SR 520 Bridge Traffic and Revenue Study 2017 Update

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WSDOT Toll Division

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1.0 INTRODUCTION

Stantec Consulting Services Inc. ("Stantec") was retained by the Washington State Department of Transportation (WSDOT) to conduct a Traffic and Revenue (T&R) study for the existing SR 520 bridge across Lake Washington near Seattle in the Central Puget Sound Region. The study includes forecasts of traffic and gross toll revenue potential for fiscal years 2018 through 2056.

1.1 STUDY PURPOSE

The SR 520 Bridge Investment Grade Traffic and Revenue Study report dated August 29, 2011 (the "September 2011 Forecast") was prepared by the Traffic Consultant, CDM Smith. It contained their professional opinion of the forecasted traffic and gross revenue for the facility as of the date of the report. Since the publishing of that original study, CDM Smith has completed report updates and revised their forecasts as part of the following studies:

- September 2012 Forecast
- October 2013 Forecast
- November 2014 Forecast
- November 2015 Forecast
- November 2016 Forecast

Stantec has been retained as the Traffic Consultant and issued a revised forecast on November 2, 2017 (the "November 2017 Forecast"). The revised forecast accounted for detailed information for tolling experience January 1 to December 31, 2016, preliminary tolling experience January 1 to June 30, 2017, revised bridge configuration with the funding of the SR 520 West Side improvements, revised closure schedule, February 2017 revised economic forecast, revised toll rate schedule, and exemption policy formally adopted by WSTC in May 2017.

The purpose of this study is to develop an updated traffic and gross toll revenue potential forecast to support ongoing SR 520 traffic and revenue needs after the final SR 520 bond sale. Stantec's efforts for this study included collecting data from existing sources, evaluating the current traffic conditions and revenue collected on the bridge, developing and calibrating a travel forecasting model for the project, and preparing a gross potential T&R stream.

As part of Stantec's on-call T&R contract with WSDOT, BERK Consulting (BERK) was retained to provide an independent review of the regional economic forecasts in the Central Puget Sound region. The most recent update to this review, completed in February 2017, was used in this study.

1.2 ORGANIZATION OF THE REPORT

The remainder of this report is organized in the following chapters:

- Chapter 2.0 – Project Description and Historical Performance: This chapter describes the study corridor, its current configuration, and its role in the highway network. It also discusses the project history in terms of its configuration changes, toll policy and traffic and revenue.

- Chapter 3.0 – Existing Conditions: This chapter gives an overview of the existing traffic conditions on SR 520 and summarizes the travel conditions in the corridor in terms of traffic volumes, classification data, travel speeds, and current payment shares.
- Chapter 4.0 – Socioeconomic Variables and Land Use: This chapter describes the socioeconomic projections used to develop the traffic forecasts, and an assessment of the region's economy and future development in the study area.
- Chapter 5.0 – Model Development and Calibration: This chapter explains the modeling methodology used to produce the traffic and gross toll revenue potential forecasts. It includes a discussion of the regional travel demand model and the toll diversion model.
- Chapter 6.0 – Traffic and Gross Toll Revenue Potential Forecast: This chapter presents the long-range traffic and gross toll revenue potential forecasts for the SR 520 bridge, as well as the assumptions and methodology used to prepare the forecasts.

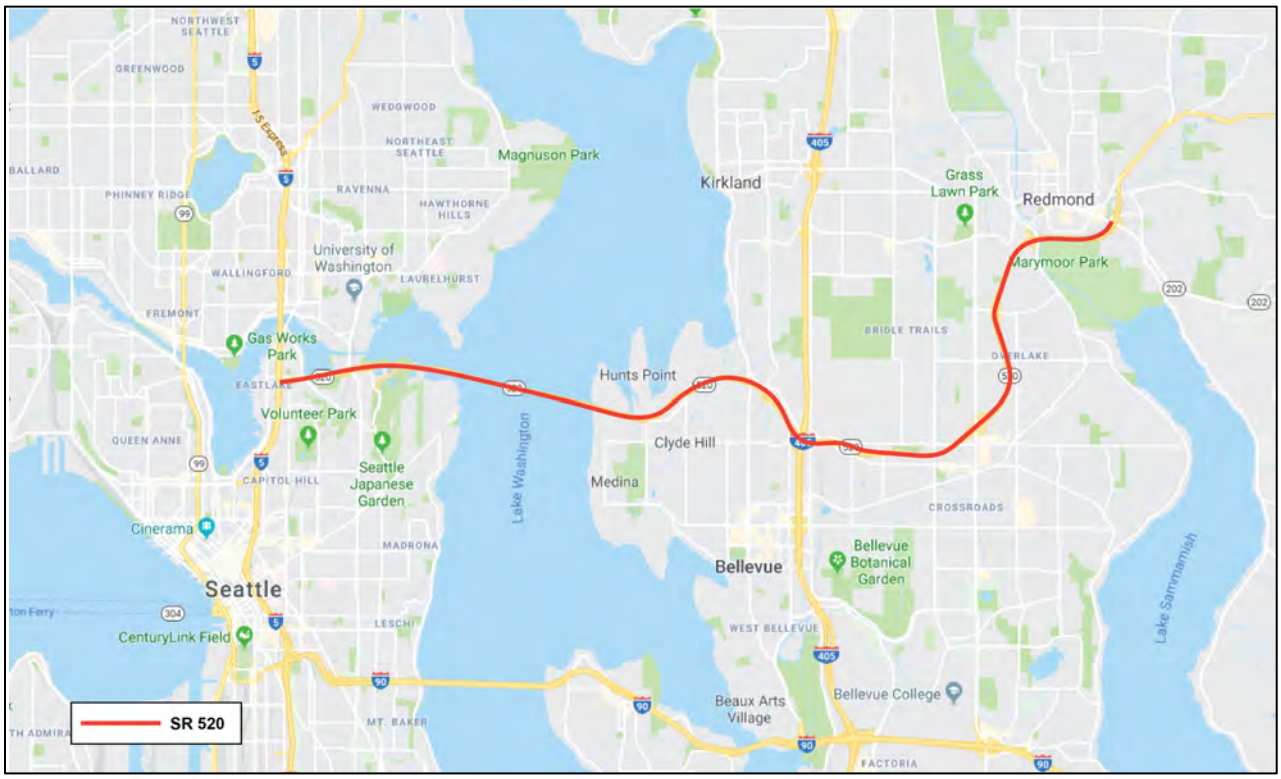
2.0 PROJECT DESCRIPTION AND HISTORY

The following chapter provides an overview of the SR 520 project, as well as the description of the WSDOT's SR 520 Bridge Replacement and HOV Program, and details of the existing and future configuration of the facility. The historical toll rates and traffic and gross toll revenue are also discussed.

2.1 PROJECT DESCRIPTION

SR 520 extends about 13 miles from I-5 in the west, over Lake Washington, to SR 202 in the east. it has a major interchange with I-405 on the east side of the lake. The facility provides a vital highway link between Seattle on the west side of Lake Washington and the eastside communities including Bellevue, Kirkland and Redmond. Figure 2.1 shows the location of SR 520 in the Seattle area. Tolls for crossing the floating bridge portion of the facility crossing Lake Washington are collected on the east side of the bridge via electronic tolling. The purpose of this study is to update the future toll traffic and gross toll revenue potential forecasts based on the most recent data available.

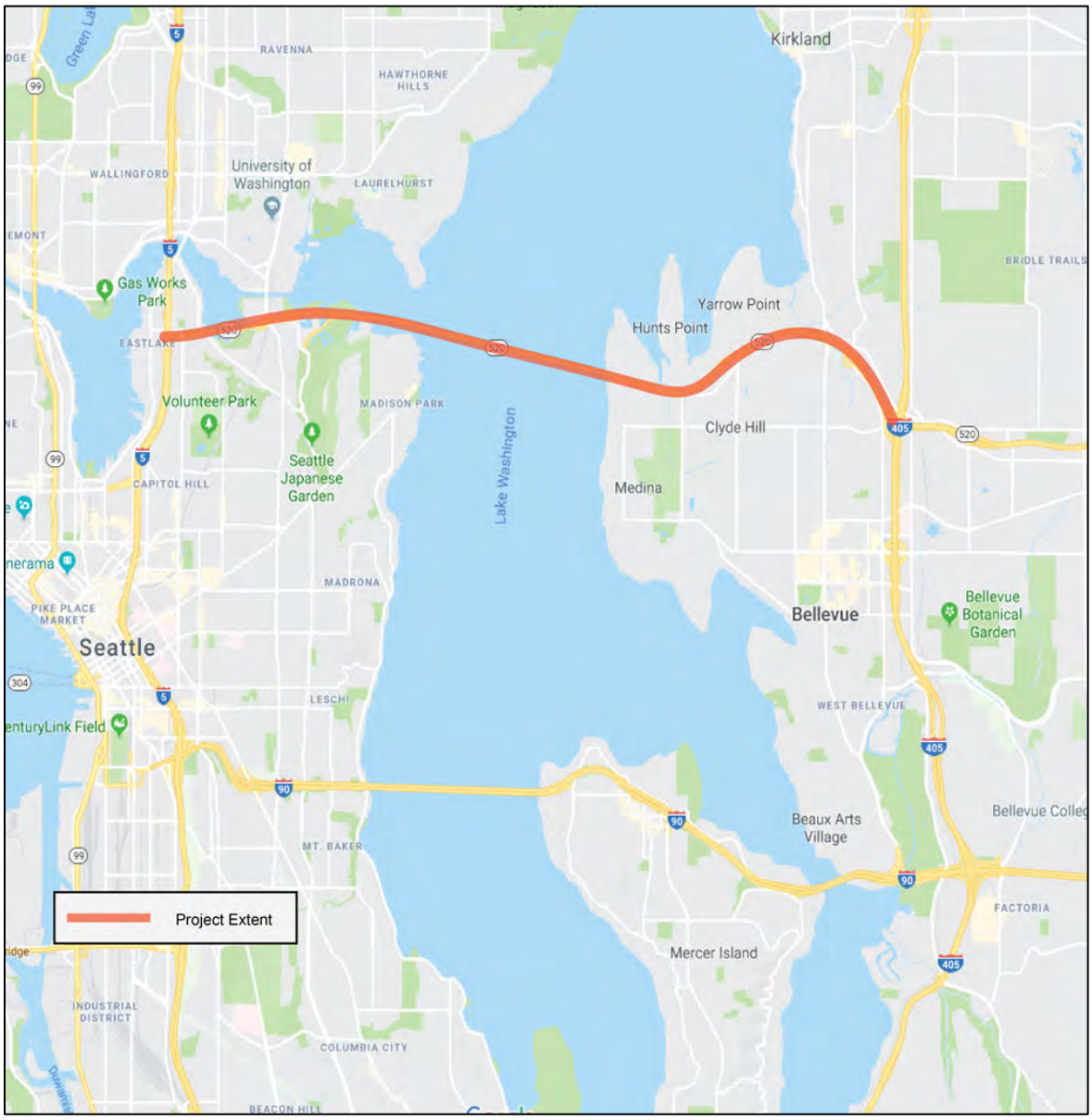
Figure 2.1: SR 520 Location Map



2.2 SR 520 BRIDGE REPLACEMENT AND HOV PROGRAM

WSDOT is making major enhancements to the SR 520 Bridge Replacement and HOV Program between I-5 and I-405. The program is improving traffic safety by replacing SR 520's aging and vulnerable bridges, while making other key highway improvements to enhance public mobility and transportation options throughout the corridor. The portion of SR 520 that is part of the SR 520 Bridge Replacement and HOV Program is highlighted in Figure 2.2.

Figure 2.2: SR 520 Bridge Replacement and HOV Program



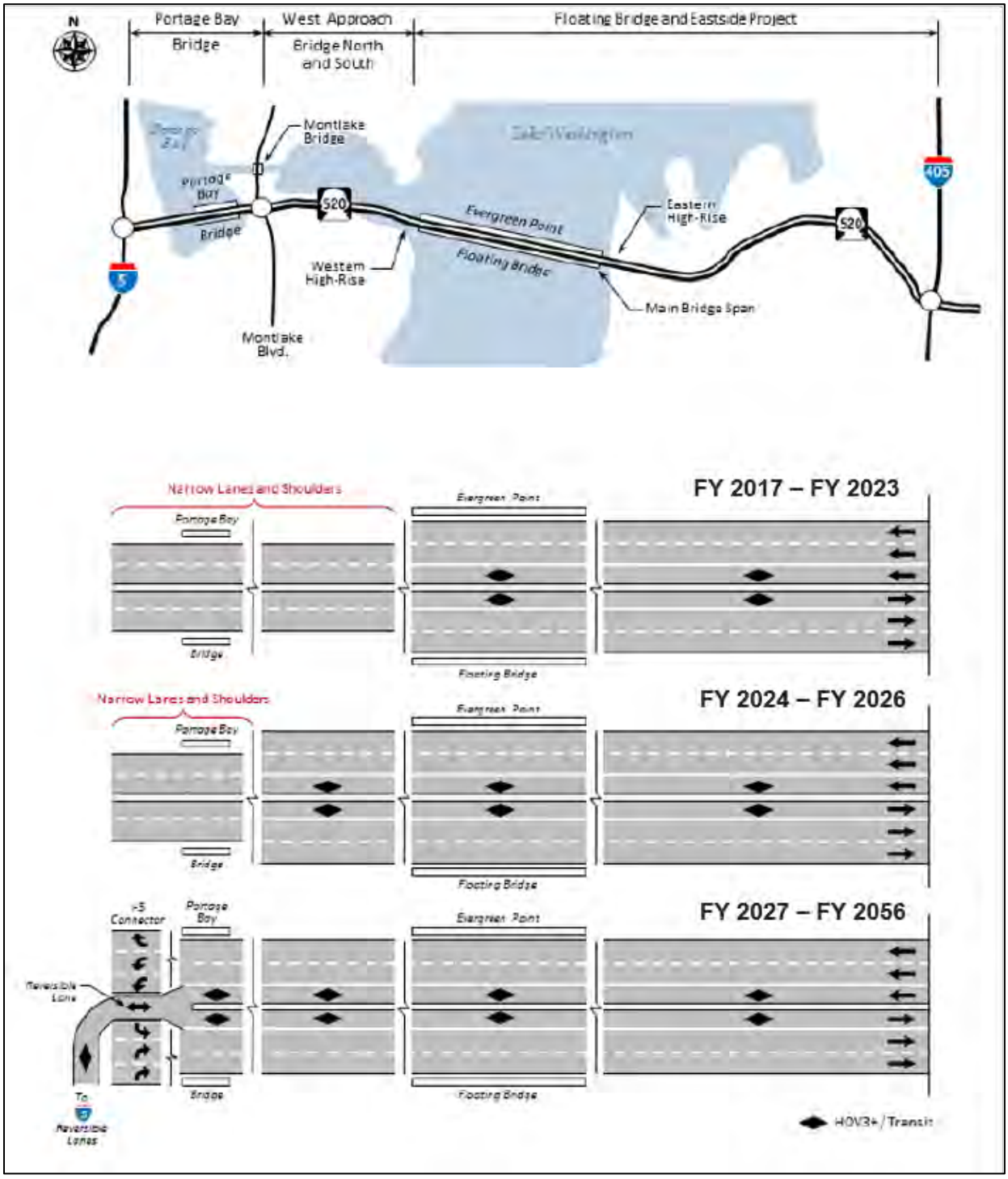
The SR 520 Bridge Replacement and HOV Program consists of five major components:

- The Pontoon Construction (complete),
- The Eastside Transit and HOV Project (complete),
- The Floating Bridge and Landings Project (complete),
- The West Approach Bridge North (complete), and
- The I-5 to Lake Washington ("Rest of the West"), including the West Approach Bridge South, the new Portage Bay Bridge and the second Montlake Boulevard bascule bridge across the Montlake Cut.

These improvements include: a new, safer, six-lane floating bridge, with a cross-lake bicycle and pedestrian path; 77 bridge pontoons built at facilities in Grays Harbor and Tacoma; the corridor's Eastside transit and HOV improvements between Lake Washington and I-405; the north (westbound) half of a new west approach bridge connecting Seattle to the new floating bridge (WABN); a replacement West Approach Bridge South for eastbound traffic connecting Seattle to the new floating bridge; a second Montlake Boulevard bascule bridge over the Montlake Cut; a new, six-lane Portage Bay Bridge; an extension of a regional bicycle and pedestrian path from Montlake to I-5; and mitigation of the program's environmental impacts.

Figure 2.3 shows the timeline of improvements used in this study. The timeline shows the configuration of the roadway that will be in place in each year. As shown, the roadway configuration of the floating bridge and the area to the east of the floating bridge have no changes planned at this time. West of this area, an additional HOV lane in each direction is scheduled to be constructed by FY 2024 and extended by FY 2027.

Figure 2.3: SR 520 Bridge Replacement and HOV Program Construction Assumptions



2.3 SR 520 BRIDGE TOLLING HISTORY

2.3.1 Toll Rate History

Tolling on the original SR 520 bridge began on December 29, 2011 to supplement funding for the construction of the new floating bridge which opened in April 2016. Tolls vary by time of day and by weekday and weekend. Two primary toll payment methods are available: a *Good To Go!* prepaid account which detects the user via a pass or license plate recognition, and Pay By Mail in which the vehicle's registered owner name and address are identified from the license plate and mailed a toll bill. There is no cash toll collection. The Washington State Transportation Commission (WSTC) has approved and implemented six separate toll increases since tolling began. These increases commenced on July 1 of every year between 2012 and 2017, which is the start of each Fiscal Year (FY). No further toll increases are planned at this time; the current FY 2018 rates are assumed to be in effect through the forecast period. Table 2-1 and Table 2-2 show the weekday *Good to Go!* and Pay by Mail passenger car toll schedules in effect from FY 2012 onward. Table 2-3 and Table 2-4 show the weekend *Good to Go!* and Pay by Mail passenger car toll schedules in effect from FY 2012 onward. The weekday *Good to Go!* passenger car rates are also shown in Figure 2.4.

