOPRS, represents an electrified system that is fully grade-separated. This service type could only reach its maximum speeds of 220+ mph outside of existing transportation corridors because existing railroad alignments are not compatible with the speeds and they do not have the required room for separation of freight and high-speed rail. In areas where this service type is within existing transportation corridors or within constrained right-of-way that may impede the design, it would operate at lower speeds and be reflected in the travel times and ridership estimates.

3.6 Initial Corridor Service and Operating Characteristics

The operating plan elements for this evaluation include travel time, frequency of service, span of service and how the proposed service would be integrated with other passenger and freight services.

Travel Time – An operating simulation was completed for the operation of the 90 mph, 125 mph and 220 mph services along each of the corridors. The simulation established the optimum travel times for the corridors and the shortest travel times achievable for the alternatives. This maximum speed provided the shortest express service travel time achievable along the corridors as 35 minutes. In contrast, the current TRE one-way travel time of 55 minutes includes some limited mixed operation with freight services entering each downtown area of Dallas and Fort Worth, plus several station stops along the way.

Frequency of Service – The frequency of service was initially defined to reflect the travel demand expectations for each corridor, plus the incremental opportunities to add in-line stations at large activity centers, as appropriate. This definition of initial frequencies first examined the current levels of service operated along the TRE. TRE operates a generalized 30-minute headway or average time between trains in the weekday peak travel periods of 7-9am and 4-6pm, and 60-minute headways during most of the remaining weekday span of service and the full duration on weekends and holidays. This was an iterative process that was considered as part of the ridership demand methodology described in Section 4.4.3.

Span of Service - The service plan includes a span of service that reflects the travel demand profile of the corridors. The travel demand market within the corridors connecting Fort Worth and Dallas reflect a 24-hour daily travel pattern as evidenced by the hourly vehicle counts along I-30. It was assumed that the proposed alternatives would be limited by the span of service on the connecting services and the demand profile for the more centralized activity centers each will serve. As such, the span of service would be closer to 14-16 hours per day and would apply uniformly across all alternatives.

Service Integration – This aspect of the operating plan focuses on the integration or separation of the proposed new alternatives with existing TRE/Amtrak services and/or freight or full dedicated alignment that is clear of any service delays from other services. Another aspect of service integration is the separation for grade crossings with vehicular traffic. This similarly adds delay to travel time, plus safety considerations with the number and design of the crossings.

3.6.1 Summary of Service and Operating Characteristics

Sections 3.5 and 3.6 defined the speed categories and operating characteristics that would inform the definition of each corridor alternative and be employed in their evaluation. In order to evaluate each of the alternatives at the three operating speed categories described above, their service and operations characteristics provided key input to the development of ridership demand forecasts. In addition to the operating speed and other service and operational considerations, other factors were also considered. These include:

- potential station locations that could be served – these include options for terminal stations in both Dallas and Fort Worth, as well as intermediate station locations, specific to each alternative;
- trainset characteristics – consideration was given to the use of diesel-hauled and electric trainsets;
- the potential for a future one-seat ride between Dallas and Houston; and
- trip time – based on the items described above, Train Performance Calculations (TPCs) were assessed in order to identify the corresponding trip time for each alternative.

4.0 Screening Methodology

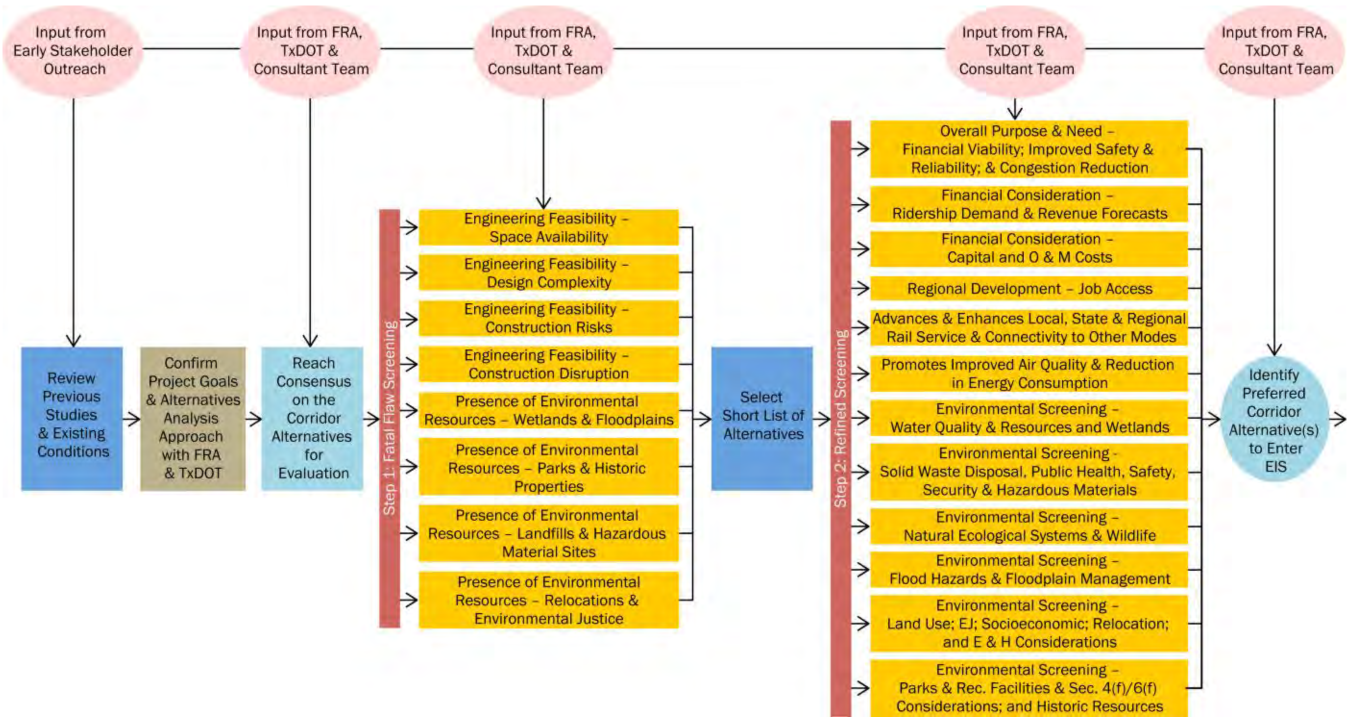
4.1 Overview of Screening Approach

This chapter presents the screening process used to evaluate the corridor alternatives described in Chapter 3. The process includes the screening methodology comprised of two-steps, beginning with a fatal flaw analysis of the critical aspects of each corridor alternative and then a more detailed Step 2 refined screening of the most viable remaining corridor alternatives. The analytical results from applying this methodology are included to present the quantitative inputs to the evaluation process. The findings and evaluation are provided in Chapter 5.

4.2 Screening Process

The two-step screening process developed for the alternatives analysis includes the purpose and need criteria developed early in the study outreach efforts, the engineering feasibility criteria for the speed and alignment options within each corridor and the environmental considerations identified in the alternatives analysis. This process is illustrated in Figure 4-1 below.

Figure 4-1: Two-step Screening Process



Step 1 provides the Project's fatal flaw review of the three initial corridor alternatives, including an assessment of the study purpose and need elements, an examination of the engineering feasibility and environmental considerations of the speed options within each corridor. The engineering criteria include measures of alignment space, complexity and risk. Environmental considerations focus on the potential for significant impacts and/or measurable mitigation efforts.

Step 2 of the process examines the corridor alternatives that passed the fatal flaw review from Step 1 and employs a greater degree of quantitative and qualitative analysis to measure their effectiveness in fulfilling the regional priorities for high speed rail service in the corridor between Dallas and Fort Worth.

4.3 Step 1 – Fatal Flaw Review

As noted above, the Fatal Flaw Review evaluates the corridor alternatives defined in Section 3.3 on their ability to address the Purpose and Need of the project as outlined in Chapter 2, and evaluates each alternative corridor for engineering feasibility and potential environmental concerns. This step is intended to eliminate those alternatives that do not meet the Project's Purpose and Need, cannot reasonably overcome overly complex engineering challenges, or may result in significant environmental impacts. Each of the evaluation criteria is further described below.

4.3.1 Overall Purpose and Need

The overall purpose for the Project is to create a financially viable, safe, reliable and environmentally sustainable passenger rail service. The overall need for the Project is to decrease regional capacity constraints in the transportation system. The overall purpose and need measures were established through the initial study outreach efforts, as the priority objectives for the study alternatives evaluation process. To evaluate the ability of the corridor alternatives to meet the project's purpose and need, a series of criteria and corresponding measures were evaluated. The objectives and evaluation criteria shown in Table 4-1 were applied in the analysis of each alternative.

Table 4-1: Overall Purpose and Need Measures

Identity	Objective	Criterion	Measure	Quantity	Source
Overall Purpose	Create a financially viable, safe, reliable, and environmentally sustainable intercity passenger rail service	Financially Viable	Additional Funding Requirement	$ Subsidy	NCTCOG Mobility 2040 Plan
		Safety	Regional Traffic Accident Rate	per Million Vehicle Miles	NCTCOG Mobility 2040 Plan
			At-grade Crossings	Eliminations	DFWCES
		Reliability	Proportion of Grade Separated Alignment	% of Alignment	DFWCES
Overall Need	Need to ameliorate capacity constraints in the existing transportation system	Reduce Congestion	Increase in travel time due to congestion	Regional Travel Time	NCTCOG Mobility 2040 Plan

- Extent to which each alternative creates a financially viable, safe, reliable and environmentally sustainable passenger rail service addressing:
    - Financial viability based on any additional funding requirement(s)

- Safety considerations of the regional traffic accident rate change due to reductions in vehicle miles of travel and the number of at-grade crossings included in each alternative
- Reliability of service based on the proportion of grade separation posed for each corridor and speed option

- Extent to which each alternative decreases capacity constraints in the existing transportation system –to reduce regional travel times. The Alternatives Analysis approximated this objective through the ridership estimate for each alternative.

The specific measures for the Purpose and Need elements broadly include consideration of how each alternative fulfils the study's expectations.

4.3.2 Engineering Feasibility

As shown in Table 4-2, engineering feasibility was evaluated by answering the following questions:

- Is there sufficient clearance available in the corridor for the implementation of each alternative?
- Are there overwhelming problematic or complex challenges that would make certain corridors or portions there of difficult or excessively expensive to construct?

Table 4-2: Fatal Flaw Review – Engineering Feasibility

Identity	Objective	Criterion	Measure	Quantity	Source
Fatal Flaw Analysis	Engineering Feasibility	Integration within existing and proposed infrastructure	Space Availability	Level of Construction Feasibility	DFWCES
			Design Complexity	Extent of Grade Separation	DFWCES
		Operational envelope clearance options within corridor	Construction Risks	Level of Construction Complexity	DFWCES
			Construction Disruption	Impact on Transportation	DFWCES

Notes to this and all other tables, as appropriate: "Source" refers to the originator of the information included in the tables; DFWCES = the Project team, including TxDOT consulting staff and FRA Monitoring & Technical Assistance Contractor staff; NCTCOG = North Central Texas Council of Governments

These engineering criteria were used to gauge the feasibility of developing an alternative within each corridor and to include measures of the magnitude of engineering challenges. These measures reflect the spatial ability to fit alignments into the corridors; a measure of the design complexity based on the extent of grade separation required – especially below grade portions; the measure of construction risks due to the constraints of the construction envelope available in each corridor; and the impact on other existing transportation services already operating within each corridor. The data sources for these evaluation criteria include this alternatives analysis and the results of the regional long range plan – The Metropolitan Transportation Plan for North Central Texas Council of Governments Year 2040 Regional Mobility Plan (NCTCOG Mobility 2040 Plan).

4.3.3 Environmental Screening

The environmental fatal flaw screening assessed significant environmental effects for each corridor alternative. The presence of a number of environmental resources was evaluated, based on a Geographic Information Systems (GIS) analysis and desktop level research. The air quality improvement potential noted in the Project's Purpose and Need was not considered in the Step 1 analysis.

Although environmental resources are present within each of the three study corridors, there are opportunities to elevate, tunnel, or shift the alternative alignments within each corridor from one side of the existing infrastructure to the other at various locations to avoid or minimize effects to these and other environmental resources and established land uses. Since the environmental resources evaluated as part of this Step 1 environmental screening are present within all three of the corridor alternatives and since there are opportunities to refine alternatives within each corridor, no environmental fatal flaws were identified for the three study corridors.

The station and operations and maintenance (O&M) facility locations were selected based on the alternatives that proceeded to the Step 2 environmental constraints screening. Therefore, environmental effects associated with station and O&M facility locations were evaluated as part of the Step 2 Refined Environmental Screening.

4.4 Step 2 – Refined Screening Process

The alternatives that met the Step 1 evaluation criteria and "passed" the Step 1 screening process were carried forward into the Step 2 evaluation process. Step 2 includes the estimation of quantitative aspects of each alternative corridor, including speed and technology options. In addition to the purpose and need screening aspects identified in the study outreach, there are project planning elements that are included in the Step 2 alternatives analyses to account for the specific characteristics of each alternative corridor and speed and technology option.

These measures were developed through the early study outreach process that included the more detailed purpose and need elements and the additional project planning, financial, engineering and environmental elements considered in the evaluation process. The quantitative evaluation factors include ridership, passenger revenue and the capital and operating and maintenance cost of each option, along with environmental factors. These factors were then used to comparatively measure the performance of each alternative.

While the results of Step 1 are not discussed in detail until Section 5.1, it is important to note that the I-30 Corridor was eliminated from further consideration based on the Step 1 analysis for reasons including significant design and construction feasibility and constraints and although not required for the Step 1 evaluation, the capital costs associated with the I-30 Corridor are approximately double that of the other two corridors.

4.4.1 Expanded Purpose and Need Measures

Step 2 of the screening process included more robust analysis of each corridor alternative, as shown on Table 4-3.

Table 4-3: Expanded Purpose and Need Measures

Identity	Objective	Criterion	Measure	Quantity	Source
P1	Advance the local, state and regional high-performance rail network	State Rail Plan Connections	State Rail Line Connections	Number of Rail Lines	DFWCES
P2	Enhance connectivity to existing and planned passenger rail services, airports, roadways, bicycle and pedestrian facilities, and be competitive with private automobile travel and air travel	Airports	Direct and Transfer Airport Connections	Number of Airports	DFWCES
		Station Access	Station Access Modes	Number of Modes	DFWCES
		Competitive With Auto Travel Time	Auto and Rail Travel Time	Auto - Number of Minutes	NCTCOG Mobility 2040 Plan
				Rail - Number of Minutes	NCTCOG Mobility 2040 Plan
P3	Promote improved air quality and reduced transportation energy consumption	Reduce Energy Consumption	Energy Savings	BTUs	NCTCOG Mobility 2040 Plan
			Difference in Vehicle Miles Traveled	VMT	NCTCOG Mobility 2040 Plan
P4	Augment economic development opportunities	Improve Accessibility	Difference in Vehicle hours spent in delay	Vehicle Hours	NCTCOG Mobility 2040 Plan
N1	Planning for rapid population and economic growth	High Speed Rail Ridership	Average Daily Trips	Trips	DFWCES
N2	Enhancing transportation connectivity to, from, and within the Metroplex	Improved Accessibility	Hourly Capacity	Miles	NCTCOG Mobility 2040 Plan
N3	Improving air quality within the Metroplex	Reduce Carbon Emissions	Carbon Emissions	Auto to Transit Trips	NCTCOG Mobility 2040 Plan

The features of each criterion shown in this table are described by the specific objectives, the measures used, the quantity for the measure and the source for each criterion – either the NCTCOG 2040 Mobility Plan or the DFWCES study analysis efforts. They broadly include consideration of how each alternative:

- **Advances the local, state and regional high-performance rail network through additional connections to the high speed rail network.** The State Rail Plan includes proposed corridors with high speed rail services. Achieving this objective was measured by the opportunity for direct transfers at each station that connects with the rail network including Dallas, Fort Worth and Arlington, and preference for the higher speed options in accordance with the State Rail Plan.
- **Enhances connectivity and the transportation network for the Metroplex.** This connectivity objective was measured by the three criteria: one each for the three major passenger transportation modes of airport access, rail station access and competitive auto/rail travel times.
  - Direct and transfer connections to the region
  - Competitive travel times in the region, particularly with the auto mode along the study corridors
- **Promotes improved air quality and reduced energy consumption.** Air quality improvement and reduced energy consumption are measured by the diverted travel from the auto mode to the rail alternatives. Reduced auto travel decreases energy consumption, and thereby improves air quality.
- **Augments economic development opportunities of the Metroplex.** Improved regional access is measured in the regional planning model by the vehicle hours spent in delay. In this alternatives analysis, this is approximated by the diversion of auto travellers to rail.
- **Plans for population and economic growth.** This was measured as the number of rail passenger trips estimated for each alternative.
- **Enhances transportation connectivity within the Metroplex.** This was measured by the passenger capacity of each alternative.

4.4.2 Study Planning Measures

The Step 2 alternatives analysis process includes the expanded purpose and need elements, plus those study planning measures that utilize the evaluation results of the alternatives analysis planning process. These study-planning measures were similarly developed in order to account for the specific characteristics of each corridor alternative's speed and technology option. The speed and technology options are the 220 mph operation (220), 125 mph operation with electric locomotives (125E), 125 mph operation with enhanced diesel locomotives (125D) and 90 mph operation with conventional diesel locomotives (90D). These characteristics and their quantified measures are shown in Table 4-4, below.

Table 4-4: Study Planning Measures

Identity	Objectives	Criterion	Measure	Quantity	Source	TRE 220	TRE 125E	TRE 125D	TRE 90D	Hybrid 220	Hybrid 125E	Hybrid 125D	Hybrid 90D
Q1	Engineering Characteristics	Alternative Alignment	Alignment Length	Miles	DFWCES	33.59	33.59	33.59	33.59	35.93	35.93	35.93	35.93
Q2		Travel Time	Terminal to Terminal Travel Time	Minutes	DFWCES	23.48	25.31	23.98	37.83	27.74	29.03	27.70	41.85
Q3		Alignment Grade	Above Grade Proportion	Above Grade Proportion	DFWCES	82%	82%	82%	50%	94%	94%	94%	79%
Q4	Financial / Economic Characteristics	Ridership Demand	Average Daily Ridership	Trips	DFWCES	3,374	3,344	3,344	2,718	5,425	5,430	5,430	4,894
Q5		Capital Cost	Total Capital Cost	$ Billion Capital Cost	DFWCES	$5.79	$5.65	$5.27	$3.49	$6.87	$6.73	$6.32	$5.27
Q6		Operating Cost	Total Operating Cost	$ Million Operating Cost	DFWCES	$27.9	$25.8	$29.2	$29.5	$31.0	$28.9	$32.3	$32.7
Q7		Local Funding Available	Regional Funding Estimate	$ Billion Total Revenue	Mobility 2040 Plan	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9
Q8		Capital Cost	$ Capital Cost per Annual Passenger	$ Cap Cost / Annual Psgr	DFWCES	$4,702	$4,629	$4,318	$3,518	$3,469	$3,396	$3,189	$2,950
Q7			$ Capital Cost per Alignment Mile	$ Million Cap Cost / Mile	DFWCES	$172	$168	$157	$104	$191	$187	$176	$147
Q7		Operating Cost	$ Operating Cost per Annual Psgr	$ Ops Cost / Annual Psgr	DFWCES	$22.66	$21.14	$23.92	$29.74	$15.66	$14.58	$16.30	$18.31
Q7		Fare Revenue	Average Fare per Rider	$ Revenue	DFWCES	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00
Q7		Fare Revenue	Total Annual Passenger Revenue	$ Million Revenue	DFWCES	$9.85	$9.76	$9.76	$7.94	$15.84	$15.86	$15.86	$14.29

Notes to this and all other tables in Chapter 5: “Source” refers to the originator of the information included in the tables; DFWCES = the Project team, including TxDOT consulting staff and FRA Monitoring & Technical Assistance Contractor staff; NCTCOG = North Central Texas Council of Governments

These study planning measures were defined to include the following:

The Engineering Characteristics were used to measure the alignment and travel time aspects of each alternative, including:

- The alignment length was used to develop cost and impact unit measures.
- The travel times were inputs to the travel demand and operating cost estimates.
- Alignment above grade proportion was used to approximate the safety contribution through a corresponding reduction in at-grade crossings.

The Financial/Economic Characteristics were calculated to measure the performance of each alternative, as described below.

- Average daily ridership is a good indicator of the market potential attractiveness of each alternative. This includes connecting riders through the proposed TCR service in Dallas and TOPRS and regional trips between Fort Worth and Dallas.
- Capital cost estimates indicate the funding level required to design and construct each alternative. The higher speed alternatives result in higher capital cost estimates.
- Operating cost estimates indicate the ongoing funding required to operate and maintain each of the alternatives.
- Local funding available for the design and construction of the recommended alternative is $2.9 Billion as included in the NCTCOG Mobility 2040 Plan. This is the funding amount included in the plan, designated as "local funds." Additional funds will be required from local, state, federal and other sources to fulfil the funding required for capital costs.
- Average fare per passenger was estimated as a constant average fare of $8.00 per trip. The actual average fare will likely vary depending upon the alternative selected for implementation.
- Total passenger revenue was calculated with ridership and average fare data to identify the level of annual funding support necessary for each alternative at this fare level.

An overview of how these key measures were defined and developed is provided in Sections 4.4.3 through 4.4.7, below.

4.4.3 Ridership Demand Estimation

This section presents a discussion on the methodology used for the travel demand modelling effort and a summary of the ridership/revenue results from the application of the model. The specific local and regional input data resources, the integration of the intra-urban, inter-city and air travel model components, and the key ridership and revenue outputs are provided.

4.4.3.1 Travel Demand Background

The purpose of the travel demand evaluation is to estimate the potential ridership that each alternative corridor and service type could attract. The ridership estimates are based primarily on alignment characteristics, travel time and station options, since a uniform baseline fare was used for all alternatives. A detailed description of the Ridership Demand Forecasting Methodology, completed by WSP/Parsons Brinckerhoff Inc., is provided in Appendix C. The key inputs to the ridership demand forecasting effort were discussed in Section 3.5, and include travel time, frequency of service, span of service, uniform fares, parking availability and cost.

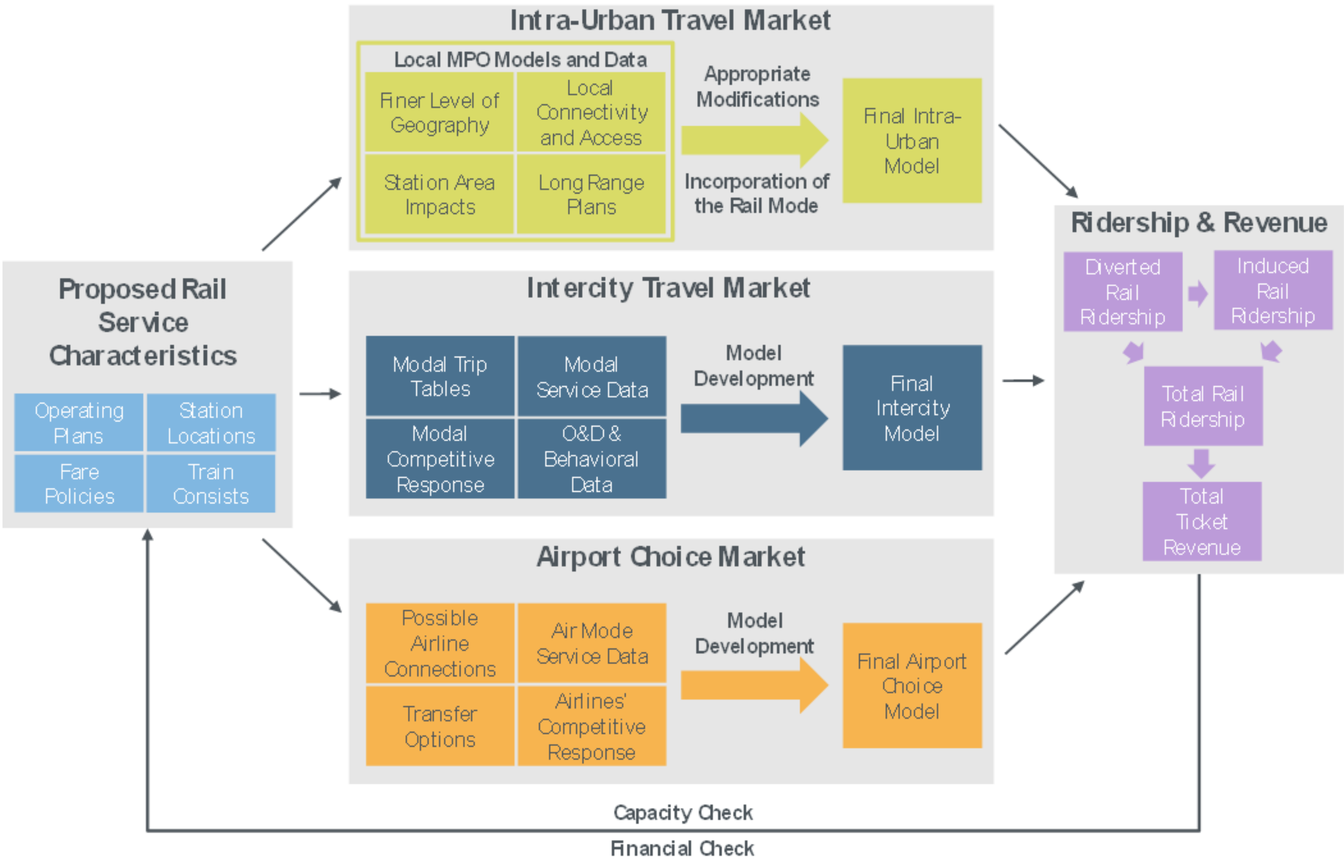
The ridership analysis included an evaluation of four different technologies: 90 mph conventional diesel powered locomotives, 125 mph enhanced diesel powered locomotives, 125 mph electric powered locomotives, and 220 mph operation for 12 different scenarios of station groupings and alignments within the corridor alternatives. The initial steps included performing a series of ridership analyses on the scenarios representative of the TRE and Hybrid corridor alignments with different technology, station combinations, and fares. These are the two corridor alignments remaining after the Step 1 screening. Results at the end of each round were analyzed to determine scenarios to be carried forward to the next round of ridership analysis. The purpose was to compare the ridership performance results by technology and fare variation and station performance through all scenarios.

4.4.3.2 Travel Demand Model Development

It should be noted that because the Project is part of a developing high-speed rail network linking two north/south high-speed rail corridors, and because there is an existing commuter rail service between Dallas and Fort Worth, all of the alternatives evaluated assume that TOPRS and TCR are operational by Year 2040. Both projects are mentioned in the North Central Texas Council of Governments' (NCTCOG) Mobility 2040 Plan (March 2016), but are not included in the Dallas-Fort Worth Expanded Travel Demand Model (DFX) for the 2040 planning horizon or on the list of fiscally constrained projects for the region.

As the Metropolitan Planning Organization for the Metroplex, NCTCOG maintains the DFX for the region. The ridership demand forecasting team worked in concert with NCTCOG and TxDOT to determine the best approach to integrating high-speed rail into the DFX model. Figure 4-2 shows the ridership demand forecasting framework which was initially employed in the TOPRS Service Development Plan and service-level EIS to address intra-urban and intercity and airport and airport travel markets. This framework has a number of unique strengths that facilitates the successful development of robust and credible ridership and revenue forecasts and guided the ridership demand forecasting for the alternatives analysis.

Figure 4-2: Ridership Demand Forecasting Methodology Framework



Source: TOPRS Service Development Plan, CH2M Hill 2016

The ridership forecasting model included the capability to forecast intra-regional high speed rail trips and their effect on destination choice, treatment of special markets unique to HSR, and the effects of inter-regional HSR trips on the transportation system within the Dallas – Fort Worth region. The work effort required integration of this enhanced modeling system with inter-regional HSR forecasts being developed separately. Thus, a number of critical model enhancements were developed to provide the necessary detail for the evaluation of changes in the overall transportation network. They include: Mode Choice Expansion; Latent and Induced Demand; Air Passenger Model; Special Events Model; Inter-regional Model Enhancements; Mode Choice Expansion; and Intercity Modeling for Dallas to Houston Corridor.

The applicable model enhancements were then integrated into the DFX and Texas Statewide Analysis Model (SAM) models. The SAM has been enhanced with an inter-regional HSR system component. The enhancements also include integration of the SAM outputs used as inputs into the enhanced DFX. The inputs to the resulting travel demand model used existing regional travel inputs from the NCTCOG model and State of Texas travel characteristics. This combination of intra-urban and inter-city travel characteristics was designed to improve its ability to estimate total travel demand on a corridor basis, and then estimate the diversion to the Dallas – Fort Worth corridor alternatives. The results of these two components were then carefully combined in a predefined process to provide total revenue and ridership for each alternative. These ridership estimates were completed for each specific corridor alternative and its individual service characteristics (speed/frequency/assumed stations/etc.).

4.4.3.3 Corridor Travel Market

The travel market for the Dallas to Fort Worth rail corridors is composed of three main submarkets—inter-city, intra-urban and air. These three submarkets are the main ridership sources for the proposed rail service, as described below.

- Inter-city travel to and from neighbouring cities that are accessible to the corridor through proposed high speed rail networks and other existing intercity modes – including auto, direct air, bus and other shuttle services
  - Intercity travel by auto: current auto trips made on the corridor which terminate in neighbouring cities outside the corridor
  - Intercity travel by air: current air trips starting or ending within the corridor and connecting to another city potentially served via the inter-city high speed rail services planned for Dallas and Fort Worth
  - Intercity travel by bus: current bus/van/shuttle trips made on the corridor that continue to a neighbouring city within the proposed high speed rail networks
  - Intercity travel by rail: Amtrak Texas Eagle (Dallas – San Antonio) and Heartland Flyer (Oklahoma – Fort Worth) services.
- Intra-urban travel within the corridor – including auto, commuter rail and other public transit between the two neighbouring cities of Dallas and Fort Worth and midline stations along the two corridors.
- The Connect Air Market (Airport Choice) is for air passengers traveling to or from a destination out of the modelling area that may use the Dallas to Fort Worth corridor to access a hub airport within the corridor. The corridor has two such hub airports, Dallas Fort Worth (DFW) and Dallas Love Field (DAL). DFW is the largest hub airport and, with improved rail access into the region, some of these passengers might divert to corridor rail alternatives.

4.4.3.4 Station Alternatives

There are two station locations within each of the terminal cities and three midline stations along the three corridors, as shown on Figure 3-2. Even though not required for Step 1 of the evaluation of alternatives, capital cost estimates (discussed in Section 4.4.4) and initial ridership demand forecasts were developed for all three corridors, including the I-30 Corridor which ultimately did not survive the Fatal Flaw evaluation in Step 1. This was done to confirm the methodology and inform the overall evaluation process. The station alternatives considered are:

- Fort Worth has two main rail stations – Texas and Pacific (T&P) and the Intermodal Transportation Center (ITC). The ITC is located within the Fort Worth central business district at the entry to the central area. The T&P is located further along the alignment into the southern portion of the central business district.
- Centreport is the existing midline station along the TRE Corridor.
- County Line is the midline option along the northern, TRE portion of the Hybrid Corridor.
- Arlington Station is the midline station along the I-30 Corridor and the Arlington segment of the Hybrid Corridor.
- Dallas has two main central Dallas Stations – Union Station and the Dallas terminal station of the proposed Texas Central Railway (TCR).

The three corridor alternatives have access to the two terminal stations in Fort Worth and Dallas.

The station stopping options are presented below in Table 4-5. These station stopping patterns were placed into eight station groupings for the ridership demand estimation. Station groupings S1 and S2 were applied in the ridership demand forecasting process to include all stations and determine their individual contributions to the ridership estimates. Fort Worth T&P is located along the end of the alignment past ITC. Station groupings S4 and S5 include only the ITC Fort Worth Station, plus only one mid-line station on each of the two corridors. Station groupings S7 and S8 are similar, but without the Dallas Texas Central Railway Station – TCR. Station groupings S10 and S11 are similar, but without the other main Dallas Union Station. These eight station stopping groups covered each of the three corridors and station options.

Table 4-5: Corridor and Station Stopping Combinations for Ridership Estimation

	Station Groups											
	TRE	*H*	*I30*	*TRE*	*H*	*I30*	*TRE*	*H*	*I30*	*TRE*	*H*	*I30*
Station	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Fort Worth T&P	X	X	X									
Fort Worth ITC	X	X	X	X	X	X	X	X	X	X	X	X
Centreport	X			X			X			X		
County Line		X										
Arlington		X	X		X	X		X	X		X	X
Dallas Union	X	X	X	X	X	X	X	X	X			
Dallas TCR	X	X	X	X	X	X			X	X	X	X

Source: WSP/Parsons Brinckerhoff Inc. 2016

4.4.3.5 Service Alternatives

The study team defined a total of 12 corridor alternatives for the three corridors from which ridership forecasts were developed. As previously noted, the three operating speeds and four trainsets that were included in the definition of the alternatives are:

- 90 mph conventional diesel locomotive,
- 125 mph enhanced diesel locomotive,
- 125 mph electric propulsion, and
- 220 mph high speed rail technology (i.e., Shinkansen).

The ridership estimation strategy estimated ridership for the speed options and with the baseline fare level of $8.00.

4.4.4 Capital Cost Estimation

Capital costs were estimated for each of the corridor alignment alternatives; the detailed methodology is provided in Appendix C. These costs were estimated based on the alignment definitions, station options, access configurations and the speed profile options described in Chapter 3. Conceptual capital costs were estimated using basic infrastructure costing categories while applying recent and designed rail project costs. These cost estimates have reflected relevant transportation industry standard unit costs applied to the estimated quantities. The quantities shown in the estimates were extracted from the corridor alternative alignments and categorized by their speed profiles. The capital cost estimates were then used in the cost related criteria for the alternatives analysis.

The capital costing methodology provided cost estimates at a level of detail applicable to this concept-level phase of project development. Unit costs per mile were developed to compare the capital costs of alignments, facilities, and train technologies. This approach provides capital cost estimates in December 2015 dollars, then escalated to base year – 2016.

The 10 FRA Standard Cost Categories are shown in Table 4-6. Each SCC is further broken down into subcategory items that further detail the capital cost estimate of each major asset category. The capital cost estimates only include categories 10 through 90 as category 100 is finance charges. The value for category 100 will be determined in subsequent stages of project development.

The capital cost estimates apply allocated and unallocated contingencies. Allocated contingency is added to each cost category, based on an assessment of the level of available design information, means and methods, and site accessibility available for individual items of work. Unallocated contingency includes more widespread uncertainties not associated with individual construction activities. Unallocated contingency was based on a percentage of the total project cost for categories 10 through 80.

Table 4-6: Federal Railroad Administration Standard Cost Categories

Standard Cost Categories
10 Track Structures and Track
20 Stations, Terminals, Intermodal
30 Support Facilities: Yards, Shops, Administration Buildings
40 Sitework, Right-of-Way, Land, Existing Improvements
50 Communications and Signaling
60 Electric Traction
70 Vehicles
80 Professional Services
90 Unallocated Contingencies
100 Finance Charges

For the Project alternatives, the allocated contingency is 30 percent to 50 percent to mitigate the many unknowns at this level of design. Allocated contingency of 50 percent was applied to Track Structure for the last 5 mile approaches to Fort Worth and Dallas to account for the many unknowns in mitigating rail capacity issues in Fort Worth and infrastructure issues in Dallas. A 30 percent contingency was applied to all of the remaining Track Structure and associated infrastructure – Stations, Systems, Storage and Maintenance Facilities, and Land Acquisition Costs to mitigate the many unknowns at this level of design. The unallocated contingency is assumed at 15 percent for the conceptual level cost to mitigate the uncertainty in the overall implementation of the project including schedule, governance, stakeholder agreements and other issues. Project contingencies reduce in value as the design and delivery approach clarifies in line with progress and detail of the overall project development. Table 4-7 lists the assumed contingencies for capital cost estimates utilized for this project.

Table 4-7: Contingency Values for Each Standard Cost Category

Standard Cost Categories	Contingencies
10 Track Structures and Track	30 - 50%
20 Stations, Terminals, Intermodal	30%
30 Support Facilities: Yards, Shops, Administration Buildings	30%
40 Sitework, Right-of-Way, Land, Existing Improvements	30%
50 Communications and Signaling	30%
60 Electric Traction	30%
70 Vehicles	30%
80 Professional Services	30%
90 Unallocated Contingencies	15%
100 Finance Charges	0%

Source: WSP/Parsons Brinckerhoff Inc. 2016

The contingency values were included for each of the cost categories. A 30% amount was included as an allocated contingency to each of the cost categories. A range of 30 percent to 50 percent contingency was included for the track and structural components, depending upon the cost risk of escalation. The higher 50 percent contingency was assigned to the segments entering the central business districts of Dallas and Fort Worth. These segments include corridor constraints that will require further engineering efforts to determine the preferred alignment options, some of which may require higher unknown costs. An additional 15% unallocated contingency was included for the wider unknowns at this stage of study and cost development. A 0% contingency amount was included for the finance costs since these have not been defined yet.

Stations - The station cost estimates are based on improvements to and the use of existing or proposed terminal facilities in the Dallas and Fort Worth central business districts and one or two new intermediate stations along each alternative corridor. For the purposes of the estimated costs, it is assumed that the existing Fort Worth T&P or the ITC and the Dallas Union Station or the proposed TCR station would provide the station buildings for the terminal stations. Costs for platforms and accessibility to those platforms for the Project are included as part of the estimates. Intermediate station sites include potential station locations in Arlington and at the TRE CentrePort Station. A standard unit cost was used for intermediate stations treating them initially as large stations per Amtrak's Station Program and Planning Guidelines (2013). The intermediate station building costs are represented as a lump sum per station.

Support Facilities - Support facility requirements were generally determined based on the proposed operation on each of the two corridors, informed by ridership demand forecasts. Support facilities include vehicle storage and light maintenance facilities, heavy maintenance facilities, wayside maintenance facilities, and administrative facilities. These costs are lump sum costs and based on past similar project maintenance facility layouts for similar fleet sizes.

Sitework, Right of Way, Land, Existing Improvements – As the Project progresses through the design process, it will include an evaluation of right-of-way needs that may consist of up to three types of property: Urban, Suburban, and Undeveloped right-of-way acquisition. The following list provides additional definition of each type of property for estimating purposes. A minimum right-of-way width of 60 feet was assumed for the Project.

- Urban Right-of-Way - Purchase of property in the densely developed areas of downtown Dallas and Fort Worth
- Suburban Right-of-Way - Purchase of property in less densely developed areas outside of downtown Dallas and Fort Worth, but with some improvements on the purchased land
- Undeveloped Right-of-Way Purchase of property without improvements (land only)

Vehicles - Vehicle unit cost estimates include diesel electric and electric vehicle technologies satisfying operating speeds of 90mph (diesel electric), 125mph (diesel electric or electric), and 220mph (electric). Vehicle purchase costs (including design) are included in FRA standard cost category 70 on a cost-per-trainset basis. The trainset number of cars and seating capacity are based on the ridership analysis and service operating plan developed for the Project. Costs for an additional 20% of vehicles (spare cars) and replacement parts are included in the estimate. The cost of vehicles were determined from recently completed studies and vehicle purchases within the United States and publicly available data regarding recent sales of comparable equipment to other High Speed Rail projects around the world.

Professional Services - The costing approach for professional services was based on percentages of the construction cost for categories 10 through 60. Professional services costs for Cost Category 70: Vehicles was excluded because professional services for vehicle procurement, design, and manufacturing is typically included in the cost of the vehicles. These percentages are common practice percentages adjusted for the anticipated magnitude of the capital cost. The following list presents the assumed percentage values that were used.

- 80.01 Service Development/Service Environmental: Not Applicable (currently underway)
- 80.02 Preliminary Engineering/Project Environmental: 4%
- 80.03 Final Design: 7%
- 80.04 Project Management for Design and Construction: 3%
- 80.05 Construction Administration and Management: 3%
- 80.06 Professional Liability and Other Non-Construction Insurance 0%, Negligible
- 80.07 Legal; Permits; Review Fees by Other Agencies and Cities: 0%, Negligible
- 80.08 Survey, Testing, and Investigation: 1%
- 80.09 Engineering Inspection: 1%
- 80.10 Start Up: Not Applicable

Unit Costs and Units of Measure – The definition of the alternatives for each corridor included the asset categories and elements to conform to the FRA Standard Cost Categories presented in Table 4-6. The Track Structures are defined by the alignment grade and track type—ballast and non-ballast—on a route mile basis. Stations are defined by the number of terminal and midline stations. Systems are defined by the communication, power and catenary requirements on a route mile basis. Vehicle storage and maintenance facility requirements were defined for the facility, servicing and maintenance of way requirements on a per vehicle basis. Existing land use cost differential was accounted by the development intensity. Acquisition cost was defined on a per acre basis for developed and undeveloped land use and then for the density of that development use.

Unit costs were derived from multiple comparable services that have been either evaluated (such as the TOPRS, California High Speed Rail, Midwest Regional Rail Initiative, Florida High Speed Rail, High Speed Rail Feasibility studies completed by the Georgia Department of Transportation and others) as well as Amtrak Acela service currently in operation in the northwestern U.S. The unit capital costs developed from these sources were in a base year of prior value and then escalated to Year 2015 values are presented in Table 4-9. The base years of the unit cost estimate were from year 2010 to 2015. These unit costs served as the basis for estimating per mile costs for analysis of the corridor alternative alignments and technologies. The project team updated all unit costs to 2015 dollars for the design and construction of the Project. Escalating these unit costs to 2015 dollars was completed by utilizing the Engineering News Record Construction Cost Index (CCI) for Dallas – Fort Worth.

Quantities - Conceptual quantities were developed based on the engineering plans for the FRA cost categories in line with the percent complete of drawings and specifications. Capital asset quantities by FRA Standard Cost Category are presented in Table 4-10 for each corridor alternative. These initial quantities are related to structures, track roadbed (ballast and non-ballasted), rail, track materials, turnouts, stations, support facilities, right-of-way, communications and signaling, electric traction, and vehicles. These asset categories have corresponding unit costs as noted in the prior table. The alternative asset quantities are defined to be comparable with the units of measure developed for each cost category. Quantities that are specific to preliminary engineering and final design including earthwork, sitework, and utilities are estimated as part of the per mile costs for the analysis of alternatives. These undefined quantities can be significant cost drivers and thus are also addressed within the allocated and unallocated contingencies. Quantities were based on plan and profile drawings, typical sections, and sketches created during the conceptual and preliminary engineering tasks. The station cost estimates are based on improvements to and the use of existing or proposed terminal facilities in the Dallas and Fort Worth central business districts and the quantities of one or two new intermediate stations along each alternative corridor. The quantities were applied to the unit capital costs to estimate the capital costs by asset category. The resulting capital costs for each corridor alternative are presented in the following section.

Table 4-8: Unit Capital Costs for Each Asset Category

	Unit	Unit Costs - Low	Unit Costs - High	ENR Conversion Factor	Adj. Unit Costs - Low	Adj Unit Costs - Avg	Adj. Unit Costs - High	Source - Note
Track Structure								
Tunnel	Route Mile	$ 247,438,514	$ 427,438,514	1.15	$ 285,000,000	$ 389,000,000	$ 492,000,000	CA, Midwest
Trench	Route Mile	$ 29,630,871	$ 88,188,514	1.15	$ 34,100,000	$ 67,800,000	$ 101,500,000	Low FLA, High Midwest
At Grade Non-Ballasted	Route Mile	$ 8,438,514	$ 17,438,514	1.15	$ 9,720,000	$ 14,900,000	$ 20,080,000	CA, Midwest, FLA
At Grade Ballasted	Route Mile	$ 7,172,737	$ 14,822,737	1.15	$ 8,260,000	$ 12,670,000	$ 17,070,000	CA Ballasted estimate 85 percent of Non-Ballasted
Embankment	Route Mile	$ 19,188,514		1.15	$ 19,900,000	$ 22,100,000	$ 24,300,000	Single data point (Midwest) -- Low/High 90/110 per
Low Aerial	Route Mile	$ 61,395,173		1.15	$ 63,600,000	$ 70,700,000	$ 77,800,000	CA, FLA, Midwest - AVG Low (20') - Low/High 90/11
High Aerial	Route Mile	$ 81,834,181		1.15	$ 84,800,000	$ 94,200,000	$ 103,600,000	CA, FLA, Midwest - AVG High (30-50')- Low/High 90/
Stations								
Terminal	Each	$ 197,363,075	$ 300,000,000	1.15	$ 227,000,000	$ 286,000,000	$ 345,000,000	Two data points (Low CA LA Union Station HSR acc
Mid Line	Each	$ 43,092,730	$ 81,662,741	1.15	$ 49,600,000	$ 71,800,000	$ 94,000,000	CA, Midwest, FLA (20 data points)
Systems								
Communication and Signaling	Route Mile	$ 3,700,000		1.03	$ 3,440,000	$ 3,820,000	$ 4,200,000	NEC Future 700 / RF - Low/High 90/110 percent
Electric Traction	Route Mile	$ 3,750,000		1.03	$ 3,480,000	$ 3,870,000	$ 4,260,000	NEC Future 710 / RF - Low/High 90/110 percent
Catenary and Pole	Route Mile	$ 3,220,000		1.03	$ 2,990,000	$ 3,320,000	$ 3,650,000	NEC Future 610 / RF - Low/High 90/110 percent
		$ 10,670,000		*0.90*				*Sum of Systems are backed out of Track structure u*
Storage And Maintenance Facilities								
Major Maintenance Facility	Each	$ 131,000,000	$ 239,000,000	1.15	$ 151,000,000	$ 213,000,000	$ 275,000,000	CA, Brazil, Australia
S&I Facility	Each	$ 32,750,000	$ 59,750,000	1.15	$ 38,000,000	$ 54,000,000	$ 69,000,000	S&I 25% of Major Maiintenance Facility
MOW Facility	Each	$ 4,830,000		1.03	$ 4,480,000	$ 4,980,000	$ 5,480,000	NEC Future (Dulles Metrorail)
Land Acquisition Costs								
Non-Developed	per acre	$ 4,000	$ 30,000	1.03	$ 4,130	$ 17,550	$ 30,960	NEC Future Rural / Undeveloped land in the N
Developed, Open Space	per acre	$ 435,600	$ 871,200	1.03	$ 449,000	$ 674,000	$ 899,000	NEC Future Derived from prior technical stud
Developed, Low Intensity	per acre	$ 2,178,000	$ 4,356,000	1.03	$ 2,250,000	$ 3,370,000	$ 4,490,000	NEC Future NEC Future Values used as high, l
Developed, Medium Intensity	per acre	$ 5,445,000	$ 10,890,000	1.03	$ 5,620,000	$ 8,430,000	$ 11,240,000	NEC Future
Developed, High Intensity	per acre	$ 10,890,000	$ 21,780,000	1.03	$ 11,200,000	$ 16,900,000	$ 22,500,000	NEC Future
Rolling Stock								
220 HSR Train Sets	Each	$ 29,000,000	$ 47,000,000	1.15	$ 33,400,000	$ 43,800,000	$ 54,100,000	UIC
125 Electric Loco	Each	$ 7,000,000	$ 10,000,000	1	$ 7,000,000	$ 8,500,000	$ 10,000,000	US RAIL CAR AND LOCOMOTIVE PROCUREMENT , 2
125 Desiel	Each	$ 6,000,000	$ 10,000,000	1	$ 6,000,000	$ 8,000,000	$ 10,000,000	US RAIL CAR AND LOCOMOTIVE PROCUREMENT , 2
90 Deisel	Each	$ 3,000,000	$ 6,000,000	1	$ 3,000,000	$ 4,500,000	$ 6,000,000	US RAIL CAR AND LOCOMOTIVE PROCUREMENT , 2
Coach	Each	$ 1,000,000	$ 2,000,000	1	$ 1,000,000	$ 1,500,000	$ 2,000,000	US RAIL CAR AND LOCOMOTIVE PROCUREMENT , 2

ENR Conversion - Engineering News Record Construction Cost Index (CCI) for Dallas – Fort Worth.

Source: WSP/Parsons Brinckerhoff Inc. 2016

Table 4-9: Capital Asset Quantities by Category for Each Alternative

	Unit	TRE - 220	TRE - 125E	TRE - 125D	TRE - 90D	I-30 - 220	I-30 - 125E	I-30 - 125D	I-30 - 90D	I-30/SH 360/TRE - 220	I-30/SH 360/TRE - 125E	I-30/SH 360/TRE - 125D	I-30/SH 360/TRE - 90D
Track Structure		3	5	7	9	11	13	15	17	19	21	23	25
Tunnel	Route Mile					10	10	10	10				
Trench	Route Mile												
At Grade Non-Ballasted	Route Mile												
At Grade Ballasted	Route Mile	5.15	5.15	5.15	15.81					0.97	0.97	0.97	7.7
Embankment	Route Mile												
Low Aerial	Route Mile	2.67	2.67	2.67	12.27	1	1	1	1	1.57	1.57	1.57	5.95
High Aerial	Route Mile	25.48	25.48	25.48	5.22	21.5	21.5	21.5	21.5	33.39	33.39	33.39	22.28
Stations													
Terminal	Each	0	0	0	0	0	0	0	0	0	0	0	0
Mid Line	Each	3	3	3	3	3	3	3	3	3	3	3	3
Systems													
Communication and Signaling	Route Mile	33.3	33.3	33.3	33.3	32.5	32.5	32.5	32.5	35.9	35.9	35.9	35.9
Electric Traction	Route Mile	33.3	33.3			32.5	32.5			35.9	35.9		
Catenary and Pole	Route Mile	33.3	33.3			32.5	32.5			35.9	35.9		
Storage And Maintenance Facilities													
Major Maintenance Facility	Each	1	1	1	1	1	1	1	1	1	1	1	1
S&I Facility	Each												
MOW Facility	Each												
Land Acquisition													
Non-Developed	Acres	0	0	0	0	0	0	0	0	0	0	0	0
Developed, Open Space	Acres	0	0	0	0	0	0	0	0	0	0	0	0
Developed, Low Intensity	Acres	0	0	0	0	0	0	0	0	0	0	0	0
Developed, Medium Intensity	Acres	0	0	0	0	0	0	0	0	0	0	0	0
Developed, High Intensity	Acres	0	0	0	0	0	0	0	0	0	0	0	0
Rolling Stock													
220 HSR Train Sets	Each	6				6				6			
125 Electric Loco	Each		6				6				6		
125 Desiel	Each			6				6				6	
90 Deisel	Each				8				8				8
Coach	Each		48	48	64		48	48	64		48	48	64

Source: WSP/Parsons Brinckerhoff Inc. 2016

4.4.5 Operations and Maintenance Cost Estimation

The Operations and Maintenance (O&M) Cost Estimation Methodology provided in Appendix D assures that the project O&M cost estimates were prepared in a consistent and uniform manner, organized and standardized in methods, and formatted to facilitate reviews and reporting for the evaluation of each corridor alternative. Operating cost estimates were prepared for both the TRE and Hybrid Corridors.

