TEXAS DEPARTMENT OF TRANSPORTATION

TEXAS TRANSPORTATION PLAN 2040

Texas Department of Transportation

February 2015

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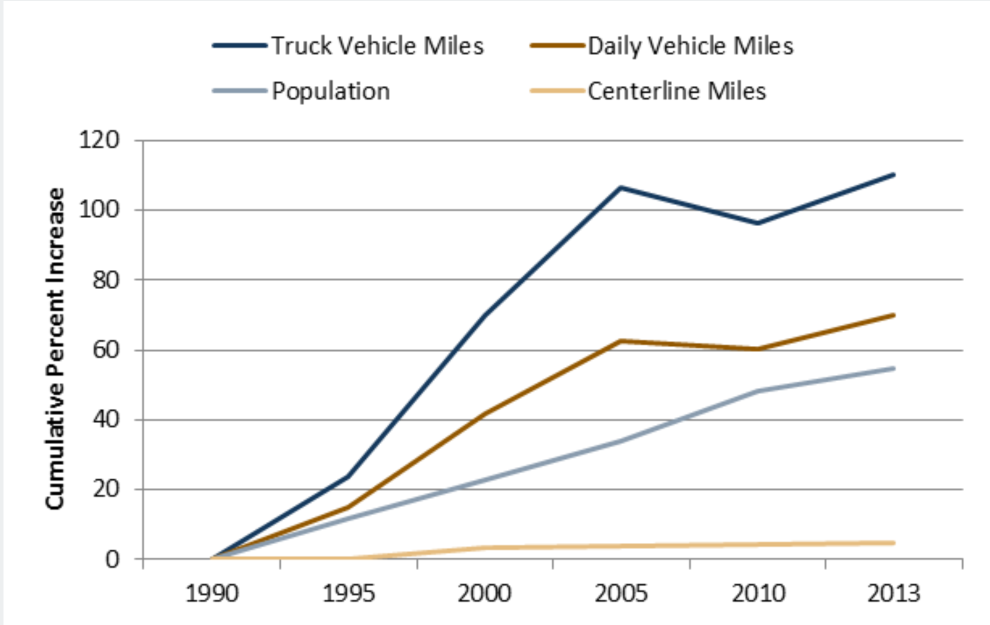
EXECUTIVE SUMMARY

The Texas Transportation Plan (TTP) 2040 documents the existing infrastructure and funding needs for all passenger and freight modes in the state over a 25-year horizon. As the state's first performance-based long-range transportation plan, the TTP provides a path forward to align transportation investment decisions with performance outcomes to address passenger and freight needs and demands amid unprecedented growth and declining revenues.

The population in Texas is expected to increase by 17 million to 45 million people between 2014 and 2040. As people continue to move to Texas, and the economy continues to grow, the transportation system must expand to accommodate this growth in a manner consistent with the priorities and desires of Texans and business leaders.

One of many challenges continues to be the increasing disparity between demand and available capacity. Since 1990, the state's population has increased by 55 percent. During the same period, daily vehicle miles traveled have increased 70 percent and daily truck miles traveled have increased 110 percent on TxDOT-maintained roadways, while roadway centerline miles have increased at a disproportionate rate of 7 percent (Exhibit ES-1).

Exhibit ES-1. Highway System and Growth Trends



This demand is expected to continue to increase. Daily vehicle miles traveled are expected to increase by 300 million miles to 800 million total miles by the year 2040 – up by more than 60 percent from the 500 million miles that were driven on the state-maintained system in 2012. The projected increase in traffic will impact safety, congestion, and the condition of the pavement and bridges on Texas roadways.

Plan Purpose

The TTP was developed concurrently with TxDOT's first freight plan – the Texas Freight Mobility Plan (TFMP) – to support TxDOT goals established in its 2015-2019 Strategic Plan, and the national goals defined in the Moving Ahead for Progress in the 21st Century (MAP-21) Act.

To address needs amid increasingly constrained resources it is critical to understand investment trade-offs and maximize the impact of every dollar spent to achieve performance objectives. Performance-based planning and programming decisions are informed by:

Strategic Direction – *Where do we want to go?*
- Goals and objectives
- Performance expectations and measures

Long-Range Planning – *How are we going to get there?*
- Identification of current trends, performance expectations, and targets
- Development of strategies consistent with Strategic Plan and TFMP goals
- Development of investment priorities based on needs and available funding

Transportation Programming – *What will it take?*
- Fiscally-constrained approach to reaching targets
- Investment and resource allocation based on project prioritization and selection criteria
- Project selection consistent with system performance expectations

Implementation and Evaluation – *How did we do?*
- Monitoring and reporting
- Communication of performance outcomes
- Collaborative evaluation to improve strategies

Strategic Direction – *Where do we want to go?*

Preliminary TTP goal areas and objectives – that aligned with Strategic Plan and MAP-21 goal areas – were identified by an internal Technical Advisory Committee, and then vetted with stakeholders and the public during outreach efforts in the early stages of the TTP development (Fall 2013).

The preliminary or "draft" goal areas were refined over time based on continuous feedback from stakeholders and the public, and finalized after an extensive stakeholder and public outreach campaign conducted between June and August of 2014 (Exhibit ES-2).

In addition to MAP-21 performance measures, TTP performance measures were developed to support state and federal transportation goals and objectives. The TTP performance measures will serve as the basis for evaluating and

Exhibit ES-2. Texas Transportation Plan Goal Areas

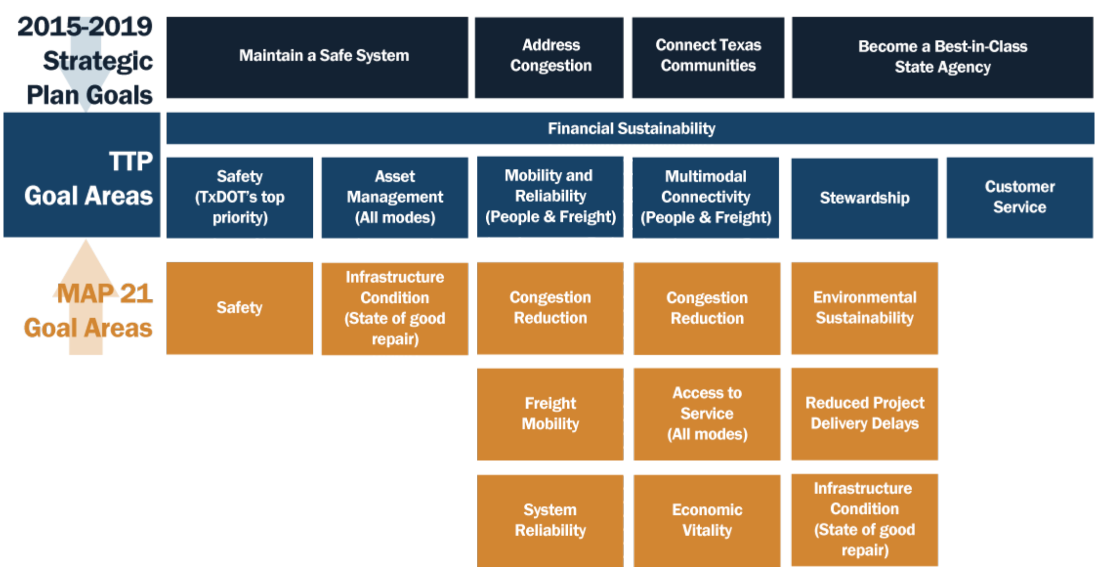


*Exhibit ES-3. State of Good Repair Needs to 2040 by Mode**

Mode	Summary of Methodology	SGR Needs through 2040 (2014 Constant 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 statewide 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 (Metropolitan Transit Authority (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

comparing investment policies and strategies and tracking the results over time to ensure TxDOT is making investments that optimize the performance of the statewide transportation system. Chapter 3 of the TTP provides additional information on the performance measures.

Long Range Planning – *How are we going to get there?*

Long-range transportation needs such as maintenance and replacement of aging infrastructure cannot be met with declining revenues from traditional funding sources such as the gas tax and vehicle registrations. Just as critical is the need to identify new and sustainable funding sources to fill the remaining gaps.

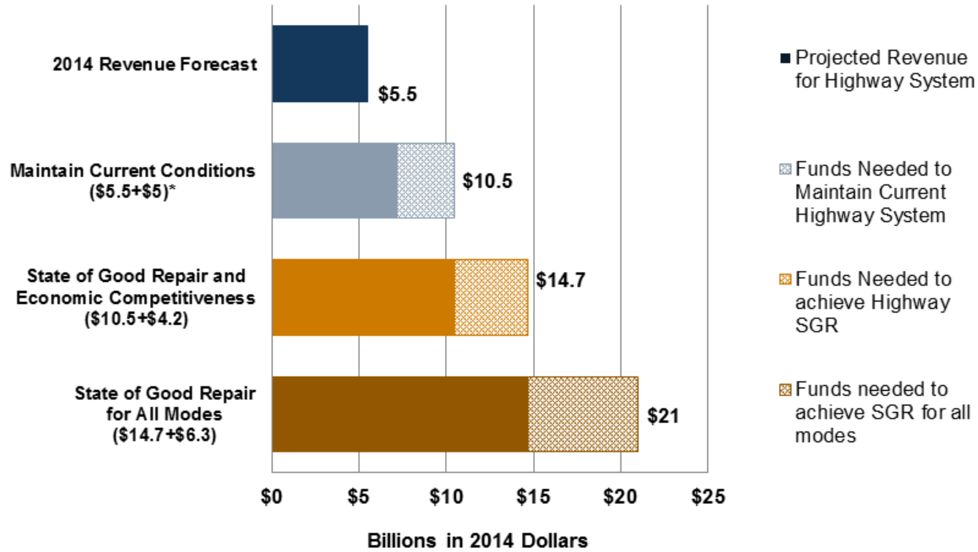
To define priorities for the TTP goal areas, TxDOT analyzed existing modal plans, metropolitan planning organization (MPO) transportation plans and programs, and rural plans to ensure consistency between state and local initiatives to address freight and passenger needs. Exhibit 2-2 in Chapter 2 of the TTP provides a summary of the documents reviewed, considered, and incorporated by reference.

Safety is TxDOT's number one priority and TxDOT strives to keep the transportation system infrastructure for which we are responsible in a state of good repair (SGR). Highway pavements are in a SGR when the roadway has minimal cracking and rides smooth while bridges are in a SGR when they are structurally sound. The TTP documents the funding needs for all passenger and freight modes to achieve performance outcomes (e.g., SGR) aligned with TTP goals.

Exhibit ES-3 summarizes the methodology used for determining SGR for various highway and non-highway modes of transportation in the state. Based on these criteria, needs were projected to meet SGR definitions and costs were calculated by mode through year 2040.

A comprehensive statewide analysis of transportation demand to capacity across various modes identified baseline performance levels to maintain the system in SGR as is required by MAP-21. SGR generally considers asset condition, service life, and operational effectiveness. The results of this analysis are presented in Exhibit ES-4, which incrementally accounts for transportation revenue needs required to address various levels of system performance, up to and including achieving SGR for all modes.

Exhibit ES-4. Average Annual Revenue Needs for System Performance (2014-2040)



*$1.74B in Proposition 1 funding addresses some needs for fiscal year 2015, but future Proposition 1 funds are uncertain

Transportation Programming – *What will it take?*

TxDOT maintains that approximately $5 billion dollars annually are needed – above existing revenues of $5.5 billion – to maintain current conditions on the state's highway system. With an extra $5 billion a year in funding, TxDOT has stated that $1 billion (20 percent) would address our backlog of statewide maintenance needs on roads and bridges, $1 billion (20 percent) would address the additional highway system impacts in our energy sector regions of the state, and $3 billion (60 percent) would address the program of mobility and connectivity needs (Exhibit ES-5).

Funding needs and gaps presented in the TTP were based on reasonably expected revenues for all passenger and freight modes to achieve performance outcomes aligned with TTP goals and federal performance goals under MAP-21. Of the $21 billion dollar projection to achieve SGR on the entire system, TxDOT would need approximately $14.7 billion a year to achieve SGR for multimodal infrastructure for which it is responsible – while $6.3 billion would need to be invested by external transportation partners and providers. Proposition 1 will provide approximately $1.74 billion of the $5 billion needed for fiscal year 2015 and TxDOT is recommending the same percentage distribution illustrated in Exhibit ES-5.

Exhibit ES-5. Proposed $5 Billion Disbursement

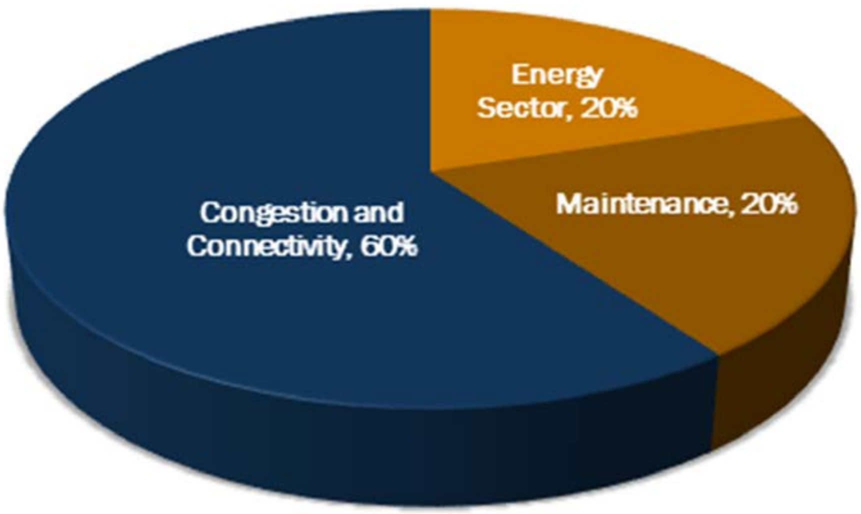


Exhibit ES-6 illustrates system performance for each of the funding levels in Exhibit ES-4. At current reasonably expected revenues, "good" condition can be achieved for existing highway (bridge and pavement) infrastructure; however, this could occur only by shifting all highway expansion dollars to preventive maintenance and capital rehabilitation activities for existing assets. The system performance for each funding level described by the following conditions:

- **Poor** –signs of significant wear, tear, and deterioration
- **Fair** – signs of some aging is evident and reduced function
- **Good** – state of good repair as previously defined

Exhibit ES-6. System Performance Outcomes for Average Annual Revenue Needs (2014-2040)

Mode	Investment Category	Performance Measure	Current Hwy Forecast ($5.5 B/yr)	Current Hwy + $5 B ($10.5 B/yr)	SGR Hwy ($14.7 B/yr)	SGR All Modes ($21 B/yr)
Pavement	National Highway System (NHS) Pavements	% NHS Pavement Lane-Miles in a State of Good Repair (based on IRI)	Poor	Good	Good	Good
		% NHS Pavement Lane-Miles in a State of Good Repair (based on Condition Score)	Poor	Good	Good	Good
	Non-NHS Pavements	% Non-NHS Pavement Lane-Miles in a State of Good Repair (based on IRI)	Poor	Poor	Good	Good
		% Non-NHS Pavement Lane-Miles in a State of Good Repair (based on Condition Score)	Poor	Poor	Good	Good
Bridge	NHS Bridges	% Structurally Deficient NHS Bridge Deck Area	Good	Good	Good	Good
		Count of Structurally Deficient NHS Bridges	Fair	Good	Good	Good
	Non-NHS Bridges	% Structurally Deficient Non-NHS Bridge Deck Area (on State System)	Good	Good	Good	Good
		Count of Structurally Deficient Non-NHS Bridges (on State System)	Fair	Good	Good	Good
Highway Mobility	Rural Mobility	Rural Level-of-Service	Poor	Fair	Good	Good
	Urban Mobility	Urban Level-of-Service	Poor	Poor	Good	Good
Transit	MTA Transit Asset Preservation	% of MTA Assets in a State of Good Repair				Good
	MTA Transit Service Enhancements	Additional MTA Annual Rider Trips in Millions				Good
	Non-MTA Transit Asset Preservation	% of Non-MTA Assets in a State of Good Repair				Good
	Non-MTA Transit Service Enhancements	Additional Non-MTA Annual Rider Trips in Millions				Good
Passenger Rail	Passenger Rail	% Passenger Rail Needs Met				Good
Non-Highway Freight	Non-Highway Freight	% Non-Highway Freight Needs Met				Good
Intelligent Transportation Systems (ITS)	ITS	% ITS Needs Met				Good
Aviation	National Plan of Integrated Airport Systems (NPIAS) Aviation	NPIAS Project Backlog				Good
	Non-NPIAS Aviation	Non-NPIAS Project Backlog				Good
Bicycle and Pedestrian	Bicycle and Pedestrian	% Bicycle and Pedestrian Needs Met				Good

If transportation investments continue to be made using historical funding allocations, the condition and performance of the state's multimodal transportation system would decline over the long-term. The $1.7 billion for fiscal year 2015 for highway infrastructure recently approved by Texas voters addresses strategic capacity enhancements and the immediate backlog in highway asset infrastructure, but little else.

If $5 billion in transportation funds becomes available for multimodal transportation, and is invested using under an allocation strategy similar to that which is used today, the condition of the system's assets (pavements, bridges, and transit) would remain as "good." Subsequently, congestion and mobility in urban areas would be slightly worse than today's levels, and congestion and mobility in rural areas would be comparable to today's levels.

Exhibit ES-7. MetroQuest Tool Introduction Page (Spanish version)

To support greater public understanding of the gap between needs and available funding, TxDOT developed a bilingual, interactive planning scenario tool that enabled users to visualize the systemic impacts and trade-offs in performance that result from shifting financial resources from one transportation investment priority to another (e.g., from system preservation to roadway expansion). The user could also evaluate what a given level of investment "buys" in terms of various performance levels and then build their own transportation budget to reflect personal preferences for resource allocation and system performance.

The MetroQuest tool (Exhibit ES-7) was available at meetings and via a web address disseminated to meeting participants and advertised through social media. In total, more than 500 people visited the interactive planning tool website between June and September of 2014.

English and Spanish versions of the MetroQuest tool can be viewed at the following web addresses:

English: http://p1.txdot.metroquest.com/
Spanish: http://spanish.p1.txdot.metroquest.com/

Given the size and scale of the Texas transportation system, and the recent and projected population influx to the state, currently available revenues will be inadequate to meet transportation needs and growing demand. Increased funding will allow TxDOT to address more of the unfunded needs, but in a fiscally constrained environment, funding decisions and project selections must result in performance-based outcomes.

Guided by the performance goals outlined in the TTP, TxDOT is improving its current investment strategies and project selection process to link TTP goals to performance-based programming decisions that inform project selection. This performance based project selection process and current evaluation criteria are illustrated in Exhibit ES-8. Through this process, projects selected and programmed through mid-range plans and programs such as the Unified Transportation Program (UTP) and the Statewide Transportation Improvement Program (STIP) can be objectively evaluated and linked to potential performance outcomes.

Additional steps must be taken by TxDOT and our planning partners to effectively meet TTP and MAP-21 performance goals and to deliver safe and sustainable multimodal transportation options into the future, TxDOT must:

- Build on the existing project selection criteria to develop a transparent performance-based project prioritization process that weights and ranks all UTP projects using both quantitative and qualitative criteria to meet short- and long-term performance goals and state transportation priorities. This should combine asset management priorities with major projects identified in the UTP.
- Advance asset management planning and predictive capabilities for all project types, both at the Division and District levels.
- Make strategic capacity enhancements to reduce bottlenecks and improve travel times in key passenger and freight corridors (Exhibit ES-9).
- Compare preventive treatments against system expansion projects in order to determine the best possible allocation of existing and new transportation funds.

Exhibit ES-8. Performance – Based Project Selection Criteria

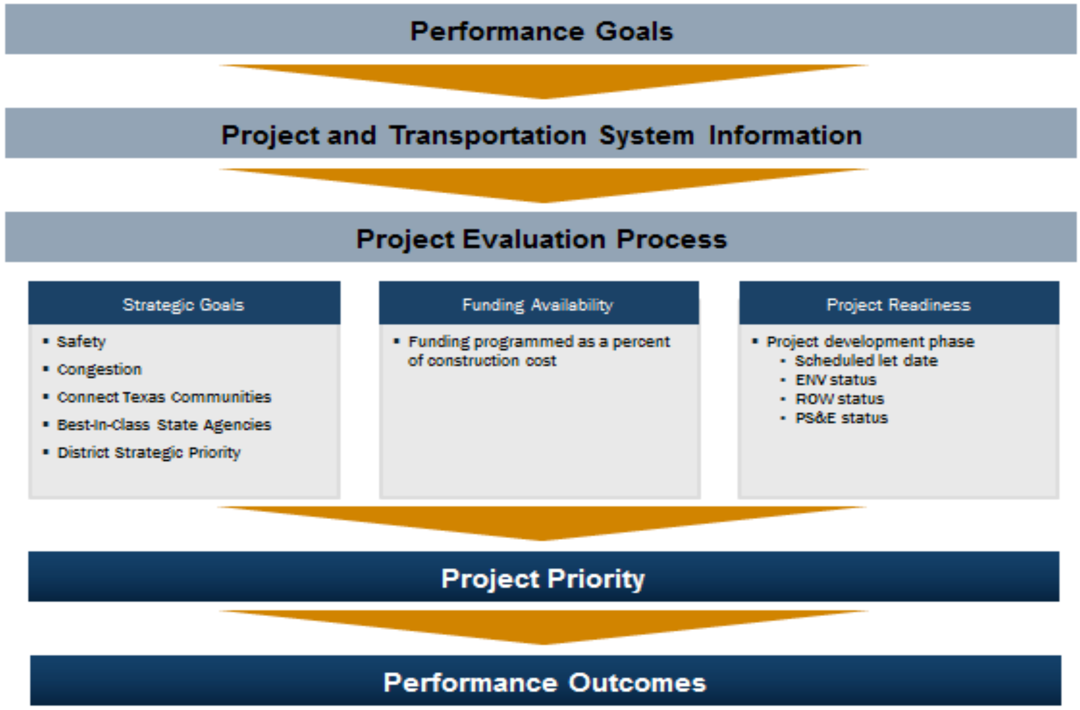
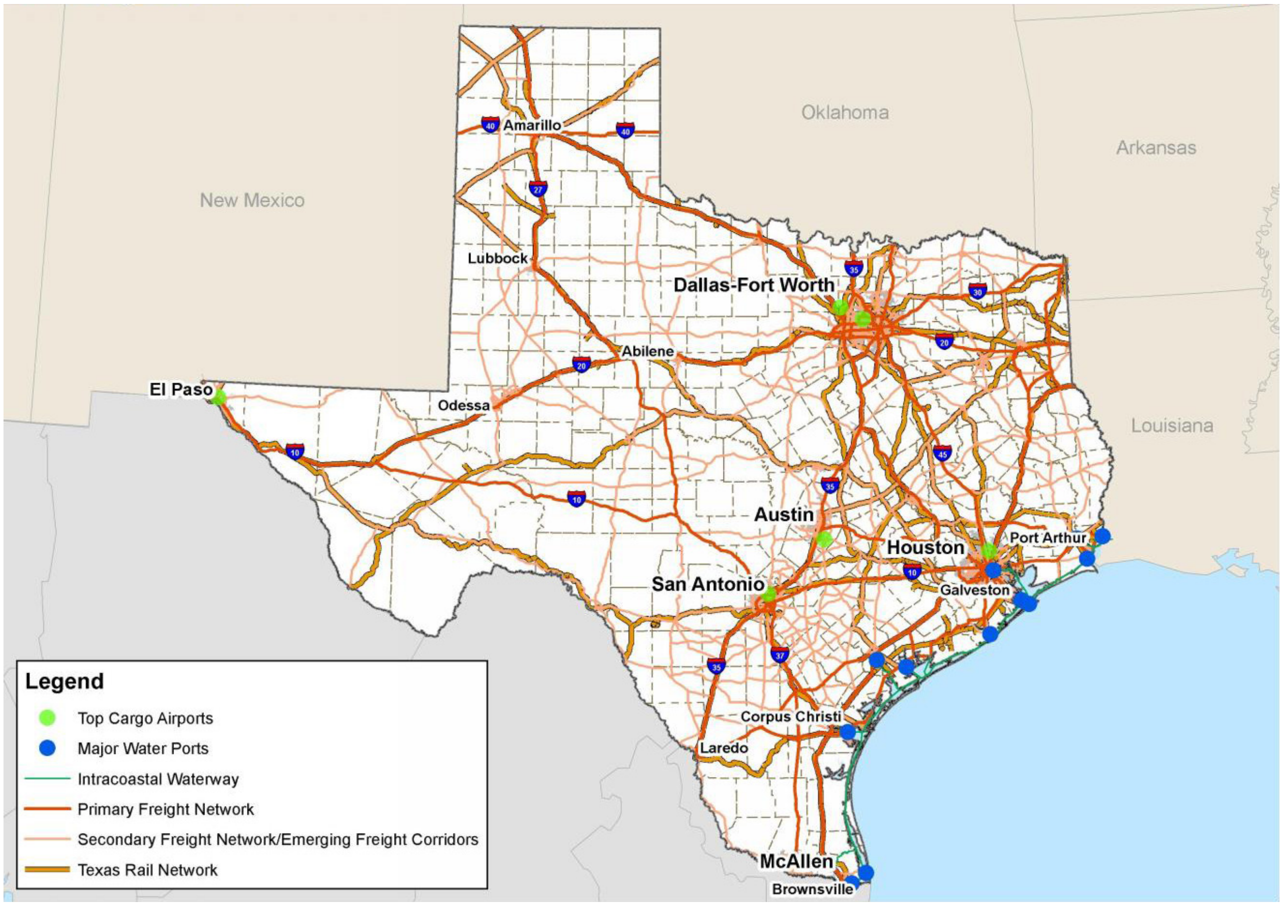
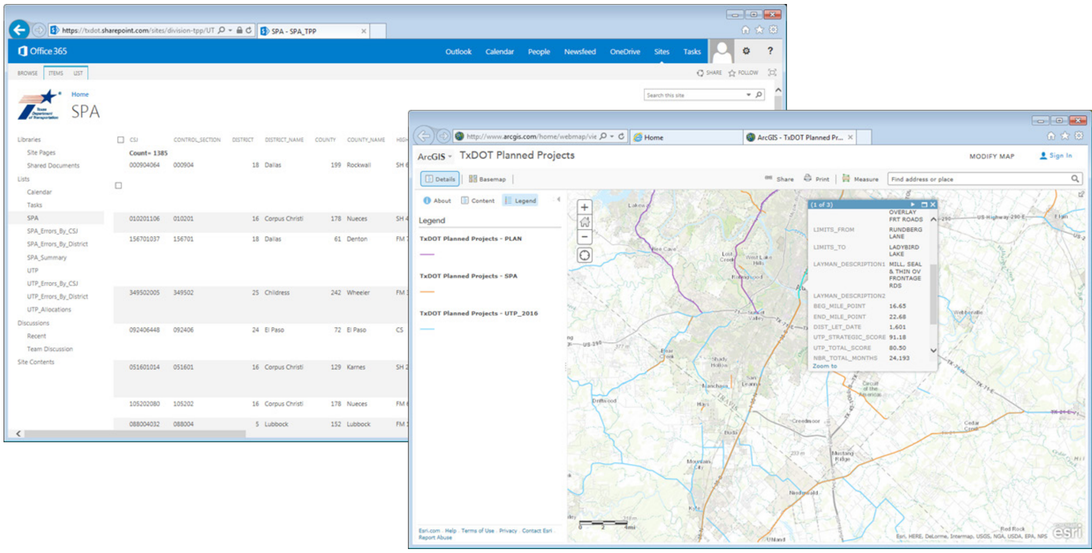


Exhibit ES-9. Texas Freight Network



TxDOT is working on developing systems to manage and maintain project information for use in project evaluation. Furthermore, the department will ensure project information is available and accessible to planning partners, like our metropolitan planning organizations, and to the general public. This involves the development of web-based applications, as shown in Exhibit ES-10, that outline the criteria for evaluating and prioritizing projects.

Exhibit ES-10. Web-Based Project Evaluation and Information Systems



As a further step toward improving information requirements for performance programming, TxDOT is in the process of implementing its first electronic STIP – a tool that will enable a "real-time" financial evaluation and assessment of projects constructed or implemented against available revenues to improve resource allocation and streamline project delivery.

Implementation and Evaluation – *How did we do?*

As new strategies and processes are implemented, TxDOT must continue to monitor system operations, measure performance, and evaluate project selection decisions. Annually, TxDOT will report progress toward meeting (or exceeding) established targets for TTP and MAP-21 goals to stakeholder and public. Substantial changes to planning requirements or available revenues may require TxDOT to revise the TTP and seek additional stakeholder and public input on adjustments to strategies, goals, and targets to ensure that the process by which TxDOT is prioritizing and investing in projects is transparent and inclusive (Exhibit ES-11).

Exhibit ES-11. Performance-Based Planning Process

Similar to most states in the nation, Texas faces a serious transportation funding challenge. Declining state and federal revenues are impacting safety conditions, congestion and delay, and the condition of pavement on bridges and highways. Exhibit ES-12 illustrates a comparison of system performance in Texas for 2012 to other state and national averages for several of the national performance measures under MAP-21.

Exhibit ES-12. National Performance Measure Comparisons

2012 Highway Fatality Rates

Rank	State	Total Statewide Rate
1	Massachusetts	0.62
2	Minnesota	0.69
3	Connecticut	0.75
4	Washington	0.78
5	New Jersey	0.79
40	Texas	1.43
46	Arkansas	1.65
47	North Dakota	1.69
48	Montana	1.72
49	South Carolina	1.76
50	West Virginia	1.76
U.S. Average		1.13

Source: FHWA

2012 Annual Hours of Delay per Commuter

Very Large (over 3 million)	
National	52
Houston	52
Dallas-Fort Worth	45
Large (1 - 3 million)	
National	37
Austin	44
San Antonio	38
Medium (500K - 1 million)	
National	29
El Paso	32
McAllen	28
Small (Under 500K)	
National	23
Beaumont	25
Brownsville	25
Laredo	19
Corpus Christi	14

Source: 2012 Urban Mobility Report

*2012 Percent IRI <95**

Rank	State	Total Percent of Lane Miles**
1	Nevada	89.70%
2	Georgia	86.84%
3	Alabama	81.72%
4	Florida	81.40%
5	Kentucky	79.36%
32	Texas	53.89%
46	Massachusetts	33.14%
47	New Jersey	32.83%
48	Hawaii	32.06%
49	California	31.32%
50	Rhode Island	20.34%
U.S. Average		59.03%

Source: FHWA

*International Roughness Index “Good” or “Better”

**State-maintained

Conclusions

Texas is at a turning point. Texas faces serious transportation funding challenges given the decline in both state and federal sources.

- At current funding levels and without additional sustainable funding in the future, "good" conditions on pavements and bridges can only be maintained by shifting all highway expansion dollars to preventive maintenance and capital rehabilitation.
- The $1.7 billion for highway infrastructure, recently approved by Texas voters under Proposition 1, will address some of the strategic capacity enhancement, connectivity, and maintenance needs for fiscal year 2015, but will not be sufficient to address growing needs into the future.
- TxDOT estimates that $5 billion more per year (2014 dollars) in highway investment is needed to generally maintain the current level of congestion and condition of our highway infrastructure.

The transition of current practices to a more performance-based approach is an ongoing process that begins with the adoption of the TTP 2040 – TxDOT's first performance-based, long-range, multimodal plan. As we implement this Plan, TxDOT will:

- Advance asset management planning and predictive capabilities for all project types, both at the Division and District levels;
- Make strategic capacity enhancements to reduce bottlenecks and improve travel times in key passenger and freight corridors;
- Continue to work with elected officials to identify and develop sustainable funding sources; and
- Continue its partnerships with multimodal transportation providers to develop and implement provide new technologies, demand management strategies, system operations and non-motorized transportation improvements to meet identified needs.



INTRODUCTION

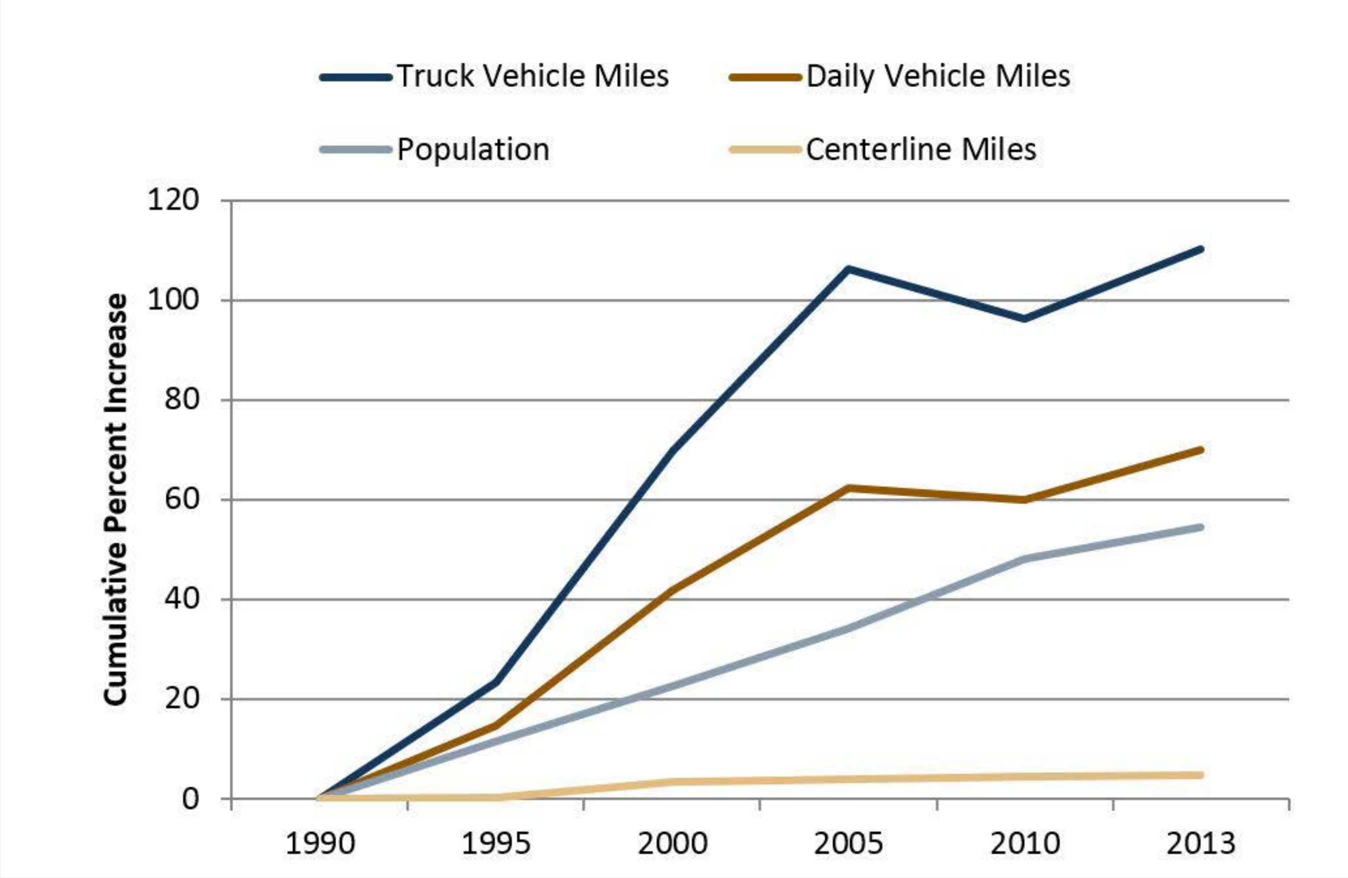
The Texas Transportation Plan (TTP) 2040 documents the existing infrastructure and funding needs for all passenger and freight modes in the state over a 25-year horizon. As the state's first performance-based long-range transportation plan, the TTP provides a path forward to align transportation investment decisions with performance outcomes to address passenger and freight needs and demands amid unprecedented growth and declining revenues.

The population in Texas is expected to increase by 17 million to 45 million people between 2014 and 2040. As people continue to move to Texas, and the economy continues to grow, the transportation system must expand to accommodate this growth in a manner consistent with the priorities and desires of Texans and business leaders.

One of many challenges continues to be the increasing disparity between demand and available capacity. Since 1990, the state's population has increased by 55 percent. During the same period, daily vehicle miles traveled have increased 70 percent and daily truck miles traveled have increased 110 percent on TxDOT-maintained roadways, while roadway centerline miles have increased at a disproportionate rate of 7 percent (Exhibit 1-1).

The TTP was developed concurrently with TxDOT's first freight plan – the Texas Freight Mobility Plan (TFMP) – to support TxDOT goals established in its 2015-2019 Strategic Plan, and the national goals defined in the Moving Ahead for Progress in the 21st Century (MAP-21) Act.

Exhibit 1-1. Highway System and Growth Trends



1.1 Texas Transportation Plan Purpose

In support of the Strategic Plan, the TTP is TxDOT's long-range, multimodal, performance-based transportation plan. It will guide planning and programming decisions for the development, integrated management, and operation of the statewide transportation system over the next 25 years. The TTP documents the funding needs and identifies funding gaps based on reasonably expected revenues for all passenger and freight modes to achieve performance outcomes aligned with TTP goals and federal performance goals under MAP-21. The TTP includes modal needs by reference to other mode-specific plans and programs.

Performance-based planning and programming decisions are informed by:

Strategic Direction – *Where do we want to go?*

- Goals and objectives
- Performance expectations and measures

Long-Range Planning – *How are we going to get there?*

- Identification of current trends, performance expectations, and targets
- Development of strategies consistent with Strategic Plan and TFMP goals
- Development of investment priorities based on needs and available funding

Transportation Programming – *What will it take?*

- Fiscally-constrained approach to reaching targets
- Investment and resource allocation based on project prioritization and selection criteria
- Project selection consistent with system performance expectations

Implementation and Evaluation – *How did we do?*

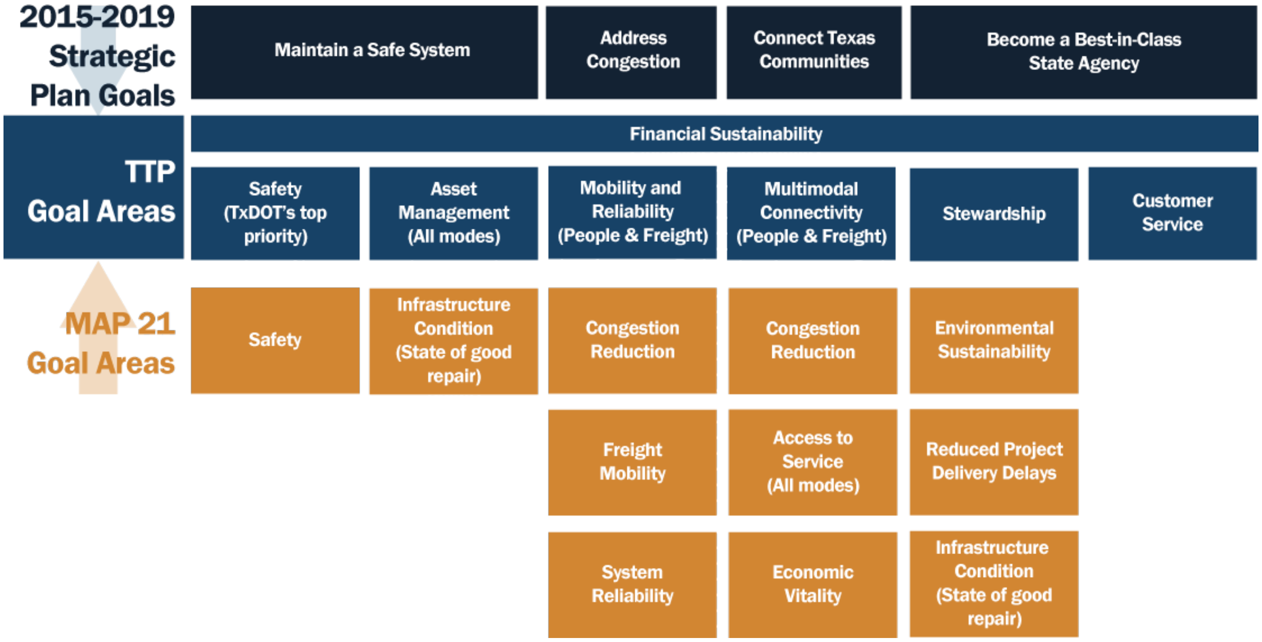
- Monitoring and reporting
- Communication of performance outcomes
- Collaborative evaluation to improve strategies

Exhibit 1-2 illustrates the Performance-Based Planning Process.

Exhibit 1-2. Performance-Based Planning Process

Exhibit 1-3 shows how TTP goals were developed to align with Strategic Plan goals and with national goals established under MAP-21.

Exhibit 1-3. Texas Transportation Plan Goal Areas



1.2 Goals, Objectives, and Performance Measures

The final goals for the TTP are as follows:

- **Safety** – Improve multimodal transportation safety.
- **Asset Management** – Maintain and preserve multimodal assets using cost-beneficial treatments.
- **Mobility and Reliability** – Reduce congestion and improve system efficiency and performance.
- **Multimodal Connectivity** – Provide transportation choices and improve system connectivity for all passenger and freight modes.
- **Stewardship** – Manage resources responsibly and be accountable and transparent in decisionmaking.
- **Customer Service** – Understand and incorporate customer desires in decision processes and be open and forthright in all agency communications.
- **Sustainable Funding** – Identify and sustain funding sources for all modes.

Exhibit 1-4 provides an overview of TTP performance measures. More information regarding the development of the TTP goals and the objectives aligning to these goals is provided in Chapter 3, Sections 3.1 and 3.2.

Exhibit 1-4. Texas Transportation Plan Performance Measures

Performance Measure and Definition	Plan Goal Areas Supported	Focus
Rural and Urban Level of Service (LOS), Total Delay, and Congestion Severity Index (CSI)	Mobility and Reliability Multimodal Connectivity	Highway Congestion
National Highway System (NHS) and NonNHS % Lane-Miles with a "Good" or "Better" International Roughness Index (IRI) and % Lane-Miles with a "Good" or "Better" Pavement Condition Score	Asset Management Stewardship Safety	Highway Pavements
NHS and NonNHS % Structurally Deficient (SD) Deck Area, Count of Bridges and % Deck Area with Cyclic Maintenance Needs, Count of Bridges and % Deck Area with Preventive Maintenance Needs, and Count of Bridges and % Deck Area with Rehabilitation or Replacement Needs	Asset Management Stewardship Safety	Highway Bridges
Metropolitan Transit Authority (MTA) and NonMTA % of Transit Assets in "Good" or "Better" condition and Additional Annual Transit Ridership	Asset Management Mobility and Reliability	Non-Highway Infrastructure (Transit)
% Passenger Rail Needs Met	Mobility and Reliability	Modal Alternatives (Passenger Rail)
% ITS Needs Met	Asset Management Mobility and Reliability	Highway Congestion
National Plan of Integrated Airport Systems (NPIAS) and NonNPIAS Backlog of Aviation Projects	Asset Management Multimodal connectivity	Non-Highway Infrastructure (Aviation)
Number of Fatalities and Serious Injuries	Safety	Multimodal Safety
% Bicycle and Pedestrian Needs Met	Stewardship Multimodal Connectivity	Modal Alternatives (Bicycle and Pedestrian)
% NonHighway Freight Needs Met	Mobility and Reliability Multimodal Connectivity	Modal Alternatives (Non-Highway Freight)

1.3 Expected Revenues and Multimodal Needs

Revenues for highway and non-highway investment that will be available to meet the multimodal transportation needs identified in the TTP total approximately $9.1 billion (2014 constant dollars) annually over the 25-year horizon. Revenues were forecasted using estimates for reasonably expected available funds for the highway and non-highway modes identified in the TTP.

A summary of unconstrained needs through 2040 for each mode analyzed in the TTP is provided in Exhibit 1-5, indicating that $21 billion is needed each year for passenger and freight transportation modes in the state. This means that in order to meet long-range transportation goals, more than twice the average annual investment in the state's transportation system – for all modes – is needed. More information regarding the methodologies and assumptions used in the analyses can be found in Chapter 4. It is important to note that unconstrained needs for all modes total more than twice the $5 billion in estimated highway needs that has been cited by TxDOT to maintain system conditions, but includes TxDOT and non-TxDOT responsibilities.

Exhibit 1-5. Unconstrained Needs through 2040 by Mode

Mode	Unconstrained Needs (2014 Dollars in Billions)
Highways - Pavement	$103.7
Highways - Bridge/Culvert	$40
Highways - Expansion	$239.2
Transit (excluding Passenger Rail)	$101.2
Passenger Rail	$21
Bicycle and Pedestrian	$2.19
Aviation	$20.4
ITS	$13
Non-Highway Freight	$5.7 (total) - $3.9 B (freight rail) - $0.8 B (port/waterway) - $1.0 B (air cargo)
Total	**$547 B ($21 B/year)**

1.4 Meeting Needs with Available Revenues

The single greatest challenge to meeting transportation needs in Texas is available revenue. The TTP development team has identified the needs and analyzed the costs for meeting those needs over the next 25 years. Growth in population and demand for transportation services has outpaced growth in transportation revenues. Traditional funding sources do not provide the needed revenues to keep pace with growth and demand. There are additional challenges that must be considered.

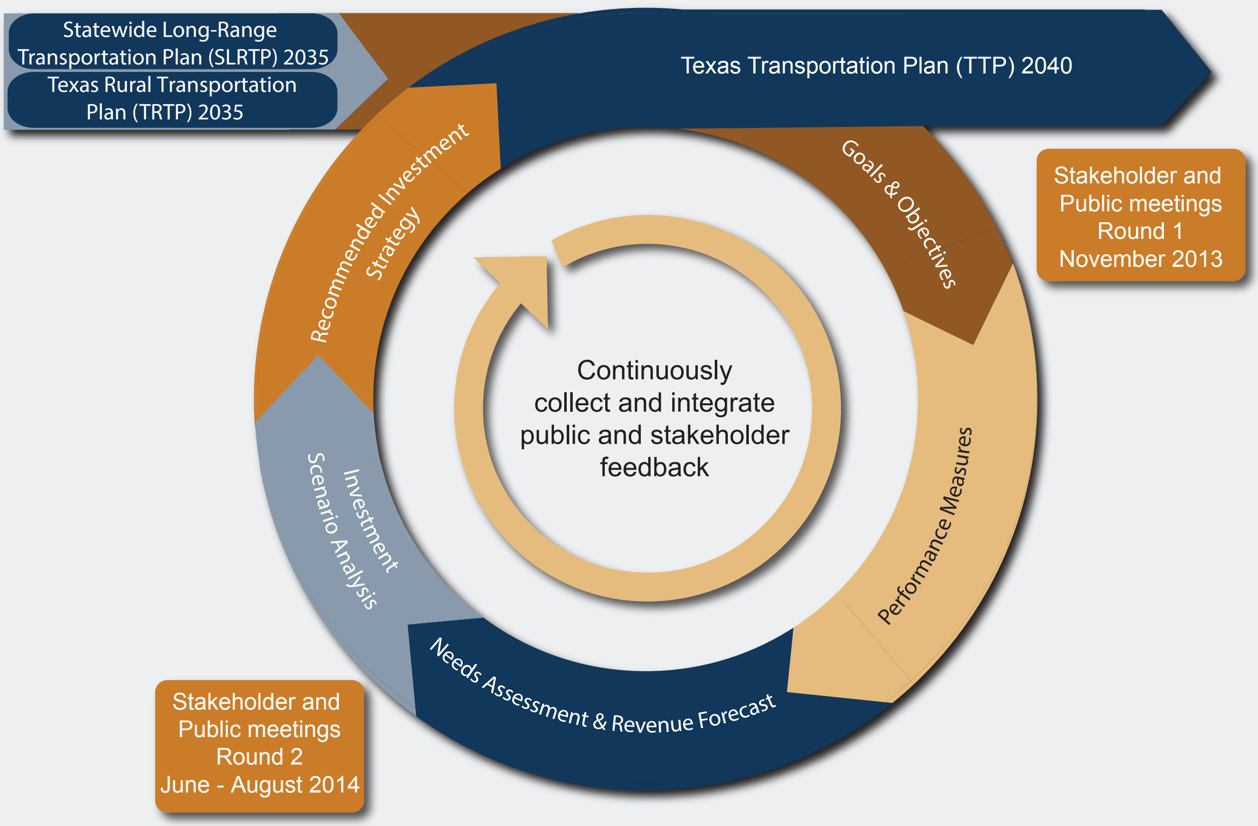
- **Inflation**. The purchasing power of the dollar has diminished over time, but the rates at which revenue is collected have remained static for two decades.
- **Fuel Efficient Vehicles.** As vehicles become more fuel efficient, less fuel is purchased resulting in declining fuel tax revenues.
- **Federal Funding**. The Federal Highway Trust Fund (HTF) that states rely upon is near insolvency.
- **Aging Infrastructure**. Many highway pavements and bridges have reached or exceeded their expected lifespan. Deferred maintenance and reconstruction increase construction costs dramatically.

The issues discussed in this Introduction are analyzed and explained in depth in Chapters 2 through 8.

TEXAS TRANSPORTATION PLAN DEVELOPMENT

The Texas Transportation Plan (TTP) advances performance-based planning concepts and integrates existing and ongoing state transportation plans and initiatives. While TxDOT's role as owner-operator, partner, or advocate varies widely across transportation modes, the TTP provides goals and objectives in addition to needs and anticipated revenues for all passenger and freight modes, including those falling within and outside of TxDOT's direct responsibilities.

Exhibit 2-1. Texas Transportation Plan 2040 Development Process



2.1 Plan Framework: Integration with Other Transportation Plans and Programs

2.1.1 TxDOT 2015-2019 Strategic Plan

In accordance with TxDOT's commitment to operational excellence and innovation, the TTP applies state-of-the-art methodologies that link investment decisions with the achievement of the long-term goals defined in TxDOT's Strategic Plan (Exhibit 2-2).

Exhibit 2-2. TxDOT Mission, Values, and Goals as Defined in the 2015–2019 Strategic Plan

Mission	Work with others to provide safe and reliable transportation solutions for Texas
Values	Trust: We strive to earn and maintain the confidence of our partners and the people of Texas.
	Integrity: We honor our commitments and keep our word.
	Responsibility: We are accountable to the people of Texas for carrying out our mission and roles.
	Excellence: We do our work at a high level of quality.
	Service: We do what we do for the people of Texas.
Goals	Maintain a Safe System
	Address Congestion
	Connect Texas Communities
	Become a Best-in-Class State Agency

2.1.2 Texas Freight Mobility Plan

The early freight specific findings of the Texas Freight Mobility Plan (TFMP) have been included in the TTP. As the TFMP is still in development, this document maybe updated to included information from the final TFMP as appropriate. TFMP draft goal areas included:

- Enhancing freight mobility and improving economic competitiveness through efficient, reliable, and safe transport of goods throughout the state;
- Defining policies and investments that will enhance Texas' freight transportation system into the future; and
- Establishing a framework for Texas' first comprehensive freight planning program to inform freight stakeholders and decisionmakers.

2.1.3 Other Plans and Programs

TTP development included analyses of existing TxDOT and metropolitan planning organization (MPO) transportation plans and programs to ensure consistency with other ongoing planning efforts and initiatives. Exhibit 2-3 provides a summary of the documents reviewed, considered, or incorporated into the TTP by reference.

Exhibit 2-3. TxDOT Plans for Coordination with Texas Transportation Plan

Plan/Program	Developed By	Approved By	Content
State Implementation Plan	Texas Commission on Environmental Quality & Non-Attainment MPOs	Environmental Protection Agency	A description of control strategies, or measures to deal with pollution, for areas that fail to achieve national ambient air quality standards
TxDOT Strategic Plan	TxDOT	Texas Transportation Commission	TxDOT's operational goals and strategies
Statewide Long-Range Transportation Plan (SLRTP) 2035 and Texas Rural Transportation Plan (TRTP)	TxDOT	Texas Transportation Commission	Future goals, strategies, and performance measures for the multimodal transportation system
Texas Freight Mobility Plan	TxDOT (in development)	Texas Transportation Commission	Establish a framework for Texas' first comprehensive freight planning program and decision making
Texas Rail Plan	TxDOT	Texas Transportation Commission	Long-range rail investment program for freight and passenger infrastructure
Texas Airport System Plan	TxDOT	Texas Transportation Commission	Guidelines to help planners determine how to maximize the return on investment of public funds and identifies what capital improvements would best serve the state's aviation needs

Exhibit 2-3. TxDOT Plans for Coordination with Texas Transportation Plan

Plan/Program	Developed By	Approved By	Content
Texas Ports Capital Program	Port Authority Advisory Committee	Texas Transportation Commission	Identifies funding requests for port transportation and economic development projects submitted by ports
Statewide Transportation Improvement Program	TxDOT	USDOT (FHWA/ FTA)	Multimodal transportation projects/investments
Unified Transportation Program	TxDOT	Texas Transportation Commission	Multimodal projects to be funded/implemented in a 10-year period
Transportation Improvement Programs – TxDOT Rural	TxDOT Districts	Governor (delegated to TxDOT)	Multimodal transportation projects/investments
Transportation Improvement Programs – MPOs	MPOs	MPO Policy Boards	Multimodal transportation projects/investments
Metropolitan Transportation Plan	MPOs	MPO Policy Boards	Policies, programs, and projects for development that respond to adopted goals and expenditures for state and federal funds over the next 20+ years
Corridor Studies (e.g., IH 35, IH 69)	TxDOT	Texas Transportation Commission	Benefit cost analysis and feasibility
Highway Safety Plan	TxDOT	Governor (delegated to TxDOT)	Identifies goals, strategies, performance measures and objectives
Strategic Highway Safety Plan	TxDOT	Texas Transportation Commission	Crash data analysis, survey data, crash reduction goals and objectives including actions

2.1.4 Meeting Legislative Requirements

The TTP complies with state and federal legislation for long-range transportation planning.

2.1.4.1 Texas Administrative Code Requirements

The specific requirements for the development of a statewide, long-range transportation plan for Texas (Title 43, Part 1, Chapter 16, Subchapter B of the Texas Administrative Code [Rule 16.54]) are as follows:

- A minimum 24-year planning horizon with an update cycle of every 4 years;
- The inclusion of all modes of the transportation system;
- The integration with the Statewide Transportation Improvement Program (STIP) and Unified Transportation Program (UTP);
- The inclusion of specific, long-term goals for the state that advance Strategic Plan goals;
- The inclusion of specific, measurable targets for each goal;
- The consideration of MPO and Regional Council of Government metropolitan transportation plans and strategies;
- The identification of priority corridors, projects, or areas of concern with respect to meeting TTP goals; and
- The inclusion of a participation plan for obtaining input on goals, targets, and project selection and prioritization.

2.1.4.2 Moving Ahead for Progress in the 21st Century Act Requirements

Moving Ahead for Progress in the 21st Century (MAP-21) Act calls for a performance-based approach to transportation decision-making and provides a clear sense of purpose for transportation investments through the establishment of seven national goal areas: safety, infrastructure condition, congestion reduction, system reliability, freight movement and economic vitality, environmental sustainability, and reduced project delivery delays. States and MPOs are required to measure and report on performance in these areas.

2.1.5 Texas Transportation Plan Structure

The TTP is performance-based, with a focus on achieving the TTP goals and objectives through statewide multimodal transportation investments. The performance-based structure includes:

- **TTP goals and objectives** that identify components that can be measured and tracked given the high-level priorities developed by TxDOT in cooperation with stakeholders. In addition to state-specific goals, the TTP incorporates MAP-21 national goals.
- **TTP performance measures** provide a means to better understand the impacts of investments in TTP goals. Measures in the TTP include both those that are predictive (used in TTP analyses) as well as those recommended for tracking and monitoring system performance and TTP implementation over time.
- **Performance-based multimodal needs assessments** were conducted to identify the minimum investment amount required to achieve a state of good repair or similar performance targets through 2040.
- **TTP scenario analyses** for several investment approaches were conducted to better evaluate the costs and outcomes of investing various amounts of funding across modes and infrastructure on the Texas transportation system. The expected revenues available to meet statewide multimodal transportation needs were also presented.

2.2 Plan Technical Components

The TTP content was developed as a series of Technical Memoranda over an 18-month period (Exhibit 2-4). These Tech Memos detail all data, methodologies, and findings in the TTP.

Exhibit 2-4. Technical Memoranda Developed for the Texas Transportation Plan

Tech Memo #	Title	Contents
1	Plan Assessment and Framework	Provides an overview of the TTP development process and recommends a performance-based framework
2	TTP Goals & Objectives “Building Blocks”	Documents key components of TTP goals and objectives consistent with on-going activities of the state
3	Passenger Methodology • Pavement • Bridge/Culvert • Transit • Passenger Rail • Bicycle and Pedestrian • Aviation • Intelligent Transportation Systems • Statewide Analysis Model (SAM) v3	Lists the current transportation plans, programs, and studies collected for Plan and provides the methodology for the development of system needs as detailed in Tech Memo #6 Passenger Modal Profiles
4	Freight Methodology	Includes an assessment of the data provided from the TFMP and summarizes how TFMP findings will be incorporated into the TTP
5	Transportation Today “Snapshot”	Provides the existing conditions and future trends affecting the statewide transportation system
6	Passenger Modal Profiles • Pavement • Bridge/Culvert • Transit • Passenger Rail • Bicycle and Pedestrian • Aviation • ITS • Highway Expansion	Present demand and backlog as well as forecasted demand and unconstrained future needs for all passenger modes
7	Freight Modal Profile	Summarizes demand and backlog as well as forecasted demand based on TFMP findings
8 and 9	Project Development and Selection Processes	Summarizes the various phases in the project planning and development process and provides recommendations for furthering performance-based planning and programming

Exhibit 2-4. Technical Memoranda Developed for the Texas Transportation Plan

Tech Memo #	Title	Contents
10	Revenue Forecast and Investment Scenarios/Performance Outcomes	Provides four example investment approaches to better evaluate the costs and outcomes of investing in the Texas transportation system
11	Safety and Security	Identifies safety issues to be addressed and identifies potential mitigation strategies to meet state safety goals
12	SLRTP 2035 and TRTP Implementation Progress	Summarizes the progress towards implementing the goals in the SLRTP 2035 and TRTP as well as the progress of the TTP
13	Performance Measures and Targets	Addresses the state's progress toward the establishment of MAP-21 performance measures and targets as well as the specific measures applied in the TTP

2.3 Public Outreach and Opportunities for Input

Effective communication and engagement is critical to the successful development and implementation of a statewide multimodal transportation plan. TTP outreach efforts were designed to:

- Gather input on goals and objectives used to develop the TTP;
- Educate the public and stakeholders about the TTP as a performance-based plan and about tradeoffs between types of investments and levels of funding; and
- Collect data on public and stakeholder values related to transportation priorities and types of investments as well as revenues available for transportation improvements.

For nearly a year, a variety of TTP outreach opportunities were provided in order to inform, engage, and collect feedback from TxDOT representatives, external partners and stakeholders, and the general public on a continuing basis throughout Plan development (Exhibit 2-1), including:

- The formation and convening of an internal TxDOT Technical Advisory Committee (Section 2.3.1);
- Two rounds of stakeholder and public meetings with supporting materials (meeting notices, website publications, exhibits, and questionnaires) available in English and Spanish and accessible to those in attendance or online. Bilingual staff was also present at all meetings (Section 2.3.2);
- Outreach to several individual transportation advisory committees, MPO boards, Councils of Government, and public advocacy groups;
- A presence at the TxDOT Planning Conference 2014 held in Corpus Christi, Texas;
- Project webpages on www.TxDOT.gov that were accessible October 2013 through October 2014;
- Public and stakeholder comments received via email on www.TxDOT.gov or at TxTransPlan2040@txdot.gov;
- A transportation questionnaire (available online and at meetings) and comment forms distributed at meetings; and
- An interactive planning scenario tool built on a MetroQuest platform that was featured during Outreach Round 2 meetings and available online June 2, 2014 through September 30, 2014 (Section 2.3.2).

The TTP outreach effort will culminate with a public hearing and associated comment period during which all TTP comments will be addressed before it is finalized. Notification of the public hearing and the final TTP publication will be provided to those who attended a meeting, visited the website and provided their contact information, and stakeholders.

The public hearing notification and final TTP will also be posted on TxDOT.gov. Additional information regarding the Technical Advisory Committee meetings, stakeholder and public outreach, and the MetroQuest interactive planning scenario tool and questionnaire are provided in the following sections.

2.3.1 Technical Advisory Committee

The Technical Advisory Committee composed of representatives from various TxDOT divisions met five times during the development of the TTP and was continuously engaged and involved in reviewing Plan content (e.g., modal methodologies and assumptions) and outreach materials. A summary of what was discussed and decided upon at each Technical Advisory Committee meeting is provided below.

- **Meeting 1, October 10, 2013**
  - Technical Advisory Committee priorities for long-range planning in Texas
  - Proposed TTP schedule, Outreach Round 1 stakeholder and public meetings schedule, opportunities for coordination among state planning activities
- **Webinar, November 1, 2013**
  - Follow-up web-based meeting to confirm draft goals and objectives prior to presenting them to the stakeholders and public
- **Meeting 2, January 29, 2014**
  - Goal and objective recommendations (finalize language)
  - Modal needs methodologies
- **Meeting 3, May 14, 2014**
  - Unconstrained multimodal needs
  - TTP scenario analysis and MetroQuest tool
  - Proposed Outreach Round 2 stakeholder and public meetings schedule
- **Meeting 4, August 25, 2014**
  - Outreach Round 2 stakeholder and public meetings findings
  - TTP development and review (including modal profiles)

2.3.2 Stakeholder and Public Participation

Disseminating information and collecting comments from stakeholders and the general public was a critical component of developing the TTP. The following objectives outlined in the *Stakeholder and Public Participation Plan* guided stakeholder and public outreach:

- Establish **early and continuous public participation** opportunities that provide timely information about transportation issues and decision-making processes to all interested parties;
- Provide **reasonable public access** to educational, technical, and policy information to enhance the public's knowledge and ability to participate in the development of the TTP;
- Provide **adequate public notice** of participation opportunities during the development of the TTP; and time for public review and comment at key decision points in the planning process;
- Ensure that public participation opportunities are held at **convenient and accessible** (Americans with Disabilities Act) **locations and times**;
- **Make information comprehendible** using visualization techniques, and available in appropriate electronically-accessible formats and means via the TxDOT website, technology-enabled media, and video-teleconferencing;
- Include measures for seeking input from and **considering the needs of those traditionally underserved by existing transportation systems** as defined in Title VI of the Civil

Rights Act of 1964, such as low-income, minority, and non-English speaking households who may face challenges accessing employment and other services; and

- Provide for the **periodic review of the public participation process** to ensure the effectiveness of TxDOT's public involvement efforts and revise the process as appropriate.

While stakeholder and public input was collected and responded to throughout TTP development, there were two rounds of targeted public outreach meetings. The first round occurred in November of 2013 and the second round occurred from June 2014 through August 2014. Notices and meeting information for both rounds of outreach was distributed through the TxDOT website, media press releases, electronic notices, MPO correspondence, telephone calls, electronic mail, Twitter, and Facebook.

2.3.2.1 Outreach Round 1 Stakeholder and Public Meetings

The first round of stakeholder and public meetings was held in November 2013 in eight of the 25 TxDOT Districts (Exhibit 2-5). Stakeholder meetings were held from 9:30 a.m. to 11:30 a.m. and public open-house meetings were held from 4:00 p.m. to 7:00 p.m. Video television conference was made available for the stakeholder and public meetings held in Dallas and San Antonio District offices. In total, 166 stakeholders and members of the general public attended a meeting during Outreach Round 1.

Exhibit 2-5. Outreach Round 1 Meeting Schedule

District	Video Television Conference	Date
San Antonio	✓	November 6, 2013
Pharr		November 7, 2013
Houston		November 13, 2013
Bryan		November 14, 2013
Lubbock		November 18, 2013
Wichita Falls		November 19, 2013
Dallas	✓	November 20, 2013
Abilene		November 21, 2013

Outreach Round 1 was intended to inform and educate meeting attendees about the TTP effort, answer questions and collect comments, and engage attendees to discuss statewide transportation topics and concerns; additionally, the TTP draft goals and objectives were presented and discussed. Meeting materials included display boards and handouts. A PowerPoint presentation was provided during the stakeholder meeting to communicate draft goals and objectives and facilitate discussion regarding transportation priorities from the perspectives of each participant.

The stakeholders generally supported the initial TTP draft goals and objectives and suggested an additional goal of sustainable funding which was subsequently added. Additional stakeholder and public feedback was collected through comment forms, a transportation questionnaire, and a demographic survey.

2.3.2.2 Outreach Round 2 Stakeholder and Public Meetings

Outreach Round 2 was held in summer 2014 with public and stakeholder meetings conducted in all 25 districts across the state (Exhibit 2-6). Stakeholder meetings were held from 2:00 p.m. to 4:00 p.m. and public open-house meetings were held from 5:30 p.m. to 7:30 p.m. with some variation depending on location. In total, 668 stakeholders and members of the general public attended a meeting during Outreach Round 2.

Outreach Round 2 educated the general public and stakeholders about future multimodal transportation system needs and funding gaps, created a dialogue about necessary tradeoffs between types of investments and levels of funding, and garnered comments and attitudes related to transportation investments and funding.

Meeting materials included display boards and handouts about the TTP development process and integration with other TxDOT plans and programs as well as information regarding current and future forecasted revenue streams and expenditures. A PowerPoint presentation was used during the stakeholder meetings to communicate and facilitate discussion around the multimodal unconstrained needs, methodologies, and assumptions as well as the anticipated funding gap through 2040 given reasonably expected revenues. Additional stakeholder and public feedback was solicited through comment forms, a transportation questionnaire, a demographic survey, and a MetroQuest tool that was developed for the TTP as described in Section 2.3.3.3.

Exhibit 2-6. Outreach Round 2 Meeting Schedule

District	Date
Bryan	June 9, 2014
Beaumont	June 10, 2014
Houston	June 11, 2014
Lufkin	June 12, 2014
San Angelo	June 16, 2014
Odessa	June 17, 2014
El Paso	June 18, 2014
Atlanta	June 24, 2014
Paris	June 25, 2014
Tyler	June 26, 2014
Dallas	July 7, 2014
Wichita Falls	July 8, 2014
Fort Worth	July 9, 2014
Brownwood	July 10, 2014
Laredo	July 14, 2014
Pharr	July 15, 2014
Corpus Christi	July 16, 2014
Yoakum/Victoria	July 17, 2014
Waco	July 21, 2014
Abilene	July 28, 2014
Childress	July 29, 2014
Amarillo	July 30, 2014
Lubbock	July 31, 2014
San Antonio	August 4, 2014
Austin	August 5, 2014

2.3.3 Input Collected from Outreach Methods and Tools

As discussed in Section 2.3, gathering input from the public and stakeholders was of paramount importance to TxDOT in the development of the TTP. As such, several methods and tools were developed and applied to engage and gather input from multimodal owners, operators, and users of the Texas transportation system.

More than 2,500 comments and responses were received (Exhibit 2-7) as a result of the extensive outreach effort. In general, the comments reflected the following:

- TTP goals and objectives were generally supported. As noted in Section 2.3.2.1, a goal of “Sustainable Funding” was added, along with supporting objectives, based on stakeholder feedback received during Outreach Round 1;
- Additional transportation funding is needed. Current diversions of funds should be reduced or eliminated;
- Preservation of the existing transportation system is a top priority;
- Addressing congestion is a top priority though the high cost of expanding facilities and the difficulty in managing current and future demand was generally acknowledged and understood;
- Performance-based planning makes logical sense and should be used to allocate resources; and
- All modes of transportation should be considered in the transportation planning process.

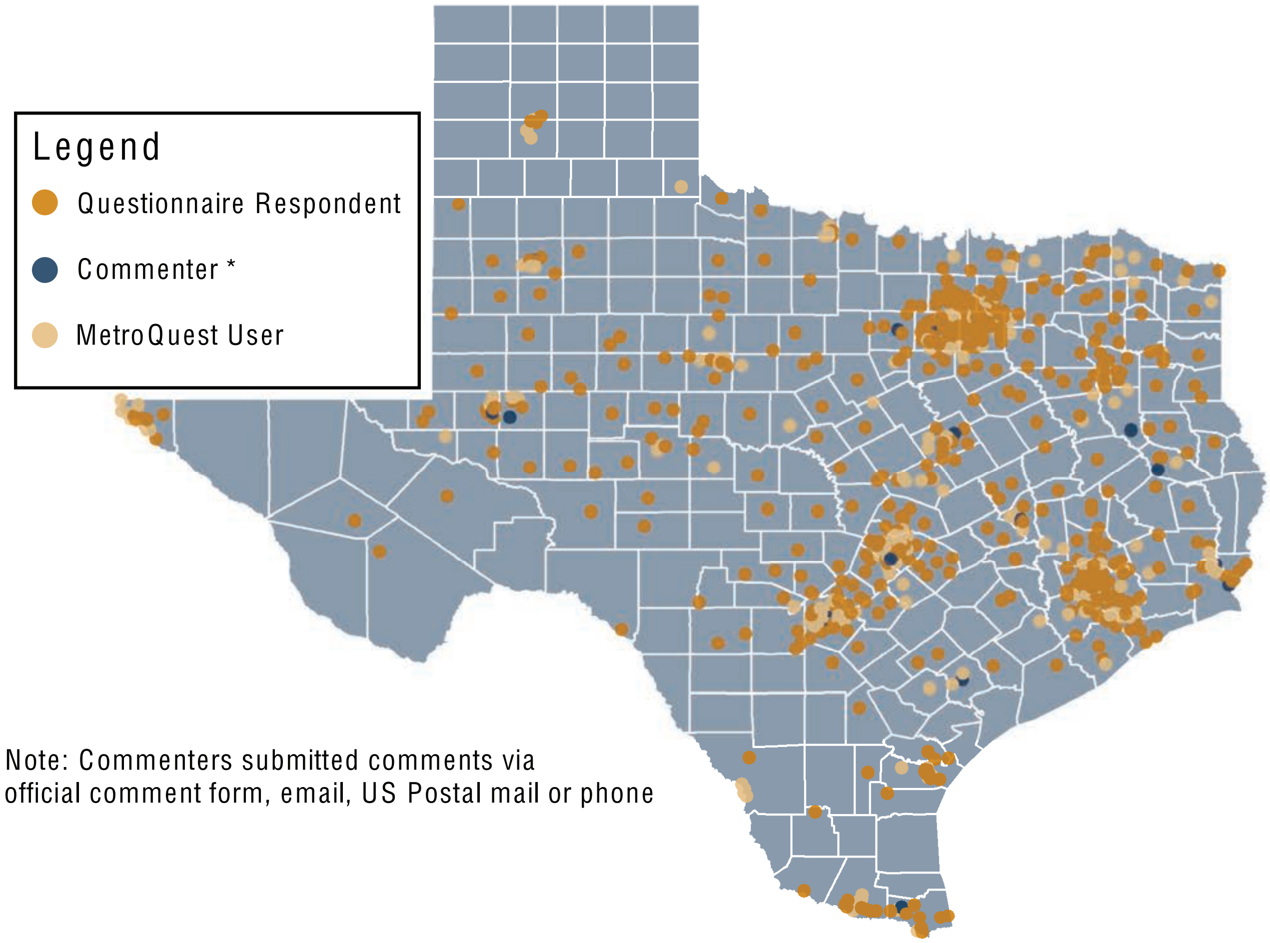
The following sections provide a summary of the feedback received via each outreach method and tool. In addition to these specific means used to collect feedback, TxDOT welcomed direct input via email, phone and postal mail. For more details regarding the feedback that was received, including a complete list of comments, please refer to Appendix A.

2.3.3.1 Comment Forms

To help inform the development of the TTP, stakeholders and the general public were encouraged to fill out comment forms at meetings during both rounds of meetings; individuals who could not attend meetings or did not have time to fill out comment forms at meetings were encouraged to email, mail or phone comments. Over 200 individual comment forms were received throughout the development of the TTP. Common themes among comments received included:

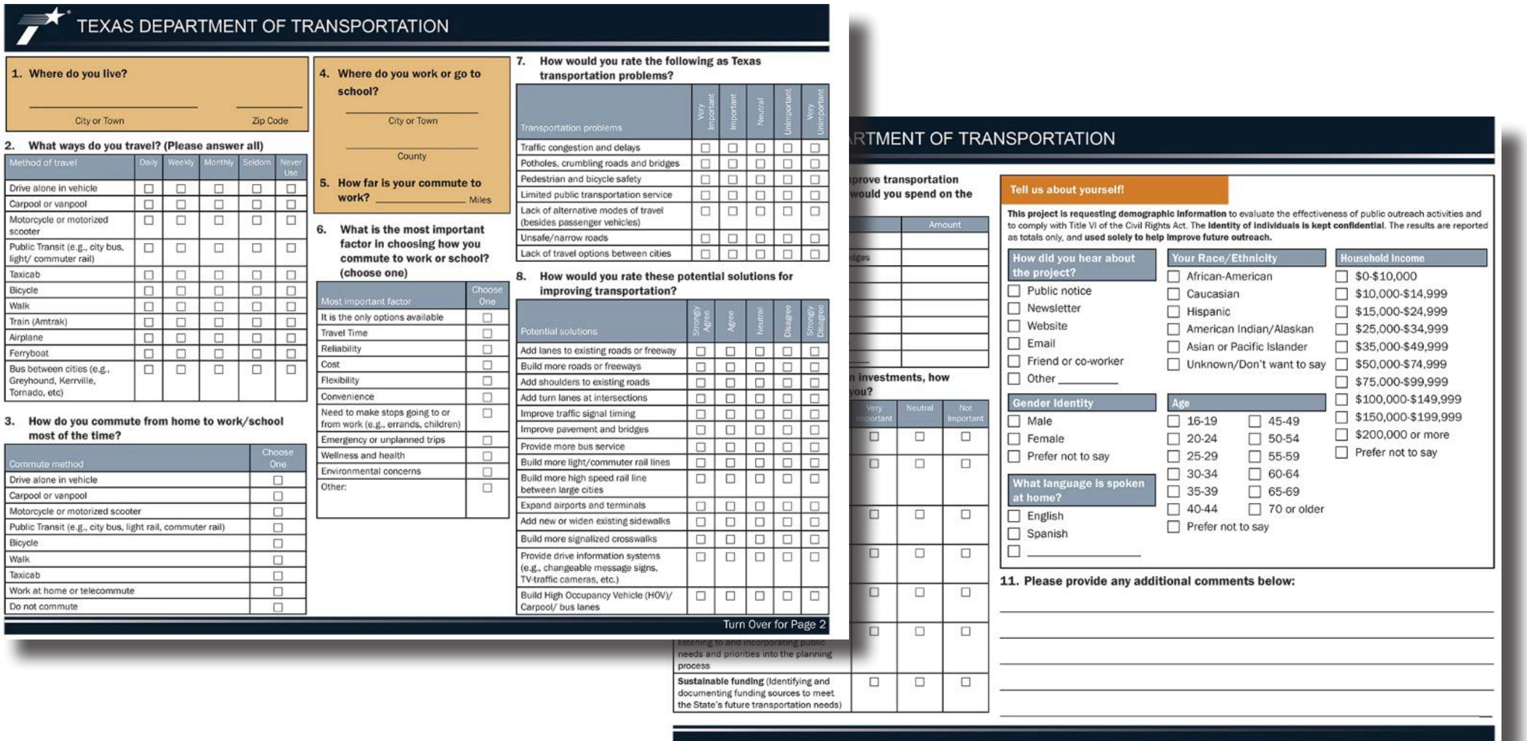
- Agreement for safety as TxDOT’s top priority with numerous safety concerns cited throughout the state;
- Requests for sustained or increased funding for local maintenance;
- Understanding of and preference for a balanced funding approach between roadway expansion and maintenance;

Exhibit 2-7. Statewide Public Involvement Responses



- Recognition that more transportation funding is needed, with proposed solutions including: reducing or eliminating the diversion of funds, indexing/raising the gas tax, increasing vehicle registration fees, using royalty fees for transportation improvements, and transitioning to a user fee system. Comments indicated mixed feelings towards the increased use of toll facilities;
- Encouragement of small design enhancements (e.g., adding turn lanes, "Super 2s", roadway shoulders, roadway realignment, improved signage, and the provision of railroad crossings) that benefit roadway operations and safety;
- Recognition of congestion as a major problem across the state with suggested solutions including roadway widening to eliminate bottlenecks and travel demand strategies to better manage the existing network;
- Understanding that transit (high speed rail, commuter rail, passenger rail, Bus Rapid Transit, and para-transit) is a viable means to address congestion in the state and provide access to goods and services for disadvantaged, elderly, and disabled populations. Increased transit investments that result in increased ridership and improved access should be encouraged;
- Support for increased investment in and prioritization of bicycle and pedestrian facilities as part of a comprehensive transportation system;
- Encouragement of Intelligent Transportation System infrastructure to manage traffic and adapt to future technological advances that will impact current uses of the transportation system;
- Encouragement of improved coordination between TxDOT and localities to support better land use and transportation interactions;
- Recognition of freight as a top priority for the state that impacts its economic competitiveness, with specific references directed at the importance of the Ports-to-Plains initiative. Mobility improvements are needed along roadways and on rail facilities as well as at intermodal facilities where cargo is transitioned between freight modes. Potential solutions include the provision of inland ports, more efficient freight transfer facilities (including air cargo), enhancements to ports, and maximizing the use of rail facilities for freight transport; and
- Commendation and endorsement for TxDOT's evaluation of multimodal system performance based on investment levels.

Exhibit 2-8. Transportation Questionnaire


TEXAS DEPARTMENT OF TRANSPORTATION

1. Where do you live?

City or Town ______ Zip Code ______

2. What ways do you travel? (Please answer all)

Method of travel	Daily	Weekly	Monthly	Seldom	Never Use
Drive alone in vehicle	☐	☐	☐	☐	☐
Carpool or vanpool	☐	☐	☐	☐	☐
Motorcycle or motorized scooter	☐	☐	☐	☐	☐
Public Transit (e.g., city bus, light/ commuter rail)	☐	☐	☐	☐	☐
Taxicab	☐	☐	☐	☐	☐
Bicycle	☐	☐	☐	☐	☐
Walk	☐	☐	☐	☐	☐
Train (Amtrak)	☐	☐	☐	☐	☐
Airplane	☐	☐	☐	☐	☐
Ferryboat	☐	☐	☐	☐	☐
Bus between cities (e.g., Greyhound, Kerrville, Tornado, etc)	☐	☐	☐	☐	☐

3. How do you commute from home to work/school most of the time?

Commute method	Choose One
Drive alone in vehicle	☐
Carpool or vanpool	☐
Motorcycle or motorized scooter	☐
Public Transit (e.g., city bus, light rail, commuter rail)	☐
Bicycle	☐
Walk	☐
Taxicab	☐
Work at home or telecommute	☐
Do not commute	☐

4. Where do you work or go to school?

City or Town ______

County ______

5. How far is your commute to work? ______ Miles

6. What is the most important factor in choosing how you commute to work or school? (choose one)

Most important factor	Choose One
It is the only options available	☐
Travel Time	☐
Reliability	☐
Cost	☐
Flexibility	☐
Convenience	☐
Need to make stops going to or from work (e.g., errands, children)	☐
Emergency or unplanned trips	☐
Wellness and health	☐
Environmental concerns	☐
Other:	☐

7. How would you rate the following as Texas transportation problems?

Transportation problems	Very Important	Important	Neutral	Unimportant	Very Unimportant
Traffic congestion and delays	☐	☐	☐	☐	☐
Potholes, crumbling roads and bridges	☐	☐	☐	☐	☐
Pedestrian and bicycle safety	☐	☐	☐	☐	☐
Limited public transportation service	☐	☐	☐	☐	☐
Lack of alternative modes of travel (besides passenger vehicles)	☐	☐	☐	☐	☐
Unsafe/narrow roads	☐	☐	☐	☐	☐
Lack of travel options between cities	☐	☐	☐	☐	☐

8. How would you rate these potential solutions for improving transportation?

Potential solutions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Add lanes to existing roads or freeway	☐	☐	☐	☐	☐
Build more roads or freeways	☐	☐	☐	☐	☐
Add shoulders to existing roads	☐	☐	☐	☐	☐
Add turn lanes at intersections	☐	☐	☐	☐	☐
Improve traffic signal timing	☐	☐	☐	☐	☐
Improve pavement and bridges	☐	☐	☐	☐	☐
Provide more bus service	☐	☐	☐	☐	☐
Build more light/commuter rail lines	☐	☐	☐	☐	☐
Build more high speed rail line between large cities	☐	☐	☐	☐	☐
Expand airports and terminals	☐	☐	☐	☐	☐
Add new or widen existing sidewalks	☐	☐	☐	☐	☐
Build more signalized crosswalks	☐	☐	☐	☐	☐
Provide drive information systems (e.g., changeable message signs, TV-traffic cameras, etc.)	☐	☐	☐	☐	☐
Build High Occupancy Vehicle (HOV)/ Carpool/ bus lanes	☐	☐	☐	☐	☐

Turn Over for Page 2

RTMENT OF TRANSPORTATION

prove transportation would you spend on the

Amount

dges

n investments, how you?

Very Important | Neutral | Not Important

listening to and incorporating public needs and priorities into the planning process

Sustainable funding (Identifying and documenting funding sources to meet the State's future transportation needs)

Tell us about yourself!

This project is requesting demographic information to evaluate the effectiveness of public outreach activities and to comply with Title VI of the Civil Rights Act. The **identity of individuals is kept confidential**. The results are reported as totals only, and **used solely to help improve future outreach.**

How did you hear about the project?
☐ Public notice
☐ Newsletter
☐ Website
☐ Email
☐ Friend or co-worker
☐ Other ______

Your Race/Ethnicity
☐ African-American
☐ Caucasian
☐ Hispanic
☐ American Indian/Alaskan
☐ Asian or Pacific Islander
☐ Unknown/Don't want to say

Household Income
☐ $0-$10,000
☐ $10,000-$14,999
☐ $15,000-$24,999
☐ $25,000-$34,999
☐ $35,000-$49,999
☐ $50,000-$74,999
☐ $75,000-$99,999
☐ $100,000-$149,999
☐ $150,000-$199,999
☐ $200,000 or more
☐ Prefer not to say

Gender Identity
☐ Male
☐ Female
☐ Prefer not to say

Age
☐ 16-19 ☐ 45-49
☐ 20-24 ☐ 50-54
☐ 25-29 ☐ 55-59
☐ 30-34 ☐ 60-64
☐ 35-39 ☐ 65-69
☐ 40-44 ☐ 70 or older
☐ Prefer not to say

What language is spoken at home?
☐ English
☐ Spanish
☐ ______

11. Please provide any additional comments below:

2.3.3.2 Transportation Questionnaire

A transportation questionnaire was developed for the TTP to collect data on transportation behavior, travel preferences, and current transportation issues and potential solutions. The questionnaire was made available beginning November 2013 both electronically at TxDOT.gov and in hardcopy form at both rounds of meetings through August 2014. More than 2,150 completed questionnaires were submitted. A complete summary of responses including the zip codes of respondents is provided in Appendix A.

While the questionnaire was self-selected and thus not intended to provide a representative sampling of Texans, responses collected from all areas of the state provide insights into general travel preferences and behaviors as well as priority transportation issues and potential solutions. The following summarizes these trends, issues, and investment priorities:

- The majority of respondents (81 percent) commute by driving alone;
- Traffic congestion and delays was generally considered by respondents to be the most critical transportation problem;
- Respondents indicated the following as the top three areas of transportation investment: (1) reducing congestion on highways, (2) repairing or maintaining highways and bridges, and (3) improving public transit; and
- Safety (infrastructure preservation to maintain a safe system) and mobility and reliability (congestion reduction, commerce facilitation, system efficiency, and performance) were generally considered by respondents to be top transportation priorities.

2.3.3.3 MetroQuest Tool

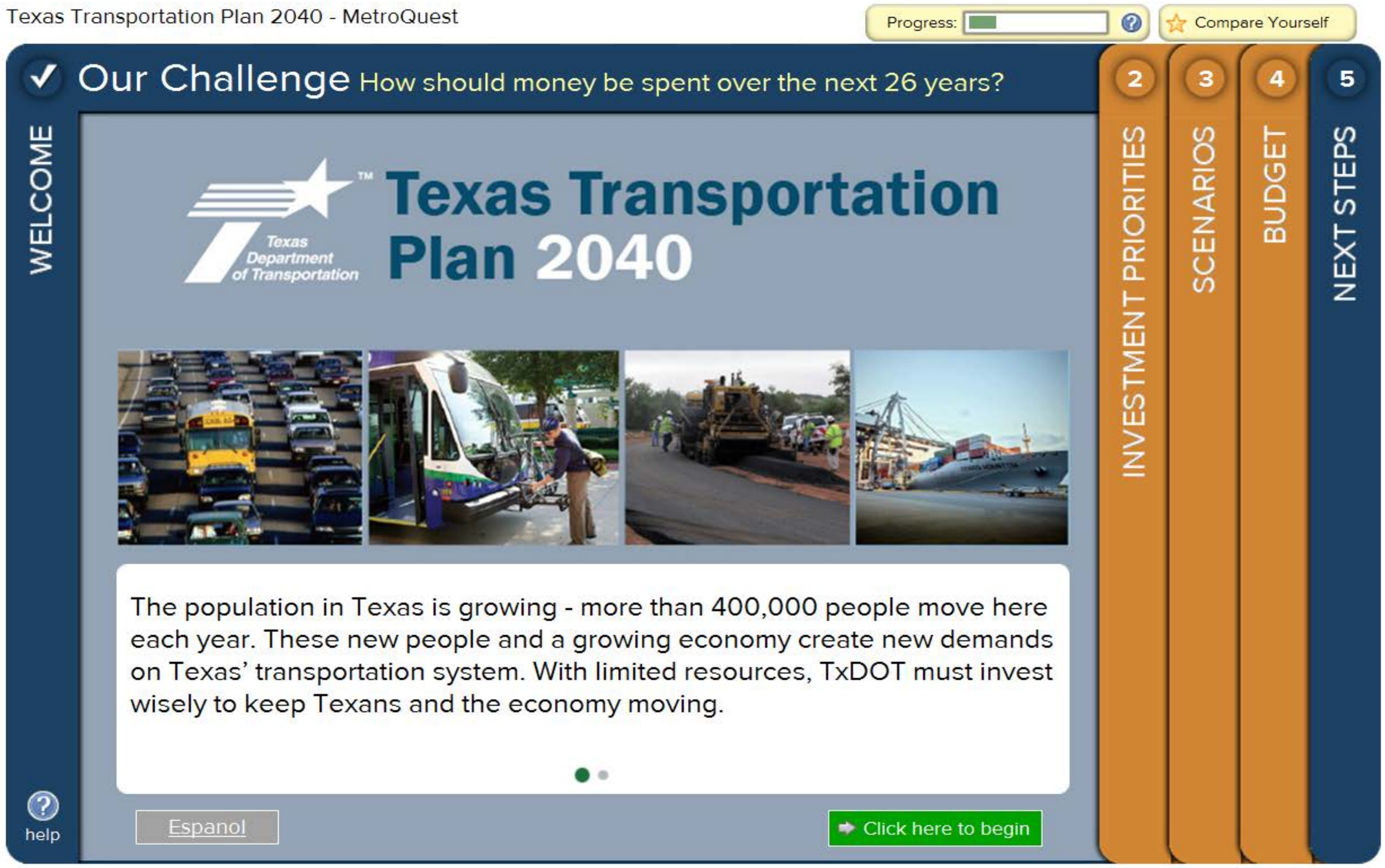
To support greater public understanding of TxDOT decision-making processes within the context of constrained resources, TxDOT developed an interactive planning tool using MetroQuest – a public outreach software application. The MetroQuest tool enabled users to visualize the systemic impacts and tradeoffs that result from shifting resources from one transportation investment priority to another (e.g., from system preservation to roadway expansion) and what a given level of investment can "buy" in terms of various performance measures. The MetroQuest tool was featured at the Outreach Round 2 stakeholder workshops and public open houses (Exhibit 2-9); it was also made available online on TTP's webpage located on TxDOT's website from June 6, 2014 through September 2014. The MetroQuest web link was disseminated to meeting participants and advertised through social media. In total, more than 500 people visited the interactive planning tool website.

The MetroQuest tool educated the public and stakeholders about trade-offs between types of investments and levels of funding and gathered input on values related to transportation investments and funding through the following exercises:

- Investment Priorities: The identification and ranking of top transportation priorities;
- Scenarios: The rating of three investment approaches and their associated costs: (1) System Preservation, (2) Metropolitan Mobility, and (3) Connectivity and Freight Mobility;
- Budget: The allocation of funding across investment categories including highway pavement, highway bridge, highway capacity, transit maintenance, transit expansion, as well as bicycle/ pedestrian and safety investments; and
- Next Steps: The submission of answers to questions regarding increased transportation investment in Texas and what additional investment categories should be considered.

The tool was well received by the public and stakeholders with many providing positive feedback regarding its usability. Tool participants indicated that congestion and pavement condition are their top priorities. The ranking of these as top priorities is consistent with the amount of money users allocated in the tool's "create a budget" exercise. A complete summary of tool responses including the zip codes of respondents is provided in Appendix A.

Exhibit 2-9. Interactive Tradeoff Tool Introduction Page



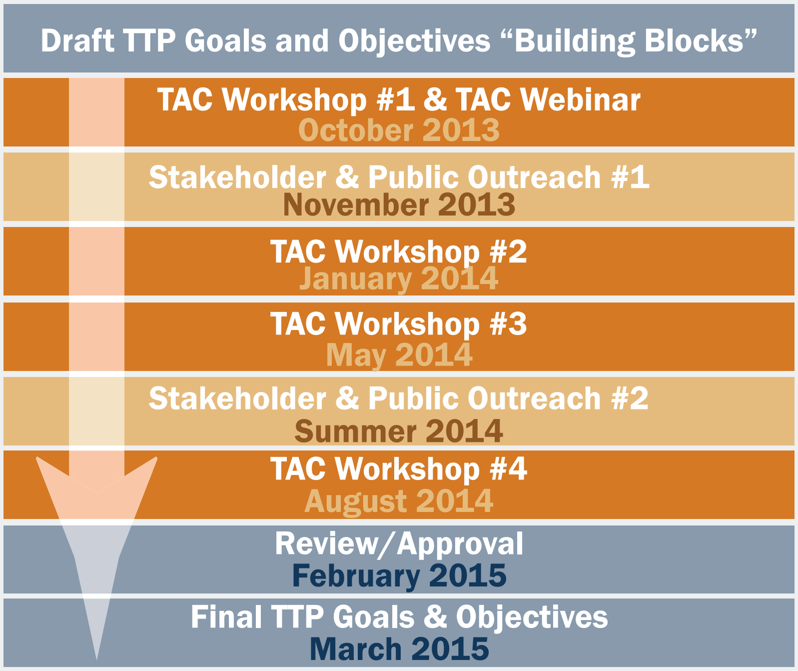
GOALS, OBJECTIVES AND MEASURES

3.1 Development of Texas Transportation Plan Goals and Objectives

3.1.1 Development Process

As shown in, Exhibit 3-1, developing goals and objectives for the Texas Transportation Plan (TTP) was an inclusive process, and started with an evaluation of TxDOT's 2015-2019 Strategic Plan and the requirements of MAP-21. "Building Blocks" for TTP goals and objectives were presented in *Technical Memorandum #2: TTP Goals and Objectives*, and were reviewed with the TTP Technical Advisory Committee. After the Technical Advisory Committee input was used to develop specific language for TTP goals and objectives, they were shared with the public in stakeholder and public Outreach Round 1 and finalized for review and approval following stakeholder and public Outreach Round 2.

Exhibit 3-1. Texas Transportation Plan Goal and Objective Development Process

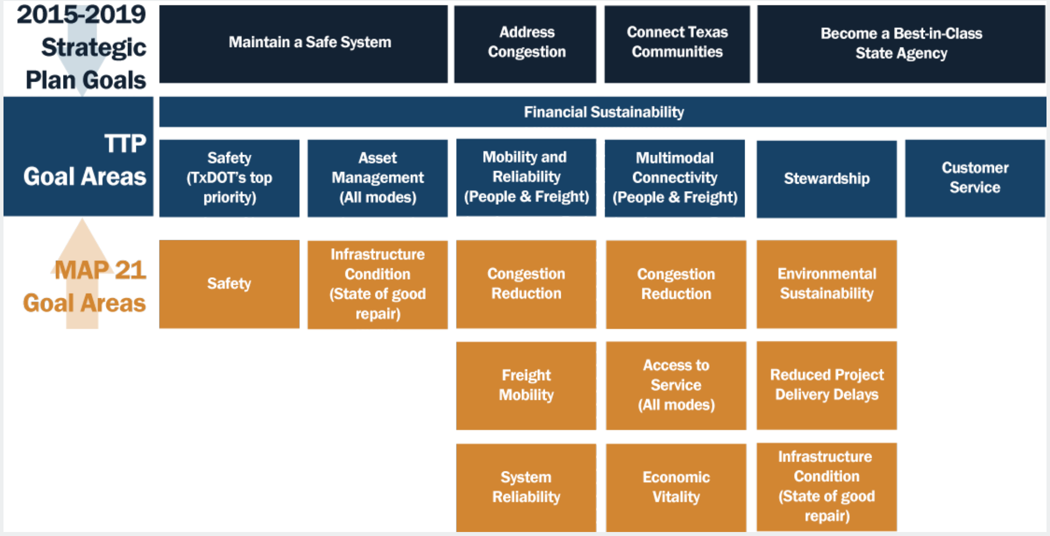


3.1.2 Incorporating National Goals

MAP-21 established seven national goals for the federal-aid highway program. These goals are incorporated into the TTP as a requirement of MAP-21:

- **Safety**: To achieve a significant reduction in traffic fatalities and serious injuries on all public roads;
- **Infrastructure condition**: To maintain the highway infrastructure asset system in state of good repair;
- **Congestion reduction**: To achieve a significant reduction in congestion on the National Highway System (NHS);
- **System reliability**: To improve the efficiency of the surface transportation system;
- **Freight movement and economic vitality**: To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development;
- **Environmental sustainability**: To enhance the performance of the transportation system while protecting and enhancing the natural environment; and
- **Reduced project delivery delays**: To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices.

Exhibit 3-2. Texas Transportation Plan Goal Areas



State DOTs must incorporate these national goals into their long-range plans. Under-performance in these areas may affect their ability to receive federal funding under the MAP-21 core programs: the National Highway Performance Program, Highway Safety Improvement Program, and Congestion Mitigation and Air Quality Program (CMAQ).

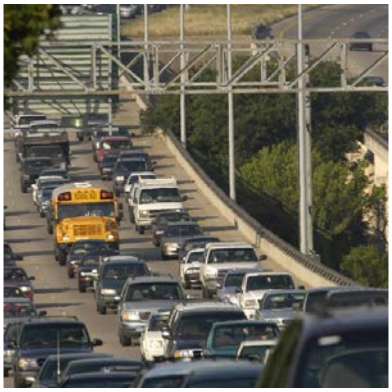
3.2 Texas Transportation Plan Goals and Objectives

Based on input from the TTP Technical Advisory Committee and feedback from Texas transportation stakeholders and the public, the final TTP goals are provided in Exhibit 3-2.

Draft TTP objectives were developed to respond to the TTP Technical Advisory Committee priorities and recommendations. Final language for TTP goals and objectives is as follows:

- **Safety**
  - Improve multimodal transportation safety
  - Reduce fatalities and serious injuries
  - Improve safety of at-grade rail crossings
  - Eliminate conflicts between modes wherever possible
  - Increase bicycle and pedestrian safety through education, the design and construction of new facilities, and improvements to existing facilities
  - Educate the public on the dangers of high-risk driving behaviors
  - Coordinate with enforcement to improve driver compliance with laws
  - Improve incident response times

- **Asset Management**
  - Maintain and preserve multimodal assets using cost-beneficial treatments
  - Decrease the number of bridges that are structurally deficient, functionally obsolete, or substandard-for-load
  - Achieve state of good repair for pavement assets, keeping pavements smooth and pothole free
  - Achieve state of good repair for transit assets such that they are comfortable and reliable
  - Identify and mitigate risks associated with asset failure
  - Identify existing and new funding sources and innovative financing techniques for all modes of transportation
  - Build upon and regularly update the asset inventories for all transportation modes



- **Mobility and Reliability**
  - Reduce congestion and improve system efficiency and performance
  - Plan, design, and construct strategic capacity projects
  - Implement alternative strategies that reduce peak demand
  - Improve operations within existing right-of-way
  - Increase travel options and accessibility for all, especially elderly, disabled, and disadvantaged populations
  - Increase freight and passenger travel time reliability
  - Increase the capacity and efficiency of the transportation system across travel modes

- **Multimodal Connectivity**
  - Provide transportation choices and improve system connectivity for all passenger and freight modes
  - Provide and improve access to jobs, transportation choices, and services for all Texans
  - Provide safe and convenient travel choices for all Texans with a focus on the complete trip
  - Support the efficient and coordinated movement of goods and services between freight modes to facilitate statewide, national, and global commerce
  - Support multimodal and intermodal planning, project development, and investments
  - Improve connectivity between urban, suburban, and rural areas and between travel modes

- **Stewardship**
  - Manage resources responsibly and be accountable and transparent in decisionmaking
  - Identify sustainable funding sources and leverage resources wisely to maximize the value of investments and minimize negative impacts
  - Develop and implement a project development process that recognizes quality-of-life concerns for all system users and future generations of Texans
  - Link transportation planning with land use
  - Reduce project delivery delays
  - Coordinate project planning and delivery with all planning partners and stakeholders
  - Minimize impacts to natural, cultural, and historic resources and promote sustainability in project design and delivery

- **Customer Service**
  - Understand and incorporate customer desires in decision processes and be open and forthright in all agency communications
  - Collect and integrate feedback using innovative engagement techniques and technology
  - Promote and enable public participation in project planning and development
  - Improve accessibility of information through innovative, understandable, and relatable communication techniques
  - Educate the public and stakeholders on transportation costs, funding availability, and investment tradeoffs

- **Sustainable Funding:**
  - Identify and sustain funding sources for all modes
  - Identify and document costs to meet the state's future transportation needs
  - Consider all funding sources to fill the needs-to-revenues gap
  - Educate the public and stakeholders on the costs associated with constructing and preserving the system
  - Evaluate the feasibility of innovative financing solutions
  - Improve predictive capabilities for revenue forecasting and long-term needs assessments

3.3 Performance Measures

In accordance with MAP-21 requirements, the USDOT will provide state departments of transportation and MPOs with national performance measures to collect and report on through a series of rulemaking refinements shown in Exhibit 3-3. States and MPOs will be responsible for setting their own targets with respect to these measures.

These federal requirements take effect with the first plan adoption deadline following the USDOT's adoption of the final rules governing performance-based planning and performance management. While these requirements are not yet in effect, TxDOT is taking steps to begin incorporating some aspects of these federal requirements into the process of defining TTP-specific goals, objectives, and performance measures to better prepare the Texas transportation planning community for working with TxDOT to improve performance-based planning and programming processes.

Exhibit 3-3. USDOT Guidance on MAP-21 Performance Rulemaking

Program	Measure Category
Status I	Serious injuries per vehicle miles traveled (VMT)[1] Fatalities per VMT[1] Number of serious injuries[1] Number of fatalities[1]
Status II	Pavement condition on the Interstates[2] Pavement condition on the NonInterstate NHS[2] Bridge condition on NHS[2]
Status III	Traffic congestion[3] On-road mobile source emissions[3] Freight movement on the Interstate[4] Performance of Interstate system[2] Performance of NonInterstate NHS[2]

Source: Osbourne, 2013

Notes:

1 Highway Safety Improvement Program

2 National Highway Performance Program

3 Congestion Mitigation and Air Quality(CMAQ)

4 Freight policy

3.3.1 Texas Transportation Plan Performance Measures

The TTP is TxDOT's long-range, multimodal, performance-based transportation plan that will guide planning and programming decisions for the development, integrated management, and operation of the statewide transportation system in Texas over the next 25 years. The performance measures shown in Exhibit 3-4 and detailed below are recommended for long-range planning and have been used to support TTP predictive modal analyses. These measures provide a direct link to TTP goals and objectives.

Exhibit 3-4. Texas Transportation Plan Performance Measures

Mode	Performance Measure and Definition	TPP Goal Areas Supported
Safety*	Number of Fatalities and Serious Injuries	Safety
Mobility and Congestion Reduction	Rural and Urban Level of Service (LOS), Total Delay, and Congestion Severity Index (CSI)	Mobility and Reliability Multimodal Connectivity
Pavements	National Highway System (NHS) and NonNHS % Lane- Miles with a "Good" or "Better" International Roughness Index (IRI) and % Lane-Miles with a "Good" or "Better" Pavement Condition Score	Asset Management Stewardship Safety
Bridges	NHS and NonNHS % Structurally Deficient (SD) Deck Area, Count of Bridges and % Deck Area with Cyclic Maintenance Needs, Count of Bridges and % Deck Area with Preventive Maintenance Needs, and Count of Bridges and % Deck Area with Rehabilitation or Replacement Needs	Asset Management Stewardship Safety
Transit	Metropolitan Transit Authority (MTA) and NonMTA % of Transit Assets in "Good" or "Better" condition and Additional Annual Transit Ridership	Asset Management Mobility and Reliability
Passenger Rail	% Passenger Rail Needs Met	Mobility and Reliability
Intelligent Transportation System (ITS)	% ITS Needs Met	Asset Management Mobility and Reliability
Aviation	National Plan of Integrated Airport Systems (NPIAS) and NonNPIAS Backlog of Aviation Projects	Asset Management Multimodal connectivity
Bicycle and Pedestrian	% Bicycle and Pedestrian Needs Met	Stewardship Multimodal Connectivity
Non-Highway Freight	% NonHighway Freight Needs Met	Mobility and Reliability Multimodal Connectivity

*Safety is not a mode, but safety is addressed for each mode.

These measures are defined further as follows:

- **Number of Fatalities:** Number of fatalities sustained in reportable motor vehicle traffic crashes. System improvements may help reduce the severity of crashes but cannot control for driver behavior.
- **Number of Serious Injuries:** Number of incapacitating injuries sustained in reportable motor vehicle traffic crashes. System improvements may help reduce the severity of crashes but cannot control for driver behavior.
- **Level of Service (LOS):** The LOS is a standardized grade on an A (best) to F (worst) scale that is used to evaluate the level of roadway congestion. Definitions for each level can be found in *The Highway Capacity Manual* and *American Association of State Highway and Transportation Officials (AASHTO) Geometric Design of Highway and Streets*, most generally:
  - LOS A = Free flow
  - LOS B = Reasonably Free Flow
  - LOS C = Stable flow, at or near free flow
  - LOS D = Approaching unstable flow
  - LOS E = Unstable flow, operating at capacity
  - LOS F = Forced or breakdown flow. Congested roadways are considered to be those that are at or below LOS D.
- **Total Delay:** The total additional time (hours) that vehicles spend in traffic relative to a free flow scenario. This is a function of system demand and roadway capacity.
- **Congestion Severity Index (CSI):** The CSI metric, developed by FHWA, represents the total delay per vehicle miles traveled on the statewide freeway and arterial system.

- **Percent Lane-Miles with a "Good" or "Better" International Roughness Index (IRI):** IRI is an AASHTO-supported MAP-21 measure of pavement roughness. The ride quality of the pavement is determined by capturing the roughness experienced by drivers in terms of inches per mile that a vehicle's suspension is jostled at standardized speeds. A lower IRI indicates a smoother pavement. What is considered "good" depends on the functional classification of the roadway: for a NHS pavement, 95 inches per mile or lower is preferred; for a non-NHS pavement, 170 inches per mile or lower is preferred.
- **Percent Lane-Miles with a "Good" or "Better" Pavement Condition Score:** Pavement Condition Score is a TxDOT-defined comprehensive pavement condition index to measure the overall pavement condition considering both pavement distress and roughness. It ranges from 1 (worst) to 100 (best). A score between 90 and 100 is considered "Very Good"; a score between 70 and 89 is considered "Good", a score between 50 and 69 is considered "Fair"; a score between 35 and 49 is considered "Poor"; and a score less than 35 is considered "Very Poor."
- **Percent Structurally Deficient (SD) Deck Area:** Percent of deck area of structures that are deemed to be in need of structural rehabilitation or replacement. While not necessarily unsafe, these structures are due for improvements to load carrying capacity, waterway adequacy, and component condition ratings. Technically speaking, the National Bridge Inventory (NBI) database defines a SD bridge as either having a deck, superstructure, substructure, or culvert condition rating of 4 or less or a structural evaluation and waterway adequacy rating of 2 or less. These ratings are based on biannual or more frequent inspections using a 0 (worst) to 9 (best) scale.
- **Count of Bridges and Percent Deck Area with Cyclic Maintenance Needs:** Number of structures and percent deck area of structures with a deck, superstructure, substructure, or culvert NBI rating of 7 or higher. These structures require minimal work due to being in a state of good repair.
- **Count of Bridges and Percent Deck Area with Preventive Maintenance Needs:** Number of structures and percent deck area of structures with a deck, superstructure, substructure, or culvert NBI rating of 5 or 6. These structures can be targeted for preventive treatments that can extend the life of the bridge or culvert by reducing their rate of deterioration.
- **Count of Bridges and Percent Deck Area with Rehabilitation or Replacement Needs:** Number of structures and percent deck area of structures with a deck, superstructure, substructure, or culvert NBI rating of 4 or less. These structures are deemed SD and require more extensive work to improve the condition rating of one or multiple components.
- **Percent of Transit Assets in "Good" or "Better" condition:** Percentage of transit facilities, stations, vehicles, and guideway elements in a state of good repair. State of good repair is defined as components that are operable and sufficient to provide smooth and comfortable service to customers.
- **Additional Annual Transit Ridership:** Represents the additional ridership that can be served through system expansion and operational efficiency improvements.
- **Percent Passenger Rail Needs Met:** Represents the percentage of unconstrained needs in terms of planned and programmed projects that can be funded. These include high speed rail service as well as planned AMTRAK expansions and reroutes.
- **Percent Intelligent Transportation System (ITS) Needs Met:** Represents the percentage of unconstrained needs that are able to be funded. Projects include an array of activities ranging from dynamic messaging signs to smart signal.
- **Backlog of Aviation Projects:** Number of projects that remain unfunded at specified investment level. These projects may include runway, taxiway, apron construction or rehabilitation, airfield lighting, signage, and drainage, planning and environmental studies, weather observation stations, and safety improvements.
- **Percent Bicycle and Pedestrian Needs Met:** Represents the percentage of unconstrained needs able to be funded. Bicycle and pedestrian needs include local projects identified to preserve facility infrastructure, enhance connectivity, and improve safety.
- **Percent Non-Highway Freight Needs Met:** Represents the percentage of unconstrained needs able to be funded. Non-highway freight needs include infrastructure improvements to the ports, rail, and aviation distribution centers and their connectivity to the highway system.

3.3.2 National Performance Measures

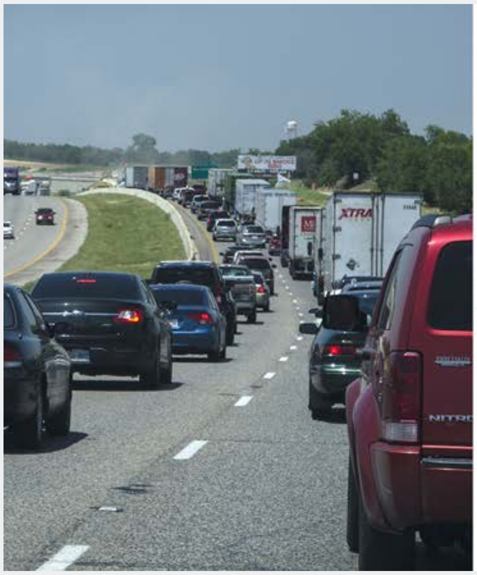
The Texas A&M Transportation Institute assisted TxDOT in determining fiscal year 2014 urban, rural and statewide targets for MAP-21 Congestion Reduction, System Reliability, and Freight Vitality. As can be seen in Exhibit 3-5, statewide targets will only be set and results reported for safety, freight, bridge and pavement condition, system performance, and transit measures; no targets have been established for CMAQ measures. In some cases, separate performance targets are provided for rural and urban areas of the state.

Exhibit 3-5. TxDOT National Performance Measures for MAP-21 Reporting

2015-2019 Strategic Plan Goals	TTP 2040 Goals	MAP-21 Goals	Performance Measures	FY 2014 Target		
				Urban	Rural	Statewide
Maintain a Safe System	Safety	Safety	Fatality Rate (5-year moving average)	0.94	2.14	1.36
			Number of Fatalities (5-year moving average)	1,442	1,767	3,209
			Serious Injury Rate (5-year moving average)	37.9	31.3	35.59
			Number of Serious Injuries (5-year moving average)	58,232	25,894	84,126
	Asset Management	Infrastructure Condition	% Structurally Deficient Deck Area on NHS Bridges – Percent based on total NHS Deck Area			1.1%
			% Structurally Deficient Deck Area on NonNHS Bridges – Percent Based on Total NonNHS Deck Area			2.0%
			Count of Bridges (Entire Inventory) with Cyclic Maintenance Needs			28,280
			% Bridges (Entire Inventory) by Deck Area with Cyclic Maintenance Needs			53.9%
			Count of Bridges (Entire Inventory) with Preventive Maintenance Needs			23,800
			% Bridges (Entire Inventory) by Deck Area with Preventive Maintenance Needs			44.8%
			Count of Bridges (Entire Inventory) with Rehabilitation or Replacement Needs			840
			% Bridges (Entire Inventory) by Deck Area with Rehabilitation or Replacement Needs			1.3%
			Transit State of Good Repair Average Condition. Ratings are 1=Bad, 2=Poor, 3=Fair, 4=Good, 5=Excellent	4.00	4.00	4.00
			Interstate Pavement in Good Condition (IRI <95)			68.08%
			Interstate Pavement in Fair Condition (IRI 95 – 170)			28.89%
			Interstate Pavement in Poor Condition (IRI > 170)			3.03%
			NonInterstate NHS Pavement in Good Condition (IRI <95)			51.58%
			NonInterstate NHS Pavement in Fair Condition (IRI 95 – 170)			41.69%
			NonInterstate NHS Pavement in Poor Condition (IRI > 170)			6.73%
Address Congestion/ Connect Texas Communities	Mobility and Reliability/ Multimodal Connectivity	Congestion Reduction/ System Reliability/ Freight Vitality	Annual Hours of Truck Delay – Interstates (millions)	11.5	1.0	12.5
			Truck Reliability Index	1.86	1.07	1.58
			Annual Hours of Delay – NHS (millions)	384.5	43.8	428.3
			Annual Hours of Delay – Interstates (millions)	122.8	4.1	126.9
			Annual Hours of Delay – NonInterstate NHS	261.7	39.7	301.4
			Reliability Index – NHS	1.91	1.18	1.66
			Reliability Index – Interstates	1.86	1.07	1.58
			Reliability Index – NonInterstate NHS	1.94	1.27	1.73
Become a Best-in-Class State Agency	Stewardship	Environmental Sustainability	Daily kilograms of VOC reduced by the latest annual program of CMAQ projects in areas with 1 million pop. or more (5-year average)			
			Daily kilograms of NOx reduced by the latest annual program of CMAQ projects in areas with 1 million pop. or more (5-year average)			
			Daily kilograms of CO reduced by the latest annual program of CMAQ projects in areas with 1 million pop. or more (5-year average)			
			Annual Hours of Delay Reduced by CMAQ Projects in areas with 1 million pop. or more (1,000 of hours)			

Additional information the development of TTP-specific performance measures and targets for the MAP-21 national performance measures can be found in *Technical Memorandum #2: TTP Goals and Objectives*.

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%

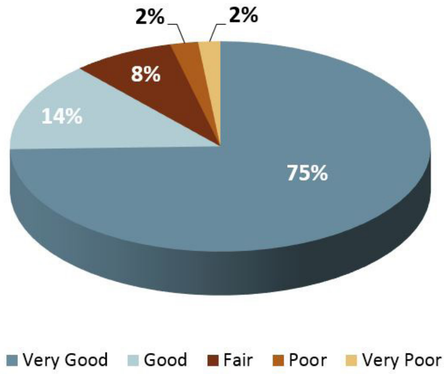
Source: US Census. 2012. American Community Survey. 3-year estimate

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

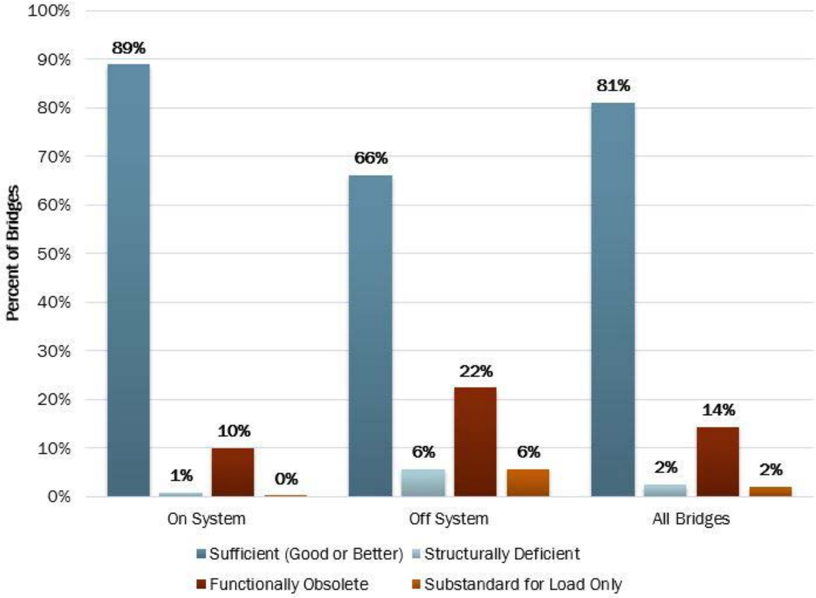
Source: TxDOT PMIS Annual Report (2010-2013)

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

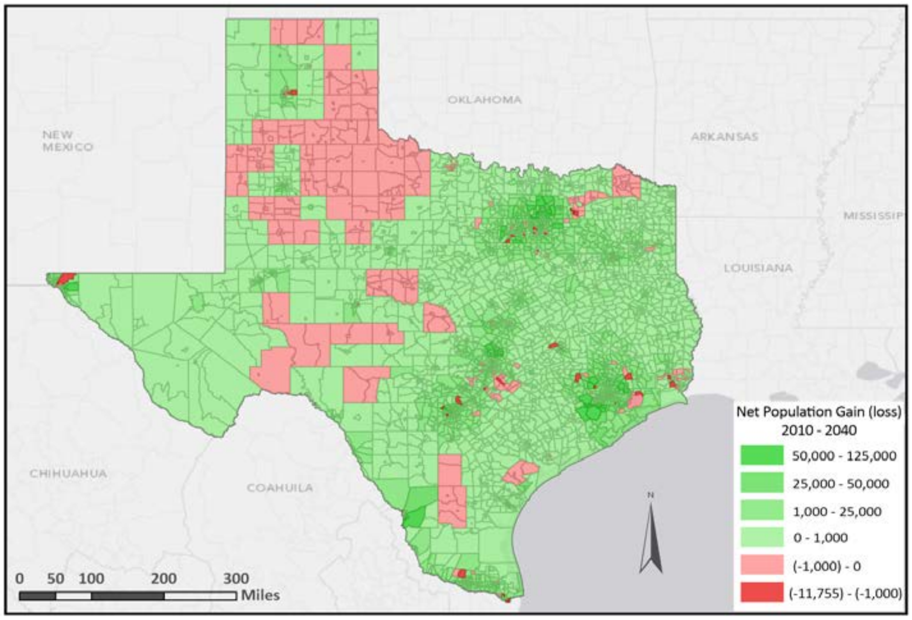
9 TxDOT. 2012. Report on Texas Bridges. http://ftp.dot.state.tx.us/pub/txdot-info/library/reports/gov/bridge/fy12.pdf
10 TxDOT. 2012. Report on Texas Bridges. http://ftp.dot.state.tx.us/pub/txdot-info/library/reports/gov/bridge/fy12.pdf

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

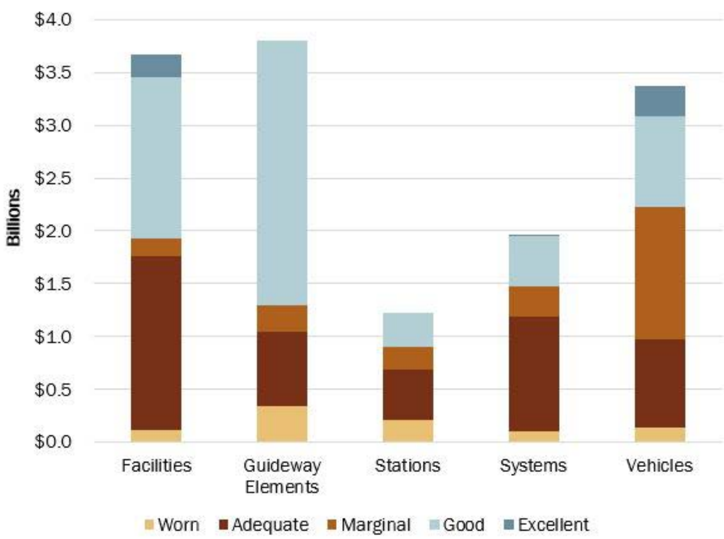


Exhibit 4-9. Current Condition of Transit Assets by Travel Mode

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.

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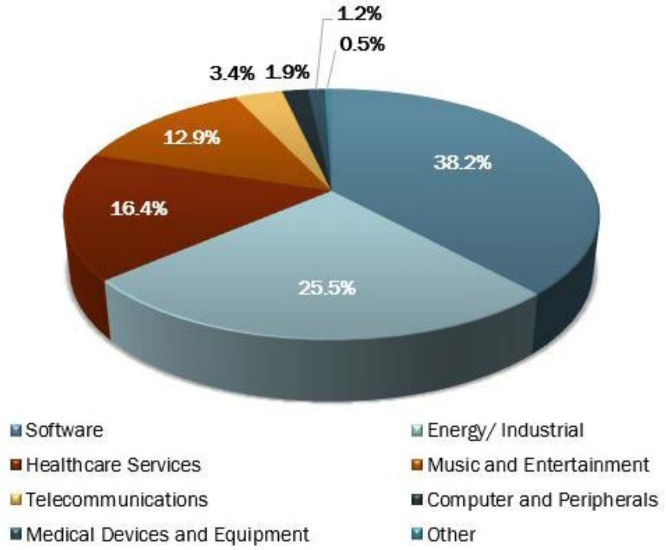
13 USDOT. 2014. RITA. Bureau of Transportation Statistics. http://www.transtats.bts.gov/airports.asp?pn=1
14 Alliance for Biking & Walking. 2012. Bicycling and Walking in the United States, 2012 Benchmarking Report Facts Sheet. http://www.peoplepoweredmovement.org/site/images/uploads/Media_Fact_Sheet_-_Benchmarking_2012.pdf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



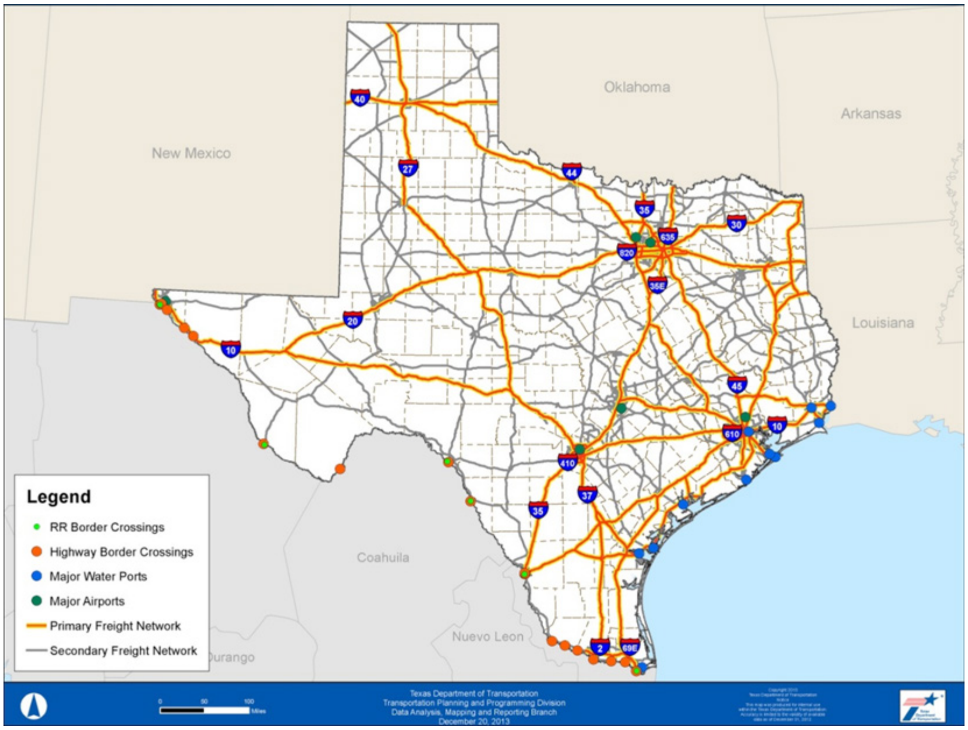
Source: PricewaterhouseCoopers and National Venture Capital Association. 2014. Money Tree Report

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]

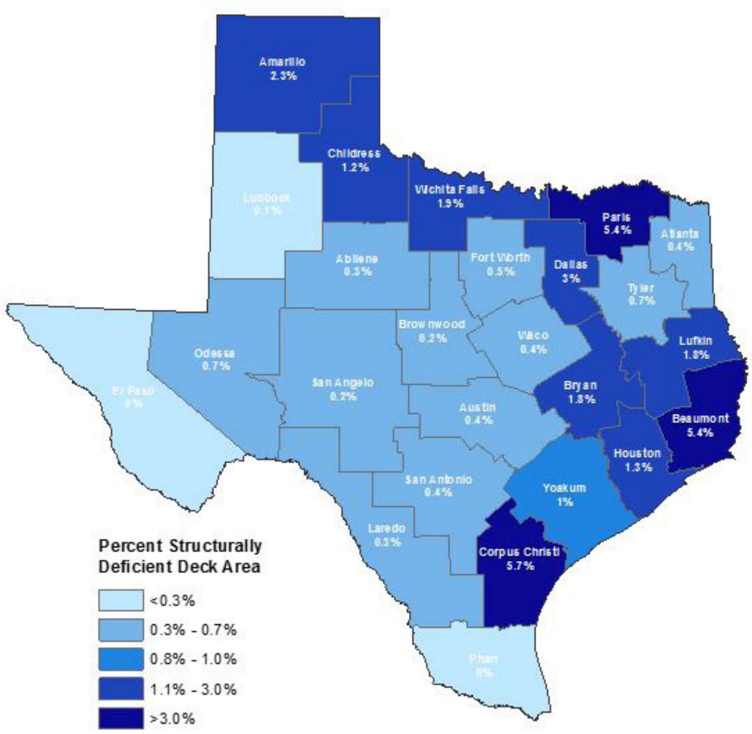
Exhibit 4-13. Existing Conditions by Bridge and Culvert Network

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.

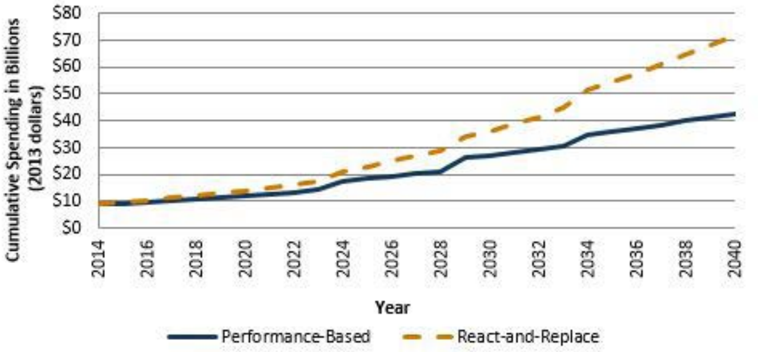
33 US Department of Transportation. 2012. National Bridge Inventory Database.

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).

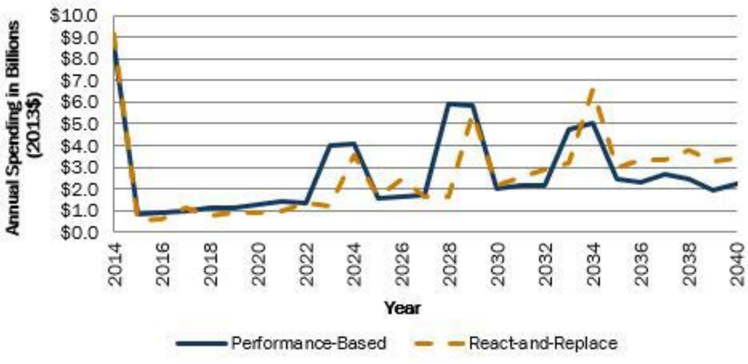
Because of the planning-level nature of the TTP, initial estimates of projected needs/dollar values were first identified in previous sections and the presented in various parts of this document. These estimates served as a baseline and were then refined and interpolated based on projections, normalized 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



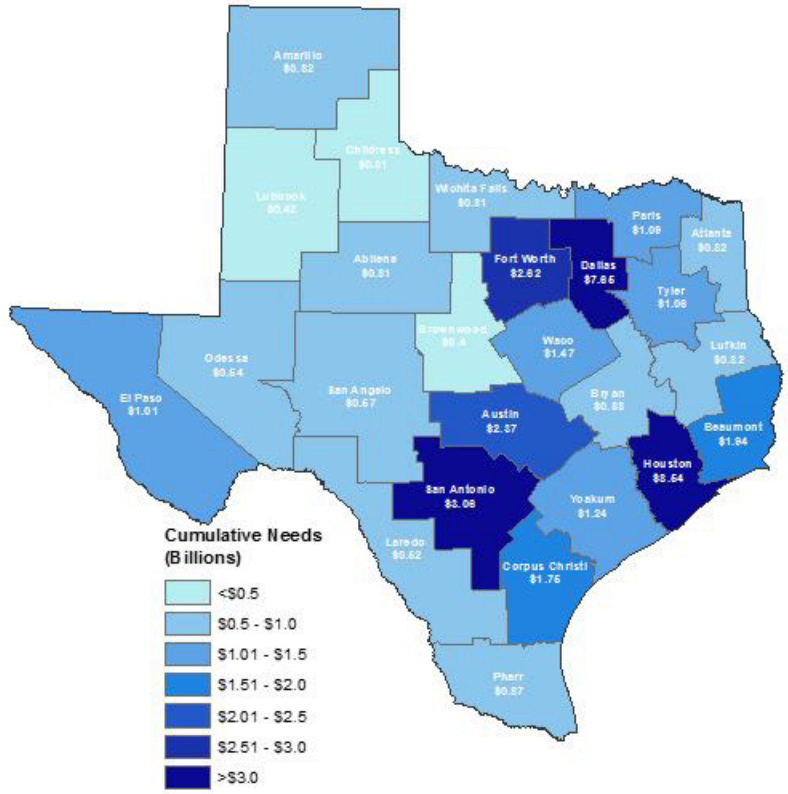
Approximately 80 percent of the total needs are anticipated to be required on the NHS due to the larger inventory of structures and higher improvement needs resulting from relatively high truck volumes; roughly half of this cost is expected to be split between the Interstate and nonInterstate systems. 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

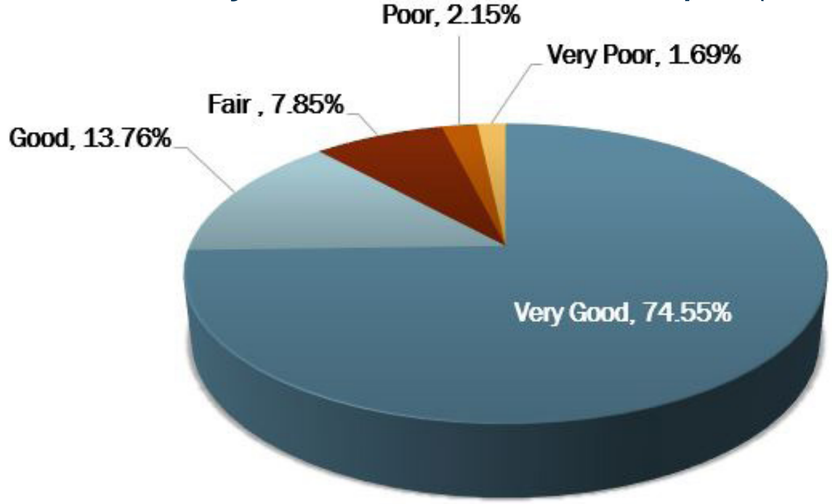
Pavement Type	Lane-Miles	Percent
Flexible or Asphalt Concrete Pavement	179,600	91.07
Continuously Reinforced Concrete Pavement	13,779	6.99
Jointed Concrete Pavement	3,823	1.94
Total	**197,202**	**100**

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

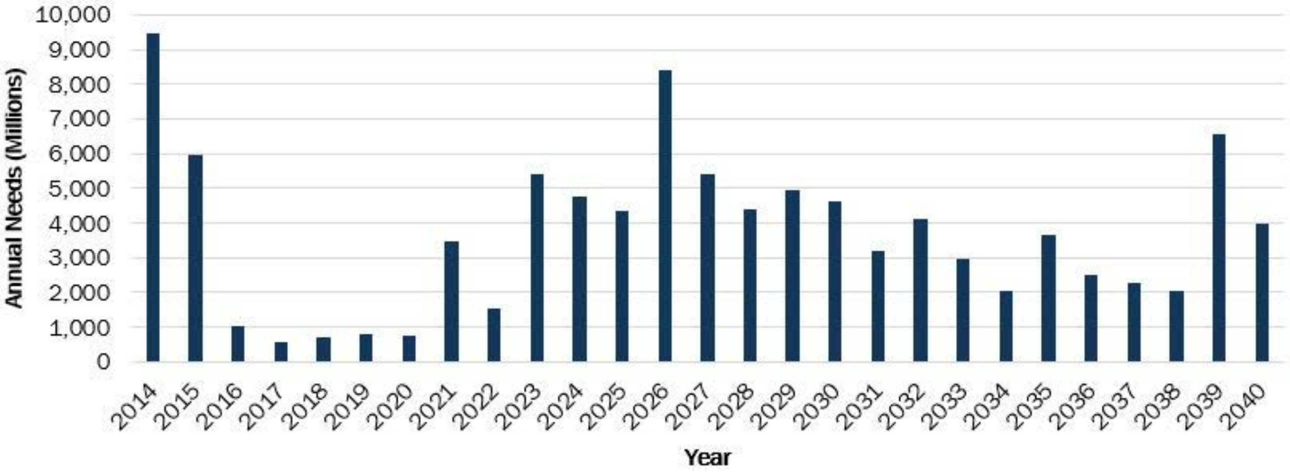
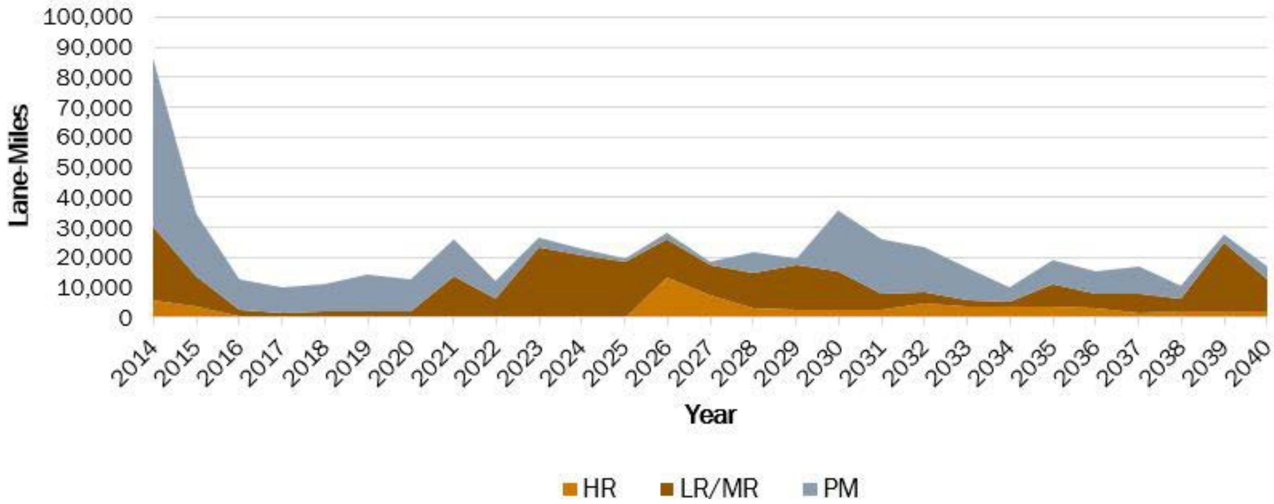
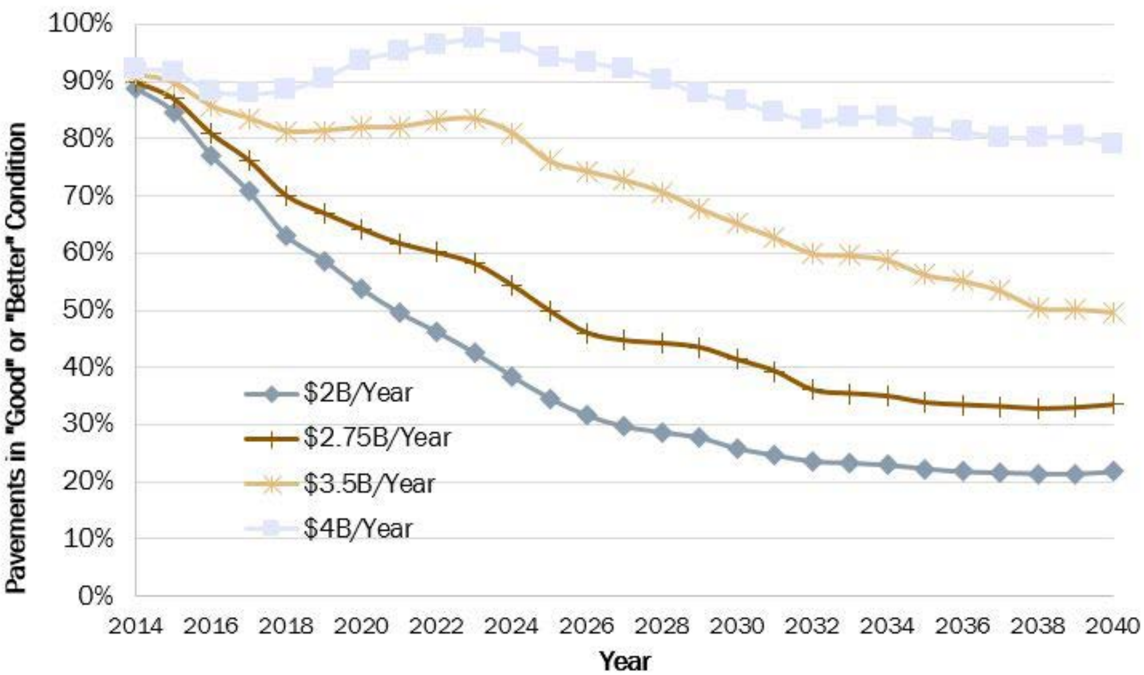


Exhibit 4-25. Lane-Miles of Needs by Treatment Type



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

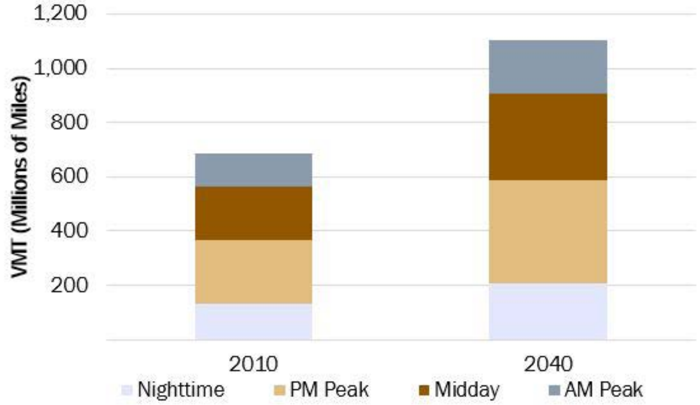


Exhibit 4-29. Forecasted Increase in Commuter Stress Index

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:

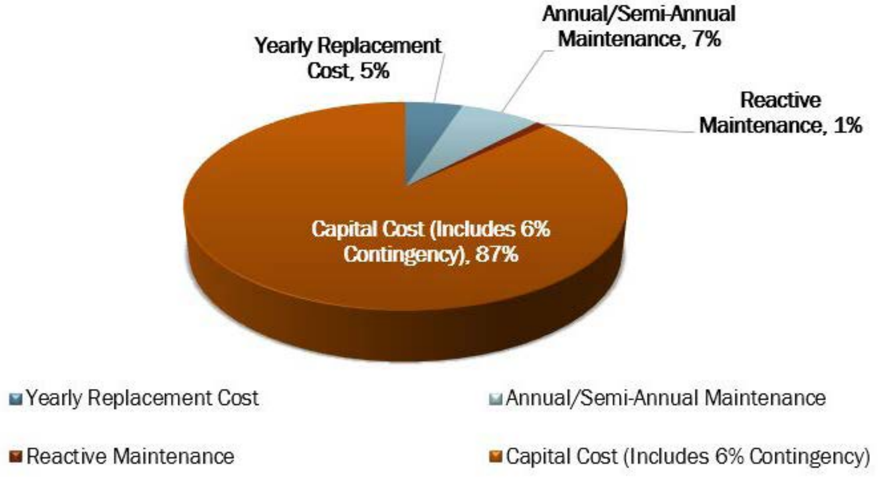
- Closed Circuit Television Cameras
- Dynamic Message Signs
- Lane Control Signals
- Radar Detection
- Loop Detection
- Highway Advisory Radio
- Ramp Meters
- Automatic Vehicle Identification
- Flood Warning
- Weather Sensors
- Not included: traffic signals, illumination, signing, pavement markings,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

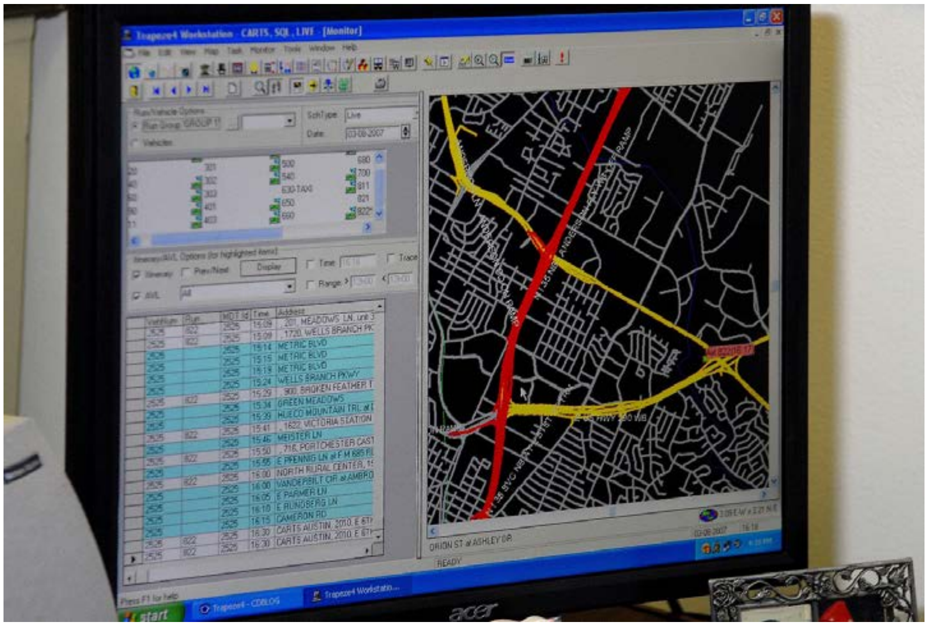
Existing ITS devices were assumed to remain in place and functional through 2040. New ITS devices were added to the annual inventory based on the ITS deployment plans, with all identified projects assumed to have been implemented except for those classified as long-range projects (i.e., not yet implemented). 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)

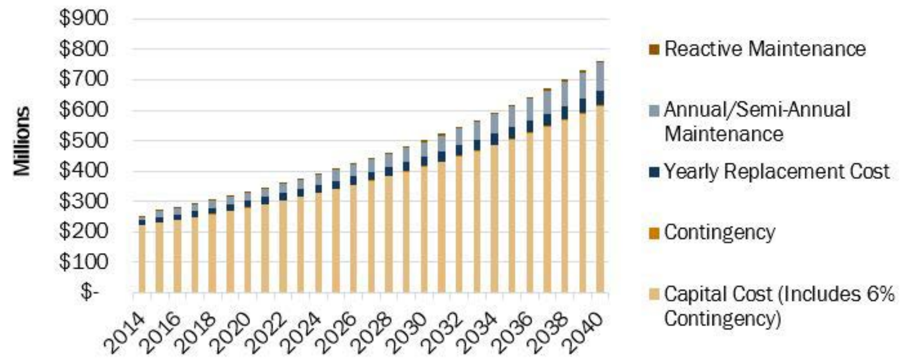
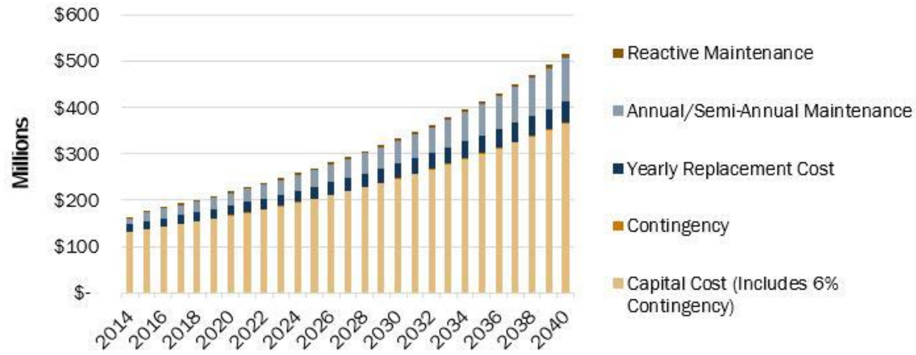


Exhibit 4-35. Total Life-Cycle Maintenance Costs of Intelligent Transportation System Assets – 50 Percent Funded (Year of Expenditure)



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.

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

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 4-39. 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

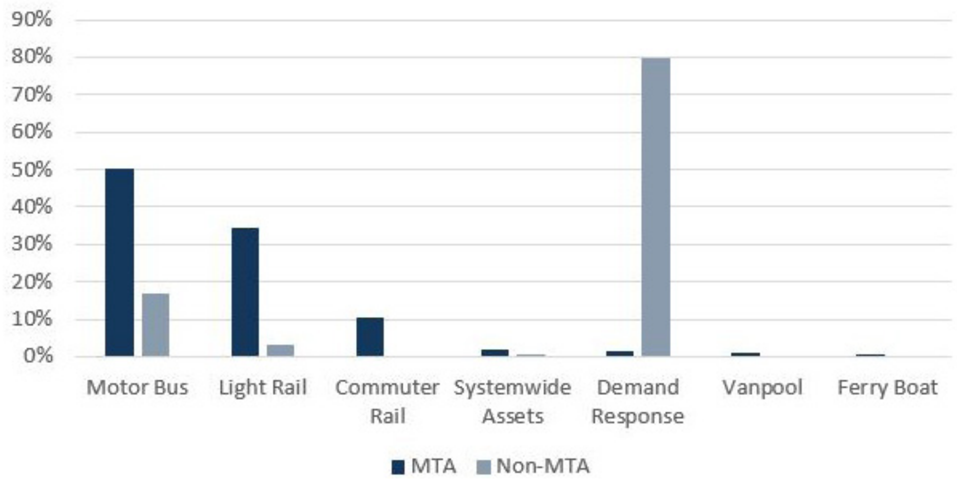


Exhibit 4-42. Estimated Public Transit Asset Condition for Metropolitan Transit Authority Agencies

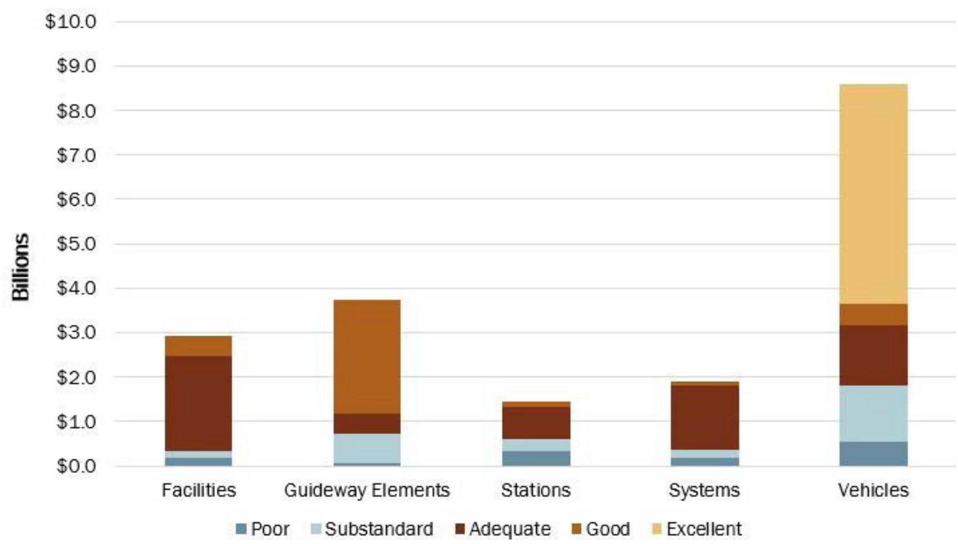
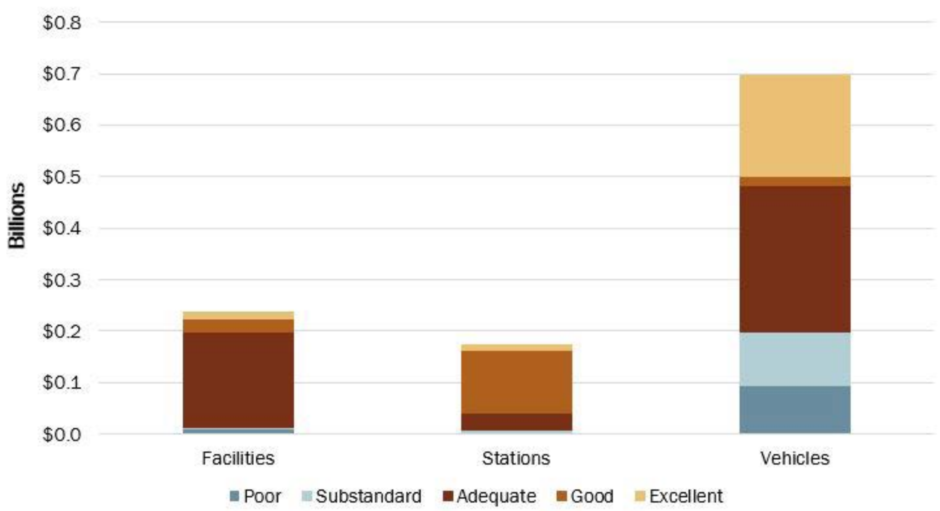


Exhibit 4-43. Estimated Public Transit Asset Condition for Non-Metropolitan Transit Authority Agencies



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.

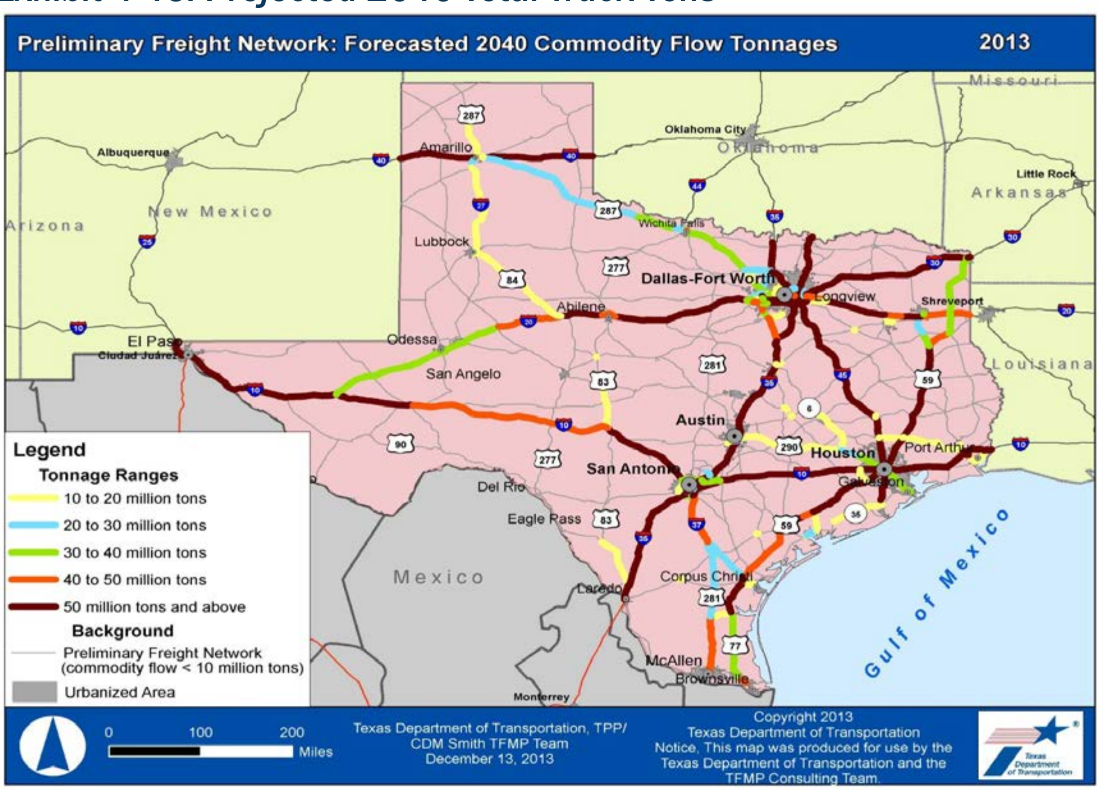
A larger concern for the unconstrained projection is the minimal number of Major New Service projects scheduled beyond the next 10 years. Only 39 of the 132 projects planned for MTAs are scheduled to occur past 2024. There are no planned statewide, urban, or RTD Major New Service projects beyond 2020. 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

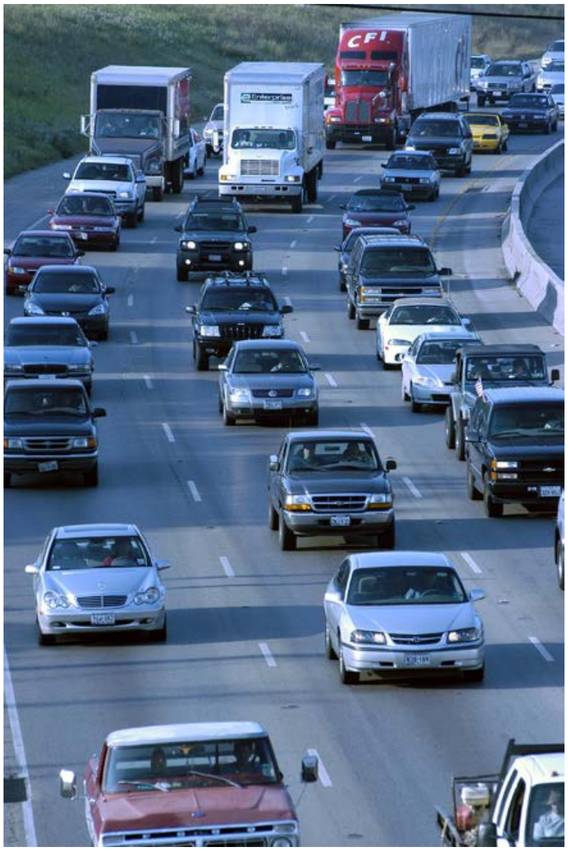


Source: Global Insights. 2010. TRANSEARCH

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.

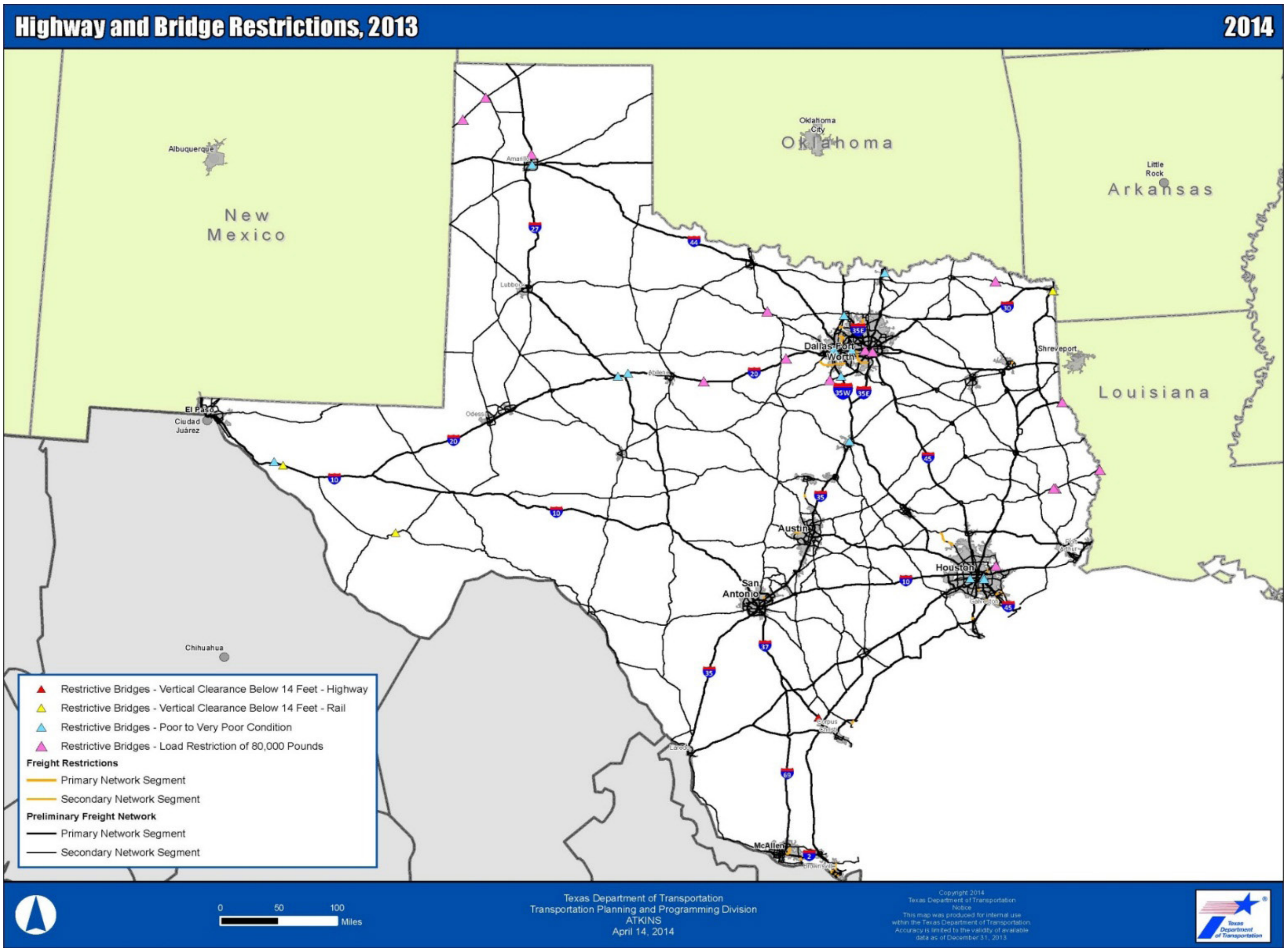
As passenger and freight traffic volumes continue to increase on the Interstates and US highways, causing trucks to seek alternate routes, rural state highways may become a more integral part of the freight network. More resources will be required to reconstruct and maintain rural highways at a level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

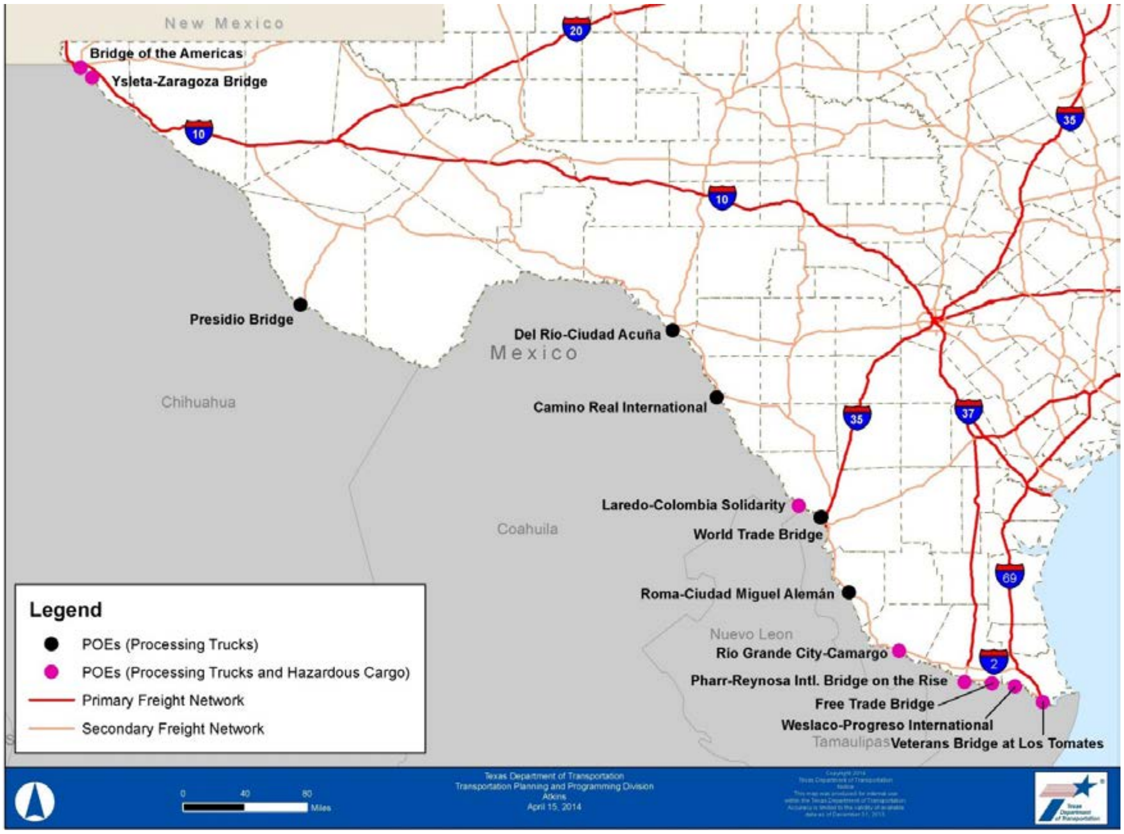
There are 13 land ports of entry along the 1,254 mile Texas border for trucks traveling between the US and Mexico (Exhibit 4-48). The crossings are located over the entire length of the Texas-Mexico border but are concentrated in or near the three major metropolitan areas of El Paso, Laredo and Brownsville. 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.

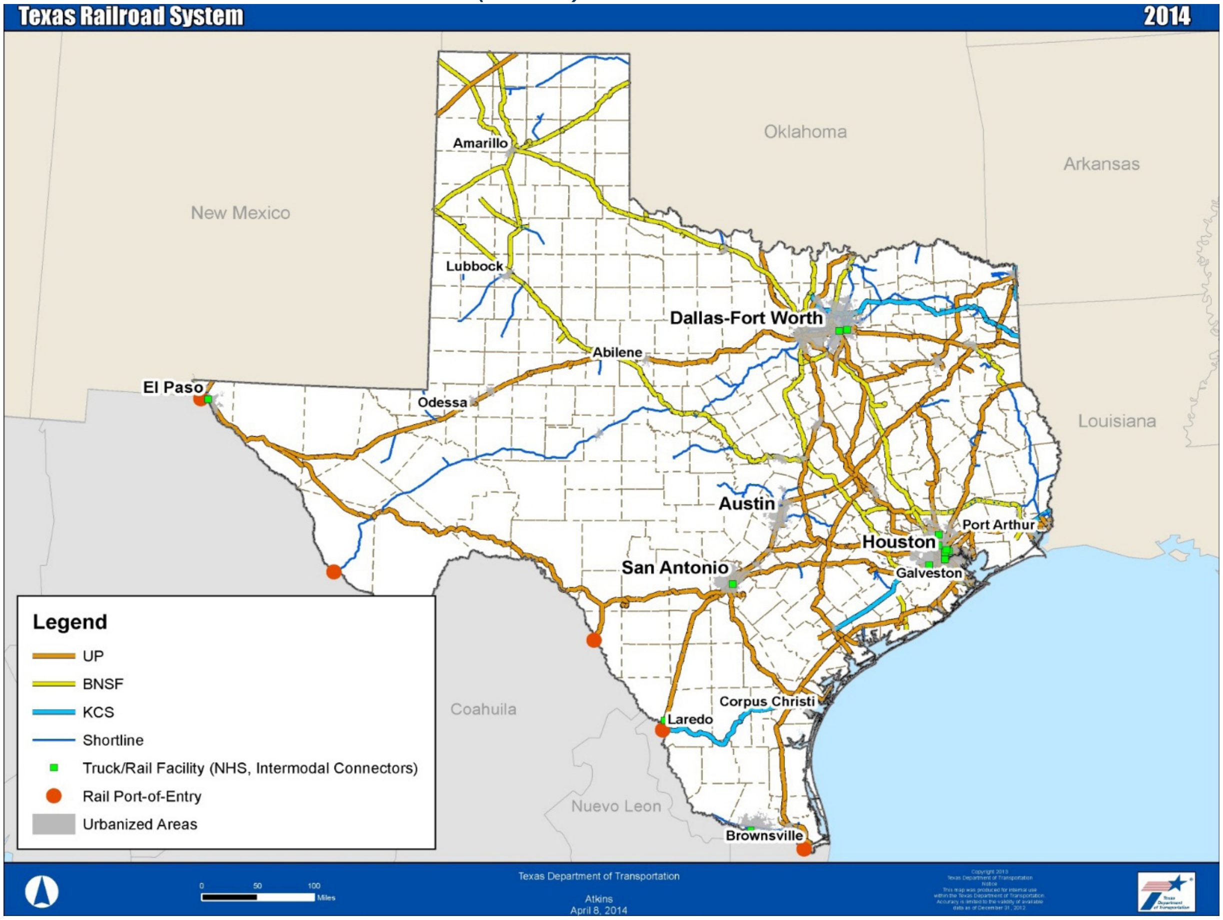
4.5.2 Freight Rail

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)

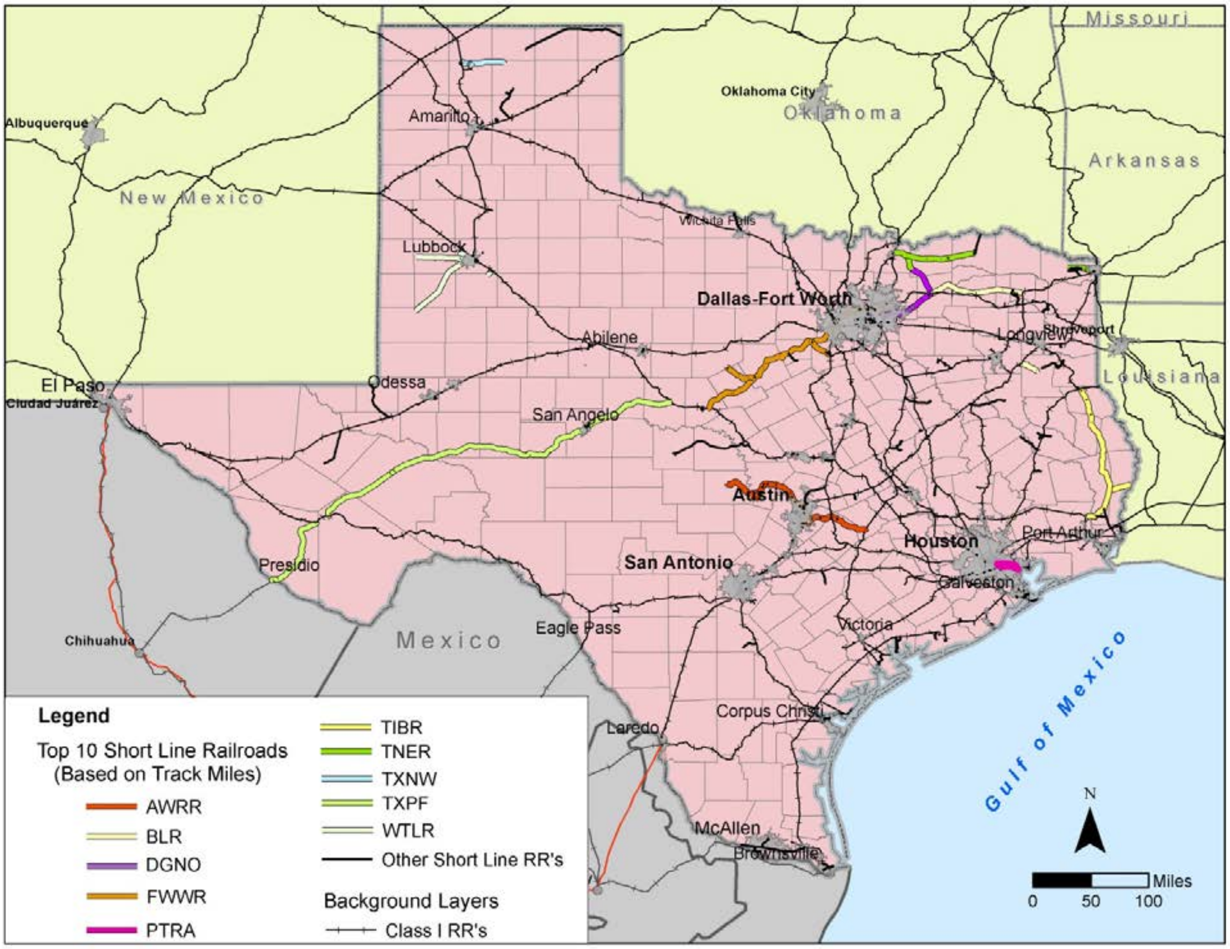


Source: USDOT. 2013. Bureau of Transportation Statistics. National Transportation Atlas.

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.

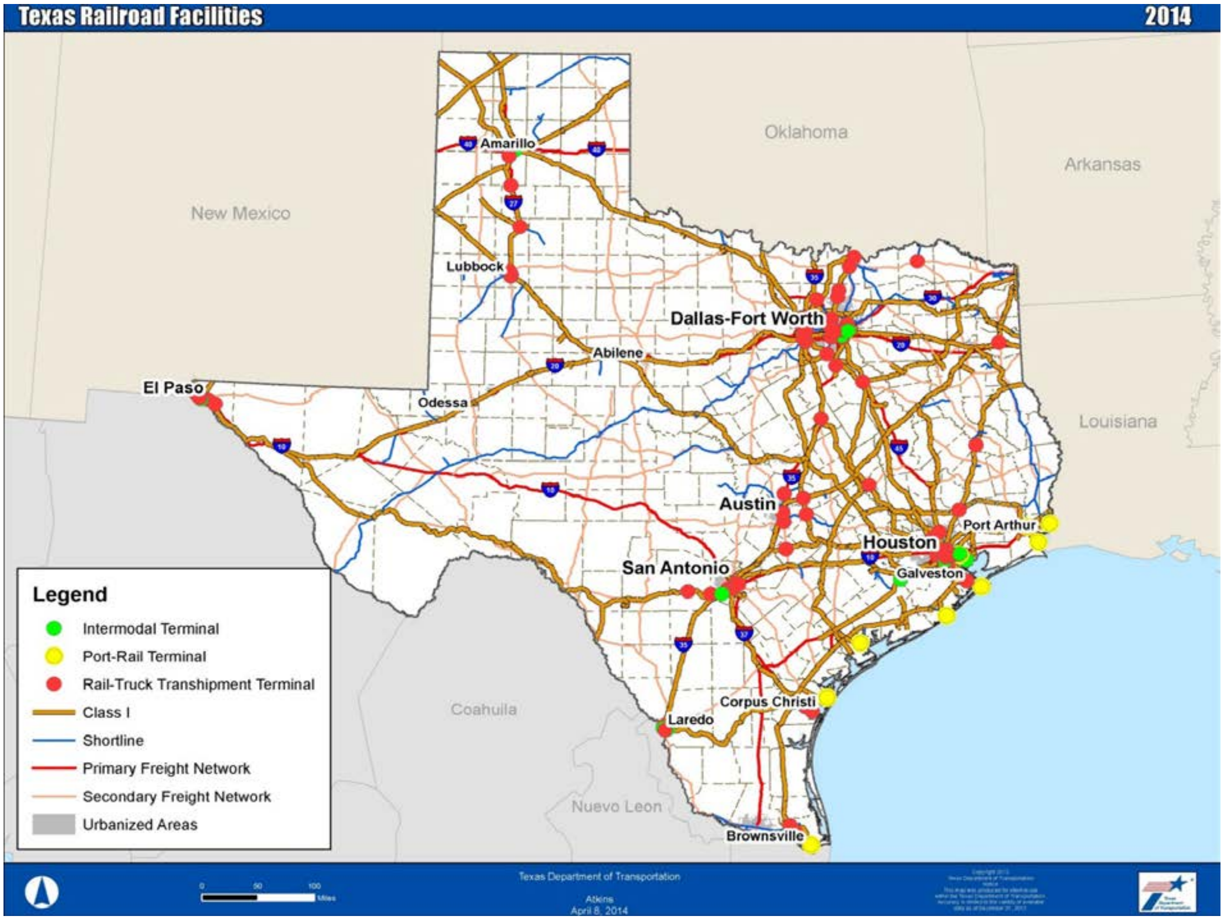
Exhibit 4-51. Texas Land Ports of Entry with Rail Connections (2013)

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

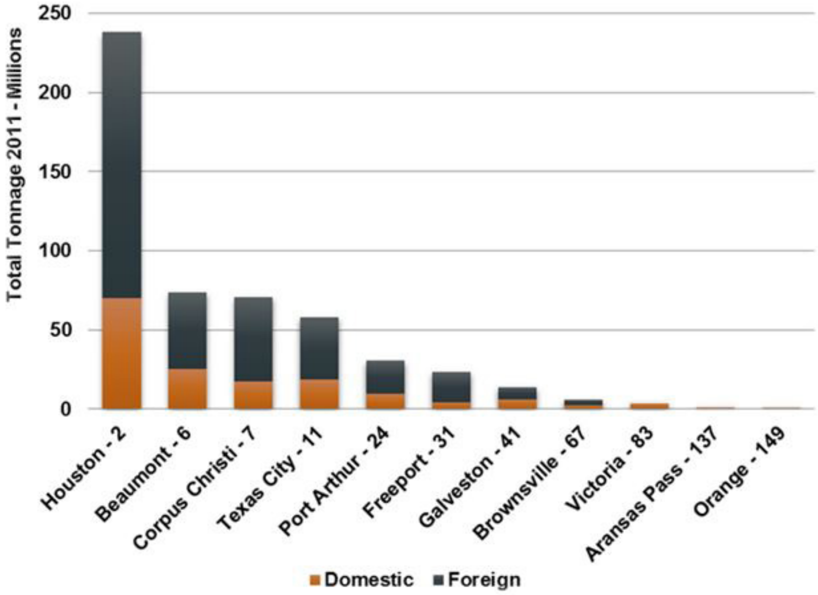
4.5.3 Ports and Waterways

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

<table>
<tr><th colspan="2"></th><th>Austin</th><th>Bush</th><th>Corpus Christi</th><th>Houston Hobby</th><th>San Antonio</th><th>Dallas – Fort Worth</th></tr>
<tr><td rowspan="2">Airport Cost</td><td>Air Cargo</td><td>-</td><td>$445,346,000</td><td>-</td><td>-</td><td>-</td><td rowspan="4">$260,888,005*</td></tr>
<tr><td>Belly Cargo</td><td>$420,134</td><td>-</td><td>-</td><td>$13,090,000</td><td>-</td></tr>
<tr><td rowspan="2">3rd Party Cost</td><td>Air Cargo</td><td>$193,626,293</td><td>-</td><td rowspan="2">$2,124,000</td><td>-</td><td>$78,040,000</td></tr>
<tr><td>Belly Cargo</td><td>$12,747,875</td><td>-</td><td>-</td><td>-</td></tr>
</table>

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

4.5.5 Pipelines

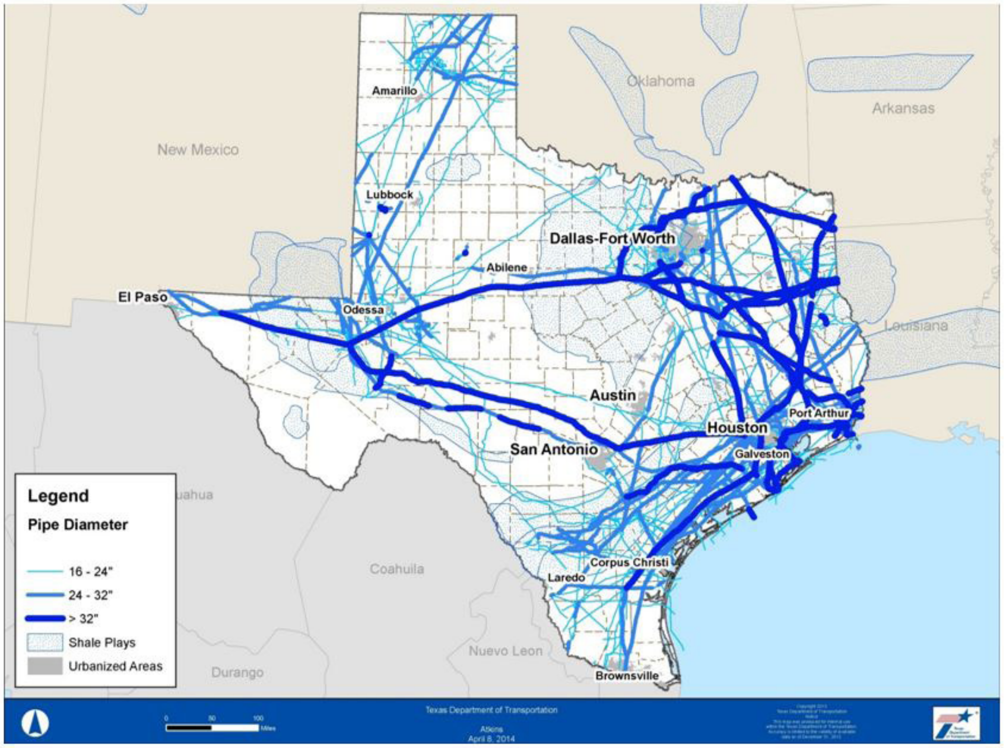
Pipeline transportation includes the gathering, transmission, or distribution of gas, oil, or other commodities by pipeline. The pipeline network is composed of the following three different line types:

- 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/nantional_highway_system/intermodal_connectors/texas.cfm

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

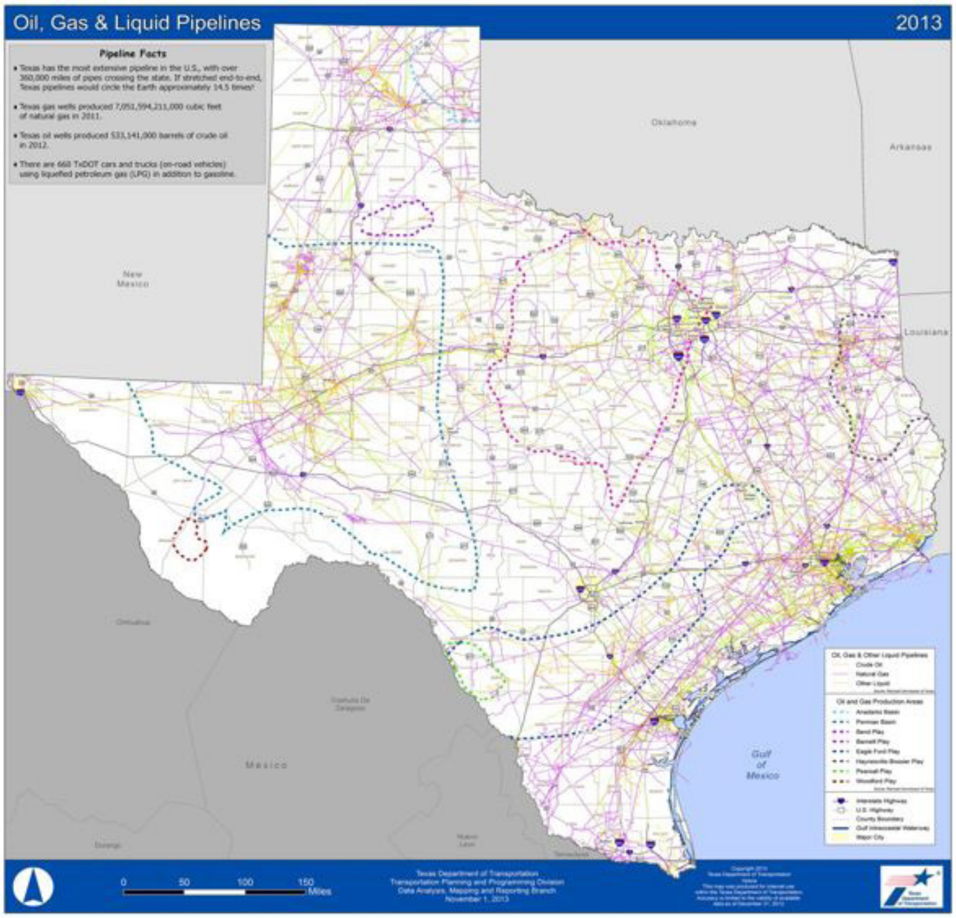
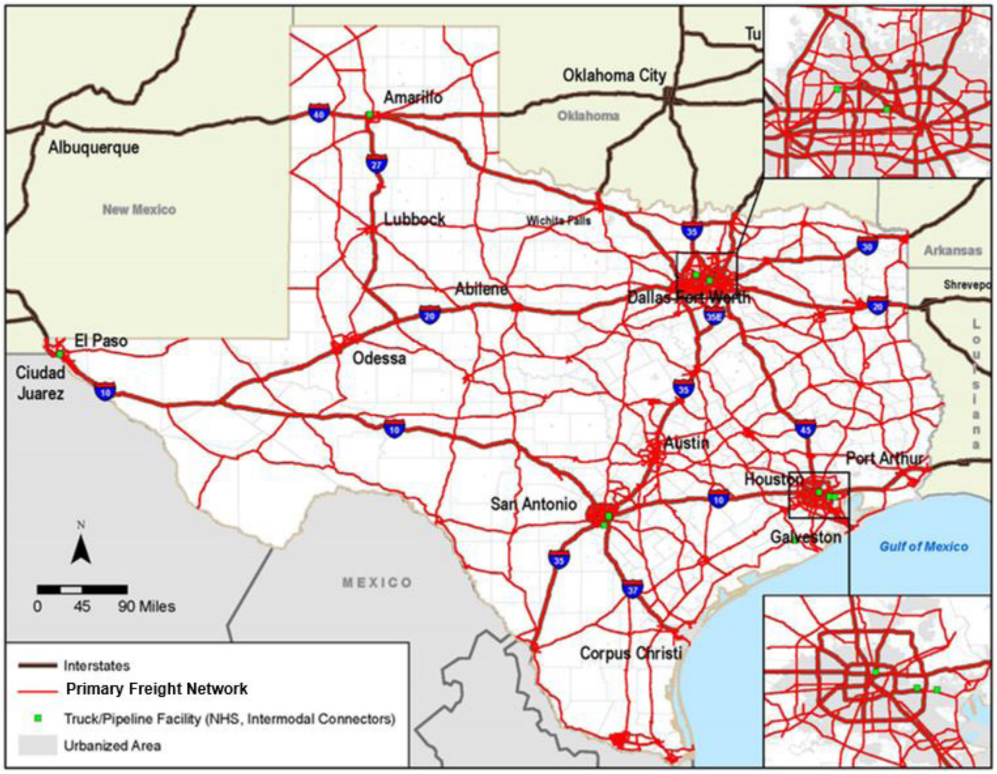


Exhibit 4-63. National Highway System Truck Pipeline Intermodal Terminals (2013)



REVENUE FORECAST

As summarized in Chapter 4, a performance-based needs assessment was conducted for the Texas Transportation Plan (TTP) to identify the minimum investment required to achieve state of good repair (SGR) or similar performance targets for each mode over the TTP horizon. This chapter provides information on reasonably anticipated revenues over that same 25-year timeframe in order to better understand the gap between long-range needs and transportation funds.

5.1 Highway Revenues

5.1.1 Revenue Sources

TxDOT highway revenues from federal, state, and other sources are deposited into the State Highway Fund (SHF).[1] A significant portion of the SHF revenues are generated by:

- **State motor fuels taxes.** State motor fuels taxes collected – currently 20 cents per gallon on gasoline and 15 cents per gallon on diesel fuel – have not been raised since 1991. Seventy-five percent of the revenue generated by state motor fuels tax is allocated to the SHF, with the remaining 25 percent allocated to the Available School Fund. According to the Texas Comptroller of Public Accounts, motor fuels taxes generated $3.3 billion in revenue for fiscal year 2014 – of which, $2.47 billion was allocated to the SHF.
- **Vehicle registration fees.** An annual motor vehicle registration fee is assessed per vehicle. Various rates are charged based on the type, age, and weight of the motor vehicle. Passenger cars and light trucks less than 6,000 pounds are charged $50.75. Vehicle registration fees generated $1.35 billion in revenue for fiscal year 2014.
- **Federal Highway Trust Fund (HTF).** Federal motor fuels taxes collected – currently 18.4 cents per gallon on gasoline and 24.4 cents per gallon on diesel fuel – are used to support the HTF. Texas receives an allocation from the federal HTF for obligation to projects that are eligible for federal reimbursements. Net revenues from Federal Receipts Matched for transportation programs for fiscal year 2014 were $3.85 billion. Other sources include accrued interest from revenue bonds and short-term notes, lubricant sales tax, and toll revenues, among others.

5.1.2 Revenue Forecast

5.1.2.1 Trends and Challenges

Forecasting of revenues, expenditures and fund balances is a critical function of TxDOT. The cash balance of the SHF changes daily and is impacted by economic trends. Likewise, the needs of the traveling public and subsequent responsibilities of TxDOT continue to change. Thus, while TxDOT maintains a methodology by which revenue sources and expenditures can be tied together to project future cash flows, the revenue forecast developed for the TTP represents an extrapolation of cash flow from not only TxDOT's revenue baseline, but also from current revenues of the state's transit agencies. More information regarding the TTP revenue forecasting assumptions is provided in Section 5.1.1.

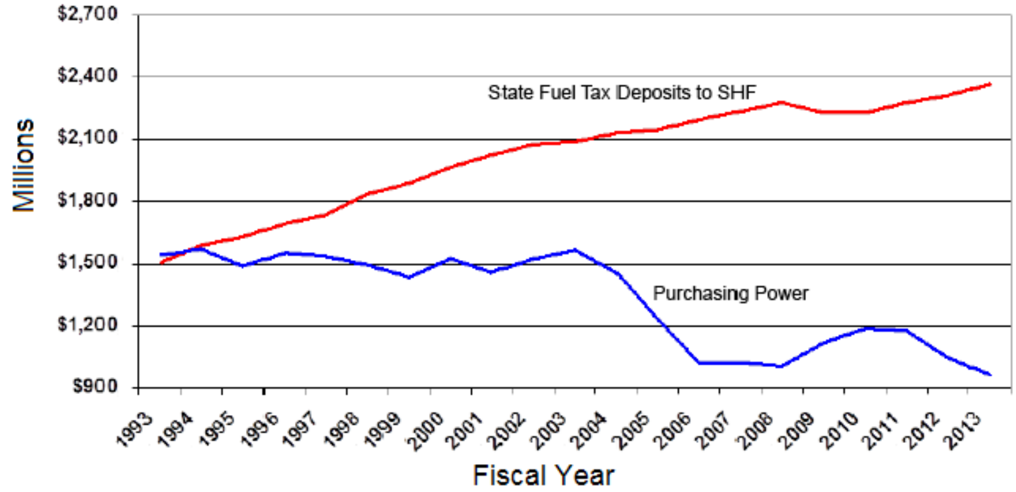
TxDOT faces the following funding challenges:

- **Federal Funding Issues.** Several factors, including the expiration of the current surface transportation legislation – Moving Ahead for Progress in the 21st Century (MAP-21) Act – at the end of May 2015, and the impending insolvency of the HTF, make federal funding increasingly unpredictable. The HTF continues to pay out more money to states than it is taking in. Multiple general revenue infusions into the HTF have kept the fund solvent. Without further Congressional action, the HTF would be unable to meet obligations in a timely manner in the summer of 2015, which could result in delayed payments to states. In addition, Texas continues to rate near the bottom in the percentage of fuel tax revenue sent to Washington, compared to the percentage of funds that are returned for projects. These circumstances make it difficult to plan for future transportation projects.

1 Texas Comptroller of Public Accounts. State of Texas Annual Cash Report. November 2014. http://www.texastransparency.org/State_Finance/Budget_Finance/Reports/Cash_Report/14/texas_annual_cash_report_2014.pdf

- **State Highway Funds.** Trends in vehicle miles traveled and the number of vehicles registered in the state will greatly impact the amount of revenue generated for the SHF. As previously noted, total trip volumes are expected to increase by 57 percent in the state in accordance with population and employment growth. However, as vehicles become more fuel efficient, the amount of revenues collected from fuel taxes will not keep pace with transportation needs of the state, which includes the increase in wear and tear on transportation facilities resulting from higher vehicle miles traveled. As shown in Exhibit 5-1 the funding shortfall has been – and will continue to be – exacerbated by the fact that state fuel taxes are not indexed to inflation, which greatly diminishes the purchasing power of the funds generated.

Exhibit 5-1. State Fuel Tax Deposits to State Highway Fund (1993-2013)



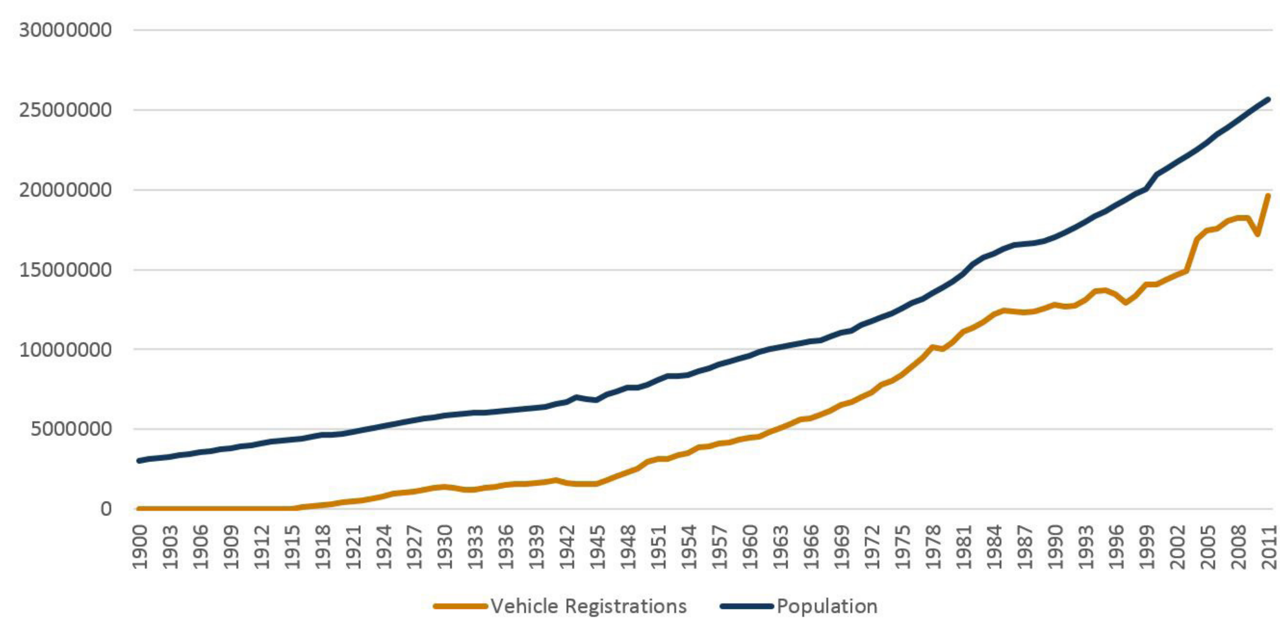
Source: TxDOT. Transportation Funding: Understanding Transportation Funding in Texas. 2014.

Beyond the state and federal gas tax contributions, vehicle registration fees constitute approximately 18 percent of the total SHF revenues. As shown in Exhibit 5-2, the number of vehicle registrations has and is expected to continue to grow along with but at a slower rate than the increase in population. Exhibit 5-3 indicates the total and effective (inflation-adjusted) SHF revenues generated by private and commercial vehicle registrations from 1993 to 2012.