Table 2.1: SR 520 Weekday 2-Axle Toll Schedule-*Good to Go!* Rates

Time Period	Actual and Planned Rate Assumptions	5-6 AM	6-7 AM	7-9 AM	9-10 AM	10AM-2PM	2-3 PM	3-6 PM	6-7 PM	7-9 PM	9-11 PM	11PM-5AM
FY 2012	Opening Rates	$1.60	$2.80	$3.50	$2.80	$2.25	$2.80	$3.50	$2.80	$2.25	$1.60	$0.00
FY 2013	+2.5% (No Rounding)	$1.64	$2.87	$3.59	$2.87	$2.31	$2.87	$3.59	$2.87	$2.31	$1.64	$0.00
		+2.5%	*+2.5%*	*+2.6%*	*+2.5%*	*+2.7%*	*+2.5%*	*+2.6%*	*+2.5%*	*+2.7%*	*+2.5%*	
FY 2014	+2.5% Nickel Rounding	$1.70	$2.95	$3.70	$2.95	$2.35	$2.95	$3.70	$2.95	$2.35	$1.70	$0.00
		+3.7%	*+2.8%*	*+3.1%*	*+2.8%*	*+1.7%*	*+2.8%*	*+3.1%*	*+2.8%*	*+1.7%*	*+3.7%*	
FY 2015	+2.5% Nickel Rounding	$1.75	$3.00	$3.80	$3.00	$2.40	$3.00	$3.80	$3.00	$2.40	$1.75	$0.00
		+2.9%	*+1.7%*	*+2.7%*	*+1.7%*	*+2.1%*	*+1.7%*	*+2.7%*	*+1.7%*	*+2.1%*	*+2.9%*	
FY 2016	+2.5% Nickel Rounding	$1.80	$3.10	$3.90	$3.10	$2.45	$3.10	$3.90	$3.10	$2.45	$1.80	$0.00
		+2.9%	*+3.3%*	*+2.6%*	*+3.3%*	*+2.1%*	*+3.3%*	*+2.6%*	*+3.3%*	*+2.1%*	*+2.9%*	
FY 2017	+5.0% Nickel Rounding	$1.90	$3.25	$4.10	$3.25	$2.55	$3.25	$4.10	$3.25	$2.55	$1.90	$0.00
		+5.6%	*+4.8%*	*+5.1%*	*+4.8%*	*+4.1%*	*+4.8%*	*+5.1%*	*+4.8%*	*+4.1%*	*+5.6%*	
FY 2018 and After	+5.0% and Night Tolling with Nickel Rounding	$2.00	$3.40	$4.30	$3.40	$2.70	$3.40	$4.30	$3.40	$2.70	$2.00	$1.25
		+5.3%	*+4.6%*	*+4.9%*	*+4.6%*	*+5.9%*	*+4.6%*	*+4.9%*	*+4.6%*	*+5.9%*	*+5.3%*	

Note: Fiscal Year (FY) is defined as the 12-month period ending June 30 of that year. For example, FY 2013 refers to the 12-month period beginning July 1, 2012 and ending June 30, 2013.

Table 2.2: SR 520 Weekday 2-Axle Toll Schedule-Pay by Mail Rates

Time Period	Actual and Planned Rate Assumptions	5-6 AM	6-7 AM	7-9 AM	9-10 AM	10AM-2PM	2-3 PM	3-6 PM	6-7 PM	7-9 PM	9-11 PM	11PM-5AM
FY 2012	Opening Rates	$3.10	$4.30	$5.00	$4.30	$3.75	$4.30	$5.00	$4.30	$3.75	$3.10	$0.00
FY 2013	+2.5% (No Rounding)	$3.18	$4.41	$5.13	$4.41	$3.84	$4.41	$5.13	$4.41	$3.84	$3.18	$0.00
		+2.6%	*+2.6%*	*+2.6%*	*+2.6%*	*+2.4%*	*+2.6%*	*+2.6%*	*+2.6%*	*+2.4%*	*+2.6%*	
FY 2014	+2.5% Nickel Rounding	$3.25	$4.50	$5.25	$4.50	$3.95	$4.50	$5.25	$4.50	$3.95	$3.25	$0.00
		+2.2%	*+2.0%*	*+2.3%*	*+2.0%*	*+2.9%*	*+2.0%*	*+2.3%*	*+2.0%*	*+2.9%*	*+2.2%*	
FY 2015	+2.5% Nickel Rounding	$3.35	$4.60	$5.40	$4.60	$4.05	$4.60	$5.40	$4.60	$4.05	$3.35	$0.00
		+3.1%	*+2.2%*	*+2.9%*	*+2.2%*	*+2.5%*	*+2.2%*	*+2.9%*	*+2.2%*	*+2.5%*	*+3.1%*	
FY 2016	+2.5% Nickel Rounding	$3.45	$4.70	$5.55	$4.70	$4.15	$4.70	$5.55	$4.70	$4.15	$3.45	$0.00
		+3.0%	*+2.2%*	*+2.8%*	*+2.2%*	*+2.5%*	*+2.2%*	*+2.8%*	*+2.2%*	*+2.5%*	*+3.0%*	
FY 2017	Good To Go! Toll Rates + $2.00 PBM increment	$3.90	$5.25	$6.10	$5.25	$4.55	$5.25	$6.10	$5.25	$4.55	$3.90	$0.00
		+13.0%	*+11.7%*	*+9.9%*	*+11.7%*	*+9.6%*	*+11.7%*	*+9.9%*	*+11.7%*	*+9.6%*	*+13.0%*	
FY 2018 and After	Good To Go! Toll Rates + $2.00 PBM increment	$4.00	$5.40	$6.30	$5.40	$4.70	$5.40	$6.30	$5.40	$4.70	$4.00	$3.25
		+2.6%	*+2.9%*	*+3.3%*	*+2.9%*	*+3.3%*	*+2.9%*	*+3.3%*	*+2.9%*	*+3.3%*	*+2.6%*	

Note: Fiscal Year (FY) is defined as the 12-month period ending June 30 of that year. For example, FY 2013 refers to the 12-month period beginning July 1, 2012 and ending June 30, 2013.

Table 2.3: SR 520 Weekend 2-Axle Toll Schedule-*Good to Go!* Rates

Time Period	Actual and Planned Rate Assumptions	5-8 AM	8-11 AM	11AM-6PM	6-9 PM	9-11 PM	11PM-5AM
FY 2012	Opening Rates	$1.10	$1.65	$2.20	$1.65	$1.10	$0.00
FY 2013	+2.5% (No Rounding)	$1.13	$1.69	$2.26	$1.69	$1.13	$0.00
		+2.7%	*+2.4%*	*+2.7%*	*+2.4%*	*+2.7%*	
FY 2014	+2.5% Nickel Rounding	$1.15	$1.75	$2.30	$1.75	$1.15	$0.00
		+1.8%	*+3.6%*	*+1.8%*	*+3.6%*	*+1.8%*	
FY 2015	+2.5% Nickel Rounding	$1.20	$1.80	$2.35	$1.80	$1.20	$0.00
		+4.3%	*+2.9%*	*+2.2%*	*+2.9%*	*+4.3%*	
FY 2016	+2.5% Nickel Rounding	$1.25	$1.85	$2.40	$1.85	$1.25	$0.00
		+4.2%	*+2.8%*	*+2.1%*	*+2.8%*	*+4.2%*	
FY 2017	+5.0% Nickel Rounding	$1.30	$1.95	$2.50	$1.95	$1.30	$0.00
		+4.0%	*+5.4%*	*+4.2%*	*+5.4%*	*+4.0%*	
FY 2018 and After	+5.0% and Night Tolling with Nickel Rounding	$1.40	$2.05	$2.65	$2.05	$1.40	$1.25
		+7.7%	*+5.1%*	*+6.0%*	*+5.1%*	*+7.7%*	

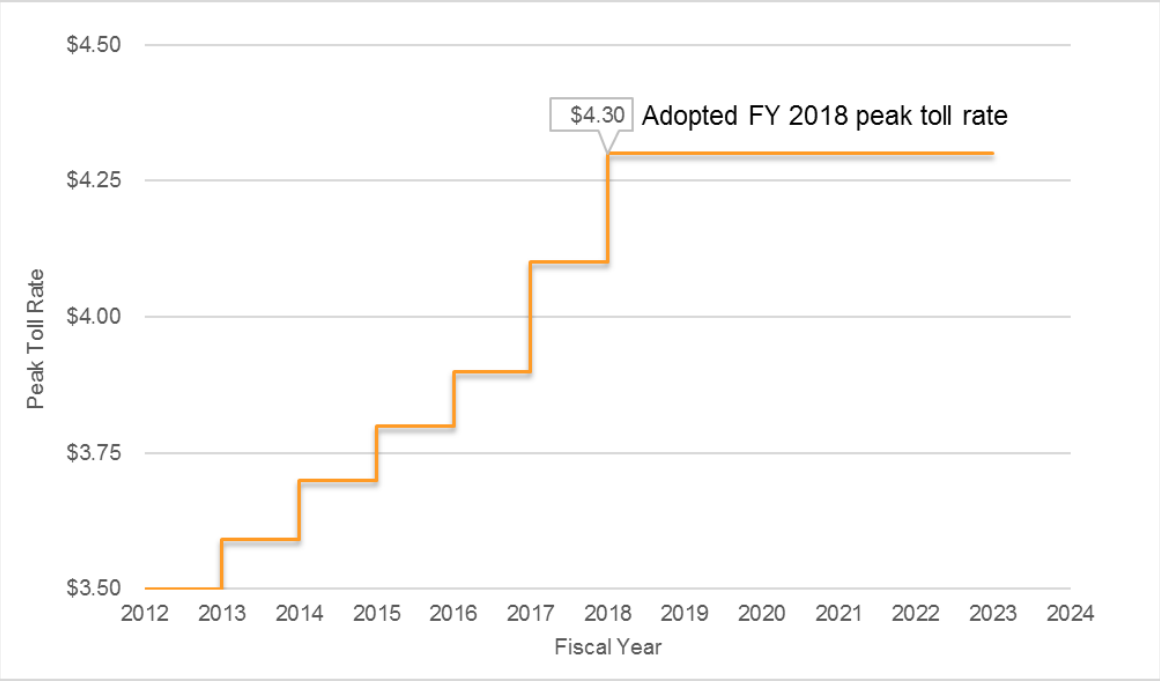
Table 2.4: SR 520 Weekend 2-Axle Toll Schedule-Pay by Mail Rates

Time Period	Actual and Planned Rate Assumptions	5-8 AM	8-11 AM	11AM-6PM	6-9 PM	9-11 PM	11PM-5AM
FY 2012	Opening Rates	$2.60	$3.15	$3.70	$3.15	$2.60	$0.00
FY 2013	+2.5% (No Rounding)	$2.67	$3.23	$3.79	$3.23	$2.67	$0.00
		+2.7%	*+2.5%*	*+2.4%*	*+2.5%*	*+2.7%*	
FY 2014	+2.5% Nickel Rounding	$2.75	$3.30	$3.90	$3.30	$2.75	$0.00
		+3.0%	*+2.2%*	*+2.9%*	*+2.2%*	*+3.0%*	
FY 2015	+2.5% Nickel Rounding	$2.80	$3.40	$4.00	$3.40	$2.80	$0.00
		+1.8%	*+3.0%*	*+2.6%*	*+3.0%*	*+1.8%*	
FY 2016	+2.5% Nickel Rounding	$2.85	$3.50	$4.10	$3.50	$2.85	$0.00
		+1.8%	*+2.9%*	*+2.5%*	*+2.9%*	*+1.8%*	
FY 2017	Good To Go! Toll Rates + $2.00 PBM increment	$3.30	$3.95	$4.50	$3.95	$3.30	$0.00
		+15.8%	*+12.9%*	*+9.8%*	*+12.9%*	*+15.8%*	
FY 2018 and After	Good To Go! Toll Rates + $2.00 PBM increment	$3.40	$4.05	$4.65	$4.05	$3.40	$3.25
		+3.0%	*+2.5%*	*+3.3%*	*+2.5%*	*+3.0%*	

From FY 2013 through FY 2016 toll rates were increased by 2.5 percent, however because nickel rounding was instituted in FY 2014, the FY 2014 through FY 2016 rates vary slightly; some toll rates show increases slightly lower than 2.5 percent while others show increases slightly higher than 2.5 percent. In FY 2017 and 2018, *Good to Go!* rates were increased by 5 percent. Again, the actual increases were slightly different than the 5 percent because toll were rounded to the nearest nickel. Also beginning in FY 2017, the Pay by Mail rate is equal to the *Good to Go!* rate plus a $2.00 increment. The multi-axle vehicle toll rate is equal to the per-axle rate for 2-axle vehicles multiplied by the number of axles and then rounded to the nearest $0.05. The toll rate for a vehicle with more than six axles is 6-axle vehicle rate. As shown, overnight tolling, between 11 PM and 5 AM, began in FY 2018 on both weekdays and weekends.

The maximum *Good to Go!* 2-axle toll in the current toll schedule is $4.30 which is in effect on weekdays from 7 to 9 AM and from 3 to 6 PM, the peak commuting hours. The maximum weekend 2-axle *Good to Go!* toll is $2.65. Overnight tolls on both weekdays and weekends are low; the *Good to Go!* 2-axle rate is $1.25.

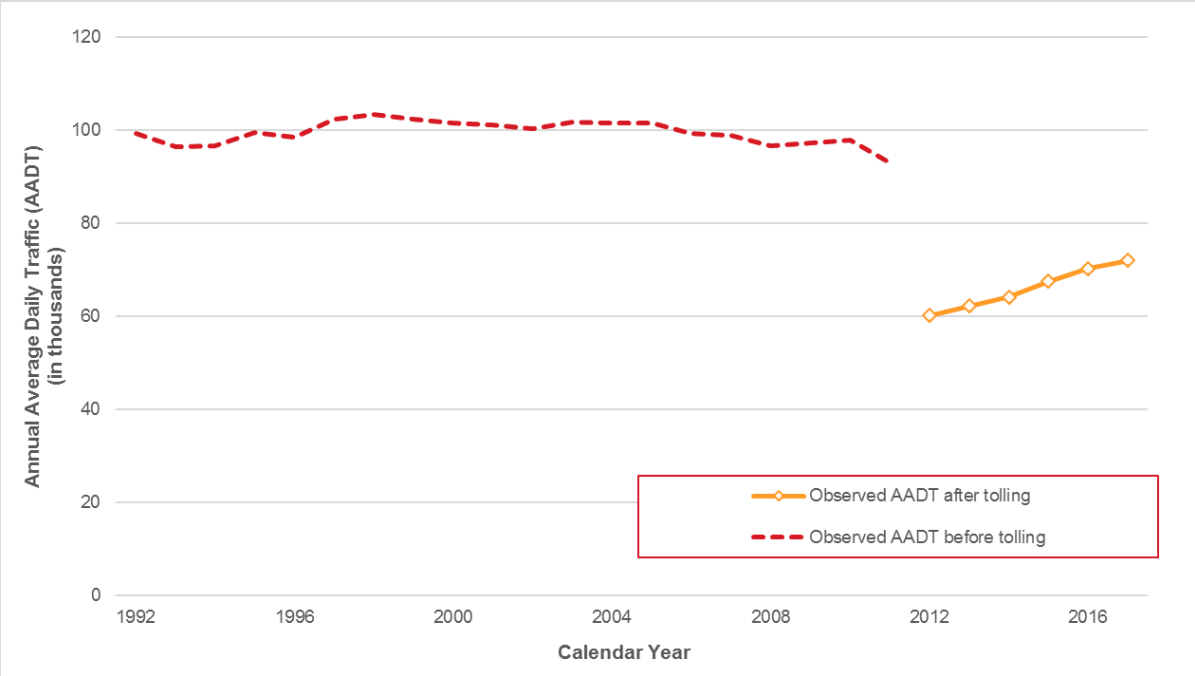
Figure 2.4: SR 520 2-Axle *Good-to-Go!* Weekday Maximum Toll Rate History



2.3.2 Traffic and Revenue History

Figure 2.5 shows the historical AADT, by calendar year, on SR 520. AADT is the Average Annual Daily Traffic and is equivalent to the total annual traffic (tolled and non-tolled) divided by the number of days in a year. As shown, before tolling commenced, traffic was generally flat on SR 520; capacity constraints prevented traffic growth even through the region was growing in population and employment. Traffic did show a slight decrease in the late 2000's during the recession and the subsequent prolonged economic recovery. As shown, traffic decreased by about 36 percent when tolling commenced in December 2011; this number represents an estimate of the diversion due to tolling.

