



TDOT 25-YEAR LONG-RANGE TRANSPORTATION POLICY PLAN



TRAVEL TRENDS & SYSTEM PERFORMANCE POLICY PAPER

TN TDOT
Department of
Transportation

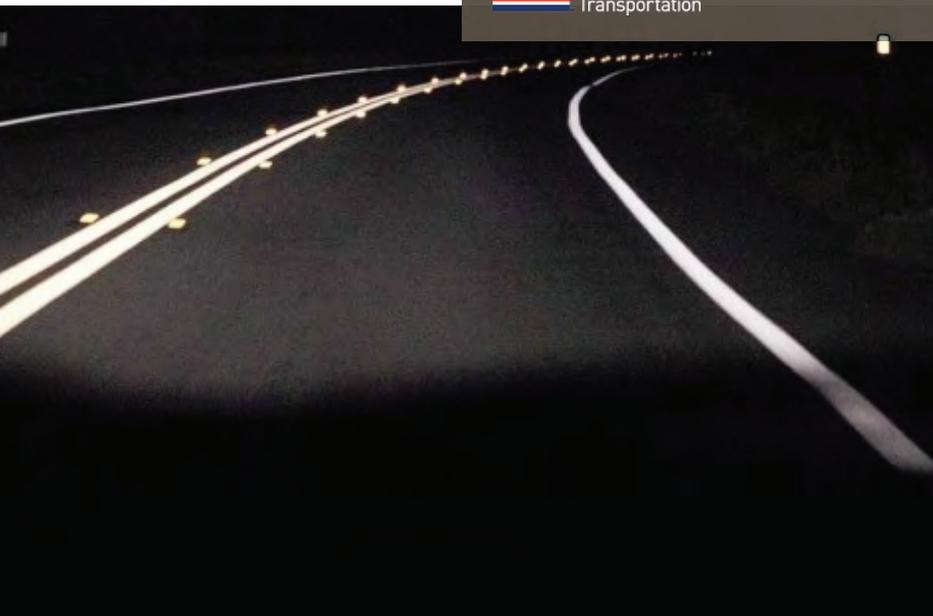
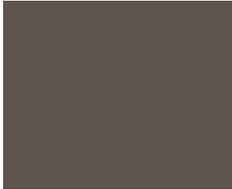


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1.0 INTRODUCTION

1.1 PURPOSE

Travel trends and system performance are two transportation related categories where one has a direct effect on the other. Travel trends can be followed by tracking and projecting the population, employment, and industry in the state. The trends seen from growth or decline in these categories affect the transportation system performance. The purpose of this policy paper is to describe current policies and programs of the State for travel trends and system performance and to recommend policies and programs consistent with the Guiding Principles of the Department's 25-Year Policy Plan. This is accomplished by evaluating performance measures currently used by the Tennessee Department of Transportation (TDOT), assessing the transportation system, evaluating travel trends in the state and nationally, and including noteworthy practices as they apply to Tennessee. The result will be tools for TDOT to utilize in determining performance measures that can be implemented to assist in the project prioritization process. The measures presented here will need to be dynamic and are expected to require some revisions as federal transportation legislation guidance continues to be developed. However, it is expected that these measures will serve as a basis to be built upon as TDOT continues to strive towards their vision of becoming the best multimodal DOT in the nation. In keeping with TDOT's multi-modal philosophy, this paper includes pedestrians, bicyclists, transit users, rail, air, and water, as well as motorists, in the evaluation of the State's transportation system.

1.2 RELATION TO GUIDING PRINCIPLES

TDOT has developed a set of guiding principles that are intended to guide the Department's decisions toward its vision. The relationship of the guiding principles to the topics of travel trends and system performance is described below.

1.2.1 Travel Trends

Travel trends pertain to how, why, and who is making a trip. How a trip is made is influenced by the modes available and accessibility to a mode, such as location to transit stops or owning a bicycle, noting that the distance of the trip will likely affect the chosen mode. Why a trip was made, or the purpose of a trip, can arise from activities such as work, school, shopping, or recreational purposes. Who makes a trip involves many variables that need to be considered. Planning for the demographics of the future plays an important role in the evaluation of the system. The relevance of travel trends to the Guiding Principles is provided below:

- **Preserve and Manage the Existing System** - Evaluating the trends of the population and movement on the transportation system enables TDOT to do a better job of maintaining the system and provides an opportunity to improve current transportation patterns of the existing system.
- **Provide for Efficient Movement of People and Goods** – Providing for the efficient freight movement to accommodate future employment and industry growth will help the state's economy.
- **Maximize Safety and Security** – Improving the safety and security of the operation of the transportation system can create an environment that can support the expected population and employment trends.
- **Build Partnerships for Sustainable and Livable Communities** – Awareness of the travel trends

seen in Tennessee helps to create a safe environment for all users that will help preserve the system and provide a safe environment for all users of the transportation system.

- Protect Natural, Cultural, and Environmental Resources – Creating a transportation system appropriate for the natural and built environment helps communities create an identity unique to their surroundings.
- Emphasize Financial Responsibility – Trends in transportation funding require consideration of various funding programs to ensure the state remains fiscally responsible.

1.2.2 System Performance

How the transportation system performs affects daily commuting trips as well as trips made by travelers passing through the state. An evaluation of the transportation system requires various measurements to determine where the system may need improvements. Evaluating the system using specific metrics and setting targets helps TDOT measure the effectiveness of programs and policies and identify where projects may be needed. The relevance of the system performance to the Guiding Principles is provided below:

- Preserve and Manage the Existing System – Measures that evaluate the existing conditions of the transportation system provide information on system performance that can be used to identify projects to improve the function of the existing system.
- Provide for Efficient Movement of People and Goods – Metrics that quantify efficient movement of freight can help identify projects on the transportation system that will improve the flow of people and goods.
- Maximize Safety and Security – Improving safety and security for all modes and users of the transportation system creates an environment where all users can rely on the ability to safely move throughout the state.
- Build Partnerships for Sustainable and Livable Communities – Through an evaluation of specific metrics, TDOT can identify ways to assist communities in becoming more sustainable and livable.
- Protect Natural, Cultural, and Environmental Resources – Reviewing and measuring environmental effects of transportation projects helps to preserve the environment and build a stronger relationship between the state and the communities affected by these system improvements.
- Emphasize Financial Responsibility – The measurement of system performance is a critical component for a successful DOT in determining appropriate funding options and the how to complete projects from start to finish on time and on-budget.

2.0 SUMMARY OF FINDINGS

The purpose of this policy paper is to describe current policies and programs of the State relating to the performance and usage of Tennessee's roadway, rail, water, and air infrastructure in order to accurately depict the current and future users and associated needs. The brief summary includes recommendations for programs and policies that are consistent with the Guiding Principles of TDOT's 25-Year Policy Plan.

Summary of Findings:

- In Tennessee, there are over 28,413 miles of functionally classified roads.
 - Region 3 has the most roadway miles (8,235) and Region 2 has the least (5,765).
 - 75% of total roadway miles are in rural areas, while 25% are in urban areas.
 - 41% of all Daily Vehicle-Miles-Traveled (DVMT) occurred on rural roadways, while 59% occurred on urban roadways.
 - Of the 166,826,911 miles traveled (DVMT) on Tennessee's roadways in 2012, 34% were traveled on Interstates, which make up only 4% of total roadway miles.
 - While Collector roads account for 63% of all roadway miles in Tennessee, these roadways only make up 15% of DVMT. The majority (87%) of these roadways are located in rural areas versus 13% located in urban areas.
- There are 20,087 bridges on public roads within Tennessee.
 - 42% (8,437) are *State Maintained* meaning that TDOT owns, operates, and maintains these structures.
 - 58% (11,650) are *Non-State Maintained* meaning they are owned, operated, and maintained by local governments.
 - 8,101 of the State Maintained bridges are rated as "not structurally deficient", while 254 are rated as "structurally deficient".
 - Region 3 has the most structurally deficient bridges with 94.
 - Using 2013 dollars, it would take approximately \$3.1 billion to replace or repair all structurally-deficient bridges in the state.
- TDOT maintains 19 park-and-ride lots across the state with more than 920 parking spaces.
 - The majority of lots (63%) are located in Region 3 around the Nashville MSA.
 - While all TDOT lots are paved, only 32% have lighting.
- TDOT provides financial assistance for the operations of 26 public transit systems serving Tennessee counties, while also providing administration for several programs and services related to public transportation.
 - In 2012, 32,300,974 trips were taken by public transportation (all modes) in Tennessee.
 - For all regions, ridership mainly occurred in urban areas (more than 90%).
 - Region 3 and 4 experienced the most ridership in 2012 making up 33% and 39% of

the state's overall total, respectively.

- In 2011, 12,696 miles of state highway were assessed for bicycle level of service (BLOS) suitability. Of these state highways, 36% reported having a BLOS rating of C or better.
- Within the state there are over 1,200 miles of Class I railroads owned and operated by 6 railroad companies and 21 short line railroads (18 of which receive funding through TDOT's Short Line Railroad Authorities Program).
- The state has 949 miles of navigable waterways with a total of 90 Tennessee counties located within 50 miles of this system.
 - 887 miles are on main river channels (Tennessee, Cumberland, and Mississippi Rivers).
 - 226.3 million tons of freight were moved by way of these three rivers in 2010.
 - While the Mississippi River has the least mileage of the three (176 miles), it moved 73% of the overall tonnage.
 - TDOT is responsible for two ferry services: the Benton-Houston ferry in Benton and Houston Counties and the Cumberland City ferry in Stewart County
- Tennessee has 5 commercial airports in the cities of Nashville, Memphis, Knoxville, Chattanooga, and the Tri-Cities area.
 - The majority of cargo shipped by air in the state is shipped to/from three of these airports: Memphis, McGhee Tyson (Knoxville), and Nashville International.
 - While all three airports shipped a combined 10.8 million tons, 10.5 million tons was shipped through Memphis alone (the largest shipper in the U.S.).

Recommendations

As state DOTs across the country work towards adopting standards to meet federal transportation legislation, TDOT is well positioned to respond to these requirements. TDOT currently reports on 36 unique performance measures. Categorized as either strategic or operational, these measures align well with MAP-21 National Goals and Guiding Principles of TDOT's 25-Year Policy Plan.

A review of surrounding, peer, and noteworthy state DOT practices provides a powerful backdrop from which TDOT can expand the Department's performance measurement system. There are a number of emerging performance measurement practices. This policy paper highlights their use, application, and potential transferability to Tennessee.

The following recommendations are provided for TDOT's consideration as they relate to travel trends and system performance:

- TDOT should evaluate its training and standard procedures on environmental compliance as it delivers and maintains its transportation system.
- TDOT should employ process improvement practices for continuous improvement of TDOT's oversight and involvement in project environmental review.
- TDOT should investigate tools that allow for economic analysis of its programmed projects as well as those recommended for programming.
- TDOT should go beyond a traditional Benefit Cost Analysis in order to understand the economic impacts of both current and future transportation investments.

- TDOT should adopt performance measures specific to monitoring congestion (e.g., speed, delay, throughput, travel time reliability, etc.).
- TDOT should support a program for congestion reduction investments (e.g., Chokepoints, Transportation Systems Management & Operations (TSM&O), Intelligent Transportation Systems (ITS), Signal Timing, Active Transportation and Demand Management (ATDM), etc.) in the 3-Year Plan.
- At the risk of not adding capacity, TDOT should promote maintenance and preservation of its assets.
- TDOT should continue to promote asset management as a means of maintaining and preserving Tennessee's transportation infrastructure in a state of good repair (i.e. to desired target conditions).
- TDOT should increase its capabilities and technical resources in asset management to advance greater understanding and investments in Tennessee's transportation infrastructure.

3.0 EXISTING TDOT POLICIES, PLANS, AND DATA ANALYSIS

3.1 EXISTING CONDITIONS AND SYSTEM PERFORMANCE

The transportation system in Tennessee includes not only roadways, but air, rail, water, and pipelines. As such, it is intended to serve vehicular travel and freight movement as well as transit, bicycle, and pedestrian travel. Combining all modes and users together requires a balance of land use, environment, and transportation to enable people, goods, and services to move efficiently.

The roles and responsibilities of TDOT for roadway, rail, water, and air infrastructure are outlined below:

- Roadway – Manages all projects on the State Route System and National Highway System, such as pavement and operations projects. Assists local governments and agencies in the development and implementation of major projects off of the State or National Systems, while administering federal and state grant funding to these entities.
- Rail – Assists in funding and completing safety improvement projects at railroad crossings, as well as administering funds for rail and track structure improvement projects for shortline railroads. TDOT also acts as the State Safety Oversight Agency for all rail fixed guideway systems (RFGS) in Tennessee.
- Water – Provides limited funding for port and marine projects while also providing coordination and technical assistance in port development and intermodal access needs that may be required.
- Air - Distributes Federal Aviation Administration (FAA) funds for airport projects including runway and hangar improvements and assists in the review of master plans, airport layout plans, and major projects.

This section of the policy paper describes the existing transportation system for each mode.

3.1.2 Highways and Bridges

Highways

The Federal-aid Highway Program (FAHP) is a broad term that encompasses the federal programs that provide highway funding to the states. FHWA apportions federal-aid highway funds which are financed out of the Highway Trust Fund (HTF) in addition to any necessary supplemental appropriations, while state DOTs administer the program and provide coordination with local governments and agencies. The Federal-aid Highway System refers to the roadways capable of receiving such federal aid highway funds, which total nearly 1-million miles as of early 2014. The National Highway Performance Program (NHPP) has become one of the largest federal-aid highway programs, with around \$22 billion authorized for FY2014. These dollars are designated for improving the condition and performance of the National Highway System (NHS). The NHS includes the Interstate Highway System, a large percentage of urban and rural principle arterials, the Strategic Defense Highway Network (STRAHNET), and strategic highway connectors. Highlighted for national and regional significance, these roadways are subject to meeting national minimum condition and performance requirements with states encouraged to focus federal funds on improving safety and efficiency along these routes. State highway systems are owned and operated by state DOTs. These are subject to their own varying standards aside from those that overlap the NHS.

Federal regulations require state DOTs to functionally classify their roadways into three categories:

arterial, collector, and local roads. This classification is based on how a roadway serves the users by assessing the trade off between access and mobility. It is developed through state, regional, and local coordination and results in the Federal-aid System. This system determines federal eligibility for roadway projects and provides general design guidelines and regulations. Table 1 lists the number of miles of roadways per functional classification for each region of the state. Table 2 shows the percentage of each of the roadway classifications by region of the state. It is important to note that no classified freeways exist in rural areas of the state - hence representation by zeros in Tables 1, 2, and 3.

Table 1 Tennessee Roadway Centerline Miles by Functional Classification

Functional Classification	Total Miles	Percent Miles	Area	State Total	Region 1	Region 2	Region 3	Region 4
Interstate	1,105	4%	Urban	417	132	56	155	75
			Rural	687	214	164	199	111
Other Freeway	155	1%	Urban	155	12	48	60	35
			Rural	0	0	0	0	0
Principal Arterial	3,456	12%	Urban	1,551	459	219	475	398
			Rural	1,905	316	501	495	593
Minor Arterial	5,697	20%	Urban	2,505	694	463	624	724
			Rural	3,192	714	715	1057	705
Collector	18,002	63%	Urban	2,348	786	325	674	563
			Rural	15,654	3,459	3,275	4,495	4,424
Total	28,413	100%	Urban	6,976	2,082	1,110	1,988	1,795
			Rural	21,438	4,702	4,655	6,247	5,834

Source: TDOT Tennessee Roadway Information Management System (TRIMS) 2013

Table 2 Percent of Tennessee Roadway Centerline Miles by Functional Classification

Functional Classification	Area	Total Miles	Region 1	Region 2	Region 3	Region 4
Interstate	Urban	417	32%	13%	37%	18%
	Rural	687	31%	24%	29%	16%
Other Freeway	Urban	155	8%	31%	39%	22%
	Rural	0	-	-	-	-
Principal Arterial	Urban	1,551	30%	14%	31%	25%
	Rural	1,905	17%	26%	26%	31%
Minor Arterial	Urban	2,505	28%	18%	25%	29%
	Rural	3,192	22%	23%	33%	22%
Collector	Urban	2,348	33%	14%	29%	24%
	Rural	15,654	23%	20%	30%	27%
Statewide	Urban	6,976	30%	16%	28%	26%
	Rural	21,438	22%	22%	29%	27%

Source: TDOT TRIMS 2013

The amount of traffic on a roadway can be explained using a variety of metrics, one of which is Vehicle-Miles-Traveled (VMT). VMT is a measurement illustrating the total number of vehicle miles traveled within a defined geographic area over a given amount of time and can be used as an

indicator of land use and transportation connection, emissions, and overall travel patterns within a region. On a most basic level, reviewing the number of Daily Vehicle-Miles-Traveled (DVMT) on each roadway by functional classification shows the amount of traffic experienced on each type of facility. DVMT is equal to the Average Annual Daily Traffic (AADT) multiplied by the total miles of the roadway(s) within the identified study area. Table 3 shows the DVMT per region for the State of Tennessee and the percentage of DVMT per functional classification.

