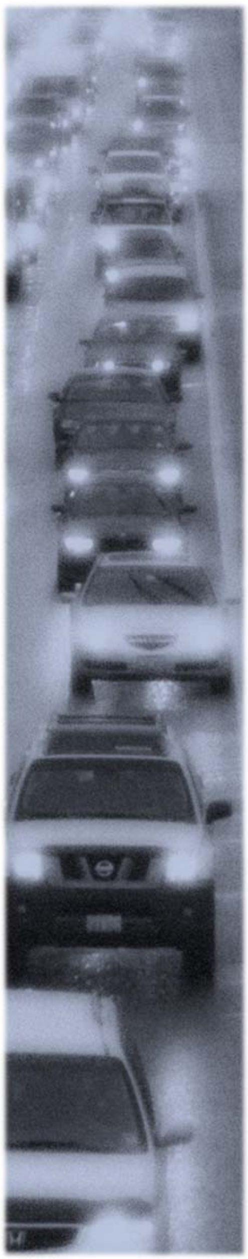
Chapter 2: System Monitoring



Chapter 2 contains a narrative and visual display of the system performance measures contained in the Congestion Management Process.

System monitoring is described in two sections. The first, **System Performance Measures**, consists of data compiled for measuring system performance at the corridor level. It is comprised of data that supports the analysis of the Congestion Management System. The second, **Areas of Concern**, uses shorter segment transportation data, with supporting data[8] provided online, to identify specific segments with congestion concerns related to volume-to-capacity ratio and speed.

There are many causes of traffic congestion including bottlenecks, traffic incidents, bad weather, construction, poor signal timing, and other events. The source of congestion can vary from one corridor to another, such that the strategies to improve capacity must be tailored to each corridor.

This report measures and quantifies average weekday morning and evening peak period "congestion" consistently across the congestion management corridors, through the use of performance measures.

System Performance Measures

Volumes: Vehicle Volumes

AM and PM peak hour vehicle volumes were compiled from the regional traffic count database[9]. Volumes represent traffic counts within each corridor and provide a good comparison of the relative difference in travel demand among the congestion management corridors.

Peak hour traffic volumes for the congestion management corridors are delineated by four volume range categories. These categories are intended to provide a regional picture of travel flows for the Clark County region.

PM peak hour trends are similar to AM peak hour; although, most congestion management corridors carry higher volumes during the PM Peak.

Map 4 (Page 30): During the PM peak, I-5 and I-205 and of SR-14 west of 164th Avenue display volumes greater than 3,000 vehicles per hour. Within the region,

[8] *http://www.rtc.wa.gov/programss/cmp/*
[9] *http://www.rtc.wa.gov/data/traffic/*

AM and PM peak hour vehicle volumes were compiled from the regional traffic count database.

facilities carrying more than 1,500 vehicles in the PM peak hour include segments of SR-14, SR-500, SR-503, Mill Plain, Fourth Plain, Padden Parkway, Andresen Road, 112th Avenue, 164th Avenue, and 192nd Avenue.

Volumes: Highest Volume Intersections

Table 3 displays the highest volume intersections in 2015 based on the total number of vehicles entering an intersection on an average weekday. At-grade intersections along SR-500, Mill Plain, SR-503, and Padden Parkway dominate the list.

Table 3: Highest Volume Intersections

Rank	East/West	North/South	Volume
1	Mill Plain	Chkalov Drive	79,000
2	Fourth Plain	SR-500	72,000
3	SR-500	54th Avenue	62,000
4	Mill Plain	136th Avenue	61,000
5	SR-500	42nd Avenue	58,000
6	Fourth Plain	Andresen Road	58,000
7	Padden Parkway	SR-503	57,000
8	78th Street	Highway 99	54,000
9	Padden Parkway	Andresen Road	53,000
10	Mill Plain	120th Avenue	51,000
11	Mill Plain	164th Avenue	51,000
12	Mill Plain	NE 117th Avenue	51,000
13	134th Street	20th Avenue / Hwy 99	51,000
14	SR-502	SR-503	50,000
15	McGillivray Blvd.	SE 164th Avenue	49,000

The Interstate Bridge reached capacity during peak hours in the early 1990s.

Volumes: Columbia River Bridge Volumes

A good indicator of change in bi-state travel is the number of vehicle crossings over the Columbia River bridges (I-5 and I-205) between Washington and Oregon. Table 4 shows the historical growth in Columbia River bridge crossings since 1980.

The Interstate Bridge (I-5) carried approximately 33,500 vehicles a day in 1961. Volumes had increased to over 108,000 vehicles a day by 1980. With the opening of the Glenn Jackson Bridge (I-205) in late-1982, total Columbia River crossings had increased to 144,000 vehicles a day by 1985. By 1995, total river crossings had more than doubled compared to 1980 with 222,700 crossings. Glenn Jackson Bridge traffic volumes began to exceed Interstate Bridge traffic volumes on a daily basis in 1999. Total bridge crossings have declined twice since 1961, in 1974 (oil embargo) and 2006-2008 (recession). The Glenn Jackson Bridge had its first vehicle volume decline ever in 2008. Currently total Columbia River crossing are nearing 300,000 vehicles a day.

Both Columbia River bridges are suffering daily congestion during morning and evening peak periods. The Interstate Bridge had reached capacity during peak hours in the early-1990s, and the Glenn Jackson Bridge in the mid-2000s. With both Columbia River bridges reaching capacity in the morning and evening peak periods, peak spreading has occurred. Peak spreading leads to a flattening and longer peak period as trips shift to times immediately before and after the peak demand. The impact of this type of congestion means that the peak hour becomes a peak period that can last three or more hours. The ongoing growth in all-day bridge crossings is now occurring during non-peak periods.

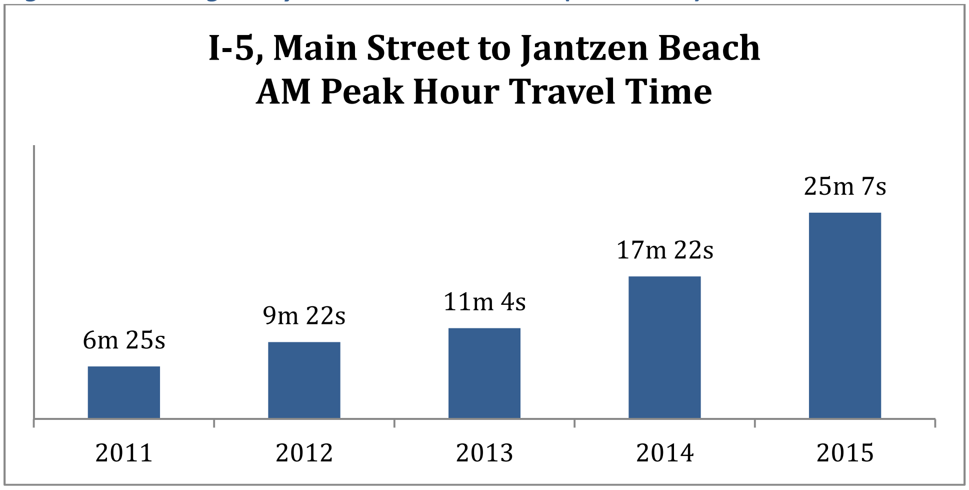
Table 4: Average Weekday Traffic across the Columbia River

Year	I-5	I-205	Total
1980	108,600	N/A	108,600
1985	91,400	52,600	144,000
1990	95,400	87,100	182,500
1995	116,600	106,100	222,700
2000	126,900	132,100	259,000
2005	132,600	145,900	278,500
2010	126,700	145,500	272,200
2015	135,696	158,409	294,105

The I-5 Interstate Bridge is a lift bridge, which is a bottleneck to both auto and river traffic. Bridge lifts occur approximately 15 times per month in off peak periods, with each lift last approximately 10 minutes and often results in over an hour of traffic congestion. Due to peak period congestion, bridge lifts, and other incidents the Interstate Bridge experiences auto congestion five to eight hours a day.

Delay represents the additional travel time experienced due to congestion. The greatest delay within Clark County is experienced on I-5 South, SR-14 approaching I-205, and I-205 South. For example, the AM peak (6:30-8:30 a.m.) drive on I-5 from Main Street to Jantzen Beach Exit (3.63 miles) takes over 25 minutes, which is 18 minutes and 42 seconds longer than it took in 2011. Figure 3 displays the increase morning delay that is occurring in the I-5 corridor. Significant delay also occurs on I-5 and I-205 bridges heading from Oregon into Washington during the evening commute.

Figure 3: Morning Delay on I-5 South Corridor (3.63 miles)



Capacity: Corridor Capacity Ratio

The corridor capacity ratio is an aggregation of the volume/capacity ratios for the individual general-purpose segments that make up a facility within a corridor. The corridor capacity ratio is calculated for both the AM and PM peak hours and for the peak directions of travel within a corridor. For each segment in a corridor, the volume/capacity ratio, vehicle miles traveled, and vehicle miles traveled weighted by volume/capacity ratio (the product of the volume/capacity ratio and vehicle miles traveled) for the peak hour are calculated. The corridor capacity ratio is the sum of the weighted link ratios.

The corridor capacity ratio is an indicator of congestion. The higher the ratio, the more traffic congestion a driver is likely to experience. A facility with a corridor capacity ratio above 0.90 will feel congested. An exception is where a bottleneck causes the demand to exceed capacity. At the bottleneck traffic will slow down and a backup will occur. The result is that fewer vehicles are able to get through the bottleneck, while the corridor capacity ratio appears to improve. This scenario occurs on the I-5 Columbia River Bridge most weekday mornings, where the demand significantly exceeds the capacity.

Corridors with a capacity ratio above 0.90 include the following:

1. I-5: Jantzen Beach to Main Street (AM) – >1.00
2. 18th Street: 112th to 162nd Avenue (PM) – >1.00
3. SR-14: I-205 to 164th Avenue (AM/PM) – >0.90
4. I-205: Airport Way to SR-500 (AM) – >0.90
5. Main Street: Ross Street to Mill Plain (AM) - >0.90
6. Fourth Plain: 117th Avenue to 162nd Avenue (PM) – >0.90
7. SR-500/SR-503: NE 119th Street to Fourth Plain (PM) - >0.90

Figure 4: Highest Volume to Capacity Ratio Corridors

Map 5 (Page 31): The AM periods show congestion along major facilities such as I-5 South, Main Street, I-205 South, and SR-14 Central. Much of the AM period congestion can be attributed to the demand for crossing the two Interstate bridges into Oregon. Generally, the PM period displays higher corridor congestion than that experienced in the AM period.

Map 6 (Page 32): In the PM period, congestion is shown along I-205 South, SR-503 South, SR-14 Central, Fourth Plain East, and 18th Street. In the PM period the interstate bridge limits vehicle flow from Oregon, resulting in low congestion on the Washington side of the Columbia River.

Map 7 (Page 33): In addition to existing corridor capacity ratio, the 2035 PM corridor capacity ratio was calculated using the regional travel forecasting model (2014 RTP forecast model version). The 2035 model shows that the full funding of planned transportation improvements positively impact future corridor capacity.

Speed: Auto Travel Speed

Travel time along arterials is directly connected to delay at signalized intersections.

Travel time data is collected annually. The data is collected using global positioning system (GPS) units and by driving corridors as many times as possible during peak periods (6:30-8:30 AM and 4:00-6:00 PM). Travel speed is computed from the travel time data. It consists of utilizing the travel time and distance to calculate the average travel speed in the peak period for through movements.

Slow corridor travel speed can be an indicator of delay and congestion. Better progression and coordination between signals will improve overall travel time, reliability, and safety. The lowest speed corridors include:

1. I-5: Main Street to Jantzen Beach (AM) – 9 mph
2. Andresen Road, Mill Plain to SR-500 (PM) – 14 mph
3. *Mill Plain, Fourth Plain to I-5 (PM) – 15 mph
4. Main Street, I-5 to Mill Plain (AM) – 17 mph
5. NE 112th Avenue, Mill Plain to SR-500 (PM) – 18 mph
6. Fourth Plain: Andresen to NE 117th Avenue (PM) – 18 mph

   **Construction in corridor*

Figure 5: Lowest Speed Corridors

Map 8 & 9 (Pages 34-35): Corridor travel speed continues to be a problem. As the economy improves, corridor travel speed continues to decline. One concern is regional facilities that have a travel speed below 20 mph, which may encourage trips to divert to alternate routes. During the AM period, I-5 South and Main Street display average speeds below 20 mph, and are resulting in cut-through traffic on local Vancouver streets.

Slow corridor travel time is an indicator or congestion.

In the PM period, corridors with travel speed below 20 mph include Andresen, 112th Avenue, Mill Plain, and Fourth Plain. However, the majority of the principle arterials operate only slightly above 20 mph.

Speed: Speed as Percent of Speed Limit

Travel speed was converted to a percent of posted speed limit for each of the congestion management corridors. This was intended to provide another measure of the delay along the corridor.

As development occurs along the corridors, travel speed often decreases because of congestion, multiple driveways, and additional traffic signals. One of the difficulties is in balancing access to land uses and maintaining the throughput travel speed on arterials.

The speed percentages for the freeway facilities are generally close to 100% of the posted speed limit. While facilities with multiple signalized intersections and driveways are generally between 60% and 80% of the posted speed limit. The lowest speed percentage or worst performing corridors compared to posted speed limit include:

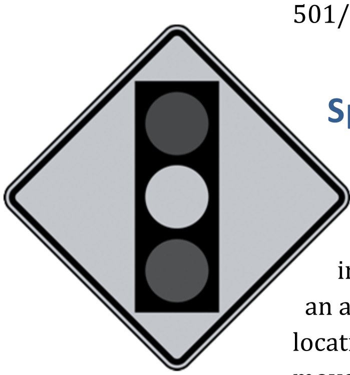
1. I-5, Main St. to Jantzen Beach (AM) – 15%
2. Andresen, Mill Plain to SR-500 (PM) – 40%
3. SR-14, 164th Av. to I-205 (AM) – 44%
4. Fourth Plain, SR-503 to 162nd Avenue (PM) – 48%
5. *Mill Plain, I-5 to Fourth Plain (PM) – 50%
6. SR-500, I-5 to Andresen Rd. (PM) – 50%
7. 164th Avenue, SR-14 to Mill Plain (PM) – 50%

*Construction in corridor

Figure 6: Lowest Speed Percentage Corridors

Map 10 (Page 36): In the AM period, I-5 South and SR-14 Central operate at less than 50% of the posted speed.

Map 11 (Page 37): In the PM period, Andresen South, Fourth Plain East, SR-501/Mill Plain, and SR-500 West all operate at less than 50% of the posted speed.



Speed: Intersection Delay

The delay at an intersection, for the through movement, was recorded as part of the PM travel time. Delay time represents the period of time travel speed below 5 mph due to the intersection control. The delay time at an intersection was averaged for the multiple travel time runs. Intersections with an average delay time of greater than 45, 60, and 90 seconds were identified as a location of delay along a corridor. This delay is only calculated for through movement on the congestion management corridor and does not include delay associated with left turns or cross street traffic.

The goal of signal coordination is to get the greatest number of vehicles through a corridor with the fewest stops in the safest and most efficient manner. The higher volume movement is generally favored over lower volume movements. In this situation, the benefit gained by traffic on the higher volume approach exceeds the degradation in operations experienced by the lower volume approach and the overall intersection operations are improved.

Map 12 (Page 38): Generally, intersections that displayed a 45 second or greater delay, for the average through movement on a CMP corridor, were located where two major arterials intersect. Map 12 displays the location of the 45 intersections that demonstrated this characteristic. Of these intersections, 21 had at least one direction with an average delay between 60-89 seconds and 9 had at least one direction with an average delay greater than 90 seconds. Delay at these intersections adds to the overall travel time and increases congestion at these locations.

The longest delays are at the following intersections:

1. Fourth Plain/Andresen Rd. (Northbound) – 182 seconds
2. *Mill Plain/Columbia St. (Eastbound) – 157 seconds
3. Fourth Plain/SR-500 (Eastbound) – 154 seconds
4. SR-500/42nd Av./Falk Rd. (Eastbound) – 122 seconds
5. *Padden Parkway/NE 94th Av. (Westbound) – 103 seconds
   **Construction near intersection*

In addition to intersection delay, delay can also occur at freeway off-ramps, where high volumes of traffic are loaded onto the arterial system. This can create a significant problem when traffic backs onto the freeway. Locations known to experience this characteristic in the PM peak include northbound I-205 off-ramp to SR-14, Mill Plain, and SR-500. In the AM peak, backups can occur on SR-500 and SR-14 ramps to I-5 South, and Padden Parkway, SR-500, and SR-14 ramps to I-205 South.

Occupancy: Vehicle Occupancy

Average automobile occupancy is calculated by observing passenger cars at a given location and the number of people in each vehicle. The number of people divided by the number of passenger cars is the average automobile occupancy for that location. Trucks, buses, and other commercial vehicles are excluded from average automobile occupancy. Data is collected for the AM and PM time periods.

Table 5: Average Automobile Occupancy by Time of Day

Facility Type	AM	PM
Freeway *	1.11	1.17
Arterial	1.12	1.25

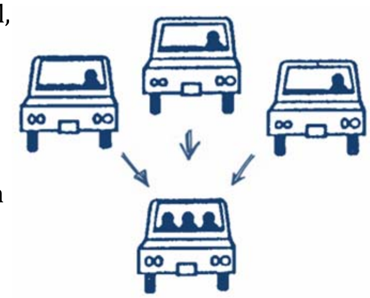
** Freeway includes I-5, I-205, SR-14, and SR-500*

The AM time period displays a lower average automobile occupancy, with the AM average automobile occupancy at 1.11 persons per vehicle. The PM average automobile occupancy rate is approximately 1.21 persons per vehicle.

It may be that the AM peak period is more of a traditional commute time, while the PM peak period likely has a greater percentage of discretionary trips such as shopping where drive-alone trips are less prominent.

Occupancy: Carpool and Vanpool

Carpools and vanpools are modes that mitigate congestion and increase vehicle occupancy in the peak periods. Carpools and vanpools form when a group of people commute together. Carpools are generally informal, including 2 or more people, while vanpool arrangements are generally more formal and include 5 or more people. C-TRAN owns, maintains, manages, insures, and licenses a fleet of vans which are available to commuter groups. In 2015, C-TRAN had thirty-one vanpools in service.



Safety: Collisions

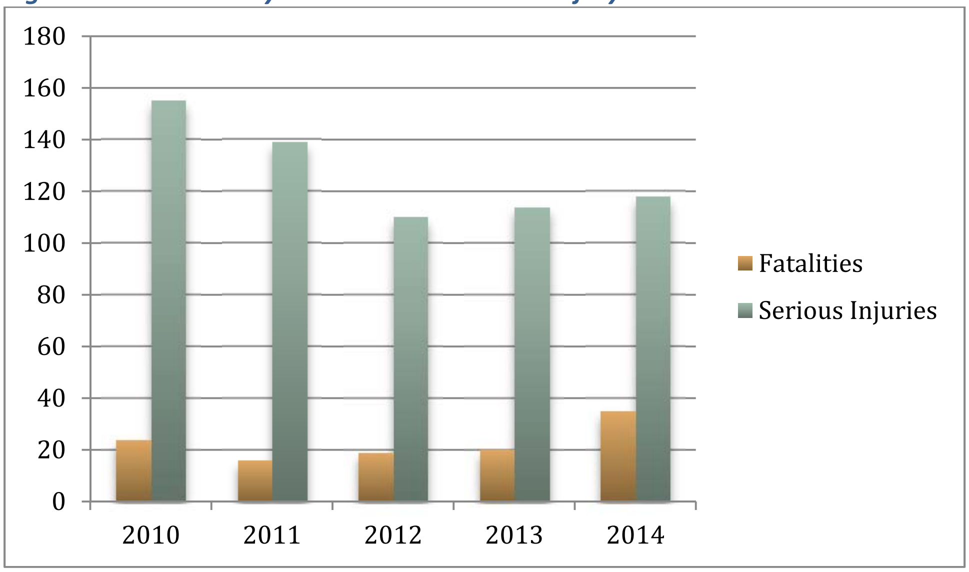
Safety for all modes of travel is an important component of the regional transportation planning process. Congestion often occurs as a result of collisions or other incidents that temporarily reduce a road's capacity. As such, the region completed a *2014 Safety Management Assessment for Clark County*[10]. The 2014 Safety Management Assessment for Clark County includes a number of recommendations to help the region meet safety goals.