5.1.3 Highway Revenues Available to Meet Texas Transportation Plan Needs

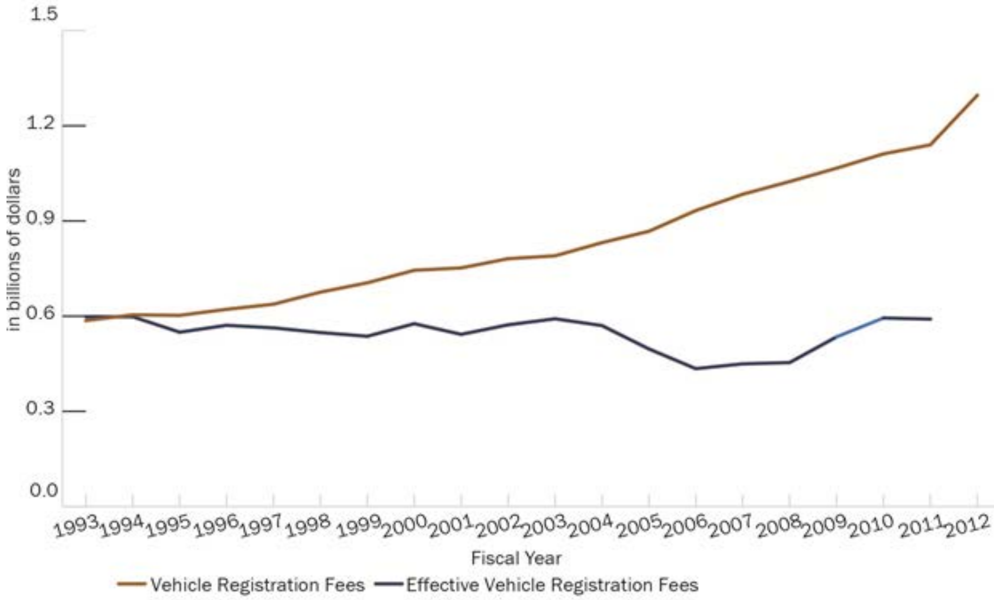
While TxDOT's allocation of SHF revenues is estimated at more than $8 billion annually, it is important to note that some of the allocated funds are committed to TxDOT agency operations and other ongoing projects and activities, and not available for current investment activities identified in the TTP. To better understand which SHF revenues can be used for future highway investment needs identified in the TTP, it is important to detail the funding categories utilized by TxDOT for internal programming (Exhibit 5-4).

Exhibit 5-2. Vehicle Registrations and Population Growth (1900-2011)



Source: USDOT. Highway Statistics.Texas Population Estimates. US Census. http://www.census.gov/

Exhibit 5-3. State Highway Fund Revenues Generated by Vehicle Registration Fees (1993-2012)



Source: TxDOT. TxDOT Funding:2013 Educational Series.
http://ftp.dot.state.tx.us/pub/txdot-info/sla/education_series/txdot_funding.pdf

Exhibit 5-4. Category Funding at a Glance

	Funding Category	Project Selection	State/Federal Share
1	Preventive Maintenance and Rehabilitation	Projects selected by districts. Commission allocates funds through Allocation Program.	Federal 90% State 10% or Federal 80% State 20% or State 100%
2	Metropolitan and Urban Area Corridor Projects	Projects selected by Metropolitan Planning Organizations (MPOs) in consultation with TxDOT. Commission allocates funds through Allocation Program.	Federal 80% State 20% or State 100%
3	NonTraditionally Funded Transportation Projects	Project selection varies based on the funding source, such as Proposition 12, Proposition 14, Pass-Through Toll Finance, Regional Toll Revenue and Local Participation.	Federal 80% State 20% or State 100% or Local 100% Varies by agreement and rules
4	Statewide Connectivity Corridor Projects	Projects selected by commission based on corridor ranking. Project total costs cannot exceed commission-approved statewide allocation.	Federal 80% State 20% or State 100%
5	Congestion Mitigation and Air Quality Improvement	Projects selected by MPOs in consultation with TxDOT and funded by districts' Allocation Program. Commission allocates funds based on population percentages within areas failing to meet air quality standards.	Federal 80% State 20% or Federal 80% Local 20% or Federal 90% State 10%
6	Bridges Federal Highway Bridge Program, Federal Railroad Grade Separation Program	Projects selected by the Bridge Division as a statewide program based on the Federal Highway Bridge Program and the Federal Railroad Grade Separation Program eligibility and ranking. Commission allocates funds through Statewide Allocation Program.	Federal 90% State 10% or Federal 80% State 20% or Federal 80% State 10% Local 10%
7	Metropolitan Mobility and Rehabilitation	Projects selected by MPOs in consultation with TxDOT. Funded by district's Allocation Program. Commission allocates funds according to the federal formula.	Federal 80% State 20% or Federal 80% Local 20% or State 100%

Exhibit 5-4. Category Funding at a Glance

	Funding Category	Project Selection	State/Federal Share
8	Safety Federal Highway Safety Improvement Program, Federal Railway-Highway Crossing Program, and the Safety Bond Program	Projects selected statewide by federally mandated safety indices and prioritized listing. Commission allocates funds through Statewide Allocation Program.	Federal 90% State 10% or Federal 90% Local 10% or State 100%
9	Transportation Alternatives Program (TAP)	Local entities/TxDOT nominate projects. FHWA/FTA determine eligibility. Eligible projects selected and approved by commission on a per-project basis.	Federal 80% State 20% or Federal 80% Local 20%
10	Supplemental Transportation Projects State Park Roads, Railroad Grade Crossing Replanking, Railroad Signal Maintenance, Landscape Incentive Awards, Green Ribbon Landscape Improvement, Curb Ramp Program, Coordinated Border Infrastructure Program, Comprehensive Development Agreements and Congressional High Priority Projects	Projects selected statewide by Traffic Operations Division or Texas Parks and Wildlife Department or district. Commission allocated funds to districts or approves participation in federal programs with allocation formulas. Coordinated Border Infrastructure Program funds are allocated to districts according to the federal formula.	State 100% or Federal 80% State 20% or Federal 100%
11	District Discretionary	Projects selected by TxDOT districts. Commission allocates funds through Allocation Program.	Federal 80% State 20% or Federal 80% Local 20% or State 100%
12	Strategic Priority	Commission selects projects which generally promote economic opportunity, increase efficiency on military deployment routes or to retain military assets in response to the federal military base realignment and closure report, or maintain the ability to respond to both man-made and natural emergencies. Also, the commission approves pass-through financing projects in order to help local communities address their transportation needs.	Federal 80% State 20% or State 100%

Exhibit 5-5 Highway Revenue Assumptions and Totals (2014 Constant Dollars)

Highway Revenues	Average Annual Budget (Billions)
TxDOT Project Letting	$3.1
Non-Letting (Highway Projects)	
Maintenance (routine and contracted maintenance for existing and new facilities)	$1.8
Preliminary Design/Construction Engineering	$0.5
ROW Acquisition	$0.1
Total Highway Revenues	**$5.5**

5.2 Revenues for Non-Highway Modes

Revenues for non-highway modes can be found in the modal plans and improvement programs listed in Chapter 2, Exhibit 2-2.

INVESTMENT SCENARIOS

As detailed in Chapters 4 and 5, Texas' multimodal transportation needs – estimated at $21 billion annually (2014 constant dollars) illustrated in Exhibit 4-12 – far outstrip the approximately $9.1 billion in average annual funding that is expected to be available to fund transportation improvements in the state through 2040. Based on the likelihood that sufficient funding will not be available to meet the identified needs across passenger and freight modes, various investment approaches were analyzed to determine and compare the likely performance outcomes of spending transportation dollars in different ways. These approaches, detailed in the sections that follow, were presented to the stakeholders and public during Outreach Round 2 to communicate the challenges involved in meeting multiple performance goals with limited funding and to collect input from the stakeholders and public on their preferences and values.

6.1 Illustrative Investment Approaches – Public Outreach

To help inform stakeholders and the public how to spend limited resources, various example approaches were developed and analyzed to determine long-range performance impacts and evaluate tradeoffs. Each approach was designed to advance the performance of the transportation system in a targeted way. The underlying assumptions (e.g., what is versus is not included), estimated cost of implementation, and anticipated performance impacts for each approach were presented to the stakeholders and public during Outreach Round 2 via the MetroQuest tool. As described in further detail in Section 2.3.3.3, users were asked to rate the approaches based on their values and priorities.

The following sections provide detailed descriptions of Approaches 1–3 as they were considered in the analysis and presented to the public and stakeholders. Approach 4 was not presented during Outreach Round 2 but was instead created to reflect input obtained from the interactive tool during outreach. While initially based on the $9 billion in transportation funding that is expected to be available each year, Approach 4 examines what could happen if an additional $5 billion (totaling $14 billion) was available to fund transportation improvements in the state. In all cases, performance outcomes are presented on a scale of "high-medium-low," which corresponds to a "good-fair-poor" condition or operating state for the measure being analyzed:

- **Low performance thresholds** represent poor conditions and can be characterized as system conditions that are worse than today – for example, significant wear and tear on infrastructure and transit assets and worsening congestion or gridlock.
- **Medium performance thresholds** represent fair conditions. Infrastructure assets in fair condition represent conditions worse than today. Fair/medium mobility conditions represent congestion levels similar to those experienced today.
- **High performance thresholds** represent ideal conditions. This includes achieving state of good repair (SGR) for infrastructure and transit assets and congestion levels that are better than those experienced today.

6.1.1 Approach 1 – System Preservation

Approach 1 is focused on investing in the existing statewide transportation system to achieve a SGR for highway, bridge, Intelligent Transportation System (ITS), and transit assets. In this approach, deficient assets with respect to condition or performance (e.g., functional obsolescence) are prioritized and addressed. The total cost of Approach 1 is $230 billion (2014 constant dollars) through 2040 (Exhibit 6-1).

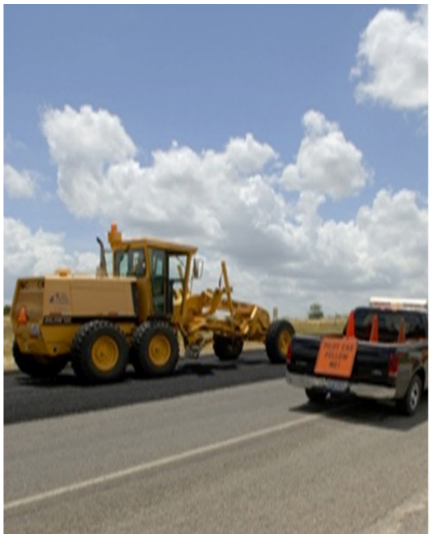
Exhibit 6-1. Approach 1 – Investments and Costs

Investment Area	Approach 1 – Performance Goals	Cost to Achieve (Billions in 2014 Constant Dollars)
Pavement	Achieve and maintain SGR for existing state-owned highways with proactive maintenance and capital reinvestment	$108
Bridge/Culvert	Achieve and maintain SGR for existing state-owned bridges and culverts with proactive maintenance and capital reinvestment	$42
ITS	Maintain SGR for existing assets	$2
Highway Capacity	Allow congestion to worsen	$0
Transit	Achieve and maintain SGR for existing assets and existing service levels	$73
Safety/Other	Address any additional statewide safety needs	$5
Total Estimated Cost		**$230**

Exhibit 6-2 shows the performance outcomes at the end of the Texas Transportation Plan (TTP) horizon (25 years) for each measure analyzed if $230 billion were invested as noted in Exhibit 6-1. Exhibit 6-3 as presented to the public in Outreach Round 2 shows that pavements and bridges as well as transit assets will be in excellent condition at the end of the TTP horizon if Approach 1 were followed. More specific outcomes of Approach 1:

- Bridges would be kept in good condition, remaining structurally sound and open for use.
- State roadways would be generally pothole free and support a smooth ride.
- Buses, trains, and associated facilities in the state would be comfortable and reliable.
- With current transit service levels maintained, ridership as a percentage of the total population would decrease since new service would not be provided.
- Congestion in all areas of the state would be worse than today.
- Preserving our system would create a minimal number of new jobs.
- Safety is TxDOT's number one priority and all statewide safety concerns would be addressed.

State legislation requires the identification of priority corridors and projects in the state that are of particular concern in meeting goals and objectives of the TTP. Approach 1 is focused largely on the TTP goals of asset management, safety, and



stewardship, using resources to make cost-beneficial investments to achieve SGR for highway, bridge, and transit assets. This approach does not attempt to reduce or manage congestion statewide; and does not improve mobility, connectivity, and freight movements. Statewide mobility would be reduced given the lack of investment in highway expansion and multimodal alternatives.

Exhibit 6-2. Investment Approach 1 – Performance Outcomes

Investment Area	Performance Measure	State of Repair
Bicycle and Pedestrian	% Bicycle and Pedestrian Needs Met	High
NonHighway Freight	% Non-Highway Freight Needs Met	Low
Mobility and Congestion Reduction	Rural LOS	Low
	Urban LOS	Low
Pavements on the National Highway System (NHS)	% NHS Pavement Lane-Miles in "Good" Condition (by IRI)	High
	% NHS Pavement Lane-Miles in "Good" or "Better" Condition (by Condition Score)	High
NonNHS Pavements	% NonNHS Pavement Lane-Miles in "Good" Condition (by IRI)	High
	% NonNHS Pavement Lane-Miles in "Good" or "Better" Condition (by Condition Score)	High
Bridges on the NHS	% Structurally Deficient NHS Bridges	High
	Count Structurally Deficient NHS Bridges	High
NonNHS Bridges	% Structurally Deficient NonNHS Bridges	High
	Count Structurally Deficient NonNHS Bridges	High
MTA Transit	% of MTA Assets in SGR	Low
	Additional MTA Annual Riders	High
NonMTA Transit	% of NonMTA Assets in SGR	Low
	Additional NonMTA Annual Riders	High
Passenger Rail	% Passenger Rail Needs Met	Low
ITS	% ITS Needs Met	Low
NPIAS Aviation	NPIAS Project Backlog	Medium
NonNPIAS Aviation	NonNPIAS Project Backlog	High

TxDOT is also analyzing the impacts of each proposed investment approach on "Ladders of Opportunity," or connectivity gaps in access to essential services. Essential services include housing, employment, health care, schools (education), and recreation. In the case of Investment Approach 1, the transportation system's connectivity to essential services would not be improved. Investment Approaches 2 and 3 provide investment scenarios to address gaps.

6.1.2 Approach 2 – Metropolitan Mobility

Approach 2 is focused on addressing congestion in highly populated areas of the state through strategic capacity enhancements, operational improvements, and investments in multimodal facilities. System reliability is addressed by enhancing transit alternatives in fastest-growing areas and "collar" regions, which are the suburban growth areas outside or large metropolitan areas. Highway/bridge preservation dollars in this approach are focused on the Interstate system. The total cost of Approach 2 is $475 billion (2014 constant dollars) through 2040 (Exhibit 6-4).

Exhibit 6-3. Investment Approach 1 – Impacts on Long-Range Goals

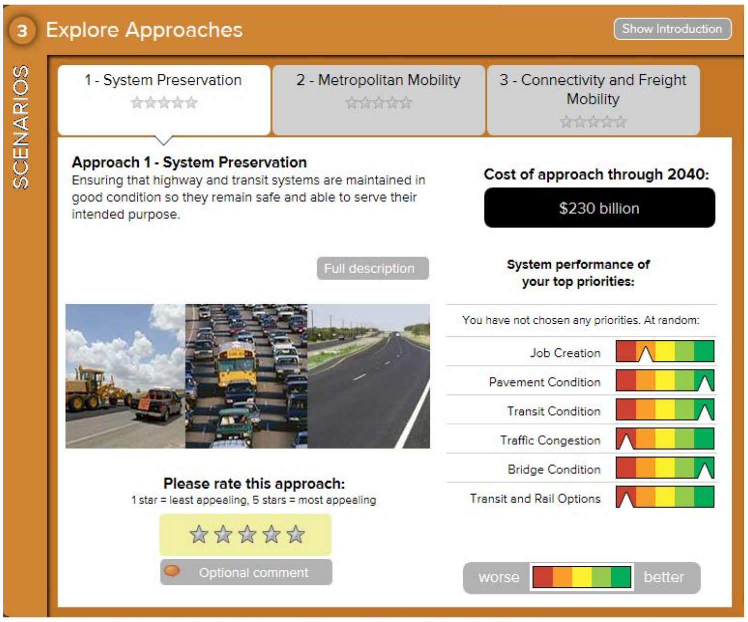
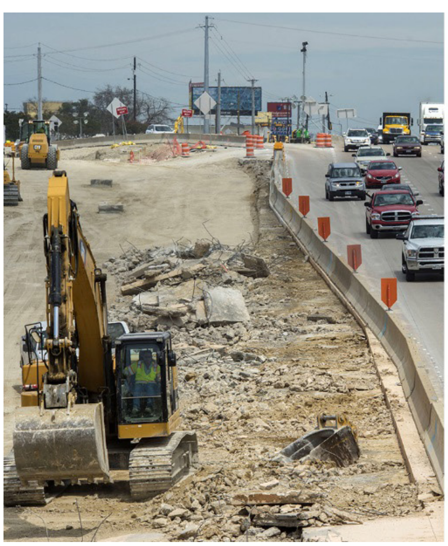


Exhibit 6-4. Approach 2 – Investments and Costs

Investment Area	Approach 2 – Performance Goals	Cost to Achieve (Billions in 2014 Constant Dollars)
Pavement	Achieve and maintain SGR for the Interstate system with proactive maintenance and capital reinvestment	$83
Bridge/Culvert	Achieve and maintain state of fair repair for existing state-owned bridges and culverts with proactive maintenance and capital reinvestment; achieve SGR on Interstate system	$39
ITS	Maintain SGR for existing assets and deploy new ITS in metropolitan areas	$14
Highway Capacity	Ensure LOS D or better in metropolitan areas	$235
Transit	Achieve and maintain SGR for existing and new assets in metro areas; expand beyond existing service levels	$96
Safety/Other	Address any additional safety needs as well as bike and pedestrian needs statewide	$8
Total Estimated Cost		**$475**

Exhibit 6-5 shows the performance outcomes at the end of the TTP horizon (25 years) for each measure analyzed if $475 billion were invested as noted in Exhibit 64. Exhibit 66 – as presented to the public in Outreach Round 2 – shows that Approach 2, while costing more than twice as much as Approach 1, would only maintain current congestion levels and would not meet SGR for all infrastructure assets in the state. More specific outcomes of Approach 2:

- Bridges on the interstate system and other major roads would be kept in good condition, with some signs of aging. The condition of bridges on other roadways would deteriorate further with only routine maintenance applied.
- Pavement on the interstate system and other major roads would be kept in fair condition with some potholes and cracking evident. Pavement on other roads would show significant wear and tear with only routine maintenance applied.
- Buses, trains, and associated facilities in urban areas would be kept in good condition, while the condition of those assets in rural areas will deteriorate with only basic maintenance applied.
- Transit and rail ridership in urban regions of the state would increase as transit services are enhanced to accommodate population growth and expanded to reach previously underserved areas. Current ridership trends are assumed to remain the same for rural areas. Additional bike and pedestrian enhancements are provided in urban areas. Additional “Ladders of Opportunity” for access to essential services would be provided in urban areas of the state.
- Congestion in urban areas would be the same as it is today despite high population growth; reducing congestion in metropolitan areas would increase access and support urban job growth.
- Safety is TxDOT’s number one priority and all statewide safety concerns would be addressed.



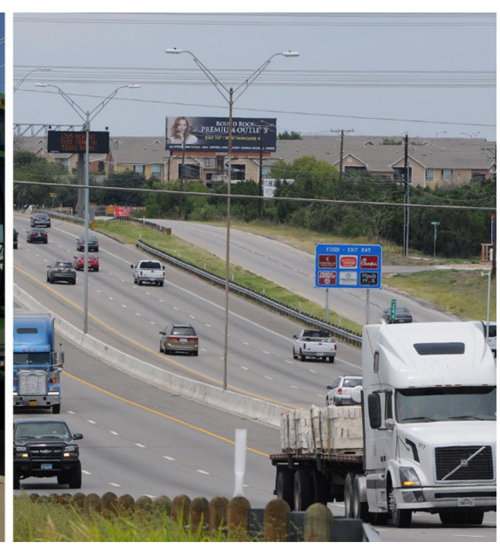


Exhibit 6-5. Investment Approach 2 – Performance Outcomes

Investment Area	Performance Measure	State of Repair
Bicycle and Pedestrian	% Bicycle and Pedestrian Needs Met	High
Non-Highway Freight	% Non-Highway Freight Needs Met	Low
Mobility and Congestion Reduction	Rural LOS	Low
	Urban LOS	High
Pavements on the National Highway System (NHS)	% NHS Pavement Lane-Miles in "Good" Condition (by IRI)	Low
	% NHS Pavement Lane-Miles in "Good" or "Better" Condition (by Condition Score)	Low
Non-NHS Pavements	% Non-NHS Pavement Lane-Miles in "Good" Condition (by IRI)	Low
	% Non-NHS Pavement Lane-Miles in "Good" or "Better" Condition (by Condition Score)	Low
Bridges on the NHS	% Structurally Deficient NHS Bridges	Low
	Count Structurally Deficient NHS Bridges	Low
Non-NHS Bridges	% Structurally Deficient Non-NHS Bridges	High
	Count Structurally Deficient Non-NHS Bridges	High
MTA Transit	% of MTA Assets in SGR	High
	Additional MTA Annual Riders	High
Non-MTA Transit	% of Non-MTA Assets in SGR	High
	Additional Non-MTA Annual Riders	High
Passenger Rail	% Passenger Rail Needs Met	Low
ITS	% ITS Needs Met	High
NPIAS Aviation	NPIAS Project Backlog	Medium
Non-NPIAS Aviation	Non-NPIAS Project Backlog	Low

6.1.3 Approach 3 – Connectivity and Freight Mobility

Approach 3 is focused on supporting the efficient movement of goods and services to create jobs and sustain a vibrant and growing economy. This approach is largely focused on rural investments, and includes improving interregional connectivity along the primary and secondary freight network, adding intercity passenger rail between major state and economic activity centers (Oklahoma to south Texas and Dallas-Fort Worth to Houston), and increasing the accessibility of rural residents to goods and services. The total cost of Approach 3 is $460 billion (2014 constant dollars) through 2040 (Exhibit 6-7).

Exhibit 6-6. Investment Approach 2 – Impacts on Long-Range Goals

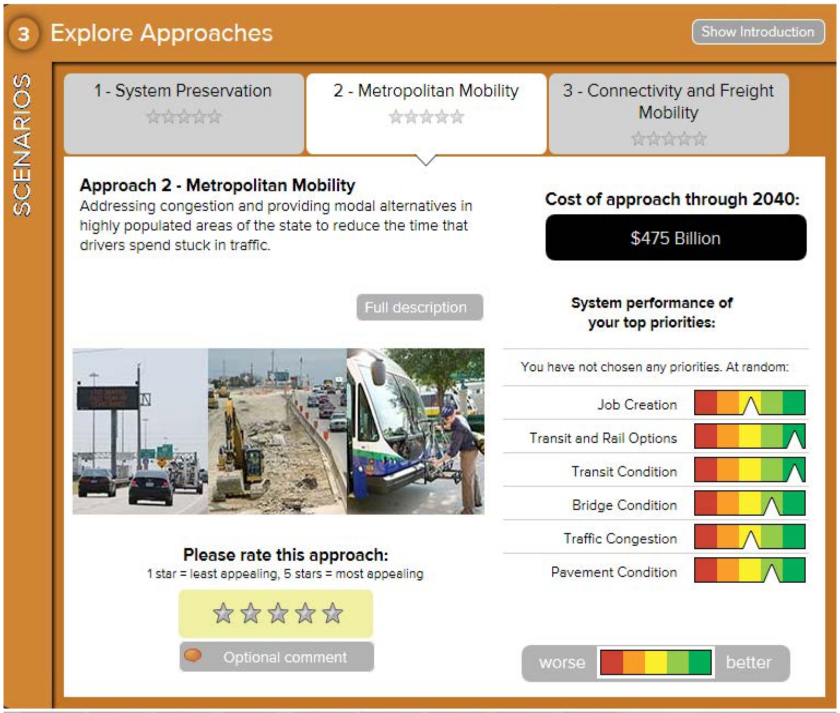
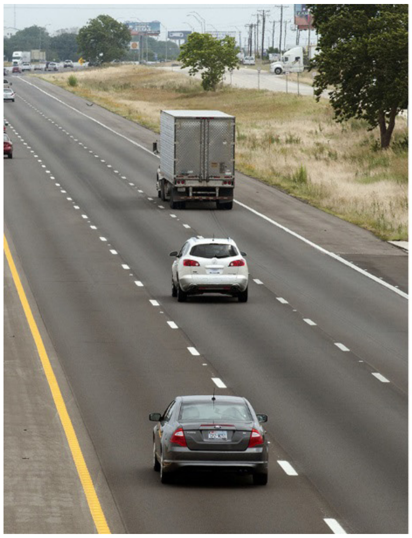


Exhibit 6-7. Approach 3 – Investments and Costs

Investment Area	Approach 3 – Performance Goals	Cost to Achieve (Billions in 2014 Constant Dollars)
Pavement	Achieve and maintain SGR for the Primary Freight Network with proactive maintenance and capital reinvestment	$93
Bridge/Culvert	Achieve and maintain state of fair repair for existing state-owned bridges and culverts with proactive maintenance and capital reinvestment; achieve SGR on Primary Freight Network	$36
ITS	Maintain SGR for existing assets	$2
Highway Capacity	Eliminate freight bottlenecks (LOS C or better on Primary Freight Network)	$246
Transit	Achieve and maintain SGR for existing and new assets in rural areas; expand beyond existing service levels and add intercity passenger rail	$74
Safety/Other	Address any additional safety needs as well as bike and pedestrian needs statewide and Primary Freight Network rumble strips	$9
Total Estimated Cost		**$460**

Exhibit 6-8 shows the performance outcomes at the end of the TTP horizon (25 years) for each measure analyzed if $460 billion were invested as noted in Exhibit 67. Exhibit 69 was presented to the public in Outreach Round 2. Due to the focus of Approach 3 on rural connectivity and freight mobility, congestion at a state level and specifically on the Primary Freight Network – as identified in the TFMP – would be similar to or improved from today's levels, though congestion in metropolitan areas would become worse. More specific outcomes of Approach 3:

- Bridges located along roadways with significant freight traffic would be maintained in good condition, with some signs of aging. The condition of bridges on other roadways would deteriorate further with only routine maintenance applied.
- Pavement on roadways that support significant freight traffic would be kept in fair condition with some potholes and cracking evident. Pavement on other roadways would show significant wear and tear with only routine maintenance applied.
- Buses, trains and associated facilities in rural areas would be maintained in good condition and enhanced to accommodate rural needs. The condition of assets in urban areas would deteriorate with only basic maintenance applied. Additional "Ladders of Opportunity" for access to essential services would be provided within and between areas of the state.
- Transit and passenger rail ridership would increase for transit and passenger rail in rural areas as more accessible and convenient travel options are provided in these regions as well as intercity rail between major metropolitan areas. Current ridership trends would persist for urban areas. Additional bicycle and pedestrian enhancements would be provided in rural areas.



- Reducing travel delays for freight traffic would reduce the cost of moving goods, support the state's growing economy, and create jobs.
- Safety is TxDOT's number one priority and all statewide safety concerns are addressed.

Exhibit 6-8. Investment Approach 3 – Performance Outcomes

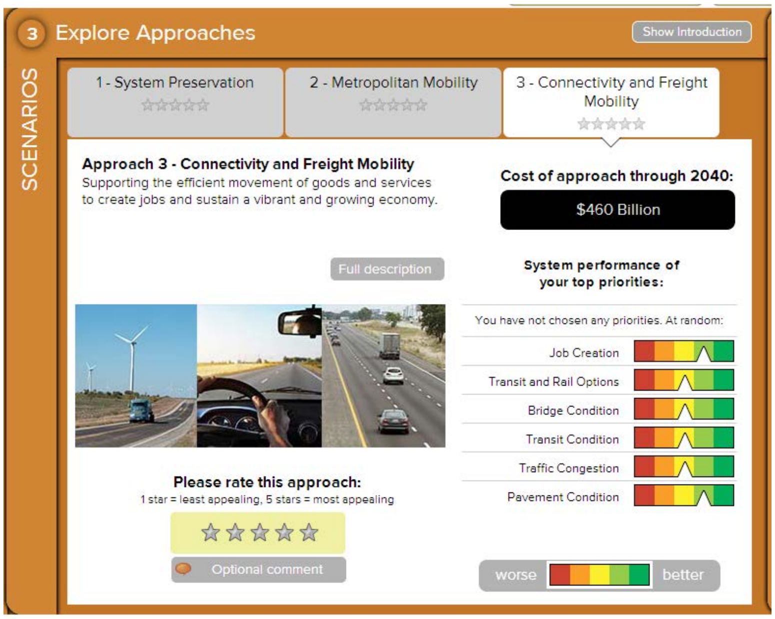
Investment Area	Performance Measure	State of Repair
Bicycle and Pedestrian	% Bicycle and Pedestrian Needs Met	Low
Non-Highway Freight	% Non-Highway Freight Needs Met	Low
Mobility and Congestion Reduction	Rural LOS	Low
	Urban LOS	High
Pavements on the National Highway System (NHS)	% NHS Pavement Lane Miles in "Good" Condition (by IRI)	Low
	% NHS Pavement Lane Miles in "Good" or "Better" Condition (by Condition Score)	Low
Non-NHS Pavements	% Non-NHS Pavement Lane Miles in "Good" Condition (by IRI)	Low
	% Non-NHS Pavement Lane Miles in "Good" or "Better" Condition (by Condition Score)	Low
Bridges on the NHS	% Structurally Deficient NHS Bridges	Low
	Count Structurally Deficient NHS Bridges	Low
Non-NHS Bridges	% Structurally Deficient Non-NHS Bridges	High
	Count Structurally Deficient Non-NHS Bridges	High
MTA Transit	% of MTA Assets in SGR	Low
	Additional MTA Annual Riders	High
Non-MTA Transit	% of Non-MTA Assets in SGR	High
	Additional Non-MTA Annual Riders	High
Passenger Rail	% Passenger Rail Needs Met	Low
ITS	% ITS Needs Met	Low
NPIAS Aviation	NPIAS Project Backlog	Medium
Non-NPIAS Aviation	Non-NPIAS Project Backlog	High

6.1.4 Approach 4 – Balanced

The total revenues available through 2040 for all transportation modes in the state are likely adequate to achieve a preservation-focused strategy; however, as previously noted, many of these funds are committed to agency operations and other projects. Because of these constraints, TxDOT has estimated that an additional $5 billion in revenues is needed each year to maintain current system conditions. As can be seen from Approaches 2 and 3, the amount needed to even "move the needle" on expansion needs in the state is significantly higher.

Approach 4 represents a balanced approach informed by stakeholder and public input obtained during TTP Outreach Round 2. Approach 4 was evaluated for the TTP to show the performance outcomes associated with investments under the state's 2014 revenue forecast ($9 billion per year) assuming an additional $5 billion becomes available each year to fund multimodal improvements ($14 billion total annually). Unlike Approaches 1 through 3, Approach

Exhibit 6-9. Investment Approach 3 – Impacts on Long-Range Goals



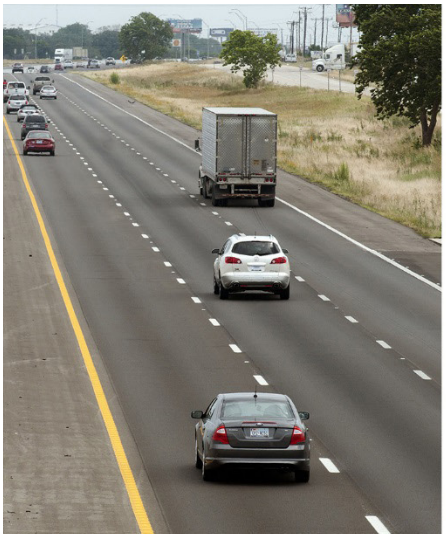
4 is not performance-based in that it is not designed to meet specific performance goals for the system; rather, it is shown to understand expected outcomes if the state continues to invest the $9 billion similarly across investment categories, and spends an additional $5 billion across investment categories as allocated by stakeholders and the public using MetroQuest (Exhibit 6-10).

Exhibit 6-10. Approach 4 – Investment Allocations

Investment Area	Cost to Achieve (Billions in 2014 Constant Dollars)
Pavement	$100
Bridge/Culvert	$40
ITS	$12.5
Highway Capacity	$75
Transit	$97.5
Additional Safety Needs	$10
NonHighway Freight	$12.5
Bicycle/Pedestrian	$2.5
Total Estimated Cost	**$350**

Exhibit 6-11 shows the performance outcomes at the end of the TTP horizon (25 years) for each measure analyzed if $14 billion annually or $350 billion total was invested as noted in Exhibit 6-10. Specific outcomes of Approach 4:

- Bridges and pavements on the Interstate system and other major roads would be kept in good condition, with some signs of aging. The condition of bridges on other roadways would deteriorate further with only routine maintenance applied.
- Buses, trains, and associated facilities in both urban and rural areas would be kept in good condition.
- Bicycle and pedestrian enhancements are provided in rural and urban areas.
- Intercity passenger rail is not funded.
- Non-highway freight needs are being developed as part of the TFMP, and were not available to evaluate against the allocated amount. Highway freight needs are incorporated into the general highway, bridge and expansion needs.
- Transit and rail ridership in urban regions of the state would increase as transit services are enhanced to accommodate population growth and expanded to reach previously underserved areas. Current ridership trends are assumed to remain the same for rural areas.
- Congestion in urban areas would be worse than it is today; however, strategic mobility enhancements and operations strategies would be funded.
- Safety is TxDOT's number one priority and all statewide safety concerns would be addressed.



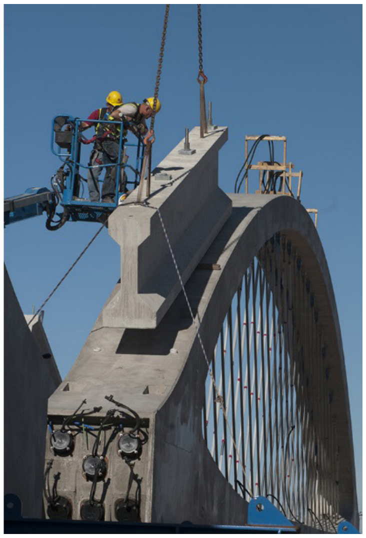


Exhibit 6-11. Investment Approach 4 – Performance Outcomes

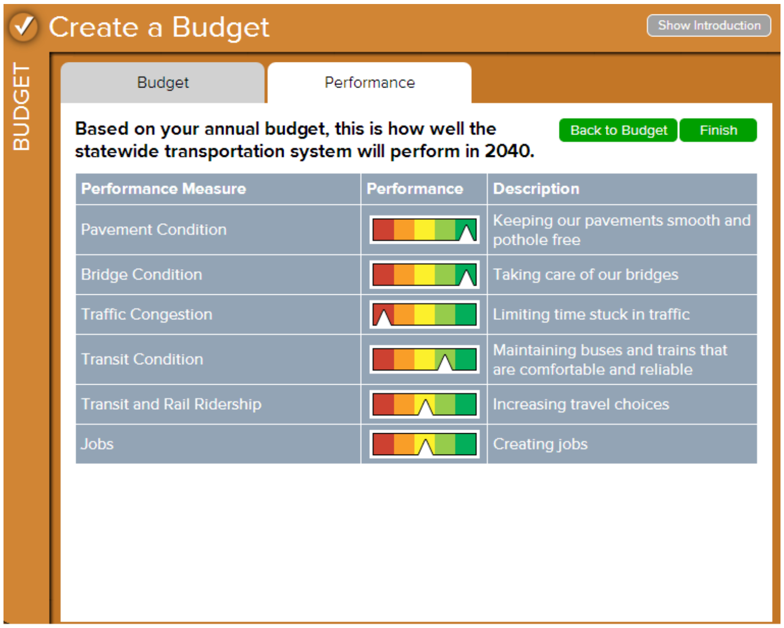
Investment Area	Performance Measure	State of Repair
Bicycle and Pedestrian	% Bicycle and Pedestrian Needs Met	High
NonHighway Freight	% Non-Highway Freight Needs Met	High
Mobility and Congestion Reduction	Rural LOS	Low
	Urban LOS	Low
Pavements on the National Highway System (NHS)	% NHS Pavement Lane-Miles in “Good” Condition (by IRI)	High
	% NHS Pavement Lane-Miles in “Good” or “Better” Condition (by Condition Score)	High
Non-NHS Pavements	% Non-NHS Pavement Lane-Miles in “Good” Condition (by IRI)	Medium
	% Non-NHS Pavement Lane-Miles in “Good” or “Better” Condition (by Condition Score)	High
Bridges on the NHS	% Structurally Deficient NHS Bridges	High
	Count Structurally Deficient NHS Bridges	High
Non-NHS Bridges	% Structurally Deficient Non-NHS Bridges	High
	Count Structurally Deficient NonNHS Bridges	High
MTA Transit	% of MTA Assets in SGR	High
	Additional MTA Annual Riders	High
Non-MTA Transit	% of Non-MTA Assets in SGR	High
	Additional Non-MTA Annual Riders	High
Passenger Rail	% Passenger Rail Needs Met	Low
ITS	% ITS Needs Met	High
NPIAS Aviation	NPIAS Project Backlog	Medium
Non-NPIAS Aviation	Non-NPIAS Project Backlog	High

As previously noted, Approach 4 was not presented to the stakeholders and public during Outreach Round 2; the development of Approach 4 was informed by inputs gathered during outreach via a budgeting exercise in the MetroQuest tool. With respect to the activity, $14 billion in annual funding was to be allocated amongst various investment categories subject to the following constraints:

- **Highway/Bridge** – A total annual budget of $5.5 billion was estimated and pre-allocated assuming a 40 percent/60 percent split between highway preservation (bridge and pavement condition) and expansion. It is important to note that this amount will likely degrade significantly over the TTP horizon given the uncertainty in federal funds and diminishing state and federal gas tax revenues unless alternative revenue sources/collection methods are addressed. This estimate is greater than the UTP total budget because it includes major and minor maintenance, ROW, and preliminary engineering.
- **Transit** – A total annual budget of $3.5 billion was estimated and pre-allocated; this estimate includes MTA and small urban/rural funds as well as funds that “pass through” TxDOT.
- The remaining $5 billion of unrestricted “new” money could be allocated by the user in a manner reflective of his/her priorities.

Users could visualize the impact of their spending decisions in real-time via a “dashboard” that indicated the performance of each measure on a red to green color scale (Exhibit 6-12).

Exhibit 6-12. Investment Approach 4 – Impacts on Long-Range Goals



6.2 Approach Comparison

Four distinct examples of investment approaches were evaluated as part of Outreach Round 2 for the TTP, in consideration of forecasted revenue and the potential for future capital investment. Exhibit 6-15 provides a comparison of all approaches.

It is important to note that these approaches do not represent a discrete choice for Texas; rather, they represent the difficult decisions and tradeoffs that will need to be considered to support Texas' transportation and economic future. Approach 4 also assumed an additional $5 billion that TxDOT needs, but does not have, to be allocated by investment area according to a stakeholder's preference. Tradeoffs between system preservation and mobility will need to be considered during the performance target setting and resource allocation process.

Exhibit 6-15. MetroQuest Outreach Investment Approach Summary

Investment Area	Performance Measure	Approach 1: System Preservation ($230 Billion)	Approach 2: Metropolitan Mobility ($475 Billion)	Approach 3: Connectivity & Freight Mobility ($460 Billion)	Approach 4: Balanced Approach ($350 Billion)
Bicycle and Pedestrian	% Bicycle and Pedestrian Needs Met	High	High	Low	High
NonHighway Freight	% Non-Highway Freight Needs Met	Low	Low	Low	High
Mobility and Congestion Reduction	Rural LOS	Low	Low	Low	Low
	Urban LOS	Low	High	High	Low
Pavements on the National Highway System (NHS)	% NHS Pavement Lane-Miles in "Good" Condition (by IRI)	High	Low	Low	High
	% NHS Pavement Lane-Miles in "Good" or "Better" Condition (by Condition Score)	High	Low	Low	High
Non-NHS Pavements	% Non-NHS Pavement Lane-Miles in "Good" Condition (by IRI)	High	Low	Low	Medium
	% Non-NHS Pavement Lane-Miles in "Good" or "Better" Condition (by Condition Score)	High	Low	Low	High
Bridges on the NHS	% Structurally Deficient NHS Bridges	High	Low	Low	High
	Count Structurally Deficient NHS Bridges	High	Low	Low	High
Non-NHS Bridges	% Structurally Deficient Non-NHS Bridges	High	High	High	High
	Count Structurally Deficient Non-NHS Bridges	High	High	High	High
MTA Transit	% of MTA Assets in SGR	Low	High	Low	High
	Additional MTA Annual Riders	High	High	High	High
Non-MTA Transit	% of Non-MTA Assets in SGR	Low	High	High	High
	Additional Non-MTA Annual Riders	High	High	High	High
Passenger Rail	% Passenger Rail Needs Met	Low	Low	Low	Low
ITS	% ITS Needs Met	Low	High	Low	High
NPIAS Aviation	NPIAS Project Backlog	Medium	Medium	Medium	Medium
Non-NPIAS Aviation	Non-NPIAS Project Backlog	High	Low	High	High

6.3 Investment Approaches – State of Good Repair

Since the development of the approach scenarios for Outreach Round 2, TxDOT has developed an updated revenue forecast that reflects additional revenue for fiscal year 2015. Because Approaches 1 through 4 were based on previously forecasted revenues plus an additional $5 billion that was proposed (i.e., the source unidentified), TxDOT developed five additional investment strategies by incorporating updated TxDOT revenue forecasts, passage of Proposition 1, and MAP-21 language to reflect more realistic investment allocations of reasonably available revenues.

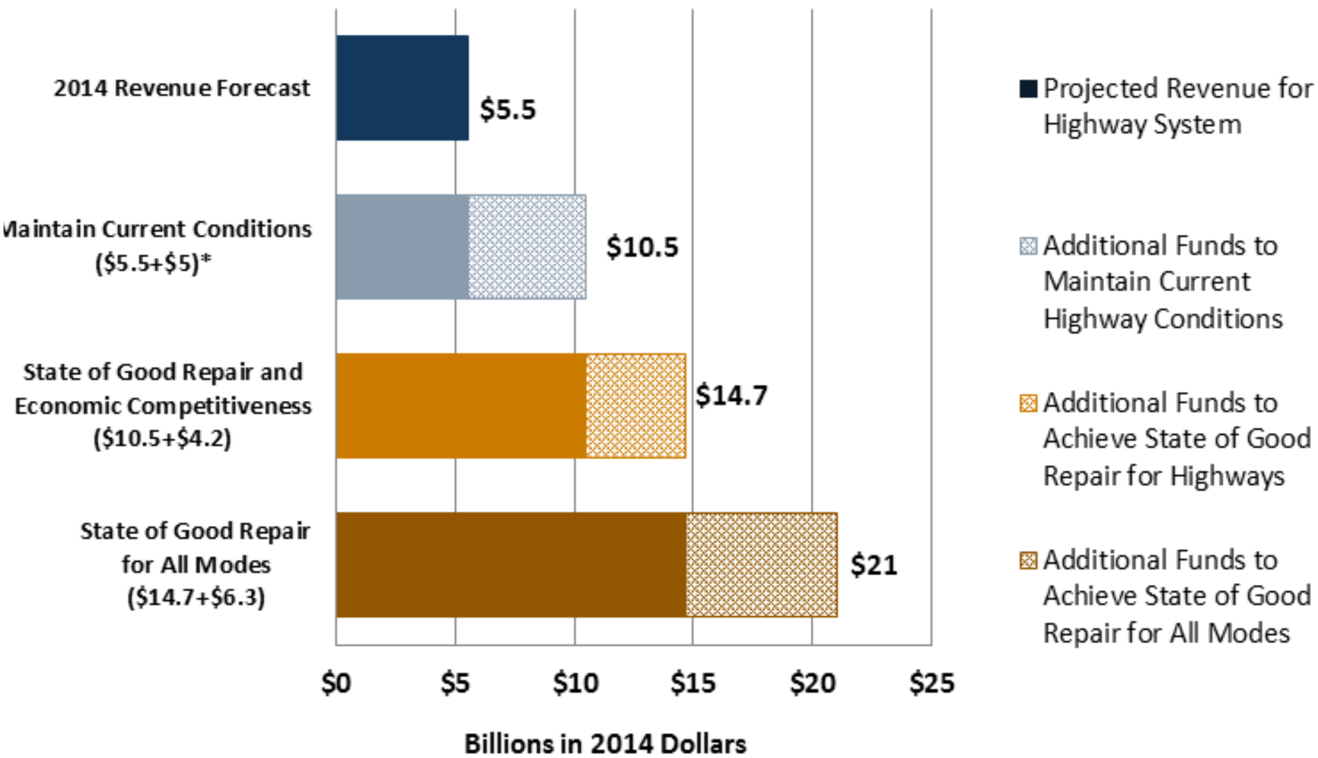
Although the language and definitions used to explain performance measures and approach summaries were simplified for the public, the same tool and methodology was used to analyze the additional investments using updated revenue numbers.

The additional investment strategies in Exhibit 6-16 illustrate a comparison of varying revenue forecasts for 2040 in billions of 2014 dollars.

Exhibit 6-16 summarizes the methodology used for determining SGR for various highway and non-highway modes of transportation in the state. Based on these criteria, needs were projected to meet SGR definitions and costs were calculated by mode through year 2040.

A comprehensive statewide analysis of transportation demand to capacity across various modes identified baseline performance levels to maintain the system in SGR as is required by MAP-21. SGR generally considers asset condition, service life, and operational effectiveness. The results of this analysis are presented in the graph following in Exhibit 6-17, which incrementally accounts for transportation revenue needs required to address various levels of system performance, up to and including achieving SGR for all modes.

Exhibit 6-16. Average Annual Revenue Needs for System Performance (2014-2040)



*Some current conditions may be maintained by Proposition 1 ($1.74 B in FY15), but future funding levels through Proposition 1 are uncertain

Funding levels represent 2014 dollars and transportation system conditions and may increase due to inflation and changes in system condition.

*Exhibit 6-17. State of Good Repair Needs (Unconstrained) to 2040 by Mode**

Mode	SGR Definition	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 statewide 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 (Metropolitan Transit Authority (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

6.3.1 Performance Summary

Exhibit 6-18 illustrates system performance for each of the funding levels in Exhibit 6-16. At current reasonably expected revenues, "good" condition can be achieved for existing highway (bridge and pavement) infrastructure; however, this could occur only by shifting all highway expansion dollars to preventive maintenance and capital rehabilitation activities for existing assets. The system performance for each funding level described by the following conditions:

- Poor –signs of significant wear, tear, and deterioration of the performance measures
- Fair – signs of some aging is evident and reduced function of the performance measure
- Good – a state of good repair of the performance measure

Exhibit 6-18. Additional Investment Approach Summary

Investment Area	Performance Measure	Current Hwy Forecast ($5.5 B/yr)	Current Hwy + $5 B ($10.5 B/yr)	SGR Hwy ($14.7 B/yr)	SGR All Modes ($21 B/yr)
National Highway System (NHS) Pavements	% NHS Pavement Lane-Miles in a State of Good Repair (by IRI)	Poor	Good	Good	Good
	% NHS Pavement Lane-Miles in a State of Good Repair (by Condition Score)	Poor	Good	Good	Good
Non-NHS Pavements	% Non-NHS Pavement Lane-Miles in a State of Good Repair (by IRI)	Poor	Poor	Good	Good
	% Non-NHS Pavement Lane-Miles in a State of Good Repair (by Condition Score)	Poor	Poor	Good	Good
NHS Bridges	% Structurally Deficient NHS Bridges	Good	Good	Good	Good
	Count Structurally Deficient NHS Bridges	Fair	Good	Good	Good
Non-NHS Bridges	% Structurally Deficient Non-NHS Bridges (on State System)	Good	Good	Good	Good
	Count Structurally Deficient Non-NHS Bridges (on State System)	Fair	Good	Good	Good
Mobility and Congestion Reduction	Rural Level of Service	Poor	Fair	Good	Good
	Urban Level of Service	Poor	Poor	Good	Good
MTA Transit	% of MTA Assets in SGR				Good
	Additional MTA Annual Riders				Good
Non-MTA Transit	% of Non-MTA Assets in SGR				Good
	Additional Non-MTA Annual Riders				Good
Passenger Rail	% Passenger Rail Needs Met				Good
Non-Highway Freight	% Non-Highway Freight Needs Met				Good
ITS	% ITS Needs Met				Good
NPIAS Aviation	NPIAS Project Backlog				Good
Non-NPIAS Aviation	Non-NPIAS Project Backlog				Good
Bicycle and Pedestrian	% Bicycle and Pedestrian Needs Met				Good

TRANSPORTATION SAFETY AND SECURITY

Safety and security are high priorities for TxDOT. Throughout the Texas Transportation Plan (TTP) planning process, TxDOT, stakeholders and the public have consistently listed safety as the most important concern for the state. Safety and security needs are captured in the TTP through the modal needs assessments; a separate needs assessment was not done specifically for safety- or security-related projects. The following sections provide a summary of current planning documents related to safety and security and explains the rationale behind the inclusion of the safety and security goal areas and performance measures that have been included in the TTP.

7.1 Transportation Safety Planning

Moving Ahead for Progress in the 21st Century (MAP-21) Act establishes seven national performance goals for the federal highway program, one of which is to achieve a significant reduction in traffic fatalities and serious injuries on all public roads. MAP-21 planning rules call for consideration of eight planning factors, one of which is to increase the safety of the transportation system for motorized and non-motorized users.

7.1.1 Safety Plans

TxDOT's previous statewide plan – the Statewide Long-Range Transportation Plan (SLRTP) 2035, Section 6 – addressed transportation safety and security. It provided a brief description of TxDOT responsibilities in administering federal and state grant programs to improve safety on various modes of the transportation systems in Texas. The SLRTP 2035 also listed information on safety programs for bicycle and pedestrian, public transportation, freight rail, airport, waterways, pipeline, water ports, and border ports of entry.

TxDOT continues to incorporate safety considerations in all planning documents and has developed the following plans that specifically address transportation safety and security: the Texas Strategic Highway Safety Plan (SHSP), the Texas Highway Safety Plan (HSP) and the Texas Strategic Action Plan for Motorcycles 2013–2018. In addition, metropolitan planning organizations (MPOs) across the state have incorporated safety considerations into the long-range transportation planning processes and plans.

- Texas Strategic Highway Safety Plan. The Texas SHSP was first produced in 2006, establishing statewide goals, objectives, and key emphasis areas for transportation safety and identifying key safety needs for guiding investment decisions to reduce fatalities and serious injuries on all public roads. A progress report is produced annually for the SHSP and discusses whether goals and objectives are being met while identifying countermeasures and programs that could be considered to help meet statewide safety goals. The Texas SHSP was updated in 2014.

- Texas Highway Safety Plan. The Texas HSP identifies goals, strategies, performance measures and objectives Texas has set for improving the behavioral safety performance of the roadway system. The plan also lists other programs goals for each of the Texas Traffic Safety Program's areas, specifies the strategies employed to accomplish the goals, and reports the status of the performance measures based on the most current data. The HSP was updated in 2014.
- Texas Strategic Action Plan for Motorcycles 2013–2018. Motorcycle deaths in Texas increased by 10 percent in 2011 and accounted for 16 percent of total traffic fatalities in 2011. To reduce the rate of motorcycle crashes per registered motorcycle and reduce the rate of fatal and severe motorcycle injuries, TxDOT and the Texas A&M Transportation Institute developed the Texas Strategic Action Plan for Motorcycles 2013–2018 (published June 2013). The plan is organized under 13 key focus areas. For each area, the plan identifies several initiatives and action steps, prioritized by motorcycle safety experts.

These plans and others are further described in *Technical Memorandum 11: Safety and Security*. Complete versions of the plans can be found on TxDOT's website (http://www.txdot.gov/).

7.1.2 Existing Safety Plans – Emphasis Areas

There are common characteristics and general patterns among the transportation safety documents and plans from different state departments and local jurisdictions. Generally, emphasis areas are identified for transportation safety planning are developed using historic crash data, roadway network characteristics, federal and state policies on transportation safety management, and other relevant information. The most common emphasis areas are:

- Motorcyclist, bicyclist, and pedestrian safety;
- Drivers under the influence (DUI);
- Speeding;
- Aggressive or distracted driving;
- Seatbelt usage; and
- Child safety and safety seats.

The State of Texas has developed a data-driven process for identifying the emphasis areas and setting the targets on transportation safety performance. To meet the goals and performance measures that the state set for transportation safety, the following issues have been identified as ones that should be addressed.

- Safety planning documents or guidance for non-motorized users of the roadway system such as pedestrians and bicyclists.
- Safety planning at the local level should be emphasized. Though many Texas MPOs include transportation safety as an integral part of their transportation planning efforts, some still do not.
- Safety performance reviews of commercial vehicles – especially trucks that are oversized and overweight – and traffic code enforcement should be enhanced.

To improve safety statewide for all users of highways and local roadways, transportation safety must be incorporated into comprehensive transportation planning processes at both the state and local levels.

7.1.3 Transportation Safety Goals and Performance Measures

The TTP incorporates the safety goal areas from existing plans by reference. The following performance measures are recommended to track and measure the effectiveness of efforts to improve safety the meet safety goals discussed in Chapter 3 of the TTP.

- Number of fatalities
- Number of serious injuries
- Number of fatalities/serious injuries per 100 million vehicle miles traveled
- Number of fatalities/serious injuries per million population
- Number of crashes between train and vehicle
- Number of crashes between train and vehicle resulting in fatalities or serious injuries
- Number of pedestrian and bicyclist fatalities and serious injuries
- Number of pedestrian and bicyclist fatalities per million population
- Number of fatal and serious injury crashes involving cell phone use
- Number of fatal and serious injury crashes involving speeding
- Safety belt usage rate
- Number of fatal crashes due to DUI
- Average incident response time/incident clearance time

7.2 Transportation Security Planning

7.2.1 Security Plans

Texas has critical transportation infrastructure that could be vulnerable to a myriad of natural and manmade disasters. As a result, the Texas Department of Public Safety has developed the State of Texas Emergency Management Plan and the Office of the Governor developed the Texas Homeland Security Strategic Plan 2010-2015. In addition, some MPOs across the state have incorporated security considerations into their transportation planning processes and plans.

- The State of Texas Emergency Management Plan. This plan describes how the state will prepare for, respond to, mitigate, and recover from the impacts of hazards to public health and safety. It establishes operational concepts and identifies tasks and responsibilities required to carry out a comprehensive emergency management program. It describes the state's emergency management organization and a statewide system of coordination, as well as the emergency responsibilities of TxDOT.
- The Texas Homeland Security Strategic Plan 2010–2015. This plan provides high-level guidance that informs other state, regional, and local homeland security and emergency management plans and operations.

7.2.2 Transportation Security Goals and Performance Measures

The focus for transportation security is to ensure the security of the critical infrastructure in Texas and minimize the possible impacts when natural and manmade disasters occur. Goals include:

- Development of a comprehensive database for all critical infrastructures within the state;
- Establishment of an integrated statewide emergency response system minimize response times;
- Coordination of transportation security activities at the state, county, and local levels of government; and
- Transportation security training for law enforcement and first responders.

The following performance measures are recommended to track and measure the effectiveness of efforts to improve security and meet safety goals:

- Percentage of critical infrastructure identified and archived in the state critical infrastructure database;
- Emergency response time;
- Frequency of transportation security training and drills held among state, county and city agencies; and
- Percentage of state population that receive training and/or educational materials on transportation security response protocol.

CONSIDERATIONS FOR TEXAS TRANSPORTATION PLAN IMPLEMENTATION

In accordance with TxDOT's commitment to operational and innovation excellence, the Texas Transportation Plan (TTP) was developed as a performance-based plan. Scenario analysis developed for the TTP links potential investment approaches with the achievement of long-range goals. Achieving goals depends on the revenues available to meet the state's growing transportation needs as well as the allocation of those revenues to the best possible transportation projects.

To fully implement the TTP, an approach to performance-based planning and programming will be adopted. This approach will carry the goals and objectives from the TTP through the programming and project selection processes used to inform the development of TxDOT's Unified Transportation Program (UTP), metropolitan and rural transportation improvement programs (TIPs), and the Statewide Transportation Improvement Program (STIP). Supplemental Program Authority (SPA) projects and other state priority projects identified by TxDOT's Districts will be prioritized and selected to best meet TTP goals. Prioritized projects will then be programmed in the UTP for further development, listed in the STIP as funds for construction become available, and finally advanced to construction.

8.1 Investment Strategies

TxDOT maintains more miles of highway and more bridges than any other state. With continued population and economic growth, demand on these assets continues to increase. Several broad investment strategies – with identified priorities – are recommended to help frame a performance-based approach and address transportation needs across the State of Texas.

8.1.1 Safety and Maintenance Priorities

While safety is TxDOT's number one priority, the rate of fatal accidents on Texas roadways in 2012 exceeded the national average by 26.5 percent. The number one goal of TxDOT's Highway Safety Office is to identify traffic safety problem areas and programs to reduce the number and severity of traffic related crashes, injuries, and fatalities.

In fiscal year 2013, TxDOT funded 298 behavioral and enforcement projects under the Texas Traffic Safety Program at a cost of $56 million in federal and state grant funds. These projects are designed to increase the proper use of safety belts and child safety seats as well as to deter dangerous driving behaviors such as speeding, aggressive or distracted driving, and driving under the influence of alcohol and other drugs. Additional information on TxDOT's safety goals and performance targets can be found in the 2015 Highway Safety Plan.

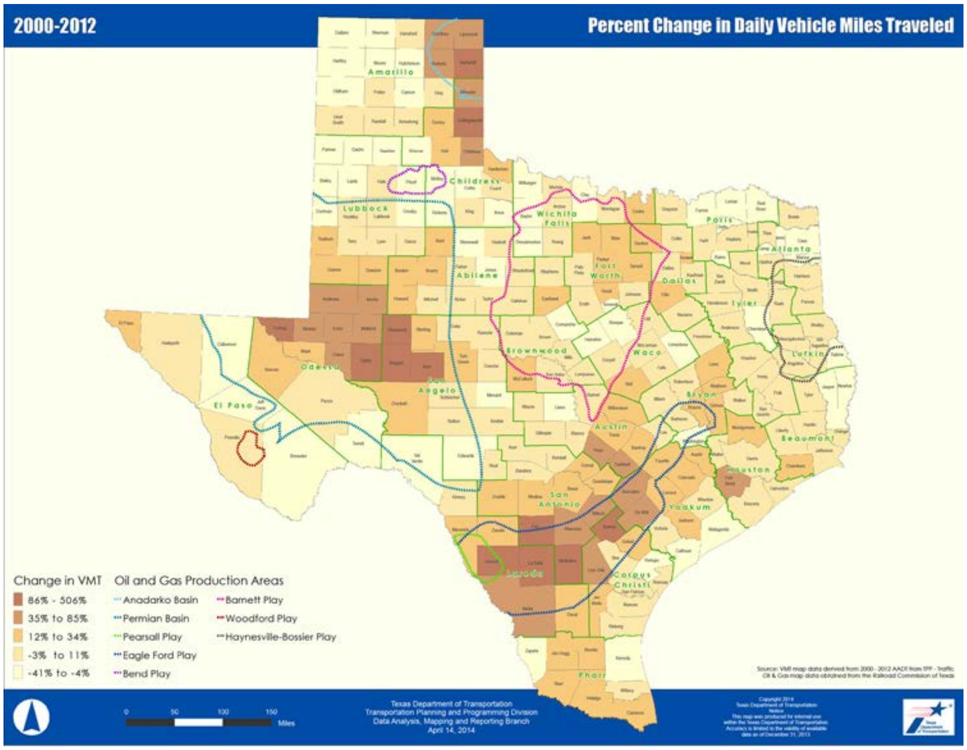
Maintenance of existing highway infrastructure is also a high priority for safety, operational, and economic reasons. Priorities for transportation investments should ensure that the state maintains performance standards in all of areas of the state.

Maintenance can be as minor in scope as applying a seal coat surface to an existing roadway, but also includes major interstate reconstruction activities (e.g., IH 10 in El Paso and IH 345 in Dallas).

8.1.2 Energy Sector Priorities

Energy producing areas of the state have seen a tremendous increase in traffic growth (Exhibit 8-1), much of it associated with trucking activities. The continued maintenance and expansion of infrastructure to support the energy industry are integral to continued growth and economic development in the energy sectors throughout the state.

Exhibit 8-1. Energy Producing Areas and Traffic Growth



8.1.3 Interstate Corridor Widening and Development

The Interstate Highway System in Texas represents the backbone of our transportation network. Investment should be made to continue efforts to widen key segments of existing Interstate corridors (Exhibit 8-2) to provide for a minimum of three travel lanes in each direction throughout both metropolitan and rural areas of the state.

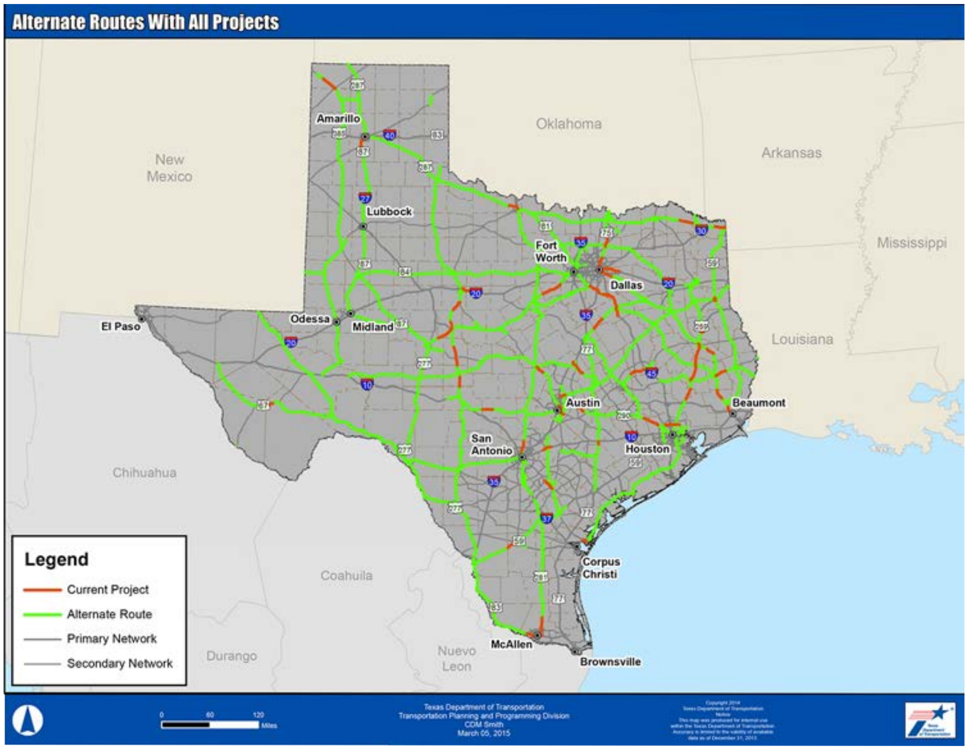
Additionally, continued investment in the extension and development of future Interstates should be made throughout the state. This would include western extensions of IH 2 in south Texas and continued development of IH 69 across the state. In addition to these routes, future planning consideration may be given to development and extension of other Interstate routes, including possible extensions of IH 27 in west Texas and possible Interstate designation along portions of US 190 in central Texas.

Exhibit 8-2. Long-Range Interstate Corridor Priorities

8.1.4 Alternative Rural Corridors

In addition to the Interstate Highway System needs outlined above, a number of alternative highway system needs exist throughout the state where corridor improvements are needed to serve existing travel demands and potentially represent opportunities to divert traffic from increasingly congested Interstate Highway corridors. Improvements along these alternative routes may include widening some roadways to "Super 2" standards – providing passing lanes, continuous four-lane widening, and bypasses or overpasses at priority locations. Candidate alternative route projects are illustrated in Exhibit 8-3. These include Texas Trunk System routes and strategic corridors such as:

Exhibit 8-3. Alternate Rural Corridors

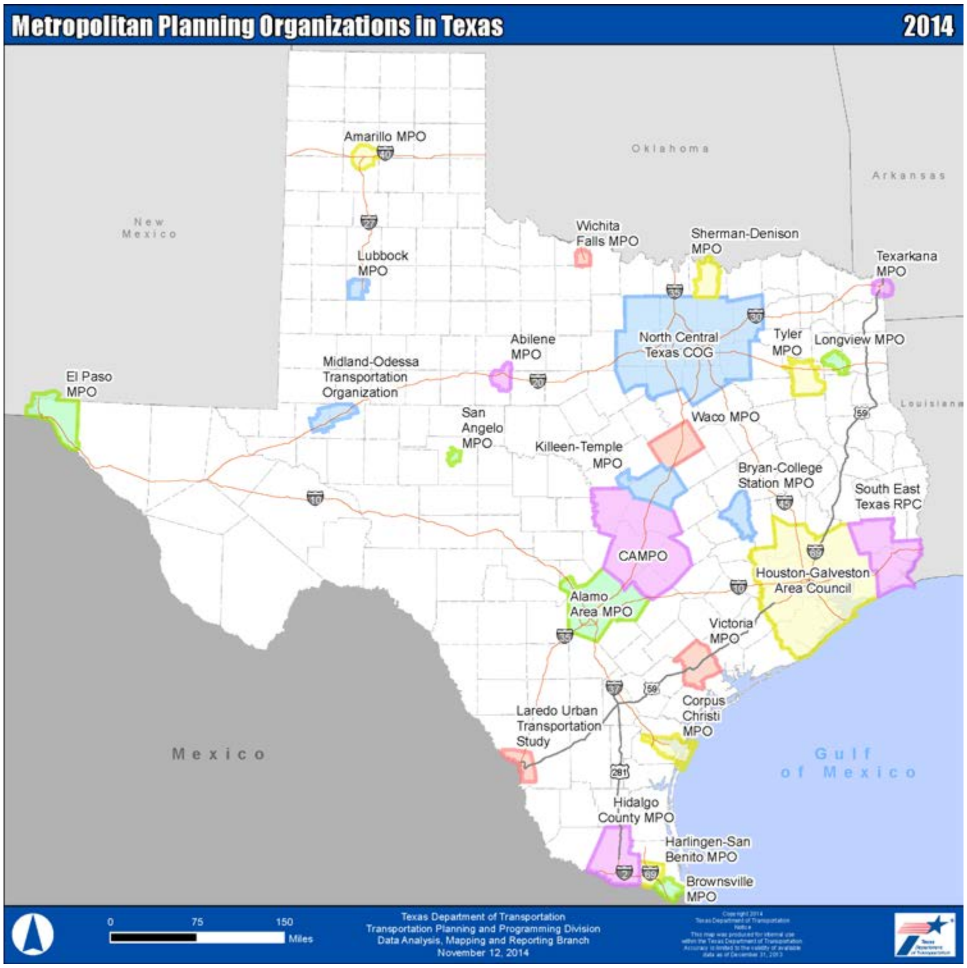


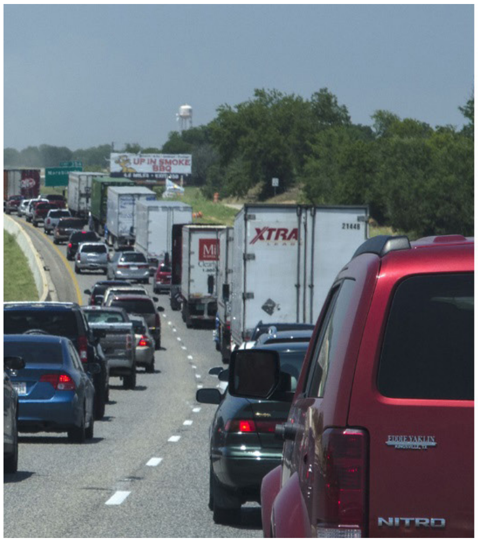
- Ports-to-Plains Corridor – connecting trade through the western portion of the state from the Texas/Mexico border at Laredo, through Del Rio, San Angelo, Midland/Odessa, Big Spring, Lubbock and Amarillo and extending through other US states to Canada.
- US 190/Ports to Forts Corridor – generally including portions of IH 10 and US 190 to extend from El Paso (Fort Bliss) through Killeen (Fort Hood) to Fort Polk, Louisiana. The corridor also includes additional highway connections to the ports of Beaumont and Corpus Christi.

8.1.5 Metropolitan Mobility Improvements

Vehicle of hours of delay in urban areas is projected to triple by 2040 from levels reported in 2010. Planning to address these needs in urban areas is coordinated through the twenty-five different Metropolitan Planning Organizations (MPOs) that exist in the urbanized areas of the state. These MPOs, shown in Exhibit 8-4, are governed by policy boards or committees that include representatives of local governments, transportation providers, and TxDOT District offices in the regions they serve. Each MPO is responsible for developing a long-range multimodal transportation plan and a shorter-range transportation improvement program. These plans and programs are in Chapter 2 (Exhibit 2-2), and incorporated into this document by reference.

Exhibit 8-4. Texas Metropolitan Planning Organizations



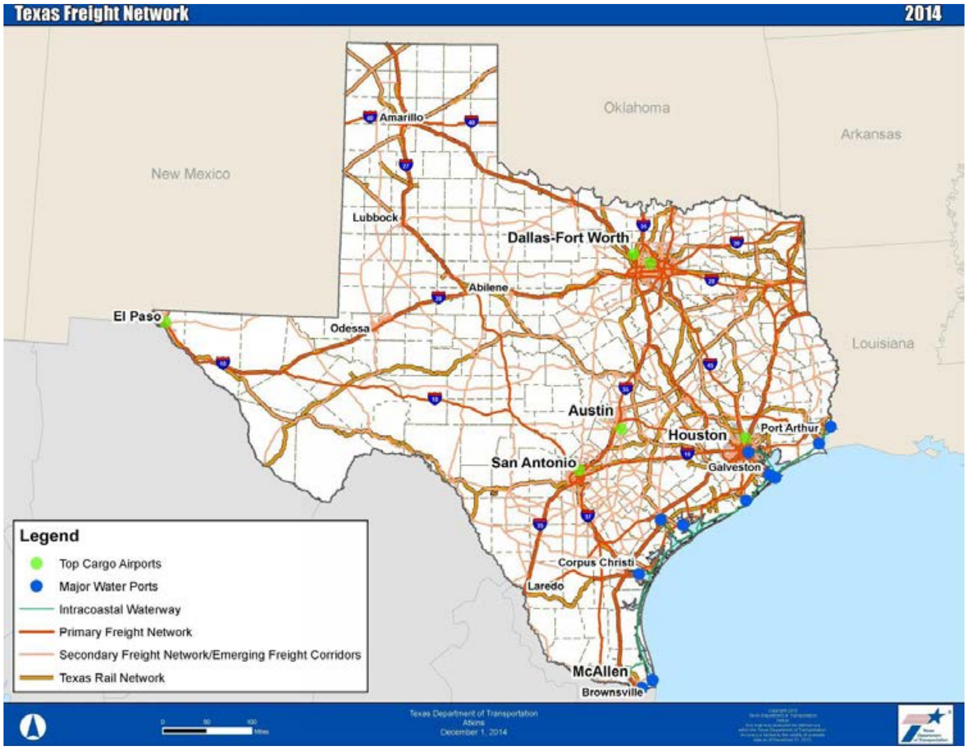


8.1.6 Freight System Priorities

As the economy in Texas continues to grow, so too does the demand for the efficient movement of freight (Exhibit 8-5). Freight gateways include international border crossings, maritime seaports, cargo airports and rail/highway intermodal hubs. A wide range of freight generators exist throughout the state – ranging from agriculture and energy products in rural areas to manufacturing and distribution centers in urban areas.

Transportation investments should consider our state's evolving freight needs and prioritize opportunities for improving the speed and efficiency of freight flow. In addition, the department will continue efforts to effectively coordinate with various freight stakeholders in the planning and development of multimodal transportation projects. This includes the on-going work of the Freight Advisory Committee that was established as part of the development of the Texas Freight Mobility Plan. Representation on the committee includes Class 1 and short-line railroads, ports, border trade operators, local officials, and industry experts.

Exhibit 8-5. Texas Freight Network



8.1.7 Multimodal Priorities

In addition supporting to a wide range of highway-related needs and improvements, TxDOT will continue to work and partner with multimodal stakeholders to facilitate the development of non-highway improvements to meet freight and passenger needs. TxDOT is presently coordinating with locally and privately funded efforts to develop several intercity high-speed passenger rail corridors as alternative modal options for regional travel.

One of those efforts is a private sector initiative to develop high-speed rail service between Dallas and Houston along the IH 45 corridor, with a locally planned extension between Dallas and Fort Worth (Exhibit 8-6).

In a similar effort, TxDOT is working with the Federal Railroad Administration and local officials on the Texas-Oklahoma Passenger Rail Study (Exhibit 8-7) to examine a potential rail corridor that would connect Oklahoma City to south Texas. This corridor could eventually extend to Monterrey, Mexico.

Additional high-speed and commuter rail corridors are envisioned along the IH 35 corridor. Currently, an environmental study is underway on the Lone Star Passenger Rail Corridor between Austin and San Antonio (Exhibit 8-8).

TxDOT will continue to work with local transit agencies to coordinate the planning and development of transportation improvements that effectively serve both highway and public transportation needs, such as high-occupancy vehicle and managed lanes in congested urban corridors.

Exhibit 8-6. Dallas to Houston High-Speed Rail

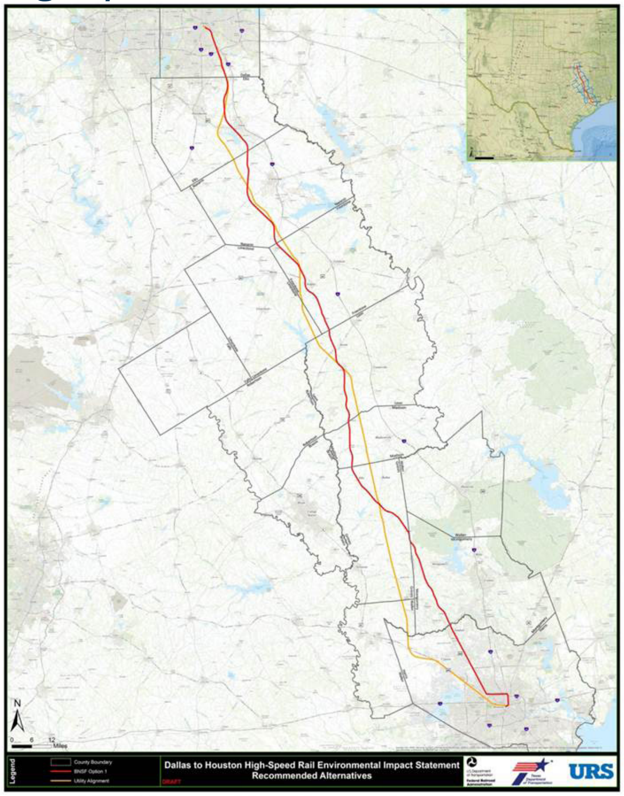
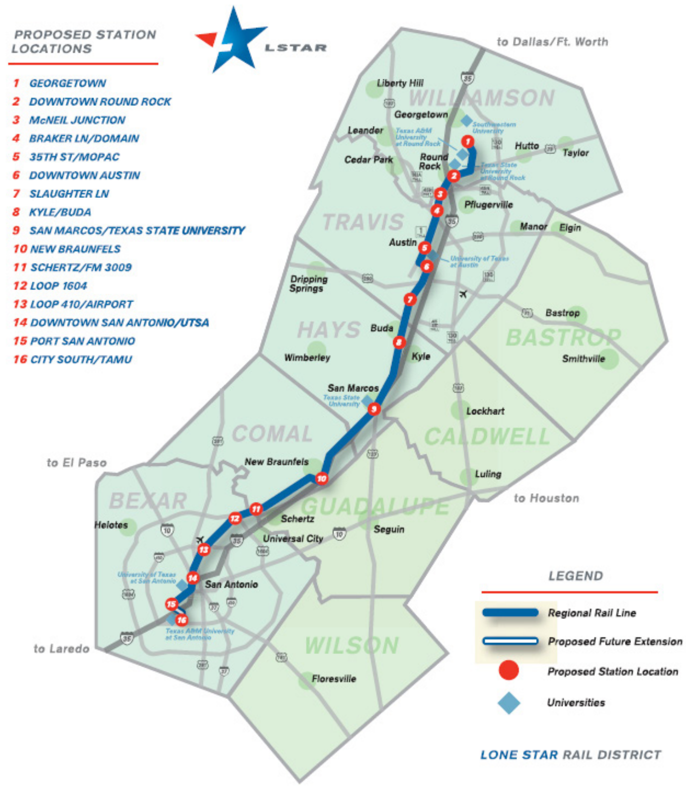


Exhibit 8-7. Texas-Oklahoma Passenger Rail

Exhibit 8-8. Proposed Lone Star Passenger Rail



TxDOT recognizes that pedestrian and bicycle facilities are 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. While bicycle and pedestrian projects have traditionally been implemented primarily by local governments, TxDOT is working to include bicycle and pedestrian infrastructure in roadway projects. Additionally, through new funding programs such as the Transportation Alternatives Program, TxDOT will directly fund bicycle and pedestrian construction projects throughout the state.

8.2 Sustainable Revenue Sources

As previously discussed, reasonably expected, currently available revenues will not be adequate to meet Texas' transportation needs and growing demand and ensure that Texas remains economically strong.

- At current funding levels and without additional sustainable funding in the future, "good" conditions on pavements and bridges can only be maintained by shifting all highway expansion dollars to preventive maintenance and capital rehabilitation.
- The $1.7 billion for highway infrastructure recently approved by Texas voters under Proposition 1, will address some of the strategic capacity enhancement, connectivity, and maintenance needs for fiscal year 2015, but will not be sufficient to address growing needs into the future.

- TxDOT estimates that $5 billion more per year (2014 constant dollars) in highway investment is needed to generally maintain the current level of congestion and condition of our highway infrastructure.

Sustainable funding is necessary to continue to invest in the Texas transportation system across all modes. Stakeholder and public outreach conducted for the TTP shows that these groups value and desire investments in transit and non-highway alternatives. At the same time, TTP outreach initiatives underscore the importance of system preservation and a recognition that Texas must continue to preserve and maintain its transportation system.

TxDOT can maximize the use of existing funding through performance-based project selection and operational enhancements to improve efficiency throughout the department, but these initiatives will not close the funding gap between needs and revenues. TxDOT will need to work closely with state and local elected officials to increase existing revenues and create new capital.

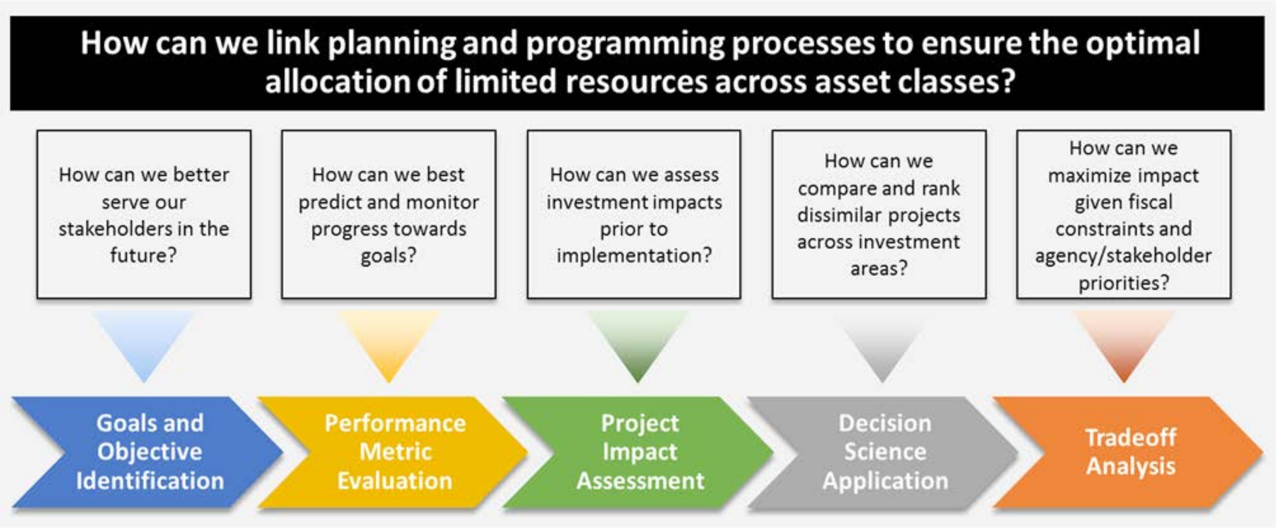
- **Motor Vehicle Sales Tax.** Some legislative leaders have suggested using a portion of vehicle sales tax revenue for transportation.
- **Public-Private Partnerships.** Partnering with the private sector brings in additional money. It allows projects to be built sooner rather than waiting until traditional funding becomes available.
- **Texas Mobility Fund.** Any new revenue sources for the Texas Mobility Fund could help retire debt or expand the capacity of the fund to accelerate new projects.
- **Transportation Reinvestment Zones.** Transportation reinvestment zones provide another local funding option for entities that choose to participate. Increased property values generate revenue within the improved zone to finance transportation projects.
- **Vehicle Miles Traveled tax.** Replacing or augmenting the current per-gallon fuel tax with a user fee based on vehicle miles traveled that directly connects road usage to the user. This fee structure would be more inclusive and compensate for lost revenues due to fuel efficient, hybrid, and electric vehicles.
- **Index or increase the motor fuel tax.** Indexing the motor fuel tax to inflation or increasing it would compensate for the declining purchasing power of the dollar and increased fuel efficiency. A one cent increase in the tax would generate about $110 million a year in revenue for the State Highway Fund.
- **Increase vehicle registration fees.** Each $10 increase in motor vehicle registration fees could yield almost $210 million annually in additional revenues.
- **Tolling.** Toll roads play a significant role in providing revenues to fund transportation solutions. While toll roads cannot be the state's only approach to providing new roadways, they offer drivers alternative routes and more time-saving choices.

8.3 Performance Management

Performance measures and performance management are widely accepted by TxDOT and among the state's transportation planning partners. Monitoring the performance of the transportation system – including the condition of physical assets and travel times on the network – is critical for transparency and accountability as required under MAP21. Senate Bill 1420 provides additional context and requirements for state-developed and reported performance measures.

While the concepts of performance management and performance measures are generally understood, deciding how to best allocate limited resources across various types of investments to provide acceptable transportation system performance poses a persistent and difficult challenge not only for TxDOT, but for most transportation agencies in the nation. In general, agencies struggle with technical challenges and data analytics, fear of a "black box" approach to project prioritization, and other institutional barriers and historic approaches to resource allocation. This is in addition to the larger agency challenge of the need to directly link planning and programming; in many if not most cases, projects selected for a transportation agency's capital program are not directly tied to well-thought-out agency goals and priorities. As TxDOT continues to feel the pressures of transitioning to a performance-based planning approach, these linkages will be strengthened.

Exhibit 8-9. NCHRP 08-91 Cross-Asset Allocation Framework



Work conducted for the National Cooperative Highway Research Program's (NCHRP) 0891 Project, Cross Asset Resource Allocation and Impacts on System Performance provides a framework for institutionalizing performance-based planning and program development. The simple 5-step framework (Exhibit 8-9) provides the opportunity for TxDOT to link TTP goals and objectives with various modal plans, programs and project lists.

Blending planning principles with readily collected data and available predictive management tools, the framework integrates:

1. Goals and objectives developed for the TTP;
2. TTP performance measures;
3. Predictive models to forecast likely project impacts on system performance;
4. Decision science and utility theory to "score" projects on a level playing-field and optimize their selection for programming based on their anticipated benefits and the relative importance of those benefits to TxDOT; and
5. Tradeoff analysis to reinforce scenario planning and compare priorities given fiscal constraints.

By directing resources towards the most cost-beneficial investments, performance-based planning principles are reinforced in the framework. Critical to the framework is the use of performance modeling to predict project impacts with respect to a holistic set of performance metrics within investment types. This has been conducted in the TTP needs assessment and will be continued.

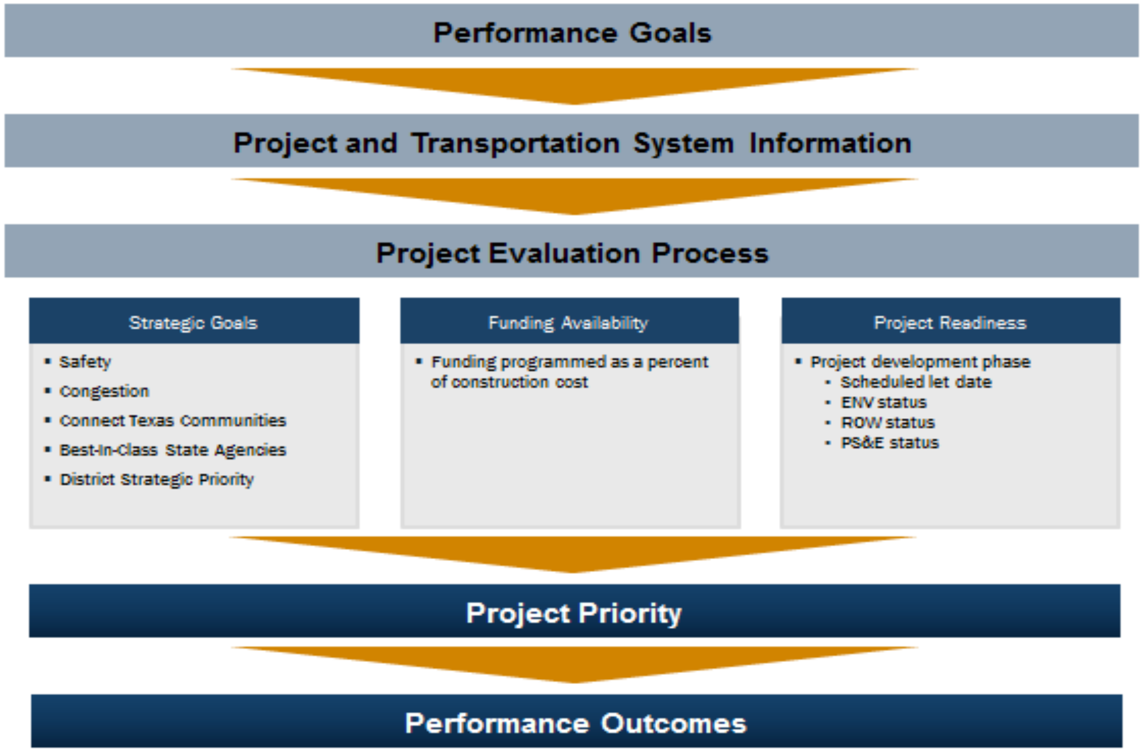
8.4 Transitioning to Performance-Based Planning

Performance-based planning and programming will help TxDOT transform its current project selection and investment strategies to link long-range TTP planning goals directly to performance-based programming decisions that inform mid-range financial plans (Cash Flow Forecast and Asset Management Plan), and programs like the UTP and STIP. TxDOT currently employs criteria-based project selection for highway projects included in its UTP, but the criteria will continue to be evaluated and strengthened during TTP implementation. More information on criteria and selection processes for other modes are documented in TxDOT's modal-specific plans and programs.

A full performance-based planning and programming approach starts with the planning process and utilizes planning-level goals and objectives as the foundation of not only long-range plan development, but also project prioritization and selection. The TTP provides comprehensive goals and objectives, performance measures, and unconstrained needs as well as a high-level review of long-range revenues. In the short-term, these principles will be incorporated into project selection, where financially-constrained decision-making is directly influenced by needs analyses in the TTP.

As implementation of the TTP progresses, projects will be reviewed with respect to their performance impact on the system. Risk will also be considered, and will be holistically included in the implementation of the TTP by selecting risk mitigation projects, incorporating and simulating probabilistic performance models, and setting aside contingency funds based on risk tolerance.

Exhibit 8-10. Performance – Based Project Selection Criteria

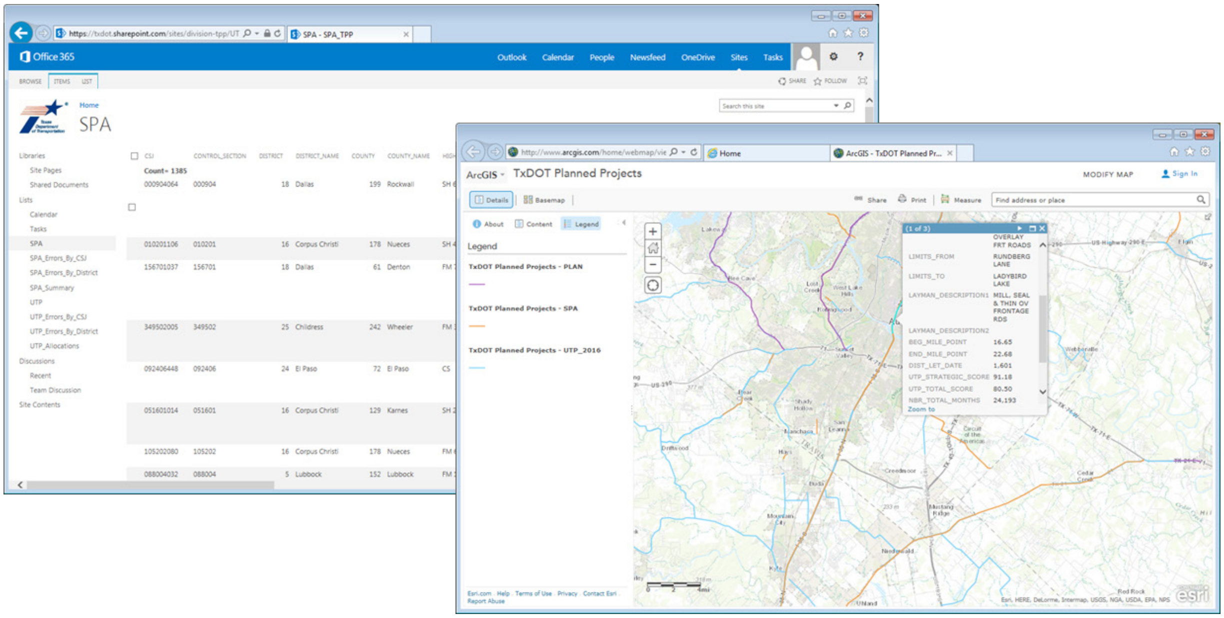


Guided by the comprehensive performance goals outlined in the TTP, TxDOT is improving its current investment strategies and project selection process to link TTP goals to performance-based programming decisions that inform project selection. This performance-based project selection process and current evaluation criteria are illustrated in Exhibit 8-10. Through this process, projects selected and programmed through mid-range plans and programs such as UTP and STIP can be objectively evaluated and linked to potential performance outcomes.

TxDOT is working on developing systems to manage and maintain project information for use in project evaluation. Furthermore, the department will ensure project information is available and accessible to planning partners, like our metropolitan planning organizations, and to the general public. This involves the development of web-based applications, as shown in Exhibit 8-11, that outline the criteria for evaluating and prioritizing projects.

As a further step toward improving information requirements for performance programming, TxDOT is in the process of implementing its first electronic STIP – a tool that will enable a “real-time” financial evaluation and assessment of projects constructed or implemented against available revenues to improve resource allocation and streamline project delivery.

Exhibit 8-11. Web-based Project Evaluation and Information Systems



8.5 Texas Transportation Plan Implementation - Next Steps

To achieve performance goals, an understanding of how to invest and where to achieve longrange performance goals is also needed. TTP implementation requires that projects are analyzed and committed only when their impact on performance is thoroughly understood. Without this planning to programming linkage, it is unlikely that any capital program can meet Texas' transportation priorities and goals. To complete the implementation of this TTP, TxDOT will:

- Advance asset management planning and predictive capabilities for all project types, both at the Division and District levels;
- Make strategic capacity enhancements to reduce bottlenecks and improve travel times in key passenger and freight corridors;
- Compare preventive treatments against system expansion projects in order to determine the best possible allocation of existing and new transportation funds;
- Build on the existing project selection criteria to develop a transparent performance-based project prioritization process that weights and ranks all UTP projects using both quantitative and qualitative criteria to meet short- and long-term performance goals and state transportation priorities. This will combine asset management priorities with major projects identified in the UTP;
- Continue to work with elected officials to Identify and develop sustainable funding sources; and
- Continue its partnerships with multimodal transportation providers to develop and implement new technologies, demand management strategies, system operations and non-motorized transportation improvements to meet identified needs.

APPENDIX A

PUBLIC INVOLVEMENT ELECTRONIC NOTEBOOK

Texas Transportation Plan

Public Involvement Electronic Notebook

December 31, 2014

Contents

Appendices

Introduction

The Texas Transportation Plan 2040 (TTP 2040) will serve as the Texas Department of Transportation's (TxDOT) long-range, performance-based transportation plan. The TTP 2040 will guide planning and programming decisions for the development, integrated management, and operations of the statewide, multimodal transportation system in Texas over the next 25 years. Public involvement was a critical component of the plan's development. The statewide public involvement effort was the most comprehensive information and education campaign ever conducted by TxDOT.

The tools and techniques utilized included a variety of high-touch (personal interaction) and high-tech methods for collecting public input and opinion. These methods included engaging a diverse group of TxDOT personnel, transportation partners, stakeholders, and the public across the state using a combination of traditional and innovative, online communication and visualization tools in English and Spanish. The following represents the basis of the effort:

- Development of and revisions to the Stakeholder and Public Participation Plan
- Establishment and periodic meetings of the Technical Advisory Committee
- Stakeholder meetings
- Public meetings
- Transportation Questionnaire
- Demographic Survey
- Web-Based Interactive Planning Scenario Tool

This electronic notebook describes the public information tools and techniques used during the development of the TTP 2040. It is intended to document the effort and provide guidance for future public participation for planning initiatives.

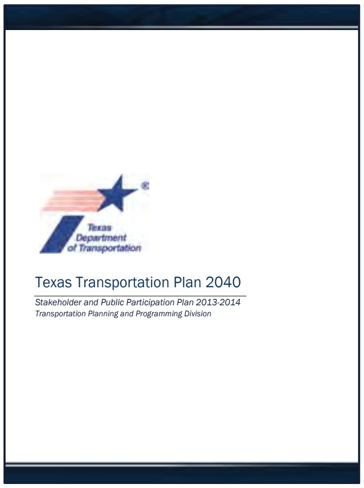
Stakeholder and Public Participation Plan

The roadmap for the public involvement effort was developed in the Stakeholder and Public Participation Plan (SP3). The SP3 outlines the public engagement objectives and the activities to be conducted to meet them. Please note that anyone who uses the TxDOT system could be considered a stakeholder. However, for purposes of this document and the entire effort, stakeholder is defined as someone who is directly involved in transportation planning either as a technical expert or a decision maker. The public is defined as all other parties who may be impacted. The SP3 was updated once over the course of the effort. The complete plan can be found in Appendix A.

The objectives outlined in the SP3 are as follows:

- Establish **early and continuous public participation opportunities** that provide timely information about transportation issues and decision-making processes to all interested parties;
- Provide **reasonable public access** to educational, technical, and policy information to enhance the public's knowledge and ability to participate in the development of the TTP;

- Provide **adequate public notice** of participation opportunities during the development of the TTP, and time for public review and comment at key decision points in the planning process;
- Ensure that public participation opportunities are held at **convenient and accessible** (Americans with Disabilities Act – ADA) **locations and times**;
- **Make information comprehensible** using visualization techniques, **and available** in appropriate electronically-accessible formats and means via the TxDOT website, technology-enabled media, and video-teleconferencing;


Texas Department of Transportation
Texas Transportation Plan 2040
Stakeholder and Public Participation Plan 2013-2014
Transportation Planning and Programming Division

- Include measures for seeking input from and considering the needs of those traditionally underserved by existing transportation systems as defined in **Title VI** of the Civil Rights Act of 1964, such as low-income, minority, and non-English speaking households who may face challenges accessing employment and other services; and
- Provide for the **periodic review of the public participation process** to ensure the effectiveness of TxDOT's public involvement efforts and revise the process as appropriate.

In order to accomplish these objectives, the tools listed and described in this document were implemented and recorded.

Technical Advisory Committee

The Technical Advisory Committee (TAC) was the initial step in obtaining stakeholder involvement. The TAC was formed as a multi-disciplinary group to provide feedback and insight to the planning team throughout the TTP development. The committee was comprised of TxDOT administrators, civil engineers, planners, environmental experts, and public information specialists. The TAC met four times. Each meeting was purposeful and supported a significant planning milestone.

During the first meeting the group helped develop the TTP framework and draft goals and objectives and preview the initial public outreach effort. Subsequent meetings included status updates, presentation of TTP components, and public involvement strategies and outreach methods. TAC contributions included review and comment on public involvement materials and exhibits, the unconstrained modal profiles, public surveys and the planning scenario tool as well as assisting with getting other stakeholders informed and involved. The TAC effort wrapped up with the committee providing comments to the draft TTP. For complete TAC meeting summaries, please refer to **Appendix B**.

Stakeholder Meetings

Stakeholder meetings were held during each of the two public outreach rounds. The meetings were intended to collect thoughts, feedback, and information from local transportation planners and decision makers. Each meeting was held in the same location, and prior to, the public open house.

All the materials for the public open house were set up for stakeholders to view and ask questions. The format for the meeting was a presentation followed by a facilitated discussion. The facilitated discussion had pointed questions to help guide the discussion in a manner that produced a meaningful dialogue between the TTP planning team and the participants.

The keys to successful stakeholder participation were early notice of the meeting so stakeholders could anticipate attending and thoughtful development of the facilitated discussion. For the second round of meetings, stakeholder notices were sent more than a month in advance as a *save the date* e-mail. The email included all meeting dates and times along with a link to the transportation survey (discussed below) as well as the TTP TxDOT website pages and the ability to forward the information to others.

With regard to the facilitated discussion, the planning team collaborated on the development of the questions. The questions corresponded to the phase of the plan's development and were intended to stimulate the conversation, not to be used as a script. The facilitator guided the discussion and another team member recorded the notes on a flipchart for the entire group to view. The flipchart notes allowed everyone participating to view the information being documented. It also gave the participants the ability to correct any misunderstandings prior to formal documentation.

The presentation provided information similar to the meeting exhibits with much more technical detail. The conversations that followed the presentation gave the planning team valuable information in terms of TTP development as well as local issues in advance of the public open houses. The stakeholder meetings were very well received particularly during the second round when every TxDOT District and associated stakeholders had the opportunity to participate. For complete stakeholder meeting summaries, please refer to Appendix C.

Public Meetings

Public meetings were held in two series. The first series of meetings took the planning team to eight TxDOT Districts and the second series of meetings were held in all 25 TxDOT Districts. For purposes of this document, the public involvement effort will be focused on the second series of meetings. The effort included early and extensive outreach and notice, open house style meetings, easy to understand exhibits and meeting materials, bilingual (Spanish) meeting materials and staffing, various methods for submitting comments, and follow-up emails.

The early and extensive outreach and notice included a number of electronic and print media. TxDOT and the planning team partnered with traditional media outlets, third party organizations, and TxDOT District Public Information Officers to spread the word about the meetings. Traditional media outlets (television, newspaper, and radio) were sent press releases and conducted interviews with the TxDOT Project Manager and Deputy Project Manager. Third party organizations were asked to pass along the public meeting notice to their membership and email databases. These organizations included other transportation agencies (RMA, MPO, etc.), elected officials, government entities (municipal and county), transportation and planning related professional organizations, chambers of commerce, freight and cargo service providers, transportation advocacy groups (bike, rail, etc.), Native American groups, universities and colleges, and other civic and professional organizations. With regard to TxDOT District Public Information Officers, the TTP Project Manager hosted a WebEx meeting to ensure all officers were aware and knowledgeable of the effort. The WebEx meeting provided the PIOs with the meeting schedule, the planning effort process, a sample press release, frequently asked questions with media talking points, and the opportunity to ask questions and obtain more information. The PIOs proved to be invaluable with 33 local newspapers publishing the notices and 46 local media outlets covering the meetings in both print and televised formats.

The actual meetings were conducted in an open house format. This format provides the public with an opportunity to attend anytime during the published open house hours, and tostay for as little or as much time as desired. Attendees viewed exhibits, asked questions, used the interactive planning scenario tool (see below), completed the transportation survey (see below) and the demographic survey, and used the comment card to capture additional thoughts. The transportation survey, interactive planning scenario tool, and comment card provided opportunities to submit comments and the project manager’s business cards were made available. All attendees were asked to sign in and provide contact information. Electronic mail addresses that were provided at the sign-in table were used to send follow-up emails. The follow-up email included a thank you for attending along with information about future meetings, a request to pass the information along, links to complete the transportation survey and use the interactive planning scenario tool, and another opportunity to provide comments. The meeting exhibits were created to be visually appealing and easy to understand. All materials were available in Spanish and English. Please refer to Appendix D to view the comment card and meeting exhibits.

Email Campaigns

Email campaigns were integral to the statewide effort. The campaigns were used for initial outreach as well as follow up after the meetings. Each campaign consisted of a visually appealing graphic with links to the various planning and outreach tools. The information could also be viewed in text only format or through a web browser. While the email campaigns may not have generated a large number of public meeting attendees, at a minimum the campaigns raised awareness of the TTP effort for the nearly 3,200 that received it. To view the various email notices, please see Appendix E. The following represents the various campaigns:

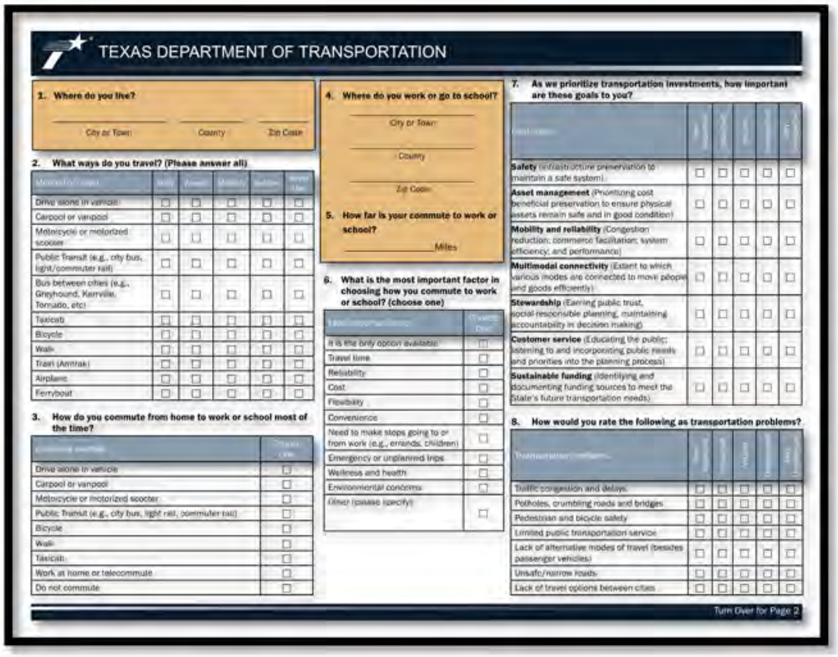
- Save the Date and Survey (sent approximately two months prior): The stakeholder meeting schedule was sent to the stakeholder database with a link to the transportation survey (see below) and project website, and the ability to forward the information.
- Open House Announcement (sent approximately one month prior): The open house meeting schedule was sent to the stakeholder and public database with a link to the transportation survey and project website, and the ability to forward the information.
- Stakeholder Invitation (sent approximately one month prior): The stakeholder meeting schedule with locations was sent to the stakeholder database with a link to the transportation survey and project website, and the ability to forward the information.
- Follow-Up to Meeting Attendance (on average sent within 10 days of attending the meeting): Everyone who attended a meeting and provided an email address was sent a thank you for attending along with information about future meeting dates (when appropriate), links to the transportation survey, project website, and the interactive planning scenario tool, a request to pass the information along, and another opportunity to provide comments.
- Draft TTP Available (approximately one month prior to the public hearing): Everyone who attended a meeting and provided an email address as well as the initial stakeholder and public email databases was sent a thank you for contributing to the development of the plan and a notice of the TTP Public Hearing along with a link to review the draft plan.

Transportation Questionnaire

The TTP Transportation Questionnaire was one tool the team used to collect public opinion and gain information on travel trends. Specifically, it was developed to give the public an opportunity to share information related to:

- Personal travel modes and commutes,
- Prioritizing the TTP goals,
- Rating transportation problems and potential solutions,
- How funds should be distributed for transportation improvements,
- Demographic information, and
- Additional comments.

The online link to the questionnaire was emailed as part of the above-mentioned campaigns and was distributed to stakeholder and public meeting attendees in hard copy format. It was available in Spanish online and in hard copy. The effort garnered over 2,150 responses. While not scientific, responses informed the TTP Team and provided useful insights into what is important in transportation and how Texans want to see resources spent. The demographic information, particularly zip codes, was plotted onto a map of the state to show the results of the statewide outreach effort. To view the questionnaire, please see Appendix F.



TEXAS DEPARTMENT OF TRANSPORTATION

1. Where do you live?

City or Town ______ County ______ Zip Code ______

2. What ways do you travel? (Please answer all)

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Drive alone in vehicle	☐	☐	☐	☐	☐
Carpool or vanpool	☐	☐	☐	☐	☐
Motorcycle or motorized scooter	☐	☐	☐	☐	☐
Public Transit (e.g., city bus, light/commuter rail)	☐	☐	☐	☐	☐
Bus between cities (e.g., Greyhound, Kerrville, Tornado, etc)	☐	☐	☐	☐	☐
Taxicab	☐	☐	☐	☐	☐
Bicycle	☐	☐	☐	☐	☐
Walk	☐	☐	☐	☐	☐
Train (Amtrak)	☐	☐	☐	☐	☐
Airplane	☐	☐	☐	☐	☐
Ferryboat	☐	☐	☐	☐	☐

3. How do you commute from home to work or school most of the time?

[illegible]	[illegible]
Drive alone in vehicle	☐
Carpool or vanpool	☐
Motorcycle or motorized scooter	☐
Public Transit (e.g., city bus, light rail, commuter rail)	☐
Bicycle	☐
Walk	☐
Taxicab	☐
Work at home or telecommute	☐
Do not commute	☐

4. Where do you work or go to school?

City or Town ______

County ______

Zip Code ______

5. How far is your commute to work or school?

______ Miles

6. What is the most important factor in choosing how you commute to work or school? (choose one)

[illegible]	[illegible]
It is the only option available	☐
Travel time	☐
Reliability	☐
Cost	☐
Flexibility	☐
Convenience	☐
Need to make stops going to or from work (e.g., errands, children)	☐
Emergency or unplanned trips	☐
Wellness and health	☐
Environmental concerns	☐
Other (please specify)	☐

7. As we prioritize transportation investments, how important are these goals to you?

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Safety (infrastructure preservation to maintain a safe system)	☐	☐	☐	☐	☐
Asset management (Prioritizing cost beneficial preservation to ensure physical assets remain safe and in good condition)	☐	☐	☐	☐	☐
Mobility and reliability (Congestion reduction; commerce facilitation; system efficiency; and performance)	☐	☐	☐	☐	☐
Multimodal connectivity (Extent to which various modes are connected to move people and goods efficiently)	☐	☐	☐	☐	☐
Stewardship (Earning public trust, social responsible planning, maintaining accountability in decision making)	☐	☐	☐	☐	☐
Customer service (Educating the public; listening to and incorporating public needs and priorities into the planning process)	☐	☐	☐	☐	☐
Sustainable funding (Identifying and documenting funding sources to meet the State's future transportation needs)	☐	☐	☐	☐	☐

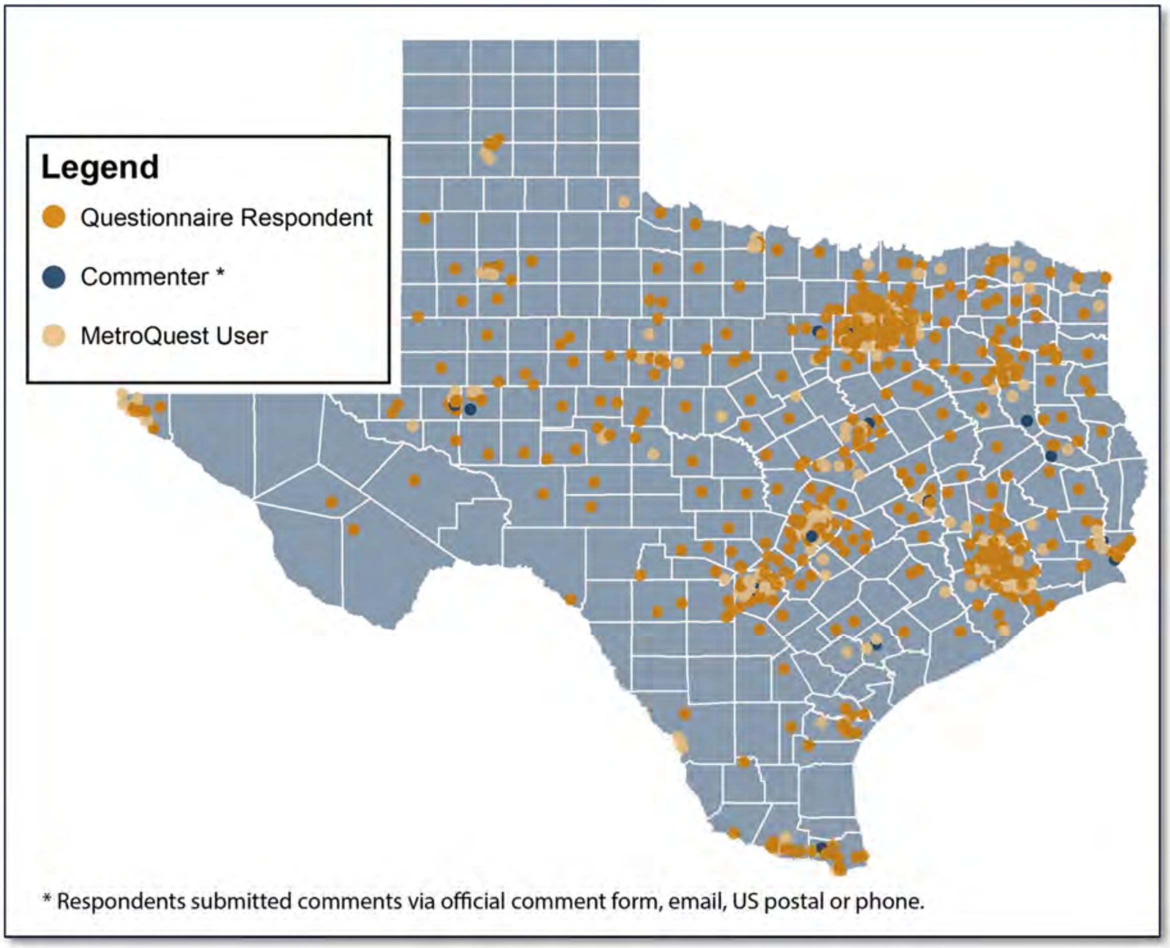
8. How would you rate the following as transportation problems?

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Traffic congestion and delays	☐	☐	☐	☐	☐
Potholes, crumbling roads and bridges	☐	☐	☐	☐	☐
Pedestrian and bicycle safety	☐	☐	☐	☐	☐
Limited public transportation service	☐	☐	☐	☐	☐
Lack of alternative modes of travel (besides passenger vehicles)	☐	☐	☐	☐	☐
Unsafe/narrow roads	☐	☐	☐	☐	☐
Lack of travel options between cities	☐	☐	☐	☐	☐

Turn Over for Page 2

Demographic Survey

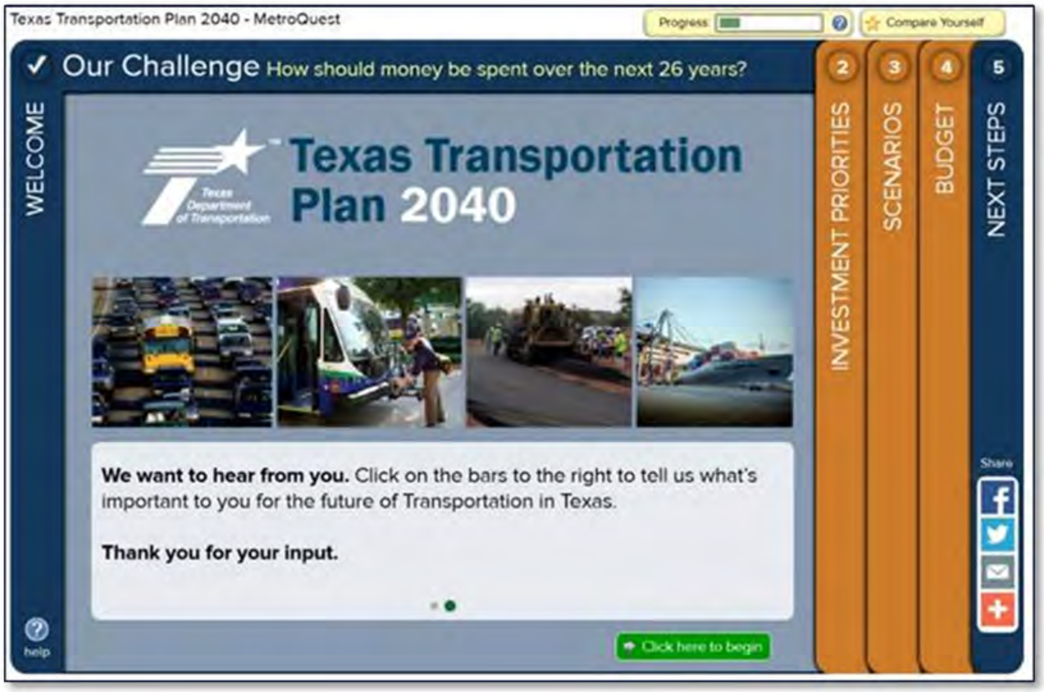
As part of the Title VI requirements under the Civil Rights Act and maintaining consistency with TxDOT Title VI policies, a demographic survey was available at stakeholder and public meetings. The completion of the form was voluntary and clearly noted on the form. It was available in English and Spanish. The first section of the form inquired about zip code, gender, age, disability, ethnicity/race, language preference, and household income and size. The second section asked for information related to advocates representing minority or elderly populations, persons with disabilities, and low-income populations. While this information is not critical for the development of the TTP, it is required and useful to gauge who participated and helpful for ensuring accommodations were made. To view the Demographic Survey, please see Appendix G.



Web-Based Interactive Planning Scenario Tool

The centerpiece of the public engagement for the second round of outreach was the Interactive Planning Scenario Tool (Tool). The Tool was developed as a collaborative effort between the Planning Team and MetroQuest. It was intended to support greater understanding of the gap between needs and available funding. Specifically, the Tool enabled users to visualize the impacts and trade-offs from shifting resources between transportation investments (i.e., from system preservation to roadway expansion). Users also were able to experience what a given level of investment can "buy" in terms of various performance measures. The Tool also captured demographic and contact information as well as provided another opportunity for submitting comments.

The Tool was presented, and very well received, on a tablet device, in English and Spanish, at the stakeholder and public meetings. It was also available online and the link was sent with each of the email campaigns outlined above. In all, over 500 people experienced the Tool. The feedback generated by it was used to inform the TTP Team of public preferences for investment approaches and additional comments. Please see Appendix H for the Web-Based Interactive Planning Scenario Tool Summary.



Summary Conclusion

When deploying a public engagement effort, it is most effective to use a variety of outreach tools and participation methods. Outreach tools should have a two-fold purpose: 1) to raise awareness and 2) to solicit input and participation. Participation methods should allow the public to easily and conveniently provide their input and feedback. It is also important to communicate the information in a manner that easy to understand and visually appealing. The tools described in this document highlighted this approach and allowed for Texans to contribute to the development of the TTP in a meaningful way.

Appendix A
Stakeholder and Public Participation Plan

Texas Transportation Plan 2040

Stakeholder and Public Participation Plan 2013-2014

Transportation Planning and Programming Division

Introduction

Over the next year the Transportation Planning and Programming (TPP) Division of the Texas Department of Transportation (TxDOT) will be engaged in the development of the Texas Transportation Plan (TTP) 2040. When completed, the TTP will serve as TxDOT's long-range, performance-based transportation plan that will guide planning and programming decisions for the development, integrated management, and operation of the statewide, multimodal transportation system in Texas over the next 25 years.

Project Objectives

The TTP will address the statewide planning requirements under the current federal surface transportation act – Moving Ahead for Progress in the 21st Century Act (MAP-21), and Title 43, Texas Administrative Code, Chapter 16. It will promote TxDOT's Strategic Plan goals and build on the progress made toward goals identified in TxDOT's 2035 Statewide Long-Range Plan and Texas Rural Transportation Plan.

As the foundation for TxDOT's first performance-based, multimodal transportation plan, a comprehensive statewide analysis of transportation demand to capacity across various modes will allow decision-makers to better manage transportation assets, develop performance measures and targets to prioritize needs, and align resources for optimizing system performance.

The analysis will include:

- A descriptive inventory of the existing system elements and current usage;
- A description of future infrastructure and service needs to improve system performance;
- A projection of future funding available to meet projected needs;
- A description of the existing funding sources and an analysis of alternative and innovative sources to address the shortfall in traditional funding; and
- The identification of performance goals, measures, and targets to maximize financial investments to improve multimodal system performance statewide.

Purpose of Stakeholder and Public Participation Plan (SPPP)

TxDOT and the Consultant Team understand that communication and transparency are critical to building trust with stakeholders and the public. Well-informed stakeholders can provide valuable input to the transportation planning process and the project team will thoughtfully consider the input and feedback on TTP content received during the public involvement process.

The SPPP will:

- Define and guide the work in Task 2 (Consultation, Participation, and Public Involvement) of the project scope of services for the Consultant Team and TxDOT Division and District staff members; and

- Outline a public involvement process that is transparent and provides stakeholders and the public with:

  - Educational materials and access to the data and information (e.g., documents, exhibits, schematics, maps, photographs, etc.) used in the development of the TTP; and

  - Opportunity for review and input at key decision points throughout the development of the TTP and the completion of this project.

Stakeholder and Public Participation Objectives

1) Establish early and continuous public participation opportunities that provide timely information about transportation issues and decision-making processes to all interested parties;

2) Provide reasonable public access to educational, technical, and policy information to enhance the public's knowledge and ability to participate in the development of the TTP;

3) Provide adequate public notice of participation opportunities during the development of the TTP, and time for public review and comment at key decision points in the planning process;

4) Ensure that public participation opportunities are held at convenient and accessible locations and times (in compliance with the Americans with Disabilities Act of 1990);

5) Make information comprehendible using visualization techniques, and available in appropriate electronically-accessible formats and means (i.e., PDF and PowerPoint) via the TxDOT website, technology-enabled media (i.e., Facebook and Twitter), and video-teleconferencing (VTC) via WebEx;

6) Include measures for seeking input from and considering the needs of those traditionally underserved by existing transportation systems as defined in Title VI of the Civil Rights Act of 1964 (Title VI), such as low-income, minority, and non-English speaking households who may face challenges accessing employment and other services; and

7) Provide for the periodic review of the public participation process to ensure the effectiveness of TxDOT's public involvement efforts and revise the process as appropriate.

Stakeholder and Public Participation and Public Participation Approach

The TTP stakeholder and public participation activities are intended to solicit meaningful input from:

- Users of the transportation system (all modes), including disabled, low-income, minority, and non-English speaking populations
- Metropolitan and Rural Planning Organizations (MPOs and RPOs)
- Public transportation agencies (metropolitan and rural)
- Freight shippers and providers of freight services (in coordination with the Texas Freight Mobility Plan stakeholder engagement efforts)
- Private providers of transportation
- Affected state and federal resource agencies
- Affected Tribal Governments
- State and local elected officials (metropolitan and non-metropolitan areas)
- All other interested parties

Technical Advisory Committee (TAC) Meetings

The TAC will include subject matter experts from within TxDOT who will meet, as necessary, to participate in an on-going dialogue with regard to TTP goals, measurements, and targets to ensure a cross-disciplined approach to the development of a performance-based, multimodal, long-range transportation plan.

Stakeholder Workshops/Public Meetings

All stakeholders are of vital importance to TxDOT, and will play a significant role in the development of the TTP. A smaller representative group of stakeholders and planning partners (*Texas Planning Partners Group*) with subject matter expertise in transportation planning and delivery – defined in 23 USC 135(f)(3) as “interested parties” – will be chosen to participate in two (2) rounds of TTP development workshops. The TAC will assist the project team in identifying potential participants from around the state to ensure a well-balanced, multi-disciplined, and multimodal approach to the development of the TTP.

TxDOT and the Consultant Team will use traditional participation methods and technology-enabled media to inform the general public of the TTP, solicit their input, and invite them to actively participate, online and in-person, in its development. We will promote activities through neighborhood and community groups, churches, and educational institutions, and will consider the needs of those traditionally underserved by existing transportation systems as defined in Title VI, such as low-income, minority, and non-English speaking households who may face challenges accessing employment and other services.

Two rounds of stakeholder workshops and public meetings will be held in various locations throughout the state. Round 1 will include eight (8) stakeholder workshops and eight (8) public meetings (Table 1). Round 2 will include 25 stakeholder workshops and 25 public meetings (Table 2) in each TxDOT district.

Table 1. Round 1 Workshop and Meeting Schedule

Date	In-Person TxDOT District Office Location	VTC Simulcast (Public Meeting)
Round 1 (2013)		
Wed. November 6	San Antonio	✓
Thurs. November 7	Pharr	
Wed. November 13	Houston	
Thurs. November 14	Bryan	
Mon. November 18	Lubbock	
Tues. November 19	Wichita Falls	
Wed. November 20	Dallas	✓
Thurs. November 21	Abilene	

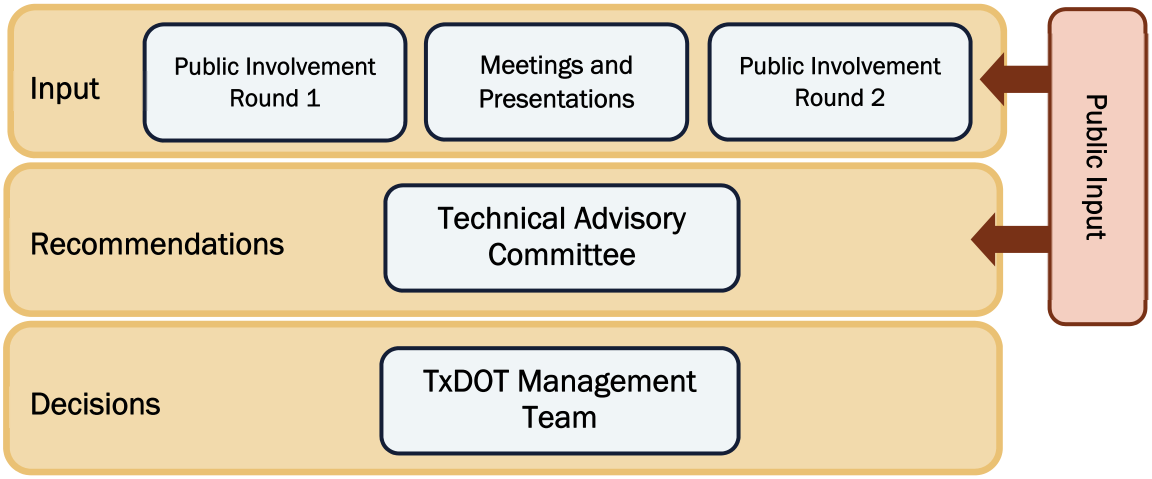
Table 2. Round 2 Workshop and Meeting Schedule

Date	Location	Media coverage* (Public Meeting)
Round 2 (2014)		
Mon., June 9	Bryan	
Tues., June 10	Beaumont	✓
Wed., June 11	Houston	✓**
Thurs., June 12	Lufkin	✓
Mon., June 16	San Angelo	✓
Tues., June 17	Odessa	✓
Wed., June 18	El Paso	✓**
Tues., June 24	Atlanta	✓
Wed., June 25	Paris	
Thurs., June 26	Tyler	✓
Mon., July 7	Dallas	✓
Tues., July 8	Wichita Falls	✓
Wed., July 9	Fort Worth	
Thurs., July 10	Brownwood	
Mon., July 14	Laredo	
Tues., July 15	Pharr	✓**
Wed., July 16	Corpus Christi	✓
Thurs., July 17	Victoria (Yoakum district)	✓
Mon., July 21	Waco	✓
Mon., July 28	Abilene	✓
Tues., July 29	Childress	✓
Wed., July 30	Amarillo	✓
Thurs., July 31	Lubbock	✓
Mon., August 4	San Antonio	✓
Tues., August 5	Austin	✓

* Historical information added upon completion of Round 2
**Spanish-speaking media present

The purpose of the first round of workshops and meetings will be to describe to the attendees the purpose of the TTP and to solicit input to guide its initial development. The second round of workshops and meetings will be held to present the preliminary results of the data analysis to solicit input for recommendations regarding transportation system goals and performance measurements for consideration by TxDOT Management and Administration (Figure 1).

Figure 1: Process for Input and Adoption of TTP Content



To maximize resources and ensure consistency, workshops and meetings will be held at different times on the same day (with breaks between meetings), at the same location, using the same project information and visualization resources. In consultation with TxDOT staff, the Consultant Team will determine the date, geographic location, and venue for each workshop/meeting.

Select public meetings will be accessible via VTC at TxDOT District offices. TxDOT will be responsible for all stakeholder invitations, public meeting notices, and arrangements for VTC access. TxDOT and the Consultant Team will cooperatively develop all educational and informational materials for the workshops and meetings.

The Consultant Team will package meeting materials including a narrated PowerPoint presentation, illustrative boards, comment forms, and handouts for use by TxDOT staff at meetings not attended or coordinated by the consultants. The materials will be the same as those used for the scheduled workshops and meetings.

Meeting notices, surveys, and comment forms will be available at the public meetings and on the TxDOT website/project webpage in both English and Spanish. Every reasonable effort will be made to accommodate persons with disabilities who have special communication or accommodation needs who plan to attend a public meeting. Instructions regarding requests will be included in the meeting notices.

Additional Meetings/Conferences

TxDOT and the Consultant Team recognize the need to convey critical messaging surrounding the TTP to audiences other than those listed specifically in the SPPP. As such, selected members of the Consultant Team will attend up to eight (8) conferences or additional meetings to present TTP materials, background, and findings as authorized by TPP.

Interactive Planning and Programming Tool

Following Round 1 of stakeholder and public engagement activities, the Consultant Team will develop a web-based Interactive planning and programming Tool to provide a "real-time" planning and budgeting experience that can be explored by workshop and meeting participants to be showcased at the 2014 Texas Transportation Planning Conference and Round 2 meeting venues. The MetroQuest tool will enable users to simulate decision-making scenarios encountered in the planning and programming processes.

The tool will be developed in consultation with the TAC, based on existing conditions and needs scenarios outlined in Tasks 3 (*Data Collection, Review, and Assessment*) and 4 (*Existing Conditions, Current/Forecasted Demands and Needs*) of the project scope – taking into consideration, the comments gathered and transportation priorities identified during the first round of stakeholder workshops and public meetings.

Electronic Contact and Mailing List

The Consultant Team will prepare, and update monthly, an electronic contact and mailing list for E-Blast messages and public meeting notifications that will be distributed via E-mail (and USPS upon request) where possible. This mailing list will be based on existing TxDOT contact information and may include research to identify new stakeholders for inclusion.

Throughout the stakeholder and public participation process, interested parties will be added to the electronic contact list upon request through the project webpage or at any meeting, allowing for follow-up, continued notification, and interaction.

The electronic contact list will be stored in a single database to be used by the project team to maintain consistency of the data and for tracking purposes.

E-Blast Messages

The project team will distribute project information via E-Blast – in addition to the information provided on the project webpage – for the duration of the project. TxDOT's Public Involvement

Office will review and approve the content of each E-Blast message. All project information will be distributed electronically whenever possible (USPS delivery available to any stakeholder or member of the public upon request).

The first message will be prepared and distributed to those on the contact list prior to the first round of stakeholder and public meetings and at those meetings. It shall include information on the dates, times and locations of meetings and a description of the purpose of the project.

The second message will be prepared midway through the project to provide recipients an update on the development of the TTP. It will be distributed to those on the contact list prior to the second round of stakeholder and public meetings. It shall include a project status and an invitation to provide comments and feedback via the survey or MetroQuest tool.

The final message will provide information on the results of the project and will be distributed to those on the contact list prior to the public hearing.

Surveys

Survey instruments will be available on the project webpage (to complete on-line), in the TxDOT District Offices, and at each Round 1 and Round 2 meeting venue to solicit stakeholder and broad community feedback. The surveys will be simple and straightforward with check-offs or priority listing. The survey will not require detailed answers or extensive writing. Hard copies of the surveys may also be completed and mailed or faxed in using the information provided on the survey.

Project Webpage and Social Media

TxDOT – in consultation with the Consultant Team – will develop a project webpage on TxDOT.gov, and make regular updates to the webpage content. TxDOT will be responsible for developing, maintaining, monitoring, and adding content to the webpage and will review and approve all webpage content developed by the Consultant Team.

TPP and the Consultant Team will establish and monitor a project E-mail address to obtain public input and comments for the duration of the project. All public comments obtained via the webpage will be delivered to the Consultant Team for inclusion in an electronic notebook. The project team will group comments and draft general responses to public comments and questions for review for inclusion in the public record.

The Consultant Team will prepare up to three (3) media releases for distribution by TxDOT staff and will support TxDOT's use of social media by providing text for up to six (6) Facebook posts. TPP will be responsible for all media relations and social media with the Communications Division and Public Information Officers.

Electronic Notebook for Stakeholder/Public Engagement Activities

The Consultant Team will document stakeholder and public participation activities in an electronic notebook for internal use by the project team. The contents will include a summary of the engagement process and copies of all E-Blast message content, meeting notifications, mailing lists, attendee sign-in sheets, meeting photos, meeting summaries, stakeholder/public comments, and TxDOT's responses to all comments received.

Public Hearing

A public hearing will be conducted by TxDOT, in Austin, prior to finalizing the plan. The Consultant Team will provide materials for the public hearing, and the Consultant Team Project Manager will attend the hearing to support TxDOT staff and document any public comments received. Every reasonable effort will be made to accommodate persons with disabilities and those with special communication needs at the hearing. Instructions regarding requests will be included in the hearing notice.

Concurrent TxDOT Public Engagement Efforts

Similar public engagement initiatives for other planning activities and projects (e.g., Texas Freight Mobility Plan) will be initiated or underway concurrent with the development of the TTP. To avoid confusing the public and to prevent engagement "fatigue," the project team will coordinate activities and will accept comments from stakeholders and the public for any TxDOT activity and ensure those comments are routed to the appropriate recipient for response/action.

Key Stakeholder and Public Participation Activities

The key public engagement activities and tools to be implemented in the development of the TTP are summarized in Table 3.

Table 3. Key Stakeholder and Public Participation Activities

Event	Description	Approximate Date	Desired Outcome
First Round of Outreach			
E-Blast #1	E-Blast announcing study and upcoming meeting	October 2013	Notify public of planning efforts and public meetings (Round 1)
Stakeholder Workshops	Workshops with stakeholders (MPOs, elected officials, etc.) in 8 districts	November 2013	Notify stakeholders of planning efforts; Obtain input/feedback on TTP framework and study methodology
Public Meetings	Open house public meetings in 8 districts	November 2013	Notify public of planning efforts; Obtain input/feedback from the public on TTP framework
Second Round of Outreach			
E-Blast #2	E-Blast announcing study results to date, Round 2 meetings, survey and MetroQuest Tool	May 2014	Notify public of current status and public meetings (Round 2)
Stakeholder Workshops	Workshops with stakeholders (MPOs, elected officials, etc.) in all 25 districts	June-August 2014	Notify stakeholders of TTP development status/initial study results; Continue to obtain input/feedback
Public Meetings	Open house public meetings in all 25 districts	June-August 2014	Notify public of TTP development status/initial study results; Continue to obtain input/feedback
Public Hearing			
E-Blast #3	E-Blast announcing study results and upcoming public hearing	October 2014	Notify public of DRAFT final TTP study results; Announce the Public Hearing
Public Hearing	Conduct a Public Hearing (Austin)	October or November 2014	Present DRAFT final TTP document and obtain feedback from all affected stakeholders

Appendix B
Technical Advisory Committee Meeting Summaries

TAC #1 WORKSHOP SUMMARY

DATE/TIME: Thursday, October 10, 2013/ 1:30 PM-3:15 PM

LOCATION: TxDOT Riverside Campus – Building 118, Room 1B.31

PREPARED BY: Stephanie Lind, Alyson Welsh-Reaves

SUBJECT / MEETING TOPIC: Texas Transportation Plan - TAC Meeting (TAC #1)

Introduction

The TxDOT Texas Transportation Plan (TTP) Technical Advisory Committee (TAC) meeting #1 was held on October 10th, 2013 from 1:30-3:15 PM. Jack Foster welcomed the group to the meeting and prompted introductions. Meeting attendees were as follows:

TTP Technical Advisory Committee - Attendees
Michelle Conkle, TTP Project Manager, Transportation Planning and Programming Division
Ed Collins, Austin District
Jim Cotton, Traffic Operations
Casey Dusza, Transportation Planning and Programming Division
Jack Foster, Transportation Planning and Programming Division
Jefferson Grimes, Office of Public Involvement
Dan Harmon, Maritime Division
Orlando Jamandre, Rail Division
Kelly Kirkland, Public Transportation Division
Caroline Love, TxDOT Commission Office
Caroline Mays, Transportation Planning and Programming Division
Greg Miller, Aviation Division
Michael O'Toole, Bridge Division
Peggy Thurin, Transportation Planning and Programming Division
Diana Vargas, Austin District
Marc Williams, Director, Transportation Planning and Programming Division

Consultant Team:
Michelle Maggiore, TTP Project Manager (CH2M HILL)
Emily Braswell, Performance Measures Technical Lead (RS&H)
Mark Callahan (CH2M Hill)
Stephanie Lind, Transportation Planner (CH2M Hill)
Alyson Reaves, SLRTP Goals and Objectives Technical Consultant (CH2M HILL)

After introductions, Michelle Maggiore outlined the remaining agenda items: 1) TTP project overview; 2) TTP framework; 3) discussion; and 4) next steps.

TTP Project Overview

Michelle Maggiore summarized the purpose of the TTP. The TTP will advance the goals of the 2013-2017 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan (TRTP). The Plan will integrate other planning documents and efforts including the Unified Transportation Program (UTP), Transportation Improvement Programs (TIPs), Statewide Transportation Improvement Program (STIP), and the Texas Freight Mobility Plan (TFMP) that is currently being developed. TTP development will be coordinated with ongoing TxDOT initiatives including the development of performance measures.

Michelle Maggiore provided an overview of how the goals and objectives will be developed for the Plan. Goals and objectives will be coordinated with other adopted plans and will use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of Moving Ahead for Progress in the 21st Century Act (*MAP-21*). Marc Williams, the Director of Planning for TxDOT, noted that the TTP will take advantage of all previous and ongoing planning efforts in order to comprehensively address the needs of the State. The Plan will help TxDOT and State legislators optimize investment decisions and evaluate trade-offs with respect to system performance.

To develop a performance-based plan, the Project Team will use the Strategic Plan goals for the overall vision of the TTP. Specific TTP goals will be developed using information obtained from the TAC, stakeholders, and the public, in addition to previous and ongoing planning efforts. The goals will be confirmed by TxDOT. Using the approved goals, the Project Team will perform scenario analysis targeted to maximize the value of investments with respect to long-term goals; this analysis will be used to ultimately inform UTP/STIP project selection. Performance measures linked to Plan goals will be used to evaluate and monitor investment scenarios and impacts in addition to plan implementation and system performance over time.

TTP Framework

Alyson Reaves provided an overview of state and national legislative requirements that will guide the development of the Plan including Texas Administrative Code Title 43, Chapter 16, MAP-21, and other national freight and environmental streamlining provisions. Alyson provided a review of the required goal areas under MAP-21, noting that they will be integrated into whatever goals are established in the TTP. She discussed how the current goals in the 2013 – 2017 Strategic Plan overlap with the federal requirements. Lastly, Alyson noted that states typically align their long-range plan goals with national goals.

Discussion

Michelle Maggiore introduced the discussion portion of the meeting, noting the purpose of the discussion exercise:

- Generate ideas for TTP-specific goals, including long-range priorities for each goal area;
- Identify gaps, identify new priorities/goal areas; and
- Begin to look at performance measures.

Emily Braswell explained that she would lead the discussion in a round-robin fashion, working around the room, giving everyone an opportunity to discuss their key areas of concern as they relate to potential TTP goals. The following responses were provided:

- Accountability and process for decisions and transparency in planning, project development, and project delivery reporting
- Enhance public trust
- Educate the public and all stakeholders, including TxDOT Divisions/Districts, on the investment decision-making process
- Educate the public/stakeholders about where the money comes from and where the money goes
- Improve transportation safety
- Reduce fatalities and injuries at highway-rail crossings
- Local coordination for planning and project development
- Deliver an accountable and responsive planning process for all stakeholders
- Innovative finance and non-traditional project development/delivery for both highway and non-highway modes
- Economic development and productivity/competitiveness
- Freight and passenger reliability and congestion reduction
- Facilitation of state-national-global commerce
- System connectivity
- Customer service and messaging regarding investment decisions
- Provide guidance to/sharing information with transit agencies, particularly in rural areas and for disadvantaged populations
- Safety, asset condition and performance, for on/off-system bridges
- Safety, system preservation, economic development/utilization, and support for business users (aviation)
- Environment
- Listen to our customers
- Define infrastructure investment priorities
- Operate and maintain our system as efficiently and effectively as possible/costs of system preservation
- Funding shortfalls and needs
- Coordination with transportation planning and delivery partners and private sector to deliver a more efficient system and to build consensus for investment decisions across modes
- Multimodal (including intermodal) – deliver a system that connects modes and leverages resources/modes/agencies
- Changes in the way we travel – older generation/younger generation

Next Steps

Michelle Conkle thanked everyone for attending the TAC meeting and providing valuable input. She then discussed next steps for the TTP that will include a series of stakeholder events and open houses throughout the state in November. The first round of outreach will focus on collecting and integrating feedback regarding the Plan goals and objectives and on educating the public about planning efforts and decision-making challenges. The second round of outreach will begin in May 2014 and will focus on investment scenarios. The format for the meetings will include a morning stakeholder meeting and an early evening open house with a presentation and an opportunity for questions/answers. Some meetings will include Video Teleconferencing (VTC) capabilities to make the presentation available to those who cannot attend in person. While all the dates and locations have not been finalized, the following list was presented to the TAC for a total of 8 Round 1 outreach meetings:

- Wednesday, November 6 – San Antonio District Complex with VTC
- Thursday, November 7, Pharr District Complex
- Wednesday, November 13, Houston District Complex
- Thursday, November 14, Bryan District Complex
- Monday, November 18, Lubbock District Complex
- Tuesday, November 19, Wichita Falls District Complex
- Wednesday, November 20, Dallas District Complex with VTC
- Thursday, November 21, Abilene Center for Contemporary Artists

Michelle Conkle encouraged the TAC members to provide names of relevant stakeholders to invite to the events. She then thanked everyone for their attendance at today's meeting and for their continued involvement in the TTP planning efforts. Based on participant feedback, the next TAC meeting will occur after the first round of outreach, which concludes in November.

TAC #2 WORKSHOP SUMMARY

DATE/TIME:	Wednesday, January 29, 2014/ 1:30 PM-3:15 PM
LOCATION:	TxDOT Riverside Campus – Building 120, Room 1A.2
PREPARED BY:	Stephanie Lind
SUBJECT / MEETING TOPIC:	Texas Transportation Plan - TAC Meeting (TAC #2)

1. INTRODUCTION

The Texas Transportation Plan (TTP) Technical Advisory Committee (TAC) Workshop #2 was held on January 29, 2014 from 1:30-3:15 PM. The Consultant Team Project Manager Michelle Maggiore provided opening remarks and prompted introductions. Meeting attendees were as follows:

1.1 TTP Technical Advisory Committee - Attendees

- Michelle Conkle, TTP Project Manager, Transportation Planning and Programming Division
- Casey Dusza, TTP Deputy Project Manager, Transportation Planning and Programming Division
- Ed Collins, Austin District
- Jim Cotton, Traffic Operations
- Jack Foster, Transportation Planning and Programming Division
- Dan Harmon, Maritime Division
- Susan Howard, Office of Public Involvement
- Orlando Jamandre, Rail Division
- Teri Kaplan, Public Transportation Division
- Kelly Kirkland, Public Transportation Division
- Jenny Li, Maintenance Division
- Caroline Mays, Transportation Planning and Programming Division
- Greg Miller, Aviation Division
- Michael O'Toole, Bridge Division
- Peggy Thurin, Transportation Planning and Programming Division
- Diana Vargas, Austin District
- Darla Walton, Public Transportation Division

1.2 Consultant Team:

- Michelle Maggiore, TTP Project Manager (CH2M HILL)
- Susan Atherton (CH2M HILL)
- Emily Braswell (RS&H)
- Mark Callahan (CH2M HILL)
- Kevin Ford (CH2M HILL)
- John Kelly (CH2M HILL)

- Stephanie Lind (CH2M HILL)
- Alyson Reaves (CH2M HILL)

After introductions, Michelle Maggiore outlined the agenda items: 1) TAC Summary; 2) TTP Schedule and Development Process; 3) Stakeholder Outreach and Survey Summary; 4) Draft TTP Goal Areas; 5) Draft Goal and Objective Statements for TAC Review; 6) Discussion – Additional Goal Areas/Objectives; and 7) Next Steps.

1.3 TAC Summary

Michelle Maggiore summarized the purpose of the TTP and provided an overview of the TTP goal and objective development process. Draft goal areas and corresponding goal and objective statements were developed based on feedback from TAC Workshop #1 in October and were presented to the public and stakeholders during Round 1 of outreach in November. The current list of draft goals and objectives reflects public and stakeholder comments that were collected during Round 1 of outreach and as part of an ongoing web survey.

1.4 TTP Schedule and Development Process

Michelle Maggiore presented the TTP Development Schedule and highlighted progress to date. Currently, the Consultant Team is working to:

- Finalize the goals and objectives
- Analyze current and forecasted multimodal conditions, demand and needs
- Develop performance measures and targets
- Develop and evaluate multimodal investment strategies and trade-offs based on performance measures and current and expected future revenues
- Review TxDOT project selection and project development processes
- Support ongoing stakeholder and public involvement efforts.

1.5 Stakeholder Outreach and Survey Summary

Michelle Maggiore provided an overview of Round 1 of Plan outreach. The project team presented to 8 districts as planned and 3 additional groups upon request. In general, comments received from 81 stakeholders and 91 members of the general public during Round 1 of outreach revealed that:

- Long-range funding and sustainability of funds should be considered as an over-arching Department goal.
- Safety is more than highway safety – bicycle and pedestrian safety is very important.
- ‘Taking care of what we have’ is critical and cost effective practices should be adopted.
- Modal options and connectivity are important in urban and rural areas across the state.
- The distinct travel needs of the elderly and disabled should be considered and prioritized.
- The ‘last mile’ of a non-highway trip for both passengers and freight is often the most critical.

- Communicating, gathering feedback and being honest with the public is desired.

Casey Dusza provided a summary of the survey responses collected at the public meetings and via the project website (as of January 14, 2014). The survey will continue to be available throughout TTP development. TTP Project Manager Michelle Conkle noted the importance of the survey and asked meeting attendees to help increase awareness of the survey and encourage participation.

1.6 Draft TTP Goal Areas

Alyson Reaves explained how the proposed TTP goal areas align with the goals established in the 2013 – 2017 Strategic Plan and with the national goals established under MAP-21. Six TTP goal areas were developed based on the transportation priorities identified by the TAC at Workshop #1:

- Safety
- Asset Management
- Mobility and Reliability
- Multimodal Connectivity
- Stewardship
- Customer Service

These draft goal areas were presented to the stakeholders and public during Round 1 of Plan outreach for consideration. Among the feedback collected included the suggestion for a “Sustainable Funding” goal area based on its critical importance to Texas’ transportation future.

1.7 Draft Goal and Objective Statements for TAC Review and Discussion

Alyson Reaves summarized the draft goals and objectives that have been developed to date and asked the TAC to provide comments and suggested revisions. Due to time limitations, TAC members were asked to write additional comments or edits on handouts that were collected at the end of the workshop. Suggested revisions from the discussion are provided below; additional comments obtained from the handouts are attached.

- Define “multimodal” and “intermodal”
- Emphasize that safety issues are often associated with points of conflict.
- Rephrase the safety objective to “Increase bicycle and pedestrian safety through education and design enhancements” to include initial design of facilities in addition to design improvements, and use another word for “enhancements”.
- Rephrase the asset management objective to “build and maintain an asset inventory” to acknowledge existing inventories by mode as well as ongoing efforts to develop management systems.
- Discuss the behavioral causes of congestion and its relationship to sustainability.

In considering whether “Sustainable Funding” should be included as a standalone goal area:

- There was general agreement among TAC members that it should be included as a standalone goal area.

- A meeting participant noted that due to the complexity of funding programs, it may be difficult to draw out all of the funding sources for the state that may include local and/or regional sources.
- A meeting participant noted the importance of legislation in supporting the successful implementation of this goal.

1.8 Next Steps and Needs Methodologies

Michelle Maggiore provided an overview of next steps in the TTP development process: 1) finalize goals and objectives based on TAC and executive feedback; 2) develop performance measures based on the final set of goals and objectives and data availability; 3) estimate unconstrained needs for all modes represented in the Plan; 4) forecast reasonably expected revenues over the Plan horizon; and 5) prioritize investments under constrained funding scenarios and evaluate alternative scenarios.

Michelle Conkle thanked the meeting attendees for their ongoing support and participation in the TTP development process.

TAC #3 WORKSHOP SUMMARY

DATE/TIME:	Wednesday, May 14, 2014 / 1:30 PM-3:30 PM
LOCATION:	TxDOT Riverside Campus – Building 120, Room 1A.2
PREPARED BY:	Michelle Maggiore
SUBJECT / MEETING TOPIC:	Texas Transportation Plan - TAC Meeting (TAC #3)

Introduction

The Texas Transportation Plan (TTP) 2040 Technical Advisory Committee (TAC) Meeting #3 was held on May 14, 2014 from 1:30-3:30 PM. A PowerPoint presentation was used throughout the meeting and can be referenced for additional information. Marc Williams welcomed the group to the meeting and provided an overview of the TTP. Michelle Conkle also welcomed the group and prompted introductions. Meeting attendees were as follows:

TTP Technical Advisory Committee – Attendees:
Michelle Conkle, TTP Project Manager, Transportation Planning and Programming Division
Casey Dusza, TTP Deputy Project Manager, Transportation Planning and Programming Division
Ed Collins, Austin District
Dan Harmon, Maritime Division
Susan Howard, Office of Public Involvement (via telephone)
Orlando Jamandre, Rail Division
Teri Kaplan, Public Transportation Division
Kelly Kirkland, Public Transportation Division
Caroline Mays, Transportation Planning and Programming Division
Greg Miller, Aviation Division
Michael O'Toole, Bridge Division
Peggy Thurin, Transportation Planning and Programming Division
Diana Vargas, Austin District
Darla Walton, Public Transportation Division
Marc Williams, Transportation Planning and Programming Division
Sarah Bagwell, Maritime Division
Caroline Love, Government and Public Affairs Division
Magdy Mikhail, Construction Division
Veronica Beyer, Public Involvement Office
Brian Huntsinger, Maintenance Division

Consultant Team:
Michelle Maggiore, TTP Project Manager (CH2M HILL)
Emily Braswell (RS&H)
Stephanie Lind (CH2M Hill)
Alyson Reaves (CH2M HILL)

After introductions, Michelle Maggiore outlined the agenda items: 1) TTP 2040 Schedule; 2) TAC #2 Recap/TTP Draft Goals; 3) Stakeholder/Public Outreach Round 2 Overview; 4) Outreach Schedule; 5) Outreach Tool and Investment Approaches; 6) Unconstrained Needs Assessment by Mode; and 7) TTP 2040 Next Steps.

TTP Development Schedule

Michelle Maggiore presented the TTP Development Schedule for the TAC and highlighted where the planning team was in the overall process. Currently, the team is:

- Developing performance measures and targets;
- Developing and evaluating multimodal investment strategies and trade-offs based on performance measures and current and expected future revenues;
- Reviewing TxDOT project selection and project development processes; and
- Preparing for the second round of stakeholder and public outreach.

TAC #2 Recap and Draft TTP 2040 Goal Areas

Michelle Maggiore provided a recap of TAC Meeting #2 whereby participants were asked to provide feedback for and suggest modifications to the DRAFT TTP 2040 goals and objectives. The most significant change offered was the addition of a "Financial Sustainability" goal area. This suggestion as well as other revisions were incorporated into the latest set of goals and objectives, with all changes documented in a technical memo that was distributed to the TAC. **Figure 1** illustrates the latest set of DRAFT TTP 2040 goal areas and their alignment to the 2013-2017 Strategic Plan and MAP-21.

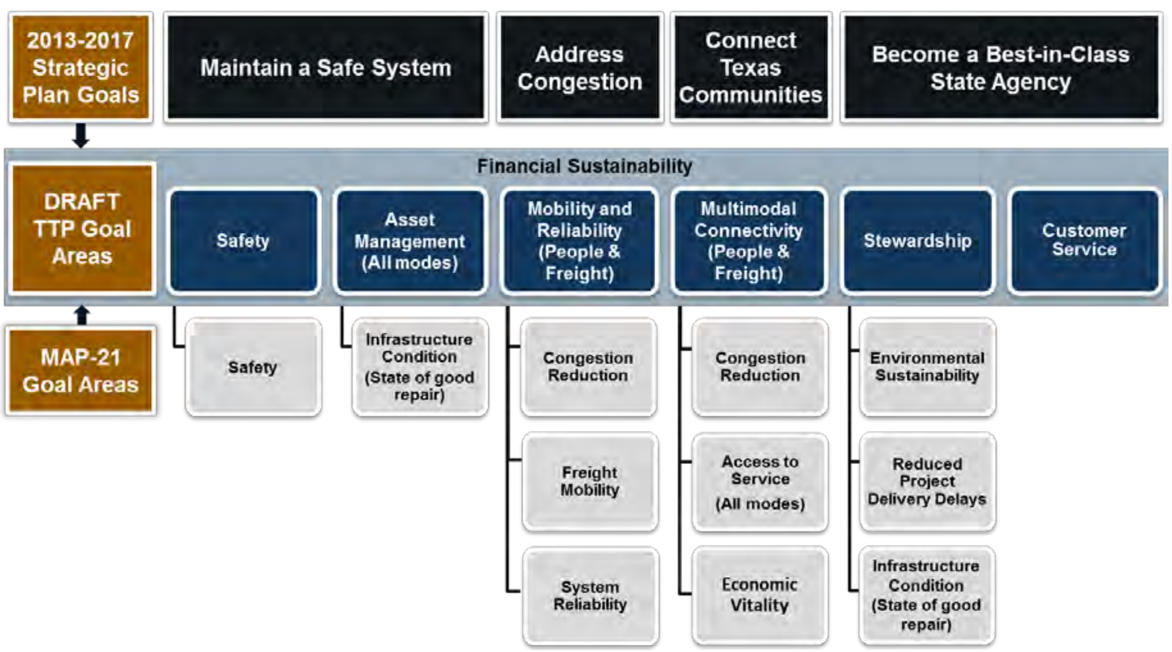


Figure 1: DRAFT TTP 2040 Goal Areas and Alignment to the 2013-2017 Strategic Plan and MAP-21

Stakeholder and Public Outreach Overview

Stephanie Lind provided an overview of the public outreach activities to date and what is ahead. Public notice has been posted on the web for all upcoming meetings; additionally, the team is working to make personal calls and send emails to MPOs/RPOs and industry stakeholders regarding upcoming meetings. The team has been coordinating with TxDOT on posting project updates to social media outlets including Twitter and Facebook.

The second round of outreach will involve two meetings at each of the 25 Texas districts: a facilitated workshop for stakeholders in the afternoon and an open house for the general public in the evening that will showcase the public involvement tool.

Michelle Conkle provided an update on the transportation survey responses to date. Over 875 people have filled out the most current version of the survey. The survey is available through SurveyMonkey with links provided on the TxDOT website.

MetroQuest Tool Features

Michelle Maggiore provided an overview of the MetroQuest tool. The tool utilizes distinct investment approaches and a budget exercise to educate the public on the performance impacts and tradeoffs of focusing investments in different ways.

Emily Braswell introduced the MetroQuest tool. The tool is currently being reviewed by TxDOT with suggested changes to be submitted by Friday, May 23rd. Emily explained that the tool walks users through two main exercises:

1) Selecting and ranking their top three transportation priorities for the state and observing how these priorities and others perform under three investment approaches.
Users are asked to select and rank their top three priorities from a set of six possible choices:

- Bridge condition
- Pavement condition
- Transit condition
- Transit/rail ridership
- Traffic congestion
- Job creation

Users can observe through the use of performance indicators how their top priorities and others are expected to change under three investment approaches (all of which address safety as the number one priority):

1. System Preservation: Investing in the existing State transportation system to achieve state-of-good-repair for highway, bridge, and transit assets.

2. Metropolitan Mobility: Addressing congestion in urban and suburban areas through strategic capacity enhancements, operational improvements, and investments in multimodal facilities.

3. Connectivity and Freight Mobility: Investing in rural areas of the state to facilitate the movement of freight, support Texas industry, and provide rural residents with access to goods and services.

Users can then rate the approaches based on the cost of implementation and how well the anticipated performance outcomes align with their top priorities.

2) Spending hypothetical "new" dollars on different types of transportation investments and observing how the system performs given the specified budget allocation.
Users are asked to move money around across six funding categories:

- Pavement preservation
- Roadway expansion
- Transit service expansion
- Bridge preservation

- Transit service preservation
- Freight projects

Performance indicators are displayed on a dashboard to show how well the statewide system performs given the specified allocation.

Performance-Based Needs Assessment

Michelle Maggiore provided an overview of the unconstrained needs to 2040 as expressed in 2014 constant dollars. As the TTP 2040 is a performance-based plan, unconstrained needs were determined as the costs to achieve specific performance thresholds. The total unconstrained needs to 2040 across all modes was determined to be **$611.58 Billion** ($514.58 Billion without MTAs). Alyson Reaves discussed specific modal needs and the assumptions used to estimate needs as summarized below. Additional information on the modal assumptions and methodologies is provided in the "Needs Update" Technical Memo.

Unconstrained Needs – Pavement
Pavement needs were estimated to be **$107.7 Billion** ($4 Billion average annual calculated over 27 years from 2014-2040). These needs were estimated to reflect the preservation, rehabilitation, and reconstruction costs required to keep on-system roads in good or better condition based on least life-cycle cost activity selection; expansion needs are not included in this cost.

Unconstrained Needs – Highway Expansion
Highway expansion needs were estimated to be **$297.6 Billion** ($9.9 Billion average annual calculated over 30 years from 2010-2040). These needs were estimated to reflect the cost of expanding the system to achieve a level of service C or better on the state highway system (on an A-F scale); bridge and pavement preservation needs are not included in this cost.

Unconstrained Needs – Bridge and Culvert
Bridge and culvert needs were estimated to be **$41.5 Billion** ($1.5 Billion average annual calculated over 27 years, from 2014-2040). These needs were estimated to reflect the maintenance, rehabilitation, and replacement costs required to avoid structural deficiency (i.e., achieve an NBI rating of 5 or better for all bridge components) and minimize functional obsolescence for all on-system bridges and culverts over 20 feet in length; expansion needs are not included in this cost. The team will vet the unit cost assumptions for bridge maintenance and reconstruction with representatives from the Bridge Division.

Unconstrained Needs – Transit
Transit needs were estimated to be **$105.1 Billion** (97.0 Billion MTAs/$8.1 Billion non-MTAs or $3.9 Billion average annual calculated over 27 years from 2014-2040). These needs were estimated to reflect the capital and operating costs for existing transit assets and services to maintain "good or better" state-of-repair; and expansion needs by region (major urban, collar, small urban, rural) to accommodate population growth and address underserved areas.

Unconstrained Needs – Passenger Rail
Passenger rail needs were estimated to be **$22.4 Billion** ($0.8 Billion average annual calculated over 27 years, from 2014-2040). These needs were estimated to reflect the capital costs for two new high speed rail corridors ($2 Billion) as well as expansion costs for existing Amtrak services ($400 M). The needs assessment does not include other proposed routes or the maintenance and operating costs for Amtrak.

Unconstrained Needs – Bicycle and Pedestrian

Bicycle and pedestrian needs were estimated to be **$2.3 Billion** ($0.1 Billion average annual calculated over 27 years from 2014-2040). These needs were estimated to reflect MPO identified projects ($1.87 Billion) and additional needs for rural areas ($0.4 Billion).

Unconstrained Needs – Aviation

The aviation needs were estimated to be **$21.2 Billion** ($0.8 Billion average annual calculated over 27 years from 2014-2040). These needs were developed by extrapolating the costs of projects included in TxDOT's RAMP and TADS systems to year 2040; the costs of additional expansion projects from large commercial airports or preservation needs for facilities and runways are not included in the assessment due to data limitations.

Unconstrained Needs – ITS

The ITS needs were estimated to be **$13.7 Billion** ($0.5 Billion average annual calculated over 26 years, from 2015-2040). These needs were estimated to reflect the costs required to operate, maintain, and replace existing ITS assets; and the costs required to implement, operate, and maintain future planned assets as identified by TxDOT. This estimate does not include any operational strategies identified in the Freight Mobility Plan or technologies required for future changes to revenue collection, for example, High Occupancy Toll (HOT) lanes.

Unconstrained Needs – Freight

The freight needs are being developed in coordination with the Texas Freight Mobility Plan effort. Other freight mode-specific plans including ports and maritime and freight rail will be incorporated and checked for consistency.

Next Steps

Michelle Maggiore noted that technical memos are available for each mode with detailed information on the methodology used to estimate unconstrained needs. She then discussed next steps for the project which include scenario analysis, embarking on the second round of outreach, and finalizing/ launching the MetroQuest tool. Michelle Conkle invited TAC members to attend the statewide outreach and asked for their assistance in getting the word out about the stakeholder meetings and open houses.

TAC #4 MEETING SUMMARY

DATE/TIME:	Monday, August 25, 2014 / 1:30 PM-3:30 PM
LOCATION:	TxDOT Riverside Campus – Building 120, Room 1A.2
PREPARED BY:	Stephanie Lind
SUBJECT / MEETING TOPIC:	Texas Transportation Plan - TAC Meeting (TAC #4)

Introduction

The Texas Transportation Plan (TTP) 2040 Technical Advisory Committee (TAC) Meeting #4 was held on August 25, 2014 from 1:30-3:30 PM. A PowerPoint presentation was used throughout the meeting and can be referenced for additional information. Michelle Conkle welcomed the group to the meeting and thanked everyone for their involvement in the TTP. Meeting attendees were as follows:

TTP Technical Advisory Committee – Attendees:
Michelle Conkle, TTP Project Manager, Transportation Planning and Programming Division
Casey Dusza, TTP Deputy Project Manager, Transportation Planning and Programming Division
Laura Perez, TTP, Transportation Planning and Programming Division
Magdy Mikhail, Construction Division
Diana Vargas, Austin District
Tonia Norman, State Legislative Affairs
Susan Howard, Office of Public Involvement
Orlando Jamandre, Rail Division
Peggy Thurin, Transportation Planning and Programming Division
Sarah Bagwell, Maritime Division
James Koch, Transportation Planning and Programming Division
Teri Kaplan, Public Transportation Division
Kelly Kirkland, Public Transportation Division

Consultant Team:
John Kelly (CH2M Hill)
Stephanie Lind (CH2M Hill)
Alyson Reaves (CH2M Hill), via telephone

Michelle Conkle outlined the agenda items: 1) TTP 2040 Refresher and TAC Meetings Summary; 2) TTP Development Schedule; 3) Stakeholder/Public Outreach Round 2 Process/Feedback; 4) Investment Approach 4 – Balanced Approach; 5) Approach 4 – Plan Performance Measures; 6) Approach 4 - Outcomes; and 7) Discussion and Next Steps.

TTP 2040 Refresher and TAC Meetings Summary

Michelle Conkle began by summarizing how the Texas Transportation Plan is performance based. The Plan includes the following:

- Existing conditions,
- System goals, objectives, and performance measures,

- Current and future demand,
- Long-range transportation needs by mode,
- Funding forecast,
- Investment scenarios and performance outcomes, and
- Implementation and tracking.

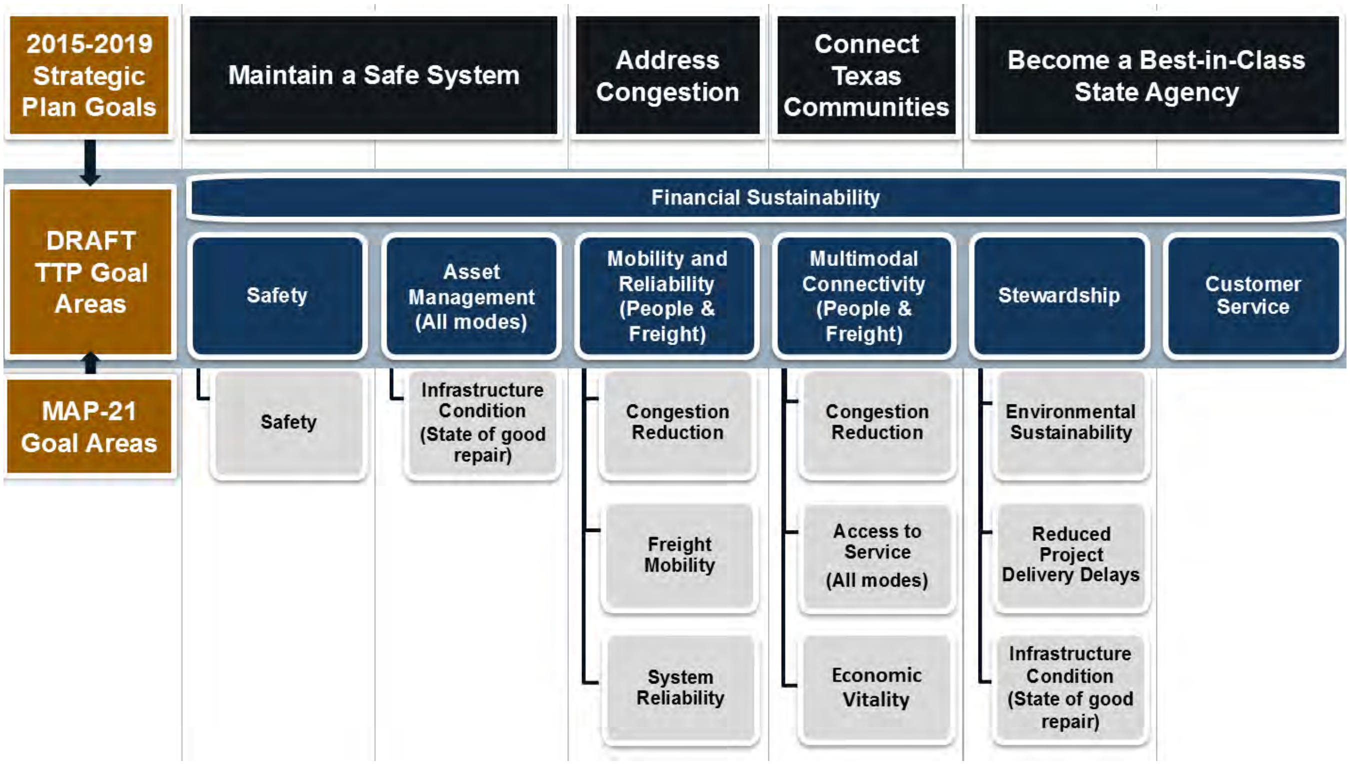
The TTP will look at the long range needs of the state that includes the costs to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the plan horizon. To do this, the TTP looks at different investment scenarios to better understand the tradeoffs among goals and objectives.

Michelle provided an overview of what has been presented to the TAC to-date at each of the four TAC meetings. Information presented by meeting included:

- TAC 1, October 10, 2013
    - TAC priorities for long-range planning in Texas,
    - Proposed TTP schedule, outreach for round 1 schedule, opportunities for coordination among State planning activities, and
    - Draft goals and objectives (via webinar on November 1, 2013).
- TAC 2, January 29, 2014
    - Goal and objective recommendations (finalize language) and
    - Modal needs methodologies.
- TAC 3, May 14, 2014
    - Unconstrained multimodal needs,
    - TTP scenario analysis and MetroQuest tool, and
    - Outreach round 2 schedule.
- TAC 4, August 25, 2014
    - Outreach findings and
    - TTP development and review (including Modal profiles).

Michelle presented a summary of the TTP 2040 goal areas and explained how they are related to the 2013 – 2017 Strategic Plan goals and MAP-21 goal areas. The goal areas for the TTP include: safety, asset management (all modes), mobility and reliability (people & freight), multimodal connectivity (people & freight), stewardship, customer service and financial sustainability.

Figure 1 - TTP 2040 Goal Areas and Alignment to the 2013-2017 Strategic Plan and MAP-21



Michelle reviewed the TTP development schedule highlighting the final steps in the development and adoption of the TTP.

The modal profiles that provide the unconstrained needs assessment for the TTP have been or are under review by TxDOT. Michelle Conkle asked if anyone on the TAC is still reviewing modal profiles and encouraged them to finalize their review.

Outreach Round 2 – Process and Feedback

Stephanie Lind provided an overview of the public outreach activities as part of round 2 of outreach on the TTP. The planning team supported two meetings at each of the 25 Texas districts: a facilitated workshop for stakeholders in the afternoon and an open house for the general public in the evening. The stakeholder workshops drew 194 attendees and the open house drew 475 attendees across the state.

Stephanie went through some preliminary results from the MetroQuest tool that was developed for the TTP. The tool is available through the end of September, once the tool has been taken down, final results will be developed. Highway expansion and congestion reduction were top priorities for tool users for both the prioritization exercise and the budget allocation. When the results from the rating of the three investment approaches were reviewed, in general, all three were equally popular. Lastly, most users supported allocating more money toward transportation.

Investment Approach 4

Alyson Reaves introduced "approach 4" to the TAC. Approach 4 was presented as an example of a balanced approach to investment for the statewide transportation system. It assumes that statewide multimodal needs for TxDOT and its transportation partners cannot be achieved under the current revenue forecast, it reflects feedback that was heard in round 2 of outreach on the TTP. This approach assumes that $5 billion in additional funding is available annually to support multimodal investments in Texas. This approach was not presented to the public, it is presented for illustrative purposes. TxDOT has the opportunity to experiment with performance goals and investment options with the tools developed under the TTP by CH2M Hill.

Approach 4 investment allocations provide a balanced investment approach with a focus on preservation. The allocations are categorized as follows:

- Pavement: $4.0 B
- Bridge and culvert: $1.6 B
- ITS: $0.5 B
- Highway capacity: $3.0 B
- Transit: 3.9 B
- Additional safety needs: $0.4 B
- Non-highway freight: $0.5 B
- Bicycle and pedestrian: $0.1 B
- **Total: $14.0 B**

Alyson summarized the performance measures that were used to develop Approach 4 and what goal areas were supported under each. TAC members asked for clarification on what is meant by "state of repair", Alyson explained that thresholds were developed by mode or facility type, for example, for bridge state of repair, the team used the National Bridge Inventory system and picked a rating. The thresholds used are detailed in the modal profiles that were distributed to TAC members and are on the SharePoint site.

Several TAC members noted that the performance measures should be consistent with what is required under MAP-21. Alyson introduced the specific performance measures associated with facilities and modes and asked the TAC whether they had specific questions. Questions and discussion from the TAC included the following:

- Bike and pedestrian needs will be in a state of "high" repair if all needs identified in the regional transportation plans are met.
- The freight needs are tied to the Statewide Freight Plan, hopefully that information will be available in time for TTP adoption.
- The total needs of the state are included in the modal profiles that information is available to anyone and is on SharePoint.

Discussion and Next Steps

Michelle Conkle thanked everyone for their involvement. She noted that there is a more technical tool available to analyze performance and needs across the state and she is currently reviewing it. The TAC discussed whether members had an opportunity to review the MetroQuest tool before it went out to the public, a number of TAC members supplied comments on the tool and those were considered in the finalization of the tool. Overall, the public feedback on the MetroQuest tool was very good. Stakeholders felt the tool provided an interactive way to educate the public on complex transportation issues.

TAC members were encouraged to complete their review of modal profiles if they have not yet done so. The draft TTP will be available the first week in September with a revised draft the second or third week of September. While the public hearing and presentation to the commission have not yet been scheduled, the hope is to do both in the fall of 2014.

Appendix C
Stakeholder Meeting Summaries

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	June 9, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Bryan District
PREPARED BY:	Stephanie Lind
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #1 was held on June 9, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Maggiore welcomed the group to the meeting and thanked them for their attendance.

Workshop Participants
Paul Casper, City of Bryan
Travis Milner, TxDOT TPP
Darla Walton, TxDOT PTN
Chad Bohn, TxDOT Bryan
Brad McCaleb, B/CS MPO
Jeremy Williams, BVCOG

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT TPP
Laura Perez, TxDOT TPP
Michelle Maggiore, TTP Project Manager, CH2M HILL
Stephanie Lind, CH2M HILL
Emily Braswell, RS&H
Sonia Jimenez, Ximenes and Associates
Yolanda Hotman, Ximenes and Associates

TPP Project Overview

As part of the Public Outreach Round 2, the TTP planning team is visiting all 25 TxDOT districts in Texas. In each district, the team will have an afternoon stakeholder workshop and an evening open house. The Bryan district meeting is the first meeting.

Michelle Maggiore summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan, which will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

The TTP incorporates a long-range funding forecast for the state. Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2013 – 2017 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach for the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Michelle Maggiore explained the assumptions that were used to estimate unconstrained needs for the TTP. Details on those assumptions are included in the referenced PowerPoint presentation. Michelle also explained the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Michelle Conkle thanked everyone for their attendance and support of the TTP 2040.

Emily Braswell guided the stakeholders through a discussion of the different investment approaches.

Investment Approaches Discussion

- Bridge safety is a top priority.
- Prioritizing investments that have a low cost and high benefit first would be most efficient.
- There is a lack of funding available to meet the current transportation needs.
- Some modes (bicycle, pedestrian or transit) have less support for funding.
- There is not enough money to go around and there is no way to make everyone happy.
- How do we manage expectations with limited money and resources?
- Users who want simple, inexpensive high benefit solutions are frustrated with the complexity and timeliness of transportation solutions.
- The public has lost trust in the transportation providers and public/private systems. There is a need to educate the public on the transportation project development process.
- Clarification was needed on the third investment approach, and staff clarified the following:
  - Improvements in the Texas Trunk System which are primarily in the rural areas
  - Focus on connecting for smaller and mid-size cities
  - Improvement to rural and small urban transit systems
  - Improvements for statewide pedestrian and bike
- How do we use the tool in developing the plan?
  - Educating the public
    - Transportation needs
    - Trade-offs
    - System performance
  - Gathering information for the plan
  - Gathering information on people's priorities and values
- The goal is to develop a measurable performance-based plan that the public and the legislature can look at to determine how well we are doing over the short and long-term.

- Has the planning team considered focusing investment in urban areas? Staff clarified that the team has not done this, although they could.
- What is the TTP going to look like?
  - The TTP will incorporate needs, trends, and recommendations.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Twenty (20) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	June 10, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	South East Texas Regional Planning Commission (TxDOT Beaumont District)
PREPARED BY:	Stephanie Lind
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #2 was held on June 10, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance. Michelle Maggiore introduced herself and asked everyone to introduce themselves.

Workshop Participants
Shiraz Mansour, TxDOT
Steven Stafford, Jefferson County
Bob Dickinson, SETRPC-MPO
John Rory, Port of Beaumont
Joseph Majdalani, City of Beaumont
Megan Campbell, SETRPC-MPO
Jimmie Lewis, City of Orange
Phillip Lujan, TxDOT-BMT
Marc Shepherd, TxDOT-BMT
Don Rao, Jefferson County
Sarah Dupre, TxDOT-PIO

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT TPP
Laura Perez, TxDOT TPP
Michelle Maggiore, TTP Project Manager, CH2M HILL
Stephanie Lind, CH2M HILL
Emily Braswell, RS&H
Sonia Jimenez, Ximenes and Associates
Yolanda Hotman, Ximenes and Associates

TPP Project Overview

As part of the Public Outreach Round 2, the TTP planning team is visiting all 25 TxDOTdistricts in Texas. In each district, the team will have an afternoon stakeholder workshop and an evening open house. The Beaumont district meeting is the second meeting.

Michelle Maggiore summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan, which will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

The TTP incorporates a long-range funding forecast for the state. Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2013 – 2017 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach for the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Michelle Maggiore explained the assumptions that were used to estimate unconstrained needs for the TTP. Details on those assumptions are included in the referenced PowerPoint presentation. Michelle also explained the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Emily Braswell guided the stakeholders through a discussion of the draft goals to be included in the TTP.

Discussion of TTP Draft Goals

- Emphasis should be placed on the maintenance of existing infrastructure, keeping it in good condition.
- TxDOT should utilize technologies (TDM, ITS, alternative transportation) to manage demand for transportation.
- Interstate 10 improvements are needed to move people and goods as safely and efficiently as possible.
- TxDOT should utilize underused assets (for example, relocating trucks to the Gulf Intracoastal Waterway [GIWW]).
- The benefits of reducing congestion on surface facilities include many positive environmental impacts (air quality, runoff).
- TxDOT should consider rail projects to reduce the demand for roadway facilities.

Discussion of TTP Draft Unconstrained Needs

- Intercity Rail: The team looked at MTA projects and two specific corridors (OK – South Texas and DFW – Houston). The analysis aggregates needs based on those inputs; the costs could be higher if it included additional facilities across the state.
  - Michelle Conkle clarified that Amtrak has been looked at some, but historically TxDOT has not considered intercity rail in its planning efforts.
  - The group discussed possible sources for additional funding for high speed rail.
- Capacity: What's the background on adding capacity? Is the assumption that you can build your way out of congestion?
  - Michelle Maggiore clarified that it is almost impossible to build yourself out of congestion. The goal is not to solve congestion, but to estimate the cost of achieving a Level of Service (LOS) C. Michelle Conkle emphasized that it is nearly impossible to fully address congestion.

  - The group noted that congestion management varies by state; congestion in Beaumont can be managed more realistically than at the statewide level or in large urban areas.

Discussion of TTP Approaches Used in MetroQuest Tool

Emily Braswell provided an overview of the three investment approaches used in the MetroQuest tool. Discussion included:

- What does Level of Service (LOS) mean to the typical user? Staff explained that LOS C is a measure clarified in the Highway Capacity Manual and is associated with near free-flow traffic. The group also discussed how to shift traffic to the marine highway. Switching to water-based freight transport will require changes to the "just in time" delivery. Generally, it costs more to transport freight by water than truck, and financial incentives might be required. Safety may be improved; however, the economic cost may outweigh the benefits.
- Increasing the gas tax to fund capacity increases might also shift congestion and promote alternative modes.
- The group noted that investments need to be strategic and should be based on getting the most benefit.
- The group also discussed that different approaches are needed in different parts of the state.

Michelle Maggiore explained the next steps in the TTP process and asked the group to provide feedback on the tool and any exercise.

- Bob Dickson expressed that this was a very useful meeting and thanked the team for coming to Beaumont.
- Megan Campbell noted the importance of valuing different needs in each region or district.

Michelle Conkle thanked everyone for their attendance and support of the TTP 2040.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Fourteen (14) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	June 11, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Houston District
PREPARED BY:	Stephanie Lind
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #3 was held on June 11, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Julie Beaubien, TxDOT, OPI
Mark Kirschkie, City of Houston
Charles Airiohuodion, TxDOT
Robert Mascardo, TxDOT
Jeff Pynes, City of Freeport
Cristin Emshoff, City of Stafford
Eliana Hayes, City of Sugarland
Maureen Crocker, Gulf Coast Rail District
Andrew Mao, TxDOT Houston
Travis Milner, TxDOT
Carol Lewis, Gulf Coast Rail District
Gwen Goodwin, TSU-CTTR

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Laura Perez, TxDOT, TPP
Michelle Maggiore, TTP Project Manager, CH2M HILL
Stephanie Lind, CH2M HILL
Emily Braswell, RS&H
Marcela Aguirre, RS&H
Mark Everett, RS&H
Sonia Jimenez, Ximenes and Associates
Yolanda Hotman, Ximenes and Associates

TPP Project Overview

As part of the Public Outreach Round 2, the TTP planning team is visiting all 25 TxDOT districts in Texas. In each district, the team will have an afternoon stakeholder workshop and an evening open house. The Houston district meeting is the third meeting.

Michelle Maggiore summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan, which will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

The TTP incorporates a long-range funding forecast for the state. Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2013 – 2017 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach for the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Michelle Maggiore introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Next, Michelle explained the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Emily Braswell guided the stakeholders through a discussion of goals, unconstrained needs, and investments. The stakeholder group had no comments or changes to goals.

Unconstrained Need Discussion

- Were commuter rail projects included in the analysis? To the extent that they are included in MTPs and the STIP, they were included.
- In Houston, there are a number of activity centers located in the area and commuter rail needs to extend beyond downtown with new corridors and the acquisition of new ROW.
- High-speed rail improvements may not be funded by TxDOT. Many will be funded by private investments, grants, or directly through the MTA with no TxDOT involvement.
- The group discussed whether the TTP will include only TxDOT funded programs and infrastructure. The plan looks at the statewide needs and also specifically at what TxDOT could fund.

Investment Approach Discussion

- Safety needs were included in each approach. The analysis includes at-grade crossings, but the planning team is uncertain as to what extent.
- Stakeholders discussed the goal of keeping facilities to Level of Service (LOS) D rather than C. There are additional investments that can be made that could help alleviate congestion rather than bringing congestion to LOS C.
- Are bike and pedestrian projects separate from roadway projects? To the extent that bike and pedestrian improvements were included in the MTP/TIP, they were included. The

estimate is likely underestimated since many roadway projects have bike and pedestrian enhancements that are not specifically called out in the MTP/TIP.

- Bridge analysis included bringing bridges out of functional obsolescence when fixing structural deficiencies.
- Geometric design enhancements were included to the extent that they are in the MTP.
- Hurricane and ice issues were not called out specifically although inherently improvements to evacuation routes are included. Emergency Relief projects were not included in the analysis although there is some risk analysis that incorporates that cost estimate. Deterioration models do incorporate some elements of storm and extreme event occurrences.
- Since capacity enhancements are limited, how are demand management strategies included? They are mostly included in the form of ITS and alternative transportation projects.
- Bicycle and pedestrian needs are based on Regional Transportation Plans (RTP) data but then we estimated costs beyond initial investments to maintain and rehabilitate those facilities.
- Project costs are based on statewide estimates. The project costs are not as precise as what is shown in the STIP and do not include contingencies.
- The network that was analyzed includes only the state network.
- Keeping bridges in "good condition" uses National Bridge Inventory (NBI) numbers. The analysis keeps the NBI rating and maintains the rating at a 5 or better.

Next Steps

Michelle Maggiore described the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Twenty-five (25) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	June 12, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Lufkin District
PREPARED BY:	Stephanie Lind and Yolanda Hotman
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #4 was held on June 12, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail. Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Kathie Whitis, TxDOT, PIO
Bobby Boles, City of Huntington
Darla Walton, TxDOT, PTN
Kevin Buranakikipinyo, TxDOT
Kevin Harbuck, TxDOT
Dale Brown, City of Huntington
Erin Ford, Houston County, County Judge
Julie Beaubien, TxDOT, OPI
Cheryl Flood, TxDOT
Jesse Sisco, TxDOT
Mark Payne, TxDOT

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Laura Perez, TxDOT, TPP
Stephanie Lind, CH2M HILL
Emily Braswell, RS&H
Sonia Jimenez, Ximenes and Associates
Yolanda Hotman, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas. In each district, the team will have an afternoon stakeholder workshop and an evening open house. The Lufkin district meeting is the fourth meeting.

Stephanie Lind summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan that will investigate existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs.

Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon. The TTP incorporates a long-range funding forecast for the state. Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2013 – 2017 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Stephanie Lind introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Next, Stephanie described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Emily Braswell guided the stakeholders through a discussion of goals, unconstrained needs, and investments.

Goals Discussion

- The plan should consider new corridors and bypassing existing congested corridors. For example, use another corridor than the I-35 corridor for freight.
- Consider turning Hwy 19 into I-45; revisit the feasibility of those plans. There are a number of existing facilities that could be upgraded rather than expanding other major highways.
- 1-10 and 1-69 should be expanded.

Unconstrained Needs Discussion

- Many of the 2-lane highways need shoulders. It is a major safety concern if vehicles need to pull off the road.
- Highway 19 from Huntsville north to Crocket has 4-lane capacity and narrows to 2 lanes. Consider making it 4 lanes.
    - Consistency and connectivity are concerns for the region.

Investment Approaches Discussion

- The investment approaches should address oil and gas production, logging and other industries. Roadways are deteriorating at a rapid rate due to heavy use, and the costs to repair these facilities should be borne by the heavy users.
- Additional corridors (for example, 2109 and 706) should be included in plan analysis.
- GPS and tracking technologies can be used to direct traffic to different corridors.
- TxDOT should have a more active role in directing industry where to go, especially in rural areas.
- Prioritize truck routes to direct funding and enhancements to key corridors.
- Approach 1 applies the best to rural areas with a focus on maintaining existing infrastructure. Maintaining FM system should be a priority.

- TxDOT should consider additional revenue streams. Ports are growing and additional fees or tariffs could be assessed per container.
- Analysis is needed and should be provided to the legislature on the cost by different units, weights, and usage.
- The cost to maintain the system needs to be equally distributed across users.
- Technology will have a profound impact on transportation through 2040. To the extent possible, technological improvements should be considered. For example, driver-less cars could change the capacity of the existing roadway network.

Next Steps

Emily Braswell described the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Twenty-one (21) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	June 16, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	San Angelo Visitor's Center, San Angelo, TX
PREPARED BY:	Stephanie Lind and Sonia Jimenez
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #5 was held on June 16, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail. Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Tracy Cain, TxDOT
Doray Hill, San Angelo MPO
Joe Clark, TxDOT, TPP
John DeWitt, TxDOT

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Casey Dusza, TxDOT, TPP
John Kelly, CH2M HILL
Stephanie Lind, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Liz Burt, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas. In each district, the team will have an afternoon stakeholder workshop and an evening open house. The San Angelo district meeting is the fifth meeting.

Stephanie Lind summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

The TTP incorporates a long-range funding forecast for the state. Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2013 – 2017 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Stephanie Lind introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Next, Stephanie described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Stephanie Lind guided the stakeholders through a discussion of goals, unconstrained needs, and investments.

Goals Discussion

- Infrastructure and the condition of assets are top priorities, particularly where asphalt is at the end of its life.
- Public transportation should be considered.
- Funding for rail and freight is important.
- Safety is a top priority and current safety statistics are poor.

Investment Approaches

- Clarification is needed about the sources of the additional $5 billion funding that is needed. The investment tool may be misleading in that it appears that money is easily available.
- Approach 1 is likely the most appropriate for the San Angelo area. There are not a lot of capacity needs.
- Approach 3 is important because it addresses some of the freight needs of the state, namely, to get freight off I-35. This approach is the 2nd preferred approach for the area.
- Preservation was a major focus for the tool. Currently, basic maintenance and preservation needs are not being met. There is often a focus on building capacity versus preserving the current system, and there needs to be more education on the life cycle costs of infrastructure and required maintenance.
- The public needs education on the gas tax and the need to index to inflation.

Next Steps

Stephanie Lind described the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Sixteen (16) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	June 17, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Odessa District
PREPARED BY:	Stephanie Lind and Sonia Jimenez
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #6 was held on June 17, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail. Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Cameron Walker, MOTOR MPO
Gene Powell, TxDOT
Gary Law, TxDOT
Jane Jiang, TxDOT
Gabriel Ramirez, TxDOT
Robert Ornelas, TxDOT
Joe Clark, TxDOT, TPP
Matt Carr, TxDOT

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Casey Dusza, TxDOT, TPP
John Kelly, CH2M HILL
Alyson Reaves, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Liz Burt, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas, in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Odessa district meeting is the sixth meeting.

John Kelly summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

The TTP incorporates a long-range funding forecast for the state. Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2013 – 2017 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Alyson Reaves introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Next, Alyson described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Alyson Reaves guided the stakeholders through a discussion of unconstrained needs and investment approaches.

Investment Approaches Discussion

- There is another approach that is not outlined–the "do nothing approach." It would be interesting to see how the system would perform if nothing were done to address current growth.
- The costs used to estimate widening projects were statewide estimates based on facility type.
- Performance measures match the Federal performance requirements. TxDOT needs time to evaluate between Level of Service (LOS) goals and determine best place for funding. Currently, local project decisions are determined through a competitive process. There is a need for both autonomy and collaboration between local and state.
- There is a need to develop local funding forecast.
- The 2040 TTP is a long range policy plan, it will not select projects, but will include statewide goals and analysis of funding tradeoffs.
- The TTP should consider escalated deterioration due to freight and oil/gas industry.
- Deterioration curves are much different in rural areas than in urban.
- Innovative funding is needed to address deterioration of roads due to oil and gas industry.
- How much did increases to registration costs generate?
- TxDOT is working to put together data on the impact of freight on the transportation network.

Next Steps

Michelle Conkle described the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Eighteen (18) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	June 18, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	El Paso Multi-Purpose Center
PREPARED BY:	Stephanie Lind and Sonia Jimenez
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #7 was scheduled for June 18, 2014 from 2:00 p.m. to 4:00 p.m. Only one person attended the stakeholder meeting–Julia Jerome from TxDOT. Therefore, with no attendance, no formal presentation was made nor was there any facilitated discussion with stakeholders.

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
John Kelly, CH2M HILL
Alyson Reaves, CH2M HILL
Michelle Maggiore, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Liz Burt, Ximenes and Associates

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT ELP District officials attended the open house. Forty-nine (49) people attended the open house. Since no stakeholders had shown up at 2:00 p.m. for the Stakeholder Meeting, an expedited showing of the 2040 Plan PowerPoint was presented, with an opening explanation to the audience that this meeting was not for the purpose of addressing the public's concerns about the Lincoln Center historic site, contrary to some apparently incorrect meeting notice info to the contrary. Because of the potential controversy, local media were in attendance.

The public was concerned about the closing and demolition of the Lincoln Center, a local community center, for long-delayed construction of a TxDOT interchange project. Michelle Conkle took questions and encouraged attendees to submit their comments and explained that she would get the comments to the appropriate staff in Austin. There was an overriding sentiment that TxDOT El Paso public involvement efforts are minimal and citizens are informed of projects only when they are going to be constructed. There was also a common concern that planning and projects benefit the Mexican maquiladora manufacturing industry and not the local community.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	June 24, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Atlanta District
PREPARED BY:	Stephanie Lind
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #8 was held on June 24, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
David Cockrell, City of Atlanta
Rea Donna Jones, TxDOT
John Hendrick, ETCOG
Deanne Simmons, TxDOT
Dennis Beckham, TxDOT
Brian Lee, Titus County
Marcus Sandifer, TxDOT
Hudson Old, NETRMA

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Laura Perez, TxDOT, TPP
Stephanie Lind, CH2M HILL
Emily Braswell, RS&H
Sonia Jimenez, Ximenes and Associates
Linda Ximenes, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOTdistricts in Texas, in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Atlanta district meeting is the eighth meeting.

Emily Braswell summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will investigate existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

The TTP incorporates a long-range funding forecast for the state. Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2013 – 2017 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Goals Discussion

- I-30 needs improvements/
- Safety data is available for roads and corridors throughout the state through TxDOT.
- Rail facilities have demands from freight and passenger traffic. TxDOT is working on Freight and Rail plans.

Unconstrained Need Discussion

Stephanie Lind introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Next, Stephanie went over the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Emily Braswell guided the stakeholders through a discussion of unconstrained needs, and investments.

- Capacity enhancements do not include driver-less cars.
- Rail costs include costs above and beyond what TxDOT is or would be responsible for. The needs numbers are not fiscally constrained or limited to what TxDOT funds. It is uncertain if locating high speed rail corridors in TxDOT right-of-way is feasible.
- It is uncertain what the likelihood of Proposition 1 is of passing.
- It is clear that more funding is needed to meet the needs of the state. The state should consider putting together a marketing plan to explain the needs and build support for raising funds.
- Ports are included in the freight analysis. An inland port near Texarkana was not included, but has support of some in the area.

Investment Approaches Discussion

- The freight mobility approach is the preferred approach. Put more freight on railroads and relieve Dallas and Austin traffic.
- Urban mobility should be a focus. Congestion is a serious problem in urban areas, and by making enhancements there, the whole state would benefit.
- Freight issues need to be addressed as issues will only get worse as time goes on.
- To the extent possible, freight should be relocated from supercenter locations (ideally incorporating rail) to the end user or seller.

Revenue Discussion

- Changes are needed to taxing structure. TxDOT should consider mileage-based user fees.

