Department of Transporta

The 2014

Corridor Capacity Report

The 13th edition of the annual *Congestion Report*

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Lynn Peterson, Secretary of Transportation

WSDOT's comprehensive annual analysis of multimodal state highway system performance

Developed in partnership with

community transit smile & ride

C-TRAN

INTERcity TRANSIT

King County METRO

Puget Sound Regional Council PSRC

SOUNDTRANSIT

RTC Southwest Washington Regional Transportation Council

SRTC Spokane Regional Transportation Council

Spokane Transit

thurston regional planning council

TRAC

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Finding capacity on state highways

Driving in Washington is returning to what it used to be before the recession, and as population grows in the Evergreen state, congestion is growing too. Meanwhile, more drivers are heading out to work each day as the statewide economy continues to rebound.

What can be done to reduce the congestion that affects key commute corridors, resulting in lost time for drivers and costing the state as a whole, hundreds of millions of dollars?

The 2014 *Corridor Capacity Report* (CCR) was created to help inform WSDOT policy makers, planners and engineers as they examine the multimodal capacity opportunities for state highways. This report supports WSDOT's Practical Solutions and performance-based planning initiatives. It also apprises WSDOT, the Legislature, stakeholders, educational and research institutions, the media, and the public about highway system conditions and how we can work together to reduce congestion.

The CCR provides multimodal system analysis, tracking not only congestion trends, but detailing usable capacity on state highways, mass transit and ferries. The report also considers congestion's impacts on air quality and people's wallets, providing a more complete picture of how traffic affects the state as a whole. WSDOT and University of Washington experts analyze data that span two years (2011 and 2013) to identify state highway system trends that cannot be evaluated by using a one-year comparison.

Changes to the report

Based on the positive feedback received for last year's report, WSDOT continues to enhance the multimodal aspects of system performance evaluation from a corridor perspective. For this year's edition, multimodal capacity is evaluated along with travel time analyses for all major urban areas statewide where data is available.

This report consists of three parts: this *Corridor Capacity Report*, a data Appendix and a detailed methodology report (*Handbook for Corridor Capacity Evaluation*).

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Congestion on the rise, but still below pre-recession levels

Statewide indicators

- 2009 was the least congested year statewide since the most recent recession began in 2008.
- The statewide congestion indicator – vehicle hours of delay – increased 1.5% between 2011 and 2013, mirroring increases of economic indicators (including taxable retail sales, employment levels and driving age population).
- In 2013, average per person delay remained steady at about 4 hours and 42 minutes, roughly the same amount of time spent in 2011.
- Delay on state highways cost drivers and businesses $858 million in 2013 compared to $845 million in 2011 (about $125 per Washingtonian, both in 2011 and 2013).
- In 2013, 1,026 (5.5%) of the 18,662 state highway lane miles experienced congestion, compared to 1,007 highway lane miles in 2011. More than half of them were on urban commute corridors (I-5, I-90, I-205, I-405, SR 167 and SR 520).
- In 2013, vehicle miles traveled (VMT) on all public roadways statewide increased 0.4% from 2011, hitting an all-time high of 57.211 billion.
- In 2013, per person (per capita) VMT was the second lowest recorded since 1988. In 2013, per person VMT was at 8,313 miles annually on all public roads and 4,598 on state highways.
- There are 350 park and ride facilities statewide.

Regional indicators

- Per person hours of delay on highways in the Puget Sound area remained at 8 hours and 23 minutes in both 2011 and 2013.
- Per person hours of delay on Vancouver area highways decreased from 23 minutes in 2011 to 17 minutes in 2013, partly due to a successful capacity expansion project on SR 14 in Camas and Washougal.
- Per person hours of delay on Spokane area highways remained at 8 minutes in both 2011 and 2013.
- Per person hours of delay on Tri-Cities area highways decreased from 35 minutes in 2011 to 12 minutes in 2013 due to lower employment levels at Hanford.

Accessibility analysis under development

WSDOT is developing an approach to measure and illustrate "accessibility," such as the number of jobs that can be reached within an average commute time. WSDOT will publish this analysis in a future edition of the *Gray Notebook*. A draft methodology is included in WSDOT's *Handbook for Corridor Capacity Evaluation*, pp. 35-36.

Commute corridor indicators

This report analyzed 84 urban commute corridors on state highways that span 720 miles. As some of this information was not in the 2011 report, comparisons to data from that year are not possible for all measures.

- In 2013, there were 165 miles of routinely congested segments, resulting in 63 hours of congestion daily.
- In 2013, there were 1,506 transit vehicles in service during peak periods; 570 had more than 90% utilization daily.
- There were more than 102,400 peak period transit riders along the commute corridors each weekday in 2013, helping avoid 1.03 million miles of solo vehicle travel and 873,000 pounds of greenhouse gas emissions daily.
- Ferry vessels made more than 162,000 sailings with an on-time performance of 95.6% and an annual ridership of 22.5 million in 2013.

WSDOT expands multimodal measures

WSDOT's 2014 *Corridor Capacity Report* is the agency's 13th annual statewide analysis of multimodal system performance. This report further "fine tunes" the multimodal and environmental measures introduced in the *2013 Corridor Capacity Report*, extending them statewide to all urban areas where data is available.

This report provides average annual transit statistics for each commute, which include ridership and percent of seats occupied, along with the number of peak transit trips with more than 90% utilization. Transit information also notes vehicle trips removed from the single occupant vehicle lanes and greenhouse gas (GHG) emissions avoided by transit ridership along the urban commute corridors. It also reports GHG emissions (measured in pounds of carbon dioxide equivalents emitted) as well as congestion's cost per person during peak periods.

In addition to a data Appendix, WSDOT has developed its first edition of the Handbook for Corridor Capacity Evaluation, which serves as a one-stop shop to help readers navigate the annual *Corridor Capacity Report*'s multimodal analysis of transportation system performance.

This handbook is a tool for technical professionals working to implement system performance measurement and reporting as part of their agency's accountability initiatives and/or the federal Moving Ahead for Progress in the 21st Century (MAP-21) requirements.

Dashboard of Indicators

2014 *Corridor Capacity Report* Dashboard of Indicators	**2009**	**2010**	**2011**	**2012**	**2013**	**Difference '11 vs. '13**
Demographic and economic indicators						
State population (thousands)	6,672	6,725	6,768	6,818	6,882	1.7%
Gasoline price per gallon (annual average)[1]	$2.80	$3.22	$3.85	$3.90	$3.64	-5.5%
Washington total employment (thousands of workers)[2]	2,863	2,837	2,873	2,922	2,990	4.1%
Taxable retail sales (billions of dollars)[1]	$109.5	$107.7	$107.4	$110.7	$117.2	9.1%
Multimodal performance measures						
Drive alone commuting rate[3]	72.1%	73.0%	73.3%	72.2%	72.7%	-0.6%
Carpooling commuting rate[3]	11.3%	10.5%	10.2%	10.7%	10.1%	-0.1%
Bicycling and walking commuting rate[3]	4.3%	4.4%	4.2%	4.5%	4.3%	0.1%
Public transit commuting rate[3]	5.9%	5.5%	5.6%	5.8%	6.3%	0.7%
Transit ridership[4] (in millions)	210.1	207.8	213.0	218.1	--	--
WSDOT Ferries ridership[4] (in millions)	22.5	22.6	22.3	22.2	22.5	0.9%
Statewide congestion indicators						
Greenhouse gas emissions						
Million metric tons of carbon dioxide equivalents (CO_2e)[5]	95.0	96.1	--	--	--	--
Transportation as percent of emissions from all sources statewide [5]	44.8%	43.9%	--	--	--	--
Per person, total vehicle miles traveled on all public roads, state highways only						
All public roads vehicle miles traveled (VMT) (in billions)	56.461	57.191	56.965	56.607	57.211	0.4%
All public roads per person VMT (miles)	8,462	8,505	8,417	8,303	8,313	-1.2%
State highways VMT (in billions)	31.456	31.764	31.455	31.214	31.648	0.6%
State highways per person VMT (miles)	4,714	4,724	4,648	4,578	4,598	-1.1%
Congestion on state highway system						
Total state highway lane miles	18,571	18,630	18,642	18,659	18,662	0.1%
Lane miles of state highway system congested	966	1,025	1,007	1,026	1,026	1.9%
Percent of state highway system congested[6]	5.2%	5.5%	5.4%	5.5%	5.5%	0.1%
Per person, total, and cost of delay on state highways						
Annual hours of per person delay on state highways[7]	4.21	4.71	4.72	4.52	4.71	-0.4%
Total vehicle hours of delay, in millions of hours[7]	28.1	31.6	31.9	30.9	32.4	1.5%
Cost of delay on state highways (in millions)[7]	$742	$837	$845	$817	$858	1.5%
Corridor specific congestion indicators (84 commutes statewide)						
Annual Maximum Throughput Travel Time Index (MT^3I)[8]	1.30	1.39	1.38	1.39	1.43	4%
Number of commute routes with $MT^3I > 1$[9]	43[9]	47	60	58	56	-7%
WSDOT congestion relief projects (cumulative)						
Number of completed Nickel and Transportation Partnership Program mobility projects as of December 31 each year	65	73	82	91	94	12
Project value (dollars in millions)	$2,212	$2,596	$2,802	$3,851	$3,985	$1,183

Data source: Washington State Office of Financial Management, U.S. Energy Information Administration, Bureau of Labor Statistics – Consumer Price Index, Washington State Employment Security Department, Washington State Department of Revenue, WSDOT State Highway Log, U.S. Census Bureau - American Community Survey, National Transit Database, Washington Department of Ecology.

Notes: WSDOT's annual *Congestion Report* was renamed as the *Corridor Capacity Report* beginning with the 2013 publication. 1 These dollar values are inflation-adjusted using the Consumer Price Index (CPI), and are reported in 2013 dollars. 2 Employment only includes nonagricultural workers. 3 Based on one-year estimates from the American Community Survey, commuting rates are of workers age 16 and older. 4 Ridership means the number of boardings, also called unlinked passenger trips. 5 2011 and 2012 values will be published by the Washington Department of Ecology in December 2014. 6 Based on below 70% of posted speed. 7 Based on maximum throughput speed threshold (85% of posted speed). 8 Averaged for the 52 commute routes in the central Puget Sound area. 9 MT^3I greater than one means the commute route experiences congestion.

WSDOT aims to maximize throughput performance

WSDOT uses maximum throughput speed as the baseline speed for congestion and capacity performance measurement. This is the speed at which the highest number of vehicles can move through a highway segment.

Maximum throughput is achieved when vehicles travel at speeds between 42 and 51 mph (roughly 70% to 85% of a posted 60 mph speed). At maximum throughput speeds, highways operate at peak efficiency because more vehicles are passing through the segment than at posted speed limit. This happens because drivers at maximum throughput speeds can safely travel with a shorter distance between vehicles than they can at posted speeds. WSDOT aims to provide and maintain a system that maximizes capacity and yields the most productivity and efficiency.

WSDOT is building on this existing maximum throughput philosophy for vehicle travel to expand its application to multiple travel modes. This takes into account the capacity available on other modes along with that of the highway system with an aim to maximize person throughput.

As part of this effort, beginning in the [2013 *Corridor Capacity Report*], WSDOT incorporated multimodal performance measures to define system performance and available capacity across all modes. WSDOT introduced multimodal measures with an emphasis on person-based metrics to supplement the existing transportation system analysis. The multimodal measures include:

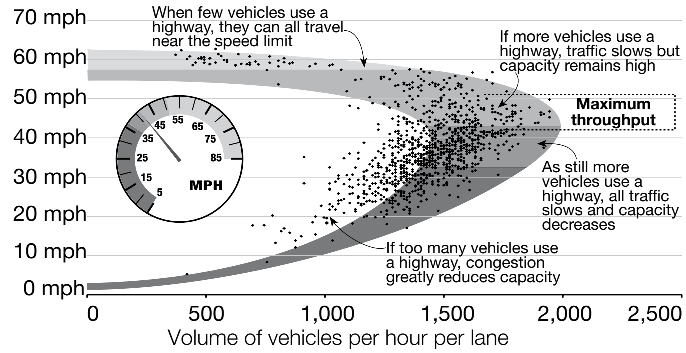
- Transit-oriented performance measures, such as total ridership, single occupant vehicle miles not driven and transit capacity used along the high-demand commute corridors.
- Greenhouse gas emissions per person during peak periods on commute corridors.
- Person-based measures, such as miles traveled per person and hours of delay per person in traffic along with the per person trip travel time on commute corridors.

Maximum throughput speeds vary from one highway segment to the next depending on prevailing roadway design (roadway alignment, lane width, slope, shoulder width, pavement conditions, presence or absence of

Understanding maximum throughput: An adaptation of the speed/volume curve

Represents I-405 northbound at 24th NE, 6-10 a.m. weekday volumes; Speed limit 60 mph; Maximum throughput speed ranges between 70%-85% of posted speed

of the speed/volume curve
Represents I-405 northbound at 24th NE, 6-10 a.m. weekdays volume; Speed limit 60 mph; Maximum throughput speed ranges between: 70%-85% of posted speed



Data source: WSDOT Northwest Region Traffic Office.

median barriers), weather and traffic conditions (traffic composition, conflicting traffic movements, heavy truck traffic, etc.). The maximum throughput speed is not static and can change over time as conditions change. Ideally, maximum throughput speeds for each highway segment should be determined through comprehensive traffic studies and validated by field surveys. For surface arterials (interrupted flow facilities), maximum throughput speeds are difficult to predict because they are influenced by interruptions in flow due to the conflicting traffic movements at intersections.

WSDOT uses the maximum throughput speed standard as a basis for measurement to assess travel delay relative to a highway's most efficient condition at maximum throughput speeds (85% of posted speed). For more information on changes in travel delay performance, see pp. 6-7.

WSDOT also uses maximum throughput speed as a basis for evaluating the system through the following measures:

- Total vehicle delay and per person delay
- Percent of highway lane miles delayed and/or congested
- Lost throughput productivity
- Maximum Throughput Travel Time Index—MT^{3}I
- Duration of the congested period
- Commute congestion cost

See [WSDOT's Handbook for Corridor Capacity Evaluation] for details on WSDOT's measurement and analysis approach for these and other system evaluation metrics.

Statewide Congestion Indicators

Per person vehicle miles traveled second lowest since 1988

Vehicle miles traveled (VMT) per person (per capita) in 2013 was the second lowest on record in the past quarter century. This does not mean the VMT is declining. In fact, VMT on all roads was at its record high in 2013. In 2013, VMT per person was recorded at 8,313 miles annually on all public roads (104 fewer miles per person than in 2011) and 4,598 on state highways (50 fewer miles per person than in 2011).

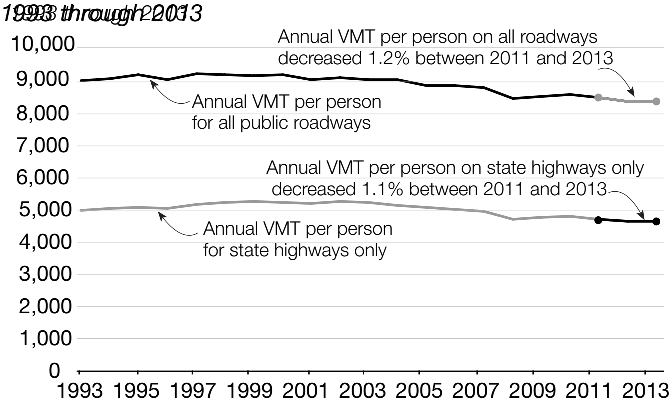
Total vehicle miles traveled (VMT) on the rise while VMT per person continues near record low levels
2009 through 2013; Population in thousands

Year (population)	Total vehicle miles traveled (billions): State highways	Total vehicle miles traveled (billions): All public roads	Vehicle miles traveled per person: State highways	Vehicle miles traveled per person: All public roads
2009 (6,672)	31.456	56.461	4,714	8,462
2010 (6,725)	31.764	57.191	4,724	8,505
2011 (6,768)	31.455	56.965	4,648	8,417
2012 (6,818)	31.214	56.607	4,578	8,303
2013 (6,882)	31.648	57.211	4,598	8,313
Δ 2013 vs. 2011	0.193	0.246	-50	-104
%Δ 2013 vs. 2011	0.6%	0.4%	-1.1%	-1.2%

Data source: WSDOT Transportation Data and GIS Office, Washington State Office of Financial Management.

The VMT per person on all public roads decreased 1.2% between 2011 and 2013. The VMT per person measured exclusively for state highways showed a decrease of 1.1% from 2011 to 2013. The table above lists the annual vehicle miles traveled and VMT per capita for the past five years. The VMT per person on all public roads shows that the average Washingtonian drove 104 fewer miles in 2013 than in 2011, but 10 more miles annually than in 2012. For VMT accumulated exclusively on state highways, Washingtonians drove 50 fewer miles in 2013 than in 2011 and 20 more miles than in 2012. A lower per-person miles driven translates to fewer greenhouse gas emissions and a smaller carbon footprint per person.

In 2013, annual vehicle miles traveled (VMT) per person at second lowest level since 1988
1993 through 2013



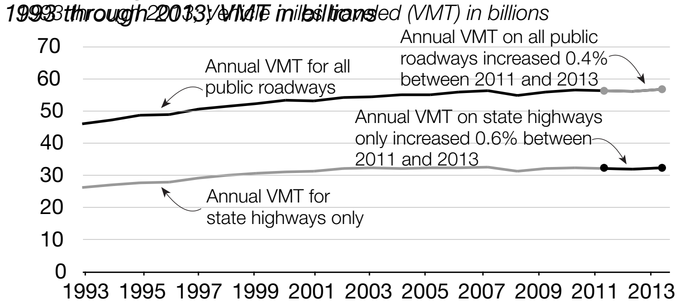
Data source: WSDOT Transportation Data and GIS Office and Washington State Office of Financial Management.

Statewide vehicle miles traveled hits a new record high in 2013

In 2013, VMT on all public roadways in Washington hit an all-time high of 57.211 billion miles (highest since 1980, when the state started collecting public roadway VMT data). The second highest VMT was recorded in 2010 at 57.191 billion. Both of these years saw VMT values higher than the pre-recession value of 56.964 billion miles recorded in 2007.

The average annual VMT on all public roadways in Washington increased 0.4% to 57.211 billion between 2011 and 2013. The 2013 annual VMT increased 1.1% from 2012 for all public roadways. The VMT on state highways in 2013 increased 0.6% compared to 2011 and 1.4% compared to 2012.

Record high statewide vehicle miles traveled in 2013
1993 through 2013; VMT in billions



Data source: WSDOT Transportation Data and GIS Office.

Statewide per person vehicle hours of delay steady in Washington

Each Washingtonian spent 4 hours and 42 minutes delayed due to traffic in 2013, which is roughly the same amount of time as in 2011. While tolling on State Route (SR) 520 and ongoing construction might have shifted where the delay occurred on Puget Sound area highways, hours of delay per person in the region remained at 8 hours and 23 minutes in both 2011 and 2013. The other urban centers across the state such as Spokane, the Tri-Cities and Vancouver experienced less than 30 minutes of delay per person annually. Current statewide delay is lower than 2007 pre-recession levels by about 8%.

Travel delay on state highways costs $858 million

Estimated annual travel delay and cost of delay on state highways by urban area
2009 through 2013; Delay in hours; Cost of delay in millions in 2013 dollars

Urban area	2009	2010	2011[1]	2012	2013	%Δ 2011 vs. 2013
Puget Sound (King, Snohomish and Pierce counties)	27,236,023	30,750,000	31,165,000	30,170,000	31,737,500	1.8%
Spokane (Spokane County)	39,000	97,500	65,000	77,500	70,000	7.7%
Tri-Cities (Benton and Franklin counties)	86,750	155,000	155,000	141,000	55,000	-64.5%
Vancouver (Clark County)	272,500	157,500	167,500	160,000	130,000	-22.4%
Other areas	450,727	485,000	417,500	351,500	457,500	9.6%
Statewide annual	**28,085,000**	**31,645,000**	**31,970,000**	**30,900,000**	**32,450,000**	**1.5%**
Annual cost of delay	**$742**	**$837**	**$845**	**$817**	**$858**	**1.5%**

Data source: WSDOT Urban Planning Office.
Note: 1 2011 delay numbers do not match previous years' reports as segmentation changes were made in order to compare with 2013 analysis.

Puget Sound area has the most delay

On an average weekday, Washingtonians spent more time delayed in traffic in 2013 than in 2011. Between 2011 and 2013, average statewide delay increased 1.5% while Puget Sound area delay increased 1.8%. The Puget Sound area accounts for 97.8% of statewide delay, while urban centers such as Spokane, the Tri-Cities and Vancouver along with the rest of the state highway system accounts for the remaining 2.2%.

Hours of delay per person remains steady statewide
2009 through 2013; Annual delay in hours:minutes

Urban areas	2009	2010	2011	2012	2013	%Δ 2011 vs. 2013
Puget Sound[1]	7:26	8:19	8:23	8:03	8:23	0.0%
Spokane County	0:05	0:12	0:08	0:09	0:08	0.0%
Tri-Cities[2]	0:21	0:36	0:35	0:32	0:12	-65.7%
Vancouver (Clark Co.)	0:38	0:22	0:23	0:22	0:17	-26.1%
Statewide	**4:12**	**4:42**	**4:43**	**4:31**	**4:42**	**-0.4%**

Data source: WSDOT Urban Planning Office, Washington State Office of Financial Management.
Notes: 1 King, Snohomish, Pierce counties. 2 Benton, Franklin counties.

The Tri-Cities and Clark County showed significant reductions in delay (see table above). The Tri-Cities delay reduction along SR 240 might be due to a drop in employment at the Hanford cleanup project. The Clark County delay reduction was partly due to an interchange project in the Camas-Washougal area, further evaluated on p. 47.

More delay along Puget Sound area freeway corridors in 2013 than in 2011

WSDOT tracks delay and VMT on five specific freeway corridors in the central Puget Sound area. Except for SR 520, travel delay on all corridors increased from 2011 to 2013, while VMT decreased by 1%.

Tolling SR 520 impacted travel patterns in the central Puget Sound area after it began in December 2011. Ongoing construction on several freeways continues to affect vehicle travel. Despite ongoing construction, vehicle delay on SR 520 decreased from 1,335 hours in 2011 to 486 hours in 2013. Some vehicles that used SR 520 prior to tolling shifted to I-90. The daily delay on I-90 increased nearly 400 hours due to this shift in traffic and growth because of the rebounding economy. I-5 and I-405 also saw delay increase by 57% and 39%, respectively. See Appendix p. 4 for corridor-specific delay values.

Travel delay costs Washington drivers and businesses $858 million in 2013

Statewide travel delay cost drivers and businesses in Washington $858 million in 2013, up from $845 million in 2011 (see table at top of page). As the Puget Sound area contributes 97.8% of total statewide delay, it is estimated that $811 million in delay costs occur in the Puget Sound area. For more details on calculating the cost of delay, see WSDOT's Handbook for Corridor Capacity Evaluation pp. 8-10.

See Appendix p. 4 for more statewide indicators data.

Statewide greenhouse gas emissions

According to the Washington State Department of Ecology, transportation-related activities contributed 44% of all greenhouse gases released into the atmosphere in 2010 (2012 values will be released late in 2014). Transportation accounts for 27% of emissions nationally, according to the Environmental Protection Agency. The local percentage of all emissions is higher than the national average due to the relatively low emissions from hydroelectric power plants in Washington state that harness abundant renewable resources.

In 2013, the annual (all-day) greenhouse gas emissions from vehicles on the 84 high-demand commute corridors in the urban areas statewide were estimated to be 2.77 million metric tons (or 6.11 billion pounds) of carbon dioxide equivalents (CO_2e), 1.6% less than in 2011.

Economic factors affect congestion

Traffic congestion, travel times and delay are influenced by a number of factors, including the availability of public modes of transport, the rate of carpooling, and the overall economy. Congestion tends to worsen as employment levels improve due to an increased number of commuters, especially when these workers are driving alone.

According to the American Community Survey, 72.7% of Washingtonians drove alone to work in 2013, a slight drop from 73.3% in 2011. Of the remaining Washington workers, 10.1% carpooled, 6.3% rode public transportation, 5.3% worked from home, 3.5% walked and less than 1% biked.

Employment continues upward trend

Nonagricultural employment in Washington reached 2.99 million workers in 2013, a 4.1% increase from 2011. Despite this growth, total employment is still slightly lower than the 2008 peak level. Employment in King, Clark and Snohomish counties grew more than 5% from 2011 to 2013.

Washington's unemployment rate dropped to 7% in 2013, from 9.2% in 2011. While on the surface this indicates an improvement in the economy, there are several factors to consider. First, the decline in the unemployment rate can be partially attributed to workers leaving the labor force. Between 2011 and 2013, Washington's labor force participation rate (the percentage of the population currently working or actively seeking work) fell from 51.3% to 50.3%. Second, average weekly hours worked by all Washington employees were relatively stable between 2011 and 2013, while average hourly earnings adjusted for inflation declined.

Taxable retail sales hit five year high

Taxable retail sales can be a proxy for consumers' confidence in the economy and representative of truck traffic on Washington roadways, given that retail stores need to be supplied with goods. Retail sales increased 9.1% from 2011 to 2013, and 5.9% from 2012 to 2013, the largest annual growth since 2007. This improvement in consumer confidence and increased consumption is likely related to the growth in employment, and therefore linked to increased commute traffic that leads to congestion.

Summary of Washington's economic indicators
2011 and 2013

Indicator	2011	2013	%Δ	Trend
Driving age population (16 years and over, in millions)	5.37	5.48	2.0%	↑
Employment (millions of workers)	2.87	2.99	4.1%	↑
Unemployment rate	9.2%	7.0%	-2.2%	↓
Taxable retail sales[1] (billions of dollars)	$107.4	$117.2	9.1%	↑
Gasoline price per gallon[1]	$3.85	$3.64	-5.5%	↓
Passenger vehicle registrations (millions)	4.34	4.44	2.2%	↑

Data source: Washington State Office of Financial Management, Washington State Employment Security Department, Washington Economic and Revenue Forecast Council, Washington State Department of Revenue, and U.S. Energy Information Administration.
Note: 1 Adjusted for inflation and reported in 2013 dollars.

Gas prices decrease 5.5% since 2011

The average gas price in Washington fell 5.5% between 2011 and 2013, when accounting for inflation, from $3.85 per gallon in 2011 to $3.64 in 2013. The highest average gas price was observed in 2012 at an annual average of $3.90 per gallon. The average price of gas in Washington exceeded the national average by 14 cents in 2013.

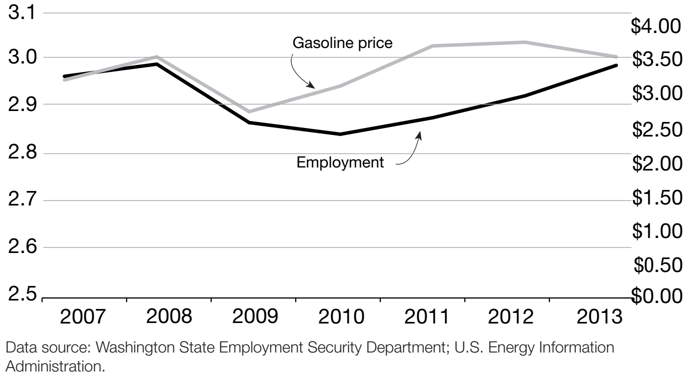
Falling gas prices have a tendency to worsen traffic congestion: when gas prices decline, driving becomes less expensive and people often use single occupant vehicles rather than alternative commute modes.