Over the past several decades, national, statewide, and local safety trends have shown significant reduction in fatalities and serious injuries resulting from traffic collisions. With the recovery of the economy in the last few years the local, state,

[10] *http://rtc.wa.gov/reports/safety/SafetyMgmt2014.pdf*

and national trend appears to have reversed, with both fatalities and serious injuries remaining flat or increasing. Year 2014 was a particular bad year for fatalities in Clark County. Figure 7 shows Clark County trend for both fatalities and serious injuries, between years 2010-2014 (most recent available years).

Figure 7: Clark County Fatalities and Serious Injury Totals



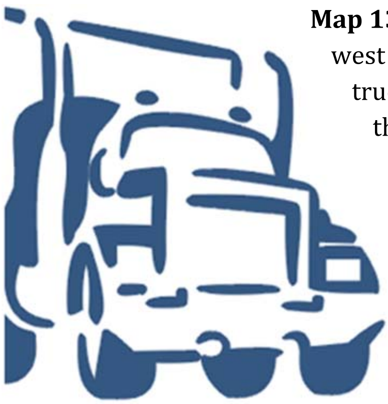
Clark County traffic safety priorities are set based upon the most frequently cited contributing factors. Table 6 lists the priority factors for Clark County:

Table 6: Clark County Priority Collision Factors

Collission Factors	Total Fatalities	Percent	Total Serious Injuries	Percent
Impaired Driver	57	50.0%	143	22.5%
Speeding	47	41.2%	167	26.3%
Run Off the Road	41	36.0%	153	24.1%
Young Driver 16-25	41	36.0%	295	46.4%
Distracted Driver	28	24.6%	132	20.8%
Intersection Related	28	24.6%	251	39.5%

Trucks: Truck Percentage

Traffic counts are collected at several locations where vehicles are classified according to the number of axles. This provides a measure of trucks as a percentage of all vehicles traveling on the roadway. Trucks are defined as vehicles with more than two axles, such as typical tractor/trailer rigs, traveling on the roadway during the peak period. It is important to note that trucks often travel outside of peak periods to avoid congestion.



Map 13 (Page 39): Overall, I-5 North, I-205 North, Fourth Plain and Mill Plain west of I-5, and Pioneer Street in Ridgefield display the highest percentage of truck volumes during the PM peak period with truck percentages greater than 7 percent. In the AM period, the percentage of trucks is generally higher, with both Mill Plain and Fourth Plain west of I-5 averaging over 15% trucks during the morning commute.

The State Freight and Goods Transportation System classify roadways according to the annual gross freight tonnage they carry. This system designates I-5, I-205, SR-14, and Mill Plain west of I-5 as the highest tonnage facilities.

Transit: Transit System Ridership

Table 7 provides 2015 annual C-TRAN patronage by type of service. C-TRAN moved to automated passenger count system in 2013, which resulted in decline in the passengers counted. For purpose of this report 2013 to present passenger counts will be considered. Between 2013 and 2015 minor transit service revisions were made and fare increases were implemented. Between 2013 and 2015 total ridership decreased by 4.8%.

Approximately 82% of C-TRAN system ridership was made up of urban fixed route patrons, followed by commuter service that carried 12% of the total riders and C-VAN that carried almost 4% of the total riders. Vanpool usage has increased to over 1% of the total ridership.

Table 7: 2015 C-TRAN Ridership by Type of Service

Service Type	Annual Riders	Percent
Urban/Local	5,083,118	82.3%
Commuter	729,796	11.8%
C-VAN	249,801	4.0%
Events/Other	29,451	0.5%
Connector	18,460	0.3%
Vanpool	68,961	1.1%
Total	**6,179,587**	**100.0%**

Transit: Transit Seat Capacity Used

Transit seat capacity used includes transit riders divided by the transit capacity at a defined location. Transit seat capacity represents the percentage of seats that are occupied during the two-hour peak period. C-TRAN uses an automated ridership collection system on their vehicles. RTC compiled this data at a specific location in each corridor to calculate bus capacity based on the vehicle type and frequency of service. This process has allowed for the estimation of transit patronage and capacity for congestion management corridors.

Map 15 (Page 40): Generally, in the PM Peak period, the number of available seats is higher to accommodate the greater transit demand. In the PM period, 27 corridors utilize more than 50% of the available seat capacity.

Transit: Park and Ride Capacity

Park and Ride capacity and daily average usage include lots owned or leased by C-TRAN. In addition to the capacity shown in Table 8, there are WSDOT maintained or informal park and ride and park and pool facilities located throughout the County. Clark County park and ride capacity and usage for C-TRAN served facilities are shown in Table 8.

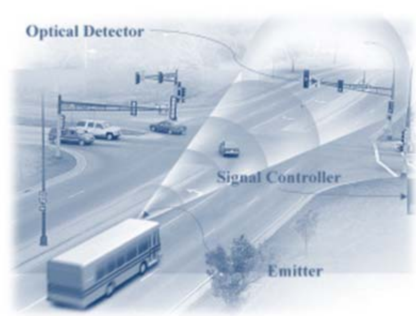
Table 8: Clark County Park and Ride Capacity and Usage in 2013

Facility	Lot Capacity	Lot Usage	Occupancy
99th Street	610	409	67%
Evergreen	279	37	13%
Salmon Creek	467	260	56%
BPA Ross	N/A	Closed	N/A
Andresen/Living Hope	60	97	162%
Fisher's Landing	560	511	91%
Total	**1,976**	**1,314**	**66%**

Transit: Transit On-Time Performance

Traffic congestion, station dwell time, wheel chair boardings, and other factors can impact transit vehicles' ability to maintain a schedule.

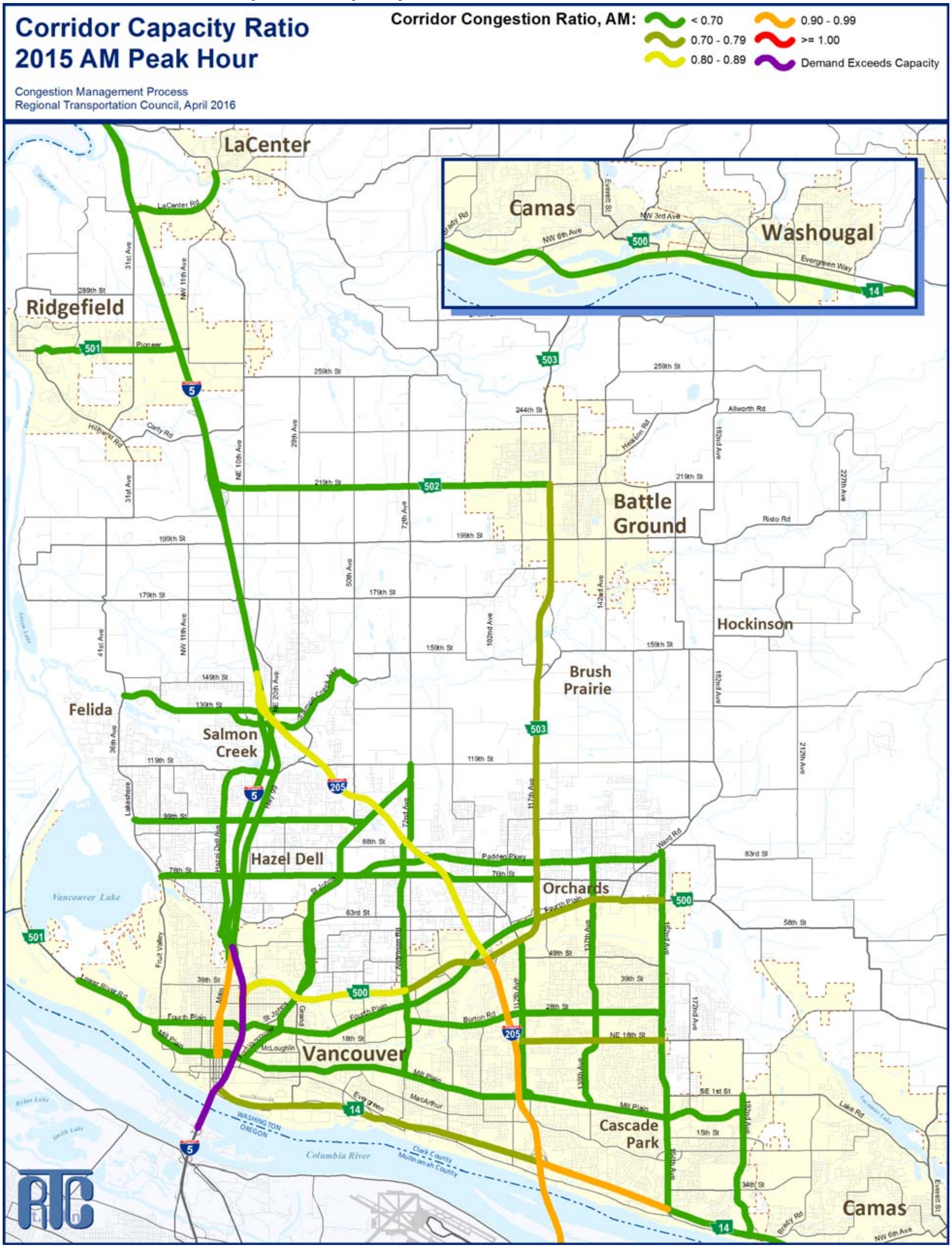
To improve on-time performance, C-TRAN tested a pilot project in 2013 to implement Transit Signal Priority along 22 signals in the Mill Plain corridor. This Transit Signal Priority project allowed buses to communicate with traffic signals and allow additional green time where needed. C-TRAN evaluated its performance and found that this technology showed improvements to corridor travel time and on-time performance without negatively impacting roadway traffic. C-TRAN is moving forward to implement a similar technology in the Highway 99 corridor.



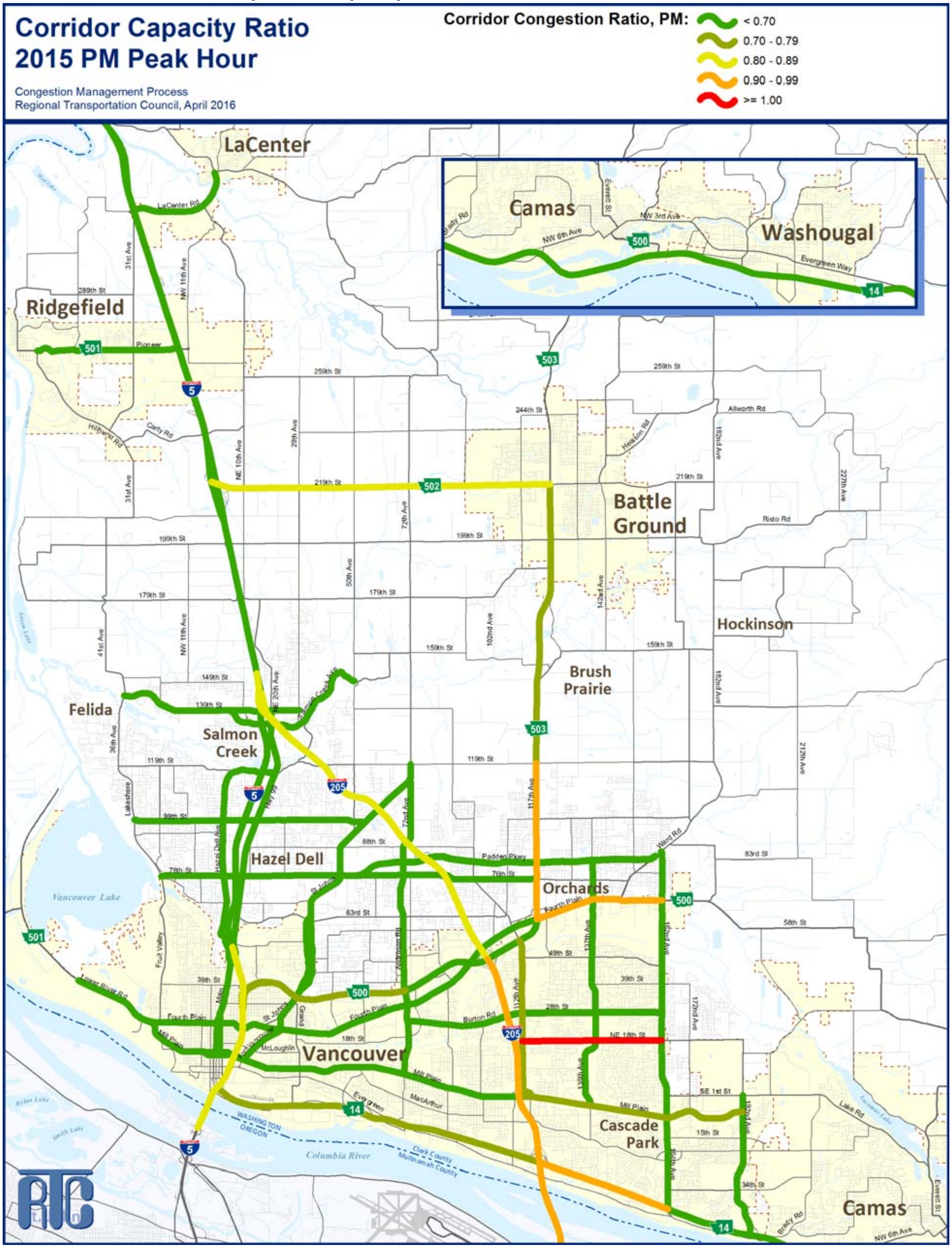
C-TRAN's 2015 On-Time Performance Report shows that routes that cross the Columbia River into Oregon had the lowest on-time performance due to congestion. This includes all Express Routes, Route 44 (Fourth Plain Limited), and Route 47 (Battle Ground Limited).

Map 4: PM Vehicle Volumes

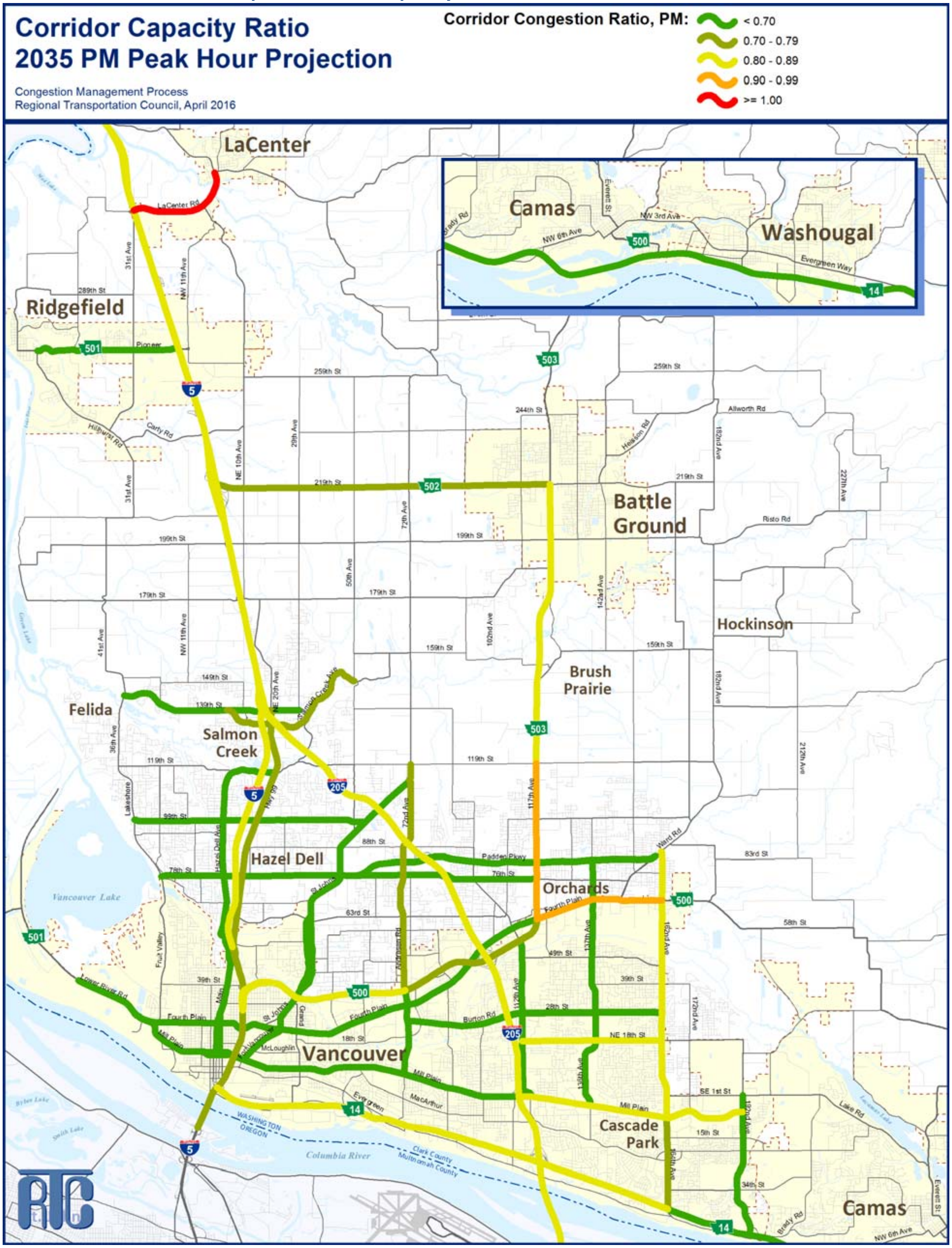
Map 5: AM Capacity Ratio



Map 6: PM Capacity Ratio



Map 7: 2035 PM Capacity Ratio



Map 8: AM Corridor Travel Speed

Map 9: PM Corridor Travel Speed

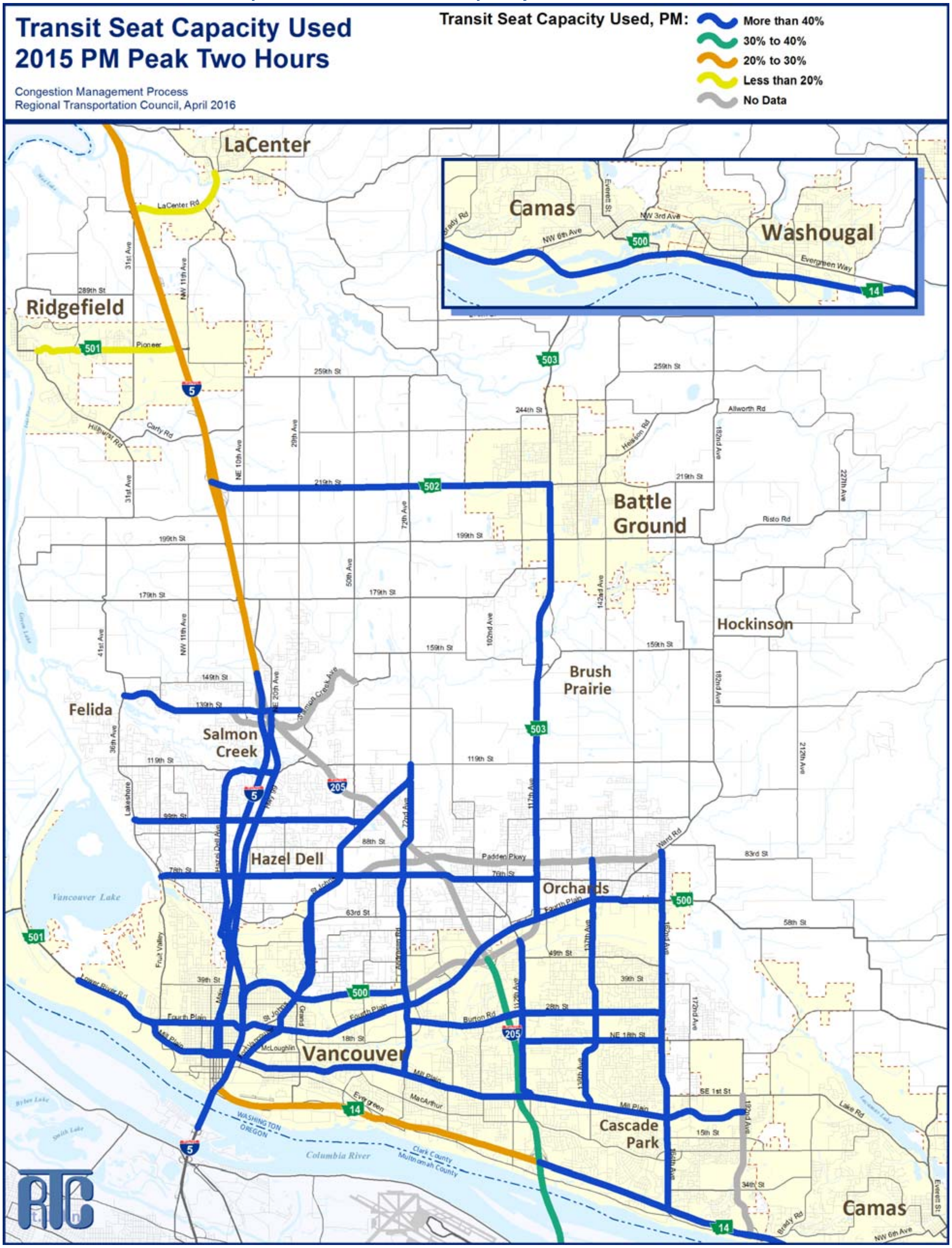
Map 10: AM Speed as a Percent of Speed Limit

Map 11: PM Speed as a Percent of Speed Limit

Map 12: PM Intersection Delay

Map 13: PM Truck Percentage

Map 14: PM Transit Seat Capacity Used



Areas of Concern

Using the individual CMS corridor segment data, areas of concerns were identified. Areas of concern are defined as segments within an individual corridor with a volume-to-capacity (V/C) ratio greater that 0.9 or a travel speed 60% or less of the posted speed limit.