Figure 2.5: Historical SR 520 CY AADT



Source: WSDOT's annual traffic reports

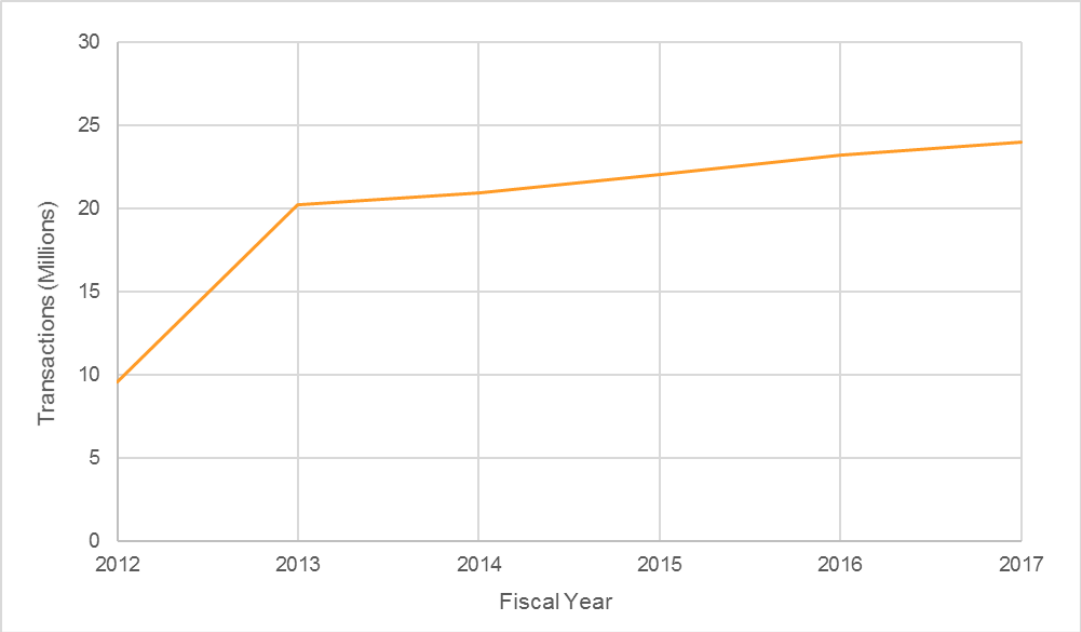
Table 2-5 and Figure 2.6 show the annual fiscal year transactions on SR 520, beginning when tolls commenced on December 29, 2011. Annual transactions have increased from 20.2 million transactions in FY 2013, the first full year of toll operations, to 24.0 million transactions in FY 2017, a total increase of 3.8 million or about 18.6 percent. Between FY 2016 and FY 2017, annual transactions increased by 3.3 percent.

Table 2.5: Historical FY Annual Transactions and Revenue

Fiscal Year	Total Transactions (millions)	Gross Toll Revenue (millions)
2012	9.6	$28.1
2013	20.2	$61.3
2014	21.0	$64.6
2015	22.0	$69.4
2016	23.2	$74.8
2017	24.0	$81.9

Source: Annual T&R reports (TRFC Vol II-83)

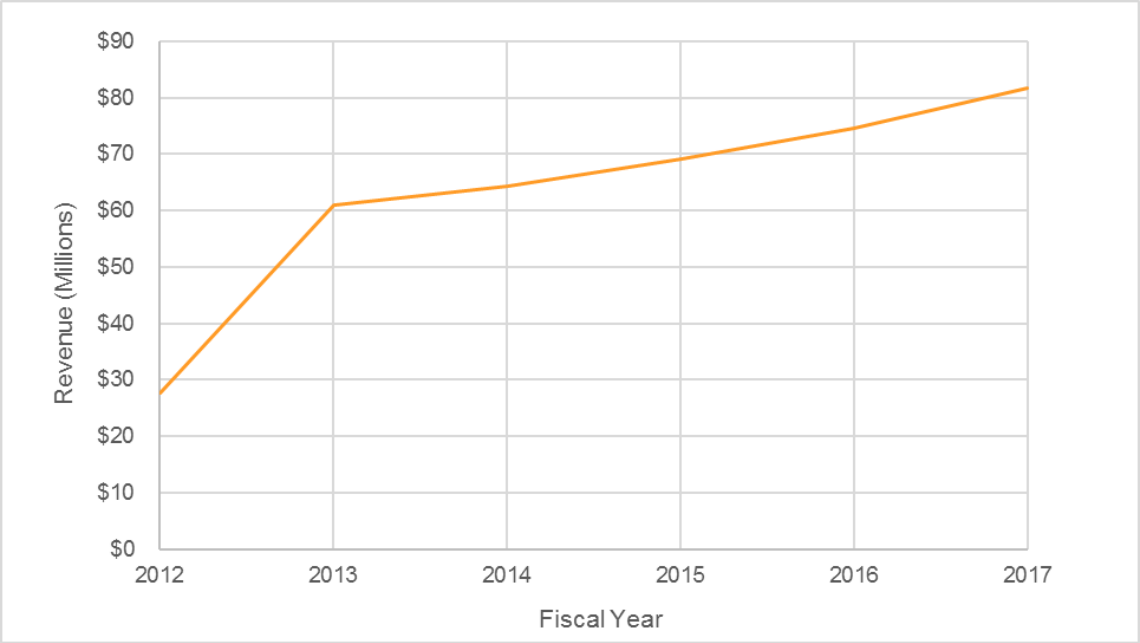
Figure 2.6: Historical SR 520 FY Transactions



Source: Annual T&R reports

Table 2-5 and Figure 2.7 show the annual gross toll revenues on SR 520, beginning when tolls commenced on December 29, 2011. Annual toll revenues have increased from $61.3 million in FY 2013 to $81.9 million in FY 2017, a total increase of 20.6 million or about 33.6 percent. Between FY 2016 and FY 2017, annual gross toll revenue increased by 9.5 percent.

Figure 2.7: Historical SR 520 FY Reported Revenue



Source: Annual T&R reports

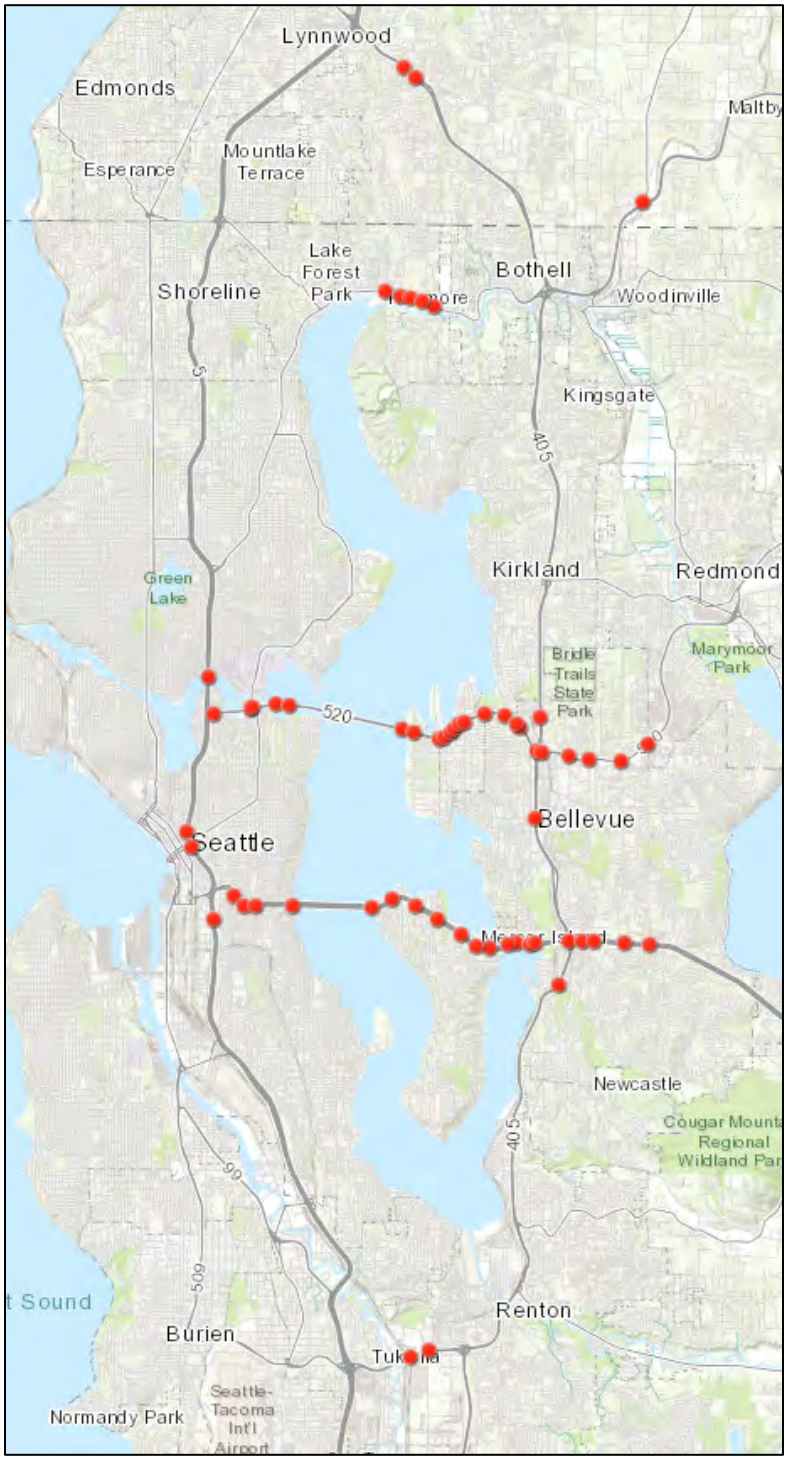
3.0 EXISTING CONDITIONS

The base model year for the project is 2015. As such, existing 2015 traffic data on SR 520 were used to calibrate corridor-specific volumes and speeds to the regional transportation model. Most of the data collection was focused on SR 520, however screenline traffic counts along the main feeder and collector routes were summarized to support the model calibration in detailing the travel movements throughout the study area. This chapter details the existing traffic volumes and speeds along with the current payment shares on SR 520.

The focus of the traffic summaries was to reflect a typical weekday traffic on the main SR 520 bridge span, as well as critical parallel and feeder routes. The primary source for these data was the WSDOT network of permanent pavement loops that collect traffic and speed data on the major routes throughout the region. Stantec used the WSDOT data retrieval software, the Compact Disk Data Retrieval software (CDR), to access the data. The CDR software is used to download and analyze a designated subset of the data based on specific days, locations, and analysis options. It also provides an estimate of the reliability or validity of specific data. Tuesday to Thursday volumes from September to November 2015 were summarized using the CDR software. Historic speeds were also summarized from the CDR software and were supplemented with publicly available data from the SigAlert website. SigAlert collects cell phone data to estimate real-time speeds along major traffic corridors throughout the United States and makes the data available online. Figure 3.1 shows all the permanent count locations that were evaluated.

In addition, transaction data were summarized from the Customer Service Center (CSC) records for calendar years (CY) 2015 and 2016 and fiscal year (FY) 2016 (July 2015-June 2016). These data were used to verify the count data from the permanent count locations and were used in both the calibration and the evaluation of recent trends on the facility. The transaction data were also used to determine the historical payment type splits on the SR 520 bridge. The permanent count data were used to fill in the “gap” for the overnight period, as that period was not tolled and therefore overnight traffic was not included in the CSC totals.

Figure 3.1: Study Area Permanent Count Locations

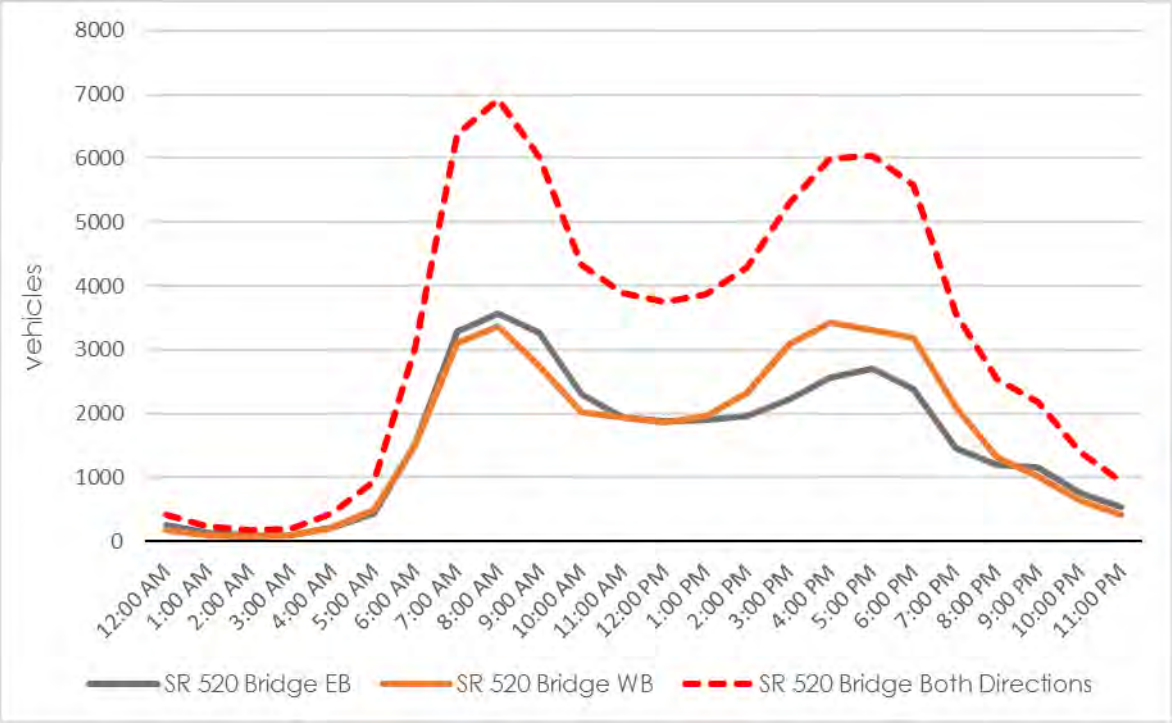


3.1 SR 520 TRAFFIC VOLUMES

3.1.1 Daily Traffic Volumes

The typical daily traffic over the SR 520 bridge was calculated by averaging the non-holiday weekday traffic for available days between September and November 2015. Data from WSDOT's permanent count location network were downloaded from the CDR site. Stantec considered the "validity of data" statistic which is a measure of quality/reliability for the reported data when summarizing the data. Figure 3.2 shows the traffic that travels over the SR 520 bridge on an average weekday (Tuesday-Thursday). The morning traffic peaks around 8:00 AM for both directions at around 3,500 vehicles per direction. In the afternoon period, the westbound traffic peaks at around 4:00 PM at about 3,500 vehicles, approximately one hour earlier than the eastbound traffic at about 2,800 vehicles. AM peak period volumes are similar in both directions with the eastbound volumes only slightly higher than the westbound volumes; westbound volumes are higher in the PM peak period. The bridge carries an average of 78,000 vehicles per weekday in each direction.

Figure 3.2: Typical Weekday SR 520 Bridge Traffic



Source: Tuesday-Thursday CDR data, September – November 2015

3.1.2 Traffic Volumes by Day of the Week

Table 3-1 shows the summarized CSC transaction data by day of the week for CY 2015 and FY 2016. Note that these data do not include overnight transactions as tolls were not collected during the overnight hours in CY 2015 and FY 2016. These summaries also are not adjusted for the times when the bridge was impacted by construction. Since overnight volumes tend to be very low and the number of days affected by construction are also low when

considering all the days of the year, these data do serve to approximate the distribution of traffic volumes crossing the SR 520 bridge by day. As shown, traffic crossing the bridge is much lower over the weekend than on a weekday. Sunday is the least traveled day while Wednesday and Thursday are the most traveled days of the week. Monday is the least traveled weekday.

Table 3.1: SR 520 Transactions by Day of the Week

Day of Week	CY 2015 - Transactions		FY 2016 - Transactions	
	Day Total	Percent of Annual	Day Total	Percent of Annual
Sun	1,970,000	8.6%	1,972,000	8.5%
Mon	3,396,000	14.9%	3,441,000	14.8%
Tue	3,761,000	16.5%	3,800,000	16.4%
Wed	3,795,000	16.6%	3,917,000	16.9%
Thu	3,831,000	16.8%	3,929,000	16.9%
Fri	3,663,000	16.0%	3,684,000	15.9%
Sat	2,415,000	10.6%	2,447,000	10.6%
Total	**22,831,000**	**100%**	**23,190,000**	**100%**

Source: CSC data for CY 2015 and FY 2016. Note that these data do not include overnight transactions as overnight toll collection was not in effect in CY 2015 and FY 2016.

3.1.3 Traffic Volumes by Month

Table 3-2 shows the summarized CSC transaction data by month for CY 2015 and FY 2016. Note that these data do not include overnight transactions as toll were not collected during the overnight hours in CY 2015 and FY 2016. These summaries also are not adjusted for the times when the bridge was impacted by construction and it is assumed that these data also serve to approximate the distribution of traffic volumes crossing the SR 520 bridge by month. As shown, traffic crossing the bridge tends to be lower in the winter months than the summer months.

Table 3.2: SR 520 Transactions by Month

Month	CY 2015 - Transactions		FY 2016 - Transactions	
	Monthly Total	Percent of Annual	Monthly Total	Percent of Annual
Jan	1,805,000	7.9%	1,902,000	8.2%
Feb	1,715,000	7.5%	1,850,000	8.0%
Mar	1,949,000	8.5%	2,046,000	8.8%
Apr	1,941,000	8.5%	1,667,000	7.2%
May	2,021,000	8.8%	2,075,000	8.9%
Jun	1,871,000	8.2%	2,139,000	9.2%
Jul	2,047,000	9.0%	2,047,000	8.8%
Aug	1,932,000	8.5%	1,932,000	8.3%
Sep	1,901,000	8.3%	1,901,000	8.2%
Oct	2,054,000	9.0%	2,054,000	8.8%
Nov	1,750,000	7.7%	1,750,000	7.5%
Dec	1,854,000	8.1%	1,854,000	8.0%
Total	**22,840,000**	**100%**	**23,217,000**	**100%**

Note: These data do not include overnight transactions as overnight toll collection was not in effect in CY 2015 and FY 2016.

Table 3-3 shows the historical transactions by month since the bridge began tolling in December 2011. The amount of transactions each month is affected by factors including construction closures, weather events, traffic events, and the number of weekdays and weekend days each month.

