REVIEW OF STUDDED TIRES IN OREGON

Final Report

SPR 304-671

RESEARCH

Oregon Department of Transportation

REVIEW OF STUDDED TIRES IN OREGON

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16. Abstract

This study provides an update to the previous studded tire study for Oregon completed in 2000. The focus of this research was to quantify current use of studded tires and the wear and cost caused by that use. Some results include a decline in studded tire use from about 16 percent of registered vehicles in 1995 to about 4 percent in the 2013-14 winter season. A wear rate for PCC of about 0.0091 inches per 100,000 studded tire passes, while the wear rate of asphalt pavement is about 0.0295 inches per 100,000 studded tire passes.

Three different cost categories of studded tire damage mitigation were identified. The three scenarios are included in this study, but the base case scenario for these estimates predicts an annual average expenditure of about $4 million from the year 2012 up to the year 2022. These estimates are only for the State Highway System and exclusive of any amounts to be spent by the cities and counties on their road systems.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS					APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	When You Know	Multiply By	To Find	Symbol	Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH					**LENGTH**		
in	inches	25.4	millimeters	mm	mm	millimeters	0.039	inches	in
ft	feet	0.305	meters	m	m	meters	3.28	feet	ft
yd	yards	0.914	meters	m	m	meters	1.09	yards	yd
mi	miles	1.61	kilometers	km	km	kilometers	0.621	miles	mi
		AREA					**AREA**		
in^2	square inches	645.2	millimeters squared	mm^2	mm^2	millimeters squared	0.0016	square inches	in^2
ft^2	square feet	0.093	meters squared	m^2	m^2	meters squared	10.764	square feet	ft^2
yd^2	square yards	0.836	meters squared	m^2	m^2	meters squared	1.196	square yards	yd^2
ac	acres	0.405	hectares	ha	ha	hectares	2.47	acres	ac
mi^2	square miles	2.59	kilometers squared	km^2	km^2	kilometers squared	0.386	square miles	mi^2
		VOLUME					**VOLUME**		
fl oz	fluid ounces	29.57	milliliters	ml	ml	milliliters	0.034	fluid ounces	fl oz
gal	gallons	3.785	liters	L	L	liters	0.264	gallons	gal
ft^3	cubic feet	0.028	meters cubed	m^3	m^3	meters cubed	35.315	cubic feet	ft^3
yd^3	cubic yards	0.765	meters cubed	m^3	m^3	meters cubed	1.308	cubic yards	yd^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.									
		MASS					**MASS**		
oz	ounces	28.35	grams	g	g	grams	0.035	ounces	oz
lb	pounds	0.454	kilograms	kg	kg	kilograms	2.205	pounds	lb
T	short tons (2000 lb)	0.907	megagrams	Mg	Mg	megagrams	1.102	short tons (2000 lb)	T
		TEMPERATURE (exact)					**TEMPERATURE (exact)**		
°F	Fahrenheit	(F-32)/1.8	Celsius	°C	°C	Celsius	1.8C+32	Fahrenheit	°F

*SI is the symbol for the International System of Measurement

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DISCLAIMER

Executive Summary

This study provides an update to the previous studded tire study completed in 2000. Like the previous study, it does not emphasize the advantages or drawbacks of studded tires in the areas of safety or environmental impacts. The focus of this research is to quantify current use of studded tires and the wear and cost caused by that use.

The use of studded tires in Oregon has declined since the previous survey was taken in 1995. While the survey conducted in 1995 determined that about 16 percent of registered vehicles in Oregon were equipped with studded tires, the survey taken for the 2013-14 winter season found a reduction in that number to about 4 percent. Another significant change was from a mix of cars equipped with studded tires on either both axles or just the driving axle in 1995 to almost all cars equipped with studded tires on both axles today. This created a 2014 effective use rate of about half of the 1995 studded tire effective usage; 16 percent for 1995 to 8 percent for 2014.

Wide ranges of wear rates were found for various sections of PCC and asphalt pavements. This reflects the many factors that contribute to pavement rutting susceptibility. Portland Cement Concrete (PCC) is more resistant to rutting than asphalt. The PCC wear rate is about 0.0091 inches per 100,000 studded tire passes, while the wear rate of asphalt pavement is about 0.0295 inches per 100,000 studded tire passes.

Three different cost categories of studded tire damage mitigation were identified. However, the expenditure projections for mitigating studded tire damage might be the most important estimate for policy purposes. This expenditure was first estimated for the period spanning 11 years from2012 to 2022. Three scenarios are included in this study, but the base case scenario for these estimates predicts an annual average expenditures of about $4 million from the year 2012 up to the year 2022. These estimates are only for the State Highway System and exclusive of any amounts to be spent by the cities and counties on their road systems. It is important to note that project costs might include other construction aspects, or damage after most of the pavements useful life had elapsed, that are not part of studded tire damage mitigation. Consequently, the project costs might appear different from the damage mitigation costs.

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1.0 INTRODUCTION

The Oregon Department of Transportation (ODOT) last completed an analysis of studded tire use and impact almost 15 years ago. Since the completion of that research there have been both developments in non-studded winter tire technology and pavement design. Also, the use of only light weight studs, mandated for Oregon, has been in place for some time. In order to understand the current impact of studded tires, any change in the use of studded tires needed to be established as well as any resultant change in wear caused by studded tires.

This report constitutes an update to the 2000 ODOT study done by Mazen Malik study. A review of literature published in the intervening time since 2000 was made. A new survey of Oregon drivers was completed to determine current studded tire use. Pavement wear data was reviewed to determine current damage estimates based on that studded tire use. The economic analysis presented in the 2000 study was updated using the models developed in that study. All of this was compiled into a representation of the current status of studded tire use and impact.

1.1 STUDDED TIRE DAMAGE COST ESTIMATES IN OREGON

In the early 1970's ODOT reported damage estimates due to studded tires. Those estimate were updated with a study conducted in the mid 1990's culminating in a report published in 2000 *(Malik 2000)* This report noted that while studded tires do damage roads, several steps had been taken to reduce that damage, notably the requirement to use light weight studs and a shortening of the studded tire season. Also at that time a new soft rubber traction tire was gaining acceptance as an alternative to studded tires.

The study that is presented in this report updates the 2000 study with current studded tire use and damage estimates. The same methodology as the previous work was used to provide a comparison of results.

1.2 RESEARCH APPROACH

Research first started with a catalog of highways with a studded tire pattern of ruts in the wheel path. Once those highways were determined, the Pavement Management Database was used to determine the amount of usable data of rut measurements for the selected highways. Over 1,000 lane-miles and rut depth measurements from 1994 to 2012 were analyzed. The level of studded tire use was determined by a Portland State University phone survey taken in 2014 and from a 1995 survey done by the University of Oregon. The resulting analysis was combined with traffic data (a weighted average of average daily traffic per year), seasonal volume, lane distribution, and traffic composition (percent of passenger cars) to determine the studded tire traffic for each rut depth measurement taken. Estimates for studded tire passes versus the rut depth were then regressed to find an estimated rate of increased depth per studded tire pass.

Two types of pavement were examined, Portland cement concrete and asphalt (both open and dense grades).

There are slight variances between this methodology and that used in the original 2000 report *(Malik 2000)*. First, since the Pavement Service unit had rut depth data from 1994 on, this was used to capture the rut depth growth for certain highways through the years. The Pavement Management Database had rut depth data for most state owned highway segments in Oregon. This allowed for analysis to be done for highway segments in all of ODOT's five regions. Studded tire passes had to be found every year because of changes of traffic volumes every year. Average Daily Traffic (ADT) data is available from 1994 on to determine the studded tire passes for a given year. These passes were then summed to find the accumulative studded tire passes for the year the rut depth was recorded by the Pavement Management unit.

The wear rate estimates were then applied to traffic data for the entire Highway System to determine rut depth for each highway segment. Each highway is segmented at the points where the traffic volumes change. The pavement rutting was then used to estimate the cost of mitigating the damage. Three types of cost estimates were defined in this study. First: *Estimated Cost of Mitigating Total Damage* provides a measure of all pavement damage from 2012, expressed in terms of resurfacing costs, including rutting on highways with very low traffic volumes and studded tire use. The second cost definition is *Effective Damage Cost.* Effective damage is defined as damage that is expected to reduce the useful life of the pavement. Thus, the effective damage is the annualized cost of pavement repair equivalent to the shortened useful life of the pavement. Finally, growth factors for traffic and studded tire use were used to project *Annual Expenditures* for repair of studded tire pavement damage through the year 2022. The annual expenditures are estimated as the pavement repair costs at the year when the repairs become necessary or the rut depth reaches the critical level.

All of the traffic count data and cost estimation procedures are limited to the state highway system

2.0 LITERATURE REVIEW

The intent of the following literature review is to focus on research and developments in studded tire use subsequent to the 2000 Oregon study completed by Mazen Malik. This review includes pertinent literature on reduction of service life of pavements and maintenance impacts due to studded tires. It also includes literature dealing with comparisons between studded tires and new non-studded winter tires. Mitigation efforts for winter driving and safety studies involving crash data are presented related to studded tire use.

The Malik study relied on literature published prior to the mid 1990's. Subsequent to Malik's study there have been several comprehensive literature reviews and synthesis papers on studded tire use. Two notable reviews are 'An Overview of Studded and Studless Tire Traction and Safety" by Scheibe et al and "A Synthesis on Studded Tires" by Angerinos et al. Both studies were performed for the Washington State Transport Center(TRAC).

In addition to the prior focus on the reduction of service life caused by studded tires, recent research has revolved around areas of maintenance impacts due to studded tires, requirements to maintain safe driving conditions without studded tires and crashes as the result of banning or limiting use of studded tires

2.1 OREGON CLIMATE PARAMETERS

The discussion of studded tire use in Oregon should be framed in the context of Oregon specific winter conditions. During winter, much of the state does not experience significant amounts of ice or snow conditions. Table 2.1 shows the average number of snow days and amounts of snow fall for various areas of the state. This is important when reviewing existing literature because much of what has been published is from other parts of the country or the world with more significant snow fall. These regions experience 60 snow days or more while only the Cascade Mountains in Oregon approach this level of snow activity. This is particularly true when considering economic analysis of mitigation to snow events compared to stud use which tends to extend throughout the winter season regardless of snow events.

Table 2.1: Oregon climate data

	Average Number of Snow Days	**Average Snow Fall (inches)**
Oregon Coast	0 - 2	0 - 1.4
Willamette Valley	2 - 3	3.0 - 6.2
Cascade Mountians	4 - 60	4.1 - 246.3
Central Oregon	3 - 15	5.1 - 24.3
Eastern Oregon	3 - 26	6.3 - 58.3

Currentresults.com - 9/2014

2.2 SERVICE LIFE REDUCTION DUE TO STUDDED TIRES

All studies of studded tire use show that studs causes wear to the road surface *(Cotter, 2010)*. Reported wear rates vary widely and may be explained by varying quality of paving materials. In general, the surface wear per one million studded tire passes is consistently higher for asphalt concrete pavement as compared to PCC pavements *(Angerinos 1999)*. Angerinos also highlights factors that affect pavement wear, namely:

- stud protrusion
- stud weight
- driving speed
- number of studs per tire

Of these factors, stud protrusion and stud weight have decreased over the years resulting in significant reductions in pavement wear, perhaps as much as 40 percent *(Angerinos 1999)*. However, as allowable speeds are increased the damage from studs is expected to increase as well.

More recently, studies have been conducted using various material improvements and construction techniques to mitigate studded tire damage. One research project conducted in Washington State looked at PCC pavements with special mix designs. The objective of the study was to test if higher flexural strength or higher cement content mixes would be more resistant to studded tire wear. Also, an alternate carpet drag surface texturing rather than a tined finish was reviewed. The result determined that the alternate mix designs were not more resistant to stud damage than the conventional WSDOT 650 psi flexural strength mix design and that there was no correlation between amount of wear and surface finish method *(Anderson 2011)*.

2.3 TRACTION DUE TO STUDS

Several publications document research on performance and safety of studded tires. In comparison developments in ‘’studless” winter tires have increased recently as restrictions on studded tires have occurred. Of particular interest is the comparison of the performance of these tires to commonly use all season radials and studded tires.

In an overview report produced for the Washington State Transportation Center, the researchers focus on a review of current studded tires as compared to the new “studless” winter tires such as the Blizzak made by Bridgestone/Firestone *(Scheibe 2002)*. After reviewing studies performed in the 1990s, the report makes several notable conclusions.

1. Studded tires produce their best traction on snow or ice near the freezing mark and lose proportionately more of their tractive ability at lower temperatures than do studless or all-season tires.

2. The traction of studded tires is slightly superior to studless tires only under an ever-narrowing set of circumstances. With less aggressive (lightweight) studs being mandated, and with the advent of the new “studless” tire, such as the Blizzak, since the early 1990s, the traction benefit for studded tires is primarily evident on clear ice near the freezing mark, a condition whose occurrence is limited. For the majority of test results reviewed for snow, and for ice at lower temperatures, studded tires performed as well as or worse than the Blizzak tire. For those conditions in which studded tires provided better traction than studless tires, the increment usually was small.

3. Studded tires reduce the difference in friction factor between optimum-slip and locked-wheel braking in comparison to non-studded tires. This may reduce the risk of drivers misjudging the necessary braking distance and may improve the braking potential for anti-lock brakes. In one set of stopping distance tests in Alaska, studded, studless, and all-season tires performed nearly equally on snow, when averaged across several vehicles. On ice, stopping distances for studded tires were 15 percent shorter than for Blizzaks, which in turn were 8 percent shorter than for all-season tires.

4. In another set of tests in Alaska, studless Blizzak tires offered the best traction performance, especially for braking on both packed snow and ice in comparison to studded tires (which were second) and all-season tires (which were last).

5. On bare pavement, studded tires tend to have poorer traction performance than other tire types. This is especially true for concrete; for asphalt, there is little difference in stopping distance between studded and non-studded tires.

6. Tractive performance of studded tires is sensitive to stud wear. Studded tires may lose more of their tractive ability over time (from stud wear) than studless tires. When stud protrusion diminishes to 0.024 in. (0.6 mm), the frictional effect from the studs becomes negligible. Tire tread wear (on studded tires) has relatively little frictional effect if stud protrusion is maintained at 0.039 in. to 0.043 in. (1.0- 1.1mm).

7. A number of driver behavior issues have been postulated that tend to affect the judgment of studded tire effectiveness. There is not consensus on these points: 1) drivers with studded tires care more about safety, hence they drive more safely, 2) they drive faster (because of a false sense of security or confidence), and 3) drivers with non-studded tires avoid driving when weather is severe *(Scheibe 2002)*.

2.4 SAFETY EFFECTS OF STUDDED TIRES RELATED CRASHES

Recent studies of safety effects of studded tires have primarily been done in Scandinavian countries and Japan. Within these countries there has been a high rate of studded tire use. In recent years some countries, Norway and Japan for example, have advocated for a reduction in studded tire use, in part because of concerns of excessive road surface damage, increased maintenance costs and the generation air born particles *(Asano 2001, Fridstrom 2001)*.

A study of Norwegian cities looked at the safety effect of studded tire use. The author describes what he terms “offsetting behavior” or “risk compensation” for driver response to noted changes in road surface conditions. Speed decreases with snow fall and further decreases when studs are not in use. However, the use of studded tire serves to increase the speed level. This study described what appears to be an effect of increased traction for all vehicles due to studded tires wearing down the ice surface of the road, while ordinary tires tend to polish the an icy surface *(Fridstrom 2001)*. With all of these factors considered Fridstrom concluded that:

> “By and large, a halved use of studded tires is estimated to increase the number of injury accidents by 2 to 3 percent, as reckoned over the entire winter season. Property-damage-only accidents appear to be more or less unaffected by the rate of studded tire use.”

Scheibe also noted “the roughening of ice and pavement from studded tires provides a safety benefit for all vehicles (with and without studs) by helping to prevent formation of smooth, glare ice” is described throughout the literature *(Scheibe 2002)*.

3.0 STUDDED TIRES IN OREGON

Several studies concerning the use of studded tires in Oregon have been completed in the last 20 years. Several methods of counting studded tires have been employed from parking lot counts to phone surveys. Malik notes in the 2000 study that the phone survey was considered more reliable and it was used for the analysis. Based on the information from the previous study a phone survey was again used for the analysis. The Portland State University (PSU) Survey Research Lab was contracted to provide this survey. The phone survey was also able to collect other information related to winter driving. The complete survey report is contained in Appendix A.

Part of the purpose of the survey was to determine studded tire use regionally in Oregon. The state was essentially broken into the 5 regions used by ODOT. The following map shows the counties represented by each ODOT region. The one exception to the county groupings shown was that for the PSU survey Columbia County was grouped with the counties of Region 1. This was done to maintain consistency with the 1995 survey when it was part of Region 1.

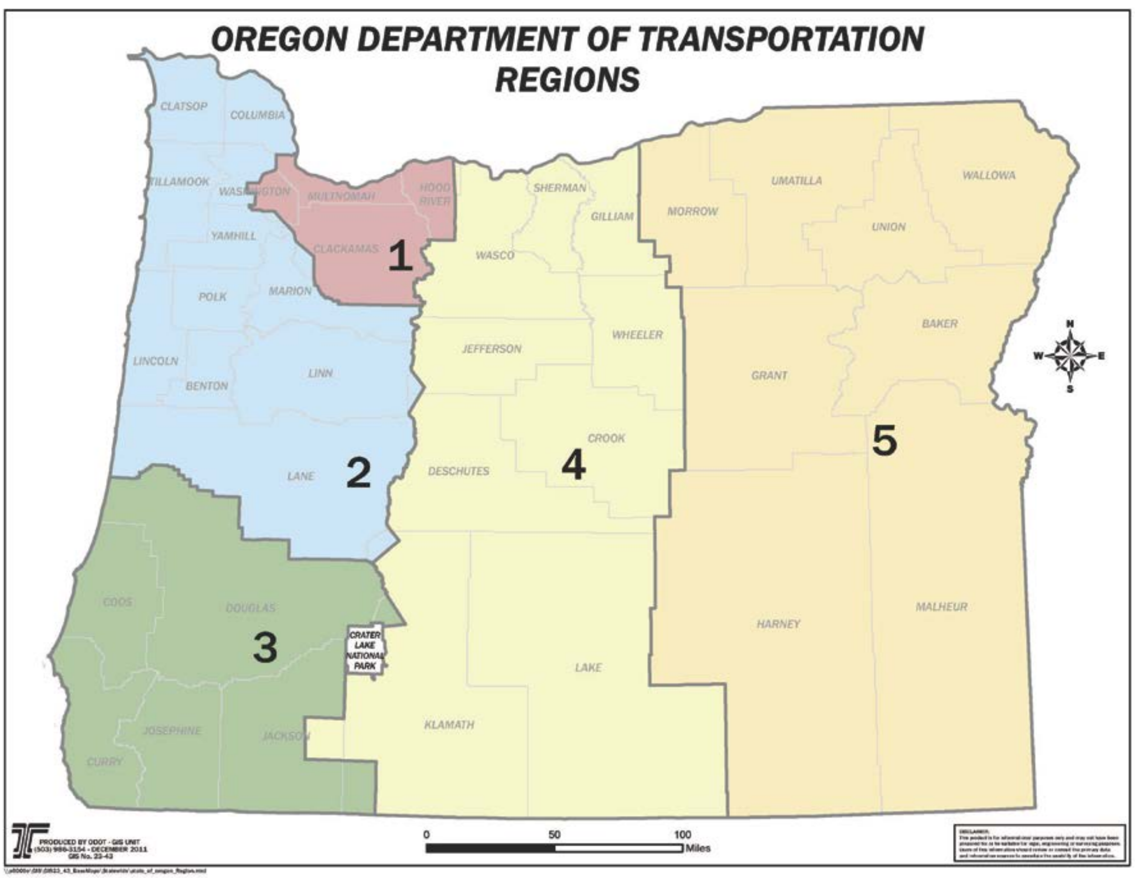

Figure 3.1: Regional Map of Oregon

3.1 CURRENT ESTIMATES OF STUDDED TIRE USE IN OREGON

The Table 3.1 presents a summary of studded tire use by region compiled from the 2013 - 2014 telephone survey. One notable result from the current survey is that, unlike the previous study data, virtually all cars with studded tires have the studs installed on all 4 wheels. Previously there was a mixture of installation on 2 wheels and 4 wheels which need to be accounted for by an effective use calculation. For consistency with those previous studies, the current effective use value is calculated in the same manner resulting in an effective use number based on the 4 wheel current studded tire usage.

Table 3.1: Presents the results from the PSU phone survey for studded tire use in Oregon for the 2013-14 winter driving season.

ODOT Region	2013 Registered Passenger Vehicles (DMV)	Nominal Vehicle		Effective Use
1	1,295,426	2.6%		5.1%
2	837,994	2.0%		4.0%
3	423,189	1.3%		2.7%
4	368,935	13.3%		26.6%
5	159,533	10.9%		21.8%
Weighted State Average	3,085,077	4.0%		7.9%

Table 3.2 presents a comparison to the studded tire effective use by region from the 2000 Malik study.

Table 3.2: Comparison of effective studded tire use

ODOT Region	**ODOT 1995 Telephone Survey**	**ODOT 2014 Telephone Survey**
1	15.6%	5.1%
2	12.4%	4.0%
3	5.4%	2.7%
4	40.1%	26.6%
5	30.2%	21.8%
Weighted State Average	16.0%	7.9%

3.2 OTHER PHONE SURVEY FINDINGS

The survey provided additional information on winter driving in Oregon. The following findings are highlighted.

- Of those that use studded tires last year, more than 50 % started using studded tires more than 10 years ago.
- Most studded tire users put them on in November and December and take them off in March and April.
- Those that stopped using studded tires stated the following reasons among others:
  - Don't need them (35%)
  - Don't drive as much or in bad weather (12%)
  - Use 4 wheel drive (12%)
  - Switched to stud-less winter tires (12%)
  - Studded tires ruin roads (9%)
- In 2013 – 2014 winter season almost 13 % of households used non-studded winter tires compared with 11% of households using studded tires.

4.0 WEAR RATE ESTIMATION

This chapter describes the data, process, model and results of determining a wear rate estimation of studded tires on pavement surfaces. It is important to note that observational data was used here and can only really provide a correlation and not causation. However, most pavement engineers would agree there are two main causes to ruts in the pavement, permanent deformation due to heavy load trucks and abrasion primarily due to studded tires on passenger cars or chains on passenger cars and trucks. ODOT did its best to only analyze segments with known rutting from studded tire use.

4.1 DATA

ODOT has compiled an extensive catalog of data for this study to help in determining the relationship between studded tires and pavement ruts.

4.1.1 Rut Depth Data

Every two years a Profiler van drives the highway network in the State of Oregon. A Profiler van has precision lasers attached to the bumper. These lasers measure rut depth in the left and right wheel track at approximately fifteen foot intervals. This data is extracted by the Pavement Management Unit and averaged for every one-tenth of a mile. The Pavement Management Unit then uses those measurements and averages them to get a rut depth for a segment of state highway. These segments are predetermined by the Pavement Management Engineer. The segments vary in length from less than one mile to as long as twenty miles. The average rut depth for every pavement management segment is recorded in a database. Data goes back to 1994.

Although a Profiler is not as accurate as hand measurement, the speed and cost of this method makes it a clear choice to use to collect data on a state wide level. Profiler vans need to be calibrated and can vary in their measurements year to year. This is especially true when a new Profiler van is used. Over a long enough time frame, this 'noise' is reduced and a pattern of increasing rut depth emerges.

4.1.2 Calibration of Profiler

The Profiler van is calibrated once each week using the manufacturer's guidelines while data collection is taking place. The vehicle goes through rigorous tests before it is deemed suitable to collect data. Once the data is collected, there is a post-processing analysis of the data to make sure that it is reliable and repeatable. In the office it is checked again for continuity before being entered into the Pavement Management Database.

4.1.3 Pavement Segments

Segments of Oregon highways with measurable and quantifiable rutting issues were used in the analysis. All segments of highway in the Pavement Management Database were examined for rutting and segments that had deeper rutting at a given pavement life span than would be expected if there were no stud wear were chosen. Segments with known truck ruts and segments where tire chains were known to have caused severe wear in just a few winter storms were excluded. Truck ruts have a tell-tale sign of a dual rut in each wheel path (See Figure 4.1). Also, representative portions of pavement from each region and type of material were part of the consideration for analysis. Oregon pavements are made of two materials, asphalt (AC) and Portland Cement Concrete (PCC). Asphalt can be subcategorized as dense grade (D) or open grade (O).

Figure 4.1: I-84 West of La Grande: The dual rut caused by heavy load trucks can be seen.

ODOT frequently patches ruts and other parts of asphalt highways because of damage from various sources. Any segment that had more than 10% of its surface area patched was not used in this analysis.

4.1.4 Traffic Data

ODOT has a detailed count of traffic for all state owned highways. Much of this data is collected by traffic counters, both manual and machine. The data is processed to give a good approximation of average daily traffic (ADT) for segments of highway. ADT data is recalculated every time there is a point on the highway where the traffic volumes significantly changes. This could mean a new count of ADT as often as every 0.06 miles. The ADT is also divided up by type of vehicle. Data reliably goes back to 1994.

ODOT also collects total vehicle miles traveled on its roads. This is the amount of miles that all the vehicles in Oregon travel on state owned highways. This information is usually processed and delivered by the year. This information was not used in the estimating the studded tire wear rate but was used extensively in the estimation of costs in the next chapter.

4.1.5 Passenger Cars

Data extracted from the ADT tables was originally for passenger cars only (02 vehicles according to the federal highway classification system). Passenger cars are the main users of studded tires, so it is believed that this would be the best way to investigate the relationship of ruts and studded tire use. It was found that other types of passenger vehicles could also be classified as non-commercial trucks (03 vehicles according to the federal highway classification system). This includes Sport Utility Vehicles (SUVs) and light weight trucks used by the general public. These types of vehicles also use studded tires. So ADT of both types of vehicles was extracted from the table and summed to find all traffic on the road that could potentially have studded tires. Passenger cars referenced in this report include 02 and 03 vehicles according the federal highway classification system.

4.1.6 Cumulative Studded Tire Passes

The goal of this study is to find the relationship between studded tires passes and rut depth of the pavement. Every two years rut depth data is collected that accounts for all the tire passes that have happened until the measurement is taken. From the initial time a pavement is constructed or resurfaced, rut depth accumulates from the traffic's effects on it. Hence, the total studded tire passes that the pavement has experienced each year over its life time needs to be found. Each year, studded tire passes experienced for that year was determined from calculated yearly ADT for each segment and factors applied as described in the next sections. Those studded tire passes are summed from the beginning of the pavement's life until the rut depth was taken, as indicated below.

$$Cumulative\ Studded\ Tire\ Passes = \sum_{n=Year\ pavement\ is\ open\ to\ traffic}^{Year\ rut\ measurement\ was\ taken} Studded\ tire\ passes\ for\ year_n$$

4.1.7 Seasonal Variation

ODOT also keeps records on monthly variations of traffic. Traffic on state highways is often higher in the summer months with a few exceptions. These monthly variations were reported as percentages of total average daily traffic. This is an important step because studded tire use is usually illegal on cars in Oregon between April 1st and October 31st. Only months that see studded tire traffic should be included in the analysis. Oregon has monthly variations reported for every automatic traffic recorder (ATR) in the state. The monthly variation percents that were used for this study were the ones reported by an ATR closest to and on the given segment of Highway. For example, a segment on I-5 from mile point 11.44 to 18.70 had the monthly variations extracted from an ATR at MP 11.03. The next ATR on that highway was at MP 28.33, so the MP 11.03 ATR was the closest. ATR data used in this report is in Appendix B. The only highway examined in this study that did not have an ATR located on the highway was OR217 in the Portland area. Fortunately, Portland State University (PSU) had monthly volumes of traffic on their website (http://portal.its.pdx.edu/Portal/index.php/highways/twoqty/9/9). These traffic volumes seemed to match the overall trend for all state highways, and hence were deemed usable based on reasonableness and a lack of data elsewhere. Data from the ATRs was from 2012. It is assumed for this study that the monthly trends remained constant from year to year and thus were applied all years that ADT data was available. Seasonal Trends can be found at (http://www.oregon.gov/ODOT/TD/TDATA/tsm/docs/Summary_2012.pdf).

4.1.8 Lane Distribution

Another consideration is that the rut depth is usually only collected for one lane. For a two lane highway with traffic in both directions, rut depth in typically collected in the increasing mile point directional lane of the highway. It is usually the right lane for a four lane highway. On bigger, freeway type highways with three or more lanes in each direction, it is collected in the middle lane or one lane to the left of the right most lane. On larger, physically split highways it is often collected in both directions. ODOT strives to get the ruts in the lane most heavily traveled by passenger cars. Since the rut data is only for one lane and ADT data is given for the entire highway in both directions, a lane distribution factor has to be used. ODOT does not usually collect this information, but it is possible to collect it at the ATRs. A special request had to be made to collect this information from ATRs around the state. The Traffic Planning Analysis Unit extracted a variety of lane distributions from ATRs on various rural and urban four lane freeways and highways and six lane freeways. The factors were determined by real traffic counts that occurred in January and February of 2014. They are shown in the Table 4.1.

Table 4.1: Lane Distribution Factors

# of Lanes total	Setting	Type	Inside lane Distribution	Middle Lane Distribution	Outside Lane Distribution
4	Urban	Non-Freeway	0.47	NA	0.53
4	Rural	Non-Freeway	0.36	NA	0.64
6	Urban	Freeway	0.26	0.37	0.37
4	Rural I-84	Freeway	0.20	NA	0.80
4	Rural I-5	Freeway	0.36	NA	0.64
4	Urban South or East Oregon	Freeway	0.34	NA	0.66
4	Urban Eugene Area	Freeway	0.38	NA	0.62
4	Urban Salem - Portland Area	Freeway	0.42	NA	0.58

Of course not all segments of pavement easily fit into one of these lane categories. Because of the difficulty in getting this data, the following assumptions were made to best determine what lane distribution to use for each pavement segment:

- Climbing shoulders for trucks on the highway were not counted as lanes.
- Exit only lanes were not counted as a lane.
- Passing lanes on rural highways were not counted as a lane.
- If the number of lanes varied per segment, the dominate number of lanes determined the distribution factor.

4.1.9 Studded Tire Survey

ODOT has done two phone surveys to find the usage of studded tires around the state for each of ODOT's regions. One was conducted in 1995 and was used in the 2000 report by Mazen Malik. Another one was done this year, 2014, by Portland State University (PSU). Since the data used in this report to find the wear rate dates back to as far as 1994, it makes sense to use usage rates that reflect that period of time. It was determined that to incorporate the usage rates from 1995 and 2014, a linear model between those years would be used to determine a different usage rate for each year between 1995 and 2012. The survey and the results are included in Appendix A. The rates used per year for each region is in Appendix C.

Table A13 in the PSU study was used in calculating the studded tire passes observed for each given segment of highway for 2014. It is interesting to note that originally only the months that studded tires are legal were going to be examined. The phone survey showed that a significant portion of survey responders in central and eastern Oregon reported that they use studded tires in both October and April. Therefore, those months were included in the analysis in all regions.

4.1.10 Calculating Studded Tire Passes on Pavement for a Given Year

If the ultimate goal is to determine the relationship between studded tires and pavement damage, one must isolate the number of studded tires on that pavement. Using the data and factors above, the final calculation was done to obtain the studded tire passes that the pavement experiences using the following formula.

Studded tire passes for a pavement segment for a given year

$$= ADT \times \frac{1}{2} \times LD \times 2 \times \sum_{n=Oct}^{April} SV_n \times \#\, of\ Days\ in\ month \times STU_n$$

Where,

ADT – Average Daily Traffic. This is a weighted average for a given year of daily passenger car traffic for a segment of pavement[1].

½ - Since ADT is for both directions, half the traffic is assumed for one direction.

LD - Lane Distribution. Since rut measurement is only taken in one lane, the LD factor will vary based on what lane the rut measurement was taken in and how many lanes the highway has.

2 - Two wheels for each car that passes over the given pavement. Studded tires are assumed to be been put on all four wheels. Only one of the wheel paths of the lane is measured.

SV - Seasonal Variation. This accounts for how much traffic had the possibility of using studs based on the months studs are in use. Season Variation is kept as a percent of the ADT. Season variation is assumed to be the same for all the years data was used.

# of Days in month. Since the traffic count is an average daily count, the total for the year has to include the days in the year that the studs were on the car.

STU - Studded Tire Usage. This is the percent of passenger cars for the region that have studded tires for a given month. The studded tire usage varied per year and per region.

SV and STU both vary depending on the month.

[1] Since the ADT counts did not have the same beginning and ending mile points as the pavement management segments, a weighted average was used to find the ADT for each pavement management segment.

4.2 METHODOLOGY

4.2.1 Model Selection

Once the data was processed, cumulative studded tire passes from the time of the pavement's construction until the observed year versus rut depth for that year were analyzed as an independent (studded tire passes)/dependent (rut depth) relationship.

For instance, OR 217 in the Portland Metro area (ODOT Road ID 144) had an asphalt inlay between mile point 1.47 and 6.39 in 2006 in both directions. Rut depth was measured later that year and every other year onwards and is shown in the Table 4.2.

Table 4.2: Rut Depth for OR 217

Year of Rut measurement	Rut Depth in Inches
2006	0.11
2008	0.23
2010	0.42
2012	0.55

The question now becomes how many studded tire passes did that pavement receive in 2006 to achieve a rut depth of 0.11 inches. By 2008 a rut depth of 0.23 inches was recorded. How many passes of studded tires did the pavement receive by 2008? Cumulative studded tire passes were determined for every year a rut depth was available.

$$\text{Cumulative Studded Tire Passes} = \sum_{n=\text{Year pavement is open to traffic}}^{\text{Year rut measurement was taken}} \text{Studded tire passes for year}_n$$

The end result is a table like that shown in Table 4.3:

Table 4.3: Studded Tire Passes and Rut Depth for OR 217

Year of Rut measurement	Cumulative Studded Tire Passes	Rut Depth in Inches
2006	638,496	0.11
2008	1,804,422	0.23
2010	2,817,124	0.42
2012	3,712,182	0.55

This can now be plotted to see the relationship between studded tire passes and rut depth as shown in Figure 4.2. This method is especially useful in that it provides enough data points over a pavement's life time to see an overall trend. Since there are other influences on measured rut depth (specific material type, location, profiler variance, etc.), using as much good data as possible helps eliminate a lot of noise caused by these other influences.

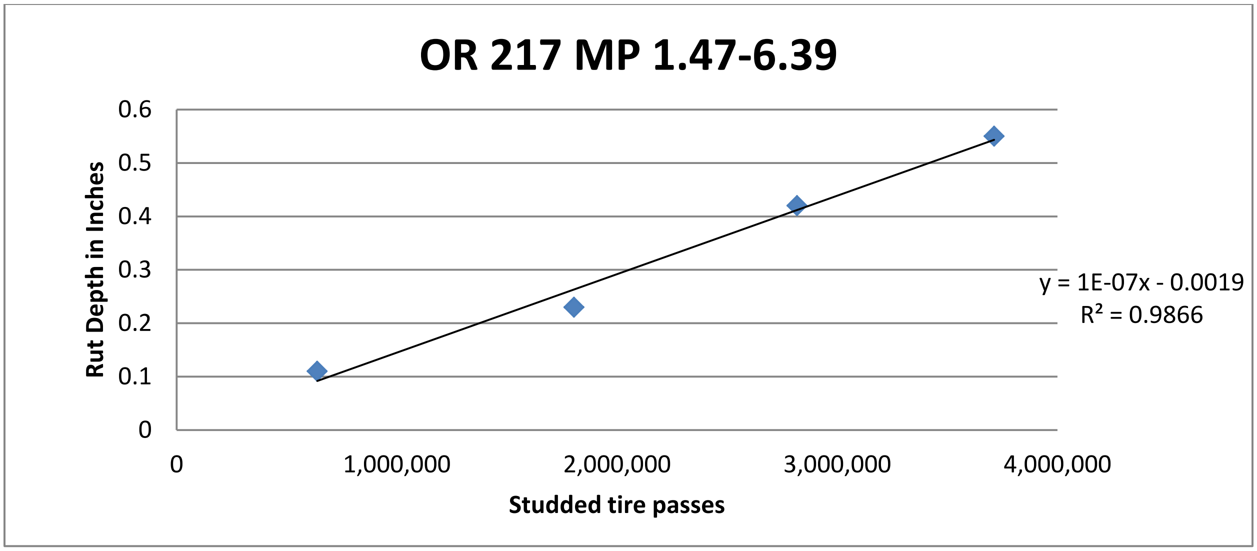

Figure 4.2: Rut-Depth versus Studded Tire-Passes for OR 217

It already has been well established that rut depth is a function of studded tire passes. A linear relationship has been assumed in the past *(Malik 2000)*. ODOT did not want to limit this study to linear models, so a few different types of functions were explored. It has been suggested that asphalt surfaces rut the most in the first two years because of secondary compaction[2] . Concrete is said to get stronger as it ages, which may be less susceptible to rutting as time passes. Most of the concrete pavement examined in this study is not over 20 years of age, but the concept led to considering models besides linear functions. Exponential, logistic, logit, and logarithmic functions were also explored as they are common models in statistical inference and modeling life cycles.

Highway segments with known studded tire rutting wear had their rut depths and studded tire passes plotted. As with ODOT's 2000 study by Mazen Malik, the best fit was a linear regression model.

Further in depth examples of rut depth, cumulative studded tire passes and the statistical analysis for US 97, OR 217, I-5, OR 99W, and I-84 can be found in Appendix D.

4.2.2 The Model

General Principle of Wear Rate

The rut depth of pavement is taken as a linear function of studded tire passes in form of:

$$R=A*P$$

[2] http://ascelibrary.org/doi/pdf/10.1061/9780784413159.308.

Where

R = Rut depth estimate

A = wear rate

P = number of studded tire passes

For asphalt material there is also a secondary compaction that happens once the pavement is open to traffic. This secondary compaction can be explained by a y-intercept and thus takes on the linear form of:

$$\mathbf{R = A * P + B}$$

Where

R = Rut depth estimate

A = wear rate

P = number of studded tire passes

B = rut depth caused by secondary compaction

Use of this model requires some assumptions. One is that the wear rate is not affected by previous wear, time, or any past damage. Also there is no way to account for the rut also caused by heavy truck loads. Care was taken not to pick segments that are known for having ruts due to truck traffic.

Another assumption that was considered is that there is no y-intercept for pavements and that all rut depth is caused by studded tire wear. This has been used in previous studies *(Malik 2000)*. However, the inclusion of a y-intercept term for asphalt pavements has been shown by data to produce a better fitting model. Field personal and experts in pavement have also noticed that there are slight ruts formed not long after the pavement has traffic driving over it[3]. Almost all the data in the ODOT database has shown a slight rut the first year the asphalt pavement is open to traffic. This phenomenon known as secondary compaction should be included when trying to evaluate a predictive model of rut depth. However it cannot be attributed to studded tires alone. All traffic over an asphalt pavement will contribute. Most of this secondary compaction occurs the first two years of the pavements life.[3]

Concrete pavement does not experience this secondary compaction like asphalt. It does not exhibit plastic deformation after it hardens. However, analysis of the actual data determined that a forced zero y-intercept assumption led to a slight over estimate of the wear rate. Also

[3] http://ascelibrary.org/doi/pdf/10.1061/9780784413159.308

there are a variety of ways to calculate R-squared values when forced through a data point. For consistency and loyalty to the data, the y-intercept for concrete was not set to be zero. The average y-intercept for the concrete segments was 0.011 inches or approximately 1/100th of an inch, which is within the measurement error margins for the Profiler and very close to a zero intercept value.

4.2.3 Linear Analysis

By plotting the studded tire passes on the x-axis and the rut depth of the pavement on the y-axis, the wear rate will be the slope of the linear regression of that relationship. Since seasonal variation, lane variation, and studded tire use per region per year were incorporated into finding the relationship between studded tire passes and rut depth, it was hoped that a universal wear rate could be derived for both PCC surfaces and AC surfaces. However, individual segments ended up being statistically significant which shows that material and location are also significant since that is what makes up individual segments. After accounting for that, a relationship between studded tire passes and rut depth emerge. The following pavement segments were examined and the relationships are shown Tables 4.4 and 4.5. Note that some segments of highway are shown more than once; this if for different pavement surfaces that occurred for that segment in the last 20 years. Some of the pavement management segments were combined when they were not statistically significant from each other, made from the same material, approximately the same age and adjacent to one another. This produced more data points per segment as seen below for a better statistical analysis.

Table 4.4: Wear Rates for Asphalt Segments

Region	Route	Pavement Type: Dense (D) or Open (O)	ODOT Road ID	Beg. MP	End MP	Slope per studded tire pass	Y-inter	R-sq
Reg 1	US 26	D	047	57.00	70.68	6.29E-08	0.142	0.648
	OR 99E	D	081	1.31	5.46	5.75E-08	0.127	0.606
	OR 99W	D	091	1.24	12.20	1.19E-07	0.083	0.682
	OR 99W	D	091	14.67	15.67	1.70E-07	0.251	0.954
	US 26	O	047	55.19	57.00	2.22E-07	0.006	0.924
	US 26	O	047	57.00	73.43	3.32E-08	0.177	0.607
	I-205	O	064	1.24	24.88	8.66E-08	0.124	0.755
	OR 99E	O	081	13.04	24.67	1.22E-07	0.104	0.735
	OR 99W	O	091	12.20	16.67	1.75E-07	-0.104	0.934
	OR 217	O	144	0.00	7.52	4.58E-08	0.147	0.648
Reg 2	OR 58	D	018	8.08	33.24	7.01E-07	0.087	0.607
	OR 58	D	018	33.24	48.30	9.91E-07	0.105	0.545
	OR 569	D	069	3.10	3.92	1.30E-07	0.105	0.664
	OR 99W	D	091	19.44	23.76	2.07E-07	0.073	0.774
	OR 99W	D	091	27.09	28.05	1.15E-07	0.155	0.764

	OR 99W	D	091	35.19	39.14	1.28E-07	0.141	0.873
	OR 99W	D	091	62.12	84.24	1.43E-07	0.117	0.553
	OR 99W	D	091	108.92	122.26	3.85E-07	0.068	0.859
	I-105	D	227	3.49	3.95	1.44E-07	0.005	0.963
	US 26	O	047	52.30	55.19	1.84E-07	0.054	0.905
	OR 569	O	069	0.00	2.22	5.70E-08	0.239	0.673
	OR 569	O	069	3.92	12.78	6.22E-08	0.136	0.661
	OR 99W	O	091	46.50	54.80	3.52E-07	0.035	0.865
	OR 99W	O	091	54.80	57.40	2.01E-07	0.237	0.549
	OR 99W	O	091	57.40	62.12	4.32E-07	-0.095	0.984
	OR 99W	O	091	63.79	79.77	8.22E-08	0.145	0.445
	OR 99W	O	091	109.65	121.14	2.56E-07	0.066	0.786
	OR 34	O	210	0.34	3.58	1.08E-07	0.049	0.771
	OR 34	O	210	3.58	16.89	1.20E-07	0.156	0.786
	I-105	O	227	0.91	9.98	1.34E-07	0.059	0.897
Reg 3	I-5	D	001	11.44	18.81	1.50E-06	0.063	0.843
	I-5	D	001	26.73	28.33	4.63E-07	0.054	0.744
	I-5	D	001	58.18	97.90	1.05E-06	0.067	0.728
	I-5	D	001	97.90	112.57	5.91E-07	0.065	0.597
	I-5	O	001	11.44	18.70	6.80E-07	0.048	0.885
	I-5	O	001	28.94	35.75	2.79E-07	0.007	0.899
	I-5	O	001	43.09	58.18	2.90E-07	0.080	0.779
	I-5	O	001	67.00	71.32	3.16E-07	0.078	0.851
	I-5	O	001	71.32	80.80	3.97E-07	0.081	0.842
	I-5	O	001	80.36	87.36	4.89E-07	0.123	0.774
	I-5	O	001	97.90	112.57	5.92E-07	0.060	0.786
	I-5	O	001	112.57	125.38	2.68E-07	0.104	0.817
	I-5	O	001	125.38	128.77	4.34E-07	0.155	0.880
	I-5	O	001	136.52	147.88	5.40E-07	0.071	0.805
	I-5	O	001	147.78	162.20	5.20E-07	0.161	0.838
Reg 4	US 97	D	004	92.08	93.17	2.69E-07	0.123	0.867
	US 97	D	004	96.04	123.17	9.91E-08	0.074	0.898
	US 97	D	004	123.17	132.67	1.77E-07	0.042	0.949
	US 97	D	004	132.67	134.93	2.63E-07	-0.007	0.987
	US 97	D	004	138.63	149.48	2.78E-07	0.041	0.903
	US 97	D	004	265.65	272.58	1.59E-07	0.110	0.746
	US 20	D	017	15.10	20.99	7.05E-08	0.195	0.605
	OR 58	D	018	70.00	75.00	2.84E-07	0.034	0.883
	US 97	O	004	97.50	111.91	7.07E-08	0.132	0.812
	US 97	O	004	111.91	132.67	5.44E-08	0.171	0.569
	US 97	O	004	267.08	269.43	2.54E-07	0.049	0.765

	US 97	O	004	272.58	277.61	1.31E-07	0.032	0.867
	US 97	O	004	278.03	280.51	2.01E-07	0.053	0.865
	US 20	O	017	0.00	18.18	1.19E-07	0.147	0.547
Reg 5	I-84	D	006	213.04	217.77	4.31E-07	-0.021	0.790
	I-84	D	006	237.99	259.19	5.48E-07	0.024	0.843
	I-84	D	006	259.19	260.26	1.03E-06	0.012	0.871
	I-84	O	002	149.50	163.50	4.34E-07	0.057	0.857
	I-84	O	002/006	163.50	188.04	9.18E-08	0.113	0.716
	I-84	O	006	213.05	217.77	1.45E-07	0.122	0.524
	I-84	O	006	248.55	252.83	2.37E-07	0.165	0.532
	I-84	O	006	327.45	329.11	4.01E-07	-0.004	0.935
	I-84	O	006	329.22	335.97	1.87E-07	0.038	0.887
	I-84	O	006	335.97	342.12	1.37E-07	0.028	0.693
	I-84	O	006	368.16	374.08	2.96E-07	0.110	0.943
	I-84	O	006	374.08	377.92	9.83E-08	0.201	0.557
					Average	2.95E-07	0.088	0.773

For PCC there were fewer segments and fewer data points as it is not a predominate material in Oregon.

Table 4.5: Wear Rates for PCC Segments

Region	Route	Pavement Type	ODOT Road ID	Beg. MP	End MP	Slope	Y-inter	R-sq
1	I-5	PCC	001	282.65	307.45	5.36E-08	-0.066	0.714
1	I-84	PCC	002	12.52	16.67	5.35E-08	0.079	0.414
2	I-5	PCC	001	238.76	244.44	4.96E-08	0.016	0.852
2	I-5	PCC	001	253.73	282.65	8.36E-08	-0.012	0.739
5	I-84	PCC	006	217.77	225.84	1.67E-07	0.080	0.699
5	I-84	PCC	006	225.84	237.99	1.42E-07	-0.024	0.806
5	I-84	PCC	006	285.33	313.65	8.78E-08	0.006	0.787
					Average	9.11E-08	0.011	0.716

On average the asphalt wear rates are slightly lower than what was reported in 2000. This can probably be attributed to the use of light weight studs and more rut resistant asphalt. It is interesting to note that the concrete wear rate remained about the same as it did in 2000. Further investigation is needed to determine why there was not the reduction in wear rate in concrete as was seen in asphalt even after the use of light weight studs was enacted by law in 1995.

4.2.4 Comparison to Other Rates:

The wear rate for PCC surfaces was lower than that of AC surfaces by a factor of a little more than three. This is to be expected as concrete is known to be harder and less susceptible to deformation than asphalt. Rates for this study are compared to those from other studies in Table 4.6

Table 4.6: Average Wear Rate per 100,000 studded tire passes found by ODOT and others in Oregon

Year	Asphalt	Concrete
2014 (ODOT)	0.0295	0.0091
2000 (ODOT)	0.0386	0.0093
1995 (Brunette)	0.034	0.009
1994 (Malik)	0.035	0.008
1974 (ODOT)	0.066	0.026

4.3 HOW THIS METHODOLOGY DIFFERS FROM THE 2000 REPORT BY MAZEN MALIK

It was a goal at ODOT to use as much methodology as was previously used in ODOT's 2000 report "Studded Tires in Oregon". That however could not always be done, sometimes because better information was now available and sometimes because of time constraints.

Rut depth data in the original study was only taken for one year, 1995. We now have a database and have been tracking rut depth in that database since 1994. It made sense to use rut depth over time to see the growth of the rut to get a more accurate picture of that growth. In the original study, there were manual measurements of rut depth. That was not done here. The time, traffic control, and cost to do that made it not feasible.

The Profiler measurements in the 2000 study were checked with hand measurements. In this study the profiler is calibrated once a week during the collection cycle per manufactures guidelines. There was no manual calibration, as the Profiler has been used for many years now and has a known accuracy.

Pavement segments in this study were predetermined by the Pavement Management Database. These segment's rut averages are what is collected every other year at a minimum since 1994. The 2000 study used its own segments. The segments chosen in this study were meant to represent segments that had ruts caused by studded tires (see Figure 4.3), but also be representative of all regions of Oregon and types of pavements. The 2000 study mainly focused on Interstate highways with a few exceptions. In 2000, only B-mix and F-mix asphalts had rut depths measured. ODOT now uses mainly C-mix for its dense grades, and F and E-mix for its open grades. B-mix, C-mix, F-mix and E-mix were used in this study.

Figure 4.3: Studded Tire Ruts

One can see the narrow, single wheel ruts caused by studded tire wear in the center lane of this segment on I-5 SB near Wilsonville.

Since the 2000 report used 1995 rut depth data, it had to interpolate ADT growth. That information is now available. All ADT used in this report was from ODOT's Transportation Systems Monitoring unit, and was found every year of the pavement's life for segments used in this study. No interpolation or estimates of ADT growth was necessary unless the pavement was built before 1994. Only a few segments in this study were looked at that were older and by only a few years. ADT was assumed to be the same as 1994 for all pavements built before that in this study.

The concepts of passenger cars, cumulative studded tire passes, seasonal variation and lane distribution were kept the same for this report as in 2000. The seasonal variations and lane distributions were updated using data from ATRs and ODOT's Transportation Planning and Analysis Unit.

The studded tire survey in 2014 to find usage rates was similar to that in 1995. It is interesting to note that more questions were asked to the public about studded tire alternatives, as they are more widely available now. Also of interest is that studded tire use has appeared to decline since 1995. The original study had predicted an increase.

The calculation of the studded tire passes on pavement for a given year did vary from the original report. With now having rut data for many years and ADT data for those same years, little estimation and interpolation had to be done. The actual recorded numbers could be used.

The data was modeled in the same manner as the 2000 report with life time of studded tire passes vs rut depth plotted. This report did decide to use a y-intercept unlike the original report. It was found to give a better approximation of the data and also helped alleviate some concerns about rut caused by secondary compaction and heavy load trucks. Much like the 2000 report, the model was linear. However many more segments of pavement were analyzed in this report than in 2000 as many more segments' data were available. This included many non-freeway segments such as OR 99E, OR 99W, OR 34, OR 58, and US 26. Segments from ODOT's Region 3 (Southern Oregon) and Region 5 (Eastern Oregon) were also included in this report unlike the 2000 report.