Volume-to-capacity Ratio

The volume-to-capacity ratio identifies road segments where current volumes are approaching road capacity. This limitation on road capacity leads to congestion.

Map 16 (Page 42): Prominent volume-to-capacity ratio areas of concern in the AM peak period are the bottlenecks at the two interstate bridges. The AM period shows a high volume-to-capacity ratio with related poor system performance on portions of I-5, Main Street, I-205, SR-14, and SR-500.

Map 17 (Page 43): In the PM period, additional volume-to-capacity ratio areas of concern showed up. The PM period shows congestion on portions of I-5, I-205, SR-14, SR-500, SR-502, SR-503, Mill Plain, Fourth Plain, 112th Avenue, and 18th Street.

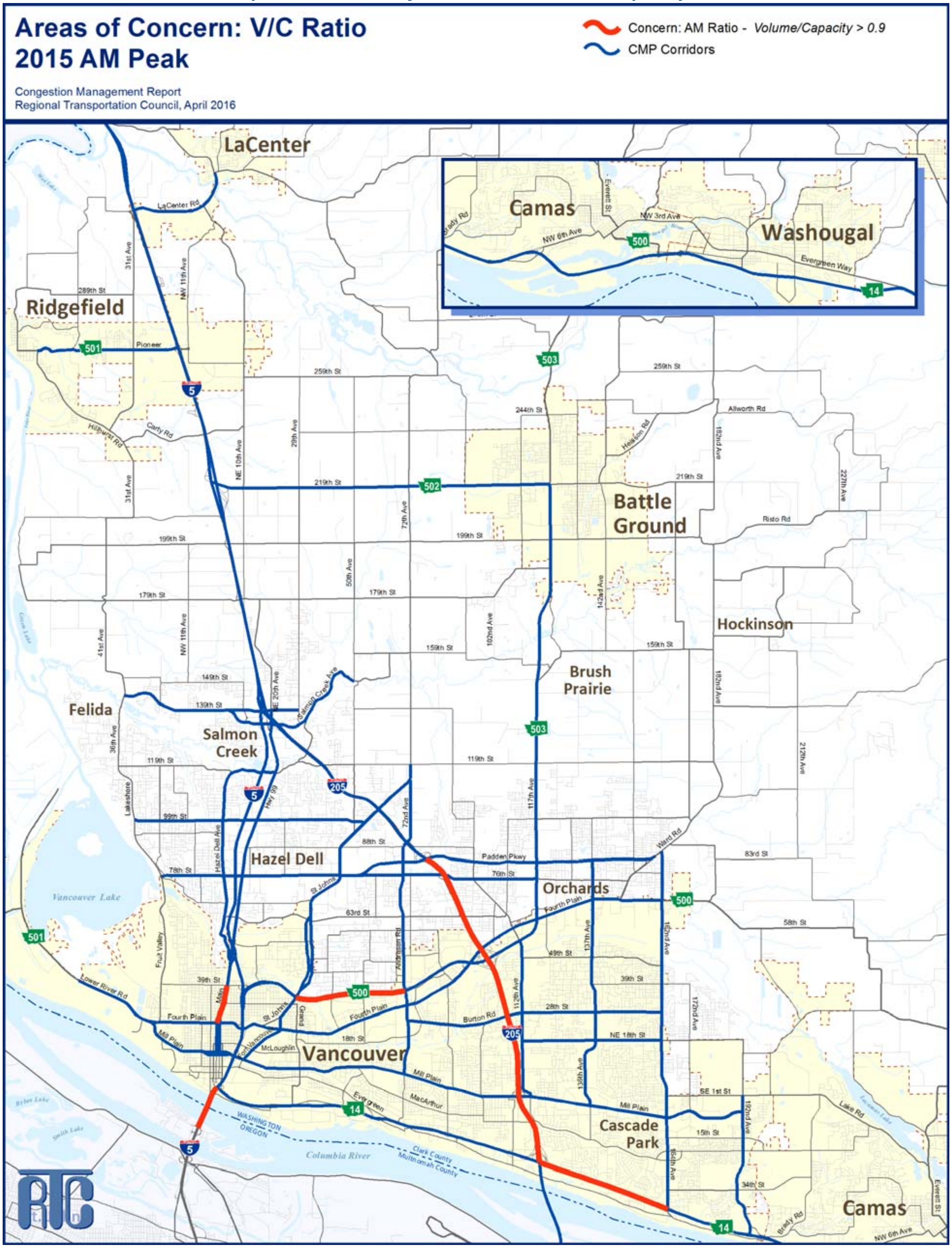
Speed

A travel speed lower than 60% of the posted speed limit is an indicator of delay, which can result in congestion. Often these speed areas of concern occur at locations with multiple traffic signals in close proximity or with a high volume intersection.

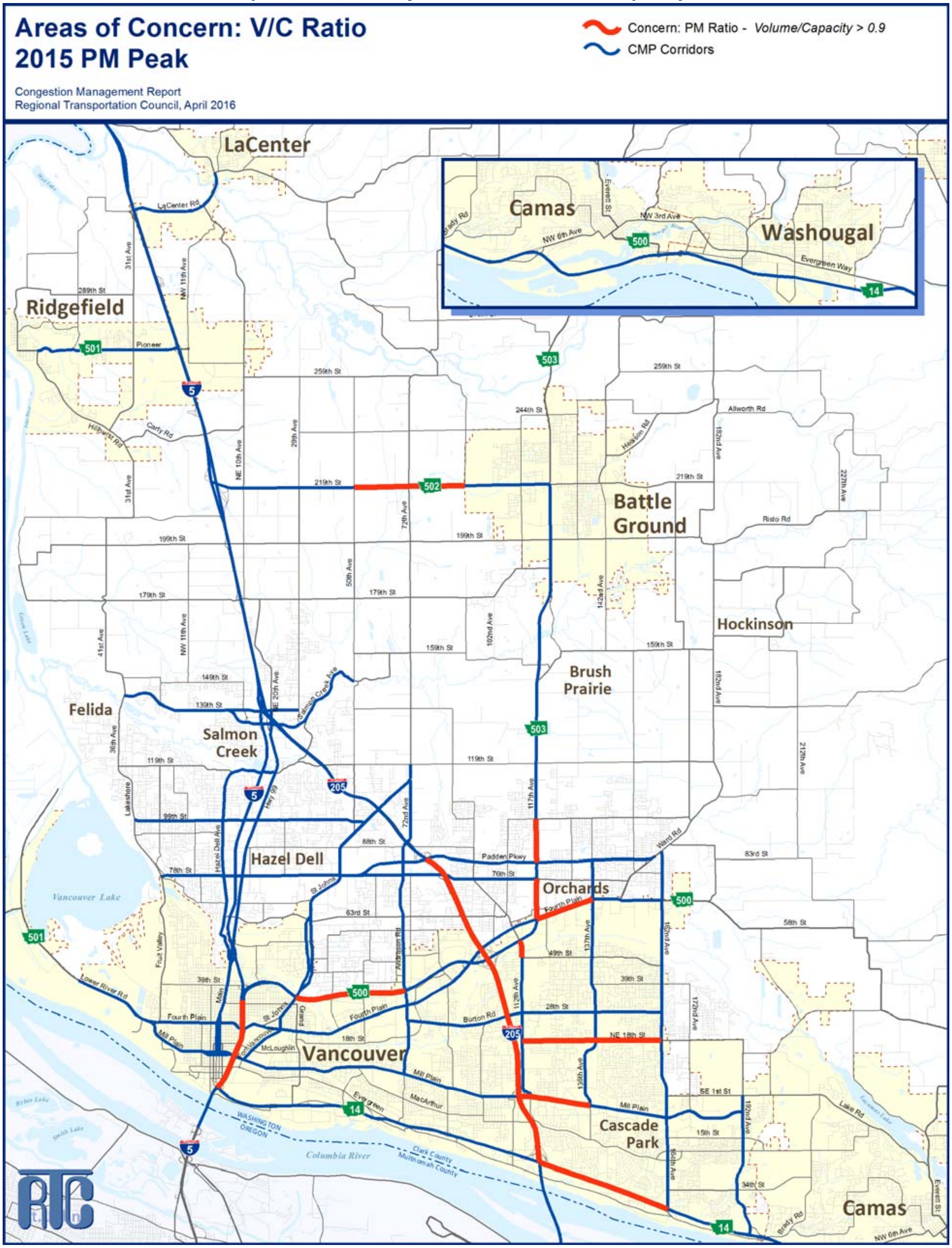
Map 18 (Page 44): In the AM period, speed areas of concern occur along portions of I-5, Main Street, Hazel Dell Avenue, Highway 99, Ft. Vancouver, St. Johns, Andresen, SR-503, 112th Avenue, 137th Avenue, 162nd Avenue, 192nd Avenue, SR-14, Mill Plain, Fourth Plain, 78th Street, and Padden Parkway.

Map 19 (Page 45): In the PM period, speed areas of concern occur along portions of most of the congestion management corridors in the Vancouver Urban Area, with the exception of grade-separated facilities (I-5, I-205, and SR-14).

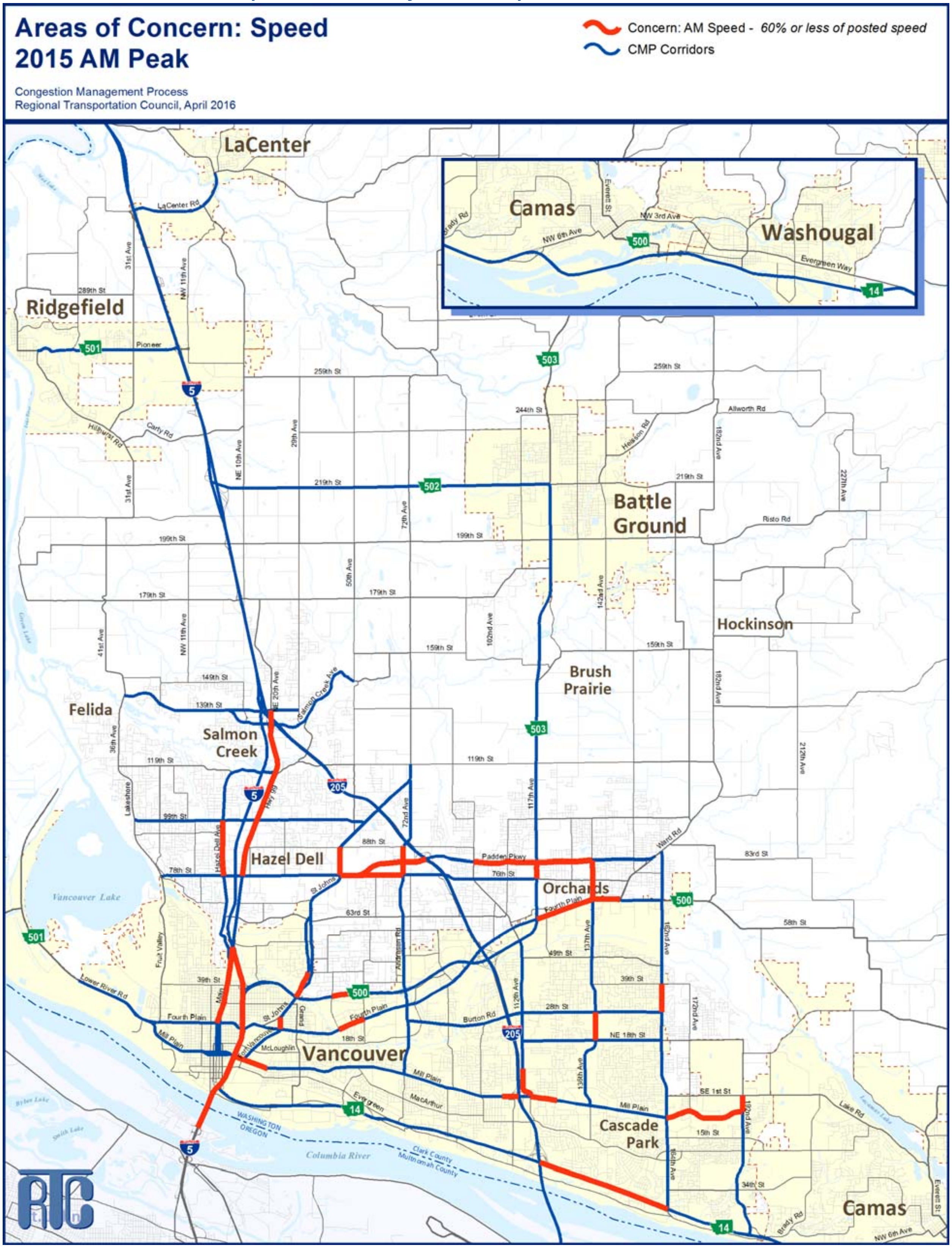
Map 16: AM Areas of Concern: Volume-to-capacity Ratio



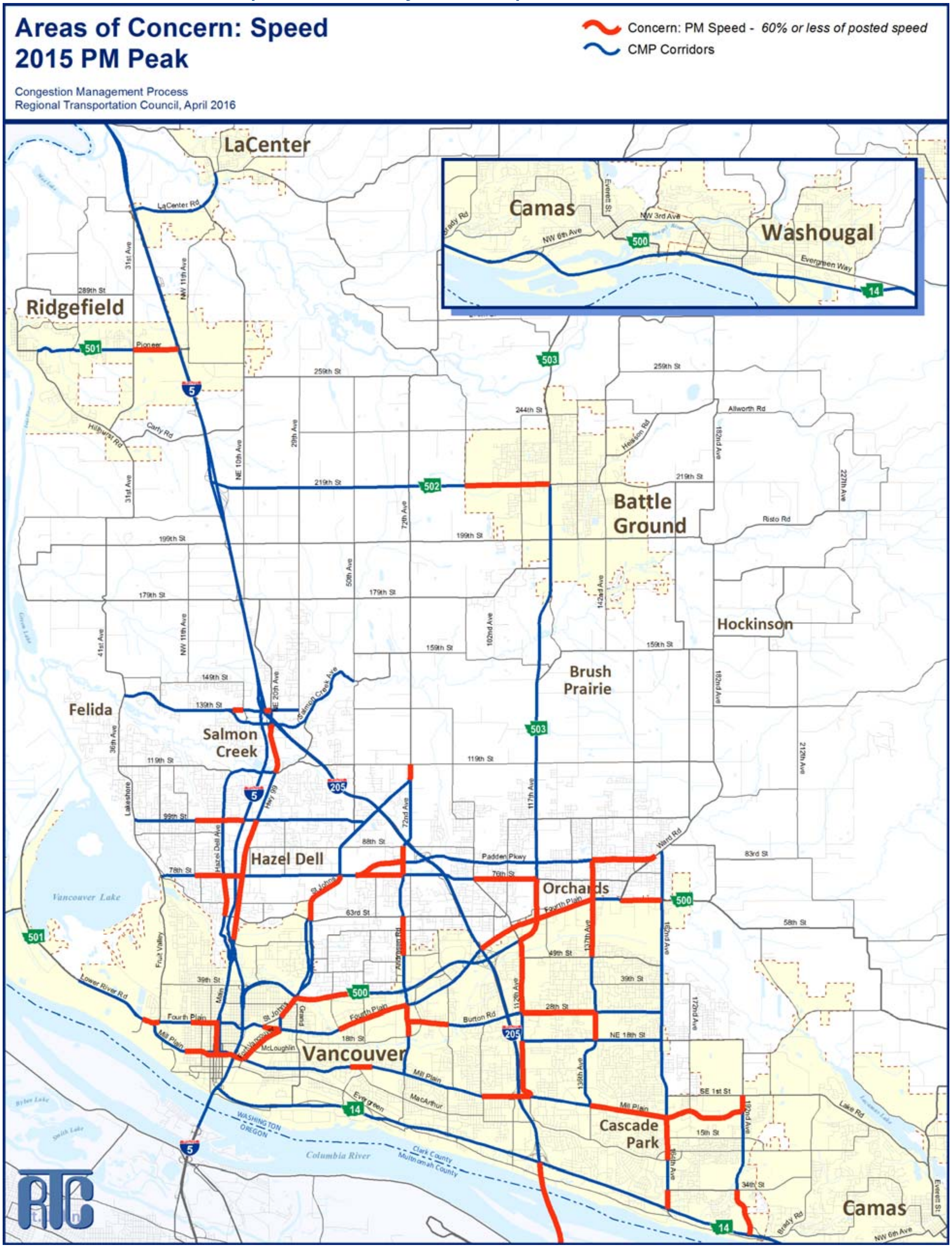
Map 17: AM Areas of Concern: Volume-to-capacity Ratio



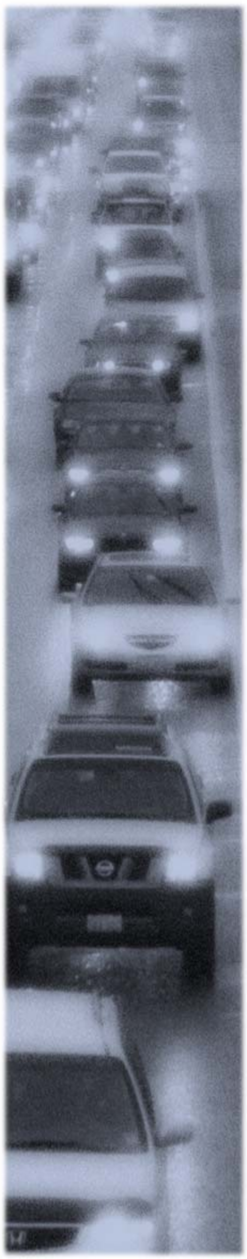
Map 18: AM Areas of Concern: Speed



Map 19: PM Areas of Concern: Speed



Chapter 3: Strategies



Because each roadway corridor has its own characteristics, congestion management efforts must be tailored to meet the needs of a roadway. Transportation professionals must employ a variety of strategies to effectively manage congestion.