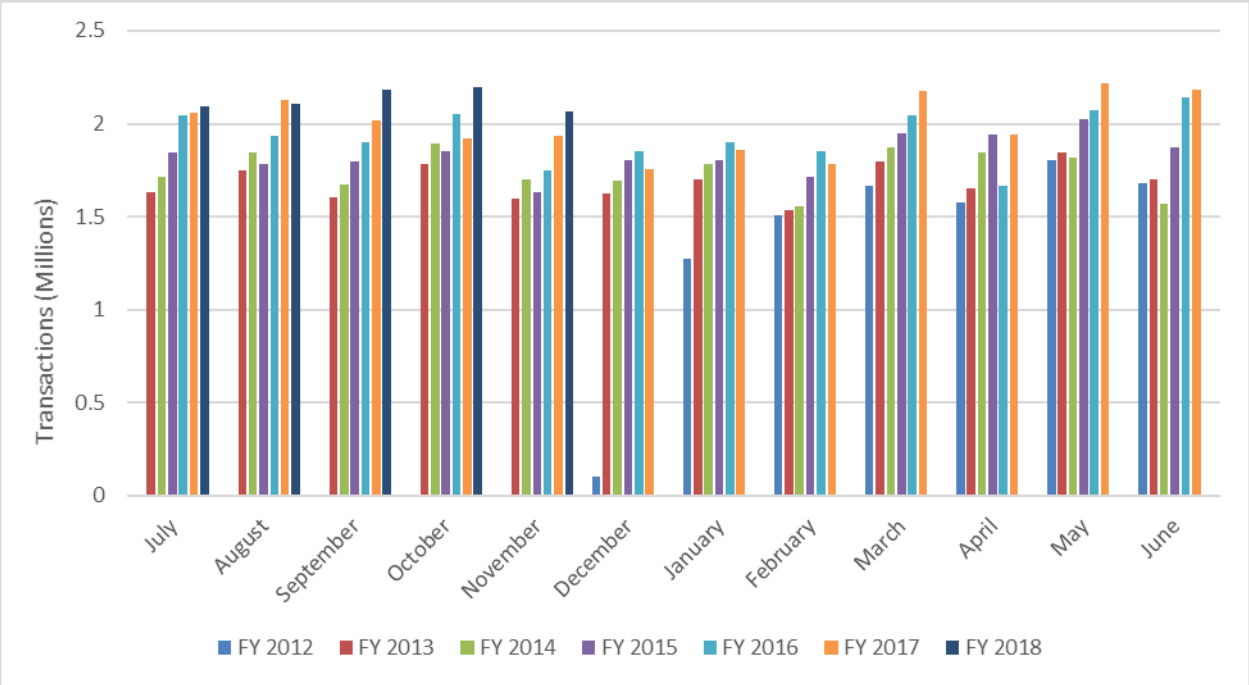
Table 3.3: Historical Transactions by Month

Month	FY 2012	FY 2013		FY 2014		FY 2015		FY 2016		FY 2017		FY 2018
	Monthly Transactions	Monthly Transactions	Percent of Annual	Monthly Transactions	Percent of Annual	Monthly Transactions	Percent of Annual	Monthly Transactions	Percent of Annual	Monthly Transactions	Percent of Annual	Monthly Transactions
Jul		1,634,862	8.1%	1,714,340	8.2%	1,845,510	8.4%	2,047,488	8.8%	2,058,224	8.6%	2,093,627
Aug		1,748,279	8.6%	1,843,593	8.8%	1,785,013	8.1%	1,931,941	8.3%	2,129,472	8.9%	2,107,483
Sep		1,605,673	7.9%	1,672,627	8.0%	1,796,980	8.2%	1,901,386	8.2%	2,013,952	8.4%	2,181,627
Oct		1,780,703	8.8%	1,891,073	9.0%	1,853,706	8.4%	2,053,773	8.8%	1,920,209	8.0%	2,193,620
Nov		1,595,208	7.9%	1,698,416	8.1%	1,632,066	7.4%	1,749,637	7.5%	1,937,514	8.1%	2,063,777
Dec	101,620	1,627,330	8.0%	1,692,471	8.1%	1,804,291	8.2%	1,853,500	8.0%	1,758,571	7.3%	
Jan	1,275,306	1,697,451	8.4%	1,782,226	8.5%	1,804,665	8.2%	1,901,672	8.2%	1,860,068	7.8%	
Feb	1,505,263	1,537,817	7.6%	1,555,759	7.4%	1,714,604	7.8%	1,849,759	8.0%	1,780,747	7.4%	
Mar	1,667,299	1,794,438	8.9%	1,871,405	8.9%	1,949,255	8.9%	2,046,140	8.8%	2,172,872	9.1%	
Apr	1,579,205	1,651,778	8.2%	1,848,497	8.8%	1,940,953	8.8%	1,667,332	7.2%	1,941,236	8.1%	
May	1,800,544	1,843,724	9.1%	1,816,370	8.7%	2,021,484	9.2%	2,075,349	8.9%	2,216,001	9.2%	
Jun	1,679,936	1,703,339	8.4%	1,572,796	7.5%	1,871,243	8.5%	2,139,023	9.2%	2,185,913	9.1%	
Annual	**9,609,173**	**20,220,602**	**100%**	**20,959,573**	**100%**	**22,019,770**	**100%**	**23,217,000**	**100%**	**23,974,779**	**100%**	**10,640,134**

Note: Overnight tolling began FY 2018. FY 2012 is a partial year as tolling began in December 2012. Full year data is not available for FY 2018 at the time of this report.

Figure 3.3 shows the monthly trends in transactions since opening. As shown, the trend is generally increasing each year for each month.

Figure 3.3: Fiscal Year Transactions by Month



3.1.4 Vehicle Classification

Vehicle classification data from the permanent count recorders were also summarized for Tuesdays, Wednesdays, and Thursdays from September to November 2015. The recorders classify the vehicles into four categories (bins) based on the vehicle length. For calibration purposes, Stantec used this to represent the distribution of vehicles across the bridge. Table 3-3 shows the vehicle length distribution by direction and time period. Vehicles categorized into the 42.1'-72.0' and 72.1'-115.0' bins were considered heavy vehicles. As shown, heavy vehicles represent a small portion of the traffic on SR 520. The highest percentages of heavy vehicles in eastbound direction occur during the PM period (1.6 percent); the highest percentage of heavy vehicles occur in the overnight period (10-11 PM and 5-6 AM) in the westbound direction (2.5 percent).

Table 3.4: SR 520 Average Weekday Shares of Heavy Vehicle by Length[1]

Direction	AM (5-9am)	MD (9am-3pm)	PM (3-6pm)	EV (6-11pm)	ON (11pm-5am)
EB	1.4%	1.4%	1.6%	1.3%	2.3%
WB	2.1%	1.4%	1.7%	0.8%	2.5%

Source: Tuesday-Thursday CDR data, September – November 2015

[1] Vehicles that are more than 42 feet long are considered heavy vehicles.

SR 520 tolls are categorized by the number of axles. As shown in Table 3-4, summarized transaction data from the Customer Service Center showed that heavy vehicles with more than 3-axles represented 0.8 to 1.7 percent of the total vehicles crossing the bridge in both directions. While the two data sources classified heavy vehicles using different parameters, both indicated that the heavy vehicle usage percentage was low.

Table 3.5: SR 520 Average Weekday Shares of Heavy Vehicle by Axle[1]

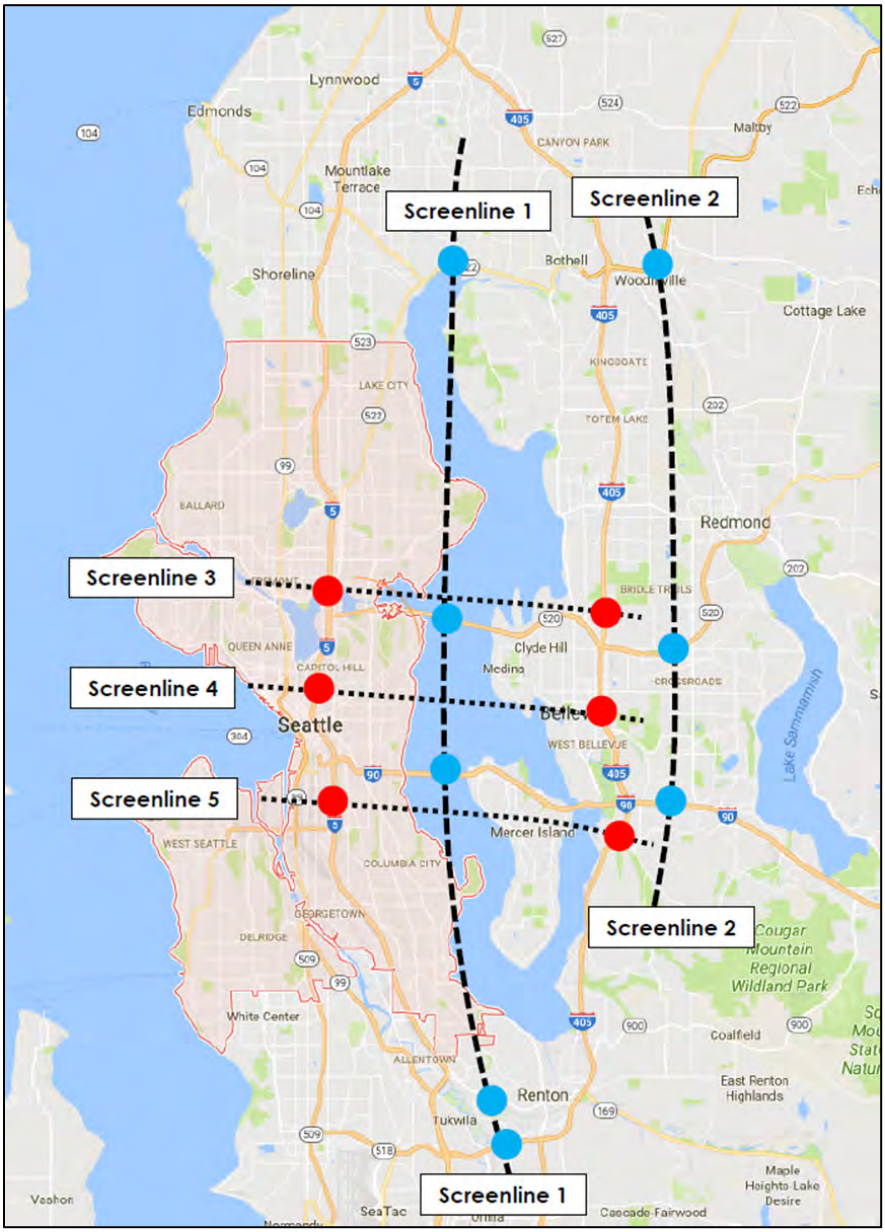
AM (5-9am)	MD (9am-3pm)	PM (3-6pm)	EV (6-11pm)	ON (11pm-5am)
1.7%	1.4%	1.7%	1.0%	2.4%

Source: Total eastbound and westbound directions; Tuesday-Thursday CSC data, September – November 2015
[1] Vehicles with more than 2 axles are considered heavy vehicles.

3.2 SCREENLINE VOLUMES

To understand the distribution of traffic and regional traffic trends around the Puget Sound region, traffic volume data were summarized along five screenlines, as shown in Figure 3.4 and Table 3-5 summarizes the daily volumes at each of the screenline locations by direction. Data for these summaries was derived from the CDR data site and the WSDOT online geoportal count data site. Volumes were summarized for Tuesdays, Wednesdays, and Thursdays from September to November 2015.

Figure 3.4: Screenline Location Map



The most important screenline in terms of understanding the travel behavior on the SR 520 bridge is Screenline 1, which accounts for traffic crossing Lake Washington. As shown, I-90 carries about 33 percent of the daily eastbound traffic across Lake Washington while SR 520 carries about 15 percent of this traffic. In the westbound direction, I-90 carries about 32 percent of the traffic crossing Lake Washington while SR 520 carries about 16 percent of this traffic.

Table 3.6: Daily Screenline Volumes by Direction

Screenline	Facility	Northbound/Eastbound		Southbound/Westbound	
		Daily		Daily	
		GP + HOV		GP + HOV	
		Obs	%	Obs	%
1: Lake Washington	SR 522 at 68th Ave NE	29,800	12%	26,700	11%
	SR 520/Evergreen Point Floating Bridge	37,900	15%	40,600	16%
	I-90/Murrow Memorial Bridge	84,400	33%	79,200	32%
	SR 900 East of I-5	14,500	6%	14,500	6%
	I-405 East of SR 181	88,900	35%	85,900	35%
	Total	**255,500**	**100%**	**246,900**	**100%**
2: East of I-405	SR 522	26,400	15%	28,500	18%
	SR 520	63,700	37%	52,900	34%
	I-90	80,700	47%	75,800	48%
	Total	**170,800**	**100%**	**157,200**	**100%**
3: North of SR-520	I-5	102,800	51%	101,500	52%
	I-405	97,400	49%	95,500	48%
	Total	**200,200**	**100%**	**197,000**	**100%**
4: Between SR-520 and I-90	I-5	100,400	55%	123,300	62%
	I-405	82,000	45%	74,500	38%
	Total	**182,400**	**100%**	**197,800**	**100%**
5: South of I-90	I-5	114,200	59%	129,800	65%
	I-405	78,600	41%	70,200	35%
	Total	**192,800**	**100%**	**200,000**	**100%**

Source: Tuesday-Thursday CDR data, Sep – Nov 2015

Table 3-6 summarizes the volumes by time period for Screenline 1, the screenline crossing Lake Washington. The SR 520 share in the eastbound direction is greatest in the AM period (17 percent) while the I-90 share is greatest in the eastbound direction during the PM period (36 percent). The SR 520 share in the westbound direction is greatest in the PM period (21 percent) while the I-90 share in the westbound direction is greatest during the AM period (36 percent).

Table 3.7: Screenline1 Volumes by Period

Facility	Northbound/Eastbound													
	AM (5-9AM)		MD (9AM-3PM)		PM (3PM-6PM)		EV (7PM-9 PM)		ON1 (9 PM-11 PM)		ON2 (11:00 PM-5:00 AM)		Daily	
	GP + HOV		GP + HOV		GP + HOV		GP + HOV		GP + HOV		GP + HOV		GP + HOV	
	Obs	%	Obs	%	Obs	%	Obs	%	Obs	%	Obs	%	Obs	%
SR 522 at 68th Ave NE	6,200	12%	9,800	12%	6,200	12%	4,500	12%	1,855	11%	1,242	10%	29,800	12%
SR 520/Evergreen Point Floating Bridge	8,800	17%	13,300	16%	7,500	14%	5,100	13%	1,923	12%	1,331	11%	37,900	15%
I-90/Murrow Memorial Bridge	17,400	34%	28,000	33%	19,400	36%	12,200	32%	4,690	29%	2,647	21%	84,400	33%
SR 900 East of I-5	3,000	6%	4,800	6%	3,000	6%	2,200	6%	902	6%	604	5%	14,500	6%
I-405 East of SR 181	15,100	30%	28,100	33%	17,400	32%	14,700	38%	6,872	42%	6,751	54%	88,900	35%
Total	**50,500**	**100%**	**84,000**	**100%**	**53,500**	**100%**	**38,700**	**100%**	**16,242**	**100%**	**12,574**	**100%**	**255,500**	**100%**
Facility	**Southbound/Westbound**													
	AM (5-9AM)		MD (9AM-3PM)		PM1 (3:00-6:00)		EV (7PM- 9 PM)		ON1 (9 PM-11 PM)		ON2 (11:00 PM-5:00 AM)		Daily	
	GP + HOV		GP + HOV		GP + HOV		GP + HOV		GP + HOV		GP + HOV		GP + HOV	
	Obs	%	Obs	%	Obs	%	Obs	%	Obs	%	Obs	%	Obs	%
SR 522 at 68th Ave NE	5,600	10%	9,300	11%	5,300	11%	4,000	11%	1,531	12%	943	8%	26,700	11%
SR 520/Evergreen Point Floating Bridge	8,500	15%	12,900	16%	9,800	21%	6,600	18%	1,665	13%	1,076	10%	40,600	16%
I-90/Murrow Memorial Bridge	21,200	36%	25,700	32%	15,100	32%	11,100	31%	3,694	29%	2,406	21%	79,200	32%
SR 900 East of I-5	3,100	5%	5,000	6%	2,900	6%	2,200	6%	832	7%	512	5%	14,500	6%
I-405 East of SR 181	19,900	34%	28,200	35%	14,600	31%	11,900	33%	4,929	39%	6,341	56%	85,900	35%
Total	**58,300**	**100%**	**81,100**	**100%**	**47,600**	**100%**	**35,900**	**100%**	**12,652**	**100%**	**11,277**	**100%**	**246,800**	**100%**

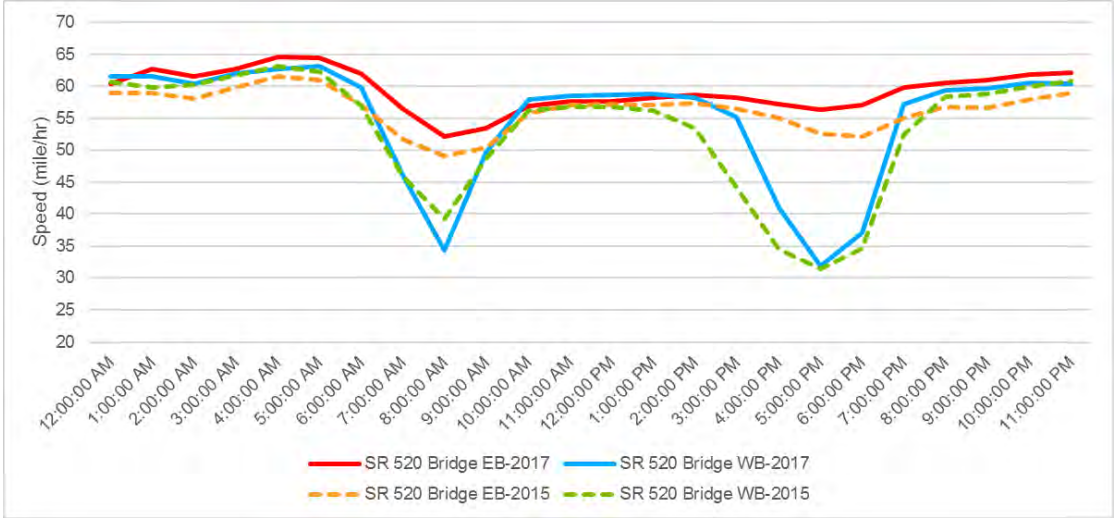
Source: Tuesday-Thursday CDR data, September – November 2015

3.3 SPEEDS

3.3.1 SR 520 Bridge Speeds

Figure 3.5 shows the speed profile on a typical weekday for vehicles traveling across the SR 520 bridge. The speed is the summarized speed measure from the CDR site for the Tuesdays, Wednesdays, and Thursdays from September to November 2015. Westbound traffic generally experiences lower speeds than the eastbound traffic during peak periods, partly due to higher discretionary trips headed westbound to downtown Seattle. In the westbound direction, average AM peak period speeds slow to about 40 mph in the AM period and to about 31 mph in the PM peak period. In the eastbound direction, average AM peak period speeds slow to about 50 mph in the AM period and to about 52 mph in the PM peak period. Average midday speeds and overnight speeds hover around 60 mph.