Table 3 Daily Vehicle Miles Traveled by Functional Classification and Region

Functional Class	Total DVMT	% DVMT	Area	State Total	Region 1	Region 2	Region 3	Region 4
Interstate	56,541,135	34%	Urban	32,645,403	7,881,864	3,724,013	14,562,391	6,477,135
			Rural	23,895,732	7,214,961	6,054,469	7,129,281	3,497,021
Other Free-way	5,505,678	3%	Urban	5,505,678	318,251	1,471,531	2,385,036	1,330,860
			Rural	0	0	0	0	0
Principal Arterial	44,119,842	26%	Urban	29,340,700	9,123,619	3,443,458	9,325,639	7,447,984
			Rural	14,779,142	3,139,586	3,325,447	3,807,786	4,506,323
Minor Arterial	36,216,642	22%	Urban	22,689,934	5,476,991	3,527,595	6,854,713	6,830,635
			Rural	13,526,708	3,575,563	2,415,435	5,101,452	2,434,258
Collector	24,444,614	15%	Urban	8,206,291	2,310,139	807,882	3,095,760	1,992,510
			Rural	16,238,323	4,432,591	3,458,090	4,790,934	3,556,708

Source: <http://www.tdot.state.tn.us/hpms/2012>

Bridges

Bridges play an integral role in the transportation system throughout the country and Tennessee is no exception. TDOT realizes the importance of maintaining bridges on the transportation system and has developed a solid bridge inspection program. After a peer review was conducted of the program in 2008, TDOT implemented additional training for bridge evaluators, updated the load permitting process to enhance the ability to issue permits, employed sonar scanning technology to monitor deep-water bridges, and employed computer monitoring of rainfall events to observe bridge scour.

For purposes of this policy paper, Tennessee bridge data are categorized and discussed as State Maintained bridges and Non-State Maintained bridges. State Maintained bridges are located on the Interstate System, the National Highway System, and the State Routes System, and are maintained, owned, and operated by the state. Non-State Maintained bridges are owned, operated, and maintained by local governments (including counties, cities, and towns) in Tennessee. Of all the bridges on public roads in the state, 42% of the bridges are State Maintained and 58% are Non-State Maintained.¹

TDOT has two measures to evaluate the bridge maintenance program. The first measures the operational management effectiveness of the Regional Bridge Inspection program and is required by the Federal Highway Administration (FHWA) guidelines. Inspections are performed by certified bridge inspectors on all structures and culverts spanning a distance greater than 20 feet. TDOT continuously tracks the timing and accuracy of bridge inspections, and in FY 2012 100% of bridges in each region were inspected within their two-year cycle. TDOT evaluates a bridge's condition and appraisal rating - which determines whether a bridge is structurally deficient. Structurally deficient bridges are not inherently unsafe; instead, they are "functionally adequate" meaning they typically

¹ www.tdot.state.tn.us/bridgeinfo/bridgeprogram.htm

require significant maintenance and repair to remain open to traffic with eventual rehabilitation or replacement. This classification is based upon structural and condition assessments of the three primary components of a bridge: substructure, superstructure, and the deck. During FY 2012, TDOT classified fewer than 5% of the State Maintained bridges as being structurally deficient. Table 4 shows the number of bridges, both structurally deficient and those not structurally deficient in each TDOT Region.

Table 4 State Maintained and Non-State Maintained Bridges in Tennessee

Bridge Rating	Region 1		Region 2		Region 3		Region 4	
	State Maintained	Non-State Maintained						
Not Structurally Deficient	1,896	2,073	1,376	1,663	2,427	4,207	2,402	3,018
Structurally Deficient	54	209	29	84	94	163	77	315

Source: TDOT 2014

Between 1982 and 2012, TDOT funded bridge replacement and repair projects using \$1.97 billion under the federal bridge replacement program and an additional \$309 million from the state grant bridge program. Using 2013 dollars, it would take approximately \$3.1 billion to replace or repair all deficient bridges in Tennessee. Due to the limited funding and the cost/benefit comparison, TDOT has looked at rehabilitating structurally deficient bridges rather than replacing them. This extends the life of the structure, but the bridge remains on the schedule for replacement.² As MAP-21 legislation consolidated a portion of the Bridge Replacement Program with the National Highway System (NHS) and Interstate Maintenance (IM) programs, extending the life of bridges as they approach the typical 50-year life span may become more common.

3.1.3 Multimodal System

TDOT recognizes the importance of providing a quality transportation system by improving all modes for all users. Providing multimodal options to the transportation users will help reduce congestion and environmental impacts caused from vehicular travel. This section of the policy paper will review the existing conditions and measures used to evaluate the condition of public transportation, rail, water, aviation, pedestrian, and bicycle facilities.

Park-and-Ride Lots

Park-and-ride lots are essential to both ride-sharing and transit ridership. One of the challenges to using a mode of travel other than a Single Occupant Vehicle (SOV) is finding a secure place to park a vehicle. The features, benefits, and amenities that commuters seek out in park-and-ride lots prompt them to ask questions, including:

- Are there ample spaces available? Is the lot paved, stone, or another surface? Are spaces clearly marked?
- Can I save money by parking here versus parking in another location (perhaps by paying less to park or in gas by not driving as far when ride-sharing or using transit)?
- Will my car be safe here? Is the lot well-lit? Is the area patrolled by police or security? Are there fences or other barriers around the perimeter? Can potential vandals or burglars be

² *Bridge the Gap Restoring and Rebuilding the Nation's Bridges*, AASHTO, July 2008, pg. 28-29

seen from the road or nearby businesses? Are there security cameras?

- How close is the lot to my home and work location? Is it easy to see from the road? Is it easily accessible (easy entry and exit) by car, bicycle, and/or on foot (i.e. are there sidewalks nearby if I'm walking)?
- Does public transit service this location? If so, are there covered shelters where I can wait for the bus or train in case of inclement weather?
- Are there other amenities that make this location attractive, such as bike racks or lockers, newspaper or other vending, and/or nearby places to take care of errands before or after work like grocery stores, dry cleaning, retail, daycare, fast food, or other similar establishments?
- Who owns the lot and will I be at risk of being towed for any reason? Who do I contact if there is a problem and how?

Some transit agencies, such as the Regional Transportation Authority (RTA) of Middle Tennessee and the Nashville Metropolitan Transit Authority (MTA), provide website links for park-and-ride lots, but there is not an organized, central location where commuters can find this information, along with non-transit park-and-ride lots. Being able to locate those lots is particularly important to ride-sharing commuters. Table 5 lists the statewide park-and-ride lots maintained by TDOT.

Table 5 Park-and-Ride Locations in Tennessee

Location	Exit	County	City	Capacity	Paved	Lighted
I-40 & SR-109	232	Wilson	Lebanon	40	Yes	No
I-24 & Almaville Road	70	Rutherford	Smyrna	25	Yes	No
I-24 & New Hope Road	32	Cheatham	Ashland City	32	Yes	No
I-24 & SR-76	11	Montgomery	Clarksville	100	Yes	No
I-24 & SR-96	78	Rutherford	Murfreesboro	78	Yes	No
I-40 & SR-56 N.	280	Putnam	Cookeville	40	Yes	No
I-65 & Concord Road	71	Williamson	Brentwood	50	Yes	No
Rossvie Road	8	Montgomery	Clarksville	100 +	Yes	No
SR-41A & SR-49	24	Cheatham	Pleasant View	30	Yes	No
SR-79 & SR-105		Carroll	Trezevant	52	Yes	No
W. Franklin & Foster		Sumner	Gallatin	35	Yes	Yes
I-40 & SR 96	182	Williamson	Fairview	75	Yes	No
SR 28 & College Station Road		Bledsoe	Pikeville	14	Yes	No
I-75 & SR-60	25	Bradley	Cleveland	29	Yes	No
I-40 W. Highway 70 (MTA)	196	Davidson	Nashville	68	Yes	Yes
Old Hickory Blvd (MTA)		Davidson	Lakewood City Hall	20	Yes	Yes
US 441 & Wiley Oakley Drive		Sevier	Gatlinburg	150	Yes	Yes
Westmoreland		Sumner	Westmoreland	50	Yes	Yes
I-181 & Oakland Avenue	36	Washington	Johnson City	50	Yes	Yes

Source: TDOT, Division of Multimodal Transportation Resources

Vanpools and Carpools

The ride-sharing tab on the Tennessee Smart Commute website, (www.tdot.state.tn.us/smartcommute), contains content that is well-formulated to press “hot buttons” that are important to the commuting public, such as: the increasing costs associated with driving alone in a personal

vehicle, stress and tension associated with fighting traffic alone and/or driving during rush hour, and the personal time that is lost every day during the work commute that could be spent doing something else (like reading the newspaper or napping). Successful Transportation Demand Management (TDM) efforts create action and behavior change, not just awareness, by moving travelers along a decision-making continuum. The language on this site serves to encourage commuters to find a solution to the issues they are facing by using a ride-matching service. The site then directs the user to van-pooling and carpooling options. Carpool programs listed on the Tennessee Smart Commute website include:

- Tennessee Carpool Center: connect with other carpoolers in your area – this is an online “bulletin board” for carpool matching provided by eRideshare.com; it is a free site where commuters can list their desired route, days of travel, and other pertinent details to try finding travel companions. There may be some privacy risk involved for individuals in using this type of site, as you must post your contact information in an all-access public forum. At the time this paper was written, there were 59 listings on this site for Tennessee.
- RTA Carpool Ridematch: find a friend to share a ride – this ridematching service is provided by the Regional Transportation Authority (RTA) of Middle Tennessee, the transit system that provides bus routes and regional rail. The RTA promotes carpooling and vanpooling, provides an Emergency Ride Home program to those who carpool or vanpool, and maintains a database of over 3,000 potential ridesharers in Middle Tennessee.
- Memphis Rideshare: connect with carpoolers in the Memphis area – the Memphis Area RideShare Program’s (MAR) mission is to encourage commuters to consider alternatives to driving single occupancy vehicles to work every day. To promote carpooling, MAR provides a web-based matching service through the Shelby County website and offers incentives to those who participate in the program when they register their carpool on the site.
- Knoxville Smart Trips: connect with carpoolers in the Knoxville area – Smart Trips, which is housed within the Knoxville - Knox County Metropolitan Planning Commission, is a free, online program that encourages people to take alternative commutes such as walking, riding a bicycle, or carpooling instead of driving alone to work. Smart Trips helps commuters find carpool partners or learn to navigate the area by bike, bus, or on foot while saving money on gas and helping the environment. Smart Trips was founded in 2003 with part-time staff and hired a full-time coordinator in 2005. In 2007, they began an incentive program. More information on Smart Trips is featured later in this report, as it is a comprehensive, full-service TDM program with reportable data.
- Carpool World: worldwide match for commuters based on proximity to home – this is another online “bulletin board” for carpool matching similar to eRideshare.com (see above); however, it shows those seeking rides for the entire country and beyond. At the time this paper was written, there were no listings on this site for Tennessee.

There are also two links under “Carpool Links” that help commuters locate park-and-ride sites: Middle TN Region – a list of lots provided by the Regional Transportation Authority (RTA) of Middle Tennessee and Nashville – a list of lots provided by the Nashville Metropolitan Transit Authority (MTA).

Vanpool Programs listed on the Smart Commute Tennessee website include:

- RTA RideMatch: find a friend to share a ride – as is described regarding Carpool Programs; the same is applicable except with the vanpool program, commuters are eligible for Qualified Transportation Fringe Benefits, as vanpoolers enter a formal agreement and do not use their personal vehicles per the established guidelines.

- TMA: vanpool fleet serving nine Middle Tennessee counties – the website lists this as a vanpool resource for nine counties, but the Transportation Management Association (TMA) Group’s website says that the service provides this and other commuter services in 16 Middle Tennessee counties, including: Williamson, Wilson, Sumner, Rutherford, Robertson, Putnam, Montgomery, Maury, Marshall, Lawrence, Humphreys, Hickman, Dickson, Davidson, Coffee, and Cheatham. The TMA Group is a 501(c)(3) nonprofit corporation established in 1988 as a public-private partnership of business, governmental, and community leaders, who support a regional transportation system that provides a variety of accessible, affordable, reliable, and interconnected transportation choices that are both healthy for the environment and for people. The TMA Group provides their “Vanstar” vanpools on behalf of Williamson County, Tennessee, and the Regional Transportation Authority. They raise public awareness, promote TDM and mobility management solutions to transportation challenges throughout the region, and provide additional transit-related services under contract with the Franklin Transit Authority, as well as other services in various areas.
- Vride: Memphis Area Rideshare – Memphis Area Rideshare (MAR) as listed above under Carpool Programs, offered through the Shelby County Air Quality Improvement Branch, has partnered with vRide (formerly known as VPSI, Inc.), a national vanpool vendor, to provide this program. vRide offers ridematching services and is the nation’s largest private provider of commuter vanpools with more than 6,500 vans on the road today.
- Statewide: Tennessee Vans – Tennessee Vans (TN Vans) is a social business enterprise whose mission is to meet the mobility needs of the transportation disadvantaged in a financially sustainable manner. Founded in 1990, TN Vans works in partnership with community agencies that provide services to persons with disabilities, workforce participants, the youth, seniors, recovery program participants, and community outreach programs. Through these partnerships, TN Vans is able to maintain program sustainability and produce positive financial, social, and environmental outcomes and benefits to its program participants, investors, and communities in Tennessee. Through its vehicle provision (including a staffed driver) and financial service programs, TN Vans is currently providing approximately 1.2 million trips per year for more than 2,500 people using a fleet of 200 vehicles. (Note: Also listed under this link is The Knoxville Commuter Pool (KCP), a regional commuter van service. KCP’s mission is to provide vehicles and support services to community groups and employee groups who desire to use vans to meet transportation needs.)

There is also a link under “Vanpool Links” that helps commuters locate park-and-ride sites (RTA Park-and-Ride Lots); see above under the Carpool Programs section.

Public Transportation

TDOT provides financial assistance for the operations of 26 public transit systems serving Tennessee counties. The service provided by each transit system depends on the community’s needs and ranges from rail to fixed route bus to demand response vans to trolley.

Ridership as reported in 2010 is provided by TDOT Region in Table 6.

Table 6 Annual Transit Ridership

	Region 1	Rides Per Capita	Region 2	Rides Per Capita	Region 3	Rides Per Capita	Region 4	Rides Per Capita	Statewide
Urban	5,283,717	3.14	3,144,420	3.12	10,321,865	4.92	12,099,998	7.74	30,850,000
Rural	364,643	0.22	262,699	0.26	435,896	0.21	387,736	0.25	1,450,974
Total	5,648,360	3.35	3,407,119	3.38	10,757,761	5.12	12,487,734	7.98	32,300,974
Percent of Total	17%	-	11%	-	33%	-	39%	-	100%

Source: TDOT Multi-Modal Transportation Resource Division, 2010 Annual Report

TDOT is responsible for the administration of several programs and services related to public transportation such as the following FTA programs. The parenthetical number refers to the program's corresponding section number under 49 U.S. Code Chapter 53.

- Safety (5329)
- State of Good Repair Grants (5337)
- Asset Management Provisions (5326)
- Bus and Bus Facilities Program (5339)
- Emergency Relief (5324)
- Urbanized Area Formula Grants (5307)
- Rural Area Formula Grants (5311)
- Enhanced Mobility of Seniors and Individuals with Disabilities (5310)
- Fixed Guideway Capital Investment Grants (5309)
- Metropolitan, Statewide, and Nonmetropolitan Planning Programs (5303, 5304, and 5305)
- Research, Development, Demonstration, and Deployment (5312)
- Technical Assistance and Standards (5314)
- Human Resources and Training (5322)

The State Operating Assistance Program is intended to help local governments meet public transportation needs throughout the state and requires legislative approval. These funds are typically used for the non-federal share of operating and capital costs.

In 2010, a Multimodal Transportation Resource Division Annual Report was prepared by TDOT which included detailed information on all 26 transit systems including the types of transit service provided, the geographic coverage of each system, and ridership as well as some other transit performance measures. This report also includes statewide measures such as ridership numbers, vehicle revenue miles, and revenues or funding provided from both federal and state programs. A short definition of each statewide performance measure is given below:

- Farebox Recovery Ratio – amount the passenger fares contribute towards total operating expenses

- Expense per Vehicle Revenue Mile – effectiveness of transit system in terms of cost to provide service
- Expense per Vehicle Revenue Hour - effectiveness of transit in terms of cost to provide service
- Expense per Trip – provides an indication of efficiency and takes into consideration both productivity and the provider’s cost structure
- Passenger Trips per Revenue Mile – indication of system efficiency
- Passenger Trips per Revenue Hour – indication of system efficiency

The report included values for the different types of services offered by the transit systems in the state as well as listing a statewide average. Examples of transit systems falling under the “Other” category include trolley systems, inclines, and ferries. Table 7 lists the performance measure values.