Transportation Planning Efforts

RTC is involved in a number of transportation planning efforts intended to address the impacts of traffic congestion. The following is a list of current transportation planning efforts:

The Regional Transportation Plan[11] for Clark County (RTP) is the most prominent planning document. The plan is designed to be a guide for the effective investment of public funds for regional transportation needs over a twenty-year period. The region uses a wide range of data to develop a regional travel demand forecasting model. The model simulates both current travel demand and also forecasts travel demand twenty years into the future based on planned land use growth. Using the model, the region can identify where future congestion is most likely to occur.

The Transportation System Management and Operations Plan[12] (TSMO) was adopted in June 2011. TSMO focuses on low-cost, quickly implemented transportation improvements that aim to utilize existing transportation facilities more efficiently. TSMO combines advanced technologies, operational policies and procedures, and existing resources to improve coordination and operation of the multimodal transportation network. TSMO project examples include traffic signal integration, ramp metering, access management, traveler information, smart transit management, and coordinated incident response to make the transportation system work better.

The C-TRAN 20-year Transit Development Plan[13] was adopted in 2010. This planning process is designed to build upon existing service and develop future operating scenarios for public transit. The plan incorporates the recommendations of the High Capacity Transit System Plan.

[11] *http://rtc.wa.gov/programs/rtp/clark/*
[12] *http://rtc.wa.gov/programs/vast/docs/tsmoReport2011.pdf*
[13] *http://www.c-tran.com/about-c-tran/reports/c-tran-2030*

The CTR program is intended to improve transportation system efficiency, conserve energy, and improve air quality by decreasing the number of commute trips made by people driving alone. RTC approved a Regional Commute Trip Reduction Plan and endorsed CTR plans for unincorporated Clark County, Vancouver, Camas, and Washougal. The City of Vancouver is implementing their CTR plan through Destination Downtown[14].

The Clark County Freight Mobility Study[15] (RTC, 2010) provides useful information and analysis designed to inform regional transportation planning, local comprehensive planning, and project design. Study efforts included an evaluation of freight traffic movement, identification of freight system deficiencies, identified future infrastructure needs, and identified policy issues to support freight mobility in Clark County.

The 2014 Human Services Transportation Plan for Clark, Skamania, and Klickitat Counties[16] summarizes the transportation needs for people who, because of disability, low income, or age, face transportation challenges. It also identifies the transportation activities to respond to these challenges.

The 2014 Safety Management Assessment for Clark County[17] is intended to be an organized approach to transportation safety. Safety for all modes of travel is an important component of the regional transportation planning process. The purpose of the plan is to consider ways to increase the safety of the transportation system.

Identify and Evaluate Transportation Strategies

The information and data contained in the System Monitoring chapter is used to identify appropriate congestion management strategies for the region. The identification and selection of strategies for a particular segment or corridor should be tied to the specific congestion issue. RTC will work collaboratively with member agencies to identify and advance appropriate strategies for managing congestion.

Strategies are detailed in the CMP Toolbox. The intent of the CMP Toolbox is to provide a reference for the development of alternative strategies for consideration in corridor development in relationship to the Regional Transportation Plan.

Objectives of Strategies

Reducing congestion in the region will require accomplishing the following objectives:

[14] *http://www.cityofvancouver.us/ced/page/destination-downtown*
[15] *http://rtc.wa.gov/studies/freight/*
[16] *http://rtc.wa.gov/programs/hstp/*
[17] *http:// http://rtc.wa.gov/reports/safety/SafetyMgmt2014.pdf*

- Preservation and maintenance of the existing system
- Improving system performance through operation and management strategies
- Where possible, shifting trips to other modes
- Addition of auto capacity at key bottlenecks

CMP Toolbox

One of the components of RTC's Congestion Management Process is a toolbox of congestion reduction and mobility strategies. The intent of this toolbox is to encourage ways to deal with congestion and mobility issues prior to traditional roadway widening projects. Prior to adding single occupant vehicle (SOV) capacity, agencies and jurisdictions should give consideration to the various strategies identified in this section. Usually, multiple strategies are applicable within a corridor, while other strategies are intended to be applied region-wide.

The CMP toolbox strategies were assembled to provide a wide range of strategies that could be used to manage congestion. They are arranged so that the strategies are considered in order from first to last. Even with the addition of capacity, many of the strategies can be implemented with the project to ensure the long-term management of a capacity project.

Preservation and maintenance of existing systems is essential to mobility.

System Preservation and Maintenance

Essential for continued transportation mobility is the preservation and maintenance of the existing roadway, bridge, ports, rail, transit, bicycle, pedestrian, and other systems.

Safety Improvements

It is vital that the region builds and maintains a transportation system that provides a safe and secure means of travel by all modes. The type of safety improvement is dependent on the need at each location.

Transportation Demand Management

Transportation Demand Management: Options such as alternative work hours, telecommuting, ridesharing, and other options can remove, shift, or combine trips to reduce overall demand during peak periods. Many of these strategies can be successfully implemented through a Commute Trip Reduction (CTR) program and Transportation Management Associations.

Transit Improvements

Bus Route Coverage

Provides better transit accessibility to a greater share of the population.

Bus Frequencies and Transit Amenities

Makes transit more attractive to use.

Park-and-Ride Lot

In conjunction with express bus service, can encourage the use of transit for longer distance commute trips.

High Capacity Transit

Provides a higher transit service to maximize transit usage in dense urban corridors.

Bicycle and Pedestrian Improvements

New Sidewalks and Bicycle Lanes, Separated Pathways, and Trails

Provides better pedestrian and bicycle accessibility to a greater share of the population. Also increases the perception of pedestrian and bicycle safety.

Bicycle Amenities

Bicycle racks, lockers, and other bicycle amenities at transit stations and other trip destinations increases security and provides incentives for using bicycles.

Pedestrian-Oriented Development

Building setback restrictions, streetscape, and other pedestrian oriented development can be codified in zoning ordinances to encourage pedestrian activity.

Bicycle and Pedestrian Safety

Maintaining lighting, signage, striping, traffic control, and other safety improvements can increase bicycle and pedestrian usage.

Transportation System Management and Operations

Traffic Signal Coordination

This improves traffic flow and minimizes stops on arterial streets.

Incident Management System

Is an effective way to alleviate non-recurring congestion. Primarily applicable on freeways.

Ramp Metering

This allows freeway to maintain flow rates, resulting in improved operations and reducing congestion on freeways.

Highway Information Systems

These systems provide travelers with real-time information that can be used to make trip and route decisions.

Advanced Traveler Information Systems

This provides data to travelers in advanced by computer or to other devices.

Access Management

Left Turn Restrictions

Turning vehicles can impede traffic flow and are more likely to be involved in collisions.

Consolidation or Relocation of Driveways

In some situations, increasing or improving access to property can improve traffic flow and reduce collisions.

Interchange Modification

Modification of interchanges can reduce weaving and improve traffic flow.

Minimum Intersection/Interchange Spacing

Appropriate spacing of intersection/interchanges can reduce number of conflict points and merge areas, resulting in fewer incidents and better traffic flow.

Collector-Distributor Roads

Collector-distributor roads are used to separate interchange traffic from through traffic at closely spaced interchanges, resulting in fewer incidents and better traffic flow.

Land Use

Mixed-Use Development

This can allow many trips to be made in an area by walking rather than use of a vehicle.

Infill and Densification

This takes advantage of existing infrastructure, rather than requiring new infrastructure to be built.

Transit Oriented Development

Allows improved pedestrian access from transit to housing and businesses.

Parking Enforcement

Enforcement of existing regulations can improve traffic flow in urban areas.

Location Specific Parking Ordinances

Parking requirements can be adjusted for factors such as availability of transit, mix of land use, and pedestrian oriented development that reduces the need for on-site parking.

Carpool/Vanpool Parking

Preferential, reduced, or free parking for carpool/vanpool can provide an incentive and reduce parking demand.

Roadway Improvements

Geometric Design Improvements

Addition of turn lanes at intersections, roundabouts, improved sight distance, auxiliary lanes, and other geometric improvements can reduce congestion by removing bottlenecks.

Upgrade Roads to Urban Standards

Upgrading from rural roads to urban standards with improved geometry, bicycle lanes, sidewalks, and transit amenities can improve traffic flow for all modes.

Grade Separation

Upgrade high volume intersection to an interchange or grade separated facility can significantly reduce traffic delay and reduce congestion.

Road Widening to Add Travel Lanes

Can increase capacity and remove congestion.

The CMP provides information to help guide the investment of transportation funding toward improving congestion.

Strategy Implementation

RTC's Congestion Management Process provides a tool for monitoring the region's traffic congestion. The CMP provides information to help guide the investment of transportation funding toward improving congestion. Information developed through the Congestion Management Process will be applied through the RTC regional transportation planning process.

In coordination with WSDOT, C-TRAN, and local agencies, RTC utilizes the Congestion Management Process to identify transportation system needs. This effort is supported by regional studies, local capital facility plans, regional transportation model, and other planning efforts which all feed into the development of the Regional Transportation Plan[18] (RTP). Needs are developed based on a planning level analysis that considers how various strategies can address congestion prior to adding capacity. Identified congestion needs are then incorporated into Regional Transportation Plan recommendations. Project sponsors then must give consideration to the various strategies from the CMP Toolbox as projects move forward to implementation.

Local project priorities are then submitted to RTC and prioritized through the regional Transportation Improvement Program[19] (TIP) which selects priority projects for implementation. For purpose of selecting projects to fund through the TIP process, additional points are awarded to a project that:

- Are Located on the CMP Network
- Addresses Congestion
- Incorporates Alternative Modes
- Incorporates Transportation System Management Alternatives

The Transportation Improvement Program and Annual List of Obligation will allow the region to track the implementation of congestion management strategies.

Monitor Strategy Effectiveness

This report contains data that allows for the continuing development and updating of information to track the performance of the regional transportation system and implemented strategies.

In assessing the degree to which the CMP strategies address congestion issues, projects are tracked through the project implementation process and results are reported back to regional technical committees.

[18] *http://www.rtc.wa.gov/programs/mtp/*
[19] *http://www.rtc.wa.gov/programs/tip/*

As part of the project implementation process, all regionally selected projects are required to complete a before and after analysis that identifies project goals and outcomes. This information is reported back to the Regional Transportation Advisory Committee. The region also tracks effectiveness through a 10 year corridor analysis.

Strategy Corridor Analysis

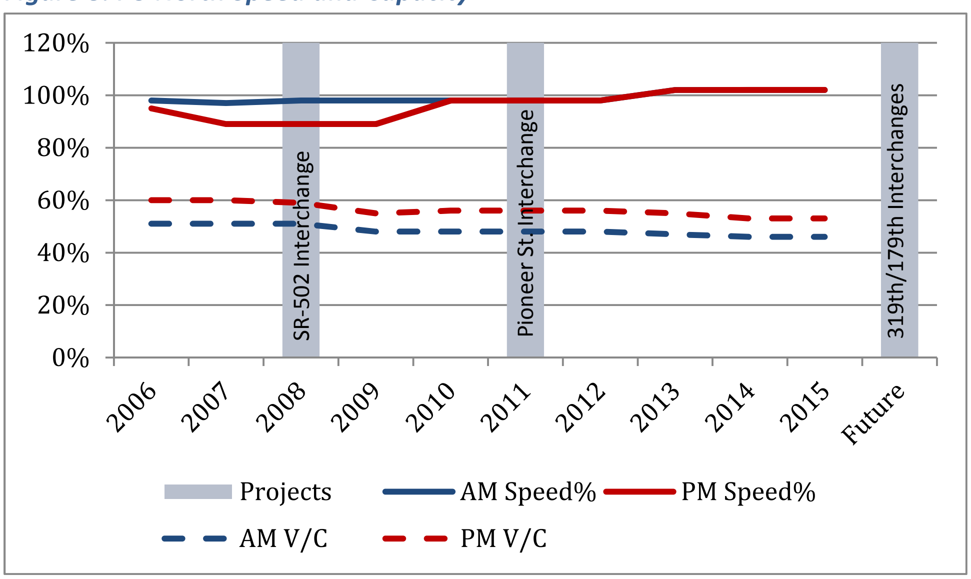
This section displays the linkages between transportation infrastructure improvements and corridor performance. System infrastructure improvements often impact the operation within a corridor. Sometimes a project removes a localized bottleneck, while other projects have corridor-wide impacts.

The following graphs show overall corridor travel speed compared to posted speed limit and volume to capacity ratio in comparison to implemented and future infrastructure improvements. This analysis is for each facility as a whole, and is not necessarily an indicator of individual bottlenecks. Roadways are likely to experience corridor-wide congestion when average travel speed falls under 60 percent of posted speed limit or when average volume to capacity ratio is greater than 90 percent.

I-5 North, County Line to I-205 Junction

Neither speed nor capacity indicates potential corridor-wide congestion. Recent and future corridor improvements are reflective of the need for improved access to the I-5 Corridor.

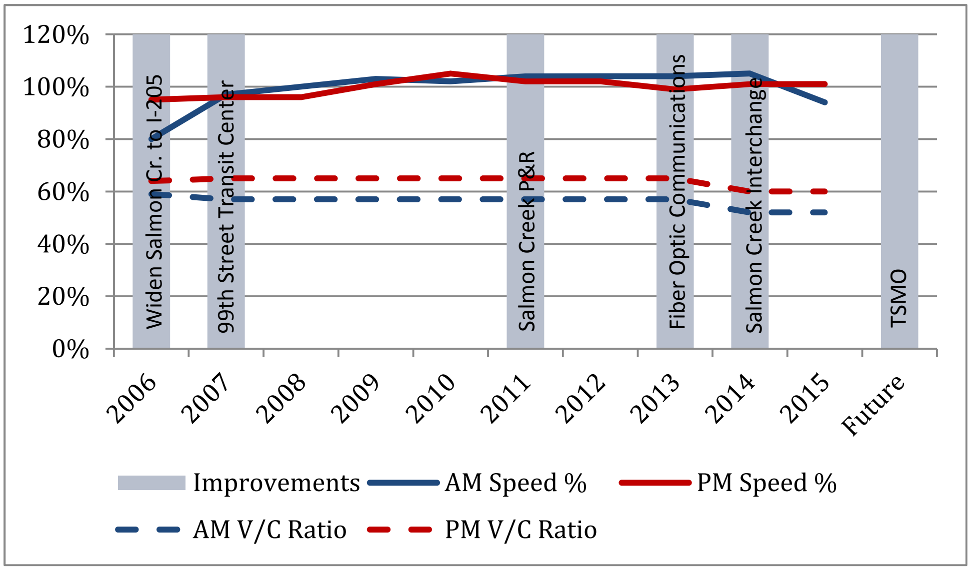
Figure 8: I-5 North Speed and Capacity



I-5 Central, I-205 Junction to Main Street

The 2006 widening project provided needed capacity in the corridor. Neither existing speed nor capacity indicates potential corridor-wide congestion. Future corridor improvements include Transportation System Management and Operational (TSMO) projects.

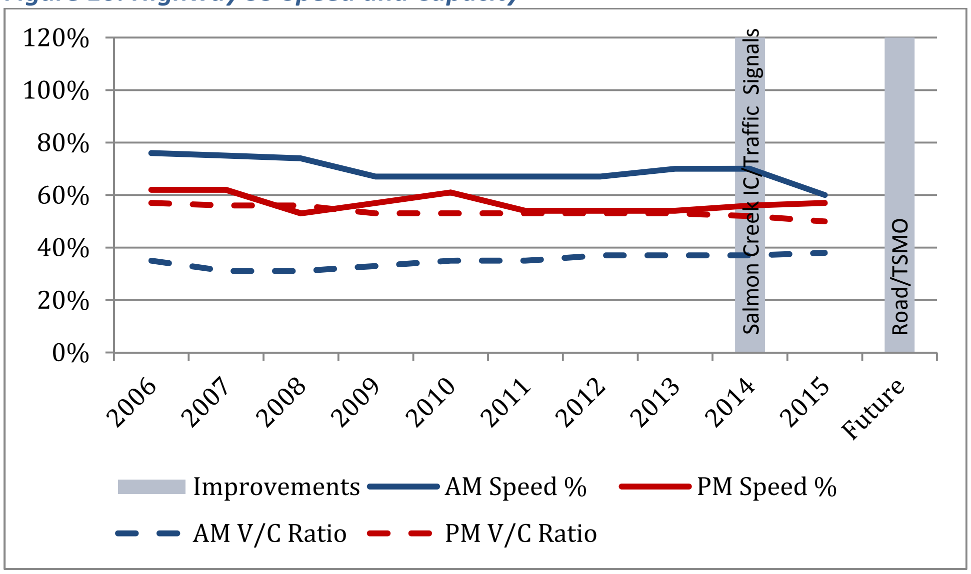
Figure 9: I-5 Central Speed and Capacity



Highway 99, 139th Street to I-5

The evening speed indicates potential corridor-wide congestion. Future corridor enhancements include select road improvements, TSMO, and transit projects.

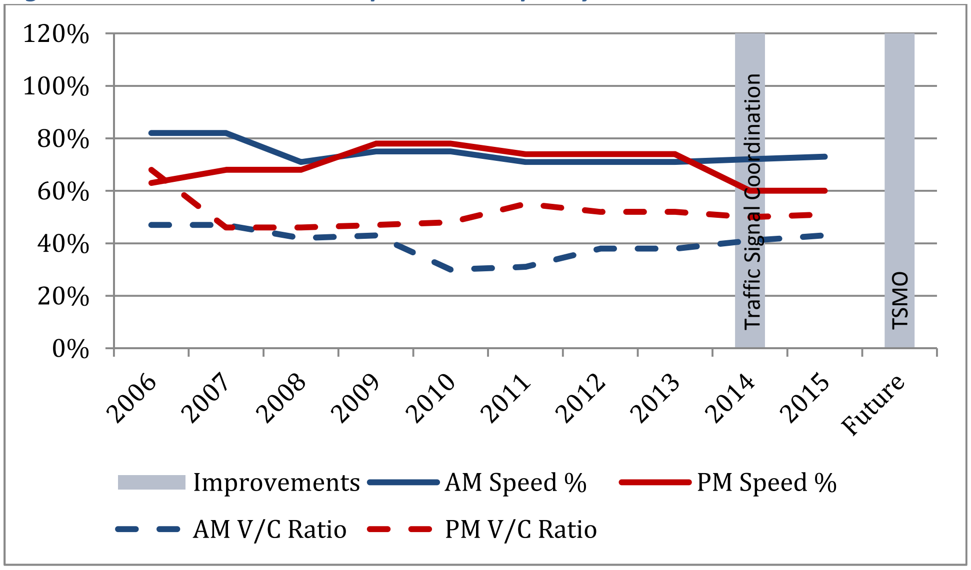
Figure 10: Highway 99 Speed and Capacity



Hazel Dell Avenue, Highway 99 to 63rd Street

Neither speed nor capacity indicates a pattern of potential corridor-wide congestion. Future corridor improvements include TSMO projects.

