



# CALIBRATION & VALIDATION

of the I-5 Tumwater to Mounts Road Transportation Models

Thurston Regional  
Planning Council  
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# INTRODUCTION

In 2018, the Washington State Department of Transportation (WSDOT) Headquarters and Olympic Region and Thurston Regional Planning Council (TRPC) entered in partnership to develop a transportation modeling framework for the Thurston Region and adjacent areas, with emphasis on the I-5 corridor between 93rd Avenue in Tumwater to Mounts Road and SR-101 from I-5 to Black Lake Boulevard. The modeling framework includes integrated Travel Demand Model (TDM) and Dynamic Traffic Assignment (DTA) model platforms.

This report documents the calibration/validation for the updated TDM and new DTA model (I-5 DTA), with emphasis on the I-5 corridor.

The modeling framework will be used to analyze near-term actions identified in the Near-Term Action Agenda for I-5 (WSDOT) as well as mid- and long-term actions identified in the Tumwater to Mounts Road Study (WSDOT Olympic Region and TRPC).

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# MODEL FRAMEWORK OVERVIEW

The integrated modeling framework includes enhancements to the existing Regional Travel Demand Model as well as the development of the I-5 DTA.

## Regional Travel Demand Model

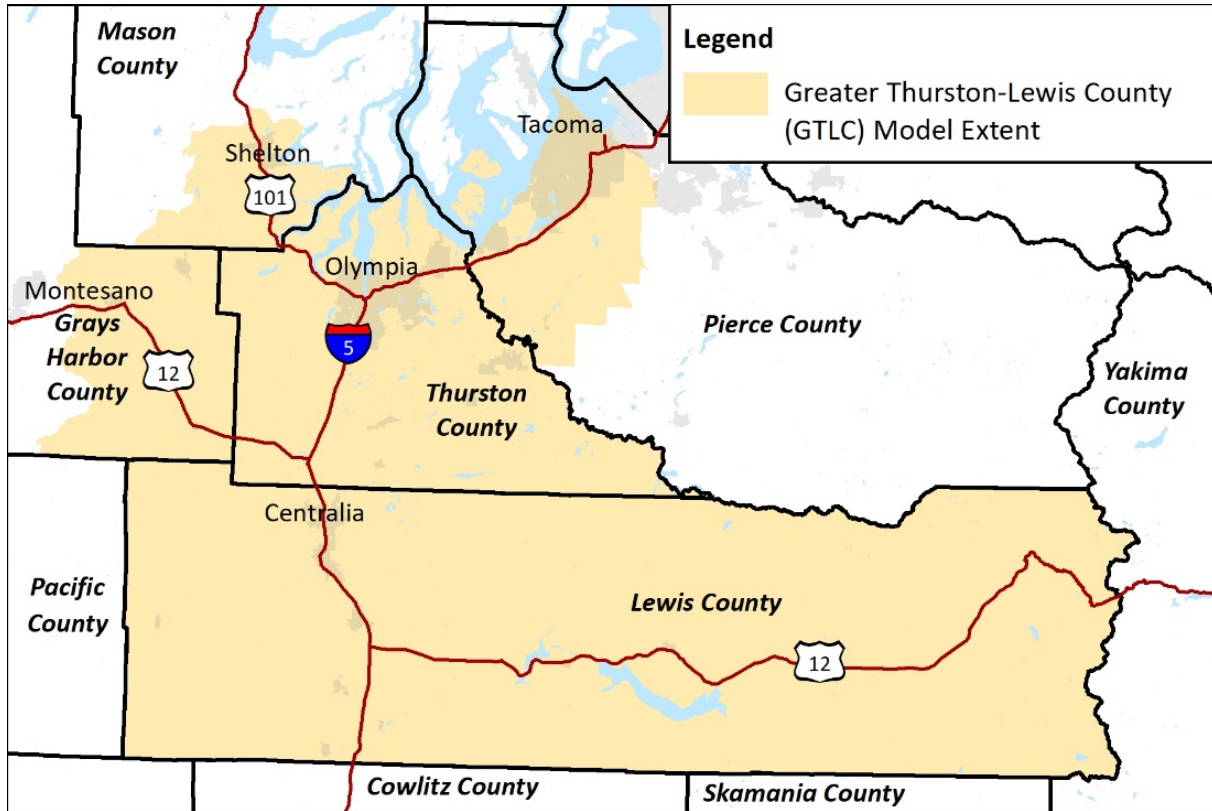
TRPC's Greater Thurston-Lewis County (GTLC) Model, a macro model developed in the EMME modeling platform, covers all of Thurston and Lewis counties, and parts of Pierce, Mason, and Grays Harbor counties (Figure 1). Macro models are typically used to evaluate the impacts of future changes in either transportation facilities (supply) or land use location and/or quantity (demand) on the regional transportation system's level of service.

The GTLC model provides estimates of trips (volume) and speeds (delay) in the peak hour by various modes of travel such as vehicles, trucks, transit, school buses, bicycles, and pedestrians on all major roadways and paths within the model area. The trip tables generated in the travel demand model are used as inputs into the I-5 DTA.

While a macro model can quickly forecast impacts of significant changes in supply and demand, many more location-specific policy decisions require analytics that stretch the applicability of macro models, such as measuring the impact of intersection controls, presence of turning bays at intersections, impact of buses stopping in the roadway, and response to other traffic through car following, and lane changing. These shortcomings can be overcome by using a DTA model in conjunction with the regional model.

Full documentation of the GTLC is available on TRPC's website: <http://www.trpc.org/860/Regional-Travel-Demand-Model>.

**FIGURE 1: Geographic extent of the Greater Thurston-Lewis County model**

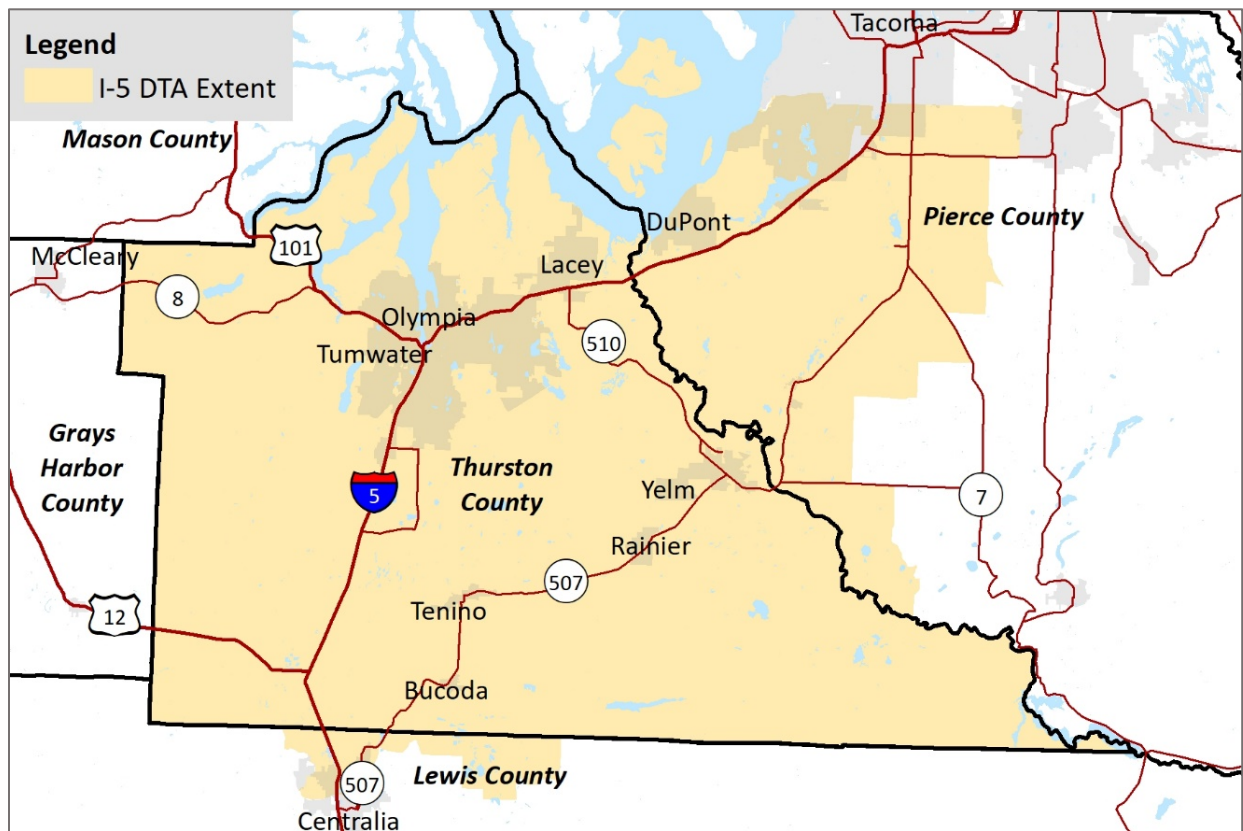


## Dynamic Traffic Assignment Model

The DTA model developed for the study (I-5 DTA) is a subarea mesoscopic traffic model built in the Dynameq modeling platform. The Dynameq modeling platform allows for the simulation of the movement of individual vehicles on lanes, with car-following models, gap-acceptance models, and explicit signal timings normally associated with conventional microscopic models such as Synchro. The I-5 DTA will be used to model traffic flows, intersection movements, and traffic delay.

The I-5 DTA model extends from Pierce County (SR-512) to Lewis County (including Centralia), and covers all of Thurston County (Figure 2).