Table 7 Transit Performance Measures

Performance Measure	FY 2010					
	Fixed Route	Demand Response	Rail	Vanpool	Other	Statewide
Farebox Recovery Ratio	17%	26.4%	38.6%	100%	34.5%	22.5%
Expense per Vehicle Revenue Mile	\$6.42	\$2.26	\$19.81	\$0.94	\$1.89	\$3.76
Expense per Vehicle Revenue Hour	\$87.68	\$36.29	\$139.10	\$46.93	\$26.19	\$55.27
Expense per Trip	\$4.31	\$28.45	\$5.15	\$4.32	\$9.33	\$6.03
Passenger Trips per Revenue Mile	1.47	0.08	3.84	0.22	0.18	0.62
Passenger Trips per Revenue Hour	20.02	1.2	26.98	10.86	2.55	9.17

Source: 2010 Multimodal Transportation Resource Division Annual Report, Ch. 2

Pedestrian and Bicycle

In 2011 a statewide Bicycle and Pedestrian Plan was created for the state of Tennessee by TDOT. As part of the analysis conducted to evaluate the appropriate roads for bicycle routes, the Bicycle Level-of-Service (BLOS) was calculated for all of Tennessee’s state routes. BLOS is a calculation that uses the characteristics of the roadway to determine how well suited a specific roadway is for bicycle travel. Examples of the variables used in the calculation are lane widths, shoulder widths, land use in the area, on-street parking, and speed limit. A roadway segment with a high BLOS score may include a combination of bicycle-friendly characteristics such as the presence of a protected bike lane, a low speed limit, a low number of travel lanes, good pavement condition, and signal timings that consider a bicyclist’s ability (i.e., speed) to clear an intersection. Elements of a roadway with lower BLOS scores include higher speed limits, high traffic volumes, presence of rumble strips, and high numbers of right turn conflicts. A BLOS of D or above is considered acceptable – based on the current Plan. Table 8 shows the miles of roadway with each BLOS per region and Table 9 shows the percentage of mileage functioning at each level.

Table 8 2011 BLOS Mileage per Region for Tennessee State Routes

BLOS	Region 1	Region 2	Region 3	Region 4	Statewide
A	397	288	341	207	1,233
B	240	253	515	234	1,242
C	550	497	519	517	2,083
D	687	602	727	636	2,652
E	631	428	688	504	2,251
F	420	628	1,005	1,182	3,235
Total Miles	2,925	2,696	3,795	3,280	12,696

Source: TDOT Statewide Bicycle Plan

Table 9 2011 BLOS Percentages per Region for Tennessee State Routes

BLOS	Region 1	Region 2	Region 3	Region 4	Statewide
A	14%	11%	9%	6%	10%
B	8%	9%	14%	7%	10%
C	19%	18%	14%	16%	16%
D	23%	22%	19%	19%	21%
E	22%	16%	18%	15%	18%
F	14%	23%	26%	36%	25%

Source: TDOT Statewide Bicycle Plan

Although the state identifies the presence of sidewalks in their roadway inventory management system (TRIMS) database, sidewalks have not been tracked over time. The Statewide Bicycle and Pedestrian Plan commented that sidewalks and pathways along State highways represent a distinct problem, one that may be resolved through coordination with local agencies. It is recommended that TDOT headquarters work closely with the TDOT region offices to develop an identification and response system, sweeping schedule, and funding strategies for state highways that have shoulders.

Rail

Tennessee's economy relies on the activity and freight movement that occurs along the shortline and Class I railroads. TDOT is recognized as a leader in preserving the rail freight service on light-density rail lines that were abandoned by the national railroad system through the Shortline Rail Program. TDOT established the Shortline Rail Program for funding track and bridge rehabilitation for Shortline Railroad Authorities who are accepted into the program. Funds can be applied to projects for track and bridge improvements and to fund engineering services for authorities. There are 21 shortline railroads in Tennessee, of which 18 are eligible to receive funding through TDOT's program. However, Tennessee's shortline rail funding is endangered by the new ruling on the Shortline Equity Fund, which disallows the state to charge a diesel fuel tax on rail cars that shift funds between classes of rail service. The decision is currently pending an appeal.

The approximate 1,200 miles of Class I railroads in Tennessee, shown in Figure 1, are comprised of CSX Transportation, Norfolk Southern (NS), Burlington Northern Santa Fe Railway, Canada National/Illinois Central (CN), Kansas City Southern Railway, and Union Pacific Railroad. The Class I railroads are line haul freight railroads with a 2010 operating revenue of over \$401.4 million. More information on rail infrastructure in Tennessee can be found in the Statewide Rail Plan.

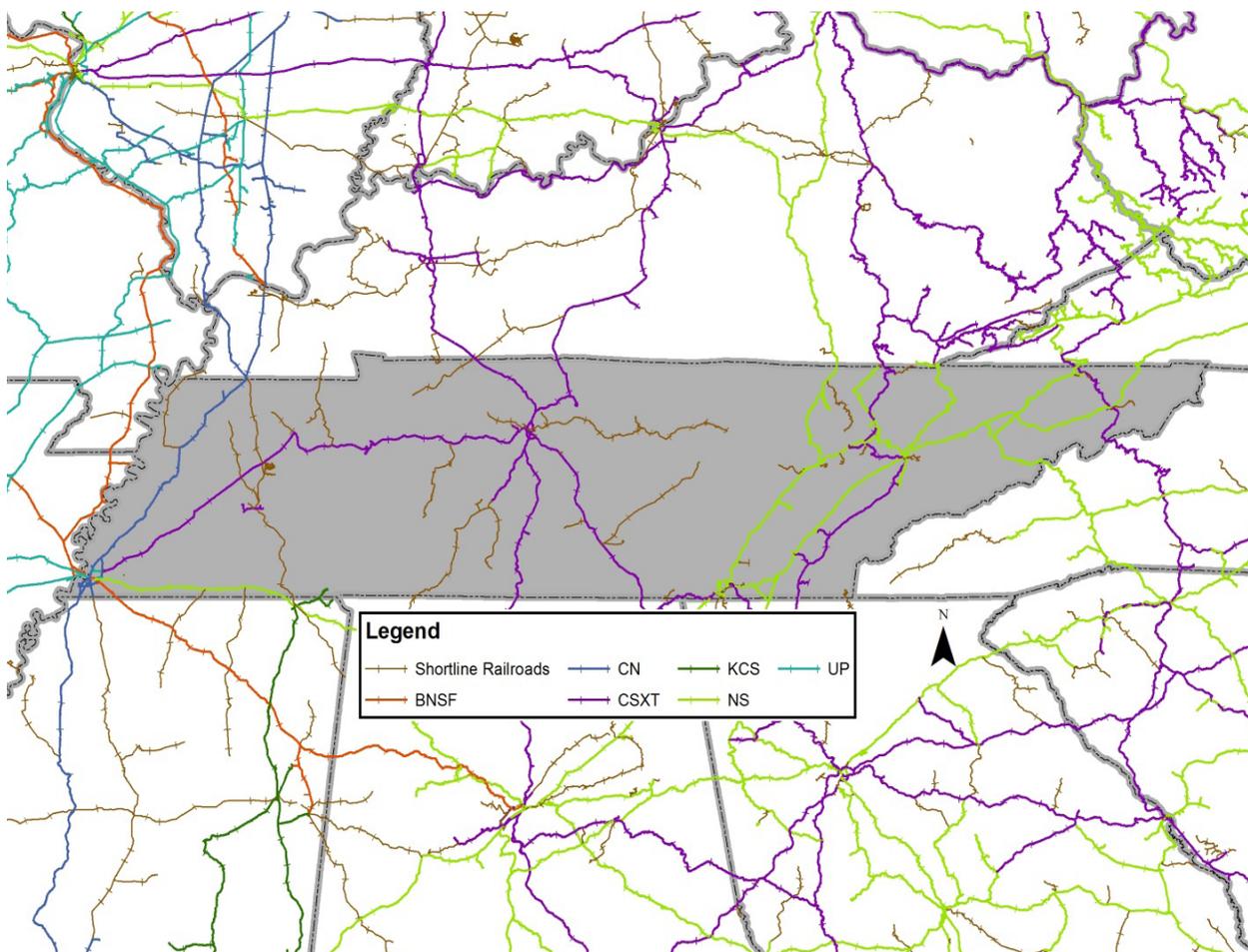


Figure 1 Railroads in Tennessee

Waterways

The role of navigable waterways in the transportation system is important, especially when considering freight movement. Each barge is equivalent to 15-20 rail cars or 50-60 truckloads of material. Although moving freight by barge is slower than by air, truck, or rail, it has benefits such as cost savings and lower fuel emissions but is typically used for the movement of bulk commodities.

The navigable waterways in Tennessee also play an important role in the economy by moving commodities with barges. The 949 miles of navigable waterways, consisting of both main channel and tributaries, are within 50 miles of 90 counties in the State. TDOT is responsible for the operation of two ferries in the state, which provide transportation connections across main river channels. The Benton-Houston ferry traverses the Tennessee River between Benton and Houston Counties, while the Cumberland City ferry provides connection over the Cumberland River in Stewart County. The Tennessee, Cumberland, and Mississippi Rivers connect to major metropolitan markets in the north and ocean ports in the south as shown in Figure 2. The breakdown of the 887 main channel miles of navigable river are listed in Table 10. Table 11 shows navigable waterways by TDOT Region.

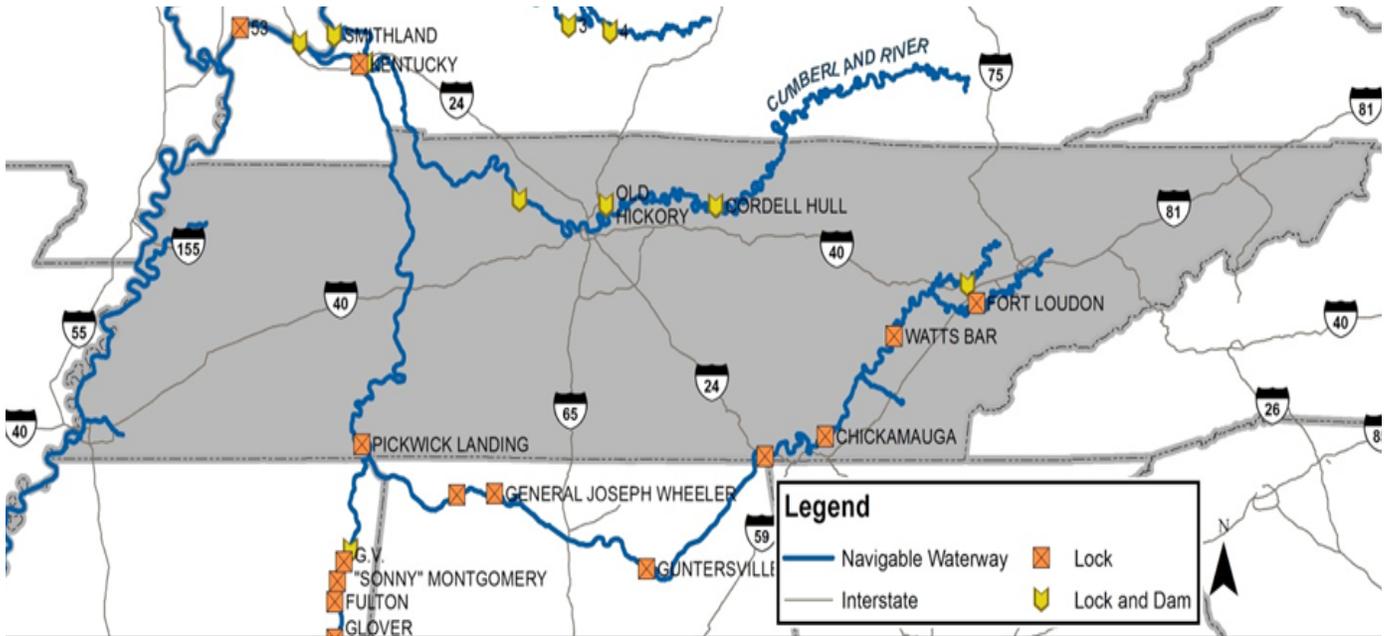


Figure 2 Navigable Waterways, Locks and Dams (US Army Corps of Engineer)

Table 10 Characteristics of Navigable Rivers in Tennessee

River	Miles in TN	Annual Freight Volume (tons)*	Commodities Transported	Locks	Publicly Owned Ports
Tennessee	401	39.2 mil	Metals, Sand & Gravel, Aggregates, Petroleum, Grain	Pickwick Lock Nickajack Lock Chickamauga Lock Watts Bar Lock Fort Loudon Lock	Port of Nickajack – (owned by New Hope Port Authority) Centre South River Port – (owned by Hamilton County Port Authority)
Cumberland	310	20.8 mil	Coal Fired Power Plants, Sand & Gravel, Aggregates, Grains, Metal	Cheatham Lock Old Hickory Lock Cordell Hull Lock	None in operation
Mississippi	176	166.3 mil	Coal, Food/Agriculture, Petroleum, Crude Materials	No locks in Tennessee	Port of Memphis Port of Cates Landing

* CY 2009

Source: 2010 Multimodal Transportation Resources Division

Table 11 Navigable Waterways per Region

Navigable Waterways	Region	Mileage
Tennessee	1	125
	2	125
	3 & 4	151
Cumberland	2	55
	3	255
Mississippi	4	176

Tennessee also has seven navigable waterways that branch off the Tennessee River including Hiwassee River, Clinch River, Kings Creek, Little Tennessee River, Soddy Creek, Emory River, and French Broad/Little Pigeon. The other two navigable waterways in the state are off the Mississippi River and include McKellar Lake and Wolf River Lagoon.³

Air

Discussions of air travel in Tennessee include passenger as well as freight cargo. Airports are categorized as Commercial Service, Cargo Service, Reliever, and General Aviation Airports. Commercial Service Airports are defined as publicly owned airports that have at least 2,500 passenger boardings each calendar year and receive scheduled passenger service. Primary commercial service airports are divided into hub types: Large, Medium, and Small. They have more than 10,000 passenger boardings annually. Nonprimary commercial service airports are considered Nonhubs and must have at least 2,500 and no more than 10,000 passenger boardings each year. Figure 3 shows the distribution of airports and heliports throughout the state; labeled symbols show the commercial and reliever airports while the unlabeled symbols represent all other airports. Table 12 shows the number of airports and heliports per region.

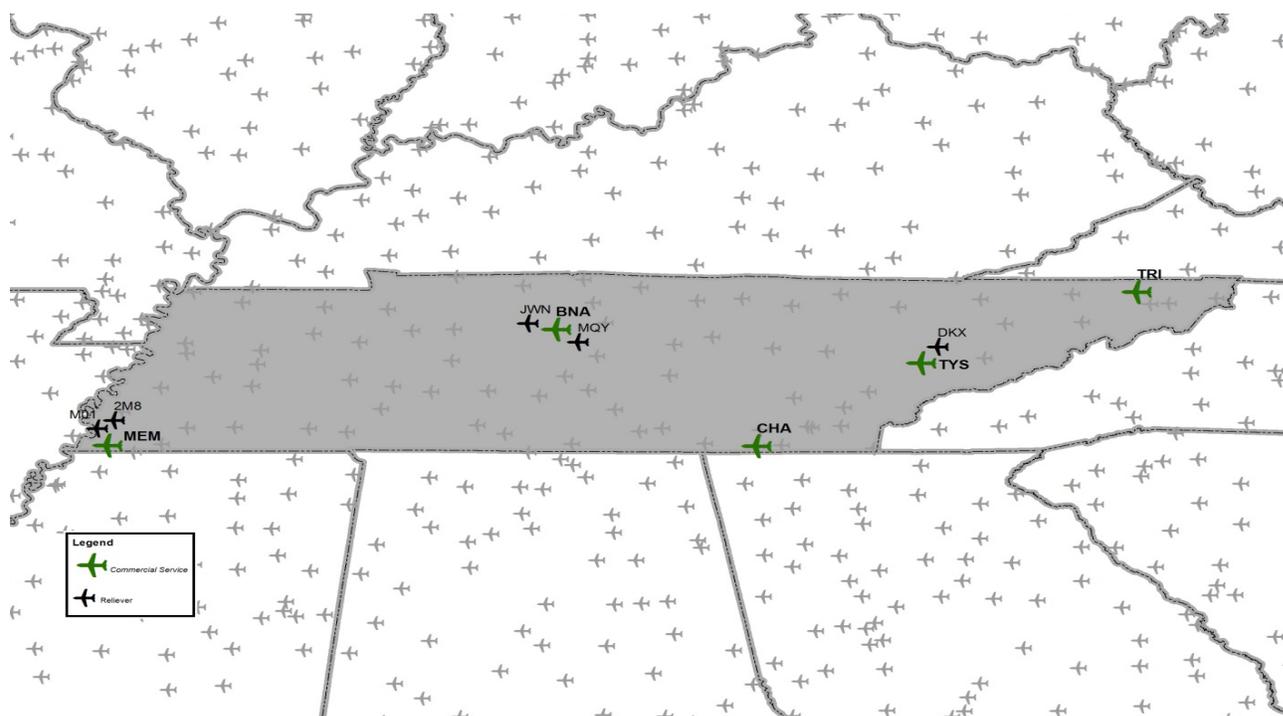


Figure 3 Tennessee Airports

Table 12 Tennessee Airports by TDOT Region

	Statewide	Region 1	Region 2	Region 3	Region 4
Total	79	15	19	24	21
Medium Hub*	2**	0	0	1**	1**
Small Hub*	1**	1**	0	0	0
Nonhub *	2	1	1	0	0
General Aviation	74(5***)	13(1***)	18	23(2***)	20(2***)

*Commercial Service **Cargo Service ***Reliever

Tennessee has five commercial airports in the cities of Nashville, Memphis, Knoxville, Chattanooga, and the Tri-Cities area (Bristol/Johnson City/Kingsport). Nashville and Memphis International are classified as Medium hub airports, McGee-Tyson (Knoxville) as a Small hub, while Chattanooga Metropolitan and Tri-cities Regional are classified as Nonhubs. In addition, Tennessee has five reliever airports; Knoxville Downtown Island, General DeWitt Spain (Memphis), Charles W. Baker (Millington), John C. Tune (Nashville), and Smyrna Airport. Table 13 shows the number of enplanements at each of the five commercial service airports based on the Air Carrier Activity Information System (ACAIS) database maintained by FAA. The most notable difference between 2011 and 2012 enplanements was seen by the Memphis airport which experienced a decrease of 22.7%.