The O&M cost estimates are represented by key inputs of system capacity, service options and operating plans. Service options include ridership, route miles, annual operating days, annual trips, annual train miles, average ridership per train, cars per train, annual car miles, and stations. The speed and technology options are identical to those employed in the ridership demand forecasting effort, described in Section 4.4.1.

Parametric cost information from existing passenger rail operations and recently completed studies were used to develop the O&M cost estimates. Parametric costs were identified for the following overall O&M Cost Categories:

- **Maintenance of Way** – Cost of maintaining the track, signals, buildings, structures, bridges, etc.
- **Maintenance of Equipment** – Cost of layover and turnover servicing and preventive maintenance, wreck and accidents, and contractor maintenance.
- **Transportation (train movement)** – Operating cost of train crew, bus connections, train fuel, propulsion power, and railroad access.
- **Sales and Marketing** – Operating cost of advertising, marketing, and reservations.
- **Station** – Operating cost of station staff (ticketing, baggage etc.), building rent, utilities, and security and station maintenance costs—cleaning, trash pickup, lighting, fire, emergency egress, communication systems, and connecting bus/shuttle service.
- **General / Administrative Expenses**

4.4.6 Fare Revenue Estimation

The estimation of passenger revenue started with the existing commuter rail fares and then adapted to a market-based fare structure for the premium status of the higher speed rail service options in this alternatives analysis study. The initial effort was oriented to a calculation of the average fare rate for the TRE that connects Fort Worth and Dallas with a commuter rail service. This was than increased to rates that reflect the premium value of higher speed rail alternatives. All fares reflect one-way, 2015 prices.

The passenger fare assumptions are based upon subsidized precedents and without the benefit of detailed surveys reflecting unique Metroplex characteristics. Thus these fares are not expected to yield an operating profit/net revenue, in the way that an unsubsidized concessionaire or private operator would require.

Average fares make allowances for concessions and advance purchase discounts. In addition, the fare assumptions show no difference in fares charged from/to Dallas Union Station or TCR station; no difference in fares from/to Fort Worth T&P or ITC terminal stations; and no difference between business and non-business baseline fares. The baseline fares assumptions are thus:

- $8.00 average passenger fare Dallas – Fort Worth
- $4.00 average passenger fare to/from intermediate stations to terminal stations

The study determined that in the interest of the evaluation of alternatives on a comparable basis, these baseline fare rates were used in the ridership estimation process and the resulting passenger revenue estimation.

4.4.7 Environmental Screening

The Step 2 environmental screening was based on a more detailed comparison of the corridor alternatives carried forward from the Step 1 screening to determine whether some of the alignment alternatives within the selected corridors would result in potential environmental impacts substantially greater than other alternatives. The more refined environmental screening was developed within the context of the overall NEPA process.

The corridor alignments that were evaluated included alignments north and south of the existing rights-of-way as well as "refined" alignments that shift from north to south/east to west of the existing rights-of-way. Thus, the refined environmental screening was performed for the following six potential alignment alternatives within the TRE and Hybrid corridors:

1. **TRE North:** Alignment that runs exclusively to the north of the existing TRE rail infrastructure.
2. **TRE South:** Alignment that runs exclusively to the south of the existing TRE rail infrastructure.
3. **TRE Refined:** Alignment that shifts from the north and south of the existing TRE rail infrastructure in order to minimize environmental issues/concerns and optimize operations.
4. **Hybrid North:** Alignment that runs exclusively to the north of the existing I-30 highway infrastructure and TRE rail infrastructure and west of the existing SH 360 highway infrastructure crossing at Post and Paddock Road as part of the curve to the TRE.
5. **Hybrid South:** Alignment that runs exclusively to the south of the existing I-30 highway infrastructure and TRE rail infrastructure and west of the existing SH 360 highway infrastructure crossing at Post and Paddock Road as part of the curve to the TRE.
6. **Hybrid Refined:** Alignment that shifts from the north and south of the existing I-30 and TRE rail infrastructure and west of the existing SH 360 highway infrastructure crossing at Post

and Paddock Road as part of the curve to the TRE in order to minimize environmental issues/concerns and optimize operations.

This permitted an optimization of alignment alternatives from an environmental perspective. This Step 2 screening was based on a Geographic Information Systems (GIS) analysis and desktop level research from readily available state and federal databases. Fieldwork, modeling, and a detailed technical evaluation of alternatives in accordance with NEPA and FRA's procedures will be completed as part of the EIS.

Table 4-10, below, presents the environmental criteria that will be studied as part of the overall NEPA evaluation process, as discussed in the Dallas – Fort Worth Core Express Service Environmental Methodology Report provided in Appendix E. The table also specifies which criteria were screened as part of this alternatives analysis for the six alignment options described above, and those that will be studied in more detail as part of the EIS.

Table 4-10: Environmental Resources Analyses

Environmental Criteria	Studied In	
	AA	EIS
Air Quality		X
Water Quality and Water Resources	X	X
Noise & Vibration		X
Solid Waste Disposal	X	X
Natural Ecological Systems and Wildlife		X
Wetlands	X	X
Threatened & Endangered Species		X
Flood Hazards and Floodplain Management	X	X
Energy Resources		X
Utilities		X
Geologic Resources		X
Aesthetics		X
Land Use	X	X
Environmental Justice, Socioeconomic, Relocation, Elderly, Handicapped	X	X
Public Health, Safety, Security, and Hazardous Materials	X	X
Parks and Recreational Facilities and Section 6(f)	X	X
Historic Resources	X	X
Archaeological Resources		X
Transportation		X
Construction Impacts		X
Indirect and Cumulative Impacts		X
Section 4(f)	X	X

Table 4-11 presents the environmental evaluation criteria analyzed during the refined environmental screening process. In order to estimate potential effects, a preliminary environmental study area was identified for each alternative. The environmental study area for the alignments is limited to the ROW[1], with the exception of the environmental justice criteria, which includes a study area of the ROW plus 0.5 miles[2].

[1] While ROW widths can vary considerably, according to WSP / Parsons Brinckerhoff Inc., the right-of-way is approximately 70 feet wide throughout the project area (see Appendix E).
[2] The environmental justice study area was selected as the ROW plus 0.5 miles to assess the human health, economic, and social impacts on potential minority and low-income populations that utilize resources within the community (including accessibility to community resources and employment opportunities).

Table 4-11: Environmental Screening Criteria[3]

Environmental Screening Criteria	Measure	Alignment Study Area	Data Source	Description
Wetlands	Acres	ROW	-US Fish and Wildlife Service National Wetland Inventory -National Land Cover Dataset	National Wetland Inventory wetlands impacted
Streams	No. of Stream Crossings	ROW	National Atlas	Direct alignment crossing of waterways
Floodplains	Acres	ROW	Federal Emergency Management Act (FEMA)	100-year floodplain impacted
Parks & Recreational Facilities	No. Publically owned parks	ROW	-Texas Parks and Wildlife Department (TPWD) -Google Maps	Publically owned parkland
Threatened and Endangered Species	No. of elements of occurrence	ROW	-TPWD Texas Natural Diversity Database	Known locations of species based on at least one observation (representation of a known population of an element)
Historic Resources	No. of Historic Sites	ROW	-Texas Historical Commission -National Register of Historic Places	NRHP listed or eligible properties and districts impacted
Hazardous Material Sites	No. of sites	ROW	-Geosearch	Superfund, permitted industrial hazardous waste, radioactive waste, and treatment/disposal/ storage sites
Landfills	No. of sites	ROW	Texas Commission on Environmental Quality	Permitted solid waste disposal sites and landfills impacted
Land Use	Acres	ROW	North Central Council of Governments	Commercial, industrial, and residential land impacted
Environmental Justice	No. of census block groups of non-white residents (>50% of population)	ROW+ 0.5 mile buffer	US Census Bureau (2008-12)	Estimated non-white population affected
	No. of household income below poverty level	ROW + 0.5 mile buffer	US Census Bureau (2008-12)	Estimated population below the poverty line impacted
Relocations	No. of Buildings	ROW	Google Earth (manual count)	-Corridor: Residential and non-residential relocations required -Alignment: Residential relocations required

[3] In early 2015, the US Army Corps of Engineers (ACOE) issued a Record of Decision for the Dallas Floodway project, which will include the construction of the two recreational facilities: 1) Trinity River Standing Wave and 2) Santa Fe Trestle Trail. Both of these facilities are south of the DFWCES project and outside the project's area of impact. In addition, WSP/Parsons Brinkerhoff met with the ACOE in June 2015 to discuss potential impacts of the project and the ACOE did not express concern for the two recreational resources. NQ: Not Quantified

This information informed the approach utilized to assess each criterion and employed a ratio method to score the alignment, station, and O&M alternatives. Scoring for each environmental evaluation criterion was based on the lowest score having the least potential to create an environmental impact. The environmental screening criteria were not weighted during Step 2 because each has regulatory processes, mitigation requirements, public involvement and/or costs associated with impacting these resources.

Table 4-12 provides an example of scoring environmental evaluation criteria using the ratio method and shows the potential alignment alternatives and the scoring for floodplain criteria.

Table 4-12: Scoring Example: Ratio Methodology

Alignments	Floodplains	
	Acreage	Score
TRE South	62	6.000
TRE North	62	6.000
TRE Refined	60	5.583
Hybrid North	55	4.542
Hybrid South	38	1.000
Hybrid Refined	39	1.208

In this example, because there are six alternative alignments, the scores range from 1.000 to 6.000 (note that if there are only two alternatives, the scores range from 1.000 to 2.000). For each criterion, the lowest impact is scored a 1.000 (Hybrid South) and the greatest impact(s) is scored a 6.000 (TRE South and TRE North). The remaining potential alternative alignments are scored relative to the minimum and maximum scores using the following formula:

$$X = A - ((H - I_x)/(H - L)*(H - 1))$$

Where the variables for the equation above are presented in Table 4-13, below.

Table 4-13: Scoring Formula Variable Definitions

Variable	Units	Description
X	Point value	Score for the alternative environmental resource being analyzed
A	Number	No. of alternatives
H	Acre or number	Value of the highest impact
I_x	Acre or number	Value of impact of the alternative environmental resource being analyzed
L	Acre or number	Value of the lowest impact

4.5 Presentation Format for Summary Evaluation Results

The presentation of results for the evaluation of alternatives in Step 2 used both qualitative and quantitative values. The results are presented in a graphical format referred to as Consumer Reports' product review charts, or "Harvey Balls." Harvey Balls are round ideograms used for visual communication of information. They are commonly used in comparison tables to indicate the degree to which a particular item meets a particular criterion. This presentation format provides a clear structure to highlight the comparative benefits of alternatives.

They were used here as a means to communicate relative progress towards the highest value of each goal. Generally, there are five differing measures that are presented in the increasing cover of a circle. More coverage was always used to indicate a better measure performance.

○	Little or no contribution
◔	0-25% are the first quadrant
◑	25-50% the half full quadrant
◕	50-75% the three quarters full
●	75-100% full circle

5.0 Alternatives Analysis Evaluation Results

This chapter presents the results of the evaluation of alternatives in a comparative format to assist decision-makers and other stakeholders in identifying the preferred alternative(s) for the subsequent environmental documentation. The two-step evaluation framework was described in detail in Chapter 4 and the findings are provided below.

5.1 Evaluation of Alternatives – Step 1 Fatal Flaw Analysis

The Fatal Flaw Analysis was performed to identify the extent to which the three corridors (TRE, I-30 and Hybrid) have the potential to fulfil the purpose and need for the Project, have feasible engineering aspects or physical characteristics and have the potential to yield no significant impacts.

5.1.1 Overall Purpose and Need Evaluation Results

The impacts of the Project's Overall Purpose and Need measures were approximated using the consumer-based graphical presentation approach described in Chapter 4. This section applies the engineering and financial results from the alternatives analysis as an input to the study purpose and need elements to evaluate the three corridors, as shown in Table 5-1. Each measure's value was either directly applied based on the alternatives analysis results or inferred from these results as consumer-based graphics to illustrate the evaluation results.

Table 5-1: Overall Purpose and Need Evaluation Results

						TRE				I-30				Hybrid			
Identity	Objectives	Criterion	Measure	Quantity	Source	220	125E	125D	90D	220	125E	125D	90D	220	125E	125D	90D
Overall Purpose	Create a financially viable, safe, reliable, and environmentally sustainable intercity passenger rail service	Financially Viable	Additional Funding Requirement	$ Subsidy	NCTCOG Mobility 2040 Plan	◕	◕	◕	●	○	○	○	○	◔	◔	◑	◕
		Safety	Regional Traffic Accident Rate	per Million Vehicle Miles	NCTCOG Mobility 2040 Plan	◑	◑	◑	◔	●	●	●	●	●	●	●	◕
			At-grade Crossings	Eliminations	DFWCES	◕	◑	◑	◑	●	●	●	●	◕	◕	◕	◕
		Reliability	Grade Separated Alignment	% of Alignment	DFWCES	◕	◑	◑	◔	◕	◕	◕	◕	◕	◕	◕	◑
Overall Need	Need to reduce capacity constraints in transportation system	Reduce Congestion	Travel Time Increase Due to Congestion	Regional Travel Time	NCTCOG Mobility 2040 Plan	◑	◑	◑	◔	●	●	●	●	●	●	●	◕

The findings for the criteria to create a financially viable, safe, reliable and environmentally sustainable intercity passenger rail service are summarized below.

Financially Viable – the TRE alternatives with lower capital costs led to a lower local funding requirement. The I-30 alternatives all had the highest capital cost estimates, and thereby, the lowest ranked financially viable criterion. The lower speed technologies have relatively lower capital costs and thereby lower additional funding requirement.

Safety – the Hybrid alternatives yield the highest increase in rail travel (ridership) and corresponding reduction in auto vehicle miles of travel and more limited use of at-grade crossings. The I-30 alternatives had slightly better travel times achieved with less distances and fewer at-grade crossings. Reductions in auto vehicle miles combined with a lower number of at-grade crossings leads to improvements in safety measures.

Reliability – the I-30 alternatives measure better by the greater proportion of grade separated alignment. The Hybrid alternatives ranked next, followed by the TRE alternatives due to the extent of the grade separation. With a lower number of at-grade crossings, reliability, as well as safety, will also be improved.

Reduce or improve capacity constraints in the existing transportation system – The Hybrid alternatives, with higher ridership estimates provide better results to reduce congestion. While not evaluated for ridership due to the corridor engineering issues, the I-30 alternatives have slightly lower travel times, due to the shorter alignment lengths, and would thereby attract a correspondingly higher ridership than the other two corridors. These I-30 alternatives would contribute slightly more to improve capacity constraints. Ridership will reduce the east-west traffic within the region and reduce the congestion levels experienced along these corridors.

5.1.2 Engineering Feasibility

The findings of the assessment of engineering feasibility for each of the corridor alternatives relied heavily on the alignment considerations described for each of the corridors in Chapter 3. A detailed discussion of how each of the objectives was measured is provided below.

- **Space Availability:** Generally, all three corridors have sufficient room to accommodate a rail alignment with the exception of the eastern half of the I-30 Corridor. The complex interchanges do not have space to accommodate an alignment without an unacceptably high viaduct, expensive and difficult tunnelling.
- **Design Complexity:** All three corridors present design complexity, especially along the entrances to the Dallas and Fort Worth central areas. The I-30 Corridor presents the most complexity due to the highway interchanges entering Dallas and to a lesser extent Fort Worth. The TRE and the Hybrid corridors present a certain level of design challenges that can be accommodated through increased contingency amounts for these entry areas.
- **Construction Risks:** For all three corridors, construction within the central area approaches will be difficult and constrained by the density of highway and rail structures and the heavy vehicular traffic using them. The I-30 Corridor is especially constrained due to the additional highway density and its expanding aerial structure. TRE and Hybrid Corridors have construction risks due to their entry into Dallas along the rail corridor and entry into Fort Worth through the rail freight traffic, but not to the same extent as I-30 Corridor.

- **Construction Disruption:** While all three corridors will involve some degree of construction disruption at various locations, the disruption to traffic at the I-30 interchanges for tunnel construction beneath the highway lanes will be an order of magnitude higher.

Contributing to the assessment of the Engineering Feasibility was the development of capital costs for each corridor alternative. Although not called for in Step 1 of the evaluation, the information was used since it was available. The order-of-magnitude capital cost estimates developed for each corridor alternative confirm this assessment of the particular engineering complexity for the I-30 Corridor. Germaine to the engineering challenges, the capital costs show that the infrastructure costs alone for the I-30 Corridor are almost double the infrastructure costs for the TRE and the Hybrid Corridors. This is due to the challenges faced in the eastern and western ends of the corridor, approaching the Dallas and Fort Worth central areas.

A summary of the results of the Step 1 fatal flaw evaluation for engineering feasibility are illustrated in Table 5-2. The Engineering Feasibility factors were qualitatively measured using the consumer-based graphical presentation using the methodology described in Chapter 4 as the basis. The factor values were approximated and directly applied based on the physical constraints of each corridor.

The TRE and Hybrid Corridors, having the highest construction feasibility and lowest construction complexity and impact on other facilities, through the available rights-of-way present the highest values of the three corridors for the Step 1 measures. The I-30 Corridor is the most direct, but presents the greatest engineering challenges, the highest design and construction complexity and construction risks, and the highest capital cost. The Hybrid Corridor that includes the more feasible portions of the TRE and the I-30 Corridors performs well with these Step 1 measures. The Hybrid Corridor includes the easier segments for entry into Dallas and Fort Worth. There is a distinct difference among the three corridors, with the TRE and Hybrid Corridors demonstrating characteristics for a feasible solution to the high-speed rail needs between Dallas and Fort Worth.

Table 5-2: Fatal Flaw Engineering Feasibility Evaluation Results

			TRE				I-30				Hybrid			
Criterion	Measure	Quantity	220	125E	125D	90D	220	125E	125D	90D	220	125E	125D	90D
Integration within existing and proposed infrastructure	Space Availability	Level of Construction Feasibility	◑	◕	◕	◕	◔	◔	◔	◔	◕	●	●	●
	Design Complexity	Extent of Grade Separation	◔	◑	◑	◕	◔	◔	◔	◔	◕	◕	◕	◑
Operational envelope clearance options within corridor	Construction Risks	Level of Construction Complexity	◑	◑	◑	◕	○	○	○	○	◑	◑	◕	◕
	Construction Disruption	Impact on Transportation	◑	◑	◔	◔	○	○	○	○	◕	◕	◕	◑

Notes to this and all other tables in Chapter 5: The operating characteristic for each alternative are: 220 = operating speed at 220 mph; 125E = operating speed at 125 mph, with electric locomotive power; 125D = operating speed at 125 mph, with diesel-powered locomotives; and 90D = operating speed at 90 mph, with diesel-powered locomotives.

5.1.3 Environmental Considerations

As indicated in Section 4.3.3, the Step 1 environmental assessment showed that environmental resources are present within each of the three study corridors (I-30, TRE and Hybrid). However, there are opportunities to elevate, tunnel, or shift the alternative alignments within each corridor from one side of the existing infrastructure to the other at various locations to avoid or minimize effects to these and other environmental resources and established land uses. Therefore, no environmental fatal flaws were identified for the three study corridors (I-30, TRE and Hybrid). The station and operations and maintenance (O&M) facility locations were evaluated as part of the Step 2 environmental screening.

5.1.4 Step 1 Evaluation Conclusion

As illustrated by the Step 1 results, the alternatives proposed along the I-30 Corridor have significant design and construction feasibility and constraints that differentiate them from the other two corridor options. In addition, none of the speed and technology options for the I-30 Corridor were able to resolve these constraints. Although not required for the Step 1 evaluation, the capital costs associated with the I-30 Corridor are approximately double that of the other two corridors. For these reasons, the I-30 Corridor was eliminated from further consideration in this alternatives analysis and did not proceed to Step 2.

5.2 Evaluation of Alternatives – Step 2 Refined Screening Process

The Step 2 refined screening process focused on the speed and technology alternatives available for high speed rail service connecting Fort Worth and Dallas within the two remaining corridors—the TRE and Hybrid Corridors.

5.2.1 Ridership Estimation Results

The ridership demand estimation results for each of the alignment alternatives are provided in Table 5-3; the ridership numbers reflect average weekday totals. Important to this discussion is how the initial round of ridership estimates were employed to identify the preferred station combinations that were carried forward in the evaluation process. The TRE Corridor was used to illustrate the ridership effects of market-based fares. To accomplish this, the market-based fares for Dallas to Fort Worth travel of $22.00 for the 125mph alternatives and $27.00 for the 220mph alternative. These were tested on the TRE alternatives to establish the higher market-based fare effects on ridership within a particular corridor. Ridership estimates decreased in this corridor with these market-based fares. This TRE Corridor could not maintain demand levels with the higher fares for the higher speed rail alternatives.

The baseline fare, $8.00 for Dallas/Fort Worth trips, was applied to the other eight station options—S1, S2, S4, S5, S7, S8, S10, and S11 to identify the preferred station groupings for a consistent fare level. The baseline fare of $4.00 was included for intermediate station trips. No alternatives were eliminated, rather ridership scenarios were completed for only those scenarios to demonstrate the demand profile for the station options, market and baseline subsidized fare structures and the technology options.

These scenarios were selected to demonstrate the ridership potential of the alternative in the two remaining corridors. The TRE Corridor was used to test the ridership demand for the two terminal stations in both Dallas and Fort Worth. S1 includes all four of the terminal stations and the market-based fares for the higher speed technology options. S4 includes only the ITC Station in Fort Worth and both stations in Dallas. S7 includes only the ITC in Fort Worth and Union Station in Dallas. S10 includes the ITC in Fort Worth and only the TCR Station in Dallas. These ridership terminal station options were used to test the demand for the terminal stations under a single technology option of 90 mph diesel service. The TRE ridership scenarios also showed the lack of ridership differentiation between the diesel and electrical 125 mph alternatives. The TRE Corridor was used to illustrate the ridership demand of these station and technology options. This same approach was used to test the station options for the Hybrid Corridor, too.

Table 5-3: Ridership Estimates by Alternative

Characteristics	TRE Alternative				I-30/SH360/TRE (Hybrid) Alternative		
Speed	90 mph D	125 mph D	125 mph E	220 mph E	90 mph D	125 mph D/E	220 mph E
Station Groups	**S1**				**S2**		
Total riders	**3,468**	**2,356**	**2,310**	**1,959**	**5,520**	**6,368**	
TOPRS-related	1,254	921	921	786	3,366	3,497	
TCP-related	1,217	956	923	818	967	1,449	
Local riders	998	480	467	354	1,187	1,422	
Station Groups	**S4**				**S5**		
Total riders	**2,718**	**3,344**		**3,374**	**4,894**	**5,430**	**5,425**
TOPRS-related	1,254	1,379		1,379	3,341	3,497	3,497
TCP-related	889	1,260		1,285	935	1,166	1,163
Local riders	575	705		710	619	767	764
Station Groups	**S7**				**S8**		
Total riders	**1,488**				**3,611**		
TOPRS-related	1,254				3,341		
TCP-related	0				0		
Local riders	234				271		
Station Groups	**S10**				**S11**		
Total riders	**2,375**				**4,560**		
TOPRS-related	1,254				3,341		
TCP-related	947				1,026		
Local riders	174				193		

First round of scenarios evaluated in ridership forecasting

Scenarios eliminated based on first round forecasting results

By dropping T&P and County Line stations, dropping the I-30 alternatives altogether, and keeping both Union Station and TCP stations, all of the stations pairs in the table above were eliminated, except for S4 and S5. 125 D and E are similar enough that there is no need to test them separately.

Second round of scenarios evaluated

Final round/scenario evaluated

This run was performed after all other analysis, as it represents the highest ridership scenario.

Source: WSP/Parsons Brinckerhoff Inc. 2016

The second round of ridership estimation scenarios were used to complete the ridership estimates for the 125 mph and 220 mph technology options for S4 and S5 alternatives without the Fort Worth T&P Station. The highest ridership estimate was for the last S2 scenario. This scenario illustrates the highest demand for the Hybrid Corridor that combines the higher speed technology option with the intermediate demand of the Arlington Station.

These results support the following station conclusions:

- Texas Central Railway Dallas Terminal Station connection is important to the ridership success of the Dallas – Fort Worth connection.

- The T&P Station in Fort Worth appears similarly important. But this was found to be driven by the free parking available at this station. With comparable parking fees, these riders divert to the closer Fort Worth ITC Station and this T&P Station becomes unnecessary.
- Both TOPRS and TCR high speed rail services contributed significant portions of the ridership estimates - much higher than the local Dallas – Fort Worth ridership.
- The Arlington Station was the only midline station that contributed measurable passenger trips. This is due to both the greater trip destinations in the Arlington Station vicinity and the potential connection to the TOPRS rail service at Arlington proposed by that study.

The next stage of the ridership estimation process included model runs for the speed and technology options. Conclusions from this effort included the following:

- Differences between the 125 mph electric and diesel options were indiscernible because the simulation-based travel times were not very different, further ridership runs for both technology options were determined to be unnecessary.
- Both Dallas terminal stations provide measurable ridership contributions that justify the inclusion of both Dallas terminal stations in the evaluation process.

The third stage of the ridership estimation process involved the higher speed options for the preferred station stop series and the baseline $8.00 fare structure. The TRE Corridor S1 scenarios for the higher speed technology options used the higher value market-based fares. This consistent baseline fare option provided insight into the travel demand for the baseline fare rates and the most likely station stopping sequence at the constant fares. The Hybrid Corridor attracted the higher ridership estimates compared with the TRE alternatives. This is likely due to the Arlington Station as the midline station on this corridor. The 125 mph and 220 mph speed alternatives, with shorter travel times, garnered the higher ridership as expected when the baseline fare was consistently used. The key decision for the next phase of study is to determine the trade-offs between higher speed operations from the technology options and the higher capital and operating costs.

5.2.2 Capital Cost Estimation Results

These capital cost estimates demonstrate the cost levels of high speed rail, especially in congested urban corridors. In addition, these cost estimate results illustrate that the higher the speed, the higher the capital construction cost.

The TRE Corridor alternatives include a range of capital costs from a low of $3.49 billion for the 90 mph diesel service to a high of $6.87billion for the highest 220 mph electric service. The Hybrid Corridor that combines portions of the TRE and I-30 Corridors has the second highest range of capital costs—from a low of $5.27 billion for the 90 mph diesel alternative to $6.87 billion for the highest speed 220 mph electric service. The I-30 Corridor capital costs are at the highest range and are reflective of the engineering challenges faced in this corridor by each of the service and speed alternatives. Although not included in the Step 2 Screening Process, cost estimates for the I-30 Corridor were developed to support the Step 1 Screening Process relating to engineering feasibility/complexity. This is shown on Table 5-4, below.

Table 5-4: Capital Cost Estimation Results

TRE Corridor	
90 mph diesel electric	$3.49 Billion
125 mph diesel	$5.27 Billion
125 mph electric	$5.65 Billion
220 mph electric	$5.79 Billion
Hybrid (I-30/SH360/TRE) Corridor	
90 mph diesel electric	$5.27 Billion
$5.27 Billion	$6.32 Billion
125 mph electric	$6.73 Billion
220 mph electric	$6.87 Billion
I-30 Corridor	
90 mph diesel electric	$10.8 Billion
125 mph diesel	$10.8 Billion
125 mph electric	$11.1 Billion
220 mph electric	$11.3 Billion

Source: WSP/Parsons Brinckerhoff 2016

5.2.3 *Operating and Maintenance Cost Estimation Results*

The annual operating cost estimates were prepared in year 2015 dollars for each of the speed/technology options in the two corridors. These operating cost estimates were based on comparable services, mainly in the US, and are shown in Table 5-5.

Table 5-5: Annual Operating and Maintenance Cost Results

TRE Corridor	
90 mph diesel electric	$29.5 Million
125 mph diesel	$29.2 Million
125 mph electric	$25.8 Million
220 mph electric	$27.9 Million
Hybrid Corridor	
90 mph diesel electric	$32.7 Million
125 mph diesel	$32.3 Million
125 mph electric	$28.9 Million
220 mph electric	$31.0 Million

Source: WSP/Parsons Brinckerhoff Inc. 2016

5.2.4 Study Planning Elements

The evaluation of alternatives used the Study Planning Elements information described in Chapter 4 and the same presentation process of results. The measures represent the study priorities established by the purpose and need assessment, and include both quantitative and qualitative measures.

5.2.4.1 Expanded Purpose and Need Evaluation Results

During early outreach efforts for the Project, several additional purpose and need elements were identified. These additional measures went beyond the overall purpose and need and reflect regional expectations for the Project. The evaluation results for these additional alternatives analysis measures are presented in Table 5-6 and highlighted below.

Table 5-6: Expanded Purpose and Need Evaluation Results

						TRE				Hybrid			
Identity	Objectives	Criterion	Measure	Quantity	Source	220	125E	125D	90D	220	125E	125D	90D
P1	Advance high-performance rail network	State Rail Plan Connections	State Rail Line Connections	Number of Rail Lines	DFWCES	◑	◑	◑	◑	◕	◕	◕	◕
P2	Enhance connectivity to existing and planned passenger rail services, airports, roadways, bicycle and pedestrian facilities, and be competitive with private automobile travel and air travel	Airports	Airport Connections	Number of Connections	DFWCES	◕	◕	◕	◕	◑	◑	◑	◑
		Station Access	Station Access Modes	Number of Modes	DFWCES	◑	◑	◑	◑	◕	◕	◕	◕
		Competitive With Auto Travel Time	Auto and Rail Travel Time	Auto - Number of Minutes	NCTCOG Mobility 2040 Plan	●	◕	●	◔	◕	◑	◕	◔
				Rail - Number of Minutes	NCTCOG Mobility 2040 Plan	●	◕	●	◔	◕	◑	◕	◔
P3	Promote improved air quality and reduced transportation energy consumption	Reduce Energy Consumption	Energy Savings	BTUs	NCTCOG Mobility 2040 Plan	◑	◑	◑	◔	●	●	●	◕
			Difference in Vehicle Miles Traveled	VMT	NCTCOG Mobility 2040 Plan	◑	◑	◑	◔	●	●	●	◕
P4	Augment economic development opportunities	Improve Accessibility	Difference in Vehicle hours spent in delay	Vehicle Hours	NCTCOG Mobility 2040 Plan	◑	◑	◑	◔	●	●	●	◕
N1	Planning for rapid population and economic growth	High Speed Rail Ridership	Average Daily Trips	Trips	DFW CES	◑	◑	◑	◔	●	●	●	◕
N2	Enhancing Metroplex transportation connectivity	Improved Accessibility	Hourly Capacity	Miles	NCTCOG Mobility 2040 Plan	◑	◑	◑	◔	●	●	●	◕
N3	Improving air quality within the Metroplex	Reduce Carbon Emissions	Carbon Emissions	Qualitative	NCTCOG Mobility 2040 Plan	◑	◑	◑	◔	●	●	●	◕

The table's measures were based on the following factors for each criterion:

- Advance the local, state and regional high-performance rail network – the Hybrid alternatives provide the additional TOPRS connection in Arlington.
- Enhance connectivity to existing and planned passenger rail services, airports, roadways, bicycle and pedestrian facilities, and be competitive with private automobile travel and air travel.
  - Airport Connections – the TRE alternatives with a Centreport midline station provide the nearest DFW connection.
  - Station Access Modes – the Hybrid alternatives provide the additional TOPRS connection in Arlington.
  - Competitive with Auto Travel Time and Rail Travel Time – based on travel times, higher speed alternatives within the TRE corridor perform the best.
- Promote improved air quality and reduced transportation energy consumption – the Hybrid alternatives, with higher ridership estimates, provide better results.
- Augment economic development opportunities – the Hybrid alternatives, with higher ridership estimates, provide better results to improve accessibility through reduced vehicle delay.
- Planning for rapid population and economic growth – the Hybrid alternatives, with higher ridership estimates, provide better population and economic growth results.
- Enhancing transportation connectivity to, from, and within the Metroplex – the Hybrid alternatives, with higher ridership estimates, provide better connectivity results.
- Improving air quality within the Metroplex – the Hybrid alternatives, with higher ridership estimates, provide better carbon emissions reduction results.

While the TRE alternatives performed well with the engineering and financial factors, the Hybrid alternatives rated higher with the Purpose and Need factors based mainly on their higher ridership and better connectivity through the Arlington Station.

5.2.4.2 Study Planning Evaluation Results

The Study Planning measures were approximated using the same consumer-based graphical presentation. The factor values were either directly applied based on the study results (refer to Table 4-4) or inferred from these results as consumer-based graphics. Table 5-7 presents the Summary Study Planning Evaluation Results. A list of the key findings is provided below.

- Financial/Economic Considerations are the ridership market demand, revenue and cost impacts of the alternatives.
  - Ridership Demand – the Hybrid alternatives have higher ridership demand estimates.

- Capital Cost per Alignment Mile – TRE alternatives have lower unit capital cost measures.
- Operating Cost per Annual Passenger – TRE alternatives have lower unit operating cost measures.
- Total Passenger Revenue – the Hybrid alternatives have higher revenue opportunity based on higher ridership and consistent average passenger fare for all alternatives.

- Regional Development Facilitation represents a regional planning priority of NCTCOG to improve accessibility throughout the region.
  - Number of jobs accessible within 30 minutes by automobile – This is the same for all alternatives except for the midline station, with Arlington offering better employment access for the Hybrid alternatives.
  - Number of jobs accessible within 60 minutes by transit – This is the same for all alternatives except for the midline station with Arlington offering better employment access for the Hybrid alternatives.

Table 5-7: Summary Study Planning Evaluation Results

						TRE				Hybrid			
Identity	Objectives	Criterion	Measure	Quantity	Source	220	125E	125D	90D	220	125E	125D	90D
F1	Financial/ Economic Considerations	Ridership Demand	Average Daily Ridership	Trips	DFWCES	◑	◑	◑	◔	●	●	●	◕
F2		Capital Cost	$ Capital Cost per Annual Passenger	$ Cap Cost / Psgr	DFWCES	◔	◔	◑	◕	◕	◕	●	●
F3			$ Capital Cost per Alignment Mile	$ Cap Cost/ Mile	DFWCES	◑	◑	◕	●	◔	◔	◑	◕
F4		Operating Cost	$ Operating Cost per Annual Passenger	$ Ops Cost / Psgr	DFWCES	◑	◑	◑	◔	●	●	●	◕
F5		Fare Revenue	Total Passenger Revenue	$ Revenue	DFWCES	◑	◑	◑	◔	●	●	●	◕
R1	Regional Development Facilitation	Improved Accessibility	Jobs Accessible within 30 Minutes by Automobile	Jobs in 30 Minutes	NCTCOG Mobility 2040 Plan	◑	◑	◑	◑	◕	◕	◕	◕
R2		Improved Accessibility	Jobs Accessible within 60 Minutes by Transit	Jobs in 60 Minutes	NCTCOG Mobility 2040 Plan	◑	◑	◑	◑	◕	◕	◕	◕

The result of the alternative evaluation with these Study Planning Measures is a preference for the Hybrid Corridor alternative, followed by the TRE Corridor. The Hybrid Corridor benefits from higher ridership and better access through the Arlington Station in particular.

5.2.5 Refined Environmental Screening Results

The refined environmental screening results are provided as outlined in Section 4.4.7, with the evaluation of alignment alternatives, station (both terminal stations and line stations) locations and operations and maintenance facility locations discussed in turn.

5.2.5.1 Refined Environmental Screening Results for Alignment Alternatives

Table 5-8 on the next page, presents the results of the Environmental Constraints Screening for the alignment alternatives. The table provides a comparison of the effects for each alignment alternative employing the methodology described in Section 4.4.7; the table illustrates the quantified impact, point allocation, and total score for each alignment.

Table 5-8: TRE & Hybrid Alignment Step 2 Environmental Screening Results

Environmental Screening Criteria		Alternative Alignments					
		TRE North	**TRE South**	**TRE Refined**	**Hybrid North**	**Hybrid South**	**Hybrid Refined**
Wetlands	Acres	2	2	2	2	2	2
	Score	1.000	1.000	1.000	1.000	1.000	1.000
Streams	No.	6	6	6	5	5	5
	Score	6.000	6.000	6.000	1.000	1.000	1.000
Floodplains	Acres	62	62	60	55	38	39
	Score	6.000	6.000	5.583	4.542	1.000	1.208
Parks & Recreational Facilities	No.	3	7	5	4	6	4
	Score	1.000	6.000	3.500	2.250	4.750	2.250
Threatened & Endangered Species	No.	14	14	14	16	16	16
	Score	1.000	1.000	1.000	6.000	6.000	6.000
Historic Resources (Properties)	No.	1	0	0	1	0	0
	Score	6.000	1.000	1.000	6.000	1.000	1.000
Historic Resources (Districts)	No.	4	3	2	4	3	2
	Score	6.000	3.500	1.000	6.000	3.500	1.000
Hazardous Material Sites	No.	1	1	1	0	2	0
	Score	3.500	3.500	3.500	1.000	6.000	1.000
Landfills	No.	8	9	9	0	0	0
	Score	5.444	6.000	6.000	1.000	1.000	1.000
Land Use (Industrial)	Acres	12	7	9	5	3	4
	Score	6.000	3.222	4.333	2.111	1.000	1.556
Land Use (Commercial)	Acres	70	75	57	65	55	45
	Score	5.167	6.000	3.000	4.333	2.667	1.000
Land Use (Residential)	Acres	35	43	24	31	9	16
	Score	4.824	6.000	3.206	4.235	1.000	2.029
Environmental Justice (Minority Population)	No.	82	80	81	114	113	113
	Score	1.294	1.000	1.147	6.000	5.853	5.853
Environmental Justice (Low Income Population)	No.	5,607	5,460	5,528	7,910	7,763	7,750
	Score	1.300	1.000	1.139	6.000	5.700	5.673
Residential Relocations (Single Family)	No.	5	22	2	27	12	0
	Score	1.926	5.074	1.370	6.000	3.222	1.000
Residential Relocations (Multi-Family)	No.	0	0	0	123	8	0
	Score	1.000	1.000	1.000	6.000	1.325	1.000
	Total Score	**57.455**	**57.296**	**43.779**	**63.471**	**46.017**	**33.570**

The scores of the alignment alternatives were totalled based on the aggregation of the individual scores received for each environmental screening criterion. The alignment alternatives were then ranked from lowest to highest score, with the lowest score (1) identified as the potential for least adverse environmental impact. Table 5-9, below, identifies the rank of the potential alignment alternatives from fewest effects to most effects.

Table 5-9: TRE & Hybrid Alignment Ranking

Alignment Alternative	Total Score	Rank	
Hybrid Refined	33.570	1	Least Adverse Environmental Effects
TRE Refined	43.779	2	
Hybrid South	46.017	3	
TRE South	57.296	4	
TRE North	57.455	5	
Hybrid North	63.471	6	Most Adverse Environmental Effects

The Hybrid Refined alignment alternative has the least adverse environmental impact. In addition, the TRE Refined alignment and the Hybrid South alignments have considerably fewer effects than the TRE South, TRE North, and Hybrid North alignments.

5.2.5.2 *Environmental Screening Results for Terminal Stations*

There are a total of four terminal station location options associated with the Hybrid Refined and TRE Refined alignments; two in Fort Worth (ITC and T&P) and two in Dallas (Union Station and DAL-TCR). Please refer to Section 3.3 for details on the terminal station locations. One, or a combination of terminal stations in Fort Worth and in Dallas, will ultimately be selected for either corridor alignment. Tables 5-10 and 5-11 present the Environmental Constraints Screening conducted for the two stations in Fort Worth and the two stations in Dallas, respectively.

Table 5-10: Fort Worth Terminal Station Environmental Screening Results

Environmental Screening Criteria		ITC	T&P
Wetlands	Acres	0	0
	Score	1.000	1.000
Floodplains	Acres	0	0
	Score	1.000	1.000
Parks & Recreational Facilities	No.	0	0
	Score	1.000	1.000
Threatened and Endangered Species	No.	0	0
	Score	1.000	1.000
Historic Resources (Properties and Markers)	No.	1	0
	Score	2.000	1.000
Historic Resources (Districts)	No.	0	1
	Score	1.000	2.000
Hazardous Material Sites	No.	0	0

Environmental Screening Criteria		ITC	T&P
	Score	1.000	1.000
Landfills	No.	0	0
	Score	1.000	1.000
Relocations – Industrial	No.	0	0
	Score	1.000	1.000
Relocations - Commercial	No.	1	0
	Score	2.000	1.000
Relocations – Residential	No.	0	0
	Score	1.000	1.000
Environmental Justice (Minority Population)	No.	5	3
	Score	2.000	1.000
Environmental Justice (Low Income Population)	No.	591	498
	Score	2.000	1.000
	Total Score	**17.000**	**14.000**

Table 5-11: Dallas Terminal Station Environmental Screening Results

Environmental Screening Criteria		Union Station	TCR
Wetlands	Acres	0	0
	Score	1.000	1.000
Floodplains	Acres	0	0
	Score	1.000	1.000
Parks & Recreational Facilities	No.	0	0
	Score	1.000	1.000
Threatened and Endangered Species	No.	0	0
	Score	1.000	1.000
Historic Resources (Properties and Markers)	No.	0	0
	Score	1.000	1.000
Historic Resources (Districts)	No.	1	0
	Score	2.000	1.000
Hazardous Material Sites	No.	0	0
	Score	1.000	1.000
Landfills	No.	0	0
	Score	1.000	1.000
Relocations – Industrial	No.	0	0
	Score	1.000	1.000
Relocations - Commercial	No.	0	0
	Score	1.000	1.000
Relocations – Residential	No.	0	0
	Score	1.000	1.000
Environmental Justice (Minority Population)	No.	4	5
	Score	1.000	2.000
Environmental Justice (Low Income Population)	No.	92	87
	Score	2.000	1.000
	Total Score	**15.000**	**14.000**

Based on the results of the terminal station screening, the station in Fort Worth that would have the least adverse effects is the T&P station and the station in Dallas that would have the least adverse effects is the TCR station. Since the scoring differentials between terminal stations (Fort Worth and Dallas) are relatively small it is recommended, based on the environmental constraints screening, that all terminal stations be further analyzed in the EIS.

5.2.5.3 Environmental Screening Results for Line Stations

There is one midline station alternative for the Hybrid Refined alignment (Arlington) located in the Arlington Entertainment District. Two potential midline stations for the TRE Refined alignment were considered; one at the existing CentrePort/Dallas – Fort Worth TRE station (CentrePort) and one potential new location immediately west of the Tarrant/Dallas county line near Trinity Way and the TRE commuter rail line (County Line); they are described in Section 3.3.

Since there is only one midline station alternative location for the Hybrid Refined alignment, the screening was not performed. There were no wetlands, floodplains, parks & recreational facilities, threatened and endangered species, historic resources, hazardous material sites, or landfills in the proposed Arlington line station location. In addition, no relocations would be required for the construction of this station.

Table 5-12, below, presents the screening conducted for both line stations along the TRE Refined alignment.

Table 5-12: Line Station Environmental Screening Results: TRE Refined Alignment

Environmental Screening Criteria		CentrePort	County Line
Wetlands	Acres	0	0
	Score	1.000	1.000
Floodplains	Acres	0	0
	Score	1.000	1.000
Parks & Recreational Facilities	No.	0	0
	Score	1.000	1.000
Threatened and Endangered Species	No.	0	0
	Score	1.000	1.000
Historic Resources (Properties and Markers)	No.	0	0
	Score	1.000	1.000
Historic Resources (Districts)	No.	0	0
	Score	1.000	1.000
Hazardous Material Sites	No.	0	0
	Score	1.000	1.000
Landfills	No.	0	0
	Score	1.000	1.000
Relocations – Industrial	No.	0	0
	Score	1.000	1.000
Relocations - Commercial	No.	0	0
	Score	1.000	1.000
Relocations – Residential	No.	0	0

Environmental Screening Criteria		CentrePort	County Line
	Score	1.000	1.000
Environmental Justice (Minority Population)	No.	6	4
	Score	2.000	1.000
Environmental Justice (Low Income Population)	No.	180	148
	Score	2.000	1.000
	Total Score	**15.000**	**13.000**

Based on the results of the line station Environmental Constraints Screening, -County Line would impact a smaller minority and low-income population. However, CentrePort is an existing station and therefore, the actual effects on the minority and low income populations could be greater by constructing County Line since it is not an existing facility. The CentrePort midline station along the TRE Refined alignment was ultimately selected based primarily on the ability to attract ridership.

5.2.5.4 Environmental Screening Results for Operations and Maintenance Facilities

A total of seven operations and maintenance (O&M) facility location alternatives are located along the TRE Refined alternative (M-FW1, M-FW2, M-FW3, M-DAL1, M-DAL2, M-DAL3, M-DAL4) and four of these O&M facilities are also located along the Hybrid Refined alignment (M-DAL1, M-DAL2, M-DAL3, M-DAL4); their locations are provided in Section 3.3.

Tables 5-13, below, presents the Environmental Constraints Screening conducted for the O&M facilities.

Table 5-13: O&M Facility Step 2 Environmental Screening Results (TRE Refined Alignment)

Environmental Screening Criteria		Maintenance Area Location Alternatives						
		Fort Worth			Dallas			
		M-FW1	M-FW2	M-FW3	M-DAL1	M-DAL2	M-DAL3	M-DAL4
Wetlands	Acres	0	0	0	0	0	0	0
	Score	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Floodplains	Acres	0	3.1	2.01	0	0	0	0
	Score	1.000	7.000	4.890	1.000	1.000	1.000	1.000
Parks & Recreational Facilities	No.	0	0	0	0	0	0	0
	Score	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Threatened and Endanagered Species	No.	0	0	0	0	0	0	0
	Score	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Historic Resources (Markers)	No.	0	0	0	0	0	0	0
	Score	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Historic Resources (Districts)	No.	0	0	0	0	0	0	0
	Score	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Hazardous Material Sites	No.	0	1	1	0	0	1	1
	Score	1.000	7.000	7.000	1.000	1.000	7.000	7.000
Landfills	No.	0	0	0	0	0	0	0
	Score	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Relocations (Industrial)	Acres	10	3	1	1	3	1	1
	Score	7.000	2.333	1.000	1.000	2.333	1.000	1.000
Relocations (Commercial)	Acres	4	2	3	1	25	34	26
	Score	1.545	1.182	1.364	1.000	5.364	7.000	5.545
Relocations (Residential)	Acres	0	0	0	1	0	0	0
	Score	1.000	1.000	1.000	7.000	1.000	1.000	1.000
Environmental Justice (Minority Population)	No.	1	1	1	12	2	1	1
	Score	1.000	1.000	1.000	7.000	1.545	1.000	1.000
Environmental Justice (Low Income Population)	No.	322	328	237	916	282	164	164
	Score	2.261	2.309	1.582	7.000	1.941	1.000	1.000
	Total Score	**20.806**	**27.824**	**23.836**	**31.000**	**20.184**	**25.000**	**23.545**

Hybrid Corridor O&M Facility

For the Hybrid Refined alternative, the O&M facility location alternatives (M-DAL1, M-DAL2, M-DAL3, and M-DAL4) were ranked from lowest to highest score, with the lowest score (1) identified as the potential for least adverse environmental impact. Table 5-14, below, identifies the rank of the potential O & M facility alternatives from fewest effects to most effects.

Table 5-14: Hybrid Corridor O&M Facility Environmental Screening Results

Alignment Alternative	Total Score	Rank	
M-DAL4	18.273	1	Least Adverse Environmental Effects
M-DAL2	18.925	2	↓
M-DAL3	19.000	3	
M-DAL1	22.000	4	Most Adverse Environmental Effects

The O&M facility that would have the least adverse effects is the M-DAL2 location. The significance of these effects and other environmental effects not quantified in the alternatives analysis are recommended for further analysis in the DEIS.

TRE Corridor O&M Facility

The O&M facility location alternatives for the TRE Refined alternative were ranked from lowest to highest score, with the lowest score (1) identified as the potential for least adverse environmental impact. Table 5-15, below, identifies the rank of the potential alignment alternatives from fewest effects to most effects.

Table 5-15: TRE Corridor O&M Facility Environmental Screening Results

Alignment Alternative	Total Score	Rank	
M-DAL2	20.184	1	Least Adverse Environmental Effects
M-FW4	20.806	2	
M-DAL4	23.545	3	↓
M-FW6	23.824	4	
M-DAL3	25.000	5	
M-FW5	27.824	6	Most Adverse Environmental Effects
M-DAL1	31.000	7	

The M-DAL2 O&M facility location alternative has the least adverse environmental effect, followed by M-FW1, based on the Environmental Constraints Screening process. The significance of these effects and other environmental effects not quantified in the alternatives analysis are recommended for further analysis in the DEIS.

Table 5.16 below, provides a summary of the evaluation results for the environmental elements that were evaluated.

Table 5-16: Environmental Elements Summary

Identity	Objective	Criterion	Measure	Quantity	Source	TRE				I-30/SH 360/TRE			
						220	125E	125D	90D	220	125E	125D	90D
Env1	Potential Environmental Impacts	Alignments	Viable alignment options available	Potential Environmental Impacts	DFWCES	◑	◑	◑	◑	◕	◕	◕	◕
Env2		Terminal Stations	Viable Locations Available	Potential Environmental Impacts	DFWCES	◑	◑	◑	◑	◑	◑	◑	◑
Env3		Line Stations	Viable Locations Available	Potential Environmental Impacts	DFWCES	●	●	●	●	◕	◕	◕	◕
Env4		Operation and Maintenance Facility	Viable Locations Available	Potential Environmental Impacts	DFWCES	◔	◔	◔	◔	◕	◕	◕	◕

5.2.6 Environmental No Build

The project would not be constructed under the No-Build Alternative and therefore would not present major environmental challenges. However, the current rail routes between Fort Worth and Dallas would continue to be used, resulting in continued minor environmental effects such as erosion and sedimentation from railroad grades to adjacent waterbodies and wetlands and noise. Other travel modes would continue to be used and would likely become more congested in the future as travel demand increases, resulting in potential effects on sensitive areas (i.e., air emissions, right-of-way acquisitions for infrastructure improvements). In addition, other passenger rail sections in this area could be developed and result in acquisition of right-of-way and effects on sensitive areas.

5.3 Presentation Format for Summary Evaluation Results

The presentation of results for the evaluation of alternatives in Step 2 used both qualitative and quantitative values. The results are presented in the same graphical format described in Section 4.6, employing the use of Harvey Balls.

