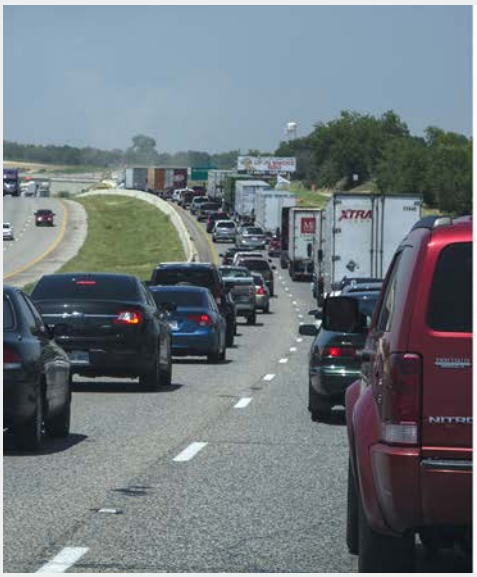
MODAL PROFILES AND NEEDS



4.1 Transportation Snapshot

As the largest transportation system in the nation, the Texas transportation system permits users to drive, ride, walk, bike, or fly to get where they need to go and enables freight transport by ship, air, rail, truck and pipeline to facilitate state, national, and global commerce and support industry. Providing for such diversity of travel requires a complex and interconnected network of roads, bridges, airports, railroads, ports, and other elements – all of which must be maintained and expanded in accordance with the demand for use to provide their intended function at a level that users expect. Exhibit 4-1 provides a high-level overview of the existing multimodal transportation system in Texas.

Exhibit 4-1. Texas Transportation at a Glance

People	• 25.1 million Texans (2010)[a] • 237,440 million vehicle miles traveled annually[b] • 85% of population resides in metro areas[c] • 10.9% of population aged 65 or older[d]
Pavement	• Over 313,000 total centerline miles of pavement[e] • Over 80,000 centerline miles maintained by TxDOT • Over 195,000 lane-miles operated and maintained by TxDOT • Over 24,000 lane-miles of Interstates • 88% of pavement lane-miles on state-owned roads in “Good” or “Better” condition[f] • $9,305 million invested in the transportation system annually • 39% of investment used to expand current system[g]
Bridges	• 52,536 bridges[h] • 33,513 owned and maintained by TxDOT[i] • More than 81% of total bridges in “Good” or “Better” condition[j]
Transit and Passenger Rail	• 8 metropolitan, 30 urbanized, and 37 (see 4.4.5) non-urbanized transit systems[k] • More than 88 elderly and disability transit programs[l] • Constitutes 1.63% of work commute trips[m] • Over 281 million total transit trips in 2011[n] • Served by the Texas Eagle, Sunset Limited, and Heartland Flyer Amtrak routes

Exhibit 4-1. Texas Transportation at a Glance

Freight	• 11 deep-draft and 10 shallow ocean ports • 10,384 total miles of freight rail operated by 47 railroad companies[o] • 73% of Texas-manufactured goods are transported by truck[p] • By air, freight leaving Texas can reach any North American market in less than 4 hours[q]
International Trade	• 26 international border crossings (264,491 vehicles and 137,687 pedestrians cross daily)[r] • Greater than $17 billion of imports and exports processed annually[s]

Notes:
[a] US Census. 2010. Texas Population http://quickfacts.census.gov/qfd/states/48000.html
[b] USDOT – RITA, 2012. State Facts. http://gis.rita.dot.gov/StateFacts/StateFacts.aspx?StateName=Texas
[c] US Census, 2010. http://www.census.gov/geo/reference/ua/urban-rural-2010.html
[d] US Census, 2013. Get Facts http://quickfacts.census.gov/qfd/states/48000.html
[e] TxDOT. 2012. Standard Reports
[f] TxDOT Condition of Pavements, PMIS Annual Report 2010 – 2013
[g] TxDOT. 2013. Annual Budget.
[h] TxDOT Condition of Pavements, PMIS Annual Report 2010 – 2013
[i] USDOT, 2012. http://www.fhwa.dot.gov/bridge/owner.cfm
[j] USDOT – RITA, 2012. State Facts. http://gis.rita.dot.gov/StateFacts/StateFacts.aspx?StateName=Texas
[k] TxDOT. 2012. Transit Statistics. https://ftp.dot.state.tx.us/pub/txdot-info/ptn/transit_stats/2011.pdf
[l] TxDOT. 2012. Transit Statistics. https://ftp.dot.state.tx.us/pub/txdot-info/ptn/transit_stats/2011.pdf
[m] USDOT. 2012. State Facts. http://gis.rita.dot.gov/StateFacts/
[n] TxDOT. 2012. Texas Transit Statistics. https://ftp.dot.state.tx.us/pub/txdot-info/ptn/transit_stats/2011.pdf
[o] TxDOT. 2014. Rail Facts. http://www.dot.state.tx.us/business/rail/
[p] TxDOT. 2013. Texas Trucking Fact Sheet. http://ftp.dot.state.tx.us/pub/txdot-info/freight/trucking-fact-sheet.pdf
[q] TxDOT. 2013. Air Cargo Fact Sheet. http://ftp.dot.state.tx.us/pub/txdot-info/freight/air-fact-sheet.pdf
[r] TxDOT. 2013. Condition of Pavements, PMIS Annual Report 2010-2013
[s] TxDOT. 2013. Texas-Mexico Border Crossing Study. https://www.txdot.gov/inside-txdot/projects/studies/statewide/border-crossing/crossings.html

4.1.1 Passenger Travel

4.1.1.1 Highway

With 86 percent of the Texas population residing in metropolitan areas,[1] there is a large demand for urban roadways. In 2012, there were 167,002 million vehicle miles traveled (VMT) in urban areas and 70,834 million VMT in rural areas throughout the state – roughly two and three times the national averages, respectively.[2] While rural roadways may carry less than half the traffic volume of urban highways, the rural highway system is essential to the economic vitality of the state. It provides access to jobs and services for the millions of Texans residing in rural areas, facilitates commerce, and supports the activities of many Texas industries including farming, ranching, timber and logging, mineral extraction, and energy.

Houston, Dallas, Fort Worth, and Austin rank among the top-20 most congested cities in the nation in terms of annual person-hours of delay.[3] Nearly 75 percent of the top-100 most congested roadways in Texas are located in the Houston and Dallas-Fort Worth metropolitan areas (i.e., in Harris, Dallas, and Tarrant County).[4] Congestion in these and other metropolitan areas is expected to worsen significantly between 2010 and 2040 due to high population growth. The population in 35 Texas counties is expected to increase by 50 percent or more, with the highest percentage increases occurring in the Austin, Dallas, San Antonio, and Houston metropolitan areas. The 2040 baseline scenario of the Texas Statewide Analysis Model (SAM) v3 predicts that VMT will increase approximately 62 percent from 2010 to 2040 as a result of high population and employment growth (Exhibit 4-2).

1 US Census 2010. Urban and Rural Classification http://www.census.gov/geo/reference/ua/urban-rural-2010.html
2 USDOT. 2014. Annual Vehicle Miles. http://www.fhwa.dot.gov/policyinformation/statistics/2011/vm2.cfm
3 RITA. 2011. Annual Person Hours of Highway Traffic Delay per Auto Commuter. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_01_69.html
4 TxDOT. 2012. 100 Congested Roadways. http://www.txdot.gov/inside-txdot/projects/100-congested-roadways.html

Exhibit 4-2. Transportation Demographics Forecast

Texas Transportation Demographics	Forecasted Percent Increase (2010 – 2040)
Population	61
Employment	80
Vehicle Miles Traveled	62
Vehicle Hours Traveled	85
Number of Personal Trips (Total)	57
Number of Personal Trips (by Transit)	57
Number of Vehicle Trips	57

Source: Texas Statewide Analysis Model (SAM) V3

Despite high levels of congestion, the majority of work travel in the state's large metropolitan areas still occurs via single occupancy vehicles. As shown in Exhibit 4-3, driving alone accounts for 81 percent of work travel in the Austin metropolitan area; 85 percent in the Dallas metropolitan area; 81 percent in the El Paso metropolitan area; 83 percent in the Houston metropolitan area; and 83 percent in the San Antonio metropolitan area.[5]

Exhibit 4-3. Commuter Mode Choice Profile

	Austin	Dallas	El Paso	Houston	San Antonio
Drive alone	81%	85%	81%	83%	83%
Carpooled	12%	11%	11%	11%	12%
Public transportation	3%	1%	2%	1%	2%
Walked	2%	1%	2%	1%	2%
Taxicab, motorcycle, bicycle or other	3%	2%	3%	2%	1%

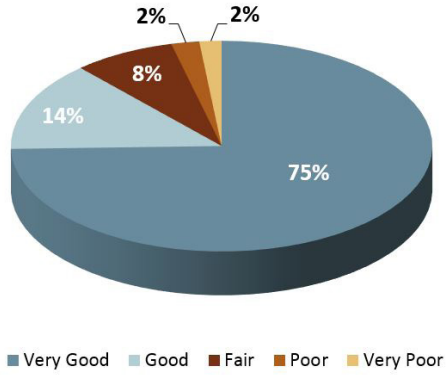
Source: US Census. 2012. American Community Survey. 3-year estimate

In addition to congestion reduction, highway safety and infrastructure preservation are among the top transportation priorities for the state. Continuing and focused efforts to improve highway safety have shown some success thus far: between 2003 and 2013, fatalities from crashes decreased by 11 percent, from 3,822 to 3,399.[6] Efforts to improve the condition and performance of infrastructure assets are ongoing and include an enhanced focus on developing and implementing proactive and strategic asset management practices and capabilities. Considering the size of the Texas transportation system and the total number of highway assets – pavement segments, bridges, and other ancillary assets – applying least life-cycle cost methods for the selection of preservation, rehabilitation, or replacement activities has the potential for huge cost savings when applied consistently throughout the state.

There are over 313,000 centerline miles of public roadways in Texas, of which over 80,000 are operated and maintained by TxDOT.[7] As shown in Exhibit 4-4, 88.3 percent of pavement lane-miles statewide were in "good" or "better" condition in fiscal year 2013. This represents the first overall improvement in pavement condition that occurred in the last four years and the highest percentage of pavement in "good" or "better" condition since fiscal year 2002 when the Texas Transportation Commission established the goal of 90 percent "good" or "better" pavement lane-miles statewide.[8]

5 US Census. 2012. American Community Survey. 3-year estimate.
6 TxDOT. 2012. Comparison of Motor Vehicle Traffic Deaths, Vehicle Miles, Death Rates and Economic Loss. http://ftp.dot.state.tx.us/pub/txdot-info/trf/crash_statistics/2012/comparisons.pdf
7 TxDOT. 2012. Standard Reports.
8 TxDOT. 2013. Condition of Pavements, PMIS Annual Report 2010-2013.

Exhibit 4-4. Statewide Pavement Condition (by lane-miles)



Condition Score	State of Good Repair
90-100	Very Good
70-89	Good
50-69	Fair
35-49	Poor
1-34	Very Poor

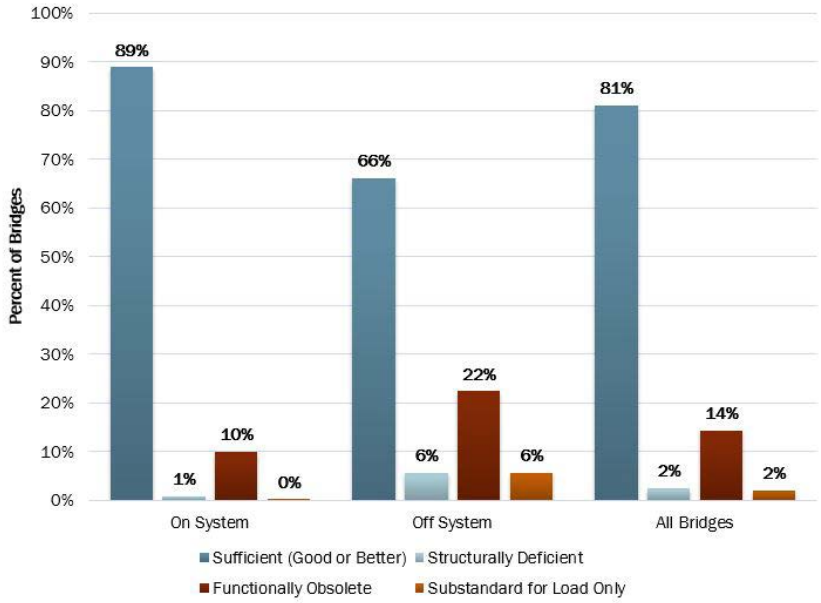
Source: TxDOT PMIS Annual Report (2010-2013)

There are 52,536 highway bridges in Texas, constituting 9 percent of the nation's total inventory of bridges.[9] Bridge performance is classified by condition, with deficient structures designated as structurally deficient or functionally obsolete based on FHWA reporting standards or as substandard-for-load if the carrying capacity is less than the maximum permitted by state law. Bridges in a state of good repair are not deficient in any respect.

As shown in Exhibit 4-5, bridge inspection data from September 2012 reveals that at the time of the inspection:

- More than 53 percent of highway bridges in Texas were built after 1970.
- Approximately 88 percent of on-system bridges (those located on the state highway network), 65 percent of off-system bridges, and 80 percent of total bridges were in a state of good repair.
- Less than 1 percent of on-system bridges were structurally deficient.
- Over 7,000 bridges (13.5 percent) in Texas were functionally obsolete.[10]

Exhibit 4-5. Condition of Texas Bridges by Count (September 2012)



Source: TxDOT. 2012. Report on Texas Bridges. http://ftp.dot.state.tx.us/pub/txdot-info/library/reports/gov/bridge/fy12.pdf

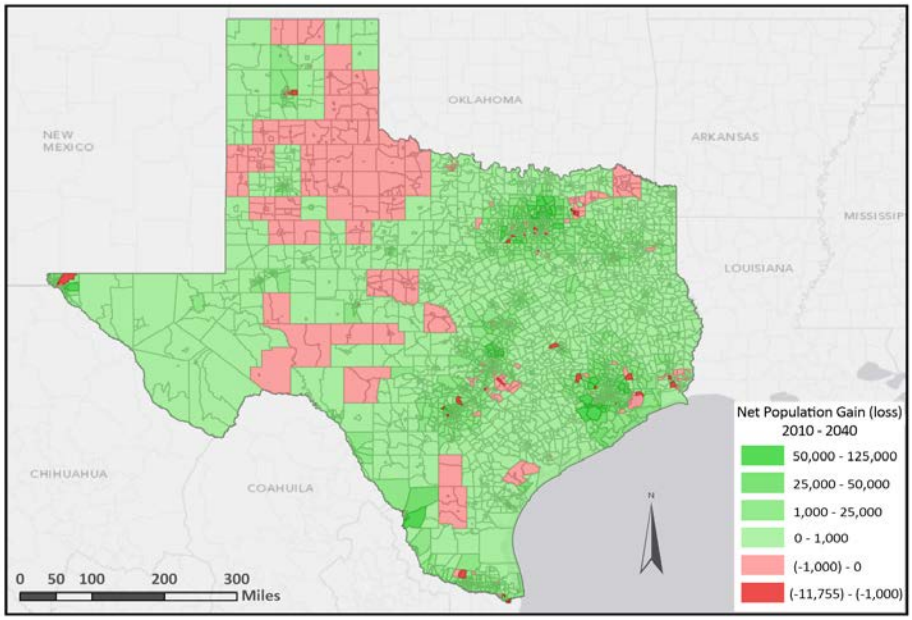
9 TxDOT. 2012. Report on Texas Bridges. http://ftp.dot.state.tx.us/pub/txdot-info/library/reports/gov/bridge/fy12.pdf
10 TxDOT. 2012. Report on Texas Bridges. http://ftp.dot.state.tx.us/pub/txdot-info/library/reports/gov/bridge/fy12.pdf

4.1.1.2 Transit

Transit provides a critical transportation option in metropolitan and rural areas alike. In 2011, there were 281 million transit passenger boardings in the state; this reflects an annual 2 percent increase in transit ridership between 2002 and 2012.[11] Transit services in Texas are primarily focused in the largest urban areas in accordance with the prevalence of use; however, every county has some form of public transportation.

Exhibit 4-6 illustrates the population shift projected from rural to urban areas between 2010 and 2040. Continuing urbanization in Texas combined with a high influx of new residents concentrated primarily in metropolitan areas will make transit an even more attractive and essential transportation option for the safe and efficient movement of people. As such, 2040 baseline scenario of SAM v3 predicts that passenger trips by urban rail will more than double between 2010 and 2040 (Exhibit 4-7).

Exhibit 4-6. Texas Population Change Projected from 2010 to 2040



Source: TxDOT. 2014. Texas Statewide Analysis Model (SAM) v3

Exhibit 4-7. Percent Change in Trips by Mode from 2010 to 2040

Passenger Transportation Mode	Forecasted Change in Trips from 2010 to 2040
Drive Alone	+ 57%
Share Ride (2 persons)	+ 57%
Share Ride (3+ persons)	+ 56%
Bus	+ 45%
Urban Rail	+ 201%
Long Distance Trip (Air and Intercity Rail)	+ 75%
Total Trips across All Modes	+ 57%

Source: TxDOT. 2014. Texas Statewide Analysis Model (SAM) v3

11 TxDOT. 2012. Texas Transit Statistics. http://www.txdot.gov/inside-txdot/forms-publications/publications/public-transportation.html

Rail transit is available in Houston, Dallas, Fort Worth, Austin, and Galveston. Additionally, rail transit provides access between Denton County and the Dallas-Fort Worth metropolitan area. Intercity rail services are available through Amtrak via the Sunset Limited route, which runs approximately 2,000 miles between New Orleans, San Antonio, and Los Angeles; the Texas Eagle, which travels daily between Chicago and San Antonio; and the Heartland Flyer, which connects between Oklahoma City and Fort Worth.

The current condition of transit assets in Texas is detailed in Tech Memo 6a summary is provided in Exhibit 4-8 by asset category and in Exhibit 4-9 by travel mode based on the following designations:

- **Excellent:** No visible defects – like new condition
- **Good:** Some (slightly) defective or deteriorated component(s)
- **Adequate:** Moderately defective or deteriorated component(s)
- **Marginal:** Defective or deteriorated component(s) in need of replacement
- **Worn:** Critically damaged component(s) or in need of immediate repair

Exhibit 4-8. Current Condition of Transit Assets by Asset Category

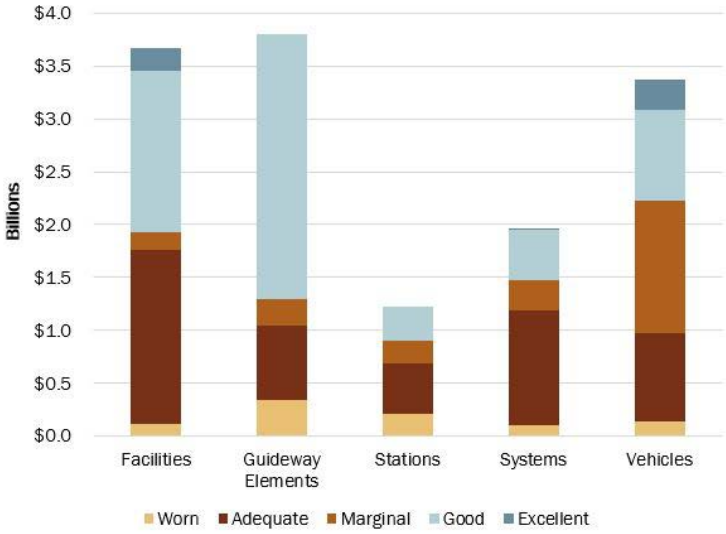
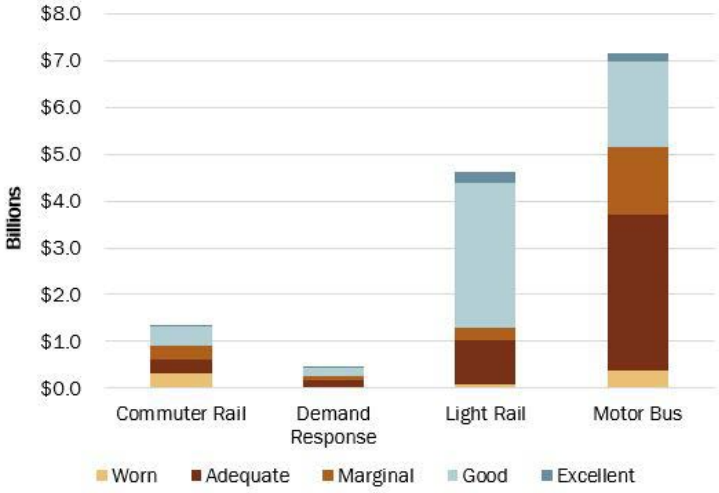


Exhibit 4-9. Current Condition of Transit Assets by Travel Mode



4.1.1.3 Aviation

Air travel is another significant passenger travel mode and an important contributor to the Texas economy based on its role in promoting tourism, creating jobs, and facilitating commerce. The Texas airport system is the largest in the nation with over 1,600 public and private landing sites, 292 airports, and two heliports. Of the total airports in Texas, 27 are classified as commercial service airports (26 primary and 1 non-primary based on annual passenger enplanements), 24 are classified as reliever airports, and 241 are classified as General Aviation airports.[12] Commercial service airports and the majority of reliever airports in Texas are located in large metropolitan areas. General Aviation airports provide access to more remote areas of the state and connect widely dispersed economic activity centers.