**FIGURE 2: Geographic extent of the I-5 DTA model**



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# I-5 DTA MODEL DEVELOPMENT

## Updates to the Regional Travel Demand Model

The GTLC model underwent several updates to facilitate development of the I-5 DTA model. They included:

- Updating the base year data (land use and transportation network) to 2017 using building permits.
- Developing a mid-range future year projection (2025) and updated future year (2040)
- Adding a morning peak (AM) component
- Adding zonal detail (266 additional transportation analysis zones were added to the model, increasing the number of zones to 1,500)
- Development of a sub-area model with the I-5 DTA model extents

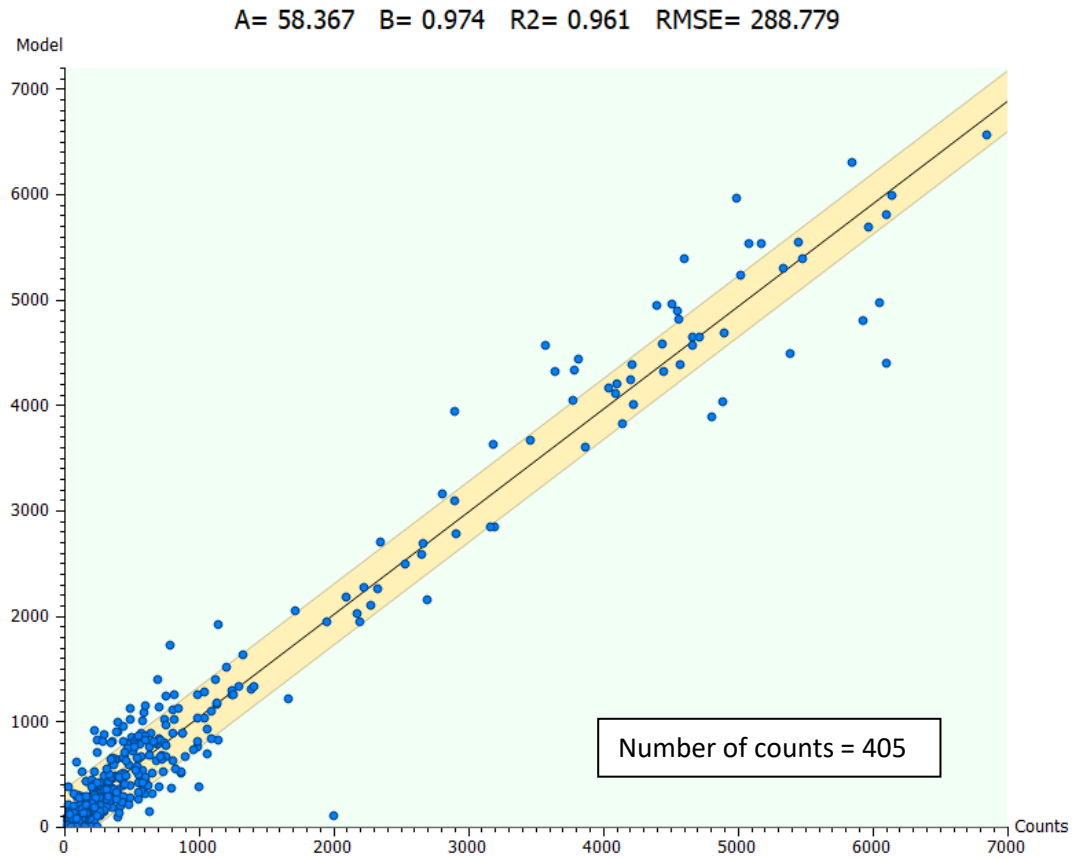
## Model Validation/Calibration

The GTLC model was re-validated/calibrated after the updates. Validation/calibration consisted of two components, calibrating mode choice to the regional household travel survey, and validating the model to 2017 traffic counts. The mode-split comparison with household travel survey is shown in Table 1. The correlations (R squared values) of 2017 model volumes to traffic counts at the peak hour are shown in Figure 3.

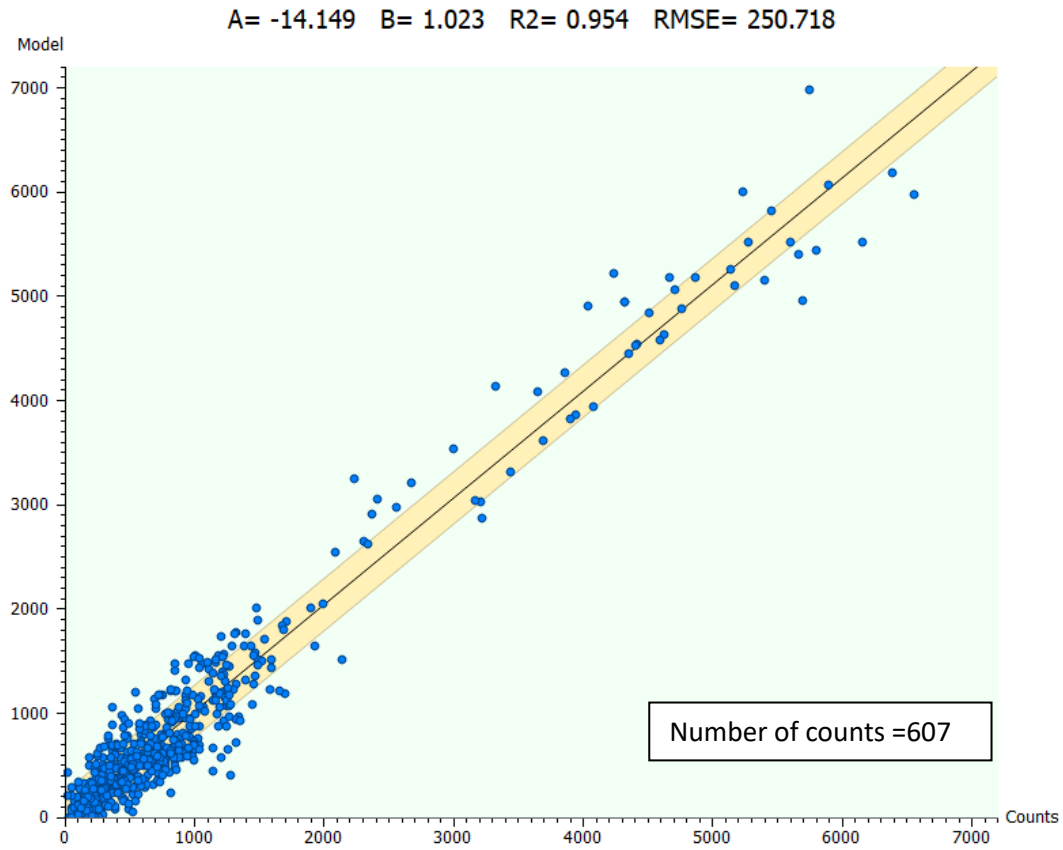
**TABLE 1: Mode Choice for Thurston County, GTLC model versus Household Travel Survey**

Mode Choice	MODEL		HOUSEHOLD TRAVEL SURVEY	
	Daily Trips	Percent	Daily Trips	Percent
Single Occupancy Vehicle	552,602	51.1%	558,082	51.6%
High Occupancy Vehicle	393,000	36.3%	389,820	36.0%
Walk	86,844	8.0%	86,855	8.0%
Bike	16,875	1.6%	16,761	1.5%
Transit	21,174	2.0%	20,881	1.9%
School Bus	9,542	0.9%	7,664	0.7%
Vanpool	2,197	0.2%	2,172	0.2%
<b>Total</b>	<b>1,082,235</b>	<b>100.0%</b>	<b>1,082,235</b>	<b>100.0%</b>

**FIGURE 3A: R squared correlation between GTLC model volumes and traffic counts – AM Model**



**FIGURE 3B: R squared correlation between GTLC model volumes and traffic counts – PM Model**



## GTLC Model Feature Extraction for the I-5 DTA

Several features were extracted from the GTLC model to begin development of the I-5 DTA. They included:

*Zonal Structure:* The I-5 DTA subarea model was developed to have a consistent zonal structure (transportation analysis zones) with the GTLC model to facilitate streamlined exchange of information such as trip tables between the two models.

*Network:* The GTLC network (nodes, centroids, and links) provided a basis for I-5 DTA network development.

*Trip Tables:* Trip tables were developed for a subarea cut of the GTLC model and exported to the I-5 DTA model.

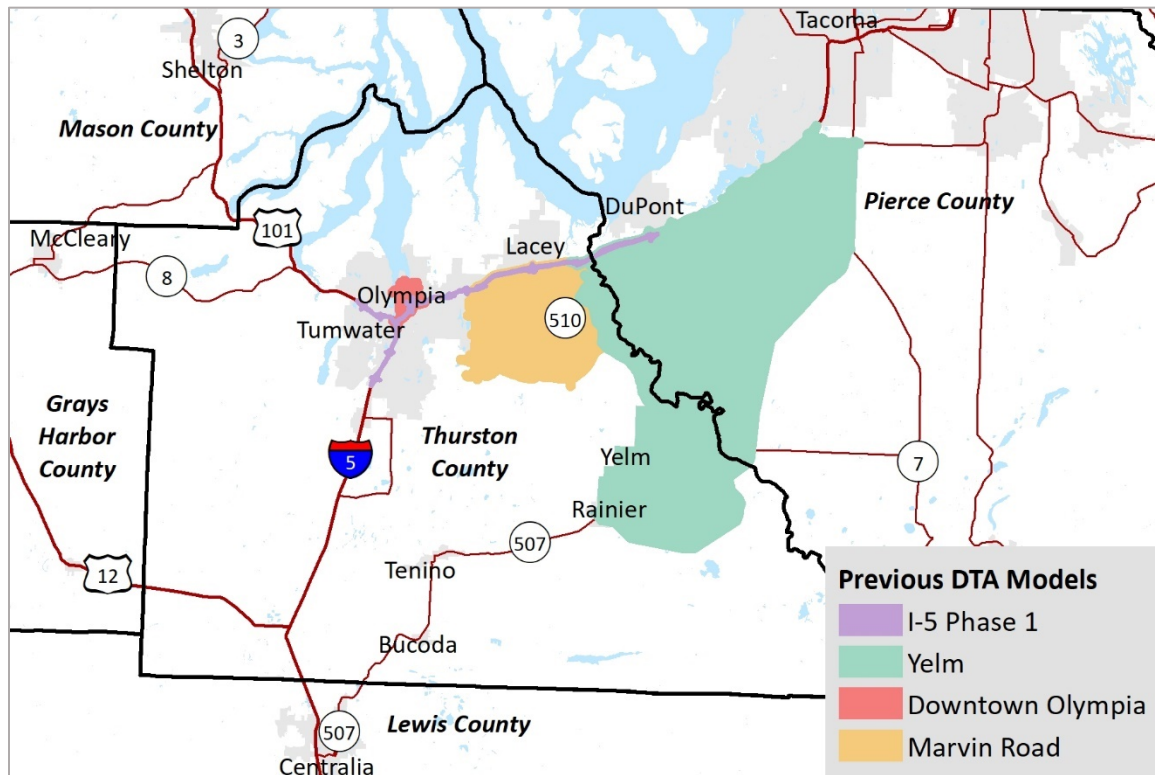
*Traffic Counts:* Traffic counts were input into the GTLC model and exported to the I-5 DTA model.

