Oregon Department of Transportation

2020 STATEWIDE CONGESTION OVERVIEW

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Executive Summary

Supporting the daily activity of Oregon businesses and residents is key to the mission of the Oregon Department of Transportation (ODOT). Policy-makers must make strategic choices about how and where resources are spent. Effective solutions require an understanding of how travel affects people's lives and the economy. As Oregon grows, congestion in urban centers rises, which impacts mobility. When making transportation choices, businesses and people consider cost, time, safety, and reliability. It is important to understand the economic motivations behind travel, mobility and congestion in order to develop effective policies and strategic investment plans. For the purpose of this report, mobility means having quality transportation options that enable businesses and people to safely fulfill needs within budgets for time and money. Mobility directly impacts the quality of life for Oregonians every day. ODOT must understand factors underlying mobility in order to develop effective means to optimize system performance and support a sustainable economy, while serving the needs of a diverse set of individual users.

The purpose of this report is 3-fold:

- Identify factors affecting transportation demand in a manner that informs policy development,
- Quantify system use, measure how much the system is used, provide context with respect to system capacity and condition,
- Measure the quality of system performance, identify how well the system functions and report congestion issues.

Mobility directly impacts the quality of life for Oregonians every day.

The Economy

A well-functioning transportation system is foundational to a robust economy. Oregon has experienced significant economic growth over the last 20 years. **Figure S1** illustrates change in population, employment and vehicle miles traveled between 2000 and 2018:

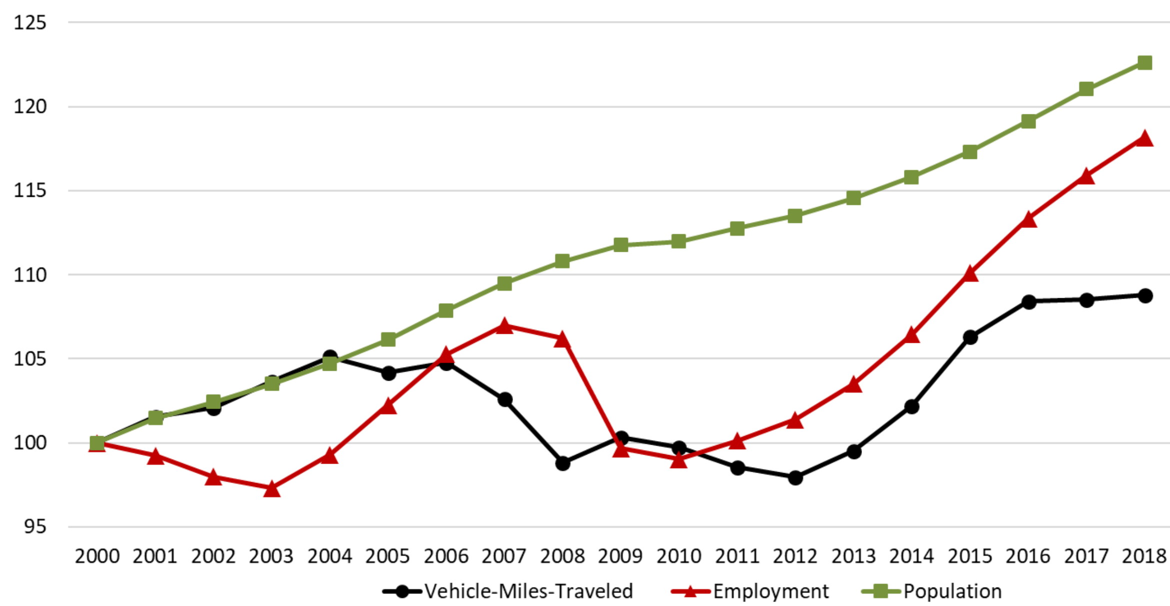
- Oregon population increased 23 percent, from 3.4 million people to 4.2 million.
- Oregon employment increased 18 percent, from 1.6 million to 1.9 million.
- Vehicle-miles-traveled (VMT) in Oregon has increased 8.8 percent.

Over this 19 year period there were two recessions, one in 2001 (8 months) and the Great Recession of 2007-2009 (18 months). During these recessions employment declined, unemployment rose, population continued to grow, but at slower rates. VMT rose 5% between 2000 and 2004, followed by a decline during the Great Recession. VMT remained at or below year 2000 levels until 2014, rising to statewide VMT 8.8% higher than year 2000 By 2012 the Oregon economy was in full recovery: population began to grow faster and employment began rising faster than population. The fact that

Economic conditions affect population and employment, which impacts travel.

VMT is rising slower than population indicates household travel choices may be changing, trips are conserved, trip distances may be shorter and non-auto modes are utilized more than in the past. The change in patterns may be in response to rising congestion levels, or indicate a change in choices and attitudes.

FIGURE S1. OREGON POPULATION, EMPLOYMENT AND VMT OVER TIME: 2000-2018

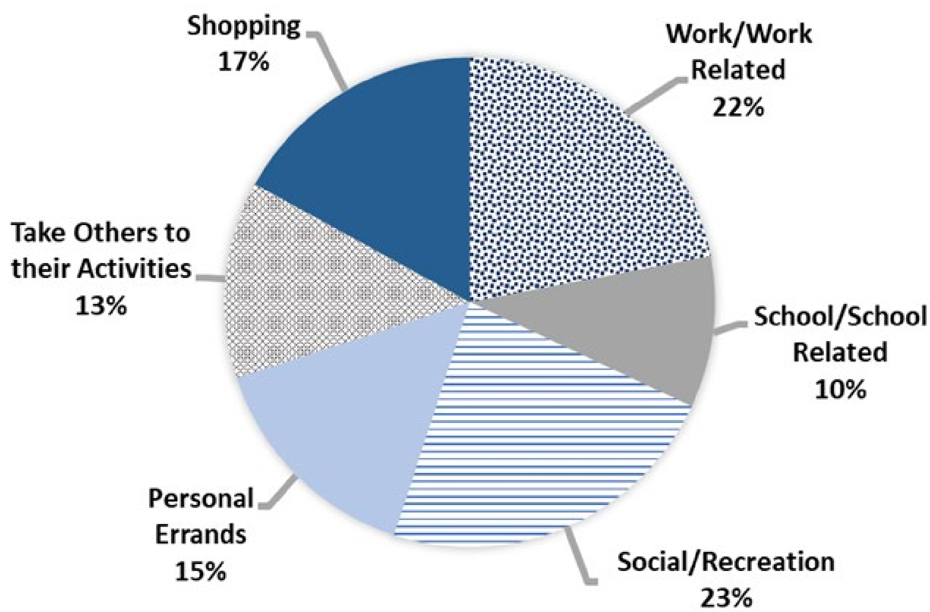


<u>Household Economic Activity</u>

Individual household activity varies depending on characteristics such as household size, age, income, number of workers, and presence of children. Travel occurs for a variety of reasons, presented in **Figure S2**. According to the most recent Oregon statewide household activity survey, about 55 percent of trips are for social/recreational activity, shopping and personal errands. Twenty-two percent are for work or work-related, while 23 percent are for school, school-related, or escorting others for their activity (e.g., children, elderly).

Each household has different mobility needs that rely on transportation.

FIGURE S2. HOUSEHOLD TRAVEL TRIP PURPOSE – STATEWIDE AVERAGE WEEKDAYS



<u>Commercial Economic Activity</u>

Individual businesses have diverse transportation needs which vary across the industry within which they operate. However, they all need access to workers, materials and services to support production activity, and markets where their goods and services are sold.

One aspect of commercial activity involves freight movement in heavy trucks, consisting of a large variety of commodities used in different ways across industries. Oregon freight moves predominantly by heavy truck, 70 percent of freight moves by truck, while other freight modes such as rail, air and marine depend on trucks for the first and last mile. Freight movement supports Oregon trade, our top trading partners include Washington, California, Idaho, Minnesota and Texas, which rely on trucks.

Another aspect of commercial activity involves medium trucks, used for commercial activity, trade services such as plumbing, electricians, roofing, painting and other construction; as well as local deliveries for e-commerce, groceries and nursery goods.

Each business has different mobility needs that rely on transportation.

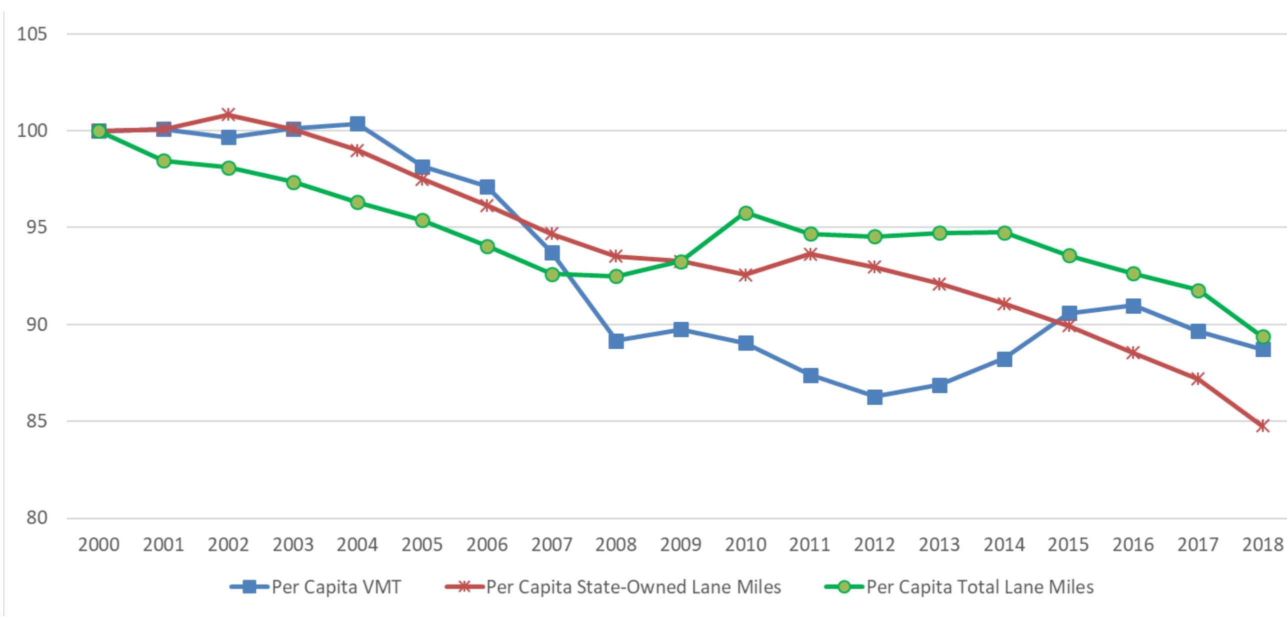
QUANTIFYING USE

Transportation roadway use can be quantified using metrics such as VMT and VMT per capita. Since year 2000, total statewide VMT has risen steadily, while per capita VMT has declined over time. This means the reduction in average VMT per person has not been enough to compensate for overall growth in population and employment, which has led to an overall increase in statewide VMT over the last 19 years. At the same time, the number of system lane miles has not kept pace with increasing use. Since 2000, total state owned lane miles have remained the same, while city and county lane miles increased by 9.5 percent.

Figure S3 illustrates growth in lane miles relative to growth in system per capita VMT, per capita state-owned lane miles, and per capita total lane miles. State-owned highway lane miles make up 18 percent of statewide lane miles and accommodated 59 percent of VMT in 2018, but per capita state-owned lane miles have decreased 15% since 2000. Per capita statewide VMT decreased 15 percent since 2000, while total statewide per capita lane miles decreased 11%. During this time congestion levels have been rising in urban areas where the majority of growth occurs.

Highway system capacity has not kept pace with demand.

FIGURE S3. CHANGE IN PER CAPITA VMT AND PER CAPITA LANE MILES: 2000-2018 (INDEXED TO YEAR 2000)



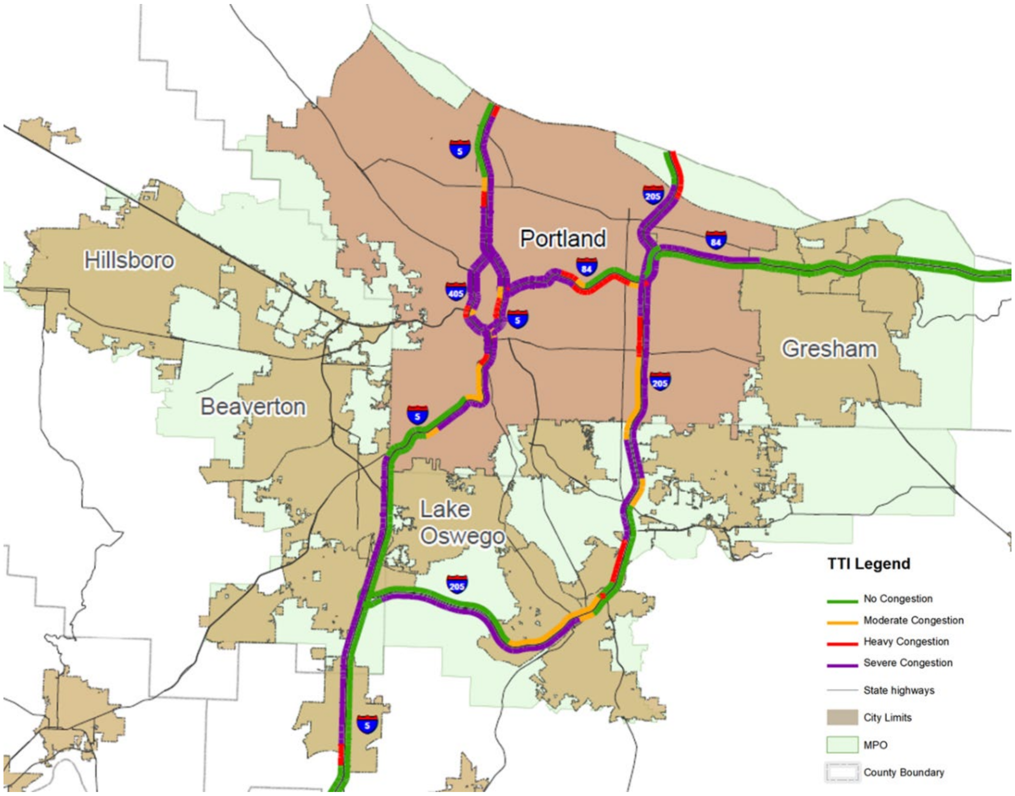
Measuring Quality

As congestion levels rise, the quality of system use is impacted. There are performance measures revealing how well the system operates, the focus of this report is on freeway congestion and reliability. In the future, non-freeway and non-motorized modal information may be added to reporting metrics. Congestion falls into two distinct categories: recurring and non-recurring congestion. According to federal data, recurring congestion relates to bottlenecks and capacity issues which account for 40% of total congestion. Non-recurring congestion relates to less predictable causes, such as traffic incidents, weather, construction work zones and special events.

Effective solutions require a clear understanding of the root cause of congestion, which relies heavily on timely observed data. Measuring quality includes metrics looking at peak period travel times, using the Travel Time Index (TTI) and the Planning Time Index (PTI) to measure congestion and reliability. **Figure S4** illustrates afternoon peak period congestion for the Portland region using the TTI. The most severe congestion occurs in the Portland metropolitan area, which experiences multiple hours of congested conditions on a daily basis. As the state grows, congestion is expected to become more severe and spread beyond typical peak periods in many areas of the state.

Congestion is an urban issue, predominantly in the Portland Metro region, but rising in other urban areas.