Figure 3.5: SR 520 Bridge Average Weekday Speed

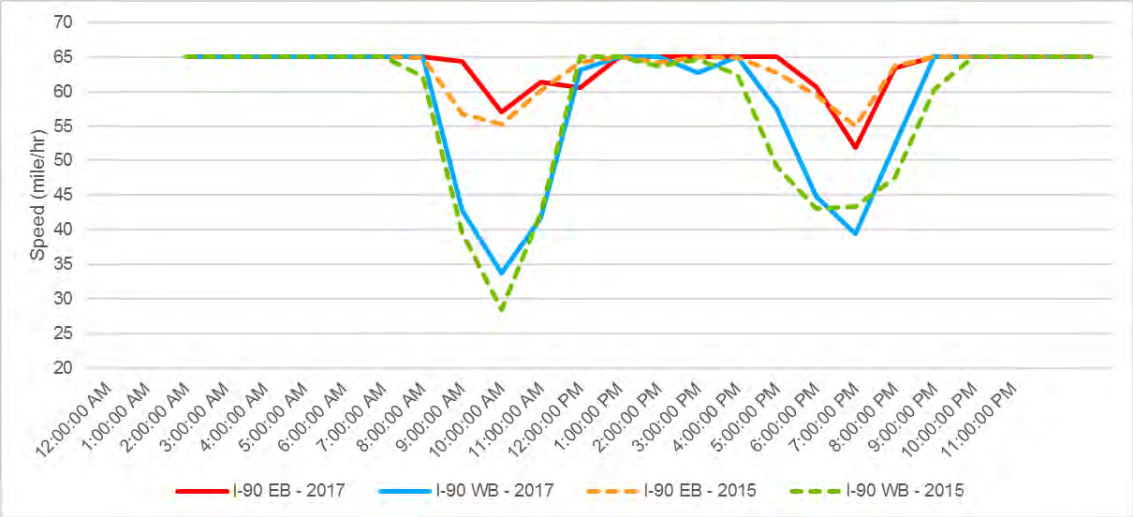


Source: Tuesday-Thursday CDR data, September – November 2015 and October-November 2017

3.3.2 I-90 Speeds

Figure 3.6 shows the speed profile on a typical weekday for vehicles traveling across the I-90 bridge. The speed summaries are the raw speed measure from the CDR site for the Tuesdays, Wednesdays, and Thursdays from September to November 2015. Westbound traffic generally experiences lower speeds than the eastbound traffic during peak periods, partly due to increased discretionary trips in the westbound direction towards downtown Seattle. In the westbound direction, average AM peak period speeds slow to about 27 mph in the AM period and to about 40 mph in the PM peak period. In the eastbound direction, both average AM and PM peak period speeds slow to about 48 mph. Average midday speeds and overnight speeds hover around 55-60 mph.

Figure 3.6: I-90 Bridge Average Weekday Speed



Source: Tuesday-Thursday CDR data, September – November 2015 and October-November 2017

3.4 TRANSACTIONS BY PAYMENT TYPE

Table 3-7 shows the transactions by payment type for CY 2014 through CY 2016. The majority of transactions are paid using a Good-to-Go! account. Over the last few full calendar years, about 84 percent of transactions are paid using *Good-to-Go!* accounts. On one hand, the share using a *Good to Go!* tag has been decreasing, from 66.7 percent of all revenue transactions in CY 2014 to 63.0 percent of all revenue transactions in CY 2016, while, on the other, pay by plate with a *Good to Go!* account has been increasing, from 17.7 percent of all revenue transactions in CY 2014 to 21.7 percent of all revenue transactions in CY 2016. Note that the non-revenue transactions represent about 2 percent of the total transactions that are processed by the CSC every calendar year.

Table 3.8: CY Transactions by Payment Type

Year	*Good To Go!*		*Pay By Mail*			Total	Non-Rev
	Pass	Pay By Plate	Paid on Time	Unbillable	Unpaid / Sent NOCP		
Reported Transactions							
CY 2014	14,098,722	3,747,195	2,303,977	444,482	558,591	21,152,967	449,430
CY 2015	14,453,941	4,704,456	2,546,124	649,280	476,590	22,830,391	455,288
CY 2016	14,791,255	5,089,156	2,136,375	992,214	460,704	23,469,704	497,558
Payment Share of Billable Transactions							
CY 2014	66.7%	17.7%	10.9%	2.1%	2.6%	100.0%	
CY 2015	63.3%	20.6%	11.2%	2.8%	2.1%	100.0%	
CY 2016	63.0%	21.7%	9.1%	4.2%	2.0%	100.0%	

Source: WSDOT CSC transaction reports

Figure 3.7 shows the weekday transactions by time of day for FY 2016. As shown, transactions are the highest during the peak periods and are about 25 percent lower than the peaks in the midday period. The number of transactions increase rapidly before the AM Peak and decrease rapidly after the PM Peak. This figure also shows the distribution of the FY 2016 transactions by each payment type. As expected, *Good to Go!* payments are most frequent in the AM and PM Peak periods, when the most frequent users, commuters, are on the facility. Pay by Mail is not as prevalent in the AM peak but more so in the midday and early PM peak; these are the times of the day when less frequent users who are less likely to have a tag or account would be using the facility.

Figure 3.7: FY 2016 Weekday Transaction Payment Type Distribution by Hour

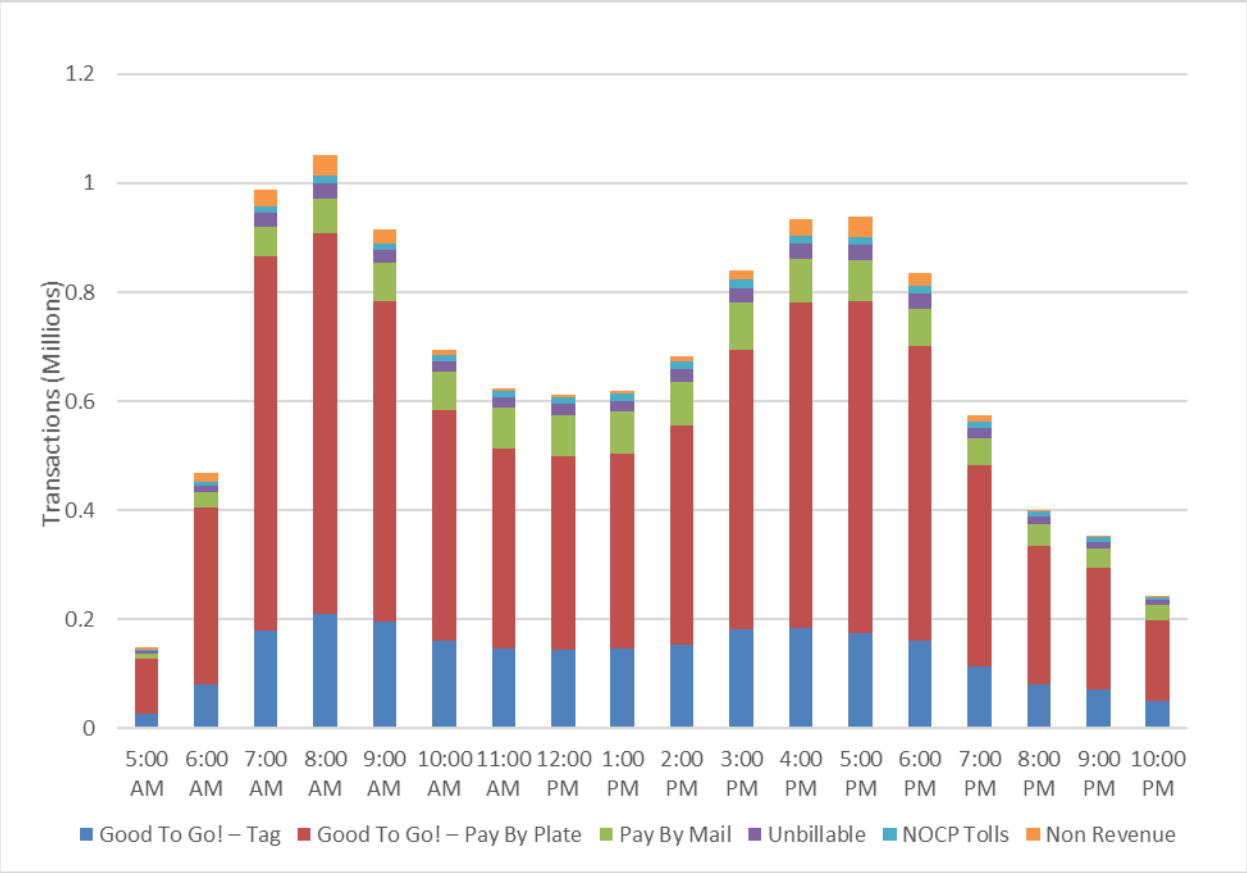


Table 3-8 shows the revenue distribution by payment type by class for FY 2016. As shown, most of the revenue is attributed to 2-axle vehicle. Most of the non-revenue vehicles are classified as 3-axle vehicles, the classification which includes transit buses.

Table 3.9: FY 2016 Transactions by Payment Type and Class

Vehicle Class	*Good To Go!*		*Pay By Mail*			Non-Rev	Total Transactions	Share of Rev Transactions
	Pass	Pay By Plate	Paid on Time	Unbillable	Unpaid / Sent NOCP			
2	14,506,000	4,915,200	2,403,600	760,700	437,000	305,100	23,327,600	99.3%
3	46,500	19,900	12,700	10,000	1,900	173,100	264,100	0.4%
4	13,900	6,700	3,900	2,200	400	150	27,250	0.1%
5	8,600	5,900	4,100	2,700	400	50	21,750	0.1%
6	18,100	5,100	1,700	1,900	100	10	26,910	0.1%

4.0 SOCIOECONOMIC VARIABLES AND LAND USE

A key factor in the development of the traffic and revenue forecast is the forecast of households, population, and employment. Stantec retained BERK Consulting to provide an independent review of available regional and subarea land use forecasts for the Central Puget Sound region. The purpose of this review was to assess whether adjustments needed to be made to the existing socioeconomic inputs to the Puget Sound Regional Council (PSRC) regional model in order to produce reasonable T&R forecasts for the area. When necessary, BERK performed additional analyses to prepare land use forecast data for all PSRC traffic analysis zones (TAZs) in the Central Puget Sound region[1]. This chapter describes the key findings of their review, and the methodology used to develop their 2015 baseline estimates and the socioeconomic forecasts for the years 2025 and 2045.

4.1 DATA REVIEWED

To evaluate the reasonableness of the existing socioeconomic forecasts, BERK reviewed several sources of demographic data including: the PSRC Macroeconomic Forecast (released in 2015), the PSRC Land Use Vision (LUV) version 1.0 (released in 2015), the PSRC Future Land Use, the Washington State Office of Financial Management (OFM) Small Area Estimates (released in 2015), and the City of Seattle Comprehensive Plan. BERK also reviewed the comprehensive plans of nearby jurisdictions, the PSRC Total Employment Estimates by Census Tract and data from the 2014 Census Longitudinal Employment Household Dynamics (LEHD) and the 2014 Origin-Destination Employment Statistics (LODES).

4.2 2015 BASELINE

As the model was calibrated to 2015, BERK established a 2015 baseline socioeconomic dataset. BERK created a 2015 households and population baseline using 2015 OFM estimates and a combination of sources for employment (PSRC 2013 estimates, LEHD/LODES 2014, ESD 2015, and King County commercial permit data through 2015).

4.2.1 2015 Households and Population

PSRC had not released a land use estimate or forecast product for the year 2015. Therefore, BERK needed to create a new forecast product based on other data sources. For areas within the City of Seattle, BERK reviewed and utilized 2015 baseline housing counts by Seattle TAZ.[2] For areas outside of Seattle, BERK reviewed OFM's small area estimates released in Fall 2015, including all associated methodological and user documentation. These data were deemed the best available source for 2015 population, households, and housing units outside of the City of Seattle. OFM 2015 group quarter population estimates were used for all areas. Additional GIS analysis was performed to reaggregate population and housing estimates to PSRC TAZ utilizing parcel assessment data and calculated capacity. Final results were then adjusted slightly to conform to PSRC regional control totals for 2015.

[1] This study summarizes data by PSRC's 2010 TAZ boundaries. All generic references to "TAZ" in this document refer to these PSRC TAZ boundaries.
[2] City of Seattle maintains their own TAZ boundaries that are smaller than PSRC's 2010 TAZ boundaries.

4.2.2 2015 Employment

No 2015 employment estimates by small area were available as a starting point for analysis. Therefore, the process for developing baseline employment estimates required several additional steps, as described below.

4.2.2.1 Regional and County Control Totals

The first step was to project 2015 employment by county and sector for 2015. These values are used as regional control totals to which tract-level changes in employment must conform. For regional control totals, BERK used PSRC's 2015 Macroeconomic Forecast. BERK then analyzed 2010 and 2013 total employment estimates by county from PSRC to calculate relative rates of change by county and employment sector. BERK also analyzed non-farm employment data from the ESD to calculate 2013 – 2015 growth rates by county.[3]

In conjunction, these two reference points were used to estimate relative rates of growth by county and sector for 2013 – 2015, assuming sector growth trends from 2010-2013 continue. These relative rates of growth were then used to develop preliminary projections for 2015 employment by county and sector. Finally, these preliminary projections were scaled to conform to the regionwide control totals from PSRC's Macroeconomic Forecast. The final results are shown in shown in Table 4-1.

Table 4.1: BERK 2015 Employment Projections

County	Constr./ Resource	Manuf./WTU	Retail/Food Services	FIRE/Other Services	Gov./ Higher Ed.	K-12	Military	Total
King	73,211	221,676	229,154	687,401	127,930	49,550	580	1,389,503
Kitsap	5,519	16,463	18,434	37,749	11,292	6,607	7,882	103,946
Pierce	24,681	47,942	62,283	131,293	40,045	21,611	36,247	364,102
Snohomish	24,677	84,052	59,585	117,002	21,608	16,539	4,711	328,174
Total	**128,088**	**370,133**	**369,457**	**973,446**	**200,874**	**94,307**	**49,420**	**2,185,725**

4.2.3 Employment Subarea Estimates

2015 subarea estimates for employment were developed in two stages. First, BERK developed estimates by census tract. Then these estimates were reaggregated to PSRC TAZ boundaries. For areas inside the City of Seattle, estimated 2015 employment by Seattle TAZ were aggregated by census tract for analysis, while PSRC total employment estimates were used to determine the proportional breakdown of total employment by employment sector. Outside of Seattle, BERK used PSRC total employment estimates by census tract[4] adjusted to account for growth inconsistencies. BERK did not consider employment growth rates at the tract level when determining the allocation of growth to reach 2015 control totals. Instead, the remaining increment of employment growth was allocated to tracts using a combination of data sources. For King County, BERK first analyzed assessor data to summarize net square footage of non-residential construction by land use category built 2013 to 2015. Standard

[3] King and Snohomish counties were combined in this dataset requiring further analysis to estimate the growth rates for each county individually.
[4] 2013 estimates featured suppressed sector totals. To address this, BERK replaced suppressed totals with 2010 data and allocated the remaining discrepancy to suppressed job sectors (proportionally, based on 2010 sector estimates), by tract.

employment density factors were then used to estimate new employment by sector.[5] The sum of this growth did not exceed projected King County employment growth in any sector. Therefore, the remaining increment of growth was allocated to tracts proportionally based on each tract's relative share of total employment growth by sector in 2014. For the other three counties, all projected growth beyond 2013 was allocated based on each tract's relative share of countywide employment by sector in 2014.

The preliminary growth estimates were then compared to estimated employment growth capacity by census tract. Total employment growth in excess of estimated capacity and absorption through filling of vacancy[6] was reallocated to tracts with spare growth capacity and additional growth forecasted for 2020 by PSRC LUV.0.[7] Additional GIS analysis was required to re-aggregate census tract level employment estimates to TAZ. BERK first used GIS to intersect census tracts with PSRC TAZ boundaries and then used LODES employment counts by sector type for 2014 by census block to determine proportion of sector-level census tract estimates to attribute to each intersected tract/TAZ pair. Employment counts were then reaggregated to TAZ boundaries.

4.3 2025 AND 2045 FORECAST REVIEW AND ADJUSTMENTS

BERK's review and adjustment of PSRC's land use forecasts was conducted at four levels of geographic scale: regional, county, jurisdiction, and TAZ. Each geographic level had a control total used as a guide for estimating socioeconomic inputs at the lower levels. The regional- and county-level estimates are discussed in the section below. BERK focused exclusively on population forecasts at the regional, county, and jurisdictional reviews. More detailed household estimates were developed at the TAZ level.