Next Steps

Michelle Conkle described the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. – 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Eleven (11) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	June 25, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:00 PM – 7:00 PM
LOCATION:	TxDOT Paris District
PREPARED BY:	Stephanie Lind and Sonia Jimenez
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #9 was held on June 25, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Julie Rook, TxDOT
Rick Mackey, TxDOT
Paul Montgomery, TxDOT
Aaron Bloom, TxDOT
Tammy Sims, TxDOT
Allen West, City of Whitewrite
Michael Schmitz, Texoma Council of Governments
Chris Brown, Ark-Tex Council of Governments
Sherry Howard, City of Tom Bean
Dr. Randy McBrown, Texoma Council of Governments
Judge Sparky Carter, Fannin County
John Hedrick, ETCOG/ETRPO
Penny Sansom, TxDOT

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Laura Perez, TxDOT, TPP
Stephanie Lind, CH2M HILL
Emily Braswell, RS&H
Sonia Jimenez, Ximenes and Associates
Linda Ximenes, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas. In each district, the team will have an afternoon stakeholder workshop and an evening open house. The Paris district meeting is the ninth meeting.

Emily Braswell summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

The TTP incorporates a long-range funding forecast for the state. Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2013 – 2017 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Stephanie Lind introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details of those assumptions are included in the referenced PowerPoint presentation. Next, Stephanie described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Emily Braswell guided the stakeholders through a discussion of unconstrained needs and investment approaches.

Unconstrained Needs Discussion

- A center lane is needed down Highway 11. Growth is expected in that area, and a turn lane is needed.
- Traffic control is needed at FM2729. TxDOT has been contacted regarding a possible light or walkway to improve mobility for residents. There are high numbers of senior citizens in the area, and an overall population over 1000.
- Better business access and sight distance enhancements are needed on Highway 60 near Hwy 11 where Hwy 160 turns into Hwy 69. There are a number of rock haulers that come through each day, and safety is a concern.
- Traffic control which may include traffic signals are needed in Fannin County on access roads to lake areas.
- Highway 75 has congestion issues and safety concerns.
- Highway expansion should be considered on Highways 30, 82 and 59 (access roads include 19, 271 and 37). There is significant truck traffic.
- The RPO needs to have a more active role in transportation decision making.
- Fannin County has several roads in disrepair and heavy truck traffic that needs to be addressed.
- Improvements on Highways 82 and 122 will help spur growth in the county.

Investment Approaches Discussion

- Maintenance of the current system is a top priority.
- Communication transportation information is important.
- Freight should use additional corridors to reduce maintenance needs and congestion on major freight corridors.
- High speed rail should be considered from Sherman to Austin.
- Travel to Austin can take a significant amount of time–up to 8 hours–when it should take 4.5 hours.
- A definition for different rail types is needed (for example, high speed vs. commuter).

Revenue Discussion

- There needs to be a statewide discussion on transportation funding.
- Toll roads are increasingly popular and provide funding for infrastructure. Users that choose to use facility pay for the facility.
- MPOs and RPOs can be used to learn what funding mechanisms are supported at the local level.
- TxDOT is doing a great job with what they have.

Next Steps

Emily Braswell described the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:00 p.m. to 7:00 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Twenty-seven (27) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	June 26, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Tyler District
PREPARED BY:	Stephanie Lind and Sonia Jimenez
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #10 was held on June 26, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Bill Lacy, City of Troup
Melissa Cure, ETCOG
Gene Cottle, City of Troup
Dale Booth, TxDOT
Neil Boitnott, RS&H
Heather Nick, Tyler Area MPO
Elizabeth High, RS&H
Michael Howell, Tyler Area MPO
Kate Lindekugle, RS&H
Susan Linnard, TxDOT
Vernon Webb, TxDOT

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Laura Perez, TxDOT, TPP
Stephanie Lind, CH2M HILL
Emily Braswell, RS&H
Sonia Jimenez, Ximenes and Associates
Linda Ximenes, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas. In each district, the team will have an afternoon stakeholder workshop and an evening open house. The Tyler district meeting is the tenth meeting.

Emily Braswell summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures.

The TTP will estimate current and future demand on the transportation system and associated needs. The TTP incorporates a long-range funding forecast for the state. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2013 – 2017 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Stephanie Lind introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Next, Stephanie described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Emily Braswell guided the stakeholders through a discussion of unconstrained needs and investment approaches.

Unconstrained Needs Discussion

- Safety is a high priority for the Tyler area. The area has a high crash rate. Factors include geometric design, terrain, speed, and distracted driving. There is a need to look at innovative ways to address safety issues (for example, photo enforcement).
- Winding, rolling FMs carry a lot more traffic than they were designed for. Some facilities should be redesigned, but there is not budget for it.
- Drivers don't realize that Tyler has a high crash rate, and the public typically asks for additional capacity rather than safety enhancements.
- Targeted education is needed for the public and specifically for young people.
- Section of south Loop 323 and 69/Broadway are very congested; demand management is needed or diversion to alternative routes.
- Area is close to non-attainment and may become an issue.
- There are a number of safety issues on I-20 including ramp length (too short for acceleration), railing location, bridge height, and lack of frontage roads.
- Preservation and maintenance are top priorities, and the public needs education on this.
- Tyler area has capacity needs with the area growing quickly.
- Rail should be considered along I-20 (inter-city rail) although it is controversial.
- There is a need for more bicycle facilities for both commuting and recreating. Facilities on state highways should be considered.
- Connections are needed between residential areas and open spaces for both hiking and biking.
- Better access management and land-use is needed on 69/Broadway.
- The City of Troup has bottleneck issues with a railroad switching station. Emergency access is a top concern. There are 4 crossings, and only one is accessible to large trucks.
- Legislation to prohibit texting and driving would be beneficial.
- Public transit is lacking funding for both rural and urban operations. It is a challenge for the underserved to get to where they want to go.
- Bicyclists and pedestrians have issues crossing major intersections.

- Bus Rapid Transit (BRT) might be a good solution to connect specific locations (downtown, mall, UTHSC).
- More funding is needed for transportation; however, obtaining the local match for projects can be a challenge.
- Transit services have been cut back in many areas and fees have increased. This has reduced mobility.
- Area bus fleets are aging and do not have funds for timely replacement.
- Congestion on Broadway and Loop 323 hurts downtown community.
- Opportunity for significant growth and economic development if corridor improvements are made for "Golden T" area.
- While the population of Tyler is just under 100,000, being a major regional center, there are approximately 400,000 people visiting Tyler in any given day.
- Most significant growth has been in northwest and northeast Tyler.
- Voucher system is needed for seniors needing public transportation (for example, Smith County).

Investment Approaches Discussion

- Approach 3 is the most applicable for Tyler area. This is followed closely by Approach 1. Focusing on freight and mobility will help economic development activities and could provide revenues for transportation infrastructure.
- Pavement preservation is important. The area understands that it will cost more in the long run if you do not maintain facilities. TxDOT has a good partnership with the counties to provide maintenance.
- Congestion is not a top priority; safety is more important.

Revenue Discussion

- Partnerships have been beneficial in the area.
- Toll roads are supported in the area including congestion pricing.
- Incentives should be considered.
- A managed lane to Shreveport could be beneficial.

Next Steps

Emily Braswell described the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Nineteen (19) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	July 7, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	DalTrans Transportation Management Center, Conference Room 4777 East Highway 80, Mesquite, TX
PREPARED BY:	Sonia Jimenez and Stephanie Lind
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #11 was held on July 7, 2014 from 2 p.m. to 4 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Michelle Ragion, TxDOT
Jim Dobbins, TxDOT
Chelsea Dilday, TxDOT
Chris Barker, City of Euless
Maher M. Ghanayem, TxDOT
Tamelia Spillman, TxDOT
Gina Nash, City of Forney
Tim Tumulty, City of Rockwall
Wes McClure, TxDOT
Morgan Bridgewater, TxDOT
Chris Metz, City of Forney
Daniel Plummer, Dallas County Sherriff's Office

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Casey Dusza, TxDOT, TPP
Laura Perez, TxDOT, TPP
John Kelly, CH2M HILL
Alyson Welsh, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Yolanda Hotman, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas, and in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Dallas district meeting is the eleventh meeting.

John Kelly summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. The TTP incorporates a long-range funding forecast for the state. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2015 – 2019 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Alyson Welsh introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Next, Alyson described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investments approaches, and potential funding options. A summary of that discussion is included below.

Needs Discussion

- The legislature needs more education on the needs for the transportation system through 2040.
- The City and County of Rockwall have anted-up local funding to assist TxDOT with projects in their area, including major funds for on-system projects (for example, IH-30), due to lack of state funding to address rapid growth needs
- State highways provide the backbone of the transportation system in Texas. Two lanes 24' in width do not always accommodate the safety needs of the corridor; "super-two" (3-lanes) and 4-lane facilities are needed in many cases to address traffic growth.
- Cities and counties have taken a more proactive role in maintaining and providing transportation infrastructure.
- U.S. 80 and IH-20 have many transportation needs and should be addressed.
- It is difficult for small rural communities to communicate with the legislature about their need for state and federal dollars; staff time and travel dollars to travel to Austin for face-to-face interactions are not available.
- It is uncertain how much the population will grow in Texas through 2040; there are too many uncertainties.
- Freight-related bottlenecks are a major cause of highway congestion (for example, IH-30)

- While the approaches discussed a Level of Service (LOS) C or D as a target, LOS C or even LOS B would be better.
- Congestion varies regionally; there should be incentives for smart planning and addressing congestion.
- More funding is needed for rail, bicycle, and pedestrian projects.
- Local governments have an interest in joining up with regional transportation programs; however, the law would need to change (for example, for communities to join DART now, after 30 years of operation, takes a substantial back-payment for past years of non-participation in the agency's sales tax funding).
- Loop 9 around southern Dallas County is needed in the near term; howeve,r complete funding is many decades away.
- Localities should consider imposing and enforcing additional weight limits on roads.

Funding Discussion

- The Dallas area needs more funding; because of a lack of funding, there is an increase in toll roads.
- Better education is needed for the public and decision makers on the gas tax and the fact that it is not indexed.
- If possible, developers (particularly residential developers in Greenfield areas) should pay for transportation infrastructure, and localities should make sure their roads are adequately connected to the existing transportation network.
- RMAs offer some new avenues for funding and programming transportation projects.

Next Steps

Sonia Jimenez described the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff was available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Seventeen (17) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	July 8, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Wichita Falls District
PREPARED BY:	Sonia Jimenez and Stephanie Lind
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #12 was held on July 8, 2014 from 2 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Jaimie Lee, Wichita Falls MPO
Tammy Marlow, TxDOT
Lin Barnett, Wichita Falls MPO

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Casey Dusza, TxDOT, TPP
Laura Perez, TxDOT, TPP
John Kelly, CH2M HILL
Alyson Welsh, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Yolanda Hotman, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas, and in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Wichita Falls district meeting is the twelfth meeting.

John Kelly summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

The TTP incorporates a long-range funding forecast for the state. Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2015 – 2019 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Alyson Welsh introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Following this, Alyson described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investment approaches, and potential funding options. A summary of that discussion is included below.

Stakeholder Recap of Presentation

- More money is needed to maintain the transportation system.
- The tool was liked, it is useful in explaining the funding challenges for TxDOT.

Need Discussion

- With more people moving into the state, there should be more revenue coming in to help cover the cost to maintain and add transportation infrastructure (for example, vehicle registration fees).
- Innovative solutions are needed to help discourage congestion (for example, congestion pricing in Baltimore).
- The oil and gas industry is damaging transportation infrastructure; they should pay for their share of the increased maintenance costs.
- Congestion is not a local issue. The roadways of the area are generally safe.
- Programs that support bicycling should be expanded (for example, bicycle racks, bicycle share, etc.).
- The area benefits from strong coordination and partnerships between TxDOT, council. and MPO.
- Most of district money goes toward maintenance in the area. Some money is needed for added capacity including a needed loop. The Kell Freeway will not be finished until 2020 due to lack of funding.
- The area would like to construct a bike/ped loop trail; it is at the top of the MPO's list once money is available. This is in support of the Wichita Falls annual "Hotter 'n Hell 100" Bike Race.
- Travel behavior is changing; younger people are not as interested in owning a vehicle.
- Top priority projects for the area include:
  - US 287 upgrades
  - Bicycle circle
- The MPO has refined how it conducts project selection for the Long Range Transportation Plan (LRTP). Projects are selected by priority and compared against each other; the challenge is ranking roads versus bike/ped facilities fairly.

Funding Discussion

- With more people moving into the state, there should be more revenue coming in to help cover the cost to maintain and add transportation infrastructure (for example, vehicle registration fees).
- The legislature needs to revisit options for generating more money for transportation.
- The funding formula needs to be changed; the Wichita Falls area is not getting much money.
- The gas tax needs to change (for example, flat gas tax, vehicle miles traveled-based, raise the gas tax).
- As vehicles change (for example, electric cars), there needs to be a way to obtain some sort of tax/fee from those vehicles to account for their use of the system.

Next Steps

Sonia Jimenez went over the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Four (4) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	July 9, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Fort Worth District
PREPARED BY:	Sonia Jimenez and Stephanie Lind
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #13 was held on July 9, 2014 from 2 p.m. to 4 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Robert Porter
Shannon Hawkins, TxDOT
Darrell Cockerham, Hood County Judge
Sara Finch, TxDOT
Jose Perez, FHWA
Loyl Bussell, TxDOT

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Casey Dusza, TxDOT, TPP
Laura Perez, TxDOT, TPP
John Kelly, CH2M HILL
Alyson Welsh, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Yolanda Hotman, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas, and in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Fort Worth district meeting is the thirteenth meeting.

John Kelly summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. The TTP incorporates a long-range funding forecast for the state. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2015 – 2019 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Alyson Welsh introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Following this, Alyson described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investment approaches, and potential funding options. A summary of that discussion is included below.

Stakeholder Recap of Presentation

- The cost to bring facilities to Level of Service (LOS) C is very high.
- The cost to preserve the existing system is substantial. The total needs of the state require twice as much funding as what is available.
- It is more cost effective to maintain the infrastructure that is under distress from energy sector industry around the Barnett Shale than to rebuild.
- The information was presented in a thoughtful way; the tool and presentation help clarify the amount of money needed for transportation through 2040.

Needs Discussion

- Activity in the oil and gas industry has slowed down; there are fewer new wells coming in since the Barnett Shale play has been underway for 10 years.
- The legislature has not provided the funding that is needed for transportation projects. Grant processes can be cumbersome and require additional resources to write (for example, writers, attorneys, etc.), especially to access energy sector rehab grants.
- An overpass is needed near the railroad crossings at 377 and 171 in Cresson to alleviate delays. The county is willing to commit money toward the project and would like TxDOT to also contribute.
- The Fort Worth area is working on a transit plan that will focus on underserved areas. TexRail to connect downtown Fort Worth to the D/FW airport will enhance connectivity.
- More funding is needed in rural areas; much of the money available currently goes to urban areas (for example, no MPO funds in rural areas). The Regional Transportation Council (D/FW's MPO) covers 12 of the 16 counties in the area.
- The Fort Worth "T" has a new CEO who is looking more broadly at how transit can broaden its reach in the western part of the Metroplex.
- In Hood County, with 70% of the workforce going to Fort Worth, there is a need to focus investment on US 377, which has heavy traffic and needs either a relief route or an alternative solution.
- Congestion and preservation should be a top priority.
- Tolled facilities have increased; people are getting used to using tolls and are willing to pay. Tolled facilities should include an HOV component.

Funding Discussion

- Innovation is needed to find additional funding sources.
- Make grant programs easier to apply for.
- Consider raising the gas tax or allow localities to raise the gas tax locally.
- Proposition 1 will have the opportunity to allocate more money to transportation.
- Hood County collaborated with the oil and gas industry to get them to put money toward maintaining roads.
- More money is needed for transit.
- More funding is needed for the federal highway system.

Next Steps

Sonia Jimenez described the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. – 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Fifteen (15) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	July 10, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Brownwood District
PREPARED BY:	Sonia Jimenez and Stephanie Lind
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #14 was held on July 10, 2014. While the stakeholder meeting was scheduled for 2:00 p.m. to 4:00 p.m., no stakeholders attended the meeting. Instead, stakeholders attended the Open House portion of the meeting, and an abbreviated stakeholder meeting was held then, including the Powerpoint presentation. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Elias Rmeili, TxDOT District Engineer
Jason Scantling, TxDOT TP&D
Bennie Hromodka, Hamilton County Farm Bureau
Donald Hatcher, City of Brownwood
Wanda Furgason, Early, TX Economic Development Council

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Casey Dusza, TxDOT, TPP
Laura Perez, TxDOT, TPP
John Kelly, CH2M HILL
Alyson Welsh, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Yolanda Hotman, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas, and in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Brownwood district meeting is the fourteenth meeting.

John Kelly summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures.

The TTP will estimate current and future demand on the transportation system and associated needs. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

The TTP incorporates a long-range funding forecast for the state. Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2015 – 2019 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Alyson Welsh introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Following this, Alyson described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investments approaches and potential funding options. A summary of that discussion is included below.

Stakeholder Recap of Presentation

- Freight makes up much of the traffic and transportation needs in the state.
- The trade-off tool Approaches considers rural needs, which is important.
- TxDOT is committed to making the transportation system safer.
- Financial sustainability is important, needs should take inflation into account since the needs are based on projections.
- There is significant congestion in urban areas and towns.
- Clarification was sought on whether the oil and gas industry contributes to TxDOT revenue. There is currently a severance tax of 4.7%. Proposition 1, if passed in November 2014, will move some of the severance tax money from the "Rainy Day" fund to the highway fund. Proposition 1 has the potential to bring $1.4 billion annually to TxDOT.
- The state needs more revenue. This could come from a variety of sources including increased registration fees or a restructuring of the gas tax to be based on the vehicle miles traveled.
- Toll roads could be expanded for longer distances (for example, Dallas to Houston).

Needs Discussion

- Truck freight traffic poses safety concerns near Brady (getting around the downtown square), particularly when traveling through the center of cities, near water sources, and/or railroad lines. Accidents are and could be a major problem.
- The Brady airport is extending its airport runway in 2016 – 2017. The Brownwood airport is also extending its runway, although the timing is uncertain.
- Rail improvements are needed to infrastructure in Brady to facilitate the movement of goods related to the energy and agricultural sector.
- Brownwood needs added capacity for railroad facilities to help prevent backups and long delays.

- Drainage improvements are needed at FM 2126 and FM6784 at Pecan Bayou in the Brownwood area. Currently, during severe storm events the bridge is underwater.
- Bicycle and pedestrian facilities are needed in the Brownwood area; current bike/ped facilities focus on recreational access.
- Improvements are needed for SH 6 and US 281 near Hico to accommodate freight traffic (for example, wind turbine equipment being transported).
- In the Hamilton area, on SH 36 and US 281, improvements are needed to support freight truck traffic. Trucks are using FM roads that cannot support the heavy loads.
- When Ann Richards was governor, there was a discussion that part of the lottery money was proposed to go to TxDOT. Did that happen? Where does the money come from that goes into the "Rainy Day fund"? (oil and gas severance taxes)
- Early, TX sees significant heavy truck traffic and this causes safety issues.
- FM roads were designed for farmers to get to the market, but they are now being used by many other types of users which can pose safety issues as the users have different travel speeds, sight distances, sizes, and familiarity with the roadway. These users include:
  - Heavy trucks
  - Farm equipment (some very wide)
  - Motorcyclists
  - Bicyclists

Next Steps

Sonia Jimenez went over the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Five (5) people attended the open house as stakeholders and are noted above.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	July 14, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Laredo District
PREPARED BY:	Stephanie Lind and Sonia Jimenez
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #15 was held on July 14, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Raul Leal, TxDOT
Albert Ramirez, TxDOT
Sara Garza, TxDOT
Carlos Rodriguez, TxDOT
Nathan Bratton, City of Laredo/MPO
Melissa Montemayor, TxDOT

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Laura Perez, TxDOT, TPP
Judith Ibarra-Bianchetta, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Liz Burt, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 districts in Texas, and in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Laredo district meeting is the fifteenth meeting.

Stephanie Lind summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. The TTP incorporates a long-range funding forecast for the state. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2015 – 2019 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Stephanie Lind introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Following this, Stephanie described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investment approaches, and potential funding options. A summary of that discussion is included below.

Presentation Discussion and Recap

- The common issue for at least two of the approaches is traffic congestion.
- Laredo has a lot of freight traffic; maintaining the flow of international commerce is a big interest for the area.

Needs Discussion

- The Eagle Ford Shale development has greatly impacted transportation infrastructure in the area. The roads were not built to support the heavy use that is occurring.
- Locals want to know why funds cannot be used to maintain roads that are coming in from the development.
- Maintaining existing infrastructure should be a top priority.
- It is important to document whether performance measures are being met. The suggestion was made to incentivize meeting measures or penalize those that do not meet targets.
- The project selection process should be objective and built around local needs and values.
- TxDOT should consider using universal language to define congestion and capacity needs across the state.
- Population projections vary between state departments and should be consistent.
- Top priority corridors for the area include Loop 20, FM 1472 and 144/105.
- Safety is the area’s number one priority.
- There are some bottlenecks caused by freight rail in the downtown area. At-grade crossings are an issue.
- Loop 20 has some lighting issues that need to be addressed.

Funding Discussion

- It is difficult to estimate what the revenue will look like in 2040, and the sources of funding will inevitably change between now and then.
- Leveraging of funds has and will continue to be important. Federal and state funds should be used to leverage additional funds.

Next Steps

Sonia Jimenez explained the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes.

A large number of stakeholders attended the open house so the TTP team decided to make the stakeholder presentation at 5:30 for all those present. Ten (10) people attended the open house as stakeholders and are noted above.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	July 15, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Pharr District
PREPARED BY:	Stephanie Lind
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #16 was held on July 15, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Raymond Sanchez, TxDOT
Homer Bazan, TxDOT
Toribio Garza, TxDOT
Octavio Saenz, TxDOT
Pedro Alvarez, TxDOT
Robin Gelston, TxDOT
Edwardo Mendoza, City of McAllen

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Laura Perez, TxDOT, TPP
Judith Ibarra-Bianchetta, CH2M Hill
Sonia Jimenez, Ximenes and Associates
Liz Burt, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas, and in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Pharr district meeting is the sixteenth meeting.

Stephanie Lind summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. The TTP incorporates a long-range funding forecast for the state. Long-range

transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2015 – 2019 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Stephanie Lind introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Following this, Stephanie described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investment approaches and potential funding options. A summary of that discussion is included below.

Presentation Discussion and Recap

- The Plan does not appear to solve the needs of the state. It will identify needs and present a framework for making recommendations. The Plan will not include a list of projects—it will make broad recommendations on how to incorporate performance measures and plan goals into the project selection process.
- The transit needs of the state are high. It would be interesting to know what the current investment is and Level of Service (LOS).
- Freight needs will be incorporated into the final plan from the Freight Mobility Plan.

Needs Discussion

- Competing maintenance needs are a challenge for the district. FM roads must compete for funding with Interstate and state highway facilities.
- TxDOT could deliver projects more efficiently and more cost effectively. Some of those costs can be attributed to the cost of bureaucratic oversight. There have been some improvements in MAP-21 to expedite project development and delivery.
- Freight traffic is going to increase exponentially and place tremendous burden on the Texas transportation system. TxDOT needs to evaluate what that will mean for the roadway network (for example, Mazatlan to Matamoros).
- There is energy sector growth in Matamoros, and there will likely be potential transportation impacts.
- Space X will have an impact on the region although it is uncertain what that impact will be.
- There are and will be a number of high priority corridors:
  - I-69C
  - I-69E
  - I-2
  - SH 68
  - FM 935
  - Second access to South Padre Island (2nd Causeway)
  - US 83

  - SL 195
  - Outer Parkway (Cameron County)
  - US 281
  - SH 365
  - IBTC
- There is a need for a regional transit authority in the area.

Funding Discussion

- Consider re-designating roadways to make them eligible for new funding sources (for example, I-69).
- There is a need to look at new funding sources (for example, mileage-based user fees).

Next Steps

Sonia Jimenez explained the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes.

A large number of stakeholders attended the open house so the TTP team decided to make the stakeholder presentation at 5:30 for all those present. Twenty-four (24) people attended the open house as stakeholders and are noted above.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	July 16, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Corpus Christi District
PREPARED BY:	Stephanie Lind and Judith Ibarra-Bianchetta
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #17 was held on July 16, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Sara Garza, TxDOT
Paula Sales Evans, TxDOT
Amber Longoria, TxDOT
Loyd Neal, Nueces County Judge
Elena Buntello, City of Corpus Christi
Victor Vourcos, TxDOT

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Laura Perez, TxDOT, TPP
Stephanie Lind, CH2M HILL
Judith Ibarra-Bianchetta, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Liz Burt, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas, and in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Corpus Christi district meeting is the seventeenth meeting.

Stephanie Lind summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. The TTP incorporates a long-range funding forecast for the state. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2015 – 2019 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Stephanie Lind introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Following this, Stephanie described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investment approaches, and potential funding options. A summary of that discussion is included below.

Need Discussion

- The needs of the state are overwhelming. Basically it feels like all we can do is work on preservation and maintenance activities.
- The Harbor Bridge is a great project, but it takes a long time to get major projects funded and built, and that project will divert funding from other projects.
- Localities often bear the burden of transportation improvements.
- Small, regional airports can help relieve freight congestion as well.
- There is a need to take some of the loads off roadways to reduce the burden on facilities. This could include diverting some traffic to rail, pipeline, or barge.
- It is a challenge to develop a plan for the state since the values and needs are so different across the state.
- Educating the public and decision makers on the transportation needs of the state is needed.
- Traffic varies throughout the year and there could be alternatives to manage events and peak periods (for example, tourist traffic)
- Hurricane evacuation related needs need to be considered.
- Bike and pedestrian enhancements in the area are largely geared toward recreational needs.
- There appears to be no funding for updating ferry boats.
- High priority projects for the area include:
  - Schlitterbahn on South Padre Island
  - Heavy industrial activity areas (for example, Voestlepine, San Patricio Port, TPCO steel plant)
  - SH 361
  - JFK Causeway
- In the Corpus Christi area, traffic varies greatly based on season and makes planning difficult.
- Emergency evacuation planning is important to the area. The evacuation routes need to be regularly reviewed (quarterly versus annually).
- The area has seen an increase in the accidents in rural areas that is likely due to the growth in the energy sector.

- Ferry system wait times can cause bottlenecks. Planners need to evaluate the capacity needs and also consider economic development potential surrounding ferry use.

Funding Discussion

- An alternative funding source is needed from the gas tax.
- The state should stop raiding the transportation fund for other needs besides transportation.
- If additional fees are used to fund transportation, consider looking at monthly fees as opposed to one-time fees or the gas tax.

Next Steps

Sonia Jimenez explained the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Sixteen (16) people attended the open house as stakeholders and are noted above.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	July 18, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	City of Victoria, Conference Room 204 700 Main Center, Victoria, TX
PREPARED BY:	Stephanie Lind and Judith Ibarra-Bianchetta
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #18 was held on July 18, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Clint Ives, Victoria County Commissioner
Danny Garcia, Victoria County Commissioner
Doise Miers, TxDOT
Randy Vivian, Victoria Chamber
Jon New, New Distributing
Marett Hanes, City of Victoria
Paul Reitz, TxDOT
John Crews, Coldwell Banker
Mansour Shiraz, TxDOT
Emett, City of Victoria Council
Mary Craighead, Victoria MPO
Terry Hlauinke, Hlauinke Equip Co.
Mike Walsh, TxDOT
Rissa Shaw, KAVU Newscenter 25

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Laura Perez, TxDOT, TPP
Stephanie Linda, CH2M HILL
Judith Ibarra-Bianchetta, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Liz Burt, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 districts in Texas, and in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Victoria district meeting is the eighteenth meeting.

Stephanie Lind summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. The TTP incorporates a long-range funding forecast for the state. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2015 – 2019 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Stephanie Lind introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details of those assumptions are included in the referenced PowerPoint presentation. Following this, Stephanie described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investments approaches and potential funding options. A summary of that discussion is included below.

Presentation Discussion and Recap

- Staff clarified how the Level of Service (LOS) C target was developed and the associated need to obtain that LOS.
- Staff clarified how interstate maintenance and expansion is included in the Plan. Maintenance and expansion are included in the needs estimates for both maintenance of bridges and pavement as well as the capacity needs estimate.
- Local TxDOT representatives explained how frontage access rules and requirements are determined.
- Under Approach 3, the target for LOS for the interstate system is a "C" across the state. This would optimally address all freight bottlenecks, although that might not be possible in reality due to other factors (for example, right-of-way issues, environmental concerns, political will). The needs estimates are based on high-level analysis of statewide needs.

Needs Discussion

- High speed rail could be a viable option for moving people around the state. It is uncertain whether they could physically carry personal vehicles around the state as well and/or what that cost might be.
- Freight traffic is a concern for the area and causes much congestion.
- While the needs of urban areas are great, it is uncertain whether it is physically possible to construct the infrastructure needed to alleviate congestion.

- I-35 is congested and is always under construction. In the future, it would be ideal if projects of such significance could be completed more quickly.
- Traffic from high-use corridors could be diverted to other corridors that have capacity (for example, 77/281 or locally Navarro/Main).
- More money is needed to maintain the FM system. The energy sector is placing significant strain on that system.
- New facilities are already falling apart (for example, 87 west of Nixon).
- Top priority corridors for the area include:
  - Loop 463
  - Business 59
  - Salem Road
  - Overpass on Hansleman Road
  - Business 77
  - Ben Jordan/Airline
- TxDOT's actions can greatly impact businesses. They should consider the local business needs in their decision making. Maintaining access to businesses is extremely important. More transparency is needed in the local decision making process.

Funding Discussion

- The gas tax should be indexed to inflation.
- The RAMP program provides needed funds to airports; a similar program is needed for ports.
- An increase in the car registration fee could be a possible revenue source for the state. It should be dedicated to highway needs.
- A vehicle sales tax might also be a possible revenue source; it would be beneficial if a percentage went to local projects.

Next Steps

Sonia Jimenez explained the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes.

A large number of stakeholders attended the open house so the TTP team decided to make the stakeholder presentation at 5:30 for all those present. Eight (8) people attended the open house as stakeholders and are noted above.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	July 21, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	Waco Transit Center Administration Building, Conference Room, 301 South 8th Street, Waco, TX
PREPARED BY:	Sonia Jimenez and Stephanie Lind
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #19 was held on July 21, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Chris Evilia, Waco MPO
Ed Kaobel, Jr., TxDOT
Bobby Littlefield, TxDOT
Malcolm Duncan, City of Waco
Cheryl Maxwell, KTMPO
Mark Collier, KTMPO
Susan Howard, TxDOT

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Laura Perez, TxDOT, TPP
Stephanie Lind, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Laura Vasquez, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas, and in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Waco district meeting is the nineteenth meeting.

Stephanie Lind summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. The TTP incorporates a long-range funding forecast for the state. Long-range

transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2015 – 2019 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Stephanie Lind introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Following this, Stephanie described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investment approaches, and potential funding options. A summary of that discussion is included below.

Stakeholder Recap of Presentation

- Financial sustainability is important to being able to maintain the transportation system to 2040.
- The three approaches are quite different and focus on different needs.
- There is a need for more funds to maintain the current transportation and meet performance targets going forward.
- What makes up the primary freight network from the Texas Freight Mobility Plan (TFMP) could impact where money is prioritized.

Needs Discussion

- Congestion is an issue in the area; high priority corridors for the area include the following (in no particular order):
  - 1637
  - I-35
  - SH 36
  - 340
  - US 84
  - Bus 77
  - SH 317
  - SH 201 (extension, could be used to alleviate traffic issues on US 190)
  - US 190, I-13 designation (Copperas Cove to I-35)
- Investments are often reactive rather than proactive in nature.
- Many facilities in the area need to be upgraded, they were designed for different conditions and volumes.
- Much of the growth in the area is on the periphery, where there is no infrastructure. There is capacity in the urban core to support growth, and infill and growth should be encouraged there.

- KTMPO is dealing with growth from the south and trying to match transportation projects to the projected growth and needs. There will likely be capacity issues as the area continues to grow (for example, comparison to Round Rock in the 1970s).
- Non-attainment could be an issue for the area in the future.
- Ft. Hood area has unique transportation needs that must be considered. Additionally, more people are retiring to the area who were stationed at Ft. Hood, which places additional strain on transportation facilities.
- Development in new areas has placed additional strain on funds because needs exceed available funding.
- The area is looking at demand management strategies that focus on using alternative modes and reducing automobile trips. Examples of strategies include:
  - Increase use of the bus system that is in place
  - Focus on alternative modes for short trips (less than 1 mile)
  - Provide infrastructure for bicyclists and pedestrians (for example, ADA facilities)
- The area has an efficient urban transit system and would like to provide service to rural areas. There is a need for better coordination between rural service providers. Rural residents need access to services in the urban area. The rural ridership has dropped significantly. Most rural service is for Paratransit trips, and the area would like to provide commute options for rural areas.
- The area has been looking at prioritizing funding toward assets that have maintenance needs on the existing system before adding capacity.
- Truck freight is a concern, and to the extent possible, alternatives for moving freight should be considered (for example, pipelines and rail).
- The public has experienced some planning fatigue. There have been many planning studies in the area, and little has been implemented.
- Educating the public and communicating the needs to policy makers needs to be done to get more funding.
- There is little flexibility in where money can be spent. Funds come with rules and restrictions on their use, and this makes planning and programming challenging. It would be ideal if the money could be spent where it is really needed.
- Localities use widely different design criteria for their roads. This presents a challenge as the area grows and the roadway doesn't meet the needs of current traffic and users.
- Roadways need to be designed for more users (for example, Context Sensitive Solutions [CSS]).

Next Steps

Sonia Jimenez explained the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Twenty-nine (29) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	July 28, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	T&P Depot, 1101 North First Street, Abilene, TX
PREPARED BY:	Stephanie Lind and Sonia Jimenez
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #20 was held on July 28, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Dean Carter, Abilene MPO
Stan Swiatek, TxDOT
Alan Hufstutler, TxDOT
James Condry, City of Abilene
Blair Haynie, TxDOT
James Rogge, City of Abilene
Elisa Smetana, Abilene MPO
Thomas Cook, Abilene MPO
Brian Crawford, TxDOT
Dale Spurgin, Abilene, MPO

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Casey Dusza, TxDOT, TPP
John Kelly, CH2M HILL
Stephanie Lind, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Michelle Martinez, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas, and in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Abilene district meeting is the twentieth meeting.

John Kelly summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. The TTP incorporates a long-range funding forecast for the state. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2015 – 2019 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Stephanie Lind introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Following this, Stephanie described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investments approaches and potential funding options. A summary of that discussion is included below.

Stakeholder Recap of Presentation

- In the approaches used in the MetroQuest tool, approaches 2 and 3 are more costly.
- Clarification was provided on the prioritization of funds toward the interstate system (approach 2) versus the primary freight network (approach 3).
- The MetroQuest tool provides the public with an interesting way to explore options.
- TxDOT provided clarification on how funds are allocated across the state (for example, clarifying the amount of money western Texas receives).
- Approach 1 aligns more with the needs of rural areas and western Texas. Approaches 2 and 3 tend to focus on congested corridors and do not spread resources throughout the state.
- Approach 1 is important when considering the preservation needs of the entire state.
- Current funding levels barely meet the preservation needs of the state; more funding is needed.
- To ascertain the bike and pedestrian need, the planning team looked at MPO and TxDOT plans. There is a need for better statewide needs data for these modes.

Needs Discussion

- Abilene area needs more multimodal connections between rail and trucks.
- While alternative transportation and Intelligent Transportation System needs were incorporated into the analysis, some emerging technologies (for example, driverless cars) were not. At this time, it is uncertain how much of an impact emerging technologies will have through 2040.
- Safety concerns are a top priority for the area. These include, but are not limited to:
  - Access to roadways – this includes ramps, driveways and frontage roads.
  - Medians are needed in some areas to allow for safe turn movements.
  - Other geometric design features could make roadways safer in the area.

  - Speeding has led to incidents throughout the area.
  - Driver distractions are a concern. The state should consider innovative ways to cut down on distracted driving (for example, "no cell phone" lanes, which could operate similarly to HOV lanes).
- There is a need for more multimodal facilities for bicyclists and pedestrians; the lack of facilities is a safety concern. The area could benefit from more hike and bike trails. The city and private groups are looking at increasing bicycle and pedestrian facilities with a focus on recreation.
- The area could benefit from having a transit center.
- The oil and gas industry will impact the transportation system of the area. As the Cline Shale is developed, there is a potential for increased traffic and impacts on the entire system. This will lead to more preservation and maintenance needs; it is uncertain where the impact will be west of Sweetwater.
- With wind farm development there has been some concern over whether the transportation network can handle the large trucks that transport equipment.
- Freight traffic greatly impacts the area this includes:
  - Safety concerns (for example, I-20 vehicle turnovers)
  - Key corridors:
    - 87
    - 277
    - 180
    - 83
  - Impact on facilities when route through city center
  - Safety concerns around the transport of hazardous materials
  - Truck traffic on local roads that cannot support loads/widths
  - Bridge damage (clearance, weight restrictions, etc.)
  - Need to rehabilitate bridge infrastructure to support freight traffic
- As population continues to grow in the Abilene area, there is concern whether the transportation system can support new growth. Currently congestion only occurs during peak times, but that could expand.

Next Steps

Sonia Jimenez went over the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Eighteen (18) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	July 29, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	Childress City Auditorium, Conference Room A 1000 Commerce Street NW, Childress, TX 79201
PREPARED BY:	Stephanie Lind and Sonia Jimenez
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #21 was held on July 28, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Annabel Jurado, TxDOT
Lynn Daniel, TxDOT
Barbara Seal, TxDOT

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Casey Dusza, TxDOT, TPP
John Kelly, CH2M HILL
Stephanie Lind, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Michelle Martinez, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas, and in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Childress district meeting is the twenty-first meeting.

John Kelly summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. The TTP incorporates a long-range funding forecast for the state. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2015 – 2019 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Stephanie Lind introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Following this, Stephanie described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investment approaches, and potential funding options. A summary of that discussion is included below.

Stakeholder Recap of Presentation

- There is not enough money to fund the needs across the state.
- If you neglect one area or mode, the entire system will suffer. Tradeoffs need to be considered when prioritizing projects and investment approaches.

Needs Discussion

- The area has had to make their dollars stretch as needs outweigh the funding coming to the district.
- The oil and gas industry has placed strain on FM and local roads.
- Many of the industrial needs of the area are based around resource extraction and the agricultural industry. In addition to placing strain on the transportation system, many other services are impacted (for example, housing, public services, social services, etc.).
- Investments have been prioritized toward maintaining the system where deficiencies exist.
- While the Childress area doesn't have congestion, there is a need for enhanced connectivity with economic centers and the rest of the state.
- Area residents understand the importance of funding statewide needs because they experience congestion when they go into the urban areas for services and goods.
- Local residents are concerned about roadway maintenance including the pavement condition and mowing along corridors.
- Safety is a concern in the area. Specific areas of concern include:
  - Pavement condition
  - Incidents due to high speeds (specifically related to truck traffic carrying heavy loads)
  - Specific corridors with safety concerns including FM 592, SH 152 and I-40 (Shamrock)
- Locals do not want to put in bypasses, but the trucking industry advocates for them due to traffic lights in many of the towns in the area.

Next Steps

Sonia Jimenez explained the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Five (5) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	July 30, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Amarillo District
PREPARED BY:	Alyson Welsh and Stephanie Lind
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #22 was held on July 31, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
Gus Khankarli, TxDOT TP&D
Peggy Thurin, TxDOT
Jack Foster, TxDOT
Robert Bryant
Terry Nix, TxDOT
Paul Braun, TxDOT
Gary Holwick, Amarillo MPO
Travis Muno, Amarillo MPO

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Casey Dusza, TxDOT, TPP
John Kelly, CH2M HILL
Alyson Welsh, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Michelle Martinez, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas, and in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Amarillo district meeting is the twenty-second meeting.

John Kelly summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. The TTP incorporates a long-range funding forecast for the state. Long-range

transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2015 – 2019 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Alyson Welsh introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Following this, Alyson described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investment approaches, and potential funding options. A summary of that discussion is included below.

Stakeholder Recap of Presentation

- Given the high cost of adding capacity, it is almost impossible to address the congestion needs of the state.
- More money is needed for freight. Freight should be a higher priority, Texas' rail system carries 8% of all freight rail for the U.S.
- The expansion costs for approaches 2 and 3 have a similar dollar value. This is likely due to the similar number of lane miles that need to be added under the approaches.
- Rural districts may not be competitive for funding at the state level.
- The cost of transferring freight between rail and truck vehicles is high and money is needed to just maintain the current system. It is unlikely it could be improved.

Needs Discussion

- There is a lot of freight moving through the Amarillo area. With expansion, local mobility has improved. Current assets and programs include:
  - Ports to Plains program
  - I-40
  - International airport
  - 2 rail lines
  - Amarillo as a central hub for freight
  - Alternative landing site for space shuttle
- University expansion plans will impact the transportation system, this includes:
  - West Texas A&M engineering school
  - Texas Tech pharmacy school and medical complex
- Downtown Amarillo is going through some revitalization. There are plans to build a minor league baseball park along with hotels, parking garages, and other supporting businesses.
- Freight could be redirected to go around downtown (for example, construct loop) to make the downtown more pedestrian friendly.

- Over the past 20 years, the Panhandle has seen new industries take root. These include wind farms, dairies, cheese plants, prisons, egg farms, livestock facilities. This has created a burden on the transportation system.
- A lot of the freight needs reflect heavier freight (for example, cattle, oil/gas, etc). This heavy freight has big impacts on the condition of the roadways.
- There is a need to provide affordable access to underserved populations in the area with rural transit, although the geographic area is very large and it is difficult to reach all areas (Amarillo District has 17 counties).
- There is concern that local transit will lose some transit funding if the SMSA area population exceeds 200,000. This could place additional burden on the City of Amarillo to cover the loss of funds to maintain local transit service.
- Amarillo is near the PANTEX nuclear facility (15 miles east of town), which is the largest plutonium holding facility in the world. This is where all the nuclear weapons have been dismantled. PANTEX (managed by the Department of Energy) is the largest employer in the Panhandle.
- IH-40 and Loop 335 are high priority projects for the area. In order to upgrade portions of Loop 335, some new alignment outside the existing alignment may be necessary to avoid extensive ROW impacts.

Next Steps

Sonia Jimenez explained the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Thirteen (13) people attended the Open House.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	July 31, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Lubbock District
PREPARED BY:	Sonia Jimenez and Stephanie Lind
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #23 was held on July 31, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
H. David Jones, Lubbock MPO
Tammy Walker, Lubbock MPO
Jerry Cash, TxDOT
Nick Olenik, Lubbock County Public Works
Kristi Schwartz, TxDOT

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Casey Dusza, TxDOT, TPP
John Kelly, CH2M HILL
Alyson Welsh, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Michelle Martinez, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas, and in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Lubbock district meeting is the twenty-third meeting.

John Kelly summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. The TTP incorporates a long-range funding forecast for the state. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2015 – 2019 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Alyson Welsh introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Following this, Alyson described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investment approaches, and potential funding options. A summary of that discussion is included below.

Stakeholder Recap of Presentation

- The transportation funding needs of the state are great.
- It is important to maintain a state of good repair for what is already in place.
- The three different approaches all serve very different purposes.
- The information presented in the tool and presentation was done in a thoughtful way and is very interesting.

Needs Discussion

- With lacking resources, some local streets may need to fall under the "turn back" program; those facilities would then be maintained by local jurisdictions.
- Intelligent Transportation System (ITS) programs may not always be an efficient allocation of funding. Bridge, pavement, and capacity projects should take priority over ITS.
- Dynamic Message Signs can be distracting and cause safety issues; however, they can be useful during construction projects.
- Lubbock has tried to proactively address population growth by adding capacity; however, there is some congestion on the outer loop.
- There is some bicycling in the Lubbock area but the mode share is limited for a number of reasons including environmental reasons (high winds and sand). Use tends to be recreational in nature, and there are two local bicycle clubs.
- Spartan Public Transit provides most of the rural transit service for the area. They would expand if they had additional funding.
- CitiBus provides transit services to the more urban areas of Lubbock; they are currently going through route reductions and evaluating ridership trends.
- Industry and its impacts on transportation:
  - The oil and gas industry has not impacted the Lubbock area; however, locals are concerned that the industry and its impacts may be on the horizon.
  - There has been growth in the wind farm sector, and the turbine components are being shipped to Lubbock via train. One local project has been delayed to allow for delivery of the wind turbine components before reconstruction begins.
  - The dairy and livestock industries have grown (north of FM 400) and have caused increased truck traffic.
  - Heavy truck traffic on FM roads has caused maintenance requests.

- There is a new development at SH 207 and US 385 that has caused a significant increase in traffic.
- Ports to Plains has led to expansion of SH 349. Not all proposed P-to-P projects are supported, and funding was lost for a proposed P-to-P upgrade relief route at Lamesa because of public opposition to the relief route bypassing town.
- Texas Tech is working to increase their enrollment from current enrollment of 33,000 to 40,000. This will impact the transportation system.
- Additional development that could impact the transportation system includes:
  - Cooper ISD facilities—this is in an unincorporated but rapidly-growing residential area near Woodrow Road in southern Lubbock area
  - Exurban growth in rural areas
  - New school development in Friendship
  - Industrial Development in Levelland
- Freight traffic continues to increase each year and place additional strain on the transportation system.
- Air travel comments and needs:
  - Currently there are three commercial carriers at the airport offering 16 – 18 flights per day.
  - There is a need for more money to maintain facilities.
  - The airport is finishing up a runway extension.
- Rural connectivity is important to the area. Congestion is not a big concern; maintaining current network is a top priority.
- Roadway design elements can help alleviate congestion and improve safety such as "Super 2s". The area has 60 miles of "Super 2s".
- Truck traffic in and around the WalMart distribution center in Plainview has increased need for maintenance. The roadway capacity is adequate but repairs are needed.

Next Steps

Sonia Jimenez explained the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Thirty-seven (37) people attended the open house.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	August 4, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT San Antonio District
PREPARED BY:	Stephanie Lind and Sonia Jimenez
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #24 was held on August 4, 2014 from 2:00 p.m. to 4:00 p.m. at the TxDOT SAT District Office, Building #2. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Michelle Conkle welcomed the group and thanked them for their attendance.

Workshop Participants
David Kruse, Alamo Area Council of Governments
Nick Page, Alamo Area MPO
Clay Smith, VIA-ATD
Tim Juarez, TxDOT, TPP
Joe Ramos, Alamo Area Council of Governments
Garry Ford, City of New Braunfels
Dale R. Stein, Jr, Frio County
Doise Miers, TxDOT
Amanda Worden, TxDOT
Vic Boyer, San Antonio Mobility Coalition
Abigail Rodriguez, VIA

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Casey Dusza, TxDOT, TPP
Lori Morel, TxDOT, TPP
Michelle Maggiore, CH2M HILL
John Kelly, CH2M HILL
Stephanie Lind, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Liz Burt, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas, and in each district the team will have an afternoon stakeholder workshop and an evening open house. The San Antonio District meeting is the twenty-fourth meeting.

John Kelly summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. The TTP incorporates a long-range funding forecast for the state. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

Different investment scenarios and performance outcomes will be evaluated as part of the TTP. Finally, the TTP will incorporate implementation strategies and tracking mechanisms.

The TTP will advance the goals of the 2015 – 2019 Strategic Plan and build upon the 2035 Statewide Long-Range Transportation Plan (SLRTP) and Texas Rural Transportation Plan. During the first round of outreach on the Texas Transportation Plan 2040, the team developed draft goals for the TTP which were refined and incorporated into the Plan. Goals and objectives were coordinated with other adopted plans and use the 2013 – 2017 Strategic Plan as the umbrella vision while meeting the requirements of State and Federal legislation.

Michelle Maggiore introduced the methodology used to estimate unconstrained needs. The needs of the state through 2040 are roughly twice that of expected revenues. Details on those assumptions are included in the referenced PowerPoint presentation. Following this, Michelle described the assumptions used to develop the three investment approaches showcased in the MetroQuest tool.

Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investment approaches, and potential funding options. A summary of that discussion is included below.

Stakeholder Recap of Presentation

- There are conflicting transportation funding needs estimates being discussed at the local level and the legislature (for example, $5 billion, $20 billion, and other cost estimates). It would be helpful if the same "needs numbers" were being circulated. It was conceded that the $20 billion figure would be too hard for legislators and the public to digest.
- Given the timeframe for the long range transportation plan (over 25 years), it is difficult to push for more funding through the legislature since they tend to plan and program for smaller periods of time into the future.
- The interactive nature of the scenario planning tool was helpful and similar to other interactive media (for example, Fantasy Football).
- There is a lack of funding for transportation, and better messaging needs to be developed to articulate this throughout the state.
- Many funding sources have limitations on their utilization and often are not available for multimodal projects.
- The statewide transportation needs are great, and there is no clear solution to obtaining more funds, although more money is needed. Political resistance to tax or fee increases in the legislature hamstrings the ability to get to sustainable funding options.
- The needs numbers are large and hard to digest; policy makers and the public need to understand the value of the dollars spent.
- Policy makers and the public need to consider the economic cost of not maintaining the transportation system which could potentially make Texas less competitive for business relocations and expansions. That "jobs and economic vitality" messaging should be developed.

- Texas needs to find a better balance between metro, local, state, and rural transportation interests.
- Rural areas need transit service; aging populations in rural areas could benefit from service.
- Policy makers and the public need to be educated on the impacts of shifting money to other priorities. Funding should be prioritized to what is most important.
- Rail and freight needs are important and should be considered especially as freight traffic grows throughout Texas.

Questions or Comments on the Presentation

- Will the plan consider other alternatives besides adding capacity to address growth (for example, peak hour spreading, trip reduction, flexible work schedules, teleworking, etc.)? The Plan does consider the provision of transportation options and Intelligent Transportation Systems (ITS). Transportation Demand Management (TDM) strategies are included indirectly in the modeling and forecasting assumptions although it is difficult to forecast their impact on travel through 2040.
- Will other funding options be included in the Plan (for example, ways of reducing current expenditures)? Other funding options and scenarios will be included and evaluated to the extent that TxDOT would like them included.
- TxDOT and local transportation planning organizations cannot solve all the problems of the state. The responsibility and funds associated with meeting the needs of the state need to be modified. This can help improve connectivity and cooperation between metro and rural entities.
- Preservation is important at the local level. There should be flexibility in the funding for locals to make decisions versus a statewide one-size-fits-all approach.

Needs Discussion -

- The legislature which experiences biennial turnover, especially in the House of Representatives, needs more thorough education on the transportation needs of the state and the complex issues related to the variety of funding sources currently available. It is difficult for elected officials to prioritize funding at the statewide level. It is easier to look at specific needs for a community or metro area.
- There are funding issues that need to be dealt with before the legislature will seek more funds. For example, actually effecting the long-discussed elimination of the “diversion” of up to $800 million out of TxDOT’s Highway Fund #6 budget to substantially support the Department of Public Safety’s operations would take that issue off the table and allow legislators to move forward on addressing TxDOT’s funding sustainability. Several options for enhancing sustainable funding are being considered such as increasing the comparatively low Texas vehicle registration fee; or shifting the vehicle sales tax revenues above a baseline level from the General Fund to Highway Fund #6. The borrowing undertaken in Prop12 and Prop 14 has dramatically increased the state’s debt load, and the interest payments are consuming a significant portion of TxDOT’s available funds and will continue to do so for a number of years ahead. Hence, “the credit card is max-ed out”.
- Often funding goes toward projects that are “shovel-ready” rather than truly the highest priority needs. There are many constraints that get in the way of funding the top priority projects (for example, environmental process, engineering constraints, budgeting, planning, etc.).
- It is unclear what the real economic benefit of Texas’ expansive growth will be with all the demands new residents place on already-stressed infrastructure (for example, transportation and water resources). There is a trade-off between new tax revenues generated versus new system demands.

- To date, the San Antonio area does not have some of the alternatives to adding capacity that other metro areas of the state have, specifically toll roads, which have had difficulty moving forward. The area needs to think of innovative ways of addressing the needs for additional capacity.
- The energy sector has placed additional strain on transportation resources, and it would be ideal if the state would allocate substantially more money from the energy sector severance taxes to the localities impacted.
- The public needs better education on the magnitude of the funding shortfalls to meet the needs of the state. They need to understand how little they pay toward transportation (for example, their contribution through the gas tax and vehicle registration fees). The public also needs better education on gas tax indexing and inflation.
- There are many rural and exurban needs, and often those are not prioritized within MPOs.
- The formula for allocating money doesn't fully consider the impact of freight on roadways (for example, freight vehicles cause much more wear and tear on roadways and that does not correlate with the funding formula, such as, one 18-wheeler does damage equivalent to 10,000 cars).
- Localities could benefit from finding better ways to legally receive money from new sources (for example, private and developer donation, heavy user contributions, etc.).
- New alternatives need to be looked at along freight corridors. For example, on I-35 between San Antonio and Laredo, traffic flows well until there are two trucks side-by-side slowing the flow due to very high percentage of heavy trucks (NAFTA and Energy Sector traffic). The state needs to look at the needs between San Antonio and Laredo on I-35.
- There is a need to eliminate freight bottlenecks.
- The state should look at ways to expedite projects rather than pushing them out in time and having to deal with cost escalations and inflation.

Next Steps

Sonia Jimenez explained the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Forty-two (42) people attended the Open House.

STAKEHOLDER WORKSHOP AND PUBLIC OPEN HOUSE SUMMARY

DATE/TIME:	August 5, 2014 Stakeholder Workshop 2:00 PM – 4:00 PM Open House 5:30 PM – 7:30 PM
LOCATION:	TxDOT Austin District
PREPARED BY:	Sonia Jimenez and Stephanie Lind
SUBJECT / MEETING TOPIC:	Workshop Notes and Summary of Public Open House

Introduction

The TxDOT Texas Transportation Plan (TTP) Stakeholder Workshop #25 was held on August 5, 2014 from 2:00 p.m. to 4:00 p.m. Refer to the Stakeholder Meeting PowerPoint Presentation that was presented at the meeting for additional detail.

Casey Dusza welcomed the group and thanked them for their attendance.

Workshop Participants
Ed Collins, TxDOT
Lisa Weston, CAMPO
Steve Linhart, TxDOT
Joseph Carrizales, TxDOT
Greg Malatek, TxDOT D.E.
Karen Lorenzini, TxDOT
Bonnie Lister, TxDOT
Diana Vargas, TxDOT
Tim Juarez, TxDOT

TTP Staff and Consultant Team:
Michelle Conkle, TTP Project Manager, TxDOT, TPP
Casey Dusza, TxDOT, TPP
Michelle Maggiore, CH2M HILL
John Kelly, CH2M HILL
Stephanie Lind, CH2M HILL
Sonia Jimenez, Ximenes and Associates
Michelle Martinez, Ximenes and Associates

TPP Project Overview

The TTP planning team is visiting all 25 TxDOT districts in Texas, and in each district, the team will have an afternoon stakeholder workshop and an evening open house. The Austin district meeting is the twenty-fifth meeting.

Michelle Conkle summarized the purpose of the Texas Transportation Plan 2040 (TTP). The TTP incorporates the needs of a growing state through 2040. The TTP will be a performance-based plan. It will look at existing conditions, system goals, objectives and performance measures. The TTP will estimate current and future demand on the transportation system and associated needs. The TTP incorporates a long-range funding forecast for the state. Long-range transportation needs will include the cost to preserve, maintain and expand Texas' transportation system to meet good or better conditions over the TTP planning horizon.

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Sonia Jimenez guided the stakeholders through a discussion of area needs, preferred investment approaches, and potential funding options. A summary of that discussion is included below.

Stakeholder Recap of Presentation

- The approaches present different priorities. They show tradeoffs when spending money on different priorities.
- Decision makers need to prioritize what is the best use of the money.
- One of the biggest challenges is balancing the needs of the urban areas with allocating funds to rural areas. Focus should be placed on spending as efficiently as possible, in order to get the "most bang for your buck."
- There is a need to think about the system comprehensively to make the best investments.

Needs Discussion

- The Austin area has many needs and doesn't receive enough money to address the needs.
- The Austin area struggles with meeting the urban needs versus thinking more regionally.
- The public needs education on the impacts of dwindling federal dollars.
- Project delays cause costs to go up due to escalations and inflation. Federal and state oversight can increase costs and delay projects.
- Austin has seen an increase in the implementation of Transportation Demand Management (TDM) strategies; however, more money is needed to implement these programs. Examples of existing programs and areas of expansion include employer-based programs. The MPO has one staff person that is devoted to this; however, without additional funds (for example, CMAQ), there is not funding to support more.
- There are some challenges with implementing TDM programs that rely heavily on technology, and not all people have access to resources (for example, phone apps for ride share).
- Austin area needs more viable alternatives to getting across town from north to south and from east to west. The system is fragmented, and there is opposition to loop systems.

- Much of the growth in the area is occurring in environmentally sensitive areas, and providing transportation infrastructure can be difficult. Residents in these areas are car-dependent and there are few services located nearby.
- There is uncertainty about transportation behavior in the future. For example, fewer young people are getting cars, and people are more willing to pay more for gas.
- Local transportation initiatives have impacts on the state system. For example, “road diets” are helping to provide bicycle and pedestrian infrastructure, but they also increase congestion and divert cars to the state system.
- Local land use decisions greatly impact the state system (for example, school zones on the state highway).
- There is a growing need for transit service in rural areas, which includes “urban collar” areas and underserved “donut” areas.
- Project Connect has the potential to expand service throughout the urban area, but benefits are many years down the road.
- The cost of living in the urban core is forcing people to look for housing further out (for example, San Marcos residents moving out to exurban areas). Some of the impacts of people moving further out include:
  - Lack of services in rural areas (for example, hospitals)
  - Property values are increasing rapidly in urban areas and making living in the urban area unaffordable
  - Low-income populations must live further out and obtain cars when they previously could use transit
- There is a need for integrated corridor management similar to the TxDOT Pilot Program on US 75/North Central Expy in far north Dallas, where a managed/HOV lane and DART light rail line run adjacent to the general-purpose lanes, and comprehensive management and ITS and phone apps are being used to encourage best utilization of available corridor capacity.
- Capital Metro and the City of Austin are working to maximize the capacity of the corridor areas and transit hubs in the urban area.
- The Austin area needs a local transportation champion, a non-partisan and altruistic civic leader who can command the respect of a broad cross-section of community leaders and the general public.
- Tolled facilities and specifically managed lanes are one way the area is attempting to improve mobility. While they may not always decrease congestion, they are part of the regional solution.
- The district is always looking at innovative ways to design facilities. There is a need to use funds more efficiently while maintaining the needed level of service. However, there are inherent risks in deviating from design standards.
- Major transit and rail projects need to use a more integrated approach (for example, Project Connect and Lone Star Rail).
- The bicycle infrastructure needs vary based on the type of user. Some prefer to ride on the road while others want separated facilities.
- There needs to be better coordination between governmental entities in the construction of transportation projects. For example the state and city might have projects along the same corridor that could be done in coordination (for example, drainage improvements and roadway projects).
- Currently the TxDOT district is developing a bicycle master plan for all 11 counties. This should lead to better coordination and provision of connected facilities.
- The TxDOT district is also developing county transportation plans for each of their counties, which should also help lead to better coordination.

- Overall, there needs to be better coordination between the City of Austin and TxDOT on projects (for example, intersection re-design near Crestview transit/rail station).
- The Austin airport's ability to have and maintain cargo routes is critical to technology companies in the area. Companies need to be able to ship their products.
- Development impact fees should be implemented and private developer contributions/donations should be encouraged for transportation infrastructure as an additional source of transportation funding .
- Austin area is the gateway to the hill country. It's important to consider the transportation connections to that area as well as those of Austin.
- If Austin doesn't address congestion issues, people and businesses won't stay in the area.
- Localities and TxDOT need to be proactive about preserving right-of-way for future expansion projects (for example, US 183).
- In rural areas, more "Super 2s" are needed to combat congestion and keep facilities safe.

Increasing Funding

- Motor vehicle registration fees could be increased to provide more revenue.
- Receive money from the energy sector to spend on the facilities they are impacting (for example, business version of "adopt a highway").

Next Steps

Sonia Jimenez explained the next steps for the TTP 2040 outreach efforts.

Open House

An open house was held to inform the public on the TTP from 5:30 p.m. to 7:30 p.m. The open house featured 9 display boards, the MetroQuest interactive tool, and comment forms. Staff were available to answer questions. Local TxDOT staff were available to answer questions about local projects and processes. Eleven (11) people attended the open house.

Appendix D
Public Meeting Comment Card and Meeting Exhibits

TEXAS TRANSPORTATION PLAN (TTP) 2040
PUBLIC MEETING

COMMENT FORM

This form is provided to document your comments regarding the Texas Transportation Plan (TTP) 2040. Information about the TTP 2040 is available on TxDOT's website at https://www.txdot.gov; search key phrase "TTP 2040." Please use the space provided below to write comments, and attach additional pages if necessary. You may leave the form at the meeting, or mail it to the address provided below. You may also submit comments via E-mail to TxTransPlan2040@txdot.gov. Public comments will be accepted throughout the development of the TTP until September 1, 2014. We appreciate your interest and value your input.

Did you attend a Public Meeting? (circle one) No Yes Meeting Location? ________________
Comments:

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Please mail your comments to:

TxDOT TPP Division TTP 2040
Attn: Michelle Conkle
P.O. Box 149217
Austin, Texas, 78714-9217

Please Print:

Your Name: ________________________

Address: ___________________________

____

Email: _____________________________

(Texas Transportation Code, §201.811(a)(5)): check each of the following boxes that apply to you:

☐ I am employed by TxDOT

☐ I do business with TxDOT

☐ I could benefit monetarily from the project or other item about which I am commenting

PLAN DE TRANSPORTE DE TEXAS (TTP) 2040
REUNION PUBLICA

HOJA PARA COMENTARIOS

Este formulario se le provee para documentar sus comentarios respecto al Plan de Transporte de Texas (TTP por sus siglas en inglés) 2040. Información del TTP 2040 está disponible en el sitio web de TxDOT en https://www.txdot.gov; busque usando la frase clave "TTP 2040". Favor de usar el espacio a continuación para escribir sus comentarios, y si necesita, agregue hojas adicionales. Puede dejar el formulario en la reunión, o mandarlo por correo a la dirección a continuación. También puede entregar comentarios por correo electrónico a TxTransPlan2040@txdot.gov. Se aceptaría comentarios del público durante todo el periodo de desarrollo del TTP hasta el 1º de septiembre de 2014. Apreciamos su interés y valoramos sus opiniones.

¿Asistió a una de las reuniones públicas? (marque uno) No Sí

¿El local de la reunión?____

Comentarios:

____

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Favor de mandar sus comentarios por correo a:
TxDOT TPP Division TTP 2040
Attn: Michelle Conkle
P.O. Box 149217
Austin, Texas, 78714-9217

Favor de escribir en letra de molde:

Nombre: ____________________________

Dirección: ____________________________

____

Correo Electrónico: __________________

(Código de Transporte de Texas, §201.811(a)(5)): marque cada una de las frases que puedan aplicarse a usted:

☐ Soy empleado de TxDOT

☐ Hago comercio con TxDOT

☐ Yo podría beneficiar económicamente de este proyecto u otro asunto sobre lo cual estoy comentando.

Texas Department of Transportation

Welcome!

We're glad you came to help plan the future of Texas transportation!

While you're here, you can:

- Review displays and talk with staff
- Use the interactive planning tool
- Provide input on investments and funding options

Please sign in; thank you for your interest and participation!

¡Bienvenidos!

¡Nos da mucho gusto que usted vino a ayudarnos a planear el futuro del transporte de Texas!

Mientras usted está aquí puede:

- Revisar las exhibiciones y platicar con el personal
- Usar la herramienta interactiva de planeación
- Aportar sus opiniones respecto a opciones para inversiones y gastos

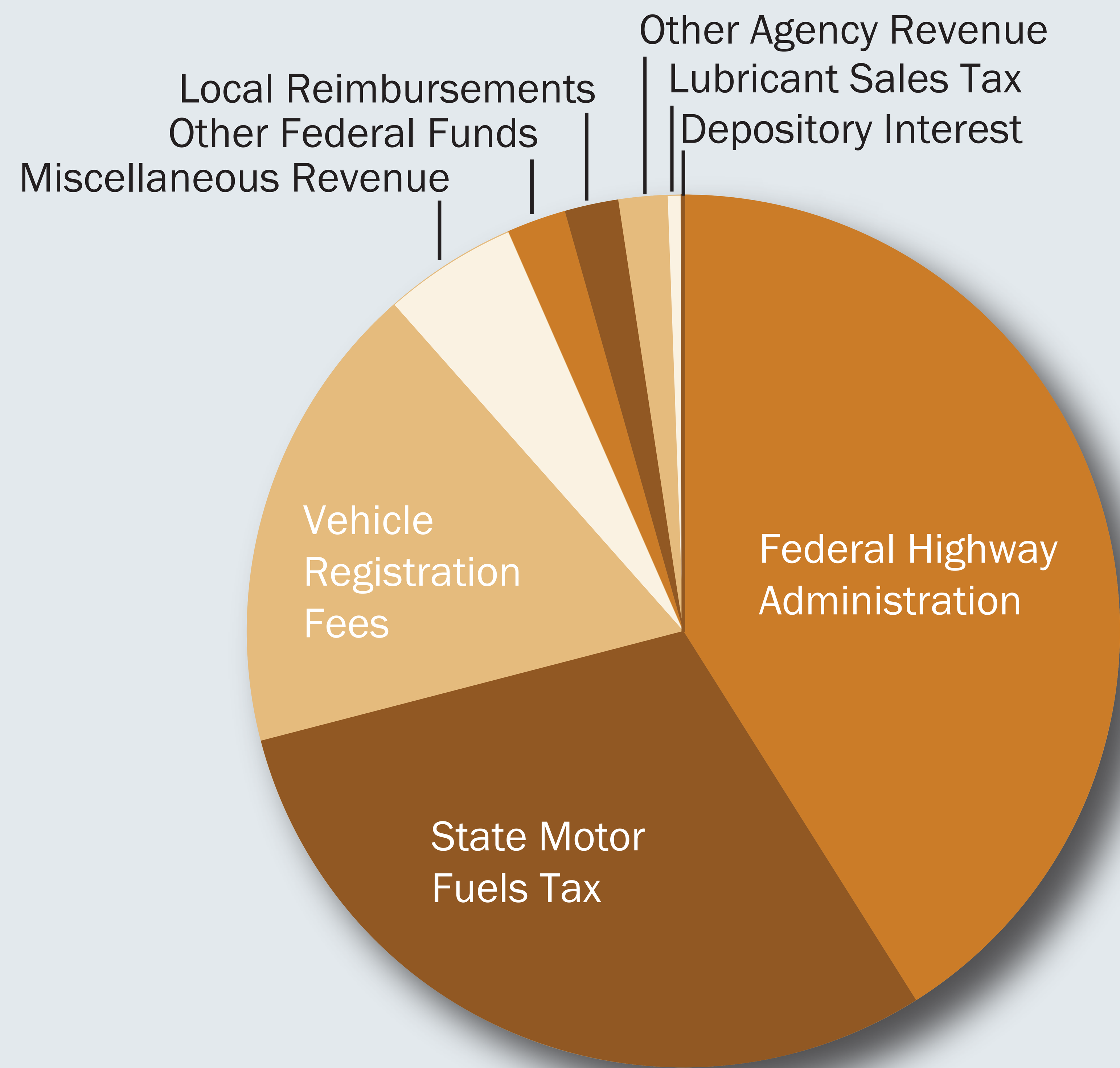
Favor de registrarse. ¡Gracias por su interés y participación!

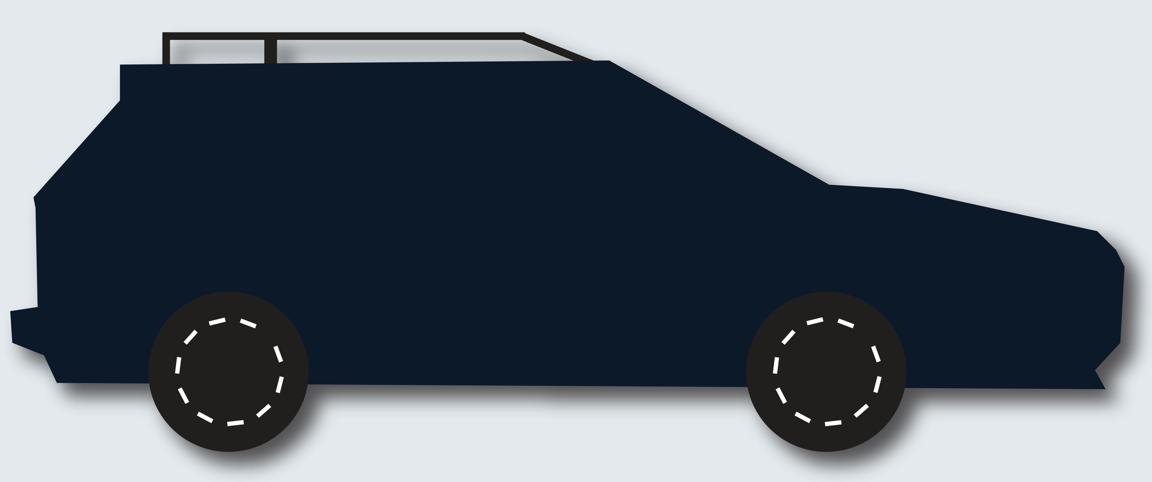
Sources of Revenue

The 2014 Numbers

Source	Amount	Percent
Federal Highway Administration	$3,295,511,850	41%
State Motor Fuels Tax	$2,400,995,000	30%
Vehicle Registration Fees	$1,405,984,165	18%
Miscellaneous Revenue	$398,367,527	5%
Other Federal Funds	$175,863,940	2%
Local Reimbursements	$160,000,000	2%
Other Agency Revenue	$145,604,320	2%
Lubricant Sales Tax	$43,275,000	1%
Depository Interest	$2,681,636	0.03%
Total:	**$8,028,283,438**	**100%**

Numbers reflect FY 2014 estimates.
Actual revenue may differ slightly from the Comptroller's Annual Cash Report in the event the Comptroller makes post-FY adjustments



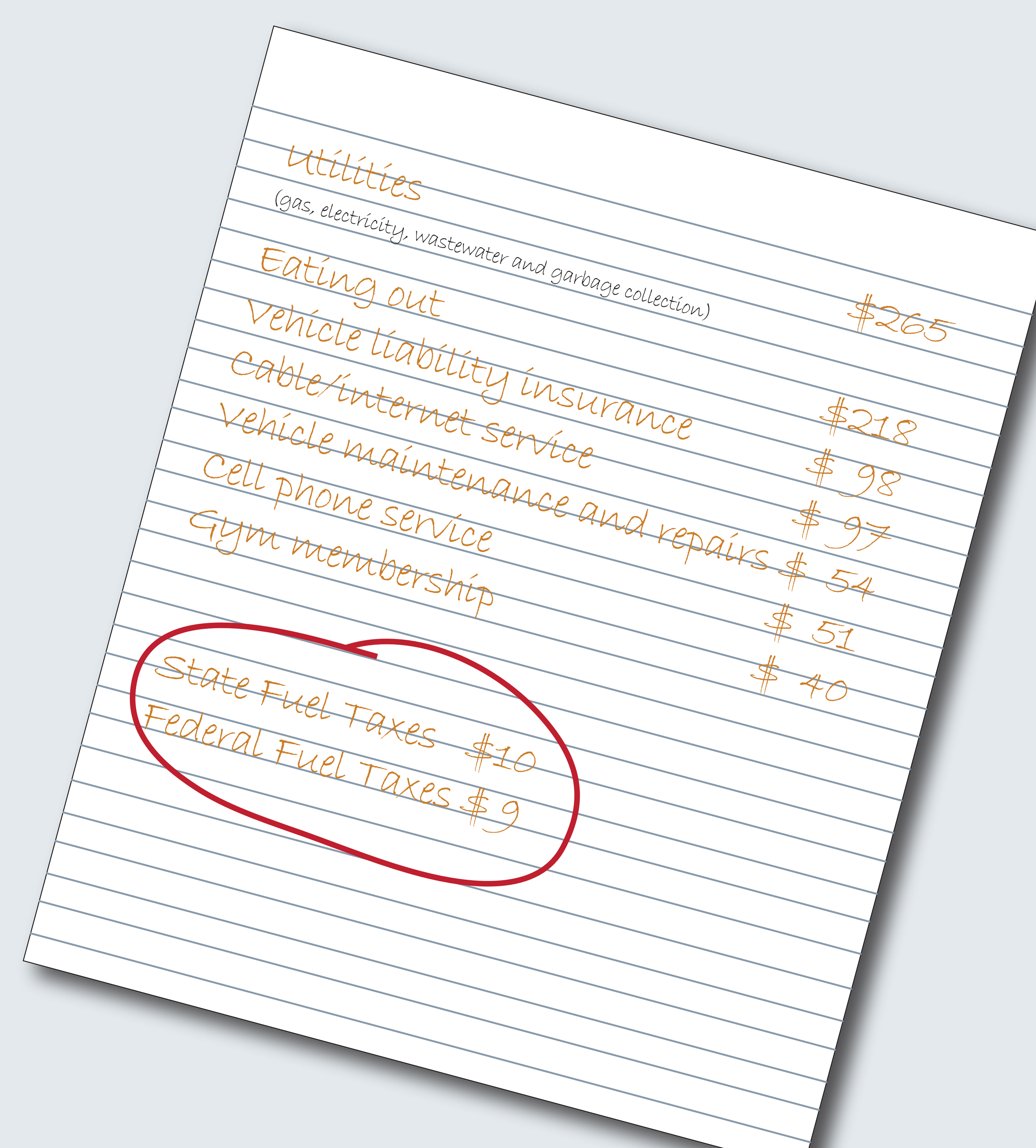


How much do I pay?

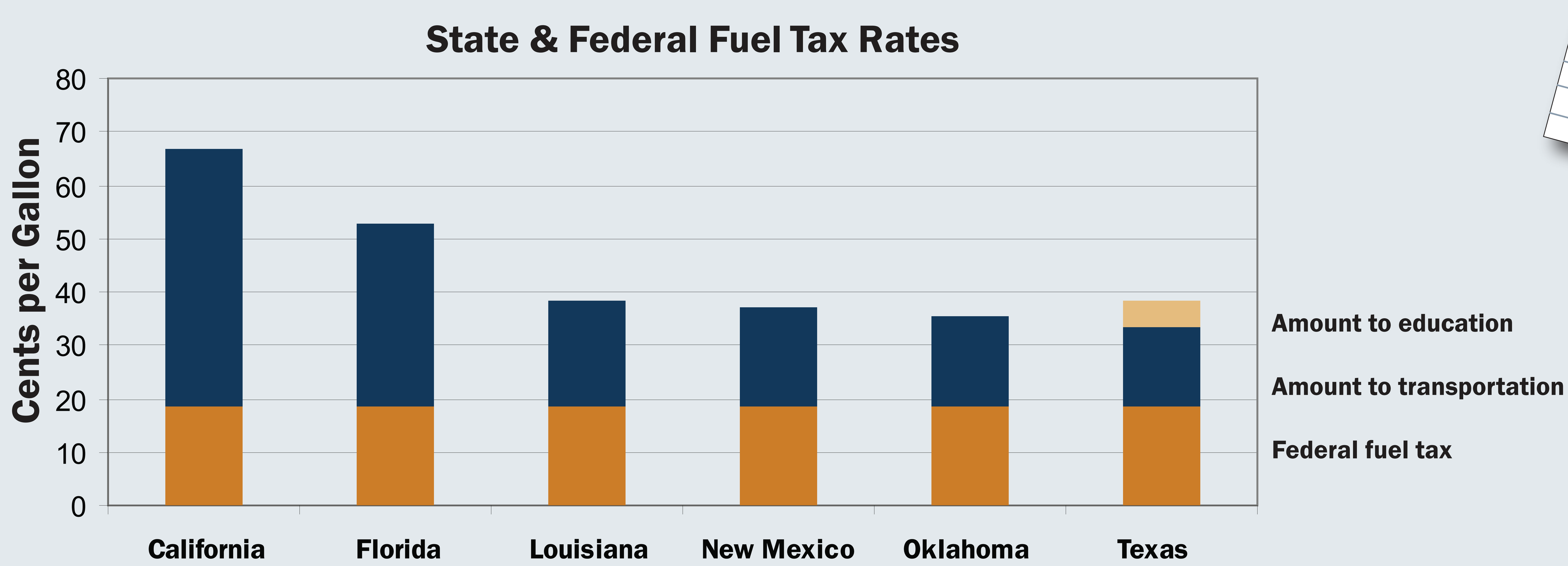
Our state gas tax is 20 cents per gallon. Of this tax, 15 cents goes to the highway fund and 5 cents goes to public education. The average driver pays $9.52 each month in state fuel taxes and contributes $7.14 each month to the highway fund. For this analysis, the average driver travels 12,000 miles each year and drives a vehicle that gets 21 miles per gallon.

The federal government collects an additional 18.4 cents per gallon.

Monthly household expenses compared to fuel tax payments



How do other states compare?



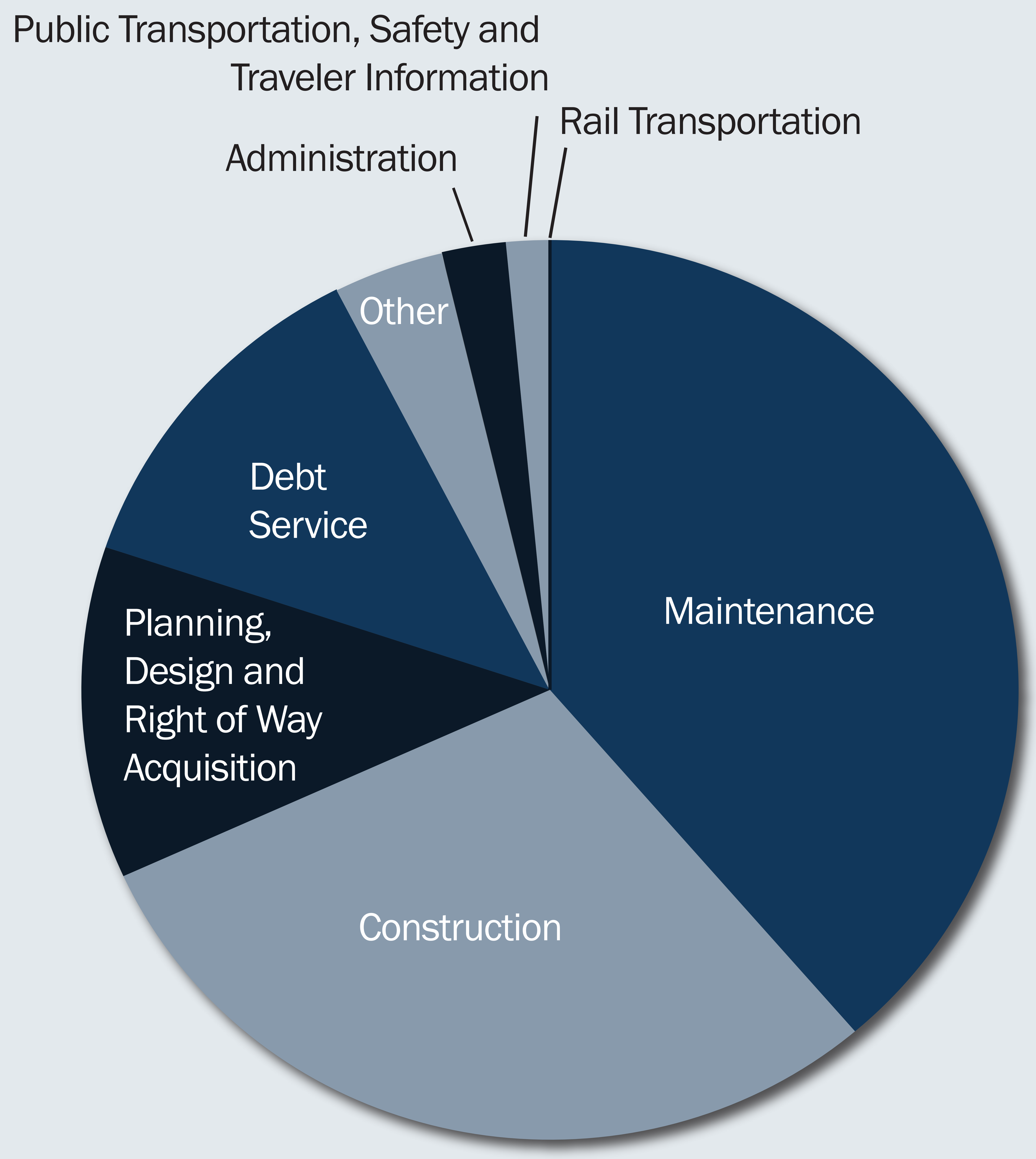
Transportation Budget

The 2014 Budget Numbers

Appropriation	Budget	Percentage
Maintenance	$ 4,279,851,277	39%
Construction	$ 3,258,506,985	29%
Planning, Design, and Right-of-Way Acquisition	$ 1,325,277,015	12%
Debt Service	$ 1,366,903,325	12%
Other	$ 416,835,214	4%
Administration	$ 242,251,441	2%
Public Transportation, Safety, and Travel Information	$ 165,840,999	1.5%
Rail Transportation	$ 36,690,829	0.30%
Total	**$ 11,092,157,085**	**100%**

Source: 2014 Planned Appropriations

2014 Transportation Appropriations



Typical Life Cycle Costs of a Highway

10 miles of Interstate pavement under different maintenance strategies

(2 lanes in each direction)

No Maintenance Strategy

Construction ($120M)

Road Condition

Re-construction ($263M)

Road Condition

Re-construction ($576M)

Total Cost: $959M*

Year 0 5 10 15 20 25 30 35 40

Extensive Maintenance Strategy

Resurfacing and Maintenance Work

Construction ($120M)

Routine Maintenance ($2.2M)

Resurfacing ($18.4M)

Routine Maintenance ($3.2M)

Resurfacing ($27.2M)

Routine Maintenance ($4.8M)

Resurfacing ($40.2M)

Routine Maintenance ($7.1M)

Re-construction ($576M)

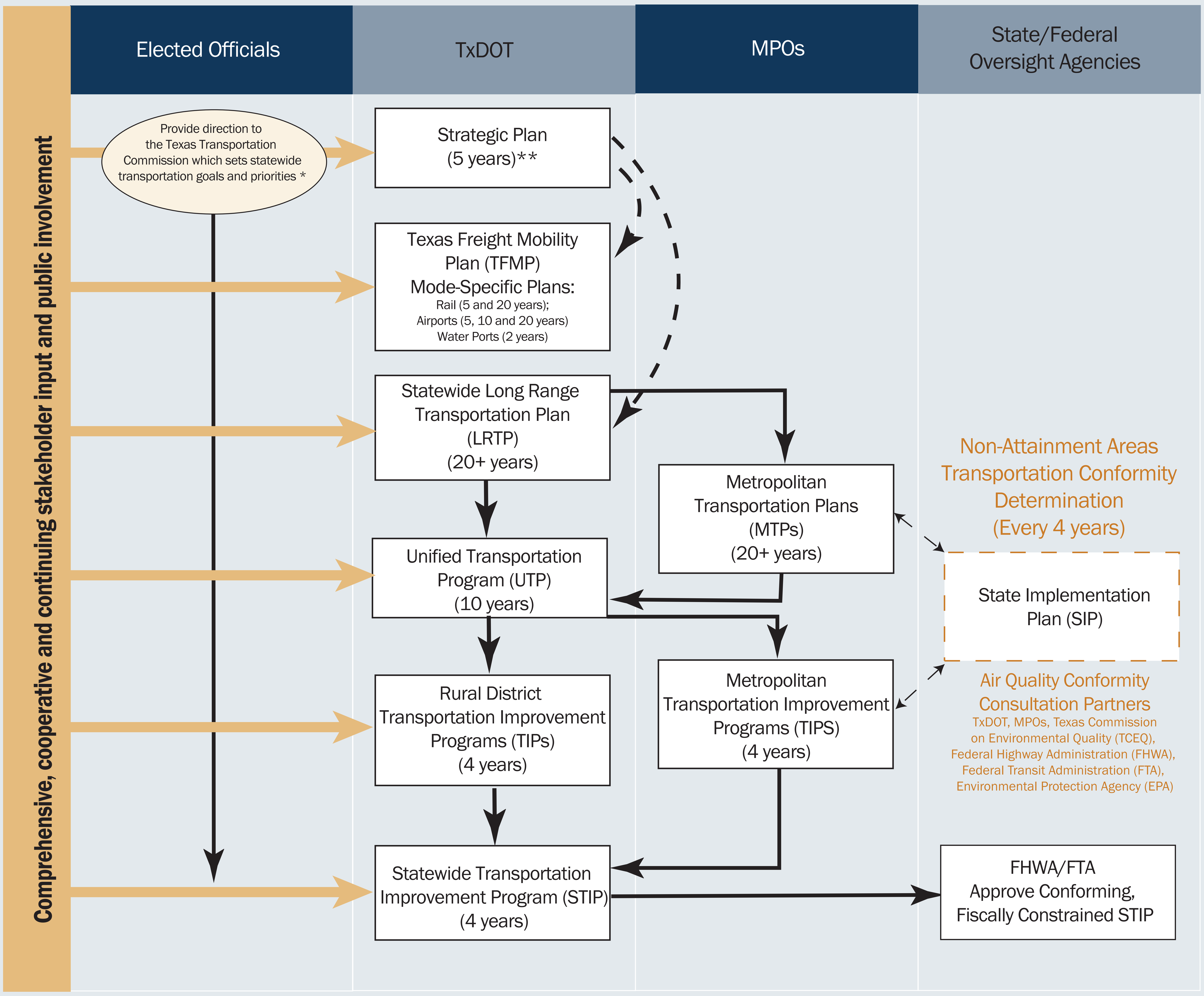
Total Cost: $799M*

Year 0 5 10 15 20 25 30 35 40

* Assumes 4% inflation

Maintaining the roadway saves $160M over 40 years!

Transportation Planning and Programming Planning Documents

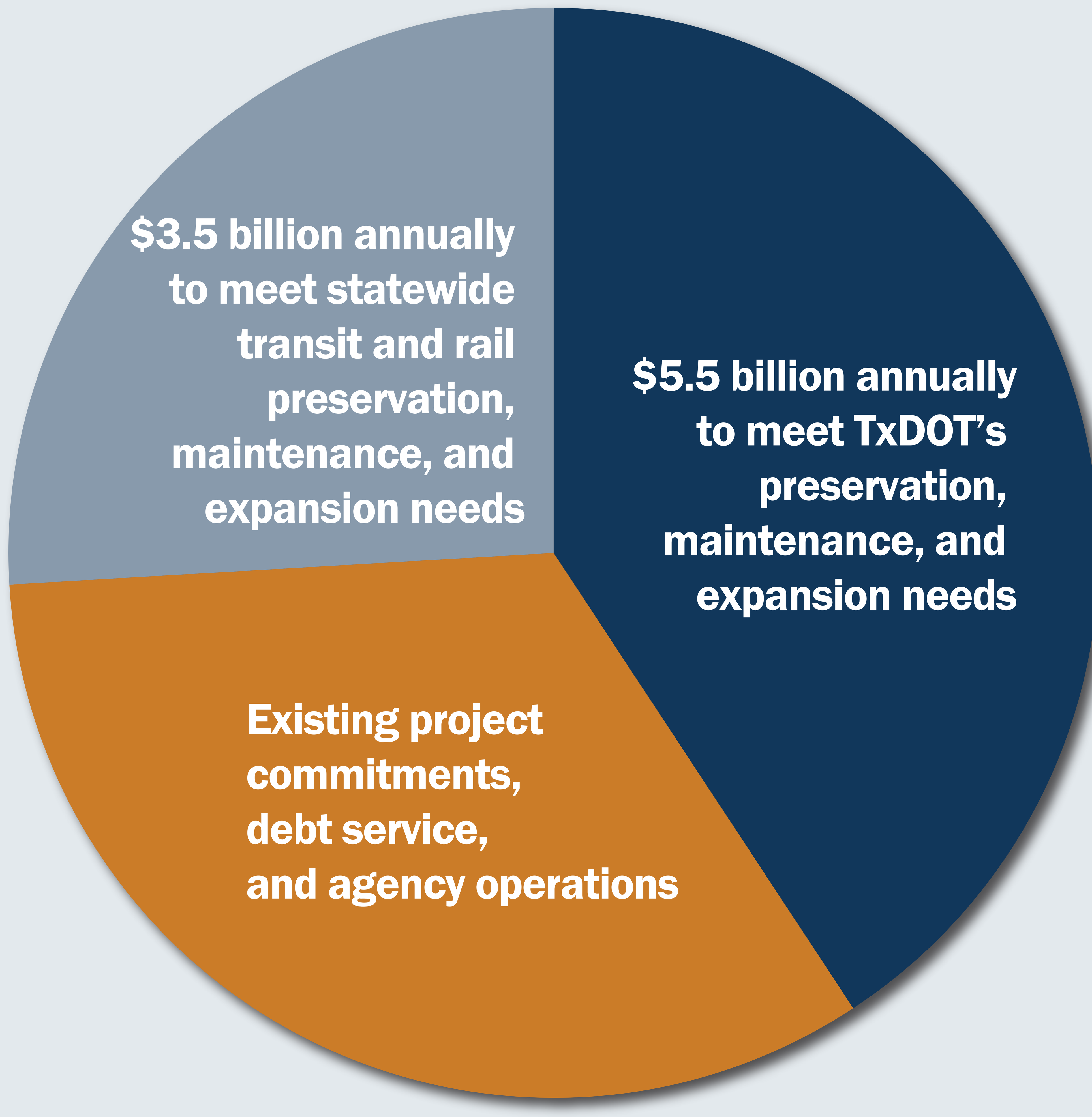


* Elected Officials provide direction to the Commission, but are also engaged to the public involvement process and development of all plans and programs
** TFMP and Modal Plans as well as TxDOT's LRTP reflect and are consistent with TxDOT's Strategic Plan goals.

Transportation Plans and Descriptions

Plan/Program	Developed By	Approved By	Content
State Implementation Plan (SIP)	TCEQ & Non-Attainment MPOs	EPA	A description of control strategies, or measures to deal with pollution, for areas that fail to achieve national ambient air quality standards (NAAQS)
TxDOT Strategic Plan	TxDOT	Texas Transportation Commission	TxDOT's operational goals and strategies
Statewide Long-Range Transportation Plan (SLRTP)	TxDOT	Texas Transportation Commission	Future goals, strategies, and performance measures for the multi-modal transportation system
Texas Freight Mobility Plan (TFMP)	TxDOT	Texas Transportation Commission	Establish a framework for Texas' comprehensive freight planning program and decision making
Texas Rail Plan	TxDOT	Texas Transportation Commission	Long-range rail investment program for freight and passenger infrastructure
Texas Airport System Plan	TxDOT	Texas Transportation Commission	Guidelines to help planners determine how to maximize the return on investment of public funds and identifies what capital improvements would best serve the state's aviation needs
Texas Ports Capital Plan	Port Authority Advisory Committee	Texas Transportation Commission	Identifies funding requests for port transportation and economic development projects submitted by ports
Statewide Transportation Improvement Program (STIP)	TxDOT	USDOT (FHWA/FTA)	Multi-modal transportation projects/investments
Unified Transportation Program (UTP)	TxDOT	Texas Transportation Commission	Multi-modal projects to be funded/implemented in a 10-year period
Transportation Improvement Programs (TIPs) - TxDOT Rural	TxDOT Districts	Governor (delegated to TxDOT)	Multi-modal transportation projects/investments
Transportation Improvement Programs (TIPs) - MPO	MPOs	MPO Policy Board	Multi-modal transportation projects/investments
Metropolitan Transportation Plan (MTP)	MPO	MPO	Policies, programs, and projects for development that respond to adopted goals and expenditures for state and federal funds over the next 20+ years
Corridor Studies (e.g., IH 35, IH 69)	TxDOT	Texas Transportation Commission	Benefit cost analysis and feasibility

Commitments and Investment Categories

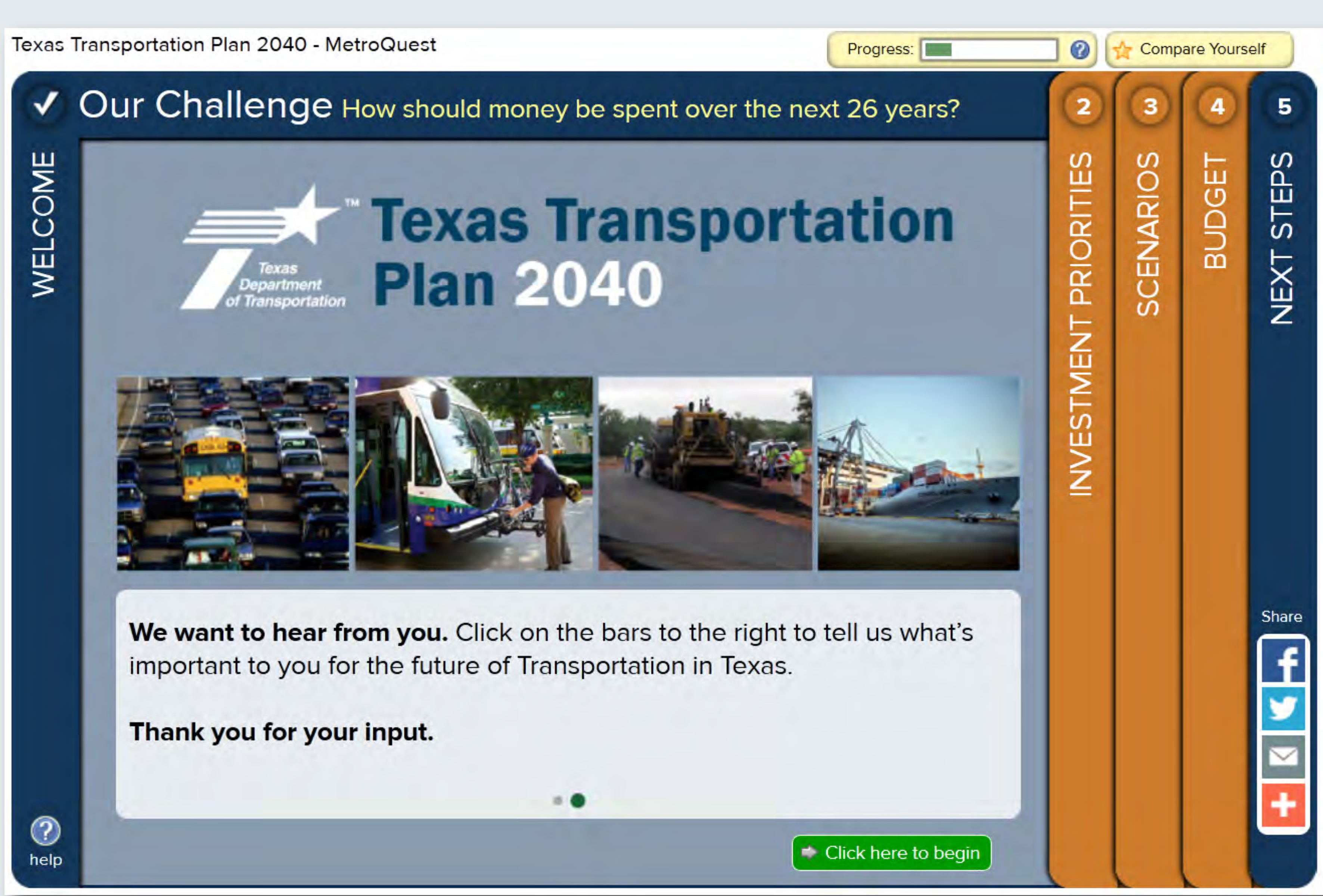


With More Transportation Needs, More Money Is Needed

Given our needs and population growth, the State has estimated that at least $5 billion annually is required to maintain existing system conditions and performance. That means that $5 billion is needed for the State to simply "hold ground" when it comes to our transportation goals.

If you had $5 billion to invest annually for transportation in Texas, how would you spend it?

Use the MetroQuest interactive tool to learn about how and where investments are most needed and provide your feedback on alternative investment approaches by building your own annual transportation budget.



MetroQuest Tool

Appendix E
E-mail Campaign Messages

eBlast Campaign for Texas Transportation Plan 2040

The consultant team used eBlasts to notify stakeholders and the public of upcoming TTP 2040 events and to thank attendees for their attendance and provide follow-up after attendees came to an event. Mail Chimp was used for this. For the TTP2040 project, we will tried to target Wednesdays for email blasts although that was not always possible. Other points that were consider in the development of the eBlast campaign for the TTP2040 include:

- People tend to open emails more during the day
- More links leads to more clicks, placing a link in an email more than once may increase the number of clicks for the link.

In addition the eBlasts that the consultant team sent out, TxDOT also sent out their own email announcements through the GovDelivery System.

Schedule of Consultant eBlasts

Message	Date/Time	Message	Audience	Subscribers	Open Rate (1)	Clicks (2)	Date to TxDOT for Review
1	Wednesday, May 15 at 4:00 pm	Save the date for open house. What is the TTP. Fill out the survey.	TTP 2040 General Contact List	3181	29.9%	7.2%	4/27/2014
2	Wednesday, June 4, 2014	Announce that open houses begin next week	TTP 2040 General Contact List	3181	28.1%	6.2%	5/27/2014
3	Friday May 30, 2014	Stakeholder Workshop Invitation	Stakeholder List	265	41.4%	12%	5/26/2014
4 – 11 (TBD)	Week after each round of outreach	Thank you for attending, here are the links to the survey, tool and more info	Workshop and Open House attendees	606	45.4% (avg)	7.32% (avg)	5/26/2014

(1) Industry average is: 19.4%

(2) Industry average is: 1.9%

Information on TxDOT's Texas Transportation Plan 2040 View this email in your browser

TEXAS TRANSPORTATION PLAN 2040

TxDOT wants your input!

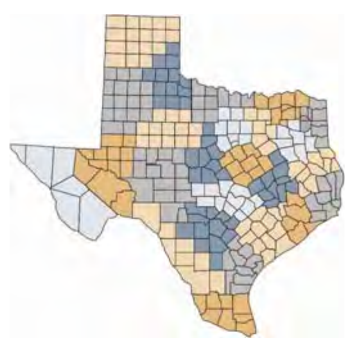
The Texas Transportation Plan 2040 team is coming to a town near you!

Mark your calendar to attend one of the 25 open houses that will be held throughout the state. TxDOT is looking for feedback on transportation issues to develop a long-range plan out to 2040. Open houses will be held in the following locations. (More information>>)

Abilene	Laredo
Amarillo	Lubbock
Atlanta (Texarkana)	Lufkin
Austin	Odessa
Beaumont	Paris
Brownwood	Pharr
Bryan	San Angelo
Childress	San Antonio
Corpus Christi	Tyler
Dallas	Waco
El Paso	Wichita Falls
Fort Worth	Yoakum
Houston	

If you can't make an open house, fill out a transportation survey online!

For more information on the Texas Transportation Plan 2040, check out our website. (More



information>>)

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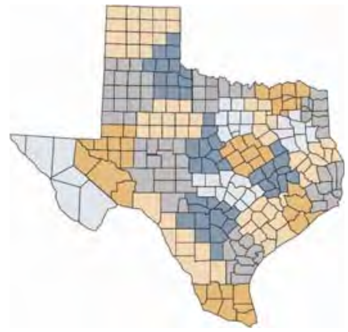
TEXAS DEPARTMENT OF TRANSPORTATION Stakeholder Workshop Invite

You're Invited to a Stakeholder Workshop



The Texas Transportation Plan 2040 planning team will be hosting workshops throughout the state beginning in June 2014. Workshops will be held from 2 - 4 p.m. and are designed to solicit feedback from transportation stakeholders. Please mark your calendar to attend one of the 25 workshops, click here for meeting locations and times.

TxDOT District	Date
Bryan	6/9/2014
Beaumont	6/10/2014
Houston	6/11/2014
Lufkin	6/12/2014
San Angelo	6/16/2014
Odessa	6/17/2014
El Paso	6/18/2014
Atlanta	6/24/2014
Paris	6/25/2014
Tyler	6/26/2014
Dallas	7/7/2014
Wichita Falls	7/8/2014
Fort Worth	7/9/2014
Brownwood	7/10/2014
Laredo	7/14/2014
Pharr	7/15/2014
Corpus Christi	7/16/2014
Yoakum (meeting held in Victoria)	7/17/2014

Waco	7/21/2014
Abilene	7/28/2014
Childress	7/29/2014
Amarillo	7/30/2014
Lubbock	7/31/2014
San Antonio	8/4/2014
Austin	8/5/2014

Stakeholders will have the opportunity to work with an electronic investment tool and while tablets will be available, you are welcome to bring your own personal computing device (ex: tablet or laptop).

Please note that a public open house is scheduled for the evening of the same day, the afternoon workshop is targeted at transportation stakeholders.

If you have any questions or concerns, please email the planning team at: TxTransPlan2040@txdot.gov.

Please feel free to share this email with colleagues and staff.

For more information on the Texas Transportation Plan 2040, check out our website. (More information>>)

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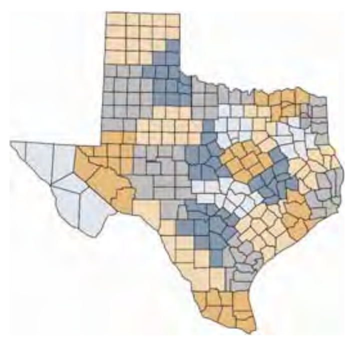
TEXAS TRANSPORTATION PLAN 2040

Mark your calendar to attend an open house!

The Texas Transportation Plan 2040 team is coming to a town near you and they want your input!

Mark your calendar to attend one of the 25 open houses that will be held throughout the state. TxDOT is looking for feedback on transportation issues to develop a long-range plan out to 2040. **We'll be in Bryan, Beaumont, Houston and Lufkin the week of June 9th, check the complete list of open houses for one near you.** (More information>>)

Abilene	Laredo
Amarillo	Lubbock
Atlanta	Lufkin
Austin	Odessa
Beaumont	Paris
Brownwood	Pharr
Bryan	San Angelo
Childress	San Antonio
Corpus Christi	Tyler
Dallas	Waco
El Paso	Wichita Falls
Fort Worth	Victoria
Houston	



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The open houses will feature a new interactive planning tool. The interactive planning tool puts you in the driver seat, allowing you to explore different approaches to funding transportation in Texas and create your own transportation budget. You will be able to measure the performance of your transportation budget in real-time, mark your calendar today to attend an open house!

Interactive Planning Tool

For more information on the Texas Transportation Plan 2040, check out our website. (More information>>)

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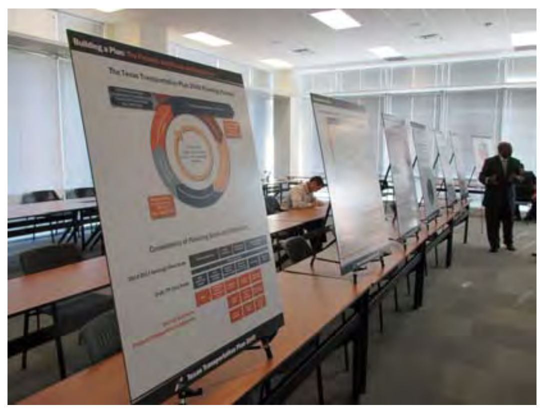
TEXAS TRANSPORTATION PLAN 2040

Thank you for your input!

The Texas Transportation Plan 2040 team appreciates your time and involvement!

The Texas Transportation Plan (TTP) 2040 planning team would like to thank you for taking the time to provide input on the TTP. We will continue to host meetings and open houses around the state; for a complete list of open houses, click here. Please help us spread the word about future open houses and the availability of our interactive planning tool and survey!

Did you get a chance to try out our interactive transportation planning tool? It is also available online, check it out today!



All meeting materials will be available at the TxDOT website, click here for more information.

If you have any additional comments, questions or suggestions, please contact us at: TxTransPlan2040@txdot.gov.

Appendix F
Transportation Questionnaire

TEXAS DEPARTMENT OF TRANSPORTATION

1. Where do you live?

______________ ______________ ______________
City or Town | County | Zip Code

2. What ways do you travel? (Please answer all)

Method of travel	Daily	Weekly	Monthly	Seldom	Never Use
Drive alone in vehicle	☐	☐	☐	☐	☐
Carpool or vanpool	☐	☐	☐	☐	☐
Motorcycle or motorized scooter	☐	☐	☐	☐	☐
Public Transit (e.g., city bus, light/commuter rail)	☐	☐	☐	☐	☐
Bus between cities (e.g., Greyhound, Kerrville, Tornado, etc)	☐	☐	☐	☐	☐
Taxicab	☐	☐	☐	☐	☐
Bicycle	☐	☐	☐	☐	☐
Walk	☐	☐	☐	☐	☐
Train (Amtrak)	☐	☐	☐	☐	☐
Airplane	☐	☐	☐	☐	☐
Ferryboat	☐	☐	☐	☐	☐

3. How do you commute from home to work or school most of the time?

Commute method	Choose One
Drive alone in vehicle	☐
Carpool or vanpool	☐
Motorcycle or motorized scooter	☐
Public Transit (e.g., city bus, light rail, commuter rail)	☐
Bicycle	☐
Walk	☐
Taxicab	☐
Work at home or telecommute	☐
Do not commute	☐

4. Where do you work or go to school?

____
City or Town

____
County

____
Zip Code

5. How far is your commute to work or school?

______________Miles

6. What is the most important factor in choosing how you commute to work or school? (choose one)

Most important factor	Choose One
It is the only option available	☐
Travel time	☐
Reliability	☐
Cost	☐
Flexibility	☐
Convenience	☐
Need to make stops going to or from work (e.g., errands, children)	☐
Emergency or unplanned trips	☐
Wellness and health	☐
Environmental concerns	☐
Other (please specify):	☐

7. As we prioritize transportation investments, how important are these goals to you?

Goal areas	Very Important	Important	Neutral	Unimportant	Very Unimportant
Safety (Infrastructure preservation to maintain a safe system)	☐	☐	☐	☐	☐
Asset management (Prioritizing cost beneficial preservation to ensure physical assets remain safe and in good condition)	☐	☐	☐	☐	☐
Mobility and reliability (Congestion reduction; commerce facilitation; system efficiency; and performance)	☐	☐	☐	☐	☐
Multimodal connectivity (Extent to which various modes are connected to move people and goods efficiently)	☐	☐	☐	☐	☐
Stewardship (Earning public trust, social-responsible planning, maintaining accountability in decision making)	☐	☐	☐	☐	☐
Customer service (Educating the public; listening to and incorporating public needs and priorities into the planning process)	☐	☐	☐	☐	☐
Sustainable funding (Identifying and documenting funding sources to meet the State's future transportation needs)	☐	☐	☐	☐	☐

8. How would you rate the following as transportation problems?

Transportation problems	Very Important	Important	Neutral	Unimportant	Very Unimportant
Traffic congestion and delays	☐	☐	☐	☐	☐
Potholes, crumbling roads and bridges	☐	☐	☐	☐	☐
Pedestrian and bicycle safety	☐	☐	☐	☐	☐
Limited public transportation service	☐	☐	☐	☐	☐
Lack of alternative modes of travel (besides passenger vehicles)	☐	☐	☐	☐	☐
Unsafe/narrow roads	☐	☐	☐	☐	☐
Lack of travel options between cities	☐	☐	☐	☐	☐

Turn Over for Page 2

TEXAS DEPARTMENT OF TRANSPORTATION

9. How would you rate these potential solutions for improving transportation?

Potential solutions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Add lanes to existing roads or freeway	☐	☐	☐	☐	☐
Build more roads or freeways	☐	☐	☐	☐	☐
Add shoulders to existing roads	☐	☐	☐	☐	☐
Add turn lanes at intersections	☐	☐	☐	☐	☐
Improve traffic signal timing	☐	☐	☐	☐	☐
Improve pavement and bridges	☐	☐	☐	☐	☐
Provide more bus service	☐	☐	☐	☐	☐
Build more light/commuter rail lines	☐	☐	☐	☐	☐
Build more high speed rail lines between large cities	☐	☐	☐	☐	☐
Expand airports and terminals	☐	☐	☐	☐	☐
Add new or widen existing sidewalks	☐	☐	☐	☐	☐
Build more signalized crosswalks	☐	☐	☐	☐	☐
Provide driver information systems (e.g., changeable message signs, traffic cameras)	☐	☐	☐	☐	☐
Build High Occupancy Vehicle (HOV)/ carpool/bus lanes	☐	☐	☐	☐	☐
Reduce traffic conflicts between heavy trucks and passenger vehicles	☐	☐	☐	☐	☐
Land use development that encourages transportation options	☐	☐	☐	☐	☐

10. If you could spend $100 to improve transportation facilities in Texas, how much would you spend on the following?

Category	Amount ($100 Total)
Reducing congestion on highways	
Repairing or maintaining highways and bridges	
Improving public transit	
Improving airports	
Improving route and facilities for freight	
Improving ports	
Improving pedestrian and bicycle facilities	
Other:____________________________	

Tell us about yourself!

This project is requesting demographic information to evaluate the effectiveness of public outreach activities and to comply with Title VI of the Civil Rights Act. The **identity of individuals is kept confidential**. The results are reported as totals only, and **used solely to help improve future outreach.**

How did you hear about the project?

- ☐ Public notice
- ☐ Newsletter
- ☐ Website
- ☐ Email
- ☐ Friend or co-worker
- ☐ Other ________________

Your Race/Ethnicity

- ☐ African-American
- ☐ Caucasian
- ☐ Hispanic
- ☐ American Indian/Alaskan
- ☐ Asian or Pacific Islander
- ☐ Unknown/Don't want to say

Household Income

- ☐ $0-$9,999
- ☐ $10,000-$14,999
- ☐ $15,000-$24,999
- ☐ $25,000-$34,999
- ☐ $35,000-$49,999
- ☐ $50,000-$74,999
- ☐ $75,000-$99,999
- ☐ $100,000-$149,999
- ☐ $150,000-$199,999
- ☐ $200,000 or more
- ☐ Prefer not to say

Gender Identity

- ☐ Male
- ☐ Female
- ☐ Prefer not to say

Age

- ☐ 16-19
- ☐ 20-24
- ☐ 25-29
- ☐ 30-34
- ☐ 35-39
- ☐ 40-44
- ☐ 45-49
- ☐ 50-54
- ☐ 55-59
- ☐ 60-64
- ☐ 65-69
- ☐ 70 or older
- ☐ Prefer not to say

What language is spoken at home?

- ☐ English
- ☐ Spanish
- ☐ ________________

11. Please provide any additional comments below:

____

____

____

____

____

Appendix G
Demographic Survey

Texas Transportation Plan (TTP) 2040 Demographic Survey

Location: ________________________ Date: ________________ Your home ZIP code

Voluntary Information

Please provide the following information about yourself. Please check appropriate circle.

Sex
- ○ Female
- ○ Male

Age
- ○ 1-21
- ○ 22-40
- ○ 41-65
- ○ Over 65

Disability
- ○ Yes
- ○ No

Ethnicity / Race
- ○ White (non-Hispanic)
- ○ Asian
- ○ American Indian
- ○ Native Hawaiian / other Pacific Islander
- ○ Black
- ○ Hispanic
- ○ Other: _________

First Language
- ○ English
- ○ Spanish
- ○ Vietnamese
- ○ Chinese dialect
- ○ Russian
- ○ Other: _________

Second Language
- ○ English
- ○ Spanish
- ○ Vietnamese
- ○ Chinese dialect
- ○ Russian
- ○ Other: _________

Household Income
- ○ $0-$12,000
- ○ $12,000-$24,000
- ○ $25,000-$36,000
- ○ $37,000-$48,000
- ○ $49,000-$60,000
- ○ $60,000 +

Household size: Adults___ Children___

Who are you representing?

Voluntary Information

(1) Minority population / organization
- ○ Asian
- ○ American Indian
- ○ Native Hawaiian / other Pacific Islander
- ○ Black
- ○ Hispanic
- ○ Other: _________

(2) Low-income population
- ○ Yes
- ○ No

(3) Persons with disabilities
- ○ Yes
- ○ No

(4) Elderly population
- ○ Yes
- ○ No

Appendix H
Web-Based Interactive Planning Scenario Tool Summary

SUMMARY OF METROQUEST INPUT

DATE/TIME: August 27, 2014

PREPARED BY: Stephanie Lind

SUBJECT / MEETING TOPIC: Summary results from MetroQuest tool developed for Texas Transportation Plan 2040

Introduction

This is a draft summary of data gathered from the MetroQuest tool developed for the Texas Transportation Plan 2040 (TTP 2040). This information will be updated once the public comment period has closed for the TTP 2040.

Background and Purpose

A scenario planning tool was developed using MetroQuest for the TTP 2040. The tool was developed by CH2M Hill in coordination with TxDOT. The purpose of the MetroQuest tool was to:

- Educate the public and stakeholders about trade-offs between types of investments and levels of funding, and
- Gather input about values related to transportation investments and funding.

The tool became available for use on June 2, 2014. The tool was made available through the internet. Users could access it online or at outreach events in the summer of 2014. Links to the tool were publicized through email eBlasts, Twitter, Facebook, the TxDOT website, and word of mouth. The tool was showcased through statewide outreach that took place from June 2014 through August 2014. That outreach included a stakeholder workshop that discussed the tool and an open house where members of the public were invited to use the tool.

Users were guided through 5 tabs in the tool, the first tab provided introductory text. The second tab asked users to identify their top three investment priorities. The third tab allowed users to explore three distinct funding scenarios and view how the state-wide transportation system would perform under those scenarios. The three scenarios included: (1) system preservation, (2) metropolitan mobility, and (3) connectivity and freight; users were asked to rate each scenario from 1 to 5 stars. The fourth tab allowed users to create their own transportation budget and view the performance of their system based on their allocations. Lastly, the Stay Involved screen asked users whether they supported additional investment in transportation in Texas, what additional investment categories should be considered and for the user's zip code.

Summary of Findings

In general, users felt that congestion and pavement condition are or should be top priorities. The selection of these priorities in most user's top three selected priorities is consistent with where users allocated money in the budget exercise. Pavement preservation and rehabilitation and Roadway reconstruction and expansion received on average the most money when users built their own transportation budget.

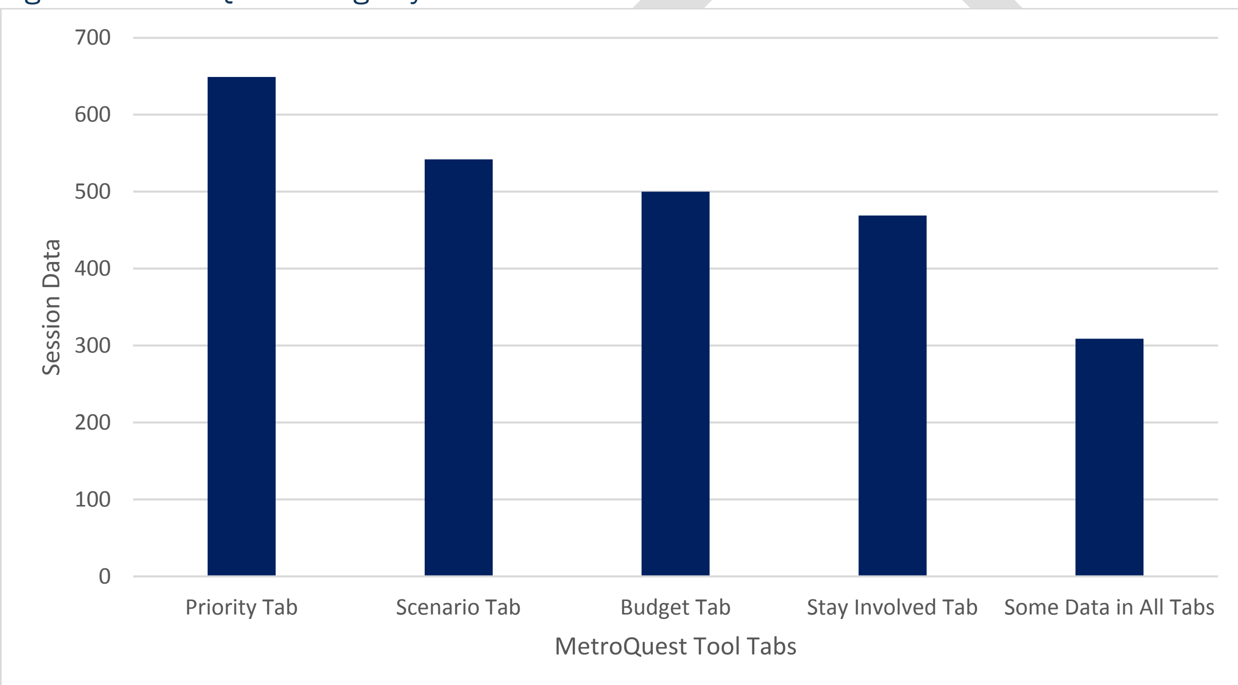
Users were able to rate three different investment approaches: (1) system preservation, (2) metropolitan mobility and (3) connectivity and freight. In general, users rated them all about equally. This was also supported by where users allocated money in the budget exercise.

Lastly, when users were asked several follow-up questions, most users responded that more money is needed to fund transportation in the state of Texas.

Tool Use

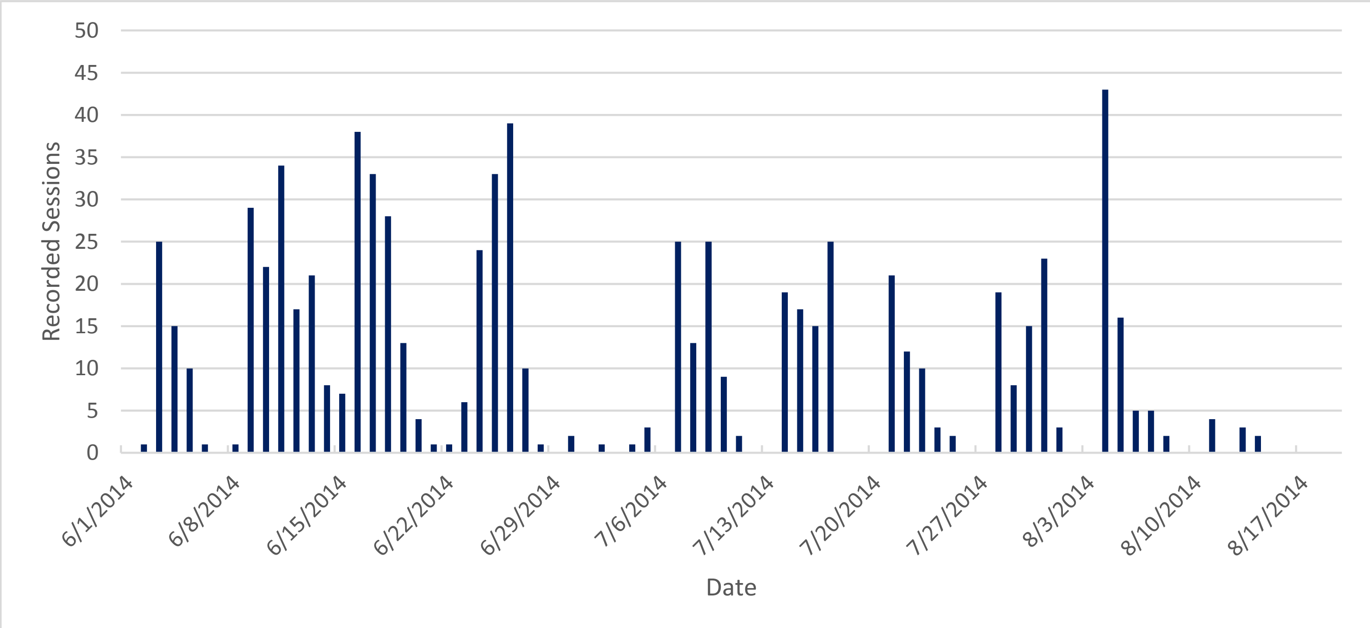
To obtain an estimate of the number of people that used the tool, staff reviewed the raw output of all session data captured. There were more than 1,803 MetroQuest sessions initialized as of Tuesday, August 19, 2014 at 12:00 p.m. Some sessions were attributed to a device restarting and captured no data. As a user went through the tool, data was captured on each screen, in some cases, a user might not have entered data in each screen. Of the user sessions, 783 users entered in some type of input. The graph below shows how many sessions had data captured by the individual tabs of the MetroQuest tool. 309 users responded to questions on all four tabs of the MetroQuest tool.

Figure 1 - MetroQuest Usage by the which tab had data recorded



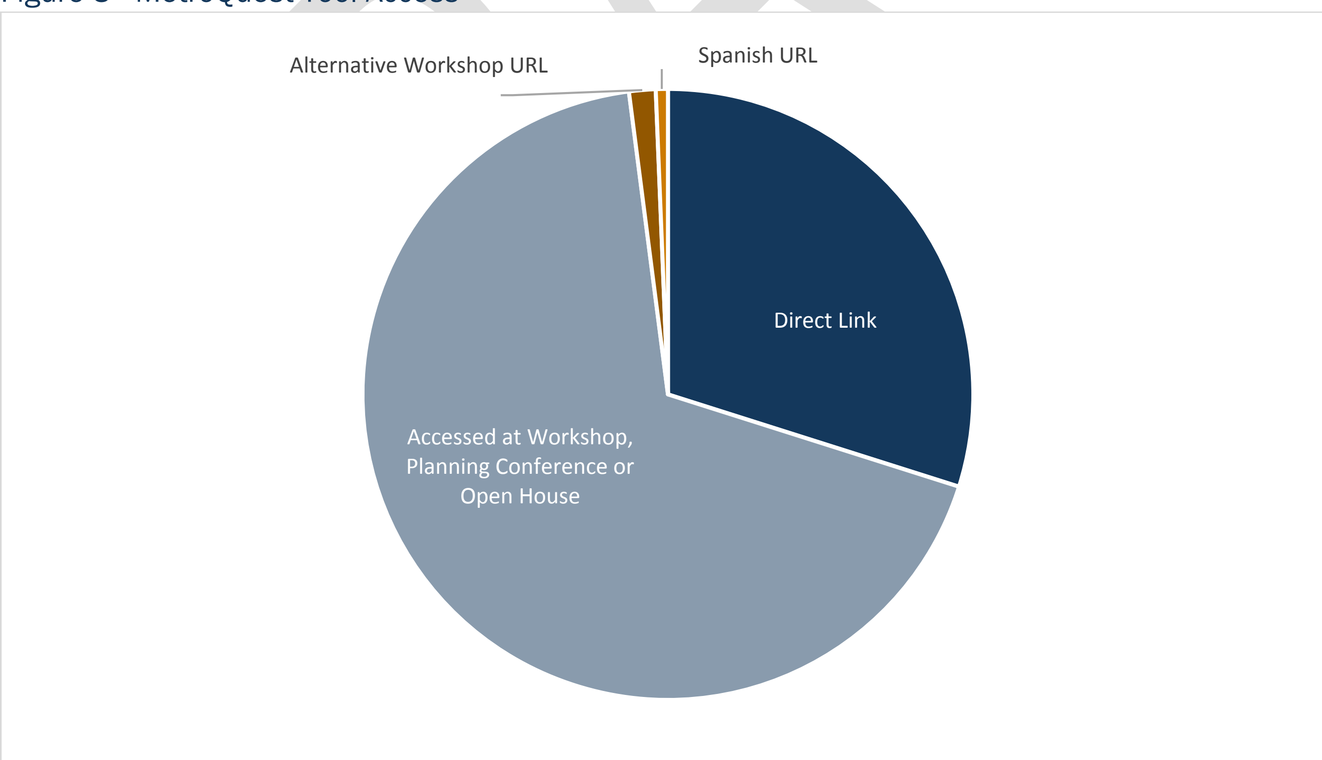
Usage of the tool was highest on days when the tool was being showcased at the TxDOT Transportation Planning Conference and at outreach meetings for the TTP 2040. The chart below shows tool usage by date.

Figure 2 - MetroQuest Use by Date



Nearly 70 percent of users accessed the tool at TxDOT meetings or at the TxDOT Transportation Planning Conference. 30 percent of the users of the tool accessed the tool through the direct link that could be found on the TxDOT website and was distributed to the public. Only 1 percent of the users accessed the tool through the link provided to agency stakeholders. Less than 1 percent of users (5) used the Spanish translated version of the tool.

Figure 3 - MetroQuest Tool Access



MetroQuest Input

In the following section, a summary of responses for each tab of the MetroQuest tool is presented. The introductory screen is the first screen that a user saw when using the tool.

Welcome Tab

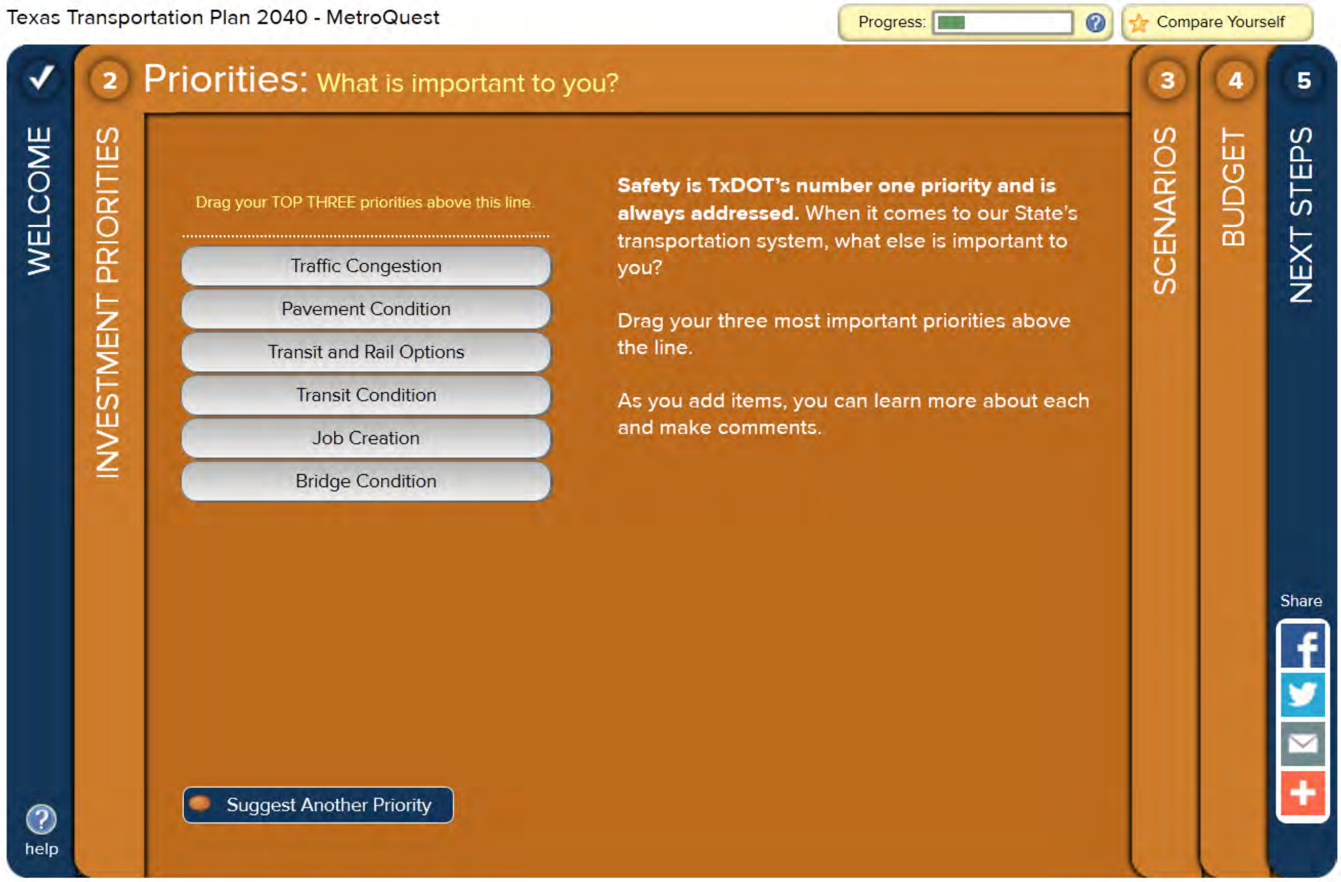
The Welcome Tab provided introductory text and basic directions for using the tool.

Figure 4- MetroQuest Tool Welcome Tab

Priorities Tab

The Priorities Tab allows users to select their top three priorities. The user will see their top three priorities listed when they review three different approaches in the following tab which is entitled Scenarios. What priorities a user selects does not change the scenarios on the following screen or their performance. **The purpose of this exercise is to let the user choose what is most important to them and see how those priorities are impacted by the static approaches on the following tab.** 649 users filled out some portion of this tab.

Figure 5 - MetroQuest Tool Priorities Tab



Traffic congestion and pavement condition were top priorities for those that used the tool. 78 percent of those that used the tool had traffic congestion as one of their top three priorities.

Table 1 - MetroQuest Top Priorities

Priorities	First	Second	Third	TOTAL	In Top 3 Priorities
Traffic congestion	232	150	127	509	78%
Pavement condition	146	168	126	440	70%
Transit and rail options	125	104	74	303	48%
Bridge condition	63	103	107	273	43%
Job creation	51	43	76	170	27%
Transit condition	32	57	80	169	27%

Additional suggested priorities

Users had an opportunity to suggest other priorities that were not listed, a summary of those suggestions is included below, for a complete list, see the Appendix.

- Safety (3 users)
- Technology to reduce demand
- Bicycle and pedestrian infrastructure (9 users)
- Complete streets
- Land use (4)
- Connectivity
- Freight (3)
- Road construction or added capacity (3
- Financing, tolling or (1)

- Maintenance
- Interstate designation
- Environmental concerns including air quality, water and stewardship (2)
- Maintaining two-way frontage roads
- Economic growth

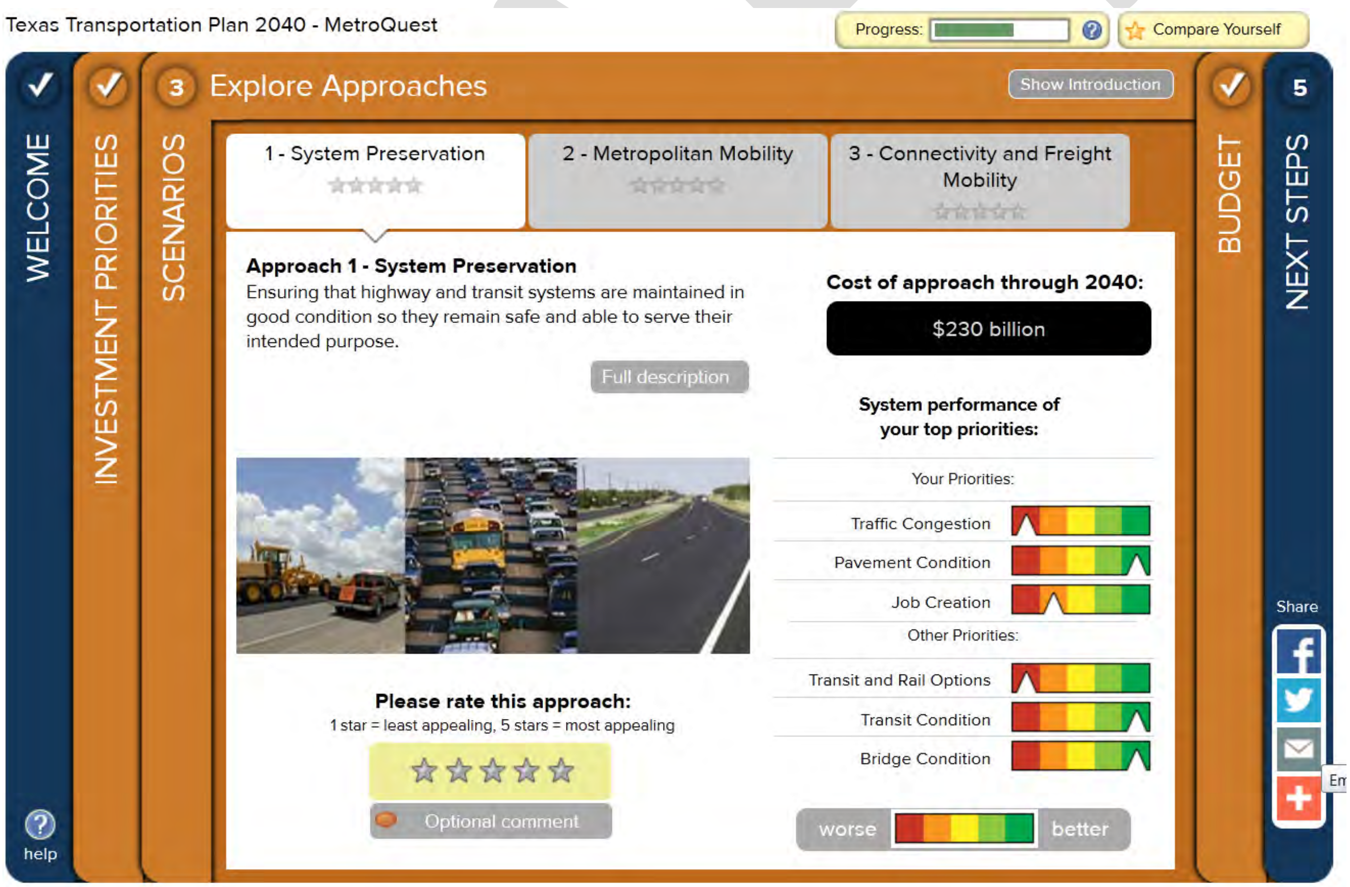
Users could also provide comments for the priorities listed, a complete list of those priorities is included in the Appendix.

Scenarios Tab

The Scenarios Tab showcases three different, static approaches to funding transportation in Texas. Detailed descriptions and specifications for each investment approach were provided.

The information presented is static. **The purpose of this exercise is to review and rate each approach.** This allows users to review different packages of investments and view the system-wide performance under each approach. 542 users filled out some portion of this tab.

Figure 6 - MetroQuest Tool Approaches Tab



Approach 2 received the most 5 star ratings followed by Approach 1.

Table 2- Ratings by Approach

Approaches	5 stars	4 stars	3 stars	2 stars	1 stars	Did not Rate

Approach 1 - System preservation	149	136	125	63	52	258
Approach 2 - Metropolitan mobility	205	141	101	39	21	276
Approach 3 - Connectivity and freight mobility	100	186	159	49	19	275

If you consider how many users rated each approach 3 stars or more, the three approaches were all equally popular.

Table 3 - Ratings of 3 Stars or Higher by Approach

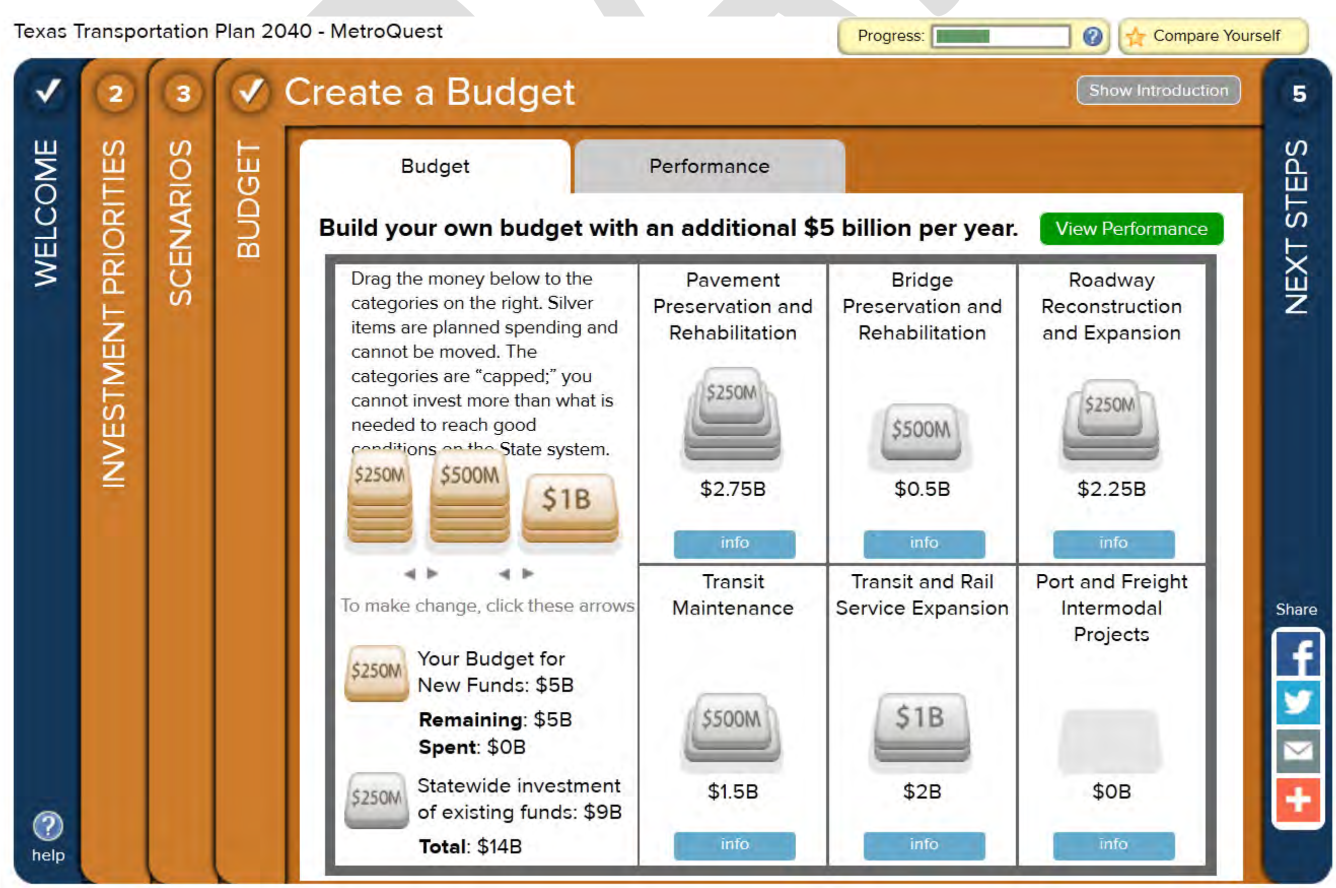
Approaches	3 stars or higher
Approach 1 - System preservation	410
Approach 2 - Metropolitan mobility	447
Approach 3 - Connectivity and freight mobility	445

Users had an opportunity to provide comments on the three approaches that were not listed the complete list, see the Appendix. Comments varied greatly and often related to local projects rather than reflected statewide approaches to investing transportation funding.

Budget Tab

The Budget Tab allows users to create their own transportation budget and view the statewide performance of selected performance measures. The purpose of this exercise is to let the user choose where to spend limited funds and evaluate the system-wide performance of the choices they make. The user will have to make trade-offs based on their own preferences and priorities.

Figure 7 - MetroQuest Tool Budget Tab



The current budget for transportation across Texas is $9 billion dollars. This amount will not cover the total needs of the State, which is over $20 billion. The user is given $5 billion dollars of new money to spend as he or she wishes.

There are six categories that users can allocate money to, these include and are “capped” at the following amounts:

- Pavement preservation and rehabilitation, $4 billion
- Bridge preservation and rehabilitation, $1.5 billion
- Roadway reconstruction and expansion, $10 billion
- Transit maintenance, $2.5 billion
- Transit and rail service expansion, $3 billion
- Port and freight intermodal project, $0.5 billion

The user cannot allocate more funds than what is needed to achieve a “good” condition for the category, this is reflected in the “cap”. Some of the categories are pre-loaded with funds. Users can exchange “chips” to invest in $250 million, $500 million, and $1 billion increments.

500 users filled out some portion of the Budget Tab. In general, users allocated the largest amount of money to roadway reconstruction and expansion as well as pavement preservation and rehabilitation. This is consistent with what users indicated were their top priorities in the Priorities Tab.

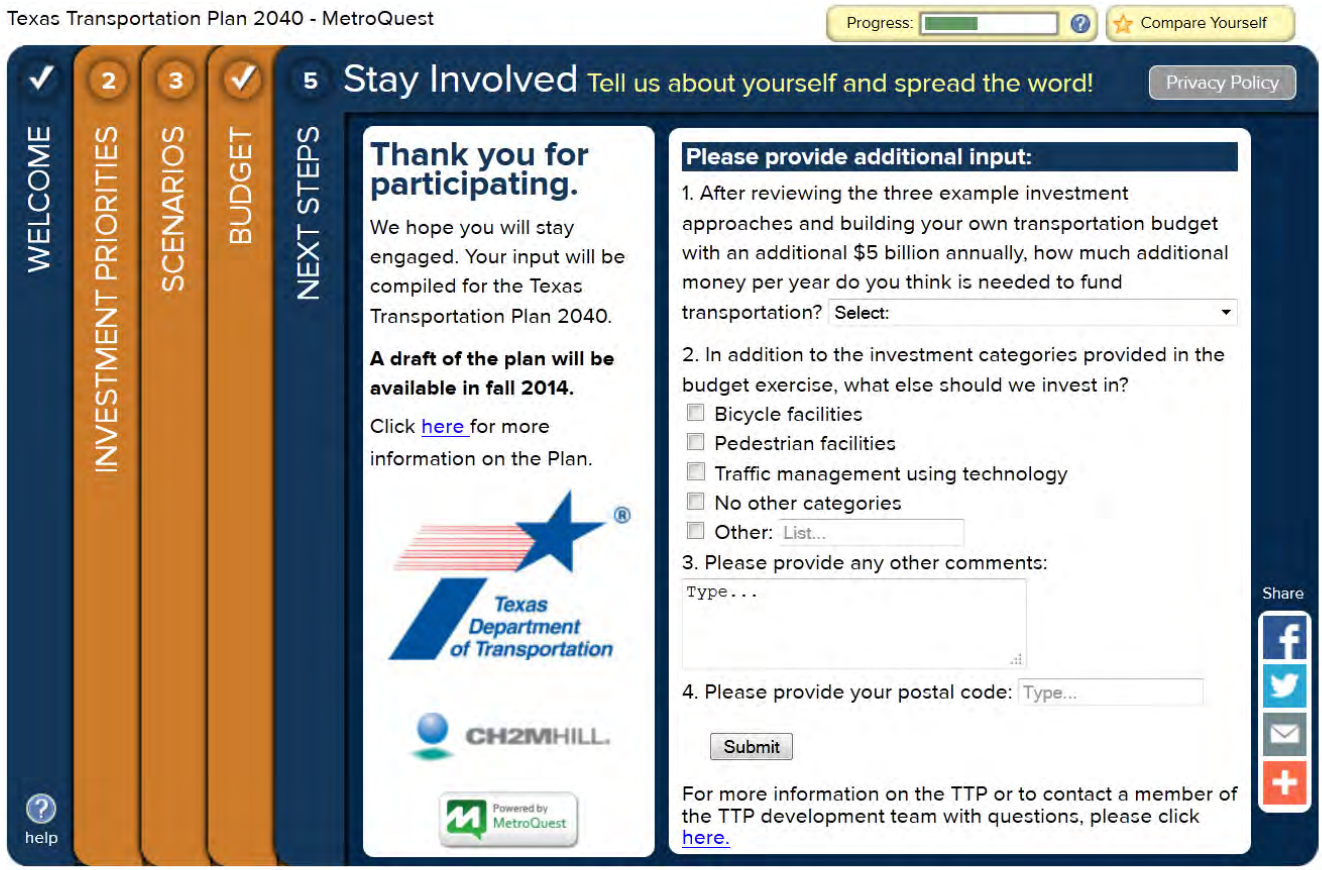
Table 4 - Budget Allocations by Category

Budget Category	Need/Cap	Pre-Loaded Amount	Average
Pavement preservation and rehabilitation	$4 billion	$2.75 billion	3.53
Bridge preservation and rehabilitation	$1.5 billion	$0.5 billion	1.18
Roadway reconstruction and expansion	$10 billion	$2.25 billion	3.90
Transit maintenance	$2.5 billion	$1.5 billion	1.95
Transit and rail service expansion	$3 billion	$2 billion	2.53
Port and freight intermodal projects	$0.5 billion	$0	0.25

Next Steps Tab

In the Next Steps Tab, users are asked several follow-up questions that are related to the tool. The data entered is summarized below. 469 users entered in some data into this tab.

Figure 8 - MetroQuest Next Steps Tab



Reponses to Questions:

Question 1:
After reviewing the three example investment approaches and building your own transportation budget with an additional $5 billion annually, how much additional money per year do you think is needed to fund transportation?

441 users responded to this question.

Table 5 - Next Steps Question 1 Responses

Response	Respondents
I do not think additional funds are needed	5% (21)
We need to invest more, but not sure how much	24% (106)
Less than $5 billion per year	8% (36)
$5 billion per year	19% (83)
More than $5 billion per year	44% (195)

Most users responded that more money is needed to fund transportation. 63 percent of respondents indicated that $5 billion or more is needed per year.

Question 2:
In addition to the investment categories provided in the budget exercise, what else should we invest in?

450 users responded to this question.

Table 6 - Next Steps Question 2 Responses

Response	Respondents
Bicycle facilities	41% (183)
Pedestrian facilities	71% (320)
Traffic management using technology	6% (28)
No other categories	7% (31)
Other (see below for inputs)	9% (40)

71 percent of those that answered this question felt that more money should be allocated toward pedestrian facilities. Respondents had the option of choosing "other" and entering in their own priority, responses are indicated below.

Additional other investment categories

Users had an opportunity to suggest other investment categories that were not listed, a summary of those suggestions is included below, for a complete list, see the Appendix.

- Access management (3)
- High speed rail (4)
- Transit (4)
- Rail infrastructure, generic (3)
- Signs and signal enhancements (2)
- Travel demand management
- Driver education
- Enforcement of driver registration
- Freight rail and associated facilities (3)
- Light rail (2)
- Heavy rail or passenger rail (4)
- Connectivity improvements (2)
- At grade rail crossing
- Maintenance
- Shoulders and passing lanes
- Pedestrian infrastructure (2)
- Innovative transportation financing mechanisms

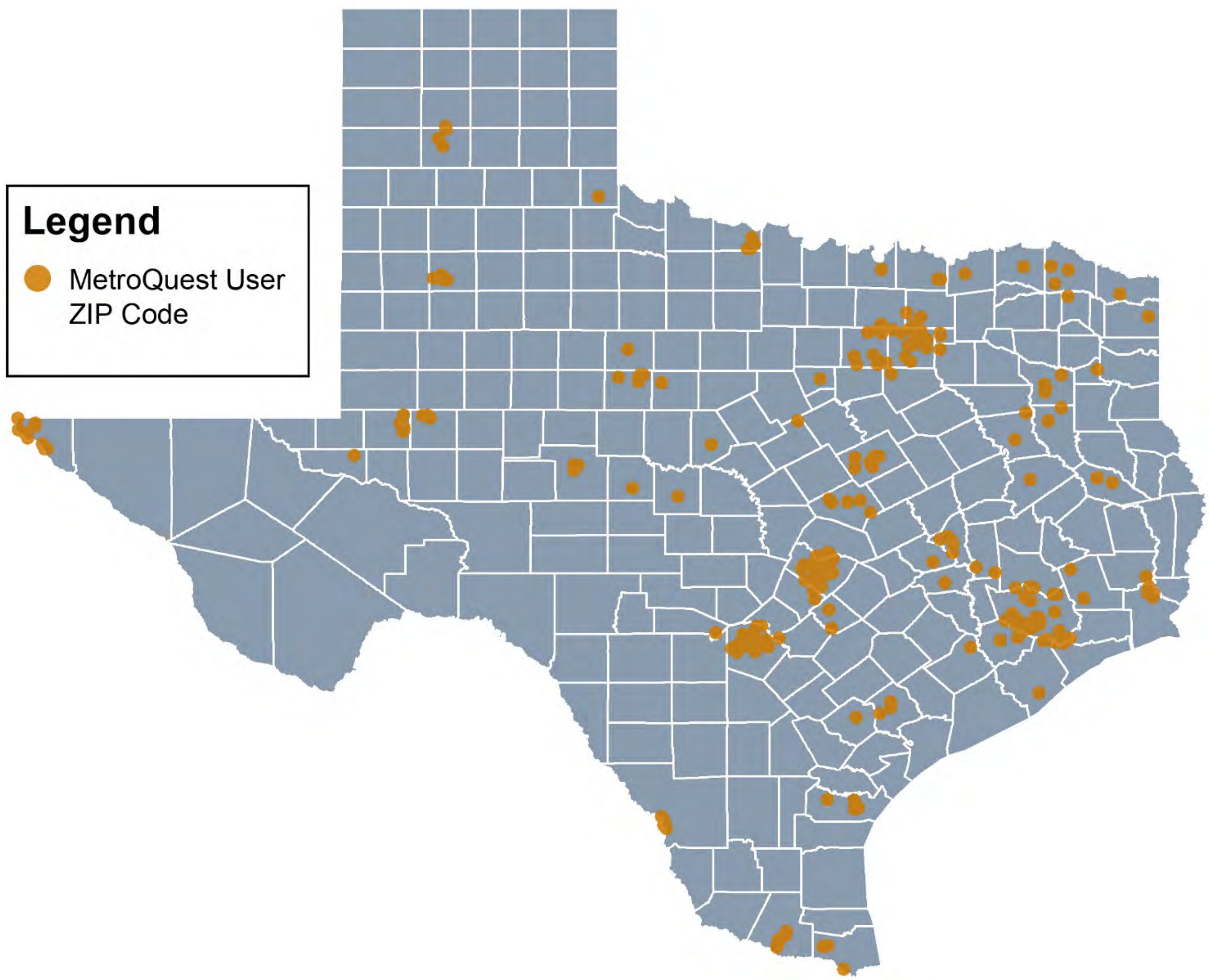
Question 3: Please provide any other comments:

104 users elected to provide additional comments, those comments varied greatly and are included in the Appendix.

Question 4: Please provide your postal code:

388 respondents provided their zip code. The map below shows where respondents are from throughout Texas. As expected, there were users from all over the state and specifically near TxDOT district offices where TTP 2040 outreach sessions were held in the summer of 2014.

Figure 9 -MetroQuest Respondent Zip Codes



Appendix

This Appendix contains the raw comments that were submitted during the use of the MetroQuest tool.

Priorities Tab

Additional suggested priorities

Users had an opportunity to suggest other priorities that were not listed, here are their responses.

- Walkable neighborhoods
- Technology to reduce demand
- Safety - new TOPICS style program
- Safety
- Road construction
- Reducing sprawl
- Promoting urban land use and economic development
- Project process on traffic loops. In hico and Hamilton
- Non-motorized options on state roads particularly close to or within cities.
- No tolled overpasses
- No displacement of communities. People over profit
- Multimodal transportation solutions for address congestion
- more travel lanes on I-10 in El Paso Texas
- Maintenance
- Local roadways
- Interstate designation
- Improvement of air quality
  Investment in adding water resources
- Frontage. Road, two way
- Freight Rail
- Freight
- Freight
- Environmental stewardship
- Economic growth and additional tax revenue
- Connectivity options
- Complete streets
- Bicycle pedestrian access along with ADA accessibility
- Bicycle Lanes
- Bicycle infrastructure
- Bicycle infrastructure
- Bicycle and pedestrian access and mobility should be top priority
- Better Bicycle environment
- Alternate transportation form - hiking/bike trails
- Active Transportation (Bike/Ped) facilities

Open ended comments related to priorities:

Traffic Congestion

- Especially the extreme increase in traffic on Hwy 67 from San Angelo to Big Lake.
- Instead of spending millions for the look of the road how2 about some new travel lanes.
- Just build more roads.
- Resurfacing of existing roadways seems to overuse the "chip and seal" procedures for this process. This is a less fuel efficient surface for drivers and detrimental to the safety of cyclists trying to use these same roadways.
- Specifically Hwy 281
- The traffic conditions for midland Odessa are horrible and getting worse. Nothing seems to be being done
- Use rail more, too much money is spent on roads and very little on rail
- We need new crosswalks

Pavement Condition

- Especially where it's unsafe for cyclist.
- Especially with the extreme increase in traffic from San Angelo to Big Lake.
- Just build more roads
- less chip & seal pavement
- Our community needs medians.
- Shoulders are often non-existent or too poor a surface for cycling. Chip seal also costs drivers mpgs and tire wear.
- The road surface conditions here in Texas are some of the worst... why not use rubberized asphalt instead of all this concrete? Need surface paving options that will stand up better to the soil shifts.
- Would be nice instead of spending on the looks along the side of the road, the money should be spent on upgrading the wore out pavement.

Transit and Rail Options

- Alternatives such as bike lanes and extending bike routes. Not streetcars downtown
- As more millennial workers move to the city of Houston and the region, many will be looking to live near their workplace. Providing alternative modes of transportation is of utmost importance.
- Double tracking will lead to faster freight service and get more trucks off roads
- Eliminating bottlenecks or enhancing access for rail and port such as at the Port of Beaumont should be a priority. Please consider less expensive and underutilized areas
- Has the state considered mobility options such as BRT in lieu of rail? I know some cities in Texas have bus lines with similar characteristics to BRT but they do not consider a full BRT system. As funding continues to decline perhaps an economical option such as BRT would work. Marketing seems to always be lacking with such options to garner support from the public.
- I believe that our transit systems can become more efficient by eliminating suburban routes and focusing our efforts on high-density corridors.
- I would use the train to travel to Dallas, Austin, Houston, and other cities throughout the nation. Currently the options are limited to one departure per day--very inconvenient!
- Interested in truck traffic and roadway coordination specifically in Freeport, Texas. There is no or poor signage and nighttime lighting which is causing dangerous roadway conditions.
- We must have good transportation infrastructure to facilitate commerce
- We need a rail option between major Texas cities!
- We need non-DART options. How can we get public transit without losing our 1%? Need flexibility for other funding options.
- We need to revive the train tracks. We may not be able to have subways but we sure have

the space for tracks (which were pulled out years ago)

Bridge Condition

- Build more roads
- No interest in light rail as it doesn't adjust to development, and unreasonable cost per rider. Really geared to support developers
- There is an article about how many bridges are close to failing. Can we get all of ours fixed and then brag about it to the rest of the nation?

Job Creation

- We have a significant number of people that have not secured employment in 18 or more months considered non employable. Invest them in a spa type program working aligned with TXDOT

Approaches Tab

Open ended comments related to approaches:

Approach 1 – System preservation comments:

- As integrated as communities are becoming coordinated signage between Ports or major roadways would be beneficial.
- Asphalt in the Valley highways are not a great. Using concrete like in Houston and Dallas would be better for the roads
- First assess the value of the existing system and determine whether it is a vital portion of the system prior to investment making decisions.
- Hi would like to see rail or buses easily connect cities.
- It appears that this method will not be able to effectively meet the needs of an actively growing city. While maintenance is good, I believe we need a plan that will incorporate room for growth and innovation.
- Maintain what you have priority 1
- Nafta hwy ih 35needs constant oversight
- No one wants more congestion, but you have to maintain what is already built. System preservation has to be foremost and then mobility should be addressed.
- Preserving bad transportation is very much like the definition of crazy - doing the same thing over and over and hoping for a different result.
- This is key- reducing vehicles on the road through public transportation. This will help ease congestion and take use off of pavement

Approach 2 – Metropolitan mobility comments:

- Construction of the loop around hidalgo county is taking a long time. It would be better to construct that first since it would help traffic better. What happen to the time where getting funding was after like when the interstate was first constructed?
- If we improve the bus system, we can use that to transport more people using less cars and less lanes. I think the first step is that most people think the bus is not as acceptable of a method of travel. There is a stigma to it.
- more travel lanes thru el paso on I-10
- Not enough focus on transit.
- Not sure why multimodal option is not also considered a job builder option as well

- Not to just decrease travel time but to reduce the number of single occupancy vehicles on the road.
- Provided that complete streets and placemaking are in every phase of planning, design, review and engineering
- Spending less time is traffic is an unreasonable and unrealistic goal. Instead, focus on additional options - commuter rail, etc. Provide incentives for employers to participate in work-from-home options, reduced cost transit passes for employees, etc. Provide incentives to communities to cluster employment centers and cooperate on transit services to those areas.

Approach 3 – Connectivity and freight mobility comments:

- Better, but need more focus on transit.
- I agree with creating jobs, but in Freeport,Tx we need more signage coordination on txdot roadways to get commercial vehicles to the correct location. We also have serious lighting concerns from the City of Freeport on these roadways. Our port and industrial large volume of traffic is a 24/7 activity. The lighting at night and no signage is placing these large commercial vehicles on residential streets and causing accidents.
- I think we need to move freight by trains
- Most important to keep our transportation of freight competitive
- Relieve I-35 traffic!
  Priority 1: Del Rio to San Angelo divided highway to complete Ports-to-Plains Corridor (Texas has the last link to complete.)
  Priority 2: After that, Ballinger to Abilene divided highway to link Mexico to DFW by way of an alternative route than I-35. Del Rio to San Angelo to Abilene to DFW. Its a more efficient route for goods being trucked from Mexican Pacific ports or from Central Mexico by way of Chihuahua, MX (which connects to Mexico City). Mexico has developed the highways (or has nearly completed the construction), thus the alternative route becomes viable.
- This plan also works with a strong passenger rail and multimodal approach

Next Steps Tab

The following represents the user input that was entered in under the Next Steps tab.

Responses to question 2. "In addition to the investment categories provided in the budget exercise, what else should we invest in?" Optional input for "other":

- Access Management
- Accessible signals
- Assess management
- Bullet Trains!!!
- Bus to rural community
- Coordinated signage for Port (Freeport)
- demand management investments
- Drivers safety outreach and education free driver
- Enforcement of registration tax law
- Freight rail, high tech freight trains, barge

- High speed rail
- High Speed Rail to West Texas to shift the
- High-Speed Rail
- Hirerealhighwayengineers
- Intermodal freight transportation
- Intrastate Rail
- Light rail
- Light rail
- More connection undeveloped area
- Multimodal connectivity
- Passenger rail
- Passenger Rail
- Passenger rail service from west Texas to I-35
- Planning especially to avoid future congestion
- Public Transit
- Public transportation
- Rail facilities
- Rail for freight
- Rapid transit
- Road Crossing Rail
- ROW maintenance in City Limits
- Shoulders and passing lanes
- Sidewalk infer structure
- Subway
- taxing single occupant drivers
- Trails and ped/Bike access
- Train transportation
- travel lanes thru el paso
- Two access feeders
- V2x

Responses to question 3: "Please provide any other comments":

104 users elected to provide additional comments, those are listed below.

- Accommodations for pedestrians, should be a priority. Sidewalks and bike routes would provide significant improvement.
- After visiting Europe, very impressed with high speed rail service from downtown to downtown. For our aging population, that would be a winning investment.
- Appeal to younger adult city dwellers by creating more public transportation and creating bicycle lanes.
- Apply Complete street guidelines for all new roads
- As a city dweller, the biggest waste of transportation dollars enable the single occupant driver to corrode our system. One person driving in a 5 passenger, 2000 pound auto is a 20$ utilization or capacity rate. Would an airline survive if it flew with 4-5ths of its seats empty?
- Bicycle trials ideally would be separated physically from auto areas like in Quebec City, e.g.
- Bike & Ped facilities are important, however these should be handled and funded on a strictly local

basis.

- Build roads
- Building a robust transportation infrastructure will require more than just putting down more roads, rails, trails, and sidewalks. All those paths must go somewhere efficiently and effectively. That means the land surrounding them needs to be designed appropriately for the transportation that serves it. No sidewalks next to the Interstate. No train stations in industrial parks. Make smart land use decisions and make sure each mode of transportation has a place for it. Above all else, don't try and squeeze a bunch of transportation modes together that travel at different speeds on the same road. Traveling by bike is not the same as traveling by car.
- Building dedicated bicycle lanes on roadways has proven to increase ridership and safety.
- City budgets can't afford to maintain unattended and overgrown TxDOT ROW areas along freeways.
- Collaboration between txdot and local transit planning authorities.
- Congestion big factor in Laredo
- Develop a Texas Transit System to tie local transit systems to others and make it more efficient and economical for people to use transit on a state level to assist in addressing vehicle congestion on the highways.
- Easier way to communicate with txdot official at the executive admin level
- Emphasis needs to be placed on lighting and signage in Freeport to safely coordinate and light industrial roadways for safety
- Excellent planning tool
- Fun and informative.
- Gas tax needs to go away and new trans tax implemented.
- Gas taxes based on population and use; spend the $ where you get the $.
- Generate needed revenue via a VMT-based user charge
- Good exercise
- Great tool! Better than a regular paper survey and very educational.
- High speed rail triangle would be great,especially for such a big state.. Would go from Dallas to Waco to Austin to San Antonio to Houston to College Station back to Dallas.
- Hirewelltrainedhigwayandrailroadengineersisteadofthepoliticallywellconnectedtrashthatisawatthismeeting
- How come that investing in mass transit did not improve congestion in the scenario? Research suggests that adding more road capacity leads to mo congestion, so there is only a temporary relief if any. Do the scenarios consider this suggestion?
  Then the job creation - more livable streets with bike&pedestrian facilities have positive impact on local economy - are these jobs considered in the scenarios?
- I don't like that transit is CAPPED at 3B when roadway expansion is capped at 10B. Would have preferred to allocate as I wanted, not as this exercise limited -- then you would see where my priorities are in a more accurate fashion.
- I don't ride bikes, but I saw the new bike lanes in Austin. They look pretty neat, and if they keep the bikes out of my way then I like that.
- I had no idea how to do the budget stuff.
- I am very concerned in the transportation demands that will occur as highways reach out beyond the current suburbs.
- i see employees diging up good asphalt ...putting down new asphalt. i see employees with a blade going along the edge of the road blading and digging up the edge and then going back and filling in the asphalt the blade dug up. waste of money.
- I think better and more optional transit should be available throughout the El Paso, TX county and all over Texas. Furthermore, I think TxDOT is doing a great job in the El Paso County, but more could be done to make our lives easier in moving from one side of our city to the other.
- I use my bicycle for daily commute. It will be nice to have more efficient bike accessibility transportation methods
- I want intercity trains

- I would really like to see an increase in public transportation options and pedestrian/bike traffic in San Angelo, TX.
- I'd love to see public transit available south of Slaughter Lane. With the cost of housing in the City of Austin being so high, more and more people are moving to the outskirts.
- Increase the gas tax
- increasing traffic capacity doesn't relieve congestion - not even in Texas
- Intelligent traffic monitoring at stop lights. Improve (reduce wait time) at stop lights/intersections.
- Intelligently designed road systems, down to nitty-gritty details like ramp location, direction, and merging between mainlane and frontage, has a huge impact on congestion.
- International bridges have to be more people friendly. No need to scare people who are coming to shop and visit.
- Invest in passenger and multimodal options before oil and energy production leaves a sprawl based platform obsolete
- Investing in high quality transit options will improve traffic congestion, despite the fact that your survey does not reflect it in the performance evaluation of the budget.
- It is important to fund completion of 6 lanes on I-10 all the way from Orange to Houston
- It seems no matter the investment traffic congestion will never be achieved?
- Key is to get more freight on to rail and more people onto public transportation
- Light rail is a solution to connect this large metropolitan and it should be explored, analyzed, and implemented! Traffic congestion on roadways is true for all high populated cities and cannot be avoided. Adding more roads is not the answer. Other modes of transportation and a diversity in developments (schools, hospitals, business parks, malls) per location will help transport goods and people shorter distances to their destinations.
- Long-range strategies needed to optimize mobility while minimizing carbon footprint. Mass transit is key, along with increased options for multimodal public transit using regional and statewide coordination.
- Look at up sizing other highways to relieve traffic off freeways.
- look into google driverless cars
- Maintenance
- Make roads with shoulders and wide enough to provide safe pedestrian walking areas and safe areas to prevent accidents. More cash to Odessa!
- Make sure we are coming up with a system that works for the State vs. continuing with items that have not been working.
- Make videos of actual situations around the state like in the oil producing regions to warn motorists of the dangers and what precautions to take including people passing thru from other states
- Mass transit
- Mass transit
- Money should be spent to reduce the number of at grade road crossings on RR tracks.
- More cycling options in rural areas is needed.
- More money for rural counties.
- More transit additional movement of freight
- Na
- Need better ... Easier access to existing businesses in planning. Two way feeders should be installed in many areas particularly when overpasses are more than mile away.
- Need high speed rail within the RGV and Hill Country
- Need mileage based fees
- Need to increase focus on alternative modes -- providing people with more viable options for how they travel could improve the overall performance of the transportation system.
- Need to provide more evacuation routes. Increase transit service.
- Nice exercise
- Not much discussion on aviation needs

- On the budget page, I was able to multiple denomination chips on the various highway and pavement options, but not the transit. I wanted to put more then $1 billion on transit, but it did not allow me to do that. This is unaccesptable.
- Our city desperately needs a multimodal facility
- Passenger train
- Plan for the interstate to bo use for another 40 years. Too many projects are started by TXDOt and stop short of the HGWY 54 and New Mexico State line. West TX and Southern NM needed to partner-up and make this happen ASAP. Building billion dollar highways and stoppping just short of the NM State line is a waste of taxpayer's hard-earned money. Period. Also Loop 375 around El Paso is very dangerous and must be finished ASAP! Doing all theses construction projects at once puts a huge burden on a transportation system that is already severely challenged. Working on theses projects at the same time at night is ludicrous and illogical.
- Please implement measures to encourage safer and more civil drivers.
- Ports to plains
  Loop 335
- Promote bicycles as a healthy alternative and reduce congestion for some of those trips from home under 2 miles.
- Raise gas tax
- Reconstruction of LBJ East should be TOP priority
- Reviving and/or placing new tracks all over the city to important points would be very beneficial as far as public transportation goes, also, creating better bus routes
- Road repair, smoother roads, bicycle friendly paving practices and slower speed limits.
- Rural safety and mobility needs should be included as an area of concern for improving.
- Sad that we here in as got tripped up by insane streetcar, but not sophisticated rapid transit for citizens, not moving tourists around
- Self-driving cars are coming. TxDOT & the lege need to make sure our system accommodates & welcomes their use in Texas. The coordinated communication between self-driving vehicles should mitigate much of the anticipated increase in congestion. Also, TxDOT should consider exploring other "smart highway" options, such as the experimental highway in the Netherlands.
- separated bicycle lanes and buffered sidewalks along arterials
- Stop wasting our money on hike and bike trails, rail and other nonsense. Fix our roads without tolls I as the top priority. Stop tolling the urban areas to death. It will hurt job creation and the Texas economy by exploding the tax burden.
- Technology and more tolling and user charges
- Thanks for receiving public input.
- The approaches here all reflect an emphasis on motorized transportation and roadways for these motorized vehicles. What is missing is an 4th approach based on reprioritizing transportation approaches to focus on safe and accessible use of roadways for active transportation - walking and biking, then multi-modal, and finally cars and trucks. The options available in scenarios and budgets do not even consider such an approach built on viable transportation options, complete streets, or vision zero considerations.
- The obvious solution is to make every highway a tollroad right? You already cant go north of Plano or Farmers Branch without paying a toll.
- This tool provides great information and is very educational.
- This was very informative. We need to get the general public to understand the infrastructure investment needed to improve mobility.
- To general for the public to understand
- To reduce traffic congestion suggest funding ride sharing programs where companies are reimbursed for employees commuting together to work . Good example is California model.
- Traffic congestion is a main concern of mine along with everyone else, but for some reason my "budget" did not bid it any concern...might need to check how the metrics are generated on the backend of this survey?

- Traffic management timing lights big need, but probably more of a metro responsibility
- TxDOT needs to consider alternative revenue sources, looking ahead several decades!
- TXDOT needs to invest more in areas outside the I-35 corridor to relieve traffic safety concerns. A strategy of building four-lane divided highways to connect all metropolitan areas greater than 100,000 population.
- TxDOT should take a more active role in funding mass transit projects across the state, as these types of investments will do far more for sustainable mobility and job creation than simply expanding freeways. With federal funding for all kinds of transportation projects becoming increasingly unreliable, it is up to the state to ensure that our quality of life isn't squandered by shortsightedness.
- Use toll roads
- Very interactive tool but a lot to read and comprehend
- VMT is declining and the trend is expected to continue. Investing in more road capacity for autos is inefficient and ineffective and should be discontinued. Transit, bike and pedestrian improvements should take priority.
- We need a complete streets policy and aggressive spa campaign to improve and encourage multi-modal transportation. Prioritize spending by active transportation, public transit and cars in that order
- We need more expansion of roadways that diagonal across state or parallel IH system to take load off them.
- We need multimodal solutions. We cannot pave our way out of congestion!
- Would like additional new roads to only be toll roads as a last resort. Would support very small increase on fuel tax, vehicle taxes instead of toll roads.

APPENDIX B

TECHNICAL MEMORANDUM

Texas Transportation Plan

Tech Memo 1: Plan Assessment and Framework

October 10, 2013

Acknowledgements

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Contents

Exhibits

1.0 Introduction

In fulfillment of the Texas statutory requirements to develop a statewide, multimodal, and intermodal plan with a forecast period of 24 years, the Texas Transportation Plan (TTP) is currently being developed as an update to the 2035 Statewide Long-Range Transportation Plan (SLRTP). The TTP framework will advance performance-based decision-making to link transportation investments with the Department's 2013-2017 Strategic Plan. By providing a transparent and outcome-oriented decision process that increases accountability and maximizes the use of taxpayer dollars, the TTP will uphold the Texas Department of Transportation's (TxDOT's) commitment to customer service and will enhance the Department's reputation as a "best in class" state agency.

This Technical Memorandum (Tech Memo #1) is organized into two sections: Plan Assessment and Plan Framework. The Plan Assessment provides context for the development of the TTP based on existing TxDOT plans and initiatives, specific challenges and considerations for the multimodal system, and State/ Federal legislative requirements. Based upon findings from the Plan Assessment, the Plan Framework outlines the development of a performance-based plan.

2.0 Plan Assessment

The following sections provide a review of TxDOT initiatives and implications for the TTP, a summary of TxDOT plans for coordination with the TTP, a discussion of potential challenges for the Texas transportation system, and a summary of legislative requirements regarding TTP development and outreach.

2.1 Ongoing TxDOT Initiatives and Implications for the TTP

TxDOT has long been recognized as a national leader in transportation excellence, providing for and maintaining a diverse and multimodal transportation system that serves the equally diverse needs of Texas and its growing economy. In recent years, recognizing that continuous improvement is needed to remain a best in class agency, TxDOT started to transform the transportation delivery process and the culture in which it operates. Many of these changes have occurred through *Modernization*, the first of three "Phases of Change" as outlined in the Strategic Plan. These phases define TxDOT's path towards becoming a "performance-driven organization, a great place to work, and an organization committed to quality customer service."

With the majority of *Modernization* activities complete, TxDOT is now working towards the second phase, *Operational Excellence*, by focusing on the achievement of continuous, disciplined improvement and performance with respect to agency processes and the management of resources. The focus of the third phase, *Innovation*, is on becoming a national leader in the development and deployment of transportation solutions.

In accordance with TxDOT's commitment to operational excellence and innovation, the TTP will be performance-based and will apply state-of-the-art methodologies that link investment decisions with the achievement of the long-term goals defined in the Strategic Plan (Exhibit 1). In addition to the clear articulation of goals, the TTP will include a method for predicting and tracking progress towards Plan goals over time as well as the effects of investments on system performance.

Exhibit 1: TxDOT Mission, Values, and Goals as defined in the 2013-2017 Strategic Plan

Mission	Work with others to provide safe and reliable transportation solutions for Texas
Values	**Trust:** We understand the importance of being trustworthy and credible, both as an agency and as individuals.
	Integrity: We honor our commitments and keep our word.
	Responsibility: We are reliable and dependable in carrying out our mission and roles.
	Excellence: We do our work at a high level of quality.
	Service: We do what we do for others with a spirit of humility and honor.
Goals	Maintain a Safe System
	Address Congestion
	Connect Texas Communities
	Become a Best in Class State Agency

2.2 TxDOT Plans for TTP Coordination

TTP development will include any analysis of existing and ongoing TxDOT, metropolitan planning organization (MPO), rural, and modal plans to ensure consistency with other ongoing efforts and initiatives. Exhibit 2 provides a summary of the plans that will be reviewed and considered throughout TTP development. The Texas Freight Mobility Plan will also be integrated into the TTP. With an expected completion date of September 2014, this effort represents the State's first comprehensive and multimodal freight plan to:

- Enhance freight mobility and improve economic competitiveness through efficient, reliable, and safe transport of goods throughout the state
- Define policies and investments that will enhance Texas' freight transportation system into the future
- Establish a framework for Texas' comprehensive freight planning program and decision-making.

The Texas multimodal transportation system is comprised of many owners and operators. While TxDOT is responsible for assessing needs and funding gaps for all modes as part of the TTP, its role as owner-operator, partner, and advocate varies widely across modes.

Exhibit 2: TxDOT Plans for Coordination with TTP (Source: 2035 SLRTP)

Plan/Program	Who Develops?	Who Approves?	Time Period	Content	Update Cycle
Statewide Long-Range Transportation Plan (SLRTP)	TxDOT	Texas Transportation Commission	24 years	Future goals, strategies, and performance measures	Every 4 years
TxDOT Strategic Plan	TxDOT	Texas Transportation Commission	5 years	TxDOT's operational goals and strategies	Every 2 years
Statewide TIP	TxDOT	USDOT	4 years	Transportation investments	Every 2 years
Unified Transportation Program (UTP)	TxDOT	Texas Transportation Commission	Current year + 10 years	Projects to be funded/built in a 10-year period	Annual
Metropolitan Transportation Plan (MTP)	Metropolitan Planning Organization	MPO	20+ years	Future goals, strategies, and projects	Every 5 years (Every 4 years in Air Quality Non-Attainment Area)
Transportation Improvement Programs (TIPS)	MPO-TxDOT Districts	Governor*/MPOs	4 years	Transportation investments (projects)	Every 2 years)
Corridor Studies (e.g., MY-35)	TxDOT	Texas Transportation Commission	N/A	Benefit cost analysis and feasibility	As needed
Texas Rail Plan	TxDOT	Texas Transportation Commission	5 and 20 years	Future goals and strategies	Every 5 years
Texas Airport System Plan	TxDOT	Texas Transportation Commission	5, 10, and 20 years	Focus on general aviation needs	Annual
Texas Port 2010–2011 Capital Plan	Port Authority Advisory Committee	Texas Transportation Commission	2 years	Goals, objectives, and projects	Annual
Texas Transit Statistics	TxDOT	TxDOT	1 year	Public Transportation Operation Statistics	Annual

Note:
* While the legislature gives the approval authority to the Governor, the Governor delegates the authority back to TxDOT.

2.3 Potential Challenges for the Texas Transportation System

> ***"Transportation is an engine of economic development. If we fail to respond to the need to maintain and develop our transportation infrastructure, we will choke the growth of Texas."***
> – Drew Crutcher, 2030 Committee, from *It's About Time: Investing in Transportation to Keep Texas Economically Competitive*

According to the Strategic Plan, the Texas population is expected to grow from 25 million to 40 million by 2035, with the majority of growth occurring in urban areas. This will present specific challenges with respect to congestion mitigation and the condition of bridges and pavements under more frequent loadings. Additionally, the general aging of the population as described in the Strategic Plan will require a renewed focus on ensuring multimodal access for the elderly, especially in rural areas. Other future challenges for the Texas transportation system include but are not limited to:

- Diminishing revenues and higher transportation costs:
  TxDOT, like most other departments of transportation (DOTs) throughout the country, is experiencing declining revenues and increasing demands on the transportation system. As noted in the Strategic Plan, funding from traditional sources such as the gas tax cannot keep pace with the growing demands on the system that include preserving aging infrastructure, expanding multimodal capacity to accommodate population growth, and enhancing the design of the system to improve traffic operations, safety, and viability for freight traffic. To address these demands amid constrained resources, it is critical to maximize the impact of every dollar spent. This is the value of performance-based planning, which seeks to determine how to invest wisely to achieve goals and improve system performance over time.
- Addressing multimodal transportation system needs in urban and rural areas:
  Texas is "more than a triangle;" the rural areas located outside of Dallas, Houston, Austin, and other metropolitan boundaries are critical to the state economy and home to millions of Texans. As noted in the Texas Rural Transportation Plan (TRTP), the rural transportation system facilitates state, national, and global commerce and supports the activities of many Texas industries including farming, ranching, timber and logging, mineral extraction, and energy. While the TRTP was provided as a standalone supplement to the 2035 SLRTP to specifically address the condition and multimodal needs of the rural transportation system (i.e., occurring outside of MPO boundaries), the TTP will consolidate both to provide a comprehensive assessment of condition, needs, and investment scenarios across all areas of the state. The TTP will consider the distinctive qualities and priorities of the rural and urban transportation systems, including:
  - Multimodal access in rural areas with a focus on aging and disadvantaged populations
  - Capacity enhancements in urban areas to accommodate population growth
  - The different safety needs of rural and urban interstates (e.g., safe passing on rural interstates)
  - High freight volume on rural roads.

2.4 *Long-Range Transportation Plan (LRTP) Legislative Requirements*

2.4.1 Texas

The SLRTP provides the framework for advancing TxDOT's values, mission, and goals identified in the Strategic Plan. Through coordination with existing TxDOT plans and those in development, the TTP will link the Strategic Plan goals with project prioritization and programming.

The specific Texas requirements for the development of a SLRTP (as found in Title 43, Part 1, Chapter 16, Subchapter B of the Texas Administrative Code [Rule 16.54]) are as follows:

- A 24-year planning horizon with an update cycle every 4 years
- The inclusion of all modes of the transportation system
- The integration with the Statewide Transportation Improvement Program (STIP) and Unified Transportation Program (UTP)
- The inclusion of specific, long-term goals for the state that advance Strategic Plan goals
- The inclusion of specific, measurable targets for each goal
- The consideration of MPO and regional planning organization (RPO) transportation plans and strategies
- The identification of priority corridors, projects, or areas of concern with respect to meeting plan goals
- The inclusion of a participation plan for obtaining input on goals, targets, and project selection and prioritization.

2.4.2 National

Federal requirements for the development of a statewide transportation plan based on Title 23 U.S.C. 135 and 23 C.F.R. Part 450 include that it be based on a minimum forecast period of 20 years at the time of adoption, that it provides for the development and implementation of a multimodal transportation system, and that it considers the following eight federal planning factors:

- Support economic vitality
- Increase transportation system safety for motorized and nonmotorized users
- Increase transportation system security for motorized and nonmotorized users
- Protect and enhance the environment, promote energy conservation, improve quality of life, and promote consistency between land use and transportation improvements
- Enhance, integrate, and connect the multimodal transportation system for people and freight
- Promote efficient system management and operation
- Emphasize transportation system preservation.

2.4.3 MAP-21

Moving Ahead for Progress in the 21st Century (MAP-21) was signed into law in 2012 as a reauthorization of SAFETEA-LU. Changes from the previous legislation with respect to LRTP development include:

- **The endorsement of a performance-based approach to transportation decision making**: In recognition of the growing revenue gaps facing state DOTs, MAP-21 calls for a performance-based approach to transportation decision-making and provides a clear sense of purpose for transportation investments through the establishment of seven national goal areas: ***safety, infrastructure condition, congestion reduction, system reliability, freight movement and economic vitality, environmental sustainability, and reduced project delivery delays***. States and MPOs are required to measure and report on performance in these areas; however, the legislation does not stipulate the use of performance measures to guide investment decisions.
- **Continued focus on environmental streamlining to reduce project delivery delays:** MAP-21 recognizes that the majority of project delivery delays result from the environmental review process required under the National Environmental Policy Act (NEPA), and that these delays have significant financial and practical consequences. To achieve the goal of reduced project delivery delays, MAP-21 establishes a method for streamlining the state and federal environmental review processes to avoid duplication. It is important to note that although environmental streamlining will not directly impact the development of the TTP (as transportation plans are not subject for review under NEPA), these improvements will accelerate the project transition from the TTP to the UTP and, for select projects, the subsequent advancement to the STIP for implementation.
- **The advancement of performance-based provisions for the national freight system:** MAP-21 establishes a policy to improve the condition and performance of the national freight network in order to achieve goals related to ***economic competitiveness and efficiency; congestion; productivity; safety, security, and resilience of freight movement; infrastructure condition; use of advanced technology; performance, innovation, competition, and accountability in the operation and maintenance of the network; and environmental impacts***. MAP-21 requires the U.S. Department of Transportation (USDOT) to develop a set of national freight measures within 18 months of bill enactment. States are encouraged to designate a freight advisory committee composed of public- and private-sector freight stakeholders and to develop comprehensive freight movement plans for immediate and long-range freight planning and investment.

3.0 Plan Framework

The following sections provide a review of best practices and legislative guidance with respect to the components of a performance-based plan:

- Plan goals and objectives
- Plan performance measures
- Project prioritization/resource allocation
- Performance-based data for Plan analysis and for monitoring and reporting on Plan progress over time.

3.1 Goals and Objectives

Goals and objectives serve a critical purpose in the development of a long-range transportation plan. By identifying Plan components that can be measured and tracked given the high-level priorities of stakeholders in Plan development, they can indirectly articulate a long-range vision for the multimodal transportation system. Because the distinction between goals and objectives varies widely in practice (and is sometimes used synonymously with “guiding principles” and/or “strategies”), the following definitions will be applied for the TTP:

- **Goal**: Broad statement of priority that is largely directional in nature
- **Objective**: Specific desired outcome.

3.1.1 Best Practices and Legislative Guidance

Goals and objectives vary among state DOTs in accordance with agency, planning partner, and stakeholder priorities and reflect the specific challenges and future shared vision for the state transportation system. A synthesis study of SLRTPs conducted by the John A. Volpe National Transportation Systems Center found that the majority of state DOTs adopt and implement goals that align with national goals (*Trends in Statewide Long-Range Transportation Plans: Core and Emerging Topics*, 2012). In particular, the study found that the five most commonly cited goals—safety/security, mobility/accessibility, environmental stewardship, economic development, and preservation—correspond directly with the SAFETEA-LU planning factors, the prevailing legislation at the time of study development.

MAP-21 replaced SAFETEA-LU as the nation’s surface transportation bill in 2012, establishing seven national goals for the federal-aid highway program:

- **Safety**: To achieve a significant reduction in traffic fatalities and serious injuries on all public roads
- **Infrastructure condition**: To maintain the highway infrastructure asset system in a state of good repair
- **Congestion reduction**: To achieve a significant reduction in congestion on the National Highway System (NHS)

- **System reliability:** To improve the efficiency of the surface transportation system
- **Freight movement and economic vitality:** To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development
- **Environmental sustainability:** To enhance the performance of the transportation system while protecting and enhancing the natural environment
- **Reduced project delivery delays:** To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices.

State DOTs must incorporate these national goals into their long-range plans. Under-performance in these areas may affect their ability to receive federal funding under the MAP-21 core programs: the National Highway Performance Program (NHPP), Highway Safety Improvement Program (HSIP), and Congestion Mitigation and Air Quality Program (CMAQ).

3.1.2 Texas Transportation Plan Goals and Objectives

The Strategic Plan goals will direct agency decisions and investments through 2017; TTP goals will continue to implement Strategic Plan goals over 24 years and will meet MAP-21 requirements, such as by addressing environmental stewardship and system reliability.

Exhibit 3 shows how the **DRAFT** TTP goal areas may fit within the context of the Strategic Plan and MAP-21 and how they compare to the 2035 SLRTP goals. These goals are based on a review of current TxDOT plans and are presented here as the starting point for the goal and objective development process shown in **Exhibit 4**. As described in Technical Memo #2: Goal and Objective "Building Blocks," the development of TTP goals and objectives will follow an iterative and inclusive process that considers the opinions of multimodal owners, operators, stakeholders, and users of the Texas transportation system.

Exhibit 3: DRAFT TTP Goal and Objective "Building Blocks"

Strategic Plan Goals	Maintain a Safe System	Address Congestion	Connect Texas Communities	Become a Best-in-Class State Agency
DRAFT TTP Goals	Reduce fatal and serious injury crashes	Address corridor bottlenecks	Increase passenger travel time reliability	Improve customer service
	Reduce pedestrian- and bicycle-related crashes	Increase roadway capacity where appropriate	Increase freight travel time reliability	Improve project delivery
	Improve work zone safety	Reduce travel times in select corridors	Ensure multimodal access	Maximize multimodal transportation benefits while managing agency costs
	Encourage responsible driving behaviors	Encourage design enhancements and system management and operations to improve traffic flow and manage demand	Support economic development	Responsibly manage current resources for future generations
	Improve safety at highway-railway crossings	Improve incident response times		
	Achieve State-of-Good-Repair for transportation assets			
Corresponding MAP-21 Goal Areas	Safety	Congestion Reduction	System Reliability	Environmental Sustainability
	Infrastructure Condition		Freight Movement and Economic Vitality	Reduced Project Delivery Delays

Exhibit 4: TTP Goal and Objective Development Process

3.2 Performance Measures

Transportation system performance measurement is not new; state DOTs and MPOs use performance information to manage state and regional systems, to evaluate project-level investment alternatives, to assess transportation-land use issues, and for many other purposes. However, the use of performance measures for evaluating, selecting, and programming projects to achieve agency goals is much less common. States and MPOs are only beginning to develop performance-based plans that incorporate performance management concepts for all modes, for operations, and for the achievement of broad economic efficiency, economic development, and social equity goals.

3.2.1 Best Practices and Legislative Guidance

Performance measures form the foundation of a performance-based plan. While applying measures is conceptually straightforward, implementing them in a meaningful way can present some challenges. In order to maximize the value of the measures for informing agency processes and investments while minimizing the burdens of implementation, it is critical to select the “right” measures, collect quality data to support the measures, and apply them appropriately (e.g., for decision-making, performance tracking and reporting, etc.).

MAP-21 will provide state DOTs and MPOs with national performance measures to collect and report on through a series of rulemaking refinements shown in Exhibit 5. States and MPOs will be responsible for setting their own targets with respect to these measures.

Exhibit 5: U.S. DOT Guidance on MAP-21 Performance Rulemaking

Program	Measure Category
Status I January 2015	Serious injuries per VMT[1] Fatalities per VMT[1] Number of serious injuries[1] Number of fatalities[1]
Status II April 2015	Pavement condition on the Interstates[2] Pavement condition on the Non-Interstate NHS[2] Bridge condition on NHS[2]
Status III July 2015	Traffic congestion[3] On-road mobile source emissions[3] Freight movement on the Interstate[4] Performance of Interstate system[2] Performance of Non-Interstate NHS[2]

Notes:
[1]Highway Safety Improvement Program
[2]National Highway Performance Program
[3]Congestion Mitigation and Air Quality (CMAQ)
[4]Freight policy

Source: Osbourne, 2013
NHS = National Highway System
VMT = vehicle miles traveled

3.2.2 Texas Transportation Plan Performance Measures

The TTP performance measures will link directly to the final set of TTP goals and objectives and will evolve over time based on data availability among other considerations. In general, performance measures selected for use in the TTP will:

- Be supported by existing resources
- Be important to decision-makers and stakeholders
- Reflect agency priorities and influence
- Be suitable for a statewide context
- Support predictive capacity
- Integrate national priorities.

There are several ongoing efforts at TxDOT and at MPOs/RPOs to establish performance measures for implementation within the department and to inform the development of national measures. One such effort was the Association of Texas Metropolitan Planning Organizations (TEMPO) meeting held on August 20, 2013 with the purpose of discussing current TxDOT measures and recommendations for national measures in the areas of safety, bridge and pavement condition, freight, system performance, congestion mitigation and air quality, and transit. The full set of measures discussed at the meeting is presented in Exhibit 6 along with the AASHTO Standing Committee on Performance Measures (SCOPM) recommendations for national measures. Important insights from the discussion include that:

- TxDOT is transitioning towards an asset-management approach for system preservation; this will not impact what is currently in the pipeline but will affect future project selection.
- Transit ridership should be considered as a potential TxDOT and national measure.
- Vehicle miles traveled (VMT) and vehicle hours traveled (VHT) should be used to provide context for congestion but should not be applied as measures themselves.

It is difficult to determine the impacts of congestion mitigation measures on air quality.