FIGURE S4. PORTLAND REGION, TRAVEL TIME INDEX 2017, PM PEAK PERIOD 4 PM - 6 PM



CONCLUSION

As Oregon continues to experience economic growth, there will be increased demand for people and goods to move around using the transportation system. Most of the severe congestion occurs in the Portland Metropolitan area today. However, despite the downward trend in per capita VMT, continued statewide growth will likely lead to rising congestion in Portland and other urban regions of the state spreading beyond the typical peak periods.

Managing the Oregon transportation system effectively is complex, especially given the varied needs of diverse users while ensuring travel is as safe as possible. Making data-driven decisions will better reveal root causes and lead to developing effective solutions.

Introduction

1.1 Travel Mobility

Supporting the daily lives of Oregon businesses and residents is key to the mission of the Oregon Department of Transportation (ODOT). Policy-makers must make strategic choices about how and where resources are spent. Effective solutions require an understanding of how travel affects people's lives and the economy. It is important to understand the economic motivations behind travel, mobility and congestion in order to develop effective policies and strategic investment plans. As Oregon grows, congestion in urban centers rises, which impacts mobility.

Answering the question "what is mobility" is not as simple as it initially appears, mobility is not synonymous with transportation. The Mobility Lab[1] describes having mobility is having access to the places needed to fulfill a rich and satisfying life, such as a job, schools, medical services, shopping, parks, and personal amenities such as seeing your kid's game after work. In this sense, mobility means having quality transportation options enabling businesses and people to safely fulfill needs within budgets for time and money. Mobility directly impacts the quality of life for all Oregonians every day.

Roadways are preserved and maintained by multiple agencies, ODOT, counties and cities, covering more than 74 thousand lane miles.[2] Oregon has over 4.1 million registered vehicles: about 80 percent are passenger vehicles and 20 percent commercial[3]; 3.1 million licensed drivers, which is about 70 percent of the state population. The ability for businesses, freight and people to move throughout the state depends on having robust transportation infrastructure.

Mobility means having quality transportation options that enable businesses and people to safely fulfill needs within budgets for time and money

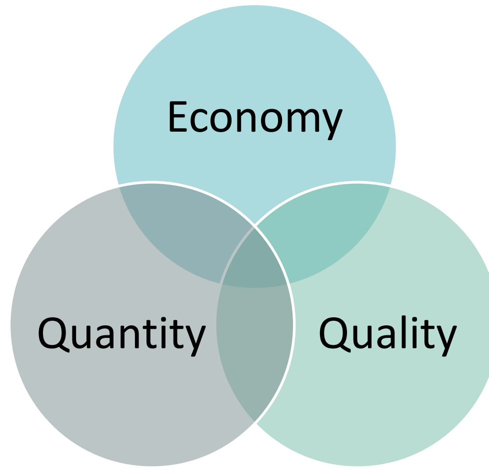
When making transportation choices, businesses and people consider cost, time, safety, and reliability. In order to support Oregon's quality of life, ODOT must understand factors underlying mobility in order to manage safety, develop effective means to optimize system performance, support a sustainable economy, while serving the needs of a diverse set of individual users.

[1] https://mobilitylab.org/2018/07/26/what-is-mobility/
[2] 2018 Oregon Annual Mileage Report: https://www.oregon.gov/odot/data/pages/road-assets-mileage.aspx#OMR
[3] DMV Key Facts online

1.2 How Do We Evaluate Roadway Mobility?

The "ease" of moving on Oregon's highway system can be examined from several different vantage points:

- **Economy:** Economic activity generates demand for transportation systems. What factors impact travel demand? Why is a well-functioning transportation system important to the Oregon economy?
- **Quantity:** How many people use the freeway system? How much freight is transported on our freeways? Are businesses able to access customers? Are customers able to access businesses?
- **Quality:** How well are people and goods being transported on the system? What is user perception of freeway operation? How reliable is the system - where is congestion associated with incidents, such as crashes, weather, and other activity?



Looking at mobility from multiple perspectives provides a more holistic view of system performance.

Section 2 of this report highlights the fundamental role played by the Oregon economy, revealing different market forces related to day-to-day decisions impacting the overall use of the transportation system. Section 3 presents performance measures on the quantity and quality of system use and performance.

1.3 Purpose of this Report

Managing the transportation system effectively is challenging and complex. Information on system performance will position ODOT to gain a deeper understanding of statewide mobility issues. Fact-based, data-driven reporting provides information supporting transportation policy development and long range planning. The purpose of this report is to support data-driven development of transportation policy and investment, with a focus on three areas:

- Economic context, identify factors affecting transportation demand in a manner that informs policy development,
- Quantify system use, measure how much the system is used, provide context with respect to system capacity and condition,
- Measure the quality of system performance, identify how well the system functions and report congestion issues.

Data sources, technical methods and procedures have been developed and vetted for reporting on freeways, which is the focus of this report. This approach is designed for high-level statewide monitoring with the intent to inform long range planning efforts, such as the Oregon Transportation Plan[4] and Oregon Highway Plan[5]. This report can also support regional planning and analysis, such as the information prepared for the ODOT "Portland Region Traffic Performance Report"[6], which evaluates corridor performance. This type of reporting requires development of performance measures, high-quality observed data and technical methods to produce statistically valid results. This report presents information based on currently available data and reporting methods.

The purpose of this report is to support data-driven development of transportation policy and investment.

2 The Role of the Economy in Mobility

Is freeway mobility changing because Oregonians are making different business, lifestyle and travel choices, or are business, lifestyle and travel choices changing in response to congestion and delays on our freeways? It is likely both are occurring simultaneously. Complex economic relationships between freeway mobility and travel behavior are continually in flux and have long created challenges for transportation analysts. Land use characteristics such as density, accessibility, and travel mode connectivity influence where businesses and households choose to locate.

This section takes a look at several high-level indicators related to the movement of people, goods and services in Oregon. Economists refer to transportation as a "derived demand" because demand for transportation is mostly derived from demand to access goods and services. **Figure 1** illustrates how economic activity of households and businesses generates demand for transportation. Thus, the economy plays a very large role in the demands on the transportation system, while ODOT has very limited influence on transportation users' choice and economic behavior.

[4] https://www.oregon.gov/odot/planning/pages/plans.aspx
[5] https://www.oregon.gov/odot/planning/pages/plans.aspx#OHP
[6] 2018 report is available here: https://www.oregon.gov/ODOT/Projects/Project%20Documents/2018TrafficPerformanceReport.pdf

FIGURE 1. TRANSPORTATION AS A DERIVED DEMAND

ECONOMIC ACTIVITY			
Household Production/Activity		**Business Production/Activity**	
Workers - Earn Income	Attend School	Hire Workers	Produce Goods
Consume Goods	Consume Services	Provide Services	Capital Investment

DERIVED DEMAND	
Household Demand for Trips:	**Business Demand for Trips**
Household trips by purpose:	Worker trips destined to job site
Work and work related	Service trips to customers
School and school related	Freight trips coming in and going out:
Social/Recreation	Within Oregon, outbound, inbound
Personal business	Freight by different modes
Shopping	Light, Medium & Heavy Vehicles
Escorting others to their activities (kids, elderly)	Rail, Air, Marine, & Pipeline

2.1 The Economy

Since 2001, the Oregon economy has been expanding faster than the national average[7], attracting more people, jobs and freight movement as it grows. **Table 1** reports vehicle-miles-traveled (VMT) by highway ownership and vehicle weight group. This information was compiled from the Oregon Highway Cost Allocation study, which defines light vehicles as weighing less than 10,000 pounds and heavy vehicles weighing more than 10,000 pounds. In 2018 fifty-nine percent of total VMT occurred on state-owned highways[8], which account for 18 percent of lane miles. City and county roads carried 41 percent of total VMT in 2018, while accounting for 82 percent of Oregon lane miles. The majority of heavy vehicle VMT occurs on the state system (78 percent), while city and county roads carry the remaining 22 percent. About 8 percent of overall statewide VMT is from heavy vehicles, where 10 percent of state-owned highway VMT is from heavy vehicles and 4 percent of non-state highway VMT is from heavy vehicles.

[7] Oregon Center for Public Policy: https://www.ocpp.org/2019/04/18/SWO-strong-economic-growth/ accessed 02/14/2020.

[8] This pattern has been consistent over time. Further detail can be found in Exhibit 4-4 of the 2011 Highway Cost Allocation Study Report available here: https://www.oregon.gov/das/OEA/Documents/2011report.pdf

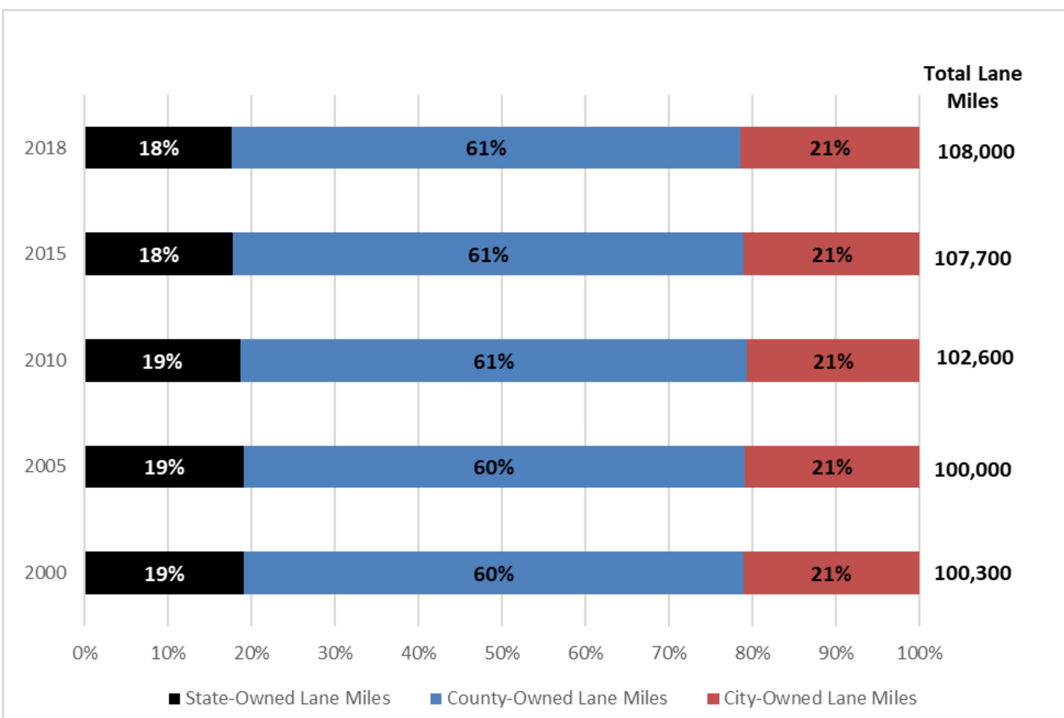
TABLE 1. 2018 VEHICLE-MILES-TRAVELED BY HIGHWAY JURISDICTIONAL OWNERSHIP AND WEIGHT GROUP

	Total VMT, in millions	Percent of Total	Share of Lane Miles	Light Vehicles		Heavy Vehicles	
State Roads	**22,739**	**59%**	**18%**	20,378	57%	2,361	78%
Interstate	10,050	26%					
Non-Interstate	12,688	33%					
Local Roads	**15,796**	**41%**	**82%**	15,118	43%	678	22%
County Roads	8,424	22%	61%				
City Streets	7,372	19%	21%				
TOTAL All Roads	**38,535**	**100%**		**35,496**	**92%**	**3,039**	**8%**

Source: VMT - Highway Cost Allocation Study: 2017-2019 Biennium, Oregon Department of Administrative Services, Office of Economic Analysis; Lane Miles - Highway Performance Monitoring System, ODOT

Major expansion of the national highway system ended with the completion of the Interstate system in 1992[9]. Since this time, Oregon infrastructure investment has focused on relatively small enhancement projects designed to optimize system performance – especially in the areas of safety and reliability, but not adding a large amount of capacity. **Figure 2** reports lane miles by jurisdictional ownership between years 2000 and 2018. Total lane miles increased 7.7 percent over the last eighteen years, most of the change occurred on the local system to accommodate new housing and businesses.[10]

FIGURE 2. OREGON LANE MILES BY OWNERSHIP 2000-2018



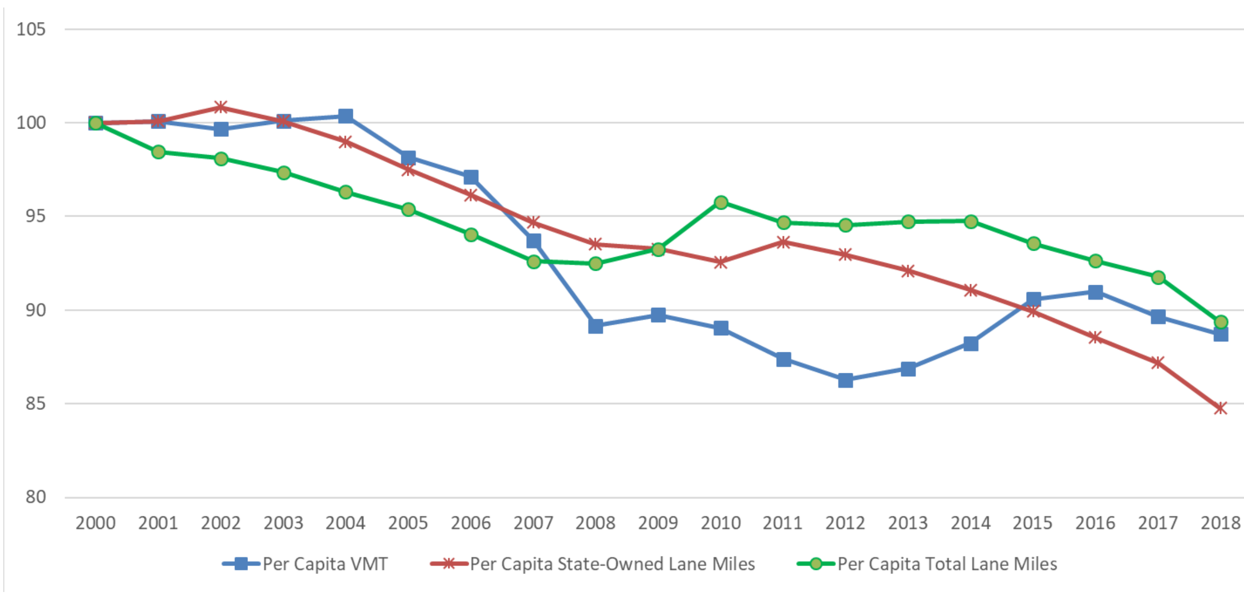
[9] https://en.wikipedia.org/wiki/Interstate_Highway_System accessed 02/14/2020.

[10] State-owned lane miles have remained effectively flat over time, through a combination of jurisdictional transfers, changes in highway configuration and limited construction of new lane miles.

Figure 3 illustrates the change in lane miles and VMT over time relative to changes in population, reported as per capita VMT. These figures are indexed to year 2000 as a reference to illustrate relative change over time. Since 2000, the overall trend in per capita VMT is downward. The Great Recession contributed to lower per capita VMT, but there was some rebound once the economy fully recovered from the recession. By 2018, per capita VMT was 11% lower than year 2000.

Between years 2000 and 2008, population grew 11 percent. New infrastructure is necessary to accommodate this growth, resulting in additional lane miles for city streets and county roads. While, overall population and statewide lane miles have increased, state-owned highway lane miles have remained very close to the same level over time. State highway lane mile capacity accommodates about 60 percent of statewide VMT each year.