As more data becomes available and as the technology to collect that data progresses, there is no doubt that future studies of the relationship between studded tires and rut depth will be even more enlightening

5.0 COST ESTIMATES

Three types of cost analyses were conducted using a wear rate estimate and studded tire and traffic data for the state highway system in 2012, following the same methodology, whenever practical, as the 2000 Studded Tire Report. All cost estimates are expressed in terms of repair costs. Those repair costs are limited to a rehabilitation strategy of an asphalt overlay of 2” thickness.

The first cost category is the cost of *total damage.* This estimate is a measure of all the rutting damage on the highways. This includes rutting damage that is not expected to reach the limiting rut threshold of 0.75”. It also includes damage that might not be the main trigger for pavement rehabilitation. Although some of the expenditures are not anticipated, damage has occurred. Therefore, this damage will not require repair in total, but it represents the cost of mitigation if all the damage were to be fixed, regardless of how deep the rutting gets on any particular highway segment. There is no inclusion in this category of the consequent social costs in terms of safety and comfort effects (discussed in section 2.4). The use of repair costs cannot be utilized to quantify these indirect effects, and does not provide means of measuring the accelerated wear (beyond Rutting damage) of roadways due to studded tire use.

The second cost category is the *effective damage* cost. The effective damage cost estimate includes studded tire damage that is expected to reduce the useful life of pavement surfaces. The effective damage cost estimate will not include roads with very low traffic volume or very low studded tire use that may exhibit some rutting, but the studded tire traffic is not considered sufficient to require an overlay before other age and pavement fatigue-related problems warrant reconstruction. Therefore, this cost category concentrates on the damage that will require mitigation expenditures in the future, and annualizes this expenditure to the current year.

The final type of estimate is the Annual or Cashflow expenditures on pavement repair of studded tire damage. Damage mitigation is projected by the year of failure of the pavement. The horizon for this category is projected for the years 2012-2022. The projections are bases on studded tire usage factors estimated from the 1995 and 2014 Studded Tire Surveys.

The three cost analyses utilize some common assumptions:

- Rut Limit – Pavements will require resurfacing when the rut is 0.75 inches or greater.
- Design Life- Pavements will require resurfacing or reconstruction when they reach the end of their design life. This is the expect life in the absent of ruts in the pavement.
- Studded tire use, passenger vehicle usage, and seasonal traffic level are factored in by Region.
- No distinction is made between types of asphalt surfaces. Wear rates used for asphalt are the same for open-graded and dense-graded mixes.

- Repair costs: The assumed method of rut is repair for the purpose of this report is a 2" overlay of asphalt. All lanes are assumed to be 12 feet wide. The overall cost of this is $98,300,000 per lane mile. This cost includes material costs, mobilization, traffic control, labor and other additional costs directly related to paving a 2" overlay. Cost estimates were found through the pavement management sections historic cost data for similar repairs on Oregon's state highway system and inflated for costs in 2012.

- Concrete overlays have to be over the whole section of highway while asphalt overlays can just be done in the affected lane. Since one cannot just overlay one lane of concrete pavement, the cost of a concrete overlay is considerably higher than that of asphalt. The shoulders and also need to be overlaid to match the grade of the pavement. Shoulders are assumed to be 10 feet and 6 feet wide, which is equivalent to adding 1.33 lanes to the pavement section.

- The same wear rate, as described in chapter 4, is used in all three types of cost analyses.

- Pavement Life. The Pavement Management Unit provided the Pavement Life displayed in Table 5.1.

Table 5.1: Pavement Life

Pavement Life		
	Asphalt	PCC
Short	12	30
Base	16	40
Long	20	50

- Lane distribution of total and heavy truck traffic. The Traffic Planning Analysis Unit provided the lane distributions for this report[4] displayed in Table 5.2.

Table 5.2: Lane Split Factors for Traffic and Trucks

Lane Split Factors for Total Traffic and Trucks						
	Two Lanes			Three Lanes		
	left	right		left	center	right
Total Traffic	37.5%	62.5%		26.0%	37.5%	36.5%
Heavy Truck Traffic	6.0%	94.0%		0.0%	6.0%	94.0%

- All vehicles are either heavy trucks or passenger vehicles.

[4] Unlike the estimation procedures for wear rate and total damage, it is necessary to assign rutting to a particular lane for the effective damage and expenditure projections. In the previous estimations, an assumption of linear dependence was made. However, the cost calculation is not a continuous function, but rather a discrete event: when the rut depth reaches 0.75", an expense occurs. It was necessary to utilize the "best" available information on lane split of traffic, and to make an additional assumption for the lane split of trucks

5.1 TOTAL DAMAGE COST ESTIMATE

The Total Damage cost model effectively "accumulates" all the rut depth into sections that are 0.75" deep, then calculates the cost for an equivalent number of lane-miles. For example, a three-mile lane section with 0.5" rut depth is equivalent to 2 miles with 0.75". The damage cost is then calculated for the two miles of asphalt overlay.

5.1.1 Total Damage Estimation Methodology

The total damage cost estimation procedure does not require linking studded tire traffic to any particular highway segment because all rutting is accumulated to meet the threshold. Overall traffic volume can be used rather than highway traffic data. Vehicle Miles Traveled[5] (VMT) data were provided by ODOT's Transportation Data Section. These data were broken down by region and surface type (asphalt and concrete). This data on regional VMT by pavement type are shown in Table 5.3.

Table 5.3: 2012 VMT by Surface Type

2012 VMT by Surface Type				
Region	**Asphalt**	**PCC**	**Other (Gravel)**	**Total**
1	5,501,079,552	791,309,422	0	6,292,388,974
2	6,014,883,455	644,487,497	0	6,659,370,952
3	2,419,580,250	322,498,448	27,084	2,742,105,782
4	2,009,086,545	43,818,581	60,829	2,052,965,956
5	1,342,391,632	330,055,909	72,395	1,672,519,936
Total	17,287,021,434	2,132,169,856	160,308	19,419,351,598

The 2014 survey revealed that actual studded tire use decreased between 1994 and 2014. In Region 1, the effective studded tire usage decreased from 15.6 percent in 1994 to 5.1 percent in 2014. Interpolating linearly, the Region 1 effective studded tire usage rate for 2012 used this study is 6.21 percent. In comparison, at the time of the 2000 study, studded tire use was expected to increase 2.5 % from 1996 to 2005. Figure 5.1 charts the 2000 study expected growth in the effective studded tire usage in Region 1 along with the current survey results.

[5] VMT = a measure of total mils traveled by all vehicles in the area for a specific time period.

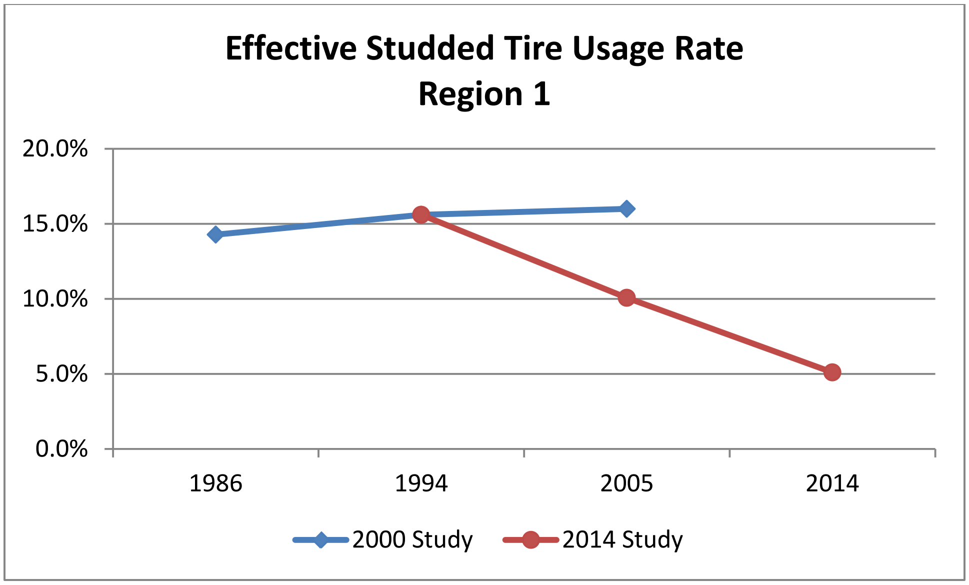

Figure 5.1: Studded Tire Usage Rate

Applying regional factors for passenger vehicles (Table 5.4), seasonal traffic volume and studded tire use, an estimate for Studded Tire VMT was generated for the year 2012.

Table 5.4: Regional Summaries

Regional Summaries					
	2012 % Passenger Vehicle	2012 % Seasonal Factors	1995 % Effective studded tire usage	2012 % Effective studded tire usage*	2014 % Effective studded tire usage
Reg 1	91.05	56.99	15.6	6.21	5.10
Reg 2	84.94	55.53	12.4	4.88	4.00
Reg 3	79.94	54.30	5.4	2.97	2.68
Reg 4	75.66	52.25	40.1	28.06	26.64
Reg 5	68.61	52.65	30.2	22.68	21.80

Then the estimated wear rate, a, was applied for each surface type using the relationship:

$$\mathbf{Rut_{12} = a * VMT_{12}}$$

The following steps were taken for both surface types in each region:

1. Studded tire VMT * wear rate = Total rut

2. The resulting number is equivalent to total rut depth. Since repair is assumed to take place when rut depth reaches a threshold of 0.75”, dividing by 0.75 yields the equivalent number of lane miles at the threshold.

3. $$\frac{\text{Total LnMi rut}}{0.75''} = \text{Total LnMi at Threshold}$$

4. Multiply Total Lane Miles at Threshold by the cost of repair per lane mile
   Total Mitigation Cost = Total LnMi at threshold * cost LnMi

5.1.2 Total Damage Cost Results

The model estimates that 2012 total studded tire traffic, using the base wear rate, produced damage equivalent to 0.75” rut depth on 6.95 lane miles of PCC and 200.53 lane miles of asphalt on the state highway system alone. The associated cost of repairing this level of damage is $27 million, with 97 percent of the costs for asphalt surfaces as shown in Table 5.5 and illustrated in Figure 5.2.

Table 5.5: Total cost of mitigating studded tire damage.

Mitigating Studded Tire Damage Cost	
Pavement	State Roads
Concrete	$ 910,582
Asphalt	$ 26,282,169
	$ 27,192,751

Studded Tire Pavement Damage Estimator For 2012

Region	Pavement Type	Gross VMT	% lt Veh	Seasonal Factor	% stud use	VMT season	IN/LN/MI Damage
1	Concrete	791,309,422	91.1%	57.0%	6.21%	25,498,612	2.32
1	Asphalt	5,501,079,552	91.1%	57.0%	6.21%	177,263,015	52.29
2	Concrete	644,487,497	84.9%	55.5%	4.88%	14,834,546	1.35
2	Asphalt	6,014,883,455	84.9%	55.5%	4.88%	138,448,090	40.84
3	Concrete	322,498,448	79.9%	54.3%	2.97%	4,157,651	0.38
3	Asphalt	2,419,580,250	79.9%	54.3%	2.97%	31,193,238	9.20
4	Concrete	43,818,581	75.7%	52.3%	28.06%	4,860,698	0.44
4	Asphalt	2,009,086,545	75.7%	52.3%	28.06%	222,863,498	65.74
5	Concrete	330,055,909	68.6%	52.6%	22.68%	26,994,379	2.46
5	Asphalt	1,342,391,632	68.6%	52.7%	22.68%	109,978,573	32.44

			Wear rates			
Damage Factors	Per Million VMT	Concrete	0.091	Inch/LANE/MILES Damages	Concrete	6.95
		Asphalt	0.295		Asphalt	200.53

Mitigating Strategy	Replacement Costs LN/MI	Threshold (inches)	Pavement Type	**Cost**
2" AC Overlay (PCC)	98,300	0.75	Concrete	$ 910,582
2" AC Overlay	98,300	0.75	Asphalt	$ 26,282,169
				$ 27,192,751

Figure 5.2: 2012 Studded Tire Pavement Damage Estimator for 2012

5.2 EFFECTIVE DAMAGE COST ESTIMATE

The *effective damage* cost estimate includes studded tire damage that is expected to reduce the useful life of pavement surfaces. Costs are assigned to the year in which the damage is incurred on an annualized basis, rather than linked to the year that the expenditure is made.

5.2.1 Effective Damage Estimation Methodology

The effective damage cost analysis utilizes a database provided by ODOT’s Pavement Management Section. The pavement database divides the state highway system into roughly 2,200 highway segments of various lengths. Beginning and ending mileposts designate each segment. Data provided include directional ADT and surface type. For each segment, only one ADT value is provided.

Unlike the wear rate estimation, the cost analysis requires isolating rutting to each particular lane. Total traffic is determined for each lane of highway. Studded tire traffic is then calculated using the regional factors for seasonal traffic and studded tire use.

The following steps are taken for each highway section in the pavement database:

Step 1: Split ADT by lane using lane distribution factors for total traffic to determine Lane Average Daily Traffic (LADT):

$$LADT = ADT * L_{x,y}\%$$

Where, $LADT_x$ = Average daily traffic for 2012 in lane x,

ADT = Average Daily Traffic for 2012,

$L_{x,y}$ = Lane factor for the x lane (Left, Center, Right) on a y (two or three) lane highway

Step 2: Adjust lane traffic to isolate passenger vehicle Lane ADT (PvLADT) using the assumed lane distribution of truck traffic.

$$PvLADT_x = LADT_x - (LADT_x * T_x * (1 - PV_k))$$

Where PV_k = fraction of passenger vehicle traffic in Region k, and

T_x = fraction of truck traffic in lane x

Step 3: Apply regional factors for seasonal volume and studded tire use to calculate 2012 studded tire traffic:

$$SP_x = PvLADT_x * 365 * S_k\% * ST_k\%$$

Step 4: Apply the appropriate wear rate, a, for each surface to calculate the rut depth attributable to 2012 traffic:

$$R_x = SP_x * a$$

Where, R_x = the estimated average rut depth along the entire lane x

Step 5: Calculate the Expected Life (EL), the expected number of years until the: pavement reaches the threshold rut depth of 0.75”:

$EL_x = 0.75''/R_x$

Where, EL_x = the Expected Life of lane x of the pavement section

Step 6 Determine whether studded tire traffic will reduce the pavement life:

If the Expected Life is less than the Design Life (DL) for the surface type, then the studded tire traffic is considered sufficient to reduce the useful life of the pavement.

For asphalt, a cost is calculated if the following criterion is met:

If $EL_x < DL$,

Then a cost is charged.

Recall that when any lane of a PCC surface highway requires an overlay, the entire width of the road, as well as the shoulders, must be overlaid. A cost is charged for PCC surfaces[6] when the following conditional criterion is met:

$(EL_L \text{ or } EL_C \text{ or } EL_R) < DL$,

Where, EL_L = EL for the left lane, EL_C = EL for the center lane, EL_R = EL for the right lane,

Step 7. Cost calculation:

The cost of an asphalt overlay attributed to 2012 ($cost^{12}$) is based on an even distribution of the overlay cost among the years of useful life of the pavement:

[6] Sections of pavement with PCC in only one direction and asphalt in the other are charged as PCC surfaces

For Asphalt,

Total Cost = $98,300*LnMi

$Cost^{12}$ = Total Cost ÷ EL_x

For PCC,

Total Cost = $98,300*LnMi*(Lanes + 1.333)

$Cost^{12}$ = Total Cost ÷ EL

Where, Lanes = the number of lanes, and

1.333 = the lane equivalent of adding both shoulders.

5.2.2 Effective Damage Cost Results

The cost estimates do not necessarily represent expenditures made during 2012, but rather damage incurred during 2012. A summary of the costs for the Base design life - per region - is provided in Table 5.6 while the statewide design life estimates for Short, Base, and Long are summarized in Table 5.7.

Table 5.6: Summary of Effective Cost estimates, Base case*

	Asphalt	PCC	Total Cost
Region 1	**$4,312,163**	**$103,462**	**$4,415,625**
Region 2	**$43,286**	**$0**	**$43,286**
Region 3	**$0**	**$0**	**$0**
Region 4	**$3,918,429**	**$74,777**	**$3,993,206**
Region 5	**$86,927**	**$0**	**$86,927**
Statewide	**$8,360,805**	**$178,239**	**$8,539,044**

Asphalt design life and wear rate: 16 years, 0.0295
PCC design life and wear rate: 40 years, 0.0091

The results indicate the cost of effective damage from studded tires, in the base case scenario, was slightly over $8.5 million in 2012 for the state highway system. In the Base case, 98 percent of the cost is for asphalt surfaces, which is by far the predominant surface type in Oregon. Most of the costs, 52 percent, occur in Region 1. That is not unusual due to the high volume interstate highways located in Region 1, and the high proportion of PCC surface roads. PCC surface roads are costly to overlay because all lanes must be resurfaced if any lane is resurfaced. Approximately 46 percent of the total statewide costs occur in Region 4 with 98 percent of the costs attributed to asphalt, which has relatively low volumes but high studded tire use. Region 5 accounted for 1 percent of statewide costs while Region 2 occasioned only 1/2 percent of the cost. Regions 3 contributed none of the effective damage cost in the Base case.

Table 5.7: Summary of Effective Cost Estimates

Design Life	Asphalt	PCC	Total Cost
Short	**$5,727,427**	**$52,243**	**$5,779,670**
Base	**$8,360,805**	**$178,239**	**$8,539,044**
Long	**$10,960,145**	**$333,407**	**$11,293,552**

The three scenarios result in cost estimates ranging from slightly less than $5.8 million to slightly greater than $11.2 million, depending on the design life values used. The design life, as used in this study, is basically the expected useful life of a pavement surface in the absence of studded tires. A shorter design life lowers the cost estimate because it lowers the relative impact of studded tire damage on the useful life. The actual useful life of a pavement is influenced by many factors, such as construction design, aggregate type and size, other materials, climate and traffic conditions. Furthermore, the determination of a useful life is by no means uniform in all cases. Some differences of opinion exist regarding the level of damage when a pavement absolutely requires repair or reconstruction.

5.3 PROJECTED EXPENDITURES FOR MITIGATING STUDDED TIRE DAMAGE

The expenditure projections utilize the same pavement database that was used in the effective damage cost estimation. Historical growth factors for studded tire use and traffic volume were used to calculate the total studded tire traffic over the life of each pavement section. Application of the wear rate estimate produced an estimate of accumulated rut depth as of 2012. Pavement sections that had acquired ruts greater that the threshold prior to 2012 were assumed to have been inlayed and the costs were not charged. Then, using forecasted growth rates, cumulative rut depth was estimated for each year through 2022.

The model assumes there are two possible reasons that a road section will require some rehabilitative action. First, if the pavement age reaches its design life, the entire road section is reconstructed due to deterioration other than studded tire damage. No cost is charged to studded tire use. Second, if the pavement has not yet reached its design life, and its rut depth due to studded tire traffic reaches 0.75", then an asphalt overly is required. In these cases, the entire cost of the overlay is charged to studded tire use.

In either case, the surface in the following year is assumed to be brand new, with no accumulated rutting. When PCC surfaces are overlaid, the surface becomes asphalt until the original design life dictates that reconstruction takes place. The decision processes for PCC and asphalt are illustrated in the flow charts in Figure 5.3 and 5.4.

5.3.1 Methodology

Step 1. As in the methodology for the effective damage cost estimation, calculate studded tire traffic for each lane for 2012.

Step 2. Calculate the lifetime studded tire traffic using effective growth figures and the equations in the manner specified in Section 4.1.5.

Step 3. Apply wear rates to estimate the total rut depth accumulated as of 2012.

$$\text{Total Rut} = \text{Splife} * a$$

Step 4. Determine action: Determine whether reconstruction (due to age) or asphalt overlay (due to rutting) or no action is needed. Apply cost for overlays (only in 2012); no cost is charged for reconstruction. In both cases, the pavement age is adjusted to 1 year in 2013.

Step 5. 2013 (and subsequent years): apply forecasted growth rate for traffic and studded tire use to estimate the studded tire traffic for 2013. Apply wear rate and add to last year’s cumulative rut. If the surface age is 1 year, last year’s rut was 0.

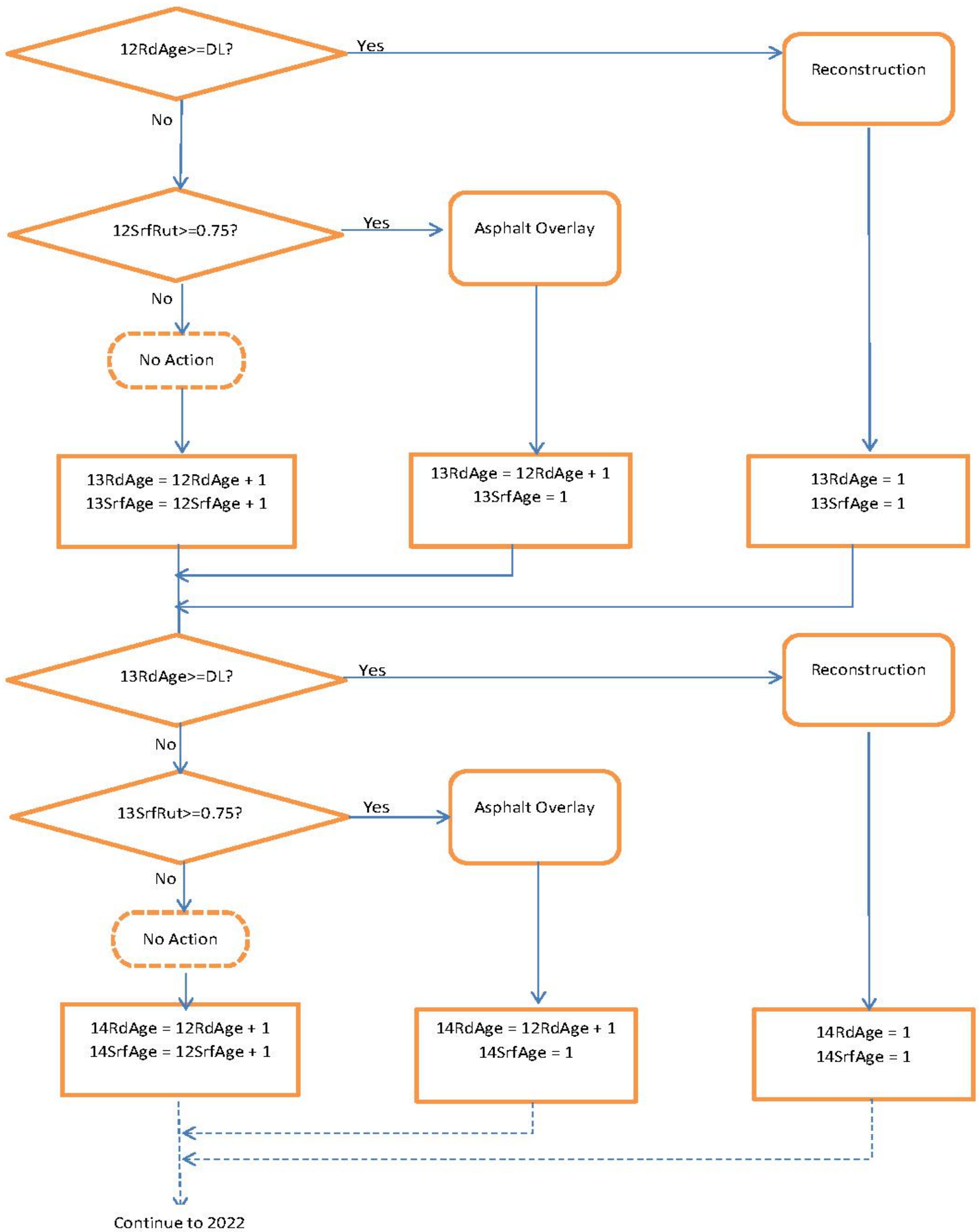

Figure 5.3: Decision Process for Asphalt Pavement

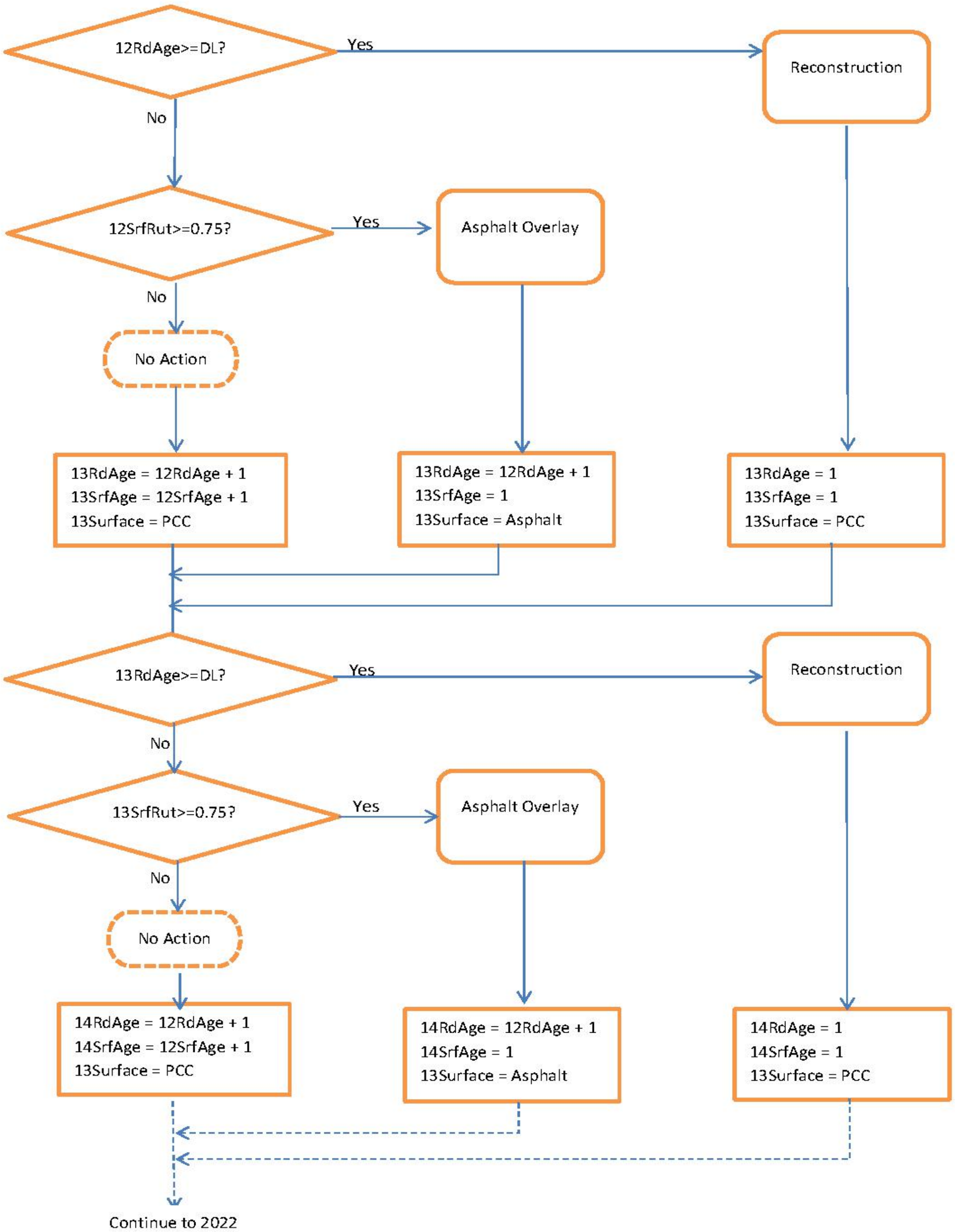

Figure 5.4: Decision Process for PCC Pavement

5.3.2 Estimates of Projected Expenditures for Mitigation of Studded Tire Damage

Summaries of expenditures projected under the Base scenario are shown in Figures 5.5 and 5.6. The base design life of 16 years for asphalt, and 40 years for PCC are considered. The Base Case model estimates that total expenditures for repairing studded tire damage will be just above $44 million for the 11 years spanning 2012 to 2022.

	ASPHALT					
	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	**Statewide**
2012	749,046	796,230	0	2,772,060	941,714	5,259,050
2013	4,208,082	702,339	0	2,110,985	0	7,021,406
2014	2,790,105	0	0	2,705,616	326,167	5,821,888
2015	1,223,406	0	0	4,612,097	78,662	5,914,165
2016	1,582,269	0	0	2,086,761	0	3,669,030
2017	2,399,950	0	0	1,481,319	0	3,881,269
2018	219,128	0	0	2,281,129	0	2,500,257
2019	1,651,766	0	0	774,125	0	2,425,891
2020	403,883	0	0	1,428,593	0	1,832,476
2021	167,994	0	0	991,400	179,824	1,339,218
2022	0	0	0	3,865,983	0	3,865,983
11-year	**15,395,629**	**1,498,569**	**0**	**25,110,068**	**1,526,367**	**43,530,633**

	PCC					
	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	**Statewide**
2012	648,289	0	0	0	0	648,289
2013	0	0	0	0	0	0
2014	0	0	0	0	0	0
2015	0	0	0	0	0	0
2016	0	0	0	0	0	0
2017	0	0	0	0	0	0
2018	0	0	0	0	0	0
2019	0	0	0	0	0	0
2020	0	0	0	0	0	0
2021	0	0	0	0	0	0
2022	0	0	0	0	0	0
11-year	**648,289**	**0**	**0**	**0**	**0**	**648,289**

Effective Studded Tire Usage (%)			
Region	1995	2014	annual delta
1	15.60	5.10	-0.55
2	12.40	4.00	-0.44
3	5.40	2.68	-0.14
4	40.10	26.64	-0.14
5	30.20	21.80	-0.44

	Design Life	
	Asphalt	PCC
Base	16	40

AC and PCC Total	
	Projected Repair Totals
2012	**$ 5,907,339**
2013	**$ 7,021,406**
2014	**$ 5,821,888**
2015	**$ 5,914,165**
2016	**$ 3,669,030**
2017	**$ 3,881,269**
2018	**$ 2,500,257**
2019	**$ 2,425,891**
2020	**$ 1,832,476**
2021	**$ 1,339,218**
2022	**$ 3,865,983**
total	**44,178,922**

Figure 5.5: Summaries of expenditures projected under the Base scenario

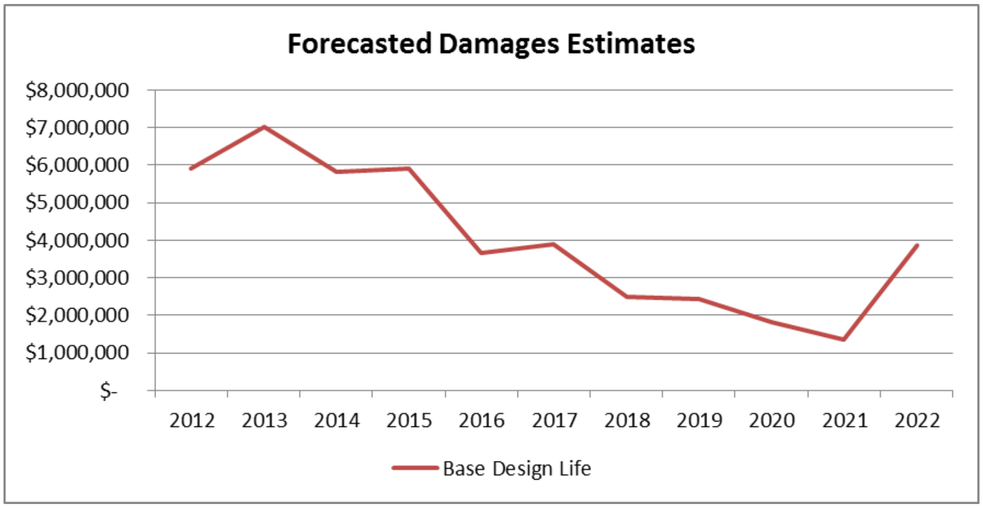

Figure 5.6: Forecasted Damages Estimates

Summaries of expenditures projected under the Short Design life and Long Design Life scenarios are shown in Appendix E.

6.0 SUMMARY OF FINDINGS

- Studded tires improve the braking, traction and cornering performance of vehicles on icy surfaces. The improved handling can be offset by a slight increase in driving speed. Research shows that non-studded winter tires perform as well or better than studded tires in almost all winter driving conditions.

- The use of studded tires in Oregon has declined since the previous survey was taken in 1995. While the survey conducted in 1995 determined that about 16 percent of registered vehicles in Oregon were equipped with studded tires, the survey taken for the 2013-14 winter season found a reduction in that number to about 4 percent.

- Another significant change was from a mix of cars equipped with studded tires on either the driving axle or both axles in 1995 to almost all cars equipped with studded tires on both axles today.

- Wide ranges of wear rates were found for various sections of PCC and asphalt pavements. This reflects the many factors that contribute to pavement rutting susceptibility. PCC is more resistant to rutting than asphalt. Within the asphalt pavements, there was no obvious advantage of open-graded mixes over dense-graded mixes. The PCC wear rate is about 0.0091 inches per 100,000 studded tire passes, while the wear rate of asphalt pavement is about 0.0295 inches per 100,000 studded tire passes.

- An estimate of the total pavement damage caused by studded tire in 2012 indicates a mitigation cost of about $27 million for the state highway system (county and city roads were not included in this study due to a lack of available traffic data).

- An estimate of effective pavement damage - damage sufficient to reduce the useful pavement life - indicates that mitigating damage caused by 2012 studded tire traffic will cost over $8.5 million for the state highway system. This is the base pavement life case scenario among three different estimates ranging from $5.8 million on the low side to a maximum of $11.3 million.

- Expenditures for repairing studded tire damage for 11 years were projected to total around $44.2 million by 2022. This estimate represents the base pavement design life. The three scenarios of short, base, and long pavement life range from $26.8 million up to a high of $64.4 million. All estimates are for the state highway system alone.

- Considering studded tire alternatives and popularity of all-wheel and four-wheel drive vehicles, studded tire use and the resulting damage of the pavements is expected to continue to decline while pavement life is expected to remain constant. Going forward, it seems that the most plausible scenario for the 11- year expenditures will be the base scenario of $44.2 million.

7.0 REFERENCES

Anderson, K.W., J. Uhlmeyer, M. Russell, J. Weston. *Studded Tire Wear Resistance of PCC Pavement Special Mix Designs*. Washington State Department of Transportation, 2011.

Angerinos, M.J., J. Mahoney, R. Moore, and A. O'Brien. *A Synthesis On Studded Tires*.Washington State Department of Transportation, Olympia, WA, 1999.

Asano, M., M. Hirasawa, and S. Oikawa. Recent Situation of Winter Road Management and Traffic Accidents in Hokkaido. *Transportation Research Record,* No. 1741, Washington D.C., 2001.

Cotter, A., S.T. Muench. *Studded Tire Wear on Portland Cement Concrete Pavement in the Washington State Department of Transportation Route Network*. University of Washington, Washington State Transportation Center, Washington State Department of Transportation, 2010.

Fridstrom, L. The Safety Effect of Studded Tyres in Norwegian Cities. *Nordic Road and Transport Research*, No. 1, 2001.

Malik, M.G. *Studded Tires in Oregon*. Oregon Department of Transportation, Salem, Oregon, 2000.

Scheibe, R.R. *An Overview of Studded and Studless Tire Traction and Safety*. University of Washington, Washington State Transportation Center, Washington State Department of Transportation, 2002.

APPENDIX A

OREGON DEPARTMENT OF TRANSPORTATION STUDDED TIRE USAGE PHONE SURVEY

Final Results Report

Oregon Department of Transportation Studded Tire Usage Phone Survey

Portland State University

Survey Research Lab

This report was prepared for:

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Introduction

The Survey Research Lab (SRL) at Portland State University (PSU) assisted the Oregon Department of Transportation (ODOT) Research Unit in implementing a random household phone survey of Oregon residents. The purpose of the survey was to document studded and non-studded winter tires and winter travel behaviors of motorists driving in Oregon. This study was based on a similar survey conducted in 1995. SRL worked collaboratively with ODOT to revise the previous survey, develop a sampling plan, and implement the statewide phone survey.

Survey calling began on April 14, 2014 and concluded on May 19, 2014, for a total of 29 phone survey calling days. A final total of 1,944 people completed the survey distributed across the State and organized into five regions. The overall response rate was 23.7% and the statewide sampling error was ±2.22%. Sampling errors for each of the five regions ranged from ±4.96% to ±4.99%.

This report provides a summary of the methodology employed for the survey, as well as a presentation of the findings, including selected regional comparisons.

Methodology

The SRL worked closely with ODOT research staff to review and revise the 1995 studded tire survey instrument, maintaining the same item content whenever possible to allow for longitudinal comparisons between the 1995 and 2014 data. The changes to existing questions were not extensive and mainly focused on clarity, providing definitions, adding options, and making adjustments to the survey formatting. The biggest change implemented in 2014 was including a new survey section that focused on non-studded winter tire usage. This new series of questions mirrored the 1995 survey items that focused on studded tire usage.

The finalized survey instrument was programmed in Voxco Virtual Call Center (VCC)[1] software. SRL staff conducted internal pre-testing to ensure appropriate wording of questions, correct functioning of all skip patterns, and accurate data collection. A copy of the final survey is included in Appendix A of this report.

Once the survey was finalized, the project training included the SRL Senior Research Assistant, two interview coordinators, and thirteen interviewers. The Senior Research Assistant provided an overview of the background and purpose of the survey to familiarize interviewers with the context within which the survey was being conducted. This was followed by a round-table review of the entire survey in order to review the survey items, discuss idiosyncratic issues related to the population being surveyed, and clarify the investigator's data needs. Finally, interviewers participated in on-line practice of the survey before going live. Any remaining issues were discussed with ODOT research staff and final changes were implemented.

Survey calling started on **April 14, 2014** and concluded on **May 19, 2014**, and resulted in **1,944 completed surveys.** Calls were made during both weekdays and weekends, in the afternoon and evening hours, until calling was complete.

Coordinators provided on-site monitoring and supervision during all calling hours to ensure the highest quality data collection, as well as accurate real-time data entry. For quality assurance purposes, the Interview Coordinators frequently monitored interviewers, with the level of monitoring varying depending upon the individual needs of each interviewer. The interview monitoring was live and involved the Coordinator patching into the telephone conversation to listen to the interviewer conducting the survey, as well as viewing the interviewer's input of the data being collected. The Computer Assisted Telephone Interviewing (CATI) software allowed the Coordinators to pull up the live interview on their computer screen to view the real-time typing, away from the interviewer's view for reduced distraction. Interviewers were then given immediate feedback. Additional quality assurance checks were conducted repeatedly throughout survey calling, with a higher frequency at the beginning of calling. These included the Senior Research Assistant reviewing the collected data and the Interview Coordinators continuously overseeing the data collection process. Any issues that came up during the survey were quickly resolved with ODOT staff.

[1] http://www.voxco.com

Sampling Plan and Margin of Error

The SRL worked with ODOT to develop a target number of completes based on the goals of achieving a response rate of at least 20% and being able to generalize the findings to the population of interest within each of the five regions. The goal of completing 1,920 surveys was established in order to achieve a sample error of ±5% in each of the five geographic regions in Oregon. This was based on a goal of 384 completed surveys in each region in order to generalize the survey findings to the populations of each region. Also, a sufficient number of completed surveys in each region was desired in order to conduct statistical comparisons across the regions to determine significant differences, if any existed.

The SRL purchased a sample of 21,900 phone numbers distributed proportional to the populations of the 36 counties in the State of Oregon[2]. This sample consisted of 10,080 listed, 4,320 randomly generated unlisted, and 3,750 cell phone numbers. Once the sample was received, it was formatted to be uploaded and seven replicates of randomly selected numbers distributed proportionally across the regions and sample types for gradual and systematic uploading. Overall, only 12,725 sample records were loaded (10,230 unlisted and listed, and 2,495 cell phone numbers) to maintain the highest possible response rate, reduce nonresponse bias, and achieve the total number of targeted completes.

Determining the margin of error (i.e., the level of accuracy we have in the results) requires (a) knowledge of the final sample size, (b) the population from which the sample was drawn, (c) the confidence we would like to have that the data gathered from the sample is representative of the entire population, and (d) knowledge of the population's variability on a key characteristic (Kraemer & Thiemann, 1987[3]; Dillman, 2000[4]; Fowler, 1993[5]). The commonly accepted value for sampling error is plus or minus five percent (denoted ±5%) and a typical confidence interval used in survey research is 95%. For the current survey, the maximum variation was used. Based on these assumptions, the achieved sample size of 1,920 completed surveys, and an estimated Oregon population[6] of 3,919,020, the final sampling error was ±2.22%. The sampling errors for the individual regions ranged from ±4.96% to ±4.99%.

Following the data collection period, SRL submitted a final status report to the ODOT staff that itemized the status of all the telephone numbers in the sample. The numbers were divided into two groups, active and resolved, and these two groups were further subdivided into call disposition codes. The final counts for the resolved and active disposition codes are presented in Table 1. The average length of a completed survey was 7.76 minutes.

[2] Sample purchased from Marketing Systems Group, http://www.m-s-g.com.
[3] Kraemer, H.S. & Thiemann, S. (1987). How many subjects? Newbury Park, CA: Sage.
[4] Dillman, D.A. (2000). Mail and internet surveys: The tailored design method. NY: Wiley.
[5] Fowler, F.J.,Jr. (1993). Survey research methods (2nd ed.). Newbury Park, CA: Sage.
[6] Portland State University, Population Research Center. (2013). Population estimates for Oregon and Counties. http://www.pdx.edu/prc/sites/www.pdx.edu.prc/files/2013CertifiedPopEst_web_StateCounties.pdf

Table 1: Survey Resolved and Active Disposition Codes		
Disposition Codes: Resolved Records	Count	Percent
Completed interviews	1,944	28.7%
Fax machine*[7]	162	2.4%
Cell phone refusal**	9	0.1%
Non-working, disconnected number*	3,817	56.4%
Non-residential number*	485	7.2%
Language/Disability barrier	114	1.7%
Group home (assisted living, nursing, dorm)*	10	0.1%
Suspend without callback**	66	1.0%
R DK/RF county question**	2	0.0%
Non-OR resident or driver	28	0.4%
Region Quota Full / Removed Data Quality Issue	5	0.1%
Refusal - Never callback**	123	1.8%
Total Resolved Records	**6,765**	**100%**
Disposition Codes: Active Records	Count	Percent
Answering machine/Voicemail	3,398	57.0%
Busy	214	3.6%
No answer	631	10.6%
Specific English callback	25	0.4%
Suspend with English callback	0	0.0%
Generic English callback	310	5.2%
Refusal**	443	7.4%
Immediate Hang Up**	935	15.7%
Not yet called*	4	0.1%
Total Active Records	**5,960**	**100%**
Total Sample	**12,725**	**100%**

[7] Asterisks (* and **) will be defined in the *Response and Refusal Rates* section of this report.

Response and Refusal Rates

Initially, the response rate goal for the telephone survey was 20%. The actual, final response rate for this survey was calculated two different ways. It was first calculated using all eligible numbers in the denominator, which includes all of the numbers within the resolved and active disposition codes listed in Table 1 ***except*** for numbers classified as fax machine, non-working/disconnected, non-residential, group home, or not yet called (denoted with an asterisk, *). This calculation resulted in a **response rate of 23.67% for eligible numbers**. The second approach to calculating the response rate was based on only resolved numbers. This includes both the eligible and ineligible resolved numbers, but excludes any numbers that are not resolved (i.e., active numbers). This rate represents the proportion of all resolved numbers that are actually completed surveys. This alternate calculation resulted in a **response rate of 28.74% for resolved numbers**. The refusal rate was also calculated, using any numbers classified as a cell phone refusal, suspended without callback, refusal-never callback, refusal, or immediate hang up (denoted with two asterisks, ** in Table 1). These counts were considered relative to the total eligible sample, resulting in a **refusal rate of 19.21%**.

Final Count of Completed Surveys

A final total of 1,944 surveys were completed with people who reside in or drive in the State of Oregon. Table 2 presents the final number of completed surveys for each region and Table 3 presents the distribution of completed surveys by Oregon county, grouped by region.

Table 2: Number of Completed Surveys

State of Oregon Regions	Original Completed Survey Goal	Actual Completed Survey Count
Region 1: Clackamas, Columbia, Hood River, Multnomah, Washington	384	386
Region 2: Benton, Clatsop, Lane, Lincoln, Linn, Marion, Polk, Tillamook, Yamhill	384	390
Region 3: Coos, Curry, Douglas, Jackson, Josephine	384	386
Region 4: Crook, Deschutes, Gilliam, Jefferson, Klamath, Lake, Sherman, Wasco, Wheeler	384	386
Region 5: Baker, Grant, Harney, Malheur, Morrow, Umatilla, Union, Wallowa	384	386
Live Outside of, but Drive in Oregon	0	10
TOTALS	**1,920**	**1,944**

Table 3:	Distribution of Completed Surveys by Oregon County (n=1,944 households)	
Region 1	Count	Percent
Clackamas	97	5.0%
Columbia	14	0.7%
Hood River	5	0.3%
Multnomah	157	8.1%
Washington	113	5.8%
Region 2	Count	Percent
Benton	32	1.7%
Clatsop	20	1.0%
Lane	126	6.5%
Lincoln	14	0.7%
Linn	46	2.4%
Marion	83	4.3%
Polk	28	1.4%
Tillamook	15	0.8%
Yamhill	26	1.3%
Region 3	Count	Percent
Coos	48	2.5%
Curry	20	1.0%
Douglas	93	4.8%
Jackson	156	8.1%
Josephine	69	3.6%
Region 4	Count	Percent
Crook	18	0.9%
Deschutes	188	9.7%
Gilliam	2	0.1%
Jefferson	25	1.3%
Klamath	109	5.6%
Lake	8	0.4%
Sherman	7	0.4%
Wasco	26	1.3%
Wheeler	3	0.2%
Region 5	Count	Percent
Baker	51	2.6%
Grant	25	1.3%
Harney	23	1.2%
Malheur	44	2.3%
Morrow	25	1.3%
Umatilla	133	6.9%
Union	57	2.9%
Wallowa	28	1.4%

Respondent Demographics

Table 4 presents the demographic characteristics of the entire sample of respondents who participated in the survey.

Table 4: Respondent Demographics (N=1,944 households)

Gender	Count	Percent
Male	806	41.5%
Female	1138	58.5%
Missing or Refused	0	0.0%
Education Level	Count	Percent
Less than 12th grade (not a high school graduate)	82	4.2%
High School Graduate or GED	446	22.9%
Some College or Other Post-Secondary Education	535	27.5%
Associates Degree or Technical Degree (AA or AS)	181	9.3%
Bachelor’s Degree (BA, AB, BS)	368	18.9%
Some Post-Graduate	54	2.8%
Master’s Degree	201	10.3%
Other Professional or Doctoral Degree	55	2.8%
Don’t Know	9	0.5%
Missing or Refused	13	0.7%
Age	Count	Percent
18 - 29 years old	102	5.2%
30 - 49 years old	318	16.4%
50 - 64 years old	611	31.4%
65 or older	906	46.6%
Missing or Refused	7	0.4%
Number of People Living in Household (mean=2.38, standard deviation=1.364)	Count	Percent
1	436	22.4%
2	921	47.4%
3	250	12.9%
4	171	8.8%
5	76	3.9%
6	35	1.8%
7	22	1.1%
8	4	0.2%
9	7	0.4%
10	2	0.1%
11	1	0.1%
Missing or Refused	19	1.0%

Table 4: Respondent Demographics (N=1,944 households)		
Race or Ethnicity	**Count**	**Percent**
White or Caucasian	1781	91.6%
Black or African-American	10	0.5%
Asian or Asian-American	21	1.1%
American-Indian or Alaskan Native	41	2.1%
Native Hawaiian or other Pacific Islander	12	0.6%
Spanish, Hispanic, or Latino	51	2.6%
Other (Please Specify)	4	0.2%
Don't Know	2	0.1%
Missing or Refused	73	3.8%
Household Income	**Count**	**Percent**
Less than $10,000	79	4.1%
$10,000 to $14,999	100	5.1%
$15,000 to $24,999	201	10.3%
$25,000 to $34,999	211	10.9%
$35,000 to $49,999	208	10.7%
$50,000 to $74,999	315	16.2%
$75,000 to $99,999	205	10.5%
$100,000 or more	271	13.9%
Don't Know	67	3.4%
Missing or Refused	287	14.8%

Weighting

Using a sampling approach focused on completing a similar number of completed surveys within each of the five geographic regions, resulted in a distribution of surveys that does not reflect the actual distribution of the Oregon households. Also, the distribution of respondent ages does not reflect the distribution of licensed drivers (the subset of the population of interest for this survey)[8]. For those reasons, statistical weighting was used to adjust for the artificially increased influence of lower populated regions and older drivers. To create the weights, US Census data was queried to identify the total number of households in each region and Oregon DMV data was used to identify the number of licensed drivers in each age grouping used in the survey[9]. Each weight was calculated by multiplying the percentage found in the population to the sample size of completed surveys. This results in a count of completed surveys that is in proportion to the number of households in each region or number of people in a given age group. For example, the proportion of households in Region 1 is 44.7% of the total number of households in Oregon. Applying that percentage to the 1,934[10] total surveys completed, results in an adjusted sample size of 864 for Region 1. The weight is calculated by dividing the adjusted sample size by the actual sample size. For Region 1, 864 divided by 386 results in a weight of 2.2383. The same approach was used to calculate the age weights. Table 5

[8] The other demographic variables were not considered in the weighting process due to either reasonable comparability with existing data for Oregon households or licensed drivers (e.g., household income) or no data available for those variables for licensed drivers in Oregon (e.g., race or ethnicity).

[9] http://www.oregon.gov/ODOT/DMV/docs/stats/age/2013_Age_Summary.PDF

[10] The ten respondents living outside of, but driving in Oregon, could not be assigned to any of the five regions, so they had to be excluded.

presents all of the region and age group weights. To apply both of those weights simultaneously to the data file, they were multiplied together for each respondent based on their region and age group. For example, the weight applied for a 50-64 year old in Region 2 was 1.2303.

Table 5: Calculated Weights for Region and Age Groups

State of Oregon Regions	Region Weight	Age Group	Age Weight
Region 1	2.2383	18 to 29 Years	3.7221
Region 2	1.4667	30 to 49 Years	2.1532
Region 3	0.6606	50 to 64 Years	0.8388
Region 4	0.4093	65 Years or Older	0.4086
Region 5	0.2228		

Once the weights were applied to the data file, the counts of completed surveys for each region changed, with Regions 1 and 2 increasing, and Regions 3, 4 and 5 decreasing. Also, due to the overall effect of using weighting for both geography and age, the total number of completed surveys increased. Table 6 presents the weighted counts of completed surveys by region and Table 7 presents the weighted respondent demographics.

Table 6: Weighted Counts of Completed Surveys

State of Oregon Regions	Weighted Completed Surveys Count	Weighted Completed Surveys Percent
Region 1: Clackamas, Columbia, Hood River, Multnomah, Washington	988	47.7%
Region 2: Benton, Clatsop, Lane, Lincoln, Linn, Marion, Polk, Tillamook, Yamhill,	625	30.1%
Region 3: Coos, Curry, Douglas, Jackson, Josephine	234	11.3%
Region 4: Crook, Deschutes, Gilliam, Jefferson, Klamath, Lake, Sherman, Wasco, Wheeler	148	7.1%
Region 5: Baker, Grant, Harney, Malheur, Morrow, Umatilla, Union, Wallowa	78	3.8%
TOTALS	**2,073**	**100%**

NOTE: Data weighted for region and age.