12 TxDOT. 2010. Airport Systems Plan. http://ftp.dot.state.tx.us/pub/txdot-info/avn/tasp_2010.pdf

Dallas-Fort Worth (DFW) International and Houston George Bush Intercontinental (IAH) consistently rank among the nation's busiest airports: in 2012, DFW ranked 3rd in the US for passenger arrivals and departures and 3rd overall for total departures; IAH ranked 13th in the US for passenger arrivals and departures and 7th overall for total departures.[13]

4.1.1.4 Non-Motorized

Providing safe, interconnected, and well-maintained pedestrian and bicycle facilities is essential for creating livable and sustainable communities, for improving residents' quality of life, and for supporting the use of walking and biking as viable travel modes rather than strictly for recreational purposes. While bicycle and pedestrian projects are implemented primarily by local governments, all major construction and reconstruction highway projects in Texas may include provisions for bicycle travel, and local agencies may fund the incorporation of bike lanes on state roads.

Texas ranked 45th in the nation with respect to the combined bike and walk to work share based on results from the 2007-2009 American Community Survey. Austin (#27), Houston (#37), El Paso (#42), San Antonio (#45), Arlington (#46), Dallas (#49) and Fort Worth (#51) all ranked among the top 51 US cities with respect to bike and walk to work share from 2007 to 2009.[14]

Pedestrian and bicycle safety is a top priority for the state. In 2010, Texas averaged 1.37 pedestrian fatalities per 100,000 residents—20th overall among states and slightly lower than the national rate of 1.38 pedestrian fatalities per 100,000 residents.[15] TxDOT is currently working with the Federal Highway Administration (FHWA) to develop and implement an aggressive plan to reduce pedestrian crashes, fatalities, and injuries.

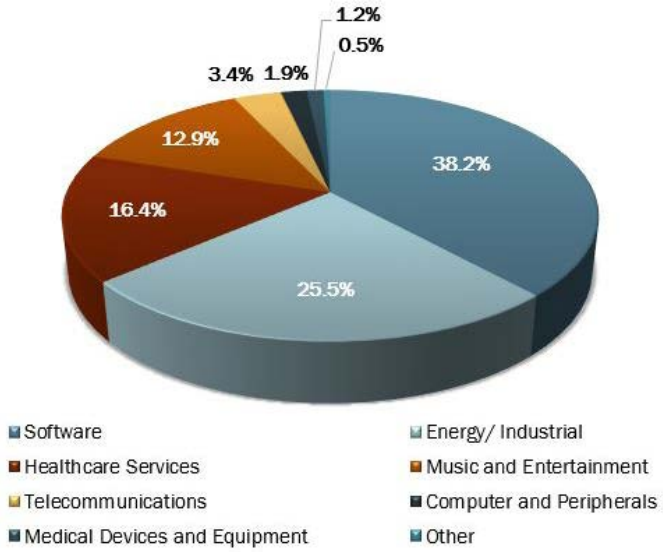
4.1.1.5 Intelligent Transportation System

Intelligent Transportation System (ITS) serve several purposes in Texas transportation that include traffic management, information dissemination, and border security. ITS devices provide real-time monitoring of system conditions and can be used to reduce incident response times and provide pertinent and timely information to travelers. The types of devices used in Texas include Dynamic Message Signs; Closed Circuit Television Camera; Lane Control Signals; radar detection; detection loops; Highway Advisory Radio; ramp meters; Automatic Vehicle Identification; flood warning sensors; and weather sensors.

In the future, ITS and transportation operations technologies will continue to be a critical component of system management and congestion reduction as a more cost effective alternative to traditional highway expansion. As technology becomes more robust and more integrated into the day-to-day lives of Texans, it will be critical to consider the changes that enhanced technology may bring about in the Texas Transportation Plan (TTP) 2040 horizon. For example, smart phones and electronic media will continue to change the way we travel and in many cases allowing us to not travel at all. In the TTP horizon, the Google driverless car will likely become a reality, further pushing the envelope of technology integration into the transportation network.

13 USDOT. 2014. RITA. Bureau of Transportation Statistics. http://www.transtats.bts.gov/airports.asp?pn=1
14 Alliance for Biking & Walking. 2012. Bicycling and Walking in the United States, 2012 Benchmarking Report Facts Sheet. http://www.peoplepoweredmovement.org/site/images/uploads/Media_Fact_Sheet_-_Benchmarking_2012.pdf
15 US Department of Transportation. Traffic Safety Facts 2010. http://www-nrd.nhtsa.dot.gov/Pubs/811659.pdf

Exhibit 4-10. Percentage of Dollars Invested in Texas by Industry



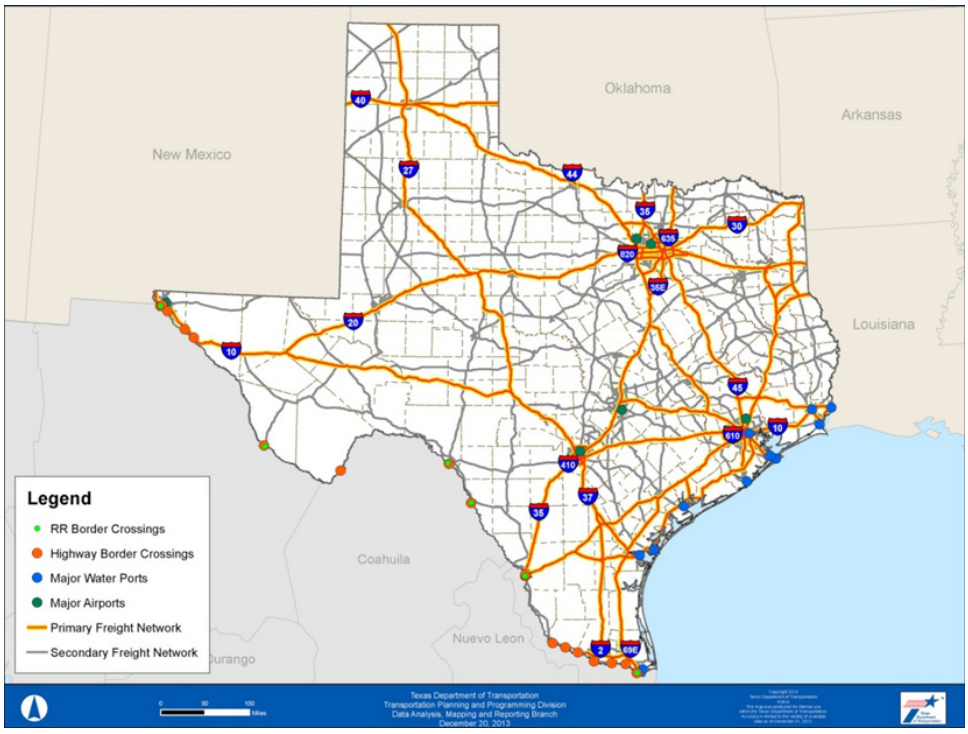
Source: PricewaterhouseCoopers and National Venture Capital Association. 2014. Money Tree Report

4.1.2 Freight

Texas has maintained strong economic and job growth despite the nation's economic downturn, and freight has played a key role in the state's economic resilience.[16] Industries that are largely fueling the growing Texas economy include software, energy/industrial, and healthcare services as shown in Exhibit 4-10.[17]

The Texas Primary Freight Network facilitates commerce and supports industry by transporting goods by ship, air, rail, truck, and pipeline (Exhibit 4-11). While some modes such as pipelines transport only goods, others such as the highway system transport both people and goods, and conflicts between freight and passenger movements have significant capacity and safety implications. In the case of the highway system, private automobiles and long-haul truckers mix primarily on the major interstates traversing the state.

Exhibit 4-11. Texas Freight Networks



Note: The Presidio Border Crossing is closed as of the writing of this report.

16 TxDOT. 2013. Lets Talk Freight. http://ftp.dot.state.tx.us/pub/txdot-info/freight/newsletter-0813.pdf
17 The Texas Economy. 2014. Industries that are fueling Texas Economic Growth. http://www.thetexaseconomy.org/business-industry/industries/articles/article.php?name=industries-fueling-growth

4.1.2.1 Trucking

Texas provides a land bridge for freight movements from California to the east coast along IH 10 and IH 40, and from Mexico to US destinations and Canada along IH 35, IH 69, and US 59. On average, heavy vehicle traffic constitutes approximately 12 percent of the vehicle miles traveled in Texas annually.[18]

1.2 billion tons of freight were transported on the Texas highway system in 2011, constituting more than 46 percent of all freight moved in the state that same year; by 2040, truck tonnage is expected to increase by 78 percent and account for 56 percent of all freight moved.[19] Trucking supports the Texas economy by:

- **Creating jobs:** 1 in 16 Texans are employed by approximately 66,000 trucking companies, including over 185,000 truck drivers.
- **Supporting Texas industry:** 73 percent of goods manufactured in Texas are transported by truck.
- **Facilitating international trade:** 85 percent of trade between Texas and Mexico is transported by truck.[20]

TxDOT is currently developing the first statewide, multimodal freight plan – the Texas Freight Mobility Plan (TFMP) – which is included in the TTP 2040 by reference.

4.1.2.2 Water Ports

There are 11 deep-draft water ports, 10 shallow, and five other (categorized as "other") ports in Texas that are connected by the Gulf Intracoastal Waterway (GIWW), a navigable inland waterway that runs along the state's eastern coastline. Collectively, Texas ports rank first nationally in goods exports and waterborne commerce and account for 19 percent of the total port tonnage in the US, handling approximately 564 million tons of foreign and domestic freight annually.[21]

In 2011, maritime cargo activity at ports generated $277 billion in economic value, representing 25 percent of the State Gross Domestic Product (GDP).[22] In addition to increasing GDP, ports support the Texas economy by creating opportunities for employment: approximately 1.5 million jobs are directly or indirectly related to moving cargo via port terminals in the state. Port security is vital for preventing illegal imports/ exports or the mishandling of hazardous imports and – when expanded to include maritime security – the economic losses resulting from piracy and other criminal activities that threaten the security and economic competitiveness of the state.

4.1.2.3 Railroads

Texas ranks first in the nation for the number of rail miles with approximately 10,400 total miles.[23] On average, Texas railroads transport 8.8 million car loads of freight annually – the second highest annual number of car loads in the country.[24] In 2011, over 7 million tons of intermodal rail freight was transported from Texas. Coal and chemicals account for the majority of rail freight originating and terminating in the state.[25]

18 TxDOT. 2013. Texas Freight Mobility Plan – Trucking Factsheet. http://ftp.dot.state.tx.us/pub/txdot-info/freight/trucking-fact-sheet.pdf
19 TxDOT. 2013. Texas Freight Mobility Plan – Trucking Factsheet. http://ftp.dot.state.tx.us/pub/txdot-info/freight/trucking-fact-sheet.pdf
20 TxDOT. 2013. Texas Freight Mobility Plan – Trucking Factsheet. http://ftp.dot.state.tx.us/pub/txdot-info/freight/trucking-fact-sheet.pdf
21 TxDOT. 2013. Texas Freight Trends and Issues. http://ftp.dot.state.tx.us/pub/txdot-info/freight/white-papers/white-paper-freight-trends-and-issues.pdf
22 TxDOT. 2012. Impacts on Texas Ports and the Landslide Transportation System from the Panama Canal Expansion. https://ftp.dot.state.tx.us/pub/txdot-info/adm/2012/documents/minute_orders/dec13/4aPanama-Canal-Report.pdf
23 TxDOT 2013. Texas Freight Mobility Plan – Texas Railroads. http://ftp.dot.state.tx.us/pub/txdot-info/freight/rail-fact-sheet.pdf
24 TxDOT. 2013. Let's Talk Freight. http://ftp.dot.state.tx.us/pub/txdot-info/freight/newsletter-0813.pdf
25 TxDOT. 2013. Let's Talk Freight. http://ftp.dot.state.tx.us/pub/txdot-info/freight/newsletter-0813.pdf

Freight rail in Texas ranks first in the nation for employment. More than 17,000 Texans are employed by 47 freight railroad companies that operate in the state, of which there are three Class I (major) railroad companies: Union Pacific (UP), Burlington Northern Santa Fe (BNSF), and Kansas City Southern (KCS).[26]

Five of seven total rail crossings between the US and Mexico are located in Texas, and these crossings handle 89 percent of the total rail containers transported from Mexico to the US. In addition to handling the majority of cross-border freight transported by rail (by volume), Texas is a major hub for national freight rail movements. As one of the busiest and most congested railroad hubs in the country, Tower 55 near Fort Worth provides a critical junction point for the national freight and passenger rail networks alike, with nearly 100 freight and passenger trains moving through the area every day.[27]

4.1.2.4 Air Cargo

Due to the high cost of shipping, goods transported by air are primarily perishable or of high value.[28] For this reason, while the weight share of goods shipped by air compared to the total goods transported via freight modes is less than 1 percent, the value share of goods shipped by air is approximately 16 percent of the total value of goods transported via freight modes. Imported goods constitute the majority of air freight handled in Texas.

As a growing part of the state economy, air cargo is particularly contributing to the rapid expansion of oil and gas exploration and the local biomedical industry in Houston. These industries are helped by the fact that flights leaving any airport in Texas can reach any domestic market in less than 4 hours.

International air cargo shipments at DFW International airport have more than doubled between 1999 and 2013. In 2012, DFW (#10) and IAH (#17) ranked among the top-20 US airports with respect to the gross weight of air cargo handled. IAH is the fastest growing air cargo hub in the state.[29]

4.1.2.5 Pipeline

Texas has the most extensive pipeline in the US, with over 360,000 total miles of pipelines carrying crude oil, natural gas, and other liquids. Respectively, in 2013 oil and natural gas production in Texas comprise 32 percent and 27 percent – respectively – of the total amounts produced domestically[30].

Over the past decade, the state has experienced a tremendous increase in the exploration and production of energy resources. As an example, shale natural gas production in Texas doubled between 2008 and 2013.[31] This increase in energy-related activity has greatly benefited local and state economies. However, the increase in heavy truck volume to support oil and gas production has accelerated the deterioration of the state's roadways – many of which were not initially designed to support heavy traffic loads.[32] Determining and addressing energy sector impacts on the condition of Texas roadways will continue to be a priority for the state going forward.

26 TxDOT. 2013. Let's Talk Freight. http://ftp.dot.state.tx.us/pub/txdot-info/freight/newsletter-0813.pdf
27 BNSF Railway Company. 2010. Tower 55 Fact Sheet. http://www.corridorsofcommerce.com/tower55/pdf/T-55-Fact-Sheet.pdf
28 TxDOT. 2013. Freight Mobility Plan – Air Cargo. http://ftp.dot.state.tx.us/pub/txdot-info/freight/air-fact-sheet.pdf
29 TxDOT. 2013. Air Cargo Fact Sheet. http://ftp.dot.state.tx.us/pub/txdot-info/freight/air-fact-sheet.pdf
30 U.S. Energy Information Administration. 2013 Production. Accessed February 2015. www.eia.gov
31 U.S. Energy Information Administration. 2015. Natural Gas Gross Withdrawals and Production. Accessed February 2015. www.eia.gov
32 Railroad Commission of Texas. 2013. http://www.rrc.state.tx.us/data/gasservices/vitalstats/mileage.php Accessed November 7, 2013

4.2 Achieving State of Good Repair – Needs Summary

As previously noted, the TTP is performance-based, with needs estimated using performance measures to better understand the costs to achieve SGR or similar performance targets over the TTP 25-year horizon. The unconstrained needs presented by mode in Exhibit 4-12 and in sections that follow represent the costs to achieve SGR goals for state-owned pavements, bridges, culverts, and ITS devices as well as for all Metropolitan Transit Authority (MTA) and nonMTA transit assets; to achieve moderate system expansion and manage congestion given expected population growth; and to increase mode choice by investing in transit and bicycle and pedestrian modes among others. Unconstrained freight needs estimated as part of a parallel effort to develop the TFMP are also presented. Additional information regarding the existing conditions and needs development for each mode can be found in the corresponding Modal Profiles in *Technical Memorandum #6.*

Based on the methodologies and assumptions described in the sections that follow, unconstrained needs were estimated at $21 billion annually (2014 constant dollars) with the state primarily responsible for modes that account for 60 percent of the identified long-term investments.

*Exhibit 4-12. State of Good Repair Needs to 2040 by Mode**

Mode	Summary of Methodology	SGR Needs through 2040 (2014 Dollars)
Highways – Pavement	Life-cycle cost analysis on road operated and maintained by TxDOT to determine cost-beneficial investments to achieve roadways that are pothole free and support a smooth ride	$103.7 B ($4.0 B/year)
Highways – Bridge/Culvert	Life-cycle cost analysis to determine cost-beneficial investments to achieve bridges that are structurally sound and open for use	$40 B ($1.5 B/year)
Highways – Expansion	Statewide Analysis Model (SAM) v3 used to identify the additional lane miles needed to achieve a state average of LOS C and the associated implementation costs based on unit cost assumptions	$239.2 B ($9.2 B/year)
Transit (excluding Passenger Rail)	Life-cycle cost analysis to determine cost-beneficial investments that result in buses, trains, and associated facilities in all areas of the state that are comfortable and reliable for existing assets; coordination with MPO plans and transit agencies to determine expansion needs by region (major urban, collar, small urban, rural)	$101.2 B ($3.9 B/year) - $93.6 B (MTAs) - $7.6 B (non-MTAs)
Passenger Rail	Costs to construct and operate two new high speed rail systems from Oklahoma City to south Texas and from Dallas-Fort Worth to Houston; costs to expand existing AMTRAK services	$21.6 B ($0.8 B/year)
Bicycle and Pedestrian	MPO transportation plans compiled to develop needs along with information from recreation agencies and interest groups on opportunities for expansion; additional needs ($0.4 B) assumed for rural areas	$2.19 B ($0.08 B/year)
Aviation	Needs extrapolated from TxDOT's RAMP and TADS systems and other costs identified by commercial services and general aviation airports and reported to TxDOT	$20.4 B ($0.8 B/year)
ITS	Costs to operate/maintain/replace existing ITS devices and to implement/operate/maintain future planned devices as identified by TxDOT	$13 B ($0.5 B/year)
Non-Highway Freight	In addition to highway bottleneck reduction and all pavement and bridge needs identified in the TTP, additional freight needs for the TTP horizon include private needs for rail and ports based on TFMP and other existing data sources	$5.7 B ($0.22 B/year) $3.9 B (freight rail) $0.8 B (port & waterway) $1.0 B (air cargo)
Total		**$547 B ($21 B/year)**

*Safety is not a mode, but safety is addressed for each mode in the unconstrained total

4.3 Modal Profile – Highways and Bridges

4.3.1 Bridge and Culvert Existing Conditions and Unconstrained Needs

TxDOT maintains 33,513 bridges and culverts on the state system that are on average 36 years old and 2 percent structurally deficient by deck area (Exhibit 4-13).[33]

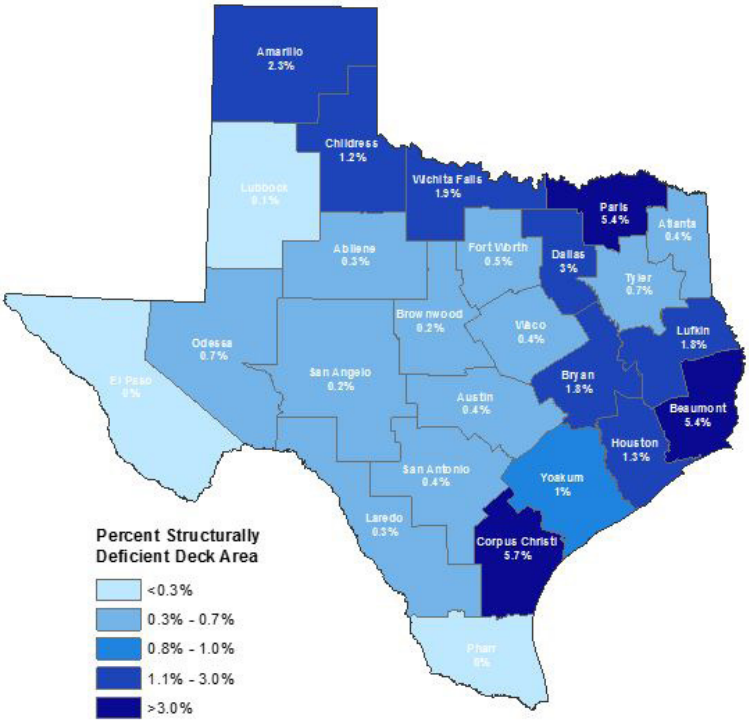
Exhibit 4-13. Existing Conditions by Bridge and Culvert Network

Network	Inventory Count	Average Age (Years)	Percent Structurally Deficient Deck Area
National Highway System (NHS)	18,384	32	1.5%
Non-NHS	16,808	41	2.0%
On Freight System*	7,797	32	3.4%
Off Freight System*	27,463	37	1.4%
Statewide	**35,260**	**36**	**1.6%**

*Freight System refers to the NBI field "Designated National Truck Route" in the National Bridge Inventory dataset published by the USDOT Federal Highway Administration.