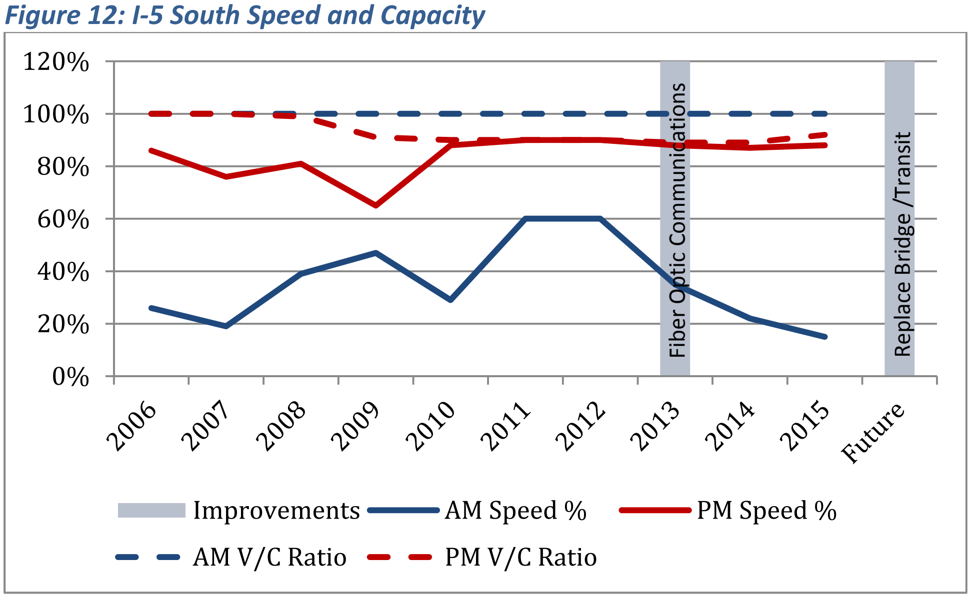
Figure 11: Hazel Dell Avenue Speed and Capacity



I-5 South, Main Street to Jantzen Beach

Morning speed and capacity indicate a pattern of corridor-wide congestion. Future corridor improvements include a new I-5 Bridge, interchange replacements, and added transit capacity. In the short-term the region needs to focus on Transportation Demand Management (TDM) and Transportation System Management (TSM) solutions to get the most out of the existing corridor.

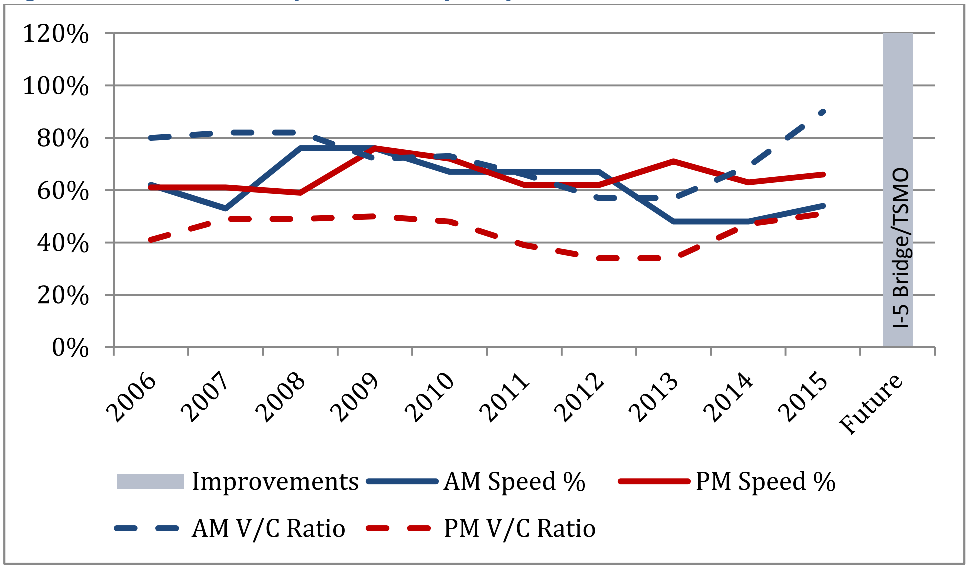
Figure 12: I-5 South Speed and Capacity



Main Street, I-5 to Mill Plain

Morning speed and capacity congestion indicates a pattern of corridor-wide congestion, as trips divert from the congested I-5 corridor. Future corridor improvements include I-5 Bridge replacement and TSMO projects.

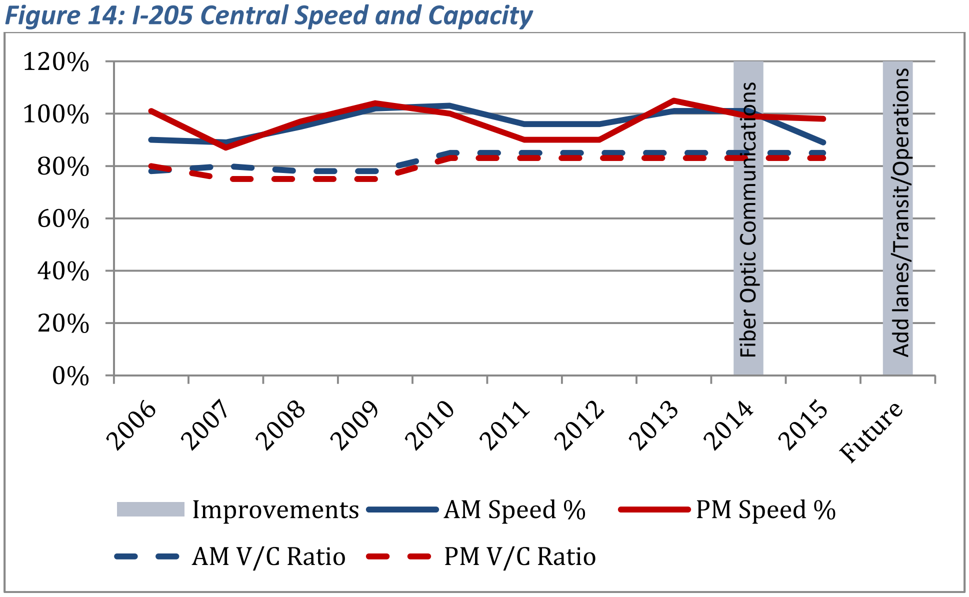
Figure 13: Main Street Speed and Capacity



I-205 Central, I-5 to SR-500

Corridor data indicates a very busy corridor that is near capacity. Future corridor improvements include addition of travel lanes, transit, operational, and interchange projects.

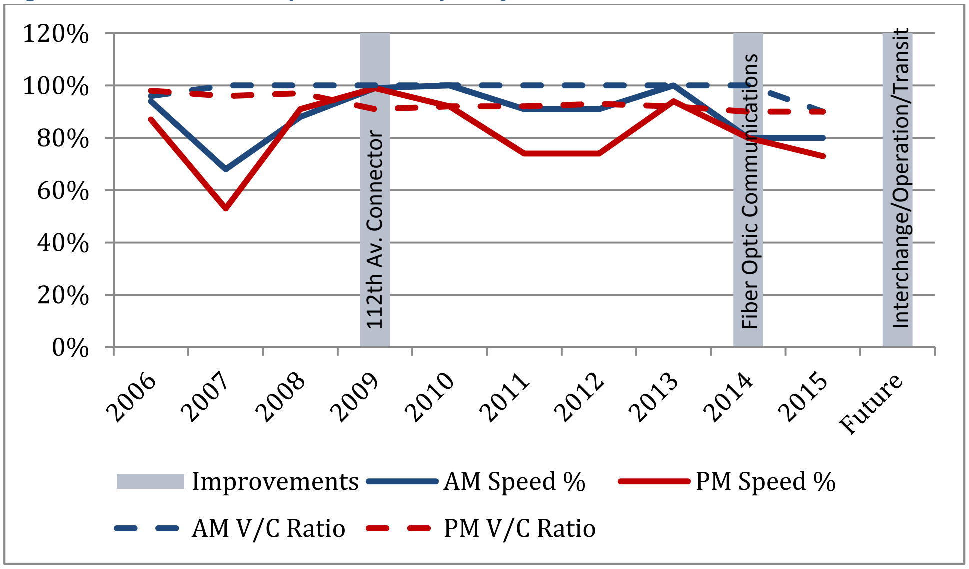
Figure 14: I-205 Central Speed and Capacity



I-205 South, SR-500 to Airport Way

Corridor data indicates capacity congestion and significant variation of speed. Future corridor improvements include a new interchange, travel lanes, transit, and TSMO projects. WSDOT will complete a new interchange at 18th Street in 2017.

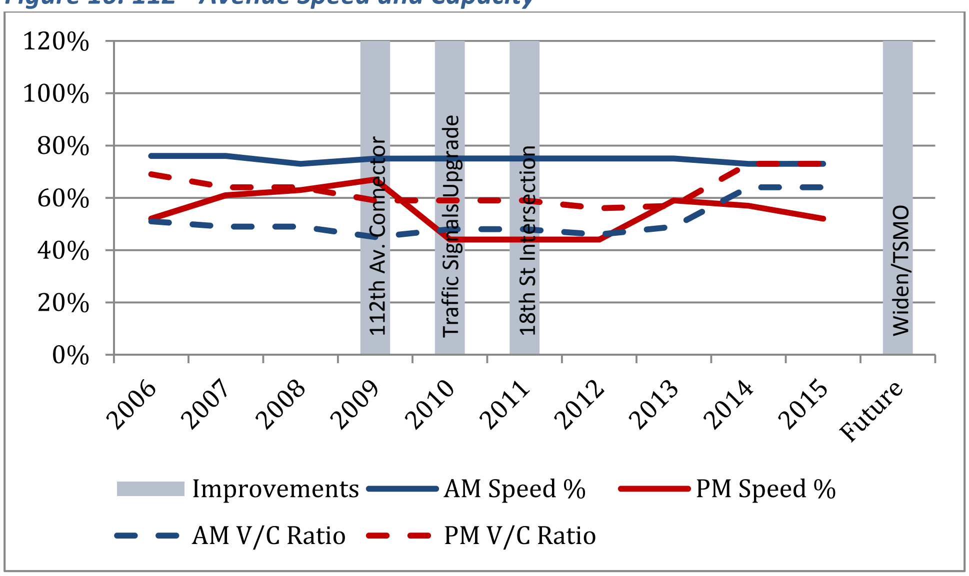
Figure 15: I-205 South Speed and Capacity



112th Avenue, SR-500 to Mill Plain

Evening speed indicates potential corridor-wide congestion. Future corridor improvements include widening of narrow travel lanes and TSMO projects.

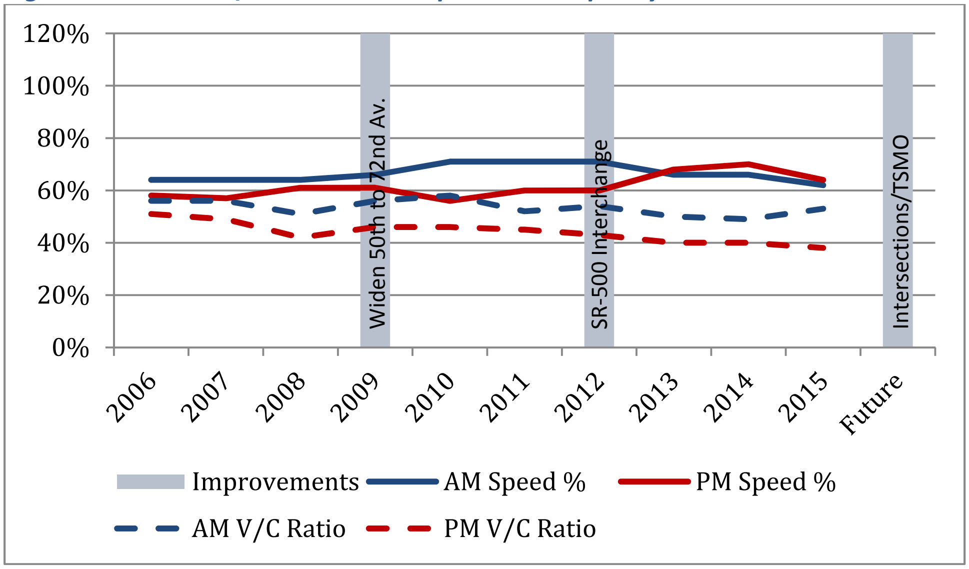
Figure 16: 112th Avenue Speed and Capacity



St. Johns/Ft. Vancouver, 72nd Avenue to Mill Plain

Both morning and evening speeds indicate some congestion in the corridor. Future corridor improvements include intersection and TSMO projects.

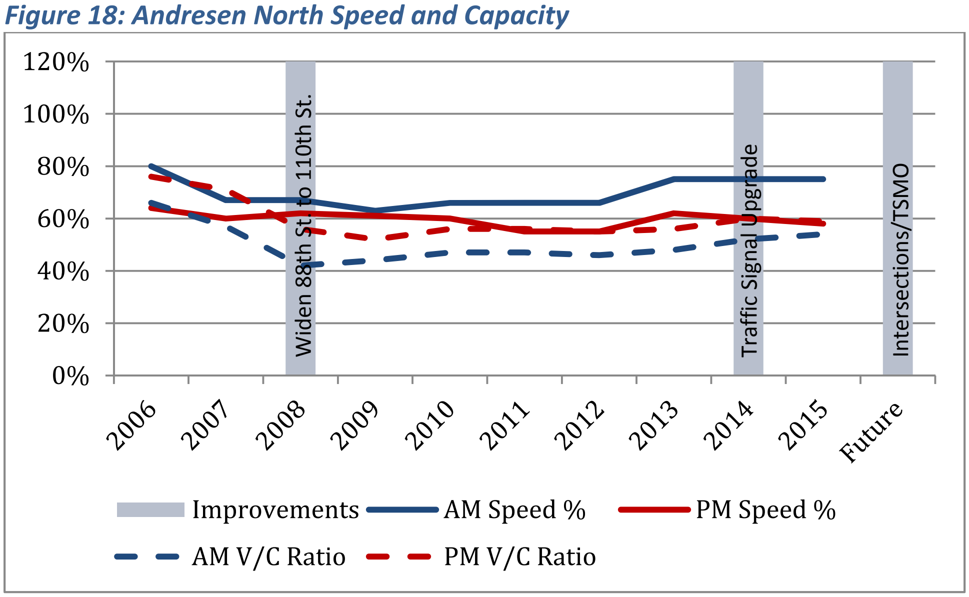
Figure 17: St. Johns/Ft. Vancouver Speed and Capacity



Andresen North, 119th Street to SR-500

Evening speed indicates potential corridor-wide congestion. Future corridor improvements include intersection and TSMO projects.

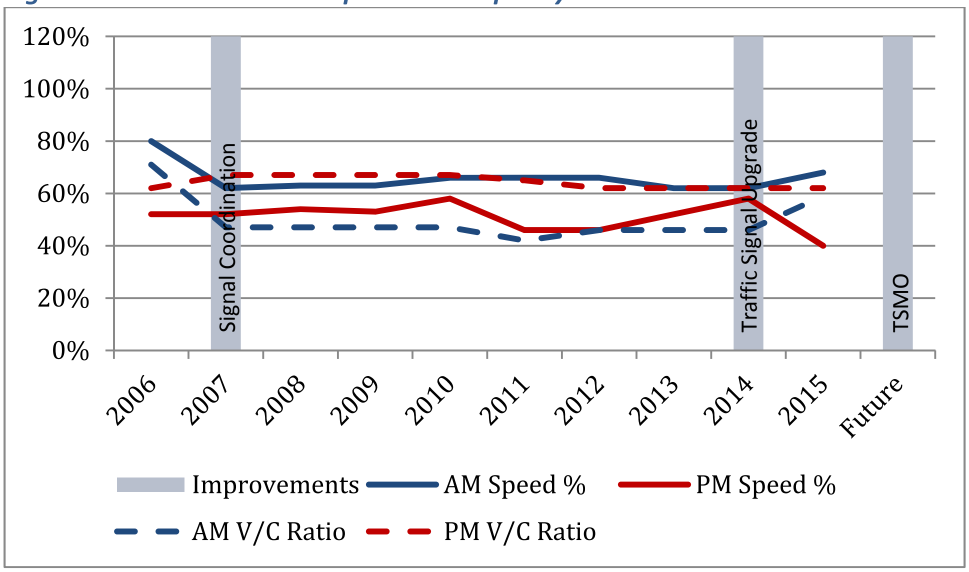
Figure 18: Andresen North Speed and Capacity



Andresen South, SR-500 to Mill Plain

Evening speed in 2015 indicates potential corridor-wide congestion. Future corridor improvements include TSMO projects.

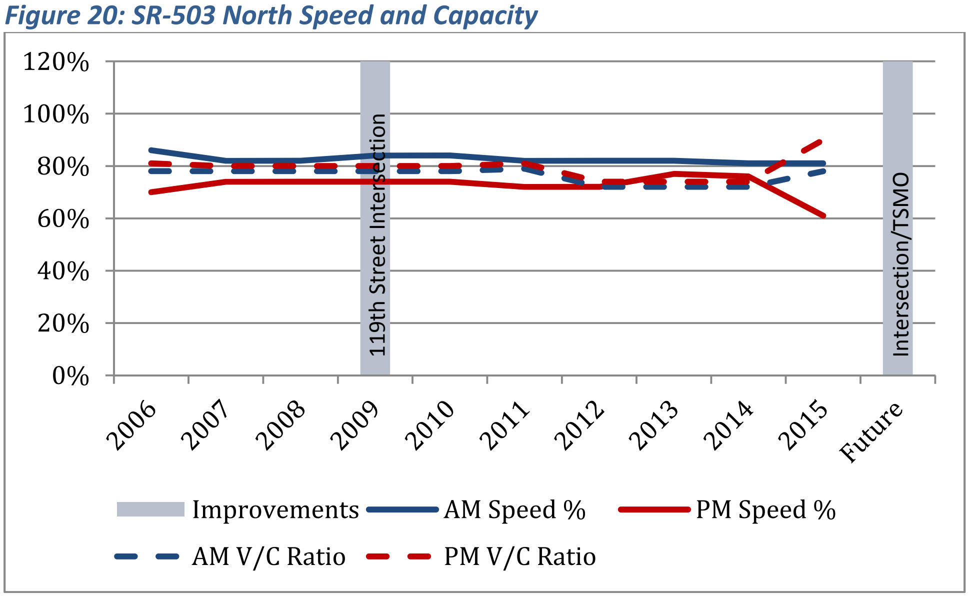
Figure 19: Andresen South Speed and Capacity



SR-503 North, SR-502 to 119th Street

In 2015, this corridor showed a significant increase in evening capacity congestion and decrease in speed. All of which demonstrate evening corridor wide congestion. Future corridor projects include SR-502/SR-503 Intersection improvement and TSMO projects.

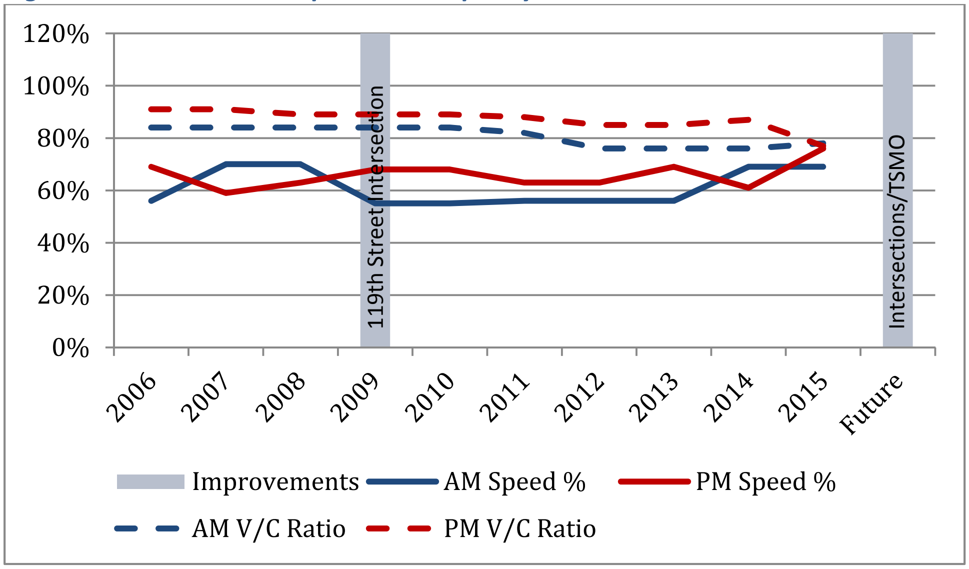
Figure 20: SR-503 North Speed and Capacity



SR-503 South, 119th Street to Fourth Plain

This is a very busy corridor that indicates corridor-wide congestion associated with capacity. Future corridor improvements include 99th Street & Fourth Plain intersections, access management, and TSMO projects.