BERK reviewed the Macroeconomic Forecast and after determining it adequately estimated long term trends in the region, adopted it as published. At the regionwide scale, BERK's forecast adjustments show slower growth in the 2015-2025 period compared to the LUV 2010-2025 forecast in large part because of the rapid growth the region experienced leading up to 2015 and the decision to maintain the 2025 Macroeconomic Forecast regionwide totals. Historically, economic growth has been cyclical with periods of economic growth, or expansion, typically followed by periods of economic contraction, or recession. While the forecast is conservative when evaluating the recent regional trends, the economic forecast BERK prepared for this study for use in the modeling tasks is intended to evaluate long term average growth and the cyclical nature of economic cycles.

4.3.1 Population

PSRC's Macroeconomic Forecast provides household population, households, group quarter population, and employment breakdowns for each year between 2010 and 2040 for the four-county region. PSRC's LUV land use forecast is based on the same macroeconomic regional control totals. BERK reviewed the Macroeconomic Forecast and adopted it as published. The furthest horizon year included in PSRC's Macroeconomic Forecast is 2040. To extrapolate the region's population growth rate from 2040 to 2045, BERK assumed a continuation of the average

[5] Growth in construction employment was allocated to tracts proportionally to the total volume of construction 2013 – 2015 found in BERK's analysis of King County assessor data.
[6] Colliers International reports office vacancy rates in the Puget Sound Region declining from over 16% in 2010 to approximately 10% in 2015. They also report industrial vacancy rates declining from over 9% to less than 4% over the same period. See reports at: http://www.colliers.com/en-us/seattle/insights.
[7] LUV.0 was a draft dataset released in advance of PSRC's LUV 1.0 forecast before additional adjustments were made for the final data product.

annual population growth rate forecasted by PSRC for 2035-2040, or 0.9 percent. This results in an average annual population growth rate for the entire 2025-2045 forecast period of 0.84 percent, slightly higher than PSRC's forecasted rate for the 2025-2040 period of 0.76 percent. A comparison of the forecasted population growth rates is shown in Table 4-1.

Table 4.2: Comparison of Average Annual Population Growth Rates

County	OFM Actual[1]		PSRC LUV 1.0 Forecast[2]		BERK Adjusted Forecast	
	2000-2010	2010-2015	2010-2025	2025-2040	2015-2025	2025-2045
King	1.06%	1.23%	0.97%	0.57%	0.96%	0.71%
Kitsap	0.80%	0.56%	1.25%	1.17%	0.72%	1.17%
Pierce	1.28%	0.85%	1.25%	0.98%	0.91%	0.98%
Snohomish	1.64%	1.21%	1.19%	0.90%	1.18%	0.90%
Region	1.20%	1.10%	1.09%	0.77%	0.98%	0.84%
PSRC Macroeconomic Forecast	1.20%	1.29%	1.08%	0.76%	0.98%	0.84%

Notes: [1]OFM 2000 and 2010 are directly from the decennial Census. 2015 is estimated by OFM based on permitted building activity and the Census American Community Survey.
[2]PSRC's Macroeconomic Forecast concluded in year 2040. The growth rate shown here assumes a continuation of PSRC's forecasted trend to extrapolate growth between 2040 and 2045.

Table 4-2 Compares BERK's population forecast to the PSRC forecast for the four counties in the region. The table shows that during the first five years of PSRC's 2010 – 2025 forecast period, population grew considerably slower in Kitsap and Pierce counties than forecasted, while it grew faster than forecasted in King County. BERK does not see evidence in a fundamental demographic or real estate market change that would result in a major shift to the comparative rates of growth between counties during the 2015 – 2025 forecast period. Therefore, BERK adjusted PSRC's forecasted growth rate by county to develop new growth rates for the 2015 – 2025 forecast period. Effectively, these changes shift some growth that was forecasted for Kitsap and Pierce counties in the PSRC LUV 1.0 to King County instead.

Table 4.3: Comparison of County Population Forecasts

County	2025 Forecasts			BERK 2045 Population Forecast
	PSRC LUV 1.0	BERK	% Difference	
King	2,231,599	2,267,792	1.62%	2,613,282
Kitsap	302,722	293,436	-3.07%	370,046
Pierce	958,669	936,883	-2.27%	1,138,123
Snohomish	852,031	849,106	-0.34%	1,015,925
Total	4,345,021	4,347,217	0.05%	5,137,376

Note: As the PSRC LUV 1.0 is based on the PSRC Macroeconomic Forecast, the two are essentially the same.

Table 4.4: Population Forecast for King County and Main Cities

	CAGR 2016-25	CAGR 2026-45	2020 Population	2040 Population
King County	0.96%	0.71%	2,153,140	2,522,454
Four Main Cities				
Seattle				
Bellevue	1.20%	0.85%	971,421	1,171,156
Kirkland				
Redmond				

4.3.2 Employment

A similar method was used to extrapolate employment growth from 2040 to 2045; these employment growth rate comparisons can be seen in Table 4-4.

Table 4.5: Comparison of Average Annual Employment Growth Rates

County	PSRC Total Employment Estimates	PSRC LUV 1.0 Forecast		BERK Adjusted Forecast	
	2010-2014	2010-2025	2025-2040	2015-2025	2025-2045
King	2.85%	1.77%	1.34%	1.07%	1.47%
Kitsap	0.74%	1.29%	1.49%	0.57%	1.20%
Pierce	1.50%	1.30%	1.79%	0.58%	1.55%
Snohomish	3.35%	1.84%	1.74%	0.75%	1.50%
Region	2.61%	1.68%	1.48%	0.92%	1.48%
PSRC Macroeconomic Forecast	3.20%	1.68%	1.47%	0.92%	1.48%

As with population, BERK shifted some forecast growth from Kitsap County to King County. With the implementation of Sound Transit's light rail network, King County will be the center of an even larger transit system, increasing demand for employment growth and increasing its position as the employment center of the Puget Sound region. Table 4-5 compares PSRC and BERK's total employment forecasts for 2025 and presents BERK's updated forecast.

Table 4.6: Comparison of County Employment Forecasts

	2025 Forecasts			BERK 2045 Employment Forecast
	PSRC LUV 1.0	BERK	% Difference	
King	1,536,894	1,545,263	0.54%	2,070,648
Kitsap	118,042	110,025	-6.79%	139,670
Pierce	385,773	385,780	0.00%	524,733
Snohomish	353,486	353,635	0.04%	476,295
Total	2,393,707	2,394,703	0.04%	3,211,345

Table 4.7: Employment Forecast for king County and Main Cities

	CAGR 2016-25	CAGR 2026-45	2020 Employment	2040 Employment
King County	1.07%	1.47%	1,465,180	2,070,648
Four Main Cities	1.18%	1.39%	865,413	1,127,443
Seattle				
Bellevue				
Kirkland				
Redmond				

5.0 MODEL DEVELOPMENT AND CALIBRATION

This chapter provides an overview of the modeling methodology and development and also the calibration of the model used to produce the SR 520 bridge traffic and gross toll revenue potential forecasts.

5.1 METHODOLOGY OVERVIEW

A two-tier travel demand modelling process was used to perform the traffic and revenue forecast. First, Stantec utilized the Puget Sound Regional Commission (PSRC) regional model encompassing Seattle and much of the surrounding area. Stantec then used a customized Toll Diversion Model (TDM) to analyze the SR 520 floating toll bridge patronage. For this second step, network and vehicle demand coverage were retained at the regional model level, however, the trips were subdivided into twelve time periods to reflect the variation in toll cost and traffic demand throughout the day. The toll diversion model results serve as the basis for the traffic and revenue forecast. The base model calibration reflects 2015 traffic conditions, using traffic volume and travel time data compiled for this effort as detailed in Chapter 3 of this report.

5.2 REGIONAL TRAVEL DEMAND MODEL

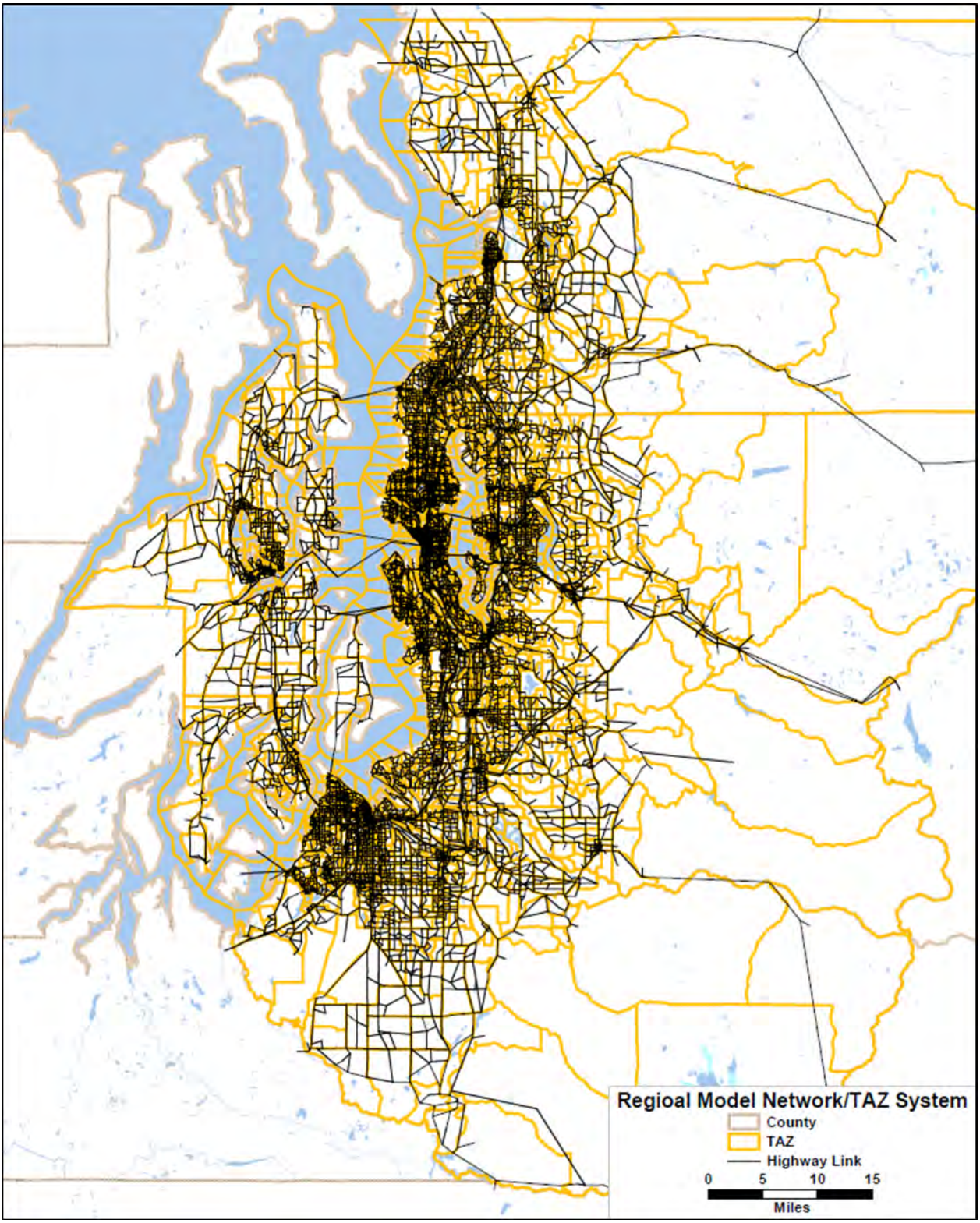
Stantec employed the Trip-Based Travel Model 4K Version 4.03 that is developed and maintained by PSRC as the regional modeling platform. Stantec's primary objective was to estimate the vehicular travel demand for the trans-Lake Washington corridor, to facilitate downstream toll diversion modeling for the late-2015 base year (model calibration), and the 2025 and 2045 horizon years.

The PSRC 4K model is a full-featured, 4-step travel demand model that encompasses the Central Puget Sound region, including the counties of King, Pierce, Snohomish, and Kitsap. The model consists of 3,700 internal TAZs, 18 external stations, and an additional 150 zones representing Park-and-Ride facility locations within the region. Figure 5.1 shows the regional highway network coverage.

5.2.1 Traffic Analysis Zones (TAZs) System

The model coverage consists of the four-county Puget Sound region, including King, Snohomish, Kitsap, and Pierce counties, centering on the City of Seattle. The model has a total of 3,700 internal and 18 external TAZs, in addition to 150 Park-and-Ride (PNR) zones, with corresponding highway and transit network details to support the zonal system.

Figure 5.1: Regional Highway Network Coverage



5.2.2 NETWORK ASSUMPTIONS

The base model calibration year transportation network is reflective of Fall 2015 traffic conditions, featuring the SR 520 bridge under the pre-existing configuration prior to the HOV-lane implementation. For the 2025 and 2045 forecast years, interim-build and final build networks were created that include major highway capacity/connectivity improvement projects with relevance to this T&R effort, specifically along competitive and feeder roadways, including I-5, I-90 and I-405, as well as major state highways such as SR 167, SR 522, and SR 590. In addition, significant transit improvements as identified in the Sound Transit 3 Plan were also incorporated.

5.2.3 CORRIDOR CALIBRATION SUMMARY AT REGIONAL LEVEL

The goal of the regional calibration process is to ensure that the model can be relied upon to predict future traffic volumes. As such, the process was focused on replicating observed vehicular traffic flows consistent with 2015 base year travel conditions across the Trans-Lake Washington corridor. In Table 5-1, the combined GP and Express/HOV lane traffic estimated by the regional model was compared to observed data at various roadway segments along a screenline crossing Lake Washington. At an aggregate level, the estimated traffic flows resulting from the model are closely approximating the observed daily traffic, showing that the model overpredicts traffic by between 2 and 4 percent. Note that this regional level calibration is an initial step in the broader calibration process and the differences for individual links in modelled versus observed traffic are corrected in the toll diversion model calibration.

Table 5.1: Observed v. Model Estimated Daily Traffic Across Lake Washington

Facility	Daily Volume					
	GP + HOV			GP + HOV		
	Obs	Est	% Diff (Est-Obs)	Obs	Est	% Diff (Est-Obs)
SR 522 at 68th Ave NE	18,882	11,822	-37%	24,112	13,005	-46%
SR 520/Evergreen Point Floating Bridge	36,728	39,394	7%	40,592	39,242	-3%
I-90/Murrow Memorial Bridge	80,294	94,312	17%	80,026	91,959	15%
SR 900 East of I-5	14,500	10,314	-29%	14,500	9,410	-35%
I-405 East of SR 181	88,935	92,365	4%	85,894	97,389	13%
Total	239,338	248,207	4%	245,124	251,004	2%

5.2.4 REGIONAL LEVEL FORECAST SUMMARIES

In the PSRC trip-based demand modeling process, daily person trips are estimated from the SED variables (including the number of households and jobs by employment type) pertinent to the internal TAZs within the Puget Sound region, based on a set of pre-defined trip production and attraction relationships, in additional to the trips specified for the 18 external stations in the model. A total of 7 trip purposes are maintained in the modeling process, from trip generation to mode choice with further stratification by four Income levels, where applicable:

- Home-Based Work (HBW)
- Home-Based College (COL)
- Home-Based School (SCH)
- Home-Based Shop (HBS)
- Home-Based Other (HBO)
- Non-Home-Based Work (WBO)
- Non-Home-Based Other (OBO)

In addition to household resident trips, commercial vehicles (or trucks), are also considered in the PSRC model, respectively for light, medium, and heavy truck classes. Truck trips are generated for individual TAZ and specified for each external station from SED attributes (primarily zonal employment).

The mode choice modeling process apportions each person trip matrix by purpose to the available travel modes at a daily level after the trip distribution step. The available mode choice options are specified as below:

- Drive alone (SOV)—Single-occupancy auto trips
- Shared ride 2 (HOV2)—Auto trips with two occupants
- Shared ride 3+ (HOV3+)—Auto trips with three or more occupants
- Transit – Walk access
- Transit - Drive access
- Walk
- Bicycle

A time-of-day choice modeling process then respectively stratifies the household resident and commercial vehicle trips using pre-defined survey-based factors or, where applicable, probabilistic functions which consider the time period specific congested highway travel time to stratify daily trips into different time periods. A total of five time periods are maintained in the PSRC trip-based model, including AM (6am to 9am), MD (9am to 3pm), PM (3pm to 6pm), EV (6pm to 1pm), and NI (10pm to 6am). A subsequent modeling step will then prepare the corresponding input trip matrices for traffic assignment purposes. For auto/highway vehicle assignment, person trips are converted to vehicles with appropriate occupancy factors for HOV2 and HOV3+ trips. The highway assignment considers a total of 11 vehicle classes as listed below:

- SOV (HBW Income 1)
- SOV (HBW Income 2)
- SOV (HBW Income 3)
- SOV (HBW Income 4)
- SOV (all other purposes)
- HOV2 (all purposes)
- HOV3+ (all purposes)
- Vanpool vehicles
- Light Truck
- Medium Truck
- Heavy Truck

Travel demand in the Central Puget Sound region is forecasted to grow between 2015 and 2045, resulting in more travel delay, and decreasing network-wide travel speeds, as summarized in Table 5-2. While daily person trips increase over the forecast period, it is important to note that the mode by which trips are made is shifting. The share of people walking and biking increases slightly, and conversely, the share of HOV2+ and SOV trips decreases slightly. The transit share stays stable at 3.6 to 3.7 percent level.

Table 5.2: Project Growth in Travel Demand

		Model Results		
		2015	2025	2045
Daily Person Trip		15,623,000	18,133,500	22,229,000
Mode Shares	SOV	43.1%	43.1%	42.9%
	HOV2+	42.0%	42.2%	41.8%
	Transit	3.7%	3.7%	3.6%
	Walk & Bike	11.1%	10.9%	11.7%
Daily Vehicle Trips		10,036,500	11,635,200	14,220,500
Vehicle-Mile Traveled		77,406,300	88,949,400	104,902,200
Vehicle-Hour Traveled		2,575,400	2,968,735	3,671,619
Speed		30.1	30.0	28.6

Source: PSRC Trip-Based Travel Model 4K Version 4.03

The projected growth in vehicular travel demand in the region as estimated by model is summarized in Table 5-3. The enhanced roadway capacity is likely to attract/absorb additional traffic in the near-term future, as reflected by the compounded annual growth rate (CAGR) of 1.5 percent for the 2015-2025 period. With limited increases in roadway capacity in the region and growing congestion, a more modest compounded annual traffic growth rate of 1.0 is expected in the outer twenty forecast years, 2025 to 2045.