Exhibit 4-14 illustrates the percentage of structurally deficient deck area by district as currently exists. No districts currently have structurally deficient (a 4 or lower NBI condition rating) deck areas exceeding the federally mandated 10 percent on the NHS. In terms of the current backlog of corrective repairs and replacements, TxDOT District's Paris, Corpus Christi, and Beaumont currently have just over 5 percent structurally deficient deck area. A small percentage of the State system (0.2 percent) has an NBI rating of 3 or less indicating higher structural risk; of these, the Beaumont District has nearly half of the higher risk deck areas while the Amarillo District has the largest number of higher risk structures.

Exhibit 4-14. Existing Bridge Conditions – Percent Structurally Deficient Deck Area by District



Source: US Department of Transportation. 2012. National Bridge Inventory Database.

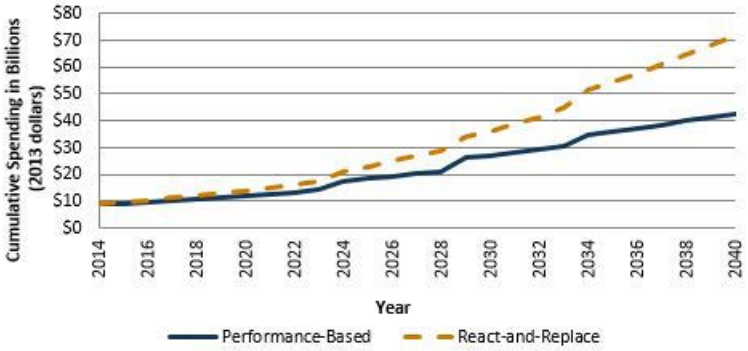
33 US Department of Transportation. 2012. National Bridge Inventory Database.

As defined by TxDOT, bridges and culverts are considered to be in a state of good repair when not structurally deficient, functionally obsolete, or sub-standard for load. Thus, unconstrained bridge needs reflect the routine and preventive maintenance cyclical costs and the capital cost required to 1) prevent and eliminate structural deficiency and strengthen sub-standard for load structures; and 2) correct for functional obsolescence at the time a cost-effective replacement activity is programmed to address structural deficiency. This performance-based needs assessment is consistent with MAP-21 guidance and best practices across state DOTs.

In using the methodology summarized above – and described in further detail in Technical Memorandum #6: Bridge and Culvert Modal Profile – it was found that TxDOT would need over $42.41 billion (2013 dollars) or $1.57 billion on average each year to eliminate structural deficiencies, reduce functional obsolescence, and minimize life-cycle costs on the state network through 2040. This strategy is termed the "performance-based" scenario. Alternatively, if TxDOT preferred to streamline the replacement of older structures at the time of predicted structural deficiency – termed the "react-and-replace" scenario – costs would be predicted to reach over $71.43 billion through 2040 (2013 dollars) or an average of $2.65 billion annually. Through a performance-based strategy, nearly $29.02 billion worth of savings (2013 dollars) may be realized over the TTP 25-year horizon (Exhibit 4-15).

Because of the planning-level nature of the TTP, initial estimates of projected needs/dollar values were first identified in previous sections and the presented in various parts of this document. These estimates served as a baseline and were then refined and interpolated based on projections, normalized growth rates and coordination with TxDOT and other stakeholders. These revisions varied based on mode type and the associated factors previously mentioned; refined values are listed in Exhibit ES-3 and Exhibit 4-12.

Exhibit 4-15. Forecasted Cumulative Expenditures in an Unconstrained Scenario



Based on the predicted timings to structural deficiency, and considering that groupings of assets are often constructed around the same time, peaks in activity timings are expected to occur throughout the TTP horizon. Three peaks in particular have been identified, with multiple higher cost activities anticipated to be required around 2024, 2029, and 2034 (Exhibit 4-16).

Exhibit 4-16. Forecasted Annual Expenditures in an Unconstrained Scenario

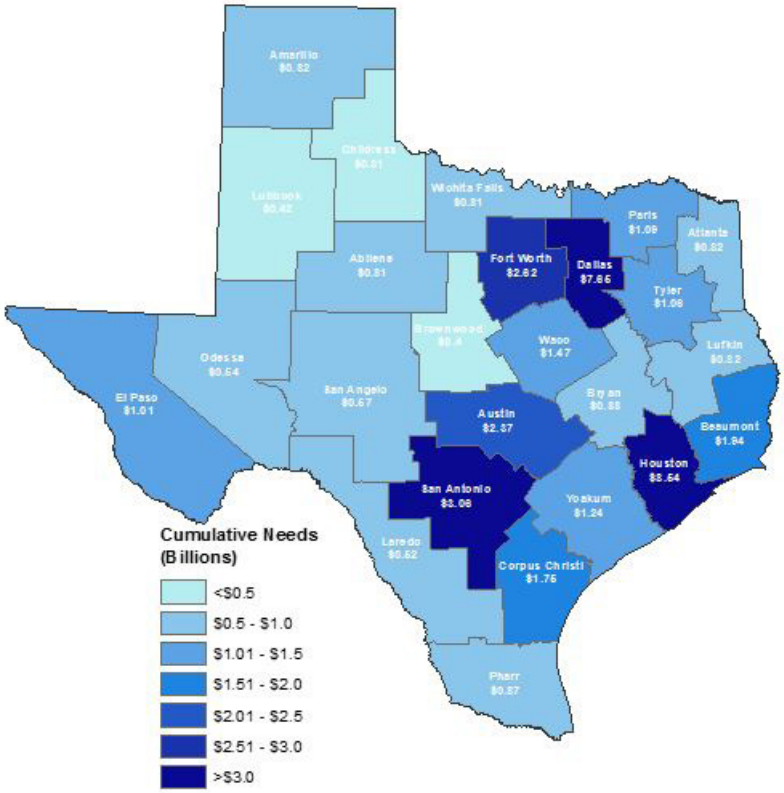
Approximately 80 percent of the total needs are anticipated to be required on the NHS due to the larger inventory of structures and higher improvement needs resulting from relatively high truck volumes; roughly half of this cost is expected to be split between the Interstate and nonInterstate systems. A slightly higher split (40 percent/60 percent) is projected for needs on and off the designated National Freight Network, respectively, given the larger inventory of bridge and culvert assets located off the National Freight Network (Exhibit 4-17).

Exhibit 4-17. 2040 Bridge and Culvert Needs (On-System Network)

Network	Needs (Billions in 2013 Dollars)
NHS Interstate	$16.03
NHS Non-Interstate	$17.29
Non-NHS	$9.09
On Freight System*	$17.16
Off Freight System*	$25.26
Statewide	**$42.41**

*Freight System refers to the NBI field "Designated National Truck Route" in the National Bridge Inventory dataset published by the USDOT Federal Highway Administration.

Exhibit 4-18. Forecasted 2040 Bridge Needs by District



The magnitude of needs is expected to be greater around major cities due to higher concentrations of structures and higher unit costs in urban versus rural areas of the state. As shown in Exhibit 4-18, the Houston District is expected to have the greatest cumulative bridge needs through 2040, followed by the Dallas, San Antonio, Fort Worth, and Austin Districts, respectively.

Given uncertainties in future revenue and the potential for an infusion of resources, trade-off analyses were conducted around the performance bought at different investment levels (Exhibit 4-19).

4.3.2 Pavement Existing Conditions and Unconstrained Needs

Texas has the largest highway system in the nation. The pavements are aging while passenger and freight movement in Texas continues to grow. Therefore, it is vital to maintain highway pavements in "good" condition to provide an acceptable level of service. The public is also aware of pavement distresses and potholes, and keeping Texas' pavements smooth and structurally sound supports the TxDOT's safety goals.

The TxDOT maintains a Pavement Management Information System (PMIS) that contains basic inventory information and annual inspection data for all on-system pavements. Based on information obtained from the PMIS, TxDOT owns and maintains approximately 197,200 lane-miles of pavements as of 2013. Exhibit 4-20 presents the lane-miles for each facility type on the highway system.

Exhibit 4-19. Forecasted Performance over Planning Horizon Relative to Investment Level

Exhibit 4-20. On-System Lane-Miles by Facility Type 2013

Highway Facility Type	Lane-Miles	Percent of Total
Interstate Highways	24,650	12.50
US Highways	39,9654	20.27
State Highways	43,352	21.98
Business Routes	3,210	1.63
Farm-to-Market Roads	85,262	43.23
Principal Arterial Streets	80	0.04
Park Roads	683	0.35
Total	**197,202**	**100**

Note: Compiled by CH2M HILL from TxDOT sources for the TTP 2040

Three types of pavements are used on the state system: flexible or asphalt concrete pavement, continuously reinforced concrete pavement, and jointed concrete pavement. Exhibit 4-21 presents the lane-miles for each type of pavement, indicating that more than 90 percent of on-system pavements are asphalt concrete pavement.

Exhibit 4-21. On-System Pavement Lane-Miles by Pavement Type 2013

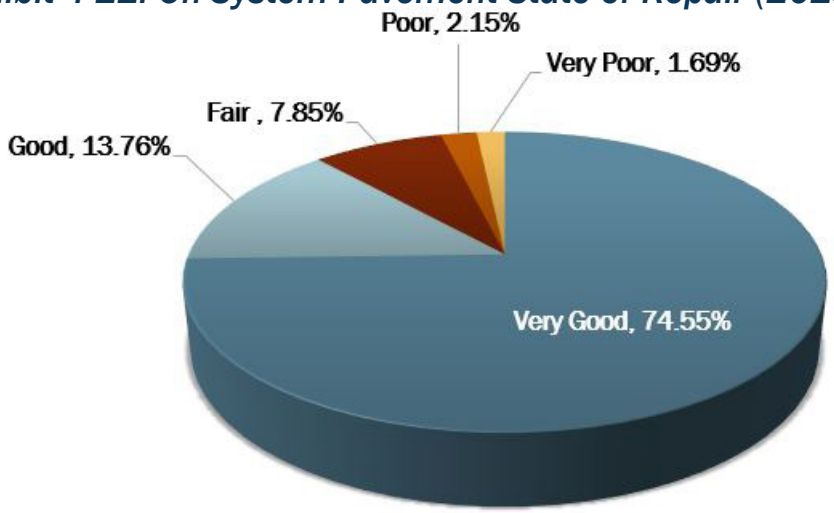
Pavement Type	Lane-Miles	Percent
Flexible or Asphalt Concrete Pavement	179,600	91.07
Continuously Reinforced Concrete Pavement	13,779	6.99
Jointed Concrete Pavement	3,823	1.94
Total	**197,202**	**100**

The SGR for on-system pavements based on 2013 inspection data from the PMIS is shown in Exhibit 4-22. This exhibit shows that pavements rated "good" or "better" totaled 88.3 percent based on the Pavement Condition Score as defined in Section 3.3.1, with further details provided in *Technical Memorandum #6: Pavement Modal Profile.*

Unconstrained pavement needs reflect the costs to maintain, preserve, and rehabilitate on-system roadways to achieve "good" or "better" pavement condition with respect to the Pavement Condition Score; this measure incorporates both pavement ride quality and structural health as described in Section 3.3.1. Routine maintenance is conducted regularly by TxDOT to repair localized failures such as potholes and cracks. Pavement treatments beyond routine maintenance are generally grouped into four categories in the PMIS: preventive maintenance, light rehabilitation, medium rehabilitation, and heavy rehabilitation or replacement. These treatments are more expensive and extensive than routine maintenance and are applied in order to improve the functional and structural condition of roadways.

Since routine maintenance is applied on a consistent basis, the average annual routine maintenance cost for the past five years for on-system pavements was used to develop the routine maintenance needs through 2040. The decision trees presented in *Technical Memorandum #3 (Section 3.1): Pavement Methodology* were used to identify the most effective preservation or rehabilitation treatments based on the predicted condition of individual pavement segments over the TTP horizon; this ensures that the initial backlog of needs is addressed and prevented from accruing further. As there could be several

Exhibit 4-22. On-System Pavement State of Repair (2013)



possible sets of treatments and associated timings for a given pavement segment, life-cycle cost analysis was used to identify the optimal combinations of treatments and timings that minimize total cost over the asset's usable life. The sum of needs for all individual pavement segments was assumed to be equal to the unconstrained pavement needs for the entire network.

The unconstrained needs through 2040, as determined by the methodology described above, totals $111.71 billion or an average of $4.14 billion each year (2014 dollars). As shown in Exhibit 4-23, approximately 90 percent of the total needs (approximately $99.94 billion) are for preventive maintenance and rehabilitation while the remaining 10 percent of needs (approximately $11.billion) are for routine maintenance. The needs fluctuate throughout the TTP horizon (Exhibit 4-24) and are largest at the beginning due to the existing backlog. The next largest needs are expected to occur in 2026 due to the relatively high number of lane-miles predicted to be in need of heavy rehabilitation (Exhibit 4-25).

Because the TTP is a planning document and not a program, initial estimates of projected needs and their respective dollar values were first identified in the modal profile and presented in various parts of this document. These estimates served as a baseline and were then refined and interpolated based on projections, normalized growth rates and coordination with TxDOT and other stakeholders. These revisions varied based on mode type and the associated factors previously mentioned; refined values are listed in Exhibit ES-3 and Exhibit 4-12.

Exhibit 4-23. Summary of Unconstrained Needs through 2040 by Pavement Treatment Type

Category	Pavement Treatment Type	2014-2040 Needs (Billions)	Equivalent Annual Needs (Billions)
Routine Maintenance	Total Routine Maintenance	$11.77	$0.44
Preventive Maintenance and Rehabilitation	Preventive Maintenance	$7.72	$0.29
	Light/Medium Rehabilitation	$59.51	$2.20
	Heavy Rehabilitation/ Reconstruction	$32.72	$1.21
	Total Preventive Maintenance and Rehabilitation	$99.94	$3.70
Total		**$111.71**	**$4.14**

Exhibit 4-24. Annual Pavement Preventive Maintenance and Rehabilitation Needs

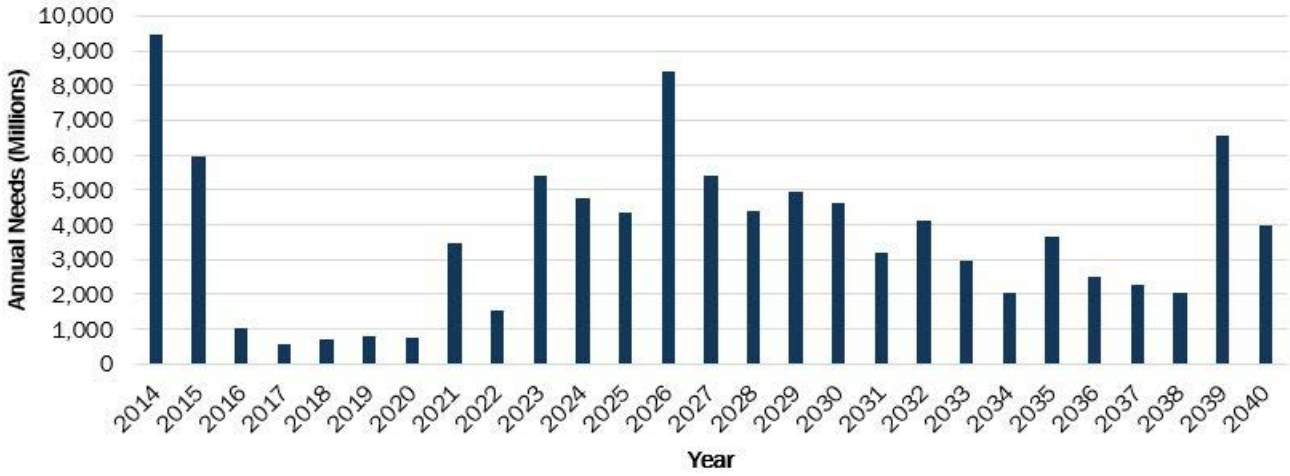
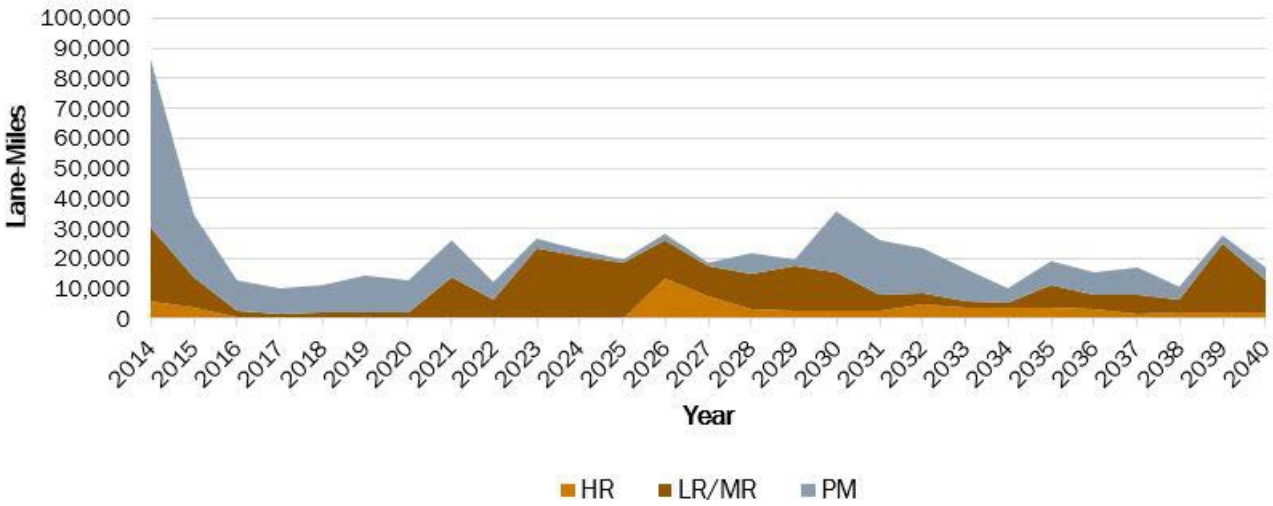
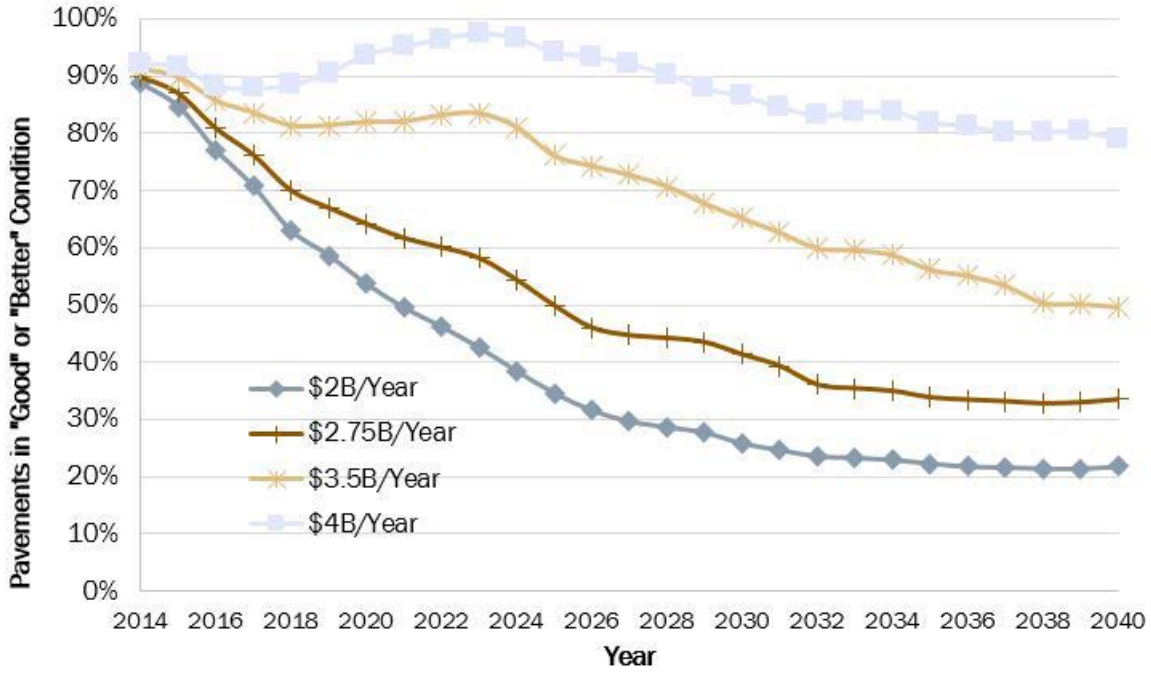


Exhibit 4-25. Lane-Miles of Needs by Treatment Type



Given uncertainties in future revenue projections and the potential for an infusion of additional resources, trade-off analyses were conducted at different budget levels to predict the resulting percentage of pavements in "good" or "better" condition (Exhibit 4-26).

Exhibit 4-26. Pavement State of Good Repair Trend at Different Budget Levels



4.3.3 Expansion Existing Conditions and Unconstrained Needs

As previously noted, Texas is projected to experience robust growth through 2040 in terms of both population and employment that will be concentrated in urban areas of the state. This growth is expected to result in a 57 percent increase in total trip volumes from 2010 levels (Exhibit 4-27). As a result of this increase in traffic combined with roadway expansion limitations, congestion is expected to worsen over the TTP horizon, particularly in the morning and evening peak travel periods but also in the midday and overnight periods as drivers adjust their schedules to avoid peak congestion (Exhibit 4-28).