Table 13 Enplanements (2010-2012)

Airport	Enplanements (in thousands)			
	2010	2011	2012	% Change (2010-2012)
Nashville International Airport	4,432	4,673	4,797	+8.24
Memphis International Airport	4,931	4,344	3,360	-31.86
McGee-Tyson Airport (Knoxville)	805	841	846	+5.09
Chattanooga Metropolitan Airport	293	304	314	+7.17
Tri-Cities Regional Airport	202	221	207	+2.48

The majority of cargo shipped by air in Tennessee is shipped from/to three cargo service airports including Memphis International, McGhee-Tyson, and Nashville International. Cargo Service Airports are airports that, in addition to any other air transportation services that may be available, are served by aircraft providing air transportation of only cargo with a total annual landed weight of more than 100 million pounds. Combined, all three airports shipped 10.8 million tons annually, but the majority of that was from Memphis where 10.5 million tons were shipped by air. Memphis is the largest air shipper in the U.S. according to the FAA.

3.1.3 Asset Management

In the broadest sense of the term, asset management refers to the strategic management of the transportation system in a cost-effective and efficient manner. Given the extent of the aforementioned assets under the Department's oversight as well as the limited funding available for investing in the continuously-aging infrastructure, strong asset management principles are key to preserving its life and quality. A key component to a successful asset management program includes the monitoring and evaluation of system performance. Measuring system performance allows a DOT to understand the operation and quality of the transportation system and to prioritize the need for investments in operating, maintaining, or updating infrastructure elements. The following information on the performance of TDOT's assets directly impacts the Department's management of those assets since these critical data points measure the quality, safety, and efficiency that users have come to expect from Tennessee's transportation system.

3.2 EXISTING SYSTEM PERFORMANCE MEASURES IN TENNESSEE

Federal transportation legislation moves the Federal-aid highway program towards being a performance-based program. It requires State DOTs, MPOs, and transit agencies to establish performance targets and measures for improving the transportation system that relate to the nationally-established U.S. DOT performance goals and measures. The Office of Strategic Planning is charged with the management of TDOT's performance measurement framework, as well as the various tools used to assist the Executive Leadership in developing a balanced set of performance measures.

3.2.1 Correlation of Guiding Principles to National Goals and Performance Measures

TDOT annually prepares an Existing Measurement Report to track the Department's key performance measures. The report is intended to assist TDOT's leaders with:

- Assessment of TDOT in attaining objectives and meeting performance targets,
- Evaluation of progress being made, if any, towards achieving TDOT's strategic goals,
- Making decisions about resource allocations based on facts and data, and
- Identifying where critical improvements may be needed⁴.

The performance measures included in the report fall into two broad categories: strategic and operational. The report includes 36 unique performance measures that are reported in relation to five perspectives that include:

- Customer - focuses on TDOT customers' perceptions of the quality of goods and services, the effectiveness of delivery, and overall customer service and satisfaction.
- Financial - considers TDOT's organizational budget and funding information and issues such as the return on investment, efficiency of TDOT's programs and services, and efforts to reduce or contain costs.
- Organizational Effectiveness - focuses on key internal processes and TDOT's use of innovative technology and management practices to achieve intended results. Assessing TDOT's ability to achieve intended results includes monitoring the effectiveness of processes, examining productivity, and scheduling performance and efficiency.
- Transportation System - assesses the performance of the statewide transportation system with focus on the operation, preservation and maintenance of the system.
- Workforce - focuses on the quality and culture of the workplace environment and TDOT's capacity and capability to achieve its mission and strategic direction. This includes having the right people in the right jobs and the resources to achieve high quality results.

Measurements used to evaluate TDOT's workforce may not directly relate to a specific Guiding Principle but in essence relate to all of them. In order to achieve the goals set by the Guiding Principles, TDOT needs satisfied, qualified staff with a common goal which means the workforce measures relate to all of the Guiding Principles. The performance measures used to measure the workforce include:

- Minority Representation in TDOT's Workforce

⁴ TDOT Measurement Report, pg. 1.

- TDOT Vacancy Rate
- TDOT Turnover Rate
- TDOT Employees – On the Job Injuries

The remaining performance measures that TDOT maintains can be applied to at least one Guiding Principle. In some cases, the performance measure applies to multiple principles. When this occurred, one Guiding Principle was chosen to simplify the process and omit repetitiveness. Categorization of the performance measures as they relate to TDOT's Guiding Principles are in Table 14.

Table 14 National Goals to Guiding Principle to Performance Measure

National Goals	Guiding Principle	Performance Measure
Infrastructure Condition Congestion Reduction System Reliability Reduced Project Delivery Delays	Preserve and Manage the Existing System	Bridge Inspections on a 2-Year Cycle
		Interstate Mileage Managed by ITS Infrastructure
		Maintenance Rating Index (MRI) – Interstate & State Roads
		Interstate IRI (Roughness Index) Pavement Rating
		Bridges – Not Structurally Deficient – State Maintained
		Pavement Quality Index for State Routes and Interstates
		Highway Lane Miles Receiving a Preservation Treatment
		*Environmental Assessments Processing Time
		*Environmental Impact Statement Processing Time
Freight Movement And Economic Vitality	Provide for Efficient Movement of People and Freight	Highway Incidents Cleared within 90 Minutes - HELP
		Projects in State Transportation Improvement Program On Schedule
		Shortline Rail Track Miles Capacity
Safety	Maximize Safety and Security	Fatality Rate
		Reduction in Fatality Rate
		Number of Fatalities on TN Roadways
		Seat Belt Usage
		Number of Crashes in TN Work Zones
Environmental Sustainability	Build Partnerships for Sustainable and Livable Communities	Highway Rail Grade Crossing Fatal Crashes
		Statewide Transit Passenger Trips Increase
		*Transit Vehicle Revenue Miles
Environmental Sustainability	Protect Natural, Cultural, and Environmental Resources	**Miles of State Routes Accommodating Bicycles and Pedestrians
		*Biofuels Refueling Pumps
Reduced Project Delivery Delays	Emphasize Financial Responsibility	**Environmental Compliance Score
		Variation from State Transportation Improvement Program (STIP) Estimation to Actual Bids
		Construction Contracts Completed by Original date
		Construction Contracts Completed by Extension date

*Not reported in TDOT's FY 2013 Measurement Report

**New measure added in TDOT's FY 2013 Measurement Report

3.2.2 TDOT's Performance Measures and Targets

TDOT established performance measures and targets in compliance with the 2002 Tennessee Government Accountability Act requiring a performance-based budget initiative. Under the Finance and Accounting guidance for this Act, the results of the measures should indicate how effectively and efficiently services are being delivered. In review of TDOT's Measurement Report for Fiscal Year 2013, performance targets were set for 23 of the 36 measures; some are measured by calendar year (CY), fiscal year (FY), or over a range of years. Of the 23 measures, nine met or exceeded their targets. Seven performance measures missed their target by less than 5% and seven performance measures missed their targets by 5% or more. TDOT reviews the historical trends to ensure realistic targets are set. The current measures give TDOT a good evaluation of the condition of the transportation system and the effectiveness of the organization. The historical trends of the performance measures TDOT currently tracks are shown in the following graphs as well as the targets for each, if applicable (as noted by the crosshair target icon and text within each graph).

Guiding Principle: Preserve and Manage the Existing System (Figures 4 - 11)

The measures shown in Figure 4 and Figure 5 below are used to determine the condition of the transportation system which relates directly to the preservation and management of the system. The performance measures tracked in this section demonstrate how well Tennessee does in maintaining assets such as bridges and roadways. The targets are identified to show how the measures are performing.

Figure 4 depicts the percentage of bridges in Tennessee that are inspected on a 24-month cycle. This operational measure shows the management effectiveness of the Regional Bridge Inspection programs. The bridge inspections should be on a 22- to 25-month schedule per FHWA guidelines.

Figure 5 shows the number of interstate miles managed by the Intelligent Transportation System (ITS). ITS has a direct effect on the operation of the transportation system since it has the capability to inform travelers and system operators of recurring and nonrecurring incidents. The number of roadway miles providing ITS information enhances the potential for improving system performance in those corridors.

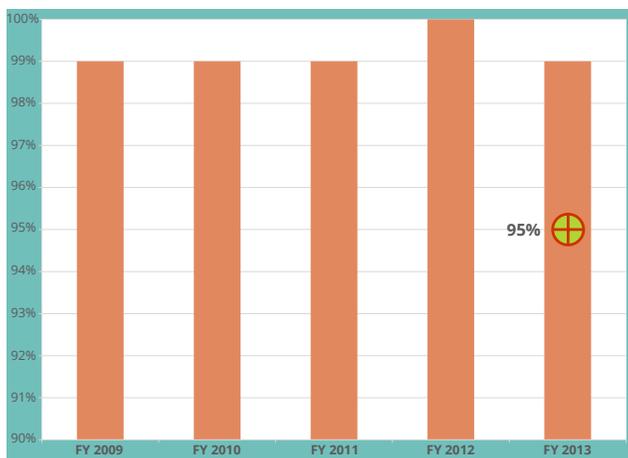


Figure 4 Bridge Inspection; 2-Year Cycle

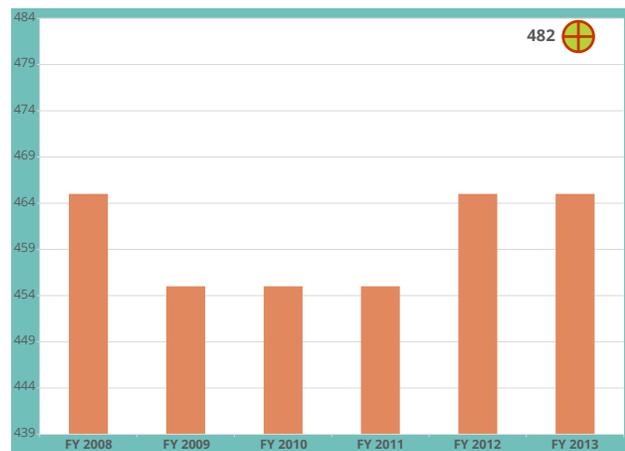


Figure 5 Miles of Interstate Managed by ITS

Figure 6 shows the maintenance rating index (MRI) for roadways that TDOT maintains. The MRI is designed to assess the condition of the roadway from a maintenance perspective. The MRI scores roadway characteristics, such as traveled pavement, shoulder, drainage, and traffic services, at random tenth-of-a-mile segments. Random tenth-of-a-mile roadway segments are inspected and scored based on roadway characteristics. An average score of 75 or less across all road segments inspected may prompt management to further analyze factors causing the low score. The target for 2012 MRI was 90. The measurement supports highway maintenance budget requests.



Figure 6 Maintenance Rating Index (MRI)

The International Roughness Index (IRI) is used to measure irregularities in the roadway pavement surface that adversely affect vehicle ride quality on the NHS. An IRI rating of “good” or “very good” is greater than “94%.” The IRI results for Tennessee’s 4,400 lane miles of Interstates are shown in Figure 7 from 2006 to 2012 with a target of 95%. TDOT’s interstate resurfacing program works to maintain smoothness at an acceptable level.

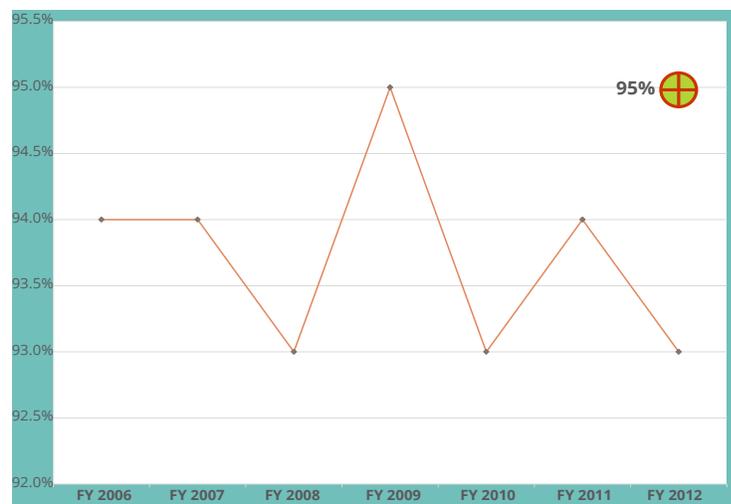


Figure 7 International Roughness Index (IRI)

Inspections of the State Maintained bridges are conducted regularly to evaluate the safety of the bridge. A structurally deficient bridge requires significant maintenance, rehabilitation, or replacement. The percent of bridge deck area not structurally deficient is shown in Figure 8.



Figure 8 State Maintained Bridges Not Structurally Deficient

The Pavement Quality Index (PQI) is collected for the Interstate System and State Route System. The PQI is on a scale of 1 (in need of resurfacing) to 5 (not a priority for resurfacing). It is calculated based on the Pavement Distress Index (PDI) and the Present Serviceability Index (PSI). The PDI and PSI account for aspects of ride quality and surface distress to help identify sections with a need for rehabilitation or maintenance. The performance standard for interstates is 100% of roadway miles to have a PQI above 3.5 and 0% of the miles to have a PQI less than 2. The performance standard for state routes is 96% of roadway miles to have a PQI above 3.5 and 0% of the miles to have a PQI less than 2. Figure 9 shows the PQI for the Interstate and State Route Systems, and Table 15 shows the miles by TDOT Region and PQI.

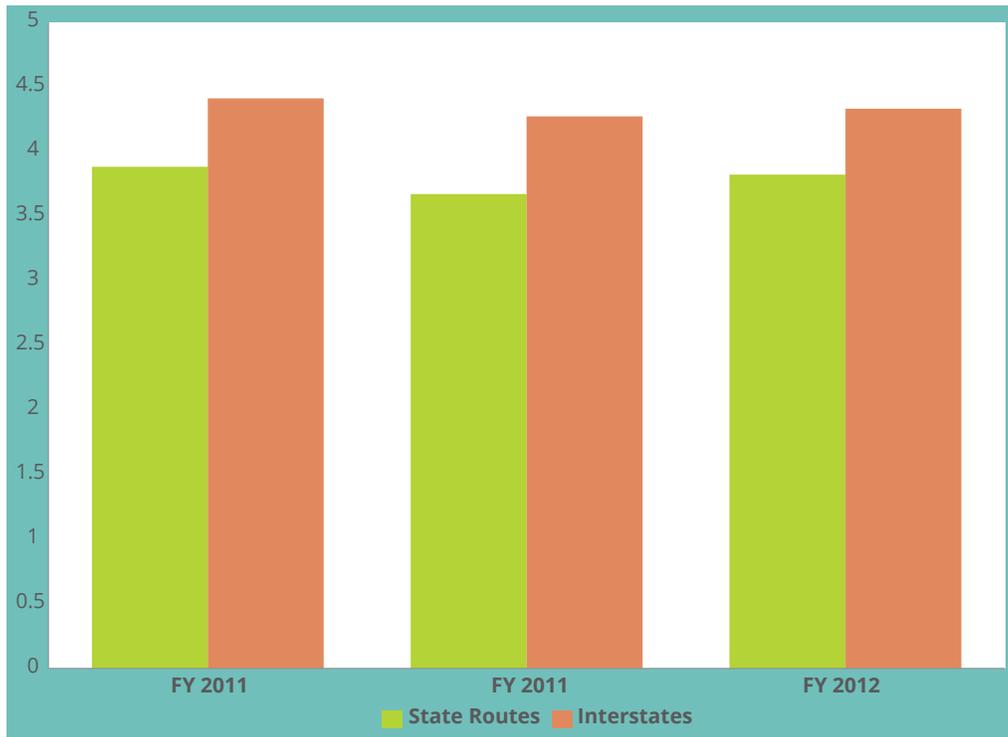


Figure 9 Pavement Quality Index (PQI)

Table 15 2013 Miles by PQI and TDOT Region

PQI	Region 1		Region 2		Region 3		Region 4	
	Interstate	State Routes						
1	0	0	0	0	0	0	0	0.25
2	0	0.4	0	0	0	1.5	0	2.5
3	1.63	90.63	0	64.62	3.29	98.09	2	821.04
4	86.67	1255.74	13.39	980.68	65.31	1961.7	88.1	2048.23
5	601.86	1589.95	425.99	1071.62	639.13	1666.58	281.76	471.66

Various pavement treatments extend the service life of Tennessee’s roads. The number of highway lane miles that receive treatments such as overlays, micro-surfacing, and chip seal, is based on work performed by contractors. Figure 10 shows the number of highway lane miles receiving treatment broken down for Interstates and State Routes.