## I-5 DTA Subarea Development

The I-5 DTA model contains a greater degree of network detail than the GTLC model. For instance, the I-5 DTA contains details such as turn lanes and intersection controls (stop signs, roundabouts, or traffic signals, including traffic signal timing) that cannot be modeled in a macro model or TDM.

Four DTA models existed within the study area, as shown in Figure 4. The detailed network geometries and signal controls from the existing DTA models were spliced into the I-5 DTA shell taken from the GTLC model.

**FIGURE 4: Existing DTA models used to build the I-5 DTA model**



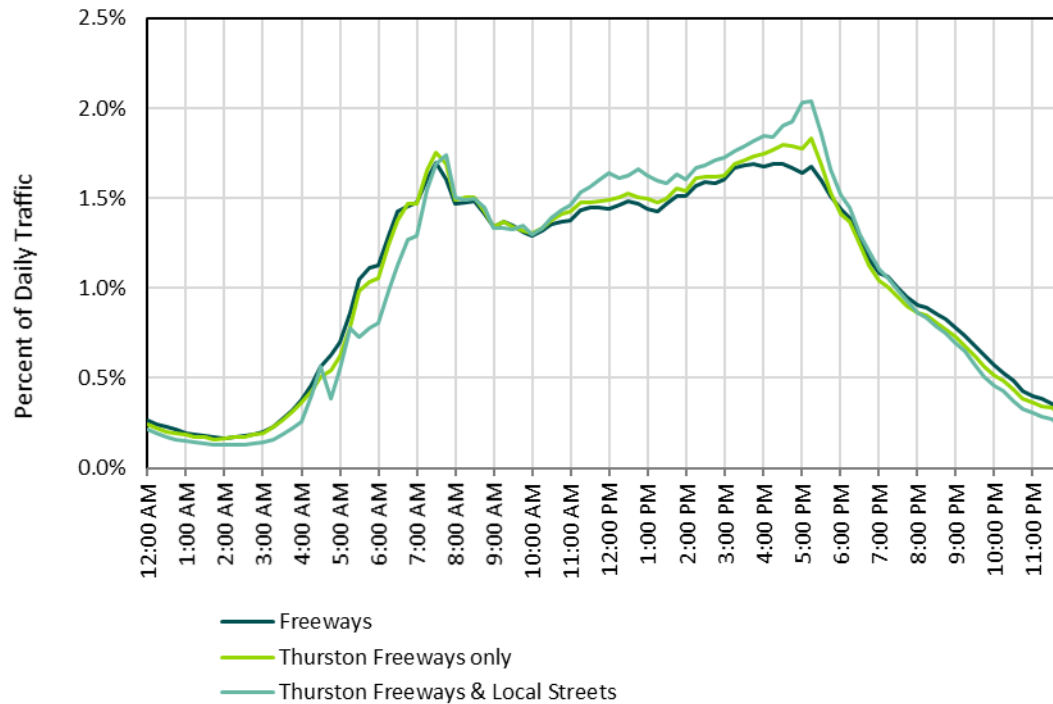
The I-5 DTA model shell was then edited to include add necessary roadways details as well as intersection controls and geometries such as turn lanes. Intersection stop lines and turn lane configurations were determined by referencing online air photo imagery integrated into the Dynameq software package. Google and Bing maps with fields observations were used for facilities with recent roadway improvements. Signal control plans along the I-5 corridor and all of Thurston County were collected from local jurisdictions and input into the I-5 DTA model. For areas within the study area where signal control plans were not available, they were simulated using Dynameq software, with input from the software vendor – INRO – who served as a project consultant.

## Determining Trip Distribution

Recent traffic counts were obtained from TRPC, WSDOT, and local jurisdictions, including the cities of Lacey, Lakewood, Olympia, Tumwater, and Yelm, Thurston County, and Pierce County to determine the distribution of traffic over an average 24-hour weekday period (Figure 5).

This information was used to determine the distribution of traffic around the GTLC model peak hour periods (7-8 AM and 4-5 PM) to develop a five-hour distribution of trips for both the AM and PM periods.

**FIGURE 5: Traffic patterns within the study area**



## Trip Table Distribution

Travel demand for the I-5 DTA model was developed by extracting trip tables from the GTLC model. The GTLC model has a 2015 base year and future year of 2040. The 2017 base year was developed by updating land use using building permits.

The one-hour peak period trip tables derived from the GTLC model were used to develop a five-hour set of trip tables for the I-5 DTA using travel distributions from observed traffic counts. Table 2 shows how the PM trip distributions were calculated.

**TABLE 2. Example of using traffic count data to develop distribution of hourly trip tables**

PERCENT OF DAILY TRIPS ON THURSTON FREEWAYS		
Time	15-minute Intervals	Hourly
14:00:00	1.60%	
14:15:00	1.67%	
14:30:00	1.68%	6.39%
14:45:00	1.71%	
15:00:00	1.73%	
15:15:00	1.76%	
15:30:00	1.79%	6.76%
15:45:00	1.82%	
16:00:00	1.84%	
16:15:00	1.84%	
16:30:00	1.90%	7.10%
16:45:00	1.92%	
17:00:00	2.03%	
17:15:00	2.04%	
17:30:00	1.85%	6.83%
17:45:00	1.66%	
18:00:00	1.52%	
18:15:00	1.45%	
18:30:00	1.30%	5.14%
18:45:00	1.21%	

The focus for the I-5 DTA was developing trip tables to simulate three hours of peak traffic. An additional hour was added before and after the three-hour peak to account for traffic loading on to, and off of, the network for a total analysis period of five hours.

### Trip Table Classes

The vehicle classes from the GTLC has trip tables were summarized into ten modes of travel excluding transit, five modes each for both military and non-military trips. Non-military trips are restricted from traveling on Joint Base Lewis-McChord. Transit trips were added to the I-5 DTA in a separate module. Bike and walk trip are not captured in operational models such as Dynameq. The five-hour demand trip tables, by vehicle class, are summarized in Table 3.

**TABLE 3: Trip table summary for the I-5 DTA, five-hour peak period**

AM 2017		
	VEHICLE CLASS	TRIPS
<b>NON-MILITARY</b>		
SOV	Single Occupancy	243,324
LOV	Low Occupancy Vehicles (2 Persons)	23,302
HOV	High Occupancy Vehicles (+3 Persons)	32,986
VAN	Van Occupants (+3.5 Persons)	870
TRK	Middle & Heavy Trucks	15,716
<b>MILITARY</b>		
MSOV	Single Occupancy	34,280
MLOV	Low Occupancy Vehicles (2 Persons)	4,742
MHOV	High Occupancy Vehicles (+3 Persons)	1,903
VAN	Van Occupants (5 Persons)	50
MTRK	Middle & Heavy Trucks	252
<b>TOTAL</b>		<b>357,425</b>

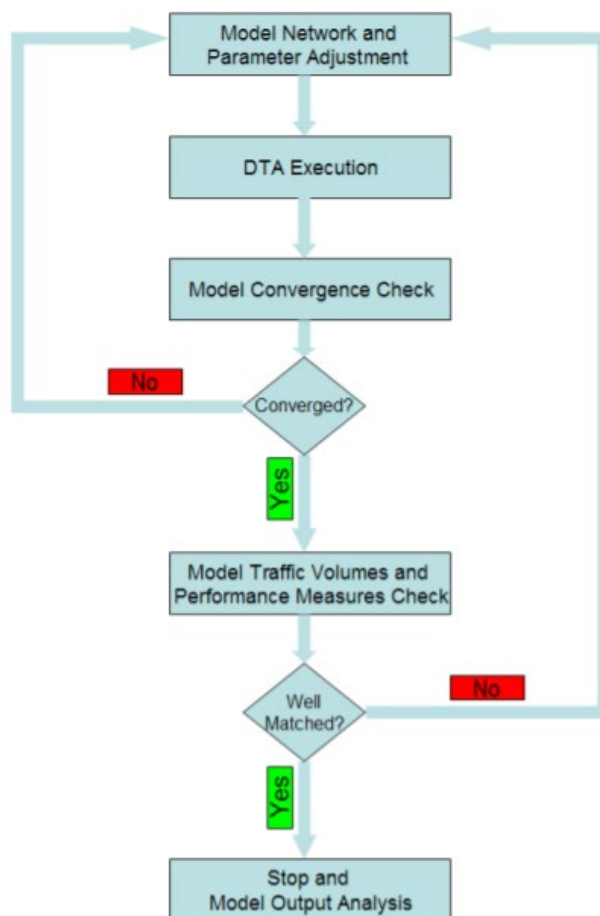
PM 2017		
	VEHICLE CLASS	TRIPS
<b>NON-MILITARY</b>		
SOV	Single Occupancy	389,211
LOV	Low Occupancy Vehicles (2 Persons)	81,844
HOV	High Occupancy Vehicles (+3 Persons)	38,835
VAN	Van Occupants (+3.5 Persons)	503
TRK	Middle & Heavy Trucks	15,363
<b>MILITARY</b>		
MSOV	Single Occupancy	31,253
MLOV	Low Occupancy Vehicles (2 Persons)	5,023
MHOV	High Occupancy Vehicles (+3 Persons)	2,406
VAN	Van Occupants (+3.5 Persons)	69
MTRK	Middle & Heavy Trucks	763
<b>TOTAL</b>		<b>565,270</b>