FIGURE 3. CHANGE IN PER CAPITA VMT AND PER CAPITA LANE MILES: 2000-2018 (INDEXED TO YEAR 2000)



2.2 Population and Employment

As the Oregon economy grows, greater demands are placed on state highways to accommodate rising levels of freight and people movement, while lane miles increase very little. For this reason, the need to understand and optimize use of highways is key to supporting the Oregon economy.

Historically Oregon has been growing faster than the national average. **Figure 4** illustrates change in population, employment and VMT for years 2000 through 2018. During this time state population increased 23 percent[11], from 3.4 million to 4.2 million. The number of jobs in Oregon rose 18 percent[12], from 1.6 million to 1.9 million. Oregon's economy relies on the transportation system to get goods and

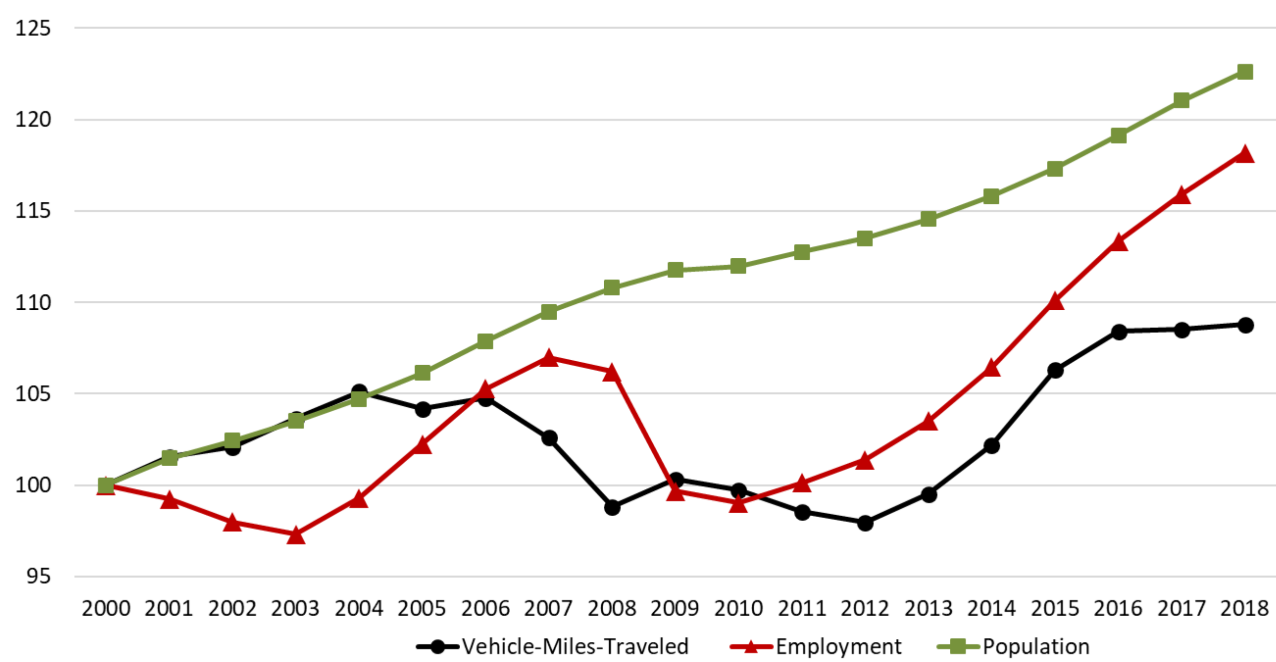
[11] PSU Population Research Center Current Population Estimates data series

[12] Oregon Employment Department, Current Employment Statistics data series.

services to markets, workers to their jobs and consumers to marketplaces. This resulted in total statewide VMT increasing 8.8%[13].

Over this 19 year period there were two recessions, one in 2001 (8 months) and the Great Recession of 2007-2009 (18 months). During these recessions employment declined and population continued to grow, but at slower rates VMT rose 5% between 2000 and 2004, followed by a decline during the Great Recession. VMT remained at or below year 2000 levels until 2014, rising to statewide VMT 8.8% higher than year 2000 By 2012 the Oregon economy was in full recovery: population began to grow faster and employment began rising faster than population. The fact that VMT is rising slower than population indicates household travel choices may be changing, trips are conserved, trip distances may be shorter and non-auto modes are utilized more than in the past. The change in patterns may be in response to rising congestion levels, or indicate a change in choices and attitudes.

FIGURE 4. OREGON POPULATION, EMPLOYMENT AND VMT OVER TIME: 2000-2018



While population growth has occurred in both rural and urban areas of Oregon, the majority of increased population has been in metropolitan areas. **Table 2** reports Oregon population by Metropolitan Planning Organization (MPO) for years 2010 and 2018. Bend MPO has been growing the fastest, increasing nearly 20 percent in population over the last 8 years. Albany MPO and Portland Metro grew 12 percent, while the remaining MPOs grew between 6 and 9 percent, resulting in an overall average increase of 11 percent for Oregon MPOs. Smaller cities and rural areas of Oregon have

[13] FHWA Highway Statistics, Table VM-2; statistics for year 2018 are not currently published

risen steadily over time, 7 percent since 2010. Overall, Oregon's state population has increased 10 percent over the last 8 years.

Table 2. Oregon Population 2010 and 2018, Statewide, MPO, Other Cities and Rural Areas

Geographic Area	Census 2010 Population	July 1, 2018 Estimate	Population Change	Percent Change
Albany MPO	57,714	64,802	7,088	12%
Bend Area MPO, Deschutes Co.	85,305	101,658	16,353	19%
Corvallis MPO, Benton Co.	65,311	71,113	5,802	9%
Eugene-Springfield MPO, Lane Co.	249,800	266,921	17,121	7%
Grants Pass/Middle Rogue MPO	56,560	59,952	3,392	6%
Medford/Rogue River MPO, Jackson Co.	167,895	180,678	12,783	8%
Portland Metro MPO	1,502,867	1,680,169	177,302	12%
Salem-Keizer MPO	243,500	265,121	21,621	9%
Total All Metropolitan Areas	**2,428,952**	**2,690,415**	**261,463**	**11%**
Other Cities and Rural Areas	**1,402,122**	**1,504,885**	**102,763**	**7%**
Oregon Statewide	**3,831,074**	**4,195,300**	**364,226**	**10%**

Sources: Census 2010 - US Census Bureau; 2018 Population Estimates - Population Research Center, Portland State University

2.3 Human Behavior: Moving People and Goods

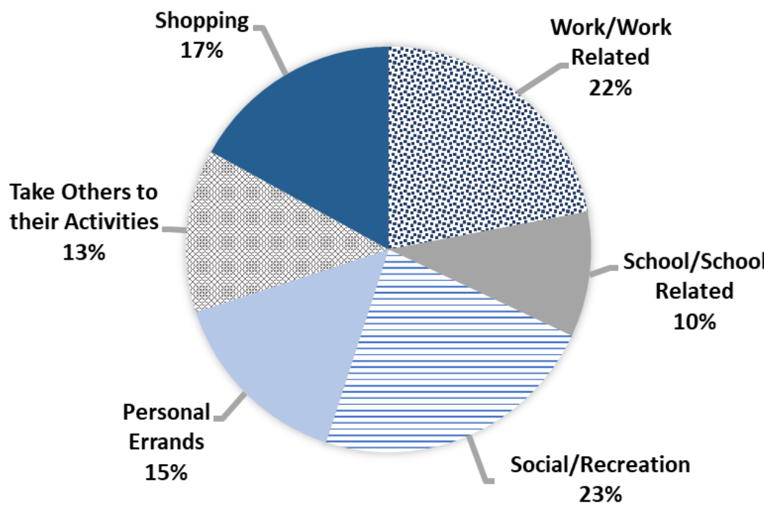
A growing population places additional demands on the highway system as people partake in household activity, such as commuting to work, shopping, household errands, escorting children to school and activities, and recreational travel. A growing economy also places additional demands on the system as businesses hire more workers, demand for services rise, and more freight is moved between businesses and to final markets. Most of Oregon's MPOs are located along the I-5 corridor, with the exception of Bend. For this reason, it is no surprise to see congestion rising on the urban sections of the interstate freeway system.

2.3.1 Household Travel

On an average weekday, households make about 9 trips per day[14]. The number of trips varies by household characteristics, such as age of household members, household size, household income, number of workers, presence of children, and availability of vehicles. The specific purpose varies as well, where some trips are mandatory and others more flexible in terms of time-of-day or day-of-week. **Figure 5** illustrates the average proportion of household trips by purpose statewide.

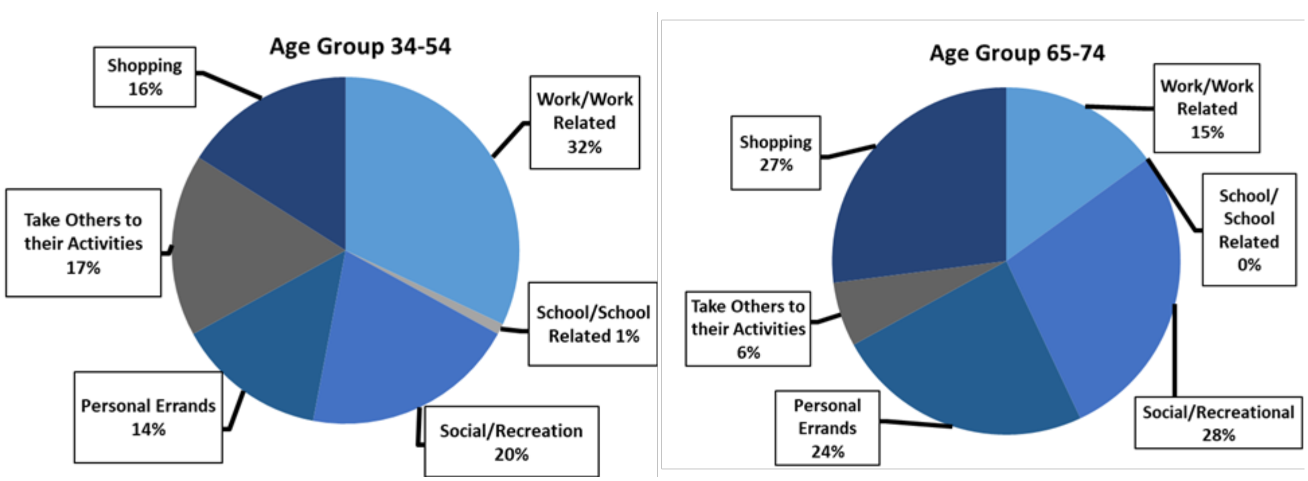
[14] Stacey Bricka (2019), *Personal Travel in Oregon: A Snapshot of Daily Household Travel Patterns*. Accessible on Oregon Department of Transportation website: https://www.oregon.gov/ODOT/Planning/Documents/OHAS-Daily-Travel-In-Oregon-Report.pdf.

FIGURE 5. HOUSEHOLD TRAVEL TRIP PURPOSE – STATEWIDE AVERAGE WEEKDAYS



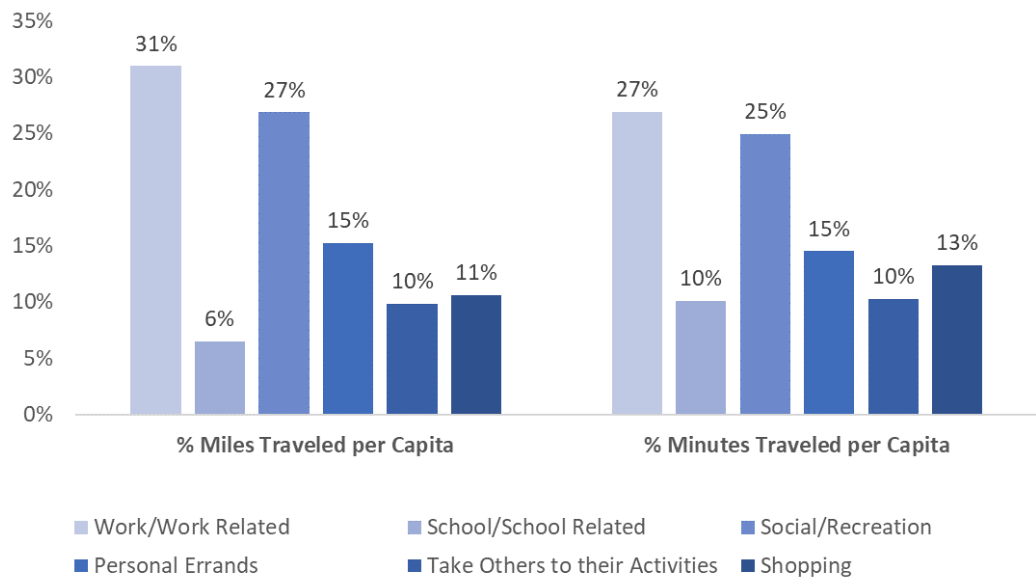
As Oregon's population ages, the overall statewide patterns may change. **Figure 6** illustrates how age impacts travel by comparing two age groups: ages 34-54 and ages 65-74. People in the age group 34-54 have a large share of trips related to work and taking others to their activities, making up nearly half of all trips. People in the age group of 65-74 have a large share of trips related to social/recreation and shopping, making up 55 percent of all trips. Thus, travel patterns vary by household characteristics and these differences are important to understand when developing transportation policy. Travel patterns are continuously changing as new modes become available, such as ride-services (Uber, Lyft), e-bikes, and e-scooters. Utilization of existing options are also likely to change as the system matures, such as bicycling, walking, transit and rising use of online shopping.

FIGURE 6. SHARE OF TRIPS BY PURPOSE FOR AGE GROUPS 34-54 AND 65-74



Household trips vary in terms of distance and time. **Figure 7** illustrates the variation in patterns by distance and travel time for average weekday travel. Work-related travel is typically longer in terms of time and distance, social/recreational trips follow a similar pattern. School-related trips are generally the shortest in terms of distance, since households are typically located fairly close to schools. Trips involving personal errands, shopping and taking others to activities as a group make up nearly 40 percent of travel in terms of time and distance combined, but each trip has different needs related to reliability and ability to avoid congested time periods This reveals the complexity associated with managing the highway system and developing public policy to meet the diverse needs of personal travel.

FIGURE 7. TRAVEL TIME AND DISTANCE BY TRIP PURPOSE

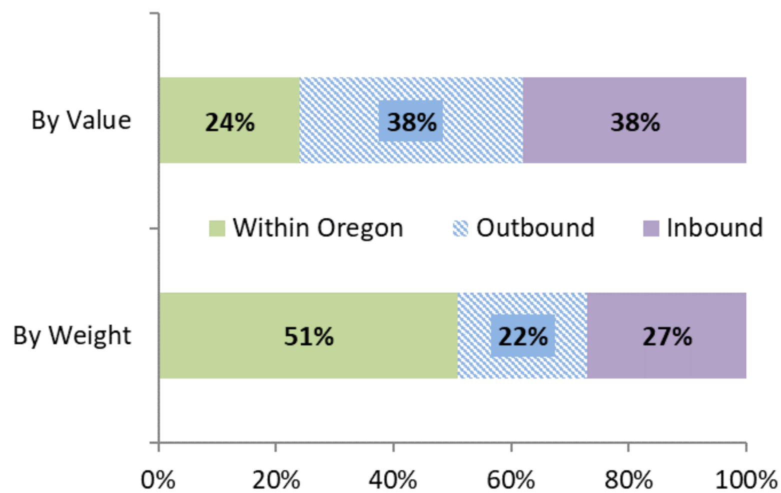


2.3.2 Freight and Commercial Travel

Commercial travel is the other distinct group of highway users. The majority of this travel is to move freight and provide business services. As an export-dependent economy, freight movement plays a major role in Oregon. Firms follow logistic management techniques designed to operate supply chains effectively and efficiently. Companies strive to get their goods to market in the most cost-effective manner by minimizing overhead, inventory and cost-per-order processing. These firms follow logistic strategies with the ultimate goal of meeting the desires of customers at the lowest feasible cost. Logistic strategies vary by industry, commodity and individual firms. Information regarding freight logistics is difficult to come by, firms operate in competitive markets and keep operational details private. Thus, analytical capabilities are less for commercial activity relative to household travel.