Exhibit 4-27. Statewide Analysis Model (SAM) v3 Base Scenarios

Scenario	Percent Average Annual Growth (2010-2040)	Percent Increase (2010-2040)
Population	2.03	60.9
Employment	2.36	70.9
Vehicle Miles Traveled	2.02	60.6
Vehicle Hours Traveled	2.68	80.3
Number of Person Trips	1.90	57.0
Number of Vehicle Trips	1.91	57.3

As further defined in Section 3.3.1, the Commuter Stress Index (CSI) and total delay measures can be used to identify and predict future roadway deficiencies with respect to the degree of congestion severity and time lost due to congestion, respectively. Exhibit 4-29 and Exhibit 4-30 indicate that increases in both CSI and total delay are expected to outpace increases in population and employment over the TTP horizon. Current and future congestion will need to be addressed to ensure that increased traffic on Texas roadways does not hinder the state's economic competitiveness.

Exhibit 4-28. Vehicle Miles Traveled Growth by Time of Day

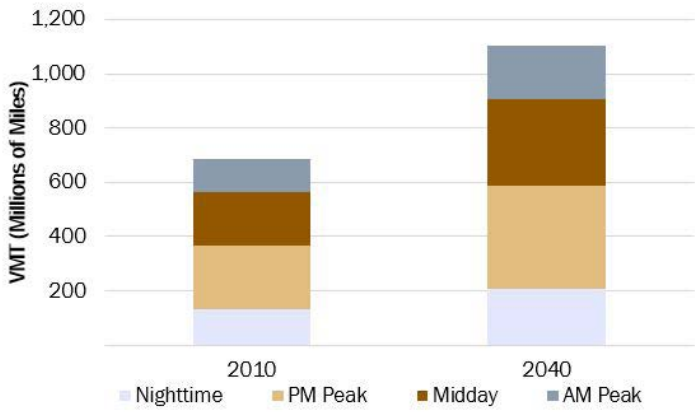


Exhibit 4-29. Forecasted Increase in Commuter Stress Index

Area	2010 CSI	2040 CSI	Percent Average Annual Growth	Percent Increase (2010–2040)
Statewide Total	4,924	10,655	3.9	116

Exhibit 4-30. Forecasted Increase in Annual Delay by Area Type

Area	2010 Delay (Vehicle-hours)	2040 Delay (Vehicle-hours)	Percent Average Annual Growth	Percent Increase (2010–2040)
Rural	100,721,100	548,715,200	14.8	445
Urban	406,239,700	1,199,396,300	6.5	195
Statewide Total	**506,960,800**	**1,748,111,500**	**8.2**	**245**

To determine system expansion needs through 2040, the amount of extra capacity needed to allow roadways on the state system to operate at or above a given level of congestion throughout the TTP horizon was estimated, with the cost of improvements determined based on unit cost assumptions. The SAM v3 provided the network and traffic data used for this analysis. Additional details regarding the methodology – including unit cost assumptions for capacity enhancement and right-of-way – can be found in *Technical Memorandum #6: Expansion Modal Profile.*

The level of service (LOS) measure – as applied in *The Highway Capacity Manual* and American Association State Highway and Transportation Officials (*AASHTO) Geometric Design of Highway and Streets* – was used to identify current and predicted future network deficiencies with respect to congestion. This measure allows for flexibility in qualitatively defining an acceptable level of congestion. LOS A represents free flow traffic and LOS F represents a complete breakdown of flow. Below is a brief description of each LOS category.

A. **Free flow.** Traffic flows at or above the posted speed limit and motorists have complete mobility between lanes. The effects of incidents or point breakdowns are easily absorbed.

B. **Reasonably free flow.** LOS A speeds are maintained while maneuverability within the traffic stream is slightly restricted.

C. **Stable flow, at or near free flow.** Most experienced drivers are comfortable, roads remain safely below but efficiently close to capacity, and posted speed is maintained. Minor incidents may still have no effect but localized service will have noticeable effects and traffic delays will form behind the incident. This is the target LOS for some urban and most rural highways.

D. **Approaching unstable flow.** Speeds slightly decrease as traffic volume slightly increases. Minor incidents are expected to create delays. Examples are a busy shopping corridor in the middle of a weekday, or a functional urban highway during commuting hours. It is a common goal for urban streets during peak hours, as attaining LOS C would require prohibitive cost and societal impact in bypass roads and lane additions.

E. **Unstable flow, operating at capacity.** Flow becomes irregular and speed varies rapidly as there are virtually no usable gaps to maneuver in the traffic stream. Any incident or disruption to traffic flow, such as merging ramp traffic or lane changes, will create a shock wave affecting traffic upstream. This is a common standard in large urban areas where congestion is inevitable.

F. **Forced or breakdown flow.** Every vehicle moves in lockstep with the vehicle in front of it, with frequent slowing required. Travel time cannot be predicted, with generally more demand than capacity. A road in a constant traffic jam is at this LOS.

Exhibit 4-31 identifies the cost to achieve varying levels of service for a 30-year horizon (2010-2040) based on the number of additional lane miles needed to keep baseline or forecasted future volumes at that desired service level. Unconstrained needs, defined as achieving LOS C in both rural and urban areas, were found to be $297.76 billion (2014 dollars), or about $10 billion per year.

Exhibit 4-31. Additional Lane-Miles and Costs to Achieve Varying Levels of Service through 2040

Rural LOS Achieved	Urban LOS Achieved	Additional Lane-Miles	Total Cost (Billions in 2014 Dollars)	Total Annual Cost (Billions in 2014 Dollars)
C	**C**	**27,785**	**$297.76**	**$9.93**
E	E	14,281	$207.24	$6.91
C	E	23,934	$220.02	$7.33
E	C	18,133	$285.00	$9.50
D	C	19,898	$287.37	$9.58
D	E	16,047	$209.61	$6.99
E	D	15,453	$232.84	$7.76
C	D, urban primary freight at LOS C	26,127	$270.78	$9.03
C	D	25,105	$245.62	$8.19
D	D	17,218	$235.21	$7.84

4.3.4 Energy Sector Impacts to Highways and Bridges

While beneficial to the Texas economy – generating tax revenues and employing thousands including in economically disadvantaged areas with limited jobs otherwise – the energy sector is detrimental to transportation infrastructure in the state. Energy sector activities associated particularly with oil, natural gas, and wind energy exploration and production require a large number of heavy vehicles that damage roadway and bridge infrastructure and reduce their service life. The Center for Transportation Research at the University of Texas estimates that activities related to gas production reduce pavement service life by up to 30 percent from an average of 20 years; oil well operations are estimated to reduce pavement service life by up to 16 percent.[34] Bridges are designed to withstand the heavy loads; however, many have geometric constraints with respect to vertical clearance or width to accommodate drilling rigs or other oversized loads that must be addressed.

Damaged or insufficient infrastructure presents a safety hazard to motorists and a funding and logistical challenge for TxDOT and local governments that are struggling to address growing infrastructure needs amid increasingly constrained resources. Proactive asset management approaches are understood to be much more cost-effective than reactive maintenance and replacement, with some estimates citing up to a 700 percent reduction in overall repair and maintenance costs.[35] However, the "boom or bust" nature of energy production makes it challenging for state and local agencies to preemptively and gradually increase maintenance and rehabilitation efforts to prepare roadways for future high volumes of heavy vehicles.

In 2014, TxDOT requested $400 million of general revenue to repair existing infrastructure to accommodate energy-related activity along state highways, and $600 million of general revenue in each year of the biennium to reinforce existing state highway pavements impacted by energy-related activity. While TxDOT's primary responsibility is to construct and maintain the state highway system, it provides millions of dollars of financial assistance annually for county roads through the Local Government Assistance Program and through administration of the federal Highway Bridge Replacement and Rehabilitation Program which provides funding for off-system bridges.

4.4 Modal Profile – Non-Highway Passenger Modes

4.4.1 Bicycle and Pedestrian Existing Conditions and Unconstrained Needs

The bicycle and pedestrian facilities are served by a variety of on-road and off-road facilities that are constructed and maintained at all levels of government. Facility types include:

- **Sidewalk** – Pathway separate from but adjacent to roadway. Typically used by pedestrians; bicycle use varies by jurisdiction.
- **Signed Shared Roadway** – A roadway that is open to both bicycle and motor vehicle travel.[36] A roadway that is officially designated and marked as a bicycle route, but which is open to motor vehicle travel and upon which no bicycle lane is designated.[37] A Signed Shared Roadway shall include posted bike route signs and may include pavement markings.
- **Shoulder** – The portion of roadway contiguous with the travel way that accommodates stopped vehicles, emergency use, and lateral support for sub-base, base, and surface course. Shoulders where paved are often used by bicyclists.[38]

34 TxDOT. 2013. Educational Series: Energy Sector
35 TxDOT. 2013. Educational Series: Energy Sector
36 AASHTO. 2012. *Guide for the Development of Bicycle Facilities*
37 TxDOT. 2014. Bikeways: Can we Talk? http://ftp.dot.state.tx.us/pub/txdot-info/dal/bicycle/mtg-062014.pdf
38 AASHTO. 2012. *Guide for the Development of Bicycle Facilities*

- A **Signed Shoulder Bike Route** shall include posted bike route signs and may include pavement.[39]
- **Bike or Bicycle Lane** – A portion of a roadway that has been designated for preferential or exclusive use by bicyclists by pavement markings and, if used, signs. It is intended for one-way travel, usually in the same direction as the adjacent traffic lane, unless designated as a contra-flow lane.[40]
- **Shared Use Path** – A bikeway outside the traveled way and physically separated from motor vehicle traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way or within an independent alignment. Shared use paths may also be used by pedestrians, skaters, users of manual and motorized wheelchairs, joggers and other authorized motorized and nonmotorized users. Most shared use paths are designed for two-way travel.[41]
- **Cycle Track** – A Cycle Track is an exclusive bicycle facility that has elements of a separated path and on-road bike lane. A Cycle Track, while still within the roadway, is physically separated from motor traffic and is distinct from the sidewalk.[42]
- **Wide Curb Lane** – A wide, 14 foot, outside curb lane provides space for a motorist to safely pass a bicycle without changing lanes. Wide curb lanes do not have a line distinguishing the space between motorists and bicyclist; however, sharrow - a shared bicycle lane – marking can be painted in the lane to indicate motorists and bicyclists need to share the wide lane. These facilities are usually not signed shared lanes because they do not meet AASHTO's guidelines.

According to data collected by the American Community Survey between 2008 and 2012, Texas currently ranks 40th of 50 states with respect to the percentage of bicycle commuters. The 2012 bicycle commuting rate of 0.28 percent represents an approximate 20 percent increase from the 2005 rate of 0.23 percent. With respect to bicycle and pedestrian safety, Texas ranks 39th and 41st in the country for bicyclist and pedestrian fatality rates, respectively (a ranking of first represents the fewest fatalities). Reflected in Exhibit 4-32, fatality rates for these modes in Texas and in the US have increased from 2007 to 2012 based on data obtained from the National Highway Traffic Safety Administration's (NHTSA) *Traffic Safety Facts*.

Exhibit 4-32. Pedalcyclist and Pedestrian Fatalities in Texas and the US*

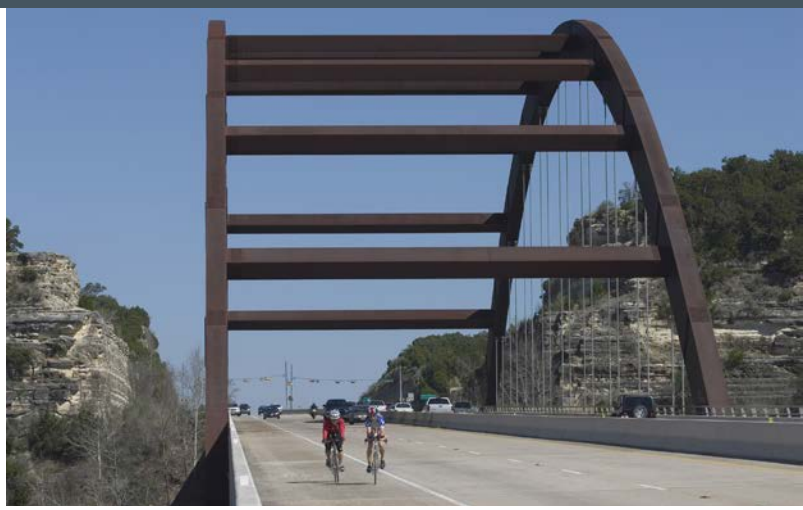
Location	Year	Pedalcyclist Fatalities	Percent Pedalcyclist of Total Traffic Fatalities	Pedalcyclist Fatalities per 100,000 Population	Pedestrian Fatalities	Percent Pedestrian of Total Traffic Fatalities	Pedestrian Fatalities per 100,000 Population
Texas	2007	48	1.4%	2.01	387	11.5%	1.62
US Total	2007	698	1.7%	2.31	4,654	11.3%	1.54
Texas	2012	56	1.6%	2.15	478	14.1%	1.83
US Total	2012	726	2.2%	2.31	4,743	14.1%	1.51

Source: NHTSA. 2012. Traffic Safety Facts (2007 and 2012 Data)
*Pedalcyclists include bicyclists and other cyclists

MPOs and cities vary in their interest and commitment to supporting the use of bicycle and pedestrian modes. Larger metropolitan areas and smaller communities associated with colleges and universities tend to place more emphasis on bicycle and pedestrian planning and investment. As such, facilities specifically designated for bicycles and pedestrians are more commonly located in urban and suburban areas, while rural areas are under-represented. Bicyclists and pedestrians in rural areas may use sidewalks where available but are often forced to travel on roadways that are not designed for shared use and may create unsafe conditions for both the motorists and the bicyclists.

TxDOT is in the process of developing a complete geographic information system (GIS) inventory and map of bikeways on state maintained roadways beginning with a pilot project in the Tyler District. The inventory and map will be developed using information from current TxDOT databases and pavement condition photos. When completed, the inventory will provide useful information to bicycle and pedestrian travelers including signed bike routes and roadway attributes such as shoulder widths and pavement types.

39 TxDOT. 2014. Bikeways: Can we Talk? http://ftp.dot.state.tx.us/pub/txdot-info/dal/bicycle/mtg-062014.pdf
40 AASHTO. 2012. *Guide for the Development of Bicycle Facilities*
41 AASHTO. 2012. *Guide for the Development of Bicycle Facilities*
42 NACTO. 2012. NACTO Urban Bikeway Design Guide. http://www.nyc.gov/html/dot/downloads/pdf/2012_nacto-guide_trb2012.pdf



Significant data gaps exist for the bicycle and pedestrian modes including current and future forecasted usage data. In fact, a majority of cities and regions do not have a complete inventory of their existing bicycle and pedestrian facilities. Due to the lack of statewide bicycle and pedestrian information available, needs were determined by compiling bicycle and pedestrian project information from Metropolitan Transportation Plans (MTPs), and stand-alone MPO and city bicycle and pedestrian plans (where available).

The information obtained and analyzed was highly variable among the MPOs and cities. Inconsistencies with respect to how bicycle and pedestrian improvements were included in each of the plans reviewed may result in over- or underestimating bicycle and pedestrian needs at the statewide level as follows:

- Financial needs may be underestimated and do not include planned projects with known bicycle and pedestrian components where these component costs were not broken out.
- Financial needs may be overestimated and include all reported Transportation Enhancement (TE) projects in 9 of the 25 MPOs. TxDOT began funding TE projects in 1993. Although the TE program included 12 eligible categories, bicycle and pedestrian improvements received over 70% of the funding historically. The TE program ended with Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) in 2012. The Transportation Alternatives Program is the current federal program with dedicated funding for bicycle and pedestrian improvements. However, bicycle and pedestrian projects are also eligible for federal funding under transportation programs typically used to construct bridges and roadways.
- Some jurisdictions did not provide an unconstrained needs project list, which may underestimate bicycle and pedestrian needs
- Some bicycle and pedestrian projects were listed in MTPs but had no corresponding cost information. This may also underestimate bicycle and pedestrian needs.

Based on the approach summarized above and detailed in *Technical Memorandum #6: Bicycle-Pedestrian Modal Profile,* unconstrained needs through 2040 for bicycle and pedestrian facilities on the TxDOT system, as well as those owned and maintained by city or county governments, was found to be approximately $4.20 billion. According to the MPO and city pedestrian and bicycle plans, $3.0 billion of projects included in this amount have dedicated funding, while the remaining $1.20 billion represent “wish list” projects for which there is no funding currently available. Considering the limitations of the approach due to data availability and consistency, this number should be viewed as a starting point for future needs determinations, which should additionally consider the growing interest in bicycle and pedestrian modes nationally and by Texans as well as the high population growth and urbanization that is expected to occur in the state.

Because the TTP is a planning document and not a program, initial estimates of projected needs and their respective dollar values were first identified in the modal profile and presented in various parts of this document. These estimates served as a baseline and were then refined and interpolated based on projections, normalized growth rates and coordination with TxDOT and other stakeholders. These revisions varied based on mode type and the associated factors previously mentioned; refined values are listed in Exhibit ES-3 and Exhibit 4-12.

4.4.2 Intelligent Transportation Systems Existing Conditions and Unconstrained Needs

As described in *Technical Memorandum #3 (Section 3.6): Intelligent Transportation Systems,* TxDOT has developed an inventory of ITS devices that it maintains that are currently deployed on state-owned facilities. All other devices located in Texas that are not included in the inventory are assumed to be maintained by a local agency. Approximately 9,000 different ITS devices were included in the inventory at the time of review (late 2013), including such technologies as:

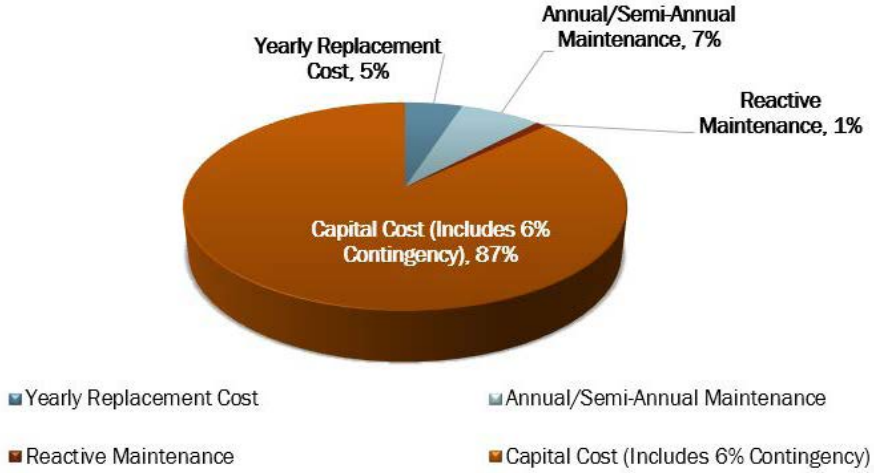
- Closed Circuit Television Cameras
- Dynamic Message Signs
- Lane Control Signals
- Radar Detection
- Loop Detection
- Highway Advisory Radio
- Ramp Meters
- Automatic Vehicle Identification
- Flood Warning
- Weather Sensors
- Not included: traffic signals, illumination, signing, pavement markings, etc.

Proposed ITS projects and their estimated costs were obtained from TxDOT ITS deployment plans. These deployment plans contain financially unconstrained lists of needs (i.e., projects and related costs) that were compiled by local stakeholders prior to 2005. These plans were the only sources of data available during the development of the TTP.

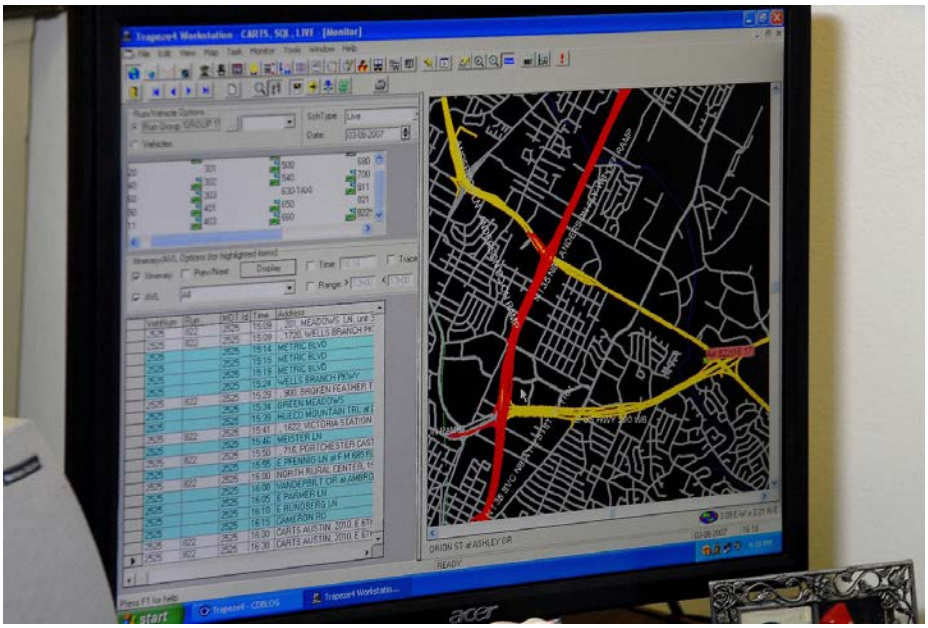
Existing ITS devices were assumed to remain in place and functional through 2040. New ITS devices were added to the annual inventory based on the ITS deployment plans, with all identified projects assumed to have been implemented except for those classified as long-range projects (i.e., not yet implemented). Annual maintenance costs were determined as the costs to maintain and replace existing and new ITS devices (once deployed) on a planned schedule. Total unconstrained needs reflect the accumulated costs for ITS maintenance and capital projects distributed annually based on current dollar values.