Exhibit 6: TxDOT Performance Measures Recommended for National Use and AASHTO SCOPM Recommendations for National Performance Measures

TxDOT Strategic Plan Goals	TxDOT Strategic Plan Objectives	MAP-21 Goal Area	AASHTO SCOPM Perf Area	Performance Measure	Recommended by TEMPO?	Recommended by AASHTO SCOPM?
Maintain a Safe System	Reduce crashes and fatalities on the system through innovations, technology, and public awareness	Safety	Safety	Number of Fatalities (5-year moving average)	X	X
				Fatality Rate (5-year moving average)	X	X
				Number of Serious/ Non-Fatal Injuries (5-year moving average)	X	X
				Serious/ Non-Fatal Injury Rate (5-year moving average)	X	X
	Maintain and preserve the transportation assets of the state of Texas	Infrastructure Condition	Bridge Condition	% (by total NHS deck area) of SD deck area on NHS bridges	X	X
				% (by total non-NHS deck area) of SD deck area on non-NHS bridges[1]	X	
				% (by deck area) of NHS bridges in good/fair/poor condition	X	X
				Count and % (by deck area) of bridges with cyclic maintenance needs[1]	X	
				Count and % (by deck area) of bridges with preventive maintenance needs[1]	X	
				Count and % (by deck area) of bridges with rehabilitation/replacement needs[1]	X	
				Functional obsolescence[2]		
				Substandard for load[2]		
			Pavement Condition	Interstate (NHS) pavement by SGR (% of 0.1 mile segment)	X	X
				Non-interstate (NHS) pavement by SGR (% of 0.1 mile segment)	X	X
				Pavement Structural Health Index		X
Address Congestion	Partner with local officials to develop and implement congestion mitigation plans in Texas	Congestion Reduction	Congestion Mitigation and Air Quality	Annual Hours of Delay (AHD)	X	X
				Annual Hours of Truck Delay (AHTD)	X	X

Exhibit 6: TxDOT Performance Measures Recommended for National Use and AASHTO SCOPM Recommendations for National Performance Measures

TxDOT Strategic Plan Goals	TxDOT Strategic Plan Objectives	MAP-21 Goal Area	AASHTO SCOPM Perf Area	Performance Measure	Recommended by TEMPO?	Recommended by AASHTO SCOPM?
Become a Best in Class State Agency	Ensure the agency deploys its resources responsibly and has a customer service mindset	Environmental Sustainability	Congestion Mitigation and Air Quality	Daily kg of NOx reduced by the latest annual program of CMAQ projects[3]	X	X
				Daily kg of CO reduced by the latest annual program of CMAQ projects[3]	X	X
				Daily kg of VOC reduced by the latest annual program of CMAQ projects[3]	X	X
				Daily kg of PM reduced by the latest annual program of CMAQ projects		X
				Annual hours of delay reduced by the latest annual CMAQ program[4]	X	
Connect Texas Communities	Prioritize new projects that will increase the state GDP and enhance access to goods and services throughout the state	System Reliability	System Performance	Annual Hours of Delay (AHD)	X	X
				Reliability Index[5]	X	X
				Rural connectivity (% of rural pop. with access to public transportation service administered by TxDOT)	X	
				Average condition of TxDOT-funded fleet	X	
				Average condition of Elderly and Individuals with Disabilities Program fleet	X	
				Average condition of Rural Areas Program fleet	X	
				Average condition of Small Urban Program fleet	X	
		Freight Movement and Economic Vitality	Freight	Annual Hours of Truck Delay (AHTD)	X	X
				Truck Reliability Index (RI)[5]	X	X

Notes:

1 Consistent with the AASHTO Subcommittee on Bridges and Structures (SCOBS) recommendations

2 TxDOT desired measure but not currently collected; will likely be required at national level

3 Five-year moving average of on-road, mobile source criteria pollutant emissions in areas with 1 million population or more

4 In areas with 1 million population or more

5 NHS interstates based on 80th percentile travel time

AHD = Annual Hours of Delay
AHTD = Annual Hours of Truck Delay
CMAQ = Congestion Mitigation and Air Quality Program
CO = carbon monoxide
kg = kilograms
NHS = National Highway System
NOx = nitrogen oxide
PM = particulate matter
SCOPM = Standing Committee on Performance Measures
SD = structurally deficient
SGR = state-of-good-repair
VOC = volatile organic compound

3.3 *Project Selection and Resource Allocation*

While the Strategic Plan directs all TxDOT business decisions and investments, and the TTP supports the Strategic Plan, progress towards goals is largely dictated by the projects selected for implementation. Thus, to support the achievement of Strategic Plan goals, the TTP will provide a method for aligning planning and programming decisions in order to maximize the value of investments in the Texas transportation system. This will be developed by analyzing alternative investment scenarios given Plan needs and reasonably expected revenues, with a focus on reporting outcomes using the performance measures identified in the Plan.

3.3.1 Best Practices and Legislative Guidance

The states maintain the sovereign power to prioritize and select specific projects; Congress by law authorizes federally-funded transportation programs as well as eligibility and programmatic requirements. In accordance with the nationwide shift towards performance management (John A. Volpe National Transportation Systems Center, 2012), some state DOTs are beginning to use performance measures to evaluate, select, and prioritize projects; however, the majority do not consider fiscal constraints, or what could actually be implemented based on currently available funds and anticipated future revenues. Additionally, long-range plans can be policy-based and are largely not developed to include specific projects in practice.

Best practices in the literature are increasingly calling for a consistent, repeatable, and defensible approach to project selection and ranking that considers:

- Performance constraints/ minimum performance thresholds
- Budgetary constraints
- Identification of multimodal Plan investment scenarios
- An evaluation of tradeoffs to determine impacts across scenarios
- The development of a recommend investment strategy to guide high-level resource allocation.

3.3.2 Texas Transportation Plan - Resource Allocation Analysis

The TTP will be developed to both incorporate the UTP and to guide future UTP projects. The TTP 43 TAC Rule 16.105 requires the UTP to link high-level planning activities from the SLRTP with more detailed programming activities in the STIP. The UTP is a listing of all projects that TxDOT intends to develop or initiate construction for during the program period. However, the UTP is not fiscally constrained; it does not obligate funding for projects nor guarantee that they will be constructed.

The UTP Toolkit provides specific programming instructions based on 12 funding categories. Pursuant to 43 TAC Rule 16.105, all projects excluding Category 1 projects (preventative maintenance and rehabilitation) that are included in the UTP must be ranked as Tier 1-3 based on a set of criteria. This ranking is used to inform the advancement of some projects to the STIP and then to project letting for implementation. To standardize the approach and criteria for ranking projects, the 2014 UTP Toolkit provides a Project Ranking Tool that encompasses three criteria areas:

- **Project need** based on the potential of the project to advance the goals of the Strategic Plan (34 points possible)
- **Funding availability** based on secured and local committed funding as a percent of construction cost (33 points possible)
- **Project readiness** based on current phase of project development: plan, develop, construct, and let (33 points possible).

Using Plan-specific goals and objectives that align with the Strategic Plan and incorporate UTP criteria, the TTP will include the development of resource allocation scenarios and a recommended investment strategy that can align with TxDOT's capital program and operating budget. In addition to informing UTP projects, the TTP will include the identification of priority corridors, projects, or areas of the state that are of particular concern in meeting goals and objectives.

3.4 Performance Data Collection, Monitoring, and Reporting

Performance monitoring serves several important functions in the context of a performance-based plan. It is used to support agency decision-making on a daily or longer-term basis; to inform the development of performance targets based on what can realistically be achieved; to refine/calibrate predictive tools and methodologies based on a comparison of actual to predicted performance outcomes; and to track progress towards goals. Through clear communication of how well the system is performing against established benchmarks, reporting can be used to support internal coordination and collaboration; remain accountable to the public and stakeholders; justify the need for increased Federal funding; and comply with MAP-21 requirements.

3.4.1 Best Practices and Legislative Guidance

Information management systems are often used for performance monitoring and reporting. State DOTs commonly maintain roadway, structural, safety and facility, and mobility data systems (**Exhibit 7**); however, there is significant variation in the data collected and maintained by DOTs that further complicates the selection of national measures.

In the context of a performance-based plan, these databases are used not only for monitoring system condition and performance but also as the basis for transportation investments. Historic data can be used to calibrate predictive tools and methodologies that assess likely project impacts prior to implementation. In this way, the expected "value" of a given project with respect to long-term goals can be determined and compared to others in order to select the set of projects that achieves the greatest overall benefit. Such data-driven decision processes require quality data to ensure that investments are truly aligned with the best and most probable performance outcomes.

Developing and maintaining quality databases is very resource intensive. Fiscally-constrained DOTs and MPOs often lack the resources to continually update the databases with the most recent information. As such, key challenges that are currently being addressed by transportation agencies include the development of cost-effective data collection methodologies and the use of data sharing agreements with the private sector and other public agencies to avoid duplicating efforts.

Exhibit 7: Common State DOT Data Systems

Data Category	Database System
Roadway Data	Highway Performance Management System (HPMS). Includes data in highway inventory, condition, performance, and operations. It also describes functional characteristics, performance, and operations. PMS Database. Most state agencies collect pavement data to support PMS, but there is no standard format for how the information is collected and stored. Different state agencies collect different pavement data, and examples of pavement data include pavement type, land width, shoulder width, number of lanes, layer thickness, pavement layer material, drainage, subgrade type, cracking, IRI, and rutting data.
Structure Data	National Bridge Inventory (NBI). NBI is a federally mandated database of bridge inventory and conditions, and this data is submitted to FHWA. The NBI data set contains condition/rating data by bridge component: deck, superstructure, substructure, channel/channel protection, and culvert. It also contains data on a bridge's functionality, such as under clearances and load-posting information. Pontis BMS. The Pontis database contains additional data on the distribution of conditions by condition state for each structural element of the superstructure, including elements such as girders, stringers, and floor beams.
Safety Feature and Facility Data	Most state DOTs collect and maintain asset inventory data of their safety features and facilities. The data is stored in a variety of ways, ranging from filed books to database applications. There are no standards for collecting asset data for safety features and facilities, and data availability varies from one agency to another. LOS is commonly used to support performance-based budgeting or resource allocation. Commonly used safety data includes Fatality Analysis Reporting System (FARS), Highway Safety Information System (HSIS), State Crash Data Systems, and State Highway Safety Improvement Plans (HSIP).
Mobility Data	State DOTs typically use HPMS as a source of mobility data. The FHWA Highway Economic Requirements System (HERS-ST) uses HPMS data to generate mobility measures. Most state DOTs maintain databases for tracking highway inventory and traffic data in addition to what they report to FHWA through the HPMS Program. However, there are no standards for how and what additional data are collected and stored.

Notes:
Sources: Wiegmann & Yelchuru, 2012) as adapted from (Cambridge Systematics, Inc., 2007); (Cambridge Systematics, Inc., Applied Research Associates, Inc., Arora and Associates, KLS Engineering, PB Consult, Inc., Lambert, Louis, 2009
BMS = Bridge Management System
DOT = Department of Transportation
FHWA = Federal Highway Administration
IRI = International Roughness Index
LOS = level of service

3.4.2 Texas Transportation Plan Performance Data

The TTP will include an extensive review of the multimodal data systems that are currently used and maintained by TxDOT and other transportation providers within the state. At a minimum and based on an initial review, TxDOT maintains the following for performance data:

- Highway Performance Management System (HPMS): Includes highway inventory, condition, and performance data for on-system roadways and others depending on functional classification
- National Bridge Inventory (NBI): Includes condition data by bridge deck, superstructure, and substructure, as well as functional data including underclearances and load-posting
- TxDOT Road–Highway Inventory Network (RHiNo) database
- Project Tracker: Publically available database via the TxDOT website that provides project-specific information including schedule and costs to date.

4.0 Plan Outreach

Plan outreach is critical for cultivating trust with the public and stakeholders, increasing public participation and "buy-in," and achieving internal acceptance and support. Successful plans are those that are (1) comprehensive with respect to statewide and multimodal transportation priorities; (2) relevant for all system users and stakeholders; (3) and useful for supporting agency processes and decision-making. Regardless of the specific approach taken, these characteristics can generally be achieved by continuously collecting and integrating feedback from a diverse set of transportation users and stakeholders throughout plan development and implementation.

4.1 Plan Outreach Requirements

While specific approaches to plan outreach vary among DOTs, there are significant legislative requirements regarding who should be involved in the development process. In summary, these include:

- Texas (43 TAC Rule 16.54): Other state agencies, political subdivisions, metropolitan planning organizations, rural planning organizations, local transportation entities, other officials who have local responsibility for the various modes of transportation, and members of the general public.
- National (23 USC 135): Governments in metropolitan, non-metropolitan, and Indian tribal areas; all other interested parties including local elected officials, the general public, freight stakeholders, multimodal representatives, and private industry transportation providers, among others.

4.2 *Texas Transportation Plan Outreach*

TTP outreach will be conducted in two rounds:

- Round #1 will occur in the fall/ winter of 2013/ 2014 and will include the presentation of Draft TTP Goals and Objective for public input.
- Round #2 will occur in the spring/ summer of 2014 and will provide the public with an opportunity to consider various long-term investment strategies, the costs of these strategies, and the impact of these investments on system performance.
- TxDOT is currently developing a Public Outreach Plan (POP) for the TTP. While the specific approach and milestones will be discussed in a separate technical memo, it will generally be based on a "comprehensive, cooperative, and continuing" (3-C) planning process that is transparent and inclusive of all transportation stakeholders. It will be fully compliant with the state and national statutory requirements listed in 43 TAC 16.54 and 16.55 and 23 USC 135, respectively.

5.0 Plan Communication/Data Presentation

In support of a more inclusive process, and to provide greater accountability and transparency to the public and stakeholders, state DOTs are working to create a format for communicating system performance that is understandable to a diverse set of audiences. While narrative formats including handouts and fact sheets are still preferred by some DOTs, infographics including report cards and dashboards are becoming increasingly utilized by DOTs to more clearly communicate progress towards benchmarks and to support internal decision-making processes.

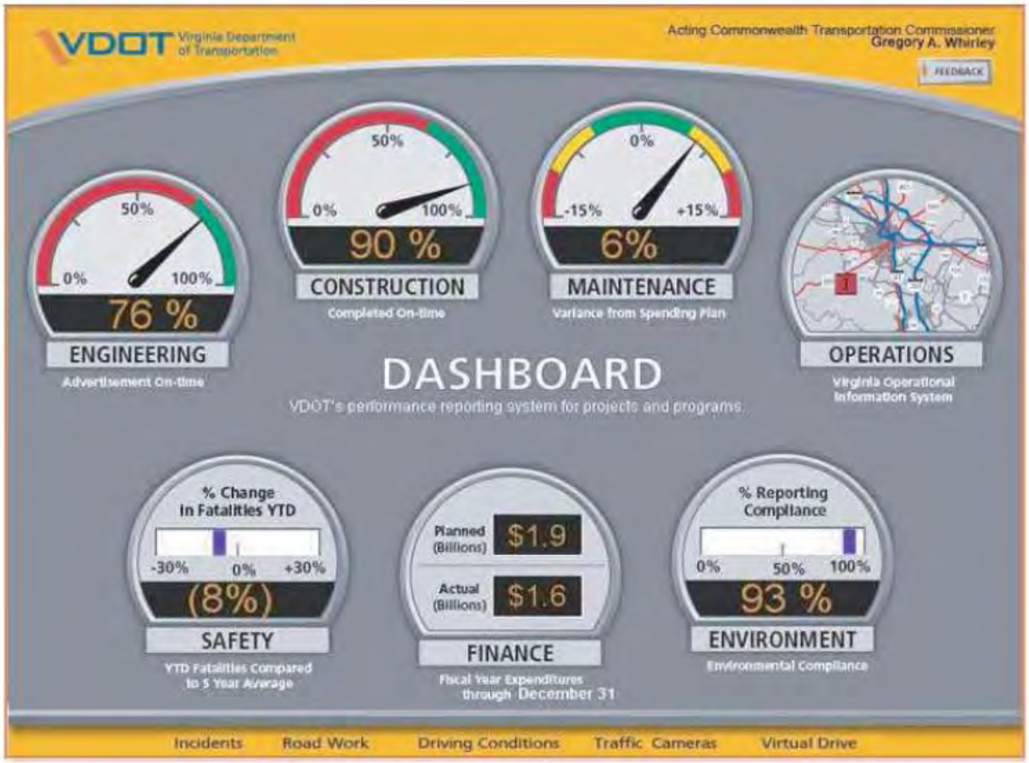
5.1 *Best Practices in Plan Communication/ Data Presentation*

Infographics can be used to translate technical information into a format that can be easily understood by the general public. Tools such as report cards/scorecards (Exhibit 8) and dashboards (Exhibit 9) can be used to establish greater trust and accountability with the public and stakeholders by allowing them access to the performance of the multimodal transportation system. Both of these formats are best served by a centralized database that supports the continuous updating of performance indicators for public viewing.

Legislative guidance for SLRTP communication and data presentation provided by 23 USC 135 (as amended by MAP-21) requires state DOTs to employ visualization techniques to the extent practicable when describing the Plan or its findings to the general public.

Exhibit 8: ASCE 2013 Systemic Report Card

Exhibit 9: Example Dashboard Developed by VDOT



5.2 Texas Transportation Plan Communication/ Data Presentation

Effective plan communication is critical to successful TTP development and implementation. As such, the Plan framework calls for the use of innovative, interesting, and understandable methods for communicating findings and "decision points" to the public for consideration and feedback. The TTP communications and data presentation will focus on building trust with the Texas public through greater transparency and accountability in agency decision-making and with respect to the current and anticipated future performance of the multimodal system. In these ways, TTP communications will provide improvement from those of past plans, which the Strategic Plan notes were not consistently "viewed by various audiences as timely, reliable, or accurate."

The TTP will include updates to the TxDOT website to reflect ongoing development and outreach activities and to continuously collect feedback from the public and stakeholders. Additionally, it will employ visualization techniques to improve general understanding of the multimodal system needs and funding gaps and to comply with national requirements. Data presentation techniques that will be considered include GIS maps that display the statewide performance of the system across goal areas, and performance indicators that visually communicate current progress towards goals. Additionally, to support greater public understanding of TxDOT decision processes within the context of constrained resources, an interactive tool will be provided that allows users to visualize the systemic impacts and tradeoffs that result from shifting resources from one priority to another (e.g., from system preservation to expansion) and what a given level of investment can "buy" with respect to performance across all goal areas.

The 2030 Committee report *It's About Time: Investing in Transportation to Keep Texas Economically Competitive* warns that sustained underinvestment in the Texas transportation system will result in a degraded future system with worsening traffic congestion and insufficient connectivity to support the Texas economy. The alternative requires Texans to invest more in order to preserve the quality and reliability of the transportation system for years to come. While this conclusion is never politically popular, it will be an easier sell if the Texas public understands the severity of the funding gap, its pervasive consequences, and that their individual contributions (i.e., via taxes and fees) are critical for enhancing the performance of the multimodal transportation system.

6.0 Recommended Plan Framework

Based on findings from the Plan Assessment and a review of best practices, the TTP will focus on outcomes of proposed investments on the Texas multimodal transportation system and will showcase technical analyses using innovative, effective, and transparent communication and data presentation techniques that cultivate trust with the public and improve general understanding of the Plan.

The Plan Framework will include the following components:

- **Goals and objectives** that implement the Department's mission and long-term vision as identified in the Strategic Plan as well as the incorporation of MAP-21 goals/ requirements and additional agency/ stakeholder priorities. Goals and objectives will be developed using input from the TTP Technical Advisory Committee (TAC), the state's planning partners and TEMPO, and the public (Round #1 of Public Outreach).
- **Performance measures** and supporting data that track progress towards goals and facilitate data-driven decision processes.
- **Outcome-based investment analysis** to guide project development and selection. This analysis will be based on a multimodal needs assessment and existing/ project revenues and will include the identification of priority corridors, projects, or areas of the state that are of particular concern in meeting goals and objectives. Evaluation will include input from the public on how/ where investments should be made across the multimodal system (Round #2 of Public Outreach).
- A methodology for tracking and reporting on **Plan implementation progress** over time will be included in the final TTP.

The TTP will use **inclusive and engaging public outreach methods** that result in meaningful and diverse contributions to the TTP development process. The public will be presented with the opportunity to understand the outcomes of investment decisions on system performance using language that is easily understood.

Texas Transportation Plan

Tech Memo 2: TTP Goals & Objectives "Building Blocks"

September 26, 2013

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Contents

Tables

Figures

1.0 Background

The Texas Transportation Plan (TTP) will serve as the statewide long-range transportation plan (SLRTP) in compliance with state and federal requirements under Title 43 of the Texas Administrative Code and Senate Bill (SB) 1420, 23 U.S. Code (USC) 135 (as amended by MAP-21), and 23 Code of Federal Regulations (CFR) 450.214. The TTP will implement the statewide vision and goals as identified in the 2013-2017 Strategic Plan and will incorporate—by reference—statewide, metropolitan, and rural plans, programs, and studies relevant to the evaluation and performance of the statewide and multimodal transportation system, including:

Passenger Modes

- Highway/Bridge
- Bus Transit and Inter-city Bus
- Passenger Rail
- Aviation
- Bicycle and Pedestrian
- Intelligent Transportation Systems.

Freight Modes

- Truck Freight
- Freight Rail and Intermodal
- Ports and Waterways
- Pipeline

In addition, the TTP will integrate pending changes to statewide planning regulations as they are issued by the U.S. Department of Transportation (DOT) under MAP-21, including the development of national measures and other relevant provisions.

This Technical Memorandum (Tech Memo #2) summarizes the “building blocks” of – and development process for – the goals and objectives (G&O) for the TTP.

1.1 Requirements for SLRTP Development

Under Title 23, state departments of transportation (DOTs) are required to develop SLRTPs in coordination and cooperation with statewide transportation planning and delivery partners, stakeholders, and the public. The basic federal requirements for statewide planning include the development of a multimodal statewide transportation plan with a minimum 20-year time horizon.

Under Title 43 of the Texas Administrative Code (TAC) and SB 1420, the Texas Department of Transportation (TxDOT) is required to develop an SLRTP with a 24-year planning horizon that contains specific, long-term transportation goals and performance targets and identifies priority corridors, projects, or areas of concern with respect to achieving these goals.

1.2 TTP G&O – Development Process

The development of goals and objectives for the TTP is a critical part of the statewide planning process. Building blocks for TTP G&O are defined by documents, provisions, and on-going TxDOT agency initiatives as well as state and federal legislation, national transportation planning trends, and existing statewide planning efforts as documented in:

- Title 23 USC § 135 Statewide Transportation Planning
- 23 the U.S. Code of Federal Regulations (CFR) Parts 450 and 500

- Moving Ahead for Progress in the Twenty-first Century (MAP-21)
- Title 43 of the TAC [Rule 16.54 and 16.55]
- TxDOT's Strategic Plan (2013 – 2017)
- The Texas Rural Transportation Plan 2013-2037 (TRTP)
- TxDOT's 2035 Statewide Long-range Transportation Plan.

While these regulations and plans form the basis of G&O development, the involvement of decision-makers, planning partners, stakeholders, and the public is essential to ensure that the goals are comprehensive and reflective of statewide multimodal priorities. To incorporate the ideas of these diverse groups, the TTP G&O development follows an iterative process that includes:

- A review of existing plans and regulations
- Presentation and discussion of the G&O building blocks to TxDOT's TPP Technical Advisory Committee (TAC) (Oct 10, 2013)
- Development of Draft TTP G&O for distribution to the TTP TAC and for review by TxDOT executives
- Presentation and discussion of Draft G&O during Public Outreach Round #1 (fall/ winter 2013)
- Updates to G&O and presentation/ adoption of final TTP G&O by TxDOT executives for the TTP (winter 2013).

2.0 Building Blocks

2.1 TxDOT Strategic Plan

The TxDOT 2013-2017 Strategic Plan provides direction for TxDOT's business and operational decisions and investments. The TTP will implement the Strategic Plan using performance-based planning concepts with a focus on the State's multimodal transportation system.

2.1.1 Strategic Plan Priorities

As documented in the Strategic Plan, TxDOT's priorities are to:

- Be the safest state department of transportation in the United States
- Develop and implement authorized Comprehensive Development Agreements (CDAs) and discuss the need for additional CDAs
- Develop innovative maintenance approaches that reduce costs and improve/preserve transportation system conditions
- Develop effective information systems
- Act as resource for transportation funding
- Implement congestion mitigation projects
- Further strengthen and enhance relationships with MPOs, counties, and other key stakeholders.

2.1.2 Strategic Plan Goals

Developed by the Texas Transportation Commission and TxDOT executives, the Strategic Plan goals provide broad directional areas of focus for TxDOT's mission to "Work with others to provide safe and reliable transportation solutions for Texas." The Strategic Plan goals focus on improving business processes and the performance of the Texas transportation system. As an expression of TxDOT priorities, the following Strategic Plan goals and objectives provide the umbrella framework for the development of TTP G&O:

Goal: Maintain a Safe System

Objective(s):

- Reduce crashes and fatalities on the system through innovations, technology, and public awareness
- Maintain and preserve the transportation assets of the state of Texas

Goal: Address Congestion

Objective(s):

- Partner with local officials to develop and implement congestion mitigation plans in Texas

Goal: Connect Texas Communities

Objective(s):

- Prioritize new projects that will increase the state GDP and enhance access to goods and services throughout the state

Goal: Become a Best in Class State Agency

Objective(s):

- Ensure the agency deploys its resources responsibly and has a customer service mindset
- Focus on work environment, safety, succession planning, and training to develop a great workforce

2.2 SLRTP 2035

Adopted on November 18, 2010, the 2035 Statewide Long Range Transportation Plan (SLRTP) identifies the following goals to support the implementation of the Strategic Plan:

- Develop an organizational structure and strategies designed to address the future multimodal transportation needs of all Texans
- Enhance safety for all Texas transportation system users
- Maintain the existing Texas transportation system
- Promote congestion relief strategies

- Enhance system connectivity
- Facilitate the development and exchange of comprehensive multimodal transportation funding strategies with transportation program and project partners.

2.3 Texas Rural Transportation Plan

Adopted on June 28, 2012 as a supplement to the SLRTP, the 2013-2037 Texas Rural Transportation Plan (TRTP) specifically addresses the multimodal transportation system condition and needs in rural areas (i.e., outside of MPO boundaries). The TRTP considered all six goals from the SLRTP with a specific focus on two over-arching goals:

- Promote Congestion Relief Strategies
- Enhance System Connectivity.

2.4 Texas Freight Mobility Plan

The Texas Freight Mobility Plan (TFMP) is currently under development and is scheduled to be completed in 2014. As the State's first comprehensive freight plan, the TFMP will develop short-, mid-, and long-term needs for freight-related transportation investments as part of an integrated multimodal system approach that includes:

- Freight Rail
- Air Cargo
- Pipelines
- Border Crossings
- Ports/Waterways
- Highways/Trucks.

An important part of this effort was the establishment of the Texas Freight Advisory Committee (TxFAC) to guide TFMP development and support implementation. The Freight Stakeholder Engagement Plan outlines the TFMP outreach activities and strategies to support increased participation by private and public sector freight stakeholders throughout the state.

2.5 Federal Legislation

Under SAFETEA-LU, as codified in 23 USC Section 135, states were afforded significant flexibility in the development of SLRTP goals, objectives, and content. The national legislation provided guidance for Plan development and required only that the following eight federal "planning factors" be considered:

- Support the economic vitality of the United States, the States, nonmetropolitan areas, and metropolitan areas, especially by enabling global competitiveness, productivity, and efficiency
- Increase the safety of the transportation system for motorized and non-motorized users
- Increase the security of the transportation system for motorized and non-motorized users
- Increase accessibility and mobility of people and freight

- Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns
- Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight
- Promote efficient system management and operation
- Emphasize the preservation of the existing transportation system.

MAP-21 amends the planning factors by providing specific national goals for incorporation into the SLRTP and establishes an outcome-driven framework for investment, where states and metropolitan planning organizations (MPOs) shall work to measure, manage, and improve upon system conditions and performance and incorporate the following national goals into the statewide long-range transportation planning process:

- Safety: Reduce fatalities and injuries on all public roads
- Condition: Maintain the National Highway System (NHS) to a state of good repair
- Congestion: Significantly reduce congestion on the NHS
- Reliability: Improve efficiency for passengers and freight
- Freight movement and economic vitality: Improve connectivity, access, and rural economic development
- Environmental sustainability: Enhance performance while protecting and enhancing the natural environment
- Project delivery: Accelerate project completion and promote jobs and the economy.

MAP-21 regulations for national measures will be issued according to the schedule shown in Exhibit 1. TxDOT is continuing to inform the Federal Highway Administration (FHWA) rulemaking for national measures through coordination with the American Association of State Highway and Transportation Organization (AASHTO) Standing Committee on Performance Measurement (SCOPM). The TTP will incorporate these measures at a minimum.

Exhibit 1: FHWA Guidance on MAP-21 Performance Rulemaking

	Measure Category
Status I January 2015	• Serious injuries per VMT[1] • Fatalities per VMT[1] • Number of serious injuries[1] • Number of fatalities[1]
Status II April 2015	• Pavement condition on the Interstates[2] • Pavement condition on the Non-Interstate NHS[2] • Bridge condition on NHS[2]
Status III July 2015	• Traffic congestion[3] • On-road mobile source emissions[3] • Freight movement on the Interstate[4] • Performance of Interstate system[2] • Performance of Non-Interstate NHS[2]

Notes:
[1]Highway Safety Improvement Program
[2]National Highway Performance Program
[3]Congestion Mitigation and Air Quality (CMAQ)
[4]Freight Policy

VMT = vehicle miles traveled
NHS = National Highway System

Source: Osbourne, 2013

Other key federal initiatives include the broad sweeping requirement for performance-based planning[1] that is the cornerstone of MAP-21, the development of a national freight policy, and environmental streamlining to accelerate project design and delivery.

National Freight Policy Goals (as established in 23 U.S.C. 167)

MAP-21 includes a provision to improve the condition and performance of the national freight network in order to support the global economic competitiveness of the United States and achieve the following goals:

- Improve the contribution of the freight transportation system to economic efficiency, productivity, and competitiveness
- Reduce congestion on the freight transportation system
- Improve the safety, security, and resilience of the freight transportation system
- Improve the state of good repair of the freight transportation system
- Use advanced technology, performance management, innovation, competition, and accountability in operating and maintaining the freight transportation system
- Reduce adverse environmental and community impacts of the freight transportation system.

MAP-21 also requires the U.S. DOT to establish a national freight network to provide strategic direction for States on highway investments that enhance freight mobility.

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[1] The components and importance of performance-based planning and its application to SLRTP development are further defined in TTP Tech Memo #1: Plan Assessment and Framework.

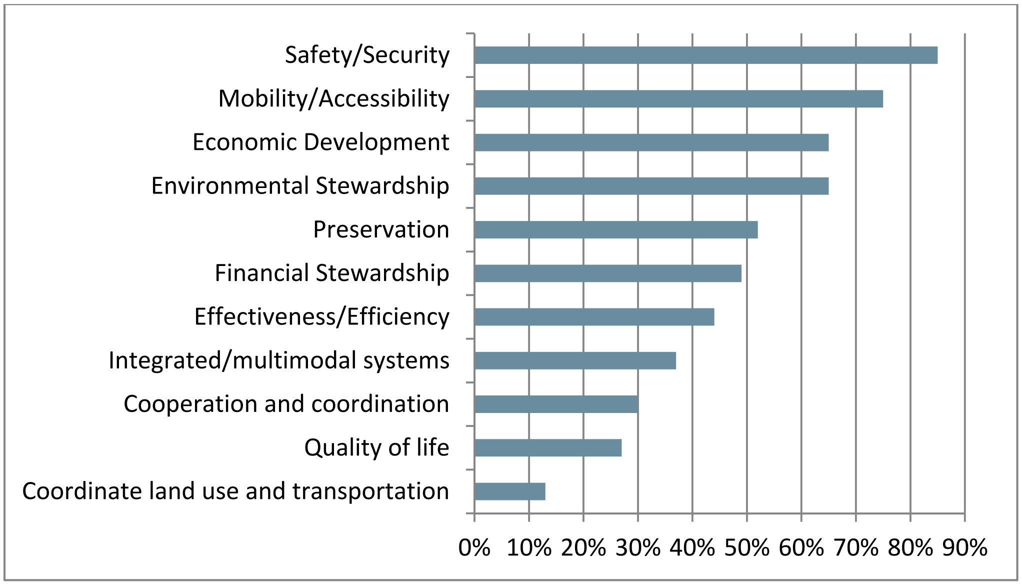
NEPA Streamlining

MAP-21 promotes accelerating project delivery and encourages innovation through the increased use of Categorical Exclusions, programmatic approaches, and planning and environmental linkages in 22 different sections. To speed project delivery, MAP-21 encourages timely decisions by environmental agencies. The Bill authorizes a process for U.S.DOT and the environmental agencies to establish deadlines for issuance of project approvals and a process for the elevation of disputes among agencies.

2.6 National Trends in LRTP Goals

A 2012 review of state DOT SLRTPs completed by the Volpe National Transportation Systems Center provides a summary of trends in statewide planning goals (Exhibit 2). Prior to MAP-21, many of the overarching goals defined in SLRTPs were consistent with the federal planning factors outlined in SAFETEA-LU.

Exhibit 2. Trends in Statewide Planning Goals



Source: Volpe, Trends in Statewide Long-Range Transportation Plans, March, 2012

3.0 Next Steps

3.1 Developing TTP-specific Goals

The TTP goal development process assumes the following definitions:

- Goal area: A broad identification of general direction that aligns with TxDOT Strategic Plan goals and priorities (safety); goal areas will be developed for the TTP with the Strategic Plan as the umbrella framework
- Goal: A more targeted statement of directional priority within the general goal area (e.g., improve pedestrian and bicycle safety); TTP goals will incorporate MAP-21 national goals as well as state priorities

- **Objective**: A specific and measurable statement of action (e.g., reduce the number of pedestrian- and bicycle-related crashes); TTP objectives will be developed with the TAC and TxDOT leadership.

3.2 *Aligning MAP-21 to Strategic Plan*

Exhibit 3 illustrates how the national goals identified under MAP-21 align with those of the Strategic Plan. In addition to providing specific guidance on the achievement of Strategic Plan goals, the TTP goals will be used to fill any existing gaps with MAP-21 requirements, such as by addressing environmental stewardship and system reliability requirements.

Exhibit 3. Aligning MAP-21 Goals to the TxDOT Strategic Plan

Strategic Plan Goals	MAP-21 Goals
Maintain a Safe System	**Safety:** To achieve a significant reduction in traffic fatalities and serious injuries on all public roads **Infrastructure Condition:** maintain assets to a state of good repair*
Address Congestion	**Congestion Reduction:** To achieve a significant reduction in congestion on the NHS
Connect Texas Communities	**System Reliability:** To improve the efficiency of the surface transportation system* **Freight Movement and Economic Vitality:** To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development
Become a Best in Class State Agency	**Reduced Project Delivery Delays:** To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery **Environmental Sustainability:** To enhance the performance of the transportation system while protecting and enhancing the natural environment **Infrastructure Condition:** maintain assets to a state of good repair*

Note:
*Additional coordination with TxDOT and the TTP TAC is required to identify where these MAP-21 goal areas best fit under TxDOT's 2013-2017 Strategic Plan.

3.3 *Defining Performance Measures*

Another integral part of this process is the identification and development of performance measures to address the requirements of MAP-21 and as part of the TxDOT modernization process. Criteria for "good" performance measures include the following development indicators:

- Supported by existing resources
- Important to decision-makers, partners and stakeholders
- Aligned with the Department mission, values, and goals
- Appropriate with respect to Department responsibilities and influence
- Suitable for context
- Supportive of predictive capabilities
- Reflective of state and national priorities

MAP-21 national measures will be integrated into the TTP per AASHTO/ FHWA recommendations.[2]

3.4 TAC Input

After reviewing the building blocks for the TTP and identifying the strategic goals, the next step is to work with the internal partners and stakeholders through the TTP TAC to develop draft working goals, objectives, and performance measures.

Draft working goals will be taken out to external partners and stakeholders for review and refinement, then brought forward into the TTP scenario development process.

3.4.1 Schedule

The schedule for the remainder of 2013 will focus on the TTP G&O development process and will continue as follows:

October 10, 2013	TTP TAC
Fall/Winter 2013	Partner and Stakeholder Meetings and Webinars Round #1
Fall/Winter 2013	Public Meetings and Webinars Round #1
January 2014	Draft final goals, objectives, and performance measures
February 2014	Final goals, objectives, and performance measures

[2] Final rulemaking for SLRTP/ national performance measures has not yet been issued by FHWA, but will be issued according to the schedule shown in Exhibit 1.

Texas Transportation Plan

Tech Memo 3.1: Pavement

January 15, 2014

Acknowledgements

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Contents

Tables

Figures

1.0 Introduction

In supporting the long-range Texas Transportation Plan (TTP), this Technical Memorandum describes the methodology for conducting an assessment of highway pavement investment needs required to maintain state-owned highway pavements in good condition over the planning horizon while providing an acceptable level of service for road users. This methodology will be employed in Task 4 of the TTP.

The suggested performance-based approach incorporates the methodology used in the Texas Pavement Management Information System (PMIS) and uses a life-cycle analysis framework to conduct long-term pavement needs assessment. It provides cost-effective investment needs for pavement maintenance, preservation, rehabilitation, and reconstruction to maximize the use of resources and optimize pavement performance.

The following sections discuss the scope of the analysis, data collection, and determination of needs.

2.0 Scope of Analysis

2.1 Types of Investment

Pavement investment can be broken out into two broad categorizations: preservation and service expansion.

- Preservation: Pavement preservation generally refers to all types of pavement treatments that maintain, strengthen, and enhance the serviceability of pavements assets. According to the TxDOT PMIS, the following four categories of pavement treatments are typically applied for Texas pavements: preventive preservation, light rehabilitation, medium rehabilitation, and heavy rehabilitation (including reconstruction). For each pavement section, a combination of the above four categories of treatments will be programmed over the planning horizon to generate the optimal pavement performance while minimizing the life-cycle cost.
- Service Expansion: Expansion or “capacity” projects listed in the existing Texas Statewide Long-Range Transportation Plan 2035 and Metropolitan/Regional Transportation long-range plans will be evaluated for inclusion in the statewide travel demand model (SAMv3). Based in part on the predicted traffic volume, roadway capacity expansion projects will be considered to further alleviate traffic congestion and support economic movement. Then the preservation investment needs during the planning horizon for new constructed pavements in roadway expansion projects will also be identified.

2.2 Modal Overview

With approximately 197,000 lane-miles of roadway owned and operated by TxDOT, the PMIS is used to track conditions, costs, and maintenance histories. As part of this system, Texas staff are currently working to update performance models and decision trees to more accurately project future needs. A description of TxDOT divisions, roles, responsibilities, and efforts to update the PMIS predictive framework are described as follows:

- Overview of Texas agencies/departments:
  - The TxDOT Maintenance Division oversees the preservation, upkeep, and restoration of Texas highways. Under the Maintenance Division, the Pavement Preservation Branch is responsible for the maintenance of pavements.
  - The Transportation Planning and Programming Division administers planning funds, prepares maps, collects data on the highway system, and programs projects, as well as acting as the central clearinghouse for project selection.
  - The Construction Division performs inspection and testing and provides administrative oversight for all department construction contracts. The division is responsible for contractor pre-qualification, bid proposal issuance, and awarding (letting) construction and maintenance contracts.
- Overview of pertinent transportation plans, programs, and studies reviewed:
  - The current TxDOT Strategic Plan, Texas Statewide Long-Range Transportation Plan 2035, TxDOT 2013 Unified Transportation Program (UTP), the most recent TxDOT Statewide Transportation Improvement Program, and 25 Metropolitan/ Regional Transportation Plans were reviewed. These plans will be evaluated to validate forecasted needs and priorities and to identify committed projects for inclusion in the development of the TTP.
  - TxDOT PMIS and the study *Project 0-6386: Evaluation and Development of Pavement Scores, Performance Models and Needs Estimates* (TxDOT Project 0-6386) were also reviewed. The Project 0-6386 publication has supported TxDOT staff in updating the PMIS with detailed information on pavement condition evaluation, performance modeling, and decision trees for pavement programming. As the PMIS processes are being updated, the current PMIS is limited to a 10-year planning horizon. The outcomes of this study and the methodologies used by TxDOT PMIS will serve as a base for the pavement methodology used in the development of the TTP.

3.0 Data Collection

3.1 Data Availability and Sources

The following data was obtained from the Pavement Preservation Branch of the Maintenance Division at TxDOT:

1. Pavement Inventory Data:
   - TxDOT roadway inventory data - RHiNO File (http://www.txdot.gov/inside-txdot/division/transportation-planning.html)
   - TxDOT PMIS pavement section information

2. Pavement Condition Data:
   - Pavement condition data from Year 2001 to Year 2013
   - Pavement distress score (scale: 1 to 100), ride score (scale: 0 to 5), International Roughness Index (scale: 1 to 950), and condition score (scale: 1 to 100) for each pavement section
3. Pavement Treatment Categories and Detailed Pavement Treatment List
4. Pavement Treatment Cost Information: the average unit cost ($/lane-mile) for each TxDOT defined pavement treatment category, including preventive maintenance, light rehabilitation, medium rehabilitation, and heavy rehabilitation

The following information and data were obtained from *Project 0-6386: Evaluation and Development of Pavement Scores, Performance Models and Needs Estimates*:

1. Pavement performance models for each distress type and ride score for each pavement type
2. Decision trees used to identify pavement treatments for each type of pavement

3.2 Gaps in Data and Recommendations

As seen in Section 3.1, several types of pavement data have been collected for the development of TTP. However, some important information is still limited or missing:

1. **Pavement construction and maintenance history**. Pavement maintenance and rehabilitation history provided by the Pavement Preservation Branch of the Maintenance Division is limited. Additionally, age information (i.e., build year or the reconstruction year) is unavailable, which may affect the accuracy regarding the identification of appropriate pavement rehabilitation treatments and timings.
2. **Unit cost of pavement treatment in each functional class.** The average unit cost ($/lane-mile) for each pavement treatment category has been collected; but the disaggregated unit cost of pavement treatment at each functional class is not available. Higher functional class roadways typically have incrementally larger costs. Consequently, an average aggregated cost is to be used unless sufficient unit cost information by functional class can be obtained.

The Consultant Team will make efforts to attain supplemental information by:

1. Reaching out to the Construction and Design Divisions as potential data sources for pavement construction and maintenance histories
2. Contacting the programming officials at TxDOT to identify typical treatment unit costs for each functional class. The Federal Highway Administration's (FHWA) Highway Economic Requirements System (HERS), which provides cost ratios between different functional classes at the national level, may be accessed to help disaggregate unit costs should Texas data be unavailable.

4.0 Needs Determination

4.1 Defining "Needs"

Generally, the pavement needs refer to the treatments required to keep the pavement ride surface and structural health in good condition. Several performance measures have been used to measure the condition of pavement in TxDOT PMIS: Distress Score, Ride Score, and Condition Score. Among these performance measures, the Condition Score is used to measure the overall State-of-Good-Repair (SGR) of pavements.

Also, according to FHWA staff and recommendations from the *AASHTO Standing Committee on Performance Management (SCOPM) Task Force Findings on National-Level Performance Measures*, the International Roughness Index (IRI) is a likely to be included in MAP-21 final rulemaking. This measure, similar to the Ride Score, measures the smoothness of the roadway surface and can be used to represent user satisfaction with driving conditions. The SCOPM recommends that a minimum condition level for rural interstate segments should be set at less than or equal to 20 percent of segments rated poor (IRI>170) based on IRI. Currently, most pavements in Texas are in much better condition than this threshold.

Considering TxDOT best practices, both the Condition Score and IRI are proposed to be used as performance measures to evaluate the SGR for pavements in Texas.

Two types of analyses will be conducted by the Consultant Team: unconstrained needs assessment and financially-constrained scenarios. Unconstrained needs refer to the pavement treatments and timings that maintain pavements at a targeted condition level. Typically, the target is to avoid any poor condition pavement. If the forecasted budget is not enough to implement all the recommend treatments in the unconstrained needs, financially-constrained analysis can be conducted to select treatments that can optimize the pavement performance under the available budget.

4.2 Predicting Performance

To realize the benefits of performance-based decision-making in long-term planning, reliable statistical models based on real data are critical. A comprehensive set of performance models have been developed for the TxDOT PMIS via TxDOT Project 0-6386; the Consultant Team recommends application of these models for development of the TTP. Additionally, the Consultant Team plans to develop a similar set of models to capture IRI predictions, which can be used for monitoring system performance as part of the upcoming Texas Transportation Asset Management Plan.

The TxDOT PMIS divides pavements into three types: Asphalt Concrete Pavement (ACP), Continuously Reinforced Concrete Pavement (CRCP), and Jointed Concrete Pavement (JCP). The performance models for each type of pavement will be discussed in the following sections.

4.2.1 Performance Prediction for Asphalt Concrete Pavement

Asphalt concrete pavement's performance is affected by climate and subgrade types. The state is divided into 4 zones based on climate and subgrade (Figure 1):

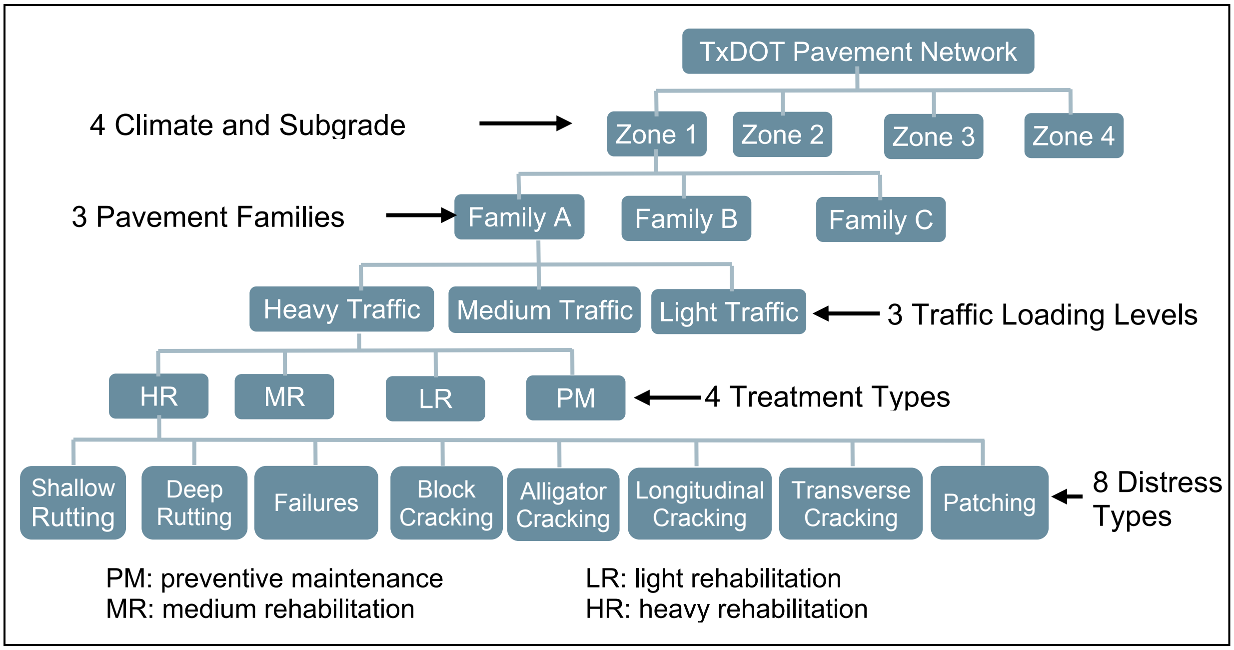
- **Zone 1:** wet-cold climate and poor, very poor, or mixed subgrade
- **Zone 2:** wet-warm climate and poor, very poor, or mixed subgrade
- **Zone 3:** dry-cold climate and good, very good, or mixed subgrade
- **Zone 4:** dry-warm climate and good, very good, or mixed subgrade

In each zone, pavements are divided into three families based on pavement material types:

- **Pavement Family A:** includes thick, Intermediate, and overlaid ACP
- **Pavement Family B:** includes composite and concrete pavement overlaid with ACP
- **Pavement Family C:** includes thin and thin-surfaced ACP

For each pavement family, pavements are further divided into three traffic levels: light traffic, medium traffic, and heavy traffic. Under each traffic level, there will be post-treatment performance models for preventive maintenance, light rehabilitation, medium rehabilitation, and heavy rehabilitation. Within each of these categories, the following post-treatment performance models are to be analyzed: shallow rutting, deep rutting, failures, block cracking, alligator cracking, longitudinal cracking, transverse cracking, patching, and ride score models.

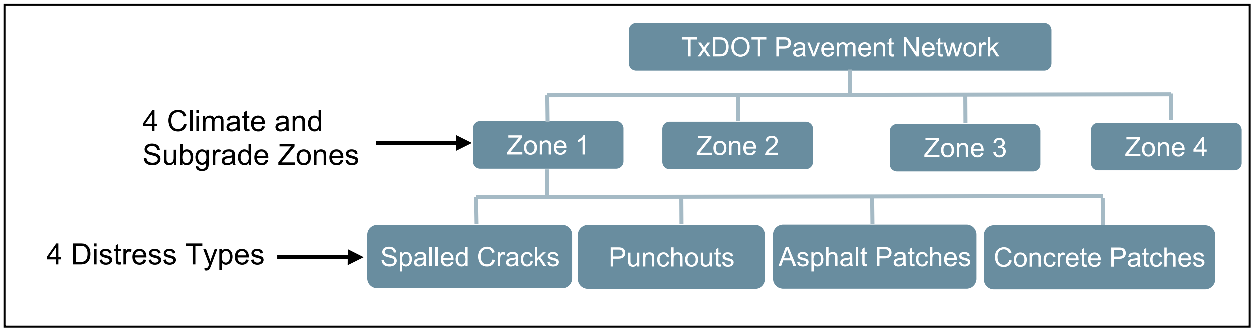
Figure 1: Illustration of Groupings of ACP Performance Models (Source: TxDOT, 2012)



4.2.2 Performance Prediction for Continuously Reinforced Concrete Pavement

Similarly, continuously reinforced concrete pavements follow the same zone classification as for ACP (Figure 2). CRCP has performance models for spalled cracks, punchouts, asphalt patches, concrete patches, and ride score.

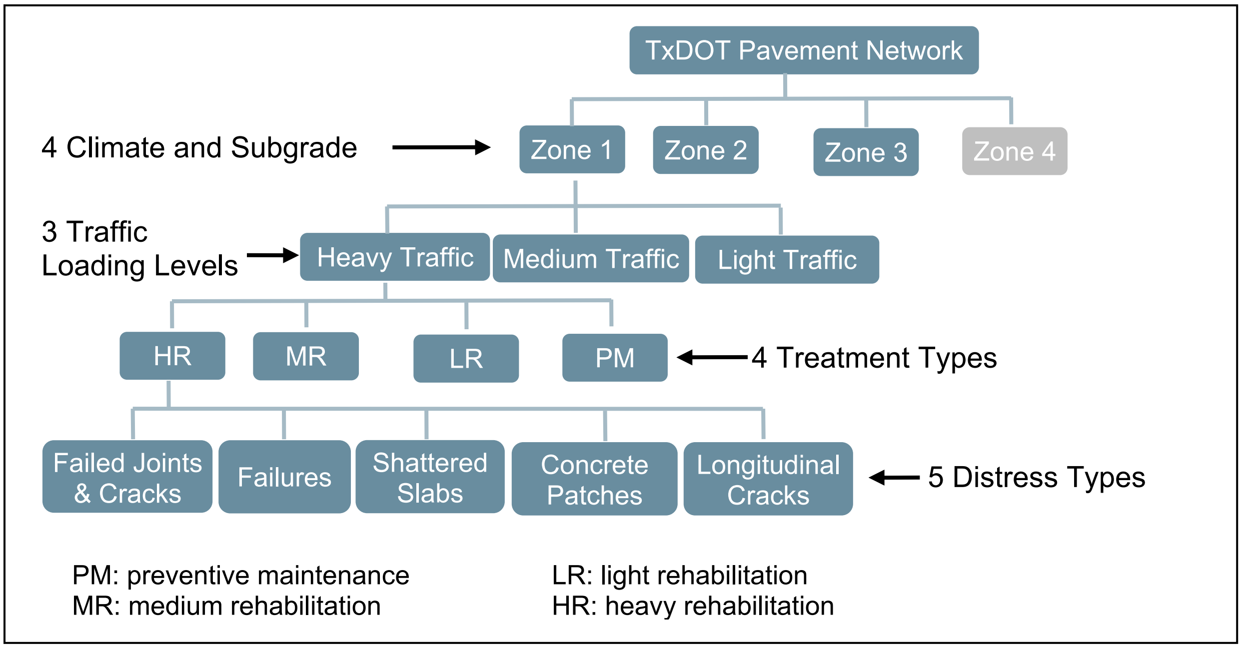
Figure 2: Illustration of Groupings for CRCP Performance Models (Source: TxDOT, 2012)



4.2.3 Performance Prediction for Jointed Concrete Pavement

The same classification of zones is used for jointed concrete pavements (JCP). The only difference is that currently there is no JCP in Zone 4 (TxDOT, 2012). Following the same traffic level classification and treatment categories as those for ACP, post-treatment performance models were developed for each treatment category at each traffic level and in each zone. These post-treatment performance models include failed joints and cracks, failures, shattered slabs, concrete patches, longitudinal cracks, and ride score models.

Figure 3: Illustration of Groupings for JCP Performance Models (Source: TxDOT, 2012)



For detailed performance models of these three types of pavement, please refer to the report: *FHWA/TX-12/0-6386-3 Evaluation and Development of Pavement Scores, Performance Models and Needs Estimates*.

4.3 Identifying Investments

The performance models discussed in Section 4.2 will be used to predict pavement conditions. Based on the predicted conditions, decision trees in TxDOT PMIS can be applied to identify pavement treatments.

4.3.1 Asphalt Concrete Pavement Decision Tree

ACP treatments are identified based on ride quality and pavement distresses, including failures, alligator cracking, block cracking, longitudinal cracking, transverse cracking, patching, deep rutting, and shallow rutting. Tables 1–3 present treatments based on each distress for different traffic levels. In the tables, treatments are identified based on one distress or ride quality range. Therefore, a section may have several different distresses, but the trigger will be based on the distress that generates the highest needs estimate suggestion.

Table 1: Needs Estimate Trigger Criteria for ADT from 0 to 99

Distress	Needs Estimate Suggestion				
	NN	PM	LR	MR	HR
Ride Score	-	-	-	-	-
Failures	0	1 to 2	3 to 4	5 to 7	8 or more
Alligator Cracking	0% to 2%	3% to 24%	25% to 49%	50% to 79%	≥80%
Block Cracking	0% to 7%	8% to 15%	16% to 23%	24% to 29%	≥30%
Longitudinal Cracking	0' to 50'	51' to 125'	126' to 175'	≥176'	NA
Transverse Cracking	0 to 4	5 to 6	7 to 8	≥9	NA
Patching	0% to 7%	8% to 41%	42% to 54%	55% to 84%	≥85%
Deep Rutting	0% to 6%	7% to 8%	9% to 10%	11% to 12%	≥13%
Shallow Rutting	0% to 7%	8% to 11%	12% to 15%	≥16%	NA

Notes:
HR: heavy rehabilitation
LR: light rehabilitation
MR: medium rehabilitation
NN: need nothing
PM: preventive maintenance

Table 2: Needs Estimate Trigger Criteria for ADT from 100 to 999

Distress	Needs Estimate Suggestion				
	NN	PM	LR	MR	HR
Ride Score	-	-	-	-	0.1 to 1.5
Failures	0	1	2	3	4 or more
Alligator Cracking	0% to 2%	3% to 19%	20% to 44%	45% to 59%	≥60%
Block Cracking	0% to 7%	8% to 15%	16% to 23%	24% to 29%	≥30%
Longitudinal Cracking	0' to 50'	51' to 100'	101' to 150'	151' to 200'	≥201'
Transverse Cracking	0 to 3	4 to 6	7 to 8	≥9	NA
Patching	0% to 7%	8% to 31%	32% to 44%	45% to 74%	≥75%
Deep Rutting	0% to 6%	7% to 8%	9% to 10%	11% to 12%	≥13%
Shallow Rutting	0% to 7%	8% to 11%	12% to 15%	16% to 18%	≥19%

Notes:
HR: heavy rehabilitation
LR: light rehabilitation
MR: medium rehabilitation
NN: need nothing
PM: preventive maintenance

Table 3: Needs Estimate Trigger Criteria for ADT from 1000 to 4999

Distress	Needs Estimate Suggestion				
	NN	PM	LR	MR	HR
Ride Score	-	-	-	-	0.1 to 1.5
Failures	0	1	2	3	4 or more
Alligator Cracking	0% to 2%	3% to 14%	15% to 39%	40% to 54%	≥55%
Block Cracking	0% to 7%	8% to 15%	16% to 19%	20% to 27%	≥28%
Longitudinal Cracking	0' to 25'	25' to 100'	101' to 150'	151' to 200'	≥201'
Transverse Cracking	0 to 2	3 to 6	7	8	≥9
Patching	0% to 3%	3% to 21%	22% to 34%	35% to 64%	≥65%
Deep Rutting	0% to 4%	5% to 8%	9% to 10%	11% to 12%	≥13%
Shallow Rutting	0% to 4%	5% to 9%	10% to 13%	14% to 18%	≥19%

Notes:
HR: heavy rehabilitation
LR: light rehabilitation
MR: medium rehabilitation
NN: need nothing
PM: preventive maintenance

Table 4: Needs Estimate Trigger Criteria for ADT Greater than or Equal to 5000

Distress	Needs Estimate Suggestion				
	NN	PM	LR	MR	HR
Ride Score	-	-	-	-	0.1 to 2.0
Failures	0	1	2	3	4 or more
Alligator Cracking	0% to 2%	3% to 9%	10% to 34%	35% to 49%	≥50%
Block Cracking	0% to 3%	4% to 11%	12% to 19%	20% to 27%	≥28%
Longitudinal Cracking	0' to 24'	25' to 100'	101' to 150'	151' to 175'	≥176'
Transverse Cracking	0 to 2	3 to 4	5 to 6	7 to 8	≥9
Patching	0% to 2%	3% to 11%	12% to 24%	25% to 54%	≥55%
Deep Rutting	0% to 4%	5% to 7%	8% to 9%	10% to 11%	≥12%
Shallow Rutting	0% to 4%	5% to 9%	10% to 13%	14% to 18%	≥19%

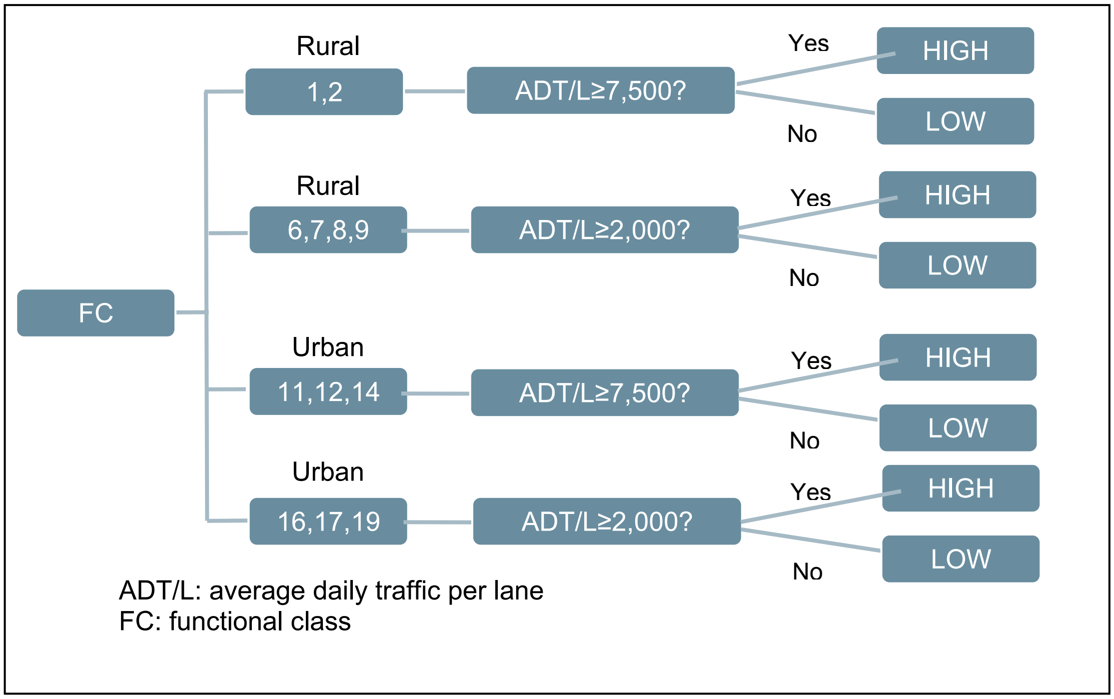
Notes:
HR: heavy rehabilitation
LR: light rehabilitation
MR: medium rehabilitation
NN: need nothing
PM: preventive maintenance

Performance models for ACP in Section 4.2.1 are used to predict pavement conditions during the planning horizon. Then, based on pavement conditions, life-cycle cost analysis and decision tree are applied to find the most cost-effective set of treatments and timings for each pavement section during the planning horizon to maintain the pavement in good condition while minimizing the life-cycle cost.

4.3.2 Continuously Reinforced Concrete Pavement

CRPC's decision tree has two parts: the Functional Classification and the ADT level classified as High or Low (Figure 4).

Figure 4: Functional Classification ADT High/Low Decision Tree (TxDOT, 2012)



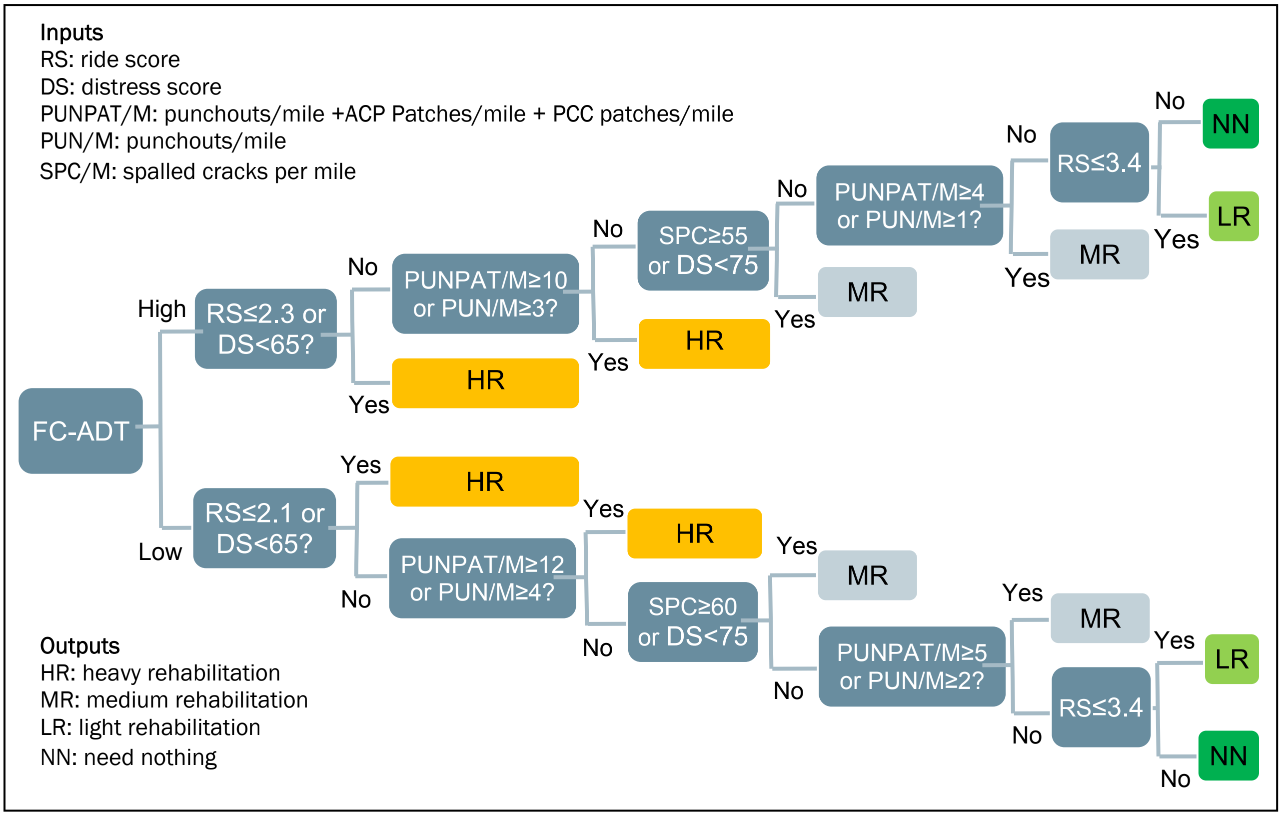
Notes:

Functional Classes:

Rural:	Urban:
1 = Interstate	11 = Principal Arterial (Interstate)
2 = Principal Arterial	12 = Principal Arterial (Other Freeway)
6 = Minor Arterial	14 = Principal Arterial (Other)
7 = Major Collector	16 = Minor Arterial
8 = Minor Collector	17 = Collector
9 = Local	19 = Local

For treatment identification, there are four levels of treatments: Need Nothing (NN), Light Rehabilitation (LR), Medium Rehabilitation (MR), and Heavy Rehabilitation (HR). Based on the condition and traffic levels, treatments can be identified using the decision tree displayed in Figure 5.

Figure 5: Pavement Needs Estimation Tree (Source: TxDOT, 2012)

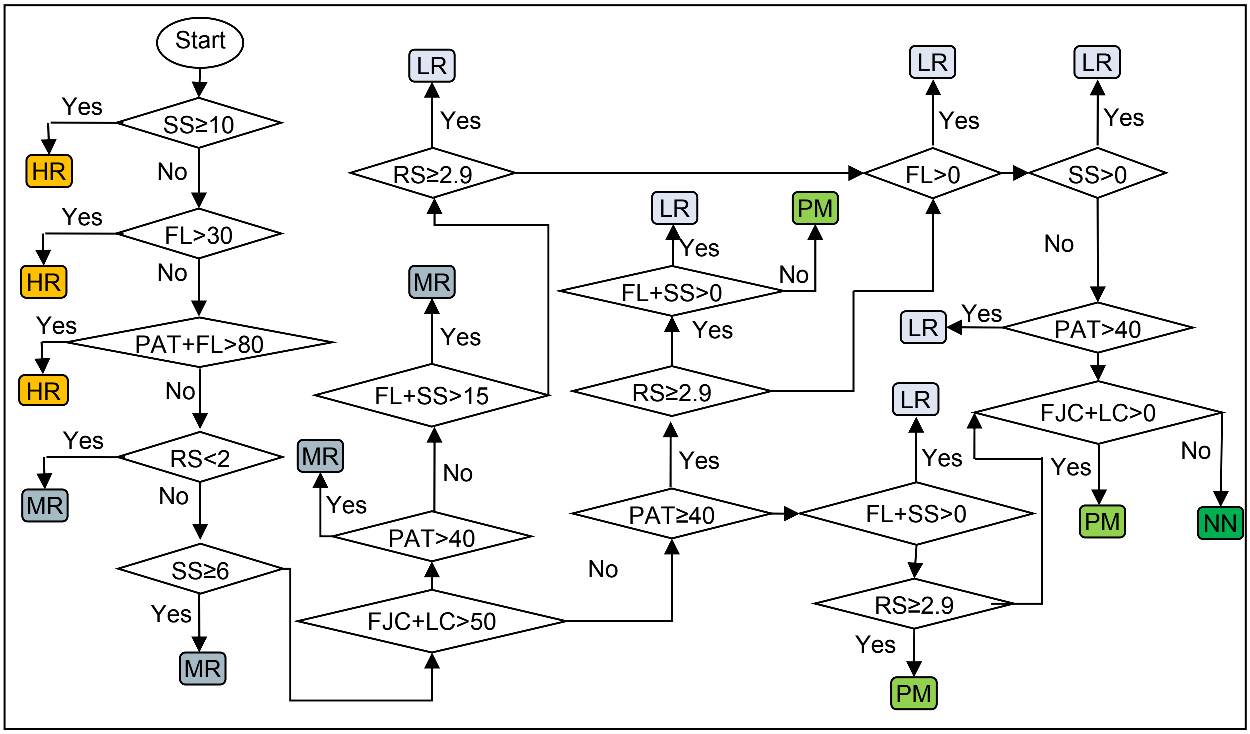


Performance models in Section 4.2.2 are used to predict pavement conditions during the planning horizon. Based on the pavement conditions, using life-cycle cost analysis and the decision tree presented in Figure 5, the set of treatments and timings for each pavement section during the planning horizon can be identified.

4.3.3 Joint Concrete Pavement

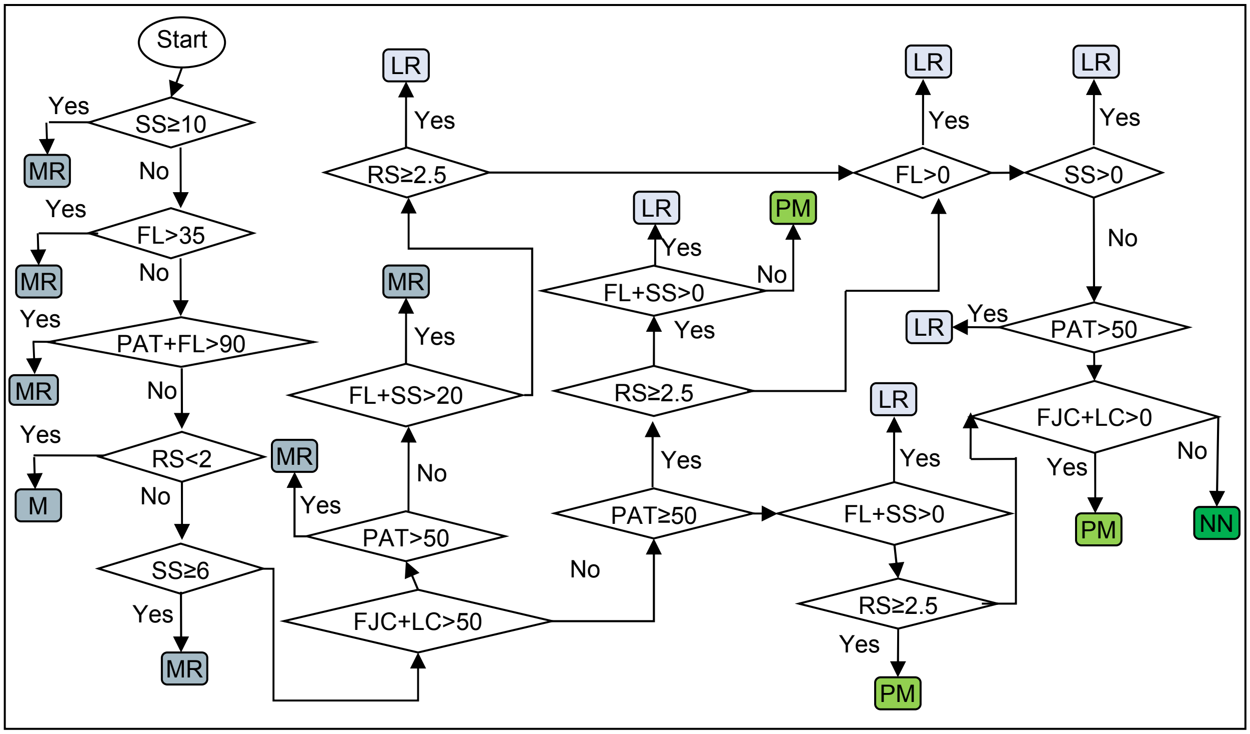
Similarly, a decision tree is used to identify treatments for each JCP section based on traffic levels and pavement conditions. Figures 6 and 7 present the decision trees for high traffic JCP and low traffic JCP, respectively. The determination of traffic levels are presented in Table 5.

Figure 6: High Traffic JCP Decision Tree for JCP (Source: TxDOT, 2012)



Notes:
FJC: failed joints & cracks, %failed
FL: failures, number/mile
PAT: concrete patches, number/mile
RS: ride score
SS: shattered slabs, % slabs

Figure 7: Low Traffic JCP Decision Tree for JCP (Source: TxDOT, 2012)



Notes:
FJC: failed joints & cracks, %failed
FL: failures, number/mile
PAT: concrete patches, number/mile
RS: ride score
SS: shattered slabs, % slabs

Table 5: Decision Tree for Traffic Levels (Source: TxDOT, 2012)

Functional Class		Traffic Level	
Area	Functional Class Code	High	Low
Rural	1,2	ADT/L >=7,500	ADT/L < 7,500
	6	ADT/L >=3,000	ADT/L < 3,000
	7,8,9	ADT/L >=2,000	ADT/L < 2,000
Urban	11,12,14	ADT/L >=7,500	ADT/L < 7,500
	16	ADT/L >=3,000	ADT/L < 3,000
	17,19	ADT/L >=2,000	ADT/L < 2,000

Note:
ADT/L: average daily traffic per lane

Performance models for JCP in Section 4.2.3 are used to predict pavement conditions (i.e., distresses and ride score) during the planning horizon. Then, based on pavement conditions, life-cycle cost analysis and decision tree are applied to find the most cost-effective set of treatments and timings for each pavement section during the planning horizon to maintain the pavement in good condition while minimizing the life-cycle cost.

4.4 Evaluating Alternatives

Pavement needs assessment can be conducted both at the project- and network-levels. At the project level, decision trees are used to identify treatments for each pavement section based on predicted pavement condition. However, during the planning horizon, there could be several possible combinations of treatments and timings. Life-cycle cost analysis is applied to identify the optimal set of treatments and corresponding timings that can minimize the life-cycle cost of the pavements while maintaining the pavement sections in good condition. The sum of all the pavement section needs represent the unconstrained pavement needs for the entire network.

At the network-level, when the predicted revenue is not enough to cover all the unconstrained needs, financially-constrained analysis may need to be conducted. In this process, a large number of investment alternatives are available. The prioritization/optimization techniques are adopted to identify the alternative that can optimize the pavement performance using the limited budget. Due to the uncertainty of future funding levels, scenarios for a range of budgets will be analyzed in order to compare potential tradeoffs.

4.5 Assessing "Needs" and Financial Constraints

Unconstrained needs refer to the pavement treatments required to avoid having pavement sections in a poor state-of-repair during the planning horizon. Through a bottom-up approach, the cost of treatments recommended over the planning horizon will be combined to assess network needs.

Financially-constrained analysis represents the best performance outcome that can be achieved with funding less than the unconstrained needs total. As part of this process, the Consultant Team will consider expected pavement performance outcomes for a range of budgets given findings from the revenue forecasting task team and potential allocation strategies. For each scenario, the projects will be identified to maximize system performance given an overall budget [which can be broken down by National Highway System (NHS) and Non-NHS].

Best practices for financially-constrained analysis is to apply prioritization/ optimization principles. This is done by scoring projects based on a set of performance measures; for example, metrics could be the Pavement Condition Score (PCS) and IRI. For each candidate project, a generalized utility is used to measure the benefit of its implementation on a normalized scale. The utility is calculated as:

*Total Utility = w_1 * [(condition score after the project implementation) - (condition score before the project implementation)-)] * AADT * lane-miles + w_2 * [(normalized IRI after the project implementation) - (normalized IRI before the project implementation)-)] * AADT * lane-miles*

Since Pavement Condition Score and IRI have difference scales (Condition Score: 1-100; IRI: 1-950), IRI is normalized to 1 to 100 in the above equation where 100 represents the lowest IRI and 1 represents the highest IRI. w_1 and w_2 are weights of Pavement Condition Score and IRI, respectively. Since the Pavement Condition Score is the main performance measure currently used by TxDOT and already incorporates pavement ride quality, w_1=0.8 and w_2=0.2 are suggested in the above equation. In addition, the above equation incorporates annual average daily traffic (AADT) to make sure the pavement sections with higher traffic volumes have higher priority for programming. Based on the utility for each project, the benefit/cost ratio can be calculated as:

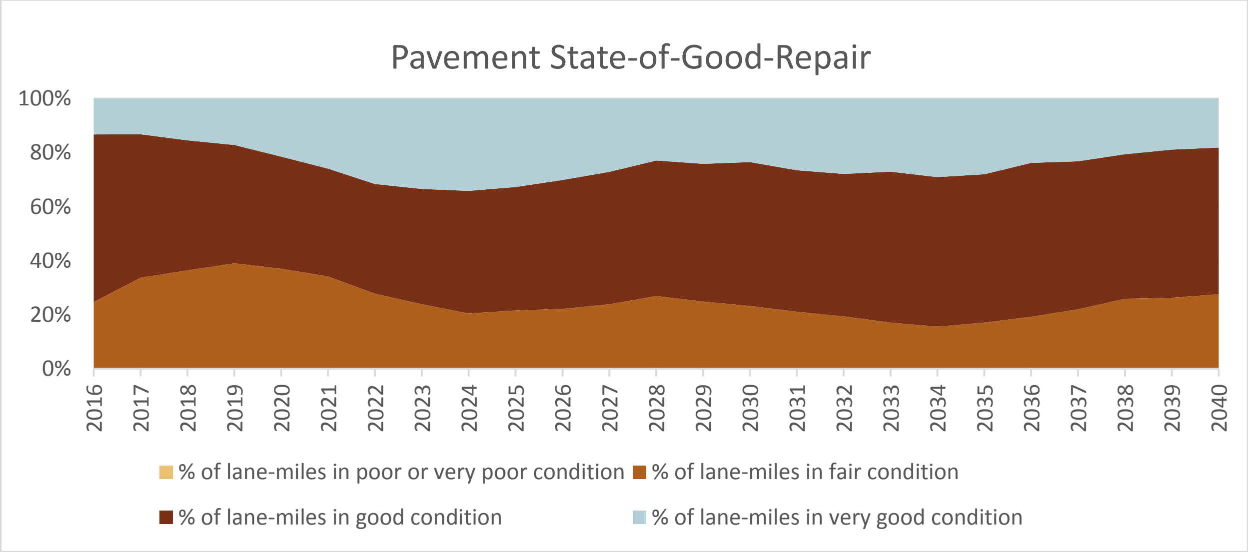
Benefit/Cost Ratio = Total Utility / Project Cost

The benefit/cost ratio can be used to prioritize candidate projects to provide a general overview of the importance of each project. Then, optimization techniques, i.e., integer programming, will be used to select projects that maximize the total utility of all projects under available budget. In the optimization, performance target can be set to make sure the target can be met. In addition, to avoid very poor or very rough pavements, the pavements with very poor or very rough condition will have a higher programming priority.

For both unconstrained and financially-constrained needs, the following outputs will be provided:

- Pavement treatments, timings, and costs for each pavement section over the planning horizon
- Total investment needs/costs in dollars by function class, by pavement type, by district, and by county
- Pavement State-of-Good-Repair (Figure 8) based on Pavement Condition Score and IRI over the planning horizon by function class, by pavement type, by district, and by county.

Figure 8: Illustration of Pavement State-of-Good-Repair over Planning Horizon



Texas Transportation Plan

Tech Memo 3.2: Bridge/Culvert

January 15, 2014

Acknowledgements

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Contents

Tables

Figures

1.0 Introduction

An understanding of future system needs is critical for effective transportation planning. Using data-driven techniques to predict future highway/bridge performance, potential peaks in preservation expenditures can be anticipated and communicated to stakeholders in time to solicit essential revenue sources. In supporting the long-range Texas Transportation Plan (TTP), this technical memo describes best practices (also consistent with MAP-21) for analyzing financially-unconstrained needs and assessing financially-constrained scenarios for state-controlled bridges and NBI-length culverts including structures on the National Highway System (NHS), Texas trunk system, and Interstate system. This work will be conducted in Task for of the TTP.

The memo is organized into four sections:

1. Scope of Bridge Analysis
    a. Types of Investment
    b. Reviewed TxDOT Structural Publications
2. Data Collection
    a. Data Availability and Sources
    b. Gaps in Data and Recommendations
3. Needs Determination
    a. Defining "Need"
    b. Predicting Performance
    c. Identifying Investments
    d. Evaluating Alternatives
    e. Assessing "Needs"
4. Financially-Constrained Scenarios
    a. Project Prioritization
    b. Optimizing Performance

2.0 Scope of Analysis

The following subsections provide a summary of the types of financial need, or investment, considered in the analysis and the scope of services included for consideration in the TTP.

2.1 Types of Investment

Bridge/culvert investments in existing infrastructure can most generally be classified as maintenance and repair, painting, rehabilitation, improvement, structure replacement, emergency, and other (Table 1).

Table 1: Pontis Work Item Groupings

Action Group	Work Items
Maintenance and Repair	Routine/preventive maintenance, minor element repair, major element repair
Painting	Zone/partial paint, replace paint system
Rehabilitation	Element rehabilitation, overlay deck/slab, replace element, replace superstructure
Improvement	Widen structure, raise structure, strengthen structure, scour remediation, fatigue remediation, seismic retrofit
Structure Replacement	Remove structure, replace structure
Emergency	Temporary cribbing
Other	Various

The decision of when to apply these investments can be based on a combination of asset age and performance. Texas preservation policy is to cyclically apply routine/preventive maintenance, conduct reactive maintenance upon emergency, and to plan for rehabilitation, improvement, and replacement activities based on asset performance.

2.2 Reviewed TxDOT Structural Publications

Bridge/culvert information management at the TxDOT is conducted by the Bridge Division. This division supports the planning, design, review, construction, and inspection of over 50,000 structures – about 89 percent more than any other state.

As part of agency efforts, various publications are readily available for consultants/contractors. The following documentation was obtained/reviewed by the CH2M HILL-led team prior to developing the proposed unconstrained needs methodology (txdot.gov):

- Annual Bridge Facts (2008 through 2012)
- Annual Bridge Unit Costs (2009 through 2011)
- Construction and Maintenance
  - Asbestos Management on TxDOT Bridge Projects, Bridge Division Workshop: Bridge Deck Workshop, Bridge Division Workshop: Drilled Shaft Inspectors Workshop, Guidelines for Handling Asbestos, Header Type Bridge Joints, Precast Concrete Stay-in-Place Forms for Bridge Decks, Saw-Cutting Grooves on Bridge Decks, Shop Plan Contacts, Underwater Drilled Shaft Construction – Geotech, Welding Certifications
- Design
  - Design Example for Two Drilled Shaft Footing Using Strut-and-Tie Method, Design Example for Elastomeric Bearings for Prestressed Concrete Beams, Design Software Programs, Detailing Guide, Pile Type Selection – Geotech, Prestressed Concrete I-Beams Distribution Factor Spreadsheet, Prestressed Concrete U-Beams Distribution Factor Spreadsheet, Quality Assurance/Quality Control Guide, Recommended Beam Spacings, Recommended Span Lengths for Double-T Beams, Recommended Span Lengths for I-Girders, Recommended Span Lengths for Slab Beams, Recommended Span Lengths for Load and Resistance Factor Design (LRFD), Box Beams, Rectangular Reinforced Concrete Caps, Shear Design Spreadsheets, Steel Bridge Design Preferred Practices
- Geotechnical Resources
  - Approved Concrete Block Retaining Wall Systems, Approved Mechanically Stabilized Earth (MSE) Panel Systems, Drilled Shaft Design Examples, Loss of Backfill in Mechanically Stabilized Earth, MSE Wall Design Example, Piling Design Examples, Proprietary Retaining Wall System Review, Spread-Footing Wall Design Example, Tied-Back Wall Design Examples, Texas Secondary Evaluation and Analysis for Scour (TSEAS)

- Inspection
  - Critical Inspection Finding Report, Coding Guide
- Biannual Report on Texas Bridges (2002 through 2012)
- Substructure/Superstructure Design Examples and Spreadsheets
- Texas Bridge Underclearance
- Bridge Geometry System (BGS) User's Guide, Version 9 (Draft)

Additionally, the Consultant Team reviewed the 2013 Unified Transportation Program (UTP), 2035 Statewide Long-Range Transportation Plan (SLRTP), 2030 Committee Report – *It's About Time: Investing in Transportation to Keep Texas Economically Competitive*, Bridge Inspection Manual, Bridge Performance Measure Determination file, Bridge Project Development Manual, the 2011 Texas Transportation Institute Study – Framework for a Comprehensive Bridge Management and Information Systems (BMIS), and various Metropolitan Transportation Plans (MTPs).

3.0 Data Collection

3.1 Data Availability and Sources

Given the size and complexity of information collected on Texas structures, a series of subsystems make up the Texas Bridge Management Information System (Figure 1):

- Design and Construction Information System
- Maintenance Management Information System
- Bridge Inventory, Inspection, and Appraisal System
- PonTex
- Pontis
- Financial Information Management System
- Texas Permit Routing Optimization System

Using these systems, TxDOT maintains histories of maintenance activities, bridge component (deck, superstructure, substructure) and element (AASHTO Core Elements) conditions, cost data, and geographic locators. Due to technical difficulties in obtaining access to core element data, the focus of the analysis team has been to compile component bridge inspection ratings.

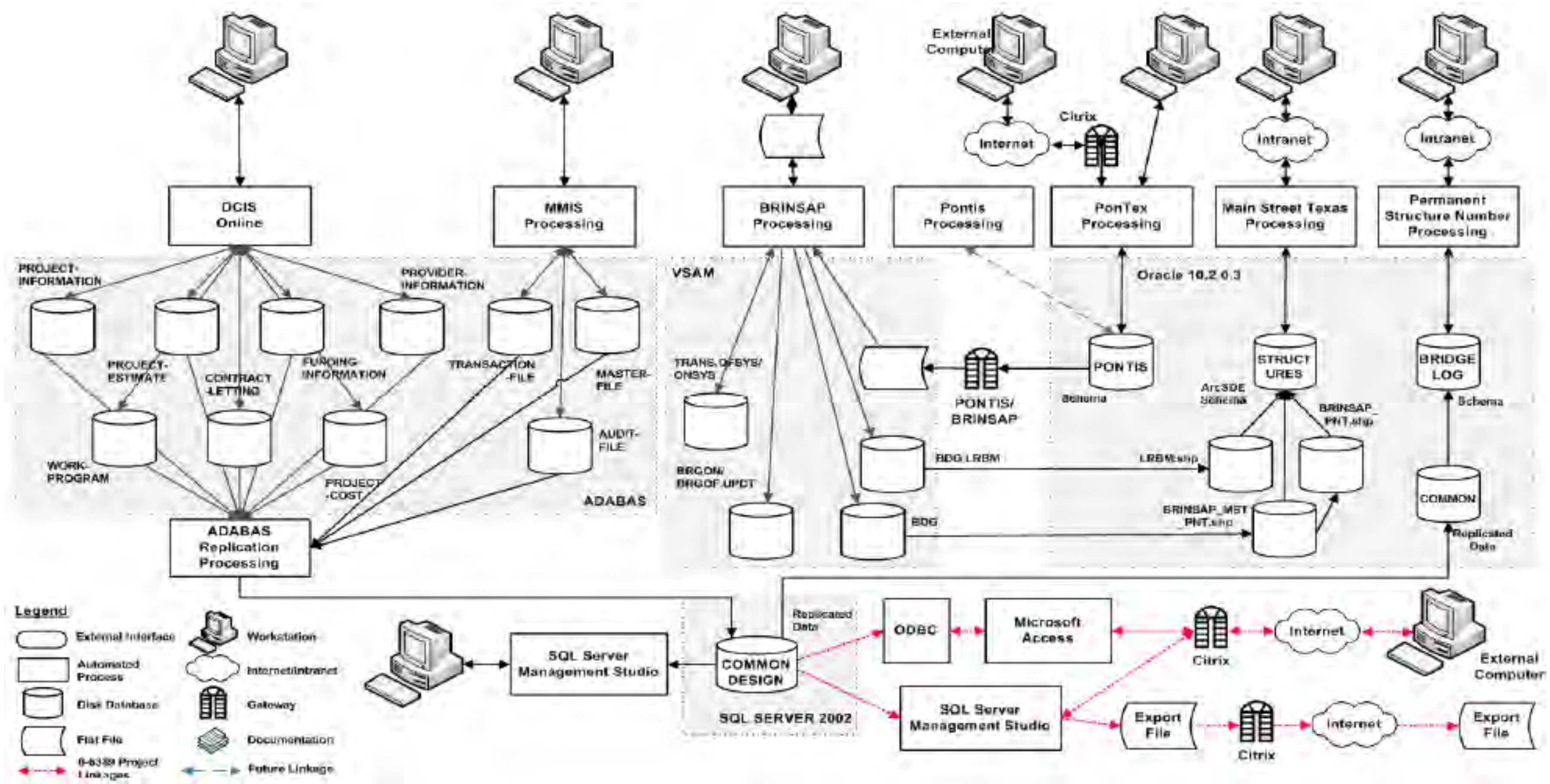
Component ratings for bridges and culverts greater than 20 feet in length are stored both in the Texas BMIS and are reported annually (with a slight reduction in data fields) in the National Bridge Inventory (NBI). The CH2M HILL-led team has put in a data request to obtain recent and historical bridge inspection and cost data but in the meantime have compiled historical bridge data between 1992 and 2012 for Texas from the NBI.

As part of NBI reporting, the following structural condition ratings are available for analysis:

- Condition ratings for the deck, superstructure, substructure, scour, and channel/channel protection
- Additional ratings for deck geometry, structural evaluation, inventory, and sufficiency
- Structurally deficient and functionally obsolete status.

In addition to preservation data, operational data on traffic volumes have been obtained from the T-Log and RHiNO systems to support widening/expansion decisions. Aggregated average maintenance/repair cost values have also been obtained from the TxDOT annual Bridge Unit Cost publication series.

Figure 1: Bridge-Related Systems at TxDOT



(Quiroga, Weissmann, Koncz, Le, Li, & Wimsatt, 2011)

3.2 Gaps in Data and Recommendations

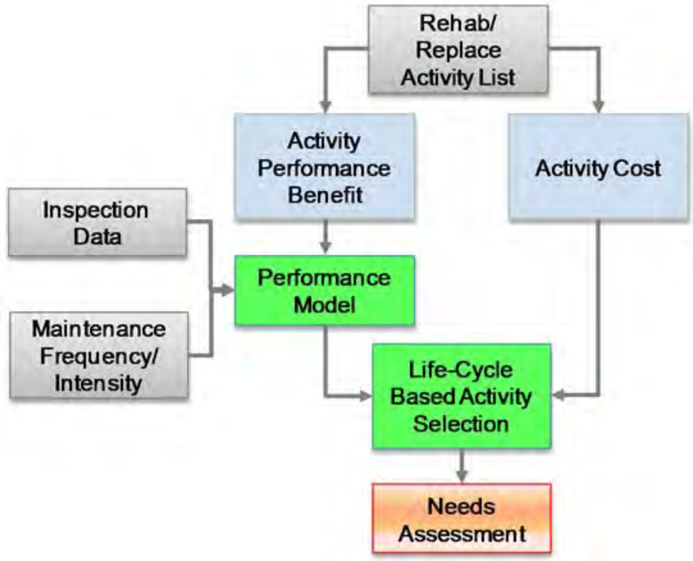
As the analysis team waits for the bridge data request to be fulfilled by TxDOT, anticipated gaps in information include:

- Access to Core Element Data – This data is not necessary to assess planning level needs, but would support a more precise needs assessment total, particularly for validating short-term project selections.
- Additional Cost Data – The bridge unit costs obtained from TxDOT publications are highly aggregated and does not provide a breakdown by work item or major repair/replacement activity. Should the Financial Information Management System have additional details, a more accurate needs number may be reached through the Coonsultant Team's analysis.
- Historical Repairs – In order to estimate the effectiveness of major repairs and maintenance strategies, historical records can be used to supplement assumptions made in the following section. With sufficient repair records, deterioration models could be more accurately calibrated for bridges with varying maintenance strategies.

4.0 Needs Determination

To make sense of varying TxDOT information sources, the Texas Transportation Institute (TTI) – in a 2011 study funded by the Federal Highway Administration (FHWA) and TxDOT – has recommended a comprehensive framework based on the principles proposed in National Cooperative Highway Research Program (NCHRP) Report 590. A similar methodology is proposed herein via the framework in Figure 2. This process serves as the basis of CH2M HILL's Transportation Asset Management (TAM) Tools, which are proposed to be used to automate the needs assessment.

Figure 2: Proposed Unconstrained Needs Assessment Methodology



By defining what performance is “needed”, a data-driven approach that predicts performance for varying maintenance intensities, economically evaluates repair/replacement activities, and aggregates cost-effective projects across the network can be used to assess long-term unconstrained needs. The following subsections provide a high-level summary of the methods proposed to estimate system needs for the TTP.

4.1 Defining “Needs”

The unconstrained needs for bridges and culverts (greater than 20 feet in length) is defined as the anticipated amount of dollars required to avoid having structurally deficient structures (a MAP-21 performance measure for the NHS) on state-controlled structures. In addition to these needs, considerations for reducing functionally obsolete and sub-standard for load structures will be determined at the time of repair/replacement activities. In Texas, the state-of-good-repair (SGR) is then defined as having a system of bridges/culverts that are not:

Structurally Deficient = either having a deck/superstructure/substructure/culvert condition rating of 4 or less or a structural evaluation/waterway adequacy rating less than 2

Functionally Obsolete = either having a structural evaluation/waterway adequacy/deck geometry/underclearances/approach roadway alignment of 3 or less

Sub-standard for load = designed load carrying capacity less than state legal load.

To help track bridge performance, the MAP-21 consistent measures in Table 2 have been identified by TxDOT for monitoring performance on the NHS (Interstate and non-Interstate). These measures indicate thresholds for when maintenance activities of varying intensity are called for, which are then added to repair/replacement system needs.

Table 2: TxDOT Bridge Performance Measures and Descriptions

Measure(s)	Description
Percent Structurally Deficient Deck Area on NHS and non-NHS	Percent of system deck area that have structures deemed Structurally Deficient
Count of Bridges and Percent Deck Area with Cyclic Maintenance Needs	Number of structures and deck area of structures with a deck/superstructure/substructure/or culvert rating of 7 or higher
Count of Bridges and Percent Deck Area with Preventative Maintenance Needs	Number of structures and deck area of structures with a deck/superstructure/substructure/or culvert rating of 5 or 6
Count of Bridges and Percent Deck Area with Rehabilitation or Replacement Needs	Number of structures and deck area of structures with a deck/superstructure/substructure/or culvert rating of 4 or less

From provided file “TxDOT Bridge Performance Measure Determination”

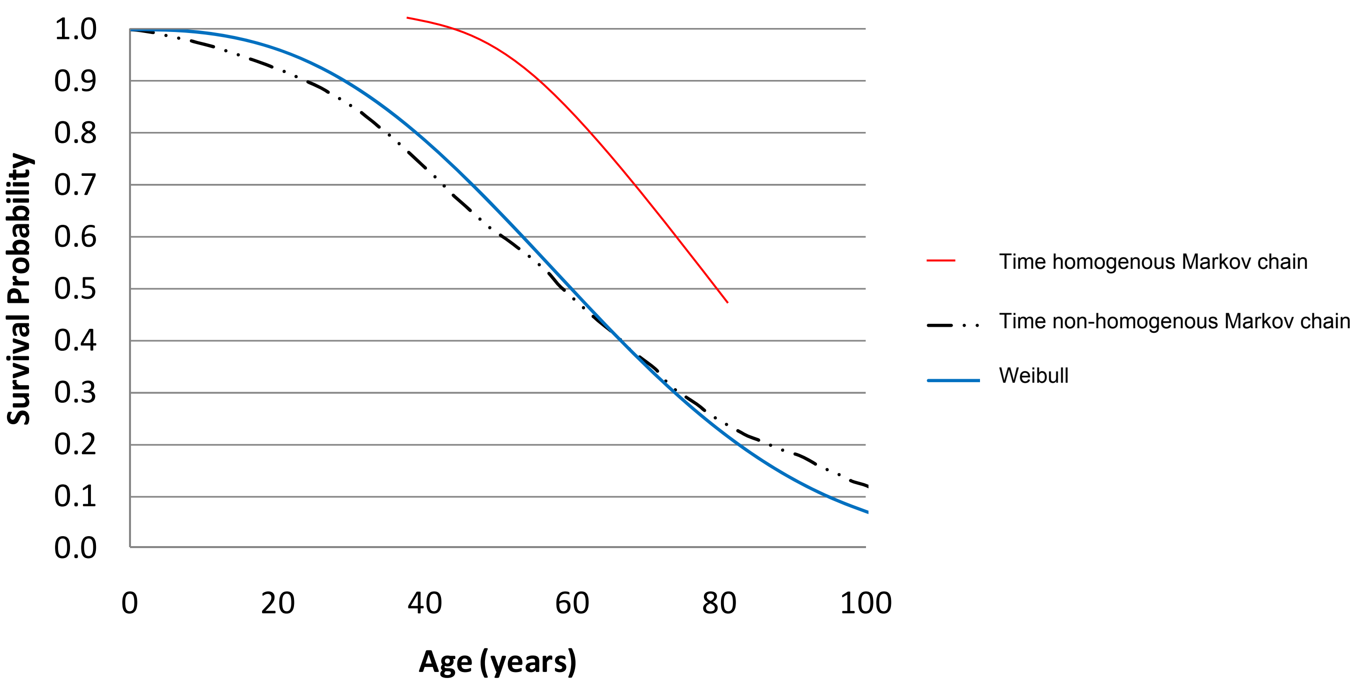
4.2 *Predicting Performance*

To aid long-term analysis, structural performance and traffic forecast models can be calibrated to predict future conditions.

4.2.1 Structural Performance Modeling

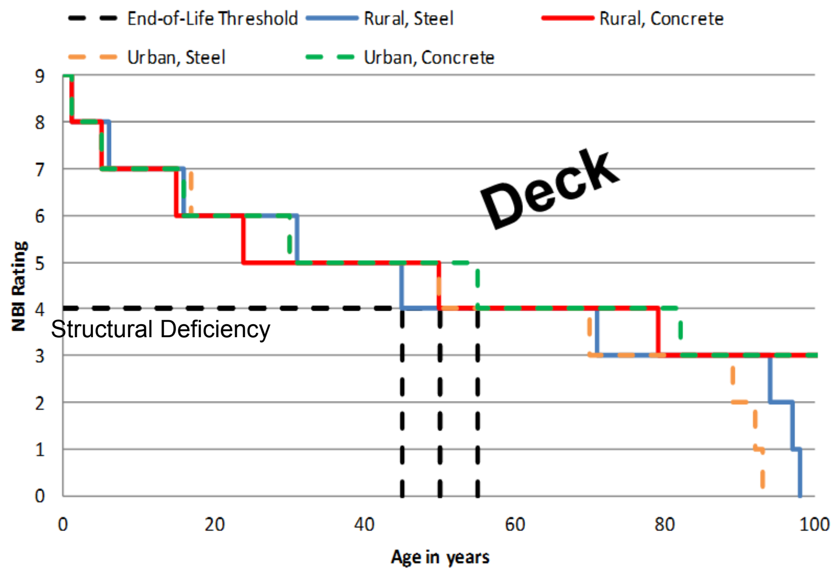
Consistent with TTI recommendations, Markovian analysis is a common technique for projecting bridge/culvert condition ratings. An advancement to the TTI approach, however, is the use of time-non-homogenous (deterioration rates allowed to vary with time) Markov chains; these models are representative of the Weibull functional form assumed in Pontis v5.2 (Figure 3).

Figure 3: Comparison of Bridge Deterioration Models



Markov chains are built by linking deterioration rates over time. These rates can be observed or regressed against explanatory variables based on historical inspections. Often referred to as transition probabilities, the deterioration rates represent the probability of transitioning from one condition state to the next given the age and initial condition rating of the asset. As these probabilities are multiplied over time, the likelihood of being in any condition state at any point in time can be approximated; the most likely condition rating at every point in time is used to build the average performance curve starting from the age and condition rating at the time of the most recent bridge inspection (Figure 4).

Figure 4: Example Time Non-homogenous Markov Chains for Existing Bridge Decks



Group	Estimate
Rural, Steel	45 yrs
Rural, Concrete	50 yrs
Urban, Steel	50 yrs
Urban, Concrete	55 yrs

The Concultant Team proposes to generate these average performance curves (scaled to expert opinion as necessary) for a variety of asset groupings based on the following:

- Existing/new construction status (if components built after 2010, then an assumed "life" of 100 years – far beyond the planning horizon of 2040 – is assumed until structural deficiency)
- Steel/concrete material type (predominant superstructure material for bridges)
- Urban/rural geographic setting
- Deck/super/sub/culvert component
- Non-NHS, NHS Non-Interstate, NHS Interstate functional classifications

Additional groupings of assets for modeling purpose are to be explored by the Consultant Team pending a sufficient number of historical observations.

4.2.2 Traffic Forecasts

Alongside structural condition ratings, traffic volumes are essential for evaluating the sufficiency of bridge/culvert assets. Estimates of average daily traffic volumes are used to estimate the deck geometry rating (traffic levels compared against bridge width) and structural evaluation rating (traffic levels compared against bridge inventory rating, in conjunction with component condition ratings).

As part of NBI reporting, recent and forecasted traffic volumes are included on each bridge asset. Additionally, traffic volumes are available in the TxDOT RHiNO file with forecasts in the T-Log. Further supplementing traffic volumes is the SAM-v3 model that can be used to estimate the grow traffic counts by adding the forecasted change in traffic volumes between an existing model run and future scenario model runs.

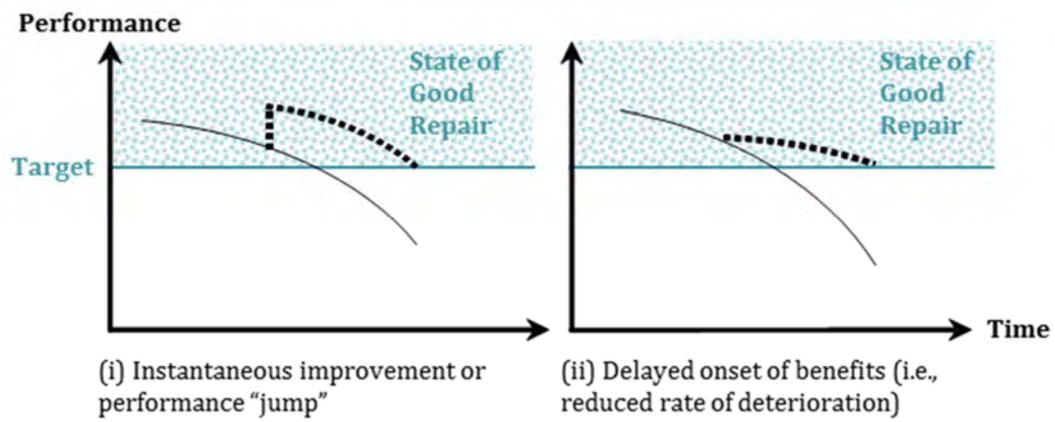
The Consultant Team will start by interpolating recent and forecasted traffic volumes in the NBI assuming exponential growth. These volumes will be validated against the remaining data sources and may be alternatively used, so as to determine if widening widening activities may be required for a bridge/culvert structure.

4.3 Identifying Investments

In preserving bridge and culvert assets, a combination of cyclical maintenance activities and performance-based repair/replacement activities are to be evaluated by the analysis team. Cost and performance impact assumptions corresponding to each activity will be used to build the unconstrained needs.

Performance impacts resulting from an activity can result in an instantaneous improvement in performance and/or a reduced rate of deterioration (Figure 5). The Markovian models will be used to quantify the effectiveness of such activities.

Figure 5: Activity Performance Benefits



In the following sections, assumptions of programmable activity benefits and costs are detailed based on past project experience and expert judgment for making more applicable for Texas. Opportunities for updating benefit and cost assumptions will be pursued through contact with bridge/culvert leads within TxDOT.

4.3.1 Bridge Activities

With the desire to minimize expenditures across the life-cycle of bridge assets, a focus is placed on routinely applying preventive/minor corrective maintenance activities. Given the importance of including both routine and life-extending preservation, the activities in Table 3 are recommended to be included in determining TxDOT network needs. These more minor activities are expected to reduce the rate of bridge deterioration.

Table 3: Bridge Maintenance Activities

Work Item	Proposed Frequency	Cost
Deck & Substructure Flushing/Washing	1 year	Rural: $0.50/SF Urban: $0.65/SF
Deck Surface Patching	2 years	Rural: $0.25/SF Urban: $0.30/SF
Deck Structural Repairs	10 years	Rural: $6.50/SF Urban: $8.00/SF
Barrier Repair	10 years	Rural: $1.00/SF Urban: $1.25/SF
Spot Joint Sealing/Repair	15 years	Rural: $6.50/SF Urban: $8.00/SF
Deck Thin Overlay – Epoxy/Asphalt*	15 years	Rural: $9.50/SF Urban: $12.00/SF
Spot Joint Replacement*	15 years	Rural: $6.50/SF Urban: $8.00/SF
Spot Bearing Repair*	15 years	Rural: $3.75/SF Urban: $4.75/SF
Spot Bearing Replacement*	10 years	Rural: $9.00/SF Urban: $11.00/SF
Spot Repaint Steel Beams *	15 years	Rural: $9.50/SF Urban: $12.00/SF

Notes:
Cost data assumptions based on past project expereinece and expert opinon; cost data and assumptions will be updated with TxDOT feedback for Task 4 analysis

*As a result of the more intensive maintenance activities (cycles to start once a Deck condition rating of 6 is reached), a 5-year extension of time until the superstructure or substructure becomes structurally deficient is expected with an additional 15 years for the bridge deck.

**In the case of new construction, a more aggregated assumption is made given uncertainty in maintenance needs: Years 0 – 10: Rural – $0.40/SF; Urban – $0.50/SF; Years 11 – 25: Rural – $0.95/SF; Urban – $1.20/SF; Years 26+: Rural – $2.95/SF; Urban – $3.70/SF

For both a reduced rate of deterioration and an immediate jump in performance, a set of major repair/replacement activities are to be evaluated based on predicted condition ratings. These activities are to be evaluated in various combinations, each representing a package of multiple work items, described as follows:

- **Superstructure Rehabilitation** – This Activity is composed of work items Beam End Repair and Fracture Critical Member Repairs (intended to cover other miscellaneous repairs for non-fracture critical steel and concrete bridges).
- **Substructure Rehabilitation** – This Activity is composed of work items Bearing Repair, Bearing Replacement, and Substructure Repair.
- **Deck Structural Overlay** – This Activity is composed of work items Deck Structural Overlay and Joint Replacement (joint replacement @ 50%, assumed not all joints replaced).

- **Deck Replacement** – This Activity is composed of work items Deck Replacement, Barrier Replacement, and Joint Replacement.
- **Superstructure Replacement** – This Activity is considered a single work item.
- **Bridge Replacement** – This Activity is the complete replacement (deck, superstructure, and substructure) of the existing bridge in kind.

As a result of these activity packages, an immediate “jump” in performance is expected along with a reduced rate of deterioration. The performance benefits or jumps assumed for the analysis are listed in Table 4.

Table 4: Bridge Repair/Replacement Activity Benefits

Activity	Benefit (Improvement in NBI condition rating)
Superstructure Rehabilitation	Super: + 1
Substructure Rehabilitation	Sub: + 2
Superstructure and Substructure Rehabilitations	Super: + 1; Sub: + 2
Deck Structural Overlay	Deck: + 2
Superstructure Rehabilitation & Deck Structural Overlay	Deck: + 2; Super: + 1
Substructure Rehabilitation & Deck Structural Overlay	Deck: + 2; Sub: + 2
Superstructure and Substructure Rehabilitations & Deck Structural Overlay	Deck: + 2; Super: + 1; Sub: + 2
Deck Replacement & Superstructure and Substructure Rehabilitations	Deck: + 9; Super: + 1; Sub: + 2
Superstructure Replacement and Substructure Rehabilitation	Deck: + 9; Super: + 9; Sub: + 2
Bridge Replacement	Deck: + 9; Super: + 9; Sub: + 9

Notes:
Condition improvement assumptions based on past project experience and expert opinion; assumptions will be updated with TxDOT feedback for Task 4 analysis

*For steel structures, a full painting add-on option will be included as an alternative for activities involving a superstructure rehabilitation; generally it is assumed that a full painting will add 30 years until structural deficiency of the superstructure when combined with a rehabilitation.

**For posted structures deemed sub-standard for load, a one-time strengthening work item (+50% cost) will be added to the superstructure rehabilitation.

***For functionally obsolete structures due to an insufficient deck geometry rating (assumed rating of 4 or less), widening (+50% cost) is to be added on top of any replacement activity.

****For functionally obsolete structures due to an insufficient underclearance (assumed rating of 3 or less), raising (+20%) will be added to any rehabilitation/replacement activity.

The benefits of applying these more major repair/replacement activities are to be economically weighed against the corresponding cost estimate. Cost estimates and assumptions to be used in evaluating repair/replacement activities are listed in Table 5. These costs with built-in contingency dollars have been compiled based on past experience and are subject to validation with the TxDOT average unit cost report and any additional cost information available from TxDOT's Financial Information Management System. For specific activities, costs can be determined based on scope of work and structure size – so as to reflect economy-of-scale savings, which can be interpolated.

Table 5: Bridge Repair/Replacement Activity Costs

Scope of Work Code	Construction Cost per SF of Smallest Structure	Construction Cost per SF of Largest Structure	Smallest Structure (in Thousand SF)	Largest Structure (in Thousand SF)
Deck				
Rehab (Minor)	Rural: $65/SF Urban: $80/SF	Rural: $45/SF Urban: $55/SF	5	20
Rehab (Major)*	Rural: $65/SF Urban: $80/SF	Rural: $45/SF Urban: $55/SF	5	20
Replacement	Rural: $100/SF Urban: $130/SF	Rural: $70/SF Urban: $90/SF	2	15
Superstructure				
Rehab (Minor)	Rural: $50/SF Urban: $65/SF	Rural: $40/SF Urban: $50/SF	3	15
Rehab (Major)*	Rural: $70/SF Urban: $90/SF	Rural: $50/SF Urban: $65/SF	3	15
Replacement	Rural: $115/SF Urban: $145/SF	Rural: $70/SF Urban: $90/SF	0.7	15
Substructure				
Rehab (Minor)	Rural: $75/SF Urban: $95/SF	Rural: $50/SF Urban: $65/SF	1	15
Rehab (Major)*	Rural: $125/SF Urban: $160/SF	Rural: $75/SF Urban: $95/SF	1	15
Replacement	Rural: $225/SF Urban: $285/SF	Rural: $115/SF Urban: $145/SF	0.7	15
Painting				
Full Paint	Rural: $60/SF Urban: $75/SF	Rural: $45/SF Urban: $55/SF	3	20
Roadway Factor				
Replace	2.5	1.75	1.5	15
Rehabilitation	1.9	1.3	1.5	15

Notes:

Cost data assumptions based on past project experience and expert opinion; cost data and assumptions will be updated with TxDOT feedback for Task 4 analysis

*The major scope of work is presumed to be required for all assets at or above 60 years of age

**Rehabilitation costs are assumed to double when correcting for structural deficiency

***Additional costs are to be estimated as a percentage of construction cost: Rehabilitation Design – 30%; Replacement Design – 27%; Mobilization – 5%; Right-of-Way – 25% (for total bridge replacement projects only); Utilities – 2% (for total bridge replacement projects only); Roadway Factor – varies 130% to 250% as shown in table.

4.3.2 Culvert Activities

Similar to bridge activities, maintenance items to grow needs for traffic-carrying culverts greater than 20 feet are listed in Table 6.

Table 6: Culvert Maintenance Activities

Work Item	Proposed Frequency	Cost
Culvert Flushing/Washing	1 year	Rural: $0.50/SF Urban: $0.65/SF
Roadway Surface Patching	2 years	Rural: $0.25/SF Urban: $0.30/SF
Culvert Structural Repairs	10 years	Rural: $6.50/SF Urban: $8.00/SF
Barrier Repair	10 years	Rural: $1.00/SF Urban: $1.25/SF
Joint Sealing/Repair	15 years	Rural: $6.50/SF Urban: $8.00/SF
Roadway Thin Overlay – Epoxy/Asphalt*	15 years	Rural: $9.50/SF Urban: $12.00/SF
Joint Replacement*	15 years	Rural: $6.50/SF Urban: $8.00/SF
Scour Protection*	15 years	Rural: $3.75/SF Urban: $4.75/SF
Spot Repaint Steel Frame *	15 years	Rural: $9.50/SF Urban: $12.00/SF

Notes:
Cost data assumptions based on past project experience and expert opinion; cost data and assumptions will be updated with TxDOT feedback for Task 4 analysis

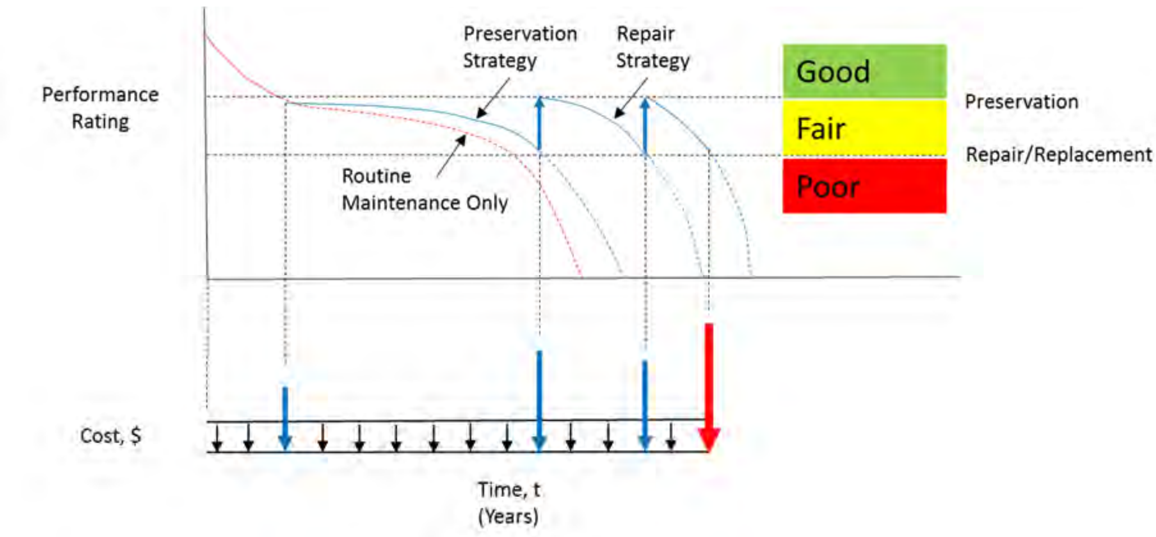
*As a result of the more intensive maintenance activities (cycles to start once a Culvert condition rating of 6 is reached) a 15-year extension until structurally deficient

With fewer primary components, major activities for culverts are considered to be either a rehabilitation or replacement activity. For this more limited activity set, performance jumps in the culvert condition rating are considered to be +1 for the rehabilitation activity and +9 for the replacement activity. Costs for rehabilitations are assumed to be $1,250 per linear foot of length and replacements are assumed to be $5,000 per linear foot of length.

4.4 *Evaluating Alternatives*

With routine/preventive maintenance costs to be compiled on a cyclical basis throughout the 30-year planning horizon, major repair/replacement activities are to be evaluated on the basis of life-cycle cost. As shown in Figure 6, cash flow diagrams can be linked to performance profiles over time.

Figure 6: Activity Timings and Life-Cycle Cost Analysis (LCCA)



By evaluating all feasible repair/replacement activities – considered 5 years prior to predicted structural deficiency – and a do-nothing option, alternative profiles can be compared using a life-cycle cost metric (e.g., benefit-cost ratio, equivalent uniform annualized cost, net present value). The profile that minimizes life-cycle cost is then recommended for each asset.

Feasibility of applying activities is determined based on the following assumptions:

- Repair/replacement activity must improve dominating component (i.e., component expected to become structurally deficient first).
- Replacement activities of major structures (over 100,000 SF) are considered impractical.
- Bridges or culverts with a NBI rating of 3 or less are presumed to be beyond cost-effective repair and must be replaced.
- Painting activity is only applicable for steel structures that have never been painted or had a full painting occurring more than 30 years ago.
- One-time strengthening activity is to be required with superstructure rehabilitation activities for sub-standard for load structures (bridge posting rating of 4 or less).
- One-time widening is to be included with any replacement activity for structures with insufficient capacity (deck geometry rating of 4 or less).
- One-time raising/lowering is to be included with any repair/replacement activity for structures with inadequate underclearance (underclearance rating of 3 or less).

Under these assumptions, the selection of activities will be further validated by comparing recommended projects to those listed in Texas Metropolitan Transportation Plans and the Unified Transportation Plan.

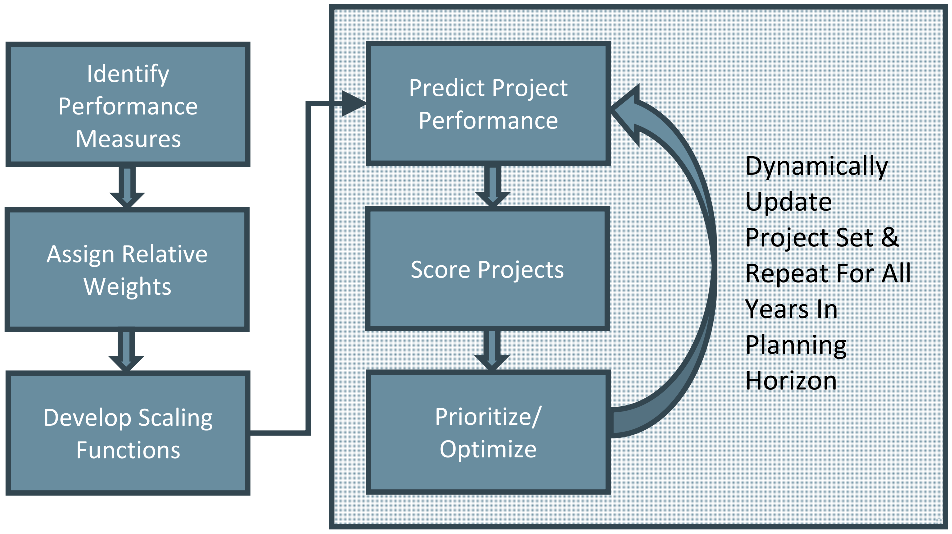
4.4.1 Assessing "Needs"

With a set of maintenance and repair/replacement activities, corresponding activity costs and benefits, data-driven predictive models, and application of life-cycle cost analysis, the final unconstrained needs is then the sum of the most cost-effective activity profiles for all state-controlled bridge and culvert assets. This "bottom-up" approach will support MAP-21 requirements and estimation and monitoring of performance measures identified by TxDOT. The ultimate needs total is to be validated by TxDOT staff and reevaluated for evolving assumptions and considerations of contingency.

5.0 Financially-Constrained scenarios

Recognizing that the anticipated revenues may not be sufficient to address all projects identified in the unconstrained analysis, a financially-constrained methodology is proposed herein (Figure 7).

Figure 7: Proposed Financially-Constrained Analysis Methodology



Note: CH2M HILL proposed methodology for TxDOT TTP

With various needs and priorities across the state, decision-makers must weigh multiple objectives when selecting projects. To help guide this typically subjective process, the CH2M HILL-led team proposes a more transparent, performance-based framework that identifies a baseline set of projects. Through this more quantitative approach, a repeated process for assessing performance tradeoffs can be utilized to inform stakeholder decisions.

5.1 Project Prioritization

In order to compare diverse projects and performance measures, decision science techniques can be used to score bridge/culvert projects. For instance, it is recommended that TxDOT consider prioritizing projects based on both a reactive (worst-first) and a proactive (opportunity for savings) basis. By addressing threats (represented by the structural evaluation rating) and opportunities (represented by life-cycle cost savings), TxDOT can link risk management processes to project programming. Comparisons between these dissimilar metrics can be done by normalizing the performance values on a common scale. A common approach, consistent with the Pontis v5.2 software and AASHTO TAM Guide recommendations, is to use utility scaling [typically on a 0 (worst) to 100 (best) scale] – where utility represents a unitless measure that is consistent with decision-maker preference for various outcome levels (Figure 8).

Figure 8: Utility Scaling Functions

By combining weights and scaled performance values, a score representative of agency preferences can be obtained:

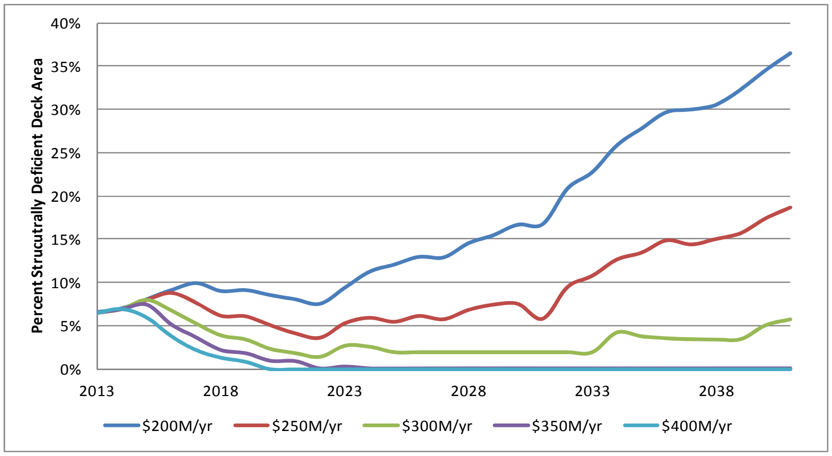
$$Score = Weight_1 * (Utility\ After\ Project_1 - Utility\ Before\ Project_1) +$$
$$Weight_2 * (Utility\ After\ Project_2 - Utility\ Before\ Project_2)$$

An initial ranking of projects can then be reviewed, with iterative changes to weights and scaling functions so as to more closely reflect intended agency preferences and priorities.

5.2 *Optimizing Performance*

Once a prioritized list has been developed, mathematical optimization can be applied to develop a draft set of projects that maximize system performance (represented by the program score) given financial constraints. This process can be readily replicated for any budget level, allowing for the assessment of statewide performance tradeoffs (Figure 9). Such curves can additionally aid short- and long-term performance target setting.

Figure 9: Example Linkage Between System Performance and Investment Level



As a result of the constrained methodology, the analysis team will be able to identify a draft set of prioritized bridge/culvert projects, an understanding of performance tradeoffs relative to investment level, and realistic targets that may be achieved at the expected funding level.

Texas Transportation Plan

Tech Memo 3.3: Transit and Passenger Rail

January 15, 2014

Acknowledgements

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- Appendix A: Texas Transit Agency List
- Appendix B: Data Needs and Sources
- Appendix C: Initial Vehicle Price List
- Appendix D: Acronyms and Abbreviations

1.0 Introduction

This Technical Memorandum for Transit and Intercity Bus (Tech Memo #3: Transit Analysis Methodology) addresses the methodology to be employed to determine the long-term investment needs for transit systems in Texas in Task 4 of the TTP. The methodology described below is based on the Federal Transit Administration's (FTA's) national-level approach for transit condition and performance reporting, which contributes to the biennial Congressional Conditions and Performance Report and National State of Good Repair (SGR) Assessment. This methodology is also consistent with FTA's expected requirements for transit systems under MAP-21. (A list of abbreviations and acronyms is included as Appendix D.)

Both transit and intercity bus services are referred to collectively as "transit services" throughout the memo. The memo is organized into three sections:

1. Scope of Transit Analysis
    a. Type of Investment
    b. Transit Services Included
2. Transit Needs Determination
    a. Current Inventory Data and Conditions
    b. Financial Assumptions
    c. Estimation of Preservation and Service Expansion Needs
    d. Major New Service Project Collection
    e. Constrained Funding Scenarios
3. Investment Prioritization for Transit
    a. Prioritization Routine
    b. SGR Backlog Impacts

The methodology for Passenger Rail mode is also included in the Memo (Section 2.2.2).

2.0 Scope of Transit Analysis

The following sections provide a summary of the types of financial need, or investment, considered in the transit analysis and the scope of transit services included for consideration in the Texas Transportation Plan (TTP).

2.1 Types of Investment

Investment needs are divided into their intended usage categories in this study. The financial needs related to these investments include both capital and operating costs. These usage categories include:

1. **Preservation:** the capital reinvestment required to maintain existing assets in a state of good repair (SGR). Reinvestment needs include rehabilitation and replacement of transit assets, as

well as annual capital maintenance (ACM) needs. Preservation also includes the cost of operation and maintenance (O&M) of existing assets for current service levels.

2. **Service expansion:** the capital investments and O&M costs for projected growth in service levels based on projected growth in ridership. Service expansion includes fleet expansion and related facility expansion in response to growth in population and underlying demand. It does not include the addition of services into new geographic areas or addition of new modes of transit.
3. **Major new service:** the capital investments and related O&M costs to significantly improve transit performance via enhancements to core capacity or extension of services into new areas or modes.

2.2 Transit Services Included

There are more than 70 transit agencies operating in Texas, with most agencies providing multiple modes of service under varying contractual arrangements. Given the complexity and breadth of services offered, it is critical to define which transit and intercity bus services are included for consideration in the TTP. The following sections detail both the services which are included in the scope of this analysis and also how those services are categorized for the purposes of reporting.

2.2.1 Modes Included in Analysis

All transit modes will be included in the TTP analysis. The transit modes currently operating in Texas, as reported to the National Transit Database (NTD) are:

- Commuter rail
- Light rail, which includes street car operations
- Hybrid light rail
- Commuter bus, which includes some intercity bus services
- Motor bus
- Demand response, which includes demand response taxi services
- Ferry boat
- Vanpool

There are also intercity bus services operated by private operators, such as Greyhound, who do not report to NTD. These services often share multimodal transfer hubs with local bus operators, and their services have also benefited from public funding in the past via FTA's Over-the-Road Bus Grants program. While their private fleet assets are not considered as part of the transit analysis, any shared public facilities or assets with public investment will be included. TxDOT will provide accounting from PTMS or other grant information to determine which intercity bus investments to include.

In addition to the modes listed above, the transit and intercity bus task includes analysis of system-wide assets. These are assets that are not linked to a specific mode but exist to support the operations of an entire agency. Examples of system-wide assets include administrative buildings and communications equipment, such as phones and network cabling.

Inventory, conditions, and investment needs will be reported by mode, as well as by service provider (as seen in Section 2.2.4).

2.2.2 Passenger Rail Methodology

It is important to distinguish between commuter rail services and passenger rail services, as the methodology for assessing needs is different for these intercity modes. Commuter rail services are a transit rail mode, which are administered or operated by transit agencies, and are regulated, defined, and funded by the FTA. These systems must also comply with Federal Rail Administration (FRA) regulations. Transit rail services are included in the methodology described in this memo (no heavy rail services are reported for Texas so they do not appear in the transit modes listed above).

Passenger rail services are operated by providers such as Amtrak, which are also regulated and partially funded by the FRA. However, these services do not report to the FTA as transit services. Passenger rail services are also intercity, so tend to be longer distance. These services are included for consideration in a separate sub-task with projections based on the Texas Rail Plan (TRP).

Expansion plans for intercity rail are currently produced and updated on a regular basis for successive editions of the TRP. Rather than trying to reproduce that work as a parallel effort, intercity rail investment and operating cost needs for the TTP will therefore be obtained from the most recent version of the TRP, but limited to those sections of the plan that address intercity passenger needs (freight needs are addressed in a different methodology document). The intercity passenger rail plan of the TRP is currently being updated by a consultant team that supports TRP. The intercity passenger rail component of the TTP will be based on that update. This approach has been confirmed with the TxDOT Passenger Rail Division staff.

2.2.3 Services Included in Analysis

Transit operators can be grouped into two different categories for the purposes of project funding: agencies that receive funding directly from the FTA for capital and operating expenses, and agencies that are sub-recipients of funding through TxDOT. Sub-recipients tend to be small urban or rural transit providers, while direct recipients are larger urban operators. For the purposes of the TTP, all agencies are included, though the focus of the analysis will be on TxDOT sub-recipients.

Transit services are also divided between two categories: directly operated (DO) services and contracted services (PT). Both types of service are reported to NTD for the purposes of tracking service levels and assets. Both types of service also require capital investments and O&M expenditures. However, capital investments in PT services are harder for agencies to determine, as contractors often include the cost of capital in operating contracts. Both types of service will be included in the TTP analysis, though needs related to PT services may be less detailed than those related to DO services.

Appendix A lists all of the agencies, modes and service types which are considered “in scope” for the TTP under transit and intercity bus services.

2.2.4 Grouping of Service Providers for Reporting

There are 25 Metropolitan Planning Organizations (MPOs) in Texas, each of which has developed a long-term plan for transportation projects in their area called either a Metropolitan Transportation Plan (MTP) or a Regional Transportation Plan (RTP). As noted below in Section 3.2.1, the MTPs serve as a data source for Major New Service projects and a sense check on the analysis of Service Expansion and Preservation investments. Most of the agencies engaged in MPOs are either large Metropolitan Transit Authorities (MTAs) or smaller urbanized system providers, both of which are funded under §5307 by the FTA.

There are also 38 rural agencies that provide transportation in nonurbanized areas of Texas. In several cases these rural agencies also provide limited service in urbanized areas, and receive FTA §5307 funds from the local designated recipient (as a contractor or direct recipient). Additionally, in other cases the rural transit district also serves as an urban transit district, and may be a direct recipient of FTA §5307 funds. In order to report on the needs and condition of transit assets, these rural operators have been grouped as nonurbanized providers, funded under §5311.

There is also separate FTA funding for the Seniors and Individuals with Disabilities Program (§5310). Any size operator can provide §5310 services, so this group will be reported separately from the size categories listed above.

The grouping of individual agencies is shown in Appendix A. While the outputs of analysis are grouped for reporting, the detailed data on each agency will be available to TxDOT for purposes of verification and public comment.

3.0 Transit Needs Determination

The following sections provide a high-level summary of the methods used to estimate transit system needs for the TTP. The summary includes:

- Current Inventory Data and Conditions
- Financial Assumptions
- Estimation of Preservation and Service Expansion Needs
- Major New Service Project Collection
- Investment to Address “Urban Collar” Growth
- Constrained Funding Scenarios.

3.1 Current Inventory Data and Conditions

A summary of all the data needs and sources described below is also provided in Appendix B.

3.1.1 Sources of Data

Data on the current inventory of transit assets was gathered from multiple sources, depending on the asset type. Exhibit 1 summarizes how asset types are categorized by the FTA for transit services.

Exhibit 1: FTA Transit Asset Hierarchy

Asset Category	Types of Assets Included
Guideway Elements	• Trackwork defined by – Type of track (curve, tangent, turnout) – Type of attachment (embedded, ballasted, direct fixation) • Guideway structures defined by – Type of structure (underground, at-grade, or elevated) – Type of service (light rail, commuter rail, heavy rail) • Special structures, such as fencing • Bus guideway by type
Facilities	• Buildings defined by – Function (administration, maintenance, etc.) – Building component (if applicable) • Equipment defined by type (maintenance, furniture, IT) • Central Control • Storage Yards • Major Shops
Systems	• Electrification defined by mode • Revenue collection, including in-station and on-board • Communications, including radio and phone systems • Train Control • Utilities, including drainage and HVAC
Stations	• Building by type • Access • Parking by type
Vehicles	• Revenue Vehicles defined by – Mode – Vehicle type (e.g., bus 40 ft hybrid) • Non-Revenue

For revenue vehicles, the initial source of data will be the inventory reported to the NTD in 2012. For rural revenue vehicles, the mode served by each vehicle record was not reported. To complete the data required for analysis (Section 3.3.1 below) the vehicles for rural services were divided into modes based on the reported proportion of services to NTD (in the 2012 Subrecipient Service Data table). This initial fleet inventory will be improved based on Public Transportation Management System (PTMS) inventory data, provided by TxDOT. Improvements will include updated vehicle counts to reflect the most recent data and adjusted useful lives to reflect actual agency practices.

The primary source of data for the remaining asset types was the most recent data reported by agencies to the FTA for use in the Transit Economic Requirements Model (TERM). TERM is used to estimate transit investment needs at the federal level, and is the basis for the Preservation and Service Expansion analysis completed for TxDOT. The inventory contained in TERM was accessed from various sources, including direct agency reporting, previous industry studies, and condition estimates done for the FTA. <u>As with the NTD data, any inventory records provided by TxDOT with more recent or more accurate information will be used to improve the analysis.</u>

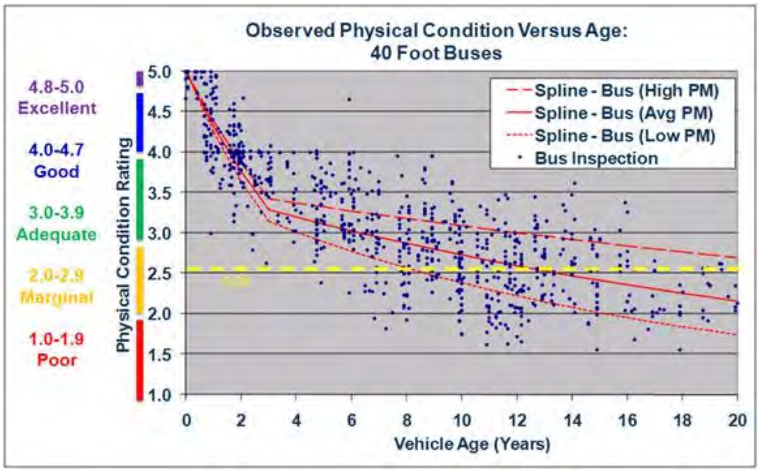
Some of the inventory records in TERM are 'generated' records based on set relationships between vehicle fleets, employees, and supporting infrastructure. For example, there are rural agencies that do not report to NTD in enough detail to determine the inventory for their supporting facilities and systems. In this case, the quantity and cost of furniture, phones, utilities, and others are generated based on an understanding of the quantity of vehicles or staff operating in the system. <u>In order to minimize the impact of generated records on the analysis, any additional data available from TxDOT, either through PTMS or Texas Transportation Institute (TTI), will be used to update the inventory.</u>

3.1.2 Estimation of Current Conditions

The snapshot of current transit services will be presented based on 2012 NTD data and any updates provided by TxDOT.

Condition estimates for the state-wide transit system will be aggregated based on the condition of each asset in the inventory described above as of the start year for analysis, presumably 2013. Asset conditions in TERM are based on FTA's decay curves, which use age as the basis for determining condition. While direct physical evaluation of the condition of an asset provides more accurate condition ratings, this approach is not feasible for a state-wide project such as the TTP. The benefits of using FTA's decay curve approach include:

- Using a common scale for all asset types, such as the FTA's five-point rating scale for all asset types (5=like new/excellent through 1=poor), so wide differences in asset useful life across asset types are addressed by a common scale.
- Decay curves are available for all transit asset types.
- Decay curves predict condition as function of age and include asset utilization and other factors for some assets.



- Accurate and complete asset ages are easier, quicker, and cheaper to collect than on-site condition assessments.
- Decay curves are dynamic as they allow the condition of an asset to be reevaluated each year of analysis.
- Decay curves reflect the actual decay experiences of U.S. transit assets.

The five-point scale for rating transit asset conditions is illustrated in more detail below in Exhibit 2.

Exhibit 2: FTA Condition Rating Scale

Condition	FTA Rating	Description
Excellent	5	• New asset • No visible defects
Good	4	• Asset showing minimal signs of wear • Some (slightly) defective or deteriorated component(s)
Adequate	3	• Asset has reached its mid-life (condition 3.5) • Some moderately defective or deteriorated component(s)
Marginal	2	• Asset reaching or just past the end of its useful life (reached between 2.75 and 2.5) • Increasing number of defective or deteriorated component(s) and increasing maintenance needs
Poor	1	• Asset is past its useful life and is in need of immediate repair or replacement • May have critically damaged component(s)

These condition ratings do not imply that an asset is unfit for service or unsafe, though low ratings may mean that the likelihood of sub-optimal performance is increased (that is, reliability and availability performance may decrease).

3.2 Financial Assumptions

A basic set of financial assumptions is required to estimate capital and O&M costs for transit operations over time. These assumptions include unit replacement costs, life cycle costs, and inflation rates. The assumptions used in this analysis are presented below.

However, these assumptions can be applied with varying degrees of consistency based on the data source. For example, the unit cost to replace vehicles for Preservation or Service Expansion is uniform across the inventory based on TxDOT input. At the same time, projects taken from MTP/RTPs may use different unit costs for vehicles based on regionally specific purchasing agreements or cost profiles. In general, the assumptions below will be applied to the TEX Lite model, described in Section 3.3.1, while individual MPO assumptions will apply to their own MTP/RTP projects.

3.2.1 Unit Costs

Developing and maintaining quality databases for transit asset inventory is very resource intensive. Many transit agencies do not have the resources available to continuously update their inventory with the required level of detail for unit cost reporting. As such, some assumptions have been made to fill in the unit replacement costs of revenue vehicles specific to Texas. The initial "price list" for revenue vehicles, which will be verified by TxDOT based on recent procurements, is attached in Appendix C.

Similarly, generated assets and any asset reported to FTA, PTMS or TTI without an associated cost will rely on default unit cost assumptions. Each asset type included in TERM, and TERM Lite (the individual agency version of TERM federal), has an associated default unit cost. These have been determined through industry studies and previous agency submissions to the FTA. If a unit cost was submitted by an agency to TERM federal, that cost applies.

3.2.2 Cost Inflation

The needs reported for capital and O&M are in year of expenditure dollars (YOE), as per TxDOT requirements for MPOs. In order to inflate current dollars to YOE, an inflation rate of 4% will be used (unless costs reported by planning entity have already been adjusted for inflation). This rate is recommended by TxDOT for long-term planning. However, the largest MPO in the state – Houston Galveston – uses a much lower inflation rate at 2.54%. This means that direct comparison to individual MPO needs will not always be possible. The 4% inflation rate will be applied to Preservation and Service Expansion needs for all agencies. This rate applies to these estimates because asset inventory and ridership are used in TEX Lite to develop estimates, as described below, instead of a list of projects.

However, as some MPOs do not report the inflation rate used in their analysis of Major New Service projects, there is no way to determine the un-inflated (i.e., current dollar) value of those projects. For this reason, a single inflation rate cannot be used for Major New Service projects. The YOE values reported for these projects will be based on whatever inflation rates were used by the individual MPO, which may vary across the state.

3.2.3 Funding Growth

In order to determine the impact of constrained funding on future asset conditions and the backlog, preliminary capital funding scenarios need to be developed. CH2M HILL will coordinate with TxDOT on historic funding levels and potential future funding to generate these preliminary scenarios. More detailed and final funding scenarios will be developed in Task 6.

Carryover of capital budgets from year to year is an option within TEX Lite's budget constraint scenarios. For the purposes of this analysis, it is assumed that transit agencies can carry over capital funds into future years.

3.3 Estimation of Preservation and Service Expansion Needs

While some Texas MPOs have included Preservation and Service Expansion funding in their MTP/RTPs, some have not included these estimates due to expected budget constraints or lack of detail regarding transit expenditures. Therefore, an external model will be used to generate a state-wide unconstrained needs estimate for these two investment types.

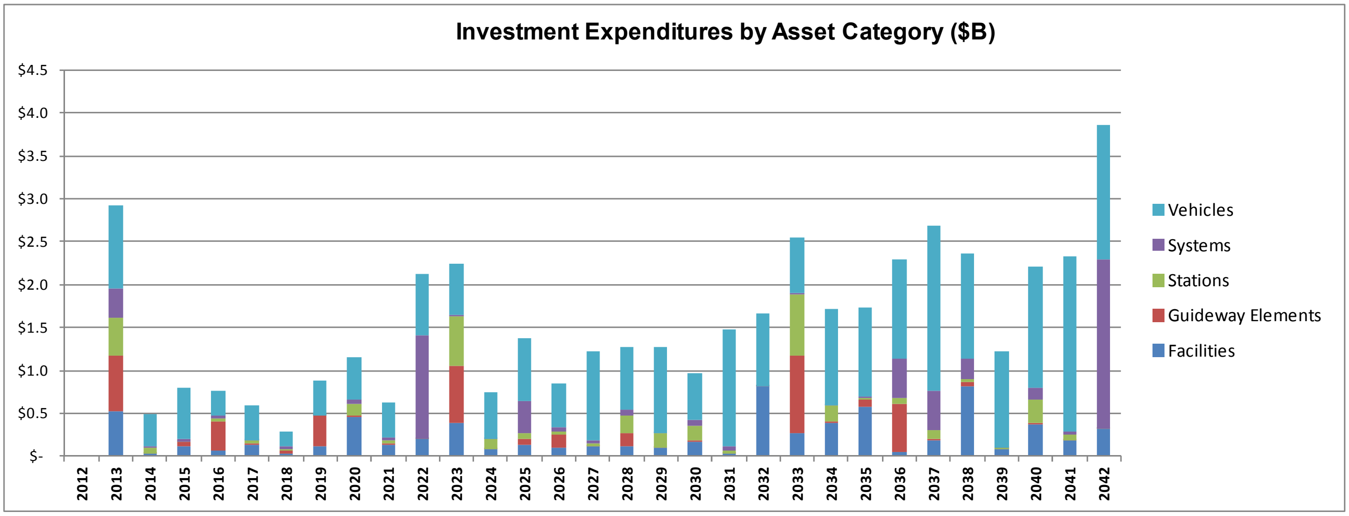
The MTP/RTPs will serve as a 'sense check' on the results of the following methodology. However, as noted above in Section 3.2.2, individual MPOs may be using different inflation rates than those used in this study. Therefore, a one-to-one cost comparison is not appropriate for the purposes of this analysis.

3.3.1 TEX Lite

In order to estimate capital and O&M needs for Preservation and Service Expansion, the most recent version of FTA's TERM Lite was customized to model Texas transit asset needs out to 2040. TEX Lite estimates the total level of reinvestment needed to reach and maintain SGR. For this analysis an asset is in a "state of good repair" if it does not exceed its useful life and does not require rehabilitation (rehab). If no reinvestment action can be taken for an asset that is due for replacement or rehabilitation as a result of budget constraints, that asset will go into the SGR backlog.

To project reinvestment needs TEX Lite determines the age and condition of assets in each year of the projection (that is, from current year to 2040) and uses life cycle profiles to determine if rehabilitation or replacement is needed, and the associated costs. Life cycle profiles are described in more detail below as they are critical to the outputs of the model. Cost inflation is then applied to the costs in each year (4% annually, as recommended by TxDOT). **Exhibit 3** is an example output of TEX Lite which shows the total reinvestment need in each year by category of asset.

Exhibit 3: TEX Lite – Example Investment Expenditures by Asset Category



TEX Lite was customized for TxDOT to include O&M cost modeling based on the same algorithms used in TERM federal. The O&M costs are based on changes in fleet size over time and baseline O&M cost relationships which are defined by mode. As O&M costs are dependent on fleet size in the model, the O&M costs for Preservation and Service Expansion are estimated simultaneously as the fleet grows. However, O&M costs will be reported for existing fleet (Preservation) and expansion fleet (Service Expansion) separately.

TEX Lite's projections of O&M costs may not include many of the 5310 agencies listed in Appendix A, as most of these agencies do not own revenue fleet vehicles to put in inventory. For these agencies an alternative projection method will be developed in collaboration with TxDOT, based on their understanding of 5310 operations and funding.

All investment needs will be estimated initially using an "unconstrained" scenario, where funding is not limited. Under this scenario, the current SGR backlog will be eliminated in the first year of projections because all investment needs can be met with unconstrained funding. It is important to note that this analysis assumes it is possible to eliminate the current deferred maintenance backlog in one year and to reinvest at a rate that continues to keep the backlog at zero. In reality this is not likely to occur as each agency has restricted capacity to access right of way and passenger facilities for the purposes of construction and may not be able to expend the reinvestment capital required in any given year. It is also not realistic to assume that funding will be entirely unconstrained, as described in Section 3.5.

3.3.2 Life Cycle Profile Components

The life cycle of an asset is defined by three components: the useful life, the rehab policy, and the annual capital maintenance needs. The useful life determines when an asset requires replacement and is set in years. If no agency useful life has been provided or cannot be determined from TTI provided inventory, TEX Lite will use default assumptions for each asset type. However, unique environmental features, usage patterns and maintenance regimes can impact the useful life of an asset at a specific agency. If possible, useful lives have been entered for agency records.

Rehab policies are also generally unique to an agency based on their maintenance approach and/or asset management plans. As TEX Lite is being used for state-wide analysis of transit needs, rehab policies must remain generic. The following components have been set to defaults by asset type based on previous FTA research:

- **Number of Rehabs Allowed:** This setting determines the number of rehabs the model will "perform" for each asset type over a full asset life-cycle, with zero (0) to five (5) rehabs per asset as options.
- **Rehab Age:** This setting determines the timing of each rehab as a percent of the asset's useful life (the model will ultimately round this value to a specific age). For example, if an asset is given

a useful life of 20 years, and there is a value of "50%" for one of these rehabs, the tool will assume all assets of this type and useful life will require a rehab at 10 years of age (20 × 0.50).

- **Rehab Cost:** Similarly, this setting determines the cost of each rehab as a percent of the asset's replacement value. For example, if an asset is given a replacement value of $100,000 and there is a value of "25%" for the cost of a rehab, the tool will assume all assets of this type and replacement cost will require a rehab of value $25,000 ($100,000 × 0.25).

Finally, an annual capital maintenance setting greater than zero allows the user to ensure that a small amount of reinvestment occurs for assets of that type every year of the 20-year analysis period. Hence, if the value of an asset is $100,000 and the user enters a value of "0.25%" for annual capital maintenance, TEX Lite will assume all assets of this type and replacement cost will require an annual investment amount of $250 ($100,000 × 0.0025). Annual capital maintenance is intended to help address reinvestment needs that are small on average but recurring in nature.

3.3.3 Ridership Projections

TEX Lite also provides projections of new Service Expansion needs (including fleet vehicles, facilities, and O&M costs) based on ridership growth factors for each mode at each agency. The growth rates are currently based on analysis of historical ridership data reported to the NTD. Specifically, this preliminary analysis focused on growth in unlinked trips for Texas urbanized areas (UZAs) segmented by population size of the urbanized area and mode (**Exhibit 4**). If growth rates were negative according to NTD data, the model assumes flat ridership (0% growth) for calculations. These growth rates are intended for preliminary analysis only.

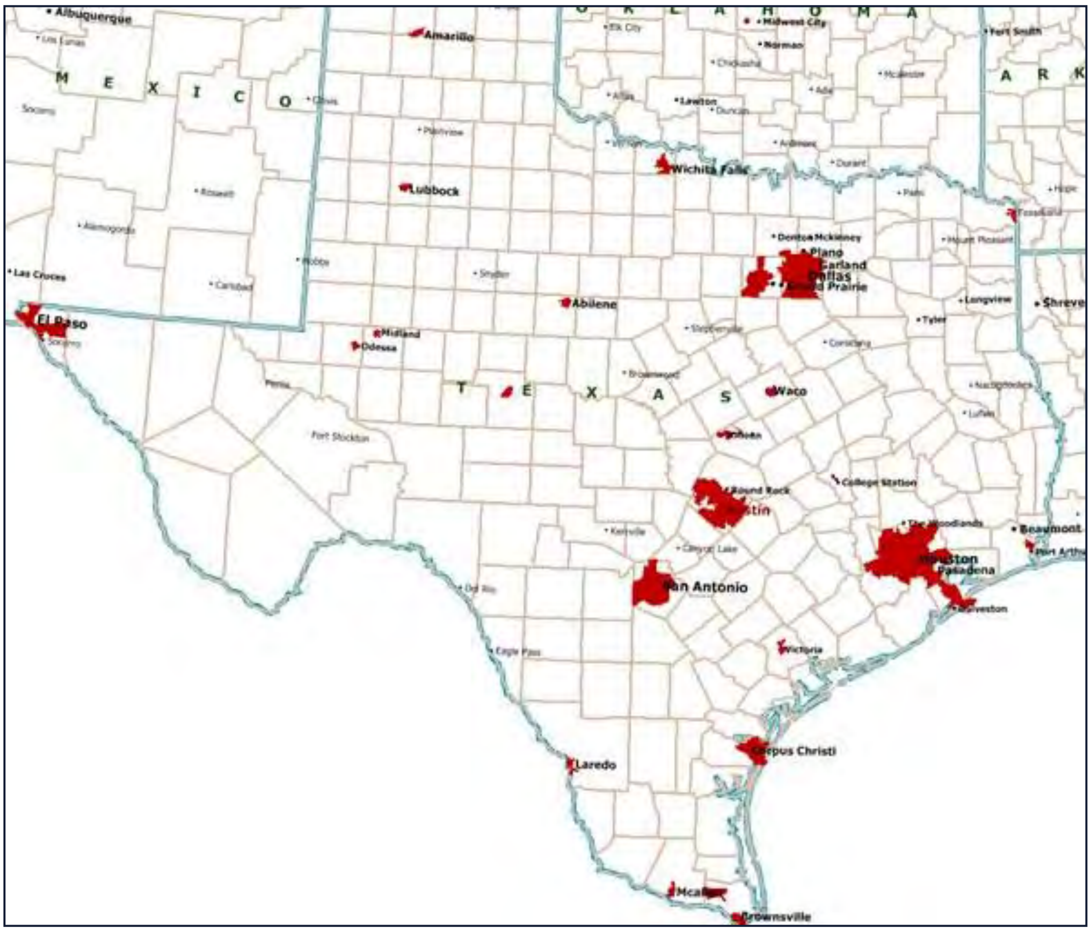
Exhibit 4: Preliminary Ridership Growth Rates by UZA Sizes

UZA Size	System Mode	Growth Rate
Over 1 Million	Commuter Rail	-0.18%
	Demand Response	4.28%
	Light Rail and Hybrid Light Rail	1.93%
	Motor Bus	-3.71%
	System-wide	2.33%
	Vanpool	9.33%
Over 200 Thousand	Demand Response	12.70%
	Ferry Boat	10.78%
	Light Rail and Hybrid Light Rail	-21.66%
	Motor Bus	3.85%
	System-wide	8.04%
	Vanpool	9.33%
Under 200 Thousand	Demand Response	7.05%
	Light Rail and Hybrid Light Rail	0.65%
	Motor Bus	6.54%
	System-wide	5.37%

The preliminary growth rates shown above will be replaced with SAM-V3 analysis of fixed route transit demand in urban areas when available. **Exhibit 5** highlights in red the UZAs that SAM V3 will cover, including:

- Corpus Christi
- Laredo
- San Antonio
- Austin
- Waco
- Dallas-Ft Worth
- El Paso
- Abilene
- Midland
- Odessa
- Houston
- Port Arthur
- Victoria
- McAllen
- Harlingen
- Brownsville
- Texarkana
- Lubbock
- Wichita Falls
- Amarillo
- Killeen

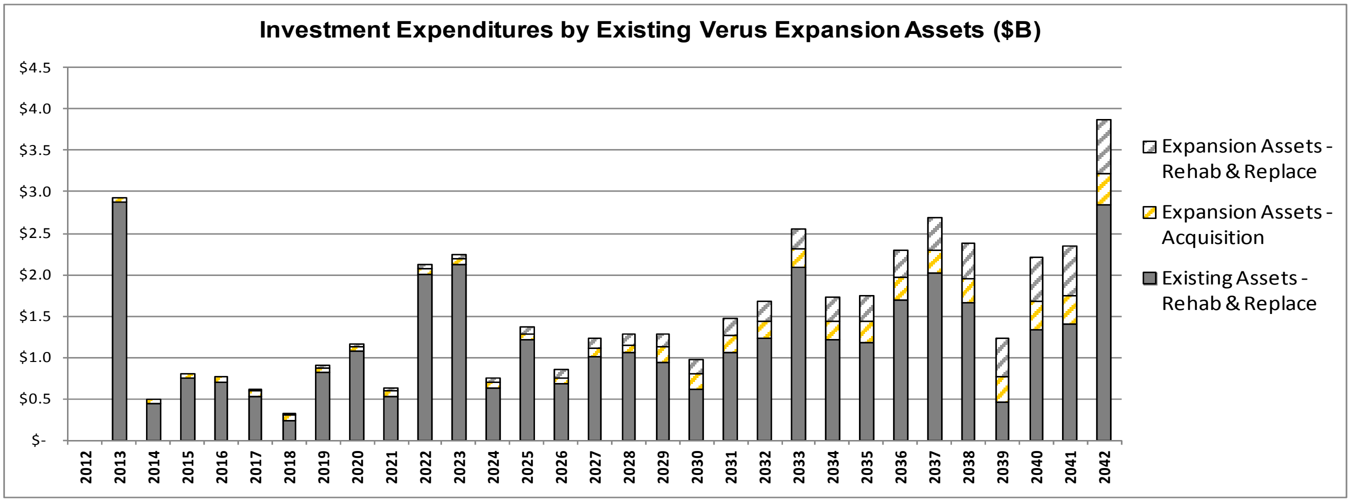
Exhibit 5: SAM V3 Projection Areas



The fixed route services that will be projected by SAM V3 include urban bus, commuter rail, light rail (including streetcar), and hybrid light rail in the areas noted above. Any urbanized areas with fixed route services that fall outside these areas, such as College Station-Bryan, and fixed route rural bus and ferry boat will not be projected by SAM V3. Demand response and vanpool in both urban and rural areas will also be excluded. For all of the agencies that fall outside of the SAM V3 analysis, final ridership rates will be projected in coordination with TxDOT using historical trends and potential population or demographic changes.

Ridership growth rates are used by TEX Lite to estimate the rate at which existing vehicle fleets must expand to maintain current vehicle capacity utilization (i.e., "maintain performance") given the trend rate of increase in ridership for each study area over the next 25 years. The algorithms used to increase fleet are based on TERM federal. While investing in fleet expansion, TEX Lite also estimates the required level of infrastructure investment needed to support the increasing fleet. These investments include maintenance facilities, and expanded rail guideway assets, including track, systems, and stations. Once new assets are 'acquired' in the model for Service Expansion, TEX Lite begins to estimate their reinvestment needs over time. As seen in Exhibit 6, the Service Expansion component of TEX Lite can be reported in both acquisition and reinvestment capital, alongside the Preservation capital needs.

Exhibit 6: TEX Lite – Example Investment Expenditures for Existing and Expansion Assets



All of TEX Lite's projected investment costs for Service Expansion are based on standard cost values maintained in the TERM federal database for asset types which were obtained through FTA capital cost research.

3.4 Major New Service Project Collection

The most recent MTP/RTPs will be used to determine the investment needs for Major New Services. Each MPO reports projects at a different level of detail and with different associated costs. Many MPOs also report a different scope of planning for transit services, with some projecting only the next few years of needs. Given this differential in detail, TxDOT has proposed that TTI harmonize long-term Major New Service plans for Urbanized agencies which will replace MPO plans where appropriate.

The *Texas Rural Transportation Plan 2035 – Final Report* will be used as a basis for rural and TxDOT-financed urbanized transit Major New Service needs, <u>with a potential update from TTI to 2040</u>.

3.4.1 Review of Existing Transit Plans

The most recent MTP/RTPs will be used to determine the investment needs for Major New Services. Each MPO reports projects at a different level of detail and with different associated costs. As much as possible, the costs included or excluded in project estimates will be reported as part of the review. If 'normalization' is required for these costs, then the consultant will confirm which costs should be in/out of scope with TxDOT representatives and develop estimates for those costs excluded from some project plans.

Exhibit 7 provides a summary of the MPO and rural plans that will be reviewed and considered throughout TTP development.

Exhibit 7: TxDOT Plans for Coordination with TTP

Plan/Program	Developed By	Time Period (FY)	Most Recent Date Published
Texas Rural Transportation Plan 2035 – Final Report	TxDOT	25 years	June 28, 2012
Abilene MTP	MPO	2010-2035	Jan 12, 2010
Amarillo MTP	MPO	2010-2035	Oct 20, 2011 (Revised)
Brownsville MTP	MPO	2010-2035	Dec 9, 2009
Bryan/College Station MTP	MPO	2010-2035	Feb 9, 2011
Capital Area RTP (CAMPO 2035)	MPO	2010-2035	May 24, 2010
Corpus Christi MTP	MPO	2010-2035	Jul 1, 2013 (updated project list)
El Paso MTP (Amended Mission 2035)	MPO	2010-2035	Dec 7, 2012
Harlingen San Benito MTP	MPO	2010-2035	Dec 9, 2009
Hidalgo County MTP	MPO	2010-2035	Jul 18, 2013 (Amended)
Houston Galveston RTP (Bridging Our Communities 2035)	MPO	2010-2035	Jan 25, 2011
Killeen-Temple (Mobility 2035) MTP	MPO	2010-2035	Oct 21, 2009 (Revised)
Laredo MTP	MPO	2010-2035	Dec 11, 2009
Longview MTP (Transportation 2035)	MPO	2010-2035	Jun 21, 2012 (Revised)
Lubbock MTP	MPO	2012-2040	Aug 21, 2012
Midland-Odessa MTP	MPO	2010-2035	Nov 30, 2009
North Central Texas MTP (Mobility 2035-Update 2013)	MPO	2010-2035	June, 2013 (Updated)

Exhibit 7: TxDOT Plans for Coordination with TTP

Plan/Program	Developed By	Time Period (FY)	Most Recent Date Published
San Angelo MTP	MPO	2010-2035	Jan, 2013 (Revised)
San Antonio-Bexar County (Mobility 2035) MTP	MPO	2010-2035	Dec 7, 2009
Sherman Denison (Transportation Outlook 2035) MTP	MPO	2010-2035	Apr 25, 2012 (Amended)
South East Texas Regional Planning Commission (SETRPC) MTP	MPO	2010-2035	Apr 19, 2013
Texarkana MTP	MPO	2010-2035	Oct 1, 2009
Tyler Area MTP	MPO	2010-2035	Apr 22, 2010 (Revised)
Victoria UZA MTP	MPO	2010-2035	Dec 11, 2012 (Amended)
Waco MTP (Connections 2035)	MPO	2010-2035	Aug 2010 (Amended)
Wichita Falls MTP	MPO	2010-2035	Jun 4, 2012 (Revised)

Where possible, committed sources of funding for projects will be identified as these projects will (theoretically) not compete for future funding with those projects that are currently 'unfunded'. The total investment needs related to Major New Service projects, and the proportion of needs that are funded/unfunded will also be reported. If these estimates cannot be determined through review of plans and interface with TxDOT planners, alternative means of estimating Major New Service needs will be considered given the time and budget available.

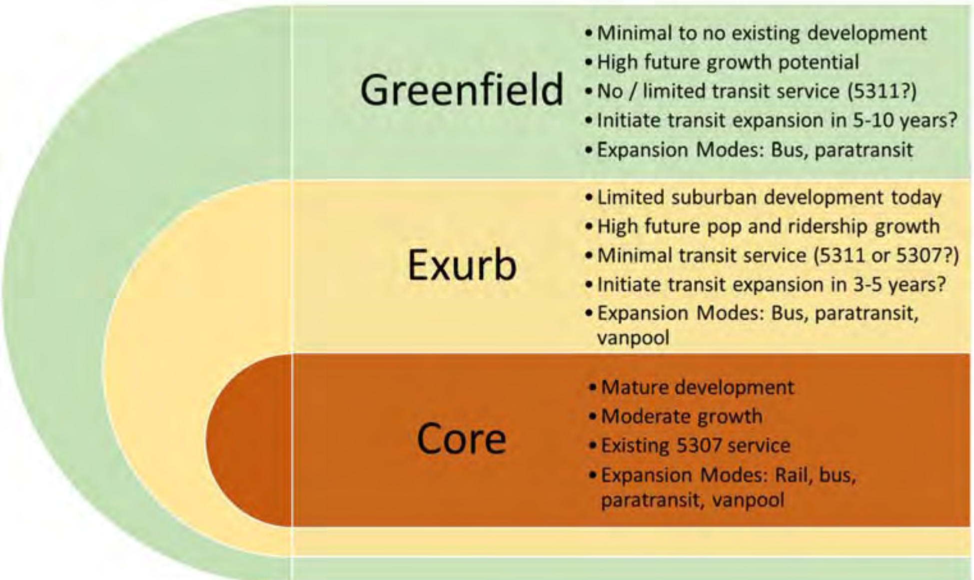
3.4.2 O&M Costs for Major New Services

Most MPO financial plans do not include the O&M costs related to Major New Service projects. As such, the O&M costs associated with these projects will be estimated using the relationship between the new fleet size and O&M costs which are built into TERM federal. If an agency has reported O&M costs related to new services, these costs will be used instead of estimates.

3.5 Investment to Address "Urban Collar" Growth

Texas's major urbanized areas – including Houston, Dallas, Austin and San Antonio – are undergoing rapid and significant growth. Much of this growth is concentrated in "collar" areas that surround the urban core and includes "exurb" regions, which currently have lower density development with little or no existing fixed-route transit services, as well as "greenfield" sites with little or no development and no fixed-route transit service. Both of these collar areas, as seen in **Exhibit 8**, are likely to require transit investment over the 25 year time horizon covered by the plan.

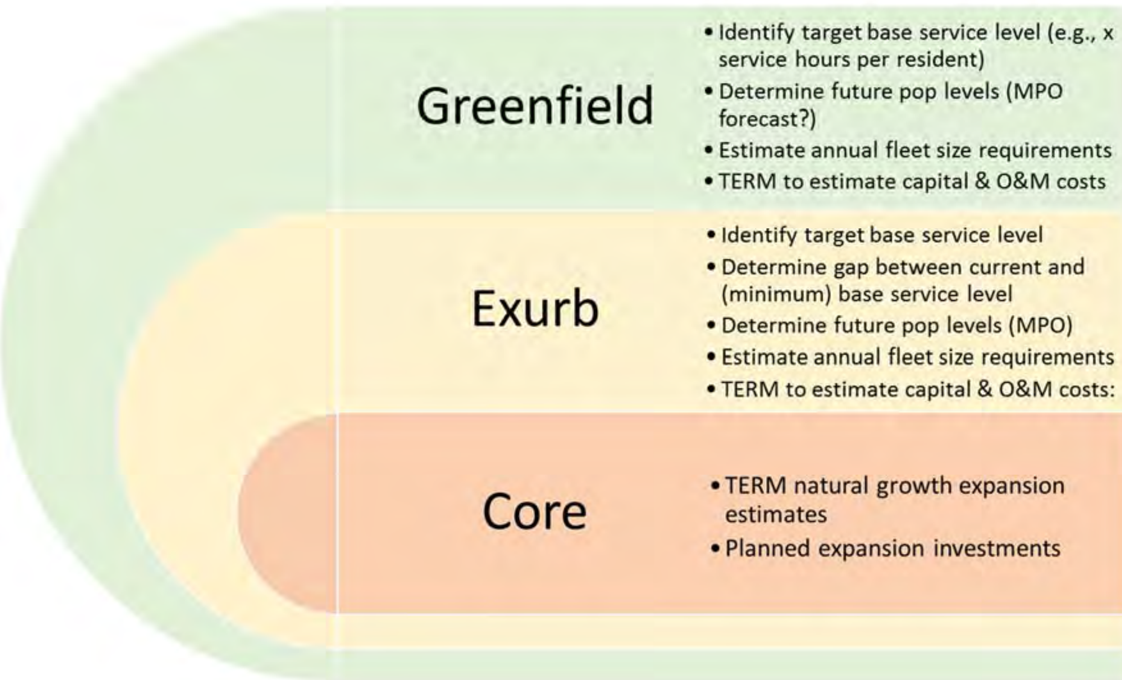
Exhibit 8: UZA Core and Collar Regions



Given the characteristics of these exurb and greenfield regions (none to minimal existing transit service but significant anticipated increase in transit demand), the approaches proposed above to cover natural growth needs for existing transit operations (3.3) and review of plans for major new expansion investments (3.4) may not capture the significant expansion investment needs required in the long term. Rather, the proposed approach to assessing urban collar capital investment and O&M cost needs will rely on the following analysis components/steps:

1. **Establish a base (minimum) transit service standard for collar regions:** This standard will most likely be based on a ratio of service levels per resident (e.g., hours or miles of revenue service per capita). The actual base service standard can be based on existing ratios of service per resident for more developed suburban areas within the same UZA (e.g., existing hours of transit service per resident in developed areas of Austin could be used to develop a future standard "target" for undeveloped collar regions around the Austin core).
2. **Obtain annual projections of population growth for the exurb and greenfield regions:** Population growth forms the driver to estimate total service hour needs based on the base service standard target (and in turn investment needs), as seen in **Exhibit 9**. Annual growth projections will be obtained at the county level through 2050 from the Texas State Data Center.
3. **Estimate annual service level requirement based on population forecasts and existing transit services:** Use the base service standard to estimate the total service hour or mile requirement for all projections years. Forecast will need to take into account areas that already have some level of service towards the standard (or areas that exceed the standard).

Exhibit 9: Methodology for Investment Projections in Collar Areas



4. **Estimate fleet and facility requirements to support projected service levels:** Annual fleet and facility requirements will be estimated outside of TEX Lite. These investment needs will then be entered into TEX Lite as expansion records to estimate capital expansion costs and O&M operating costs for these services throughout the 30-year time horizon. Some consideration will need to be made of whether there is a lag between the time a given service level is warranted vs. the expected time to plan, procure, and launch these expansion transit services (e.g., 5 to 10 years delay?). Collar region transit services may include bus and paratransit (and potentially vanpool).

Challenges: Key challenges in implementing this approach include the following:

1. Identifying the collar boundaries (including those for "greenfield" and "exurb" locations)
2. Determining any double counting of investment needs that may be captured in growth projections for surrounding areas.

Establishing the base service standard per resident and levels of investment to attain these standards are considered significantly less challenging given the availability of detailed NTD and TxDOT PTMS and related data sources. Determining possible double counting with TEX Lite projections of surrounding areas will be done in conjunction with TxDOT staff.

3.6 Constrained Funding Scenarios

In addition to the transportation challenges due to population growth and an aging population, the Texas transportation system is subject to a common trend across the country: diminishing revenues and higher costs. TxDOT, like most other departments of transportation (DOTs) throughout the country, is experiencing declining revenues and increasing demands on the transportation system. As noted in the Strategic Plan, funding from traditional sources such as the gas tax cannot keep pace with the growing demands on the system. In addition, recession-induced funding cuts have continued to present challenges to transit agencies while costs continue to inflate faster than fare revenues.

Given these limitations, more realistic scenarios of constrained funding and constrained capacity to expend that funding will be developed to determine the impact on transit asset conditions. CH2M HILL will generate projected revenue streams for the following two scenarios:

- Scenario 1: Expected capital funding (current capital funding forecast)
- Scenario 2: Funding required to maintain the current level of backlog.

The first scenario is based on the growth in capital funding for transit in Texas. Actual capital funding totals reported to NTD for FY2011 and FY2012 will be used for the backlog year and first year of analysis, which are divided into preservation and expansion funding based on past proportions of expenditure. The following year forecasts will be based on a trend rate of increase in capital funding using a weighted average of growth rates reported for funding over the relevant time period in available MTP/RTPs. The resulting 3.7% annual growth rate will be applied to a baseline year. Again, not all MPOs reported growth rates for funding sources, so the weighted average rate will not result in a one-to-one comparison of funding growth for MPOs.

The second scenario is a 'what if' analysis based on roughly maintaining the current value of the SGR backlog for transit. In order to determine the level of funding required to maintain that value, the TEX Lite model uses a 'goal seek' function to determine the correct level of annual investment needed to keep the backlog roughly steady.

4.0 Investment Prioritization

To address transit demands amid constrained resources, it is critical to maximize the impact of every dollar spent. This is the value of performance-based planning, which seeks to determine how to invest wisely to achieve goals and improve system performance over time. In this analysis, the issue of prioritizing investments with constrained funding is addressed by prioritizing the replacement or rehab of individual assets based on prioritization criteria built into TEX Lite. The resulting mix of investment actions and assets in the SGR backlog then reflect, roughly, the priorities of the State under constrained funding.

Note: The following prioritization method only applies to capital investments for Preservation of existing assets in TEX Lite. Expansion funding constraints can only be described by the expected funding gap and potential of not meeting transit demands.

4.1 Prioritization Routine

For each year of a 25-year model run, TEX Lite first identifies which of the State's assets require some reinvestment action (e.g., rehab or replacement) to attain SGR. Next, the TEX Lite assigns prioritization scores to each of these assets, and the model will reinvest in the highest scoring assets until the expected amount of reinvestment funding for that year is exhausted. Using this prioritization, TEX Lite then determines for each year what assets undergo reinvestment actions and what assets enter the SGR backlog.

A higher-level conceptual overview of TEX Lite's SGR reinvestment needs and prioritization analysis is shown in Exhibit 10. This representation emphasizes the model's reliance on the asset inventory data obtained from the agencies, TxDOT and NTD reporting. Exhibit 10 also highlights the simulation process used for each year of the 25-year period of analysis to:

1. Assess needs for each analysis year
2. Score and rank all potential investment actions
3. Undertake the highest ranked investment actions subject to expected funding capacity.

Exhibit 10: TEX Lite – SGR Needs Forecasting and Prioritization Tool Combined

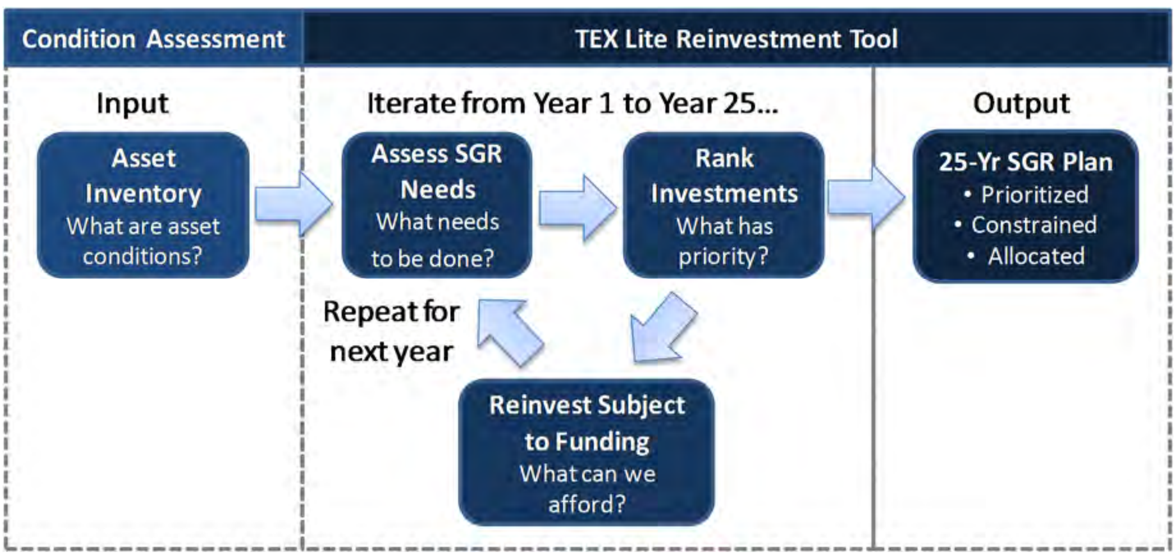
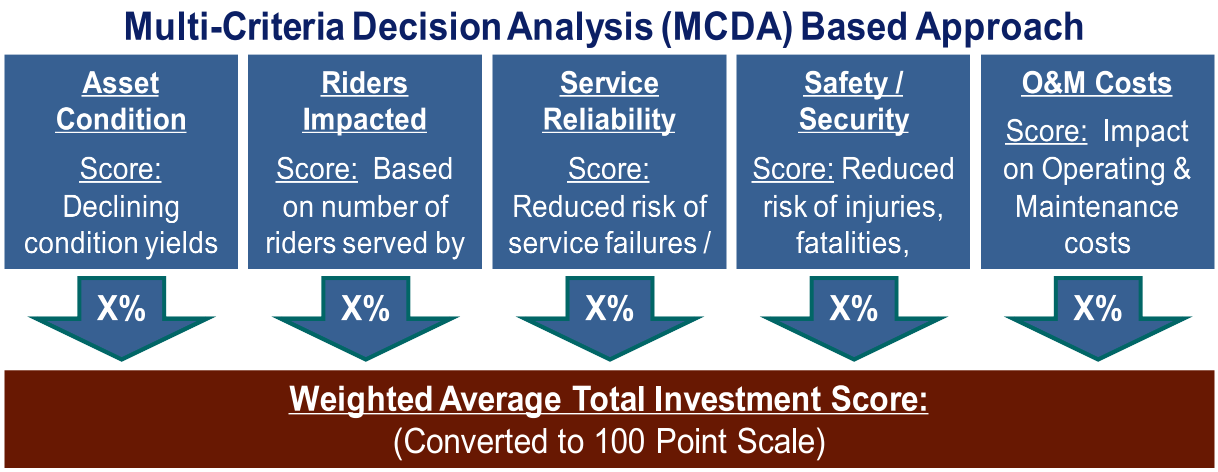


Exhibit 11 provides an overview of the five investment criteria used to score and rank all potential SGR reinvestment actions – including asset condition, number of riders impacted, and the contribution of reinvestment actions to each of service reliability, safety and security, and O&M cost reduction. The weight placed on each criterion is variable within TEX Lite and hence can be varied to reflect the State's policies or to conduct sensitivity analyses.

Exhibit 11: TEX Lite – SGR Investment Prioritization Criteria and Scoring



The process used to score each SGR reinvestment criterion is highlighted in Exhibit 12. The weighting of each criterion will be calibrated based on the goals developed for TTP prioritization.

Exhibit 12: Approach to Scoring by SGR Investment Criterion

Criterion	Approach	Dynamic or Static?	Illustration
Asset Condition	• Decay curve based condition estimate – Age based 1 to 5 scale	Dynamic	
O&M Costs	• Fixed Score by asset type	Static	
Service Reliability & Safety/Security	• Combination of: – Fixed Score by asset type – Dynamic score by asset age	Mixed	
Riders Impacted	• Logarithmic score based on share of total agency riders impacted – Scale ensures all assets obtain score	NA	

Scoring is “dynamic” throughout the 25-year period covered by each model run for some criteria. Specifically, TEX Lite assesses each asset’s condition at the start of each analysis year (including the start or “backlog year”). This evaluation is then used to score and rank potential SGR investments with respect to asset condition, reliability and safety/security (with scoring for reliability and safety/security driven in part by condition). Due to this constant re-evaluation, the scoring for all assets is constantly changing (i.e., is “dynamic”) throughout the 25 years of each model run.

4.2 SGR Backlog Impacts

With constrained funding some assets will enter the SGR backlog if they are lower priority for reinvestment. The ranking of each asset type for prioritization and the weighting of the five criteria will determine which assets enter the backlog. The value, or size, of the backlog is not impacted by this ranking. However, the composition of the backlog will be impacted by prioritization rankings.

For example, revenue vehicles tend to rank highly (5 out of 5) for safety and security impacts. When the safety and security criterion is weighted highly, revenue vehicles will rarely enter the SGR backlog. This also means that revenue vehicles will make up a large portion of the investment expenditures in the model. Various approaches to weighting criteria and the resulting impact on investments, and conversely, the backlog are shown in **Exhibits 13 and 14.**

Exhibit 13: Example Prioritization Criteria Weighting Outcomes for Asset Types

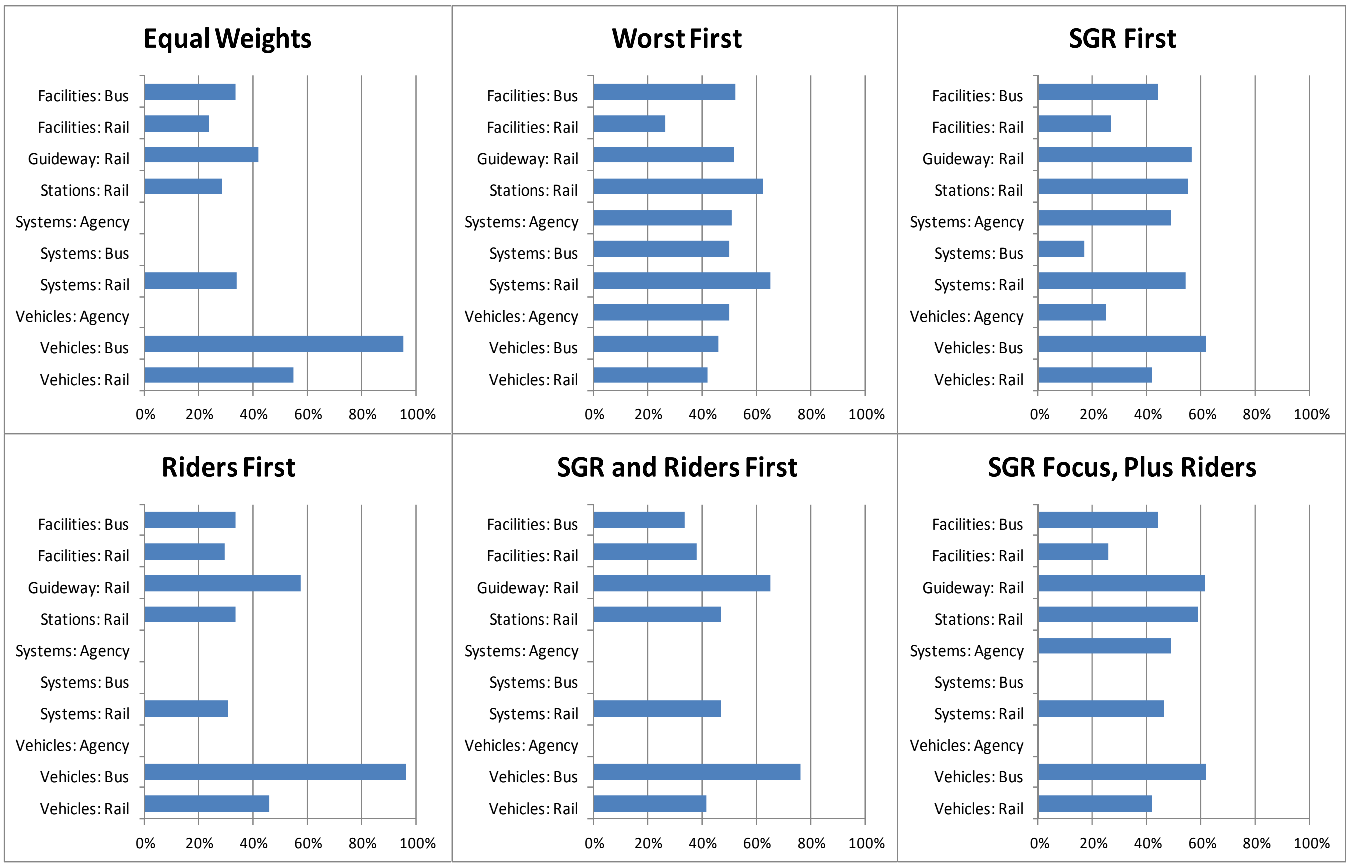
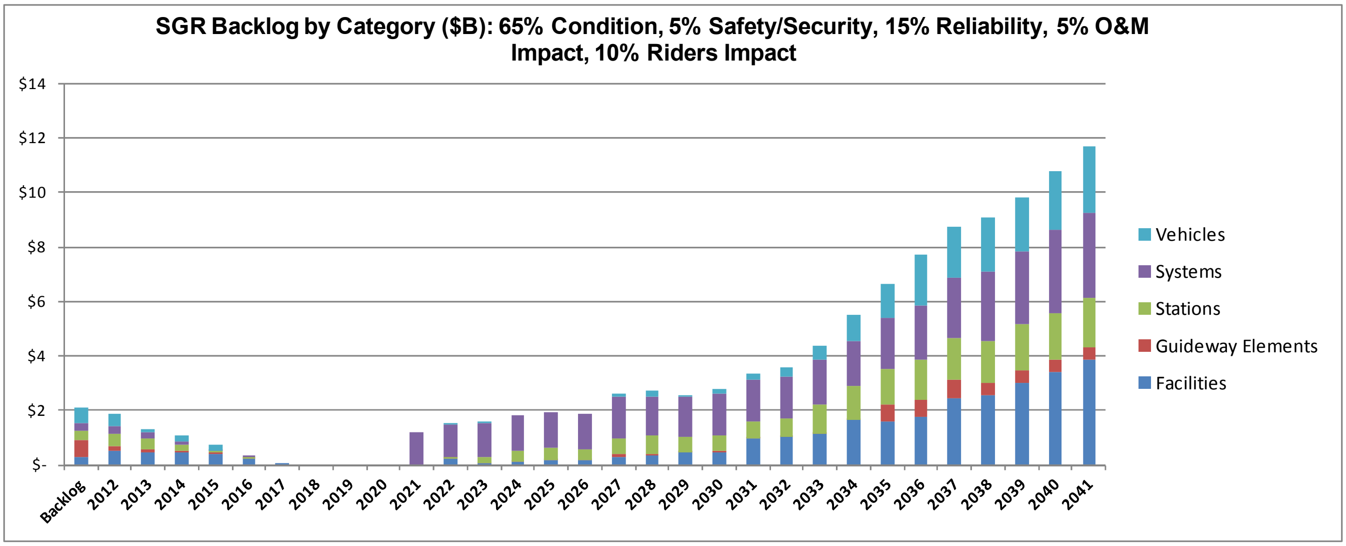


Exhibit 14: TEX Lite – Example SGR Backlog Projection with Constrained Funding and Prioritization



Appendix A: Texas Transit Agency List

Note that private intercity bus operators are not on this list, though any publicly-funded assets related to those services will be captured in inventory as TxDOT provides grant details for those assets.

Agency groupings need to be further discussed with TxDOT in order to allow for reporting agency needs as appropriate for the TTP.

§5307 and §5311 Agencies

TRS ID	Agency	Agency Grouping
6001	Amarillo City Transit	Urbanized Area
6006	Mass Transit Department City of El Paso	MTA
6007	Fort Worth Transportation Authority	MTA
6008	Metropolitan Transit Authority of Harris County	MTA (Houston)
6009	Laredo Transit Management Inc.	Urbanized Area
6010	City Transit Management Company Inc.	Urbanized Area (Lubbock)
6011	VIA Metropolitan Transit	MTA (San Antonio)
6012	Waco Transit System Inc.	Urbanized Area
6013	Port Arthur Transit	Urbanized Area
6014	City of Brownsville Brownsville Urban System	Urbanized Area
6016	Beaumont Municipal Transit System	Urbanized Area
6035	Wichita Falls Transit System	Urbanized Area
6040	Abilene Transit System	Urbanized Area
6041	Handitran Special Transit Division City of Arlin	Urbanized Area (City of Arlington – part of Dallas-Fort Worth-Arlington UZA)
6048	Capital Metropolitan Transportation Authority	MTA
6051	Corpus Christi Regional Transportation Authority	MTA
6056	Dallas Area Rapid Transit	MTA
6059	Brazos Transit District	Urbanized Area (Two: College Station-Bryan and Conroe-The Woodlands), and Nonurbanized
6068	City of Grand Prairie Transportation Services Depa	Urbanized Area (City of Grand Prairie – part of Dallas-Fort Worth-Arlington UZA)
6070	City of Mesquite	Urbanized Area (City of Mesquite – part of Dallas-Fort Worth-Arlington UZA)
6081	Longview Transit	Urbanized Area
6082	The Gulf Coast Center	Urbanized Area (Two: Lake Jackson-Angleton and Texas City), also Nonurbanized
6084	Dallas VPSI Inc	Urbanized Area (as subrecipient or contractor of §5307 funds from designated recipient in Dallas-Fort Worth-Arlington UZA)
6089	City of Tyler	Urbanized Area
6090	Lower Rio Grande Valley Development Council	Urbanized Area (Two: part of McAllen and Harlingen), and Nonurbanized
6091	Hill Country Transit District	Urbanized Area (Two: Killeen and Temple), and

TRS ID	Agency	Agency Grouping
		Nonurbanized
6093	Texarkana Urban Transit District	Urbanized Area (Texarkana) and Nonurbanized
6095	Golden Crescent Regional Planning Commission	Urbanized Area (Victoria) and Nonurbanized
6097	Midland-Odessa Urban Transit District	Urbanized Area (Two: Midland and Odessa)
6099	City of McAllen McAllen Express Transit	Urbanized Area (City of McAllen, part of McAllen UZA)
6101	Denton County Transportation Authority	MTA
6102	Concho Valley Transit District	Urbanized Area (San Angelo) and Nonurbanized
6103	Fort Bend County Public Transportation	Urbanized as subrecipient or contractor to designated recipient of §5307 funds, also Nonurbanized
6107	Texoma Area Paratransit System Inc.	Urbanized Area (Two: Sherman and McKinney) and Nonurbanized
6108	Harris County Community Services Department, Office of Transit Services	Urbanized as subrecipient or contractor to designated recipient of §5307 funds
TX001	Aspermont Small Business Development Center, Inc.	Nonurbanized
TX002	Panhandle Community Services	Nonurbanized
TX003	Ark-Tex Council of Governments	Nonurbanized (but also urbanized for Texarkana, see urban list)
TX004	South East Texas Regional Planning Commission	Nonurbanized
TX005	Central Texas Rural Transit District	Nonurbanized
TX008	Rolling Plains Management Corporation	Nonurbanized
TX009	Bee Community Action Agency	Nonurbanized
TX010	Kleberg County Human Services	Nonurbanized
TX011	Rural Economic Assistance League, Inc.	Nonurbanized
TX012	Community Services, Inc.	Nonurbanized
TX013	SPAN, Inc.	Nonurbanized
TX014	City of Cleburne	Nonurbanized
TX015	Public Transit Services	Nonurbanized
TX016	The Transit System, Inc.	Nonurbanized
TX018	Webb County Community Action Agency	Nonurbanized
TX019	Caprock Community Action Association, Inc.	Nonurbanized
TX020	West Texas Opportunities, Inc.	Nonurbanized
TX022	Texoma Area Paratransit System Inc.	Nonurbanized (but also urbanized for Sherman and McKinney, see urban list)
TX023	Southwest Area Regional Transit District	Nonurbanized
TX024	Lower Rio Grande Valley Development Council	Nonurbanized (but also urbanized for part of McAllen and Harlingen, see urban list)
TX025	Town of South Padre Island	Nonurbanized
TX026	Concho Valley Rural Transit District	Nonurbanized (but also urbanized for San Angelo, see urban list)
TX027	Alamo Area Council of Governments	Nonurbanized

TRS ID	Agency	Agency Grouping
TX028	Community Action Council of South Texas	Nonurbanized
TX029	East Texas Council of Governments	Nonurbanized
TX030	Heart of Texas Council of Governments	Nonurbanized
TX031	Colorado Valley Transit, Inc.	Nonurbanized, but subrecipient or contractor to designated recipient of §5307 funds
TX032	Golden Crescent Regional Planning	Nonurbanized (but also urbanized for Victoria, see urban list)
TX033	Capitol Area Rural Transportation System	Both: Nonurbanized and Urbanized as direct recipient for San Marcos UZA, and contractor to designated recipient of §5307 funds in Austin UZA
TX034	El Paso County	MTA
TX035	South Plains Community Action Association, Inc.	Nonurbanized
TX036	STAR Transit	Nonurbanized
TX038	City of Del Rio	Nonurbanized
TX042	Fort Bend County Rural Transit District	Nonurbanized
TX047	Senior Center Resources and Public Transit, Inc.	Nonurbanized

§5310 Agencies

- 100 D.I.D. Memor Nurs & Rehab Ctr (Dumas)
- Adult Day Activity & Health Center (Lubbock)
- Air Force Village Foundation, Inc. (San Antonio)
- Aliviane NO-AD, Inc. (El Paso)
- Amarillo Multi. Ctr. for the Aging (Amarillo)
- American Red Cross Chisholm Chapter (Fort Worth)
- American Red Cross-Gtr Houston Area Chpt (Houston)
- Andrews Central Smith County (Tyler)
- Austin Groups for the Elderly (AGE) (Austin)
- Austin State Supported Living Center (Austin)
- Austin Travis Center Integral Care (Austin)
- Bastrop Co Emergency Food Pantry & Support Ctr Inc. (Bastrop)
- Big Bend Community Action Comittee, Inc. (Marfa)
- Big Bend Regional Medical Center (Alpine)
- Blessed Sacrament Church Senior Center (San Antonio)
- Booker Booster Club, Inc. dba Twin Oakes (Amarillo)
- Bowie Senior Citizens Project, Inc. (Bowie)
- Buena Vida Adult Daycare Center dba Lutheran Social Services
- C.C. Young Memorial Home (Dallas)
- Camp County Services Industries (Pittsburg)
- Centro de Salud Familiar La Fe, Inc. (El Paso)

- Chillicothe Travelers, Inc. (Chillicothe)
- Christian Senior Services (San Antonio)
- City of Marfa (Marfa)
- City Of Port Isabel (Port Isabel)
- City of San Antonio Support Serv. for Elderly (San Antonio)
- Coastal Bend Rural Health Partnership (Alice)
- Community Health Core (Marshall)
- Dallas County Department of Health & Human Serv. (Dallas)
- Dawson Co. Sr. Cits. Center (Lamesa)
- East Texas Support Services, Inc. (Jasper)
- Eden Hill Communities (New Braunfels)
- Electra Service Corporation (Electra)
- Evangelical Luth Good Sam Soc/dba Pks Good Sam Vge (Odessa)
- Faith In Action Caregiving (Round Rock)
- Farwell Convalescent Center (Farwell)
- Foard County Senior Citizens Corp. (Crowell)
- Foundation for MHMR/Permian Basin (Midland)
- Friendship Center of Montgomery County (Conroe)
- Gateway Community Partners, Inc. (Jacksonville)
- Golden Age Home (Lockhart)
- Good Samaritan Society White Acres (El Paso)
- Goodwill Industries of San Antonio (San Antonio)
- Greater Randolph Area Services Program (Converse)
- Harris County Transportation (Houston)
- Hays County Veterans Administration (San Marcos)
- Hill Country MHMR Center (San Marcos)
- Hockley County Senior Citizens (Levelland)
- Inman Christian Center (San Antonio)
- James L. West Presby. Spec Care Ctr (Fort Worth)
- Jim Hogg County (Hebbronville)
- Kirby Senior Center (Kirby)
- L.U.L.A.C. Project Amistad (El Paso)
- Legacy Assisted Living (Dalhart)
- Lubbock Independent School District Social Education (Lubbock)
- Marian Moss Enterprises, Inc. (Lubbock)
- Mary Lee Foundation (Austin)
- Menard County (Menard County)
- MHMR Services for Concho Valley (San Angelo)
- MHMR Tarrant County (Fort Worth)

- Mission Road Develop. Ctr. (San Antonio)
- Nazareth Hall Nursing Center (El Paso)
- Pecos Senior Center (Pecos)
- Plano Community Homes Sponsor (Plano)
- Prairie Acres Nursing Home (Friona)
- Presa Community Service Ctr. (San Antonio)
- Rio Concho Manor (San Angelo)
- Rio Concho West, Inc. (San Angelo)
- Salvation Army William Booth Garden Apts. (Tyler)
- San Antonio AIDS Foundation (San Antonio)
- San Antonio Lighthouse (San Antonio)
- San Juan de Los Lagos Church (San Antonio)
- Senior Adult Services (Farmers Branch)
- Senior Citizen Project of Chambers County (Anahuac)
- Seven Acres Jewish Geriatric Center (Houston)
- Southwest Key Program, Inc. (Brownsville)
- St. Gregory the Great Parish (San Antonio)
- Starr County Rural Transportation (Rio Grande City)
- Sterling County (Sterling County)
- Texarkana Special Education Center, Inc. (Texarkana)
- Town of Van Horn (El Paso)
- Trinity Terrace Retirement Center (Fort Worth)
- United Cerebral Palsy (Dallas)
- University Medical Center (El Paso)
- Ward County Grandfalls Senior Citizens (Grandfalls)
- Ward County Senior Citizens Center (Monahans)
- Wilmer Senior Center (Wilmer)
- Young County Senior Cub Center (Olney)
- Zapata County (Zapata)

Appendix B: Data Needs and Sources

Data Need	Purpose	Source
Verification of services, agencies in scope and groupings	• Some rural transit districts may provide urban (§5307) service and vice versa – need division of agency assets in order to report properly	TxDOT
Intercity bus assets public investment	• Intercity bus inventory • For intercity bus Preservation and Service Expansion Needs	TxDOT – PTMS or §5311 grant history
Revenue Fleet Vehicle Inventory	• Update to most recent vehicle counts – particularly for §5310 operators • Calculate agency specific useful lives • For all modes Preservation and Service Expansion Needs	• NTD 2012 • TERM Fed • TxDOT: PTMS
Facility Inventory	• Verify facility counts by agency and determine date built for facilities • For all modes Preservation and Service Expansion Needs	• NTD 2012 • TERM Fed • TxDOT: PTMS and TTI
Systems, Equipment and Guideway Inventory	• Verify/replace any generated records with actual inventory • All modes Preservation and Service Expansion Needs	• TERM Fed • TxDOT
Vehicle Prices from recent procurements	• Verify Vehicles Price List • All modes unit costs	TxDOT
Formula funding – historic and projections	• Projected formula funding for constrained revenue scenarios	TxDOT and CH2M HILL
5310 O&M Cost History and Funding	• For agencies with no transit capital assets, need to determine historic O&M expenditures and funding • Determine method for future O&M costs outside of TEX Lite	TxDOT and CH2M HILL
Ridership projections outside of SAM V3	• Historic trends and future projections for ridership • Demand response, vanpool, ferry and rural bus route Service Expansion projections	TxDOT and CH2M HILL
Major New Service Estimates	• Update MTP/RTP details to include similar timeframe and project scope for Major New Service projects • Update *Texas Rural Transportation Plan 2035* for Major New Services	TxDOT (with TTI support)

Appendix C: Initial Vehicle Price List

Initial Source: FTA's TERM Federal default pricing. To be updated by PTMS cost data when provided.