In 2017, 240 million tons of freight valued at $280 billion moved within, to and from Oregon via truck, rail, air, marine, pipeline, and combinations of these modes.[15] **Figure 8** illustrates the proportion of freight commodity flows by direction, including domestic, import and export flows. By weight, about half of total commodity flows start and end within the state, while 22 percent leaves the state heading to domestic and foreign destinations and 27 percent enters the state originating from external locations. By value, 24 percent of total commodity flows starts and ends within Oregon, while 38 percent leaves the state for other destinations and 38 percent enters the state originating from external locations.

FIGURE 8. OREGON COMMODITY FLOWS BY DIRECTION, 2017



Many different commodities move from, to and within Oregon. **Table 3** reports the top ten freight commodities of Oregon for 2017 in terms of value by direction.[16] Sixty-three percent of commodities originating and destined within Oregon falls under the top ten categories, dominated by the top five categories of mixed freight, electronics, wood products, other foodstuffs, and motorized vehicles. Seventy-four percent of commodities from Oregon destined for locations in other states and countries fall within ten categories, with the top four categories making up nearly half of the total outbound flows. Seventy-two percent of commodities originating outside of Oregon, both domestic and foreign, fall within the top ten categories, with the top five making up half of the total flows.

[15] Commodity flow data obtained from the Freight Analysis Framework 4.5 Summary Statistics for Oregon: https://faf.ornl.gov/faf4/FUT.aspx

[16] Commodity flow data obtained from the Freight Analysis Framework 4.5 Summary Statistics for Oregon: https://faf.ornl.gov/faf4/FUT.aspx Commodities are classified into 41 different categories.

TABLE 3. OREGON'S TOP TEN COMMODITY FLOWS BY VALUE, 2017

Within Oregon	Share of total	Outbound	Share of total	Inbound	Share of total
Mixed freight	13%	Motorized vehicles	17%	Electronics	19%
Electronics	11%	Electronics	14%	Motorized vehicles	10%
Wood prods.	8%	Mixed freight	12%	Mixed freight	8%
Other foodstuffs	7%	Machinery	7%	Machinery	6%
Motorized vehicles	6%	Wood prods.	6%	Misc. mfg. prods.	6%
Other ag prods.	4%	Other foodstuffs	5%	Coal, n.e.c.*	6%
Machinery	4%	Textiles/leather	4%	Pharmaceuticals	5%
Furniture	4%	Coal, n.e.c.*	3%	Other foodstuffs	4%
Plastics/rubber	3%	Precision instruments	3%	Precision instruments	4%
Paper articles	3%	Misc. mfg. prods.	3%	Plastics/rubber	3%
Top 10 total share	63%	**Top 10 total share**	74%	**Top 10 total share**	72%

* n.e.c. = not elsewhere classified

Efficient freight movement relies on an integrated transportation system designed to utilize efficiencies provided by different modes. Freight mode choice for each commodity depends on cost, reliability, time sensitivity, fragility, and other factors. **Table 4** reports the share of freight movement by transportation mode for 2017. Whether looking at freight in terms of weight or value, trucks currently move about 70 percent of Oregon freight. Pipeline and Rail tend move heavy commodities of lower value, while commodities shipped by multiple modes are lighter in weight and higher in value. Constraints on movement for one mode or facility can create additional pressures on the other parts of the system. The Oregon Freight Plan[17] explores issues affecting all modes of freight transportation and identified strategies to optimize system performance.

[17] Oregon Freight Plan, adopted 2011, amended 2017; https://www.oregon.gov/ODOT/Planning/Documents/OFP-2017-Amended.pdf

TABLE 4. OREGON SHARE OF FREIGHT FLOWS BY TRANSPORT MODE, 2017

	By Weight	By Value
Truck	71%	70%
Pipeline	14%	3%
Rail	9%	5%
Multiple Modes & Mail	4%	17%
Marine	2%	< 1%
Air (includes truck-air)	< 1%	4%
Other/Unknown	< 1%	< 1%
Total	100%	100%
Source: FHWA Freight Analysis Framework 4.5		

Oregon is a trade-dependent state. **Table 5**[18] presents Oregon's top five trade partners. Thirty-seven percent of commodities by value move internally between Oregon businesses and manufacturers. Washington is Oregon's largest trade partner, buying 24 percent of commodities by value. California is the second largest trade partner, buying 15 percent of Oregon commodities by value. Altogether, the top five trade partners, including Oregon businesses, represent 80 percent of traded commodities measured by value.

Looking at traded commodities by weight, 70 percent are traded internally to Oregon. California has the largest share of Oregon commodities by weight, 14 percent. Washington is next in line, purchasing 10 percent of Oregon commodities by weight. Altogether, the top five trade partners, including Oregon businesses, represent 95 percent of traded commodities measured by weight.

TABLE 5. OREGON'S TOP 5 TRADING PARTNERS – BY VALUE AND WEIGHT, 2017

Commodities From Oregon To:	By Value	Commodities From Oregon To:	By Weight
Oregon (internal trade)	37%	**Oregon (internal trade)**	70%
Washington	24%	**California**	14%
California	15%	**Washington**	10%
Idaho	2%	**Idaho**	1%
Minnesota	2%	**Texas**	1%
Top Ten Share of Total	80%	**Top Ten Share of Total**	95%
Source: FHWA Freight Analysis Framework 4.5			

Medium-sized commercial vehicles are another distinct sector of transportation users. These vehicles are owned and operated by firms conducting day-to-day business using vehicles weighing less than 26,000 pounds.[19] Some commercial travel occurs using passenger vehicles, but there is virtually no

[18] Table 5 excludes flows for imported goods, which are included in Figure 8.

[19] DMV defines this category of medium sized trucks as used for carrying loads other than passengers. Full detailed description is available online: https://www.oregon.gov/ODOT/DMV/docs/Oregon_Vehicle_Reg_Stat_Reports.pdf

available data revealing light-vehicle commercial travel separate from household travel. Other commercial travel is conducted using medium trucks. Examples of businesses using medium trucks include services for plumbing, electricians, roofing, other trade services, local deliveries for daily business production (e.g. fresh produce for grocery stores and restaurants), other construction-related, mail and small package delivery. **Figure 9** presents medium truck registrations since 2001, including the percent change from the previous year. Registration levels for commercial trucks are strongly correlated with economic conditions. The early 2000's Oregon was recovering from a recession, following this event medium truck registrations peaked in year 2006. The Great Recession began the very end of year 2007, where the number of medium truck registrations begin to decline and hit a minimum number in 2010. As Oregon came out of the recession the number of medium registrations began to rise to the levels we see today, which are about 9 percent below the peak levels of 2006.

FIGURE 9. MEDIUM TRUCK REGISTRATION COUNT AND ANNUAL CHANGE, 2001-2018

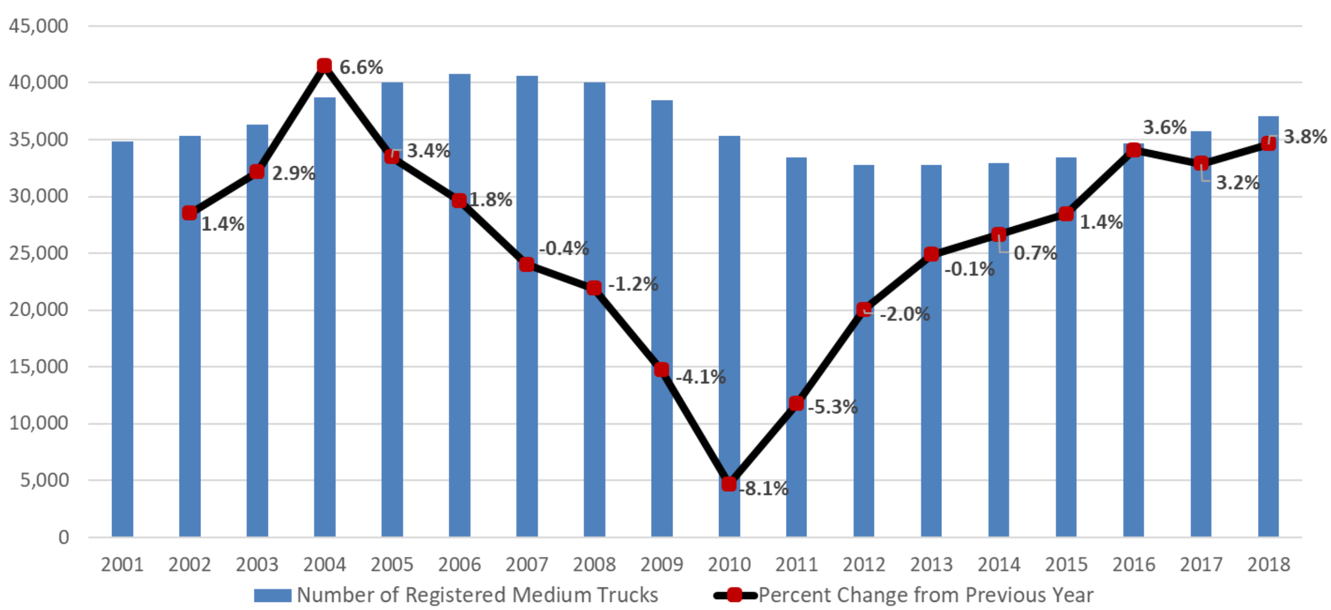


Table 6 presents a summary of annual truck VMT on all Oregon highways for years 2007 to 2018. The most notable change over time is in the share of medium truck VMT. The share of total VMT for this group changed from 646 million miles in 2007 to 869 million miles, rising from 1.8 percent of total VMT to 2.3 percent.

TABLE 6. ANNUAL TRUCK VEHICLE MILES TRAVELED 2007-2018, MILES IN MILLIONS

	2007	2009	2011	2013	2015	2018
Medium Trucks	646	559	625	780	805	869
Share of Total VMT	1.8%	1.6%	1.7%	2.3%	2.2%	2.3%
Heavy Trucks	2,145	1,740	1,843	1,955	2,044	2,184
Share of Total VMT	5.7%	4.8%	5.1%	5.8%	5.7%	5.6%
Total	2,791	2,299	2,468	2,735	2,849	3,053
Share of Total VMT	7.5%	6.4%	6.8%	8.1%	7.9%	7.9%

Source: Oregon Highway Cost Allocation Studies, Exhibit 4-1

The transportation system is the economy in motion. People travel to access jobs, services and goods. Businesses travel to access customers and depend on the transportation system to access employees and the goods and services needed to conduct their business activity. Each person, business, commodity, and industry has different needs and expectations from the transportation system. Accommodating a variety of needs while maintaining safety within a constrained budget requires strategic decision making and acknowledgement of required trade-offs. All economic "agents" must balance trade-offs, whether it is done by households, businesses or public agencies. Developing a good understanding of the underlying economic motivations and decision criteria utilized by transportation system users supports informed investment decisions.

3 PERFORMANCE MEASURES

3.1 Quantity: How much is Moving?

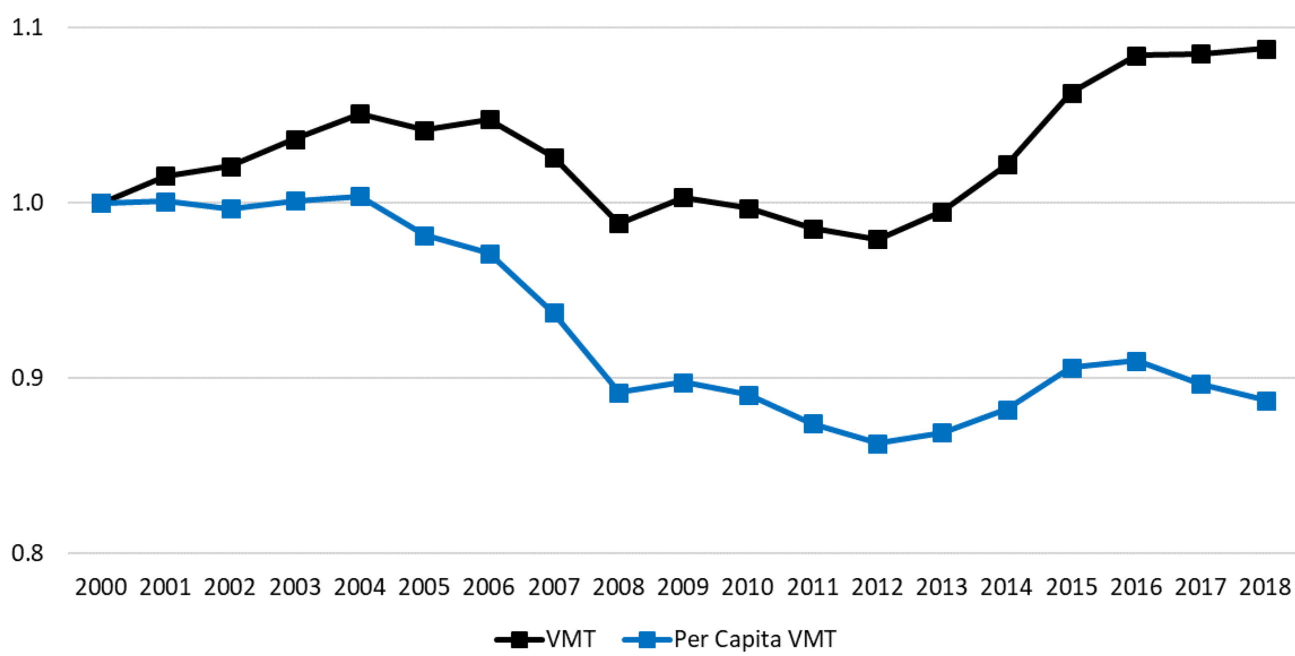
Measures of "**quantity**" report the overall use of the highway system. These measures include:

- Annual Vehicle Miles Travelled (VMT) – the annual number of miles travelled by all vehicles.
- VMT Per Capita –the annual number of miles travelled by all vehicles divided by the population. This broad measure reveals the amount of travel occurring relative to population, providing information on whether people are travelling more or less on average or whether there is more travel overall due to a growing population.
- Annual Truck VMT– annual number of miles travelled by trucks.
- Truck VMT Per Capita – the annual number of heavy truck miles travelled divided by the population. This broad measure reveals the amount of commercial travel occurring relative to population, providing information on whether the amount of freight moving is rising more or less relative to the population overall.

3.1.1 Annual Vehicle Miles Travelled

Figure 10 presents statewide annual VMT and VMT per capita side-by-side to illustrate how overall VMT is following a rising trend due to the expanding Oregon economy: rising population and employment along with increasing medium and heavy truck movement across the highway system. Per capita VMT is declining over time indicating households, businesses and trucks are reducing the number of trips and/or distances traveled on average. However, the reduction is not large enough to completely account for increased activity of higher population and employment. There are a variety of factors that could be contributing to this emerging pattern, such as rising congestion levels, concentration of growth in urban areas with closer access to goods and services, an aging population, more efficient freight logistics, and online access to business services.