Driving age population grows faster than overall state population

Washington's driving age population (age 16 and older) increased 2% from 2011 to 2013, from 5.37 million to 5.48 million people. This exceeded the growth rate of total state population, which increased 1.7% from 2011 to 2013.

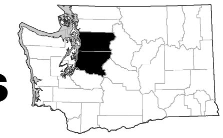
There were 5.2 million licensed drivers in Washington in 2013, a 3% increase from 2011. In addition, there were 4.4 million registered passenger vehicles, a 2.2% rise from the previous two years. This means that there were about 0.85 passenger vehicles per licensed driver in Washington. This rate of vehicle availability has been relatively stable since 2009.

Washington state employment continues to grow slowly as gas prices fall
Washington State employment and gas prices
2007 through 2013; Gas prices in 2009 dollars



Data source: Washington State Employment Security Department; U.S. Energy Information Administration.

Interstate 5 Corridor Capacity Analysis



Annual person miles traveled

2011 vs. **2013**
2,472 2,472
in millions of miles
0.0%

Annual vehicle delay[1]

2011 vs. **2013**
1,919 3,010
in thousands of hours
57%

Annual emissions

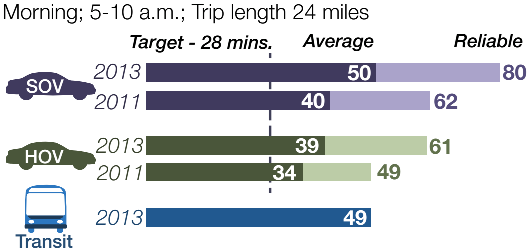
2011 vs. **2013**
2,068 2,018
in millions of pounds of CO_2 equivalents
2.4%

Commute travel times

2011 and 2013; Weekday travel times in minutes at the peak 5-minute interval including average and reliable[2] travel times for single occupant vehicle (SOV) and high occupancy vehicle (HOV) trips as well as maximum throughput (target) and planned transit[3] travel times.

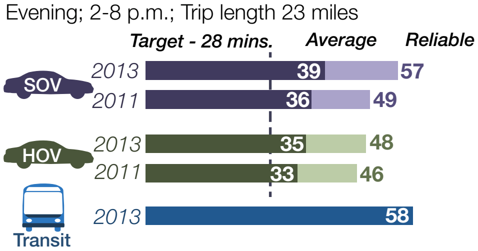
Everett to Seattle

Morning; 5-10 a.m.; Trip length 24 miles



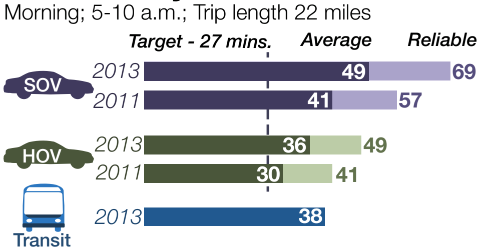
Seattle to Everett

Evening; 2-8 p.m.; Trip length 23 miles



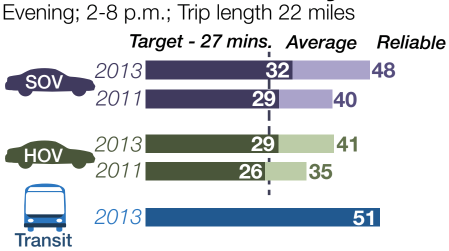
Federal Way to Seattle

Morning; 5-10 a.m.; Trip length 22 miles

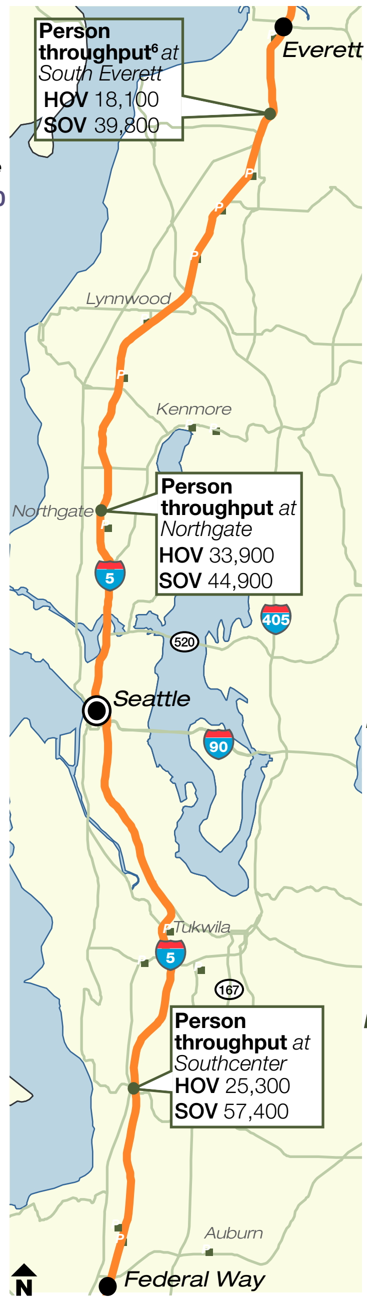


Seattle to Federal Way

Evening; 2-8 p.m.; Trip length 22 miles



See Appendix pp. 5-15 for more commute routes



Transit system use

2013; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) peak periods; Ridership and percent of available seats occupied on select commutes

Corridor-wide[4] ridership

13.8 million — *transit riders annually*

252.8 million — *passenger miles traveled annually*

79% — *transit seats occupied on average*

By commute

By commute	**Daily peak period riders**	**Percent of seats occupied**
Morning (6-9 a.m.)		
Federal Way to Seattle (*Includes Tacoma to Seattle bus routes)	10,472	89%
Everett to Seattle	8,565	64%
SeaTac to Seattle	5,748	95%
Evening (3-6 p.m.)		
Seattle to Federal Way (*Includes Seattle to Tacoma bus routes)	10,411	93%
Seattle to Everett	8,036	60%
Seattle to SeaTac	6,968	110%

Park and ride capacity

2013; Parking spaces and average percent occupied for select park and rides (P&R)[5] (see map for locations)

Everett-Seattle commute

Park and ride	Spaces	Percent occupied
Lynnwood Transit Center	1,370	100%
Ash Way P&R	1,022	100%
Mountlake Terrace P&R	877	100%
Kenmore area	693	100%
S. Everett Freeway Station	397	100%
Northgate area	1,024	99%
Mariner P&R	644	75%
Everett Station	921	35%

Federal Way-Seattle commute

Park and ride	Spaces	Percent occupied
Auburn area	633	100%
Sumner train station	302	100%
Tukwila area	855	99%
Kent area	996	97%
Tacoma Dome	2,283	96%
Puyallup area	583	94%
Lakewood area	1,093	84%
Federal Way area	2,067	73%

Data source: Washington State Transportation Center (TRAC) at the University of Washington, WSDOT Urban Planning Office, Sound Transit, King County Metro, Community Transit and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: Measures at the top of the page are for the I-5 corridor between Everett and Federal Way for SOV trips only. 1 WSDOT defines delay when average speeds are slower than 85% of the posted speed limit. 2 Reliable travel time is the travel time that will get a commuter to their destination on time or early 19 out of 20 weekdays, or 95% of the time. 3 Transit travel times by bus, Link light rail and Sounder rail include off-highway travel to stops and may not be comparable to SOV/HOV times which are highway only. 4 Peak period corridor-wide ridership includes trips on all I-5 central Puget Sound area corridors. 5 For more park and ride information, see http://www.wsdot.wa.gov/choices/parkride.htm. 6 Person throughput values include morning (6-9 a.m.) and evening (3-6 p.m.) peak period values.

Transit ridership contributes to I-5 person throughput

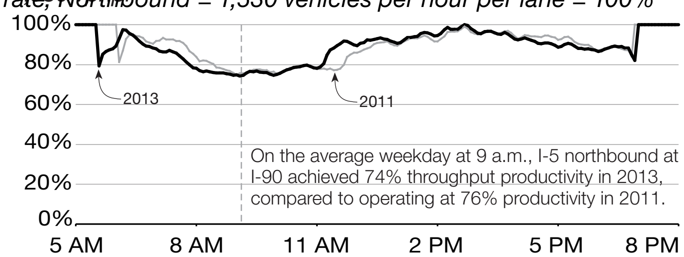
Interstate 5 (I-5) between Federal Way and Everett serves as a key commute and freight corridor in the central Puget Sound area. The morning (5-10 a.m.) and evening (2-8 p.m.) commutes experience heavy congestion at specific locations along the corridor on a daily basis. Hours of delay per person annually on the I-5 corridor increased 59% from 5 hours and 27 minutes in 2011 to 8 hours and 40 minutes in 2013. As a result, the average commuter on I-5 spent an additional 3 hours and 13 minutes on the road over the course of 2013 compared to 2011. For this same time period, person-miles traveled along the I-5 commute corridors in the central Puget Sound area held steady, while annual emissions decreased 2%.

I-5 corridor productivity analysis

Highway productivity: As traffic increases, roads are able to carry fewer vehicles, resulting in a drop in productivity at speeds slower than maximum throughput speed. In order to gauge lost productivity on the central Puget Sound area I-5 corridor, throughput was analyzed at three locations: 188th Street near SeaTac, NE 103rd Street near Northgate and at the I-90 interchange. In 2011 and 2013, productivity at these locations ranged from 74% to 85%. For example, in 2013, I-5 at I-90 saw productivity losses of up to 26% (northbound) and 24% (southbound) between 6 a.m. and 8 p.m. The graphs below show how throughput productivity can vary by direction of travel and time of day.

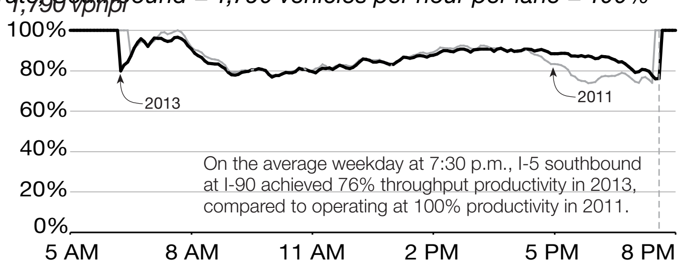
Throughput along northbound I-5 at I-90 (MP 164.0)
2011 and 2013; Based on the highest observed 5-minute flow rate; Northbound = 1,530 vehicles per hour per lane = 100%

Northbound I-5 at I-90 (MP 164.0)
Based on the highest observed 5 min. flow rate; Northbound = 1,530 vphpl



Throughput along southbound I-5 at I-90 (MP 164.0)
2011 and 2013; Based on the highest observed 5-minute flow rate; Southbound = 1,790 vehicles per hour per lane = 100%

Southbound I-5 at I-90 (MP 164.0)
Based on the highest observed 5 min. flow rate; Southbound = 1,790 vphpl



Data source: WSDOT Urban Planning Office.

Vehicle throughput worsens along I-5 near Seattle
2011 and 2013; Maximum loss of vehicle throughput by commute direction

Location	Direction	Loss compared to 100% in 2011	2013	Change
I-5 at S 188th Street, near SeaTac	Northbound	15%	20%	5%
	Southbound	17%	21%	4%
I-5 at I-90	Northbound	25%	26%	1%
	Southbound	26%	24%	-2%
I-5 at NE 103rd Street, near Northgate	Northbound	15%	20%	5%
	Southbound	20%	30%	10%

Data source: Washington State Transportation Center (TRAC) at the University of Washington. Data analysis: WSDOT Urban Planning Office and Office of Strategic Assessment and Performance Analysis.
Note: Negative values indicate vehicle throughput improved in 2013 compared to 2011.

The table above provides data on the productivity losses at certain locations by direction to illustrate the opportunities to maximize system capacity.

Transit capacity: In 2013, the average transit ridership along the 22-mile stretch of I-5 between Federal Way and Seattle was about 10,500 daily riders during the morning commute and 10,400 daily riders during the evening commute. These numbers include riders from Tacoma, Federal Way, and SeaTac to Seattle via express buses, Central Link light rail and Sounder commuter rail. For the 24-mile stretch of I-5 between Everett and Seattle, average transit ridership was about 8,600 daily riders during the morning commute and about 8,000 daily riders during the evening commute. Local transit routes between Northgate and Seattle along the I-5 corridor carried an additional 17,300 average daily riders.

Transit use on the I-5 corridor was high, ranging from 60% to 110%; values greater than 100% indicate standing room only. During the morning and evening peak periods, central Puget Sound area transit agencies deployed about 70% of their fleet, helping reduce vehicle miles traveled and greenhouse gas emissions.

Park and ride capacity: Availability of park and ride (P&R) locations within the transit service network is integral for transit ridership. Park and ride locations need to have enough parking spaces to accommodate demand. Along the I-5 corridor in the central Puget Sound area, P&R utilization rates ranged from 35% to 100%, with the majority of them in the 70% to 100% range. For example, the Mariner P&R recorded 75% utilization of the 644 available spaces while the Lynnwood Transit Center had 100% utilization of its 1,370 spaces (see map on p. 9).

Corridor capacity constraints plague peak period travelers

Capacity constraints along I-5

There are several routinely congested segments along the I-5 corridor between Federal Way and Everett that lengthen the commute trip time. Congestion lasting approximately an hour or more on a daily basis are presented here. Roadway alignment, lane utilization and traffic demand can all affect corridor capacity.

Peak period commutes – Federal Way and Seattle: The morning commute along northbound I-5 from Federal Way to Seattle routinely experienced congestion at two locations. The first congested segment near Federal Way began at 5:35 a.m., lasted for 2 hours and 35 minutes and created nine miles of congestion between South 288th Street and Southcenter Hill. After six miles of congestion relief, the next congested segment near Boeing Field usually began at 6:10 a.m., lasted for 3 hours and 45 minutes and extended for 6.5 miles. Evening congestion between Michigan Street and the I-5 express lanes (4.5 miles) lasted for 4 hours and 25 minutes starting at 2 p.m. Congestion continued through downtown Seattle, as noted below for the “Everett to Seattle” commute route.

The southbound I-5 morning commute from Seattle to Federal Way experienced congestion starting at 7:05 a.m. for 1 hour between Dearborn Street and the I-90 interchange creating 1.5 miles of congestion. Evening congestion in the southbound direction occurred at two locations. The first congested segment near Seattle began at 2 p.m., lasted for 4 hours and 30 minutes and extended for 1.5 miles between Dearborn Street and the West Seattle Bridge. After seven miles of congestion relief, congestion occurred between SR 599 and Military Road (five miles) usually beginning at 2:45 p.m. and lasting for 3 hours.

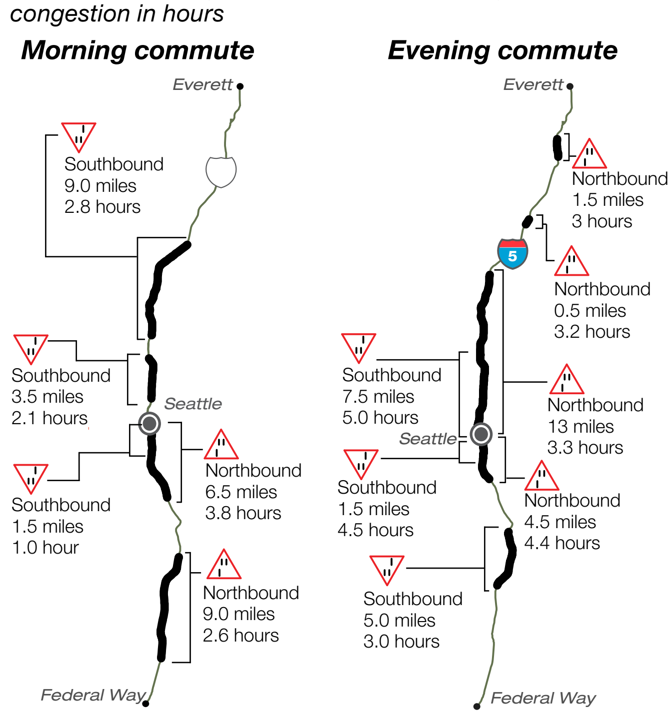
Peak period commutes – Seattle and Everett: The morning commute along southbound I-5 from Everett to Seattle experienced congestion at several locations. One nine-mile long congested segment from SR 524 in Lynnwood to NE 145th Street near Shoreline began at 6:10 a.m. and lasted 2 hours and 50 minutes. Another congested segment 3.5 miles long between NE 85th Street and SR 520 began at 7:15 a.m. and lasted 2 hours and 5 minutes. Congestion also typically occurred at Mercer Street in Seattle at 7:25 a.m., lasting only 25 minutes (not shown in the map to the right). Southbound I-5 experienced 7.5 miles of evening congestion between the entrance to the I-5 express lanes near Northgate and the Convention Center in downtown Seattle, beginning at 2 p.m. and lasting 5 hours.

The northbound I-5 morning commute from Seattle to Everett did not experience any significant congestion on an average weekday. However, the evening commute experienced congestion at several locations. The first congested segment started in downtown Seattle (as noted under the Federal Way to Seattle discussion previously). It began at 3:30 p.m., lasted for 2 hours and 50 minutes and extended for 6.5 miles until the express lanes exit approaching Northgate. After a half-mile of congestion relief, the next congested segment extended for another 6.5 miles to the King/Snohomish county line, beginning at 3:10 p.m. and lasting 3 hours and 20 minutes (these are combined in the map below). A third congested location was a half-mile segment at 164th Street SW. Congestion at this location began at 2:45 p.m. and lasted for 3 hours and 10 minutes. The fourth congested segment developed approaching Everett and usually began at 2:40 p.m., lasting for 3 hours and extending for 1.5 miles toward Broadway in Everett (see map below).

Commute trip reliability and average travel times increase on I-5

There are three major commutes on the I-5 corridor between Federal Way and Everett: 1) Federal Way-Seattle, 2) SeaTac-Seattle, and 3) Everett-Seattle. Of the 52 high

Routinely congested segments of I-5
2013; For weekday morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Length of backup in miles; Daily duration of congestion in hours



Data source: Washington State Transportation Center (TRAC) at the University of Washington.

Delay and travel times increase along I-5 in Seattle

demand commute routes monitored in the central Puget Sound area, 10 are on the I-5 corridor, five each in morning and evening peak periods. The commutes with the most significant changes in travel times are associated with the intensity of routine congestion noted previously.

Of the five morning commutes, Everett to Seattle southbound and Federal Way to Seattle northbound showed significant increases in travel times from 2011 to 2013. The 24-mile Everett to Seattle commute had significant congestion between SR 524 (in Lynnwood) and SR 520, and saw average and reliable travel times of 50 minutes and 80 minutes in 2013, 10 and 18 minutes longer than in 2011, respectively. The 22-mile Federal Way to Seattle commute saw average and reliable travel times of 49 minutes and 69 minutes in 2013, 8 and 12 minutes longer than in 2011, respectively.

Of the five evening commutes, Everett to Seattle experienced a significant increase in travel time while the other routes saw moderate increases of up to 3 minutes from 2011 to 2013. The average travel time for the 24-mile Everett to Seattle commute was 50 minutes while the reliable travel time was 74 minutes in 2013, which are 8 minutes and 7 minutes longer than in 2011, respectively.

Increased delay on the I-5 corridor

On average weekdays, I-5 commuters in the central Puget Sound area experienced 57% more delay in 2013 than in 2011 (from 7,354 to 11,534 daily vehicle hours of delay). Delay is measured in vehicle hours, and occurs when average speeds are less than 85% of posted speeds. Much of the increase in delay occurred in 2012, although delay continued to grow in 2013. The spiral graphs below show the occurrence of delay at various locations along the corridor by time of day and direction of travel for 2013.

Greenhouse gas emissions decline

All-day greenhouse gas emissions from vehicles traveling on the I-5 corridor between Federal Way and Everett totaled 7.7 million pounds of carbon dioxide equivalents (CO_2e) in 2013, 2% less than in 2011. While emissions per mile increase with delay (vehicles burn fuel less efficiently at slower speeds), other factors also affect emissions such as the improving fuel efficiency of vehicles resulting in reduced overall emissions even while delay increased along these routes.

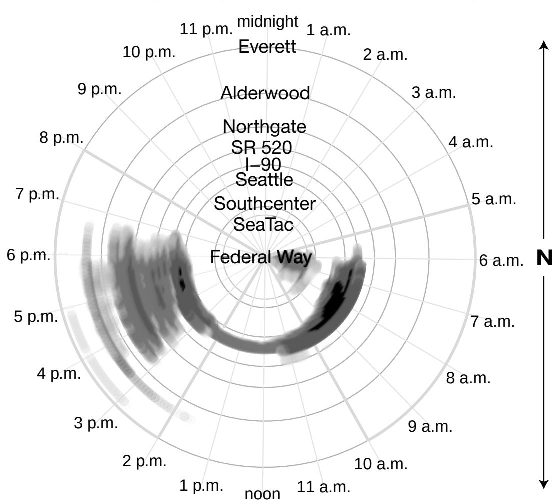
See Appendix pp. 13-14 for the emissions per person, per trip along the I-5 central Puget Sound area commutes.

How much is congestion costing you?

In 2013, the commute congestion cost incurred by each person along the I-5 corridor ranged from $1,200 to $2,100 per year for round trips in the peak direction (toward Seattle in the morning) – the Everett to Seattle round trip was the most expensive, when measured in wasted time and gas. The southbound trips out of Seattle in the morning had much less congestion and round-trip costs were only $500 annually, while the trip to Everett in the morning returning to Seattle in the evening cost about $1,200 annually.

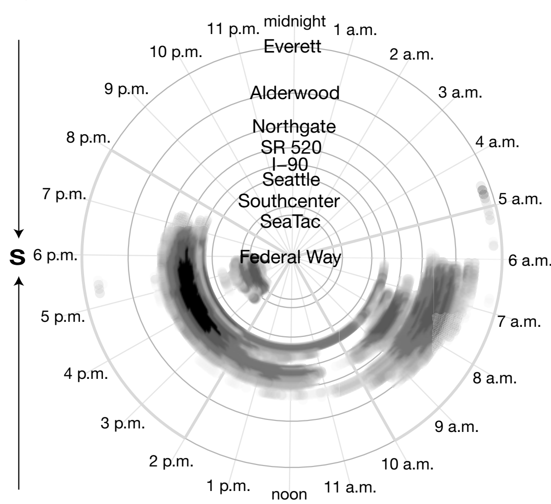
See Appendix pp. 5-23 for corridor performance data.

I-5 delay between Federal Way and Everett
2013; Weekdays only; Vehicle hours of delay; Shading represents intensity of delay

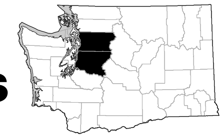


Spiral graphs are read by direction as indicated by the arrows. Northbound is read from the center of the circle to the outer edge; southbound from the outer edge of the circle to the center.

Around the Seattle area and I-90 interchange, delay lasts through both the morning and evening commutes, with a high intensity of delay between 6 a.m. and 10 a.m. Delay on I-5 northbound is more widespread during the evening commute but less intense than evening delay on I-5 southbound.



Data source: Washington State Transportation Center (TRAC) at the University of Washington and WSDOT Office of Strategic Assessment and Performance Analysis.



Interstate 405 Corridor Capacity Analysis

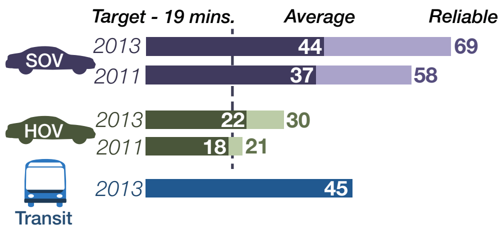
Annual person miles traveled		Annual vehicle delay[1]		Annual emissions	
2011 vs. **2013**		**2011** vs. **2013**		**2011** vs. **2013**	
1,154 — 1,154	0.0%	1,493 — 2,082	39%	974.4 — 951.3	2.4%
in millions of miles		in thousands of hours		in millions of pounds of CO_2 equivalents	

Commute travel times

2011 and 2013; Weekday travel times in minutes at the peak 5-minute interval including average and reliable[2] travel times for single occupant vehicle (SOV) and high occupancy vehicle (HOV) trips as well as maximum throughput (target) and planned transit[3] travel times.

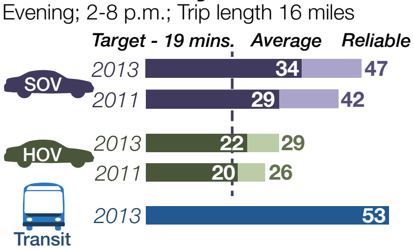
Lynnwood to Bellevue

Morning; 5-10 a.m.; Trip length 16 miles



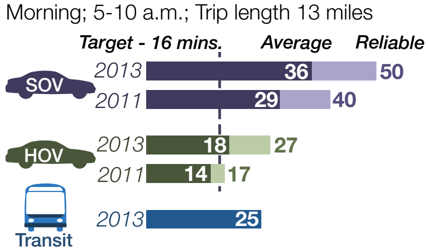
Bellevue to Lynnwood

Evening; 2-8 p.m.; Trip length 16 miles



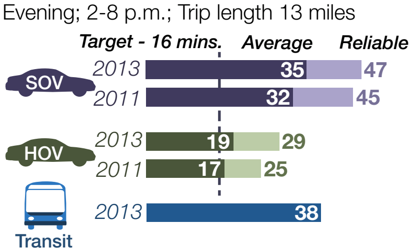
Tukwila to Bellevue

Morning; 5-10 a.m.; Trip length 13 miles



Bellevue to Tukwila

Evening; 2-8 p.m.; Trip length 13 miles



See Appendix pp. 5-15 for more commute routes

Transit system use

2013; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) peak periods; Ridership and percent of available seats occupied on select commutes

Corridor-wide[4] ridership

743,900 *transit riders annually*

13.7 million *passenger miles traveled annually*

68 % *transit seats occupied on average*

By commute	Daily peak period riders	Percent of seats occupied
Morning (6-9 a.m.)		
Everett to Bellevue	679	90%
Lynnwood to Bellevue	349	83%
Tukwila to Bellevue	323	59%
Evening (3-6 p.m.)		
Bellevue to Everett	691	87%
Bellevue to Tukwila	354	59%
Bellevue to Lynnwood	263	63%

Park and ride capacity

2013; Parking spaces and average percent occupied for select park and rides (P&R)[5] (see map for locations)

Lynnwood-Bellevue commute

Park and ride	Spaces	Percent occupied
Ash Way P&R	1,022	100%
Canyon Park P&R	302	99%
Bothell P&R	220	99%
Kenmore area	693	92%
Brickyard P&R	443	82%
South Kirkland P&R	783	75%

Tukwila-Bellevue commute

Park and ride	Spaces	Percent occupied
South Bellevue P&R	519	100%
Renton P&R	150	96%
Renton Municipal P&R	200	87%
Wilburton P&R	186	87%
Newport hills P&R	275	84%

Data source: Washington State Transportation Center (TRAC) at the University of Washington, WSDOT Urban Planning Office, Sound Transit, King County Metro, Community Transit and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: Measures at the top of the page are for the I-405 corridor between Lynnwood and Tukwila for SOV trips only. 1 WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. 2 Reliable travel time is the travel time that will get a commuter to their destination on time or early 19 out of 20 weekdays, or 95% of the time. 3 Transit travel times by bus include off-highway travel to stops and may not be comparable to SOV/HOV times which are highway only. 4 Peak period corridor-wide ridership includes trips on all I-405 central Puget Sound area corridors. 5 For more park and ride information, see http://www.wsdot.wa.gov/choices/parkride.htm. 6 Person throughput values include morning (6-9 a.m.) and evening (3-6 p.m.) peak period values.