Table 5.3: Vehicular Demand Growth for the Corridor Subarea

Time Period	Model Results			CAGR	
	2015	2025	2045	2015-25	2025-45
AM (6:00-9:00)	1,720,300	1,954,400	2,377,700	1.3%	1.0%
MD (9:00-3:00)	3,833,200	4,507,200	5,478,800	1.6%	1.0%
PM (3:00-6:00)	2,150,300	2,448,400	2,980,500	1.3%	1.0%
EV (6:00-10:00)	1,779,600	2,063,900	2,536,100	1.5%	1.0%
NI (10:00-6:00)	553,100	661,300	847,400	1.8%	1.2%
Daily	10,036,500	11,635,200	14,220,500	1.5%	1.0%

Source: PSRC Trip-Based Travel Model 4K Version 4.03

5.3 TOLL DIVERSION MODEL AND CALIBRATION

The second element of the modeling process involved a toll diversion model (TDM) incorporated into EMME software environment. The input trip tables were adopted from the regional level model and the highway network is adopted from the regional level highway network with enhanced coding to enable toll diversion modeling. The TDM is a logit-based route choice model embedded within an equilibrium assignment routine. The calibration of the base year 2015 model focused on both matching the observed corridor volumes as well as calibrating the model to adequately predict the SR 520 floating bridge usage.

In the TDM, the five time periods from the regional model are further broken down into 12 sub-periods, reflective of the toll periods implemented by WSDOT on the SR 520 bridge under the existing and future year schemes. The regional model and the TDM time periods are listed in Table 5-4.

Table 5.4: Model Time Periods

Regional Model Period	Toll Diversion Model Period	Toll Periods
NI (10:00-6:00)	NI2	12:00-5:00
	AM1	5:00-6:00
AM (6:00-9:00)	AM2	6:00-7:00
	AM3	7:00-9:00
MD (9:00-3:00)	MD1	9:00-10:00
	MD2	10:00-2:00
	MD1	2:00-3:00
PM (3:00-6:00)	PM1	3:00-6:00
EV (6:00-10:00)	EV1	6:00-7:00
	EV2	7:00-9:00
NI (10:00-6:00)	NI1	9:00-11:00
	NI2	11:00-12:00

5.3.1 Toll Diversion Modeling Parameters

The toll diversion model adopted for this project is based on a process initially developed in 2001 for the Central Texas Turnpike System (CTTS) in Austin, Texas. This model has successfully predicted traffic and revenue for several new toll roads and was recently recalibrated to replicate current conditions. The diversion model is essentially a logit-based route choice model embedded within a highway assignment routine to allocate traffic into appropriate toll-usage type. The structure of the toll diversion model is defined as follows:

Toll Share = $(1 / (1+ e^{U}))$

Where:

Toll Share = Probability of selecting a toll road
e = Natural Logarithm
U = “Utility” of Toll Route: a * (TimeTR-TimeFR) + b * Cost + CTR + CETC
TimeTR = Toll road travel time in minutes
TimeFR = Nontoll road travel time in minutes
Cost = Toll in dollars
CTR = Constant for toll road bias
CETC = Constant for ETC bias
a,b = Coefficients

The value of time used in the modelling effort varies by trip purpose and vehicle occupancy as shown in Table 5-5. Of the three trip purposes listed, Home Based Work (HBW), Home Based Other (HBO) and Non-Home Based (NHB), work trips have the highest value of time. The value of time for vehicles with two and more occupants is higher than the value of time for single occupant vehicles because more than one individual experiences times savings.

Table 5.5: Value of Time by Trip Purpose and Vehicle Occupancy (2015$)

Trip Purpose	Occ.	Value of Time
HBW	SOV	$19.88
	HOV2+	$22.86
	HOV3+	$28.58
HBO	SOV	$16.02
	HOV2+	$18.42
	HOV3+	$23.03
NHB	SOV	$16.54
	HOV2+	$19.02
	HOV3+	$23.78

5.3.2 Toll Diversion Model Calibration Results

The TDM calibration efforts included segment-specific capacity and speed adjustments to match observed volumes. The objective of the calibration effort is to replicate the overall traffic level at the various screenlines (as illustrated in Figure 5.2), with the emphasis on traffic across Lake Washington (Screenline 1), and ultimately, the patronage of SR 520 and its major competitive roadway, I-90. The results at individual time period and the daily level for corresponding facilities across various screenlines, listed in Table 5-6, show that the model estimated traffic for screenlines is within 5 percent of the observed volumes. The exception, Screenline 2 located east of I-405, likely due lower highway network coverage of arterial roadways in the model for the corresponding area.

Compared to the regional model results (listed in Table 5-1), the daily volumes across the Lake Washington screenline (Screenline 1) estimated by the TDM are closer to the observed volumes at 1 percent. The estimated volumes for the individual facilities in the screenline also more closely match the daily observed volumes, while the regional model estimates differed by significantly higher margin when compared to observed volumes.

In addition, the estimated versus observed SR 520 bridge volumes for the individual time periods during the morning peak, inter-peak and afternoon peak periods (11 hours in total from 7:00 am to 6:00 pm) are well within 10%. Overall, the TDM replicates the observed peaking patterns across Lake Washington reasonably well.

Figure 5.2: Screenline Locations

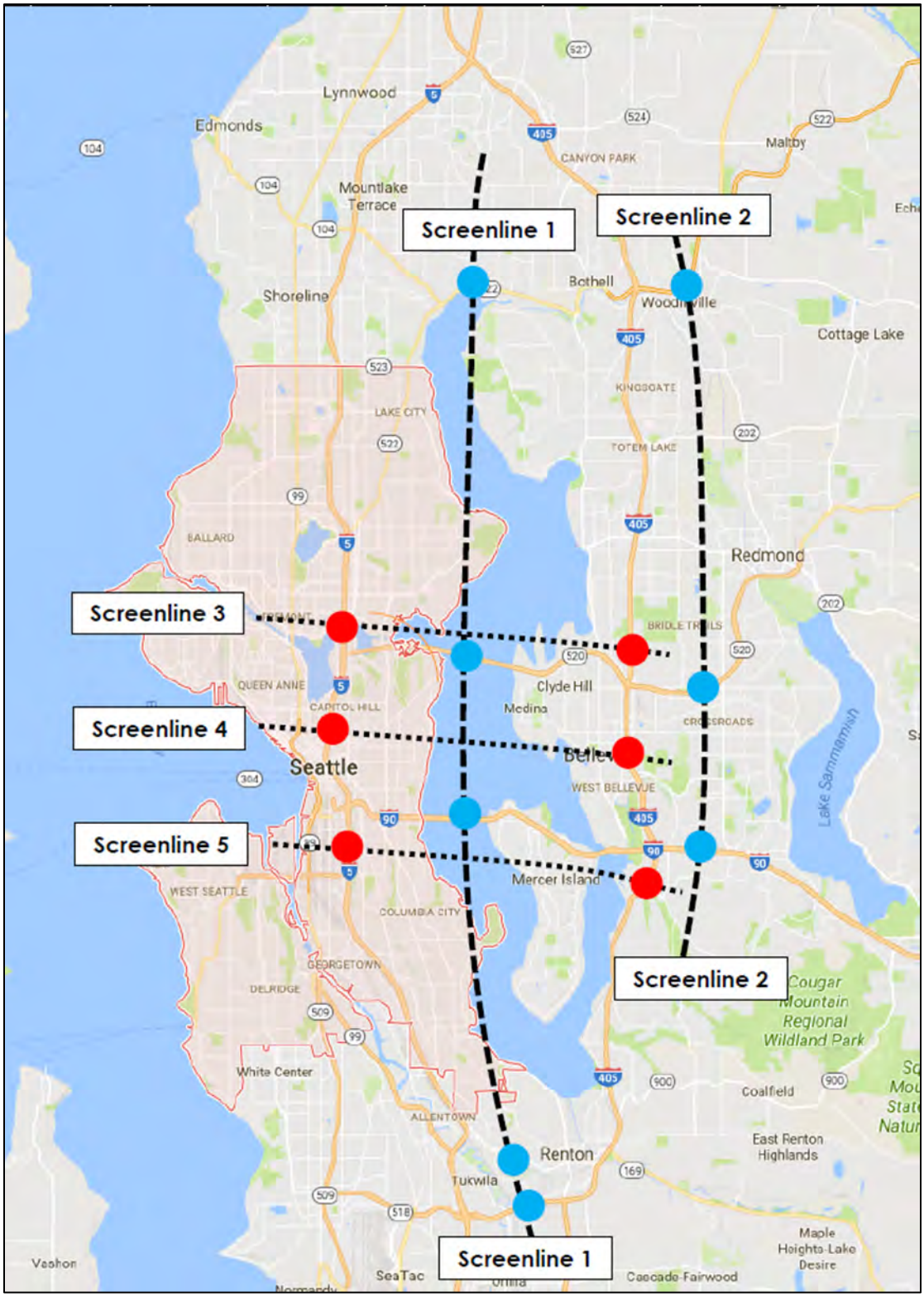


Table 5.6: Calibration Results for Screenlines by Time Period

Screenline	Facility	Total Two-Way Volume											
		AM1 (5:00-6:00)			AM2 (6:00-7:00)			AM3 (7:00-9:00)			MD1 (9:00-10:00/2:00-3:00)		
		GP + HOV			GP + HOV			GP + HOV			GP + HOV		
		Obs	Est	% Diff (Est-Obs)	Obs	Est	% Diff (Est-Obs)	Obs	Est	% Diff (Est-Obs)	Obs	Est	% Diff (Est-Obs)
1: Lake Washington	SR 522 at 68th Ave NE	1,720	1,610	-6%	3,453	2,937	-15%	6,669	6,877	3%	6,671	6,101	-9%
	SR 520/Floating Bridge	929	1,933	108%	3,019	4,425	47%	13,323	12,823	-4%	10,314	9,910	-4%
	I-90/Murrow Memorial Bridge	3,885	5,001	29%	10,108	9,713	-4%	24,585	24,041	-2%	20,145	22,798	13%
	SR 900 East of I-5	891	489	-45%	1,783	1,540	-14%	3,408	4,022	18%	3,431	3,495	2%
	I-405 East of SR 181	7,689	6,400	-17%	9,157	8,896	-3%	18,168	20,184	11%	19,137	18,919	-1%
	Total	**15,114**	**15,433**	**2%**	**27,520**	**27,510**	**0%**	**66,154**	**67,947**	**3%**	**59,697**	**61,223**	**3%**
2: East of I-405	SR 522	2,683	2,816	5%	3,650	3,737	2%	7,135	8,260	16%	6,489	8,210	27%
	SR 520	2,728	4,960	82%	5,316	7,384	39%	17,624	16,998	-4%	15,099	15,737	4%
	I-90	4,085	5,080	24%	8,829	9,397	6%	21,550	23,353	8%	19,074	21,473	13%
	Total	**9,496**	**12,856**	**35%**	**17,795**	**20,519**	**15%**	**46,310**	**48,611**	**5%**	**40,662**	**45,420**	**12%**
3: North of SR-520	I-5	6,181	7,512	22%	10,258	12,442	21%	24,721	27,974	13%	23,799	23,445	-1%
	I-405	6,959	5,855	-16%	11,037	9,607	-13%	24,647	22,716	-8%	23,440	21,985	-6%
	Total	**13,141**	**13,367**	**2%**	**21,294**	**22,049**	**4%**	**49,368**	**50,690**	**3%**	**47,240**	**45,430**	**-4%**
4: Between SR-520 and I-90	I-5	7,982	7,955	0%	12,237	11,927	-3%	26,501	26,257	-1%	25,175	23,915	-5%
	I-405	6,386	6,968	9%	10,051	9,690	-4%	20,892	20,897	0%	19,393	19,292	-1%
	Total	**14,368**	**14,923**	**4%**	**22,288**	**21,616**	**-3%**	**47,392**	**47,154**	**-1%**	**44,568**	**43,207**	**-3%**
5: South of I-90	I-5	10,299	10,653	3%	13,742	14,531	6%	26,218	31,321	19%	26,644	30,195	13%
	I-405	6,564	6,473	-1%	8,900	8,444	-5%	18,503	17,617	-5%	16,910	16,102	-5%
	Total	**16,863**	**17,125**	**2%**	**22,642**	**22,976**	**1%**	**44,720**	**48,939**	**9%**	**43,555**	**46,298**	**6%**

Screenline	Facility	Total Two-Way Volume											
		MD2 (10:00-2:00)			PM1 (3:00-6:00)			EV1 (6:00-7:00)			EV2 (7:00-9:00)		
		GP + HOV			GP + HOV			GP + HOV			GP + HOV		
		Obs	Est	% Diff (Est-Obs)	Obs	Est	% Diff (Est-Obs)	Obs	Est	% Diff (Est-Obs)	Obs	Est	% Diff (Est-Obs)
1: Lake Washington	SR 522 at 68th Ave NE	12,390	10,825	-13%	11,467	10,605	-8%	3,538	2,987	-16%	5,009	4,091	-18%
	SR 520/Floating Bridge	15,842	14,582	-8%	17,335	18,600	7%	5,587	4,885	-13%	6,116	6,061	-1%
	I-90/Murrow Memorial Bridge	33,562	39,115	17%	34,536	37,904	10%	10,405	11,176	7%	12,919	15,371	19%
	SR 900 East of I-5	6,371	6,907	8%	5,878	5,976	2%	1,812	1,516	-16%	2,575	1,992	-23%
	I-405 East of SR 181	37,197	38,325	3%	31,958	30,985	-3%	10,266	9,553	-7%	16,364	13,622	-17%
	Total	**105,362**	**109,754**	**4%**	**101,174**	**104,070**	**3%**	**31,608**	**30,117**	**-5%**	**42,984**	**41,137**	**-4%**
2: East of I-405	SR 522	11,684	14,700	26%	12,262	12,496	2%	3,244	3,838	18%	3,871	5,278	36%
	SR 520	25,617	28,433	11%	22,882	26,502	16%	7,051	7,786	10%	9,874	10,720	9%
	I-90	34,079	38,856	14%	33,404	36,414	9%	9,664	10,607	10%	12,598	14,517	15%
	Total	**71,380**	**81,989**	**15%**	**68,548**	**75,411**	**10%**	**19,960**	**22,231**	**11%**	**26,343**	**30,515**	**16%**
3: North of SR-520	I-5	47,000	50,465	7%	31,773	44,111	39%	11,446	13,562	18%	19,950	18,843	-6%
	I-405	43,975	41,942	-5%	36,341	38,188	5%	10,385	11,691	13%	15,553	16,549	6%
	Total	**90,975**	**92,407**	**2%**	**68,113**	**82,298**	**21%**	**21,830**	**25,253**	**16%**	**35,503**	**35,392**	**0%**
4: Between SR-520 and I-90	I-5	48,922	49,635	1%	39,095	43,042	10%	13,139	13,577	3%	20,674	19,251	-7%
	I-405	35,653	36,924	4%	27,198	35,815	32%	8,049	9,930	23%	12,543	14,099	12%
	Total	**84,575**	**86,560**	**2%**	**66,293**	**78,857**	**19%**	**21,188**	**23,507**	**11%**	**33,217**	**33,350**	**0%**
5: South of I-90	I-5	53,461	56,363	5%	42,322	47,775	13%	14,025	15,194	8%	22,864	21,711	-5%
	I-405	32,879	31,638	-4%	25,333	28,203	11%	7,763	8,191	6%	13,020	12,058	-7%
	Total	**86,340**	**88,000**	**2%**	**67,655**	**75,978**	**12%**	**21,787**	**23,386**	**7%**	**35,885**	**33,769**	**-6%**

Screenline	Facility	Total Two-Way Volume								
		NT1 (9:00-11:00)			NT2 (11:00-5:00)			Daily		
		GP + HOV			GP + HOV			GP + HOV		
		Obs	Est	% Diff (Est-Obs)	Obs	Est	% Diff (Est-Obs)	Obs	Est	% Diff (Est-Obs)
1: Lake Washington	SR 522 at 68th Ave NE	3,385	2,605	-23%	2,184	1,948	-11%	56,486	50,585	-10%
	SR 520/Floating Bridge	3,589	3,155	-12%	2,407	3,293	37%	78,462	79,667	2%
	I-90/Murrow Memorial Bridge	8,384	10,166	21%	5,052	6,871	36%	163,580	182,156	11%
	SR 900 East of I-5	1,734	946	-45%	1,116	538	-52%	29,000	27,421	-5%
	I-405 East of SR 181	11,802	11,576	-2%	13,092	11,308	-14%	174,829	169,768	-3%
	Total	**28,894**	**28,447**	**-2%**	**23,852**	**23,958**	**0%**	**502,357**	**509,596**	**1%**
2: East of I-405	SR 522	1,800	3,524	96%	2,043	3,134	53%	54,862	65,993	20%
	SR 520	5,696	8,370	47%	4,682	7,472	60%	116,569	134,361	15%
	I-90	7,695	10,183	32%	5,538	7,717	39%	156,517	177,598	13%
	Total	**15,191**	**22,077**	**45%**	**12,263**	**18,322**	**49%**	**327,947**	**377,952**	**15%**
3: North of SR-520	I-5	14,816	15,668	6%	14,367	13,977	-3%	204,311	228,000	12%
	I-405	9,905	11,167	13%	10,733	8,414	-22%	192,975	188,114	-3%
	Total	**24,721**	**26,835**	**9%**	**25,100**	**22,392**	**-11%**	**397,286**	**416,115**	**5%**
4: Between SR-520 and I-90	I-5	14,805	16,563	12%	15,145	14,031	-7%	223,675	226,153	1%
	I-405	8,086	10,272	27%	8,278	9,472	14%	156,530	173,359	11%
	Total	**22,891**	**26,835**	**17%**	**23,424**	**23,503**	**0%**	**380,205**	**399,511**	**5%**
5: South of I-90	I-5	17,184	17,662	3%	17,258	15,449	-10%	244,017	260,854	7%
	I-405	9,153	10,093	10%	9,833	10,360	5%	148,858	149,180	0%
	Total	**26,337**	**27,755**	**5%**	**27,091**	**25,809**	**-5%**	**392,876**	**410,034**	**4%**

6.0 TRAFFIC AND GROSS TOLL REVENUE POTENTIAL FORECAST

The traffic and revenue forecasts for the SR 520 bridge have been prepared using the modeling procedures documented in Chapter 5 of this report. Using this model, average weekday forecasts were prepared for 2025 and 2045. This chapter documents the future year modeling assumptions and the procedures that were used to convert the daily weekday traffic and revenue model results to an annual forecast for fiscal years 2017 through 2056.