FIGURE 10. STATEWIDE VMT AND PER CAPITA VMT OVER TIME: 2000-2018 INDEXED TO YEAR 2000



3.1.2 Truck VMT

As an economy grows with population and employment rising, more freight movement occurs. The Oregon Highway Cost Allocation Study[20] conducted every two years reports VMT by vehicle weight categories. **Figure 11** illustrates truck VMT since 2007 for heavy and medium trucks. The values are indexed to 2007 to compare current levels to pre-recession levels. 2009 truck VMT declined 18 percent from 2007 levels due to the recession, illustrating the strong link between freight and economic conditions. Between years 2013 and 2015 truck VMT recovered to prerecession levels. 2018 truck VMT level is about 9% above the 2007 values. Most of the increase is due to VMT from medium trucks, which is 35 percent higher than 2007 levels, while heavy truck VMT is only 2 percent higher than the 2007 level.

[20] https://www.oregon.gov/das/OEA/Pages/hcas.aspx , accessed December 2019, Table 4-1

FIGURE 11. CHANGE IN TRUCK VMT 2007-2018, INDEXED TO 2007

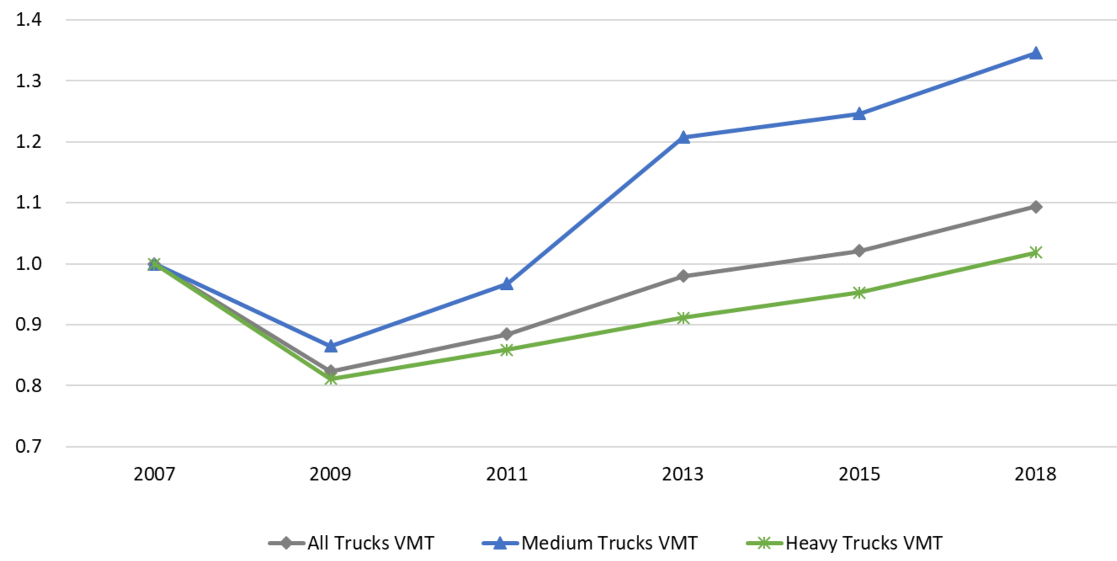
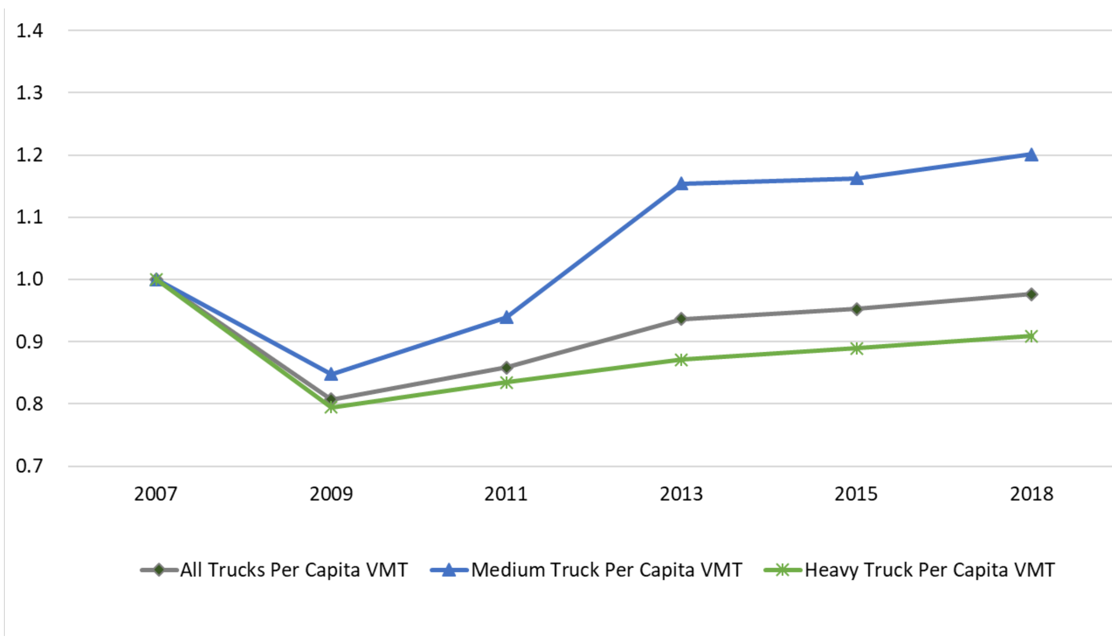


Figure 12 presents per capita truck VMT to account for the increase in population versus a change in the average per person levels. This reveals overall truck per capita VMT is 2 percent above 2007 levels. Heavy truck per capita VMT is 9 percent lower than 2007 levels, while medium truck per capita VMT is 20 percent above 2007 levels. Thus, the overall average rise in per capita VMT is due to the rise in medium truck per capita VMT. This may be due in part from the rise in e-commerce deliveries and growing demand for trade services, but understanding the complete details behind such change is limited due to lack of detailed data over time.

FIGURE 12. CHANGE IN PER CAPITA TRUCK VMT 2007-2018, INDEXED TO 2007



In addition to these observed trends are emerging trends with very little data available for analysis. For example, car sharing and ride-share services, such as Uber and Lyft, are expected to impact household vehicle ownership and use. It will be important to monitor this over time. Continued growth in e-commerce is expected to impact the number of trucks on the road. Obtaining observed data for medium trucks is key to determining the net impacts of e-commerce on statewide VMT. There is currently debate as to whether e-commerce reduces VMT by eliminating household shopping trips or increases VMT by generating more delivery trips. The impacts may vary by region.

3.2 Quality: What conditions are experienced by road users?

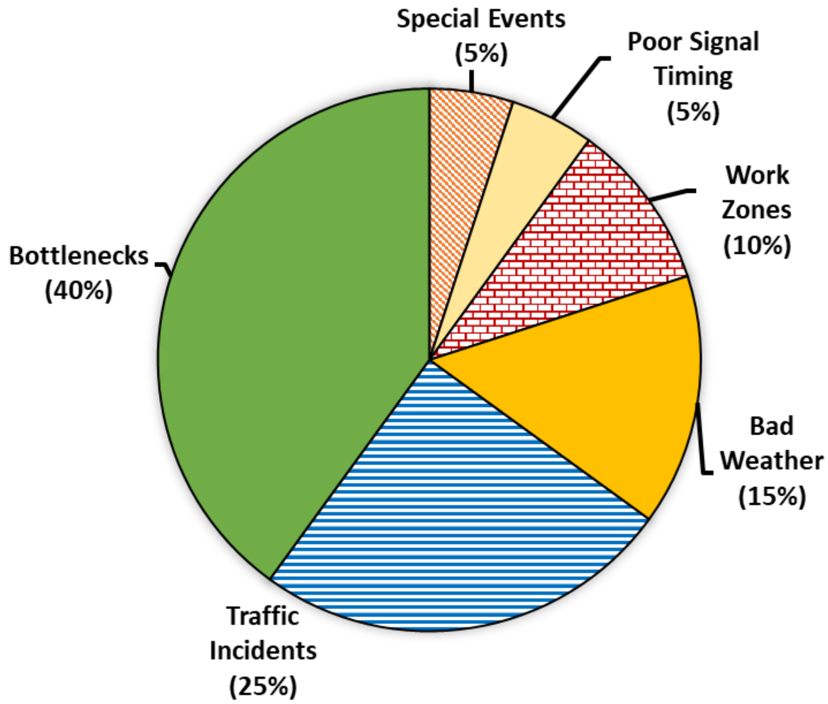
Measures of **"quality"** relate to the travel experience, primarily focused on traffic congestion and system reliability. Various factors influence congestion, which can be broadly classified into two types. The first type of congestion is the general everyday congestion typically occurring due to capacity constraints in the morning and afternoon peak periods. This is referred to as *recurring congestion*. Sections of highway where vehicles must merge onto or diverge off of the roadway, locations where the volume is greater than the capacity, or in weaving sections where traffic is both trying to enter or exit from the highway are examples of recurring congestion. Locations with these patterns may be referred to as bottlenecks.

The second type is *non-recurring congestion*. This type of congestion is due to temporary, unexpected events, such as crashes, vehicle breakdowns, inclement weather, work zones, signal timing, and special events causing delay and stop-n-go traffic conditions. This type of congestion impacts system reliability, which is a key component of system quality. Predictable delay can be adapted to by users, while unpredictable delay impacts activity requiring timeliness, such as on-time delivery, on-time services and arriving at work or appointments on time.

Figure 13 illustrates a breakdown of delay causes nationally[21]. Recurring congestion due to bottlenecks (capacity constraints and high demand) make up 40 percent of total congestion. The remaining 60 percent is caused by non-recurring events, such as incidents, weather, construction work zones, special events and poor signal timing. The distinction between the two types of congestion is important when developing effective solutions.

[21] https://ops.fhwa.dot.gov/congestion_report/executive_summary.htm#figES_2

FIGURE 13. BREAKDOWN OF THE CAUSES OF CONGESTION



ODOT uses several different approaches to optimize system performance in order to maintain and enhance mobility:

- Safety improvements – safety projects reduce crashes and incidents, which reduces fatalities, personal injuries and property damage; fewer crashes and incidents translate into reduced congestion and improved reliability.
- Optimize use of infrastructure – investments directed towards maximizing current infrastructure performance, such as locations with traffic weaving and merging;
- Manage the traffic network efficiently - use of infrastructure is optimized by leveraging new technology and traffic operations to improve system performance[22], maximizing throughput and reliability; traffic control centers employ technology to provide timely information to highway users and help them choose alternative modes and routes to avoid congestion.
- Support multi-modal transportation options - Oregon ranks among the top states for numbers of walk, bike, ride-transit, telecommute and shared-rides; multimodal transportation options reduce reliance on single-occupancy vehicles, while improving the health of Oregonians through active modes and promoting environmental benefits.

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[22] http://www.oregon.gov/ODOT/MCT/Documents/MobilityProcedureManual.pdf

Developing solutions to resolve traffic congestion is complex. No single solution will eliminate congestion, but there are methods to manage it. Implementing effective solutions necessitates developing multiple performance measures, when combined they create multidimensional information that can be used to develop effective solutions to manage and optimize system performance.

As Oregon grows, more people and freight are squeezed onto a transportation system that cannot expand at the same pace. As long as the Oregon economy continues to grow, traffic congestion will be a transportation issue and developing an approach to monitor conditions is needed.

This report relies on the following metrics to measure congestion and reliability:

- **Average Annual Daily Traffic/Capacity (AADT/C)** – average annual daily traffic (AADT) divided by peak hour capacity (C) identifies where large-scale congestion occurs and enables ODOT to monitor locations over time for spreading beyond a typical two-hour peak period. This measure was develop as a Key Performance Measure[23] for mobility reported by ODOT annually. AADT/C is measured using observed traffic volumes and applying FHWA methods required for the Highway Performance Monitoring System annual submittal. This measure reports conditions for highways on the National Highway System (NHS).
- **Travel Time Index (TTI) –** this congestion measure compares the 80th percentile travel time of a trip on each highway segment at a peak hour compared to an off-peak uncongested hour. The higher the TTI, the longer the travel times and higher the congestion. For example, a TTI of 2.0 indicates that a trip that takes ten minutes in light traffic will take 20 minutes in congested conditions. The Travel Time Index is calculated using proprietary speed data available for purchase from private vendors. For this study ODOT used HERE data[24]. For this initial report, this measure reports conditions for the interstate highways only.
- **Planning Time Index (PTI) –** this reliability measure represents the total travel time users should account for in order to be on time 95 percent of the time relative to free flow speeds. Free flow speed is defined as the posted regulatory speed limit. The lower the PTI, the more reliable the travel time will be. For example, a PTI of 3.0 indicates that a trip taking ten minutes in light traffic should plan for 30 minutes to ensure arriving on time with 95 percent confidence. The Planning Time Index is calculated using proprietary speed data available for purchase from private vendors. ODOT used HERE data for this initial study, reporting conditions for the interstate highways only.

3.2.1 Peak Period Congestion: AADT/C

ODOT recently implemented a new way to measure mobility statewide, designed to link state policy to highway performance and monitor progress towards meeting mobility goals for highways on the

[23] More information is available online: https://www.oregon.gov/odot/performmang/pages/index.aspx

[24] The ODOT contract for this data source expires soon. Once a new data contract is established, methods of accessing, processing and reporting vehicle-probe data can be developed and automated in a manner that supports consistent reporting. Ability to report by region, MPO or corridor will be part of the development process.

National Highway System (NHS)[25]. The traditional approach using traffic volume to highway capacity ratios (V/C) does not reveal the extent or duration of congested periods, nor does it capture impacts of non-recurring delay caused by traffic incidents, weather or other unique events. AADT/C measures average daily congestion beyond the peak period, capturing the duration and "intensity" of congestion[26] and providing insight into the number of hours on an average day experiencing congestion.

As the AADT/C value increases, it reflects rising congestion levels, indicating peak-period congestion is spreading to adjacent hours. The measure applies to lane miles, not centerline miles, accounting for system capacity relative to demand. The data used to calculate this measure comes from the annual Highway Performance Monitoring System data submittal to FHWA[27], which includes information for all highways on the national highway system.

Six levels of congestion are used to evaluate AADT/C. These levels are based on categorizations developed for the Oregon Congestion Management System[28] and presented in **Table 7**. The table color coding is helpful when evaluating congestion levels on the entire state roadway system. The color green indicates free flow conditions. The color yellow identifies low levels of congestion, a transitional period where traffic flow is moving, but capacity is impacted by minor disruptions such as traffic incidents or weather. The color orange represents congested conditions occurring on a regular basis and reliability declining. The next three levels of congestion represented using colors red, purple and brown indicated increasingly higher levels of congestion occurring over more hours of the day.

TABLE 7. AADT/C SCALE OF VALUES FOR MEASURING CONGESTION

Color	Interpretation	AADT/C
Green	Uncongested traffic flow	Less than 7
Yellow	Moderate congestion	7 – 8.99
Orange	Congested conditions	9 – 9.99
Red	Congested and transitioning to very congested	10 – 13.99
Purple	Very congested and transitioning to extremely congested	14+

[25] The National Highway System is a network of strategic highways within the United States, including the interstate highway system and other roads and highways serving major airports, ports, rail or truck terminals, railway stations, pipeline terminals and other strategic transportation facilities. Highways were assigned this designation through the National Highway System Designation Act of 1995.