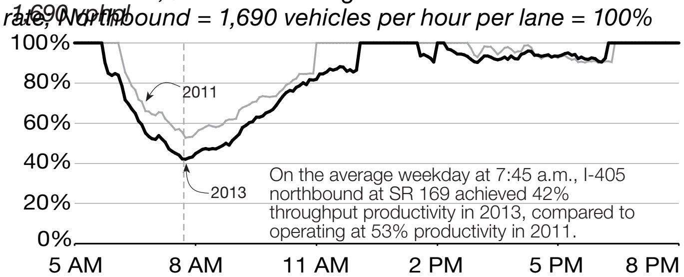
I-405 in Renton experiences 58% loss in throughput

Interstate 405 (I-405) runs parallel to I-5 in the central Puget Sound area between Tukwila and Lynnwood and serves as one of the key commute and freight corridors. The morning (5-10 a.m.) and evening (2-8 p.m.) commutes experience heavy congestion at locations along the corridor on a daily basis. Hours of delay per person annually along the I-405 corridor increased 42% from 5 hours and 54 minutes in 2011 to 8 hours and 24 minutes in 2013. This means an average commuter spent an additional 3 and a half hours on the road over the course of 2013 compared to 2011. For this same time period, person-miles traveled along the I-405 commute corridors remained steady while the annual emissions decreased 2%.

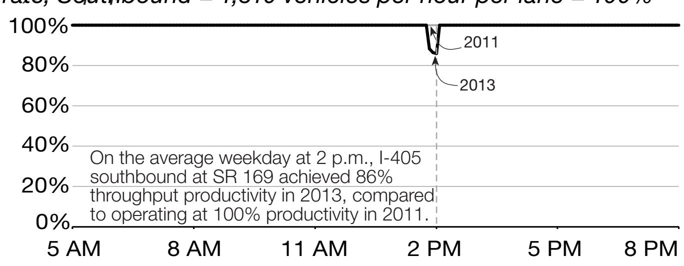
I-405 corridor productivity analysis

Highway productivity: As traffic increases, roads are able to carry fewer vehicles, resulting in a drop in productivity at speeds slower than maximum throughput speed. In order to gauge the lost productivity on the I-405 corridor, throughput was analyzed at two locations: SR 169 near Renton and NE 160th Street near Kirkland. In 2011 and 2013, productivity at these locations ranged from 42% to 100%. For example, the worst productivity loss of 58% in 2013 was at 7:45 a.m. in the northbound direction at SR 169, meaning more than half of the roadway's capacity was unavailable due to congestion. The graphs below show how throughput productivity can vary by direction of travel and time of day.

Throughput along northbound I-405 at SR 169 (MP 4.0)
Northbound I-405 at SR 169 (MP 4.0)
2011 and 2013; Based on the highest observed 5-minute flow rate; Northbound = 1,690 vehicles per hour per lane = 100%
Based on the highest observed 5 min. flow rate: Northbound= 1,690 vphpl



Throughput along southbound I-405 at SR 169 (MP 4.0)
Southbound I-405 at SR 169 (MP 4.0)
2011 and 2013; Based on the highest observed 5-minute flow rate; Southbound = 1,810 vehicles per hour per lane = 100%
Based on the highest observed 5 min. flow rate: Southbound= 1,810 vphpl



Data source: WSDOT Urban Planning Office.

Vehicle throughput worsens along I-405 near Kirkland
2011 and 2013; Maximum loss of vehicle throughput by commute direction

Location	Direction	Loss compared to 100% in 2011	2013	Change
I-405 at SR 169, in Renton	Northbound	47%	58%	11%
	Southbound	0%	14%	14%
I-405 at NE 150th Street, in Kirkland	Northbound	15%	19%	4%
	Southbound	26%	43%	17%

Data source: Washington State Transportation Center (TRAC) at the University of Washington. Data analysis: WSDOT Urban Planning Office and Office of Strategic Assessment and Performance Analysis.

The table above provides data on productivity losses at sample locations by direction to illustrate the potential opportunities to maximize system capacity.

Transit capacity: In 2013, the average transit ridership along the 13-mile stretch of I-405 between Tukwila and Bellevue was about 320 daily riders during the morning commute and 350 daily riders during the evening commute. For the 16-mile stretch of I-405 between Lynnwood and Bellevue, average transit ridership was about 350 daily riders during the morning commute and 260 daily riders during the evening commute.

Transit use rates on I-405 ranged from 59% to 90%. During the morning and evening peak period, central Puget Sound area transit agencies deployed about 70% of their fleet, helping reduce vehicle miles traveled and greenhouse gas emissions.

Park and ride capacity: Availability of park and ride (P&R) locations within the transit service network is integral for ridership. Park and ride locations need to have enough parking spaces to accommodate demand. Along the I-405 corridor in the central Puget Sound area, P&R utilization rates ranged from 75% to 100%. For example, the Ash Way P&R recorded 100% utilization of 1,022 available spaces while the South Kirkland P&R recorded 75% utilization of the 783 available spaces (see map on p. 13).

Capacity constraints along I-405

There are several routinely congested segments along the I-405 corridor between Tukwila and Lynnwood that lengthen the commute trip time. Congestion lasting approximately an hour or more on a daily basis are presented here. Roadway alignment, lane utilization and traffic demand often affect corridor capacity.

Note: The information below is presented in order of the routinely congested locations along the corridor for

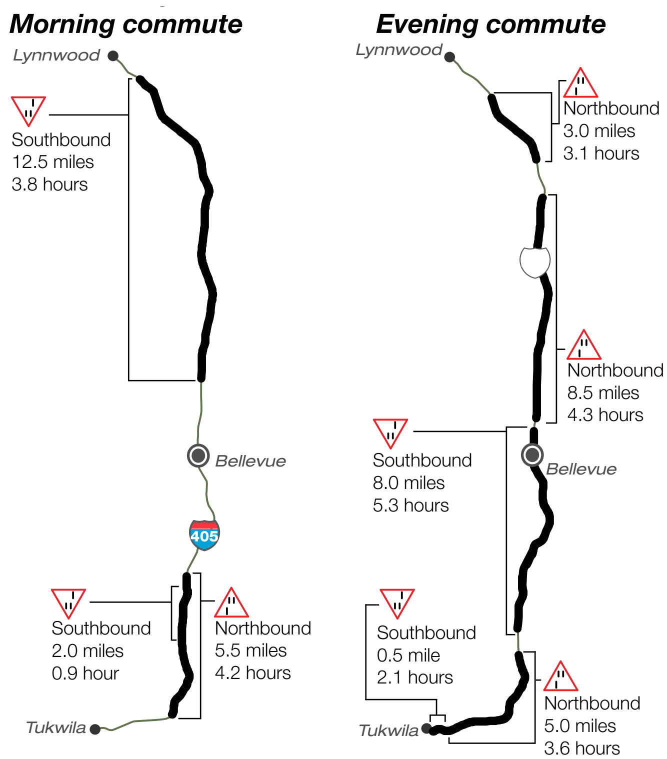
Congested segments along I-405 extend up to 12.5 miles

the specified direction of travel. For example, traveling northbound from Tukwila to Bellevue, the routinely congested segments for the morning peak period is presented, followed by the evening peak period. Similar information follows in a separate paragraph for the Bellevue to Tukwila reverse commute.

Peak period commutes – Tukwila and Bellevue: The morning commute along northbound I-405 from Tukwila to Bellevue experienced congestion between SR 167 and NE 44th Street that began at 5:45 a.m., lasted for 4 hours and 10 minutes and created 5.5 miles of congestion. Evening congestion between I-5 and SR 900 (five miles) began at 2:25 p.m. and lasted for 3 hours and 35 minutes.

The southbound I-405 commute from Bellevue to Tukwila experienced two miles of congestion starting at 7:15 a.m. and lasting for 55 minutes between NE 44th Street and NE 30th Street. Evening congestion along southbound I-405 occurred at several locations. The first location occurred between NE 10th Street and NE 30th Street (eight miles), usually beginning at 2 p.m. and lasting 5 hours

Routinely congested segments of I-405
2013; For weekday morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Length of backup in miles; Daily duration of congestion in hours



Data source: Washington State Transportation Center (TRAC) at the University of Washington.

and 15 minutes. Congestion also occurred on a half-mile segment near the I-5 interchange, which began at 2:45 p.m. and lasted for 2 hours and 5 minute (see map below left).

Peak period commutes – Bellevue and Lynnwood: The southbound I-405 morning commute from Lynnwood to Bellevue experienced congestion for 12.5 miles between Damson Road and NE 70th Street, beginning at 6:10 a.m. and lasting for 3 hours and 45 minutes. There was also some evening southbound congestion for a half-mile near the I-405/SR 522 interchange, beginning at 4:45 p.m. and lasting only 35 minutes (not shown on the map).

The northbound I-405 morning commute from Bellevue to Lynnwood did not experience any significant congestion on an average weekday. However, there was congestion during the evening commute at two locations on the trip from Bellevue to Lynnwood. The first congested segment was between Northrup Way and the University of Washington Bothell campus (8.5 miles), which began at 2:25 p.m. and lasted 4 hours and 20 minutes. After two miles of congestion relief, the next segment occurred between the King/Snohomish county line and SR 527 (three miles), beginning at 3:10 p.m. and lasting for 3 hours and 5 minutes (see map to left).

Commute trip reliability and average travel times increase on I-405

There are two major commute routes along the I-405 corridor between Tukwila and Lynnwood: between Tukwila and Bellevue and between Lynnwood and Bellevue. Of the 52 high demand commute routes in the central Puget Sound region, eight are on the I-405 corridor (four morning and four evening).

Of the four morning commutes, the Lynnwood to Bellevue southbound commute and the Tukwila to Bellevue northbound commute experienced significant increases in travel times from 2011 to 2013. For example, the average travel time for the 16-mile Lynnwood to Bellevue commute was 44 minutes while the reliable travel time was 69 minutes in 2013, 7 and 11 minutes longer than in 2011, respectively. This commute experienced significant congestion for 12.5 miles between Damson Road and NE 70th Street. Similarly, the 13-mile Tukwila to Bellevue commute saw average and reliable travel times of 36 minutes and 50 minutes, respectively, in 2013. This is a 7-minute increase in average travel time and a 10-minute increase in reliable travel time compared to 2011.

I-405 greenhouse gas emissions decrease slightly

Of the four evening commutes, Bellevue to Lynnwood experienced significant increases in travel time while the other routes saw moderate increases no greater than 3 minutes. The average travel time for the 16-mile Bellevue to Lynnwood commute was 34 minutes while the reliable travel time was 47 minutes in 2013, both of which are 5 minutes longer than in 2011.

Increased delay on I-405 corridor

On average weekdays in 2013, I-405 commuters experienced 7,976 daily vehicle hours of delay. This is 39% more delay than the 5,719 hours experienced in 2011. Delay is measured in vehicle hours, and occurs when average speeds are less than 85% of posted speeds. Much of the increase in delay occurred in 2012, although delay continued to grow in 2013, continuing a trend that started with the local economy turning around. The spiral graphs below show the occurrence of delay at various locations along the corridor by time of day and direction of travel for 2013.

Greenhouse gas emissions decline 2%

All-day greenhouse gas emissions from vehicles traveling along the I-405 corridor between Tukwila and Lynnwood totaled 3.6 million pounds of carbon dioxide equivalents (CO_2e) daily in 2013, 2% less than in 2011. While emissions per mile increase with delay (vehicles burn fuel less efficiently at slower speeds), other factors also affect emissions such as the improving fuel efficiency of vehicles resulting in reduced overall emissions even while delay increased along these routes.

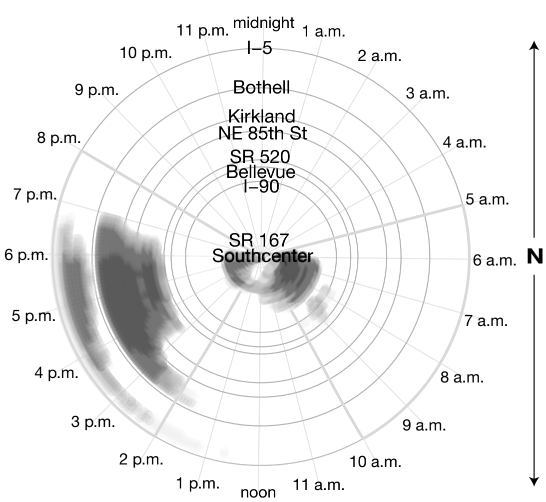
See Appendix pp. 13-14 for the emissions per person, per trip along the I-405 central Puget Sound area commutes.

How much is congestion costing you?

In 2013, the commute congestion cost incurred by each person along the I-405 corridor ranged from $2,300 to $2,500 per year for round trips in the peak direction (toward Bellevue in the morning). The reverse trips out of Bellevue in the morning had much less congestion, and the related round-trip costs were only $300 to $500 annually, when measured in wasted time and gas.

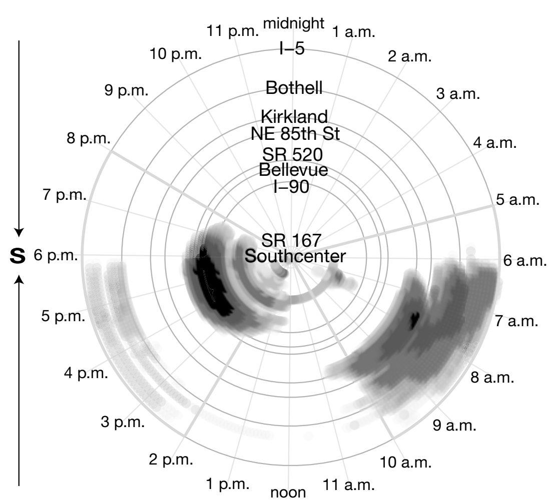
See Appendix pp. 5-23 for corridor performance data.

I-405 delay between Tukwila and the Lynnwood I-5/I-405 interchange
2013; Weekdays only; Vehicle hours of delay; Shading represents intensity of delay



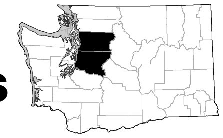
Spiral graphs are read by direction as indicated by the arrows. Northbound is read from the center of the circle to the outer edge; southbound from the outer edge of the circle to the center.

On I-405, delay is widespread and intense during both peak periods. Delay on I-405 southbound peaks during the morning commute, with noticeable delay from Bellevue to the Lynnwood I-5/I-405 interchange, mirroring the extent of delay on the northbound evening commute.



Data source: Washington State Transportation Center (TRAC) at the University of Washington and WSDOT Office of Strategic Assessment and Performance Analysis.

State Route 520 Corridor Capacity Analysis



Annual person miles traveled	Annual vehicle delay[1]	Annual emissions
2011 vs. 2013	2011 vs. 2013	2011 vs. 2013
290.2 / 231.3	348.4 / 126.8	266.2 / 219.4
in millions of miles	in thousands of hours	in millions of pounds of CO_2 equivalents
20%	64%	18%

Commute travel times

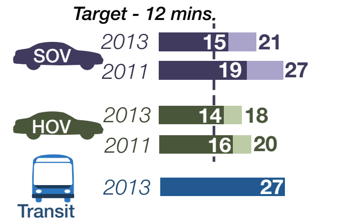
2011 and 2013; weekday travel times in minutes at the peak 5-minute interval including average and reliable[2] travel times for single occupant vehicle (SOV) and high occupancy vehicle (HOV) trips as well as maximum throughput (target) and planned transit[3] travel times.

Average SOV Average HOV
Reliable SOV Reliable HOV
Planned transit time

See Appendix pp. 5-15 for more commute routes

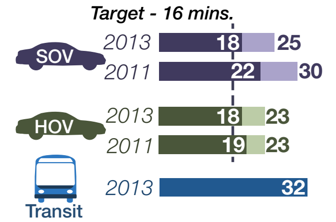
Bellevue to Seattle

Morning; 5-10 a.m.; Trip length 10 miles



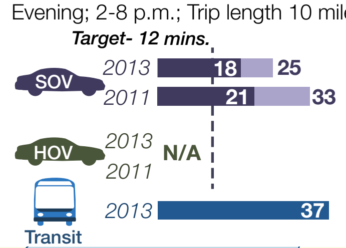
Redmond to Seattle

Morning; 5-10 a.m.; Trip length 13 miles



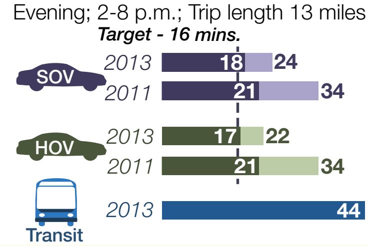
Seattle to Bellevue

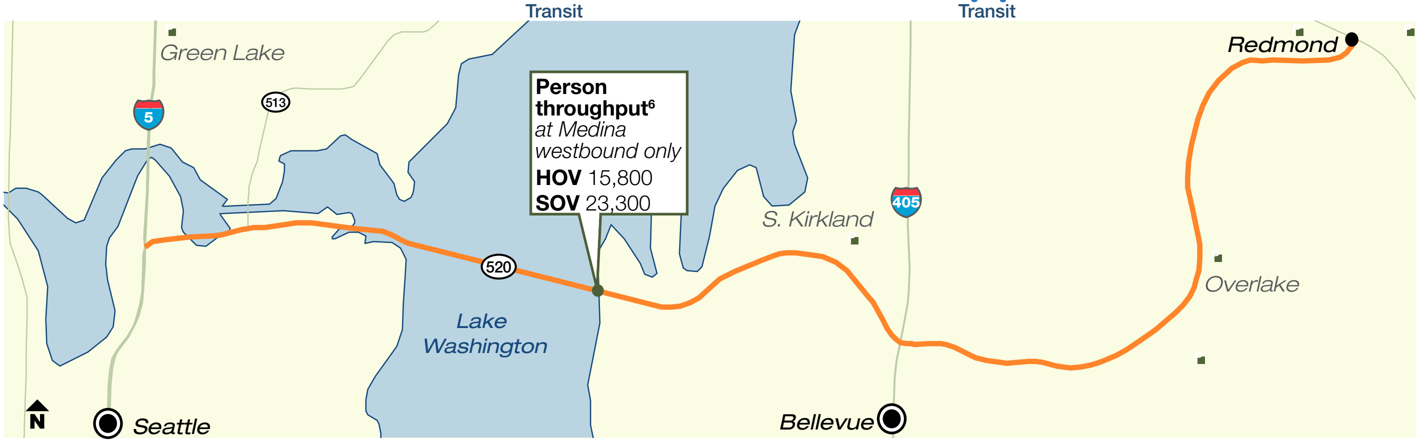
Evening; 2-8 p.m.; Trip length 10 miles



Seattle to Redmond

Evening; 2-8 p.m.; Trip length 13 miles





Transit system use

2013; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) peak periods; Ridership and percent of available seats occupied on select commutes

Corridor-wide[4] ridership

4.1 million — *transit riders annually*

47.0 million — *passenger miles traveled annually*

61% — *transit seats occupied on average*

By Commute

By Commute	Daily peak period riders	Percent of seats occupied
Morning (6-9 a.m.)		
Redmond to Seattle	4,244	73%
Bellevue to Seattle	607	55%
Seattle to Bellevue	500	57%
Evening (3-6 p.m.)		
Seattle to Redmond	4,596	63%
Redmond to Seattle	1,755	58%
Seattle to Bellevue	761	59%

Park and ride capacity

2013; Parking spaces and average percent occupied for select park and rides (P&R)[5] (see map for locations)

Seattle-Bellevue commute

Park and ride	Spaces	Percent occupied
Greenlake P&R	411	100%
South Kirkland P&R	783	75%

Redmond-Bellevue commute

Park and ride	Spaces	Percent occupied
Redmond P&R	377	100%
Bear Creek P&R	283	100%
Overlake Transit Center	222	100%
Overlake P&R	203	42%

Data source: Washington State Transportation Center (TRAC) at the University of Washington, WSDOT Urban Planning Office, Sound Transit, King County Metro, Community Transit and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: Measures at the top of the page are for the SR 520 corridor between Seattle and Redmond for SOV trips only. 1 WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. 2 Reliable travel time is the travel time that will get a commuter to their destination on time or early 19 out of 20 weekdays, or 95% of the time. 3 Transit travel times by bus include off-highway travel to stops and may not be comparable to SOV/HOV times which are highway only. 4 Peak period corridor-wide ridership includes trips on all SR 520 central Puget Sound area corridors. 5 For more park and ride information, see http://www.wsdot.wa.gov/choices/parkride.htm. 6 Person throughput values include morning (6-9 a.m.) and evening (3-6 p.m.) peak period values.

SR 520 tolling increases person throughput

State Route 520 (SR 520) was the most congested corridor in the central Puget Sound area until tolling started on that highway in December 2011. The only portion of SR 520 that is tolled is the Evergreen Point Floating Bridge, which runs parallel to I-90 across Lake Washington and is one of the key commute and freight corridors connecting Seattle, Bellevue and Redmond. The morning (5-10 a.m.) and evening (2-8 p.m.) commutes experience heavy congestion at specific locations along the corridor on a daily basis. Hours of delay per person annually on the SR 520 corridor decreased 53% from 2 hours and 8 minutes in 2011 to 1 hour in 2013. As a result, the average commuter spent 1 hour and 8 minutes less on the road over the course of 2013 compared to 2011. For this same time period, person-miles traveled along area SR 520 decreased 20% and annual emissions decreased 23%.

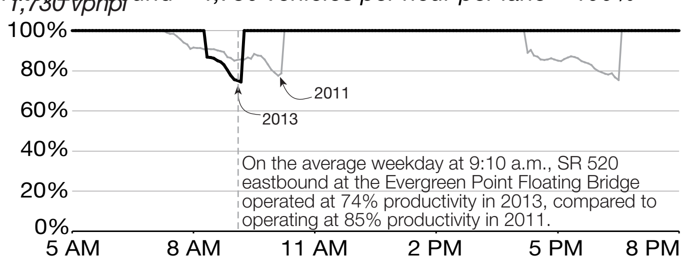
SR 520 corridor productivity analysis

Highway productivity: As traffic increases, roads are able to carry fewer vehicles, resulting in a drop in productivity at speeds slower than maximum throughput speed. In order to gauge the lost productivity, throughput was analyzed on SR 520 at the Evergreen Point Floating Bridge. In 2011 and 2013, productivity at this location ranged from 74% to 100%. In 2013, the peak productivity loss of 26% occurred at 9:10 a.m. in the eastbound direction. As a result, more than a quarter of the roadway's capacity was unavailable due to congestion. The graphs below left show how throughput productivity can vary by direction of travel and time of day.

The table below provides data on the productivity losses at sample location by direction to illustrate the opportunities to maximize system capacity.

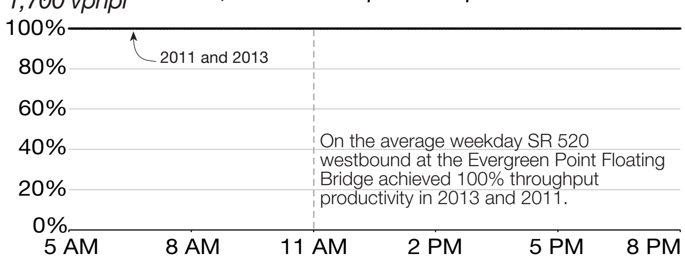
Throughput along eastbound SR 520 at the Evergreen Point Floating Bridge (MP 1.5)
2011 and 2013; Based on the highest observed 5-minute flow rate: Eastbound = 1,730 vehicles per hour per lane = 100%

Eastbound SR 520 at Evergreen Point Floating Bridge (MP 1.5)
Based on the highest observed 5-min. flow rate, Eastbound = 1,730 vphpl



Throughput along westbound SR 520 at the Evergreen Point Floating Bridge (MP 1.5)
2011 and 2013; Based on the highest observed 5-minute flow rate: Westbound = 1,700 vehicles per hour per lane = 100%

Westbound SR 520 at Evergreen Point Floating Bridge (MP 1.5)
Based on the highest observed 5-min. flow rate, Westbound = 1,700 vphpl



Data source: WSDOT Urban Planning Office.

Vehicle throughput on SR 520 holding steady
2011 and 2013; Maximum loss of vehicle throughput by commute direction

		Loss compared to 100% in		
Location	**Direction**	**2011**	**2013**	**Change**
SR 520 at Evergreen Point Floating Bridge	Eastbound	25%	26%	1%
	Westbound	0%	0%	0%

Data source: Washington State Transportation Center (TRAC) at the University of Washington. Data analysis: WSDOT Urban Planning Office and Office of Strategic Assessment and Performance Analysis.

Transit capacity: In 2013, the average transit ridership along the 13-mile stretch of SR 520 (between Seattle, Bellevue and Redmond) was about 7,600 daily riders during the morning commute and 8,000 daily riders during the evening commute. When tolling started in 2011 on SR 520, transit agencies added 140 daily trips (20% increase) across the floating bridge. Ridership increased about 46% from fiscal year (FY) 2010 (July 2009 through June 2010) to FY2014 (see p. 20).

SR 520 transit use ranged from 20% to 73% of the available transit capacity. However, the majority of the transit trips had more than 50% utilization. During the morning and evening peak period, central Puget Sound area transit agencies deployed about 70% of their fleet, helping reduce vehicle miles traveled and greenhouse gas emissions.

Park and ride capacity: Availability of park and ride (P&R) locations within the transit service network is integral to ridership. Park and ride locations need to have enough parking spaces to accommodate demand. Along the SR 520 corridor, P&R utilization rates ranged from 42% to 100%. For example, the South Kirkland P&R recorded 75% utilization of the 783 available spaces while the Green Lake P&R recorded 100% utilization of the 411 available spaces (see map on p. 17).