Table 7: Weighted Respondent Demographics

Gender	Count	Percent
Male	971	46.9%
Female	1102	53.1%
Education Level	**Count**	**Percent**
Less than 12th grade (not a high school graduate)	93	4.5%
High School Graduate or GED	398	19.2%
Some College or Other Post-Secondary Education	531	25.6%
Associates Degree or Technical Degree (AA or AS)	238	11.5%
Bachelor’s Degree (BA, AB, BS)	489	23.6%
Some Post-Graduate	36	1.7%

Table 7: Weighted Respondent Demographics

Education Level (cont.)	Count	Percent
Master's Degree	227	11.0%
Other Professional or Doctoral Degree	45	2.2%
Don't Know	4	0.2%
Missing or Refused	12	0.6%

Age	Count	Percent
18 - 29 years old	484	23.3%
30 - 49 years old	723	34.9%
50 - 64 years old	507	24.5%
65 or older	349	16.9%
Missing or Refused	9	0.5%

Number of People Living in Household (mean=3.03, standard deviation=1.706)	Count	Percent
1	286	13.8%
2	721	34.8%
3	365	17.6%
4	357	17.2%
5	156	7.5%
6	74	3.6%
7	38	1.8%
8	10	0.5%
9	34	1.6%
10	7	0.3%
11	0	0.0%
Missing or Refused	25	1.2%

Race or Ethnicity	Count	Percent
White or Caucasian	1801	86.9%
Black or African-American	30	1.4%
Asian or Asian-American	47	2.3%
American-Indian or Alaskan Native	48	2.3%
Native Hawaiian or other Pacific Islander	25	1.2%
Spanish, Hispanic, or Latino	110	5.3%
Other (Please Specify)	2	0.1%
Don't Know	3	0.1%
Missing or Refused	72	3.5%

Household Income	Count	Percent
Less than $10,000	96	4.6%
$10,000 to $14,999	105	5.0%
$15,000 to $24,999	178	8.6%
$25,000 to $34,999	198	9.6%

Table 7: Weighted Respondent Demographics		
Household Income (cont.)	Count	Percent
$35,000 to $49,999	212	10.2%
$50,000 to $74,999	351	16.9%
$75,000 to $99,999	227	10.9%
$100,000 or more	405	19.5%
Don't Know	69	3.3%
Missing or Refused	232	11.2%

NOTE: Data weighted for region and age.

The weighting based on region and age was used for the presentation of all the statewide findings presented in the body of this report, as well as for the regional findings presented in the detailed tables in Appendix B of this report. However, for the regional comparisons the weighting approach was adjusted. When conducting statistical tests across groups, it is important to ensure that the sample size is large enough to detect a significant difference, if one exists. In addition, for the significance tests to be valid, comparable sample sizes across the groups is important. Leaving the statewide weighting on for these comparisons would have resulted in insufficient sample sizes in Regions 4 and 5 (minimum necessary based on a power analysis is 170) and the variation in sample sizes would have reduced the validity of the tests. However, it was important to maintain the adjustment for the disproportional age groups; therefore, the data was weighted to adjust for age. The weights for each age group were calculated using the approach described above, but based on the proportion of licensed drivers in each age group within each region. The age weights applied for the regional comparisons presented in this report are listed in Table 8.

Table 8: Calculated Weights for Age Groups Applied for Regional Comparisons				
State of Oregon Regions	18-29 Years Weight	30-49 Years Weight	50-64 Years Weight	65 Years or Older Weight
Region 1	2.6026	2.0215	0.7805	0.3709
Region 2	2.2760	2.1463	0.8945	0.4488
Region 3	5.7909	1.6886	0.9868	0.5187
Region 4	5.1328	2.0614	0.8215	0.4892
Region 5	6.1378	2.0869	0.8389	0.4583

Analytic Approach

Throughout the survey, two different types of items were included: numeric and categorical. Numeric items involve asking respondents for answers that represent a quantity of something that can be represented by continuous values. For example, respondents were asked a question about the number of working vehicles that are owned or leased by people in their household. The answers could range from zero to any number of vehicles along a continuous scale of values. For these items, averages (also called means) can be calculated and statistical tests (t-tests) can compare the means of multiple groups (i.e., regions). An ANOVA (analysis of variance) determines whether or not the difference between the means of multiple groups is greater than would be expected by chance. This test also takes into account the standard deviation (i.e., spread of responses) around the mean when calculating statistical significance.

Categorical items involve asking respondents for answers that are labels or words. For example, items that result in a Yes or No response are categorical. Another example of categorical items in this survey are those that ask respondents to choose between a series of response options (e.g., vehicle is mainly used for work, leisure, shopping, all purposes, or something else). The data that results from these items is not numeric and mathematical functions (e.g., calculating means and standard deviations) cannot be applied to them. For data from these items, the statistical test that was used to consider differences across groups was the chi-square test (denoted χ^2). The chi-square test considers whether the array of responses (e.g., a 5 by 3 table of responses from five groups being compared on a survey item with three possible responses) is different than would be expected by chance.

With both of those analyses (i.e., ANOVAs and chi-square tests), the end result is a statistic (i.e., F or χ^2) and a probability value. Probability is denoted with a p and is considered statistically significant if it is less than 5% (a commonly accepted level of significance). In this report, significance is listed as $p < .05$ or $p < .01$ or $p < .001$, each of which indicates the level of how probable the difference is due to chance. A significance test with a $p < .05$ means that the difference between the two groups has a less than 5% probability of being due to chance. Alternatively, it means that there is a 95% probability that the difference between the two groups is due to something other than chance variation (e.g., people behave differently across the regions).

Finally, when presenting findings, it is common practice to identify the total sample size and analysis used. Due to the various skip patterns throughout the survey, different sample sizes are represented throughout this report to denote the number of respondents, households or vehicles that each data presentation represents. Also, when conducting statistical significance tests, responses that did not have meaning related to the question were excluded (e.g., don't know, refused, not applicable), the actual sample size was referenced, which might vary from sample sizes presented elsewhere in this report. In all cases, the reader should use caution when interpreting the results presented in tables and figures, noting the total sample size being referenced.

Findings

Vehicles and Studded Tire Usage – Statewide

Across all Oregon respondents, the 2,073 households had a total of 4,723 vehicles[11], for an average of 2.28 vehicles per household. The majority of households had either two vehicles (41.1%), three vehicles (19.9%) or one vehicle (19.3%), and only 5.0% of households had no vehicles. Two hundred twenty-one (10.7%) of households had studded tires on at least one vehicle during the most recent winter season (Fall 2013 to Spring 2014). The majority of those households (n=188, 9.1% of all households) reported putting studded tires on at least one vehicle every year. A larger proportion of all households (17.5%) reported having used studded tires at some point over the last ten years, even though they did not use studded tires during last winter season. When vehicles did have studded tires, they were usually put on all four tires rather than just two. In addition to the use of studded tires, respondents were also asked about the use of non-studded winter tires. Two hundred and sixty-five households used non-studded winter tires last winter season (12.8%) and many of those put them on at least one vehicle every year (n=211, 10.2% of all households). Slightly less than half of the respondents who did not use non-studded winter tires during the last winter season (n=116, 5.6%), reported having used them at some point over the last ten years. Table 9 presents an itemization of the vehicles and studded tire usage across Oregon respondents.

Table 9: Oregon Number of Vehicles & Studded Tire Usage

Number of Vehicles (n=2,073 households)	Count	Percent
Total Number of Working Cars, Trucks or Vans (mean=2.28 vehicles per household, standard deviation=1.250)	4,723	n/a
Households with:		
No Vehicles	103	5.0%
1 Vehicle	400	19.3%
2 Vehicles	851	41.1%
3 Vehicles	413	19.9%
4 Vehicles	163	7.9%
5 Vehicles	98	4.7%
6+ Vehicles	40	1.9%
Don't Know or Refused	5	0.3%
Households that Used Studded Tires (n=2,073 households)	**Count**	**Percent**
On Any Vehicle Last Winter Season (Fall 2013-Spring 2014)	221	10.7%
Not Last Winter Season, but Any Time Over Last 10 Years	362	17.5%
On at Least One Vehicle Every Year, for Households Using Studded Tires Last Winter Season	188	9.1%
During Last Winter Season, Number of Vehicles (n=4,723 vehicles) that Used…	**Count**	**Percent**
Studded Tires	258	5.5%
2 Studded Tires	22	0.5%
4 Studded Tires	234	5.0%

Households with Vehicles Using Studded Tires Last Winter Season	2 Tires	4 Tires	2 or 4 Tires
1st Vehicle	14	151	165
2nd Vehicle	6	63	69

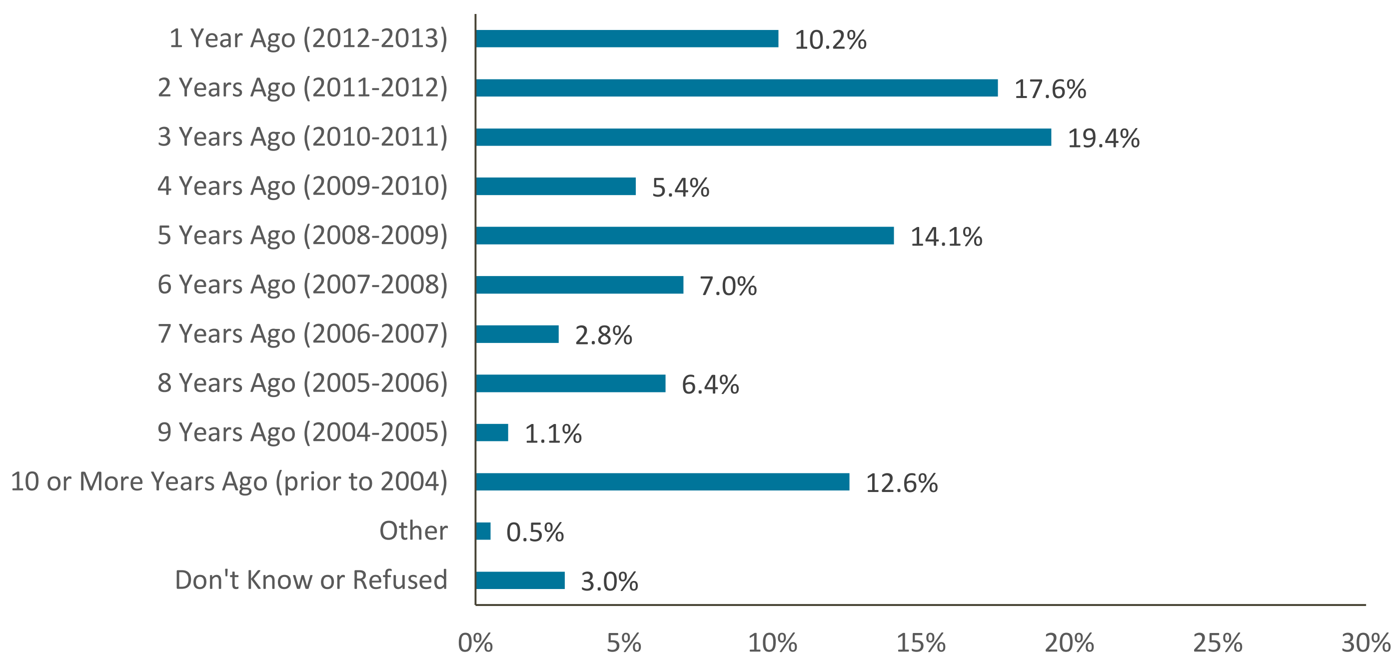
[11] To calculate total number of vehicles, households that reported 6 or more vehicles were included in the total vehicle count as 6.

Table 9: Oregon Number of Vehicles & Studded Tire Usage			
Households with Vehicles Using Studded Tires Last Winter Season (cont.)	2 Tires	4 Tires	2 or 4 Tires
3rd Vehicle	2	16	18
4th Vehicle	0	4	4
5th Vehicle	0	0	0
6th Vehicle	0	0	0
Households that Used Non-Studded Winter Tires (n=2,073 households)		Count	Percent
On Any Vehicle Last Winter Season (Fall 2013-Spring 2014)		265	12.8%
Not Last Winter Season, but Any Time Over Last 10 Years		116	5.6%
On at Least One Vehicle Every Year, for Households Using Non-Studded Winter Tires Last Winter Season		211	10.2%

NOTE: Data weighted for region and age.

Respondents from households that did not use studded tires during the last winter season (n=362), but had used them within the last 10 years, were asked how long ago they last used studded tires. As can be seen in Figure 1, although there was quite a bit of variation across the times since studded tires were last used, the largest proportions of respondents reported last using them three years ago (19.4%), two years ago (17.6%), or five years ago (14.1%).

Figure 1: Last Used Studded Tires for Oregon Households Using Them During Last 10 Years, but Not Last Winter Season (n=362 households)



NOTE: Data weighted for region and age.

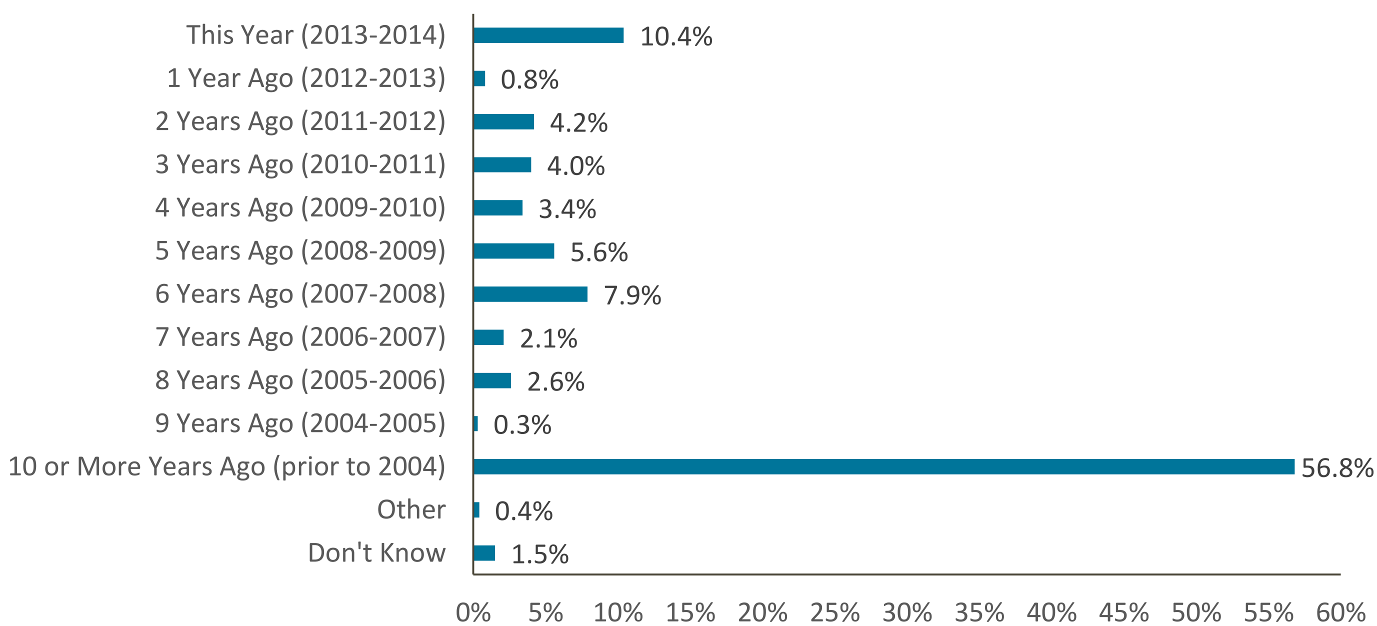
Those respondents were also asked why their household decided to stop using studded tires. The open-ended responses were reviewed and coded into categories of reasons, with some respondents providing more than one reason. The most common reason that households stopped using studded tires was related to not needing them, the weather being mild and not living or traveling in areas with severe weather. Table 10 includes a list of all the coded responses.

Table 10: Reasons Households Stopped Using Studded Tires (n=362 households)	Count	Percent
Didn't need them, weather has been mild, don't live or travel in areas with severe weather	127	35.1%
Don't drive as much, don't drive in bad weather	44	12.2%
Use 4-wheel drive or front-wheel drive instead	43	11.9%
Switched to tires that are studless	43	11.9%
Hassle and inconvenience of changing tires	39	10.8%
Studded tires ruin the roads	36	9.9%
Changed vehicles, new vehicle doesn't have studded tires	34	9.4%
Financial reasons -- cost of tires, cost of changing tires, reduced gas mileage	31	8.6%
Don't like studded tires, weren't effective, wore out quickly	23	6.4%
Switched to using chains	16	4.4%
Changed family circumstances -- retired, not working, divorce, loss of partner, job changed, family member moved out	15	4.1%
Don't know	10	2.8%
Other (e.g., recommended, uses siped tires, assumed they would be outlawed)	7	1.9%

NOTE: The percentages add up to more than 100% because respondents could provide multiple reasons. Data weighted for region and age.

Respondents who had used studded tires during the last winter season (n=221) were asked how many years ago they started using them. As seen in Figure 2, the majority of respondents reported first using studded tires ten or more years ago (56.8%).

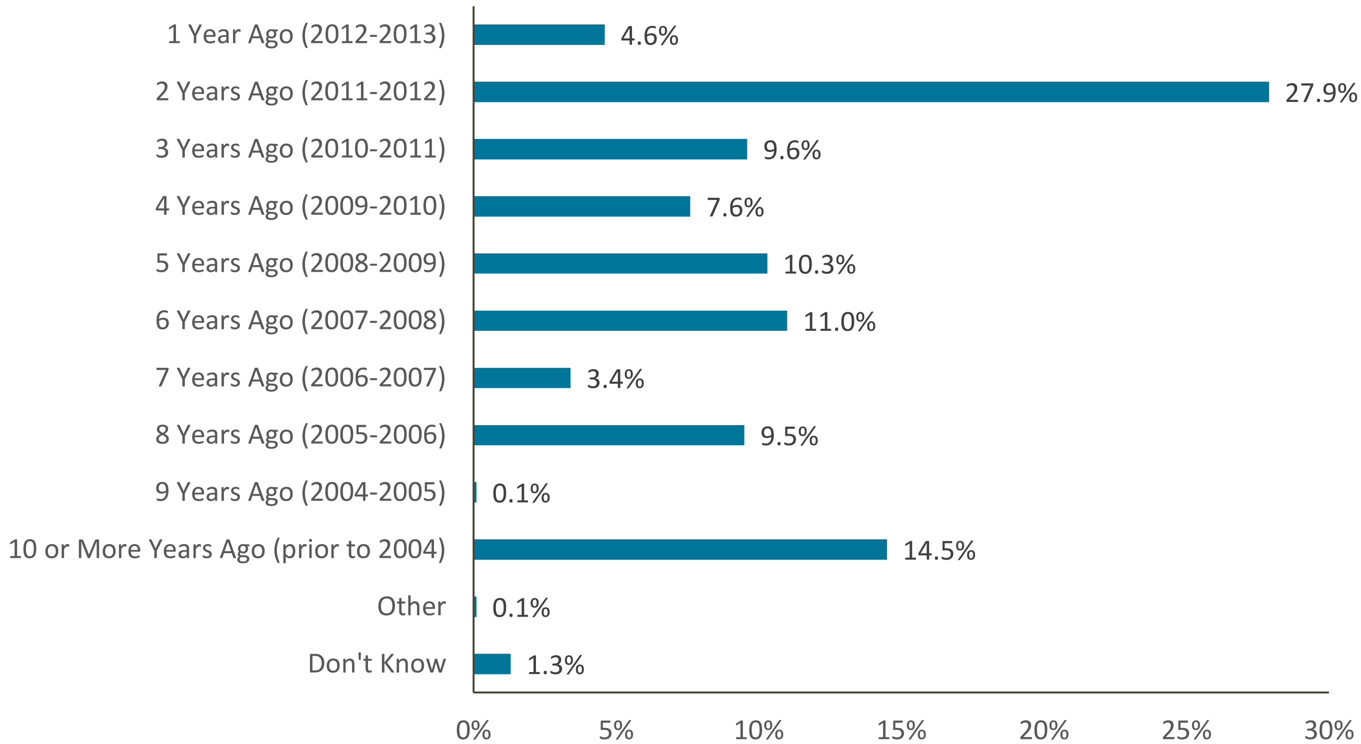
Figure 2: How Long Ago Oregon Households Started Using Studded Tires for Households Using Them Last Winter Season (n=221 households)



NOTE: Data weighted for region and age.

Respondents from households that did not use non-studded winter tires during the last winter season (n=116), but had used them within the last 10 years, were asked how long ago they last used non-studded winter tires. As presented in Figure 3, there was quite a bit of variation across the reported times since last using non-studded winter tires, with the largest proportions of respondents last using them two years ago (27.9%), ten or more years ago (14.5%) and six years ago (11.0%).

Figure 3: Last Used Non-Studded Winter Tires for Oregon Households Using Them During Last 10 Years, but Not Last Winter Season (n=116 households)



NOTE: Data weighted for region and age.

Those respondents were also asked why their household decided to stop using non-studded winter tires. The most common reason based on the coding of the open-ended responses was related to not needing them, the weather being mild, and not living or travelling in areas with severe weather. Table 11 includes a list of all the coded responses.

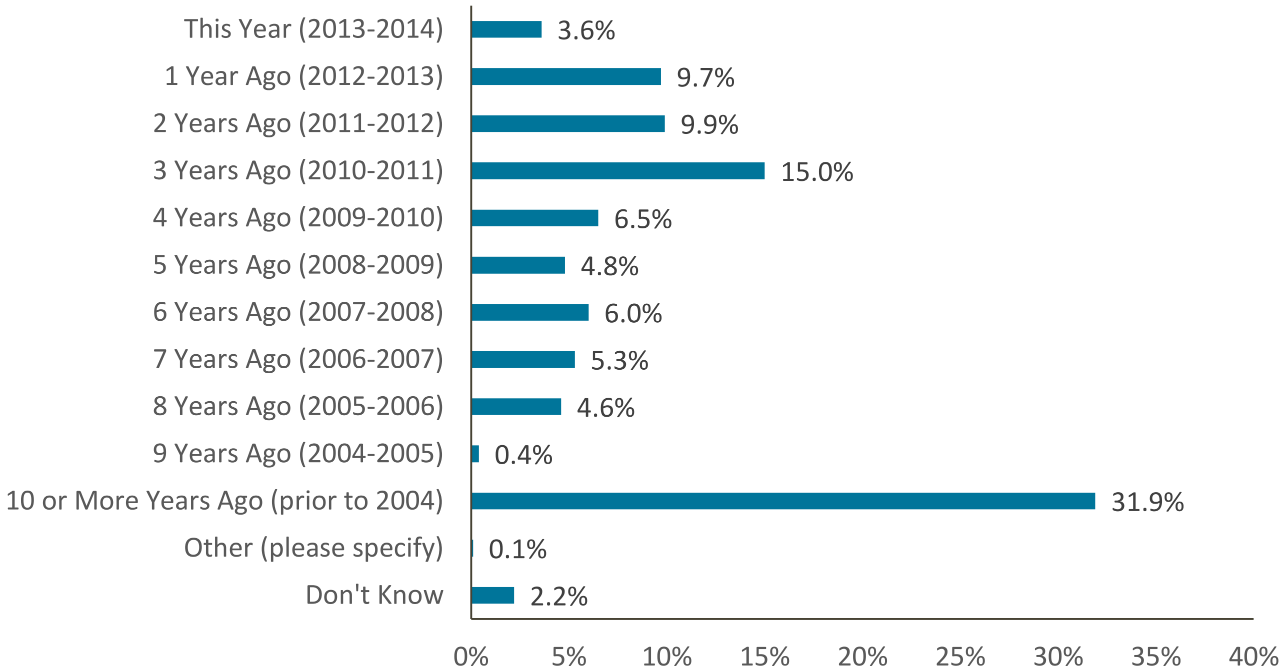
Table 11: Reasons Households Stopped Using Studded Tires (n=116 households)

	Count	Percent
Didn't need them, weather has been mild, don't live or travel in areas with severe weather	37	31.9%
Prefer studded or all-season tires	24	20.7%
Changed vehicles	21	18.1%
Weren’t effective, concerned they might not be effective, wore out quickly	19	16.4%
Hassle and inconvenience of changing tires	10	8.6%
Financial reasons	9	7.8%
Other (e.g., too noisy, prefer 4-wheel or front-wheel drive, deceased partner used them)	2	1.7%
Don't know	1	0.9%

NOTE: The percentages add up to more than 100% because respondents could provide multiple reasons. Data weighted for region and age.

Respondents who had used non-studded winter tires during the last winter season (n=265) were asked how many years ago they started using them. Figure 4 shows that the majority of respondents started using non-studded winter tires ten or more years ago (31.9%).

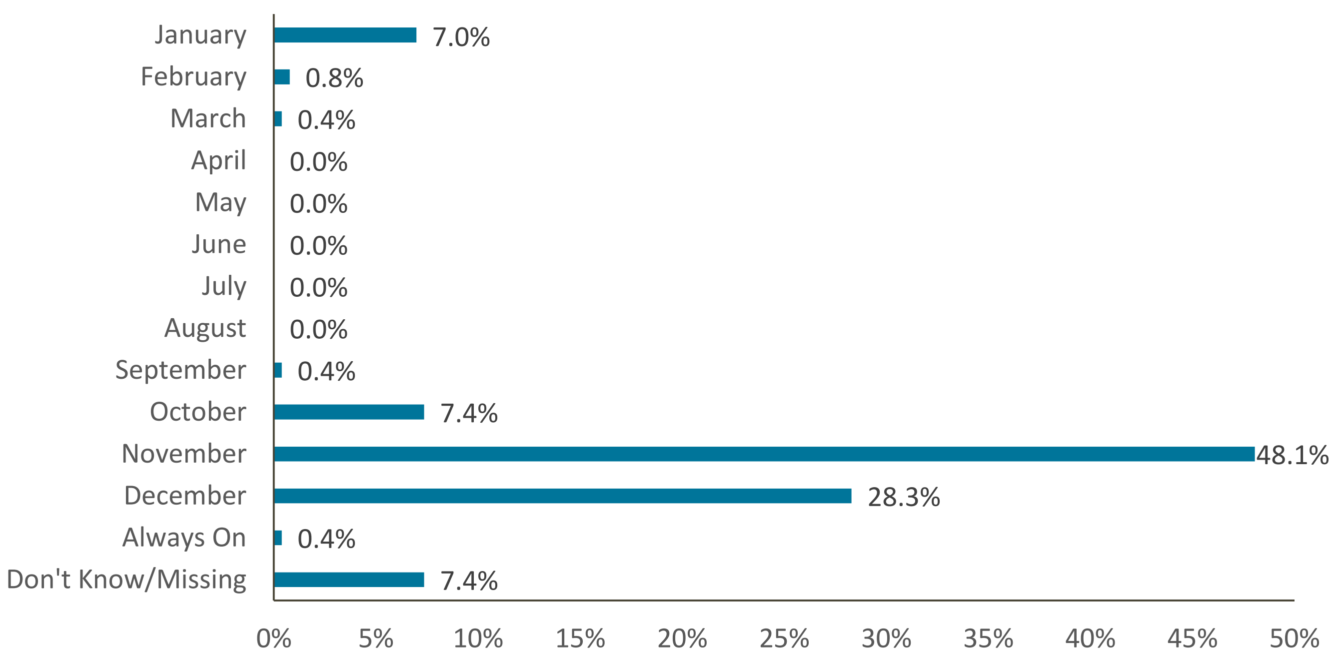
Figure 4: How Long Ago Oregon Households Started Using Non-Studded Winter Tires for Households Using Them Last Winter Season (n=265 households)



NOTE: Data weighted for region and age.

For each of the vehicles the respondents reported equipping with studded tires (n=258), they were asked what month those tires were put on. Figure 5 shows the distribution of those months, with the majority of respondents putting studded tires on their vehicles in November (48.1%) or December (28.3%).

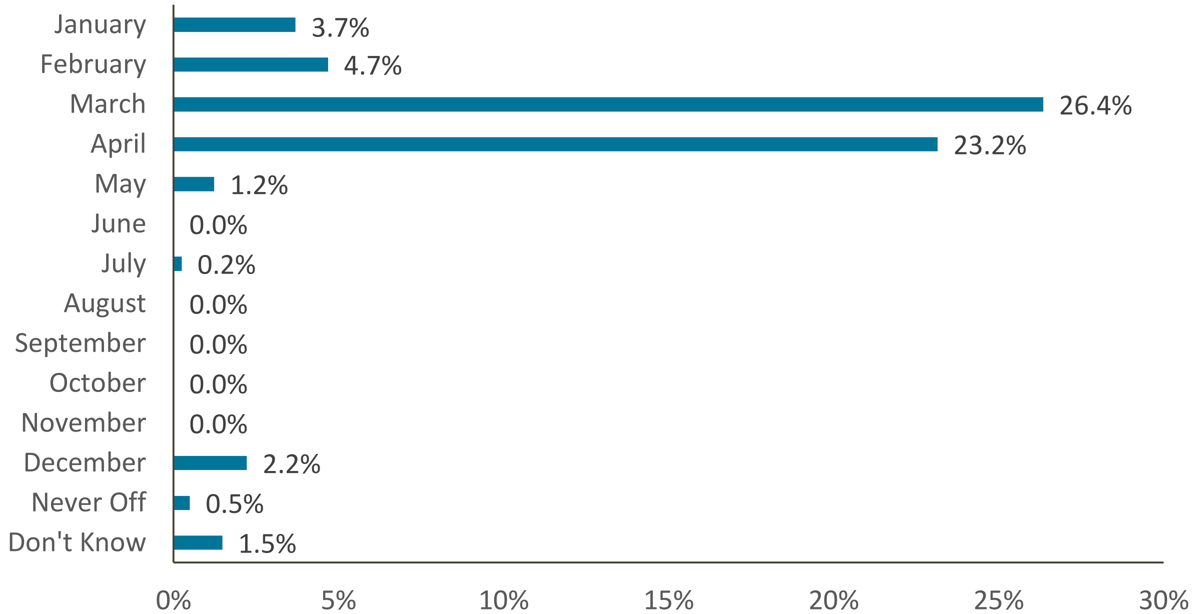
Figure 5: Month Studded Tires Were Put on Vehicles for 2013-14 Winter Season in Oregon (n=258 vehicles using studded tires)



NOTE: Data weighted for region and age.

Those respondents were also asked what month they took off those studded tires, or what month they plan to take them off if that had not occurred by the time of the survey. Figure 6 shows the distribution of those months, with the majority of respondents taking studded tires off their vehicles in March (26.4%) or April (23.2%).

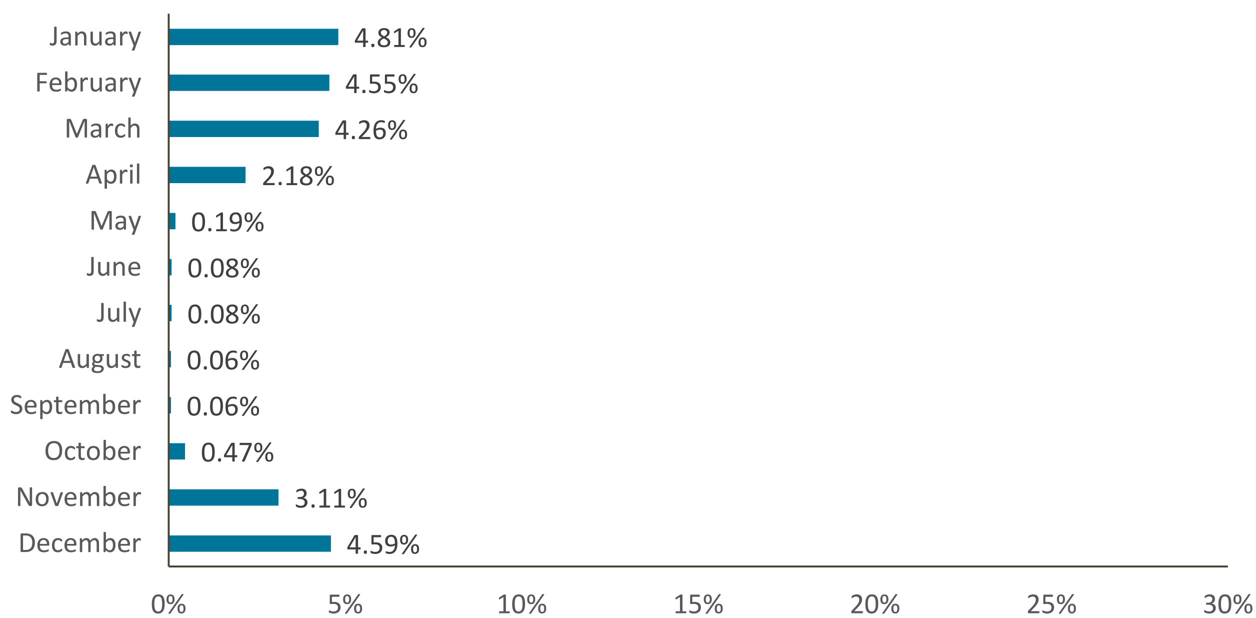
Figure 6: Month Studded Tires Were or Will be Taken Off Vehicles for 2013-14 Winter Season in Oregon (n=258 vehicles using studded tires)



NOTE: Data weighted for region and age.

Another way to consider these data is to identify the proportion of vehicles with studded tires driving on the roads in a given month. For this analysis, the percentages were calculated on the total number of vehicles for the households participating in the survey (n=4,723). Although these are not large proportions, Figure 7 shows that the months in which the greatest percentage of vehicles with studded tires are driving on Oregon roads are November through April, with the highest proportion in January (4.81%).

Figure 7: Proportion of Vehicles with Studded Tires Each Month in Oregon (n=4,723 vehicles)



NOTE: Data weighted for region and age.

Respondents who reported that studded tires were used on any of their vehicles during the last winter season were asked additional descriptive items about their vehicles. For the vehicles that were driven on average at least one day per week (n=492), the majority of vehicles were used for all purposes (62.2%) and mainly used by one person (73.9%) (Table 12).

Table 12: Vehicle Uses in Oregon Households that Used Studded Tires in 2013-14 Winter Season (n=492 vehicles)

Vehicles Used Mainly for…	Count	Percent
All Purposes	306	62.2%
Work	107	21.7%
Leisure	48	9.8%
Shopping	17	3.5%
Other	8	1.6%
Vehicles Used Mainly by…	**Count**	**Percent**
One Person	363	73.9%
More Than One Person	129	26.2%

NOTE: Data weighted for region and age.

Of the 585 total vehicles in these households (some of which are not driven on a weekly basis), the majority were described as either 2-wheel drive (50.8%) or 4-wheel drive (42.9%) (Table 13). Of the 2-wheel drive vehicles, 58.7% were front-wheel drive.

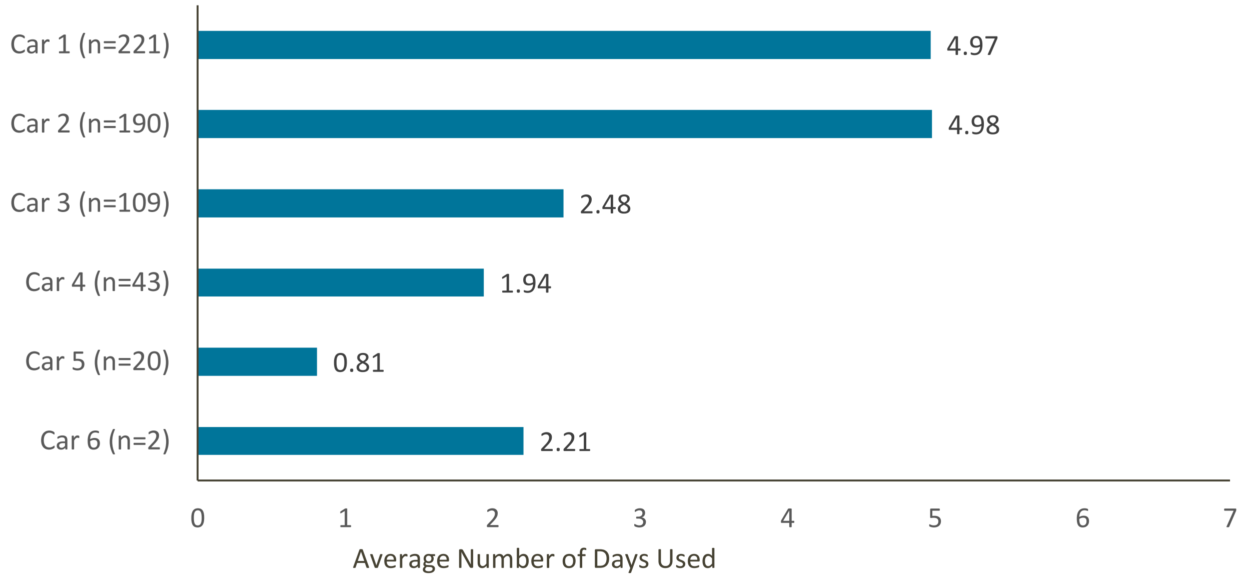
Table 13: Vehicles in Oregon Households that Used Studded Tires in 2013-14 Winter Season (n=585 vehicles)

Vehicle Is…	Count	Percent
2-Wheel Drive	297	50.8%
4-Wheel Drive	251	42.9%
All-Wheel Drive	28	4.8%
Other	4	0.7%
Don't Know	1	0.2%
2-Wheel Drive Vehicles Are… (n=298 vehicles)	**Count**	**Percent**
Front-Wheel Drive	175	58.7%
Rear-Wheel Drive	96	32.2%
Don't Know	27	9.1%

NOTE: Data weighted for region and age.

Respondents in households that used studded tires on at least one vehicle during the last winter season also reported the average number of days per week each of their vehicles is used. Overall, the average number of days per week across all 585 vehicles (including vehicles driven zero days) was 4.41 (standard deviation or SD=1.64), ranging from 4.98 (SD=2.06) days per week for the second vehicle to 0.81 (SD=1.77) days per week for the fifth vehicle (Figure 8).

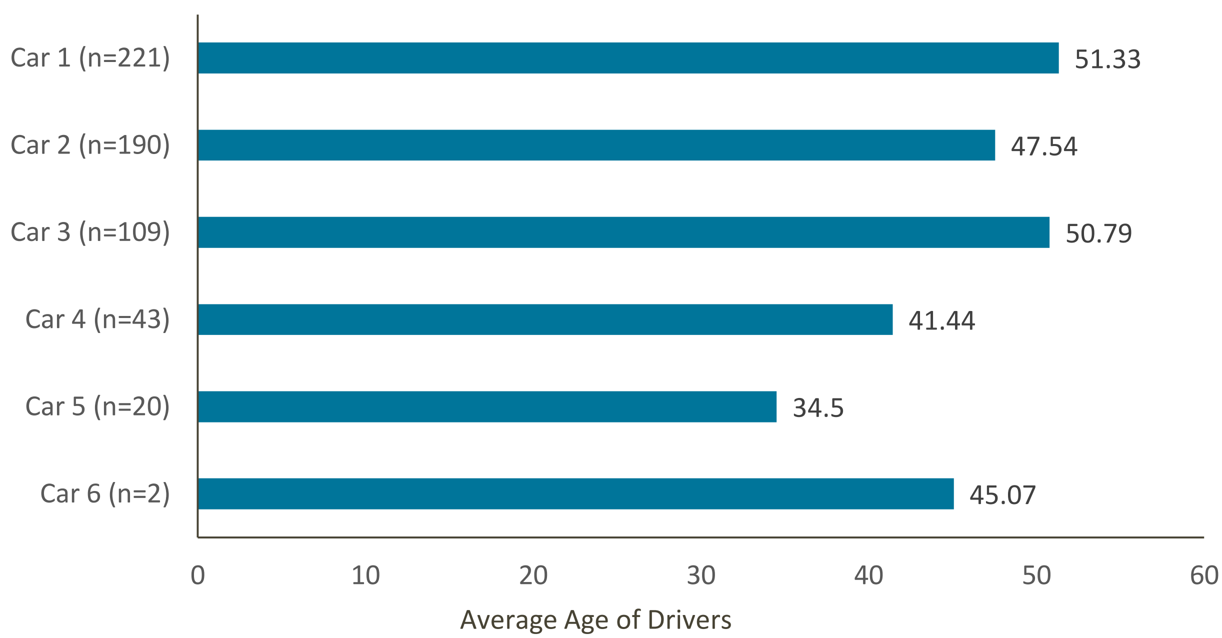
Figure 8: Average Number of Days per Week Each Vehicle is Used in Oregon Households that Used Studded Tires in 2013-14 Winter Season (n=585 vehicles)



NOTE: Data weighted for region and age.

Respondents also reported the age of the driver who uses each of the vehicles the most. The overall average age of the drivers across all 492 vehicles driven at least one day a week was 47.77 years (SD=14.66), ranging from 51.33 years (SD=15.51) for the first vehicle to 34.50 years (SD=19.51) for the fifth vehicle (Figure 9).

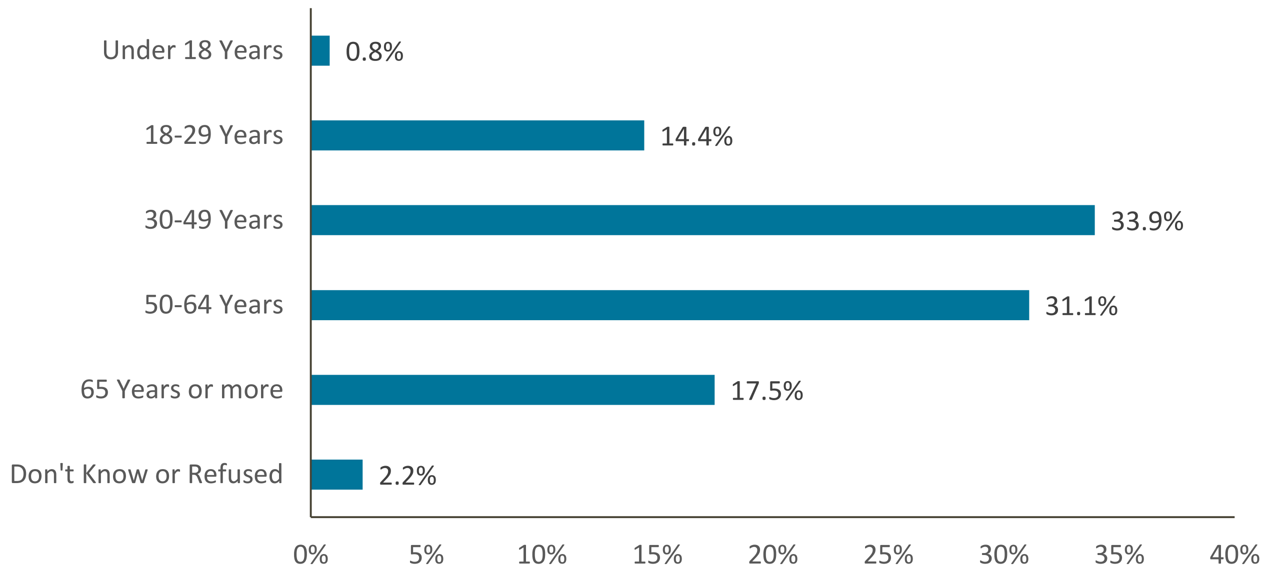
Figure 9: Average Age of the Person Who Used Each Vehicle the Most in Oregon Households that Used Studded Tires in 2013-14 Winter Season (n=492 vehicles)



NOTE: Data weighted for region and age.

Looking at age ranges of the drivers provides more detail about who is driving the vehicles. Figure 10 shows that the majority of drivers are 30 to 49 years of age (33.9%) or 50 to 65 years of age (31.1%).

Figure 10: Average Age of the Person Who Used Each Vehicle the Most in Oregon Households that Used Studded Tires in 2013-14 Winter Season (n=492 vehicles)



NOTE: Data weighted for region and age.

Vehicles and Studded Tire Usage – Regional Comparisons

ODOT staff requested that regional comparisons be conducted on some of the vehicle, studded tire usage, and non-studded winter tire usage items in the survey. Data from these items were analyzed to determine if any significant differences exist across the five Oregon regions. When conducting significance tests, only valid responses (i.e., excluding don't know or missing responses) can be included. Therefore, the sample sizes reported for these analyses reflect only those valid responses, which may be slightly different than the total sample sizes for each of those groups presented elsewhere in this report.

As noted in the Weighting section of this report, the weighting used for these analyses was based only on adjusting for age, rather than for both age and region as was done for the statewide analyses. In addition, maintaining comparable sample sizes for the statistical tests was important. Table 14 presents the distribution of completed surveys across the regions using weighting for age adjustments only.

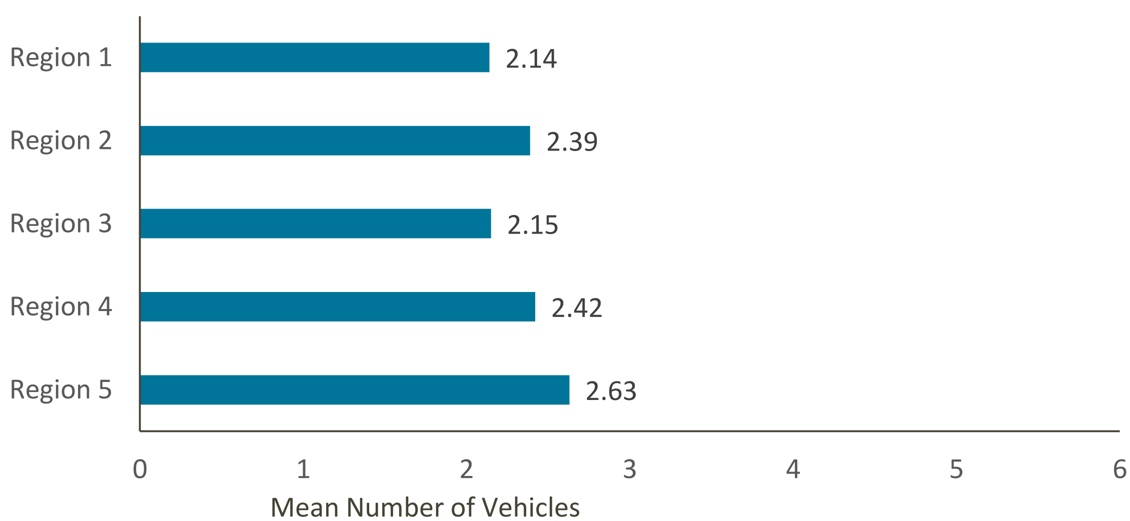
Table 14: Age-Weighted Counts of Completed Surveys Used for Regional Comparisons (n=1,934)

State of Oregon Regions	Count of Age Weighted Completed Surveys
Region 1: Clackamas, Columbia, Hood River, Multnomah, Washington	386
Region 2: Benton, Clatsop, Lane, Lincoln, Linn, Marion, Polk, Tillamook, Yamhill,	390
Region 3: Coos, Curry, Douglas, Jackson, Josephine	386
Region 4: Crook, Deschutes, Gilliam, Jefferson, Klamath, Lake, Sherman, Wasco, Wheeler	386
Region 5: Baker, Grant, Harney, Malheur, Morrow, Umatilla, Union, Wallowa	386
TOTALS	**1,934**

NOTE: Data weighted for age.

The average number of vehicles ranged from 2.14 in Region 1 to 2.63 in Region 5 (Figure 11), resulting in a statistically significant difference across the five regions (F=10.590, $p<.001$).

Figure 11: Mean Number of Working Vehicles in Households by Region*** (n=1,934 households)



*p<.05 **p<.01 ***p<.001
NOTE: Data weighted for age.

The regions differed significantly in the proportion of households that had studded tires on at least one vehicle during the most recent winter season (χ^2=240.499, p<.001) and the proportion of those households that put studded tires on at least one vehicle every year (χ^2=22.813, p<.001). Regions also differed significantly for those respondents who did not use studded tires during last winter season, but had used studded tires at some point over the last ten years (χ^2=119.482, p<.001). Studded tire usage last winter season was highest in Regions 4 (36.4%) and 5 (35.5%), and at any time during the last ten years (Region 4 = 46.9%, Region 5 = 44.0%). Looking at the households using studded tires last winter season, the largest proportion of those households that put studded tires on at least one vehicle every year were in Regions 5 (94.8%), 4 (94.1%) and 1 (85.3%). Table 15 presents an itemization of the studded tire usage across Oregon regions.

Table 15: Use of Studded Tires (Studs) by Region

	Households that Used Studs Last Winter Season***			Households that Used Studs Any Time in the Last 10 Years, but Not Last Winter Season***			Households Using Studs Last Winter Season and Putting Studs on at Least 1 Vehicle Every Year***		
	n	Count	Percent	n	Count	Percent	n	Count	Percent
Region 1	358	34	9.5%	325	59	18.2%	34	29	85.3%
Region 2	374	27	7.2%	345	70	20.3%	25	18	72.0%
Region 3	362	19	5.2%	341	59	17.3%	19	14	73.7%
Region 4	376	137	36.4%	239	112	46.9%	136	128	94.1%
Region 5	377	134	35.5%	241	106	44.0%	134	127	94.8%

*p<.05 **p<.01 ***p<.001 NOTE: Data weighted for age.

Analyses on the comparable items for non-studded winter tires revealed similar findings. The regions differed significantly in the proportion of households that had non-studded winter tires on at least one vehicle during the most recent winter season (χ^2=65.037, p<.001); however, the difference between the regions did not reach statistical significance for the proportion of households that put non-studded winter tires on at least one vehicle every year (χ^2=9.221, p=.056). Regions differed significantly for those respondents who did not use non-studded winter tires during last winter season, but had used those tires at some point over the last ten years (χ^2=9.572, p<.05). Non-studded winter tire usage last winter season was highest in Regions 4 (26.8%) and 5 (23.7%). Looking at the households using non-studded winter tires last winter season, the largest proportion of those households that put those tires on at least one vehicle every year were in Regions 4 (90.8%), 1 (83.8%) and 5 (82.2%). Table 16 presents an itemization of the non-studded winter tire usage across Oregon regions.

Table 16: Use of Non-Studded Winter Tires (NSWT) by Region

	Households that Used NSWT Last Winter Season***			Households that Used NSWT Any Time in the Last 10 Years, but Not Last Winter Season*			Households Using NSWT Last Winter Season and Putting NSWT on at Least 1 Vehicle Every Year		
	n	Count	Percent	n	Count	Percent	n	Count	Percent
Region 1	359	37	10.3%	317	23	7.3%	37	31	83.8%
Region 2	367	56	15.3%	310	19	6.1%	55	40	72.7%
Region 3	357	32	9.0%	322	16	5.0%	30	23	76.7%
Region 4	366	98	26.8%	270	29	10.7%	98	89	90.8%
Region 5	375	89	23.7%	270	26	9.6%	90	74	82.2%

*p<.05 **p<.01 ***p<.001 NOTE: Data weighted for age.

Travel Behavior – Statewide

All respondents who participated in the survey (n=2,073, weighted for both region and age), whether or not they used studded tires on any household vehicles, were asked a series of questions to characterize their common travel behavior. The 1,898 (91.6%) respondents who reported driving a vehicle, drove an average of 28.65 miles (SD=59.39) on a typical day, ranging from 0 to 840 miles.

All respondents identified the form of transportation that they use the most. Although eight modes of transportation were offered, some respondents were either unable to identify just one transportation mode (i.e., the one they use the most) or offered additional modes in the "Other, Please Specify" category. A number of the other responses were categorized and the more common combinations were specified and included in the presentation of these findings in Table 17. The original response options offered to respondents have been labeled with an asterisk (*), some of which may not be readily available in all parts of Oregon. The most common modes of transportation were driving alone in private vehicles (62.9%) and carpooling (22.1%). The "other" mode of transportation responses included ATV, dump truck, scooter, power wheel chair, road bike, all of the response options provided, and other combinations of those response options.