[26] https://ops.fhwa.dot.gov/congestion_report/chapter2.htm-

[27] The HPMS was developed to measure the scope, condition, performance, use and operating characteristics of the Nation's highways. This data is also used to determine the apportionment of Federal-aid Highway Program funds to states as well as serves as the primary data source for the biennial "Conditions and Performance Report" to U.S. Congress, which supports the development and evaluation of the FHWA's legislative, program and budget planning activities.

[28] Between the years 2001 and 2014, the Congestion Management System (CMS) was the primary management system tool used to identify and monitor congestion across the Oregon State Highway System network. The CMS process calculated roadway capacities and output different performance measures in a useful manner that enabled decision-makers to evaluate highway system needs and improvements. One of the primary elements of CMS was the AADT/C metric.

Figures 14 and 15 provide colorized maps of congestion levels represented by AADT/C color coding for year 2017. The maps quickly reveal state highway congestion occurs in the larger metropolitan areas, where Portland has the highest congestion levels, Salem/Keizer and Eugene/Springfield have congested conditions as well. **Figure 14** provides a closer look at congestion in the three largest MPOs of Oregon: Portland, Salem/Keizer and Eugene/Springfield for highways on the NHS.

Nearly half of the Portland Metro region NHS highways are classified as congested using this measure. Medium-sized urban areas of Salem/Keizer and Eugene/Springfield are experiencing increasing congested lane miles. Smaller MPOs such as Albany, Bend, Corvallis, Grants Pass and Rogue Valley (Medford area) have segments of the system transitioning from minor congestion to congested conditions.

Table 8 reports information presented in **Figures 14 and 15** to illustrate the level of congestion by region of the state. Statewide, 4.6 percent of NHS lane miles are classified as congested using AADT/C, but the extent of congestion varies by region. About 43 percent of NHS lane miles in the Portland region are congested, about 10 percent in Salem/Keizer and 7 percent in Eugene/Springfield. Congested lane miles in the smaller MPOs range between zero and 2 percent. Other small urban areas as a group have less than 1 percent of lane miles congested, while the rural NHS highways have about one tenth of one percent of their lane miles congested.

TABLE 8. CONGESTED NATIONAL HIGHWAY SYSTEM LANE MILES BY REGION, 2017

Region	Total Lane Miles	Congested Lane Miles	Proportion of NHS Lane Miles Congested
Albany	93	2.0	2.2%
Bend	76	0.0	0.0%
Corvallis	59	0.0	0.0%
Eugene	218	15.8	7.2%
Grants Pass	169	0.3	0.2%
Medford	252	0.0	0.0%
Metro	1,061	457.0	43.1%
Salem	190	19.1	10.1%
Other Urbanized	1,125	8.4	0.7%
Rural	7,886	4.1	0.1%
Total Oregon National Highway System (NHS)	11,129	507	4.6%

Monitoring this performance measure will reveal whether peak period congestion is spreading to other time periods, as well as increasing in severity over time. However, this measure alone tells an incomplete story. Other measures are needed to understand and monitor congestion over time.

FIGURE 14. CONGESTED LANE-MILES PER AADT/C – STATEWIDE, 2017

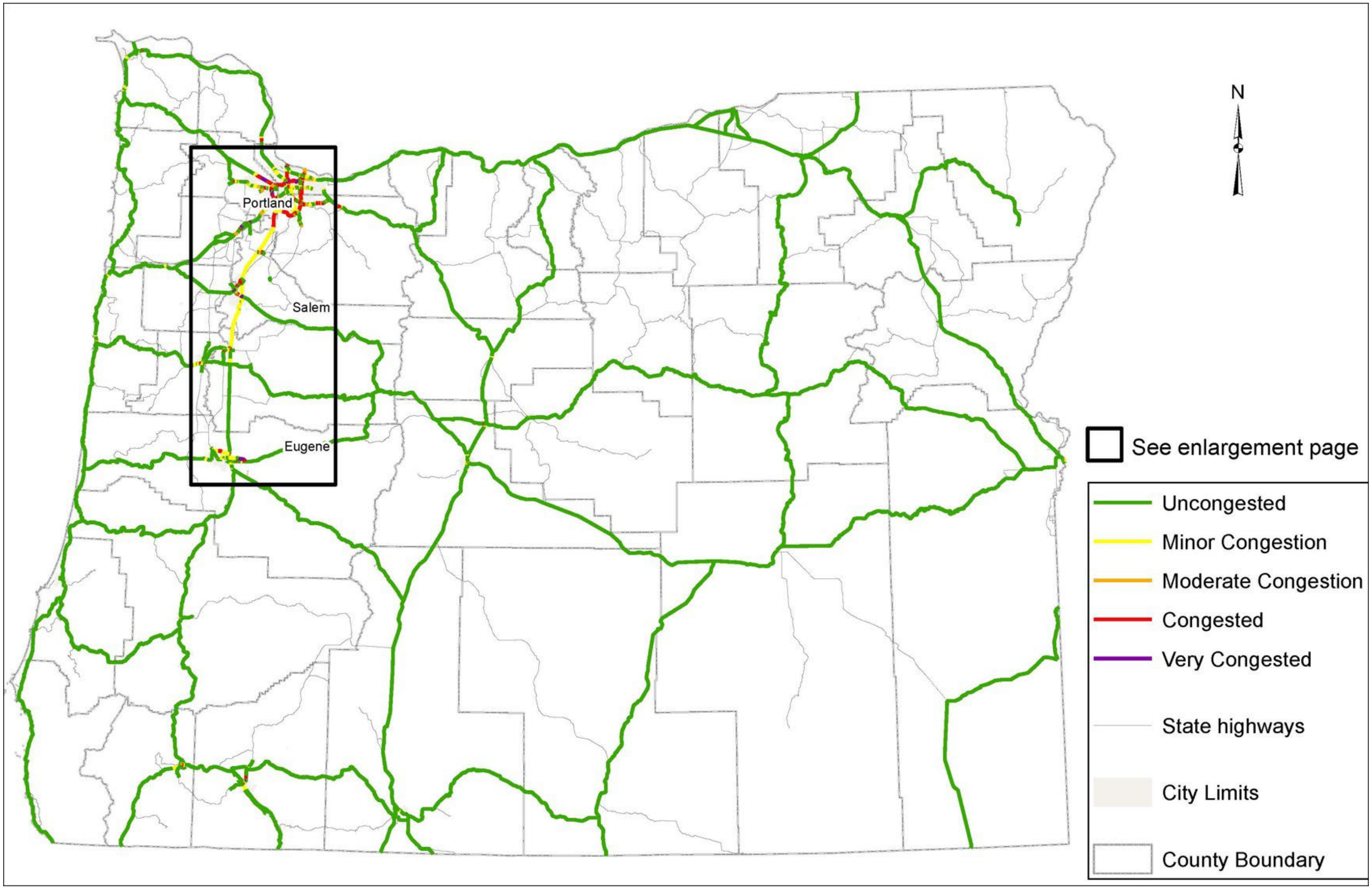
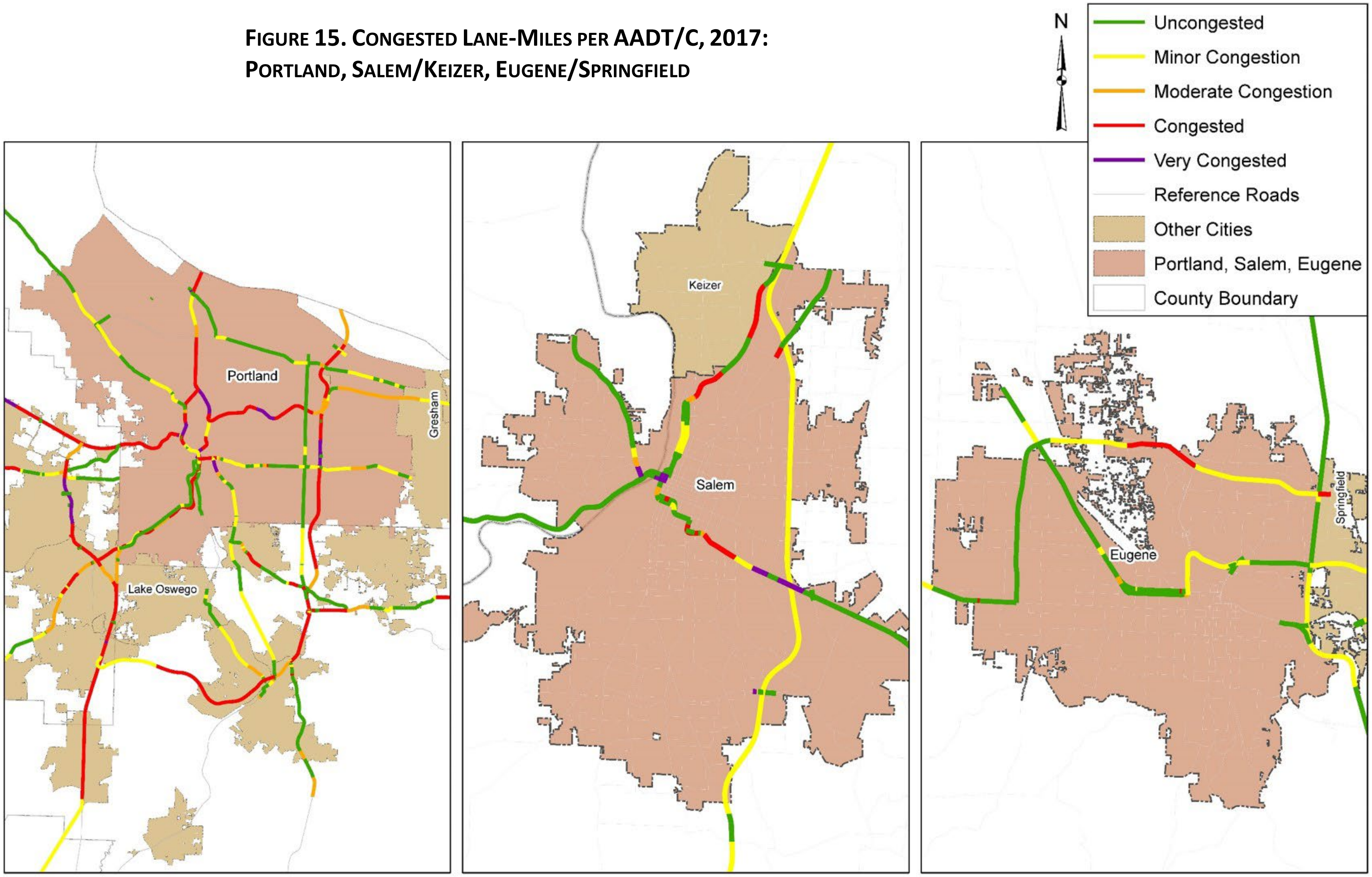


FIGURE 15. CONGESTED LANE-MILES PER AADT/C, 2017: PORTLAND, SALEM/KEIZER, EUGENE/SPRINGFIELD



3.2.2 Congestion: Travel Time Index

Availability of vehicle probe-based travel time data supports use of travel time indices to measure congestion levels. A common index used nationally by state and federal agencies to measure congestion is the Travel Time Index (TTI). The TTI compares the 80th percentile travel time of a trip on a freeway segment for a specific period to the travel time of a trip during an off-peak/uncongested period. The higher the TTI value, the longer the average travel times and greater the congestion. This measure accounts for reoccurring delay – delay that is predictable and expected due to high demand, such as peak periods. For this report, HERE traffic data is used to calculate the TTI for the interstate system. In future reports the goal is to expand TTI reporting to non-interstate highways. TTI values are calculated for each segment of the interstate highway system by direction, then categorized to a level of congestion following the ranges listed in **Table 9**.

TABLE 9. TRAVEL TIME INDEX CONGESTION CLASSIFICATION CATEGORIES: FREEWAYS

Congestion Level	Travel Time Index Value	Interpretation
No Congestion	Less than 1.2	Average travel speed is no less than ten percent below posted speed
Moderate Congestion	1.2 ≤ TTI < 1.5	Average travel speed is between 10 to 30 percent below posted speed
Heavy Congestion	1.5≤ TTI <2.0	Average travel speed is between 30 and 50 percent below posted speed
Severe Congestion	Greater than or equal to 2.0	Average travel speed is below half the posted speed limit

The TTI provides insight into highway congestion during the average weekday peak period. TTI was calculated for the interstate highways for the PM peak period of 4 pm to 6 pm. **Figure 16** illustrates PM peak period congestion for the entire interstate system. The majority of congestion occurs in the Portland region. Eugene-Springfield has congestion as well, but the remaining MPOs on the interstate system do not have measurable congestion using this index.

FIGURE 16. STATEWIDE TRAVEL TIME INDEX 2017, PM PEAK PERIOD 4 PM - 6 PM

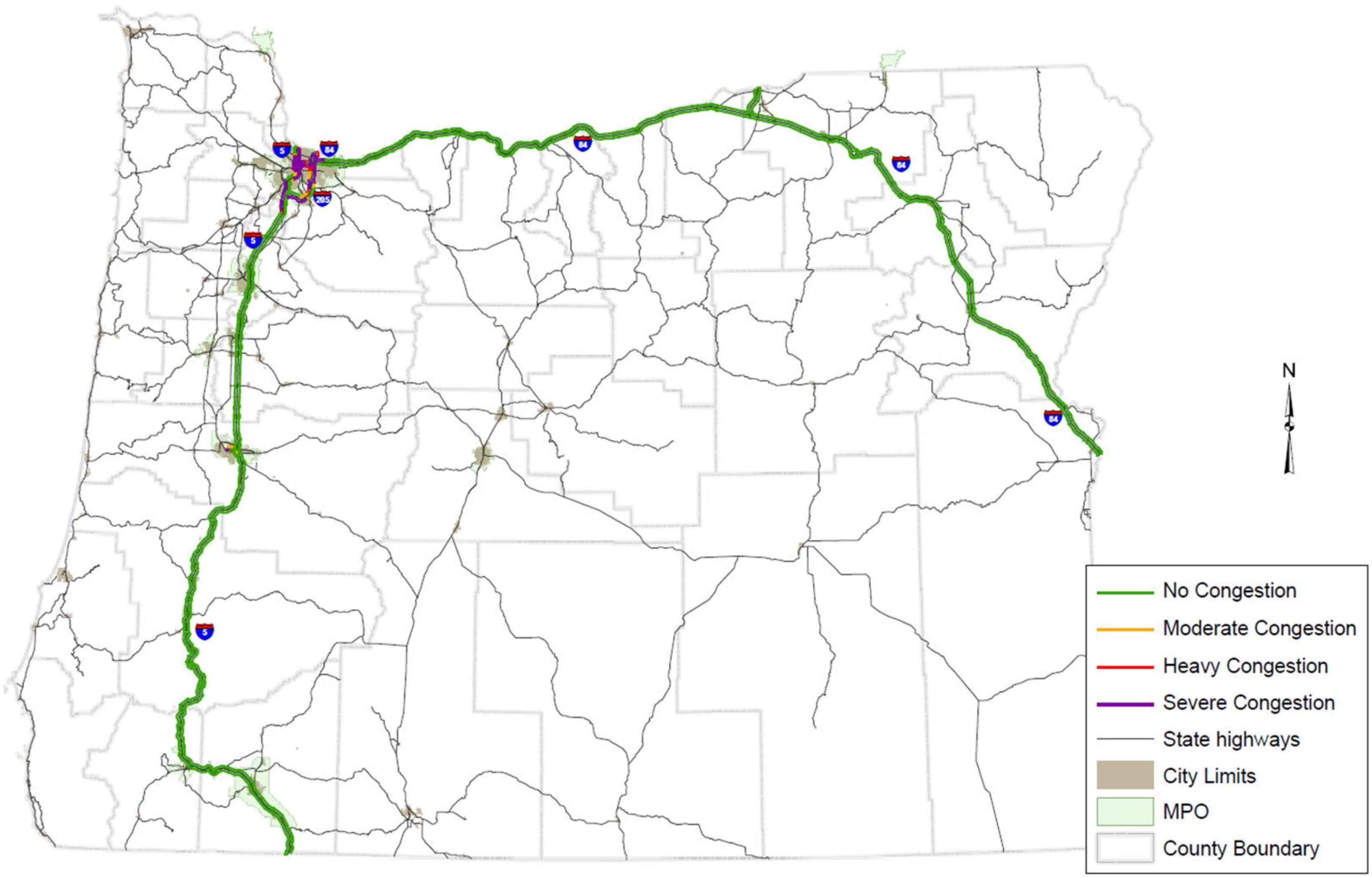


Figure 17 illustrates PM peak period congestion for the Portland region interstate highways. The Travel Time Index reveals the Portland region experiences a concentration of congested conditions during the afternoon peak period. In the vicinity of central Portland congestion is severe in both directions on I-5, I-84 and I-405. Northbound traffic on I-5 leaving Portland experiences heavy to severe congestion. Southbound traffic leaving Portland has moderate to no congestion until reaching the Beaverton area until Wilsonville. I-84 between I-5 and I-205 is heavy to severely congested for eastbound traffic, westbound traffic become congested midway between the two freeways. I-84 is severely congested westbound on the edge of Gresham entering Portland. I-205 heavy to severe congestion varies by direction with sections of moderate to no congestion. The intersection of I-205 with I-84 is severely congested in both directions.