Capacity constraints along SR 520

There are several routinely congested segments along SR 520 between Seattle, Bellevue and Redmond that lengthen the commute trip time. Congestion lasting

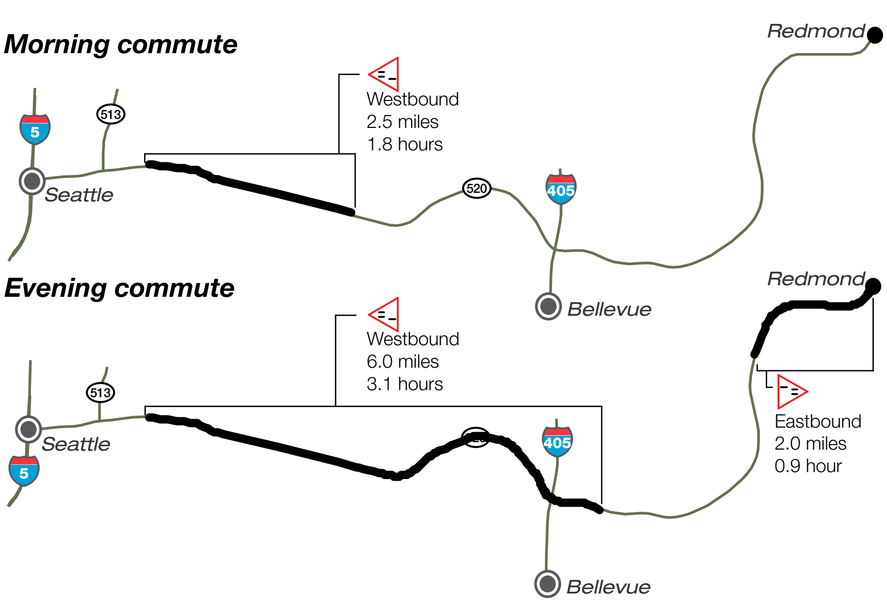
Significant improvements in SR 520 trip reliability

approximately an hour or more on a daily basis are presented here. Roadway alignment, lane utilization and traffic demand often affect corridor capacity.

Peak period commutes – Seattle, Bellevue and Redmond: The morning commute on eastbound SR 520 from Seattle to Bellevue routinely experienced congestion between Montlake Boulevard and the west end of the floating bridge, which began at 8:25 a.m., lasted for 25 minutes and created one mile of congestion (not shown on the map below). The eastbound SR 520 evening commute from Bellevue to Redmond experienced congestion between NE 51st Street and SR 202. Congestion on this two-mile segment began at 5:10 p.m. and lasted for 55 minutes.

The westbound SR 520 morning commute routinely experienced congestion on the Evergreen Point Floating Bridge across Lake Washington. Congestion along this 2.5-mile segment began at 7:25 a.m. and lasted for 1 hour and 50 minutes. During the evening commute, westbound SR 520 from Bellevue to Seattle experienced congestion between NE 124th Avenue and the west end of the floating bridge. Congestion along this six-mile segment began at 3:40 p.m. and lasted for 3 hours and 5 minutes (see map below).

Routinely congested segments of SR 520
2013; For weekday morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Length of backup in miles; Daily duration of congestion in hours



Data source: Washington State Transportation Center (TRAC) at the University of Washington.

Commute trip reliability and average travel times improve on SR 520

Of the 52 high demand commute routes monitored in the central Puget Sound region, 12 are along the SR 520 corridor between Seattle, Bellevue and Renton. Of these 12 commutes, eight are tolled trips that cross the Evergreen Point Floating Bridge. The other four commutes are between Bellevue and Redmond, and are not subject to tolling.

Between 2011 and 2013, all eight morning and evening peak period commutes that use the tolled Evergreen Point Floating Bridge saw significant improvements in average and reliable travel times ranging from 2 to 10 minutes. For example, the average travel time for the 10-mile Bellevue to Seattle evening commute was 22 minutes while the reliable travel time was 34 minutes in 2013, improvements of 8 and 9 minutes relative to 2011. Following the start of SR 520 tolling, all commutes crossing Evergreen Point Floating Bridge experienced much faster travel times. Tolling on SR 520 helps manage one of the most congested highway segments in the central Puget Sound area as some commuters shift modes to transit or carpool to avoid tolls, take alternative routes, or avoid non-critical trips across Lake Washington.

The other four SR 520 commutes between Bellevue and Redmond that are not subject to tolling saw mixed results. Both the morning commutes, Redmond to Bellevue and Bellevue to Redmond saw up to 1-minute improvements in average and reliable travel times. The evening commute on SR 520 between Bellevue and Redmond saw no change in average travel time while the reliable travel time increased by 2 minutes. Similarly, the SR 520 Redmond to Bellevue evening commute average and reliable travel times increased 4 minutes and 5 minutes, respectively.

See gray box on p. 20 for more details on SR 520 tolling.

SR 520 commuters experience less delay

Delay improves following SR 520 tolling

On average weekdays, SR 520 commuters in the central Puget Sound area experienced 64% less delay in 2013, from 1,335 daily vehicle hours of delay in 2011 to 486 hours in 2013. Delay is measured in vehicle hours, and occurs when average speeds are less than 85% of posted speeds. Most of the decrease in delay is due to implementing tolling on SR 520 across the Evergreen Point Floating Bridge in December 2011. The spiral graphs below show the occurrence of delay at various locations along the corridor by time of the day and direction of travel for 2013.

Greenhouse gas emissions decline 18%

All-day greenhouse gas emissions from vehicles traveling along the SR 520 corridor between Seattle and Redmond totaled 219.4 million pounds of carbon dioxide equivalents (CO_2e) in 2013, 18% less than in 2011. Emissions per mile increase with delay (vehicles burn fuel less efficiently at slower speeds), and other factors also affect emissions such as the improving fuel efficiency of vehicles. Along SR 520, decreased delay and traffic volume and improved fuel efficiency all contributed to reducing overall emissions along these routes.

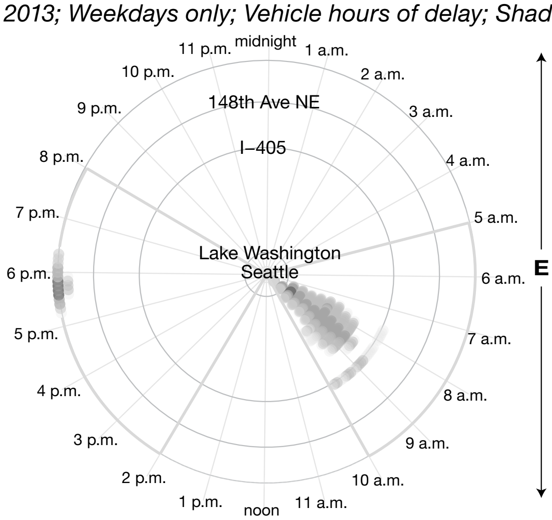
See [Appendix pp. 13-14] for the emissions per person, per trip along the SR 520 central Puget Sound area commutes.

How much is congestion costing you?

In 2013, the round trip commute congestion cost incurred by each person along the SR 520 corridor was up to $960 annually; the Seattle to Redmond round trip was the most expensive in 2013, a 33% decrease from $1,420 in 2011. SR 520 tolling has helped reduce the cost of delay per driver by $460 annually on this round trip, helping offset some of the cost of tolls on the floating bridge. Shorter trips between Seattle and Bellevue and between Bellevue and Redmond cost between $210 and $770 annually.

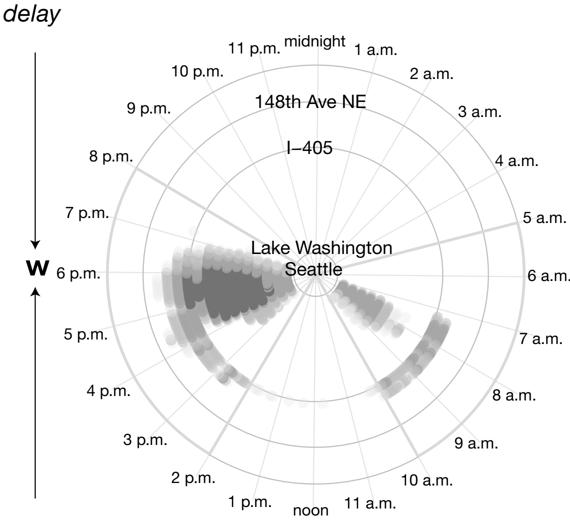
See [Appendix pp. 5-23] for corridor performance data.

SR 520 delay between Seattle and Redmond
2013; Weekdays only; Vehicle hours of delay; Shading represents intensity of delay



Spiral graphs are read by direction as indicated by the arrows. Eastbound is read from the center of the circle to the outer edge; westbound from the outer edge of the circle to the center.

On SR 520, there is more delay during the morning commute in the eastbound direction. In the evening, delay is more prominent on SR 520 westbound. Around the I-405 interchange, delay occurs during both the morning and evening commute.



Data source: Washington State Transportation Center (TRAC) at the University of Washington and WSDOT Office of Strategic Assessment and Performance Analysis.

SR 520 tolling reduces congestion

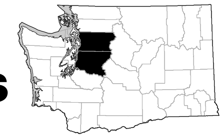
An average of 72,000 vehicles crossed the SR 520 Evergreen Point Floating Bridge each weekday during fiscal year (FY) 2014 (July 2013 through June 2014), compared to 70,000 vehicles during FY2013. Traffic volumes on the SR 520 Bridge are down about one-third from pre-tolling levels. Some of this volume was absorbed by the 140 daily bus trips added along SR 520 (20% increase), as transit passenger volumes crossing Lake Washington on the SR 520 Bridge increased 46% in FY2014 compared to FY2010. Additionally, more than 200 vanpools crossed the lake on SR 520 in FY2014, an increase of more than 50%. Improvements in travel time along the SR 520 corridor, realized with the start of tolling, have continued through FY2014.

Tolling to help pay for rebuilding bridge

Tolling on the SR 520 Bridge began in December 2011 with two central goals: to help fund the replacement of the bridge and to reduce congestion along SR 520. Tolling is expected to raise $1.2 billion toward the construction of the SR 520 Bridge Replacement and High Occupancy Vehicle (HOV) Program, which will build 12.8 miles of safety and mobility improvements from I-5 in Seattle to SR 202 in Redmond.

See [Appendix p. 35] for SR 520 transit ridership trend.

Interstate 90 Corridor Capacity Analysis



Annual person miles traveled

2011 vs. **2013**
472.1 501.7
in millions of miles
6.3%

Annual vehicle delay[1]

2011 vs. **2013**
147.5 251.6
in thousands of hours
71%

Annual emissions

2011 vs. **2013**
585.9 606.8
in millions of pounds of CO_2 equivalents
3.6%

Commute travel times

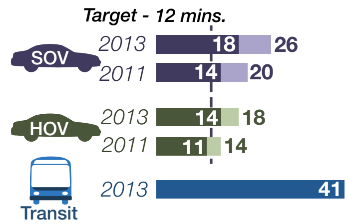
2011 and 2013; Weekday travel times in minutes at the peak 5-minute interval including average and reliable[2] travel times for single occupant vehicle (SOV) and high occupancy vehicle (HOV) trips as well as maximum throughput (target) and planned transit[3] travel times.

Average SOV | Average HOV
Reliable SOV | Reliable HOV
Planned transit time

See Appendix pp. 5-15 for more commute routes

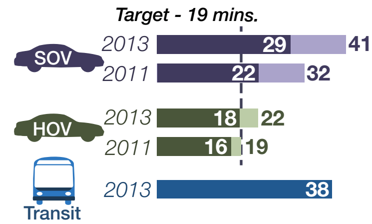
Bellevue to Seattle

Morning; 5-10 a.m.; Trip length 10 miles



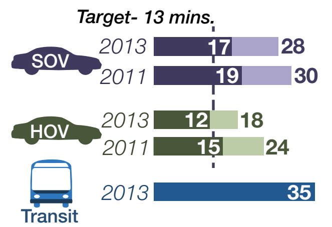
Issaquah to Seattle

Morning; 5-10 a.m.; Trip length 15 miles



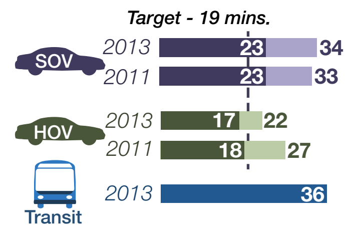
Seattle to Bellevue

Evening; 2-8 p.m.; Trip length 11 miles



Seattle to Issaquah

Evening; 2-8 p.m.; Trip length 16 miles



Transit system use

2013; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) peak periods; Ridership and percent of available seats occupied on select commutes

Corridor-wide[4] ridership

3.7 million *transit riders annually*

47.9 million *passenger miles traveled annually*

79% *transit seats occupied on average*

By Commute

By Commute	Daily peak period riders	Percent of seats occupied
Morning (6-9 a.m.)		
Issaquah to Seattle	3,493	82%
Bellevue to Seattle	2,230	85%
Issaquah to Bellevue	310	68%
Evening (3-6 p.m.)		
Seattle to Issaquah	3,037	79%
Seattle to Bellevue	2,282	85%
Bellevue to Seattle	837	92%

Park and ride capacity

2013; Parking spaces and average percent occupied for select park and rides (P&R)[5] (see map for locations)

Seattle-Bellevue commute

Park and ride	Spaces	Percent occupied
South Bellevue P&R	519	100%
Mercer Island P&R	447	100%

Bellevue-Issaquah commute

Park and ride	Spaces	Percent occupied
Eastgate P&R	1,614	99%
Issaquah Transit Center	819	99%
Issaquah Highlands P&R	1,010	98%

Data source: Washington State Transportation Center (TRAC) at the University of Washington, WSDOT Urban Planning Office, Sound Transit, King County Metro, Community Transit and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: Measures at the top of the page are for the I-90 corridor between Seattle and Issaquah for SOV trips only. 1 WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. 2 Reliable travel time is the travel time that will get a commuter to their destination on time or early 19 out of 20 weekdays, or 95% of the time. 3 Transit travel times by bus include off-highway travel to stops and may not be comparable to SOV/HOV times which are highway only. 4 Peak period corridor-wide ridership includes trips on all I-90 central Puget Sound area corridors. 5 For more park and ride information, see http://www.wsdot.wa.gov/choices/parkride.htm. 6 Person throughput values include morning (6-9 a.m.) and evening (3-6 p.m.) peak period values.

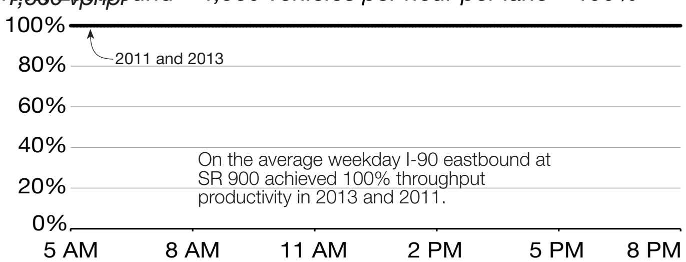
More than 80% transit utilization along the I-90 corridor

Interstate 90 (I-90) was one of the most congested corridors in the central Puget Sound area before and after tolling began on SR 520 in December 2011. I-90 runs parallel to SR 520 across Lake Washington, connecting Seattle, Bellevue and Issaquah, and is one of the region's key commute and freight corridors. The morning (5-10 a.m.) and evening (2-8 p.m.) commutes experience heavy congestion at specific locations along the corridor on a daily basis. Hours of delay per person annually on the I-90 corridor increased 67% from 39 minutes in 2011 to 1 hour and 5 minutes in 2013. As a result, the average commuter spent an additional 26 minutes on the road over the course of 2013 compared to 2011. For this same time period, person-miles traveled along the I-90 corridor in the central Puget Sound area increased 6.3% and the annual emissions increased 3.6%.

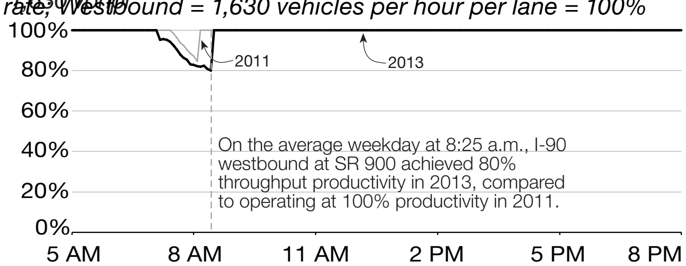
I-90 corridor productivity analysis

Highway productivity: As traffic increases, roads are able to carry fewer vehicles, resulting in a drop in productivity at speeds slower than maximum throughput speed. In order to gauge the lost productivity, throughput was analyzed on I-90 at SR 900 in Issaquah. In 2011 and 2013, productivity at these locations ranged from 80% to 100%. In 2013, the worst productivity loss of 20% occurs at 8:25 a.m. in the westbound direction, meaning one-fifth of the roadway's throughput capacity was unavailable due to congestion. The graphs below show how throughput productivity can vary by direction of travel and time of day.

Throughput along eastbound I-90 at SR 900 (MP 16.5)
2011 and 2013; Based on the highest observed 5-minute flow rate; Eastbound = 1,660 vehicles per hour per lane = 100%



Throughput along westbound I-90 at SR 900 (MP 16.5)
2011 and 2013; Based on the highest observed 5-minute flow rate; Westbound = 1,630 vehicles per hour per lane = 100%



Data source: WSDOT Urban Planning Office.

Vehicle throughput worsens along I-90 near Issaquah
2013 and 2011; Maximum loss of vehicle throughput by commute direction

Location	Direction	Loss compared to 100% in 2011	Loss compared to 100% in 2013	Change
I-90 at SR 900 near Issaquah	Eastbound	0%	0%	0%
	Westbound	15%	20%	5%

Data source: Washington State Transportation Center (TRAC) at the University of Washington. Data analysis: WSDOT Urban Planning Office and WSDOT Office of Strategic Assessment and Performance Analysis.

The table above provides data on the productivity losses at sample locations by direction to illustrate the opportunities to maximize system capacity.

Transit capacity: In 2013, the average transit ridership along the 16-mile stretch of I-90 between Seattle and Issaquah was about 7,300 daily riders during the morning commute and 6,900 daily riders during the evening commute. These numbers include the ridership between Seattle and Bellevue as well as between Bellevue and Issaquah. Local transit routes between Bellevue and Issaquah parallel to the I-90 corridor run an additional 500 trips during morning and evening peak periods.

I-90 transit use ranged from 45% to 92%. However, the majority of the transit trips had more than 80% utilization. During the morning and evening peak periods, central Puget Sound area transit agencies deployed about 70% of their fleet, helping reduce vehicle miles traveled and greenhouse gas emissions.

Park and ride capacity: Availability of park and ride (P&R) locations within the transit service network is integral to ridership. Park and ride locations need to have enough parking spaces to accommodate demand. Along the I-90 corridor in the central Puget Sound area, P&R utilization rates neared 100% at all locations. For example, the South Bellevue P&R recorded 100% utilization of 519 available spaces while the Eastgate P&R recorded 99% utilization of the 1,614 available spaces (see map on p. 21).

Capacity constraints along I-90 corridor

There are several routinely congested segments along the I-90 corridor between Seattle, Bellevue and Issaquah that lengthen the commute trip time. Congestion lasting approximately an hour or more on a

Eastbound I-90 trips are more reliable than westbound

daily basis are presented here. Roadway alignment, lane utilization and traffic demand often affect corridor capacity.

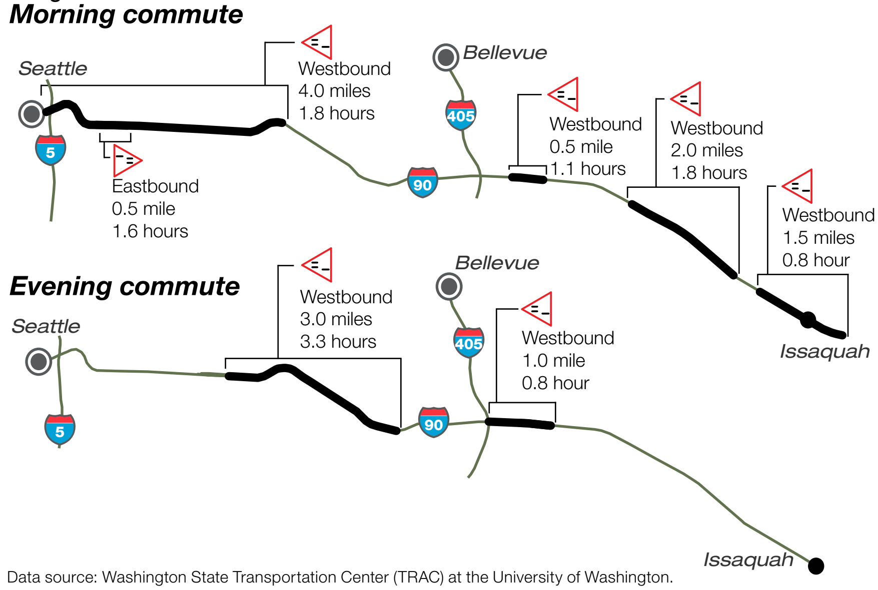
Peak period commutes – Seattle, Bellevue and Issaquah: The eastbound I-90 morning commute from Seattle to Bellevue routinely experienced congestion along a half-mile segment at the I-5/I-90 interchange, beginning at 7:30 a.m. and lasting for 1 hour and 35 minutes.

The westbound I-90 morning commute experienced congestion at four locations. Congestion extended for 1.5 miles near I-90's intersection with SR 900, starting at 7:10 a.m. and lasted 50 minutes. A two-mile congested segment occurred around the West Lake Sammamish Parkway interchange that began at 7:15 a.m. and lasted for 1 hour and 50 minutes. The third congested location was a half-mile segment at NE 148th Avenue that began at 7:45 a.m. and lasted for 1 hour and 5 minutes. Morning congestion also occurred on a four mile segment between Island Crest Way and downtown Seattle that started at 7:25 a.m. and lasted for 1 hour and 45 minutes.

Evening congestion occurred at two locations in the westbound direction. The first congested location was a one-mile segment around NE 148th Avenue that began at 4:45 p.m. and lasted for 50 minutes. After 2.5 miles of travel at 45 mph or faster, the next congested segment occurred between West Mercer Island Way and the HOV ramp entrance at MP 8.5 (three miles), usually began at 3:35 p.m. and lasted for 3 hours and 20 minutes (see map top right).

Routinely congested segments of I-90

2013; For weekday morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Direction of travel; Length of backup in miles; Daily duration of congestion in hours.



Data source: Washington State Transportation Center (TRAC) at the University of Washington.

Commute trip reliability and average travel times on I-90 improves

Out of the 52 high demand commute routes monitored in the central Puget Sound area, 12 are on I-90 corridor between Seattle, Bellevue and Issaquah. Of these 12 commutes, eight cross the I-90 floating bridges and the other four commutes are between Bellevue and Issaquah.

Of the six eastbound morning and evening peak period commutes, five saw average travel time reductions of up to 2 minutes while the Bellevue to Issaquah evening commute saw a 2-minute increase in travel times from 2011 to 2013. Similarly, reliable travel times on these six eastbound commutes saw an improvement of 5 minutes in the morning while the evening commutes saw an increase of up to 4 minutes. The largest improvement in reliable travel time of 5 minutes was on morning commutes between Seattle and Bellevue, and Seattle and Issaquah. The largest increase of 4 minutes in reliable travel time was on the Bellevue to Issaquah evening commute.

Of the six westbound commutes during the morning and evening peak periods, five saw average travel time increases ranging from 2 to 7 minutes while the Issaquah to Bellevue commute remained unchanged. Reliable travel times on four of these commutes increased up to 9 minutes while the other two saw 1-minute improvements from 2011 to 2013.

Corridor delay worsens on I-90

On average weekdays, I-90 commuters in the central Puget Sound area experienced 70% more delay in 2013, from 565 daily vehicle hours of delay in 2011 to 964 hours in 2013. Delay is measured in vehicle hours, and occurs when speeds are less than 85% of posted speeds. Some of the increases in delay on I-90 can be attributed to the implementation of tolling on SR 520 across the Evergreen Point Floating Bridge that began in December 2011. The spiral graphs on the next page show the occurrence of delay at various locations along the corridor by time of the day and direction of travel for 2013.

Greenhouse gas emissions increase 4% on I-90

I-90 greenhouse gas emissions increase between 2011 and 2013

All-day greenhouse gas (GHG) emissions from vehicles traveling along the I-90 corridor between Seattle, Bellevue and Issaquah totaled 4.13 million pounds of carbon dioxide equivalents (CO_2e) daily in 2013, 4% more than in 2011. Emissions per mile increase with delay (vehicles burn fuel less efficiently at slower speeds), while other factors effectively reduce emissions per mile, such as the improving fuel efficiency of vehicles. Along the I-90 routes, the net effect is an increase in emissions along with the increased delay following tolling of the parallel SR 520 floating bridge.

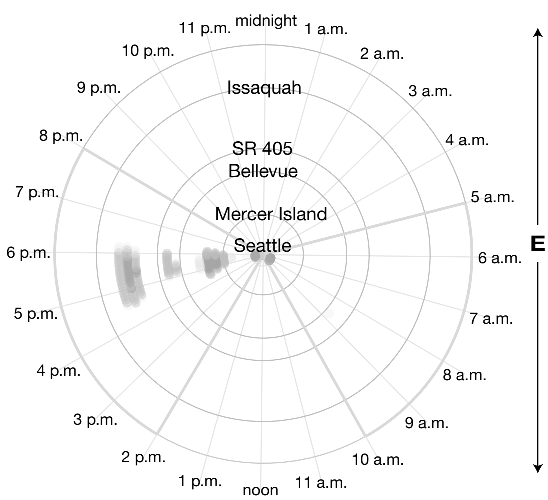
See Appendix pp. 13-14 for the emissions per person, per trip along the I-90 central Puget Sound area commutes.

How much is congestion costing you?

In 2013, the round trip commute congestion cost incurred by each person on the I-90 corridor varied widely. Round trips from Issaquah into Bellevue or Seattle in the morning ranged from $790 to $1,010 annually, similar to the Seattle to Bellevue round-trip commute ($1,050 annually), which was the most expensive commute on I-90, when measured in wasted time and gas. Trips in the opposite directions on these same routes cost between $130 and $720 annually.

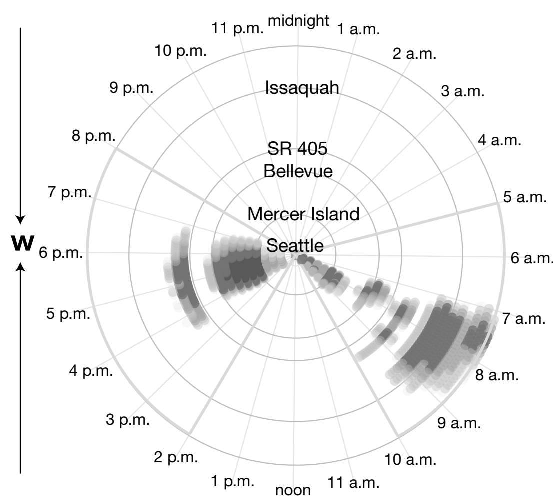
See Appendix pp. 5-23 for more corridor performance data.

I-90 delay between Seattle and Issaquah is more intense in the westbound direction
2013; Weekdays only; Vehicle hours of delay; Shading represents intensity of delay



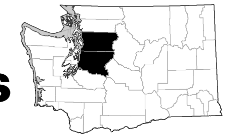
Spiral graphs are read by direction as indicated by the arrows. Eastbound is read from the center of the circle to the outer edge; westbound from the outer edge of the circle to the center.

Delay is more prominent in the westbound direction for both the morning and evening commutes. The most intense delay occurs around Issaquah from 7 a.m. to 9 a.m., and between Bellevue and Seattle during the evening commute.



Data source: Washington State Transportation Center (TRAC) at the University of Washington and WSDOT Office of Strategic Assessment and Performance Analysis.