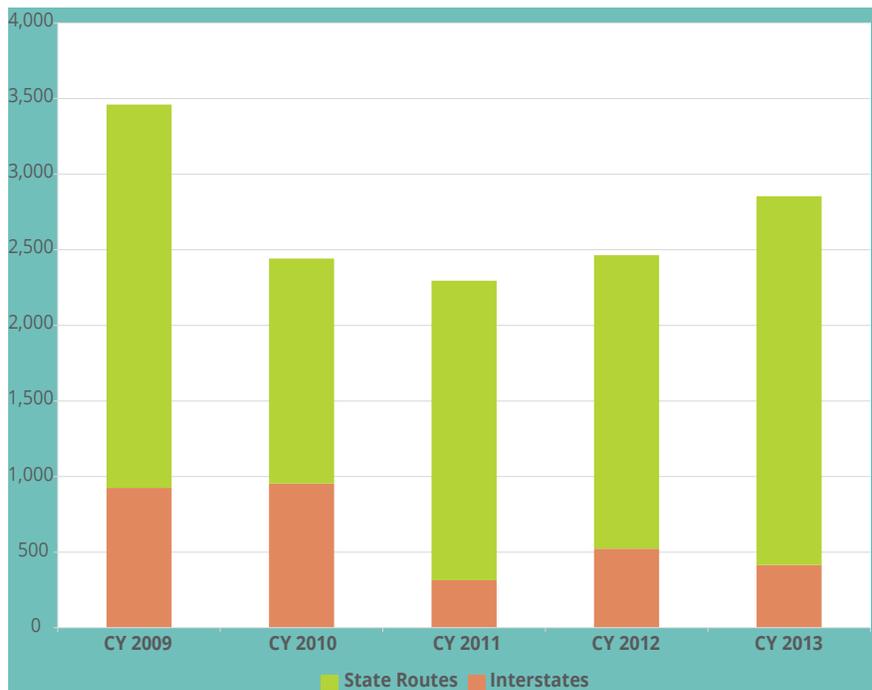


Figure 10 Highway Lane Miles Receiving Preservation Treatment

Figure 11 shows the number of months it takes to complete required Environmental Assessments and Environmental Impact Statements broken down by federal fiscal year (FFY). The documents are prepared to report on why a particular project is being proposed, alternatives under consideration, potential environmental impacts per alternative, and proposed avoidance, minimization and/or compensation measures. No target has been set by TDOT, but FHWA set a goal for processing time in 2003 of 36 months for EIS.

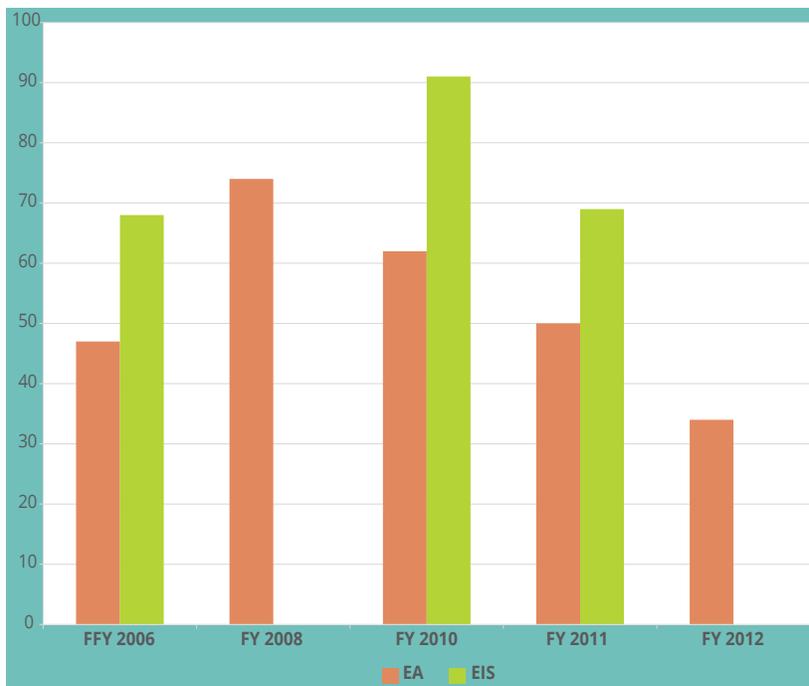


Figure 11 Environmental Document Processing Time in Months

Guiding Principle: Provide for Efficient Movement of People and Freight (Figures 12 - 14)

Mobility through the state is often measured by the efficiency of the transportation system. An efficient transportation system does not only affect the movement of people and goods, but it also affects the economy in the state.

Clearing non-recurring incidents in a timely manner has a direct effect on the movement of passengers and freight. Measuring how quickly incidents are cleared gives the state an idea of where improvements are needed in the HELP system. Figure 12 shows the percentage of incidents cleared within 90 minutes, with a target of 98%. The amount of time it takes to complete a project directly affects traffic flow especially if lane closures or varying traffic patterns are required. Therefore, TDOT tracks how many projects in the STIP are on schedule. Figure 13 shows the percentage of projects on time in the 4-year program.

About one third of Tennessee's rail lines are shortline tracks, most of which are rated at 263,000 pounds. Most Class I rail lines are rated at 286,000 pounds (286k) making them more efficient. Increasing the capacity of the short line rail tracks to 286k helps the roadways because it gives another option to shippers. The percentage of short line track miles at 286k is shown in Figure 14.

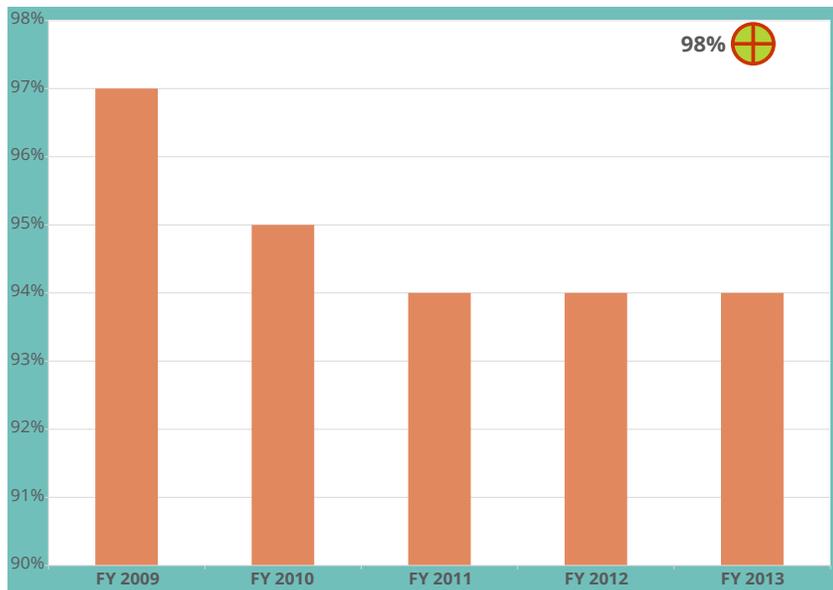


Figure 12 Highway Incidents Cleared Within 90 Minutes



Figure 13 Percent of Projects in STIP on Schedule

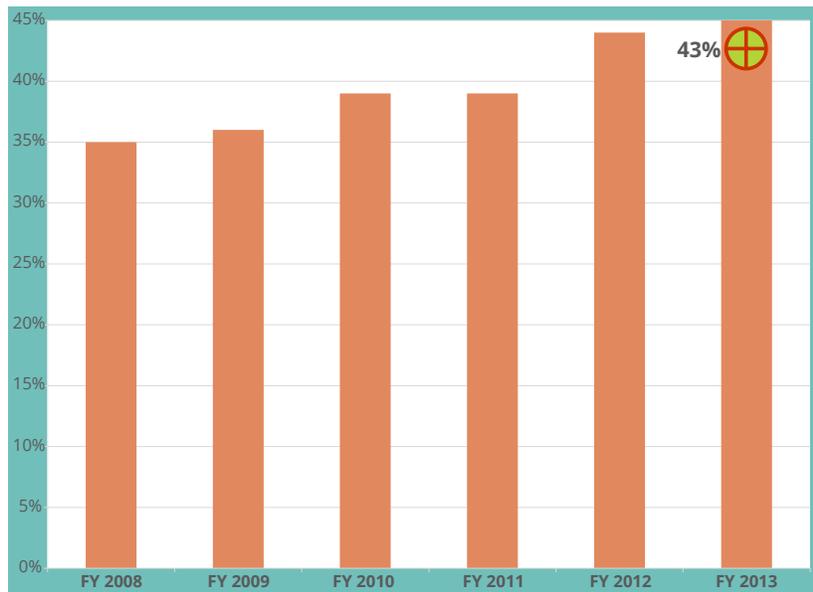


Figure 14 Percent of Shortline Tracks at 286K Capacity

Guiding Principle: Maximize Safety and Security (Figures 15 - 20)

Improving safety and security on the transportation system is always a high priority for TDOT and relates directly to the guiding principle to maximize safety and security. Performance measures are used to evaluate the effectiveness of the department’s safety programs on a yearly basis.

TDOT evaluates on a regular basis the actual number of fatalities on Tennessee roadways. Shown in Figure 15 are fatalities reported in the Fatality Analysis Reporting System (FARS). Another measure evaluated is the actual fatality rate, based on the number of highway deaths per 100 million vehicle-miles-traveled (VMT). The fatality rate is used to normalize the fatalities by the amount of exposure and allows for equal comparison between other states. The fatality rates are shown in Figure 16.



Figure 15 Actual Number of Fatalities

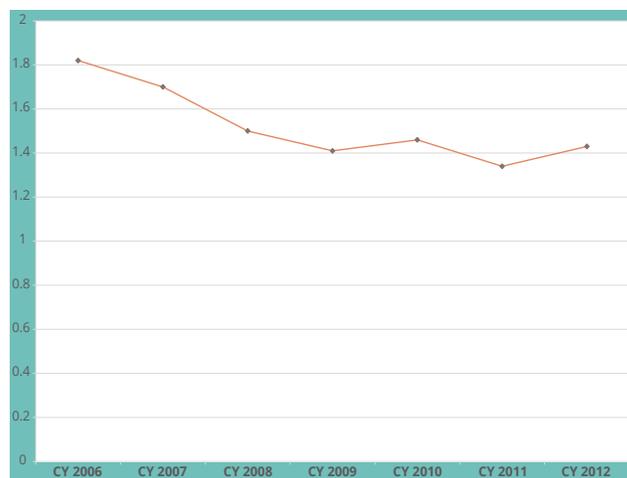


Figure 16 Actual Fatality Rate

In addition, TDOT also tracks the reduction of the fatality rate per year, shown in Figure 17. TDOT has set a target for the fatality rate to be reduced by 10% over a 5-year period. In 2010 and 2012, the fatality rate did not decrease, which explains the 0% values in those years.

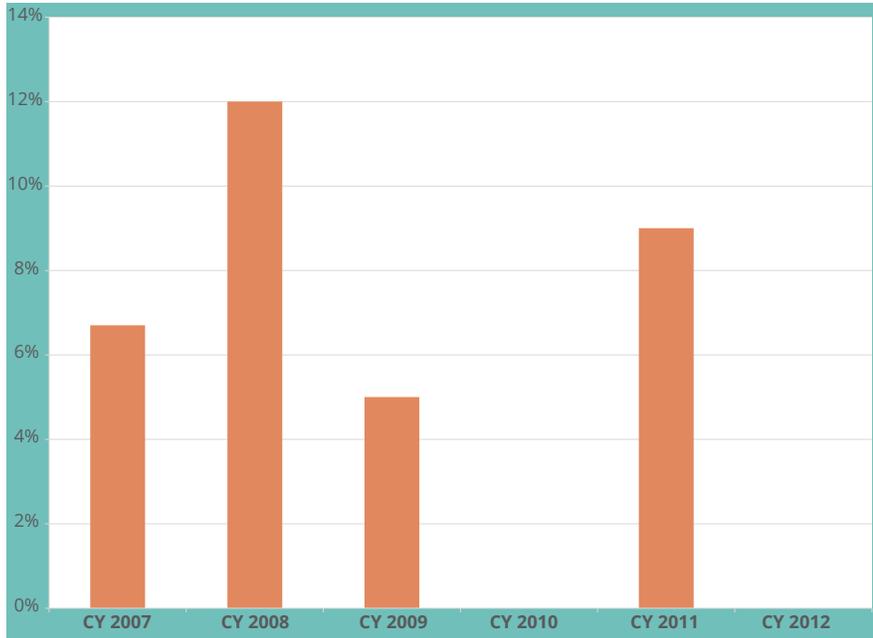


Figure 17 Reduction in Fatality Rate Per Year

Other safety measures that TDOT tracks include seat belt usage, number of crashes in work zones, and number of fatal crashes at highway rail grade crossings. The seat belt usage is based on an annual statewide survey conducted each June. It is the National Occupant Protection Use Survey (NOPUS), which is the only seat belt usage survey conducted in the United States. The results for Tennessee are shown in Figure 18.

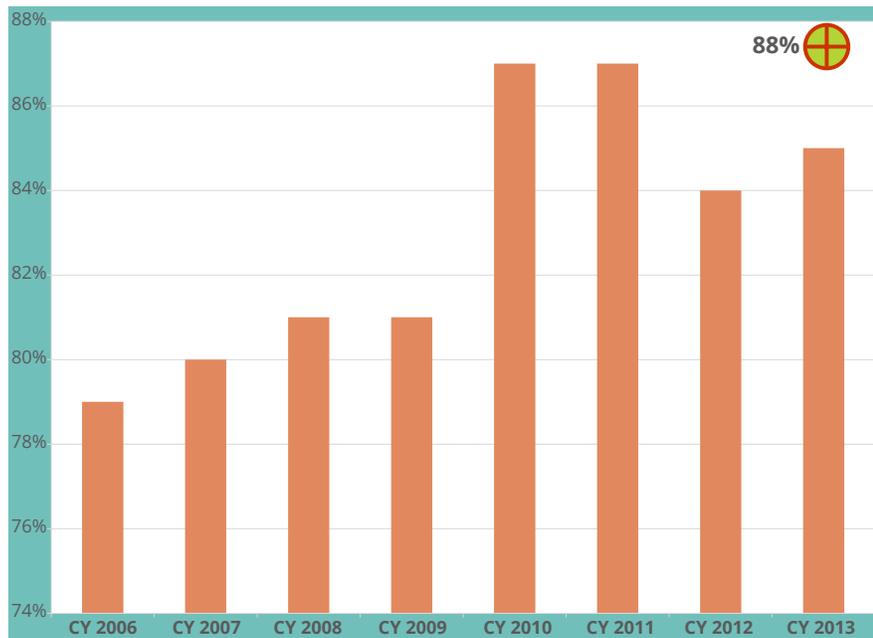


Figure 18 Seat Belt Usage in Tennessee

The number of crashes in Tennessee work zones, shown in Figure 19, includes both on- and off-system crashes in construction, maintenance, utility, and other work zones.



Figure 19 Crash Trends in Work Zones

Historically, highway rail grade crossing have been the greatest source of injuries and fatalities for railroads. Although this trend is changing, TDOT tracks the number of crashes at highway/rail grade crossings, with fatalities shown in Figure 20.