FIGURE 17. PORTLAND REGION, TRAVEL TIME INDEX 2017, PM PEAK PERIOD 4 PM - 6 PM

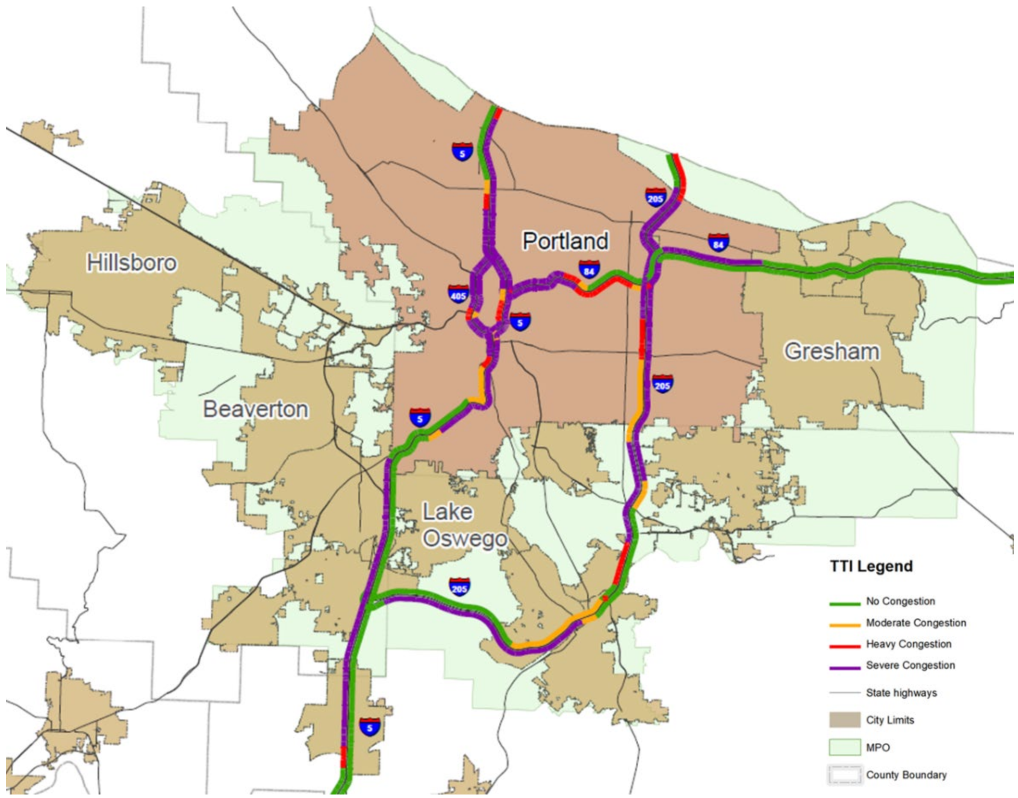
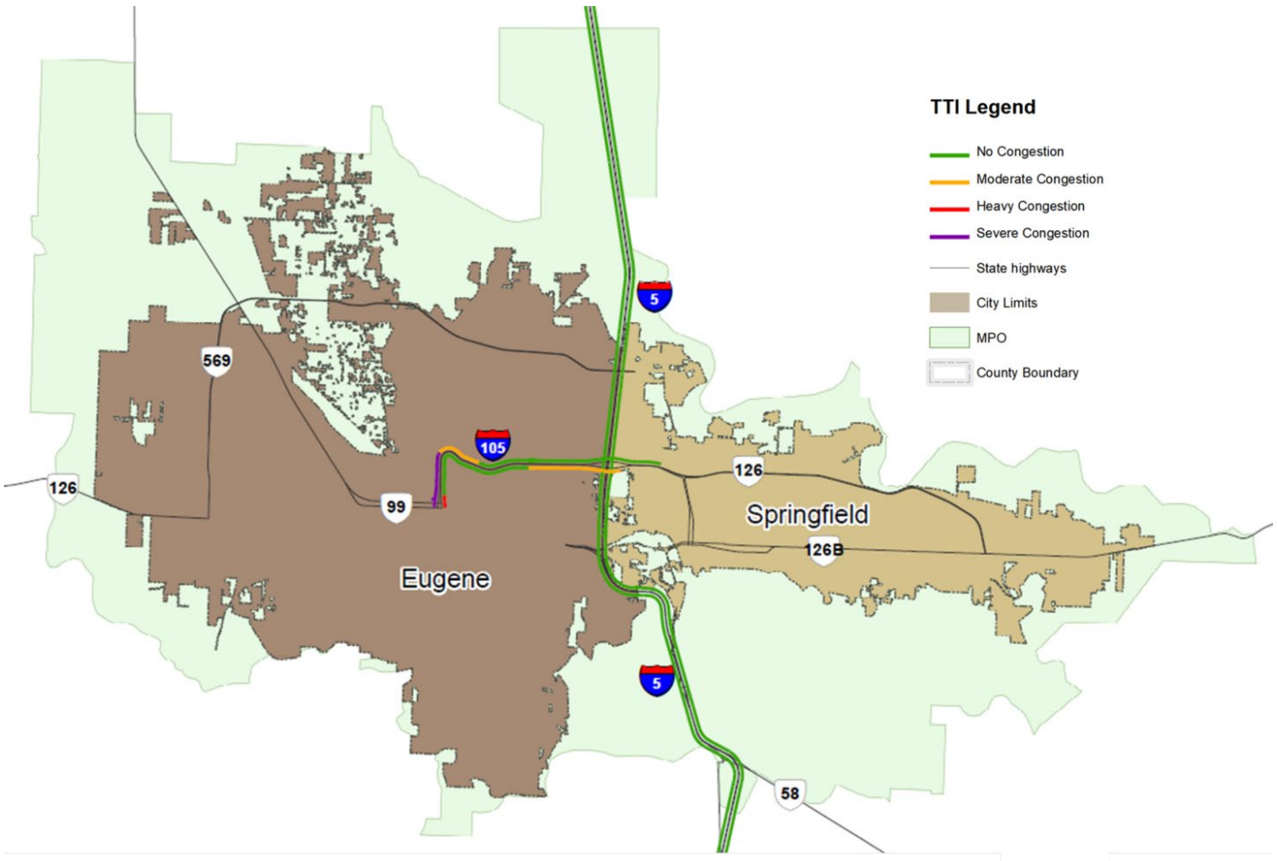


Figure 18 illustrates PM peak period interstate congestion for the Eugene-Springfield region. I-5 does not have measurable congestion using this metric. However, I-105 has severe congestion at the entry point for eastbound traffic and moderate congestion on the approach to I-5. I-105 westbound transitions from moderate congestion to severe congestion as the freeway approaches OR 99 in central Eugene.

FIGURE 18. EUGENE-SPRINGFIELD REGION, TRAVEL TIME INDEX 2017, PM PEAK PERIOD 4 PM - 6 PM



The TTI is a useful tool to identify the worst congested locations on the interstate system. It is a data-driven method to monitor changes in system performance statewide over time. This is a relatively new reporting capability dependent upon access to vehicle speed data, which is expected to provide more reporting capabilities in the future.

3.2.3 Reliability: Planning Time Index

Where the Travel Time Index measures congestion occurring repeatedly caused by high demand, the Planning Time Index (PTI) measures variation in travel time caused by unexpected events, such as crashes, vehicle breakdowns, work zones, and inclement weather causing delay and stop-n-go conditions. Variability in travel times day-to-day reflects the reliability of a transportation system, also referred to as non-recurring congestion, which is random and unpredictable. This form of congestion makes is difficult to plan trips requiring punctuality. An estimated 60 percent of traffic delay is due to non-recurring congestion.

When people travel, they plan based on the worst days, not the average day. Travelers must include extra travel time for regularly planned trips, such as commuting to work. However, trips requiring punctuality, such as catching a plane flight, making a freight delivery, attending a work meeting, or seeing your child’s game after school may require extra time to guarantee on-time arrival. The PTI is designed to measure system reliability and the extra time needed to ensure punctuality. It represents the total time travelers should allow to make sure they arrive at their destination on-time knowing there may be unexpected delay. As with the TTI, the PTI is calculated using HERE speed data for the interstate system. In future reports the expectation is to expand PTI reporting to include non-interstate highways. PTI values are calculated for each segment of the interstate highway system by direction, then categorized to a level of reliability following the ranges listed in **Table 10**.

TABLE 10. PLANNING TIME INDEX CONGESTION CLASSIFICATION CATEGORIES: FREEWAYS

Reliability Level	Planning Time Index Value	Interpretation
Reliable	Less than 1.33	Average travel speed is no less than 25 percent below posted speed
Moderately Unreliable	$1.33 \leq PTI < 2.0$	Average travel speed is between 25 to 50 percent below posted speed
Highly or Extremely Unreliable	Greater than or equal to 2.0	Average travel speed is at least 50 percent below the posted speed limit

The PTI provides insight into interstate highway reliability during the average weekday peak period. PTI was calculated for the interstate highways for the PM peak period of 4 pm to 6 pm. **Figure 19** illustrates PM peak period reliability for the entire interstate highway system. The Portland region has the majority of unreliable lane miles, but there are also unreliable sections in the metropolitan regions of Salem-Keizer, Albany, and Eugene-Springfield. The remaining MPOs do not have segments meeting the criteria for being unreliable on the interstate system in 2017. Non-metropolitan sections of the interstate system do not have locations exhibiting reliability issues for the afternoon peak period.

FIGURE 19. STATEWIDE PLANNING TIME INDEX 2017, PM PEAK PERIOD 4 PM – 6 PM

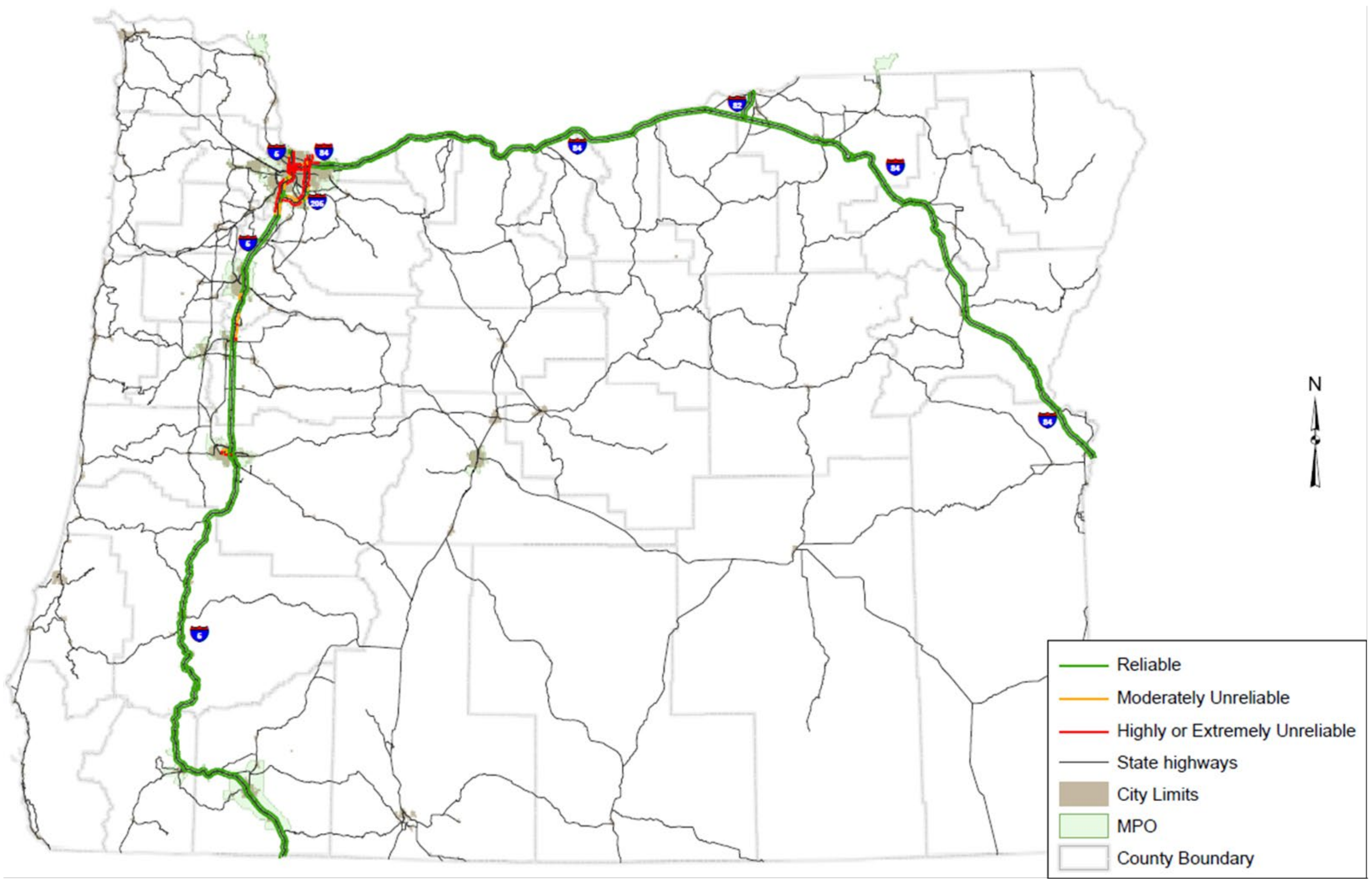


Figure 20 illustrates the PTI for the Portland region interstate highways. The PTI reveals the majority of lane miles on the interstate system in this region are unreliable. Segments defined as reliable using this metric are represented in green, but they are bounded by moderately unreliable segments transitioning to highly or extremely unreliable segments.