State Route 167 Corridor Capacity Analysis



Annual person miles traveled

2011	vs.	2013	
309.2		300.5	↓ 2.8%

in millions of miles

Annual vehicle delay[1]

2011	vs.	2013	
140.2		177.5	↑ 27%

in thousands of hours

Annual emissions

2011	vs.	2013	
273.1		256.2	↓ 6.2%

in millions of pounds of CO_2 equivalents

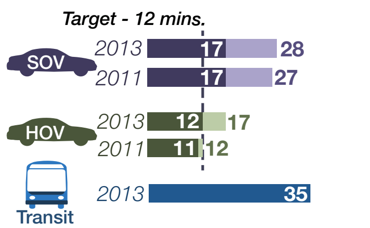
Commute travel times

2011 and 2013; Weekday travel times in minutes at the peak 5-minute interval including average and reliable[2] travel times for single occupant vehicle (SOV) and high occupancy vehicle (HOV) trips as well as maximum throughput (target) and planned transit[3] travel times.

Average SOV · Average HOV · Reliable SOV · Reliable HOV · Planned transit time

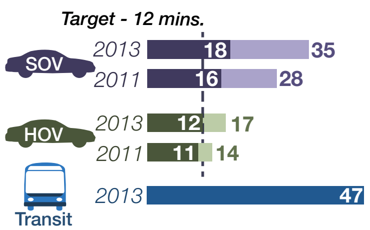
Auburn to Renton

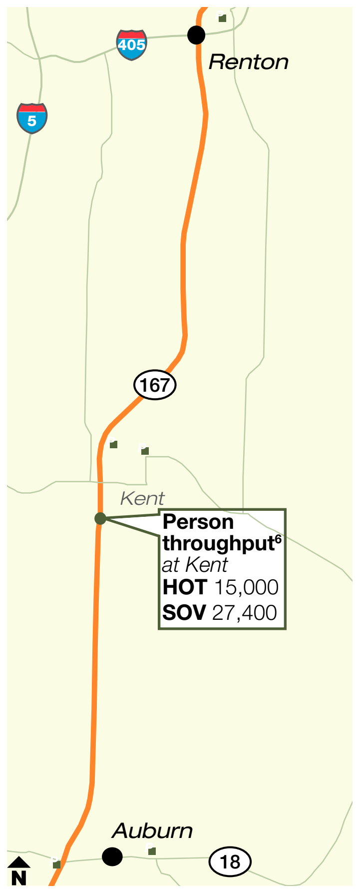
Morning; 5-10 a.m.; Trip length 10 miles



Renton to Auburn

Evening; 2-8 p.m.; Trip length 10 miles





Transit system use

2013; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) peak periods; Ridership and percent of available seats occupied on select commutes

Corridor-wide[4] ridership

1.2 million — *transit riders annually*

13.1 million — *passenger miles traveled annually*

94% — *transit seats occupied on average*

By Commute	Daily peak period riders	Percent of seats occupied
Morning (6-9 a.m.)		
Auburn to Renton	2,186	95%
Evening (3-6 p.m.)		
Renton to Auburn	2,325	94%

Park and ride capacity

2013; Parking spaces and average percent occupied for select park and rides (P&R)[5] (see map for locations)

Auburn-Renton commute

Park and ride	Spaces	Percent occupied
Auburn Station	633	100%
South Renton P&R	373	100%
Kent Area	996	97%
Renton P&R	150	96%
Peasley Canyon P&R	54	93%
Renton Municipal P&R	200	87%
Auburn P&R	244	67%
Kent/James Street P&R	713	27%

Data source: Washington State Transportation Center (TRAC) at the University of Washington, WSDOT Urban Planning Office, Sound Transit, King County Metro, Community Transit and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: Measures at the top of the page are for the SR 167 corridor between Auburn and Renton for SOV trips only. 1 WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. 2 Reliable travel time is the travel time that will get a commuter to their destination on time or early 19 out of 20 weekdays, or 95% of the time. 3 Transit travel times by bus and Sounder rail include off-highway travel to stops and may not be comparable to SOV/HOV times which are highway only. 4 Peak period corridor-wide ridership includes trips on all SR 167 central Puget Sound area corridors. 5 For more park and ride information, see http://www.wsdot.wa.gov/choices/parkride.htm. 6 Person throughput values include morning (6-9 a.m.) and evening (3-6 p.m.) peak period values.

State Route 167 (SR 167) is an extension to the I-405 corridor and runs parallel to I-5 in the central Puget Sound area. SR 167 between Auburn and Renton serves as one of the region's key commute and freight corridors. The morning (5-10 a.m.) and evening (2-8 p.m.) commutes experience heavy congestion at specific locations along the corridor on a daily basis. Hours of delay per person annually on the SR 167 corridor increased 34% from 1 hour and 22 minutes in 2011 to 1 hour and 50 minutes in 2013. As a result, the average SR 167 commuter spent an additional 28 minutes on the road over the course of 2013 compared to in 2011. For the same time period, person-miles traveled along SR 167 decreased by 3% and annual emissions decreased 6%.

SR 167 corridor productivity analysis

Highway productivity: As traffic increases, roads are able to carry fewer vehicles, resulting in a drop in productivity at speeds slower than maximum throughput speed. In 2011 and 2013, productivity on SR 167 near 84th Avenue SE in Kent ranged from 77% to 92%. The worst productivity loss of 23%

Sounder contributes to significant person throughput

occurred at 5:30 p.m. in the southbound direction. As a result, almost a quarter of the roadway's capacity was unavailable due to congestion. The graphs below show how throughput productivity can vary by direction of travel and time of day.

The table to the right provides data on the productivity losses at the sample location to illustrate opportunities to maximize system capacity.

Transit capacity: In 2013, the average transit ridership along the 10-mile stretch of SR 167 between Auburn and Renton was about 2,200 daily riders during the morning commute and 2,300 daily riders during the evening commute.

The SR 167 corridor serves as a complementary corridor to parts of I-5 as Sounder commuter rail travels along SR 167 corridor on its way from Tacoma to Seattle. Transit use on the corridor averaged 94%. Express bus service carried 530 morning riders and 550 evening riders, about 23% of ridership for both the morning and evening commutes.

Park and ride capacity: Availability of park and ride (P&R) locations within the transit service network is integral to ridership. Park and ride locations need to have enough parking spaces to accommodate demand. Along the SR 167 corridor, P&R utilization rates ranged from 27% to 100%. For example, the Kent area P&R recorded 97% utilization of the 996 available spaces (see map on p. 25).

Capacity constraints along SR 167

There are several routinely congested segments along the SR 167 corridor between Auburn and Renton that lengthen the commute trip time. Congestion lasting approximately an hour or more on a daily basis is presented here. Roadway alignment, lane utilization and traffic demand can affect corridor capacity.

Vehicle throughput variable along SR 167 near Kent
2011 and 2013; Maximum loss of vehicle throughput by commute direction

Location	Direction	Loss compared to 100% in 2011	2013	Change
SR 167 at 84th Avenue SE, near Kent	Northbound	12%	8%	-4%
	Southbound	14%	23%	9%

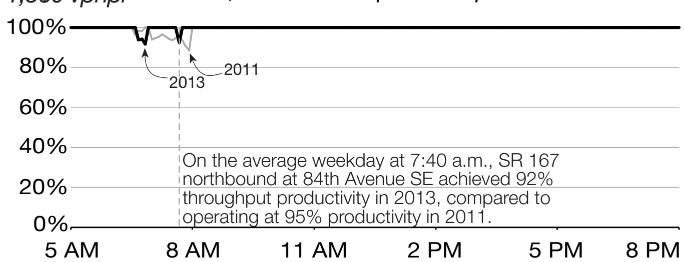
Data source: Washington State Transportation Center (TRAC). Data analysis: WSDOT Urban Planning Office and WSDOT Office of Strategic Assessment and Performance Analysis.
Note: Negative values indicate vehicle throughput improved in 2013 compared to 2011.

Peak period commutes – Auburn and Renton: The northbound SR 167 morning commute between Auburn and Renton experienced congestion at two locations. Between SR 18 and the Green River, congestion extended for five miles and lasted for 2 hours and 45 minutes, starting at 5:35 p.m. A second congested segment occurred approaching I-405 that extended for one mile starting at 6:15 a.m. and lasted for 2 hours and 30 minutes. The southbound evening commute experienced extensive congestion between the Green River and SR 18, a 6.5-mile segment that began at 2:15 p.m. and lasted for 4 hours and 10 minutes (see map on next page).

Commute trip reliability and average travel times steady on SR 167

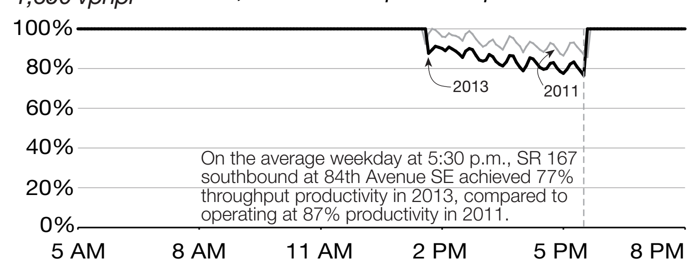
Of the 52 high demand commute routes monitored in the central Puget Sound region, four are along the SR 167 corridor between Auburn and Renton, three of which had no significant change in average or reliable travel times. The average travel time for the 10-mile commute from Renton to Auburn was 18 minutes and the reliable travel time was 28 minutes in 2013, increases of 2 minutes and 1 minute from 2011 travel times, respectively. Significant congestion occurred at East Valley Road as well as between Green River and SR 18. For more details on SR 167 high occupancy toll (HOT) lanes, see p. 28.

Throughput along northbound SR 167 at 84th Avenue SE (MP 21.5)
Northbound SR 167 at 84th Avenue SE (MP 21.5)
2011 and 2013; Based on the highest observed 5-minute flow rate; Northbound = 1,560 vehicles per hour per lane = 100%
Based on the highest observed 5-min. flow rate; Northbound = 1,560 vphpl



Data source: WSDOT Urban Planning Office.

Throughput along southbound SR 167 at 84th Avenue SE (MP 21.5)
Southbound SR 167 at 84th Avenue SE (MP 21.5)
2011 and 2013; Based on the highest observed 5-minute flow rate; Southbound = 1,690 vehicles per hour per lane = 100%
Based on the highest observed 5-min. flow rate; Southbound = 1,690 vphpl



Data source: WSDOT Urban Planning Office.

Delay on SR 167 increases while emissions decrease

Corridor delay increases on SR 167

Based on average weekdays, SR 167 delay increased 27% from 537 daily vehicle hours in 2011 to 680 hours in 2013. Delay is measured in vehicle hours, and occurs when average speeds are less than 85% of posted speeds. Most of the increase in delay is due to increasingly intense congestion, particularly during the evening commute. It is possible that as congestion increases in the single occupant vehicle (SOV) lanes, a portion of SOV traffic shifts to the high occupancy toll (HOT) lanes while others choose alternative commute modes (see p. 28 for HOT lane analysis). The spiral graphs below show the occurrence of delay at various locations on SOV lanes along SR 167 by time of day and direction of travel in 2013.

Greenhouse gas emissions decrease 6%

All-day greenhouse gas emissions from vehicles traveling along the SR 167 corridor between Auburn and Renton totaled 0.98 million pounds of carbon dioxide equivalents (CO_2e) daily in 2013, 6% less than in 2011. While emissions per mile increase with delay (vehicles burn fuel less efficiently at slower speeds), other factors also affect emissions such as improving fuel efficiency of vehicles resulting in reduced overall emissions even while delay increased along these routes.

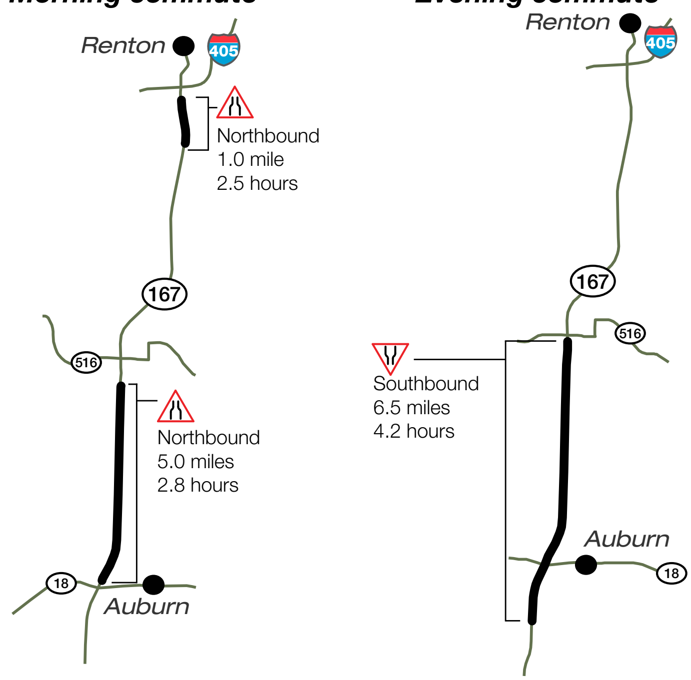
See [Appendix pp. 13-14] for the emissions per person, per trip along the SR 167 commutes.

How much is congestion costing you?

In 2013, the commute congestion cost incurred by each person on the SR 167 corridor was about $760 annually on the Auburn to Renton round-trip commute, when measured in wasted time and gas.

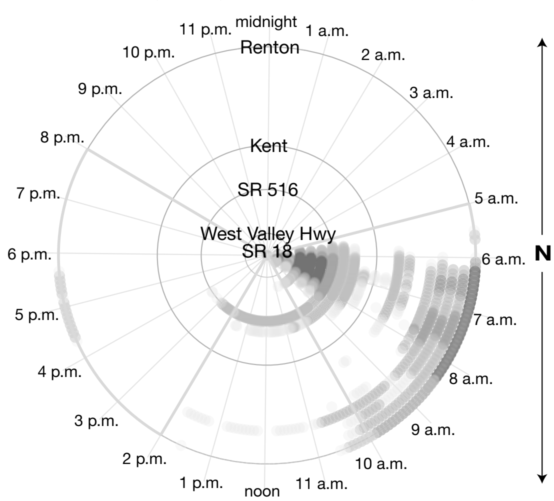
See [Appendix pp. 5-23] for corridor performance data.

Routinely congested segments of SR 167
2013; For weekday morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Length of backup in miles; Daily duration of congestion in hours



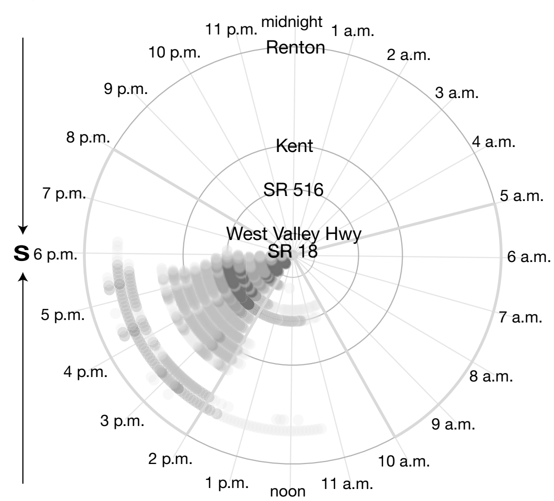
Data source: Washington State Transportation Center (TRAC) at the University of Washington.

SR 167 delay between Auburn and Renton
2013; Weekdays only; Vehicle hours of delay; Shading represents intensity of delay



Spiral graphs are read by direction as indicated by the arrows. Northbound is read from the center of the circle to the outer edge; southbound from the outer edge of the circle to the center.

Along the entire SR 167 corridor, there is noticeable delay in the northbound direction between 6 a.m. and 10 a.m. There is comparable delay in the same area on SR 167 southbound between 2 p.m. and 5:30 p.m.



Data source: Washington State Transportation Center (TRAC) at the University of Washington and WSDOT Office of Strategic Assessment and Performance Analysis.

HOT lane use along SR 167 continues to increase

SR 167 high occupancy toll lane usage benefits all drivers

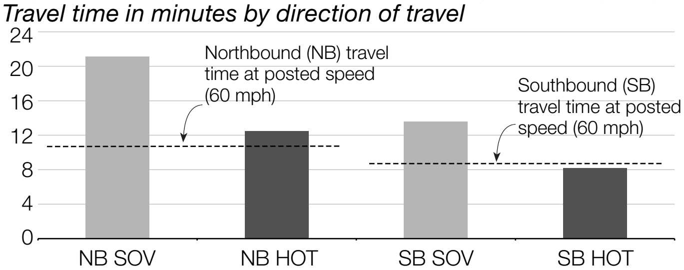
The first six years of operation for the SR 167 high occupancy toll (HOT) lanes have yielded significant results, both for the drivers who access the HOT lanes and for those in the adjacent, non-tolled lanes. Drivers who choose to use the HOT lanes save time and reduce the stress associated with their daily commute, while also reducing the volume of the traffic in the single occupant vehicle (SOV) lanes. The result is traffic that is more likely to move efficiently, benefitting all SR 167 users.

HOT lanes result in faster travel times

Between July 2013 and June 2014 (FY2014), the northbound HOT lanes saved weekday drivers an average of 8 minutes of travel time during the peak hour (7-8 a.m.). Average travel time in the HOT lane was 13 minutes compared to 21 minutes in the SOV lanes. The average toll for single occupant vehicles to use the northbound HOT lane during the morning peak hour was $2.25.

The weekday southbound HOT lane saved drivers an average of 6 minutes during the evening peak hour (4-5 p.m.), with average travel times of 8 minutes in the HOT lane and 14 minutes in the SOV lane; the average toll was $1.50.

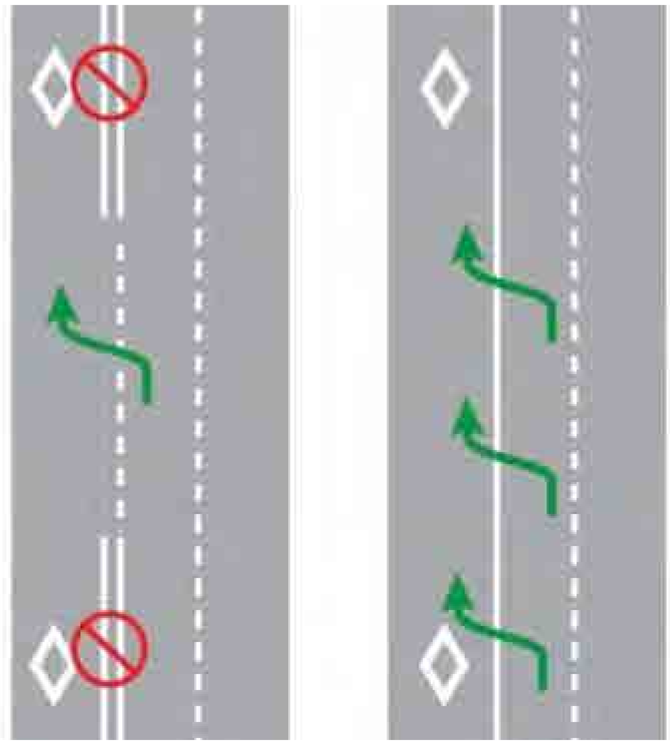
SR 167 high occupancy toll lanes save drivers time
July 2013 through June 2014; Tuesday through Thursday only; Travel time in minutes by direction of travel



Data source: WSDOT Northwest Region Traffic Office.
Note: SOV = single occupant vehicle; HOT = high occupancy toll.

SR 167 HOT lane usage more than quadruples since opening

The FY2014 data demonstrates the public's understanding of HOT lane benefits; the average daily number of tolled trips continues to rise. Tolled trips increased more than 7% from 4,200 average daily trips in June 2013 to more than 4,500 trips one year later. Tolled trips have more than quadrupled since June 2008, when the average daily number of tolled trips was slightly more than 1,000. See Appendix p. 35 for a graph showing average daily users on SR 167 since May 2008.



In the original configuration (left), it is illegal to cross double white lines, and drivers must enter and exit at the dashed line segments. In the new configuration (right), drivers may access the high occupancy toll (HOT) lanes wherever there is a single white line.

WSDOT removes double white lines

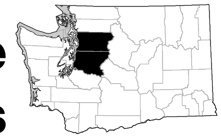
According to a 2012 driver survey, 40% of customers responded that they did not like the restrictive entry and exit points for the HOT lanes. Transit agencies have also stated that it is challenging for them to use the HOT lanes because buses frequently need to enter and exit the highway to make stops. In August 2014, contractor crews removed lane striping and updated signage on the SR 167 HOT lanes, enabling drivers to enter and exit the lanes along nearly the entire length of the corridor between Renton and Auburn. WSDOT is partnering with the University of Washington to evaluate the impact of the change, and will report on the results in future editions of the *Corridor Capacity Report*.

Good To Go! passes good on all Washington state tolled facilities

There are currently three tolled facilities in Washington state: the SR 520 Bridge (see p. 20), the SR 167 HOT lanes and the SR 16 Tacoma Narrows Bridge. A *Good To Go!* pass can be used on any of these facilities.

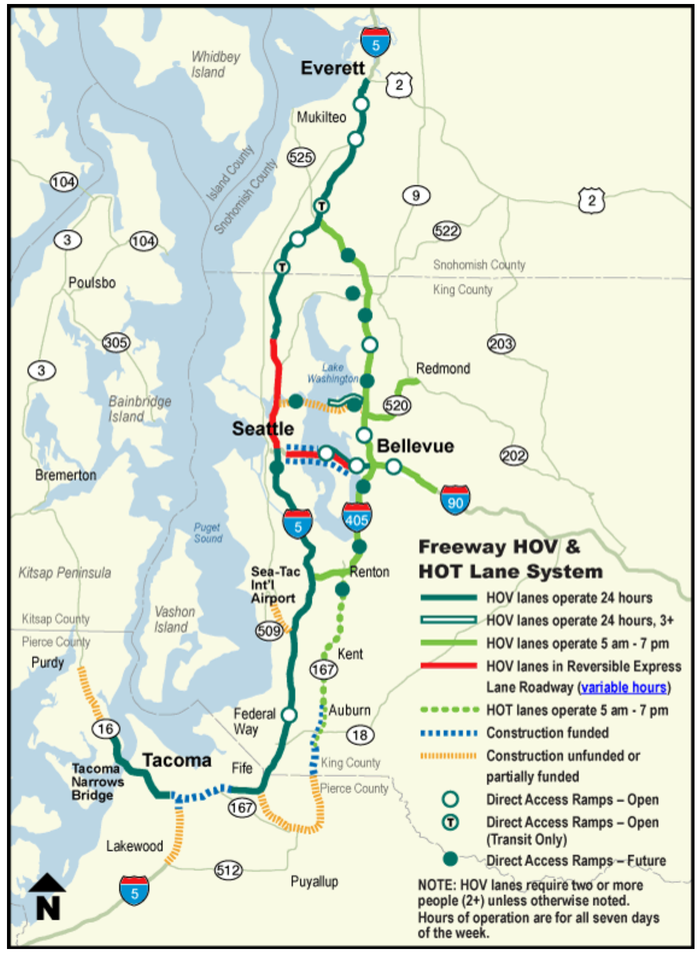
For more information about *Good To Go!* visit: http://www.wsdot.wa.gov/goodtogo/passes.htm.
Toll rates are available online at: http://www.wsdot.wa.gov/Tolling/TollRates.htm.

High Occupancy Vehicle Trip Analysis



The central Puget Sound area freeway network includes a system of high occupancy vehicle (HOV) lanes that serve travelers who carpool, vanpool, or use public transit. This system is designed to provide faster and more reliable options for travelers who choose to rideshare. It also enhances the efficient operation of the freeway network by moving more people in fewer vehicles, compared to adjacent single occupant vehicle (SOV) freeway lanes. About 310 lane-miles of the planned 320-mile Puget Sound area HOV network have been completed. More information about the HOV lane network can be found at http://www.wsdot.wa.gov/hov/.

WSDOT monitors three aspects of Puget Sound area HOV lane performance: 1) overall travel performance and reliability on freeway HOV corridors, 2) the person-carrying performance of HOV lanes as compared to the adjacent general purpose lanes, and 3) travel time performance for HOV lane users.



Approximately 310 lane-miles of a planned 320-mile freeway system of high occupancy vehicle (HOV) lanes have been built in the central Puget Sound area since 1970.

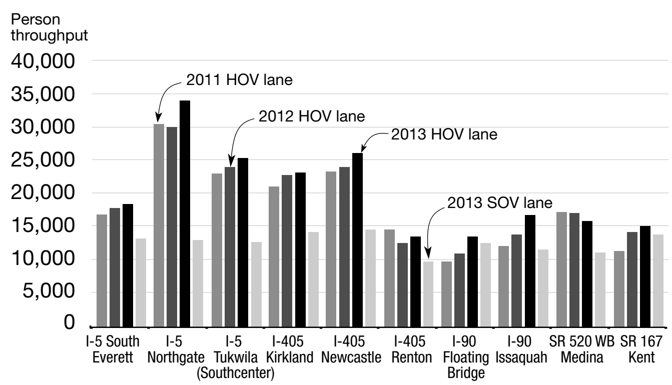
HOV lanes outperform SOV lanes for person throughput

One of the key metrics of HOV lane performance is the ability of the HOV network to efficiently move more travelers. WSDOT estimates the number of vehicles and travelers at 10 mainline freeway locations on the major freeway corridors in the central Puget Sound area, to evaluate how the HOV network is contributing to the efficient movement of more people in fewer vehicles.

The graph at right shows HOV lane person throughput at 10 monitoring locations during peak periods. Since 2010, there has been an upswing in the number of travelers carried by the HOV lanes, following a period of lower volumes during the recession. Nine of 10 locations showed higher HOV person throughput in 2013 than in 2012. The graph also shows peak period SOV lane person throughput for 2013. The HOV lane person throughput is higher than that of the average adjacent SOV lane at all 10 monitored locations in 2013.

The number of persons using the HOV lane varies by location and time of day; the most successful examples of HOV lane usage occur when the HOV lane offers a clear travel time benefit, combined with strong transit service. The Northgate area of Interstate 5 (I-5) north of downtown

Person throughput[1] on HOV lanes outperform SOV lanes
2011 through 2013; Morning and evening peak period volumes, combined; Number of people in thousands



Data source: Washington State Transportation Center (TRAC) at the University of Washington.
Note: 1 Person volume estimates are based on most recent 2011-2013 transit ridership and other data. The SOV lane volumes are the estimated person volumes for the average SOV lane at each location.

Transit & HOV lanes: A great recipe for person throughput

Seattle is one such example. This location is in a heavily traveled freeway corridor for commuting that is used by a number of transit routes. In previous years, this location has consistently shown HOV lane travel time benefits and significant usage. In 2013, during the average morning peak period, the southbound I-5 HOV lane at Northgate carried more than 15,600 travelers toward downtown Seattle; this represented 46% of all southbound morning peak period I-5 travelers at this location, in only 21% of the vehicles. The HOV lane at this location carried an average of 3.8 persons per vehicle, or about three times the number of persons per vehicle as the adjacent SOV lanes. Overall, the HOV network attracts a significant number of ridesharing travelers; across all the monitoring locations, an average of about 36% of the people using the freeway during the peak periods at these locations use the HOV lanes. These values have been generally consistent from year to year.