6.0 Conclusion and Recommendation

6.1 Technical Results

Both the Step 1 and Step 2 technical results from the analysis of alternatives are presented in Chapter 5; the Step 1 Evaluation Conclusion is provided in Section 5.1.4. The Step 2 analysis results are summarized below.

Table 6-1: Summary Step 2 Alternatives Analysis Measures

						TRE				Hybrid			
Identity	**Objectives**	**Criterion**	**Measure**	**Quantity**	**Source**	**220**	**125E**	**125D**	**90D**	**220**	**125E**	**125D**	**90D**
Overall Purpose	Financially viable, safe, reliable, and environmentally sustainable	Financial Viability, Safety and Reliability	Additional Funding Requirement	$ Subsidy	NCTCOG Mobility 2040 Plan	◕	◕	◕	●	◔	◔	◑	◕
Overall Need	Improve capacity constraints in transportation system	Reduce Congestion	Travel time increase due to congestion	Regional Travel Time	NCTCOG Mobility 2040 Plan	◑	◑	◑	◔	●	●	●	◕
Summary 1	Financial/ Economic Considerations	Ridership Demand	Average Daily Ridership	Trips	DFWCES	◑	◑	◑	◔	●	●	●	◕
Summary 2		Capital Cost	$ Capital Cost per Alignment Mile	$ Cap Cost/ Mile	DFWCES	◑	◑	◕	●	◔	◔	◑	◕
Summary 3		Operating Cost	$ Operating Cost per Annual Passenger	$ Ops Cost / Psgr	DFWCES	◑	◑	◑	◔	●	●	●	◕
Summary 4	Environmental Impacts	Screening Results	Viable Options	Potential Environmental Impacts	DFWCES	◑	◑	◑	◑	◕	◕	◕	◕
Summary 5	Engineering Feasibility	Integration within infrastructure	Impact on Infrastructure	$ Construction Planned	DFWCES	◔	◔	◑	◑	◑	◑	◕	◕
Summary 6	Development Facilitation	Improved Accessibility	Jobs accessibility	Jobs in 30 Minutes	DFWCES	◑	◑	◑	◑	◕	◕	◕	◕

Notes to table: "DFWCES" refers to the alternatives analysis study team evaluation results. "D" refers to diesel locomotive power. "E" refers to electric locomotive power.

6.2 Recommendation

Based on these findings, both of the corridors evaluated in Step 2 are clearly viable, but at the 90 mph and 125 mph operating scenarios. Safety requirements for passenger equipment (rolling stock) intended for operations up to 220 mph have not been issued by the FRA; this issue is described in Section 6.3.2. The Hybrid Corridor performs slightly better, mainly due to higher ridership from serving the Arlington Station connection with TOPRS service, and lower overall environmental impacts. However, the TRE Corridor offers the best financial viability, with the lower capital costs. It is therefore recommended that both corridors proceed into the EIS process.

6.3 Topics Requiring Additional Review

In addition to the traditional analysis of environmental impact areas included in the EIS process, there are a number of topics that need future consideration.

6.3.1 Public and Stakeholder Input

The alternatives analysis was completed following an extensive public outreach effort. The Project's Purpose and Need and definition of alternatives reflect regional priorities and stakeholder input. The findings and recommendation provided above will need to be shared with the public and stakeholders, as the project continues into the EIS process.

6.3.2 High Speed Rail Operation at 220 Miles per Hour

Current FRA regulations do not address rolling stock requirements for train speeds above 150 mph. The Texas Central Railway has applied for an exemption from existing FRA regulations that will employ Shinkansen-type of service with planned speeds of 220 mph. The operation at this speed on either corridor would require a similar application for this exemption. In addition, a potential operator for the service along the Dallas to Fort Worth corridor needs to be identified.

6.3.3 Project Uses of State of Texas Owned Right-of-Way

The Hybrid Corridor in particular, proposes to use or impact State Highway 360 and portions of the Interstate highway system. Approval from the Texas Transportation Commission will be required if any state-owned right-of-way is dedicated for the Project. This will require ongoing coordination as the Project continues into the EIS process.

6.3.4 Type of Rolling Stock

Two alternative forms of locomotive power were identified in the scenarios for 90 mph and 125 mph operation. Both diesel and electric locomotives have been considered and their performance characteristics are reflected in the analysis. Each type of locomotive has benefits and drawbacks, when considering the cost, environmental impact, visual impact and performance. While more costly, the electric locomotives are faster, mainly because they accelerate faster than diesel trains and have higher maximum speeds. There are also differences affecting their respective operating and maintenance costs and need for additional infrastructure (electrification). This issue will need to be addressed in the EIS.

Appendix A:
Project Purpose and Need

Dallas-Fort Worth Core Express Service

Purpose and Need

Version 1 August 2015

Prepared for:
Federal Railroad Administration and
Texas Department of Transportation

Prepared by:
Parsons Brinckerhoff, Inc.

August 2015

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1.0 Statement of Purpose and Need

1.1 Project Overview

The Texas Department of Transportation (TxDOT) is working with the Federal Railroad Administration (FRA) to study a possible high-performance, intercity passenger rail service between Dallas and Fort Worth, Texas. The 30-mile, Dallas-Fort Worth Core Express Service (Project) will evaluate the potential for a high-speed rail connector, linking other potential high- and higher-speed passenger rail projects in Texas.

In addition to providing faster, limited-stop trains for people traveling between Dallas and Fort Worth, the Project could provide a critical link between projects including:

- The proposed 240-mile Dallas to Houston High-Speed Rail Project, which would terminate in Dallas; and,
- The Texas-Oklahoma Passenger Rail Study (TOPRS), which evaluates a range of possible conventional, higher-speed and high-speed service alternatives that could span 850 miles from Oklahoma City to South Texas, through the Dallas-Fort Worth Metroplex.

This Purpose and Need Statement defines needs to be addressed by the Project, provides a basis for evaluating alternatives, and supports the decision-making process in selecting a Preferred Alternative.

1.2 Project History and Background

The Project builds on the results of the TOPRS Program Level Environmental Impact Statement (EIS). TOPRS evaluated alternatives to provide high-performance passenger rail service along an 850-mile corridor extending between Edmond, Oklahoma north of Oklahoma City and south Texas (Corpus Christi, Laredo, and the Rio Grande Valley). TOPRS examined the study area in three geographic passenger rail markets:

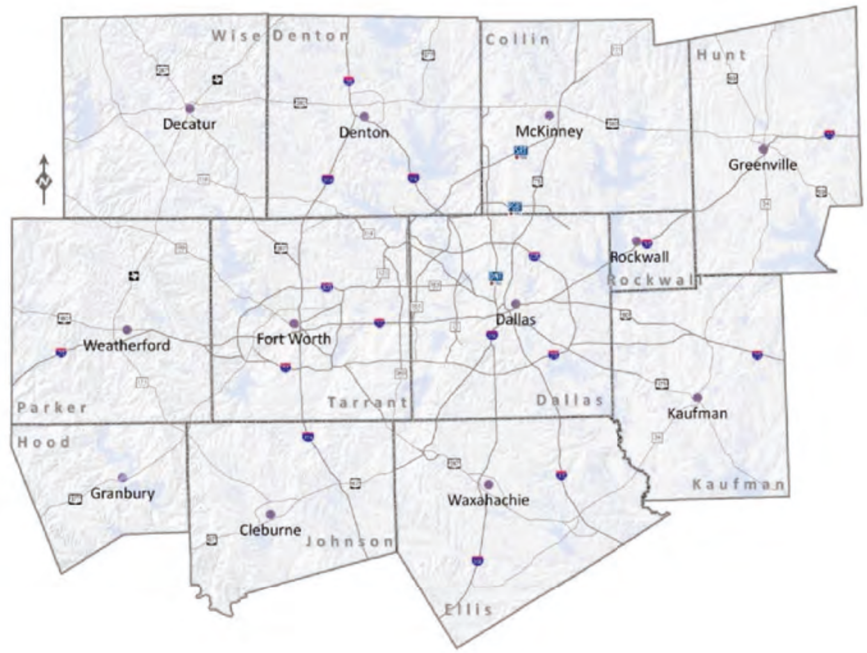
- Northern Section: Edmond, Oklahoma (just outside Oklahoma City) to Dallas and Fort Worth, Texas
- Central Section: Dallas and Fort Worth to San Antonio
- Southern Section: San Antonio to south Texas (Laredo, Corpus Christi, and the Rio Grande Valley)

Each of these sections has a “distinct level of existing passenger rail service and opportunity for development while remaining connected to and interdependent with the passenger rail network across the overall Program corridor” (*TOPRS*, *TxDOT* 2014).

The Project is in the Dallas-Fort Worth-Arlington, Texas Metropolitan Statistical Area (MSA), otherwise referred to as the Metroplex. The 12-county Metroplex includes the cities of

Arlington, Carrollton, Dallas, Denton, Frisco, Fort Worth, Grapevine, Irving, McKinney, Plano, and Richardson. *Figure 1-1* illustrates the Metroplex.

Figure 1-1: Dallas-Fort Worth-Arlington Metroplex



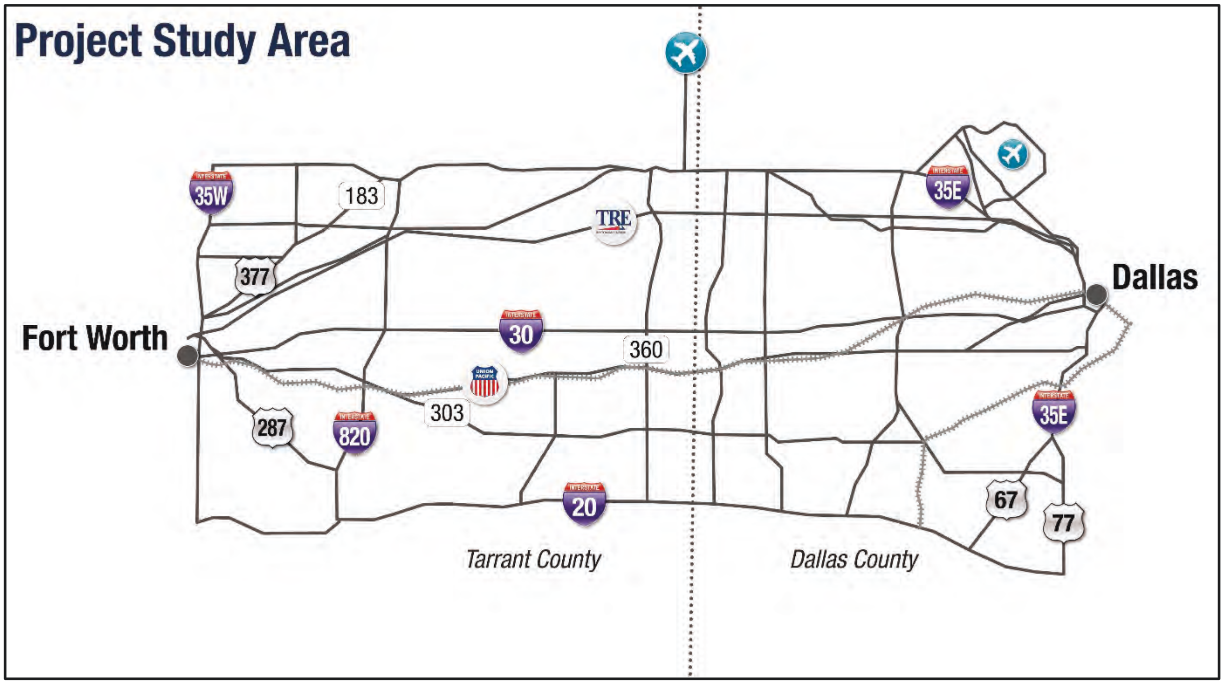
Source: North Central Texas Council of Governments (NCTCOG), *Mobility 2035,* 2013

1.3 Project Description

The Project includes an approximately 30-mile corridor through Tarrant and Dallas counties. The largest cities in the Project study area are Dallas (the county seat of Dallas County), Fort Worth (the county seat of Tarrant County), Arlington (in Tarrant County), Irving (in Dallas County) and Grand Prairie (in both Tarrant and Dallas counties). The Project study area includes two major airports, Dallas-Fort Worth (DFW) and Love Field. The Project study area also includes the approximately 2,700-acre Arlington Entertainment District, which contains several major attractions: Six Flags Over Texas, Hurricane Harbor, Texas Rangers Ballpark, Legends of the Game Museum, AT&T Stadium (home of the Dallas Cowboys), Lincoln Square Mall, and the Arlington Convention Center.

Primary transportation routes between Dallas and Fort Worth include Interstates 30 (I-30), I-20, the Trinity Railway Express (TRE), Amtrak's Texas Eagle, and the Union Pacific Railroad (UPRR). *Figure 1-2* illustrates the study area for the Project.

Figure 1-2: Study Area for the Project



Source: Parsons Brinckerhoff 2015

1.4 Federal, State and Local Transportation Planning Initiatives

A goal of the Project is to be consistent with federal, state, and local transportation planning initiatives. Descriptions of these federal, state, and local transportation planning initiatives are discussed in the following sections.

1.4.1 National Passenger Rail Strategy

In 2008, Congress enacted a major reauthorization of intercity rail passenger programs, creating a new priority for rail passenger service, known as the Passenger Rail Investment and Improvement Act of 2008 (Public Law 110-432). As a result, federal appropriations supporting high-speed and intercity passenger rail services were authorized and implemented. In the American Recovery and Reinvestment Act of 2009, Congress appropriated $8 billion in capital assistance for high-speed rail corridors and intercity passenger rail service. Also in 2009, FRA issued a strategic plan entitled, *A Vision for High-Speed Rail in America* (FRA 2009), which described the agency's plan for intercity passenger rail development and subsequent program guidance to implement a High-Speed Intercity Passenger Rail Program.

1.4.2 TxDOT Texas Rail Plan

The *Texas Rail Plan* establishes the vision, goals, and objectives for the passenger and freight rail system in the state (*TxDOT* 2010). The vision is to "provide cost-effective, energy-efficient, sustainable personal mobility and goods movement that connects Texas communities and links Texas businesses with domestic and international markets, minimizing environmental impacts, reducing road congestion, improving air quality, and promoting economic growth" (*TxDOT* 2010).

1.4.3 Texas-Oklahoma Passenger Rail Study

The 850-mile TOPRS extends from Edmund, Oklahoma in the north through Oklahoma City, Fort Worth, Austin, and San Antonio to destinations in south Texas, including Laredo, Corpus Christi, and Brownsville. Existing passenger rail service includes intercity service on the Heartland Flyer (Oklahoma City to Fort Worth), Texas Eagle (Chicago to San Antonio via Dallas and Fort Worth), and Sunset Limited (Los Angeles to New Orleans via San Antonio) operated by Amtrak, and regional/commuter rail service on the Trinity Railway Express (Dallas to Fort Worth) and Capital MetroRail (Austin) operated by Texas operators. The purpose of TOPRS is to evaluate alternatives to provide high performance passenger rail service to meet future intercity travel demand and to improve rail facilities, reduce journey times, and improve connections with regional public transit services.

1.4.4 TxDOT Statewide Long-Range Transportation Plan 2035

In 2011, TxDOT published the *Statewide Long-Range Transportation Plan*. This plan:

> "provides an inventory and addresses the need for improvements to the state's transportation system-roadways, pedestrian and bicycle facilities, transit, freight and passenger rail, airports, waterways and ports, pipelines, and intelligent transportation systems (ITS)" (*TxDOT* 2011).

The goal of the plan is to:

> "provide safe and efficient movement of people and goods, enhance economic viability, and improve the quality of life for the people that travel in the state of Texas by maintaining existing roadways and collaborating with private and local entities to plan, design, build and maintain expanded transportation infrastructure" (*TxDOT* 2011).

This plan also emphasizes delivering a modern, interconnected, and multimodal transportation system in Texas.

1.4.5 NCTCOG Mobility Plans

In 2013, the North Central Texas Council of Governments (NCTCOG) published its long-range transportation plan, *Mobility 2035,* for the Metroplex. The plan defines a vision for the region's multimodal transportation system and identifies guidelines for expenditures of state and federal funds over the next 20+plus years. *Mobility 2035* provides, "a blueprint for a comprehensive, modern transportation system for the Dallas-Fort Worth area" (*NCTCOG* 2013).

NCTCOG is currently developing the next long-range transportation plan, known as *Mobility 2040*. Draft recommendations are expected to be available in late 2015, and the Regional Transportation Council is expected to approve the new long-term plan in spring 2016.

1.4.6 Dallas Area Rapid Transit 2030 Transit System Plan

The Dallas Area Rapid Transit's (DART's) *2030 Transit System Plan* identifies planned improvement projects that result from changing land use and development patterns in its service area (*DART* 2006). Guiding principles for this plan include providing an efficient, cost-effective, and affordable transit system that integrates with other modes in the transportation system, while promoting accessibility and performance to meet customer needs, and attract new customers.

1.4.7 Fort Worth Transportation Authority, Tex Rail

The Fort Worth Transportation Authority (The T) completed a Draft EIS in 2008 for the proposed Southwest-to-Northeast Rail Corridor regional passenger rail service, now known as TEX Rail. The Record of Decision for the project was issued by the Federal Transit Administration in September 2014. TEX Rail is a 27-mile commuter rail project that will follow existing rail lines from downtown Fort Worth into the DFW Airport. The route will provide access to major activity centers in the corridor and connect with other transportation services, including the TRE commuter rail service, Amtrak, and The T's downtown bus transfer center at the downtown Fort Worth Intermodal Transportation Center and the Texas & Pacific Station.

1.4.8 Fort Worth Transportation Authority 2010 Strategic Plan

In 2010, The T began implementing a 25-year long-range strategic plan to enhance public transportation services and cover more of Tarrant County. The *Strategic Plan* will expand the transportation network, improves performance and upgrade technology (*The T* 2010).

1.5 Project Purpose

The TOPRS EIS defined the purpose of the Project as introducing a new, limited service transportation option in the Metroplex. The Project will increase intercity mobility to, from, and within the Metroplex by providing enhanced passenger rail service as a transportation option that is competitive with automobile, bus, and other travel modes. The Metroplex is an integral part of the larger Northern and Central Sections evaluated in the TOPRS EIS. The connection to other high- performance intercity passenger rail services in Texas, as well as regional transit service is critical to facilitate improved travel to, from, and within the Metroplex.

Building upon the TOPRS program rationale, the purpose of the Project is to create a financially viable, safe, reliable, and environmentally sustainable intercity passenger rail service connecting Dallas and Fort Worth, while providing a key linkage to the existing and developing Texas high-performance passenger rail system. Specifically, the Project will provide a link between the proposed high-speed rail service between Dallas and Houston on the east end and passenger rail services linking Oklahoma City and South Texas metropolitan areas via the Metroplex. This service will provide a convenient alternative to travel by automobile and enhance existing public transportation travel to and from the state's largest metropolitan areas.

The Project is being developed to:

- Advance the local, state and regional high-performance rail network in accordance with the *State Rail Plan* by linking the Metroplex with other planned high-performance rail corridors linking Austin, Houston, and San Antonio;
- Enhance connectivity of the Metroplex to other existing and planned passenger rail services, freight rail, commercial airports, roadway infrastructure, bicycle and pedestrian facilities, and be competitive with private automobile travel and air travel as a viable additional transportation option;
- Promote improved air quality and reduced transportation energy consumption by providing a new travel option within the Metroplex to compete with private automobile travel; and
- Augment economic development opportunities of the Metroplex by providing improved access to employment, entertainment, recreation, health, and shopping opportunities for residents of, and visitors to, the region and the state.

1.6 Project Need

The need for the Project results from capacity constraints in the existing transportation system. If nothing is done to address these constraints, the region will experience greater levels of traffic congestion and travelers to and from the Metroplex will continue to have limited mobility options. Expected growth in both population and economic development opportunities will further strain the congested transportation system. Existing and future transportation issues to be addressed by the Project include:

- Planning for rapid population and economic growth of the Metroplex and the state through 2040;
- Enhancing transportation connectivity to, from, and within the Metroplex;

- Facing access constraints to the DFW Airport and other major activity centers because of limited transportation options within and beyond the Metroplex; and
- Improving air quality within the Metroplex.

1.6.1 Population and Economic Growth

Between 2010 and 2040, the state of Texas is anticipated to grow by approximately 45 percent (*Table 1-1*), and the Metroplex is one of its fastest growing urbanized areas within the state. Increasing population and economic growth of the Metroplex will increase travel demand, congestion, and vehicle miles travelled (VMT). In 2010, the MSA had a population of approximately 6.3 million (*Table 1-2)*. By the year 2040, the MSA is forecasted to grow to 10.7 million residents, an increase of more than four million people (*NCTCOG* 2015). This growth represents a 68 percent increase in the population of North Central Texas (*NCTCOG* 2015).

Table 1-1: Estimated Population in Texas between 2010 and 2040.

Year	Population	Population Change from 2010 (Percent)
2010	25,145,561	-
2020	28,813,282[A]	14.59
2030	32,680,217	29.96
2040	36,550,595	45.36

Source: Office of the State Demographer. 2014. Texas Population Projections 2010 to 2050

A. Data from the Office of the State Demographer and the Texas State Data Center using a 0.5 migration scenario. The 0.5 scenario represents an approximate average rate of migration from 2000 to 2010 and is the recommended scenario for conducting long-term planning.

As shown in *Table 1-2*, the population of Tarrant and Dallas counties are projected to grow by 1,306,249 (73 percent) and 1,019,728 (44 percent), respectively, between 2010 and 2040. The Metroplex has continued to sustain an unprecedented level of population and economic growth as a result of factors such as favorable business climate, attractive tax policies, and an abundance of available land (*TxDOT* 2014). According to the NCTCOG, "The transportation system is central to this growth because it allows for the efficient movement of people and goods. Understanding not only population but employment growth is critical to the transportation planning process and to providing the best system to move people to and from jobs" (*NCTCOG* 2013). Increasing population and economic growth within the Metroplex will increase travel demand, congestion, and vehicle miles traveled on the already strained transportation system. The additional constraints on the system will limit the ability of citizens to move in and out of the Metroplex to other destinations in Texas and beyond.

Table 1-2: Population and Employment Growth by County, 2010-2040

Population			County	Employment		
2010	2040	% Change		2010	2040	% Change
778,427	1,560,421	100.5%	Collin	452,982	762,919	68.4%
2,337,741	3,357,469	43.6%	Dallas	1,884,799	3,197,471	69.6%
652,270	1,241,681	90.4%	Denton	251,394	445,079	77.0%
148,000	283,898	91.8%	Ellis	58,519	96,874	65.5%
50,481	81,578	61.6%	Hood	18,045	29,450	63.2%
84,260	131,022	55.5%	Hunt	40,702	70,102	72.2%
148,290	252,521	70.3%	Johnson	64,198	105,195	63.9%
102,014	210,097	105.9%	Kaufman	40,558	64,037	57.9%
113,806	195,286	71.6%	Parker	52,532	80,406	53.1%
77,678	166,357	114.2%	Rockwall	33,163	53,369	60.9%
1,788,400	3,094,649	73.0%	Tarrant	1,036,558	1,739,330	67.8%
58,147	101,865	75.2%	Wise	31,516	47,227	49.9%
6,339,514	**10,676,844**	**68.4%**	**Total**	**3,964,966**	**6,691,459**	**68.8%**

Source: NCTCOG Regional Data Center, 2040 Demographic Forecast, May 2015.

According to the Dallas Chamber of Commerce, the Metroplex is the Number 1 visitor and leisure destination in the State of Texas, attracting over 44 million visitors annually. Activity centers/employment areas are seeing strong employment demand, including downtown Dallas, the Southwestern Medical District, Stemmons Corridor, Las Colinas, Galleria/Tollway Corridor, DFW Airport, the Telecom Corridor, and Legacy. Additionally, NCTCOG is projecting continued high employment growth in Beach Street, North Richland Hills-Iron Horse, North Richland Hills-Smithfield, and Summer Creek areas (*TEX Rail* 2014). This dispersal of employment and entertainment centers results in complex travel patterns in the Metroplex that affects residents, business travelers, and tourists.

As a major economic, social, and political center, the Metroplex supports a diverse economy and is home to 18 *Fortune 500* companies. As shown in *Table 1-2,* jobs within the MSA are predicted to increase 69 percent from 3,964,966 in 2010 to 6,691,459 in 2040. According to NCTCOG's 2040 Demographic Forecasts, the highest increase in the number of jobs is projected to occur in Dallas County at 1,312,672; a growth rate of 70 percent. Dallas County is followed by Tarrant County, which is projected to have 702,772 additional jobs or a 68 percent increase.

Additionally, an increase in freight volumes also contributes to rising congestion on the transportation system within the Metroplex and on the Texas transportation system. According to TxDOT (2010), "Texas freight volumes are expected to increase overall by about 82 percent between 2008 and 2035. In this timeframe, rail and rail/truck volume (a combination of freight in rail cars and truck trailers shipped by rail) will increase 91 percent and truck volume will increase 77 percent." Congestion and intensity of freight movement affect traveler and business connectivity to and from and within the Metroplex.

The transportation system is central to the continued growth of the Metroplex because it allows for the efficient movement of people and goods. NCTCOG recommends improving transportation options, travel efficiency measures and system enhancements that balance land use and transportation, and develop programs that reduce automobile trips (*NCTCOG* 2013). This is also consistent with the *Texas Rail Plan* (*TxDOT* 2010), which focuses on alternative modes of transportation to "provide cost-effective, energy-efficient, sustainable personal mobility and goods movement that connects Texas communities and links Texas businesses with domestic and international markets, minimizing environmental impacts, reducing road congestion, improving air quality, and promoting economic growth" (*TxDOT* 2010).

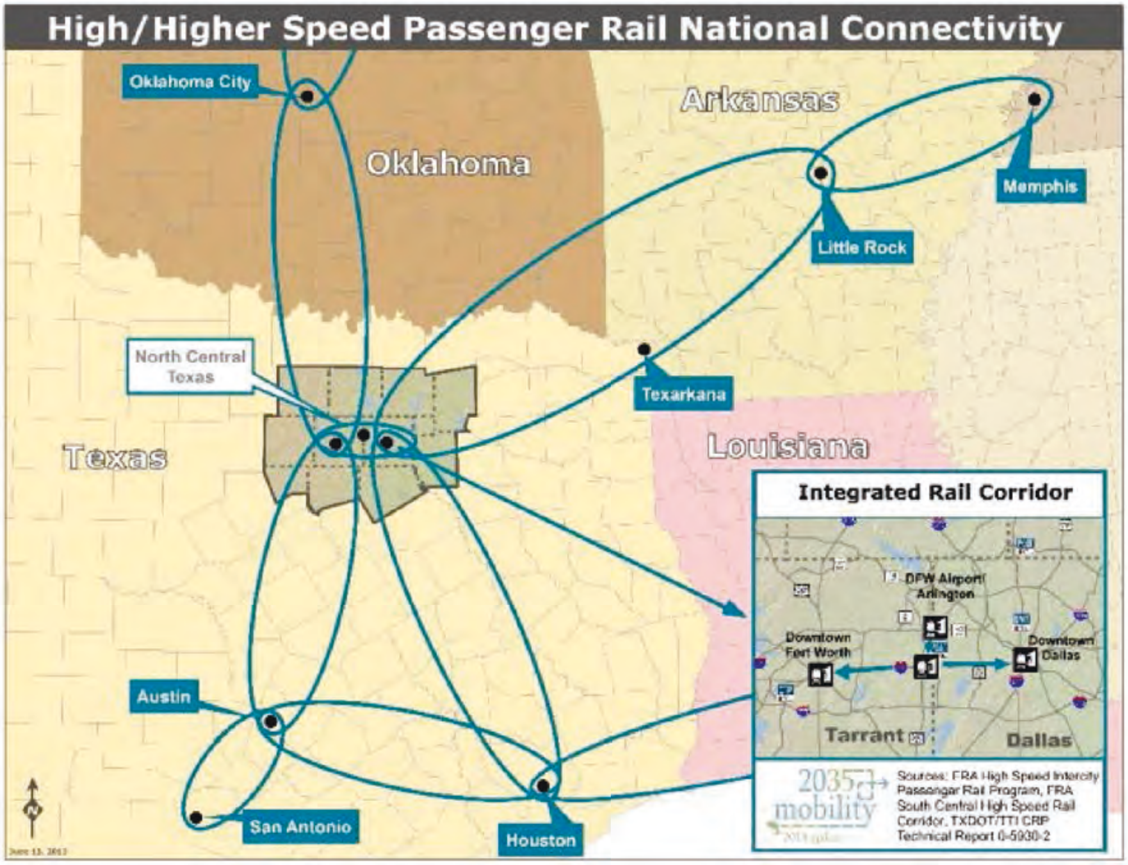
1.6.2 Regional Transportation Connectivity of the Metroplex

In accordance with federal and state plans to establish a high-performance rail network, NCTCOG is examining the potential for high-performance rail in the Metroplex.

> "The Regional Transportation Council has discussed where stations would initially be located and identified three points of interest including Fort Worth, Dallas/Fort Worth International Airport (with access to the airport coming from Arlington), and Dallas. Options include corridors between North Central Texas and Austin, Houston, Oklahoma City, and Little Rock. The Dallas-Fort Worth to Houston corridor has been identified as the corridor with the most potential for high-speed rail service." (NCTCOG 2013).

TOPRS and the Project, along with the Dallas Houston High-Speed Rail Project, the DART Rail Orange Line (light rail),and the proposed Cotton Belt (commuter rail) and TEX Rail (commuter rail) are all potential components of this integrated passenger rail system. Such a system has the potential to operate at speeds high enough to compete with air travel over distances up to about 400 miles. The service could provide an alternative to automobile and air travel within the state for business, tourism, and other travel purposes. *Figure 1-3* illustrates potential high-speed rail linkages.

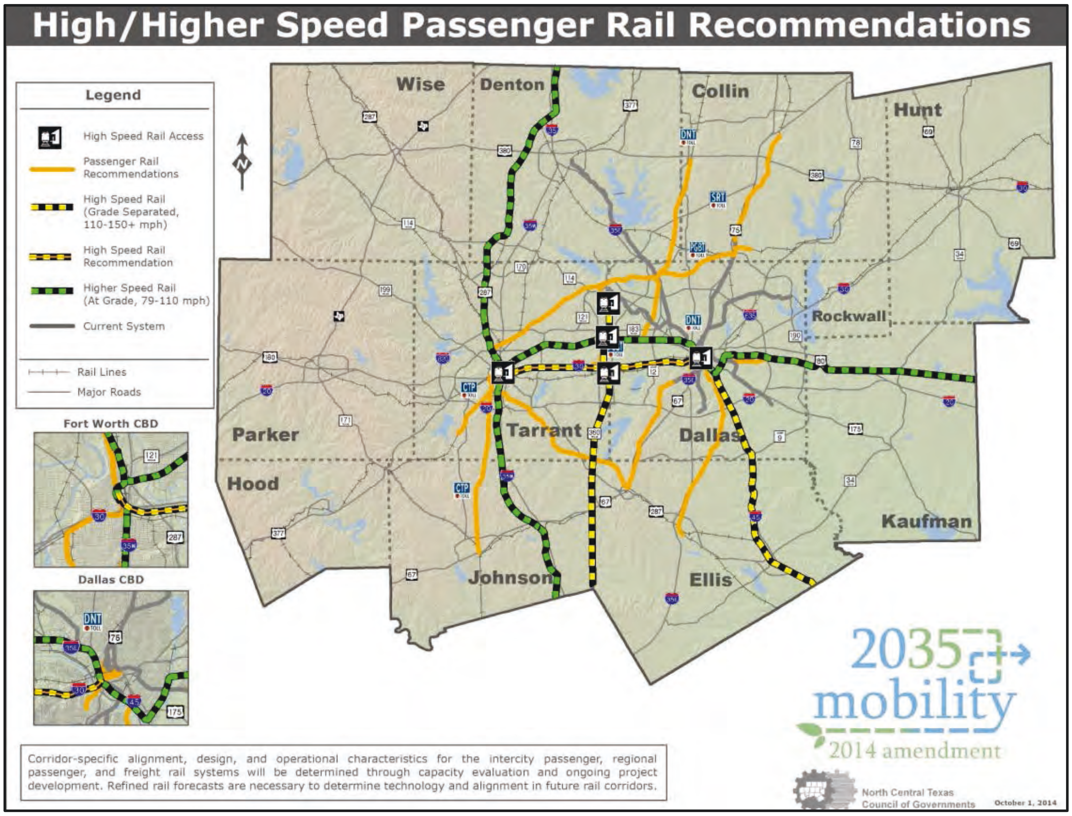
Figure 1-3: High/Higher Speed Rail Connectivity



Source: NCTCOG, *Mobility 2035,* Mobility Options.

In its 2014 amendment to *Mobility 2035*, NCTCOG proposed high- or higher-speed rail (grade separated, 110-150+ mph) along I-30 (funded recommendation), SH 360, and I-45 East, as well as higher-speed rail (at grade, 79-110 mph) along the TRE line, I-35 West, and US 80 (NCTCOG 2014). *Figure 1-4* illustrates NCTCOG's recommendations for high- and higher-speed passenger rail service.

Figure 1-4: Proposed High/Higher Speed Rail Alignments



Source: NCTCOG, *Mobility 2035: 2014 Amendment*, Frequently Referenced Maps

1.6.3 Airport and Activity Center Accessibility

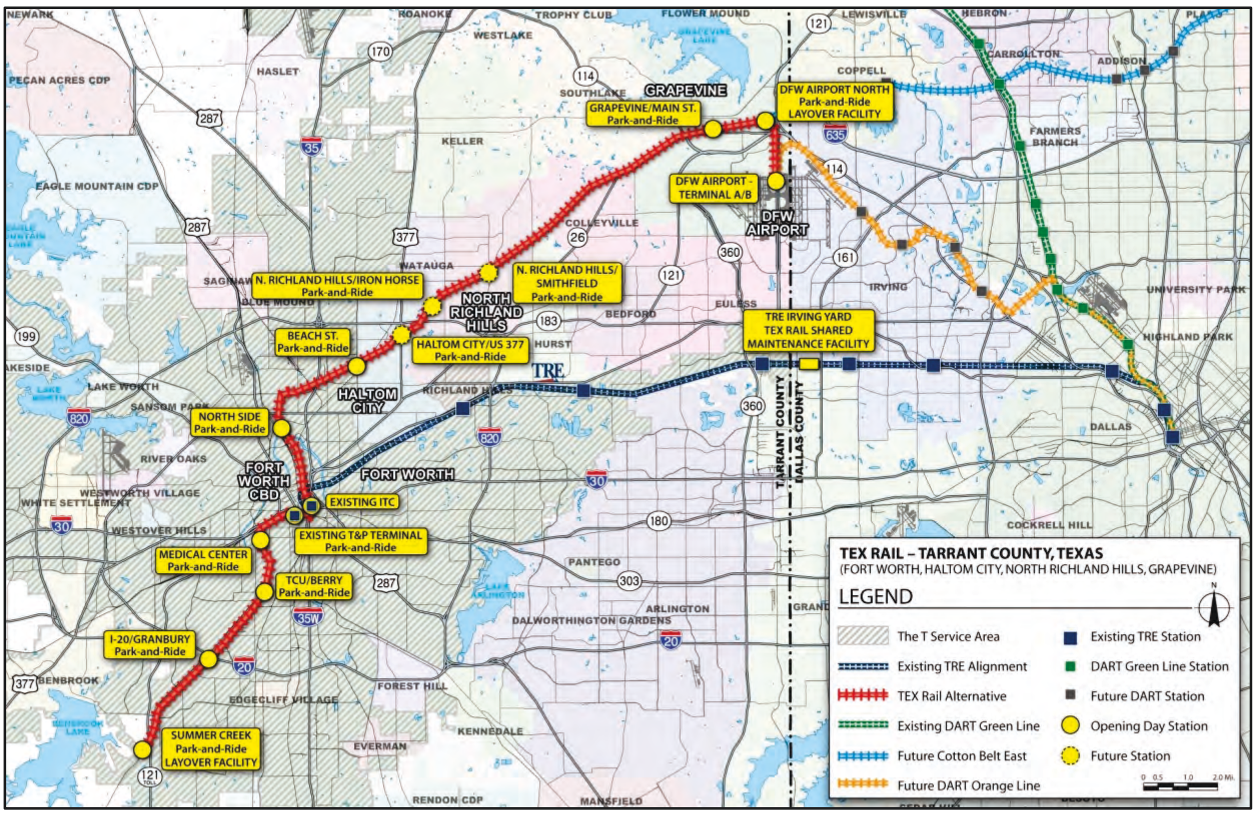
As indicated in several studies (i.e. *Dallas 2030, Mobility 2035, Cotton Belt Corridor [2010], TEX Rail [2014]*), improving access to major activity centers, such as the DFW Airport is

> "an important goal of the region as mobility and air quality issues demand alternative modes of travel to single occupant vehicles. Current transit access to DFW Airport and other activity centers is limited in scope due to [sic] access and travel time constraints and residents outside The T's service area currently do not have access to transit." (*The T* 2014)

The length and unreliability of travel times for existing over-the-road transit modes because of congestion along the major roadways between the Fort Worth and Dallas downtowns and the DFW Airport inconvenience travelers. Additionally, most transit trips from the downtowns to the airport require multiple transfers. As a result, the existing level of transit offers no advantage in travel time or convenience over the automobile. The reliability of bus service to the DFW Airport and other activity centers within the Metroplex would be further affected by traffic congestion and other traffic incidents. As shown in *Figure 1-5*, the DART Rail Orange Line (light rail) and the proposed Cotton Belt (commuter rail) and TEX Rail (commuter rail) lines connect the Dallas and Fort Worth Central Business Districts to the DFW Airport from the north, but there is no direct southern rail route to the airport.

Additionally, a transportation option that is able to operate efficiently during severe weather conditions that ground planes will benefit travelers to and from the Metroplex. To provide better transit connectivity and reduce single-occupancy vehicle travel and roadway congestion, it is important to provide efficient, reliable, and multi-modal transportation options to the airport and other activity centers in the Metroplex and for those travelers connecting through DFW from Oklahoma and other parts of Texas

Figure 1-5: Rail Transit Network and DFW Airport Connections



Source: *TEX Rail*, 2014

1.6.4 Air Quality

Dallas and Tarrant counties currently do not meet the federal air quality standard for ozone. However, the efficiency in high performance passenger rail would reduce fuel consumption and associated air emissions. According to the American Public Transportation Association (2012), no other mode of transportation could reduce the demand for fossil fuel as dramatically as high performance passenger rail. Depending on the power source, the amount of fuel savings varies, but in general, train travel is 21 percent more fuel efficient than auto travel per mile and 17 percent more efficient than airlines on a per-passenger-mile basis (*APTA* 2012). By providing a transportation option to and within the Metroplex that is competitive with the automobile and air travel, the Project would contribute to improving air quality while also reducing energy consumption for transportation.

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Appendix B:
Ridership Demand Forecasting Methodology

Technical Memorandum

To: Chad Coburn, TxDOT; Catherine Dobbs and Melissa Hatcher; FRA
From: Ed Campbell
Cc: Melissa Neeley, Erik Stevens, Mark Werner, TxDOT; Margarita Gagliardi, MTAC
Date: March 24, 2016
Subject: Ridership Forecasting Methodology Overview

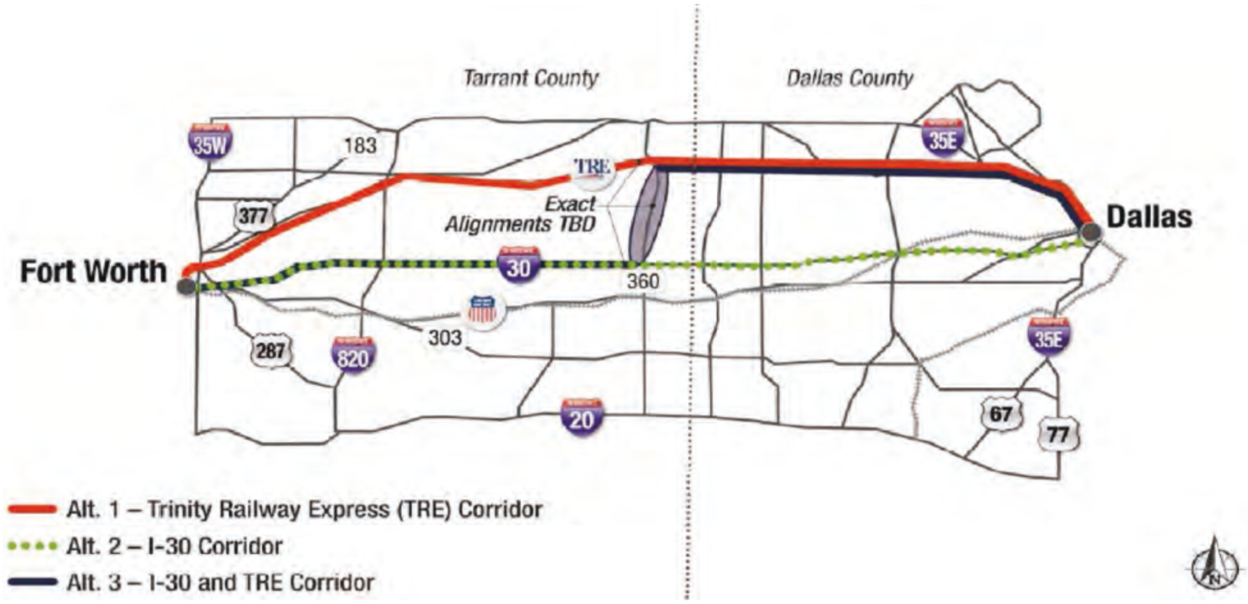
1 Introduction

1.1 Project Description

The Texas Department of Transportation (TxDOT) is working with the Federal Railroad Administration (FRA) to study a possible high-speed, intercity passenger rail service between Dallas and Fort Worth, Texas. The Dallas–Fort Worth Core Express Service (the Project) supports a statewide framework of high-speed rail service connecting Oklahoma City through Fort Worth to South Texas and the Dallas/Fort Worth Metroplex to Houston. A private developer, Texas Central Partners, is advancing the Dallas to Houston corridor as a privately funded and operated service (Texas Central Railway or TCR). The Texas Oklahoma Passenger Rail Study (TOPRS) is a Tier 1 Environmental Impact Statement (EIS) that includes a high-level evaluation of the Dallas/Fort Worth Metroplex as part of its corridor alternatives analysis.

The Project is a Tier 2 EIS that evaluates the environmental impacts, service characteristics, and capital, operating and maintenance costs to identify a preferred alternative alignment and service plan. The Project evaluates steel wheel on steel rail trainsets with operational speeds of 90, 125, and 220 miles per hour (mph). The physical limits of the project extend from downtown Fort Worth at either the Intermodal Transportation Center (ITC) or the Texas & Pacific (T&P) Station on the south side of downtown at the western terminus to downtown Dallas at either the Dallas Union Station or the proposed Texas Central Railway (TCR) Station near the Interstate (I)-30/I-35E interchange south of Union Station on the east. The alternative conceptual corridors under evaluation consist of the I-30 corridor, the Trinity Railway Express (TRE) corridor, and the corridor along I-30, State Highway (SH) 360 and the TRE, as shown in Figure 1.

FIGURE 1: PROJECT LOCATION MAP AND ALTERNATIVE CORRIDORS



1.2 Objective

This Technical Memorandum provides an overview of the ridership forecasting methodology, the descriptions of the ridership input variables, and estimated fare structures. It serves as an interim deliverable, and will be augmented with the No Build Alternative Technical Memorandum (submitted under separate cover for interim review). The analyses from these technical memoranda will be included in the Project's Alternatives Analysis Report (AA).

1.3 Purpose and Need

The Purpose and Need Statement for the Project (August, 2015) defines the purpose as :

> *".....to create a financially viable, safe, reliable, and environmentally sustainable intercity passenger rail service connecting Dallas and Fort Worth, while providing a key linkage to the existing and developing Texas high-performance passenger rail system."*

It should be noted that because the Project is part of an overall developing high-speed rail network linking two north/south high-speed rail corridors, and because there is an existing commuter rail service between Dallas and Fort Worth in the Metroplex, all of the alternatives evaluated assume that TOPRS and TCR are operational by 2040. Both projects are mentioned in the North Central Texas Council of Governments (NCTOG's) Mobility 2040 Plan (March 2016), but are not included in the Dallas-Fort Worth Expanded Travel Demand Model (DFX) for the 2040 planning horizon or on the list of fiscally constrained projects for the region.

2 Ridership Methodology Overview

2.1 Modifications to Existing Travel Demand Models

As the Metropolitan Planning Organization for the Metroplex, NCTCOG maintains the DFX for the region. In August 2014, discussions between NCTCOG, the Texas Department of Transportation (TxDOT) and WSP | Parsons Brinckerhoff were initiated to determine the best approach to integrating high-speed rail into the DFX. As a result, a scope of work to augment the 2010 DFX was developed to incorporate an intra-regional high-speed rail (HSR) ridership forecasting model for the Metroplex. In part, this scope of work states:

> *"The HSR ridership forecasting model shall include the capability to forecast intra-regional HSR trips and their effect on destination choice, treatment of special markets unique to HSR, the effects of inter-regional HSR trips on the transportation system within the DFW region. The work effort will also require integration of this enhanced modeling system with inter-regional HSR forecasts being developed separately….."*[1]

As discussed below, model enhancements were developed to provide the necessary detail in the DFX to determine HSR ridership and evaluate the changes in the transportation network as a result.

2.1.1 DFX Model Enhancements

2.1.1.1 Mode Choice Expansion

The 2010 DFX did not include HSR as a modal option; therefore the first task was to develop a module to expand the modal choice component of the model. The mode choice expansion module also predicts the various ways in which riders access the HSR system, such as commuter rail, car, bus transit, light rail, walking, or by air, with the necessary intermediate linkages.

2.1.1.2 Latent and Induced Demand

The introduction of a new transportation mode may provide enough enhancement to the overall transportation network to encourage more usage by passengers who would like to use the system but don't (latent demand) or generate new usage on the new mode and/or connecting links due to the nature of the mode (induced demand).

2.1.1.3 Air Passenger Model

An explicit air passenger model is important to understand how the intercity HSR might complete with airlines for the D-FW to Houston travel market. This enhancement also

[1] Texas Department of Transportation (2015), Contract 83-2SDP5008 Work Authorization No. 4, Exhibit B Services to be Provided by the Engineer.

provides for analysis of the access and egress patterns of diverted air passengers. This component was developed by the WSP | Parsons Brinckerhoff team.

2.1.1.4 Special Events Model

NCTOG's 2035 long-range transportation plan included a representative corridor for HSR service along I-30 with a station in Arlington to serve the entertainment district that includes Six Flags, AT& T Stadium (home of the Dallas Cowboys), Globe Life Park (home of the Texas Rangers), Six Flags Hurricane Harbor, and the Arlington Conventions Center, among other venues. This component evaluates how the Arlington Station shifts passengers from passenger vehicles to the HSR system for special events, including baseball and football games.

2.1.2 Inter-regional Model Enhancements

The Texas Statewide Analysis Model (SAM) has been enhanced with an inter-regional HSR system component. The enhancements also include integration of the SAM outputs used as inputs into the enhanced DFX.

2.1.2.1 Mode Choice Expansion

SAM was expanded to include HSR as a mode choice between Dallas and Houston based on TOPRS in order to maintain consistency for the system. For the connect air market (for trips that use a hub airport in one of the metropolitan airports but with an ultimate origin or destination outside the Metroplex), an air itinerary choice model was estimated based on the revealed preferences of current air travelers in the D-FW and Houston air markets. Rail access connect air forecasts produced by the model were added to the inter-urban rail forecasts.

2.1.2.2 Intercity Modeling for D-FW to Houston Corridor

An inter-urban HSR ridership forecasting model is included for the TCR. The inter-urban forecast provides anticipated ridership based on the demand between the metropolitan areas of Houston and D-FW.

The model study area includes the 240-mile corridor between D-FW and Houston metropolitan areas and extends 50 miles on either side of the DHSSR corridor. Trip tables were developed using current anonymous cell phone data from AirSage, processed to distinguish between trips made by Texas residents and out-of-state visitors. Trip tables for intercity bus were created from a supply-side analysis of bus schedules with an estimated load factor. Air trip tables were developed from public data available at the Bureau of Transportation Statistics.

2.1.2.3 Urban Access to HSR Station in Houston

The travel demand model for the Houston-Galveston Area Council of Governments (H-GAC) was used to evaluate the access and egress from one terminal station in the greater Houston area.

2.2 System Integration and Calibration

The applicable model enhancements are integrated into a copy of the DFX model and into a copy of the SAM to forecast HSR ridership, including ridership along the D-FW to Houston corridor, and the impact of HSR system on the other modes at a sufficient level of detail to support the comparison of alternatives, including the No Build Alternative, for the EIS effort of the Project. Testing and calibration of the individual enhancements as well as the fully assembled enhanced model will be documented in the Model Development Report.