NTD Name	TERM Element	TERM Sub-Element	Cost Year	Soft Cost	Unit Price
Articulated Bus (60 ft)	Bus	Articulated Bus (60 ft)	2008	0	$811,137.00
Articulated Bus (60 ft) - CNG	Bus	Articulated Bus (60 ft) - CNG	2008	0	$811,137.00
Articulated Bus (60 ft) - Diesel	Bus	Articulated Bus (60 ft) - Diesel	2008	0	$811,137.00
Articulated Bus (60 ft) - Hybrid	Bus	Articulated Bus (60 ft) - Hybrid	2008	0	$811,137.00
Automobiles	Vans, Cutaways and Autos	Automobile	2004	0	$26,480.90
Bus	Bus	-	2004	0	$438,559.24
Bus (<30 ft)	Bus	Bus (<30 ft)	2008	0	$87,451.00
Bus (<30 ft) - CNG	Bus	Bus (<30 ft) - CNG	2008	0	$87,451.00
Bus (<30 ft) - Diesel	Bus	Bus (<30 ft) - Diesel	2008	0	$87,451.00
Bus (<30 ft) - Hybrid	Bus	Bus (<30 ft) - Hybrid	2008	0	$87,451.00
Bus (30 ft)	Bus	Bus (30 ft)	2004	0	$261,893.78
Bus (30 ft) - CNG	Bus	Bus (30 ft) - CNG	2004	0	$261,893.78
Bus (30 ft) - Diesel	Bus	Bus (30 ft) - Diesel	2004	0	$261,893.78
Bus (30 ft) - Hybrid	Bus	Bus (30 ft) - Hybrid	2004	0	$261,893.78
Bus (35 ft)	Bus	Bus (35 ft)	2008	0	$338,665.15
Bus (35 ft) - CNG	Bus	Bus (35 ft) - CNG	2008	0	$338,665.15
Bus (35 ft) - Diesel	Bus	Bus (35 ft) - Diesel	2008	0	$338,665.15
Bus (35 ft) - Hybrid	Bus	Bus (35 ft) - Hybrid	2008	0	$338,665.15
Bus (40 ft)	Bus	Bus (40 ft)	2008	0	$438,559.24
Bus (40 ft) - CNG	Bus	Bus (40 ft) - CNG	2008	0	$438,559.24
Bus (40 ft) - Diesel	Bus	Bus (40 ft) - Diesel	2008	0	$438,559.24
Bus (40 ft) - Hybrid	Bus	Bus (40 ft) - Hybrid	2008	0	$438,559.24
Commuter rail locomotives	Commuter Rail	Revenue Locomotive	2004	0	$2,644,328.99
Commuter rail passenger coaches	Commuter Rail	Passenger Car	2004	0	$2,286,375.00
Commuter rail self-propelled passenger cars	Commuter Rail	Self-Propelled Passenger Car	2004	0	$2,523,500.00
Cutaway	Vans, Cutaways and Autos	Light-Duty Van	2009	0	$52,000.00
Ferryboats	Ferry Boat	Ferry Boat	2004	0	$8,045,195.03
Light rail vehicles (Streetcars)	Light Rail	Street Car	2008	0	$4,053,788.55
Minivan	Vans, Cutaways and Autos	Mini-Van	2009	0	$36,000.00
Over-the-road bus	Bus	Over-the-Road Coach	2009	0	$466,839.00
Sports utility vehicle	Vans, Cutaways and Autos	SUV	2009	0	$52,000.00
Taxicab sedan	Vans, Cutaways and Autos	Automobile	2004	0	$26,480.90
Taxicab van	Vans, Cutaways and Autos	Raised Roof Van	2004	0	$ 46,154.19
Van	Vans, Cutaways and Autos	Medium-Duty Van	2010	0	$ 65,629.00

Appendix D: Acronyms and Abbreviations

ACM	annual capital maintenance
DO	directly operated services
DOT	department of transportation
FRA	Federal Rail Administration
FTA	Federal Transit Administration
MPO	Metropolitan Planning Organization
MTA	Metropolitan Transit Authority
MTP	Metropolitan Transportation Plan
NTD	National Transit Database
O&M	operation and maintenance
PT	contracted services
PTMS	Public Transportation Management System
RTP	Regional Transportation Plan
SETRPC	South East Texas Regional Planning Commission
SGR	State of Good Repair
TERM	Transit Economic Requirements Model
TRP	Texas Rail Plan
TTI	Texas Transportation Institute
TTP	Texas Transportation Plan
UZA	urbanized area
YOE	year of expenditure

Texas Transportation Plan

Tech Memo 3.4: Bicycle and Pedestrian

January 15, 2014

Acknowledgements

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Contents

Tables

1.0 Introduction

This memo describes the methodology proposed for assessing the bicycle-pedestrian mode within the Texas Transportation Plan (TTP). Bicycle and pedestrian planning has historically been performed at the local level and often lacks data and tools need to appropriately analyze usage, performance, and long-range forecasts. As interest and participation in these non-motorized modes continues to increase, local, regional, and statewide plans would ideally bring bicycle and pedestrian planning out of an existing informal and piecemeal process into a more formal process supported by data and tools. This will require a commitment at multiple levels of government as well as assistance from the public and advocacy groups.

While bicycle/pedestrian modal data are limited, a methodology for assessing system use and needs is described in the following sections. This methodology will be applied in Task 4 and includes investment types, an overview of agencies and plans reviewed, data availability and sources, information gaps, and methods for needs determination.

2.0 Scope of Analysis

The following sections provide a summary of the types of financial need, or investment, to be considered in the analysis for the TTP.

2.1 Types of Investment

Government entities at various levels as well as other organizations and advocacy groups are involved with bicycle and pedestrian facility planning and construction in Texas. Investments within the bicycle/pedestrian mode can take on many forms, but typically involve the following general types of investment:

- Adding connectivity/service expansion
- Maintenance and preservation
- Safety enhancements
- Accessibility and implementation of Americans with Disabilities Act (ADA) standards

2.2 Modal Overview – Bicycle/Pedestrian Mode

2.2.1 Overview of Texas Agencies/Departments

TxDOT

At the statewide level, TxDOT's bicycle and pedestrian interests are coordinated by the Statewide Bicycle and Pedestrian Coordinator within the Public Transportation Division. The Coordinator works cooperatively with TxDOT Divisions and Districts, local bicycle/pedestrian coordinators at cities and metropolitan planning organizations (MPOs), bicycle/pedestrian advocacy groups, and with the Federal Highway Administration (FHWA).

TxDOT also operates under a March 23, 2011 "*Memorandum for Guidelines Emphasizing Bicycle and Pedestrian Accommodations.*" These guidelines reflect a federal policy statement emphasizing an increased commitment to, and investment in, bicycle facilities and walking networks. The guidelines provide District Engineers with guidance regarding the inclusion of bicycle and pedestrian facilities in urban and rural settings with designs constructed according to Texas Accessibility Standards and Americans with Disabilities Act Accessibility Guidelines, as well as the American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities* and TxDOT's *Roadway Design Manual*.

TxDOT maintains a Bicycle Advisory Committee within the Transportation Planning and Programming Division. This Committee involves representatives of the public and advises the Transportation Commission on bicycle issues and the Safe Routes to School Program (now part of the Transportation Alternatives Program). The Bicycle Advisory Committee advises the Commission regarding the Texas Bicycle Tourism Trails Act. This act was enacted by the Texas legislature in 2005 to develop bicycle tourism trails that reflect the geography, scenery, history, and cultural diversity of the state. Recommendations are made in consultation with the Texas Parks and Wildlife Department (TPWD) and may include multiuse trails to accommodate pedestrians, equestrians, and other non-motorized users.

Texas Parks & Wildlife Department

TPWD manages approximately 90 state parks that offer a large variety of trails and roads for mountain biking, cycling, hiking, and nature walks. Trails are rated according to degree of difficulty and are typically included in informational brochures and maps available at each state park. In addition, TPWD manages the Great Texas Wildlife Trails Program, based around nine driving trails that direct users to over 950 destinations to view birds and wildlife. The program's first trail – The Great Texas Coastal Birding Trail (central coast section) – was developed in 1995 and was the nation's first wildlife trail.

Texas Historical Commission

The Texas Historical Commission (THC) manages the Texas Heritage Trails Program. The Trails Program is a heritage tourism and economic development initiative that encourages communities, regions, and the state to partner and promote Texas' historic and cultural resources. The program is based around 10 heritage regions and scenic driving trails, with some regions promoting cycling.

Metropolitan Planning Organizations

The 25 MPOs in Texas coordinate bicycle and pedestrian needs on a regional basis via their Metropolitan Plans (MTP) and/or stand-alone bicycle/pedestrian plans. A list of the MPOs and their bicycle/pedestrian plans can be found in Table 1 below (Section 3.1).

Cities

Many of the larger cities in Texas plan bicycle and pedestrian needs on a local level via city bicycle/pedestrian plans. A list of city bicycle/pedestrian plans associated with cities within the 25 Texas MPOs can be found in Table 1 below (Section 3.1).

2.2.2 Overview of Pertinent Transportation Plans, Programs, and Studies Reviewed

Various plans, programs, and studies from government entities were reviewed for the bicycle and pedestrian modes and include the following:

US Department of Transportation and other National Sources

- US Federal Highway Administration (FHWA) National Household Travel Survey (NHTS)
- US Census American Community Survey (ACS)
- National Highway Traffic Safety Administration (NHTSA) Traffic Safety Facts – Bicyclists and Other Cyclists, April, 2013

TxDOT

- Memorandum for Guidelines Emphasizing Bicycle and Pedestrian Accommodations, 2011
- Transportation Alternatives Program
- Texas Bicycle Tourism Trails Act

TPWD

- Great Texas Wildlife Trails Program

THC

- Texas Heritage Trails Program

MPOs

- MTPs/Regional Transportation Plans (RTPs)
- Stand-alone Bicycle/Pedestrian Plans
- Other (see Table 1, Section 3.1)

Cities

- City Bicycle/Pedestrian Plans

In addition to these government entities, other organizations and advocacy groups are involved with bicycle and pedestrian facility planning, construction, and advocacy in Texas. Organizations operating on a national or statewide level and their pertinent plans, programs, and studies include the following:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO published their *"Guide for the Development of Bicycle Facilities, 4th Edition"* in 2012. TxDOT has implemented these guidelines for the planning, design, construction, maintenance, and operation of facilities that meet the needs of bicyclists and other highway users.

League of American Bicyclists

The League of American Bicyclists, a national bicycle advocacy and education group, publishes an annual report analyzing U.S. Census Bureau American Community Survey Data regarding bicycling and bicycle commuting, which also ranks cities and states regarding bicycling statistics. The current report is titled "*Where We Ride – Analysis of Bicycling in American Cities, Annual American Community Survey Data Report for 2012.*"

Bike Texas

Bike Texas was formed in 1991 and is a non-profit bicycle education and advocacy organization whose mission is advancing bicycle access, safety, and education in Texas. Bike Texas's "*Strategic Plan 2014–2019*" details their strategies and goals for Texas-wide bicycle advocacy and education on the national, statewide, and local levels.

Rails-to-Trails Conservancy

Formed in 1986, the Rails-to-Trails Conservancy (RTC) is a non-profit organization whose mission is to create a nationwide network of trails from former and active rail lines and connecting corridors. RTC's "*America's Rails-with-Trails – A Resource for Planners, Agencies and Advocates on Trails Along Active Railroad Corridors,*" September 2013, provides data, examples, and practical tools to assist planners and advocates with rail-trail concepts and advancement of policies and practices that support rail-trail development.

Alliance for Biking and Walking

The Alliance for Biking and Walking is a nonprofit organization which serves as a coalition of North America's local and state/province bicycle and pedestrian advocacy organizations. Their U.S. Bicycling and Walking Benchmarking Project is an on-going effort to collect and analyze data on bicycling and walking. Their latest report is titled "*Bicycling and Walking in the United States – 2012 Benchmarking Report*."

3.0 Data Collection

3.1 Data Availability and Sources – Bicycle/Pedestrian Mode

3.1.1 Source(s) of Asset Conditions

While TxDOT works cooperatively with local governments and advocacy groups regarding bicycle/pedestrian projects and now operates with enhanced emphasis on bicycle/pedestrian facilities (via the March, 2011 "*Memorandum for Guidelines Emphasizing Bicycle and Pedestrian Accommodations*"), MPOs continue to be the main sources of bicycle/pedestrian planning and information within Texas. As discussed above, all 25 MPOs within Texas were surveyed for bicycle/pedestrian modal information within their respective MTPs and/or stand-alone bicycle/pedestrian plans. Table 1 depicts the 25 Texas MPOs reviewed, including information regarding their MTPs and any stand-alone bicycle/pedestrian plans or other pertinent plans and studies.

Table 1: MPO Bicycle and Pedestrian Plans

MPO	Location	Bike/Ped Included in MTP?	Additional Studies/Plans
Abilene MPO	Abilene, Texas	Yes	2004 Abilene Comprehensive Plan 2006 City of Abilene Sidewalk Master Plan 2008 A Safe Routes to School Master Plan for Abilene
Amarillo MPO	Amarillo, Texas	Yes	2010 Amarillo Hike and Bike Plan 2010 Amarillo Comprehensive Plan
CAMPO (Capital Area MPO)	Austin, Texas	Yes	2009 Bicycle Master Plan Update 2009 Sidewalk Master Plan 2011 Downtown Austin Plan Imagine Austin, 2012
South East Texas Regional Planning Commission (SETRPC)	Beaumont, Texas	Yes	
Brownsville MPO	Brownsville, Texas	Yes	1996 Bicycle and Pedestrian Plan 2003 Bicycle and Pedestrian Plan Update Brownsville Comprehensive Plan
Bryan-College Station MPO (BCSMPO)	Bryan-College Station, Texas	Yes	2009 City of College Station Comprehensive Plan 2010 Bicycle, Pedestrian, and Greenways Master Plan
CRP	Corpus Christi, Texas	Yes	Oso Parkway Plan, 1993 Parks Master Plan for Corpus Christi, 2002 Corpus Christi Thoroughfare Plan, 2003 Corpus Christi MPO Bicycle and Pedestrian Plan, 2005
El Paso	El Paso, Texas	Yes	Regional Bikeways Plan Study, 1997
Harlingen-San Benito MPO (HSB MPO)	Harlingen, Texas	Yes	Harlingen's Vision 2020 Comprehensive Plan First Major Plan Update, 2002
Houston-Galveston Area Council (H-GAC)	Houston-Galveston, Texas	Yes	2007 Regional Bikeway Plan Pedestrian and Bicyclist Special District Studies Building Better Bikeways, 2009 Pedestrian Pathways Bayou Greenway Initiative
Hidalgo MPO (HMPO)	Hidalgo, Texas	Yes	Multi-Modal Study, 2007 HCMPO Bike Plan, 2012
Killeen-Temple MPO (K-T MPO)	Belton, Texas	Yes	Killeen-Temple MPO Regional Thoroughfare and Bicycle/Pedestrian Plan, 2011
Laredo	Laredo, Texas	Yes	Laredo Urban Transportation Study
Longview MPO	Longview, Texas	Yes	
Lubbock	Lubbock, Texas		Texas Metropolitan Mobility Plan, 2006 Lubbock CBD Redevelopment Plan, 2006 Lubbock Metropolitan Area Bike Plan, 2007 2012 Bike Plan Update
Midland-Odessa Transportation Organization (MOTOR)	Odessa, Texas	Yes	Midland Master Plan 2025

Table 1: MPO Bicycle and Pedestrian Plans

MPO	Location	Bike/Ped Included in MTP?	Additional Studies/Plans
North Central Texas Council of Governments (NCTCOG)	Dallas-Fort Worth, Texas	Yes	Bicycle and Pedestrian Advisory Committee Bike Fort Worth, A Comprehensive Bicycle Transportation Plan, 2009 2011 Dallas Bike Plan
San Angelo MPO	San Angelo, Texas	Yes	The San Angelo Pedestrian/Transit Access Improvement Plan, The North Chadbourne Corridor Pedestrian/Transit Access Improvement Plan, 2010 2005 Bicycle/Pedestrian Plan for the San Angelo Area, Amended 2012 San Angelo Comprehensive Plan, 2009 2011 Streetscape Master Plan Parks, Recreation & Open Space Master Plan, 2012 Bicycle & Pedestrian Improvement Project, 2012
San Antonio-Bexar County MPO (SABC MPO)	San Antonio, Texas	Yes	Bicycle Mobility Advisory Committee Pedestrian Mobility Advisory Committee Complete Streets Resolution, 2009 Regional Bicycle Master Plan, 2011 San Antonio Bike Plan 2011 + Implementation Strategy Pedestrian Safety Action Plan, 2012
Sherman-Denton MPO (SD-MPO)	Sherman, Texas	Yes	Bicycle and Pedestrian Mobility Plan, 1998
Texarkana MPO	Texarkana, Texas	Yes	Master Bicycle and Pedestrian Plan, 2009
Tyler MPO	Tyler, Texas	Yes	The Regional Trail Plan, 2009
Victoria	Victoria, Texas	Yes	Paseo de Victoria, A Pedestrian and Bicycle Master Plan for Transportation and Recreation, 2013
Waco Urban Transportation Study (WUTS)	Waco, Texas	Yes	Downtown Waco Master Plan
WFS MPO	Wichita Falls, Texas	Yes	Bicycle Master Plan, 2005-2030 Vision 2020 Wichita Falls, 2008

In general, data and information provided by the MTPs and other bicycle/pedestrian plans include the following:

- Maps of bicycle and pedestrian facilities – existing conditions and future projects
- Bicycle/pedestrian program goals and objectives
- Lists of accomplishments/completed projects
- Lists of priority future projects
- Definitions of facility types
- Fiscal information – constraints, priorities, unfunded projects
- Facility design best practices
- Promotion of biking and walking
- Safety information

3.2 Gaps in Data and Recommendations – Bicycle/Pedestrian Mode

3.2.1 Information Gaps

While interest and participation in non-motorized travel such as biking and walking continues to expand, significant data gaps remain for the bicycle/pedestrian mode. Current usage data and forecasting tools have historically not been available. Consequently, bicycle and pedestrian needs assessments have typically been performed informally, without the measurement and attention given to other modes. In addition, a lack of statewide inventories, a lack of rural area information, and the variable level of detail provided by MPOs and cities presents some data gaps regarding the extent of the existing bicycle/pedestrian network.

3.2.2 Recommendations of Additional Data Needed to Address Information Gaps

While national surveys provide some limited data, Texas MPOs that have made significant bicycle and pedestrian investments may provide some data and information regarding bicycle/pedestrian usage. In addition, non-Texas MPOs and other jurisdictions and/or universities have investigated methods to address these common information gaps for the bicycle and pedestrian modes.

4.0 Needs Determination

The following sections provide a high-level summary of the methods used to estimate system needs for the TTP. The summary includes how bicycle/pedestrian needs can be defined, identified, and assessed given the data gaps discussed above.

4.1 Defining "Needs"

As discussed above, measurement of bicycle/pedestrian usage and future needs assessment is not widely performed and suffers from a lack of available information. However, due to increased focus and participation within these modes, the TTP will estimate system bicycle/pedestrian needs based on available information. With a lack of usage and performance data, needs will be identified and assessed as described below.

4.2 Identifying Investments

Identification of bicycle/pedestrian improvement projects with respective costs and benefits can be performed as follows:

1. Compile MPO or city-identified future projects with costs where available.
2. Identify urban area bike/ped system gaps that have no planned projects to address them and could benefit from future construction. Following identification of these system gaps, apply high-level estimated costs to identify potential future project costs and include these in the financial needs determination.
3. Include needs identified in Outreach Round 1.

4.3 Assessing "Needs"

Following the identification of improvement projects as described above, gaps would remain for rural area bicycle/pedestrian needs and maintenance and accessibility needs and costs where not identified by MPOs or cities. Assumptions could be attempted for these, but might be difficult to identify. Nevertheless, the sum of MPO and city-identified future project costs (#1 above) in addition to the high-level estimated projects and costs (#2 above) will provide cost information for statewide bicycle/pedestrian needs.

Texas Transportation Plan

Tech Memo 3.5: Aviation

February 28, 2014

Acknowledgements

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Table

1.0 Introduction/Scope

As the Texas state economy continues to grow at one of the fastest rates in the nation, increased demand for aviation services will create an operational challenge for the 292 airports[1] and two heliports for which TxDOT oversees capital development and maintenance programs and administers a block grant program. Aeronautics in the State of Texas had a total economic impact of $59.5 billion ($14.5 billion from general aviation) and supported 771,355 jobs in the State of Texas in 2010. With further forecasted economic growth in oil and gas production and a 61 percent and 80 percent respective growth in population and employment between 2010 and 2040, Texas airports will require significant investment levels to maintain/improve current levels of service.

This memo details a methodology for assessing long-term needs in light of forecasted airport service demand, and identifies data availability and gaps. The scope of the analysis will include the following:

- For all airports (commercial and general aviation) – collect, report, and develop needs based on data extrapolated from the existing 20-year capital program
- Provide recommendations for constrained priorities, as well as ongoing performance monitoring.

Furthermore, per discussions with TxDOT staff, a brief overview of best practices in airport asset management is included to help prepare future plans for a performance-based approach.

The memo is organized as follows:

- Introduction and Scope of aviation analysis
- Aviation demand forecasts
- Airport data availability and asset management best practices
- Methodology for needs assessment

2.0 Aviation Demand Forecasts

In 2012 the State of Texas ranked 3rd (behind California and Florida) in Tower Operations (which includes Touch-and-goes and Over flights) with a total of 4,674,903 Operations (Source: FAA). Preliminary estimates, reported in the 2010 Texas Airport System Plan, anticipates general aviation operations (takeoffs and landings) to increase by nearly 20 percent with a 65 percent increase in passenger enplanements between 2010 and 2025. Assuming the corresponding annual compounded growth rate (1.2 percent for general aviation operations and 3.4 percent for enplanements) continues, Texas airport operations can be expected to reach 7.4 million general aviation operations and 165 million passenger enplanements by 2040.

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[1] Of the 292 airports, 241 are classified as General Aviation. 26 as Primary Commercial Service, 24 as Reliever, and one non-primary commercial service.

Table 1: Expected Growth in Airport Operations

Demand Measure	2010	2025	2040 (extrapolated)
General Aviation Operations	5.2 Million	6.2 Million	7.4 Million
Passenger Enplanements	60.5 Million	~100 Million	165 Million

Source: 2010 Texas Airport System Plan

Texas' two busiest Airports, DFW (Dallas/Ft. Worth International Airport), and IAH (George Bush Intercontinental/Houston Airport) had 27,557,000 and 19,356,000 enplanements respectively in 2010. The FAA predicts that DFW will have an annual compounded growth rate of 1.96 percent while IAH will have a growth rate of 3.18 percent.

With urban growth and further economic development around increasing oil and gas production, airports may need to build longer runways to accommodate larger business aviation aircraft. This new demand could lead to a widening funding gap in the future if it is not properly anticipated and planned for. This recognition leads to the importance of improving data collection and analytical efforts through enhanced TxDOT Airport Asset Management processes.

3.0 Data Collection

Along with reviewing future demand projections, the Consultant Team gathered and reviewed the following documents: the 2010 Texas Airport System Plan, the General Aviation Economic Impact Study, the Pavement Management Program, the Routine Airport Maintenance Program (RAMP), and various FAA Reports including Operations counts and TAF Summary Reports.

To further understand the state airport management practices, the Consultant Team compiled the following questions concerning current conditions and long-term investment needs. This informal questionnaire was sent to a random sampling of General Aviation and Commercial airport operators across the state to better understand the data available for integration into the TTP 2040:

1. What is the average lifespan of a piece of airport equipment?
2. Do you have a program or system for tracking airport facility and equipment useful life?
3. Do you have an obstruction plan in your airport layout plan set?
4. Are there any obstructions around the airport impacting normal operations?
5. Do you have any obstruction removal plans? Do you have a Comprehensive Zoning Ordinance that helps limit tall structures and obstructions?
6. When was the last master plan?
7. Was there anything missing in the master plan?
8. Do your fuel farms fully comply with environmental regulations?
9. Do you have a Storm Water Management Plan?

10. Do you have a storm water pollution prevention plan (SWPPP) for your tenants?
11. Do you have your own pavement maintenance program?
12. What type of asset rehabilitation plans do you have (Pavement, Buildings, etc.)?
13. Do you have an adequate capital maintenance budget to keep all of your (airport owned) assets in their best condition for maximizing useful life?
14. Do you get money from TxDOT for capital maintenance each year? If so, how much do you receive?

This informal survey generally found that no common data system is available to identify future projects at the network level.

Discussions with Central Office staff additionally provided information on the System Plan Overview, Capital Programs, and how Capital Needs are supported. Information about the Block Grant Program and the Planning and Engineering Services that are provided to smaller airports were also discussed. As a result of these discussions, TxDOT staff expressed interest in best practices that could be applied to improve the ability to predict and meet future needs. Prior to discussing the needs methodology, a discussion of airport asset management programs is presented herein.

4.0 Best Practices

Having adequate asset management programs, obstruction management plans, appropriate funding, and the ability to maintain environmental compliance will benefit the continued growth and robust capital improvement programs of the Aviation Division of the Texas Department of Transportation.

Many airports in Texas do not have asset management programs, complete Pavement Condition Index (PCI) data, or an obstruction management plan, or do not maintain full environmental compliance. In addition, many airports do not fully take advantage of the State's funding system. The following are some best practices applicable to all airports within the Texas Airport System.

4.1 Pavement and Building Maintenance (Asset Management Programs)

Asset management is the planned, proactive, and cost-effective practice of constructing, operating, maintaining, upgrading, and disposing of assets. It can refer to the act of managing assets to achieve the greatest possible return on investment and to optimize the total cost of ownership for the owner. An effective asset management program can cover everything from airport vehicles, buildings, and pavements to security systems, signage, and drainage.

Airport industry best practices regarding the management of physical assets would include strong leasehold maintenance language with enforcement rights for airport owners, as well as lease reversion for longer-term leased assets. The American Association of Airport Executives maintains a data base of best practice standard lease agreements that can be used as a solid starting point for airport owners in need of a better return for their leasing programs.

Currently TxDOT also offers programs to help offset the costs of eligible asset maintenance work items. The first one is the Routine Airport Maintenance Program (RAMP), which covers items such as pavement maintenance, airfield lighting, security, etc. The program will match up to $50,000 per year for each airport that qualifies. In 2012, only 214 airports took advantage of the program. This is an excellent program in that it allows airports to leverage their local maintenance budgets as a means of doubling their civil works airport maintenance programs.

TxDOT also offers funding for construction of new terminal buildings under the Terminal Building Program. The state will split a 50/50 cost share for design and construction up to $1,000,000; 50/50 cost share for vehicle parking and entrance road up to $100,000; and a 90/10 cost share for aircraft parking aprons in addition to the building grant amount. These building and facility renovation programs can be used to revamp and improve the revenue potential for these airport facilities while relieving the airport owner from the high level of maintenance costs associated with older facilities.

A PCI is recommended for establishing a pavement maintenance program at all airports with hard pavement. Currently, many of the state's airports do not have PCIs for their pavements. Having an airport wide PCI for each TxDOT airport would establish a deterioration baseline and set the schedule and timing for more significant capital pavement maintenance. Managing the PCI and resulting maintenance regime would greatly extend the useful life of the more heavily used runway pavements. TxDOT offers a new program that conducts PCI studies annually and establishes a PCI for those airports not currently having one. It is highly recommended that airports take advantage of this service. Having a complete up-to-date PCI is extremely important from a long-term asset management perspective for all airports in the Texas system. As a Federal Block Grant Program state, Texas is able to offer airports within the state system access to maintenance and large capital funding to both maintain and remediate airports with low PCI pavements.

4.2 Obstruction Management

Obstruction management is the proactive act of keeping the airspace around the airport clear of any ground-based obstructions that may impede aircraft either arriving at or departing from a given airport. Obstruction management is extremely important for all airports. Obstructions can create extreme approach or departure routes and are obviously unsafe around airports.

For many airports in the National Airspace System, it is a struggle to keep Runway Protected Zones and Imaginary Surfaces free of obstacles. In many cases this is a maintenance issue related to the funding levels at airports. Federal Aviation Regulation (FAR) Part 77 includes standards for determining obstructions in navigable airspace, which apply to existing and future manufactured objects, objects of natural growth, and terrain. The airport operator is responsible for clearing and protecting the "imaginary surfaces" as defined in Part 77. It is recommended that airports push for a comprehensive zoning plan to help enforce these regulations. If an object is an obstruction to a Part 77 surface, it should be removed if feasible. If not achievable or feasible, the obstruction is subject to FAA analysis under the U.S. Standard for Terminal Procedures Order 7400.2 (TERPS) to determine if the object is a hazard to air navigation. Hazards that cannot be removed usually result in restrictions in the airspace environment. Federal funds are available for any feasible obstruction removal programs.

Best practices for obstruction maintenance at airports are centered on comprehensive zoning ordinances that are typically enacted by local municipalities. These ordinances are very effective in helping to maintain the full use of airport runways, and instrument approach procedures in locations where they are in force. Many state aviation agencies have compatible legislation that provides an additional layer of support to municipal airport owners regarding airport compatible zoning provisions. Some states also provide a zoning ordinance best practice clearinghouse function for their airports that includes educational programs and blanket zoning ordinances that can easily be adapted to each individual airport and municipality.

4.3 Environmental Compliance

Environmental compliance covers everything from water quality, air quality, and erosion control to fuel farm compliance. Environmental compliance is more important than ever. Not only does the Environmental Protection Agency (EPA) monitor environmental conditions, but there are smaller city and county governmental agencies that are empowered to monitor environmental compliance at the local level.

Fuel farms are required to be maintained under certain standards under the EPA. The EPA also requires a Spill Prevention, Control, and Countermeasure (SPCC) Plan if a hydrocarbon spill from the fuel farm could reach water and/or the airport stores of oil or gas in aboveground quantities of more than 1,320 gallons or completely buried tanks with more than 42,000 gallons below ground. Fuel farms that do not completely comply with state and federal regulations are eligible for funding under the RAMP Program. Additionally, TxDOT offers a very robust funding program for decommissioning and rebuilding fuel farms that are no longer environmentally compliant. The Texas airports should work with and seek advice from TxDOT regarding their fuel farm environmental compliance needs.

4.4 Airport Master Plans

In pulling all of these data collection and airport programs together, it is recommended for Texas airports to maintain an updated master plan. The FAA recommends initiating an airport master plan update for most airports on a 5-year cycle. This best practice helps the state and the airport sponsor plan for future airport needs. The plan should include planning for all traditional short-, medium-, and long-term capital needs. Additionally, for certain airports in the commercial service or reliever airport designation, the FAA will now fund safety and security planning and business/strategic planning modules as part of a master plan update, or possibly as a stand alone. It is highly recommended that the Texas airports take advantage of these planning programs as a means of improving the business/commercial, and safety/security aspects of their airport operations.

Currently, certain rural airports lack the funding to match TxDOT grant funding to perform an airport master plan. Additionally, certain reliever and more substantial general aviation airports have airport master plans that are dated and no longer valid. TxDOT offers these and other airports planning and engineering services that they can take advantage of at a reasonable local match cost. Also, TxDOT, through the Block Grant Program, is very responsive in programming funding for master plan updates for those airports that apply.

5.0 Methodology

5.1 Unconstrained Needs Assessment

TxDOT needs assessments have been traditionally developed through the Texas Airport Development System (TADS). The TADS provides a 20-year outlook of identified airport projects throughout the state. For each project the TADS maintains a database including a description, airport location, FAA Priority Score (including individual scoring components), and estimated construction cost.

The needs for the state over the next 20 years are then the total cost of projects in the TADS. From this number, extrapolation techniques (due to a lack of airport data available across the network) are to be applied to estimate long-term needs through 2040. For instance, demand forecasts are one metric that can be linked to current needs to help provide a clearer long-term picture for Texas. This needs total would then represent the cost to remove all current and projected deficiencies with regard to safety/security, statutory emphasis projects, reconstruction/rehabilitation, environment, planning, capacity, standards, and other local projects.

5.2 Financially-Constrained Analysis and Performance-Based Recommendations

As most clearly seen by the current backlog of projects, Texas airport investment levels are not expected to be able to fully fund identified needs. Towards this end, an approach to quantify what can be achieved at reduced funding levels is critical to set realistic performance targets. The proposed framework to support TxDOT in linking performance to investment level is to optimize sets of projects from the TADS for a variety of potential budget levels. This is proposed to be done by maximizing the program FAA priority score relative to the constraining budget by changing which projects can be implemented.

Additionally, performance measures will be analyzed and recommendations will be made to gather/monitor performance data. In the long-term, this information can be reported to provide potential performance scenarios for the state, along with the overall percent needs able to be funded.

Texas Transportation Plan

Tech Memo 3.6: Intelligent Transportation Systems

January 15, 2014

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Contents

Tables

Figure

1.0 Introduction

The purpose of this memorandum is to describe how the planning team will develop a long-range cost analysis for all Intelligent Transportation System (ITS) devices located in each district of the Texas Department of Transportation to assist with the long-range statewide planning.

The memorandum is organized into the following sections:

1. Scope of Analysis
    a. Investment
    b. Overview
2. Data Collection
    a. Data Availability
    b. Gaps in Data
3. Needs Determination
4. Constrained Analysis

2.0 Scope of Analysis

The following sections provide a summary of the types of financial need, or investment, considered in the analysis and the scope of services included for consideration in the Texas Transportation Plan (TTP). Also provided is the agency/stakeholder involvement by district and/or metropolitan planning organization (MPO) and a summary list of the documents reviewed.

2.1 Types of Investment

- **Preservation:** The capital investment required to maintain existing assets in a state of good repair (SGR). Reinvestment needs include rehabilitation and replacement of assets, as well as annual capital maintenance (ACM) needs. This will also include the cost of operating and maintaining (O&M) existing assets for current levels.
- **Service Expansion:** The capital investments and O&M costs for projected growth in levels based on the established long-range plans for each district. Service expansion includes the placement of new ITS devices, and the related expansion to existing facilities in response to growth and demand.
- **Major New Service:** The capital investments and related O&M costs to significantly improve levels of performance via enhancements to existing ITS systems or the extension and placement of new ITS systems and programs into new areas based on the established long-range plans for each district.

2.2 Agency Involvement

There are multiple agencies/stakeholders (including private groups) within the state of Texas that are or will be responsible for the funding, implementation, and O&M of the existing and proposed ITS assets. In some regions, ITS is managed primarily at the TxDOT District while in other regions ITS planning and implementation are coordinated by regional stakeholders. The stakeholders are identified in each District's or region's ITS Deployment Plan and will not be repeated here. Each region's ITS Deployment Plan identifies the responsible agency(s) but typically does not provide the sharing percentages when multiple agencies are involved. The following sections will identify the different services and agencies currently involved in ITS planning at an aggregated level.

2.2.1 Stakeholder Participation

A diverse group of stakeholders provide guidance and input to the development of each District or region's ITS Architecture and Deployment Plans. The stakeholders include not only the TxDOT District, but also numerous other participants:

- City Agencies
- County Agencies
- MPOs
- Emergency Services
- TxDOT Central Office Divisions
- FHWA
- Motor Carrier Administration
- ISPs
- Border Patrol
- School Districts
- Department of Safety

2.2.2 ITS Regional Transportation Services

As each TxDOT District developed the ITS Deployment Plan, the projects to be deployed were identified as short-term (<5 years), mid-term (5-10 years), and long-term (20 years). The projects to be deployed were then grouped with other like projects and placed in the categories below:

- Travel/Traffic Management
- Commercial Vehicle Operations
- Emergency/Incident Management
- Maintenance and Construction Operations
- Public Transportation Management
- Information (Archived Data) Management

2.2.3 ITS Regional Transportation Plans, Programs, and Studies

The Texas Regional Intelligent Transportation System Architectures website describes the regional architectures for the majority of TxDOT districts, with the major urban centers of Dallas and Houston represented by the regional MPO. Texas began to develop the regional ITS architecture in 2002, with the most recent plan completed by Eagle Pass in 2013. The regions and completion dates are listed below:

- Amarillo—January 2003
- Atlanta—November 2003
- Austin—February 2007
- Beaumont—December 2003
- Brazos Valley (Bryan)—April 2004
- Childress—August 2003
- Corpus Christi—April 2003
- Del Rio—February 2004
- Eagle Pass—October 2013
- El Paso—October 2003
- Laredo—June 2003
- Lower Rio Grande Valley (Pharr)—July 2003
- Lubbock—February 2005
- Lufkin—June 2005
- Paris—May 2005
- Permian Basin (Odessa)—March 2005
- San Angelo—November 2004
- San Antonio—August 2007
- Tyler—July 2003
- Waco—October 2004
- West Central Texas (Abilene and Brownwood)—September 2004
- Wichita Falls—January 2005
- Yoakum—July 2005

There are 25 MPOs in the state of Texas. The MPOs collaborated with TxDOT in the development of the ITS Architecture, but each MPO also produces a long-range regional transportation plan. Typically, the long-range plans address the mobility needs of the study areas from 2010 through 2035 and produce a funded and unfunded project list and included a four-year Transportation Improvement Program (TIP). The plans most often do not break out the ITS architecture needs from the other projects. Plans are available from the following MPOs:

- Abilene MPO
- Amarillo MPO
- Austin MPO (CAMPO)
- Beaumont-Port Arthur MPO (SETRPC-MPO)
- Brownsville MPO
- Bryan-College Station MPO
- Corpus Christi MPO
- Dallas-Fort Worth MPO (NCTCOG)
- El Paso MPO
- Harlingen-San Benito MPO
- Hidalgo County MPO
- Houston-Galveston MPO (HGAC)
- Killeen-Temple MPO (KTMPO)
- Laredo MPO
- Longview MPO
- Midland-Odessa MPO (MOTOR)
- San Angelo MPO
- San Antonio-Bexar County MPO
- Sherman-Denison MPO
- Texarkana MPO
- Tyler Area MPO
- Victoria MPO
- Waco MPO
- Wichita Falls MPO

Each MPO provides a TIP that is developed in accordance with the requirements of metropolitan planning guidance received from the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA). Some of the specific requirements include:

- Establish a priority list of projects to be implemented during a 4-year period
- Include a financial plan showing the source of funding for each project
- Assure that projects are consistent with the RTP
- Assure that the public is allowed time to comment on the TIP prior to approval
- Assure that the entire metropolitan region is included in the TIP
- Verify that previous TIPs show progress in implementing projects

3.0 ITS Data Collection

The following sections provide a summary of the data used to estimate ITS needs in later sections for the TTP. The summary includes:

- Current Inventory provided by TxDOT
- ITS Projects by District
- ITS Data collected from non-TxDOT sources
- ITS Subsystem/Unit Costs

3.1 Current Inventory Data

Each TxDOT District office provided an aggregated summary of ITS devices in place as of 2013. The summary includes the number of devices by type for each district. The devices include the following:

- Digital Message Sign (DMS)
- Closed Circuit Television Camera (CCTV)
- Lane Control Signals (LCS)
- Radar Detection
- Detection Loops
- Highway Advisory Radio (HAR)
- Ramp Meters
- Automatic Vehicle Identification (AVI) Sites
- Flood Warning Sensors
- Weather Sensors

Table 1 Texas ITS Asset Inventory

District	DMS	CCTV	CCTV Wireless	LCS	Radar Detection	Loops	HAR	Ramp Meter	AVI Site	Flood Warning	Weather Sensor	Total	RITA
Abilene (West Central TX)	4	0	0									4	4
Amarillo	13	16	0				1				0	30	29
Atlanta	10	0	14		0						2	26	0
Austin	49	168	0	389	35	2720	6					3367	301
Beaumont	19	0	30									49	19
Brownwood (West Central TX)	3	0	4									7	7
Bryan (Brazos Valley Region)	3	6	2									11	11
Childress	0	0	0									0	0
Corpus Christi	22	40	0		5							67	57
Dallas	92	193	118	24	250							677	657
El Paso	50	112	0	206	281		13					662	264
Ft Worth	71	81	98		141					0		391	465
Houston	181	636	75		165	0	11	86	158	24	23	1359	1149
Laredo (Laredo/Del Rio/Eagle Pass)	18	23	12	64	14	64						195	48
Lubbock	4	15	6		4					3	0	32	25
Lufkin	0	0	0									0	0
Odessa (Permian Basin TxDOT)	4	0	6								1	11	10
Paris	4	0	0									4	0
Pharr (Lower Rio Grande Valley)	16	1	0									17	0
San Angelo	0	0	0									0	0
San Antonio	216	147	19	263	149	1025	1			19		1839	720
Tyler	2	0	0				0					2	0
Waco	6	2	2									10	7
Wichita Falls	4	0	9			22				1	8	44	13
Yoakum	6	0	0		1							7	0
STATEWIDE	797	1440	395	946	1045	3831	32	86	158	47	34	8811	3786

Notes:
AVI: automatic vehicle identification
CCTV: closed circuit TV
DMS: digital message sign
HAR: highway advisory radio
LCS: lane control signal
RITA: Research and Innovative Technology Administration

The condition or location of each asset is not available at this time.

3.2 ITS Projects

The ITS Architectural Plans provided by each district identified service packages (formerly known as market packages) to launch and categorize the packages as High Priority, Medium Priority, and Low Priority. Service packages provide an accessible, service-oriented perspective to the National ITS Architecture. Stakeholders from each district were asked to prioritize the service packages. The packages are tailored to fit, separately or in combination, real work transportation problems and needs. Simply put, the packages identify the pieces of the physical architecture that are required to implement a particular ITS service. Each district then selected projects that meet the needs of the priority packages and categorized each project as short-term (<5 years), mid-term (5-10 years), and long-term (10-20 years). Each of the projects identified included an estimated cost, agency responsibility, and funding source (if available). It should be noted that even if a service package is considered high-priority, it could be classified as a long-term project because of funding or prerequisite project requirements, so deployment might not be feasible for several years.

3.3 Other ITS Data

The database and shapefiles used in the ITS Asset Viewer on the U.S. Department of Transportation – Research and Innovative Technology Administration (RITA) website was obtained. A screenshot of the ITS Viewer near the interchange of I-35 and State Route 290 in Austin, Texas is included below. This database provides the ITS asset type and location for most devices in place. The database appears to be current through 2012, but does differ from the aggregated summary provided by TxDOT as described in Section 3.1.

Figure 1 RITA ITS Viewer

3.4 ITS Costs—Capital and O&M

Historical ITS costs are not available from TXDOT. To arrive at a reliable estimate of costs, historical costs will be used from a national database. RITA provides access to its Costs Database which provides cost estimates for ITS deployments. The Costs Database will be used to assist in determining the long-term funding needed to maintain existing ITS assets as well as the capital costs of projects that are to be launched and maintained. The Costs Database provides both unit costs as well as system costs summaries. The unit costs will be used to determine the maintenance and replacement costs while the systems costs can be used to estimate the funds needed to launch future projects.

3.5 Gaps in Data and Recommendations

The accuracy of the needs estimate could be improved with additional data.

1. Age of current ITS assets—An accurate age of each device in place would allow for replacement costs to be accurately forecasted, or more specifically, when a specific device would be forecasted to fail. This is not a fatal flaw to determine the overall need, as the age of the devices can be spread out based on the forecasted life span of each device.
2. The life spans of the existing and proposed ITS assets will be based on information provided from the RITA website. The RITA website is an average across the United States and does not take into account the weather conditions of the different parts of the country. If the life spans of devices in Texas vary, that will not be accounted for unless that specific information can be provided.
3. Ideally, updated deployment plans for each district would be provided to identify which of the projects have been launched, implemented, removed/added to the long-range plan. The deployment plans would also include the specific devices to be installed or the forecasted annual maintenance cost for each project.
4. Finally, ideally the RITA database reflecting the ITS assets in place in the state of Texas would match the aggregated summary provided by the districts. While this will not have a direct impact on the needs determination, it would allow more accurate future management of the devices.

4.0 Needs Determination

The following sections provide a high-level summary of the methods used to estimate ITS needs for the TTP. The summary includes:

- Assumptions
- Estimate of Preservation and Service Expansion needs
- Major New Service project collection
- Constrained funding scenarios

4.1 *Financial Assumptions*

A basic set of financial assumptions are required to estimate capital and O&M costs for ITS assets over time. The assumptions include replacement costs, life-cycle costs, and inflation rates; and are presented below.

4.1.1 Unit Costs

Developing and maintaining an accurate database for the ITS asset inventory is a resource intensive task in itself. Rather than create the database, RITA has established system costs and unit costs that can be used at both the planning level and the O&M level.

Table 2 shows unit capital costs and O&M costs for select ITS devices in place throughout the multiple districts within TxDOT. The average costs between the high and low estimates will be used for both the capital costs and the O&M costs. All costs are reflected in year 2009 dollars. The unit costs applied to ITS assets in Texas will be adjusted to current year figures.

Table 2 ITS Cost Elements (USDOT/RITA)

Subsystem/Unit Cost Element	Lifetime (years)*	Capital Cost ($K)		O&M Cost ($K/year)		Description
		Low	High	Low	High	
Inductive Loop Surveillance on Corridor	5	2	6	0.3	0.5	Double set (four loops) with controller, power, etc.
Inductive Loop Surveillance at Intersection	5	7.5	13.3	0.8	1.2	Four legs, two lanes per approach.
Infrared Sensor Active		4.7	6			Sensors detects movement in two directions and determines vehicle speed, classification, and lane position.
Infrared Sensor Passive		0.6	1.0			Sensor covers one lane and detects vehicle count, volume, and classification.
CCTV Video Camera	10	8	16	1	2.0	Cost includes color video camera with pan, tilt, and zoom (PTZ), cabinet, electrical services, encoder/decoder, and installation.
CCTV Video Camera Tower	20	5	14			Low cost is for a 35 ft tower. High cost is for 90 ft tower. Includes foundation, pole, conduit, and labor. Camera lowering unit would be additional. Camera tower requires minimal maintenance.
Environmental Sensing Station (Weather Station)	25	25	42	1.6	3	Environmental Sensing Station (ESS), also known as a weather station, consists of pavement temperature sensor, subsurface temperature sensor, precipitation sensor (type & rate), wind sensor (speed & direction), air temperature and humidity sensors, visibility sensors, and remote processing unit (RPU). ESS provide condition data and are basic components of larger Road Weather Information Systems (see RWIS under TMC subsystem). RPU replaced every five years. O&M includes calibration, equipment repairs, and replacement of damaged equipment. O&M costs could be higher if state provided maintenance.
Ramp Meter	5	21	42	1.0	2.3	Includes ramp meter assembly, signal displays, controller, cabinet, detection, and optimization.
Software for Lane Control	20	25	50	2	5	Software and hardware at site. Software is off-the-shelf technology and unit price does not reflect product development.
Lane Control Gates	20	66	100	1.3	2	Per location.
Fixed Lane Signal	20	4	5	0.4	0.5	Cost per signal.
Dynamic Message Sign	10	41	101	2.0	5	Low capital cost is for smaller DMS installed along arterial. High capital cost is for full matrix, LED, three-line, walk-in DMS installed on freeway. Cost does not include installation.
Dynamic Message Sign Tower	20	28	136			Low capital cost is for a small structure for arterials. High capital cost is for a larger structure spanning three to four lanes. DMS tower structure requires minimal maintenance.
Dynamic Message Sign – Portable	14	15.9	21	0.5	1.6	Trailer mounted full matrix DMS (three-line, 8-inch character display); includes trailer, solar or diesel powered, and equipped with cellular modem for remote communication and control. Operating costs are for labor and replacement parts.
Highway Advisory Radio	20	15	36	0.6	1	Capital cost is for a 10-watt HAR. Includes processor, antenna, transmitters, battery back-up, cabinet, rack mounting, lighting, mounts, connectors, cable, and license fee. Super HAR costs can exceed $9K additional. Primary use of the super HAR is to gain a stronger signal.
Highway Advisory Radio Sign	10	4	8	0.22		Cost is for a HAR sign with flashing beacons. Includes cost of the controller.

Notes:
* Not available for all unit cost elements
^ Applicable to ITS Deployment Analysis System (IDAS) software

4.1.2 Cost Inflation

The needs reported for capital and O&M are in year of expenditure dollars (YOE), as per TxDOT requirements for MPOs. In order to inflate current dollars to YOE, an inflation rate of 4 percent will be used. This rate is recommended by TxDOT for long-term planning. The largest MPO In the state, HGAC, uses a much lower inflation rate of 2.54 percent, which means that the direct comparison of costs to individual MPOs may vary.

4.1.3 Funding Growth

In order to determine the impact of constrained funding on future assets, preliminary capital funding scenarios will be developed. CH2M HILL will coordinate with TxDOT on historic funding levels and potential future funding to generate the preliminary scenarios.

4.2 Estimation of Preservation and Expansion Needs

A model will be derived to calculate both the statewide unconstrained and constrained needs to maintain the existing devices and to provide for future needs.

4.2.1 ITS Needs Model

The model will be used to estimate the total level of reinvestment needed to maintain state of good repair (SGR). All existing ITS assets will be assumed to be in the "state of good repair" that is on par with the assumed age of each device. The model will determine for each year the capital costs needed for replacement of existing ITS assets based on the forecasted life span and the O&M cost for each ITS asset that has not reached the end of its useful life.

All investment needs will be initially estimated using an unconstrained scenario where funding is not limited. In reality, this is not likely to occur as each agency has restricted funding and may not be able to expend the reinvestment capital required to maintain ITS assets in SGR.

4.2.2 Life Cycle Profiles of Assets

The life cycle of an asset is defined by its useful life, and the annual capital maintenance needs. Both of these figures are provided in Table 2. Because the age of each ITS asset is not available, the age of each asset will be prorated based on the number of devices in place and the stated life span. For example, if a specific ITS device has a life span of 3 years and there are a total of 3 devices in place, the age of each device will be assumed to be 0, 1, and 2 years old respectively for the current year of analysis. Devices will be assumed to be replaced at the end of its useful life cycle, and all other years will require an annual maintenance cost beginning at the end of the first year.

4.3 Expansion—Capital & O&M Costs

The ITS Deployment plans completed by the TxDOT districts provide projects to be implemented over the short-, medium-, and long-terms. Due to the age of each deployment plan, it is necessary to make assumptions of what has or has not been implemented. For the sake of the analysis (with the exception of Eagle Pass), all short-term and mid-term projects are assumed to be implemented and included in the current inventory of ITS devices. All long-term projects will be assumed to be on track to be implemented in the future. In the unconstrained analysis, all long-term projects will be assumed to be implemented between the current year and 10 years out and allocated equally for each year. O&M costs for each project coming on line will be assumed to be 3 percent per year. The life cycle for each project coming on line will be accordance with Table 2.

4.4 Constrained Funding Scenario

The Texas transportation system is subject to a common trend across the country: diminishing revenues and higher costs. TxDOT, like most other departments of transportation (DOTs) throughout the country, is experiencing declining revenues and increasing demands on the transportation system.

Given the limitations, more realistic scenarios of constrained funding and constrained capacity to expend that funding will be developed to determine the impact on ITS asset conditions. CH2M HILL will generate projected revenue streams for the following two scenarios:

- Scenario 1: Expected capital funding (current capital funding forecast)
- Scenario 2: Funding required to maintain the current SGR

The first scenario is based on the growth in capital funding in Texas. Actual capital funding totals reported for FY2010 and FY2011 will be used for the first year of analysis. The following year forecasts will be based on a trend rate of increase in capital funding using a weighted average of growth rates reported for funding over the relevant time period in available MTP/RTPs. The resulting 3.7 percent annual growth rate will be applied to a baseline year. Again, not all MPOs reported growth rates for funding sources, so the weighted average rate will not result in a one-to-one comparison of funding growth for MPOs.

The second scenario is a 'what if' analysis based on roughly maintaining the current value of the SGR. In order to determine the level of funding required to maintain that value, the model uses a 'goal seek' function to determine the correct level of annual investment needed to keep the backlog roughly steady.

Texas Transportation Plan

Tech Memo 3.7: Statewide Analysis Model (SAM-V3)

February 26, 2014

Acknowledgements

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Contents

Tables

Figures

1.0 Overview

This Technical Memorandum (Tech Memo #3.7) is organized into two sections: travel demand model background; and model network refinement for the Texas Transportation Plan (TTP). The work described in this report consisted of enhancing the Texas Statewide travel demand model (SAM-V3) such that outputs of the traffic model will provide reasonable and replicable forecast year traffic volumes for both the Build (with project) alternatives and No Build (without project) conditions. The following sections provide information on the steps of the development of the traffic forecasts including data inputs, analysis assumptions, and methodology (including any adjustments made to the SAM-V3).

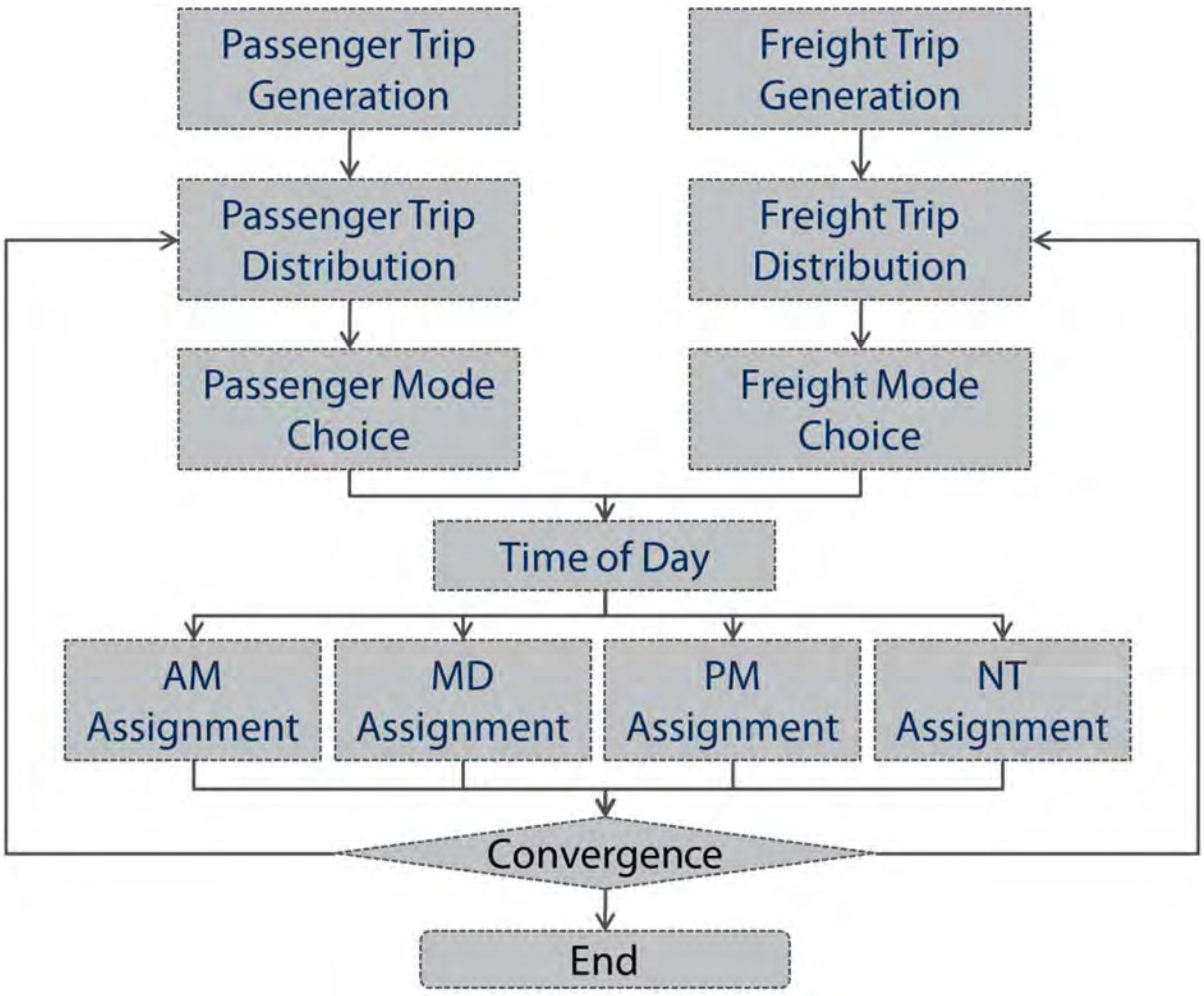
2.0 Travel Demand Model Background

Travel demand models forecast traffic volumes based upon the relationship between population (demand) and the transportation system (supply). The same general four steps are found in most travel demand models developed for an urban area: Trip Generation; Trip Distribution; a Mode Choice; and Multimodal Traffic Assignment, which can have a feedback loop for trip distribution through assignment, as discussed later in this memorandum.

The Texas Department of Transportation maintains a robust statewide travel demand model, referred to as the Texas Statewide Analysis Model (SAM). In 2013, the third version of the SAM was completed. The Texas Statewide Analysis Model Version 3 (SAM-V3) is a state of the practice multimodal travel model that provides highway traffic forecasts for both highway passenger travel and freight transport, intercity and high speed passenger rail ridership, freight rail tonnage and train forecasts, and forecasts of air passenger travel to and from Texas airports. The SAM-V3 provides travel forecasts at a level of detail suitable for use in comparative analyses of large-scale transportation corridor projects and other large scale investments. The model can also be used to perform analyses of the transportation outcomes and economic impacts of state-level transportation, land use, and economic policy decisions and strategies.

Figure 1 depicts the designed model structure for the SAM-V3, which shows how passenger trips go through trip generation, distribution and mode choice steps, and then are joined together with freight truck trips at the time of day step. The SAM-V3 has four time of day periods: AM (morning peak), MD (mid-day off-peak), PM (evening peak), and NT (night time off-peak). Finally, the figure shows how congested travel time is fed back to passenger trip distribution so that the distribution is based on more realistic highway travel times.

Figure 1: Model Structure



2.1 Passenger Models

The SAM-V3 includes daily trips that are similar to those that occur within an urbanized area, which are no different from those that are modeled in existing urban models. These trips are referred to as daily trips. However when considering statewide travel in a state the size of Texas and interstate travel between Texas and surrounding states, there are much longer trips that may occur over several days that require further refinement of the types of trip purposes defined. The longer and multi-day trips are referred to as infrequent long distance trips. To distinguish between long distance versus daily trips, trips that are less than 150 miles are considered day trips and trips that exceed 150 miles are considered long trips.

Seven internal trip purposes are identified in the SAM-V3 model application:

- Intra-city trips
  - Home based work (HBW)
  - Home based other (HBO)
  - Home based school (HBS – HB school)
  - Non-home based other (NHBO)
  - Non-home based visitor (NHBV – NHB visitor)
- Inter-city trips
  - Infrequent long distance business trips (ILDB)
  - Infrequent long distance other trips (ILDO)

2.1.1 Trip Generation

Trip Generation is the first of the four primary steps in the travel demand model process. The result of the Trip Generation step in the travel demand model process is a set of trip productions and trip attractions for each TAZ by trip purpose or, in the case of freight, by commodity. These productions and attractions are used to populate a seed matrix that is passed to the trip distribution step.

By definition, a person trip is a person traveling from one place to another for a defined purpose. Consequently, trip generation is closely related to both the characteristics of a place and a person. Socioeconomic attributes of each TAZ, including the population and employment counts, are utilized by the Trip Generation model to determine the number of trips produced and attracted to each TAZ.

The production rates for the SAM-V3 were derived using 2009 National Household Travel Survey (NHTS) data, more specifically, the 20,000 NHTS add-on surveys sponsored by TxDOT. Trip rates were computed as motorized person trips. Passenger trip productions were then stratified by:

- Four household size categories
- Four income segments
- Eight area type categories.

Both the household size and income stratifications were determined using 2000 Census Transportation Planning Package (CTPP) data.

Trip attractions were estimated from work place surveys for four urban areas in the state and the 2009 NHTS. Attraction rates were estimated by area type, employment type, income group, and trip purpose. The stratification by income group was included to allow income segments to be maintained throughout the model stream for use in the traffic assignment step. This stratification allowed for more accurate analysis of toll facilities and more detailed interpretation of mode choice utilities.

2.1.2 Trip Distribution

Trip Distribution is the second step of the traditional four-step model, which identifies the production zone and attraction zone of a trip generated in the trip generation model based on the trip length frequency curve.

The SAM-V3 uses a traditional Gravity Model that distributes trips according to characteristics of land use and the transportation system in the study area. This Newtonian analogy states that the number of trips traveling between any zone pair is a function of the magnitude of the total productions and attractions in the two zones and the travel impedance between the zones. The highway network attributes describe the transportation system characteristics used to measure travel impedance (e.g., distance, travel time, etc.). The model can be mathematically stated as:

$$T_{ij} = P_i \times \frac{A_j \times F_{ij}}{\sum_k A_k \times F_{ik}}$$

Where:

T_{ij} = forecast flow produced by zone *i* and attracted to zone *j*

P_i = the forecast number of trips produced by zone *i*

A_j = the forecast number of trips attracted to zone *j*

F_{ik} = friction factor between zone *i* and zone *k* (F-Factors)

Travel time is used as the measurement of separation between zones for the purposes of applying the Gravity Model, with trip lengths measured in minutes. In the SAM-V3 trip lengths are derived from the NHTS. Separate distribution models are run for the income segments within each trip purpose.

2.1.3 Mode Choice

Mode Choice is the third step in the travel demand modeling process. Mode Choice models are used to assign a mode of travel to each person trip.

The passenger mode choice model in the SAM-V3 is structured as a nested logit model. The mode choice models are structured in a manner similar to many urban models in which peak travel times are used for work related trip purposes and mid-day travel times are used for non-work related trip purposes. This structure allows one mode choice model to be run for each trip purpose. The time of day step is located after mode choice, thus avoiding the running of four mode choice models for each trip purpose. Trips can be forecast for auto drivers, auto passengers, intercity rail passengers, high speed rail passengers and air passengers.

Alternative Modes

The transportation modes considered in the SAM-V3 are the following:

- Drive alone
- Share ride 2
- Share ride 3+
- Urban bus
- Urban rail Intercity rail with a combination of 3 access modes and 3 egress modes
  - Drive access, rail access, and walk access respectively
  - Drive egress, rail egress, and walk egress respectively
- High speed rail with a combination of 3 access modes and 3 egress modes
  - Drive access, rail access, and walk access respectively
  - Drive egress, rail egress, and walk egress respectively
- Air travel with a combination of 3 access modes and 3 egress modes
  - Drive access, rail access, and walk access, respectively
  - Drive egress, rail egress, and walk egress, respectively

2.2 Freight Models

The process to address freight performance in the SAM-V3 follows a similar four-step model approach for model development. A four-step model develops trip tables, which are then assigned to modal networks where the resulting modal volumes, routing, and travel time information can then be used to evaluate freight performance by mode. The SAM-V3's freight models were developed using the 2010 Texas centric TRANSEARCH freight flow database produced by IHS Global Insights (IHS), which is a commodity flow database. The following sections describe the individual steps of the four-step freight model in detail.

2.2.1 Trip Generation

The freight trip generation model is very similar to the passenger generation model in that both are based upon relationships that are estimated with an observed set of data. In the trip generation model, the Texas TRANSEARCH database provides data on movements of freight to and from Texas counties by Commodity Groups. These movements are used as the dependent variable to estimate the freight trip generation. The trip generation model estimates the tonnage of freight produced at a location, and the freight tonnage attracted to a location (in annual tons), for the 15 commodity groups listed in Table 1.

Table 1: Commodity Groups

Commodity Number	Commodity Name
1	Agriculture
2	Mining
3	Coal
4	Nonmetallic Minerals
5	Food
6	Consumer Manufacturing
7	Non-Durable Manufacturing
8	Lumber
9	Durable Manufacturing
10	Paper
11	Chemicals
12	Petroleum
13	Clay, Concrete, Glass
14	Primary Metal
15	Secondary & Misc. Mixed

The dependent variable in the development of freight generation equations needs to be a measure of those activities which give rise to freight movements. An appropriate measure of the amount of economic activity by industry is the quantity of employment in each industry. Demographic and economic inputs were developed for the SAM-V3 for industries according to the North American Industrial Classification System (NAICS). Employment totals were aggregated by NAICS defined industry for all traffic analysis zones (TAZs) within each Texas county.

2.2.2 Trip Distribution

Trip distribution is the step which determines the flow linkages between the origin of trips and the destinations of trips. In trip distribution, the productions and attractions developed in trip generation are distributed based on distance skims (impedances) to get an origin-destination (O-D) trip table for each commodity group. For each commodity group, the freight distribution model allocates the annual tons produced at an origin to the annual tons attracted to a destination. This distribution process meets the economic theory requirement that trips being distributed from each origin must sum to its productions and that those being distributed to each destination must sum to its attractions.

2.2.3 Mode Choice

In freight mode choice, the origin and destination tables developed during trip distribution are allocated to the various modes of travel. Modes include truck, carload rail, and intermodal rail. The incremental logit choice model utilized by the SAM-V3 allows for the consideration of known mode shares derived from the TRANSEARCH database while allowing for changes in mode share stemming from changes in the cost of travel to be considered.

For each of the 15 distinct commodity groups, the freight mode choice model allocates the annual tons distributed between an origin and a destination to the modes available to carry freight between that origin and that destination. The baseline for applying the increments was a Texas focused TRANSEARCH database purchased by TxDOT.

2.2.4 External Trips

Freight is also generated at the boundary of the area covered by the SAM-V3, the Texas state line, at points referred to as external stations. The trip generation process used for freight within Texas does not account for freight flows to external locations for which the model does not have information on the socioeconomic characteristics. The water and air modes are recognized to be the domestic portion of a shipment, the foreign portion of the freight shipment is not included in the SAM-V3, and the freight shipment is assumed to begin or end at freight generators within Texas.

A freight model to distribute tonnage between Texas and other US states, Mexican states, and Canadian Consolidated Metropolitan Areas and Provinces was developed for SAM-V3. This freight distribution model required productions and attractions for all Texas-North American Freight Forecasting Model (TX-NAFF) zones external to Texas as well as for zones in Texas. The trip generation procedure described above provides the productions and attractions for all zones in Texas. The model does not, however, estimate productions and attractions for zones outside of Texas. For those zones, the productions and attractions were obtained from the TRANSEARCH database. The trip distribution model then joins the two sets of productions and attractions into trips.

2.2.5 Convert Annual Tonnage to Weekday Trucks

While the freight model forecasts freight flows in annual tons, the SAM-V3 highway traffic assignment step assigns vehicles to its model networks to allow for interaction with passenger vehicles. Therefore, the SAM-V3 converts the annual flow of truck tonnages into flows of freight trucks. This is done using annual factors and a table of payload factors, which are unique to each commodity group. The Texas 2010 TRANSEARCH database reports flows both in units, which for the truck mode is trucks, and tons. This TRANAEARCH information was used to develop the table of payload factors. It should be noted that the TRANSEARCH payload factors include only fully loaded trucks.

2.3 Joint Passenger and Freight Steps

2.3.1 Time of Day

After the passenger and freight mode choice models are run, time-of-day factors are applied to allow for separate traffic assignment for each of four time periods (AM peak, midday, PM peak, and overnight). Diurnal factors by direction were estimated from the 2009 NHTS for passenger trip purposes, and from vehicle classification counts for truck trip purposes. In the SAM-V3, which forecasts both passenger travel and several modes of freight travel, diurnal factors are developed separately for the passenger and freight components, but are applied in the same step, the Time of Day step.

2.3.2 Assignment

The assignment of traffic to the highway network is the final step in the traditional modeling process. It assigns trips to the most efficient route based on travel time and cost. The combination of all assigned trips on a roadway network produces an estimate of the flow of traffic.

In SAM-V3, the passenger and freight highway trips are combined and assigned using a multi-class highway assignment procedure. The model was designed to perform at the daily (that is, 24-hour) level with the flexibility to examine four distinct time periods: AM Peak, Mid-Day, PM Peak, and Overnight. Toll analysis is handled with a generalized cost function during traffic assignment. Daily flows of truck tonnages are converted to freight trucks for assignment purposes using payload factors for each commodity group.

Feedback Loop

The SAM-V3 includes a feedback loop from the trip assignment step to the trip distribution step. The purpose of the feedback loop is to produce realistic travel times on the highway network for a given analysis year, particularly future forecast years. The feedback loop takes congested travel times from the assignment step and supplies the travel time for the next iteration of trip distribution. During each iteration, a comparison of assigned traffic volumes to previous iterations is performed using the Method of Successive Averages (MSA). The feedback loop iterates until the convergence criterion is met.

2.4 Networks

The two basic building blocks of a travel demand model are the transportation system networks and the traffic analysis zones (TAZs). The networks represent the multimodal transportation system, including different categories of roads (such as freeways, arterials, collectors, ramps, etc.). Most travel demand models are structured to rely heavily upon information about the transportation systems. Commonly, the following types of information are retrieved from the network layer:

- Speed of facilities
- Travel time from zone to zone
- Capacity of each facility in the system
- User cost (tolls and operating cost).

Some of these inputs to the travel demand model, in turn, are themselves calculated from additional information about the transportation facilities. While the posted speed limit or the toll for a facility is stored directly on the network layer, network layer attributes such as capacity are calculated based on the physical and functional characteristics of the facility. These characteristics can be stored on the network layer where the characteristics can be modified to test transportation improvement scenarios.

The TAZs are geographical areas that link land uses with the transportation system. The data describing socioeconomic and demographic characteristics of the TAZs are tied to the transportation system using zonal centroids and their associated centroid connectors. The network and zonal densities (granularity) of these two elements should be relatively consistent in order to produce realistic loading of traffic onto the transportation system.

The SAM-V3 uses a multiyear and multimodal network for the analysis of travel demand in the State of Texas. The SAM-V3 multiyear multimodal network is described from three aspects:

- Network attributes (both road network and other mode networks)
- Network selection criteria
- Methods and procedures for development of some attributes of the network.

Figure 2 and Figure 3 show the SAM-V3 multimodal network, by mode, for the State of Texas and for the North American Area.

Figure 2: SAM-V3 Network by Mode Code (Texas)

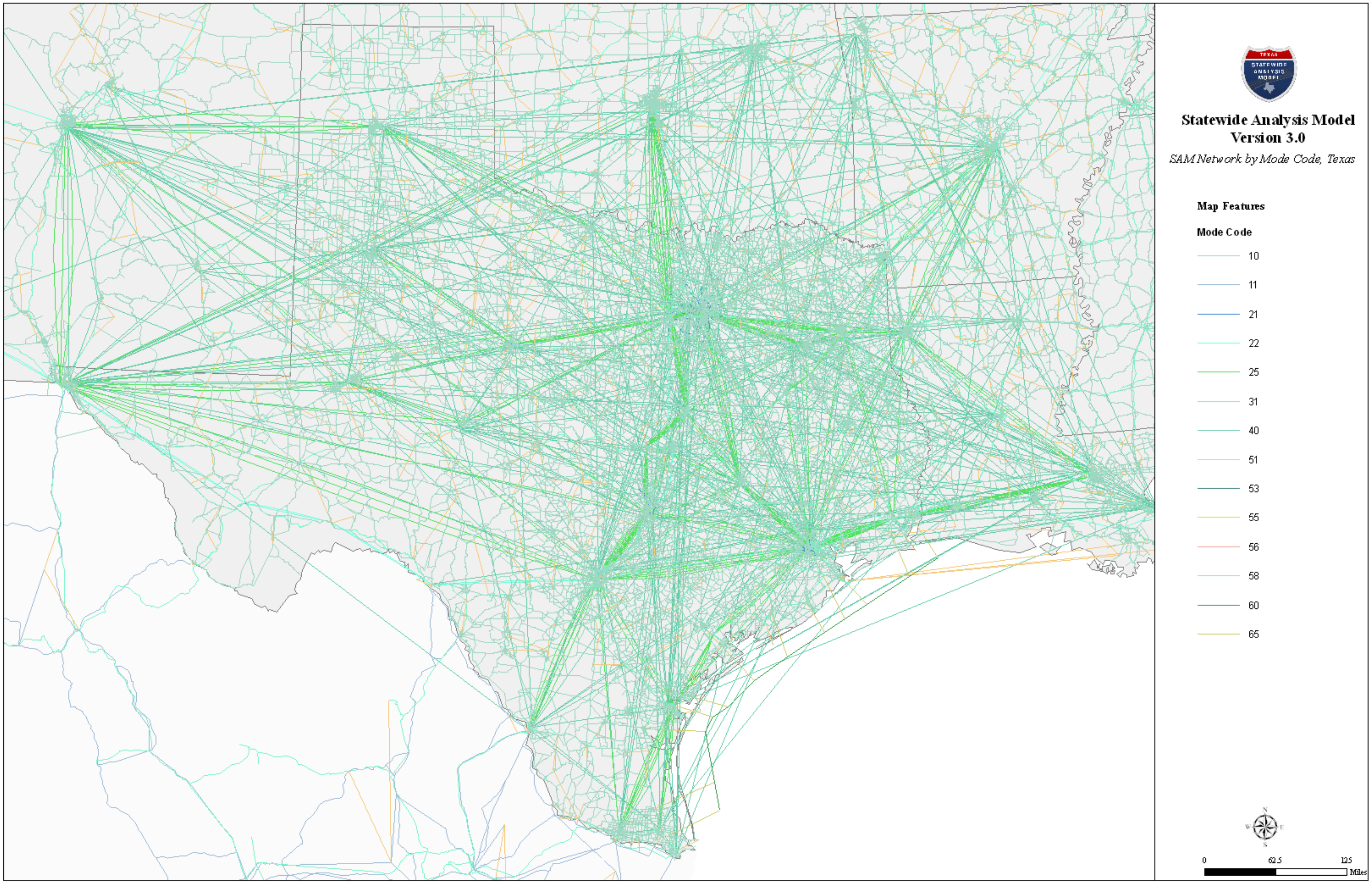
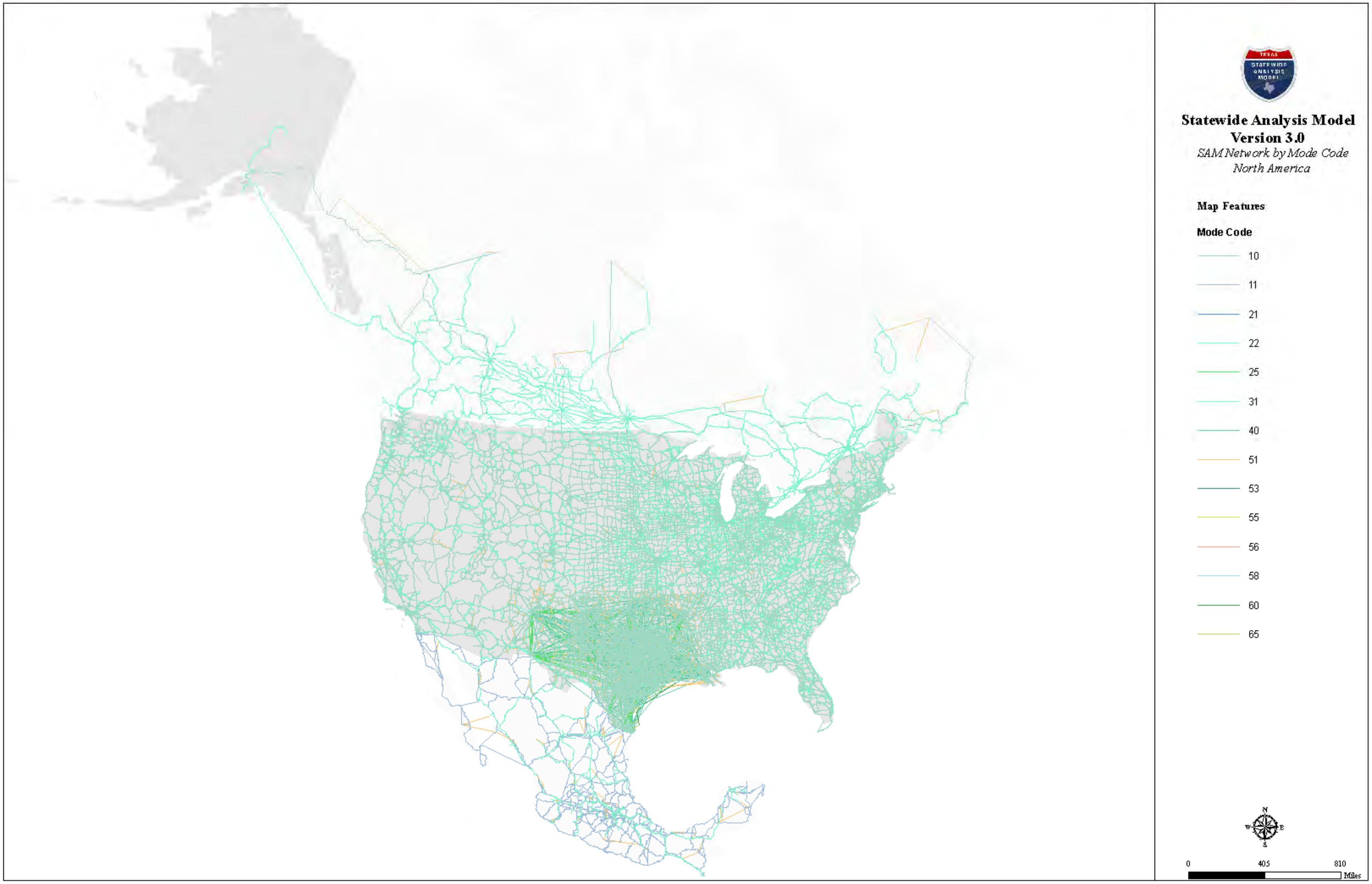


Figure 3: SAM-V3 Network by Mode Code (North America)



The SAM-V3 includes up-to-date network elements for all passenger modes, including:

Roadway Network Attributes

- Future Projects: Major existing and future roadway projects in Texas
- Posted Speed: Recent speed limit changes on Texas interstates
- HOV/HOT Lanes: HOV and HOT lanes from the Houston and Dallas metropolitan areas
- Toll Roads: Toll rates on existing and future roadways

Attributes for other modal networks

- Intercity Passenger Rail
- Urban Passenger Rail
- High Speed Passenger Rail

2.4.1 Additional Road Network Attributes

The basic road network attributes include attributes needed for the capacity procedure, as well as the results of the capacity procedure. These attributes contain capacities and travel times for both the 24-hour time period, and for four shorter time periods, representing peak and off-peak travel times. In the following section, attributes related to the future road improvement, specifically HOV lanes and toll road facilities, are explained.

2.4.2 Attributes for Other Modal Networks

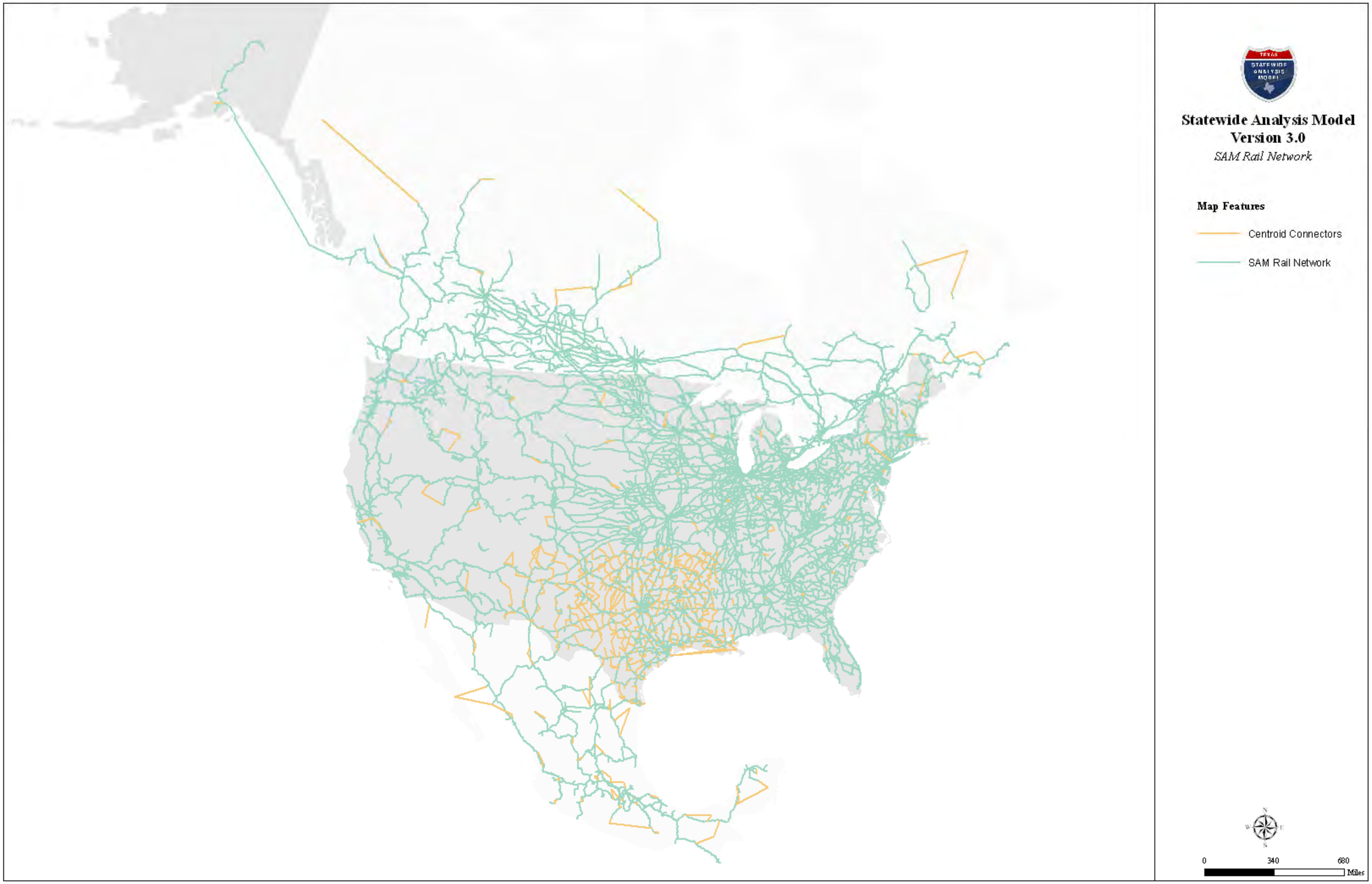
The SAM-V3 multi-modal network also includes a rail network, an air network, and a water network. In this section, attributes for the network components associated with passenger modes other than automobile are discussed.

Rail Network

The SAM-V3 rail network includes freight rail and passenger rail. The SAM-V3 rail network is based on a rail network developed and maintained by the Oak Ridge National Laboratory Center for Transportation Analysis (CTA).

The CTA Railroad Network is a representation of the North American railroad system that contains every railroad route in the US, Canada, and Mexico that has been active since 1993, as shown in Figure 4. It is intended for logical network programming, traffic analyses, and mapping applications. Railroad corporate ownership changes frequently. Therefore, corporate structure, a key to the simulation of routing, is explicitly temporal, thus allowing for historical studies and comparisons. Supporting data on interlines and corporate ancestry allows the construction of routable networks for a specific target date. The network is an extension of the Federal Railroad Administration's (FRA) strategic network.

Figure 4: SAM-V3 Rail Network



The CTA rail network contains the following characteristics:

1. Virtually all active US lines that have 100 meter geographic accuracy
2. Rail subdivision
3. Traffic densities that have been transcribed from the FRA strategic network of 2005 for all US lines above 1 million gross tons/yr. (Classes: 1=below 1M tons, 2=5M, 3=10M, 4=20M, 5=40M, 6=60M, 7=above).

Passenger Rail

The passenger rail network includes three types of rail: urban rail, intercity rail and high speed rail (HSR). Currently, four metropolitan areas in Texas are serviced by urban rail: Austin, Houston, and Dallas/Fort Worth. A few more urban rail lines are planned for the future, according to the respective Metropolitan Planning Organizations' (MPO) transportation plans. The existing and planned urban rail lines were all coded into the SAM-V3 network as shown in **Figure 5** and are distinguished by their constructed years. The route ID range for urban rail has also been designed to reflect service locations, as shown in **Table 2**.

Table 2: Urban Rail Route ID Ranges[1]

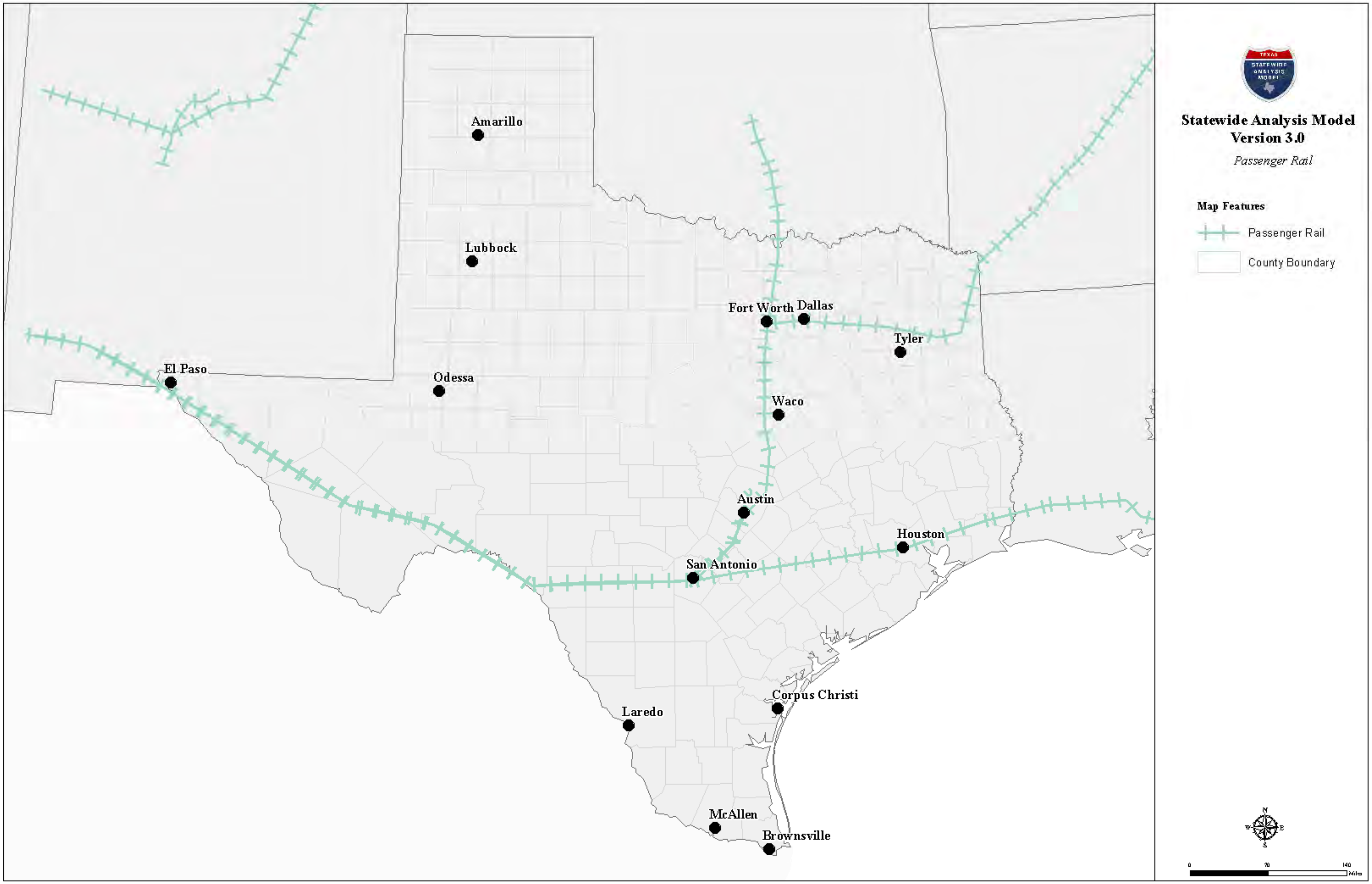
Route ID Range	Location	MODE_CODE	Number of Routes
2001-2099	Dallas Area	21	18
2101-2199	Houston Area	21	8
2201-2299	Austin Area	21	2
2301	LSTAR (between Austin and San Antonio)	22	1

The intercity rail network for the SAM-V3 was developed based upon route information from AMTRAK, which was the only long distance passenger rail service operation in Texas in 2010. A review of AMTRAK stops and stations was also conducted, and the rail layer was updated to reflect recent changes to the service. This updating process was done to ensure that the proper connectivity of the passenger rail system was maintained. In 2010 there were three AMTRAK routes that served Texas:

- The Heartland Flyer
- The Texas Eagle
- The Sunset Limited.

[1] It should be noted that although LSTAR commuter rail was categorized as urban rail based on the rail characteristics, it runs between cities, and thus was modeled as intercity rail with mode coded as 22.

Figure 5: SAM-V3 Passenger Rail



3.0 Model Refinement for the Texas Transportation Plan

TxDOT has long been recognized as a national leader in transportation excellence, providing for and maintaining a multimodal transportation system that serves the equally diverse needs of Texans and the state's growing economy. In order to accurately represent the rapidly expanding transportation system in the travel demand model used for the Texas Transportation Plan, the project team refined the SAM-V3 network to include the most up-to-date conditions—as well as future conditions—of the Texas transportation system. This section explains how the project team decided which projects should be included in the refined SAM-V3 network, and how those projects were then coded into the network.

3.1 Plan Review

For urbanized areas with a population greater than 50,000, the planning and coordination of federal highway and transit investments are the responsibility of MPOs. Each of the 25 MPOs in Texas are required to maintain and update a Transportation Improvement Program (TIP) and Metropolitan Transportation Plan (MTP) to provide short- and long-term plans for transportation investments in their respective regions. In refining the SAM-V3 network, the project team thoroughly reviewed all financially committed projects within each MPO's MTP, as well as in the Statewide Transportation Improvement Program (STIP). Table 3 below shows the plans that were reviewed for this task.

Table 3: Plans Incorporated into the SAM-V3 Network Update

MPO	Reference Name	Adoption Date
Statewide Transportation Improvement Program (STIP)	Statewide Transportation Improvement Program, STIP, by District	August 2012
Abilene MPO	Abilene MPO MTP 2010-2035	January 12, 2010
Amarillo MPO	Amarillo MTP 2010-2035	October 20, 2011 (amended)
CAMPO (Austin) MPO	CAMPO 2035 RTP	May 24, 2010
Beaumont – Port Arthur MPO	SETRPC-MPO for the JOHRTS Area MTP 2035	April 19, 2013
Brownsville MPO	2010-2035 Brownsville MTP	December 9, 2009
Bryan – College Station MPO	BCS MPO 2010-2035 MTP	February 9, 2011 (amended)
Corpus Christi MPO	Corpus Christi MTO MTP 2010-2035	March 3, 2011 (amended)
Hidalgo County MPO (Pharr)	2010-2035 MTP	December 10, 2009
El Paso MPO	Horizon 2040 MTP	October 4, 2013
Houston Galveston MPO	The 2035 RTP Update	January 25, 2011 (approved)
Harlingen MPO	2010-2035 MTP	December 9, 2009
Killeen – Temple MPO	Mobility 35 MTP	October 21, 2009 (amended)
Laredo MPO	Laredo MTP 2010-2035 Update	December 11, 2009
Longview MPO	Transportation 2035 Longview MTP	May 15, 2013 (amended)

Table 3: Plans Incorporated into the SAM-V3 Network Update

MPO	Reference Name	Adoption Date
Lubbock MPO	Lubbock MTP 2012-2040	August 21, 2012
Midland Odessa MPO	Midland Odessa 2035 Transportation Plan Update	November 30, 2009
North Central Texas MPO	2035 Mobility, 2013 Update	June 13, 2013 (amended)
San Angelo MPO	San Angelo MTP 2010-2035	January 2013 (amended)
San Antonio – Bexar County MPO	Mobility 2035 MTP	December 7, 2009
Sherman – Denison MPO	Transportation Outlook 2035	April 25, 2012 (amended)
Texarkana MPO	TUTS 2035 MTP	October 1, 2009
Tyler Area MPO	TAMPO MTP 2035	April 22, 2010 (amended)
Victoria MPO	Victoria Urbanized Area MTP 2035	December 11, 2012 (amended)
Waco MPO	Connections 2035 Waco MTP	August 2010
Wichita Falls MPO	Wichita Falls MPO 2010-2035 MTP Update	June 4, 2012

Note:
CAMPO = Capitol Area Metropolitan Planning Organization

From these plans the project team identified **regionally significant projects that would affect the capacity of the transportation system**. These projects included new roadways, tollways and HOV lanes; road widening projects, including new turning lanes; conversion of existing lanes to tolled or managed facilities; and other capacity-adding projects. Once these projects were selected, they were then coded into the SAM-V3 network, as is described in more detail in the next section.

Network Coding

The SAM-V3 network stores information about the current and future characteristics of each facility in the Texas transportation system. This information includes physical attributes such as posted speed limit and number of lanes, as well as changes that are planned in the future, such as road widening projects. To code the projects identified in the MPO plans into the SAM-V3 network, the project team input information about each project into a Microsoft Access database that could be read by SAM-V3 to automatically update the network attributes of the transportation system for a specified model year. The attributes input into the project data are described in **Table 4** below.

The project database method allows facilities that will be affected by multiple projects over time to be updated incrementally. For example, a single roadway segment may have three projects associated with it, each adding additional lanes in separate years. To code this, the three projects are listed separately in the project database with their expected completion dates, and are then read by SAM-V3 to automatically update the attributes of that segment after running the network update procedure. This method also allows modelers to add or remove specific projects from a given scenario for an analysis. For example, one may wish to observe the effect of adding a freeway in 2020 that is not planned to be constructed until 2040.

Table 4: Project Database Attributes

Field Name	Description
ID	Automatically generated Microsoft Access ID
AddRemove	Flag denoting whether to include or exclude a project from a given scenario
ProjectID	Unique identifier for a project. The ProjectID is coded on each link in the network affected by the project. The format of the Project ID is: MPO abbrev. + MPO project ID.
ProjectYear	Year project begins operation
RemovedYear	Year facility is removed from network
OneWay	Controls how the number of lanes is populated on the network line layer. A "ONEWAY" flag in this field tells the interface to divide the value in the field “NumLanes” by two and transfer the value to the network directionally.
NumLanes	The total number of lanes associated with the roadway
FC	The functional classification of the roadway
DIV	Flag denoting if the facility is divided or not
Shoulder	Shoulder width if the project includes adding a shoulder
Posted_SP	Posted speed for roadway
MODE_CODE	Mode code of a link
Terrain	Flag denoting the topology of land. Topology affects the capacity of roadways. 1 = flat, 2 = rolling, 3= mountainous
Parking	Parking value to use for number of parking movements. The presence of on street parking reduces roadway capacity.
Lane_Config	Only for links at roadway intersection. Contains a code used to determine the lane group configuration (e.g., “L1LS0T3RS1R1” = # dedicated left, # shared left, # through, # shared right, # dedicated right)
ProjectSource	Note documenting the source of the project information
CSJ	Note that can be used to document the project CSJ
Name	Name of the facility
Type	Project types: • Build frontage rd. • Change to Toll • New HOV • New Managed Lanes • New road • Widen • Upgrade to expressway • Upgrade to freeway
Note	Optional field for notes
Alternative ID	Optional field for other ID for a project
MTP version	Optional field for MTP information
Toll Notes	Optional field to document the toll way note

Texas Transportation Plan

Tech Memo 4: Freight Methodology

April 10, 2014

Acknowledgements

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QUALITY REVIEWERS: Michelle Maggiore

Contents

This memo outlines the methodology for developing freight needs and performance-based outcomes for the Texas Transportation Plan (TTP) and identifies work that will be incorporated from the Texas Freight Mobility Plan (TFMP). This proposed methodology will be more thoroughly defined in Tech Memo 3.8: Freight Methodology. The Task 4 Freight modal profile Tech Memo will include all detailed freight analyses and recommendations to be used in developing the TTP.

1.0 Introduction

This section will include the MAP-21 objectives for freight and their importance to the Texas Transportation Plan (TTP). It will also reference the TFMP and its importance to the TTP.

The memo will be organized into two primary sections:

- Section 2: TFMP Overview, including summary/ scope of analysis of the State's first freight plan
- Section 3: TTP Freight Methodology, including a description of the Freight Plan components identified for incorporation into TTP, the sources of freight data and information to be utilized in the TTP, the TTP technical methodology, and recommendations for TTP scenarios/ additional SAMv3 runs

2.0 Texas Freight Mobility Plan Overview

This section will summarize the TFMP and summarize key information for TTP development:

2.1 Freight Plan Background

- Scope, timeline for completion, and modes considered (Truck, Rail, Ports and Inland Waterways, Air, and Pipeline)
- Outline of Final Report as presented to the Texas Freight Advisory Committee (TxFAC) February 20, 2014
- Goals, objectives, and performance measures

2.2 Freight Plan Data and Development Methodology

- Methodology for developing primary and secondary freight networks
- Methodology for developing freight needs
- Methodology for identifying freight projects
- Methodology for establishing benefit cost analysis and project prioritization strategies

2.3 Freight Plan Recommendation Areas

- Three categories: Projects and corridor improvement; programs; policies
- Nine proposed topic areas for evaluation: Capacity, operations, safety and security, intermodal and rural connectivity, NAFTA and border challenges, energy and environment, education and public awareness; institutional, industry, and interagency cooperation; funding and finance

3.0 TTP Freight Methodology

This section will provide recommendations for incorporating the State Freight Plan into the TTP and will identify additional data to be analyzed to develop multimodal freight needs for the Plan.

3.1 Data and Tech Memos

- SAMv3 forecast, including TRANSEARCH data
- Freight Plan Tech Memos on conditions and needs (list memos)
- Freight Plan and TTP stakeholder and public outreach findings

3.2 Methodology

- Summarize State Freight Plan goals, objectives, and performance measures
- Existing conditions – Incorporate TFMP Tech Memos for:
    a. Facility inventory for all freight modes modes: Truck, Rail, Ports and Inland Waterways, Air, and Pipeline
    b. System conditions
    c. Preliminary system needs (More work will be done to ensure that definition of "needs" for State Freight Plan is consistent with TTP definitions, where needs will be performance-based and not a project-specific wish list.)
- Demand forecasts – Utilize the SAMv3 baseline for the interaction of freight and passenger traffic in all modes, which includes TRANSEARCH data
- Needs analysis – Utilize SAMv3 and TFMP Tech Memos to develop:
    a. Projects and corridor improvement to eliminate bottlenecks and enhance network connectivity
    b. Programs and policies to manage and operate the Freight network and support economic growth
    c. Strategic intermodal projects and other specific modal project needs as identified in the TFMP

3.3 Plan Scenarios

- Describe recommended freight performance measures as defined in the TFMP and their relationship to scenario development
- Consider capacity and strategic projects in an Economic Growth scenario for the TTP, and evaluate the following outcomes and implementation issues/ challenges/ concerns (using SAMv3 and policy evaluation):
    – Operations
    – Safety and Security
    – Intermodal and Rural Connectivity

- NAFTA and Border Challenges
- Energy and Environment
- Educations and Public Awareness
- Institutional, Industry, and Interagency Cooperation
- Funding, finance, additional revenues, and P3 opportunities

4.0 List of Needs from State Freight Plan Team

Approved technical memorandum and reports from the following:

- Goals, Objectives, and Performance Measures for all Modes TFMP Task 9
- Inventory and Assesment of the State's Freight Assets TFMP Task 4
- Identified Tiers of Freight Highway Network – Texas Freight Priority Network White Paper
- Analysis of Condition and Performance of the State's Freight Assets TFMP Task 5
- Modal Profiles for All Modes – Highway, Rail, Port and Inland Waterways, Air, and Pipeline
- Freight Forecasting Methodology, Forecasts TFMP Task 7 Technical Memorandum 7.1, 7.2, 7.3
- Identified Needs by Mode and Type – Project, Policy, Program
- Economic Context of Freight, benefit identification TFMP Task 10
- Project Prioritization and Selection Methodology
- Recommended Projects and Improvement Strategies with Benefits by Mode and Type – Project, Policy, Program

It is understood that some documents associated with this list are completed or are in their final drafts while others are just starting. A list of the documents, their status, schedule and location would be helpful and is requested.

Texas Department of Transportation

Texas Transportation Plan

Tech Memo 5: Transportation Snapshot

February 28, 2014

Acknowledgements

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Contents

Tables

Figures

1.0 Introduction

The Texas Department of Transportation (TxDOT) is committed to providing and maintaining a diverse and multimodal transportation system that serves the diverse needs of Texans and the State's growing economy. As people continue to move to the State, and the economy continues to expand, the transportation system must evolve to accommodate this growth in a manner consistent with the priorities and desires of Texans and Texas industry. Significant and strategic investments are required to operate, maintain, expand, and modernize the multimodal transportation system in order to achieve the level of service that users expect while making efficient use of taxpayer dollars and delivering on TxDOT's commitment to customer service.

As the official statewide long-range transportation plan, the *Texas Transportation Plan (TTP) 2040* will document the needs for the multimodal transportation system over a 25-year horizon and identify funding gaps based on reasonably expected revenues. To make the best use of limited resources, the TTP 2040 will advance performance-based decision-making to link transportation investments with the goals established in the 2013-2017 Strategic Plan as well as those identified as part of TTP development. The TTP 2040 is being developed as a cooperative effort with transportation stakeholders, multimodal owners and operators, and customers of the State transportation system.

As part of the TTP 2040 planning effort, and to better understand the size and complexity of the Texas transportation system and its importance to a variety of users, this document provides a "snapshot" of Texas' multimodal transportation system as it exists today with respect to all passenger and freight travel modes. It also provides a synopsis of current thinking on future trends that will be analyzed in more detail in Plan development.

2.0 Transportation Today

2.1 Transportation in Texas

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. Table 1 provides a high-level overview of the existing multimodal transportation system in Texas.

Table 1. Texas Transportation at a Glance

People	• 25.1 million Texans (2010)[i] • 237,440 million vehicle miles traveled annually[ii] • 85% of population resides in metro areas[iii] • 10.9% of population aged 65 or older[iv]
Pavement	• Over 313,000 total centerline miles of pavement[v] • Over 197,000 lane miles operated and maintained by TXDOT[vi] • Over 15,000 lane miles of interstates[vi] • 88% of pavement lane miles on state-owned roads in good or better condition[vi] • $9,305 million invested in the transportation system annually[vii] • 39% of investment used to expand current system[vii]
Bridges	• 52,227 bridges[viii] • 33,513 owned and maintained by TXDOT[viii] • More than 81% of total bridges in good or better condition[viii]
Transit and Passenger Rail	• 8 metropolitan, 30 urbanized, and 38 non-urbanized transit systems[ix] • 88 elderly and disability transit programs[ix] • Constitutes 1.55% of work commute trips[ii] • Over 281 million total transit trips in 2011[ix] • Served by the Texas Eagle, Sunset Limited, and Heartland Flyer Amtrak routes[x]
Freight	• 11 deep-draft and 10 shallow ocean ports[xi] • 10,384 total miles of freight rail operated by 47 railroad companies[xii] • 73% of Texas-manufactured goods are transported by truck[xii] • By air, freight leaving Texas can reach any North American market in less than 4 hours[xii]
International Trade	• 26 international border crossings (264,491 vehicles and 137,687 pedestrians cross daily)[xiii] • Greater than $17 billion of imports and exports processed annually[xiv]

2.2 Passenger Travel

2.2.1 Highway

With 86 percent of the Texas population residing in metropolitan areas,[xv] 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.[xvi] 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.[xvii] 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 counties combined).[xviii] 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.[xi] 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 (Table 2).

Table 2. SAM V3 Baseline Forecast

Texas Transportation Demographics	Forecasted Change from 2010 to 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 Table 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.[xix]

Table 3. Commuter Mode Choice Profile

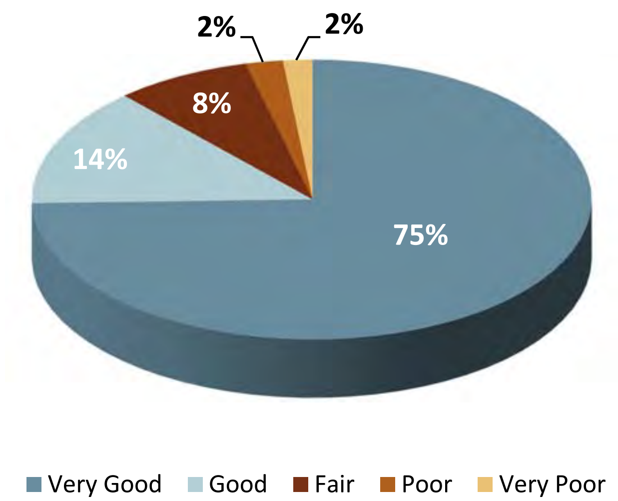
	Austin	Dallas	El Paso	Houston	San Antonio
Drive alone	81%	85%	81%	83%	83%
Carpooled	12%	11%	11%	11%	12%
Public transportation	3%	1%	2%	1%	2%
Walked	2%	1%	2%	1%	2%
Taxicab, motorcycle, bicycle or other	3%	2%	3%	2%	1%

Note:
American Community Survey 2012, 3 year estimate[xix]

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.[xx] 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 300,000 centerline miles of public roadways in Texas, of which over 80,000 are operated and maintained by TxDOT.[v] As shown in **Figure 1**, 88.3 percent of pavement lane miles statewide were in "good or better" condition in FY 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 FY 2002 when the Texas Transportation Commission established the goal of 90 percent "good or better" pavement lane miles statewide.[vi]

Figure 1. 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

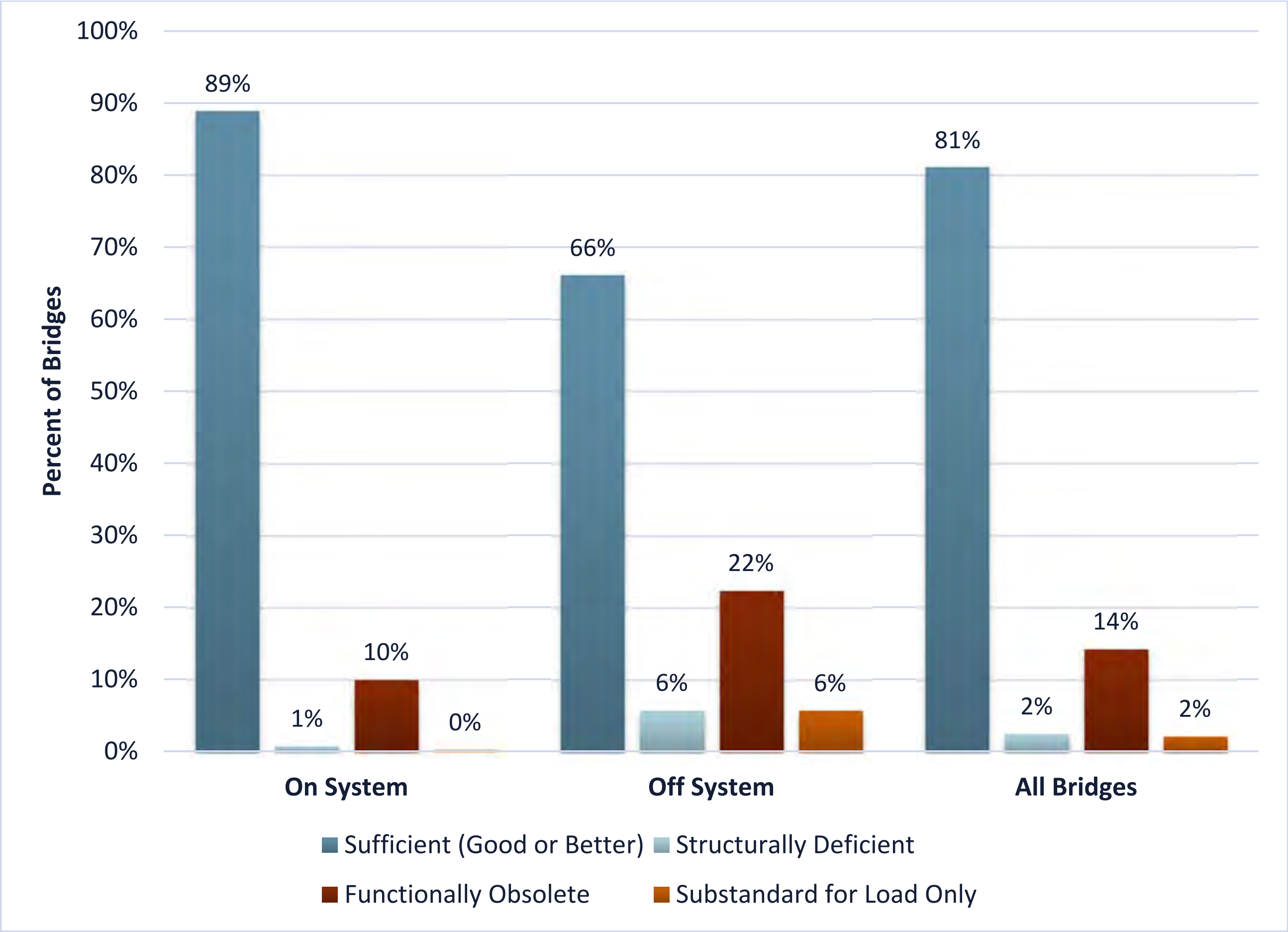
Source: TXDOT PMIS Annual Report 2010-2013

There are 52,000 highway bridges in Texas, constituting 9 percent of the nation's total inventory of bridges. Bridge performance is classified by condition, with deficient structures designated as structurally deficient or functionally obsolete based on FHWA reporting standards[viii] 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.

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 Texas State highway network), 65 percent of off-system bridges, and 80 percent of total bridges were in a state-of-good repair (**Figure 2**).
- Less than 1 percent of on-system bridges were structurally deficient.
- Over 7,000 bridges (13.5 percent) in Texas were functionally obsolete.

Figure 2. Condition of Texas Bridges by Count in September 2012

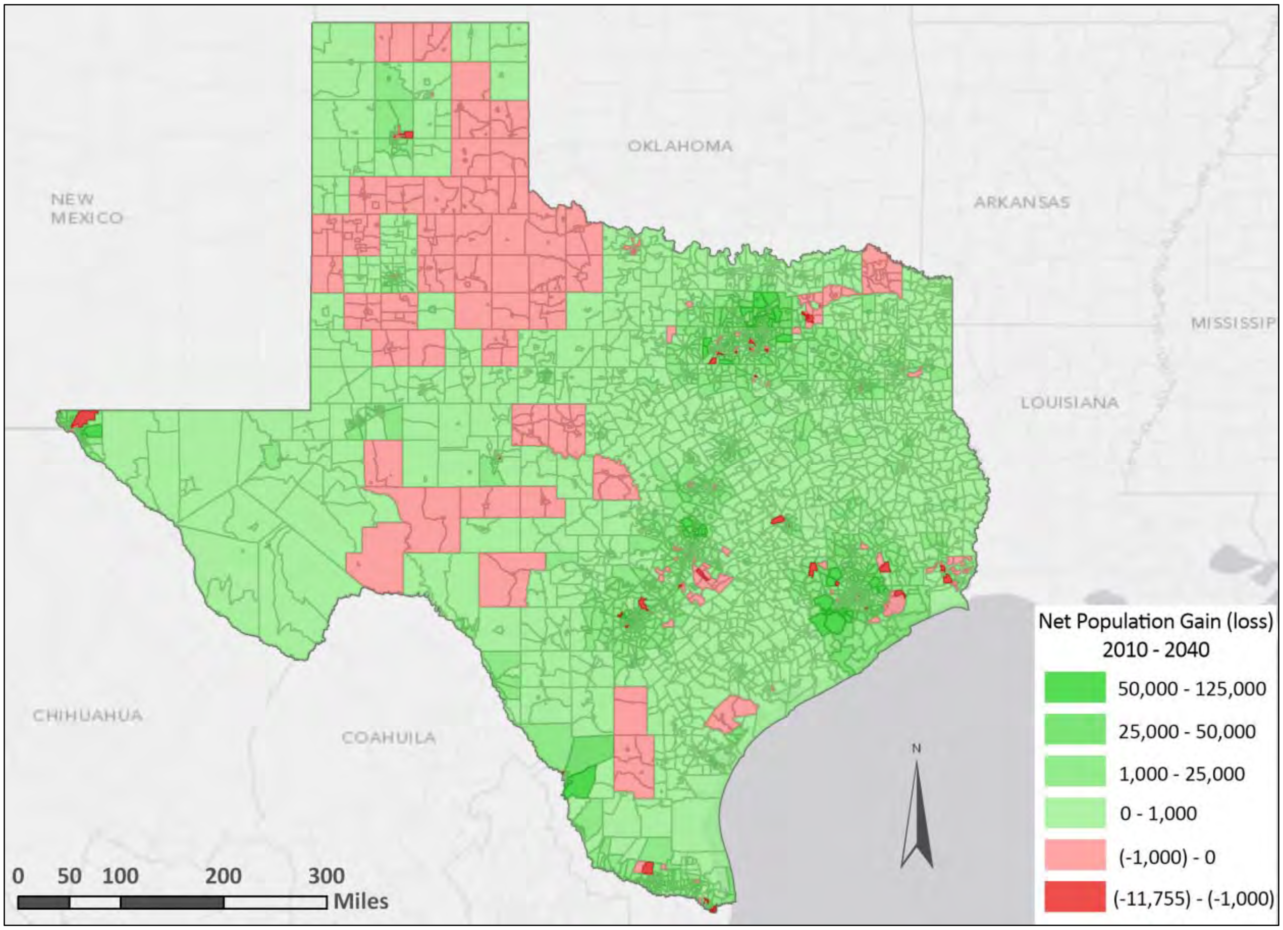


2.2.2 Transit

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.[ix] 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.

Figure 3 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 (Table 4).

Figure 3. Texas Population Change Projected from 2010 to 2040



Source: Texas Statewide Analysis Model (SAM) V3

Table 4. Percent Change in Total Trips by Mode from 2010 to 2040

Passenger Transportation Mode	Forecasted Change in Total 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: Texas Statewide Analysis Model (SAM) V3

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 (DFW) 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.[x]

The current condition of transit assets in Texas is provided in **Figure 4** by asset category and in **Figure 5** 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

2.2.3 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 2 heliports. Of the total airports in the State, 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.[xxi] 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.[xxi]

Figure 4. Current Condition of Transit Assets by Asset Category

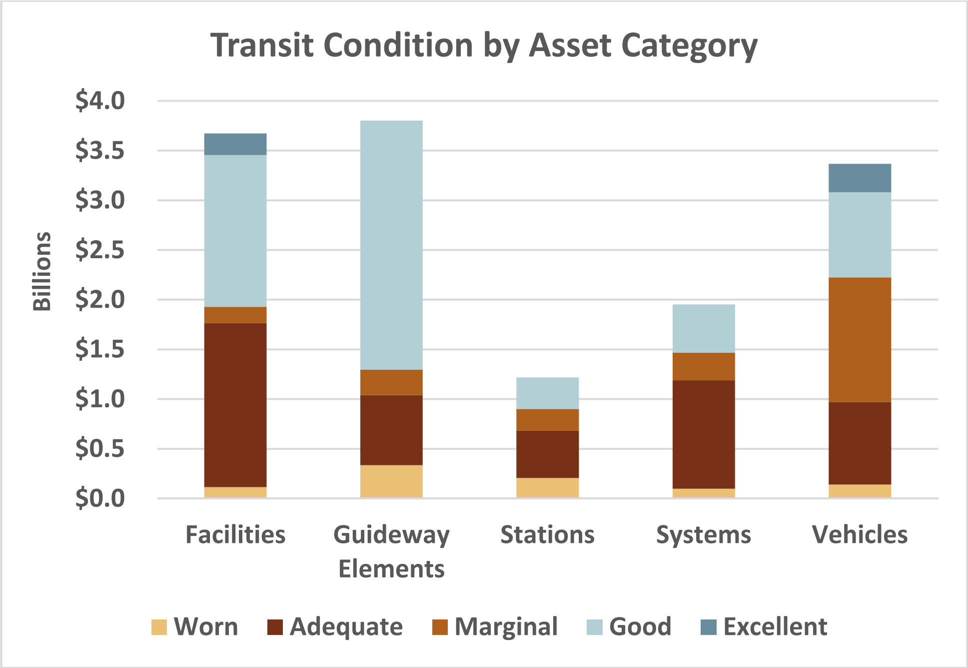
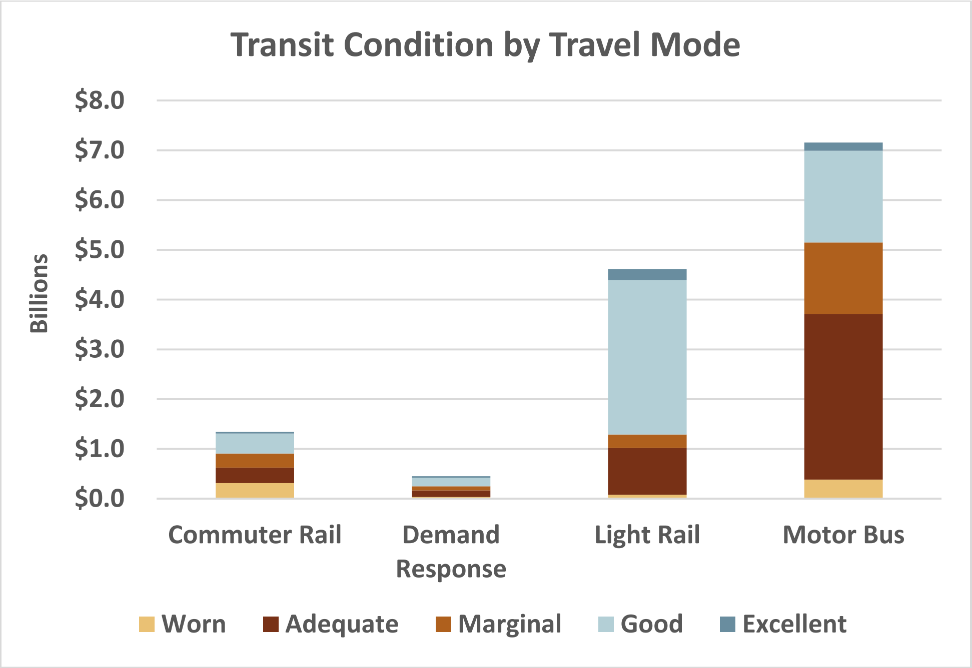


Figure 5. Current Condition of Transit Assets by Travel Mode



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

2.2.4 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 U.S. cities with respect to bike and walk to work share from 2007 to 2009.[xxiii]

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.[xxiv] TxDOT is currently working with the FHWA to develop and implement an aggressive plan to reduce pedestrian crashes, fatalities, and injuries.

2.2.5 Intelligent Transportation Systems (ITS)

Intelligent Transportation Systems (ITS) serve several purposes in Texas transportation that include traffic management, information dissemination, and border security.[xi] 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 Digital Message Signs (DMS); Closed Circuit Television Camera (CCTV); Lane Control Signals (LCS); radar detection; detection loops; Highway Advisory Radio (HAR); ramp meters; Automatic Vehicle Identification (AVI); flood warning sensors; and weather sensors.

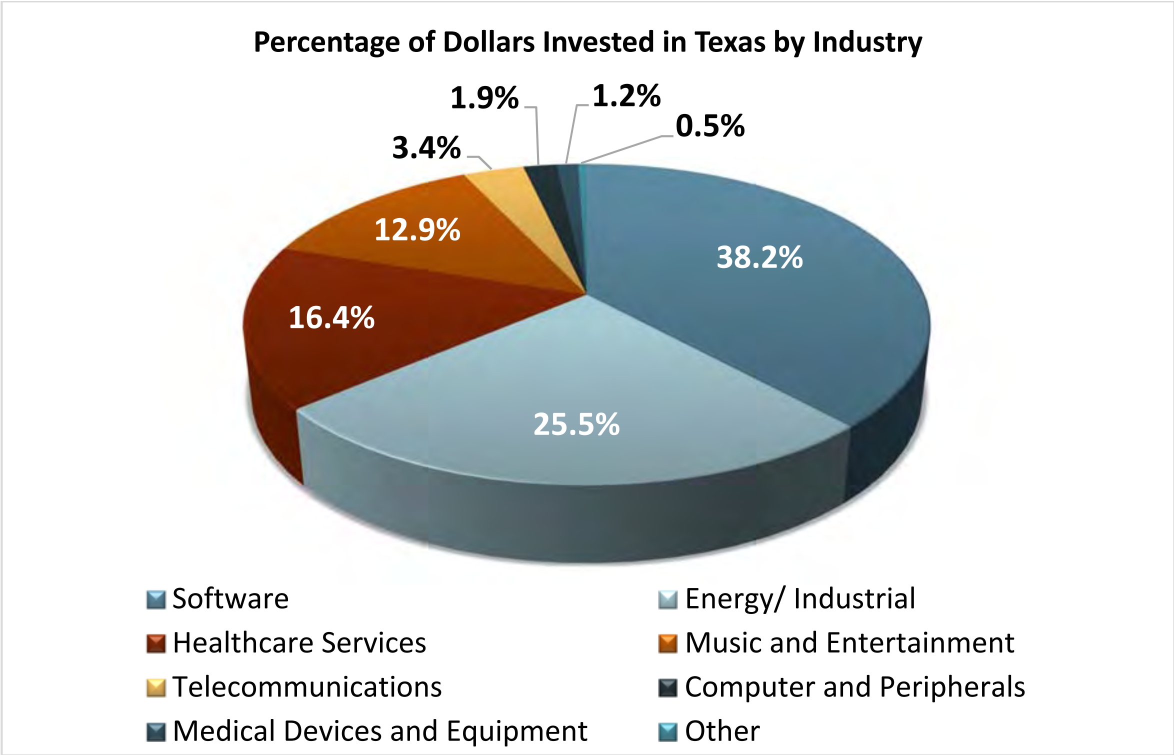
In the future, ITS and transportation operations technologies will continue to be a critical component of system management and congestion reduction as a more cost effective alternative to traditional highway expansion. As technology becomes more robust and more integrated into the day-to-day lives of Texans, it will be critical to consider the changes that enhanced technology may bring about in the Plan 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 Plan horizon, the Google driverless car will likely become a reality, further pushing the envelope of technology integration into the transportation network.

2.3 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.[xxv] Industries that are largely fueling the growing Texas economy include software, energy/industrial, and healthcare services as shown in Figure 6.[xxvi]

The Texas freight system facilitates commerce and supports industry by transporting goods by ship, air, rail, truck, and pipeline. 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.

Figure 6. Industries Fueling Texas' Economic Growth



Source: PricewaterhouseCoopers and National Venture Capital Association's Money Tree Report

2.3.1 Trucking

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

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. Trucking supports the Texas economy by:[xii]

- **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:** 85percent of trade between Texas and Mexico is handled by trucks.

TxDOT is currently developing the State's first State Freight Plan, which will be integrated with the TTP 2040.

2.3.2 Ports

There are 11 deep-draft ocean ports and 10 shallow ports in Texas that are connected by the Gulf Intracoastal Waterway, a navigable inland waterway that runs along the State's eastern coastline.[xi] Collectively, Texas ports rank 1st nationally in goods exports and waterborne commerce and account for 19 percent of the total port tonnage in the U.S., handling approximately 564 million tons of foreign and domestic freight annually.[xi]

In 2011, maritime cargo activity at ports generated $277 billion in economic value, representing 25 percent of the State Gross Domestic Product (GDP).[xxx] 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.[xi]

2.3.3 Railroads

Texas ranks 1st in the nation for the number of rail miles with approximately 10,400 total miles. [xxvii] On average, Texas railroads transport 8.8 million car loads of freight annually – the second highest annual number of car loads in the country.[xxvii] In 2011, over 7 million tons of intermodal rail freight was transported from Texas.[xxvii] Coal and chemicals account for the majority of rail freight originating and terminating in the State.[xxvii]

Freight rail in Texas ranks 1st in the nation for employment.[xxvii] 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).[xxvii]

Five of seven total rail crossings between the U.S. and Mexico are located in Texas, and these crossings handle 89 percent of the total rail containers transported from Mexico to the U.S. 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.[xxviii]

2.3.4 Air Cargo

Due to the high cost of shipping, goods transported by air are primarily perishable or of high value.[xxix] 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.[xxix]

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

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

2.3.5 Pipeline

Texas has the most extensive pipeline in the U.S., with over 360,000 total miles of pipelines carrying crude oil, natural gas, and other liquids. Oil and natural gas production in Texas comprise 20 percent and 25 percent, respectively, of the total amounts produced domestically.

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 nearly tripled between 2009 and 2012. 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.[vi] Determining and addressing energy sector impacts on the condition of Texas roadways will continue to be a priority for the State going forward.

2.4 Environmental Concerns

Motor vehicles are a major source of air pollution, including ground-level ozone or smog, particulate matter (PM), carbon monoxide, and air toxins. PM presents one of the greatest air quality challenges in Texas, and motor vehicle exhaust is a major source of fine particulates ($PM_{2.5}$). Coarse particulates (PM_{10}) are caused by vehicle exhaust as well as traffic on streets and highways that stirs dust into the air, construction activity on transportation facilities, and travel on unpaved roads. In addition to PM, ozone presents significant air quality challenges in Texas, particularly in major metropolitan areas.

The Environmental Protection Agency (EPA) established national ambient air quality standards under the Clean Air Act that limit the concentrations of air pollutants including transportation emissions. Regions of the country that persistently exceed the maximum concentrations established by the standards are designated as "nonattainment." States with nonattainment areas are required to develop a plan for submittal to the EPA that details the steps they will take to meet and continue to meet national ambient air quality standards. Currently, El Paso County is in nonattainment for PM_{10}, and the Dallas-Fort Worth and Houston-Galveston-Brazoria regions are in nonattainment for ozone.

2.5 Economic Growth and Transportation Funding

Over the past 10 years, the Texas economy has been among the strongest and most dynamic in the nation. Texas is increasingly interrelated with other geographies and economies domestically and globally. This geographic expansion of trade links has fostered economic growth, but at the same time has placed a significant burden on the Texas transportation system. As shown in Figure 7, three major revenue sources comprise approximately 85 percent of the total funding available for improvements and enhancements to State roadways:[xxx]

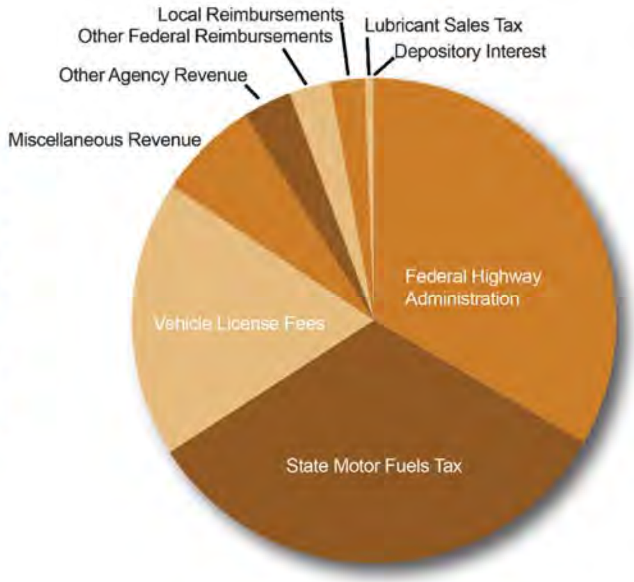
- **State fuel tax:** 20 cents per gallon for gasoline and diesel (last raised in 1991)
- **Federal fuel tax:** 18.4 cents per gallon for gasoline / 24.4 cents per gallon for diesel (last raised in 1993)
- **Vehicle license fees:** $50.75 for personal vehicles annually (some counties add no more than $11.50)

Figure 7. Sources of Transportation Revenue

The Numbers - Sources of Transportation Revenue

Source	Amount	Percent
Federal Highway Administration	$2,428,195,624	33%
State Motor Fuel Tax	$2,366,071,688	33%
Vehicle License Fees	$1,347,719,383	19%
Miscellaneous Revenue	$487,348,436	7%
Other Agency Revenue	$235,581,073	3%
Other Federal Reimbursements	$202,466,423	3%
Local Reimbursements	$165,354,044	2%
Lubricant Sales Tax	$42,526,000	1%
Depository Interest	$2,476,501	0.03%
Total	$7,277,739,173	100%

Actual revenue may differ slightly from the Comptroller's Annual Cash Report in the event the Comptroller makes post-FY adjustments.

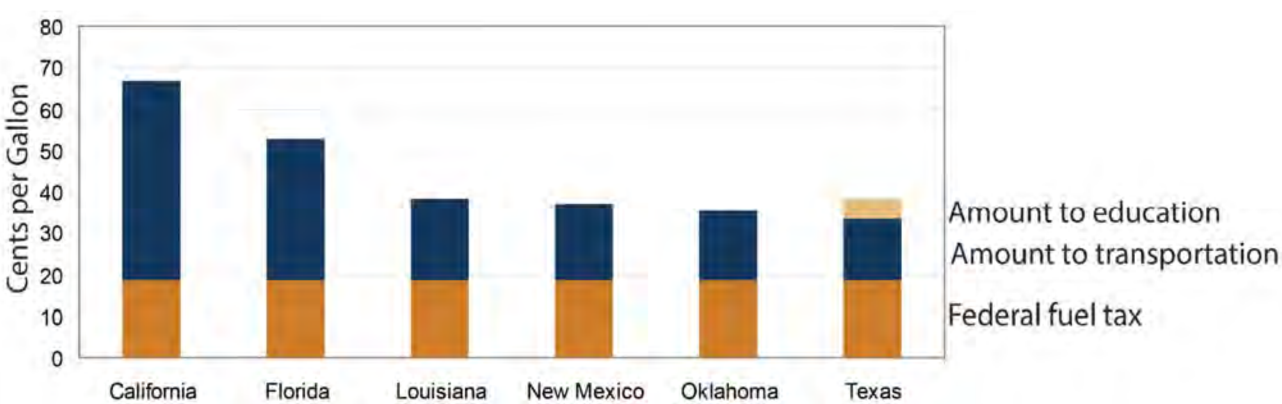


Transportation fees are lower in Texas than in 43 other states including California, Florida, New Mexico, Louisiana, and Oklahoma (**Figure 8**).[xxxi] Specifically, among the 50 states, Texas ranks:

- 18th in vehicle registration fees
- 29th in state gasoline tax rate
- 44th in overall annual cost of vehicle ownership

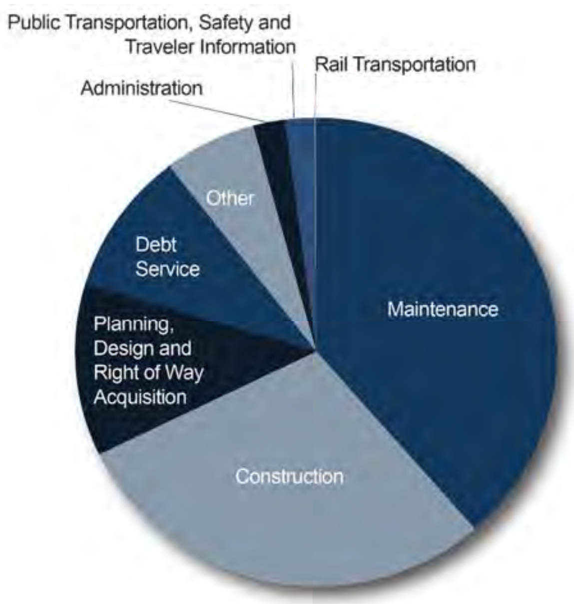
A Texas resident who drives 12,000 miles per year in a vehicle that averages 21 miles per gallon will pay approximately $8.76 in gas taxes to the federal highway fund and $9.52 in taxes to the State roadway fund per month. Currently, most Texas residents pay less than $20.00 per month for transportation infrastructure through fuel taxes.

Figure 8. State and Federal Fuel Tax Rates



TxDOT, either directly or through grants, provides maintenance for more than 190,000 lane-miles of highways, 33,500 on-system bridges, 17,000 off-system bridges, 300 airports, and 2,700 rural and small urban public transportation vehicles.[xxxii] As shown in Figure 9, maintenance is the largest transportation expenditure in Texas, constituting approximately 40 percent of the annual transportation budget.[7] Together with maintenance expenditures, initial construction, planning, design, and right of way, along with debt service, comprise 90 percent of the total transportation expenditures in Texas. Miscellaneous fees and other disbursements constitute the additional 10 percent of expenditures.

Figure 9. TxDOT Transportation Expenditures



The Numbers - Transportation Expenditures (in millions)

Expenditure	Amount	Percentage
Maintenance	$3,593.0	39%
Construction	$2,713.5	29%
Planning, Design and Right of Way Acquisition	$1,111.6	12%
Debt Service	$919.5	10%
Other	$578.3	6%
Administration	$199.0	2%
Public Transportation, Safety and Travel Information	$182.0	2%
Rail Transportation	$7.7	0.1%
Total	**$9,304.6**	**100%**

Source: TxDOT Budget | 2013

As the Texas transportation system ages, there is an imperative need to invest in the existing transportation system to maintain an acceptable level of service for current and future generations. Sound asset management practices that include the timely application of rehabilitation and preventive maintenance activities can be adopted and implemented to extend the life of infrastructure assets and reduce life-cycle costs. However, such investment in system preservation must be balanced against investment in system expansion and other priorities to accommodate growth and achieve the State's overall transportation vision, goals, and objectives.

3.0 Looking Ahead

In the next 25 years, the Texas population is expected to grow from 25 million to 38.5 million,[xxxiii] and freight miles traveled are expected to increase at twice the rate of passenger miles traveled. This growth in population and freight traffic is likely to result in increased congestion, decreased multimodal safety and reliability, and the accelerated deterioration of bridge and pavement assets under heavier and more frequent loadings. The Texas transportation system will need to grow to accommodate the increase in passenger and freight users in a manner that reflects their desires for more reliable, accessible, convenient, safe, and efficient transportation choices while simultaneously considering the disparate needs and priorities of rural, urban, and suburban areas across the State.

With the continuing depletion of the national Highway Trust Fund and predictions of insolvency by as early as 2015,[xxxiv] it is unclear how states and the federal government will meet the growing transportation needs of tomorrow. Procuring sustainable funding presents a significant underlying challenge to maintaining and improving upon the condition and performance of the Texas transportation system today and for years to come.

Other significant challenges for the future Texas transportation system include:

- Making the system safer: Improving multimodal safety continues to be TxDOT's number one priority with specific emphasis placed on reducing fatal and serious injury crashes and improving pedestrian and bicycle safety.
- Managing the agency and the system despite diminishing revenues and higher transportation costs: Like most other DOTs throughout the country, TxDOT is experiencing declining revenues and increasing demands on the multimodal transportation system. There is an urgent need to invest more in the State transportation system to keep pace with growth and to take care of existing assets. As revenues from traditional sources continue to decline, TxDOT will need to identify and pursue innovative techniques to fill the funding gap in order to prevent the deterioration of multimodal system condition and level of service.
- Making sure all regions of the State benefit from transportation investments: Rural areas located outside of metropolitan boundaries are home to millions of Texans with different mobility and accessibility needs than those of urban and suburban residents. Multimodal access for all rural residents with a particular focus on aging, disabled, and disadvantaged populations will continue to be a critical priority for TxDOT. Additionally, rural areas are essential to the Texas economy: the transportation system that serves these areas facilitates State, national, and global commerce and supports the activities of many Texas industries. Specific rural transportation priorities such as those relating to system connectivity and infrastructure viability for freight traffic should be considered and addressed in order to ensure future economic prosperity.

The *TTP 2040* will provide a framework that links investments to the desired future vision for the Texas transportation system while fulfilling both State and federal planning requirements. It will be focused on outcomes that include improving multimodal system condition and safety and expanding transportation choices for Texans in all areas of the State. As a performance-based plan, the TTP will prioritize investments in light of Plan goals and objectives, determine the costs required to achieve the goals, forecast future funding sources/levels, and calculate funding gaps.

4.0 Endnotes

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Tech Memo 6: Aviation Modal Profile

August 15, 2014

Acknowledgements

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Figures

1.0 Introduction

The 2040 Texas Transportation Plan will guide the State of Texas Transportation System into the future by reviewing existing conditions, conducting demand modeling, establishing future needs, and developing financially-constrained investment scenarios for all transportation modes, including the State's Aviation System. This technical memorandum summarizes the long-term capital improvement project needs of the Texas Aviation System and evaluates how well current levels of State funding support those needs as well as presents the benefit, in terms of the number of projects able to be executed, of increasing projected funding toward satisfying the total Aviation System need.

2.0 Overview of Existing Conditions

In conjunction with the Federal Aviation Administration (FAA), the Aviation Division of the Texas Department of Transportation (TxDOT) administers capital improvement grant funding for airports included in the Texas Airport System Plan. Texas is one of the few states that participates in the FAA's State Block Grant Program. This program allows the State to control the allocation of Federal grant funding to lower tier eligible airports that would normally be managed by FAA.

Texas has 292 airports and two heliports in its State Aviation System Plan. In 2012, Texas ranked 3rd in Tower Operations (which includes touch-and-goes and overflights) with a total of 4,674,903 Operations (Source: FAA). As reported in the 2010 Texas Airport System Plan, general aviation operations (takeoffs and landings) are estimated to increase by nearly 20 percent with a 65 percent increase in passenger enplanements between 2010 and 2025.

3.0 Unconstrained Needs Determination

3.1 Methodology and Assumptions

The analysis used two primary sources to determine the total unconstrained capital improvement needs of the State's airports. For Primary Commercial airport needs, FAA's 2013–2017 National Plan of Integrated Airports Systems (NPIAS) Report Development Costs was used (Source: FAA). For general aviation (GA), Non-Primary Commercial, and Reliever type airport needs, the TxDOT Aviation Division provided their 20-year project needs database, known as the Texas Airport Data System (TADS). For the remainder of the memorandum, the term "GA" will include GA, Non-Primary Commercial, and Reliever airports.

TxDOT GA needs assessments have been traditionally developed through the Texas Airport Data System (TADS). The TADS provides a 20-year outlook of identified airport improvements throughout the state. For each improvement item, the TADS maintains a database including a description, airport location, FAA Priority Score (including individual scoring components), and estimated construction cost. Multiple improvements will be grouped into a larger project when they are constructed. However, for the purposes of this Technical Memo, the term "project" will refer to an individual improvement item.

TxDOT does not provide any funding for Primary Commercial Service airports. Those airports receive their funding directly from the FAA. TxDOT does, however, provide funding for GA airports. The revenue to fund these airports comes from State and Federal Resources. For this study, TxDOT recently met with the FAA and agreed the best way to determine the needs for Primary Commercial Airports was to use the FAA published NPIAS Report. This report describes the Total Development Cost over the next 5 years for each airport listed.

The total unconstrained Aviation System needs for the state are the average annual capital project cost needs for Primary Commercial and GA airports from the above sources extrapolated over the planning period to the year 2040 as is summarized in the next section.

3.2 Unconstrained Needs to 2040

As described above, the TxDOT TADS database provided the GA capital project cost needs for the next 20 years to 2032. Again, the FAA NPIAS Report provided the Primary Commercial capital project cost needs over a 5-year period from 2013 to 2017. On average, this equates to $626M of need for Primary Commercial airports and $105M of need for GA airports (in current day dollars) annually. Assuming the average annual need remains constant over the planning period to the year 2040, the total Primary Commercial need is calculated to be $18.2B. Likewise, a total GA need of $2.9B is calculated over the planning period to the year 2040. Combined, the total need of $21.1B (in current day dollars) represents the cost to implement capital improvement projects over the planning period that address Aviation System deficiencies that focus on enhancing safety/security, FAA's statutory emphasis projects, reconstruction/rehabilitation, environment, planning, capacity, standards, and other local projects.

4.0 Anticipated Revenues

TxDOT aviation estimates that on average they receive $51M annually in Federal Block Grant Funds and $15M annually in state funds to support GA airports. Many states have an aviation fuel tax that is used to fund an aviation account; however, Texas receives its aviation funding from the Highway Trust Fund which is supported by a state motor fuel tax.

Texas Primary Commercial airports are primarily funded by Airport Improvement Program (AIP) grants from the FAA. In 2013, the FAA awarded Texas Primary Commercial airports with almost $169M in the form of AIP grants (Source: FAA).

5.0 Fiscally-Constrained Analysis and Funding Gap

The Transportation Plan is focused on the financial gap in the State of Texas. As stated in Section 3.1 of this memo, Primary Commercial Service airports are funded solely by the FAA. Since the commercial service airports do not have an impact on the TXDOT aviation fiscal budget, they were excluded from this analysis.

The Fiscally Constrained Analysis uses only projects at GA airports identified in TxDOT's TADS database. For the purposes of this study it was assumed that all projects listed in the database were eligible for State and/or Federal Funding. In addition, it was assumed that each airport could also fund their required share of the project cost.

In order to receive FAA funding, there are certain eligibility requirements for the airport. The airport must be a public use airport and included in the NPIAS. The NPIAS identifies all existing and proposed airports that are significant to national air transportation.

The FAA also has requirements on what types of projects are eligible for funding. Projects that are related to enhancing airport safety, capacity, security, and environmental concerns are typically funded where projects related to revenue-generating are typically not. See Table 5-1 for examples of eligible and ineligible projects from the FAA website; the table does not cover all airport projects.

Table 5-1. Examples of Eligible versus Ineligible AIP Projects

Eligible Projects	Ineligible Projects
Runway construction/rehabilitation	Maintenance equipment and vehicles
Taxiway construction/rehabilitation	Office and office equipment
Apron construction/rehabilitation	Fuel farms*
Airfield lighting	Landscaping
Airfield signage	Artworks
Airfield drainage	Aircraft hangars*
Land acquisition	Industrial park development
Weather observation stations (AWOS)	Marketing plans
Navigational Aids such as REILs and PAPIs	Training
Planning studies	Improvements for commercial enterprises
Environmental studies	Maintenance or repairs of buildings
Safety area improvements	
Airport layout plans (ALPs)	
Access roads only located on airport property	
Removing, lowering, moving, marking, and lighting hazards	
Glycol Recovery Trucks/Glycol Vacuum Trucks** (11/29/2007)	

Notes:
*May be eligible. Contact the Airport District of Regional Office for more information
**To be eligible, the vehicles must be owned and operated by the Airport and meet the Buy American Preference specified in the AIP grant.
Source: www.FAA.gov/airports/aip/overview

The State’s eligibility requirements are much simpler. All the projects within the TADS database are eligible for state funding with the exception of the projects from four FAA designated Reliever Airports (Pearland Regional, West Houston, David Wayne Hooks, and Houston SW Airports). These airports are only eligible for federal funding.

In addition to State and Federal Funding, the projects are never funded without a local share of the funding. This share is at least 10 percent of the total project cost. To meet this requirement, the analysis removes 10 percent from the total cost of each individual project listed in the TADS.

5.1 Project Prioritization

Using the project FAA priority score (developed from FAA methodologies for AIP funding) and project cost found in the TADS, a Score-to-Cost Ratio is created for each project. Rather than the project priority score alone, this Score-to-Cost Ratio is used as the prioritization method for determining which projects are funded with the allocated annual budget available. If a project is not funded during a specific year, it is added to the pool of projects for the next year’s budget until the year 2040. Using this method, the analysis maximizes the amount of projects programmed per dollar available during the planning period. The cost of all remaining unfunded projects comprise the State’s funding gap.

5.2 Fiscally-Constrained and Tradeoff Analysis

Similar to the determination of unconstrained needs, the fiscally-constrained analysis extends the current 20-year TADS database compiled of 9,283 total projects and a total cost of $2.1B to estimate the Aviation System funding gap in 2040.

The projects within the TADS database are separated into two different funding categories: NPIAS and Non-NPIAS. Again, NPIAS projects are eligible for both State and Federal funding whereas Non-NPIAS are only eligible for State funding. The groups of projects are analyzed separately with their current respective Federal and State budget allocations available. Additionally, the analysis includes results for a range of budget and allocation scenarios. For example, if the State chose to assign its entire annual state budget of $15M to Non-NPIAS airports, only Federal money would be available to fund NPIAS airport projects that year. If in the next year it decided to allocate $6M of the State money to Non-NPAIS, it would have the Federal budget along with the remainder of the State budget (the $9M left over from the $15M annual State budget) to fund NPIAS airport projects.

Table 5-2 presents a range of possible State funding for Non-NPIAS airports and estimates of the resulting funding gap. The highlighted row is the current available annual state aviation funding received from the Highway Trust Fund. If all $15M of the Annual State Budget is used every year to fund the 20-year TADS need of $211M, the entire Non-NPIAS system would be completely funded. This however, is an unlikely scenario as it would not leave any additional funding for NPIAS airports.

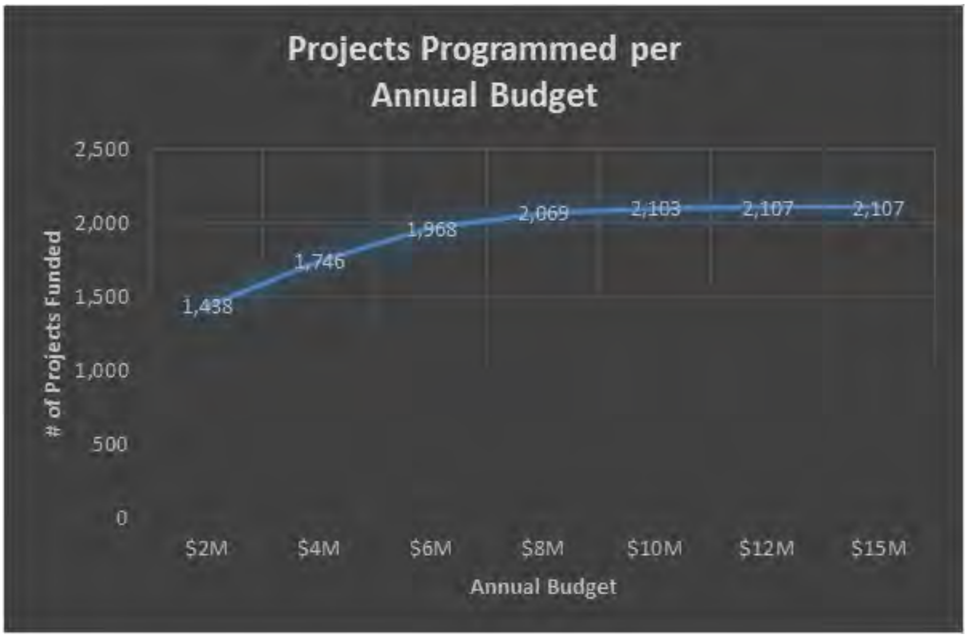
Table 5-2. Non-NPIAS Annual Budget Scenarios

Annual State Budget ($M)	20-year TADS Capital Project Cost Need ($M)	No. of 20-year TADS Projects Completed	20-year TADS Value of Projects Completed ($M)	20-year TADS Funding Gap ($M)	Estimated 2040 Funding Gap ($M)
$2M	$211M	1,438	$40M	$171M	$239M
$4M	$211M	1,746	$80M	$131M	$183M
$6M	$211M	1,968	$120M	$91M	$127M
$8M	$211M	2,069	$160M	$51M	$71M
$10M	$211M	2,103	$200M	$11M	$15M
$12M	$211M	2,107	$235M	$0M	$0M
$15M	$211M	2,107	$235M	$0M	$0M

Note:
*Highlighted row denotes State Funding Budget

While the TADS database does not provide project-level detail to the year 2040, Figure 5-1 illustrates the number of Non-NPIAS projects that can be funded within the 20-year framework of the TADS based on varying State budget funding scenarios ranging from $2M annually to $15M annually when all 20-year projects can be completed. It is expected this level of annual funding would continue to be required to meet State Aviation System needs. As is discussed above, the analysis prioritizes the project list and funds as many of the projects with the budget available.

Figure 5-1. Non-NPIAS Projects Programmed per Annual Budget



From Figure 5-1, it is observed that after the State's annual funding increases to $8M the number of funded projects levels out as higher cost and lower priority projects remain. This suggests that $7M of the total $15M annual State allocation may be better spent to support NPIAS airport projects. At a budget of $8M annually, there is an estimated Non-NPIAS funding gap of $71M in the year 2040.

Under that funding scenario, the current total annual budget of $58M ($51M [Federal] + $7M [State]) would be available to fund NPIAS airport projects. This equates to a funding gap of $672M by the year 2040. Note, the constraints of the NPIAS analysis did not allow for the extraction of the four NPIAS airports ineligible for State Funding (Pearland Regional, West Houston, David Wayne Hooks, and Houston SW). However, the State's contribution toward a total project value of $66.3M is expected to be approximately 10 percent and is determined not to be significant to the results of the analysis.

Like the Non-NPIAS analysis, **Table 5-3** presents a range of possible funding scenarios for NPIAS airports and estimates of the resulting funding gap. The highlighted row is the current available annual Federal aviation funding received from the FAA.

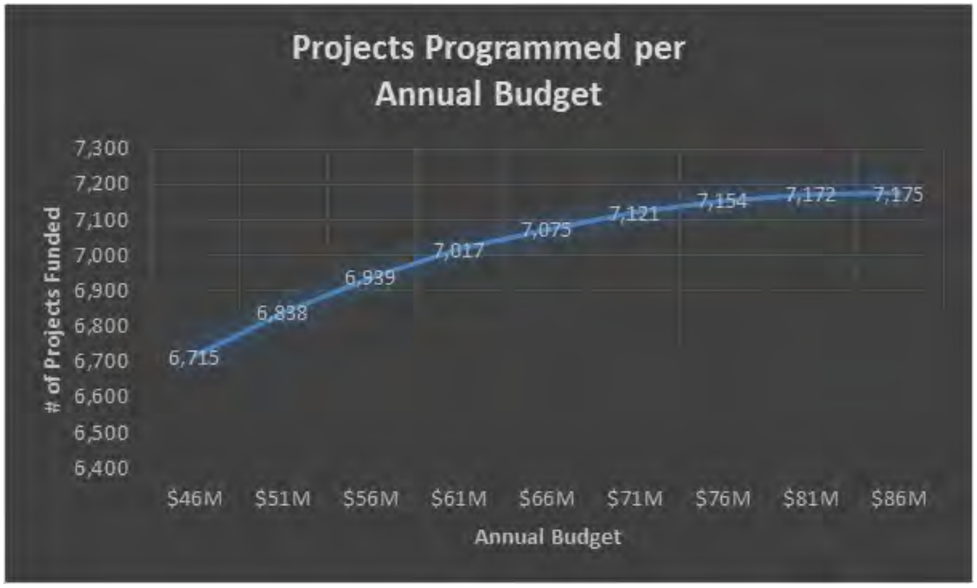
Table 5-3. NPIAS Annual Budget Scenarios

Annual Federal Budget ($M)	20-year TADS Capital Project Cost Need ($M)	No. of 20-year TADS Projects Completed	20-year TADS Value of Projects Completed ($M)	20-year TADS Funding Gap ($M)	Estimated 2040 Funding Gap ($M)
$46M	$1640M	6,715	$920M	$720M	$1,008M
$51M	$1640M	6,838	$1,020M	$620M	$868M
$56M	$1640M	6,939	$1,120M	$520M	$728M
$61M	$1640M	7,017	$1,220M	$420M	$588M
$66M	$1640M	7,075	$1,320M	$320M	$448M
$71M	$1640M	7,121	$1,420M	$220M	$308M
$76M	$1640M	7,154	$1,520M	$120M	$168M
$81M	$1640M	7,172	$1,620M	$20M	$28M
$86M	$1640M	7,175	$1,720M	$0M	$0M

Notes:
Highlighted Row denotes Federal Funding Budget
This includes the four NPIAS Airports ineligible for State funding.

Again, while the TADS database does not provide project-level detail to the year 2040, **Figure 5-2** illustrates the number of NPIAS projects that can be funded within the 20-year framework of the TADS based on varying Federal and State budget funding scenarios ranging from $46M annually to $86M annually when all 20-year projects can be completed. It is expected this level of annual funding would continue to be required to meet Aviation System needs.

Figure 5-2. NPIAS Projects Programmed per Annual Budget



With Non-NPIAS and NPIAS combined, the analysis estimates a total Aviation System funding gap of almost $800M ($105M [Non-NPIAS] + $672M [NPIAS]) by the year 2040 and is approximately one-quarter of the total $2.9B worth of the State's unconstrained need. As determined earlier, the amount of annual funding needed to fund the entire system is $86M for NPIAS projects and $12M for Non-NPIAS projects for a total of $98M needed annually. This is $32M per year more than the $66M per year that is currently provided by Federal and State sources. While some increase in Federal funding may occur over time, the State will likely need to support the majority of the budget shortfall.

Texas Transportation Plan

Tech Memo 6: Bicycle-Pedestrian Modal Profile

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1.0 Introduction

As the State's long-range transportation plan, the Texas Transportation Plan 2040 (TTP 2040) will document the size and scope of the Texas transportation system with respect to existing conditions, current and future demand, funding needs by mode, and fiscally-constrained investment scenarios and probable outcomes. The bicycle and pedestrian modes are included in the TTP 2040; however, these modes have been historically under-represented at the statewide planning level in Texas and the nation. As described in *Technical Memorandum #3, Bicycle-Pedestrian Methodology*, bicycle and pedestrian planning generally occurs at the local level and typically lacks the data and tools needed to analyze usage and performance, and forecast future needs. This lack of data provides a challenge when attempting to document bicycle and pedestrian needs, particularly as compared to other modes.

The following sections present an attempt to document fiscally-constrained and unconstrained bicycle and pedestrian needs within the State of Texas. As described in the following sections, this methodology is generally an accounting of Metropolitan Planning Organization (MPO)-reported needs, which tend to vary widely in their respective methodologies. As such, this needs analysis should be considered as a baseline or starting point when discussing bicycle and pedestrian needs in Texas. This is particularly true given the rapidly growing population of the state and the increasing interest of Texans to utilize these modes for transportation.

2.0 Overview of Existing Conditions

Unlike other modes of transportation identified within the TTP 2040, the bicycle and pedestrian modes include facilities constructed and maintained at all levels of government, not just accommodations on TxDOT's State Highway System (SHS). As such, the pedestrian/bike needs reported in the following sections include bicycle and pedestrian facilities on the TxDOT system, as well as facilities owned by county and city governments.

The bicycle and pedestrian modes are served by a variety of facility types, which include both on-road and off-road facilities. The most common types of bicycle and pedestrian facilities include the following:

- 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 (AASHTO, 2012). 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 (TxDOT, 2011). A Signed Shared Roadway shall include posted bike route signs and may include pavement markings.
- Signed Shoulder Bike Route – 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 (AASHTO, 2012). A Signed Shoulder shall include posted bike route signs and may include pavement markings.

- 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 (AASHTO, 2012; TxDOT, 2011). It is intended for one-way travel, usually in the same direction as the adjacent traffic lane, unless designated as a contra-flow lane (AASHTO, 2012).
- 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 (AASHTO, 2012; TxDOT, 2011). Shared use paths may also be used by pedestrians (including skaters, users of manual and motorized wheelchairs, joggers) and other authorized motorized and non-motorized users. Most shared use paths are designed for two-way travel (AASHTO, 2012).
- 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.

Facilities specifically designated for bicycles and pedestrians are more commonly located in urban and suburban areas, while rural areas are typically under-represented. Rural bicyclists and pedestrians may use sidewalks where available, but often utilize the existing roadway network, which is often less accommodating.

MPOs and cities vary in their interest and commitment to the bicycle and pedestrian modes. Larger metropolitan areas in Texas and smaller communities associated with colleges and universities tend to place additional emphasis on bicycle and pedestrian planning and investment. For example, the North Central Texas Council of Governments (NCTCOG) in the Dallas-Fort Worth area continues to develop a Regional Veloweb, which is a network of off-street shared-use paths. The Veloweb is intended to serve as a regional expressway for bicycles, and also serves other non-motorized transportation. As of the 2013 update to their 2035 Metropolitan Transportation Plan (MTP), the Regional Veloweb contains 318 miles of existing facilities, with 1,377 miles planned. In addition, this latest MTP update identifies approximately $1.5 billion of potential funding for “active” transportation improvements through 2035. This high level of planning and financial support that includes the bicycle and pedestrian modes is not typical as compared to other regions of Texas, and serves to illustrate the wide variety of commitments and funding, as well as the local nature of bicycle and pedestrian planning.

2.1 *Bicycle – Pedestrian System Performance*

Unfortunately, significant data gaps exist for bicycle and pedestrian performance metrics. In general, current usage data and forecasting tools are not available. In fact, many cities and regions do not have a complete inventory of their existing bicycle and pedestrian networks. As one would expect, performance of the bicycle and pedestrian network in Texas, as in all states, is highly variable by location. Bicycle and pedestrian planning and investment is generally focused at the local and regional levels, and, as described previously, cities and regions provide varying levels of commitment to these modes, resulting in differences in network size and quality.

2.1.1 Usage

On a statewide level, national bicycle and pedestrian advocacy groups such as the League of American Bicyclists and the Alliance for Biking and Walking provide some insight into how Texans are utilizing bicycle and pedestrian accommodations for transportation versus other states. In their report "*Where we Ride – Analysis of Bicycling in American Cities*", the League of American Bicyclists compiled American Community Survey data for 2012. In this report, Texas is ranked #40 of 50 states in regard to percentage of bicycle commuters. Texas' 2012 bike commuting rate was 0.28%, which represented a 19.5% increase from the 2005 rate of 0.23%. In 2012 Oregon ranked #1 in bicycle commuting with a rate of 2.5%. The League also ranked the top 70 largest cities in the U.S. with regard to percentage of bicycle commuters. Texas cities included in the list, along with their national rank and 2012 percentage of bike commuters can be seen in Table 1 below.

Table 1. Top 70 Largest Cities with Highest Share of Bicycle Commuters (2012)

City	Rank	% of Bike Commuters	Population	% Growth 1990-2012	% Growth 2000-2012
Portland, OR	1	6.1%	603,650	430.3%	248.6%
Austin, TX	16	1.6%	842,595	100.1%	67.6%
Houston, TX	52	0.4%	2,161,686	7.1%	-17.9%
Corpus Christi, TX	53	0.4%	312,192	50.4%	44.2%
Arlington, TX	59	0.3%	375,598	56.4%	48.9%
Fort Worth, TX	60	0.2%	782,027	26.3%	83.7%
Dallas, TX	65	0.2%	1,241,108	31.8%	51.6%
San Antonio, TX	67	0.2%	1,383,194	17.2%	9.7%
El Paso, TX	69	0.1%	672,534	-71.9%	-20.4%
Plano, TX	70	0.1%	270,816	-69.8%	-40.9%

Source: League of American Bicyclists, Where we Ride – Analysis of Bicycling in American Cities, 2013

2.1.2 Safety

The Alliance for Biking and Walking's *Bicycling and Walking in the United States – 2014 Benchmarking Report* ranks all 50 states in regard to biking and walking safety. The report utilizes National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS) and American Community Survey data. Of the 50 states, Texas is ranked #39 in regard to bicyclist fatality rates, and #41 in regard to pedestrian fatality rates. In addition, of the 52 largest cities in the U.S., Arlington is Texas' top bicycle and pedestrian performer, ranked #1 (lowest fatality rate) in regard to bicyclist fatality rates and #24 in regard to pedestrian fatality rates.

Utilizing raw numbers, the NHTSA's *Traffic Safety Facts* also provides data regarding bicycle and pedestrian safety in Texas and the nation. Table 2 provides a snapshot of fatality rates for biking and walking in the years 2012 and 2007. As can be seen, rates in Texas have increased over the 5-year period.

Table 2. Pedalcyclist and Pedestrian Fatalities, Texas and U.S. Totals

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

Source: NHTSA Traffic Safety Facts (2012 and 2007 Data) – Bicyclists and Other Cyclists; Pedestrians

2.1.3 Funding

In addition to safety and other factors, The Alliance for Biking and Walking's *Bicycling and Walking in the United States – 2014 Benchmarking Report* also ranks the 50 states based on percentage of federal transportation dollars applied to bicycling and walking. Utilizing FHWA's Fiscal Management Information System (FMIS) 2009–2012 data, the Alliance ranks Texas #29 of the 50 states, spending 1.6% of federal transportation dollars on bike/ped. The highest ranked state, Delaware, spends 3.7% on bike/pedestrian facilities.

2.2 Bicycle – Pedestrian System Deficiencies

As previously discussed, the data necessary to analyze bicycle and pedestrian usage and system performance and condition is lacking, particularly at a statewide level. Emphasis on these modes is variable among cities and MPOs, which results in having varying levels of network information. An important first step in understanding the statewide bicycle and pedestrian network is a complete inventory and mapping of the city, county, and state maintained networks. Only after a full inventory of the networks can system deficiencies be identified. A top-down coordinated approach to system inventorying and mapping, beginning with the state (TxDOT) and proceeding to MPOs and cities would seem ideal. Agencies responsible for roadway planning, design, construction, and maintenance should take inventory of bicycle and pedestrian accommodations by type, surface material, and width. It is recommended that local, regional, and state transportation agencies inventory bicycle and pedestrian accommodations annually and provide annual Geographic Information System (GIS) updates to local planning organizations for regional mapping.

TxDOT has in fact begun such an inventory of bicycle and pedestrian facilities on the State Highway System. TxDOT's Statewide Bicycle and Pedestrian Coordinator has begun a pilot project starting with the Tyler District to map bikeways on state maintained roadways. The map and associated database will be compiled from current TxDOT databases, maintained by TxDOT's Transportation Planning and Programming Section, as well as statewide pavement condition photos taken by TxDOT's Materials and Pavement Section. The map and database will be developed as an interactive tool to provide a variety of roadway information in conjunction with the identification of existing bike routes. Information will include signed bike routes by type (shared roadway, shoulder, bike lane, cycle tracks, and off-road shared use paths) with roadway information such as shoulder widths, pavement type, posted speed limit, annual average daily traffic, etc. The ultimate goal of the project will be to have a complete GIS inventory of bikeways on the State Highway System with information useful to bicyclists and pedestrians. Eventual availability of the data as a mobile phone application will be considered in project development.

Following a thorough inventory of a jurisdiction's bicycle and pedestrian network, local, regional, and state planners and engineers will have the opportunity to identify system deficiencies. Based on a jurisdiction's priorities, future projects can then be programmed to fill in connectivity gaps, improve conditions of the existing system, or address other priorities.

3.0 Needs Determination

The following sections provide a summary of the TTP 2040 bicycle and pedestrian needs determination methodology as well as results of the fiscally-constrained and unconstrained needs analysis to 2040.

3.1 Methodology and Assumptions

The previous *Technical Memorandum #3, Bicycle-Pedestrian Methodology* described the methodology proposed for assessing the bicycle and pedestrian modes within the TTP 2040. The modal overview reviewed the roles of governmental agencies and departments involved with bicycle and pedestrian planning in Texas such as the U.S. Department of Transportation, TxDOT, Texas Parks & Wildlife Department, Texas Historical Commission, Metropolitan Planning Organizations, and cities. In addition, the roles of other organizations and advocacy groups were reviewed such as the American Association of State Highway and Transportation Officials (AASHTO), League of American Bicyclists, Alliance for Biking and Walking, BikeTexas, and the Rails-to-Trails Conservancy.

A review of data sources revealed that MPOs and cities continue to be the primary sources of bicycle and pedestrian information within Texas. As described in *Technical Memorandum #3, Bicycle-Pedestrian Methodology*, all 25 MPOs within Texas were surveyed for bicycle/pedestrian modal information within their respective Metropolitan Transportation Plans and/or stand-alone bicycle/pedestrian plans. In addition, where present, city bicycle plans were reviewed for the larger cities within the 25 Texas metro areas served by MPOs.

Following a review of available data, significant data gaps were found to exist for the bicycle and pedestrian modes. Data gaps included a lack of usage and performance data, lack of statewide inventories, lack of local inventories in some locations, and lack of rural area information. Where information was available from MPOs and cities, a significant constraint was the variable level of reporting, detail, and assumptions made by the reporting jurisdictions.

3.1.1 Defining "Needs"

As described above, due to a lack of bicycle and pedestrian information at the statewide level, needs were assessed by reviewing the 25 Texas MPOs for bicycle and pedestrian modal information within their Metropolitan Transportation Plans and/or stand-alone bicycle/pedestrian plans. Additionally, where present, city bicycle plans were also reviewed for the larger cities within the 25 Texas metro areas. Following a review of these MPO and city plans, future bicycle and pedestrian programs and projects, and their associated costs (where available), were compiled.

While the MPO and city-identified programs and projects were found to represent the bulk of the available bicycle and pedestrian needs information, additional methodologies were proposed in *Technical Memorandum #3, Bicycle-Pedestrian Methodology.* These methods were described as follows:

- Where projects are not identified within urban areas, identify high-level connectivity and safety issues (where discussed) which could benefit from future construction. Maintenance and accessibility needs would likely be more difficult to identify, and would not be included. Following identification, apply high-level estimated costs to identify project costs.
- Integrate priority needs identified in Outreach Round 1.

Upon further review of the available bicycle and pedestrian data, identification of additional high-level connectivity and safety issues was found to be too time-consuming and project-specific for analysis at the statewide level. However, priority needs were identified in Outreach Round 1, particularly from BikeTexas, which is a statewide advocacy, safety, and education non-profit organization focused on biking and walking. BikeTexas' comments address TxDOT and infrastructure policy, funding, and performance standards, and can be found in the Public Involvement Technical Memorandum. In addition, while rural area bicycle/pedestrian information was generally unavailable, bicycle and pedestrian needs of rural areas were included and are described in Section 3.2 below.

3.2 *Fiscally-Constrained Needs to 2040*

Table 4 presents the results of a review of the 25 most recent Texas MTPs as well as available stand-alone bicycle/pedestrian plans from MPOs and larger Texas cities. As can be seen, the reported information was highly variable among the MPOs and cities. Some MPOs reported extensive lists of bicycle and pedestrian programs and projects with associated costs, while others reported very little. Per federal requirements, most MPOs reported some level of fiscally-constrained financial need for the bicycle and pedestrian modes. Variability and potential shortcomings within the reported bicycle and pedestrian data were common, and included the following:

- Financial needs do not include planned projects with known bicycle and pedestrian components where these component costs were not broken out. This will result in underestimating bike/pedestrain needs.
- Financial needs include all reported Transportation Enhancement projects in 9 of the 25 MPOs. While Transportation Enhancement Program funds are often used for bicycle and pedestrian projects, they are not required to be, and this may overestimate bike/pedestrian needs.
- Some bicycle and pedestrian projects were listed in MTPs, but had no corresponding cost information. This will result in underestimating bike/pedestrian needs.

Rural needs were also assessed and included, as shown in Tables 3 and 4. Per population statistics shown in Table 3, rural needs were calculated as 12% of reported Metro area needs.

Table 3. Texas Population, 2012 Projections

Location	Population	Percentage of Total
Texas	26,146,548	100%
Metropolitan (MSA)	23,077,613	88%
Non-metropolitan	3,068,935	12%

Source: Texas Department of State Health Services (http://www.dshs.state.tx.us/chs/popdat/st2012.shtm)

While imperfect due to data gaps and variability, fiscally-constrained needs through 2040 for the bicycle and pedestrian modes were calculated and estimated to be approximately $3 billion, as shown in Table 4. Due to its limitations, this fiscally-constrained needs analysis should be considered as a baseline or starting point when discussing bicycle and pedestrian needs in Texas. This is particularly true given the rapidly growing population of the state and the increasing interest of Texans to utilize these modes for transportation.

Table 4. MTP and/or Stand-alone Bicycle/Pedestrian Plan Fiscally-Constrained and Unconstrained Needs

MPO	Financial Need from MTP and/or Stand-alone Bike/Pedestrian Plan	Fiscally-Constrained Needs	Unconstrained Additional Needs
Abilene	MTP lists bike/ped needs under traditional and enhanced funding scenarios. Not all needs are accounted for, such as Safe Routes to School (SRTS) and Transportation Enhancements. Cost figures are presented for ADA ramps, sidewalks, bikeways, etc.	$17,319,000	
Amarillo	MTP Lists four Safe Routes to School projects they would like funded and will compete for, three of which include cost estimates. Also lists one Trans. Enhancement project they will compete for that is bike/ped - Rails to Trails Phase 2, $4,000,000.	$4,800,000	
CAMPO-Austin	Many roadway projects will include bike/ped components, which are not broken out. Stand-alone bike/ped projects and programs are grouped together on constrained list and cost $444,000,000 (regionally funded - fed, state, or local). Other priority locally-only funded projects are listed for roadways and include bike/ped without breaking out. The City of Austin, in their 2009 Bicycle Plan, projects a cost of $254,000,000 for complete build-out of the bicycle network. The Transportation Policy Board has determined to "Allocate at least 15 percent of available CAMPO discretionary federal funding (STP-MM) to bicycle and pedestrian projects through the CAMPO TIP process, using the Priority Pedestrian Districts Map and Priority Regional Bicycle Corridors Map in the project evaluation," (Policy 4). No CAMPO "Bike Plan".	$444,000,000	$254,000,000
SETRPC-Beaumont	This region is under a conformity lapse and therefore only exempt projects are listed, however, bike/ped projects are exempt. Bike/ped constrained projects total $5,629,849. They also list other generic grouped bike/ped projects with no estimated costs, as well as a placeholder for transportation enhancements of $14,821,214.	$20,451,063	
Brownsville	From 2010 MPO Bike & Ped Needs Assessment Study. They need 400 miles of sidewalks, which would cost $44,292,000. City of Los Fresnos compiled some Safe Routes to School Needs, totaling $745,393. MTP does not provide bike/ped cost estimates.	$745,393	$44,292,000
BCSMPO-Bryan/College Station	The MTP lists 3 bike/ped projects with funding identified, $11,170,000. Ped facilities are listed with other projects, but ped. costs are not broken out. One additional sidewalk project in Bryan is listed but not funded, Texas Ave., $6,000,000. The City of College Station, in its 2010 Bike/Ped Plan has proposed approximately $85,000,000 in short-long term needs for bike/ped. No MPO bike plan.	$11,170,000	$91,000,000
CRP-Corpus Christi	July, 2013 amendment to MTP added $1,036,698 for bike/ped projects. The MTP lists bike/ped projects totaling $2,900,000.	$3,936,698	
El Paso	Horizon 2040 MTP lists the following total project costs: Bike $4,602,600; Bike & Ped $21,289,233; Pedestrian $18,129,798; for a total of $44,021,631. No MPO or city Bike Plan.	$44,021,631	

Table 4. MTP and/or Stand-alone Bicycle/Pedestrian Plan Fiscally-Constrained and Unconstrained Needs

MPO	Financial Need from MTP and/or Stand-alone Bike/Pedestrian Plan	Fiscally-Constrained Needs	Unconstrained Additional Needs
HSBMPO-Harlingen	MTP lists financially constrained trans. enhancements as $7,994,168.	$7,994,168	
H-GAC-Houston	From 2035 Regional Bikeway Plan (2007), grand total of bike/ped projects in RTP is $280,367,511. 2035 RTP Update lowered funding expectations, but didn't break-out bike/ped. No City of Houston bike plan. Contacted H-GAC in June, 2014. They have some draft new constrained needs $, but are not yet ready to present to the public. City of Sugar Land Bike/Ped Plan lists a projected cost for high priority recommendations of $36-45 million ($40,500,000 average), with no funding secured.	$280,367,511	$40,500,000
HCMPO - Hidalgo County	MTP list available funding for trans. Enhancements at $36,504,000. Bike/ped projects total $9,758,857.	$46,262,857	
K-TUTS Killeen/ Temple	Detailed tables of recommended bike and ped. facilities in Appendix C of KTMPO 2011 Regional Thoroughfare and Pedestrian/Bicycle Plan. Belton $12.79m, Copperas Cove $5.95m, Harker Heights $6.31m, Kempner $236.1k, Killeen $24.66m, Little River/Academy $474.5k, Morgan's Point Resort $56.4k, Nolanville $1.76m, Temple $28.25m, Salado $3.24m, Bell County $37.35m, Coryell County $4.85m, Lampasas County $3.98m, Fort Hood $7.45m, USACE $4.91m. MTP lists a maintenance placeholder for trans. enhancements of $22,701,310. Short range trans. enhancement projects at various locations $6,544,565. Long range trans. enhancement projects at various locations $16,156,745. Unfunded regionally significant bike/ped projects - sidewalk project $1,000,000; pedestrian bridge $1,193,536.	$45,402,620	$142,267,000
Laredo	The MTP lists one large project as feasible under their constrained analysis - the Manadas Creek Hike and Bike Trail - $27,239,455.	$27,239,455	
Longview	Projected needs match projected revenue for bike/ped. One specific trail listed as well as other general trails and enhancements.	$21,724,532	
Lubbock	From the Lubbock MPO Comprehensive Bicycle Plan, 3 phases are proposed for expanding the bikeway system, with a total cost of $1,513,137.	$1,513,137	
MOTOR-Midland/ Odessa	Five constrained projects were listed, totaling $8,848,002 year of expenditure cost. The projected amount available for Transportation Enhancements (bike/ped) 2010-2035 is $11,218,824.	$11,218,824	

Table 4. MTP and/or Stand-alone Bicycle/Pedestrian Plan Fiscally-Constrained and Unconstrained Needs

MPO	Financial Need from MTP and/or Stand-alone Bike/Pedestrian Plan	Fiscally-Constrained Needs	Unconstrained Additional Needs
NCTCOG-DFW	A “Regional Veloweb” is recommended as an off-street network of shared-use paths. Costs are estimated at $800,000/mile. Total funding required to complete all veloweb projects is $1.12 billion. The latest MTP update identifies approx. $1.5 billion of potential funding for “active” trans. improvements between now and 2035. Specific projects include Spot Improvement Program $66,468,000; Safe Routes to School - accounted for through the more than $237,248,000 identified for active transportation in the region; Trans Enhancement Program - same; Local Air Quality - same; Sustainability and Livability - same; Complete Streets - same; Access to Rail - same; Pedestrian Facilities - same; Safety countermeasures - same; On-street bike facility initiative - same; Congestion Mit/Air Quality - same; Regional Veloweb $1,190,724,000. Mobility 2035-2013 Update Bike/Ped revenue & expenditures = $1,495,700,000. No separate MPO bike/ped plan. 2011 Dallas Bike Plan does not contain $ estimates. Bike Ft. Worth 2009 includes $159,897,000 (Planning level construction costs, no maintenance).	$1,495,700,000	$159,897,000
San Angelo	Funded project list: Safe Routes to School 2007 $899,999; Lone Wolf Bridge Ped project $1,400,000; N. Chadbourne Corridor Ped/Transit Access $337,613; Safe Routes to School 2009 $499,999; Red Arroyo Shared Use Path $3,999,140. Unfunded project list: CBD Bike/Ped Improvements $1,200,000. MTP Appendix B, Prioritization of Future bike/ped projects, 2 pages of projects with total of $33,670,500.	$7,136,751	$34,870,500
SABC MPO-San Antonio	Amount funded: Stand Alone Ped $25M; Stand Alone Bike $25M; Trans Enhancement Program Cat. 9 $3M/year for a total of $76.3M through 2035. No separate MPO bike plan. San Antonio Bike Plan 2011: An order-of-magnitude cost projection for complete build out of the entire bicycle network is estimated to cost approximately $250 million to $275 million ($262.5 million average).	$126,300,000	$262,500,000
SD MPO-Sherman/ Denison	Transportation Enhancements historic average annually $96,393. Enhancement projects various locations $497,338. MPO bike plan was from 1998 and contained no $ estimates.	$497,338	
Texarkana	Arkansas constrained project list 2010 to 2035 $850,799; Texas $4,362,590	$5,213,389	
Tyler	Projected Cat.9 Trans. Enhancement Funding: $1,625,000, MTP says this category is typically bike/ped. MTP lists other priority projects & costs that include a bike component, but do not break out the bike/ped costs.	$1,625,000	
Victoria	MTP lists one unconstrained needs project that includes bike/ped: Airline Rd. extension with 10' multipurpose path. Total cost is $12,000,000 with no break-out of bike/ped cost.		$0

Table 4. MTP and/or Stand-alone Bicycle/Pedestrian Plan Fiscally-Constrained and Unconstrained Needs

MPO	Financial Need from MTP and/or Stand-alone Bike/Pedestrian Plan	Fiscally-Constrained Needs	Unconstrained Additional Needs
WUTS-Waco	MTP identifies bike/ped priority projects: Sidewalk program $2,660,000; Brazos riverwalk $800,000; $2,750,000; $5,500,000; Sidewalk program long-term $9,340,000; 4th and 5th Streets $270,000; Austin Ave. $20,000; East Herring Ave. $55,000; Herring/Lyle Aves. $200,000; Univ. Parks Dr. $205,000; Clifton/Elm/Washington Ave. $130,000; Priority Projects 12-21 $3,885,000.	$25,815,000	
WFS MPO-Wichita Falls	MTP lists un-funded bike/ped needs. 9 projects are listed, 7 of which have an estimated cost totaling $9,925,000.		$9,925,000
Rural Texas	Per population statistics in Table 3, calculated as 12% of Metro area needs.	$318,054,524	$124,710,180
Total		$2,968,508,891*	$1,163,961,680*

Note:
*Year of Expenditure Dollars

3.3 *Unconstrained Needs to 2040*

Table 4 also presents the results of a similar review of bicycle and pedestrian unconstrained needs to 2040. As can be seen, the reported unconstrained needs information was also highly variable among the MPOs. In general, unconstrained needs were underreported, with only nine of 25 MPOs reporting financial information. Review of the various MTPs and stand-alone plans revealed that many jurisdictions were hesitant to report unconstrained "wish lists" of bicycle and pedestrian projects during the last economic recession, when many of the MTPs were written. Additionally, some of the jurisdictions likely did not have enough network data or bicycle/pedestrian planning in place to create an unconstrained needs project list. This lack of reported unconstrained needs obviously underestimates the unconstrained needs of the Texas bicycle and pedestrian system.

While also imperfect due to data gaps and variability, unconstrained needs through 2040 for the bicycle and pedestrian modes were calculated and estimated to be approximately $1.2 billion, as shown in Table 4. Due to its limitations, this unconstrained needs analysis should also be considered as a baseline or starting point when discussing bicycle and pedestrian needs in Texas. This is particularly true given the rapidly growing population of the state and the increasing interest of Texans to utilize these modes for transportation.

4.0 Anticipated Revenues and Funding

Funding for the bicycle and pedestrian modes is provided through a variety of federal, state, local, and private sources. While some funding programs are specifically dedicated to bicycle and pedestrian projects, other programs require bicycle and pedestrian projects to compete with other transportation project types for funding. In addition, funding programs change over time, particularly when new federal surface transportation laws are implemented. The most recent long-term federal authorization, MAP-21 (Moving Ahead for Progress in the 21st Century) provides states and local jurisdictions more flexibility and local control in the use of federal transportation funds. Unfortunately, MAP-21 also consolidated some bicycle and pedestrian-specific programs and reduced total funding for these modes. A non-exhaustive list of some bicycle and pedestrian funding programs at various levels of government includes the following:

- Transportation Alternatives Program (TAP) – Transportation Enhancement Activities
- Surface Transportation Program (STP)
- Congestion Mitigation and Air Quality Improvement (CMAQ) Program
- Highway Safety Improvement Program (HSIP)
- National Highway Performance Program (NHPP)
- Federal Transit Administration Capital Funds
- Associated Transit Improvement (ATI)
- Section 402 – State and Community Highway Safety Grant Program
- Federal Lands Highway Program
- Texas Parks and Wildlife Department Recreational Trail Grants
- Local Bonds
- Private Funds

While a variety of funding programs exist for bicycle and pedestrian projects, only a small percentage of federal transportation dollars are spent on these modes. Using FHWA FMIS data (2009-2012), the Alliance for Biking and Walking's *Bicycling and Walking in the United States – 2014 Benchmarking Report* reveals only 2.1% of federal transportation dollars are spent on bicycle and pedestrian projects.

In Texas, past state-reported spending on bicycle and pedestrian facilities and programs in the last 10 years is depicted in Table 5. As can be seen, bicycle and pedestrian spending in Texas has fluctuated quite a bit over the last decade.

As described previously, the current trend of federal funding for the bicycle and pedestrian modes is to provide states and local jurisdictions more flexibility and local control in the use of federal transportation funds. In addition, due to increasing congestion in urban areas and demographic trends, participation in bicycling and walking is likely to continue to increase in Texas and the nation. Only through increased data collection and planning will states and local jurisdictions be able to understand bicycle and pedestrian system deficiencies and needs. With the future of funding for bicycle and pedestrian accommodations uncertain, an increased understanding of bike/pedestrian deficiencies should allow for more equitable planning and funding for these modes, and the resulting transportation, economic, social, and health benefits bicycling and walking provide.

Table 5. Federal-Aid Highway Program Texas-Reported Bicycle and Pedestrian Spending, FY 2004-2013

State	2013 $	2012 $	2011 $	2010 $	2009 $	2008 $	2007 $	2006 $	2005 $	2004 $
Texas	51,046,087	56,770,715	34,702,839	55,362,819	73,533,819	23,504,849	38,845,360	20,241,366	18,604,604	16,191,200

Source: http://www.fhwa.dot.gov/environment/bicycle_pedestrian/funding/bipedfund.cfm

Texas Transportation Plan

Tech Memo 6: Bridge/Culvert Modal Profile

August 14, 2014

Acknowledgements

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Contents

Tables

Figures

1.0 Introduction

With over 35,000 structures on the state-maintained system, TxDOT is responsible for providing safe and reliable bridges and culverts for infrastructure users. This memorandum details the current and forecasted future conditions of on-system bridges/culverts for the state of Texas through the year 2040.

In applying the methodology detailed in Technical Memo #3, it was found that TxDOT would need – in $2013 – over $42B ($1.6 B/yr) to eliminate structural deficiencies, reduce functional obsolescence, and minimize life-cycle costs on the state-network through 2040. With an anticipated $0.5 B/yr available in revenue, this represents a gap of over one billion dollars each year throughout the 2014 to 2040 analysis period. As a result, initial forecasts suggest structural deficiency by deck area will reach the 10% federal mandate by 2030 if no additional investment is applied.

A full summary of results for the state-owned bridge/culvert system in Texas is provided herein, as well as recommendations for next steps.

2.0 Overview of Existing Conditions

In breaking down the on-system inventory, it was found that all bridges/culverts across the state are on average 36 years old and 2% structurally deficient by deck area (**Table 1**).

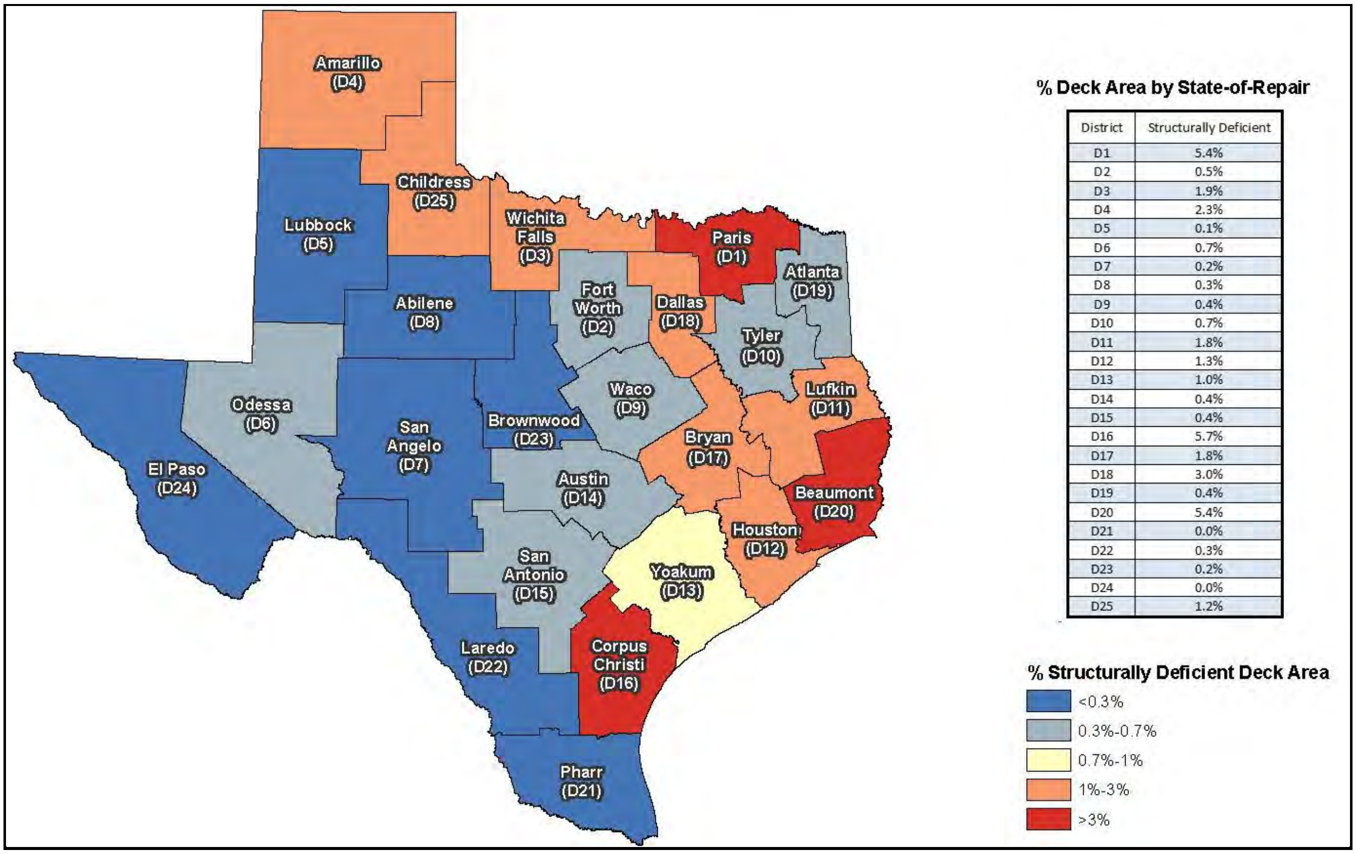
Table 1: Existing Conditions by Bridge/Culvert Network

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

"Freight System refers to the NBI field "Designated National Truck Route"

Figure 1 illustrates percentage of structurally deficient deck area by district as currently exists. From a geographic perspective, structural conditions by district (**Figure 2**) show that no districts currently have structurally deficient (a four or lower NBI condition rating) deck areas exceeding the federally mandated 10% on the NHS. In terms of the current backlog of corrective repairs/replacements, Districts 1, 16, and 20 currently have just over 5% structurally deficient deck area; 0.2% of the system have an NBI rating of 3 or less indicating a higher structural risk – of these District 20 has nearly half of the higher risk deck areas while District 4 has the most number of higher risk structures (**Figure 3**).