# I-5 DTA MODEL CALIBRATION AND VALIDATION

## Overview

Calibration / validation of a DTA model is an iterative process of troubleshooting. Once a preliminary model is developed, it is “executed” or built. The model is then run through a convergence check. If the model does not converge, changes are made to the model network or other inputs such as trip tables, and the model is run again. Once the model reaches convergence, the outputs are checked against real data such as traffic counts and corridor travel time/speeds. Adjustments are made to the network or other inputs until the model outputs are reasonably similar to observed conditions. At that point the model is ready to be used. This process shown in Figure 6.

**FIGURE 6: Model calibration / validation process**

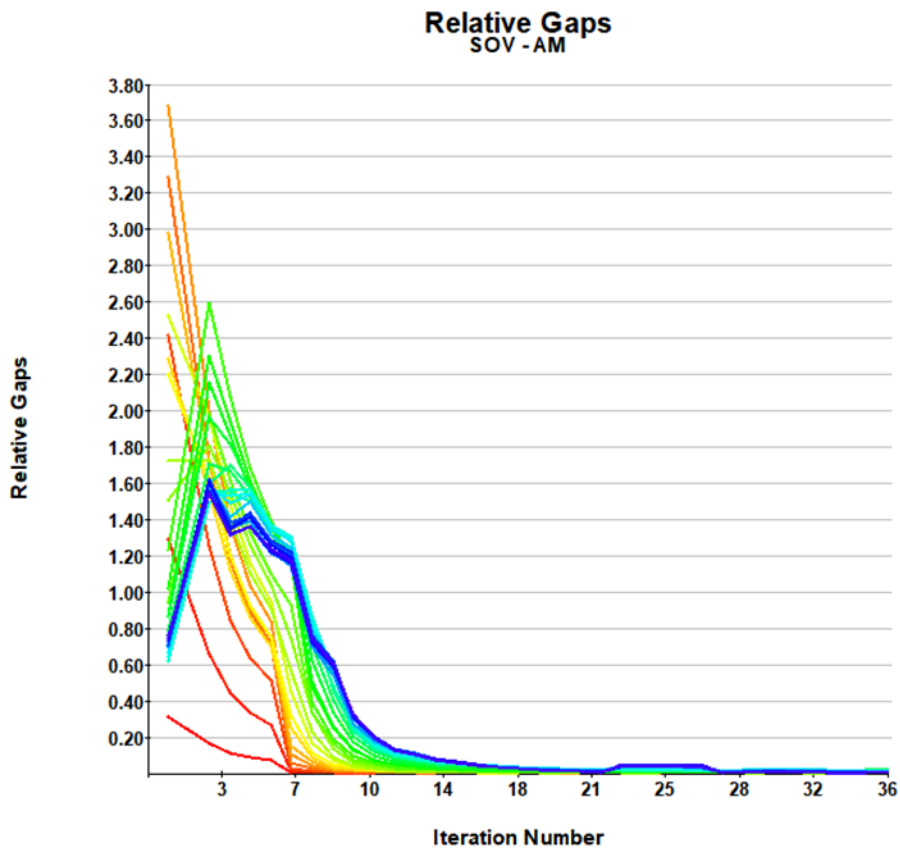


From: Application of Dynamic Traffic Assignment (DTA) Model to Evaluate Network Traffic Impact during Bridge Closure - A Case Study in Edmonton, Alberta. Zin, P., Bhowmick, Arun, and Juran, I. Paper Prepared for presentation at the Session “Best Practices in Urban Transportation Planning” Of the 2014 Conference of the Transportation Association of Canada Montreal, Quebec.

## Model Convergence

DTA models use an iterative traffic assignment process that will yield different model outputs until the model is run through enough iterations that the various network assignments achieve convergence around the equilibrium condition for various modes of travel. Convergence is measured by relative gap in travel times between origin-destination pairs, and is most easily seen in Figure 7. When all the various lines begin to “converge” the model has reached equilibrium, meaning the model will yield similar results each time it is run. Table 4 lists convergence results by vehicle class.

**FIGURE 7: Model convergence graphs for the single occupancy vehicle class in the AM model**



**TABLE 4: Convergence results by vehicle class (relative gap)**

VEHICLE CLASS	AM		PM	
	MINIMUM CONVERGENCE AT 36 ITERATIONS		MINIMUM CONVERGENCE AT 36 ITERATIONS	
	NON-MILITARY	MILITARY	NON-MILITARY	MILITARY
SOV	0.0029	0.0128	0.0023	0.0029
HOV	0.0061	0.0176	0.0035	0.0088
LOV	0.0075	0.0149	0.0037	0.0075
VAN	0.0091	0.0059	0.0187	0.0053
TRK	0.0036	0.0162	0.0022	0.0136

## Traffic Volume Validation

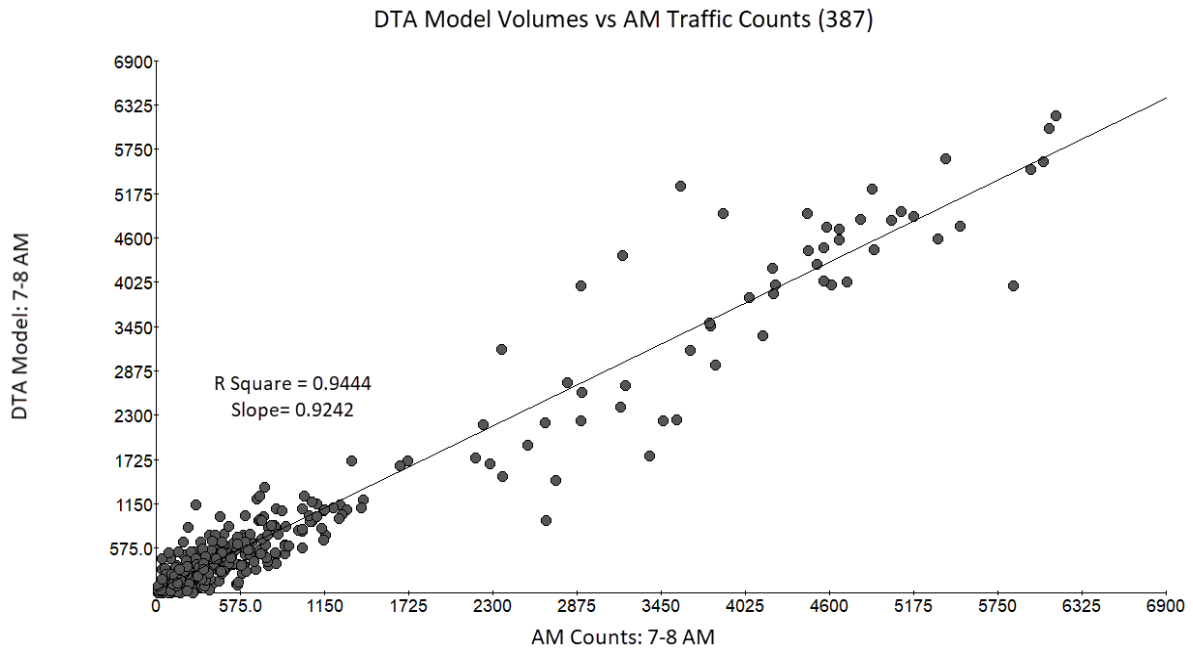
Travel models are expected to replicate observed conditions within reason before being used for analysis. A standard part of the model validation process is to compare modeled traffic volumes with traffic counts measured on the road network. Traffic counts were assembled for morning (AM) and afternoon (PM) traffic in 2017/2018 for use in validating the I-5 DTA model.