Transit ridership contributes to higher person throughput in HOV lanes

Bus ridership is a significant component of person volumes on the HOV network. Ridership on King County Metro and Sound Transit continued a recent growth trend (this includes boardings within the downtown Seattle ride free area prior to its discontinuation in September 2012). Metro reported a 2.7% growth in ridership in 2013, nearly matching the pre-recession all-time high. This ridership growth was likely affected by improvements in the regional economy, higher employment levels, and significant bus service restructuring. Sound Transit bus boardings increased 7.6% in 2013, while Community Transit ridership held steady from 2012. Transit agencies' budget constraints and other issues could affect future ridership: in September 2014, Metro cut bus service in response to reduced projected revenues, while Community Transit is adding service after several years of service cuts and lower ridership during the recession.

HOV lanes are faster, more reliable than SOV lanes

WSDOT monitors the benefits for HOV lane users by tracking the travel times and reliability of HOV trips that parallel each of WSDOT's 40 high-demand commute corridors. For some SOV commute routes there are two HOV routes, such as commutes along I-5 and I-90 where there are reversible express lanes.

Of the 42 HOV trips analyzed for 2013, 32 were more than 2 minutes faster during times of peak congestion compared to the associated SOV trip, while the other 10 trips showed no significant travel time difference between the SOV and HOV route options. Overall, the 2013 HOV travel time results are similar to those seen in previous years.

The 95th percentile reliable travel times are faster by more than 2 minutes on 35 of the 42 HOV trips relative to their SOV counterparts (up from 30 routes in 2012). The other seven trips showed little or no difference in 95th percentile travel times. These shorter reliable travel times illustrate another benefit of using HOV lanes.

See Appendix pp. 16-23 for the travel time and reliability performance of each monitored HOV and SOV lane.

Four of 14 HOV corridors met reliability standards in 2013

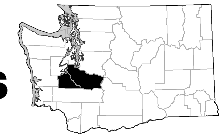
The performance and reliability standard for freeway HOV lanes that was adopted by WSDOT and the Puget Sound Regional Council (PSRC), in 1991, states that travelers in the HOV lane should be able to maintain an average speed of at least 45 mph, 90% of the time during the peak hour of travel.

Four of the 14 monitored HOV peak-direction corridors met the state performance standard in 2013 (two each in the morning and evening), compared to five corridors that met the standard in 2012. The degree of compliance with the performance standard held steady or worsened for all of the monitored locations in 2013 compared to the year before. This continues a trend in the past three years where HOV corridor compliance with the standard has generally worsened year-to-year. The 2013 HOV lane performance on most corridors is similar to conditions in 2007 prior to the start of the economic recession.

During the off-peak times of day, all HOV corridors generally meet the standard. Even during peak congested periods when HOV performance is reduced, HOV lanes still generally continue to provide a speed and reliability benefit relative to the adjacent SOV lanes.

See Appendix p. 20 for a table that summarizes the degree to which each HOV corridor met the state performance standards in recent years in the peak direction of travel.

South Sound I-5 Corridor Capacity Analysis



Annual person miles traveled			Annual vehicle delay[1]			Annual emissions		
2011 vs.	2013		2011 vs.	2013		2011 vs.	2013	
1,540	1,571	2.0%	552.8	746.5	35%	1,374	1,392	1.3%
in millions of miles			in thousands of hours			in millions of pounds of CO_2 equivalents		

Commute travel times

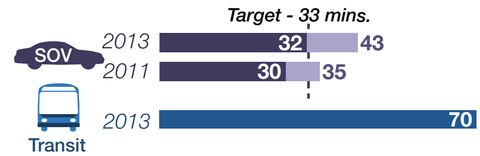
2011 and 2013; Weekday travel times in minutes at the peak 5-minute interval including average and reliable[2] travel times for single occupant vehicle (SOV) and high occupancy vehicle (HOV) trips as well as maximum throughput (target) and planned transit[3] travel times

Average SOV
Reliable SOV
Planned transit time

See Appendix pp. 26-30 for more commute routes

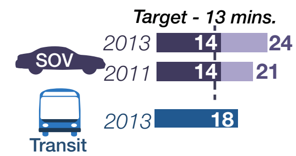
Olympia to Tacoma

Morning; 5-10 a.m.; Trip length 27 miles



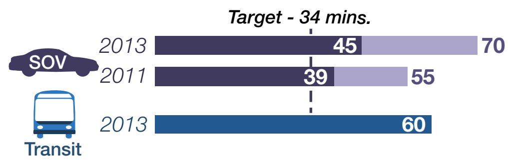
Tacoma to Federal Way

Morning; 5-10 a.m.; Trip length 11 miles



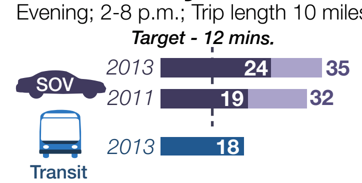
Tacoma to Olympia

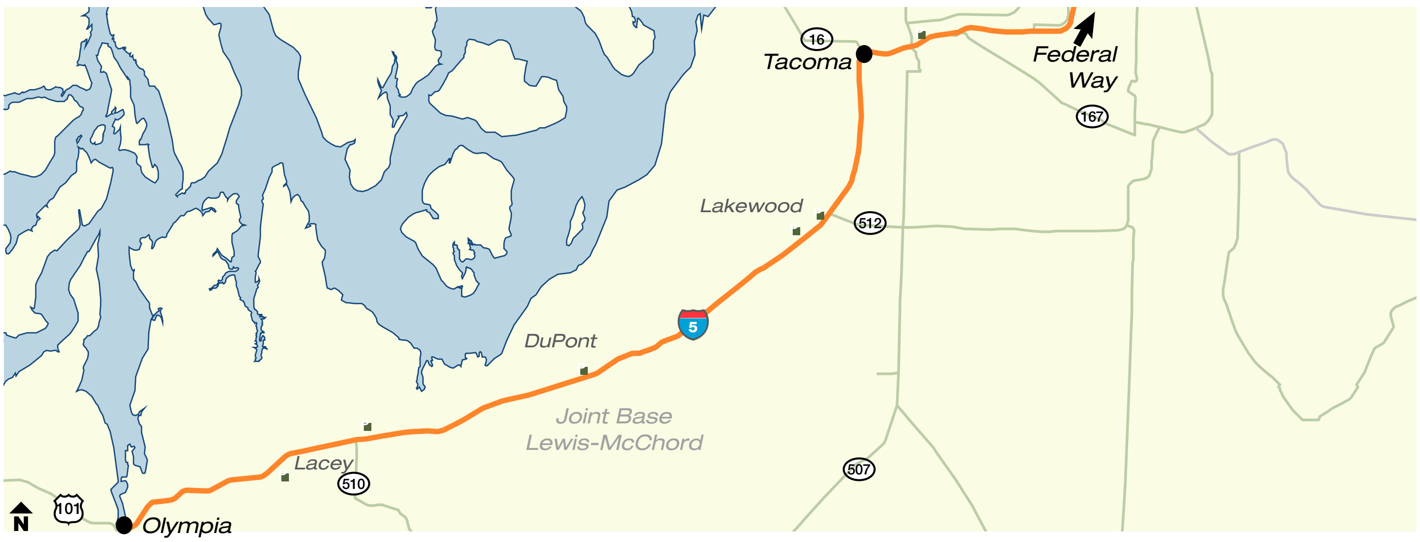
Evening; 2-8 p.m.; Trip length 28 miles



Federal Way to Tacoma

Evening; 2-8 p.m.; Trip length 10 miles





Transit system use

2013; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) peak periods; Ridership and percent of available seats occupied on select commutes

Corridor-wide[4] ridership

4.5 million — *transit riders annually*

50.0 million — *passenger miles traveled annually*

73% — *transit seats occupied on average*

By commute

	Daily peak period riders	Percent of seats occupied
Morning (6-9 a.m.)		
Tacoma to Federal Way[5]	7,344	93%
Olympia to Tacoma	132	32%
Evening (3-6 p.m.)		
Federal Way to Tacoma[5]	7,950	100%
Tacoma to Olympia	143	47%

Park and ride capacity

2013; Parking spaces and average percent occupied for select park and rides (P&R)[6] (see map for locations)

Olympia-Federal Way commute

Park and ride	Spaces	Percent occupied
SR 512 Lakewood P&R	493	98%
Tacoma Dome Station	2,273	96%
Lakewood Station	600	74%
DuPont P&R	126	70%
Martin Way P&R	318	40%
Hawks Prairie P&R	332	15%

Data source: Washington State Transportation Center (TRAC) at the University of Washington, Intercity Transit, WSDOT Olympic Region, and WSDOT Office of Strategic Assessment and Performance Analysis

Notes: Measures at the top of the page are for the I-5 corridor between Olympia and Federal Way for SOV trips only. 1 WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. 2 Reliable travel time is the travel time that will get a commuter to their destination on time or early 19 out of 20 weekdays, or 95% of the time. 3 Transit travel times by bus and Sounder rail include off-highway travel to stops and may not be comparable to SOV/HOV times which are highway only. 4 Peak period corridor-wide ridership includes trips on all I-5 south Puget Sound area corridor commutes. 5 Includes the Olympia/Tacoma-Seattle commutes. 6 For more park and ride information, see http://www.wsdot.wa.gov/choices/parkride.htm.

Express buses contribute to significant VMT reductions

Interstate 5 (I-5) serves as the key commute and freight corridor connecting the south and central Puget Sound areas. Morning (5-10 a.m.) and evening (2-8 p.m.) commutes experience moderate to heavy congestion at specific locations along the corridor on a daily basis. Annual per person hours of delay along the I-5 corridor increased 32% from 2 hours and 3 minutes in 2011 to 2 hours and 42 minutes in 2013. As a result, the average commuter spent an additional 39 minutes on the road over the course of 2013 compared to 2011. For this same time period, person-miles traveled along the I-5 corridor in the south Puget Sound area increased 2% and annual emissions increased 1.3%.

I-5 corridor productivity analysis

Highway productivity: As traffic increases, roads are able to carry fewer vehicles, resulting in a drop in productivity at speeds slower than maximum throughput speeds. In order to gauge the lost productivity along I-5 in the south Puget Sound area, vehicle throughput was analyzed at three locations: near 14th Avenue in Olympia, near Joint Base Lewis-McChord (JBLM), and at the Tacoma Dome. In 2011 and 2013, productivity at these locations ranged from 69% to 100%. For example, in 2013, I-5 near JBLM in the northbound direction saw productivity losses of 22% and 28% during the morning and evening peak periods, respectively, meaning that a quarter of the roadway's capacity was unavailable due to congestion depending on the time of the day. In the southbound direction, I-5 near JBLM saw a productivity loss of 22% during the evening commute around 6:30 p.m.

WSDOT is working with regional partners including JBLM to implement congestion mitigation strategies to increase throughput along I-5 near JBLM and the Tacoma Dome in particular. One funded strategy under development is ramp metering, which regulates the flow of traffic onto the freeway and improves the operational efficiency of the system. The

Vehicle throughput along I-5 between Olympia and Tacoma fluctuates from 2011 to 2013
2011 and 2013; Maximum loss of vehicle throughput by commute direction

Location	Direction	Loss in 2011	Loss in 2013	Change
I-5 at 14th Avenue overpass Olympia (MP 105.5)	Northbound	0%	0%	0%
	Southbound	0%	22%	22%
I-5 at Joint Base Lewis-McChord (MP 122.5)	Northbound	31%	28%	-3%
	Southbound	22%	22%	1%
I-5 at Tacoma Dome (MP 133.5)	Northbound	16%	30%	14%
	Southbound	30%	15%	-14%

Data source: WSDOT Olympic Region Traffic Office.
Note: Negative values indicate vehicle throughput improved in 2013 compared to 2011.

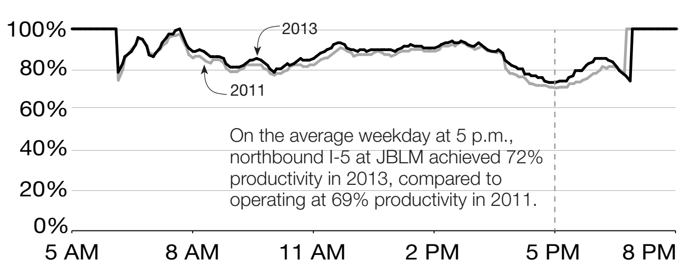
graphs below show how throughput productivity can vary by direction of travel and time of day. The table above provides data on percent loss in productivity at certain locations by direction to illustrate the opportunities to maximize system capacity by operating the system more efficiently.

Planned operational improvements along this segment of I-5 are discussed here: http://www.wsdot.wa.gov/NR/rdonlyres/AF7D7CC7-7829-457D-A51F-76B22D96DF53/0/UPDATEDJBLMFolioJULY2013.pdf.

Transit capacity: In 2013, the average transit ridership along the 28-mile stretch of I-5 (between Olympia and Tacoma) was about 132 daily riders during the morning commute northbound and 197 daily riders during the evening commute southbound. Significant ridership also occurred outside of the peak periods. Ridership on Intercity Transit's express buses (routes 603, 609 and 612) was about 950 riders daily. Transit use was 32% and 47% of the available capacity for the morning and evening peak periods, respectively.

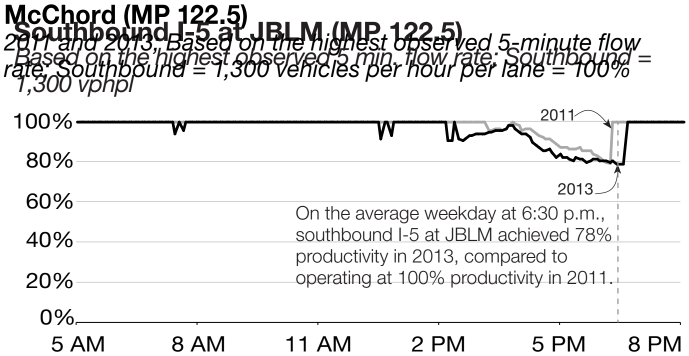
As a result of transit, the I-5 corridor in the south Puget Sound area has avoided more than 22,900 vehicle

Throughput along northbound I-5 at Joint Base Lewis-McChord (MP 122.5)
2011 and 2013; Based on the highest observed 5-minute flow rate; Northbound = 1,540 vehicles per hour per lane = 100%



Data source: WSDOT Olympic Region Traffic Office.

Throughput along southbound I-5 at Joint Base Lewis-McChord (MP 122.5)
2011 and 2013; Based on the highest observed 5-minute flow rate; Southbound = 1,300 vehicles per hour per lane = 100%



Data source: WSDOT Olympic Region Traffic Office.

Capacity constraints evident at JBLM and Tacoma Dome

miles of travel that would otherwise have occurred on a daily basis, thereby eliminating close to 8,500 pounds of carbon dioxide equivalents (CO_2e).

During the morning and evening peak periods, Intercity Transit deployed on average 83% of their fleet, helping reduce vehicle miles traveled and greenhouse gas emissions within its service area.

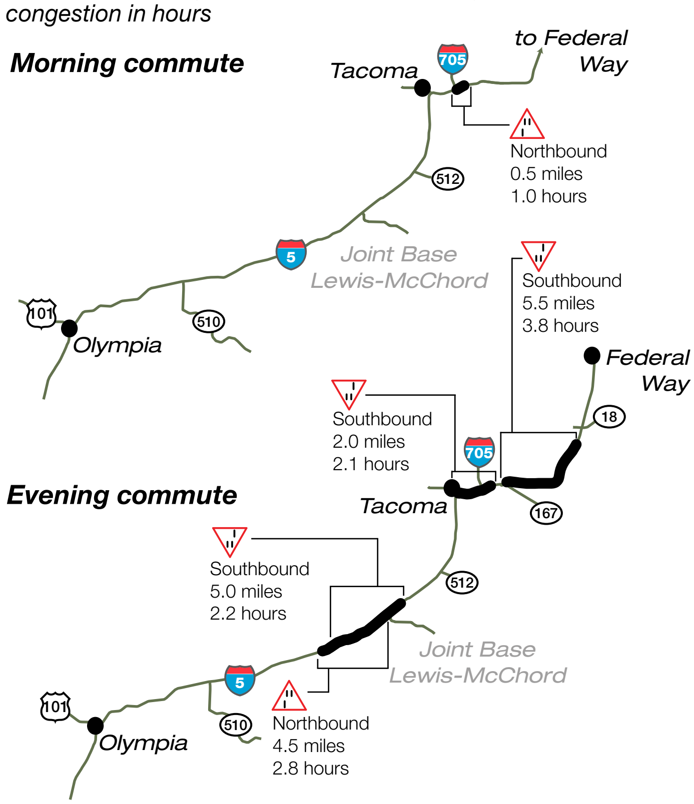
Park and ride capacity: Availability of park and ride (P&R) locations within the transit service network is integral to ridership. Park and ride locations need to have enough parking spaces to accommodate demand. Along the I-5 corridor in the south Puget Sound area, P&R utilization rates ranged from 15% to 98% depending on location. For example, the Martin Way P&R recorded 40% utilization while the Tacoma Dome Station P&R recorded 96% utilization of the 2,273 available spaces (see map on p. 31).

Capacity constraints along I-5 corridor

The I-5/U.S. 101 interchange, JBLM, Tacoma Dome and Fife vicinities are some of the prominent points that are

Routinely congested segments of I-5 in the south Puget Sound area

2013; For weekday morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Length of backup in miles; Daily duration of congestion in hours



Data source: WSDOT Olympic Region Traffic Office.

routinely congested, contributing to longer commute trip times in the south Puget Sound area. Congestion lasting approximately an hour or more on a daily basis is presented here. Roadway alignment, lane utilization and traffic demand can affect corridor capacity (see map below left).

Peak period commutes – Olympia, Tacoma and Federal Way: On an average weekday in 2013, northbound morning traffic routinely experienced a half-mile of congestion (speeds slower than 45 mph) near the Tacoma Dome, which lasted for about an hour. The daily northbound evening congestion near JBLM started at 3:20 p.m. and lasted 2 hours and 50 minutes, extending 4.5 miles between DuPont and Thorne Lane.

The southbound I-5 morning commute from Federal Way to Tacoma did not experience any congestion on an average weekday in 2013. However, the evening commute routinely experienced congestion at three locations between Federal Way and Olympia. The first congested segment near Fife began at 2:45 p.m. and lasted 3 hours and 50 minutes, extending for 5.5 miles. After a mile of relief, the next congested segment occurred near the Tacoma Dome. It usually began at 3:35 p.m., lasted 2 hours and 5 minutes and extended for two miles. Congestion relief extended eight miles past the Tacoma Dome. JBLM congestion usually started at 3:55 p.m., extended about five miles and lasted 2 hours and 10 minutes. Past JBLM, the typical weekday commute trip was relatively congestion-free until the U.S. 101 interchange, which experienced a backup extending about three miles to Pacific Avenue (not shown on map). It is important to note that delay (speeds slower than 51 mph) is experienced at various locations along the corridor in both directions of travel.

Commute trip average travel times increase and reliability worsens

Commuters traveling along I-5 between Olympia and Federal Way during the peak periods experienced moderate to significant increases in average and reliable travel times based on the presence of the routinely congested segments.

Morning commutes: Of the 10 morning commutes in both directions, two northbound commutes (Lakewood to Tacoma and Tacoma to Federal Way) experienced travel times that exceeded the target (maximum throughput) travel time. The average travel time for the five-mile Lakewood to Tacoma commute was 7 minutes while the reliable travel time was 9 minutes in 2013, each 1 minute longer than in 2011. This commute experienced congestion at the Tacoma Dome.

Southbound travel along I-5 less reliable through JBLM

Evening commutes: Of the 10 evening commutes in both directions, eight experienced longer than target travel times. Three commutes saw increases in travel times: Federal Way to Tacoma, Lacey to Lakewood, and Lakewood to Lacey.

The 10-mile evening trip from Federal Way to Tacoma, which should take 12 minutes at the target speed, took an average of 24 minutes in 2013 (5 minutes longer than in 2011). In 2013, the reliable travel time for this trip was 35 minutes, 3 minutes longer than in 2011. This commute routinely experienced congestion near Fife and near the Tacoma Dome.

The 16-mile northbound evening trip from Lacey to Lakewood should take 19 minutes at the target speed. It took 32 minutes in 2013, 2 minutes longer than in 2011. In 2013, the reliable travel time for this trip was 51 minutes, 2 minutes longer than in 2011.

The 17-mile southbound evening trip from Lakewood to Lacey, which should take 20 minutes at the target speed, instead took 31 minutes in 2013. This is 5 minutes longer than in 2011. In 2013, the reliable travel time for this trip was 52 minutes, 14 minutes longer than in 2011.

Even though the northbound and southbound trips between Lacey and Lakewood had similar average travel times in 2013, the increases in southbound average and reliable travel times (5 minutes and 14 minutes, respectively, from 2011 to 2013) indicate that southbound travel through JBLM has become less reliable than northbound travel.

Delay along I-5 corridor increases 35%

On average weekdays in 2013, commuters along the I-5 corridor in the south Puget Sound area experienced 2,860 daily vehicle hours of delay, up 35% from 2,118 vehicle hours of delay in 2011. Delay occurs when average speeds are less than 85% of posted speeds. Most of this increase in delay is attributed to the prominent congested locations along the I-5 corridor in both directions of travel such as JBLM, the Tacoma Dome and Fife. The spiral graphs below show the occurrence of delay at various locations along I-5 by time of day and direction of travel in 2013.

Greenhouse gas emissions decline

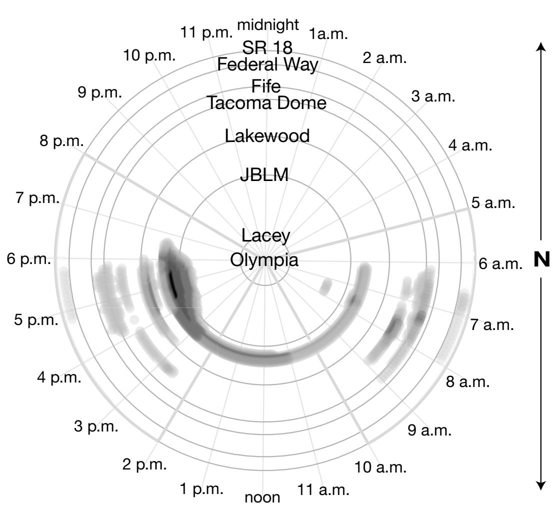
All-day greenhouse gas emissions from vehicles traveling along the I-5 corridor between Olympia and Federal Way totaled 6.8 million pounds of carbon dioxide equivalents (CO_2e) daily in 2013, 11% less than in 2011. While emissions per mile increase with delay (vehicles burn fuel less efficiently at slower speeds), other factors also affect emissions. Improvement in the fuel efficiency of vehicles has resulted in reduced overall emissions despite an increase in delay along these routes. See Appendix pp. 27-28 for the emissions per person, per trip along the I-5 south Puget Sound area commutes.

How much is congestion costing you?

The northbound evening commute along I-5 from Olympia to Tacoma experienced the most congestion of all south Puget Sound area commutes. This 28-mile trip claimed the highest cost due to congestion (measured in wasted time and gas), about $950 per person annually.

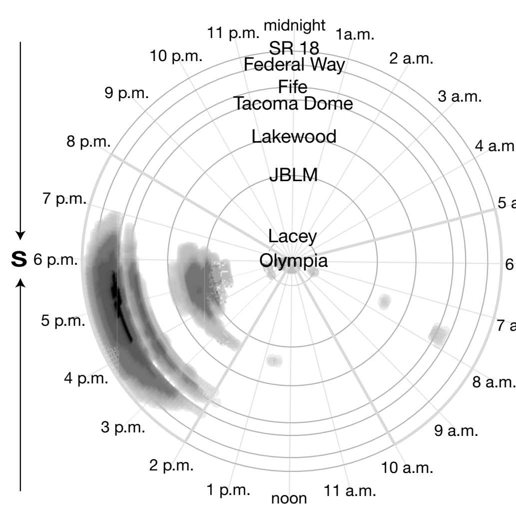
See Appendix pp. 24-28 for corridor performance data.

I-5 delay between Olympia and Federal Way
2013; Weekdays only; Vehicle hours of delay; Shading represents intensity of delay



Spiral graphs are read by direction as indicated by the arrows. Northbound is read from the center of the circle to the outer edge; southbound from the outer edge of the circle to the center.

Along the southbound I-5 corridor, there is widespread delay between Joint Base Lewis-McChord (JBLM) and State Route 18 interchange during the evening commute. Northbound I-5 shows less intense delay; however, delay around JBLM lasts from 6 a.m. past 6 p.m and is especially noticeable during the eveing peak period.



Data source: Washington State Transportation Center (TRAC) at the University of Washington and WSDOT Office of Strategic Assessment and Performance Analysis.

Vancouver Area Corridor Capacity Analysis
I-5 and I-205

Annual person miles traveled

2011 vs. **2013**
592.7 605.5 (2% increase)
in millions of miles

Annual vehicle delay[1]

2011 vs. **2013**
40.5 51.9 (28% increase)
in thousands of hours

Annual emissions

2011 vs. **2013**
486.6 487.4 (0.2% increase)
in millions of pounds of CO_2 equivalents

Commute travel times

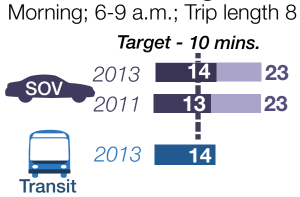
Average and reliable[2] travel times in minutes for single occupant vehicle (SOV) trips; Maximum throughput (target) and planned transit[3] travel times in minutes. No high occupancy vehicle (HOV) lanes are present.

Average SOV
Reliable SOV
Planned transit time

Interstate 5 commutes

I-205 to I-5 bridge

Morning; 6-9 a.m.; Trip length 8 miles



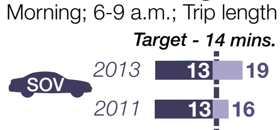
I-5 bridge to I-205

Evening; 3-6 p.m.; Trip length 8 miles

Interstate 205 commutes

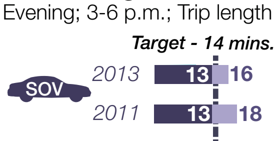
I-5 to I-205 bridge

Morning; 6-9 a.m.; Trip length 12 miles



I-205 bridge to I-5

Evening; 3-6 p.m.; Trip length 12 miles



See Appendix pp. 29-31 for more commute routes

Transit system use

2013 data only; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) peak periods; Ridership and percent of available seats occupied on select commute routes

Corridor-wide[4] ridership

577,500 *transit riders annually*

2.1 million *passenger miles traveled annually*

52% *transit seats occupied on average*

By commute	**Daily peak period riders**	**Percent of seats occupied**
Morning (6-9 a.m.)		
I-5: I-205 to I-5 bridge	602	49%
I-205: SR 500 to I-205 bridge	448	58%
Evening (3-6 p.m.)		
I-5: I-5 bridge to I-205	540	48%
I-5: I-5 bridge to SR 500	490	51%

Park and ride capacity

2013; Parking spaces and average percent occupied for select park and rides (P&R)[5] (see map for locations)

Interstate 5 commute route

Park and ride	**Spaces**	**Percent occupied**
Andresen P&R	60	86%
99th Street Transit Center	610	65%
Salmon Creek P&R	467	61%
BPA P&R	185	34%

Interstate 205 commute route

Park and ride	**Spaces**	**Percent occupied**
Fisher's Landing Transit Center	560	90%
Evergreen Transit Center	279	10%

Data source: WSDOT Southwest Region Planning Office, Southwest Washington Regional Transportation Council, C-Tran, private sector speed data, and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: Measures at the top of the page are for the I-5 and I-205 corridors in the Vancouver area for SOV trips only. 1 WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. 2 Reliable travel time is the travel time that will get a commuter to their destination on time or early 19 out of 20 weekdays, or 95% of the time. 3 Transit travel times by bus include off-highway travel to stops and may not be comparable to SOV/HOV times which are highway only. 4 Peak period corridor-wide ridership includes trips on all I-5 and I-205 Vancouver area commutes. 5 For more park and ride information, see http://www.wsdot.wa.gov/choices/parkride.htm.