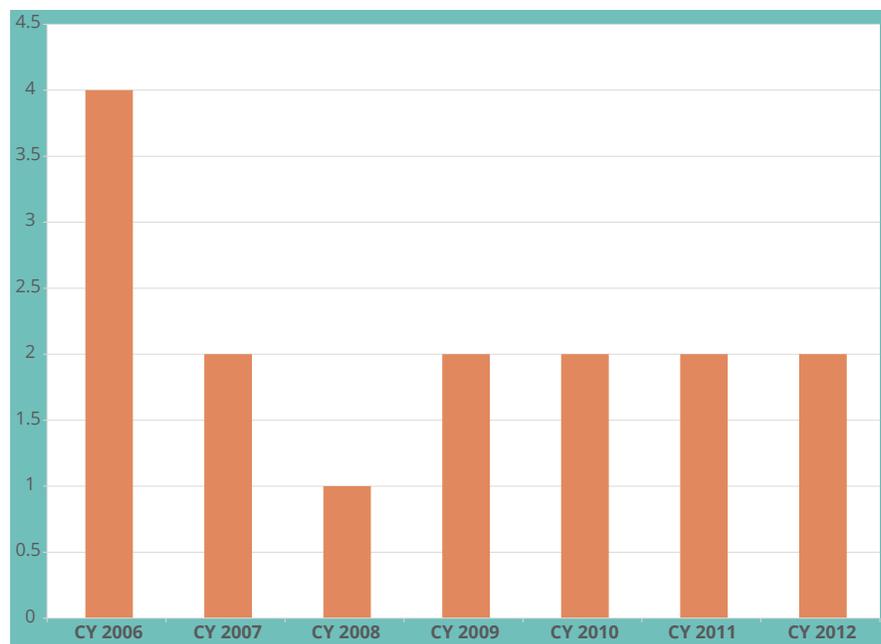


Figure 20 Rail Grade Crossing Fatalities

Guiding Principle: Sustainable and Livable Communities (Figures 21 - 23)

TDOT's Guiding Principle of building partnerships for sustainable and livable communities can be achieved in part by creating a safe environment for all users. Performance measures that relate to this guiding principle evaluate the transit system, pedestrian facilities, and bicycle facilities. Over the years, TDOT has measured transit system performance utilizing two measures: transit vehicle miles and transit passenger trips. Vehicle revenue miles are miles traveled while transit vehicles are available to the public and expected to be carrying paying passengers, shown in Figure 21; the target is a 1% increase per year. As of fiscal year 2013, this measure is no longer reported in TDOT's Measurement Report. The number of transit passenger trips reported by all urban and rural transit systems in Tennessee is a measure used by TDOT to track transit ridership, shown in Figure 22.

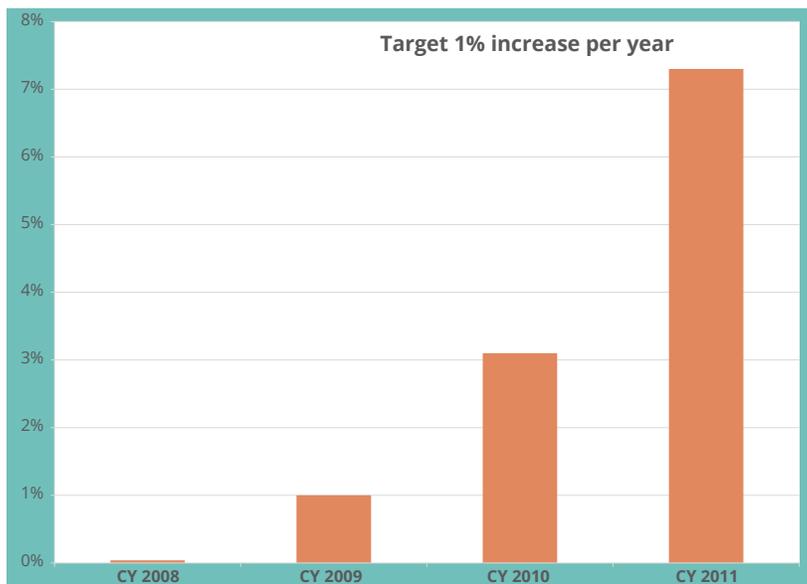


Figure 21 Percent Increase in Transit Revenue Miles



Figure 22 Percent Change in Statewide Transit Ridership

TDOT also tracks performance with regard to the provision of bicycle and pedestrian accommodations. Specifically, the measure reports the miles of states routes that accommodate bicycles and pedestrians by having a paved shoulder at least four feet wide or a designated bike lane. The historic data for this measure and its relation to the current target of 4,600 miles are shown in Figure 23.

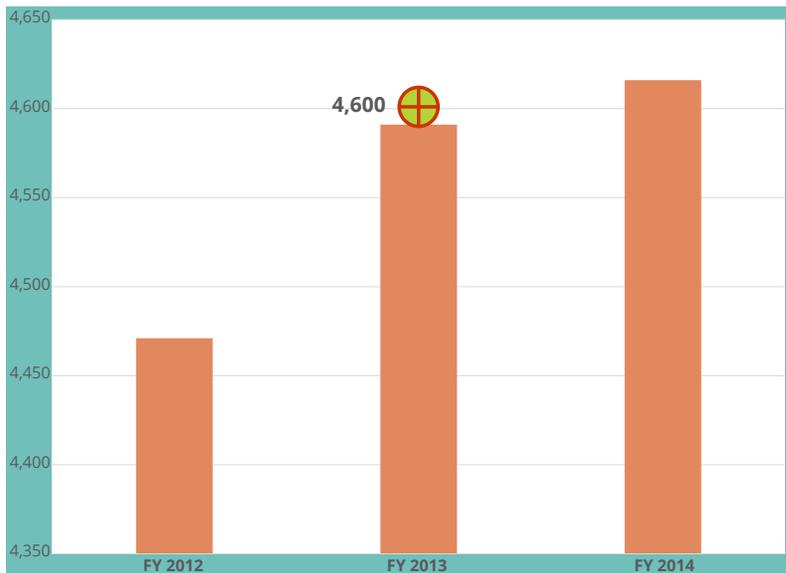


Figure 23 Miles of State Routes with Paved Shoulders 4 Feet Wide or Bike Lanes

Guiding Principle: Protect Natural, Cultural, and Environmental Resources (Figures 24 - 25)

Creating a transportation system that works within its environmental setting benefits communities throughout the state. The measures used to determine how TDOT is addressing environmental concerns are based on the natural environment.

The state tracks the number of biofuel refueling stations in Tennessee, shown in Figure 24. For 2012, the target was 95 stations. As of fiscal year 2013, these measures are no longer reported in TDOT's Measurement Report.

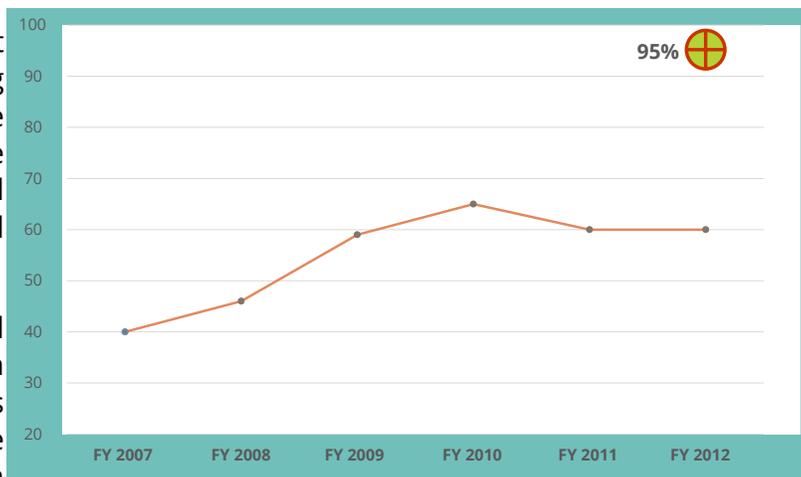


Figure 24 Biofuel Refueling Pumps

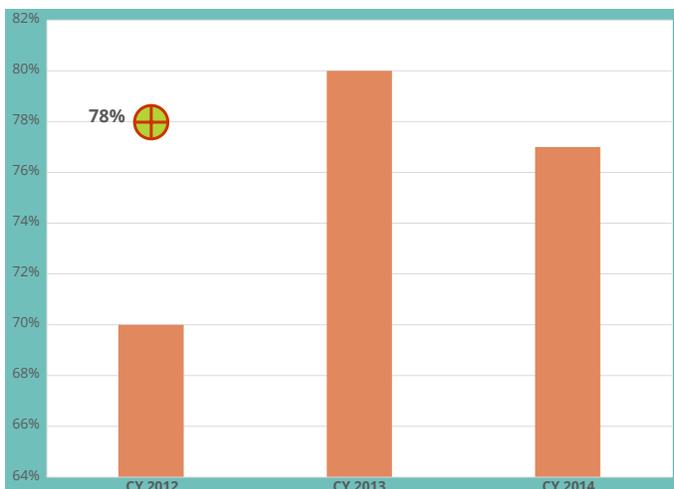


Figure 25 Statewide Average Environmental Compliance Score

TDOT also tracks performance with regard to environmental compliance. Specifically, the measure reports a statewide average environmental compliance inspection score for TDOT regional, district, and county facilities and is shown in Figure 25. The target set for the 2012 calendar year (CY) was 78.

Guiding Principle: Emphasize Financial Responsibility (Figures 26 - 27)

Measuring financial responsibility of the department is important to TDOT as well as to the citizens of the state. Evaluating the efficiency of the department in determining actual project costs and completion of projects on schedule is used to determine if inadequate planning is costing the department money.

TDOT tracks the comparison of the State Transportation Improvement Program (STIP) construction cost estimate versus the actual letting cost, shown in Figure 26. This evaluation allows TDOT to determine if the STIP construction cost estimates, which are used to determine where transportation dollars are spent, are accurately reflecting the project cost. A target cost has been set to be within 30% of the estimated cost. Another measure that evaluates the efficiency of the project is scheduling. TDOT tracks if construction projects meet the original date set or the extension date if one is given as shown in Figure 27. Targets of 78% and 92% have been set for the number of projects that meet their original and extension dates, respectively.



Figure 26 Variation in Construction Estimates to Letting Costs

As outlined above, TDOT tracks numerous performance measures that allow them to evaluate how they are reflecting the Guiding Principles. However, TDOT is lacking in performance measures that focus on all modes of the freight system, including air and water, and other facility users, including pedestrians and bicyclists. Adding measures that evaluate other modes of transportation and all users will give TDOT a true measure of the impact of the projects on the entire transportation system. Measures can be used to determine where the system is lacking or to identify project requirements to accomplish the mission of the Department.



Figure 27 Construction Contracts Completed by the Original or Extension Date

4.0 FUTURE GROWTH, TRENDS, AND TECHNOLOGY

4.1 COMPARISONS TO SURROUNDING, PEER, AND OTHER NOTEWORTHY STATES

The purpose of conducting a peer review on the performance measures used by other state DOTs is to provide TDOT an overview on the types of measures used, the various approaches or methods for how they are used, and ultimately serve as a menu of options for which the Department can pull from to modify current performance measures or adopt new ones.

This section provides insight on the following topics: performance measures used by other state DOTs, performance measures considered emerging, potential changes necessary by TDOT if it were to pursue any of the documented methods of the other state DOTs, and lastly, a projected outlook on future trends in how performance measures will be used and for which focal areas they would be geared. Throughout the discussion, methods used by other states will be presented within the context of comparison to TDOT's Guiding Principles or its current set of performance measures.

MAP-21 transportation legislation promulgated performance monitoring and established national performance goals; however, state DOTs around the U.S. are awaiting the final rulemaking on specific performance measures. This section discusses performance measures used across the U.S. by various state DOTs along with their respective goals/objectives within the framework or context of MAP-21 requirements; TDOT's measures and Guiding Principles are also be discussed in this context. Some state DOTs have already begun identifying preliminary performance measures in an effort of aligning with federal transportation legislation; however, the focus of this paper is to describe the performance measures that extend beyond the preliminary preparation, especially in light of the lack of certainty with regard to the actual performance measures that will ultimately become required for state DOTs. The discussion is based on what a state DOT currently monitors and uses as far as performance measures.

The states studied for this policy paper fall into two primary categories: Tennessee's surrounding states and peer and noteworthy states. The surrounding states included Alabama, Arkansas, Georgia, Kentucky, Mississippi, Missouri, North Carolina, and Virginia. Information on the States of Mississippi and Arkansas in terms of performance measures was limited. For Mississippi, a recent report prepared by the state's joint legislative committee on Performance Evaluation and Expenditure Review⁵ (PEER) indicated the Mississippi DOT (MSDOT) had been making progress with articulating and documenting transportation needs around the state, but had yet to identify or develop system-wide performance measures. Similarly, for the State of Arkansas not enough information was found for the purpose of this policy paper; therefore, it was safest to categorize performance measurement and monitoring for both of these states as a work in progress⁶. The states considered peer states were Washington, Florida, Texas, Utah, Indiana, and Minnesota; the peer states shown in Figure 28 were chosen to align with those identified as peers in TDOT's 2013 Customer Survey, as they were similar to Tennessee in the areas of geographic size, demographics, growth trends, and/or DOT practices. The State of Ohio was looked at for informational purposes and, therefore, considered noteworthy for reference (see Figure 28). Table 16 provides a listing of each state along with descriptive statistics.

⁵ <http://www.peer.state.ms.us/reports/rpt581.pdf>

⁶ In its 2012 Annual Report, there were no performance measures mentioned. http://www.arkansashighways.com/annual_report/AnnualReport2012.pdf

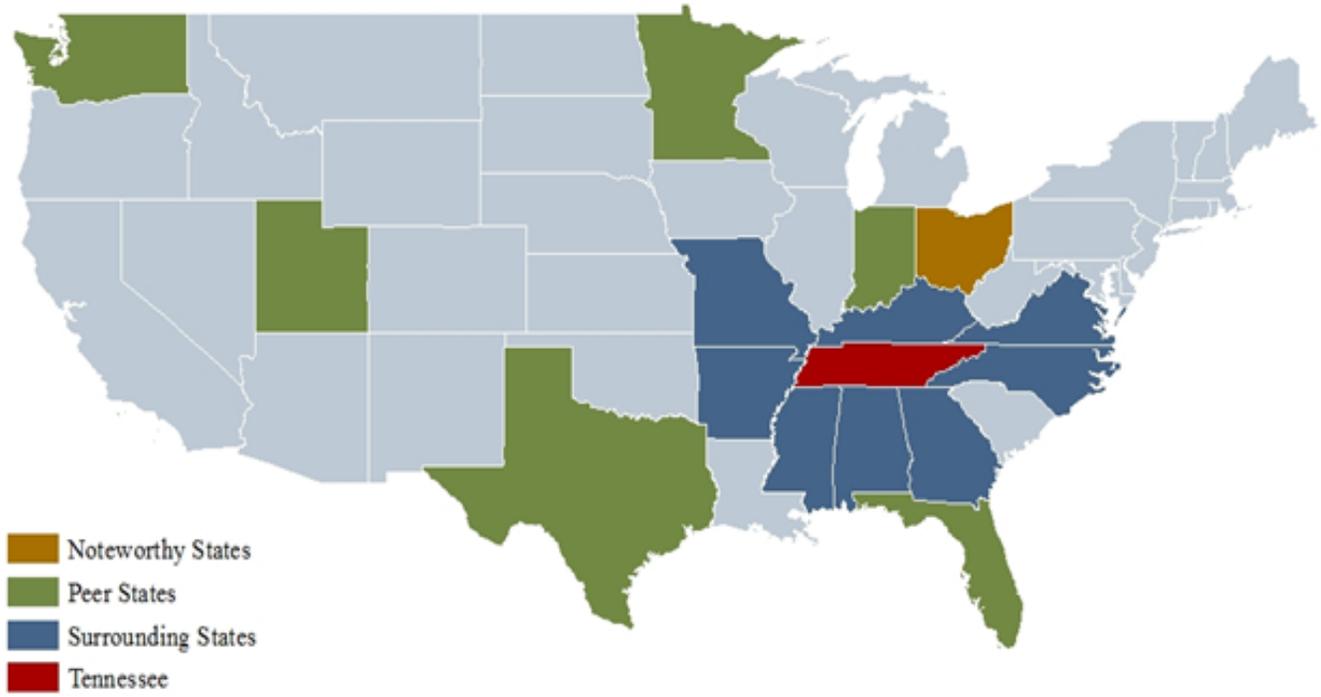


Figure 28 Surrounding, Peer, and Other Noteworthy States

Table 16 Surrounding and Peer State Comparison

	Population (in millions)	Employment (in millions)	Land Area (Thousands of Square Miles)	State Administered Roadway Miles - Total	State Administered Roadway Miles (% Urban / % Rural)	Annual VMT (in millions)	Transit Ridership (in thousands)	Airports (Number of Airports)	Railroad Miles	Waterways Miles
Surrounding States										
Alabama	4.8	2.5	50.6	10,894	20%/80%	64,914	8,663	182	3,255	1,270
Arkansas	2.9	1.5	52	16,395	11%/89%	32,953	6,972	213	2,698	1,860
Georgia	10	5.3	57.5	17,912	22%/78%	108,454	168,573	335	4,666	720
Kentucky	4.4	2.3	39.5	27,625	9%/91%	48,061	30,280	153	2,562	1,590
Mississippi	3	1.5	47	10,886	12%/88%	38,851	3,615	186	2,432	870
Missouri	6	3.5	68.8	33,884	9%/91%	68,789	71,628	359	3,958	1,030
North Carolina	9.8	5.2	48.6	79,333	22%/78%	103,772	78,274	335	3,245	1,150
Tennessee	6.3	3.5	42.2	13,885	22%/78%	71,129	33,441	68	2,029	887
Virginia	8.2	4.8	39.5	58,296	19%/81%	80,974	79,110	290	3,214	670
Peer and Other Noteworthy States										
Florida	19.5	9.9	53.6	12,079	51%/49%	191,855	283,339	497	2,902	1,540
Indiana	6.6	3.5	35.8	11,006	21%/79%	76,485	36,878	404	4,273	350
Minnesota	5.4	3.4	79.6	11,833	11%/89%	56,685	106,029	329	4,449	260
Ohio	11.6	6.5	40.8	19,236	26%/74%	111,990	114,687	490	5,338	440
Texas	26.4	14.3	261.2	80,268	17%/83%	237,440	299,867	1,450	10,425	830
Utah	2.9	1.6	82.2	5,866	19%/81%	26,222	47,701	90	1,343	0
Washington	7	3.8	66.4	7,054	19%/81%	56,955	256,435	366	3,157	1,060

4.1.1 Overview of Performance Measures in Other States

This section provides a description on the various methods and roles performance measures have in the respective surrounding, peer, and noteworthy states; it also presents an overview on the general type and number of measures the state DOT tracks and discusses the themes or focus areas for which a state DOT's performance measures are derived.