Table 17: Most Common Forms of Transportation (n=2,073 respondents)

	Count	Percent
Driving alone in private vehicles*	1,304	62.9%
Driving with other people in private vehicles (carpooling)*	458	22.1%
Walking*	76	3.7%
MAX train*	57	2.8%
Bus*	53	2.6%
Driving alone and with other people	44	2.1%
Bicycle*	28	1.3%
Other*	17	0.8%
Car-share vehicles*	10	0.5%
Alternative transportation (e.g., medical transport, dial-a-ride, retirement community van)	6	0.3%
Alone or with others in company or commercial vehicle	4	0.2%
Motorcycle	4	0.2%
Taxi	3	0.1%
Multiple public transportation modes	3	0.1%
Don't know or Refused	3	0.1%
Streetcar*	2	0.1%

NOTE: Data weighted for region and age.

Respondents reported that they adjusted their travel behavior on 0 to 180 days (mean=6.72, SD=13.04) because of the weather during the last winter season (Fall 2013 through Spring 2014). They also reported that their work or school was canceled on 0 to 120 days (mean=1.99, SD=3.89) due to bad weather during the last winter season.

Of the 1,931 respondents who drive, 83.4% (n=1,610) reported changing their driving behavior during winter weather conditions, while another 14.3% (n=296) reported driving as they normally would (1.3%, n=25, either didn't know or refused to answer). For those who did not drive as they normally would, respondents were first asked if they avoid driving completely during winter weather conditions. Depending on their answer to that item, as a follow-up question, they were either asked what they do to get around instead of driving or how they alter their driving to adjust to the weather conditions. Approximately one-quarter (27.1%) of the respondents reported that they avoid driving completely; however, when asked how they usually get around during winter weather conditions, some of the responses provided suggest that they actually might still drive. For that reason, the responses to both of the follow-up questions (i.e., what they do instead of driving and how they adjust their driving) are combined for this presentation (Table 18). The percentages are calculated based on the total number of respondents who reported changing their driving behavior (n=1,610). Also, large groups of "other" responses were recoded into their own category. The original response options offered to respondents have been labeled with an asterisk (*). Percentages add up to more than 100% because respondents could provide more than one answer to both of the follow-up questions.

The largest proportion of people who reported that they avoid driving completely indicated that they just stay home (33.3%). For the respondents who said they still drove, but made adjustments to their driving, the most common adjustments were driving slower (64.5%), driving less (40.9%), driving at different times (25.7%), and driving on different roads (22.8%).

Table 18: Adjustments to Travel and Driving During Winter Weather Conditions (n=1,610 respondents)

Responses to How People Get Around Instead of Driving	Count	Percent
Stay home*	536	33.3%
Walk or ride a bike instead of driving*	176	10.9%
Take public transit instead of driving*	105	6.5%
Get a ride from someone else	96	6.0%
Other*	3	0.2%
Responses to How People Get Around During Winter Weather Conditions	**Count**	**Percent**
Drive slower*	1,038	64.5%
Drive less*	659	40.9%
Drive at different times*	414	25.7%
Drive on different roads*	367	22.8%
Put chains on tires*	239	14.8%
Take extra time or driving more carefully	101	6.3%
Use a 4-wheel, all-wheel or front-wheel drive vehicle	64	4.0%
Other*	23	1.4%
Carry emergency supplies	11	1.0%
Use public transportation, bicycle or fly	11	1.0%
Weight back of vehicle	5	0.3%
Get a ride from someone else	5	0.3%
Check weather, road conditions or ODOT website	4	0.2%
Use (unspecified) alternate vehicle	3	0.2%
Use studded tires	2	0.1%
Don't Know	2	0.1%
Use snow tires	1	0.1%

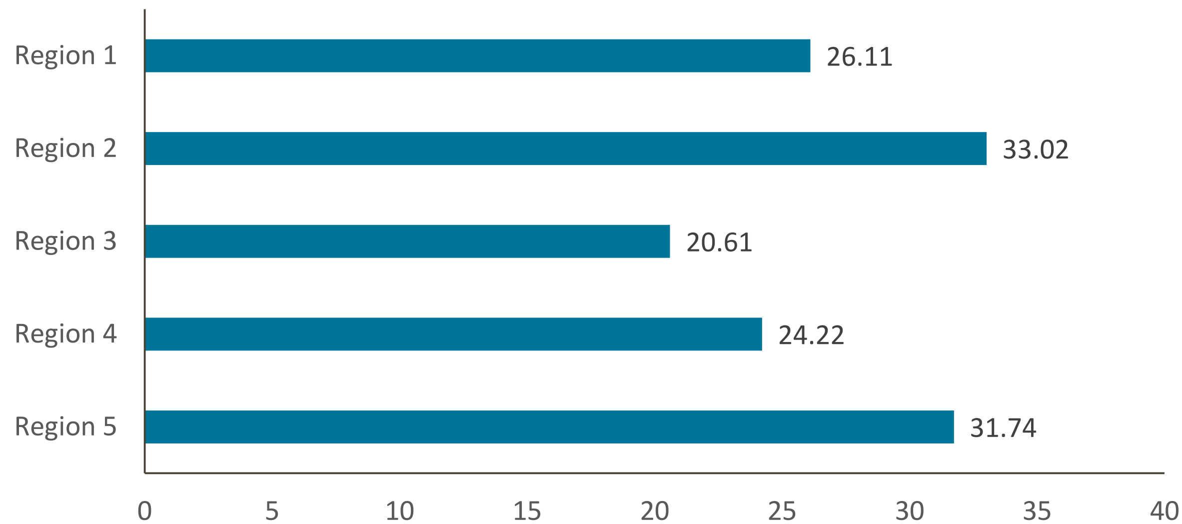
NOTE: Data weighted for region and age.

Travel Behavior – Regional Comparisons

ODOT staff requested that regional comparisons be conducted on some of the survey travel behavior items to determine if significant differences exist across the five Oregon regions. As mentioned above, when conducting significance tests, only valid responses can be included; therefore, the sample sizes reported for these analyses may be slightly different from the total sample sizes for those groups presented elsewhere in this report. Also, the data was weighted for age only, so the total sample size is 1,934 (see Table 14).

The average number of miles driven on a typical day by respondents who reported driving a vehicle ranged from 20.61 in Region 3 to 33.02 in Region 2 (Figure 12), which represents a statistically significant difference across the five regions ($F=3.934$, $p<0.01$).

Figure 12: Mean Number of Miles Driven on a Typical Day by Region*** (n=1,792 respondents)



*p<.05 **p<.01 ***p<.001
NOTE: Data weighted for age.

Before transportation mode could be analyzed for regional differences, the response options for Bus, Car-share Vehicle, Streetcar and MAX Train were recoded to "Other" because they are not equally available in all regions of Oregon. In addition, Driving Alone and With Other People was so common among the "Other" responses, that it was included as a separate category. The chi-square analysis revealed that the most common form of transportation differed significantly ($\chi^2=74.308$, $p<.001$), but this is most likely due to the different mode choices across all respondents rather than differences across the five regions (Table 19).

Table 19: Form of Transportation by Region* (n=1,929)**

	Driving Alone in Private Vehicles		Driving With Other People in Private Vehicles (Carpooling)		Walk		Bicycle		Driving Alone and With Other People		Other	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Region 1	232	60.3%	79	20.5%	12	3.1%	6	1.6%	10	2.6%	46	11.9%
Region 2	268	69.1%	84	21.6%	15	3.9%	4	1.0%	5	1.3%	12	3.1%
Region 3	235	60.9%	102	26.4%	17	4.4%	7	1.8%	13	3.4%	12	3.1%
Region 4	253	65.7%	101	26.2%	5	1.3%	7	1.8%	10	2.6%	9	2.3%
Region 5	253	65.7%	89	23.1%	16	4.2%	1	0.3%	11	2.9%	15	3.9%

*p<.05 **p<.01 ***p<.001 NOTE: Data weighted for age.

The final travel behavior items of interest to ODOT for regional comparisons were the adjustments to travel and driving during winter weather conditions. As a reminder, different subsets of respondents were asked the travel behavior items. Of the 1,826 (with age weighting) respondents who drive, 84.2% (n=1,537) reported changing their driving behavior. Of those respondents, 450 reported avoiding driving completely, who were then asked how they get around. To conduct those analyses, each response option was analyzed separately. Taking public transit instead of driving differed significantly across the regions (χ^2=32.569, p<.001), possibly due to the differences in availability of public transportation options across Oregon. Walking or riding a bike instead of driving also differed significantly across the regions (χ^2=14.184, p<.01). Staying home (the most common alternative to driving in winter weather), getting a ride from someone else, and doing something else were all not significantly different across the regions. Table 20 presents the counts and percentages for each of the response options for how people get around instead of driving during winter weather conditions.

Table 20: How People Get Around Instead of Driving by Region (n=450)

	Take Public Transit Instead of Driving***		Walk or Ride a Bike Instead of Driving**		Stay Home		Get a Ride From Someone Else		Something Else	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Region 1	25	22.7%	36	32.7%	104	94.5%	21	19.1%	0	0.0%
Region 2	15	12.9%	37	31.9%	112	96.6%	17	14.7%	1	0.9%
Region 3	5	5.3%	28	29.8%	87	92.6%	11	11.7%	2	2.1%
Region 4	2	3.4%	6	10.0%	58	98.3%	5	8.3%	0	0.0%
Region 5	0	0.0%	14	20.0%	65	91.5%	6	7.1%	0	0.0%

*p<.05 **p<.01 ***p<.001 NOTE: Data weighted for age.

The respondents who continue to drive were asked how they adjust their driving during winter weather conditions. Putting chains on tires (χ^2=35.440, p<.001) was more common in Regions 1 and 2 than in the other three regions. Driving on different roads (χ^2=22.508, p<.001) was more common in Regions 1, 2 and 3. Driving less (χ^2=18.257, p<.001) was more common in Regions 1 and 2. Driving slower (χ^2=12.111, p<.05) was slightly more common in Regions 1, 4 and 5. The other five ways people adjust their driving behavior during winter weather were not statistically significant across the regions. Table 21 presents the counts and percentages for each of the response options for how people who continue driving adjust their behavior to get around during winter weather conditions.

Table 21: How People Get Around During Winter Weather Conditions by Region (n=1,110)

	Put Chains on Your Tires***		Drive on Different Roads***		Drive Less**		Drive Slower*	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Region 1	48	27.0%	72	40.4%	117	65.7%	175	98.3%
Region 2	46	21.5%	66	30.1%	135	63.4%	199	93.4%
Region 3	33	14.9%	69	31.4%	127	57.7%	209	95.0%
Region 4	18	7.1%	55	21.7%	135	53.4%	249	98.4%
Region 5	36	14.8%	57	23.5%	117	48.1%	236	97.1%

*p<.05 **p<.01 ***p<.001 NOTE: Data weighted for age.

Table 21: How People Get Around During Winter Weather Conditions by Region (n=1,110) (cont.)

	Drive at Different Times		Take Extra Time or Driving More Carefully		Use a 4-Wheel, All-Wheel or Front-Wheel Drive Vehicle		Something Else	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Region 1	69	38.8%	13	7.3%	10	5.6%	10	5.6%
Region 2	83	39.0%	25	11.7%	14	7.5%	12	5.6%
Region 3	89	40.5%	16	7.2%	11	4.9%	9	4.0%
Region 4	101	39.9%	23	9.1%	10	4.0%	14	5.5%
Region 5	92	37.9%	20	8.2%	12	4.9%	8	3.3%

*p<.05 **p<.01 ***p<.001 NOTE: Data weighted for age.

Appendix A: Survey Instrument

ORGPH

Imported Phone Number

SRLID

Master SRLID

I_REGION

Imported Region (from Sample)

Choices	
REGION 1 [Columbia, Clackamas, Multnomah, Washington, Hood River]	1
REGION 2 [Clatsop, Tillamook, Lincoln, Yamhill, Benton, Lane, Linn, Marion, Polk]	2
REGION 3 [Coos, Curry, Douglas, Jackson, Josephine]	3
REGION 4 [Gilliam, Sherman, Wasco, Wheeler, Crook, Deschutes, Lake, Klamath, Jefferson]	4
REGION 5 [Umatilla, Morrow, Grant, Harney, Baker, Malheur, Union, Wallowa]	5

CELLSAMP

Cell Phone Sample

Choices	
Active (Cell Phone)	1
Unknown (Cell Phone)	2

INTRO

Phone number: 999-999-9999

Callback Notes: <F6> <CELLSAMP>

Choices			
OK - Continue	00	D	
Answering Machine	01		==> INT01
Busy	02		==> INT02
No Answer	03		==> INT03
Fax Machine	04		==> INT04
Number Change (Operator Intercept)	05		==> /TEL01
Cell Phone Refusal	06		==> INT06
Non-working, Disconnected Number	07		==> INT07
Non-Residential Number (Businesses, Pay Phones)	08		==> INT08
Language or Disability Barrier	09		==> INT09
Group Home (Assisted Living, Nursing Homes, Dormitory)	10		==> INT10

NTRO1

Hello, this is <name> calling from Portland State University on behalf of the Oregon Department of Transportation. We're conducting a brief survey about winter travel habits. I assure you, I'm not selling anything. Are you an adult household member, 18 years of age or older, who knows about your household's transportation behavior?
(Is now a good time to complete the survey?)
(May I speak to someone who is familiar with your household's transportation behavior?)

Choices			
Yes, that would be me (Continue Survey)	1	D	==> SECT1
Not good time now (Schedule Specific CB)	2		==> INT50
Not interested or not now (Automatic CB in 3 days)	3		==> INT55
Language or Disability Barrier	6		==> INT09
Non-Residential Number	7		==> INT08
Hung Up (w/out saying anything)	8		==> INT95
Refused to Start	9		==> INT91

INT06

(If calling at a bad time:) May we call you at another time (during off-peak hours)?

CELL RF CONVERSION: Since cell phone users are often not represented in phone surveys, it's very important that we include people on cell phones. We want to make sure your household's transportation habits are properly represented and included in this study. We did not get this number from a list or your cell phone company, this number was randomly created. (If they don't want to do the survey because they are on their cell phone:) Is there another number I can reach you at?

IF NUMBER CHANGE: After you entered the new phone number and are back on this screen (press the 'Escape' key) BACK-UP to INTRO to schedule a callback or start new survey (calling the new number).
Cell Phone Refusal: Should only be used if R refuses to complete the survey because they are using a cell phone.
==> +1 IF NOT (INTRO=06)

Choices			
Cell Phone Refusal	06	D	==> /END
R has Landline (Number Change)	12		==> /TEL01

INT09

PLEASE RECORD BARRIER TYPE OR POSSIBLE LANGUAGE (AS BEST YOU CAN) FOR LANGUAGE BARRIER IN OPEN-END TEXT BOX
Language Barrier: (if no one else in household speaks English) Sorry to have bothered you. We do not have anyone that speaks your language. Thank you for your time today.
Disability Barrier: Sorry to have bothered you. Thank you for your time today. Hearing Problem: Sorry to have bothered you. We are not able to complete this survey with a TTY system.
Should be used for R's who cannot complete the survey due to language barrier or a cognitive/mental/physical disability that prevents them from answering and/or understanding questions. If you deem a R to fit into one of these categories, the survey should NOT be conducted with that R.
==> SKIP +1 IF NOT (INTRO=09 OR NTRO1=6)

Choices			
Language or Disability Barrier	09	DO	==> /END

INT10

Sorry to have bothered you. Thank you for your time today.

Should be used where residents do not have their own individual lines.

==> SKIP +1 IF NOT (INTRO=10)

Choices			
Group Home (Assisted living, Nursing home, Dormitory)	10	D	==> /END

INT50

When would be a better time for us to try calling back?

Specific Callback

==> SKIP +1 IF NOT (NTRO1=2)

Choices			
English Specific Callback	50	D	==> /CB

INT55

Not Interested or Not Now (Automatic Callback in 3 Days)

==> SKIP +1 IF NOT (NTRO1=3)

Choices			
English Generic Callback	55	D	==> /END

INT91

REFUSAL CONVERSION TEXT (See end of booklet)

==> SKIP +1 IF NOT (NTRO1=9)

Choices			
Refusal (Please specify)	91	O	==> /END
Never Callback	92		==> /END

SECT1

Great, thank you. This survey will take about 5 to 10 minutes to complete. It is completely voluntary and anonymous. You can stop at any time or skip any item you don't want to answer.

Choices		
Press 'Enter' to Continue	0	D

COUNTY

DO NOT READ OPTIONS

First, what county do you currently live in?

	Choices
Baker	01
Benton	02
Clackamas	03
Clatsop	04
Columbia	05
Coos	06
Crook	07
Curry	08
Deschutes	09
Douglas	10

COUNTY

Gilliam	11		
Grant	12		
Harney	13		
Hood River	14		
Jackson	15		
Jefferson	16		
Josephine	17		
Klamath	18		
Lake	19		
Lane	20		
Lincoln	21		
Linn	22		
Malheur	23		
Marion	24		
Morrow	25		
Multnomah	26		
Polk	27		
Sherman	28		
Tillamook	29		
Umatilla	30		
Union	31		
Wallowa	32		
Wasco	33		
Washington	34		
Wheeler	35		
Yamhill	36		
Lives in Oregon, but doesn't know which county (Record city name if possible)	95	O	
Washington State Resident	96		==> ORE1
Other Out-Of-State (Record state)	97	O	==> ORE1
Don't Know	98		==> INT15
Refused	99		==> INT15

INT15

I'm sorry, but without that information we cannot continue the survey. Thank you for your time, goodbye.

R DK/RF County Question

==> SKIP +1 IF NOT (COUNTY=98,99)

Choices			
R DK/RF County Question	15	D	==> /END

ORE1

Do you drive in Oregon on a regular basis?

IWR NOTE: Please only consider driving personal passenger vehicles when answering this question.

==> SKIP TO Q1 IF NOT (COUNTY=96,97)

Choices		
No	0	==> /INT16
Yes	1	
Don't Know	8	==> /INT16
Refused	9	==> /INT16

INT16

Thank you. We're looking for people who live and drive in Oregon on a regular basis, but thank you for your time today, good-bye.

Not an Oregon Resident and Doesn't Drive in Oregon on regular basis.

==> SKIP +1 IF NOT (ORE1=0,8,9)

Choices			
Non-OR Resident or Driver	16	D	==> /END

Q1

DO NOT READ OPTIONS

In total, how many working cars, trucks or vans are owned or leased by people in your household?

IWR NOTE: Include only working vehicles. IWR NOTE: Do not include motorcycles or scooters. IWR NOTE: This can include vehicles owned by non-family members living in the household. IWR NOTE: If R lives out-of-state, but only drives certain vehicles regularly in OR, clarify with: When answering these questions, please only include vehicles driven in Oregon on a regular basis.

Choices		
Zero	0	==> SECT2
One	1	
Two	2	
Three	3	
Four	4	
Five	5	
Six (or more)	6	
Don't Know	8	==> SECT2
Refused	9	==> SECT2

Q2_STUD

Were studded tires used on any of your household's vehicles during the last winter season?

IWR NOTE: Studded tires have metal pins or "studs" protruding from them.

IWR NOTE: "Last winter season" would be from this past Fall 2013 through Spring 2014. IWR NOTE: If R's HH has multiple vehicles, this is a general question and applies to using studded tires on any of their vehicles.

IWR NOTE: If R lives out-of-state, but only drives certain vehicles regularly in OR, clarify with: When answering these questions, please only include vehicles driven in Oregon on a regular basis.

==> SKIP TO SECT2 IF Q1=0,8,9

Choices		
No	0	==> Q3_STUD1
Yes	1	==> Q4_STUD
Don't Know	8	==> Q3_STUD1
Refused	9	==> Q3_STUD1

Q3_STUD1

Thinking back over the last 10 years, has your household ever used studded tires?

IWR NOTE: Studded tires have metal pins or "studs" protruding from them.

==> SKIP TO Q4_STUD IF NOT (Q2_STUD=0,8,9)

Choices		
No	0	==> Q2_SOFT
Yes	1	
Don't Know	8	==> Q2_SOFT
Refused	9	==> Q2_SOFT

Q3_STUD2

READ OPTIONS 1-10 IF NESSESARY

When did your household last use studded tires?

IWR NOTE: Your best estimate is fine. IWR NOTE: If R says "this year (i.e., 2013-2014 winter season), verify this was in fact the last time they used studded tires, and if so, back-up in the survey and re-ask them Q2_STUD.

==> SKIP +2 IF NOT (Q3_STUD1=1)

Choices		
1 Year Ago (2012-2013)	01	
2 Years Ago (2011-2012)	02	
3 Years Ago (2010-2011)	03	
4 Years Ago (2009-2010)	04	
5 Years Ago (2008-2009)	05	
6 Years Ago (2007-2008)	06	
7 Years Ago (2006-2007)	07	
8 Years Ago (2005-2006)	08	
9 Years Ago (2004-2005)	09	
10 or More Years Ago (prior to 2004)	10	
Other (please specify)	77	O
Don't Know	88	
Refused	99	

Q3_STUD3

Why did your household decide to stop using studded tires?

Choices		
Enter Response	0	DO
Don't Know	8	
Refused	9	

Q4_STUD

Are studded tires put on at least one of your household's vehicles every year?

==> SKIP Q2_SOFT IF NOT (Q2_STUD=1)

Choices		
No	0	
Yes	1	
Other (please specify)	7	O
Don't Know	8	
Refused	9	

Q5_STUD

READ OPTIONS 0-10 IF NESSESARY

How many years ago did your household start using studded tires?

IWR NOTE: Your best estimate is fine.

Choices		
This Year (2013-2014)	00	
1 Year Ago (2012-2013)	01	
2 Years Ago (2011-2012)	02	
3 Years Ago (2010-2011)	03	
4 Years Ago (2009-2010)	04	
5 Years Ago (2008-2009)	05	
6 Years Ago (2007-2008)	06	
7 Years Ago (2006-2007)	07	
8 Years Ago (2005-2006)	08	
9 Years Ago (2004-2005)	09	
10 or More Years Ago (prior to 2004)	10	
Other (please specify)	77	O
Don't Know	88	
Refused	99	

Q2_SOFT

Were non-studded winter tires used on any of your household's vehicles during the last winter season? Non-studded winter tires are not all-season tires; they're special soft-rubber traction tires designed for winter weather conditions.

IWR NOTE: Non-studded winter tires are NOT all-season tires. Non-studded winter tires are made of a soft rubber compound with microscopic pores that help the tire grip the road. Some have a special symbol on the tire sidewall: a three-peaked mountain and snowflake.

IWR NOTE: These might also be called Studless Soft Rubber Winter Traction Tires, Studless Winter Tires, Winter Traction Tires, or Non-Studded Winter Friction Tires.

IWR NOTE: "Last winter season" would be from this past Fall 2013 through Spring 2014.

IWR NOTE: If R's HH has multiple vehicles, this is a general question and applies to using non-studded winter tires on any of their vehicles.

IWR NOTE: If R lives out-of-state, but only drives certain vehicles regularly in OR, clarify with: When answering these questions, please only include vehicles driven in Oregon on a regular basis.

Choices		
No	0	==> Q3_SOFT1
Yes	1	==> Q4_SOFT
Don't Know	8	==> Q3_SOFT1
Refused	9	==> Q3_SOFT1

Q3_SOFT1

Thinking back over the last 10 years, has your household ever used non-studded winter tires?

IWR NOTE: These might also be called Studless Soft Rubber Winter Traction Tires, Studless Winter Tires, Winter Traction Tires, or Non-Studded Winter Friction Tires.

==> SKIP TO Q4_SOFT IF NOT (Q2_SOFT=0,8,9)

Choices		
No	0	==> COMP1
Yes	1	
Don't Know	8	==> COMP1
Refused	9	==> COMP1

Q3_SOFT2

READ OPTIONS 1-10 IF NESSESARY

When did your household last use non-studded winter tires?

IWR NOTE: Your best estimate is fine. IWR NOTE: If R says "this year (i.e., 2013-2014 winter season), verify this was in fact the last time they used studded tires, and if so, back-up in the survey and re-ask them Q2_SOFT.

==> SKIP +2 IF NOT (Q3_SOFT1=1)

Choices		
1 Year Ago (2012-2013)	01	
2 Years Ago (2011-2012)	02	
3 Years Ago (2010-2011)	03	
4 Years Ago (2009-2010)	04	
5 Years Ago (2008-2009)	05	
6 Years Ago (2007-2008)	06	
7 Years Ago (2006-2007)	07	
8 Years Ago (2005-2006)	08	
9 Years Ago (2004-2005)	09	
10 or More Years Ago (prior to 2004)	10	
Other (please specify)	77	O
Don't Know	88	
Refused	99	

Q3_SOFT3

Why did your household decide to stop using non-studded winter tires?

Choices		
Enter Response	0	DO
Don't Know	8	
Refused	9	

Q4_SOFT

Are non-studded winter tires put on at least one of your household's vehicles every year?

==> SKIP TO COMP1 IF NOT (Q2_SOFT=1)

Choices		
No	0	
Yes	1	
Other (please specify)	7	O
Don't Know	8	
Refused	9	

Q5_SOFT

READ OPTIONS 0-10 IF NESSESARY

How many years ago did your household start using non-studded winter tires?

IWR NOTE: Your best estimate is fine.

Choices		
This Year (2013-2014)	00	
1 Year Ago (2012-2013)	01	
2 Years Ago (2011-2012)	02	
3 Years Ago (2010-2011)	03	
4 Years Ago (2009-2010)	04	
5 Years Ago (2008-2009)	05	
6 Years Ago (2007-2008)	06	
7 Years Ago (2006-2007)	07	
8 Years Ago (2005-2006)	08	
9 Years Ago (2004-2005)	09	
10 or More Years Ago (prior to 2004)	10	
Other (please specify)	77	O
Don't Know	88	
Refused	99	

COMP1

==> *Q1

Choices	
	0
your vehicle	1
each of your household's vehicles	2
each of your household's vehicles	3
each of your household's vehicles	4
each of your household's vehicles	5
each of your household's vehicles	6
	8
	9

CAR

Next, I'd like to ask a few questions about <COMP1>.

==> SECT2 IF NOT (Q2_STUD=1)

Choices		
Press 'Enter' to Continue	0	D

COMP2

==> *Q1

Choices	
	0
your	1
your first	2
your first	3
your first	4
your first	5
your first	6
	8
	9

CAR1

Thinking about <COMP2> vehicle, did this vehicle have studded tires on this past winter season?

IWR NOTE: "Past winter season" would be from this past Fall 2013 through Spring 2014.

Choices		
No	0	==> CAR1_E
Yes	1	
Don't Know	8	==> CAR1_E
Refused	9	==> CAR1_E

CAR1_A

Were the studded tires put on just 2 tires, or all 4 tires of that vehicle?

==> SKIP TO CAR1_E IF NOT(CAR1=1)

Choices		
Two Tires	2	
Four Tires	4	
Other (please explain)	7	O
Don't Know	8	
Refused	9	

CAR1_B

DO NOT READ OPTIONS

This past winter season, what month were the studded tires put ON that vehicle?

IWR NOTE: "Past winter season" would be from this past Fall 2013 through Spring 2014.

IWR NOTE: I assure you this survey is completely anonymous. We do not know your name or address.

Choices		
January	01	
February	02	
March	03	
April	04	
May	05	
June	06	
July	07	
August	08	
September	09	
October	10	
November	11	
December	12	
Never take off Studded Tires	77	==> /CAR1_E
Don't Know/Don't Remember	88	
Refused	99	

CAR1_C

DO NOT READ OPTIONS

In what month were the studded tires taken OFF that vehicle?

IWR NOTE: I assure you this survey is completely anonymous. We do not know your name or address.

==> SKIP TO CAR1_E IF CAR1_B=77

Choices	
January	01
February	02
March	03
April	04
May	05
June	06
July	07
August	08
September	09
October	10
November	11
December	12
Never take off Studded Tires	66
Haven't Taken Studded Tires off Yet	77
Don't Know/Don't Remember	88
Refused	99

CAR1_D

DO NOT READ OPTIONS

In what month do you plan to take OFF the studded tires from that vehicle?

IWR NOTE: I assure you this survey is completely anonymous. We do not know your name or address.

==> SKIP +1 IF NOT (CAR1_C=77)

Choices	
January	01
February	02
March	03
April	04
May	05
June	06
July	07
August	08
September	09
October	10
November	11
December	12
Never take off Studded Tires	77
Don't Know/Don't Remember	88
Refused	99

CAR1_E

ENTER NUMBER 1-7

On average, how many days per week is this vehicle used?

Choices	
Zero (This vehicle is not usually used)	00
Don't Know	88
Refused	99

CAR1_F

DO NOT READ OPTIONS

Is this vehicle used mainly for work, leisure, shopping, or all purposes?

==>SKIP TO CAR1_I IF CAR1_E=00

Choices		
Work	1	
Leisure	2	
Shopping	3	
All Purposes	4	
Other (please specify)	7	O
Don't Know	8	
Refused	9	

CAR1_G

DO NOT READ OPTIONS

Is this vehicle used mainly by one person or more than one person?

Choices	
One Person	1
More Than One Person	2
Don't Know	8
Refused	9

CAR1_H

ENTER AGE 15-96

How old is the person who uses this vehicle the most?

Choices	
97 years of age or older	97
Don't Know	98
Refused	99

CAR1_I

Is this vehicle a two or four wheel drive?

Choices	
2-Wheel Drive	2
4-Wheel Drive	4
All-Wheel Drive	6
Other	7
Don't Know	8
Refused	9

CAR1_J

Is this vehicle a front-wheel or rear-wheel drive?

==> SKIP +1 IF NOT (CAR1_I=2)

Choices	
Front-Wheel Drive	0
Rear-Wheel Drive	1
Don't Know	8
Refused	9

Section repeats up to 6 times to collect information for all vehicles in household.

CAR2	CAR3	CAR4	CAR5	CAR6
CAR2_A	CAR3_A	CAR4_A	CAR5_A	CAR6_A
CAR2_B	CAR3_B	CAR4_B	CAR5_B	CAR6_B
CAR2_C	CAR3_C	CAR4_C	CAR5_C	CAR6_C
CAR2_D	CAR3_D	CAR4_D	CAR5_D	CAR6_D
CAR2_E	CAR3_E	CAR4_E	CAR5_E	CAR6_E
CAR2_F	CAR3_F	CAR4_F	CAR5_F	CAR6_F
CAR2_G	CAR3_G	CAR4_G	CAR5_G	CAR6_G
CAR2_H	CAR3_H	CAR4_H	CAR5_H	CAR6_H
CAR2_I	CAR3_I	CAR4_I	CAR5_I	CAR6_I
CAR2_J	CAR3_J	CAR4_J	CAR5_J	CAR6_J

SECT2

Next, I have a few questions about your travel habits.

Choices		
Press 'Enter' to Continue	0	D

DRIVE

(To verify) Do you ever drive a vehicle?

Choices	
No	0
Yes	1
Refused	9

MILES

ENTER MILES (Example format: 50, 50-60)

On average, on a typical day, about how many miles do you drive?

IWR NOTE: Include all travel for any purposes.

IWR NOTE: Please only include driving you do yourself (i.e., Do not include miles traveled if you are just a passenger).

IWR NOTE: Your best estimate is fine.

==> SKIP TO MODE IF DRIVE=0,9

Choices		
ENTER MILES	0	DO
Don't Know	8	
Refused	9	

TIME

ENTER MINUTES OR HOURS (Example format: 20 minutes, 2 hours, 20-30 minutes)

Could you estimate how long you spend driving, on a typical day?

IWR NOTE: Your best estimate is fine.

==> SKIP +1 IF NOT (MILES=8)

Choices		
ENTER TIME	0	DO
Don't Know	8	
Refused	9	

MODE

READ OPTIONS 1-8; SELECT MAIN MODE

What form of transportation do you use the most?

IWR NOTE: Car sharing is a model of car rental where people rent cars for short periods of time, often by the hour or minute. Examples of this are Car2Go, Zipcar, and Getaround.

IWR NOTE: Record motorcycle or scooter travel in "Other."

Choices		
Driving alone in private vehicles	01	
Driving with other people in private vehicles (carpooling)	02	
Car-share vehicles	03	
Walk	04	
Bicycle	05	
Bus	06	
Streetcar	07	
MAX train	08	
Other (please specify)	77	O
Don't Know	88	
Refused	99	

WINT1

ENTER TOTAL DAYS 0-365

Approximately how many total days during the last winter season do you think you adjusted your travel behavior because of the weather?

IWR NOTE: "Last winter season" would be from this past Fall 2013 through Spring 2014.

Choices	
Don't Know	888
Refused	999

WINT2

ENTER TOTAL DAYS 0-365

Approximately how many total days during the last winter season was your work or school canceled due to bad weather?

IWR NOTE: If R says they're retired, verify and probe by saying, "Got it, so just to verify, you do not go to work or school?" If the R verifies they don't go to work or school, code "N/A - I don't go to work or school" and continue to the next question.

IWR NOTE: "Last winter season" would be from this past Fall 2013 through Spring 2014.

IWR NOTE: Only include complete cancellations and not delayed start times.

IWR NOTE: This is asking about the R's work or school, not other HHMs.

Choices	
N/A (I don't go to work or school)	777
Don't Know	888
Refused	999

WINT3_A

During winter weather conditions, do you drive as you normally would, or do you change your driving behavior?

IWR NOTE: Winter weather conditions could include things like snow, sleet, or ice.

==> SKIP TO DEMO IF DRIVE=0,9

Choices		
Drive as you normally would (no changes)	0	==> /DEMO
Change your driving behavior	1	
Don't Know	8	
Refused	9	

WINT3_B

During winter weather conditions, do you avoid driving completely?

IWR NOTE: Winter weather conditions could include things like snow, sleet, or ice.

==> SKIP TO DEMO IF WINT3_A=0

Choices		
No	0	==> /WINT3_D
Yes	1	==> /WINT3_C
Don't Know	8	==> /WINT3_D
Refused	9	==> /WINT3_D

WINT3_C

READ OPTIONS 1-3 and 7; PAUSING AFTER EACH TO ALLOW FOR 'YES' OR 'NO' RESPONSE; SELECT ALL THAT APPLY

During winter weather conditions, do you usually...

IWR NOTE: Winter weather conditions could include things like snow, sleet, or ice.

==> SKIP TO DEMO IF NOT (WINT3_B=1)

Choices		
Take public transit instead of driving	1	
Walk or ride a bike instead of driving	2	
Stay home	3	
Anything else? (What do you do?)	7	O
Don't Know	8	X
Refused	9	X

WINT3_D

READ OPTIONS 1-5 and 7; PAUSING AFTER EACH TO ALLOW FOR 'YES' OR 'NO' RESPONSE; SELECT ALL THAT APPLY

During winter weather conditions, do you usually...

IWR NOTE: Winter weather conditions could include things like snow, sleet, or ice.

==> SKIPT TO DEMO IF WINT3_B=1

Choices		
Drive less	1	
Drive at different times	2	
Drive on different roads	3	
Drive slower	4	
Put chains on your tires	5	
Anything else? (What do you do?)	7	O
Don't Know	8	X
Refused	9	X

DEMO

We're almost done. The last few questions are for demographic purposes only.

Choices		
Press 'Enter' to Continue	0	D

GENDER

Record R'S gender, as observed. If you can't tell, ask: "I'm sorry but I'm not allowed to make assumptions, so I have to ask you your gender. Are you male or female?"

Choices	
Male	1
Female	2
Refused	9

EDU

READ OPTIONS 1-7 IF NESSESARY

What is the highest level of education you have completed?

Choices	
Less than 12th Grade (not a high school graduate)	00
High School Graduate or GED	01
Some College or Other Post-Secondary Education	02
Associates Degree or Technical Degree (AA or AS)	03
Bachelor's Degree (BA, AB, BS)	04
Some Post-Graduate	05
Master's Degree	06
Other professional or doctoral degree	07
Don't Know	88
Refused	99

AGE

READ OPTIONS 1-4 UNTIL STOPPED

Which of the following age groups are you in?

Choices		
18 to 29	1	
30 to 49	2	
50 to 64	3	
65 or older	4	
Under 18	7	==> /INT17
Don't Know	8	
Refused	9	

INT17

I'm sorry, but we can only complete this survey with household members 18 years of age or older. Thank you for your time, goodbye.

R DK/RF County Question

==> SKIP +1 IF IF NOT (AGE=7)

Choices			
R is under 18 (made it halfway through the survey)	17	D	==> /END

ZIP

ENTER 5-DIGIT ZIP CODE

What is your home zip code?

Choices	
Don't Know	88888
Refused	99999

CELL

Is the phone you are speaking on now a cell phone?

CELL RF CONVERSION: Since cell phone users are often not represented in phone surveys, it's very important that we include people on cell phones. We want to make sure your household's transportation habits are properly represented and included in this study. We did not get this number from a list or your cell phone company, this number was randomly created.

Choices	
No	0
Yes	1
Don't Know	8
Refused	9

CELL_LL

What types of phones does your household currently have...

IWR Note: Landline could also be called a Land Phone, Fixed-Line, or Main Line." Landlines would include cordless home phones. IWR Note: Please consider all household members' phones when answering this question.
CELL RF CONVERSION: Since cell phone users are often not represented in phone surveys, it's very important that we include people on cell phones. We want to make sure your household's transportation habits are properly represented and included in this study. We did not get this number from a list or your cell phone company, this number was randomly created.

Choices	
Only cell phones	1
Both cell and landline phones	2
Only landline phones	3
Don't Know	8
Refused	9

HHM

ENTER TOTAL NUMBER OF HHMS 1-30

Including yourself, how many people currently live in your household?

IWR NOTE: This includes family and non-family members currently living in household. IWR NOTE: This includes children.

Choices	
Refused	99

RACE

READ OPTIONS 1-6; SELECT ALL THAT APPLY

Which of the following groups best identifies you?

IWR NOTE: Please only use the "Other" option if R refuses to choose an available race/ethnicity category. If R provides a mixture of codable and non-codable responses, code what you can using the available options 1-6 and record only non-codable responses into 'Other.'
IWR NOTE: 'Asian or Asian American' could include Chinese, Filipino, Japanese, Asian Indian, Korean, Vietnamese, etc. IWR NOTE: 'Spanish, Hispanic, or Latino' could include Mexican, Mexican American, Chicano, Puerto Rican, Cuban, Argentinean, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, etc.

Choices		
White or Caucasian	1	
Black or African-American	2	
Asian or Asian-American	3	
American-Indian or Alaskan Native	4	
Native Hawaiian or other Pacific Islander	5	
Spanish, Hispanic, or Latino	6	
Other (Please Specify)	7	O
Don't Know	8	X
Refused	9	X

INCOME

READ OPTIONS 0-7 UNTIL STOPPED

Please stop me when I reach the category that best describes your yearly total household income, from all sources, before taxes, in 2013.

Choices	
Less than $10,000	0
$10,000 to $14,999	1
$15,000 to $24,999	2
$25,000 to $34,999	3
$35,000 to $49,999	4
$50,000 to $74,999	5
$75,000 to $99,999	6
$100,000 or more	7
Don't Know	8
Refused	9

THEND

Thank you! That completes the survey. Do you have any questions or comments about the survey?

Choices		
No	0	
Yes (Record R's Comments)	1	O

INT99

Again, thank you for your time. Good-bye.

Your time for this survey was: $T
If you have any questions about this survey, please contact: Norris Shippen at ODOT, 503-986-3538
If you have questions about the validity of the study or the Survey Research Lab you may call Dr. Debi Elliott, the Director of the Survey Research Laboratory at Portland State University, at 503-725-5198 or visit the Survey Research Lab website at www.srl.pdx.edu.

Choices		
COMPLETE	CO	D

I0

******Hang Up with the Respondent, and then answer the following questions*****

Do you have any comments, for the CLIENT, about how the interview went?

Choices		
No Comments	0	
Yes (Please Specify)	1	O

I1

Overall, how much difficulty did R have in understanding the questions?

Choices	
No Difficulty	1
A Little Difficulty	2
Moderate Difficulty	3
A Great Deal of Difficulty	4

I2

How cooperative was the R?

Choices	
Not at All	1
A Little	2
Moderately	3
Very	4

I3

How distracted did the R seem by other people or things (e.g. television) during the interview?

Choices	
Not at All	1
A Little	2
Moderately	3
Very	4

I4

Was the phone initially answered by the R who completed the survey?

Choices		
No	0	==> /I5
Yes	1	==> /END

I5

What was the person who initially answered the phone...
==> SKIP +1 IF I4=1

Choices		
A child	0	==> /END
Female adult	1	==> /END
Male adult	2	==> /END

F9

Special Study Information

PURPOSE: The purpose of this survey is to help the Oregon Department of Transportation (ODOT) better understand how people in Oregon travel, especially during the winter months. This information will help ODOT better plan for future use of Oregon roadways.

REFUSAL CONVERSION: The results of this survey will be used by the Oregon Department of Transportation (ODOT) to help them better understand how people in Oregon travel, especially during the winter months. It is completely voluntary and anonymous and takes about 5 to 10 minutes to complete. Can we ask you some questions now, or would there be a more convenient time for us to call you back?

For more information about studded tires and winter driving visit the ODOT website: Oregon.gov/ODOT

AT THE END OF THE INTERVIEW ONLY: If R asks about when studded tires are allowed to be on vehicles say: The State of Oregon allows motorists to use studded tires from November 1st through March 31st.

If R asks how their phone number was selected, say: Your number was randomly selected from all households in Oregon.

If R is concerned about confidentiality, say: I assure you this survey is completely anonymous. We do not know your name or address. Your phone number will not be linked to your responses or shared with ODOT.

If you have any questions about this survey, please contact: Norris Shippen at ODOT, 503-986-3538

If you have questions about the validity of the study or the Survey Research Lab you may call Dr. Debi Elliott, the Director of the Survey Research Laboratory at Portland State University, at 503-725-5198 or visit the Survey Research Lab website at www.srl.pdx.edu.

If you have concerns or questions about your rights as a research subject or your privacy protection, please contact the PSU Human Subjects Research Review Committee at 503-725-2227 or 1-877-480-4400.

Appendix B: Detailed Tables

Table A1: Actual and Weighted Counts of Completed Surveys by Oregon County				
	Actual Unweighted Completed Surveys		Weighted Completed Surveys	
Region 1	Count	Percent	Count	Percent
Clackamas	97	5.0%	251	12.1%
Columbia	14	0.7%	34	1.6%
Hood River	5	0.3%	14	0.7%
Multnomah	157	8.1%	360	17.3%
Washington	113	5.8%	330	15.9%
Region 2	Count	Percent	Count	Percent
Benton	32	1.7%	68	3.3%
Clatsop	20	1.0%	23	1.1%
Lane	126	6.5%	195	9.4%
Lincoln	14	0.7%	16	0.8%
Linn	46	2.4%	69	3.3%
Marion	83	4.3%	141	6.8%
Polk	28	1.4%	52	2.5%
Tillamook	15	0.8%	21	1.0%
Yamhill	26	1.3%	41	2.0%
Region 3	Count	Percent	Count	Percent
Coos	48	2.5%	29	1.4%
Curry	20	1.0%	10	0.5%
Douglas	93	4.8%	54	2.6%
Jackson	156	8.1%	102	4.9%
Josephine	69	3.6%	40	1.9%
Region 4	Count	Percent	Count	Percent
Crook	18	0.9%	6	0.3%
Deschutes	188	9.7%	81	3.9%
Gilliam	2	0.1%	0[12]	0.0%
Jefferson	25	1.3%	8	0.4%
Klamath	109	5.6%	37	1.8%
Lake	8	0.4%	2	0.1%
Sherman	7	0.4%	2	0.1%
Wasco	26	1.3%	11	0.5%
Wheeler	3	0.2%	1	0.0%
Region 5	Count	Percent	Count	Percent
Baker	51	2.6%	9	0.4%
Grant	25	1.3%	4	0.2%
Harney	23	1.2%	5	0.2%
Malheur	44	2.3%	8	0.4%
Morrow	25	1.3%	5	0.2%
Umatilla	133	6.9%	30	1.4%

[12] Due to having only two respondents in Gilliam County and both of those respondents falling in the oldest age group, the weighting reduced their influence to less than one-half of a respondent. Numerical rounding results in the count for that county represented as zero in the frequency distribution.

Table A1: Actual and Weighted Counts of Completed Surveys by Oregon County

	Actual Unweighted Completed Surveys		Weighted Completed Surveys	
Union	57	2.9%	13	0.6%
Wallowa	28	1.4%	5	0.2%

NOTE: Data weighted for region and age.

Table A2: Region 1 Number of Vehicles & Studded Tire Usage (n=988 households)			
Number of Vehicles		Count	Percent
Total Number of Households		988	n/a
Total Number of Working Cars, Trucks or Vans (mean = 2.16 vehicles per household)		2,132	n/a
Households with:			
No Vehicles		63	6.4%
1 Vehicle		184	18.6%
2 Vehicles		442	44.8%
3 Vehicles		190	19.3%
4 Vehicles		60	6.0%
5 Vehicles		40	4.0%
6+ Vehicles		9	0.9%
Don't Know or Refused		0	0.0%
Households that Used Studded Tires		Count	Percent
On Any Vehicle Last Winter Season (Fall 2013-Spring 2014)		87	8.8%
Not Last Winter Season, but Any Time Over Last 10 Years		153	15.5%
On at Least One Vehicle Every Year, for Households Using Studded Tires Last Winter Season		74	7.4%
During Last Winter Season, Number of Vehicles that Used… (2,132 vehicles)		Count	Percent
Studded Tires (i.e., 2 or 4 studded tires)		85	4.0%
2 Studded Tires		6	0.3%
4 Studded Tires		79	3.7%
Households with Vehicles Using Studded Tires Last Winter Season	2 Tires	4 Tires	2 or 4 Tires
1st Vehicle	6	56	62
2nd Vehicle	0	21	21
3rd Vehicle	0	2	2
4th Vehicle	0	0	0
5th Vehicle	0	0	0
6th Vehicle	0	0	0
Households that Used Non-studded Winter Tires		Count	Percent
On Any Vehicle Last Winter Season (Fall 2013-Spring 2014)		91	9.2%
Not Last Winter Season, but Any Time Over Last 10 Years		59	6.0%
On at Least One Vehicle Every Year, for Households Using Non-Studded Winter Tires Last Winter Season		74	7.5%

NOTE: Data weighted for region and age.

Table A3: Region 2 Number of Vehicles & Studded Tire Usage (n=625 households)			
Number of Vehicles		Count	Percent
Total Number of Households		625	n/a
Total Number of Working Cars, Trucks or Vans (mean = 2.41 vehicles per household)		1,505	n/a
Households with:			
No Vehicles		21	3.3%
1 Vehicle		123	19.7%
2 Vehicles		233	37.3%
3 Vehicles		122	19.6%
4 Vehicles		63	10.2%
5 Vehicles		38	6.1%
6+ Vehicles		18	2.9%
Don't Know or Refused		5	0.9%
Households that Used Studded Tires		Count	Percent
On Any Vehicle Last Winter Season (Fall 2013-Spring 2014)		44	7.0%
Not Last Winter Season, but Any Time Over Last 10 Years		108	17.3%
On at Least One Vehicle Every Year, for Households Using Studded Tires Last Winter Season		32	5.2%
During Last Winter Season, Number of Vehicles that Used… (1,505 vehicles)		Count	Percent
Studded Tires (i.e., 2 or 4 studded tires)		54	3.6%
2 Studded Tires		12	0.8%
4 Studded Tires		43	2.9%
Households with Vehicles Using Studded Tires Last Winter Season	2 Tires	4 Tires	2 or 4 Tires
1st Vehicle	7	30	37
2nd Vehicle	4	10	14
3rd Vehicle	1	3	4
4th Vehicle	0	0	0
5th Vehicle	0	0	0
6th Vehicle	0	0	0
Households that Used Non-studded Winter Tires		Count	Percent
On Any Vehicle Last Winter Season (Fall 2013-Spring 2014)		97	15.5%
Not Last Winter Season, but Any Time Over Last 10 Years		30	4.9%
On at Least One Vehicle Every Year, for Households Using Non-Studded Winter Tires Last Winter Season		73	11.7%

NOTE: Data weighted for region and age.

Table A4: Region 3 Number of Vehicles & Studded Tire Usage (n=234 households)

Number of Vehicles	Count	Percent
Total Number of Households	234	n/a
Total Number of Working Cars, Trucks or Vans (mean = 2.18 vehicles per household)	509	n/a
Households with:		
No Vehicles	13	5.4%
1 Vehicle	54	22.9%
2 Vehicles	95	40.7%
3 Vehicles	40	17.2%
4 Vehicles	19	8.0%
5 Vehicles	9	4.0%
6+ Vehicles	4	1.8%
Don't Know or Refused	0	0.0%

Households that Used Studded Tires	Count	Percent
On Any Vehicle Last Winter Season (Fall 2013-Spring 2014)	12	5.0%
Not Last Winter Season, but Any Time Over Last 10 Years	37	15.8%
On at Least One Vehicle Every Year, for Households Using Studded Tires Last Winter Season	9	3.7%

During Last Winter Season, Number of Vehicles that Used… (509 vehicles)	Count	Percent
Studded Tires (i.e., 2 or 4 studded tires)	12	2.4%
2 Studded Tires	1	0.2%
4 Studded Tires	9	1.8%

Households with Vehicles Using Studded Tires Last Winter Season	2 Tires	4 Tires	2 or 4 Tires
1st Vehicle	0	6	6
2nd Vehicle	1	3	4
3rd Vehicle	0	0	0
4th Vehicle	0	0	0
5th Vehicle	0	0	0
6th Vehicle	0	0	0

Households that Used Non-studded Winter Tires	Count	Percent
On Any Vehicle Last Winter Season (Fall 2013-Spring 2014)	19	8.3%
Not Last Winter Season, but Any Time Over Last 10 Years	10	4.4%
On at Least One Vehicle Every Year, for Households Using Non-Studded Winter Tires Last Winter Season	14	5.8%

NOTE: Data weighted for region and age.

Table A5: Region 4 Number of Vehicles & Studded Tire Usage (n=148 households)		
Number of Vehicles	Count	Percent
Total Number of Households	148	n/a
Total Number of Working Cars, Trucks or Vans (mean = 2.36 vehicles per household)	359	n/a
Households with:		
No Vehicles	4	2.7%
1 Vehicle	36	18.0%
2 Vehicles	57	38.3%
3 Vehicles	37	25.1%
4 Vehicles	11	7.6%
5 Vehicles	8	5.3%
6+ Vehicles	4	3.0%
Don't Know or Refused	0	0.0%
Households that Used Studded Tires	Count	Percent
On Any Vehicle Last Winter Season (Fall 2013-Spring 2014)	51	34.3%
Not Last Winter Season, but Any Time Over Last 10 Years	43	29.2%
On at Least One Vehicle Every Year, for Households Using Studded Tires Last Winter Season	47	32.0%
During Last Winter Season, Number of Vehicles that Used… (359 vehicles)	Count	Percent
Studded Tires (i.e., 2 or 4 studded tires)	70	19.5%
2 Studded Tires	1	0.3%
4 Studded Tires	69	19.2%

Households with Vehicles Using Studded Tires Last Winter Season	2 Tires	4 Tires	2 or 4 Tires
1st Vehicle	1	38	39
2nd Vehicle	0	21	21
3rd Vehicle	0	7	7
4th Vehicle	0	3	3
5th Vehicle	0	0	0
6th Vehicle	0	0	0

Households that Used Non-studded Winter Tires	Count	Percent
On Any Vehicle Last Winter Season (Fall 2013-Spring 2014)	39	26.2%
Not Last Winter Season, but Any Time Over Last 10 Years	11	7.3%
On at Least One Vehicle Every Year, for Households Using Non-Studded Winter Tires Last Winter Season	35	23.8%

NOTE: Data weighted for region and age.