Figure 1: Existing Bridge Conditions – Percent Structurally Deficient Deck Area by District



District	Structurally Deficient
D1	5.4%
D2	0.5%
D3	1.9%
D4	2.3%
D5	0.1%
D6	0.7%
D7	0.2%
D8	0.3%
D9	0.4%
D10	0.7%
D11	1.8%
D12	1.3%
D13	1.0%
D14	0.4%
D15	0.4%
D16	5.7%
D17	1.8%
D18	3.0%
D19	0.4%
D20	5.4%
D21	0.0%
D22	0.3%
D23	0.2%
D24	0.0%
D25	1.2%

Figure 2: Percent Deck Area by State-of-Repair for Each District

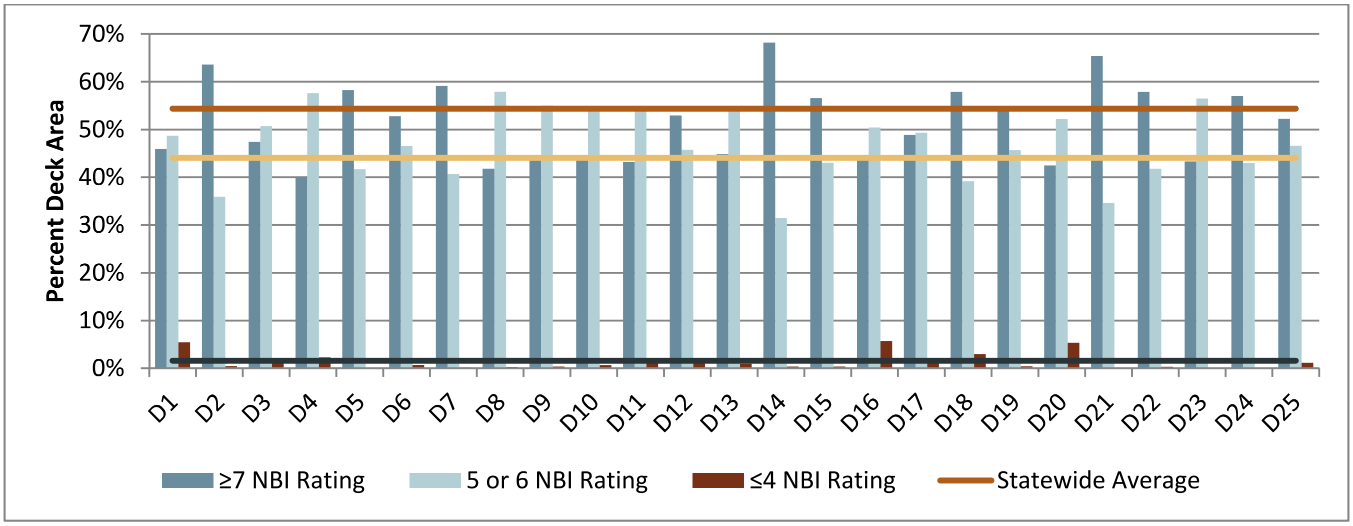
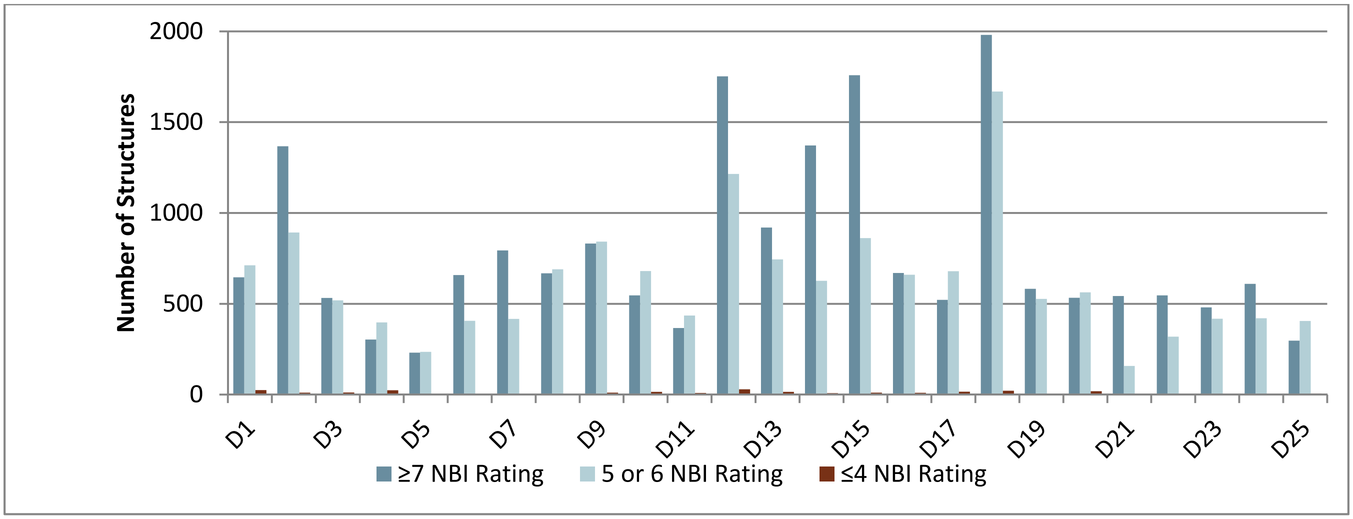


Figure 3: Structure Count by State-of-Repair for Each District



To further improve upon these conditions and to prevent further assets from reaching a structurally deficient state, an unconstrained analysis was conducted to quantify the total amount of money required to eliminate structural deficiencies statewide for TxDOT maintained bridge/culvert assets.

3.0 Unconstrained Needs Determination

3.1 Methodology and Assumptions

3.1.1 Defining "Needs" and State-of-Good Repair

As defined by TxDOT, bridge/culverts are considered to be in a state-of-good-repair when not structurally deficient, functionally obsolete, or sub-standard for load. Therefore, when defining "needs" within this document, the financial total refers routine and preventive maintenance cyclical costs and the capital cost to 1) prevent/eliminate structural deficiency and strengthen sub-standard structures for load and 2) correct for functional obsolescence at the time of a cost-effective replacement activity determined by structural deficiency correction. This performance-based needs assessment has been found to be a best practice across state DOTs and is further called for in the MAP-21 legislation. In using the methodology, the TxDOT performance measures described in Table 2 were able to be quantified.

Table 2: TxDOT Bridge Performance Measures and Descriptions

Measure(s)	Description
Percent Structurally Deficient Deck Area on NHS and non-NHS	Percent of system deck area that have structures deemed Structurally Deficient
Count of Bridges and Percent Deck Area with Cyclic Maintenance Needs	Number of structures and deck area of structures with a deck/superstructure/substructure/or culvert rating of 7 or higher
Count of Bridges and Percent Deck Area with Preventative Maintenance Needs	Number of structures and deck area of structures with a deck/superstructure/substructure/or culvert rating of 5 or 6
Count of Bridges and Percent Deck Area with Rehabilitation or Replacement Needs	Number of structures and deck area of structures with a deck/superstructure/substructure/or culvert rating of 4 or less

From provided file "TxDOT Bridge Performance Measure Determination"

3.1.2 Predicting Future Performance and Selecting Investments

Performance predictions were determined using CH2M HILL's Bridge TAM Tool. This tool, similar to the upcoming version of PONTIS, uses probabilistic models (calibrated based on historical data) to forecast the most likely deterioration for each component given the age and most recent condition inspection data. Separate models were calibrated for existing/new construction, predominantly steel/concrete superstructure material, wet non-freeze/dry non-freeze climate zone, and NHS Interstate/NHS Non-Interstate/Non-NHS functional class.

The predicted condition states, using the NBI 0 (worst) to 9 (best) scale, were utilized to identify feasible activities including cyclic/preventive maintenance and rehabilitation/replacement per TxDOT definition.

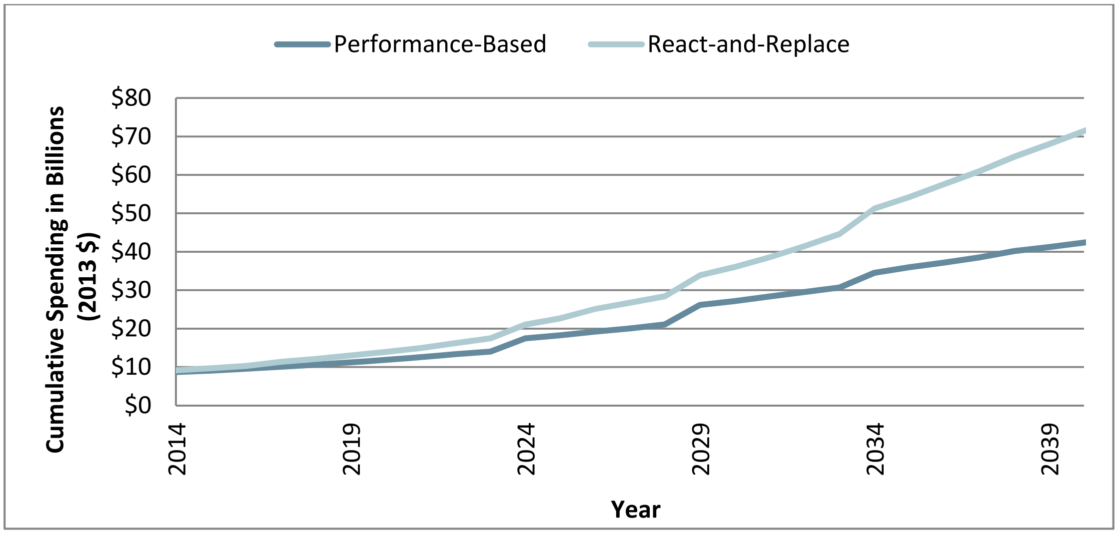
To determine the most cost effective activity, life-cycle-cost analysis was conducted. The activity profile yielding the lowest equivalent annual cost was carried forward for each bridge/culvert asset on the state system. These costs were aggregated over the 2040 planning horizon to reflect the unconstrained needs detailed in the following section.

3.2 Unconstrained Needs to 2040

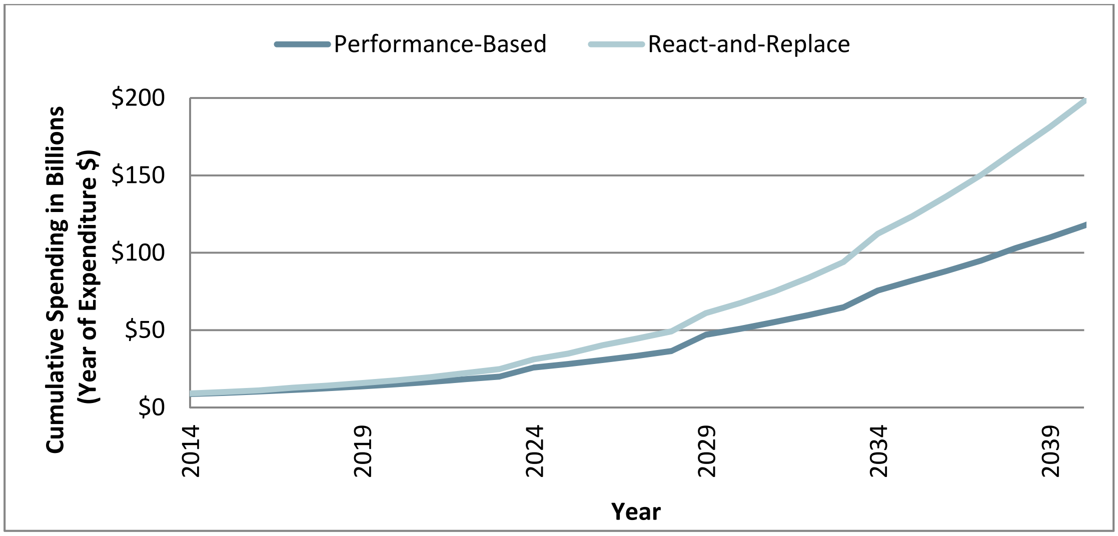
In using the described methodology, it was found that TxDOT would need – in 2013$ – over $42B ($1.6B/yr) to eliminate structural deficiencies, reduce functional obsolescence, and minimize life-cycle costs on the state-network through 2040. This strategy is termed the "performance-based" scenario. Alternatively, if TxDOT preferred to streamline the replacement of older structures at the time of predicted structural deficiency – termed the "react-and-replace" scenario, costs would be predicted to reach – in 2013$ – over $71B ($2.8 B/yr) to eliminate structural deficiencies and reduce functional obsolescence. Through a preservation-focused strategy, nearly $30B worth of savings – in 2013$ – may be realized (Figure 4).

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 planning horizon. Three peaks in particular have been identified, with multiple higher cost activities anticipated to be required around 2025, 2030, and 2035 (Figure 5); Figure 6 shows the corresponding count of activities expected over the planning horizon.

Figure 4: Forecasted Cumulative Expenditures in an Unconstrained Scenario

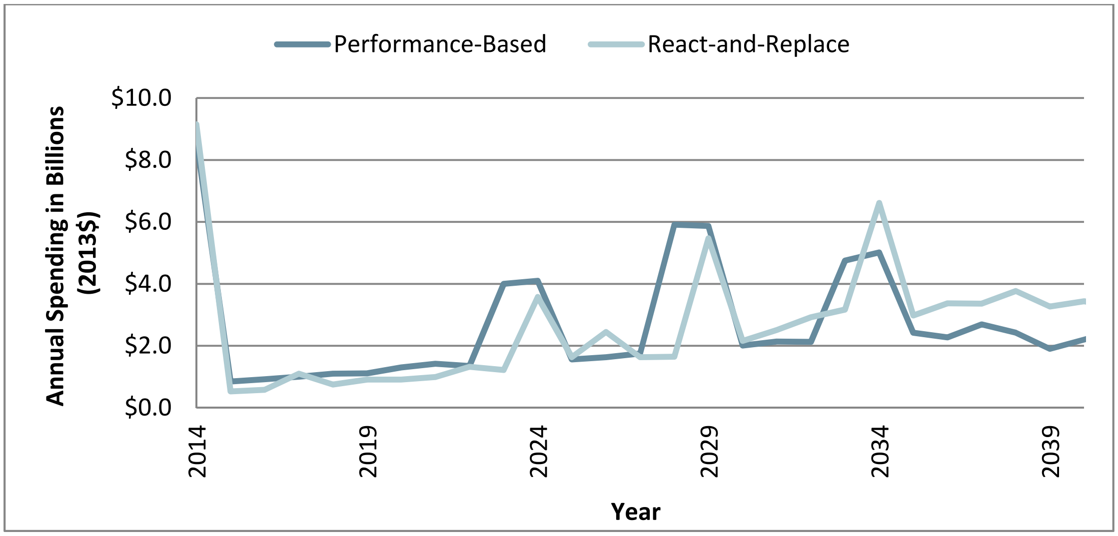


(a) 2013 Dollars

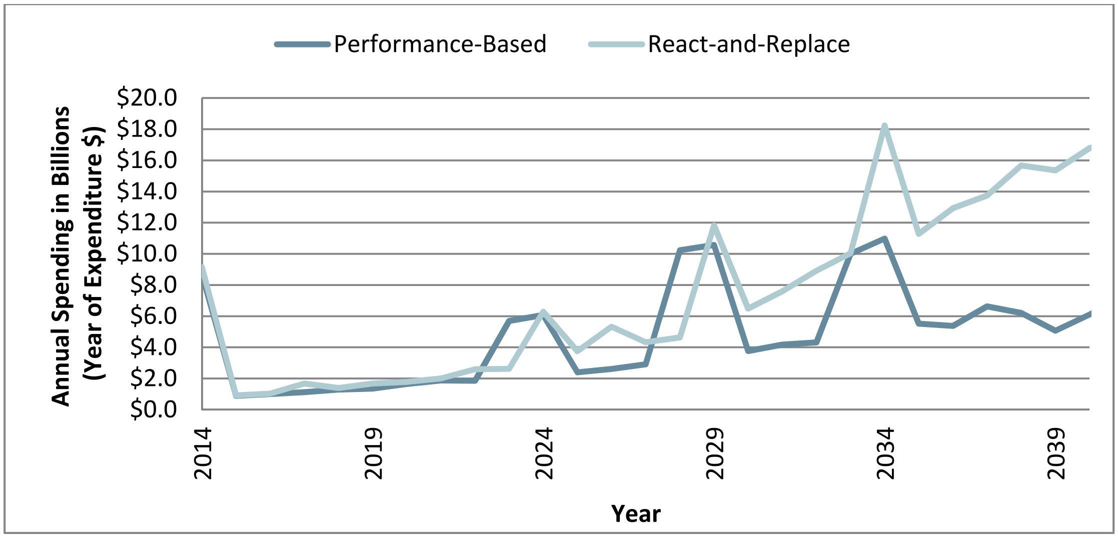


(b) Year of Expenditure (Inflation-Adjusted) Dollars

Figure 5: Forecasted Annual Expenditures in an Unconstrained Scenario

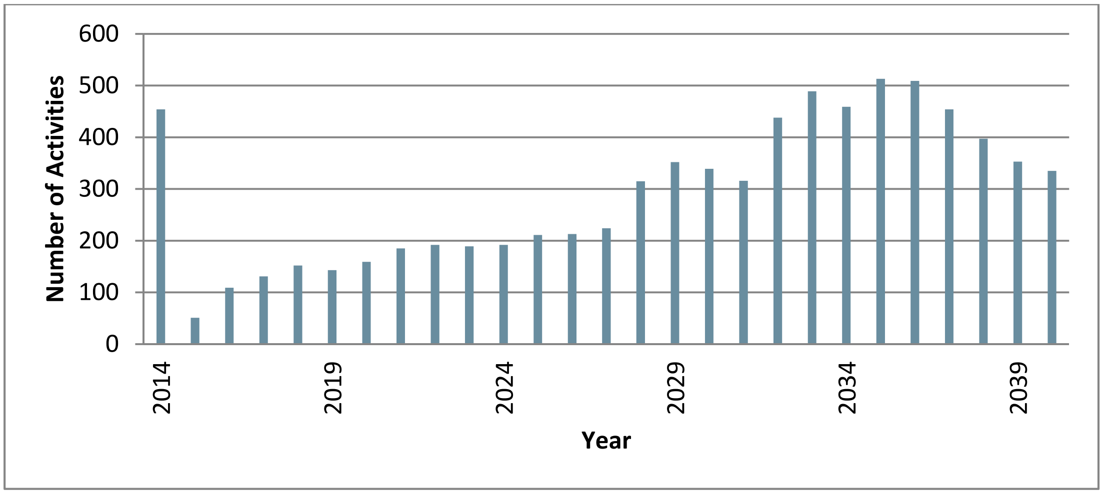


(a) 2013 Dollars



(b) Year of Expenditure (Inflation-Adjusted) Dollars

Figure 6: Forecasted Capital Rehabilitation/Replacement Activities in an Unconstrained Scenario



The bulk of needs, nearly 80%, are anticipated to be required on the NHS due to higher truck volumes, corresponding improvement costs, and a higher inventory of structures; roughly half of this cost is expected to be split between the Interstate and non-Interstate systems. In terms of freight needs, given the large number of inventory not on the designated national truck route, a slightly higher (60/40) split in needs is projected (Table 3).

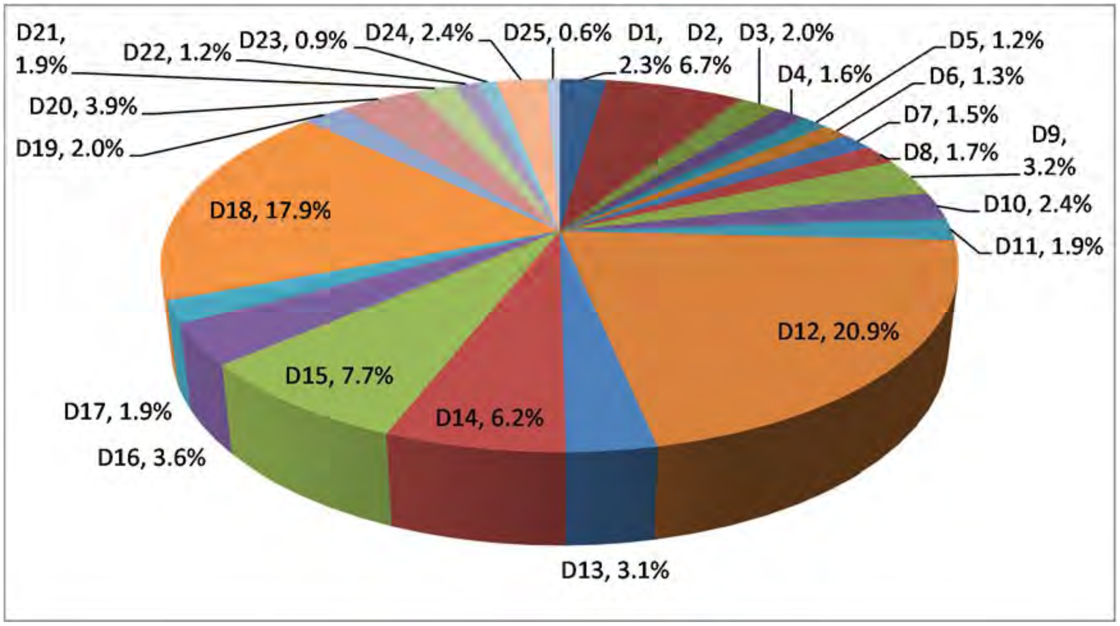
Table 3: 2040 Bridge/Culvert Needs by On-System Network

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

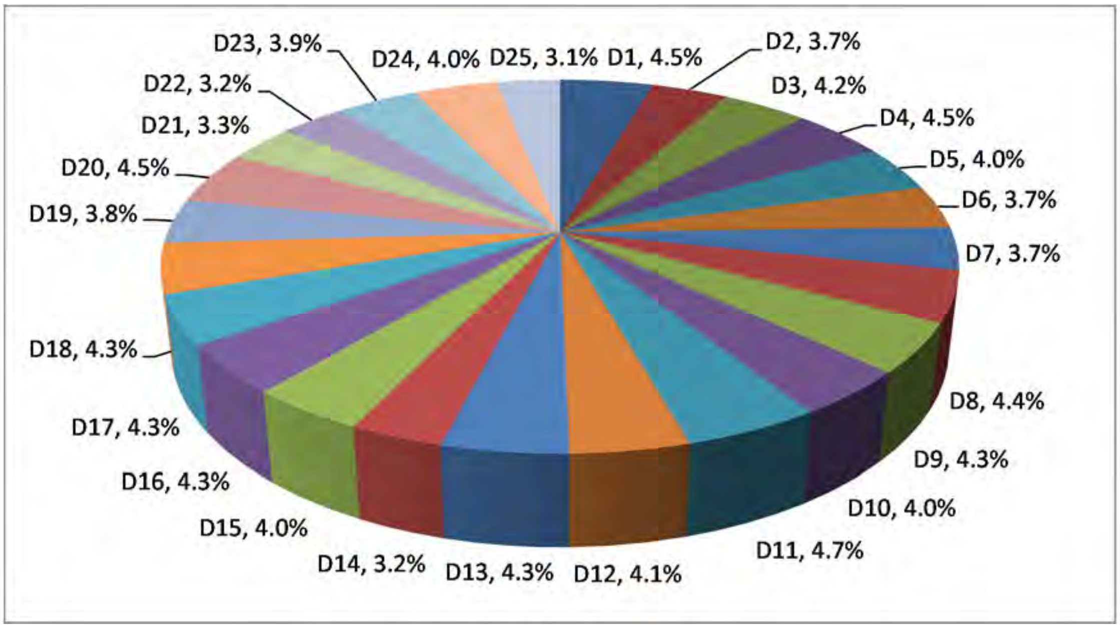
"Freight System refers to the NBI field "Designated National Truck Route"

When viewed from a district perspective (Figure 7), the majority of needs – in terms of magnitude – are expected around major cities which have the largest concentration of structures and higher unit costs: Houston (D12), Dallas (D18), San Antonio (D15), Fort Worth (D2), and Austin (D14), respectively. However, when considered from a dollar per square foot vantage point, far more equity across the state can be visualized; in fact the top five districts on a per unit of deck area basis are as follows: Beaumont (D20), Amarillo (D4), Corpus Christi (D16), Paris (D1), and Abilene (D8). Figure 8 illustrates forecasted 2040 bridge needs by district.

Figure 7: Percent Total Needs through 2040 by District

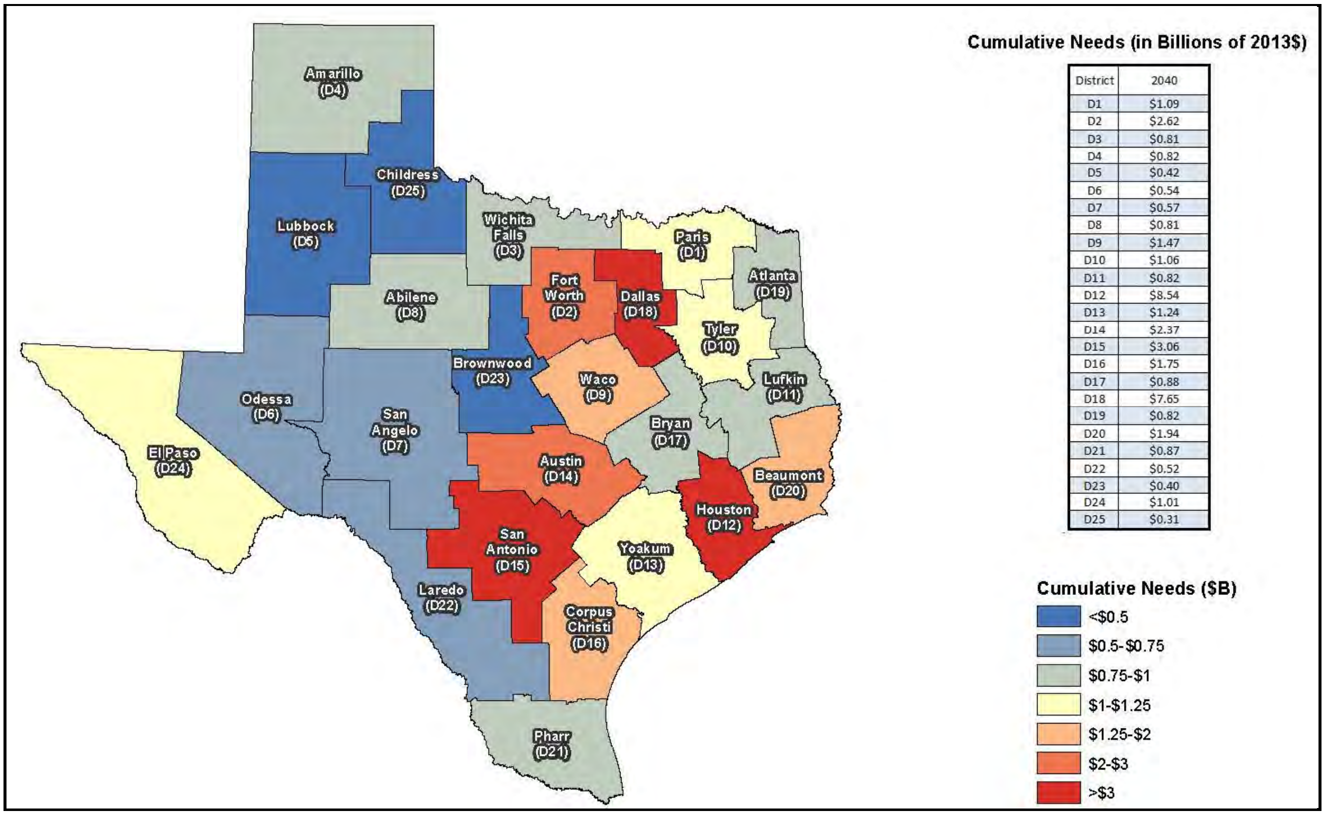


(a) Total Needs by Magnitude



(b) Total Needs per Square Foot

Figure 8: Forecasted 2040 Bridge Needs by District



District	2040
D1	$1.09
D2	$2.62
D3	$0.81
D4	$0.82
D5	$0.42
D6	$0.54
D7	$0.57
D8	$0.81
D9	$1.47
D10	$1.06
D11	$0.82
D12	$8.54
D13	$1.24
D14	$2.37
D15	$3.06
D16	$1.75
D17	$0.88
D18	$7.65
D19	$0.82
D20	$1.94
D21	$0.87
D22	$0.52
D23	$0.40
D24	$1.01
D25	$0.31

In the 2030 Committee Report, TxDOT estimated needing a cumulative total of $25B (2013$) from 2010 through 2030; in using the CH2M HILL TAM Tool, this estimate is $27B (from 2014 through 2030). Relative to the previous TxDOT SLRTP, on-system bridge needs were approximated to be $27B (2013$) from 2010 through 2035; in using the CH2M HILL TAM Tool, this estimate is $36B from 2014 through 2035 — the main difference in these estimates being that a lower assumption for replacement cost per square foot was used in past publications (~$200/SF instead of $300/SF) and varying definitions of “needs” (for example, the 2030 Committee Report looked at continuing 2010 conditions). As such, the provided results herein are considered in line with past publications.

4.0 Fiscally-Constrained Analysis

4.1 Project Prioritization

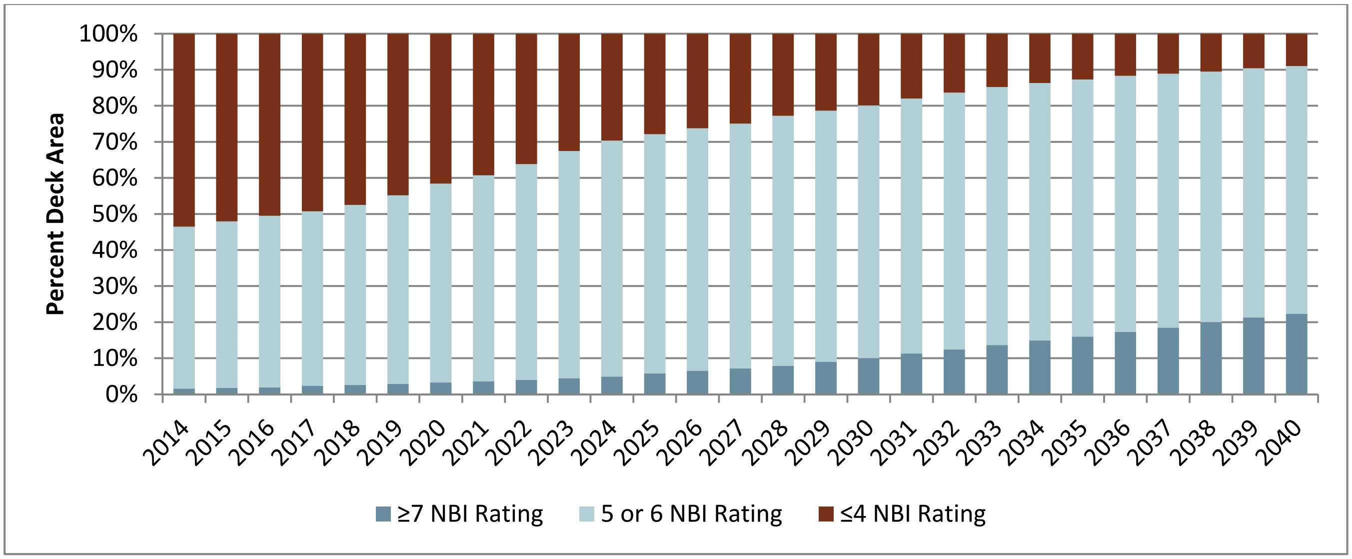
A “bottom-up” (project-level) approach was utilized to establish the linkage between system performance and investment level. As such for each activity identified by the CH2M HILL Bridge TAM Tool, a priority score was assigned weighing the benefit of the activity in reducing structural risk (worst-first based on condition ratings) and life-cycle costs (opportunity-based given potential savings from effectively timed activities). These two components were weighed on a 50/50 basis and updated for each year throughout the 2040 planning horizon with the tool conducting an optimization to maximize the program score relative to the annual budget – currently expected at $500M. The performance with and without implementation of each project was used to aggregate results.

4.2 Fiscally-Constrained and Tradeoff Analysis

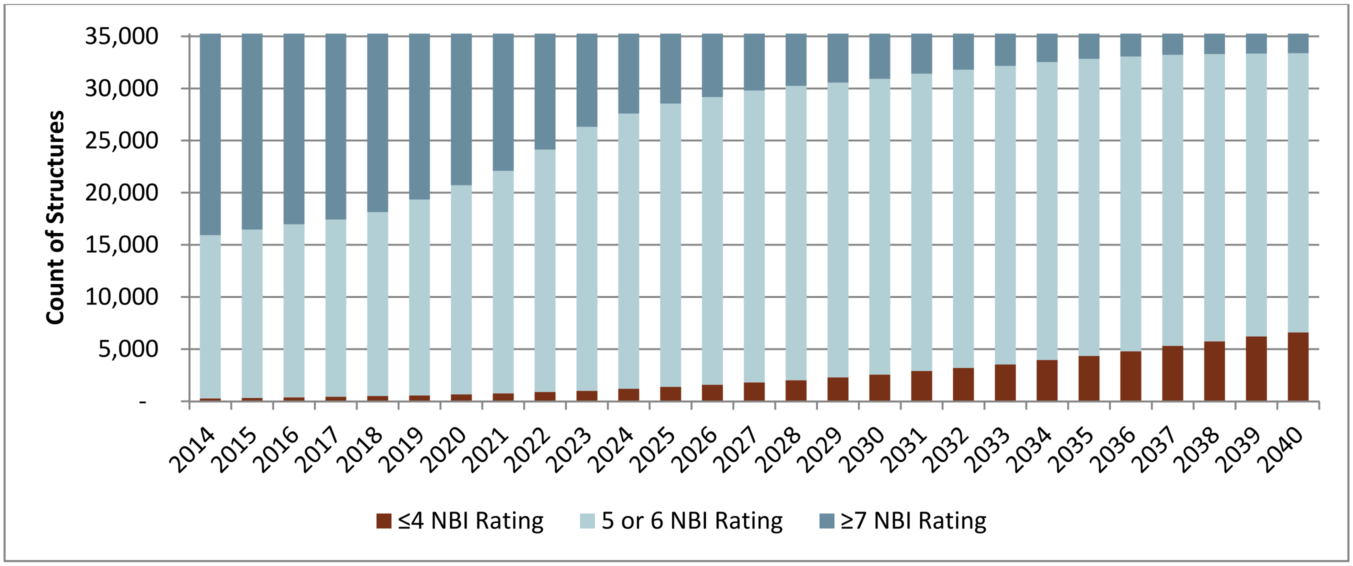
As a result of an annual, inflation adjusted $500M budget, structural condition is predicted to be relatively stable through 2020 but not sufficient to meet state goals throughout the 2040 planning horizon. At this funding level, structural deficiency is forecasted to exceed 10% by deck area on the NHS (part of MAP-21 rulemaking) by 2030 and ultimately reach 22% overall by 2040.

With most bridge/culvert assets across the system reaching their design life (50 years in age) in 2030, more extensive repair requirements will create a challenge for the agency to keep pace (Figure 9). It is forecasted that roughly twice the expected budget is needed to sufficiently address TxDOT on-system bridge needs; a comparison of performance at this increased funding level is provided in Table 5.

Figure 9: Financially-Constrained Forecast for Bridge/Culvert State-of-Repair at $500M Annual Investment Level



(a) By Deck Area



(b) By Count

Table 5: 2040 Bridge/Culvert Forecasted State-of-Repair by Annual Investment Level

TxDOT Needs Classification	Percent Deck Area ($500M/yr)	Count of Structures ($500M/yr)	Percent Deck Area ($1,000M/yr)	Count of Structures ($1,000M/yr)
Cyclic Maintenance (≥7 NBI Rating)	9.0%	1,893	11.7%	2,157
Preventive Maintenance (5 or 6 NBI Rating)	68.7%	26,757	77.2%	17,218
Rehabilitation or Replacement (≤4 NBI Rating)	22.3%	6,610	11.1%	15,885

By system, it was forecasted that the structures on the NHS will reach 21.6% (11.4% if double investment) structural deficiency by deck area and structures on the freight highway system will reach 23.7% (13.2% if double investment) (Table 6a). Should this occur, to meet federal requirements on the NHS, a tradeoff will be needed to improve NHS conditions at expense of the non-NHS.

If the annual $500M were allocated to TxDOT districts based on the percent total needs (Table 6b), TxDOT is predicted to be able to mitigate only 7% (64% at $1,000M/yr) of predicted structural deficiencies by count and 2% (approximately half at $1,000M/yr) by deck area, on top of cyclical/preventive maintenance.

Table 6: 2040 Bridge/Culvert Forecasted Structural Deficiency at $1B/yr

(a) by Network

Network	% SD Deck Area ($500M/yr)	Count of SD Structures ($500M/yr)	% SD Deck Area ($1,000M/yr)	Count of SD Structures ($1,000M/yr)
NHS	21.6%	3,919	11.4%	1,570
Non-NHS	24.8%	2,691	10.3%	1,022
On Freight System*	23.7%	1,977	13.2%	798
Off Freight System*	21.5%	4,633	9.9%	1,794
Statewide	**22.3%**	**6,610**	**11.1%**	**2,592**

Table 6: 2040 Bridge/Culvert Forecasted Structural Deficiency at $1B/yr

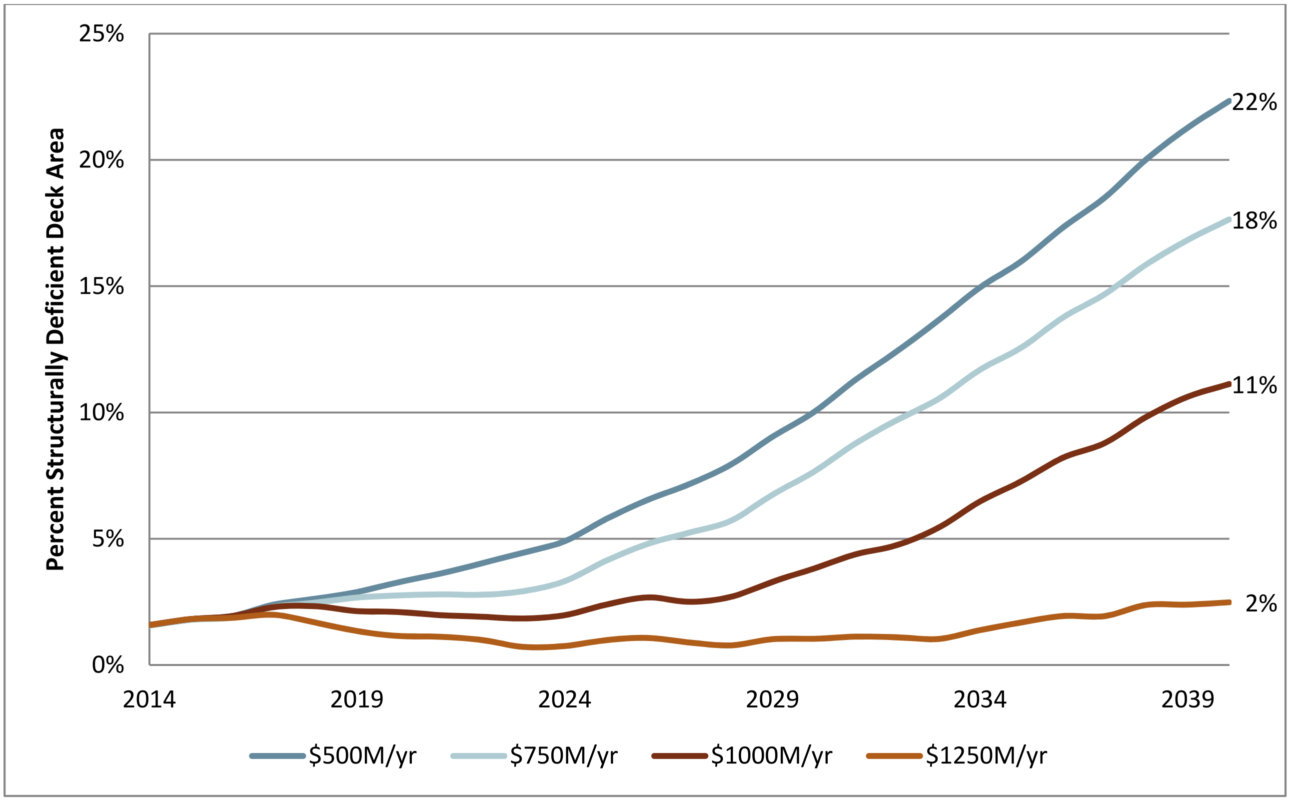
(b) by District

District	Assumed Annual Budget Allocation*	% SD Deck Area ($500M/yr)	Count of SD Structures ($500M/yr)	% SD Deck Area ($1000M/yr)	Count of SD Structures ($1000M/yr)
1 – Paris	2.6%	34.8%	344	20.7%	217
2 – Fort Worth	6.2%	14.1%	397	8.0%	177
3 – Wichita Falls	1.9%	21.4%	205	9.2%	60
4 – Amarillo	1.9%	33.3%	186	19.6%	91
5 – Lubbock	1.0%	11.5%	50	2.8%	10
6 – Odessa	1.3%	22.7%	137	4.6%	27
7 – San Angelo	1.3%	18.3%	127	4.8%	17
8 – Abilene	1.9%	33.8%	318	19.9%	181
9 – Waco	3.5%	40.7%	409	20.5%	122
10 – Tyler	2.5%	32.2%	269	17.2%	114
11 – Lufkin	1.9%	39.6%	223	25.4%	120
12 – Houston	20.1%	16.7%	483	4.9%	29
13 – Yoakum	2.9%	37.7%	361	14..4%	92
14 – Austin	5.6%	10.9%	227	7.4%	138
15 – San Antonio	7.2%	17.7%	375	6.2%	54
16 – Corpus Christi	4.1%	28.2%	220	15.4%	133
17 – Bryan	2.1%	32.9%	332	17.8%	148
18 – Dallas	18.0%	24.4%	883	16.7%	577
19 – Atlanta	1.9%	28.0%	195	11.6%	38
20 – Beaumont	4.6%	32.0%	274	18.6%	132
21 – Pharr	2.0%	18.0%	50	12.6%	27
22 – Laredo	1.2%	16.9%	85	4.1%	3
23 – Brownwood	0.9%	32.4%	145	10.0%	20
24 – El Paso	2.4%	22.3%	200	8.2%	39
25 – Childress	0.7%	24.0%	115	10.7%	26
Statewide	**100%**	**22.3%**	**6,610**	**11.1%**	**2,592**

*Budget allocations are based on % of relative needs and not any indication of TxDOT policy

Given uncertainties in future revenue and the potential for an infusion of resources, tradeoff analyses were conducted around the performance bought at different investment levels. For instance, if funds are increased by $25M/yr then structural deficiencies in 2040 would be expected to decrease by 4% of deck area; for another $25M/yr on top of that, structural deficiencies by deck area could be cut in half (Figure 10).

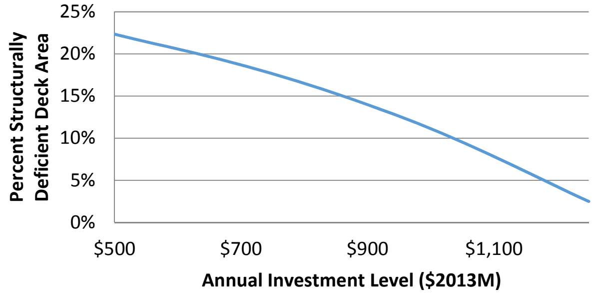
Figure 10: Forecasted Performance over Planning Horizon Relative to Investment Level



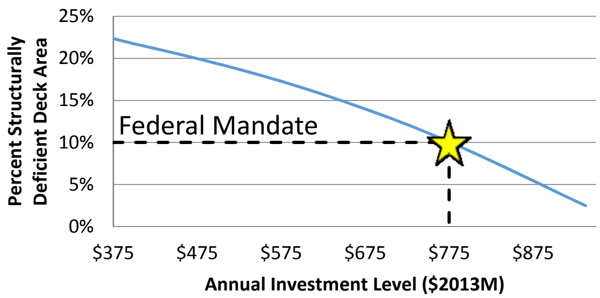
In order to meet federal mandates on structurally deficient deck area through 2040, an annual investment of $775M/yr is predicted to be required; this value currently exceeds the total on-system budget without consideration of the non-NHS. The tradeoff curves in Figure 11 can be used to inform the setting of long-range performance targets and identifying early what performance trajectory can be expected at current budgets.

Given the age of the system, it is recommended that TxDOT seek new revenues, particularly by 2020, to mitigate future structural deficiencies. Particular focus will be needed to meet federal requirements on the NHS. To help align these bridge needs with other modes, a performance-based resource allocation approach is recommended amongst the modes. For instance, if pavement targets are allowed to slip slightly, the improvement in bridge targets may more than make up for the change in performance. Agency preferences will be critical to make the difficult decisions surrounding possible future performance outcomes.

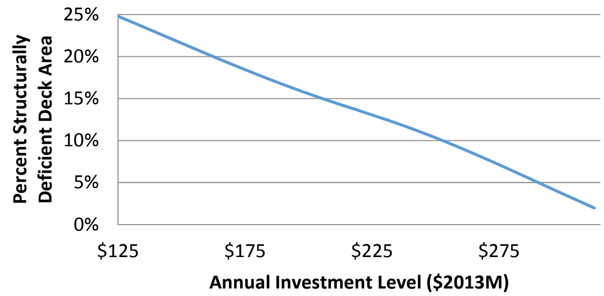
Figure 11: Forecasted 2040 Performance by Network Relative to Investment Level



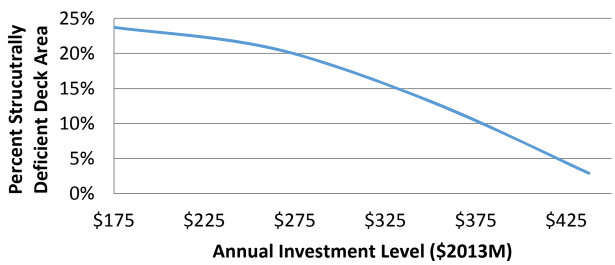
(a) Overall 2040 Conditions



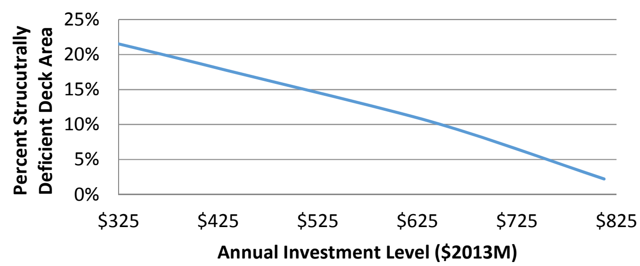
(b) 2040 Conditions on the NHS



(c) 2040 Conditions on the Non-NHS



(d) 2040 Conditions On-Freight Network



(e) 2040 Conditions Off-Freight Network

Texas Transportation Plan

Tech Memo 6: Expansion Modal Profile

August 15, 2014

Acknowledgements

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Contents

Tables

Figures

1.0 Introduction

As part of the development of the Texas Transportation Plan (TTP), the project team set out to identify highway capacity needs. To accomplish this, a methodology was developed to define deficient roadways by identifying roadways operating below a specific level of service (LOS). The amount of extra capacity needed to allow a given roadway to operate above the deficient level was then calculated and the cost of the improvement estimated.

The Texas Statewide Analysis Model version (SAM-V3) provided the network and traffic data use for this analysis, while the Texas Transportation Planning (TPP) highway expansion unit cost was utilized to calculate potential capacity improvement costs. This analysis was conducted for both the base year (2010) and baseline horizon year (2040), as well as for three future network scenarios: the Connectivity and Freight Mobility Scenario, the Urban Mobility Scenario, and the System Preservation Scenario. This technical memorandum describes the methodology used to identify highway capacity deficiencies and presents the results of analysis for 2010 and 2040.

2.0 Identification of Highway Deficiencies

The first step in the process was to define deficiencies in terms of roadway network performance. The highway LOS measure, which is used in *The Highway Capacity Manual* and *AASHTO Geometric Design of Highway and Streets,* was utilized to evaluate roadway network performance. 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. LOS A occurs late at night in urban areas, frequently in rural areas.

B. **Reasonably free flow.** LOS A speeds are maintained, 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 because there are virtually no usable gaps to maneuver in the traffic stream and speeds rarely reach the posted limit. Speeds are still at or above 50 mph. Any disruption to traffic flow, such as merging ramp traffic or lane changes, will create a shock wave affecting traffic upstream. Any incident will create serious delays. This is a common standard in larger urban areas, where some roadway 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.

The specific ranges of free flow speed, and passenger car density used to define the LOS and identify deficiencies are presented in Appendix C.

3.0 Baseline Deficiencies

The evaluation of deficient roadways and the calculation of the cost of adding the additional capacity necessary to mitigate these deficiencies is described in this section. Roadway deficiencies are reported using the following measures:

- Total delay, in vehicle-hours
  - by functional classification of the roadway
  - by area type (Rural or Urban)
  - by time period (AM Peak, Mid-day, PM Peak, Overnight)
- Percent of system congested
  - by time period (AM Peak, Mid-day, PM Peak, Overnight)
  - by functional classification of the roadway
- Congestion Severity Index (CSI)

These measures are described in more detail in this section.

3.1 Total Delay

Total delay (in vehicle-hours) measures the total time loss due to congestion for all vehicles using roadways included in the Texas Statewide Model (SAM-V3). This measure can be used to prioritize highly travelled sections above those that are less heavily travelled. Changes in total delay between different scenarios can show which improvements affect the state's roadway system or a particular corridor. Annual statewide delay, by functional class, is presented in Table 1 for the 2010 and 2040 baseline scenarios.

$$TotalDelay = (Congested\ Time - Free\ Flow\ Time) * Volume$$

Table 1: Statewide Annual Delay by Functional Class (in vehicle-hours)

FC	FC Description	2010 Delay	2040 Delay
1	Rural Interstate	12,600,376	108,646,815
2	Rural Principal Arterial	14,576,528	152,820,139
6	Rural Minor Arterial	31,528,891	113,361,094
7	Rural Major Collector	32,366,955	135,373,176
8	Rural Minor Collector	5,161,232	24,700,580
9	Rural Local	4,487,119	13,813,428
11	Urban Interstate	62,424,772	213,886,436
12	Urban Freeway & Expressway	52,059,142	222,893,523
14	Other Urban Principal Arterial	220,268,744	549,352,393
16	Urban Minor Arterial	49,658,127	134,681,670
17	Urban Collector	9,885,620	29,697,173
19	Urban Local	1,073,456	2,702,983
111	HOV and HOT lanes	10,869,800	46,182,073
Total		**506,960,761**	**1,748,111,486**

Table 2: Statewide Annual Delay by Area Type (vehicle-hours)

Area	2010 Delay	2040 Delay
Rural	100,721,100	548,715,234
Urban	406,239,661	1,199,396,252

3.2 Percent of System Congested

The Percent of System Congested measure describes the extent of congestion on the highway system. This measure is calculated by dividing the number of congested lane miles by the total lane miles for all roadway links in the system. Roadways that are at or below LOS D are assumed to be in congestion. Table 3 below shows the Percent of System Congested by Time Period for the 2010 and 2040 baseline scenarios.

Table 3: Percent of System Congested (LOS D or worse) by Time Period

Period	2010 % Congested	2040 % Congested
AM	3.7%	8.4%
MD	0.6%	2.3%
PM	3.2%	7.5%
NT	0.0%	0.0%

Table 4 presents the Percent of System Congested by Functional Classification for both 2010 and 2040.These numbers show that 2040 system-wide congestion is significantly higher than 2010 system-wide congestion for each of the functional classes.

Table 4: Percent of System Congested (LOS D or worse) by Functional Class

FC	FC Description	2010 % Congested	2040 % Congested
1	Rural Interstate	0.4%	5.9%
2	Rural Principal Arterial	1.1%	5.3%
6	Rural Minor Arterial	1.1%	2.8%
7	Rural Major Collector	0.8%	2.2%
8	Rural Minor Collector	0.4%	1.2%
9	Rural Local	0.2%	0.8%
11	Urban Interstate	19.3%	31.1%
12	Urban Freeway & Expressway	13.9%	18.1%
14	Other Urban Principal Arterial	2.4%	6.4%
16	Urban Minor Arterial	2.0%	5.3%
17	Urban Collector	1.7%	5.1%
19	Urban Local	2.6%	7.7%
111	HOV and HOT lanes	49.4%	22.7%
Percent of System Congested – Statewide		2.4%	5.7%

3.3 Congestion Severity Index (CSI)

The Congestion Severity Index (CSI) describes congestion severity by calculating system wide freeway and arterial delay by the amount of vehicle miles traveled. The statewide CSI, which is computed for an average 24-hour day, is shown for the 2010 and 2040 baseline conditions in Table 5 below.

Table 5: Congestion Severity Index (Freeway Delay per Million Miles of Travel)

Congestion Severity Index	2010	2040
Statewide	4,924	10,655

The following measures, while not summarized in this memo, have been calculated and included along with the above measures in Excel format.

- Daily Freight Congestion Cost
  - The daily freight congestion cost is computed as the delay experienced by truck volumes multiplied by truck value of time.
- Total delay per mile
  - This measure is computed as the total delay divided by the roadway length. This measure can indicate the congestion levels without the difference in roadway length affecting the ranking. This measure was computed for the SAM-V3 highway network, and can be used to identify most congested sections.
- Texas Congestion Index (TCI)
  - The TCI is the ratio of actual travel time to the free flow travel time, which measures the amount of extra time for any trip. The TCI is calculated for the SAM-V3 highway network.
- Commuter Stress Index
  - The commuter stress index measures the amount of extra time for traveling in the peak direction during both peak periods, which reflects most commuters' stress level and is an indicator for people's general perception of congestion. This measure is calculated for the SAM-V3 highway network.

4.0 Scenarios Testing Mitigation of 2040 Deficiencies

Once deficient roadway links were identified, the project team determined the additional lane miles needed to keep 2040 congestion levels at a desired level of service. For this analysis, three scenarios were tested, each defined by different target levels of service. These three scenarios included:

- **The Connectivity and Freight Mobility Scenario,** with a target Rural LOS C and Urban LOS D for the 2040 horizon year;
- **The Urban Mobility Scenario,** with a target Rural LOS D and Urban LOS D for the 2040 horizon year;
- **The System Preservation Scenario,** with the target Rural LOS and Urban LOS remaining the same as the LOS from the 2040 baseline scenario (that is, the LOS resulting from projects included in MTPs and STIP).

For each of the three scenarios, the minimum improvement needed to address the identified deficiencies in both peak periods was calculated. If the AM peak warranted one additional lane to address deficiencies but the PM peak warranted two additional lanes, the two additional lanes for the PM peak was selected as the amount of capacity needed. The additional lane-miles required by functional class are shown in Table 6 below. Table 7 shows required lane-miles by area type. Note that the System Preservation scenario does not require any additional lanes as it is the same as the baseline 2040 scenario.

Table 6: Additional Lane Miles Needed by Functional Class

FC	FC Description	Connectivity & Freight Mobility	Urban Mobility	System Preservation
1	Rural Interstate	0	513	-
2	Rural Principal Arterial	1,480	1,921	-
6	Rural Minor Arterial	2,926	1,264	-
7	Rural Major Collector	3,238	1,650	-
8	Rural Minor Collector	4,722	397	-
9	Rural Local	1,016	185	-
11	Urban Interstate	435	3,299	-
12	Urban Freeway & Expressway	4,041	3,505	-
14	Other Urban Principal Arterial	3,737	2,645	-
16	Urban Minor Arterial	2,691	903	-
17	Urban Collector	904	243	-
19	Urban Local	243	17	-
111	HOV and HOT lanes	677	677	-
Statewide Additional Lane Miles		26,127	17,219	-

Table 7: Additional Lane-Miles Needed by Area Type

Area Type	Connectivity & Freight Mobility	Urban Mobility	System Preservation
Rural	13,816	5,930	-
Urban	12,310	11,289	-

4.1 Cost Estimates

The project team next developed cost estimates for the extra capacity needed to address roadway deficiencies in 2040. The draft methodology and assumptions used for the cost estimates are included in Appendix A for reference. The costs associated with addressing roadway deficiencies for the three scenarios (by facility type) are presented in Table 8.

Table 8: Estimated Cost for Improvements, by Facility Type (in thousands of 2014 dollars)[1]

FC	FC Description	Connectivity & Freight Mobility	Urban Mobility	System Preservation
1	Rural Interstate	2,660,878.55	923,246.57	-
2	Rural Principal Arterial	4,293,677.08	2,819,353.49	-
6	Rural Minor Arterial	4,268,689.26	1,666,471.32	-
7	Rural Major Collector	5,377,889.34	1,879,243.78	-
8	Rural Minor Collector	1,157,298.70	451,733.16	-
9	Rural Local	495,916.11	210,149.64	-
11	Urban Interstate	100,015,462.69	82,128,578.50	-
12	Urban Freeway & Expressway	89,605,839.69	84,703,577.63	-
14	Other Urban Principal Arterial	19,584,705.87	19,250,574.68	-
16	Urban Minor Arterial	4,402,930.01	4,395,181.00	-
17	Urban Collector	1,066,947.11	1,066,947.11	-
19	Urban Local	87,672.48	87,672.48	-
111	HOV and HOT lanes	17,637,675.16	17,637,675.16	-
Statewide Estimated Cost		250,655,582	217,220,405	

Note:

1 The estimated cost is the average of the normal cost and high cost estimated based on the unit expansion cost.

Mapping the results of this analysis provides a general idea of the areas in the state where capacity improvements may be warranted in order to have a functioning highway system. Note that the maps on the following pages are produced as examples for internal use only, and should not be distributed. Figure 1 through Figure 3 below depict areas of the state in which roadway links have been classified as being deficient (not at target LOS) for the three scenarios presented in this memorandum. Figure 1 and Figure 2 depict where lanes need to be added to achieve the target LOS. Figure 3 depicts areas that are below LOS C if no improvements are made.

Figure 1: 2040 Connectivity and Freight Mobility Scenario

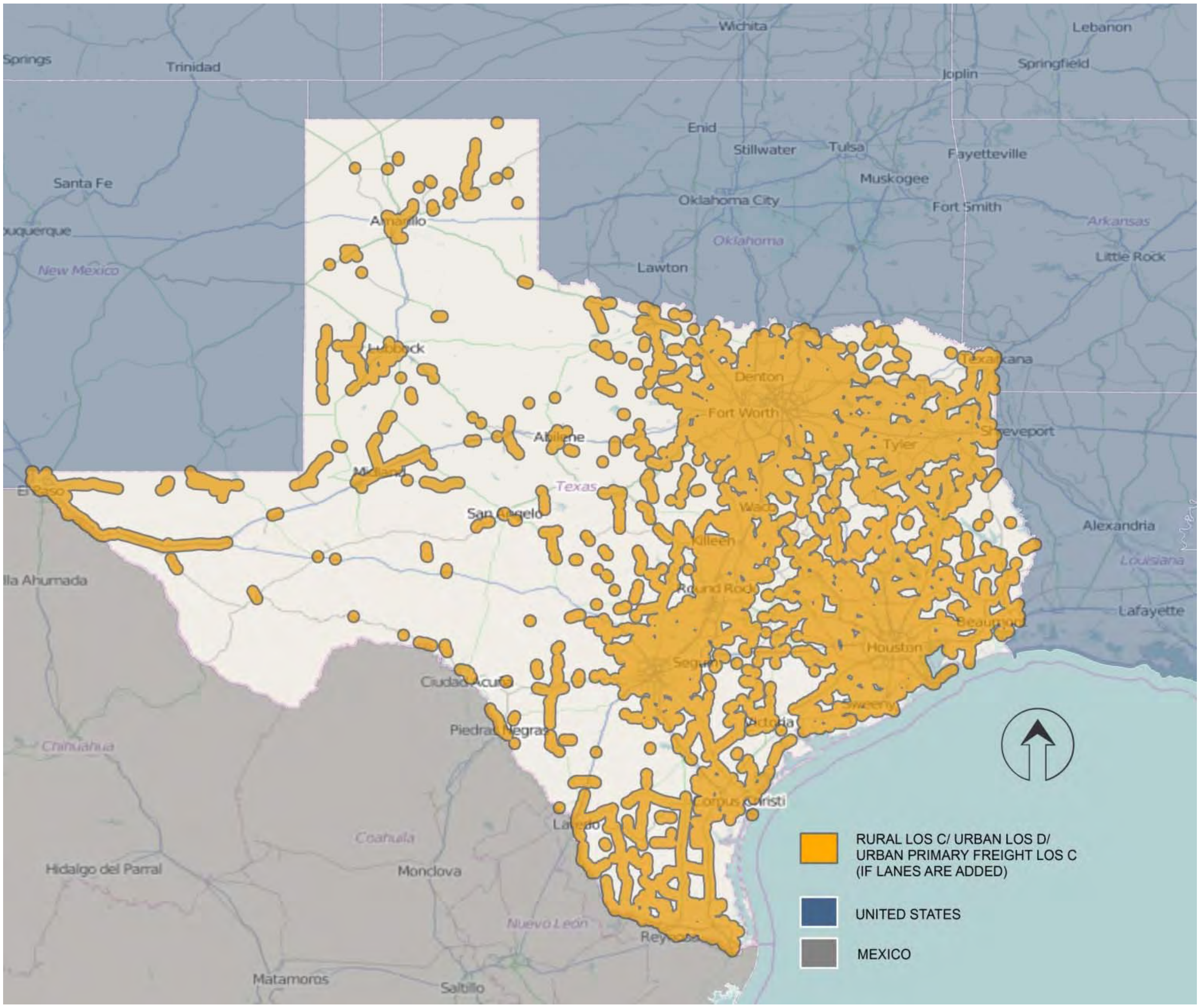


Figure 2: 2040 Urban Mobility Scenario

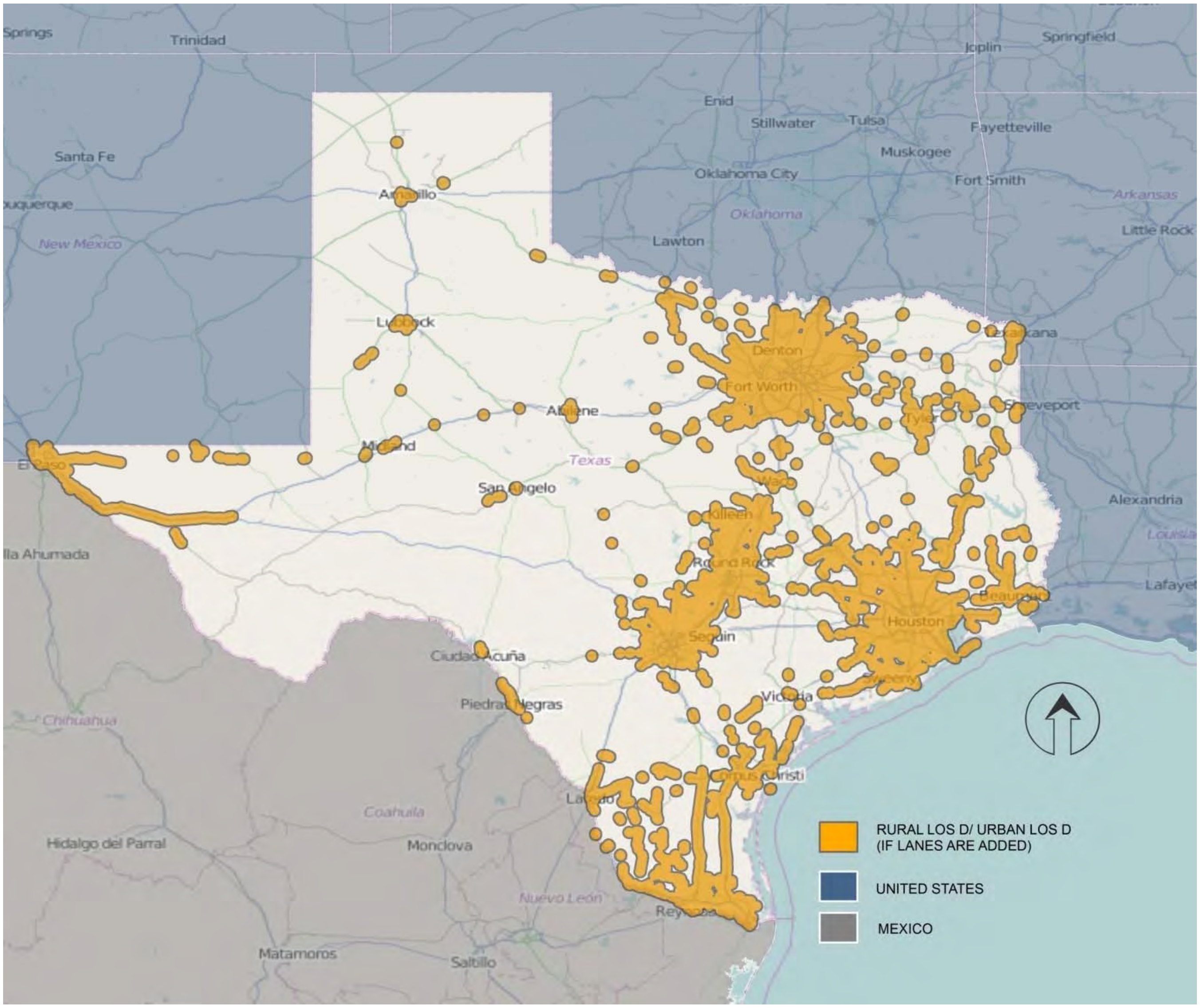
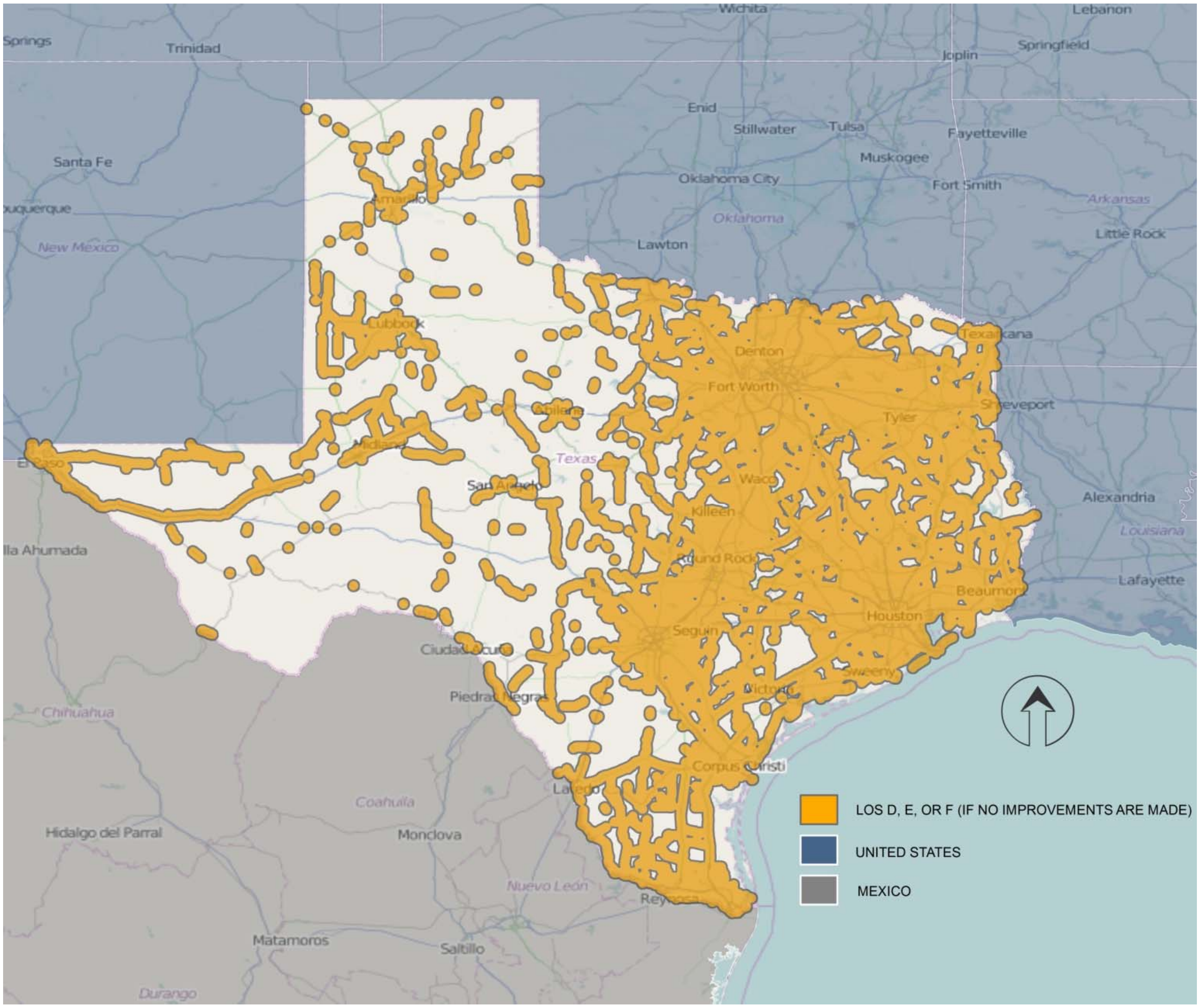


Figure 3: 2040 System Preservation Scenario



5.0 Impacts of Improvements on System Performance

Future congestion levels were next assessed with the identified needs (that is, additional lanes of capacity) included in each of the three network scenarios. The same congestion measures presented for the unimproved system were calculated for the improved systems. The results of this analysis are presented in this section.

5.1 Total Delay

As shown in Table 9 below, the unconstrained improvements enhanced system performance by decreasing annual delay (in vehicle-hours) in both the Connectivity & Freight Mobility and Urban Mobility scenarios, as compared with the 2040 baseline scenario.

Table 9: Statewide Annual Delay by Functional Class (in vehicle-hours)

FC	FC Description	2040 Baseline Delay	Connectivity & Freight Mobility	Urban Mobility	System Preservation
1	Rural Interstate	108,646,815	45,447,371	63,243,165	108,646,815
2	Rural Principal Arterial	152,820,139	56,315,073	64,110,870	152,820,139
6	Rural Minor Arterial	113,361,094	49,991,569	61,838,926	113,361,094
7	Rural Major Collector	135,373,176	60,826,471	74,817,643	135,373,176
8	Rural Minor Collector	24,700,580	10,167,798	12,794,542	24,700,580
9	Rural Local	13,813,428	7,377,252	8,949,837	13,813,428
11	Urban Interstate	213,886,436	28,108,405	33,538,657	213,886,436
12	Urban Freeway & Expressway	222,893,523	27,870,218	29,364,497	222,893,523
14	Other Urban Principal Arterial	549,352,393	269,087,071	270,609,739	549,352,393
16	Urban Minor Arterial	134,681,670	56,531,470	56,567,024	134,681,670
17	Urban Collector	29,697,173	13,883,491	13,883,491	29,697,173
19	Urban Local	2,702,983	1,516,200	1,516,200	2,702,983
111	HOV and HOT lanes	46,182,073	9,378,655	9,378,655	46,182,073
Total Statewide Delay		**1,748,111,486**	**636,501,043**	**700,613,246**	**1,748,111,486**

As shown in **Table 10**, the unconstrained improvements enhanced system performance by significantly decreasing annual delay (in vehicle-hours) in both the Connectivity & Freight Mobility and Urban Mobility scenarios, as compared with the 2040 baseline scenario.

Table 10: Statewide Annual Delay by Area Type (in vehicle-hours)

Area	2040 Baseline Delay	Connectivity & Freight Mobility	Urban Mobility	System Preservation
Rural	548,715,234	230,125,534	285,754,983	548,715,234
Urban	1,199,396,252	406,375,510	414,858,263	1,199,396,252

5.2 *Percent of System Congested*

Table 11 below shows the improvement in percent of the system that is congested between the 2040 baseline scenario and the three scenarios for each of the four time periods.

Table 11: Percent of System Congested (LOS D or Worse) with Improvements by Time Period

Period	2040 Baseline % Congested	Connectivity & Freight Mobility	Urban Mobility	System Preservation
AM	8.4%	2.1%	4.2%	8.4%
MD	2.3%	0.2%	0.3%	2.3%
PM	7.5%	1.4%	3.2%	7.5%
NT	0.0%	0.0%	0.0%	0.0%

The improvement in percent of the system that is congested between the 2040 baseline scenario and the three scenarios, by functional class, is presented in **Table 12** below.

Table 12: Percent of System Congested (LOS D or worse) by Functional Class

FC	FC Description	2040 Baseline % Congested	Connectivity & Freight Mobility	Urban Mobility	System Preservation
1	Rural Interstate	5.9%	0.0%	1.4%	5.9%
2	Rural Principal Arterial	5.3%	0.5%	1.4%	5.3%
6	Rural Minor Arterial	2.8%	0.2%	1.7%	2.8%
7	Rural Major Collector	2.2%	0.1%	1.5%	2.2%
8	Rural Minor Collector	1.2%	0.0%	0.8%	1.2%
9	Rural Local	0.8%	0.0%	0.4%	0.8%
11	Urban Interstate	31.1%	4.5%	10.0%	31.1%
12	Urban Freeway & Expressway	18.1%	9.4%	11.2%	18.1%
14	Other Urban Principal Arterial	6.4%	0.7%	0.7%	6.4%
16	Urban Minor Arterial	5.3%	0.5%	0.5%	5.3%
17	Urban Collector	5.1%	1.7%	1.7%	5.1%
19	Urban Local	7.7%	1.3%	1.3%	7.7%
111	HOV and HOT lanes	22.7%	5.9%	5.9%	22.7%
Percent of System Congested – Statewide		5.7%	1.1%	2.4%	5.7%

5.3 Congestion Severity Index (CSI)

Finally, the change in the statewide Congestion Severity Index (CSI) between the 2040 baseline scenario and the three scenarios is shown in Table 13.

Table 13: Congestion Severity Index

	2040 Baseline	Connectivity & Freight Mobility	Urban Mobility	System Preservation
Statewide	10,655	3,863	4,173	10,655

Texas Transportation Plan

Tech Memo 6: Intelligent Transportation Systems Modal Profile

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Acknowledgements

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Figures

1.0 Introduction

As the State's long-range transportation plan, the Texas Transportation Plan 2040 (TTP 2040) will document the size and scope of the Texas transportation system with respect to existing conditions, current and future demand, funding needs by mode, and fiscally-constrained investment scenarios and probable outcomes. This memo will document the existing conditions, current and future demand, funding needs, and fiscally-constrained investment scenarios for the Intelligent Transportation System (ITS) devices.

2.0 Overview of Existing Conditions

The inventory of ITS devices located within the state of Texas were collected by TxDOT as described in the Technical Memorandum #3 and include only devices that are maintained by TxDOT. At the time of inventory there were approximately 9000 different ITS devices located through the entire state. The inventory included the following devices:

- Closed Captioned Television Cameras (CCTV)
- Dynamic Message Signs (DMS)
- Lane Control Signals (LCS)
- Radar Detection
- Loop Detection
- Highway Advisory Radio (HAR)
- Ramp Meters
- Automatic Vehicle Identification (AVI)
- Flood Warning
- Weather Sensors

At this time, the inventory did not include other items such as traffic signals, illumination, signing, and pavement markings. The age of the ITS devices are unknown, but each device is assumed to be in working order and maintained by TxDOT on a TxDOT facility. All other devices are assumed to be maintained by a local agency.

3.0 Unconstrained Needs Determination

The following section provides a summary of the TTP 2040 ITS needs determination methodology as well as a fiscally-constrained and unconstrained needs analysis to 2040.

3.1 Methods and Assumptions

The previous Technical Memorandum #3, Intelligence Transportation System Methodology, described the methodology proposed for assessing the ITS devices inventory within the TTP 2040. The memorandum reviewed the stakeholder involvement and types of investment, regional transportation plans and programs, the existing inventory data collection, the proposed capital projects, and historical maintenance and operations costs.

Existing ITS devices are assumed to remain in place and functional through 2040. This includes the necessary maintenance and replacement of devices on a planned schedule. New ITS devices are added to the yearly inventory based on the ITS deployment plans developed for each district or MPO. The costs to maintain the new ITS devices is incorporated into the yearly maintenance costs. It was assumed that the costs for maintenance and capital projects would be evenly distributed yearly based on current dollar values.

The ITS deployment plans developed for each district contained estimated costs for each proposed project including local and state projects. The majority of the deployment plans were developed over ten years ago, so the accuracy as to what projects have been implemented is questionable. As a result, it was assumed that only the long-range plans are yet to be implemented. MPOs have developed plans that may be more recent, but did not identify specific ITS projects. It appears that most MPOs are including future ITS devices as part of major rehabilitations to existing facilities. In addition, nearly all MPOs do not provide specific ITS costs. Based on this data, ITS needs were based on the ITS deployment plans with the accumulated costs distributed equally year over year.

3.2 Unconstrained Needs to 2040

In using the described methodology, it was found that TxDOT would need approximately $30 million each year (2014 dollars) just to maintain the existing ITS system. By 2040, TxDOT will have spent $1 billion to maintain the existing network. This assumes that all devices in place will be maintained on a regular schedule and replaced as needed. It also assumes a 6 percent contingency to cover unforeseen expenditures. Figure 1 displays the necessary expenditures to maintain the existing ITS system.

In addition to maintaining the existing system, new projects are planned. These new projects will require initial funding as well as the yearly maintenance. It is projected the new projects would require an annual funding of over $300 million (2014 dollars) to cover the initial capital costs and anticipated yearly maintenance. A contingency amount of 6% is also included to cover any unforeseen costs. Through 2040 the total needs for the ITS capital projects would exceed $8 billion (2014 dollars). The results are displayed below in Figure 2.

Figure 1: Maintain Existing ITS Devices (YOE)

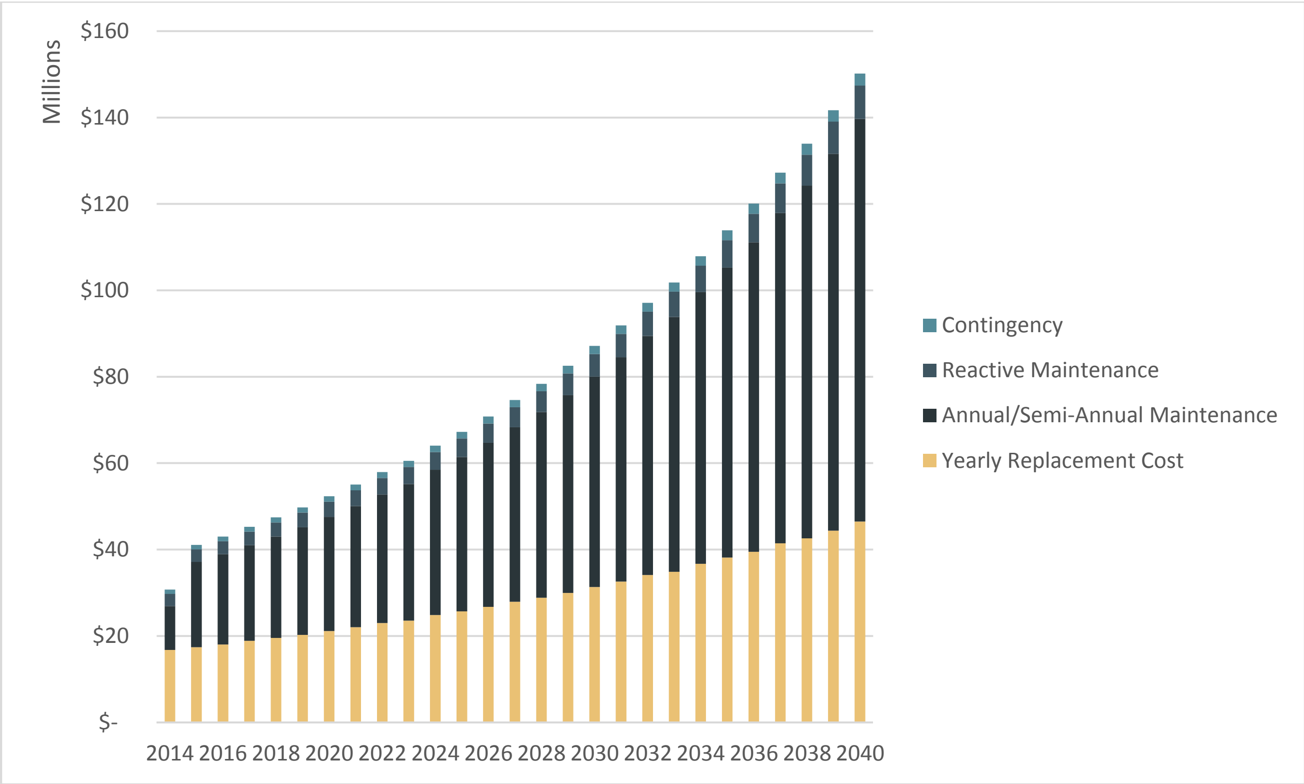
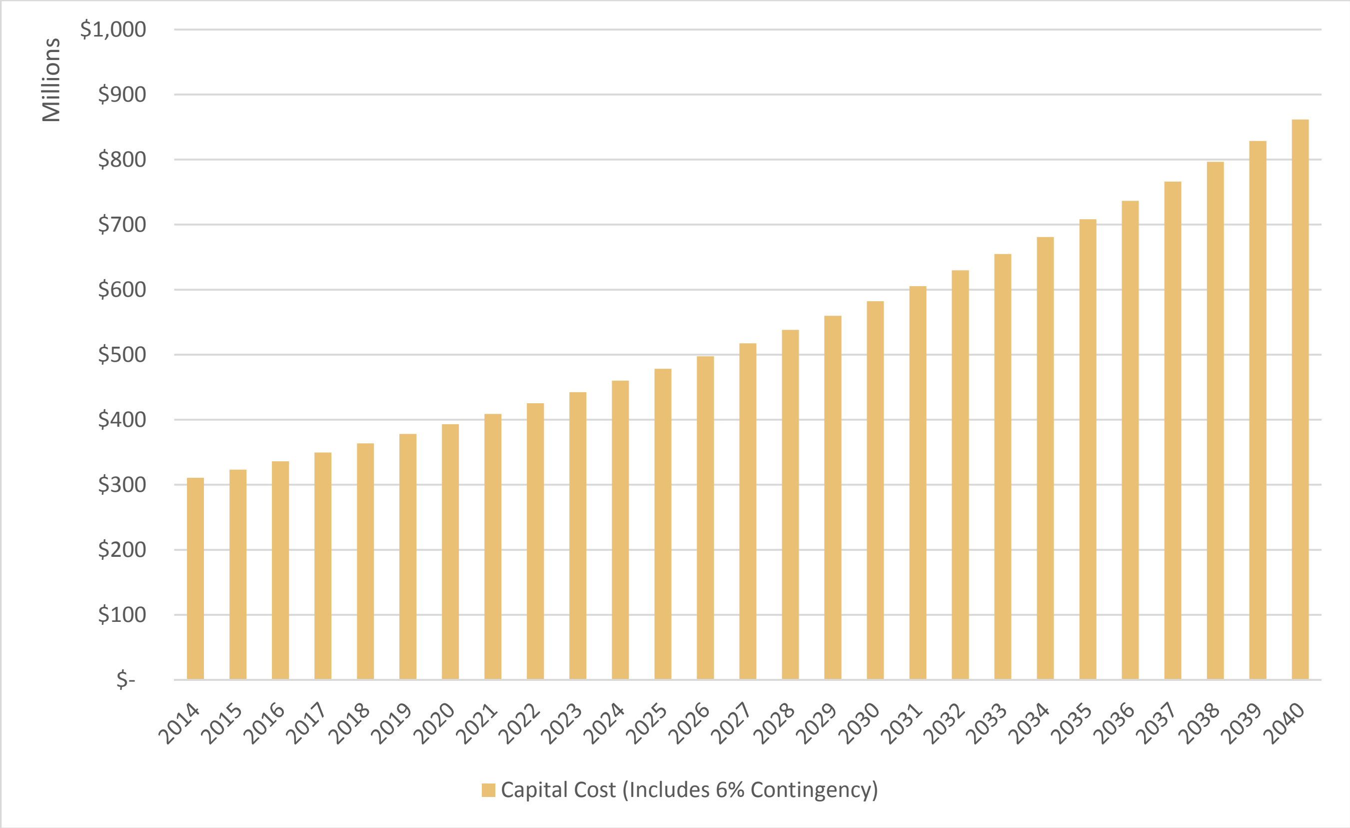
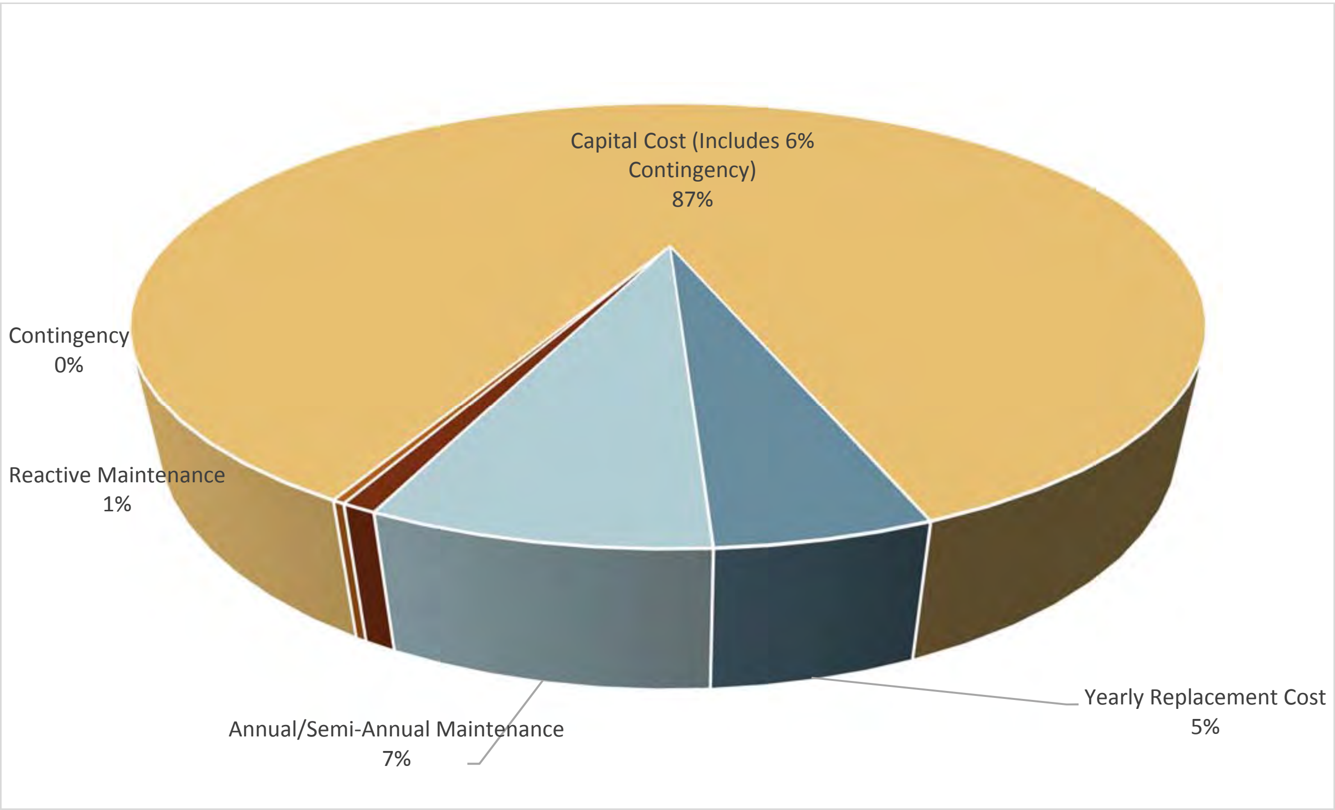


Figure 2: ITS Capital Projects (YOE)



As mentioned above, contingency and reactive maintenance are included in the budgets. One should expect that these would reduce over time as maintenance becomes a regular part of the lifecycle of an ITS device. It should also be noted that the majority of the funding is to implement future capital projects (and corresponding future maintenance) as shown in Figure 3.

Figure 3: ITS Total Needs By Magnitude Total LCM Costs (2013-2040) Unconstrained (with Inflation)



4.0 Anticipated Revenues and Funding Gap

Upon evaluating the TxDOT financial documents, including revenue forecasts and historical expenditures, the average annual transportation revenue anticipated through 2040 is $11.6 billion. Of this amount nearly all ($11.5 billion) is earmarked to highway/bridge and transit, which leaves less than $100 million to fund all other modes, including ITS. The ITS needs alone exceed $300 million, so it should be expected that the ITS needs will not be fully met in the future.

5.0 Fiscally-Constrained Analysis

As the methodology described above shows, the ITS capital projects are not programmed and therefore are assumed to be implemented equally through 2040. A funding shortage allocated to ITS would result in slower implementation of the ITS capital projects, which in turn would result in lower yearly maintenance costs of all future projects. Since the earmarked funding for ITS projects is not available, it cannot be determined what the gaps or tradeoffs would be when considering different scenarios other than using a straight hypothetical percentage.

The figures below display two funding scenarios—75% (**Figure 4**) and 50% (**Figure 5**) of the needs funded.

Figure 4: Total LCM Costs of ITS Assets – 75% Funded (YOE)

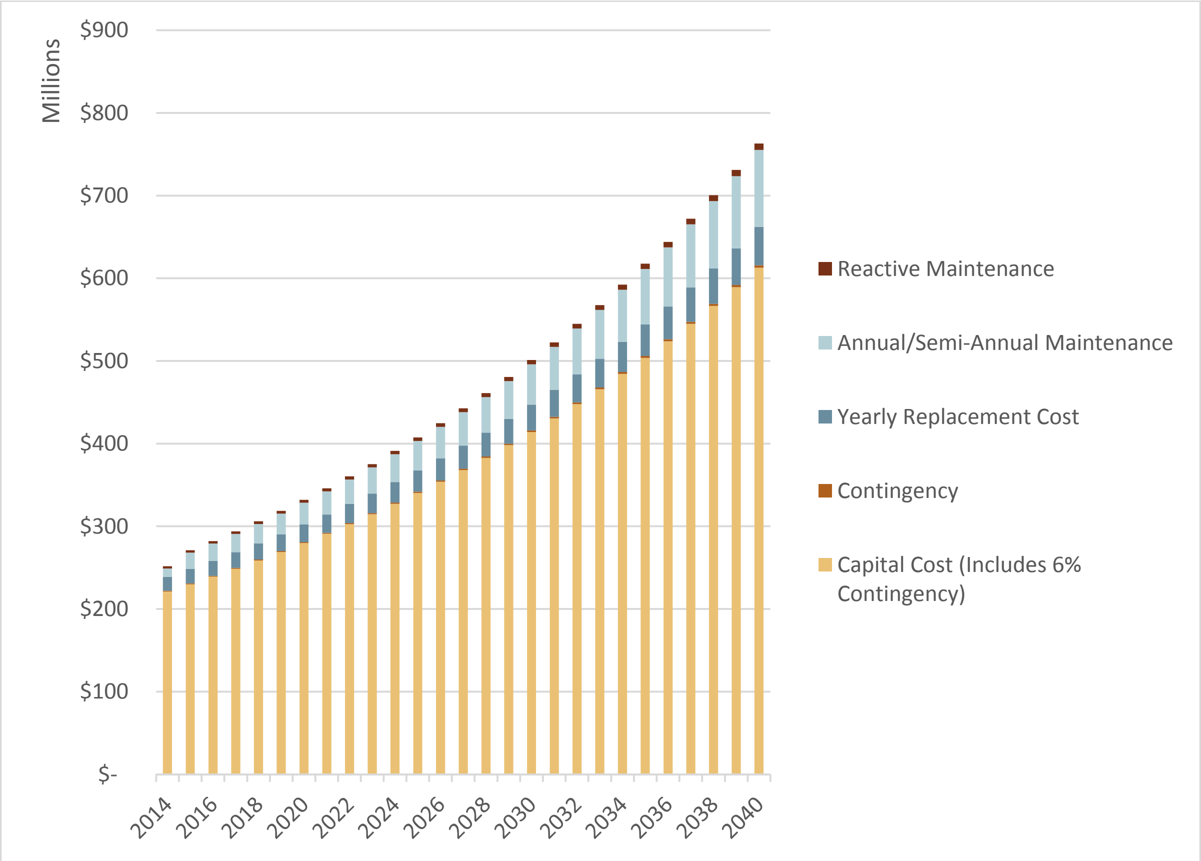
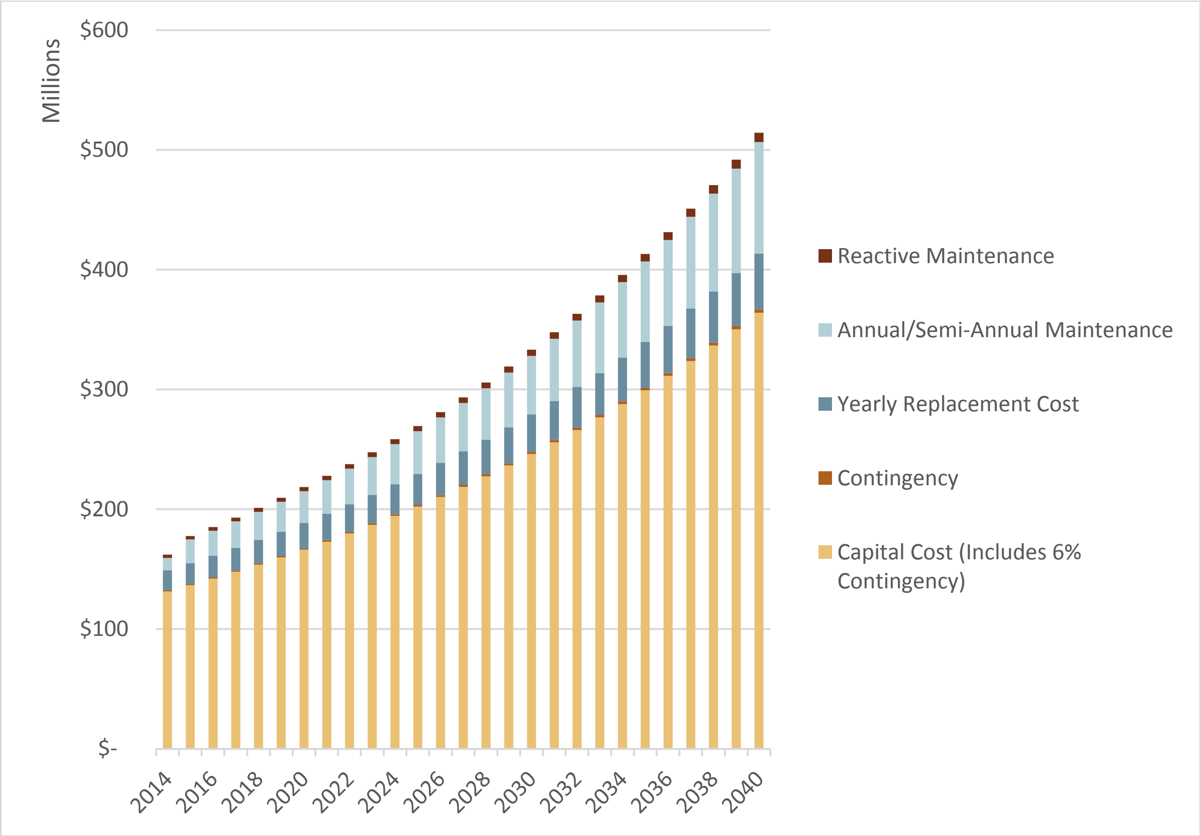


Figure 5: Total LCM Costs of ITS Assets – 50% Funded (YOE)



Under both scenarios the annual maintenance and replacement costs will remain steady at $30 million per year (2014 dollars). If the funding meets 75% of the ITS needs, this will result in the reduced implementation of capital projects of approximately $90 million per year (2014 dollars). By 2040 the total ITS needs would have a shortfall of approximately $10 billion (2014 dollars). Should the funding meet only 50% of the ITS needs, this would result in the reduced implementation of capital projects of approximately $190 million per year (2014 dollars). By 2040, the total ITS needs would have a shortfall of approximately $12 billion (2014 dollars). In any event, it is apparent that it will be difficult to fully fund the ITS needs through 2040 based on the overall existing funding of all TxDOT assets. At a minimum, TxDOT should anticipate providing funding to cover the needs of all existing ITS assets. In the future, before implementing ITS capital projects, the future maintenance needs of each should be accounted for in the total funding needs.

There are methods to decrease the necessary ITS funding. The most direct way is to continue with the inventory of all ITS devices throughout the state and document not only the location, but include date of implementation, current condition, and dates and costs of maintenance. This data would allow each district to better anticipate when devices fail, decreasing the need to rely on contingency funding and reactive maintenance funding. It would also allow each district to better understand and forecast maintenance costs for specific devices.

Texas Transportation Plan

Tech Memo 6: Passenger Rail Modal Profile

August 21, 2014

Acknowledgements

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Tables

Figures

1.0 Introduction

The purpose of this technical memorandum is to document the process conducted to identify the existing and planned and programmed passenger rail systems in preparation for and support of the Texas Transportation Plan (TTP) update, public outreach and associated performance evaluations. It should be noted that this document is not intended to supplement the legislative requirements put forth in Senate Bill 1382 (Section 201.6012-6013 – Transportation Code), which mandates an annual update for the statewide passenger rail system.

The process to document passenger rail initiatives included compiling and reviewing passenger rail system plans, in addition to obtaining and reviewing plans and programs for new and/or expanded passenger rail services throughout the state of Texas. For the purposes of this report, passenger rail services identified and researched include High Speed Rail and Intercity Passenger Rail as outlined in subsequent sections.

2.0 Overview of Existing Conditions

The following section provides an overview of existing conditions in relation to current or planned passenger rail service. In order to obtain this information, federal, state and local plans were reviewed as discussed in the following section. *The Texas Rail Plan, November 2010* served as the basis for this effort due to a recent update of the Passenger Rail chapter (Chapter 4) in December 2013. The *Texas Rail Plan* was reviewed in detail, the accuracy of the information assessed, the plans and programs identified were catalogued, and updated versions were reviewed and obtained, as necessary.

2.1 High Speed Rail

The Federal Railroad Administration (FRA) has defined and categorized High Speed Rail (HSR) services into three distinct categories as listed in Table 1.

Table 1. High Speed Rail Facility Types

Type	Corridor Length (miles)	Top Speeds (mph)	Dedicated Tracks	Population Served	Level of Service
Core Express Corridors	Up to 500	125-250	Yes, except in terminal areas	Major population centers	Frequent express, electrified
Regional Corridors	100-500	90-125	Dedicated and shared tracks	Mid-sized urban areas and smaller communities	Frequent
Emerging/Feeder Routes	100-500	Up to 90	Shared tracks	Moderate population centers, with smaller, more distant areas	Less frequent

Currently, there are no existing HSR operations in Texas. In fact, the only operational system in the United States is Amtrak's Acela Train service that provides services between Boston, Massachusetts and the District of Columbia (Washington, DC) with top speeds of up to 150 miles per hour (MPH). Figure 1 depicts the federally designated HSR corridors. The two rail corridors in Texas that have received federal designation as future high speed rail corridors are the "South Central" and "Gulf Coast." The Gulf Coast corridor was designated in 1998; the South Central corridor was designated in 2000. These two corridors coincide with portions of existing Amtrak routes.

Figure 1. Federally Designated High Speed Rail Corridors

2.2 *InterCity Passenger Rail*

The National Railroad Passenger Corporation (Amtrak) is currently the sole provider of intercity passenger rail service in Texas. The three Amtrak routes in Texas include the Heartland Flyer, Texas Eagle, and Sunset Limited. The Heartland Flyer is operated on a 206-mile corridor between Fort Worth and Oklahoma City and is jointly funded by Texas and Oklahoma. The Texas Eagle route includes stops from San Antonio to Chicago and the Sunset Limited travels from Los Angeles to New Orleans.

2.2.1 Existing Intercity Rail

An overview of the Amtrak intercity services, such as the route description, station locations, ridership and schedule are included in the following sections:

Texas Eagle

The Texas Eagle provides daily service between San Antonio and Chicago via Fort Worth, Dallas, and St. Louis, for a distance of 1,305 miles (Figure 2). Within Texas, the Texas Eagle operates on approximately 404 miles of Union Pacific track, except between Temple and Fort Worth where the trains operate on 126 miles of Burlington Northern Santa Fe (BNSF) track. The Texas Eagle joins the Sunset Limited in San Antonio and continues to Los Angeles for a total route length of 2,728 miles between Chicago and Los Angeles. After San Antonio, the Texas Eagle connects with and follows the schedule of the Sunset Limited. Current service between San Antonio and Los Angeles involves a three-times-per-week connection with the Sunset Limited at San Antonio. According to *Amtrak's Fiscal Year 2013 Ridership and Revenue Report*, ridership on the Texas Eagle resulted in a minor increase of 0.6% from 337,973 to 340,081 passengers for the period of October 2012 to September 2013. During this same time period, ticket revenue was up 5.1% from $26,304,505 to $27,650,161. Table 2 lists information for each station along the route including location description, boardings and alightings, and transportation connections / transfer options.

Figure 2. Texas Eagle from Chicago to San Antonio *(to Los Angeles with Sunset Limited)*

Source: www.sharemap.org/public/Amtrak_Texas_Eagle Year: 11/23/13

Table 2. Texas Eagle Stations

Amtrak – Texas Eagle Route			
Station	Boardings/Alightings		Description and Transit Connections
	2012	2013	
Alpine, TX (ALP)	4,416	4,921	• Limited on-site parking • Greyhound Bus Services located 0.5 miles west of station
Austin, TX (AUS)	41,638	38,929	• Limited on-site parking • Capital Metropolitan Transportation Authority Bus Station is located 0.15 miles southwest of station
Cleburne, TX (CBR)	4,536	4,143	• Limited on-site parking • Station also services a regional bus station and dispatching station for CLETRAN (Cleburne's local transit)
Dallas, TX (DAL)	55,764	56,564	• Limited short-term parking, hourly and contract parking • Station also services Trinity Rail Express (TRE) and Dallas Area Rapid Transit (DART) light rail and local bus • Greyhound Bus Services located 6 blocks northeast of station
Del Rio, TX (DRT)	2,175	2,443	• Limited short-term parking on-site and long-term street parking off-site • Station also services a local bus service • Del Rio International (DRT) Airport is 1.5 miles northwest of the station
El Paso, TX (ELP)	12,329	13,093	• Station also services El Paso Sun Metro local bus and Las Cruces Shuttle • Greyhound Bus Services located 6 blocks east of station
Fort Worth, TX (FTW)	141,696	129,389	• Limited on-site parking, long-term parking off-site • Station is an Intermodal Transportation Center that services Trinity Railway Express (TRE), the Fort Worth Transportation Authority's local bus service (the "T"), Greyhound Bus services, the Lake Worth Shuttle, a bikeshare, and Molly the Trolley
Longview, TX (LVW)	49,126	41,305	• Limited on-site parking • A major renovation completed in fall 2013 • Longview Transit Services located 0.7 miles northwest of station • Greyhound Bus Services located 0.5 miles northwest of station
Marshall, TX (MHL)	10,025	10,555	• 20 long-term and 20 short-term parking spaces • Ford's Affordable Rental Cards located 1.3 miles east of station • Enterprise located 2.2 miles southeast of station • National located 4.5 miles southeast of station
McGregor, TX (MCG)	4,988	5,209	• Unstaffed station • 30 unattended parking spaces owned by BNSF Railway
Mineola, TX (MHL)	6,956	7,213	• Limited on-site parking

Table 2. Texas Eagle Stations

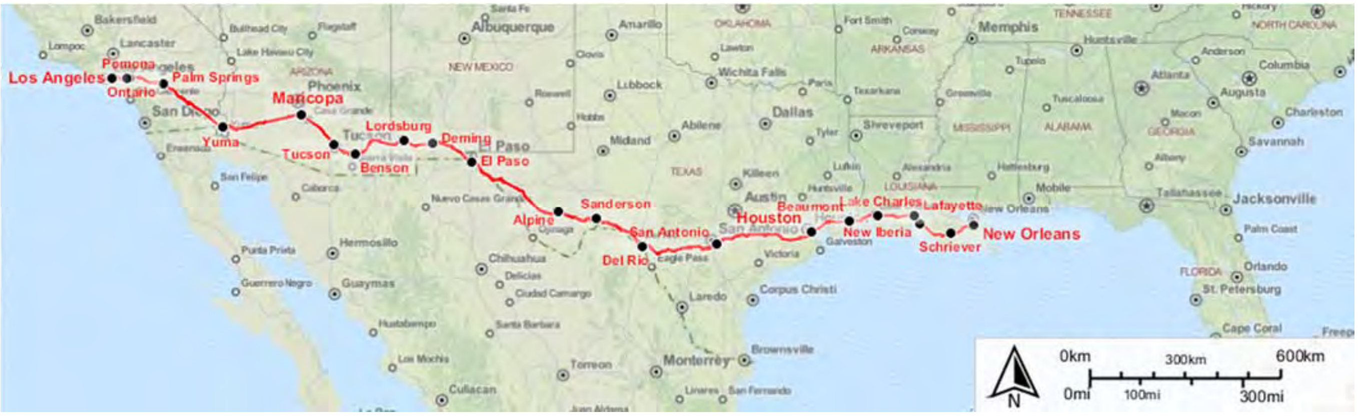
Amtrak – Texas Eagle Route			
Station	Boardings/Alightings		Description and Transit Connections
	2012	2013	
San Antonio, TX (SAS)	70,161	68,268	• No on-site parking • VIA Metropolitan Transit Services located 2 blocks north of station • Greyhound Bus Services located 1.2 miles northwest of station • Rio San Antonio River Taxi Services located 0.4 miles west of station
San Marcos, TX (SMC)	7,294	7,995	• Station also services Capital Area Rural Transportation System Services interurban coach passengers, and Greyhound/Trailways/Kerrville Bus Services
Sanderson, TX (SND)	255	261	• Flag stop station
Taylor, TX (TAY)	4,979	5,425	• Station also services a Union Pacific office building
Temple, TX (TPL)	17,856	17,690	• Ample on-site parking • Greyhound Bus Services located 2 blocks north of station

Note:
Any other local transit within 5 miles of the station is listed.

Sunset Limited

The Sunset Limited is an east-west route that traverses Texas for 937 miles on Union Pacific (UP) track between New Orleans to Los Angeles (**Figure 3**). In Texas, the Sunset Limited provides service to Houston, San Antonio, and El Paso, with stops in Beaumont, Del Rio, Sanderson, and Alpine also shown on **Figure 3**. After leaving Texas, the route continues through New Mexico, Arizona, and California before terminating in Los Angeles. This route is currently scheduled to run three times a week in each direction, providing transportation options for trips within the state as well as to destinations outside of Texas. The Sunset Limited travels a total of approximately 3,000 miles as it crosses five states. According to *Amtrak's Fiscal Year 2013 Ridership and Revenue Report*, ridership on the Sunset Limited resulted in a minor increase of 1.7% from 101,217 to 102,924 passengers for the period of October 2012 to September 2013. During this same time period, ticket revenue was up 6.0% from $11,584,844 to $ $12,275,400. **Table 3** lists information for each station along the route including location description, boardings and alightings, and transportation connections/transfer options.

Figure 3. Sunset Limited from New Orleans to LA



Source: www.sharemap.org/public/Amtrak_Sunset_Limited Year: 11/10/13

Table 3. Sunset Limited Stations

Amtrak – Sunset Limited Route			
Station	Boardings/Alightings		Description and Transit Connections
	2012	2013	
Alpine, TX (ALP)	4,416	4,921	• Limited on-site parking • Greyhound Bus Services located 0.5 miles west of station
Beaumont, TX (BMT)	2,724	3,458	• Limited on-site short-term and long-term parking • Greyhound Bus Services located 4 miles northeast of station
Del Rio, TX (DRT)	2,175	2,443	• Limited short-term parking on-site and long-term street parking off-site • Station also services a local bus service • Del Rio International (DRT) Airport is 1.5 miles northwest of the station
El Paso, TX (ELP)	12,329	13,093	• Station also services El Paso Sun Metro local bus and Las Cruces Shuttle • Greyhound Bus Services located 6 blocks east of station
Houston, TX (HOU)	20,327	21,617	• Limited on-site parking • This station has plans to be moved when the new Burnett Plaza station is completed • METRO Rail Light Rail Services (UH-Downtown stop) located 7 blocks northeast • Greyhound Bus Services located 1.6 miles south
San Antonio, TX (SAS)	70,161	68,268	• No on-site parking • VIA Metropolitan Transit Services located 2 blocks north of station • Greyhound Bus Services located 1.2 miles northwest of station • Rio San Antonio River Taxi Services located 0.4 miles west of station
Sanderson, TX (SND)	255	261	Station is a flag stop

Note:
Any other local transit within 5 miles of the station is listed.

Heartland Flyer

The Heartland Flyer route includes a 206-mile corridor providing daily service to/from Fort Worth and Oklahoma City. This route is subsidized by TxDOT in partnership with the Oklahoma Department of Transportation (ODOT) with TxDOT contributing approximately $1.4 million annually. The Heartland Flyer provides one trip daily in each direction and serves the Texas cities of Fort Worth and Gainesville, providing connections to the Texas Eagle at Fort Worth (Figure 4). In Texas, the Heartland Flyer operates on 72 miles of BNSF Railway (BNSF) track. According to *Amtrak's Fiscal Year 2013 Ridership and Revenue Report*, ridership on the Texas Eagle resulted in a moderate decrease of 7.6% from 87,873 to 81,226 passengers for the period of October 2012 to September 2013. During this same time period, ticket revenue was down -3.0% from $2,086,587 to $ 2,022,956. Table 4 lists information for each station along the route including location description, boardings and alightings, and transportation connections/transfer options.

Figure 4. The Heartland Flyer

Table 4. Heartland Flyer Stations

Amtrak – Heartland Flyer Route			
Station	Boardings/Alightings		Description and Transit Connections
	2012	2013	
Fort Worth, TX (FTW)	141,696	129,389	• Limited on-site parking, long-term parking off-site • Station is an Intermodal Transportation Center that also services Trinity Railway Express (TRE), the Fort Worth Transportation Authority's local bus service (the "T"), Greyhound Bus services, the Lake Worth Shuttle, a bikeshare, and Molly the Trolley
Gainesville, TX (GNS)	8,055	6,476	• Limited on-site parking • Jefferson Lines (Intercity Bus) located 2.1 miles northwest of station

Note:
Any other local transit within 5 miles of the station is listed.

3.0 Unconstrained Needs Determination

The following sections provide an overview of all planned and programmed projects for passenger rail throughout the state of Texas. Section 3.1 identifies the plans reviewed, which served as the basis for the methodology and assumptions used in the unconstrained analysis.

3.1 Methodology and Assumptions

In order to ensure the most current passenger rail system plans were identified in support of the TTP, the latest year documents were compiled and reviewed. This information was supplemented by coordination with TxDOT and other agencies, technical resources, and industry professionals with working knowledge of federal, state and local planning efforts. Table 5 lists the plans and programs that were collected and reviewed for this task.

Table 5. Reviewed Plans and Programs

Agency/Program Name	Documents
Amtrak's Texas Eagle, Sunset Limited, Heartland Flyer, Tower 55 Multi-modal Improvement Project, and Southwest Chief	Amtrak Fact Sheet of Texas Ridership, Fiscal Years 2012 and 2013
Dallas Area Rapid Transit (DART) and Fort Worth Transportation Authority's Trinity Railway Express	DART 2030 Transit System Plan, 2012 National Transit Database
Denton County Transportation Authority (DCTA)'s A-Train	DCTA Long Range Service Plan, DCTA Comprehensive Annual Financial Report
Capital Metropolitan Transportation Authority's MetroRail	Capital Metropolitan Strategic Plan FY2013, Capital Metropolitan Transportation Authority Operating and Capital Budget and Five Year Capital Improvement Plan FY 2014 and ServicePlan2020
Dallas Area Rapid Transit's DART Rail	DART 2030 Transit System Plan, 2012 National Transit Database
Metropolitan Transit Authority of Harris County (METRO)'s METRORail	http://www.ridemetro.org/Services/Rail.aspx

Table 5. Reviewed Plans and Programs

Agency/Program Name	Documents
City of Austin's Urban Rail	http://centralaustincdc.org/transportation/austin_urban_rail.htm
North Central Texas Council of Governments (NCTCOG)'s Texas Local Option Transportation Act (TLOTA)-formerly Rail North Texas	Regional Rail Corridor Study, Mobility 2035 – 2013 Update, Unified Work Program, TIP 2011-2014
East Texas Council of Governments (ETCG)'s Ark-La-Tex Corridor Council and East Texas Corridor Council (ETCC)	Bossier City-DFW Rail Service, May 1999, http://www.etcog.org/513/About-UsHistory.htm
Texas High Speed Rail and Transportation Corporation (THSRTC)'s T-Bone	Texarkana MTP 2035, San Antonio – Bexar Mobility 2035, Dallas – Mobility 2035, Houston MPO 2035
Capital Area Metropolitan Planning Organization (CAMPO)	Annual Project Listing, TIP 2013-2026, Regional Transportation Plan, MTP 2035
Lone Star Rail District (LSRD)'s LSTAR	2004 Feasibility Study, Station Area Economic Impact Analysis (2006), Financial and Economic Benefits Study (2007)
South East Texas Regional Planning Commission MPO (SETRPC-MPO)'s Exempt Project Jefferson-Orange-Hardin Regional Transportation Study	MTP 2035
Abilene MPO's Abilene Metropolitan Area	MTP 2010-2035
Amarillo MPO's Amarillo Urban Transportation Study	MTP 2010-2035
Brownsville MPO	MTP 2010-2035
Bryan/College Station MPO	MTP 2010-2035
Corpus Christi MPO	Long-Range Project Listing, TIP 2013-2016, MTP 2010-2035
El Paso MPO's Horizon	Rail Project Feasibility and Development Report, Transit Corridor Feasibility Study, TIP 2013-2016, Amended Mission 2035 MTP, MTP 2040
Harlingen-San Benito MPO	MTP 2010-2035
Hidalgo County MPO	MTP 2010-2035, MTP Amendment on 07-18-2013
Houston-Galveston MPO's H-GAC	TIP Summarized Project Listing 2012, TIP 2013-2016, 2035 RTP Update
Killeen-Temple MPO's Killeen-Temple Urban Transportation Study (K-TUTS)	MTP 2035
Laredo MPO's Laredo Urban Transportation Study	STIP 2013-2026, MTP 2010-2035
Longview MPO	MTP 2035, Traffic Operations Plan
Lubbock MPO	MTP 2012-2040
Midland Odessa Transportation Organization (MOTOR) MPO	MTP 2035, 2035 Transportation Plan Update
San Angelo MPO	MTP 2010-2035
Alamo Area MPO's Smart Way SA	LRTP, Transit Project Listing, TIP 2015-2018, Mobility 2035
Sherman-Denison MPO's Transportation Outlook	MTP 2035
Texarkana MPO's Texarkana Urban Transportation Study (TUTS)	MTP 2035
Tyler Area MPO	MTP 2035

Table 5. Reviewed Plans and Programs

Agency/Program Name	Documents
Victoria MPO's Victoria Urbanized Area	MTP 2035
Waco MPO	Unified Planning Work Program FY 2014 & 2015, Connections 2035 (MTP)
Wichita Falls MPO	MTP Project List 2010-2020, 2010-2035 MTP Update

3.2 High Speed Rail Initiatives

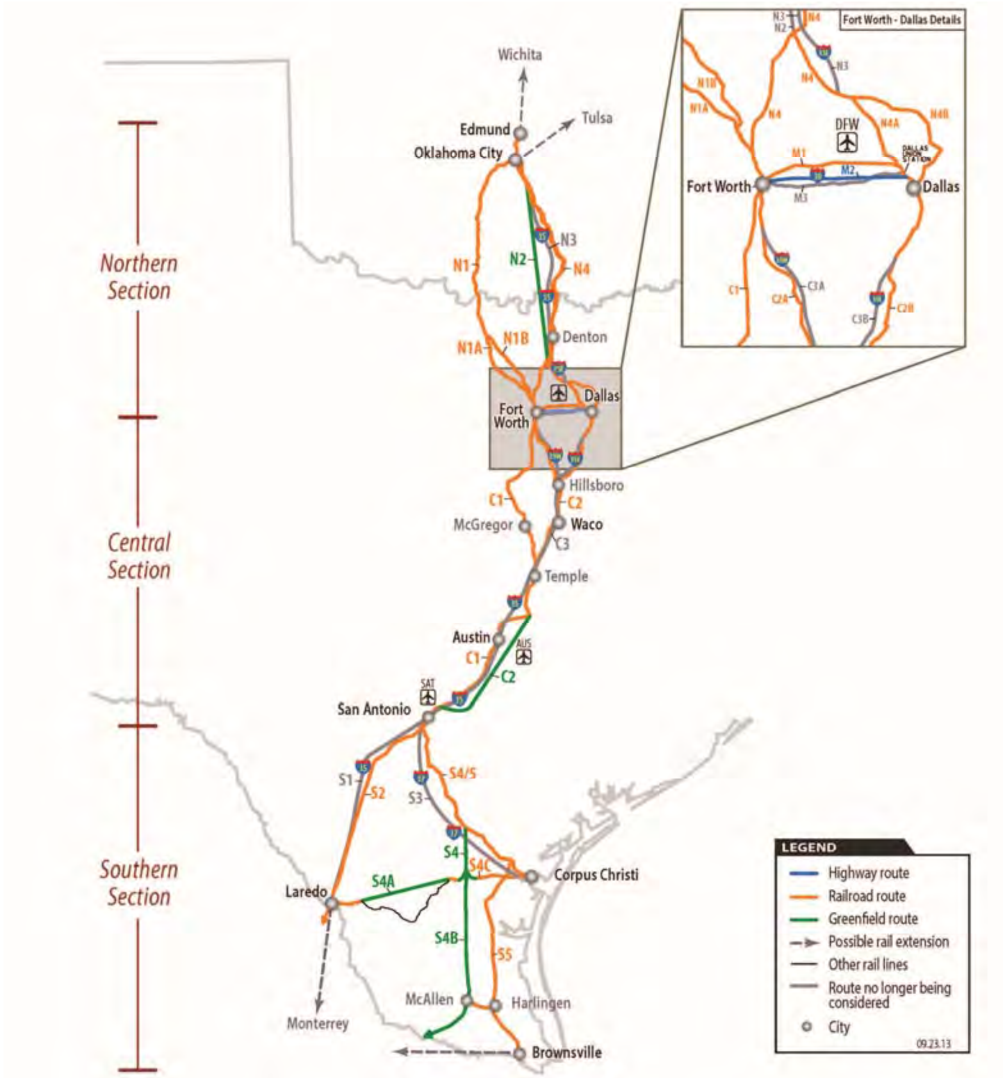
The following sections describe the Texas HSR initiatives, which primarily involve four rail corridors including the Oklahoma City to South Texas corridor, Dallas-Fort Worth to Houston corridor, Austin to Houston corridor, and the Texas "T-Bone" concept.

Two potential HSR corridors are currently being evaluated within the State of Texas, which includes routes from Oklahoma City to South Texas and Dallas-Fort Worth to Houston. TxDOT, in cooperation with the Oklahoma Department of Transportation, is conducting a study to evaluate a range of passenger rail service options in an 850-mile corridor from Oklahoma City to South Texas through the Texas-Oklahoma Passenger Rail Study. Limited information, as discussed below, is available regarding the Texas Central Railway's plans for HSR between Dallas-Fort Worth and Houston. Previous studies include an evaluation of HSR from Austin to Houston and the Texas "T-Bone".

Oklahoma City to South Texas

The federally funded Texas to Oklahoma Passenger Rail Study (TOPRS) is evaluating a range of passenger rail service options along the 850-mile IH-35 corridor from Oklahoma City to South Texas. The study will end with a service level environmental impact statement (EIS) and service development plan. The study is being conducted to account for the increase in population and employment, with much of its growth occurring in the congested IH-35 corridor area. TxDOT is anticipate to complete the study by December 2014. As part of the National Environmental Policy Act (NEPA) requirements, a service-level environmental impact study (EIS) is documenting the costs, benefits, and impacts of rail route and service alternatives as compared to a no-build, or do nothing, alternative (Figure 5). According to preliminary analysis, the project has the potential to serve approximately 3 million riders annually on a combination of the alternatives being considered. Initial cost estimates are estimating the project cost to exceed $11 billion.

Figure 5. Oklahoma to South Texas HSR Alternatives



A service development plan will also provide a high-level review of rail needs and potential service options in the corridor. The study could conclude with a decision to advance individual projects for more detailed study or a decision against making further investments in passenger rail in the corridor.

Dallas/Fort Worth to Houston

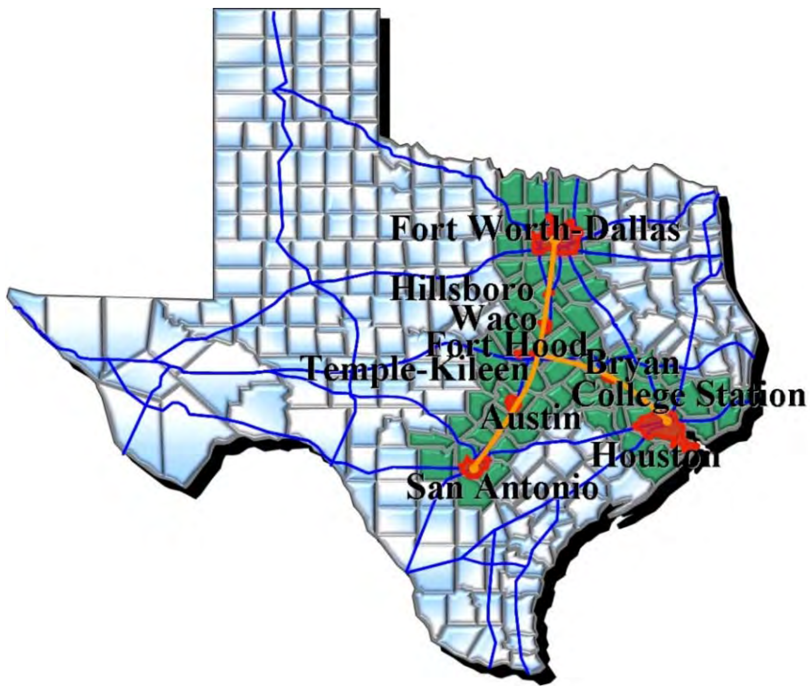
The Texas Central Railway (TCR) is evaluating the feasibility of providing high-speed intercity passenger rail along an approximately 250-mile corridor between Dallas/Fort Worth and Houston, which is considered Phase 1. The project will be privately-funded with $15 million obligated by FRA in federal funding. Preliminary cost estimates are not readily available, but it is anticipated that the project may exceed $10 billion. Moreover, the latest available ridership projections based on a 2009 Study are estimated at approximately 108,000 riders per day in 2025. The Texas Central Railway has identified a second phase of the project that would connect the cities of Austin and

San Antonio to the system along the I-35 corridor. It should also be noted that Memoranda of Understanding are in place with FRA with TxDOT handling the Fort Worth to Dallas section and TCR handling the Dallas to Houston section.

Texas T-Bone Corridor

The Texas High Speed Rail and Transportation Corporation (THSRTC) has evaluated a high speed rail network referred to as the 'Texas T-Bone'. The Texas T-Bone is a 490-mile corridor that would connect the four largest metropolitan areas in Texas by 2020: Dallas/Fort Worth, San Antonio, Austin, and Houston (**Figure 6**). The corridor would also connect with future and existing transit systems, highways, airports, and seaports. The goal of the system would be to extend into Oklahoma City and into Tulsa, Oklahoma and through Franklin and Bowie Counties into North Little Rock, Arkansas and potentially into Memphis, Tennessee.

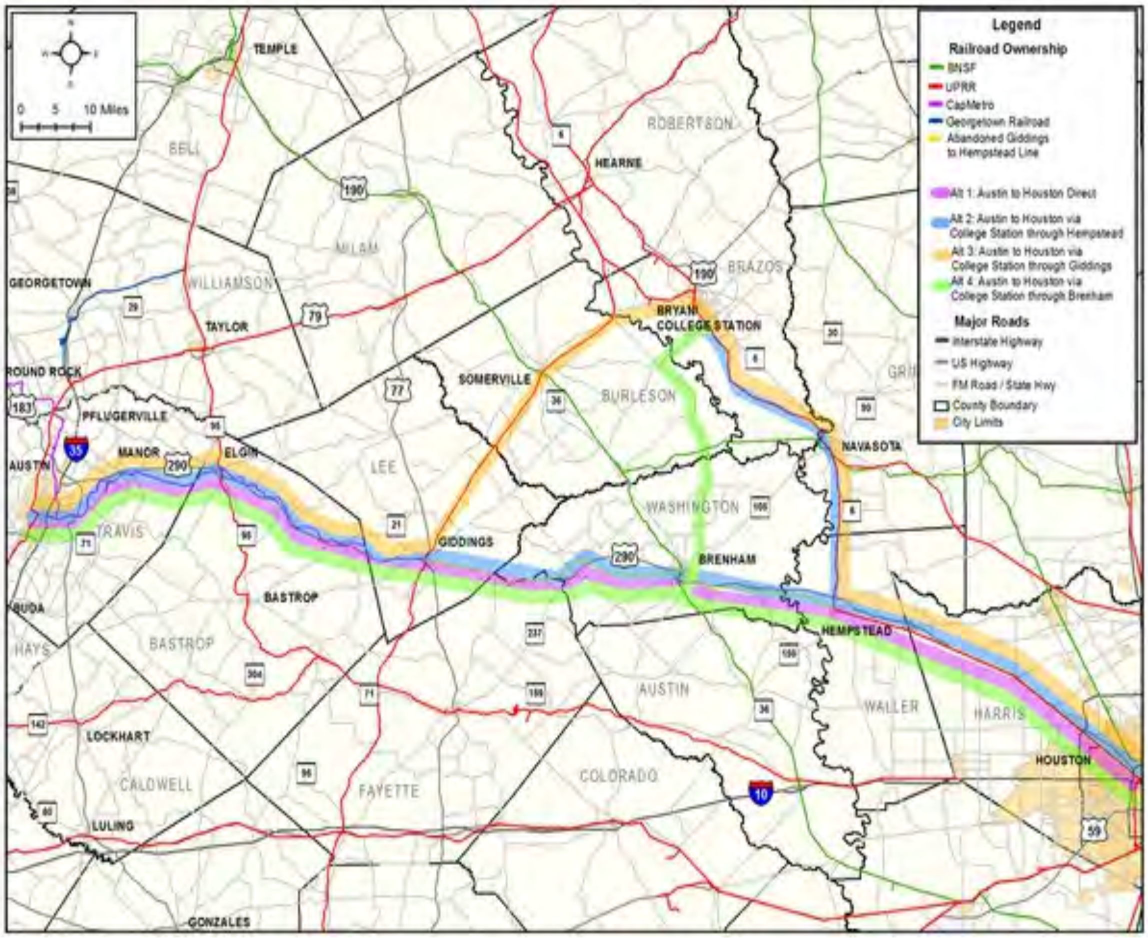
Figure 6. The 'Texas T-Bone' Corridor



3.3 *Others Initiatives – Austin to Houston Passenger Rail Study*

The Austin to Houston Passenger Rail Study was completed in December 2011 and included the evaluation of four alternatives as shown in **Figure 7**. This study involved the evaluation of an intercity passenger rail service from Austin to Houston with speeds of up to 110 mph. The intent of the study was to identify infrastructure needs and did not evaluate environmental impacts or ridership projections. The study identified potential connections in Elgin, Giddings, Brenham, Hempstead and Bryan/College Station. According to the 2011 study, the start-up cost for this system is estimated between $936 million and $1.2 billion.

Figure 7. Austin to Houston HSR Alternatives



3.4 *Planned Intercity Rail Improvements and Expansions*

The following sections provide an overview of proposed route changes in addition to planned and programmed capital improvements for the three intercity services including rolling stock, stations, track, and signal system upgrades.

3.4.1 Planned Amtrak Expansions and Reroutes

Potential expansion, rerouting, and other enhancements to the Texas Eagle, Sunset Limited, and Heartland Flyer Routes are discussed in the following sections:

Texas Eagle

Amtrak is in discussions to plan a reroute of its Texas Eagle route between Dallas and Fort Worth to the Trinity Railway Express (TRE). If the Texas Eagle shifts to the TRE route, rail service between Dallas and Houston would be reestablished and several new stops would be implemented. The cost for reroute to the Union Pacific line is estimated to cost approximately $7 million per mile (based on a 2012 study of the Texas Eagle) for a total of nearly $210 million. Signal upgrades and grade crossing improvements are not included in the cost estimate, which could be upwards of $40-50 million.

Additionally, the City of Longview is experiencing congestion related to freight operations on the existing rail line near the Longview Station. The Longview MPO realizes that future passenger rail is closely tied to freight traffic because they share the same track. In an effort to alleviate congestion, the Longview MPO has identified the need to double track the Union Pacific rail line between Longview and Marshall. This 23-mile existing single track runs parallel to U.S. 80 and is critical to the north, south, east and west of the train junction.

Sunset Limited

In coordination with the reroute of Amtrak's Texas Eagle, there is potential to develop a passenger rail service between Houston and Dallas. This potential 240-mile intercity rail corridor could shift the need away from short airline trips and has the potential to relieve the two primary air hubs in Texas (DFW International Airport and George Bush Intercontinental Airport).

Amtrak also has a goal to increase passenger service on the Sunset Limited by adding daily passenger service and increasing speeds up to 40 mph. Amtrak is investigating two locations, either between San Antonio and Houston (200 miles) or Houston and New Orleans (350 miles).

Heartland Flyer

Amtrak has recently completed a project to improve crossing signal timing in the BNSF Fort Worth subdivision on the Heartland Flyer route. Between Fort Worth and Gainesville, signal improvements were implemented to increase the operating speed to 79 mph. TxDOT acquired over $3 million from the FRA to fund the improvements and decrease the overall trip time by approximately 18 minutes. TxDOT recently completed a project with BNSF Railway to improve crossing signal timing at 15 highway-rail grade crossings.

Southwest Chief

The Southwest Chief is a passenger rail route that presently goes through Chicago and Albuquerque to Los Angeles while traveling north of Texas. Amtrak is currently in discussion with BNSF and other states to reroute Southwest Chief to the new BNSF Transcon route. Cost estimates associated with the reroute exceed $10 million annually for operations and maintenance and include a one-time capital investment of approximately $100,000,000. The Transcon route has the same starting and ending locations as the Southwest Chief route but the Transcon route travels south into Kansas and would allow travel into North Texas. TxDOT has already evaluated potential rail station sites in the Amarillo area in hopes to have access to more passenger rail.

Dallas/Fort Worth to Arkansas and the Louisiana Border

Although there is currently passenger rail between Dallas and Arkansas and Louisiana along the Texas Eagle route, the East Texas Corridor Council (ETCC) is hoping to improve track infrastructure to accommodate higher speeds. One of the ETCC's long-term goals is to fund a double-tracking of the Union Pacific (UP) main line between the Metroplex and Arkansas and Louisiana border connections. The I-20 and U.S. 59 (I-69) rail infrastructure upgrade is seen as an incremental step toward higher speed passenger rail.

3.4.2 Other Amtrak Proposals

Amtrak is proposing a new connection on their Crescent route. The current Crescent route travels from New York to New Orleans. Amtrak envisions a connection route from Dallas/Fort Worth to Meridian, Mississippi. This plan is supported in East Texas by passenger rail advocates promoting a route between Dallas and Shreveport, Louisiana. TxDOT and Amtrak are currently working together on developing the Texas portion of this route.

Amtrak and TxDOT are also in the process of performing a feasibility study to evaluate new Amtrak service between Bossier City, in Northwest Louisiana to Dallas and Fort Worth. This passenger rail corridor would run along I-20 twice daily with seven intermediate stops. TxDOT requested that locations at DFW Airport (Centre Point), Mesquite, Forney, Terrell and Wills Point be considered during the study. The ETCC received $265,000 in federal funds for the corridor study, which was conducted by Amtrak.

Amtrak is currently discussing a new long-distance route that will travel from Fort Worth to Denver, Colorado. This 840-mile potential rail corridor has been deemed the “Caprock Express” and will travel through the Panhandle of Texas. The route would travel through the cities of Abilene, Lubbock, and Amarillo on the way to La Junta, Colorado Springs, and Denver, Colorado.

TxDOT has partnered with Amtrak to improve infrastructure in San Antonio, including a proposed bypass route for non-local UP freight. San Antonio is planning to reroute freight traffic in the hopes of developing an intercity passenger rail service between Round Rock and San Antonio. If freight traffic is cleared from this rail corridor, it would be possible to provide service on the existing tracks that Amtrak travels now. TxDOT is studying the feasibility of this idea while the rerouting of trains is studied further.

3.4.3 Miscellaneous Amtrak Statistics and Improvements

Tables 6 and 7 provide an overview of the 2017 Capital Plan and Funding Source.

Table 6. 2017 Capital Plan by Asset Type

	Capital Plan by Asset Type ($ millions)					
	FY2013	FY2014	FY2015	FY2016	FY2017	Total
Track and Other Infrastructure	$628	$1,421	$1,385	$1,067	$1,330	$5,830
Rolling Stock Acquisitions	314	608	266	326	468	1,981
Rolling Stock Overhauls and Engineering	235	332	375	290	232	1,463
Technology Programs	53	82	136	73	71	415
Customer Experience Programs	17	42	29	29	22	140
Security Programs	37	10	13			60
Environmental Remediation	5	9	14	18	12	58
Other	6	8	30	18	15	76
Total Capital Plan	**$1,295**	**$2,513**	**$2,248**	**$1,820**	**$2,149**	**$10,024**

Table 7. 2017 Capital Plan by Funding Source

	Capital Plan by Funding Source ($ millions)					
	FY2013	FY2014	FY2015	FY2016	FY2017	Total
Federal General Capital	$703	$2,032	$1,793	$1,511	$1,867	$7,906
Sandy Capital Relief Appropriation		91	91	19	19	220
NY-NJ High Speed Rail Grant	51	86	130	94	55	416
Railroad Rehabilitation & Improvement Financing	131	70	98	59	1	359
DOT Early Buy Out Grant	110					110
Internal Amtrak Funds	62	1				63
Department of Homeland Security	36	10	6			51
State, Local and Other Funds	202	222	130	137	208	899
Total Capital Plan	**$1,295**	**$2,513**	**$2,248**	**$1,820**	**$2,149**	**$10,024**

3.4.4 Amtrak Rolling Stock Upgrades

Amtrak anticipates that its non-Northeast Corridor (NEC) equipment acquisition during the FY2013 – FY2017 period will consist of completing the acquisition of 130 single-level, long distance passenger cars pursuant to a contract entered into with CAF USA in August 2010. Amtrak anticipates delivery of the first cars for testing by end of calendar year 2014 with the final unit entering revenue service by the end of calendar 2015. The total project cost will be $342.8 million.

The FY2013 payment for acquisition of these cars and related spare parts is being requested as part of the federal capital appropriation request.

Amtrak is also responsible for the condition and reliability of its rolling stock fleet. The fleet is a unique competitive advantage for Amtrak as it provides the basis for daily service and has the capability, if the national network is maintained, to provide “surges” of capacity in response to changes in demand, such as seasonal traffic or disaster relief needs. While the capacity of lines and terminals cannot be changed in the short term, the fleet provides vital flexibility that allows Amtrak to develop or improve service on short timelines, and it is therefore a uniquely important asset. Equipment requires continual maintenance and cannot be purchased on the spur of the moment. Its configuration and operating qualities are long-term factors that can exert major influence on revenues and costs. For these reasons, the fleet requires detailed and careful management. Amtrak’s planned FY2013 - FY2017 Fleet Overhaul program calls for $697 million in funding for the non-NEC fleet as shown in the following table. Descriptions of the fleet overhaul programs is provided in Table 8.

Amtrak is migrating from a conventional overhaul philosophy to a Life Cycle Progressive Maintenance (LCPM) program for the non-NEC diesel locomotives, plus modifications required by Federal agencies including the Transportation Safety Administration (TSA), Environmental Protection Agency (EPA), and Federal Railroad Administration (FRA). This program enables Amtrak to maintain the locomotive fleet to a state of good repair, increase locomotive reliability and availability, extend the useful life of the locomotive, comply with applicable federal rules and regulations, and mitigate future expenses associated with an aging fleet.

The passenger car programs fund the various levels of overhauls that range from mandatory maintenance to complete equipment overhauls, reconfigurations and conversions of equipment, and modifications required by statutes including the Americans with Disabilities Act (ADA) and modifications required by the FRA. The non-NEC programs service the Superliner, Auto Carrier, Viewliner, Talgo, Heritage, Horizon, and Surfliner fleets. All car configurations including passenger coach, diner, café/club, lounge, sleeper, and cab cars are included. These passenger car programs enable Amtrak to maintain equipment in a state of good repair, to return the assets to current Amtrak standards, improve reliability and availability of equipment, enhance overall customer experience, comply with applicable federal regulations, and mitigate equipment failures that result in customer discomfort and inconvenience.

Table 8. Fleet Overhaul Program

$ millions	Fleet Overhauls – Federal Capital						Other Funds	Fleet Overhauls – Total Funding						
	FY2013	FY2013	FY2015	FY2016	FY2017	5 Years	FY2013	FY2013	FY2013	FY2015	FY2016	FY2017	FY2013	5 Years
Locomotives – non-NEC	29	41	27	35	30	162		29	41	27	35	30		162
Superliner	54	64	106	95	90	410	3	57	64	106	95	90		413
Auto Carrier	1		7	1	1	10		1		7	1	1		10
Heritage	3	2	1			6		3	2	1				6
Horizon	7	8	12	9	9	44		7	8	12	9	9		41
Surfliner	4	1	5	4	4	18		4	1	5	4	4		18
Talgo	1	1	1			2		1	1	1				2
Viewliner	8	9	9	8	8	42		8	9	9	8	8		42
Total Overhauls non-NEC	$106	$126	$168	$152	$142	$694	$3	$109	$126	$126	$152	$142		$697

3.4.5 Amtrak Station Improvements

Amtrak is currently upgrading five stations on the three routes throughout the state of Texas as part of the Accessible Stations Development Program (ASDP). The plan is based on funding at the average annual rate of approximately $50 million over the next several years, to support such station work as ASDP, passenger information display systems, and a platform gap solution. The five stations currently under design, as of the date of this report, include the Alpine Station, McGregor Station, Marshall Station, Longview Station, and Houston Station.

3.4.6 Amtrak Positive Train Control

Positive Train Control (PTC) is a communication system that has the potential to improve traditional collision prevention measures and adds automated protection by enforcing permanent and temporary speed restrictions. On January 15, 2010 the FRA issued its PTC Rule which, pursuant to the Rail Safety Improvement Act of 2008, requires Class I railroads and each railroad hosting intercity or commuter rail passenger service to have a PTC system installed and operating by December 31, 2015. This is applicable for all main lines, which are defined as having five million or more gross tons of railroad traffic annually or used for intercity or commuter rail passenger service.

According to Amtrak's Fiscal Years 2013 – 2017 Five Year Plan, "Additional funding to fully comply with PTC requirements is necessary. It is important to note that compliance with PTC requirements on the host railroads outside of the NEC could drive significant costs to Amtrak. Amtrak's contribution to PTC installation and maintenance on host railroad property will be based on the federal statute governing 'incremental costs,' which are costs incurred by hosts solely as a result of Amtrak's presence. Changes in freight and passenger traffic on Class I host railroad lines could cause changes to PTC requirements. If those incremental costs can be attributed solely to Amtrak's operations on the property, the company could be responsible for significant costs outside of its own infrastructure."

3.4.7 Amtrak Expenditures and Projected Ridership

Amtrak's five-year capital program proposals total $10.024 billion. Expenditures for the Texas routes are summarized in Table 9. The majority of this program is dedicated to infrastructure improvements, the acquisition of rolling stock including exercising buyout options on leased equipment, overhauling existing rolling stock, and technology investments.

Table 9. 2017 Statistics By Route

$ millions except Contr./(Loss) per Rider	Ridership	Revenue	Expense	Allocation of Federally Funded Capital Projects(2)	Contr./(Loss) per Rider	Avg. PM per Core employee (000's)(3)	Avg. SM per Core employee (000's)(3)
Texas Eagle	356,056	$34.0	$72.0	$10.7	($106.69)	42	54
Sunset Limited	110,166	$15.4	$62.8	$10.0	($430.22)	21	39
Heartland Flyer	94,628	$8.7	$10.5	$1.8	($18.88)	24	48

Notes:

(1) Budget route results are projected based on APT historical ratios. Expenses exclude depreciation, accruals for post-retirement benefits, non-capitalizable project costs, and interest expense.

(2) This represents the allocation of Federally Funded Capital Projects to Routes.

(3) Employee data is not aggregated by route in Amtrak's Financial Systems. The data presented here is based on an allocation of Core employees based on total costs of each route.

PM = Passenger Miles

SM = Seat Miles

3.4.8 Tower 55

The Tower 55 Multimodal Improvement Project is focused on improvements around a rail intersection known as Tower 55. The project is composed of improvements to bridges and underpasses, city streets and intersections, emergency vehicle access, and rail capacity, including a new track, a new interlocker, approach trackage, and signaling. These improvements will happen along Burlington Northern and Santa Fe Railway's (BNSF) Fort Worth and Wichita Falls Subdivisions and in Union Pacific's (UP) Duncan, Choctaw, Fort Worth and Dallas Subdivisions. One of the goals of the project is to reduce delays and improve on-time performance for the Heartland Flyer and Texas Eagle routes. The project is fully funded, with $65 million combined from BNSF and UP Railroad and $34 million from a TIGER grant awarded to TxDOT. TxDOT and the City of Fort Worth also provided $1 million each.

3.4.9 Miscellaneous Improvements

BNSF plans to invest approximately $240 million on maintenance and rail capacity expansion projects in Texas. These capacity improvement projects include expansion of rail capacity at Tower 55 in Fort Worth, completing replacement of the Galveston Causeway Bridge, installation of a siding extension near Somerville, expansion of the Houston Intermodal Facility, construction of a loop track facility in San Antonio, and signal upgrades for positive train control. BNSF will continue its track maintenance program, which includes an estimated 4,400 miles of track improvements including the replacement of about 115 miles of railroad.

3.5 Methodology and Assumptions

The following section reviews the methodology and assumptions used to assess existing conditions and predict future conditions for passenger rail service.

3.5.1 Project Identification and Consideration

The projects identified in Section 3.1 were identified and considered for reasonability and feasibility based on factors such as maintenance of an existing route, planned expansion, and implementation of the new system. These projects were then further considered on the basis of cost and current stage of project development. These qualitative measures were supplemented by discussions with project stakeholders, the TxDOT rail office, and desktop research to determine what projects should be included in the unconstrained needs analysis in the 2040 forecast year.

3.6 Unconstrained Needs to 2040

3.6.1 Amtrak Expansions

The following Amtrak expansions were identified for consideration into the Metro Quest Tool.

1. Southwest Chief Reroute
   a. Reroute through southern Kansas, the Texas Panhandle, and eastern New Mexico
   b. $10 million annual O&M / $100,000,000 capital investment
   c. Estimated Ridership: 102,924 annual trips, based on 2013 ridership
2. Heartland Flyer
   a. Existing route from Fort Worth to Oklahoma City
   b. Annual TxDOT contribution: $1.4 million on average annually
   c. Estimated Ridership: 81,226 annual trips, based on 2013 ridership
3. Texas Eagle Reroute
   a. Relocate Texas Eagle on Union Pacific's line between Dallas and Fort Worth
   b. Estimated cost: $7 million per mile (based on a 2012 study of the Texas Eagle) x 30 miles = $210 million. Signal upgrades and grade crossing improvements not included in the cost estimate, which could be estimated at $40-50 million.
   c. Estimated Ridership: 340,081 annual trips, based on 2013 ridership
4. Sunset Limited Reroute
   a. Introduce new service from Houston to Dallas/Fort Worth
   b. Estimated cost: Cost not available
   c. Estimated Ridership: 102,924 annual trips, based on 2013 ridership

3.6.2 High Speed Rail

The following High Speed Rail projects were identified for consideration into the Metro Quest Tool.

1. TOPRS (assumes Higher Speed Rail)
   a. 850-mile corridor from South Texas to Oklahoma City, Oklahoma
   b. Estimated cost: $11 billion (combination of alternatives – northern, central, and southern)
   c. Estimated Ridership: 3 million annual riders (combination of alternatives – northern, central, and southern)
2. Texas Central Railway HSR
   a. 250-mile corridor between Dallas/Fort Worth and Houston
   b. Estimated cost: $10-$12 billion
   c. Estimated Ridership: 108,000 riders per day in 2025 based on a 2009 Study, per the Texas Rail Plan

4.0 Anticipated State Contributions for passenger rail

As previously mentioned, TXDOT contributes approximately $1.4 million annually to the Heartland Flyer route which consists of an approximately 206-mile route that provides daily service to/from Fort Worth and Oklahoma City. In addition, TxDOT contributed $1 million for the Tower 55 improvement project. It is anticipated that additional state funding for capital and operations and maintenance costs will be required for the TOPRS project in addition to other major investments in passenger rail services as projects are identified.

5.0 Financial and Funding Considerations Summary

Due to the nature of funding sources for existing and planned and programmed for intercity passenger rail services, the future condition for this mode is largely dependent on appropriations from the United States Congress via FRA funding, various federal grants, and, in the case of High Speed Rail, private funding sources and investors. Therefore, the information contained herein is intended to provide an overview of identified planning-level cost estimates for various passenger rail projects and associated infrastructure to support these services.

Texas Transportation Plan

Tech Memo 6: Highway Pavement Modal Profile

August 15, 2014

Acknowledgements

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Contents

Tables

Figures

1.0 Introduction

The Texas Transportation Plan (TTP) 2040 is the official statewide long-range transportation plan to document the 2014 to 2040 needs to provide and maintain a multimodal transportation system serving passenger travel and freight movement needs in Texas.

Texas has the largest highway system in the nation. As an important asset of that system, highway pavements account for most of the linear length of the highway system. The pavements are aging while 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 for passengers and freight.

In supporting the TTP, this technical memorandum describes the existing condition of Texas pavements and presents unconstrained needs as well as financially-constrained needs assessments through 2040 for the existing on-system pavements. In the needs assessment process, to make the best use of limited resources, a performance-based decision-making methodology was applied to link pavement State-of-Repair with investment levels.

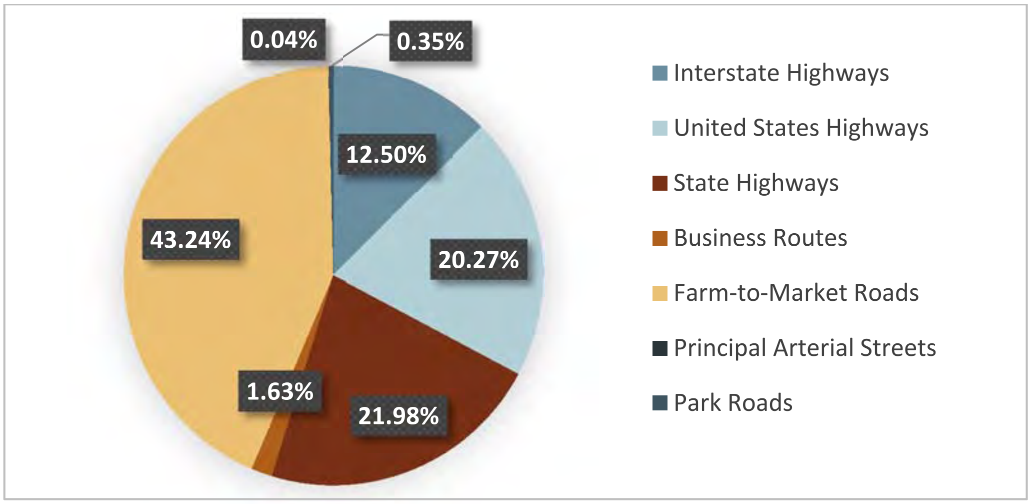
2.0 Overview of Existing Conditions

The Texas Department of Transportation (TxDOT) maintains a Pavement Management Information System (PMIS), which maintains the basic inventory information and the annual condition inspection data for all on-system pavements. Based on PMIS, in 2013, TxDOT owns/maintains 197,201.8 lane miles of pavements. Table 1 presents the lane miles for each highway system. Figure 1 shows the share of each particular highway system. The Farm-to-Market Road System has the largest share (43.24 percent) and has around 85K lane miles. The Interstate Highway System has 24.65K lane miles and accounts for 12.5 percent.

Table 1. Texas Highway Lane Miles by Highway System 2013

Highway System	Lane Miles
Interstate Highways	24,650.0
United States Highways	39,964.8
State Highways	43,352.2
Business Routes	3,210.2
Farm-to-Market Roads	85,262.0
Principal Arterial Streets	79.8
Park Roads	682.8
Total	**197,201.8**

Figure 1. Texas Highway Shares by Highway System 2013



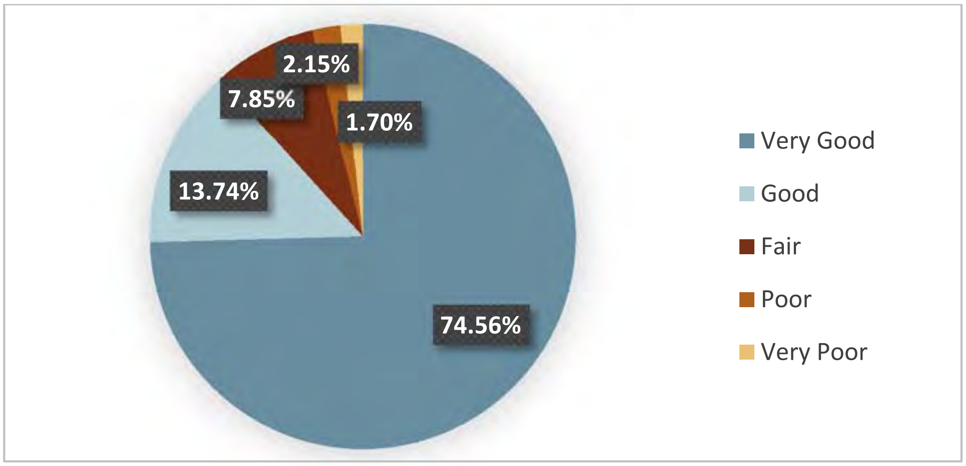
In Texas, there are three types of pavements: Flexible or Asphalt Concrete Pavement (ACP), Continuously Reinforced Concrete Pavement (CRCP), and Jointed Concrete Pavement (JCP). Table 2 presents the lane-miles for each type of pavement. More than 90 percent of the pavements are asphalt concrete pavements.

Table 2. Texas Highway Pavement Miles by Pavement Type 2013

Pavement Type	Lane Miles	Percentage
Flexible or Asphalt Concrete Pavement	179,599.9	91.1%
Continuously Reinforced Concrete Pavement	13,778.7	7.0%
Jointed Concrete Pavement	3823.2	1.9%
Total	**197,201.8**	**100.0%**

Based on the condition inspection data in PMIS, the State-of-Repair of Texas pavements in 2013 is shown in Figure 2. Pavements rated "Good" or better total 88.3 percent.

Figure 2. Texas Highway State-of-Repair 2013



3.0 Unconstrained Needs Determination

3.1 Methodology and Assumptions

3.1.1 Defining "Needs" and State-of-Good Repair

Pavement Condition Score is used as the primary performance measure for assessing pavement conditions in the Texas Transportation Plan (TTP). It is an overall pavement condition index in the TxDOT PMIS and combines the evaluations of all types of pavement distresses and ride quality to form a single index ranging from 1 (very poor) to 100 (very good). The classes of Pavement Condition Score are presented in **Table 3**. The pavements in "Good" or better condition by Pavement Condition Score are considered as in State-of-Good-Repair in Texas.

Table 3. Pavement Condition Score Classes

Pavement Condition Score	Description
90 - 100	Very Good
70 - 89	Good
50 - 69	Fair
35 - 49	Poor
1 - 34	Very Poor

Pavement International Roughness Index (IRI) is used as a secondary performance measure in the TTP. IRI is a standard measure of pavement roughness and is incorporated into the Pavement Condition Score in the form of pavement ride quality. However, MAP-21 requires the use of IRI as the national pavement performance measure. Therefore, IRI is used as a secondary performance measure in the TTP to report pavement roughness. TxDOT also defines the pavement classes based on IRI for the Interstate System and Non-Interstate National Highway System (NHS) using the definition shown in **Table 4** (Source: TxDOT Performance Measures, Texas Department of Transportation, 2013). The pavements in "Good" condition by IRI are considered as in State-of-Good-Repair for Texas NHS in TTP.

Table 4. IRI Classes for NHS

Pavement Condition (IRI)	Description
< 95	Good
95 – 170	Fair
>170	Poor

3.1.2 Investment Identification

Pavement unconstrained needs refer to the pavement treatments and timings that maintain pavements in good condition without considering budget limitations. Pavement treatments can be divided into two groups: (1) routine maintenance (RM) and (2) preventive maintenance and rehabilitation (M&R). Routine maintenance is typically conducted to repair localized failures to prevent further deterioration of roadways. Examples of routine maintenance activities include crack sealing, pothole repair, and edge repair. Preventive maintenance, rehabilitation, and replacement are more expensive and extensive pavement treatments to restore pavement's functional and structural condition.

Since routine maintenance is conducted with regularity, the average annual cost over the past five years was used for the routine maintenance cost estimation.

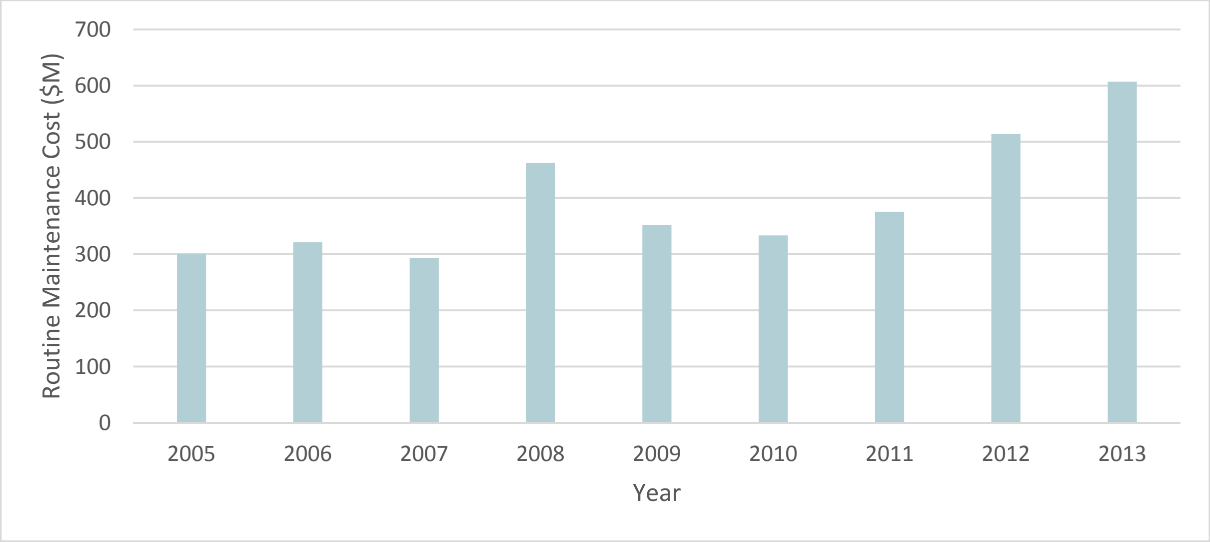
The decision trees presented in Tech Memo 3 were used to identify the preventive maintenance and rehabilitation needs. Decision trees provide a methodology to identify the most effective treatment based on pavement distresses and ride quality. Pavement preventive maintenance and rehabilitation needs assessment can be conducted both at the project level and network level. At the project level, decision trees are used to identify treatments for each pavement section based on predicted pavement condition. However, during the planning horizon, there could be several possible combinations of treatments and timings. Life-cycle cost analysis was applied to identify the optimal set of treatments and corresponding timings that can minimize the life-cycle cost of the pavements while maintaining the pavement sections in good condition. The sum needs of all the pavement sections represent the unconstrained pavement needs for the entire network.

3.2 Unconstrained Needs to 2040

3.2.1 Routine Maintenance

PMIS documents routine maintenance cost for every on-system pavement segment. Figure 3 summarizes the annual pavement routine maintenance costs of the entire network from 2005 to 2013. The average annual routine maintenance cost over the past 5 years is about $436M (in 2014 dollars).

Figure 3. Annual Pavement Routine Maintenance Costs (in 2014 dollars)



3.2.2 Preventive Maintenance and Rehabilitation

The unconstrained needs assessment was conducted based on the existing pavement condition and pavement treatment decision tree. The annual preventive maintenance and rehabilitation costs are presented in Figure 4. Under this unconstrained needs assessment, 100 percent of the pavements are in “Good” or better condition. The needs fluctuate across the planning horizon and are larger at the beginning due to the existing backlogs. The overall needs for preventive maintenance and rehabilitation through 2040 are $99.94B.

Figure 4. Annual Pavement Preventive Maintenance and Rehabilitation Needs (in 2014 dollars)

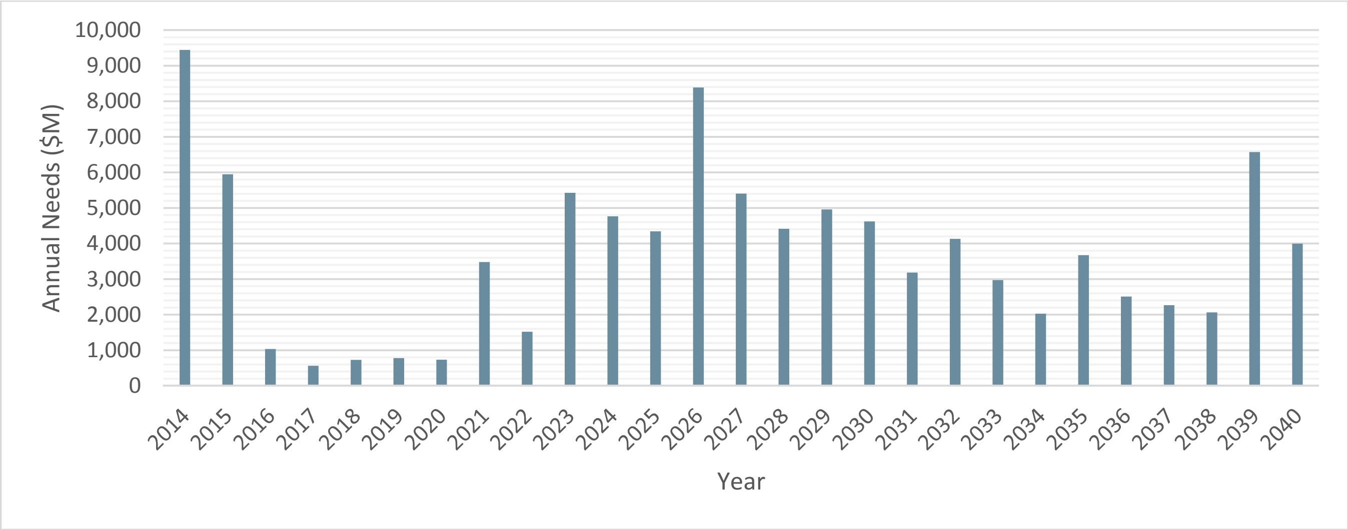
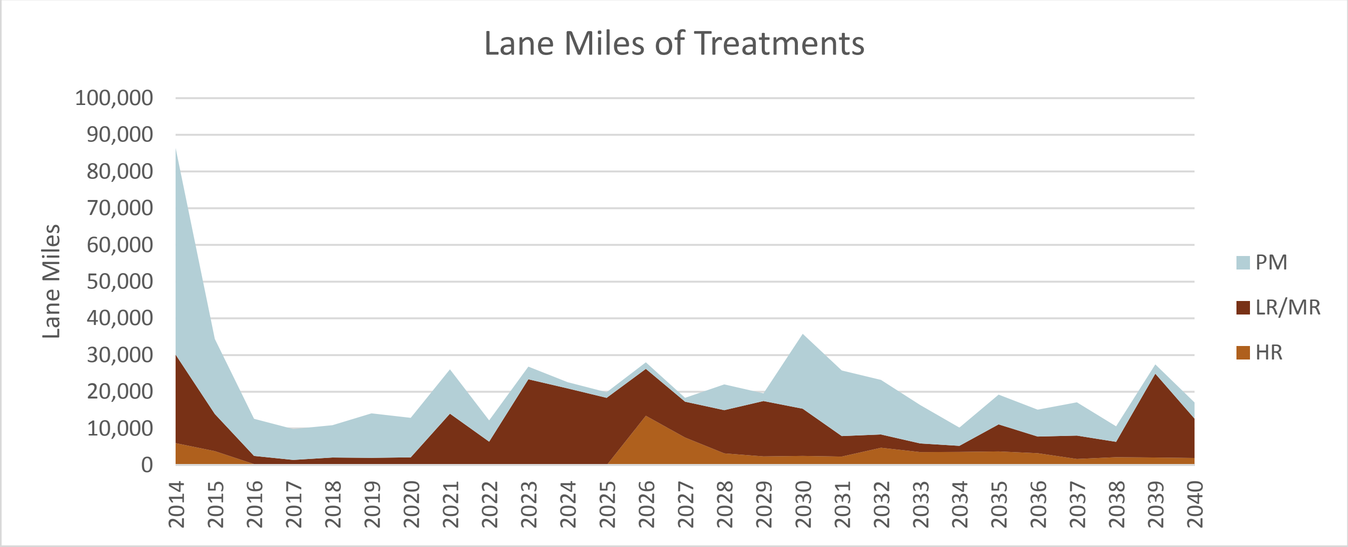


Figure 5 shows the unconstrained needs (lane miles of treatments) by treatment type. There are large needs (lane miles of treatments) at the beginning, which corresponds to the large needs (in $) at the beginning in **Figure 4**. Overall, most of the treatment needs (lane miles) are preventive maintenance (PM) and light/medium rehabilitations (LR/MR). This is consistent with common sense that it is better to conduct more preventive maintenance and light/medium rehabilitations, rather than to perform expensive heavy rehabilitation (HR) (i.e., replacement).

Figure 5. Lane Miles of Treatment Needs by Treatment Type



Correspondingly, **Table 5** presents the unconstrained needs by treatment type. About 60 percent of the costs go to light/medium rehabilitation.

Table 5. Summary of Unconstrained Needs by Treatment Type

	Preventive Maintenance	Light/Medium Rehabilitation	Heavy Rehabilitation
Total Cost	$7.72B	$59.51B	$32.72B

Table 6 summarizes the unconstrained pavement needs through 2040. It shows that the total needs through 2040 are $111.71B (in 2014 dollars), about $4.14B per year. **Table 7** presents the needs by highway system.

Table 6. Summary of Unconstrained Needs through 2040

Category	2014-2040 Needs	Equivalent Annual Needs
Routine Maintenance	$11.77B	$0.436B
Preventive Maintenance and Rehabilitation	$99.94B	$3.70B
Total	$111.71B	$4.14B

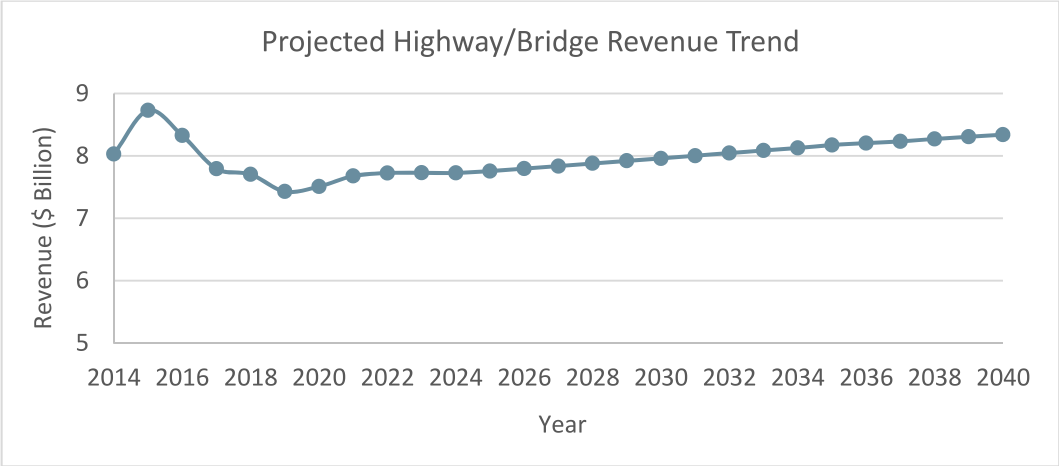
Table 7. Unconstrained Pavement Needs by Highway System

Highway System	Needs in 2014$
NHS Interstate	$18.09B
NHS Non-Interstate	$24.80B
Non-NHS	$68.82B
Statewide	$111.71B

4.0 Anticipated Revenues and Funding Gap

The main funding sources for the highway/bridge mode are state motor fuel tax, FHWA reimbursements, and vehicle registration fees. The revenue forecasting team has finished 2014-2040 revenue projection for the TTP, which has been approved by TxDOT for public outreach. The predicted revenue trend for highway/bridge is presented in **Figure 6**. The average revenue is $8B/year, which is then distributed to three areas: pavements, bridges/culverts, and highway expansion. The share for pavement projects is $2.75B/year. Compared to the unconstrained needs, $4.14B/year, the funding shortfall is approximately $1.39B/year.

Figure 6. Highway/Bridge Revenue Forecasting 2014-2040



5.0 Fiscally-Constrained Analysis

5.1 Project Prioritization/Optimization

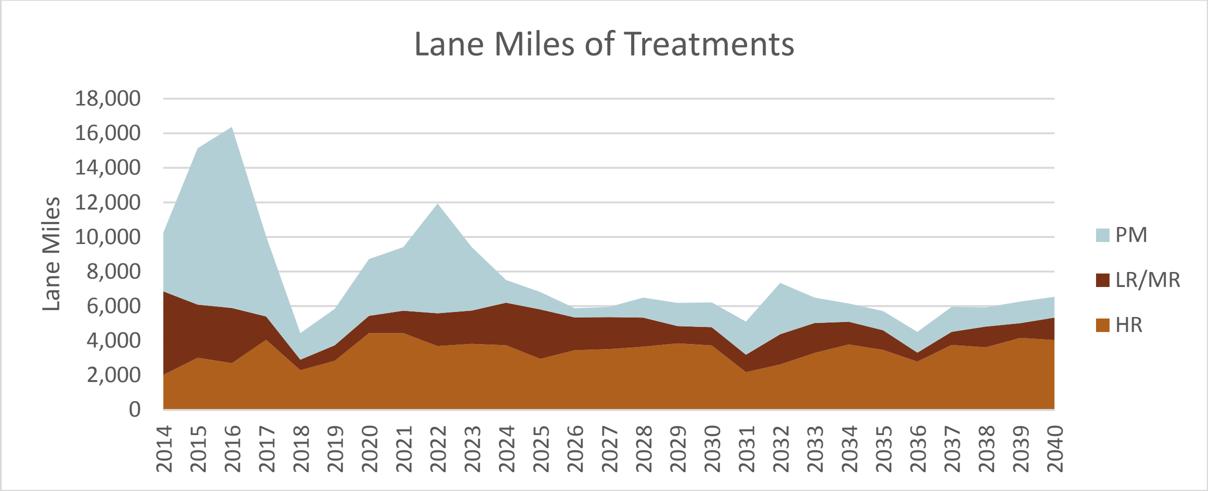
As shown in Section 4, the predicted revenue is not enough to cover the unconstrained needs, so a financially-constrained analysis is necessary to identify the best utilization of the limited budget. Using the methodology presented in Tech Memo 3 for this process, the prioritization/optimization techniques identified alternatives to optimize the pavement performance under the limited budget.

In the project prioritization process, the routine maintenance budget is first set aside from the total budget; the remaining budget is then used for the prioritization for all the preventive maintenance and rehabilitation projects. In addition, to avoid “Very Poor” pavements, the pavements with “Very Poor” condition will have a high programming priority.

The predicted budget for pavements is $2.75B/year. The routine maintenance budget is $436M/year; thus, the budget for preventive maintenance and rehabilitation is $2,314M/year. At this budget level, the financially-constrained needs assessment was conducted.

Figure 7 presents the lane miles of each type of treatment during the planning horizon. Compared to unconstrained needs in Figure 5, the total lanes miles of pavements that receive treatments are fewer. It also shows that, among the pavements receiving treatment, a higher proportion of pavements received HR (heavy rehabilitation) than in the unconstrained needs (Figure 5). This is because when the budget is not enough to cover all the PM and LR/MR in the unconstrained needs, some pavement treatments are delayed to a point when the pavement deteriorates to such a bad condition (for example, “Very Poor” condition) that only HR can be applied.

Figure 7. Lane Miles of Treatment Needs (Constrained) by Treatment Type



Correspondingly, for the fiscally-constrained analysis, the summary of pavement treatments is presented in **Table 8**. By comparing **Table 5** and **Table 8**, it can be seen that, in unconstrained needs (**Table 5**), about 60 percent of the costs go to light/medium rehabilitation. However, in constrained needs (**Table 8**), more than 75 percent of the costs go to heavy rehabilitation. As explained previously, this is because the delay of LR/MR treatments causes some pavements to deteriorate to such a condition that only HR can be applied. **Table 9** presents the constrained needs by highway system. Compared with the unconstrained needs (**Table 7**), the Non-NHS decreases the most.

Table 8. Summary of Constrained Needs by Treatment Type

	Preventive Maintenance	Light/Medium Rehabilitation	Heavy Rehabilitation
Total Cost ($B)	$2.10B	$10.78B	$49.60B

Table 9. Financially-Constrained Pavement Needs by Highway System

Highway System	Needs in 2014 Dollars
NHS Interstate	$15.12 B
NHS Non-Interstate	$22.26 B
Non-NHS	$36.87 B
Statewide	$74.7 B

The State-of-Repair based on Pavement Condition Score for the financially-constrained analysis is presented in **Figure 8**. Under the constrained needs, about 65 percent of pavements would be in “Poor” or “Very Poor” condition in 2040. Correspondingly, the percentage of pavements in “Good” or better condition is show in **Figure 9**. Compared to the unconstrained needs, where 100 percent of pavements would be in “Good” or better condition, it can be seen that by 2040, only around 35 percent of pavements will be in “Good” or better condition.

Figure 8. Pavement State-of-Repair under Constrained Needs

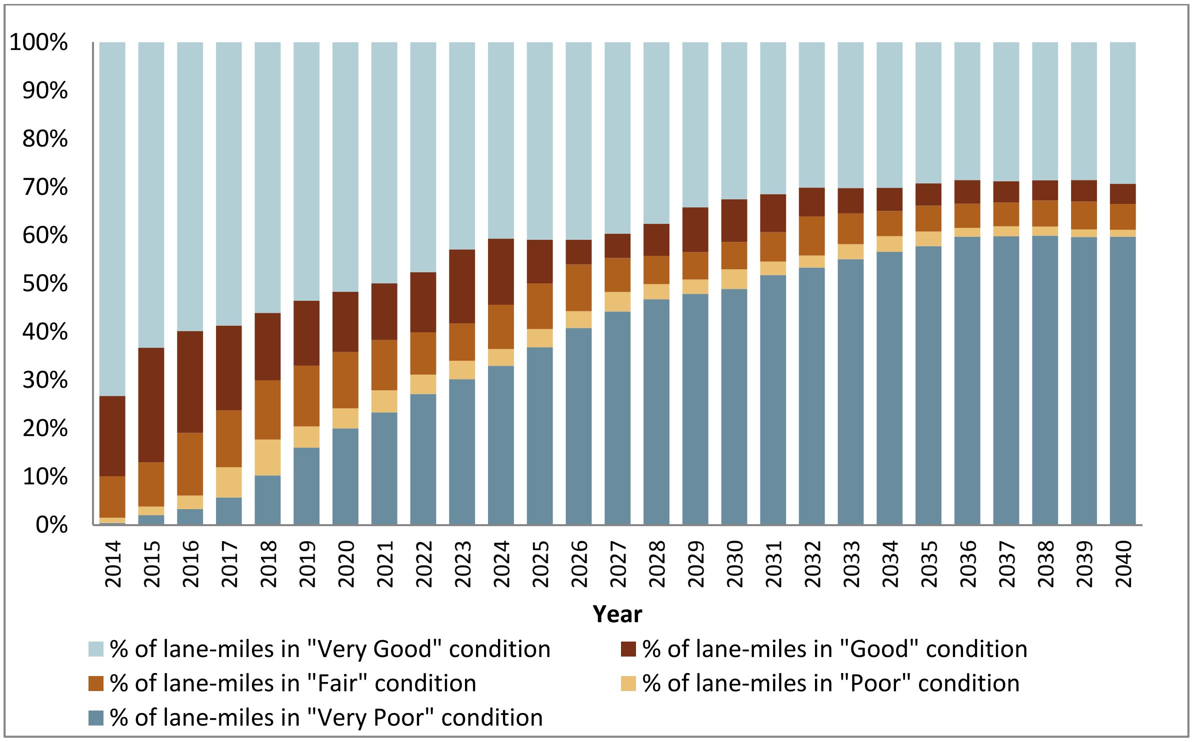


Figure 9. Percentage of Pavements in "Good" or Better Condition under Constrained Needs

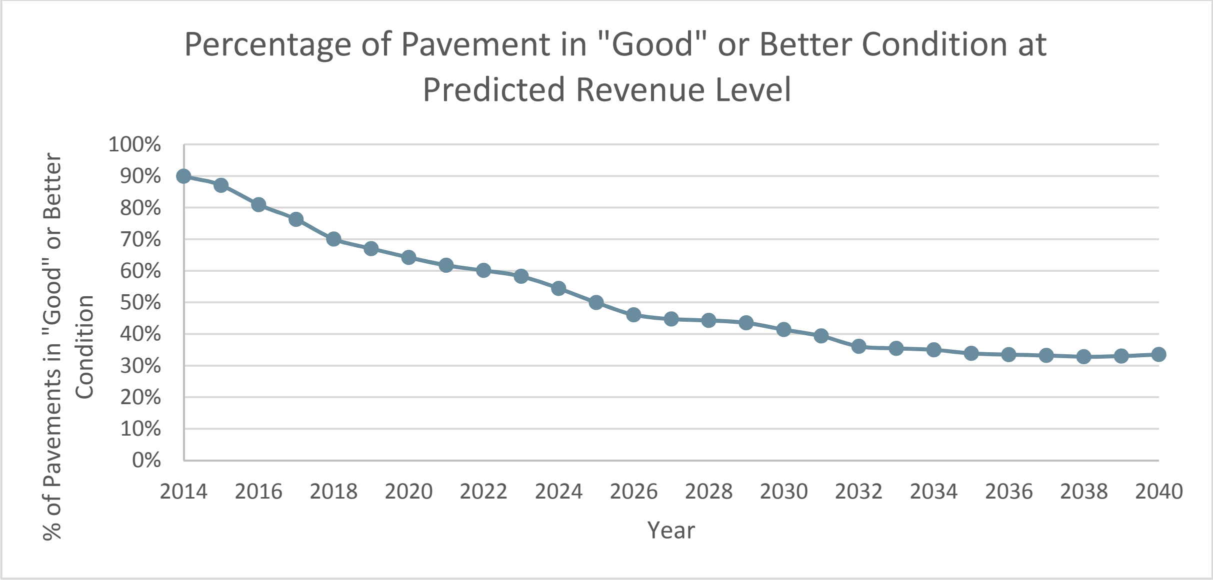
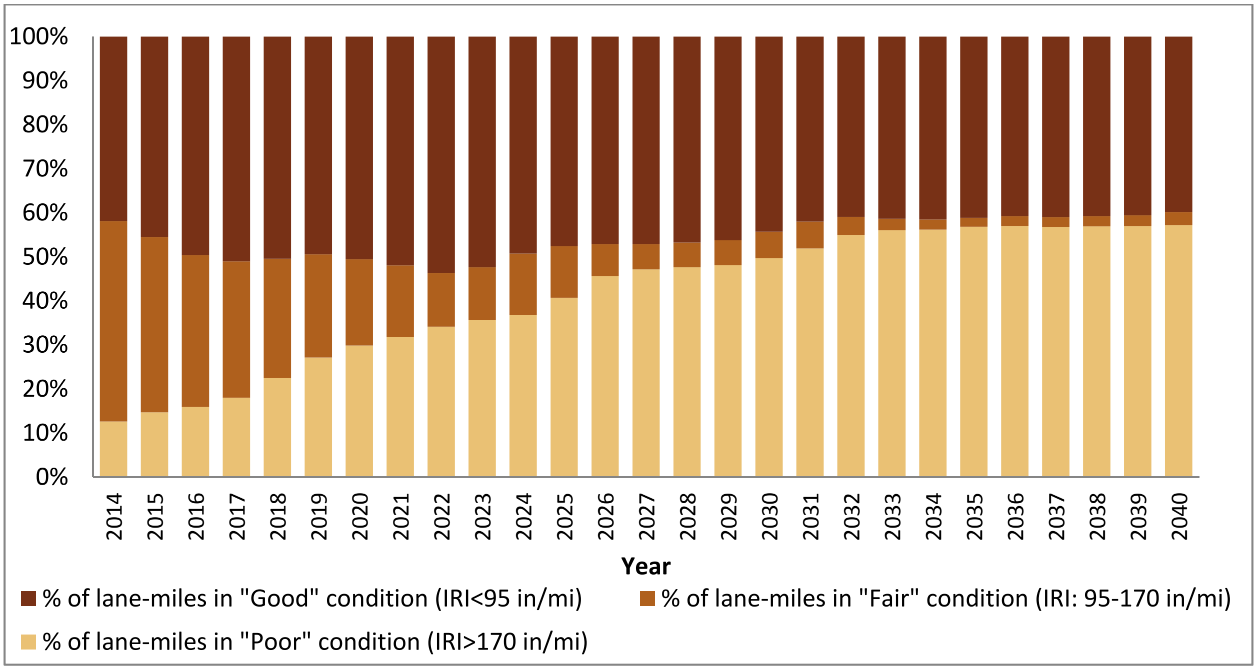


Figure 10 presents the State-of-Repair based on IRI for the financially-constrained needs assessment. By 2040, more than 55 percent of pavements would be in “Poor” condition based on IRI.

Figure 10. Pavement State-of-Repair by IRI under Financially-Constrained Needs



Fortunately, MAP-21 only sets the State-of-Repair definition for Interstate and Non-Interstate NHS. **Figures 11** and **12** present the State-of-Repair based on IRI for the Interstate System and for Non-Interstate NHS, respectively. Still, about 35 percent of Interstate and 30 percent of Non-Interstate NHS pavements would be in “Poor” condition by 2040.

Figure 11. Interstate Pavement State-of-Repair based on IRI

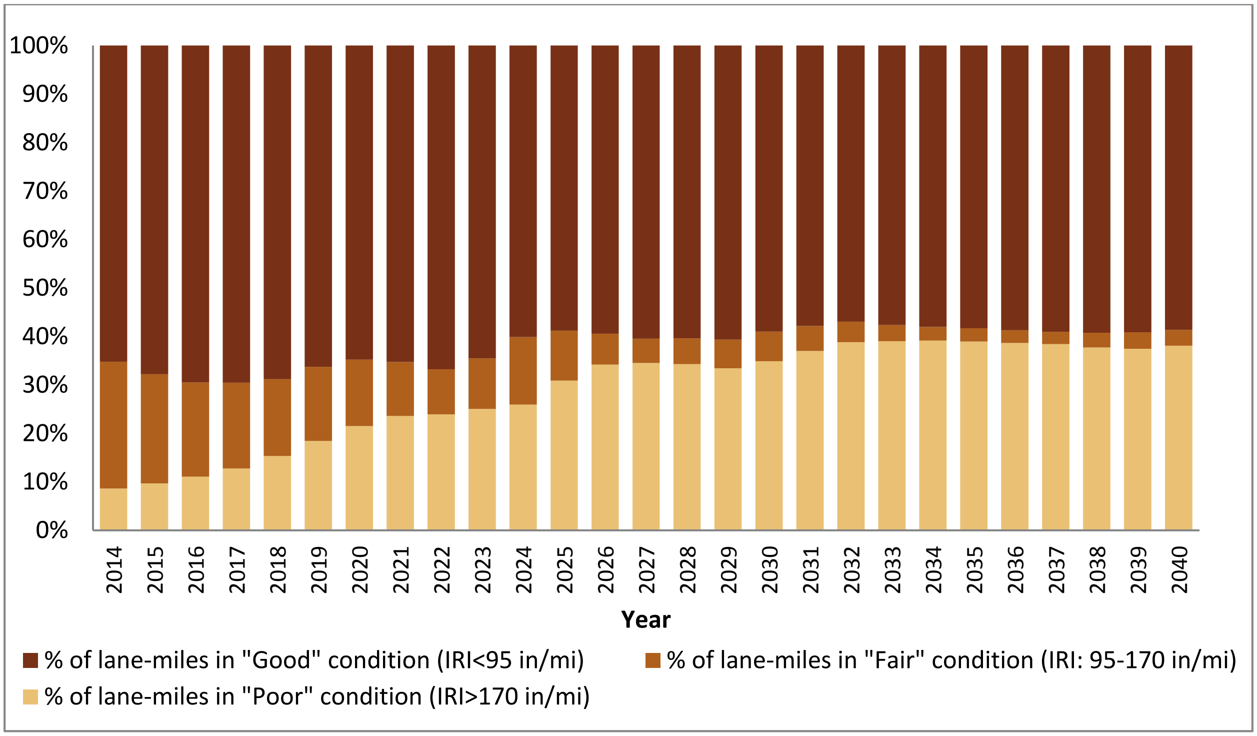
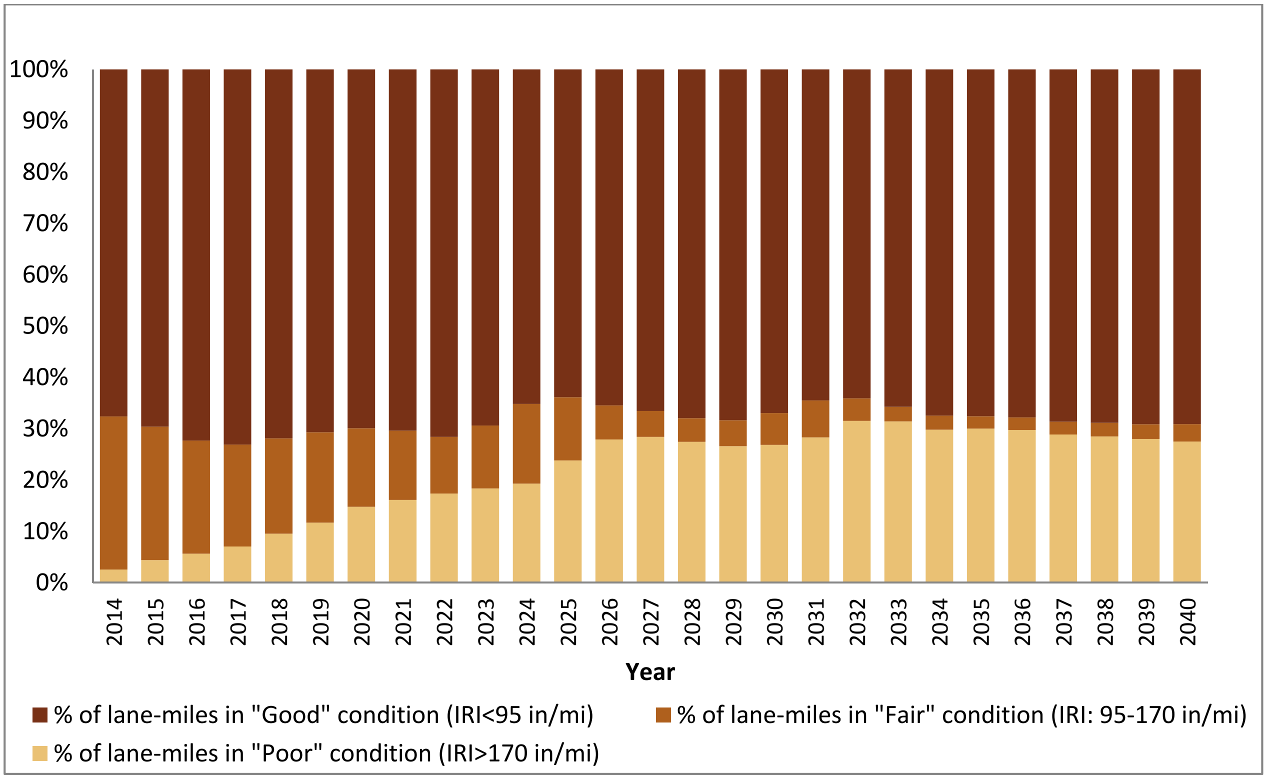
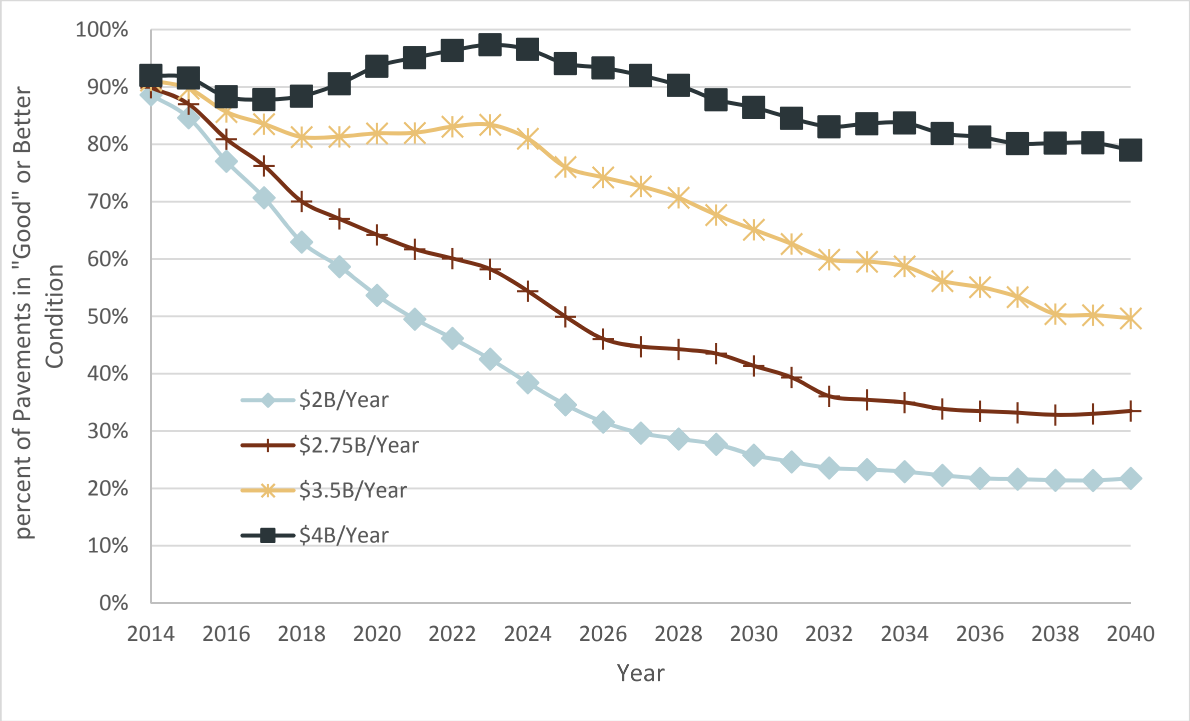


Figure 12. Non-Interstate NHS Pavement State-of-Repair based on IRI



Given uncertainties in future revenue and the potential for an infusion of resources, tradeoff analyses were conducted at different budget levels (Figure 13). If funds are increased by $750M/year, then the percentage of pavements in "Good" or better condition in 2040 would be expected to increase by 16 percent.

Figure 13. Pavement State-of-Good-Repair Trend at Different Budget Levels



Texas Transportation Plan

Tech Memo 6: SAM Baseline Documentation

August 15, 2014

Acknowledgements

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Contents

Tables

Figures

Appendices

1.0 Introduction

The purpose of this Technical Memorandum is the delivery of an updated 2010 Baseline and 2040 financially constrained scenarios for support of the Texas Transportation Plan (TTP). The 2040 run includes capacity expanding roadway projects in any of the Metropolitan Transportation Plans (MTPs) developed by each of the 25 Texas Metropolitan Planning Organizations (MPOs) or the Texas Statewide Transportation Improvement Plan (STIP).

The memo is organized into two sections: 1) Overview of the Statewide Analysis Model (SAM), including the demographics, transportation system, and validation; and 2) Modeled scenarios descriptions and results. The results section contains descriptions of model outputs including some accompanying examples of what can be produced using those outputs. The memo is accompanied by a geodatabase containing the SAM 2010 and 2040 network assignment results, along with a comprehensive data dictionary of all contained variables.

2.0 Statewide AnalySis Model (SAM)

The Texas State Department of Transportation (TxDOT) maintains a robust statewide travel demand model, referred to as the Texas Statewide Analysis Model (SAM). The SAM is an advanced state of the practice multimodal travel model that provides highway traffic forecasts for both passenger vehicles and trucks, intercity and high speed passenger rail ridership, urban rail and bus travel, freight rail tonnage forecasts, and forecasts of air passenger travel. The model is useful in statewide planning in that it can be used to perform analyses of specific transportation infrastructure under consideration, alternate demographics forecasts, the impact or freight movements on highways and rail facilities, and modal investment tradeoffs.

Key to the SAM's ability to forecast passenger and freight travel demand and the transportation system congestion that is an issue in many places are detailed estimates of demographic and employment that allow for the estimation of travel demand and a representation of the current and planned transportation system.

2.1 Demographic and Employment Data

The SAM assesses the viability of the statewide transportation network and produces travel demand metrics through use of baseline and forecast demographic and employment data. Demographic and employment data are critical components of regional travel demand models because the amount of households and employment help determine the number of trips produced by the model. The SAM uses 2010 as the base year, and has the capability to provide forecasts for 2020, 2030, and 2040; model results for the TTP utilize a 2010 base year and a 2040 forecast year. The following subsections provide an overview of how the demographic and employment data are incorporated into the SAM.