3 Ridership Input Variables

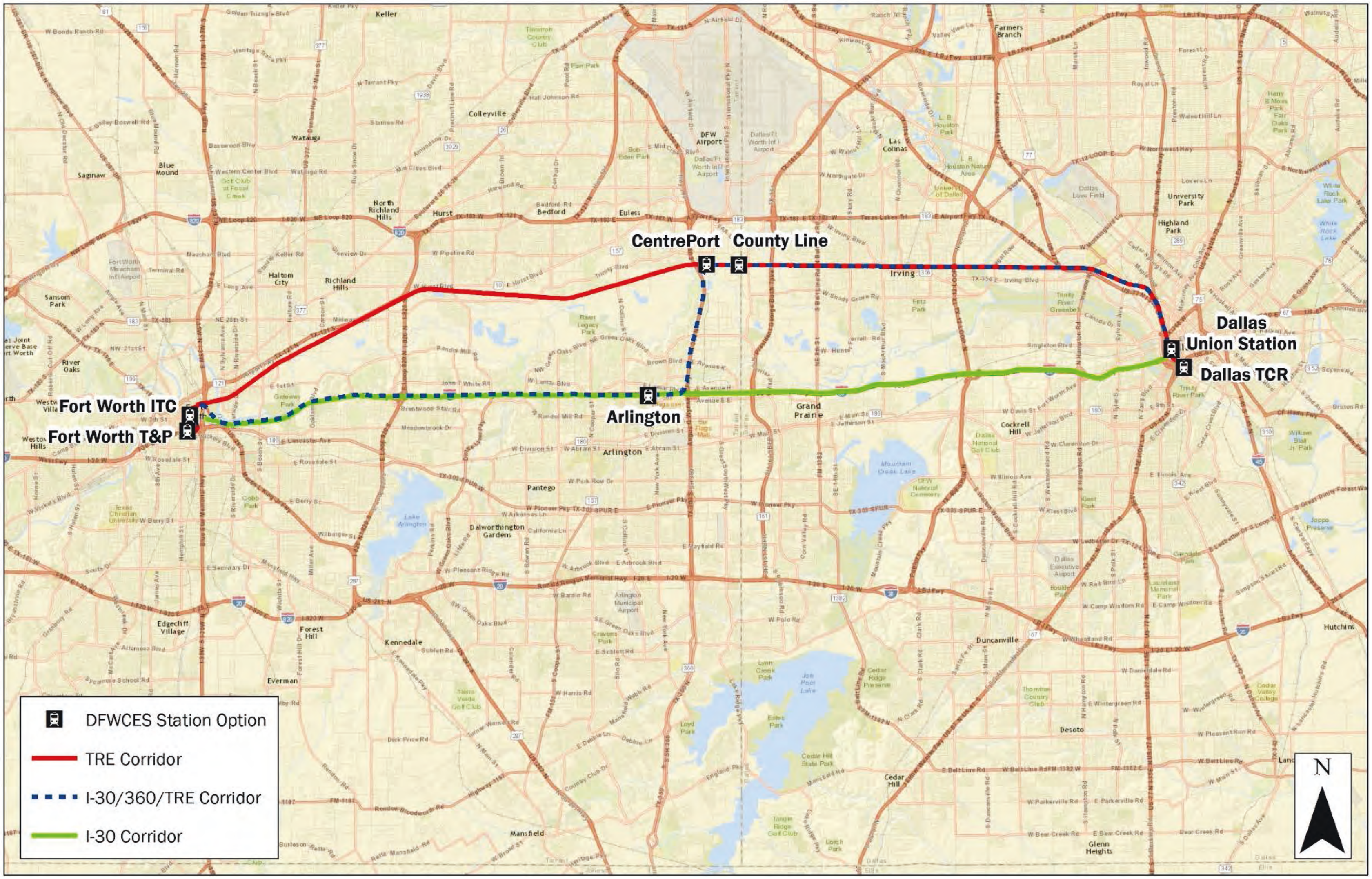
Ridership forecasting requires a set of input of data to describe an alternate which is defined by a corridor alignment and a combination of stations locations. The alignment alternatives shown in Figure 1 are:

- Trinity Railway Express (TRE) Corridor,
- Interstate 30 (I-30) Corridor, and
- I-30/State Highway 360 (SH 360)/TRE Corridor.

The station options shown in Figure 2 are:

- Fort Worth T & P Station is on the south edge of downtown and a terminal stop on the TRE. Two bus routes serve this station
- Fort Worth Intermodal Transportation Center (ITC) Station is on the southeast side of downtown and the primary terminal station for the TRE. Seventeen local all day and nine peak hour express bus routes serve this station. A free downtown circulator trolley also serves the ITC.
- CentrePort Station is near the Dallas/Tarrant county line in east Fort Worth. The descriptions of the three bus services are provided below in Section 3.1.2.
- Arlington Station is adjacent to I-30. This is a new station that is served by one modified existing express shuttle described below in Section 3.1.2.
- County Line Station is approximately one mile east of CentrePort on the TRE. This a station option is on a CentrePort circulator route and served by a free DFW Airport shuttle comparable to the one serving CentrePort.

FIGURE 2: POTENTIAL STATION OPTIONS FOR THE PROJECT



- Dallas Union Station is in downtown Dallas and provides connectivity via the Dallas Area Rapid Transit (DART) light rail system and five existing bus routes. A shuttle between Union Station and the proposed Dallas Texas Central Railway (TCR) Station is included in the model for those alternatives that do not include both stations. The shuttle is assumed to be free. This assumption may be adjusted based upon the evaluation for the AA.
- Proposed Dallas TCR Station for the TCR project, located southeast of Union Station, south of I-30 and adjacent to the Union Pacific Railroad. The undeveloped property does not have any existing transit connections. A modification to Dallas Area Rapid Transit (DART) Route 26 is assumed with all alternatives to provide connectivity to Cedars Station on the Red and Blue light rail lines. Cedar Station is approximately 2,100 feet east of the preliminary station location.

The characteristics of the alignment corridors and stations are summarized in the following sections. The appendix to this memo presents for each alternative by corridor and each station the specific characteristics or variables that will be used in the ridership model.

3.1 Alignment Variables

For each corridor, a geographic information system (GIS) shapefile was created to link the track alignment with the attributes associated with travel time between stations, local transit modifications and fare. The attributes that do not change across alternatives are called constants. Those attributes that change are the variables and the variables that can be altered to evaluate the impact on ridership are called variants.

3.1.1 Constant Attributes

For the alignments, there are three constants attributes: station locations, connectivity to TOPRS and TCR, and terminal locations.

3.1.1.1 Station Locations

Table 1 indicated the stations being considered for each alternative alignment.

TABLE 1: STATIONS CONSIDERED FOR EACH ALIGNMENT WITHIN THE CORRIDORS

Station Name	Location	New or Existing	Existing Connecting Transit Service	Proposed Connecting Transit Service	Alignment Alternative		
					TRE	I-30	Hybrid
T & P	Downtown Fort Worth	Existing	Bus, Commuter Rail	Local Bus, Commuter Rail	X	X	X
Intermodal Transportation Center	Downtown Fort Worth	Existing	Local and Express Bus, Trolley Commuter Rail, Amtrak	Local and Express Bus, Trolley Commuter Rail, Amtrak	X	X	X
Arlington	Arlington on I-30	New	N/A	Express Bus		X	X
CentrePort	East Fort Worth	Existing	Express Bus, Circulator Bus and Airport Shuttle	Express Bus, Circulator Bus and Airport Shuttle	X	X	X
County Line	Grand Prairie	New	N/A	Circulator Bus, Airport Shuttle			X
Union Station	Downtown Dallas	Existing	Bus, Commuter Rail, Light Rail, Amtrak	Bus, Commuter Rail, Light Rail, Amtrak, and Station Shuttle*	X	X	X
TCR	South Downtown Dallas	New	N/A	Local Bus and Station Shuttle*	X	X	X

Notes: * Station Shuttle between Union Station and TCR Station for those alternatives that do not include both stations.

The City of Arlington submitted an optional location for its station approximately 5,000 feet west of the location identified by the study team. Since the access to I-30 and the location relative to the Entertainment District are comparable, the ridership analysis did not vary the location of the Arlington station. Figure 2 show the location of the Arlington station sites and major venues in the Entertainment District.

3.1.1.2 Connectivity with TOPRS and TCR

All alignments will be connected to TOPRS on the west side of the corridor and TCR on the east side.

3.1.1.3 Terminal Locations

The primary terminal stations are the ITC on the west side of the corridor and Dallas Union Station on the east side. There are several alignment options that include terminal stops at the T&P in Fort Worth and the proposed TCR station in Dallas.

3.1.2 Variable Attributes

Attributes that may change depending upon the alignment alternative are called variable attributes. The primary variable attribute for the Project is local transit modifications.

Modifications to bus routes included in *Mobility 2040*, are included in the model if necessary to provide a link to the public transportation networks operated by the Fort Worth Transportation Authority (The T) and/or DART. Each transportation authority operates a bus system and jointly operates the TRE, the commuter train service between downtown Fort Worth and Downtown Dallas. DART also has a light rail network that is laid out in spokes from downtown shown in Figure 3.

FIGURE 3: DART LIGHT RAIL NETWORK

Source: https://www.dart.org/maps/printrailmap.asp, Accessed March 18, 2016

The following sections summarizes the transit route modifications that are in the alignment shapefiles for those alternatives that include the stations listed below. No modifications are included for the five routes serving the T&P nor the 28 routes serving the ITC.

3.1.2.1 CentrePort Station

The CentrePort station on the TRE provides a connection to three separate bus operations:

- The Arlington MAX (MAX) is sponsored by City of Arlington, Arlington Chamber of Commerce, University of Texas Arlington, DART, The T, and the TRE The service is an express bus (DART, Route 221) that connects the University of Texas at Arlington, downtown Arlington and the Entertainment District with the TRE station at CentrePort in east Fort Worth. A single trip fare is $5.00.[2] This service is included in the DFX.
- The CentrePort Circulator (The T, Route 30) is a three-route network that serves CentrePort, a 1,300-acre mixed use development south of DFW Airport. The development has over 100 tenants with land uses that include multi-family, retail, distribution, corporate offices, and call centers.[3] This service is included in the DFX
- DFW Airport operates a free shuttle service between CentrePort Station and the south remote parking lot. Passengers then transfer to one of three shuttles goes directly to one or more terminals.

The TRE corridor alternatives do not require any changes to the existing bus service. The I-30 corridor requires a modification to the MAX service to include the Arlington station. The I-30/SH 360/TRE alternative requires modification to the MAX route for those alternatives that include the Arlington station.

3.1.2.2 County Line

The County Line station is a station on the I30/SH 360/TRE alignment corridor located approximately one mile east of CentrePort on the TRE, between Trinity Boulevard (Fort Worth) and Valley View Lane (Irving, north of TRE) / Roy Orr Boulevard (Grand Prairie, south of TRE). The horizontal curve between the SH 360 leg and the TRE leg of the I-30/SH 360/TRE alignment does not permit the use of CentrePort station, even with a speed reduction to 40 mph.

The CentrePort Circulator East Loop route passes the proposed station location on Trinity Boulevard. It is assumed this route can be used to access the commuter rail at CentrePort Station.

- A new free DFW Airport Shuttle is assumed in all alternatives with the County Line station to provide the comparable service to DFW Airport's south remote parking lot that is currently in place at CentrePort Station.
- Extending the existing DART bus service from the West Irving Station, 2 miles east of the County Line station, was considered but not included in the ridership forecasting. The

[2] http://www.ridethemax.com/
[3] Fort Worth Chamber of Commerce, http://www.fortworthchamber.com/chamber/old/eco/industrial_bus.html#4

existing commuter rail service provides the connection to these bus routes at a lower cost and the local routes do not serve a major traffic generator, such as DFW Airport.

The I-30/SH 360/TRE Corridor is the only one that includes the County Line station.

3.1.2.3 Arlington

The Arlington Station has two potential locations that are being evaluated as part of the station planning task. Road access and parking capacity are comparable; thus ridership is assumed to be equivalent. The location used for the ridership modeling is on the south side of I-30 between Legends Way and Ballpark Way just north of the Arlington Convention Center. The parking lot serves as overflow parking for both the convention center and the sporting venues.

The MAX route is modified to include Arlington station for all of the I-30 alternatives and the I-30/SH 360/TRE alternatives that include the Arlington Station. The route modification provides the link to UT Arlington, downtown Arlington and to DFW Airport through the transfer to the DFW Airport Shuttle at CentrePort station.

The City of Arlington does not have a public transportation system and no new service is included in Mobility 2040. There is a three bus circulator within the University of Texas-Arlington campus and a four shuttle circulator that serves the Entertainment District. These services are not included in the ridership model due to the limited service areas.

3.1.2.4 Dallas Union Station

The intermodal Dallas Union Station includes commuter and light rail as well as five bus routes. The Central Business District (CBD) West Transfer Center is eight blocks northeast of the station.

For those alternatives that have Dallas Union Station as the terminal station, an express shuttle to the proposed TCR Station is included to provide the connection. The shuttle is assumed to be free or included in the price of the fare.

3.1.2.5 TCR Station

The TCR Station is proposed as a mixed use development with a substantial amount of parking on the south side of downtown Dallas on undeveloped property adjacent the Union Pacific Railroad. The current proposed location is approximately 0.7 mile southeast of Union Station. For more information on the Dallas/Houston High Speed Rail project (see www.texascentral.com).

For those alternatives that have the TCR Station as the terminal station and do not include a stop at Union Station, an express shuttle to the TCR Station is included to provide the connection. The shuttle is assumed to be free or included in the price of the fare.

The modification to DART, Route 26, is included in all alternatives, whether there is a stop at the TCR Station or not, to provide a bus connection to the light rail service at Cedars Station approximately 2,100 feet east of the TCR Station.

3.1.3 Variant Attributes

Attributes that may be changed to compare with impact of the change the ridership forecast are called variants. The variants are operating speed and fare structure.

3.1.3.1 Operating Speed

Operation speed is a key variant for the ridership forecasting. For each alignment corridor, travel times are generated between stations for three operating speeds and two trainset technologies shown in Table 2. The travel times are developed using geometrically defined horizontal and vertical alignment for each corridor.

TABLE 2: TRAINSET TECHNOLOGY BY OPERATING SPEED

Trainset Technology	Maximum Operating Speed		
	90 mph	125 mph	220 mph
Diesel-Electric	X	X	
Electric		X	X

Two technologies are considered for 125 mph to compare the anticipated improvement in travel time but higher capital cost for an electric propulsion system compared to the lower capital cost and slower travel time for a diesel-electric (diesel) propulsion system.

Travel times for the TRE and the I-30/SH 360/ TRE corridors are summarized in Table 3 and Table 4 below for early review. Note, the I-30 corridor travel times will be included in the final version of this technical memorandum.

For each corridor, a series of stopping patterns (combinations of termini and intermediate stops) are evaluated in the eastbound (EB) and westbound (WB) directions. The end-to-end travel times shown in Table 3 and Table 4 include a one minute dwell time at each intermediate station. Total travel times are shown for each stopping patterns, by technology and maximum operating speed in a combination of four trainsets.

TABLE 3: TRE CORRIDOR TRAVEL TIMES

Stopping Pattern		220 mph Shinkansen		125 mph ICE ED		125 mph Pendolino		90 mph Diesel	
		EB	WB	EB	WB	EB	WB	EB	WB
1	T&P, ITC, CentrePort, Dallas Union St, TCR	0:27:23	0:27:23	0:27:45	0:27:52	0:29:31	0:29:39	0:43:09	0:44:45
4	ITC, CentrePort, Dallas Union St, TCR	0:25:01	0:25:01	0:25:27	0:25:33	0:26:58	0:27:06	0:40:01	0:41:38
7	ITC Centreport, Dallas Union St	0:22:29	0:22:28	0:22:59	0:23:03	0:24:19	0:24:18	0:36:49	0:38:19
9	ITC Centreport, TCR	0:23:39	0:23:41	0:24:09	0:24:14	0:25:29	0:25:41	0:38:12	0:39:58

TABLE 4: I-30/SH 360/TRE HYBRID CORRIDOR TRAVEL TIMES

Stopping Pattern		220 mph Shinkansen		125 mph ICE ED		125 mph Pendolino		90 mph Diesel	
		EB	WB	EB	WB	EB	WB	EB	WB
2	T&P, ITC, Arlington, County Line, Dallas Union St, TCR	0:34:19	0:34:23	0:34:06	0:34:19	0:36:15	0:36:34	0:51:17	0:52:44
5	ITC, Arlington, Dallas Union St, TCR	0:29:17	0:29:27	0:29:10	0:29:25	0:30:45	0:31:22	0:44:02	0:45:14
8	ITC, Arlington, Dallas Union St	0:26:44	0:26:53	0:26:42	0:26:55	0:28:06	0:28:34	0:40:50	0:42:25
11	ITC, Arlington, TCR	0:27:56	0:28:08	0:27:53	0:28:07	0:29:16	0:29:57	0:42:14	0:44:02
16	ITC, County Line, Dallas Union St, TCR	0:29:19	0:29:19	0:29:10	0:29:17	0:31:01	0:31:12	0:45:23	0:46:33
17	ITC, Arlington, County Line, Dallas Union St	0:28:47	0:28:50	0:28:39	0:28:49	0:30:33	0:30:43	0:44:39	0:45:59
18	ITC, Arlington, County Line, TCR	0:29:58	0:30:05	0:29:49	0:30:01	0:31:42	0:32:07	0:46:02	0:47:34
19	ITC, County Line, TCR	0:27:57	0:28:00	0:27:52	0:27:59	0:29:31	0:29:48	0:43:34	0:44:49

3.1.3.2 Fare Structure

The draft base fare structure will be provided as a separate technical memorandum. Fares are considered a variant and will be modified in some of the ridership forecasting runs to assess the impact on ridership.

The estimated fares are based on United States precedents from other operating systems in Texas, Maryland, California as well as other high speed rail studies (TOPRS, and California High Speed Rail) for trips of a similar length to the Project (around 30 miles) in urban areas.

It should be noted that the overall service characteristics including potential speed are considered; however travel time saving estimates were not available. As a result, the value of time savings are not factored in the analysis. Similarly, no consideration was given to differences in the operating costs or service plans between the rail technologies, and no surveys were undertaken so no adjustment was made for unique characteristics of the Metroplex.

Being based upon subsidized precedents and without the benefit of detailed surveys these fares will not be operating profit/ net revenue maximizing in the way an unsubsidized concessionaire or private operator would require. Thus it is likely that the ridership levels forecasted will be higher than those forecast by such a concessionaire (or as part of a shadow bid estimate of the viability of a Public Private Partnership/Comprehensive Development Agreement.

The following are included in the base fare assumptions:

- All fares one way
- 2015 prices
- Average fare makes allowances for advance purchase discounts
- No difference in fare charged from/to Dallas Union Station or TCR Station.
- No difference in fare from/to Fort Worth T&P or ITC.
- Once boarded there is a charge minimum fare (i.e. Dallas TCR Station to Union Station).

As described in the sections below, fare assumptions varied by the speed of the system being measured.

220 mph Capable Alternatives

Based on the California High Speed Rail Metropolitan Transportation Commission zones and TOPRS, the fare estimation for the 220 mph alternatives use the following assumptions:

- $15.00 boarding fee + $0.30/mile for non-business and $0.45/mile for business use.
- Minimum fare of $19.50
- Incremental cost of through trip from Houston $0.30/mile for non-business and $0.45/mile for business

125mph Capable Alternatives

Based on the Northeast Corridor regional pricing and TOPRS, the fare estimation for the 125 mph alternatives use the following assumptions:

- $10.00 boarding fee + $0.30/mile for non-business and $0.45/mile for business.
- Minimum Fare of $14.50.

90 mph Capable Alternatives

Based on Caltrain, the California commuter rail line on the San Francisco Peninsula and in the Santa Clara Valley, and the Maryland Area Regional Commuter (MARC) 2 Zone system, the 90 mph Capable Alternatives assumes $4.00 per zone

Fare Table Summary

Table 5 summarizes the results of the fare analysis for the Project. For the 220 mph alternatives, fares range from $19.50, non-business class from Dallas to CentrePort to $28.50 from Dallas to Fort Worth, within an additional $13.50 for passengers originating in Houston. For the 125 mph alternatives, fares range from $14.50 to $23.50. At 90 mph, the fares range between $4.00 and $8.00.

TABLE 5: FARE SUMMARY TABLE

Speed	220 mph Alternatives		125 mph Alternatives		90 mph Alternatives	
Type	Non-Business	Business	Non-Business	Business	Non-Business	Business
Dallas Union/TCR Station to:						
CentrePort	$19.50	$21.75	$14.50	$16.75	$4.00	$4.00
Fort Worth	$24.00	$28.50	$19.00	$23.50	$8.00	$8.00
Additional Fare charged to Passengers originating in Houston:						
CentrePort	+$4.50	+$6.75	-	-	-	-
Fort Worth	+$9.00	+$13.50	-	-	-	-

3.2 Station Variables

Each station is defined as a point shapefile with group of attributes at that are defined for each alternative. Those attributes that change are the variables that can be altered to evaluate the impact on ridership are called variants.

3.2.1 Constant Attributes

The attributes that do not change across alternatives for a specific station include:

- Rail Transit Connectivity. The status for existing commuter and light rail is maintained. *Mobility 2040* does not include any new rail service to the existing stations.
- Distance and Walk Times for Park and Ride/Kiss and Ride. The number of parking spaces is a variant; however the assumption is additional parking will be accomplished by construction of a garage. Therefore the distance to the mid-point of the parking area does not change. The location of the kiss and ride drop-off points remain the same.
- Transit Modifications. Where transit modifications are proposed, the peak and off-peak headways remain the same across the alternatives.

3.2.2 Variable Attributes

The following attributes change as a result of operating speed or station combination or a variable used to define the station:

- Station Type. A station is either elevated or at-grade, depending on the operating speed and/or alignment corridor. The walk time from station entrance to platform varies with station type.
- Total Walking Time. This value is the sum of park and ride walk time plus station to platform walk time. The station type changes, this value will also change.

3.2.3 Variant Attributes

The following attributes may be modified to compare the impact of the change on the ridership forecast within a specific alternative:

- Parking cost. As parking costs increase, passengers may shift access to the stations to transit or may shift mode to commuter rail.
- Number of parking spaces. A change in the number of parking spaces may shift passenger access to or away from transit.
- Transit Fares. The current fares for connecting services are used as for the initial run of each alternative. A change in transit fare may shift passenger access to or away from transit.

DFWCES Alternative Corridor Characteristics

Characteristics	TRE Alternative			I-30			I-30/SH360/TRE (hybrid)		
Speed	90 mph	125 mph	220 mph	90 mph	125 mph	220 mph	90 mph	125 mph	220 mph
Station Combinations	#1 Ft.Worth T&P /Ft. Worth ITC/ CentrePort/ Dallas Union Station/ Dallas TCR	#1 Ft.Worth T&P /Ft. Worth ITC/ CentrePort/ Dallas Union Station/ Dallas TCR	#1 Ft.Worth T&P /Ft. Worth ITC/ CentrePort/ Dallas Union Station/ Dallas TCR	#3 Ft. Worth T&P /Ft. Worth ITC/ Arlington / Dallas Union Station /Dallas TCR	#3 Ft. Worth T&P /Ft. Worth ITC/ Arlington / Dallas Union Station /Dallas TCR	#3 Ft. Worth T&P /Ft. Worth ITC/ Arlington / Dallas Union Station /Dallas TCR	#2 Ft. Worth T&P/ Ft. Worth ITC/ Arlington / County Line/Dallas Union Station / Dallas TCR	#2 Ft. Worth T&P/ Ft. Worth ITC/ Arlington / County Line/Dallas Union Station / Dallas TCR	#2 Ft. Worth T&P/ Ft. Worth ITC/ Arlington / County Line/Dallas Union Station / Dallas TCR
	#4 Ft. Worth ITC/ CentrePort/ Dallas Union Station / Dallas TCR	#4 Ft. Worth ITC/ CentrePort/ Dallas Union Station / Dallas TCR	#4 Ft. Worth ITC/ CentrePort/ Dallas Union Station / Dallas TCR	#6 Ft. Worth ITC/ Arlington / Dallas Union Station /Dallas TCR	#6 Ft. Worth ITC/ Arlington / Dallas Union Station /Dallas TCR	#6 Ft. Worth ITC/ Arlington / Dallas Union Station /Dallas TCR	#5 Ft. Worth ITC/ Arlington / Dallas Union Station / Dallas TCR	#5 Ft. Worth ITC/ Arlington / Dallas Union Station / Dallas TCR	#5 Ft. Worth ITC/ Arlington / Dallas Union Station / Dallas TCR
	#7 Ft. Worth ITC/ CentrePort/ Union Station	#7 Ft. Worth ITC/ CentrePort/ Union Station	#7 Ft. Worth ITC/ CentrePort/ Union Station	#9 Ft. Worth ITC/ Arlington / Dallas Union Station	#9 Ft. Worth ITC/ Arlington / Dallas Union Station	#9 Ft. Worth ITC/ Arlington / Dallas Union Station	#8 Ft. Worth ITC/ Arlington /Dallas Union Station	#8 Ft. Worth ITC/ Arlington /Dallas Union Station	#8 Ft. Worth ITC/ Arlington / Dallas Union Station
	#10 Ft. Worth ITC/ CentrePort/ Dallas TCR	#10 Ft. Worth ITC/ CentrePort/ Dallas TCR	#10 Ft. Worth ITC/ CentrePort/ Dallas TCR	#12 Ft. Worth ITC/ Arlington/Dallas TCR	#12 Ft. Worth ITC/ Arlington/Dallas TCR	#12 Ft. Worth ITC/ Arlington/Dallas TCR	#11 Ft. Worth ITC/ Arlington /Dallas TCR	#11 Ft. Worth ITC/ Arlington /Dallas TCR	#11 Ft. Worth ITC/ Arlington /Dallas TCR
							#16 Ft. Worth ITC/ County Line/ Dallas Union Station / Dallas TCR	#16 Ft. Worth ITC/ County Line/ Dallas Union Station / Dallas TCR	#16 Ft. Worth ITC/ County Line/ Dallas Union Station / Dallas TCR
							#17 Ft. Worth ITC/ Arlington /County Line/Dallas Union Station	#17 Ft. Worth ITC/ Arlington /County Line/Dallas Union Station	#17 Ft. Worth ITC/ Arlington /County Line/Dallas Union Station
							#18 Ft. Worth ITC/ Arlington /County Line/Dallas TCR	#18 Ft. Worth ITC/ Arlington /County Line/Dallas TCR	#18 Ft. Worth ITC/ Arlington /County Line/Dallas TCR
							#19 Ft. Worth ITC/ County Line/Dallas TCR	#19 Ft. Worth ITC/ County Line/Dallas TCR	#19 Ft. Worth ITC/ County Line/Dallas TCR
Trainset	Diesel	Diesel	N/A	Diesel	Diesel	N/A	Diesel	Diesel	N/A
	N/A	Electric	Electric	N/A	Electric	Electric	N/A	Electric	Electric
1-seat ride (Ft.Worth to Houston)	N/A	N/A	Yes	N/A	N/A	Yes	N/A	N/A	Yes
Shared Use	Yes (freight, TRE, TxRail, TRE Express, Amtrak	Yes (freight, TRE, TxRail, TRE Express, Amtrak	N/A	Yes (freight, TRE, TxRail, TRE Express, Amtrak	Yes (freight, TRE, TxRail, TRE Express, Amtrak	N/A	Yes (freight, TRE, TxRail, TRE Express, Amtrak	Yes (freight, TRE, TxRail, TRE Express, Amtrak	N/A
Frequency	Peak - 30 minutes (6 to 9 AM, 4 to 7 PM)	Peak - 30 minutes (6 to 9 AM, 4 to 7 PM)	Peak - 30 minutes (6 to 9 AM, 4 to 7 PM)	Peak - 30 minutes (6 to 9 AM, 4 to 7 PM)	Peak - 30 minutes (6 to 9 AM, 4 to 7 PM)	Peak - 30 minutes (6 to 9 AM, 4 to 7 PM)	Peak - 30 minutes (6 to 9 AM, 4 to 7 PM)	Peak - 30 minutes (6 to 9 AM, 4 to 7 PM)	Peak - 30 minutes (6 to 9 AM, 4 to 7 PM)
	Non-peak -60 minutes	Non-peak -60 minutes	Non-peak -60 minutes	Non-peak -60 minutes	Non-peak -60 minutes	Non-peak -60 minutes	Non-peak -60 minutes	Non-peak -60 minutes	Non-peak -60 minutes
Trip Time	See alternative-specific sheets.								

No-Build	Consists of all existing and planned services in 2040 Plan, without DFWCES.

Ridership Alternative	Corridor	Station						
		FT. Worth T&P	Fort Worth ITC	Centreport	County Line	Arlington	Dallas Union Station	TCR
1	TRE	X	X	X			X	X
2	Hybrid	X	X		X	X	X	X
3	I-30	X	X			X	X	X
4	TRE		X	X			X	X
5	Hybrid		X			X	X	X
6	I-30		X			X	X	X
7	TRE		X	X			X	
8	Hybrid		X			X	X	
9	I-30		X			X	X	
10	TRE		X	X				X
11	Hybrid		X			X		X
12	I-30		X			X		X
16	Hybrid		X		X		X	X
17	Hybrid		X			X	X	
18	Hybrid		X		X	X		X
19	Hybrid		X		X			X

13,14,15 - Not Used

Alternative	Station Stop	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station Entrance to Platform (min)	Park and Ride*			Kiss and Ride^	
								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
TRE Alt 1-90	**Texas & Pacific (T&P)**	90	8.00	8.00	Start	2:06	10036	Yes	1.33	No			Yes	1.30	No	NA	Yes	No	386	0	X		0	0.100	2.0	1.5	0.004	0.1
TRE Alt 1-90	**Intermodal Transportation Center**	90			2:08	19:15	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
TRE Alt 1-90	**CentrePort Station**	90	4.00	4.00	17:41	18:05	30251	Yes	1.33	No			Yes	1.30	No	NA	Yes	Yes	1015	0	X		0	0.124	2.5	2	0.009	0.2
TRE Alt 1-90	**Union Station**	90	N/A	N/A	18:09	2:19	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
TRE Alt 1-90	**Texas Central Railway – Dallas**	90	N/A	N/A	2:11	Start	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

from NCTCOG 2040 DFX Model
* Based on Tarrant County 1 zone discounted monthly pass rate
http://www.trinityrailwayexpress.org/farezones.html
^^New connection to Cedars Station

The T Park and Ride parking space source:
http://www.tmasterplan.org/wp-content/uploads/2015/09/T-State-of-the-System-150917_FINAL-REV_Overview-of-Services.pdf

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^ If not an existing KNR, used an average based on 7 stations in 3 services. See KNR tab

Alternative	Station NameStation Stop	Fare and Travel Time							Station TAZ	Transit Connectivity									ProposedParking				Station Type		Walk Time Station Entrance to Platform (min)	Park and Ride*			Kiss and Ride^	
										Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
TRE Alt 1-125	**T&P**	125	19.00	23.50	Start	1:18	Start	1:33	10036	Yes	1.33	N			Yes	1.30	No	NA	Yes	No	386	0		X	0.5	0.100	2.0	1.5	0.004	0.1
TRE Alt 1-125	**Intermodal Transportation Center**	125			1:18	11:05	1:33	11:49	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
TRE Alt 1-125	**CentrePort Station**	125	14.50	16.75	11:00	10:59	11:29	11:29	30251	Yes	1.33	N			Yes	1.30	No	NA	Yes	Yes	1015	0		X	0.5	0.124	2.5	2	0.009	0.2
TRE Alt 1-125	**Union Station**	125	N/A	N/A	10:59	1:30	11:50	1:48	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
TRE Alt 1-125	**Texas Central Railway – Dallas**	125	N/A	N/A	1:28	Start	1:39	Start	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000			X	0.5	0.104	2.1	2	0.016	0.3

from NCTCOG 2040 DFX Model
* Based on Tarrant County 1 zone discounted monthly pass rate
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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									ProposedParking				Station Type							
								Bus					Commuter Rail		Light Rail								Walk Time	Park and Ride*			Kiss and Ride^	
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated	Station Entrance to Platform (min)	Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
TRE Alt 1-220	**T&P**	220	24.00	28.50	Start	1:22	10036	Yes	1.33	N			Yes	1.30	No	NA	Yes	No	386	0		X	0.5	0.100	2.0	1.5	0.004	0.1
TRE Alt 1-220	**Intermodal Transportation Center**	220			1:22	10:36	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
TRE Alt 1-220	**CentrePort Station**	220	19.50	21.75	10:29	10:52	30251	Yes	1.33	N			Yes	1.30	No	NA	Yes	Yes	1015	0		X	0.5	0.124	2.5	2	0.009	0.2
TRE Alt 1-220	**Union Station**	220			11:00	1:33	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
TRE Alt 1-220	**Texas Central Railway – Dallas**	220			1:32	Start	7817	YES	1.82	Yes - #26^^	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Stop	Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)	City	Station TAZ
		Fare and Travel Time						
TRE Alt 4-90	**Intermodal Transportation Center**	90	8.00	8.00	Start	19:14	Fort Worth	40789
TRE Alt 4-90	**CentrePort Station**	90			17:41	18:05	Fort Worth	30251
TRE Alt 4-90	**Union Station**	90	4.00	4.00	18:09	2:19	Dallas	7494
TRE Alt 4-90	**Texas Central Railway – Dallas**	90			2:11	Start	Dallas	7817

Station Stop	Transit Connectivity								
	Bus					Commuter Rail		Light Rail	
	Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare
Intermodal Transportation Center	Yes	1.33	No			Yes	1.30*	No	NA
CentrePort Station	Yes	1.33	No			Yes	1.30	No	NA
Union Station	Yes	1.82	No			Yes	1.82	Yes	1.82
Texas Central Railway – Dallas	YES	1.82	Yes - #26^^	30	35	NO		NO	

Station Stop	ProposedParking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Intermodal Transportation Center	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
CentrePort Station	Yes	Yes	1015	0	X		0	0.124	2.5	2	0.009	0.2
Union Station	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Texas Central Railway – Dallas	YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

from NCTCOG 2040 DFX Model
* Based on Tarrant County 1 zone discounted monthly pass rate
http://www.trinityrailwayexpress.org/farezones.html
^^New connection to Cedars Station

the T Park and Ride parking space source:
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^ If not an existing KNR, used an average based on 7 stations in 3 services. See KNR tab

Alternative	Station Name	Fare and Travel Time: Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)	Station TAZ
TRE Alt 4-125	**Intermodal Transportation Center**	125	19.00	23.50	Start	11:04	Start	11:49	40789
TRE Alt 4-125	**CentrePort Station**	125			11:00	10:59	11:29	11:29	30251
TRE Alt 4-125	**Union Station**	125	14.50	16.75	10:59	1:30	11:50	1:48	7494
TRE Alt 4-125	**Texas Central Railway – Dallas**	125			1:28	Start	1:39	Start	7817

Station Name	Transit Connectivity: Bus Available?	Bus Avg# Discounted Fare	Bus Route Mods?	Bus Peak Headway (min)	Bus Off Peak Headway (min)	Commuter Rail Available?	Commuter Rail Avg Discounted Fare	Light Rail Available?	Light Rail Avg Discounted Fare
Intermodal Transportation Center	Yes	1.33	No			Yes	1.30*	No	NA
CentrePort Station	Yes	1.33	No			Yes	1.30	No	NA
Union Station	Yes	1.82	No			Yes	1.82	Yes	1.82
Texas Central Railway – Dallas	YES	1.82	Yes - #26^^	30	60	NO		NO	

Station Name	ProposedParking: Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	Station Type: At-grade	Elevated	Walk Time Station to Platform (min)	Park and Ride*: Distance (mi)	Park and Ride*: Walk Time (min)	Park and Ride*: Circulaton Time (min)	Kiss and Ride^: Distance (mi)	Kiss and Ride^: Walk Time (min)
Intermodal Transportation Center	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
CentrePort Station	Yes	Yes	1015	0		X	0.5	0.124	2.5	2	0.009	0.2
Union Station	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Texas Central Railway – Dallas	YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

from NCTCOG 2040 DFX Model
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http://www.trinityrailwayexpress.org/farezones.html
^^New connection to Cedars Station

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^ If not an existing KNR, used an average based on 7 stations in 3 services. See KNR tab

Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
TRE Alt 4-220	**Intermodal Transportation Center**	220	24.00	28.50	Start	10:36	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
TRE Alt 4-220	**CentrePort Station**	220			10:29	10:52	30251	Yes	1.33	N			Yes	1.30	No	NA	Yes	Yes	1015	0		X	0.5	0.124	2.5	2	0.009	0.2
TRE Alt 4-220	**Union Station**	220	19.50	21.75	11:00	1:33	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
TRE Alt 4-220	**Texas Central Railway – Dallas**	220			1:32	Start	7817	YES	1.82	Yes - #26^^	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

from NCTCOG 2040 DFX Model
* Based on Tarrant County 1 zone discounted monthly pass rate
http://www.trinityrailwayexpress.org/farezones.html
^^New connection to Cedars Station

the T Park and Ride parking space source:
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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									ProposedParking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulato n Time (min)	Distance (mi)	Walk Time (min)
TRE Alt 7-90	**Intermodal Transportation Center**	90	8.00	8.00	Start	19:14	40789	Yes	1.33	No	NA	NA	Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
TRE Alt 7-90	**CentrePort Station**	90			17:41	18:05	30251	Yes	1.33	No	NA	NA	Yes	1.30	No	NA	Yes	Yes	1015	0	X		0	0.124	2.5	2	0.009	0.2
TRE Alt 7-90	**Union Station**	90	4.00	4.00	18:08	Start	7494	Yes	1.82	New HSR Shuttle**	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
	TCR is not a stop on the 'run' but the information still needs to be attached to the station																											
TRE Alt 7-90	**Texas Central Railway – Dallas**						7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

from NCTCOG 2040 DFX Model
* Based on Tarrant County 1 zone discounted monthly pass rate
http://www.trinityrailwayexpress.org/farezones.html
^^New connection to Cedars Station
** New shuttle connection to TCR
The T Park and Ride parking space source:
http://www.tmasterplan.org/wp-content/uploads/2015/09/T-State-of-the-System-150917_FINAL-REV_Overview-of-Services.pdf

http://www.tmasterplan.org/wp-content/uploads/2015/09/T-State-of-the-System-150917_FINAL-REV_Overview-of-Services.pdf

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^ If not an existing KNR, used an average based on 7 stations in 3 services. See KNR tab

Alternative	Station Name	Fare and Travel Time: Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)	City	Station TAZ	Transit Connectivity – Bus: Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Commuter Rail: Available?	Avg Discounted Fare	Light Rail: Available?	Avg Discounted Fare	Proposed Parking: Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	Station Type: At-grade	Elevated	Walk Time Station to Platform (min)	Park and Ride*: Distance (mi)	Walk Time (min)	Circulaton Time (min)	Kiss and Ride^: Distance (mi)	Walk Time (min)
TRE Alt 7-125	**Intermodal Transportation Center**	125	19.00	23.50	Start	11:04	Start	11:49	Fort Worth	40789	Yes	1.33	N	NA	NA	Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
TRE Alt 7-125	**CentrePort Station**	125			11:00	10:59	11:29	11:29	Fort Worth	30251	Yes	1.33	N	NA	NA	Yes	1.30	No	NA	Yes	Yes	1015	0		X	0.5	0.124	2.5	2	0.009	0.2
TRE Alt 7-125	**Union Station**	125	14.50	16.75	10:59	Start	11:50	Start	Dallas	7494	Yes	1.82	New HSR Shuttle**	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
	TCR is not a stop on the 'run' but the information still needs to be attached to the station																														
TRE Alt 7-125	**Texas Central Railway – Dallas**								Dallas	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

from NCTCOG 2040 DFX Model
* Based on Tarrant County 1 zone discounted monthly pass rate
http://www.trinityrailwayexpress.org/farezones.html
^^New connection to Cedars Station
** New shuttle connection to TCR
The T Park and Ride parking space source:
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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulation Time (min)	Distance (mi)	Walk Time (min)
TRE Alt 7-220	**Intermodal Transportation Center**	220	24.00	28.50	Start	10:36	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
TRE Alt 7-220	**CentrePort Station**	220			10:29	10:52	30251	Yes	1.33	N			Yes	1.30	No	NA	Yes	Yes	1015	0		X	0.5	0.124	2.5	2	0.009	0.2
TRE Alt 7-220	**Union Station**	220	19.50	21.75	11:00	Start	7494	Yes	1.82	New HSR Shuttle**	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3

TCR is not a stop on the 'run' but the information still needs to be attached to the station

TRE Alt 7-220	**Texas Central Railway – Dallas**						7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type							
								Bus					Commuter Rail		Light Rail									Park and Ride*			Kiss and Ride^	
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated	Walk Time Station to Platform (min)	Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
TRE Alt 10-90	**Intermodal Transportation Center**	90	8.00	8.00	Start	19:14	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
TRE Alt 10-90	**CentrePort Station**	90			17:41	19:44	30251	Yes	1.33	N			Yes	1.30	No	NA	Yes	Yes	1015	0	X		0	0.124	2.5	2	0.009	0.2
TRE Alt 10-90	**Texas Central Railway – Dallas**	90	4.00	4.00	19:31	Start	7817	Yes	1.82	New HSR Shuttle**	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
								YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Fare and Travel Time: ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)	Station TAZ	Transit Connectivity: Bus: Available?	Bus: Avg# Discounted Fare	Bus: Route Mods?	Bus: Peak Headway (min)	Bus: Off Peak Headway (min)	Commuter Rail: Available?	Commuter Rail: Avg Discounted Fare	Light Rail: Available?	Light Rail: Avg Discounted Fare	Proposed Parking: Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	Station Type: At-grade	Elevated	Walk Time Station to Platform (min)	Park and Ride*: Distance (mi)	Park and Ride*: Walk Time (min)	Park and Ride*: Circulaton Time (min)	Kiss and Ride^: Distance (mi)	Kiss and Ride^: Walk Time (min)
TRE Alt 10-125	**Intermodal Transportation Center**	125	19.00	23.50	Start	11:04	Start	11:49	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
TRE Alt 10-125	**CentrePort Station**	125			11:00	12:10	11:29	12:52	30251	Yes	1.33	N			Yes	1.30	No	NA	Yes	Yes	1015	0		X	0.5	0.124	2.5	2	0.009	0.2
TRE Alt 10-125	Texas Central Railway – Dallas	125	14.50	16.75	12:09	Start	13:00	Start	7817	Yes	1.82	New HSR Shuttle**	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
										YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Bus					Commuter Rail		Light Rail		Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulation Time (min)	Distance (mi)	Walk Time (min)
								Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare												
TRE Alt 10-220	**Intermodal Transportation Center**	220	24.00	28.50	Start	10:36	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
TRE Alt 10-220	**CentrePort Station**	220			10:29	12:05	30251	Yes	1.33	N			Yes	1.30	No	NA	Yes	Yes	1016	0		X	0.5	0.124	2.5	2	0.009	0.2
TRE Alt 10-220	**Texas Central Railway – Dallas**	220	19.50	21.75	12:10	Start	7817	Yes	1.82	New HSR Shuttle**	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
								YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					City	Station TAZ	Transit Connectivity									Proposed Parking				Station Type							
									Bus					Commuter Rail		Light Rail									Park and Ride*			Kiss and Ride^	
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare Business From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)			Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated	Walk Time Station to Platform (min)	Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
IH 10 Alt 3-90	**T&P**						Fort Worth	10036	Yes	1.33	N			Yes	1.30	No	NA	Yes	No	386	0	X		0	0.100	2.0	1.5	0.004	0.1
IH 10 Alt 3-90	**Intermodal Transportation Center**						Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
IH 10 Alt 3-90	**Arlington**						Arlington	9903			Yes - MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 10 Alt 3-90	**Union Station**						Dallas	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 10 Alt 3-90	**Texas Central Railway – Dallas**						Dallas	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

from NCTCOG 2040 DFX Model
* Based on Tarrant County 1 zone discounted monthly pass rate
http://www.trinityrailwayex| Assumed
^^New connection to Cedars Station

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Alternative	Station Name	Fare and Travel Time							City	Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
											Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare Business From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)			Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
IH 30 Alt 3-125	**T&P**								Fort Worth	10036	Yes	1.33	N			Yes	1.30	No	NA	Yes	No	386	0		X	0.5	0.100	2.0	1.5	0.004	0.1
IH 30 Alt 3-125	**Intermodal Transportation Center**								Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 3-125	**Arlington**								Arlington	9903			Yes -Max	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 3-125	**Union Station**								Dallas	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 30 Alt 3-125	**Texas Central Railway – Dallas**								Dallas	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					City	Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
									Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas	Fare Business From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)			Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
IH 30 Alt 3-220	**T&P**						Fort Worth	10036	Yes	1.33	N			Yes	1.30	No	NA	Yes	No	386	0		X	0.5	0.100	2.0	1.5	0.004	0.1
IH 30 Alt 3-220	**Intermodal Transportation Center**						Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 3-220	**Arlington**						Arlington	9903			Yes - MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 3-220	**Union Station**						Dallas	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 30 Alt 3-220	**Texas Central Railway – Dallas**						Dallas	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					City	Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare Business From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)			Bus: Available?	Bus: Avg# Discounted Fare	Bus: Route Mods?	Bus: Peak Headway (min)	Bus: Off Peak Headway (min)	Commuter Rail: Available?	Commuter Rail: Avg Discounted Fare	Light Rail: Available?	Light Rail: Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
IH 30 Alt 6-90	**Intermodal Transportation Center**						Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 6-90	**Arlington**						Arlington	9903			Yes - MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 6-90	**Union Station**						Dallas	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 30 Alt 6-90	**Texas Central Railway – Dallas**						Dallas	7817	Yes	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time							City	Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
											Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare Business From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)			Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
IH 30 Alt 6-125	**Intermodal Transportation Center**								Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 6-125	**Arlington**								Arlington	9903			Yes - MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 6-125	**Union Station**								Dallas	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 30 Alt 6-125	**Texas Central Railway – Dallas**								Dallas	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					City	Station TAZ	Transit Connectivity									Proposed Parking				Station Type							
									Bus					Commuter Rail		Light Rail									Park and Ride*			Kiss and Ride^	
		Speed (mph)	Fare (Non-Business) From Dallas	Fare Business From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)			Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated	Walk Time Station to Platform (min)	Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
IH 30 Alt 6-220	**Intermodal Transportation Center**						Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 6-220	**Arlington**						Arlington	9903			Yes - MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 6-220	**Union Station**						Dallas	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 30 Alt 6-220	**Texas Central Railway – Dallas**						Dallas	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					City	Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
									Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare Business From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)			Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
IH 30 Alt 9-90	**Intermodal Transportation Center**						Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 9-90	**Arlington**						Arlington	9903			Yes - MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 9-90	**Union Station**						Dallas	7494	Yes	1.82	New HSR Shuttle**	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
	TCR is not a stop on the 'run' but the information still needs to be attached to the station																												
IH 30 Alt 9-90	**Texas Central Railway – Dallas**						Dallas	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

from NCTCOG 2040 DFX Model
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**New shuttle to TCR
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Alternative	Station Name	Fare and Travel Time: Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare Business From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)	City	Station TAZ	Transit Connectivity: Bus: Available?	Bus: Avg# Discounted Fare	Bus: Route Mods?	Bus: Peak Headway (min)	Bus: Off Peak Headway (min)	Commuter Rail: Available?	Commuter Rail: Avg Discounted Fare	Light Rail: Available?	Light Rail: Avg Discounted Fare	Proposed Parking: Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	Station Type: At-grade	Elevated	Walk Time Station to Platform (min)	Park and Ride*: Distance (mi)	Park and Ride*: Walk Time (min)	Park and Ride*: Circulaton Time (min)	Kiss and Ride^: Distance (mi)	Kiss and Ride^: Walk Time (min)
IH 30 Alt 9-125	**Intermodal Transportation Center**								Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 9-125	**Arlington**								Arlington	9903			Yes - MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 9-125	**Union Station**								Dallas	7494	Yes	1.82	New HSR Shuttle**	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
TCR is not a stop on the 'run' but the information still needs to be attached to the station																															
IH 30 Alt 9-125	**Texas Central Railway – Dallas**								Dallas	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					City	Station TAZ	Transit Connectivity								
									Bus					Commuter Rail		Light Rail	
		Speed (mph)	Fare (Non-Business) From Dallas	Fare Business From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)			Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare
IH 30 Alt 9-220	**Intermodal Transportation Center**						Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA
IH 30 Alt 9-220	**Arlington**						Arlington	9903	Yes	1.33	Yes for MAX	30	60	No	No	No	No
IH 30 Alt 9-220	**Union Station**						Dallas	7494	Yes	1.82	New HSR Shuttle**	30	60	Yes	1.82	Yes	1.82
TCR is not a stop on the 'run' but the information still needs to be attached to the station																	
IH 30 Alt 9-220	**Texas Central Railway – Dallas**						Dallas	7817	YES	1.82	Yes - #26^^	35	35	NO		NO	

Alternative	Station Name	Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
		Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
IH 30 Alt 9-220	**Intermodal Transportation Center**	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 9-220	**Arlington**	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 9-220	**Union Station**	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 30 Alt 9-220	**Texas Central Railway – Dallas**	YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					City	Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
									Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare Business From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)			Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
IH 30 Alt 12-90	**Intermodal Transportation Center**						Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 12-90	**Arlington**						Arlington	9903			Yes - Max	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 12-90	**Texas Central Railway – Dallas**						Dallas	7817	YES	1.82	New HSR Shuttle**	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
											Yes - #26^^	35	35																

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Alternative	Station Name	Fare and Travel Time: Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare Business From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)	City	Station TAZ
IH 30 Alt 12-125	**Intermodal Transportation Center**								Fort Worth	40789
IH 30 Alt 12-125	**Arlington**								Arlington	9903
IH 30 Alt 12-125	**Texas Central Railway – Dallas**								Dallas	7817

Station Name	Transit Connectivity: Bus: Available?	Bus: Avg# Discounted Fare	Bus: Route Mods?	Bus: Peak Headway (min)	Bus: Off Peak Headway (min)	Commuter Rail: Available?	Commuter Rail: Avg Discounted Fare	Light Rail: Available?	Light Rail: Avg Discounted Fare
Intermodal Transportation Center	Yes	1.33	N			Yes	1.30*	No	NA
Arlington			Yes- MAX	30	60	No	No	No	No
Texas Central Railway – Dallas	YES	1.82	New HSR Shuttle**	30	60	NO		NO	
			Yes - #26^^	35	35				

Station Name	Proposed Parking: Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	Station Type: At-grade	Elevated	Walk Time Station to Platform (min)	Park and Ride*: Distance (mi)	Park and Ride*: Walk Time (min)	Park and Ride*: Circulaton Time (min)	Kiss and Ride^: Distance (mi)	Kiss and Ride^: Walk Time (min)
Intermodal Transportation Center	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Arlington	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Texas Central Railway – Dallas	YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					City	Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
									Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas	Fare Business From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)			Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
IH 30 Alt 12-220	**Intermodal Transportation Center**						Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 12-220	**Arlington**						Arlington	9903			Yes for MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 12-220	**Texas Central Railway – Dallas**						Dallas	7817	YES	1.82	New HSR Shuttle**	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
											Yes - #26^^	35	35																

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Alternative	Station Name	Fare and Travel Time: Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)	Station TAZ	Transit Connectivity – Bus: Available?	Bus: Avg# Discounted Fare	Bus: Route Mods?	Bus: Peak Headway (min)	Bus: Off Peak Headway (min)	Commuter Rail: Available?	Commuter Rail: Avg Discounted Fare	Light Rail: Available?	Light Rail: Avg Discounted Fare	Proposed Parking: Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	Station Type: At-grade	Elevated	Walk Time Station to Platform (min)	Park and Ride*: Distance (mi)	Park and Ride*: Walk Time (min)	Park and Ride*: Circulaton Time (min)	Kiss and Ride^: Distance (mi)	Kiss and Ride^: Walk Time (min)
Hybrid Alt 2-90	**T&P**	90	8.00	8.00	Start	2:25	10036	Yes	1.33	N			Yes	1.30	No	NA	Yes	No	386	0	X		0	0.100	2.0	1.5	0.004	0.1
Hybrid Alt 2-90	**Intermodal Transportation Center**	90			2:26	17:35	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 2-90	**Arlington**	90			17:21	9:14	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 2-90	**County Line**	90			8:25	17:11		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 2-90	**Union Station**	90	4.00	4.00	16:54	2:19	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 2-90	**Texas Central Railway – Dallas**	90			2:11	Start	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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^^ New connection to Cedars Station