I-5 bridge a bottleneck between Portland and Vancouver

Interstate 5 (I-5) and I-205 are key commute and freight corridors in the Vancouver-Portland metropolitan area. Morning (5-10 a.m.) and evening (2-8 p.m.) commutes experience moderate to heavy congestion on a daily basis. Annual per person hours of delay along the I-5 and I-205 corridors increased about 25%, from 13 minutes in 2011 to 16 minutes in 2013. For this same time period, person-miles traveled along the I-5 and I-205 commute corridors increased more than 2% while annual emissions increased marginally by 0.2%.

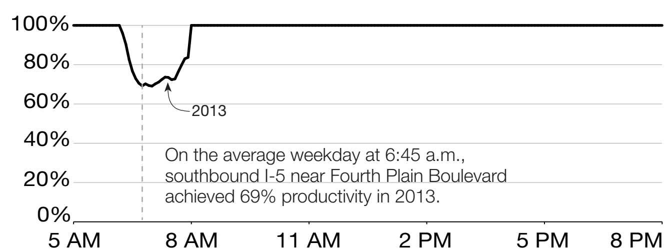
I-5 and I-205 corridor productivity analysis

Highway productivity: As traffic increases, roads are able to carry fewer vehicles, resulting in a drop in productivity at speeds slower than maximum throughput speed. In order to gauge the lost productivity along the I-5 and I-205 corridors, vehicle throughput was analyzed at four locations, including I-5 near Fourth Plain Boulevard and I-205 near 10th Street. In 2013, productivity at these locations ranged from 69% to 100%. For example, I-5 near Fourth Plain Boulevard in the southbound direction saw a productivity loss of 31% at 6:45 a.m., meaning that almost a third of the roadway's capacity was unavailable due to congestion. WSDOT anticipates that the full productivity of this corridor cannot be recovered without adding capacity to the I-5 Columbia River Bridge. In the northbound direction, I-5 near Fourth Plain Boulevard saw no productivity loss during the evening commute. This is due to the constrained flow of vehicles crossing the I-5 Bridge from Oregon, which all but ensures that the arrival of vehicles will never exceed the available roadway capacity.

The availability of throughput data on I-5 and I-205 at specific locations is limited to 2013 data. There are bottleneck locations along these corridors for which information is unavailable for analysis, specifically along I-205. Areas of congestion along I-205 include southbound from Padden Parkway to SR 500 (morning peak), I-205 southbound on-ramp from SR 500 (morning peak), I-205 northbound across the Glenn Jackson Bridge to the SR 14 off-ramp (evening peak), I-205 northbound from Mill Plain to SR 500 (evening peak), and I-205 northbound from SR 500 to Padden Parkway (evening peak).

Throughput along southbound I-5 near Fourth Plain Boulevard (MP 1.41)

2013 only; Based on the highest observed 5-minute flow rate; Southbound = 1,450 vehicles per hour per lane = 100%



Data source: WSDOT Southwest Region Planning Office.

Note: This graph is for a specific location and not representative of operations along the entire corridor. There are areas of congestion that are not displayed on this graph due to the limited data available.

Northbound I-5 and I-205 operate efficiently just beyond critical bottlenecks

2013; Maximum loss of vehicle throughput by commute direction

Location	Direction	Loss in 2013
I-5 near Fourth Plain Boulevard (MP 1.41)	Northbound	0%
	Southbound	31%
I-205 near 10th Street (MP 27.8)	Northbound	0%
	Southbound	0%

Data source: WSDOT Southwest Region Planning Office.

Note: 2011 data was not available for comparison as the detectors were not yet activated.

The graph to the left shows how throughput productivity can vary by the direction of travel and time of day. The table above provides data on the productivity losses at certain locations by direction to illustrate the opportunities to maximize system capacity.

Transit capacity: Hundreds of people ride transit along the I-5 and I-205 corridors each day during the peak commute periods between Vancouver and Portland. In 2013, transit use along I-5 was 51% (735 daily riders) for southbound morning trips and 50% (1,030 daily riders) for northbound evening trips. Similarly, transit use along I-205 between the SR 500 interchange and the Glenn Jackson Bridge for southbound morning trips was 58% (448 daily riders); there was no transit ridership attributed to the I-205 corridor during the evening return commute from Portland.

Bridge lifts on I-5 cause congestion and unreliable travel times for Washington drivers.

I-5 bridge causes nearly 10 hours of daily congestion

The disproportionate ridership between morning and evening trips along the I-5 and I-205 corridors occurs because all transit that uses I-205 entering Portland takes I-5 to return to Vancouver. Using I-205 during the evening peak period would put transit at a disadvantage due to heavy freeway congestion in Portland and lack of dedicated transit lanes such as high occupancy vehicle (HOV) lanes. Even though northbound I-5 in Portland experiences severe congestion during the evening commute heading into Vancouver, the presence of HOV lanes alleviates the time that transit has to spend in traffic and has become a more attractive alternative. This scenario exemplifies the benefits of HOV lanes in maximizing person throughput.

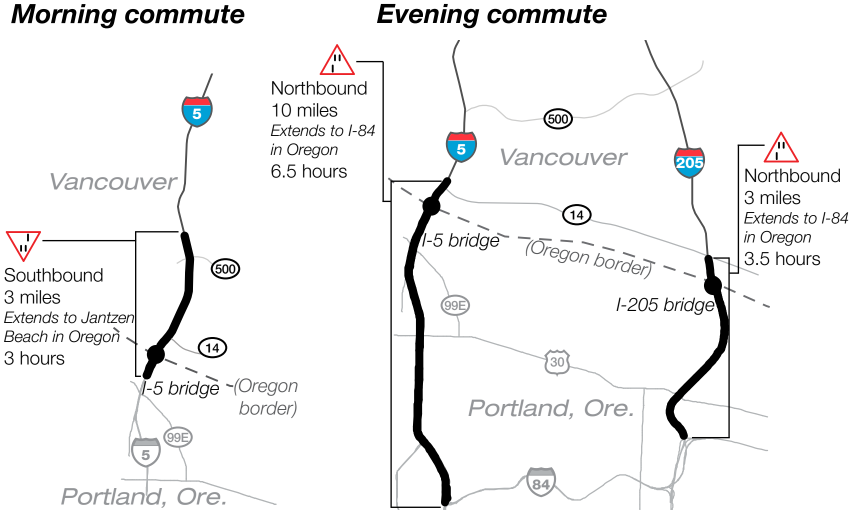
Due to the significant transit ridership along both I-5 and I-205, the Vancouver area avoided 4,910 vehicle miles of travel that would otherwise have occurred on a daily basis, thereby eliminating 3,202 pounds daily of carbon dioxide equivalents (CO_2e) emissions along the corridor.

During the morning and evening peak period, C-Tran deployed on average 83% of their fleet, helping reduce vehicle miles traveled and greenhouse gas emissions within the C-Tran service area.

Park and ride capacity: Availability of park and ride (P&R) locations within the transit service network is integral to ridership. Park and ride locations need to have enough parking spaces to accommodate demand. Along the I-5 and I-205 corridors in the Vancouver area, P&R utilization rates range from 10% to 90% depending on location. For example, the 99th Street Transit Center and Salmon Creek P&R locations had utilization rates of 65% and 61%, respectively, while the Bonneville Power Administration and Andresen P&R locations had rates of 34% and 86%. Along I-205, the Fisher's Landing Transit Center reached 90% while the Evergreen Transit Center had 10% utilization (see map on p. 35).

Routinely congested segments of I-5 and I-205 in the Vancouver area

2013; For weekday morning (5-10 a.m.) and evening (2-8 p.m.) peak periods; Length of backup in miles; Daily duration of congestion in hours



Data source: WSDOT Southwest Region Planning Office.

Capacity constraints along I-5 corridor

Peak period commute – I-5 southbound: The I-5 Columbia River Bridge is the prominent point of congestion that lengthens the morning commute trip time southbound to Oregon (see map below left). The number of lanes and posted speed limit are reduced as traffic approaches the I-5 Bridge. In addition, there are closely spaced on and off ramps (creating weaving between Mill Plain and SR 14), downstream congestion (ramp to Jantzen Beach, in Oregon), and short merge locations (SR 14 on-ramp). These route characteristics lead to a reduction in the capacity of the corridor. Congestion routinely occurred starting at the Jantzen Beach exit just south of the I-5 Columbia River Bridge at 5:45 a.m., causing backups that extended three miles to the north and lasted for 3 hours during the morning peak period.

Peak period commute – I-5 northbound: The I-5 Columbia River Bridge acts as a bottleneck during the evening peak period northbound, which creates congestion in Oregon for drivers heading into Washington. Drivers commuting across the river experience significant delays south of the bridge in Oregon, which is not accounted for in Washington's congestion data. This recurring congestion began at the SR 14 off-ramp just north of the I-5 bridge and extended 10 miles to the south, lasting for 6 hours and 30 minutes during the evening commute.

Capacity constraints along I-205 corridor

Peak period commute – I-205 northbound: The I-205 corridor experienced congestion in the rightmost lane during the evening peak period (3-6 p.m.) at the off-ramp to SR 14 due to the high volume of northbound traffic exiting to SR 14 eastbound. The capacity of the ramp is reduced due to a tight curve and a posted advisory speed of 30 mph.

Traffic sluggish between SR 500 and I-5 bridge

Even if the ramp did not have this tight curve, the off-ramp demand would require an additional lane to accommodate the number of vehicles exiting I-205. The length of the queue extends south into Oregon from the SR 14 off-ramp and typically lasts for 3 hours and 30 minutes.

Peak period commute – I-205: There are other locations along I-205 in the Vancouver area where congestion is routinely observed. These locations include I-205 southbound from Padden Parkway to SR 500 (morning peak), the I-205 southbound on-ramp from SR 500 (morning peak), I-205 northbound across the Glenn Jackson Bridge to the SR 14 off-ramp (evening peak), I-205 northbound from Mill Plain to SR 500 (evening peak), and I-205 northbound from SR 500 to Padden Parkway (evening peak).

Commute trip average travel times hold steady while reliability worsens

Commuters traveling from Vancouver to Portland along I-5 during the morning peak period experienced travel times that were 3 minutes longer than the 10-minute target travel time. At the peak of the morning commute (6:55 a.m.), it took an average of 8 minutes at a speed of about 15 mph in 2013 to drive the two-mile southbound trip along I-5 from SR 500 to the I-5 Columbia River Bridge. This congestion is caused by demand exceeding capacity at the narrow I-5 bridge, the nearby SR 14 on-ramp which has a tight radius and short merging area, downstream congestion (ramp to Jantzen Beach in Oregon), and the closely spaced on- and off-ramps between SR 500 and the I-5 Columbia River Bridge.

The average travel time for the morning commute along I-205 remained fairly stable between 2011 and 2013. However, the reliable travel time increased by 3 minutes.

Corridor delay increases for I-5/I-205

On average weekdays in 2013, commuters on the I-5 and I-205 corridors experienced 199 daily vehicle hours of delay, up from 155 hours in 2011 (28% increase). Delay is measured in vehicle hours, and occurs when average speeds are less than 85% of posted speeds. Most of this increase in delay is attributed to the I-5 and I-205 routinely congested segments previously discussed.

Clark County delay declines after highway improvement project

The Clark County delay published in the statewide indicator section on p. 7 shows a 22.4% drop in delay, which may be partly due to the SR 14 Camas Washougal capacity improvements (see p. 47) that appear to have reduced delay and enhanced safety along SR 14 in the Camas-Washougal area.

Greenhouse gas emissions hold steady

All-day greenhouse gas emissions along the I-5 and I-205 corridors totaled 2.8 million pounds of carbon dioxide equivalents (CO_2e) daily in both 2011 and 2013, which was stable despite increased traffic volumes along these commute corridors. While emissions per mile increase with delay (vehicles burn fuel less efficiently at slower speeds), other factors also affect emissions such as the improving fuel efficiency of vehicles, resulting in reduced overall emissions even while delay increased along these routes. See Appendix p. 31 for the emissions per person, per trip along the I-5 and I-205 Vancouver area commutes.

How much is congestion costing you?

Out of all Vancouver area commutes, the southbound morning commute along I-5 from SR 500 to the Columbia River Bridge experienced the most congestion. This one-way, two-mile trip along the I-5 corridor claimed the highest annual cost due to congestion (measured in wasted time and gas), about $310 per person annually. The majority of the delay for the evening commute occurred in Oregon. While it is understood that many Washington drivers are impacted by this congestion, costs to Washington drivers delayed in Oregon during the evening commute were not evaluated for this report.

See Appendix pp. 29-31 for corridor performance data.

Tri-Cities area commute corridors

The 2013 Tri-Cities Metropolitan Area Congestion Management Process, lead by the Benton-Franklin Council of Governments, identified three congested corridors along state highways: SR 240 between Route 10 (MP 20.48) and Stevens Drive (MP 28.84); SR 240 between Jadwin Avenue (MP 30.63) and the SR 182 off-ramp (MP 34.57); and SR 182 between Dallas Road (MP 0.87) and the I-182 westbound on-ramp from George Washington Way southbound (MP 4.40). The detailed plan can be accessed online at http://www.bfcog.us/transportation.html.

Currently, travel data is not available for these corridors. This made it difficult for WSDOT to develop performance measures similar to the ones analyzed for other urban centers in the state. Upon the availability of private sector speed data, WSDOT hopes to present the Tri-Cities area corridor analysis in the future editions of the annual *Corridor Capacity Report*.

Spokane Area I-90 Corridor Capacity Analysis

Annual person miles traveled			Annual vehicle delay[1]			Annual emissions		
2011 vs.	2013		2011 vs.	2013		2011 vs.	2013	
200.9	226.9	↑ 13%	28.4	35.2	↑ 24%	185.0	182.0	↓ 1.6%
in millions of miles			in thousands of hours			in millions of pounds of CO_2 equivalents		

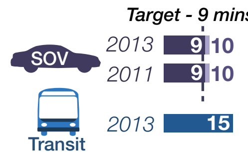
Commute travel times

2011 and 2013; Weekday travel times in minutes at the peak 5-minute interval including average and reliable[2] travel times for single occupant vehicle (SOV) as well as maximum throughput (target) and planned transit[3] travel times.

Average SOV
Reliable SOV
Planned transit time

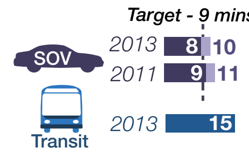
Argonne Rd. to Division St.

Morning; 5-10 a.m.; Trip length 7.5 miles



Division St. to Argonne Rd.

Evening; 2-8 p.m.; Trip length 7.5 miles



Transit system use

2013; For typical weekday morning (6-9 a.m.) and evening (3-6 p.m.) peak periods; Ridership and percent of available seats occupied on select commutes

Corridor-wide[4] ridership

268,000 *transit riders annually*

1.9 million *passenger miles traveled annually*

63% *transit seats occupied on average*

By commute

	Daily peak period riders	Percent of seats occupied
Morning (6-9 a.m.) Argonne to Division	580	57%
Evening (3-6 p.m.) Division to Argonne	446	65%

Park and ride capacity

2013; Parking spaces and average percent occupied for select park and rides (P&R)[5] (see map for locations)

Argonne-Division commute

Park and ride	Spaces	Percent occupied
Liberty Lake P&R (not on map)	165	100%
Mirabeau Point P&R	198	90%
Valley Transit Center	236	78%

See Appendix pp. 32-33 for more commute routes

Data source: WSDOT Eastern Region Planning Office, Spokane Transit Authority, and WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: Measures at the top of the page are for the I-90 corridor in the Spokane area for SOV trips only. 1 WSDOT defines delay as when average speeds are slower than 85% of the posted speed limit. 2 Reliable travel time is the travel time that will get a commuter to their destination on time or early 19 out of 20 weekdays, or 95% of the time. 3 Transit travel times by bus include off-highway travel to stops and may not be comparable to SOV/HOV times which are highway only. 4 Peak period corridor-wide ridership includes trips on all I-90 Spokane area commutes. 5 For more park and ride information, see http://www.wsdot.wa.gov/choices/parkride.htm.

Interstate 90 (I-90) in the Spokane area is one of the region's key commute and freight corridors. Morning (7-10 a.m.) and evening (3-6 p.m.) commutes experience moderate congestion during weekdays. Annual per person hours of delay along the I-90 corridor increased 9.8% from 19.8 minutes in 2011 to 21.4 minutes in 2013. Person-miles traveled along the I-90 corridor increased 13% while all-day emissions decreased 1.6%.

I-90 corridor productivity analysis

Highway productivity: As traffic increases, roads are able to carry fewer vehicles, resulting in a drop in productivity at speeds slower than maximum throughput speed. In order to gauge lost vehicle productivity along the I-90 corridor in the Spokane area, traffic throughput rates were analyzed at three locations near Freya Street, Custer Road and Fancher Road.

For example, I-90 at Fancher Road in the westbound direction saw a productivity loss of 49% at 8 a.m., meaning that almost half of the roadway's capacity was unavailable due to congestion (see graph on p. 40). In 2011, this location lost 24% of its capacity due to congestion. The graphs on the next page show how throughput productivity can vary by time of day and direction of travel. The table on p. 40 provides data on the productivity losses at sample locations by direction to illustrate the opportunities to maximize system capacity.

Transit, park and ride helps improve person throughput

Transit capacity: In 2013, the average transit ridership along this six-mile stretch of I-90 in Spokane was about 580 daily riders during the westbound morning commute (57% of available capacity), and 446 for eastbound evening trips (65% of capacity). As a result, 4,425 solo vehicle miles of travel were avoided and 3,244 pounds of carbon dioxide equivalents (CO_2e) were eliminated on a daily basis along the I-90 corridor in the Spokane area.

During the morning and evening peak periods, the Spokane Transit Authority deployed on average 82% of its fleet, helping reduce vehicle miles traveled and greenhouse gas emissions.

Park and ride capacity: Availability of park and ride (P&R) locations within the transit service network is integral to ridership. Park and ride locations need to have enough parking spaces to accommodate demand. Along the I-90 corridor between Argonne Road and Division Street, the Liberty Lake, Valley Transit Center and Mirabeau Point P&R lots recorded between 78% and 100% use. For example, the Liberty Lake and Mirabeau locations operated at more than 90% capacity with 363 total spaces. Valley Transit Center P&R recorded 78% utilization of 236 spaces (see map on p. 39).

Capacity constraints along I-90 corridor

Congestion occurred routinely along the I-90 westbound morning commute near Custer and Fancher Roads. These congested segments extended for about half a mile and lasted for 15 minutes. During the eastbound evening commute along I-90 near Freya Street, congestion extended for about a half-mile and lasted for 25 minutes.

Commute trip average travel times improve for evening commuters

Between 2011 and 2013, average travel time remained steady for morning eastbound and westbound traffic. In the evening, travel times improved in both directions by about 1 or 2 minutes. Reliable travel times changed by a minute or less, with slight improvements in the evening in each direction.

Vehicle throughput along I-90 variable near Spokane
2011 and 2013; Maximum loss of vehicle throughput by commute direction

Location	Direction	Loss in 2011	Loss in 2013	Change
I-90 at Freya Street (MP 283.79)	Eastbound	18%	16%	-2%
	Westbound	0%	0%	0%
I-90 at Custer Road (MP 284.59)	Eastbound	0%	0%	0%
	Westbound	16%	13%	-3%
I-90 at Fancher Road (MP 285.26)	Eastbound	0%	0%	0%
	Westbound	24%	49%	25%

Data source: WSDOT Eastern Region Planning Office.
Note: Negative values indicate vehicle throughput improved in from 2011 to 2013.

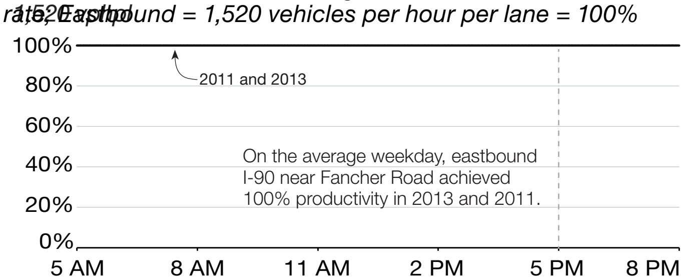
The commute routes along I-90 through the Spokane area do not routinely experience travel conditions with average speeds slower than 45 mph, the threshold for congestion. However, these routes did experience congestion occasionally. During the morning peak period in either direction, there was up to a 7% chance of experiencing congestion. For evening commutes, travelers were less likely to experience congestion in 2013 than in 2011.

Greenhouse gas emissions decrease

All-day greenhouse gas emissions from vehicles along the I-90 corridor between Division and Argonne amounted to 697,000 pounds of carbon dioxide equivalents (CO_2e) daily in 2013, down 1.6% from daily emissions in 2011. Improved vehicle efficiency and faster travel speeds in 2013 could be key factors behind this improvement. See Appendix p. 32 for the emissions per person, per trip along the I-90 Spokane area commutes.

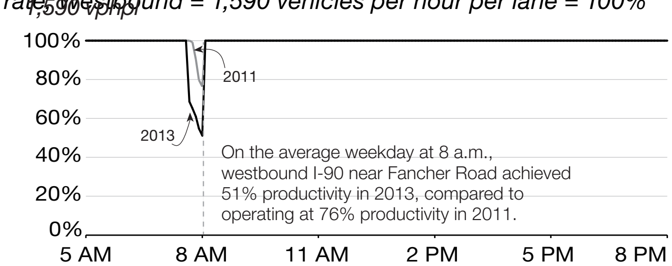
See Appendix pp. 31-32 for corridor performance data.

Throughput along eastbound I-90 near Fancher Road (MP 285.26) in the Spokane area
2011 and 2013; Based on the highest observed 5-minute flow rate; Eastbound = 1,520 vehicles per hour per lane = 100%



Data source: WSDOT Eastern Region Planning Office.

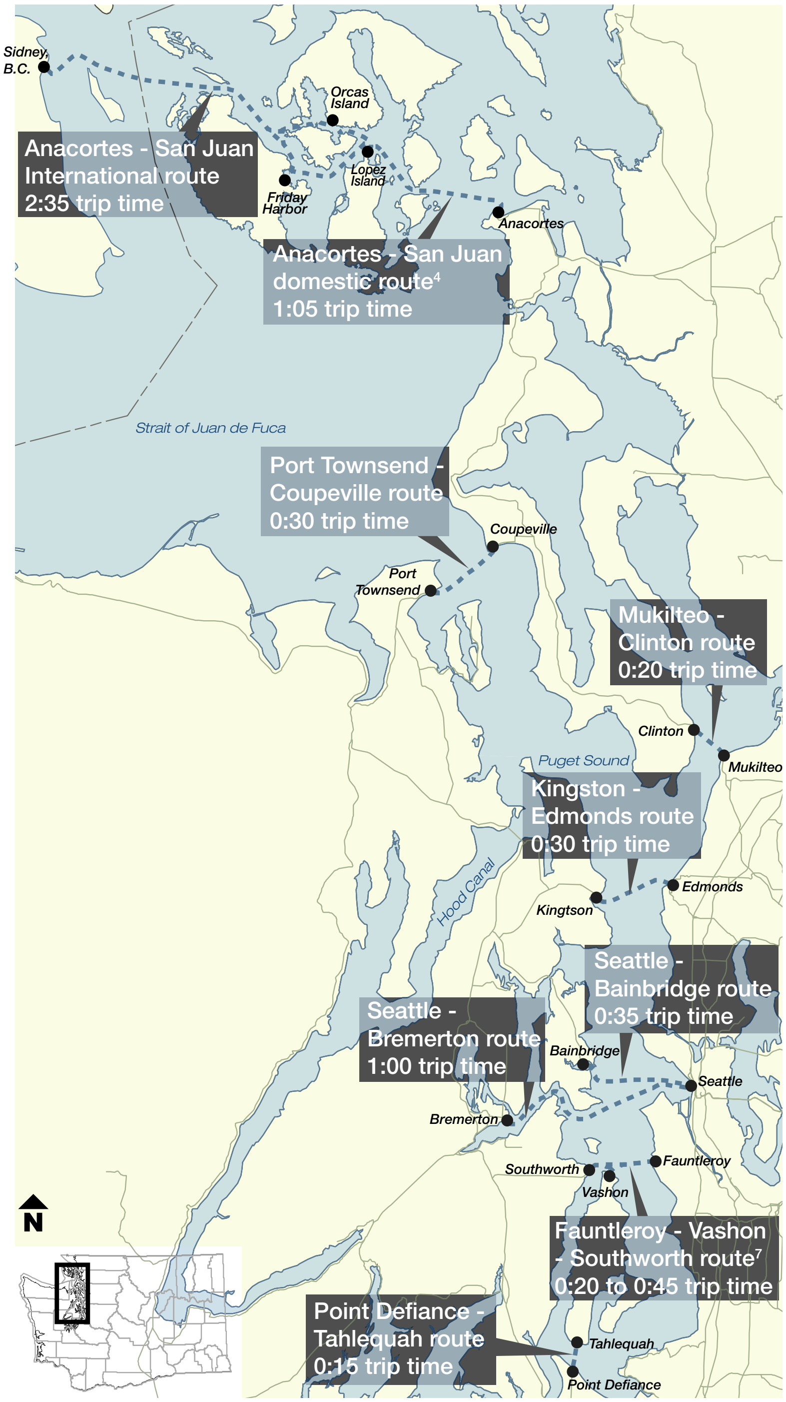
Throughput along westbound I-90 near Fancher Road (MP 285.26) in the Spokane area
2011 and 2013; Based on the highest observed 5-minute flow rate; Westbound = 1,590 vehicles per hour per lane = 100%



Data source: WSDOT Eastern Region Planning Office.