In recent years, transparency into state DOTs' operations and decision making has received increased priority; as a general practice, performance measures are used to guide planning, project development, maintenance, and operations decisions. Project prioritization and selection are other objectives for which performance measures are used, which will be discussed later in this paper.

Among surrounding, peer, and noteworthy states, performance measures were used for the following purposes:

- Demonstrate the degree of progress toward achieving goals,

- Meet requirements from the state legislature,
- Determine funding allocations for projects;
- Establish desired trends, and
- Adopt goals by the state DOT and/or state legislature.

Methods of Performance Monitoring

For the purposes of reporting the progress or activity of a state's performance measures, states were observed through reports that were submitted on varying update cycles (e.g. every two years, annually, biannually, or quarterly). For example, Washington DOT (WSDOT) creates a quarterly report titled, The Gray Notebook⁷. This report provides in-depth illustration on the performance of the state's transportation system. WSDOT's performance measures are established by the state's Strategic Plan which identifies the objectives and strategies the transportation agency will focus on over the next six years. The Georgia DOT is similar, where its Planning Office prepares the legislatively-required State Strategic Transportation Plan (SSTP)⁸. This plan establishes the state's business case for identifying strategies and investment packages for the transportation system; it is updated every two years where progress reports are submitted biannually, documenting the progress made toward carrying out the state's adopted goals and vision. Another documented method for performance monitoring is the dashboard, which is typically housed on a state DOT's webpage and updated routinely⁹. Among the states reviewed, five had maintained dashboards: Georgia, Florida, North Carolina, Utah, and Virginia. These five states also prepared some form of performance reports in tandem with maintaining their dashboards.

Policy Frameworks and Programs of Surrounding & Peer States

Understanding the policies and strategic objectives for which performance measures are typically based provides context for the why and how certain measures were used (e.g., TDOT's Guiding Principles). During the scanning of other states, these policies or programs were grouped into key themes or focus areas. Some of the states' performance goals or focus areas were developed or established in a state's strategic plan or promulgated by its state legislature. Another trend observed was although some states did not explicitly identify a particular focus area, a performance measure that was based on that specific area was listed. For example, most state DOTs had a mission or vision statement that was predicated in some way on customer service, but some states did not articulate customer service explicitly as an official performance goal. Yet, some of the performance measures that a state might track are geared toward improving or enhancing customer service. Generally, the surrounding and peer states have goals that are fairly comparable to the national performance goals set forth by MAP-21 (see Table 17); this also applies to TDOT's Guiding Principles.

⁷ <http://wsdot.wa.gov/publications/fulltext/graynotebook/Sep13.pdf>

⁸ <http://www.dot.ga.gov/IS/SSTP>

⁹ Kentucky does not have a dashboard per se, but it recently launched a web portal referred to as its 'DataMart', where it houses transportation data and information for the public. <http://datamart.business.transportation.ky.gov/>

Table 17 National Performance Goals

MAP-21 National Performance Goals	Description
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
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

Florida, Kentucky, Minnesota, Texas, and Virginia had transportation policies that were distinguishable among the other states, and Table 18 provides an abbreviated list of some of these policy areas.

Table 18 Other Focus Areas of Policies

Focus Area	State(s)
Land Use	Virginia
Quality of Life	Florida
Community Development	Minnesota
Air Quality	Kentucky
Economic Development	Florida/Missouri
Funding Allocation for Congestion	Texas

State policies and programs tended to be indigenous to the environment of that particular state; therefore, due to that fact alone, discovering unique policies was not surprising. However, there are two documented policies that have national relevance and are considered unique. These policies are discussed below.

- Congestion: Most of the states have policies or strategies aimed at addressing congestion mitigation, but Texas, via its state legislature, had a mandated approach for directing state resources toward relieving congestion.
- Policies supporting the relationship between freight movement and mobility and economic development: Florida and Missouri have policies that support improving the mobility of freight movement on their state highway networks. Florida merged economic development and freight into one focus area. Freight as a performance measure will be discussed in a later section of this paper. It is considered to be an emerging field in performance monitoring, therefore a number of states are in the process of establishing measures addressing this focus area. Minnesota extended its focus beyond the highway mode by additionally monitoring

freight tonnage via its ports and rail network.

Most of the policies which also tied to a state's performance measures fell in the categories of Safety, Preservation, Project Delivery, and System Reliability & Mobility. This trend is reported to be common around the U.S.¹⁰

As mentioned previously, performance goals along with their measures typically fall into two categories, system based or organizational focused. System-based goals focus on the state of the transportation network, whereas organizational or agency performance-based goals encompass the daily operations and needs of an agency, necessary for managing the transportation network. Most of the states studied have a combination of both system- and organizational-based performance goals. Similarly, TDOT's Guiding Principles have the same mixture of system and organizational goals (Table 19).

Table 19 TDOT's Guiding Principles

Guiding Principles
<p><u>Preserve and Manage the Existing System</u></p> <p>Balance maintenance and preservation needs with critical capacity enhancements and operations. Optimize system capacity and safety through cost effective management and new technologies.</p>
<p><u>Provide for the Efficient Movement of People and Freight</u></p> <p>Deliver an integrated, multimodal transportation system that optimizes the movement of people and goods by providing greater access to transportation services for all people and by building better connections among different modes of transportation.</p>
<p><u>Support the State's Economy</u></p> <p>Invest in transportation infrastructure that advances quality economic development and redevelopment, economic competitiveness, tourism, and increased access to people, places, goods and services within and through the State.</p>
<p><u>Maximize Safety and Security</u></p> <p>Reduce injuries and fatalities in all modes of transportation; minimize construction-related safety incidents; improve disaster and extreme weather preparedness and incident response.</p>
<p><u>Build Partnerships for Sustainable and Livable Communities</u></p> <p>Provide early and ongoing opportunities for broad public input on plans and programs; work closely with local public and private planning efforts; proactively coordinate land use and transportation planning to optimize the efficiency and long term viability of the transportation system.</p>
<p><u>Protect Natural, Cultural and Environmental Resources</u></p> <p>Responsibly plan and manage the transportation system to maintain the integrity of communities, historical sites and the natural environment, minimize and mitigate impacts of transportation projects, and develop a transportation network that improves congestion and addresses air quality issues.</p>
<p><u>Emphasize Financial Responsibility</u></p> <p>Provide accountability; maximize Tennessee's share of federal transportation funding; develop alternative funding strategies; select projects based on identified regional needs; allow flexibility in local management of projects where feasible.</p>

So far, performance goals and policies have been described, identified in terms of trends, and placed within the realm of MAP-21 requirements. The next section discusses the actual performance measures, along with their functions, used by surrounding, peer, and noteworthy states.

¹⁰ Performance Management Practices in Europe and the USA, Van der Lei, Van, & Klok, 2013

4.1.2 Overview on Performance Measures in Surrounding, Peer, and Noteworthy States

Some states do not present their complete listing of performance measures on their website (i.e. Georgia's dashboard reports on only 12 of its 17 measures because it believes those 12 are of the most interest to its citizens). Additionally, some states are in the process of updating their strategic plans; therefore, some measures were under development and were not listed. Therefore, performance measures will be discussed in terms of the latest version of measures documented during the review of states and will present the overall direction for a given state as far as its performance measures are concerned. This section is not intended to be an exhaustive list or a 'final word' for a state's list of performance measures, especially considering the dynamic nature of policy environments and transportation needs present in each state.

Since the surrounding and peer states' measures were centered on four common themes (i.e. Safety, Preservation, Project Delivery, and System Reliability & Mobility), common measures used were the percent of bridges rated in good condition, monitoring the statewide crash rate, monitoring the percent of miles below 45 mph in AM or PM peak periods, measuring the annual rail and express bus transit ridership numbers, and monitoring both travel time reliability and variability. There were unique qualities observed for each state, which typically were attributed to the geographical region of a state and in some cases the policy environment. One distinguishing factor among the states, however, was whether a state DOT utilized measures that were multimodal. Table 20 provides an overview of each state in terms of how many measures a state DOT employed as well as the states with multimodal measures.

Table 20 Surrounding and Peer States with Multimodal Measures

State	Number of Measures	Multimodal Measures
Surrounding States		
Kentucky	19	
Alabama	24	
Georgia	17	
Missouri	58	
North Carolina	22	✓
Virginia	57	
Peer and Other Noteworthy States		
Washington	13	✓
Florida	33	✓
Minnesota	21	✓
Ohio	21	

Performance measures that were considered unique among the peer states are presented below:

- Response Time in Inclement Weather - Six state DOTs utilize measures that essentially track the response time to travel incidents, lane closures, etc. related to inclement weather. The states observed using these types of measures were Alabama, Ohio, Kentucky, Missouri, Minnesota, and Florida. TDOT's Maximize Safety and Security Guiding Principle corresponds to this performance measure.
- Retrofitting for ADA and Bike and Pedestrian Provisions - Minnesota and Missouri have measures designed to help ensure compliance with Americans with Disabilities Act of 1990 (ADA) regulations. Both states also utilize performance measures that assist with implementing and tracking the DOT's progress with providing more comprehensive bike-

pedestrian facilities and networks.

- **Freight** - This is an important field of analysis and, as previously mentioned, is a national performance goal. It is also considered an emerging focus area, which will be discussed later in this paper. During the peer review, only Florida, Missouri, and Minnesota had explicit freight measures. Florida and Missouri, more so than Minnesota, draw a connection between freight and economic development strategies. Two of TDOT's Guiding Principles also relate to supporting the state's economy and the goal of providing adequate mobility for its citizens as well as for movement of goods.
- **Funding Allocation for Congestion** - Texas utilizes two measures that track funding allocation toward improving what the state termed the 'Top 100 Most Congested Roadways'; measures tracked include the percent of non-MPO funds allocated and the percent of MPO funds allocated to these congested roadways. The state's legislature emphasized the importance of focusing resources on addressing congestion; therefore, the purpose of these two measures is to provide the status of how funds were allocated, specifically pursuant to congestion relief.
- **Research & Development** - Utah tracks multiple measures tied back to its research and development program, where the ultimate focus is whether procured products or strategies were meeting their expected value or impact. The key measure was 'Percent of Projects Meeting Expectations'.

4.1.3 Emerging Trends in Surrounding States

There is a substantial amount of activity in the area of tracking, monitoring, and developing performance measures among the surrounding state DOTs. However, for the purposes of this section, only the measures that were considered emerging and those that are germane to TDOT's Guiding Principles are discussed. Given the unique policy environments of each state, its performance measures present relative value; therefore, the lack of discussion concerning a state DOT's measure(s) within this section is not indicative of a lack of value or relevance. The following section is organized by emerging performance measures with details from each applicable DOT practice.

Freight

- **Georgia** - This state adopted its Statewide Freight and Logistics Plan ¹¹, but an explicit freight measure had not been implemented. Its freight measure is under development and is planned for utilization in the near future. In the interim, the state's legislature has enabled special consideration of freight throughout the state, whereas it has exempted what is called the State Freight Corridor from the DOT's congressional district balancing. With regard to TDOT's Guiding Principle covering the provision for the efficient movement of people and freight, potential new developments in Georgia are recommended for monitoring in the coming months as improving the movement of freight is a MAP-21 performance goal.
- **Missouri** - This state tracks multiple measures related to freight, and each was directly tied to the state's mission of advancing economic development. The specific freight measures were a goods movement competitiveness metric, freight tonnage by mode, annual hours of truck delay, and a truck reliability index. These measures provide a context for how well Missouri performs among other states and also tracks the level of service on its roadways for the operations of the trucking industry.

¹¹ <http://www.dot.ga.gov/IS/GeorgiaFreight>

Economic Development

- *Missouri* – This state tracks over 10 measures relating to economic development, but two stand out, which are measuring the economic return on transportation investment and the number of jobs created via projects funded by its economic development program. TREDIS modeling is a tool used by this state to measure the impact that the projects in its STIP had on the state’s economy. This state established a program called ‘The Cost Share/Economic Development Program’ which is intended to build partnerships with local entities in pooling efforts and limited resources in order to deliver state highway and bridge projects. MoDOT allocates Cost Share/Economic Development funds based on the Missouri Highways and Transportation Commission’s approved funding distribution formula. At least \$5 million is set aside for projects that demonstrate economic development through job creation. Economic development set-aside balances in excess of \$25 million are available for any Cost Share/Economic Development project. Projects are selected by the Cost Share/Economic Development Committee, which consists of the Chief Engineer, Chief Financial Officer and the Assistant Chief Engineer. They are then recommended for approval via a STIP amendment ¹².

Environmental Planning and Impacts

- *North Carolina* – This state employs an environmental compliance score on construction and maintenance projects for the purposes of tracking how activities relating to environmental compliance are progressing and/or identifying the challenges.

Project Delivery

- *North Carolina* – This state tracks a measure intended to calculate the percentage of municipal and locally managed STIP projects that are let on schedule. This measure is intended to inform decision makers on the overall project delivery status as well as how locally-let projects impact the bottom line in terms of project scheduling in the DOT’s work program. Reducing project delivery delays is also a MAP-21 performance goal.
- *Georgia* – This state tracks measures related to project completion, risk management, and project completion within allotted budget(s). The measures’ purposes are to help staff to remain aware of relevant risks, fiscal constraints, and the necessary steps in achieving timely project delivery. As performance improves and/or declines, it is also captured on their dashboard ¹³.

Travel Time on Interstates

- *North Carolina* – This state measures the travel time index on certain interstates in order to measure the mobility on these key travel arteries. Although this measure fell under their goal for improved mobility, it was intended to direct focus on the movement of goods and people, which inherently has freight implications. System reliability and congestion reduction are MAP-21 performance goals.

System Performance, Reliability, and Congestion

- *Virginia* – This state has two metrics that focus on travel time on its interstates and tallies the total number of hours of delay per traveler. The purpose for these measures is to track the performance of mobility and therefore to highlight potential problem spots on the transportation system.

¹² http://epg.modot.org/index.php?title=141.1_Cost_Share/Economic_Development_Program

¹³ <http://www.dot.ga.gov/informationcenter/statistics/performance/Pages/default.aspx>

Incident Clearance Times

- *Georgia* – This state measures the response time of its HERO (Highway Emergency Response Operator)¹⁴ units for accidents where it also subsequently tracks the amount of time it takes to clear the scene of crashes. The HERO program only covers freeways in the Atlanta metropolitan area. The impedance to traffic related to accidents (i.e. lane closures) qualifies as non-recurring delay, which is a form of congestion that impacts a user’s mobility and travel time.
- *North Carolina* – Similarly to Georgia, this state tracked the average time to clear crashes, but it did so on a statewide level.
- *Missouri* – This state also employs a similar measure for determining the trends in incident clearance, but more specifically on the state highway system.

Options for Advancing TDOT’s Guiding Principles

TDOT currently has 36 performance measures; the following areas are identified as potential areas for opportunity to refine these measures. Where feasible, the Department should investigate financial measures with regard to project programming that help leverage or place priority on transportation projects located on a freight heavy corridor; this could assist TDOT in achieving its Guiding Principle of moving freight, goods, and people within its current fiscal means. TDOT could also employ Missouri’s approach by leveraging its current relationships with the trucking and freight industries in Tennessee; it could begin mutually sharing freight specific data, which would help it establish its freight performance measures. Examples of data are the quantity and types of shipments, frequency of shipments along with origins and destination, and the modes utilized for these shipments.