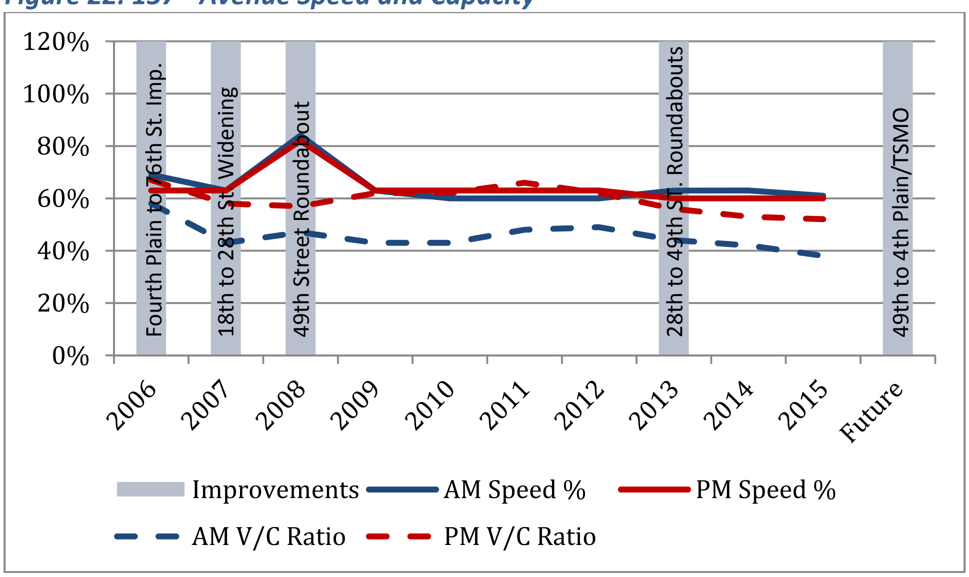
Figure 21: SR-503 South Speed and Capacity



137th Avenue, Padden Parkway to Mill Plain

Although, capacity does not indicate potential corridor-wide congestion, speeds are approaching a level that can lead to congestion. Future corridor projects include road improvements between 49th Street and Fourth Plain and TSMO improvements.

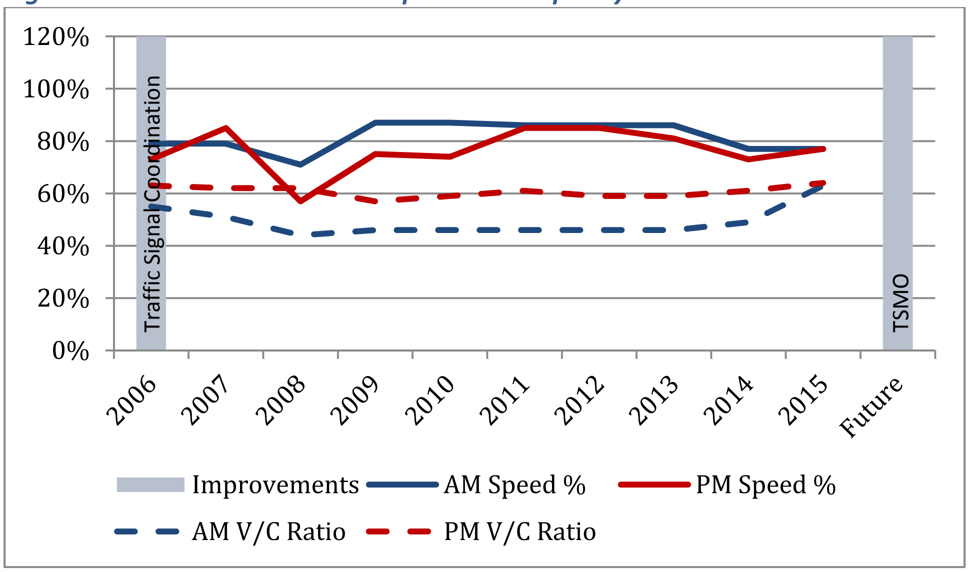
Figure 22: 137th Avenue Speed and Capacity



162nd Avenue North, Ward Road to Mill Plain

Neither speed nor capacity indicates potential corridor-wide congestion. Future corridor improvements include TSMO projects.

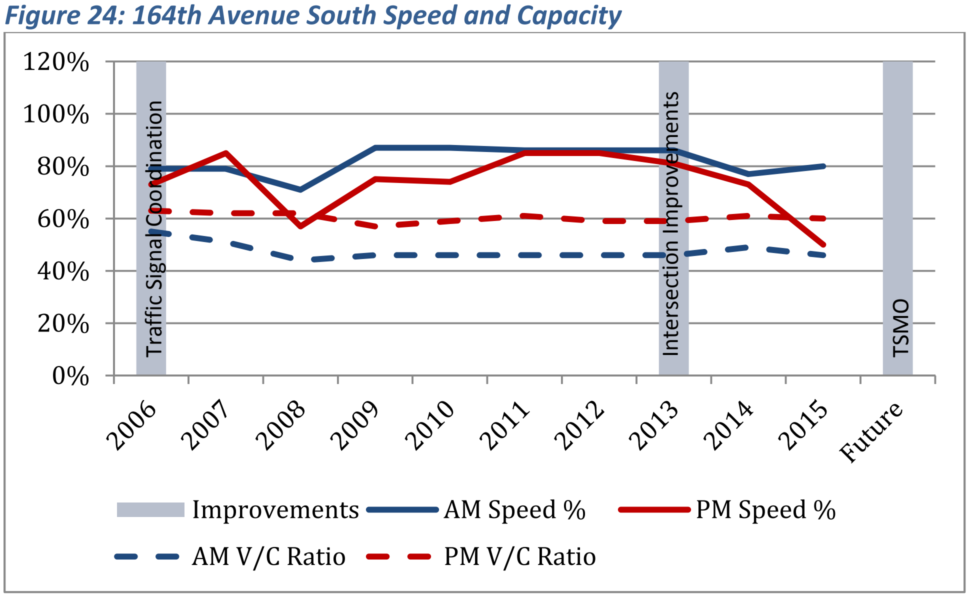
Figure 23: 162nd Avenue North Speed and Capacity



164th Avenue South, Mill Plain to SR-14

In 2015, evening speed showed a sharp decile to congested levels. Evening speeds should be monitored to see if this becomes a trend. Future corridor improvements include TSMO projects.

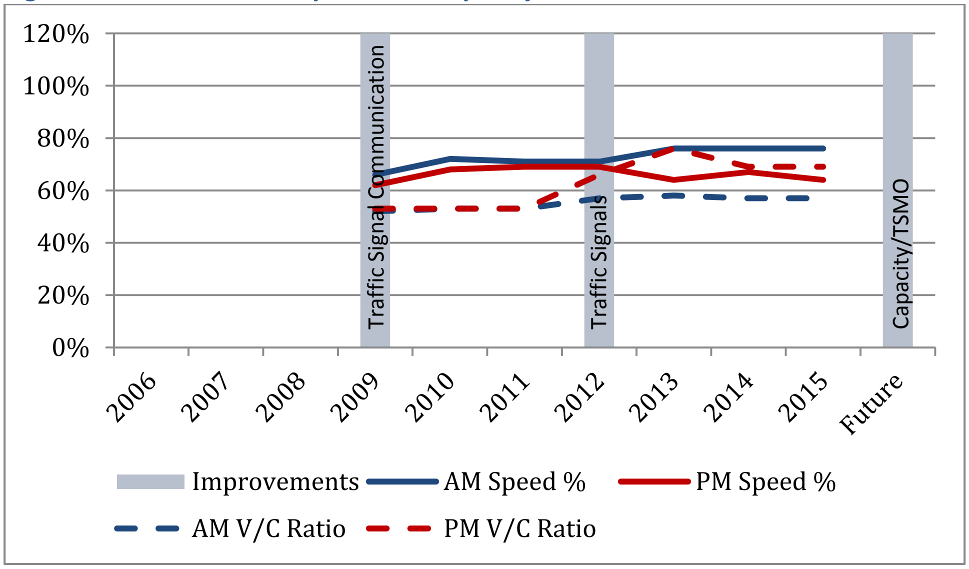
Figure 24: 164th Avenue South Speed and Capacity



192nd Avenue, Padden Parkway to Mill Plain

Neither speed nor capacity indicates potential corridor-wide congestion. Future corridor improvements include road widening between NE 1st Street and NE 18th Street and TSMO projects.

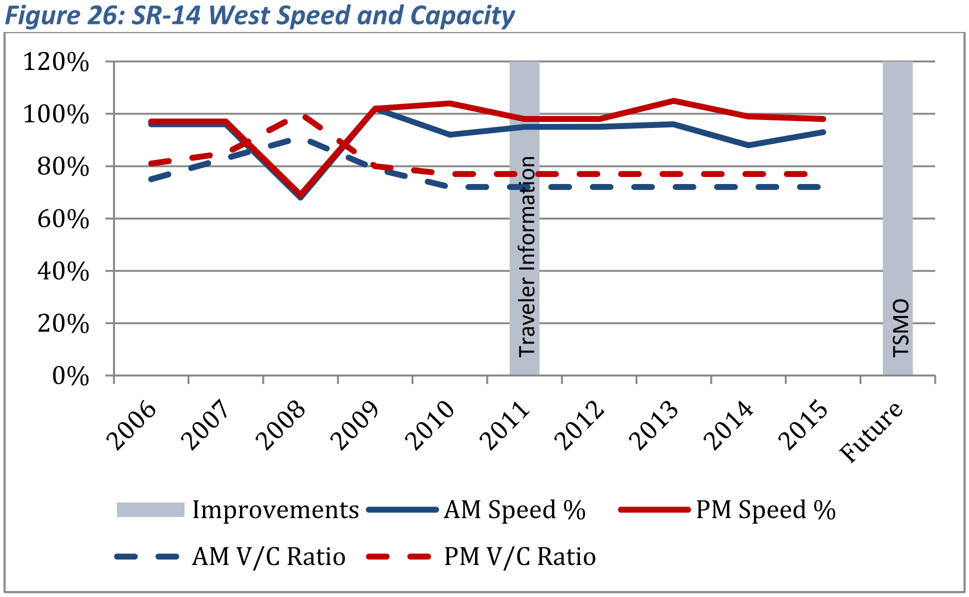
Figure 25: 192nd Avenue Speed and Capacity



SR-14 West, I-5 to I-205

Neither speed nor capacity indicates potential corridor-wide congestion. Future corridor improvements include TSMO projects.

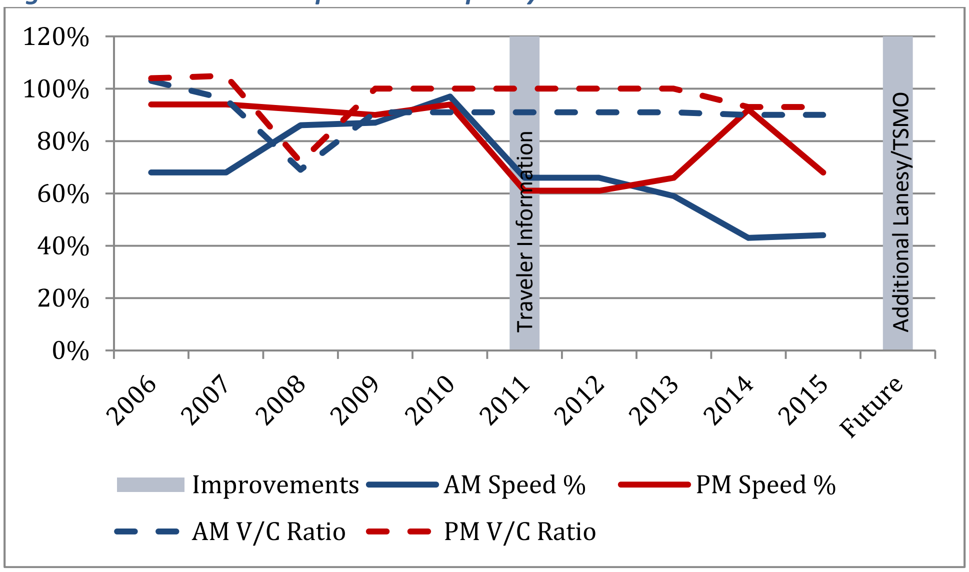
Figure 26: SR-14 West Speed and Capacity



SR-14 Central, I-205 to 164th Avenue

Both speed and capacity indicate corridor-wide congestion. Future corridor improvements include additional lanes, transit, and TSMO projects.

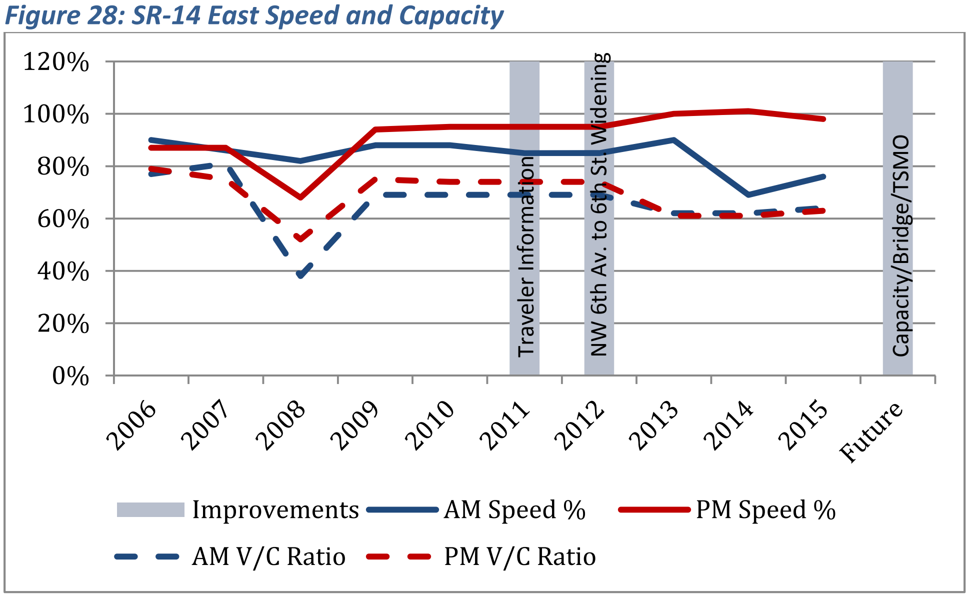
Figure 27: SR-14 Central Speed and Capacity



SR-14 East, 164th Avenue to County Line

Neither speed nor capacity indicates potential corridor-wide congestion. Future corridor improvements include added access and capacity east of 6th Street, replacement of West Camas Slough Bridge, and TSMO projects.

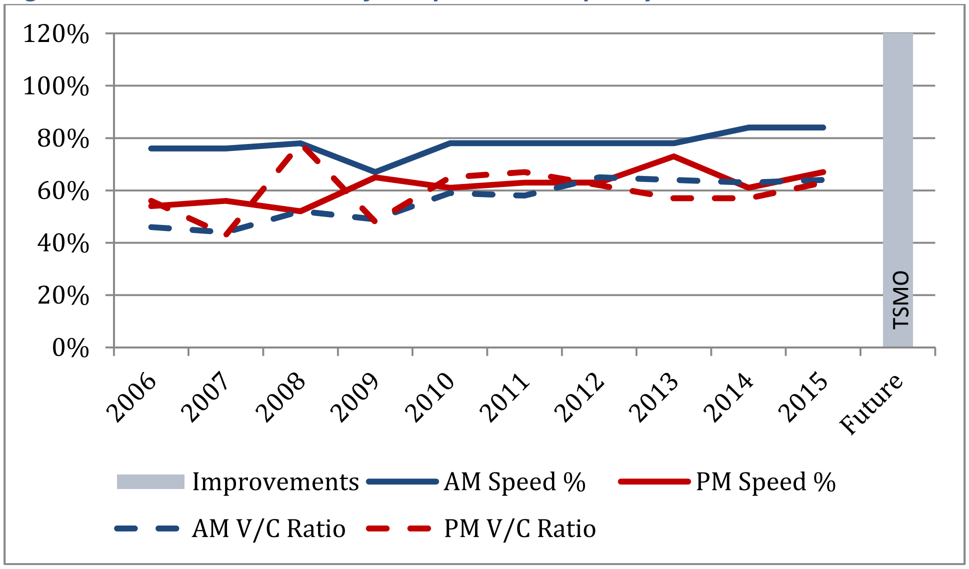
Figure 28: SR-14 East Speed and Capacity



Fourth Plain, I-5 to Port of Vancouver

Neither speed nor capacity indicates potential corridor-wide congestion. Future corridor improvements include TSMO projects.

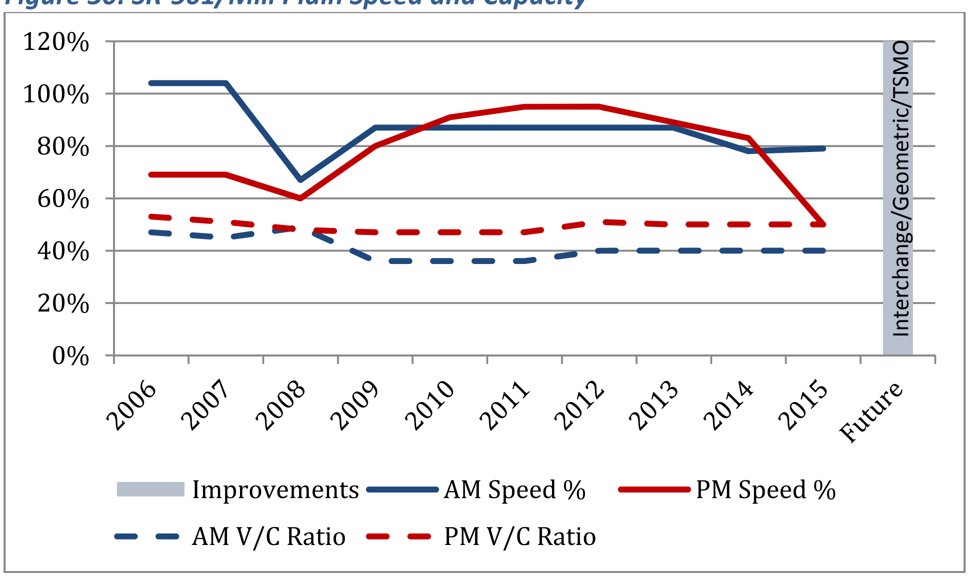
Figure 29: Fourth Plain west of I-5 Speed and Capacity



SR-501/Mill Plain, I-5 to Fourth Plain

In 2015, evening speed indicates congestion. Analysis of the corridor showed significant congestion near Columbia Street, where a new apartment complex was under construction. Future corridor improvements include both road and interchange modifications to improve freight movement.