Table A6: Region 5 Number of Vehicles & Studded Tire Usage (n=78 households)			
Number of Vehicles		Count	Percent
Total Number of Households		78	n/a
Total Number of Working Cars, Trucks or Vans (mean = 2.68 vehicles per household)		209	n/a
Households with:			
No Vehicles		2	2.1%
1 Vehicle		13	16.8%
2 Vehicles		24	30.4%
3 Vehicles		23	29.1%
4 Vehicles		10	12.6%
5 Vehicles		3	4.0%
6+ Vehicles		4	4.9%
Don't Know or Refused		0	0.0%
Households that Used Studded Tires		Count	Percent
On Any Vehicle Last Winter Season (Fall 2013-Spring 2014)		28	35.7%
Not Last Winter Season, but Any Time Over Last 10 Years		21	26.7%
On at Least One Vehicle Every Year, for Households Using Studded Tires Last Winter Season		26	33.8%
During Last Winter Season, Number of Vehicles that Used… (969 vehicles)		Count	Percent
Studded Tires (i.e., 2 or 4 studded tires)		36	17.2%
2 Studded Tires		1	0.5%
4 Studded Tires		34	16.3%
Households with Vehicles Using Studded Tires Last Winter Season	2 Tires	4 Tires	2 or 4 Tires
1st Vehicle	1	20	21
2nd Vehicle	0	9	9
3rd Vehicle	0	4	4
4th Vehicle	0	1	1
5th Vehicle	0	0	0
6th Vehicle	0	0	0
Households that Used Non-studded Winter Tires		Count	Percent
On Any Vehicle Last Winter Season (Fall 2013-Spring 2014)		19	24.0%
Not Last Winter Season, but Any Time Over Last 10 Years		6	7.3%
On at Least One Vehicle Every Year, for Households Using Non-Studded Winter Tires Last Winter Season		15	19.6%

NOTE: Data weighted for region and age.

Table A7: Last Used Studded Tires for Households Not Using Studs in 2013-14 Winter Season by Region										
	Region 1 (n=153 households)		Region 2 (n=108 households)		Region 3 (n=37 households)		Region 4 (n=43 households)		Region 5 (n=21 households)	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
1 Year Ago (2012-2013)	12	7.9%	12	10.8%	3	7.6%	8	19.7%	2	9.0%
2 Years Ago (2011-2012)	35	22.7%	11	10.2%	6	15.1%	8	18.5%	4	20.4%
3 Years Ago (2010-2011)	25	16.5%	29	26.7%	4	9.7%	8	18.4%	4	21.2%
4 Years Ago (2009-2010)	10	6.8%	2	2.3%	2	5.3%	3	7.2%	1	7.1%
5 Years Ago (2008-2009)	18	11.6%	22	20.2%	2	6.0%	6	14.7%	3	13.3%
6 Years Ago (2007-2008)	12	7.9%	9	8.1%	2	6.7%	1	2.4%	1	5.4%
7 Years Ago (2006-2007)	2	1.2%	2	2.3%	3	8.9%	2	4.4%	1	3.6%
8 Years Ago (2005-2006)	11	7.4%	5	5.1%	5	13.0%	1	1.2%	1	4.9%
9 Years Ago (2004-2005)	1	0.6%	1	0.6%	1	3.8%	1	1.2%	1	2.7%
10 or More Years Ago (prior to 2004)	18	11.8%	12	11.5%	8	22.5%	4	10.4%	2	11.0%
Other (Please Specify)	0	0.0%	1	1.1%	0	0.7%	1	1.2%	0	0.4%
Don’t Know	9	5.6%	1	1.1%	0	0.7%	0	0.8%	0	0.9%

NOTE: Data weighted for region and age.

Table A8: Started Using Studded Tires by Region

	Region 1 (n=87 households)		Region 2 (n=44 households)		Region 3 (n=12 households)		Region 4 (n=51 households)		Region 5 (n=28 households)	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
This Year (2013-2014)	13	15.2%	5	11.5%	2	19.2%	2	4.1%	0	1.7%
1 Year Ago (2012-2013)	0	0.0%	0	0.0%	0	2.3%	1	2.7%	0	0.7%
2 Years Ago (2011-2012)	5	5.6%	0	0.0%	1	7.1%	2	4.5%	1	4.6%
3 Years Ago (2010-2011)	7	7.7%	0	0.0%	1	4.8%	1	2.7%	0	0.7%
4 Years Ago (2009-2010)	5	5.6%	0	0.0%	0	2.3%	1	2.7%	1	4.0%
5 Years Ago (2008-2009)	7	7.7%	2	4.7%	0	0.0%	3	5.9%	1	2.0%
6 Years Ago (2007-2008)	8	9.6%	5	12.5%	0	2.3%	2	3.1%	2	6.3%
7 Years Ago (2006-2007)	0	0.0%	0	0.0%	1	12.2%	2	4.7%	1	2.7%
8 Years Ago (2005-2006)	0	0.0%	1	2.8%	1	12.2%	2	4.7%	1	2.4%
9 Years Ago (2004-2005)	0	0.0%	1	1.4%	0	0.0%	0	0.3%	0	0.0%
10 or More Years Ago (prior to 2004)	42	48.7%	26	60.0%	4	37.6%	32	63.5%	20	72.9%
Other (Please Specify)	0	0.0%	0	0.0%	0	0.0%	0	0.7%	0	1.7%
Don’t Know	0	0.0%	3	7.0%	0	0.0%	0	0.3%	0	0.3%

NOTE: Data weighted for region and age.

Table A9: Last Used Non-Studded Winter Tires for Households Not Using Them in 2013-14 Winter Season by Region	Region 1 (n=59 households)		Region 2 (n=30 households)		Region 3 (n=10 households)		Region 4 (n=11 households)		Region 5 (n=6 households)	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
1 Year Ago (2102-2013)	0	0.0%	3	10.0%	0	0.0%	2	19.1%	0	4.8%
2 Years Ago (2011-2012)	18	31.3%	10	34.3%	1	7.9%	2	16.1%	1	16.6%
3 Years Ago (2010-2011)	2	3.1%	7	21.9%	2	19.2%	0	0.0%	1	13.3%
4 Years Ago (2009-2010)	7	11.3%	0	0.0%	0	0.0%	1	6.3%	1	26.2%
5 Years Ago (2008-2009)	7	11.1%	1	3.9%	2	21.7%	1	11.0%	1	13.3%
6 Years Ago (2007-2008)	10	17.7%	1	2.0%	1	5.4%	1	11.4%	0	0.0%
7 Years Ago (2006-2007)	0	0.0%	1	2.0%	1	10.8%	2	20.4%	0	1.6%
8 Years Ago (2005-2006)	6	9.5%	2	8.0%	3	24.6%	0	3.2%	0	3.2%
9 Years Ago (2004-2005)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	1.6%
10 or More Years Ago (prior to 2004)	9	16.1%	5	16.0%	1	10.6%	1	4.7%	1	16.2%
Other (Please Specify)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	1.6%
Don't Know	0	0.0%	1	2.0%	0	0.0%	1	7.9%	0	1.6%

NOTE: Data weighted for region and age.

Table A10: Started Using Non-Studded Winter Tires by Region

	Region 1 (n=91 households)		Region 2 (n=97 households)		Region 3 (n=19 households)		Region 4 (n=39 households)		Region 5 (n=19 households)	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
This Year (2013-2014)	0	0.0%	1	1.3%	2	10.1%	5	12.5%	2	8.1%
1 Year Ago (2012-2013)	9	10.2%	12	11.9%	1	7.3%	2	4.8%	2	8.5%
2 Years Ago (2011-2012)	10	11.5%	10	10.0%	2	10.2%	3	7.6%	1	6.5%
3 Years Ago (2010-2011)	17	18.8%	18	19.0%	1	4.2%	2	6.2%	1	5.5%
4 Years Ago (2009-2010)	11	11.6%	1	1.3%	0	1.4%	3	7.6%	2	12.1%
5 Years Ago (2008-2009)	2	2.0%	6	6.5%	1	4.2%	2	4.5%	2	11.0%
6 Years Ago (2007-2008)	6	6.3%	2	2.5%	1	7.3%	4	9.9%	2	12.4%
7 Years Ago (2006-2007)	8	8.4%	4	3.9%	0	1.4%	2	5.4%	0	1.0%
8 Years Ago (2005-2006)	9	10.5%	1	1.3%	0	1.4%	1	2.6%	0	1.0%
9 Years Ago (2004-2005)	0	0.0%	0	0.0%	1	2.9%	0	0.9%	0	0.5%
10 or More Years Ago (prior to 2004)	18	19.7%	38	39.1%	9	48.2%	14	35.3%	6	29.8%
Other (Please Specify)	0	0.0%	0	0.0%	0	0.0%	0	0.4%	0	0.0%
Don’t Know	1	1.0%	3	3.3%	0	1.4%	1	2.2%	1	3.5%

NOTE: Data weighted for region and age.

Table A11: Month Studded Tires Put On in 2013-14 Winter Season Across All Vehicles by Region

	Region 1 (n=2,132 vehicles)		Region 2 (n=1,505 vehicles)		Region 3 (n=509 vehicles)		Region 4 (n=359 vehicles)		Region 5 (n=209 vehicles)	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
January	10	0.5%	1	0.1%	0	0.0%	6	1.7%	2	1.0%
February	0	0.0%	0	0.0%	0	0.0%	1	0.3%	1	0.5%
March	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
April	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
May	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
June	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
July	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
August	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
September	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
October	10	0.5%	0	0.0%	1	0.2%	7	1.9%	1	0.5%
November	41	1.9%	21	1.4%	5	1.0%	37	10.3%	19	9.1%
December	24	1.1%	26	1.7%	2	0.4%	14	3.9%	5	2.4%
Never Take Studs Off	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Don't Know	1	0.1%	8	0.5%	3	0.6%	5	1.4%	4	1.9%

NOTE: Data weighted for region and age.

Table A12: Month Studded Tires Taken Off in 2013-14 Winter Season Across All Vehicles by Region

	Region 1 (n=2,132 vehicles)		Region 2 (n=1,505 vehicles)		Region 3 (n=509 vehicles)		Region 4 (n=359 vehicles)		Region 5 (n=209 vehicles)	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
January	2	0.1%	11	0.7%	0	0.0%	2	0.6%	0	0.0%
February	10	0.5%	3	0.2%	1	0.2%	2	0.6%	3	1.4%
March	37	1.7%	16	1.1%	5	1.0%	31	8.6%	17	8.1%
April	25	1.2%	23	1.5%	2	0.4%	29	8.1%	15	7.2%
May	0	0.0%	1	0.1%	2	0.4%	2	0.6%	0	0.0%
June	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
July	1	0.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
August	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
September	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
October	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
November	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
December	8	0.4%	1	0.1%	0	0.0%	0	0.0%	0	0.0%
Never Take Studs Off	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Don't Know	0	0.0%	1	0.1%	1	0.2%	3	0.8%	1	0.5%

NOTE: Data weighted for region and age.

Table A13: Vehicles with Studded Tires During Each Month Out of All Vehicles by Region

	Region 1 (n=2,132 vehicles)		Region 2 (n=1,505 vehicles)		Region 3 (n=509 vehicles)		Region 4 (n=359 vehicles)		Region 5 (n=209 vehicles)	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
January	76	3.6%	46	3.1%	9	1.8%	65	18.1%	31	14.8%
February	74	3.5%	35	2.3%	9	1.8%	65	18.1%	32	15.3%
March	64	3.0%	35	2.3%	9	1.8%	64	17.8%	29	13.9%
April	28	1.3%	24	1.6%	4	0.8%	33	9.2%	15	7.2%
May	3	0.1%	2	0.1%	2	0.4%	2	0.6%	0	0.0%
June	3	0.1%	1	0.1%	0	0.0%	0	0.0%	0	0.0%
July	3	0.1%	1	0.1%	0	0.0%	0	0.0%	0	0.0%
August	2	0.1%	1	0.1%	0	0.0%	0	0.0%	0	0.0%
September	2	0.1%	1	0.1%	0	0.0%	0	0.0%	0	0.0%
October	12	0.6%	1	0.1%	2	0.4%	7	1.9%	1	0.5%
November	51	2.4%	22	1.5%	6	1.2%	43	12.0%	23	11.0%
December	75	3.5%	46	3.1%	8	1.6%	59	16.4%	29	13.9%

NOTE: Data weighted for region and age.

Table A14:Vehicle* Uses Across All Vehicles in Households That Use Studded Tires by Region

	Region 1 (n=181 vehicles)		Region 2 (n=100 vehicles)		Region 3 (n=27 vehicles)		Region 4 (n=119 vehicles)		Region 5 (n=76 vehicles)	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Work	49	27.1%	14	14.0%	6	1.2%	26	21.8%	11	14.5%
Leisure	20	11.0%	7	7.0%	2	0.4%	11	9.2%	9	11.8%
Shopping	2	1.1%	8	8.0%	1	0.2%	3	2.5%	3	3.9%
All Purposes	109	60.2%	61	61.0%	16	3.2%	75	63.0%	46	60.5%
Other	1	0.6%	2	2.0%	1	0.2%	3	2.5%	1	1.3%
	Region 1 (n=181 vehicles)		Region 2 (n=100 vehicles)		Region 3 (n=27 vehicles)		Region 4 (n=119 vehicles)		Region 5 (n=76 vehicles)	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Used by One Person	133	73.5%	70	70.0%	19	70.3%	89	74.8%	50	65.8%
Used by More Than One Person	45	24.9%	25	25.0%	8	29.6%	30	25.2%	20	26.3%

NOTE: Data weighted for region and age.
*Includes only those vehicles that were drivent on average at least one day per week.

Table A15: Types of Vehicles Across All Vehicles in Households That Use Studded Tires by Region

	Region 1 (n=205 vehicles)		Region 2 (n=130 vehicles)		Region 3 (n=34 vehicles)		Region 4 (n=133 vehicles)		Region 5 (n=85 vehicles)	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
2-Wheel Drive	103	50.2%	78	60.0%	20	58.8%	65	48.9%	34	40.0%
4-Wheel Drive	95	46.3%	48	36.9%	11	32.4%	55	41.4%	39	45.9%
All-Wheel Drive	9	4.3%	3	2.3%	3	8.8%	9	6.8%	5	5.9%
Other	0	0.0%	1	0.8%	0	0.0%	2	1.5%	3	3.5%
Don't Know	0	0.0%	0	0.0%	0	0.0%	1	0.8%	0	0.0%
	Region 1 (n=103 2-wheel drive vehicles)		Region 2 (n=78 2-wheel drive vehicles)		Region 3 (n=20 2-wheel drive vehicles)		Region 4 (n=65 2-wheel drive vehicles)		Region 5 (n=34 2-wheel drive vehicles)	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Front-Wheel Drive	54	52.4%	48	61.5%	7	35.0%	42	64.6%	22	64.7%
Rear-Wheel Drive	36	35.0%	20	25.6%	9	45.0%	17	26.2%	8	23.5%
Don't Know	12	11.7%	7	9.0%	4	20.0%	5	7.7%	1	2.9%

NOTE: Data weighted for region and age.

Table A16: Most Common Forms of Transportation by Region

	Region 1 (n=988 households)		Region 2 (n=625 households)		Region 3 (n=234 households)		Region 4 (n=148 households)		Region 5 (n=78 households)	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Driving alone in private vehicles*	583	59.0%	431	69.0%	142	60.8%	95	64.6%	52	66.3%
Driving with other people in private vehicles (carpooling)*	209	21.1%	127	20.4%	64	27.2%	40	26.9%	18	23.4%
Driving alone and with other people	24	2.4%	7	1.2%	7	3.1%	4	2.8%	2	2.4%
Car-share vehicles*	5	0.5%	4	0.7%	0	0.1%	0	0.1%	0	0.5%
Walking*	31	3.2%	30	4.9%	9	4.0%	2	1.5%	3	3.7%
Bicycle*	14	1.4%	8	1.3%	3	1.3%	2	1.6%	0	0.4%
Bus*	43	4.4%	9	1.4%	1	0.2%	1	0.6%	0	0.2%
Streetcar*	2	0.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MAX train	57	5.8%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other*	42	4.3%	14	2.3%	15	6.3%	7	4.7%	4	5.2%
Alone or with other in company or commercial vehicle	0	0.0%	1	0.2%	2	0.8%	1	0.6%	0	0.1%
Alternative transportation (e.g., medical transport, dial-a-ride, retirement community van)	2	0.2%	2	0.3%	2	0.8%	0	0.0%	0	0.2%
Driven by others, some in combination with public transportation or walking	1	0.1%	0	0.0%	0	0.1%	0	0.0%	0	0.4%
Motorcycle	0	0.0%	0	0.0%	3	1.2%	0	0.1%	1	1.1%
Multiple public transportation modes	3	0.3%	0	0.0%	0	0.0%	0	0.1%	0	0.0%
Taxi	0	0.0%	2	0.3%	0	0.1%	0	0.1%	1	0.7%
Don't know or refused	2	0.2%	1	0.1%	0	0.0%	0	0.0%	0	0.2%

*Original response options offered to respondents

NOTE: Data weighted for region and age.

Table A17: Travel Behavior by Region

Miles Driven on a Typical Day	Minimum Value	Maximum Value	Mean	Standard Deviation
Region 1 (n=886)	0	600	27.51	59.17
Region 2 (n=585)	0	840	33.88	71.43
Region 3 (n=216)	0	550	21.06	36.04
Region 4 (n=138)	0	300	24.80	33.64
Region 5 (n=73)	0	400	30.13	45.30
Days of Adjusted Travel	**Minimum Value**	**Maximum Value**	**Mean**	**Standard Deviation**
Region 1 (n=944)	0	100	5.88	11.84
Region 2 (n=605)	0	120	7.05	10.52
Region 3 (n=230)	0	150	6.62	14.59
Region 4 (n=141)	0	120	9.43	20.51
Region 5 (n=76)	0	180	9.79	20.10
Days of Cancelled Work or School	**Minimum Value**	**Maximum Value**	**Mean**	**Standard Deviation**
Region 1 (n=813)	0	30	1.68	2.98
Region 2 (n=502)	0	120	2.80	4.92
Region 3 (n=180)	0	50	1.95	5.02
Region 4 (n=116)	0	20	0.96	1.80
Region 5 (n=62)	0	20	1.69	3.01

NOTE: Data weighted for region and age.

Table A18: Additional Survey Comments
A lot of people are against studs on the highway, but we have to use them to be safe.
Are there laws coming about making studded tires illegal? Studded tires tear up the roads so I wonder if they will make them illegal.
Are they going to get rid of studded tires? We live in the mountains and we need studded tires.
Are they trying to outlaw studded tires? I have seen a lot of folks around here use studded, it'll be interesting to see how that turns out.
Bus transportation in rural Oregon would be wonderful, trains would be even better.
Hopefully you will ban studded tires.
I am retired now. I do not know if it's relevant, but if it's snowing out I don't drive. I do not have to do a lot of that stuff. If I were going to work then some of my answers would be different.
I assume this was about studded tires. When you live in rural Eastern Oregon, they seem much more important than when living in an urban or suburban area. I've lived in both and I didn't realize how important they were for rural or Eastern Oregon
I carry chains with me and keep my car prepared.
I do have a comment on the road conditions during winter weather. Sometimes seeing the white line becomes difficult when going over the mountain passes. Especially during winter weather.
I do hope that they get rid of studded tires someday, they ruin the roads.
I do not really drive much when it is snowy or icy. We had freezing rain this year. I live in a small town, Coburg, so I can walk to the stores. I just do not go anywhere when it is too rotten out. It is too dangerous.
I find the race question aggravating and out of date. I enjoy Max and Street Car I would like it to run through Hood River. We use the Cleveland street station in Gresham to get into Portland and I asked Tri-met if they could have a secured parking lot and the parking time extended so that the people on this side could stay longer.
I grew up in snow; it does not scare me. Everyone in my family drives a four-wheel drive vehicle of some kind and it makes a huge difference. It keeps you on the road. It's the people who don't know how to drive in snow that are dangerous.
I have no comments about the survey, but I see you are calling from Portland and hope you guys don't try to take away our studded tires because they make me feel safe.
I hope people stop using studded tires because they ruin the roads and cost us money. When I was younger we did not use studded tires, we just drove more cautiously. The grooves in the roadway caused by studded tires cause particular ice in the grooves that become a danger.
I hope that they will ban studded tires. They are unnecessary in Oregon. I know nobody who uses them and I think it is outrageous that damage is done to our roads and the people who are using them are not assessed any annual fees for using them. I mean a huge, huge fee like 1,000 dollars. If they want to go to the mountains, they can use chains.
I hope they outlaw studded tires.
I hope they put a penalty on people who buy studded tires. I think they are ruining our roads and people who buy studded tires should have to step up and pay extra for it. They put ruts all over our roads. They should charge a surcharge for people who buy studded tires. That money could go back to the state for road repair for stud erosion or stud ruts. All you have to do is drive a foot to the right or to the left of the ruts and the roads are much smoother and quieter. We have never used studded tires so we are very biased. We do not think they are necessary, especially in this city. Maybe if they don't feel safe they should just stay home or call a taxi or dial-a-bus or something.
I hope this is to get rid of studs.
I know there has been talk of banning studded tires. In our part of the state, they are essential. In order to be safe getting around in the winter, we have to have them.
I know there is a big controversy about snow tires versus using something else, and in my opinion, I have not driven off the road or had an accident in the 25 years I have been driving back and forth. I think people drive carefully with studded tires. If they take the studs away, we are not going to have a good enough tire to drive with. I hope we are able to keep them or something suitable enough so that we can get back and forth to work.

Table A18: Additional Survey Comments
I live in Salem and I would say please make more bike roads. I do not ride my bike to school because I almost get hit. I ride the bike lanes, but I would prefer more bike roads that are away from the roadway.
I lived in Central Oregon for three years. There was snow on the ground from Halloween until Memorial Day. Those people do not have the same driving problems we have. They should have a whole different set of rules than Western Oregon has. I think they should be able to use studded tires until the snow stops.
I love studded tires but they do damage the road.
I personally always used studded tires when I worked. I lived 20 miles from the store, so I always drove with studded tires. Now with some vehicles changing, I do not need studded tires because they are so good in the snow. If you have some little so-so car, you should most definitely have studded tires. Here, you might go off the side of the mountain. So that's a big deal. I do realize they tear up the roads, but then again so do the big trucks. I do think safety is more important.
I really hope the legislature gets rid of studded tires. They are destroying our roads. We believe very strongly that they should be banned. My husband is German and they banned those 25 years ago. I really hope they get rid of them. Stud less tires are better than studded tires anyways.
I think studded tires are ridiculous in Oregon. The cost versus the benefit is ridiculous. I would heartily support any referendum to abolish them.
I think that Marion County needs better public transportation.
I think that studded tires are important where needed, but those that have not practiced their wintertime driving skills use them as a crutch when it is not necessary.
I think there are trying to get studs taken off the road. They tear up the roads.
I think they should re-do their questions for the older people who do not work that take the survey.
I think they are trying to get rid of studded tires. Do not let them get rid of them.
I think this is crazy and a waste of time. I cannot imagine what good it is going to do.
I thought you would be asking about the highways specifically. We go to Portland at least 10 times a year and we use the highway, but we are not using studded tires.
I go over 10,000 miles on my Harley when the weather is nice.
I used to drive for a company all the time across the state. In driving all that time across the mountains and especially between Bend and Redmond you can sure see how studded tires tear up the highway. It is just like wagon wheel ruts. If you got out of one trench, it is hard to control, because your car would lose control between trenches and ruts. I can see why people slide off the road. It is hard to for people to keep their cars in control if they are not driving in the wagon ruts. It makes it very easy to drive off the highway. Those studded tires if they get filled with snow; they are not any more advantageous than regular tires. Especially if it is icy or snowy, it is hard to stay in the ruts in the road. The company I worked for had snow tires and we carried chains with us. I drove with those snow tires and driving defensively, I only had to use my chains once in the 9 years I drove for them. Studded tires are useless especially without snow or ice on the road they tear up the road. You can hear them a long way off driving down the city streets. They are tearing up the pavement, even if they are copper studs or whatever they are using these days. It costs more to repair the roads than to give everyone snow tires.
I want to know if they will make us stop using studded tires. They do not tear up the road as much as people think they do.
I want to tell whoever is looking to get information out of this survey that it is tough to look at this between the city dwellers in Portland, where everything is located right next to them, and people that are living in rural counties that have to drive to get what we need. Do not paint us in with the people who do not have to drive. We have no choice.
I wish people would stop using studded tires. I think people would stop driving so much with them through town.
I am against studded tires. I do not think they do much good.
I am from Eastern Oregon and we absolutely need studded tires out here. They may not need them in the valley and they may eat up the roadways, but I think they sure as hell save lives. If you are going to get rid of studded tires, you should have classes for the people from Portland and the Willamette

Table A18: Additional Survey Comments
Valley to learn how to drive up here in Eastern Oregon.
I am in my late 80's and don't go into town too often.
I am never giving up my studs, even if I have to pay extra taxes.
I have learned that when you drive on snow and ice you slow down.
If I ever needed them I would probably buy them. I am getting older and my driving is getting a little shakier, so if I ever needed the studded tires, I would buy them.
If people drove a bit slower, ODOT would not have to spend so much money. Working in a hospital, you see what happens when people do not drive slower. Even with studs on, ice is nothing to mess with.
In our area, they redid the roads that were damaged by the studded tires but they did not fill it with asphalt completely and now it feels like you are driving over a railroad track.
In this area, most of us have four wheel drive and that's what we need.
Include motorcycles next time.
Is it specifically about studded tires? Us old-timers have learned to drive safely without these crutches. My opinion is studded tires should be outlawed.
Is this going to get rid of studded tires? Because most people put them on, and never need them.
It depends on where you live. My behavior was completely different when I was in the Portland area vs. when I lived in Central Oregon. Totally different driving conditions.
It is important for our way of life up here with a lot of snow and icy roads that we have studs on our tires.
It snowed on me yesterday. We drive in snow all winter long. I did go away from studs this year.
It was long and kind of ridiculous.
It would be nice and useful if the public transportation were able to be versatile or frequent enough that people would be able to use it.
Just do not take away studded tires.
Klamath County is an agricultural county and they keep making turn lanes that are not conducive to truck and trailers. It causes damage to roadways and people's equipment.
La Grande should plow their roads. They do not even plow at all.
My husband really feels strongly about using studded tires, but he also appreciates that it causes wear and tear on the road. He is willing to pay a tax to use them though because he knows it tears up the roads.
Need to fix the potholes first.
ODOT does a great job.
On the highway between Klamath Falls and the California boarder, there are some spots that need to be fixed. The winter has been rough on the road. Oregon is very good about keeping up the roads.
Our information kind of skews the data because we do not live in Oregon in the winter. We drive out of Oregon in December and we drive back in the last week of March.
Please plow Highway 97 to Antelope Road, ODOT never seems to get that taken care of.
Some Oregon congressman wants to charge people by the miles they drive, but they need to look at studs. A lighter car does not do as much damage as studs do. Studs do more damage than anything. Especially in Eastern Oregon people use studs.
Studded tires do not contribute to any significant degree to the condition of the roads surface. What does is chains put on heavy trucks when there is not snow. If you follow along behind these trucks you can see it. You can see the twin depressions caused by the chain. The depressions are wider than regular cars. Truck drivers are required to put on those chains even when there is not snow. As long as studded tires are used seasonally, they are fine. They are responsible for preventing many accidents, even if they are just minor fender benders, but do not contribute significantly to road damage.
Studded tires really tear up our roads and cost taxpayers money.
Tell them to get rid of studs.
The ODOT traffic cameras are very helpful. When kids are coming home from college you can say, hey

Table A18: Additional Survey Comments
there is black ice on the road, slow down. Especially the cameras that have the temperature on them, that is super helpful.
The Oregon Department of Transportation should impose a surcharge or tax on people who use studs.
The reason we use studded tires is because even though ODOT says they do all the safety tests, the tests I look to are Scandinavia and Iceland's tests, and I compare those to the east side. Those tests show that cars stop faster with studded tires. It really bothers me a lot that people are willing to put road damage above someone's health and safety, which is a situation we face over here. Before people take a stance, I would like to be certain that all of the costs associated. People that do not have studded tires cause accidents. I would like to see what would happen when people do not have adequate tires. I go to specialists in Bend and Boise and in order to get to them, I cannot help going over two mountain passes and you cannot know when they will be icy and when they will not. We have too much ice to not be allowed to use studded tires. There is not a good solution that does not involve road wear. They have closed the freeway here for bike travel for a certain stretch because there is less than a foot of shoulder. Yet people are allowed to not only ride their bikes but also use up very wide trails. It really is a matter of safety. I would like to see those road reports and see what the damage is and the amount of property damage is.
We use studded tires because my parents live on the other side of the pass in Bend. We find studded tires are the safest way to cross the pass. We try to go out there several times a month, even during the winter months. When we get to bend the roads are icy, especially the corners. They do not salt any side roads. You are basically driving on packed snow until it melts and then it freezes at night because it's the high desert. So, it's basically just driving on ice. It is not a problem if you are driving through Bend on the highway because they salt the highways pretty well. We use studded tires for that reason. I know they are controversial but it is imperative for us that we try to stay safe. We try to go over the pass twice a month. My parents are getting old and since I cannot get a job there, I cannot afford to move there, but I do try to go check on them as often as I can.
The studded tires tear the heck out of the road.
The survey comes across as driving habits and then turns into a social aspect that has nothing to do with the original call. I do not like that and no one else does.
The survey is geared toward the big city while this is a rural area.
The survey is too black and white for the average retired person. We do not live in the part of Oregon that gets all the money; we get nothing.
There is no bus service where I live.
There is very little public transportation where I live, which is my explanation for why I do so much is driving. My county is different from downtown Portland. I like it when they use the chemicals on the road, because the rocks break our windows.
They had the opportunity to have something good going in public transportation but they completely blew it. The bus only went a couple of miles; it did not make sense. I was very unhappy that they never improved it. The bus would only connect to Medford and you could not get around your own town.
They need to talk to our county because they did not plow our roads. They just plowed the main streets and highway, and no one else got plow service or sanding until later.
They raised the weight limits on the roads and bridges in the last 10-15 years. That is what caused the bridge failures and the roads being rutted out. There is a bunch of extra weight on the roads that increases the damage. Studs save lives.
They say they fixed the potholes, but it does not seem like they did.
They should eliminate the studded tires.
They should quit asking people what color they are.
They stopped with the smudge pots. I grew up in Medford and we used to get a lot of fog in the day. Now there is a lot less fog. They do not use the smudge pots.
Those studded tires are bad on the roads. There is a budget factor. We do have to pay for that.
We are in an icy area and we never use studded tires.
We do support studded tires in order to travel to the mountains.
We drive a lot and we lived in Spokane where it snowed more, snow does not bother us.

Table A18: Additional Survey Comments
We feel pretty strongly about the damage that studs do and how much it costs the county. We are very anti-studs.
We have lived here for 25 year and you can see how much the studs have chewed up the roads but some people will continue to use studs for as long as they can.
We live in an area that has no access to public transportation for those in a wheel chair. In bad weather conditions, we would have no access to the Max Station without the bus yet we cannot get around with my husband in a wheel chair.
We live in Deschutes where people go over the mountain often and in Portland, studded tires are not needed. I am really mixed about outlawing studded tires. I put studded tires on my work van but studless snow tires work just as well.
We need to find a way to get around without having tires that pick at the roads, and we also have to tell people to stay home when things get bad outside.
We prefer studs because of the stopping abilities and the traction that they provide over conventional all-season tires.
We really need studded tires in Baker County in the wintertime.
We will probably get studded tires next season.
I do not believe in studded tires.
What is more important little bit of road repair or a person's life without studded tires on their vehicle? What is life worth? STUDS are worth it they save lives. Of all the highway taxes that we pay why don't they put that money into repairing highways instead of wasting it on stupid things? If our road taxes come from gasoline, the money does not go into repairing highways.
What your survey failed to ask was how I change my driving habits. I switch to four-wheel drive.
When you are talking about people traveling in the winter or any time you have to differentiate between the people who have to get out regardless of the weather and what types of impacts the weather would have on them versus people who are retired and don't have to leave the house if they don't want to. So the weather doesn't have that much of an impact on them. I can stay home because I am retired.
When you live in Curry County, you usually do not get ice or snow. The driving problem does not exist.
Where I live in Ashland, above the boulevard is uphill and very dangerous, even if you have studded tires. All the cars slide. It is really bad. They do try to gravel the road, but it is still very dangerous.
Why do you ask if you put studs on two or four tires when it's against Oregon law to put studs on just two tires?
Winter weather in Oregon is not severe. I drive as normal unless its black ice.
You should be contacting professional drivers. Stud tires are a waste of time because all-weather tires work just as well.
You should include fog in your winter weather conditions.

APPENDIX B

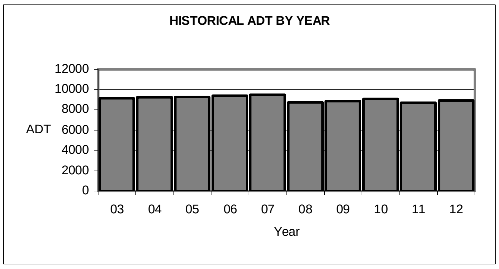
ATR SUMMARY

Location: I-84; MP 286.65; OLD OREGON TRAIL NO. 6; 0.45 mile south of south of Union-Baker County Line

Site Name: Baker Valley (01-011)
Installed: January, 1973

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	9137	***	***	***	***	***
2004	9236	160	15.9	12.5	11.9	11.4
2005	9277	182	15.1	12.5	11.8	11.4
2006	9394	175	14.1	12.4	11.7	11.2
2007	9526	154	15.6	12.7	11.8	11.3
2008	8750	158	16.4	13.4	11.8	11.4
2009	8881	161	16.8	13.6	12.6	12.2
2010	9070	166	14.4	13.5	12.7	12.3
2011	8714	148	15.6	12.9	12.2	11.9
2012	8939	151	16.5	13.0	12.4	11.9



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	6388	71	6263	70
February	6967	78	6891	77
March	8044	90	8283	93
April	8484	95	8678	97
May	9342	105	9403	105
June	10220	114	10520	118
July	10733	120	11296	126
August	11002	123	11365	127
September	9990	112	9945	111
October	9047	101	9157	102
November	8267	92	8375	94
December	6994	78	7090	79

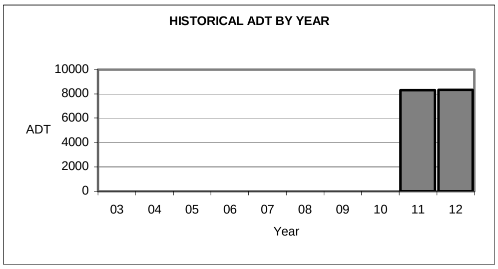
Classification Breakdown	Percent of ADT
Motorcyles	0.88
Passenger cars	45.73
Light Trucks	12.11
Buses	0.10
Single unit trucks (2 axles)	1.51
Single unit trucks (3 axles)	1.15
Single unit trucks (4 or more axles)	0.16
Single trailer trucks (4 or less axles)	4.36
Single trailer trucks (5 axles)	27.97
Single trailer trucks (6 or more axles)	3.47
Multi trailer trucks (5 or less axles)	0.24
Multi trailer trucks (6 axles)	0.17
Multi trailer trucks (7 or more axles)	2.15

Location: I-84; MP 309.02; OLD OREGON TRAIL NO. 6; 4.27 miles north of Encina Interchange

Site Name: South Baker (01-013)
Installed: May, 2010

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	***	***	***	***	***	***
2007	***	***	***	***	***	***
2008	***	***	***	***	***	***
2009	***	***	***	***	***	***
2010	***	***	***	***	***	***
2011	8304	179	15.5	12.9	12.3	12.0
2012	8328	***	***	***	***	***



2012 TRAFFIC DATA

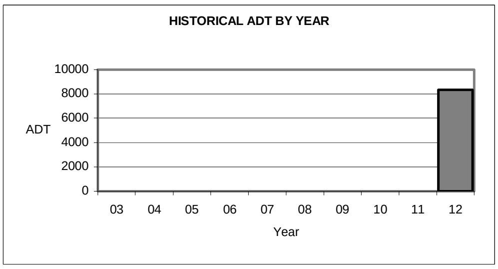
	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	5846	70	5732	69
February	6354	76	6266	75
March	7496	90	7740	93
April	7966	96	8231	99
May	8534	102	8680	104
June	9500	114	9900	119
July	10100	121	10700	128
August	10605	127	10964	132
September	9100	109	9200	110
October	7872	95	8150	98
November	7567	91	7731	93
December	6441	77	6638	80

Classification Breakdown	Percent of ADT
Motorcyles	1.14
Passenger cars	48.74
Light Trucks	9.17
Buses	0.32
Single unit trucks (2 axles)	2.30
Single unit trucks (3 axles)	0.84
Single unit trucks (4 or more axles)	0.01
Single trailer trucks (4 or less axles)	2.72
Single trailer trucks (5 axles)	28.22
Single trailer trucks (6 or more axles)	2.55
Multi trailer trucks (5 or less axles)	1.14
Multi trailer trucks (6 axles)	0.43
Multi trailer trucks (7 or more axles)	2.42

Location: 84; MP 336.29; OLD OREGON TRAIL NO. 6; 0.53 mile south of Weatherby Interchange **Site Name:** Weatherby (01-014)
Installed: July, 2011

HISTORICAL TRAFFIC DATA

Year	ADT	Max Day	Max Hour	Percent of ADT 10TH Hour	20TH Hour	30TH Hour
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	***	***	***	***	***	***
2007	***	***	***	***	***	***
2008	***	***	***	***	***	***
2009	***	***	***	***	***	***
2010	***	***	***	***	***	***
2011	***	***	***	***	***	***
2012	8336	157	16.8	12.7	11.9	11.6



2012 TRAFFIC DATA

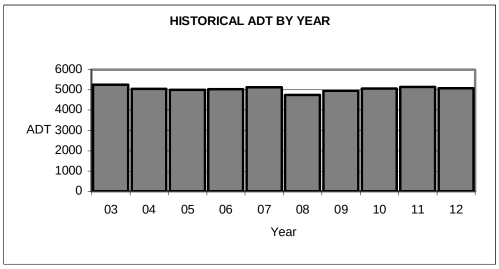
	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	5913	71	5809	70
February	6401	77	6326	76
March	7405	89	7688	92
April	7928	95	8133	98
May	8656	104	8757	105
June	9547	115	9872	118
July	9854	118	10487	126
August	10228	123	10640	128
September	9201	110	9246	111
October	8397	101	8553	103
November	7676	92	7834	94
December	6510	78	6692	80

Classification Breakdown	Percent of ADT
Motorcyles	0.20
Passenger cars	23.74
Light Trucks	21.15
Buses	0.19
Single unit trucks (2 axles)	2.03
Single unit trucks (3 axles)	0.72
Single unit trucks (4 or more axles)	0.01
Single trailer trucks (4 or less axles)	1.63
Single trailer trucks (5 axles)	42.28
Single trailer trucks (6 or more axles)	3.86
Multi trailer trucks (5 or less axles)	1.19
Multi trailer trucks (6 axles)	0.52
Multi trailer trucks (7 or more axles)	2.48

Location: OR99W; MP 94.90; PACIFIC HIGHWAY WEST NO. 91; 5.47 miles north of Monroe Cemetery Road **Site Name:** Monroe (02-007)
Installed: April, 1953

HISTORICAL TRAFFIC DATA

Year	ADT	Max Day	Max Hour	Percent of ADT 10TH Hour	20TH Hour	30TH Hour
2003	5248	139	14.2	11.5	11.1	10.8
2004	5051	142	13.0	11.5	11.2	10.9
2005	5007	140	13.2	11.3	10.9	10.7
2006	5032	155	16.9	12.2	11.2	10.9
2007	5119	144	15.5	11.3	11.0	10.7
2008	4762	139	14.9	12.1	11.5	11.0
2009	4961	***	***	***	***	***
2010	5066	137	16.5	11.7	11.2	11.0
2011	5144	138	15.9	11.8	11.2	10.9
2012	5086	145	16.8	11.5	11.4	11.1



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	4401	87	4243	83
February	4899	96	4858	96
March	4589	90	4558	90
April	4986	98	5025	99
May	5124	101	5222	103
June	5492	108	5401	106
July	5674	112	5615	110
August	5758	113	5636	111
September	5622	111	5525	109
October	5349	105	5356	105
November	5197	102	5131	101
December	4561	90	4464	88

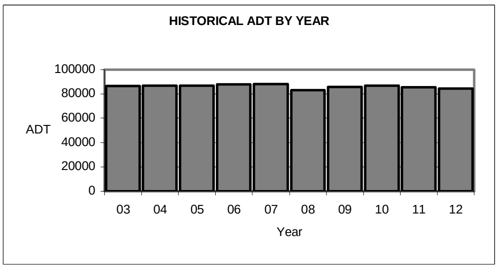
Classification Breakdown	Percent of ADT
Motorcyles	1.30
Passenger cars	58.01
Light Trucks	26.80
Buses	0.18
Single unit trucks (2 axles)	3.55
Single unit trucks (3 axles)	3.78
Single unit trucks (4 or more axles)	0.00
Single trailer trucks (4 or less axles)	0.32
Single trailer trucks (5 axles)	5.64
Single trailer trucks (6 or more axles)	0.26
Multi trailer trucks (5 or less axles)	0.02
Multi trailer trucks (6 axles)	0.00
Multi trailer trucks (7 or more axles)	0.14

Location: I-5; MP 281.20; PACIFIC HIGHWAY NO. 1; 1.38 miles south of Wilsonville-Hubbard Highway No. 51 Interchange (OR551)

Site Name: Wilsonville (03-011)
Installed: August, 1973

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	86362	132	10.4	9.2	9.1	9.0
2004	86727	131	10.1	9.1	8.9	8.9
2005	86787	132	10.1	9.0	8.9	8.8
2006	88038	129	8.9	8.8	8.7	8.6
2007	88174	***	***	***	***	***
2008	83161	134	10.7	9.3	9.2	9.1
2009	85731	127	9.4	9.1	9.0	8.9
2010	86646	128	9.8	9.1	9.0	8.9
2011	85451	128	9.4	9.0	8.9	8.8
2012	84342	130	10.3	9.1	9.0	8.9



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	72364	86	71969	85
February	78287	93	78477	93
March	79365	94	79930	95
April	81769	97	84103	100
May	83859	99	85466	101
June	89552	106	90349	107
July	91533	109	93469	111
August	94421	112	95726	113
September	86609	103	89082	106
October	80620	96	82970	98
November	81240	96	81973	97
December	79064	94	78585	93

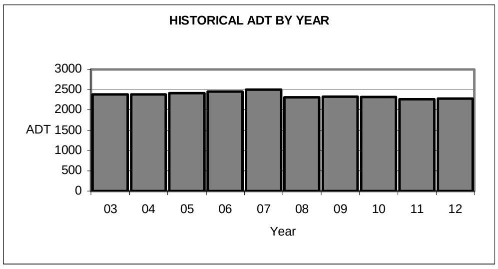
Classification Breakdown	Percent of ADT
Motorcyles	0.25
Passenger cars	65.48
Light Trucks	17.62
Buses	0.19
Single unit trucks (2 axles)	2.78
Single unit trucks (3 axles)	0.69
Single unit trucks (4 or more axles)	0.01
Single trailer trucks (4 or less axles)	0.83
Single trailer trucks (5 axles)	8.27
Single trailer trucks (6 or more axles)	2.53
Multi trailer trucks (5 or less axles)	0.08
Multi trailer trucks (6 axles)	0.05
Multi trailer trucks (7 or more axles)	1.22

Location: OR211; MP 24.23; WOODBURN-ESTACADA HIGHWAY NO. 161; 3.05 miles northeast of Wall Street

Site Name: Colton (03-014)
Installed: October, 1957

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	2388	128	11.7	10.9	10.8	10.6
2004	2386	133	21.7	20.0	18.2	16.9
2005	2415	136	15.9	11.3	10.9	10.7
2006	2457	130	12.1	11.6	11.2	11.0
2007	2498	135	13.1	11.9	11.4	11.1
2008	2313	134	13.3	12.1	11.5	11.4
2009	2322	133	13.0	11.8	11.4	11.2
2010	2318	135	13.1	12.0	11.6	11.3
2011	2267	137	13.4	12.1	11.9	11.6
2012	2276	140	13.8	12.3	11.8	11.5



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	1815	80	1832	81
February	2043	90	2019	89
March	1897	83	1953	86
April	2231	98	2284	100
May	2354	103	2352	103
June	2319	102	2342	103
July	2523	111	2598	114
August	2564	113	2651	116
September	2709	119	2704	119
October	2529	111	2454	108
November	2242	98	2154	95
December	1993	88	1968	86

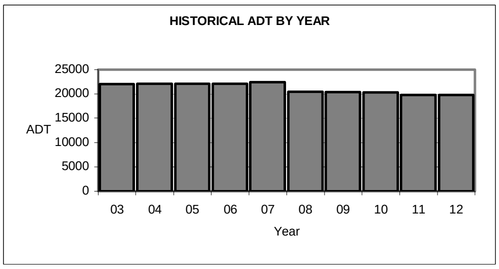
Classification Breakdown	Percent of ADT
Motorcycles	3.80
Passenger cars	59.22
Light Trucks	20.24
Buses	0.56
Single unit trucks (2 axles)	10.61
Single unit trucks (3 axles)	1.02
Single unit trucks (4 or more axles)	0.05
Single trailer trucks (4 or less axles)	3.21
Single trailer trucks (5 axles)	0.79
Single trailer trucks (6 or more axles)	0.29
Multi trailer trucks (5 or less axles)	0.10
Multi trailer trucks (6 axles)	0.00
Multi trailer trucks (7 or more axles)	0.11

Location: US97; MP 142.41; THE DALLES-CALIFORNIA HIGHWAY NO. 4; 0.17 mile south of China Hat Road

Site Name: Lava Butte (09-003)
Installed: January, 1951

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	22041	148	12.2	11.5	11.2	11.0
2004	22128	142	12.1	11.2	11.0	10.8
2005	22101	***	***	***	***	***
2006	22150	141	11.9	11.3	11.1	10.9
2007	22460	***	***	***	***	***
2008	20472	145	12.0	11.5	11.1	10.9
2009	20395	145	12.3	11.5	11.2	11.0
2010	20347	147	12.4	11.8	11.4	11.2
2011	19800	153	12.5	11.8	11.4	11.3
2012	19816	154	13.1	12.0	11.7	11.5



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	15766	80	15458	78
February	17067	86	16747	85
March	17619	89	17078	86
April	18766	95	18211	92
May	20418	103	20292	102
June	23270	117	22949	116
July	25456	128	25449	128
August	25903	131	25873	131
September	22444	113	22111	112
October	20260	102	19534	99
November	18340	93	17620	89
December	16847	85	16473	83

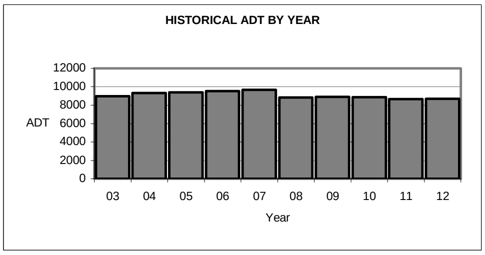
Classification Breakdown	Percent of ADT
Motorcyles	1.05
Passenger cars	71.76
Light Trucks	19.39
Buses	0.21
Single unit trucks (2 axles)	1.74
Single unit trucks (3 axles)	0.46
Single unit trucks (4 or more axles)	0.01
Single trailer trucks (4 or less axles)	1.08
Single trailer trucks (5 axles)	3.66
Single trailer trucks (6 or more axles)	0.42
Multi trailer trucks (5 or less axles)	0.01
Multi trailer trucks (6 axles)	0.03
Multi trailer trucks (7 or more axles)	0.18

Location: US20; MP 9.25; MCKENZIE-BEND HIGHWAY NO. 17; 0.47 mile northwest of Innes Market Road

Site Name: Three Sisters Viewpoint (09-015)
Installed: January, 2003

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	8970	164	14.5	13.4	12.9	12.7
2004	9342	160	14.8	12.9	12.5	12.3
2005	9409	160	14.4	12.9	12.4	12.2
2006	9539	154	13.6	12.7	12.3	12.1
2007	9667	154	13.3	12.6	12.4	12.1
2008	8813	156	13.6	12.9	12.7	12.6
2009	8887	157	14.0	13.1	12.7	12.6
2010	8851	159	14.4	13.7	13.2	13.0
2011	8663	160	15.2	13.7	13.2	13.0
2012	8678	162	14.8	13.8	13.5	13.3



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	6288	72	6442	74
February	6779	78	6994	81
March	6840	79	6965	80
April	7606	88	8006	92
May	8784	101	9279	107
June	10003	115	10426	120
July	10859	125	11538	133
August	10919	126	11524	133
September	9591	111	10023	115
October	8298	96	8663	100
November	7366	85	7443	86
December	6804	78	6835	79

Classification Breakdown	Percent of ADT
Motorcyles	1.13
Passenger cars	61.59
Light Trucks	17.71
Buses	2.74
Single unit trucks (2 axles)	9.71
Single unit trucks (3 axles)	0.29
Single unit trucks (4 or more axles)	0.06
Single trailer trucks (4 or less axles)	4.27
Single trailer trucks (5 axles)	1.19
Single trailer trucks (6 or more axles)	0.34
Multi trailer trucks (5 or less axles)	0.69
Multi trailer trucks (6 axles)	0.06
Multi trailer trucks (7 or more axles)	0.22

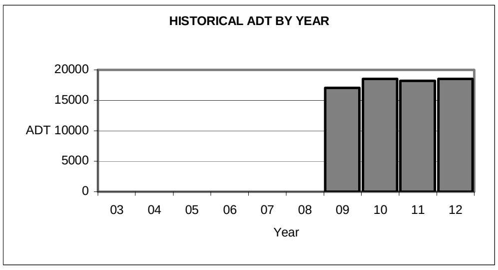
Location: US97; MP 120.92; THE DALLES-CALIFORNIA HIGHWAY NO. 4; 0.04 mile north of S.W. Antler Avenue

Site Name: Redmond-Hemlock (09-022)

Installed: July, 2008

HISTORICAL TRAFFIC DATA

		Percent of ADT				
		Max	Max	10TH	20TH	30TH
Year	ADT	Day	Hour	Hour	Hour	Hour
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	***	***	***	***	***	***
2007	***	***	***	***	***	***
2008	***	***	***	***	***	***
2009	17032	***	***	***	***	***
2010	18493	138	11.1	10.6	10.3	10.1
2011	18201	142	11.5	10.6	10.3	10.2
2012	18538	140	11.9	10.6	10.4	10.2



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	16131	87	15358	83
February	17130	92	16456	89
March	17429	94	16889	91
April	18878	102	18336	99
May	19845	107	19449	105
June	20836	112	20343	110
July	21399	115	21167	114
August	21581	116	21365	115
September	20034	108	19557	105
October	19723	106	19293	104
November	18478	100	17643	95
December	17173	93	16606	90

Classification Breakdown	Percent of ADT
Motorcyles	0.59
Passenger cars	36.17
Light Trucks	52.00
Buses	0.32
Single unit trucks (2 axles)	2.50
Single unit trucks (3 axles)	0.61
Single unit trucks (4 or more axles)	0.15
Single trailer trucks (4 or less axles)	0.75
Single trailer trucks (5 axles)	4.93
Single trailer trucks (6 or more axles)	1.41
Multi trailer trucks (5 or less axles)	0.05
Multi trailer trucks (6 axles)	0.06
Multi trailer trucks (7 or more axles)	0.46