2.1.1 Data Sources

The SAM model incorporates various sources of existing demographic and employment data from public and proprietary sources. Data sources used in the model include:

- U.S. Decennial Censuses
- U.S. Census Bureau's American Community Survey (ACS)
- Metropolitan Transportation Planning Organizations (MPOs) Demographic and Employment Forecasts
- U.S. Census Bureau's County Business Patterns (CBP)
- U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW)
- Texas Workforce Commission (TWC)
- Texas State Data Center (TxSDC)
- Woods & Poole Complete Economic and Demographic Data Source (CEDDS)

2.1.2 MPO Population and Employment Data

Each of Texas' 25 Metropolitan Planning Organizations (MPOs) regularly produce baseline and forecast population and employment estimates at the traffic analysis zone (TAZ) level. MPOs are a useful source for urban population and employment forecasts because their datasets disaggregate the population employment forecasts to TAZs. MPOs typically update their models and demographic forecasts every five years, or, if the region is classified as being in non attainment for existing air quality standards, every three years.

The forecast methodologies and timeline for releasing these forecasts are often times inconsistent between the various MPOs. It is therefore difficult to make direct comparisons of regional population and employment for a given year. In order to make direct comparisons between MPOs, the population and employment estimates for common years must be interpolated or extrapolated, as necessary. Table 1, on the following page, shows the base year and forecast year demographic data available for the Texas MPOs.

Table 1: Texas MPO Demographic Forecasts Incorporated into the SAM Travel Demand Model

MPO	Base Year	Forecast Year	Interim Years
Amarillo	2005	2035	
Austin (CAMPO)	2005	2035	2008, 2010, 2015, 2025,
Bryan-College Station (BCS)	2006	2035	
Beaumont (JORTS)	2007	2030	2015, 2025
Dallas -Fort Worth (NCTCOG)	2012	2035	2020
El Paso	2007	2040	2010, 2020, 2030
Houston (HGAC)	2011	2035	
Killeen Temple (KTMPO)	2010	2040	2020, 2030
Laredo	2003	2035	
Longview	2002	2035	
Lubbock	2000	2030	
San Angelo	2003	2035	
San Antonio	2008	2035	2015, 2025
Sherman Dennison	2003	2035	
Tyler	2002	2035	2015, 2025
Wichita Falls	2005	2035	
Regional Valley (RGV)	2004	2035	

2.1.3 Demographic Control Totals

County-level population and household control totals derived from 2010 U.S. Census Bureau estimates. In order to ensure consistent county-level control totals across Texas, the SAM forecasts take into consideration projections from the Texas State Data Center, more detailed national forecasts available at the county level, and the interplay of population and employment growth to estimate the control total population for the 2040 model forecast year.

2.1.4 Baseline Demographics

The baseline demographics used in the SAM model were updated using data from three sources:

- 2010 U.S. Census data at the Census Tract and County levels;
- 2010 mid-year U.S. Census population estimates at the County level; and
- 2010 American Community Survey (ACS) 5-year median household income estimates at the Census Tract level.

2.1.5 Demographic Forecasts

The following sources were used to derive the TAZ-level demographic forecasts:

- 2010 U.S. Census population and household estimates at the county level;
- Woods & Poole 2012 CEDDS total population, persons per household and total households forecast data at the county level out to 2040; and
- Available MPO demographic forecasts.

2.1.6 Employment Control Totals

Employment data provides an important source of trip attractions and productions, and therefore has a significant role in the allocation of trips. Unlike population data from the U.S. Census Bureau, however, employment data is not always reported in a manner that accurately provides an employer's physical location, nor are all employers always included.

County-level employment estimates and projections were available from three government agencies and one proprietary source:

1. The U.S. Bureau of Labor Statistics (BLS),[1]
2. State workforce commissions,
3. U.S. Census Bureau's County Business Pattern data (CBP),[2] and
4. Woods & Poole Economics, Inc. (W&P).

The CBP county-level employment data serves as the source of employment control totals. Government and farm employment were included in each county's employment control totals from separate census sources to represent all employment categories.[3] The forecasted county employment control totals were derived by applying county level CEDDS growth rates to the base year control totals by employment type. Population to Employment (P/E) ratios were calculated from CEDDS data for each county and each analysis year as a secondary reasonableness check on the forecasts.

2.1.7 Baseline Employment

The datasets used to develop the SAM baseline employment inputs included:

- 2010 Census county-level population data
- U.S. Census Bureau's 2010 County Business Pattern (CBP) data
- Texas Workforce Commission employment data at Census Block level
- 2012 Woods & Poole Complete Economic and Demographic Data Source (CEDDS)
- Bureau of Economic Analysis (BEA)

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1 More information can be found at http://www.bls.gov/data/#employment

2 More information can be found at http://www.census.gov/econ/cbp/index.html

3 Military employment is included in the SAM V3 as a special generator. The employment data to populate this file is being provided by TxDOT.

The estimated baseline employment by type for the urban TAZs (i.e. those within an MPO), was calculated by aggregating the MPO's TAZ employment by type into the SAM TAZ geography. The SAM TAZ employment by type data were then summed to county totals. Next, the total CBP employment by type for each county was divided by the MPO's total employment by type. This adjustment factor was then multiplied by the MPO's estimated employment by type for each SAM TAZ to produce the baseline employment estimates.

2.1.8 Employment Forecasts

The SAM 2040 TAZ-level employment forecasts were prepared using the following data sources:

- 2010 Texas Workforce Commission (TWC) employment at the Census Block level
- 2010 County Business Pattern (CBP) employment at the County level
- 2010 Census population at the County level
- 2003-2035 Woods & Poole 2012 CEDDS population and employment at the County level.

2.1.9 Summary of Demographic and Employment Updates

Table 2 shows the final statewide population estimates after updating the population data. Under these projections the total population of Texas will grow from 25.1 million residents in 2010 to 40.5 million residents in 2040, which represents an increase of 60.8 percent over that time period.

Table 2: Forecasted Statewide Population Control Totals for Texas, 2010 and 2040

	2010	2040
Total Population	25,145,561	40,458,796
Average Annual Change	--	510,441
Compounded Annual Growth Rate	--	1.60%

Table 3 summarizes the household forecasts for the SAM study area. According to these projections, the total number of households in the SAM model area is forecasted to grow by 5.4 million households from 2010 to 2040, representing an increase of 60.2 percent. **Figure 1** on the next page shows the geographic distribution of population growth by TAZ in the model area between 2010 and 2040.

Table 3: Forecasted Statewide Household Control Totals for the SAM Study Area, 2010 and 2040

Measure	2010	2040
Total Households	8,922,933	14,298,386
Average Annual Change	--	179,182
Compounded Annual Growth Rate	--	1.58%

Figure 1: Population Annual Average Growth Rate by TAZ for the SAM Study Area, 2010 to 2040

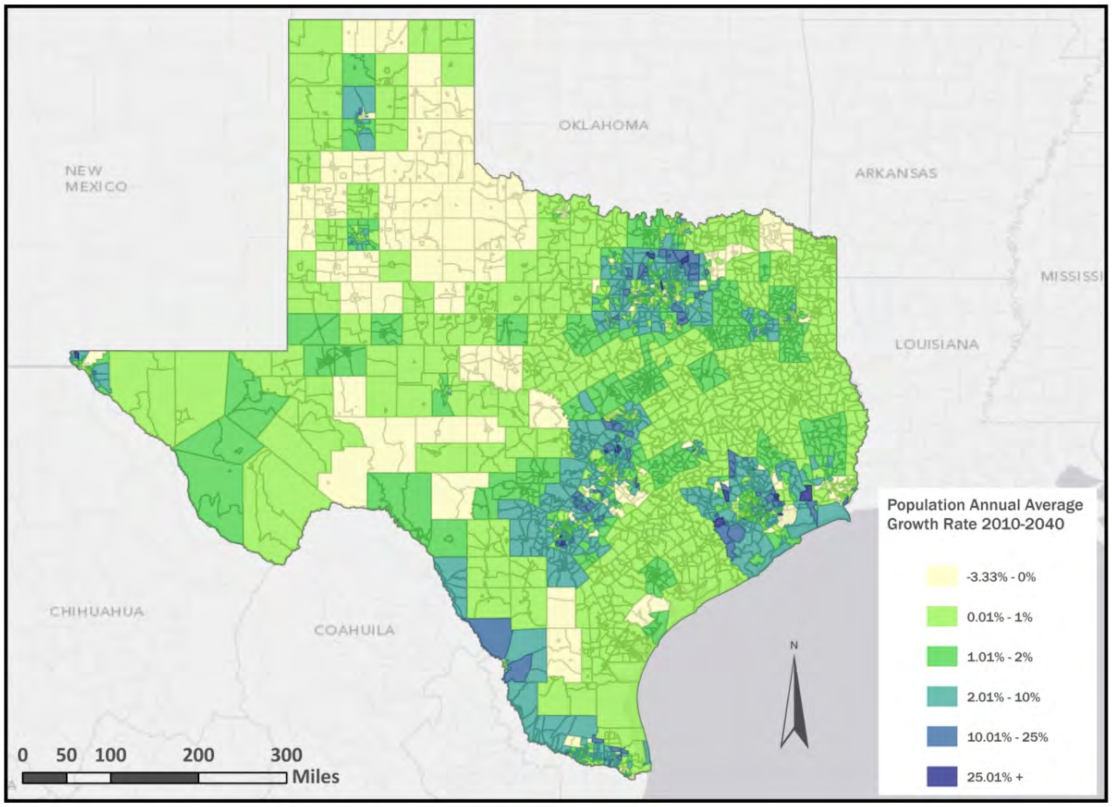
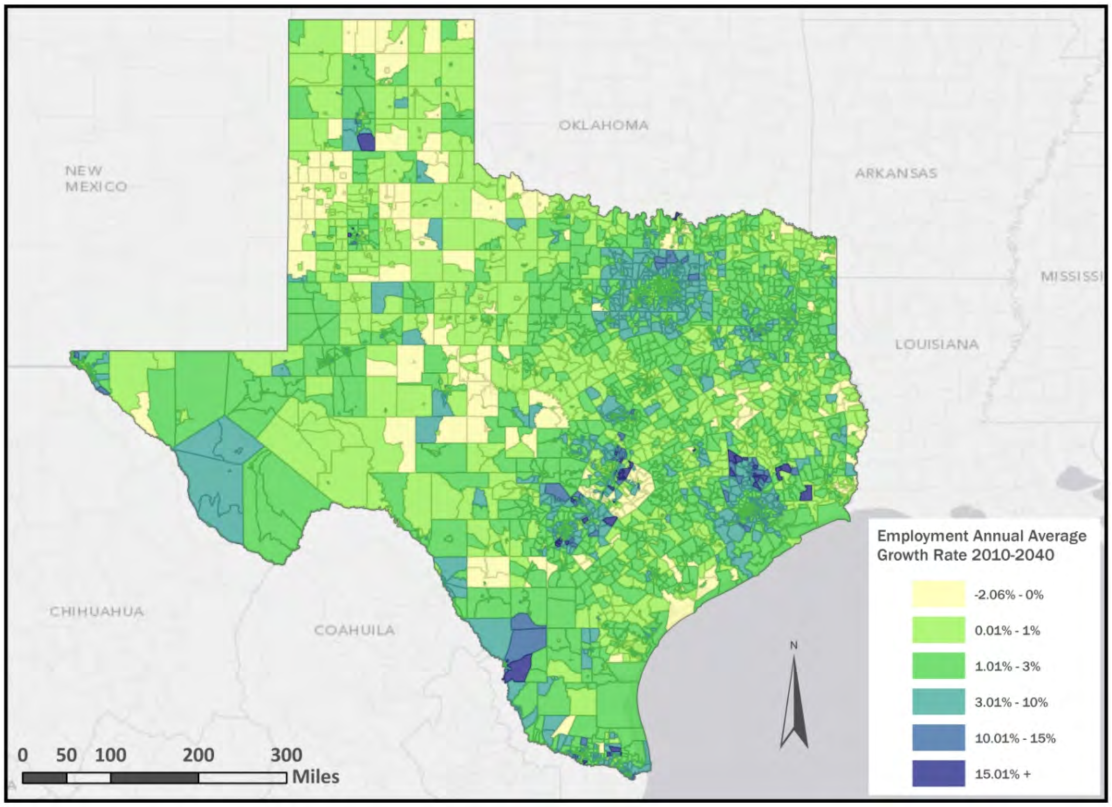


Table 4 shows the final results after updating the employment control total data for the SAM model at the statewide level. The employment forecasts anticipate robust job growth over the 30-year forecast horizon, with Texas expected to add 7.7 million jobs over that time period, representing an overall growth of 70.9 percent. **Figure 2** presents geographic distribution of employment growth and loss by TAZ in the modeled area between 2010 and 2040.

Table 4: Forecasted Statewide Employment Control Totals for the SAM Study Area, 2010 and 2040

	2010	2040
Total Employment	10,787,208	18,438,457
Average Annual Change	--	255,042
Compounded Annual Growth Rate	--	1.80%

Figure 2: Employment Annual Average Growth Rate by TAZ for the SAM Study Area, 2010 to 2040



2.2 Transportation System Update

In order to model the most current and comprehensive transportation system for development of the TTP, updates were made to the SAM transportation system. The SAM network stores information about the current and future characteristics of each facility in the Texas transportation system. This information includes physical attributes such as posted speed limit and number of lanes, as well as future changes, such as road widening projects. As part of the transportation system update, the project team refined the SAM network to include the most up-to-date conditions—as well as future conditions—of the Texas transportation system. This section describes how the project team determined which projects should be included in the refined SAM network, how those projects were coded into the network, and how the network was validated.

2.2.1 Plans Review

For urbanized areas with a population greater than 50,000, the planning and coordination of federal highway and transit investments are the responsibility of Metropolitan Planning Organizations (MPOs). Each of the 25 MPOs in Texas are required to maintain and update a Transportation Improvement Program (TIP) and Metropolitan Transportation Plan (MTP) to provide a short and long-term plan for transportation investments in their respective regions. In refining the

SAM network, the project team thoroughly reviewed all financially committed projects within each MPO's MTP, as well as in the Statewide Transportation Improvement Program (STIP). Table 5 below shows the plans that were reviewed for this task.

Table 5: Plans Incorporated into the SAM Network Update

MPO	Reference Name	Adoption Date
Statewide Transportation Improvement Program (STIP)	STIP, by District	August 2012
Abilene MPO	Abilene MPO MTP 2010-2035	January 12, 2010
Amarillo MPO	Amarillo MTP 2010-2035	October 20, 2011 (amended)
CAMPO (Austin) MPO	CAMPO 2035 RTP	May 24, 2010
Beaumont – Port Arthur MPO	SETRPC-MPO for the JOHRTS Area MTP 2035	April 19, 2013
Brownsville MPO	2010-2035 Brownsville MTP	December 9, 2009
Bryan – College Station MPO	BCS MPO 2010-2035 MTP	February 9, 2011 (amended)
Corpus Christi MPO	Corpus Christi MTO MTP 2010-2035	March 3, 2011 (amended)
Hidalgo County MPO (Pharr)	2010-2035 MTP	December 10, 2009
El Paso MPO	Horizon 2040 MTP	October 4, 2013
Houston Galveston MPO	The 2035 RTP Update	January 25, 2011 (approved)
Harlingen MPO	2010-2035 MTP	December 9, 2009
Killeen – Temple MPO	Mobility 35 MTP	October 21, 2009 (amended)
Laredo MPO	Laredo MTP 2010-2035 Update	December 11, 2009
Longview MPO	Transportation 2035 Longview MTP	May 15, 2013 (amended)
Lubbock MPO	Lubbock MTP 2012-2040	August 21, 2012
Midland Odessa MPO	Midland Odessa 2035 Transportation Plan Update	November 30, 2009
North Central Texas MPO	2035 Mobility, 2013 Update	June 13, 2013 (amended)
San Angelo MPO	San Angelo MTP 2010-2035	January 2013 (amended)
San Antonio – Bexar County MPO	Mobility 2035 MTP	December 7, 2009
Sherman – Denison MPO	Transportation Outlook 2035	April 25, 2012 (amended)
Texarkana MPO	TUTS 2035 MTP	October 1, 2009
Tyler Area MPO	TAMPO MTP 2035	April 22, 2010 (amended)
Victoria MPO	Victoria Urbanized Area MTP 2035	December 11, 2012 (amended)
Waco MPO	Connections 2035 Waco MTP	August 2010
Wichita Falls MPO	Wichita Falls MPO 2010-2035 MTP Update	June 4, 2012

The project team identified regionally significant projects from the above plans that would affect the capacity of the transportation system. These projects include new roadways, managed lanes/tollways and HOV lanes; road widening projects, including new turning lanes, conversion of existing lanes to tolled or managed facilities, and other capacity-altering projects. While the majority of projects listed in the MPTs and STIP were already included in the SAM network, 108 new projects from 11 MPOs were identified for addition to the SAM multimodal network. Table 6 below shows the number and types of projects added to the SAM network during this process.

Table 6: Projects Added to SAM Network

Project Type	Projects Added
Widen	41
Change to Toll	27
New Managed Lanes (widen)	20
New road (non toll)	16
New HOV	4
Total	108

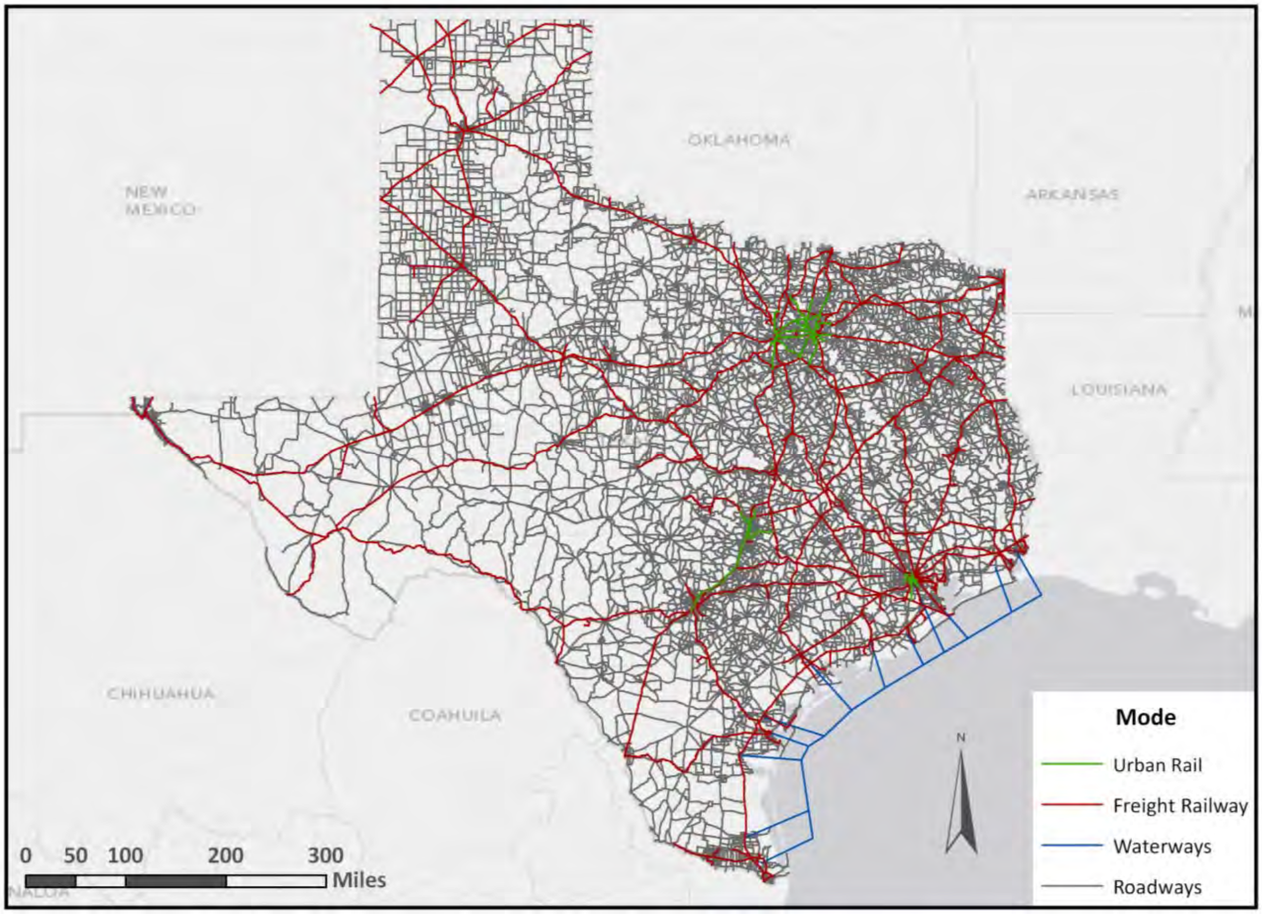
After the new projects were selected, the project team coded them into the SAM network by inputting attributes (described in Table 7) about each project into a Microsoft Access database. The database was then read by the SAM to automatically update the network attributes of the transportation system for each specified model year. The use of the project database allows for facilities that are affected by multiple projects over time to be updated incrementally. For example, a single roadway segment may have three projects associated with it, each adding additional lanes in separate years. To code this, the three projects are listed separately in the project database with their expected completion dates, and are then read by SAM to automatically update the attributes of that segment after running the network update procedure. This method allows modelers to add or remove specific projects from a given scenario for analysis. For example, one can observe the effect of adding a freeway in 2020 that is not planned to be constructed until 2040. Table 7 describes the attributes that are inputted into the SAM project database.

Table 7: Project Database Attributes

Field Name	Description
ID	Automatically generated Microsoft Access ID.
AddRemove	Flag denoting whether to include or exclude a project from a given scenario.
ProjectID	Unique identifier for a project. The ProjectID is coded on each link in the network affected by the project. The format of the Project ID is: MPO abbrev. + MPO project ID
ProjectYear	Year project begins operation.
RemovedYear	Year facility is removed from network.
OneWay	Controls how the number of lanes is populated on the network line layer. A "ONEWAY" flag in this field tells the interface to divide the value in the field “NumLanes” by two and transfer the value to the network directionally.
NumLanes	The total number of lanes associated with the roadway
FC	The functional classification of the roadway
DIV	Flag denoting if the facility is divided or not
Shoulder	Shoulder width if the project includes adding a shoulder
Posted_SP	Posted speed for roadway
MODE_CODE	Mode code of a link
Terrain	Flag denoting the topology of land. Topology affects the capacity of roadways. 1 = flat, 2 = rolling, 3=mountainous
Parking	Parking value to use for number of parking movements. The presence of on street parking reduces roadway capacity.
Lane_Config	Only for links at roadway intersection. Contains a code used to determine the lane group configuration (e.g. “L1LS0T3RS1R1” = # dedicated left, # shared left, # through, # shared right, # dedicated right)
ProjectSource	Note documenting the source of the project information
CSJ	Note that can be used to document the project CSJ
Name	Name of the facility
Type	Project types: • Build frontage road • Change to Toll • New HOV • New Managed Lanes • New road • Widen • Upgrade to expressway • Upgrade to freeway
Note	Optional field for notes
Alternative ID	Optional field for other ID for a project
MTP version	Optional field for MTP information
Toll Notes	Optional field to document the toll way note

Figure 3 below shows the SAM multimodal transportation system after the network update task was completed.

Figure 3: 2040 SAM Transportation System by Mode



2.3 *SAM Validation*

After the network was updated, a full SAM model run was conducted in order to compare base year travel volumes from the model with observed travel data. This validation process helped to ensure that the SAM model provides a realistic and reliable estimate of the magnitude and pattern of future travel in Texas. Validation procedures were conducted for highway, urban rail, Amtrak, and air modes. The validation results and data sources used for each of these modes are described in **Appendix A**, starting on page 21.

3.0 Scenario Descriptions and Results

3.1 Scenario Descriptions

As part of Task 4, the project team prepared two baseline scenarios for analysis: a demographic scenario for 2010 and a financially constrained scenario for 2040. The baseline 2010 scenario included the 2010 population and employment estimates discussed previously, as well as the multi-modal Texas transportation network as it existed in 2010. The financially constrained scenario included the 2040 population and employment forecasts, as well as the financially committed, capacity-altering projects added as part of the transportation system update process described in the previous section.

The remainder of this memorandum provides the results of the modeled scenarios performed in preparation of the Texas Transportation Plan. The 2010 demographic and 2040 financially constrained scenarios were analyzed using the SAM travel demand model, including updates made to the transportation system through inclusion of the most recent regional MTPs and STIP. The forecast year for all model results presented in this technical memorandum is 2040.

3.2 Statewide Results

Table 8 presents key summary statistics for each modeled scenario year.

Table 8: SAM Summary of Results

	2010	2040
Population	25,145,561	40,458,796
Employment	10,787,208	18,438,457
Vehicle Miles Traveled	688,003,585	1,104,744,458
Vehicle Hours Traveled	16,319,425	29,425,865
Number of Personal Trips (Total)	71,021,132	111,523,231.74
Number of Personal Trips (by Transit*)	1,344,361	2,106,377.68
Number of Vehicle Trips	50,202,955	78,946,246.14

Note:
*Transit is defined as Bus and Urban Rail modes

From 2010 to 2040, Texas trip volumes are expected to increase by 57 percent, as shown in Table 9.

Table 9: SAM Transportation Mode by Scenario Year

	2010	2040	% Increase
Drive Alone	36,437,250	57,378,639	57%
Share Ride (2 persons)	18,017,893	28,296,880	57%
Share Ride (3+ Persons)	15,221,627	23,741,335	56%
Bus	1,213,906	1,759,183	45%
Urban Rail	105,820	303,613	187%
Long Distance Trip (Air and Intercity Rail)	24,635	43,582	77%
Total	71,021,132	111,523,232	57%

3.2.1 Transportation Mode and Trip Purpose

Figure 4 (2010) and **Figure 5** (2040) indicate single-occupancy vehicle as the predominant travel mode in both modeled scenario years. From 2010 to 2040, the overall percentage of trips by bus decreases, while the percentage trips of urban rail increases.

Figure 4: 2010 SAM Mode Share

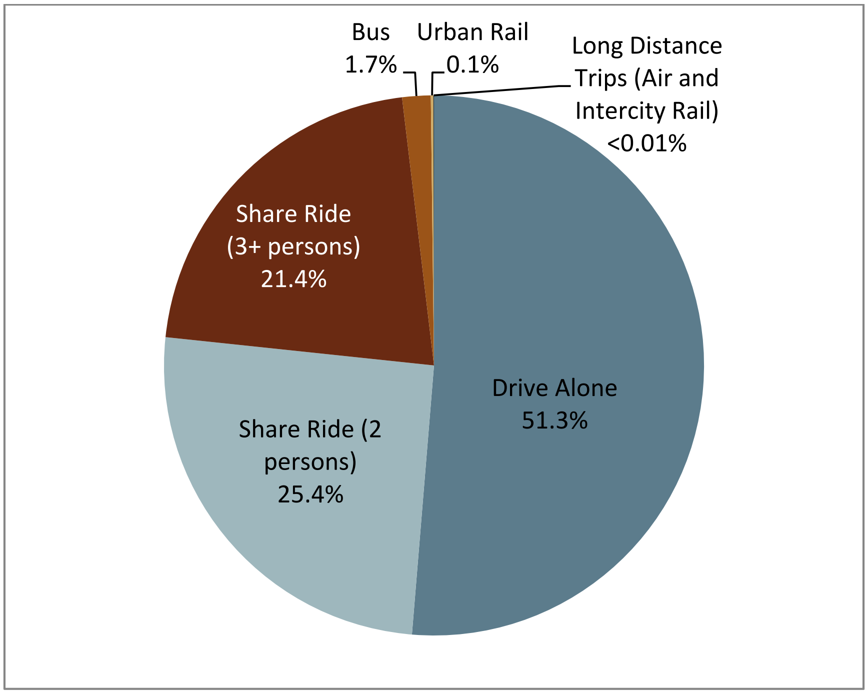


Figure 5: 2040 SAM Mode Share

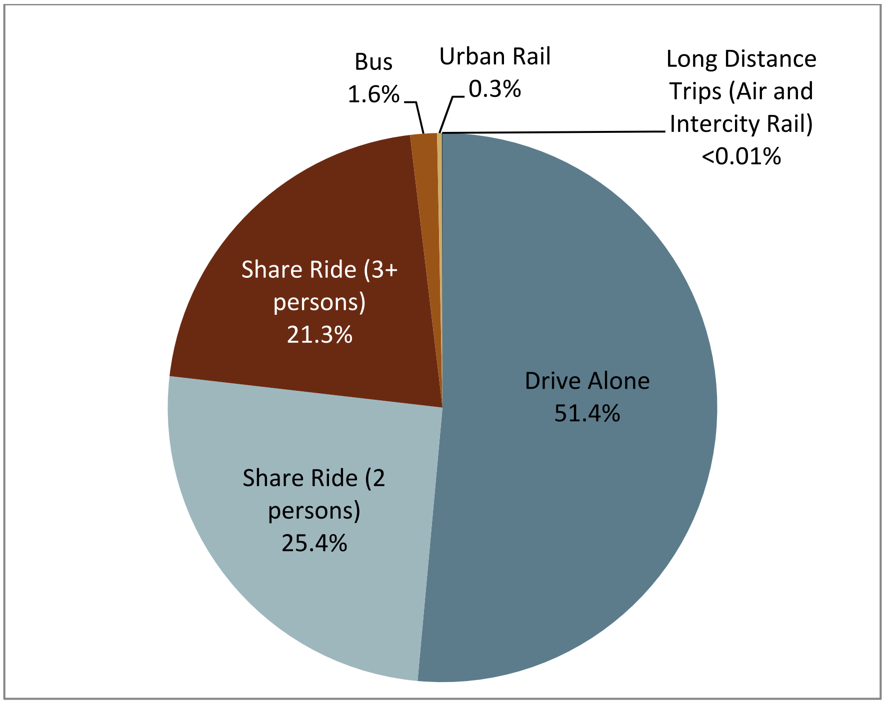


Figure 6 and **Figure 7** below present the distribution of trip purpose for 2010 and 2040, respectively. Home-based non-work (HBO) trips represent the majority of travel, followed by Home-based work (HBW). Infrequent long-distance work (ILDB) and Infrequent long-distance non-work (ILDO) trips represent the smallest share of trips for both modeled scenario years. The figures show little change in distribution of trip purpose over time.

Figure 6: 2010 SAM Trip Purpose

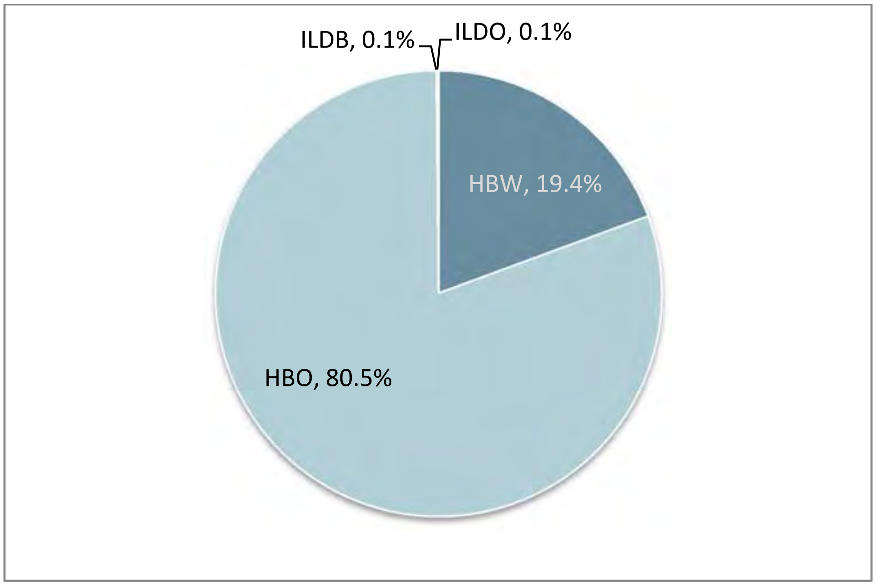
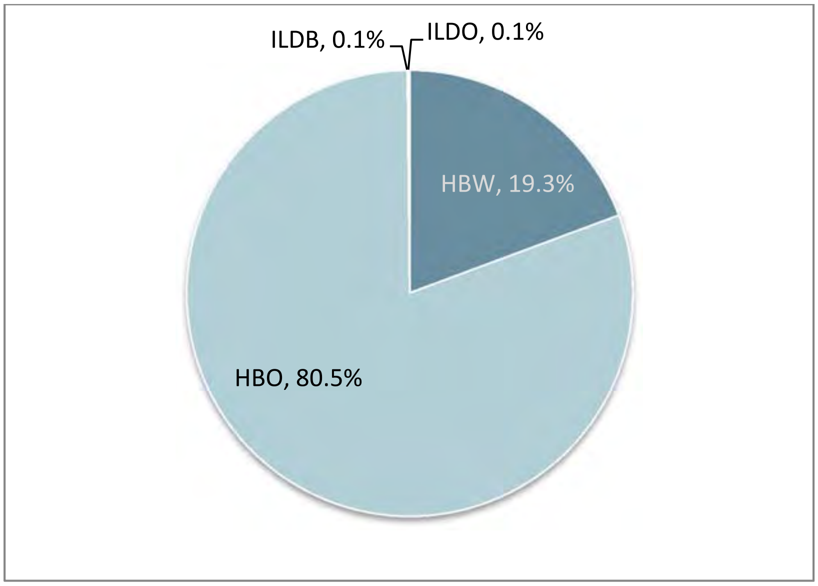


Figure 7: 2040 SAM Trip Purpose



3.2.2 Delay

Total delay measures the total time loss for all vehicles on the studied roadway segments. This measure can show improvements that affect a region's roadway system, or a particular corridor. This measure was calculated for two sub-classes within the region: regional highways, including all interstates, and regional arterials, comprising all other roadways within the Texas transportation system. These two classes are denoted in the Texas network in the attribute "REGION". See Table 10 for 24-hour total statewide delay in vehicle-hours, by roadway sub-class and scenario year.

Table 10: Statewide Mobility Metrics

		2010	2040
24-hour Total Statewide Delay (Vehicle-Hours)	Arterials	1,257,851	4,086,361
	Highways	493,408	1,573,048

3.2.3 Roadway Congestion Index

The Roadway Congestion Index (RCI) was originally developed by Texas Transportation Institute (TTI) to evaluate mobility levels on Texas streets and freeways, which is now computed annually for over 85 major U.S. cities. It is a measure of vehicle travel density on major roadways in an urban area. This measure produces a single value, calculated from delay associated with all links in the region.

$$RCI = \frac{\left(\frac{VMT_{freeway}}{Lane - mile_{freeway}}\right) * VMT_{freeway} + \left(\frac{VMT_{arterial}}{Lane - mile_{arterial}}\right) * VMT_{arterial}}{13000 * VMT_{freeway} + 5000 * VMT_{arterial}}$$

$$VMT_{freeway} = \sum_j \sum_k TotalVMT^k_{freeway,j}$$

$$VMT_{arterial} = \sum_j \sum_k TotalVMT^k_{arterial,j}$$

$$Lane - mile_{freeway} = \sum_k Total\ Number\ of\ Lanes^k_{freeway} * Length^k_{freeway}$$

$$Lane - mile_{arterial} = \sum_k Total\ Number\ of\ Lanes^k_{arterial} * Length^k_{arterial}$$

This measure assumes a capacity of 13,000 vehicles per lane per day for freeways and 5,000 vehicles per lane per day for arterials[4]. It assumes a baseline for congestion based on those capacities and does not account for daily peaking. Table 11 presents the Regional Congestion Index for the state of Texas.

Table 11: Statewide Mobility Metrics

	2010	2040
Regional Congestion Index (RCI)	0.573685	0.843891

3.2.4 Vehicle Miles Traveled (VMT) and Vehicle Hours Traveled (VHT)

Vehicle Miles Traveled (VMT) and Vehicle Hours Traveled (VHT) are important indicators of travel behavior throughout Texas. The SAM produces statewide VMT statistics for each scenario over a given time period. Statewide VMT is defined as the total miles driven by all vehicles within a given time period. VMT growth from 2010 to 2040 is shown in Figure 8. Table 12 below provides additional information.

4 "Alternative Performance Measures For Evaluating Congestion", New Jersey Institute of Technology, 2004.

Figure 8: VMT Growth 2010-2040 by Time Period

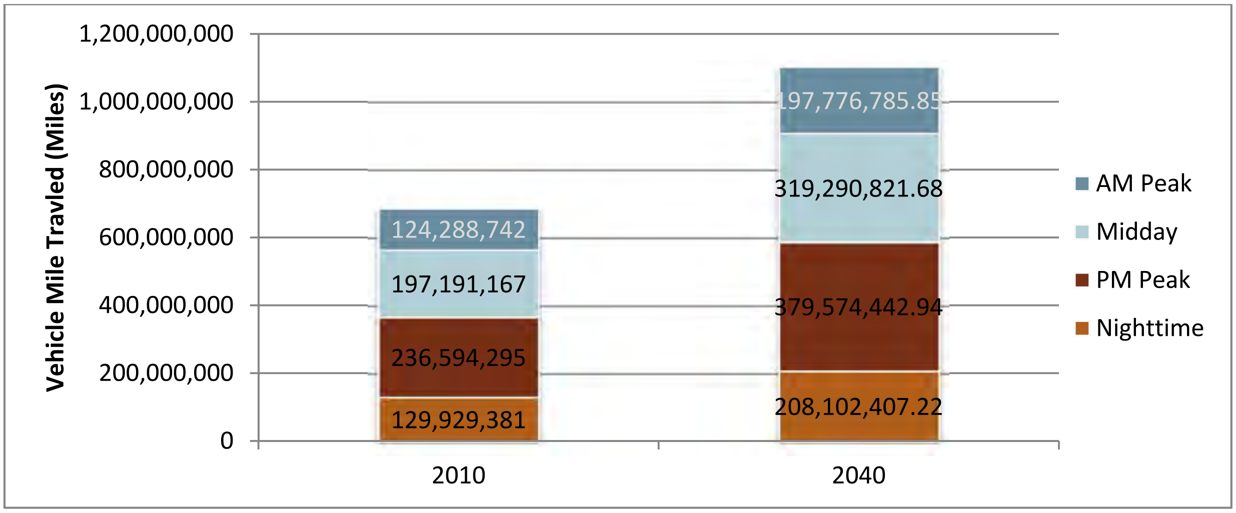


Table 12: VMT by Year and Time Period

	2010	2040	% Change from 2010 to 2040
Morning Peak	124,288,742	197,776,785.85	59%
Mid-Day	197,191,167	319,290,821.68	62%
Afternoon Peak	236,594,295	379,574,442.94	60%
Nighttime	129,929,381	208,102,407.22	60%
24-Hour	688,003,585	1,104,744,457.69	61%

The Vehicle Hours Traveled (VHT) metric also provides an indication of delay across the state. Statewide VHT is defined as the total hours driven by all vehicles within a given time period. VHT growth from 2010 to 2040 is shown in Figure 9. Table 13 on the next page provides additional information on VHT growth by year and time period.

Figure 9: VHT Growth 2010-2040

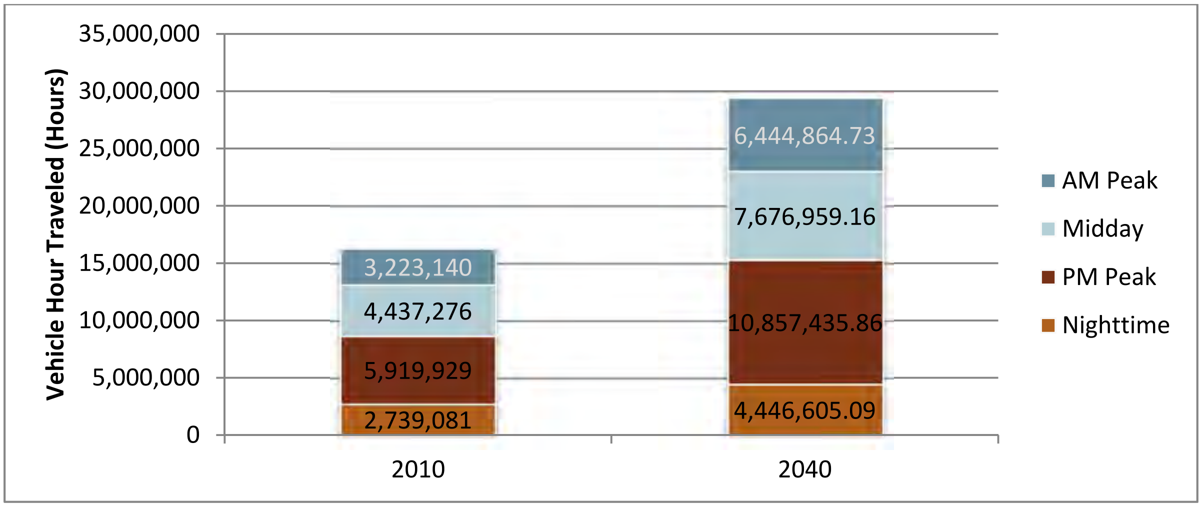


Table 13: VHT by Year and Time Period

	2010	2040	% Change from 2010 to 2040
Morning Peak	3,223,140	6,444,864.73	100%
Mid-Day	4,437,276	7,676,959.16	73%
Afternoon Peak	5,919,929	10,857,435.86	83%
Nighttime	2,739,081	4,446,605.09	62%
24-Hour	16,319,425	29,425,864.84	80%

For this study, VMT and VHT were calculated by time period for the State of Texas. A summary of statewide VMT and VHT by functional class is contained in Appendix B.

3.2.5 Statewide Freight

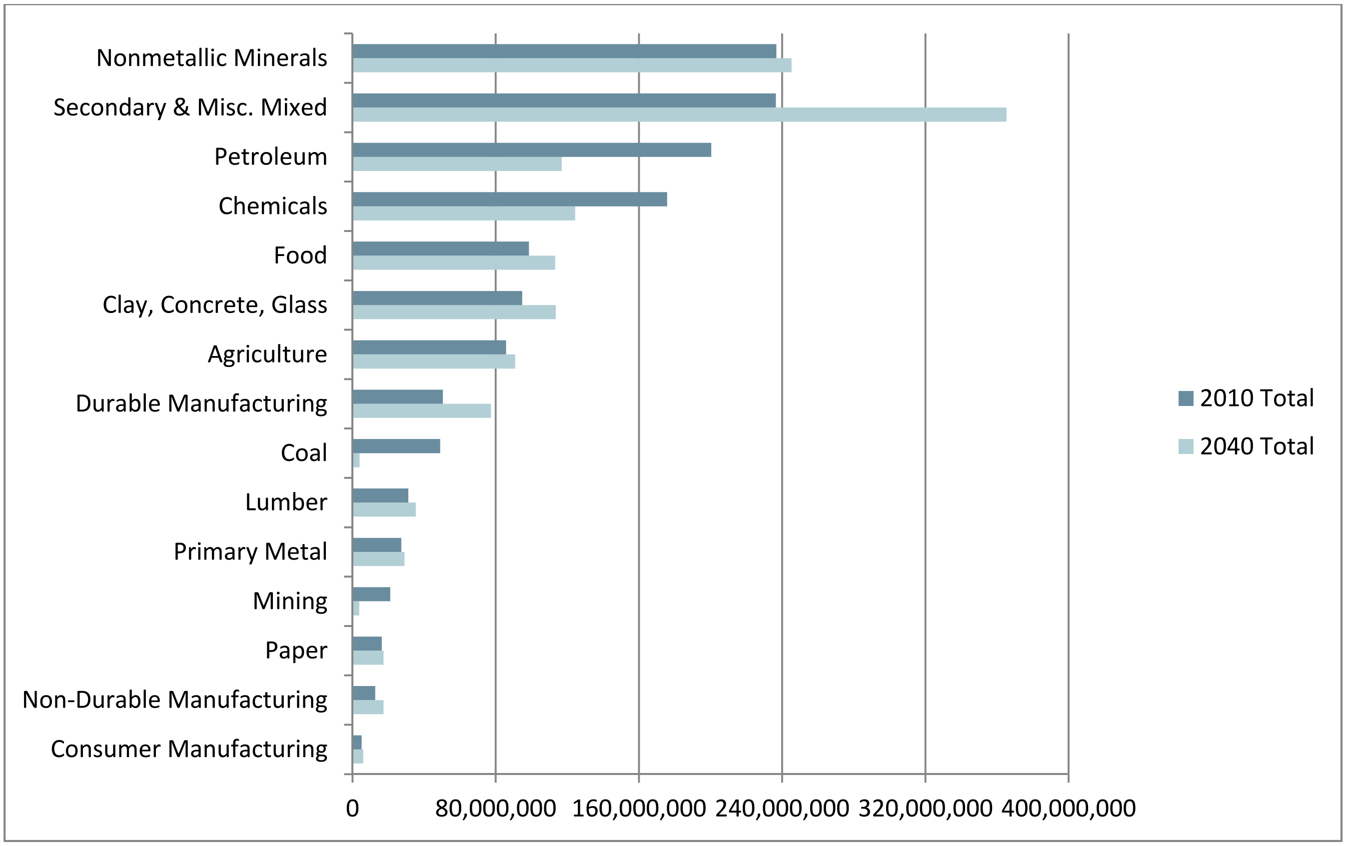
Freight statistics output by the SAM include tonnage by freight mode and freight productions and attractions by commodity group (as presented in Table 14).

Table 14: Freight Tonnage by Mode and Scenario Year

	2010	2040
Truck	970,384,709	1,359,665,251
Rail Carload (CL)	245,360,320	336,212,454
Intermodal (IMX)	23,958,736	75,883,902
Air	2,363,016	6,121,608
Water	99,646,503	93,014,260

Figure 10 shows freight tonnage productions by commodity group and scenario year.

Figure 10: SAM Tonnage Productions by Commodity and Scenario Year



3.3 Link Level Results

The travel demand model runs for each scenario provide metrics that can be used to measure and compare the performance of each scenario at the link level. These metrics are summarized in this section.

3.3.1 Volume to Capacity Ratios

The Volume to Capacity (V/C) ration is defined by TxDOT[5] as:

> *V/C – The ratio of flow rate to capacity. The V/C may be the actual or projected rate of flow on a designated lane group during a peak 15-minute interval divided by the capacity of the lane group. The V/C ratio is a measure of capacity sufficiency, that is, whether or not the physical geometry provides sufficient capacity for the subject movement.*

5 Texas Department of Transportation, TxDOT Glossary, June 2010.

The Volume-Capacity ratio (V/C ratio) is a direct output of the traffic assignment procedure, produced by time period and scenario year. It is a measure that reflects the mobility and quality of travel of a facility or a section of a facility, specifically, the number of vehicles at a snapshot in time divided by the capacity of the roadway on a roadway segment.

3.3.2 24-hour Trip Volumes

The SAM also produces link level 24-hour trip volumes for all modes, as well as for truck modes, across the modeled transportation network, at the link level.

3.3.3 Link Level Freight

Freight volumes can be analyzed at the link level using the results of the SAM. The SAM outputs include the ability to analyze freight flows by commodity type at the link level.

3.3.4 Total Freight Congestion

The truck level of service measure “Total Freight Congestion Value” was developed by the American Transportation Research Institute (ATRI). The measure is calculated by taking the miles per hour below free flow speed that trucks are traveling and multiplying the value by the number of trucks on a roadway within each hour of the day to produce an hourly freight congestion value. The SAM model is used to calculate the Total Freight Congestion Value for four time periods (AM peak, Mid-day, PM peak, and Night) on major highways within Texas. The measure is reported by major highway to allow for comparison. The larger the value reported the lower the level of freight service for the facility during the specific time period.

Appendix A: SAM Validation

After the network was updated a full SAM model run was conducted in order to compare base year travel volumes from the model with observed travel data. This validation process helped to ensure that the SAM model provides a realistic and reliable estimate of the magnitude and pattern of future travel in Texas. Validation procedures were conducted for highway, urban rail, Amtrak, and air modes.

Highway

Highway traffic volumes from the model were validated against 2010 24-hour volume counts and vehicle classification counts obtained from TxDOT, as well as a 2007 origin/destination study conducted at 21 sites along the Interstate 35 (IH-35) corridor.

One measure used to evaluate the SAM model outputs is vehicle miles of travel (VMT). Table A-1 compares the modeled VMT with observed VMT (2010) for Texas. These results show that modeled VMT was 107% of statewide VMT, which is within the ±10% validation target.

Table A-1: HPMS VMT vs. Modeled VMT

HPMS VMT (2010)	Modeled VMT	% of HPMS VMT (Observed)	Validation Target
641,809,936	688,003,582	107%	±10%

The overall validation results indicated that the SAM model provided a realistic and reliable predictor of the magnitude and pattern of highway travel in Texas.

Urban Rail

Urban rail ridership from the SAM model was validated using ridership information from each of the urban rail lines operating in Texas in 2010: the MetroRail Red Line in Austin, the MetroRail system in Houston, the Trinity Railway Express in Dallas-Fort Worth, and DART Rail in Dallas. Table A-2, on the next page, compares the modeled urban rail ridership by route to the estimated daily ridership target. Urban rail, which serves mainly as an access mode for air and high speed rail in the SAM model, compared well with the ridership targets, with the only notable differences occurring at the individual rail line or city level.

Table A-2: Modeled vs. Observed Urban Rail Trips by Route

Route	Location	Observed Average Daily	Model Result
MetroRail Red Line	Austin	1,800	10,477
MetroRail Light Rail	Houston	35,251	46,753
Trinity Railway Express	DFW	8,500	7,180
Light Rail	Dallas	59,800	42,322
Total		**105,351**	**106,731**

Amtrak

Amtrak passenger rail ridership from the SAM was validated using 2010 boarding and alighting data for each of the three Amtrak routes located in Texas: the Heartland Flyer, the Texas Eagle, and the Sunset Limited. Table A-3 compares modeled intercity rail ridership from SAM to the estimated average daily Amtrak route ridership.

Table A-3: Modeled Vs. Observed Intercity Trips

Observed Average Daily	Model Result	Difference
766	904	18%

Air

Passenger air volumes from the SAM model were validated by comparing model outputs with 2010 *Airline Origin and Destination Survey* data from the Bureau of Transportation Statistics. Table A-4 presents the SAM modeled air trips versus observed air trips.

Table A-4: Modeled Vs. Observed Daily Air Trips

Observed Average Daily	Model Result	Difference
22,632	24,009	6.1%

Freight

The SAM freight model was validated by comparing 2010 modeled flows with TRANSEARCH freight flows for all applicable modes. Table A-5 on the following page presents a comparison of daily truck trips derived from the TRANSEARCH truck-only flows and SAM freight mode choice truck trip tables. Overall, these numbers show that the model produces daily truck trips that are similar to the TRANSEARCH truck trips.

Table A-5: Comparison of Daily Truck Trips from SAM Model and TRANSEARCH Data

Daily Truck Trips	TRANSEARCH	SAM Model	Difference
Internal-Internal, Internal-External, External-Internal	151,000	157,765	4%
Internal-Internal	110,000	112,049	2%
Internal-External, External-Internal	41,000	45,717	12%

Another validation procedure was conducted to compare SAM freight mode shares with TRANSEARCH mode shares for truck, carload rail, and intermodal rail. As Table A-6 indicates, the modeled mode shares were reasonably close to observed mode shares. Air and water shares are not shown here as they are inputted directly from the TRANSEARCH data. The SAM mode choice model does not directly capture air and water modes.

Table A-6: Comparison of Modal Shares from the 2010 SAM Mode Choice Model and 2010 TRANSEARCH Commodity Flow Data (exclusive of Air and Water)

Commodity Group		Truck %		Carload Rail %		Intermodal Rail %	
Code	Name	Actual	Modeled	Actual	Modeled	Actual	Modeled
1	Agriculture	63.58%	73.52%	36.04%	25.68%	0.39%	0.80%
2	Mining	64.46%	62.04%	35.49%	37.44%	0.05%	0.53%
3	Coal	26.42%	8.28%	73.58%	91.72%	0.00%	0.00%
4	Nonmetallic Minerals	84.43%	75.30%	15.57%	24.69%	0.01%	0.01%
5	Food	80.43%	86.16%	19.41%	13.83%	0.16%	0.01%
6	Consumer Manufacturing	96.76%	87.00%	0.06%	0.09%	3.18%	12.91%
7	Non-Durable Manufacturing	97.87%	95.02%	1.28%	0.42%	0.86%	4.56%
8	Lumber	87.08%	92.97%	12.81%	6.58%	0.11%	0.45%
9	Durable Manufacturing	81.64%	84.05%	17.24%	12.20%	1.12%	3.76%
10	Paper	72.44%	71.12%	26.38%	23.53%	1.17%	5.35%
11	Chemicals	57.63%	64.16%	42.28%	35.16%	0.08%	0.68%
12	Petroleum	87.77%	81.54%	12.22%	18.41%	0.01%	0.05%
13	Clay, Concrete, Glass	93.77%	96.03%	6.16%	3.93%	0.07%	0.04%
14	Primary Metal	61.31%	82.55%	38.64%	17.44%	0.05%	0.00%
15	Secondary & Misc. Mixed	96.80%	90.84%	2.34%	1.51%	0.86%	7.65%
Total		77.50%	78.28%	22.24%	19.79%	0.27%	1.93%

Appendix B: VMT and VHT by Functional Classification

Table B-1: 2010 VMT/VHT – Total (Passenger Vehicles and Trucks) Flow by Functional Class

Code	Code Description	VMT	VHT
0	Centroid Connector	108,812,957.56	4,623,988.50
1	Rural Interstate	51,745,096.44	879,112.77
2	Rural Principal Arterial	71,074,747.17	1,486,363.81
6	Rural Minor Arterial	39,687,887.16	832,571.21
7	Rural Major Collector	43,514,262.78	906,122.07
8	Rural Minor Collector	8,087,376.79	164,198.62
9	Rural Local	3,275,687.39	102,067.59
11	Urban Interstate	112,648,599.59	1,872,358.70
12	Urban Freeway & Expressway	89,227,881.47	1,521,910.85
14	Other Urban Principal Arterial	116,576,647.61	2,921,485.13
16	Urban Minor Arterial	26,415,666.72	669,700.21
17	Urban Collector	4,748,248.06	129,835.41
19	Urban Local	221,179.10	11,178.74
30	Water Ferry	36,025.17	950.39
111	HOV and HOT Lanes	11,931,321.60	197,581.45
Total		688,003,584.60	16,319,425.45

Table B-2: 2040 VMT/VHT – Total (Passenger Vehicles and Trucks) Flow by Functional Class

Code	Code Description	VMT	VHT
0	Centroid Connector	185,550,766.60	7,825,374.79
1	Rural Interstate	84,186,808.60	1,759,576.81
2	Rural Principal Arterial	103,058,094.24	2,456,609.40
6	Rural Minor Arterial	61,824,180.47	1,523,844.18
7	Rural Major Collector	72,481,065.53	1,820,905.24
8	Rural Minor Collector	14,641,424.10	373,820.32
9	Rural Local	6,217,295.82	201,690.57
11	Urban Interstate	174,377,603.66	3,219,052.97
12	Urban Freeway & Expressway	168,161,936.42	3,277,301.16
14	Other Urban Principal Arterial	159,876,211.55	4,875,214.75
16	Urban Minor Arterial	39,347,306.75	1,286,844.88
17	Urban Collector	7,911,903.80	276,658.62
19	Urban Local	404,993.79	28,085.60
30	Water Ferry	46,308.38	1,228.34
111	HOV and HOT Lanes	26,658,557.96	499,657.21
Total		1,104,744,457.69	29,425,864.84

Table B-3: 2010 VMT/VHT – Truck Flow (Heavy and Medium Trucks) by Functional Class*

Code	Code Description	VMT	VHT
0	Centroid Connector	1,637,301.70	188,430,724.13
1	Rural Interstate	15,100,778.25	523,920,683.46
2	Rural Principal Arterial	8,296,534.91	349,548,476.28
6	Rural Minor Arterial	3,348,488.50	150,147,555.71
7	Rural Major Collector	2,891,295.66	139,909,404.09
8	Rural Minor Collector	462,477.97	18,899,623.82
9	Rural Local	124,750.81	15,553,988.06
11	Urban Interstate	10,695,739.28	149,624,552.25
12	Urban Freeway & Expressway	3,742,532.90	57,352,337.34
14	Other Urban Principal Arterial	2,730,186.75	69,099,963.18
16	Urban Minor Arterial	644,773.62	17,565,292.73
17	Urban Collector	119,316.15	4,203,452.69
19	Urban Local	1,545.88	246,770.62
30	Water Ferry	944.3	69,171.82
111	HOV and HOT Lanes	1,639.76	32,416.47
Total		49,798,306.44	1,684,604,412.66

Note:
*Truck VMT does not include smaller commercial vehicles

Table B-4: 2040 VMT/VHT – Truck Flow (Heavy and Medium Trucks) by Functional Class*

Code	Code Description	VMT	VHT
0	Centroid Connector	2,630,034.90	309,501,235.98
1	Rural Interstate	19,549,508.39	940,084,985.72
2	Rural Principal Arterial	11,748,444.96	516,816,466.17
6	Rural Minor Arterial	5,252,717.07	245,478,132.31
7	Rural Major Collector	4,742,783.56	258,640,941.29
8	Rural Minor Collector	843,598.61	36,926,882.51
9	Rural Local	241,167.08	30,241,490.78
11	Urban Interstate	13,813,952.12	227,608,407.10
12	Urban Freeway & Expressway	7,028,791.60	161,392,913.96
14	Other Urban Principal Arterial	3,624,955.40	129,004,424.11
16	Urban Minor Arterial	882,290.04	42,822,414.29
17	Urban Collector	175,922.52	8,688,428.78
19	Urban Local	5,211.95	1,227,933.49
30	Water Ferry	1,173.47	81,643.23
111	HOV and HOT Lanes	176,015.51	5,266,159.91
Total		70,716,567.18	2,913,782,459.64

Note:
*Truck VMT does not include smaller commercial vehicles

Texas Transportation Plan

Tech Memo 6: Transit Modal Profile

August 15, 2014

Acknowledgements

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Contents

Tables

Figures

Appendix

1.0 Introduction

The Texas Transportation Plan 2040 (TTP) is the State's long-range transportation plan which covers the size and scope of the Texas transportation system, including all modes of public transportation. This memo documents the existing conditions, current and future demand, funding needs, and fiscally-constrained investment scenarios for public transit agencies. The performance outcomes, based on conditions of assets and new transit ridership, are also projected for each funding scenario.

2.0 Overview of Existing Conditions

There are over 70 transit agencies operating in Texas, with most agencies providing multiple modes of service under varying 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:

- Metropolitan Transit Authorities (MTAs), which are not funded by the state and 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, as illustrated in Figure 2-1.
- Rural Transit Districts (RTDs), shown in Figure 2-2, which are subrecipients of federal funding through TxDOT.
- Special service operators who provide services under the Seniors and Individuals with Disabilities Program (Sect. 5310).
- Intercity bus services operated by private operators, such as Greyhound, also receive grant money from TxDOT to support intercity services.

For ease of reporting, all Non-MTA agencies are often grouped together in this memo as they are all direct recipients of funding from TxDOT, whereas the MTAs are not.

Figure 2-1. Texas Urban Transit Agencies

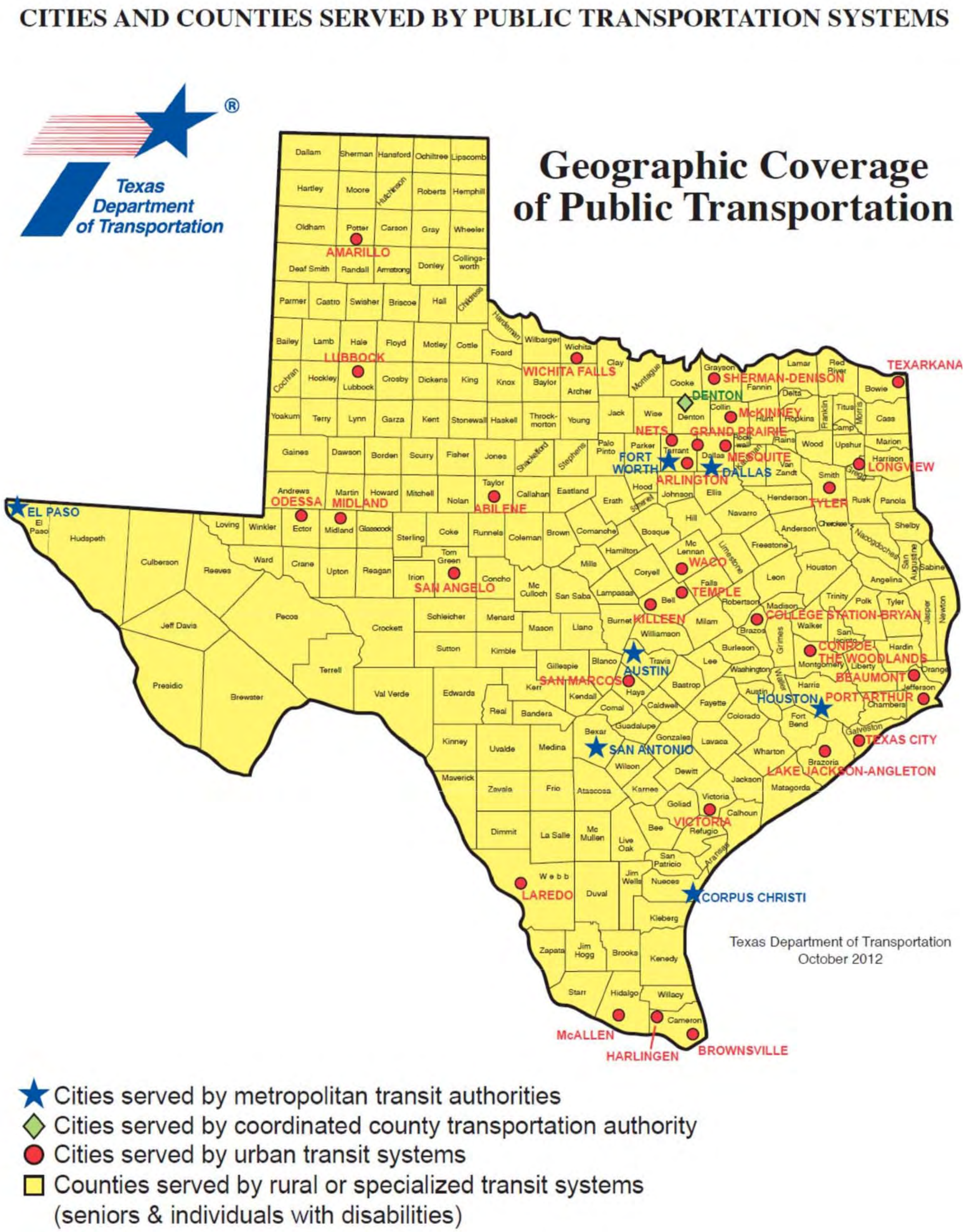
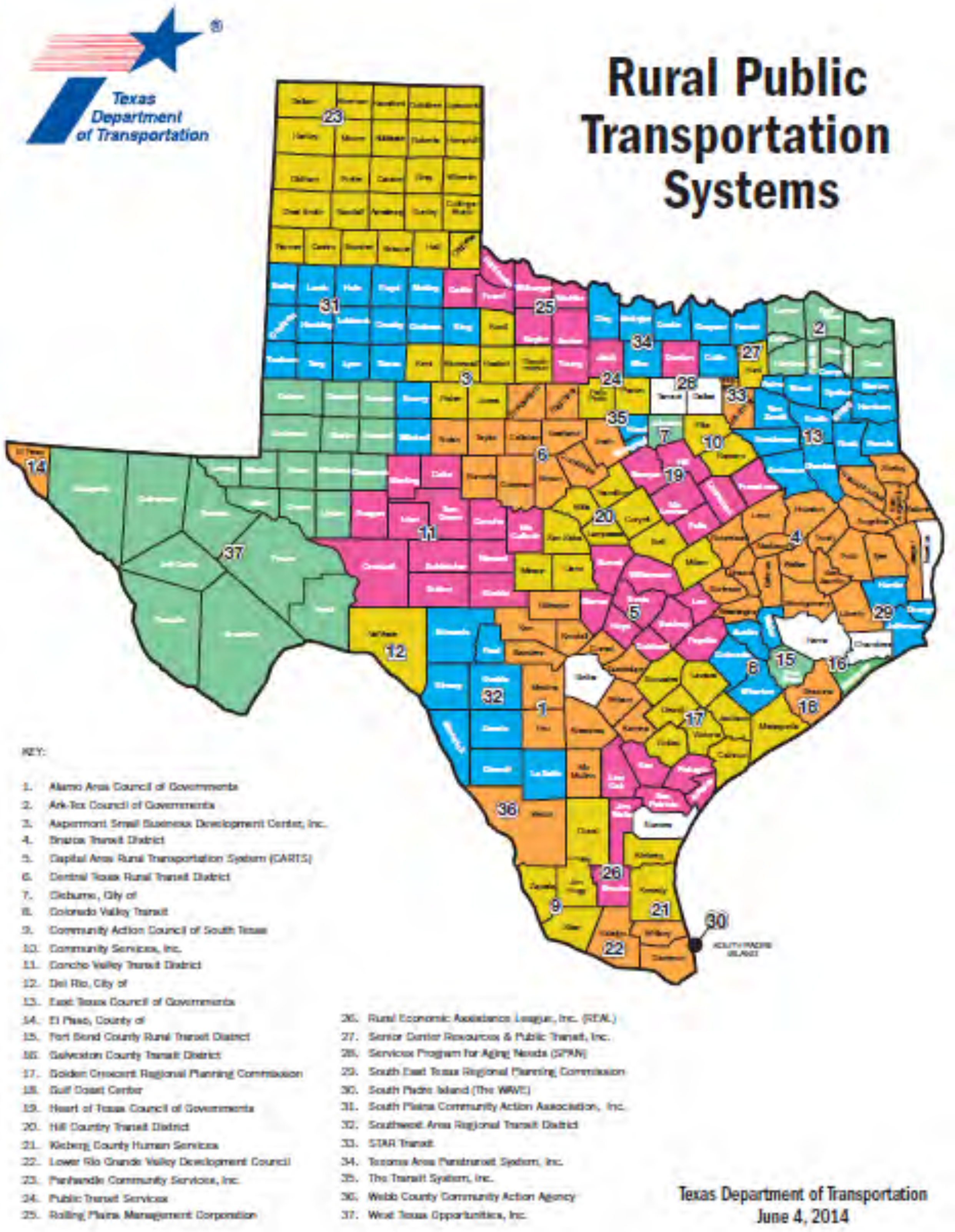


Figure 2-2. Texas Rural Transportation Districts



There are currently seven MTA agencies (in El Paso, Fort Worth, Houston, Austin, San Antonio, Corpus Christi and Dallas), and over 30 each of State Urban and RTD agencies. About 90 agencies also offer Special transit services for Seniors and Individuals with Disabilities.

A 2013 inventory of existing public transit assets was developed using inputs from TxDOT's Public Transportation Management System (PTMS) and assets reported to the National Transit Database (NTD) and TERM Federal, described in detail in the *Transit Analysis Methodology* memo. This inventory served as a baseline for estimating future state of good repair needs (SGR), described below in Section 3.1.1.

As seen in Table 2-1, this inventory totals over $17 billion. It is important to note that 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 State Urban agencies with a little less than half owned by the RTDs. Combined Intercity Bus and Special services make up less than five percent of the Non-MTA asset base. In total this inventory includes well over 10,000 revenue vehicles and approximately 350 stations and transit facilities.

Table 2-1. Statewide Replacement Value of Transit Assets (Millions of $2014)

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
Systemwide 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**

As shown in Figure 2-3, the largest portion of public transit assets are providing bus services 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. The modal profile for MTAs is significantly different from that of Non-MTA agencies. Figure 2-4 illustrates the primary differences in services provided by MTAs and Non-MTA agencies, with Demand Response dominating the State Urban, RTD, and Special services assets while MTAs are more evenly divided between fixed route, bus and rail, services.

Figure 2-3. Proportion of Statewide Public Transit Assets by Mode

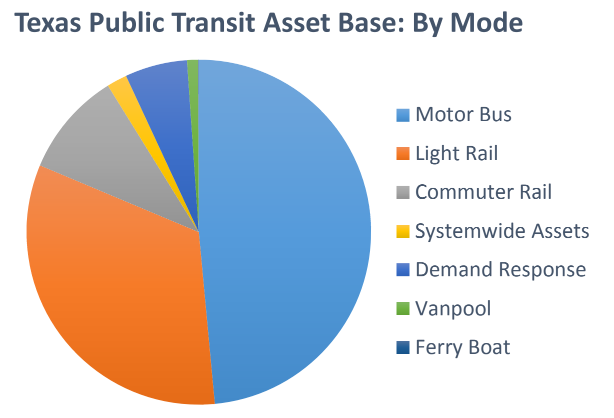
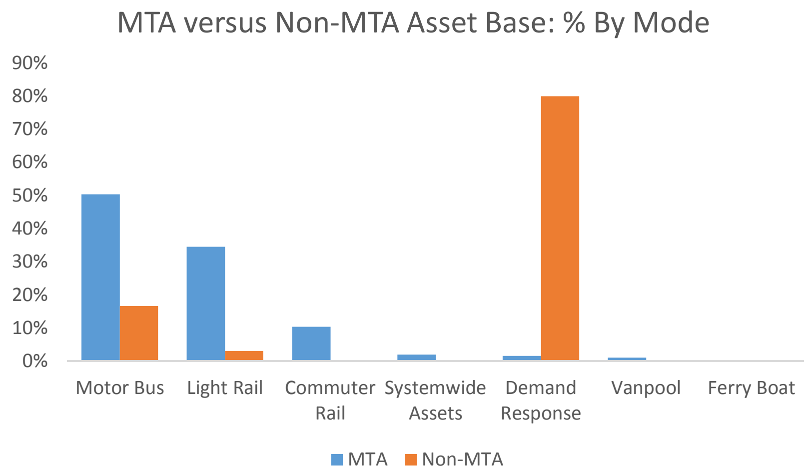
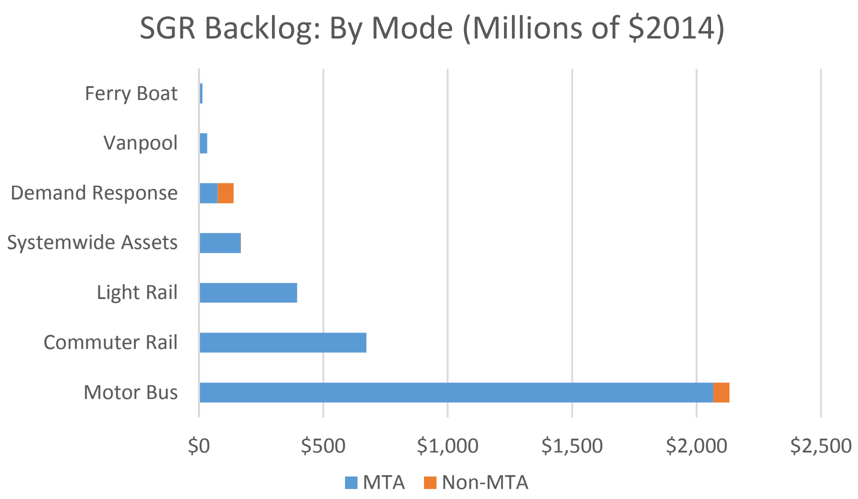


Figure 2-4. Proportion of Public Transit Assets by Mode for MTA and Non-MTA Agencies



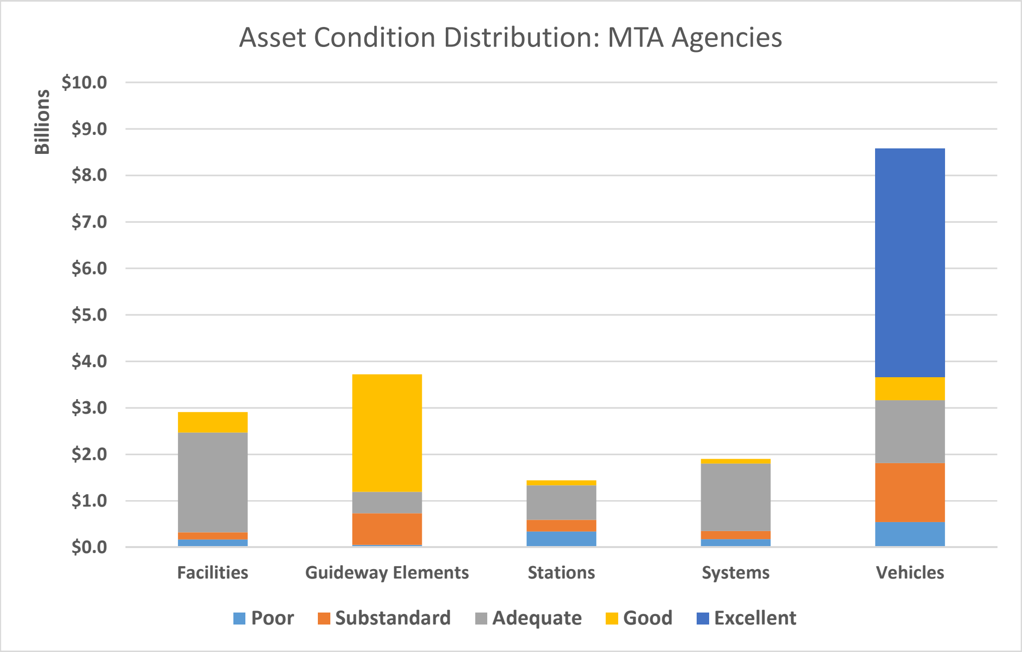
The SGR backlog for public transit is estimated based on deferred rehabilitation and replacement needs. Based on the 2013 inventory, the SGR backlog for public transit in Texas is estimated to be valued at $3.6 billion, or about 20 percent of the asset base. This current SGR backlog represents all assets that are beyond their useful life and should be replaced. Figure 2-5 shows the current SGR backlog by mode and agency tier.

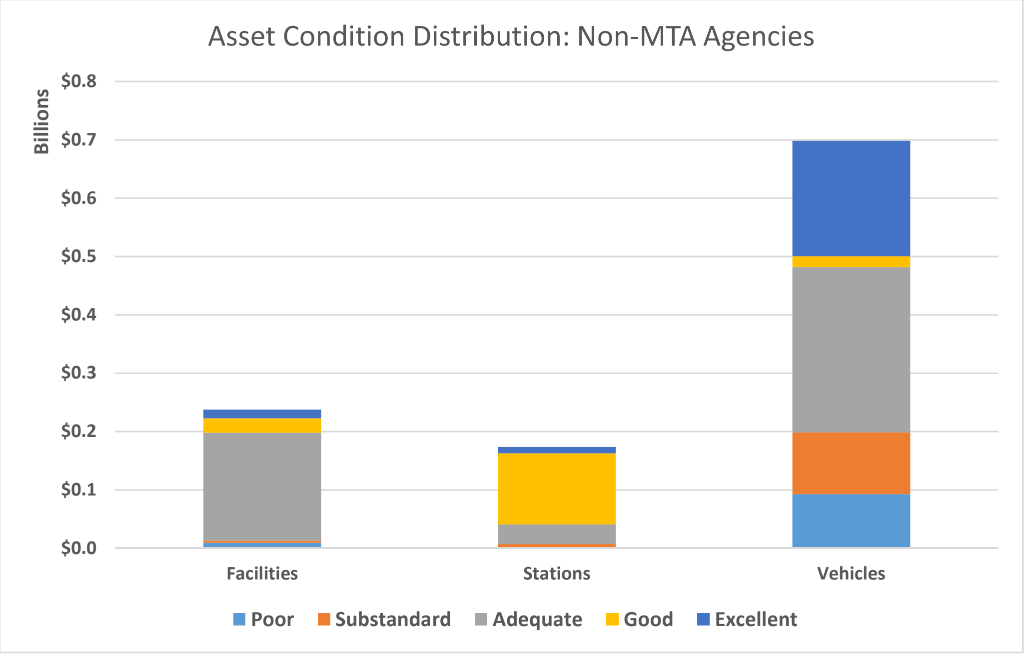
Figure 2-5. Statewide Current SGR Backlog by Mode



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 the previous*Transit Analysis Methodology* memo, is shown below in Figure 2-6 for both MTA and 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.

Figure 2-6. Estimated Public Transit Asset Condition for MTA and Non-MTA Agencies





Ridership data was provided from the National Transit Database (NTD) to serve as the baseline for projecting public transit demand going forward to 2040[1]. Statewide transit passenger boardings totaled more than 250 million in 2012, with nearly three quarters of all transit trips occurring on MTA bus services (**Figure 2-7**). **Table 2-2** also shows nearly 19 million trips occurred on Non-MTA services, again with most trips on bus routes.

Figure 2-7. 2012 Annual Boardings by Mode

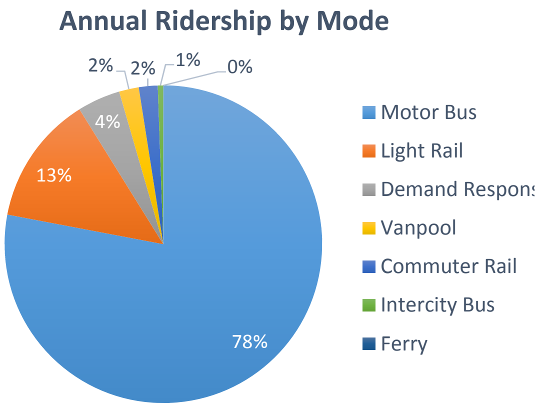


Table 2-2. 2012 Annual Boardings by Mode

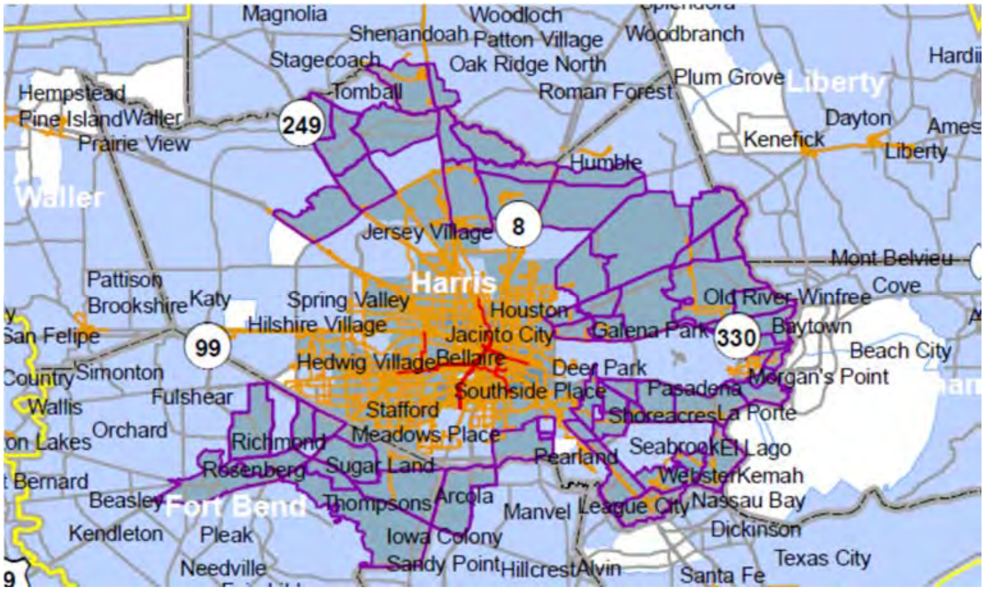
Mode	MTA	Non-MTA	Total
Motor Bus	181,640,003	13,502,098	195,142,101
Light Rail	32,920,451	31,286	32,951,737
Demand Response	7,366,253	3,549,918	10,916,172
Vanpool	3,991,280	1,025,000	5,016,280
Commuter Rail	4,812,595	-	4,812,595
Commuter and Intercity Bus	551,891	817,483	1,369,374
Ferry	52,951	-	52,951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

Source: NTD 2012

The ridership seen in MTA areas accounts for 92 percent of all public transit trips in Texas. However, there are areas surrounding and nearby these metropolitan centers with lower density development and little or no existing fixed-route transit services. These collar areas are referred to as ‘urban gaps’ and are described in more detail in Section 3.5 of the *Transit Analysis Methodology* memo. These areas with lower transit service levels than the neighboring MTA service areas are targets for improved service levels over the course of the TTP timeframe. Specifically, the analysis identified urban gap areas (e.g., see the regions sourounded in purple line in **Figure 2-8** below) for the four largest urbanized areas (Houston, Dallas, Austin and San Antonio). Here, the gap area was defined as collar areas expected to undergo increases in population density of more than 2 persons per acre through 2040. The analysis then assessed the expected total population growth in these areas. Finally, the analysis assessed the level of service (and related assets) required to support this new population at a level of service comparable to that provided in regions with similar population densities.

[1] NTD was used as the source for passenger boardings as it segments boardings by mode.

Figure 2-8. Houston Urban Gap Area with Density Increases of More than 2.0 Persons per Acre



3.0 Unconstrained Needs Determination

3.1 Methodology and Assumptions

The methodology described below is based on the FTA's national-level approach for transit condition and performance reporting, which contributes to the biennial *Congressional Conditions & Performance Report* and *National State of Good Repair Assessment*. This methodology is described in detail in the *Transit Analysis Methodology* memo.

3.1.1 Defining "Needs" and State-of-Good Repair

For the purposes of the TTP, transit needs have been divided into three categories of investment:

1. **Preservation:** the capital reinvestment required to maintain existing assets in SGR. Reinvestment needs include rehabilitation and replacement of transit assets, as well as annual capital maintenance (ACM) needs. Preservation also includes the cost of operation and maintenance (O&M) of existing assets for current service levels.
2. **Service expansion:** the capital investments and O&M costs for projected growth in service levels based on projected growth in ridership. Service expansion includes fleet expansion and related facility expansion in response to growth in population and underlying demand. It does not include the addition of services into new geographic areas or addition of new modes of transit.
3. **Major new service:** the capital investments and related O&M costs to significantly improve transit performance via enhancements to core capacity or extension of services into new areas or modes. These projects are generally funded by New Starts or Small Starts grants and are detailed in either a Metropolitan Transportation Plan (MTP) or a Regional Transportation Plan (RTP).

Preservation outcomes are measured by the percentage of assets that are in a "state of good repair" (SGR). For this analysis an asset is in SGR if it does not exceed its useful life and does not require rehabilitation (rehab). If no reinvestment action can be taken for an asset that is due for replacement or rehabilitation as a result of budget constraints, that asset will go into the SGR backlog. This measure captures assets that are above 2.5 on the FTA five-point condition rating scale described above and used in FTA's National State of Good Repair Assessement for transit. See Exhibit 2 in the *Transit Analysis Methodology* memo for a description of asset conditions.

While Preservation is measured by SGR performance, the other two categories of investment are related to growth in ridership. New riders captured by these services are therefore the performance measure for Service Expansion and Major New Services.

3.1.2 Predicting Future Performance

To project capital and O&M needs for Preservation and Service Expansion, FTA's Transit Economic Requirements Model (TERM) was customized to model Texas transit asset needs out to 2040. TERM is used to estimate transit investment needs at the federal level, and is available for individual agencies as TERM Lite.

Preservation

The customized version, TEX Lite, estimates the total level of reinvestment needed to reach and maintain SGR and includes O&M cost modeling based on the same algorithms used in TERM federal. The O&M costs are based on changes in fleet size over time and baseline O&M cost relationships which are defined by mode.

To project reinvestment needs TEX Lite determines the age and condition of assets in each year of the projection (that is, from current year to 2040) based on FTA's decay curves, which use age as the basis for determining current and future condition. While direct physical evaluation of the condition of an asset provides more accurate condition ratings than age-based estimates, this approach is not feasible for a state-wide project such as the TTP.

TEX Lite uses life cycle profiles to determine if rehabilitation or replacement is needed, and the associated costs. The life cycle of an asset is defined by three components: the useful life, the rehab policy, and the annual capital maintenance needs. The number of rehabs allowed, the age of each rehab and the cost of each have been set to defaults by asset type based on previous FTA research. Finally, ACM greater than zero ensures that a small amount of reinvestment occurs for assets every year of the analysis period.

The replacement cost of assets were taken from the asset inventory from the PTMS database provided by TxDOT. This inventory was then combined with the existing FTA inventory of Texas assets in TERM federal.

Service Expansion

Service Expansion needs are projected in TEX Lite based on:

1. Ridership growth rates by mode for each individual agency
2. Fleet capacity limitations by mode
3. Relationships between fleet size and associated infrastructure

Ridership growth rates were calculated based on Texas State Data Center projections to 2040 for population growth by county for fixed route services. Demand response services were projected based on a model used in Illinois where 59 percent weight is given to population growth and 41 percent weight is given to growth in the over 65 years of age segment of population. Special services (FTA §5310) are not projected to grow from current levels.

Urban Gap growth rates were identified based on increases in population density in metropolitan/urban areas not currently served by MTA services, as shown in the maps in Section 2. Urban Gap growth rates were identified in four of the MTA areas, with the resulting increases in demand detailed in Table 3-1.

Table 3-1. Projected Urban Gap Growth Rates

Urban Gap Location	Projected Increase Transit Ridership
Houston	30.2%
San Antonio	11.4%
Austin	28.4%
Dallas	28.9%

The resulting statewide average annual growth in transit demand from the methods described above is 2.3 percent.

Major New Services

The most recent MTP/RTPs were used to determine the investment needs for Major New Services. In addition, The Texas A&M Transportation Institute (TTI) provided a list of Major New Service projects for State Urban and RTD agencies.

Most MPO financial plans do not include the O&M costs related to Major New Service projects. As such, the O&M costs associated with these projects were estimated using the relationship between the capital investment and O&M costs of similar projects by mode or asset type. The resulting ratio of capital to O&M dollars for Major New Services (where expected O&M was not reported) are shown in Table 3-2.

Table 3-2. Estimated O&M to Capital Invested Ratio for Major New Services

Project Mode	O&M/Capital Ratio
Bus Rapid Transit	0.25
Motor Bus	0.57
Commuter/Heavy Rail	0.03
Demand Response	0.71
Ferry	0.57
Intermodal Facility	0.01
Light Rail/Streetcar	0.03

In addition, some assets procured for Major New Services will require rehab and replacement before the end of the 2040 analysis period. Given the 50- to 60-year lifespan of facilities, facility-only projects did not require reinvestment. However, projects involving rail and bus vehicles were estimated to require 40 percent reinvestment of initial project value based on the shorter life of vehicles and related systems. This reinvestment estimate only applies to projects executed in the next five years, as projects beyond that have too much uncertainty related to timing of reinvestment needs.

The estimated project costs in the MTP/RTP and TTI project listings were deflated to 2014 dollars using the reported inflation rate used by the MPO (generally four percent). All other analysis was also performed in 2014 dollars.

3.1.3 Selecting Investments

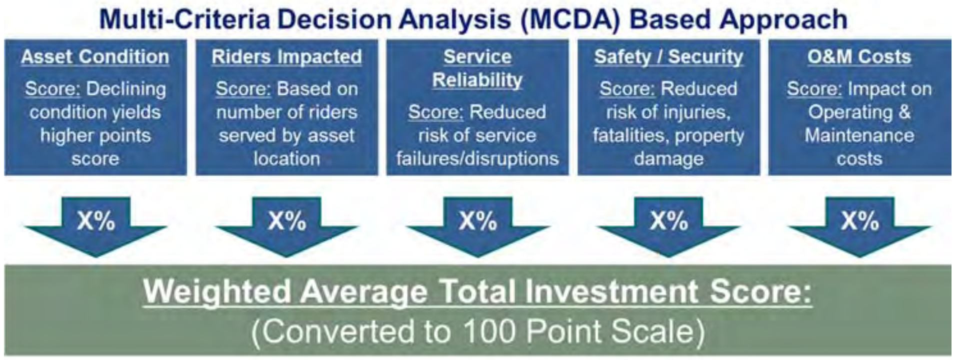
TEX Lite utilizes a prioritization regime to rank reinvestment needs when there is a budget constraint. The Multi-Criteria Decision Analysis (MDCA) approach used by TEX Lite is described in detail in Section 4.1 of the *Transit Analysis Methodology* memo.

Figure 3-1 provides an overview of the five investment criteria used to score and rank all potential SGR reinvestment actions – including asset condition, number of riders impacted, and the contribution of reinvestment actions to each of service reliability, safety and security, and O&M cost reduction. These criteria for prioritization were developed in conjunction with the Regional Transportation Authority (RTA) in Chicago, and the three operating agencies, Chicago Transit Authority, Metra and Pace, to reflect the priorities of transit in their region. They have since been adopted for use by the FTA in TERM Lite.

The weight placed on each criterion for this analysis is currently set to reflect Preservation priorities for existing assets:

- 65 percent Asset Condition
- 10 percent Impacted Riders
- 15 percent Service Reliability
- 5 percent Safety and Security
- 5 percent O&M Cost Impact

Figure 3-1. TEX Lite – Investment Prioritization Criteria and Scoring



Service Expansion investments are prioritized under constrained funding using a separate calculation within TEX Lite. The cost-effectiveness, in terms of new riders per dollar spent, is the only criteria used to prioritize expansion investments in the model. More riders per dollar receive higher ranking. Once assets are acquired for expansion, they are subject to the same prioritization for reinvestment as described above.

Major New Service projects were prioritized based on their identified level of funding and/or stage of planning. If a project was reported as fully funded, or programmed, then it was given highest priority. Partially funded or planned projects ranked second; unfunded or potential projects ranked last.

3.2 Unconstrained Needs to 2040

Based on the methods described above, the unconstrained average annual public transit needs for Texas to 2040 are $3.96 billion. Table 3-3 on the following page details the breakdown of this value by type of expenditure (capital versus operating), type of investment need and agency tier.

For Non-MTA agencies unconstrained needs to 2040 total $8.3 billion, or an average of $309 million per year. This is approximately 8 percent of the statewide public transit needs for the TTP. The remaining 92 percent of needs fall under the MTAs for preservation of existing services and expansion to incorporate increasing populations and transit demands.

The unconstrained needs result in 100 percent SGR for all modes and operators, as all rehabs and replacements have occurred and no asset exceeds its useful life in 2040. Combining Service Expansion with Major New Services, the resulting increase in statewide transit ridership totals just over 190 million trips; about nine million of those trips are taken on Non-MTA services.

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.

To address this issue, some ‘generated’ records have been created to estimate facility and support systems related to known fleet numbers. These records combined with the TERM federal and TxDOT contributions will largely address the complete needs of transit across Texas, but it must be noted that the Preservation and Service Expansion estimates below are likely conservative compared to the reality faced by individual transit agencies.

A larger concern for the unconstrained projection below is the minimal number of Major New Service projects scheduled beyond the next ten years. Of the 132 projects listed for MTAs, only 39 occur past 2024. None of the State Urban or RTD projects occur after 2020. In a truly unconstrained future, there would certainly be an ongoing need to deliver services to new areas and increase the reach of fixed transit routes. The tapering off of Major New Service needs in the numbers represented below certainly underestimates the total need in this area, and underestimates the total potential ridership growth from this type of new service.

Table 3-3. Unconstrained Public Transit Needs 2014 to 2040 (Millions of $2014)

Capital	Type of Investment	MTA	MTA Gap	State Urban	RTD	Special	Intercity Bus	Total	State DR*
Preservation: Existing Assets	Backlog	$3,410	$0	$111	$4	$16	$0	$3,541	$131
	Normal Rehab/ Replace	$26,035	$0	$1,025	$1,798	$155	$2	$29,014	$2,979
	Total	*$29,445*	*$0*	*$1,136*	*$1,802*	*$171*	*$2*	*$32,555*	*$3,110*
Service Expansion	Acquisition	$1,425	$1,596	$80	$95	$0	$0	$3,197	$176
	Normal Rehab/ Replace	$1,200	$254	$128	$178	$0	$0	$1,760	$306
	Total	*$2,625*	*$1,850*	*$208*	*$273*	*$0*	*$0*	*$4,957*	*$482*
Major New Service Projects	Acquisition	$13,339	$0	$30	$29	$0	$0	$13,398	$59
	Normal Rehab/ Replace	$2,270	$0	$10	$2	$0	$0	$2,283	$13
	Total	*$15,609*	*$0*	*$40*	*$32*	*$0*	*$0*	*$15,681*	*$72*
Total: Capital		**$47,679**	**$1,850**	**$1,384**	**$2,107**	**$171**	**$2**	**$53,193**	**$3,664**
Operating	**Type of Investment**	**MTA**	**MTA Gap**	**State Urban**	**RTD**	**Special**	**Intercity Bus**	**Total**	**State DR***
Preservation	Maintain Service	$30,804	$0	$1,801	$1,688	$159	$27	$34,479	$3,675
Service Expansion	Natural Growth	$6,845	$5,884	$337	$411	$0	$0	$13,478	$749
Major New Services	New Mode/ Location	$5,546	$0	$166	$90	$0	$0	$5,802	$256
Total: Operating		**$43,195**	**$5,884**	**$2,304**	**$2,189**	**$159**	**$27**	**$53,759**	**$4,679**
Grand Total		**$90,875**	**$7,734**	**$3,688**	**$4,296**	**$330**	**$28**	**$106,952**	**$8,343**
						Annual Average:		$3,961	

Notes:
*State DR (designated recipient) excludes MTA and MTA Gap needs.
State Urban major New Services include blended SU/RTD categories.
Numbers may not sum due to rounding

4.0 Anticipated Revenues and Funding Gap

Public transit in Texas is funded through multiple sources, from the local, state and federal level. Some of the sources are designated for capital or operating support only, though some allow agencies to use funds as needed. Public transit funding sources in Texas include but are not limited to:

- Farebox revenues;
- Local funds which are from a blend of sales taxes, property taxes and 'other funds' (as reported to NTD in 2009);
- State funds which are from a blend of gas taxes, other taxes and 'other funds' (as reported to NTD in 2009); and
- Federal funds which are divided into formula funding and competitive or one-time funding for projects.

Federal formula funding is presented in Table 4-1, including eligibility, uses and state/local match minimum requirements. Eligibility requirements are for the service areas and service types. As such they may not be applied by agency type as some agencies provide services that cross into multiple service areas (for example, some Small Urban agencies can receive § 5311 funding if they provide qualifying services).

In addition to formula funds, agencies can also receive New Starts and Small Starts grants for Major New Service projects and (now under MAP-21) capacity enhancement projects for existing systems. There are other federally funded grant programs that contribute to improvements in systems and vehicles, though those grants tend to be smaller contributions to total funding compared to the sources described above.

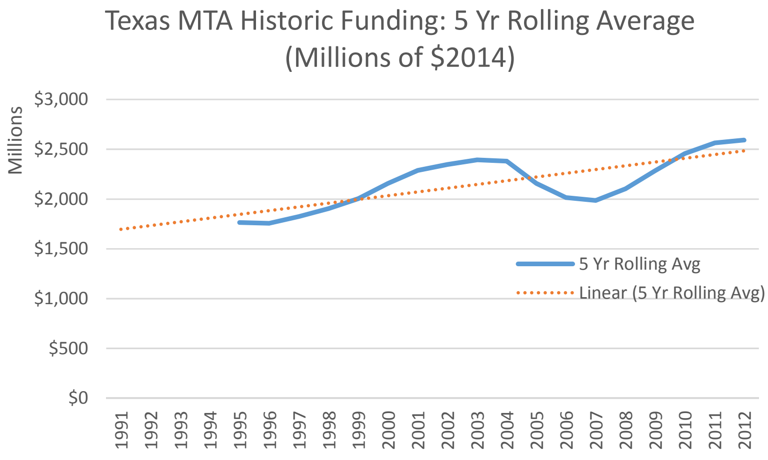
For federal funds allocated to State Urban, RTD and Special services, TxDOT is the "designated recipient" of these funds and allocates them to individual agencies. Since 2004, the TxDOT Public Transportation Division (PTN) has used formulas to allocate state and federal funds for public transportation. Measures of "need" and "performance" have been used to allocate funding since 2007. The details of the funding allocation formula used for subrecipients can be found in the most recent *Texas Transit Statistics* report, published online by TxDOT-PTN.

Table 4-1. Federal Funding Formula Sources for Public Transit Agencies

Federal Funding Source	§ 5307 Urban Area	§ 5337 State of Good Repair	§ 5339 Bus and Bus Facilities	§ 5311 Rural	§ 5310 Mobility of Seniors & Individuals w/ Disabilities
Large Urban	✓	✓	✓		
Small Urban (200K to 50K pop)	✓		✓		
Rural (under 50K pop)			✓	✓	
Special					✓
Local Match Requirement	20%	20%	20%	20%	20%
Designated Uses	Large Urban: Capital and up to 10% for Preventive Maintenance Small Urban: Capital and Operating	Capital (reinvestment only)	Capital	Capital and operating	Capital and up to 45% for operating

Federal funding formulas rely on multiple ratios that compare the services provided by an ageny and the area served by an agency against the rest of the country. The primary factors that drive most allocations are vehicle revenue miles, passenger miles, directional route miles, population, and population density. Large urban agencies in Texas have been increasing their ratios in most of these metrics compared to the rest of the country in recent years. Total funding for the MTAs has therefore been growing in real terms, as seen in **Figure 4-1**.

Figure 4-1. MTA Funding Trend

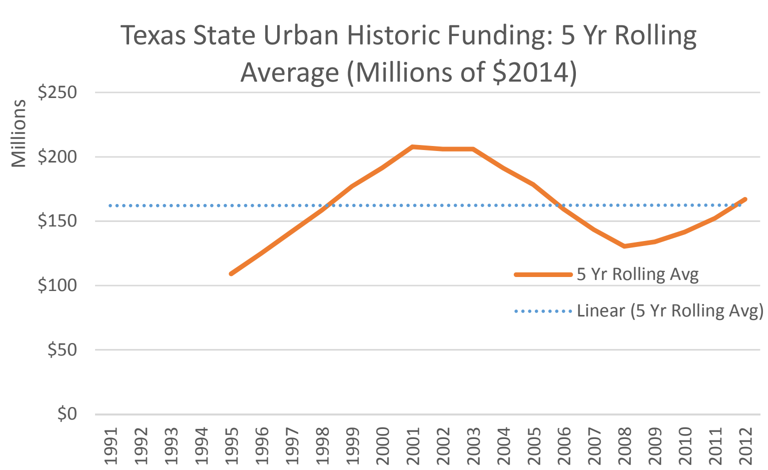


Source: NTD 2012

In addition, Texas MTAs currently have five New Starts projects funded. New Starts and Small Starts funding, along with other discretionary grants, create 'bumpy' profiles over time for agencies as they increase funding over normal levels when received. To adjust for these bumps in funding, rolling averages were used to determine historic trends and the proper baseline for growth in funding.

For MTAs, an average funding level for the past 10 years was used as the baseline for 2014 and grown at 1.2 percent in real terms to 2040 to reflect their continuing increases in population and new transit services (**Figure 4-2**). The resulting annual average funding constraint for MTAs is $2.9 billion (in 2014 dollars), including both capital and operating funds. As seen in **Table 4-2**, this results in an annual funding shortfall of about $700 million for MTAs.

Figure 4-2. Urban Historic Funding Trend



Source: NTD 2012

In addition, the Non-MTA agencies have not seen consistent increases in total funding over time. Based on this historic trend, the average funding for the last 10 years for Non-MTA agencies is held constant to 2040. The result is $227 million per year for State Urban, RTD, Special and Intercity Bus services. This estimate includes both capital and operating funds.

The total funding shortfall compared to unconstrained needs for both MTAs and Non-MTA agencies is approximately $788 million per year. Over the course of the TTP this totals over a $20 billion funding gap.

Table 4-2. Projected Annual Funding Gap (Millions of $2014 per year)

Agency Tier	Average Annual Unconstrained Needs	Average Annual Funding Constraint	Projected Annual Funding Gap
MTA	$3,652	$2,946	$707
Non-MTA	$309	$227	$82
Total	$3,961	$3,173	$788

Note: Numbers may not sum due to rounding

5.0 Fiscally-Constrained Analysis

5.1 Project Prioritization

The following priorities were assigned for allocating constrained funding to the needs identified above:

1. O&M Preservation needs for existing assets – to maintain operation of existing services
2. Fully funded or programmed Major New Service (MNS) projects, both capital and O&M – as funding is already committed to these projects
3. Capital Preservation needs for existing assets (rehab and replacement) – to achieve SGR for existing systems
4. SGR needs for the fully funded/programmed MNS projects (capital reinvestment) – to maintain SGR as new assets are added to the inventory from committed projects
5. Service Expansion needs, both capital and O&M – to meet projected ridership growth
6. Other MNS projects, either partially funded/planned or unfunded/potential

This process of prioritization was done separately for MTAs and Non-MTA agencies under the separate funding constraints noted in Section 4. Within the TEX Lite model, the prioritization routine described in Section 3.1.3 also prioritizes Preservation and Service Expansion investments when the funding constraint applies. The results of this approach are detailed in the following section.

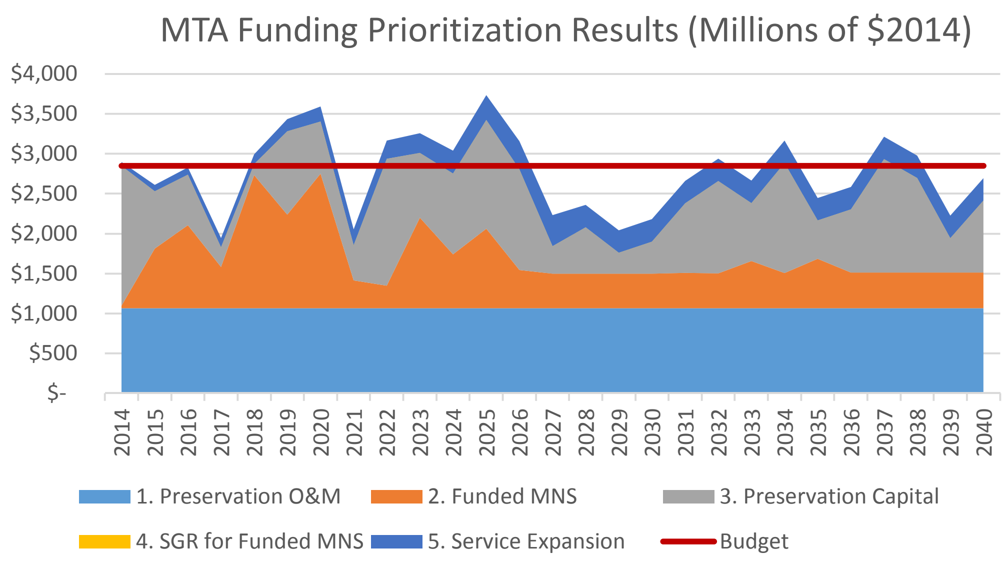
5.2 Fiscally-Constrained and Tradeoff Analysis

Under the funding constraints described above, both the MTA group of agencies and the Non-MTA agencies were allowed to carry over unused budget from one year to the next in this analysis. Carrying over budget allows for more realistic funding outcomes as agencies incur higher costs in years with MNS projects or other procurements for purchase of assets.

Figure 5-1 illustrates the allocation of funding under the constraint based on the logic described in the preceeding section for MTAs. The effect of carrying over budget can be seen in the bumpiness of the actual needs compared to the annual budget constraint. The $2.9 billion constraint allows the MTAs in this analysis to cover all existing O&M needs, all funded MNS projects, all rehabs and replacements for existing assets (Preservation) and assets purchased as part of MNS projects, and some Service Expansion needs.

Capital expenditures for Service Expansion in this scenario stop in 2027, so fleet expansions to meet growing demand in the MTA areas can only be supported to this year. The remaining years show only O&M needs related to the previously purchased expansion assets.

Figure 5-1. MTA Funding Constraint and Prioritization Results

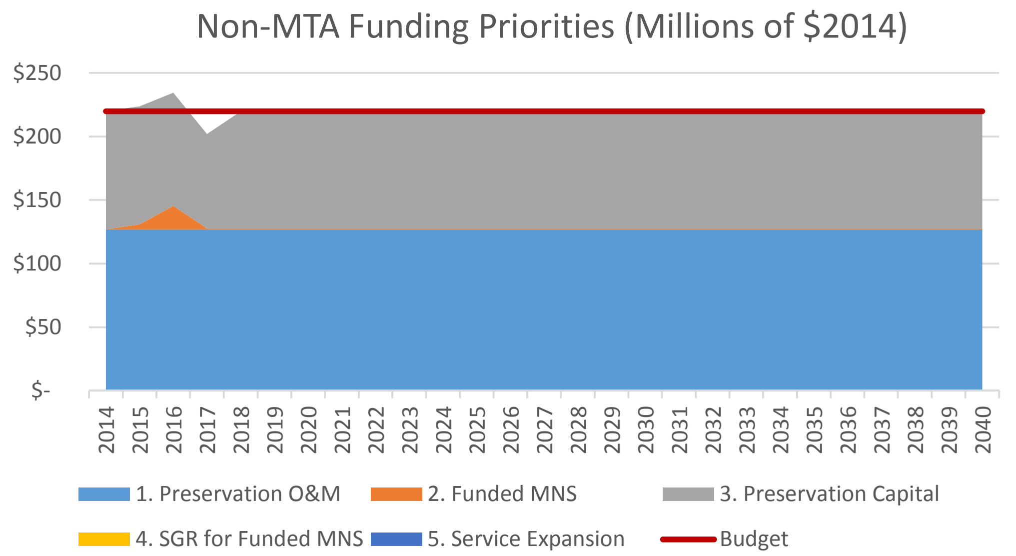


In this scenario for MTAs there is no remaining backlog for transit assets, as all assets are in SGR by 2040.

It is also important to note that the final priority, of partially or unfunded MNS projects, can not be addressed under this budget constraint. The full list projects identified as MNS projects is included in Appendix A, with fully funded projects noted. The list of MNS projects, including funding status, was circulated and verified by the MPOs and some of the agencies involved in planning.

Figure 5-2 illustrates the results of allocating the budget constraint for the Non-MTA agency needs. The expected funding for these agencies does not cover any expansion beyond the programmed MNS projects. The list of all MNS projects collected by TTI from agencies is also listed in Appendix A.

Figure 5-2. Non-MTA Funding Constraint and Prioritization Results



The budget for Non-MTA agencies also does cover all of the Preservation needs for capital rehabs and replacements. Under this funding constraint there is a remaining SGR backlog in 2040 valued at $168 million. The impact of the funding constraint on the Non-MTA SGR backlog over time is illustrated in **Figure 5-3**, where there is an SGR backlog in every year of analysis.

Figure 5-3. Estimated SGR Backlog for Non-MTA Agencies 2014 to 2040

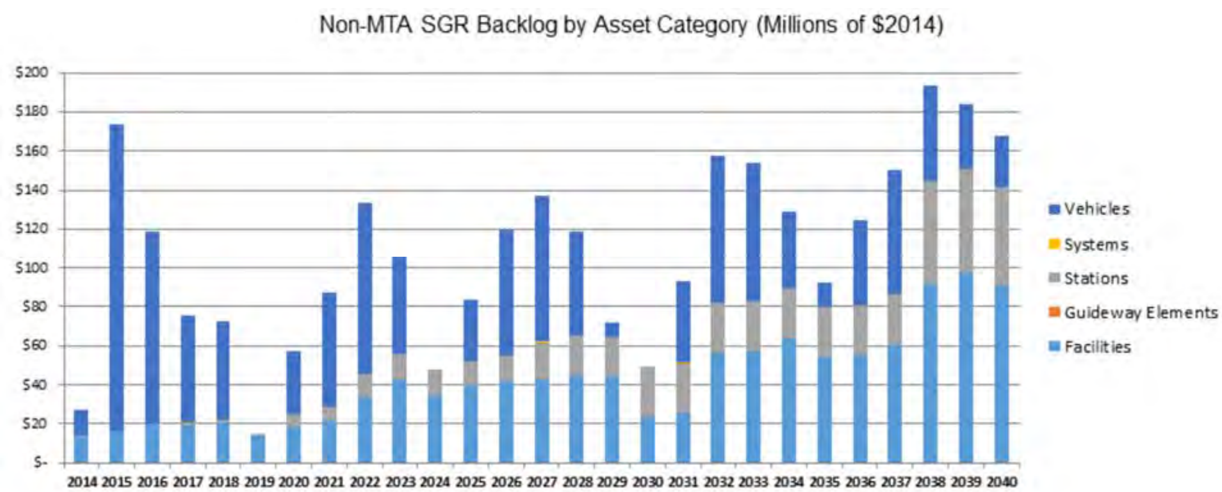


Table 5-1 summarizes the performance results for both MTA and Non-MTA agencies when applying the prioritization and funding constraints. For MTAs the funding constraint and prioritization approach result in perfect Preservation/SGR results, with moderate growth in ridership. However, not all estimated ridership demand in the MTA areas will be addressed. For the Non-MTAs the result for new ridership is far worse, with little of the estimated growth in demand addressed with the funding available. However, Preservation and SGR results using the priorities listed above are still positive.

Table 5-1. Summary and Performance Results for Constrained Scenario

	Total Invested (M 2014$)	Annual Investment (M 2014$)	2040 Performance Results
MTA			
Budget	*$ 82,480*	*$ 2,946*	
Preservation	$ 55,936	$ 1,998	100% SGR
Major New Services	$ 19,843	$ 709	104,682,204
Service Expansion	$ 6,701	$ 239	New Trips
Non-MTA			
Budget	*$ 6,364*	*$ 227*	
Preservation	$ 6,321	$ 226	
Major New Services	$ 44	$ 2	346,617
Service Expansion	$ -	$ -	New Trips
Statewide			
Budget	*$ 88,844*	*$ 3,173*	
Preservation	$ 62,257	$ 2,223	Over 99% SGR
Major New Services	$ 19,887	$ 710	105,028,821
Service Expansion	$ 6,701	$ 239	New Trips

Public Transit Performance Scales

MTA New Trips	184,745,661	147,796,529	110,847,397	73,898,264	36,949,132
Non-MTA New Trips	8,871,746	7,097,397	5,323,048	3,548,699	1,774,349
Statewide New Trips	**193,617,407**	**154,893,926**	**116,170,444**	**77,446,963**	**38,723,481**

Assets in SGR	**100%**	**86%**	**73%**	**59%**	**45%**

Note: Totals in the table above may not add up due to rounding.

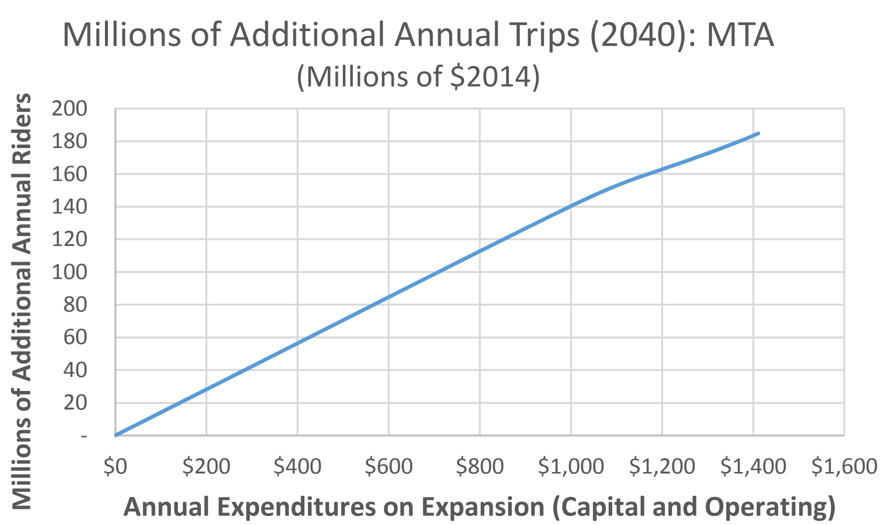
Figure 5-4 illustrates the impact of various funding levels on the performance measures for public transit. Again, these curves are based on the inventory and list of projects available for this analysis and may be underestimating the total needs for Preservation and Expansion.

For MTAs, just over $800 million per year spent on reinvestment will result in all assets being in SGR by 2040.

Figure 5-4. MTA Expenditure Needs for SGR

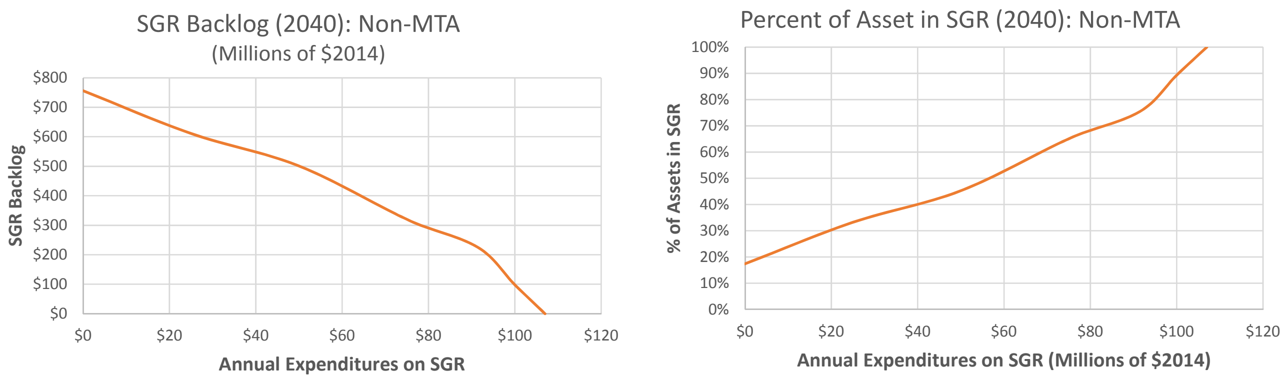
Figure 5-5 illustrates the annual expenditure needed, in both capital and O&M, for MTAs to meet growing ridership demands at various levels.

Figure 5-5. MTA Capital and Operating Expenditures for Ridership Growth



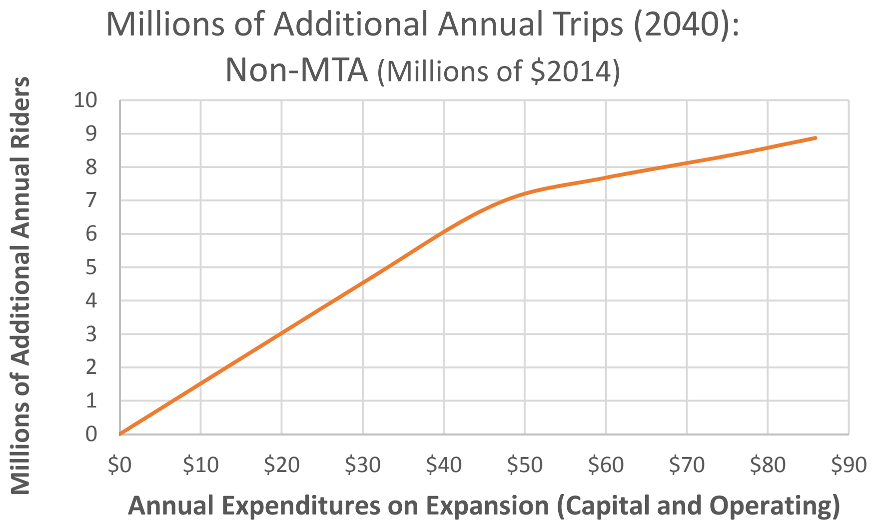
The charts below illustrate the annual expenditure needed to eliminate the SGR backlog for Non-MTA agencies by 2040. In the constrained scenario, about $91 million was available on average for capital investment in Preservation. Figure 5-6 shows that just over $110 million is needed to address the unconstrained needs for capital investment in this area. If the annual budget for Non-MTA agencies were increased by approximately $20 million per year, from the estimated $227 million to $247 million, then the SGR backlog for these agencies could be eliminated by 2040.

Figure 5-6. Non-MTA Expenditure Needs for SGR



However, there would still be some ridership demands unmet with the $247 million in funding. As seen in Figure 5-7, the unmet Service Expansion and Major New Service needs would require over $80 million in additional funding per year.

Figure 5-7. Non-MTA Expenditure Needs for Ridership Growth



Appendix A – List of Major New Service Projects

The following mode codes are used in the MTA table: APM = automated people mover, BRT = bus rapid transit, CB = commuter bus, DR = demand response, CR = commuter rail, FB = ferry, IMF = intermodal facility, HSR = high speed rail, LR = light rail, MB = motor bus, RR = commuter/passenger rail, SC = street car

Projects highlighted in orange are given highest priority as they are either reported as fully funded or programmed. Projects highlighted in grey in the MTA list are not considered in this analysis, and are covered in Passenger rail.

MPO	Mode	Project Name/Cost Description	Capital Cost (YOE$)	Start Year(s)	Funding Source	Fully Funded?	Major New Service?
Alamo Area MPO	SC	VIA Metro Transit: Streetcar	$ 231,158,000	2017	TxDOT/COSA/ Bexar County/VIA	No	Yes
Corpus Christi	FB	System Expansion: Corpus Christi Dock	$ 2,500,000	?	Unfunded (Sect 5309)	No	Yes
Corpus Christi	FB	Waterborne Transportation Service: Purchase 2 harbor ferries	$ 2,000,000	?	Unfunded (Sect 5309)	No	Yes
El Paso	BRT	Alameda Corridor Rapid Transit System (including buses, construction)	$ 37,800,000	2015	Local Funds	Yes	Yes
El Paso	BRT	Dyer Corridor Rapid Transit System (design, construct, ITS, etc)	$ 26,348,608	2015	FTA & Local Funds	Yes	Yes
El Paso	BRT	Dyer Corridor Rapid Transit System (design, construct, ITS, etc) – Cat 2	$ 9,168,000	2015	FHWA funds (CAT2)	Yes	Yes
El Paso	MB	Far Eastside Transfer Center (PE, ROW, Construction)	$ 4,520,000	2016	FTA & Local Funds	Yes	Yes
El Paso	MB	International Mass Transit (BRT/LRT) Juarez and El Paso	$ 79,473,126	2021	FTA & Local Funds	Yes	Yes
El Paso	BRT	Mesa Corridor Rapid Transit System (design and construct)	$ 18,970,000	2013	FTA & Local Funds	Yes	Yes
El Paso	BRT	Mesa Corridor Rapid Transit System (design and construct)	$ 3,443,000	2013	FHWA funds (CAT2)	Yes	Yes
El Paso	BRT	Mesa Corridor RTS (design and construct)	$ 2,686,629	2013	FHWA funds (CAT2)	Yes	Yes
El Paso	BRT	Montana Corridor Rapid Transit System (design, construct, ITS, etc)	$ 33,080,000	2017	FTA & Local Funds	Yes	Yes
El Paso	BRT	Montana Corridor Rapid Transit System (design, construct, ITS, etc)	$ 9,702,000	2017	FHWA funds (CAT2)	Yes	Yes
El Paso	SC	Oregon Street Car Project	$ 118,433,860	2020	FTA & Local Funds	Yes	Yes
El Paso	IMF	Northeast Transit Terminal	$ 14,858,000	2014	TIGER & Local	Yes	Yes
NCTCOG	RR	Cleburne Line	$ 831,000,000	2035	Local, New Starts, Innovative Financing	?	Yes

MPO	Mode	Project Name/Cost Description	Capital Cost (YOE$)	Start Year(s)	Funding Source	Fully Funded?	Major New Service?
NCTCOG	RR	Frisco Line	$ 776,000,000	2035	Local, New Starts, Innovative Financing	?	Yes
NCTCOG	RR	Mansfield Line	$ 1,190,000,000	2035	Local, New Starts, Innovative Financing	?	Yes
NCTCOG	RR	Midlothian Line	$ 587,000,000	2035	Local, New Starts, Innovative Financing	?	Yes
NCTCOG	RR	Speedway Line	$ 984,000,000	2035	Local, New Starts, Innovative Financing	?	Yes
NCTCOG	HSR	East/West Line (Downtown Dallas to Tarrant)	$ 610,000,000	2018	Local, Innovative Financing, Private	?	Yes
NCTCOG	HSR	East/West Line (Downtown Fort Worth to Tarrant)	$ 610,000,000	2018	Local, Innovative Financing, Private	?	Yes
NCTCOG	RR	Waxahachie Line	$ 884,000,000	2035	Local, New Starts, Innovative Financing	?	Yes
NCTCOG	HSR	Regional HSR Rail Connections (MPA boundary, FW, Arlington and Dallas)	$ 807,000,000	2018	Local, Innovative Financing, Private	?	Yes
NCTCOG	LR	Blue Line UNT Extension	$ 422,000,000	2018	Local	Yes	Yes
NCTCOG	LR	Cotton Belt	$ 1,241,000,000	2018	Local, New Starts, Innovative Financing	Yes	Yes
NCTCOG	LR	Downtown Dallas Second Alignment	$ 1,281,000,000	2035	Local, New Starts	?	Yes
NCTCOG	LR	A-Train (Trinity Mills to Belt Line)	$ 82,000,000	2035	Local	?	Yes
NCTCOG	LR	McKinney Line	$ 518,000,000	2035	Local, New Starts, Innovative Financing	?	Yes
NCTCOG	LR	Orange Line	$ 363,000,000	2018	Local	Yes	Yes
NCTCOG	LR	Green Line – Southeast Extension	$ 193,000,000	2035	Local, New Starts	?	Yes
NCTCOG	LR	TEX Rail	$ 959,000,000	2018	Local, New Starts, Innovative Financing	Yes	Yes

MPO	Mode	Project Name/Cost Description	Capital Cost (YOE$)	Start Year(s)	Funding Source	Fully Funded?	Major New Service?
NCTCOG	LR	Scyene Line (Lanview to Masters)	$ 176,000,000	2035	Local, New Starts, Innovative Financing	?	Yes
NCTCOG	LR	Scyene Line (Masters to Lawson Rd)	$ 1,304,000,000	2035	Local, New Starts, Innovative Financing	?	Yes
NCTCOG	LR	HSR/Airport Connector (Arlington to DFWIA)	$ 200,000,000	2018	Local, Innovative Financing	?	Yes
NCTCOG	SC	Dallas Streetcar (to Oak Cliff)	$ 91,000,000	2018	Local, TIGER grants	Yes	Yes
NCTCOG	APM	Las Colinas APM	$ 3,000,000	2018	Local	?	Yes
NCTCOG	APM	Love Field People Mover	$ 49,000,000	2018	Local	?	Yes
NCTCOG	BRT	Ferguson BRT	$ 22,000,000	2028	Local	?	Yes
CAMPO	RR	Lone Star Rail (implement new service Georgetown-San Antonio)	$ 467,000,000	2013	Fed/State/ Local	Yes	Yes
CAMPO	CR	Elgin Rail (extension from Austin to Elgin)	$ 327,000,000	2015	Fed/State/ Local	Yes	Yes
CAMPO	CR	Round Rock Commuter Rail I (construct new service to Georgetown)	$ 117,000,000	2015	Fed/State/ Local	Yes	Yes
CAMPO	CR	Round Rock Commuter Rail II (construct new service to Pflugerville)	$ 111,000,000	2015	Fed/State/ Local	Yes	Yes
CAMPO	SC	Urban Rail (implement streetcar circulator service in Austin)	$ 91,000,000	2015	Fed/State/ Local	Yes	Yes
CAMPO	SC	Urban Rail – Extension North	$ 272,000,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	SC	Urban Rail – Extension Long Center	$ 39,000,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	SC	Urban Rail – Extension South	$ 455,000,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	BRT	803 N Burnet S Lamar (implement BRT service)	$ 8,000,000	2013	Fed/State/ Local	Yes	Yes
CAMPO	BRT	Slaughter Rapid Bus (implement BRT service)	$ 3,000,000	2016	Fed/State/ Local	Yes	Yes
CAMPO	BRT	BR 826 Riverside (implement BRT service)	$ 4,800,000	2016	Fed/State/ Local	Yes	Yes
CAMPO	BRT	BR 820 Northeast (implement BRT service)	$ 3,900,000	2016	Fed/State/ Local	Yes	Yes
CAMPO	BRT	Central Rapid Bus (implement BRT service)	$ 3,000,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	BRT	BR 828 Ben White (implement BRT service)	$ 5,300,000	2020	Fed/State/ Local	Yes	Yes

MPO	Mode	Project Name/Cost Description	Capital Cost (YOE$)	Start Year(s)	Funding Source	Fully Funded?	Major New Service?
CAMPO	BRT	BR 825 Rundberg/NW (implement BRT service)	$ 9,800,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	BRT	BR 880 Oltorf (implement BRT service)	$ 4,900,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	BRT	BR 834 Parmer (implement BRT service)	$ 10,400,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	CB	901-South Mapac (CapMetro, implement EB service)	$ 1,700,000	2016	Fed/State/ Local	Yes	Yes
CAMPO	CB	922-Four Points (CapMetro, implement EB service)	$ 2,100,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	CB	Bastrop County Connector (CARTS, implement EB service)	$ 2,400,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	CB	Bastrop to San Marcos (CARTS, implement EB service)	$ 3,000,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	CB	Calwell County Connector (CARTS, implement EB service)	$ 1,600,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	CB	Dripping Springs to San Marcos (CARTS, implement EB service)	$ 2,200,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	CB	Giddings to Austin (CARTS, implement EB service)	$ 1,900,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	CB	Hays County Connector (CARTS, implement EB service)	$ 2,800,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	CB	La Grange to Austin (CARTS, implement EB service)	$ 2,800,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	CB	Luling to San Marcos (CARTS, implement EB service)	$ 2,000,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	CB	Marble Falls to Austin (CARTS, implement EB service)	$ 1,900,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	CB	Rte 726 – San Marcos (CARTS, Implement EB service)	$ 2,500,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	CB	Williamson County Connector (CARTS, Implement EB service)	$ 2,800,000	2020	Fed/State/ Local	Yes	Yes
CAMPO	CB	1071-Dripping Springs (Implement EB service)	$ 3,000,000	2026	Fed/State/ Local	Yes	Yes
CAMPO	CB	950-Taylor (CARTS, Implement EB service)	$ 12,000,000	2026	Fed/State/ Local	Yes	Yes
CAMPO	CB	951-Bee Cave (CARTS, Implement EB service)	$ 6,000,000	2026	Fed/State/ Local	Yes	Yes
CAMPO	CB	Jarrell Express (CARTS, Implement EB service)	$ 3,000,000	2026	Fed/State/ Local	Yes	Yes
CAMPO	CB	Smithville Express (CARTS, Implement EB service)	$ 3,000,000	2026	Fed/State/ Local	Yes	Yes
CAMPO	CB	Luling Express (CARTS, Implement EB service)	$ 3,000,000	2026	Fed/State/ Local	Yes	Yes
CAMPO	CB	RM 620 Express (Implement EB service)	$ 9,000,000	2026	Fed/State/ Local	Yes	Yes

MPO	Mode	Project Name/Cost Description	Capital Cost (YOE$)	Start Year(s)	Funding Source	Fully Funded?	Major New Service?
CAMPO	CB	Taylor Express (CARTS, Implement EB service)	$ 4,000,000	2026	Fed/State/ Local	Yes	Yes
CAMPO	CB	Lockhart-San Marcos Express (CARTS, Implement EB service)	$ 3,000,000	2026	Fed/State/ Local	Yes	Yes
CAMPO	CB	Liberty Hill Express (CARTS, Implement EB service)	$ 2,000,000	2026	Fed/State/ Local	Yes	Yes
CAMPO	CB	360-Loop 360 (CapMetro, Implement EB service)	$ 300,000	2026	Fed/State/ Local	Yes	Yes
CAMPO	CB	953-Lockhart (CARTS, EB service to)	$ 4,000,000	2026	Fed/State/ Local	Yes	Yes
CAMPO	CB	952-San Marcos (CARTS, EB service to)	$ 10,000,000	2026	Fed/State/ Local	Yes	Yes
CAMPO	CB	1081-Bastrop (CARTS, EB service to)	$ 3,000,000	2026	Fed/State/ Local	Yes	Yes
Houston Galveston	?	Fort Bend County: Acquire 6 large transit vehicles (phase 2) for express services b/t FM 521 P&R from Arcola-Sienna P&R	$ 6,855,684	2024	?	Yes	Yes
Houston Galveston	DR	Fort Bend County: Acquire 12 small to medium transit vehicles for county-wide DR services	$ 1,115,262	2016	?	Yes	Yes
Houston Galveston	?	Fort Bend County: Construct second O&M facility to support expanded services	$ 3,000,000	2025	?	Yes	Yes
Houston Galveston	CR	Fort Bend County: Southwest Commuter Rail Line	$ 345,000,000	2025	?	Yes	Yes
Houston Galveston	LR	Island Transit: Galveston Rail Trolley – extend to Stewart Beach	$ 7,043,380	2016	?	Yes	Yes
Houston Galveston	MB	Gulf Coast Center: Leasing vehicles for new FR bus service in Texas City	$ 261,007	2023	?	Yes	Yes
Houston Galveston	LR	Metro: East End Corridor LR transit extension to SE corridor at Gulfgate	$ 300,000,000	2035	?	Yes	Yes
Houston Galveston	BRT	Metro: Inner Katy Corridor Guided Rapid Transit	$ 420,000,000	2025	?	Yes	Yes
Houston Galveston	MB	Metro: Future Signature Bus Service	$ 10,000,000	2031	?	Yes	Yes
Houston Galveston	MB	Metro: Future Signature Bus Service	$ 4,750,000	2015	?	Yes	Yes
Houston Galveston	MB	Metro: Future Signature Bus Service	$ 10,000,000	2021	?	Yes	Yes
Houston Galveston	MB	Metro: Future Signature Bus Service	$ 10,000,000	2026	?	Yes	Yes
Houston Galveston	MB	Metro: Future Signature Bus Service	$ 2,802,000	2013	?	Yes	Yes
Houston Galveston	MB	Metro: Future Signature Bus Service	$ 2,000,000	2016	?	Yes	Yes

MPO	Mode	Project Name/Cost Description	Capital Cost (YOE$)	Start Year(s)	Funding Source	Fully Funded?	Major New Service?
Houston Galveston	MB	Metro: Future Signature Bus Service	$ 2,000,000	2017	?	Yes	Yes
Houston Galveston	MB	Metro: Future Signature Bus Service	$ 2,000,000	2018	?	Yes	Yes
Houston Galveston	MB	Metro: Future Signature Bus Service	$ 2,000,000	2019	?	Yes	Yes
Houston Galveston	MB	Metro: Future Signature Bus Service	$ 2,000,000	2020	?	Yes	Yes
Houston Galveston	MB	Metro: Future Signature Bus Service	$ 1,332,000	2013	?	Yes	Yes
Houston Galveston	MB	Metro: Future Signature Bus Service	$ 13,201,000	2013	?	Yes	Yes
Houston Galveston	MB	Metro: Signature bus express service routes (incl shelters and signage)	$ 15,000,000	2015	?	Yes	Yes
Houston Galveston	LR	Metro: North LRT from Northline commons to IAH	$ 1,000,000,000	2023	?	Yes	Yes
Houston Galveston	LR	Metro: Southeast Corridor LRT extension to Hobby/Hinmann P&R (8 stations)	$ 233,730,000	2020	?	Yes	Yes
Houston Galveston	LR	Metro: Southeast Corridor LRT extension to Sunnyside	$ 252,000,000	2024	?	Yes	Yes
Houston Galveston	?	Metro: Northwest Corridor Uptown Galleria line extension to Hempstead intermodal termsin	$ 60,000,000	2023	?	Yes	Yes
Houston Galveston	RR	Metro: SH 288 Almeda Guided Rapid Transit	$ 250,000,000	2033	?	Yes	Yes
Houston Galveston	?	Metro: Metro solutions University Corridor	$ 1,000,000,000	2016	?	Yes	Yes
Houston Galveston	?	Metro: Metro solutions uptown corridor	$ 625,000,000	2020	?	Yes	Yes
Houston Galveston	CR	Metro: SW CR Line (4 stations	$ 400,000,000	2017	?	Yes	Yes
Houston Galveston	?	City of Conroe: Purchase transit vehicles	$ 1,000,000	2014	?	Yes	Yes
Houston Galveston	?	City of Conroe: Construct conroe college terminal/mixed use dev	$ 16,000,000	2025	?	Yes	Yes
Houston Galveston	?	City of Conroe: Construct downtown terminal	$ 12,000,000	2025	?	Yes	Yes
Houston Galveston	?	City of Conroe: Construct P&R facility	$ 1,000,000	2013	?	Yes	Yes
Houston Galveston	?	City of Conroe: Construct conroe tech park transit terminal	$ 9,000,000	2017	?	Yes	Yes
Houston Galveston	CR	Galveston CR transit (7 stations)	$ 210,000,000	2024	?	Yes	Yes

Non-MTA MNS projects, which include some “Enhancement” projects deemed to address existing capacity constraints.

Agency	Name and Description of Project	Category of Project	Status of Project	Capital Costs (yoe$)	Annual O&M Costs	Funding source(s)?	Start Year
City Transit Management Company, Inc. (Lubbock)	Restore 30 minute mid-day service to routes 5,6,9,12 in one to three years.	Enhancement of existing	Potential	$0	$400,000	City of Lubbock	2016
City Transit Management Company, Inc. (Lubbock)	Restore 30 minute service to mid-day routes 1, 2, 7, 14, 19, and 34.	Enhancement of existing	Potential	$0	$350,000	City of Lubbock	2016
Community Action Council of South Texas	CACST is partnering with Valley Metro and STC to connect Starr County with Hidalgo County	**Major new service**	Planned	$561,005	$306,094	STC Match/ TxDOT Grant(s)& TDCs	2015
East Texas Council of Governments	East Texas United: fixed routes connecting cities in East Texas	**Major new service**	Potential				2017
East Texas Council of Governments	Operate flex routes in cities of Athens, Palestine, Rusk, and Henderson	**Major new service**	Potential				2017
East Texas Council of Governments	Seamless fares and fare payment along with public information campaign	Enhancement of existing	Potential				2018
Fort Bend County – Public Transportation Department	Expand Job Access service – Rosenberg, Texas	Enhancement of existing	Programmed	$75,000	$100,000	JARC	2015
Fort Bend County – Public Transportation Department	Construct Administrative and Operating Facility	**Major new service**	Programmed	$20,000,000		$6,000,000 Local, balance Federal	2016
Fort Bend County – Public Transportation Department	Commuter Service to Downtown Houston	**Major new service**	Potential	$4,900,000	$1,600,000		2016
Galveston Island Transit	Start new seawall tourist service, pending comprehensive plan completion	Enhancement of existing	Planned	$450,000	$723,840	Federal	2015
Gulf Coast Center	Establish local route and park & ride service serving City of Kemah	**Major new service**	Programmed	$1,000,000	$750,000	CMAQ, Parking and Fare Revenues	2015
Gulf Coast Center	Pearland Park & Ride. Commuter service to/from the Texas Medical Center and Houston Central Business District. (Funds have been programmed for both operating and some capital)	**Major new service**	Planned	$7,500,000	$850,000	CMAQ, JARC, Farebox, Land donation, local share	2016
Gulf Coast Center	Construct and operate administrative facility and park & ride in Texas City	**Major new service**	Planned			TBD	2015

Agency	Name and Description of Project	Category of Project	Status of Project	Capital Costs (yoe$)	Annual O&M Costs	Funding source(s)?	Start Year
Gulf Coast Center	Dickinson Park & Ride. Commuter service to/from Texas Medical Center & Houston CBD	Major new service	Planned			TBD	2017
Lower Rio Grande Valley Development Corporation	Regional Transit Service	Enhancement of existing	Planned	$15,000,000	$3,000,000	5307, 5310, 5311, 5337	2016
Lower Rio Grande Valley Development Corporation	Harligen/San Benito Fixed Route and ADA Paratransit	Enhancement of existing	Planned	$1,250,000	$1,500,000	5307, 5310, Local and TDCs	2015
Midland Odessa Transit District	Multimodal Facility	Enhancement of existing	Planned	$3,000,000	$100,000	5307	2016
Midland Odessa Transit District	Plan and implement improved route alignments and services	Enhancement of existing	Potential	$2,500,000	$500,000	5307	2017
Midland Odessa Transit District	Administrative Building	Major new service	Programmed	$2,300,000	$40,000	5307	2015
Public Transit Services	Construct new maintenance facility, construct park & ride facility, and add fixed route services to program	Enhancement of existing	Potential	$2,000,000	$50,000	5311, 5307	2016
Senior Center Resources and Public Transit, Inc	Connection to DFW for public transportation	Enhancement of existing	Planned	$420,000	$400,000	local match through inkind	2016
SPAN Inc.	SPAN studying needs in rural Denton County, expects some need for services in the future	Major new service	Potential			TBD	2020
SPCAA SPARTAN Public Transportation	Anticipate partnership with major employers for commuter services for employees (major construction project is awaiting approval from the EPA)	Major new service	Potential	$300,000	$300,000		2015
STAR Transit	Establish/improve transit center, maintenance/operations hub, and fixed routes in/near Terrell area	Enhancement of existing	Planned	$3,000,000	$500,000	FTA TXDOT local	2016

Texas Transportation Plan

Tech Memo 7: Freight Modal Profile

September 23, 2014

Acknowledgements

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Contents

Exhibits

Appendix

1.0 Introduction

The Texas Transportation Plan 2040 (TTP) is the State's long-range transportation plan which covers the size and scope of the Texas transportation system, including all modes of freight transportation. This memo documents the existing conditions, current and future demand and needs identified to enhance freight mobility and support economic development throughout the state. The material contained in this memo is taken from the current output produced from the Texas Freight Mobility Plan (TFMP) and additional sources including publicly available planning documents. The TFMP project is being conducted simultaneously with the TTP but on a slightly different schedule. The TFMP is led by the consultant CDM Smith, Inc. in cooperation with the freight planning team from Texas DOT.

The TFMP inventory and conditions analysis focuses on the identified Primary and Secondary Texas Freight Transportation Networks that include highway, rail, and waterways. Current and forecast freight volumes are identified through the study to assess impact to the modal gateway facilities such as rail hubs, ports, airports, and pipeline terminals; as well as connections to major freight generators, defined by warehousing and distribution centers, and industry clusters. The border crossing facilities are also included in the study. The Inventory is organized based on the modes by which freight travels in Texas. The results of the TFMP will focus on improvements to corridors identified as having the most benefit to freight mobility.

The TFMP is based on widespread stakeholder and agency outreach and includes the direction and active participation of the Texas Freight Advisory Committee (FAC). The FAC is a group of public sector officials and leaders from the private sector firms engaged in transportation in the state including carriers, shippers, and auxiliary service providers. The role of the FAC is to advise TxDOT on freight issues, priorities, projects and funding needs for freight improvements, and elevate freight transportation as a critical component of the state's economic vitality and competitiveness.

2.0 Overview of Existing Conditions

Texas operates the nation's largest highway network, largest interstate network, and has the one of the highest volumes of vehicle traffic in the United States. Texas also has the nation's largest rail network. The state's ports handle nearly 20 percent of the nation's total maritime cargo. Two of the nation's top ten busiest commercial airports are in Texas. The pipeline system in Texas is vast due to the concentration of the energy and chemical industries in the state. The state's pipeline network covers 374,000 miles. Due to the proximity of Mexico and the length of the border the Texas rail and truck infrastructure handle the most US to Mexico trade crossings of any state. Infrastructure in Texas is critical to business locally, nationally and globally. Understanding the current and future trends and issues influencing this system is critical to maintaining capacity and efficiency in this network so that Texas freight transportation continues to be an asset to the state's citizens and economy.

Exhibit 1. Texas Freight Tons by Mode in 2010 Summary

Source: USDOT Research & Innovative Technology Administration, State Transportation Statistics, 2012 and Texas Railroad Commission, 2012

2.1 Inventory of Freight Facilities and Freight Generators

In addition to the analysis of trends and issues, the TFMP includes an inventory to identify the freight assets that are currently utilized and projected to be utilized, in order to verify the capabilities of the freight infrastructure. The information presented here and included for the TTP is based on this inventory of assets. An examination of the infrastructure has been used to determine the current conditions for freight and to identify existing and future major freight corridors and freight movements in Texas. The inventory includes projected freight volumes and connections to modal gateway facilities, such as rail facilities, water ports, airports, and pipeline terminals, as well as connections to major freight generators, such as warehousing and distribution centers, industry clusters and the border crossing gateways.

The condition and performance analysis for the TFMP focuses on highway and rail conditions and performance, with particular attention to defining key corridors and intermodal connectivity. The assessment relies on existing data sources and analyses to provide a snapshot of current conditions and performance considerations associated with three of the TFMP goal areas:

- Asset Management – Documentation of the conditions/state of good repair for the Texas Freight Highway Network (TFHN) and Texas Freight Rail Network (TFRN)

- **Mobility and Reliability** – Identification of highway and freight bottlenecks that cause delay and unreliability in freight movements
- **Safety** – Identification of various highway and rail safety considerations including truck crash rates, truck rollovers, and at grade rail crossings

2.2 Highway

The Texas Freight Highway Network (TFHN) begins with the tiered roadway system adopted by the Federal Highway Administration (FHWA) and TxDOT then adds additional roads with particular significance to the freight community. The TFHN identifies connections to freight gateways and generators to include railroads, water ports, airports, pipeline terminals, border crossings, warehousing and distribution centers, and intermodal terminals.

As Texas is developing their TFHN, FHWA is designating a National Highway Primary Freight Network. The National Highway Primary Freight Network will be reviewed and considered as it relates to the TFHN. Further, MAP-21 specifies that states are to identify Critical Rural Freight Corridors (CRFC) defined to be non-Interstate routes that are characterized by high freight volumes. Texas' CRFC's will be identified and incorporated within the TFHN. Exhibit 2 shows the primary and secondary networks along with the facilities for the connection points for water, rail, and air. The forecast of freight tonnage for 2040 is shown in Exhibit 3 as it will flow over the highway network. These forecasts and related flow assignments were developed from the application of Global Insight's TRANSEARCH data base.

Exhibit 2. Texas Freight Primary and Secondary Networks

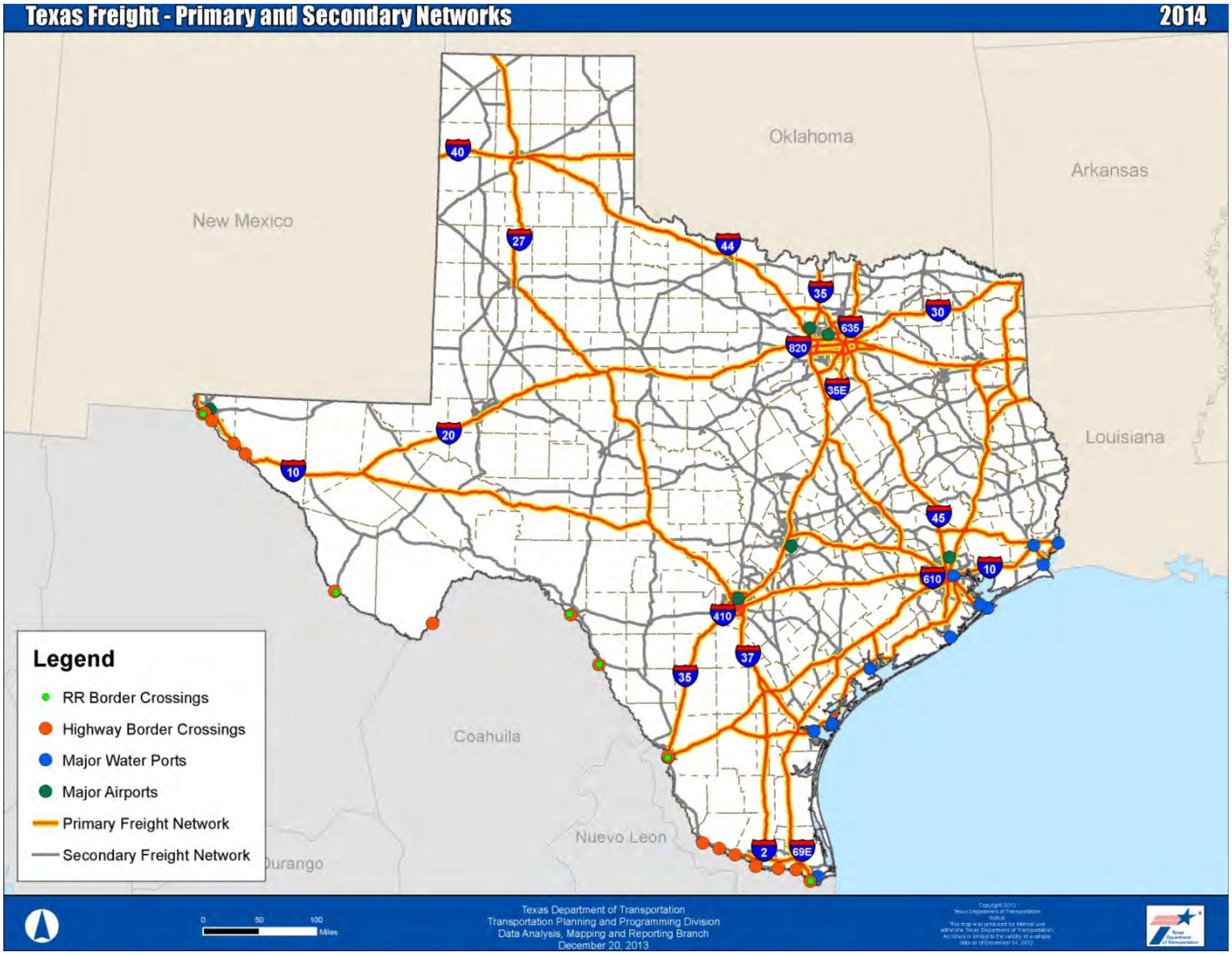
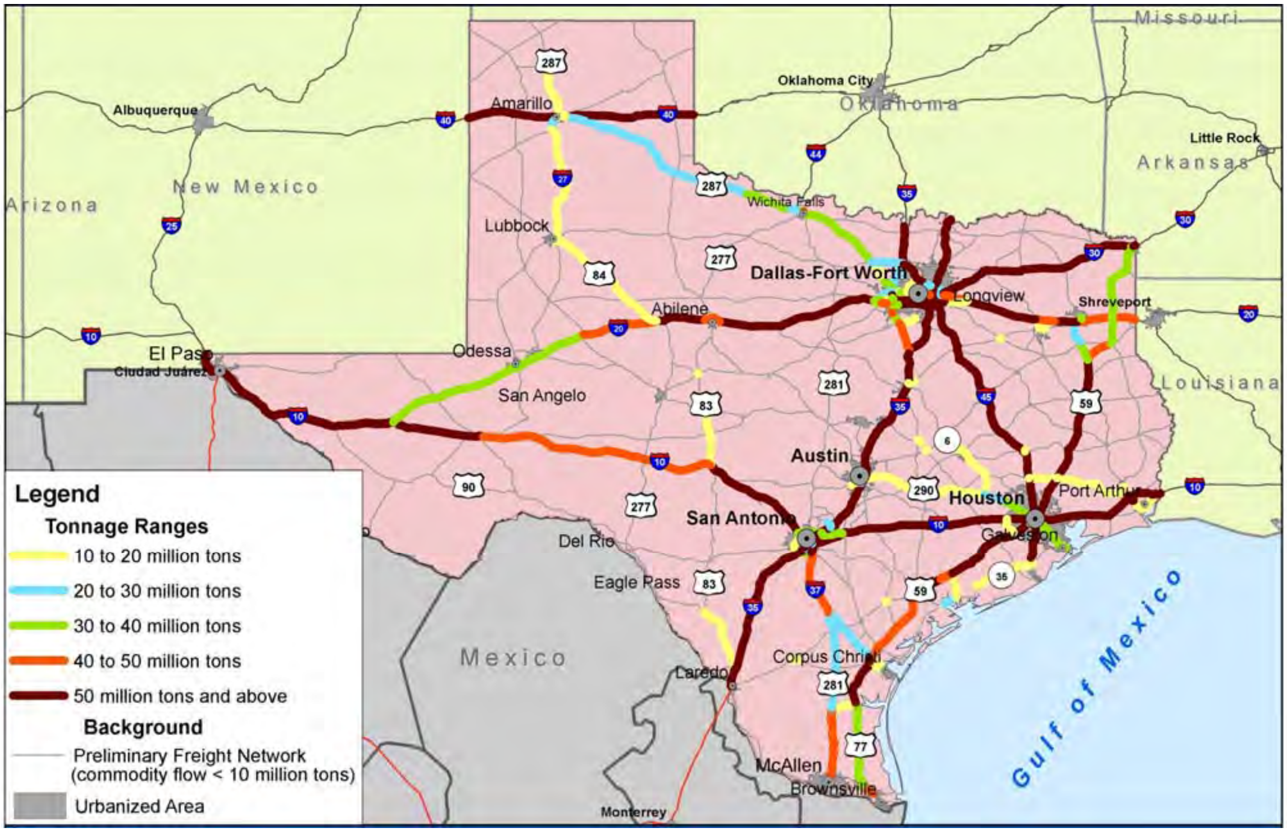


Exhibit 3. Projected 2040 Total Truck Tons



Source: TRANSEARCH, 2010

2.2.1 Highway Capacity

Freight travels on the same highway network as passenger vehicles. Congestion on these highways increases the time it takes goods to travel, which increases the costs of getting these goods to market. Highway congestion levels are measured by Level-of-Service (LOS).

The following charts in Exhibit 4 illustrate the LOS as a percent of roadway mileage on the Interstate mainlanes, the US and State Highways which are included in the TFHN.

Exhibit 4. Texas Freight Network Level-of-Service, 2013

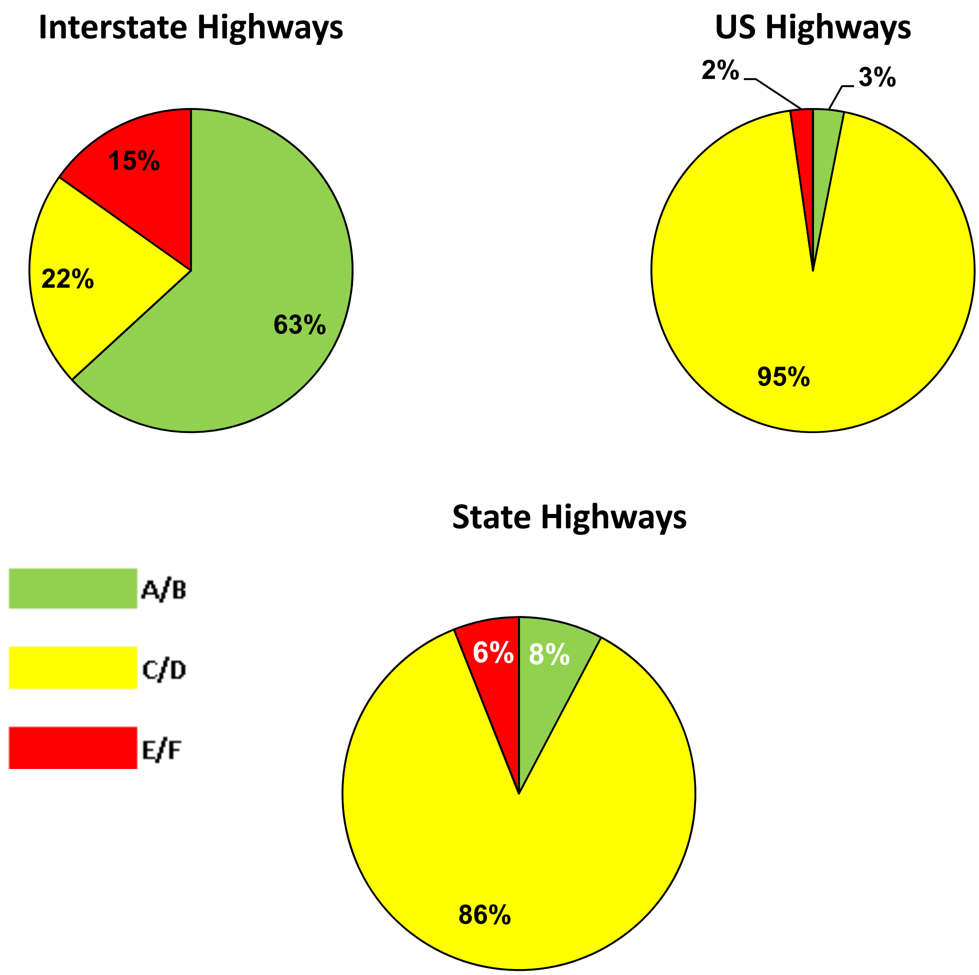


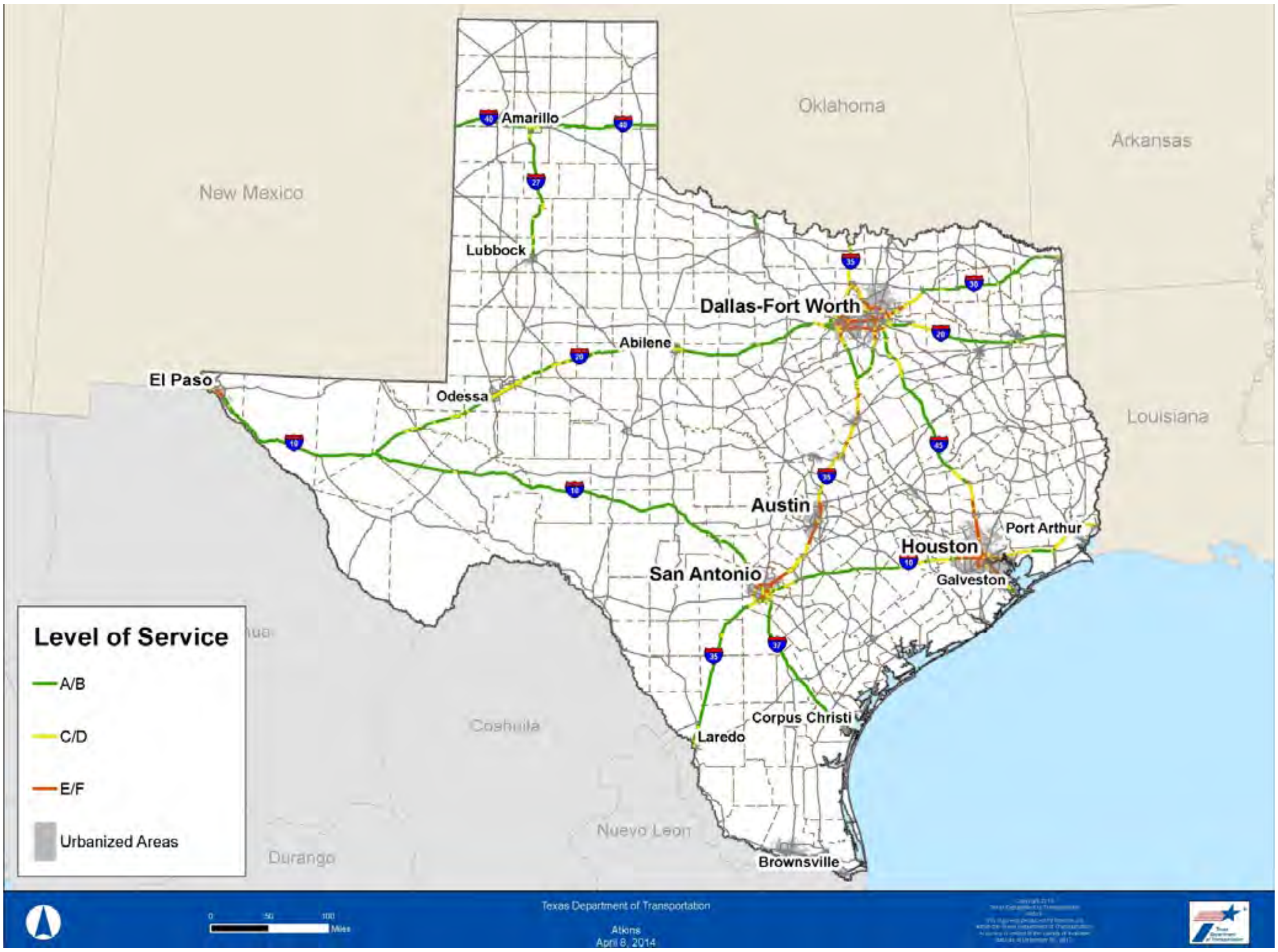
Exhibit 5 shows the statewide average percentage of traffic comprised of trucks which was calculated for the segments of the TFHN roadways with LOS E and F. This exhibit indicates that on average, the majority of traffic on the congested sections of roadway are passenger vehicles.

Exhibit 5. Average Percent Trucks on Freight Network Sections with LOS E and F, 2013

	Percent Truck Traffic (2011)	
	E	F
Interstates	10.5%	6.9%
US Highway	4.6%	4.8%
State Highways	4.5%	3.8%

Source: TxDOT RHiNO Database, 2013

Exhibit 6. Level-of-Service – Freight Network Interstate Mainlanes, 2013



Source: TxDOT RHiNO Database

As seen in **Exhibit 6** above, most of the miles of Interstate in Texas operate at LOS A or B. These are located along the rural portions of the Interstates, while the Interstates in the urban areas exhibit LOS of E or F. These areas of lower LOS are where the freight movements experience more interaction with passenger vehicles. A majority of the US Highways on the TFHN operate at LOS C or D. As with the Interstates, LOS on the US Highways degrades within the urban areas, but there is much less occurrence of LOS E and F than on the Interstates indicating there may be opportunities for freight movements to shift to these routes. The State Highways in the TFHN operate at a LOS C or D, again with concentrations of LOS E and F in the urban areas. Many State Highways in the urban areas are essential parts of the roadway network, but less so in rural areas. As the volumes of movement on the Interstates and US highways continue to increase and trucks seek alternate routes, rural State Highways may become a more integral part of the freight network. More resources may be required to develop and maintain the rural highways in order to support the additional traffic.

2.2.2 Highway Restrictions

Truck traffic is often restricted on highways due to low clearances at bridges and also at weight restricted bridges and roadways. Current limits for vehicular traffic to travel on TxDOT roadways without oversize or overweight permits 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 National Bridge Inventory database, and load restricted roadways were identified from TxDOT’s RHiNO database. These facilities are included in Exhibit 8.

There are only five bridges crossing the TFHN which are less than 14 feet (trucks over 14 feet require permits in Texas). Four of the five are railroad bridges crossing the roadway and two (one railroad and one roadway bridge) are at the same location on the I-37 frontage road. These locations are indicated in Exhibit 8 by yellow triangles and are listed in Exhibit 7. Bridges between 14 and 16 feet were also identified as many of these structures may cause impediments for trucks. There are 175 bridges crossing the TFHN within this range.

Exhibit 7. Bridges with Less than 14 Feet Clearance

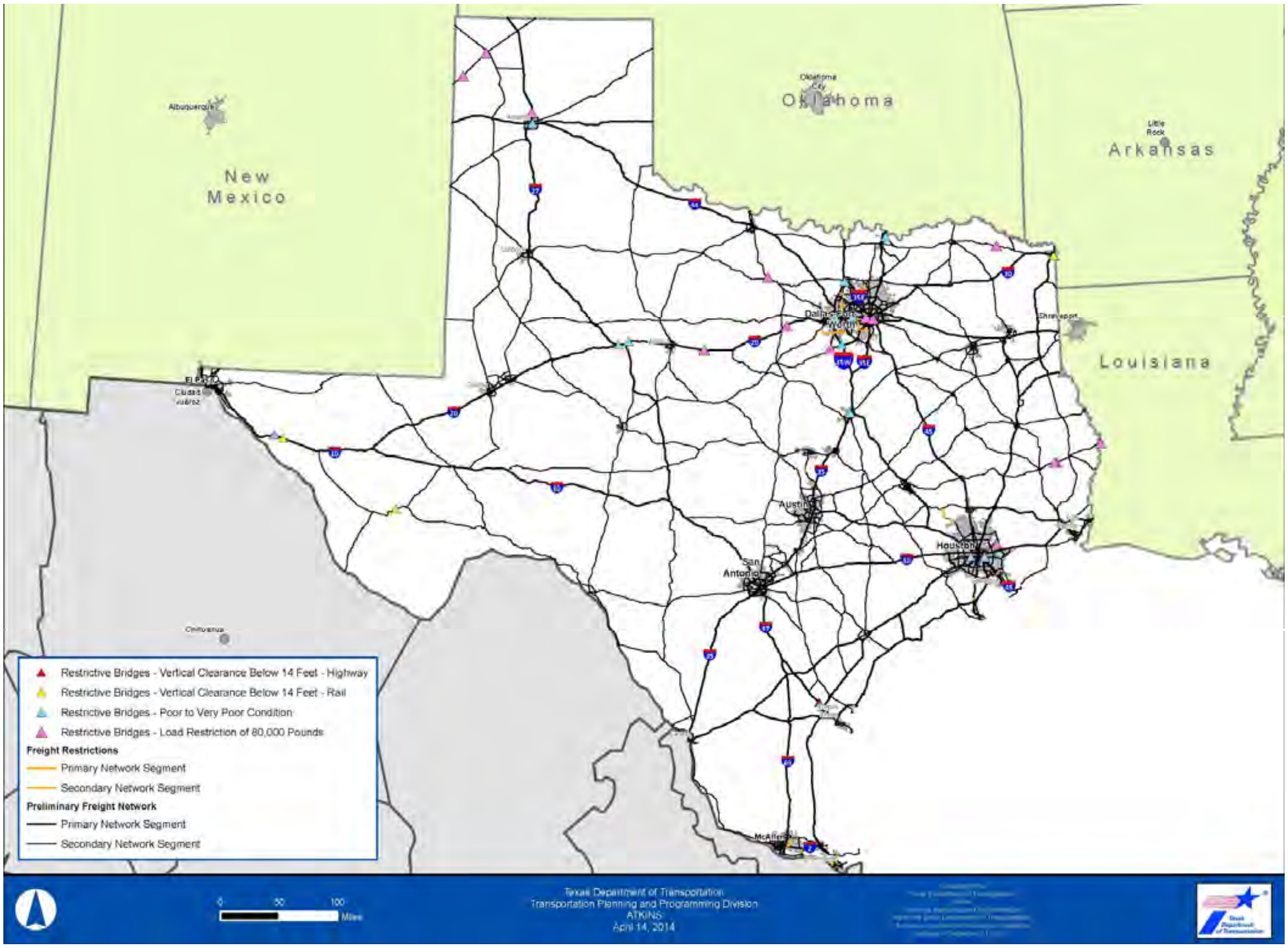
Crossing	Bridge Facility	Location
IH 37 WFR	UP RR	0.1 MI W OF IH 37
IH 37 WFR	SH 234	
BUS LP 10	SP RR	0.6 MI E OF RM 1111
US 67 NB	KCS RAILROAD	0.2 MI W OF US 82
US 67/90	SP RR	0.3 MI W OF FM 1703

Source: National Bridge Inventory, 2013

Truck routes are restricted by roadways and bridges which cannot accommodate the federal commercial vehicle maximum weight of 80,000 pounds for freight transport. The National Bridge Inventory identifies 87 bridges in Texas with weight restrictions of less than 80,000 pounds. Of these 16 have been identified on the TFHN and are indicated by pink triangles in Exhibit 8. One load restricted bridge is on I-20 west of Abilene. There are ten load restricted bridges on the US highways in Texas. These structures along the TFHN are being evaluated in the TFMP to determine the bridges which are projected to carry the most truck traffic, or are connected to emerging commodity centers and, therefore, have the most potential impact on freight movement and the greatest need for improvement. These bridges are identified by pink triangles in Exhibit 8.

Additionally, there are portions of roadways in the state that are restricted to less than 80,000 pounds. These routes are shown in orange in Exhibit 8. These segments are generally in the urban areas, where alternate routes may be available.

Exhibit 8. Highway and Bridge Restrictions, 2013



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

2.2.3 Border Crossings, Ports of Entry (POEs)

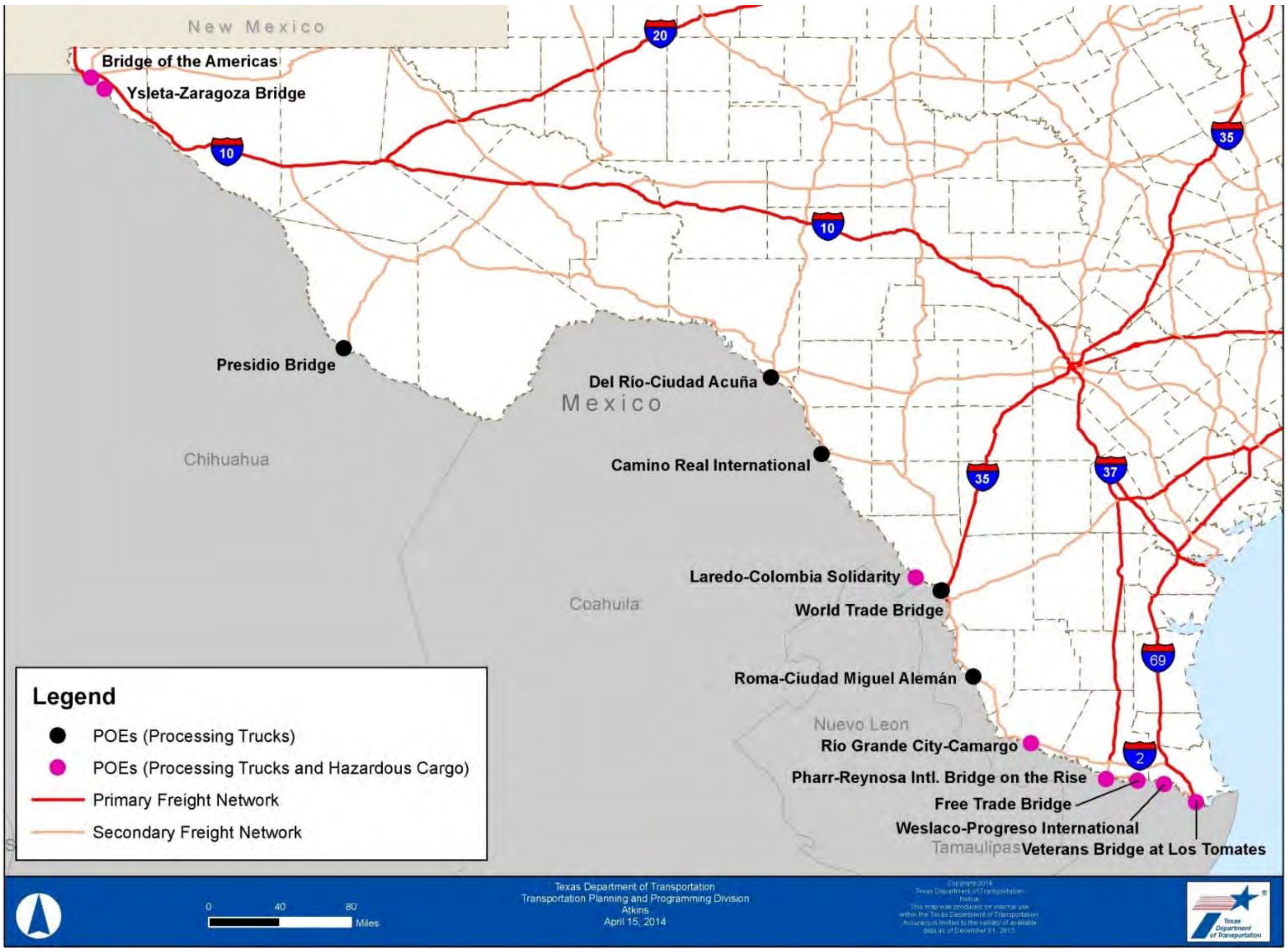
Thirteen of the 27 bridges which connect the U.S. to Mexico along the 1,254 mile Texas border carry truck traffic. The remaining bridges each carry different combinations of auto, rail, and pedestrian traffic. Some bridges are dedicated to certain travel modes. The volume of freight crossing northbound from Mexico into the U.S. included 3.5 million trucks and 7,800 trains in

2012. 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.

Currently, crossing and wait times at many of the high volume ports of entry are considered to be deterrents to free trade between the U.S. 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 (CBP) in their efforts to determine the relative effectiveness of different investment strategies designed to reduce truck delays at border crossings.[1]

Exhibit 9 depicts all the POEs that process trucks and hazardous cargo. Exhibit 10 depicts all of the train POEs. The rail crossing in Presidio is currently closed as a result of flood damage.

Exhibit 9. Texas – Mexico Truck POEs, 2012



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

Exhibit 10. Texas – Mexico Rail POEs, 2012

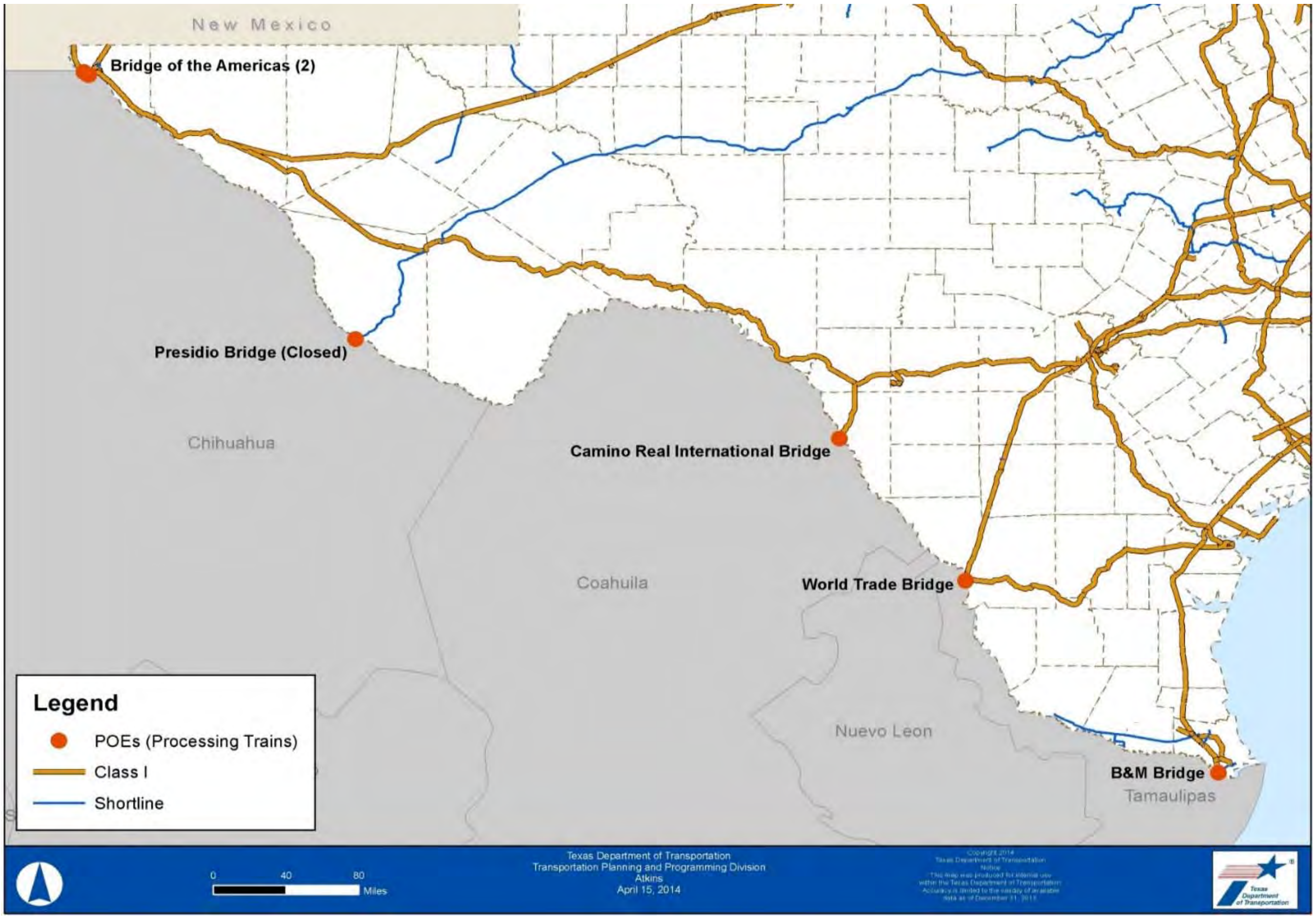


Exhibit 11. Texas – Mexico POEs, 2012

Region	City (Nearest)	Bridge Name	Total Traffic	Trucks	% Trucks	Freight Crossing Vehicle Types
El Paso – Presidio	El Paso	Ysleta-Zaragoza Bridge	3,334,819	409,930	12%	Trucks
	El Paso	Paso Del Norte Bridge	2,076,684	0	0%	
	El Paso	Bridge of the Americas	3,605,947	314,730	9%	Trucks, Rail
	El Paso	Fabens-Caseta Bridge	237,929	0	0%	
	El Paso	Fort Hancock-El Porvenir Bridge	65,868	0	0%	
	Presidio	Presidio Bridge	582,392	11,286	2%	Trucks, (Rail Closed)
Del Rio – Laredo	Del Rio	Del Río-Ciudad Acuña International Bridge	1,290,504	65,210	5%	Trucks
	Del Rio	Lake Armistad Dam Crossing	42,846	0	0%	
	Eagle Pass	Camino Real International Bridge	1,297,206	116,843	9%	Trucks, Rail
	Eagle Pass	Eagle Pass Bridge I	1,094,970	0	0%	
	Laredo	Juárez-Lincoln Bridge	3,392,917	0	0%	
	Laredo	Gateway to the Americas Bridge	895,779	0	0%	
	Laredo	World Trade Bridge	1,399,068	1,399,068	100%	Trucks, Rail
	Laredo	Laredo-Colombia Solidarity Bridge	572,480	382,401	67%	Trucks
McAllen – Brownsville	Falcon Heights	Lake Falcon Dam Crossing	68,387	0	0%	
	Roma	Roma-Ciudad Miguel Alemán Bridge	625,464	7,130	1%	Trucks
	Rio Grande City	Río Grande City -Camargo Bridge	336,532	29,160	9%	Trucks
	Mission	Anzaldúas International Bridge	1,073,968	0	0%	

Exhibit 11. Texas – Mexico POEs, 2012

Region	City (Nearest)	Bridge Name	Total Traffic / Trucks	% Trucks	Freight Crossing Vehicle Types
McAllen – Brownsville (continued)	Donna	Donna International Bridge	487,617 / 0	0%	
	Hidalgo	McAllen-Hidalgo International Bridge	2,572,150 / 0	0%	
	Pharr	Pharr-Reynosa International Bridge on The Rise	1,747,965 / 479,530	27%	Trucks
	Progresso	Weslaco-Progreso International Bridge	510,845 / 44,300	9%	Trucks
	LOS Indios	Free Trade Bridge	445,575 / 27,300	6%	Trucks
	Brownsville	B&M Bridge	1,294,961 / 0	0%	Rail
	Brownsville	Veterans International Bridge at LOS Tomates	1,466,154 / 190,204	13%	Trucks
	Brownsville	Gateway International Bridge	1,223,130 / 0	0%	

Note:
Texas-Mexico International Bridge and Border Crossings Existing and Proposed 2013
Sources: Texas Department of Transportation, 2035 State Long Range Transportation Plan, 2010

2.3 *Freight Movement Generators*

The freight supply chain describes how goods move from their origins through processing to the market and consumer. These goods may originate in Texas or they may travel through many gateways to enter the TFHN. Gateways include water ports, airports, rail terminals and border crossings. Freight generators are also an important link in the supply chain within Texas' borders. Generators include industry clusters and warehousing/distribution centers. The freight network is comprised of the links among all of the various freight facilities.

2.3.1 Industry Clusters

Industry cluster information for the TFMP was obtained from the Texas Workforce Commission. The industries were selected based on the available data and the top commodities, by ton, projected within Texas annually by 2040.

As expected, most of the industries in Texas tend to cluster in and around the urbanized areas of the state, with some locations scattered in the rural areas. Location throughout the state is partially dependent upon the industry type and related to where products are produced and consumed.

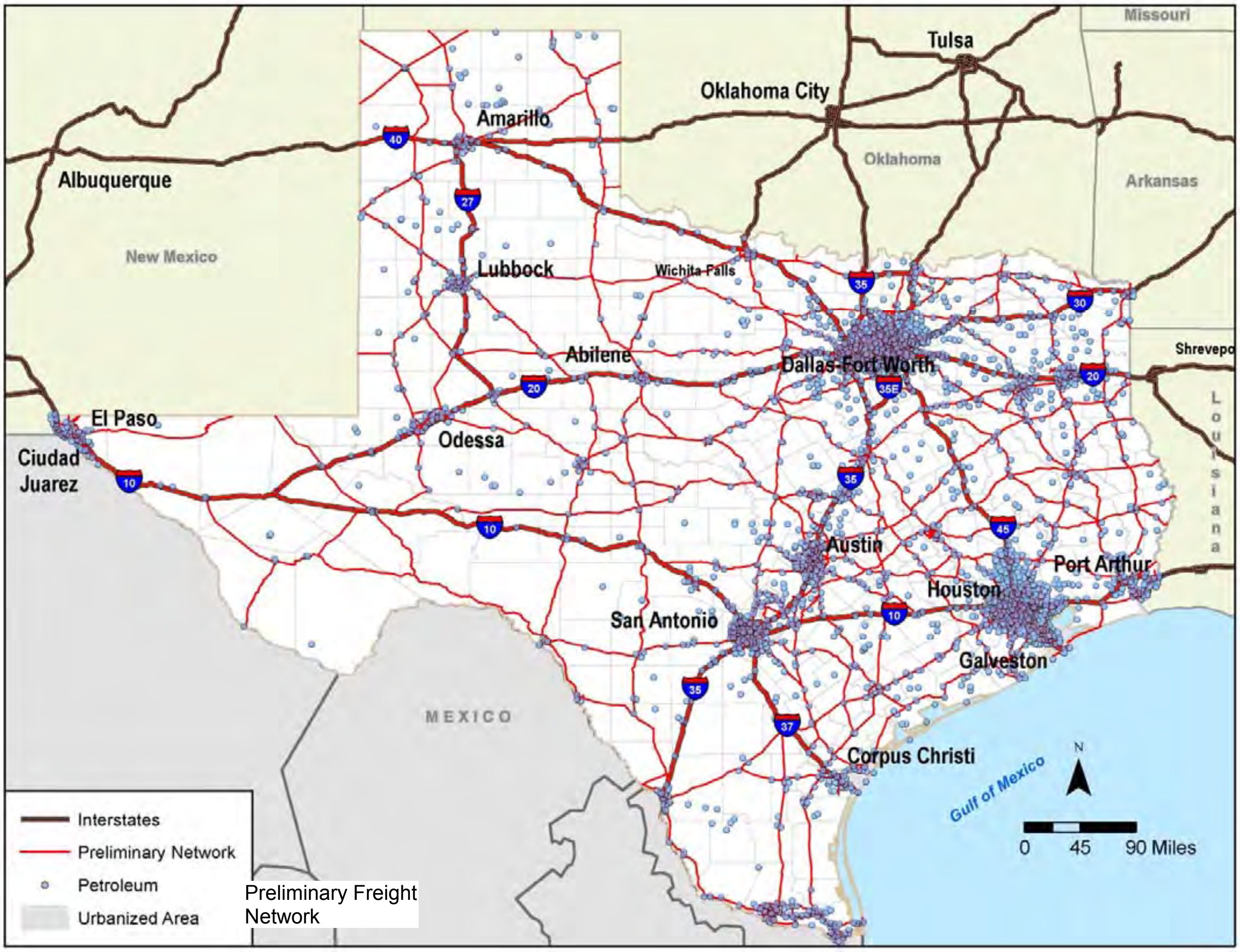
Transportation equipment and electronics are the industries which are most densely clustered in the urban areas. This would indicate that these industries depend upon the population in the urban areas for production. A majority of the locations not around the urban areas are still along the TFHN which provides industry access to the urban centers, and across the state.

Heavy construction and production support are also concentrated around the urban areas, but the clusters are larger and broader, indicating that much of these industries are located not only in the urban cores but in the suburban areas of these cities. There are also more rural locations of heavy construction and production support industries than for transportation equipment and electronics. The heavy construction industry particularly has more locations throughout northeast Texas, while production support is scattered through the eastern part of the state as well as in the western portion of the panhandle.

The agriculture, petroleum (Exhibit 12), and energy-mining industries, show some concentrations in the urban areas, but are much more widely distributed throughout the state and in the rural areas. These industries are largely dependent upon the geography, geology, and other environmental factors for their production and are not merely selected. Support services for these industries will still develop in urban areas which have ample access to the TFHN.

The location of industry concentrations are important to Texas as the goods and raw materials these industries produce have to be transported either to the next phase of production for that material or to the consumer. The reliability and convenience of this transport affects both the producer and the consumer.

Exhibit 12. Petroleum Industry, 2012

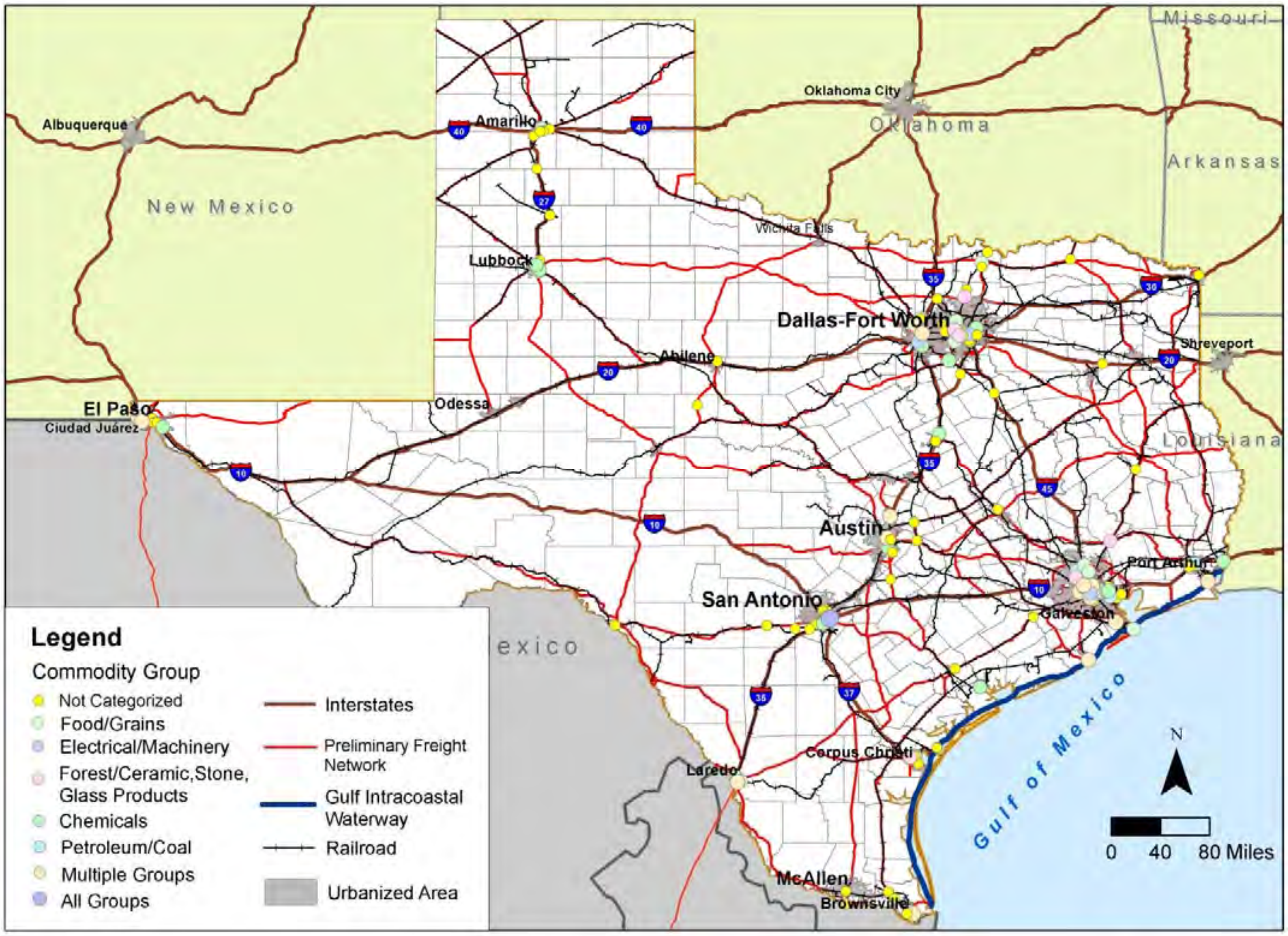


Source: Texas Workforce Commission, www.texasindustryprofiles.com, 2012

2.3.2 Warehousing and Distribution Center Facilities

Warehousing and distribution centers provide a vital link between goods and the consumer. Items from a distribution center often are distributed to retailers, wholesalers or even directly to the consumer as is often the case with internet shopping. Warehouse facilities are usually located near major market areas and in proximity to major roadway facilities. Exhibit 13 displays the major warehousing facilities by commodity group in Texas. As expected, the facilities are clustered in and around the urban areas of the state and are along the TFHN, to allow better and faster access to the consumer. Especially in today's marketplace, where two-day, next day, and even same day delivery are becoming commonplace, the ability to reach the consumer efficiently is paramount in the supply chain.

Exhibit 13. Major Warehousing and Distribution Center Facilities, 2013



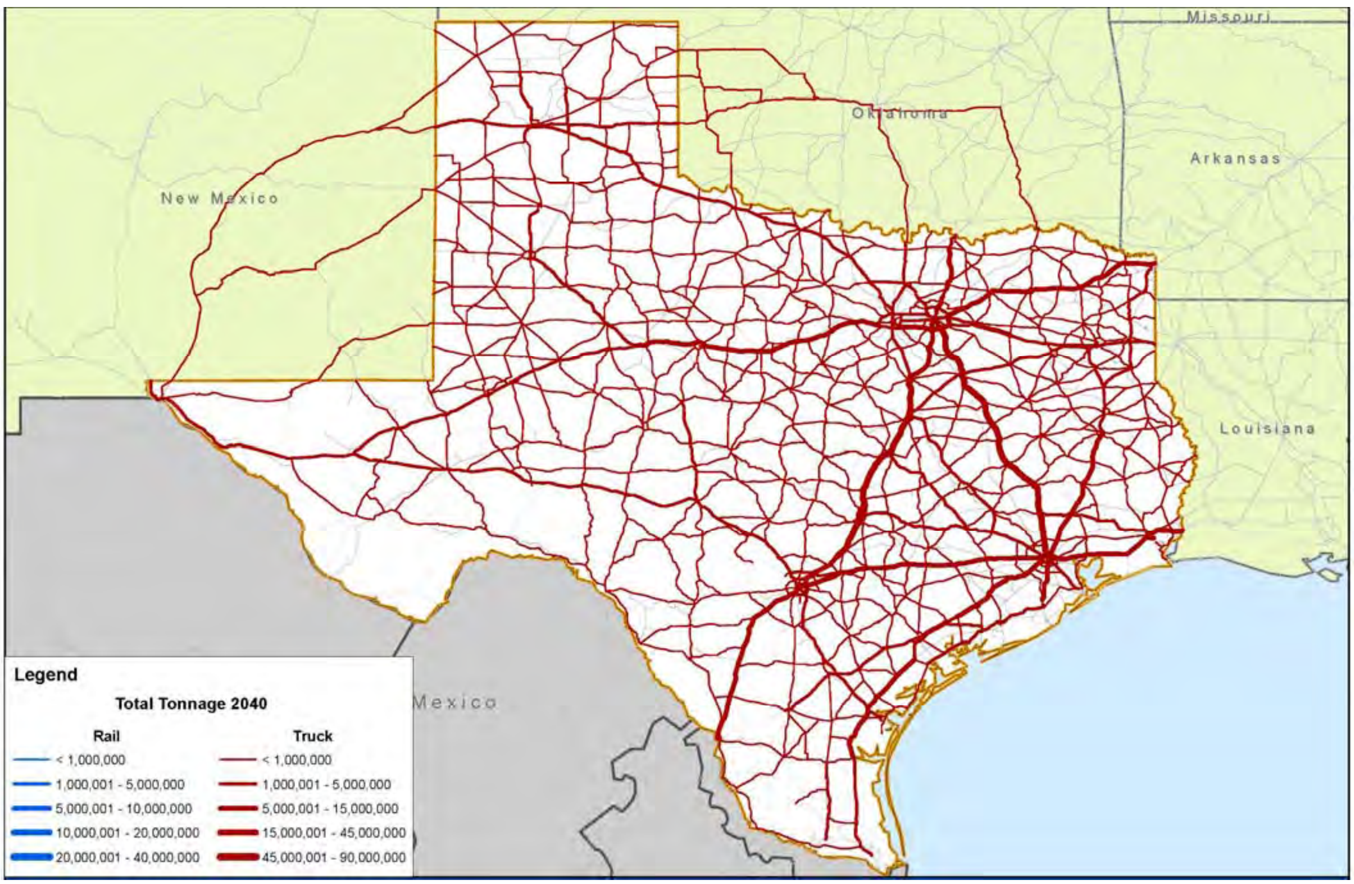
Source: Bureau of Transportation Statistics, 2013

2.3.3 Commodity Flow

The TFHN is the network by which goods reach the consumer. Based on the locations of industry clusters, generators, gateways, and the consumer, individual commodities often utilize different links in the freight network. Exhibit 14 shows the most heavily utilized highway facilities for those freight commodities in Texas projected to total over 200 million tons by 2040. Actual 2010 tonnage and projected 2040 tonnage are depicted so that growth trends may be evaluated. For all commodities, trucks carried more tonnage than rail in 2010 and that relationship holds for the forecast in 2040. In all cases, the increased tonnage projected between 2010 and 2040 occurs on the Interstates and some US highways, with the remainder of the highway network remaining about the same.