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Alternative	Station Name	Fare and Travel Time							City	Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
											Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)			Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 2-125	**T&P**	125	19.00	23.50	Start	1:59	Start	2:03	Fort Worth	10036	Yes	1.33	N			Yes	1.30	No	NA	Yes	No	386	0		X	0.5	0.100	2.0	1.5	0.004	0.1
Hybrid Alt 2-125	**Intermodal Transportation Center**	125			1:59	10:51	2:03	11:38	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 2-125	**Arlington**	125			10:42	5:35	11:10	6:11	Arlington	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 2-125	**County Line**	125			5:33	10:24	6:11	10:54	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 2-125	**Union Station**	125	14.50	16.75	10:24	1:30	11:12	1:48	Dallas	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 2-125	**Texas Central Railway – Dallas**	125			1:28	Start	1:39	Start	Dallas	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 2-220	**T&P**	220	24.00	28.50	Start	1:59	10036	Yes	1.33	N			Yes	1.30	No	NA	Yes	No	386	0		X	0.5	0.100	2.0	1.5	0.004	0.1
Hybrid Alt 2-220	**Intermodal Transportation Center**	220			1:59	10:51	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 2-220	**Arlington**	220			10:40	5:42	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 2-220	**County Line**	220			5:42	10:17		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 2-220	**Union Station**	220	19.50	21.75	10:25	1:34	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 2-220	**Texas Central Railway – Dallas**	220			1:33	Start	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 5-90	**Intermodal Transportation Center**	90	8.00	8.00	Start	17:34	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 5-90	**Arlington**	90			17:21	23:51	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 5-90	**Union Station**	90	4.00	4.00	22:30	2:19	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 5-90	**Texas Central Railway – Dallas**	90			2:11	Start	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time								Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
											Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 5-125	**Intermodal Transportation Center**	125	19.00	23.50	Start	10:50	Start	11:38	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6		x	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 5-125	**Arlington**	125			10:42	15:05	11:10	15:56	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 5-125	**Union Station**	125	14.50	16.75	15:00	1:30	15:56	1:48	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 5-125	**Texas Central Railway – Dallas**	125			1:28	Start	1:39	Start	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 5-220	**Intermodal Transportation Center**	220	24.00	28.50	Start	10:51	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 5-220	**Arlington**	220			10:40	15:02	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 5-220	**Union Station**	220	19.50	21.75	15:04	1:34	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 5-220	**Texas Central Railway – Dallas**	220			1:33	Start	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					City	Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
									Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)			Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 8-90	**Intermodal Transportation Center**	90	8.00	8.00	Start	17:34	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 8-90	**Arlington**	90			17:21	23:51	Arlington	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 8-90	**Union Station**	90	4.00	4.00	22:29	Start	Dallas	7494	Yes	1.82	New HSR Shuttle**	35	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
	TCR is a stop on the 'run' but the information still needs to be attached to the station																												
Hybrid Alt 8-90	**Texas Central Railway – Dallas**	90					Dallas	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time: Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)	City	Station TAZ	Transit Connectivity – Bus: Available?	Bus: Avg# Discounted Fare	Bus: Route Mods?	Bus: Peak Headway (min)	Bus: Off Peak Headway (min)	Commuter Rail: Available?	Commuter Rail: Avg Discounted Fare	Light Rail: Available?	Light Rail: Avg Discounted Fare	Proposed Parking: Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	Station Type: At-grade	Elevated	Walk Time Station to Platform (min)	Park and Ride*: Distance (mi)	Park and Ride*: Walk Time (min)	Park and Ride*: Circulaton Time (min)	Kiss and Ride^: Distance (mi)	Kiss and Ride^: Walk Time (min)
Hybrid Alt 8-125	**Intermodal Transportation Center**	125	19.00	23.50	Start	10:50	Start	11:38	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 8-125	**Arlington**	125			10:42	15:05	11:10	15:56	Arlington	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 8-125	**Union Station**	125	14.50	16.75	15:00	Start	15:56	Start	Dallas	7494	Yes	1.82	New HSR Shuttle**	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
	TCR is a stop on the 'run' but the information still needs to be attached to the station																														
Hybrid Alt 8-125	**Texas Central Railway – Dallas**								Dallas	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 8-220	**Intermodal Transportation Center**	220	24.00	28.50	Start	10:51	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 8-220	**Arlington**	220			10:40	15:02	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 8-220	**Union Station**	220	19.50	21.75	15:04	Start	7494	Yes	1.82	New HSR Shuttle**	30	60	Yes	1.82	Yes	1.82	yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
	TCR is a stop on the 'run' but the information still needs to be attached to the station																											
Hybrid Alt 8-220	**Texas Central Railway – Dallas**						7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Bus: Available?	Bus: Avg# Discounted Fare	Bus: Route Mods?	Bus: Peak Headway (min)	Bus: Off Peak Headway (min)	Commuter Rail: Available?	Commuter Rail: Avg Discounted Fare	Light Rail: Available?	Light Rail: Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 11-90	**Intermodal Transportation Center**	90	8.00	8.00	Start	17:34	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 11-90	**Arlington**	90			17:21	25:28	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 11-90	**Texas Central Railway – Dallas**	90	4.00	4.00	23:53	Start	7817	YES	1.82	New HSR Shuttle**	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
										Yes - #26^^	35	35																

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Alternative	Station Name	Fare and Travel Time: Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)	Station TAZ	Transit Connectivity: Bus Available?	Bus Avg# Discounted Fare	Bus Route Mods?	Bus Peak Headway (min)	Bus Off Peak Headway (min)	Commuter Rail Available?	Commuter Rail Avg Discounted Fare	Light Rail Available?	Light Rail Avg Discounted Fare	Proposed Parking: Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	Station Type: At-grade	Elevated	Walk Time Station to Platform (min)	Park and Ride*: Distance (mi)	Park and Ride* Walk Time (min)	Park and Ride* Circulaton Time (min)	Kiss and Ride^: Distance (mi)	Kiss and Ride^ Walk Time (min)
Hybrid Alt 11-125	**Intermodal Transportation Center**	125	19.00	23.50	Start	10:50	Start	11:38	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 11-125	**Arlington**	125			10:42	16:17	11:10	17:19	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 11-125	**Texas Central Railway – Dallas**	125	14.50	16.75	16:11	Start	17:06	Start	7817	YES	1.33	New HSR Shuttle**	30	60	No		No		Yes	Yes	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
												Yes - #26^^	35	35																

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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type							
								Bus					Commuter Rail		Light Rail									Park and Ride*			Kiss and Ride^	
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated	Walk Time Station to Platform (min)	Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 11-220	**Intermodal Transportation Center**	220	24.00	28.50	Start	10:51	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 11-220	**Arlington**	220			10:40	16:17	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 11-90	**Texas Central Railway – Dallas**	220	19.50	21.75	16:16	Start	7817	YES	1.82	New HSR Shuttle**	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
										Yes - #26^^	35	35																

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								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 16-90	**Intermodal Transportation Center**	90	8.00	8.00	Start	25:03	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 16-90	**County Line**	90			24:18	17:11		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 16-90	**Union Station**	90	4.00	4.00	16:54	2:19	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 16-90	**Texas Central Railway – Dallas**	90			2:11	Start	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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		Fare and Travel Time								Transit Connectivity									Proposed Parking				Station Type							
										Bus					Commuter Rail		Light Rail									Park and Ride*			Kiss and Ride^	
Alternative	Station Name	Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)	Station TAZ	Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated	Walk Time Station to Platform (min)	Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 16-125	**Intermodal Transportation Center**	125	19.00	23.50	Start	15:23	Start	16:30	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 16-125	**County Line**	125			15:18	10:24	16:10	10:54		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 16-125	**Union Station**	125	14.50	16.75	10:24	1:30	11:12	1:48	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 16-125	**Texas Central Railway – Dallas**	125			1:28	Start	1:39	Start	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 16-220	**Intermodal Transportation Center**	220	24.00	28.59	Start	15:28	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 16-220	**County Line**	220			15:21	10:17		Yes	1.33	New DFW Shuttle	35	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 16-220	**Union Station**	220	19.50	21.75	10:25	1:34	7494	Yes	1.82	N			Yes	1.82	Yes	1.82		Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 16-220	**Texas Central Railway – Dallas**	220			1:33	Start	7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

from NCTCOG 2040 DFX Model
* Based on Tarrant County 1 zone discounted monthly pass rate
http://www.trinityrailwayexpress.org/farezones.html
^^New connection to Cedars Station

The T Park and Ride parking space source:
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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 17-90	**Intermodal Transportation Center**	90	8.00	8.00	Start	17.34	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 17-90	**Arlington**	90			17:21	9:14	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 17-90	**County Line**	90	4.00	4.00	8:25	17:11		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 17-90	**Union Station**	90			16:53	Start	7494	Yes	1.82	NEW HSR shuttle**	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3

TCR is not a stop on the 'run' but the information still needs to be attached to the station

Hybrid Alt 17-90	**Texas Central Railway – Dallas**						7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time								Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
											Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)			Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 17-125	**Intermodal Transportation Center**	125	19.00	23.50	Start	10:50	Start	11:38	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 17-125	**Arlington**	125			10:42	5:35	11:10	6:11	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 17-125	**County Line**	125	14.50	16.75	5:33	10:24	6:11	10:54		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 17-125	**Union Station**	125			10:24	Start	11:12	Start	7494	Yes	1.82	NEW HSR shuttle**	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
	TCR is not a stop on the 'run' but the information still needs to be attached to the station																													
Hybrid Alt 17-125	**Texas Central Railway – Dallas**								7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 17-220	**Intermodal Transportation Center**	220	24.00	28.50	Start	10:51	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 17-220	**Arlington**	220			10:40	5:42	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 17-220	**County Line**	220	19.50	21.75	5:42	10:17		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 17-220	**Union Station**	220			10:25	Start	7494	Yes	1.82	NEW HSR shuttle**	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3

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Hybrid Alt 17-220	**Texas Central Railway – Dallas**						7817	YES	1.82	Yes - #26^^	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3

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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 18-90	**Intermodal Transportation Center**	90			Start	17:34	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 18-90	**Arlington**	90	8.00	8.00	17:21	9:14	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 18-90	**County Line**	90			8:25	18:46		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 18-90	**Texas Central Railway – Dallas**	90	4.00	4.00	18:16	Start	7817	YES	1.82	New HSR Shuttle**	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
										Yes - #26^^	35	35																

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Alternative	Station Name	Fare and Travel Time: Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)	City	Station TAZ	Transit Connectivity – Bus: Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Commuter Rail: Available?	Avg Discounted Fare	Light Rail: Available?	Avg Discounted Fare	Proposed Parking: Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	Station Type: At-grade	Elevated	Walk Time Station to Platform (min)	Park and Ride*: Distance (mi)	Walk Time (min)	Circulaton Time (min)	Kiss and Ride^: Distance (mi)	Walk Time (min)
Hybrid Alt 18-125	**Intermodal Transportation Center**	125			Start	10:50	Start	11:38	Fort Worth	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 18-125	**Arlington**	125	19.00	23.50	10:42	5:35	11:10	6:11	Arlington	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 18-125	**County Line**	125			5:33	11:36	6:11	12:18	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 18-125	**Texas Central Railway – Dallas**	125	14.50	16.75	11:34	Start	12:21	Start	Dallas	7817	YES	1.82	New HSR Shuttle**	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
													Yes - #26^^	35	35																

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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 18-220	**Intermodal Transportation Center**	220	24.00	28.50	Start	10:51	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 18-220	**Arlington**	220			10:40	5:42	9903	Yes	1.33	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 18-220	**County Line**	220			5:42	11:32		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 18-220	**Texas Central Railway – Dallas**	220	19.50	21.75	11:36	Start	7817	YES	1.82	New HSR Shuttle**	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
										Yes - #26^^	35	35																

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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type							
								Bus					Commuter Rail		Light Rail									Park and Ride*			Kiss and Ride^	
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated	Walk Time Station to Platform (min)	Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 19-90	**Intermodal Transportation Center**	90	8.00	8.00	Start	25:03	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 19-90	**County Line**	90			24:18	18:46		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 19-90	**Texas Central Railway – Dallas**	90	4.00	4.00	18:16	Start	7817	YES	1.82	New HSR Shuttle**	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
										Yes - #26^^	35	35																

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Alternative	Station Name	Fare and Travel Time							Station TAZ
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	ICE EDP Eastbound Travel Time (min)	ICE EDP West Bound Travel Time (min)	Pendolino Eastbound Travel Time (min)	Pendolino Westbound Travel Time (min)	
Hybrid Alt 19-125	**Intermodal Transportation Center**	125	19.00	23.50	Start	15:23	Start	16:30	40789
Hybrid Alt 19-125	**County Line**	125			15:18	11:36	16:10	12:18	
Hybrid Alt 19-125	**Texas Central Railway – Dallas**	125	14.50	16.75	11:34	Start	12:21	Start	7817

Station Name	Transit Connectivity: Bus					Commuter Rail		Light Rail		Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
	Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Intermodal Transportation Center	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
County Line	Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Texas Central Railway – Dallas	YES	1.82	New HSR Shuttle**	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
			Yes - #26^^	35	35																

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Alternative	Station Name	Fare and Travel Time					Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
								Bus					Commuter Rail		Light Rail													
		Speed (mph)	Fare (Non-Business) From Dallas ($)	Fare (Business) From Dallas ($)	Eastbound Travel Time (min)	West Bound Travel Time (min)		Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 19-220	**Intermodal Transportation Center**	220	24.00	28.50	Start	15.28	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 19-220	**County Line**	220			15:21	11:32		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 19-220	**Texas Central Railway – Dallas**	220	19.50	21.75	11:36	Start	7817	YES	1.82	New HSR Shuttle**	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
										Yes - #26^^	35	35																

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Station Name	City	Station TAZ	Transit Connectivity									Proposed/Available Parking				Station Type							
			Bus					Commuter Rail		Light Rail					Cost				Park and Ride*			Kiss and Ride^	
			Available?	Avg# Discounted Fare	Route Modifications	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily	At-grade	Elevated	Walk Time Station to Platform (min)	Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
T&P	Fort Worth	10036	Yes	1.33	No	-	-	Yes	1.30	No	NA	Yes	No	386	0	90	125,220	0 (90) 0.5 (125,220)	0.100	2	1.5	0.004	0.1
Intermodal Transportation Center	Fort Worth	40789	Yes	1.33	No	-	-	Yes	1.30*	No	NA	Yes	Yes	1,000	6	90	125, 220	0 (90) 0.5 (125,220)	0.09	1.8	1.5	0.046	0.9
Arlington	Arlington	9903	Shee Arligton Tab																				
Centreport Station	Fort Worth	30251	Yes	1.33	No	-	-	Yes	1.30	No	NA	Yes	Yes	1,015	0	90	125,220	0 (90) 0.5 (125, 220)	0.124	2.5	2	0.009	0.2
County Line	Grand Prairie	7176	See County Line Tab																				
Union Station	Dallas	7494	See Union Station Tab																				
Texas Central Rail Way	Dallas	7817	See TCR Tab																				

Based on NCTCOG 2040 DFX Model
* Based on Tarrant County 1 zone discounted monthly pass rate
http://www.trinityrailwayexpress.org/farezones.html

* Average based on review of 10 existing PNR in three systems (2 each). See PNR tab
^ If not an existing KNR, used an average based on7 stations in 3 services. See KNR tab

T&P	City	Station TAZ	Transit Connectivity									Proposed/Available Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
			Bus		Route Modifications	Peak Headway (min)	Off Peak Headway (min)	Commuter Rail		Light Rail		Park and Ride	Kiss and Ride	Total Parking Spaces	Cost								
			Available?	Avg# Discounted Fare				Available?	Avg Discounted Fare	Available?	Avg Discounted Fare				Daily	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
IH 30 Alt 3-90	Fort Worth	10036	Yes	1.33	N			Yes	1.3	No	NA	Yes	No	386	0	X		0	0.1	2	1.5	0.004	0.1
IH 30 Alt 3-125	Fort Worth	10036	Yes	1.33	N			Yes	1.3	No	NA	Yes	No	386	0		X	0.5	0.1	2	1.5	0.004	0.1
IH 30 Alt 3-220	Fort Worth	10036	Yes	1.33	N			Yes	1.3	No	NA	Yes	No	386	0		X	0.5	0.1	2	1.5	0.004	0.1
TRE Alt 1-90	Fort Worth	10036	Yes	1.33	N			Yes	1.3	No	NA	Yes	No	386	0	X		0	0.1	2	1.5	0.004	0.1
TRE Alt 1-125	Fort Worth	10036	Yes	1.33	N			Yes	1.3	No	NA	Yes	No	386	0		X	0.5	0.1	2	1.5	0.004	0.1
TRE Alt 1-220	Fort Worth	10036	Yes	1.33	N			Yes	1.3	No	NA	Yes	No	386	0		X	0.5	0.1	2	1.5	0.004	0.1
Hybrid 2-90	Fort Worth	10036	Yes	1.33	N			Yes	1.3	No	NA	Yes	No	386	0	X		0	0.1	2	1.5	0.004	0.1
Hybrid 2-125	Fort Worth	10036	Yes	1.33	N			Yes	1.3	No	NA	Yes	No	386	0			0.5	0.1	2	1.5	0.004	0.1
Hybrid 2-220	Fort Worth	10036	Yes	1.33	N			Yes	1.3	No	NA	Yes	No	386	0		X	0.5	0.1	2	1.5	0.004	0.1

from NCTCOG 2040 DFX Model
* Based on Tarrant County 1 zone discounted monthly pass rate
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* Average based on review of 10 existing PNR in three systems (2 each). See PNR tab. If not an existing PNR, used an average based on 10 existing stations.
^ If not an existing KNR, used an average based on7 stations in 3 services. See KNR tab

ITC	City	Station TAZ	Transit Connectivity									Proposed/Available Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
			Bus		Route Modifications	Peak Headway (min)	Off Peak Headway (min)	Commuter Rail		Light Rail		Park and Ride	Kiss and Ride	Total Parking Spaces	Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
			Available?	Avg Discounted Fare				Available?	Avg Discounted Fare	Available?	Avg Discounted Fare				Daily								
IH 30 Alt 3-90	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 3-125	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6			0.5	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 3-220	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 6-90	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 6-125	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 6-220	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 9-90	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 9-125	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 9-220	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 12-90	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 12-125	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
IH 30 Alt 12-220	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 2-90	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 2-125	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 2-220	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 5-90	Fort Worth	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 5-125	Fort Worth	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6		x	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 5-220	Fort Worth	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 8-90	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 8-125	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 8-220	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 11-90	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 11-125	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 11-220	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 16-90	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 16-125	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 16-220	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 17-90	Fort Worth	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 17-125	Fort Worth	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 17-220	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 18-90	Fort Worth	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 18-125	Fort Worth	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 18-220	Fort Worth	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 19-90	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6	X		0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 19-125	Fort Worth	40789	Yes	1.33	N			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9
Hybrid Alt 19-220	Fort Worth	40789	Yes	1.33	No			Yes	1.30*	No	NA	Yes	Yes	1000	6		X	0.5	0.09	1.8	1.5	0.046	0.9

from NCTCOG 2040 DFX Model
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^ If not an existing KNR, used an average based on7 stations in 3 services. See KNR tab

CenterPort	City	Station TAZ	Transit Connectivity									Proposed/Available Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
			Bus		Route Modifications	Peak Headway (min)	Off Peak Headway (min)	Commuter Rail		Light Rail		Park and Ride	Kiss and Ride	Total Parking Spaces	Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
			Available?	Avg# Discounted Fare				Available?	Avg Discounted Fare	Available?	Avg Discounted Fare				Daily								
TRE Alt 1-90	Fort Worth	30251	Yes	$ 1.33	No			Yes	1.3	No	NA	Yes	Yes	1015	0	X		0	0.124	2.5	2	0.00947	0.2
TRE Alt 1-125	Fort Worth	30251	Yes	$ 1.33	No			Yes	1.3	No	NA	Yes	Yes	1015	0		X	0.5	0.124	2.5	2	0.00947	0.2
TRE Alt 1-220	Fort Worth	30251	Yes	$ 1.33	No			Yes	1.3	No	NA	Yes	Yes	1015	0		X	0.5	0.124	2.5	2	0.00947	0.2
TRE Alt 4-90	Fort Worth	30251	Yes	$ 1.33	No			Yes	1.3	No	NA	Yes	Yes	1015	0	X		0	0.124	2.5	2	0.00947	0.2
TRE Alt 4-125	Fort Worth	30251	Yes	$ 1.33	No			Yes	1.3	No	NA	Yes	Yes	1015	0		X	0.5	0.124	2.5	2	0.00947	0.2
TRE Alt 4-220	Fort Worth	30251	Yes	$ 1.33	No			Yes	1.3	No	NA	Yes	Yes	1015	0		X	0.5	0.124	2.5	2	0.00947	0.2
TRE Alt 7-90	Fort Worth	30251	Yes	$ 1.33	No	NA	NA	Yes	1.3	No	NA	Yes	Yes	1015	0	X		0	0.124	2.5	2	0.00947	0.2
TRE Alt 7-125	Fort Worth	30251	Yes	$ 1.33	No	NA	NA	Yes	1.3	No	NA	Yes	Yes	1015	0		X	0.5	0.124	2.5	2	0.00947	0.2
TRE Alt 7-220	Fort Worth	30251	Yes	$ 1.33	No			Yes	1.3	No	NA	Yes	Yes	1015	0		X	0.5	0.124	2.5	2	0.00947	0.2
TRE Alt 10-90	Fort Worth	30251	Yes	$ 1.33	No			Yes	1.3	No	NA	Yes	Yes	1015	0	X		0	0.124	2.5	2	0.00947	0.2
TRE Alt 10-125	Fort Worth	30251	Yes	$ 1.33	No			Yes	1.3	No	NA	Yes	Yes	1015	0		X	0.5	0.124	2.5	2	0.00947	0.2
TRE Alt 10-220	Fort Worth	30251	Yes	$ 1.33	No			Yes	1.3	No	NA	Yes	Yes	1016	0		X	0.5	0.124	2.5	2	0.00947	0.2

from NCTCOG 2040 DFX Model
* Based on Tarrant County 1 zone discounted monthly pass rate
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* Average based on review of 10 existing PNR in three systems (2 each). See PNR tab. If not an existing PNR, used an average based on 10 existing stations.
^ If not an existing KNR, used an average based on7 stations in 3 services. See KNR tab
based on7 stations in 3 services. See KNR tab

Arlington	City	Station TAZ	Transit Connectivity									Proposed/Available Parking				Station Type							
			Bus					Commuter Rail		Light Rail					Cost				Park and Ride*			Kiss and Ride^	
			Available?	Avg# Discounted Fare	Route Modifications	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily	At-grade	Elevated	Walk Time Station to Platform (min)	Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
IH30 Alt 3-90	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 3-125	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 3-220	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 6-90	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 6-125	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 6-220	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 9-90	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 9-125	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 9-220	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 12-90	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 12-125	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 12-220	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 2-90	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 2-125	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 2-220	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 5-90	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 5-125	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 5-220	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 8-90	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 8-125	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 8-220	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 11-90	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 11-125	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 11-220	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 17-90	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 17-125	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 17-220	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 18-90	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 18-125	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid 18-220	Arlington	9903	Yes	$2.50	MAX	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.104	2.1	2	0.016	0.3

Based on http://www.ridethemax.com/#!reduced-fare-riders/c2049
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^ If not an existing KNR, used an average based on7 stations in 3 services. See KNR tab

Alternative	Station Name - County Line	City	Station TAZ	Transit Connectivity									Proposed Parking				Station Type		Walk Time Station to Platform (min)	Park and Ride*			Kiss and Ride^	
				Bus					Commuter Rail		Light Rail													
				Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Available?	Avg Discounted Fare	Available?	Avg Discounted Fare	Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	At-grade	Elevated		Distance (mi)	Walk Time (min)	Circulaton Time (min)	Distance (mi)	Walk Time (min)
Hybrid Alt 2-90	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 2-125	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 2-220	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 16-90	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 16-125	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 16-220	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 17-90	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 17-125	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 17-220	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 18-90	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 18-125	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 18-220	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 19-90	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 19-125	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3
Hybrid Alt 19-220	**County Line**	Grand Prairie		Yes	1.33	New DFW Shuttle	30	60	No	No	No	No	Yes	Yes	1000	5		X	0.5	0.100	2	2	0.016	0.3

from NCTCOG 2040 DFX Model
* Based on Tarrant County 1 zone discounted monthly pass rate
http://www.trinityrailwayexpress.org/farezones.html

* Average based on review of 10 existing PNR in three systems (2 each). See PNR tab. If not an existing PNR, used an average based on 10 existing stations.
^ If not an existing KNR, used an average based on7 stations in 3 services. See KNR tab

Alternative	h Name - Union S	City	Station TAZ	Transit Connectivity: Bus: Available?	Bus: Avg#Discounted Fare	Bus: Route Mods?	Bus: Peak Headway (min)	Bus: Off Peak Headway (min)	Commuter Rail: Available?	Commuter Rail: Avg* Discounted Fare	Light Rail: Available?	Light Rail: Avg Discounted Fare	Proposed Parking: Park and Ride	Proposed Parking: Kiss and Ride	Proposed Parking: Total Parking Spaces	Proposed Parking: Daily Parking Cost	Station Type: At-grade	Station Type: Elevated	Walk Time Station to Platform (min)	Park and Ride*: Distance (mi)	Park and Ride*: Walk Time (min)	Park and Ride*: Circulaton Time (min)	Kiss and Ride^: Distance (mi)	Kiss and Ride^: Walk Time (min)
IH 10 Alt 3-90	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 30 Alt 3-125	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 30 Alt 3-220	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 30 Alt 6-90	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 30 Alt 6-125	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 30 Alt 6-220	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 30 Alt 9-90	**Union Station**	Dallas	7494	Yes	1.82	New HSR Shuttle	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 30 Alt 9-125	**Union Station**	Dallas	7494	Yes	1.82	New HSR Shuttle	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
IH 30 Alt 9-220	**Union Station**	Dallas	7494	Yes	1.82	New HSR Shuttle	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
TRE Alt 1-90	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
TRE Alt 1-125	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
TRE Alt 1-220	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
TRE Alt 4-90	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
TRE Alt 4-220	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
TRE Alt 4-125	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
TRE Alt 7-90	**Union Station**	Dallas	7494	Yes	1.82	New HSR Shuttle	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
TRE Alt 7-125	**Union Station**	Dallas	7494	Yes	1.82	New HSR Shuttle	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
TRE Alt 7-220	**Union Station**	Dallas	7494	Yes	1.82	New HSR Shuttle	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 2-90	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 2-125	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 2-220	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 5-90	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 5-125	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 5-220	**Union Station**	Dallas	7494	Yes	1.82	No			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 8-90	**Union Station**	Dallas	7494	Yes	1.82	New HSR Shuttle	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 8-125	**Union Station**	Dallas	7494	Yes	1.82	New HSR Shuttle	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 8-220	**Union Station**	Dallas	7494	Yes	1.82	New HSR Shuttle	30	60	Yes	1.82	Yes	1.82	yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 16-90	**Union Station**	Dallas	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 16-125	**Union Station**	Dallas	7494	Yes	1.82	N			Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 16-220	**Union Station**	Dallas	7494	Yes	1.82	N			Yes	1.82	Yes	1.82		Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 17-90	**Union Station**	Dallas	7494	Yes	1.82	NEW HSR shuttle	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 17-125	**Union Station**	Dallas	7494	Yes	1.82	NEW HSR shuttle	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3
Hybrid Alt 17-220	**Union Station**	Dallas	7494	Yes	1.82	NEW HSR shuttle	30	60	Yes	1.82	Yes	1.82	Yes	Yes	1000	6		X	0.5	0.110	2.2	1	0.017	0.3

#Based on NCTCOG 2040 DFX Model
* Based on Tarrant County 1 zone discounted monthly pass rate
http://www.trinityrailwayexpress.org/farezones.html

* Average based on review of 10 existing PNR in three systems (2 each). See PNR tab. If not an existing PNR, used an average based on 10 existing stations.
^ If not an existing KNR, used an average based on7 stations in 3 services. See KNR tab

Alternative	Station Name - TCR	City	Station TAZ	Transit Connectivity: Bus^^ Available?	Avg# Discounted Fare	Route Mods?	Peak Headway (min)	Off Peak Headway (min)	Commuter Rail Available?	Avg* Discounted Fare	Light Rail Available?	Avg Discounted Fare	Proposed Parking: Park and Ride	Kiss and Ride	Total Parking Spaces	Daily Parking Cost	Station Type: At-grade	Elevated	Walk Time Station to Platform (min)	Park and Ride*: Distance (mi)	Walk Time (min)	Circulaton Time (min)	Kiss and Ride^: Distance (mi)	Walk Time (min)
IH 10 Alt 3-90	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 3-125	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 3-220	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 6-90	**TCR - Dallas**	Dallas	7817	Yes	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 6-125	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 6-220	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 9-90	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 9-125	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 9-220	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
IH 30 Alt 12-90	**TCR - Dallas**	Dallas	7817	YES	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
	TCR - Dallas					Yes - #26	35	35																
IH 30 Alt 12-125	**TCR - Dallas**	Dallas	7817	YES	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
	TCR - Dallas					Yes - #26	35	35																
IH 30 Alt 12-220	**TCR - Dallas**	Dallas	7817	YES	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
						Yes - #26	35	35																
TRE Alt 1-90	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
TRE Alt 1-125	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000			X	0.5	0.104	2.1	2	0.016	0.3
TRE Alt 1-220	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
TRE Alt 4-90	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
TRE Alt 4-220	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
TRE Alt 4-125	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
TRE Alt 7-90	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
TRE Alt 7-125	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
TRE Alt 7-220	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
TRE Alt 10-90	**TCR - Dallas**	Dallas	7817	Yes	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
				YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
TRE Alt 10-125	**TCR - Dallas**	Dallas	7817	Yes	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
				YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
TRE Alt 10-220	**TCR - Dallas**	Dallas	7817	Yes	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
				YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 2-90	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 2-125	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 2-220	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 5-90	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 5-125	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 5-220	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 8-90	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 8-125	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 8-220	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 11-90	**TCR - Dallas**	Dallas	7817	YES	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
						Yes - #26	35	35																
Hybrid Alt 11-12	**TCR - Dallas**	Dallas	7817	YES	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
						Yes - #26	35	35																
Hybrid Alt 11-90	**TCR - Dallas**	Dallas	7817	YES	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
						Yes - #26	35	35																
Hybrid Alt 16-90	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 16-12	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 16-22	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 17-90	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 17-12	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 17-22	**TCR - Dallas**	Dallas	7817	YES	1.82	Yes - #26	35	35	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
Hybrid Alt 18-90	**TCR - Dallas**	Dallas	7817	YES	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
						Yes - #26	35	35																
Hybrid Alt 18-12	**TCR - Dallas**	Dallas	7817	YES	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
						Yes - #26	35	35																
Hybrid Alt 18-22	**TCR - Dallas**	Dallas	7817	YES	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
						Yes - #26	35	35																
Hybrid Alt 19-90	**TCR - Dallas**	Dallas	7817	YES	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
						Yes - #26	35	35																
Hybrid Alt 19-12	**TCR - Dallas**	Dallas	7817	YES	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
						Yes - #26	35	35																
Hybrid Alt 19-22	**TCR - Dallas**	Dallas	7817	YES	1.82	New HSR Shuttle	30	60	NO		NO		YES	YES	5,000	6		X	0.5	0.104	2.1	2	0.016	0.3
						Yes - #26	35	35																

#Based on NCTCOG 2040 DFX Model
^^ New connection to Cedar Station
* Based on Tarrant County 1 zone discounted monthly pass rate
http://www.trinityrailwayexpress.org/farezones.html

* Average based on review of 10 existing PNR in three systems (2 each). See PNR tab. If not an existing PNR, used an average based on 10 existing stations.
^ If not an existing KNR, used an average based on7 stations in 3 services. See KNR tab

Transit System	City	PNR location	Miles from drop off midpoint of parking to station entrance		Miles from drop off midpoint of parking to platform	
			Straight	"Walkable"		
MARTA	Sandy Springs, GA	North Springs	0.062	0.089		
MARTA	Doraville, GA	Doraville	0.173	0.186		
TRE	Irving	Centreport	0.124	0.124		
TRE	Dallas	Union Station	0.104	0.110		
TRE	Fort Worth	T& P	0.100	0.105	0.060	0.078
SEPTA	Philadelphia, PA	Frankford Transportation Center	-	0.161		
SEPTA	Norristown, PA	Norristown Transportation Center	0.059	0.059		
Sounder Train	Tacoma, WA	Tacoma Dome Station	0.057	-		
Sounder Train	Auburn, WA	Auburn Station	0.024	-		
		Average	**0.088**	**0.119**		
		Total Average	**0.104**			

Transit System	City	KNR location	Miles from drop off to station entrance				
TRE	Fort Worth	Centreport/DFW Airport	0.009	50 feet			
TRE	Fort Worth	Intermodal Transportation Center (ITC)	0.046	226 Ft	but if pre-paid, the distance to platform is	140	Ft
TRE	Fort Worth	T & P	0.004				
TRE	Dallas	Union Station	0.017		Assumed curb side drop off on S. Houston Street		
MARTA	Sandy Springs, GA	North Springs	0.002				
MARTA	Stone Mountain, GA	Indian Creek	0.007				
Sounder Train	Auburn, WA	Auburn Station	0.028				
		Average	**0.016**				

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DFWCES Ridership Overview

Alternative Analysis

11-17-2016

Ridership analysis of the DFWCES TRE, Hybrid, and I-30 alternatives included an evaluation of 4 different technologies: 90 mph diesel, 125 mph diesel, 125 mph electric, and 220 mph electric for 12 different scenarios of station groupings and alignments:

	Station groups											
Alignment	*TRE*	*H*	*I30*	*TRE*	*H*	*I30*	*TRE*	*H*	*I30*	*TRE*	*H*	*I30*
Station	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Fort Worth T&P	X	X	X									
Fort Worth ITC	X	X	X	X	X	X	X	X	X	X	X	X
Centreport	X			X			X			X		
County Line		X										
Arlington		X	X		X	X		X	X		X	X
Dallas Union	X	X	X	X	X	X	X	X	X			
Dallas TCR	X	X	X	X	X	X			X	X	X	X

The initial steps included performing a series of ridership analyses on the scenarios representative of the TRE and Hybrid alignments with different technology, station combinations, and fares. Results at the end of each round were analyzed to determine scenarios to be carried forward to the next round of ridership analysis. The purpose was to compare the ridership performance results by technology and fare variation through Scenario S1 and station performance through all scenarios.

In the first round of ridership analysis the following shaded scenarios by corridor and technology were tested. I-30 scenarios were eliminated as technical and environmental review of the corridor indicated that the I30 corridor is not feasible as an alternative.

	Station groups											
Alignment	*TRE*	*H*	*I30*	*TRE*	*H*	*I30*	*TRE*	*H*	*I30*	*TRE*	*H*	*I30*
Station	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Fort Worth T&P	X	X	X									
Fort Worth ITC	X	X	X	X	X	X	X	X	X	X	X	X
Centreport	X			X			X			X		
County Line		X										
Arlington		X	X		X	X		X	X		X	X
Dallas Union	X	X	X	X	X	X	X	X	X			
Dallas TCR	X	X	X	X	X	X			X	X	X	X

DFWCES Ridership Overview

Alternative Analysis

11-17-2016

All other Scenarios were evaluated. S1 included the evaluation of all technologies – 90 mph diesel, 125 mph diesel, 125 mph electric, and 220 mph electric – and tested a spectrum of fares appropriate for the various technologies. The other scenarios S2, S4, S5, S7, S8, S10 and S11 were tested for 90 mph diesel only.

First Round Findings include:

- Elimination of the I-30 corridor ridership analysis
- S1 ridership for 125 mph diesel and 125 mph electric technologies was similar.

County Line Station performed significantly less favorably to other stations due to its location, connectivity, and access. The Fort Worth T&P and ITC stations performed as one station .

First round conclusions included that the County Line Station would be dropped. I-30 Scenarios would be dropped. 125 mph diesel and 125 mph electric performed similarly such that only one 125 mph technology would be tested in future rounds, and testing ridership on Scenarios S2, S4 and S5 would adequately compare the remaining stations, alignments, and technologies. In addition, a review of fare performance yielded a decision that an $8 fare would apply to all modes in the next round of scenarios.

Second Round ridership analysis included only Scenarios S2, S4, and S5 for the 90 mph diesel, 125 mph diesel and electric, and 220 mph electric.

	Station groups											
Alignment	*TRE*	*H*	*I30*	*TRE*	*H*	*I30*	*TRE*	*H*	*I30*	*TRE*	*H*	*I30*
Station	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Fort Worth T&P	X	X	X									
Fort Worth ITC	X	X	X	X	X	X	X	X	X	X	X	X
Centreport	X			X			X			X		
County Line		X										
Arlington		X	X		X	X		X	X		X	X
Dallas Union	X	X	X	X	X	X	X	X	X			
Dallas TCR	X	X	X	X	X	X			X	X	X	X

Second Round ridership analysis revealed that the S5 Hybrid Scenarios for 125 mph and 220 mph technologies performed better than any of the S4 TRE Scenarios. The Ft. Worth multi-station concept of the S2 Hybrid Scenarios performed best for 125mph and based on S4 results for 220 mph as well.

DFWCES Ridership Overview

Alternative Analysis

11-17-2016

Round 2 Ridership estimates

Characteristics	**TRE alternative**			**Hybrid alternative**		
Speed	90 mph D	125 mph D	220 mph E	90 mph	125 mph	220 mph
Stations	~~**S1**~~			**S2**		
Total riders	~~**3,468**~~	~~**2,356**~~	~~**1,959**~~	**5,520**	**6,368**	
TOPRS-related	~~1,254~~	~~921~~	~~786~~	3,366	3,497	
TCP-related	~~1,217~~	~~956~~	~~818~~	967	1,449	
Local riders	~~998~~	~~480~~	~~354~~	1,187	1,422	
ITC-US fare	~~$8.00~~	~~$21.93~~	~~$26.93~~	$8.00	$8.00	
ITC-US T.T.	~~37.83~~	~~23.98~~	~~23.48~~	45.67	45.67	
Stations	**S4**			**S5**		
Total riders	**2,718**	**3,344**	**3,374**	**4,894**	**5,430**	**5,425**
TOPRS-related	1,254	1,379	1,379	3,341	3,497	3,497
TCP-related	889	1,260	1,285	935	1,166	1,163
Local riders	575	705	710	619	767	764
ITC-US fare	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00
ITC-US T.T.	37.83	23.98	23.48	41.85	27.70	27.74

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To: Chad Coburn

From: Ed Campbell

cc: Mark Werner, Erik Steavens, Margarita Gagliardi, Melissa Neeley, Rick Donnelly, Leta Huntsinger, Tina Walker

Date: Sunday, January 29, 2017

Subject: Revised Ridership Approach

Revised Ridership Approach

The current scope of work and budget provides ridership forecasting for the No Build Alternative, two Build Alternatives for the Draft Environmental Impact Statement (DEIS) and the Preferred Alternative for the Final Environmental Impact Statement (FEIS). For each DEIS and FEIS alternative, there is an assumption of ten (10) model runs to test different scenarios related to variables, such as changing the amount of parking, the cost of parking, transit connections, fare structure and service plan.

The FRA has directed the study team to provide ridership forecasts on 16 conceptual alternatives, defined by the corridor, operating speed and combination of stations. There are three corridors:

- Trinity Railway Express (TRE),
- IH 30, and
- IH 30/SH 360/TRE (Hybrid).

There are three operating speeds and four trainsets:

- 90 mph conventional diesel locomotive,
- 125 mph enhanced diesel locomotive,
- 125 mph electric propulsion, and
- 220 mph high speed rail technology (e.g. Shinkansen).

The Project Team will use the SDG forecast for C4B at 186 mph, factored down to account for differences in ridership due to:

- The shorter time assumed to reach Dallas from Arlington than Fort Worth,
- The assumption of one-seat ride in C4B, and
- The additional fare and transfer time to change from TOPRS to DFWCES in Fort Worth.

Our approach also reflects the following specific approach comprised of:

- Fares between Fort Worth and all stations south of it will remain the same as assumed in the 186 mph C4B scenario.
- TOPRS C4C travel times from Fort Worth from and to all stations south accessing the DFW Metroplex will be used.
- Service planning will assume 16 trains per day as indicated in the TOPRS 186 mph scenarios.
- A 10 minute transfer time – essentially a platform-to-platform timed transfer – between DFWCES and TOPRS trains in both directions.
- Transferring passengers will pay the same fare and have same travel time between Fort Worth and Dallas as local DFWCES passengers between those two stations. That is, someone traveling from San Antonio to Dallas will be assumed to pay the SAT-FTW fare on TOPRS, as well as the FTW-DUS fare on DFWCES.
- Professional judgment, based on SDG's prior experience with the TOPRS models and PB's experience with similar scenarios in the California HSR forecast reviews, to identify the range of likely ridership reductions from C4B that we'll assume going forward.

This approach is an expedient one, necessitated by the need to try to keep the project on track. It is necessary for the project team to run a new forecast with the recommended TOPRS alternative if and when we complete the final ridership forecast for the DFWCES EIS, as those forecasts may differ from what we've assumed.

Mitigating Budget Shortfall

Our approach to mitigate some of the budget shortfall is to proceed as currently budgeted with analyses of the most promising alternatives, with the expectation that certain combinations of station groupings, fares, and service levels will quickly drop out. Once these combinations are identified in the first alignment tested, they will be dropped from subsequent alignments. Moreover, alignments with substantially similar service characteristics -- fares, travel times between Dallas and Fort Worth, and frequency of service -- can be combined and treated as a single blended alternative. There might be no practical difference from ridership standpoint between a service running between Dallas and Fort Worth that stops in Arlington versus one that stops at the proposed County Line station, for example. This multi-dimensional reduction in alternatives, and service variants of them, might reduce the number of model runs.

Risk Management

There are risks with this approach, including that it cannot be known beforehand which combinations will fall out, or how quickly. Differences in station parking cost and availability, as well as transit and highway accessibility (especially if one includes connections to commuter rail that the other does not) might outweigh small differences in overall travel time between Fort Worth and Dallas. Thus, there is no guarantee that small differences between alternatives in one dimension will necessarily result in equally small differences in ridership.

The other risk is that the budget will not provide for evaluating all of the alternatives. We can apply professional judgment and experience from other projects to inform our approach, but cannot know for certain until we see preliminary results. We will make every effort to be as frugal as possible while we move forward in coordination with TxDOT on a contract amendment to address any shortfalls.

Appendix C:
Capital Cost Estimation Methodology

Memorandum

To: Project Team

From: Ed Campbell

Date: March 7, 2016

Subject: DFWCES _Capital Cost Estimate Methodology

Technical Memorandum:

1. Introduction

1.1 *Project Description*

The Texas Department of Transportation (TxDOT) is working with the Federal Railroad Administration (FRA) to study a possible high-speed, intercity passenger rail service between Dallas and Fort Worth, Texas. The 30-mile, Dallas - Fort Worth Core Express Service (the Project) evaluates the potential for a core express rail connector, connecting the Central Business Districts of Dallas and Fort Worth and other high-speed rail projects, existing intercity passenger services, and last-mile connections. The Project evaluates environmental impacts, service characteristics, and capital costs to determine a preferred alternative alignment. The Project evaluates steel wheel steel rail trainsets with operational speeds of 90, 125, and 220 mph.

The physical limits of the project extend from the existing Fort Worth Intermodal Transportation Center (ITC) at the western terminus to the proposed Texas Central Railway (TCR) high-speed rail station near the I-30/I-35E interchange in Dallas. The alternative conceptual corridors under evaluation consist of the I-30 corridor, the Trinity Railway Express (TRE) corridor, and the Hybrid corridor of TRE from Dallas to the SH360 to I-30 to Fort Worth as shown in Figure 1.

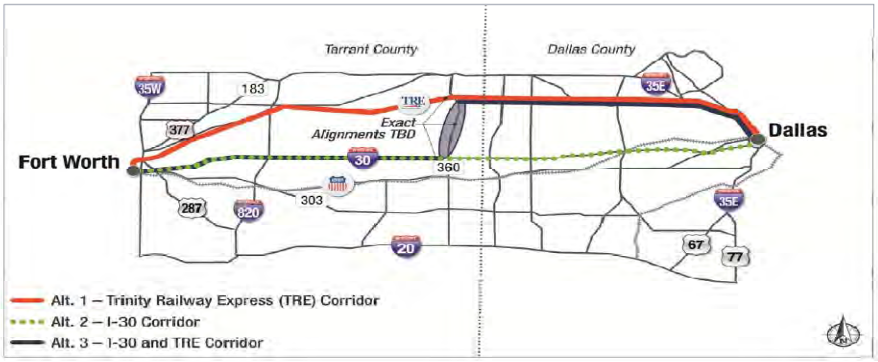

Figure 1: Project Location Map and Alternative Corridors

1.2 *Objective*

This technical memorandum provides a Capital Cost Estimate Methodology (Methodology) that assures the project capital cost estimates are prepared in a consistent and uniform manner, organized and standardized in methods, and formatted in order to facilitate estimate reviews and reporting for the Project alternatives being evaluated for TxDOT. The capital costing methodology provides cost estimates applicable to the specific Project phase. At the Project Alternative Analysis phase of the project unit costs per mile are developed to compare the capital costs of alignments, facilities, and train technologies. Capital costs will be further refined with greater detail once the Project Locally Preferred Alternative is determined. The capital cost estimate will be developed using the FRA Standard Cost Categories (SCC).

Estimating methodologies are not static and must be flexible enough to adjust to the needs of the project's stage in the development process. Each Project development phase is represented by a range of environmental review and engineering design completion and influenced by ongoing updates to the ridership demand forecast and associated revisions to estimate system capacity, service design and operating plans. The level of design detail and known information, and therefore the accuracy of capital cost estimates, increases as the project advances. This methodology aligns with the level of design completed for the evaluation of alternatives and preferred alternative and provides for the development of costs and contingencies to account for Project unknowns and risks.

1.3 *General Assumptions*

The Methodology provides Project capital cost estimates.

The Methodology provides a consistent format for reporting, estimating, and managing the Project's capital costs and uses SCC established by the FRA for the American Recovery and Reinvestment Act (ARRA) grant application requirements.

The Methodology provides the framework for development of capital cost estimates for the Alternative Analysis phase of the project and the preferred alternative phase of the project. Each phase of capital cost estimate development will be based on previously completed planning and construction United States and International projects. The Alternative Analysis phase of the Project develops capital cost estimates at a cost per mile for each of the SCC standard categories 10 through 90.

The Methodology and completed capital cost estimates will undergo review and comment from and be considered draft until they receive final review and approval from TxDOT and FRA

The Methodology provides capital cost estimates in 2015 dollars (base year). Capital costs are adjusted for inflation at a rate of 3% each year up to the anticipated mid-point of construction.

2. Capital Cost Methodology

2.1 *FRA Standard Cost Categories*

FRA's Standard Costing Category (SCC) is separated into 10 categories for capital projects/programs. Table 1 identifies the ten major categories:

Table 1: FRA Standard Cost Categories

Standard Cost Categories
10 Track Structures and Track
20 Stations, Terminals, Intermodal
30 Support Facilities: Yards, Shops, Administration Buildings
40 Sitework, Right-of-Way, Land, Existing Improvements
50 Communications and Signaling
60 Electric Traction
70 Vehicles
80 Professional Services
90 Unallocated Contingencies
100 Finance Charges

Each Standard Cost Category breaks down into subcategory items that further detail the capital cost estimate of each major category. The capital cost estimates only include categories 10 through 90 as category 100. The value for category 100 will be determined in subsequent stages of the project. Capital Cost Estimate definitions and unit costs for FRA categories 10: Track Structures & Track through 80: Professional Services are listed under Paragraph 7.

2.2 *Contingencies*

The Methodology applies allocated and unallocated contingencies. Allocated contingency is added to each cost category, based on an assessment of the level of available design information, means and methods, and site accessibility available for individual items of work. Unallocated contingency includes more widespread uncertainties not associated with individual construction activities. Unallocated contingency will be based on a percentage of the total project cost for categories 10 through 80.

For the Project the allocated contingency is 50% to mitigate the many unknowns at this level of design. The unallocated contingency is assumed at 15% for the conceptual level cost to mitigate the uncertainty in the overall implementation of the project including schedule, governance, stakeholder agreements and other issues.

Project contingencies reduce in value as the design and delivery approach clarifies in line with progress and detail of the overall project development.

Table 3 lists the assumed contingencies for capital cost estimates utilized for this project.

Table 3: Capital Cost Contingencies

Cost Category	Allocated Contingency
10 Track Structures and Track	50%
20 Stations, Terminals, Intermodal	50%
30 Support Facilities: Yards, Shops, Administration Buildings	50%
40 Sitework, Right-of-Way, Land, Existing Improvements	50%
50 Communications and Signaling	50%
60 Electric Traction	50%
70 Vehicles	50%
80 Professional Services	50%
90 Unallocated Contingency	15%

2.3 *SCC 20 Stations*

The Methodology provides station cost estimates based on improvements to and the use of existing or proposed terminal facilities in the Dallas and Fort Worth central business districts and one or two (maximum) new intermediate stations along each alternative corridor. For the purposes of the estimated costs it is assumed that the existing Fort Worth T&P or the Intermodal Transportation Center (ITC) and the Dallas Union Station or the proposed Texas Central Railway (TCR) station would provide the station buildings for the terminal stations. Costs for platforms and accessibility to those platforms for the Project will be included as part of this project's estimates.

Intermediate station sites include potential station locations in Arlington, at the TRE CentrePort Station and a county line location near the TRE CentrePort station. The Methodology provides a standard unit cost for intermediate stations treating them initially as large Stations per Amtrak's Station Program and Planning Guidelines (2013). Should ridership results indicate the station size and capital costs will be adjusted. The intermediate station building costs will be represented as a lump sum per station.

2.4 *SCC 30 Support Facilities*

Support facility requirements will be determined based on the service plan for the Project as determined by ridership. Support facilities include vehicle storage and light maintenance facilities, heavy maintenance facilities, wayside maintenance facilities, and administrative facilities. These costs will be lump sum costs and based on past similar project maintenance facility layouts for similar fleet sizes.

2.5 *SCC 40 Sitework, Right of Way, Land, Existing Improvements*

The project will include an evaluation of right-of-way needs that may consist of up to three types of property: Urban, Suburban, and Undeveloped right-of-way acquisition. Table 4 provides additional definition of each type of property for estimating purposes. A minimum right-of-way width of 60 feet will be assumed for the Project.