One model validation check is to measure hourly model link volumes to hourly traffic counts to determine how the predicted values (model volumes) fit with real data (traffic counts). The following traffic counts were used in validating the model:

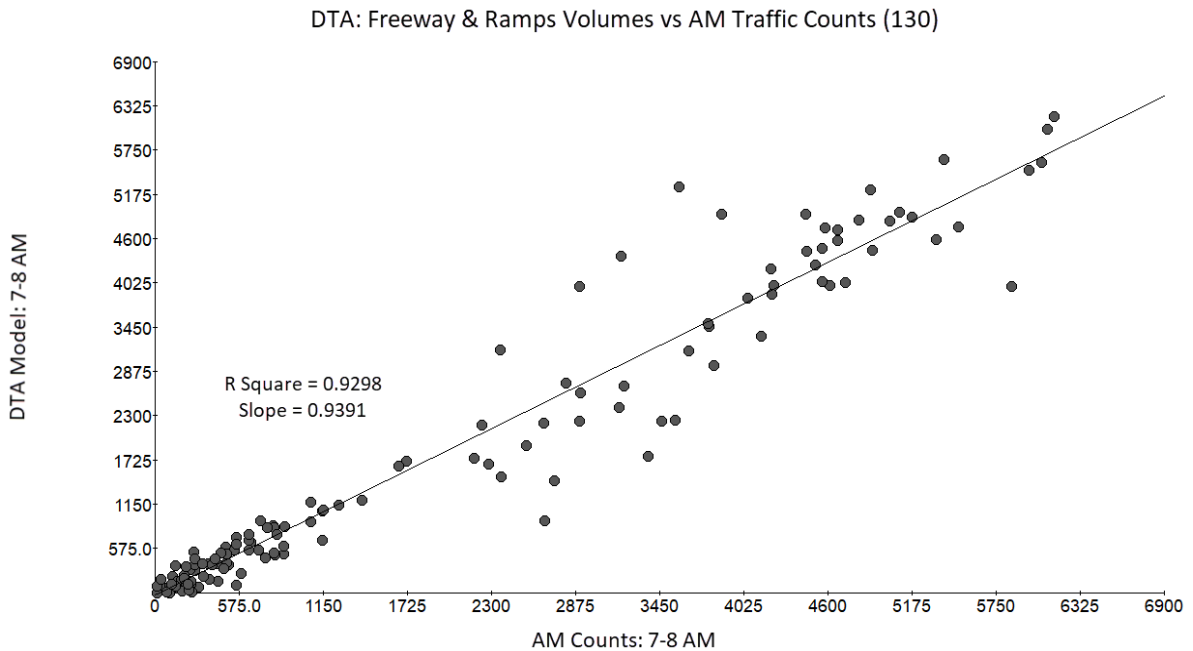
- AM Period - 387 counts total
- PM Period - 627 counts total

The I-5 DTA model volumes compared to traffic counts produced an R squared of 0.9444 for the AM peak hour, and an R squared of 0.9855 for the PM peak hour (Figure 8). The R squared was slightly higher for both peak periods when looking at freeway and freeway ramp volumes compared to counts.

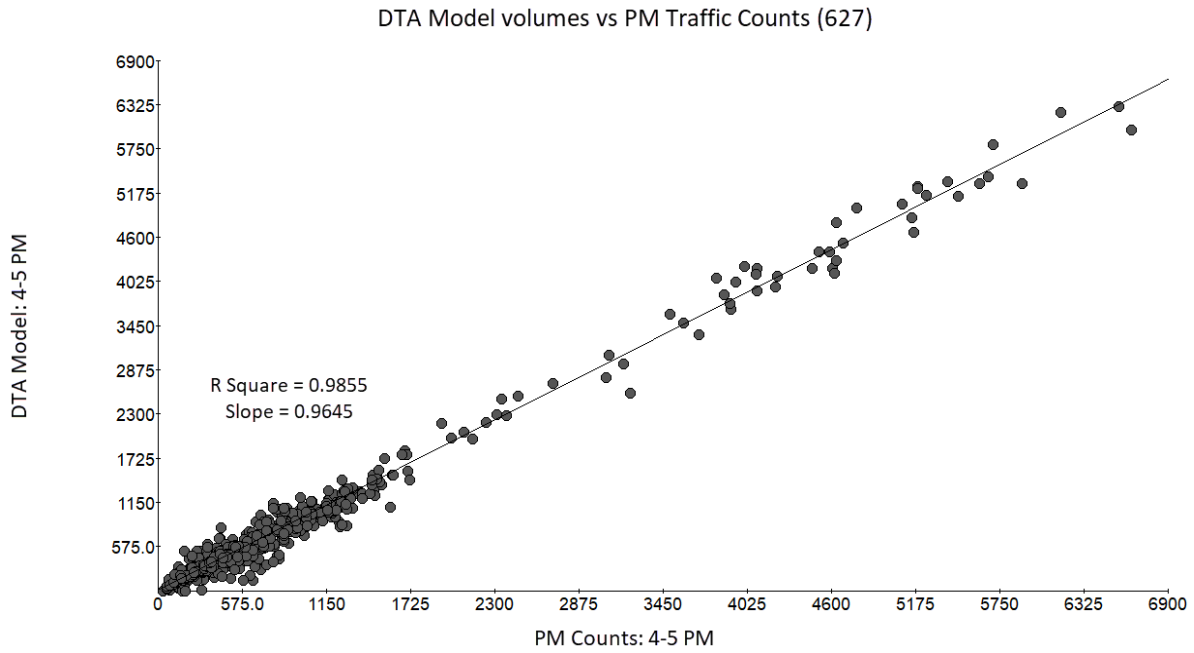
**FIGURE 8A: R squared correlation between I-5 DTA subarea model volumes and traffic counts – all facilities - AM**



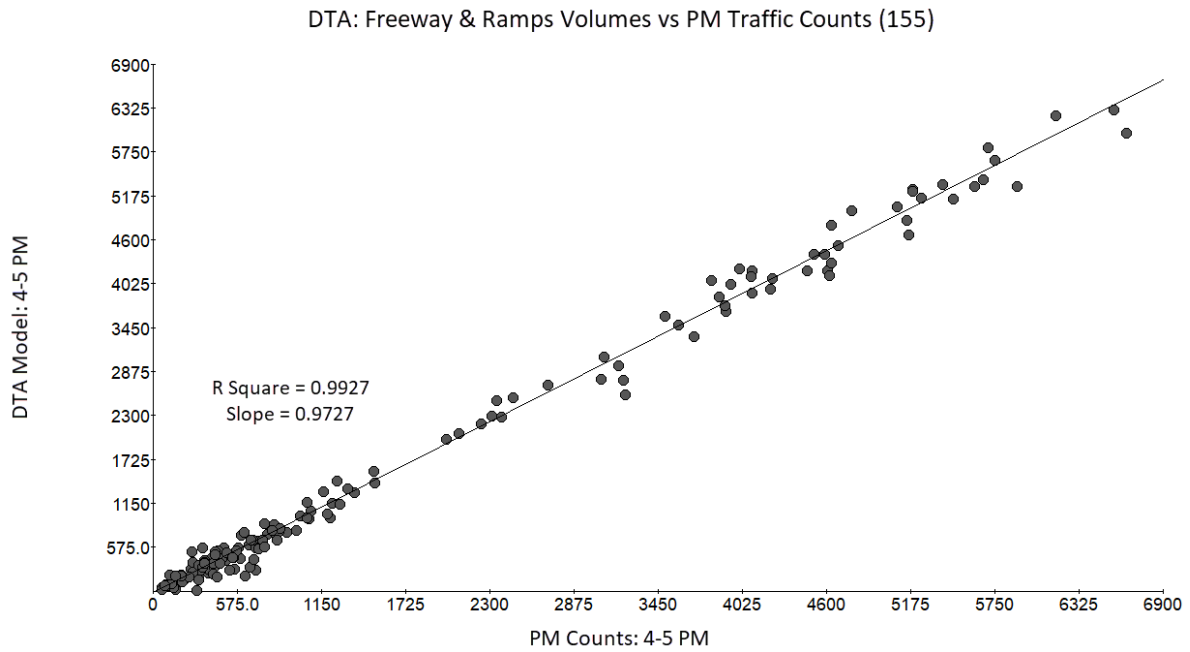
**FIGURE 8B: R squared correlation between I-5 DTA subarea model volumes and traffic counts – freeway and ramps - AM**



**FIGURE 8C: R squared correlation between DTA subarea model volumes and traffic counts – all facilities - PM**



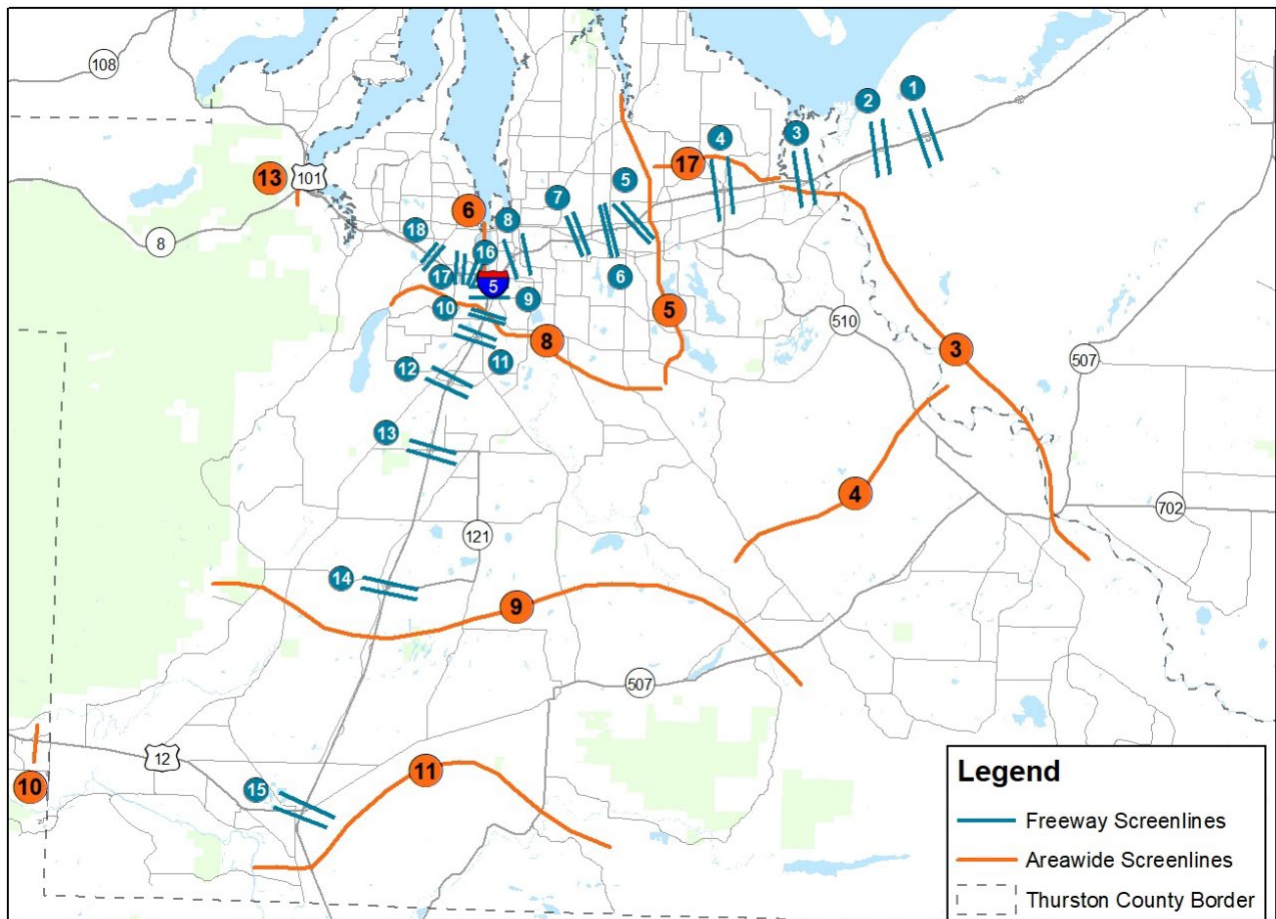
**FIGURE 8D: R squared correlation between I-5 DTA subarea model volumes and traffic counts – freeway and ramps - PM**