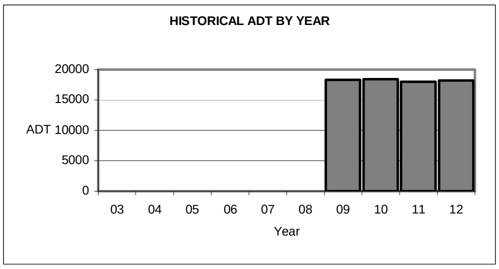
Location: US97; MP 119.09; THE DALLES-CALIFORNIA HIGHWAY NO. 4; 0.57 mile south of O'Neil Highway No. 370

Site Name: North Redmond (09-023)

Installed: August, 2008

HISTORICAL TRAFFIC DATA

		Percent of ADT				
		Max	Max	10TH	20TH	30TH
Year	ADT	Day	Hour	Hour	Hour	Hour
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	***	***	***	***	***	***
2007	***	***	***	***	***	***
2008	***	***	***	***	***	***
2009	18311	145	12.2	10.6	10.4	10.2
2010	18408	138	11.4	11.0	10.6	10.4
2011	17996	145	11.7	10.9	10.6	10.4
2012	18186	140	12.1	10.8	10.6	10.5



2012 TRAFFIC DATA

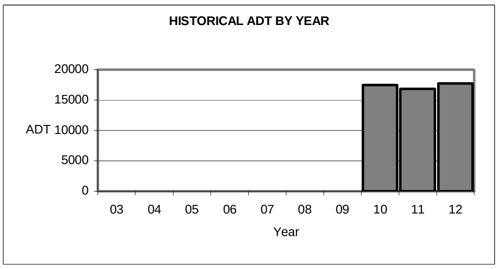
	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	15306	84	14831	82
February	16454	90	16086	88
March	16674	92	16504	91
April	17958	99	17931	99
May	19135	105	19165	105
June	20259	111	20159	111
July	20885	115	21089	116
August	21028	116	21225	117
September	19793	109	19635	108
October	18753	103	18849	104
November	17384	96	16870	93
December	16166	89	15888	87

Classification Breakdown	Percent of ADT
Motorcyles	0.29
Passenger cars	50.92
Light Trucks	37.41
Buses	0.34
Single unit trucks (2 axles)	3.18
Single unit trucks (3 axles)	0.56
Single unit trucks (4 or more axles)	0.05
Single trailer trucks (4 or less axles)	0.72
Single trailer trucks (5 axles)	4.03
Single trailer trucks (6 or more axles)	1.77
Multi trailer trucks (5 or less axles)	0.05
Multi trailer trucks (6 axles)	0.08
Multi trailer trucks (7 or more axles)	0.60

Location:	US97; MP 140.45; THE DALLES-CALIFORNIA HIGHWAY NO. 4; 0.07 mile north of Pinebrook Boulevard	**Site Name:** **Installed:**	Bend-Pinebrook (09-025) January, 2010

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	**ADT**	**Max Day**	**Max Hour**	**10TH Hour**	**20TH Hour**	**30TH Hour**
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	***	***	***	***	***	***
2007	***	***	***	***	***	***
2008	***	***	***	***	***	***
2009	***	***	***	***	***	***
2010	17458	143	11.7	11.2	10.8	10.7
2011	16828	***	***	***	***	***
2012	17765	***	***	***	***	***



2012 TRAFFIC DATA

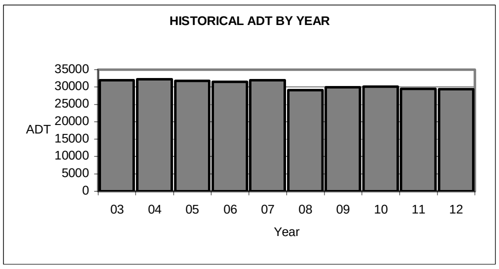
	Average Weekday Traffic	**Percent of ADT**	**Average Daily Traffic**	**Percent of ADT**
January	14389	81	13721	77
February	15311	86	14771	83
March	15524	87	14833	83
April	17152	97	16352	92
May	18200	102	17600	99
June	19800	111	19400	109
July	23308	131	22646	127
August	23946	135	23321	131
September	21239	120	20556	116
October	19613	110	18592	105
November	17736	100	16608	93
December	15386	87	14784	83

Classification Breakdown	**Percent of ADT**
Motorcyles	0.58
Passenger cars	63.34
Light Trucks	26.50
Buses	0.16
Single unit trucks (2 axles)	2.37
Single unit trucks (3 axles)	0.41
Single unit trucks (4 or more axles)	0.01
Single trailer trucks (4 or less axles)	0.98
Single trailer trucks (5 axles)	4.62
Single trailer trucks (6 or more axles)	0.61
Multi trailer trucks (5 or less axles)	0.02
Multi trailer trucks (6 axles)	0.02
Multi trailer trucks (7 or more axles)	0.38

Location:	I-5; MP 129.75; PACIFIC HIGHWAY NO. 1; 0.53 mile north of Winchester Interchange	**Site Name:** **Installed:**	Roseburg (10-005) August, 1999

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	**ADT**	**Max Day**	**Max Hour**	**10TH Hour**	**20TH Hour**	**30TH Hour**
2003	31953	***	***	***	***	***
2004	32266	149	11.5	10.2	9.9	9.7
2005	31790	153	13.5	10.6	10.2	10.0
2006	31519	146	11.6	10.2	9.9	9.8
2007	31958	150	11.7	10.4	10.1	9.9
2008	29112	***	***	***	***	***
2009	29874	136	10.7	10.2	10.0	9.9
2010	30099	***	***	***	***	***
2011	29444	145	11.6	10.3	10.0	9.9
2012	29325	***	***	***	***	***



2012 TRAFFIC DATA

	Average Weekday Traffic	**Percent of ADT**	**Average Daily Traffic**	**Percent of ADT**
January	26000	89	25000	85
February	26500	90	26000	89
March	28400	97	28000	95
April	28400	97	28000	95
May	29700	101	29000	99
June	32500	111	32000	109
July	33600	115	33800	115
August	34400	117	34200	117
September	31400	107	31000	106
October	29600	101	29000	99
November	28700	98	28500	97
December	27600	94	27400	93

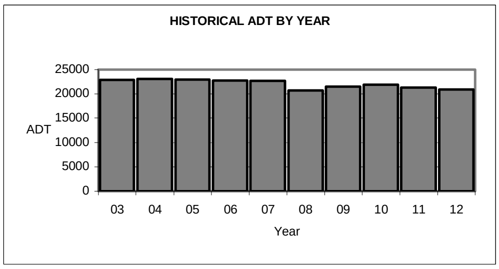
Classification Breakdown	**Percent of ADT**
Motorcyles	0.20
Passenger cars	56.57
Light Trucks	15.05
Buses	0.16
Single unit trucks (2 axles)	4.09
Single unit trucks (3 axles)	1.35
Single unit trucks (4 or more axles)	0.00
Single trailer trucks (4 or less axles)	1.72
Single trailer trucks (5 axles)	16.43
Single trailer trucks (6 or more axles)	1.08
Multi trailer trucks (5 or less axles)	0.31
Multi trailer trucks (6 axles)	0.00
Multi trailer trucks (7 or more axles)	3.04

Location: I-5; MP 145.39; PACIFIC HIGHWAY NO. 1; 5.06 miles north of OR99

Site Name: Oakland (10-007)
Installed: October, 1956

HISTORICAL TRAFFIC DATA

				Percent of ADT		
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	22896	167	13.5	11.9	11.2	10.9
2004	23093	166	13.8	11.6	10.7	10.5
2005	22935	166	14.6	12.2	11.0	10.5
2006	22734	***	***	***	***	***
2007	22668	165	12.6	10.8	10.5	10.4
2008	20708	170	15.2	12.6	11.2	10.7
2009	21488	168	14.9	12.2	11.5	11.1
2010	21893	154	14.4	12.5	11.5	11.1
2011	21273	***	***	***	***	***
2012	20930	165	14.2	12.6	11.4	11.2



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	16703	80	16583	79
February	17659	84	17696	85
March	18928	90	19382	93
April	19828	95	20242	97
May	20830	100	20861	100
June	23700	113	24014	115
July	24535	117	25379	121
August	24627	118	25391	121
September	21662	103	22008	105
October	19595	94	19973	95
November	20199	97	20523	98
December	18424	88	19106	91

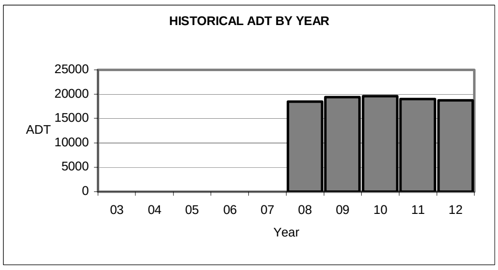
Classification Breakdown	Percent of ADT
Motorcyles	0.21
Passenger cars	52.23
Light Trucks	15.88
Buses	0.09
Single unit trucks (2 axles)	1.68
Single unit trucks (3 axles)	1.84
Single unit trucks (4 or more axles)	0.56
Single trailer trucks (4 or less axles)	0.16
Single trailer trucks (5 axles)	22.50
Single trailer trucks (6 or more axles)	2.82
Multi trailer trucks (5 or less axles)	0.32
Multi trailer trucks (6 axles)	0.38
Multi trailer trucks (7 or more axles)	1.33

Location: I-5; MP 98.82; PACIFIC HIGHWAY NO. 1; 0.54 mile north of Canyonville/Days Creek Interchange (Fifth Street)

Site Name: Canyonville (10-008)
Installed: January, 2008

HISTORICAL TRAFFIC DATA

				Percent of ADT		
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	***	***	***	***	***	***
2007	***	***	***	***	***	***
2008	18476	176	16.4	12.9	11.7	11.2
2009	19354	***	***	***	***	***
2010	19559	159	16.1	13.2	12.1	11.7
2011	19016	164	15.1	12.5	11.7	11.4
2012	18710	166	15.6	13.3	11.8	11.6



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	14716	79	14610	78
February	15380	82	15506	83
March	16750	90	17275	92
April	17470	93	17999	96
May	18551	99	18764	100
June	21250	114	21698	116
July	22010	118	23072	123
August	22315	119	23170	124
September	19367	104	19836	106
October	17471	93	17971	96
November	17716	95	18231	97
December	15544	83	16387	88

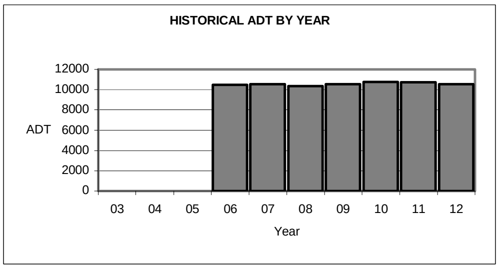
Classification Breakdown	Percent of ADT
Motorcyles	0.56
Passenger cars	56.60
Light Trucks	16.51
Buses	0.26
Single unit trucks (2 axles)	2.34
Single unit trucks (3 axles)	0.78
Single unit trucks (4 or more axles)	0.04
Single trailer trucks (4 or less axles)	2.02
Single trailer trucks (5 axles)	16.98
Single trailer trucks (6 or more axles)	1.44
Multi trailer trucks (5 or less axles)	0.67
Multi trailer trucks (6 axles)	0.23
Multi trailer trucks (7 or more axles)	1.57

Location: I-84; MP 147.78; COLUMBIA RIVER HIGHWAY NO. 2; 0.43 mile east of Heppner Highway No. 52 (OR74)

Site Name: Heppner Jct (11-009)
Installed: January, 2006

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	10480	207	24.6	16.4	15.1	14.0
2007	10518	195	22.3	16.4	15.1	14.6
2008	10334	205	23.0	17.2	15.2	14.2
2009	10521	189	21.1	16.9	16.2	15.4
2010	10774	180	21.3	16.3	15.8	14.8
2011	10751	189	21.0	15.8	15.2	14.5
2012	10566	182	21.8	16.1	15.7	15.0



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	7014	66	7057	67
February	7916	75	8214	78
March	9202	87	9791	93
April	9326	88	10007	95
May	10463	99	10946	104
June	11575	110	12430	118
July	12576	119	13802	131
August	12848	122	14124	134
September	11275	107	11935	113
October	9747	92	10625	101
November	9420	89	10064	95
December	7538	71	7799	74

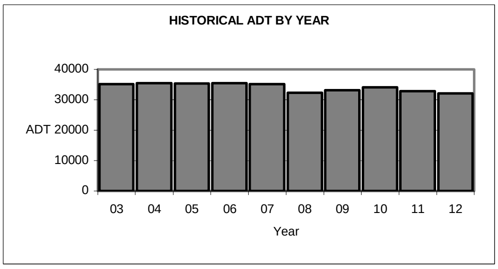
Classification Breakdown	Percent of ADT
Motorcyles	0.43
Passenger cars	41.03
Light Trucks	23.66
Buses	0.32
Single unit trucks (2 axles)	6.90
Single unit trucks (3 axles)	0.65
Single unit trucks (4 or more axles)	0.06
Single trailer trucks (4 or less axles)	3.00
Single trailer trucks (5 axles)	17.34
Single trailer trucks (6 or more axles)	2.39
Multi trailer trucks (5 or less axles)	0.61
Multi trailer trucks (6 axles)	0.73
Multi trailer trucks (7 or more axles)	2.88

Location: I-5; MP 42.84; PACIFIC HIGHWAY NO. 1; 2.77 miles south of the Valley of the Rogue Bridge Interchange

Site Name: Gold Hill (15-001)
Installed: December, 1969

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	35124	141	11.0	10.0	9.8	9.7
2004	35489	132	11.4	9.7	9.6	9.4
2005	35401	***	***	***	***	***
2006	35504	139	10.4	9.8	9.6	9.6
2007	35156	140	12.5	10.0	9.8	9.8
2008	32377	141	11.4	10.2	9.7	9.6
2009	33174	142	11.5	10.3	9.9	9.7
2010	34064	138	11.2	10.3	10.0	9.8
2011	32819	141	11.1	10.0	9.9	9.8
2012	32106	138	11.9	10.3	10.0	9.9



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	28644	89	27337	85
February	29691	92	28703	89
March	30888	96	30016	93
April	32397	101	31461	98
May	33350	104	32547	101
June	36691	114	35775	111
July	37215	116	36767	115
August	37628	117	36968	115
September	34511	107	33535	104
October	32707	102	31784	99
November	32326	101	31232	97
December	29461	92	29141	91

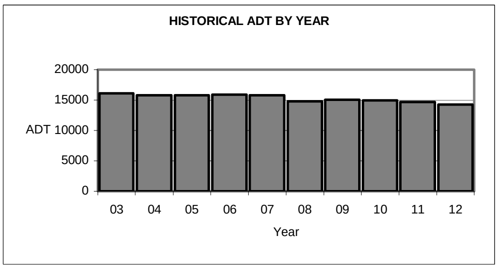
Classification Breakdown	Percent of ADT
Motorcyles	0.64
Passenger cars	49.60
Light Trucks	31.89
Buses	0.17
Single unit trucks (2 axles)	3.11
Single unit trucks (3 axles)	0.85
Single unit trucks (4 or more axles)	0.06
Single trailer trucks (4 or less axles)	1.16
Single trailer trucks (5 axles)	8.79
Single trailer trucks (6 or more axles)	1.90
Multi trailer trucks (5 or less axles)	0.22
Multi trailer trucks (6 axles)	0.22
Multi trailer trucks (7 or more axles)	1.39

Location: I-5; MP 11.03; PACIFIC HIGHWAY NO. 1; 0.86 mile south of Rogue Valley Highway No. 63 Interchange (OR99)

Site Name: Neil Creek (15-002)
Installed: November, 1964

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	**ADT**	**Max Day**	**Max Hour**	**10TH Hour**	**20TH Hour**	**30TH Hour**
2003	16100	***	***	***	***	***
2004	15792	***	***	***	***	***
2005	15799	***	***	***	***	***
2006	15890	***	***	***	***	***
2007	15821	***	***	***	***	***
2008	14785	***	***	***	***	***
2009	15052	176	17.4	13.6	12.7	12.2
2010	14937	171	17.8	14.1	13.1	12.7
2011	14664	177	16.7	13.1	12.6	12.2
2012	14280	172	24.3	14.5	13.1	12.6



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	10615	74	10864	76
February	11153	78	11603	81
March	12131	85	13016	91
April	12836	90	13492	94
May	13941	98	14122	99
June	16484	115	17032	119
July	17481	122	18480	129
August	17077	120	17938	126
September	14577	102	14846	104
October	13035	91	13430	94
November	13433	94	13973	98
December	11872	83	12566	88

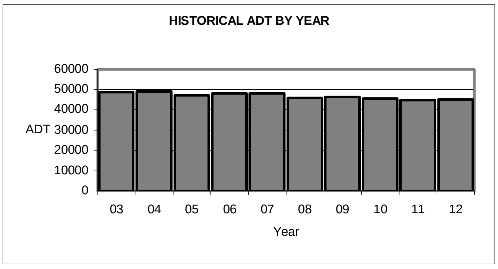
Classification Breakdown	Percent of ADT
Motorcyles	0.69
Passenger cars	50.69
Light Trucks	10.39
Buses	0.19
Single unit trucks (2 axles)	1.68
Single unit trucks (3 axles)	0.54
Single unit trucks (4 or more axles)	0.01
Single trailer trucks (4 or less axles)	2.27
Single trailer trucks (5 axles)	30.05
Single trailer trucks (6 or more axles)	0.22
Multi trailer trucks (5 or less axles)	2.74
Multi trailer trucks (6 axles)	0.43
Multi trailer trucks (7 or more axles)	0.10

Location: I-5; MP 28.33; PACIFIC HIGHWAY NO. 1; 1.96 mile southeast of the South Medford Interchange

Site Name: Medford Viaduct (15-019)
Installed: June, 1966

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	**ADT**	**Max Day**	**Max Hour**	**10TH Hour**	**20TH Hour**	**30TH Hour**
2003	48817	***	***	***	***	***
2004	49058	***	***	***	***	***
2005	47242	137	10.7	9.4	9.3	9.1
2006	48225	132	10.2	9.6	9.5	9.4
2007	48188	132	10.4	9.6	9.5	9.4
2008	45926	131	10.4	9.5	9.4	9.3
2009	46362	***	***	***	***	***
2010	45611	130	10.4	9.6	9.5	9.4
2011	44776	132	10.3	9.7	9.5	9.4
2012	45167	131	10.8	9.9	9.6	9.5



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	41200	91	39000	86
February	43000	95	40000	89
March	44587	99	42419	94
April	47103	104	44602	99
May	48061	106	45563	101
June	50719	112	48206	107
July	51506	114	49125	109
August	52673	117	49873	110
September	50370	112	47626	105
October	49480	110	46726	103
November	48252	107	45462	101
December	44684	99	43402	96

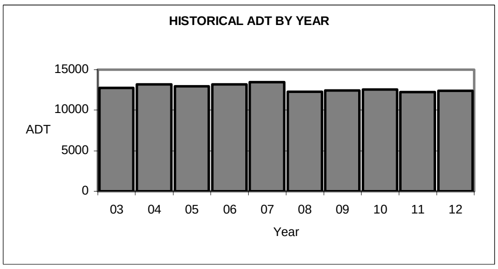
Classification Breakdown	Percent of ADT
Motorcyles	0.61
Passenger cars	67.53
Light Trucks	18.54
Buses	0.27
Single unit trucks (2 axles)	1.68
Single unit trucks (3 axles)	0.62
Single unit trucks (4 or more axles)	0.08
Single trailer trucks (4 or less axles)	1.03
Single trailer trucks (5 axles)	8.03
Single trailer trucks (6 or more axles)	0.58
Multi trailer trucks (5 or less axles)	0.53
Multi trailer trucks (6 axles)	0.21
Multi trailer trucks (7 or more axles)	0.29

Location: US97/US26 MP 97.11; THE DALLES-CALIFORNIA HIGHWAY NO. 4; 0.18 mile north of Madras-Prineville Highway No. 360 (US26)

Site Name: Madras (16-002)
Installed: September, 1951

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	12726	168	13.7	12.5	11.9	11.6
2004	13143	159	12.8	11.7	11.5	11.1
2005	12936	157	13.0	11.9	11.3	11.1
2006	13186	154	12.4	11.6	11.3	11.0
2007	13447	154	12.4	11.6	11.2	11.1
2008	12266	151	13.3	11.8	11.5	11.3
2009	12428	159	13.1	11.9	11.8	11.6
2010	12554	153	12.7	12.3	11.8	11.6
2011	12246	162	13.3	12.3	11.9	11.7
2012	12381	157	13.4	12.2	11.9	11.8



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	9596	77	9420	76
February	10667	86	10644	86
March	10982	89	11082	90
April	11897	96	12104	98
May	12926	104	13251	107
June	13884	112	14268	115
July	14505	117	15149	122
August	14421	116	15190	123
September	13406	108	13685	111
October	12244	99	12396	100
November	11297	91	11147	90
December	10227	83	10243	83

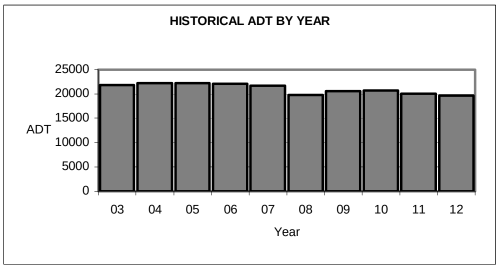
Classification Breakdown	Percent of ADT
Motorcyles	0.51
Passenger cars	28.06
Light Trucks	53.30
Buses	0.42
Single unit trucks (2 axles)	4.41
Single unit trucks (3 axles)	0.57
Single unit trucks (4 or more axles)	0.19
Single trailer trucks (4 or less axles)	1.21
Single trailer trucks (5 axles)	7.76
Single trailer trucks (6 or more axles)	1.46
Multi trailer trucks (5 or less axles)	0.11
Multi trailer trucks (6 axles)	0.02
Multi trailer trucks (7 or more axles)	1.98

Location: I-5; MP 64.20; PACIFIC HIGHWAY NO. 1; 2.08 miles south of Monument Drive (Jump Off Joe) Interchange

Site Name: Grave Creek (17-001)
Installed: January, 1938

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	21819	167	14.5	12.2	11.3	11.1
2004	22249	162	14.3	11.8	10.8	10.5
2005	22251	***	***	***	***	***
2006	22138	159	15.2	11.4	11.1	10.8
2007	21644	164	14.1	11.8	11.0	10.8
2008	19810	170	15.4	12.4	11.4	10.8
2009	20560	***	***	***	***	***
2010	20688	158	16.1	13.0	11.9	11.4
2011	20074	161	14.8	12.2	11.5	11.2
2012	19690	164	15.5	12.9	11.7	11.3



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	15722	80	15572	79
February	16397	83	16488	84
March	17795	90	18309	93
April	18550	94	19016	97
May	19575	99	19779	100
June	22207	113	22652	115
July	23097	117	24062	122
August	23072	117	23901	121
September	20382	104	20808	106
October	18522	94	18971	96
November	18898	96	19324	98
December	16622	84	17398	88

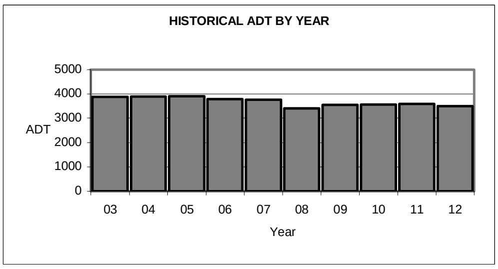
Classification Breakdown	Percent of ADT
Motorcyles	0.48
Passenger cars	59.26
Light Trucks	16.99
Buses	0.19
Single unit trucks (2 axles)	2.26
Single unit trucks (3 axles)	0.61
Single unit trucks (4 or more axles)	0.01
Single trailer trucks (4 or less axles)	2.34
Single trailer trucks (5 axles)	14.06
Single trailer trucks (6 or more axles)	0.66
Multi trailer trucks (5 or less axles)	0.47
Multi trailer trucks (6 axles)	0.27
Multi trailer trucks (7 or more axles)	2.40

Location: US97; MP 291.73; THE DALLES-CALIFORNIA HIGHWAY NO. 4; At the Oregon-California State Line

Site Name: Midland (18-019)
Installed: January, 1955

HISTORICAL TRAFFIC DATA

Year	ADT	Max Day (Percent of ADT)	Max Hour (Percent of ADT)	10TH Hour (Percent of ADT)	20TH Hour (Percent of ADT)	30TH Hour (Percent of ADT)
2003	3869	159	14.3	12.4	11.7	11.3
2004	3884	154	13.3	12.3	11.5	11.2
2005	3901	170	20.1	13.0	12.1	11.8
2006	3786	169	16.7	12.1	11.5	11.3
2007	3755	147	14.0	12.2	11.8	11.5
2008	3402	159	15.1	13.0	12.1	11.7
2009	3550	157	14.5	12.9	12.2	11.8
2010	3574	***	***	***	***	***
2011	3599	175	14.8	12.6	12.1	11.9
2012	3504	150	13.6	12.7	12.1	11.9



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	2483	71	2453	70
February	2645	75	2673	76
March	2730	78	2802	80
April	3253	93	3313	95
May	3736	107	3728	106
June	4169	119	4260	122
July	4381	125	4632	132
August	4291	122	4449	127
September	3985	114	4019	115
October	3833	109	3828	109
November	3386	97	3377	96
December	2499	71	2511	72

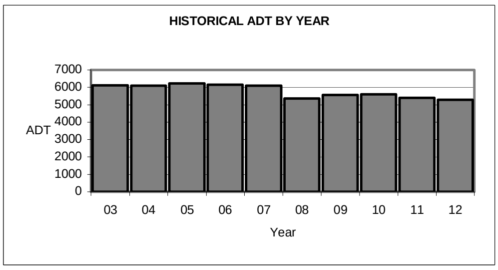
Classification Breakdown	Percent of ADT
Motorcyles	1.46
Passenger cars	43.12
Light Trucks	14.07
Buses	2.40
Single unit trucks (2 axles)	7.32
Single unit trucks (3 axles)	0.94
Single unit trucks (4 or more axles)	0.02
Single trailer trucks (4 or less axles)	4.40
Single trailer trucks (5 axles)	24.89
Single trailer trucks (6 or more axles)	0.80
Multi trailer trucks (5 or less axles)	0.33
Multi trailer trucks (6 axles)	0.25
Multi trailer trucks (7 or more axles)	0.00

Location: US97; MP 254.30; THE DALLES-CALIFORNIA HIGHWAY NO. 4; 3.53 miles north of Modoc Point Road

Site Name: Modoc Point (18-022)
Installed: January, 2001

HISTORICAL TRAFFIC DATA

Year	ADT	Max Day (Percent of ADT)	Max Hour (Percent of ADT)	10TH Hour (Percent of ADT)	20TH Hour (Percent of ADT)	30TH Hour (Percent of ADT)
2003	6109	153	12.4	11.5	11.1	10.9
2004	6092	149	13.5	11.6	11.0	10.8
2005	6226	165	13.5	11.7	11.3	11.1
2006	6155	160	12.7	11.7	11.2	11.0
2007	6079	148	13.0	11.3	11.1	10.9
2008	5346	154	13.0	11.7	11.5	11.3
2009	5569	153	14.0	12.2	11.8	11.6
2010	5599	160	13.4	12.5	12.2	11.9
2011	5395	170	14.2	12.4	11.9	11.6
2012	5281	161	13.4	12.8	12.2	11.8



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	3948	75	3834	73
February	4238	80	4173	79
March	4297	81	4331	82
April	5045	96	4975	94
May	5701	108	5613	106
June	6244	118	6389	121
July	6558	124	6846	130
August	6579	125	6836	129
September	6217	118	6215	118
October	5421	103	5417	103
November	4981	94	4869	92
December	3977	75	3872	73

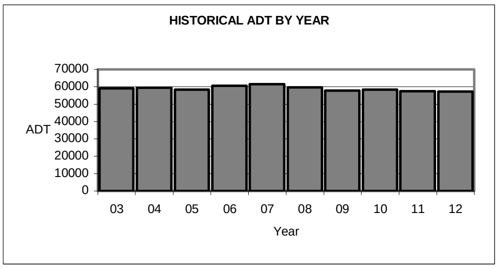
Classification Breakdown	Percent of ADT
Motorcyles	1.50
Passenger cars	50.33
Light Trucks	13.69
Buses	3.25
Single unit trucks (2 axles)	7.86
Single unit trucks (3 axles)	1.05
Single unit trucks (4 or more axles)	0.05
Single trailer trucks (4 or less axles)	9.91
Single trailer trucks (5 axles)	10.83
Single trailer trucks (6 or more axles)	0.45
Multi trailer trucks (5 or less axles)	0.56
Multi trailer trucks (6 axles)	0.26
Multi trailer trucks (7 or more axles)	0.26

Location: I-105; MP 2.82; EUGENE-SPRINGFIELD HIGHWAY NO. 227; 0.66 mile west of Pacific Highway No. 1 (I-5) in Eugene

Site Name: Willakenzie (20-008)
Installed: November, 1960

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	59168	128	10.8	10.3	10.1	10.1
2004	59361	125	10.7	10.4	10.2	10.1
2005	58393	***	***	***	***	***
2006	60515	***	***	***	***	***
2007	61659	126	10.6	10.4	10.3	10.1
2008	59575	127	10.8	10.5	10.4	10.4
2009	57809	123	10.7	10.4	10.3	10.3
2010	58322	127	10.7	10.6	10.4	10.4
2011	57441	123	10.9	10.6	10.4	10.3
2012	57200	124	10.8	10.5	10.4	10.4



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	58333	102	54369	95
February	62506	109	57784	101
March	58828	103	55121	96
April	63677	111	59370	104
May	62246	109	57882	101
June	65209	114	59934	105
July	62227	109	57232	100
August	64073	112	58181	102
September	62607	109	58340	102
October	62432	109	58026	101
November	60670	106	55705	97
December	57885	101	54459	95

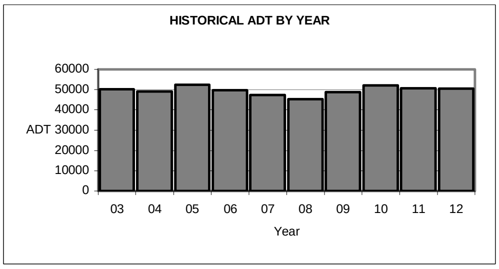
Classification Breakdown	Percent of ADT
Motorcyles	0.20
Passenger cars	78.65
Light Trucks	17.25
Buses	0.37
Single unit trucks (2 axles)	1.60
Single unit trucks (3 axles)	0.36
Single unit trucks (4 or more axles)	0.02
Single trailer trucks (4 or less axles)	0.36
Single trailer trucks (5 axles)	0.79
Single trailer trucks (6 or more axles)	0.20
Multi trailer trucks (5 or less axles)	0.03
Multi trailer trucks (6 axles)	0.02
Multi trailer trucks (7 or more axles)	0.15

Location: OR569; MP 12.00; BELT LINE HIGHWAY NO. 69; 0.76 mile west of Pacific Highway No. 1 (I-5)

Site Name: Beltline (20-011)
Installed: May, 2000

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	50108	***	***	***	***	***
2004	49161	***	***	***	***	***
2005	52270	141	11.1	10.8	10.5	10.2
2006	49718	125	10.1	9.7	9.6	9.5
2007	47344	***	***	***	***	***
2008	45275	***	***	***	***	***
2009	48772	125	11.1	9.8	9.8	9.7
2010	51965	126	10.3	9.6	9.5	9.4
2011	50662	136	10.7	10.1	9.7	9.5
2012	50471	123	10.1	9.6	9.6	9.5



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	49432	98	46701	93
February	52658	104	49562	98
March	49937	99	47757	95
April	53850	107	50901	101
May	53764	107	50999	101
June	56157	111	52796	105
July	55741	110	52755	105
August	56742	112	53185	105
September	54387	108	51470	102
October	54476	108	51283	102
November	52530	104	49246	98
December	52000	103	49000	97

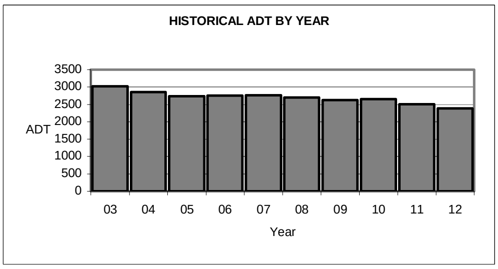
Classification Breakdown	Percent of ADT
Motorcyles	0.36
Passenger cars	72.51
Light Trucks	17.97
Buses	0.28
Single unit trucks (2 axles)	2.75
Single unit trucks (3 axles)	1.29
Single unit trucks (4 or more axles)	0.10
Single trailer trucks (4 or less axles)	0.57
Single trailer trucks (5 axles)	2.66
Single trailer trucks (6 or more axles)	1.00
Multi trailer trucks (5 or less axles)	0.11
Multi trailer trucks (6 axles)	0.01
Multi trailer trucks (7 or more axles)	0.39

Location: OR58; MP 37.36; WILLAMETTE HIGHWAY NO. 18; 0.10 mile east of Kitson Springs Road

Site Name: Oakridge (20-017)
Installed: January, 1953

HISTORICAL TRAFFIC DATA

		Percent of ADT					
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	3017	272	27.6	24.2	20.5	19.2
2004	2856	221	26.2	21.1	19.5	18.9
2005	2726	229	27.8	21.3	20.4	19.4
2006	2747	229	27.0	21.6	19.4	18.8
2007	2767	253	28.7	22.9	21.0	19.8
2008	2690	213	24.0	21.2	19.6	18.9
2009	2627	236	30.0	22.6	21.5	20.4
2010	2650	241	28.5	23.2	21.7	20.6
2011	2509	258	30.8	23.4	21.9	20.8
2012	2380	237	29.5	24.7	23.0	21.3



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	1295	54	1584	67
February	1454	61	1852	78
March	1521	64	1865	78
April	1693	71	1982	83
May	2421	102	2666	112
June	2076	87	2575	108
July	2786	117	3332	140
August	2977	125	3642	153
September	2696	113	3180	134
October	2040	86	2383	100
November	1686	71	1843	77
December	1469	62	1651	69

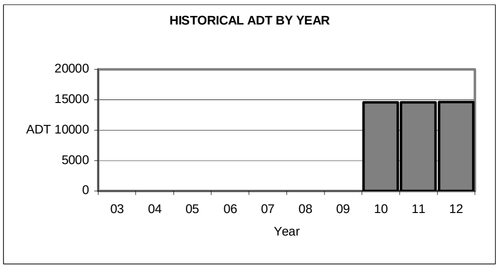
Classification Breakdown	Percent of ADT
Motorcyles	0.97
Passenger cars	38.19
Light Trucks	25.12
Buses	0.07
Single unit trucks (2 axles)	2.53
Single unit trucks (3 axles)	0.69
Single unit trucks (4 or more axles)	0.04
Single trailer trucks (4 or less axles)	3.93
Single trailer trucks (5 axles)	17.32
Single trailer trucks (6 or more axles)	6.35
Multi trailer trucks (5 or less axles)	0.14
Multi trailer trucks (6 axles)	0.43
Multi trailer trucks (7 or more axles)	4.22

Location: OR99; MP 115.28; PACIFIC HIGHWAY WEST NO. 91; 1.00 mile south of Meadowview Road

Site Name: Eugene-Meadowview (20-024)
Installed: July, 2009

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	***	***	***	***	***	***
2007	***	***	***	***	***	***
2008	***	***	***	***	***	***
2009	***	***	***	***	***	***
2010	14588	144	11.2	10.4	10.1	10.0
2011	14587	148	11.6	10.5	10.3	10.2
2012	14619	150	11.6	10.6	10.4	10.3



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	14086	96	13161	90
February	14936	102	14082	96
March	14338	98	13690	94
April	15670	107	14839	102
May	15672	107	14877	102
June	16326	112	15459	106
July	16268	111	15201	104
August	17039	117	16035	110
September	16218	111	15241	104
October	15878	109	14833	101
November	15330	105	14202	97
December	14548	100	13802	94

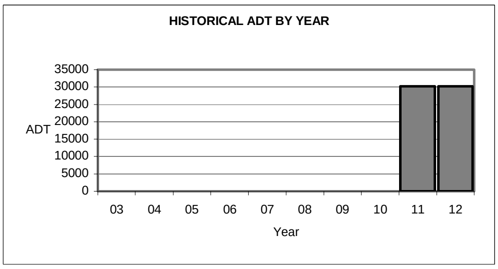
Classification Breakdown	Percent of ADT
Motorcyles	0.19
Passenger cars	54.50
Light Trucks	36.49
Buses	0.29
Single unit trucks (2 axles)	3.75
Single unit trucks (3 axles)	1.43
Single unit trucks (4 or more axles)	0.10
Single trailer trucks (4 or less axles)	0.36
Single trailer trucks (5 axles)	1.48
Single trailer trucks (6 or more axles)	0.87
Multi trailer trucks (5 or less axles)	0.06
Multi trailer trucks (6 axles)	0.01
Multi trailer trucks (7 or more axles)	0.47

Location: OR126; MP 8.66; EUGENE-SPRINGFIELD HIGHWAY NO. 227; 0.39 mile north of 52nd Street

Site Name: East Springfield (20-027)
Installed: July, 2010

HISTORICAL TRAFFIC DATA

		Percent of ADT					
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	***	***	***	***	***	***
2007	***	***	***	***	***	***
2008	***	***	***	***	***	***
2009	***	***	***	***	***	***
2010	***	***	***	***	***	***
2011	30158	122	11.2	10.5	10.4	10.3
2012	30189	122	10.7	10.4	10.4	10.3



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	29186	97	27809	92
February	30754	102	29182	97
March	29132	96	28132	93
April	31606	105	30386	101
May	32143	106	31141	103
June	33131	110	31812	105
July	33053	109	31907	106
August	33437	111	31946	106
September	32826	109	31458	104
October	32146	106	30443	101
November	31020	103	29130	96
December	30039	100	28924	96

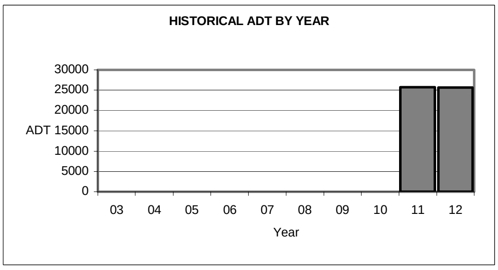
Classification Breakdown	Percent of ADT
Motorcyles	0.27
Passenger cars	79.82
Light Trucks	16.07
Buses	0.42
Single unit trucks (2 axles)	1.05
Single unit trucks (3 axles)	0.43
Single unit trucks (4 or more axles)	0.02
Single trailer trucks (4 or less axles)	0.35
Single trailer trucks (5 axles)	1.08
Single trailer trucks (6 or more axles)	0.30
Multi trailer trucks (5 or less axles)	0.00
Multi trailer trucks (6 axles)	0.00
Multi trailer trucks (7 or more axles)	0.19

Location: OR569; MP 5.20; BELT LINE HIGHWAY NO. 69; 0.42 mile south of Barger Drive Interchange

Site Name: West Beltline (20-028)
Installed: July, 2010

HISTORICAL TRAFFIC DATA

		Percent of ADT					
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	***	***	***	***	***	***
2007	***	***	***	***	***	***
2008	***	***	***	***	***	***
2009	***	***	***	***	***	***
2010	***	***	***	***	***	***
2011	25690	125	10.7	10.1	9.9	9.8
2012	25611	131	10.4	10.3	10.0	10.0



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	24994	98	23554	92
February	26529	104	25025	98
March	25170	98	24011	94
April	27179	106	25653	100
May	27562	108	26096	102
June	29065	113	27091	106
July	29034	113	27257	106
August	29575	115	27401	107
September	27842	109	26145	102
October	27461	107	25640	100
November	26508	104	24609	96
December	25979	101	24855	97

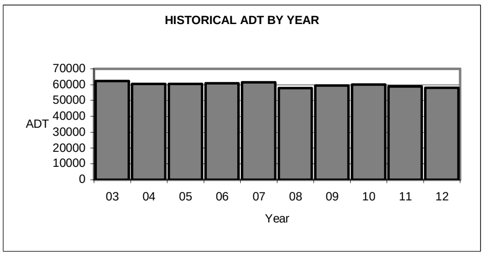
Classification Breakdown	Percent of ADT
Motorcyles	0.62
Passenger cars	72.55
Light Trucks	19.35
Buses	0.19
Single unit trucks (2 axles)	2.14
Single unit trucks (3 axles)	1.10
Single unit trucks (4 or more axles)	0.02
Single trailer trucks (4 or less axles)	0.79
Single trailer trucks (5 axles)	2.43
Single trailer trucks (6 or more axles)	0.53
Multi trailer trucks (5 or less axles)	0.00
Multi trailer trucks (6 axles)	0.02
Multi trailer trucks (7 or more axles)	0.26

Location: I-5; MP 234.80; PACIFIC HIGHWAY NO. 1; 0.41 mile north of Albany-Junction City Highway No. 58 (OR99E)

Site Name: North Albany (22-005)
Installed: October, 1999

HISTORICAL TRAFFIC DATA

				Percent of ADT		
		Max	Max	10TH	20TH	30TH
Year	ADT	Day	Hour	Hour	Hour	Hour
2003	62259	134	11.0	9.7	9.6	9.5
2004	60486	134	10.1	9.8	9.7	9.5
2005	60632	***	***	***	***	***
2006	60971	134	10.1	9.7	9.5	9.3
2007	61436	136	10.0	9.7	9.6	9.5
2008	57888	139	11.9	10.2	9.9	9.9
2009	59500	133	10.6	10.0	9.7	9.6
2010	60070	133	10.6	9.9	9.7	9.6
2011	58939	130	10.0	9.8	9.7	9.6
2012	58137	138	11.2	9.9	9.7	9.6



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	48853	84	49229	85
February	52334	90	53419	92
March	52798	91	54190	93
April	55321	95	57431	99
May	56767	98	58539	101
June	61848	106	63157	109
July	63104	109	64842	112
August	64365	111	65852	113
September	59419	102	61867	106
October	55423	95	57944	100
November	55826	96	57431	99
December	53196	92	53737	92

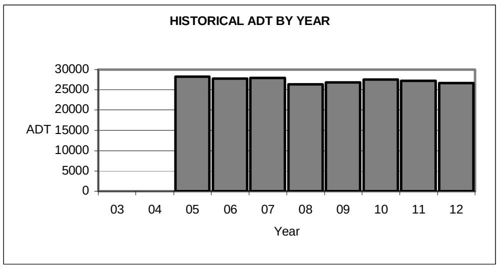
Classification Breakdown	Percent of ADT
Motorcyles	0.70
Passenger cars	62.28
Light Trucks	15.15
Buses	0.15
Single unit trucks (2 axles)	2.90
Single unit trucks (3 axles)	0.70
Single unit trucks (4 or more axles)	0.07
Single trailer trucks (4 or less axles)	1.24
Single trailer trucks (5 axles)	13.26
Single trailer trucks (6 or more axles)	1.62
Multi trailer trucks (5 or less axles)	0.23
Multi trailer trucks (6 axles)	0.13
Multi trailer trucks (7 or more axles)	1.57

Location: OR34; MP 3.92; CORVALLIS-LEBANON HIGHWAY NO. 210; 0.89 mile east of Riverside Drive

Site Name: Riverside Drive (22-020)
Installed: February, 2004

HISTORICAL TRAFFIC DATA

				Percent of ADT		
		Max	Max	10TH	20TH	30TH
Year	ADT	Day	Hour	Hour	Hour	Hour
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	28201	132	11.9	10.7	10.6	10.5
2006	27813	135	12.5	11.0	10.8	10.6
2007	27927	139	13.1	11.2	10.9	10.8
2008	26342	145	13.8	11.6	11.3	11.1
2009	26861	134	12.3	11.2	11.0	10.8
2010	27576	135	12.4	11.2	11.0	10.8
2011	27233	132	11.9	11.2	11.0	10.9
2012	26683	138	12.2	11.1	11.0	10.8



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	26712	100	24622	92
February	28879	108	27062	101
March	26899	101	25235	95
April	29279	110	27649	104
May	29131	109	27932	105
June	29533	111	27949	105
July	28350	106	26584	100
August	29120	109	27312	102
September	28778	108	27503	103
October	29477	110	28170	106
November	28373	106	27483	103
December	24307	91	22687	85

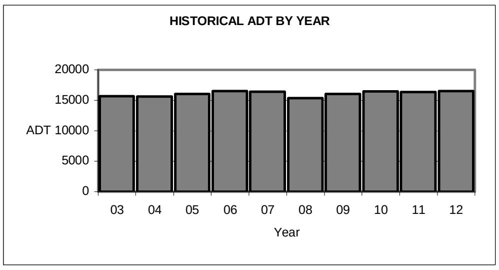
Classification Breakdown	Percent of ADT
Motorcyles	0.33
Passenger cars	72.15
Light Trucks	19.30
Buses	0.88
Single unit trucks (2 axles)	2.88
Single unit trucks (3 axles)	0.85
Single unit trucks (4 or more axles)	0.09
Single trailer trucks (4 or less axles)	0.54
Single trailer trucks (5 axles)	1.88
Single trailer trucks (6 or more axles)	0.70
Multi trailer trucks (5 or less axles)	0.00
Multi trailer trucks (6 axles)	0.02
Multi trailer trucks (7 or more axles)	0.38

Location: MP 376.98; OLD OREGON TRAIL NO. 6; 1.03 mile west of Oregon-Idaho State Line

Site Name: Snake River (23-014)
Installed: December, 1969

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	15672	138	10.5	9.9	9.6	9.3
2004	15624	141	11.3	9.9	9.5	9.3
2005	16037	156	11.3	10.0	9.4	9.2
2006	16502	151	11.4	10.0	9.4	9.1
2007	16408	***	***	***	***	***
2008	15338	141	11.2	10.0	9.4	9.2
2009	16065	139	10.8	10.2	9.7	9.4
2010	16469	143	10.2	10.0	9.6	9.4
2011	16386	147	12.7	9.8	9.6	9.4
2012	16511	***	***	***	***	***



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	13771	83	13318	81
February	14808	90	14332	87
March	15652	95	15514	94
April	16505	100	16346	99
May	17279	105	17041	103
June	18609	113	18513	112
July	18782	114	18949	115
August	19090	116	19138	116
September	18007	109	17694	107
October	17375	105	16968	103
November	16069	97	15825	96
December	14365	87	14493	88

Classification Breakdown	Percent of ADT
Motorcyles	0.45
Passenger cars	50.93
Light Trucks	19.32
Buses	0.29
Single unit trucks (2 axles)	2.15
Single unit trucks (3 axles)	0.56
Single unit trucks (4 or more axles)	0.01
Single trailer trucks (4 or less axles)	1.90
Single trailer trucks (5 axles)	18.05
Single trailer trucks (6 or more axles)	2.55
Multi trailer trucks (5 or less axles)	0.87
Multi trailer trucks (6 axles)	0.40
Multi trailer trucks (7 or more axles)	2.52

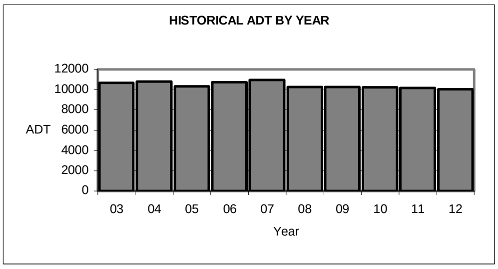
Location: OR99E; MP 34.03; PACIFIC HIGHWAY EAST NO. 81; 1.16 miles south of Hillsboro-Silverton Highway No. 140 (OR214)

Site Name: Woodburn (24-001)
Installed: January, 1937

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	10676	141	12.5	11.2	10.7	10.5
2004	10810	132	12.2	11.0	10.7	10.6
2005	10301	***	***	***	***	***
2006	10748	128	13.4	11.2	10.9	10.7
2007	10954	126	13.0	11.8	11.3	11.1
2008	10254	128	11.9	11.4	11.2	11.0
2009	10263	139	15.9	11.1	10.9	10.6
2010	10224	131	13.4	11.6	11.3	11.1
2011	10147	126	14.7	11.9	11.4	11.2
2012	10050	***	***	***	***	***

2012: No data May-Dec due to Construction.