Table 4: Real Estate Cost Items

40.07	Purchase or Lease of Real Estate	
Subcategory	Item	Definition
40.07.01	Urban Right-of-Way	Purchase of property in the densely developed areas of downtown Dallas and Fort Worth
40.07.02	Suburban Right-of-Way	Purchase of property in less densely developed areas outside of downtown Dallas and Fort Worth, but with some improvements on the purchased land
40.07.03	Undeveloped Right-of-Way	Purchase of property without improvements (land only)

2.6 *SCC 70 Vehicles*

Vehicle unit cost estimates include diesel electric and electric vehicle technologies satisfying operating speeds of 90mph (diesel electric) 125mph (diesel electric or electric), and 220mph (electric),

Vehicle purchase costs (including design) will be included in FRA standard cost category 70 on a cost-per-trainset basis. The trainset number of cars and seating capacity and be based on the ridership analysis and service operating plan developed for the project. Standard trainset amenities such as including 2 x 2 seating, video displays, automated station announcement/displays, audio entertainment availability, Wi-Fi internet access, and 110 volt power at each seat are assumed. Costs for an additional 20% of vehicles (spar cars) and replacement parts will also be included in the estimate.

The cost of rolling stock includes estimation of both revenue vehicles. Non revenue vehicles will be included as part of Operations and Maintenance cost estimates. The cost of vehicles will be determined from recently completed studies and vehicle purchases within the united states and publicly available data regarding recent sales of comparable equipment to other High Speed Rail projects around the world.

2.7 *SCC 80 Professional Services*

The costing approach for professional services will be based on percentages of the construction cost for categories 10 through 60. Cost category 70: Vehicles will be excluded because professional services for vehicle procurement, design, and manufacturing will be included in the cost of the vehicles.

These percentages are common practice percentages adjusted for the anticipated magnitude of the capital cost. Table 5 shows the assumed percentage values that will be used.

Table 5: Professional Services by Percent

80 Professional Services		
	Item	Percentage of Construction Cost
80.01	Service Development/Service Environmental	Not Applicable (currently underway)
80.02	Preliminary Engineering/Project Environmental	4%
80.03	Final Design	7%
80.04	Project Management for Design and Construction	3%
80.05	Construction Administration and Management	3%
80.06	Professional Liability and Other Non-Construction Insurance	0%, Negligible
80.07	Legal; Permits; Review Fees by Other Agencies and Cities	0%, Negligible
80.08	Survey, Testing, and Investigation	1%
80.09	Engineering Inspection	1%
80.10	Start Up	Not Applicable

3. Unit Costs and Units of Measure

Unit costs will be derived from multiple comparable services that have been either evaluated (such as the Texas-Oklahoma Passenger Rail Study, Caltrans, California High Speed Rail, Midwest Regional Rail Initiative, Florida High Speed Rail, High Speed Rail Feasibility studies completed by the Georgia Department of Transportation and others) as well as Amtrak Acela service currently in operation in the northwestern U.S. These unit costs will serve the basis for estimating per mile costs for analysis of the alternative alignments and technologies.
For the preferred alternative, unit prices will be developed based on common methods used for estimating unit prices. Unit prices for each of the items include cost of material, labor, overhead, and profit. When limited engineering details are available, historical bid price method will typically be used. Below is a list of resources that will be referenced, in addition to the previous studies when developing the unit costs:

- Published construction documents, such as "RSMeans Heavy Construction Cost Data," current edition;
- TxDOT and other State Transportation agencies' weighted unit cost;
- Federal Transit Administration (FTA) website for typical elements cost;
- Available state HSR studies, planning, and design documents;
- Various Class 1 railroad cost estimates; and
- Estimating experience and historical costs for similar planned construction elements.

The project team will update all unit costs to 2015 dollars for the design and construction of the Project. Escalating these unit costs to 2015 dollars will be conducted by utilizing the *Engineering News Record* Construction Cost Index (CCI) for Dallas/Fort Worth. The CCI uses local prices for portland cement and 2x4 lumber and the national average price for structural steel. It also uses local union wages (plus fringes) for carpenters, bricklayers, and iron workers. The following formula will be used to escalate unit costs to 2015 dollars:

$$Unit\ Cost_{\ 2015} = (Unit\ Cost_{Year\ X}) \times \frac{(October\ 2015\ Index) - (Prior\ Year\ Index)}{Prior\ Year\ Index}$$

All units will be based on U.S. Customary Units defined by the National Institute of Standards and Technology. U.S. Customary Units are officially used in the United States and are also known in the U.S. as “English” of “Imperial” units. Actual units of measure for each of the items will be determined during the capital cost estimating phase.

4. Quantities

Conceptual quantities will be developed based on the engineering plans for the FRA cost categories listed in this memorandum in line with the percent complete of drawings and specifications. These initial quantities are related to , structures, track roadbed, rail, track materials, turnouts, stations, support facilities, right-of-way, communications and signaling, electric traction, and vehicles. Quantities that are specific to preliminary engineering and final design including earthwork, sitework, and utilities are estimated as part of the per mile costs for the analysis of alternatives. These undefined quantities can be significant cost drivers and thus are also addressed within the allocated and unallocated contingencies.

Quantities will be based on plan and profile drawings, typical sections, and sketches created during the conceptual and preliminary engineering tasks.

5. Capital Cost Estimate Segments

The capital cost estimates are presented by alternative alignment along the three corridors – I-30, TRE, and the Hybrid (TRE, SH360, I-30) for alternatives on each side of the corridor egments for the three corridors and associated alternatives being evaluated for the Project:

- TRE Corridor – for North, South and North/South Alignments
  - TCR Station to Union Station
  - Union Station to the TRE Centreport Station
  - TRE Centerport Station to Fort Worth ITC Station
  - Fort Worth ITE Station to Fort Worth T&P Station
- I-30 Alternative Corridor – for North, South, and North/South Alignments
  - Union Station to Arlington Station
  - TCR to Arlington Station
  - Arlington Station to ITC Station

  Note – It is possible that an alignment from Dallas Union Station to Arlington Station is not feasible in that case only a connection to the TCR station will be estimated.

  Note – The TCR Station to Union Station and ITC Station to T&P Station costs are the same for all alternatives.
- I-30/ SH 360/ TRE Alternative Hybrid Corridor-for East, West, and East/West Alignments
  - Union Station to County Line Station

- County Line Station to Arlington Station

  Note – The Arlington Station to ITC Station costs are the same for all alternatives.

6. Life-Cycle Cost Forecast

A conceptual and high-level life cycle cost (LCC) forecast for system renewal will be developed for each of the two route alternatives. The LCC will identify significant asset capital rehabilitation investments (that go beyond routine maintenance) associated with achieving a state of good repair during the first 50 years of operations and asset replacement costs associated full replacement of major component during the first 50 years of operations. Only major system components will be included in the LCC analysis.

The LCC cost estimate will be presented in 2015 dollars (base year) as an annual cost stream over 50 years, as an average annual cost, and as a net present value at 3% and 7% discount rates. In this manner, LCC costs may be combined with operations and maintenance cost estimates developed separately for evaluation by others of overall life cycle costs, benefit-cost analysis, economic analysis, or other study needs.

The LCC will be computed for major system components with a replacement life span or mid-life rehabilitation period of 50 years or less at the FRA SCC sub-category level of detail as shown in Table 2. Costs will include allowances for professional services and allocated contingency appropriate for the conceptual design phase of future asset rehabilitation and replacement projects. The following life cycles will be used for major system components requiring renewal:

- SCC 10 Track Structures and Track
  - 136LB rail will have an average life span for passenger train operations of 25 years Concrete ties and other track material will have average life span for passenger operations of 50 years.
- SCC 20 Stations, Terminals, Intermodals
  - All SCCs are assumed to have life cycles greater than 50 years.
- SC 30 Support Facilities: Yards, Shops, Administrative Buildings
  - All SCCs are assumed to have life cycles of 50 years.
- SCC 40 Sitework, Right-of-Way, Land, Existing Improvements

  - All SCCs are assumed to have life cycles greater than 50 years.

- SCC 50 Communications and Signaling
  - All SCCs are assumed to have life cycles around 30 years.
- SCC 60 Electric Traction
  - All SCCs are assumed to have life cycles around 30 years.
- SCC 70 Vehicles
  - All SCCs are assumed to have life cycles around 25 years.

7. FRA Cost Items

In the table below are the FRA Cost items, definition, unit cost, and unit of measurement tabulated for the infrastructure and vehicle elements used for development of capital cost estimates in support of the analysis of alternatives and refinement of costs for the locally preferred alternative.

Table 5: FRA Cost Items

10 Track Structures and Track				
	Item	Definition	Unit Cost ($2015)	Unit of Measure (per)
10.01	Track Structure: Viaduct	Includes elevated track structure of significant length, consisting of multiple spans of generally equal length (substructure and superstructure)	Up to 30' height: $132,000,000 30' to 60' height: $148,000,000 Greater than 60' height: $170,000,000 Check unit costs	Corridor Mile (assumed double-track)
10.02	Track Structure: Major/Movable Bridge	Includes all elevated track structures with a movable span and/or a span of significant length (generally 400' or longer)	Not applicable	Not applicable
10.03	Track Structure: Undergrade Bridges	Includes elevated track structure greater than 20' that does not fall into cost categories 10.01 and 10.02	Double Track over Interstate: $1,830,000 Double Track over Major Roadway: $1,460,000 Double Track over Minor Roadway: $710,000 Double Track over Major Waterway: $1,150,000 Double Track over Minor Waterway: $120,000	Each
10.04	Track Structure: Culvert and Drainage Structure	Includes all minor undergrade drainage (generally 20' or less in width)	Urban Non-Dense: $60,000 Urban Dense: $500,000	Corridor Mile

	Item	Definition	Unit Cost ($2015)	Unit of Measure (per)
10.05	Track Structure: Cut and Fill (greater than 4' height/depth)	Includes grading and subgrade stabilization of roadbed	$1,550,000	Track Mile
10.06	Track Structure: At-Grade (grading and subgrade stabilization)	Includes all grading and subgrade stabilization of roadbed not included under cost categories 10.01 through 10.05, and 10.07	$750,000	Track Mile
10.07	Track Structure: Tunnel	Includes double-track section using Tunnel-Boring Machine (TBM)	Provide	Provide
10.08	Track Structure: Retaining Walls and Systems	Includes permanent retaining wall and associated appurtenances	$70	Square Foot
10.09	Track New Construction: Conventional Ballasted	Includes all ballasted track construction on prepared subgrade, on new or existing rights-of-way (rail, ties, ballast, other track materials)	136LB CWR on Concrete Ties: $2,200,000	Track Mile
10.10	Track New Construction: Non-Ballasted	Includes all slab, direct fixation, embedded, and other non-ballasted track construction on prepared subgrade, on new or existing rights of way	$2,500,000	Track Mile

	Item	Definition	Unit Cost ($2015)	Unit of Measure (per)
10.11	Track Rehabilitation: Ballast and Surfacing	Includes undercutting, ballast cleaning, tamping, and surfacing not associated with new track construction	$140,000	Track Mile
10.12	Track Rehabilitation: Ditching and Drainage	Includes regrading of existing ditches, extensions of drainage pipes, and rehabilitation of existing headwalls	$60,000	Track Mile
10.13	Track Rehabilitation: Component Replacement (rails and ties)	Includes replacement of existing rail with 136LB CWR and replacement of ties and other track materials	30% Rehabilitation: $790,000 60% Rehabilitation: $1,510,000 100% Rehabilitation: $2,200,000	Track Mile
10.14	Track: Special Track Work (switches, turnouts, and insulated joints)	Includes minor turnouts and interlocking, such as crossovers and turnouts at the ends of passing tracks	Ballasted TO (60 mph): $425,000 Ballasted TO (80 mph): $550,000 Ballasted TO (110 mph): $775,000 Ballasted TO (150 mph): $1,000,000	Each
10.15	Track: Major Interlockings	Significant interlockings at major stations and where routes converge from three or more directions.	Not applicable (no converging routes)	Not applicable

	Item	Definition	Unit Cost ($2015)	Unit of Measure (per)
10.16	Track: Switch Heaters (with power and control)	Includes cost of power distribution equipment from commercial power source to interlocking location.	$50,000	Each
10.17	Track: Vibration and Noise Dampening	Includes installation of vibration and noise dampening systems	To be determined (TBD) based on specific characteristics of the vibration and noise dampening application applied pending environmental investigation	TBD
10.18	Other Linear Structures (including fence, sound walls, and crash barrier)	Includes installation of right-of-way fencing and sound walls/crash barrier as applicable	8' Fence (curved top, 2" mesh galvanized): $600,000 Barrier Wall: $2,500,000	Corridor Mile
20 Stations, Terminals, Intermodal				
20.01	Station Buildings: Intercity Passenger Rail Only	Includes intercity passenger rail station building and associated amenities	Dallas Station: $12,000,000 (improvements/additions to Union or TCR Station) DFW/Intermediate: $25,000,000 Fort Worth Station: $12,000,000 (improvements/additions to Union or TCR Station)	Each
20.02	Station Buildings: Joint Use (commuter rail and intercity bus)	Includes joint-use passenger rail station building and associated amenities	Not applicable	Not applicable
	Item	Definition	Unit Cost ($2015)	Unit of Measure (per)

	Item	Definition	Unit Cost ($2015)	Unit of Measure (per)
20.03	Platforms	Includes construction of new and extension of existing platforms, including canopy over platform	$800	Track Foot
20.04	Elevators and Escalators	Includes installation of elevators and escalators at elevated platforms and overhead pedestrian bridge structures for access over tracks	$4,000,000	Per Station
20.05	Joint Commercial Development	Includes construction at station sites intended to support non-transportation commercial activities (shopping, restaurants, residential, office space). Does not include cost of incidental commercial use of station space intended for use by passengers (newsstands and snack bars). Costs may not be allowable for Federal reimbursement.	Not Applicable	Not Applicable

20.06	Pedestrian/Bike Access and Accommodation, Landscaping, and Parking Lots	Includes sidewalks, paths, plazas, landscape, site and station furniture, site lighting, signage, public artwork, bike facilities, and permanent fencing	Provide	Per Station
20.07	Automobile, Bus, Van Accessways (including roads)	Includes all on-grade paving, including driveways to stations	$75	Square Yard
20.08	Fare Collection Systems and Equipment	Includes fare sales/ swipe machines and fare counting equipment outside of station areas	Not applicable	Not applicable
20.09	Station Security	Includes security cameras network and other security measures	Provide	Per Station
30 Support Facilities: Yards, Shops, Administrative Buildings				
30.01	Administration Buildings: Office, Sales, Storage, Revenue Counting	Includes building space for administration activities	Not applicable (assumed as part of SCC 30.03)	Not applicable
30.02	Light Maintenance Facility	Includes service, inspection, and storage facilities and equipment.	$100,000,000	Each
30.03	Heavy Maintenance Facility	Includes heavy maintenance, overhaul facilities, equipment, and associated buildings	Provide	Size per service plan

30.04	Storage or Maintenance-of-Way Building	Includes storage and maintenance-of-way area for parts/vehicles	Not applicable (assumed as part of SCC 30.03)	Not applicable
30.05	Yard and Yard Track	Includes yard construction and track associated with the yard	Not applicable (assumed as part of SCC 30.03)	Not applicable
40 Sitework, Right-of-Way, Land, Existing Improvements				
40.01	Demolition, Clearing, Site Preparation	Includes project/program-wide clearing, demolition and fine grading	$120,000	Corridor Mile
40.02	Site Utilities and Utility Relocation	Includes all site utilities - storm, sewer, water, gas, and electric	Light: $1,000,000 Medium: $3,000,000 Heavy: $5,000,000	Corridor Mile
40.03	Hazardous Material, Contaminated Soil Removal/Mitigation, Ground Water Treatments	Includes underground storage tanks, fuel tanks, other hazardous materials and treatments	To be determined (TBD) pending environmental investigation	TBD
40.04	Environmental Mitigation: Wetlands, Historic/Archeology, Parks	Includes mitigation costs associated with environmental impacts	To be determined (TBD) pending environmental investigation	TBD
40.05	Site structures (including retaining walls and sound walls)	Includes retaining walls and sound walls for site	Not applicable (to be included in SCC 10.08)	Not applicable (to be included in SCC 10.08)

	Item	Definition	Unit Cost ($2015)	Unit of Measure (per)
40.06	Temporary Facilities and Other Indirect Costs During Construction	Includes temporary facilities/indirect costs associated with construction activities or maintaining current services	To be determined (TBD) based on specific characteristics of the corridor and temporary items that need to be applied	Lump Sum
40.07	Purchase or Lease of Real Estate	If the value of right-of-way, land and existing improvements is to be used as in-kind local match to the federal funding of the project/program, include the total cost on this line item. In backup documentation, there will be separate cost for land and cost for improvements to the land. Costs will Identify whether items are leased, purchased or acquired through payment, or for free. Includes the costs for permanent surface and subsurface easements, and trackage rights.	Urban: $1,045,440 Suburban: $696,960 Undeveloped: $522,720 (specific property costs to be determined in ongoing project phases)	Acre

	Item	Definition	Unit Cost ($2015)	Unit of Measure (per)
40.08	Highway/Pedestrian Overpass/Grade Separations	Includes earthwork, roadway, bridge, and retaining wall. Other than the grade separations included in this line item, highway-rail grade crossing safety enhancements generally fall under 50.06	Roadway overpass (2 lanes): $8,000,000 Roadway overpass (4 lanes): $10,000,000 Roadway underpass (2 lanes): $10,000,000 Roadway underpass (4 lanes): $12,000,000	Each
40.09	Relocation of Existing Households and Businesses	Costs are in compliance with Uniform Relocation Act	To be determined (TBD)	TBD
50 Communication and Signaling				
50.01	Wayside Signaling Equipment	Includes installation of wayside signals and appurtenances	$970,000	Corridor Mile
50.02	Signal Power Access and Distribution	Includes providing power to signals for operations	$5,300	Corridor Mile
50.03	On-Board Signaling Equipment	Includes on-board cab signal, Automatic Train Control (ATC), and Positive Train Control (PTC) related equipment	$400,000	Train Set
50.04	Traffic Control and Dispatching Systems	Includes equipment necessary for train dispatch/operations	$9,360,000	Lump Sum

	Item	Definition	Unit Cost ($2015)	Unit of Measure (per)
50.05	Communications	Includes associated communications equipment (fiber optic cable, conduit, et al) for service	$560,000	Corridor Mile
50.06	Grade Crossing Protection	Includes all types of highway-rail grade crossing safety enhancements except for grade separation projects, which fall under 40.08	Not applicable	Not applicable
50.07	Hazard Detectors (dragging equipment high water, and slide)	Includes all necessary items for hazard detectors	$10,000	Corridor Mile
50.08	Station Train Approach Warning System	Includes all necessary items for station approach warning systems	$150,000	Station
60 Electric Traction				
60.01	Traction Power Transmission: High Voltage	Includes all utility interfaces between the catenary system and existing poser service	$70,000 *(assumes double track operation)*	Corridor Mile
60.02	Traction Power Supply: Substations	Includes installation of traction power substations and appurtenances	$1,850,000 *(assumes double track operation)*	Corridor Mile
60.03	Traction Power Distribution: Catenary	Includes all items required for overhead catenary system	$3,670,000 *(assumes double track operation)*	Corridor Mile
60.04	Traction Power Control	Includes the SCADA system for electrified corridors	$1,680,000	Lump Sum

70 Vehicles				
	Item	Definition	Unit Cost ($2015)	Unit of Measure (per)
70.00	Vehicle Acquisition: Electric Locomotive	Includes purchase of electric locomotive trainsets	Locomotive: $5,000,000	Each
70.01	Vehicle Acquisition: Non-Electric Locomotive	Includes purchase of non-electric locomotive trainsets	Provide	Each
70.02	Vehicle Acquisition: Electric Multiple Unit	Includes purchase of electric multiple unit (EMU) trainsets	Not applicable	Not applicable
70.03	Vehicle Acquisition: Diesel Multiple Unit	Includes purchase of diesel multiple unit (DMU) trainsets	Provide	Each
70.04	Vehicle Acquisition: Loco-Hauled Passenger Cars w/ Ticketed Space	Includes cars with coach space	Passenger car: $3,000,000	Each
70.05	Vehicle Acquisition: Loco-Hauled Passenger Cars w/o Ticketed Space	Includes dedicated food service, lounge, baggage and other service support cars	Not applicable	Not applicable
70.06	Vehicle Acquisition: Maintenance-of-Way Vehicles	Includes vehicles for maintenance-of-way operations	$50,000,000	Lump Sum
70.07	Vehicle Acquisition: Non-Railroad Support Vehicles	Includes hi-rail bucket trucks and other highway vehicles	Hi-rail 6-man truck: $75,000 Hi-rail ten wheeler boom truck crew cab: $400,000 Substation bucket truck: $600,000	Each

	Item	Definition	Unit Cost ($2015)	Unit of Measure (per)
70.08	Vehicle Refurbishment: Electric Locomotive	Includes refurbishment of electric locomotive trainsets	Not applicable	Not applicable
70.09	Vehicle Refurbishment: Non-Electric Locomotive	Includes refurbishment of non-electric locomotive trainsets	Not applicable	Not applicable
70.10	Vehicle Refurbishment: Electric Multiple Unit	Includes refurbishment of electric multiple unit (EMU) trainsets	Not applicable	Not applicable
70.11	Vehicle Refurbishment: Diesel Multiple Unit	Includes refurbishment of diesel multiple unit (DMU) trainsets	Not applicable	Not applicable
70.12	Vehicle Refurbishment: Loco-Hauled Passenger Cars w/ Ticketed Space	Includes coaches and sleeping cars	Not applicable	Not applicable
70.13	Vehicle Refurbishment: Non-Passenger Loco-Hauled Car w/o Ticketed Space	Includes food service, lounge, baggage and other service support cars	Not applicable	Not applicable
70.14	Vehicle Refurbishment: Maintenance-of-Way Vehicles	Includes refurbishment of vehicles for maintenance-of-way operations	Not applicable	Not applicable
70.15	Spare Parts	Includes additional parts for ongoing vehicle maintenance	To be determined (TBD)	TBD

80 Professional Services				
	Item	Definition	Unit Cost ($2015)	Unit of Measure (per)
80.01	Service Development/Service Environmental	Includes service-level development and environmental activities	Not applicable (currently underway)	Not applicable (currently underway)
80.02	Preliminary Engineering/Project Environmental	Includes preliminary-level development and environmental activities	4%	Percentage of construction cost
80.03	Final Design	Includes final design engineering activities	7%	Percentage of construction cost
80.04	Project Management for Design and Construction	Includes management of design and construction activities	3%	Percentage of construction cost
80.05	Construction Administration and Management	Includes construction management and administration activities	3%	Percentage of construction cost
80.06	Professional Liability and other Non-Construction Insurance	Includes insurance requirements for professional services	0%, negligible	Percentage of construction cost
80.07	Legal; Permits; Review Fees by Other Agencies and Cities	Includes legal, permitting, and other fees associated with engineering	0%, negligible	Percentage of construction cost
80.08	Survey, Testing, and Investigation	Includes surveying and testing activities during engineering and construction	1%	Percentage of construction cost

	Item	Definition	Unit Cost ($2015)	Unit of Measure (per)
80.09	Engineering Inspection	Includes engineering inspection services during construction	1%	Percentage of construction cost
80.10	Start Up	Includes project start-up costs	Not applicable	Not applicable

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Appendix D:
Operations and Maintenance Cost Estimation Methodology

Memorandum

To: Project Team

From: Ed Campbell

Date: March 16, 2016

Subject: DFWCES _Operations & Maintenance Cost Estimate Methodology

Technical Memorandum:

1. Introduction

1.1 *Project Description*

The Texas Department of Transportation (TxDOT) is working with the Federal Railroad Administration (FRA) to study a possible high-speed, intercity passenger rail service between Dallas and Fort Worth, Texas. The Project evaluates environmental impacts, service characteristics, and capital and operating and maintenance costs to determine a preferred alternative. The Project evaluates steel wheel steel rail trainsets with operational speeds of 90, 125, and 220 mph. The physical limits of the project extend from the existing Fort Worth Intermodal Transportation Center (ITC) at the western terminus to the proposed Texas Central Railway (TCR) high-speed rail station near the I-30/I-35E interchange in Dallas. The alternative conceptual corridors under evaluation consist of the I-30 corridor, the Trinity Railway Express (TRE) corridor, and the Hybrid corridor of TRE from Ft. Worth to the SH360 to I-30 to Dallas as shown in Figure 1.

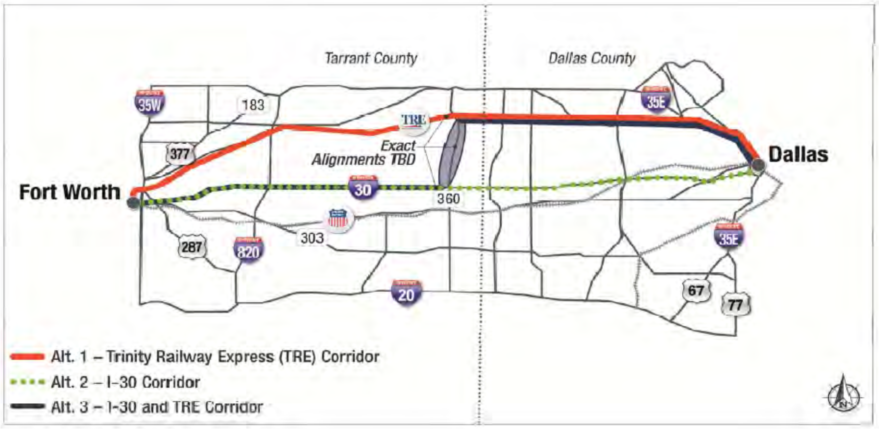

Figure 1: Project Location Map and Alternative Corridors

1.2 *Objective*

This technical memorandum provides an Operations and Maintenance (O&M) Estimate Methodology that assures the project O&M cost estimates are prepared in a consistent and uniform manner, organized and standardized in methods, and formatted in order to facilitate reviews and reporting for the evaluation of Project alternatives.

Estimating methodologies are not static and must be flexible enough to adjust to the needs of the Project's stage in the development process. Each Project development phase is represented by a range of environmental review and engineering design completion and influenced by ongoing updates to the ridership demand forecast and associated revisions to estimate system capacity, service design and operating plans. The level of development of a service plan and ridership information and therefore the accuracy of O&M cost estimates, increases as the project advances.

2. O&M Cost Methodology

2.1 *General Assumptions*

Service options including ridership, route miles, annual operating days, annual trips, annual train miles, average ridership per train, cars per train, annual car miles, and stations provide the basis for determining Project O&M Costs. O&M cost development occur during the analysis of alternatives within the following corridors:

- I-30
- TRE
- TRE/SH360/I30

For each corridor alignment, different technologies of trainsets and speeds will be evaluated including:

- 90 mph diesel electric
- 125 mph diesel electric
- 125 mph electric
- 220 mph electric

Parametric cost information from existing passenger rail operations and recently completed studies will be used to develop O&M costs and used in the comparison of alternatives. Parametric costs will be identified for the following overall O&M Cost Categories:

- **Maintenance of Way** – Cost of maintaining the track, signals, buildings, structures, bridges, etc.
- **Maintenance of Equipment** – Cost of layover and turnover servicing and preventative maintenance, wreck and accidents, and contractor maintenance
- **Transportation (train movement)** – Operating cost of trainmen, enginemen, bus connections, train fuel, propulsion power, and railroad access,
- **Sales and Marketing** – Operating cost of advertising, marketing, and reservations
- **Station** – Operating cost of station staff (ticketing, baggage etc.), building rent, utilities, and security and station maintenance costs – cleaning, trash pickup, lighting, fire, emergency egress, communication systems, and connecting bus/shuttle service.
- **General / administrative expenses**

, A contingency of 15% will be applied to the total O&M cost to account for unknowns and to mitigate the uncertainty in the overall implementation of the Project including schedule, governance, stakeholder agreements, and other issues that could impact O&M costs.

The following projects will be used as a basis in developing O&M costs for both phases of O&M cost development:

- California High Speed Rail O&M Cost Model Documentation – including international input
- FRA Heartland Flyer (Kansas City – Oklahoma City – Ft. Worth)
- FRA NEC Future Capital and O&M Cost Methodology (with approval from FRA)
- FRA Connect Model Input Capital and O&M Costs (with approval from FRA)

2.2 *O&M Cost Categories*

The following cost categories will be used in developing O&M Costs and informed by the developed service options.

Maintenance of Way

- Salary and Benefits
  - Track
    - Surfacing
    - Grinding
    - Inspection

- Work Train
- Materials and Equipment

▪ Communications and Signal
- Signals
- Communications
- Materials and Equipment

▪ Electric Traction
- Overhead Catenary
- Power Transmission
- Substation, Catenary, Transmission Materials
- Materials and Equipment

▪ Maintenance of Way Bridges and Railings
- Structures – Right-of-way and RR infrastructure
- Stations / wayside
- Materials and Equipment

Maintenance of Equipment

▪ Locomotive Maintenance
- Monthly/Quarterly Inspections
- Equipment Inspection Staffing
- Materials and Equipment

▪ Car Maintenance
- Monthly/Quarterly Inspections
- Equipment Inspection Staffing
- Materials and Equipment

▪ Major Repairs
▪ Maintenance of Equipment Vehicles
▪ Maintenance of Equipment Supplies/Expenses

<u>Transportation</u>

- Salary and Benefits
  - On Board Services

- Onboard Personnel
- Trainmen and Enginemen
  - Onboard Personnel
- Yard Dispatch
  - Yard Dispatch Personnel
- Operations Control Center
  - Personnel
- Terminal Station Control
  - Facility Wages and Personnel

- Fuel
- Power / Electric Traction
- Materials, Supplies, and Expenses
- Vehicles
- Connecting Bus Services

<u>Sales and Marketing</u>

- Sales
- Information
- Marketing and Advertising Costs

<u>Stations</u>

- Station Maintenance
- Bus/Shuttle Connections
- Station Service Staff
- Station Utilities
- Supplies and Expenses
- Police and Security
  - Police Officers
  - Police Vehicles
  - Equipment and Supplies

General and Administration

- Corporate Administration
- Vehicles
- Supplies and Expenses

Contingency

- Overall Contingency 15%

Appendix E:
DFWCES DEIS Methodology

Dallas-Fort Worth Core Express Service

Environmental Methodology Reports

Draft Version 3

Prepared for:
Federal Railroad Administration and
Texas Department of Transportation

Prepared by:
Parsons Brinckerhoff, Inc.

August 2015

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Table of Contents

List of Tables

Acronyms

APE	Area of Potential Effects
CFR	Code of Federal Regulations
EIS	Environmental Impact Statement
EJ	Environmental Justice
EO	Executive Order
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GIS	Geographic Information System
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NEPA	National Environmental Protection Act
NRHP	National Register of Historic Places
OWJ	Official with Jurisdiction
PA	Programmatic Agreement
ROD	Record of Decision
ROW	Right-of-way
RSA	Resource Study Area
SAL	State Archeological Landmarks
TAC	Texas Administrative Code
THC	Texas Historical Commission
TPWD	Texas Parks and Wildlife Department
TxDOT	Texas Department of Transportation
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

1.0 Introduction

This methodology report describes the process of (1) gathering relevant and sufficient data, (2) evaluating potential impacts under the National Environmental Policy Act (NEPA) (42 U.S.C. § 4321 et seq.), and (3) designing feasible and effective measures to mitigate significant impacts. This provides a general framework, recognizing that some resources or topics require greater flexibility than others. If a discrepancy exists between the material in this guidance and adopted federal and state agency guidelines or manuals applicable to the resources or topics analyzed by the environmental impact statement (EIS), the agency guideline or manual controls.

Within the methodology report, Project alternative refers to either the No-Build Alternative or the Build Alternatives as described below:

- The No-Build Alternative is defined as the existing transportation network that serves the Project area, plus any other committed transportation improvements independent of the Project. In the EIS, the No-Build Alternative will provide a baseline for comparing impacts with the Build Alternatives.
- The Build Alternatives include all Project components analyzed including the track alignment, maintenance areas, and opportunity zones for future station sites. The Project footprint refers to the area needed to construct, operate and maintain permanent Project service features.

1.1 Summary of Approach

Within the EIS, each resource section will begin with an overview of the resource, a summary of the crucial issues or concerns relating to the resource area, and a list of federal and state laws and regional and local regulations, and orders applicable to the resource.

The affected environment discussion will identify the resource study area (RSA) specific to each resource in terms of physical extent and existing conditions relevant to the RSA being evaluated and succinctly describe the environmental areas/resources to be affected by the Project alternatives. The affected environment discussion will focus on data and issues that may influence potential impacts, with the level of detail and analysis being commensurate with the level of impact; minor impacts will be summarized, consolidated, or simply referenced.

The RSA specific to each resource will be described in terms of physical extent and existing conditions relevant to the RSA being evaluated. The RSA will consider the full range of reasonably foreseeable impacts associated with the Project. It should be noted that the RSA for indirect and cumulative impacts encompasses the area affected by the accumulation or interaction of Project impacts with impacts of other actions. Section 22.0, Indirect and Cumulative Impacts, of this methodology provides a more detailed discussion.

The RSA contains these components:

- Facilities or features within the Project, particularly stations opportunity zones, maintenance facilities, and consequential actions that affect the environmental resource.
- Areas to determine characteristics and context relevant to the Project.
- Areas specific to the resource to evaluate the intensity and determine the significance of direct and indirect impacts, beneficial and adverse impacts of Project improvements, and associated activities.
- Areas needed to implement, operate, or maintain mitigation measures or off-site mitigation measures and mitigation sites (such as relocations and off-site storage).

The environmental consequences discussion will consider the range of impacts associated with the Project, including construction and operations impacts of the Project on each resource, as appropriate. Construction and operations impacts of the Project on the resource will be evaluated and the research and analysis used to identify impacts (e.g., data collection methods and sources, inventory of regional and local conditions, evaluation of analytical context, qualitative or quantitative data analysis techniques) will be explained. A summary in table format will be provided for each resource section, as appropriate.

The results of the analysis will be summarized in the appropriate section of the Draft EIS and Final EIS. Where appropriate, a technical report will be prepared to provide the detailed analysis for a particular resource. In general, technical reports or survey reports will be developed when reviews are requested by TxDOT from FRA, Cooperating Agencies, and/or other federal and state resource agencies. Technical reports will be provided in the EIS as a technical appendix.

For other resource areas, Project memorandums may be developed for review by TxDOT technical specialists. The format for the Project memorandum(s) will generally follow the format of the EIS (see *Project Annotated Outline*, (August 2015), and would be used to solicit consensus from TxDOT prior to the Administrative Draft EIS. *Table 1-1* identifies each environmental resource section in the Draft EIS.

It should be noted that within the various resource sections of the EIS, cross referencing will be used to develop a comprehensive analysis of Project related impacts and benefits.

Table 1-1. Resource Area Review.

Resource Area	Submission Review Method	Anticipated Review Agency
Air Quality	Technical Report	TxDOT, FRA, NCTCOG
Water Quality and Water Resources	Technical Report	TxDOT, FRA, U.S. Army Corps of Engineers (USACE)
Noise and Vibration	Technical Report	TxDOT, FRA
Solid Waste Disposal	Memorandum	TxDOT
Natural Ecological Systems and Wildlife	Technical Report (combined with Water Quality and Water Resources, above)	TxDOT, FRA, USACE, U.S. Fish & Wildlife Service (USFWS), Texas Parks and Wildlife Department (TPWD)
Wetlands		
Threatened and Endangered Species		
Flood Hazards and Floodplain Management		
Energy Resources	Memorandum	TxDOT
Utilities	Memorandum	TxDOT
Geological Resources	Memorandum	TxDOT
Aesthetics	Memorandum	TxDOT
Land Use	Memorandum	TxDOT
Environmental Justice, Socioeconomics, Relocations, Elderly and Handicapped Populations	Memorandum	TxDOT
Public Health, Safety, security and Hazardous Materials	Memorandum	TxDOT
Parks and Recreational Resources and Section 6(f)	Memorandum	TxDOT (FRA, National Park Service and TPWD for Section 6(f))
Historic Resources	Survey Report	TxDOT, FRA, Texas Historical Commission (THC), consulting parties
Archeological Resources	Survey Report	TxDOT, FRA, THC, consulting parties
Transportation	Memorandum	TxDOT
Construction Impacts	Memorandum	TxDOT
Indirect and Cumulative Impacts	Technical Report	TxDOT, FRA
Section 4(f) Evaluation	Technical Report	TxDOT, FRA, National Park Service, officials with jurisdiction

2.0 Air Quality

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for air quality analysis, including providing a concise description of existing air quality, sensitive receptors, local meteorological conditions, and monitored data along the Project. The approach will present an overview of air quality conditions and requirements in the study area and the critical issues and concerns considered in the Project analysis. A regional air quality analysis will be conducted to evaluate the Project's impact criteria pollutants. Information will be presented on local construction and operational air quality impacts, including direct, indirect, temporary, and long-term impacts. The section will also address the methodology for addressing greenhouse gases and climate change.

2.1 Laws, Regulations, and Orders

Applicable local, state, and federal laws and regulations related to air quality will be briefly described, or reference to other sections where they are more fully described will be provided. Applicable legislation and regulations include, but are not limited to, the following:

- Federal Clean Air Act Amendments and Transportation and General Conformity Requirements.
- National Ambient Air Quality Standards.
- USEPA, Control of Hazardous Air Pollutants from Mobile Sources (USEPA, 2007).
- Council on Environmental Quality's December 2014 Draft Revised Draft Guidance for Greenhouse Gas Emissions and Climate Change Impacts (*final guidance has not been released as of July 16, 2015*).
- TxDOT Environmental Compliance Air Quality Toolkit.
- Texas Clean Air Act.
- Texas Commission on Environmental Quality, Transportation Conformity.

2.2 Affected Environment

The affected environment subsection will describe the affected air quality environment in the RSA, including the region's nonattainment area status for ozone, with a classification as moderate. This discussion will identify baseline conditions, including current air pollution levels and trends and the region's compliance with state and federal standards. The subsection will include a list of the modeling input and values, as known, based on local, state, and federal guidelines. Three general classes of air pollutants are of concern for this Project—criteria pollutants, mobile source air toxics and greenhouse gases. Criteria pollutants are those for which the USEPA has set ambient air quality standards.

The study area is currently only in nonattainment for ozone. Since ozone is not directly emitted but is formed later in time away from the source, its precursor compounds, nitrogen oxides and volatile organic compounds will be analyzed. USEPA has identified seven mobile source air toxics of concern as having significant contributions from mobile sources — acrolein, benzene, 1,3 butadiene, diesel particulate matter and diesel exhaust organic gases, formaldehyde, naphthalene, and polycyclic organic matter. Greenhouse gases include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and other fluorinated gases, including nitrogen trifluoride and hydrofluorinated ethers.

A summary description of existing air quality along the Project will include:

- Attainment status for each pollutant.
- Description of the status of the Project in the applicable Metropolitan Transportation Plan.
- Provision of existing ambient air quality data at local air monitors for the past three years of available data.

2.3 *Definition of Resource Study Area*

The local air quality impact analysis focuses on the effects of criteria pollutant and mobile source air toxics emissions from both the construction and operations of the Project on nearby sensitive receivers. Sensitive receivers include residential dwellings, schools, churches, hospitals, and parks. The study area has been determined based on typical screening distances, based on USEPA modeling guidance, and project-specific factors of the Project.

The regional air quality analysis evaluates the Project's impact on criteria pollutants on a regional basis. It is this analysis that will be the basis for complying with general conformity requirements. Greenhouse gases are usually estimated on a statewide basis because their impacts are not localized or regional; this is because of their rapid dispersion into the global atmosphere. The estimation of greenhouse gases on a statewide basis provides a comprehensive study area for the analysis of the Project's impact on statewide vehicle miles traveled, aircraft travel, and energy use. (Note, depending upon the ridership modeling for the Project being developed and used, this impact area may change.)

2.4 *Environmental Consequences*

The analysis will identify direct and indirect impacts related to air quality through quantitative analysis and, where necessary, using qualitative analysis. In addition, the analysis will discuss temporary impacts which may occur during construction and long-term impacts related to operation. (Note: the analytical results for construction impacts and operations impacts are presented separately in the EIS).

The methodology used to evaluate air quality impacts is generally based on the Clean Air Act and Clean Air Act Amendments, as well as the applicable federal, state and local guidance. The analysis will determine significance of impacts under NEPA based on application of the following methods:

- Describe the emission sources included in the analysis (e.g., Project operations, traffic around stations and electrical generation for the system).
- Explain requirements, including State Implementation Plan and Transportation Improvement Plan status.
- Discuss statewide emission burden projections.

The USEPA's latest air quality model, Motor Vehicle Emission Simulator (commonly known as MOVES2014), will be used to estimate emissions for mobile sources at the national, county, and Project level for criteria pollutants, greenhouse gases, and air toxics.

For the purposes of the Project's EIS document, the evaluation of NEPA impact significance does not use intensity gradations. As described in Section 1508.27 of the NEPA regulations, context and intensity are considered together when determining whether an impact is significant under NEPA. For air quality, guidance from federal agencies specifies the use of general conformity thresholds for determining the significance of an impact.

Project emissions of criteria pollutants are compared to the general conformity *de minimis* applicability thresholds (general conformity thresholds) on a calendar-year basis for both construction and operational emissions. If annual Project-related emissions generated in a nonattainment or maintenance area exceeds the general conformity thresholds, a general conformity determination will be required.

2.5 Greenhouse Gases and Climate Change

On February 18, 2010, the Council on Environmental Quality released draft guidance on the consideration of Greenhouse Gas in NEPA documents for federal actions. The USEPA released updated draft guidance in December 2014.

Currently, TxDOT uses a qualitative method to evaluate impacts to greenhouse gases and climate change. Project specific methodology will be based on TxDOT's current practices. The analysis will also be referenced in cumulative impact section of the Draft EIS. The analysis will also acknowledge the effect of the Project on climate change, including a qualitative assessment of resilience of the Project's infrastructure in the face of extreme weather vulnerability.

A summary table of impacts will be included in the Air Quality section of the Draft EIS.

2.6 Air Quality/Greenhouse Gases Technical Report

An Air Quality Technical Report will be prepared to provide detailed information on local construction and operational air quality impacts, as well as regional air quality and statewide Greenhouse gas impacts as a result of the Project. The Draft EIS will contain a summary of the results of the analyses, in particular, the manner by which the Build Alternatives impact air quality in the RSA. The Final EIS will summarize the impacts of the Preferred Alternative on air quality.

3.0 Water Quality and Water Resources

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for water quality and water resources, including identification of relevant water quality and water resources, classification of water quality and impaired waters, and analysis of direct and indirect impacts to water quality and water resources that may occur during construction and operation.

3.1 Laws, Regulations, and Orders

Applicable local, state, and federal laws and regulations related to water quality and water resources will be briefly described, or reference made to other sections where they are more fully described. Applicable legislation and regulations include, but are not limited to, the following:

- Clean Water Act (33 United States Code (USC) § 1251 et seq.).
- Rivers and Harbors Act of 1899 (33 USC § 401 et seq.) Sections 9 and 10 /General Bridge Act of 1946 (33 USC § 525 et seq.).
- Safe Drinking Water Act of 1974 (42 USC § 300 et seq.).
- Texas Water Development Board Regional Water Plans.
- Texas Pollutant Discharge Elimination System.
- Texas Surface Water Quality Standards.
- TxDOT Environmental Compliance Water Resources Toolkit.

3.2 Affected Environment

The potentially affected water quality and water resources will be identified via desktop spatial analyses along the Build Alternatives for comparative purposes. Potential impacts to surface waters will be identified using the Geographic Information System (GIS) database layers for the Build Alternatives. Linear and area impact for waters of U.S. (streams, wetlands) will be determined and presented in tabular form. Design practices will be identified and incorporated to avoid or minimize Project impacts.

The following conditions will be discussed in the Affected Environment section:

- Climate, precipitation, and topography.
- Surface water quality.
- Groundwater.

In the Final EIS, for the Preferred Alterative, limited field verification and site surveys may be used to collect localized information necessary to develop the analysis and specific mitigation measures.

3.3 Definition of Resource Study Area

The RSA for water quality and water includes the Project footprint tributary and physical ground disturbance associated with construction.

3.4 Environmental Consequences

Project related impacts to water quality and resources will result from potential changes surface waters (streams), or ground water as a result of construction or maintenance. Potential impacts to surface water quality from runoff, potential water temperature increases caused by removal of vegetative cover, and discharges associated with Project construction will be identified, as well as actions that will be taken to conform to Texas Pollutant Discharge Elimination System requirements. Direct and indirect impacts related to water quality and water resources will be analyzed through quantitative analysis and, where necessary, with qualitative analysis

The analysis will be focused on the Project's potential to alter drainage patterns. As part of the EIS, best management practices or avoidance or minimization features of Project operations will be documented. The analysis will also identify where permit applications will be needed and will provide information to support future permit review (such as Section 404 or 408 permits).

The Draft EIS will contain a summary of the results of the analysis and will discuss how the Build Alternatives would affect the resource.

3.5 Ecological and Natural Resources Technical Report

An Ecological and Natural Resources Technical Report will be prepared to provide detailed information on the following resources: Water Quality and Water Resources (Section 3.0 of this Methodology Report), Natural Ecological Systems and Wildlife (Section 6.0), Wetlands (Section 6.5), Threatened and Endangered Species (Section 8.0), and Flood Hazards and Floodplains Management (Section 9.0).

4.0 Noise and Vibration

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for noise and vibration, including providing a description of ambient noise conditions and existing noise and vibration sensitive receptors, as well as procedures for conducting the noise and vibration impacts analysis.

4.1 Laws, Regulations, and Orders

Applicable local, state, and federal laws and regulations related to noise and vibration will be briefly described, or reference made to other sections where they are more fully described. Applicable legislation and regulations include, but are not limited to, the following:

- FRA, Railroad Noise Emission Compliance Regulation (49 Code of Federal Regulations (CFR) Part 210).
- FRA, High-Speed Ground Transportation Noise and Vibration Impact Assessment (DOT/FRA/ORD-12/15) – (FRA 2012 guidance manual).
- Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06) – (FTA 2006 guidance manual).Jurisdictional noise ordinances and codes (and their requirements applicable to the Project).
- TxDOT Environmental Compliance Traffic Noise Toolkit.

4.2 Affected Environment

The section will include a summary description of ambient noise conditions and existing noise sensitive receptors along the Build Alternatives. Relevant sensitive noise and vibration receptors will be identified, with a map to illustrate noise sensitive receptors and alternatives. The analysis will describe the ambient noise conditions in the Project area and in the vicinity of potentially affected noise receivers. Stakeholder issues and concerns from public outreach efforts and personal contact with local agencies will be described. The modeling input and values as known based on the FRA 2012 guidance manual, the FTA 2006 guidance manual and TxDOT noise analysis protocols will be listed.

4.3 Definition of Resource Study Area

The boundaries of the RSA for noise and vibration extend beyond the Project footprint. The noise and vibration impact analyses focus on the impacts of source noise and vibration on sensitive receivers, which are assessed at the receiver. Sensitive receivers include, but are not limited to, residential dwellings, schools, churches, hospitals, parks, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, libraries, picnic areas, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio and television production and sound recording studios, recreation areas, and, in some cases trails, and historic properties.

For direct noise impacts on sensitive receivers, the RSA is the Project footprint plus 350 to 600 feet from the track centerline. This RSA is based on typical screening distances as defined by FRA and Project-specific factors. If receivers are located farther than these screening distances, the FRA 2012 guidance manual has determined that impacts would be unlikely. The particular noise context, the characteristics of Project-generated noise, amount of design information, and level of design detail will be considered so that the RSA will be sufficient for the Project.

The vibration study area for the Project is as follows:

- Project station opportunity zones— 40 feet from the station boundary unless trains will bypass a station traveling at high speed (125-250 miles per hour); if so then 220 feet would be used.
- Project alignment study areas, including existing railroads — up to 220 feet from the edge of the ROW.
- Highway study areas — 40 feet from the nearest travel way.

The vibration impact assessment uses the FRA screening procedure for rail. Screening distances indicate the potential for vibration impact on vibration-sensitive receivers. FRA 2012 guidance manual was used to determine that receivers located beyond the screening distances are not likely to be affected by the Project.

4.4 *Environmental Consequences*

The analysis will be focused on the Project's potential to alter existing and future noise and vibration conditions in the RSA. Direct and indirect impacts related to noise and vibration will be analyzed generally through quantitative analysis and, where necessary, with qualitative analysis. Temporary impacts that may occur during construction and long-term impacts related to operation of the Project will be analyzed. The analysis will consider relevant aspects of context (e.g., existing noise and vibration levels, receptor sensitivity, presence of tunnel portals, stations, etc.) and appropriate factors of intensity (e.g., level of change, duration of change) for determining impacts. The evaluation of effects will also consider Project actions that improve or otherwise benefit noise and vibration values.

In addition, the discussion will identify where permit applications are needed (such as requests for FRA approval of Quiet Zones) and provide the level of analysis needed to support future permit review.

4.4.1 *Train Operation Noise and Vibration Methodology*

The analysis will estimate the operation noise and vibration levels of the Build Alternatives and No-Build Alternative using current high-speed rail system operation plans and the prediction models provided in the FRA 2012 and FTA 2006 guidance manual, as appropriate. The discussion will show a tabulation of the Project noise and existing ambient noise exposures at the identified receivers or clusters of receivers, and compare the existing and projected noise exposure to determine the level of impact (no impact, moderate impact, or severe impact) on sensitive receptors. The level of impact will be identified by comparing existing noise levels with projected noise levels. The discussion of vibration will compare the existing vibration levels at the identified receivers or clusters of receivers with the Project's projected vibration levels to determine the level of impacts as a result of the operation of the Project alternatives.

4.4.2 Station Opportunity and Maintenance Facility Zone Noise Methodology

Project noise at noise-sensitive receivers will be analyzed using methodology in the FTA 2006 guidance manual for both the station zones and the maintenance facility. An estimation procedure or measurement program will be included at representative clusters of receivers to determine existing ambient noise conditions and a noise prediction method to determine future-with-Project noise conditions.

The Draft EIS will summarize the projected noise and existing ambient noise exposures at the identified receivers or clusters of receivers and the level of impact will be determined by comparing the existing and projected noise exposure for each Build Alternative compared with the No-Build. The Final EIS will update the level of impact for the Preferred Alternative.