## Screenline Validation

Another I-5 DTA model validation check is to measure hourly directional modeled link volumes along screenlines to see how they compare to traffic counts. A screenline is an imaginary line on a map that intersects with the road/street network to capture traffic in one direction of flow. The screen line sums points along the line to see how traffic flow is captured overall, rather than at discrete points on the network. Screenlines were developed for both the freeway (Interstate 5 and US 101) and for the general model area (areawide). In general, model developers aim to have modeled volumes within 10 percent of counts.

**FIGURE 9: Screenline locations**



**TABLE 5A: Freeway I-5 DTA screenlines – counts versus model volumes – AM peak hour (7 – 8 AM)**

NUMBER	NAME	OBSERVED COUNTS	2017 AM MODEL	ABSOLUTE DIFFERENCE	% DIFF.
1	I-5 - Center Dr	10,960	9,024	(1,794)	-19.6%
2	I-5 - Mounts Rd	9,479	8,903	(782)	-9.0%
3	I-5 - Nisqually Cut-Off Rd SE	9,116	8,216	(1,049)	-13.0%
4	I-5 - Marvin Rd SE	11,017	9,552	(1,007)	-10.1%
5	I-5 - Martin Way E	11,934	10,445	(1,654)	-16.1%
6	I-5 - Sleater Kinney Rd SE	11,465	10,006	(1,530)	-15.4%
7	I-5 - Pacific Ave SE	14,840	11,182	(2,604)	-21.3%
8	I-5 - Plum St / 14th	11,187	9,984	(1,281)	-7.6%
9	I-5 - US101	8,929	11,010	(446)	-4.0%
10	I-5 - E Street SW	8,778	8,943	(61)	-0.7%
11	I-5 - Trosper Rd SE	9,502	9,699	52	0.5%
12	I-5 - Tumwater Blvd	9,336	8,513	(1,106)	-13.4%
13	I-5 - 93rd Ave SW	8,245	6,991	(1,374)	-20.0%
14	I-5 - Maytown Rd	5,877	6,995	941	13.8%
15	I-5 - Old Hwy-99	6,819	5,821	(1,113)	-19.5%
16	US101	8,886	9,448	562	5.9%
17	US101 - Crosby Blvd SW	9,796	10,686	890	8.3%
18	US101 - Black Lake Blvd SW	8,979	9,492	513	5.4%
<b>TOTALS</b>		<b>184,654</b>	<b>177,947</b>	<b>-12,843</b>	<b>-7.5%</b>

**TABLE 5B: Freeway I-5 DTA screenlines – counts versus model volumes – PM (4 – 5 PM)**

NUMBER	NAME	OBSERVED COUNTS	2017 PM MODEL	ABSOLUTE DIFFERENCE	% DIFF.
1	I-5 - Center Dr	11,291	10,477	(1,536)	-15.7%
2	I-5 - Mounts Rd	10,185	9,489	(464)	-4.8%
3	I-5 - Nisqually Cut-Off Rd SE	9,850	8,406	(689)	-7.5%
4	I-5 - Marvin Rd SE	13,661	11,719	(1,349)	-11.0%
5	I-5 - Martin Way E	12,765	12,911	(561)	-4.6%
6	I-5 - Sleater Kinney Rd SE	12,645	13,755	(562)	-4.7%
7	I-5 - Pacific Ave SE	14,840	15,287	(1,084)	-7.9%
8	I-5 - Plum St / 14th	13,380	14,269	(1,468)	-12.3%
9	I-5 - US101	13,165	12,279	(1,699)	-14.8%
10	I-5 - E Street SW	8,778	8,341	(840)	-10.1%
11	I-5 - Trosper Rd SE	10,967	9,918	(520)	-5.0%
12	I-5 - Tumwater Blvd	9,698	8,113	(1,066)	-12.3%
13	I-5 - 93rd Ave SW	7,714	6,257	(945)	-14.0%
14	I-5 - Maytown Rd	6,711	5,784	(718)	-12.0%
15	I-5 - Old Hwy-99	8,329	6,166	(1,152)	-16.1%
16	US101	8,886	9,448	562	5.9%
17	US101 - Crosby Blvd SW	9,796	10,686	890	8.3%
18	US101 - Black Lake Blvd SW	8,979	9,492	513	5.4%
<b>TOTALS</b>	<b>TOTALS</b>	<b>191,640</b>	<b>182,797</b>	<b>-9,215</b>	<b>-5.0%</b>

**TABLE 5C: Areawide I-5 DTA screenlines – counts versus model volumes – AM (7 – 8 AM)**

SCREENLINE	OBSERVED COUNTS		2017 AM MODEL		% DIFFERENCE	
	NB-EB	SB-WB	NB-EB	SB-WB	NB-EB	SB-WB
3	2,144	1,104	2,331	1,101	9%	0%
4	412	1,378	426	890	3%	-35%
5	5,906	7,890	5,584	7,196	-5%	-9%
6	5,873	3,212	5,410	4,141	-8%	29%
8	6,733	6,059	2,178	2,288	21%	5%
9	3,764	2,497	6,914	5,774	3%	-5%
10	276	316	5,536	2,590	47%	4%
11	2,584	2,503	211	310	-24%	-2%
13	1,806	2,183	2,687	2,304	4%	-8%
17	917	1,819	891	1,616	-3%	-11%
<b>Total</b>	<b>30,415</b>	<b>28,961</b>	<b>32,168</b>	<b>28,210</b>	<b>6%</b>	<b>-3%</b>

**TABLE 5D: Areawide I-5 DTA screenlines – counts versus model volumes – PM (4 – 5 PM)**

SCREENLINE	OBSERVED COUNTS		2017 PM MODEL		% DIFFERENCE	
	NB-EB	SB-WB	NB-EB	SB-WB	NB-EB	SB-WB
3	1,416	2,884	1,319	3,029	-7%	5%
4	1,047	957	1,449	819	38%	-14%
5	8,394	7,819	7,988	7,714	-5%	-1%
6	6,166	6,589	5,742	6,126	-7%	-7%
8	6,875	6,932	7,456	7,218	8%	4%
9	2,933	4,106	3,245	4,301	11%	5%
10	276	316	502	618	82%	96%
11	2,946	3,178	3,246	3,590	10%	13%
13	2,091	2,157	2,276	2,498	9%	16%
17	1,685	1,413	1,848	1,491	10%	6%
<b>Total</b>	<b>33,829</b>	<b>36,351</b>	<b>35,071</b>	<b>37,404</b>	<b>4%</b>	<b>3%</b>

Note: NB = northbound; EB = eastbound; SB = southbound; WB = westbound

## Travel Time and Speed Comparison

Other I-5 DTA model validation data sets are corridor travel time and average speed. Travel time and speed data were downloaded from the National Performance Management Research Data Set (NPMRDS) procured and sponsored by Federal Highway Administration (FHWA), and provided to Washington State Department of Transportation (WSDOT) and Metropolitan Planning Organizations such as TRPC. NPMRDS data from February of 2017 onward is provided by a team led by the University of Maryland [Center for Advanced Transportation Technology Laboratory \(CATT Lab\)](#) and is based on data collected by INRIX.

The following data were downloaded for the corridors shown in Figure 10.

- Month: Entire month of March 2018
- Days: All weekdays
- Time of day: 6-9 am and 3-6 pm
- Passenger vehicles and trucks

Data were compared to the I-5 DTA model data to validate the model for both the I-5 and US-101 corridors and other major arterials within the study area. The reliability of the NPMRDS data declines for lower volume corridors.