Capacity and Trip Analysis for Washington's Marine Highways

Annual ridership[1]			Annual trip reliability[2]			Annual fuel usage + use per service mile				
2011 vs.	2013		2011 vs.	2013		2011 vs.	2013		2011 vs.	2013
22.23	22.54	1%	99.5%	99.5%	0.0%	17.46	17.27	1% 1%	19.25	19.03
in millions of passengers and vehicles drivers			of scheduled trips sailed			in millions of gallons			in gallons per mile	



Ferry capacity utilization[3]

2013; Capacity in number of car spaces available and passengers allowed per route based on vessels that served the route; Utilization in percent of annual capacity used for all sailings average for all days of the week at all times of day and night

Ferry route

Route	Drivers + passengers	Vehicles	Number of trips
Anacortes - San Juan domestic[4]	10%	54%	26,801
Anacortes - San Juan - Sidney, B.C.	18%	57%	728
Edmonds - Kingston	10%	65%	17,142
Fauntleroy - Vashon - Southworth[5]	9%	64%	40,917
Mukilteo - Clinton	12%	68%	26,753
Point Defiance - Tahlequah	7%	47%	13,827
Port Townsend - Coupeville	11%	65%	8,484
Seattle - Bainbridge	15%	61%	16,527
Seattle - Bremerton	13%	43%	10,853
System-wide	**12%**	**60%**	**162,032**

On time[6] performance by route

2011 and 2013; Annual percent of trips that departed on time; Goal: 95% of trips depart on time annually

Ferry route

Route	2011	2013	Δ
Anacortes - San Juan domestic[4]	90.9%	91.4%	0.5%
Anacortes - San Juan - Sidney, B.C.	85.0%	88.7%	3.7%
Edmonds - Kingston	98.2%	99.3%	1.1%
Fauntleroy - Vashon - Southworth	96.4%	93.9%	-2.5%
Mukilteo - Clinton	98.5%	99.1%	0.6%
Point Defiance - Tahlequah	97.1%	99.1%	2.0%
Port Townsend - Coupeville	88.3%	92.9%	4.6%
Seattle - Bainbridge	94.8%	95.3%	0.5%
Seattle - Bremerton	96.8%	96.6%	-0.2%
System-wide	**95.5%**	**95.6%**	**0.1%**

Ridership by route

2011 and 2013 annual ridership in thousands

Ferry route

Route	2011	2013	Δ
Anacortes - San Juan domestic[4]	1,728	1,802	4%
Anacortes - San Juan - Sidney, B.C.	135	142	5%
Edmonds - Kingston	3,877	3,855	-1%
Fauntleroy - Vashon - Southworth	2,936	2,907	-1%
Mukilteo - Clinton	3,780	3,907	3%
Point Defiance - Tahlequah	644	682	6%
Port Townsend - Coupeville	662	679	3%
Seattle - Bainbridge	6,106	6,270	3%
Seattle - Bremerton	2,362	2,293	-3%
System-wide	**22,230**	**22,537**	**1%**

Data source: WSDOT Ferries Division.

Notes: 1 Passenger ridership includes vehicle drivers and passengers, as well as walk-on passengers and bicyclists. 2 Trip reliability is the ratio of actual sailings compared to the number of scheduled sailings. 3 Route capacity includes the cumulative capacity on all vessels serving that route. 4 Data for the San Juan inter-island route is combined with the San Juan domestic route, and route utilization is measured at Anacortes. 5 Route utilization for the Fauntleroy - Vashon - Southworth "triangle route" is measured at Fauntleroy. 6 A vessel is considered on time if it departs within 10 minutes of its scheduled departure. 7 Some trips are direct between two locations (with shorter trip times) and others serve all three locations.

On average, 60% of vehicle capacity on ferries is used

WSDOT's ferry service routes function as marine highways in Washington state. They are integral links across the Puget Sound, connecting island and peninsula communities with the major employment centers on the mainland.

Annual ridership increased 1%, with about 202,000 more passengers and 105,000 more vehicles in 2013 than in 2011. The annual trip reliability changed less than 1% in that timeframe, and in both years met the system wide goal of completing at least 99% of scheduled sailings. Fuel use is related to the number of sailings, the type and size of vessel, and route characteristics. Between 2011 and 2013, ferry vessel fuel use decreased 1%.

Marine highway corridor analysis:

Ridership by route: Ridership increased on six routes by 3% to 6% between 2011 and 2013. The largest ridership increase was on the Point Defiance – Tahlequah route, which was restored to two-boat service in July 2011. The Anacortes – San Juan Islands route made 30 fewer trips (4% fewer), but ridership still increased 4%. This is likely due to the limited transportation options between the islands and from the islands to the mainland. The Seattle – Bremerton route showed a 3% decrease in ridership in the two-year period.

Ferry route capacity: WSDOT owns and operates 23 ferry vessels - the newest in the fleet Motor/Vessel (M/V) *Tokitae* was launched in June 2014. These vessels serve nine routes with stops at 19 ferry terminals in Washington and one in Sidney, British Columbia (B.C.). Seven of the nine ferry routes are served by at least two vessels, operating simultaneously in order to keep terminal wait times low. The route capacity is defined as the cumulative passenger and vehicle capacities for all sailings of each vessel serving a particular route.

During the peak summer season, three vessels serve as maintenance spares, ready to replace a vessel that is taken out of service for planned or emergency maintenance. The replacement vessels may have a reduced capacity compared to those typically serving a route. Another capacity constraint relates to staffing. The U.S. Coast Guard sets the number of crew required onboard each vessel in order to sail. Some of the larger vessels can operate with fewer crew members during off-peak sailings by closing the upper level passenger decks to reduce passenger capacity. These scenarios illustrate that the capacity on a route may fluctuate.

Capacity utilization: WSDOT is for the first time reporting ferry route utilization based on ridership and vessel capacity for 2011 and 2013. These statistics reflect utilization for all sailings over the entire day, not peak period utilization similar to the measurement approach used for most other transportation modes. In 2013, the utilization of vehicle spaces on all ferry service trips averaged 60%, the same as in 2011. Vehicle space utilization on individual ferry routes ranged between 43% (between Seattle and Bremerton) and 68% (between Mukilteo and Clinton) in 2013.

Because ferry vessels are capable of carrying many more passengers than vehicles, the utilization rates are lower, ranging from 7% (between Point Defiance and Tahlequah) to 18% (between Canada and the U.S.) of the available capacity.

Between 2011 and 2013, passenger capacity utilization varied no more than one percentage point for all routes. Vehicle capacity utilization changed two percentage points or less for all ferry routes except the U.S. – Canada route (increased five percentage points), and the Point Defiance – Tahlequah route (decreased eight percentage points). In January 2012, the M/V *Chetzemoka* replaced the M/V *Rhododendron*, increasing the capacity on the Point Defiance – Tahlequah route by 33%, resulting in a smaller utilization rate.

On-time performance: There were more than 159,500 sailings in 2013, an impressive average of 437 sailings every day of the year. In 2013, 95.6% departed within 10 minutes of their scheduled departure, meeting WSDOT's annual system wide goal of at least 95%. On eight routes, on-time performance held steady or improved up to five percentage points from 2011 to 2013. The maximum improvement was on the Port Townsend – Coupeville (Keystone) route. A second vessel was added in July 2011, bringing on-time performance in 2013 to 92.9%. The second vessel reduced delays from heavy traffic. The on-time performance declined on the Fauntleroy – Vashon – Southworth route by 2% to 93.9%, due in part to vessel mechanical and crewing challenges during the busy summer months. Two other routes did not meet WSDOT's system wide goal for on time performance.

Reliability: Trip reliability changed less than one percentage point between 2011 and 2013 for all ferry routes, and eight of the nine routes met or exceeded the system wide goal of completing at least 99% of scheduled sailings. On the Port Townsend – Coupeville route the trip reliability worsened from 96.6% to 95.8% in this time frame, meaning that 97 fewer scheduled trips were completed on this route in 2013 than in 2011.

See Appendix p. 34 for more ferry performance data.

Performance Based Transportation System Management

Federal law emphasizes system performance

The Moving Ahead for Progress in the 21st Century (MAP-21) federal legislation is intended to increase the transparency and accountability of states in their investment of taxpayer dollars in transportation infrastructure and services nationwide, and ensure states invest money in transportation projects that collectively make progress toward achieving national transportation goals. The MAP-21 law sets performance measure requirements for states in various areas, including air quality and system performance. The national MAP-21 goals are:

- Improve safety
- Maintain and improve infrastructure condition
- Reduce congestion
- Improve system reliability
- Support freight movement and economic vitality
- Ensure environmental sustainability
- Reduce project delivery delays

WSDOT has proactively worked with the American Association of State Highway and Transportation Officials (AASHTO) and the U.S. Department of Transportation to propose performance measures for MAP-21. Federal rule-making will determine performance measures for several areas, including freight movement and congestion-related measures; states will set targets within one year of final rule-making. For more information about the current status for MAP-21, see *Gray Notebook* 54, p. vi.

Results Washington focuses on performance and accountability

Gov. Jay Inslee introduced Washington state's new performance management system, Results Washington, in September 2013, outlining his priorities for the state. The Governor's plan focuses on key goals that strive to strengthen the economy, protect the environment, and make Washington an ideal place to live and do business.

WSDOT manages performance measures related to sustainable, efficient infrastructure, which falls within the prosperous economy goal area. These performance measures include increasing the percent of commuters using transportation modes other than driving alone, improving travel and freight reliability, maximizing the capacity of strategic corridors, and reducing pedestrian and bicyclist fatalities.

Gov. Jay Inslee's performance management system Results Washington has five goals. Goal 2 is for a prosperous economy, which is built upon sustainable, efficient infrastructure.

WSDOT also has an interest in the clean transportation measures that fall under the sustainable energy and a clean environment goal area. These performance measures include reducing transportation-related greenhouse gas (GHG) emissions, reducing average GHG emissions for each vehicle mile traveled in Washington, improving the fuel efficiency of Washington's passenger vehicle and light duty truck fleet, and increasing the number of plug-in electric vehicles registered in the state. For more information about Results Washington, see http://www.results.wa.gov/.

Results WSDOT sets the agency's direction and priorities

Results WSDOT, the agency's strategic plan for 2014-2017, aligns with Results Washington. It differs from the agency's previous plan in that it focuses on maximizing capacity for the entire multimodal system, emphasizes working across all modes, and strives to provide and support safe, reliable and cost-effective transportation options to improve livable communities and economic vitality for people and businesses. The 2014 *Corridor Capacity Report* was created to help inform WSDOT policy makers, planners and engineers as they examine opportunities for maximizing multimodal capacity, supporting Results WSDOT's emphasis on innovation through Practical Solutions and performance based planning initiatives. For more information on Results WSDOT, see http://www.wsdot.wa.gov/Secretary/ResultsWSDOT.htm.

Smarter Highway Operations

Active Traffic Management helps drivers avoid collisions

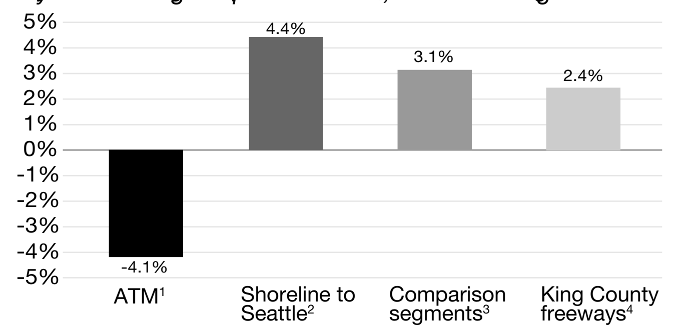
WSDOT has concluded the six-year Before and After review of collision trends within the I-5 Active Traffic Management (ATM) corridor along northbound I-5 from the SR 900 interchange near Boeing Field (MP 157.2) to exit 165 in downtown Seattle. WSDOT compared the frequency of collisions occurring within the project limits during the three years prior to ATM activation to those occurring in the three years that followed. This analysis revealed a 1.3% improvement (reduction) in weekday collisions, while weekends experienced a 14% improvement. WSDOT hypothesizes that the ability of ATM to provide real-time information to drivers who may be unfamiliar with typical area traffic conditions accounts for the larger weekend reductions.

Between 2007 and 2013, changes in travel patterns and driver behavior made it difficult to draw conclusions from simple comparisons of traffic volumes alone. Changes in driving habits due to the recession, shifts in economic development, the opening of the Central Link light rail line, and the effects of SR 520 tolling all had the potential to alter driver behavior. To account for these types of changes over time, WSDOT measured the test segment against other area roadway sections carrying comparable traffic volumes, as well as against freeways in King County as a whole. This helped control for potential influencing factors while providing insight into how the project influenced collision frequency.

The ATM corridor was compared to three freeway groupings: southbound I-5 from Shoreline to downtown Seattle; I-5 comparison segments (noted in the graph below); and all King County freeways collectively. These sections saw collision rates increase between 2.4% and 4.4% using the six-year comparison. Conversely, during the same period, the ATM section saw collisions drop 4.1%. These trends are illustrated in the graph below.

Although similar ATM systems were installed along the I-90 and SR 520 corridors, their effectiveness was not evaluated due to the direct influence of tolling-related volume shifts starting in 2011 (see p. 20), and ongoing construction along both corridors during the study period.

Collision reduction evident on the I-5 corridor following installation of Active Traffic Management
July 2007 through September 2013; Percent change in collisions



Data source: WSDOT Northwest Region Traffic Office.
Notes: Values represent total percent change in number of collisions.
1 Active Traffic Management (ATM) corridor includes northbound (NB) I-5 from from milepost (MP) 157.2 to 165.5. 2 Shoreline to Seattle includes southbound (SB) I-5 from MP 174.6 to 166.3. 3 Comparison segments include NB I-5 from MP 165.5 to 180.6 and SB I-5 from MP 180.6 to 157.2. 4 King County freeways include segments of I-5, I-90, I-405, SR 167 and SR 520.

WSDOT's Intelligent Transportation System (ITS) inventory continues to grow
Statewide inventory as of July 7, 2014

Type of device	2008	2009	2010	2011	2012	2013	2014	Approximate cost per device
Closed circuit television (CCTV) camera[1]	542	555	699	746	850	933	1,040	$15,000 - $30,000
Variable message signs (VMS)[1]	181	188	201	258	232	279	293	$100,000 - $250,000
Highway advisory radio transmitters (HART)[2]	68	70	82	88	83	86	86	$50,000
Road/weather information system	97	100	105	106	106	109	109	$25,000 - $50,000
Metered ramps	137	143	154	155	149	150	169	$10,000 - $20,000[3]
Traffic data stations[4]	554	565	639	660	742	767	816	$10,000 - $20,000
Active Traffic Management gantries[5]	0	25	53	56	56	56	56	$650,000 - $900,000

Data source: WSDOT Signal Maintenance Management System (SIMMS) database.
Notes: 1 Figures include devices that are owned by WSDOT. 2 The count of highway advisory radio transmitters (HART) in 2010 includes nine portable devices that are not include in the counts for other years. 3 This represents the cost of one ramp meter device; there may be multiple ramp meters on one ramp. 4 The number of data stations includes those operated by the WSDOT Transportation Data and GIS Office. 5 The majority increase in the numbers of CCTV, VMS, traffic data stations are a direct result of the installation of the automated traffic management system structures. While each structure is separate, the data collection as well as the data informational signing cannot be attributed to a specific structure unless actually installed upon it as they work together to form the system. The individual devices installed upon each gantry are not delineated here. All of the gantries are now installed and operational.

WSDOT teams keep traffic moving at 43,088 incidents

Incident Response (IR), WSDOT's traffic incident management program, responded to 43,088 incidents in 2013, clearing scenes to get traffic moving in an average of 12.7 minutes. WSDOT's assistance provided approximately $67.4 million in estimated economic benefit to travelers and businesses in Washington by reducing incident-induced congestion and helping prevent secondary incidents. WSDOT's annual IR budget was $4.5 million in 2013, meaning the program provided an estimated $15 benefit for every dollar spent on traffic incident management.

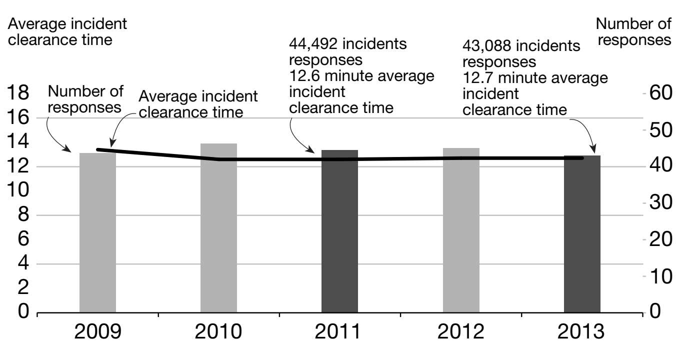
Incident clearance times are down over the long-term

WSDOT's IR teams cleared incidents in an average of 12.7 minutes in 2013. This is the same clearance time teams achieved in 2012. The average incident clearance time is roughly 42 seconds faster than in 2009. In general, faster clearance times mean less incident-induced congestion and fewer secondary collisions.

WSDOT prevents $67.4 million in delay and secondary collisions

WSDOT estimates that IR crews' proactive management of incident scenes provided an economic benefit of $67.4 million to travelers and businesses using Washington highways in 2013. These benefits are provided in two ways.

Incident clearance times remain below 13 minutes during past four years, total incidents down slightly
2009 through 2013; Clearance time in minutes; Number of incident responses in thousands



Data source: Washington Incident Tracking System.

Note: Data only includes incidents to which a WSDOT Incident Response team responded.

Traffic incident management is a key strategy for maximizing highway system performance

Traffic incidents such as collisions are responsible for nearly half of non-recurrent congestion (traffic congestion caused by one-time events). Non-recurrent congestion can also be caused by severe weather or large events like the 2013 Super Bowl parade in downtown Seattle. These events temporarily reduce the transportation system's ability to move people and goods. Traffic incident management is nationally recognized as a best practice for reducing or preventing non-recurrent congestion.

The mission of WSDOT's Incident Response program is to clear traffic incidents safely and quickly, minimizing congestion and the risk of secondary collisions. The program is active in all six WSDOT regions with about 80 trained IR drivers and 62 dedicated vehicles. Teams patrol 493 centerline miles of state highway on major corridors during peak traffic hours and assist the Washington State Patrol in traffic emergencies at all hours.

First, by clearing incidents as quickly as possible, WSDOT crews reduce the time and fuel motorists would have wasted in incident-induced congestion. In 2013, WSDOT estimates that IR crews prevented about $37.6 million in incident-related congestion costs. Second, by proactively managing traffic at incident scenes, IR crews reduce the risk of secondary incidents caused by distracted driving or sudden changes in traffic conditions. WSDOT crews prevented an estimated 8,228 secondary collisions in 2013, resulting in $29.8 million of economic benefit. See WSDOT's *Handbook for Corridor Capacity Evaluation* pp. 40-42 for delay reduction benefit calculations as well as all other IR related metrics.

A WSDOT's Incident Response crew directs traffic at the scene of an incident, helping all drivers and emergency response personnel stay safe.

WSDOT responded to 43,088 incidents in 2013

WSDOT teams' performance at incidents in 2013 prevented $67.4 million in incident-related costs
2013; Incidents by duration; Time in minutes; Cost and economic benefit in dollars

Incident type	Number of incidents	Average IR response time[1]	Average *roadway* clearance time	Average *incident* clearance time	Incident-induced delay costs	Estimated economic benefits from IR program[2]
Incident duration less than 15 minutes						
Blocking[3]	5,024	1.9	4.7	6.6	$10,248,225	$4,261,182
Non-blocking	27,757	0.3	-	5.0	$32,482,500	$15,735,375
Total[4]	**32,781**	**0.5**	**4.7**	**5.2**	**$42,730,725**	**$19,996,557**
Incident duration 15 to 90 minutes						
Blocking[3]	4,091	9.0	24.8	32.9	$44,357,340	$18,443,653
Non-blocking	5,710	7.0	-	27.0	$35,279,960	$17,090,538
Total[4]	**9,801**	**7.8**	**24.8**	**29.5**	**$79,637,300**	**$35,534,191**
Incident duration over 90 minutes						
Blocking[3]	401	21.3	150.5	174.9	$24,081,000	$10,012,810
Non-Blocking	105	30.1	-	153.8	$3,828,604	$1,854,676
Total[4]	**506**	**23.1**	**150.5**	**170.6**	**$27,909,604**	**$11,867,486**
Grand Total[4]	**43,088**	**2.4**	**19.7**	**12.7**	**$150,277,629**	**$67,398,235**

Data source: Washington Incident Tracking System, Washington State Patrol, WSDOT Traffic Office, and Washington State Transportation Center (TRAC) at the University of Washington.
Notes: 1 A majority of incidents that WSDOT teams respond to are "roved" upon, meaning the team spots the incident while on patrol and thus is present at the scene when the first recordable awareness occurs. This makes average response times, especially for shorter incidents, very small. 2 Economic benefits include the sum of benefits from saved time, gas and secondary incidents avoided due to IR teams' proactive work. Numbers may not add due to rounding. 3 An incident is defined as blocking when it closes down at least one lane of travel on the road. 4 IR teams were unable to locate (UTL) 1,950 of the 43,088 incidents they responded to, generally because the incident cleared while the IR team was en route. UTL incidents are included in the total number of incidents but not figured into clearance times or benefits calculations.

Incidents cause estimated $150 million in congestion-related costs

Traffic delay that occurred at the 43,088 incidents to which WSDOT teams responded in 2013 cost travelers on Washington highways an estimated $150.3 million. This is 7% less than the $161.6 million in costs that occurred in 2011. Without the work of WSDOT's IR crews, this cost would have been $187.9 million ($37.6 million in prevented delay costs plus $150.3 million in actual delay costs).

Blocking incidents make up less than a quarter of all incidents, half of delay

About 22% of the incidents that WSDOT's IR teams responded to in 2013 blocked at least one lane of traffic (9,516 out of the 43,088 total incidents for the year). These blocking incidents caused 52% of the incident-related congestion costs for the year.

Blocking incidents have been found to cause more congestion per minute of incident than non-blocking incidents. Also, blocking incidents tend to last longer (see the incident duration column in the table above) as they are more complicated to clear.

Major Incident Tow helps clear most severe blocking incidents

WSDOT activated the Major Incident Tow (MIT) program 19 times in 2013, costing a total of $48,586. Seventeen out of the 19 activations were successful, meaning the incidents were cleared within 90 minutes of the notice to proceed. There have been a total of 120 MIT activations since 2007, costing $271,259 as of 2013.

The MIT program was created to help clear incidents involving heavy vehicles that are blocking the road. Heavy vehicles, generally semitrucks, are involved in about 5% of all incidents but account for 25% to 30% of incidents that take more than 90 minutes to clear.

Customer feedback: Incident Response program is a life saver

WSDOT drivers give comment cards to motorists who receive assistance. Below are comments the program received in 2013.

- *We were trying to change our tire with four kids on a small shoulder and thank god John showed up to help.*
- *You saved our lives on the center divider. Thank you!*
- *A comfort to know you are out there. Thanks.*

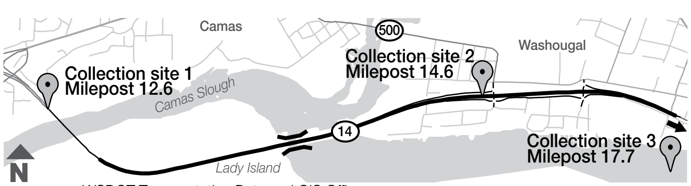
New capacity improves traffic flow on SR 14

In February 2013, the State Route (SR) 14/Camas Washougal — Add Lanes and Build Interchange project opened to traffic. Results from WSDOT's evaluation show the new capacity and redesigned interchanges reduced collisions by 29%, facilitated up to 40% more traffic and increased average traffic speeds during the morning (7-11 a.m.) and evening (1-5 p.m.) commutes close to the 55 mph posted speed limit.

The $49 million project, funded by the Transportation Partnership Program, added an extra lane in each direction to SR 14 between its intersections with Northwest 6th Avenue in Camas and 45th Street in Washougal (see map below). WSDOT constructed a new bridge next to the existing one at the east end of Lady Island to accommodate the new lanes. The agency also raised the highway 25 feet and reconfigured the SR 14 intersections with Southeast Union Street (SR 500) and Port Street in Washougal. These improvements replaced two signalized intersections with entrance/exit ramps and roundabouts, smoothing traffic flow and improving safety for drivers on both the highway and local streets.

Preliminary data shows reduction in collisions after SR 14 project

Before construction, SR 14 in the vicinity of Camas and Washougal was a two lane, high-speed highway. The corridor had multiple intersections with local streets (some signalized and others not), which slowed traffic. The area also had a history of traffic incidents, occurring primarily at the intersections. During the three years before construction an average of 41 collisions occurred annually within the project limits. During the one year after construction only 29 collisions occurred, which is a 29% reduction compared to the average number of collisions per year before project completion.



Data source: WSDOT Transportation Data and GIS Office.

WSDOT's State Route 14 project near Camas and Washougal improved traffic flow and safety by adding an extra lane in each direction and replacing signalized intersections with ramps and traffic circles.

Project Improvements
New bridge
Redesigned interchanges
Lanes added
Data collection site

Better traffic flow improves peak period speeds for all commutes

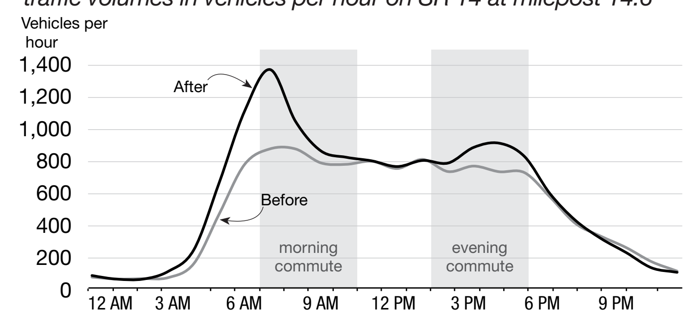
After WSDOT completed the project, traffic speeds increased on all four commutes within the construction limits. On average, speeds improved 9.2 mph; the largest increase was 14.9 mph (see table below). This allowed for greater vehicle throughput, particularly during commute periods (see graph below).

The commutes were between the eastern edge of construction at the SR 14 and Northwest 6th Avenue interchange in Camas to the intersections with 45th Street and SR 500, respectively. The agency measured speed, travel times and traffic volumes in August 2009, before the anticipated start of construction, and in September 2013, after the improved section opened to traffic.

See Appendix p. 35 for more before and after data.

State Route 14 westbound traffic volumes at Union Street increases 40% during morning commute
August 2009 (before) and September 2013 (after); Westbound traffic volumes in vehicles per hour on SR 14 at milepost 14.6

Westbound traffic volumes on SR 14 at Union Street increase 40% during morning commute
August 2009 (before) and September 2013 (after); Westbound traffic volumes in vehicles per hour on SR 14 at milepost 14.6



Data source: WSDOT Transportation Data and GIS office.

Commute speeds on SR 14 improve after WSDOT widens highway and upgrades intersections
August 2009 (before) and September 2013 (after); Average traffic speed in miles per hour; Speed limit = 55 mph

Commute	Peak period[1]	Direction	Average speed Before	After	Δ
45th St. to NW 6th Ave.	Morning	Westbound	47.0	52.9	5.9
SR 500 to NW 6th Ave.	Morning	Westbound	45.0	55.3	10.3
NW 6th Ave. to 45th St.	Evening	Eastbound	50.3	55.9	5.6
NW 6th Ave. to SR 500	Evening	Eastbound	39.4	54.3	14.9

Data source: WSDOT Transportation Data and GIS Office.
Note: 1 Morning commute was 7-11 a.m. and evening was 1-5 p.m.

Table of Tables and Graphs

Americans with Disabilities Act information

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WSDOT's 2014 *Corridor Capacity Report* is prepared by the
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