4.4.3 Construction Noise and Vibration Methodology

, the Federal Highway Administration's (FHWA) *Roadway Construction Noise Model* may be used for construction impact analysis. The criteria for highway noise impacts (relevant to the extent Project causes changes in traffic patterns) are from *Procedures for Abatement of Highway Traffic Noise and Construction Noise*. Professional judgment, based on scientific literature (such as National Cooperative Highway Research Program *Project 25-35 Final Report Appendix L, March 2014*) will be used for evaluation of noise impacts related to tunnel portals.

Noise methodology will include noise emissions from equipment expected to be used by contractors, construction methods using the equipment identified above, usage scenarios for how the equipment will be operated, estimated site layouts of equipment along the right-of-way, and relationship of the construction operations to nearby noise-sensitive receivers, as appropriate.

Construction vibration is assessed quantitatively where a potential for blasting, pile-driving, vibratory compaction, demolition, or excavation close to vibration-sensitive structures exists. Criteria for annoyance and damage are applied to determine construction vibration impacts. The methodology for comparing the Build Alternatives includes vibration source levels from equipment expected to be used by contractors, estimated site layouts of equipment along the ROW, and relationship of the construction operations to nearby vibration-sensitive receivers, as appropriate.

4.5 *Noise and Vibration Technical Report*

A Noise and Vibration Technical Report will be prepared to describe the methodologies used to determine the noise and vibration impacts caused by the Project and present the detailed analysis of impacts. Tables and figures will be used to display the results in the technical report. The Draft EIS will contain a summary of the results of the analyses, in particular, the manner by which the Build Alternatives affect the existing noise and vibration conditions in the RSA. The Final EIS will summarize the noise and vibration impacts of the Preferred Alternative.

5.0 Solid Waste Disposal

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for solid waste disposal, including providing a description of existing solid waste disposal sites; identifying relevant landfills; and describing the process for evaluating potential impacts.

5.1 *Laws, Regulations, and Orders*

Applicable local, state, and federal laws and regulations related to solid waste disposal will be briefly described, or reference to other sections where they are more fully described will be provided. Applicable legislation and regulations include, but are not limited to, the following:

- Resource Conservation and Recovery Act (42 USC § 6901 et seq.) (as applicable).
- Executive Order (EO) 12088, Federal Compliance with Pollution Control.
- Texas Health and Safety Code, Solid Waste Disposal Act (Chapter 361) (as applicable).

5.2 *Affected Environment*

The affected environment subsection will document the existing conditions within the Project footprint where the generation and removal of solid waste would be anticipated. General solid waste management practices and major waste management facilities in the Project vicinity that would be considered for disposal of Project solid waste will be identified and described. General waste generated by Build Alternatives will be identified, in addition to the capacity of handling these wastes. Municipalities within the study area that either manage their own solid waste collection program or contract with a private enterprise to manage a program will be identified.

Landfills and major industrial solid waste disposal sites within the one-mile buffer of the Project footprint will be identified by available GIS databases. An inventory of adopted local and regional plans, ordinances, or guidelines related to solid waste disposal will be developed.

5.3 Definition of Resource Study Area

The boundaries of the RSA for solid waste disposal consists of the Project plus a one-mile buffer of the Project footprint to account for issues related to the generation and disposal of solid waste by the Project and the impact of the Project to existing solid waste (landfill) disposal sites along the Build Alternatives.

5.4 Environmental Consequences

This subsection will document potential impacts of the generation, handling, and disposal of solid waste resulting from construction of the Build Alternatives and potential impacts on existing landfills and major industrial solid waste disposal sites.

The analysis of the Build Alternatives' impact to these resources will be summarized in the Draft EIS. Mapping illustrating these resources and detailed tables of the impact to the resources will be included in the Appendix to the Draft EIS. The Final EIS will address the impacts of the Preferred Alternative on these resources.

6.0 Natural Ecological Systems and Wildlife

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for natural ecological systems and wildlife, including providing a list and description of biological resources and special aquatic resources, and analyzing direct and indirect impacts that may occur during construction and operation of the Project.

6.1 Laws, Regulations, and Orders

Applicable local, state, and federal laws and regulations related to natural ecological systems and wildlife will be briefly described. Applicable legislation and regulations include, but are not limited to, the following:

- Magnuson-Stevens Fishery Conservation and Management Act (16 USC § 1801 et seq.).
- U.S. Fish and Wildlife Coordination Act (16 USC § 661–666c).
- Migratory Bird Treaty Act (16 USC § 703–712) and Treaty Reform Act (16 USC § 703 et. seq.; Public Law 108–447).
- EO 13186, Protection of Migratory Bird Populations.
- EO 13113, Invasive Species.
- TxDOT Ecological Resources Compliance Toolkit.

6.2 Affected Environment

The potential affected biological resources will be identified based on information available from reference documents and limited field investigations. The Project's regional setting will be developed using the Texas Natural Diversity Database and databases of USFWS, TPWD, and the North Central Texas Council of Governments. Vegetation classifications of the plant communities will be derived from the Ecological Mapping System of Texas maintained by TPWD. Vegetative communities will be identified, evaluated, and mapped in GIS. This information will be used to develop lists of existing biological resources, and critical habitats that may be affected by the Project. Mapping may also be used to show protected or regulated habitats.

6.3 Definition of Resource Study Areas

In general, the RSA for biological resources encompasses the entire potential area of disturbance associated with the Project footprint plus up to a 1,000-foot buffer to evaluate direct and indirect impacts.

6.4 Environmental Consequences

The fundamental method for evaluating biological impacts includes: (1) quantifying or describing qualitatively the direct and indirect impacts of the Project, and (2) determining whether the impacts are significant. Impacts will be assessed for temporary (e.g., construction) and permanent (e.g., Project placement or operational) impacts.

Direct and indirect impacts to biological resources will be described by type and acreage, and a comparison of impacts from the Project will be provided. The impact analysis will focus on areas where the Build Alternatives could disrupt biological resources that are dependent either upon habitat or movement across a landscape. For wildlife movement, existing and accessible drainage corridor crossings (e.g., bridges and culverts) will be evaluated in terms of their relative function to facilitate wildlife movement through the landscape.

The Draft EIS will summarize the analysis of the Build Alternatives' impact to these resources. Mapping illustrating these resources and detailed tables of the impact to the resources will be included in the Ecological and Natural Resources Technical Report (see Section 6.5 below). The Final EIS will address the impacts of the Preferred Alternative on these resources.

6.5 Ecological and Natural Resources Technical Report

The detailed information on wetlands will be included in the Ecological and Natural Resources Technical Report (described above in Section 3.5).

7.0 Wetlands

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for wetlands, and the process for conducting a wetland impact analysis. This section will also review the preparation of a Wetlands Delineation Report for the Preferred Alternative.

7.1 Laws, Regulations, and Orders

Applicable local, state, and federal laws and regulations related to wetlands will be briefly described, or reference to other sections where they are more fully described will be provided. Applicable legislation and regulations include, but are not limited to, the following:

- Clean Water Act (33 United States Code (USC) § 1251 et seq.), including the US EPA final rule defining waters of the US effective on August 28, 2015.
- EO 11990, Protection of Wetlands.
- USACE Regulatory Guidance Letter (08-02) dated June 26, 2008.
- Preservation of the Nation's Wetlands (U.S. Department of Transportation (USDOT) Order 5660.1A).

7.2 Affected Environment

The potentially affected wetlands will be identified via desktop spatial analyses along the Build Alternatives for comparative purposes. Potential wetlands, as determined by the final rule defining waters of the US, will be identified based on the following:

- Use of soil maps to identify areas of hydric soil.
- Review of UFWS National Wetland Inventory Maps.
- Color infrared photos.
- NCTCOG's Resource Ecological Framework.

In the Draft EIS, the area of impact for each potential wetland site shall be summarized in a table type, wetland community classification and relative quality and estimate of quantity. Wetland quality and quantity will be addressed with comparisons made between the Build Alternatives. Limited on-site investigations may be conducted where rights-of-entry are obtained.

Based on the information gathered for the Draft EIS, TxDOT and FRA will determine the need for wetland permit coordination with the USACE. If necessary, a conceptual mitigation plan for inclusion in the Draft EIS will be prepared. Types of mitigation proposed, such as restoration, enhancement, creation and banking, along with related mitigation ratios would be considered and discussed.

For the Preferred Alternative following the Draft EIS, wetland delineations would be conducted in accordance with the USACE 1987 Manual where rights of entry are available. Final Mitigation Plans will be developed as part of the Section 404 permitting process, as necessary. The Final EIS will summarize the results of the wetland delineation, and any coordination with resource agencies.

7.3 Definition of Resource Study Areas

For the wetland study area in the Draft EIS, the boundary will be the Project footprint plus a 250-foot buffer to evaluate direct and indirect impacts on wetlands. Wetland delineations and field surveys of the Preferred Alternative will be established for the Project footprint only.

7.4 Environmental Consequences

The fundamental method for evaluating wetland impacts includes a process for: (1) quantifying or describing qualitatively the direct and indirect impacts of the Project, and (2) determining whether the impacts are significant for purposes of NEPA. Impacts will be assessed for temporary (e.g., construction) and permanent (e.g., Project placement or operational) impacts.

Direct and indirect impacts related to wetlands will be analyzed through quantitative analysis and, where necessary, with qualitative analysis. Impacts which may occur during construction and operation of the Project will be analyzed. Direct and indirect impacts to wetlands will be described by type and acreage, and a comparison of impacts across the Build Alternatives will be provided.

Direct impacts occur if the Project footprint, either along the alignment or at a mitigation site, alters, disrupts, or removes existing wetlands/waters . Indirect impacts occur where wetlands/waters adjacent to the Project footprint or mitigation site would change as a result of the Project, particularly during operation. Secondary impacts occur when implementation of a mitigation measure alters, disrupts, or removes existing wetlands/waters. Indirect or secondary impacts are caused by the Project and are later in time or farther removed in distance, but are still reasonably foreseeable.

For the Preferred Alternative, impacts to jurisdictional waters will be quantified through a detailed evaluation of the Project activities and elements (e.g., stations, tracks, temporary construction areas) and the associated jurisdictional water type (e.g., canal/ditch seasonal wetland). For the majority of jurisdictional waters, direct impacts will be quantified in the manner described above by overlaying the mapped features on the construction footprint.

7.5 Ecological and Natural Resources Technical Report

The detailed information on wetlands will be included in the Ecological and Natural Resources Technical Report (described above in Section 3.5). The Draft EIS will summarize the wetland findings for the Build Alternatives. The Final EIS will summarize the findings for the Preferred Alternative.

8.0 Threatened and Endangered Species

This section summarizes the process of gathering and reporting relevant and sufficient data to identify concerns for threatened and endangered species resulting from the Project. The threatened and endangered species analysis for the Project will address impacts on federal and state endangered and threatened species of plants and wildlife. It will also cover state species of concern. Limited field investigations and habitat assessments will occur for the Preferred Alternative.

8.1 Laws, Regulations, and Orders

Applicable local, state, and federal laws and regulations related to threatened and endangered species will be briefly described. Applicable legislation and regulations include, but are not limited to, the following:

- Endangered Species Act of 1973 (16 USC § 1531 et seq.).
- Bald and Golden Eagle Protection Act (16 USC § 668–668(d); 50 CFR Part 22).
- Endangered Species (Chapter 68 of the Texas Parks and Wildlife Code).
- TxDOT Ecological Resources Compliance Toolkit.

8.2 Affected Environment

Potential locations and critical habitat for listed species will be identified by review of data provided by TPWD's Natural Diversity Database, NCTCOG's Resource Ecological Framework, and USFWS resources (including county lists). Based on this information, a technical report will be developed for review and comment. The report will include a topographic quadrangle identifying locations of protected species' preferred habitat(s) and locations of previously recorded occurrences, as necessary. The report will also include a discussion of recommendations, if appropriate.

For the Draft EIS, a preliminary habitat assessment will be conducted to determine the potential presence of species that are federally or state-listed. The habitat study area will be developed from consideration of the documented habitats in the region and reported occupied habitats. Preliminary vegetation mapping will be included in the assessment. Vegetation classifications of the plant communities will be derived from the Ecological Mapping System of Texas maintained by TPWD. For the vegetation mapping, vegetative communities will be identified, evaluated, and mapped in GIS.

Based on the data gathered for the Draft EIS, TxDOT, FRA, and the USFWS will review the need to develop a Biological Assessment for the Preferred Alternative. For the Final EIS, surveys for protected species or for habitat of protected species will include:

- Species listed by the USFWS as threatened or endangered or proposed for listing as threatened or endangered (50 CFR 17.11-12).
- Species that are candidates for review for listing by FWS as threatened or endangered (per most recently updated list in Federal Register).
- Species listed as threatened or endangered species by TPWD (State of Texas Threatened and Endangered Species Listings, TPWD).

These surveys will be summarized in the Final EIS. At this time, formal Section 7 consultation is not anticipated.

8.3 Definition of Resource Study Areas

For the TPWD review, a 1.5-mile radius will be used for the query. However, in general, the RSA for species of concern encompasses the Project footprint plus up to 1,000-foot of buffer to evaluate direct and indirect impacts to threatened and endangered species.

8.4 Environmental Consequences

For the Draft EIS, the fundamental method for evaluating threatened and endangered species impacts includes a process for (1) quantifying or describing qualitatively the direct and indirect impacts of the Project, and (2) determining whether the impacts are significant for purposes of NEPA. Impacts will be assessed for temporary (e.g., construction) and permanent (e.g., Project placement or operational) impacts.

Direct and indirect impacts related to threatened and endangered species will be analyzed through quantitative analysis and, where necessary, with qualitative analysis. Direct and indirect impacts to threatened and endangered species will be described by type and acreage, and a comparison of impacts across the Build Alternatives will be provided.

The threatened and endangered species impact analysis focuses particularly on areas where Build Alternatives disrupt threatened and endangered species that are dependent upon critical habitats. Impacts resulting from the Preferred Alternative will be documented in the Final EIS.

8.5 Ecological and Natural Resources Technical Report

The detailed information on threatened and endangered species will be included in the Ecological and Natural Resources Technical Report (described above in Section 3.5). The Draft EIS will summarize the findings for the Build Alternatives. The Final EIS will summarize the findings for the Preferred Alternative.

9.0 Flood Hazards and Floodplain Management

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for flood hazards and floodplain management, including identification of relevant floodplains, critical issues and concerns, and analysis of direct and indirect impacts to floodplains that may occur during construction and operation.

9.1 Laws, Regulations, and Orders

Applicable local, state, and federal laws and regulations related to flood hazards and floodplain management will be briefly described, or reference made to other sections where they are more fully described. Applicable legislation and regulations include, but are not limited to, the following:

- Clean Water Act (33 United States Code (USC) § 1251 et seq.) Section 408.
- Rivers and Harbors Act of 1899 (33 USC § 401 et seq.), Section 14/General Bridge Act of 1946 (33 USC § 525 et seq.).
- National Flood Insurance Act (42 USC § 4001 et seq.) and Flood Disaster Protection Act (42 USC §§ 4001 to 4128).
- EO 11990, Protection of Wetlands.
- EO 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input.
- Federal Emergency Management Agency, Draft Revised Guidelines for Implementing E 11988, Floodplain Management[1].
- USDOT Order 5650.2 (Floodplain Management and Protection).
- Trinity River Corridor Development Certificate.

9.2 Affected Environment

The presence of floodplain resources in relation to the Build Alternatives will be identified based on data obtained from Federal Insurance Rate Maps, Tarrant Regional Water District, Dallas County Flood Control District, and Trinity River Authority. The examination of floodplains will include identification of 100-year floodplains to show Special Flood Hazard Areas; evaluation of potential impacts of the Project to impede floodwaters; and determination of Project impacts on the ability of local maintaining agencies to maintain flood protection facilities.

9.3 Definition of Resource Study Area

The RSA for Flood Hazards and Floodplain Management will extend to the Flood Emergency Management Act-designated floodplains within the Project footprint.

[1] This EO was updated in the spring of 2015 to direct federal agencies to develop guidance on implementation. The U.S. DOT has not issued guidance at this time. The methodology may need to be adjusted to reflect the guidance in the Draft EIS.

9.4 *Environmental Consequences*

For the Project footprint a preliminary indication of whether the encroachment would be consistent with or require a revision to the regulatory floodplain. Impacts will be quantified through the use of GIS information and hydraulic modeling and present in tabular form.

Any incompatibility with floodplain development and preservation of floodplain values as well as the Project affect to floodplain resilience relating to climate change will be qualitatively discussed in the EIS. If necessary, a *Floodplain Risk Assessment* will be prepared for the Project.

9.5 *Ecological and Natural Resources Technical Report*

The detailed information on flood hazards and floodplain management will be included in the Ecological and Natural Resources Technical Report (described above in Section 3.5). The Draft EIS will summarize the findings for the Build Alternatives. The Final EIS will summarize the findings for the Preferred Alternative.

10.0 Energy Resources

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for energy resources that are proposed to be used in powering the Project. The process will develop a list of energy resources in the RSA and provide an energy resources impact analysis of the construction and operation of the Project.

10.1 *Laws, Regulations, and Orders*

Applicable local, state, and federal laws and regulations related to energy resources planning will be briefly described, or reference to other sections where they are more fully described will be provided. Applicable legislation and regulations include, but are not limited to, the following:

- EO 13423, Strengthening Federal Environmental, Energy and Transportation Management.
- Energy Conservation Design Standards (Texas Administrative Code (TAC), Title 34, Part 1, Chapter 19, Subchapter C) (as applicable).
- Building Energy Performance Standards (Texas Health and Safety Code, Title 5 §388.003) (as applicable).

10.2 *Affected Environment*

The Draft EIS will list the energy resources in the RSA to be used in powering the system based on information from local agencies, maps, photographs, database searches, and site surveys. This section will provide a baseline of how much electrical energy is currently used and projected to be used in the RSA and discuss how much energy would be available when needed for the Project. The discussion will describe recent trends regarding deficiencies in the region's energy supply during peak summer and winter periods (for example, rolling brown-outs). The section will also provide a discussion of how new USEPA standards may affect energy supply and demand.

10.3 Definition of Resource Study Area

The boundaries of the RSA for energy resources extend beyond the project footprint. The energy impact analysis focuses on direct and indirect impacts to changes in the transportation energy consumed, on a regional basis, and construction-related energy consumption. The RSA for cumulative impacts will be larger than the Project-related RSA to encompass the area within which Project impacts related to energy resources accumulate or interact with the impacts of other actions.

10.4 Environmental Consequences

The analysis will discuss how much energy would be used by travelers between Dallas and Fort Worth under the No-Build Alternative, compared to how much energy would be consumed with the Build Alternatives. This analysis will be based on roadway vehicle miles traveled and energy requirements of the Project.

The energy analysis will focus on four areas: (1) the Project's demand on regional energy supply and the potential need for additional electrical generation capacity to support operations; (2) peak-period electricity demand or operations; (3) overall energy consumption for transportation; and (4) construction-related energy consumption. The demand will be calculated in terms of megawatts and compared to current estimates of peak demand and supply capacity within the grid controlled by the Public Utilities Commission of Texas. In addition to the energy demand of the Project, the energy impacts in terms of fuel usage resulting from other modes of transportation affected by the Project, such as automobiles, planes, and trains, will be calculated in terms of British thermal units and barrels of oil.

Energy impacts caused by the Project might include the additional consumption of electricity required to power the Project (direct use) and consumption of resources to construct the Project facilities (indirect use). Energy data will be provided on a regional level and will be consistent with the information used in the air quality and transportation analyses. Indirect energy impacts will be evaluated quantitatively.

The Draft EIS will present the analysis of energy resources for the Build Alternatives. The Final EIS will summarize the findings for the Preferred Alternative. The modeling output will be included in an appendix to the Draft EIS.

11.0 Utilities

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for utilities, including the identification and evaluation of major utility conflicts and the development of an opinion of probable cost for impacts to major utilities.

11.1 Affected Environment

The affected environment subsection will identify and describe major utilities along the Build Alternatives (e.g. distribution wires and towers, communications lines, overhead electrical transmission lines, underground pipelines, etc.) using information gathered from available GIS based utility mapping, aerial photography, the Public Utility Commission of Texas, and the Railroad Commission of Texas. Further information may be obtained from coordination with TxDOT utility specialists.

11.2 Definition of Resource Study Area

The boundary of the RSA for utilities consists of the Project footprint.

11.3 Environmental Consequences

This subsection will identify potential utility conflicts between the Build Alternatives and major utilities. Any compatible digital location information provided by utility companies will be incorporated into a GIS database to aid in the identification of potential conflicts. An opinion of probable cost will be developed for relocating and/or adjusting the affected major utilities.

The Draft EIS will report the impacts of the Build Alternatives to major utilities. The Final EIS will summarize the findings for the Preferred Alternative. Within the Final EIS, major utility conflicts will be catalogued and evaluated using the recommended practices and procedures described in American Society of Civil Engineers Publication CI/ASCE 38-02 (Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data) per Quality Level “D”: Utility Records Research. Any planned improvements to utilities will be incorporated in the impact assessment. The opinion of probable cost will be updated for the Final EIS.

12.0 Geologic Resources

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for geologic resources, including providing descriptions of geologic surface and subsurface conditions and resources, and identifying potential geologic hazards and impacts (e.g. seismic events).

12.1 Laws, Regulations, and Orders

- Applicable local, state, and federal laws and regulations related to geologic resources will be briefly described, or reference to other sections where they are more fully described will be provided. Currently, there is no applicable legislation and regulations to be addressed in this section.

12.2 Affected Environment

The affected environment subsection will describe the geologic surface and subsurface conditions within the Project area, including topography and geology (types of soil/rock, depth to bedrock, groundwater depth) using information gathered from the U.S. Geological Survey, local jurisdictions, Texas Bureau of Economic Geology, the USEPA, U.S. Department of Agriculture, and Natural Resources Conservation Service among others. Further information may be obtained from communications with local, state, and federal agencies. Geologic resources, including minable minerals and petroleum, will be identified and a map will be created to illustrate these resources and alternatives.

12.3 Definition of Resource Study Area

The RSA boundary extends 100 feet beyond the Project footprint, in order to consider relevant geologic resources that may be impacted by construction and operation.

12.4 Environmental Consequences

This subsection will assess impacts resulting from the Build and No-Build Alternatives on geologic resources. Potential geologic hazards including seismic risk, areas of karst, swelling and corrosive soils, and areas of slope instability will be identified. Impacts on natural landmarks and landforms will be identified and discussed.

The discussion of impacts will be included in the Draft EIS for Build Alternatives and in the Final EIS for the Preferred Alternative, as needed.

13.0 Aesthetics

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for aesthetics and visual quality, including providing a concise description of existing aesthetics and visual resources along the Build Alternatives; identification of relevant aesthetic and visual resources; and evaluation of aesthetics and visual quality impacts.

13.1 Laws, Regulations, and Orders

Applicable local, state, and federal laws and regulations related to aesthetics and visual quality will be briefly described, or reference to other sections where they are more fully described will be provided. Applicable legislation and regulations include, but are not limited to, the following:

- Architectural Barriers Texas Accessibility Standards (as applicable).
- State of Texas, State Purchasing and General Services Act, Section 2166.404 of the Government Code (as applicable).
- Title 43, TAC Part I, Chapter 11, Subchapter D (as applicable).

13.2 Affected Environment

The affected environment subsection will list the aesthetic and visual resources in the Project area based on the review of applicable planning documents, observations during field surveys, or definition by local sources. Relevant aesthetic and visual resources will be identified and a map will be used to illustrate the locations of historic resources, parks, unique topography or landforms and the Project. Specific key viewpoints will be referenced when relevant.

13.3 Definition of Resource Study Area

The boundaries of the RSA for aesthetics and visual quality extend beyond the Project footprint to generally encompass the identified viewshed(s). However, the RSA will be expanded or reconfigured as warranted by resource conditions and the potential extent of impacts of the Project's improvements and operations. In addition, the RSA may be refined, in consultation with the local jurisdiction, to reflect local conditions.

13.4 Environmental Consequences

The FHWA's *Visual Impact Assessment for Highway Projects* (Pub. No. FHWA-HI-88-054) provides useful methodological guidance for transportation projects, as does TxDOT's *Landscape and Aesthetics Design Manual* (2012).

Sufficient detail will be provided to allow the analysis of the anticipated design of the completed Project or of reasonable assumptions for Project implementation. The analysis will focus on the Project's potential to alter existing conditions of the affected resources in the RSA. This analysis will clarify the important distinction between changes in visual character or quality that are incompatible with existing views, and visual changes that, while different than existing aesthetic character, are compatible with surrounding uses and resources, as well as consistent with adopted plans and policies.

The discussion of aesthetic and visual impacts will be provided in the Draft EIS for the Build Alternatives, and, as appropriate, in the Final EIS for the Preferred Alternative. Project visualizations and detailed mapping to illustrate the geographic relationship of the alternatives to the visual environment will be contained in an appendix and referenced in the text.

14.0 Land Use

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for land use, including providing a concise description of existing land use, which encompasses station planning, regional growth, agricultural lands, and joint development. Station and facility planning will have direct and indirect impacts on land use in the immediate and surrounding vicinity of station locations as well as the maintenance facility. Regional growth affects land use and development, while the development of a rail facility will have impacts on regional growth. Joint development is directly relevant to station planning.

The Project lies entirely in the Dallas-Ft Worth Census designated urbanized area and thus is not subject to the Farmlands Preservation Policy Act (7 USC 4201–4209 and 7 CFR 658).

14.1 Laws, Regulations, and Orders

Applicable local, state, and federal laws and regulations related to land use and farmlands will be briefly described. Applicable legislation and regulations include, but are not limited to, the following:

- Texas Conservation Easement Enabling Statutes (Tex. Nat. Res. Code Ann. §§ 183.001 to 183.006 (2004) (as applicable).
- Regulation of Land Use, Structures, Businesses, and Related Activities (Texas Local Government Code Title 7, Subtitles A-C).
- Regional, County and Municipal Comprehensive and Land Use Plans.
    - *Forward Dallas! Comprehensive Plan (City of Dallas).*
    - *Fort Worth Mobility and Air Quality (MAQ) Plan (City of Fort Worth).*
    - *2015 Comprehensive Plan (City of Fort Worth).*
    - *99 SQ Miles A Vision for Arlington's Future. Draft Comprehensive Plan (City of Arlington).*
    - *2008 Comprehensive Plan Update Report (City of Irving).*

14.2 Affected Environment

The affected environment subsection will include a description of existing and future land uses along the Build Alternatives. Mapping will illustrate existing land uses along the alignment and at station opportunity zones. Land uses in the Project area will be identified based on information available from local and regional planning documents, GIS data, and on-the-ground surveys, as appropriate. Future/planned uses will be identified based on reviews of sources such as current comprehensive land use plans, sub area plans, and conversations with local and regional planning agencies.

While the Project area is within a Census designated urbanized area, there are some open spaces along the Build Alternatives that may be farmed or uses for agricultural purposes. The section will list relevant known farmlands in the RSA, and show the location of agricultural conservation easements in the RSA. Data on existing agricultural lands and uses will be obtained from federal, state, regional, county, and municipal agencies, and resource conservation districts.

14.3 Definition of Resource Study Area

The boundary of the RSA for land use in undeveloped areas is generally the Project footprint, while the RSA boundary in suburban and urban areas extends 150 feet beyond the Project footprint to consider the potential change to land use composition adjacent to the Project footprint. The land use impact analysis will focus particularly on station opportunity zones and maintenance facilities, which have the greatest probability of changing land use type and intensity, population density, and patterns of development. Physical and operational elements of the RSA will be described in this subsection.

14.4 Environmental Consequences

This subsection will identify and describe potential changes to adjacent land uses along the Build Alternatives, such as disrupting established land use patterns, and conformity of these changes with land use plans. Prior and on-going efforts to avoid disruption to existing land uses and community structure will be described.

The analysis will evaluate the compatibility of the Project on the bases of: 1) the potential sensitivity of various existing land uses to the changes that likely would result from the Project; and 2) the potential impact of these changes on the type, intensity and pattern of existing land uses. It will also identify where city and county zoning and building permits, will be needed and provide analysis to support future permit review.

The analysis will address the following topics:

- Proposed project in relationship to other planned projects and whether the Project would:
  - Disrupt existing or planned development anticipated to benefit the community, or
  - Enhance or permit planned uses to be achieved.
- Direct and indirect land use and development impacts associated within increased density of development around stations opportunity zones.
- Existing development and character of the station opportunity zones (e.g., long-established single family neighborhood, industrial area, retail area, historic district, agriculture, parks and recreation, and cultural resources).
- Conceptual transit-oriented and/or station-oriented joint development.
- Relative sensitivity of existing land uses proximate to the Project to conditions arising from construction, operation or maintenance of the Build Alternatives.

The discussion of land use impacts will be provided in the Draft EIS for the Build Alternatives, and, as appropriate, in the Final EIS for the Preferred Alternative. Detailed mapping to illustrate existing and future land uses will be included in an Appendix and referenced in the text.

15.0 Environmental Justice, Socioeconomics, Relocation, Elderly and Handicapped

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for Environmental Justice (EJ), socioeconomics, relocations, and elderly and handicapped analysis, including providing a summary description of existing populations, communities, and demographic and economic conditions of the Build Alternatives; providing an overview of the potential for displacement and relocation of residences and businesses within the Project area; conducting focused outreach to EJ populations (e.g. minority and low-income populations); and evaluating impacts.

15.1 Laws, Regulations, and Orders

Applicable local, state, and federal laws and regulations related to EJ, socioeconomics, relocation, and elderly and handicapped will be briefly described, or reference to other sections where they are more fully described will be provided. Applicable legislation and regulations include, but are not limited to, the following:

- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.
- EO 13045 Protection of Children from Environmental Risks and Safety Risks
- USDOT Updated Environmental Justice Order 5610.2(a), 2012.
- Americans with Disabilities Act (42 USC §§ 12101–12213) (as applicable).
- Title VI of the Civil Rights Act of 1964, (42 USC §2000d) (as applicable).
- Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 USC § 61) (as applicable).
- Texas Property Code Annotated § 21.046: Texas Statutes - Section 21.046: Relocation Assistance Program (as applicable).
- TxDOT Environmental Compliance Community Impact Assessment Toolkit.

15.2 Affected Environment

Existing demographic and economic conditions in the region will be described based on data and issues that may influence potential impacts and environmental commitments. Existing residences, businesses and community facilities that may be affected by displacement; the displacement area population characteristics; and displacement area community service characteristics will be described.

In addition, existing populations, including elderly and disabled populations, along the Build Alternatives will be identified. Existing neighborhoods, community services, and local businesses will be mapped. Pertinent stakeholder issues and concerns from public outreach efforts will be described.

For the EJ analysis, three factors will be considered: (1) the area comprising the general population that will be affected by the Project (reference community), (2) the area that would be most directly affected by the Project (RSA), and (3) the presence of EJ populations within the RSA. Demographic characteristics for EJ populations within the RSA will be defined using US Census and American Community Survey data census tracts and block groups. The most recent American Community Survey data will be used. City, county, Metropolitan Statistical Area, and state data will be collected from the same sources for an accurate comparison of geographic units.

The following demographic characteristics will be identified:

- Total population.
- Percentage minority populations.
- Distribution of minority populations.
- Percentage of population living at or below the federal Health and Human Services poverty level.
- Percentage of population over 65 years.
- Percentage of households with limited English proficiency.
- Existing number of households.
- Percentage of households with incomes below the federal poverty level.
- Median household income.

The topics that will be used to determine impacts to EJ populations include: air quality; traffic noise; water pollution; hazardous waste; aesthetic values; community cohesion; economic vitality; employment impacts; displacement of persons, businesses, or farms and other relocation impacts; accessibility; traffic congestion; safety; and construction and/or temporary impacts.

15.3 Definition of Resource Study Area

The RSA for these resources are the boundaries of the census tracts that are abutting the Project footprint.

15.4 Environmental Consequences

15.4.1 Environmental Justice

The analysis will follow the policies expressed in the USDOT's Environmental Justice Order 5610.2(a). Changes resulting from the Project to EJ populations will be measured based on the overall population in the Project area. Any impacts that are found to be greater to EJ populations will be considered disproportionate and adverse and discussed. Coordination with EJ populations will be conducted and used to revise Project elements as necessary to reduce the level of impact. The analysis will describe the coordination and the measure to minimize harm. In determining whether a mitigation measure or an alternative is "practicable," the social, economic (including costs) and environmental effects of avoiding or mitigating the adverse effects will be taken into account. Both construction-related and operational impacts will be included in the discussion.

15.4.2 Socioeconomics Including Elderly and Handicapped

The qualitative community impact analysis will summarize potential division of adjacent communities through the physical removal of residences, businesses, and important community facilities. Particular consideration will be given to how the Project facilities affect elderly and disabled populations (populations of low mobility status). Temporary or permanent barriers that could be created by the Project facilities will also be described based on whether these barriers would isolate portions of a community, separate residents from important community facilities or services, or alter access to such resources.

15.4.3 Relocations

The number of acres and structures that would be acquired will be summarized based on the Project footprint. Residential and nonresidential units within the displacement area of the Project will be documented and the characteristics of potentially displaced buildings, types of occupants (to the extent possible through field observations), displacement area population characteristics, and displacement area community service characteristics will be summarized in tabular form and include an analysis of the availability of suitable replacement housing and business locations. The qualitative analysis of the inconvenience of relocation to residents and businesses and the potential for gain or loss in business activity for relocated firms will be summarized.

The discussion of EJ, socioeconomics, relocation, and elderly and handicapped populations will be provided in the Draft EIS for the Build Alternatives, and, as appropriate, in the Final EIS for the Preferred Alternative.

16.0 Public Health, Safety, Security and Hazardous Materials

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for public health, safety, security and hazardous materials. The section will include a list of known resources and a description of existing hazardous materials sites, in addition to describing the process for conducting an emergency services analysis and hazardous materials studies for the evaluation of potential impacts.

16.1 Laws, Regulations, and Orders

Applicable local, state, and federal laws and regulations related to public health, safety, security and hazardous materials will be briefly described, or reference to other sections where they are more fully described will be provided. Applicable legislation and regulations include, but are not limited to, the following:

- Hazardous and Solid Waste Amendment (42 USC § 6901 et seq.) (as applicable).
- Comprehensive Environmental Response, Compensation and Liability Act (42 USC § 9601 et seq.) (as applicable).
- Superfund Amendments and Reauthorization Act (42 USC § 9601 et seq.) (as applicable).
- Rail Safety Improvement Act of 2008 (Public Law 110-432) (as applicable).
- USC on Railroad Safety (49 USC § 20101 et seq.) (as applicable).
- Department of Homeland Security/Transportation Security Administration (49 CFR Part 1580) (as applicable).
- Transportation Security Administration—Security Directives for Passenger Rail (as applicable).
- TxDOT Hazardous Materials Compliance Toolkit, as applicable.

16.2 Affected Environment

The affected environment subsection for public health, safety, security, and hazardous materials will include a concise summary description of existing emergency services, law enforcement, emergency medical services, emergency response plans, community safety features, oil and gas wells, and potential environmental concern sites along the Build Alternatives.

The potential environmental sites of concern will be identified by a limited Initial Site Assessment for hazardous materials developed using the Environmental Data Resources (EDR) data base. The EDR database search will consist of a current (2015) computerized database search of readily available government environmental lists and databases for properties, supplemented by a review of past assessments and corrective actions, available historical aerial photographs, and a limited site reconnaissance to evaluate areas visually of possibly contaminated surfaces. Hazardous material issues associated with the operation of the Project will be assessed and summarized in map and table form.

The location of known public health, safety and security resources (e.g. government facilities, hospitals, etc.) will be identified and mapped using readily available published sources and information from NCTCOG and local governments.

16.3 Definition of Resource Study Area

The boundaries of the RSA for Public Health, Safety and Security extend a half-mile beyond the Project footprint.

The boundaries of the RSA for hazardous materials will consist of the Project footprint plus a 150-foot buffer. The focus will be on impacts of the presence of hazardous materials and wastes in managed conditions or as contaminants in the nearby environment on the construction and operation of the Project. For areas adjacent to landfills, the RSA will be increased to a quarter-mile to assess landfill potential to release methane gas.

16.4 Environmental Consequences

The results of the Initial Site Assessment will be based on the Project's potential to alter existing conditions of the affected resources in the RSA. Concerns identified during the Initial Site Assessment, will be addressed. The evaluation of the impacts to vulnerable populations will include a qualitative description of how the Project could affect health issues based on a literature review. Information on railroad modifications, crossings, and closures as a result of the Project footprint will also be included and a detailed map of sufficient scale will be prepared to illustrate the geographic relationship of the alternatives to public health, safety and security and clearly show the location and extent of Project impacts and major landscape features.

Impacts that may occur during construction and operation of the Project will be summarized. Additionally, the results of the emergency services analysis will be described and mapped to address any estimated change in response time of emergency services, and access to community health care facilities as a result of the Project.

The discussion of these resources will be provided in the Draft EIS for the Build Alternatives, and, as appropriate, in the Final EIS for the Preferred Alternative.

17.0 Parks and Recreational Resources and Section 6(f)

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for parks and recreational resources including providing a description of relevant public parks, recreational facilities, and open space uses, as well as an analysis of impacts to these resources, and potential mitigation measures. Also noted will be the Project's use of land from within a park or recreational area that has received funding from Section 6(f) of the Land and Water Conservation Fund. Parks and recreational facilities under Section 4(f) of the U.S. DOT Act of 1966, will be discussed below in Section 23.0.

17.1 Laws, Regulations, and Orders

Applicable local, state, and federal laws and regulations related to parks and recreational resources will be briefly described or reference to other sections where they are more fully described will be provided. Applicable legislation and regulations include, but are not limited to, the following:

- Section 6(f) of the Land and Water Conservation Fund Act (16 USC § 460l-8(f) and 36 CFR Part 59.1) (as applicable).
- Texas Parks and Wildlife Code (Chapter 26).
- TxDOT Environmental Compliance Section 4(f), U.S. Department of Transportation Act Toolkit.
- TxDOT Environmental Compliance Section 6(f), Land and Water Conservation Fund Act Toolkit.
- Open space, parks and recreation, aesthetics, land use, conservation, or other similar elements of municipal or county comprehensive/general plans.
- County and municipal parks and recreation master plans.

17.2 Affected Environment

The affected environment subsection will include a summary description of existing parks and recreational areas within the RSA. Parks and recreational uses (including trails and bikeways) will be identified and described. The analysis for Parks and recreational areas will be based on available reports and data, discussions with federal, state, and local agency representatives in the region, and limited field investigations. A map of the RSA will illustrate the locations of parks and recreational resources at a sufficient scale to illustrate the geographic relationship of these areas.

17.3 Definition of Resource Study Area

The RSA for parks and recreational facilities includes the Project footprint including any physical ground disturbance associated with construction. If necessary, the RSA will expand to include driveway access into parks and recreational facilities, if the Project alters or changes access.

17.4 Environmental Consequences

Information and discussion will be summarized to present content effectively to the general public, with the parks and recreational resources impact analysis focused on Project impacts to access and use. Detailed impact information such as parks and recreational resource acquisitions will be presented in an appendix.

Direct and indirect impacts to parks and recreational resources will be summarized based on the GIS spatial analysis, which would identify the distance of parks and recreational resource facilities from the Project. The GIS analysis will also help determine the amount of park and recreational resource land that would be acquired and facilities and functions that would be affected by the Project. This section will also use construction, ROW plans, and station area zones to determine whether the resource property will be temporarily or permanently acquired.

The potential disruption of established community and visitor use of parks and recreational resources because of temporary construction easements and general construction activity will also be summarized.

The discussion of parks and recreation areas will be provided in the Draft EIS for the Build Alternatives, and, as appropriate, in the Final EIS for the Preferred Alternative.

17.5 Section 6(f) Coordination

This section will identify Project area public parklands and recreational resources subject to Section 6(f) of the Land and Water Conservation Fund Act that would be affected by the Project. In addition to coordinating with local officials with jurisdiction, the TPWD will be contacted to determine which resources are applicable. Section 6(f) coordination requirements for those resources will be explained and coordination efforts planned or initiated will be documented.

Section 6(f) impacts will be disclosed as simply as possible as acreage of potential impact and type of facilities affected (e.g., picnic tables, play grounds, ball fields). The discussion will also include the identification of land needed for Section 6(f) conversion. Following the Record of Decision (ROD), land acquisition will adhere to TxDOT’s ROW process.

18.0 Historic Resources

This section provides the framework for conducting and reporting historic resources data gathering, determining the study area, applying relevant thresholds for identifying impacts to historic resources, sequencing of activities and preparing documentation in a manner that is in compliance with the requirements of NEPA (42 USC 4321 et seq.) and Section 106 of the National Historic Preservation Act of 1966, as amended (54 USC 300101). Specific reference will be made to related content in other sections of the EIS that influence or are influenced by the Historic Resources impact analysis, including Section 4(f) analysis (Section 23.0) and Aesthetics (Section 13.0).

The FRA is responsible for compliance with Section 106 coordination and determination requirements. The timing of the historic resources deliverables and activities conducted to comply with Section 106 will be integrated with the overall environmental document delivery schedule. The results of the Section 106 compliance efforts and consultation will be incorporated into the NEPA compliance process, to the extent feasible, so that the EIS is consistent with the stipulated mitigation measures outlined in a Memorandum of Agreement (MOA) or Programmatic Agreement (PA) that would be developed if adverse impacts would occur from the Project) and those measures included in the Project ROD.

The FRA will take the lead in consulting with Tribal consulting parties, based on the requirement to conduct government-to-government consultation. Under Section 106, additional consulting parties include Certified Local Governments, and individuals and organizations with a demonstrated interest in the undertaking. The Public Involvement Plan will be amended as necessary to identify the methods to be used to notify consulting parties and the public of the Project actions and for considering input from these parties.

18.1 Laws, Regulations, and Orders

Applicable local, state, and federal laws and regulations related to historic resources will be briefly described, or reference made to other sections where they are more fully described. Applicable legislation and regulations include, but are not limited to, the following:

- Section 106 of the National Historic Preservation Act as amended (54 USC 300101).
- Section 4(f) of the Department of Transportation Act (49 USC 303).
- The Antiquities Code of Texas (9 Texas Natural Resources Code [TNRC] § 191).
- TxDOT Environmental Compliance Historic Resources Toolkit.

18.2 Affected Environment

The affected environment subsection will describe the methodology for developing the study area for historic resources, which is defined as the Area of Potential Effects (APE) under Section 106, initiating coordination with consulting parties and the public, and conducting background and field investigations under NEPA and Section 106. Methods will be based on the TxDOT-Texas Historical Commission (THC) Memorandum of Understanding (MOU) (13 TAC § 26.25) as applicable, the, standard practices for NEPA compliance, and previous FRA projects. Further refinement or explication of methods may take place under a new MOA or PA specific to the Project or to FRA projects in Texas.

A research design will be prepared in consultation with TxDOT and the FRA to address a two-tiered approach (historical constraints survey of the Build Alternatives followed by any reconnaissance survey deemed necessary by THC).

A summary of the surveys and studies conducted to identify historic resources along the Build Alternatives will be included, making reference to technical reports as appropriate. This summary will include information about the current eligibility or listing of each resource for the National Register of Historic Places (NRHP). Pertinent stakeholder issues and concerns identified through public outreach efforts and personal contact with local agencies will be documented. All subsections of the EIS that describe the resources or are related to the resources will be cross-referenced.

18.3 Definition of Area of Potential Effects

The APE for historic resources would likely be 150 feet from existing or Project ROW within existing transportation corridors and 300 feet from Project ROW for new-location alignments. The APE will be developed in consultation between FRA and THC, and consulting parties.

18.4 Environmental Consequences

This subsection describes the process for evaluating impacts under NEPA and Section 106. Methods presented here are based on the TxDOT-THC MOU (13 TAC § 26.25) as applicable, the TxDOT's Environmental Compliance Historic Resources Toolkit, standard practices for NEPA compliance, and previous FRA projects. Further refinement or clarification of methods may take place in consultation with THC. Direct and indirect impacts to historic resources will be analyzed, including impacts that may occur during construction and operation of the Project. The analysis will be based on a review of available reports and data (including federal and state statutes, resource agency, local, and regional agency policies and ordinances), discussions with agency representatives in the region, field investigation, modeling (where applicable) and professional judgment. A thorough record of all consultation with THC, tribes, and other consulting parties will be kept for use in the Impacts Assessment.

GIS databases will be developed, including data from (1) Project design, or (2) from available federal, state, and local sources. Analysis will be focused on the Project's potential to alter existing conditions of the affected resources.

Eligibility assessment includes consultation with the THC, tribes, and consulting parties. A thorough record of all consultation will be kept. This step is followed by an assessment of whether the Project would adversely affect the characteristics of a resource that contribute to its historical significance.

Both NEPA and Section 106 describe the historic significance of a resource in terms of eligibility for listing in the NRHP. NRHP criteria, defined in 36 CFR 60.4, state that a resource must be at least 50 years old (unless meeting exceptional criteria) and possess the quality of significance in American history, architecture, archaeology, engineering, and culture and is present in districts, sites, buildings, structures, and objects that meet one or more of the following criteria:

- (a) Is associated with events that have made a significant contribution to the broad patterns of history;
- (b) Is associated with the lives of persons significant in the past;

- (c) Embodies the distinctive characteristics of a type, period, or method of construction, represents the work of a master, possesses high artistic values, or represents a significant and distinguishable entity whose components may lack individual distinction; and/or
- (d) Has yielded, or may be likely to yield, information important in prehistory or history.

A property must also retain sufficient integrity to convey its significance. There are seven aspects of integrity—location, design, setting, materials, workmanship, feeling, and association. For a property to retain integrity, it should retain most aspects of integrity, though the retention of some aspects of integrity is critical to certain properties while other aspects of integrity are not as crucial. For this reason, the determination of whether a property retains sufficient integrity to be considered significant must relate to and be informed by the qualities that make the property significant (referred to as character defining features). If a particular resource meets one of these criteria and retains integrity, it is considered as an "historic property" eligible for listing in the NRHP. For the purposes of simplicity, the term historic property is used in this guidance to refer to historic resources determined significant under both state and federal criteria.

18.5 Historic Resources Reconnaissance Survey Report

A Historic Resources Reconnaissance Survey Report will be prepared, following TxDOT's current documentation standards at sufficient levels to satisfy THC requirements for determining the presence of historically significant non-archeological properties in the APE. This report will document the historic-age resources in the APE and identify which resources, if any, are recommended eligible for the NRHP. The FRA will make the determination of eligibility and request THC's concurrence. The report will then make recommendations for determinations regarding the Project's potential to affect those resources.

18.6 Memorandum of Agreement/Programmatic Agreement

A draft MOA/PA regarding adverse impacts will be developed in consultation with the Advisory Council on Historic Preservation, TxDOT, FRA, and THC, as well as consulting parties identified for the section. The MOA or PA will be developed and made available for public review with the Final EIS. This agreement will be executed before the ROD is issued.

Upon completion of the identification, evaluation, and impacts determination for historic properties, the treatment plans will be prepared pursuant to the MOA or PA to address adversely affected historic properties and set forth applicable mitigation measures in consultation with THC, appropriate agencies, and other MOA or PA signatories. The concerns of the consulting parties will be considered in determining the measures to be implemented.

A draft MOA or PA will be prepared and submitted to TxDOT, FRA, THC, other reviewing agencies, and consulting parties for comment and concurrence. The MOA or PA will document mitigation measures to resolve adverse impacts, including treatment plans for historic resources.

19.0 Archeological Resources

This section provides the framework for conducting archeological resources data gathering, determining the study area and APE, applying relevant thresholds for determining impacts upon archeological resources, sequencing of activities and preparing documentation in a manner that is in compliance with the requirements of NEPA (42 USC 4321 et seq.) and Section 106 of the National Historic Preservation Act of 1966, as amended (54 USC 300101). Specific reference will be made to related content in other sections of the EIS that influence or are influenced by the Archeological Resources impact analysis, including Section 4(f) (Section 23.0) and Aesthetics (Section 13.0).

As discussed in Section 18.0, the FRA is responsible for compliance with Section 106 coordination and determination requirements. The timing of the archeological resources deliverables and activities conducted to comply with Section 106 will be integrated with the overall environmental document delivery schedule.

19.1 Laws, Regulations, and Orders

Applicable local, state, and federal laws and regulations related to archeological resources will be briefly described, or reference made to other sections where they are more fully described. Applicable legislation and regulations include, but are not limited to, the following:

- Section 106 of the National Historic Preservation Act, as amended (54 USC 300101)
- Section 4(f) of the Department of Transportation Act (49 USC 303).
- Native American Graves Protection and Repatriation Act (25 USC 3001-3013).
- Archaeological Resources Protection Act (16 USC 470aa-470mm).
- The Antiquities Code of Texas (9 TNRC § 191).
- TxDOT Environmental Compliance Archeological Sites and Cemeteries Toolkit.
- Texas Health and Safety Code.

19.2 Affected Environment

The affected environment subsection will describe the methodology for developing the APE for archeological resources, initiating coordination with consulting parties and the public, and conducting background and field investigations under NEPA, Section 106, and the Antiquities Code. Methods presented here are based on the TxDOT-THC Memorandum of Understanding (MOU) (13 TAC § 26.25) as applicable, the TxDOT Environmental Compliance Archeological Sites and Cemeteries Toolkit, standard practices for NEPA compliance, and previous FRA projects. Further refinement or explication of methods may take place under a new PA specific to the Project or to FRA projects in Texas.

This subsection will also include a concise summary of applicable regulations, as outlined in this guidance document. A summary of the surveys and studies conducted to identify archeological resources along the Build Alternatives will be included, making reference to technical reports as appropriate. This summary will include information about the eligibility of each resource for the NRHP. Pertinent stakeholder issues and concerns identified through public outreach efforts and personal contact with local agencies will be documented. All subsections of the EIS that describe the resources or are related to the resources will be cross-referenced.

19.3 Definition of Area of Potential Effects

For archeological resources, the APE typically consists of the entirety of the Project footprint in three dimensions, including all existing and Project ROW, easements, associated utility relocations, and Project-specific locations such as borrow pits, equipment staging areas, and drainage modifications (13 TAC § 26.25). The vast majority of archeological sites do not contain values that make them subject to indirect adverse impacts; however, in rare cases, the archeological APE may be larger than the Project footprint if such expansion is required to fully evaluate Project impacts on a known Traditional Cultural Property, NRHP district, or other sensitive resource.

FRA will develop the APE in consultation with THC, and consulting parties, including tribes.

19.4 Research and Survey

The survey, also known as a Phase I inventory, will be limited to the existing ROW and archeological work products will include 1) Background Studies, 2) Texas Antiquities Permit Application, and 3) Intensive or Reconnaissance Survey Report. A research study plan will be prepared in consultation with TxDOT and the FRA to initiate the documentation of known archeological sites and areas determined to be high probability areas.