Based on the methodology and assumptions described above, it is anticipated that approximately $1.02 billion (2014 dollars) is needed through 2040 to maintain and replace existing ITS devices, assuming a 6 percent contingency to cover unforeseen expenditures. The cost required to deploy, operate and maintain new ITS devices as identified in the ITS deployment plans is projected to exceed $8.07 billion (2014 dollars) through 2040 with a 6 percent contingency applied. The vast majority of needs (89 percent) cover the capital costs required to implement new ITS technology (Exhibit 4-33).

Exhibit 4-33. Unconstrained Intelligent Transportation System Needs by Type (2013–2040) (With Inflation)



It is unlikely that ITS needs through 2040 will be fully funded based on the level of funding expected to be available for all transportation assets. Thus, two funding scenarios were evaluated to determine the total life-cycle maintenance costs if only 75 percent (Exhibit 4-34) and 50 percent (Exhibit 4-35) of the unconstrained needs are funded, respectively. The annual maintenance and replacement costs for existing ITS devices are held constant in both cases at $30 million per year (2014 dollars). In both scenarios, ITS capital projects are initially assumed to be implemented at a constant rate through 2040; however, funding shortfalls delay implementation of new ITS projects, which in turn yields lower annual maintenance costs with fewer devices to account for.



Funding 75 percent of the total unconstrained needs would result in the delayed implementation of ITS capital projects totaling approximately $77 million per year (2014 dollars); by 2040, total unmet needs for ITS would grow to be approximately $2.16 billion (2014 dollars). Funding 50 percent of the total unconstrained needs would result in the delayed implementation of ITS capital projects totaling approximately $154 million per year (2014 dollars); by 2040, total unmet needs for ITS would grow to be approximately $4.31 billion (2014 dollars). Additional details from this analysis are provided in *Technical Memorandum #6: Intelligent Transportation Systems Modal Profile.*

Because the TTP is a planning document and not a program, initial estimates of projected needs and their respective dollar values were first identified in the modal profile and presented in various parts of this document. These estimates served as a baseline and were then refined and interpolated based on projections, normalized growth rates and coordination with TxDOT and other stakeholders. These revisions varied based on mode type and the associated factors previously mentioned; refined values are listed in Exhibit ES-3 and Exhibit 4-12.

Applying asset management practices to ITS devices in a similar manner as to bridges, pavement, and transit assets may decrease the amount of contingency and reactive maintenance (replacement) funds needed to address unexpected device failures, thereby freeing up money that can be applied towards other investments. For example, expanding the current ITS inventory to include not only the location of devices but the implementation date, current condition, and maintenance dates and costs may help districts better forecast maintenance needs for existing devices and anticipate when these devices are likely to fail.

Exhibit 4-34. Total Life-Cycle Maintenance Costs of Intelligent Transportation System Assets – 75 Percent Funded (Year of Expenditure)

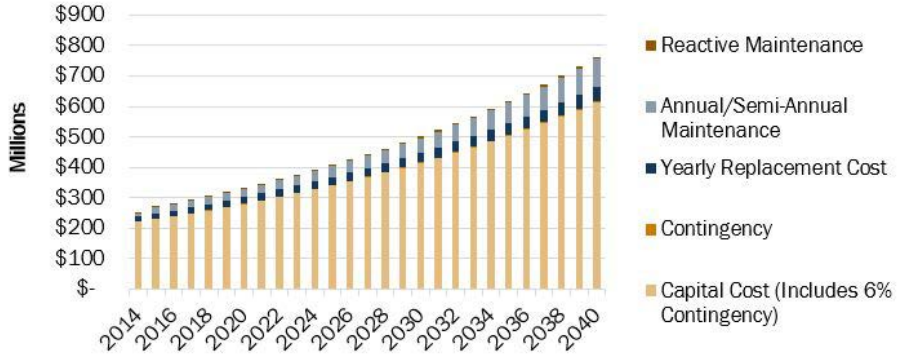
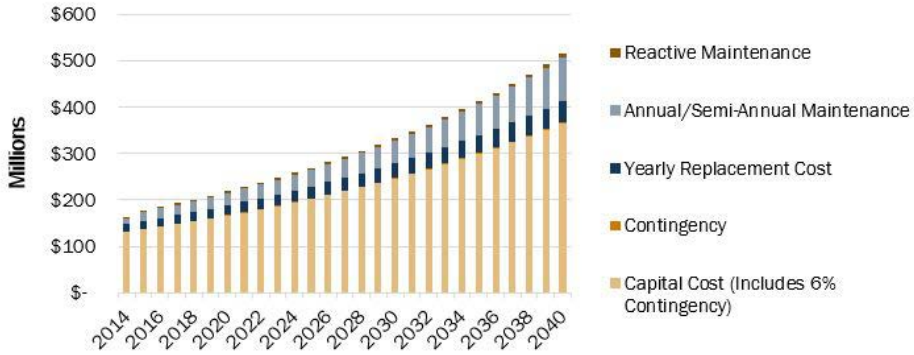


Exhibit 4-35. Total Life-Cycle Maintenance Costs of Intelligent Transportation System Assets – 50 Percent Funded (Year of Expenditure)



4.4.3 Aviation Existing Conditions and Unconstrained Needs

In conjunction with the Federal Aviation Administration (FAA), TxDOT's Aviation Division administers capital improvement grant funding for 292 airports and two heliports. Texas is one of the few states that participate in the FAA's State Block Grant Program, which permits states to allocate federal grant funding to eligible lower-tier airports that would otherwise be managed by the FAA.

Texas ranked third in the nation in 2012 for Tower Operations, which includes touch-and-goes and overflights, with a total of approximately 4.7 million operations. As reported in the 2010 Texas Airport System Plan, general aviation takeoffs and landings and passenger enplanements are expected to increase by nearly 20 percent and 65 percent between 2010 and 2025, respectively.

Two primary sources were used to determine unconstrained capital improvement needs for the state's airports: FAA's 2013–2017 National Plan of Integrated Airports Systems (NPIAS) Report was used for primary commercial airports; and the Texas Airport Data System (TADS), a 20-year project needs database maintained by the TxDOT Aviation Division, was used for general aviation, nonprimary commercial, and reliever airports. This database provides for each project a description, airport location, FAA Priority Score (broken down into individual scoring components), and the estimated construction cost for each "development item" or "project," as termed in this analysis. TxDOT does not provide any funding for primary commercial service airports, which receive funding directly from the FAA. TxDOT does, however, provide funding for general aviation, nonprimary commercial and reliever airports (general aviation airports) with revenue generated by both state (Highway Trust Fund) and federal (FAA grants) resources.

Total unconstrained needs for the Aviation System in Texas was determined by extrapolating both the summed improvement items costs in TADS database (for general aviation airport needs), and the summed total development costs for primary commercial airports as described in the FAA NPIAS Report (for primary commercial airport needs). Both of these were extrapolated out to 2040 assuming a constant average annual cost. Based on the methodology described above, the total unconstrained needs for the Aviation System in Texas totals $21.1 billion through 2040 (2014 dollars) – $18.2 billion for primary commercial airports ($626 million average annual) and $2.9 billion for general aviation airports ($105 million average annual). This reflects the cost to implement capital improvement projects over the planning period relating to safety and security, FAA's statutory emphasis projects, reconstruction/rehabilitation, environment, planning, capacity, standards, and other local projects.

Trade-off analysis was conducted to determine how various funding levels affect the number and monetary value of TADS projects completed. Projects in the TADS database are separated into two funding categories: NPIAS (i.e., federally-funded primary commercial airports) and non-NPIAS (i.e., state-funded general aviation airports). These groups of projects were analyzed separately with their current respective federal and state budget allocations of $51 million and $15 million to determine the number and value of TADS projects that could be completed given the funding constraint. A range of budget and allocation scenarios for NPIAS and non-NPIAS projects was then assessed – for example, if only $5 of the $15 million state budget is used for non-NPIAS projects, the remaining balance would be available to fund NPIAS projects.

Exhibit 4-36 and Exhibit 4-37 present a range of possible funding options for non-NPIAS and NPIAS airports, respectively, with the highlighted rows indicating the current annual budgets available. The analysis reveals that if the $10 million annual state budget is used solely for non-NPIAS projects each year for 20 years, the resulting $200 million would fund a total of 2,103 non-NPIAS projects over that period.

It was observed that the number of funded non-NPIAS projects levels out at an annual state budget of $8 million with only higher cost and lower priority projects remaining. This suggests that $7 million of the total $15 million annual state budget may be better spent on NPIAS airport projects. Under this scenario, $8 million would be used to fund nonNPIAS projects and $58 million ($51 million [federal] + $7 million [state]) would be available to fund NPIAS projects.

Exhibit 4-36. Non-National Plan of Integrated Airports Systems Annual Budget Scenarios

Annual State Budget (Millions)	20-year TADS Capital Project Cost Need (Millions)	20-year TADS Projects Completed	20-year TADS Value of Projects Completed (Millions)
$2	$211	1,438	$40
$4	$211	1,746	$80
$6	$211	1,968	$120
$8	$211	2,069	$160
$10	$211	2,103	$200
$12	$211	2,107	$235

Note: Highlighted row denotes State Funding Budget

Exhibit 4-37. National Plan of Integrated Airports Systems Annual Budget Scenarios

Annual Federal Budget (Millions)	20-year TADS Capital Project Cost Need (Millions)	20-year TADS Projects Completed	20-year TADS Value of Projects Completed (Millions)
$46	$1,640	6,715	$920
$51	$1,640	6,838	$1,020
$56	$1,640	6,939	$1,120
$61	$1,640	7,017	$1,220
$66	$1,640	7,075	$1,320
$71	$1,640	7,121	$1,420
$76	$1,640	7,154	$1,520
$81	$1,640	7,172	$1,620
$86	$1,640	7,175	$1,720

Note: Highlighted row denotes Federal Funding Budget. Budget includes the four NPIAS Airports ineligible for state funding.

4.4.4 Passenger Rail Existing Conditions and Unconstrained Needs

4.4.4.1 High Speed Rail

Currently, there are no existing High Speed Rail operations in Texas. In fact, the only operational system in the US is the National Railroad Passenger Corporation's (AMTRAK's) Acela Express Train that provides service between Boston, Massachusetts and Washington, D.C. with top speeds of up to 150 miles per hour (mph). Exhibit 4-38 depicts federally designated HSR corridors located across the country. In Texas, the "Gulf Coast" and "South Central" rail corridors were designated as future high speed rail corridors in 1998 and 2000, respectively. These corridors coincide with portions of existing AMTRAK routes.

4.4.4.2 Intercity Passenger Rail

AMTRAK is currently the sole provider of intercity passenger rail service in Texas. Three AMTRAK routes are currently provided: Heartland Flyer, which travels between Fort Worth and Oklahoma City and is jointly funded by Texas and Oklahoma; Texas Eagle, which travels between San Antonio and Chicago; and Sunset Limited, which travels between Los Angeles and New Orleans. *Technical Memorandum #6: Passenger Rail Modal Profile* provides an overview of the AMTRAK intercity services including a description of the routes, stations, schedules, and ridership.

Unconstrained Needs are addressed in *Technical Memorandum #6: Passenger Rail Modal Profile* which provides an overview of all planned and programmed HSR projects throughout the state as well as planned and programmed capital improvements to existing AMTRAK assets including upgrades to rolling stock, stations, track, and signal systems. Initial unconstrained needs for passenger rail as determined based on the projects identified in Exhibit 4-39 totals $22.4 billion (2014 dollars) through 2040.

Because the TTP is a high-level planning document, initial estimates of projected needs/dollar values were first identified in the modal profile and presented in various parts of this document. These estimates served as a baseline and were then refined and interpolated based on projections, normalized growth rates and coordination with TxDOT and other stakeholders. These revisions varied based on mode type and the associated factors previously mentioned; refined values are listed in Exhibit ES-3 and Exhibit 4-12.

Exhibit 4-38. Federally Designated High Speed Rail Corridors

US DOT. 2009. High Speed Rail Strategic Plan. https://www.fra.dot.gov/eLib/Details/L02833

Exhibit 4-39. Passenger Rail Unconstrained Needs

Type	Routes	Description	Estimated Ridership	Estimated Cost
Intercity Rail	Southwest Chief Reroute	Reroute through southern Kansas, the Texas Panhandle, and eastern New Mexico	102,924 annual trips, based on 2013 ridership	$10 M annual operation and maintenance; $100 M capital investment
	Heartland Flyer	Existing route from Fort Worth to Oklahoma City	81,226 annual trips, based on 2013 ridership	Annual TxDOT contribution: $1.4 M on average annually
	Texas Eagle Reroute	Relocate Texas Eagle on Union Pacific's line between Dallas and Fort Worth	340,081 annual trips, based on 2013 ridership	$210 M; not including $40–$50 M in signal upgrades and grade crossing improvements
High Speed Rail (HSR)	Texas to Oklahoma Passenger Rail Study	850-mile corridor from South Texas to Oklahoma City, Oklahoma	3 million annual rides (combination of alternatives)	$11.0 B
	Texas Central Railway HSR	250-mile corridor between Dallas-Fort Worth and Houston	108,000 riders per day in 2025 based on a 2009 study, per the Texas Rail Plan	$10.0–$12.0 B
Total				**Approximately $22.4 B**

4.4.5 Transit Existing Conditions and Unconstrained Needs

There are over 150 transit agencies operating in Texas, with most agencies providing multiple modes of service under various contractual arrangements. The TTP includes agencies from all areas providing all modes of service in the state, including rail, bus, and demand response. The agencies are divided into tiers for analysis, including:

- MTAs, which are direct recipients of funding from the Federal Transit Administration (FTA);
- State Urban agencies which are funded by the state and serve smaller urban areas than the MTAs;
- Rural Transit Districts (RTDs), which are subrecipients of federal funding through TxDOT;
- Special service operators who provide services under the Seniors and Individuals with Disabilities Program (Sect. 5310); and
- Intercity bus services, operated by private companies such as Greyhound, that also receive grant money from TxDOT to support intercity services.[43]

Currently in Texas there are eight MTA agencies located in El Paso, Denton County Transportation Authority, Fort Worth, Houston, Austin, San Antonio, Corpus Christi and Dallas; 30 state urban and 37 RTD agencies; and approximately 90 special transit service agencies. For ease of reporting, all non-MTA agencies are often grouped together in this section as they are all direct recipients of funding from TxDOT, whereas the MTAs are not.[44]

A 2013 inventory of existing public transit assets, for all transit agencies including both MTA and non-MTA, with a combined value of more than $17 billion (Exhibit 4-40) was developed using data from TxDOT's Public Transportation Management System (PTMS) and assets reported to the National Transit Database and the federal Transit Economic Requirements Model (TERM). In total the inventory includes over 10,000 revenue vehicles and approximately 350 buildings, including stations and transit facilities. Motor buses constitute the largest portion of public transit assets in Texas, making up about half of all transit assets by value. Light rail systems are the next largest group of assets, representing about a third of the asset base. This inventory – described in further detail in the *Technical Memorandum #3 (Section 3.3): Transit Analysis Methodology* – served as a baseline for estimating future SGR needs.

Exhibit 4-40. Statewide Replacement Value of Transit Assets (Millions in 2014 Dollars)

Mode	MTA	Non-MTA	Total
Motor Bus	$8,325	$159	$8,484
Light Rail	$5,706	$30	$5,736
Commuter Rail	$1,720	$0	$1,720
System-wide Assets	$330	$2	$333
Demand Response	$259	$761	$1,021
Vanpool	$178	$0	$178
Ferry Boat	$14	$0	$14
Total	**$16,533**	**$952**	**$17,485**

Approximately 95 percent of the public transit assets in Texas are owned and operated by MTAs. Within the non-MTA agencies, approximately half of the asset value is owned by agencies located in urban areas, with a little less than half owned by the RTDs. Intercity bus and special transit services together comprise less than five percent of the non-MTA asset base.

43 TxDOT. 2014. 2014 TxDOT Transit Statistics. https://ftp.dot.state.tx.us/pub/txdot-info/ptn/transit_stats/2014.pdf
44 TxDOT. 2014. 2014 TxDOT Transit Statistics. https://ftp.dot.state.tx.us/pub/txdot-info/ptn/transit_stats/2014.pdf

The modal profile for MTAs is significantly different from that of non-MTA agencies. As shown in Exhibit 4-41, Demand Response dominates the state urban, RTD, and special services assets for non-MTAs while MTAs are more evenly divided between fixed route, bus, and rail services.

The SGR backlog for public transit is estimated based on deferred rehabilitation and replacement needs. Based on the 2013 inventory, the SGR backlog for public transit in Texas is estimated to be valued at $3.54 billion, or about 20 percent of the asset base. This current SGR backlog represents all assets that are beyond their useful life and in need of replacement.

The current condition of public transit assets can also be estimated based on the statewide inventory. The FTA five-point rating scale for condition – described in *Technical Memorandum #3 (Section 3.3): Transit Analysis Methodology* – is shown in Exhibit 4-42 for MTA and Exhibit 4-43 for non-MTA agencies across all asset categories. The resulting condition estimates are based on individual asset ages and replacement values. For MTAs, a majority of vehicles are estimated to be in "excellent" condition, whereas 40 percent of stations are estimated to be in "substandard" or "poor" condition. By comparison, only about a quarter of non-MTA vehicles are estimated to be in "excellent" condition, while over 75 percent of stations are in "good" or "excellent" condition. All assets in "poor" condition should be replaced immediately to maintain SGR.

Ridership data for 2012 was taken from the National Transit Database to serve as the baseline level of public transit demand, which was then projected to grow to 2040.[45] As shown in Exhibit 4-44, transit unlinked passenger trips throughout the state totaled more than 250 million in 2012, with nearly three quarters of all transit trips occurring on MTA bus services. Nearly 19 million trips occurred on non-MTA services with the majority on bus routes.