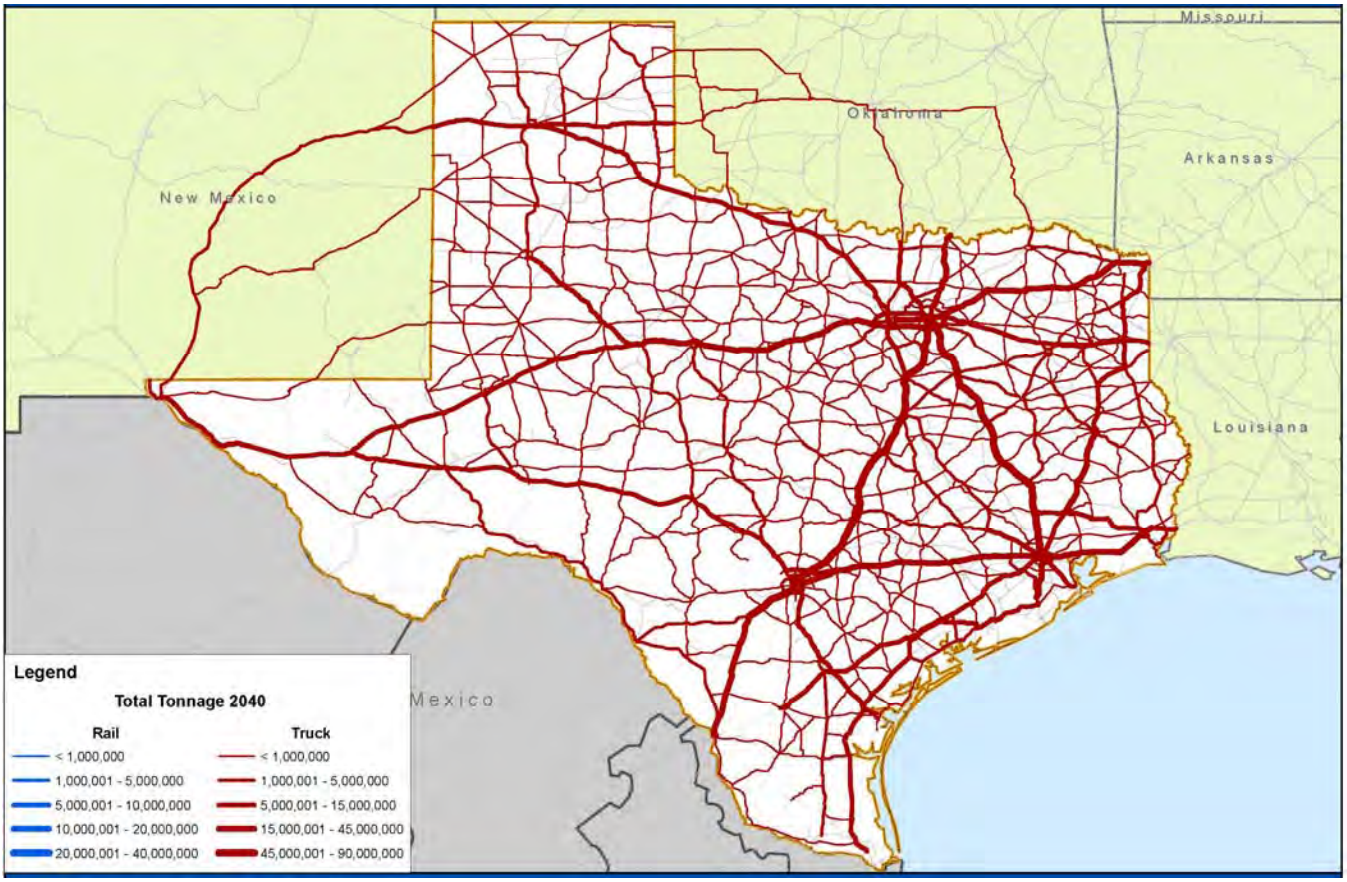
Secondary traffic, which includes movements between warehousing and retail locations, comprises most of the tonnage on the roadways and little to no movements on the railroads in the State. Exhibit 14 and Exhibit 15 show the total tonnage of secondary traffic for 2010 and 2040. Rail lines do not appear on these two exhibits, as there are no rail lines that carried secondary traffic in 2010 or are projected to carry secondary traffic in 2040. These movements between warehousing and retail are often quick turnaround routes that are not usually suitable for rail transport. The routes may be travelled weekly if not daily dependent upon the goods, for example perishable goods may need to be transported daily while a store may receive non-perishable items in weekly shipments from a warehouse. The Interstates within Texas are most heavily utilized for these movements for 2010 and 2040, as most of the warehousing (Exhibit 13) and retail consumers are located within the urban areas connected by these facilities.

Exhibit 14. Total Truck Tonnage 2010 (Secondary Traffic)



Source: TRANSEARCH, 2010

Exhibit 15. Total Truck Tonnage 2040 (Secondary Traffic)



Source: TRANSEARCH, 2010

2.4 Railroad Operations and Capacity

Rail is a major component of freight movement throughout Texas. Texas has 10,425[2] total rail miles, the most of any state. In 2010, 24% of the freight tonnage and 27% of the total value of freight in Texas was carried by the rail system[3]. 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[11]. The rail industry stratifies its network into three categories: Class I, II, and III. The TFMP utilizes these classifications as the basis to define the rail network. The rail assets in Texas are discussed based on these classifications and the connections to freight gateways and to generators.

2.5 Railroad Classification

Railroad classification is determined by the U.S. Surface Transportation Board (STB) based on annual revenue dollars. In 2012 dollars, a railroad with operating revenues greater than $433.2 million for at least three consecutive years is considered a Class I railroad. Similarly, a

2 https://www.aar.org/keyissues/Documents/Railroads-States/Texas-2010.pdf

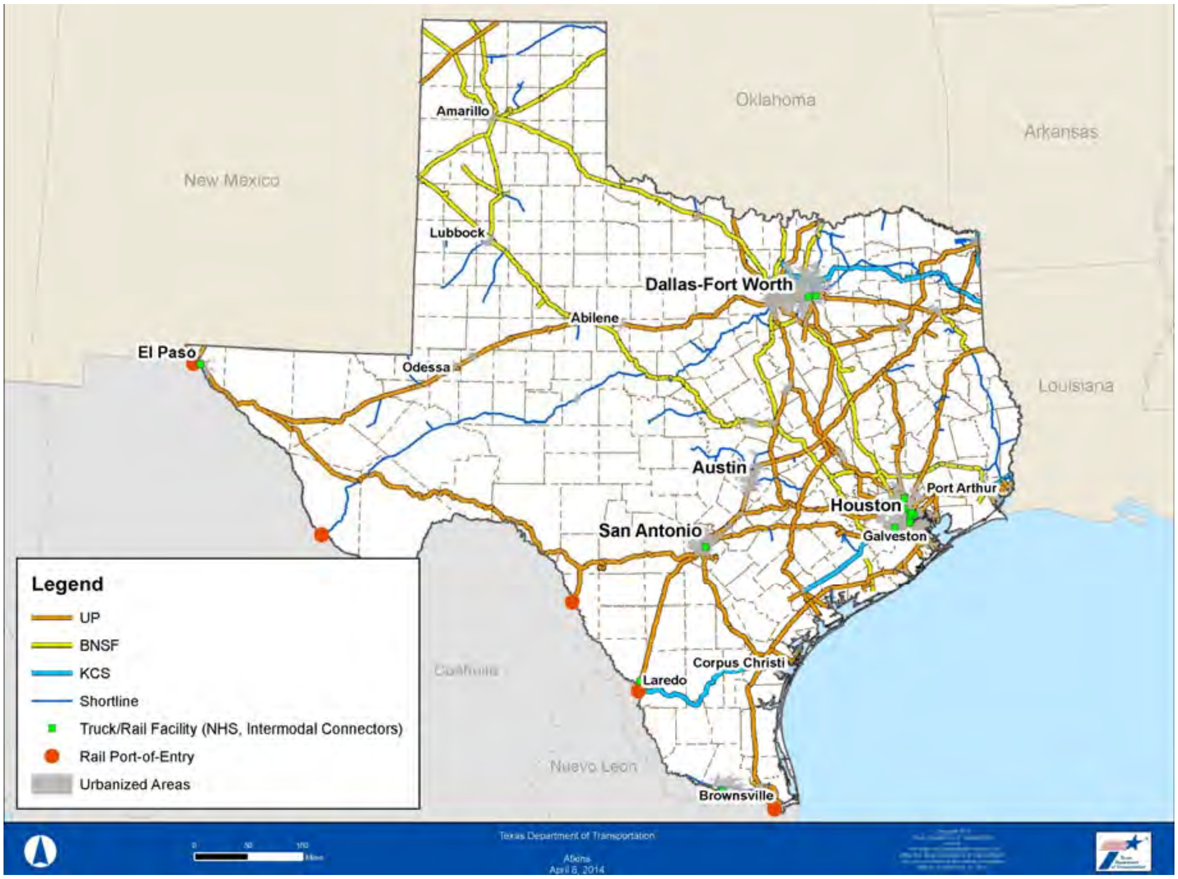
3 IHS Global Insight TRANSEARCH

railroad with revenues greater than $34.7 million, but less than $433.2 million[4], is considered a Class II railroad: Such railroads are commonly referred to as “regional” railroads.

A railroad not within the Class I or II categories is considered a Class III railroad, also known as a “short line”. As the name indicates, short lines operate over a relatively short distance. Short lines 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. The Texas rail network is shown below in Exhibit 16.

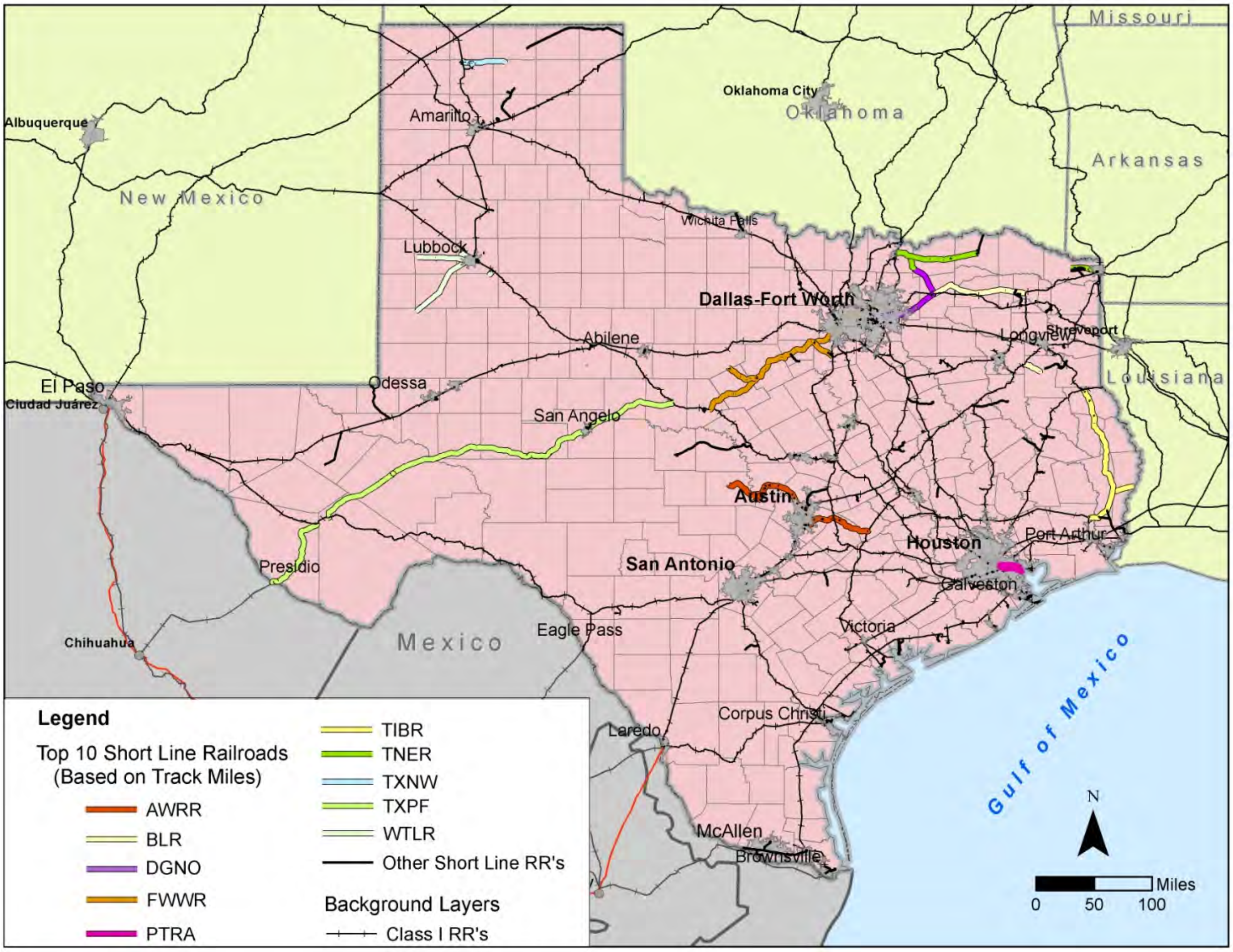
Short line railroads connect Class I railroads and commodity shippers and receivers. A total of 43 short line railroads serve Texas. These systems include a total of 2,479 track miles, ranging from 337 to 0.59 track miles per operator. The top ten short line freight systems (based on track miles) are shown in Exhibit 17.

Exhibit 16. Texas Rail Lines, 2013



4 http://www.aslrra.org/about_aslrra/faqs/

Exhibit 17. Texas Freight Short Line Rail Lines, 2013



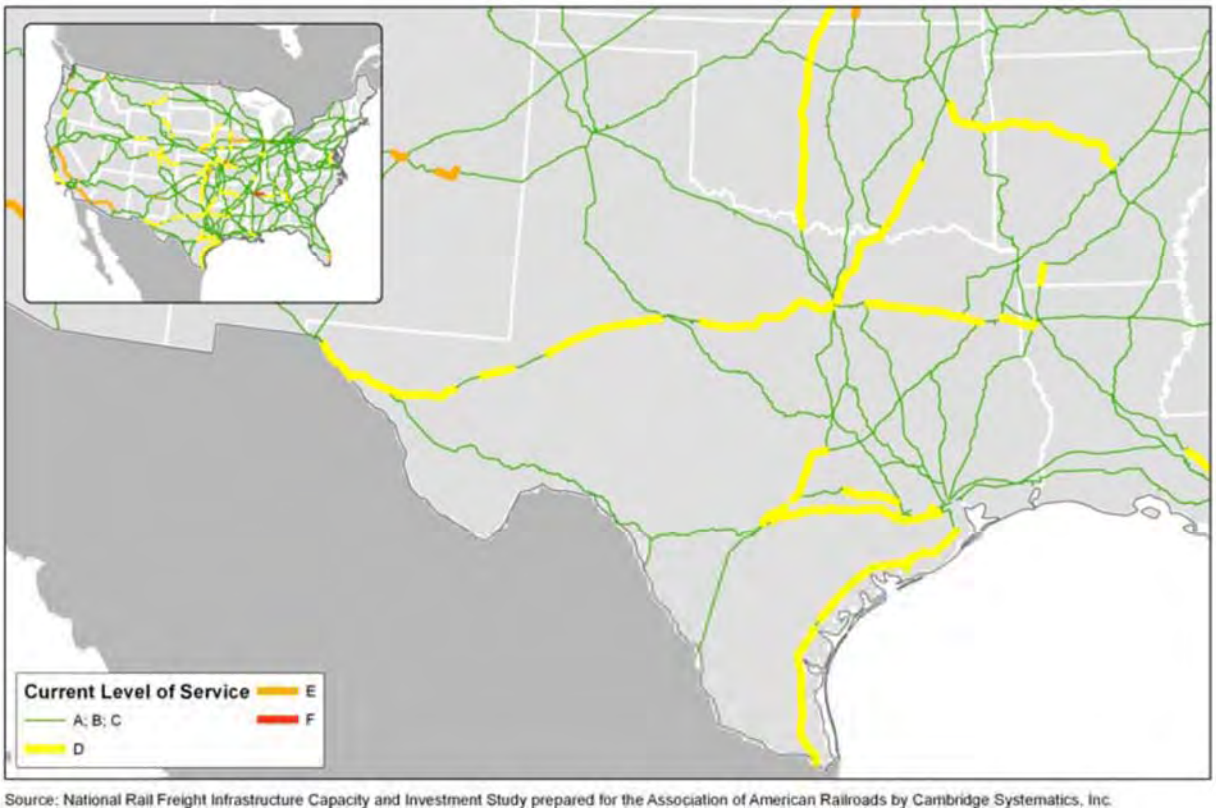
Source: National Transportation Atlas, Bureau of Transportation Statistics, 2013

2.6 Railroad Operations and Capacity

2.6.1 Texas Rail Plan November 2010

The rapid growth in overall rail freight volumes will have a dramatic effect on the Texas rail system. Exhibit 18 illustrates the level-of-service (LOS), based on volume-to capacity ratios (V/C) at which the rail system operated based on 2007 data. Green lines indicate relative free-flow through much of the state at a V/C of 0.7 or less, although some capacity issues exist on rail lines parallel to the I-20 corridor, the I-10 corridor, the I-35 corridor, and the US-59 corridor near the Gulf Coast. These corridors are operating near capacity, with V/C between 0.7 and 0.8.

Exhibit 18. Freight Rail Level-of-Service (2007)



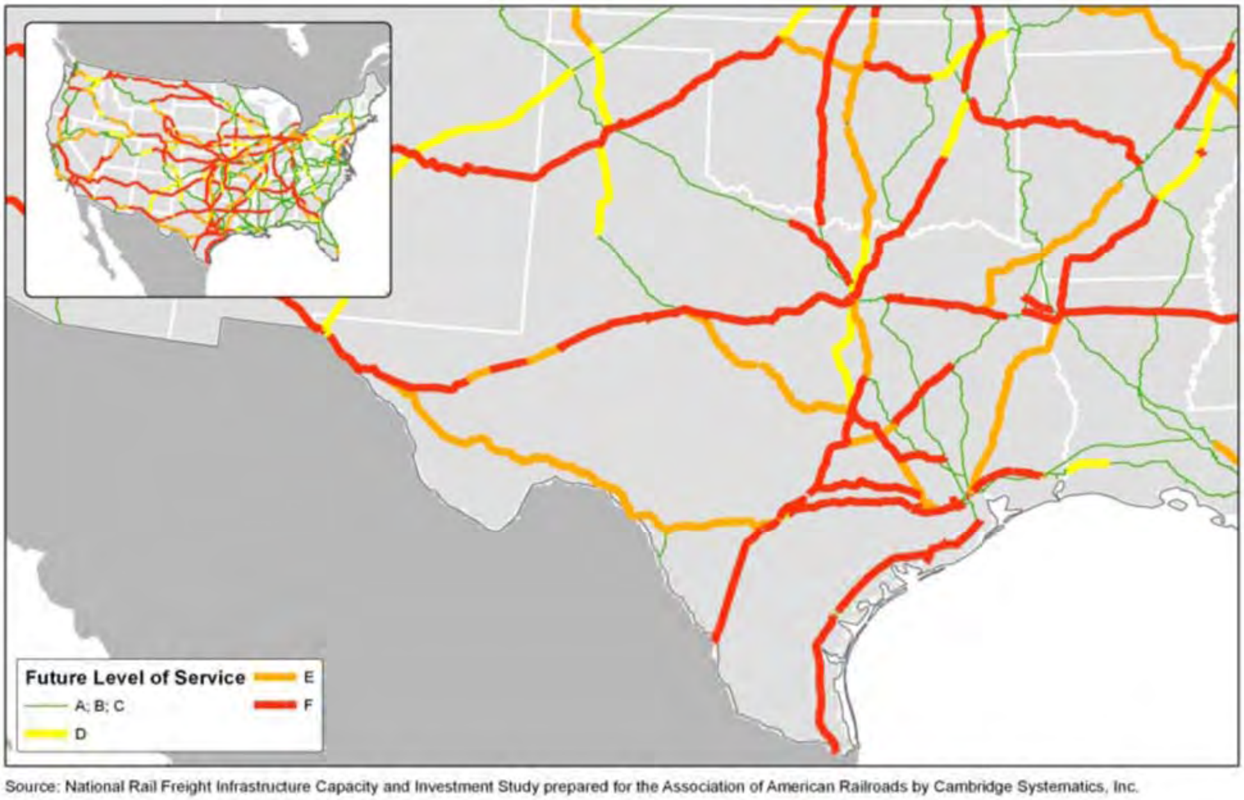
Source: Association of American Railroads, National Rail Freight Infrastructure Capacity and Investment Study

Exhibit 19 looks ahead to 2030, and assumes no dramatic improvement or expansion to the rail system. This also assumes no additional passenger rail beyond what currently exists. As a result, the statewide rail LOS drops significantly. Though there are still projected segments of the rail system operating at a fairly free-flowing LOS A, B, or C, a majority of rail miles will operate in congested conditions, particularly along the currently constrained corridors identified above. LOS E represents at- or near-capacity conditions of V/C of 0.8 to 1.0. LOS F indicates conditions with volume exceeding capacity.

2.7 Railroad Connectivity

Railroads serve as important connections to sea ports and land POE. Much of the freight carried by rail comes into Texas through these POE. Rail is often utilized for shipment of bulk goods and not typically a suitable, direct-to-consumer mode of transport. The capacity of rail to transport shipments from POE to intermodal terminals, transshipment terminals, and warehouse and distribution centers is integral to supply chain operations in Texas, nationally and globally.

Exhibit 19. Freight Rail Level-of-Service in 2030, No Improvements



Source: Association of American Railroads, National Rail Freight Infrastructure Capacity and Investment Study, 2007

2.7.1 Rail Ports of Entry

Each of the major freight sea ports in Texas is served by at least one Class I railroad, as shown in **Exhibit 20**. The land POEs with rail crossings are fairly evenly distributed across Texas' border with Mexico. **Exhibit 21** lists the Land POE with rail connections. These connections are also illustrated in **Exhibit 16**. Of the five land POE with rail connections, four are Class I railroads, while Presidio is served by the short line Texas Pacifico Transportation (TXPF) railroad. TXPF leases the South Orient Rail Line from TxDOT. The rail bridge in Presidio has been closed since it was damaged by fire in February 2008.

Exhibit 20. Texas Ports and Connecting Railroads, 2010

Port	Connecting Railroads
Beaumont	KCS, UP, BNSF
Brownsville	Brownsville & Rio Grande International switching with UP, BNSF, KCS
Corpus Christi	KCS, UP, BNSF
Freeport	UP
Galveston	UP, BNSF
Houston	UP, BNSF, KCS (via trackage rights)
Orange	UP, BNSF
Port Arthur	KCS, UP, BNSF(via trackage rights and switching)
Port Lavaca- Point Comfort	Port Lavaca via UP, Point Comfort via Point Comfort & Northern
Texas City	UP, BNSF
Victoria	UP

Source: Texas Rail Plan, TxDOT, 2010

Exhibit 21. 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

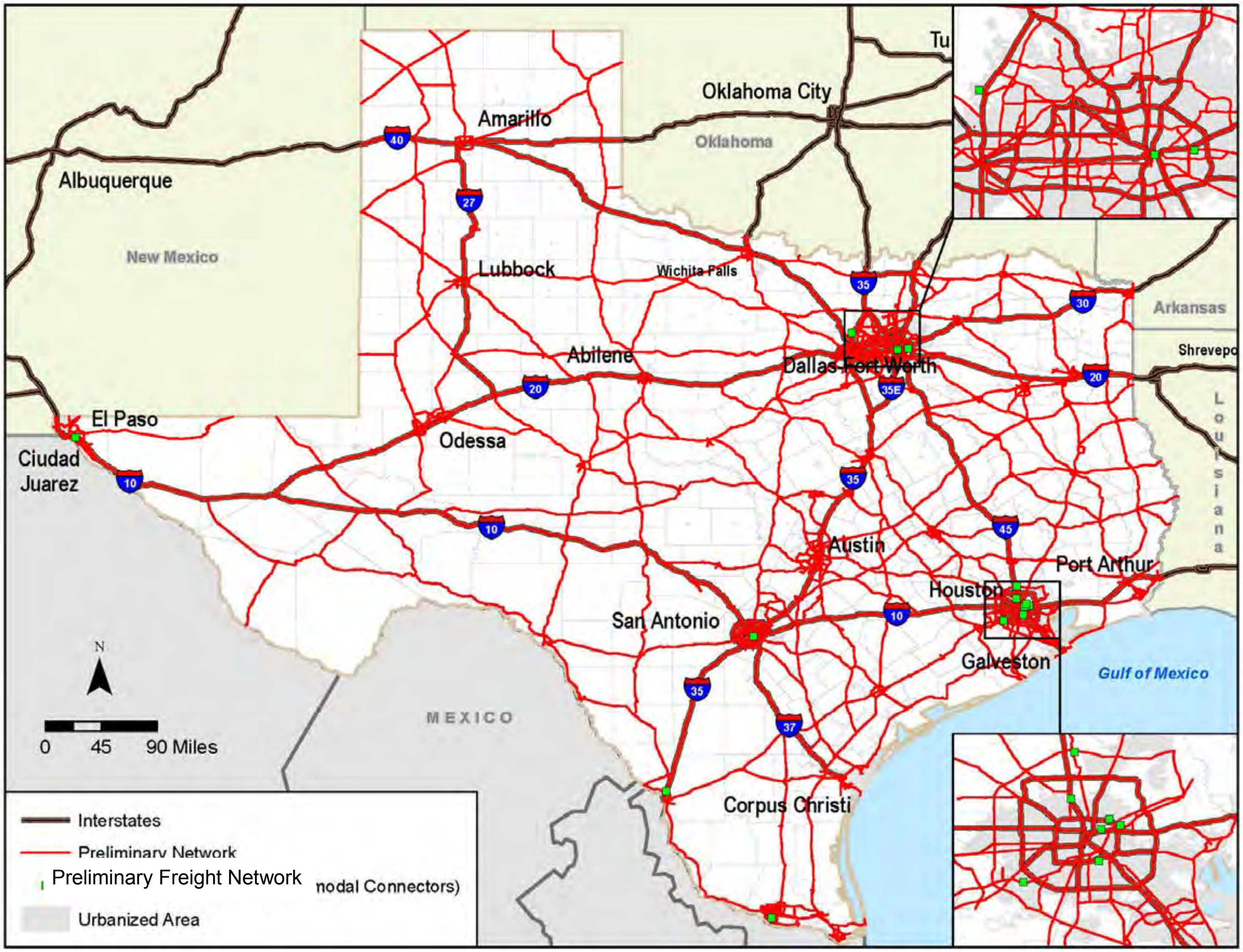
Source: Bureau of Transportation Statistics, 2013

2.7.2 Intermodal Facilities

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 22 depicts the NHS intermodal connectors that serve as truck/rail intermodal terminals where goods transfer to and from highway and rail.

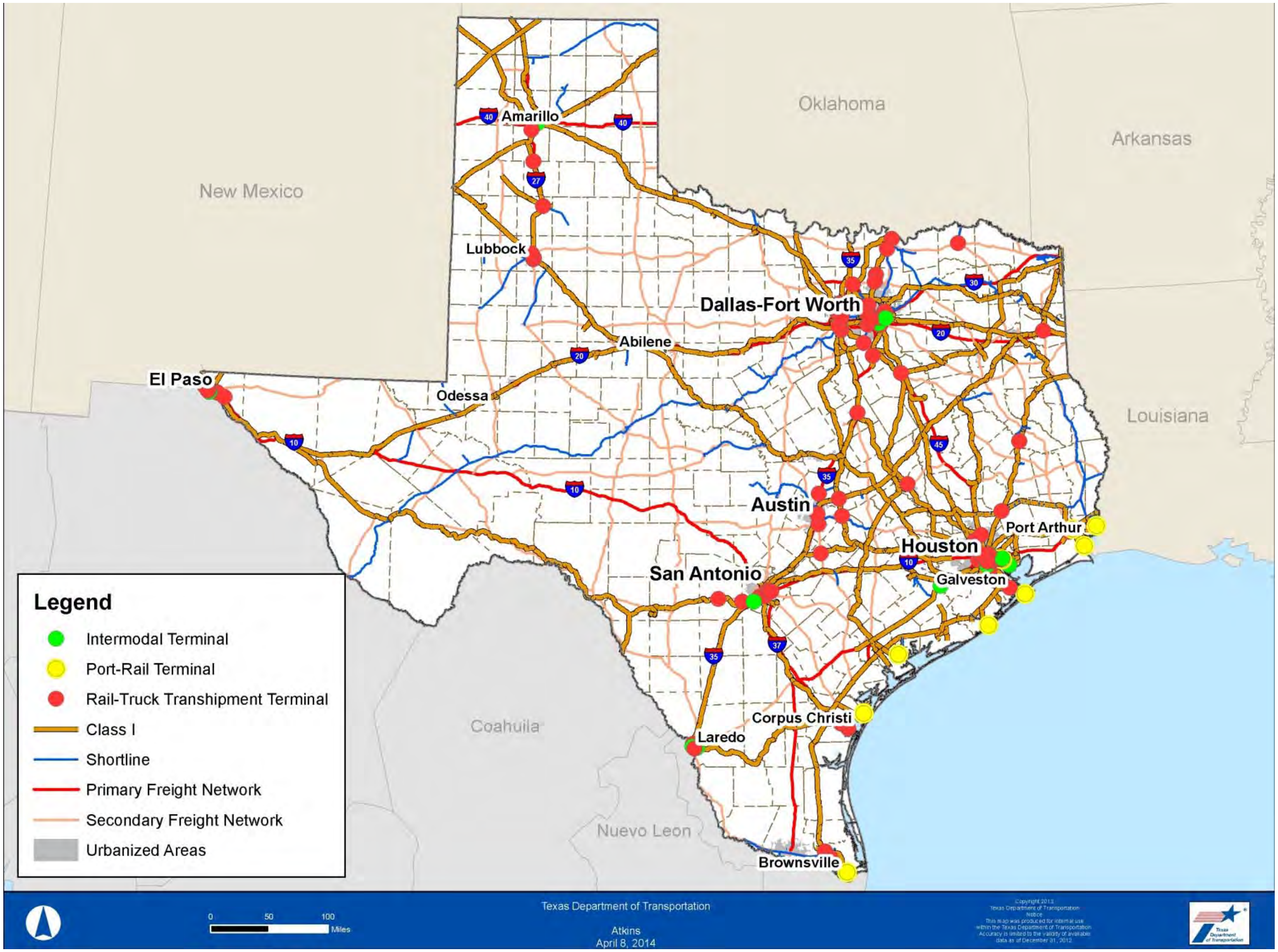
Exhibit 23 illustrates the numerous transshipment terminals located throughout Texas. Beyond the NHS intermodal connectors, there are facilities around the state which allow for the transfer of goods from rail to other modes. Most of these terminals are located near the major urban centers and along 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 22. NHS Truck/Rail Intermodal Connectors, 2013



Source: FHWA, 2013

Exhibit 23. Rail Connections, 2013



2.8 Gulf Intracoastal Waterway (GIWW)

Texas' Gulf Coast provides several freight gateways through its sea ports. Eleven Texas ports were ranked among the top 150 in the nation in 2011 based on total tonnage, with seven among the top 50[5]. Ports in Texas and beyond are connected via the Gulf Intracoastal Water Way (GIWW), a navigable inland waterway along the south coast of the US with an average depth of 12 feet. The GIWW was completed in 1949 and is primarily meant to serve barge traffic. The Waterway Freight Network including the GIWW is discussed in this section. Unless otherwise noted, port specific information was obtained from the website maintained by each port.

The Gulf Intracoastal Waterway (GIWW), depicted in Exhibit 24, is a 1,300-mile man-made canal, which runs along the Gulf of Mexico coastline from Brownsville to St. Marks, Florida. The GIWW, primarily meant to serve barge traffic, connects Texas ports to one another as well as to the other Gulf ports in the country. Within Texas, the GIWW is approximately 425 miles long with authorized channel depth of 12 feet and a width of 125 feet. It is often a challenge to maintain this channel to these dimensions. Approximately five million cubic yards of material is dredged from the Texas portion of the channel annually. In 2011, over 112 short tons of cargo moved through the GIWW, with more than 74 million (66%) travelling through the Texas portion[6]. The GIWW handles commercial navigation traffic equivalent to the fourth largest port in the US[7].

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[5] US Army Corps of Engineers (USACE) Navigation Data Center

[6] USACE Waterborne Commerce Statistics Center

[7] USACE

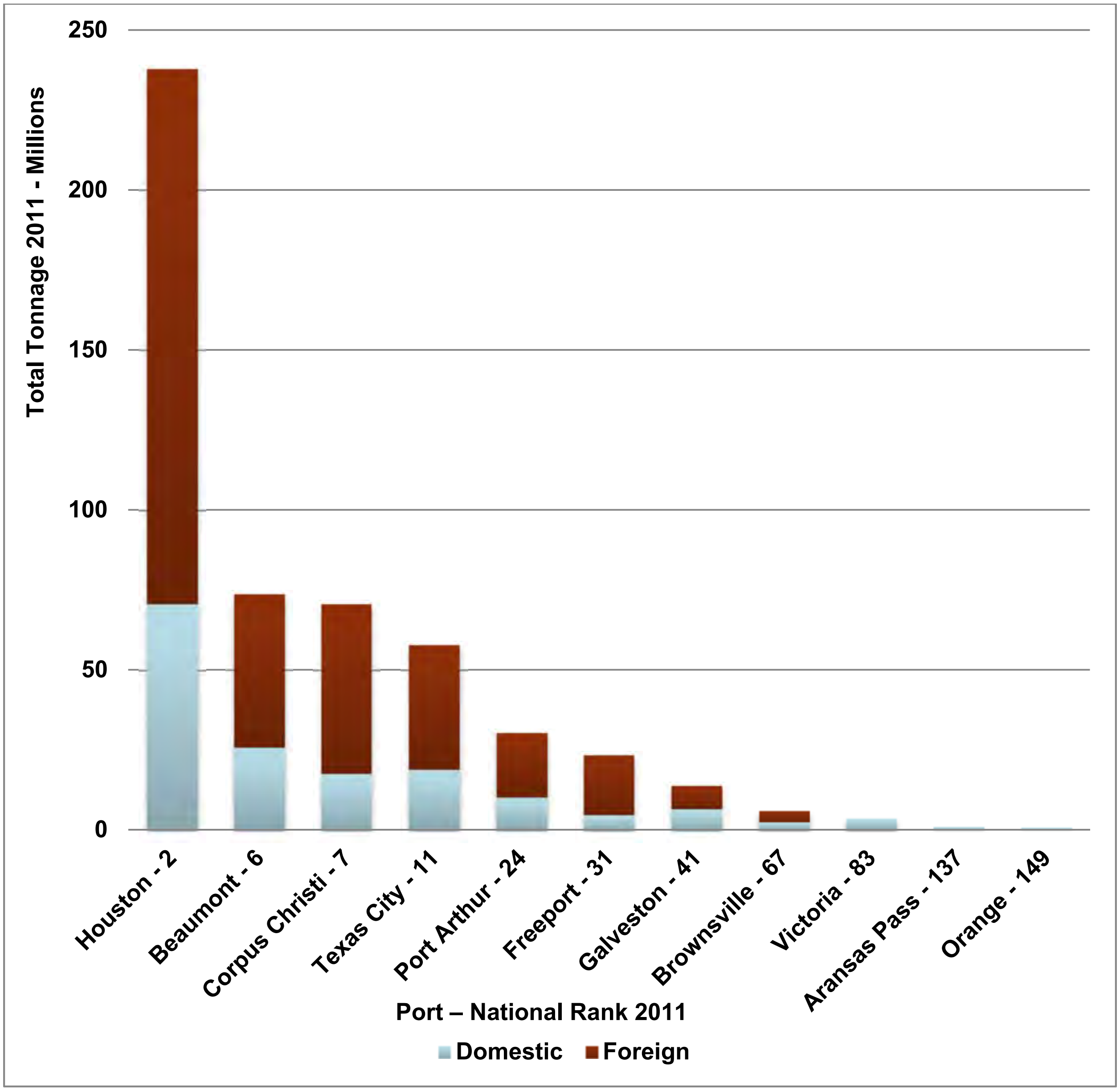
Exhibit 24. Gulf Intracoastal Waterway, 2013

Source: National Transportation Atlas, Bureau of Transportation Statistics, 2013

2.9 Texas Ports

Ports are integral to the Texas economy and connections to other transportation modes at the port facilities are necessary to provide connectivity to markets in Texas and beyond. **Exhibit 25** shows the total tonnage of freight shipped through those Texas ports that fall within the top 150 US ports in 2011. The chart shows the overall U.S. ranking, and gives a breakdown by domestic and foreign tonnage. The Port of Houston ranks second nationally in total tonnage, handling nearly 238 billion tons in 2011. **Exhibit 26** includes the channel length, depth, and width for each of these ports.

Exhibit 25. Top Texas Water Ports 2011 Tonnage



Source: U.S. Army Corps of Engineers, 2013

Exhibit 26. Port Channel Information, 2012

Port/City Name	Channel	Length (miles)	Depth (feet)	Width (feet)
Houston	Houston Ship Channel	52	45	530
Beaumont	Sabine Neches Ship Channel [a]	42	40	400
Corpus Christi	Corpus Christi Ship Channel	34	45	500
Texas City	Texas City Ship Channel [a]	9.4	45	500
Port Arthur	Sabine Neches Ship Channel	42	40	400
Freeport	Freeport Harbor Channel [a] Harbor Channel	8.5	45	400
Galveston	Galveston Channel [a]	9.3	45	1,200
Brownsville	Brownsville Ship Channel [a]	17	42	1,200[b]
Victoria	Victoria Barge Canal [a]	35	12	125
Aransas Pass	Aransas Pass Channel [a]	7	14	125
Orange	Sabine Neches Ship Channel	42	40	400

Notes:

[a] Direct access to the GIWW – Texas portion (423 miles, 12 foot depth, 125 foot width)
[b] Turning basin width

Source: Report from the Panama Canal Stakeholder Working Group, 2012

Exhibit 26 includes major roadway and Class I railroad connections to these major ports. It is significant to note that several of these top US ports are not adjacent to the Interstate or US Highway system. This highlights the importance of the secondary roadway network in the state to the movement of freight. They ultimately connect the ports to the major highways and rail terminals.

2.10 Air Cargo

The Federal Aviation Administration (FAA) categorizes public use airports into the following categories: Primary Commercial Service Airports, Non-Primary Commercial Service Airports, Reliever Airports, and General Aviation Airports. Primary Commercial Service Airports are further broken down into subcategories of Large Hub, Medium Hub, Small Hub, and Non-Hub, depending on their percentage of total U.S. passenger enplanements. Commercial Service Airports are those with at least 2,500 annual passenger enplanements and regularly scheduled commercial airline traffic.

The quantity of air cargo moving between origin and destination points, and also the amount of cargo transferring via an 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 aircraft 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.

Texas was home to five of the top cargo airports in North America in terms of total tonnage in 2012, shown in Exhibit 27.

Exhibit 27. 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

Source: Airports Council International – North America (ACI NA)
*CAGR = Compound Annual Growth Rate
+ AFW ACI-NA data not available for 2012

These five airports handled nearly 1.45 million tons of total air cargo in 2012, which represents a decrease of -0.09% annually since 2002. In this same timeframe, Texas' fastest growing airports by total tonnage were George Bush Intercontinental (IAH) at 2.88% annually and El Paso International at 0.67% annually. Austin-Bergstrom International, Dallas/Fort Worth International, and San Antonio International all experienced losses in total air cargo from 2002 to 2012.

Connections between the cargo airports and the highway and rail networks are integral to the movement of freight from these gateways. Exhibit 28 identifies the Interstate Highways and Class I railroads that are within 90 miles of these major air cargo airports in Texas. Although the Interstates may be the most heavily travelled 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 PHFN 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 28. Interstates and Class I Rail in Proximity to Cargo Airports, 2012

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

Source: http://governor.state.tx.us/files/ecodev/Logistics_Report.pdf, 2012

2.11 Pipeline Freight Network

The Pipeline and Hazardous Material Safety Administration (PHMAS), an agency of the U.S. Department of Transportation (USDOT), is the office responsible for regulating pipeline transport. In Texas, the state agency responsible for pipeline permitting and operations is the Railroad Commission of Texas (RRC). Approximately 294,000 miles of onshore gas transmission pipelines and 164,000 miles of onshore hazardous liquid pipelines move natural gas, crude oil, and petroleum products throughout the U.S. every day[8]. 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.

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:

8 https://www.npms.phmsa.dot.gov/. Accessed November 7, 2013

- A transmission line is a pipeline that transports gas/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.
- 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.

The network of transmission lines will be the focus of the pipeline information for the TFMP.

2.11.1 Pipeline Operations in Texas

In 2013, Texas contained of 374,318 total pipeline miles, which includes interstate and intrastate, and regulated and non-regulated miles[9]. In the region, these pipelines are mainly used for natural gas distribution followed by products like crude oil, liquefied petroleum, and refined products (**Exhibit 29**). The highest percentages of pipeline miles are in Harris County (5.6%), Brazoria County (3.5%), Jefferson County (2.8%), and Nueces County (2.2%)[10], which are areas of the state where there are numerous refining facilities.

The statewide transmission pipeline network includes pipelines with a diameter greater than or equal to 16 inches as depicted in **Exhibit 30**. Over 1700 companies operate pipelines in Texas. Of these companies, DCP Midstream (7.9%), Enterprise Products Operating (6.6%), Energy Transfer Company (4.8%), and Targa Midstream Services (2.6%) operate the highest percentages of pipeline miles in Texas[11].

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9 http://www.rrc.state.tx.us/data/gasservices/vitalstats/mileage.php Accessed November 7, 2013

10 https://www.npms.phmsa.dot.gov/. Accessed November 7, 2013

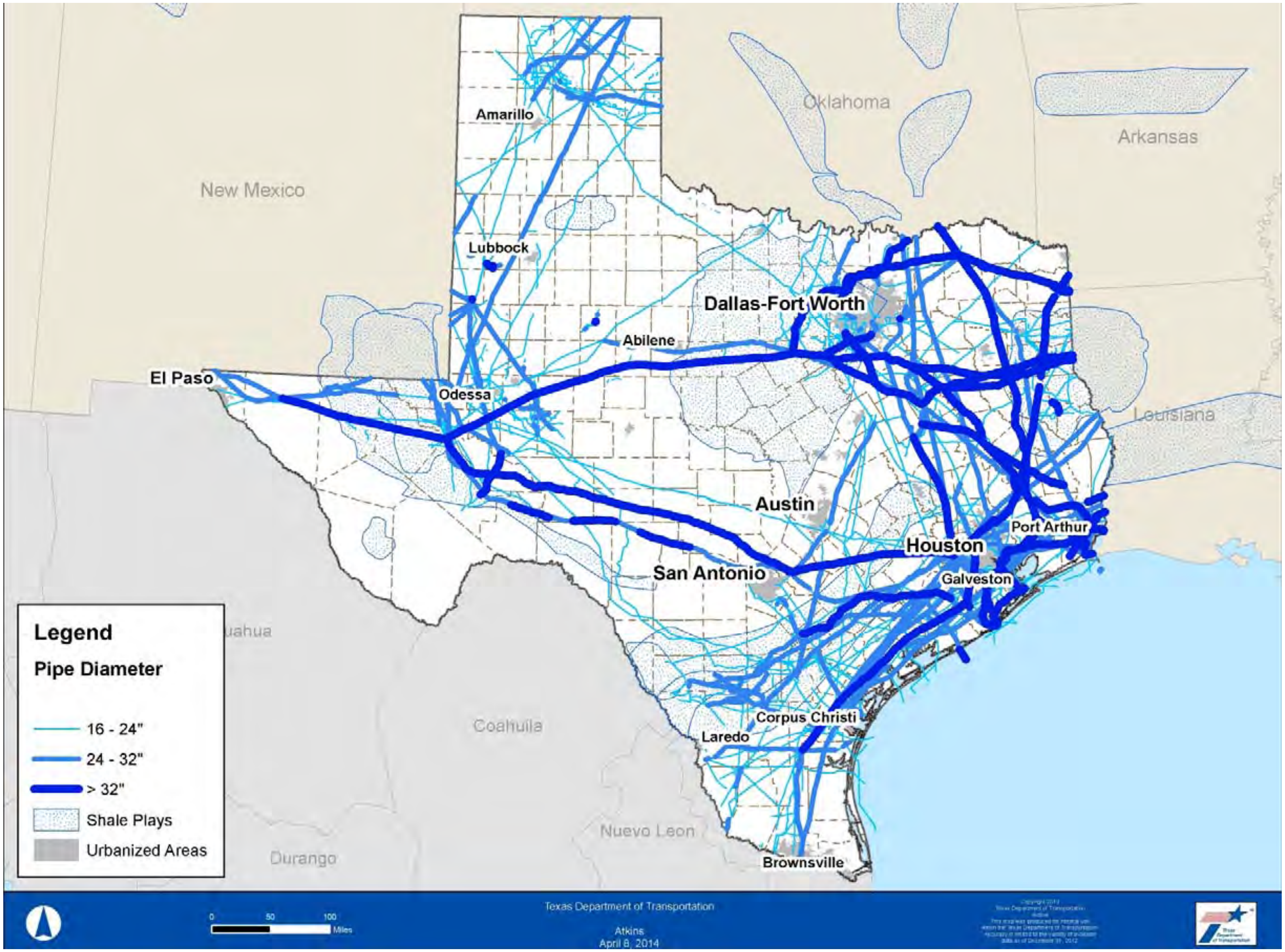
11 https://www.npms.phmsa.dot.gov/. Accessed November 7, 2013

Exhibit 29. Texas Pipeline Transmission Mileage by Commodity, 2011

Commodity	Pipelines Miles	Percentage
NG – Natural Gas	63,162	50.1%
CRD – Crude Oil	14,108	11.2%
LPG – Liquefied Petroleum Gas HVL (Highly Volatile Liquid)	12,229	9.7%
PRD – Refined Products	12,132	9.6%
NGL – Natural Gas Liquids HVL (Highly Volatile Liquid)	10,473	8.3%
OHV – Other HVL (Highly Volatile Liquid)	6,173	4.9%
EPL – Empty Liquid	3,075	2.4%
CO_2 – Carbon Dioxide	1,554	1.2%
OTG – Other Gas	1,458	1.1%
HG – Hydrogen Gas	897	0.7%
EPG – Empty Gas	257	0.2%
AA – Anhydrous Ammonia HVL (Highly Volatile Liquid)	197	0.1%
PG – Propane Gas	89	<0.1%
HVL – Highly Volatile Liquid	29	<0.1%
SG – Synthetic Gas	28	<0.1%
ETH – Ethylene HVL (Highly Volatile Liquid)	15	<0.1%
Total	**125,876**	**100%**

Source: http://primis.phmsa.dot.gov/comm/reports/safety/TX_detail1.html
Report generated on December 15, 2013, data as of 2011

Exhibit 30. Statewide Transmission Pipeline Network, 2013



Source: The Railroad Commission of Texas, 2013

2.12 *Intermodal Truck/Pipeline Terminals*

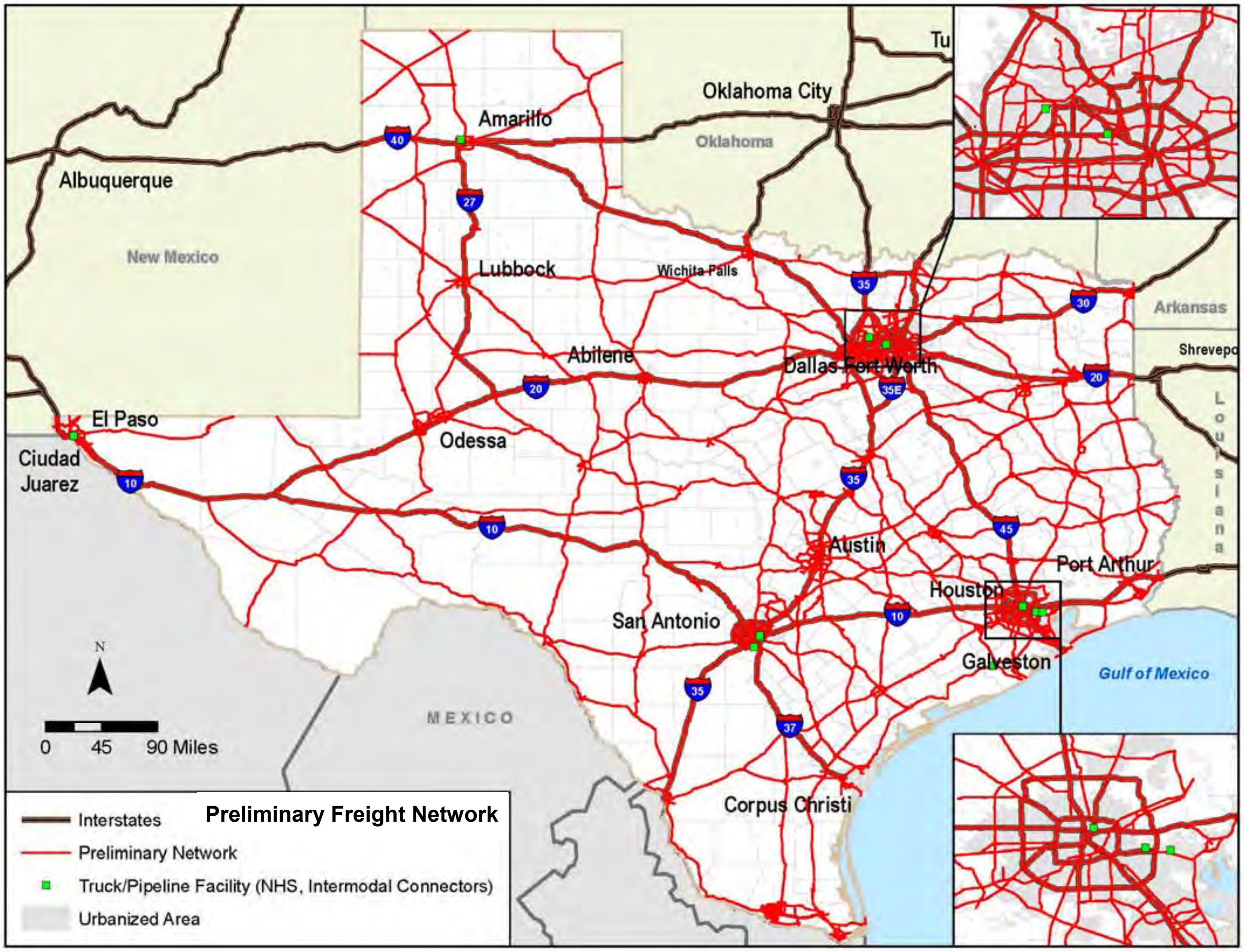
While the locations of the transmission pipelines are an important part of the Texas Freight Network, the pipelines connect to the TFHN at truck/pipeline terminals. It is at these facilities where the product being transported via the pipeline is transferred to trucks for further transport as needed. While there are many NHS truck intermodal connectors in Texas, there are only a few that handle pipeline products. Exhibit 31 identifies the NHS truck/pipeline intermodal terminals in Texas according to FHWA. These terminals are also depicted in Exhibit 32.

Exhibit 31. Texas Truck/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: http://www.fhwa.dot.gov/planning/national_highway_system/intermodal_connectors/texas.cfm, 2013

Exhibit 32. NHS Truck/Pipeline Intermodal Terminals, 2013



Source: FHWA, 2013

3.0 Key Trends and Issues

Exhibit 33. Results of TxFAC Opinion Survey of Key Trends and Issues

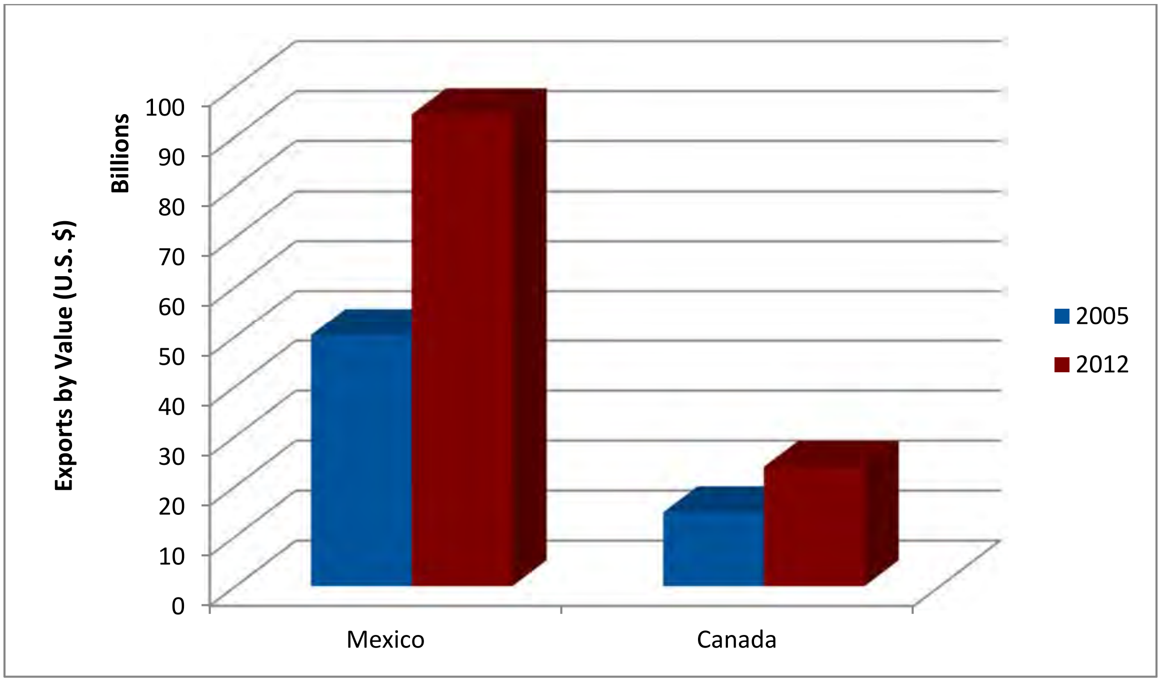
Most Influential Trends/Issues	Most Influential (Count)	Least Infuential (Count)
Economic Trends and Issues		
NAFTA Trade	5	0
Emerging Markets	6	2
Panama Canal	2	3
Port and Border Security/Efficiency	3	1
Demographic Trends and Issues		
Population Growth, Mega-regions	6	1
Infrastructure Preservation		
Port and Waterway Maintenance	3	0
Highway & Bridge Maintenance	10	0
Modal Productivity	5	2
Domestic Oil Production	1	0
Environmental Trends and Issues		
Alternative Energy	2	5
Alternative Fuels	4	2
Air Quality	1	2
Technology Trends and Issues		
Dedicated Freight Infrastructure	5	1
3D Printing	0	11

Members of the TxFAC also suggested the following as additional trends and issues to consider:

- Resurgence of Mexico: Current investment in the country's infrastructure and by private industry will substantially increase the flow of trade through the NAFTA corridor.
- The value of US Currency: Inflation and the future purchasing power of US consumers could have substantial impacts on future imports.
- Workforce development: This is a growing issue impacting logistics (i.e., truck drivers)

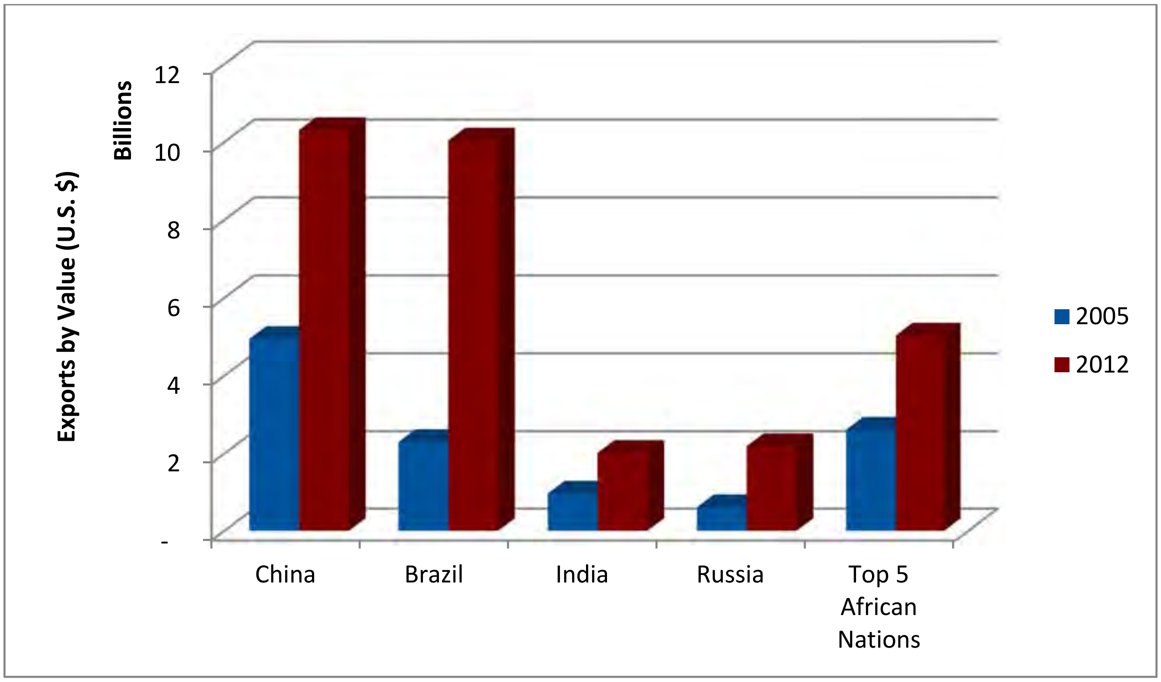
3.1 Economics

Exhibit 34. Texas Exports to Mexico and Canada 2005 and 2012



Source: International Trade Administration, US Department of Commerce

Exhibit 35. Texas Exports to Emerging Nations 2005 and 2012



Source: International Trade Administration, US Department of Commerce

3.2 Panama Canal

The expansion of the canal has spurred interest across the country. In 2012, the Texas Panama Canal Working Group studied the expansion's impact on the state and had three principal findings:[12]

1. The Panama Canal expansion…represents opportunities to expand Texas' position as a global gateway for the nation. By providing a low-cost, reliable, safe, secure, multimodal, and environmentally sustainable supply chain, the state can increase its global trade, create new jobs, and expand the economy of the state and nation.

2. As the leading goods export state in the country, Texas is well positioned to take advantage of the Panama Canal expansion and other opportunities to increase the export of dry bulk; liquid bulk; general and break bulk cargo; and containers to existing and new markets. Commodities in these general categories include agricultural produce; coal; value added manufacturing products; petrochemical and chemical products; military cargo; paper products; consumer goods; and other products. The emerging Liquid Natural Gas (LNG) export market resulting from energy developments in the state represents a major opportunity.

3. To increase global trade and economic development, Texas must develop processes that provide a transportation system focused on commerce, including Texas ports, the Gulf Intracoastal Waterway (GIWW), the roadway system, the rail system, and the pipeline network. It is critical that Texas accelerate investments in freight transportation infrastructure to grow commerce and increase the tax base of the state.

3.3 Port and Border Security

Border crossing security and efficiency are increasingly important issues for Texas due to US trade with Mexico. Security processing is often identified as a key reason for delays at the border and delays at points of entry, which are costly both economically and environmentally. Port security is also important due to containerized imports and hazardous materials (such as petrochemicals) that are handled at Texas ports.

A number of efforts have been introduced at the federal level to increase efficient border security, including the Container Security Initiative (CSI), the Secure Freight Initiative, and the Customs Trade Partnership against Terrorism (C-TPAT). CSI works with foreign governments to examine high-risk containers at foreign ports before departing for the US Currently 58 ports are participating accounting for nearly 85 percent of all US bound container traffic.[13] The Secure Freight Initiative builds on CSI to specifically address potential nuclear threats.[14] The C-TPAT partners with over

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12 Report from the Panama Canal Stakeholder Working Group, November 2012

13 U.S. Department of Homeland Security. Container Security Initiative Ports. Web. <http://www.dhs.gov/container-security-initiative-ports>.

14 U.S. Department of Homeland Security. Secure Freight Initiative. Web. <http://www.dhs.gov/secure-freight-initiative>.

10,000 stakeholders around the world to pre-screen cargo entering the country; the participants represent over 50 percent of US imports by value.[15]

Texas has developed its own program, the Border Safety Inspection Facility (BSIF) program which consists of funding and construction of temporary and permanent border inspection facilities at locations all along the Mexican border. The goal of these facilities is to provide an efficient method of inspecting and weighing commercial vehicles entering the U.S. There are eight sites are included in the BSIF Program:

- Bridge of the Americas, El Paso
- Ysleta-Zaragoza Bridge, Ysleta
- Camino Real International Bridge, Eagle Pass
- Laredo-Colombia Solidarity Bridge, Laredo
- World Trade Bridge, Laredo
- Pharr-Reynosa International Bridge on the Rise, Pharr
- Free Trade Bridge, LOS Indios
- Veterans International Bridge at LOS Tomates, Brownsville

Trusted shipper programs allow carriers meeting pre-determined criteria to register and receive less scrutiny at the border. Programs like the Free and Secure Trade (FAST) lanes are used by C-TPAT to expedite border crossings and reward safe, known carriers. Research conducted by the Texas A&M Transportation Institute (TTI) found trusted shipper programs are successful at reducing wait times, but some carriers are reluctant to join and share data.[16] The US and Mexico have worked collaboratively on border initiatives founded on co-responsibility and collaboration between customs agencies, and expanding trusted shipper programs. For example, C-TPAT's FAST lane program works with Mexico's New Program of Certified Companies.[17]

Texas convenes a Border Trade Advisory Committee to provide a forum between TxDOT, the governor, Metropolitan Planning Organizations (MPO), ports of entry, universities, and city and county officials, among others, to evaluate the effect transportation choices have on border trade and communities. This Committee produces reports, the most recent in 2012, detailing the status of current programs, opportunities and threats to the system, funding issues and future outlook of border trends.[18] Texas realizes the importance of border capacity, efficiency and security on the economic vitality of border communities as well as the state and nation. It is critical to continue

[15] U.S. Customs and Border Protection. Customs-Trade Partnership Against Terrorism (C-TPAT). Web. <http://www.cbp.gov/linkhandler/cgov/trade/cargo_security/ctpat/ctpat_program_information/what_is_ctpat/ctpat_overview.ctt/ctpat_overview.pdf>.

[16] Trotter, Bob, Brenda Manak, et al. Texas A&M Transportation Institute. Assessment of Multiple Layers of Security Screening of Trucks by Customs Border Protection in El Paso, Texas. Web. <http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/TTI-2013-6.pdf>.

[17] "Mexico-U.S. Border Cooperation Lauded by U.S. Official." IIP Digital. 19 Sept 2013. Web. <http://iipdigital.usembassy.gov/st/english/inbrief/2013/09/20130922283297.html

[18] Texas. Department of Transportation. Border Trade Advisory Committee Report 2012. Web. <http://ftp.dot.state.tx.us/pub/txdot-info/tpp/misc/btac_2012.pdf>.

collaborative efforts with Mexico and invest in capacity, technology and security upgrades where appropriate to ensure trade thrives and freight of all modes is able to freely and efficiently move across the border, throughout the state and beyond.

Using technology at border crossings and ports is one way to enhance both security and efficiency without having to build large, expensive capacity improvements or other costly infrastructure. Federal security programs like the Secure Freight Initiative already employ technology that can scan and detect radioactive material in real-time, ensuring no nuclear material is traveling inappropriately.[19]

Texas' BSIF program uses Intelligent Transportation Systems (ITS) strategies like weigh-in-motion (WIM) and dimension-in-motion (DIM) components so trucks do not have to stop, dynamic messaging signs to inform drivers, and a flow manager to ensure traffic flows smoothly.[20] The entire system is synthesized into one software system for efficient and effective management by employees. Depending on if the truck passes or fails certain points of inspection, the software diagrams their route and what steps are to be taken to rectify the issue. Cameras are installed at various points and accessible from the software as well.

Port security uses a wide array of technologies including X-ray and Radiation Portal Monitors (RPM), intelligent video systems, crane-mounted sensors, and Radio Frequency Identification (RFID) tags, among others.[21] Ports are also beginning to use strategies similar to how the Federal Aviation Administration (FAA) monitors all US air traffic, using an integrated coastal radar system to better understand and protect the borders as well as increase maritime safety in case of an emergency.

4.0 Unconstrained Needs Determination

4.1 Methodology and Assumptions

4.1.1 Defining "Needs"

Several tasks in the TFMP were directed toward the collection of information to document the state's freight assets in a comprehensive inventory, to ascertain their current condition and develop a needs assessment based on meeting future demand. Use of the TRANSEARCH database for current and forecast freight volumes was a critical element of the analysis. Data from TRANSEARCH was enhanced by interaction with both public and private sector participants including:

- Stakeholder engagement
  - Listening sessions
  - Motor carrier surveys

19 U.S. Department of Homeland Security. Secure Freight Initiative. Web. <http://www.dhs.gov/secure-freight-initiative>.

20 Sturgeon, Purser, and Darin Parish. Texas. Department of Transportation. ITS and Border Safety Inspection Facilities in Texas. 2009. Web. <http://itstexas.org/sites/itstexas.org/files/presentations/ITS_Texas_2009_Session2B_Parish.pdf>.

21 Stone, David. "Port Security: Top Threats and Technology Trends." Security Info Watch. 06 Mar 2006. Web. 23 Oct. 2013. <http://www.securityinfowatch.com/article/10558823/port-security-top-threats-and-technology-trends>.

  – Roadside Truck Driver Origin/Destination (O/D) Interviews
  - Inventory and assessment of freight transportation assets
- Analysis of the condition and performance of the freight system.

Participants in the extensive outreach program identified highway congestion, delays due to accidents, lane merge difficulties, and inadequate highway capacity to be the most problematic issues. Roughly 24% listed Texas' expansive road network as an economic strength. However, a greater proportion (34%) listed the quality of the road network as one of Texas' weaknesses.

The most common areas of congestion included I-35 and I-10 along with the areas surrounding all major cities, and specifically near Dallas/Fort Worth, Austin, and Houston.

The overall freight transportation needs were identified in 10 categories:

1. System Capacity
2. System Operations
3. Safety/Security
4. Intermodal Connectivity
5. Rural Connectivity
6. NAFTA and Border/Ports-of-Entry
7. Energy/Environment
8. Education/Public Awareness
9. Public/Private Sector Coordination
10. Funding/Financing

Exhibit 36 identifies types of needs and issues associated with the each of the 10 broader needs categories.

Exhibit 36. Key Freight Network Needs

System Capacity	Energy/Environment
Reduce rail capacity constraints	Reduce cost of alternative fuel sources
Increase number of alternate corridors/redundancy	Streamline environmental review process
Reduce congestion on key freight corridors	Understand the impact of expanded shale production on infrastructure
Reduce bottlenecks at interchanges on key freight corridors	
Improve merging lanes at interstate interchanges	
System Operations	Education and Public Awareness
Update and maintain aging infrastructure	Promote a better understanding of the impact of re-shoring on freight volumes and Texas infrastructure
Address oversize/overweight/over dimensional trucks issues (e.g., permitting and routes)	Communicate importance of freight movement to the public
Enhanced comprehensive statewide incident management	Improve communication between public-private sectors
Define a statewide priority freight network	Improve understanding by the public of commercial vehicle operational needs
Identify dedicated heavy weight truck corridors	Improve the understanding of role and responsibilities of private and public sector in funding and maintaining infrastructure
Designate and identify truck-only lanes	
Safety/Security	Public/Private Sector Coordination
Improve truck parking (including overnight/rest stops)	Connect to neighboring states' infrastructure
Reduce the number of at-grade rail crossings	Increase political/legislative support for freight issues
Improve rail connectivity in rural areas	improve internal and external communication within public agencies
Improve and update roadway geometrics	Increase coordination on technology between public and private sectors
Increase education/awareness of public about commercial vehicle needs	Improve collaboration to accommodate varying planning horizons
Intermodal Connectivity	Increase understanding of agencies to market conditions that impact long-term efforts
Identify regional corridors	Coordinate on real-time travel conditions with neighboring states
Improve port-rail connections	
Increase the number of intermodal connection points	
Rural Connectivity	Funding/Financing
Improve north-south connectivity to the border	Focus on funding on high priority freight corridors
Increase connectivity between western and eastern railroads	Balance existing transportation funding needs
Increase rural access to existing freight network	Create alternative measures for allocating funding
NAFTA and Border/Ports of Entry	Explore alternative funding mechanisms
Reduce congestion at the border	Promote importance of freight transportation to elected officials
Reduce customs processing time	

Exhibit 36. Key Freight Network Needs

System Capacity	Energy/Environment
Address border crossing staffing issues	
Increase and implement cross-border technology applications	
Promote public awareness of changing policies in Mexico (legislative, economic, funding, etc.)	
Connect U.S. Interstate to Mexico's infrastructure	
Impact of Mexican infrastructure improvements on U.S.	

4.2 System Capacity

Congestion and bottlenecks were identified as important issues with regard to the state's freight transportation system. Key congested corridors as well as those with significant bottlenecks in major urban areas identified include: I-35 in Austin; I-35 north of San Antonio; I-10, I-610, US 59 in Houston; I-35, and 635 in Dallas. Congestion at border crossings present significant freight bottlenecks.

Most of the freight rail lines in the state are single track which creates choke points in the system and affect overall rail system capacity. One of the key rail bottlenecks identified is the single track railroad bridge of the Neches River in Beaumont which handles over 50 trains a day. Additional rail lines are needed around the Port of Houston. Improvements to existing lines are needed where rail conflicts are causing highway bottlenecks such as around Corpus Christi.

The identified ports and waterway need was to deepen the Gulf Intracoastal Waterway to allow for more freight flows through Texas ports. Roadways such as I-10, I-20, Interstate 35, I-69, US-281, and US-83 were identified as some of the roadways in the state experiencing congestion and encroachment problems.

More pipelines across the state were also identified as a need to meet the demands of the energy sector activities. Additional pipeline capacity would reduce the number of trucks carrying crude oil.

4.3 System Operations

The lack of a comprehensive statewide incident management program was identified as a need related to systems operations. Improved incident management to detect, respond, and clear incidents on roadways faster as part of a robust statewide incident management program would improve reliability help in maximizing the existing infrastructure.

The need for a comprehensive statewide traffic management center was identified. The lack of real-time traveler information alerting drivers to incidents, construction, roadway conditions, etc. was noted as a critical need for facilitating efficient movement of freight throughout the state.

Updated and proper signage is also important in the efficient movement of freight. Design standards were identified as an issue needing to be addressed, specifically signal timing and placement, inadequate turning radii, and acceleration and deceleration lanes.

There is a need for a statewide freight network to support the efficient movement of freight throughout the state. This includes the need for designated truck routes, oversize/overweight truck corridors, and hazardous material routes. A dedicated freight network will promote opportunities for connectivity throughout the state, improve the efficiency of the entire transportation system, and enhance global competitiveness.

4.4 Safety/Security

Safety is a major focus of TxDOT and private sector stakeholders. A key priority should be to operate effectively and efficiently and maintain safety standards. Key safety needs include:

- Lack of safe truck parking
- Numerous at-grade rail crossings particularly in urban areas
- Poor roadway design and geometrics
- Lack of public education and awareness of commercial vehicle operations

In addition to congestion, vehicular crashes also create delays for freight and can result in significant damage to cargo and personal injury. This includes heavy truck crashes on highways and crashes at highway-rail grade crossings.

4.5 Intermodal Connectivity

Modal availability is measured in varying degrees by the regions throughout the state, though all agree the lack of strong connectivity between the modes reduces their efficient and productive use. A system with adequate and available access points, e.g. truck-rail facilities, promotes the use of alternative modes beyond truck. Without these access points, supply chain decision makers rely on trucks rather than rail, water, or air transport. This lack of access contributes to the capacity concerns on highways. Without better intermodal connectivity, the combination of higher forecasted volumes of trade and reliance on truck transport will lead to increased congestion. The lack of connectivity among modes hinders the future growth of the Texas economy.

4.6 Rural Connectivity

The TFMP outcomes should promote operational capacities and modal diversity to rural regions. This expansion will promote economic development and manage the future volumes of trade. Currently, 109 out of 253 counties in Texas are classified as rural as defined by the US census. The south and west regions have typically not been afforded access to modes beyond truck. Access to rail transport is frequently identified as a site selection criteria for new investment by manufacturers or distributors. Without modal alternatives, these regions are placed at an economic disadvantage. Farm-to-Market (FM) roads are seeing increased traffic with rural production and the state needs to ensure the system is maintained and expanded. The west Texas region has been identified as a potential site for future space-centric activities, without appropriate rail and air cargo capacities, transport will be limited to trucks, something which may impact the economic potential.

4.7 NAFTA and Border/Ports-of-Entry

Texas is the number one US trading partner with Mexico. Texas shares a common border with Mexico and as such is subject to not only the direct exchange of freight, but also a significant amount of pass-through freight as well. The increasing role of the Mexican economy within global trade has dramatically impacted Texas border crossings. Foreign investors, including China, have invested in Mexican freight infrastructure, such as Federal Highway 2 that runs along the Mexico–US border, and Port Lazaro-Cardenos, which is the largest Mexican seaport. Mexican manufacturing centers, known as maquilas, have raised the level of trade between the US and Mexico. Many of these investments are ongoing and will continue to impact trade volumes.

Activities impacting supply chain decisions by US and foreign organizations have promoted a redirection of manufacturing, assembly, and raw material processing to Mexico from Asian markets. Robotics, reducing the impact of labor wages, additive and regional manufacturing, duty-free and tariff-free material and equipment importation, and fuel-transportation costs have collectively fostered an increase of goods moving from Mexico into the US

Areas surrounding border crossings are subject to extreme traffic congestion. As trade increases and congestion worsens, the resulting situation may promote other methods of transportation for import and export traffic with Mexico. The inability to productively process trade at the international bridges and border crossings may foster alternative modal use or redirect trade volumes to crossings with other states other than Texas. Redirecting trade volumes to other states could have a negative impact on the economy.

4.8 Energy/Environment

There is a great deal of focus on exploring alternative fuel sources, particularly liquid natural gas and compressed natural gas. However, many alternative fuel sources are not financially viable options and often are not suitable for transporting hazardous materials or overweight loads. Additionally, there is a need to streamline the environmental regulatory review process to be more efficient.

4.9 Education/Public Awareness

Effective freight planning is dependent upon public awareness of key freight issues. Stakeholders stressed the importance of public education on the benefits of freight. In particular it was noted that the public needs to be made aware of the economic benefits and quality of life improvements that are supported by freight mobility including job creation and global economic competitiveness. Educating the public on safety issues related to freight is also a focus. Stakeholders believe that the general public is not aware of the challenges that the trucking industry faces. This lack of understanding can lead to safety problems.

4.10 Public/Private Sector Coordination

Planning activities often occur within the silo of a specific agency or organization, resulting in less than satisfactory implementation. Without the cooperation of other agencies and integration with other TxDOT and external agency plans, TxDOT implementation efforts may not meet the goals of the individual plan. In an effort to alleviate these shortcomings, TxDOT should form cooperative partnerships to provide efficient and economy-of-scale efforts to achieve successful implementation. Stakeholders noted that the public and private sector need to work together to create a safe, reliable, and efficient freight network in Texas.

4.11 Funding/Financing

The majority of transportation funds come from the federal gas tax which has not been raised since 1993. This has put a severe strain on the transportation sector to find alternative funding sources for transportation projects. There is a need to identify innovative and alternative funding sources.

4.12 Performance

In section 2 the primary needs of the TFHN were classified into three categories; asset management, mobility and reliability, and safety. Current conditions and future expectations for increasing freight volume direct the need for investment.

4.12.1 Asset Management

Adequately maintaining the condition of Texas' highways, bridges, and rail networks, particularly those associated with the TFHN is critical to freight movement.

Most roadways on the TFHN are currently in good condition (84 percent). This overall average, however, conceals some major concerns. Texas interstate highways, the most important part of the highway network, have a smaller percentage of sections in good condition and a larger percentage in very poor condition when compared to overall TFHN averages. The Dallas area has the most miles of roadways with pavement conditions of poor and very poor.

The 2040 traffic forecasts and pavement condition grades were used to identify the top 25 roadway segments that should be prioritized for improvement. The sections, on average, are in the poorest condition for the anticipated future truck volumes. These 25 roadway sections are presented in Exhibit 37. Five of these sections are on interstates, nine are on US highways, six are on state highways, and five of these segments are on farm-to-market (FM) roadways. These sections are prioritized because they are in very poor condition and are anticipated to carry high truck volumes in the future.

Exhibit 37. Prioritized Texas Preliminary Freight Network – Pavement Condition

Control Section	Roadway	Length	District
0675-04	IH 45	9.9	Bryan
0261-02	US 67	5.7	Dallas
2552-03	SL 375	14.4	El Paso
1890-01	FM 1976	13	San Antonio
0374-02	US 62	8	El Paso
0259-05	BU 67	5.6	Fort Worth
0264-06	US 277	5.8	San Angelo
0255-07	US 281	5.4	Pharr
0371-01	US 77	7.9	Yoakum
0271-15	IH 610	6.1	Houston
0271-14	IH 610	6.1	Houston
0441-09	IH 10	8.7	Odessa
0272-04	US 190	6.2	Brownwood
0306-03	SH 87	6.9	Beaumont
0264-05	US 277	5.8	San Angelo
0275-07	IH 40	6.4	Amarillo
0389-12	BS 146	8.3	Houston
2452-03	SL 1604	14.2	San Antonio
0400-02	SH 154	8.4	Paris
0339-05	SH 105	7.4	Beaumont
2681-02	FM 2499	14.8	Fort Worth
1802-02	FM 3461	12.8	Pharr
0254-01	US 281	5.3	Corpus Christi
1064-01	FM 676	11	Pharr
1890-01	FM 1976	13	San Antonio

Source: TxDOT Pavement Management Information System and Statewide Analysis Model v.3

Bridge Conditions. Based on analysis using the Federal Highway Administration's (FHWA's) National Bridge Inventory condition rating system, the vast majority of bridges in Texas are in good condition and less than 1 percent of bridges are in poor or very poor condition. Substructures and culverts, however, are generally in worse condition than other bridge elements.

The 25 bridges in very poor condition are presented in **Exhibit 38**. Four of these bridges are on interstates, twelve are on US highways, eight are on state highways, and one is on the FM roadway network. The bridges in very poor condition with low traffic volumes are already posted with warnings and limitations. Other bridges are in very poor condition because of their high traffic volumes and importance in the highway system.

Exhibit 38. Texas Preliminary Freight Network Bridges with Lowest Sufficiency Ratings

Bridge	Intersected Feature	City (nearest)	Sufficiency Rating
IH 35	Road (travels under)	Dallas	228
US 82	Waterway	Texarkana	330
US 190	Waterway	Lufkin	341
US 190	Waterway	Lufkin	341
SH 310	Road (travels over)	Dallas	347
US 84	Waterway	Longview	351
SH 35	Waterway	Houston	351
US 77	Waterway	Corpus Christi	355
US 287	Waterway	Wichita Falls	356
US 87	Road (travels over)	Amarillo	360
US 87	Road (travels over)	Amarillo	360
IH 45	Road (travels over)	Houston	378
SH 183	Road (travels over)	Fort Worth	389
SH 87	Waterway	Beaumont	392
SH 105	Waterway	Bryan	398
FM 720	Waterway	Dallas	403
SH 35	Waterway	Corpus Christi	408
SH 183	Rail (travels over)	Fort Worth	412
US 190	Waterway	Lufkin	341
IH 20	Waterway	Abilene	425
IH 35	Waterway	Fort Worth	430
US 84	Road (travels under)	Abilene	437
US 67	Waterway	Odessa	438
US 281	Waterway	Fort Worth	443
SH 73	Waterway	Beaumont	450
IH 35	Road (travels under)	Dallas	228
US 82	Waterway	Texarkana	330
US 190	Waterway	Lufkin	341
US 190	Waterway	Lufkin	341
SH 310	Road (travels over)	Dallas	347
US 84	Waterway	Longview	351

Track Quality. The PTFRN is the most extensive state rail system in the United States. While these rail facilities are owned by private companies, including Union Pacific, BNSF, and Kansas City Southern, track maintenance has a direct impact on operation speeds and weight capacity. Most of Union Pacific's system is approved for heavy axle rail cars that can handle up to between 286,000 lbs. and 315,000 lbs. of gross weight. BNSF provides weight restriction maps for 4-axle cars based on their length.

Nearly all railroad lines in Texas are single-track; there are four segments of multi-track rail lines. The longest multi-track rail line runs from the New Mexico border northeast through Amarillo to the Oklahoma border. There are three shorter multi-track segments in urban environments: one line between northeast San Antonio and New Braunfels; one line between Fort Worth and Dallas; and a third line, which runs within Houston. Additionally the railroad system includes 72 railroad bridges that cross waterways.

4.13 Mobility

The mobility of a freight transportation network is largely determined by the number and severity of "bottlenecks." Identification and ranking of the top freight highway bottlenecks is primarily based on the FHWA Office of Freight Management and Operations' annual Freight Performance Measures (FPM) analysis, which assesses the level of truck-oriented congestion at 250 locations on the national highway system, and results from a Texas Transportation Institute (TTI) study on freight bottlenecks to validate the results. As Exhibit 39 indicates, Texas is responsible for five of the top ten truck bottlenecks in the nation. Half of the 16 bottlenecks in Texas saw their national ranking increase between 2010 and 2012, while the other half saw improvement in relative congestion.

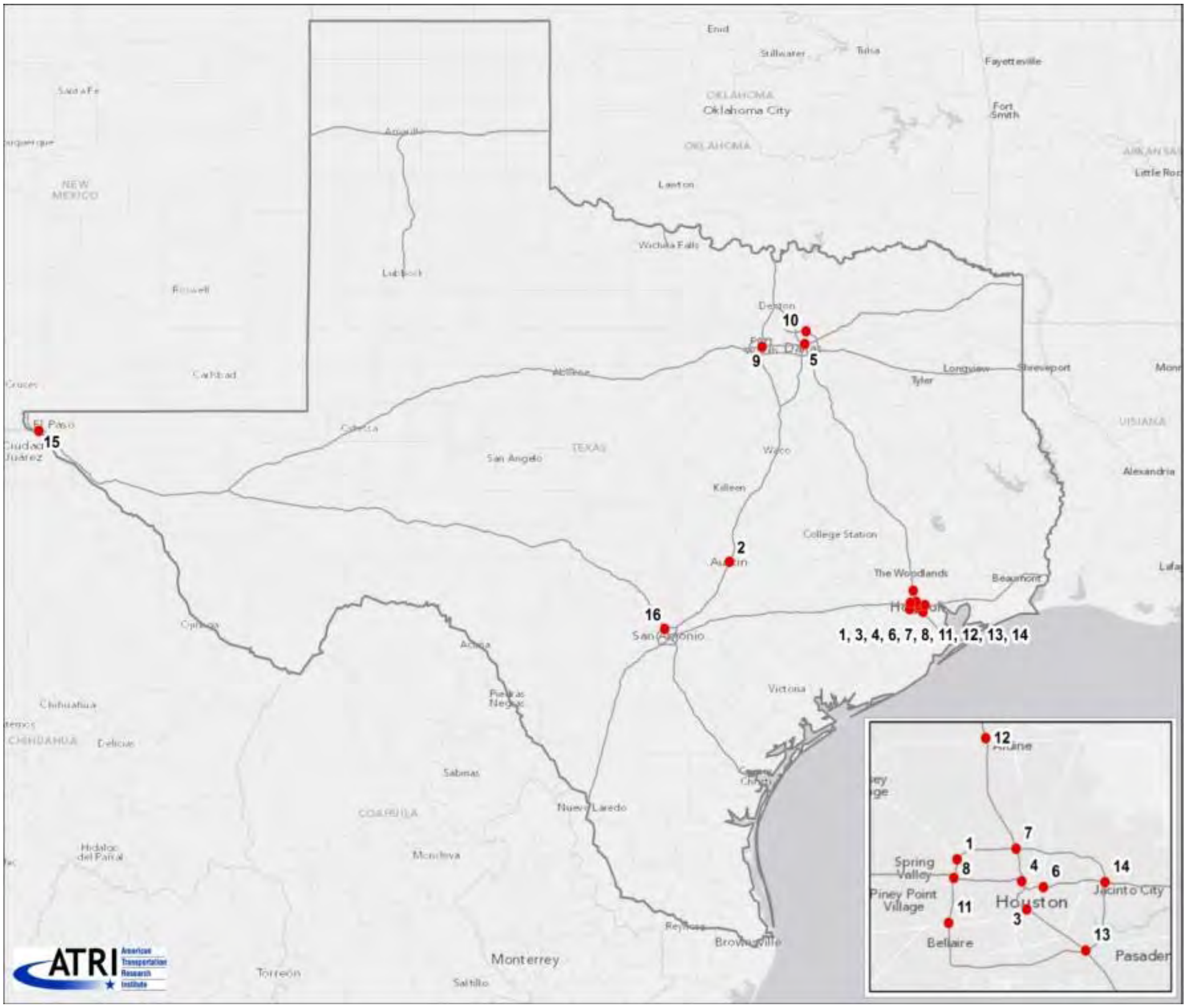
Exhibit 39. Freight Performance at Texas Bottlenecks

LOCATION	RANKING		TTI
	2012	2010	
Houston, TX: I-610 at US 290	2	12	21
Austin, TX: I-35	3	7	2
Houston, TX: I-45 at US 59	7	3	16
Houston, TX: I-10 at I-45	9	4	1
Dallas, TX: I-45 at I-30	10	13	
Houston, TX: I-10 at US 59	11	5	19
Houston, TX: I-45 at I-610 (North)	16	14	47
Houston, TX: I-10 at I-610 (West)	21	26	3
Ft. Worth, TX: I-35W at I-30	23	29	5
Dallas, TX: US 75 at I-635	30	53	14
Houston, TX: I-610 at US 59 (West)	34	50	
Houston, TX: I-45 at Sam Houston Tollway (North)	62	94	15
Houston, TX: I-45 at I-610 (South)	71	62	59
Houston, TX: I-10 at I-610 (East)	84	44	33
El Paso, TX: I-10 at I-110/US-54	103	89	50
San Antonio, TX: I-10 at I-410 (North)	146	142	83

Source: American Transportation Research Institute, 2013

Exhibit 40 illustrates the location of the 16 monitored bottlenecks in Texas. As expected, the worst bottlenecks are located in major urban areas, including Houston, Dallas-Ft. Worth, and San Antonio. There are other areas of congestion but those listed are the worst congestions locations as determined by the FHWA's FPM.

Exhibit 40. Location of Texas Bottlenecks



Source: American Transportation Research Institute, 2013

Rail bottlenecks result in delays to trains and may simultaneously cause vehicular traffic delays at blocked at-grade highway-rail crossings, increasing delays for both modes, as well as increasing public and private operating costs. As Texas has an extensive rail network with multiple intermodal connections, the statewide impact of bottlenecks can be extensive.

There are many reasons bottlenecks develop on a rail system. They can originate at a single point such as at-grade crossings of rail lines, rail junctions, a section of single track in a predominately double-track line, or a bridge with weight limitations that requires crossing at restricted speeds. Bottlenecks can result over a long area of track from conditions such as an inadequate number of passing tracks, passing tracks that are not long enough for the length of trains using the line, lack of signals, etc.

There are numerous rail bottlenecks throughout the state including regions defined by Houston, Dallas-Fort Worth, Corpus Christi, San Antonio, and Beaumont.

4.13.1 Safety

The safety hazards analysis provides a snapshot of the performance of highways and at-grade highway-rail crossings on the Texas Trunk System and main railroad lines. Crash and incident data are analyzed for commercial motor vehicles, at-grade highway-rail crossings, and mainline railroad incidents. During the period from 2010 to 2012 the total statewide number of commercial motor vehicle crashes and the number of commercial motor vehicles crashes on the PTFN have shown an upward trend. The number of total commercial motor vehicle crashes, and incapacitating injury crashes showed a dip in 2011 even though vehicle miles traveled in the state increased 1.36 percent from 2010 to 2011. Of the crashes on the PTFN involving a commercial vehicle, the percentage of fatal crashes was 1.8 percent and the number of crashes involving an injury or possible injury was 28.7 percent for the three year period. Truck rollovers were also examined and **Exhibit 41** lists the top ten rollover locations as identified by The American Trucking Research Institute (ATRI). While several of the rollover locations are located near major urban areas, particularly Dallas-Ft. Worth, many of the top rollover locations are outside of the large cities.

Exhibit 41. Rollover Frequency at Identified Locations

Top Rollover Locations		
ID	Location	Number of Rollovers
1	US 59/South St and US 59/SR 224	9
2	Central Expy and CF Hawn Fwy/US 175	9
3	SR 183, SR 114, SR 12 and S 482	8
4	I-10/US 90 and US 59	8
5	US 259 and US 59	7
6	I-30/US 67 and I-35E/US 77	7
7	I-35 near Bob Bullock Loop/SR 20	6
8	US 77 near Welder Wildlife	6
9	I-20/US 80 and US 84	6
10	I-35@ and Martin L King Jr Fwy/US 287	6

Source: American Transportation Research Institute 2013

It is difficult to attribute large truck rollover accidents to a single cause. Many different factors such as speed, road geometry, load configuration, brake condition, pavement condition, and intersections can all contribute simultaneously (though not necessarily equally) to a rollover event. While this report does not have specific information related to the driver, truck or load types and distributions, some insights about rollover cause can be drawn from the operating environment information gained by mapping the rollover crash locations.

Crash records for the rail system were obtained from the FRA's Office of Safety Analysis website and included all crashes and incidents involving rail traffic that occurred between January 1, 2010 and December 31, 2012 including incidents at highway-rail crossings, and a statewide database of all highway-rail crossings. Since 2010, the total annual number of crashes and resulting fatalities at highway-rail grade crossings in Texas has increased, while the number of injuries caused by highway-rail grade crossing crashes remained about the same over this same period. Automobiles were the vehicle most often involved in a crash at a grade crossing (31 percent) while truck-trailers were the second most-involved vehicles (26 percent). The percentages for vehicle types involved in at-grade crashes remained approximately the same over the three year period.

There are 75 highway-rail grade crossings where railroads intersect with the TFHN. Forty-eight of these crossings have a commercial motor vehicle average annual daily traffic (AADT) count greater than 500. In the past three years there have been 17 crashes at nine of these crossings resulting in no injuries and fatalities. Six of these nine crossings had an estimated commercial motor vehicle AADT greater than 500.

4.14 Unconstrained Needs

The TFMP is moving on a different schedule than the LRTP. Some of the information regarding the monetary requirements to meet the needs for improving the freight infrastructure are not yet available from the TFMP. Some information regarding highway capacity improvement has been made available from the freight planning team. Investment needs for other modes have been collected from other sources including TxDOT planning documents, plans of individual entities such as airports, and information that is publicly available. These dollar amounts should be considered preliminary and while they may be representative of project requirements they should not be considered final.

4.14.1 Highway Needs

Most of the highway and bridge needs for freight have been encompassed in the LRTP. However the entire range of highway and bridge projects for the TFMP have not been completed and some variation from the LRTP may occur. The following estimates have been provided by CDM Smith, Inc. for a series of improvements to ease capacity on both the primary and secondary freight networks. These numbers are preliminary based on the current schedule and status for the freight planning project. Exhibit 42 indicates the estimates for projects to improve capacity on those corridors in the state that have been identified as part of the Primary Freight Highway Network. The estimates were developed based on corridor segment requirements. For example the section of I-10 between El Paso and Van Horn is treated as a segment and the estimates for expansion produced accordingly. The following Exhibit 43 shows the total miles and estimated construction costs to widen roads and highways that have been designated as part of the Secondary Freight Highway Network. The exhibits show only the summary totals and the dollar amounts should be regarding as preliminary only.

Exhibit 42. Primary Corridor Capacity Improvements

Primary Freight Highway Network Capacity Improvements		Additional Mainlines	Addition of Access Roads	Total Estimate
Statewide Primary Corridor Total	Miles	4,347 Miles	2,420 Miles	
	Construction Estimate	$12,171,600,000	$7,260,000,000	$19,431,600,000

Source: CDM Smith, Inc.

Exhibit 43. Secondary Freight Highway Network Lane Expansions

Secondary Freight Highway Network Lane Expansion		Secondary Pavement 4 Lane Widening		Secondary Pavement "Super 2" Widening*
		Additional 2 Lanes	Additional 1 Lane	
Total Construction Costs All Districts	Miles	5,156 Miles	170 Miles	3,867 Miles
	Construction Estimate	$8,765,200,000	$170,000,000	$3,867,000,000

Note:
*Estimated at 75% of existing 2 lane roadway

Source: CDM Smith

4.14.2 Rail Needs

The needs for freight rail development are included here as they are presented in the Texas Rail Plan from November of 2010. The plan document is available on the TxDOT website. The table below in **Exhibit** 44 summarizes the estimated cost of rail freight capital needs in Texas through 2030 which was the planning horizon for the 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 Rail Plan to indicate the extent of the needs for freight rail improvements in the state.

Exhibit 44. Estimated Texas Freight Rail Needs, 2005 to 2030

Freight Rail Need	Cost
Crossing Closure	$18,900,000
Pedestrian Bridge	$7,500,000
Grade Separation	$2,172,400,000
New Rail Connections	$1,730,340,000
Total	**$3,929,040,000**

Source: Texas Rail Plan 2010 Executive Summary

4.14.3 Airport Needs

The Austin-Bergstrom International Airport (AUS)'s 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 Dallas/Fort Worth International Airport (DFW) 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 (SAAS)'s 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. SAAS estimated their costs in 2010 dollars.

The airport needs that are specifically attributed to freight in these airport planning documents are summarized below in **Exhibit 45**.

Exhibit 45. Airport Needs

<table>
<tr><th colspan="2"></th><th>Austin</th><th>Bush</th><th>Corpus Christi</th><th>Houston Hobby</th><th>San Antonio</th><th>Dallas – Fort Worth</th></tr>
<tr><td rowspan="2">Airport Cost</td><td>Air Cargo</td><td>-</td><td>$445,346,000</td><td>-</td><td>-</td><td>-</td><td rowspan="4">$260,888,005**</td></tr>
<tr><td>Belly Cargo</td><td>$420,134</td><td>-</td><td>-</td><td>$13,090,000</td><td>-</td></tr>
<tr><td rowspan="2">3rd Party Cost</td><td>Air Cargo</td><td>$193,626,293</td><td></td><td rowspan="2">$2,124,000</td><td></td><td>$78,040,000</td></tr>
<tr><td>Belly Cargo</td><td>$12,747,875</td><td></td><td></td><td></td></tr>
</table>

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

4.14.4 Port Needs

The project funding needs for Texas Ports is presented as taken from the Texas Ports 2013-2014 Capital Program report. This is an annual report that details funding requests for port transportation and economic development projects submitted by eligible ports. The 2013-2014 report identifies capital projects totaling $779,791,400.00. These capital projects do not represent a comprehensive listing of all capital needs of Texas ports. 11 ports provided port profiles for the FY 2013/FY 2014 period. These ports submitted 51 projects, a small part of their capital activities. State funding requirements for all of these projects at a maximum cost share level of 50 percent from the Port Access Account Fund. The report committee included every eligible project submitted with no prioritization. The projects range from improving intermodal connections to security enhancements. Specific details of the plans for each port are available in the full report at the TxDOT website.

Exhibit 46. FY 2013 Port Project Summary

Port and Project Description	Total Estimated Cost	Port Funding	Port Access Account Funding
Port of Beaumont			
Upgrade KCS Railroad Bridge across Port of Beaumont Ship Channel	$16,000,000.00	$8,000,000.00	$8,000,000.00
Orange County Railroad Overpass	$9,000,000.00	$4,500,000.00	$4,500,000.00
Wetland Impact Mitigation for 215 acres in Orange County	$5,000,000.00	$2,500,000.00	$2,500,000.00
Total	*$30,000,000.00*	*$15,000,000.00*	*$15,000,000.00*
Port of Brownsville			
Deepening and Widening Feasibility Study	$650,000.00	$325,000.00	$325,000.00
Lift Station Improvements	$60,000.00	$30,000.00	$30,000.00
Water Tank Rehabilitation	$1,033,000.00	$516,500.00	$516,500.00
New Infrastructure	$20,500,000.00	$10,250,000.00	$10,250,000.00
Improvements to docks, Warehouses, and Cargo Laydown Areas	$3,502,000.00	$1,751,000.00	$1,751,000.00
Port Security Improvements	$1,033,000.00	$1,993,000,00	$1,993,000,00
Rail Improvements	$2,200,000.00	$1,100,000.00	$1,100,000.00
Total	*$31,931,000.00*	*$15,965,500.00*	*$15,965,500.00*
Port of Corpus Christi			
Rail Infrastructure	$40,000,000.00	$20,000,000.00	$20,000,000.00
Rincon Industrial Park	$13,500,000.00	$6,750,000.00	$6,750,000.00
La Quinta Terminal Dock – Phase 1	$3,000,000.00	$1,500,000.00	$1,500,000.00
Total	*$56,500,000.00*	*$28,250,000.00*	*$28,250,000.00*
Port of Freeport			
Velasco Terminal Project	$2,809,000.00	$1,404,500.00	$1,404,500.00
Multimodal Facilities	$299,000.00	$149,500.00	$149,500.00
Project Cargo Storage and Related Development	$75,000.00	$37,500.00	$37,500.00
Cold Storage Facility	$715,000.00	$357,500.00	$357,500.00
Security Related	$143,000.00	$71,500.00	$71,500.00
Other Projects	$916,400.00	$458,200.00	$458,200.00
Total	*$4,957,400.00*	*$2,478,700.00*	*$2,478,700.00*
Port of Galveston			
41st St. Harborside Entrance	$1,500,000.00	$750,000.00	$750,000.00
RUBB Building	$7,650,000.00	$3,825,000.00	$3,825,000.00
Internal Traffic Circulation	$5,000,000.00	$2,500,000.00	$2,500,000.00
Vessel Fendering System	$950,000.00	$475,000.00	$475,000.00
Total	*$15,100,000.00*	*$7,550,000.00*	*$7,550,000.00*
Port of Harlingen			
East Dock Refurbishment (100% port funded)	$1,000,000.00	$0.00	$0.00
Security Enhancements (Federally funded)	$130,000.00	$0.00	$0.00
Total	*$1,130,000.00*	*$0.00*	*$0.00*

Exhibit 46. FY 2013 Port Project Summary

Port and Project Description	Total Estimated Cost	Port Funding	Port Access Account Funding
Port of Houston			
Barbours Cut Terminal	$56,900,000.00	$28,450,000.00	$28,450,000.00
Bayport Terminal	$207,870,000.00	$103,935,000.00	$103,935,000.00
Turning Basin Terminal	$20,000,000.00	$10,000,000.00	$10,000,000.00
Total	*$284,770,000.00*	*$142,385,000.00*	*$142,385,000.00*
Port of Palacios			
Turning Basin #1 Cargo Deck	$1,200,000.00	$600,000.00	$600,000.00
Shipyard Construction	$2,250,000.00	$1,125,000.00	$1,125,000.00
Study for Beneficial Use of Dredged Material	TBD	TBD	TBD
Total	*$3,450,000.00*	*$1,725,000.00*	*$1,725,000.00*
Port of Port Arthur			
Berth 6 and Shoreline Stabilization	$25,000 ,000.00	$12,500,000.00	$12,500,000.00
Road and Site Access	$1,500,000.00	$750,000.00	$750,000.00
Security	$1,200,000.00	$600,000.00	$600,000.00
Total	*$27,700,000.00*	*$13,850,000.00*	*$13,850,000.00*
Port of Victoria			
Rail Staging Area Enlargement	$6,500,000.00	$3,250,000.00	$3,250,000.00
Liquid Cargo Dock Additions	$3,500,000.00	$1,750,000.00	$1,750,000.00
Erosion Control	$1,500,000.00	$750,000.00	$750,000.00
Total	*$11,500,000.00*	*$5,750,000.00*	*$5,750,000.00*
Total All FY 2013 Projects	$467,038,400.00	$232,954,200.00	$232,954,200.00

Exhibit 47. FY 2014 Port Project Summary

Port and Project Description	Total Estimated Cost	Port Funding	Port Access Account Funding
Port of Brownsville			
Deepening and Widening Feasibility Study	$500,000.00	$250,000.00	$250,000.00
Improvements to Docks and Warehouses and Cargo Laydown Areas	$26,038,000.00	$13,019,000.00	$13,019,000.00
Water Tank Rehabilitation	$982,000.00	$491,000.00	$491,000.00
Total	*$27,520,000.00*	*$13,760,000.00*	*$13,760,000.00*
Port of Corpus Christi			
La Quinta Terminal	$20,000,000.00	$10,000,000.00	$10,000,000.00
Barge Fleeting Area	$3,000,000.00	$1,500,000.00	$1,500,000.00
Channel Improvement Project – La Quinta Terminal	$8,000,000.00	$4,000,000.00	$4,000,000.00
La Quinta Terminal Dock - Phase 2	$47,000,000.00	$23,500,000.00	$23,500,000.00
Total	*$55,000,000.00*	*$39,000,000.00*	*$39,000,000.00*
Port of Houston			
Barbours Cut Terminal	$58,690,000.00	$29,345,000.00	$29,345,000.00
Bayport Terminal	$114,993,000.00	$57,496,500.00	$57,496,500.00
Total	*$173,683,000.00*	*$86,841,500.00*	*$86,841,500.00*
Port of Port Arthur			
Rail Reliever	$4,000,000.00	$2,000,000.00	$2,000,000.00
Total	*$4,000,000.00*	*$2,000,000.00*	*$2,000,000.00*
Port of Victoria			
Rail Extension to Industrial Park South Property	$5,500,000.00	$2,750,000.00	$2,750,000.00
Road Improvements	$6,000,000.00	$3,000,000.00	$3,000,000.00
Container Dock Construction	$12,550,000.00	$6,275,000.00	$6,275,000.00
RO/RO Facility Construction	$5,500,000.00	$2,750,000.00	$2,750,000.00
Total	*$29,550,000.00*	*$14,775,000.00*	*$14,775,000.00*
Total All FY 2013 Projects	$312,753,000.00	$156,376,500.00	$156,376,500.00

5.0 Fiscally-Constrained Analysis

The CDM Smith and TxDOT team creating the TFMP have determined that their approach to project implementation will be to focus development on selected, prioritized corridors rather than on individual initiatives spread around the state. Application of resources to a corridor will provide a more complete return on the investment relative to the needs of the freight community and is consistent with the goals of MAP-21.

The freight planning team is in the process of developing a scoring system to be applied to the primary corridors by segments. The corridor segments are being identified and will be scored based on their ability to meet various criteria determined to be critical to freight mobility in the state. The scoring will include factors related to the goals of the TFMP and key needs and issues identified previously. Some examples would include the number of bridges and overpasses along the segment with height or weight restrictions, or the number of major freight facilities in proximity to the corridor. The corridors will be ranked based on the combined segment scoring. Cost estimates will then be completed for a short list of corridors that will have priority for development.

This work is ongoing and preliminary numbers are anticipated to be available in September. The TFMP is scheduled for completion at the end of the year and will provide more specific freight detail to supplement the LRTP.

Appendix A
List of Major New Service Projects

Texas Transportation Plan

Tech Memo 10: Scenario Analysis

August 15, 2014

Acknowledgements

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Contents

Tables

Figures

A multimodal, performance-based needs assessment was conducted for the 2040 Texas Transportation Plan (TTP) to identify the minimal investment required to achieve a state-of-good-repair or similar performance targets over the planning horizon. This Technical Memorandum #10 provides four example investment approaches to better evaluate the costs and outcomes of investing in our transportation system: (1) System Preservation, (2) Metropolitan Mobility, (3) Connectivity and Freight Mobility, and (4) Financially-Constrained “Plus”. The expected revenues available to meet statewide multimodal transportation needs are also presented.

1.0 Revenue Forecast

Texas’ population is expected to increase by 17 million by 2040. Therefore, a substantial investment in transportation infrastructure will be necessary to ensure sufficient and reliable mobility options for system users, safe infrastructure, and continued statewide economic growth. A review of available and forecasted financial resources to make progress towards these TTP goals, among others, is provided below.

1.1 State Transportation Revenues

Revenues for all modes in the State were forecasted for the 2040 TTP using estimates provided by the TxDOT Financial Division, including forecasts of vehicle registration fees, state motor fuel tax, FHWA reimbursements, and transit funds.

State transportation revenues totaled $10.5 billion in 2013 with funding from federal, state, and other sources (**Figure 1**) for all modes analyzed in the TTP. According to TxDOT’s revenue forecast shown in **Figure 2**, annual revenues are expected to peak in 2015, followed by a slight decline over the next five years and then steadily increase through 2040. On average, it is estimated that the State can expect $11.6 billion (in 2014 constant dollars) through 2040 for investment in the modes analyzed in the TTP.

Figure 1: Texas Transportation Main Revenue Sources

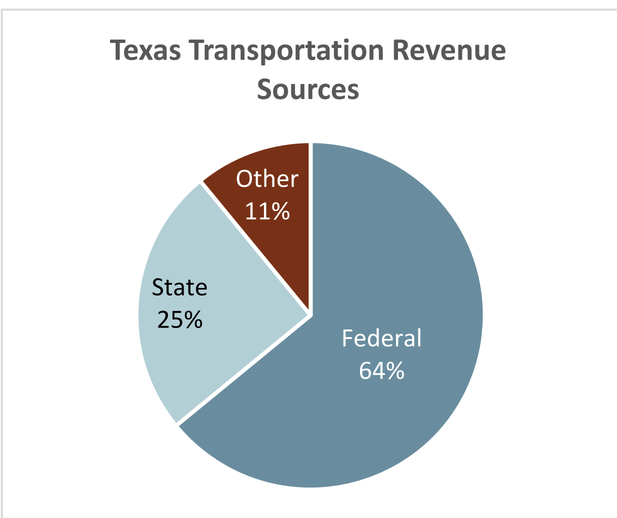
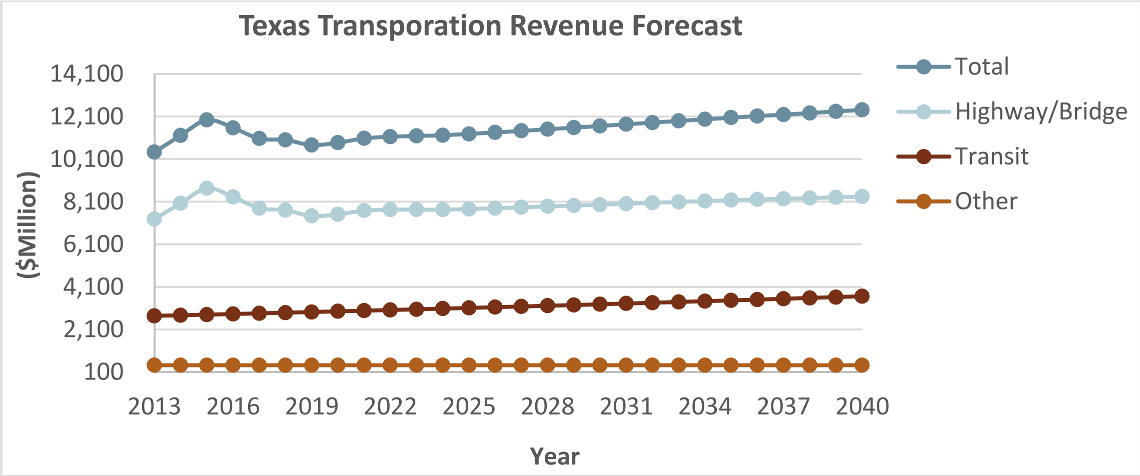


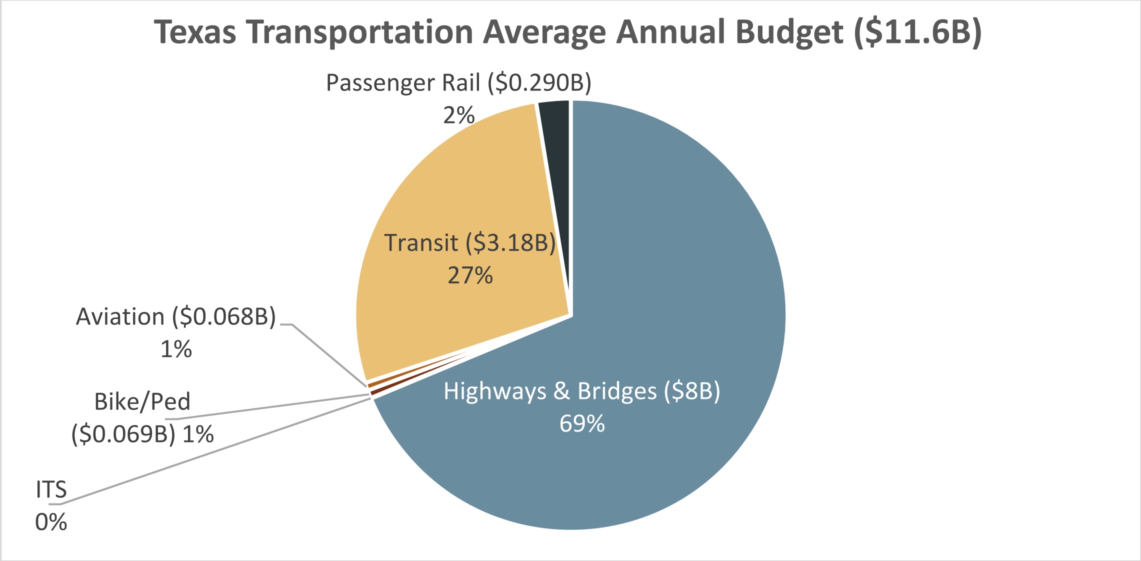
Figure 2: Revenue Forecasts for TTP Analysis



1.2 *Available Revenue by Mode*

Because the forecasted $11.6 billion per year is for all modes in the State, it must be broken out among these modes, which include highway/ bridge, transit, aviation, bicycle/ pedestrian, and passenger rail. Of course, some funds are not flexible and their spending is restricted to a certain mode (for example, federal transit revenues are restricted from being reallocated to other modes) while others are more flexible. Figure 3 shows the split of how the total available budget is typically divided between the modes analyzed in the TTP. Highways and transit investments represent more than 95 percent of the total annual budget on average.

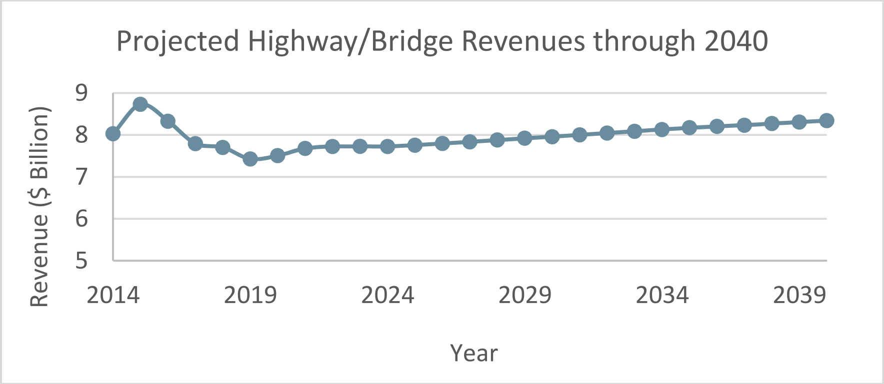
Figure 3: Annual Budget Share (in 2014 constant dollars) by Mode



1.2.1 *Highway/Bridge*

Figure 4 shows TxDOT's highway/ bridge revenue forecast through 2040. For investment in the State's highways and bridges (on the State system), ninety percent of the budget for Texas highways and bridges originates from vehicle registration fees, state motor fuel tax, lubricant sales tax, and FHWA reimbursements.

Figure 4: Highway/Bridge Revenue Forecast

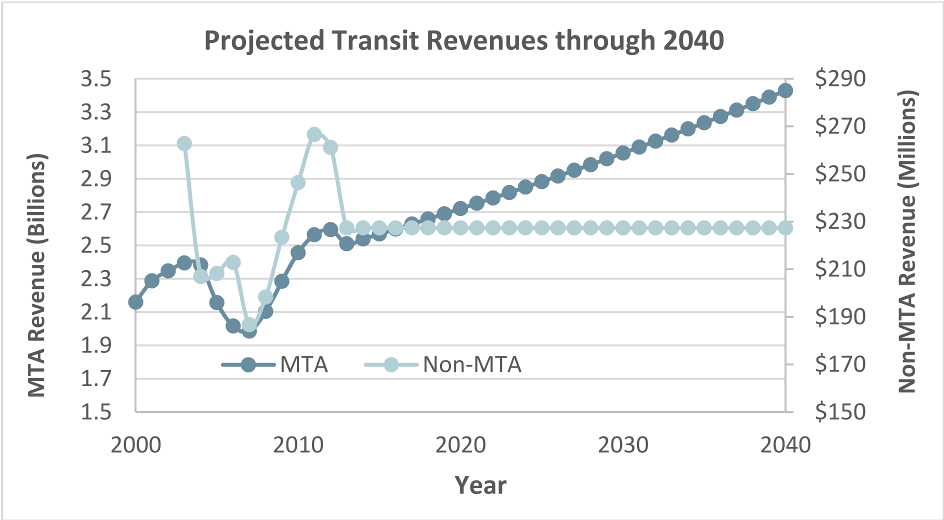


Using TxDOT revenue forecasts and historical expenditures, the average annual discretionary highway budget anticipated through 2040 is approximately $5.5 billion per year in 2014 constant dollars, which includes capital, maintenance, and other reasonably-expected available revenues available to fund TTP investments. While TxDOT's total budget is closer to $8 billion annually, it is important to note that much of the budget is committed to agency operations and other ongoing projects and activities and not available for investment activities identified in the Plan.

1.2.2 *Transit*

The TTP transit revenue forecast includes anticipated funds from Metropolitan Transportation Authorities (MTA) and non-MTA operators, which are largely funded through the State. MTAs are direct recipients of funding from the Federal Transit Administration (FTA) and do not receive state funds. Non-MTA agencies receive their funding directly from TxDOT. To forecast the MTA budget the average funding for the past 10 years was used as a baseline for 2014. By taking a longer look back at funding, the dip in MTA funds due to the recent recession were mitigated when making the forecast. A projection growth rate of 1.2 percent was included to account for population growth and new transit service through 2040 (Figure 3), resulting in projected annual average revenues of $2.9 billion in 2014 constant dollars.

Figure 5: Transit Revenue Forecast



1.2.3 Aviation

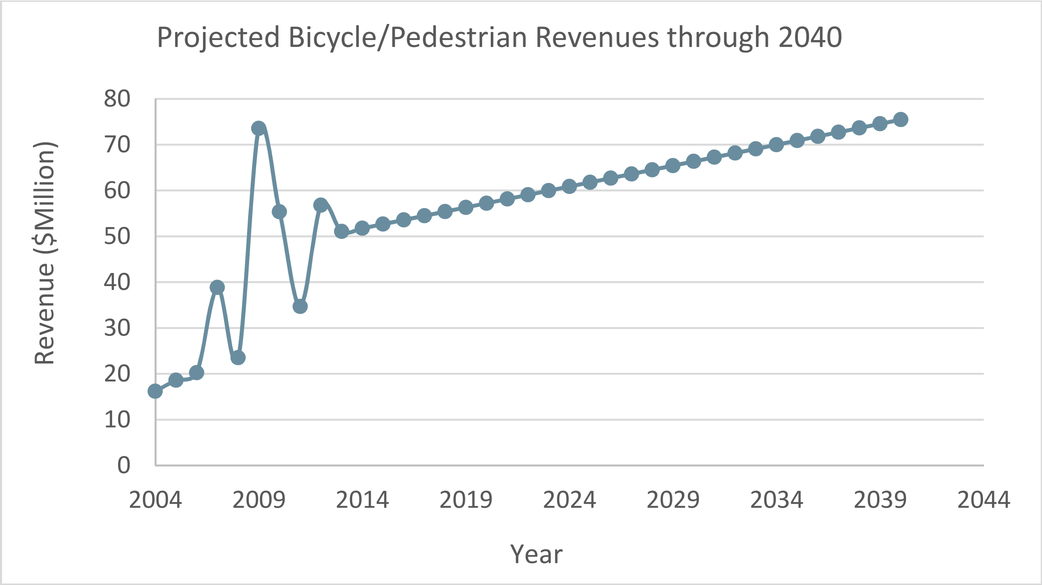
TxDOT estimates that, on average, $58 million in Federal Block Grant Funds will continue to be available through 2040 with an additional $10 million annually available in state funds to support general aviation. Many states have an aviation fuel tax which is used to fund an aviation account; however, Texas receives its aviation funding from the Highway Trust Fund which is supported by a state motor fuel tax.

1.2.4 Bicycle/Pedestrian

Funding for the bicycle and pedestrian modes is provided by a variety of federal, state, local, and private sources. In addition, funding programs change over time, particularly when new federal surface transportation laws are implemented. MAP-21 provides states and local jurisdictions more flexibility and local control in the use of federal transportation funds; however, MAP-21 also consolidated some bicycle and pedestrian-specific programs and reduced total funding for these modes.

The state-reported spending on bicycle and pedestrian facilities and programs in the last 10 years was used to forecast the revenue through 2040. The result shows that the average revenue for bicycle/ pedestrian facilities and services is about $69 million per year.

Figure 6: Bicycle/Pedestrian Revenue Forecast



1.2.5 Passenger Rail

The revenue forecast through 2040 shows that on average $290 million is available for passenger rail each year. This revenue is largely AMTRAK revenue; however, it is important to note that it would not support AMTRAK expansion projects such as Southwest Chief Reroute, and Heartland Flyer nor is it enough to invest in High Speed Rail projects such as Texas Central Railway HSR, and Texas-Oklahoma Passenger Rail Study (TOPRS) without further federal support.

2.0 Investment Approaches

As developed for the TTP, unconstrained needs were estimated at more than $20 billion annually (in 2014 constant dollars) with the State primarily responsible for modes that account for 60% of the identified long-term investments (Table 1).

Table 1: Unconstrained Needs by TxDOT Responsibility Level

Primary Responsibility	Modal Subcategories	Needs (in 2014$)
TxDOT	Pavement, Bridge/ Culvert, ITS, Highway Capacity, Safety/ Other	> $15 billion annually
Non-TXDOT	Aviation, Transit, Passenger Rail, Freight, Bicycle/ Pedestrian	> $5 billion annually
Total Statewide Multimodal Needs		> $20 billion annually

As described in Section 1, the current revenue forecast would be insufficient to satisfy the predicted statewide multimodal needs. To help inform how to spend limited resources, various example approaches were identified and analyzed for long-range performance impacts. For each approach, the corresponding costs were presented to the public in the MetroQuest tool. Each approach is designed to advance the performance of the transportation system in a targeted way.

2.1 Approach 1 – System Preservation

2.1.1 Approach Focus and Methodology

Approach 1 is focused on investing in the existing State transportation system to achieve a state-of-good-repair (SGR) for highway, bridge, ITS, and transit assets. In this approach, deficient assets with respect to condition and/ or performance (for example, functional obsolescence) are prioritized and addressed.

The total cost of this approach is $230 billion. The methodology for estimating this cost is as follows:

- CH2M HILL's TAMTools was used to estimate the costs to achieve pavement and bridge state-of-good repair (SGR) as defined by TxDOT and detailed in the TTP Task 3 modal methodology memos. TAMTools estimates the needs using life-cycle management principles in conjunction with TxDOT's current practices. Bridges and pavements on the state-owned system plus all existing ITS assets are included.
- The Transit Economic Requirements Model (TERM) was used and tailored for Texas to determine SGR needs for all existing transit stock in the state in MTA, small urban, and rural areas.
- SAM-v3 2010 was used with 2040 demographics in order to show the congestion impacts on the existing network. The committed network is not included in this approach since it is preservation only and the congestion results in LOS F in many areas on the network.
- All safety needs are addressed and the cost are included.

The Approach includes the investment areas and costs as shown in Table 2.

Table 2: Approach 1 – Investments and Costs

Investment Area	Approach 1 - Performance Goals	Cost to Achieve
Pavement	Achieve and maintain SGR for existing State-owned highways with proactive maintenance and capital reinvestment	$108 B
Bridge/ Culvert	Achieve and maintain state-of-good-repair for existing State-owned bridges and culverts with proactive maintenance and capital reinvestment	$42 B
ITS	Maintain SGR for existing assets	$2 B
Highway Capacity	Allow congestion to worsen	$0
Transit	Achieve and maintain SGR for existing assets and existing service levels	$73 B
Safety/ Other	Address any additional statewide safety needs	$5 B
Total Estimated Cost of Approach 1 (2014 $)		**$230 B**

2.1.2 Approach Performance and Deficiencies

Table 2 shows the performance outcomes for each predictive measure analyzed for the TTP. These would be the performance outcomes at the end of the planning horizon (2040) if $230 billion were invested according to this approach.

Performance outcomes are shown on a scale of "high-medium- or- low," which would correspond to a good-fair-poor condition state for the measures analyzed.

- Low performance thresholds represent poor conditions and can be characterized as system conditions that are worse than today, and would be seen by the user as significant wear and tear on infrastructure and transit assets and worsening congestion, in many cases gridlock.
- Medium performance thresholds represent fair conditions. Infrastructure assets in fair condition represent conditions worse than today. Fair/medium mobility conditions represent congestion levels similar to those experienced today.
- High performance thresholds represent ideal conditions. This includes achieving a state-of-good-repair for infrastructure and transit assets and congestion levels that are better than those experienced today.

Texas legislation requires the identification of priority corridors, projects, or areas of the state that are of particular concern in meeting goals and objectives of the TTP. Approach 1 is focused largely on the TTP goals of asset management and safety (Table 3). This approach is also focused on stewardship, using resources to make cost-beneficial investments to achieve state-of-good-repair for highway, bridge, and transit assets. This approach does not attempt to reduce or manage congestion statewide and does not improve mobility, connectivity, and freight movements.

Table 3: Investment Approach 1 – Performance Outcomes

Investment Area	Performance Measure	State-of-Repair
Bicycle and Pedestrian	% Bike/Ped Needs Met	**Low**
Non-highway Freight	% Freight Needs Met	**Low**
Mobility and Congestion Reduction	Rural LOS	**Low**
	Urban LOS	**Low**
Pavements on the National Highway System (NHS)	% NHS Pavement Lane Miles in "Good" Condition (by IRI)	**High**
	% NHS Pavement Lane Miles in "Good" or better Condition (by Condition Score)	**High**
Non-NHS Pavements	% Non-NHS Pavement Lane Miles in "Good" Condition (by IRI)	**High**
	% Non-NHS Pavement Lane Miles in "Good" or better Condition (by Condition Score)	**High**
Bridges on the NHS	% Structurally Deficient NHS Bridges	**High**
	Count Structurally Deficient NHS Bridges	**High**
Non-NHS Bridges	% Structurally Deficient Non-NHS Bridges	**High**
	Count Structurally Deficient Non-NHS Bridges	**High**
MTA Transit	% of MTA Assets in SGR	**High**
	Additional Annual MTA Riders	**High**
Non-MTA Transit	% of Non-MTA Assets in SGR	**High**
	Additional Annual Non-MTA Riders	**High**
Passenger Rail	% Passenger Rail Needs Met	**Low**
ITS	% ITS Needs Met	**Low**
NPIAS Aviation	NPIAS Project Backlog	**Low**
Non-NPIAS Aviation	Non-NPIAS Project Backlog	**Low**

The outcomes of Approach 1 as presented to the public in Outreach Round #2 is shown in **Figure 7**.

Figure 7: Investment Approach 1 – Impacts on Long-range Goals

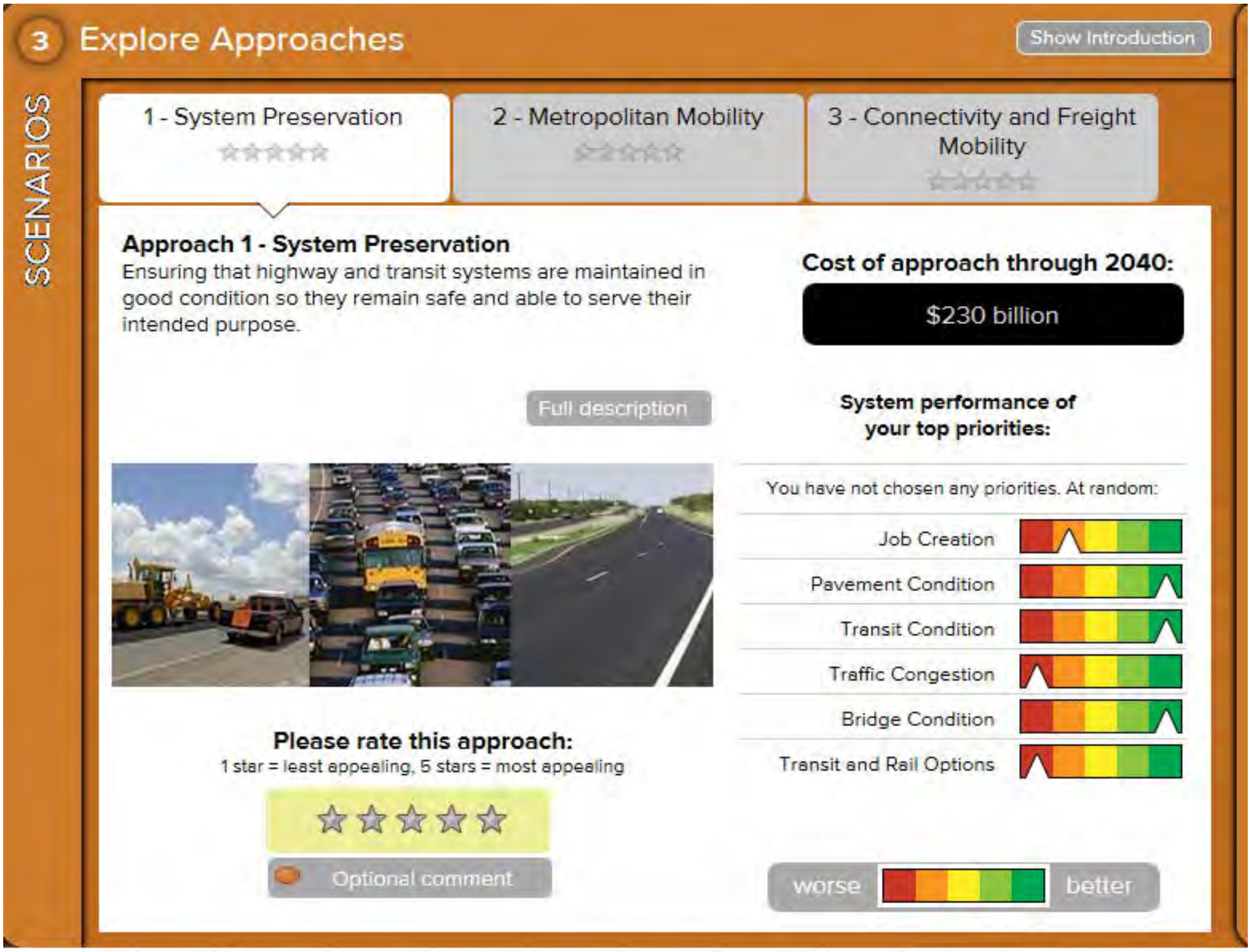


Figure 7 shows that pavements and bridges as well as transit assets statewide will be in excellent condition at the end of the planning horizon if Approach 1 were followed. Statewide mobility would be reduced given the lack of investment in highway expansion and multimodal alternatives. More specifically, if Approach 1 were implemented:

- Bridges would be kept in good condition, remaining structurally sound and open for use.
- State roadways would be generally pothole free and support a smooth ride.
- Buses, trains, and associated facilities in all areas of the state would be comfortable and reliable.
- With current transit service levels maintained, ridership as a percentage of the total population would decrease since new service would not be provided.
- Congestion in all areas of the state would be worse than today.
- Preserving our system would create a minimal number of new jobs.
- Safety is TxDOT’s number one priority and all statewide safety concerns would be addressed.

2.2 Approach 2 – Metropolitan Mobility

2.2.1 Approach Focus and Methodology

Investment Approach 2 is focused on addressing congestion in highly populated areas of the state to reduce the time that drivers spend in congested travel. The objective of this approach is to address congestion in urban and suburban areas through strategic capacity enhancements, operational improvements, and investments in multimodal facilities in order to reduce the time spent in traffic. System reliability is addressed by enhancing transit alternatives in fastest-growing areas and "collar" regions, which are suburban growth areas. Highway/ bridge preservation dollars in this approach are focused on the Interstate system. If implemented, Approach 2 would cost $475 billion (in 2014 constant dollars) through 2040.

The methodology for estimating the costs of Approach 2 is as follows:

- All committed highway expansion projects as well as additional highway widening/ROW to ensure LOS D or better in metropolitan areas (costs calculated using the SAMv3 on a per-mile basis).
- All committed transit enhancements documented in existing metropolitan transportation plans (MTPs), and the costs to achieve fair condition states for all pavement and bridge assets in the State with a focus on fair or better for the Interstate network.
- Maintenance projects for all *proposed* highway and transit assets are included since this approach uses the existing and committed network.
- Transit SGR needs in metropolitan areas.
- All urban gap transit expansion needs.

The Approach includes the investment areas and costs as shown in Table 4.

Table 4: Approach 2 – Investments and Costs

Investment Area	Approach 2 – Performance Goals	Cost to Achieve
Pavement	Achieve and maintain SGR for the Interstate system with proactive maintenance and capital reinvestment	$83 B
Bridge/ Culvert	Achieve and maintain state-of-fair-repair for existing State-owned bridges and culverts with proactive maintenance and capital reinvestment; achieve SGR on Interstate system	$39 B
ITS	Maintain SGR for existing assets and deploy new ITS in metropolitan areas	$14 B
Highway Capacity	Ensure LOS D or better in metropolitan areas	$235 B
Transit	Achieve and maintain SGR for existing and new assets in metro areas; expand beyond existing service levels	$96 B
Safety/Other	Address any additional safety needs as well as bike and pedestrian needs statewide	$8 B
Total Estimated Cost of Approach 2 (2014 $)		$475 B

2.2.2 Approach Performance and Deficiencies

Table 5 shows the performance outcomes for each predictive measure analyzed for the TTP. These would be the performance outcomes at the end of the planning horizon (2040) if $475 billion were invested according to this Approach.

Performance outcomes are shown on a scale of “high-medium- or- low,” which would correspond to a good-fair-poor condition state for the measures analyzed.

Table 5: Investment Approach 2 – Performance Outcomes

Investment Area	Performance Measure	State-of-Repair
Bicycle and Pedestrian	% Bike/Ped Needs Met	High
Non-highway Freight	% Freight Needs Met	Low
Mobility and Congestion Reduction	Rural LOS	High
	Urban LOS	High
Pavements on the National Highway System (NHS)	% NHS Pavement Lane Miles in "Good" Condition (by IRI)	High
	% NHS Pavement Lane Miles in "Good" or better Condition (by Condition Score)	High
Non-NHS Pavements	% Non-NHS Pavement Lane Miles in "Good" Condition (by IRI)	High
	% Non-NHS Pavement Lane Miles in "Good" or better Condition (by Condition Score)	High
Bridges on the NHS	% Structurally Deficient NHS Bridges	High
	Count Structurally Deficient NHS Bridges	High
Non-NHS Bridges	% Structurally Deficient Non-NHS Bridges	High
	Count Structurally Deficient Non-NHS Bridges	High
MTA Transit	% of MTA Assets in SGR	High
	Additional Annual MTA Riders	High
Non-MTA Transit	% of Non-MTA Assets in SGR	High
	Additional Annual Non-MTA Riders	High
Passenger Rail	% Passenger Rail Needs Met	High
ITS	% ITS Needs Met	High
NPIAS Aviation	NPIAS Project Backlog	High
Non-NPIAS Aviation	Non-NPIAS Project Backlog	Low

The outcomes of Approach 2 as presented to the public in Outreach Round #2 are shown in Figure 8.

Figure 8: Investment Approach 2 – Impacts on Long-range Goals

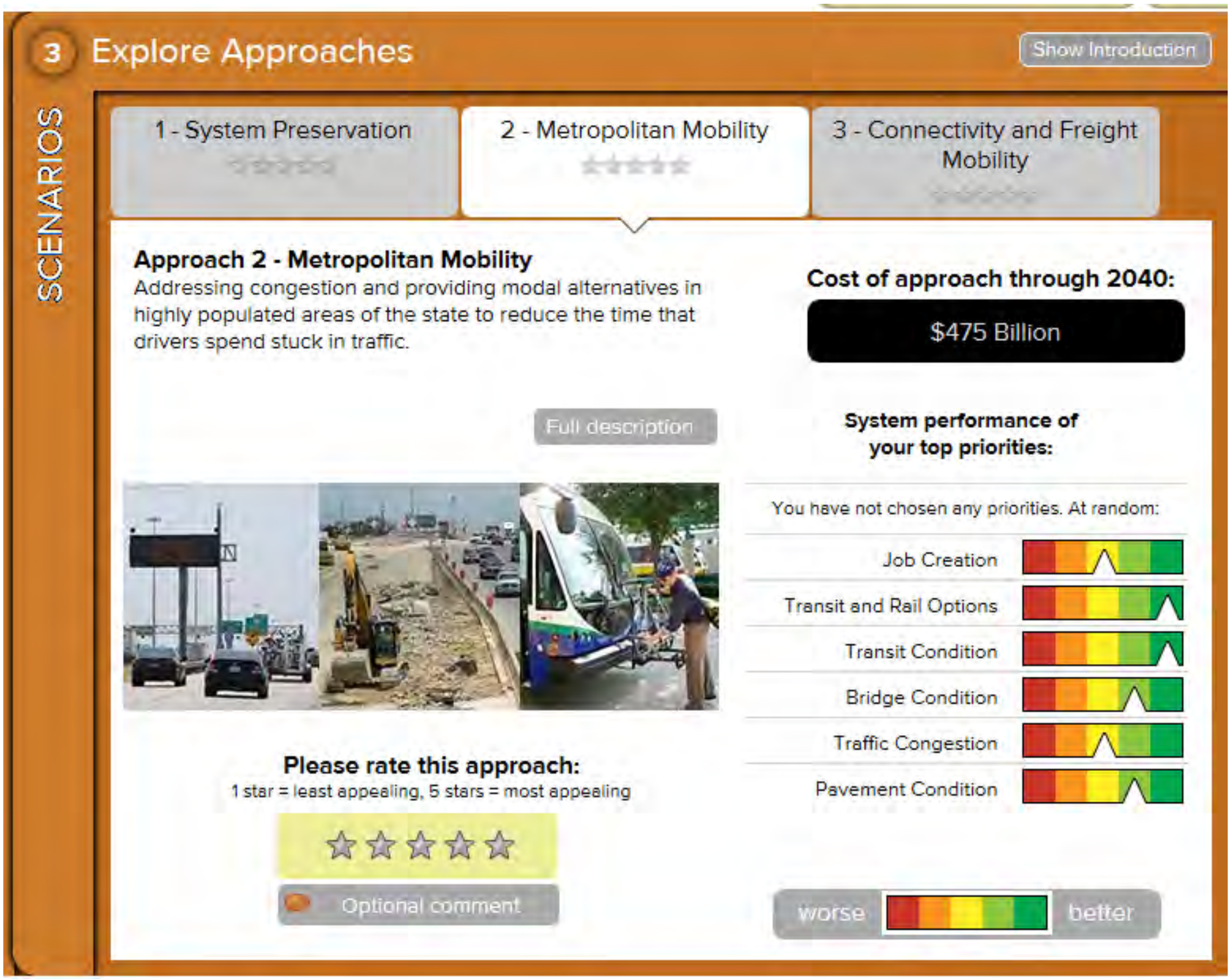


Figure 8 shows that Approach 2, while costing more than twice as much as Approach 1, would only maintain current congestion levels and would not meet SGR for all infrastructure assets in the state. More specifically, if Approach 2 were implemented:

- Bridges on the interstate system and other major roads would be kept in good condition, with some signs of aging. The condition of bridges on other roadways would deteriorate further with only routine maintenance applied.
- Pavement on the interstate system and other major roads would be kept in fair condition with some potholes and cracking evident. Pavement on other roads would show significant wear and tear with only routine maintenance applied.
- Buses, trains, and associated facilities in urban areas would be kept in good condition, while the condition of those assets in rural areas will deteriorate with only basic maintenance applied.

- Transit and rail ridership in urban regions of the state would increase as transit services are enhanced to accommodate population growth and expanded to reach previously underserved areas. Current ridership trends are assumed to remain the same for rural areas. Additional bike and pedestrian enhancements are provided in urban areas.
- Congestion in urban areas would be the same as it is today despite high population growth; reducing congestion in metropolitan areas would increase access and support urban job growth.
- Safety is TxDOT's number one priority and all statewide safety concerns would be addressed.

2.3 Approach 3 – Connectivity and Freight Mobility

2.3.1 Approach Focus and Methodology

The objective of Approach 3 is to support the efficient movement of goods and services to create jobs and sustain a vibrant and growing economy. This approach is largely focused on rural investments, and includes improving interregional connectivity along the primary and secondary freight network, adding intercity passenger rail between major State and economic activity centers (Oklahoma to South Texas and DFW to Houston), and increasing the accessibility of rural regions to goods and services. If implemented, Approach 3 would cost $460 billion (in 2014 constant dollars) through 2040.

The costs of Approach 3 were developed as follows, and include:

- All committed highway expansion projects.
- The widening of the primary freight network to eliminate bottlenecks (LOS C or better) (the Primary Freight Network includes all interstates in Texas).
- The pavement and bridge costs to achieve fair or better conditions for the systems, with good or better conditions on the Primary Freight Network.
- All costs to complete the Texas Trunk System as well as enhancements to rural transit.
- Intercity rail construction from Oklahoma to South Texas and between Dallas and Houston.

The investment focus and costs of Approach 3 are shown in Table 6.

Table 6: Approach 3 – Investments and Costs

Investment Area	Approach 3 - Performance Goals	Cost to Achieve
Pavement	Achieve and maintain SGR for the Primary Freight Network with proactive maintenance and capital reinvestment	$93 B
Bridge/ Culvert	Achieve and maintain state-of-fair-repair for existing State-owned bridges and culverts with proactive maintenance and capital reinvestment; achieve SGR on Primary Freight Network	$36 B
ITS	Maintain SGR for existing assets	$2 B
Highway Capacity	Eliminate freight bottlenecks (LOS C or better on Primary Freight Network)	$246 B
Transit	Achieve and maintain SGR for existing and new assets in rural areas; expand beyond existing service levels and add intercity passenger rail	$74 B
Safety/ Other	Address any additional safety needs as well as bike and pedestrian needs statewide and Primary Freight Network rumble strips	$9 B
Total Estimated Cost of Approach 3 (2014 $)		$460 B

2.3.2 Approach Performance and Deficiencies

Table 7 shows the performance outcomes for each predictive measure analyzed. These would be the performance outcomes at the end of the planning horizon (2040) if $460 billion were invested according to this approach.

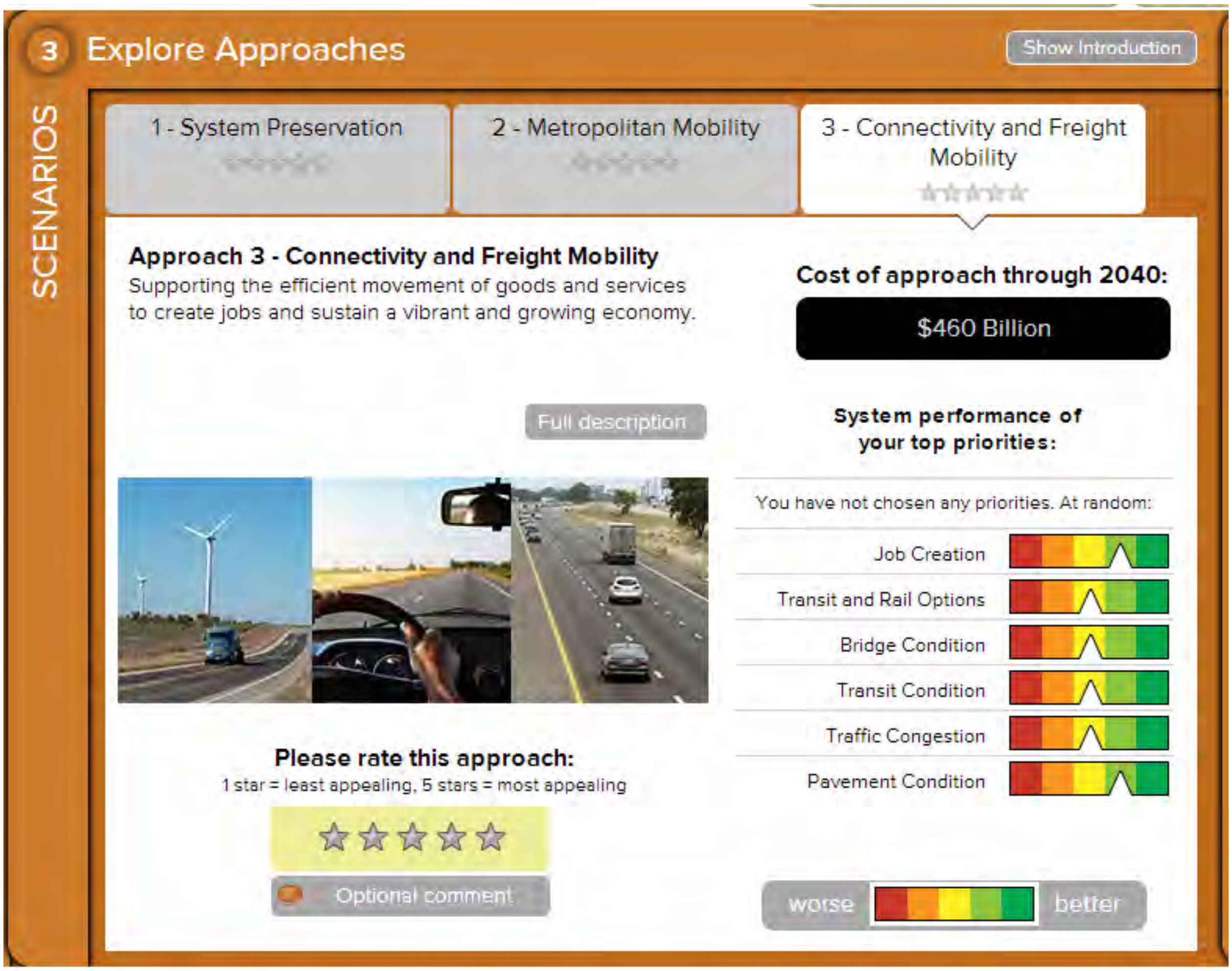
Performance outcomes are shown on a scale of “high-medium- or- low,” which would correspond to a good-fair-poor condition state for the measures analyzed.

Table 7: Investment Approach 3 – Performance Outcomes

Investment Area	Performance Measure	State-of-Repair
Bicycle and Pedestrian	% Bike/Ped Needs Met	Low
Non-highway Freight	% Freight Needs Met	High
Mobility and Congestion Reduction	Rural LOS	High
	Urban LOS	High
Pavements on the National Highway System (NHS)	% NHS Pavement Lane Miles in "Good" Condition (by IRI)	High
	% NHS Pavement Lane Miles in "Good" or better Condition (by Condition Score)	High
Non-NHS Pavements	% Non-NHS Pavement Lane Miles in "Good" Condition (by IRI)	Low
	% Non-NHS Pavement Lane Miles in "Good" or better Condition (by Condition Score)	Medium
Bridges on the NHS	% Structurally Deficient NHS Bridges	High
	Count Structurally Deficient NHS Bridges	High
Non-NHS Bridges	% Structurally Deficient Non-NHS Bridges	High
	Count Structurally Deficient Non-NHS Bridges	Medium
MTA Transit	% of MTA Assets in SGR	Low
	Additional Annual MTA Riders	High
Non-MTA Transit	% of Non-MTA Assets in SGR	High
	Additional Annual Non-MTA Riders	High
Passenger Rail	% Passenger Rail Needs Met	Low
ITS	% ITS Needs Met	Low
NPIAS Aviation	NPIAS Project Backlog	High
Non-NPIAS Aviation	Non-NPIAS Project Backlog	High

The outcomes of Approach 3 as presented to the public in Outreach Round #2 are shown in Figure 9.

Figure 9: Investment Approach 3 – Impacts on Long-range Goals



Because Approach 3 is focused on rural connectivity and freight movements, congestion in metropolitan areas would worsen; however, at a state level, conditions on the Primary Freight Network and Interstate System would be similar to today. Additional outcomes of Approach 3 are as follows:

- Bridges located along roadways with significant freight traffic would be maintained in good condition, with some signs of aging. The condition of bridges on other roadways would deteriorate further with only routine maintenance applied.
- Pavement on roadways that support significant freight traffic would be kept in fair condition with some potholes and cracking evident. Pavement on other roadways would show significant wear and tear with only routine maintenance applied.
- Buses, trains and associated facilities in rural areas would be maintained in good condition and enhanced to accommodate rural needs. The condition of assets in urban areas would deteriorate with only basic maintenance applied.
- Transit and passenger rail ridership would increase for transit and passenger rail in rural areas as more accessible and convenient travel options are provided in these regions as well as

intercity rail between major metropolitan areas. Current ridership trends would persist for urban areas. Additional bike and pedestrian enhancements would be provided in rural areas.

- Congestion in rural areas would be reduced compared to today. Congestion would be eliminated on the Primary Freight Network, but would worsen in metropolitan areas.
- Reducing travel delays for freight traffic would reduce the cost of moving goods, support the State's growing economy, and create jobs.
- Safety is TxDOT's number one priority and all statewide safety concerns are addressed.

2.4 Approach 4 – Financially Constrained "Plus"

2.4.1 Approach Focus and Methodology

While not presented to the public, Approach 4 was evaluated for the TTP to show the performance outcomes associated with investments under the State's current revenue forecast. While the total state revenues available for transportation investments for all modes through 2040 are likely adequate to achieve a preservation-focused strategy, it was previously noted that many of these funds are committed to agency operations and other projects. Because of these constraints, TxDOT has estimated that an additional $5 billion in revenues is needed annually to maintain current system conditions.

Given funds available for investment for all modes, and when invested at a multimodal level, a total average annual investment of $14 billion is used in the analysis to represent a constrained approach. It is important to note, however, that this figure represents more money than is currently available for state multimodal investments. Additionally, it is important to note that this approach is not performance-based in that it is not designed to meet specific performance goals for the system; rather, it is shown to better understand expected outcomes if the State continues to invest similarly to its current strategies ament categories.

Table 8: Approach 4 – Investment Allocations

Investment Area	Average Annual Budget (in 2014 constant dollars)
Pavement	$4 B
Bridge/ Culvert	$1.6 B
ITS	$0.5 B
Highway Capacity	$3 B
Transit	$3.9 B
Additional Safety Needs	$0.4 B
Non-Highway Freight	$0.5 B
Bicycle/ Pedestrian	$0.1 B
Total	**$14 B**

2.4.2 Approach Performance and Deficiencies

Table 9 shows the performance outcomes for each predictive measure analyzed. These would be the performance outcomes at the end of the planning horizon (2040) if $350 billion were invested according to this approach.

Performance outcomes are shown on a scale of "high-medium- or- low," which would correspond to a good-fair-poor condition state for the measures analyzed.

Table 9: Investment Approach 4 – Performance Outcomes

Investment Area	Performance Measure	State-of-Repair
Bicycle and Pedestrian	% Bike/Ped Needs Met	High
Non-highway Freight	% Freight Needs Met	TBD
Mobility and Congestion Reduction	Rural LOS	Medium
	Urban LOS	Low
Pavements on the National Highway System (NHS)	% NHS Pavement Lane Miles in "Good" Condition (by IRI)	High
	% NHS Pavement Lane Miles in "Good" or better Condition (by Condition Score)	High
Non-NHS Pavements	% Non-NHS Pavement Lane Miles in "Good" Condition (by IRI)	High
	% Non-NHS Pavement Lane Miles in "Good" or better Condition (by Condition Score)	High
Bridges on the NHS	% Structurally Deficient NHS Bridges	High
	Count Structurally Deficient NHS Bridges	High
Non-NHS Bridges	% Structurally Deficient Non-NHS Bridges	High
	Count Structurally Deficient Non-NHS Bridges	High
MTA Transit	% of MTA Assets in SGR	High
	Additional Annual MTA Riders	High
Non-MTA Transit	% of Non-MTA Assets in SGR	High
	Additional Annual Non-MTA Riders	High
Passenger Rail	% Passenger Rail Needs Met	Low
ITS	% ITS Needs Met	High
NPIAS Aviation	NPIAS Project Backlog	Low
Non-NPIAS Aviation	Non-NPIAS Project Backlog	High

Approach 4 represents a balanced investment approach with a preservation focus. It was designed to evaluate system condition and performance given funding constraints and current investment allocations.

- Bridges and pavements on the Interstate system and other major roads would be kept in good condition, with some signs of aging. The condition of bridges on other roadways would deteriorate further with only routine maintenance applied.
- Buses, trains, and associated facilities in both urban and rural areas would be kept in good condition.
- Bicycle and pedestrian enhancements are provided in rural and urban areas.
- Intercity passenger rail is not funded.
- Non-highway freight needs are being developed as part of the Texas Freight Mobility Plan and are thus not available to evaluate against the allocated amount. Highway freight needs are incorporated into the general highway, bridge and expansion needs.
- Transit and rail ridership in urban regions of the state would increase as transit services are enhanced to accommodate population growth and expanded to reach previously underserved areas. Current ridership trends are assumed to remain the same for rural areas.
- Congestion in urban areas would be worse than it is today; however, strategic mobility enhancements and operations strategies would be funded.
- Safety is TxDOT's number one priority and all statewide safety concerns would be addressed.

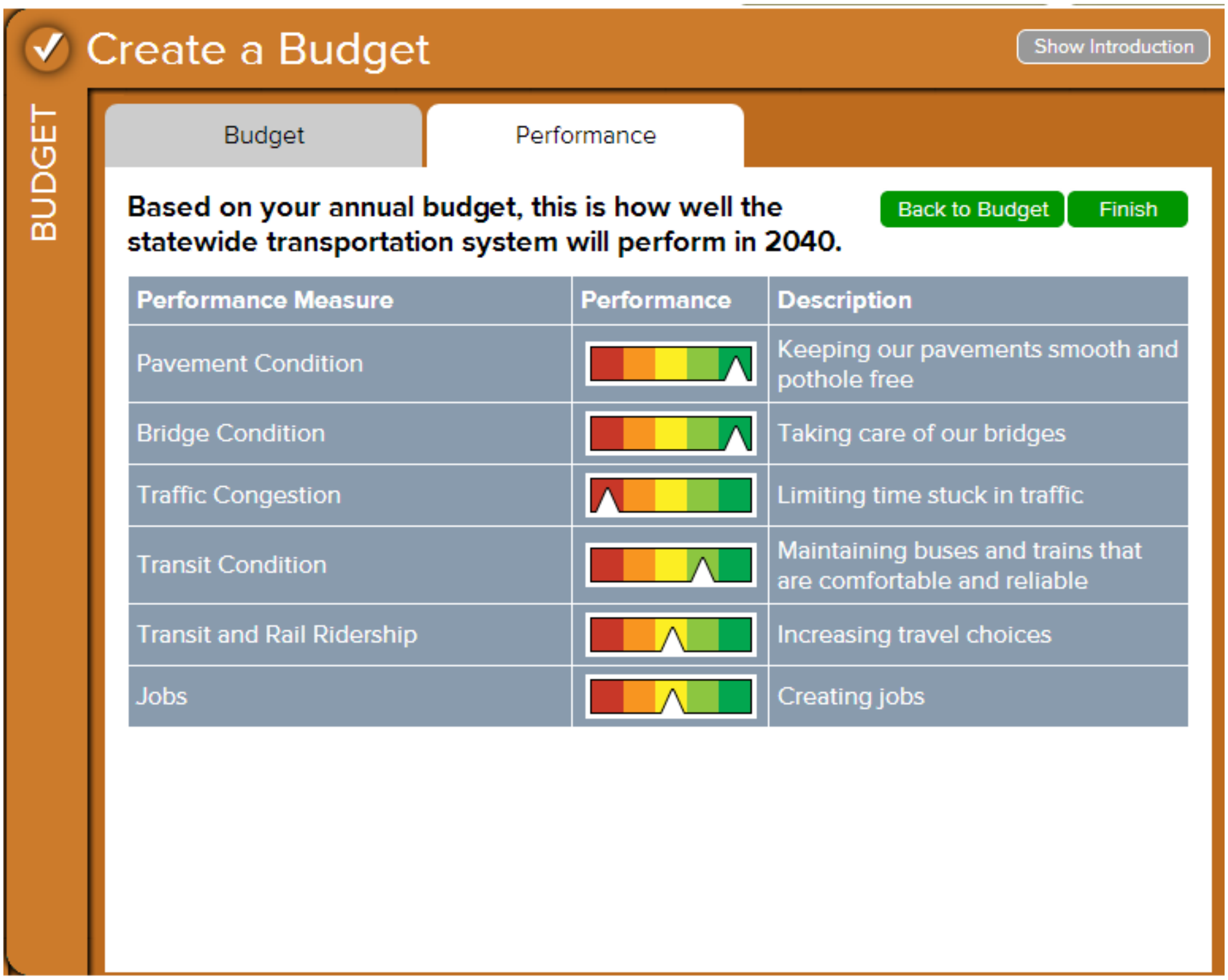
While the public was not presented with a specific Approach 4, the MetroQuest Tool was used to allow the public to better understand the long-term effects of investing in various ways. The public was asked to allocate an annual budget of $14 billion with the following constraints:

- Highway/ Bridge - A total annual budget of $5.5 billion was estimated, with a 40–60 percent "split" between highway preservation and expansion categories pre-allocated. Given the uncertainty in federal funds and diminishing value of state and federal gas tax revenues, this will likely degrade significantly over the Plan horizon unless alternative revenue sources/ collection methods are addressed. This number is greater than the UTP total budget because it includes major and minor maintenance, ROW, and preliminary engineering.
- Transit – A total annual budget of $3.5 billion was estimated, and includes MTA and small urban/ rural funds as well as funds that "pass through" TxDOT.
- Freight – No pre-existing budget was identified/ estimated for freight projects.

In the MetroQuest Tool, the public was "given" $5 billion annually in "new" money that was unrestricted. They were asked to allocate investments in highway, transit, and freight areas. The impact of their spending decisions on related performance measures was then provided in real-time on a "dashboard." The dashboard uses a readily understood red to green color scale.

The performance values behind this color scale are provided below. Using the MetroQuest Tool, the outcomes of example Approach 4 are shown in Figure 10.

Figure 10: Investment Approach 4 – Impacts on Long-range Goals



3.0 Summary

Four distinct examples of investment approaches were evaluated in this memo, in consideration of forecasted revenue and the potential for future capital infusions. Table 10 provides a comparison among all approaches.

Tradeoffs between system preservation and mobility will need to be considered during the performance target setting and resource allocation process.

Table 10: Investment Approach Summary – Performance Outcome State of Repair

Mode	Investment Category	Performance Measure	Approach 1: Preservation	Approach 2: Metro	Approach 3: Connectivity	Approach 4: Balanced with Extra $5B across all modes
Pavement	National Highway System (NHS) Pavements	% NHS Pavement Lane-Miles in a State-of-Good-Repair (based on IRI)	High	Low	Low	High
		% NHS Pavement Lane-Miles in a State-of-Good-Repair (based on Condition Score)	High	Low	Low	High
	Non-NHS Pavements	% Non-NHS Pavement Lane-Miles in a State-of-Good-Repair (based on IRI)	High	Low	Low	Medium
		% Non-NHS Pavement Lane-Miles in a State-of-Good-Repair (based on Condition Score)	High	Low	Low	Low
Bridge	NHS Bridges	% Structurally Deficient NHS Bridge Deck Area	High	Low	Low	Low
		Count of Structurally Deficient NHS Bridges	High	Low	Low	Low
	Non-NHS Bridges	% Structurally Deficient Non-NHS Bridge Deck Area (on State System)	High	High	High	High
		Count of Structurally Deficient Non-NHS Bridges (on State System)	High	High	High	High
Highway Mobility	Rural Mobility	Rural Level-of-Service	Low	Low	Low	Low
	Urban Mobility	Urban Level-of-Service	Low	High	High	Low
Transit	Metropolitan Transit Authority (MTA) Transit Asset Preservation	% of MTA Assets in a State-of-Good-Repair	Low	High	Low	High
	MTA Transit Service Enhancements	Additional MTA Annual Rider Trips in Millions	High	High	High	High
	Non-MTA Transit Asset Preservation	% of Non-MTA Assets in a State-of-Good-Repair	Low	High	Low	High
	Non-MTA Transit Service Enhancements	Additional Non-MTA Annual Rider Trips in Millions	High	High	High	High

Table 10: Investment Approach Summary – Performance Outcome State of Repair

Mode	Investment Category	Performance Measure	Approach 1: Preservation	Approach 2: Metro	Approach 3: Connectivity	Approach 4: Balanced with Extra $5B across all modes
Passenger Rail	Passenger Rail	% Passenger Rail Needs Met	Low	Low	Low	Low
Non-Highway Freight	Non-Highway Freight	% Non-Highway Freight Needs Met	Low	Low	Low	High
Intelligent Transportation Systems (ITS)	ITS	% ITS Needs Met	Low	High	Low	High
Aviation	National Plan of Integrated Airport Systems (NPIAS) Aviation	NPIAS Project Backlog	Medium	Medium	Medium	Medium
	Non-NPIAS Aviation	Non-NPIAS Project Backlog	High	High	High	High
Bicycle/Pedestrian	Bicycle/Pedestrian	% Bicycle/Pedestrian Needs Met	High	High	Low	High

Texas Department of Transportation

Texas Transportation Plan

Tech Memo 11: Safety and Security

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Contents

Tables

1.0 Introduction

The Texas Transportation Plan 2040 (TTP) is the State's long-range transportation plan which covers the size and scope of the Texas transportation system, including all modes of public transportation. This memo serves to review and analyze current and historical safety and security documentation provided by the State in order to verify that current planning efforts are consistent with federal planning requirements and strategic plan goals.

To achieve the above objective, a thorough review of available State, regional and local planning documentation was conducted in order to identify current safety and security trends. This technical memo documents conclusions and observations as related to this effort. Discussions on transportation safety and security are prepared separately in the following sections.

2.0 Overview of Transportation Safety Planning

Safety has been incorporated into the transportation planning process since federally mandated in the year 1982. This section summarizes recent efforts regarding transportation safety planning in the state of Texas, associated federal requirements, potential gaps, and strategies in moving forward.

2.1 Requirements on Transportation Safety Planning from New Legislation

In 2012, the Moving Ahead for Progress in the 21st Century (MAP-21) transportation legislation was signed into law. MAP-21 builds on and refines many of the highway, transit, bike, and pedestrian programs and policies established in 1991. Under MAP-21, performance management will transform federal highway programs and provide a means to more efficient investment of federal transportation funds by focusing on national transportation goals, increasing the accountability and transparency of the federal highway programs, and improving transportation investment decision-making through performance-based planning and programming. MAP-21 establishes seven national performance goals for the federal highway program, one of which is to achieve a significant reduction in traffic fatalities and serious injuries on all public roads. Meanwhile, MAP-21 planning rules call for consideration of eight planning factors, one of which is to increase the safety of the transportation system for motorized and non-motorized users.

2.2 Current Transportation Safety Planning in Texas

A thorough literature review revealed that transportation safety planning has been incorporated into many statewide and regional transportation planning documents in Texas. A discussion on the relevance of each document is provided in the following sections.

2.2.1 Comprehensive Transportation Safety Planning

In cooperation with other federal and state agencies, TxDOT has developed comprehensive transportation safety planning documents to guide transportation safety management and improve the safety performance for the highway system.

Texas Strategic Highway Safety Plan

TxDOT produced the first Strategic Highway Safety Plan (SHSP) for Texas in 2006. The Texas SHSP established statewide goals, objectives, and key emphasis areas for transportation safety and identified key safety needs for guiding investment decisions to reduce fatalities and serious injuries on all public roads. To make the Texas SHSP a living document, TxDOT generates a report of progress each calendar year based on the most recent available crash data. The current edition of the Texas SHSP report of progress is for the calendar year 2013.

Based on the crash data analysis results, the Texas SHSP identified several safety issues for the state and grouped them into the following four emphasis areas:

- Crash type & location, including run-off road crashes, head-on crashes, intersection crashes, work zone crashes and railroad grade crossing crashes;
- System users, including older drivers, teen drivers, motorcyclists, bicyclists, pedestrians and large trucks;
- Driver behavior, including driving under the influence, speeding, lack of restraint use, aggressive driving, and distracted driving;
- System administration, including traffic and crash records, E911 reporting systems, public awareness, and policy maker awareness.

The safety issues, crash reduction objectives for each emphasis area and potential countermeasures that may have helped to meet the objectives are included in the annual progress report.

Texas Highway Safety Performance Plan

To identify traffic safety problem areas and programs to reduce the number and severity of traffic-related crashes, injuries and fatalities, TxDOT has initiated the endeavor to develop the Texas Highway Safety Performance Plan (HSPP) for each fiscal year since 2006. The Texas HSPP for each fiscal year contains the goals, strategies, performance measures and objectives Texas has set for improving the safety performance of the roadway system.

Altogether 14 areas were covered by the TxDOT traffic safety program, which are:

- Planning and administration;
- Alcohol and other drug countermeasures;
- Emergency medical services;
- Motorcycle safety;
- Occupant protection;
- Pedestrian/bicycle safety;
- Police traffic service;
- Speed control;
- Traffic records;
- Driver education and behavior;
- Railroad/highway crossing;
- Roadway safety;
- Safe communities and
- School bus safety.

The Texas HSPP identified impaired driving, safety belts, motorcycles and speeding as areas that need special emphasis in order to improve traffic safety and decrease injuries and fatalities. As an outgrowth of the strategic planning process, Texas developed 19 specific goals for the traffic safety program, 70 specific strategies, and 39 specific performance measures. Objectives have been established for all 39 performance measures for 2013. The plan also lists other program goals for each of the Texas Traffic Safety Program's areas, specifies the strategies employed to accomplish the goals, and reports the status of the performance measures based on the most current data.

2.2.2 Transportation Safety Plan for Specific User Groups

Texas Strategic Action Plan for Motorcycles 2013-2018

Motorcycle deaths in Texas increased by 10% in 2011, from 435 in 2010 to 479 in 2011. Motorcycle deaths accounted for 16% of total traffic fatalities in 2011. In 2011, Texas experienced a decrease in the number of motor vehicle traffic deaths; however, the increased percentage of motorcyclist deaths offset gains in road traffic deaths.

To reduce the rate of motorcycle crashes per registered motorcycles and reduce the rate of fatal and severe motorcycle injuries, as established in the 2012 Texas SHSP Report of Progress, TxDOT developed the Texas Strategic Action Plan for Motorcycles (SAPM) 2013-2018.

To aid in the plan's development, several activities including a review of published literature on motorcycle safety countermeasures, a review of intelligent transportation system (ITS) and other advanced technologies for motorcycles and other vehicles, an analysis of motorcycle crash and injury data, and a statewide survey of motorcycle riders were completed. A list of potential motorcycle crash and injury countermeasures were evaluated and prioritized by motorcycle safety experts and advocates.

The plan is organized under 13 key focus areas including:

- Motorcycle/rider conspicuity,
- Motorists awareness of motorcycles,
- Licensing,
- Rider education and training,
- Impaired riding,
- Speeding,
- Personal protective gear,
- Roadway/infrastructure,
- Legislation and regulations,
- Law enforcement,
- Program management,
- Program evaluation and data, and
- Motorcycle and vehicle technologies/ITS.

For each area, the plan identified several initiatives and action steps, prioritized by motorcycle safety experts. The group prioritized and ranked approximately 73 crash reduction countermeasures on the basis of their effectiveness in preventing motorcycle crashes and in reducing the severity of injuries to riders.

San Antonio – Bexar County Pedestrian Safety Action Plan

The San Antonio-Bexar County Metropolitan Planning Organization Pedestrian Safety Action Plan (Plan) defines a set of actions to encourage walking and to make it safer. The Plan provides a framework for making decisions about facility design and allocating resources necessary to make walking a viable choice for a wide variety of trips. This Plan contains profiles for 43 recommended treatments for improving pedestrian safety. Each profile provides a definition of the recommended treatment, why and where it is used, and to what degree it is currently being implemented in the region.

2.2.3 Safety-related Sections within Comprehensive Transportation Planning

Transportation safety planning has been incorporated into the comprehensive transportation planning process at state and metropolitan planning organization (MPO) levels in Texas.

State-Level

TxDOT developed the Texas Statewide Long-range Transportation Plan (SLRTP) 2035 to provide an inventory and address the need for improvements to the state's transportation system-roadways, pedestrian and bicycle facilities, transit, freight and passenger rail, airports, waterways and ports, pipelines, and intelligent transportation systems (ITS). Section 6 of the SLRTP is about transportation safety and security.

A brief description on the responsibilities of TxDOT divisions about administering federal and state grant programs to improve safety on various modes of the transportation systems in Texas were provided first, followed by a summary on the backgrounds, key points and current status of the TxDOT SHSP and the Texas Traffic Safety Program (TTSP). The SLRTP also listed information on safety program for bicycle and pedestrian, public transportation, freight rail, airport, waterways, pipeline, ports and border, etc.

MPO-Level

Federal law requires that all urbanized areas in the United States with a population of more than 50,000 must have a designated MPO to facilitate the federally-required multimodal transportation planning process. Altogether there are 25 MPOs in the state of Texas. Five MPOs listed below were selected for in-depth investigation because of their population base and geographical distribution.

Houston Galveston Area Council

The Houston-Galveston Area Council (H-GAC) serves the urbanized areas of Houston, Conroe-the Woodlands, Lake Jackson-Angleton, and the Texas City. In August 2005, the H-GAC Transportation Policy Council (TPC) established the Regional Safety Council (RSC) to address the region's increasing traffic safety issues.

The RSC approved the State of Safety in the Region (SOSR) report in February 2007, which provided a comprehensive review of traffic safety in the Houston-Galveston region. The SOSR report identified the critical traffic safety issues in the region and outlined strategies for addressing these problems. The report made a total of 17 recommendations for improving safety.

North Central Texas Council of Governments

The North Central Texas Council of Governments (NCTCOG) serves a 16-county region of North Central Texas. Mobility 2035 - The Metropolitan Transportation Plan for North Central Texas (Mobility 2035 – 2013 Update) is a long-range transportation plan for the metropolitan planning area that guides the implementation of multimodal transportation improvements, policies, and programs in the metropolitan planning area through the year 2035. Chapter 5 of the document is about Operational Efficiency. Section 3 of Chapter 5 specifically discusses transportation system safety and security.

Mobility 2035 – 2013 Update established multiple goals for the metropolitan area transportation system. The goal on safety is to "ensure adequate maintenance and enhancing the safety and reliability of the existing transportation system." Meanwhile, the Mobility 2035 – 2013 Update supports multiple transportation system safety programs, including 1) freeway incident management program; 2) regional mobility assistance patrol program; 3) regional safety information system; 4) safety education and training program; and 5) crash casual road factors program.

The Alamo Area Metropolitan Planning Organization

The Alamo Area MPO develops transportation plans and programs to address the transportation safety needs of the greater San Antonio area. The Mobility 2035 Metropolitan Transportation Plan is the basic framework for the Alamo Area MPO's continuous, comprehensive, and coordinated regional transportation planning efforts for the next twenty-five years. To develop the best transportation system for the area, the Mobility 2035 Metropolitan Transportation Plan proposed "considering safety in the project selection process" as one of the policies for the roadway system. Based on data for the MPO region and information received from the regional safety committee, the emphasis areas for the region include impaired driving, motorcycle fatalities and injuries, road rage/aggressive driving, speed, cell phone usage and crashes, bicycle and pedestrian crashes involving a vehicle, and distracted driving, etc.

Capital Area Metropolitan Planning Organization

The Capital Area Metropolitan Planning Organization (CAMPO) is the MPO for Bastrop, Burnet, Caldwell, Hays, Travis, and Williamson Counties in Texas. The CAMPO Safety and Security Taskforce was formed in 2007 and is made up of CAMPO and other agencies. The taskforce meets as needed to discuss new data, new ideas, and to review methods of analysis for safety and security planning in CAMPO plans and programs.

CAMPO also partners with the TxDOT and other transportation agencies to track and evaluate the safety of transportation facilities in Central Texas. Data for crashes involving automobiles, bicycles and pedestrians are provided with information on the severity of injuries related to each incident. CAMPO also keeps data on a variety of other safety issues related to transportation. CAMPO and its member jurisdictions use crash data to plan and prioritize safety improvements.

Corpus Christi MPO

The Corpus Christi MPO serves the urbanized area of Corpus Christi in Texas. Mobility CC creates the framework for a comprehensive, integrated, multi-modal transportation network for the City of Corpus Christi through balancing access, mobility, health and safety needs of motorists, transit users, bicyclists, and pedestrians of all ages and abilities. To improve the safety performance of the roadway, Mobility CC incorporated several policies and objectives for the planning, designing, constructing and maintenance of the roadway network, including 1) promote bicycle, pedestrian and public transportation rider safety; 2) create safe routes to parks and open spaces; and 3) provide children with safe and appealing opportunities for walking and bicycling to school and reduce the risk of injury to children through traffic collisions near school.

2.2.4 Summary of Existing Transportation Safety Planning

The following section summarizes the common characteristics and general patterns among the transportation safety planning documents from different jurisdictions, which could be used to guide transportation safety planning for the state of Texas. Also, notable gaps in the review of these documents is identified.

Identified Emphasis Areas

Generally, emphasis areas are identified in the transportation safety planning process based on historic crash data, roadway network characteristics, federal and/or state policies on transportation safety management, etc. The identified emphasis areas could be used to guide the investment on transportation safety improvements so that maximum benefit cost ratio could be achieved.

Based on the historical crash data analysis results, different emphasis areas were selected by different agencies in their transportation safety planning. The most commonly selected emphasis areas are motorcyclists, bicyclists, pedestrian, DUI, speeding, aggressive driving, safety belt, distracted driving, children safety and traffic and crash records. The results indicate that vulnerable users including pedestrian, bicyclists and motorcyclists have been identified as emphasis areas at different jurisdiction levels so that special attention should be paid to them.

Noted Gaps in Review of Safety Planning Documents

The state of Texas employed a data-driven process for identifying the emphasis areas and setting the targets on transportation safety performenance. To meet the goals and performance measures that the state set on transportation safety, the following gaps have been noted:

- Statewide transportation safety planning documents for all roadway users
  TxDOT has developed the comprehensive transportation safety planning documents for the roadway safety management process, including the *Texas Highway Safety Performance Plan* and the *Texas Strategic Highway Safety Plan*. However, no relevant transportation safety planning documents for vulnerable roadway users, such as pedestrians, bicyclists, etc. have been developed yet. To reduce the number of fatalities for pedestrians, bicyclists and any other vulnerable roadway users, guidelines on improving transportation safety for those vulnerable roadway users are necessitated.
- Transportation safety planning in the MPO and other local agency transportation planning process
  Currently many MPOs have already included transportation safety as one integral part of their transportation planning efforts. However, still there are some MPOs for which the transportation safety has not been incorporated into their transportation planning process yet. To enhance the statewide safety performance of the whole roadway system (including both state and local system), it's necessary to incorporate the transportation safety into the comprehensive transportation planning process at all levels.
- Lack of transportation safety planning for commercial vehicles
  Specific attention should be paid to the safety performance of commercial vehicles due to the weight of the vehicle itself and severity of commercial vehicle related crashes. However, no guidelines and/or planning documents on transportation safety of commercial vehicles have been developed for the state of Texas yet. A comprehensive transportation safety planning review for commercial vehicles should be developed based on available crash data and any other relevant policies for the state of Texas.
- Strategies, Targets and Goals in Transportation Safety Planning
  To improve the safety performance of the roadway system, the transportation safety planning documents set specific strategies, goals and/or objectives for region under investigation. Table 1 lists the different goals included in the relevant transportation safety planning documents.

Table 1. Target and Goal for Different Transportation Safety Planning

Document Name	Strategy, Target and/or Goal
Texas SHSP	Crash reduction objectives for each emphasis area
Texas HSPP	19 goals for the traffic safety program and objectives for 39 performance measures
Texas SAPM	13 goals plus initiatives and action steps under each goal
Texas SLRTP	N/A
H-GAC	17 recommendations for improving safety in 4 emphasis areas
NCTCOG	One goal on safety and multiple core concepts to support the goal
Alamo Area MPO	One goal for pedestrian and bicyclist safety respectively
El Paso MPO	N/A
CAMPO	Set “safety” as one of the 12 goals on transportation planning
Corpus Christi MPO	Set specific goals on pedestrian and bicyclist safety

2.3 Texas Transportation Safety Goals, Performance Measures and Targets

The TTP sets the following goals on transportation safety in Texas: 1) improve multimodal transportation safety; 2) reduce the number of fatalities and severe injuries on public roads. Specifically, the following goals are selected to be achieved:

- Reduce fatal and serious injury crashes
- Improve safety of at-grade rail crossings
- Eliminate conflicts between modes wherever possible
- Increase bicycle and pedestrian safety through education, the design of new facilities, and improvements to existing facilities
- Educate the public on the dangers of high-risk driving behaviors
- Coordinate with enforcement to improve driver compliance with laws
- Improve incident response times

Based on the new legislation, the following performance measures are recommended to track and measure the effectiveness of the goals set in the TTP:

- Number of fatalities
- Number of serious injuries
- Number of fatalities/serious injuries per million vehicle miles traveled
- Number of fatalities/serious injuries per million population
- Number of crashes between train and vehicle
- Number of fatalities/serious injury crashes between train and vehicle

- Number of pedestrian and bicyclist fatalities and serious injuries
- Number of pedestrian and bicyclist fatalities per million population
- Number of fatal and serious injury crashes involving cell phone use/speeding
- Safety belt usage rate
- Number of fatal crashes due to DUI
- Average incident response time/incident clearance time

3.0 Transportation Security Planning in Texas

3.1 Introduction and Background

Texas is a uniquely important state, with a $1 trillion gross state product, three of the country's most populous cities, and a diverse population of over 24 million. Texas shares a 1,254-mile international border with Mexico and has a 367 mile long coastline on the Gulf of Mexico, which contains some of the busiest, most economically important shipping lanes and ports in the United States. The threats that face the State of Texas include the following categories:

- Natural hazards, such as wildfires, floods, hurricanes, tornadoes, lightning, snow, ice storms, earthquakes, and droughts;
- Technological hazards, such as major transportation accidents, oil spills, industrial fires and explosions, nuclear facility accidents, and hazardous material spills;
- Homeland security threats, including terrorists using conventional, chemical, biological, nuclear, and radiological weapons, as well as cyber attacks, and cross-border violence by transnational crime organizations;
- Other threats and hazards, including human and animal epidemics and pandemics, civil unrest, disruptions in production and distribution of critical goods and services, and energy shortages.

The most frequent major disasters in Texas are flooding, tornados, and hurricanes. Texas ranks first among the states for frequency of tornados and flash floods, and the state has more than 10 million acres of floodplain. It is second only to Florida in the number of hurricane impacts, and, nationwide, suffers the greatest economic impact from hurricane losses.

The surface transportation system of the state of Texas is a vast, open system of interdependent networks. Consisting of the subsectors of mass transit, highways, freight rail, and pipelines, this network is critical to the state's economy and the way of life of its residents. The following section summarized key points derived from major technical documents on transportation security planning and management at federal, state and MPO levels.

3.2 Transportation Security Planning at Federal Level

3.2.1 Homeland Security Presidential Directive

Critical infrastructure includes those assets, systems, and networks, which, if damaged, could result in significant consequences, such as adverse impacts on national economic security, national public health and safety, public confidence, the environment, loss of life, or some combination of these. Attacks against critical infrastructure could have a significant impact on the economy or cripple transportation, trade, and commerce.

The Homeland Security Presidential Directive (Presidential Directive) establishes a national policy for federal departments and agencies to identify and prioritize United States critical infrastructure and key resources and to protect them from terrorist attacks. The Presidential Directive requires that “the Department of Transportation and the Department of Homeland Security will collaborate on all matters relating to transportation security and transportation infrastructure protection.” The Department of Transportation is responsible for “operating the national air space system.” The Department of Transportation and the Department of Homeland Security will collaborate in “regulating the transportation of hazardous materials by all modes (including pipelines).” The Presidential Directive also requires that the Secretary of Homeland Security shall “coordinate protection activities for transportation systems, including mass transit, aviation, maritime, ground/surface, and rail and pipeline systems.”

3.2.2 Surface Transportation Security Priority Assessment

The Surface Transportation Security Priority Assessment (Assessment) provides a comprehensive framework for the continued improvement of surface transportation security and identify discrete areas of focus to guide the decisions and actions of security partners in applying their respective capabilities. The interagency staff identified 10 issue areas commonly identified by surface transportation security stakeholders that require further review to improve the effectiveness of national surface transportation security, including:

- Federal coordination
- Risk management
- Research and development
- Hardening
- Credentialing
- Federal inspections
- Grants
- Training
- Information sharing
- Rulemaking

Recommendations developed through the Assessment include the need to consider industry best practices, coordinate risk assessments and share information across the Federal agencies, incorporate vulnerability and consequence into risk assessments, and improve the grant process by clarifying Federal roles and tracking performance. Each recommendation includes a suggestion for a lead agency to execute the action item.

3.3 Transportation Security Planning at State Level

3.3.1 State of Texas Emergency Management Plan

The State of Texas Emergency Management Plan (the State Plan) describes how the State will mitigate against, prepare for, respond to, and recover from the impact of hazards to public health and safety. The State Plan establishes operational concepts and identifies tasks and responsibilities required to carry out a comprehensive emergency management program. It describes the State's emergency management organization and a statewide system of coordination. The State Plan defines the emergency responsibilities of the TxDOT as following:

- Provides for the safe, effective, and efficient movement of people and goods over State-maintained highways and farm-to-market/ranch roads, and via multimodal forms of transportation throughout the State;
- Supervises the maintenance of State highway and ferry systems and their design, environmental oversight, acquisition of right of way, materials testing and validation, and construction;
- Issues oversize/overweight permits, and routing as necessary; receives, disburses, and administers federal and State funds for general aviation airports and assists small communities in building, maintaining, and upgrading airports; provides financial and technical assistance to providers of urban, or rural, public transit for the elderly or disabled; regulates outdoor advertising along highways and rural roads; oversees programs in traffic engineering, traffic safety, and traffic management; and oversees inspection of railroad operations and equipment, hazardous-materials handling on railroads, signal operation, and railroad tracks within Texas;
- Facilitates communication with Mexican officials and advises on international transportation along the Texas-Mexico border;
- Supports tourism, by operating travel information centers and publishing travel literature.

3.3.2 Texas Homeland Security Strategic Plan 2010-2015

The Texas Homeland Security Strategic Plan 2010-2015 serves as a high-level road map for the state's homeland security efforts for calendar years 2010-2015. It provides overarching guidance for state, regional, and local homeland security and emergency management plans and operations. It also helps inform federal partners who support Texas' homeland security efforts.

Texas has a vast number of critical infrastructure that could be vulnerable to a myriad of natural and manmade disasters. The critical infrastructure for the transportation system include:

- 150 major dams
- 1,853 aircraft landing areas
- 21 international airports
- 12 deep draft ports
- 17 shallow draft ports
- 26 land ports
- 128 cargo ports
- 296,000 miles of streets, highways, interstates
- 10,000 miles of railroad line
- 76,000 miles of hazardous liquid pipeline
- 50,572 bridges
- 141,000 miles of natural gas pipeline

The Texas Gulf Coast is home to deep and shallow water ports and the Gulf Intracoastal Waterway, with interconnecting rail and highway transportation corridors that are vital to U.S. national defense. There are 29 marine ports in the state, ranging from some of the busiest freight transportation hubs in the nation to smaller recreational and fishing harbors. Of these 29 ports, 12 are classified as deep water ports, while the remaining 17 are shallow draft ports. The largest ports in terms of throughput and capacity include the Port of Houston, Port of Corpus Christi, Port of Beaumont, and the Port of Galveston. In addition to its maritime ports, Texas has 1,853 private and public airport facilities, of which 21 are international airports. While the large international airports are of obvious homeland security concern, the hundreds of smaller airports can also present a threat. Texas has 26 official land ports, from the westernmost in El Paso to the easternmost in Brownsville. Texas land ports typically experience about 33 million pedestrian crossings, 61 million vehicle crossings, and 1.1 million rail crossings annually.

3.4 Transportation Security Planning at MPO Level

3.4.1 North Central Texas Council of Governments

The North Central Texas Council of Governments (NCTCOG) incorporated transportation security into its long range transportation planning efforts. Enhancing the security of transportation system is one of the highest priorities of transportation agencies in the Dallas-Fort Worth region. Regional coordination of information sharing, response plans, response capabilities, and protection of critical infrastructure are key components to addressing transportation system security.

Annually, NCTCOG and regional transportation partners assess transportation and other regional components for nomination to the Critical Infrastructure Inventory/Key Resources. The confidential inventory is used in developing security measures for surveillance and protection of the identified regional assets. Transportation and Emergency Responders Uniform Communication System

(TERUCS) enables network communication between emergency operations centers and traffic management centers in the Dallas-Fort Worth area.

The region's intelligent transportation system infrastructure is an integral part of the transportation system security program. Current and future transportation and transit management center ITS components include closed-circuit televisions, lane control signals, dynamic message signs, ramp meters, mobility assistance patrols, vehicle detectors, transit vehicle tracking, in-vehicle navigation, integrated radio systems and automated vehicle location, automated fleet maintenance system, and automated HOV/managed lane enforcement. These traffic monitoring, incident detection, and response systems are utilized in improving the security of the regional transportation system.

NCTCOG and other regional partner agencies are working to establish coordination and organization procedures for using transportation resources for local and county agencies preparing for, responding to, and recovering from incidents which impact the residents of North Central Texas. Transportation support such as providing land, air, rail, or other resources for emergency response or assistance operations, and coordinating resources to facilitate an effective, efficient, and appropriate response and support are being assessed.

3.5 Texas Transportation Security Performance Measures and Targets

The target of the TTP on transportation security is to ensure the security of the critical infrastructure in Texas and minimize the possible effects from natural hazards, terrorism attacks, etc when occurred. Specifically, the following goals are selected to be achieved:

- Develop the comprehensive database for all critical infrastructures within the state
- Establish an emergency response system and minimize emergency response times
- Coordinate the transportation security activities at state, county and city level
- Training and education on transportation security response measures

The following performance measures are selected for monitoring the effectiveness of the goals achieved:

- Percentage of critical infrastructure identified and archived in the state critical infrastructure database
- Emergency response time
- Frequency of transportation security training and drills held among state, county and city agencies
- Percentage of State population that receive training and/or educational materials on transportation security response protocol

Table 2 provides the recommended targets, by five year increment, for each performance measure.

Table 2. Recommended Targets for Each Performance Measure

Performance Measure	2015 (baseline)	2020	2025	2030	2035
Number of fatalities	baseline	10% reduction	15% reduction	18% reduction	20% reduction
Number of serious injuries	baseline	12% reduction	20% reduction	23% reduction	25% reduction
Number of fatalities/serious injuries per million VMT	baseline	11% reduction	20% reduction	22% reduction	22% reduction
Number of fatalities/serious injuries per million population	baseline	15% reduction	22% reduction	25% reduction	30% reduction
Number of crashes between train and vehicle	baseline	25% reduction	35% reduction	45% reduction	50% reduction
Number of fatalities/serious injury crashes between train and vehicle	baseline	25% reduction	35% reduction	45% reduction	50% reduction
Number of pedestrian and bicyclist fatalities and serious injuries	baseline	8% reduction	10% reduction	13% reduction	15% reduction
Number of pedestrian and bicyclist fatalities per million population	baseline	10% reduction	12% reduction	15% reduction	18% reduction
Number of fatal and serious injury crashes involving cell phone use/speeding	baseline	20% reduction	25% reduction	28% reduction	30% reduction
Safety belt usage rate	baseline	90% usage	95% usage	95% usage	95% usage
Number of fatal crashes due to DUI	baseline	5% reduction	7% reduction	9% reduction	10% reduction
Average incident response time/incident clearance time	baseline	15% reduction	20% reduction	23% reduction	25% reduction

TEXAS TRANSPORTATION COMMISSION

ALL Counties

MINUTE ORDER

ALL Districts

In compliance with Title 23 U.S.C. §135, as implemented by 23 C.F.R. Part 450, and Transportation Code §201.601, the Texas Department of Transportation (department) has developed a performance-based, statewide long-range transportation plan – the Texas Transportation Plan (TTP) 2040 – covering a period of 25 years that provides for the development and implementation of a transportation system and contains all modes of transportation, including: (1) the systems and facilities for highways and turnpikes, aviation, public transportation, railroads and high-speed railroads, waterways, pedestrian walkways, and bicycle transportation facilities; and (2) the transportation users of each type of transportation facility.

The TTP 2040, which is attached as Exhibit A, has been developed in cooperation with the metropolitan planning organizations (MPOs) and, as appropriate, in consultation with affected state, tribal, and local agencies responsible for transportation, land use management, natural resources, environmental protection, conservation, and historic preservation. The TTP 2040 includes capital, operations and management strategies, investments, procedures, and other measures to ensure the preservation and most efficient use of the existing transportation system. In addition, it includes long-term transportation goals with measurable targets, priority corridors, and by reference, financially constrained department and MPO programs of projects.

The TTP 2040 has been presented for public comment by means of various stakeholder and public meetings conducted in each department district throughout the state to solicit input and comment from affected public agencies, representatives of transportation agency employees, freight shippers, private providers of transportation, providers of freight transportation services, representatives of users of public transit, members of the public, and other interested parties. A public hearing was held in Austin on February 11, 2015, and written comments were accepted through February 23, 2015. A summary of the comments is included in the TTP 2040.

By letter dated October 4, 2005, the governor delegated the power and responsibility for approving the statewide long-range transportation plan to the Texas Transportation Commission (commission) or its designees. After due deliberation and consideration, the commission finds that the requirements of Title 23 U.S.C. §135 and Transportation Code §201.601 have been fully satisfied as they pertain to the development of the TTP 2040.

IT IS THEREFORE ORDERED by the commission that the TTP 2040, which is attached as Exhibit A to this order, is hereby adopted.

IT IS FURTHER ORDERED that the executive director, or his designee, submit the TTP 2040 to the Federal Highway Administration in accordance with federal requirements.

Submitted and reviewed by:

James W. Koch, P.E.

Director, Transportation Planning and Programming Division

Recommended by:

Executive Director

114207 FEB 26 15

Minute Number	Date Passed
114207	FEB 26 15

TEXAS TRANSPORTATION COMMISSION

VARIOUS Counties **MINUTE ORDER**

VARIOUS Districts

In compliance with Title 23 U.S.C. §135, as implemented by 23 C.F.R. Part 450, and Transportation Code §201.601, the Texas Department of Transportation (department) created a statewide long-range transportation plan covering a period of 25 years that provides for the development and implementation of a transportation system and contains all modes of transportation. The plan, known as the Texas Transportation Plan 2040, was adopted by the Texas Transportation Commission (commission) on February 26, 2015.

The department has developed and implemented a performance-based planning and programming process dedicated to providing the executive and legislative branches of government with indicators that quantify and qualify progress toward attaining all department goals and objectives established by the legislature and the commission. The department has also developed and implemented performance metrics and measures as part of the review of strategic planning in the statewide long-range transportation plan.

Senate Bill 312 (85th Legislature, Regular Session, 2017) amended Transportation Code §201.601 and requires that the statewide long-range transportation plan contain clearly defined transportation system strategies, long-term transportation goals for the state and measurable targets for each goal, and other related performance measures. Senate Bill 312 also amended Transportation Code §201.6015 and requires that the department include the transportation system strategies, goals and measurable targets, and other related performance measures in each of its transportation plans and policy efforts.

The department has developed a set of transportation system goals, strategies, performance measures and 10-year targets, which is attached as Exhibit A. The transportation system goals and strategies were adopted by the commission in May, 2016 as part of the 2017-2021 Strategic Plan. The performance measures and 10-year targets were presented to the commission in January, 2018.

IT IS THEREFORE ORDERED by the commission that the transportation system goals, strategies, performance measures and 10-year targets, as shown in Exhibit A, are hereby adopted.

IT IS FURTHER ORDERED that the transportation system goals, strategies, performance measures and 10-year targets be incorporated into the Texas Transportation Plan 2040 and other transportation plans and policy efforts as they are created or updated.

Submitted and reviewed by:

Director, Transportation Planning and Programming Division

Recommended by:

James M Bass

Executive Director

115152 FEB 22 '18

Minute Number | Date Passed

Exhibit A

Strategic Plan Goal	Performance Vision	Key Performance Measure (KPM)	Projected 2027 Outcomes	2027 Target*
Promote Safety	Reduce crashes and fatalities through targeted infrastructure improvements, technology applications, and education	Safety: Fatalities/Yr	4,120	3,708
		Safety: Fatality Rate	1.36	1.16
Preserve our Assets	Maintain and preserve system/asset conditions through targeted infrastructure rehabilitation, restoration and replacement.	Preservation: Pavement Condition	88.0%	90%
		Preservation: Statewide Bridge Condition Score	89.1%	90%
Optimize System Performance	Enhance mobility, reliability, connectivity & mitigate congestion through targeted infrastructure & operational improvements	Congestion: Urban Congestion Index	1.23	1.20
		Connectivity: Rural Reliability Index	1.12	1.12

* Performance targets to be used for SB 312 requirements