19.4.1 Background Studies

Risk will be evaluated by conducting background research using the restricted Archeological Sites Atlas maintained by THC and the Texas Archeological Research Laboratory to identify previously recorded archeological sites, cemeteries, State Archeological Landmarks (SALs), NRHP properties and districts, and historical markers within the APE and the study area for the full range of the Build Alternatives. Historic aerial photographs and historic maps will be examined, such as soil maps, USGS topographic maps, geologic maps, Sanborn Fire Insurance maps, and TxDOT highway maps, as available, to establish potential historic-age archeological targets. A predictive model of potential archeological site locations will be constructed by querying modern topographic and soil datasets to assess where prehistoric and historic-age settlement is most likely to have occurred and to have been preserved in surface, shallow subsurface, and deep subsurface contexts. The Potential Archeological Liability Map data will be integrated for the Project area, to determine whether previously analysis by TxDOT has resulted in recommendations for no further investigation, surface survey, or deep testing (e.g., trenching/coring). Concerning the Project, the Potential Archeological Liability Map data is available for both Dallas and Tarrant counties and will be checked against other desktop sources and modified as necessary; for instance, aerial evidence of localized erosion or recent construction may allow areas called out for survey in the Potential Archeological Liability Map to be eliminated. All sources above and other appropriate references will be utilized to evaluate the long-term stability of the landscape, and the likelihood that Holocene deposits are preserved.

If required by TxDOT, the results will be presented, including conclusions from predictive modeling, in a Risk Assessment form and/or Background Study (Review Standards).

The integration of NEPA alternatives analysis may involve the public display of constraints maps that include cultural resources. The locations of SALs, archeological sites, and address-restricted NRHP districts cannot be shown publicly.

19.4.2 Texas Antiquities Permit

An application for a Texas Antiquities Permit will be prepared under 13 TAC § 26.15. The most likely level of investigation for a major rail Project is Intensive Survey (Permit Category 6 under 13 TAC § 26.15).

19.4.3 Archeological Survey Methods

Survey investigations will be conducted that meet or exceed the Archeological Survey Standards for Texas (hereafter the “Survey Standards”). Survey Standards for the Project will conform to the TxDOT-THC MOU. If necessary, however, TxDOT may deviate from the Survey Standards if the THC confirms that the deviation remains adequate.

If the Project is constructed using a design-build process, the design will not be completed until after the environmental document is finalized and after a design-build contractor is under contract. Because of this, APEs to guide survey will be based on preliminary design information. An additional factor to be considered during survey planning is that obtaining access to parcels to conduct pedestrian surveys will continue to be a challenge, and a reasonable and good-faith effort will be made to evaluate inaccessible parcels from accessible parcels and/or public ROW. The combination of preliminary engineering and lack of access may require survey fieldwork to be undertaken in phases, with revisits as additional parcels become available and/or the design shifts.

Any archeological sites encountered will be documented on standard Texas Archeological Research Laboratory archeological site forms, preferably using the TexSite database. The report will include evaluations of NRHP/SAL eligibility for all sites recorded, with the understanding that such an evaluation is provisional at this level of investigation. The methods outlined in National Register Bulletin 38 will be followed in order to identify and evaluate potential Traditional Cultural Properties and cultural landscapes that could be affected by the Project. The potential for identifying Traditional Cultural Properties of importance to Native Americans and other non-Native American descendant communities will be considered based on information gathering while conducting background research. Properties that have been previously evaluated need not be reevaluated unless the previous evaluations do not meet current standards. To determine if properties meet the NRHP eligibility threshold additional evaluative studies may be necessary.

19.5 Environmental Consequences

The process for evaluating impacts will be based on the TxDOT-THC MOU (13 TAC § 26.25) as applicable, the TxDOT Environmental Compliance Archeological Sites and Cemeteries Toolkit, standard practices for NEPA compliance, and previous FRA projects. Further refinement or clarification of methods may take place under a new PA specific to the Project or to FRA projects in Texas. Direct and indirect impacts related to archeological resources will be analyzed, including impacts that may occur during construction and operation of the Project. The analysis will be based on a review of available reports and data (including federal and state statutes, resource agency, local, and regional agency policies and ordinances), discussions with agency representatives in the region, field investigation, modeling (where applicable) and professional judgment. A thorough record of consultation with THC, tribes, and consulting parties will be used in the Impacts Assessment.

GIS databases will be developed, including data from (1) Project design or (2) from available federal, state, and local sources, which will provide sufficient detail to allow complete analysis of the anticipated design of the completed Project or of reasonable assumptions for Project implementation, including structures for grade-separated alignment crossings and water crossings, maintenance road access, all electrical and utility connections or modifications, maintenance and train storage facilities, etc. The analysis will focus on the Project's potential to alter existing conditions of the affected resources.

Eligibility assessment includes consultation with THC, tribes, and consulting parties. This step is followed by an assessment of whether the Project would adversely affect the characteristics of a resource that contribute to its historical significance.

Both NEPA and Section 106 describe the historic significance of an archeological resource in terms of eligibility for listing in the NRHP under criterion d, as defined in 36 CFR 60.4 and presented above in Section 18.4. Under Criterion D, an archeological property would be eligible for the NRHP if it "has yielded, or may be likely to yield, information important in prehistory or history."

19.6 *Archeological Survey Report*

An Archeological Survey Report will be prepared, following TxDOT's current documentation standards. This report will document the archeological resources in the APE, zones of observed disturbance, methods used to investigation surface, near-surface, and deep deposits (if applicable), and justify deviations from Council of Texas Archeologists /THC standards. The report will identify which resources, if any, are eligible for the NRHP or as SALs. The report will then make recommendations regarding the Project's potential to affect those resources (Determination of Effect) for review by TxDOT and FRA.

19.7 *Memorandum of Agreement/Programmatic Agreement*

If the Preferred Alternative would have an unavoidable adverse effect on a NRHP listed or eligible archeological resource (i.e., important for preservation in place), FRA will consult with the Advisory Council on Historic Preservation, TxDOT, and the THC, as well as consulting parties on draft MOA or PA. The concerns of the consulting parties will be considered in determining the measures to be implemented. The MOA or PA will document mitigation measures to resolve adverse impacts. The MOA or PA will be developed and made available for public review and will be executed before the ROD is issued.

20.0 Transportation

The following direction is specific to the transportation network, including at-grade intersections as well as other transportation elements. These other elements include public transportation service and facilities; railroad, bike and sidewalk facilities; roadway, and other established grade-separated and at-grade crossings of the build alternatives.

Documentation will include established local policies concerning the context of transportation impacts, such as local and regional Level of Service standards from documents such as general plans, Congestion Management Plans, and TxDOT. The date of Project implementation discussed in this section will be 2025. The design year will be 2040.

20.1 *Laws, Regulations, and Orders*

Applicable local, state, and federal laws and regulations that will be summarized include, but are not limited to, the following:

- Railroads (USC, Title 45).
- Rail Programs (USC, Title 49, Subtitle V).
- Texas Transportation Code.
- Rail Facilities (TAC, Title 43, Part 1, Chapter 7).
- Planning and Development of Transportation Projects (TAC, Title 43, Part 1, Chapter 16).
- *Texas Transportation Plan 2040*.

- *Texas Rail Plan*.
- NCTGOG's *Mobility 2040* (expected to be approved in early 2016).

20.2 Affected Environment

For the analysis, the following data will be collected for the study area:

- Commuter rail services including schedules and potential service improvements.
- Freight infrastructure and the movement of goods will be determined based on designated freight truck and rail routes.
- Average daily traffic counts on arterials adjacent and providing access to the proposed station zones and at selected locations along affected freeways and roadways.
- Traffic volume at existing at-grade crossings affected by the Build Alternatives.
- Roadway characteristics such as type (arterial, ramp, freeway), number of lanes, speed limit, parking, bicycle and pedestrian facilities, and classification. Intersection geometry including lane channelization may be necessary at selected locations. Type of traffic control (traffic signal, stop/yield sign), and signal timing and phasing at select signalized intersections.
- Non-motorized travel will identify bicycle lanes, bicycle routes, and existing walkways and pedestrian access facilities.
- Existing parking supply and of parking facilities.

Depending on the location of the Build Alternatives, signalized intersection operations within a quarter-mile of the existing and/or proposed at-grade crossings for peak traffic period impacts would be evaluated.

20.3 Definition of Resource Study Area

The boundaries of the RSA for transportation extend beyond the Project footprint. The study area for direct impacts includes the area of potential disturbance associated with Project construction, as well as intersections and transportation facilities within a quarter-mile, particularly around stations. For indirect impacts on transportation, the study area includes the extent of the roadway networks that may reflect changes in circulation as a consequence of Project conditions. The RSA also includes the vicinity of the maintenance facilities since traffic in these areas could be affected by the Project. Physical and operational elements of the RSA will be described in this subsection.

20.4 Environmental Consequences

Changes to traffic operations in the RSA for the design year from the Project will be evaluated based on the travel demand forecast model and the following parameters:

- Impacts on existing freight and commuter rail serves.
- Impacts on morning and afternoon peak periods.
- Parking accumulation (number of vehicles parked at a given instance of time) will be evaluated at each of the proposed station zones.
- Impacts on vehicular traffic, pedestrian flow, and transit operation will be evaluated for each station zone. Analysis of pedestrian flow will consist of providing for pedestrian cycle at signalized intersections and identification of pedestrian crosswalks. Impacts on transit operation will consist of including number of proposed buses on the affected locations to account for their effect on level of service and delay.

Existing 2013 aerial photography provided by NCTCOG and available internet applications, such as Google Earth, will be used to develop the baseline attributes for existing freight and commuter rail corridors, sidings, roadway, intersection, parking, and ramp configurations potentially affected by the Project.

For the station zones and required street modifications/closures for the Project features, impacts of the build alternatives will be assessed on city streets for vehicular, pedestrian, bicyclists and public transit operations. Parking accumulations will be estimated and their impact assessed. The analysis will be conducted using VISSIM for morning or afternoon peak period, and level of service or delay will be used to gauge the level of operation and identify locations and or movements that would be deficient. The results will be presented in table and maps.

For both the existing and design year, the following software will be used to determine level of service, flow rates, and density: VISSIM, HCS and/or CORSIM. Based upon the location of the Build Alternatives, a traffic data collection plan will be developed and coordinated with FRA and TXDOT to identify locations and data needed to perform analysis of existing and future conditions at at-grade crossings. The plan will also identify growth factors to bring all data to a uniform base year.

The DEIS Transportation Section will summarize the impacts for the Build Alternatives, and the FEIS Transportation will summarize the impacts for the Preferred Alternative.

21.0 Construction Impacts

The following discussion presents direction specific to construction impacts, which will be a compilation of impacts specific to construction activities affecting resources. These are the same resources for which impacts are assessed in the individual resource. Much of the information for this section will be drawn from the studies conducted to assess the existing conditions of those resources and impacts from the Project. Specific reference will be made to related content in other sections of the EIS that influence or are influenced by the construction impacts analysis and supportive/associated technical documents.

NEPA guidelines specifically state that, “Significance cannot be avoided by terming an action temporary…” 40 C.F.R. 1508.27(b)(7). Construction period impacts are those that occur for a limited time only and are considered temporary (e.g., short-term ground disturbance, construction staging and activities, construction associated with implementing mitigation measures, noise from equipment operation).

21.1 Resource Study Area

The RSA for construction impacts may not be exactly the same as the RSA for operational impacts, but will need to be developed based on the construction activities that will be conducted, the size of the area affected by those activities, and the types of equipment that will be used. The boundaries of the RSA may extend beyond the Project footprint. In determining the RSA, the analyst will start with the construction footprint, and then refer to the individual resource sections for the areas in which the resource studies considered construction impacts. The RSA will vary based on the resource type and the construction activities to be undertaken. The analysis will focus on the construction impacts to sensitive or protected resources, communities, and community services.

21.2 Environmental Consequences

A high-level summary of construction impacts resulting from the No-Build and Build Alternatives will be presented with reference made to the specific resource section where a more detailed evaluation was already provided.

This section will summarize quantitative and qualitative analysis of temporary direct and indirect impacts that may occur during construction of the Project. The analysis will be based on a review of the individual resource sections in Chapter 3 of the EIS, the resource technical reports, the alternative design schematics, and station area plans. It also will account for implementation of best management practices specifically related to construction activities.

Construction impacts will be assessed for the period extending from the initiation of Project construction to the time that it is fully operational. The impact analysis will be structured to allow for the assessment of impacts related to road closures or lane reconfigurations implemented during construction. A summary matrix will categorize construction impacts from the resource analyses by temporary and permanent impacts (as applicable).

The Draft EIS will summarize the findings for the Build Alternatives. The Final EIS will summarize the findings for the Preferred Alternative.

22.0 Indirect and Cumulative Impacts

This section guides the Project through a thorough process of gathering and reporting relevant and sufficient data for indirect and cumulative impacts, including analyzing the indirect and cumulative impacts of implementing the Project in combination with other past, present, and reasonably foreseeable future projects that contribute to those impacts; and identifying any crucial issues or concerns relating to the consideration of indirect and cumulative impacts.

22.1 Laws, Regulations, and Orders

The analysis includes indirect impact assessment and the cumulative direct impact assessment as part of standard practices for NEPA compliance as identified in the previous subsections.

Additionally, the analysis will use the first four of eight steps outlined in *National Cooperative Highway Research Program Report 466*. Community and regional plans for the study area, as well as local policies, regulations, and ordinances will be examined and areas with unique policies and requirements will be identified.

TxDOT's Environmental Compliance Toolkits contains procedural requirements which will be followed in order to complete a thorough and defensible indirect induced growth impacts analysis.

22.2 Indirect Impacts

22.2.1 Affected Environment

The Project area's ongoing trends will also be based on population growth, development trends, and regional economic and industrial trends. Mapping and spatial data will identify and general patterns of growth and development. An inventory of the study area's notable features will be prepared, with primary reliance on data collected on the affected environment for the various resource sections.

For the indirect induced growth impacts analysis, GIS databases for the Project will be developed (1) as part of Project design or (2) from available federal, state, and local sources. Sufficient detail will be provided to allow complete analysis of the anticipated design of the Project or of reasonable assumptions for Project implementation.

Quantitative analysis and GIS tools will be used to determine indirect impacts from the Project footprint, as well as land development induced by station planning zones, land use, regional growth and joint development actions. The analysis will be focused on the Project's potential to alter existing resource conditions and future land development.

22.2.2 Definition of Resource Study Area

The RSA boundaries will include political or geographic boundaries within which the Project will be forecast to draw ridership. It would also include the overall study area for the resources detailed above.

Determination of the appropriate RSA also requires consideration of an appropriate time frame. For the Project, the indirect impacts analysis will adopt the 2040 Project horizon.

22.2.3 Environmental Consequences

Potentially substantial indirect impacts of the Build Alternatives will be identified, analyzed and discussed. Indirect impacts may include encroachment-alteration impacts (direct encroachment or alteration of resources removed in time or distance) and induced growth impacts (impacts of growth and development induced by the Project). The indirect impacts analysis will document indirect impacts that were identified, regardless of whether they are considered potentially substantial. After identifying indirect impacts, their magnitude will be assessed. Only indirect impacts that are so substantial that they may be significant need to be addressed in detail.

Potential socioeconomic impacts will also be considered as part of encroachment-alteration impacts. The analysis will focus on how the Build Alternatives affect adjacent resources. The presence of potentially affected resources will be evaluated and a discussion of anticipated impacts will be included.

Along with the indirect encroachment impacts analysis, an indirect induced growth impacts analysis will also be conducted. Land use impacts will be discussed in value-neutral terms, as the desirability or undesirability of such changes depend on the local and regional context, area goals, and local perceptions. If induced growth is anticipated, subsequent impacts related to that induced growth will be summarized.

The indirect induced growth impacts analysis will focus on how station areas would indirectly impact existing and proposed development. The type of development and redevelopment opportunities that are created through potential adverse and beneficial impacts related to induced growth and development likely to result from the Project will be summarized. Where new public or private development is expected to be constructed, the availability of appropriately zoned, nearby land will be evaluated and anticipated impacts will be discussed.

22.3 Cumulative Impacts

22.3.1 Affected Environment

Based on the resource evaluations identified above, a determination will be made regarding which resources would be affected by the Project and should therefore be included in the cumulative impacts analysis. Important stress factors and pertinent environmental regulations and standards will be included in the discussion to provide a historical context. A determination will be made regarding whether the resources, ecosystems, and human communities of concern are approaching conditions where additional stresses will have an important cumulative impact. Two types of information will be used to describe stress factors: (1) the types, distribution and intensity of key social and economic activities in the region; and (2) individual indicators of stress on specific resources, ecosystems, and human communities. Special attention will be paid to common natural resource and socioeconomic issues that arise as a result of cumulative impacts.

This section will identify the reasonably foreseeable public and private future actions that would likely affect resources included in the cumulative impacts analysis. A figure showing the locations of these actions will be created and sufficient detail about the types and extent of impacts that it can be used to describe the overall relationship of the Project to the relevant cumulative impacts. For purposes of compiling the list, “reasonably foreseeable future projects” is defined to mean those that are likely to occur within the 2040 planning horizon for the Project.

22.3.2 Definition of Resource Study Area

For cumulative impacts, the RSA will include the geographic extent of each affected resource within which Project impacts accumulate or interact with the impacts of other actions. The RSA will be identified for each resource that will be used for the cumulative impacts analysis and coordination will occur with the cumulative lead in identifying any modifications to the RSA necessary to analyze fully the potential cumulative impacts of the Project.

22.3.3 Environmental Consequences

The research and analysis methods used to determine environmental consequences will be summarized. A clear and thorough description of the methodology used to identify the cumulative impacts, the existing conditions (including historic context and health of the resource), the reasonably foreseeable past, present, and future actions that contribute to the cumulative impacts and the resulting characterization of the contributions of the Project in the context of the cumulative significant impacts will be included.

A description of the cumulative impact to the resource resulting from the Project’s incremental contribution in combination with the contributions of past, present and reasonably foreseeable probable future projects, and whether the resulting cumulative impact would be significant will be summarized. If the impact is significant, the Project’s incremental contribution to the significant cumulative impact will be evaluated. A summary table will be used to illustrate the cause-and-effect relationships of past, present, and reasonably foreseeable probable future projects in combination with the Project impacts.

A summary table will be used to illustrate the cause-and-effect relationships of past, present, and reasonably foreseeable probable future projects in combination with the Project impacts.

22.4 Indirect and Cumulative Impacts Technical Report

An Indirect and Cumulative Impacts Technical Report will be prepared and included as a technical appendix. The Draft EIS will summarize the impacts for the Build Alternatives, and the Final EIS will summarize the impacts for the Preferred Alternative, as needed.

23.0 Section 4(f) Evaluation

This section only applies if a Section 4(f) evaluation or a *de minimis* impact finding is needed for the Project. This section will guide the methods used for the evaluation of actual use of Section 4(f) resources. The organization of the Section 4(f) evaluation, if required, will be organized into subsections for each resource evaluated.

The Section 4(f) resource analysis in the Draft EIS will make preliminary findings regarding the potential use of a resource as a result of the Project. Any Section 4(f) evaluation required will be included in the Final EIS. Throughout the development of the Draft and Final EIS, the Section 4(f) analysis also will refer to efforts to avoid and/or minimize resources in the alternatives analysis process.

23.1 Laws, Regulations, and Orders

Along with the regulatory context of Section 4(f), other relevant regulations and guidance include, but are not limited to, the following:

- 23 CFR Part 774, Parks, Recreation Areas, Wildlife and Waterfowl Refuges, and Historic Sites.
- 36 CFR Part 59, Land and Water Conservation Fund Program Assistance to States.
- American Association of State Highway and Transportation Officials' (AASHTO) Practitioner's Handbook Complying with Section 4(f) of the USDOT Act.
- 23 CFR 771, Environmental Impact and Related Procedures, Section 4(f).
- TxDOT Environmental Compliance Chapter 26, Parks and Wildlife Code Toolkit.
- TxDOT Environmental Compliance Section 4(f), U.S. Department of Transportation Act Toolkit.
- TxDOT Environmental Compliance Section 6(f), Land and Water Conservation Fund Act Toolkit.

23.2 Definition of Resource Study Area

The RSA for publicly owned parks, recreation areas, and wildlife areas are defined in Sections 6.0 and17.0 of this report. In Sections 18.0 and 19.0, the Section 106 APE will serve as the study area for Section 4(f) historic architecture, archeological or cultural landscape properties. If necessary, the RSA may be expanded to identify proximity impacts for each Section 4(f) resource.

23.3 Existing Conditions

Potential Section 4(f) properties will be identified early in the planning and project development process (i.e., during the alternatives analysis), so that complete avoidance will be given full and fair consideration. Potential Section 4(f) resources will be based on the results of the analysis conducted for Sections 6.0, 17.0, 18.0, and 19.0 in this methodology report. In addition, entities and individuals who are considered the officials with jurisdiction (OWJ) under Section 4(f) will be determined. A consultation summary table will be provided for each Section 4(f) resource evaluated.

23.4 Environmental Consequences

The Section 4(f) analysis in the Draft EIS (Draft Section 4(f) Evaluation) will make preliminary findings regarding the potential use, including constructive use, of a resource as a result of the Project. The Draft Section 4(f) evaluation will include various impacts to the different properties affected by the Build Alternatives. Different categories of "use" under Section 4(f) will be defined and evaluated as well. The degree of impact and impairment will be determined in consultation with the OWJ for each resource in accordance with 23 CFR 774.15(d)(3). The Section 4(f) use definitions will be applied to each property and discussion will be included on whether a use would occur as a result of the Project, considering amount of land to be used, facilities and functions affected by noise, and visual impediments, known as constructive use, created by the Project.

Where a Section 4(f) property might experience proximity impacts as a result of the Project, FRA determine whether these proximity impacts could result in a constructive use.

23.4.1 De minimis Determinations

Where appropriate, a *de minimis* impact determination may be made for the net impact on the Section 4(f) property. The Draft EIS will include sufficient supporting documentation for measures to minimize harm that were applied to the Project by FRA to make the *de minimis* impact determination. If the potential impacts have been reduced to a *de minimis* level and the OWJ is in agreement, FRA will make a *de minimis* determination, which will be reported in the Final EIS.

23.4.2 Individual Section 4(f) Resource Impacts

An Avoidance Alternatives Analysis will be conducted for each Section 4(f) resource for which a *de minimis* determination is not appropriate. When a use of Section 4(f) property by the Project is anticipated, location and design alternatives that would minimize impacts or avoid the Section 4(f) resources will be identified and evaluated. The design alternatives will be in the immediate area of the property and will consider minor alignment shifts, a reduced facility, retaining structures, noise walls, etc., individually or in combination, as appropriate.

If necessary, this section will include a description of why some alternatives are not feasible or prudent. Measures to minimize the impacts of the Project on the Section 4(f) property or properties will be discussed if there are no prudent and feasible avoidance alternatives. Detailed discussions of mitigation measures will be referenced and summarized. The Draft Section 4(f) Evaluation will be presented as a separate chapter in the Draft EIS.

The Draft Section 4(f) evaluation is required to disclose the various impacts to the different Section 4(f) properties thereby initiating the balancing process. It will also disclose the relative differences among alternatives regarding non-Section 4(f) issues such as the extent to which each alternative meets the Project purpose and need. Preliminary assessment of how the alternatives compare to each other may also be included. After circulation of the draft Section 4(f) evaluation in accordance with 23 CFR Part 774.5(a), FRA will consider comments received on the evaluation and finalize the comparison of factors listed in 23 CFR Part 774.3(c)(1) for the alternatives. The analysis and identification of the alternative with the least overall harm will be documented in the Final Section 4(f) evaluation in the Final EIS.

The basis for concluding that no feasible and prudent alternatives exist to the use of the Section 4(f) property will be documented. The supporting information will demonstrate that, “there are unique problems or unusual factors involved in the use of alternatives that avoid these properties or that the cost, social, economic, and environmental impacts, or community disruption resulting from such alternatives reach extraordinary magnitudes” (23 CFR Part 771.135(a)(2)).

The Draft Section 4(f) Evaluation, if needed, will be presented as a separate chapter in the Draft EIS. The Final Section 4(f) Evaluation, if needed, will be presented as a separate chapter in the Final EIS.

Appendix F: Environmental Assessment Approach for Alternatives Analysis

STEP 2 ENVIRONMENTAL CONSTRAINTS SCREENING

The Step 2 Environment Constraints Screening consists of a more detailed comparison of the alternatives carried forward from the Step 1 Screening to determine if some alternatives would result in potential environmental effects substantially greater than other alternatives. The TRE and I-30/SH 360/TRE corridors passed the Step 1 screening process, therefore these corridors were evaluated under the Step 2 Environmental Constraints Screening. A Step 2 Environmental Constraints Screening was also performed for the following six potential alignment alternatives within each corridor:

1. *TRE North:* Alignment that runs exclusively to the north of the existing TRE rail infrastructure.
2. *TRE South:* Alignment that runs exclusively to the south of the existing TRE rail infrastructure.
3. *TRE Refined:* Alignment that shifts from the north and south of the existing TRE rail infrastructure.
4. *I-30/SH 360/TRE North:* Exclusively to the north of the existing I-30 highway infrastructure and TRE rail infrastructure and west of the existing SH 360 highway infrastructure.
5. *I-30/SH 360/TRE South:* Exclusively to the south of the existing I-30 highway infrastructure and TRE rail infrastructure and west of the existing SH 360 highway infrastructure.
6. *I-30/SH 360/TRE Refined:* Alignment that shifts from the north and south of the existing I-30 and TRE rail infrastructure and east and west of the existing SH 360 highway infrastructure.

The Step 2 Environmental Screening is based on a Geographic Information Systems (GIS) analysis and desktop level research from readily available state and federal databases. Fieldwork, modeling, and a detailed technical evaluation of alternatives in accordance with NEPA and FRA's procedures will be completed as part of the Draft Environmental Impact Statement (DEIS).

Table E-1, below, presents the environmental criteria that will be studied as part of the NEPA evaluation process, as discussed in the Dallas-Fort Worth Core Express Service Environmental Methodology Report prepared by Parsons Brinkerhoff, Inc. in January 2016 (Appendix E). The table also specifies which criteria will be screened as part of the Alternatives Analysis (AA) and those that will be studied in more detail as part of the DEIS and FEIS.

TABLE E-1: ENVIRONMENTAL RESOURCES ANALYSES

Environmental Criteria	**Studied In**	
	AA	**DEIS/FEIS**
Air Quality		X
Water Quality and Water Resources	X	X
Noise & Vibration		X
Solid Waste Disposal	X	X

Natural Ecological Systems and Wildlife		X
Wetlands	X	X
Threatened & Endangered Species		X
Flood Hazards and Floodplain Management	X	X
Energy Resources		X
Utilities		X
Geologic Resources		X
Aesthetics		X
Land Use	X	X
Environmental Justice, Socioeconomics, Relocation, Elderly, and Handicapped	X	X
Public Health, Safety, Security, and Hazardous Materials	X	X
Parks and Recreational Facilities and Section 6(f)	X	X
Historic Resources	X	X
Archaeological Resources		X
Transportation		X
Construction Impacts		X
Indirect and Cumulative Impacts		X
Section 4(f)	X	X

Table E-2 presents the environmental evaluation criteria analyzed during the Step 2 Environmental Constraints Screening process. In order to estimate potential effects, a preliminary study area was identified for each route alternative. In addition, the study area for the corridor includes the right-of-way[1] (ROW) and a buffer, which is specific to each environmental criterion. The study area for the alignments is limited to the ROW, with the exception of the environmental justice, which includes a study area of the ROW plus 0.5 miles.

[1] While ROW widths can vary considerable, according to Parsons Brinkerhoff, the right-of-way is approximately 70 feet wide throughout the project area.

TABLE E-2: ENVIRONMENTAL SCREENING CRITERIA[2]

Environmental Screening Criteria	Measure	Corridor Study Area	Alignment Study Area	Data Source	Description
Wetlands	Acres	ROW + 250 feet buffer	ROW	-US Fish and Wildlife Service National Wetland Inventory -National Land Cover Dataset	National Wetland Inventory wetlands impacted
Streams	No. of Stream Crossings	NQ	ROW	National Atlas	Direct alignment crossing of waterways
Floodplains	Acres	ROW	ROW	Federal Emergency Management Act (FEMA)	100-year floodplain impacted
Parks & Recreational Facilities	No. Publically owned parks	ROW + 300 feet buffer	ROW	-Texas Parks and Wildlife Department (TPWD) -Google Maps	Publically owned parkland
Threatened and Endangered Species	No. of elements of occurrence	ROW + 0.5 miles	ROW	-TPWD Texas Natural Diversity Database	Known locations of species based on at least one observation (representation of a known population of an element)
Historic Resources	No. of Historic Sites	ROW + 300 feet buffer	ROW	-Texas Historical Commission -National Register of Historic Places (NRHP)	NRHP listed or eligible properties and districts impacted
Hazardous Material Sites	No. of sites	ROW + 150 feet buffer	ROW	-Geosearch	Superfund, permitted industrial hazardous waste, radioactive waste, and treatment/disposal/ storage sites
Landfills	No. of sites	ROW + 150 feet buffer	ROW	Texas Commission on Environmental Quality	Permitted solid waste disposal sites and landfills impacted
Land Use	Acres	NQ	ROW	North Central Council of Governments	Commercial, industrial, and residential land impacted
Environmental Justice	No. of census block groups of non-white residents (>50% of population)	ROW + 0.5 mile buffer	ROW+ 0.5 mile buffer	US Census Bureau (2008-12)	Estimated non-white population affected
	No. of household income below poverty	ROW + 0.5 mile buffer	ROW + 0.5 mile buffer	US Census Bureau (2008-12)	Estimated population below the poverty line impacted
Relocations	No. of Buildings	ROW + 25 feet buffer	ROW	Google Earth (manual count)	-Corridor: Residential and non-residential relocations -Alignment: Residential relocations

NQ: not quantified

Step 2 Environmental Screening Process (Methodology)

The Step 2 Environmental Screening process utilized a ratio method to score the corridor, alignment and station location alternatives. Scoring for each environmental evaluation criteria was based on the lowest score having the least potential to create an environmental impact. The environmental screening criteria analyzed were not weighted during Step 2 because each have regulatory processes, mitigation requirements, public involvement and/or costs associated with impacting these resources.

Table E-3 provides an example of scoring environmental evaluation criteria using the ratio method and includes the potential alignment alternatives and the scoring for floodplain criteria.

TABLE E-3: SCORING EXAMPLE: RATIO METHODOLOGY

Alignments	Floodplains	
	Acreage	Score
TRE Initial South	62	6.000
TRE Initial North	62	6.000
TRE Refined	60	5.583
I-30/SH 360/TRE Initial North	55	4.542
I-30/SH 360/TRE Initial South	38	1.000
I-30/SH 360/TRE Refined	39	1.208

Because there are six alternative alignments, the scores range from 1.000 to 6.000 (note that if there are only two alternatives, the scores range from 1.000 to 2.000). For each criterion, the lowest impact is scored a 1.000 (I-30/SH 360/TRE Initial South) and the greatest impact(s) is scored a 6.000 (TRE Initial South and TRE Initial North). The remaining potential alternative alignments are scored relative to the minimum and maximum scores using the following formula:

$$X = A - ((H - I_x)/(H - L)*(H - 1))$$

Where the variables for the equation above are presented in Table E-4, below.

TABLE E-4: SCORING FORMULA VARIABLE DEFINITIONS

Variable	Units	Description
X	Point value	Score for the alternative environmental resource being analyzed
A	Number	No. of alternatives
H	Acre or number	Value of the highest impact
I_x	Acre or number	Value of impact of the alternative environmental resource being analyzed
L	Acre or number	Value of the lowest impact

Corridor Step 2 Environmental Screening Results

Table 5-16 in the report presents the summary results of the Step 2 Environmental Constraints Screening for the corridor alternatives. As illustrated in this summary table, the results of the Step 2 Environmental Constraints Screening for the TRE and I-30/SH 360/TRE corridors were similar in that some of the environmental criteria scores were higher for TRE and some were higher for I-30/SH 360/TRE.

Alignment Step 2 Environmental Screening Results

Since there are opportunities to shift potential alignments from one side of the existing infrastructure to the other at various locations along the corridor in order to minimize environmental effects and established land uses, the project team performed a Step 2 Environmental Screening for the alternative alignments on the TRE and I-30/SH 360/TRE corridors.

Table 5-8 in the report presents the results of the Step 2 Environmental Constraints Screening for the alignment alternatives and Table 5-9 identifies the rank of the potential alignment alternatives from fewest effects to most effects based on the scores presented in Table 4-16.

As indicated in Table 5-9, the I-30/SH 360/TRE Refined alignment alternative has the least adverse environmental impact based on the Step 2 Environmental Constraints Screening process. In addition, the TRE Refined alignment and the I-30/SH 360/TRE South alignments have considerably fewer effects than the TRE South, TRE North, and I-30/SH 360/TRE North alignments. Since the I-30/SH 360/TRE Refined alignment is a refined version of the I-30/SH 360/TRE South alignment, only the I-30/SH 360/TRE Refined alignment and the TRE Refined alignment will move forward to the Step 2 Constructability/Financial Constraints or DEIS.

The alignments presented in this document are preliminary and subject to change. The Refined alignments will continue to be refined and evaluated in accordance with NEPA. The DEIS will further evaluate and document potential environmental effects identified through modeling, detailed field investigations, and public/agency input. These environmental effects may dictate further minor route modifications to avoid and/or minimize an effect. Additionally, the project team will refine the alignments during preliminary engineering, which will occur simultaneously with the preparation of the DEIS. FRA will evaluate the modifications to the alignments through the EIS process and ultimately identify a Preferred Alternative for the project.

Terminal Station Step 2 Environmental Screening Results

There are a total of four terminal station location options associated with the I-30/SH 360/TRE Refined and TRE Refined alignments; two in Fort Worth (FW-ITC and FW-T&P) and two in Dallas (DAL-Union Station and DAL-TCR). Please refer to Chapter 3 for details on the terminal station locations. One terminal station in Fort Worth and one terminal station in Dallas will ultimately be selected for either the I-30/SH 360/TRE Refined or TRE Refined alignment. Tables 5-10 and 5-11 in the report present the Step 2 Environmental Constraints Screening conducted for the two stations in Fort Worth and the two stations in Dallas, respectively.

Based on the results of the terminal station Step 2 Environmental Constraints Screening, the station in Fort Worth that would have the least adverse effects is the FW-T&P station and the station in Dallas that would have the least adverse effects is the DAL-TCR station. Since the scoring differentials between terminal stations (Fort Worth and Dallas) are relatively small it is recommended that all terminal stations be further analyzed in the DEIS.

Line Station Step 2 Environmental Screening Results

There is one line station alternative for the I-30/SH 360/TRE Refined alignment (ARL1-Arlington) located in the Arlington Entertainment District. There are two line stations for the TRE Refined alignment; one at the existing CentrePort/DFW TRE station (CP1-CentrePort) and one potential new location immediately west of the Tarrant/Dallas county line near Trinity Way and the TRE commuter rail line (CL1-County Line). Please refer to Chapter 3 for details on the line station locations.

Since there is only one line station alternative location for I-30/SH 360/TRE Refined alignment, a Step 2 Environmental Constraints Screening was not performed for this alternative. There were no wetlands, floodplains, parks & recreational facilities, threatened and endangered species, historic resources, hazardous material sites, or landfills in the proposed ARL1-Arlington line station location. In addition, no relocations would be required for the construction of this station. There is a low income population of 420 and a minority population of 2,000 (5 census block groups).

Table 5-12 in the report presents the Step 2 Environmental Constraints Screening conducted for the CP1-CentrePort and CL1-County Line stations. Based on the results of the terminal station Step 2 Environmental Constraints Screening, CL1-County Line would impact a smaller minority and low income population. However, CL1-CentrePort is an existing station and therefore, the actual effects on the minority and low income populations could be greater by constructing CL1-County Line since it is not a previously existing structure. Therefore, based on the environmental constraints screening, both TRE line stations be further analyzed in the DEIS.

Operations and Maintenance Facility Step 2 Environmental Screening Results

A total of seven operations and maintenance (O&M) facility location alternatives are along the TRE Refined alternative (M-FW4, M-FW5, M-FW6, M-DAL1, M-DAL2, M-DAL3, M-DAL4) and four of these O&M facilities are also along the I-30/SH 360/TRE Refined alignment (M-DAL1, M-DAL2, M-DAL3, M-DAL4). Please refer to Chapter 3 for details on the O&M facility locations. The Step 2 Environmental Constraints Screening conducted for the O&M facility locations are shown on Tables 5-13 and 5-14 in the report, which identify the rank of the potential alignment alternatives from fewest effects to most effects.

The O&M facility location along the I-30/SH 360/TRE Refined alternative that would have the least adverse effects is the M-DAL4 location. Since the scoring differentials between I-30/SH 360/TRE O&M facilities are relatively small it is recommended, based on the environmental constraints screening, that all O&M facilities be further analyzed in the DEIS.

The M-DAL2 O&M facility location along the TRE Refined alternative has the least adverse environmental effect, followed by M-FW4. The significance of these effects and other environmental effects will be further analyzed in the DEIS and FEIS.

Environmental No Build

The project would not be constructed under the No-Build Alternative and would not present major environmental challenges. However, the current rail routes between Fort Worth and Dallas would continue to be used, resulting in continued minor environmental effects such as erosion and sedimentation from railroad grades to adjacent waterbodies and wetlands and noise. Other travel modes would continue to be used and would likely become more congested in the future as travel demand increases, resulting in potential effects on sensitive areas (i.e., air emissions, ROW acquisitions for infrastructure improvements). In addition, other passenger rail sections in this area could be developed and result in acquisition of ROW and effects on sensitive areas.

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Step 2 Environmental Constraints Screening Appendices

Table E-5 provides a comparison of the effects for both corridor alternatives using information gathered during the environmental desktop study.

TABLE E-5: TRE & I-30/SH 360/TRE CORRIDOR STEP 2 ENVIRONMENTAL SCREENING RESULTS

Environmental Screening Criteria		Corridor Alternatives	
		TRE	**I-30/SH 360/TRE**
Wetlands	Acres	21	20
	Score	2.000	1.000
Floodplains	Acres	33	29
	Score	2.000	1.000
Parks & Recreational Facilities	No.	13	15
	Score	1.000	2.000
Threatened and Endangered Species	No.	14	16
	Score	1.000	2.000
Historic Resources	No.	13	10
	Score	2.000	1.000
Hazardous Material Sites	No.	2	2
	Score	1.000	1.000
Landfills	No.	6	0
	Score	2.000	1.000
Environmental Justice (Minority Population)	No.	81	113
	Score	1.000	2.000
Environmental Justice (Low Income Population)	No.	5,528	7,957
	Score	1.000	2.000
Relocations	No.	5	2
	Score	2.000	1.000
	Total Score	**15.000**	**14.000**

Table E-6 provides a comparison of the effects for each alignment alternative using information gathered during the environmental desktop study. The scores were totaled based on the aggregation of the individual scores received for each environmental screening criteria. The alignment alternatives were then ranked from lowest to highest score, with the lowest score (1) identified as the potential for least adverse environmental impact. Table E-7 identifies the rank of the potential alignment alternatives from fewest effects to most effects.

TABLE E-6: TRE & I-30/SH 360/TRE ALIGNMENT STEP 2 ENVIRONMENTAL SCREENING RESULTS

Environmental Screening Criteria		Alternative Alignments					
		TRE North	TRE South	TRE Refined	I-30/SH 360/TRE North	I-30/SH 360/TRE South	I-30/SH 360/TRE Refined
Wetlands	Acres	2	2	2	2	2	2
	Score	1.000	1.000	1.000	1.000	1.000	1.000
Streams	No.	6	6	6	5	5	5
	Score	6.000	6.000	6.000	1.000	1.000	1.000
Floodplains	Acres	62	62	60	55	38	39
	Score	6.000	6.000	5.583	4.542	1.000	1.208
Parks & Recreational Facilities	No.	3	7	5	4	6	4
	Score	1.000	6.000	3.500	2.250	4.750	2.250
Threatened & Endangered Species	No.	14	14	14	16	16	16
	Score	1.000	1.000	1.000	6.000	6.000	6.000
Historic Resources (Properties)	No.	1	0	0	1	0	0
	Score	6.000	1.000	1.000	6.000	1.000	1.000
Historic Resources (Districts)	No.	4	3	2	4	3	2
	Score	6.000	3.500	1.000	6.000	3.500	1.000
Hazardous Material Sites	No.	1	1	1	0	2	0
	Score	3.500	3.500	3.500	1.000	6.000	1.000
Landfills	No.	8	9	9	0	0	0
	Score	5.444	6.000	6.000	1.000	1.000	1.000
Land Use (Industrial)	Acres	12	7	9	5	3	4
	Score	6.000	3.222	4.333	2.111	1.000	1.556
Land Use (Commercial)	Acres	70	75	57	65	55	45
	Score	5.167	6.000	3.000	4.333	2.667	1.000
Land Use (Residential)	Acres	35	43	24	31	9	16
	Score	4.824	6.000	3.206	4.235	1.000	2.029
Environmental Justice (Minority Population)	No.	82	80	81	114	113	113
	Score	1.294	1.000	1.147	6.000	5.853	5.853
Environmental Justice (Low Income Population)	No.	5,607	5,460	5,528	7,910	7,763	7,750
	Score	1.300	1.000	1.139	6.000	5.700	5.673
Residential Relocations (Single Family)	No.	5	22	2	27	12	0
	Score	1.926	5.074	1.370	6.000	3.222	1.000
Residential Relocations (Multi-Family)	No.	0	0	0	123	8	0
	Score	1.000	1.000	1.000	6.000	1.325	1.000
Total Score		**57.455**	**57.296**	**43.779**	**63.471**	**46.017**	**33.570**

TABLE E-7: TRE & I-30/SH 360/TRE ALIGNMENT RANKING

Alignment Alternative	Total Score	Rank	
I-30/SH 360/TRE Refined	33.570	1	Least Adverse Environmental Effects
TRE Refined	43.779	2	↓
I-30/SH 360/TRE South	46.017	3	
TRE South	57.296	4	
TRE North	57.455	5	
I-30/SH 360/TRE North	63.471	6	Most Adverse Environmental Effects

Tables E-8 and E-9 presents the Step 2 Environmental Screening scores for the terminal stations in Fort Worth and Dallas, respectively.

TABLE E-8: FORT WORTH TERMINAL STATION STEP 2 ENVIRONMENTAL SCREENING RESULTS

Environmental Screening Criteria		FW-ITC	FW-T&P
Wetlands	Acres	0	0
	Score	1.000	1.000
Floodplains	Acres	0	0
	Score	1.000	1.000
Parks & Recreational Facilities	No.	0	0
	Score	1.000	1.000
Threatened and Endangered Species	No.	0	0
	Score	1.000	1.000
Historic Resources (Properties and Markers)	No.	1	0
	Score	2.000	1.000
Historic Resources (Districts)	No.	0	1
	Score	1.000	2.000
Hazardous Material Sites	No.	0	0
	Score	1.000	1.000
Landfills	No.	0	0
	Score	1.000	1.000
Relocations – Industrial	No.	0	0
	Score	1.000	1.000
Relocations - Commercial	No.	1	0
	Score	2.000	1.000
Relocations – Residential	No.	0	0
	Score	1.000	1.000
Environmental Justice (Minority Population)	No.	5	3
	Score	2.000	1.000
Environmental Justice (Low Income Population)	No.	591	498
	Score	2.000	1.000
	Total Score	**17.000**	**14.000**

TABLE E-9: DALLAS TERMINAL STATION STEP 2 ENVIRONMENTAL SCREENING RESULTS

Environmental Screening Criteria		DAL-Union Station	DAL-TCR
Wetlands	Acres	0	0
	Score	1.000	1.000
Floodplains	Acres	0	0
	Score	1.000	1.000
Parks & Recreational Facilities	No.	0	0
	Score	1.000	1.000
Threatened and Endangered Species	No.	0	0
	Score	1.000	1.000
Historic Resources (Properties and Markers)	No.	0	0
	Score	1.000	1.000
Historic Resources (Districts)	No.	1	0
	Score	2.000	1.000
Hazardous Material Sites	No.	0	0
	Score	1.000	1.000
Landfills	No.	0	0
	Score	1.000	1.000
Relocations – Industrial	No.	0	0
	Score	1.000	1.000
Relocations - Commercial	No.	0	0
	Score	1.000	1.000
Relocations – Residential	No.	0	0
	Score	1.000	1.000
Environmental Justice (Minority Population)	No.	4	5
	Score	1.000	2.000
Environmental Justice (Low Income Population)	No.	92	87
	Score	2.000	1.000
	Total Score	**15.000**	**14.000**

Table E-10 presents the Step 2 Environmental Constraints Screening conducted for the CP1-CentrePort and CL1-County Line stations.

TABLE E-10: LINE STATION STEP 2 ENVIRONMENTAL SCREENING RESULTS (TRE REFINED ALIGNMENT)

Environmental Screening Criteria		CP1- CentrePort	CL1-County Line
Wetlands	Acres	0	0
	Score	1.000	1.000

Floodplains	Acres	0	0
	Score	1.000	1.000
Parks & Recreational Facilities	No.	0	0
	Score	1.000	1.000
Threatened and Endangered Species	No.	0	0
	Score	1.000	1.000
Historic Resources (Properties and Markers)	No.	0	0
	Score	1.000	1.000
Historic Resources (Districts)	No.	0	0
	Score	1.000	1.000
Hazardous Material Sites	No.	0	0
	Score	1.000	1.000
Landfills	No.	0	0
	Score	1.000	1.000
Relocations – Industrial	No.	0	0
	Score	1.000	1.000
Relocations - Commercial	No.	0	0
	Score	1.000	1.000
Relocations – Residential	No.	0	0
	Score	1.000	1.000
Environmental Justice (Minority Population)	No.	6	4
	Score	2.000	1.000
Environmental Justice (Low Income Population)	No.	180	148
	Score	2.000	1.000
Total Score		**15.000**	**13.000**

Tables E-11 and E-12 present the Step 2 Environmental Constraints scores for the O&M facility locations. The scores were totaled based on the aggregation of the individual scores received for each environmental screening criteria. The alignment alternatives were then ranked from lowest to highest score, with the lowest score (1) identified as the potential for least adverse environmental impact. Tables E-13 and E-14 identify the rank of the O&M facility location alternatives from fewest effects to most effects.

TABLE E-11: O&M FACILITY STEP 2 ENVIRONMENTAL SCREENING RESULTS (I-30/SH 360/TRE REFINED ALIGNMENT)

Environmental Screening Criteria		M-DAL1	M-DAL2	M-DAL3	M-DAL4
Wetlands	Acres	0	0	0	0
	Score	1.000	1.000	1.000	1.000
Floodplains	Acres	0	0	0	0
	Score	1.000	1.000	1.000	1.000
Parks & Recreational Facilities	No.	0	0	0	0
	Score	1.000	1.000	1.000	1.000

Threatened and Endangered Species	No.	0	0	0	0
	Score	1.000	1.000	1.000	1.000
Historic Resources (Properties and Markers)	No.	0	0	0	0
	Score	1.000	1.000	1.000	1.000
Historic Resources (Districts)	No.	0	0	0	0
	Score	1.000	1.000	1.000	1.000
Hazardous Material Sites	No.	0	0	1	1
	Score	1.000	1.000	4.000	4.000
Landfills	No.	0	0	0	0
	Score	1.000	1.000	1.000	1.000
Relocations – Industrial	No.	1	3	1	1
	Score	1.000	4.000	1.000	1.000
Relocations - Commercial	No.	1	25	34	26
	Score	1.000	3.182	4.000	3.273
Relocations – Residential	No.	1	0	0	0
	Score	4.000	1.000	1.000	1.000
Environmental Justice (Minority Population)	No.	12	2	1	1
	Score	4.000	1.273	1.000	1.000
Environmental Justice (Low Income Population)	No.	916	282	164	164
	Score	4.000	1.471	1.000	1.000
Total Score		**22.000**	**18.925**	**19.000**	**18.273**

TABLE E-12: O&M FACILITY STEP 2 ENVIRONMENTAL SCREENING RESULTS (TRE REFINED ALIGNMENT)

Environmental Screening Criteria		M-FW4	M-FW5	M-FW6	M-DAL1	M-DAL2	M-DAL3	M-DAL4
Wetlands	Acres	0	0	0	0	0	0	0
	Score	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Floodplains	Acres	0	3.1	2.01	0	0	0	0
	Score	1.000	7.000	4.890	1.000	1.000	1.000	1.000
Parks & Recreational Facilities	No.	0	0	0	0	0	0	0
	Score	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Threatened & Endangered Species	No.	0	0	0	0	0	0	0
	Score	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Historic Resources (Markers and Properties)	No.	0	0	0	0	0	0	0
	Score	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Historic Resources (Districts)	No.	0	0	0	0	0	0	0
	Score	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Hazardous Material Sites	No.	0	1	1	0	0	1	1
	Score	1.000	7.000	7.000	1.000	1.000	7.000	7.000
Landfills	No.	0	0	0	0	0	0	0
	Score	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Relocations (Industrial)	Acres	10	3	1	1	3	1	1
	Score	7.000	2.333	1.000	1.000	2.333	1.000	1.000
Relocations (Commercial)	Acres	4	2	3	1	25	34	26
	Score	1.545	1.182	1.364	1.000	5.364	7.000	5.545
Relocations (Residential)	Acres	0	0	0	1	0	0	0
	Score	1.000	1.000	1.000	7.000	1.000	1.000	1.000
Environmental Justice (Minority Population)	No.	1	1	1	12	2	1	1
	Score	1.000	1.000	1.000	7.000	1.545	1.000	1.000
Environmental Justice (Low Income Population)	No.	322	328	237	916	282	164	164
	Score	2.261	2.309	1.582	7.000	1.941	1.000	1.000
Total Score		**20.806**	**27.824**	**23.836**	**31.000**	**20.184**	**25.000**	**23.545**

TABLE E-13: O&M FACILITY LOCATION RANKING (I-30/SH 360/TRE REFINED ALIGNMENT)

Alignment Alternative	Total Score	Rank	
M-DAL4	18.273	1	Least Adverse Environmental Effects ↓ Most Adverse Environmental Effects
M-DAL2	18.925	2	
M-DAL3	19.000	3	
M-DAL1	22.000	4	

TABLE E-14: O&M FACILITY LOCATION RANKING (TRE REFINED ALIGNMENT)

Alignment Alternative	Total Score	Rank	
M-DAL2	20.184	1	Least Adverse Environmental Effects ↓ Most Adverse Environmental Effects
M-FW4	20.806	2	
M-DAL4	23.545	3	
M-FW6	23.824	4	
M-DAL3	25.000	5	
M-FW5	27.824	6	
M-DAL1	31.000	7	