Exhibit 4-41. Proportion of Public Transit Assets by Mode for MTA and Non-MTA Agencies

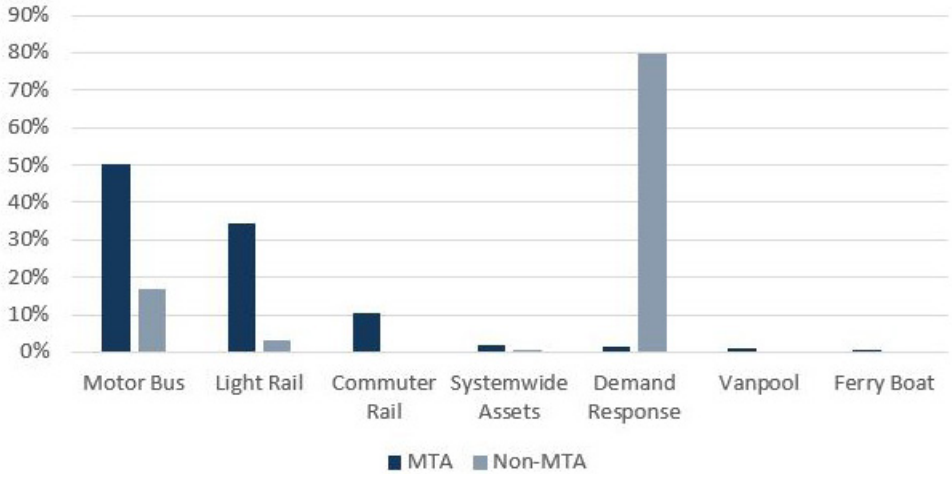


Exhibit 4-42. Estimated Public Transit Asset Condition for Metropolitan Transit Authority Agencies

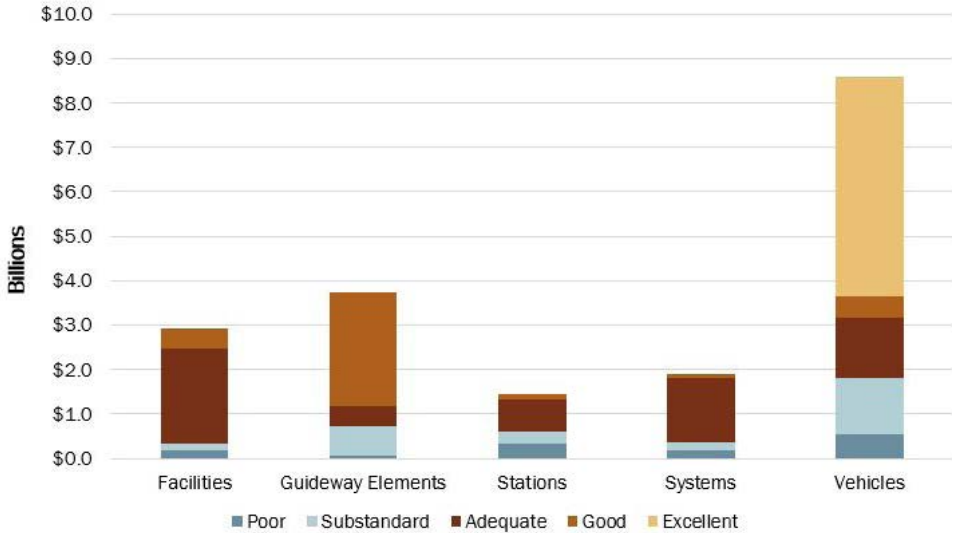
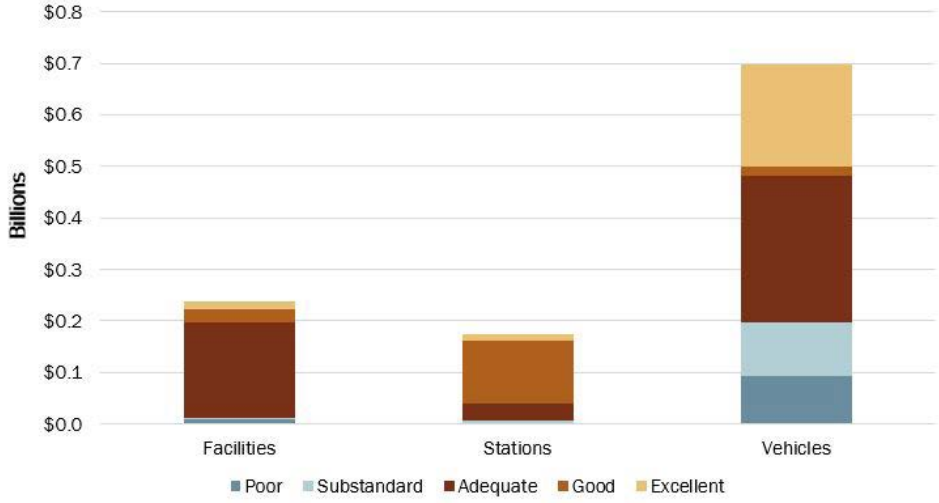


Exhibit 4-43. Estimated Public Transit Asset Condition for Non-Metropolitan Transit Authority Agencies



45 National Transit Database was used as the source for passenger boardings as it segments boardings by mode.

Exhibit 4-44. 2013 Public Transit Unlinked Passenger Trips

Mode	MTA	Non-MTA	Total
Motor Bus	181,640,003	13,502,098	195,142,101
Light Rail	32,920,451	31,286	32,951,737
Demand Response	7,366,253	3,549,918	10,916,172
Vanpool	3,991,280	1,025,000	5,016,280
Commuter Rail	4,812,595	-	4,812,595
Intercity Bus	551,891	817,483	1,369,374*
Ferry	52,951	-	52,951
Total	**231,335,425**	**18,925,785**	**250,261,210**

* The figures for Intercity Bus represent only Intercity Bus service that is supported by TxDOT using FTA Section 5311(f) funds, which is an extremely small portion of the total intercity bus service provided in Texas. Total ridership figures for these entities are likely much higher.
Source: TxDOT. 2013 Texas Public Transportation Inventory.xlsx

Unconstrained transit needs reflect the amount of funding required to achieve SGR for all modes and operators with respect to condition and performance such that no asset exceeds its useful life and all identified service expansion needs are met through 2040. Unconstrained needs were divided into three investment categories for the purpose of the TTP:

- **Preservation:** the capital reinvestment required to maintain existing assets in SGR, including annual capital maintenance, rehabilitation, and replacement costs for existing transit assets as well as operation and maintenance costs to maintain current service levels.
- **Service expansion:** the capital investments and operation and maintenance costs for projected growth in service levels to accommodate the projected growth in ridership through 2040. Service expansion includes fleet expansion and related facility expansion; it does not include the expansion of services into new geographic areas or the introduction of new transit modes into existing geographies.
- **Major new service:** the capital investments and related operation and maintenance costs to significantly improve transit performance via enhancements to core capacity or the extension of services into new geographies or modes. These projects are generally funded by New Starts or Small Starts grants and are detailed in either a MTP or a Regional Transportation Plan.

FTA's TERM Lite was customized to reflect the 2013 inventory of Texas transit assets (with the resulting model termed as "Tex Lite") in order to project Preservation and Service Expansion needs through 2040. Major New Services needs were determined by summing the costs of Major New Services projects identified in the MTPs and Regional Transportation Plans.

Based on the methodology summarized above and described in further detail in *Technical Memorandum #6: Transit Modal Profile*, the unconstrained needs initially identified were refined as discussed below.

Because the TTP is a planning document and not a program, initial estimates of projected needs and their respective dollar values were first identified in the modal profile and presented in various parts of this document. These estimates served as a baseline and were then refined and interpolated based on projections, normalized growth rates and coordination with TxDOT and other stakeholders. These revisions varied based on mode type and the associated factors previously mentioned; refined values are listed in Exhibit ES-3 and Exhibit 4-12. The total unconstrained needs for public transit are estimated to be approximately $101.2 billion through 2040 (2014 dollars), or an average of $3.89 billion per year.

As Preservation and Service Expansion needs are both based on the 2013 inventory of transit assets, the resulting needs are dependent on accurate inventory records. While every effort was made to ensure a complete transit inventory for the state, there may be missing records or incomplete records for some agencies. It must be noted that the Preservation and Service Expansion estimates are likely conservative compared to the reality faced by individual transit agencies.

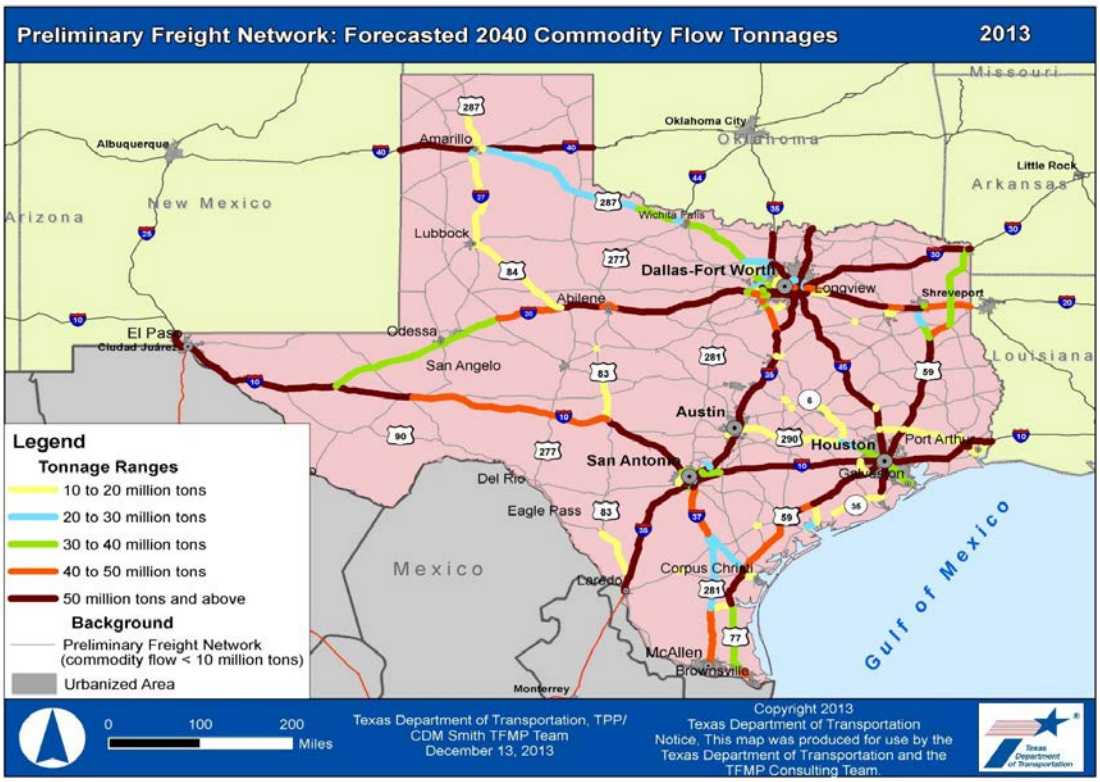
A larger concern for the unconstrained projection is the minimal number of Major New Service projects scheduled beyond the next 10 years. Only 39 of the 132 projects planned for MTAs are scheduled to occur past 2024. There are no planned statewide, urban, or RTD Major New Service projects beyond 2020. In a truly unconstrained future, there is an ongoing need to deliver services to new areas and increase the reach of fixed transit routes. This tapering off of Major New Service needs beyond the next 10 years likely underestimates the total need in this investment category and the potential ridership growth resulting from this type of new service.

4.5 Modal Profiles – Freight

4.5.1 Highway

The Texas Freight Highway Network (TFHN) consists of the tiered roadway system adopted by the FHWA and additional TxDOT roads holding particular value to the freight community. The TFHN classifies railroads, ports, airports, pipeline terminals, border crossings, warehousing and distribution centers, and intermodal terminals as connections to freight gateways or as generators. Per MAP21 requirements, the TFHN includes Critical Rural Freight Corridors which are non-Interstate routes characterized by high freight volumes. The TFHN will be reviewed and considered against the FHWA designated National Highway Primary Freight Network after it is finalized. Forecasted freight tonnage on the primary TFHN for 2040 based on Global Insight's TRANSEARCH database is shown in Exhibit 4-45.

Exhibit 4-45. Projected 2040 Total Truck Tons

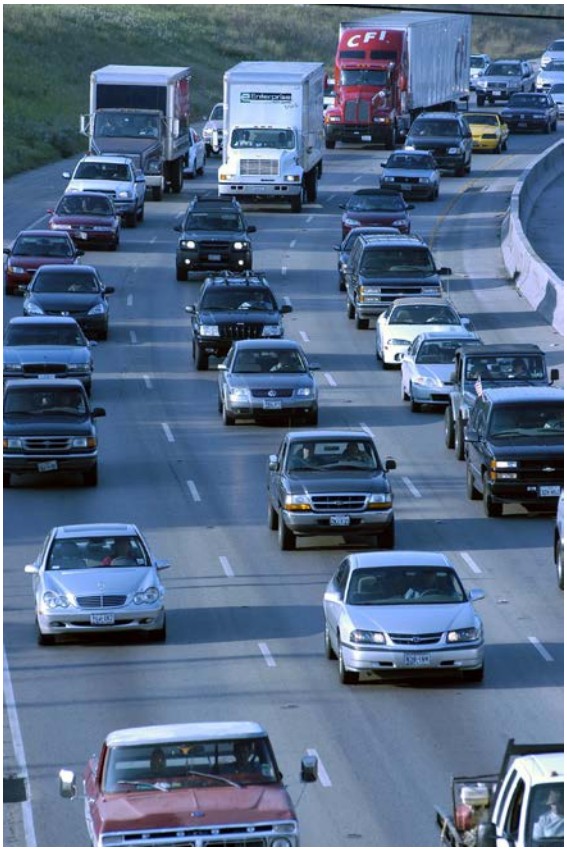


Source: Global Insights. 2010. TRANSEARCH

Exhibit 4-46. Freight Performance at Texas Bottlenecks

Location	US Ranking	
	2013	2011
Houston, TX: IH 610 at US 290	2	12
Austin, TX: IH 35	3	7
Houston, TX: IH 45 at US 59	7	3
Houston, TX: IH 10 at IH 45	9	4
Dallas, TX: IH 45 at IH 30	10	13
Houston, TX: IH 10 at US 59	11	5
Houston, TX: IH 45 at IH 610 (North)	16	14
Houston, TX: IH 10 at IH 610 (West)	21	26
Fort Worth, TX: IH 35W at IH 30	23	29
Dallas, TX: US 75 at IH 635	30	53
Houston, TX: IH 610 at US 59 (West)	34	50
Houston, TX: IH 45 at Sam Houston Tollway (North)	62	94
Houston, TX: IH 45 at IH 610 (South)	71	62
Houston, TX: IH 10 at IH 610 (East)	84	44
El Paso, TX: IH 10 at IH 110/US 54	103	89
San Antonio, TX: IH 10 at IH 410 (North)	146	142

Source: American Transportation Research Institute, 2013. FPM Congestion Monitoring. http://atri-online.org/2013/07/08/atri-100-freight-locations/



Congestion on the freight network increases the time it takes goods to travel, which increases the costs of getting these goods to market, and ultimately the cost borne by the consumer. Like passenger mobility, freight mobility is largely determined by the number and severity of bottlenecks. As Exhibit 4-46 shows, five of the top-ten US truck bottlenecks were located in Texas in 2012. The identification and ranking of these bottlenecks was based on the FHWA Office of Freight Management and Operations' annual Freight Performance Measures analysis, which assesses the level of truck-oriented congestion at 250 locations on the national highway system; a Texas A&M Transportation Institute (TTI) study on freight bottlenecks was used to validate the results of the FHWA analysis.

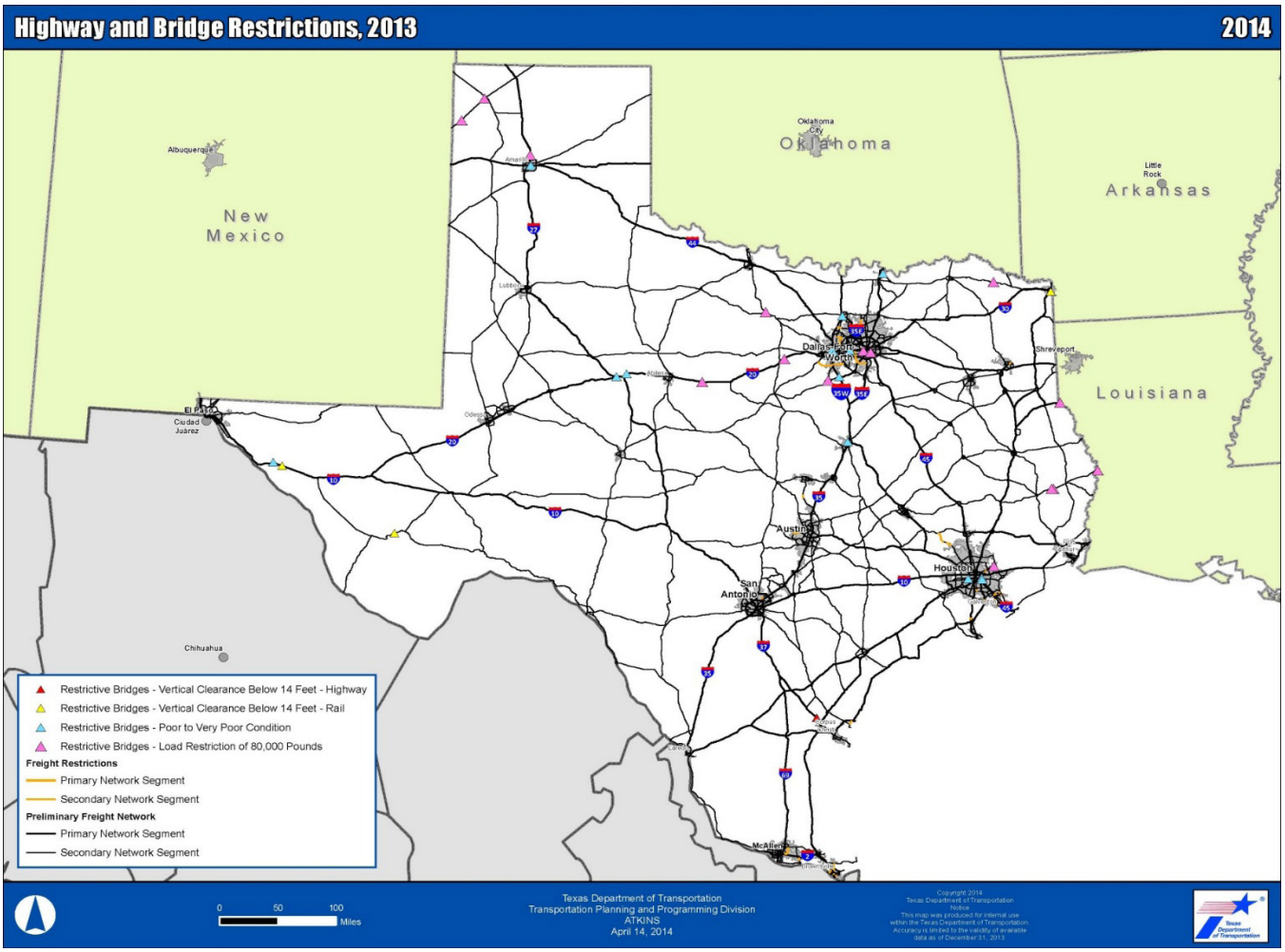
As passenger and freight traffic volumes continue to increase on the Interstates and US highways, causing trucks to seek alternate routes, rural state highways may become a more integral part of the freight network. More resources will be required to reconstruct and maintain rural highways at a level that supports the additional increase heavy vehicle loadings and dimensions.

Truck traffic is often restricted on highways due to bridge width and underclearance geometric constraints as well as weight restrictions on bridges and roadways. Current oversize or overweight limits in Texas are as follows:

- Width – 8'6"
- Height – 14'
- Gross Weight – 80,000 pounds maximum.

Bridges crossing the TFHN with clearances less than 14 feet were identified from the NBI database, and load restricted roadways were identified from TxDOT's Roadway Highway Inventory Network Offload (RHiNO) database. As of 2013, there are nine bridges crossing the TFHN with a clearance of less than 14 feet and 16 bridges with weight restrictions of less than 80,000 pounds (Exhibit 4-47). These structures are being evaluated in the TFMP to determine which has the most potential impact on freight movement and thus the greatest need for improvement and are addressed in TTP bridge needs for functional obsolescence.

Exhibit 4-47. Highway and Bridge Restrictions (2013)



Source: TxDOT. 2013. RHiNO Database; National Bridge Inventory, 2013

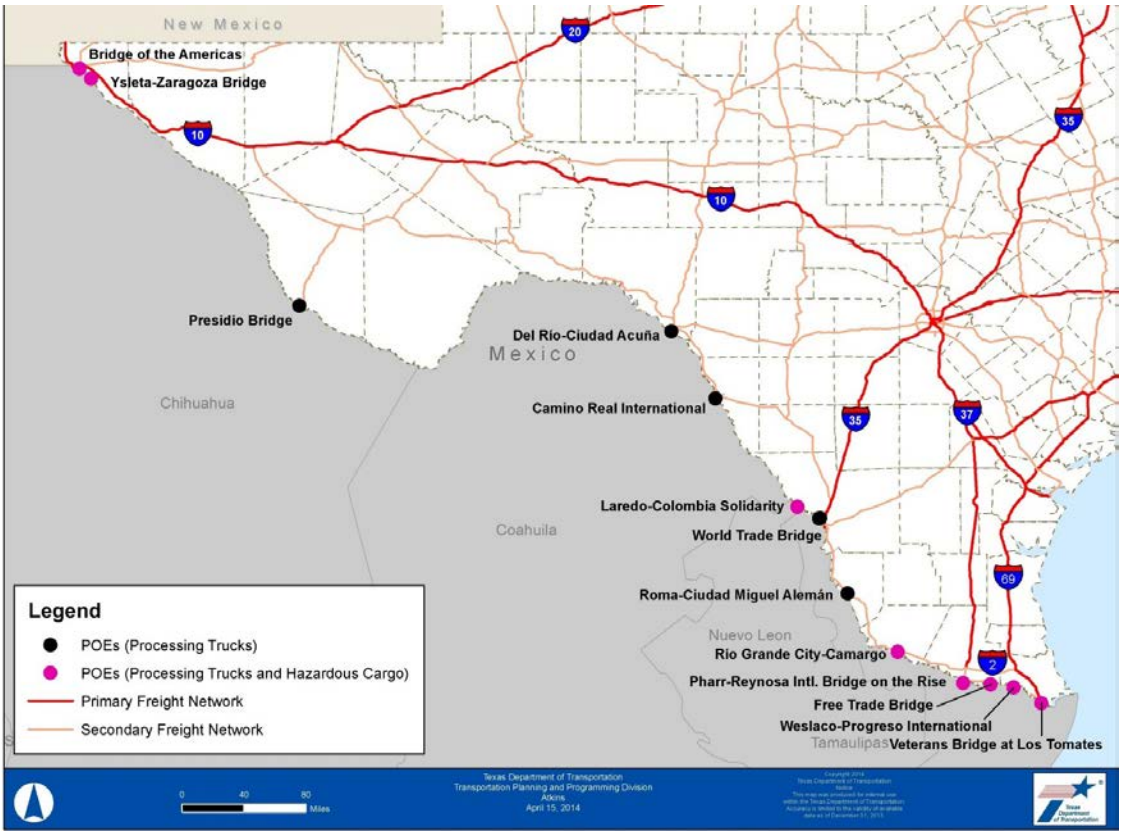
There are 13 land ports of entry along the 1,254 mile Texas border for trucks traveling between the US and Mexico (Exhibit 4-48). The crossings are located over the entire length of the Texas-Mexico border but are concentrated in or near the three major metropolitan areas of El Paso, Laredo and Brownsville. In 2012, 3.5 million trucks traveled northbound from Mexico to the US and were processed at these land ports of entry.[46]

Crossing and wait times at many of the high volume land ports of entry are considered to be deterrents to free trade between the US and Mexico. The average 'Wait Time' and bridge 'Crossing Time' for trucks at different times of day is a key statistic for TxDOT, FHWA and the Customs and Border Patrol in their efforts to determine the relative effectiveness of different investment strategies designed to reduce truck delays at border crossings.[47]

46 Bureau of Transportation Statistics. 2013. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/north_american_freight_transportation/html/executive_summary.html

47 Commercial Border Crossing and Wait Time Measurement at the Pharr-Reynosa International Bridge, Texas Transportation Institute, November, 2010, pp. 1-2

Exhibit 4-48. Texas – Mexico Truck Land Ports of Entry (2012)



4.5.1.1 Highway Needs

The highway and bridge unconstrained needs in the TTP include all highway system preservation, modernization, and expansion needs, which would also improve freight mobility and eliminate freight bottlenecks. A detailed assessment of specific freight highway needs will be provided in the TFMP when complete. TFMP freight needs may include additional and new freight-specific routes not analyzed in the TTP. The addition of these facilities may increase highway and bridge needs in the state.