FIGURE 10: Corridor segments for speed and travel time validation

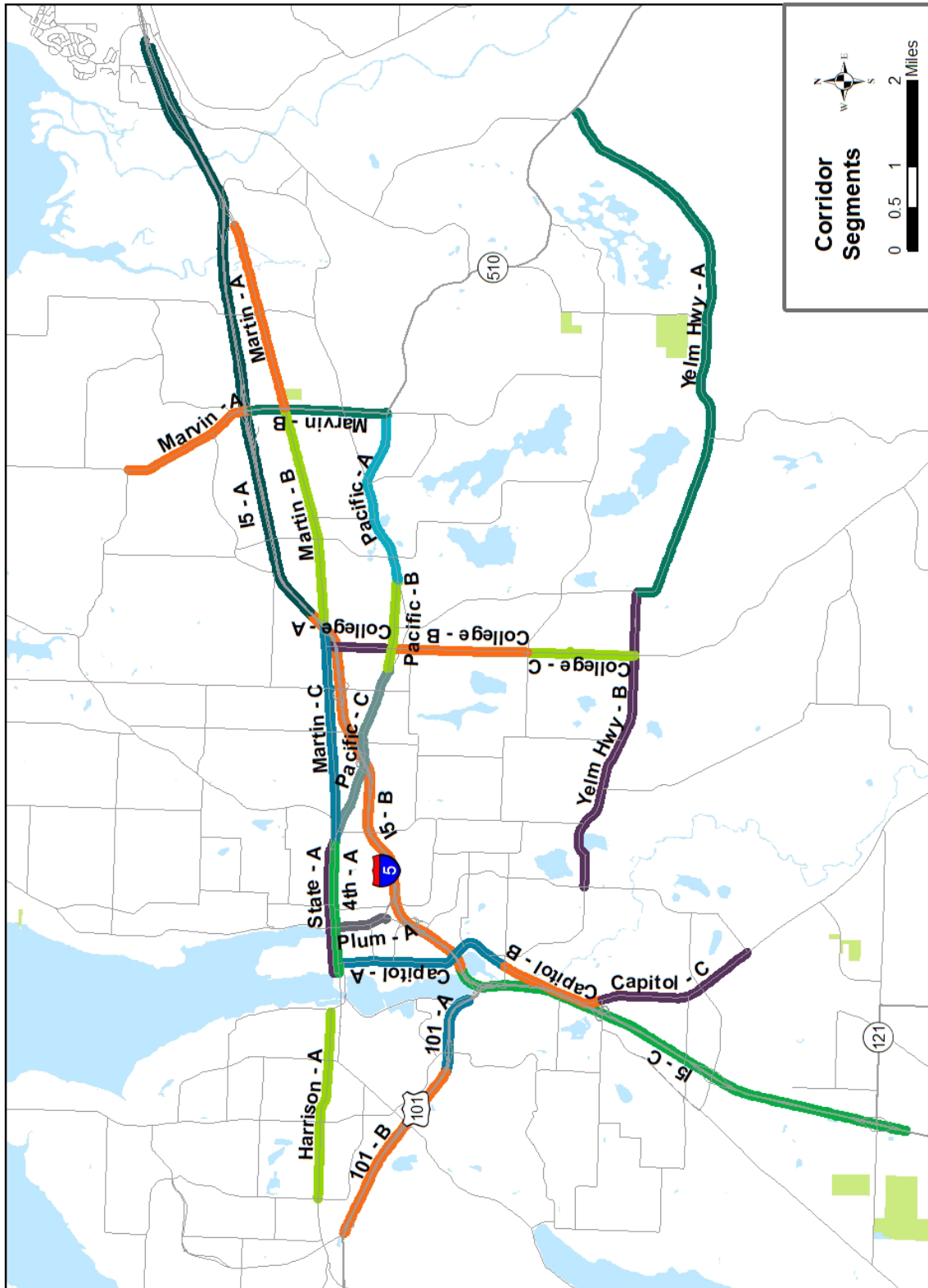


TABLE 6A: AM I-5 DTA speed comparison (miles per hour)

	NPMRDS - Corridor AM Average Congested Speed						2018 DTA - Corridor AM Congested Speed						DTA minus NPMRDS Speed					
	North Bound			South Bound			North Bound / EB			South Bound /WB			North Bound / EB			South Bound /WB		
	6 to 7	7 to 8	8 to 9	6 to 7	7 to 8	8 to 9	6 to 7	7 to 8	8 to 9	6 to 7	7 to 8	8 to 9	6 to 7	7 to 8	8 to 9	6 to 7	7 to 8	8 to 9
I-5 Seg A	51	52	58	61	61	60	58	58	58	60	59	59	-7	-6	0	1	1	0
I-5 Seg B	57	57	58	59	58	51	59	58	57	59	58	58	-2	-1	1	0	1	-7
I-5 Seg C	61	60	61	61	61	61	62	57	55	63	62	63	-1	2	6	-2	-1	-2
Martin Wy Seg A	30	30	28	33	28	29	26	22	25	28	27	28	4	8	3	4	0	1
Martin Wy Seg B	28	26	26	25	21	21	23	22	22	22	19	19	5	4	4	4	3	2
Martin Wy Seg C	20	18	17	22	18	18	19	18	19	21	21	20	1	0	-2	1	-3	-2
Capitol Blvd Seg A	18	19	19	26	20	17	20	21	20	22	21	21	-1	-2	-1	5	-1	-4
Capitol Blvd Seg B	19	17	17	22	24	23	27	24	25	22	22	22	-9	-7	-8	0	2	1
Capitol Blvd Seg C	22	14	19	22	19	21	21	18	19	23	22	22	1	-4	0	-2	-4	-1
Plum Seg A	19	17	14	22	15	15	13	14	13	18	17	18	6	3	1	4	-3	-3
College Seg A	23	18	19	19	19	20	22	19	20	24	22	21	1	-1	-1	-5	-3	0
College Seg B	27	26	22	24	16	20	31	29	30	32	31	32	-4	-3	-8	-8	-15	-12
College Seg C	28	24	27	29	23	26	29	28	28	25	24	23	-1	-4	-1	4	-1	2
Marvin Seg A	25	25	26	19	18	18	32	31	32	29	27	28	-7	-6	-6	-10	-9	-10
Marvin Seg B	21	16	19	27	21	22	19	17	18	20	19	20	3	-1	1	7	2	2
4th/State Seg A	24	22	22	20	20	19	21	21	21	21	20	20	3	1	1	-1	0	-1
Harrison Seg A	21	20	22	25	25	21	25	25	24	22	21	20	-3	-4	-3	3	3	1
Pacific/Lacey Seg A	20	22	22	27	26	21	29	28	28	27	26	26	-9	-6	-6	1	0	-5
Pacific/Lacey Seg B				24	17	21	24	22	22	23	22	22				0	-5	0
Pacific/Lacey Seg C	20	17	20	21	19	18	17	17	17	17	16	16	2	0	4	4	3	2
US 101 Seg A	52	52	51	48	46	48	50	49	49	56	55	55	2	3	2	-8	-8	-7
US 101 Seg B	59	59	59	58	54	52	60	59	60	60	60	60	-1	0	-1	-2	-6	-8
Yelm Hwy Seg A	44	44	36	40	33	26	46	46	46	46	46	46	-3	-2	-10	-6	-12	-20
Yelm Hwy Seg B	30	25	24	29	22	25	27	26	26	27	24	25	3	-1	-3	2	-2	-1

TABLE 6B: PM I-5 DTA speed comparison (miles per hour)

	NPMRDS - Corridor PM Average Congested Speed						2018 DTA - Corridor PM Congested Speed						DTA minus NPMRDS Speed								
	North Bound			South Bound			North Bound / EB			South Bound /WB			North Bound / EB			South Bound /WB					
	3 to 4	4 to 5	5 to 6	3 to 4	4 to 5	5 to 6	3 to 4	4 to 5	5 to 6	3 to 4	4 to 5	5 to 6	3 to 4	4 to 5	5 to 6	3 to 4	4 to 5	5 to 6			
I-5 Seg A	61	61	60	58	57	58	58	58	58	58	58	58	59	58	58	3	3	2	-1	-2	0
I-5 Seg B	59	59	59	48	41	39	59	51	50	56	43	40	56	43	40	0	8	9	-8	-3	-1
I-5 Seg C	62	61	61	60	60	60	63	60	61	63	61	62	63	61	62	-1	1	0	-3	0	-2
Martin Wy Seg A	25	25	24	27	25	24	27	28	28	28	27	23	28	27	23	-2	-3	-5	0	-2	1
Martin Wy Seg B	20	21	20	18	17	19	22	21	20	21	18	18	21	18	18	-2	0	0	-4	-1	0
Martin Wy Seg C	16	15	16	16	15	16	19	17	15	19	18	19	19	18	19	-3	-2	1	-4	-2	-2
Capitol Blvd Seg A	18	18	17	17	15	14	20	20	20	21	18	19	21	18	19	-2	-2	-3	-3	-3	-4
Capitol Blvd Seg B	20	16	14	24	21	19	25	23	24	22	21	20	22	21	20	-6	-7	-10	2	0	-2
Capitol Blvd Seg C	14	13	12	18	19	15	21	20	20	21	21	19	21	21	19	-7	-7	-9	-3	-2	-4
Plum Seg A	16	14	15	18	15	12	16	13	13	17	16	17	17	16	17	0	1	2	0	-1	-5
College Seg A	17	16	15	15	15	12	21	18	18	20	15	16	20	15	16	-4	-2	-4	-4	0	-4
College Seg B	14	14	16	17	20	19	30	27	27	31	30	31	31	30	31	-16	-13	-11	-14	-10	-12
College Seg C	21	18	19	23	27	21	28	28	29	25	19	19	25	19	19	-8	-10	-10	-2	8	1
Marvin Seg A	23	26	25	17	19	20	33	30	31	29	28	28	29	28	28	-11	-4	-7	-12	-9	-8
Marvin Seg B	15	15	15	17	15	15	18	17	17	16	14	10	16	14	10	-3	-2	-3	0	1	5
4th/State Seg A	17	17	16	18	18	18	21	20	20	19	17	17	19	17	17	-3	-2	-4	-1	2	1
Harrison Seg A	16	19	19	19	18	20	24	23	24	21	19	20	21	19	20	-8	-4	-5	-3	-1	0
Pacific/Lacey Seg A	24	21	22	27	23	25	24	22	19	27	26	26	27	26	26	0	-1	3	0	-3	-1
Pacific/Lacey Seg B				16	15	16	21	18	19	23	22	21	23	22	21				-8	-7	-5
Pacific/Lacey Seg C	17	16	15	17	17	17	17	14	16	16	15	16	16	15	16	0	2	-1	1	2	1
US 101 Seg A	51	52	52	49	49	48	50	48	49	54	52	50	54	52	50	1	4	3	-5	-3	-2
US 101 Seg B	60	60	60	58	58	59	60	59	59	59	59	58	59	59	58	0	0	1	-1	-1	1
Yelm Hwy Seg A	34	40	39	39	43	35	46	45	44	45	45	45	44	45	45	-11	-5	-5	-6	-2	-10
Yelm Hwy Seg B	24	22	20	27	24	22	26	25	24	27	26	26	27	26	26	-1	-2	-4	0	-1	-4