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	9126	91	8790	87
February	9771	97	9419	94
March	9611	96	9439	94
April	10153	101	10224	102
May	10600	105	10400	103
June	10800	107	10500	104
July	11400	113	11000	109
August	11600	115	11200	111
September	11100	110	10800	107
October	10800	107	10600	105
November	9800	98	9400	94
December	8876	88	8825	88

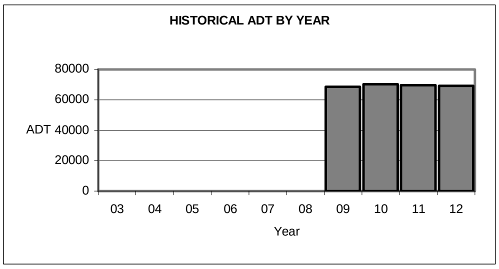
Classification Breakdown	Percent of ADT
Motorcyles	0.50
Passenger cars	67.29
Light Trucks	24.27
Buses	0.42
Single unit trucks (2 axles)	3.39
Single unit trucks (3 axles)	0.88
Single unit trucks (4 or more axles)	0.07
Single trailer trucks (4 or less axles)	0.47
Single trailer trucks (5 axles)	2.06
Single trailer trucks (6 or more axles)	0.39
Multi trailer trucks (5 or less axles)	0.02
Multi trailer trucks (6 axles)	0.02
Multi trailer trucks (7 or more axles)	0.22

Location: I-5; MP 252.20; PACIFIC HIGHWAY NO. 1; 0.02 mile north of Turner Road Overcrossing

Site Name: Salem-Kuebler (24-021)
Installed: August, 2008

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	***	***	***	***	***	***
2007	***	***	***	***	***	***
2008	***	***	***	***	***	***
2009	68542	134	10.2	9.8	9.6	9.4
2010	70265	130	10.1	9.7	9.6	9.4
2011	69484	130	9.9	9.6	9.5	9.4
2012	69134	134	10.2	9.6	9.5	9.4



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	60127	87	59732	86
February	64366	93	64620	93
March	64197	93	64819	94
April	67518	98	68807	100
May	69084	100	69942	101
June	73461	106	74208	107
July	76060	110	76804	111
August	76263	110	76923	111
September	70669	102	72580	105
October	67216	97	68871	100
November	67451	98	68077	98
December	64435	93	64229	93

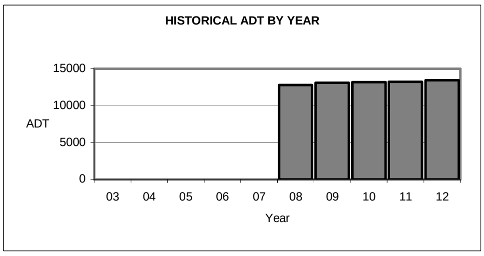
Classification Breakdown	Percent of ADT
Motorcyles	0.59
Passenger cars	62.81
Light Trucks	19.27
Buses	0.48
Single unit trucks (2 axles)	2.89
Single unit trucks (3 axles)	0.61
Single unit trucks (4 or more axles)	0.02
Single trailer trucks (4 or less axles)	1.15
Single trailer trucks (5 axles)	8.85
Single trailer trucks (6 or more axles)	1.80
Multi trailer trucks (5 or less axles)	0.14
Multi trailer trucks (6 axles)	0.24
Multi trailer trucks (7 or more axles)	1.15

Location: I-84; MP 168.55; OLD OREGON TRAIL NO. 6; 0.60 mile southeast of Columbia River Highway No. 2 Interchange (US730)

Site Name: Boardman Jct (25-008)
Installed: June, 2007

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	***	***	***	***	***	***
2007	***	***	***	***	***	***
2008	12789	175	42.2	13.9	12.6	12.1
2009	13086	166	16.1	13.7	13.3	12.3
2010	13191	163	17.3	13.4	13.0	12.6
2011	13206	171	16.9	12.9	12.4	11.9
2012	13424	163	16.7	12.9	12.2	12.1



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	9709	72	9367	70
February	10935	81	10815	81
March	12220	91	12369	92
April	12488	93	12733	95
May	13713	102	13777	103
June	14988	112	15312	114
July	15626	116	16366	122
August	16364	122	17014	127
September	15532	116	15632	116
October	13576	101	13859	103
November	12661	94	12803	95
December	10976	82	11046	82

Classification Breakdown	Percent of ADT
Motorcyles	0.05
Passenger cars	57.55
Light Trucks	16.33
Buses	0.11
Single unit trucks (2 axles)	1.53
Single unit trucks (3 axles)	0.69
Single unit trucks (4 or more axles)	0.01
Single trailer trucks (4 or less axles)	0.68
Single trailer trucks (5 axles)	15.77
Single trailer trucks (6 or more axles)	5.27
Multi trailer trucks (5 or less axles)	0.18
Multi trailer trucks (6 axles)	0.17
Multi trailer trucks (7 or more axles)	1.66

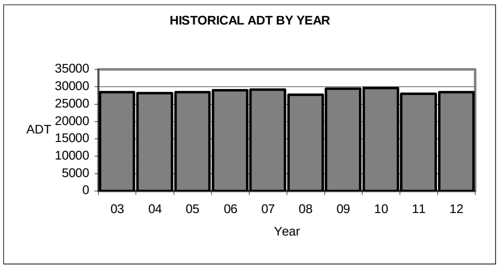
Location: I-84; MP 17.71; COLUMBIA RIVER HIGHWAY NO. 2; 0.04 mile west of Sandy River, east of Troutdale

Site Name: Troutdale (26-001)

Installed: January, 1951

HISTORICAL TRAFFIC DATA

				Percent of ADT		
		Max	Max	10TH	20TH	30TH
Year	ADT	Day	Hour	Hour	Hour	Hour
2003	28491	173	15.3	14.7	14.3	13.8
2004	28168	170	15.6	14.5	14.2	13.8
2005	28498	180	16.0	14.8	14.2	13.9
2006	28960	166	15.4	14.3	13.8	13.4
2007	29137	169	16.2	14.0	13.4	13.0
2008	27786	164	14.9	14.1	13.7	13.4
2009	29463	176	16.8	15.1	14.4	14.0
2010	29637	***	***	***	***	***
2011	28054	180	15.8	14.9	14.0	13.5
2012	28469	188	16.6	15.2	14.1	13.7



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	18960	67	19845	70
February	21087	74	22807	80
March	22498	79	24649	87
April	23429	82	27178	95
May	26601	93	30054	106
June	28716	101	32016	112
July	32777	115	36984	130
August	32630	115	37603	132
September	29579	104	32796	115
October	25200	89	28200	99
November	24100	85	26000	91
December	22500	79	23500	83

Classification Breakdown	Percent of ADT
Motorcyles	0.04
Passenger cars	57.73
Light Trucks	20.96
Buses	0.14
Single unit trucks (2 axles)	2.61
Single unit trucks (3 axles)	0.50
Single unit trucks (4 or more axles)	0.05
Single trailer trucks (4 or less axles)	0.65
Single trailer trucks (5 axles)	11.17
Single trailer trucks (6 or more axles)	3.66
Multi trailer trucks (5 or less axles)	0.66
Multi trailer trucks (6 axles)	0.30
Multi trailer trucks (7 or more axles)	1.53

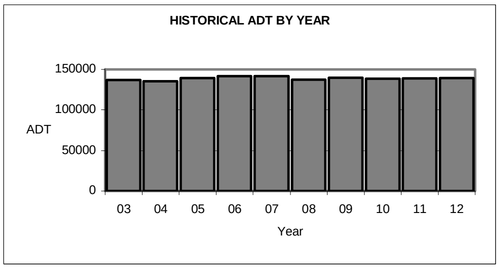
Location: US26; MP 73.75; SUNSET HIGHWAY NO. 47; 0.20 mile west of Stadium Freeway No. 61 (I-405), at the Vista Ridge Tunnels

Site Name: Vista Ridge Tunnel (26-002)

Installed: February, 1969

HISTORICAL TRAFFIC DATA

				Percent of ADT		
		Max	Max	10TH	20TH	30TH
Year	ADT	Day	Hour	Hour	Hour	Hour
2003	136942	***	***	***	***	***
2004	135317	***	***	***	***	***
2005	139325	***	***	***	***	***
2006	141633	***	***	***	***	***
2007	141408	***	***	***	***	***
2008	137150	***	***	***	***	***
2009	139800	***	***	***	***	***
2010	138369	***	***	***	***	***
2011	138937	115	7.9	7.8	7.8	7.7
2012	139387	115	8.1	7.9	7.9	7.8



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	139199	100	132277	95
February	146231	105	138906	100
March	145007	104	138751	100
April	149644	107	143938	103
May	148830	107	143356	103
June	151590	109	144499	104
July	149230	107	142431	102
August	150197	108	141970	102
September	145652	104	140128	101
October	146291	105	138617	99
November	142786	102	134439	96
December	137524	99	133335	96

Classification Breakdown	Percent of ADT
Motorcyles	0.50
Passenger cars	63.44
Light Trucks	20.37
Buses	0.88
Single unit trucks (2 axles)	9.48
Single unit trucks (3 axles)	0.74
Single unit trucks (4 or more axles)	0.02
Single trailer trucks (4 or less axles)	1.57
Single trailer trucks (5 axles)	1.51
Single trailer trucks (6 or more axles)	0.90
Multi trailer trucks (5 or less axles)	0.07
Multi trailer trucks (6 axles)	0.03
Multi trailer trucks (7 or more axles)	0.52

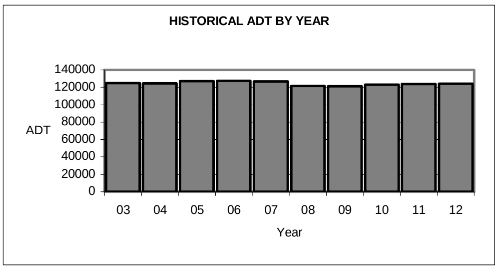
Location: I-5; MP 307.97; PACIFIC HIGHWAY NO. 1; 0.41 mile south of Oregon-Washington State Line

Site Name: Interstate Bridge (26-004)

Installed: January, 1953

HISTORICAL TRAFFIC DATA

				Percent of ADT		
		Max	Max	10TH	20TH	30TH
Year	ADT	Day	Hour	Hour	Hour	Hour
2003	124966	121	8.2	7.9	7.8	7.7
2004	124513	126	8.4	8.1	8.0	7.9
2005	127026	120	7.9	7.7	7.6	7.6
2006	127331	119	7.9	7.6	7.5	7.5
2007	126597	119	7.8	7.6	7.6	7.5
2008	121407	121	8.1	7.9	7.8	7.7
2009	121132	121	8.0	7.8	7.8	7.8
2010	123189	118	7.8	7.7	7.6	7.5
2011	123893	118	8.0	7.6	7.5	7.4
2012	124340	117	7.8	7.6	7.5	7.5



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	119080	96	114570	92
February	127950	103	122871	99
March	126848	102	123377	99
April	129948	105	125394	101
May	127600	103	123730	100
June	132617	107	128069	103
July	133826	108	129343	104
August	136039	109	130897	105
September	128052	103	125546	101
October	128334	103	124629	100
November	126465	102	122160	98
December	123722	100	121498	98

Classification Breakdown	Percent of ADT
Motorcyles	0.36
Passenger cars	65.25
Light Trucks	23.88
Buses	0.42
Single unit trucks (2 axles)	1.94
Single unit trucks (3 axles)	0.88
Single unit trucks (4 or more axles)	0.06
Single trailer trucks (4 or less axles)	0.47
Single trailer trucks (5 axles)	4.78
Single trailer trucks (6 or more axles)	1.27
Multi trailer trucks (5 or less axles)	0.26
Multi trailer trucks (6 axles)	0.10
Multi trailer trucks (7 or more axles)	0.33

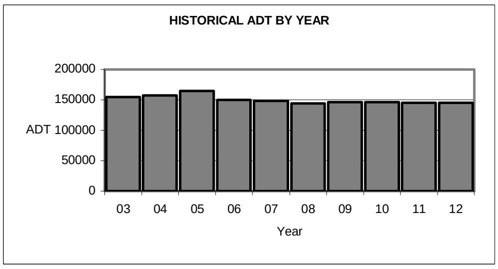
Location: I-205; MP 20.35; EAST PORTLAND FREEWAY NO. 64; 0.22 mile south of S.E. Washington Street Undercrossing

Site Name: Yamhill (26-018)

Installed: July, 1995

HISTORICAL TRAFFIC DATA

				Percent of ADT		
		Max	Max	10TH	20TH	30TH
Year	ADT	Day	Hour	Hour	Hour	Hour
2003	154332	119	8.5	8.1	8.0	8.0
2004	156809	123	8.1	8.0	7.9	7.8
2005	164804	***	***	***	***	***
2006	149978	117	8.1	7.8	7.7	7.6
2007	148487	117	7.6	7.5	7.5	7.4
2008	144227	117	7.8	7.7	7.6	7.6
2009	146509	116	7.8	7.7	7.6	7.6
2010	146277	115	7.8	7.7	7.6	7.6
2011	145358	116	7.8	7.6	7.6	7.5
2012	145124	115	7.8	7.6	7.6	7.5



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	140334	97	134073	92
February	148853	103	141742	98
March	148171	102	142401	98
April	152495	105	147281	101
May	153619	106	148205	102
June	158047	109	151397	104
July	156655	108	152112	105
August	158517	109	153327	106
September	153279	106	148046	102
October	150957	104	143725	99
November	146450	101	139881	96
December	143385	99	139304	96

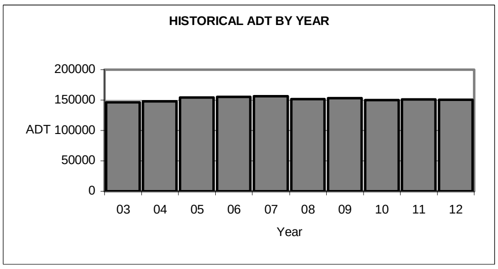
Classification Breakdown	Percent of ADT
Motorcyles	0.65
Passenger cars	76.99
Light Trucks	14.17
Buses	0.40
Single unit trucks (2 axles)	2.04
Single unit trucks (3 axles)	0.58
Single unit trucks (4 or more axles)	0.13
Single trailer trucks (4 or less axles)	0.70
Single trailer trucks (5 axles)	2.96
Single trailer trucks (6 or more axles)	0.90
Multi trailer trucks (5 or less axles)	0.09
Multi trailer trucks (6 axles)	0.06
Multi trailer trucks (7 or more axles)	0.33

Location: I-205; MP 18.25; EAST PORTLAND FREEWAY NO. 64; 0.87 mile south of Mt. Hood Highway No. 26 (US26)

Site Name: Lents (26-022)
Installed: July, 1995

HISTORICAL TRAFFIC DATA

		Percent of ADT					
Year	**ADT**	**Max Day**	**Max Hour**	**10TH Hour**	**20TH Hour**	**30TH Hour**
2003	146355	118	8.3	8.1	8.0	7.9
2004	147698	121	8.3	8.0	7.9	7.8
2005	153758	***	***	***	***	***
2006	155201	***	***	***	***	***
2007	155889	***	***	***	***	***
2008	151553	118	8.1	8.0	7.9	7.9
2009	152957	116	8.1	8.0	8.0	7.9
2010	150015	115	8.1	8.0	7.9	7.9
2011	150855	116	8.1	7.9	7.8	7.8
2012	150336	116	8.1	7.9	7.9	7.8



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2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	146420	97	139673	93
February	154694	103	147146	98
March	153528	102	146980	98
April	158377	105	152260	101
May	159519	106	153392	102
June	163990	109	156608	104
July	162390	108	157099	104
August	165048	110	159206	106
September	158928	106	153056	102
October	156886	104	148760	99
November	151940	101	145040	96
December	149163	99	144814	96

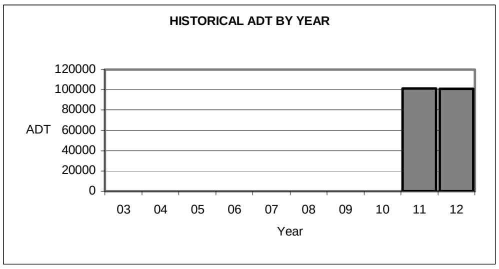
Classification Breakdown	Percent of ADT
Motorcyles	0.78
Passenger cars	71.74
Light Trucks	19.47
Buses	0.26
Single unit trucks (2 axles)	2.49
Single unit trucks (3 axles)	0.72
Single unit trucks (4 or more axles)	0.01
Single trailer trucks (4 or less axles)	0.60
Single trailer trucks (5 axles)	2.80
Single trailer trucks (6 or more axles)	0.68
Multi trailer trucks (5 or less axles)	0.08
Multi trailer trucks (6 axles)	0.03
Multi trailer trucks (7 or more axles)	0.34

Location: I-84; MP 11.45; COLUMBIA RIVER HIGHWAY NO. 2; 1.59 miles west of N.E. 181st Avenue Interchange

Site Name: Fairview (26-028)
Installed: November, 2010

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	**ADT**	**Max Day**	**Max Hour**	**10TH Hour**	**20TH Hour**	**30TH Hour**
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	***	***	***	***	***	***
2007	***	***	***	***	***	***
2008	***	***	***	***	***	***
2009	***	***	***	***	***	***
2010	***	***	***	***	***	***
2011	101367	123	8.6	8.4	8.3	8.3
2012	100864	122	8.7	8.5	8.4	8.3



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	93468	93	89809	89
February	100712	100	96734	96
March	101013	100	97946	97
April	103946	103	101925	101
May	105233	104	103181	102
June	109480	109	106650	106
July	111463	111	110455	110
August	111325	110	110851	110
September	106953	106	105668	105
October	103547	103	99234	98
November	98731	98	94124	93
December	96150	95	93792	93

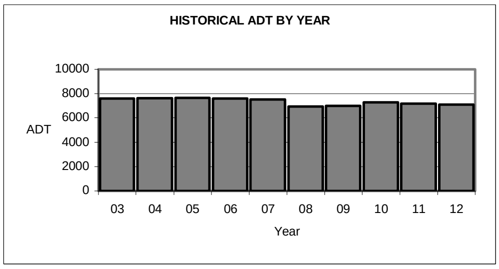
Classification Breakdown	Percent of ADT
Motorcyles	1.00
Passenger cars	46.61
Light Trucks	42.70
Buses	0.20
Single unit trucks (2 axles)	2.67
Single unit trucks (3 axles)	0.57
Single unit trucks (4 or more axles)	0.03
Single trailer trucks (4 or less axles)	0.48
Single trailer trucks (5 axles)	3.69
Single trailer trucks (6 or more axles)	1.23
Multi trailer trucks (5 or less axles)	0.11
Multi trailer trucks (6 axles)	0.12
Multi trailer trucks (7 or more axles)	0.59

Location: OR99W; MP 70.90; PACIFIC HIGHWAY WEST NO. 91; 1.43 mile north of Polk-Benton County Line

Site Name: Monmouth (27-005)
Installed: January, 2001

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	7596	151	15.9	13.8	12.1	11.5
2004	7615	135	15.4	12.7	11.6	11.3
2005	7648	141	16.5	13.8	12.0	11.5
2006	7589	163	18.2	14.4	13.3	12.1
2007	7509	149	15.6	13.5	11.9	11.4
2008	6962	154	18.0	15.2	13.0	12.3
2009	7005	153	17.0	13.8	12.6	11.8
2010	7287	159	17.6	14.4	13.3	12.0
2011	7193	146	17.5	15.1	12.9	12.1
2012	7120	150	16.9	14.1	12.8	12.0



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	6371	89	6210	87
February	7128	100	7052	99
March	6726	94	6648	93
April	7346	103	7312	103
May	7499	105	7580	106
June	7526	106	7426	104
July	7447	105	7254	102
August	7444	105	7305	103
September	7472	105	7535	106
October	7680	108	7785	109
November	7270	102	7345	103
December	6195	87	5986	84

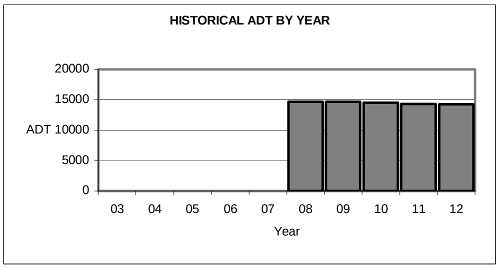
Classification Breakdown	Percent of ADT
Motorcyles	0.81
Passenger cars	72.42
Light Trucks	14.86
Buses	0.07
Single unit trucks (2 axles)	1.79
Single unit trucks (3 axles)	1.39
Single unit trucks (4 or more axles)	0.04
Single trailer trucks (4 or less axles)	0.81
Single trailer trucks (5 axles)	2.23
Single trailer trucks (6 or more axles)	5.07
Multi trailer trucks (5 or less axles)	0.01
Multi trailer trucks (6 axles)	0.00
Multi trailer trucks (7 or more axles)	0.50

Location: I-84; MP 191.40; OLD OREGON TRAIL NO. 6; 2.56 miles east of Umatilla-Stanfield Highway No. 54 Interchange (US395)

Site Name: Echo (30-027)
Installed: June, 2007

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	***	***	***	***	***	***
2007	***	***	***	***	***	***
2008	14675	146	13.8	11.5	10.8	10.3
2009	14656	147	13.0	11.9	11.2	10.8
2010	14507	160	13.0	12.1	11.5	11.3
2011	14339	158	13.5	11.5	11.1	10.9
2012	14266	147	13.6	11.5	11.2	11.0



2012 TRAFFIC DATA

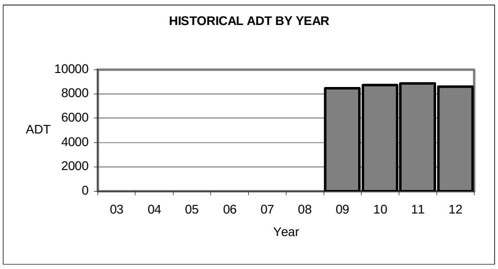
	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	10703	75	10399	73
February	12061	85	11949	84
March	13383	94	13573	95
April	13969	98	14127	99
May	14847	104	14812	104
June	15769	111	16029	112
July	16475	115	16970	119
August	16805	118	17213	121
September	15949	112	16002	112
October	14600	102	14900	104
November	13417	94	13474	94
December	11721	82	11742	82

Classification Breakdown	Percent of ADT
Motorcyles	0.17
Passenger cars	51.20
Light Trucks	14.84
Buses	0.30
Single unit trucks (2 axles)	2.60
Single unit trucks (3 axles)	0.71
Single unit trucks (4 or more axles)	0.01
Single trailer trucks (4 or less axles)	1.77
Single trailer trucks (5 axles)	22.44
Single trailer trucks (6 or more axles)	3.14
Multi trailer trucks (5 or less axles)	0.28
Multi trailer trucks (6 axles)	0.30
Multi trailer trucks (7 or more axles)	2.24

Location:	I-84; MP 260.12; OLD OREGON TRAIL NO. 6; 1.05 miles east of La Grande-Baker Highway No. 66 (US30), North La Grande Interchange	**Site Name:**	North La Grande (31-007)
		Installed:	December, 2008

HISTORICAL TRAFFIC DATA

				Percent of ADT		
Year	**ADT**	**Max Day**	**Max Hour**	**10TH Hour**	**20TH Hour**	**30TH Hour**
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	***	***	***	***	***	***
2007	***	***	***	***	***	***
2008	***	***	***	***	***	***
2009	8464	164	17.7	14.4	13.5	13.2
2010	8721	167	16.8	14.5	13.4	12.8
2011	8868	182	16.1	14.1	13.5	13.1
2012	8589	156	17.6	13.8	13.2	12.8



2012 TRAFFIC DATA

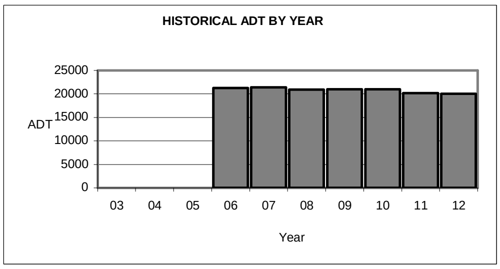
	Average Weekday Traffic	**Percent of ADT**	**Average Daily Traffic**	**Percent of ADT**
January	6057	71	5913	69
February	6622	77	6544	76
March	7704	90	7952	93
April	8094	94	8283	96
May	8893	104	8981	105
June	9812	114	10180	119
July	10441	122	11020	128
August	10621	124	11085	129
September	9605	112	9658	112
October	8592	100	8799	102
November	7868	92	8018	93
December	6531	76	6633	77

Classification Breakdown	**Percent of ADT**
Motorcyles	0.15
Passenger cars	36.46
Light Trucks	14.62
Buses	0.28
Single unit trucks (2 axles)	1.54
Single unit trucks (3 axles)	0.53
Single unit trucks (4 or more axles)	0.00
Single trailer trucks (4 or less axles)	1.53
Single trailer trucks (5 axles)	34.62
Single trailer trucks (6 or more axles)	4.90
Multi trailer trucks (5 or less axles)	0.46
Multi trailer trucks (6 axles)	1.17
Multi trailer trucks (7 or more axles)	3.74

Location:	US26; MP 56.23; SUNSET HIGHWAY NO. 47; 0.93 mile northwest of North Plains (Glencoe Road) Interchange	**Site Name:**	North Plains (34-007)
		Installed:	June, 2005

HISTORICAL TRAFFIC DATA

				Percent of ADT		
Year	**ADT**	**Max Day**	**Max Hour**	**10TH Hour**	**20TH Hour**	**30TH Hour**
2003	***	***	***	***	***	***
2004	***	***	***	***	***	***
2005	***	***	***	***	***	***
2006	21274	182	15.0	13.9	13.3	12.9
2007	21394	160	14.9	13.5	13.0	12.7
2008	20927	190	16.1	14.4	13.5	13.3
2009	21017	181	16.2	14.7	14.0	13.6
2010	21010	195	16.5	15.0	13.6	13.4
2011	20135	191	17.2	15.6	14.8	14.3
2012	20051	***	***	***	***	***



2012 TRAFFIC DATA

	Average Weekday Traffic	**Percent of ADT**	**Average Daily Traffic**	**Percent of ADT**
January	14048	70	14811	74
February	16195	81	17030	85
March	15814	79	16927	84
April	16962	85	19222	96
May	18761	94	21479	107
June	20020	100	21619	108
July	23899	119	26439	132
August	24201	121	28299	141
September	20922	104	23334	116
October	17973	90	19117	95
November	16567	83	17100	85
December	14470	72	15234	76

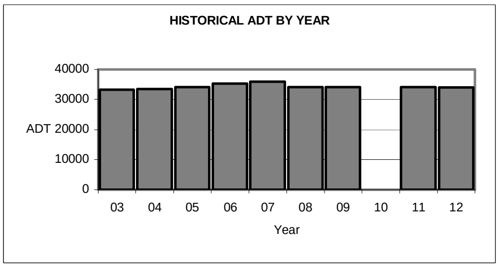
Classification Breakdown	**Percent of ADT**
Motorcycles	0.11
Passenger cars	60.55
Light Trucks	32.66
Buses	0.18
Single unit trucks (2 axles)	2.31
Single unit trucks (3 axles)	0.75
Single unit trucks (4 or more axles)	0.08
Single trailer trucks (4 or less axles)	0.22
Single trailer trucks (5 axles)	1.41
Single trailer trucks (6 or more axles)	1.06
Multi trailer trucks (5 or less axles)	0.02
Multi trailer trucks (6 axles)	0.06
Multi trailer trucks (7 or more axles)	0.59

Location: OR99W/OR219 MP 21.81; PACIFIC HIGHWAY WEST NO. 91; 0.01 mile west of Brutscher Street

Site Name: Newberg (36-004)
Installed: December, 1969

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	33269	121	9.3	9.0	8.9	8.8
2004	33463	122	9.3	9.0	8.9	8.8
2005	34128	121	9.3	8.9	8.8	8.8
2006	35302	122	8.9	8.8	8.8	8.7
2007	35985	120	8.9	8.7	8.7	8.6
2008	34049	122	9.2	8.9	8.9	8.8
2009	34060	***	***	***	***	***
2010	***	***	***	***	***	***
2011	34083	120	9.6	9.0	8.9	8.8
2012	33969	122	9.0	8.8	8.7	8.7



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	31633	93	30482	90
February	34000	100	33300	98
March	33700	99	33000	97
April	35061	103	34568	102
May	34429	101	34533	102
June	35772	105	35146	103
July	36560	108	35996	106
August	37430	110	36833	108
September	35510	105	35244	104
October	34589	102	33793	99
November	33753	99	32689	96
December	32850	97	32047	94

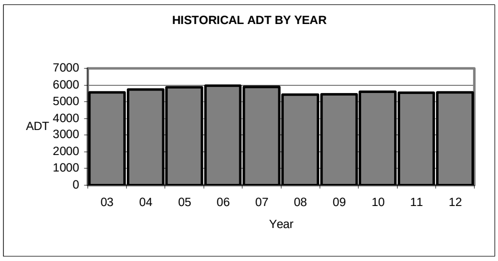
Classification Breakdown	Percent of ADT
Motorcyles	0.67
Passenger cars	74.57
Light Trucks	19.34
Buses	0.38
Single unit trucks (2 axles)	2.40
Single unit trucks (3 axles)	0.35
Single unit trucks (4 or more axles)	0.04
Single trailer trucks (4 or less axles)	0.35
Single trailer trucks (5 axles)	1.50
Single trailer trucks (6 or more axles)	0.33
Multi trailer trucks (5 or less axles)	0.01
Multi trailer trucks (6 axles)	0.00
Multi trailer trucks (7 or more axles)	0.06

Location: OR99W; MP 47.45; PACIFIC HIGHWAY WEST NO. 91; 0.07 mile north of Yamhill-Polk County Line

Site Name: Amity (36-005)
Installed: September, 1956

HISTORICAL TRAFFIC DATA

		Percent of ADT				
Year	ADT	Max Day	Max Hour	10TH Hour	20TH Hour	30TH Hour
2003	5571	140	13.2	11.5	11.0	10.9
2004	5731	132	13.3	11.4	11.1	10.9
2005	5858	***	***	***	***	***
2006	5957	137	13.2	11.5	11.1	10.7
2007	5874	132	13.2	11.3	10.9	10.7
2008	5433	131	12.9	11.8	11.2	11.0
2009	5452	132	14.5	11.8	11.3	11.0
2010	5594	135	14.7	11.8	11.2	11.0
2011	5553	135	14.5	11.8	11.3	11.1
2012	5556	133	14.6	11.8	11.6	11.4



2012 TRAFFIC DATA

	Average Weekday Traffic	Percent of ADT	Average Daily Traffic	Percent of ADT
January	5004	90	4820	87
February	5524	99	5365	97
March	5330	96	5205	94
April	5688	102	5650	102
May	5869	106	5869	106
June	5977	108	5897	106
July	5901	106	5775	104
August	6017	108	5906	106
September	5789	104	5799	104
October	5931	107	5881	106
November	5709	103	5595	101
December	5090	92	4905	88

Classification Breakdown	Percent of ADT
Motorcyles	0.67
Passenger cars	60.93
Light Trucks	31.34
Buses	0.29
Single unit trucks (2 axles)	2.81
Single unit trucks (3 axles)	0.74
Single unit trucks (4 or more axles)	0.10
Single trailer trucks (4 or less axles)	0.36
Single trailer trucks (5 axles)	1.38
Single trailer trucks (6 or more axles)	0.89
Multi trailer trucks (5 or less axles)	0.02
Multi trailer trucks (6 axles)	0.01
Multi trailer trucks (7 or more axles)	0.46

GLOSSARY

AADT: Annual Average Daily Traffic - The total traffic for the year divided by 365 (or 366 in a leap year). In most cases, the AADT is obtained by adjusting a 48-hour traffic count by applying four factors. The first two factors are seasonal and day of week factors, which account for temporal variations in traffic. They are developed from permanent traffic recording stations. The third factor is an axle factor, which is used to account for vehicles with more than two axles. This factor is obtained from vehicle classification counts. For counts not taken during the latest data year, the fourth factor is a growth factor.

ATR: Automatic Traffic Recorder – a permanently installed, continuous counting device. Includes AVC and WIM sites.

AVC: Automatic Vehicle Classifier – a permanently installed, continuous counting and classification device.

FHWA: Federal Highway Administration.

VMT: Vehicle Miles of Travel (or Vehicle Miles Traveled) – the sum of distances traveled by all motor vehicles in a specified system of highways for a given period of time.

WIM: Weigh-In-Motion – a permanently installed device for weighing vehicles in the traveled lanes.

In section I, an asterisk (*), appearing to the left of a count location description, indicates the location of an automatic traffic recorder station.

Asterisks (***), appearing in Section II, under "Historical Traffic Data", indicates recorder was inoperative during those time periods or data is unrepresentative.

Prefixes to Milepoints

T: Temporary Mileage – Mileage on a temporary traveled route, usually due to a detour or highway under construction.

Z: Overlapping Mileage – When a road is lengthened in the middle due to realignment, Z-mileage is created.

APPENDIX C

STUDDED TIRES USAGE RATES BY MONTH AND YEAR

Wear rates for the 5 Regions by Month and Year

Region 1	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1995	0.02	0.082	0.133	0.144	0.146	0.113	0.027
1996	0.019263	0.078947	0.127842	0.138316	0.140158	0.108632	0.026263
1997	0.018526	0.075895	0.122684	0.132632	0.134316	0.104263	0.025526
1998	0.017789	0.072842	0.117526	0.126947	0.128474	0.099895	0.024789
1999	0.017053	0.069789	0.112368	0.121263	0.122632	0.095526	0.024053
2000	0.016316	0.066737	0.107211	0.115579	0.116789	0.091158	0.023316
2001	0.015579	0.063684	0.102053	0.109895	0.110947	0.086789	0.022579
2002	0.014842	0.060632	0.096895	0.104211	0.105105	0.082421	0.021842
2003	0.014105	0.057579	0.091737	0.098526	0.099263	0.078053	0.021105
2004	0.013368	0.054526	0.086579	0.092842	0.093421	0.073684	0.020368
2005	0.012632	0.051474	0.081421	0.087158	0.087579	0.069316	0.019632
2006	0.011895	0.048421	0.076263	0.081474	0.081737	0.064947	0.018895
2007	0.011158	0.045368	0.071105	0.075789	0.075895	0.060579	0.018158
2008	0.010421	0.042316	0.065947	0.070105	0.070053	0.056211	0.017421
2009	0.009684	0.039263	0.060789	0.064421	0.064211	0.051842	0.016684
2010	0.008947	0.036211	0.055632	0.058737	0.058368	0.047474	0.015947
2011	0.008211	0.033158	0.050474	0.053053	0.052526	0.043105	0.015211
2012	0.007474	0.030105	0.045316	0.047368	0.046684	0.038737	0.014474
2013	0.006737	0.027053	0.040158	0.041684	0.040842	0.034368	0.013737
2014	0.006	0.024	0.035	0.036	0.035	0.03	0.013
Per year change	-0.00074	-0.00305	-0.00516	-0.00568	-0.00584	-0.00437	-0.00074

Region 2	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1995	0.005	0.077	0.105	0.107	0.111	0.092	0.02
1996	0.004789	0.073737	0.101105	0.103	0.106368	0.088368	0.019789
1997	0.004579	0.070474	0.097211	0.099	0.101737	0.084737	0.019579
1998	0.004368	0.067211	0.093316	0.095	0.097105	0.081105	0.019368
1999	0.004158	0.063947	0.089421	0.091	0.092474	0.077474	0.019158
2000	0.003947	0.060684	0.085526	0.087	0.087842	0.073842	0.018947
2001	0.003737	0.057421	0.081632	0.083	0.083211	0.070211	0.018737
2002	0.003526	0.054158	0.077737	0.079	0.078579	0.066579	0.018526
2003	0.003316	0.050895	0.073842	0.075	0.073947	0.062947	0.018316
2004	0.003105	0.047632	0.069947	0.071	0.069316	0.059316	0.018105
2005	0.002895	0.044368	0.066053	0.067	0.064684	0.055684	0.017895
2006	0.002684	0.041105	0.062158	0.063	0.060053	0.052053	0.017684
2007	0.002474	0.037842	0.058263	0.059	0.055421	0.048421	0.017474
2008	0.002263	0.034579	0.054368	0.055	0.050789	0.044789	0.017263
2009	0.002053	0.031316	0.050474	0.051	0.046158	0.041158	0.017053
2010	0.001842	0.028053	0.046579	0.047	0.041526	0.037526	0.016842
2011	0.001632	0.024789	0.042684	0.043	0.036895	0.033895	0.016632
2012	0.001421	0.021526	0.038789	0.039	0.032263	0.030263	0.016421
2013	0.001211	0.018263	0.034895	0.035	0.027632	0.026632	0.016211
2014	0.001	0.015	0.031	0.031	0.023	0.023	0.016

Per year change	-0.00021	-0.00326	-0.00389	-0.004	-0.00463	-0.00363	-0.00021

Region 3	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1995	0.006	0.035	0.047	0.044	0.039	0.037	0.01
1996	0.005895	0.033789	0.045368	0.042632	0.037895	0.036	0.009895
1997	0.005789	0.032579	0.043737	0.041263	0.036789	0.035	0.009789
1998	0.005684	0.031368	0.042105	0.039895	0.035684	0.034	0.009684
1999	0.005579	0.030158	0.040474	0.038526	0.034579	0.033	0.009579
2000	0.005474	0.028947	0.038842	0.037158	0.033474	0.032	0.009474
2001	0.005368	0.027737	0.037211	0.035789	0.032368	0.031	0.009368
2002	0.005263	0.026526	0.035579	0.034421	0.031263	0.03	0.009263
2003	0.005158	0.025316	0.033947	0.033053	0.030158	0.029	0.009158
2004	0.005053	0.024105	0.032316	0.031684	0.029053	0.028	0.009053
2005	0.004947	0.022895	0.030684	0.030316	0.027947	0.027	0.008947
2006	0.004842	0.021684	0.029053	0.028947	0.026842	0.026	0.008842
2007	0.004737	0.020474	0.027421	0.027579	0.025737	0.025	0.008737
2008	0.004632	0.019263	0.025789	0.026211	0.024632	0.024	0.008632
2009	0.004526	0.018053	0.024158	0.024842	0.023526	0.023	0.008526
2010	0.004421	0.016842	0.022526	0.023474	0.022421	0.022	0.008421
2011	0.004316	0.015632	0.020895	0.022105	0.021316	0.021	0.008316
2012	0.004211	0.014421	0.019263	0.020737	0.020211	0.02	0.008211
2013	0.004105	0.013211	0.017632	0.019368	0.019105	0.019	0.008105
2014	0.004	0.012	0.016	0.018	0.018	0.018	0.008
Per year change	-0.00011	-0.00121	-0.00163	-0.00137	-0.00111	-0.001	-0.00011

Region 4	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1995	0.035	0.247	0.3	0.302	0.296	0.255	0.108
1996	0.034158	0.240316	0.292842	0.295632	0.289947	0.250947	0.107158
1997	0.033316	0.233632	0.285684	0.289263	0.283895	0.246895	0.106316
1998	0.032474	0.226947	0.278526	0.282895	0.277842	0.242842	0.105474
1999	0.031632	0.220263	0.271368	0.276526	0.271789	0.238789	0.104632
2000	0.030789	0.213579	0.264211	0.270158	0.265737	0.234737	0.103789
2001	0.029947	0.206895	0.257053	0.263789	0.259684	0.230684	0.102947
2002	0.029105	0.200211	0.249895	0.257421	0.253632	0.226632	0.102105
2003	0.028263	0.193526	0.242737	0.251053	0.247579	0.222579	0.101263
2004	0.027421	0.186842	0.235579	0.244684	0.241526	0.218526	0.100421
2005	0.026579	0.180158	0.228421	0.238316	0.235474	0.214474	0.099579
2006	0.025737	0.173474	0.221263	0.231947	0.229421	0.210421	0.098737
2007	0.024895	0.166789	0.214105	0.225579	0.223368	0.206368	0.097895
2008	0.024053	0.160105	0.206947	0.219211	0.217316	0.202316	0.097053
2009	0.023211	0.153421	0.199789	0.212842	0.211263	0.198263	0.096211
2010	0.022368	0.146737	0.192632	0.206474	0.205211	0.194211	0.095368
2011	0.021526	0.140053	0.185474	0.200105	0.199158	0.190158	0.094526
2012	0.020684	0.133368	0.178316	0.193737	0.193105	0.186105	0.093684
2013	0.019842	0.126684	0.171158	0.187368	0.187053	0.182053	0.092842
2014	0.019	0.12	0.164	0.181	0.181	0.178	0.092
Per year change	-0.00084	-0.00668	-0.00716	-0.00637	-0.00605	-0.00405	-0.00084

Region 5	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1995	0.012	0.204	0.252	0.245	0.232	0.18	0.065
1996	0.011632	0.199053	0.246053	0.239895	0.227842	0.177842	0.065368
1997	0.011263	0.194105	0.240105	0.234789	0.223684	0.175684	0.065737
1998	0.010895	0.189158	0.234158	0.229684	0.219526	0.173526	0.066105
1999	0.010526	0.184211	0.228211	0.224579	0.215368	0.171368	0.066474
2000	0.010158	0.179263	0.222263	0.219474	0.211211	0.169211	0.066842
2001	0.009789	0.174316	0.216316	0.214368	0.207053	0.167053	0.067211
2002	0.009421	0.169368	0.210368	0.209263	0.202895	0.164895	0.067579
2003	0.009053	0.164421	0.204421	0.204158	0.198737	0.162737	0.067947
2004	0.008684	0.159474	0.198474	0.199053	0.194579	0.160579	0.068316
2005	0.008316	0.154526	0.192526	0.193947	0.190421	0.158421	0.068684
2006	0.007947	0.149579	0.186579	0.188842	0.186263	0.156263	0.069053
2007	0.007579	0.144632	0.180632	0.183737	0.182105	0.154105	0.069421
2008	0.007211	0.139684	0.174684	0.178632	0.177947	0.151947	0.069789
2009	0.006842	0.134737	0.168737	0.173526	0.173789	0.149789	0.070158
2010	0.006474	0.129789	0.162789	0.168421	0.169632	0.147632	0.070526
2011	0.006105	0.124842	0.156842	0.163316	0.165474	0.145474	0.070895
2012	0.005737	0.119895	0.150895	0.158211	0.161316	0.143316	0.071263
2013	0.005368	0.114947	0.144947	0.153105	0.157158	0.141158	0.071632
2014	0.005	0.11	0.139	0.148	0.153	0.139	0.072
Per year change	0.000368	-0.00495	-0.00595	-0.00511	-0.00416	-0.00216	0.000368

APPENDIX D

EXAMPLES OF SPECIFIC CALCULATIONS OF STUDDED TIRE PASSES VS RUT DEPTH

Appendix: Examples of Specific Calculations of Studded Tire Passes vs Rut Depth

Region 1

OR 217

Linear Regression output from R

Call:
lm(formula = Rut_Depth ~ ST_Passes)

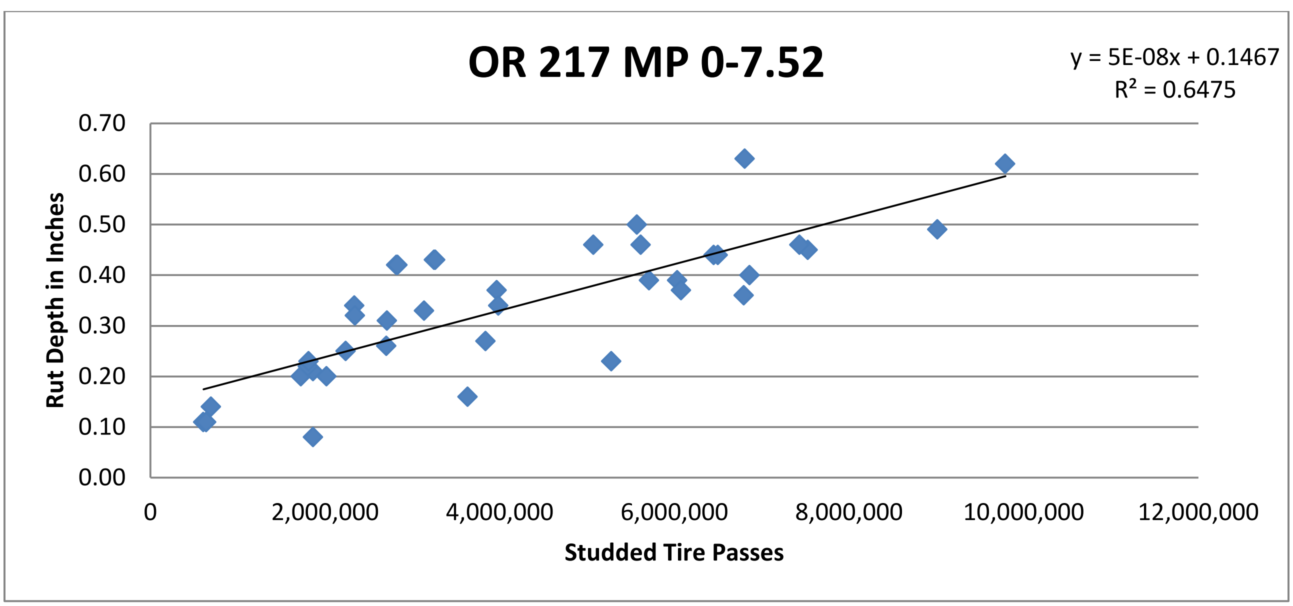
Residuals:

Min	1Q	Median	3Q	Max
-0.158598	-0.053244	-0.009951	0.045163	0.171291

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	1.467e-01	2.593e-02	5.657	1.68e-06 ***
ST_Passes	4.584e-08	5.486e-09	8.355	3.92e-10 ***

Residual standard error: 0.08276 on 38 degrees of freedom
Multiple R-squared: 0.6475, Adjusted R-squared: 0.6382
F-statistic: 69.8 on 1 and 38 DF, p-value: 3.924e-10



HWY			Road				Open or	Year	Year	Yearly	#	Lane		Seasonal Variation							Stud Use							ST-pass	Total ST	Rut
Num	BMP	EMP	Bed	Length	Reg	District	Dense	Con	Rut	ADT	lanes	Factor	ATR	Oct	Nov	Dec	Jan	Feb	Mar	April	Oct	Nove	Dec	Jan	Feb	Mar	April	for year	Passes	Depth
144	0.00	1.47	1	1.47	1	02B	O	1996	1997	89,202	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.85%	7.59%	12.27%	13.26%	13.43%	10.43%	2.55%	878,335	1,862,900	0.08
144	0.00	1.47	1	1.47	1	02B	O	1996	1999	96,141	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.71%	6.98%	11.24%	12.13%	12.26%	9.55%	2.41%	867,689	3,631,476	0.16
144	0.00	1.47	1	1.47	1	02B	O	1996	2001	98,735	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.56%	6.37%	10.21%	10.99%	11.09%	8.68%	2.26%	809,993	5,277,516	0.23
144	0.00	1.47	1	1.47	1	02B	O	1996	2003	99,373	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.41%	5.76%	9.17%	9.85%	9.93%	7.81%	2.11%	733,601	6,795,209	0.36
144	0.00	1.47	1	1.47	1	02B	O	1996	2004	105,084	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.34%	5.45%	8.66%	9.28%	9.34%	7.37%	2.04%	732,600	7,527,809	0.45
144	0.00	1.47	1	1.47	1	02B	O	2006	2006	98,917	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.19%	4.84%	7.63%	8.15%	8.17%	6.49%	1.89%	608,352	608,352	0.11
144	0.00	1.47	1	1.47	1	02B	O	2006	2008	102,814	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.04%	4.23%	6.59%	7.01%	7.01%	5.62%	1.74%	547,867	1,725,792	0.20
144	0.00	1.47	1	1.47	1	02B	O	2006	2009	103,615	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.97%	3.93%	6.08%	6.44%	6.42%	5.18%	1.67%	509,578	2,235,370	0.25
144	0.00	1.47	1	1.47	1	02B	O	2006	2010	105,382	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.89%	3.62%	5.56%	5.87%	5.84%	4.75%	1.59%	474,986	2,710,356	0.31
144	0.00	1.47	1	1.47	1	02B	O	2006	2011	103,906	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.82%	3.32%	5.05%	5.31%	5.25%	4.31%	1.52%	425,656	3,136,012	0.33
144	1.47	6.69	1	5.22	1	02B	O	1994	1995	88,811	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	2.00%	8.20%	13.30%	14.40%	14.60%	11.30%	2.70%	947,440	1,863,327	0.21
144	1.47	6.69	1	5.22	1	02B	O	1994	1997	96,508	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.85%	7.59%	12.27%	13.26%	13.43%	10.43%	2.55%	950,275	3,836,954	0.27
144	1.47	6.69	1	5.22	1	02B	O	1994	1999	102,445	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.71%	6.98%	11.24%	12.13%	12.26%	9.55%	2.41%	924,581	5,709,790	0.39
144	1.47	6.69	1	5.22	1	02B	O	1994	2001	101,848	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.56%	6.37%	10.21%	10.99%	11.09%	8.68%	2.26%	835,535	7,431,322	0.46
144	1.47	6.69	1	5.22	1	02B	O	1994	2003	104,483	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.41%	5.76%	9.17%	9.85%	9.93%	7.81%	2.11%	771,326	9,010,430	0.49
144	1.47	6.69	1	5.22	1	02B	O	1994	2004	111,788	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.34%	5.45%	8.66%	9.28%	9.34%	7.37%	2.04%	779,342	9,789,771	0.62
144	1.47	6.69	1	5.22	1	02B	O	2006	2006	103,818	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.19%	4.84%	7.63%	8.15%	8.17%	6.49%	1.89%	638,496	638,496	0.11
144	1.47	6.69	1	5.22	1	02B	O	2006	2008	106,672	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.04%	4.23%	6.59%	7.01%	7.01%	5.62%	1.74%	568,426	1,804,422	0.22
144	1.47	6.69	1	5.22	1	02B	O	2006	2009	107,734	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.97%	3.93%	6.08%	6.44%	6.42%	5.18%	1.67%	529,833	2,334,256	0.34
144	1.47	6.69	1	5.22	1	02B	O	2006	2010	107,131	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.89%	3.62%	5.56%	5.87%	5.84%	4.75%	1.59%	482,868	2,817,124	0.42
144	1.47	6.69	1	5.22	1	02B	O	2006	2011	105,312	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.82%	3.32%	5.05%	5.31%	5.25%	4.31%	1.52%	431,417	3,248,541	0.43
144	1.47	6.39	2	4.92	1	02B	O	2006	2006	104,213	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.19%	4.84%	7.63%	8.15%	8.17%	6.49%	1.89%	640,923	640,923	0.11
144	1.47	6.39	2	4.92	1	02B	O	2006	2008	107,217	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.04%	4.23%	6.59%	7.01%	7.01%	5.62%	1.74%	571,329	1,812,381	0.23
144	1.47	6.39	2	4.92	1	02B	O	2006	2009	108,274	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.97%	3.93%	6.08%	6.44%	6.42%	5.18%	1.67%	532,489	2,344,870	0.32
144	1.47	6.39	2	4.92	1	02B	O	2006	2010	107,582	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.89%	3.62%	5.56%	5.87%	5.84%	4.75%	1.59%	484,900	2,829,770	0.42
144	1.47	6.39	2	4.92	1	02B	O	2006	2011	105,678	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.82%	3.32%	5.05%	5.31%	5.25%	4.31%	1.52%	432,913	3,262,683	0.43
144	6.39	7.34	2	0.95	1	02B	O	2001	2006	100,708	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.19%	4.84%	7.63%	8.15%	8.17%	6.49%	1.89%	619,369	3,965,142	0.37
144	6.39	7.34	2	0.95	1	02B	O	2001	2008	100,344	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.04%	4.23%	6.59%	7.01%	7.01%	5.62%	1.74%	534,701	5,073,685	0.46
144	6.39	7.34	2	0.95	1	02B	O	2001	2009	101,487	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.97%	3.93%	6.08%	6.44%	6.42%	5.18%	1.67%	499,110	5,572,795	0.50
144	6.39	7.34	2	0.95	1	02B	O	2001	2010	101,888	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.89%	3.62%	5.56%	5.87%	5.84%	4.75%	1.59%	459,238	6,032,033	0.39
144	6.39	7.34	2	0.95	1	02B	O	2001	2011	101,868	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.82%	3.32%	5.05%	5.31%	5.25%	4.31%	1.52%	417,306	6,449,340	0.44
144	6.39	7.34	2	0.95	1	02B	O	2001	2012	97,077	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.75%	3.01%	4.53%	4.74%	4.67%	3.87%	1.45%	357,807	6,807,146	0.63
144	6.69	7.52	1	0.83	1	02B	O	2001	2001	84,640	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.56%	6.37%	10.21%	10.99%	11.09%	8.68%	2.26%	694,365	694,365	0.14
144	6.69	7.52	1	0.83	1	02B	O	2001	2003	88,227	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.41%	5.76%	9.17%	9.85%	9.93%	7.81%	2.11%	651,318	2,018,182	0.20
144	6.69	7.52	1	0.83	1	02B	O	2001	2004	97,926	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.34%	5.45%	8.66%	9.28%	9.34%	7.37%	2.04%	682,699	2,700,881	0.26
144	6.69	7.52	1	0.83	1	02B	O	2001	2006	102,259	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	1.19%	4.84%	7.63%	8.15%	8.17%	6.49%	1.89%	628,907	3,984,904	0.34
144	6.69	7.52	1	0.83	1	02B	O	2001	2009	102,690	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.97%	3.93%	6.08%	6.44%	6.42%	5.18%	1.67%	505,028	5,613,866	0.46
144	6.69	7.52	1	0.83	1	02B	O	2001	2010	102,881	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.89%	3.62%	5.56%	5.87%	5.84%	4.75%	1.59%	463,712	6,077,578	0.37
144	6.69	7.52	1	0.83	1	02B	O	2001	2011	103,043	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.82%	3.32%	5.05%	5.31%	5.25%	4.31%	1.52%	422,120	6,499,698	0.44
144	6.69	7.52	1	0.83	1	02B	O	2001	2012	97,890	2	0.58	PSU	0.97	0.86	0.84	0.98	0.86	1.06	0.82	0.75%	3.01%	4.53%	4.74%	4.67%	3.87%	1.45%	360,805	6,860,503	0.40

Region 2

OR99W

Linear Regression output from R

Call:
lm(formula = Rut_Depth ~ ST_Passes)