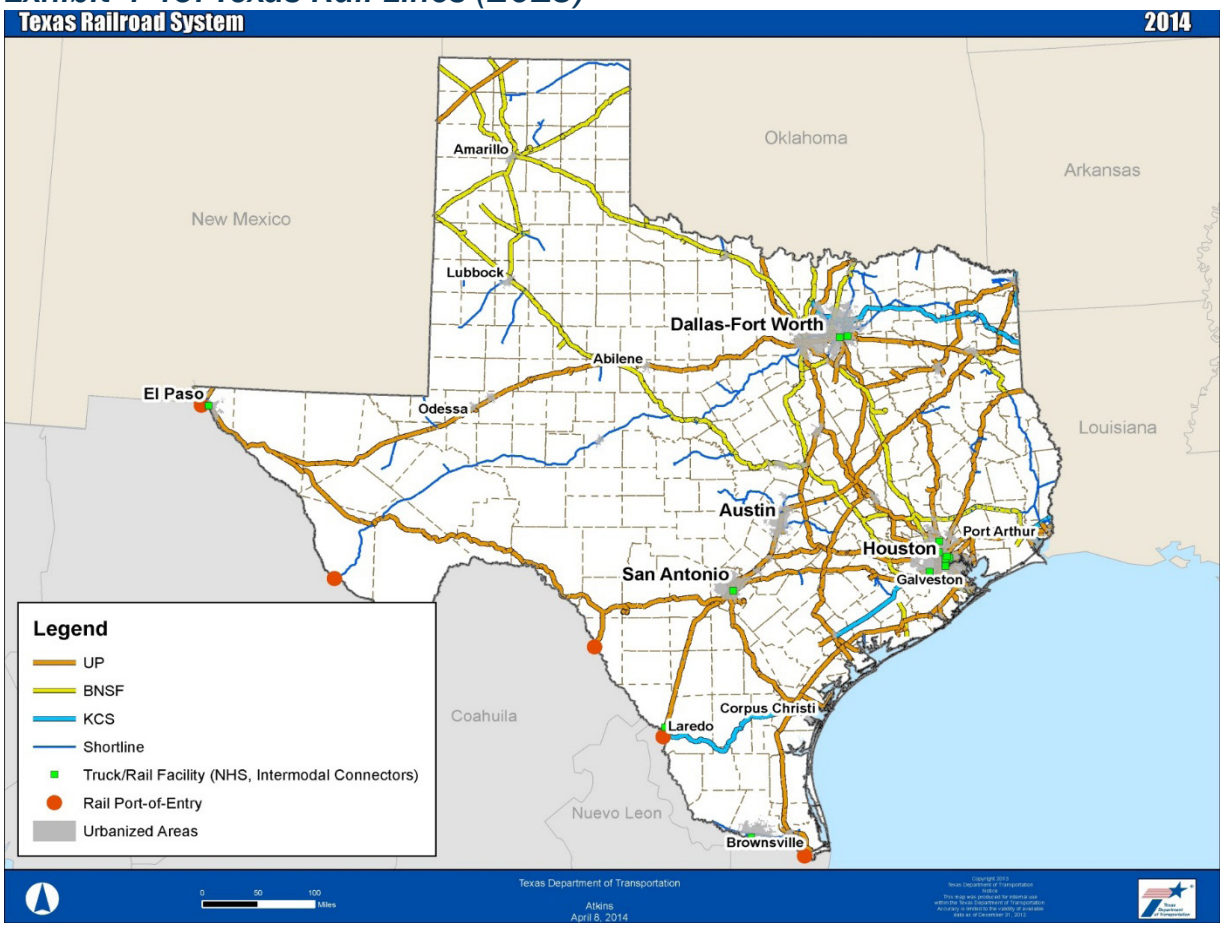
4.5.2 Freight Rail

Rail is a major component of freight movement throughout Texas. Texas has 10,425[48] total rail miles, the most of any state. In 2010, 24 percent of the freight tonnage and 27 percent of the total value of freight in Texas was carried by the rail system.[49] In 2011, Texas led the nation in total rail tons terminated, at 202.4 million tons and was fifth in total rail tons originated at 89.3 million.[50]

Railroads are classified into three categories based on annual revenue dollars: Class I (major) railroads have operating revenues greater than $433.2 million (2012 dollars) for at least three consecutive years; Class II (regional) railroads have operating revenues greater than $34.7 million but less than $433.2 million (2012 dollars) for at least three consecutive years; and Class III (short line) railroads are those not classified as Class I or Class II. The Texas rail network is shown in Exhibit 4-49.[51]

48 Association of American Railroads https://www.aar.org/keyissues/Documents/Railroads-States/Texas-2010.pdf
49 IHS Global Insight TRANSEARCH
50 Association of American Railroads. 2010. Freight Railroads in Texas. https://www.aar.org/KeyIssues/Railroads-States/Texas-2010.pdf
51 Surface Transportation Board. 2012. Railroad classifications.

Exhibit 4-49. Texas Rail Lines (2013)

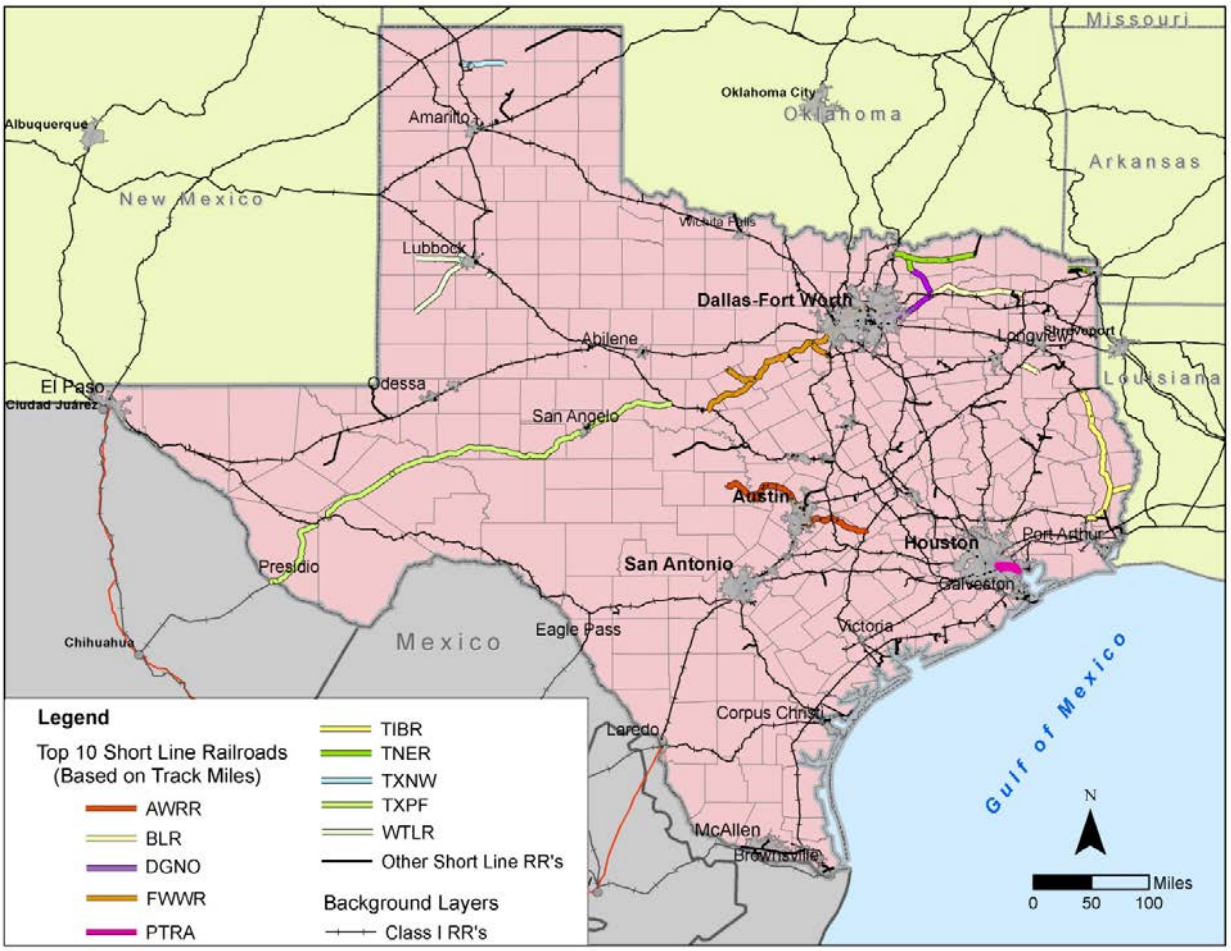


Source: USDOT. 2013. Bureau of Transportation Statistics. National Transportation Atlas.

As the name indicates, short lines operate over a relatively short distance and serve the larger railroads by collecting and distributing railcars to individual industrial and agricultural shippers and receivers. They provide a critical service, particularly in lower-density rail corridors and markets where the larger railroads cannot operate cost-effectively. From a historical standpoint, many of the nation's short lines operate on branches previously owned and operated by the Class I railroads. In total, Texas is served by 43 short line railroads comprising 2,479 total track miles. The top ten short line freight systems (based on track miles) are shown in Exhibit 4-50.

Much of the freight carried by rail comes into Texas through water and land ports of entry. Rail is often utilized for shipment of bulk goods and not typically a suitable mode of transport for direct-to-consumer goods. The capacity of rail to transport shipments from port of entries to intermodal terminals, transshipment terminals, and warehouse and distribution centers is integral to supply chain operations in Texas, nationally and globally. Land ports of entry are listed in Exhibit 4-51.

Exhibit 4-50. Texas Freight Short Line Rail Lines (2013)



AWRR = Austin Western Railroad
BLR = Blacklands Railroad
DGNO = Dallas Garland Northeastern
FWWR = Fort Worth and Western Railroad
PTRA = Port Terminal Railroad Association (Houston, TX)
TIBR = Timber Rock Railroad
TNER = Texas Northeastern Railroad
TXNW = Texas Northwestern
TXPF = Texas Pacifico Transportation Ltd. (Brownwood, TX)
WTLR = West Texas & Lubbock Railroad

Source: USDOT. 2013. Bureau of Transportation Statistics. National Transportation Atlas.

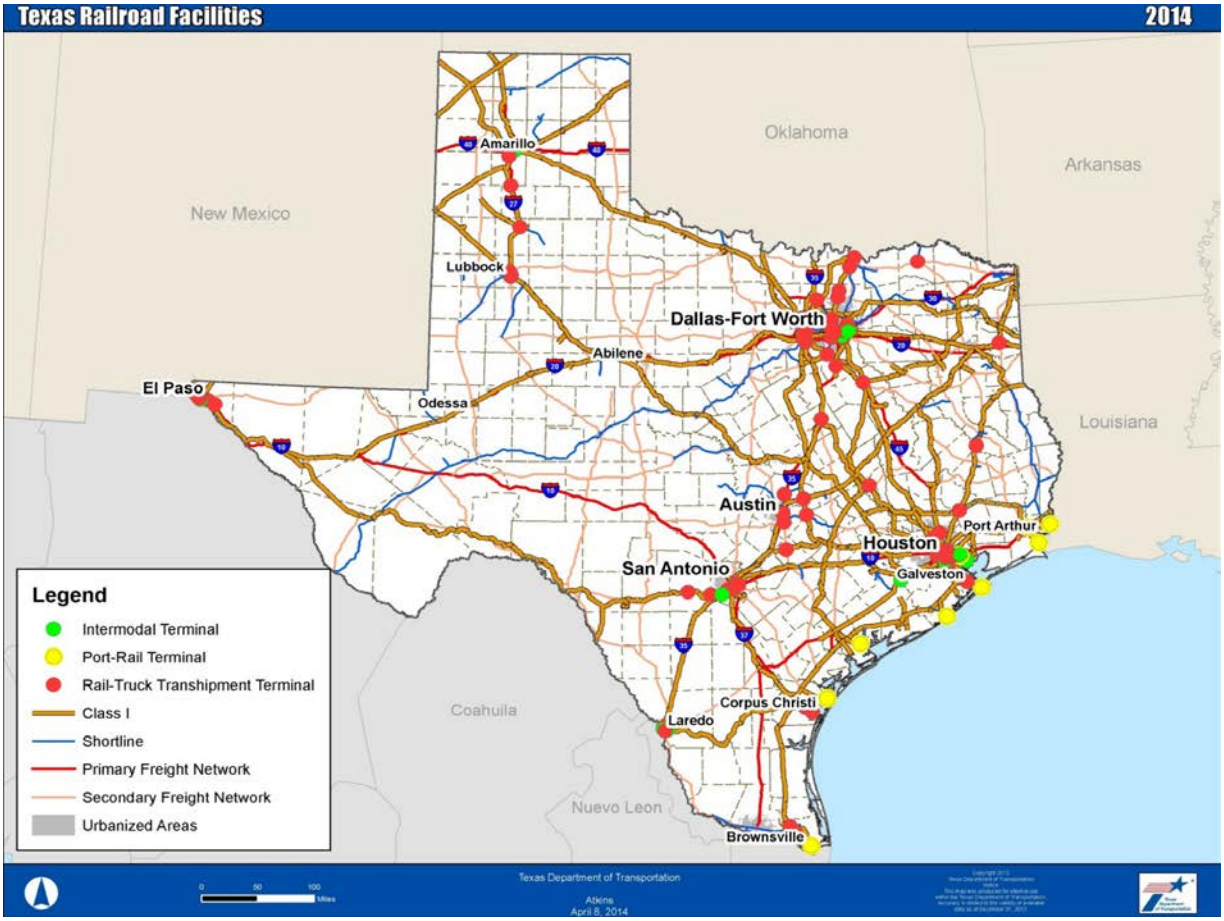
Exhibit 4-51. Texas Land Ports of Entry with Rail Connections (2013)

Class I Rail line	Connects to Port of Entry				
	El Paso	Presidio	Eagle Pass	Laredo	Brownsville
UP	X		X	X	X
BNSF*	X		X		X
KCS				X	
TXPF Shortline		X			

Note:*Via shared line operating agreement with UP
Source: USDOT. 2013. Bureau of Transportation Statistics. National Transportation Atlas

Intermodal connectors serve an important function in the freight network. They are the points at which freight transfers from one mode to another for example from rail to truck or port to rail. They serve to connect freight movements at origins or destinations as those first or last mile transit and they can allow for freight to move from one mode to another or across regions for the same mode to facilitate the continued movement of goods along the supply chain. Exhibit 4-52 depicts the NHS intermodal connectors that serve as truck/rail intermodal terminals where goods transfer to and from highway and rail. Beyond the NHS intermodal connectors, there are facilities around the state which allow for the transfer of goods from rail to other modes. Most of these terminals are located near the major urban centers and along the freight network which allows for the most efficient shipment of goods. Many major warehousing and distribution centers have adjacent sidings will allow for direct rail access to their facilities.

Exhibit 4-52. Rail Connections (2013)



Source: USDOT. 2013. Bureau of Transportation Statistics. National Transportation Atlas.

4.5.2.1 Rail Needs

The needs for freight rail development are included here as they are presented in the Texas Rail Plan from November of 2010 (available on the TxDOT website). The table below in Exhibit 4-53 summarizes the estimated cost of rail freight capital needs in Texas through 2030 which was the planning horizon for the Texas Rail Plan. Freight rail needs were extrapolated from national studies as a percentage of needs, as estimated for the nation. While these numbers are not specifically calculated for Texas, they were adopted in the Texas Rail Plan to indicate the extent of the needs for freight rail improvements in the state.

Exhibit 4-53. Estimated Texas Freight Rail Needs (2005-2030)

Freight Rail Need	Cost (Millions)
Crossing Closure	$18.9
Pedestrian Bridge	$7.5
Grade Separation	$2,172.4
New Rail Connections	$1,730.3
Total	**$3,929.1**

Source: TxDOT. 2010. Texas Rail Plan. Executive Summary. http://ftp.dot.state.tx.us/pub/txdot-info/rail/plan/exec_summ.pdf

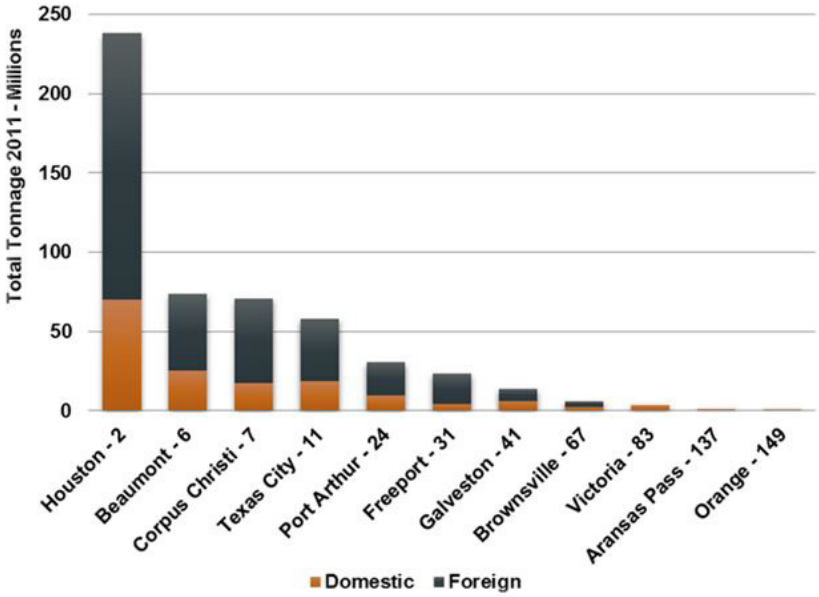
4.5.3 Ports and Waterways

Ports are integral to the Texas economy, and connections to other transportation modes at the port facilities are necessary to connect goods and services to markets in Texas and beyond. Texas' Gulf Coast provides several freight gateways through its sea ports. Eleven Texas ports ranked among the top 150 in the nation in 2011 based on total tonnage (domestic and foreign), with seven among the top 50 (Exhibit 4-54).

Ports in Texas and beyond are connected via the Gulf Intracoastal Waterway (GIWW), a 1,100 mile man-made canal which runs along the Gulf of Mexico coastline from Brownsville to St. Marks, Florida (Exhibit 4-55). Within Texas, the GIWW is

approximately 379 miles for the main channel, which TxDOT has statutory authorization as the non-federal sponsor.[52] It is often a challenge to maintain this channel as approximately five million cubic yards of material is dredged from the Texas portion of the channel annually. In 2011, more than 74 million short tons traveled through the Texas portion of the GIWW. The GIWW handles commercial navigation traffic equivalent to the fourth largest port in the US.[53]

Exhibit 4-54. National Rank of Top Texas Water Ports in 2011 by Tonnage



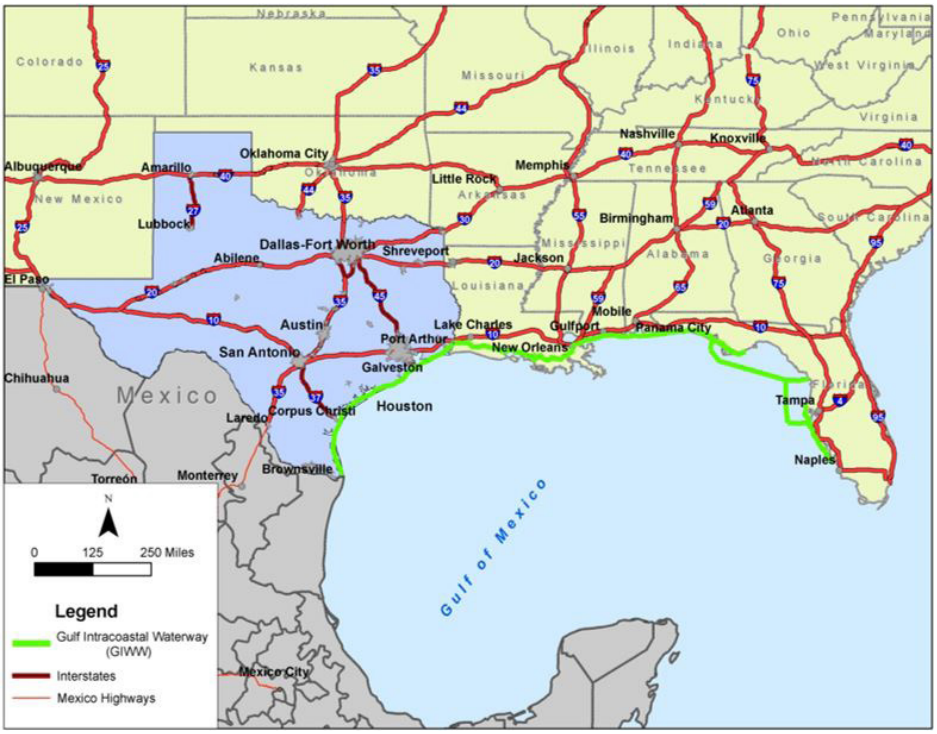
Source: U.S. Army Corps of Engineers, Waterborne Commerce of the United States, Part 5, National Summaries (New Orleans, LA: Annual Issues), tables 1-1, and 5-2, available at http://www.navigationdatacenter.us/wcsc/wcsc.htm as of Sept. 15, 2014

4.5.3.1 Port Needs

The 2015-2016 Port Capital Program was developed through a much more rigorous approach than in prior years and focuses on high-priority projects that Texas ports need to implement now in order to capture markets, tenants, and to build revenues and jobs for our communities (Exhibit 4-56). The projects in the program vary in size, scope, and emphasis, but each serves as a catalyst for economic growth, improves port access, and enhances intermodal transportation opportunities.[54]

The Port Capital Program goes on to list the current needs of ports identified in the individual port capital plans. The near term needs of Texas ports total more than $1 billion.