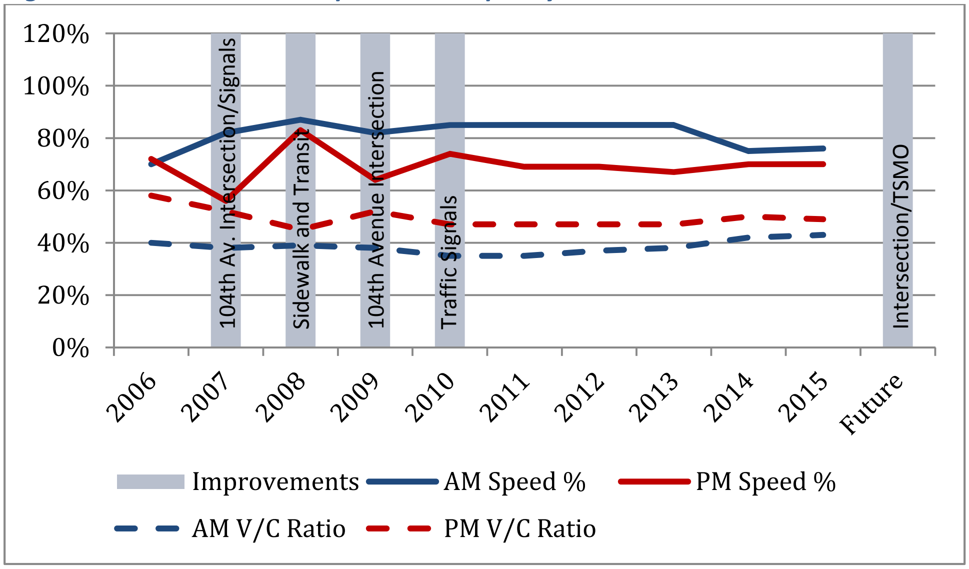
Figure 30: SR-501/Mill Plain Speed and Capacity



Mill Plain West, I-5 to I-205

Neither speed nor capacity indicates potential corridor-wide congestion. Future corridor improvements include 104/105th Intersection realignment and TSMO projects.

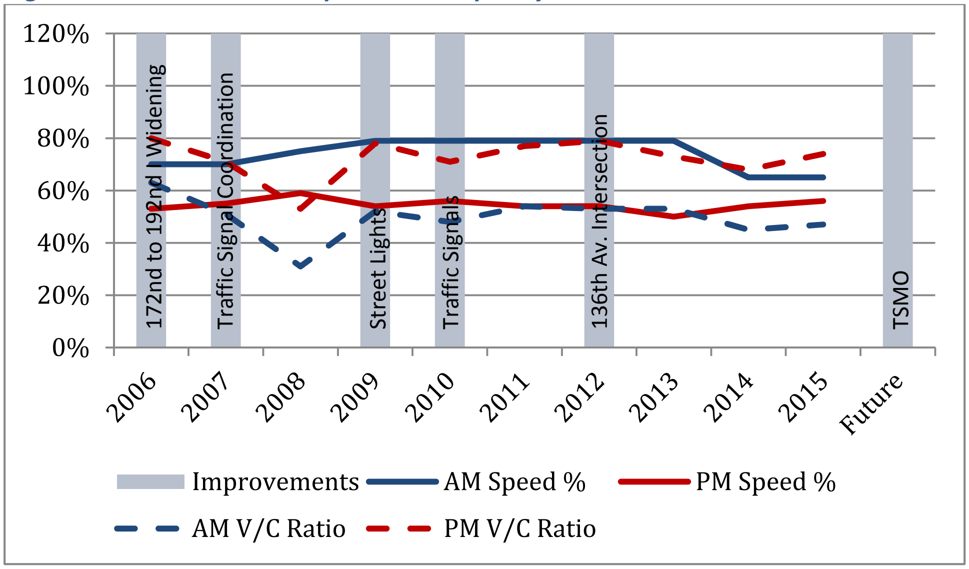
Figure 31: Mill Plain West Speed and Capacity



Mill Plain East, I-205 to 192nd Avenue

Evening speed indicates potential corridor-wide congestion. Future corridor improvements include TSMO projects.

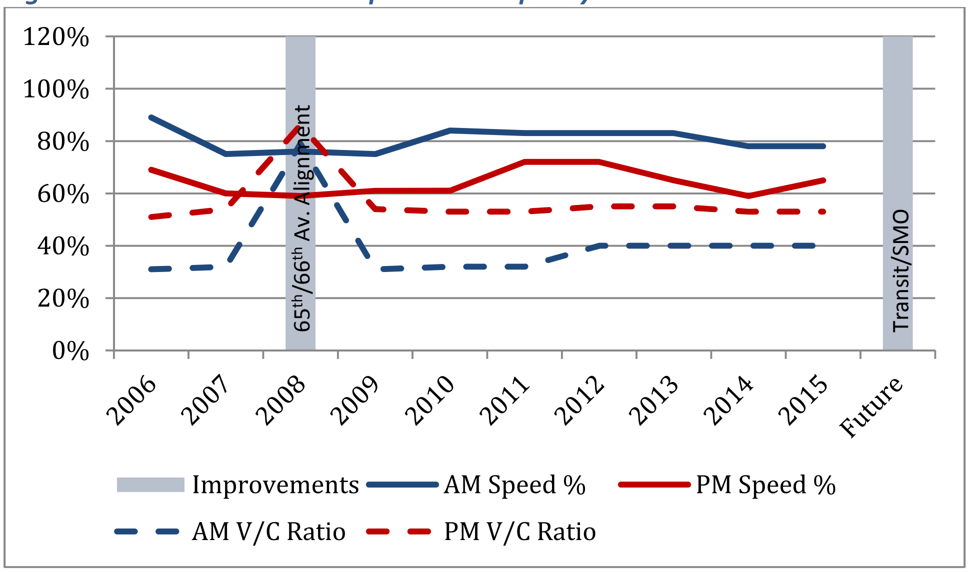
Figure 32: Mill Plain East Speed and Capacity



Fourth Plain West, I-5 to Andresen Road

Neither speed nor capacity indicates potential corridor-wide congestion. Future corridor improvements include transit and TSMO projects.

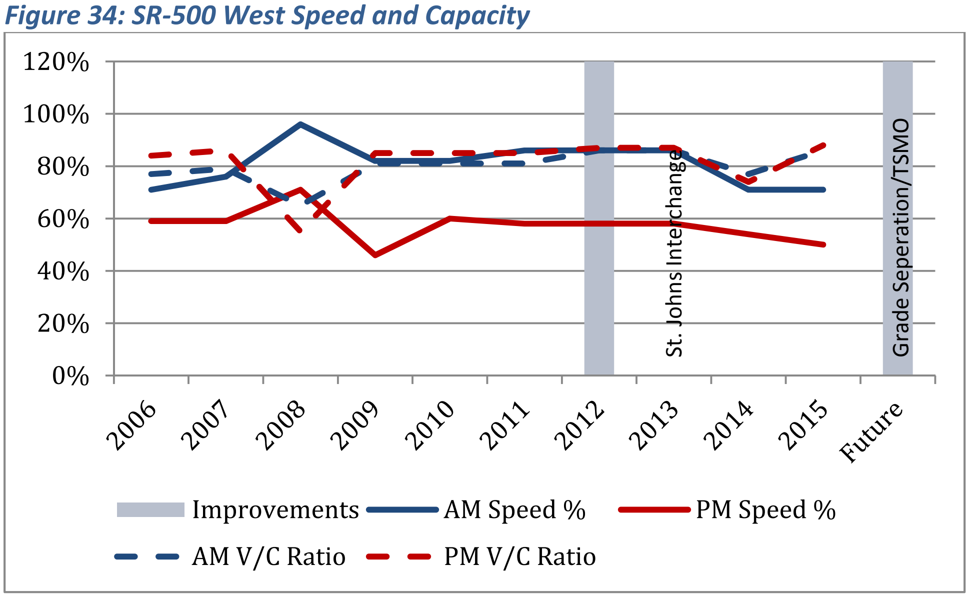
Figure 33: Fourth Plain West Speed and Capacity



SR-500 West, I-5 to Andresen Road

Evening speed and capacity congestion indicates corridor-wide congestion. Future corridor improvements include grade separation at 42nd and 54th Avenues, and TSMO projects.

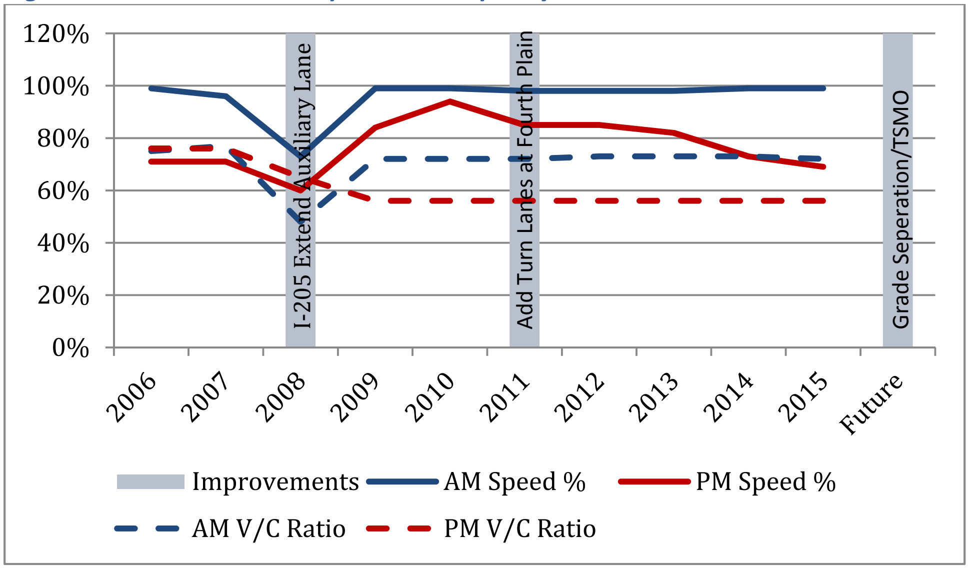
Figure 34: SR-500 West Speed and Capacity



SR-500 Central, Andresen Road to SR-503/Fourth Plain

Neither speed nor capacity indicates potential corridor-wide congestion. Future corridor improvements include grade separation at Fourth Plain, auxiliary lanes, and TSMO projects.

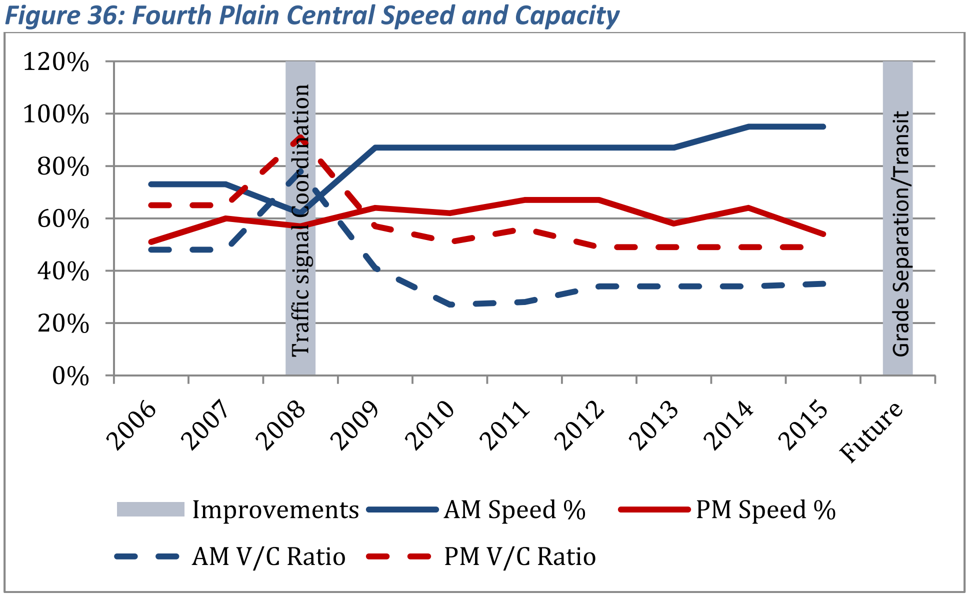
Figure 35: SR-500 Central Speed and Capacity



Fourth Plain Central, Andresen Road to SR-503

Evening speed indicates potential corridor-wide congestion. Future corridor improvements include grade separation at SR-500/Fourth Plain intersection, transit, and TSMO projects.

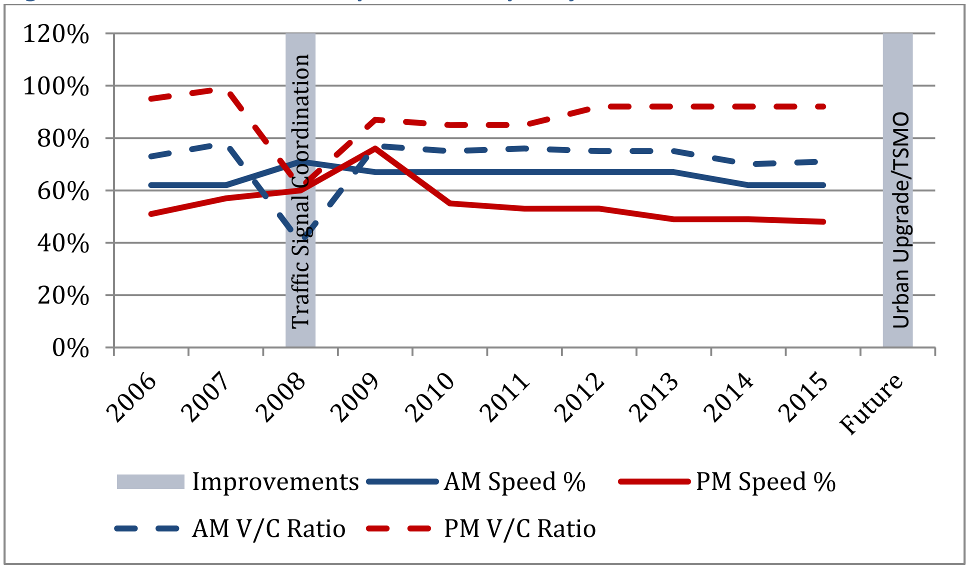
Figure 36: Fourth Plain Central Speed and Capacity



Fourth Plain East, SR-503 to 162nd Avenue

Both evening speed and capacity indicates potential corridor-wide congestion. Future corridor improvements include grade separation at Fourth Plain, Urban upgrade of full corridor, transit, and TSMO projects.

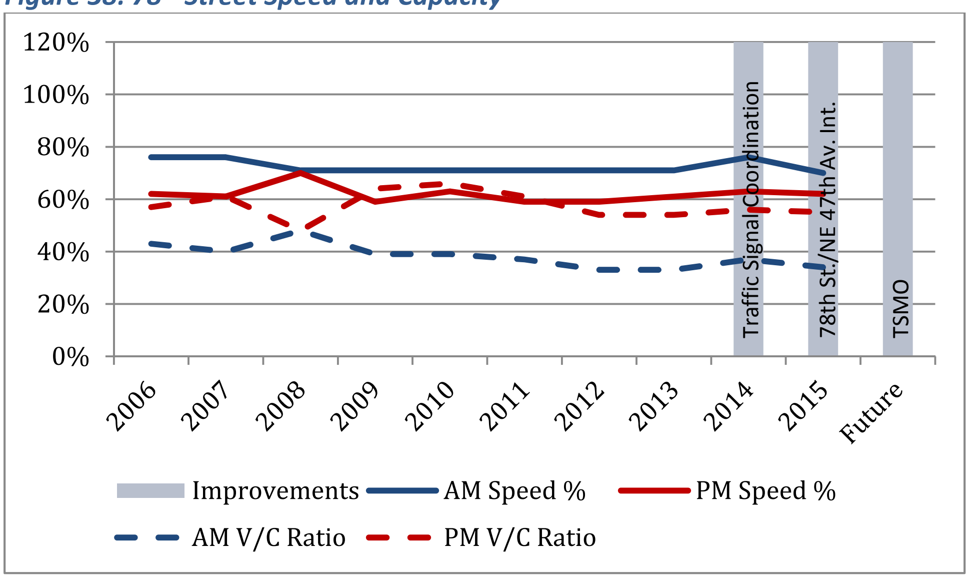
Figure 37: Fourth Plain East Speed and Capacity



78th Street, Lake Shore Avenue to SR-503

Neither speed nor capacity indicates potential corridor-wide congestion. Future corridor improvements include TSMO projects.

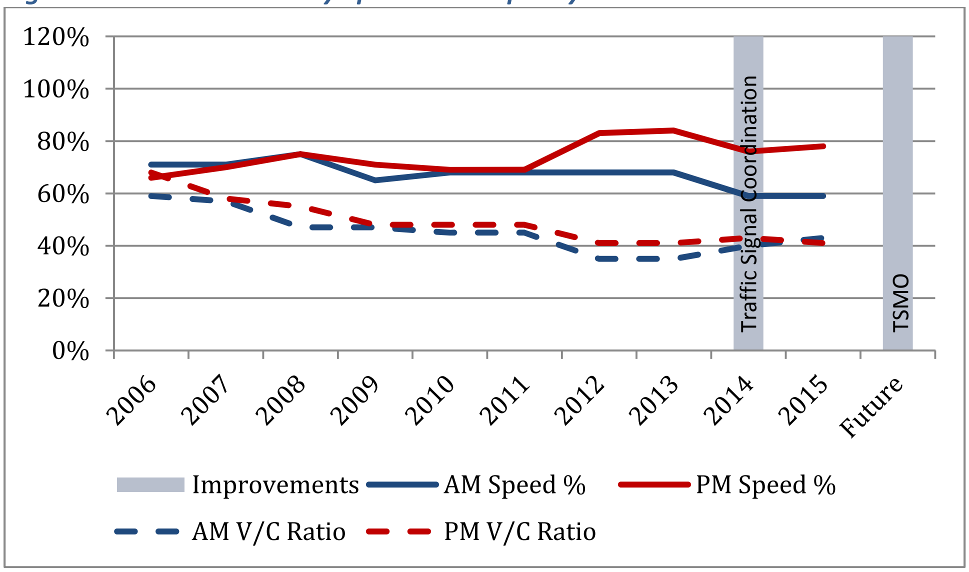
Figure 38: 78th Street Speed and Capacity



Padden Parkway, 78th Street to Ward Road

Evening speed indicates some congestion in the corridor. Future corridor improvements include TSMO projects.

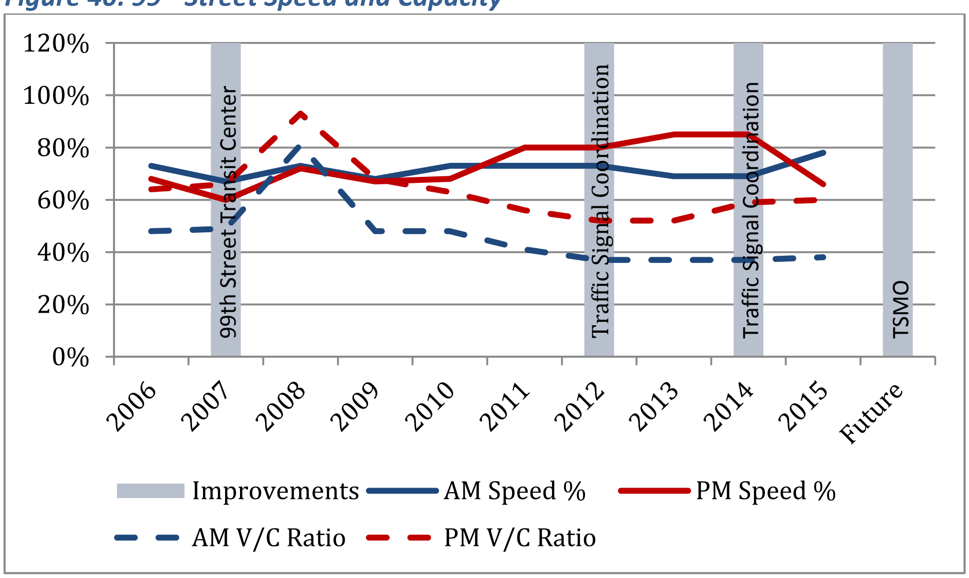
Figure 39: Padden Parkway Speed and Capacity



99th Street, Lake Shore Avenue to St. Johns Boulevard

Neither speed nor capacity indicates potential corridor-wide congestion. Future corridor improvements include TSMO projects.