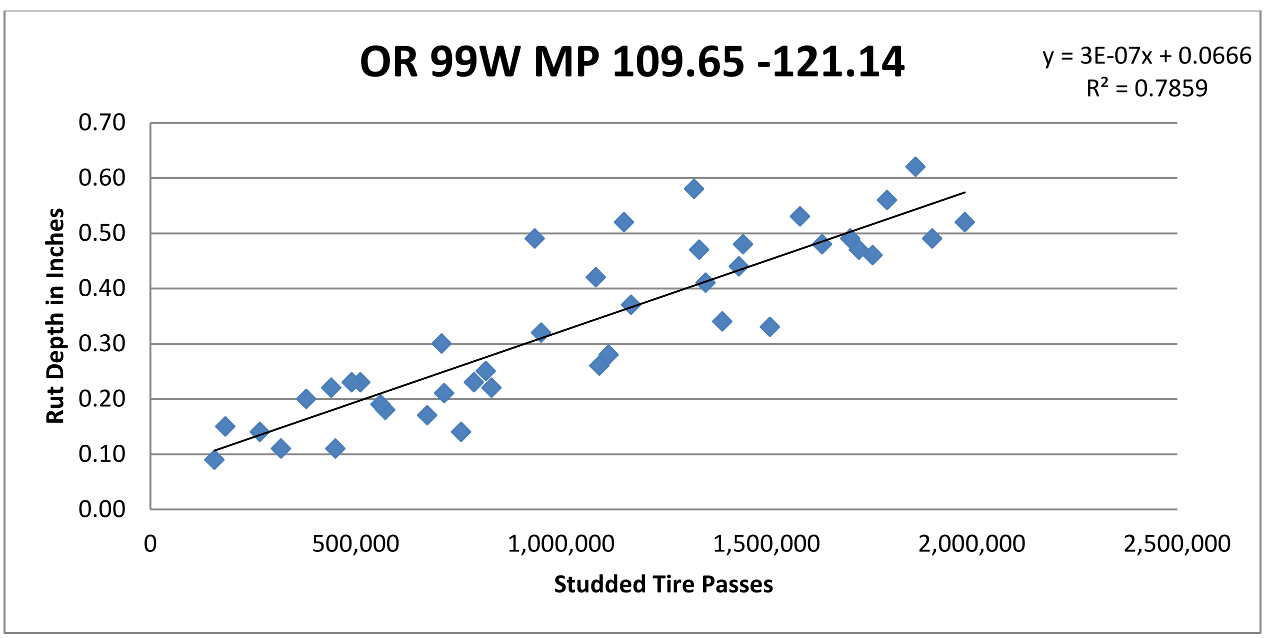
Residuals:

Min	1Q	Median	3Q	Max
-0.122616	-0.053980	-0.005213	0.037909	0.183875

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	6.662e-02	2.503e-02	2.662	0.0112 *
ST_Passes	2.558e-07	2.138e-08	11.965	1.26e-14 ***

Residual standard error: 0.072 on 39 degrees of freedom
Multiple R-squared: 0.7859, Adjusted R-squared: 0.7804
F-statistic: 143.2 on 1 and 39 DF, p-value: 1.259e-14



HWY Num	BMP	EMP	Road Bed	Length	Reg	District	Open or Dense	Year Con	Year Rut	Yearly ADT	# lanes	Lane Factor	ATR	Seasonal Variation							Stud Use							ST-pass for year	Total ST Passes	Rut_Dept h
														Oct	Nov	Dec	Jan	Feb	Mar	April	Oct	Nove	Dec	Jan	Feb	Mar	April			
091	109.65	116.70	1	7.05	2	05	O	2000	2001	13,866	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.37%	5.74%	8.16%	8.30%	8.32%	7.02%	1.87%	83,323	156,626	0.09
091	109.65	116.70	1	7.05	2	05	O	2000	2003	14,812	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.33%	5.09%	7.38%	7.50%	7.39%	6.29%	1.83%	80,162	318,225	0.11
091	109.65	116.70	1	7.05	2	05	O	2000	2005	13,248	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.29%	4.44%	6.61%	6.70%	6.47%	5.57%	1.79%	63,790	450,845	0.11
091	109.65	116.70	1	7.05	2	05	O	2000	2006	13,444	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.27%	4.11%	6.22%	6.30%	6.01%	5.21%	1.77%	60,718	511,564	0.23
091	109.65	116.70	1	7.05	2	05	O	2000	2009	13,732	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.21%	3.13%	5.05%	5.10%	4.62%	4.12%	1.71%	49,718	674,093	0.17
091	109.65	116.70	1	7.05	2	05	O	2000	2010	12,536	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.18%	2.81%	4.66%	4.70%	4.15%	3.75%	1.68%	41,642	715,735	0.21
091	109.65	116.70	1	7.05	2	05	O	2000	2012	12,547	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.14%	2.15%	3.88%	3.90%	3.23%	3.03%	1.64%	34,186	787,853	0.23
091	116.70	117.04	1	0.34	2	05	O	1994	1995	12,946	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.50%	7.70%	10.50%	10.70%	11.10%	9.20%	2.00%	100,991	182,854	0.15
091	116.70	117.04	1	0.34	2	05	O	1994	1997	13,568	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.46%	7.05%	9.72%	9.90%	10.17%	8.47%	1.96%	97,738	379,754	0.20
091	116.70	117.04	1	0.34	2	05	O	1994	1999	14,192	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.42%	6.39%	8.94%	9.10%	9.25%	7.75%	1.92%	93,759	572,606	0.18
091	116.70	117.04	1	0.34	2	05	O	1994	2001	15,403	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.37%	5.74%	8.16%	8.30%	8.32%	7.02%	1.87%	92,562	756,802	0.14
091	116.70	117.04	1	0.34	2	05	O	1994	2003	16,510	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.33%	5.09%	7.38%	7.50%	7.39%	6.29%	1.83%	89,352	936,148	0.49
091	116.70	117.04	1	0.34	2	05	O	1994	2005	14,868	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.29%	4.44%	6.61%	6.70%	6.47%	5.57%	1.79%	71,586	1,085,271	0.42
091	116.70	117.04	1	0.34	2	05	O	1994	2006	15,184	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.27%	4.11%	6.22%	6.30%	6.01%	5.21%	1.77%	68,575	1,153,846	0.52
091	116.70	117.04	1	0.34	2	05	O	1994	2009	14,188	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.21%	3.13%	5.05%	5.10%	4.62%	4.12%	1.71%	51,368	1,324,472	0.58
091	117.04	118.35	1	1.31	2	05	O	1994	1995	18,816	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.50%	7.70%	10.50%	10.70%	11.10%	9.20%	2.00%	146,781	266,678	0.14
091	117.04	118.35	1	1.31	2	05	O	1994	1997	20,239	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.46%	7.05%	9.72%	9.90%	10.17%	8.47%	1.96%	145,795	560,448	0.19
091	117.04	118.35	1	1.31	2	05	O	1994	1999	21,103	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.42%	6.39%	8.94%	9.10%	9.25%	7.75%	1.92%	139,416	831,191	0.22
091	117.04	118.35	1	1.31	2	05	O	1994	2001	21,105	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.37%	5.74%	8.16%	8.30%	8.32%	7.02%	1.87%	126,829	1,093,638	0.26
091	117.04	118.35	1	1.31	2	05	O	1994	2003	22,229	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.33%	5.09%	7.38%	7.50%	7.39%	6.29%	1.83%	120,304	1,336,905	0.47
091	117.04	118.35	1	1.31	2	05	O	1994	2004	20,894	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.31%	4.76%	6.99%	7.10%	6.93%	5.93%	1.81%	106,844	1,443,750	0.48
091	117.04	118.35	1	1.31	2	05	O	1994	2006	20,826	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.27%	4.11%	6.22%	6.30%	6.01%	5.21%	1.77%	94,059	1,636,155	0.48
091	117.04	118.35	1	1.31	2	05	O	1994	2008	18,870	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.23%	3.46%	5.44%	5.50%	5.08%	4.48%	1.73%	73,954	1,794,002	0.56
091	117.04	118.35	1	1.31	2	05	O	1994	2009	19,129	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.21%	3.13%	5.05%	5.10%	4.62%	4.12%	1.71%	69,257	1,863,259	0.62
091	118.35	119.40	1	1.05	2	05	O	1992	1995	13,722	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.50%	7.70%	10.50%	10.70%	11.10%	9.20%	2.00%	107,047	440,510	0.22
091	118.35	119.40	1	1.05	2	05	O	1992	1997	19,022	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.46%	7.05%	9.72%	9.90%	10.17%	8.47%	1.96%	137,029	709,512	0.30
091	118.35	119.40	1	1.05	2	05	O	1992	1999	19,350	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.42%	6.39%	8.94%	9.10%	9.25%	7.75%	1.92%	127,835	951,703	0.32
091	118.35	119.40	1	1.05	2	05	O	1992	2001	15,819	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.37%	5.74%	8.16%	8.30%	8.32%	7.02%	1.87%	95,061	1,170,421	0.37
091	118.35	119.40	1	1.05	2	05	O	1992	2003	16,436	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.33%	5.09%	7.38%	7.50%	7.39%	6.29%	1.83%	88,952	1,352,162	0.41
091	118.35	119.40	1	1.05	2	05	O	1992	2004	15,901	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.31%	4.76%	6.99%	7.10%	6.93%	5.93%	1.81%	81,311	1,433,473	0.44
091	118.35	119.40	1	1.05	2	05	O	1992	2006	16,326	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.27%	4.11%	6.22%	6.30%	6.01%	5.21%	1.77%	73,734	1,581,711	0.53
091	118.35	119.40	1	1.05	2	05	O	1992	2008	14,723	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.23%	3.46%	5.44%	5.50%	5.08%	4.48%	1.73%	57,701	1,704,661	0.49
091	118.35	119.40	1	1.05	2	05	O	1992	2009	14,973	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.21%	3.13%	5.05%	5.10%	4.62%	4.12%	1.71%	54,208	1,758,869	0.46
091	119.40	121.14	1	1.74	2	05	O	1995	1997	23,060	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.46%	7.05%	9.72%	9.90%	10.17%	8.47%	1.96%	166,118	490,416	0.23
091	119.40	121.14	1	1.74	2	05	O	1995	1999	23,758	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.42%	6.39%	8.94%	9.10%	9.25%	7.75%	1.92%	156,956	816,792	0.25
091	119.40	121.14	1	1.74	2	05	O	1995	2001	24,550	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.37%	5.74%	8.16%	8.30%	8.32%	7.02%	1.87%	147,528	1,116,046	0.28
091	119.40	121.14	1	1.74	2	05	O	1995	2003	24,838	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.33%	5.09%	7.38%	7.50%	7.39%	6.29%	1.83%	134,426	1,392,536	0.34
091	119.40	121.14	1	1.74	2	05	O	1995	2004	22,725	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.31%	4.76%	6.99%	7.10%	6.93%	5.93%	1.81%	116,207	1,508,743	0.33
091	119.40	121.14	1	1.74	2	05	O	1995	2006	23,378	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.27%	4.11%	6.22%	6.30%	6.01%	5.21%	1.77%	105,583	1,725,105	0.47
091	119.40	121.14	1	1.74	2	05	O	1995	2008	21,432	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.23%	3.46%	5.44%	5.50%	5.08%	4.48%	1.73%	83,995	1,904,157	0.49
091	119.40	121.14	1	1.74	2	05	O	1995	2009	21,810	2	0.53	20-024	1.01	0.97	0.94	0.9	0.96	0.94	1.02	0.21%	3.13%	5.05%	5.10%	4.62%	4.12%	1.71%	78,965	1,983,122	0.52

Region 3

I-5

Linear Regression output from R

Call:
lm(formula = Rut_Depth ~ ST_Passes)

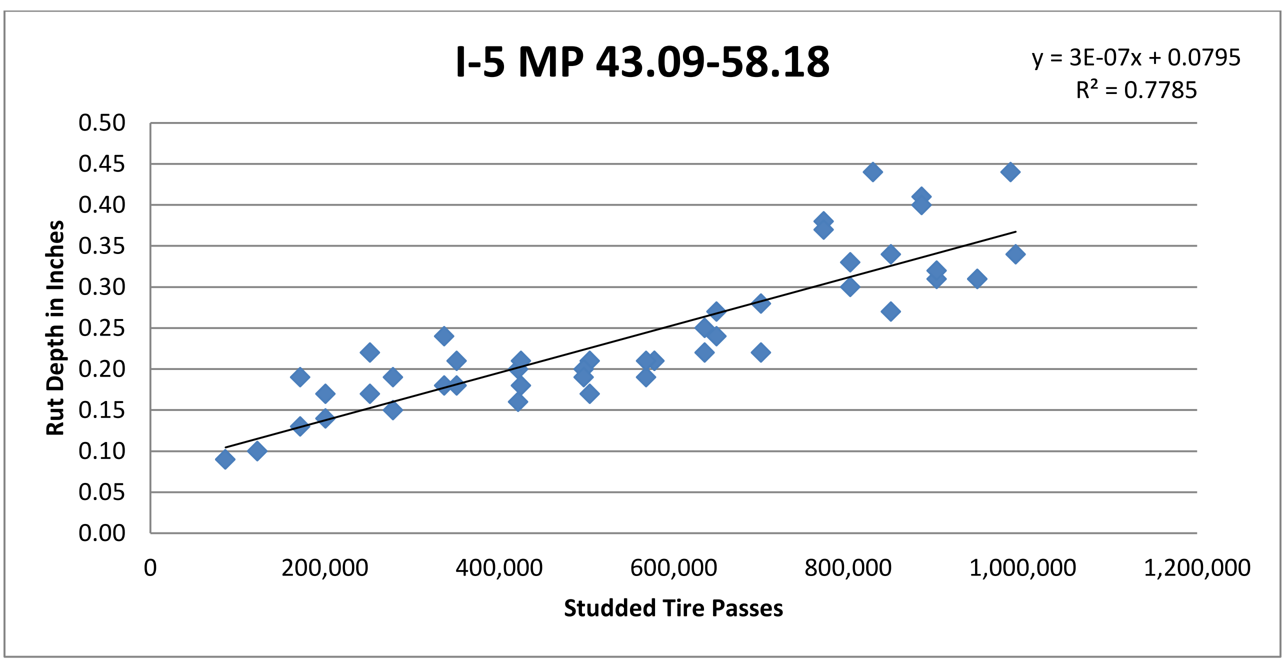
Residuals:

Min	1Q	Median	3Q	Max
-0.06277	-0.03120	-0.01247	0.01753	0.12000

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	7.948e-02	1.375e-02	5.781	5.77e-07 ***
ST_Passes	2.903e-07	2.259e-08	12.854	< 2e-16 ***

Residual standard error: 0.04304 on 47 degrees of freedom
Multiple R-squared: 0.7785, Adjusted R-squared: 0.7738
F-statistic: 165.2 on 1 and 47 DF, p-value: < 2.2e-16



HWY			Road				Open or	Year	Year	Yearly	#	Lane		Seasonal Variation							Stud Use							ST-pass	Total ST	Rut
Num	BMP	EMP	Bed	Length	Reg	District	Dense	Con	Rut	ADT	lanes	Factor	ATR	Oct	Nov	Dec	Jan	Feb	Mar	April	Oct	Nove	Dec	Jan	Feb	Mar	April	for year	Passes	Depth
001	43.09	49.07	1	5.98	3	08	O	1999	1999	25,405	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.56%	3.02%	4.05%	3.85%	3.46%	3.30%	0.96%	86,181	86,181	0.09
001	43.09	49.07	1	5.98	3	08	O	1999	2000	26,150	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.55%	2.89%	3.88%	3.72%	3.35%	3.20%	0.95%	85,695	171,876	0.13
001	43.09	49.07	1	5.98	3	08	O	1999	2001	25,276	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.54%	2.77%	3.72%	3.58%	3.24%	3.10%	0.94%	79,920	251,796	0.17
001	43.09	49.07	1	5.98	3	08	O	1999	2002	27,963	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.53%	2.65%	3.56%	3.44%	3.13%	3.00%	0.93%	85,195	336,991	0.18
001	43.09	49.07	1	5.98	3	08	O	1999	2003	28,888	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.52%	2.53%	3.39%	3.31%	3.02%	2.90%	0.92%	84,684	421,674	0.16
001	43.09	49.07	1	5.98	3	08	O	1999	2004	29,238	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.51%	2.41%	3.23%	3.17%	2.91%	2.80%	0.91%	82,342	504,016	0.17
001	43.09	49.07	1	5.98	3	08	O	1999	2005	27,420	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.49%	2.29%	3.07%	3.03%	2.79%	2.70%	0.89%	74,063	578,080	0.21
001	43.09	49.07	1	5.98	3	08	O	1999	2006	27,522	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.48%	2.17%	2.91%	2.89%	2.68%	2.60%	0.88%	71,167	649,246	0.27
001	43.09	49.07	1	5.98	3	08	O	1999	2008	23,725	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.46%	1.93%	2.58%	2.62%	2.46%	2.40%	0.86%	55,883	771,846	0.38
001	43.09	49.07	1	5.98	3	08	O	1999	2009	25,264	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.45%	1.81%	2.42%	2.48%	2.35%	2.30%	0.85%	56,597	828,443	0.44
001	43.09	49.07	1	5.98	3	08	O	1999	2010	26,208	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.44%	1.68%	2.25%	2.35%	2.24%	2.20%	0.84%	55,693	884,136	0.41
001	43.09	49.07	1	5.98	3	08	O	1999	2012	25,883	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.42%	1.44%	1.93%	2.07%	2.02%	2.00%	0.82%	49,038	986,223	0.44
001	43.09	49.07	2	5.98	3	08	O	1999	1999	25,405	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.56%	3.02%	4.05%	3.85%	3.46%	3.30%	0.96%	86,181	86,181	0.09
001	43.09	49.07	2	5.98	3	08	O	1999	2000	26,150	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.55%	2.89%	3.88%	3.72%	3.35%	3.20%	0.95%	85,695	171,876	0.19
001	43.09	49.07	2	5.98	3	08	O	1999	2001	25,276	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.54%	2.77%	3.72%	3.58%	3.24%	3.10%	0.94%	79,920	251,796	0.22
001	43.09	49.07	2	5.98	3	08	O	1999	2002	27,963	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.53%	2.65%	3.56%	3.44%	3.13%	3.00%	0.93%	85,195	336,991	0.24
001	43.09	49.07	2	5.98	3	08	O	1999	2003	28,888	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.52%	2.53%	3.39%	3.31%	3.02%	2.90%	0.92%	84,684	421,674	0.20
001	43.09	49.07	2	5.98	3	08	O	1999	2004	29,238	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.51%	2.41%	3.23%	3.17%	2.91%	2.80%	0.91%	82,342	504,016	0.21
001	43.09	49.07	2	5.98	3	08	O	1999	2005	27,420	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.49%	2.29%	3.07%	3.03%	2.79%	2.70%	0.89%	74,063	578,080	0.21
001	43.09	49.07	2	5.98	3	08	O	1999	2006	27,522	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.48%	2.17%	2.91%	2.89%	2.68%	2.60%	0.88%	71,167	649,246	0.24
001	43.09	49.07	2	5.98	3	08	O	1999	2008	23,725	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.46%	1.93%	2.58%	2.62%	2.46%	2.40%	0.86%	55,883	771,846	0.37
001	43.09	49.07	2	5.98	3	08	O	1999	2010	26,208	2	0.64	15-001	0.99	0.97	0.91	0.85	0.89	0.93	0.98	0.44%	1.68%	2.25%	2.35%	2.24%	2.20%	0.84%	55,693	884,136	0.40
001	49.07	58.18	1	9.11	3	08	O	1998	1998	36,025	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.57%	3.14%	4.21%	3.99%	3.57%	3.40%	0.97%	122,619	122,619	0.10
001	49.07	58.18	1	9.11	3	08	O	1998	1999	23,732	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.56%	3.02%	4.05%	3.85%	3.46%	3.30%	0.96%	78,126	200,744	0.14
001	49.07	58.18	1	9.11	3	08	O	1998	2000	24,346	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.55%	2.89%	3.88%	3.72%	3.35%	3.20%	0.95%	77,425	278,169	0.15
001	49.07	58.18	1	9.11	3	08	O	1998	2001	23,763	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.54%	2.77%	3.72%	3.58%	3.24%	3.10%	0.94%	72,915	351,084	0.18
001	49.07	58.18	1	9.11	3	08	O	1998	2002	25,024	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.53%	2.65%	3.56%	3.44%	3.13%	3.00%	0.93%	73,988	425,072	0.18
001	49.07	58.18	1	9.11	3	08	O	1998	2003	25,268	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.52%	2.53%	3.39%	3.31%	3.02%	2.90%	0.92%	71,885	496,957	0.20
001	49.07	58.18	1	9.11	3	08	O	1998	2004	26,084	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.51%	2.41%	3.23%	3.17%	2.91%	2.80%	0.91%	71,292	568,249	0.19
001	49.07	58.18	1	9.11	3	08	O	1998	2005	25,688	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.49%	2.29%	3.07%	3.03%	2.79%	2.70%	0.89%	67,338	635,587	0.22
001	49.07	58.18	1	9.11	3	08	O	1998	2006	25,746	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.48%	2.17%	2.91%	2.89%	2.68%	2.60%	0.88%	64,614	700,201	0.28
001	49.07	58.18	1	9.11	3	08	O	1998	2008	18,964	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.46%	1.93%	2.58%	2.62%	2.46%	2.40%	0.86%	43,354	802,517	0.30
001	49.07	58.18	1	9.11	3	08	O	1998	2009	21,481	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.45%	1.81%	2.42%	2.48%	2.35%	2.30%	0.85%	46,707	849,224	0.34
001	49.07	58.18	1	9.11	3	08	O	1998	2010	25,333	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.44%	1.68%	2.25%	2.35%	2.24%	2.20%	0.84%	52,252	901,476	0.31
001	49.07	58.18	1	9.11	3	08	O	1998	2011	23,927	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.43%	1.56%	2.09%	2.21%	2.13%	2.10%	0.83%	46,677	948,153	0.31
001	49.07	58.18	2	9.11	3	08	O	1998	1998	36,025	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.57%	3.14%	4.21%	3.99%	3.57%	3.40%	0.97%	122,619	122,619	0.10
001	49.07	58.18	2	9.11	3	08	O	1998	1999	23,732	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.56%	3.02%	4.05%	3.85%	3.46%	3.30%	0.96%	78,126	200,744	0.17
001	49.07	58.18	2	9.11	3	08	O	1998	2000	24,346	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.55%	2.89%	3.88%	3.72%	3.35%	3.20%	0.95%	77,425	278,169	0.19
001	49.07	58.18	2	9.11	3	08	O	1998	2001	23,763	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.54%	2.77%	3.72%	3.58%	3.24%	3.10%	0.94%	72,915	351,084	0.21
001	49.07	58.18	2	9.11	3	08	O	1998	2002	25,024	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.53%	2.65%	3.56%	3.44%	3.13%	3.00%	0.93%	73,988	425,072	0.21
001	49.07	58.18	2	9.11	3	08	O	1998	2003	25,268	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.52%	2.53%	3.39%	3.31%	3.02%	2.90%	0.92%	71,885	496,957	0.19
001	49.07	58.18	2	9.11	3	08	O	1998	2004	26,084	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.51%	2.41%	3.23%	3.17%	2.91%	2.80%	0.91%	71,292	568,249	0.21
001	49.07	58.18	2	9.11	3	08	O	1998	2005	25,688	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.49%	2.29%	3.07%	3.03%	2.79%	2.70%	0.89%	67,338	635,587	0.25
001	49.07	58.18	2	9.11	3	08	O	1998	2006	25,746	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.48%	2.17%	2.91%	2.89%	2.68%	2.60%	0.88%	64,614	700,201	0.22
001	49.07	58.18	2	9.11	3	08	O	1998	2008	18,964	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.46%	1.93%	2.58%	2.62%	2.46%	2.40%	0.86%	43,354	802,517	0.33
001	49.07	58.18	2	9.11	3	08	O	1998	2009	21,481	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.45%	1.81%	2.42%	2.48%	2.35%	2.30%	0.85%	46,707	849,224	0.27
001	49.07	58.18	2	9.11	3	08	O	1998	2010	25,333	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.44%	1.68%	2.25%	2.35%	2.24%	2.20%	0.84%	52,252	901,476	0.32
001	49.07	58.18	2	9.11	3	08	O	1998	2011	23,927	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.43%	1.56%	2.09%	2.21%	2.13%	2.10%	0.83%	46,677	948,153	0.31
001	49.07	58.18	2	9.11	3	08	O	1998	2012	23,818	2	0.64	17-001	0.96	0.98	0.88	0.79	0.84	0.93	0.97	0.42%	1.44%	1.93%	2.07%	2.02%	2.00%	0.82%	43,803	991,956	0.34

Region 4

US 97

Linear Regression output from R

Call:
lm(formula = Rut_Depth ~ ST_Passes)

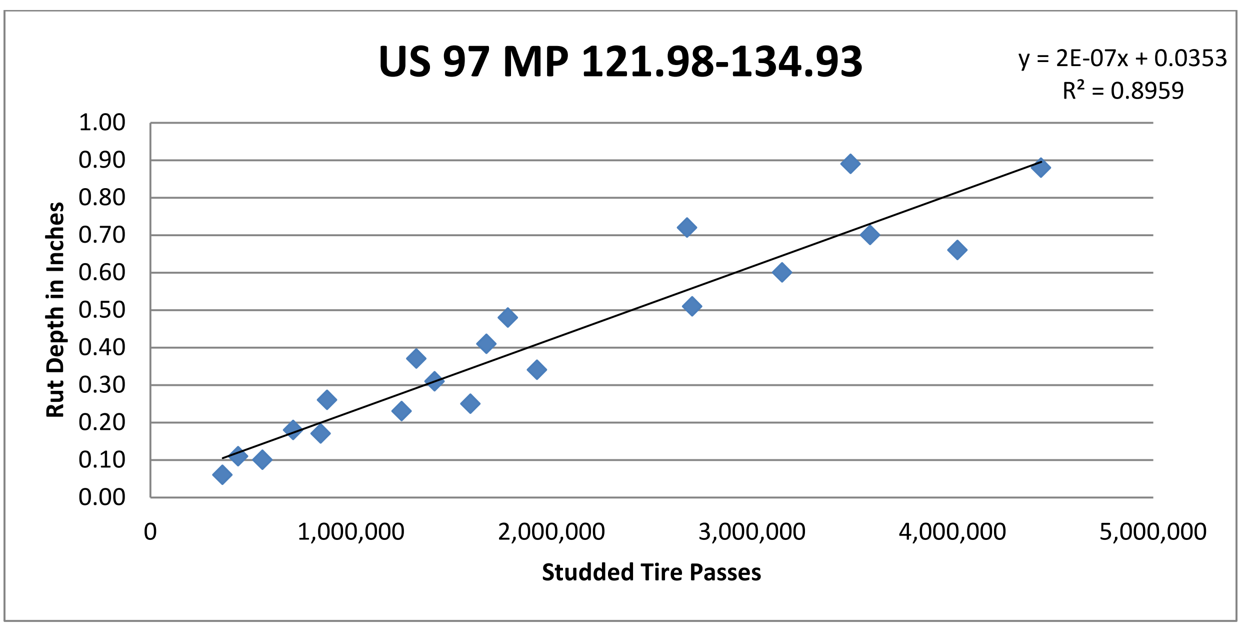
Residuals:

Min	1Q	Median	3Q	Max
-0.15451	-0.04607	-0.02263	0.05117	0.17868

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	3.528e-02	3.576e-02	0.987	0.337
ST_Passes	1.936e-07	1.556e-08	12.444	2.8e-10 ***

Residual standard error: 0.08541 on 18 degrees of freedom
Multiple R-squared: 0.8959, Adjusted R-squared: 0.8901
F-statistic: 154.9 on 1 and 18 DF, p-value: 2.804e-10



HWY			Road				Open or	Year	Year	Yearly	#	Lane		Seasonal Variation							Stud Use							ST-pass	Total ST	Rut
Num	BMP	EMP	Bed	Length	Reg	District	Dense	Con	Rut	ADT	lanes	Factor	ATR	Oct	Nov	Dec	Jan	Feb	Mar	April	Oct	Nove	Dec	Jan	Feb	Mar	April	for year	Passes	Depth
004	121.98	123.17	1	1.19	4	10	D	2008	2008	26,254	2	0.53	09-022	1.04	0.96	0.92	0.86	0.92	0.93	0.99	2.41%	16.01%	20.69%	21.92%	21.73%	20.23%	9.71%	437,552	437,552	0.11
004	121.98	123.17	1	1.19	4	10	D	2008	2009	25,476	2	0.53	09-022	1.04	0.96	0.92	0.86	0.92	0.93	0.99	2.32%	15.34%	19.98%	21.28%	21.13%	19.83%	9.62%	412,554	850,106	0.17
004	121.98	123.17	1	1.19	4	10	D	2008	2010	25,630	2	0.53	09-022	1.04	0.96	0.92	0.86	0.92	0.93	0.99	2.24%	14.67%	19.26%	20.65%	20.52%	19.42%	9.54%	402,941	1,253,048	0.23
004	121.98	123.17	1	1.19	4	10	D	2008	2011	22,557	2	0.53	09-022	1.04	0.96	0.92	0.86	0.92	0.93	0.99	2.15%	14.01%	18.55%	20.01%	19.92%	19.02%	9.45%	343,968	1,597,016	0.25
004	121.98	123.17	1	1.19	4	10	D	2008	2012	22,378	2	0.53	09-022	1.04	0.96	0.92	0.86	0.92	0.93	0.99	2.07%	13.34%	17.83%	19.37%	19.31%	18.61%	9.37%	330,671	1,927,687	0.34
004	123.17	132.67	1	9.50	4	10	D	2004	2004	24,935	2	0.64	09-022	1.04	0.96	0.92	0.86	0.92	0.93	0.99	2.74%	18.68%	23.56%	24.47%	24.15%	21.85%	10.04%	558,730	558,730	0.10
004	123.17	132.67	1	9.50	4	10	D	2004	2006	26,555	2	0.64	09-022	1.04	0.96	0.92	0.86	0.92	0.93	0.99	2.57%	17.35%	22.13%	23.19%	22.94%	21.04%	9.87%	564,728	1,675,704	0.41
004	123.17	132.67	1	9.50	4	10	D	2004	2008	23,652	2	0.64	09-022	1.04	0.96	0.92	0.86	0.92	0.93	0.99	2.41%	16.01%	20.69%	21.92%	21.73%	20.23%	9.71%	475,999	2,701,371	0.51
004	123.17	132.67	1	9.50	4	10	D	2004	2009	22,997	2	0.64	09-022	1.04	0.96	0.92	0.86	0.92	0.93	0.99	2.32%	15.34%	19.98%	21.28%	21.13%	19.83%	9.62%	449,702	3,151,073	0.60
004	123.17	132.67	1	9.50	4	10	D	2004	2010	23,111	2	0.64	09-022	1.04	0.96	0.92	0.86	0.92	0.93	0.99	2.24%	14.67%	19.26%	20.65%	20.52%	19.42%	9.54%	438,761	3,589,835	0.70
004	123.17	132.67	1	9.50	4	10	D	2004	2011	23,583	2	0.64	09-022	1.04	0.96	0.92	0.86	0.92	0.93	0.99	2.15%	14.01%	18.55%	20.01%	19.92%	19.02%	9.45%	434,269	4,024,104	0.66
004	123.17	132.67	1	9.50	4	10	D	2004	2012	23,404	2	0.64	09-022	1.04	0.96	0.92	0.86	0.92	0.93	0.99	2.07%	13.34%	17.83%	19.37%	19.31%	18.61%	9.37%	417,608	4,441,712	0.88
004	132.67	134.93	1	2.26	4	10	D	2001	2002	24,539	2	0.53	09-025	1.05	0.93	0.83	0.77	0.83	0.83	0.92	2.91%	20.02%	24.99%	25.74%	25.36%	22.66%	10.21%	437,655	881,882	0.26
004	132.67	134.93	1	2.26	4	10	D	2001	2003	25,579	2	0.53	09-025	1.05	0.93	0.83	0.77	0.83	0.83	0.92	2.83%	19.35%	24.27%	25.11%	24.76%	22.26%	10.13%	445,118	1,327,000	0.37
004	132.67	134.93	1	2.26	4	10	D	2001	2004	26,840	2	0.53	09-025	1.05	0.93	0.83	0.77	0.83	0.83	0.92	2.74%	18.68%	23.56%	24.47%	24.15%	21.85%	10.04%	455,415	1,782,415	0.48
004	132.67	134.93	1	2.26	4	10	D	2001	2006	28,141	2	0.53	09-025	1.05	0.93	0.83	0.77	0.83	0.83	0.92	2.57%	17.35%	22.13%	23.19%	22.94%	21.04%	9.87%	453,080	2,677,277	0.72
004	132.67	134.93	1	2.26	4	10	D	2001	2008	25,055	2	0.53	09-025	1.05	0.93	0.83	0.77	0.83	0.83	0.92	2.41%	16.01%	20.69%	21.92%	21.73%	20.23%	9.71%	381,672	3,491,202	0.89
004	132.67	134.93	1	2.26	4	10	D	2009	2009	24,361	2	0.53	09-025	1.05	0.93	0.83	0.77	0.83	0.83	0.92	2.32%	15.34%	19.98%	21.28%	21.13%	19.83%	9.62%	360,530	360,530	0.06
004	132.67	134.93	1	2.26	4	10	D	2009	2010	24,452	2	0.53	09-025	1.05	0.93	0.83	0.77	0.83	0.83	0.92	2.24%	14.67%	19.26%	20.65%	20.52%	19.42%	9.54%	351,267	711,796	0.18
004	132.67	134.93	1	2.26	4	10	D	2009	2012	25,754	2	0.53	09-025	1.05	0.93	0.83	0.77	0.83	0.83	0.92	2.07%	13.34%	17.83%	19.37%	19.31%	18.61%	9.37%	347,642	1,417,576	0.31

Region 5

I-84

Linear Regression output from R

Call:
lm(formula = Rut_Depth ~ ST_Passes)

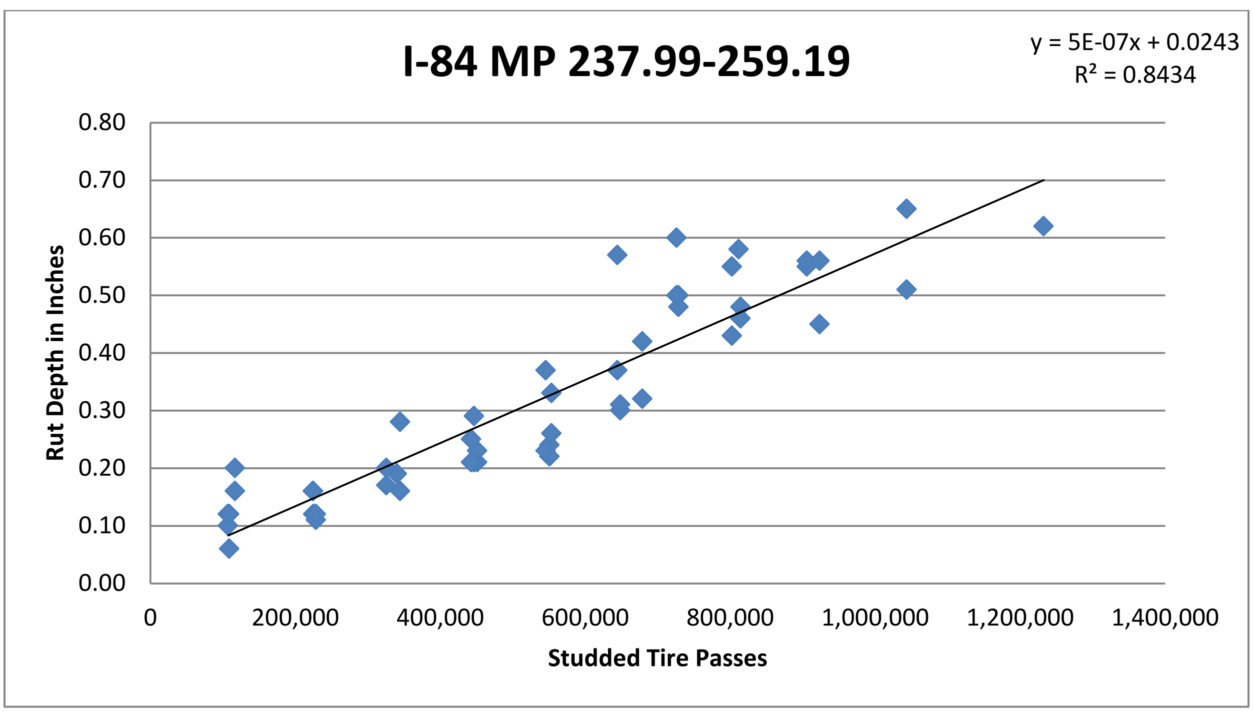
Residuals:

Min	1Q	Median	3Q	Max
-0.106175	-0.054229	-0.009157	0.037467	0.192422

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	2.433e-02	2.025e-02	1.202	0.235
ST_Passes	5.483e-07	3.341e-08	16.410	<2e-16 ***

Residual standard error: 0.0679 on 50 degrees of freedom
Multiple R-squared: 0.8434, Adjusted R-squared: 0.8403
F-statistic: 269.3 on 1 and 50 DF, p-value: < 2.2e-16



HWY			Road				Open or	Year	Year	Yearly	#	Lane		Seasonal Variation							Stud Use							ST-pass	Total ST	Rut
Num	BMP	EMP	Bed	Length	Reg	District	Dense	Con	Rut	ADT	lanes	Factor	ATR	Oct	Nov	Dec	Jan	Feb	Mar	April	Oct	Nove	Dec	Jan	Feb	Mar	April	for year	Passes	Depth
006	237.99	248.55	1	10.56	5	12	D	2002	2002	5,248	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.94%	16.94%	21.04%	20.93%	20.29%	16.49%	6.76%	107,214	107,214	0.12
006	237.99	248.55	1	10.56	5	12	D	2002	2003	5,887	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.91%	16.44%	20.44%	20.42%	19.87%	16.27%	6.79%	117,727	224,941	0.12
006	237.99	248.55	1	10.56	5	12	D	2002	2004	5,887	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.87%	15.95%	19.85%	19.91%	19.46%	16.06%	6.83%	115,192	340,133	0.19
006	237.99	248.55	1	10.56	5	12	D	2002	2005	5,800	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.83%	15.45%	19.25%	19.39%	19.04%	15.84%	6.87%	110,978	451,111	0.21
006	237.99	248.55	1	10.56	5	12	D	2002	2006	5,318	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.79%	14.96%	18.66%	18.88%	18.63%	15.63%	6.91%	99,443	550,554	0.22
006	237.99	248.55	1	10.56	5	12	D	2002	2007	5,346	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.76%	14.46%	18.06%	18.37%	18.21%	15.41%	6.94%	97,657	648,211	0.30
006	237.99	248.55	1	10.56	5	12	D	2002	2008	4,509	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.72%	13.97%	17.47%	17.86%	17.79%	15.19%	6.98%	80,419	728,630	0.50
006	237.99	248.55	1	10.56	5	12	D	2002	2009	4,919	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.68%	13.47%	16.87%	17.35%	17.38%	14.98%	7.02%	85,599	814,229	0.48
006	237.99	248.55	1	10.56	5	12	D	2002	2010	5,381	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.65%	12.98%	16.28%	16.84%	16.96%	14.76%	7.05%	91,310	905,540	0.55
006	237.99	248.55	2	10.56	5	12	D	2002	2002	5,248	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.94%	16.94%	21.04%	20.93%	20.29%	16.49%	6.76%	107,214	107,214	0.10
006	237.99	248.55	2	10.56	5	12	D	2002	2003	5,887	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.91%	16.44%	20.44%	20.42%	19.87%	16.27%	6.79%	117,727	224,941	0.12
006	237.99	248.55	2	10.56	5	12	D	2002	2004	5,887	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.87%	15.95%	19.85%	19.91%	19.46%	16.06%	6.83%	115,192	340,133	0.19
006	237.99	248.55	2	10.56	5	12	D	2002	2005	5,800	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.83%	15.45%	19.25%	19.39%	19.04%	15.84%	6.87%	110,978	451,111	0.23
006	237.99	248.55	2	10.56	5	12	D	2002	2006	5,318	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.79%	14.96%	18.66%	18.88%	18.63%	15.63%	6.91%	99,443	550,554	0.24
006	237.99	248.55	2	10.56	5	12	D	2002	2007	5,346	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.76%	14.46%	18.06%	18.37%	18.21%	15.41%	6.94%	97,657	648,211	0.31
006	237.99	248.55	2	10.56	5	12	D	2002	2008	4,509	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.72%	13.97%	17.47%	17.86%	17.79%	15.19%	6.98%	80,419	728,630	0.48
006	237.99	248.55	2	10.56	5	12	D	2002	2009	4,919	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.68%	13.47%	16.87%	17.35%	17.38%	14.98%	7.02%	85,599	814,229	0.46
006	237.99	248.55	2	10.56	5	12	D	2002	2010	5,381	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.65%	12.98%	16.28%	16.84%	16.96%	14.76%	7.05%	91,310	905,540	0.56
006	248.55	252.83	1	4.28	5	12	D	2002	2002	5,327	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.94%	16.94%	21.04%	20.93%	20.29%	16.49%	6.76%	108,837	108,837	0.06
006	248.55	252.83	1	4.28	5	12	D	2002	2003	5,975	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.91%	16.44%	20.44%	20.42%	19.87%	16.27%	6.79%	119,498	228,335	0.11
006	248.55	252.83	1	4.28	5	12	D	2002	2004	5,947	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.87%	15.95%	19.85%	19.91%	19.46%	16.06%	6.83%	116,347	344,682	0.16
006	248.55	252.83	1	4.28	5	12	D	2002	2005	5,329	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.83%	15.45%	19.25%	19.39%	19.04%	15.84%	6.87%	101,950	446,632	0.21
006	248.55	252.83	1	4.28	5	12	D	2002	2006	5,296	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.79%	14.96%	18.66%	18.88%	18.63%	15.63%	6.91%	99,035	545,667	0.23
006	248.55	252.83	1	4.28	5	12	D	2002	2007	5,400	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.76%	14.46%	18.06%	18.37%	18.21%	15.41%	6.94%	98,643	644,310	0.37
006	248.55	252.83	1	4.28	5	12	D	2002	2008	4,589	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.72%	13.97%	17.47%	17.86%	17.79%	15.19%	6.98%	81,842	726,153	0.50
006	248.55	252.83	2	4.28	5	12	D	2002	2002	5,327	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.94%	16.94%	21.04%	20.93%	20.29%	16.49%	6.76%	108,837	108,837	0.12
006	248.55	252.83	2	4.28	5	12	D	2002	2003	5,975	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.91%	16.44%	20.44%	20.42%	19.87%	16.27%	6.79%	119,498	228,335	0.12
006	248.55	252.83	2	4.28	5	12	D	2002	2004	5,947	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.87%	15.95%	19.85%	19.91%	19.46%	16.06%	6.83%	116,347	344,682	0.28
006	248.55	252.83	2	4.28	5	12	D	2002	2005	5,329	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.83%	15.45%	19.25%	19.39%	19.04%	15.84%	6.87%	101,950	446,632	0.29
006	248.55	252.83	2	4.28	5	12	D	2002	2006	5,296	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.79%	14.96%	18.66%	18.88%	18.63%	15.63%	6.91%	99,035	545,667	0.37
006	248.55	252.83	2	4.28	5	12	D	2002	2007	5,400	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.76%	14.46%	18.06%	18.37%	18.21%	15.41%	6.94%	98,643	644,310	0.57
006	248.55	252.83	2	4.28	5	12	D	2002	2008	4,589	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.72%	13.97%	17.47%	17.86%	17.79%	15.19%	6.98%	81,842	726,153	0.60
006	248.55	252.83	2	4.28	5	12	D	2002	2009	4,919	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.68%	13.47%	16.87%	17.35%	17.38%	14.98%	7.02%	85,599	811,752	0.58
006	252.83	259.19	1	6.36	5	13	D	2002	2002	5,710	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.94%	16.94%	21.04%	20.93%	20.29%	16.49%	6.76%	116,655	116,655	0.20
006	252.83	259.19	1	6.36	5	13	D	2002	2003	5,404	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.91%	16.44%	20.44%	20.42%	19.87%	16.27%	6.79%	108,069	224,724	0.16
006	252.83	259.19	1	6.36	5	13	D	2002	2004	5,157	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.87%	15.95%	19.85%	19.91%	19.46%	16.06%	6.83%	100,909	325,633	0.20
006	252.83	259.19	1	6.36	5	13	D	2002	2005	6,115	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.83%	15.45%	19.25%	19.39%	19.04%	15.84%	6.87%	116,989	442,622	0.25
006	252.83	259.19	1	6.36	5	13	D	2002	2006	5,933	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.79%	14.96%	18.66%	18.88%	18.63%	15.63%	6.91%	110,943	553,565	0.33
006	252.83	259.19	1	6.36	5	13	D	2002	2007	6,863	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.76%	14.46%	18.06%	18.37%	18.21%	15.41%	6.94%	125,373	678,937	0.42
006	252.83	259.19	1	6.36	5	13	D	2002	2008	6,932	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.72%	13.97%	17.47%	17.86%	17.79%	15.19%	6.98%	123,622	802,559	0.55
006	252.83	259.19	1	6.36	5	13	D	2002	2009	6,932	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.68%	13.47%	16.87%	17.35%	17.38%	14.98%	7.02%	120,622	923,181	0.56
006	252.83	259.19	1	6.36	5	13	D	2002	2010	7,084	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.65%	12.98%	16.28%	16.84%	16.96%	14.76%	7.05%	120,213	1,043,394	0.65
006	252.83	259.19	2	6.36	5	13	D	2002	2002	5,710	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.94%	16.94%	21.04%	20.93%	20.29%	16.49%	6.76%	116,655	116,655	0.16
006	252.83	259.19	2	6.36	5	13	D	2002	2003	5,404	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.91%	16.44%	20.44%	20.42%	19.87%	16.27%	6.79%	108,069	224,724	0.16
006	252.83	259.19	2	6.36	5	13	D	2002	2004	5,157	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.87%	15.95%	19.85%	19.91%	19.46%	16.06%	6.83%	100,909	325,633	0.17
006	252.83	259.19	2	6.36	5	13	D	2002	2005	6,115	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.83%	15.45%	19.25%	19.39%	19.04%	15.84%	6.87%	116,989	442,622	0.21
006	252.83	259.19	2	6.36	5	13	D	2002	2006	5,933	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.79%	14.96%	18.66%	18.88%	18.63%	15.63%	6.91%	110,943	553,565	0.26
006	252.83	259.19	2	6.36	5	13	D	2002	2007	6,863	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.76%	14.46%	18.06%	18.37%	18.21%	15.41%	6.94%	125,373	678,937	0.32
006	252.83	259.19	2	6.36	5	13	D	2002	2008	6,932	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.72%	13.97%	17.47%	17.86%	17.79%	15.19%	6.98%	123,622	802,559	0.43
006	252.83	259.19	2	6.36	5	13	D	2002	2009	6,932	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.68%	13.47%	16.87%	17.35%	17.38%	14.98%	7.02%	120,622	923,181	0.45
006	252.83	259.19	2	6.36	5	13	D	2002	2010	7,084	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.65%	12.98%	16.28%	16.84%	16.96%	14.76%	7.05%	120,213	1,043,394	0.51
006	252.83	259.19	2	6.36	5	13	D	2002	2012	5,787	2	0.8	31-007	1.02	0.93	0.77	0.69	0.76	0.93	0.96	0.57%	11.99%	15.09%	15.82%	16.13%	14.33%	7.13%	93,190	1,232,525	0.62

APPENDIX E

DESIGN LIFE SCENARIOS

APPENDIX E

Design Life Scenarios

ASPHALT

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	**Statewide**
2012	749,046	0	0	1,114,722	0	1,863,768
2013	4,208,082	0	0	1,386,822	0	5,594,904
2014	2,440,359	0	0	1,841,076	0	4,281,435
2015	610,668	0	0	2,560,666	0	3,171,334
2016	860,971	0	0	0	0	860,971
2017	1,257,522	0	0	530,717	0	1,788,239
2018	155,581	0	0	2,281,129	0	2,436,710
2019	1,327,714	0	0	213,785	0	1,541,499
2020	0	0	0	0	0	0
2021	0	0	0	1,656,277	85,180	1,741,457
2022	0	0	0	2,827,939	0	2,827,939
11-year	**11,609,943**	**0**	**0**	**14,413,133**	**85,180**	**26,108,256**

Effective Studded Tire Usage (%)

Region	1995	2014	annual delta
1	15.60	5.10	-0.55
2	12.40	4.00	-0.44
3	5.40	2.68	-0.14
4	40.10	26.64	-0.14
5	30.20	21.80	-0.44

	Design Life	
	Asphalt	PCC
Short	12	30

PCC

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	**Statewide**
2012	648,289	0	0	0	0	648,289
2013	0	0	0	0	0	0
2014	0	0	0	0	0	0
2015	0	0	0	0	0	0
2016	0	0	0	0	0	0
2017	0	0	0	0	0	0
2018	0	0	0	0	0	0
2019	0	0	0	0	0	0
2020	0	0	0	0	0	0
2021	0	0	0	0	0	0
2022	0	0	0	0	0	0
11-year	**648,289**	**0**	**0**	**0**	**0**	**648,289**

AC and PCC Total	**Projected Repair Totals**
2012	**$ 2,512,057**
2013	**$ 5,594,904**
2014	**$ 4,281,435**
2015	**$ 3,171,334**
2016	**$ 860,971**
2017	**$ 1,788,239**
2018	**$ 2,436,710**
2019	**$ 1,541,499**
2020	**$ -**
2021	**$ 1,741,457**
2022	**$ 2,827,939**
total	**26,756,545**

	ASPHALT					
	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	**Statewide**
2012	847,346	796,230	0	3,275,356	941,714	5,860,646
2013	4,208,082	702,339	0	2,110,985	761,859	7,783,265
2014	2,841,192	0	0	4,220,525	561,951	7,623,668
2015	1,223,406	656,210	0	7,466,712	1,196,496	10,542,824
2016	1,582,269	0	0	2,086,761	170,943	3,839,973
2017	2,399,950	411,359	0	3,977,181	0	6,788,490
2018	1,205,207	0	0	2,796,081	83,269	4,084,557
2019	1,791,289	0	0	3,339,539	184,530	5,315,358
2020	786,996	0	0	1,428,593	0	2,215,589
2021	167,994	0	0	1,606,589	2,401,602	4,176,185
2022	1,503,707	0	0	4,030,905	0	5,534,612
11-year	**18,557,438**	**2,566,138**	**0**	**36,339,227**	**6,302,364**	**63,765,167**

	PCC					
	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	**Statewide**
2012	648,289	0	0	0	0	648,289
2013	0	0	0	0	0	0
2014	0	0	0	0	0	0
2015	0	0	0	0	0	0
2016	0	0	0	0	0	0
2017	0	0	0	0	0	0
2018	0	0	0	0	0	0
2019	0	0	0	0	0	0
2020	0	0	0	0	0	0
2021	0	0	0	0	0	0
2022	0	0	0	0	0	0
11-year	**648,289**	**0**	**0**	**0**	**0**	**648,289**

Effective Studded Tire Usage (%)			
Region	1995	2014	annual delta
1	15.60	5.10	-0.55
2	12.40	4.00	-0.44
3	5.40	2.68	-0.14
4	40.10	26.64	-0.14
5	30.20	21.80	-0.44

	Design Life	
	Asphalt	PCC
Long	20	50

AC and PCC Total	
	Projected Repair Totals
2012	**$ 6,508,935**
2013	**$ 7,783,265**
2014	**$ 7,623,668**
2015	**$ 10,542,824**
2016	**$ 3,839,973**
2017	**$ 6,788,490**
2018	**$ 4,084,557**
2019	**$ 5,315,358**
2020	**$ 2,215,589**
2021	**$ 4,176,185**
2022	**$ 5,534,612**
total	**64,413,456**