6.1 FUTURE YEAR ASSUMPTIONS

6.1.1 Toll Policy

The future year forecasts herein assume the current toll schedule on the SR 520 bridge (as of July 1, 2017) will remain in effect over the entire forecast period. No future changes in toll rates were assumed, nor were any future changes assumed to the available payment options or fees. Because the future toll rates do not increase over time, the actual toll cost to the customer decreases over time and makes the toll route more attractive. Table 6-1 shows the toll rates assumed for all future years. It should also be noted that no future year changes were assumed to the payment shares other than those shifts in travel patterns that would occur because the *Good to Go!* payment type is more economical.

Table 6.1: Future Toll Rates

Time Period	FY 2018 and After			
	Good to Go!		Pay by Mail[1]	
	weekday	weekend	weekday	weekend
12-5 AM	$1.25	$1.25	$3.25	$3.25
5-6 AM	$2.00	$1.40	$4.00	$3.40
6-7 AM	$3.40	$1.40	$5.40	$3.40
7-8 AM	$4.30	$1.40	$6.30	$3.40
8-9 AM	$4.30	$2.05	$6.30	$4.05
9-10 AM	$3.40	$2.05	$5.40	$4.05
10AM - 11AM	$2.70	$2.05	$4.70	$4.05
11AM - 2PM	$2.70	$2.65	$4.70	$4.65
2-3 PM	$3.40	$2.65	$5.40	$4.65
3-6 PM	$4.30	$2.65	$6.30	$4.65
6-7 PM	$3.40	$2.05	$5.40	$4.05
7-9 PM	$2.70	$2.05	$4.70	$4.05
9-11 PM	$2.00	$1.40	$4.00	$3.40
11PM - 12AM	$1.25	$1.25	$3.25	$3.25

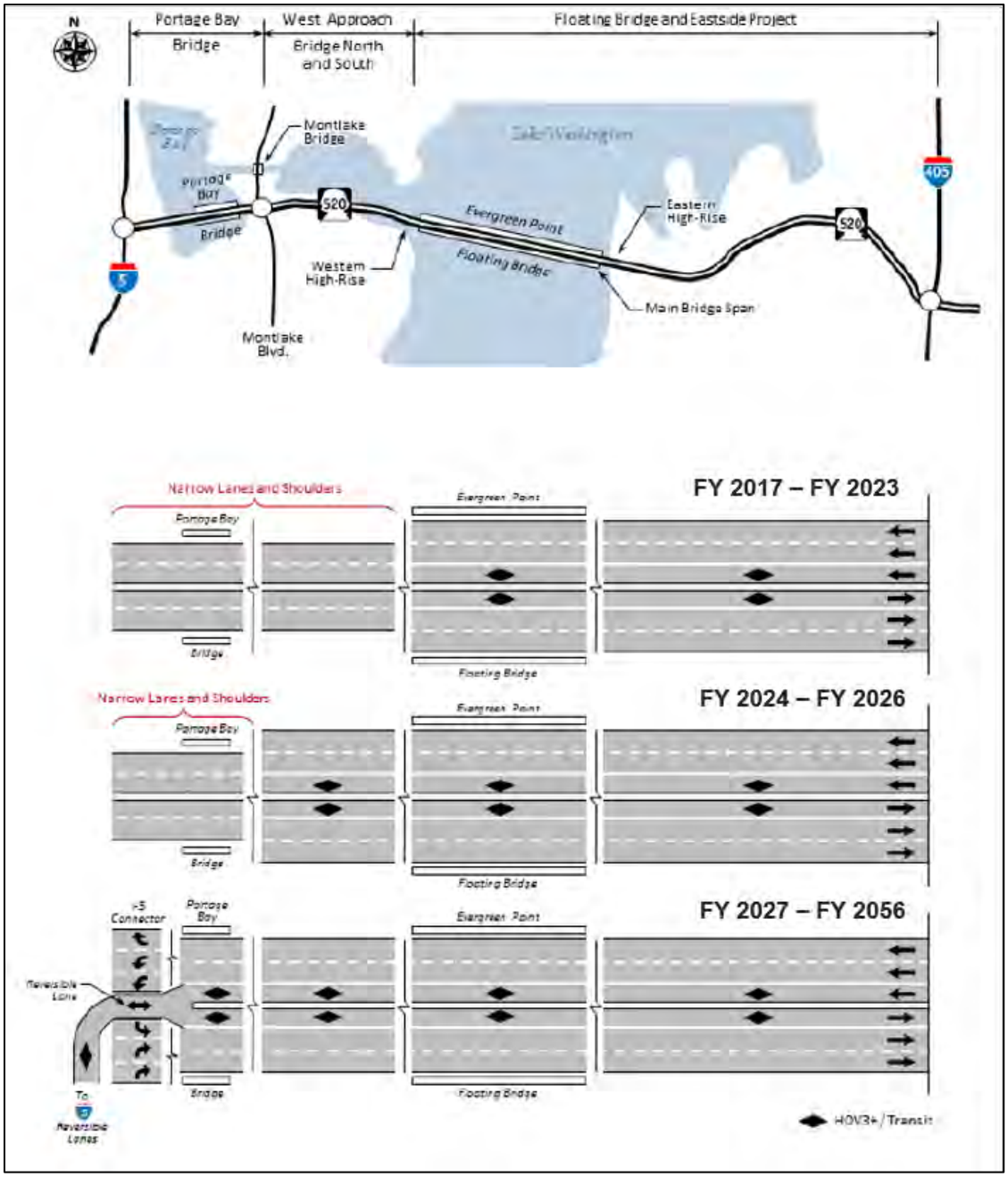
[1]Pay by Mail rates are equal to the *Good to Go!* toll rate plus a $2.00 increment.

6.1.2 Future Year Network Assumptions

6.1.2.1 SR 520 Improvements

As described in Chapter 2, the SR 520 bridge is part of the SR 520 Bridge Replacement and HOV Program. The future year construction schedule which shows the geometric assumptions by year is shown in Figure 6.1.

Figure 6.1: SR 520 Bridge Replacement and HOV Program Construction Assumptions



6.1.2.2 Other Study Area Improvements

The forecasts assume that the highway network improvements in the regional model would be implemented as assumed by the Puget Sound Regional Council in their current regional plan and their regional model. The forecasts also assume that no new competing highway facilities or transportation projects or additional improvements to competing projects will be made in the forecast period.

6.1.3 Future Year Socioeconomic Assumptions

The future year socioeconomic assumptions are documented in Chapter 4 of this report.

6.1.4 Commercial Vehicle Assumptions

The forecast assumes that the heavy truck percentages using SR 520 remain fairly constant in the future. Table 6-2 summarizes the assumptions used in the model.

Table 6.2: Horizon Year Heavy Vehicle Share Assumptions

Year	5-6 AM	6-7 AM	7-9 AM	9-10 AM	10AM - 2PM	2-3PM	3-6PM	6-7PM	7-9PM	9-11PM	11PM - 5 AM	Daily
2025	1.0%	1.0%	2.1%	2.8%	3.2%	2.8%	1.6%	0.5%	0.4%	0.6%	0.7%	1.9%
2045	0.7%	0.7%	1.8%	2.1%	2.9%	2.1%	1.3%	0.4%	0.4%	0.6%	0.6%	1.8%

6.1.5 Other Assumptions

Other assumptions integral to the forecast include:

1. The SR 520 Project will continue to be maintained and efficiently operated.
2. The tolls on other toll projects in the Central Puget Sound region shall be comparable to the rates currently envisioned during the forecast period through FY 2056.
3. The average cost of owning and operating a personal vehicle will not increase at a rate greater than the general rate of inflation. Motor fuel will continue to be in plentiful supply at prices in line with the general rate of inflation.
4. Economic conditions in the country and the Central Puget Sound region will be relatively stable and no major economic recession will occur during the forecast period through FY 2056.
5. No material natural disaster or local, state, or national emergency will occur that would alter travel patterns and divert traffic from SR 520.

As for the long-term projections themselves, while they are stated year-by-year, they are intended to show the long-term trends that may be reasonably anticipated during the forecast period.

6.2 ANNUALIZATION

To convert the average weekday modeled traffic and revenue results to an annual forecast, factors were developed from the existing CSC data. Using FY 2016 data, the resulting factor to convert weekday traffic to annual traffic is 312

and the resulting factor to convert weekday revenue to annual revenue is 297. The annual revenue factor is lower than the annual revenue factor because the toll rates vary by weekday and weekend; weekend rates are lower than weekday rates. Also, rates vary by time of day which also reduces the revenue factor.

6.2.1 Construction Closures

As part of the SR 520 Bridge Replacement and HOV Program, road closures due to construction are expected. WSDOT provided a schedule of these closures as shown in Table 6-3. Traffic and revenue forecasts were adjusted downward to account for both the planned weekday and weekend closures.

Table 6.3 : SR 520 Closure Assumptions

FY	SR 520 Main Span		Portage Bay Bridge		Total	
	Weekday Night	Weekend	Weekday Night	Weekend	Weekday Night	Weekend
2018	1.6	4.0			1.6	4.0
2019		10.0			0.0	10.0
2020	29.5	17.0	6.0	3.5	35.5	20.5
2021	29.0	16.0	8.8	5.0	37.8	21.0
2022	29.5	17.0	8.8	5.0	38.3	22.0
2023	23.0	13.0	7.5	2.5	30.5	15.5
2024			10.0	3.0	10.0	3.0
2025			10.0	3.0	10.0	3.0
2026			12.0	7.0	12.0	7.0
Total	**112.6**	**77.0**	**63.1**	**29.0**	**175.7**	**106.0**

6.3 FORECAST METHODOLOGY

The daily traffic and gross toll revenue potential for each modeled year were annualized and used to develop a revenue stream. To account for the geometric changes on SR 520 due to the construction staging, 2025 was modeled using three different configurations; the FY 2017 configuration, the FY 2024-2026 configuration, and the FY 2027-2056 configuration. The results indicated that the changes in configuration would have impacts in the annual traffic and revenue and the revenue stream was adjusted accordingly.

6.4 ANNUAL TRAFFIC AND GROSS TOLL REVENUE POTENTIAL FORECAST

The annual traffic and gross toll revenue potential forecast is shown in Table 6-4, along with the average toll rate per year and The *Good to Go!* transaction share in the forecast period. Transactions are expected to increase from 24.6 million transactions in FY 2018 to 40.6 million transactions in FY 2056, an average annual increase of 1.3 percent per year. Gross toll revenue potential is expected to increase from $87.3 million in FY 2018 to $140.8 million in FY 2056,

an average annual increase of 1.3 percent per year. The average toll rate is expected to decrease slightly over time, from $3.55 to $3.47 as the *Good to Go!* share increases from 84.3 percent to 87.3 percent over the forecast period. The annual transaction and gross toll revenue potential forecast is shown in in Table 6-4 and in Figure 6.2.

Table 6.4: Traffic and Gross Toll Revenue Potential Forecast

Fiscal Year	Transactions	Revenue	Avg. Revenue per Transaction	Good to Go! Percentage Share
2018	24,609,000	$87,336,000	$3.55	84.3%
2019	25,176,000	$89,680,000	$3.56	84.3%
2020	25,398,000	$91,329,000	$3.60	84.7%
2021	26,127,000	$93,537,000	$3.58	85.1%
2022	26,725,000	$95,041,000	$3.56	85.4%
2023	27,694,000	$97,366,000	$3.52	85.7%
2024	29,079,000	$101,107,000	$3.48	86.0%
2025	29,645,000	$103,226,000	$3.48	86.2%
2026	30,064,000	$104,718,000	$3.48	86.3%
2027	31,375,000	$108,412,000	$3.46	86.4%
2028	32,083,000	$110,581,000	$3.45	86.5%
2029	32,727,000	$112,792,000	$3.45	86.6%
2030	33,302,000	$114,765,000	$3.45	86.6%
2031	33,804,000	$116,487,000	$3.45	86.6%
2032	34,315,000	$118,235,000	$3.45	86.7%
2033	34,832,000	$120,009,000	$3.45	86.7%
2034	35,357,000	$121,808,000	$3.45	86.8%
2035	35,890,000	$123,331,000	$3.44	86.8%
2036	36,432,000	$124,564,000	$3.42	86.9%
2037	36,798,000	$125,810,000	$3.42	86.9%
2038	37,169,000	$127,067,000	$3.42	87.0%
2039	37,450,000	$128,021,000	$3.42	87.0%
2040	37,641,000	$128,981,000	$3.43	87.1%
2041	37,832,000	$129,626,000	$3.43	87.1%
2042	38,024,000	$130,275,000	$3.43	87.2%
2043	38,217,000	$130,926,000	$3.43	87.2%
2044	38,411,000	$131,254,000	$3.42	87.3%
2045	38,647,000	$131,664,000	$3.41	87.3%
2046	38,817,000	$132,470,000	$3.41	87.3%
2047	38,989,000	$133,281,000	$3.42	87.3%
2048	39,161,000	$134,097,000	$3.42	87.3%
2049	39,334,000	$134,917,000	$3.43	87.3%
2050	39,507,000	$135,743,000	$3.44	87.3%
2051	39,682,000	$136,574,000	$3.44	87.3%
2052	39,857,000	$137,409,000	$3.45	87.3%
2053	40,033,000	$138,250,000	$3.45	87.3%
2054	40,210,000	$139,097,000	$3.46	87.3%
2055	40,387,000	$139,948,000	$3.47	87.3%
2056	40,566,000	$140,804,000	$3.47	87.3%

Source: Stantec's November Forecast

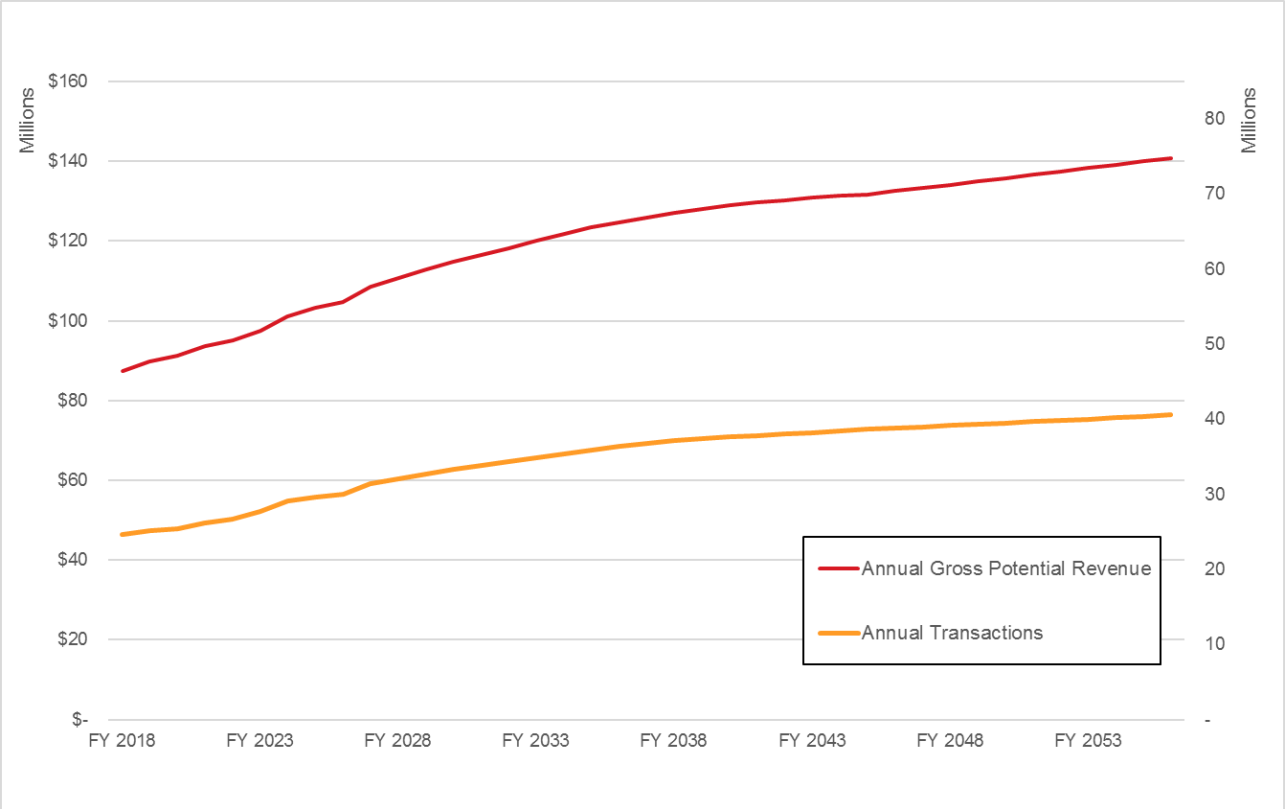



Figure 6.2: Annual Transaction and Revenue Forecast