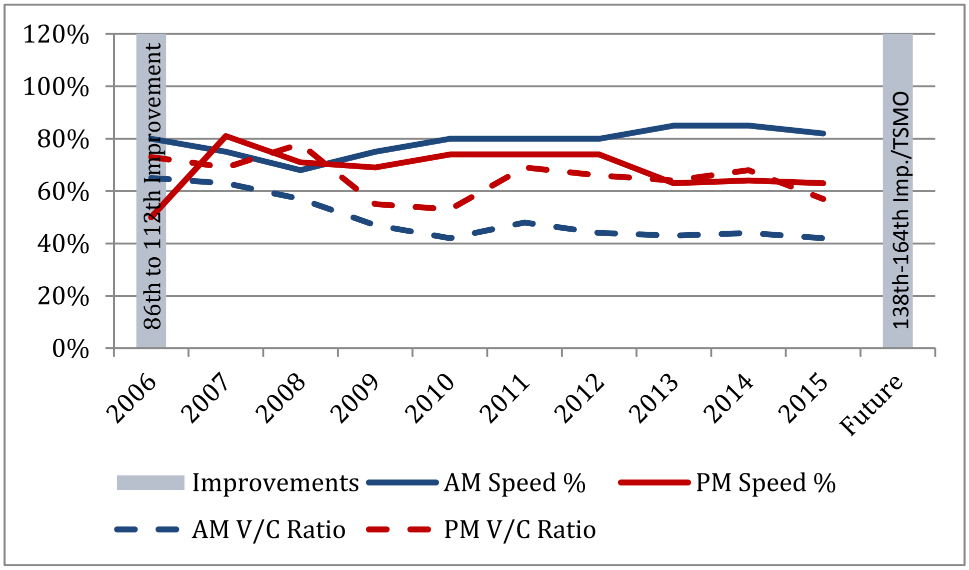
Figure 40: 99th Street Speed and Capacity



Burton Road, Andresen Road to 162nd Avenue

Neither speed nor capacity indicates potential corridor-wide congestion. Future corridor improvements from 138th Av. to 164th Av. and TSMO projects.

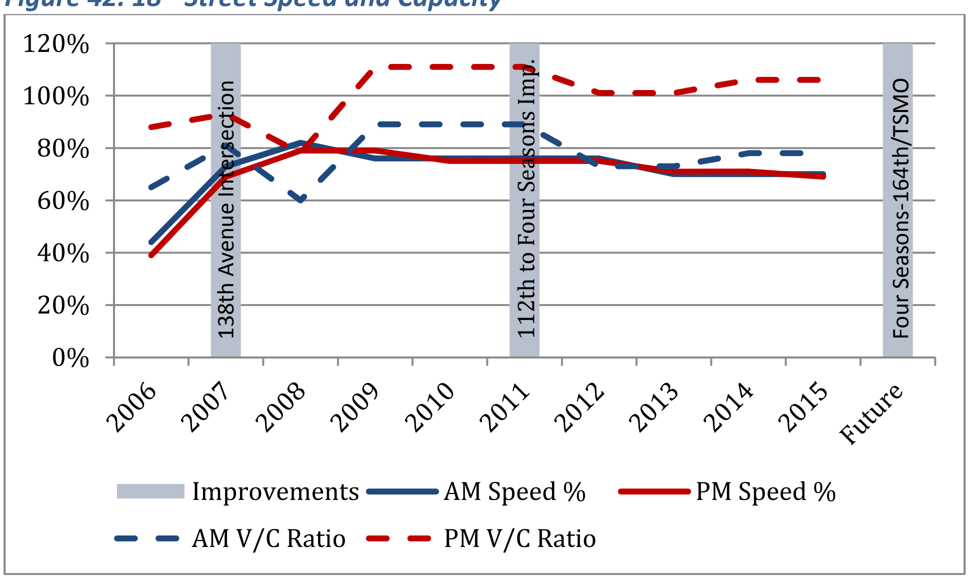
Figure 41: Burton Road Speed and Capacity



18th Street, 112th Avenue to 162nd Avenue

Evening capacity indicates potential corridor-wide congestion. With the completion of a new I-205 interchange at 18th Street in 2017, both speed and capacity are likely to worsen. Widening from Four Seasons to 136th Av. should begin in 2016. Future corridor improvements include improving 138th Avenue to 162nd Avenue, transit, and TSMO projects.

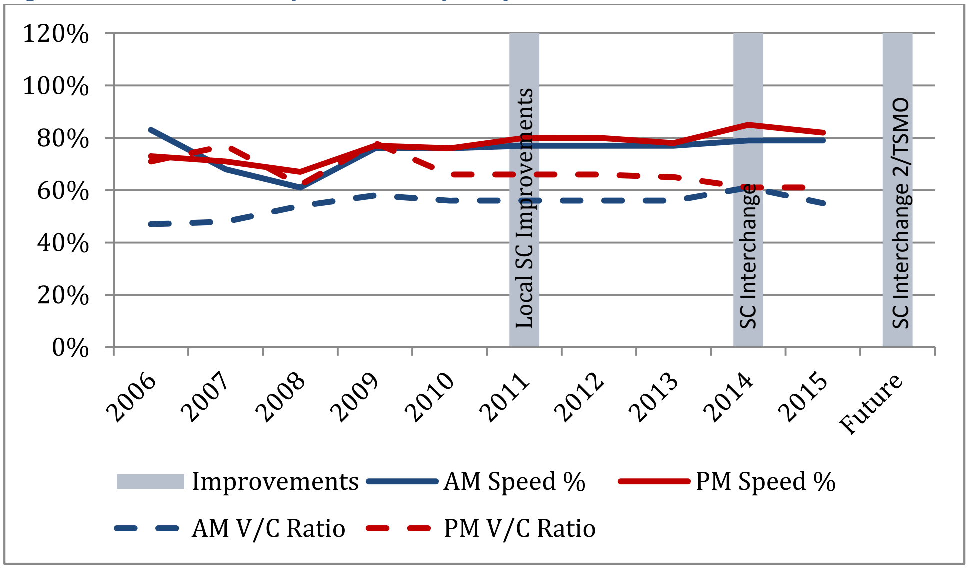
Figure 42: 18th Street Speed and Capacity



134th Street, 139th Street to 50th Avenue

Neither speed nor capacity indicates potential corridor-wide congestion. Future corridor improvements include Salmon Creek Interchange Phase 2, Salmon Creek Avenue improvements from WSU Entrance to NE 50th Avenue, and TSMO projects.

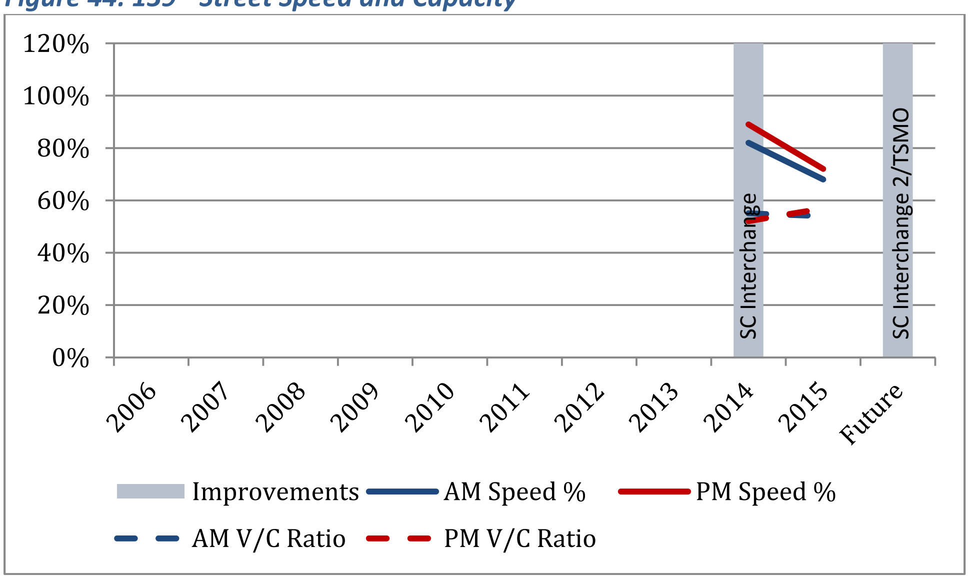
Figure 43: 134th Street Speed and Capacity



139th Street, NW 36th Avenue to NE 29th Avenue

Neither speed nor capacity indicates potential corridor-wide congestion. Future corridor improvements include Salmon Creek Interchange Phase 2 and TSMO projects.

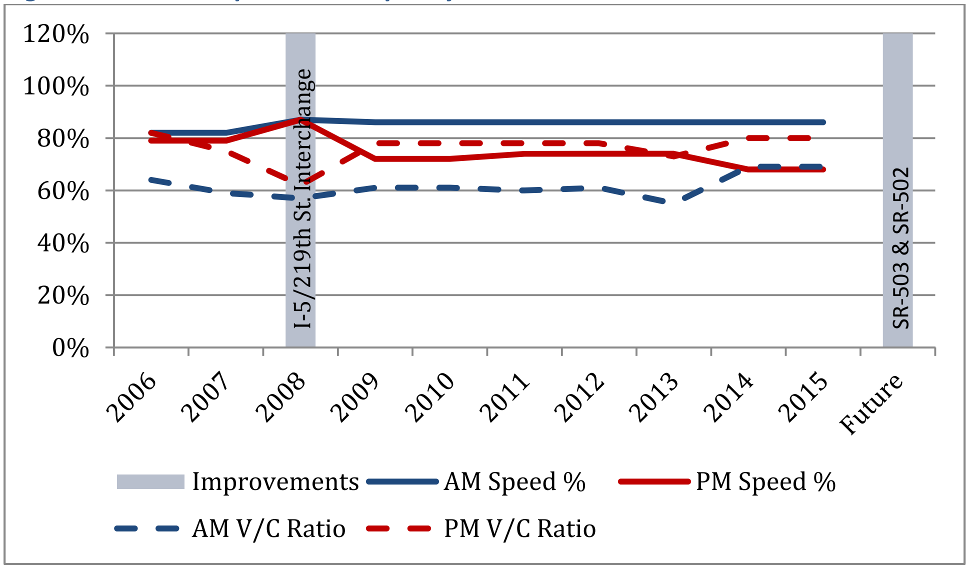
Figure 44: 139th Street Speed and Capacity



SR-502, I-5 to SR-503

Neither speed nor capacity indicates potential corridor-wide congestion. WSDOT is currently widening the corridor. Future corridor improvements include SR-502/SR-503 Intersection improvements.

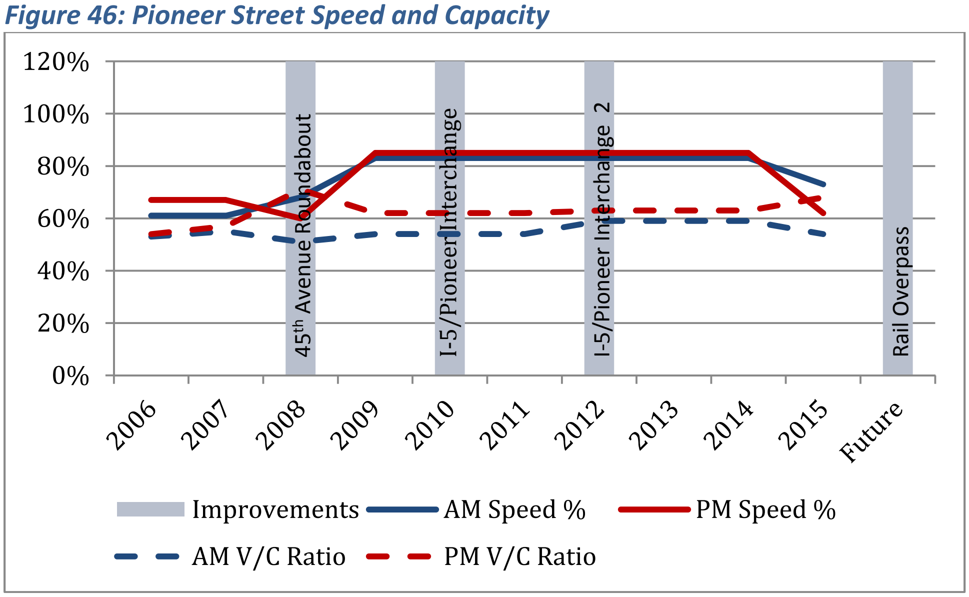
Figure 45: SR-502 Speed and Capacity



Pioneer Street (SR-501), I-5 to 9th Street

Neither speed nor capacity indicates potential corridor-wide congestion. In 2015 the corridor experienced a sharp decline in speed, because the road was narrowed to one lane due to a slide. Future corridor improvements include extension of Pioneer Street over the railroad tracks west of downtown Ridgefield.

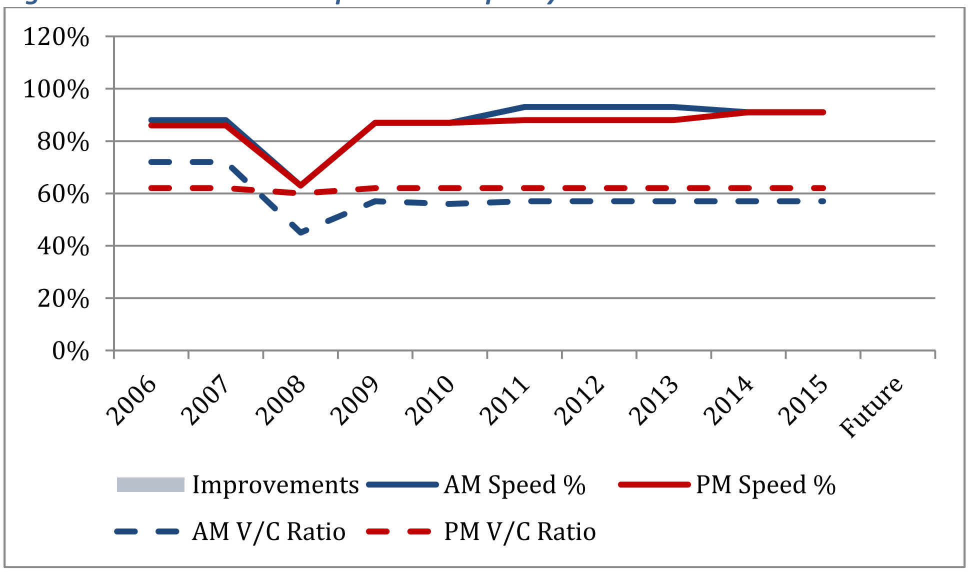
Figure 46: Pioneer Street Speed and Capacity



La Center Road, I-5 to East Fork of Lewis River

Neither speed nor capacity indicates potential corridor-wide congestion. No Future corridor improvements are planned.

Figure 47: La Center Road Speed and Capacity



Corridor Analysis Summary

The corridor analysis shows that the region needs to continue to focus on operational improvements, and select capacity improvements, and address strong demand for bi-state travel. Table 9 identifies the corridors that should be the focus of capacity and speed reliability improvements:

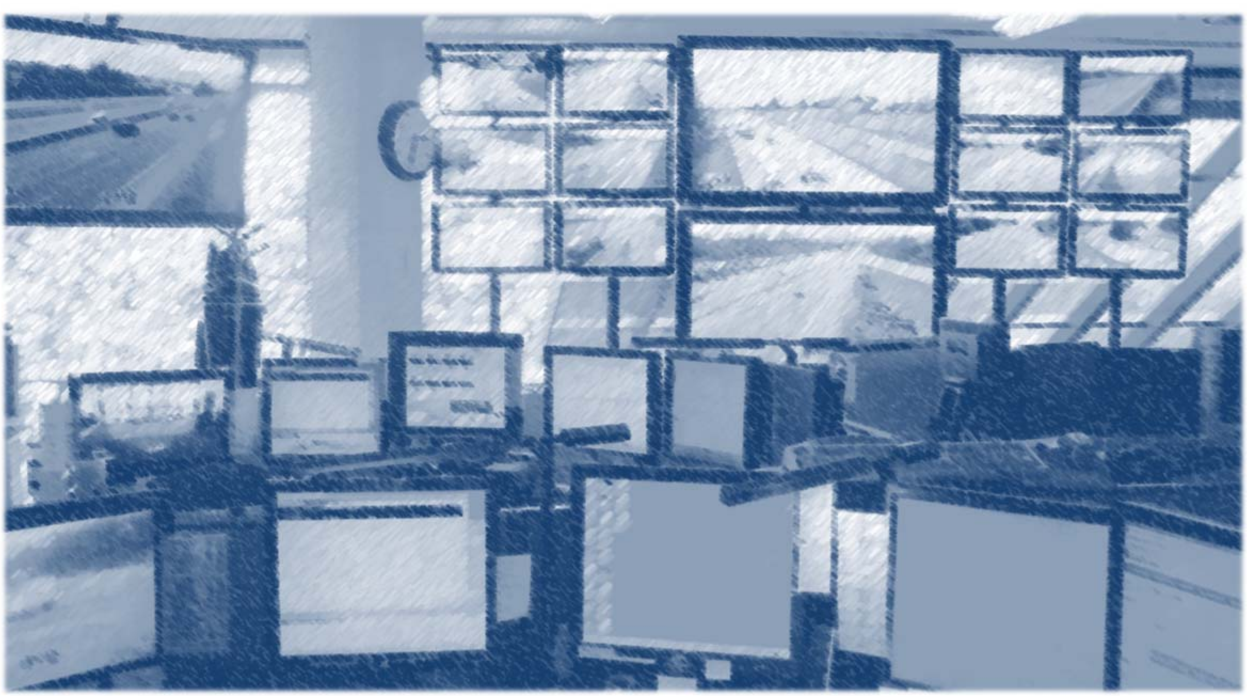


Table 9: Corridors with Capacity and/or Speed Deficiencies

Corridor	Capacity	Speed	Need
Highway 99		X	Select road improvements, transit, and TSMO
I-5 South	X	X	I-5 Bridge Replacement, Interchanges, Transit, TSMO
Main Street	X	X	I-5 Bridge Replacement, Transit, and TSMO
I-205 South	X	X	Interchanges, lanes, Transit, and TSMO
112th Avenue		X	Widen Travel Lanes and TSMO
St. Johns		X	Intersection, capacity, and TSMO
Andresen North		X	Intersection Improvements and TSMO
Andresen South		X	TSMO
SR-503 North	X	X	SR-502/SR-503 Intersection and TSMO
SR-503 South	X		Intersections, Access Management, and TSMO
137th Avenue		X	Widen 49th St. to Fourth Plain and TSMO
SR-14 Central	X	X	Additional Travel Lanes and TSMO
Mill Plain East		X	TSMO
SR-500 West		X	Grade Separation at 42nd and 54th Avenues and TSMO
Fourth Plain Central		X	Transit and TSMO
Fourth Plain East	X	X	Fourth Plain/SR-500 Intersection, Urban Upgrade, TSMO
Padden Parkway		X	Interchanges and TSMO
18th Street	X		Add Travel Lanes

Key Capacity Needs

The following are key solutions to address capacity congestion needs within Clark County:

Table 10: Key Capacity Needs

RTP Identified Needs	Solution to be Determine
I-5 Interstate Bridge	I-205/SR-14
I-5 Corridor Operational Improvements	
I-205 Corridor Operational Improvements	
I-205, SR-500 to Padden Widening	
SR-14, I-205 to 164th Av. Widening	
SR-500/42nd & 54th Av. Grade Separation	
SR-502 Widening	
SR-503 Operational Improvements	
Fourth Plain, 117th to 137th Av. Operational Imp.	
Mill Plain, I-205 to 138th Av. Operational Imp.	
NE 18th Street Widening, 112th to 164th Av.	
NE 112th Av., 49th St. to SR-500 Operational Imp.	