TABLE 7A: AM I-5 DTA travel time comparison (seconds)

	NPMRDS - Corridor AM Congested Travel Time - Seconds									2018 DTA - Corridor AM Travel Time									DTA minus NPMRDS Travel Time								
	North Bound			South Bound			North Bound			South Bound			North Bound			South Bound			North Bound			South Bound					
	6 to 7	7 to 8	8 to 9	6 to 7	7 to 8	8 to 9	6 to 7	7 to 8	8 to 9	6 to 7	7 to 8	8 to 9	6 to 7	7 to 8	8 to 9	6 to 7	7 to 8	8 to 9	6 to 7	7 to 8	8 to 9	6 to 7	7 to 8	8 to 9			
I-5 Seg A	494	485	430	425	426	433	433	434	434	434	438	438	436	438	438	438	438	438	-60	-51	5	11	12	12	5		
I-5 Seg B	304	305	297	287	291	333	297	305	310	310	298	298	293	301	298	298	298	298	-7	0	13	6	9	9	-35		
I-5 Seg C	335	341	337	332	328	332	327	353	370	331	330	330	327	331	330	330	330	330	-8	12	33	-5	3	3	-2		
Martin Wy Seg A	267	267	286	246	288	279	319	371	331	331	289	289	285	295	289	289	289	289	52	103	45	39	7	11	11		
Martin Wy Seg B	323	348	350	356	424	436	434	451	458	453	518	518	453	453	528	518	518	518	110	103	108	97	104	81	81		
Martin Wy Seg C	465	503	526	427	512	500	432	453	432	390	398	398	390	394	398	398	398	398	-34	-49	-94	-38	-117	-102	-102		
Capitol Blvd Seg A	410	399	390	286	370	452	382	360	369	349	358	360	349	358	360	360	360	360	-28	-39	-22	64	-12	-12	-92		
Capitol Blvd Seg B	243	261	266	203	188	198	166	187	182	206	203	207	206	203	207	207	207	207	-76	-74	-85	4	15	9	9		
Capitol Blvd Seg C	307	474	360	312	362	324	321	370	360	292	306	315	292	306	315	315	315	315	14	-104	1	-20	-56	-9	-9		
Plum Seg A	115	135	157	100	151	146	161	153	160	141	138	138	141	144	138	138	138	138	46	19	3	42	-7	-8	-8		
College Seg A	129	161	156	153	151	144	150	170	163	136	143	156	136	143	156	156	156	156	21	9	7	-18	-8	12	12		
College Seg B	217	222	265	239	350	285	174	187	180	167	172	168	180	167	172	168	168	168	-42	-35	-84	-72	-178	-117	-117		
College Seg C	162	188	166	158	195	176	157	164	161	186	187	196	186	187	196	196	196	196	-5	-24	-5	29	-7	20	20		
Marvin Seg A	235	241	232	310	331	339	198	204	200	217	231	226	217	231	226	226	226	226	-37	-38	-32	-92	-101	-114	-114		
Marvin Seg B	271	351	309	209	271	262	310	340	318	284	295	288	284	295	288	288	288	288	39	-11	9	75	24	26	26		
4th/State Seg A	234	255	261	283	288	301	267	268	268	270	286	282	270	286	282	282	282	282	32	13	7	-13	-2	-19	-19		
Harrison Seg A	376	393	369	324	325	380	322	324	326	366	377	391	366	377	391	391	391	391	-54	-69	-43	42	52	11	11		
Pacific/Lacey Seg A	380	342	342	271	286	355	265	273	272	285	292	296	285	292	296	296	296	296	-115	-69	-70	14	6	-60	-60		
Pacific/Lacey Seg B				156	218	173	178	189	190	168	180	181	168	180	181	181	181	181				12	-38	8	8		
Pacific/Lacey Seg C	388	446	378	362	400	418	418	432	432	443	465	463	443	465	463	463	463	463	31	-14	54	81	64	45	45		
US 101 Seg A	69	69	71	71	73	71	68	70	69	66	68	67	66	68	67	67	67	67	-1	1	-1	-5	-5	-3	-3		
US 101 Seg B	135	134	134	140	149	155	117	118	117	114	115	115	114	115	115	115	115	115	-18	-17	-17	-25	-34	-40	-40		
Yelmin Hwy Seg A	549	550	667	603	723	939	533	535	533	529	533	533	529	533	533	533	533	533	-16	-15	-135	-74	-190	-406	-406		
Yelmin Hwy Seg B	442	538	558	450	609	538	493	509	501	483	550	525	483	550	525	525	525	525	50	-28	-57	33	-59	-13	-13		

**TABLE 7B: PM I-5 DTA travel time comparison (seconds)**

	NPMRDS - Corridor PM Congested Travel Time - Seconds						2018 DTA - Corridor PM Travel Time						DTA minus NPMRDS Travel Time						
	North Bound			South Bound			North Bound			South Bound			North Bound			South Bound			
	3 to 4	4 to 5	5 to 6	3 to 4	4 to 5	5 to 6	3 to 4	4 to 5	5 to 6	3 to 4	4 to 5	5 to 6	3 to 4	4 to 5	5 to 6	3 to 4	4 to 5	5 to 6	
I-5 Seg A	413	411	419	445	457	444	434	436	436	436	436	447	450	21	25	16	-6	-10	5
I-5 Seg B	293	295	295	356	419	431	300	348	353	310	398	430	430	7	54	58	-46	-21	-1
I-5 Seg C	330	335	335	333	335	336	325	339	335	325	340	332	332	-5	4	0	-8	6	-4
Martin Wy Seg A	320	314	339	295	323	328	300	287	290	295	304	354	354	-19	-27	-49	0	-18	25
Martin Wy Seg B	461	435	443	510	520	487	449	473	487	463	535	539	539	-12	38	44	-47	15	52
Martin Wy Seg C	582	626	584	593	604	559	444	502	558	425	456	430	430	-138	-124	-26	-169	-147	-128
Capitol Blvd Seg A	425	420	458	436	496	528	373	378	380	364	417	404	404	-52	-42	-78	-72	-80	-124
Capitol Blvd Seg B	229	274	313	189	218	237	180	197	190	205	215	221	221	-49	-77	-123	16	-3	-16
Capitol Blvd Seg C	467	537	568	368	352	461	325	350	335	323	328	369	369	-141	-187	-233	-45	-24	-92
Plum Seg A	138	157	151	124	143	183	136	165	168	144	154	145	145	-2	8	17	20	11	-37
College Seg A	170	186	196	189	188	243	155	179	175	163	213	202	202	-15	-7	-21	-27	26	-42
College Seg B	397	424	365	330	290	307	176	198	198	171	177	175	175	-221	-226	-167	-159	-113	-131
College Seg C	220	252	242	198	165	217	161	162	160	181	239	236	236	-59	-90	-82	-17	73	19
Marvin Seg A	264	230	242	358	315	300	191	213	202	220	227	224	224	-73	-17	-40	-138	-88	-76
Marvin Seg B	364	389	398	347	374	369	314	346	331	353	397	554	554	-50	-43	-67	6	23	185
4th/State Seg A	329	329	356	319	312	328	273	288	287	309	345	340	340	-56	-41	-69	-10	33	12
Harrison Seg A	488	426	428	432	452	404	332	344	337	377	422	403	403	-156	-82	-91	-55	-29	-2
Pacific/Lacey Seg A	322	354	341	281	325	303	320	343	392	286	295	294	294	-2	-11	51	6	-29	-9
Pacific/Lacey Seg B				237	241	226	201	229	222	169	180	186	186				-69	-61	-41
Pacific/Lacey Seg C	457	491	507	440	432	445	428	538	463	462	492	470	470	-29	46	-43	21	59	25
US 101 Seg A	70	69	69	69	70	70	68	72	70	68	71	74	74	-2	2	1	-1	1	4
US 101 Seg B	132	133	132	139	139	137	117	118	118	116	116	118	118	-15	-15	-14	-23	-22	-19
Yelm Hwy Seg A	699	603	618	613	567	688	543	554	562	537	543	543	543	-156	-48	-56	-76	-24	-145
Yelm Hwy Seg B	543	594	663	491	541	603	518	535	547	491	514	515	515	-24	-59	-117	0	-27	-88

# SUMMARY

This report documents the development and validation/calibration of the I-5 Models in Thurston County. Transportation models are used to make objective, judicious and informed decisions on transportation investments. In addition, models provide a platform to assess future transportation issues, to identify potential solutions, and to evaluate the efficiency of such solutions.

All efforts have been made to validate the 2017 model to actual data. For the base year, the models give a reasonable estimation of regional travel behavior.

All future year models are based on land use forecasts and current travel behaviors. A forecast is only as accurate as the assumptions that underlie it. They give us important information about our general direction, given what is known today. It is recognized that many other factors, beyond the forecast, may impact future travel patterns.

It should be noted that the models are statistical estimations of regional travel behavior. As such, they should only be used for generalized planning purposes. For specific investment decisions, more detailed modeling, such as operational modeling under the guidance of a professional engineer, is generally used.