During the review of various states, economic development was often twinned with a freight measure, and MAP-21 also created this fusion of the two in a single performance goal for Freight Movement and Economic Vitality. Missouri’s model focuses on the return on investment and the number of jobs. A critical component for measuring the impact of freight activity and its relationship with economic development is acquiring the necessary software for analyzing impacts and relationships. Missouri used TREDIS for this purpose; however, another industry-backed econometric tool is REMI (Regional Economic Models, Inc.)¹⁵. REMI enables the user to evaluate the potential economic impacts of transportation projects. Multiple states use REMI to assess the economic impact of its construction work program, STIP, and other project lists. For example, Georgia currently uses REMI as a transportation planning tool.

With regard to environmental stewardship (one of TDOT’s Guiding Principles), TDOT currently has measures that track progress on Environmental Assessments (EA) and the processing time for Environmental Impact Statements (EIS), which are considered preconstruction activities. The Department could also start monitoring environmental activities in the post-construction phase similar to North Carolina. This could enable a more comprehensive approach by ensuring environmental planning is kept on pace as far as scheduling and by performing follow-up inspections to ensure environmental activities (i.e. mitigation) permits are in compliance.

For the area of project delivery, TDOT could emulate North Carolina. This state tracked the percentage of locally-managed projects in its STIP in terms of meeting project scheduling. TDOT currently has performance measures associated with project delivery; however, in the realm of augmenting its current efforts, it can also pursue another tenet of its Guiding Principles, Emphasize Financial Responsibility. TDOT could track the percentage of locally managed projects and their

¹⁴ <http://www.511ga.org/static/hero.html>

¹⁵ <http://www.remi.com/>

respective scheduling trends, but separate from its overall program (i.e. STIP management). As a result, TDOT would be able to monitor how well a project is progressing and identify critical areas to address within locally-managed projects.

All of the potential areas for opportunity described above should be pursued in synch with the roll-out of specific performance measures.

4.1.4 Emerging Trends in Peer and Noteworthy States

Similarly to the previous section, the discussion here focuses on emerging trends among the states categorized as ‘industry leaders’ and also deemed relevant to TDOT’s Guiding Principles.

Freight

- *Florida* – This state tracks four measures related to four travel modes (air, highway, rail, water). These measures are focused on the annual tonnage that traveled through or originated in the state via these modes. Additionally, this state has strategies for performance which are expanding the capacity of air and sea ports along with the associated corridors feeding into these facilities, targeting investments that enhance the state’s ability to manage imports and exports, and developing and implementing a statewide Freight Mobility and Trade Plan that would provide multiple connectivity options for the freight-handling industries.
- *Minnesota* – This state uses two freight measures: annual tonnage via port shipments to and from the state’s Great Lakes and river ports and the annual tonnage via state railroads to and from Minnesota.

Project Delivery

- *Ohio* – As previously stated, most of the peer states focus on project delivery. However, Ohio implemented a ‘Contract Program’ metric which measures the agency’s success with planning future project lettings by comparing the projected number of lettings with actual lettings. This measure helps the agency determine whether it is under-estimating the number of project lettings. This process is formally referred to as ‘The Lockdown Process’ where on January 15th of each year, the agency establishes a future snapshot of project lettings and the associated dollar amount; this snap shot serves as the baseline for comparing which projects were actually let. Ohio had another metric somewhat akin to the aforementioned measure, where the state calculates the return on investment by comparing the total costs of its construction program with the agency’s total costs of developing those projects (i.e. staff time, overhead).
- *Washington* – This state looked at its last five fiscal quarters in comparing total project costs to actual allocated budgets in order to calculate the variance. This measure allowed decision makers to observe how large or small the variance was, providing insight as to what areas are lagging in performance as far as budgetary expectations and constraints are concerned.

System Performance, Reliability, and Congestion

- *Ohio* – This state tracks a travel time reliability index (TTRI) for the purposes of measuring the percentage of free flow travel time for drivers between 5 a.m. and 9 p.m. on freeways.
- *Florida* – This state tracks six measures: the percent travel and miles meeting Level-of-Service (LOS) criteria, travel time reliability and travel time variability, vehicle hours of delay, and average travel speed. These measures are intended to help illustrate where the system is progressing and/or lagging in performance. Additionally, this state listed key strategies relating to improving system operations, which were increasing the use of Intelligent Transportation

Systems (ITS) technology, supporting commuter assistance programs for sharing rides to work, and collaborating with partners (local and regional) in revising regional evacuation plans.

- *Minnesota* – This state measures the speed on its interregional corridors by calculating the percentage of miles where travel speeds were +/- 2 mph of the target speed (55, 60, or 65 mph). Minnesota also uses this measure to report on the connectivity of its roadway network for the interregional corridors.
- *Washington* – This state uses the annual (weekday) vehicle hours of delay statewide to help capture predictability of goods and people movement by basing it on maximum throughput speeds (i.e. compares actual travel time with maximum throughput or more commonly known as free flow travel times).
- *Texas* – This state, based on its list of 100 Most Congested Roadways, tracks the percent of funding allocations toward projects located on these congested roadways; therefore, this state was capable of channeling its resources, or at least monitoring such, toward congestion relief activities.

Improving and Providing Mobility

- *Minnesota* – In order to determine whether mobility (statewide or regional) is improving, this state tracks the increase or decrease in the number/percentage of annual rail and express bus transit ridership. This measure also assists Minnesota in understanding trip patterns and modal splits of its residents.
- *Florida* – This state tracks three measures related to transit: passenger miles traveled, passenger trips, and the average headway. These are monitored to help the state evaluate the mobility of its citizens.
- *Indiana* – This state tracks congestion on selected metropolitan corridors during the AM and PM peak periods on a monthly cycle. The measurements are taken via detectors embedded in the pavement of urban interstates, measuring and storing speed data in 15 minute intervals (AM peak period was 6:00 to 9:00; PM was 3:30 to 6:30).
- *Texas* – This state tracks two measures relating to transit, specifically measuring the percent change in ridership numbers; one measure was for general public transit and the other for transit via rail.

Economic Development

- *Florida* – This state identified two premiere goals, which helped to derive their strategic goals for making strategic investments and maximizing existing facilities. Strategic investment metrics entail allocating 75% of new discretionary capacity funds to its Strategic Intermodal System (SIS), funding flexibility to meet emerging economic opportunities, and evaluating projects for economic impacts and basing future funding priorities on those projected impacts. Strategies and metrics for measuring the maximization of existing facilities centered around investing in last-mile projects and promoting multi-modal options within existing corridors. Most of the strategies listed were either qualitative or stated objectives; where specific measures were not listed, progress and targets were presented instead.
- *Minnesota* – This state tracks performance for economic activity by calculating the annual available airline seat miles on commercial flights, which helped the state quantify the impact of a poor economy on air travel.

Local Government Coordination

- *Florida* – This state implements strategies aimed at garnering local and regional resources in order to support environmental stewardship as well as increase the opportunities for stakeholders to provide input into the transportation decision making process. It also adopted a strategy to promote land uses and growth frameworks that support the viability of the transportation network. These strategies, similarly to their economic development strategies, were more along the lines of objectives and, therefore, were not accompanied by performance measures.

Incident Clearance Times

- *Washington* - This state, pursuant to its mobility (congestion relief) strategies, tracks the average clearance times for major (90+ minutes) incidents on its nine key corridors located in the western half of the state.
- *Minnesota* – This state, similar to the previous two states, measured the clearance time for its urban freeways; notably, their Twin Cities alone have approximately 400 miles of freeways, indicative of this significant undertaking.

Options for Advancing TDOT’s Guiding Principles

Potentially in tandem with TDOT’s current performance measures, the following areas are identified as potential areas of opportunity.

As previously mentioned, economic development was often twinned with a freight measure. In the case of Florida, its approach pivoted or focused on funneling funds to strategic roadways that are frequently used by freight carriers. If TDOT were to use Florida’s approach, it could be based on TDOT’s Statewide Multimodal Freight Plan where strategic freight routes receive specified priority for project selection in relationship to other corridors.

Both *System Reliability* and *Congestion Reduction* are MAP-21 performance goals. In relationship to TDOT’s Guiding Principle *Provide for the Efficient Movement of People and Freight*, there is opportunity to integrate these principles since TDOT currently does not have performance measures that explicitly fall into the category of congestion reduction. It is recommended, therefore, that TDOT begin measuring the incidence or level of delay on its roadway system.

As far as System Reliability is concerned, TDOT currently has an incident clearance measure via its HELP program and ITS initiatives. It is recommended however, that this measure be placed with the Transportation System measures group instead of its current grouping with the Organizational Effectiveness measures. Also, in complement to TDOT’s current ITS, it should consider purchasing real-time travel data (e.g. INRIX¹⁶, AirSage¹⁷), so it can begin tracking travel time on its highway system or select roadways deemed highest priority. Implementing a congestion performance measure and the previously described adjustments pertaining to System Reliability could allow TDOT the adequate resources to measure and make progress towards two performance goals.

In pursuit of its Guiding Principle, *Build Partnerships for Sustainable and Livable Communities*, TDOT could adopt Florida’s approach. Florida adopted a method of engaging local communities early in the process by, in some cases, giving communities ownership of certain activities relating to environmental stewardship. Consequently, the dialogue with local communities was continuous and it helped ensure that specific objectives were carried out on a statewide and local level. Local communities felt engaged in the transportation decision making process. TDOT could explore additional methods of stakeholder engagement, where one approach is assigning ownership of

¹⁶ <http://www.inrix.com/default.asp>

¹⁷ <http://www.airsage.com/Technology/What-we-do/>

certain activities geared toward establishing sustainable communities to the local governments. This would help establish both a dialogue with local stakeholders as well as goal sharing. This area is not considered a technical component, but rather an area involving the establishment of frameworks and policies. It should be noted, however, that although local government coordination is not explicitly referenced as a national performance goal, it is a sub-component or could be considered one with regard to project delivery. The potential areas for opportunity described above should be pursued in sync with the roll-out of specific performance measures.

4.2 ANTICIPATED FUTURE TRENDS

As far as a projected outlook on performance measures, the types utilized will depend heavily on commuting and development patterns, which future transportation regulations should reflect accordingly. From a regulatory standpoint, however, MAP-21 has already laid out the framework for which performance measures will conform. Performance measures will be centered on four program areas:

- National Highway Performance Program (NHPP) - measures will be geared toward infrastructure conditions and performance of the Interstate and National Highway System.
- Highway Safety Improvement Program (HSIP) - measures will be geared toward tracking the number of serious injuries and fatalities on a VMT basis (a listing of the proposed measures is provided later).
- Congestion Mitigation and Air Quality Improvement Program (CMAQ) - measures will be geared toward tracking impacts of congestion on mobile source emissions.
- Freight Movement – focus will be on the movement of freight on the interstates.

For each of the four program areas, there will be targets established, required performance plans (e.g. Strategic Highway Safety Plan, State Freight Plan, Asset Management Plan), and performance reporting, for which initial reports are due October 1, 2016 and every two years thereafter. Of the four program areas however, the HSIP is the furthest along in terms of development, stemming from the Notice of Proposed Rulemaking (NPRM) released on March 11, 2014. The proposed performance measures for safety are the number of fatalities, rate of fatalities, number of serious injuries, and rate of serious injuries. The rates calculation will be based on per 100 million vehicle miles traveled (VMT). As TDOT considers modifications to its current list of performance measures it should do so in close coordination with the release schedules of performance measures for the three program areas outstanding.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Tennessee historically has maintained high employment even through the economic downturn which has led to an increase in the number of residents. All indications in the economy point to this type of growth continuing into the future. Tennessee is projected to have a population increase of 2 million people and an employment increase of an equal amount by the year 2040. All of these indicators mean more trips being made by vehicles, transit users, pedestrians, and bicyclists. It also indicates more freight being moved in the state by truck, rail, barge, and air. Performance measures are an important tool for TDOT to determine where the transportation system has gaps and the types of projects needed to fill the identified gaps to provide a safe environment for all users.

Prior to recommending potential changes to TDOT's current performance measures or implementing new ones, it was established that TDOT's current Guiding Principles needed to be closely aligned with the MAP-21 performance goals. From this, one area was suggested for modification. TDOT's Emphasize Financial Responsibility Guiding Principle should be modified with project delivery strategies pursuant to MAP-21's project delivery performance goal.

5.1 SUMMARY OF FINDINGS

In conclusion, the following summarizes findings on travel trends and system performance within Tennessee.

- In Tennessee, there are over 28,413 miles of functionally classified roads.
 - Region 3 has the most roadway miles (8,235) and Region 2 has the least (5,765).
 - 75% of total roadway miles are in rural areas, while 25% are in urban areas.
 - 41% of all Daily Vehicle-Miles-Traveled (DVMT) occurred on rural roadways, while 59% occurred on urban roadways.
 - Of the 166,826,911 miles traveled (DVMT) on Tennessee's roadways in 2012, 34% were traveled on Interstates, which make up only 4% of total roadway miles.
 - While Collector roads account for 63% of all roadway miles in Tennessee, these roadways only make up 15% of DVMT. The majority (87%) of these roadways are located in rural areas versus 13% located in urban areas.
- There are 20,087 bridges on public roads within Tennessee.
 - 42% (8,437) are State Maintained meaning that TDOT owns, operates, and maintains these structures.
 - 58% (11,650) are Non-State Maintained meaning they are owned, operated, and maintained by local governments.
 - 8,101 of the State Maintained bridges are rated as "not structurally deficient", while 254 are rated as "structurally deficient".
 - Region 3 has the most structurally deficient bridges with 94.
 - Using 2013 dollars, it would take approximately \$3.1 billion to replace or repair all structurally-deficient bridges in the state.
- TDOT maintains 19 park-and-ride lots across the state with more than 920 parking spaces.

- The majority of lots (63%) are located in Region 3 around the Nashville MSA.
- While all TDOT lots are paved, only 32% have lighting.
- TDOT provides financial assistance for the operations of 26 public transit systems serving Tennessee counties, while also providing administration for several programs and services related to public transportation.
 - In 2012, 32,300,974 trips were taken by public transportation (all modes) in Tennessee.
 - For all regions, ridership mainly occurred in urban areas (more than 90%).
 - Region 3 and 4 experienced the most ridership in 2012 making up 33% and 39% of the state's overall total, respectively.
- In 2011, 12,696 miles of state highway were assessed for bicycle level of service (BLOS) suitability. Of these state highways, 36% reported having a BLOS rating of C or better.
- Within the state there are over 1,200 miles of Class I railroads owned and operated by 6 railroad companies and 21 short line railroads (18 of which receive funding through TDOT's Short Line Railroad Authorities Program).
- The state has 949 miles of navigable waterways with a total of 90 Tennessee counties located within 50 miles of this system.
 - 887 miles are on main river channels (Tennessee, Cumberland, and Mississippi Rivers).
 - 226.3 million tons of freight were moved by way of these three rivers in 2010.
 - While the Mississippi River has the least mileage of the three (176 miles), it moved 73% of the overall tonnage.
 - TDOT is responsible for two ferry services: the Benton-Houston ferry in Benton and Houston Counties and the Cumberland City ferry in Stewart County
- Tennessee has 5 commercial airports in the cities of Nashville, Memphis, Knoxville, Chattanooga, and the Tri-Cities area.
 - The majority of cargo shipped by air in the state is shipped to/from three of these airports: Memphis, McGhee Tyson (Knoxville), and Nashville International.
 - While all three airports shipped a combined 10.8 million tons, 10.5 million tons was shipped through Memphis alone (the largest shipper in the U.S.).

5.2 RECOMMENDATIONS

In conclusion, the following recommendations are proposed as they relate to travel trends and system performance in Tennessee.

- TDOT should evaluate its training and standard procedures on environmental compliance as it delivers and maintains its transportation system.
- TDOT should employ process improvement practices for continuous improvement of TDOT's oversight and involvement in project environmental review.
- TDOT should investigate tools that allow for economic analysis of its programmed projects as well as those recommended for programming.

- TDOT should go beyond a traditional Benefit Cost Analysis in order to understand the economic impacts of both current and future transportation investments.
- TDOT should adopt performance measures specific to monitoring congestion (e.g., speed, delay, throughput, travel time reliability, etc.).
- TDOT should support a program for congestion reduction investments (e.g., Chokepoints, TSM&O, ITS, Signal Timing, ATDM, etc.) in the 3-Year Plan.
- At the risk of not adding capacity, TDOT should promote maintenance and preservation of its assets.
- TDOT should continue to promote asset management as a means of maintaining and preserving Tennessee's transportation infrastructure in a state of good repair (i.e. to desired target conditions).
- TDOT should increase its capabilities and technical resources in asset management to advance greater understanding and investments in Tennessee's transportation infrastructure.