Exhibit 4-55. Gulf Intracoastal Waterway (2013)



Source: USDOT. 2013. Bureau of Transportation Statistics. National Transportation Atlas.

52 TxDOT. 2014, Maritime Division. GIWW lengths, 10/28/2014.
53 U.S. Army Corps of Engineers. 2011. Waterborne Commerce Statistics Center
54 TxDOT. 2014. Texas Ports 2015-2016 Capital Program. https://ftp.dot.state.tx.us/pub/txdot-info/tpp/giww/port-capital-plan-2015-16.pdf

Exhibit 4-56. Port Project Summary (2015-2016)

Port and Project Description	Total Estimated Cost (Millions)	Port Match (Millions)	Port Access Account Funding (Millions)
Port of Beaumont			
Construct an overpass to by-pass rail lines and improve access to the port	$10.0	$5.0	$5.0
Port of Brownsville			
Construct a new liquid bulk terminal – Oil Dock 6	$22.0	$11.0	$11.0
Port of Corpus Christi			
Construct a 15-acre expansion of the La Quinta Terminal general cargo yard	$12.0	$6.0	$6.0
Port of Galveston			
Construct a 60,000-square-foot building expansion for Cruise Terminal 2	$13.1	$6.6	$6.6
Port of Houston			
Construct a new rail spur with a sound barrier for the Bayport Terminal	$13.0	$6.5	$6.5
Port of Mansfield			
Maintenance dredging to 12 feet for an existing channel to enable vessel access	$8.0	$2.0	$6.0
Port of Palacios			
Modernize 650 feet of wharf in Turning Basin No. 1	$2.7	$0.67	$2.0
Port of Port Arthur			
Construct a new rail spur and cargo laydown yard	$7.1	$3.6	$3.5
Port of Victoria			
Construct a new liquid bulk barge terminal	$7.5	$1.9	$5.6
Total All Projects	**$95.3**	**$43.1**	**$52.2**

Source: TxDOT. 2014. Texas Ports 2015-2016 Capital Program. https://ftp.dot.state.tx.us/pub/txdot-info/tpp/giww/port-capital-plan-2015-16.pdf

4.5.4 Air Cargo

The quantity of air cargo moving between origin and destination points, and also the amount of cargo transferred via airport, is often closely related to airport infrastructure capacity. Texas' busiest cargo airports are located near major metropolitan areas that produce consistent passenger and air cargo traffic. Consequently, these facilities must be able to support large aircrafts capable of accommodating market demand. The state's smaller airports, generally located near Texas' medium sized metro areas, have infrastructure capable of supporting smaller-scale air cargo operations. These airports can be, and often are, used to move cargo traffic to larger airports and airports outside of the state.

In 2012, Texas was among the top cargo airports in the US in terms of total tonnage (Exhibit 4-57). These five airports handled nearly 1.45 million tons of total air cargo in 2012, which represents a decrease of -0.09 percent annually since 2002. In this same timeframe, Texas' fastest growing airports by total tonnage were George Bush Intercontinental (IAH) at 2.88 percent annually and El Paso International at 0.67 percent annually. Austin-Bergstrom International, DFW International, and San Antonio International all experienced losses in total air cargo from 2002 to 2012.[55]

55 Airports Council International. 2014.Stats and Resources. http://www.aci-na.org/content/stats-and-resources

Exhibit 4-57. Texas' Top Freight Airports

ID	Airport Name	Associated City	2002 Total Cargo Tonnage	2012 Total Cargo Tonnage	2002-2012 CAGR*	North American Rank 2012	Global Rank 2012
DFW	Dallas-Fort Worth International	Dallas-Fort Worth	738,890	664,749	-1.05%	11th	36th
IAH	George Bush Intercontinental	Houston	363,529	483,226	2.89%	14th	46th
AFW+	Fort Worth Alliance+	Fort Worth	176,429	N/A	N/A		
SAT	San Antonio International	San Antonio	133,441	129,167	-0.33%	36th	131st
ELP	El Paso International	El Paso	88,426	94,146	0.63%	47th	168th
AUS	Austin-Bergstrom International	Austin	142,919	77,796	-5.90%	54th	n/a

*CAGR = Compound Annual Growth Rate + AFW ACINA data not available for 2012
Source: Airports Council International. 2014.Stats and Resources. http://www.aci-na.org/content/stats-and-resources

Connections between the cargo airports and the highway and rail networks are integral to the movement of freight from these gateways. Exhibit 4-58 identifies the Interstates and Class I railroads that are within 90 miles of the major air cargo airports in Texas. Although the Interstates may be the most heavily traveled routes for freight to and from the airports, the local and regional roadways around the airports serve as important connection to local warehousing facilities and other local freight destinations. There are over 160 Primary Highway Freight Network roadway facilities within 90 miles of these top cargo airports in Texas. Many of these secondary routes are important connections for locally bound freight such as SH 114 in Dallas and SH 71 in Austin.

Exhibit 4-58. Interstates and Class I Rail in Proximity to Cargo Airports (2012)

	DFW	IAH	AFW	SAT	ELP	AUS
Interstates						
IH 10		X		X	X	X
IH 20	X		X			
IH 25					X	
IH 30	X		X			
IH 35E	X		X			
IH 35W	X		X			
IH 35				X		X
IH 37				X		X
IH 45	X	X	X			
IH 69		X				
IH 410				X		X
IH 610		X				
IH 635	X		X			
IH 820	X		X			
Class I Rail						
UP	X	X	X	X	X	X
BNSF	X	X	X			X
KCS	X	X	X			

Source: State of Texas. 2013. Texas: Logistics Hub for the Americas. http://gov.texas.gov/files/ecodev/Logistics_Report.pdf

4.5.4.1 Airport Needs

Airport needs totaling approximately $1 billion over the TTP horizon are provided in Exhibit 4-59 and were developed from the following airport planning documents:

- The Austin-Bergstrom International Airport (AUS) Master Plan Update shows planned growth in three upcoming phases. Appendix C of the AUS Master Plan details the cost estimate of each planning level, including the cost of air cargo and belly hold cargo. According to this appendix, AUS plans to pay for $420,134 of the belly hold cargo in Planning Level 2, a third party is committed to pay $73,585,186, $36,244,860 and $3,796,247 for air cargo in Planning Level 1, 2 and 3 respectively and $5,895,162, $1,891,707 and $4,961,006 for belly hold cargo in Planning Level 1, 2 and 3 respectively.
- George Bush Intercontinental Airport (IAH) also has an air cargo expansion planned as part of their Capital Improvement Program (CIP) in the IAH Master Plan. During Phase 3, IAH estimates that it will need $20,751,800 in 2017 to study/design and $93,383,100 in 2018 and another $93,383,100 in 2019 to construction the expansion. During Phase 4, IAH will need $23,782,800 in 2023 to study/design and $214,045,200 to finish the construction of the expansion. IAH has no record of funding sources for their air cargo expansion plan.
- According to their Master Plan Update, Corpus Christi International Airport (CCIA) plans to expand their support facilities in their long-term plan, Phase 3. CCIA estimates that a new cargo apron will cost $378,000 and construction of an air cargo building will cost $1,746,000. CCIA is anticipating that the development costs of their new support facilities in Phase 3 will be paid for by a private source or a source that is not the airport or federal funding. CCIA estimated their costs in 2006 dollars.
- The DFW International Airport recognizes the need for new cargo facilities in their 2009 Airport Development Plan Update (VFR 2030) so in 2007 they created seven development alternatives. From those seven alternatives, DFW identified two preferred alternative scenarios (Alternative 2 and Alternative 4), although there are no cost estimates of these alternatives at this time.
- El Paso International Airport (ELP) expanded their air cargo facilities in the past three years. Currently, they have the largest and most modern air cargo complex on the U.S.-Mexico border and have the capability of immediate expansion if needed.
- The William P. Hobby Airport (HOU) has also been working on expanding their facilities: During Phase 4 (2018–2022), HOU will also expand their belly freight facility. According to the HOU Master Plan CIP, it is anticipated that the new belly freight facility will cost $13,090,000 and that a third party will cover the total cost.
- In the San Antonio International Airport (SAT) Master Plan, air cargo development is planned 2016–2019 with the addition of a north cargo complex that will cost $78,040,000 and a taxiway connector to the complex that will cost $760,000. The total cost of the cargo improvements is anticipated to be funded by a source other than the airport. SAT estimated their costs in 2010 dollars.

Exhibit 4-59. Air Cargo Needs

		Austin	Bush	Corpus Christi	Houston Hobby	San Antonio	Dallas – Fort Worth
Airport Cost	Air Cargo	-	$445,346,000	-	-	-	$260,888,005*
	Belly Cargo	$420,134	-	-	$13,090,000	-	
3rd Party Cost	Air Cargo	$193,626,293	-	$2,124,000	-	$78,040,000	
	Belly Cargo	$12,747,875	-		-	-	

*Estimated 35% contingency based on DFW average freight values.
Source: Airport Plans

4.5.5 Pipelines

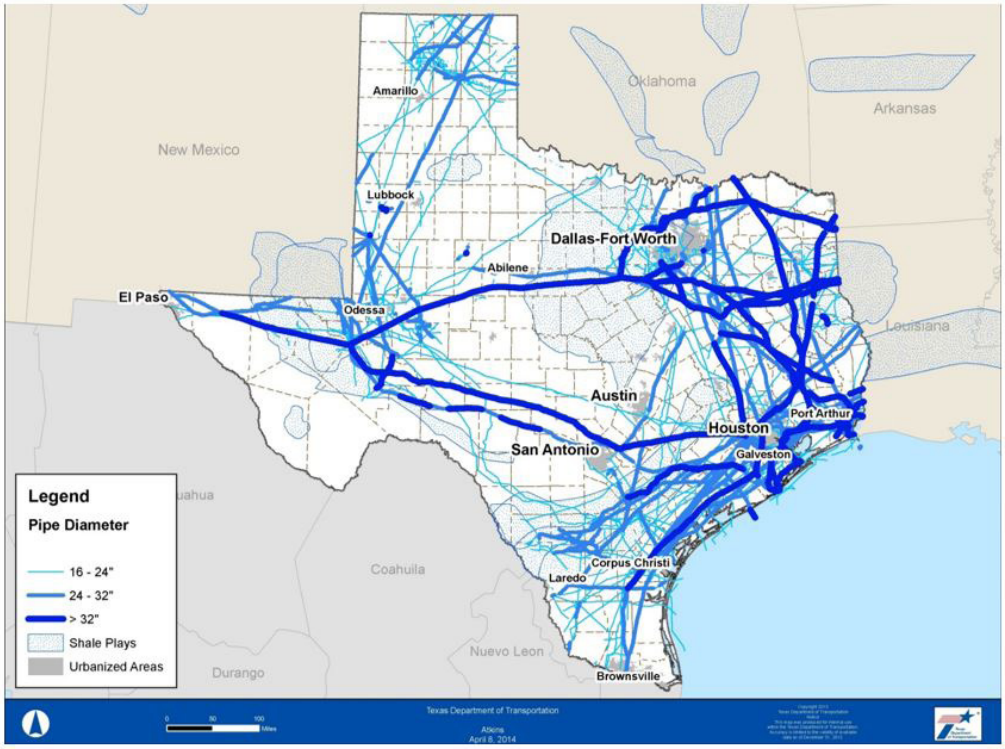
Pipeline transportation includes the gathering, transmission, or distribution of gas, oil, or other commodities by pipeline. The pipeline network is composed of the following three different line types:

- A transmission line is a pipeline that transports gas and liquid from a gathering line or storage facility to a distribution center, storage facility, or upstream large volume customer, or transports gas within a storage field. Transmission lines across the state with diameters greater than or equal to 16 inches are shown in Exhibit 4-60.
- A gathering line is a pipeline that transports gas from a production facility to a transmission line.
- A distribution line is a pipeline other than a gathering or transmission line.

USDOT's Pipeline and Hazardous Material Safety Administration is responsible for regulating pipeline transport while the Railroad Commission of Texas is responsible for pipeline permitting and operations in the state. In 2014, there were 425,939 total pipeline miles in Texas including interstate and intrastate as well as regulated and non-regulated miles.[56] These pipelines are mainly used for natural gas (50 percent) distribution followed by products like crude oil (11 percent), refined petroleum (10 percent) (Exhibit 4-61). The highest percentages of pipeline miles are in Harris County (5.6 percent), Brazoria County (3.5 percent), Jefferson County (2.8 percent), and Nueces County (2.2 percent),[57] which are areas of the state where there are numerous refining facilities.

Over 1,700 companies operate pipelines in Texas. Of these companies, DCP Midstream (7.9 percent), Enterprise Products Operating (6.6 percent), Energy Transfer Company (4.8 percent), and Targa Midstream Services (2.6 percent) operate the highest percentages of pipeline miles in Texas.[58] Pipelines are a relatively safe and inexpensive means to transport gas, oil, and petroleum. The National Transportation Safety Board indicates that pipeline transportation has a lower accident rate than other modes.

Exhibit 4-60. Statewide Transmission Pipeline Network (2013)



Source: Railroad Commission of Texas. 2013.

56 Railroad Commission of Texas. 2014.Texas Pipeline System. http://www.rrc.state.tx.us/pipeline-safety/reports/texas-pipeline-system-mileage/ Accessed December 15, 2014
57 National Pipeline Mapping System. https://www.npms.phmsa.dot.gov/. Accessed November 7, 2013
58 National Pipeline Mapping System. https://www.npms.phmsa.dot.gov/. Accessed November 7, 2013

While the locations of the transmission pipelines are an important part of the Texas Freight Network, the pipelines connect to the TFHN at truck and pipeline terminals. It is at these facilities where the product being transported via the pipeline is transferred to trucks for further transport as needed. While there are many NHS truck intermodal connectors in Texas, there are only a few that handle pipeline products. Exhibit 4-62 identifies the NHS truck and pipeline intermodal terminals in Texas according to FHWA. These terminals are also depicted in Exhibit 4-63.

Exhibit 4-62. Texas Truck and Pipeline Terminals (2013)

Intermodal Facility
Alameda Cluster
Chevron Refinery (El Paso)
Coastal States Terminal (San Antonio)
Deerpark Cluster
Diamond Shamrock Corp. Bulk Fuel Facility (DFW)
Diamond Shamrock Terminal (San Antonio)
Diamond Shamrock/Phillips (Amarillo)
Exxon Baytown Refinery
Exxon Bulk Fuel Facility (DFW)
Galena Park Cluster
GATX Terminals Corp.
Jacinto Port Cluster
Koch Refining Company (San Antonio)
Phillips Petroleum Sweeny Complex, Houston
Phillips Pipeline Co.
Shell Deer Park Chemical Plant & Refinery, Houston
Star Enterprise/Texaco

Source: USDOT. 2013.Intermodal Connectors: Texas. http://www.fhwa.dot.gov/planning/national_highway_system/intermodal_connectors/texas.cfm

Exhibit 4-61. Statewide Oil, Gas and Liquid Pipeline Network (2013)

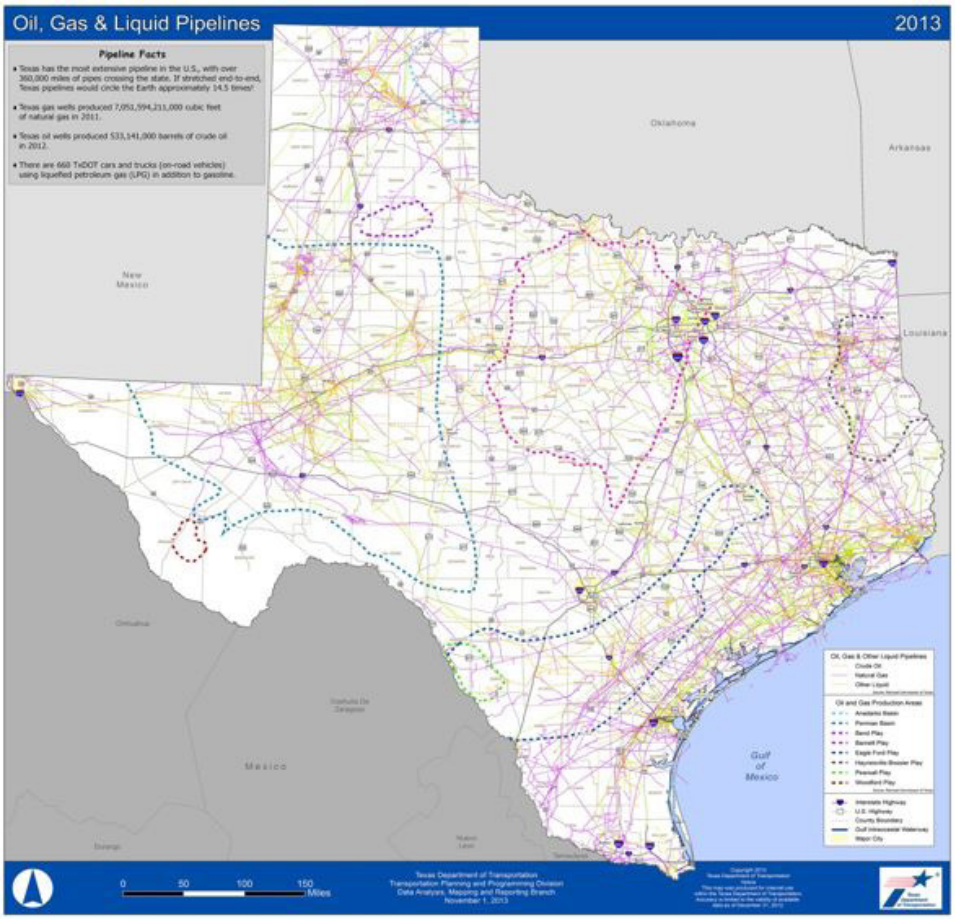
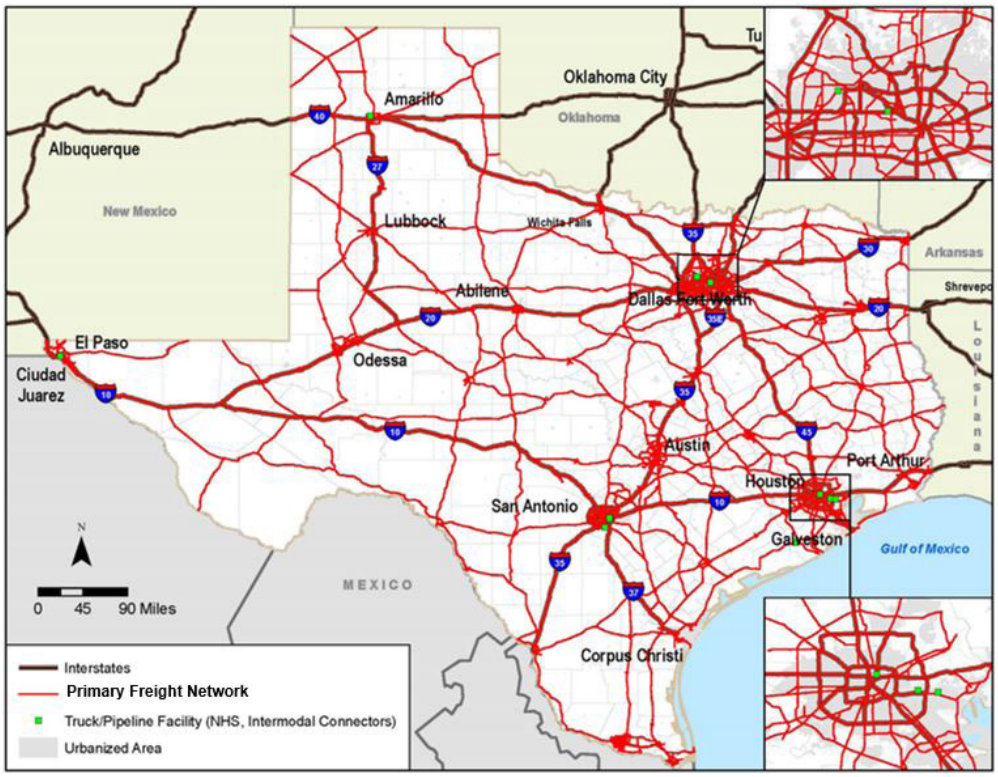



Exhibit 4-63. National Highway System Truck Pipeline Intermodal Terminals (2013)