FIGURE 20. PORTLAND REGION PLANNING TIME INDEX 2017, PM PEAK PERIOD 4 PM – 6 PM

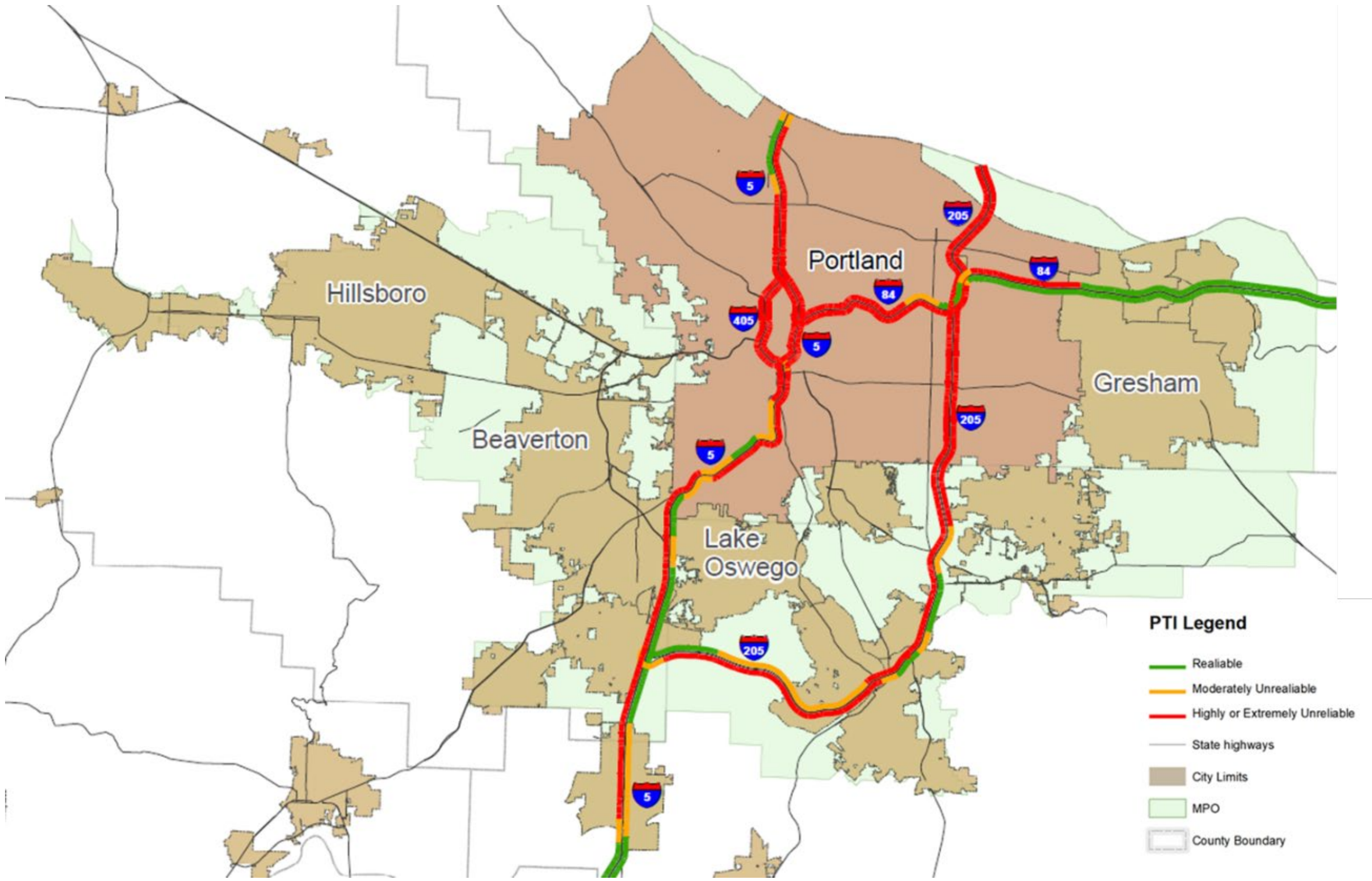


Figure 21 illustrates the PTI for Salem-Keizer and Albany interstate highways. I-5 through Salem is predominantly reliable. The southbound fringe of Salem is moderately unreliable during PM peak period. The Albany segment of I-5 northbound is moderately unreliable through Millersburg, bounded by segments of highly to extremely unreliable on both ends.

FIGURE 21. SALEM-KEIZER AND ALBANY REGION PLANNING TIME INDEX 2017, PM PEAK PERIOD 4 PM – 6 PM

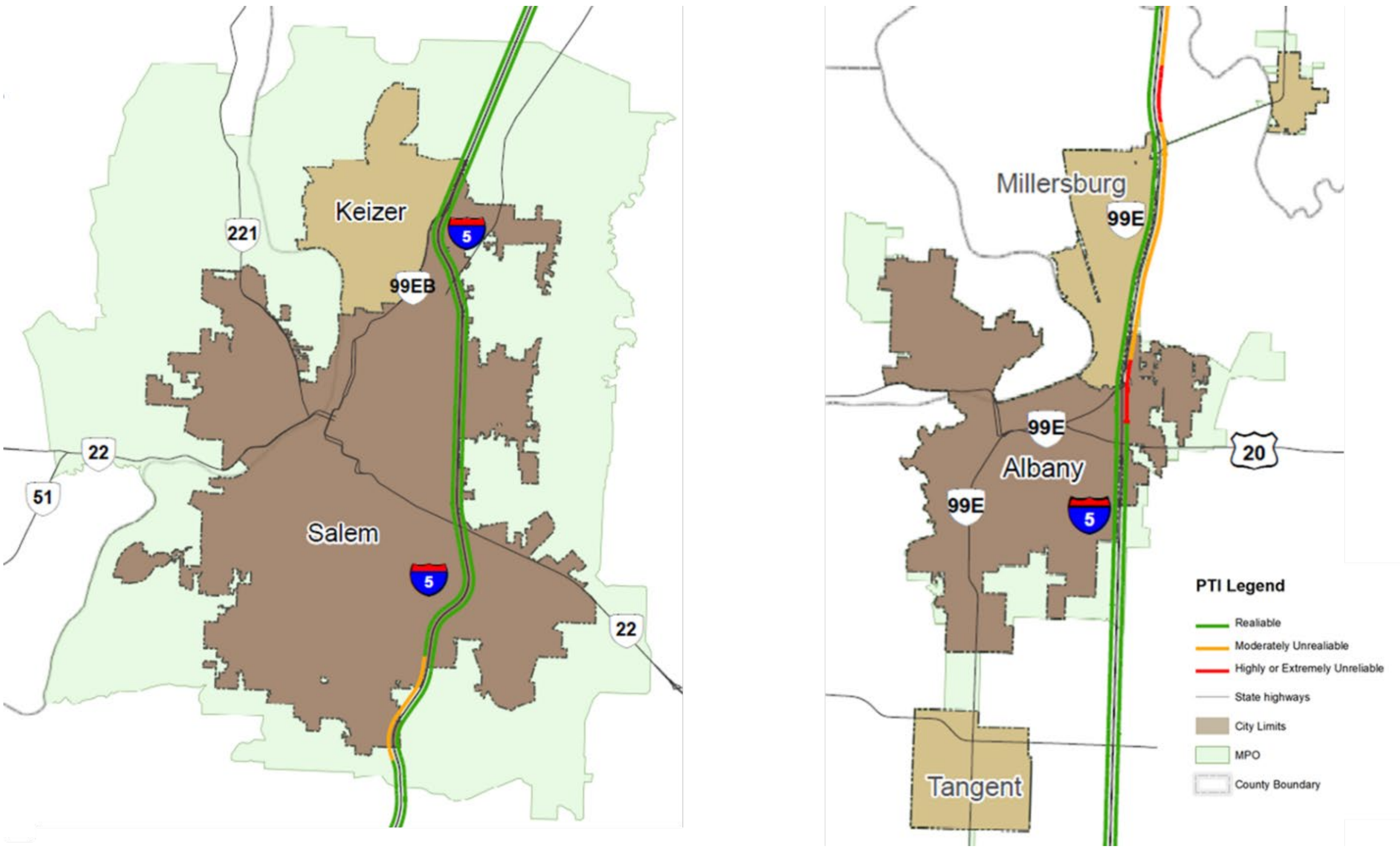
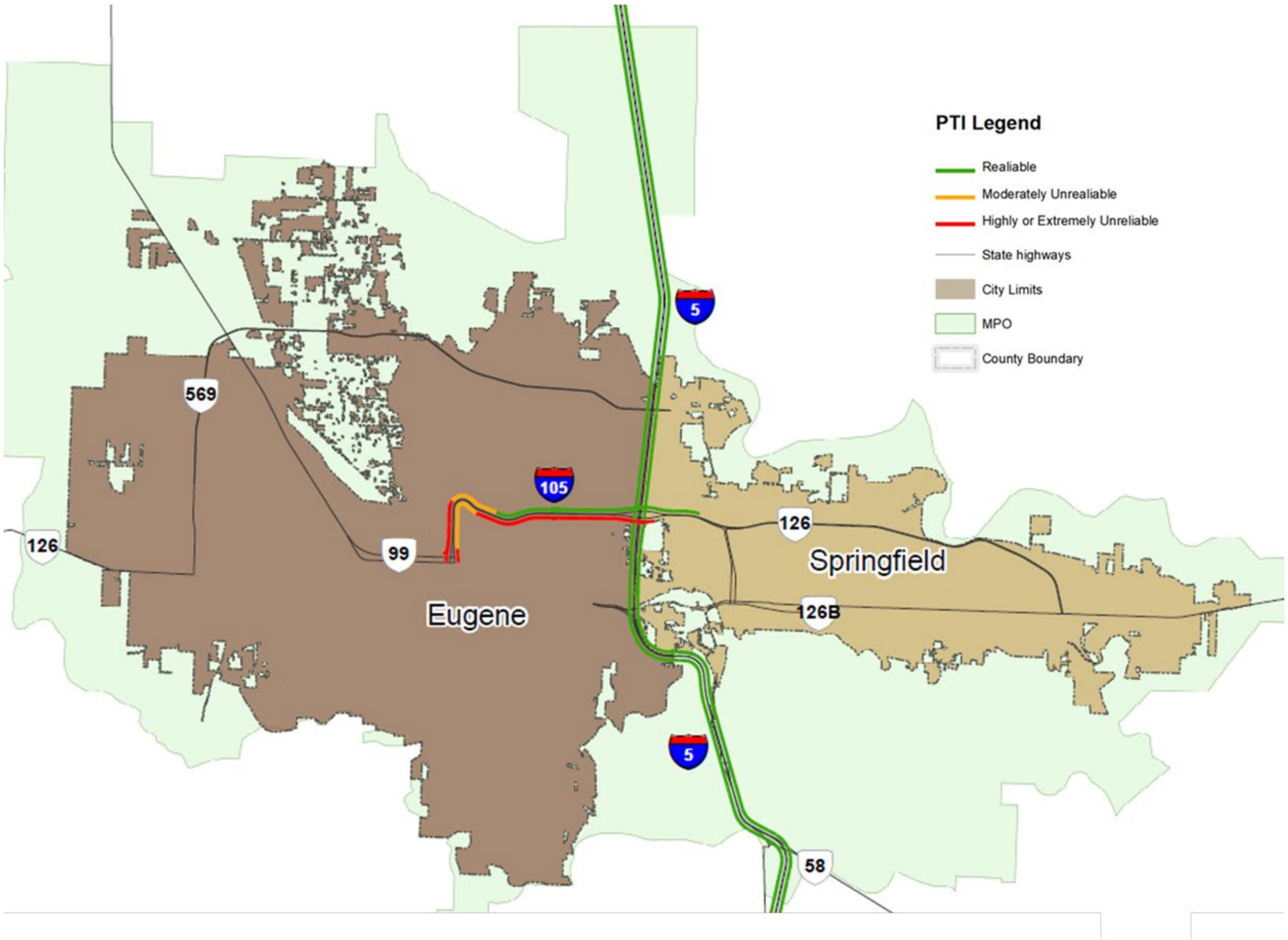


Figure 22 illustrates the PTI for Eugene-Springfield interstate highways. While the I-5 section through the region is reliable, I-105 eastbound is extremely unreliable with a portion moderately unreliable. I-105 westbound is reliable until approaching the end of the highway as it transitions to OR 99 within central Eugene.

Figure 22. Eugene-Springfield Region Planning Time Index 2017, PM Peak Period 4 PM – 6 PM



3.2.4 Truck Reliability

Freight movement within Oregon relies heavily on the highway system, 70 percent of freight moves by truck and 78 percent of heavy truck VMT occurs on the state highway system. Developing performance measures specifically designed to identify freight mobility is challenging at best – observed data is hard to come by, the few existing sources have limited detail due to the confidential nature of a competitive industry. Transporting freight requires reliable travel times, predictable congestion can be accounted for in delivery schedules. Unpredictable congestion causes late deliveries, firms incur penalty fees and risk losing customers. Unreliable travel times require firms to adapt by putting more trucks on the road to deliver the same quantity of goods on time, cargo typically stored in trucks on the road are stored in warehouses as the number of daily stops a truck can make declines. This drives up the cost of freight transportation, which is passed on to businesses and consumers. Rising costs erode Oregon's competitive advantage, presenting risk to our export dependent economy.

Daniel Murray, current senior vice president and past director of research for the American Transportation Research Institute (ATRI) said:

> *"From a freight perspective, the quintessential requirement for succeeding in a global, just-in-time economy is the ability to plan trips, deliveries, and transactions down to hours and minutes—rather than days and weeks. This makes reliability one of the single most important performance measures from a private sector perspective."*[29]

Trucks moving freight share the same highway system used by cars and busses moving people. Congestion and unreliable performance affects all highway users alike. Measures such as the Travel Time Index and Planning Time Index reveal the worst locations. Resolving these locations will help all highway users. There are specific freight bottleneck locations that have been identified within Oregon in the "Oregon Freight Highway Bottleneck Project Final Report"[30]. There have been national bottleneck studies as well, including the ATRI "2018 Top 100 Truck Bottlenecks"[31] where Portland is listed as number 62 worst location and the ATRI "2019 Top 100 Truck Bottleneck List"[32] where Portland moved up the list to number 28. When it comes to measuring the impacts of congestion and unreliable conditions on medium trucks and other commercial travel, very little is known due to a lack of data describing these users.

[29] Public Roads, Volume 68, Issue 3, page 56.
[30] https://www.oregon.gov/ODOT/Planning/Documents/FHBL_Final-Report.pdf
[31] https://truckingresearch.org/2018/01/25/2018-top-truck-bottleneck-list/
[32] https://truckingresearch.org/2019/02/06/atri-2019-truck-bottlenecks/

4 CONCLUSION

The transportation system is the economy in motion. People travel to access jobs, services and goods. Businesses depend on the transportation system to access employees, customers and the goods and services needed to conduct their business activity. Each person, business, commodity, and industry has different needs from the transportation system. Accommodating a variety of needs while maintaining safety within a constrained budget requires strategic decision making and acknowledgement of necessary trade-offs. All economic “agents” must balance trade-offs, whether it is done by households, businesses or public agencies. Building a good understanding of the underlying economic motivations and decision criteria utilized by transportation system users supports development of effective solutions and informed investment decisions.

Oregon’s growing economy means demands on the transportation system will continue into the future. Long range investment capabilities do not include adding significant capacity, investment will focus on utilizing current capacity more efficiently and effectively. Understanding the motivations behind transportation user choice helps inform development of public policy. Quantifying use of the transportation system provides information needed to develop the right solutions at the right time at the right locations. Access to observed data enables monitoring of system performance, revealing congested locations and overall system performance. In a time of declining revenue streams and rising system use, it is more important than ever to develop effective ways to manage the transportation system and provide safe and affordable mobility options to preserve the quality of life in Oregon now and into the future.